Appendix B

Year 5 Report on pH Monitoring to Evaluate the Effect of White Rain on the Smelter/Tailing Soils Investigation Unit

Freeport-McMoRan Chino Mines Company

Administrative Order on Consent Year 5 Report on pH Monitoring to Evaluate the Effect of the White Rain on the Smelter/Tailing Soils Investigation Unit

Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

March 2023

Administrative Order on Consent Year 5 Report on pH Monitoring to Evaluate the Effect of the White Rain on the Smelter/Tailing Soils Investigation Unit

Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Prepared for:
Freeport-McMoRan Chino Mines Company

Prepared by:
ARCADIS
1687 Cole Blvd.
Suite 200
Lakewood
Colorado 80401
Tel 303.231.9115
Fax 303.231.9571

Our Ref.:
B0063543.0014

Date:
March 2023

Tables

Figures

Appendices

Acronyms and Abbreviations

µm	microns
ABA	acid-base accounting
ACZ	ACZ Laboratories, Inc.
AGP	acid generation potential
ANOVA	analysis of variance
ANP	acid neutralization potential
AOC	Administrative Order on Consent
ARCADIS	ARCADIS U.S., Inc.
bgs	below ground surface
BSPM	backscatter photomicrograph
$CaCO_3$	calcium carbonate
Chino	Freeport-McMoRan Chino Mines Company
CuS	copper monosulfide
EDS	energy dispersive spectroscopy
EMPA	electron microprobe analysis
EPA	United States Environmental Protection Agency
ERA	Ecological Risk Assessment
FeS_2	pyritic sulfide
FS	Feasibility Study
GCDNM	Gila Cliffs Dwelling National Monument
HCl	hydrochloric acid
HNO_3	nitric acid
ICP-AES	inductively coupled plasma-atomic emission spectroscopy
LEGS	Laboratory for Environmental and Geological Studies
m	meter
m^2	square meters

mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MMD	New Mexico Mining and Minerals Division
N	Normal
NMED	New Mexico Environment Department
NNP	net neutralization potential
NPR	neutralization potential ratio
NRCS	Natural Resources Conservation Service
PAG	potentially acid-generating
pCu	cupric ion activity
QAPP	Quality Assurance Project Plan
RAC	Remedial Action Criteria
RI	Remedial Investigation
STSIU	Smelter Tailings Soils Investigation Unit
SVL	SVL Analytical, Inc.
t $CaCO_3$/kt	tons calcium carbonate per kiloton
UCSD	University of California Sand Diego
USDA	United States Department of Agriculture
Work Plan	AOC pH Monitoring Plan, Smelter/Tailing Soils Investigation Unit

Executive Summary

This Technical Report on the “white rain” for the Smelter and Tailing Soils Investigation Unit (STSIU, **Figure 1**) has been prepared in accordance with the Administrative Order on Consent (AOC) between Freeport-McMoRan Chino Mines Company (Chino) and the New Mexico Environment Department (NMED). An approved Remedial Investigation (RI) Report for STSIU summarized results for a number of investigations showing depressed pH and elevated copper in shallow (0 to 6-inch depth) soil (Chino 1995, SRK 2008). On January 7, 2008, however, an alkaline “white rain” fell on shallow soil within the STSIU, and subsequent increases in soil pH were measured. Once analyzed, the white rain was found to contain a milky substance with a pH of 7.2 and a calcium concentration of 5.8 milligrams per liter (mg/L; **Figure 2**). The site-wide and STSIU-specific ecological risk assessments (ERAs, Newfields 2005, Newfields 2008) linked the toxic action of copper in soil on plants (and wildlife) to cupric ion activity (quantified as pCu), which is decreased by higher pH. Therefore, any potential change in pH from the milky substance is important to further evaluate. After discussion with NMED in May 2010, Chino submitted a Soil pH Monitoring Plan (Work Plan), which proposed to monitor pH (and other parameters) of the shallow soil within STSIU for 5 years, starting in fall 2010. NMED commented on the Work Plan in June 2010, and approved the Work Plan in July 2010 (ARCADIS 2010a).

During implementation of the Work Plan in 2011, NMED issued a Pre-Feasibility Study Remedial Action Criterion (Pre-FS RAC) for shallow soil within the STSIU of pCu[1] $\geq$ 5, where total copper in soil is > 327 milligrams per kilogram (mg/kg), to reduce soil toxicity to plants from copper (NMED 2011). In setting the pre-FS RAC, NMED noted:

> *Two significant events have occurred which may reduce the area where cupric ion activity is toxic to plants; the “white rain” event in January 2008 and the demolition of the smelter in 2007. The white rain event resulted in increase of pH in soil and since the smelter is no longer in use, additional acidic emissions no longer are contributing to lowering pH in soils...*

---

[1] pCu = -log{Cu}, and is inversely correlated to cupric ion activity.

> *New information can be used to refine RACs and selection of alternatives, if sufficient information becomes available that all parties agree upon. This is supported by the NCP in §300.430(e)(2)(i) which states "establish remedial action objectives specifying contaminants and media of concern, potential exposure pathways, and remediation goals. Initially, preliminary remediation goals are developed based on readily available information….and should be modified, as necessary, as more information becomes available during the RI/FS."*

Consistent with the Work Plan and NMED (2011) correspondence, specific objectives of this report are to: (1) assess the magnitude of the white rain effect on soil pH and pCu, (2) determine if the pH and pCu increase is persistent, and (3) evaluate the effect of the white rain in remediating adverse effects of depressed pH and elevated copper on the ecosystem. This report summarizes the results related to the white rain analyses at the conclusion of the 5-year monitoring period, and provides new information that can be used by NMED in drafting the Record of Decision (ROD).

The results show that the white rain increased soil pH initially by approximately 1.2 standard units (S.U.) on average for locations in the STSIU with low pH (< 5.5); it had little to no effect on higher pH soils. For soils with an original pH of > 5.5, some natural buffering capacity may have existed before the white rain, conferring resistance in those soils to pH changes. In contrast, the originally acidic soils (pH < 5. 5) had lower buffering capacity, and the white rain resulted in an increased soil pH. The pH shift was sustained through 2014, and future persistence is benefitted by the following:

1. Future sources of potential acidity from smelting and windblown tailings have largely been eliminated by decommissioning the smelter and reclaiming most of the tailing ponds.
2. Typically, the acid soil (pH ≤ 5.5) whose pH increased to > 5.1 from the white rain had either positive net neutralization potential (NNP) values or those that met the New Mexico Mining and Minerals Division (MMD) topsoil suitability requirement of "Good" for plant establishment (> -5 kg $CaCO_3$/t).

3. Evaluation of soil mineralogy indicates that a proportion of total sulfide occurs as copper sulfides with lower reactivity relative to pyrite.
4. White rain events of various magnitude will likely occur in the future (one occurred in eastern Washington, eastern Oregon, and parts of Idaho in February 2015). The likelihood of such future events occurring in the project area is not known, however.
5. Natural pedogenic (soil-forming) processes will continue to function, and soil pH is expected to recover to baseline levels for soils of the area (pH = 6.1 to 8.4) at some time in the future.

However, persistence in the future cannot be predicted with certainty, nor likelihood of future white rain events, if any. This study evaluated persistence of a change in soil pH over a five-year period, and the report will be considered during the development of remedies in the Feasibility Study (FS) for the STSIU. It is recommended that future periodic monitoring of soil pH, as a component of the overall STSIU site remedy, be included to confirm persistence of the generally higher soil pH. The frequency of pH monitoring will be determined during the FS process.

In contrast to pH, the total copper concentration present in shallow soil is not expected to change as a result of the white rain, though other causes of natural attenuation (source reduction or source removal, clean dust deposition, and erosion) may result in decreases in soil copper concentrations over time. Current data suggest that soil copper concentrations decreased during the 5-year duration of this study. The decreases in total copper, in addition to increases in pH, increased pCu as well. Copper concentrations in soil are spatially heterogeneous, making it difficult to be certain if the decrease in copper over time is real, and the mechanism for copper decrease has not been studied.

Increases in pH can lead to increased binding of copper in soil by secondary soil minerals, such as iron hydroxides, and reduce copper uptake into plants and the food chain (Mortvedt 2000). The effect of the pH shift from the white rain on plants and wildlife was assessed by evaluating copper concentrations in tissues of plants and terrestrial invertebrates before and after the white rain event. These data had been collected during other investigations (ARCADIS 2010b, 2014a). In locations showing an improvement (increase) in soil pH, the tissue copper concentrations decreased after the white rain by more than 60 percent for the plants and by up to 40 percent for the insects. Also, plant richness improved after the white rain on the untreated plots associated with an amendment study conducted for the STSIU (ARCADIS 2014a).

These results suggest that the nature and extent of elevated copper and depressed pH in shallow soil has changed since the Remedial Investigation and ERA reports were approved by NMED (SRK 2008; Newfields 2005, 2008). Along with the cessation of historical mineral processing operations and reclamation activities, natural attenuation from the white rain has increased soil pH and pCu, since the issuance of the Pre-FS RAC. The results suggest that, if areas continue to consistently show improvement in pCu over time, monitoring the natural attenuation of mining impacts may be a viable option to include in the set of alternatives to be evaluated for remediation in the FS.

1. Introduction

This draft Technical Report on the “white rain” for the Smelter and Tailing Soils Investigation Unit (STSIU, **Figure 1**) has been prepared in accordance with the Administrative Order on Consent (AOC) between Freeport-McMoRan Chino Mines Company (Chino) and the New Mexico Environment Department (NMED). An approved Remedial Investigation (RI) Report for STSIU summarized results for a number of investigations showing depressed pH and elevated copper in shallow (0 to 6-inch depth) soil (Chino 1995, SRK 2005). On January 7, 2008, however, an alkaline “white rain” fell on shallow soil within the STSIU, and subsequent increases in pH were measured.

Once analyzed, the white rain was found to contain a milky substance with a pH of 7.2 and a calcium concentration of 5.8 milligrams per liter (mg/L; **Figure 2**). The site-wide and STSIU-specific ecological risk assessments (ERAs; Newfields 2005, Newfields 2008) linked the toxic action of total copper detected in shallow soil on plants (and wildlife) to cupric ion activity (quantified as pCu), which is decreased by higher pH. Therefore, any potential change in pH from the milky substance is important to further evaluate. After discussion with NMED in May 2010, Chino submitted a Soil pH Monitoring Plan (Work Plan), which proposed to monitor pH (and other parameters) of the shallow soil within the STSIU for 5 years, starting in fall 2010. NMED commented on the Work Plan in June 2010, and approved the Work Plan in July 2010 (ARCADIS 2010a).

During implementation of the Work Plan in 2011, NMED issued a Pre-Feasibility Study Remedial Action Criterion (Pre-FS RAC) for shallow soil within STSIU of pCu[2] $\geq$ 5, where total copper in soil is > 327 milligrams per kilogram (mg/kg), to reduce soil toxicity to plants from copper (NMED 2011). In setting the pre-FS RAC, NMED noted:

> *Two significant events have occurred which may reduce the area where cupric ion activity is toxic to plants; the “white rain” event in January 2008 and the demolition of the smelter in 2007. The white rain event resulted in increase of pH in soil and since the smelter is no longer in use, additional acidic emissions no longer are contributing to lowering pH in soils...*

---

[2] pCu = -log{Cu}, and is inversely correlated to cupric ion activity.

> *New information can be used to refine RACs and selection of alternatives, if sufficient information becomes available that all parties agree upon. This is supported by the NCP in §300.430(e)(2)(i) which states "establish remedial action objectives specifying contaminants and media of concern, potential exposure pathways, and remediation goals. Initially, preliminary remediation goals are developed based on readily available information….and should be modified, as necessary, as more information becomes available during the RI/FS."*

Consistent with the Work Plan and the NMED (2011) correspondence, the specific objectives of this report are to: (1) assess the magnitude of the white rain effect on soil pH and pCu, (2) determine if the pH and pCu increase is persistent, and (3) evaluate the effect of the white rain in remediating adverse effects of the historical acid and copper deposition on plant and wildlife communities. This report describes the objectives and methods of the monitoring and summarizes the 5 years of monitoring results.

1.1 Background

Briefly, historical mineral processing (milling and smelting) in Hurley occurred from 1939 to 2002, and the historical smelter stacks were demolished in 2007. Prior to 2007, however, Chino completed an RI of the STSIU, including an evaluation of the nature and extent of pH and total copper in shallow soil (SRK 2008). On January 7, 2008, a white rain event took place and, during the event, a milky alkaline rain containing a large amount of suspended solids with calcium oxides, calcium hydroxides (e.g., lime), and other calcium-rich minerals was deposited across southwestern New Mexico, including the STSIU.

An upward shift in soil pH and calcium was observed in the field several months after the white rain event during sampling for the STSIU Amendment Study (ARCADIS 2014a; **Table 1**). The Amendment Study was designed to assess the effectiveness of remedial options including liming (see ARCADIS 2014a). The data collected for that study coincidentally bookended this white rain event before any pilot treatments had taken place, and alerted Chino to the possible substantial effect of this rain event on soil chemistry. Subsequently, Chino submitted a Technical Memorandum to NMED in 2008, which included an evaluation of all data available associated with the white rain event as well as a geochemical conceptual site model that described the possible effect of the white rain on the STSIU. This memorandum has been updated and is presented in **Appendix A.**

The source of the suspended solids in the white rain was found to be evaporites and dust in playas to the southwest of Chino. The University of California San Diego (UCSD) found that 75 percent of the mostly submicron particulate residues in a white rain sample taken at Gila Cliffs Dwellings National Monument (GCDNM) matched the chemical signatures of the evaporites in the Willcox playa in southeastern Arizona and the Lordsburg playa in western New Mexico (**Appendix A**). The white rain water had a pH of 7.2, as reported at the weather station located 40 miles north of Chino at GCDNM (**Figure 2a**), which is higher than had been observed in rainfall in the preceding 20 years (average pH is 4.8 to 5.3, **Figure 2b**). Similarly, the calcium concentration in this rain was higher than had been observed for the preceding 12 years (**Figure 2a**) which, along with the USCD residue analysis, supports that extremely fine (submicron and nanoparticulate) calcium-rich minerals and lime were carried in the rainwater.

The geochemical conceptual model of the effect of the white rain is shown on **Figure 3**. This conceptual model predicts that soil pH will increase and, if the additional buffering capacity from the 0.4 inch of white rain is high enough, the increase will be sustained. Soils exhibit both active and potential acidity (Sobek et al.1978). Potential acidity is the amount of acid that could be liberated, and is partially determined by the minerals in the soil. The amount of alkalinity from dissolved minerals in the rainwater (based on 0.4 inch of rainfall) is low and could neutralize only a small amount of active acidity in poorly buffered soils (see **Appendix B**). It is more likely that most of the alkalinity in the white rain that neutralized active acidity came from the submicron calcium-rich particulates (such as calcite [calcium carbonate], lime [identified by USCD] and dolomite present in the source playas, see **Appendix A**). These particles would have partially dissolved when mixed with the acidic soil water, increasing the buffering capacity and eventually neutralizing not only active but also potential acidity.

Alkaline rains with suspended solids such as Chino’s white rain event are not uncommon in arid regions around the world, as soils and their evaporites that produce dust in arid regions are often high in carbonate (CO_3^{2-}), bicarbonate (HCO_3^-), and calcium (Ca^{2+}; Zhang et al. 2012). For example, dust storm-related alkaline precipitation events have been documented in Tibet (Zhang et al. 2012), India (Mouli et al. 2005), South Africa (Resane et al. 2004), Zimbabwe (Nyika et al. 1996), and as recently as February 2015 in eastern Washington, eastern Oregon, and the Idaho panhandle (Sistek 2015). The chemical makeup of the precipitation depends on the concentrations of the soil constituents and the chemical transformations that occur during cloud formation (Mouli et al. 2005). The scientific evidence, therefore, supports the concept that playa dust combined with rainwater in the region may accelerate attenuation of historical impacts at Chino (**Appendix A**). This report assesses whether the January 7, 2008 white rain has accelerated the natural attenuation of such impacts.

In 2009, shallow upland soils (0 to 6 inches below ground surface [bgs]) were sampled at various locations in the STSIU (n = 33) for pH and total copper to preliminarily assess the potential spatial extent of the pH change due to the white rain event. This preliminary assessment suggested an upward shift in soil pH in large areas of the STSIU. Pre-[3] and post-white[4] rain pH contour maps (with estimated 1 S.U. pH “zones”) created with the natural neighbor algorithm in ARCGIS were compared. This comparison of contours is only valid for the areas containing sample points in both years. In such areas, the maps suggest that the white rain reduced the footprint of the low pH zones (pH < 5; compare **Figure 4a** of pre-white rain pH contours to **Figure 5** of post-white rain pH contours in areas with samples on **Figure 5**; also see **Figure 4b** for pCu pre-white rain contours).

In contrast to pH, total copper present in shallow soil is not expected to change as a result of the white rain, though other mechanisms (source reduction or source removal, clean dust deposition, and erosion) may result in decreases in soil copper concentrations over time.

---

[3] The pre-white rain data included to create the contour maps are shown in **Appendix E**.

[4] Note that the 2009 data (as well as the 5 years of long-term monitoring data collected in this Study) are too limited in number of locations (33) to accurately assess spatial extent of the change from the white rain across the STSIU, and the post-white rain map with contours is very preliminary, used only to design the pH monitoring program. A full spatial analysis of pH and pCu post-white rain will be documented in the STSIU FS Report. Because the 2009 data were not collocated with pre-white rain data, this report does not use the 2009 data to evaluate initial magnitude of the white rain, but instead relies upon soil pH from 1999 or 2006 as pre-white rain data to compare against data from the same locations sampled post-white rain from 2008 and 2010.

1.2 Objectives

1.2.1 Magnitude of the Effect of White Rain on Soil pH and pCu

The first objective of this report is to assess the magnitude of the white rain effect on soil pH and pCu by comparing chemistry of soils in the same location before and after the white rain. Soil pH (in combination with copper) strongly influences pCu, a key compliance metric. Therefore, Chino’s ultimate objective was to estimate changes in soil pCu before and after the white rain event and the persistence of the change, as discussed further in the next section. Throughout this report, pCu is calculated from soil pH and copper concentrations (using the “upland with reference” equation in Newfields 2005), rather than empirically estimated using electrodes. Though not expected to change from the white rain, copper concentrations also are compared before and after the white rain.

1.2.2 Persistence of pH and pCu Change: 5-Year Monitoring

A second objective is to determine whether the increase in pH in upland soils that resulted from the white rain event is temporary or will persist in the future. Following the Work Plan (ARCADIS 2010a), soil pH was monitored at the same locations for 5 years from 2010 to 2014 to evaluate whether the pH improvement from the white rain was sustained. If the white rain neutralized or reduced both the active and potential acidity, the pH change should have been sustained through 2014.

The longer-term potential for pH persistence beyond 5 years also was evaluated with acid-base accounting (ABA), mineralogical analysis, and an assessment of buffering capacity. Buffering capacity, which confers resistance to pH change, was evaluated to assess the potential for future pH decreases after 2014. This capacity was determined by the:

1. Soil pH response to the white rain
2. Acid neutralization potential (ANP, as calcium carbonate available in the soil)
3. Maps showing distribution of soils on the STSIU with historically high calcium carbonates from rock.

Because sulfides in soils, particularly if they are similar to pyrite, can oxidize and produce acid in the future, ABA analyses included estimating percent of pyritic/sulfide sulfur in soils.

In the mineralogical analysis, the exact species of copper sulfide minerals in the soil were identified because sulfide species with high resistance to weathering are less likely to generate acid and alter pH. The more easily weathered sulfide minerals may cause the pH to decrease over time if sufficient ANP is not available to offset the acidity. Some of the soils in the STSIU may have an inherent capacity to buffer pH changes due to soil parent material being high in calcium carbonate (e.g., high ANP). Other soils may have poor buffering capacity, which may have increased after the white rain increased calcium-rich minerals in the soil.

As mentioned above, using initial data collected in spring 2008 through 2009, the white rain appeared to effectively buffer soils with calcium dissolved solids, removing the active acidity and increasing the pH to 5 or greater in many areas (**Figure 5**). Soils with a pH ≥ 5 in 2009 appeared to be acid-neutralizing based on initial 2009 ABA results (ARCADIS 2010a, **Appendix C, Table C-1**). Soil samples that exhibited pH < 5 were acid-generating (ARCADIS 2010a), consistent with their classification as very strongly acidic soils (pH 4.5 to 5.0) and extremely acidic soils (pH 3.5 to 4.4), as defined by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS 1998). The ABA parameters were monitored during the 5-year period to confirm this threshold for acid generation at a pH of 5.

If the initial pH increase after the white rain is persistent, the upward shift in pCu should also be persistent if copper concentrations do not increase. With cessation of historical mineral processing operations in 2002 and ongoing reclamation activities, there is no reason copper concentrations should increase; if anything, they should decrease. If pH or pCu do not change back to the pre-white rain condition, but the white rain effect diminishes over time, the amount it diminishes will also be evaluated.

1.2.3 The Effect of White Rain on Plants and Wildlife

The shift in pH, resulting in an increase in pCu and less bioavailable copper (Mortvedt 2000), has the potential to decrease copper uptake by plants and insects due to the increase in copper adsorption by secondary soil minerals (such as iron hydroxides) at higher pH values. If the shift is determined to persist, the plant and insect tissue copper concentrations are expected to decrease post-white rain, reducing toxic effects in plants and in the food chain. Results from the Insect Study (ARCADIS 2010a) and the final Amendment Report (ARCADIS 2014a) were evaluated to determine if there was a decrease in copper uptake resulting from the white rain in: (1) plants and (2) dietary items for small ground-feeding birds. These biotic media were evaluated because quality of the vegetation community in terms of cover and richness is important to wildlife habitat and rangeland, and the small ground-feeding bird is the wildlife receptor identified as of concern in the site-wide and STSIU-specific ERAs (Newfields 2005, 2008).

2. Datasets and Data Analysis Methods

The following sections provide an overview of the datasets, soil sampling design, analytical methods, and data analysis. The white rain was an unanticipated event; therefore, no study or formal work plan had been designed before the white rain to rigorously evaluate the magnitude of its effect. Instead, STSIU soil samples collected for other purposes (that often-used different field sampling methods) were used to the practical extent possible. Variability inherent in using data derived from different field sampling methods (e.g., composites vs. average of random samples) is evaluated in Section 3.4.

2.1 Datasets and Soil Sampling Design and Methods

2.1.1 Magnitude of Effect of White Rain Event on Soil pH and pCu

2.1.1.1 Initial Magnitude of Effect

In order to evaluate the initial magnitude of effect, appropriate and comparable datasets were identified for before and after the 2008 event. Shallow soil samples were identified for this purpose for 18 locations that had been sampled before and not long after the white rain event (0.5 to 2.5 years later). These locations came from the site-wide ERA (ERA locations, Newfields 2005) and amendment study locations (ARCADIS 2014a). Locations selected for the comparison were the: (1) “primary white rain effect” dataset and (2) the “validation-plus white rain effect” dataset. The “primary white rain effect” dataset includes ERA locations; the” validation-plus white rain effect” dataset includes these same ERA locations plus amendment study locations to validate results. Amendment plot data were too few to use solely as the validation dataset; rather, the amendment plot data were added to the ERA dataset to validate that the ERA dataset alone was giving reliable results. The samples in each dataset are described below for before and after the 2008 event:

Before January 2008 "primary white rain effect" dataset:

- 1999 soil samples at 14 upland ERA locations
    - These soil samples were collected in fall 1999 for the ERA (ARCADIS 2001).
    - Included were locations ERA 2 through ERA 15.
    - At the ERA locations, three shallow soil samples (0 to 6 inches bgs) were collected from each end and the center of a 50-meter transect and averaged[5]:

After January 2008 "primary white rain effect" dataset:

- 2010 samples at the same 14 upland ERA locations (0 to 6 inches bgs):
    - These soils were collected in September 2010 as part of an insect study (ARCADIS 2010b).
    - For each 2010 ERA location, one composite of 15 shallow samples (0 to 6 inches bgs) was collected within a 100-meter-radius plot.

Before 2008 "validation-plus white rain effect" dataset:

- Applies to pH data only and included the ERA locations above
- 2006 amendment study samples on four amendment plot locations also included, for which:
    - No copper data were available before the white rain, but pH data were available and included.

---

[5] Total copper (and thus calculated pCu) was not available from the amendment plot data; therefore, analyses were first restricted to only the 14 ERA locations as the "primary white rain effect" dataset for all three (pH, copper, pCu) parameters.

  - The samples of soil were collected before any treatment in spring 2006 (ARCADIS 2014a).

  - Included were North, Northeast, East, and West Amendment Plot locations.

  - Soil samples were collected at one random shallow location (0 to 4 inches or 0 to 5 inches bgs) in each 100-foot-by-100-foot plot.

  - Reference plots adjacent to amendment plots were not available in 2006.

After January 2008 "validation-plus white rain effect" dataset:

- May/June 2008 samples of pH from the same four amendment study plot locations:

  - Samples of soil were collected before any amendment or tilling in the spring of 2008 (ARCADIS 2014a).

  - In the same plots that were sampled pre-white rain in 2006, soils were sampled and sieved (< 2mm) for paste pH in the field at 10 sub-locations in each plot in May or early June 2008, and the data were averaged per plot.

  - Soils were sampled for pH[6] for lab analysis at two sub-locations in each plot from three (east, north, northeast) of the same plots in May 2008.

  - The field- and lab-analyzed pH data were pooled and averaged for the post-white rain pH analyses. For the West Amendment Plot, pH was averaged over the field sample values only because no lab pH data were collected in 2008.

This validation dataset has 18 locations total.

---

[6] Copper was also sampled post-white rain in 2008 on amendment plots and shown in graphs and tables of this report, but could not be included for the pre- and post- white rain statistical comparison for magnitude of effects because no copper data were collected pre-white rain in 2006 (nor on the West Amendment Plot in 2008, which had 2010 West Reference plot data reported as the first-post-white rain estimate).

2.1.1.2 Final Magnitude of Effect

To estimate the magnitude of the white rain effect at the study conclusion (particularly if the effect diminished), part of the “primary white rain effect” and “validation-plus white rain effect” datasets described above could be used. However, only a subset containing five locations in the “primary white rain effect” dataset and a subset containing nine locations in the “validation-plus white rain effect” dataset could be compared before the white rain and over the years after the white rain. These locations were sampled pre- (1999 or 2006) and early post-white rain (2008 or 2010) and in 2012, 2013, and 2014 (see Section 2.1.2 for methods used to sample these locations from 2012 to 2014). Because these datasets are limited and less representative, any suggestion of the white rain effect being diminished by 2014 (i.e., between 2010 and 2014) using these data was considered reliable only if the permanence monitoring dataset of 2010 to 2014 also showed a lack of persistence through time.

<u>These subset datasets include:</u>

- Primary subset: ERA 2, 3, 4, 10, and 13
- Validation-plus subset: Primary subset plus West, North, Northeast, and East Amendment (2006 and 2008) or the Reference Plots adjacent to the Amendment Plots (2010-2014; latter referred to as Reference #1, #2, #3, and #4 in the Work Plan [ARCADIS 2010a]).

The Amendment Study’s amendment plots were used for the 2006 pre-white rain data (because no adjacent reference plot data exist pre-white rain) and 2008 post-white rain data. This approach assumes that amendment plots exhibited pH estimates similar to those of the plots immediately adjacent, which were the plots that had data available for evaluating white rain effects from 2010 to 2014. The change in copper and pCu was not evaluated in the “validation-plus white rain effect” subset because the amendment plots lacked copper data pre-white rain.

2.1.2 Persistence of the pH and pCu Change: 5-Year Monitoring

The approved Work Plan was designed to evaluate the persistence of the pH and pCu change. Parameters monitored in the soil to track such changes include pH, total copper, and ABA, each monitored annually during the fall season from 2010 to 2014. Cupric ion activity, as pCu, was calculated from the pH and total copper results, as discussed earlier.

As proposed in the Work Plan, areas within three estimated pH zones (pH 4 to 5, 5 to 6, and 6 to 7) post-white rain, shown on **Figure 5**, were targeted for monitoring (ARCADIS 2010a). The zones had a lower pH prior to the white rain event. A minimum of six locations in each of the three pH zones were targeted to meet sample size criteria (see ARCADIS 2010a), which totaled 18 locations selected for long-term monitoring over a 5-year period. Four additional locations already monitored in the Amendment Study, reference plots were added to increase the total number of locations to 22 in 2010. The pre- and preliminary post-white rain pH and pCu zones used to select the 22 selected locations are shown in **Table 2**, along with five ERA locations, which were added in 2012 to comprise the long-term monitoring dataset.

Soil was excavated at four of the original sample locations in summer 2011 (FID 23, 43, 103, 104). Therefore, during the 2011 fall sampling event, only 18 of the initial 22 long-term monitoring locations were sampled. One additional location (FID 17) in 2013 was also excavated and dropped from sampling in 2013 and 2014 (**Figures 1** and **5** show their former locations). The primary excavation activities were conducted in support of reclamation of the older tailing impoundments. The excavations resulted in a final set of 17 locations that were monitored every year from 2010 to 2014 and were evaluated statistically for trends. This dataset of 17 is the “permanence monitoring” dataset.

Five new monitoring sites, which were collocated at previously sampled ERA locations, were added and sampled from 2012 to 2014 (ERA 2, ERA 3, ERA 4, ERA 10, and ERA 13).[7] These five locations met the selection criteria of low pH pre-white rain (≤ 5.5) and showed an improvement in pH post-white rain, when sampled in 2010 for the Insect Study (ARCADIS 2010b). The objective of monitoring these ERA locations differs from those objectives associated with the other locations. Adding the ERA

---

[7] The five new monitoring sites, however, cannot be included with the other 17 pH monitoring locations when statistically evaluating annual changes across the target pH zones from 2010 to 2014 because they were not sampled in 2011 and were sampled using a different method in 2010. Specifically, the area of the sampling locations used to composite soil was much larger in the 2010 Insect Study (31,416 square meters [m^2]; ARCADIS 2010b) than the area sampled from 2010 to 2014 based on the approved Work Plan (2,500 m^2; ARCADIS 2010a), and only samples that met the rigorous standards of the Work Plan were included (unlike the retrospective magnitude analysis, which required using any suitable locations with pre- and post-2008 data, even if they were not sampled using the same methods).

locations allows interpretation of longer-term changes due to the white rain by evaluating trends from 1999 to 2014 and assessing changes in the final magnitude of effect as described in Section 2.1.1.2[8]. The final numbers of locations sampled during each year of the 5-year monitoring program were 22, 18, 23, 22, and 22 locations for 2010, 2011, 2012, 2013, and 2014, respectively.

Each of the soil locations monitored from 2010 to 2014 (including amendment reference plots) in the long-term monitoring dataset was a composite of five grab samples within a 50-meter (m) by 50 m square area. The five grab samples were collected at the centers and the four corners of the 50 m by 50 m squares, as described in the Work Plan (ARCADIS 2010a). The grab samples were offset in a different cardinal direction by 5 feet each year to avoid sampling the exact same location that was disturbed the year before and still provide samples closely collocated over time for a 5-year period.

2.1.3 Effect of White Rain on Plants and Wildlife

2.1.3.1 Vegetation Tissue Sampling

ARCADIS (2014a) evaluated the change in copper concentrations in aboveground plant tissue (seeds and foliage) that represented conditions just before and after (in 2013) the white rain on the plots of the Amendment Study. They also compared copper concentrations in tissue of plants growing on ERA locations with low pH soils (< 5.5 in 1999) before and after the white rain.

Datasets used in that report included:

- Plant tissue collected on West, North, Northeast, and East Amendment (represents before white rain) and Reference (after white rain) Plots

---

[8] These locations were not originally included in the design of the approved Work Plan because they were not randomly located, represent only flat areas, under-represent locations that had very low pH (2 to 3) pre-white rain and, therefore, under-represent locations of post-white rain in the targeted pH zones of 4 to 5 and 5 to 6 (most ERA locations have a pH > 6 initially post-white rain).

- Plant tissue collected on ERA 1, 2, 3, 4, 7, 9, 10, and 13

Details on the sampling are provided in ARCADIS (2014a).

2.1.3.2 Invertebrate Tissue Sampling

ARCADIS (2010b) evaluated the change in copper concentrations in terrestrial invertebrate tissue before (1999) and after (2010) the white rain fell on 14 ERA locations.

Datasets from that study evaluated for this report included:

- Insect tissue collected on ERAs 2 through 15.

Details on invertebrate sampling methods are provided in ARCADIS 2010b.

2.2 Analytical Laboratory Methods

Samples collected pre- and post-white rain and as part of the pH monitoring program were analyzed using the following laboratory methods.

2.2.1 Magnitude of Effect of White Rain Event on Soil pH and pCu

Soil samples from the “primary white rain effect” dataset (1999 and 2010 ERA locations) were analyzed for total copper and pH by ACZ Laboratories, Inc. (ACZ), located in Steamboat Springs, Colorado. Samples were air-dried at 34 degrees Celsius before analysis, and all estimates were based on dry weight. In contrast, the 2006 and 2008 Amendment Study plot samples added to create the “validation-plus white rain effect” dataset (plus 2010 West Reference Plot substituting for missing copper value of 2008 West Amendment Plot), were analyzed for total copper (in 2008 only) and pH (2006 and 2008) by SVL Analytical, Inc. (SVL) in Coeur d'Alene, Idaho (except the West Reference Plot was analyzed by ACZ); those SVL soils were not air-dried, and results by dry weight were calculated. For both laboratories, total copper in soil was determined by subjecting samples to acid digestion using United States Environmental Protection Agency (EPA) 3050B protocol followed by inductively coupled plasma-atomic emission spectroscopy (ICP-AES) analysis (EPA 6010B) with a method detection limit of 1 mg/kg. Soil pH analysis was conducted with deionized water using a 1:1 soil to solution ratio (EPA 9045C) or, when sampled in the field, by saturated 1:1 soil to distilled water paste (ARCADIS 2001, ARCADIS 2010b, ARCADIS 2014a).

As described in the Amendment Study Report (ARCADIS 2014a), the amendment samples in the “validation-plus white rain effect” dataset collected historically (2006 to 2010) were not sieved, though the pre-FS RAC is based on sieved (< 2 mm) results. In order to conduct valid statistical analysis, all data were adjusted as if they were sieved for the 2 mm size fraction, a conservative adjustment. Regression equations displaying strong, significant relationship between sieved and unsieved soils were developed for this report by analyzing sieved and unsieved results for pH and copper from spring 2011 Amendment Study (analyzed by SVL, ARCADIS 2014a) and fall 2010 pH monitoring (by SVL and ACZ). These soils were analyzed twice, as sieved and unsieved, for the purpose of developing these regressions[9]. A comparison between sieved and unsieved soil pH data is shown on **Figure 6a**, and a comparison between sieved and unsieved soil copper data is shown on **Figure 6b**.

All pH and copper measured in years for which soils were not sieved were adjusted to estimate sieved values using these regressions. The results presented in the tables and text for this report are based on sieved or estimated sieved values. Raw unsieved data for copper collected to evaluate the white rain effect in 2009 are provided in **Appendix C** as well as other 2009 sieved data**. Appendix C** has pH and copper data that are not part of the white rain effects or permanence datasets but are included in that appendix to be available as supplemental information that illustrates the same general trends observed using the main datasets (see **Figure C-1** and Statistical Analysis in **Tables F-5, F-6, and F-7**).

2.2.2 Persistence of the pH and pCu Change: 5-Year Monitoring

This section discusses analytical methods employed to analyze the soil chemistry (pH, copper, pCu), ABA results, and mineralogy to monitor and evaluate persistence.

2.2.2.1 Soil Chemistry and Acid Generation Potential

ACZ analyzed the composite soil samples collected for the approved Work Plan for pH, total copper, and ABA, including sulfur forms. The copper and pH data were used to calculate pCu. The Work Plan states that samples analyzed for copper and pH will be sieved to less than 2 mm. This protocol was followed, except in 2010, when the four

---

[9] $pH_{sieved} = 1.191pH_{unsieved} - 1.5781$, $r^2 = 0.90$, $P < 0.001$; $Cu_{sieved} = 1.0129Cu_{unsieved} + 232.43$, $r^2 = 0.88$, $P < 0.001$.

amendment study reference plot soil samples (Reference 1 through 4) were inadvertently not sieved prior to analysis by SVL. These samples, reported on a wet weight basis, were adjusted to represent copper and pH of air-dried sieved samples using the regression equations described in Section 2.2.1.

The analytical methods used for soil chemistry (pH, copper, and ABA) include:

- Soil pH analysis using deionized water (EPA 9045C or saturated paste)

- Total copper analysis by acid digestion using EPA 3050B followed by ICP-AES (EPA 6010B) with a method detection limit of 1 mg/kg

- Samples were air-dried at 34 degrees Celsius before analysis, and all estimates were based on dry weight. Soils subjected to ABA analysis were sieved to < 250 microns (µm) following standard procedures.

- The ABA analysis included measurement of neutralization potential and sulfur forms (total sulfur, pyritic/sulfide sulfur, sulfate sulfur, and organic/insoluble sulfur) using the Modified Sobek procedure (EPA M600/2-78-054), specifically:

    - Neutralization potential in percent as calcium carbonate ($CaCO_3$) was determined using EPA M600/2-78-054 3.2.3, with a 0.1 percent method detection limit. The laboratory calculated ANP in tons $CaCO_3$ per kiloton (t $CaCO_3$/kt) by multiplying the neutralization potential by 10.

    - Sulfur forms (total, pyritic/sulfide sulfur, sulfate sulfur, and organic/insoluble sulfur) were determined using EPA M600/2-78-054 3.2.4 with a 0.01 percent detection limit. Total sulfur content was determined by combustion via Leco furnace. Sulfur forms were analyzed on separate sample aliquots, with a subsample being digested in 4.8 Normal (N) hydrochloric acid (HCl) and another being digested in 2 N nitric acid (HNO_3). ACZ uses the terms pyritic/sulfide sulfur; however, this methodology does not distinguish between true pyritic (FeS_2) and non-pyritic sulfide minerals. For example, copper monosulfide and covellite (CuS) are included in the pyritic/sulfide sulfur category, and the ABA analysis conservatively assumes that all sulfides are highly acid-generating, similar to pyrite (not true as discussed in Section 3.3).

    - ARCADIS calculated acid-generating potential (AGP) in t $CaCO_3$/kt by multiplying the sulfide sulfur content (reported as pyritic/sulfide sulfur by ACZ) in percent by a conversation factor of 31.25 based on acidity generated by pyrite oxidation (i.e., conservatively assuming that all sulfide sulfur oxidation is represented by pyrite oxidation).

- ABA results were used to determine the neutralization potential ratio (NPR = ANP/AGP) and net neutralization potential (NNP = ANP - AGP). These criteria are commonly used to categorize material into potentially acid-generating (PAG) or non-potentially acid-generating (non-PAG) categories.

Numerous interpretation schemes have been developed to assess the potential for acid generation using either criterion. For example, a sample with an NPR < 1.0 will typically be characterized as PAG; whereas an NPR > 2.0 represents a non-PAG sample (i.e., at least twice as much ANP as AGP, Steffen et al. 1992). A sample with NPR values between these designations is considered to have uncertain acid-generating characteristics and should be evaluated further. The New Mexico Mining and Minerals Division (MMD) soil and overburden suitability guidelines, which are directly applicable, rate soil material as good based on an NNP of -5 t $CaCO_3$/kt or greater and unacceptable based on an NNP of < -5 t $CaCO_3$/kt (MMD 1996).

2.2.2.2 Mineralogical Analysis

The sulfur form analysis does not provide information on the specific minerals and their acid-generating potential, which varies from mineral to mineral. In 2009, 12 of the 2009 soil sample locations on **Figure 5** were sampled for a mineralogical analysis of the form (species) of minerals containing copper. This information supplements the sulfur form data. Note, this analysis focused on species of copper in the soil, and included iron sulfide minerals lacking copper only if sorbed with copper. Dr. John Drexler's Laboratory for Environmental and Geological Studies (LEGS) at University of Colorado at Boulder performed the speciation analysis on the samples under an electron microprobe to evaluate the types of copper minerals present. Specifically, his laboratory used a JOEL 8600 electron microprobe, with four wavelength dispersive detectors (TAP, LIF, PET, LdB, LdC, and Ld1 crystals) and an energy dispersive detector. The system includes backscatter and secondary detectors for imaging and can produce both x-ray spectra and photomicrographs in TIF format.

The standard operating procedure for metal speciation is available at: http://www.colorado.edu/GeolSci/legs/speciation.html[10]. Certified mineral standards for all elements of concern were applied for electron microprobe analysis (EMPA) standardization. Representative backscatter photomicrographs (BSPMs) illustrating sample characteristics were acquired. Energy dispersive spectroscopy (EDS) spectra were also acquired. **Appendix D, Table D-1** provides the relative copper mass of species of copper in the soil samples. **Appendix D** also provides images from the spectra and frequency of occurrence of the copper species.

2.2.3 Evaluation of the Effect of White Rain on Plants and Wildlife

Plant tissue samples collected representing pre-white rain (unwashed) and post-white rain (washed and unwashed) tissues were subjected to total copper analysis similar to the soil samples. The samples were subjected to acid digestion using EPA 3050B followed by ICP-AES analysis (EPA 6010B) with a reporting limit of 1 mg/kg.

Invertebrate samples collected pre-white rain (unwashed) and post-white rain (washed) were analyzed for total copper by ICP-AES (USEPA Method 3050B / 6010B) of a homogenized subsample of insects collected. All estimates were initially based on wet weight. Percent moisture was determined for the 2010 post-white rain event tissues so that final insect tissue concentrations could be presented on a dry weight basis. Dry weight concentrations were estimated for the 1999 pre-white rain event tissues using 71 percent moisture, based on the average moisture of the 2010 insects.

2.3 Data Analysis

In addition to plotting the data to evaluate trends, statistical methods were employed to evaluate the magnitude and persistence of the white rain event impacts as discussed below. Parametric tests were employed unless assumptions of the test were not met, even after data were transformed[11]. When assumptions were not met, the non-parametric equivalent test was employed. Statistical analysis and calculations used the

---

[10] Last referenced in 2015.

[11] Transformation decisions were guided by calculating the lambda in Box-Cox transformation tests.

detection limits when values were lower than the detection limits. Additionally, the primary for each duplicate was used for the analyses.

2.3.1 Magnitude of Effect of White Rain Event on Soil pH and pCu

As discussed above in Section 2.1.1, pH, total copper, and pCu (calculated from pH and copper) were compared at locations sampled before and after the white rain event to evaluate the initial and final magnitude of the effect of the white rain. Using the "primary white rain effect" dataset (n = 14 for pH, copper and pCu, **Table 3**), the data were compared pre- and early post-white rain with two-tailed paired t tests to evaluate the initial effect. To evaluate whether the final magnitude of the effect diminished over time, the pre-white rain samples for the "subset of primary white rain effect" dataset were compared to samples from the early post-white rain period (2010) and the years 2012 to 2014, using repeated measures analysis of variance (ANOVA).[12] If the ANOVA was significant, a post-hoc pairwise comparison was conducted to assess which years significantly differed. All statistical tests in this report assumed significance if $p < 0.05$.

The white rain may not have much of a measurable effect (or at least a long-term effect) on the pH of soils that contained low acidity before the white rain (i.e., pH ≥ 5.5). Therefore, these analyses were also split into two groups of those with pH ≤ 5.5 (n = 7) and those with pH > 5.5 (n = 7) before the white rain event, based on observations of locations in the former group showing increased pH, but not those in the latter group. Finally, the pH analyses were re-run with the larger "validation-plus white rain effect" (n = 18) dataset to verify that the results are consistent with the primary dataset.

2.3.2 Persistence of the pH and pCu Change: 5-Year Monitoring

To evaluate whether the decreased acidity in post-white rain soils remained unchanged over the monitoring period, the repeated measures ANOVA test was run on the "permanence monitoring dataset" to test for significant changes over time for pH,

---

[12] A parametric repeated measure ANOVA requires both normality and sphericity of residuals. Normality was met, but the Greenhouse-Geisser or Huynh-Feldt correction was applied to all three parameters to meet the test assumption of sphericity in the main ANOVA.

copper, and pCu from 2010 to 2014. If the test was significant, post-hoc pairwise comparisons were performed to identify which years were significant.[13]

In addition to comparing samples collocated in time, all 17 samples were pooled to evaluate the overall trend in the mean over time of pH, copper, and pCu. The non-parametric Mann-Kendall trend analysis, which does not require linearity, was performed to determine if a monotonic increasing, decreasing, or stable temporal trend was apparent for any of the three parameters for the “permanence monitoring” dataset.

2.3.3 Analysis of Acid Base Accounting Results

Because the NNP and NPR data from the ABA did not meet repeated measures test assumptions, even when transformed (data were non-normal), the non-parametric Friedman test of repeated measurements on collocated samples was used to test for significant changes from 2010 to 2014 for NNP and NPR at the 17 sites in the “permanence monitoring” dataset. Additionally, to best understand the potential for acid generation that would reduce pH across the STSIU, ABA results for 32 of the 33 2009 locations sampled allowed assessment of percentage of the STSIU area with sulfide-producing minerals and that might become more acidic. This “2009 dataset” (see **Appendix C, Table C-1**) contains many of the “permanence monitoring” locations but also includes many other locations. Of note, 12 of these 2009 locations (see **Appendix D, Table D-**1) were further sampled for mineralogical analysis to evaluate the most common copper sulfide-producing minerals, as discussed above.

---

[13] A Bonferroni correction to the post-hoc comparison test p value of 0.05 was not applied to conservatively avoid Type II errors (the error of stating not significantly different when is different). Consequently, some of the significant post-hoc comparison test results may be spurious (because using 95 percent confidence level results in 5 percent of tests being significant by chance); this report mentions this when that might be the case. To meet repeated measure ANOVA test assumptions, the natural log transformation and Greenhouse-Geisser correction were applied to the pH data. The Box-Cox transformation ($\lambda = -0.16$) and Huynh-Feldt correction were applied to the copper data. The Greenhouse-Geisser correction was applied to the pCu calculated values.

2.3.4 Spatial Analysis of pH and pCu Persistence

To support the statistical analyses that test for persistence of the pH change, maps showing pH and pCu values at sampled locations in 2010 and 2014 were created. These maps were examined to evaluate whether all local areas monitored showed no change in pH or pCu during the post-white rain period, which would suggest consistent persistence. If some areas of the STSIU changed over time in a manner different from other local areas, then the change may not remain persistent in some areas, even if no pH change is observed on average across the STSIU[14].

2.3.5 Effect of White Rain on Plants and Wildlife

Statistical analyses conducted to compare plant tissue copper concentrations before and after the white rain are detailed in ARCADIS 2014a. However, the pre- and post-white rain copper concentrations in insect tissue were not statistically compared in the 2010 Insect Study because the white rain was not the focus of that study (ARCADIS 2010b). Therefore, a two-sided paired t test was employed to evaluate the significance and magnitude of the white rain effect. The 1999 insects were not originally washed, however, and the copper data were adjusted to remove the effect of soil on the 1999 unwashed insects. A comparison of the weight of a subset of the 2010 unwashed insects that were then washed suggests that the weight of the insects from soil is no more than 0.4 percent (ARCADIS 2011c). Therefore, the 1999 copper concentration data in ARCADIS 2010b were adjusted to account for 0.4 percent of the weight having soil copper concentrations at the locations sampled.

3. Results

Results from the data analysis described in Section 2 are summarized below.

---

[14] These maps do not represent a complete picture of the current distribution of pH and pCu, which will not become available until the STSIU FS report is submitted to NMED. The STSIU FS report will include contour maps based on a different and very large sample dataset specifically designed and collected for this purpose.

3.1 Magnitude of Effect of White Rain Event on Soil pH and pCu

3.1.1 Initial Magnitude

Using the “primary white rain effect” dataset (n = 14), soil pH significantly increased from 6.1 before the white rain in 1999 to 6.6 not long after the white rain in 2010 (increased by 0.5 S.U., paired t test, p = 0.04; see **Tables 3 and 4**). **Figure 7** illustrates that soils with pH ≤ 5.5 consistently increased in pH early after the white rain, but that was not true of locations with pH > 5.5. For locations in this dataset with high pH (>5.5), the data showed no significant increase in soil pH (7.3 pre- and 7.1 S.U. post-white rain, p = 0.1; **Table 4**). Conversely, for locations with low pH (≤ 5.5), the increase in soil pH was significant and large, with a 1.2 S.U. initial increase (from 4.8 to 6.0, p = 0.0004). The larger validation-plus dataset, which included the amendment plots (n = 18), produced the same results but with larger increases in pH of 0.7 S.U. increase using all data, 1.25 S.U. increase for only the soils with pH ≤ 5.5, and no significant change (p = 0.9) for soils when pH > 5.5 (**Table 4**). West Reference Plot 1, which increased from a pH of 6.5 to the 7 to 8 range, was the notable exception to high pH soils not increasing in pH after the white rain (**Figure 7**).

In contrast to pH, pre- and early post-white rain copper concentrations in 2010 did not quite show a significant change in concentrations based on the “primary white rain effect” dataset (497 mg/kg before and 434 mg/kg after, paired t test, p = 0.08; **Tables 3 and 4).** Copper concentrations at individual locations also showed no consistent pattern of change from the white rain (**Figure 8**).

Using the same “primary white rain effect” dataset, mean calculated pCu for pre- and early post-white rain periods significantly increased from 6.0 to 6.6 (0.6 unit increase, p = 0.02; **Tables 3 and 4**). Similar to pH results, locations with low pH (≤ 5.5) and correspondingly low pCu (≤ 6, **Figure 9**) showed an even higher significant increase of 1.4 pCu units (from 4.6 to 6.0, p < 0.0001) than the 0.6 average increase for all the data. Further, locations with high pH (> 5.5) showed no significant increase in soil pCu (p = 0.8).

3.1.2 Final Magnitude of Effect of White Rain Event

Statistical analysis results (discussed further in Section 3.2 below) indicate that the pH increase just after the white rain was sustained and persistent through 2014. The ancillary 2009 pH data added to other years of data also support no significant change in pH from 2009 through 2014[15]. The final magnitude of the pH effect in 2014 is concluded to be similar to the initial magnitude in acidic soils reported in Section 3.1.1. While pH remained the same, however, copper concentrations decreased during the early post-white rain period from 2010 to 2011, and the calculated pCu correspondingly significantly increased in 2011 and stayed high (increased by 0.5, see results in Section 3.2). This pCu increase is due to the copper decrease, not a delayed positive effect of the white rain. These conclusions are based on the robust “permanence monitoring” dataset representative of variable terrain and soils with altered pH.

The subset of “primary white rain effects” dataset also supports that the white rain continued to produce beneficial effects 7 years later (by 2014). Similar to the robust permanence monitoring dataset, this smaller subset ($n = 5$) of the “primary white rain effects” dataset showed no significant change in pH after the white rain through 2013. However, this dataset showed a significant decrease in the magnitude of the pH shift from the white rain in 2014, dropping from an initial pH increase of 1.4 S.U. to a diminished increase of 0.8 S.U. (repeated measures post-hoc comparisons test, $p < 0.05$; **Appendix F, Tables F-1 to F-4**, **Figure F-1**). This inconsistent finding with the rest of the results is not strongly supported because the three amendment plots that were originally acidic (North, Northeast, and East in the “validation plus white rain effects” subset) do not appear to indicate lower pH in 2014 than that observed in earlier years after the white rain (see **Figure C-1, Appendix C**). Therefore, the decrease is not consistent among locations (three of the eight locations in the subset of “validation-plus white rain effects” dataset do not decrease in 2014), and most likely represents year-to-year fluctuations.

3.2 Persistence of the Change: 5-Year Monitoring of pH, Copper, and pCu

Over the 5-year monitoring period, soil pH for the 17 collocated locations of the “permanence monitoring” dataset did not change significantly (repeated measures ANOVA, $p = 0.2$; **Table 5, Figure 10**). When restricted to locations that likely had low

---

[15] **Figure C-1 in Appendix C** provides additional supporting information using 2009 and some 2008 post-white rain data compared to collocated data in later years (later years are from the “permanence monitoring” dataset). These data show a sustained higher pH and pCu trend over the 6- or 7-year period. The pH does not significantly change during this post-white rain period from 2008 or 2009 to 2014 (**see Appendix F, Table F-5;** also see **Tables F-6 and F-7** for copper and pCu changes, respectively, with 2009 data included).

pH before the white rain (e.g., those that had pH post-white rain in 2010 of < 6.4; n = 12), the same result was obtained (p = 0.3). Overall, the means averaged over all data do not support a consistent trend downward (Mann-Kendall p = 0.7, **Figure 11, Table 6**), suggesting that the higher pH from the white rain is persisting[16]. The mean pH values for the 17 locations were similar at 5.45, 5.24, 5.27, 5.46, and 5.22 in 2010, 2011, 2012, 2013, and 2014, respectively (**Table 6**). The combined mean pH of the monitored locations over the 5-year period was 5.33[17].

Over the 5-year monitoring period, however, soil copper concentrations for the same "permanence monitoring" dataset changed significantly (repeated measures ANOVA, p < 0.0001) (**Table 5, Figure 12**). Total copper concentrations were significantly lower in 2011, 2012, 2013, and 2014 than in 2010 (post-hoc comparisons test, p < 0.05, **Table 6**). The 2010 mean was 478 mg/kg higher than the average of the four later years. Specifically, the mean total copper concentration for the dataset was 1,296 mg/kg in 2010 vs. 873 mg/kg, 851 mg/kg, 682 mg/kg, and 867 mg/kg in 2011, 2012, 2013, and 2014, respectively. Mann-Kendall analysis did not reveal a significant smooth upward or downward trend in means averaged over all data (p = 0.4, **Figure 13, Table 6**). Both statistical tests (repeated measures and Mann-Kendall) indicate that the trend is not a steady linear or monotonic change; instead, the change is largely due to a step function change after 2010, where total copper concentration dropped between 2010 and 2011 at most locations and remained at a consistently lower level through 2014.[18]

Copper concentrations in soil are heterogeneous spatially, resulting in high variability during each sampling period and increasing uncertainty in observed trends. Notably, during the lower copper concentration period of 2011 to 2014, copper was significantly

---

[16] The year 4 pH monitoring report (ARCADIS 2014b) indicated a significant change in pH from 2010 to 2013. This is driven by a drop in pH between 2010 and 2011 that was likely spurious because increases in pH observed in later years (i.e., 2011 to 2013) appear to have stabilized and made insignificant what appeared to be an initial downward trend (see **Appendix F, Table F-9**).

[17] This mean pH value is not representative of the entire STSIU, only locations where pH shifted and was monitored. The representative 2009 randomly selected samples show the STSIU average pH is estimated to be 6.7 (average of field pH data in **Table C-1, Appendix C**).

reduced again in 2013, and then significantly increased by 2014 back to the previous 2011 and 2012 level (post-hoc comparisons test, $p < 0.05$, **Appendix F, Table F-9**). Such temporary reductions illustrate fluctuations may be temporary. The significant decrease in copper between 2010 and 2011, however, has been sustained to 2014. The 2010 fall soil samples were analyzed by both SVL and ACZ (to develop a sieved and unsieved relationship) and after sieving adjustments to make the data comparable, results show similar trends of higher copper in 2010 than 2011, which supports that laboratory conditions are not responsible for the shift. It is possible that the decrease is a result of high spatial variability of copper, however, as discussed in Section 3.4.

Although there was not a significant change in pH over the 5-year monitoring period, the decrease in total copper caused a significant increase in soil pCu using the "permanence monitoring" dataset (repeated measures ANOVA, $p = 0.006$). Soil pCu was significantly higher in 2011, 2012, and 2013 (by 0.5 on average) than in 2010 (post-hoc comparisons test, $p < 0.05$; **Table 5, Figures 14 and 15**). Specifically, mean pCu values for the 17 locations in the dataset were 4.48, 4.77, 4.83, 5.26, and 4.67 in 2010, 2011, 2012, 2013, and 2014, respectively (**Table 6**). The combined mean pCu over the 5-year monitoring period was 4.80[19]. Mann-Kendall analysis of all data did not reveal a significant smooth upward or downward trend ($p = 0.4$, **Table 6**) because the decrease was mostly a step function caused by the reduction in copper by 2011. Consequently, similar to copper but in the reverse direction, an increase in pCu from 2010 to 2011 was observed, and pCu remained at a higher level through the rest of the years monitored.[20] Because the shift from 2010 to 2011 is based on the uncertain copper shift, this shift in pCu between 2010 and 2011 also is uncertain.

3.2.1 Spatial Analysis of pH and pCu Persistence

Figures 16 to 19 show the spatial distribution of soil pH and pCu results post-white rain for the 22 monitoring locations sampled in 2010 and 2014. These maps are based

---

[19] This mean pCu value is not representative of the entire STSIU, only in locations where pH shifted and was monitored. The representative 2009 randomly selected samples show that the STSIU average pCu is estimated to be 6.2 (average of pCu data in **Table C-1, Appendix C**).

[20] Following copper concentration changes, pCu significantly increased again in 2013, and then significantly decreased by 2014 back to the previous 2011 and 2012 levels (post-hoc pairwise comparisons test, $p < 0.05$, **Appendix F, Table F-10**).

on a small set of location data[21] and are only provided in this report for the purpose of comparing 2010 to 2014 data to assess whether some local areas changed in pH or pCu more than other local areas in the STSIU. The maps do not show evidence of major shifts in pH back to pre-white rain values and support that persistence of the pH change was not confined to a localized area (compare **Figures 16 and 18**). **Figures 17 and 19** show that the change in pCu between 2010 and 2014 also was not constrained to any local areas. Also, the magnitude of the shift in pH from the white rain was not associated with any particular vegetation zone (**Figure 20**), nor to any geologic unit (**Figure 21**)[22].

Spatial changes in total copper concentrations can be investigated best by looking at the bar graphs showing changes over time for individual locations. The decrease in copper concentrations that caused pCu to increase, particularly between 2010 and 2011, was consistent across the STSIU (**Figure 12**) except for FID 10, FID 17, and North Reference Plot 2. It is unclear why these three locations did not show a decrease, but they are very close to or just north of the smelter (**Figure 1**). However, the northeast Reference Plot 3, FID 15, and FID 16 are also near those three locations and did show a decrease, indicating that geographic location is probably not the reason copper did not show a decrease in the three plots. Overall, most of the monitored STSIU locations showed some decrease in copper concentrations over the monitoring period (**Figure 12**). Given the high variability of copper, it is unclear if this decrease, unrelated to the white rain, is spurious.

3.2.2 Acid-Base Accounting

Total sulfur content in the soil samples collected in the STSIU from 2009 to 2014 ranged from 0.01 to 1.02 percent, with a mean of 0.16 percent (**Table 7, Appendix C, Table C-1**). These concentrations are low and fall within the range of background concentrations for sulfur in soil in the western United States (from < 0.08 to 4.8 percent, with a mean of 0.19 percent; Shacklette and Boerngen 1984). Pyritic/sulfide

---

[21] See **Appendix E** for locations and data used to create pre- and post-white rain maps.

[22] Note that, though **Figure 21** does not show the west side of mining facilities as Gila Conglomerate Formation, this geologic unit does occur at depth in that area, creating calcareous soils (prior to mining) as shown on **Figure D-1 of Appendix D.** Sitewide Abatement Stage 1 (Golder unpublished) shows that the soil samples on the west side are more alkaline.

sulfur content was low, with levels low enough to be difficult for the laboratory to accurately quantify. For example, 50 to > 90 percent of the samples from each year exhibited detected results below the practical quantitation limit of 0.1 percent. These were flagged as estimates due to the low sulfur content (**Table 7**). The sulfur data also showed high variability, which is consistent with the inherent heterogeneity typical of soil samples.

It follows that the NNP and NPR values, calculated from the pyritic/sulfide sulfur data below the 0.1 percent practical quantitation limit, were also flagged as estimates. Partly because of high variability, the mean NNP and NPR estimates did not significantly differ at the same 17 locations over the 5-year monitoring period, even though the mean in 2010 was high, as shown below (permanence monitoring dataset, $p > 0.7$, Friedman test, **Table 7**). The mean estimates were:

- Mean NNP = 23.2, 8.7, 10.8, 15.6, and 5.9 t $CaCO_3$/kt for 2010, 2011, 2012, 2013, and 2014, respectively ($p = 0.7$).

- Mean NPR = 51.8, 10.5, 10.9, 18.3, and 14.3 for 2010, 2011, 2012, 2013, and 2014, respectively ($p = 0.9$).

Post-white rain in 2010 to 2014, 53, 47, 29, 47, and 44 percent of the 17 locations exhibited NPR less than 1.0 (meaning they are identified as PAG), and 53, 59, 29, 53, and 69 percent exhibited NPR less than 2.0 and could be identified as either “uncertain” or PAG (**Table 7**, **Figure 22**). From 2010 through 2014, however, only six, six, zero, six, and one of the samples (subjected to ABA) with pyritic/sulfide sulfur content greater than the 0.1 percent practical quantitation limit are in the uncertain or PAG NPR range. This equates to only 35, 35, 0, 35, and 6 percent of the 17 samples each year being of potential concern due to higher pyritic sulfur and being PAG.

The percentages provided above are based on monitoring locations and do not represent the entire STSIU. Of the larger, more representative, random sample of 32 soils collected throughout the STSIU in 2009 and analyzed, only 16 percent exhibited NPR < 2.0 and 12.5 percent exhibited < 1.0 (includes those with pyritic sulfide sulfur below the practical quantitation limit, see **Appendix C, Table C-1**). For this 2009 estimate, ARCADIS had to assume 60 percent of total sulfur is pyritic/sulfide sulfur, given the sulfur forms were not evaluated that year. The 60 percent estimate was used because, on average, pyritic sulfide sulfur makes up 60 percent (range of 55 to 70 percent) of the total sulfur content in samples collected from 2010 to 2014.

The ABA results for each location plotted on scatter plots of NPR or NNP against pyritic/sulfide percentages or pH for each year from 2009 to 2014 provides insight into the range of sulfide percentages associated with uncertain and PAG soils (using NPR < 2 criteria, **Figures 22 to 24**). Generally, the category of pyritic/sulfide sulfur ranged from 0.01 to 0.6 percent for PAG samples with NPR < 1 (**Figure 23**), which is a very wide range (see Price 2009) and confirms that the sulfur form analysis, with variable results from year to year, is not very helpful for identifying PAG samples.

Additionally, the soils monitored over time did not have the same PAG status every year, confirming the variability in the ABA results and soil heterogeneity. Only four of the soils that were sampled more than once (n = 25 from 2009 to 2014) exhibited an NPR consistently < 2.0 every year sampled, which were FID 16, 23, 101, and ERA 10. Another four samples exhibited an NPR of > 2.0 for 17 to 25 percent of the years sampled (FID 17, 18, 102, and East Reference #4). The rest (68 percent) were always or often NPR of > 2. The data show that soils with NPR values < 2.0 are not only inconsistently classified as PAG but often had low pyritic/sulfide sulfur content and low ANP; therefore, it is more important to consider NNP soil guidelines than to focus on NPR.

NNP data were plotted against pH to illustrate the pH range of locations higher than the MMD NNP criteria of -5 t $CaCO_3$/kt. In almost every year since 2009, almost all the samples meet the MMD criteria of “Good” and acceptable for topsoil suitability of greater than or equal to -5 T $CaCO_3$/Kt (**Figures 23 and 24**). In 2009, 2010, 2011, 2012, 2013, and 2014, only one, five, two, one, zero, and one sample, respectively, were below this MMD threshold (**Table 7, Figure 24**). More importantly, with only one exception (**FID 8 in 2010)**, all acid soils (pH < 5.5) where pH increased to >5.1 by the white rain exhibit NNP values greater than the MMD criteria of -5 T $CaCO_3$/Kt required for suitable plant establishment. Despite the high variability in NNP shown on **Figure 24**, almost all the soil NNP values never changed their classification relative to the threshold over 6 years of monitoring with respect to acid generation. Only one sample, FID 102, was lower than the MMD criteria for more than 2 years (below criteria for 3 of 5 years sampled)**.** The high variability is in part due to the near-detection levels of sulfide-sulfur, which in itself speaks for a very limited capacity of the soils to generate acid regardless of their NNP. Therefore, the ABA results support that soil with pH > 5.1 generally are not likely to be acid generating.

Finally, the buffering capacity appeared to be sufficient to resist changes from the white rain in higher pH soils (> 5.5). The low pH soils that increased in pH to > 5.5 with the addition of calcium-rich minerals after the white rain appear to have higher buffering capacity. Locations with mean pH values > 5.5 averaged ANP of 26 t $CaCO_3$/kt compared to 3 t $CaCO_3$/kt for locations with mean pH < 5.5 (using annual means of data in **Tables 5 and 7).**

3.2.3 Mineralogical Analysis

Sulfide minerals, whether copper or iron sulfides, can weather and generate acidity in soils. A primary focus of the mineralogical study in the STSIU soils was to identify the presence of copper-bearing minerals, which could potentially contribute to the future release of both acidity and copper to the soil solution. Both copper and iron sulfides are expected to be present in the STSIU soils, and this assumption for copper was confirmed by the mineralogical analysis. Ranked in order from high to low abundance, the copper sulfide content in 12 of the 2009 upland STSIU soil samples consisted of cubanite ($CuFe_2S_3$), chalcopyrite ($CuFeS_2$), bornite (Cu_5FeS_4), and covellite (CuS) (**Appendix D, Table D-1).** Other sulfide minerals, such as pyrite (FeS_2) and pyrrhotite (FeS), were not identified in the 12 STSIU soil samples from 2009 because they are not associated with copper phases, which was the focus of the mineralogical assessment. However, in the adjacent Hurley IU, a mineralogical assessment was performed that also focused on copper speciation but reported that pyrite was present (Golder 2002). It is likely that pyrite is also present in STSIU soils. In the STSIU soils, copper sulfides are expected to be more abundant than iron sulfides because the smelter was processing primarily copper ore, and iron sulfides originating from tailings weather, becoming depleted more rapidly compared to copper sulfides. Though copper sulfides are expected to be the primary sulfide-bearing minerals in STSIU soils based on the available information, sulfide-sulfur results from ABA testing could represent a combination of copper- and iron-bearing sulfides.

Copper was also found to be associated with several secondary minerals commonly found in soils, such as iron and manganese hydroxides (FeOOH, MnOOH). These secondary minerals are typical weathering products derived from oxidation of sulfides introduced from smelter fallout and windblown tailings. They also are products from weathering of major minerals (feldspars and phyllosilicates) that occur naturally in the soils. Especially for iron oxides, these secondary minerals have the capacity to attenuate copper through surface adsorption processes, which becomes more effective with increasing pH. Consequently, the net effect of the soil pH increase from the white rain is to decrease copper mobility and bioavailability by decreasing the cupric ion activity in solution.

The STSIU soils also contain an assemblage of acid-neutralizing minerals that can potentially act to counteract any acidity generated by sulfide mineral oxidation. The current investigation indicates that the important acid-neutralizing minerals contributed to the soils from the white rain are in the form of nanoparticulate calcium oxide and calcium hydroxide, which were directly identified in samples of the white rain (**Appendix A**). These minerals will eventually convert to calcite (calcium carbonate mineral) upon reaction with carbon dioxide in the soil. Because the primary focus of the white rain investigation was to identify the composition of the entrained rainwater particulates, additional acid-neutralizing minerals present in the soils were not identified. Available mineralogical data for two soil series (Abrazo and Lonti soil) within the STSIU indicate that their mineralogy is dominated by primary quartz and feldspar minerals and aluminosilicates including montmorillonite, mica, and kaolinite (NRCS Soil Survey). Although the primary minerals and aluminosilicates may contribute to the overall acid neutralizing capacity of the soils, their rates of dissolution and subsequent acid neutralization are slow relative to carbonates and other calcium minerals added by the white rain (White et al. 1999). Therefore, the white rain addition of calcite had an important effect on the acid neutralizing capacity of the soils.

3.2.4 Mineralogical Interpretation of ABA Results

Concern might be raised that oxidative weathering of sulfide minerals in STSIU soils could eventually liberate acidity and subsequently decrease soil pH. However, the ability of a soil to generate acidity upon weathering depends on both the net capacity for acid generation (NNP) in conjunction with the relative rates of acid generation and acid neutralization. Sulfide minerals are less likely to generate acid when their ratio of metal to sulfide is high (≥1), they have high resistance to weathering, they do not contain iron or arsenic, and the oxidant is oxygen rather than ferric iron (Fe^{3+}) (Kalinnikov et al. 2001, Moncur et al. 2009, EPA 1994). The copper sulfide minerals in the STSIU soils generally meet these criteria and are thus expected to have slower weathering rates and be less likely to generate acid compared to pyrite in the STSIU soils. In addition, copper sulfides also generate less acid per amount of sulfur compared to pyrite. For example, oxidation of pyrite to iron hydroxide generates 2 moles of H^+/mole sulfur:

$$FeS_2(s) + 3.75O_2(g) + 3.5H_2O(l) \rightarrow Fe(OH)_3(s) + 2SO_4^{2-}(aq) + 4H^+(aq)$$

Cubanite ($CuFe_2S_3$) only produces 1.3 moles of H^+/moles sulfur, and chalcopyrite ($CuFeS_2$) only produces 1 mole of H^+/mole sulfur upon oxidation:

$$CuFe_2S_3(s) + 6.5O_2(g) + 5H_2O(l) \rightarrow 2Fe(OH)_3 + Cu^{2+}(aq) + 3SO_4^{2-}(aq) + 4H^+(aq)$$[23]

$$CuFeS_2(s) + 4.25O_2(g) + 2.5H_2O(l) \rightarrow Fe(OH)_3(s) + Cu^{2+}(aq) + 2SO_4^{2-}(aq) + 2H^+(aq)$$

As noted in Section 2.2.2.1, the AGP (expressed as $CaCO_3$/kt) is calculated by multiplying the sulfide-sulfur content by a factor of 31.25, which assumes that all sulfide-sulfur exists as pyrite. Therefore, the AGP values would be overestimated for samples containing appreciable copper sulfides; consequently, the NPR values shown on **Figure 22** and the predominantly positive NNP values depicted on **Figures 23** and **24** could be underestimated and are thus conservative.

Although pyrite may be a minor component of the total sulfide-sulfur in the STSIU soils, this has not been confirmed; therefore, the sulfide-sulfur identified by ABA analysis could represent a combination of both iron and copper sulfide minerals. Regardless, the relative rates of acid neutralization will remain greater than the rates of acid generation, even if all acid generating minerals are conservatively assumed to be pyrite. The initial step of acid generation by pyrite as described in **Appendix A** is:

$$2FeS_2(s) + 7O_2(g) + 2H_2O(l) \rightarrow 2Fe^{2+}(aq) + 4SO_4^{2-}(aq) + 4H^+(aq)$$

Considering the site-specific mineralogy of minerals introduced into the soil from the white rain (calcite, calcium oxide, calcium hydroxide), these minerals (e.g., for calcite) will neutralize the acidity (H^+) produced by sulfide mineral oxidation as follows:

$$CaCO_3(s) + 2H^+(aq) = Ca^{2+}(aq) + CO_2(g) + 2H_2O(l)$$

The relative rates of these two competing reactions ultimately determines whether a soil with positive NNP will become net acidic or net alkaline. A compilation of weathering rate data normalized to mineral surface area indicates that calcite dissolves much more rapidly than pyrite (or chalcopyrite) under oxic conditions (Herbert and Kova 1998). These relative rates suggest that, if calcite or other soluble acid-neutralizing minerals are present in sufficient amounts, as indicated by the positive NNP values in soils with pH ≥ 5.1 (**Figure 24**), the acid-neutralizing minerals will dissolve rapidly enough to consume the acidity released from sulfide minerals and thus maintain net alkaline conditions (Herbert and Kovar 1998). All of these

---

[23] (s) = solid, (g) = gas, (l) = liquid, (aq) = aqueous ion

factors combined may explain why soil re-acidification, indicated by downward pH shifts, have not been observed during the 5-year monitoring period.

3.3 The Effect of White Rain on Plants and Wildlife

For plants, ARCADIS 2014a estimated that, after the white rain fell on the three low pH plots in the amendment study (Reference Plots 2, 3, and 4), mean copper tissue levels significantly decreased by about two thirds to 31 mg/kg, only 11 mg/kg higher than the maximum of the nutritional requirement range of 8 to 20 mg/kg copper for agricultural plants (Schulte and Kelling 1991). On the two West Control Plots in this study (includes Reference 1, which also exhibited soil pCu increase from the white rain), copper also was reduced by about the same amount (60%) to approximately this level in plants (35 to 37 mg/kg). Though this result is based on a limited sample size (four locations with 13 samples before and 26 samples total after the white rain) and some uncertain adjustments for season, the increase is consistent with the conceptual model that lime would reduce cupric ion activity and uptake of copper into plant tissue. Plant richness also increased after the white rain (ARCADIS 2014a).

Insects also showed decreases in tissue copper after the white rain. Total copper concentrations in the 2010 insect samples were significantly lower than those in the pre-white rain 1999 samples (paired t test, $p = 0.03$, **Table 4**), averaging 203 mg/kg in 1999 before the white rain and 132 mg/kg in 2010 after the white rain (35 percent decrease, **Table 10**); 71 percent of the 2010 locations exhibited lower insect copper concentrations than in 1999 (**Figure 9**). Of those locations with low soil pH pre-white rain ($\leq$ 5.5), the insect copper concentrations decreased from an average of 194 mg/kg to 117 mg/kg (40 percent decrease), though that decrease was not quite significant ($p = 0.1$), potentially because of the high mobility of flying insects (not always tied to the collocated low pH soils). The lower plant and insect copper concentrations post-white rain provide evidence that the increase in pH and pCu is reducing uptake of copper into these organisms.

3.4 Soil Data Variability

Reliability in the results depends on repeatability of the results. There are different types of variability, depending on spatial scale sampled, that reduce repeatability (ITRC 2012). The variability ranges from the smallest scale of variability in laboratory subsample duplicates to variability in field sample duplicates (within sample variability), to spatial variability in the sampled field area, and/or variability in sampling methods.

The variability in (1) field sample duplicates and (2) sampling errors in the field when sampling method changed were evaluated. For the field duplicates, the variability in pH and total copper is shown in **Table 8**. Relative percent difference in pH compared to the mean of the primary and duplicate samples in the “permanence dataset” over the 5-year monitoring period varied between 0 and 15 percent, and total copper varied between 1 and 32 percent. Additionally, if copper concentrations are on a log scale, similar to pH log scale (and often the scale of statistical analyses on copper), then the variability of copper is only 0 to 6%. The variability was within the acceptable limits set forth in the AOC Quality Assurance Project Plan for Chino (QAPP, SRK 1997), which is a relative percent difference of +/-50 percent for soil if results are greater than five times the reporting limits. This duplicate variability is consistent with the expected inherent soil heterogeneity within the composite samples.

Duplicate results in the “permanence dataset” support that variability in ANP (0 to 200 percent) and pyritic/sulfide sulfur (0 to 67 percent) in some years (**Table 8**) was relatively high, resulting in high calculated NNP and NPR variability above QAPP standards; therefore, the capability to detect differences in ABA is low. Variability in ANP and sulfur forms (used to determine AGP) was likely due to inherent soil heterogeneity and because measured values of pyritic/sulfide sulfur are very close to the detection and practical quantitation limits (0.01 and 0.1 percent, respectively), as mentioned previously. The ABA results are still useful if most of the samples, despite high variability, exhibit high NNP relative to MMD thresholds for topsoil suitability, which is the case.

After determining the laboratory variability, the variability created by using different field sampling methods was assessed. Spatial heterogeneity in soil parameters during field sampling using different sampling methods was high, as seen by comparing 0 to 6 inch bgs soil results from the same four reference locations in the Amendment Study area at the same time using three different sampling methods (**Table 9, Figure 25**). For the first method, the pH monitoring program used composite sampling in a 50 m x 50 m plot that extended beyond the original 100-foot by 100-foot amendment reference plot (2.6 times larger area sampled) but sampled in similar locations (four corners and center of 50 m x 50 m plot) each year. For the second, random sampling of three to eight samples was used for the Amendment Study to capture the average condition in the each 100-foot x 100-foot reference plot (ARCADIS 2014a). For the third method, one sample was selected at each reference plot as part of a phytotoxicity study in 2013 (ARCADIS 2014c). Comparing the pH monitoring method and Amendment Study method on the reference plots at the same time from 2010 to 2013, differences in pH and total copper can vary up to 37 and 86 percent, respectively (**Table 9, Figure 25**).

Similarly, comparing the pH monitoring method and single sample method on the reference plots in October 2013, differences in pH and copper can vary up to 27 and 91 percent, respectively. The high spatial variability in copper is one reason that the decrease in copper observed between 2011 and 2012, though statistically significant, might be uncertain. The decrease to a lower copper concentration in 2011 that does not bounce back appears to be more obvious in the pH monitoring dataset for the four plots in **Figure 25b** than in the amendment monitoring dataset, though the amendment dataset does tend to show reductions in three of the plots between 2011 and 2012.

The persistence of the pH change relies on the accuracy and precision of the pH data identified with the duplicate variability, not the method variability (method was consistent from 2010 to 2014). The finding of no significant change in pH during the monitoring period in Section 3.2 is considered reliable because the variability in the pH duplicates meets the criteria of the QAPP. The finding of a statistically significant change in copper concentrations over time, despite some variability of the copper concentrations in duplicates (30% relative percent difference), indicates that the copper shift observed after 2010 is likely to be real. The ABA data, on the other hand, are not precise enough to assess annual changes but useful to compare to threshold MMD criteria.

4. Discussion

This report summarizes the results of the effect (after 7 years) of the January 7, 2008 white rain event on the STSIU soils. The monitoring results (previously also reported in annual reports: ARCADIS 2011b, 2012, 2013, and 2014b) evaluate whether the change from the white rain in soil chemistry appears to be persistent.

4.1.1 Magnitude of the Effect of White Rain on Soil pH and pCu

The white rain event in January 2008 neutralized some of the acidity in the more poorly buffered soils of the STSIU. The white rain increased soil pH in low pH soils by an average of 1.2 S.U and pCu by an average of 1.4 units, but had little effect on high pH soils. This suggests that soils with pH > 5.5 had some natural buffering capacity before the white rain event. The exception was the high pH soil of the West Reference Plot 1, which increased from a pH of 6.5 to the 7 to 8 range (**Table 4**).

4.2 Persistence of pH and pCu Change: 5-Year Monitoring

The 1.2 S.U. magnitude of increase in pH (on average) in the monitored low pH ($\leq$ 5.5) sample locations was sustained through 2014, 7 years after the white rain event, as supported by the “permanence monitoring” dataset. The four amendment plots alone bookend the January 2008 white rain event (sampled in 2006 and May 2008), and the three originally acidic plots of these four (East, North, Northeast) show a similar increase that was sustained through 2014 (**Figure C-1 in Appendix C**). Overall, the white rain has had a beneficial effect on the STSIU by increasing soil pH in acidic areas, and most data support that the initial increase has persisted on average. This suggests that the white rain’s alkalinity and calcium-rich minerals increased the buffering capacity of even the poorly buffered soils. This increase in soil pH is expected to persist in the future because:

1. (1) Soils whose pH increased to greater than or equal to 5.5 no longer contain active acidity (Thomas 1996).
2. (2) Future sources of potential acidity have largely been eliminated.
3. (3) Soils whose pH increased to greater than 5.1 exhibit either positive NNP values or meet the MMD acceptance criteria of “Good” for topsoil suitability (NNP > -5 t $CaCO_3$/kt).

The STSIU soils formerly with a pH <5.5 contained active acidity in the form of free H^+, and also potential acidity in the form of exchangeable aluminum (Al^{3+}) and sulfide-sulfur. The white rain increased the pH of acid soils (pH ≤ 5.5) by approximately 1.2 pH units (on average from 4.8 to 6.0); therefore, active acidity from H^+ and potential acidity from exchangeable aluminum has been completely neutralized (above pH of 5.5, active acidity is essentially gone, Thomas 1996). Additional sources of potential acidity from smelting and windblown tailings have largely been eliminated by decommissioning the smelter and reclaiming most of the tailings ponds. In the absence of additional future sources, all soils with existing pH values greater than 5.1 have little to no risk of generating additional acidity based on their existing ABA status and rapid rates of acid neutralization compared to acid generation as discussed in Section 3.2.4. Additionally, sulfide contents are low, even in soils with a pH less than 5, and some copper exists in mineral forms that are less reactive, which supports the likelihood that the white rain benefit will persist, even in more acidic areas. Moreover, some of the most acidic and potentially acid-generating soils were removed during reclamation activities in 2011 (FID 23, FID 43, FID 103), which further reduces concern over future acid generation.

The addition of acidity from future rainfall is also not expected to change the potential acidity of the soils because the soil acidity likely is driven by weathering of sulfide minerals, not rainfall. The sulfide minerals, even at very low amounts, overwhelm the small contribution from the rain (see **Appendix B**). Rainwater chemistry has generally improved in the southwestern U.S. during the past two to three decades, notably becoming less acidic. For example, at the National Atmospheric Deposition Program's monitoring station in GCDNM (National Trends Network Site NTN NM01, the NTN site nearest to the STSIU), the pH of precipitation has increased from approximately 4.8 to 5.4 since 1988 (**Figure 2b**; see NM01 site at http://nadp.isws.illinois.edu/data/sites/). Concurrent with the decreased acidity at that site, sulfate deposition has steadily decreased by approximately 75 percent (i.e., the precipitation contains less sulfuric acid); and the depositions of calcium, magnesium, sodium, and potassium (base cations that indicate alkaline contributions to the buffering of acids) have remained approximately constant at a combined total of about 1 kg/ha/year (equivalent to 46.6 moles of alkalinity per ha per year based on 1985 to 2012 data in **Appendix B, Table B-2**). The pH increase and sulfate decrease are likely a result of decreased sulfuric acid emissions from power plants in the southwestern U.S. Other monitoring stations in New Mexico and Arizona have recorded similar trends of increasing pH, decreasing sulfate deposition, and approximately constant base-cation deposition since the mid-1990s (e.g., NTN NM07 – Bandelier National Monument; NTN NM12 – Capulin Volcano National Monument; NTN AZ03 – Grand Canyon National Park; NTN AZ06 – Organ Pipe Cactus National Monument; see the same NTN webpage cited above). Therefore, annual average rain chemistry at the STSIU can be expected to continue to be increasingly less acidic and contain increased net alkalinity (i.e., the difference between alkaline and acidic inputs), thereby not countering the neutralization of soil pH by occasional white rain events.

Finally, the buffering capacity appeared to be sufficient to resist changes from the white rain in most higher pH soils (> 5.5). The low pH soils that increased in pH to > 5.5 with the addition of calcium carbonate/oxides after the white rain should now also have higher buffering capacity, increasing their resistance to pH change, whether from acidic or alkaline inputs. Soils influenced by the Gila Conglomerate Formation (**Figure 21**) and those that have developed naturally to contain high calcium carbonates likely have the highest buffering capacity and resistance to change (i.e., FID 22, FID 28 [in Gila Group], and West Reference Plot 1 have highest mean ANP as calcium carbonate, **Table 7 and Appendix C, Table C-2**). **Figure D-1** shows calcium carbonate concentrations in soils without factoring in mining effects (from NRCS soil survey), showing higher calcium carbonate concentrations on the west side of the STSIU. With time, natural pedogenic processes will continue to function and soils are expected to eventually recover to baseline soil conditions. The pH of natural soils in the area ranges from 6.1 to 7.3 in Luzena soils, 6.6 to 7.3 in Muzzler soils, 7.9 to 8.4 in Plack soils, and 6.1 to 8.4 in Lonti soils (NRCS Soil Survey).

A ramification of the pH increase from the white rain has been not only an increase in soil pCu initially, but the pCu increase has been sustained or increased by 2014. The pCu improvement was enhanced by a reduction in copper over time, with the significant reduction (unrelated to the white rain) occurring mostly between 2010 and 2011 and persisting through 2014. A reduction in total copper reduces the amount of free cupric ion in the soil. An increase in pH also increases the extent of copper adsorption to secondary minerals such as iron hydroxide, and further reduces free cupric ion availability for uptake by plants.

The statistically significant reduction in copper concentration in the soil between 2011 and 2012 is uncertain as to whether it is real or is an artifact due to high variability of copper that affects sampling (see **Figure C-1 in Appendix C** for data from 2008 to 2014). Any change in copper concentrations is unlikely a result of the white rain. The white rain-deposited minerals could decrease leachability of copper from the soil (**see Appendix A**), but is not expected to decrease copper concentraitons. If the change is not an artifact of high variability, the decrease is possibly from the cessation of the smelter operation in 2002 and the reclamation of historical tailing impoundments, followed by natural erosion of upland soils removing the historical copper. Additionally, after capping tailings, clean dust is now blowing and depositing on the soils, diluting the copper. In 2011, one or more of these factors may have accelerated the reduction in copper concentrations that year. Unusually large storms in 2011 may have eroded soils on steep and rugged terrain. Storms and their effects are highly localized on the STSIU, making it difficult to ascertain from precipitation records if storms were a contributor.

Alternatively, sampling that year may have coincidentally been on locations with higher copper concentrations than later years, or the laboratory calibration of analytical equipment may have created systematic errors. Many of the fall 2010 concentrations appear high relative to fall 2009 and fall 2011 concentrations (see **Table C-2 and Figure C-1 in Appendix C**). However, in 2010, the reference plot locations of the Amendment Study were analyzed by a different laboratory (SVL) than the other locations (which were analyzed by ACZ), yet both sets of samples show a decrease between fall 2010 and fall 2011 for many of the locations (see **Figure C-1**). This and comparing SVL and ACZ data as discussed in Section 3.2., suggests that the change is not due to a laboratory bias. If the decrease is real, the combination of the 2008 white rain event and cessation of the smelter with soil erosion might be increasing pH, decreasing copper, and subsequently increasing pCu throughout the STSIU.

4.3 Effect of White Rain on Plants and Wildlife

The extent of copper adsorption to secondary minerals such as iron hydroxides increases with increasing pH, causing a decrease in the cupric ion activity, which increases the pCu of the soil solution. Thus, an increase in pCu resulting from the white rain event is expected to benefit the plant and animal community by reducing bioavailability of copper in the soil to plants. This will reduce direct absorption of copper into the tissue of living organisms (and into other organisms through the food chain) and reduce toxic effects. Such a benefit should be apparent through a decrease in copper in plant and terrestrial invertebrate tissue concurrent with the soil decrease in cupric ion activity.

For plants, ARCADIS 2014a estimated that, after the white rain fell, copper concentrations in plant tissue significantly decreased by up to two thirds on average on plots in the Amendment Study. Similarly, total copper concentrations in insects on affected locations decreased up to 40 percent. Though these datasets are not extensive and have some limitations, the lower plant and insect copper concentrations post-white rain provide evidence that the increase in pH and decrease in copper in soil is reducing uptake of copper into these organisms.

Benefits of reduced uptake of copper into plant tissues include greater survival, growth, and reproduction of the plant species making up the vegetation communities, creating improved rangeland and wildlife habitat on the STSIU. The FS will assess the expected improvement on plant communities from the pCu increase due to the white rain based on dose-response relationships with plant and vegetation community endpoints currently being developed for a phytotoxicity study using site plant species. ARCADIS 2014a has already shown that the white rain was a large factor responsible for the improvement in vegetation community richness (but not necessarily cover) on the plots in the Amendment Study. The improvement occurred in both fair and poor rangeland soils.

A benefit of reduced copper in insect and plant tissues is reduced dietary exposure to copper for wildlife, such as the sensitive small ground-feeding bird identified in the site-wide ERA. This benefit has already been discussed in ARCADIS 2011c, which evaluated and showed reduced risk to insectivorous birds using soil and insect data collected after the white rain event.

4.4 Potential Frequency of White Rains

The frequency of white rain events in southwestern New Mexico containing lime or calcium carbonate particulates that can neutralize or buffer acidic soils is unknown. Understanding the frequency would help with understanding the rate of natural attenuation of acidic impacts on the STSIU. The frequency of alkaline rains with high pH and dissolved calcium similar to the 2008 white rain may be an indicator of the possible frequency of white rains at the site, where a white rain is defined as a rain that contains a high suspended solid load of calcium-rich minerals. The 2008 white rain exhibited a pH of > 7 (7.2) in the GCDNM rainfall and concurrently high calcium concentrations of > 5 mg/L (5.8 mg/L). More than 25 years ago, on November 8, 1988, the pH of rainwater at GCDNM was 7.25, and the calcium concentration was 5.12 mg/L, similar to the 2008 white rain. This 1988 alkaline rain is a possible candidate for having been a white rain event. More recently, a rain event on October 27, 2009 exhibited a pH of 7.07 and a calcium concentration of 2.7 mg/L, both lower than the 2008 white rain event but significantly higher than the average values for precipitation in the Chino area. Thus, three alkaline rain candidates for being white rains occurred in 26 years (**Figure 2a**). It is unknown if these two other highly alkaline rains of high pH and dissolved calcium concentrations also carried dust from playas that served as nanoparticulate calcium-rich minerals that can further neutralize acidity. No reports of such a white rain that deposited a milky or liquid paper-like substance during 1988 and 2009 are known, and these events may have carried lighter suspended solids loads than the 2008 white rain.

White rain events of the magnitude seen in January 2008 may be rare and may not re-occur for a long time, or could potentially re-occur in the near future if the right conditions for dust storms and rain prevail, as was seen in the Washington, Oregon, and Idaho area in February 2015. Whether a true white rain or not, the 1988 and 2009 alkaline events mark the fact that highly alkaline rains potentially containing some calcium hydroxides (lime, the factor that drives up the rainwater pH), oxides, or carbonates are falling on the mine site more regularly now that emissions have been reduced from coal-fired plants in the region (as shown on **Figure 2b).** The alkaline rains, particularly if they typically contain nanoparticulates of calcium-containing minerals, could be steadily contributing to natural attenuation of the STSIU soils. Such attenuation could further accelerate now that the smelter is no longer operating and the historical tailings impoundments have been capped (only Tailing Pond 7 remains active).

Chino recognizes that the frequency of future white rain events cannot be predicted with a high degree of certainty; however, unless the Willcox playa becomes completely inundated with water, and/or unless localized wind patterns were to change dramatically, white rain events are still likely to occur in the future.

5. Conclusions and Recommendations

The results show that the white rain increased soil pH initially by approximately 1.2 S.U. on average for locations in the STSIU with low pH (< 5.5); it had little to no effect on higher pH soils. For soils with pH originally at > 5.5, some natural buffering capacity may have existed before the white rain, conferring resistance in those soils to pH changes. In contrast, the originally acidic soils (pH < 5.5) had lower buffering capacity, and the white rain resulted in an increased soil pH. The pH shift was generally sustained through 2014, and future persistence is benefitted by the following:

1. Future sources of potential acidity from smelting and windblown tailings have largely been eliminated by decommissioning the smelter and reclaiming most of the tailing ponds.
2. Typically, the acid soil (pH ≤ 5.5) whose pH increased to > 5.1 from the white rain have either positive NNP values or those that met the MMD topsoil suitability requirement of “Good” for plant establishment (> -5 kg $CaCO_3$/t).
3. Evaluation of soil mineralogy indicates a proportion of total sulfide occurs as copper sulfides with lower reactivity relative to pyrite.
4. White rain events of various magnitude will likely occur in the future (one occurred in eastern Washington, eastern Oregon, and parts of Idaho in February 2015). The likelihood of such future events occurring in the project area is not known however.
5. Natural pedogenic (soil-forming) processes will continue to function and soil pH is expected to recover to baseline levels for soils of the area (pH = 6.1 to 8.4) at some time in the future.

However, persistence in the future cannot be predicted with certainty, nor the likelihood of future white rain events, if any. This study evaluated persistence of a change in soil pH over a 5-year period, and the report will be considered during the development of remedies in the Feasibility Study (FS) for the STSIU. It is recommended that future periodic monitoring of soil pH, as a component of the overall STSIU site remedy, be included to confirm persistence of the generally higher soil pH. The frequency of pH monitoring will be determined during the FS process.

As a result of the pH increase, pCu also increased, and the increase was persistent during the study. In contrast to pH, total copper present in shallow soil is not expected to change as a result of the white rain, though other causes of natural attenuation (source reduction or source removal, clean dust deposition, and erosion) may result in decreases in soil copper concentrations over time. Current data suggest that soil copper concentrations decreased over time during the 5-year duration of this study. This copper decrease is uncertain due to high variability of copper in the STSIU soils. The apparent decrease in total copper, in addition to increases in pH, increased pCu as well because pCu is calculated from pH and copper concentrations.

Chino assessed the effect of the pH shift from the white rain on plant and wildlife communities by evaluating copper concentrations in tissues of plants and terrestrial invertebrates before and after the white rain event. These data had been collected during other investigations (ARCADIS 2010b, 2014a). In locations showing an improvement (increase) in soil pH, the tissue copper concentrations decreased after the white rain by an estimated 60 percent or more for the plants and up to 40 percent for the insects. Also, plant richness improved after the white rain on the untreated plots associated with an Amendment Study conducted for the STSIU (ARCADIS 2014a).

In conclusion, the white rain event of January 7, 2008 greatly benefitted the STSIU soils by increasing the pH and pCu of the acidic soils, making copper less bioavailable due to the increase in copper adsorption by secondary soil minerals, such as iron hydroxide, at higher pH values. This increase in pCu has led to a decrease in the uptake of copper into living organisms. The ultimate result appears to be reduced toxicity to wildlife and their food sources and improved wildlife and rangeland habitat. Based on MMD guidelines and mineralogical analysis, the potential of STSIU soils to generate acid is consistently low in most areas. Persistence in the future cannot be predicted with certainty, and continued monitoring as part of the STSIU FS and for the site remedy is recommended to confirm the prediction that the pH increase should be sustained.

As NMED (2011) indicated, new information can be used to refine the pCu RAC and selection of remedial alternatives. This report provides new information on the current soil pH and pCu across the STSIU that should be evaluated further in the FS. These results suggest that the nature and extent of depressed pH and elevated copper has changed since the Remedial Investigation and ERA reports approved by NMED (SRK 2008; Newfields 2005, 2008).

6. References

ARCADIS. 2001. Administrative Order on Consent, Draft Phase II RI report for the Ecological IU. May.

ARCADIS. 2010a. AOC pH Monitoring Plan, Smelter/Tailings Soils Investigation Unit. Prepared for Freeport-McMoRan Chino Mines Company, Vanadium, New Mexico.

ARCADIS. 2010b. AOC Terrestrial Invertebrate Copper Bioaccumulation and Bioavailability Study. Smelter/Tailing Soils Investigation Unit. Prepared for Freeport-McMoRan Chino Mines Company, Vanadium, New Mexico.

ARCADIS. 2011a. Administrative Order on Consent - Feasibility Study Proposal. Smelter/Tailings Soils Investigation Unit. Prepared for Freeport-McMoRAn Chino Mines Company, Vanadium, New Mexico.

ARCADIS. 2011b. Year 1 pH Monitoring Report for Smelter/Tailing Soils Investigation Unit. Prepared for Freeport-McMoRan Chino Mines Company, Vanadium, New Mexico.

ARCADIS. 2011c. Small ground bird feeding RAC. Letter to Phil Harrigan and Jerry Schoeppner, NMED from Anne Thatcher and Carolyn Meyer, ARCADIS. 1/25/2011.

ARCADIS. 2012. Year 2 pH Monitoring Report for Smelter/Tailing Soils Investigation Unit. Prepared for Freeport-McMoRan Chino Mines Company, Vanadium, New Mexico.

ARCADIS. 2013. Year 3 pH Monitoring Report for Smelter/Tailing Soils Investigation Unit. Prepared for Freeport-McMoRan Chino Mines Company, Vanadium, New Mexico.

ARCADIS. 2014a. Year 5 pH Monitoring Report for Smelter/Tailing Soils Investigation Unit Amendment Study Plots. Draft. Prepared for Freeport-McMoRan Chino Mines Company, Vanadium, New Mexico.

ARCADIS 2014b. Year 4 pH Monitoring Report for Smelter/Tailing Soils Investigation Unit. Prepared for Freeport-McMoRan Chino Mines Company, Vanadium, New Mexico.

ARCADIS. 2014c. Work Plan: Smelter Tailing Soils Investigation Unit (STSIU) – Phytotoxicity and Vegetation Community Study. Prepared for Chino Mines Company, Vanadium, New Mexico. March.

Chino. 1995. Administrative Order on Consent, Investigation Area, Remedial Investigation Background Report, Chino Mines Company, Prepared by Chino Mines Company, Hurley, New Mexico, October 5.

Golder Associates, Inc. 2002. Bioaccessibility study for the Hurley soils investigation unit, Hurley, New Mexico. Redmond, Washington.

Golder. unpublished. Sitewide Abatement. Proposed submission in 2015.

Herbert M. and K. Kovar. 1998. Groundwater Quality: Remediation and Protection. Proceedings of the GQ98 Conference, Tubingen, Germany. September 21-25.

ITRC. 2012. Incremental sampling methodology. Technical and Regulatory Guidance. Prepared by Interstate Technology and Regulatory Council, Incremental Sampling Methodology Team. http://www.itrcweb.org/ism-1/pdfs/ISM-1_021512_Final.pdf

Kalinnikov, V.T., D.V. Makarov, and V.N. Makarov. 2001. Oxidation Sequence of Sulfide Minerals in Operating and Out-of-Service Mine Waste Storage. Theoretical Foundations of Chemical Engineering, Vol. 35, No. 1, pp. 63–68.

MMD. 1996. Closeout Plan Guidelines for Existing Mines, Attachment 1 – Soil and Topsoil Suitability Ratings. Mining Act Reclamation Bureau, Santa Fe, New Mexico. New Mexico Energy, Minerals and Natural Resources Department, Mining and Minerals Division (MMD). April 30.

Moncur, M.C., J.L. Jamor, C.J. Ptacedk, and D.W. Blowes. 2009. Mine drainage from the weathering of sulfide minerals and magnetite. Applied Geochemistry 24(12):2362-2373.

Morin, K.A., N.M. Hutt and K.D. Ferguson. 1995. Measured rates of sulfide oxidation and acid neutralization in kinetic tests: statistical lessons from the database. IN: Proceedings of the Conference on Mining and the Environment, Sudbury, Ontario, May 28-June1, volume 2, p. 525-536.

Mouli, P., S. Mohan, and S. Reddy. 2005. Rainwater Chemistry at a Regional Representative Urban Site: Influence of Terrestrial Sources on Ionic Composition. Atmospheric Environment, 39:999-1008.

Mortvedt, J.J. 2000. Bioavailability of Micronutrients. In Handbook of Soil Science. Edited by Sumner, M.E., CRC Press. Boca Raton, Florida. pp: D71-D88.

Natural Resources Conservation Service (NRCS). 1998. Soil Quality Indicators: pH. Soil Quality Information Sheet. United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). January. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_019157.pdf.

New Mexico Environment Department (NMED). 2011. Letter to Mr. Ned Hall, Chino Mines Company. From Mr. William C. Olsen, New Mexico Environmental Department (NMED). Regarding AOC Informal Dispute Resolution, Smelter Tailings Soils IU, March 3.

Newfields. 2005. Chino Mines Administrative Order on Consent Site-wide Ecological Risk Assessment. Prepared for Chino Mines Company. November.

Newfields. 2008. Chino Mines Administrative Order on Consent, STSIU Ecological Risk Assessment, April.

Nyika, D., Zhande, E., Zhakata, W., Kosmus, W., and Jonnalagadda, S.B. 1996. Rainwater quality during 1991-1993 and constituents of white rain (November 1992) in Bulawayo, Zimbabwe. Science of the Total Environment 186: 273-281.

Price, W.A. 2009. Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials. MEND Report 1.20.1. December. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5336546.pdf

Resane, T., H. Annegarn, and T. Freiman. 2004. The day of the white rain: origin of unusual dust deposition in Johannesburg, South Africa. South African Journal of Science 100:483-487.

Schulte, E.E., and K.A. Kelling. 1991. Analysis: a Diagnostic Tool. University of Wisconsin-Madison, NCH-46 Crop Fertilization, RR 4/91. Available online at:http://ces.purdue.edu/extmedia/NCH/NCH-46.html

Shacklette, H.T., and J.G. Boerngen. 1984. Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States: U.S. Geological Survey Professional Paper 1270, 105 p.

Sistek, Scott. 2015. Oregon dust storm now blamed for ‘milky rain’ in Eastern Washington. KOMO 4 News. Web page Located at: http://www.komonews.com/weather/blogs/scott/Oregon-dust-storm-now-blamed-for-milky-rain-in-Eastern-Washington-291466251.html. February 10.

Sobek, A.A., W.A. Schuller, J.R. Freeman, and R.M. Smith. 1978. *Field and Laboratory Methods Applicable to Overburden and Mine soils.* Environmental Protection Agency, Office of Research and Development, Cincinnati, OH. EPA-600/2-78-054.

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at https://websoilsurvey.sc.egov.usda.gov/. Accessed 3/7/2017.

SRK. 1997. AOC Quality Assurance Plan. Prepared for Freeport-McMoRan Chino Mines Company, Hurley, New Mexico.

SRK. 2008. Administrative Order on Consent Remedial Investigation Report for the Smelter/Tailing Soils Investigation Unit, Revision 2. February 2.

Steffen, R., B.C. Kirsten Inc., and B.C. Research and Development. 1992. Guidelines for ARD Prediction in the North, Department of Indian Affairs and Northern Development, Ottawa.

Thomas, G.W. 1996. Soil pH and Soil Acidity. pp. 475-490. In D.L. Sparks et al. (eds.), Methods of Soil Analysis, Part 3 – Chemical Method. Soil Science Society of America, Madison, WI. 390 pp.

United States Environmental Protection Agency (EPA). 1994. Acid Mine Drainage Prediction. Technical Document. U.S. Environmental Protection Agency. Office of Solid Waste, Special Waste Branch, Washington, DC. EPA 530-R-94-036 NTIS PB94-201829.

White, W.W., K.A. Lapakko, and R.L. Cox. 1999. Static-test methods most commonly used to predict acid-mine drainage: Practical guidelines for use and interpretation. pp. 325-338. In G.S. Plumlee and M.S. Logsdon (eds.), The Environmental Geochemistry of Ore Deposits, Part A: Processes, Techniques, and Health Issues. Vol. 6A. Society of Economic Geologists, Inc.

Williamson, M.A., C.S. Kirby, and J.D. Rimstidt. 2006. Iron dynamics in acid mine drainage. Proceedings of the 7th International Conference on Acid Rock Drainage (ICARD), March 26-30, 2006. Published by the American Society of Mining and Reclamation (ASMR), 3134 Montavista Road, Lexington, KY 40502

Zhang, Y., S. Kang, C. Li, Z. Cong, and Q. Zhang. 2012. Wet Deposition of Precipitation Chemistry during 2005–2009 at a Remote Site (Nam Co Station) in Central Tibetan Plateau. *Journal of Atmospheric Chemistry*, 69:187-200.

Tables

Table 1
Change in pH and Calcium in Soils of Amendment Plots After White Rain

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Amendment Plot	pH (SU)			Calcium (mg/kg)	
	Pre-white rain	Post-white rain	Post-white rain	Pre-white rain	Post-white rain
	July 2006	May 2008	June 2008	July 2006	May 2008
	(0-4")	(0-6")	(0-6")	(0-4")	(0-6")
West	6.46	NA	8.16	15400	NA
North	3.78	6.02	6.72	2375	8085
Northeast	5.42	5.65	5.98	2870	4450
East	4.81	5.68	5.68	3596	3870

Notes:

NA = not available

Data originally presented in ARCADIS (2014a)

Table 2
Zones of pH and pCu of Selected Locations for Design of Long-Term Monitoring

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Location	pH Zone			pCu Zone		
	Pre-white rain	Preliminary Post-white rain 2009	Preliminary Post-white rain 2014	Pre-white rain	Preliminary Post-white rain 2009	Preliminary Post-white rain 2014
FID 18*	3-4	4-5	4-5	3-4	5-6	4-5
FID 23*[3]	3-4	4-5[2]	4-5	4-5	5-6	5-6
FID 43[3]	3-4	4-5	4-5	3-4	4-5	4-5
FID 101*	3-4	4-5	4-5	3-4	5-6	4-5
FID 102*	3-4	4-5	3-4	3-4	4-5	4-5
FID 103[3]	3-4	4-5	4-5	4-5	5-6	5-6
FID 8	3-4	5-6	4-5	3-4	5-6	4-5
FID 16*	4-5	5-6	4-5	2-3	5-6	3-4
FID 22	4-5	5-6	6-7	4-5	6-7	6-7
FID 37*	4-5	5-6	4-5	4-5	5-6	4-5
Reference 4 (East)*	4-5	5-6	5-6	4-5	5-6	4-5
FID 104*[3]	3-4	5-6	4-5	2-3	5-6	4-5
FID 105*	4-5	5-6	4-5	4-5	5-6	3-4
ERA 2[4]	5-6	6-7	4-5	5-6	5-6	3-4
ERA 3*[4]	4-5	6-7	5-6	4-5	5-6	5-6
ERA 4[4]	4-5	6-7	5-6	4-5	5-6	5-6
Reference 3 (Northeast)	5-6	6-7	5-6	3-4	5-6	3-4
FID 7	5-6	6-7	5-6	5-6	7-8	4-5
FID 10	5-6	6-7	4-5	3-4	5-6	< 3
FID 15*	4-5	6-7	5-6	3-4	5-6	3-4
FID 17*[3]	4-5	6-7	4-5	2-3	3-4	3-4
FID 106*	4-5	6-7	4-5	4-5	7-8	4-5
FID 28	6-7	6-7	> 8	7-8	6-7	7-8
ERA 10*[4]	4-5	7-8	5-6	4-5	7-8	5-6
ERA 13[4]	4-5	7-8	5-6	4-5	7-8	5-6
Reference 1 (West)	7-8	7-8	7-8	6-7	6-7	6-7
Reference 2 (North)	5-6	7-8	7-8	3-4	6-7	5-6

Notes:

*Neutralization Potential Ratio < 2 at least 60% of years sampled, meaning potentially acid generating (PAG) or uncertain PAG.

[1] Monitoring locations were selected to be well-distributed among four pH zones in gray shades.

[2] This plot created a single point zone of 4-5 that falls within a 5-6 zone (see ARCADIS 2010a).

[3] These plots were excavated and removed in 2011 or 2013 (FID 17)

[4] These plots were added in 2012

These zones are preliminary, based on contour intervals of pre-white rain and 2009 maps, used only to design the monitoring study

Table 3
Historical ERA and Amendment Location Soil Results Compared to Post-White Rain Results ("Primary White Rain Effect" Dataset)

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Soil Sample Location	Soil pH (0 to 6 inches) S.U.					Soil Cu (0 to 6 inches) mg/kg					Soil pCu (0 to 6 inches) calculated				
	Pre-White Rain[1]	Post-White Rain[2]	2012	2013	2014	Pre-White Rain[1]	Post-White Rain[2,3]	2012	2013	2014	Pre-White Rain	Post-White Rain	2012	2013	2014
ERA 2	4.80	6.20	6.40	7.00	6.00	811	860	960	420	1000	4.10	5.34	5.40	6.90	4.98
ERA 3	4.97	6.50	6.40	6.00	5.90	709	625	624	807	652	4.41	5.98	5.89	5.22	5.37
ERA 4	4.83	6.30	5.80	6.40	5.40	541	508	514	215	562	4.60	6.03	5.56	7.12	5.08
ERA 5	6.54	6.40	--	--	--	421	238	--	--	--	6.48	7.00	--	--	--
ERA 6	6.67	6.30	--	--	--	499	622	--	--	--	6.40	5.80	--	--	--
ERA 7	5.47	6.70	--	--	--	789	758	--	--	--	4.75	5.95	--	--	--
ERA 8	6.97	7.00	--	--	--	710	643	--	--	--	6.27	6.41	--	--	--
ERA 9	4.35	4.60	--	--	--	562	291	--	--	--	4.10	5.09	--	--	--
ERA 10	4.53	5.40	5.70	5.20	5.30	485	197	299	232	310	4.45	6.29	6.09	5.91	5.67
ERA 11	7.73	7.00	--	--	--	276	277	--	--	--	8.07	7.38	--	--	--
ERA 12	7.77	7.80	--	--	--	204	215	--	--	--	8.44	8.42	--	--	--
ERA 13	4.78	6.30	6.60	5.60	5.50	126	186	292	91	282	6.23	7.19	6.95	7.36	5.97
ERA 14	7.73	7.50	--	--	--	109	129	--	--	--	9.14	8.73	--	--	--
ERA 15	7.73	7.80	--	--	--	712	529	--	--	--	6.98	7.38	--	--	--
Amendment Plot or Reference #1 (West)*	6.46	8.16	7.60	7.50	8.00	--	1116	1120	605	882	--	6.85	6.33	6.95	6.98
Amendment Plot or Reference #2 (North)*	3.78	6.60	5.80	6.00	6.20	--	1946	1170	578	760	--	4.77	4.61	5.61	5.48
Amendment Plot or Reference #3 (Northeast)*	5.42	5.92	5.10	6.70	5.40	--	2714	2250	1090	1540	--	3.76	3.21	5.53	3.92
Amendment Plot or Reference #4 (East)*	4.81	5.68	4.80	6.00	4.90	--	1099	1210	923	1020	--	4.57	3.64	5.07	3.93

Notes:

[1] ERA samples were collected in 1999 (ARCADIS 2001) while Amendment Study Plot locations were sampled in 2006 before they were amended (ARCADIS 2013). Sampling protocols (average of three samples on 50-meter transects or one to two samples within 100-foot by 100-foot amendment plots) differed from pH monitoring plan protocols.

[2] ERA samples were collected post-white rain in 2010 (ARCADIS 2010b), while amendment reference plot locations were sampled in May or early June 2008 just after the January 2008 white rain (ARCADIS 2014a) event (except Cu in West plot, which was collected from West Reference plot in 2010). Samples were collected using a different protocol than pH monitoring program, with 15 samples composited over a 100-meter radius area for ERA locations and two samples in a 100-foot by 100-foot plot for amendment plots (before treated).

[3] ERA samples were reported in ARCADIS (2010b) as wet weight, but are in fact dry weight results and presented here as such.

*Only pH was collected at the amendment study plot locations in 2006. In 2006 and 2008, soil samples on amendment reference plots did not exist and only amendment plots (before amending) were sampled (ARCADIS 2014a). In 2010, the adjacent reference plots became available and sampled (since untreated) as part of the pH monitoring program from 2010 to 2014 (see Table 5), but only 2012 to 2014 data in this table are from those reference plots (except West "post-white rain", which is 2010 reference plot because no 2008 data available). The comparison of amendment plot/reference locations assumes similar conditions on amendment plot and reference plots before amendments were applied.

All samples were sieved except pre- (2006) and post-white rain (2008, except West plot is 2010) Amendment Plot Data, which were adjusted to being sieved to less than 2 mm (see main report for adjustment regressions).

-- = not applicable

ERA = ecological risk assessment

mg/kg = milligrams per kilogram

mm = millimeters

pCu = -log (cupric ion activity)

S.U. = standard units

Table 4
Summary of Pre- and Post-White Rain Statistical Results from Paired t-test on "Primary White Rain Effect" Dataset

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Parameter	Units	All Data		pH > 5.5[1]		pH ≤ 5.5[2]	
		Mean Difference	Significance (p value)[3]	Mean Difference	Significance (p value)[3]	Mean Difference	Significance (p value)[3]
Pre-White Rain vs. Early Post-White Rain							
pH (primary data set)[4]	S.U.	0.49	0.04	-0.20	0.1	1.2	0.0004
pH (validation-plus data set)[5]	S.U.	0.71	0.005	0.038	0.9	1.25	0.0003
Total Copper	mg/kg	-63	0.08	-54	0.3	-95	0.1906
pCu	unitless	0.61	0.02	-0.065	0.8	1.3	0.0002
Insect Copper	mg/kg dry wt	-72	0.03	-66	0.2	-77	0.1

Notes:

[1] Defined as those sites having pre-white rain pH greater than a threshold of 5.5.

[2] Defined as those sites having pre-white rain pH less than or equal to a threshold of 5.5.

[3] Two-sided paired t-tests were used to compare each set of paired data.

[4] Includes 14 ERA locations.

[5] Includes 14 ERA locations plus 4 Amendment Study reference plots.

-- = not applicable

mg/kg = milligrams per kilogram

pCu = -log (cupric ion activity)

S.U. = standard units

wt = weight

Table 5
2010 to 2014 Long-Term Sample Location Results – pH, Total Copper, and pCu (first 17 are "Permanence Monitoring" Dataset)
Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Soil Sample Location	Soil pH (0 to 6 inches) (S.U.)					Soil Cu (0 to 6 inches) (mg/kg)					Soil pCu (0 to 6 inches) (calculated)				
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014
FID 7	5.40	4.80	4.70	5.40	5.10	550	494	514	375	491	5.11	4.67	4.53	5.55	4.96
FID 8	6.50	6.40	5.50	6.50	4.60	545	332	252	358	473	6.14	6.62	6.10	6.62	4.54
FID 10	4.80	4.80	5.00	5.00	4.70	2060	2140	2210	1780	2550	3.03	2.99	3.13	3.38	2.69
FID 15	4.90	4.80	4.60	5.20	5.60	2520	2260	1030	1950	1850	2.89	2.92	3.64	3.46	3.90
FID 16	4.80	4.50	4.30	4.70	4.80	3550	2020	1450	1290	1440	2.40	2.77	2.97	3.47	3.44
FID 17*	5.10	6.00	4.90	--	--	4550	4220	5150	--	--	2.40	3.32	2.07	--	--
FID 18	3.90	4.30	4.40	4.30	4.20	559	254	192	141	310	3.69	4.97	5.39	5.65	4.65
FID 22	6.50	6.20	6.40	6.30	6.90	488	430	308	296	378	6.27	6.13	6.70	6.66	6.93
FID 23*	4.40	--	--	--	--	202	--	--	--	--	5.33	--	--	--	--
FID 28	7.70	6.90	6.70	6.80	7.30	527	400	271	318	423	7.29	6.87	7.13	7.04	7.17
FID 37	4.80	4.60	4.50	5.30	4.70	1210	654	765	432	708	3.64	4.16	3.89	5.29	4.16
FID 43*	6.50	--	--	--	--	636	--	--	--	--	5.96	--	--	--	--
FID 101	4.20	3.80	4.20	4.20	3.90	405	272	290	221	285	4.34	4.43	4.73	5.04	4.47
FID 102	3.80	3.60	3.70	3.70	3.50	358	303	230	171	282	4.11	4.12	4.53	4.87	4.11
FID 103*	4.00	--	--	--	--	443	--	--	--	--	4.05	--	--	--	--
FID 104*	3.80	--	--	--	--	459	--	--	--	--	3.83	--	--	--	--
FID 105	5.60	4.90	6.60	4.70	4.50	1390	668	799	816	834	4.23	4.42	5.79	4.00	3.79
FID 106	5.00	5.00	5.70	4.60	4.40	454	254	408	247	516	4.95	5.62	5.73	5.28	4.25
ERA 2	--	--	6.40	7.00	6.00	--	--	960	420	1000	--	--	5.40	6.90	4.98
ERA 3	--	--	6.40	6.00	5.90	--	--	624	807	652	--	--	5.89	5.22	5.37
ERA 4	--	--	5.80	6.40	5.40	--	--	514	215	562	--	--	5.56	7.12	5.08
ERA 10	--	--	5.70	5.20	5.30	--	--	299	232	310	--	--	6.09	5.91	5.67
ERA 13	--	--	6.60	5.60	5.50	--	--	292	91	282	--	--	6.95	7.36	5.97
Reference #1 (West)[1]	7.76	7.50	7.60	7.50	8.00	2113	597	1120	605	882	5.75	6.96	6.33	6.95	6.98
Reference #2 (North)[1]	6.43	6.00	5.80	6.00	6.20	913	687	1170	578	760	5.48	5.41	4.61	5.61	5.48
Reference #3 (Northeast)[1]	5.31	5.60	5.10	6.70	5.40	2721	1950	2250	1090	1540	3.18	3.84	3.21	5.53	3.92
Reference #4 (East)[1]	5.28	5.40	4.80	6.00	4.90	1669	1130	1210	923	1020	3.72	4.28	3.64	5.07	3.93

Notes:

[1] 2010 reference samples were tested using unsieved soil; therefore, an adjustment regression (see main report) has been applied to account for this discrepency.

*Locations FID 23, FID 43, FID 103, FID 104, and FID 17 were excavated and not sampled.

mg/kg = milligrams per kilogram

pCu = -log (cupric ion activity)

S.U. = standard units

-- = not applicable

Table 6
2010 to 2014 Average pH, Total Copper, pCu, and Acid-Base Accounting based on "Permanence Monitoring" Dataset

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Year	pH (S.U.)	Copper (mg/kg)	pCu	NNP ($tCaCO_3/kt$)	NPR
2010	5.45	1296	4.48	23.2	51.8
2011	5.24	873	4.77	8.7	10.5
2012	5.27	851	4.83	10.8	10.9
2013	5.46	682	5.26	15.6	18.3
2014	5.22	867	4.67	5.9	14.3
Mann-Kendall Trend Significance	0.7	0.4	0.4	0.3	0.3

Notes:

Means are for the same 17 locations for all years

NNP - Net Neutralization Potential

NPR - Neutralization Potential Ratio

pCu = -log (cupric ion activity)

S.U. = standard units

Table 7
2010 to 2014 Long-Term Sample Location Results – Acid-base Accounting (first 17 are "Permanence Monitoring" dataset)
Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Soil Sample Location	Total Sulfur (%)					Pyritic/Sulfide Sulfur (%)					Sulfate Sulfur (%)					Non-Sulfate Sulfur (%)					Organic Sulfur (%)				
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014
FID 7	0.05	0.07	0.02	0.05	0.04	0.04	0.03	0.02	0.03	0.03	0.01	0.01	<0.01	0.01	0.01	0.04	0.06	0.02	0.04	0.03	<0.01	0.03	<0.01	0.01	<0.01
FID 8	0.68	0.59	0.11	0.34	0.13	0.31	0.26	0.04	0.20	0.08	0.31	0.27	0.07	0.11	0.04	0.37	0.32	0.04	0.23	0.09	0.06	0.06	<0.01	0.03	0.01
FID 10	0.04	0.11	0.05	0.13	0.10	0.03	0.07	0.05	0.11	0.07	0.01	0.02	<0.01	<0.01	0.03	0.03	0.09	0.05	0.13	0.07	<0.01	0.02	<0.01	0.02	<0.01
FID 15	0.11	0.21	0.03	0.28	0.12	0.12	0.17	0.02	0.21	0.08	<0.01	0.02	0.01	0.04	0.03	0.11	0.19	0.02	0.24	0.09	0.01	0.02	<0.01	0.03	0.01
FID 16	0.27	0.26	0.06	0.22	0.10	0.15	<0.01	0.04	0.13	0.05	0.05	0.13	0.02	0.06	0.03	0.22	0.13	0.04	0.16	0.07	0.07	0.14	<0.01	0.03	0.02
FID 17*	0.57	0.48	0.68	--	--	0.37	0.38	0.56	--	--	0.12	0.05	0.07	--	--	0.45	0.43	0.61	--	--	0.08	0.05	0.05	--	--
FID 18	0.30	0.16	0.15	0.08	0.09	0.14	0.11	0.09	0.05	0.06	0.14	0.03	0.06	0.02	0.02	0.16	0.13	0.09	0.06	0.07	0.02	0.02	<0.01	0.01	0.01
FID 22	0.20	0.28	0.10	0.19	0.13	0.13	0.20	0.07	0.11	0.08	0.05	0.05	0.03	0.06	0.03	0.15	0.23	0.07	0.13	0.10	0.02	0.03	<0.01	0.02	0.02
FID 23*	0.11	--	--	--	--	0.07	--	--	--	--	0.04	--	--	--	--	0.07	--	--	--	--	<0.01	--	--	--	--
FID 28	0.18	0.19	<0.01	0.18	0.06	0.17	0.08	0.05	0.17	0.05	<0.01	0.07	<0.01	<0.01	<0.01	0.18	0.12	<0.01	0.18	0.06	0.01	0.04	<0.01	0.02	0.01
FID 37	0.07	0.05	0.02	0.02	0.03	0.02	0.03	0.01	0.02	0.02	0.04	<0.01	0.01	<0.01	0.01	0.03	0.05	0.01	0.02	0.02	0.01	0.02	<0.01	<0.01	<0.01
FID 43*	0.59	--	--	--	--	0.22	--	--	--	--	0.37	--	--	--	--	0.22	--	--	--	--	<0.01	--	--	--	--
FID 101	0.28	0.21	0.15	0.30	0.18	0.19	0.13	0.06	0.14	0.07	0.06	0.06	0.09	0.12	0.08	0.22	0.15	0.06	0.18	0.10	0.03	0.02	<0.01	0.04	0.03
FID 102	0.62	0.92	0.47	0.48	0.54	0.43	0.50	0.16	0.20	0.18	0.14	0.36	0.29	0.25	0.33	0.48	0.56	0.18	0.23	0.21	0.05	0.06	0.02	0.03	0.03
FID 103*	0.06	--	--	--	--	0.03	--	--	--	--	0.03	--	--	--	--	0.03	--	--	--	--	<0.01	--	--	--	--
FID 104*	0.98	--	--	--	--	0.31	--	--	--	--	0.61	--	--	--	--	0.37	--	--	--	--	0.06	--	--	--	--
FID 105	0.17	0.10	0.10	0.16	0.15	0.11	0.05	0.04	0.08	0.05	0.03	0.01	0.05	0.04	0.05	0.14	0.09	0.05	0.12	0.10	0.03	0.04	0.01	0.04	0.05
FID 106	0.04	0.05	0.03	0.02	0.06	0.03	0.02	0.02	0.03	0.02	0.01	0.01	0.01	<0.01	0.02	0.03	0.04	0.02	0.02	0.04	<0.01	0.02	<0.01	<0.01	0.02
ERA 2	--	--	0.15	<0.01	0.12	--	--	0.07	0.05	0.06	--	--	0.06	<0.01	0.04	--	--	0.09	<0.01	0.08	--	--	0.02	0.02	0.02
ERA 3	--	--	0.19	0.28	0.25	--	--	0.05	0.12	0.09	--	--	0.11	0.10	0.09	--	--	0.08	0.18	0.16	--	--	0.03	0.06	0.07
ERA 4	--	--	0.05	<0.01	0.07	--	--	0.03	0.02	0.02	--	--	0.02	<0.01	0.03	--	--	0.03	<0.01	0.04	--	--	<0.01	0.02	0.02
ERA 10	--	--	0.01	0.04	0.03	--	--	0.01	0.05	<0.01	--	--	<0.01	<0.01	0.01	--	--	0.01	0.04	0.02	--	--	<0.01	0.01	0.02
ERA 13	--	--	<0.01	0.02	0.02	--	--	0.02	0.03	0.02	--	--	<0.01	<0.01	<0.01	--	--	<0.01	0.02	0.02	--	--	<0.01	<0.01	<0.01
Reference #1 (West)	0.03	0.09	<0.01	<0.01	0.04	<0.01	0.03	0.03	0.02	<0.01	0.03	0.04	<0.01	<0.01	0.03	<0.01	0.05	<0.01	<0.01	0.01	<0.01	0.02	<0.01	0.02	0.03
Reference #2 (North)	0.02	0.02	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	0.02	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	0.02	<0.01	0.05	<0.01	<0.01	0.02
Reference #3 (Northeast)	0.07	0.16	0.06	0.12	0.06	0.02	0.07	0.03	0.08	0.05	0.05	0.07	0.03	0.02	0.01	0.02	0.09	0.03	0.10	0.05	<0.01	0.02	<0.01	0.02	<0.01
Reference #4 (East)	0.14	0.23	0.10	0.23	0.11	0.03	0.14	0.06	0.15	0.08	0.11	0.05	0.04	0.05	0.01	0.03	0.18	0.06	0.18	0.10	<0.01	0.04	<0.01	0.03	0.02

Notes:

[1] AGP is calculated from Pyritic Sulfide Sulfur where S(%)*31.25 = AGP. AGP was calculated using the detection limit when Pyritic Sulfide Sulfur was less than 0.1%.

[2] NNP is calculated as ANP-AGP. NNP was calculated using the detection limit when ANP was less than 0.3 $tCaCO_3$/kt.

[3] NPR is calculated as ANP/AGP. NPR was calculated using the detection limit when ANP was less than 0.3 $tCaCO_3$/kt.

*Locations FID 23, 43, 103, 104, and 17 were excavated and not sampled in subsequent years.

AGP = acid generation potential

ANP = acid neutralization potential

NNP = Net Neutralization Potential

NPR = Neutralization Potential Ratio

-- = not applicable

Table 7
2010 to 2014 Long-Term Sample Location Results – Acid-base Accounting

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Soil Sample Location	AGP (tCaCO$_3$/kt)[1] (calculated)					ANP (tCaCO$_3$/kt)					NNP (tCaCO$_3$/kt)[2] (calculated)					NPR (ANP/AGP)[3] (calculated)				
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014
FID 7	1.25	0.94	0.63	0.94	0.94	33	0	8	1	2	31.8	-0.9	7.4	0.1	1.1	26.4	0.0	12.8	1.1	2.1
FID 8	9.69	8.13	1.25	6.25	2.50	0	16	3	17	1	-9.7	7.9	1.8	10.8	-1.5	0.0	2.0	2.4	2.7	0.4
FID 10	0.94	2.19	1.56	3.44	2.19	2	5	1	2	4	1.1	2.8	-0.6	-1.4	1.8	2.1	2.3	0.6	0.6	1.8
FID 15	3.75	5.31	0.63	6.56	2.50	1	0	2	5	3	-2.8	-5.3	1.4	-1.6	0.5	0.3	0.0	3.2	0.8	1.2
FID 16	4.69	0.30	1.25	4.06	1.56	4	0	0	0	0	-0.7	-0.3	-1.3	-4.1	-1.6	0.9	0.0	0.0	0.0	0.0
FID 17*	11.6	11.9	17.5	--	--	0	8	5	--	--	-11.6	-3.9	-12.5	--	--	0.0	0.7	0.3	--	--
FID 18	4.38	3.44	2.81	1.56	1.88	19	0	1	0	2	14.6	-3.4	-1.8	-1.6	0.1	4.3	0.0	0.4	0.0	1.1
FID 22	4.06	6.25	2.19	3.44	2.50	10	16	5	12	9	5.9	9.8	2.8	8.6	6.5	2.5	2.6	2.3	3.5	3.6
FID 23*	2.19	--	--	--	--	0	--	--	--	--	-2.2	--	--	--	--	0.0	--	--	--	--
FID 28	5.31	2.50	1.56	5.31	1.56	137	35	64	90	41	132	32.5	62.4	84.7	39.4	25.8	14.0	41.0	16.9	26.2
FID 37	0.63	0.94	0.31	0.63	0.63	0	1	0	2	2	-0.6	0.06	-0.3	1.4	1.4	0.0	1.1	0.0	3.2	3.2
FID 43*	6.88	--	--	--	--	25	--	--	--	--	18.1	--	--	--	--	3.6	--	--	--	--
FID 101	5.94	4.06	1.88	4.38	2.19	0	2	0	0	0	-5.9	-2.1	-1.9	-4.4	-2.2	0.0	0.5	0.0	0.0	0.0
FID 102	13.4	15.6	5.00	6.25	5.63	0	0	28	2	0	-13.4	-15.6	23.0	-4.3	-5.6	0.0	0.0	5.6	0.3	0.0
FID 103*	0.94	--	--	--	--	2	--	--	--	--	1.1	--	--	--	--	2.1	--	--	--	--
FID 104*	9.69	--	--	--	--	0	--	--	--	--	-9.7	--	--	--	--	0.0	--	--	--	--
FID 105	3.44	1.56	1.25	2.50	1.56	0	8	5	2	0	-3.4	6.4	3.8	-0.5	-1.6	0.0	5.1	4.0	0.8	0.0
FID 106	0.94	0.63	0.63	0.94	0.63	0	0	13	2	0	-0.9	-0.6	12.4	1.1	-0.6	0.0	0.0	20.8	2.1	0.0
ERA 2	--	--	2.19	1.56	1.88	--	--	0	18	5	--	--	-2.2	16.4	3.1	--	--	0.0	11.5	2.7
ERA 3	--	--	1.56	3.75	2.81	--	--	13	3	5	--	--	11.4	-0.8	2.2	--	--	8.3	0.8	1.8
ERA 4	--	--	0.94	0.63	0.63	--	--	8	5	4	--	--	7.1	4.4	3.4	--	--	8.5	8.0	6.4
ERA 10	--	--	0.31	1.56	0.30	--	--	0	3	0	--	--	-0.3	1.4	-0.3	--	--	0.0	1.9	0.0
ERA 13	--	--	0.63	0.94	0.63	--	--	19	6	0	--	--	18.4	5.1	-0.6	--	--	30.4	6.4	0.0
Reference #1 (West)	0.30	0.94	0.94	0.63	0.30	238	101	61	166	58	238	100	60.1	165	57.7	793	108	65.1	266	193
Reference #2 (North)	0.30	0.30	0.30	0.63	0.63	3.6	11	6	5	5	3.3	10.7	5.7	4.4	4.4	12.0	36.7	20.0	8.0	8.0
Reference #3 (Northeast)	0.63	2.19	0.94	2.50	1.56	7.6	13	3	11	0	7.0	10.8	2.1	8.5	-1.6	12.2	5.9	3.2	4.4	0.0
Reference #4 (East)	0.94	4.38	1.88	4.69	2.50	<0.3	0	8	3	4	-0.6	-4.4	6.1	-1.7	1.5	0.3	0.0	4.3	0.6	1.6

Notes:

[1] AGP is calculated from Pyritic Sulfide Sulfur where S(%)*31.25 = AGP. AGP was calculated using the detection limit when Pyritic Sulfide Sulfur was less than 0.1%.

[2] NNP is calculated as ANP-AGP. NNP was calculated using the detection limit when ANP was less than 0.3 tCaCO$_3$/kt.

[3] NPR is calculated as ANP/AGP. NPR was calculated using the detection limit when ANP was less than 0.3 tCaCO$_3$/kt.

*Locations FID 23, 43, 103, 104, and 17 were excavated and not sampled in subsequent years.

AGP = acid generation potential

ANP = acid neutralization potential

NNP = Net Neutralization Potential

NPR = Neutralization Potential Ratio

-- = not applicable

Table 8
Duplicate Analysis of Samples Collected from 2010 to 2014

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Soil Sample Location	Year	Soil pH (0 to 6 inches) (S.U.)	Soil Copper (0 to 6 inches) (mg/kg)	Total Sulfur (%)	Non-Sulfate Sulfur (%)	Pyritic Sulfide Sulfur (%)	Sulfate Sulfur (%)	ANP (tCaCO$_3$/kt)
FID 17	2010	5.1	4550	0.57	0.45	0.37	0.12	0
FID 17 DUP		5.3	3900	0.65	0.58	0.51	0.07	3
Relative percent difference		**4%**	**15%**	**13%**	**25%**	**32%**	**53%**	**200%**
FID 23		4.4	202	0.11	0.07	0.07	0.04	0
FID 23 DUP		4.4	182	0.13	0.08	0.07	0.05	0
Relative percent difference		**0%**	**10%**	**17%**	**13%**	**0%**	**22%**	**0%**
FID 22	2011	6.2	430	0.19	0.15	0.04	0.04	16
FID 22 DUP		6.3	467	0.19	0.15	0.03	0.04	26
Relative percent difference		**2%**	**8%**	**0%**	**0%**	**29%**	**0%**	**48%**
FID 101		3.8	272	0.19	0.13	0.02	0.06	2
FID 101 DUP		3.9	341	0.19	0.13	<0.01	0.06	0
Relative percent difference		**3%**	**23%**	**0%**	**0%**	**67%**	**0%**	**200%**
ERA 2	2012	6.4	960	0.15	0.09	0.07	0.06	0
ERA 2 DUP		6.4	953	<0.01	<0.01	0.05	<0.01	15
Relative percent difference		**0%**	**1%**	**175%**	**160%**	**33%**	**143%**	**200%**
ERA 13		6.6	292	<0.01	<0.01	0.02	<0.01	19
ERA 13 DUP		5.7	257	<0.01	<0.01	0.01	<0.01	13
Relative percent difference		**15%**	**13%**	**0%**	**0%**	**67%**	**0%**	**38%**
FID 37	2013	5.3	432	0.02	0.02	0.02	<0.01	2
FID 37 DUP		5.2	365	0.01	0.01	0.02	<0.01	3
Relative percent difference		**2%**	**17%**	**67%**	**67%**	**0%**	**0%**	**40%**
FID 28		6.8	318	0.18	0.18	0.17	<0.01	90
FID 28 DUP		6.8	230	0.19	0.19	0.19	<0.01	81
Relative percent difference		**0%**	**32%**	**5%**	**5%**	**11%**	**0%**	**11%**
FID 37	2014	4.7	708	0.03	0.02	0.02	0.01	2
FID 37 DUP		4.9	685	0.02	0.02	0.02	<0.01	0
Relative percent difference		**4%**	**3%**	**40%**	**0%**	**0%**	**0%**	**200%**
FID 101		3.9	285	0.18	0.10	0.07	0.08	0
FID 101 DUP		3.9	291	0.21	0.12	0.10	0.09	2
Relative percent difference		**0%**	**2%**	**15%**	**18%**	**35%**	**12%**	**200%**

Notes:
ANP = acid neutralization potential
mg/kg = milligram per kilogram
S.U. - Standard units
Relative percent difference = $((\lvert X_2 - X_1 \rvert)/\text{Mean})*100$

Table 9
Effect of Sampling Method on Samples Collected from 2010 to 2013

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Date	Reference #1 (West)	Reference #2 (North)	Reference #3 (Northeast)	Reference #4 (East)
pH Results (S.U.)				
Amendment Study Method				
Oct-10	8.4	5.6	4.9	4.6
Oct-11	8.8	5.8	4.6	4.7
Oct-12	8.0	6.0	5.5	6.6
Oct-13	7.6	5.8	5.4	6.0
pH Monitoring Method				
Oct-10	7.8	6.4	5.3	5.3
Oct-11	7.5	6.0	5.6	5.4
Oct-12	7.6	5.8	5.1	4.8
Oct-13	7.5	6.0	6.7	6.0
Single Sample Method				
Oct-13	7.7	5.1	5.4	7.6
Copper Results (mg/kg)				
Amendment Study Method				
Oct-10	1116	1257	3357	1222
Oct-11	711	861	3235	1320
Oct-12	1113	1069	2268	1187
Oct-13	1021	760	2023	1100
pH Monitoring Method				
Oct-10	2113	913	2721	1669
Oct-11	597	687	1950	1130
Oct-12	1120	1170	2250	1210
Oct-13	605	578	1090	923
Single Sample Method				
Oct-13	56	501	1200	1120

Notes:

mg/kg = milligram per kilogram

S.U. - Standard units

Table 10
Historic Copper Concentrations in Insect Tissue Compared to Post-White Rain Results

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Location	1999 Insect Tissue Cu (mg/kg dry wt washed)[1]	2010 Insect Tissue Cu (mg/kg dry wt washed)
ERA 2	198	176
ERA 3	252	111
ERA 4	193	92
ERA 5	163	74
ERA 6	233	163
ERA 7	340	68
ERA 8	465	162
ERA 9	175	155
ERA 10	35	100
ERA 11	88	95
ERA 12	66	127
ERA 13	165	116
ERA 14	169	87
ERA 15	305	318
Average	203	132

Notes:

[1] Assumes 0.4% of insect weight is soil that would be removed when washed (ARCADIS 2011c), which gives ~1% of copper in insect was in soil. These tissue samples still include soil in gut or adhered to insect after washing.

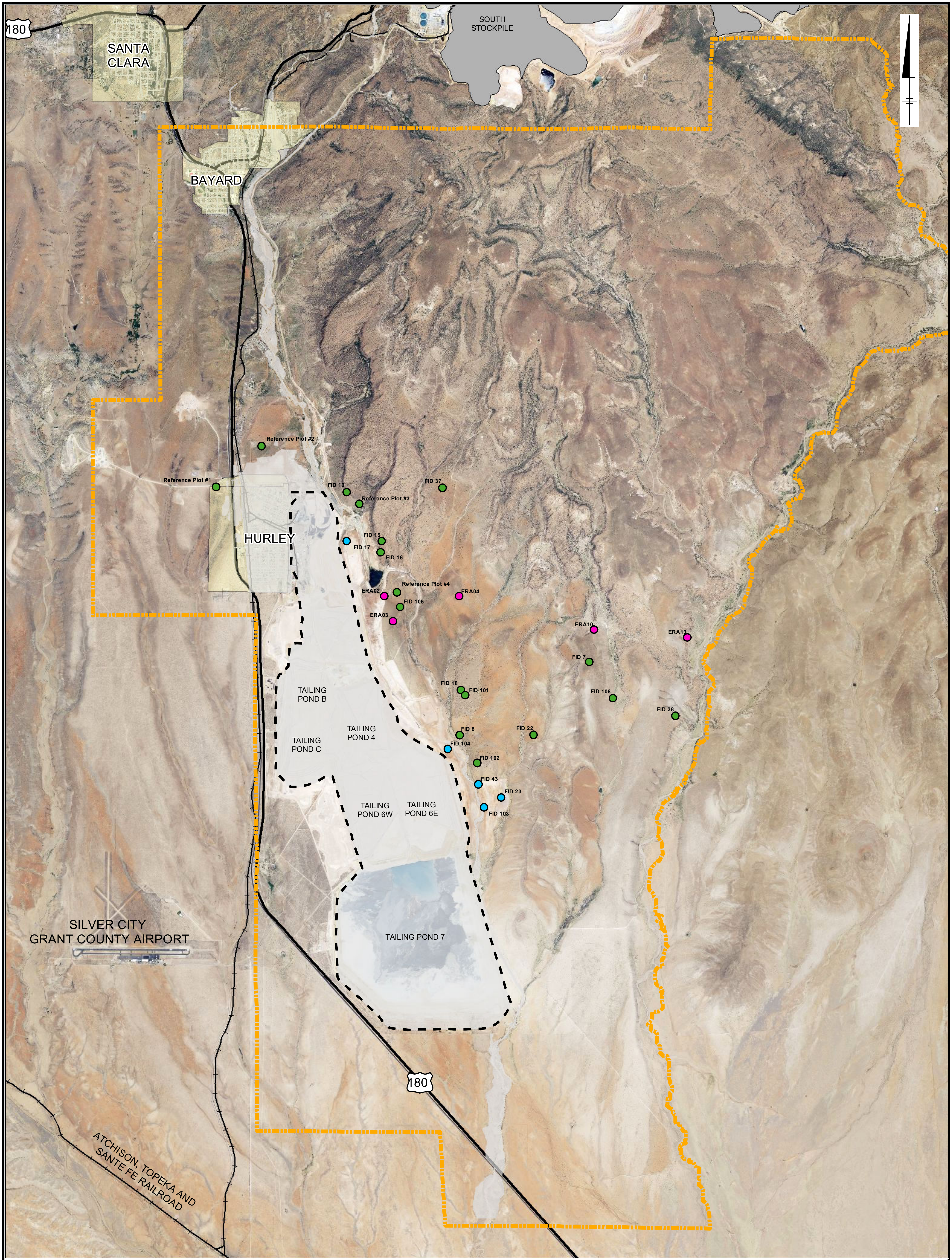
ERA = ecological risk assessment

mg/kg = milligrams per kilogram

wt = weight

Figures

OFFICE: LAKEWOOD DB: MEB TM: MB PM: AT
PROJECT# B0063543.0000 4/28/2015 4:49:52 PM
Document Path: Y:_ENV\Chino\2015\MXDs\pH_MonitoringLocations.mxd



LEGEND:

pH Monitoring Sampling Points

● Sampled 2010 - 2014

● Sampled 2010

● Sampled 2012 - 2014

▭ STSIU Boundary

0 5,000 10,000
Feet

GRAPHIC SCALE

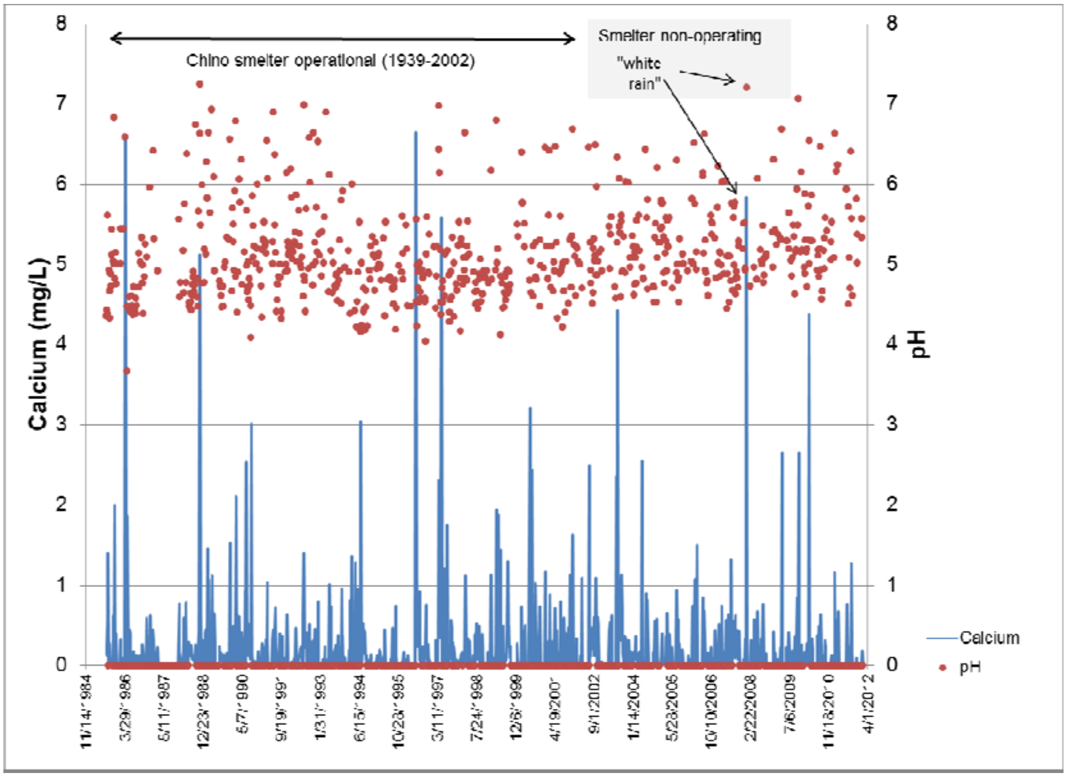
Notes:
1. Aerial orthophotography: USDA, NAIP, 2014.

FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO
2014 pH MONITORING REPORT

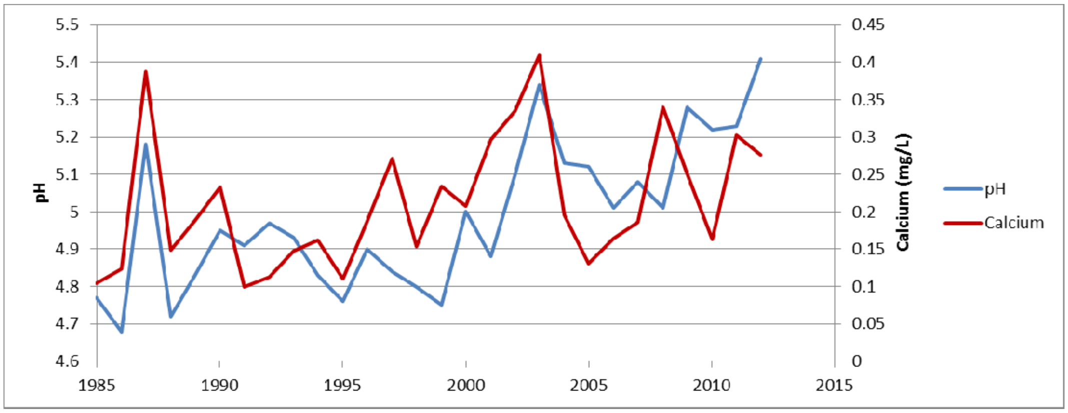
MAP OF STSIU AND MONITORING LOCATIONS

ARCADIS

FIGURE
1



a. Data for pH and calcium in rainwater for the period 1985 – 2012 as measured weekly by the NADP at the Gila Cliffs, NM station (NM01). Data are in Appendix B.



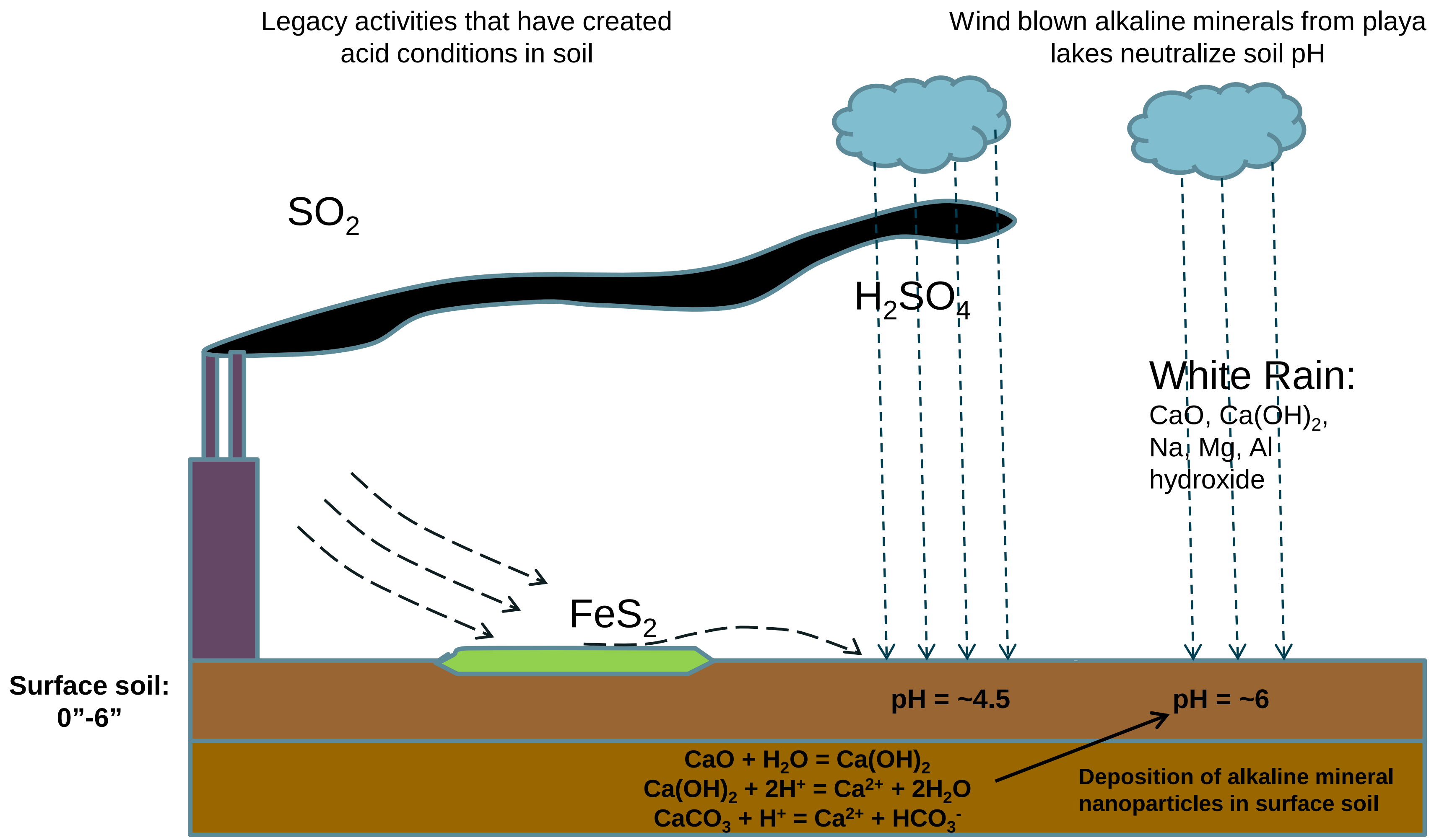
b. Annual average pH and calcium data for rainwater collected by the National Atmospheric Deposition Program at the Gila Cliffs National Monument, NM (station NM01).

Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico
Year 5 pH Monitoring Report

pH and Calcium in Rainwater

ARCADIS

FIGURE
2



Legacy activities that have created acid conditions in soil

Wind blown alkaline minerals from playa lakes neutralize soil pH

SO_2

H_2SO_4

White Rain:
CaO, $Ca(OH)_2$,
Na, Mg, Al
hydroxide

FeS_2

Surface soil:
0”-6”

pH = ~4.5

pH = ~6

$$CaO + H_2O = Ca(OH)_2$$
$$Ca(OH)_2 + 2H^+ = Ca^{2+} + 2H_2O$$
$$CaCO_3 + H^+ = Ca^{2+} + HCO_3^-$$

Deposition of alkaline mineral nanoparticles in surface soil

Note:
The smelter deposits sulfuric acid (H_2SO_4) on the soils, and the flat green area represents tailings. Iron sulfides blow off these tailings onto the soils, creating more potential acidity. To counteract the acidity, calcium-rich minerals from the Willcox and Lordsburg playa in white rain were deposited in the soil and partially dissolved, but also were present as micro- and nanoparticulates that neutralized acidity from smelter and tailings, resulting in increased pH. Presence of the nanoparticulates, with very high specific surface area, increased buffering capacity of the soil.

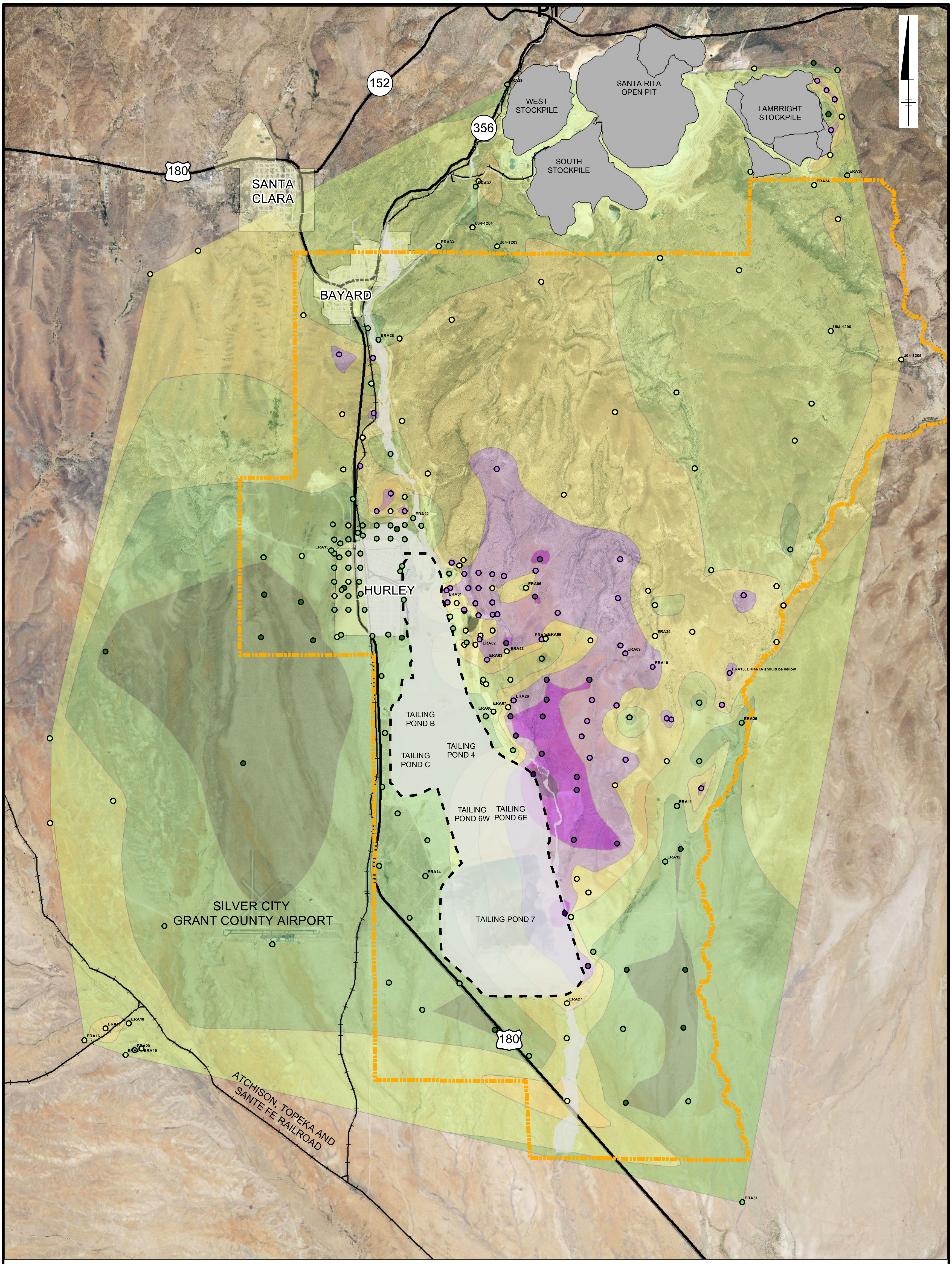
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico
Year 5 pH Monitoring Report

Conceptual Model for the Interaction of Alkaline Minerals in the White Rain with the Surface Soil at the STSIU

ARCADIS

FIGURE
3

OFFICE: LAKEWOOD DB: MB TM: MB PM: AT
PROJECT# B0063543.0000 9/3/2015 9:29:48 PM
Y:_ENV\Chino\2015\MXDs\PreWR_pH_NN.mxd



LEGEND:

Pre-White Rain pH

- ▨ < 3
- ▨ 3 - 4
- ▨ 4 - 5
- ▨ 5 - 6
- ▨ 6 - 7
- ▨ 7 - 8
- ▨ > 8

pre-White Rain pH

- ● < 3
- ● 3 - 4
- ● 4 - 5
- ● 5 - 6
- ● 6 - 7
- ● 7 - 8
- ● > 8

▭ STSIU Boundary

0 5,000 10,000 Feet

GRAPHIC SCALE

Notes:
1. Aerial orthophotography: USDA, NAIP, 2014.

FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

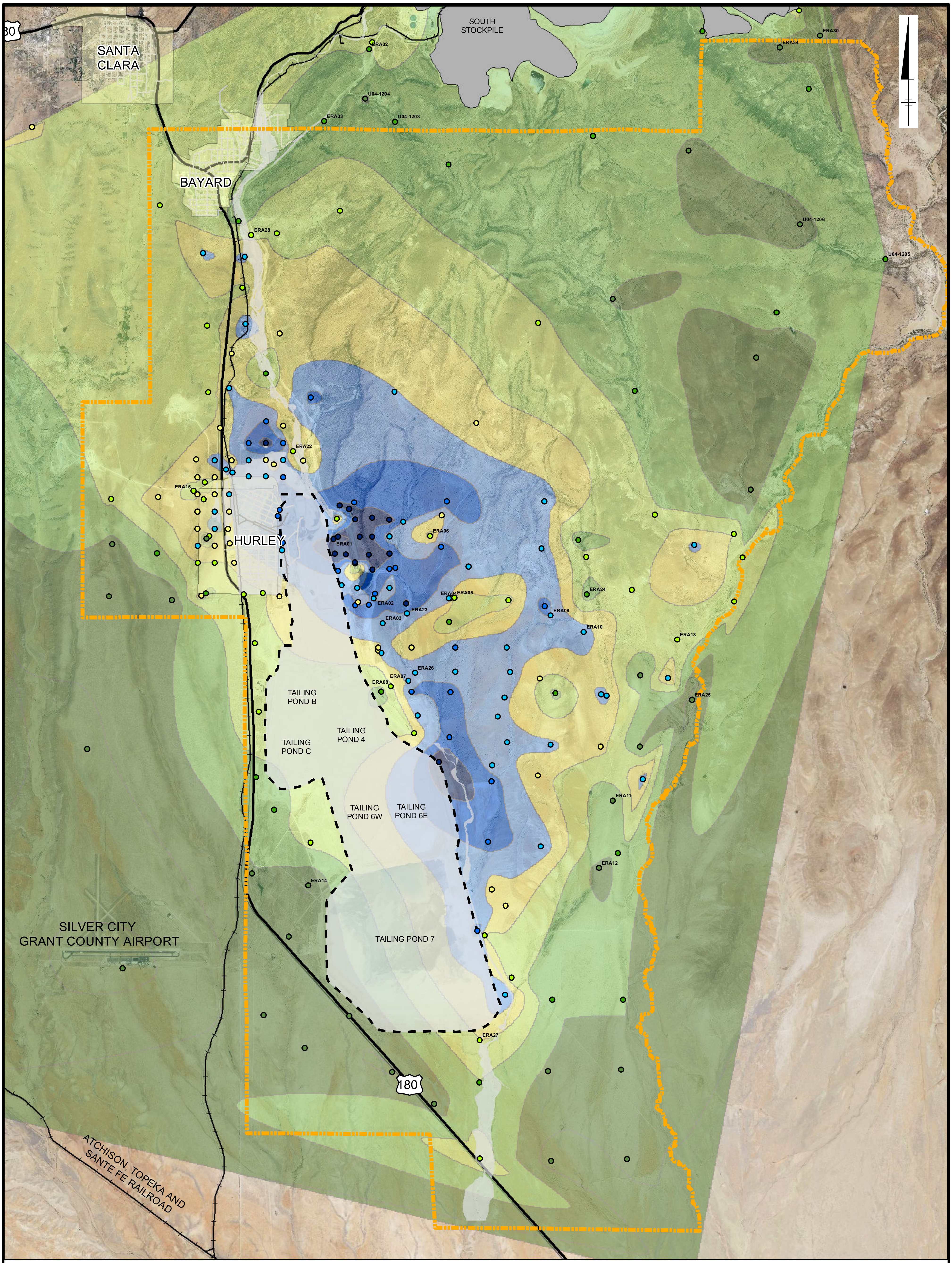
YEAR 5 pH MONITORING REPORT

pH NATURAL NEIGHBOR INTERPOLATION PRE-WHITE RAIN

ARCADIS

FIGURE
4a

OFFICE: LAKEWOOD DB: MLM TM: MB PM: AT
PROJECT# B0063543.0000 9/3/2015 9:52:02 PM
Y:_ENV\Chino\2015\MXDs\PreWR_pCu_NN.mxd



LEGEND:

pre-White Rain pCu

- ▨ < 3
- ▨ 3 - 4
- ▨ 4 - 5
- ▨ 5 - 6
- ▨ 6 - 7
- ▨ 7 - 8
- ▨ > 8

PreWR_pCu_0915

- ● < 3
- ● 3 - 4
- ● 4 - 5
- ● 5 - 6
- ● 6 - 7
- ● 7 - 8
- ● > 8

▭ STSIU Boundary

0 5,000 10,000 Feet
GRAPHIC SCALE

Notes:
1. pCu = 7.34 + 0.93*[pH] - 1.15*ln[Cu]
2. Aerial orthophotography: USDA, NAIP, 2014.

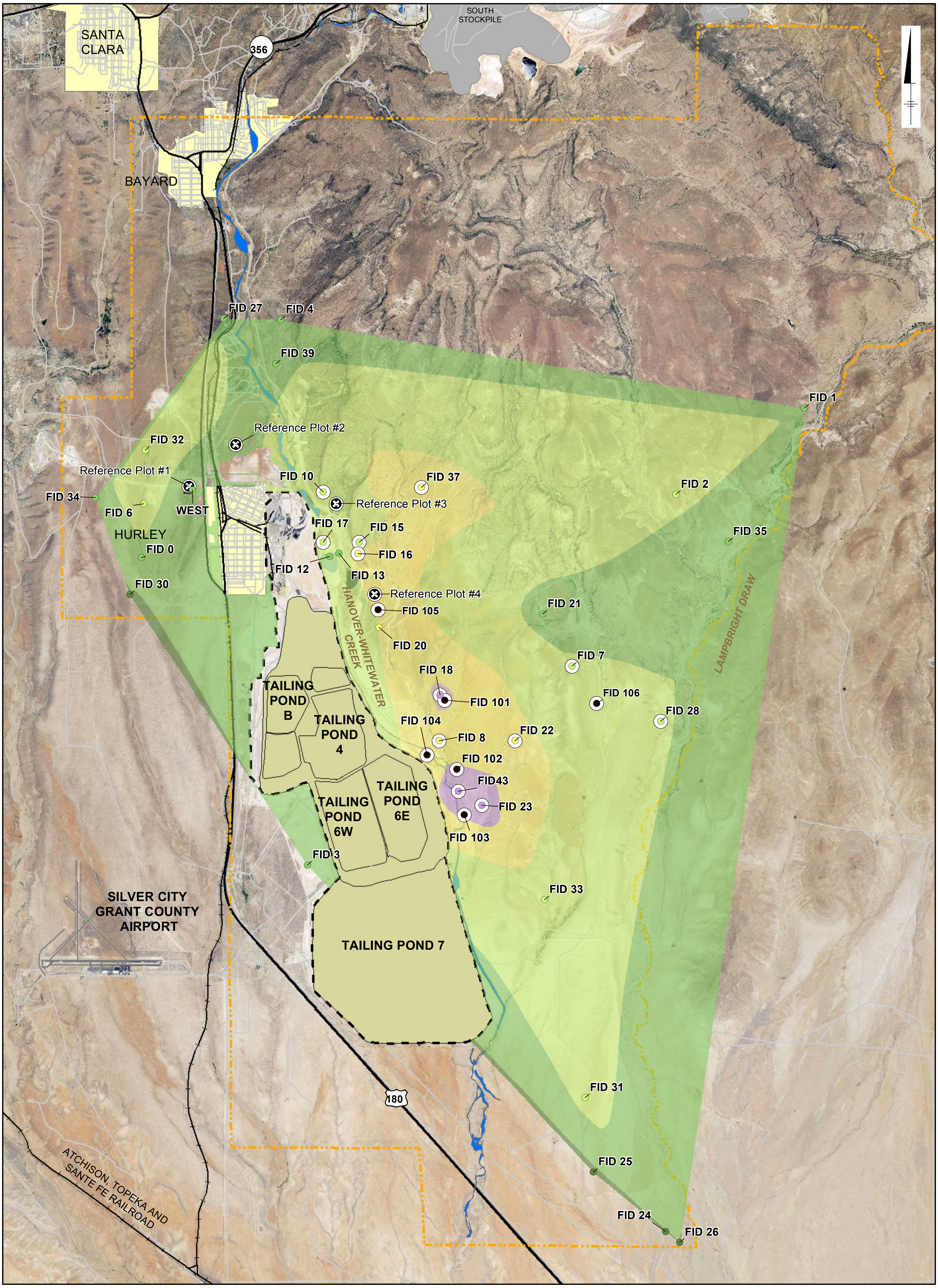
FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO
YEAR 5 pH MONITORING REPORT

pCu NATURAL NEIGHBOR INTERPOLATION PRE-WHITE RAIN

ARCADIS

FIGURE
4b

OFFICE: LAKEWOOD DB: MEB TM: MB PM: AT
PROJECT # B0063543.0000 4/16/2015 1:12:46 PM
Y:_ENV\Chino\2015\MXDs\Fig5_pHadj_Post_White_Rain_070610.mxd



LEGEND

pH

●	4-5
●	5-6
●	6-7
●	7-8
●	8-9
●	New Monitoring Locations
⊗	Reference Plots
○	Long-Term Monitoring Plots

pH Zones

🟪	4-5
🟨	5-6
🟩	6-7
🟩	7-8
🟩	8-9

0 5,000 10,000 Feet

GRAPHIC SCALE

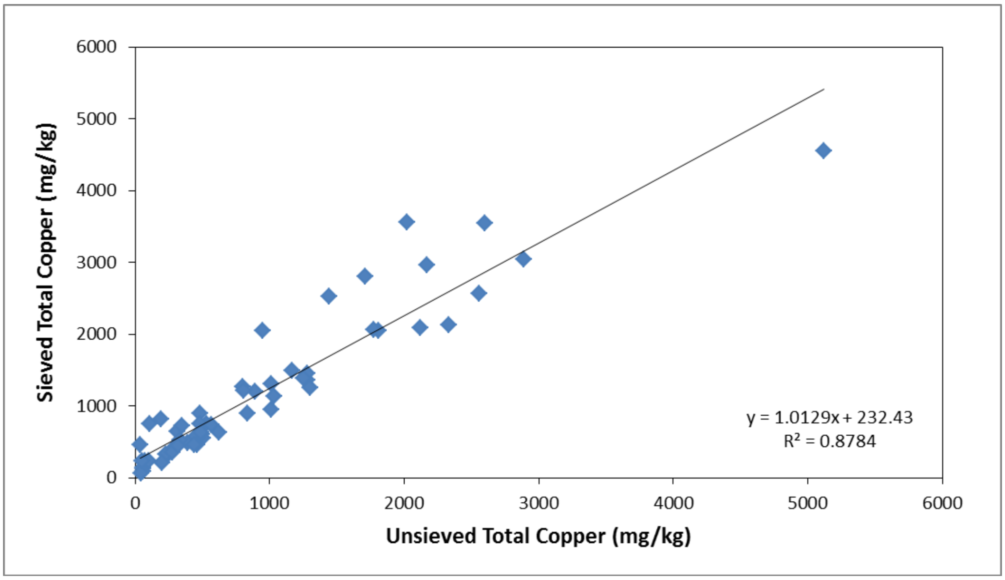
FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

YEAR 5 pH MONITORING REPORT

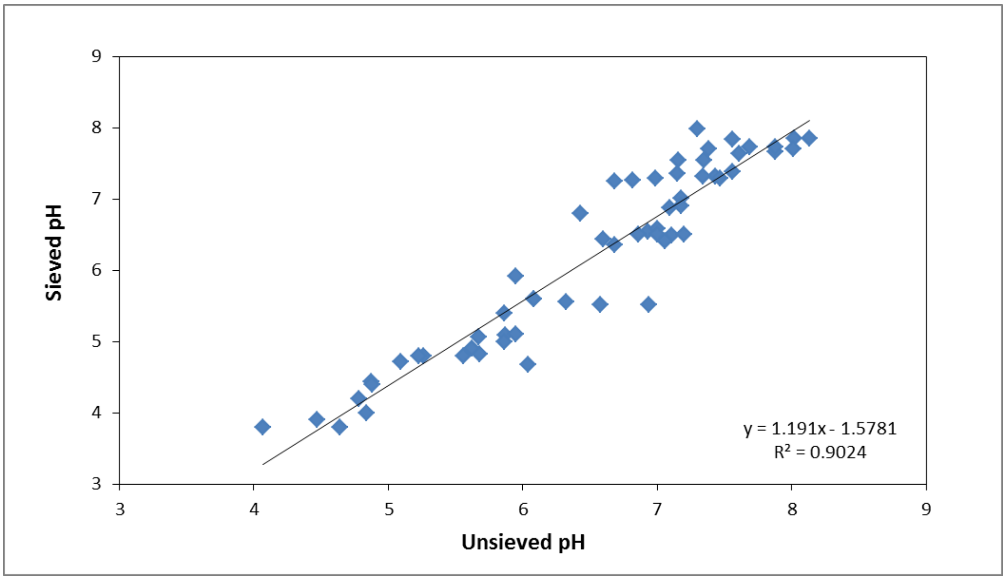
pH ZONES IN 2009 SOILS 0-6"
POST-WHITE RAIN USED FOR STUDY DESIGN

ARCADIS

FIGURE
5



a. Relationship between sieved and unsieved copper



b. Relationship between sieved and unsieved pH

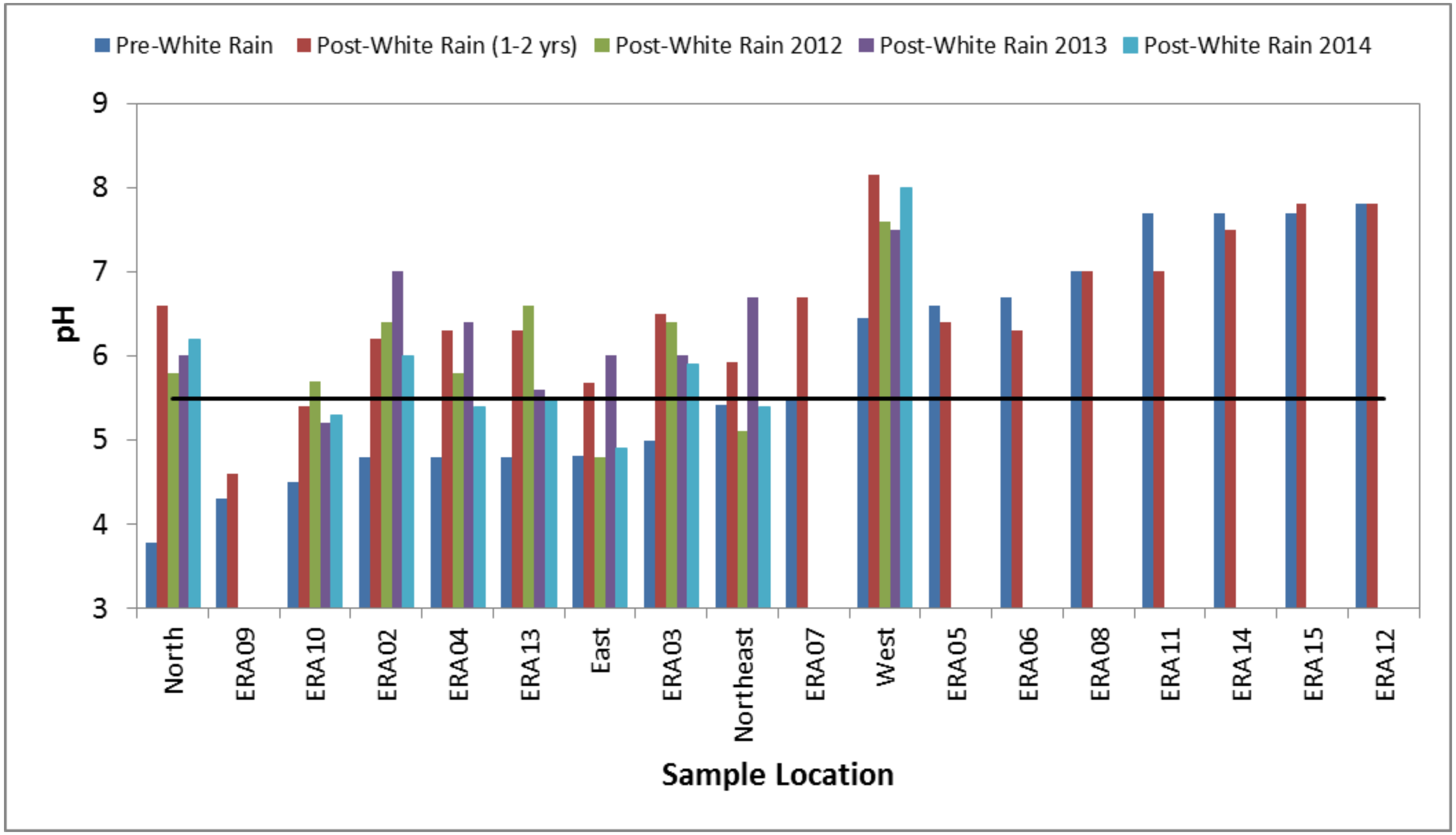
Note:
Figures use all 2010 pH monitoring (this study) and 2011 amendment study (ARCADIS 2014) data.

Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico
Year 5 pH Monitoring Report

Relationship Between Sieved and Unsieved Copper and pH

ARCADIS

FIGURE
6



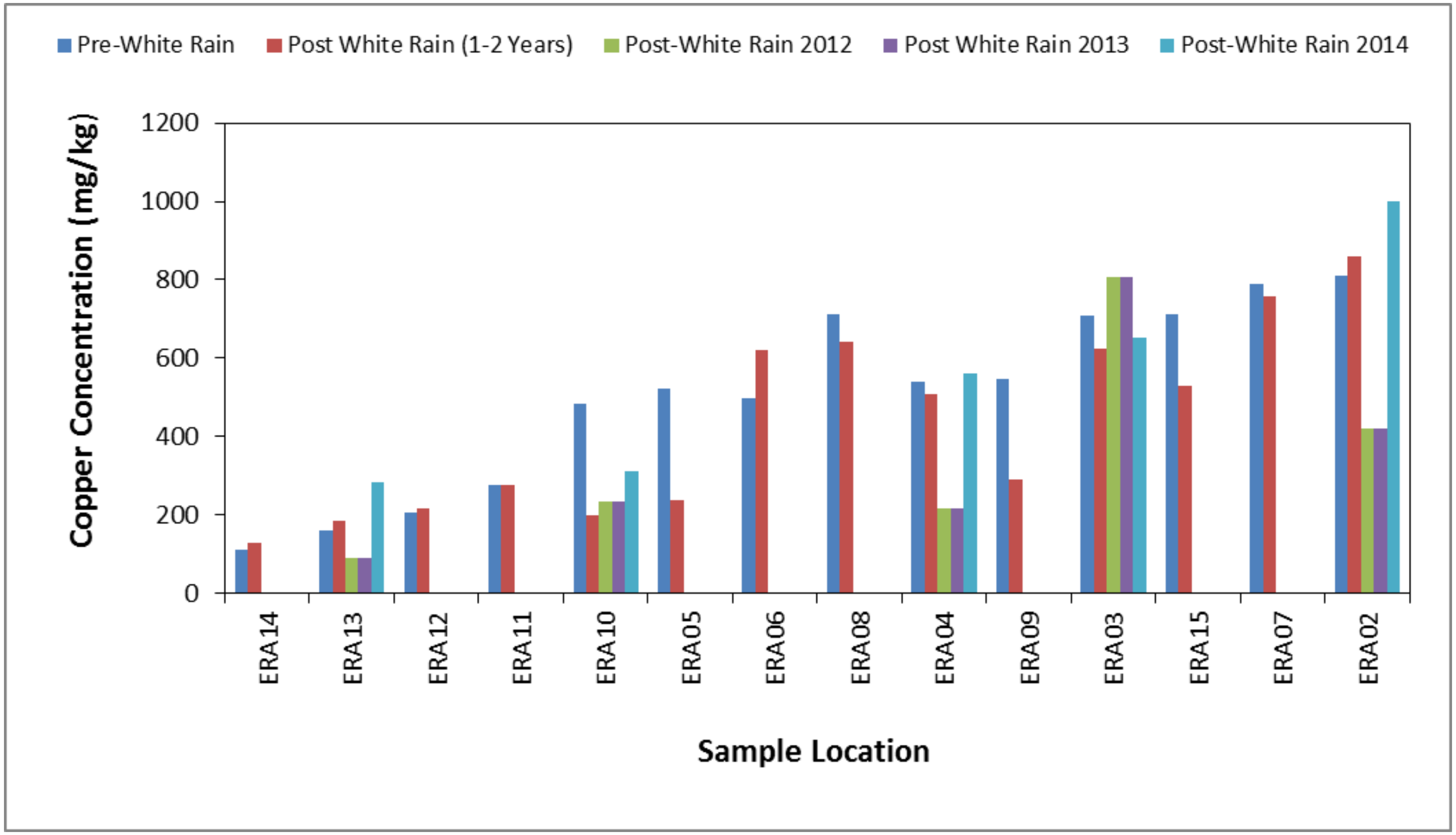
Note: pH increased in soils with low pH (≤5.5, line in graph) after the white rain, maintaining the higher pH to 2014.

Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico
Year 5 pH Monitoring Report

pH Before and After the White Rain

ARCADIS

FIGURE
7

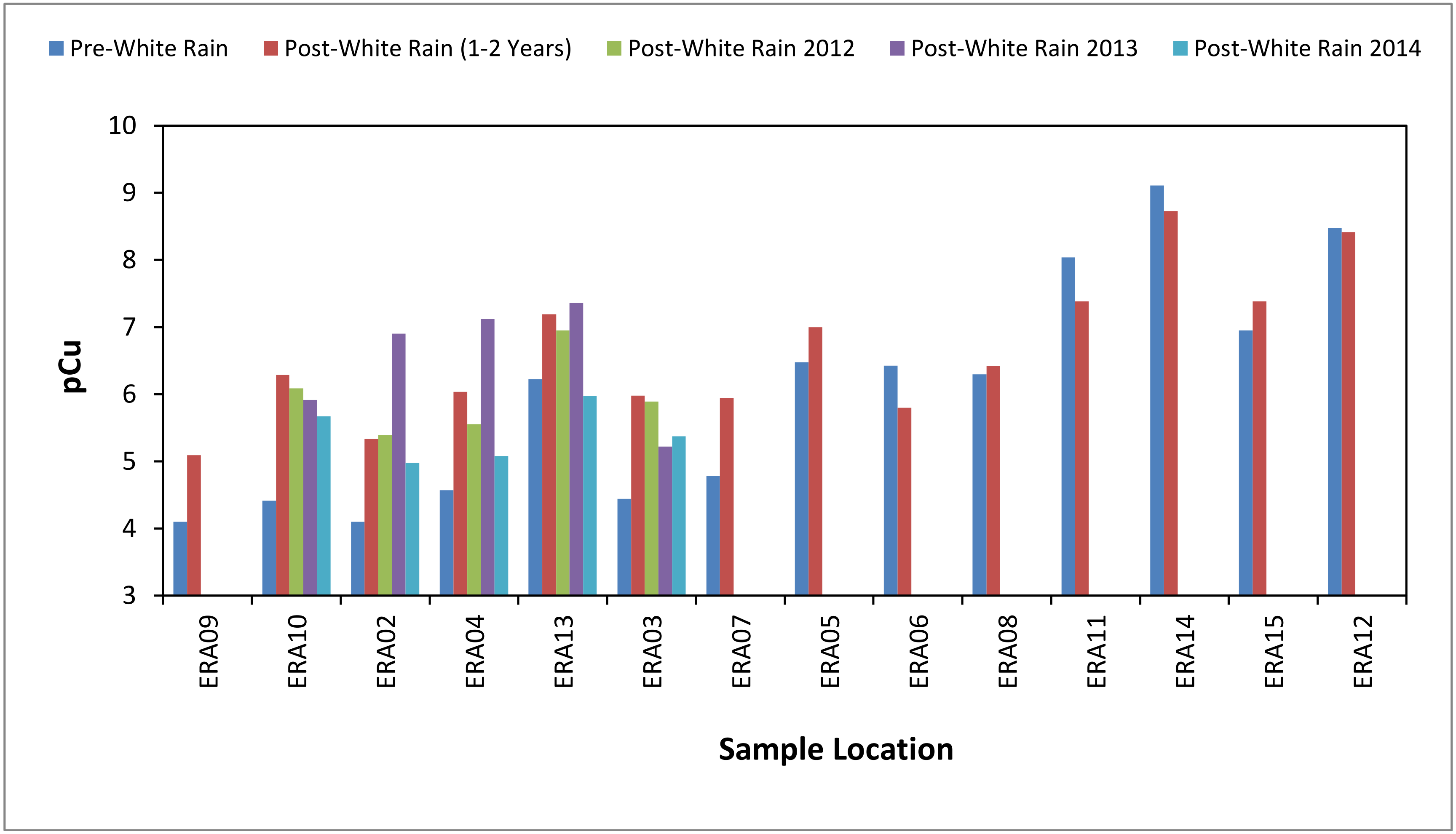


Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico
Year 5 pH Monitoring Report

Total Copper Before and After the White Rain

ARCADIS

FIGURE
8

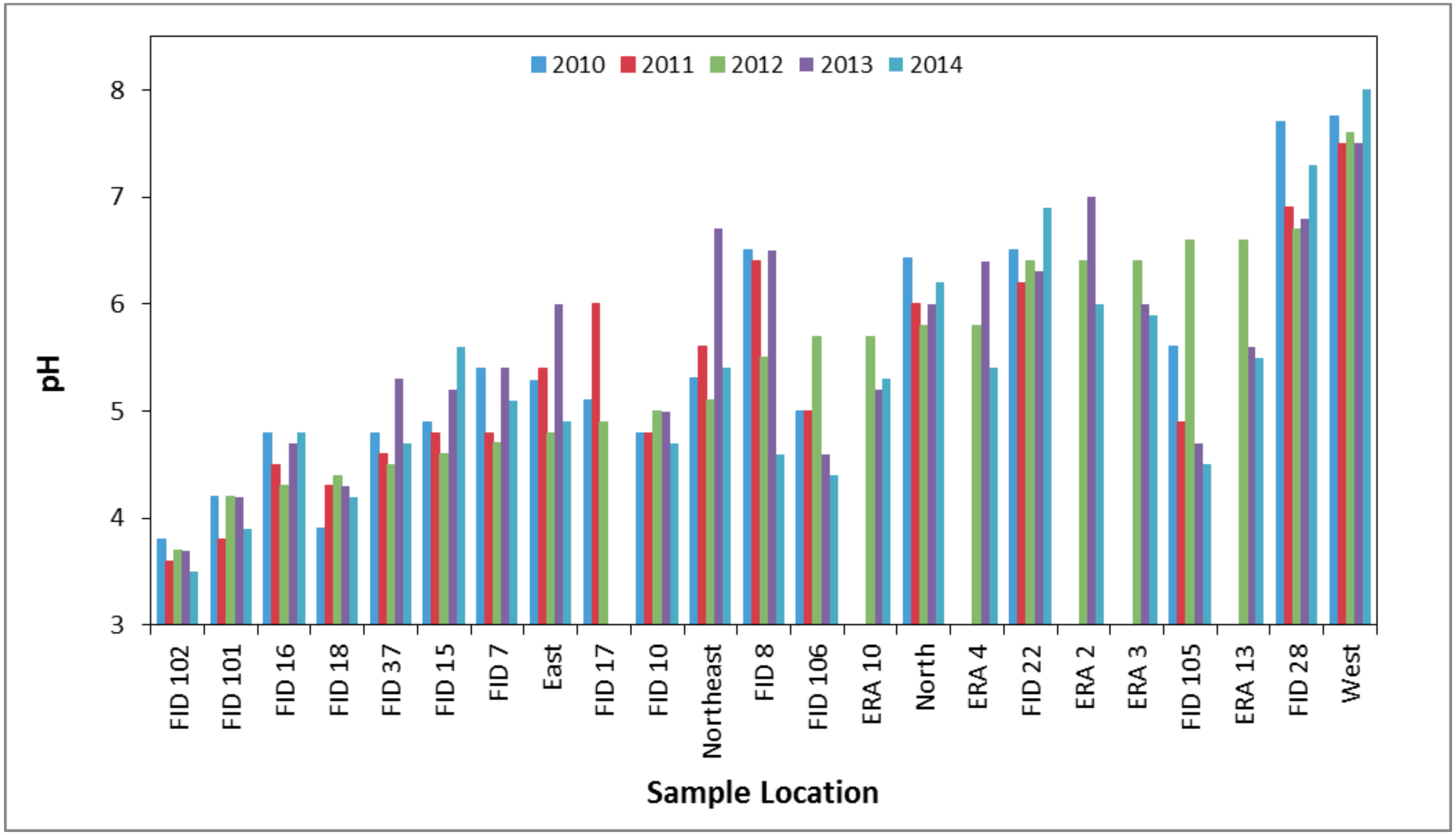


Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico
Year 5 pH Monitoring Report

pCu Before and After the White Rain

ARCADIS

FIGURE
9

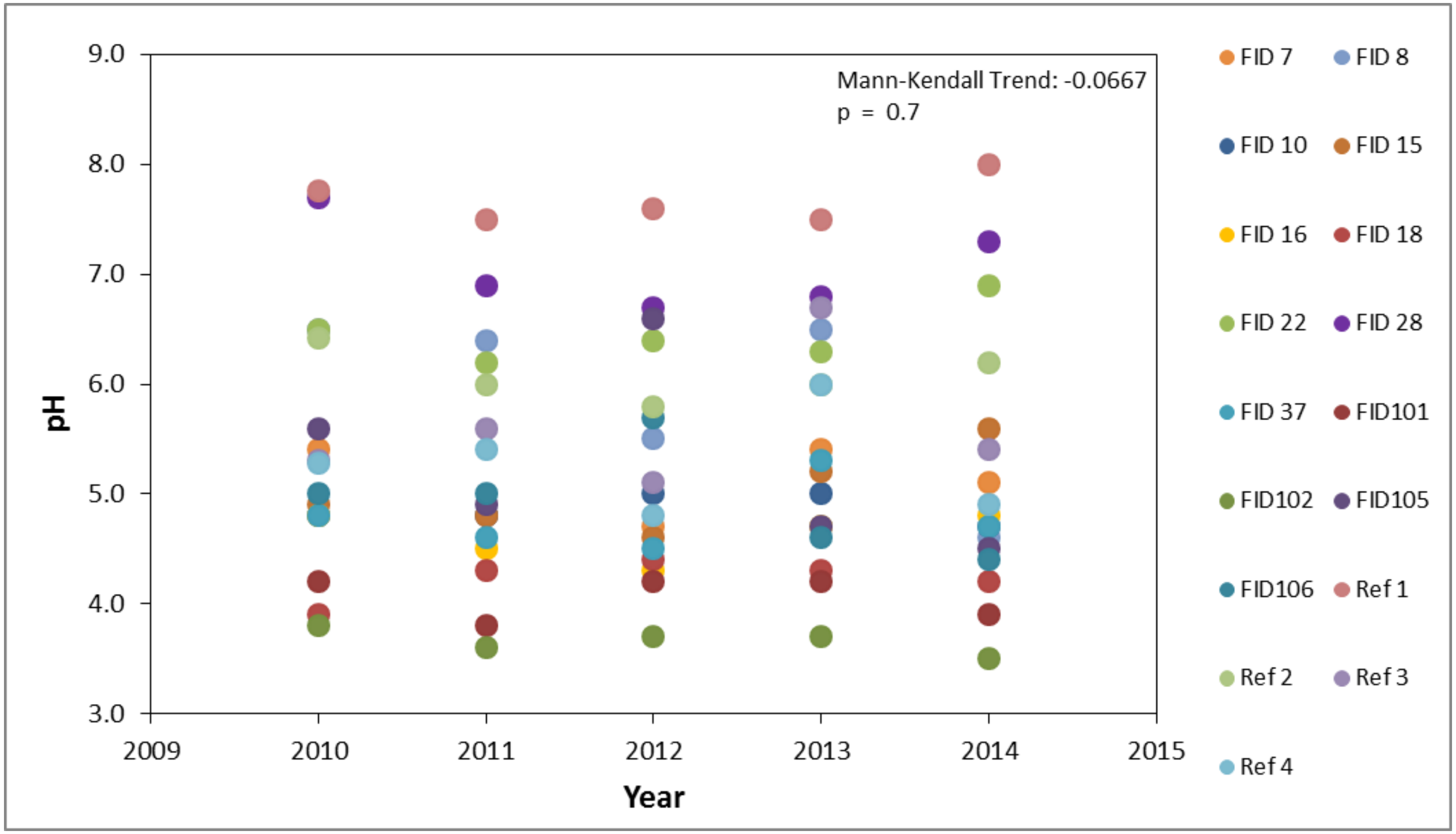


Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico
Year 5 pH Monitoring Report

pH of Soils (0 to 6 inches) on All Long-Term Monitoring Sites from 2010 to 2014

ARCADIS

FIGURE
10

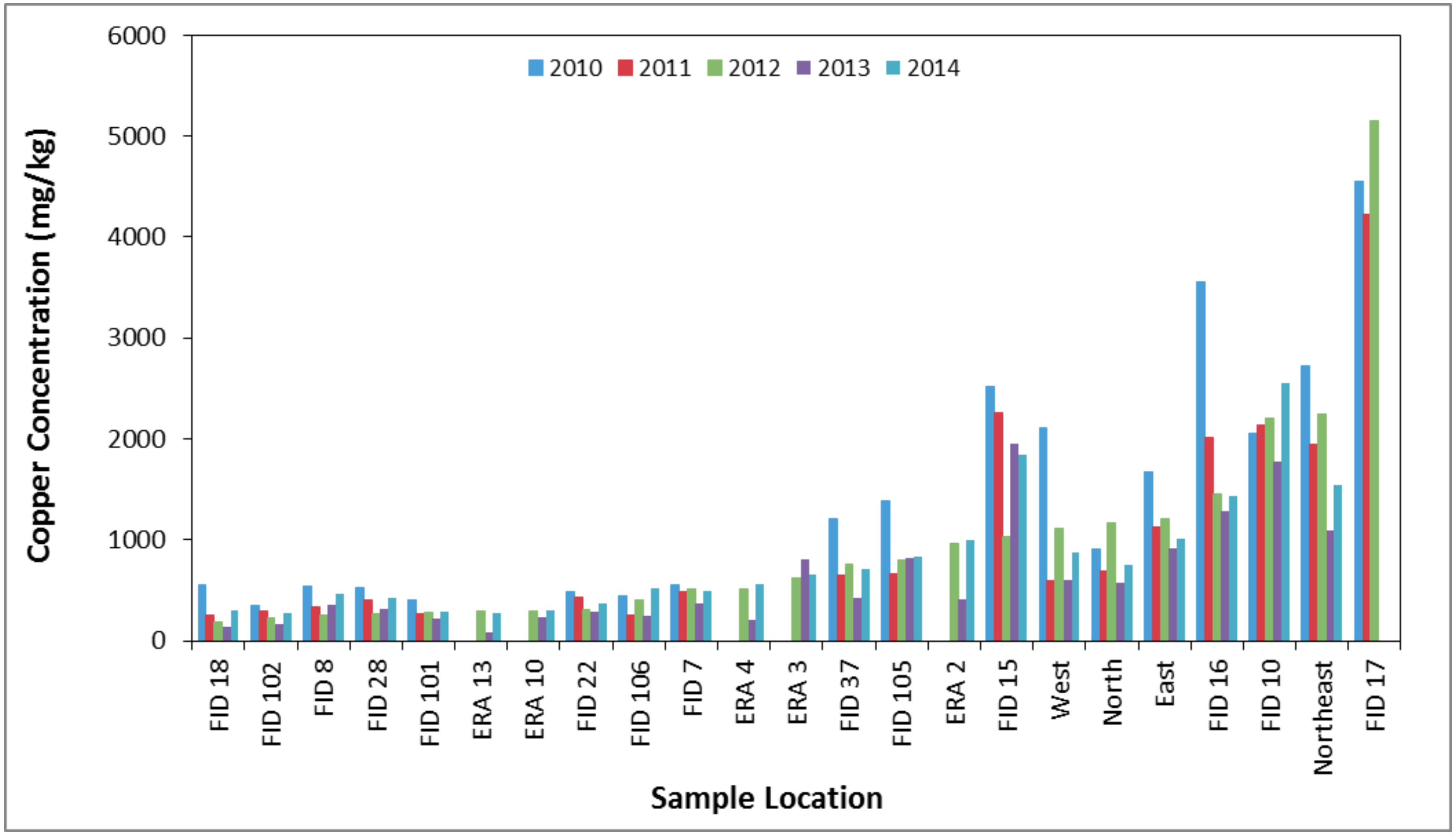


Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico
Year 5 pH Monitoring Report

pH Trend of Soils (0 to 6 inches) on 17 Permanence Monitoring Sites from 2010 to 2014

ARCADIS

FIGURE
11

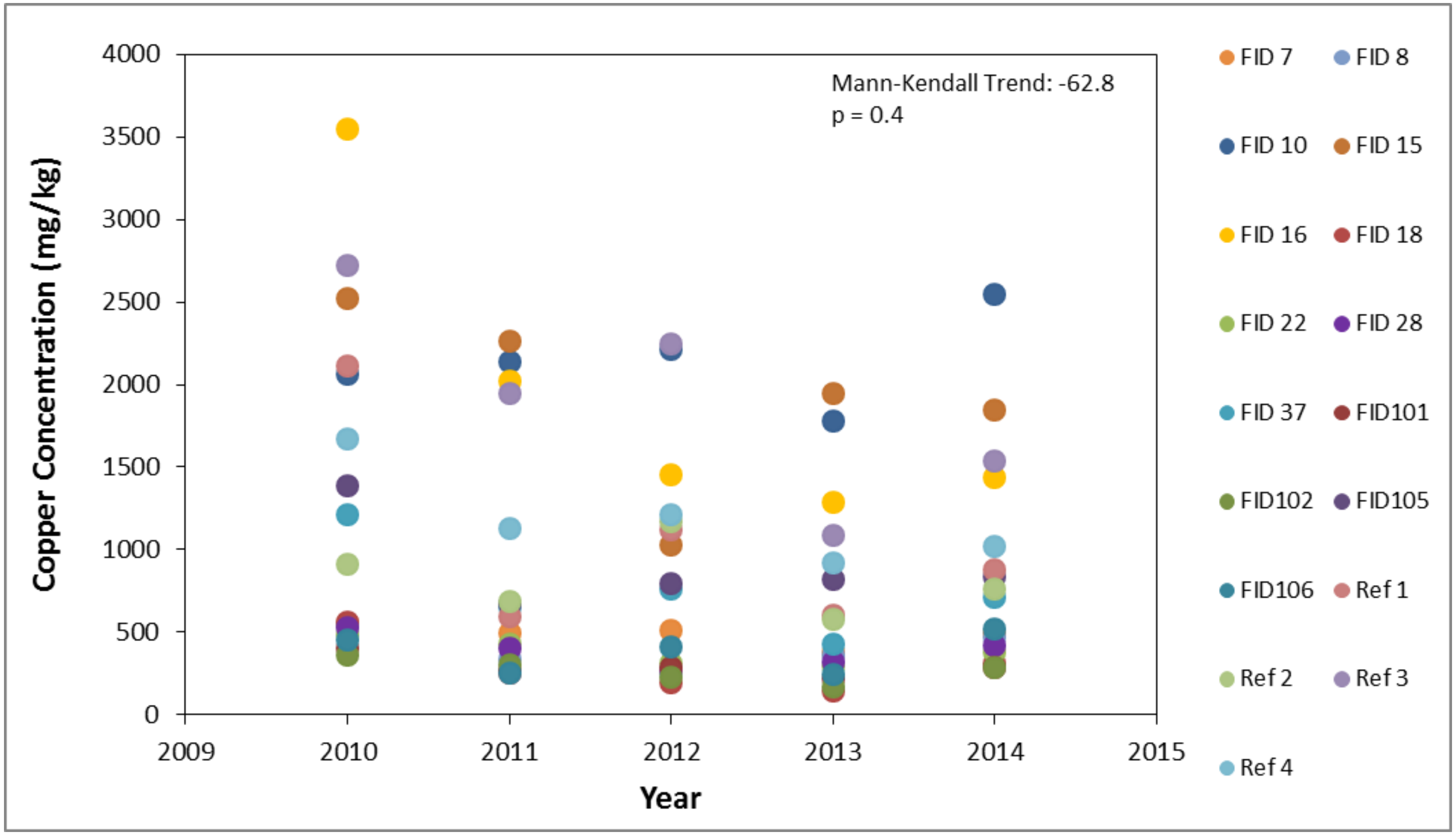


Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico
Year 5 pH Monitoring Report

Copper Concentration of Soils (0 to 6 inches) on All Long-Term Monitoring Sites from 2010 to 2014

ARCADIS

FIGURE
12

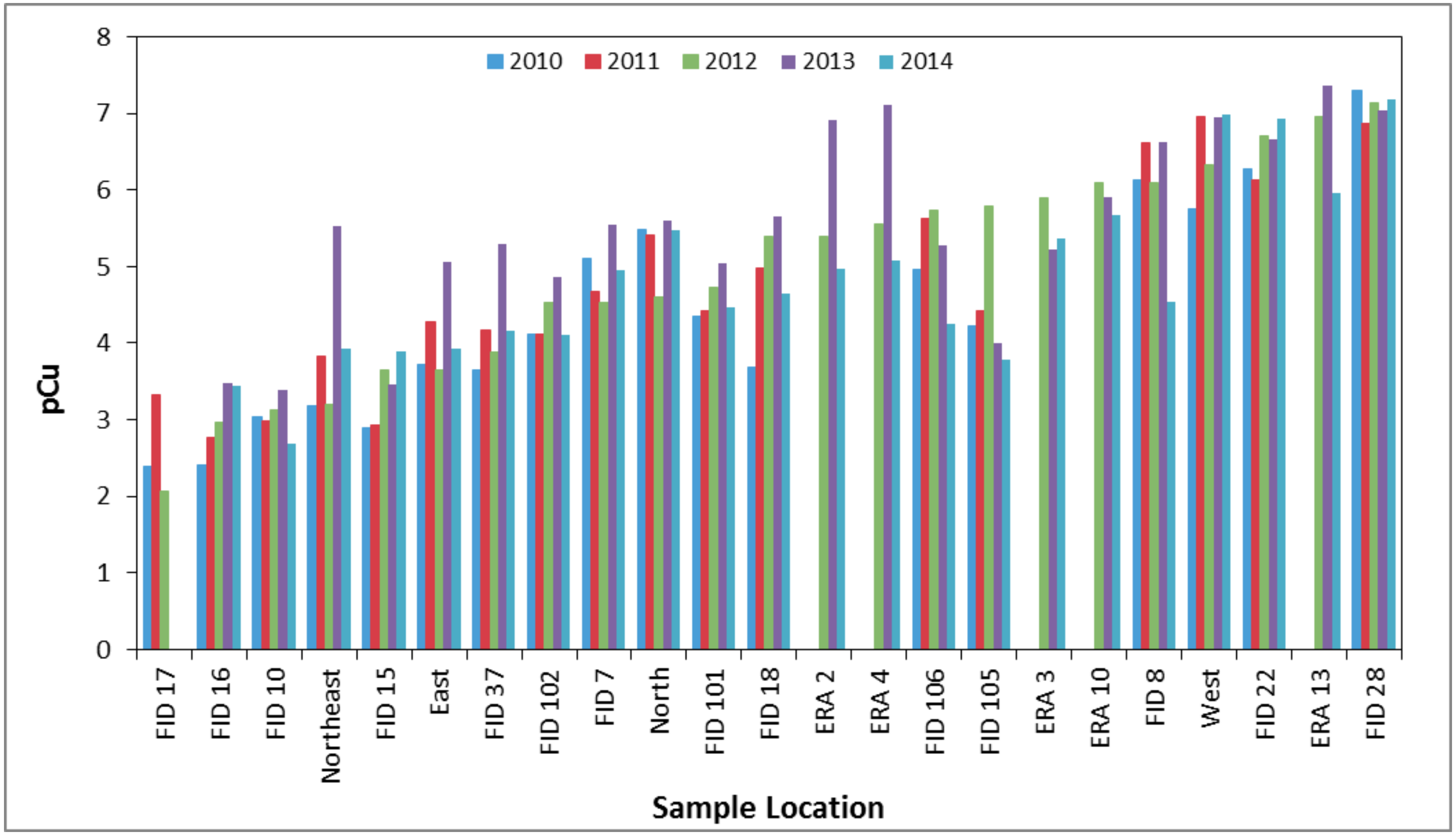


Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico
Year 5 pH Monitoring Report

Copper Concentration Trend of Soils (0 to 6 inches) on 17 Permanence Monitoring Sites from 2010 to 2014

ARCADIS

FIGURE
13

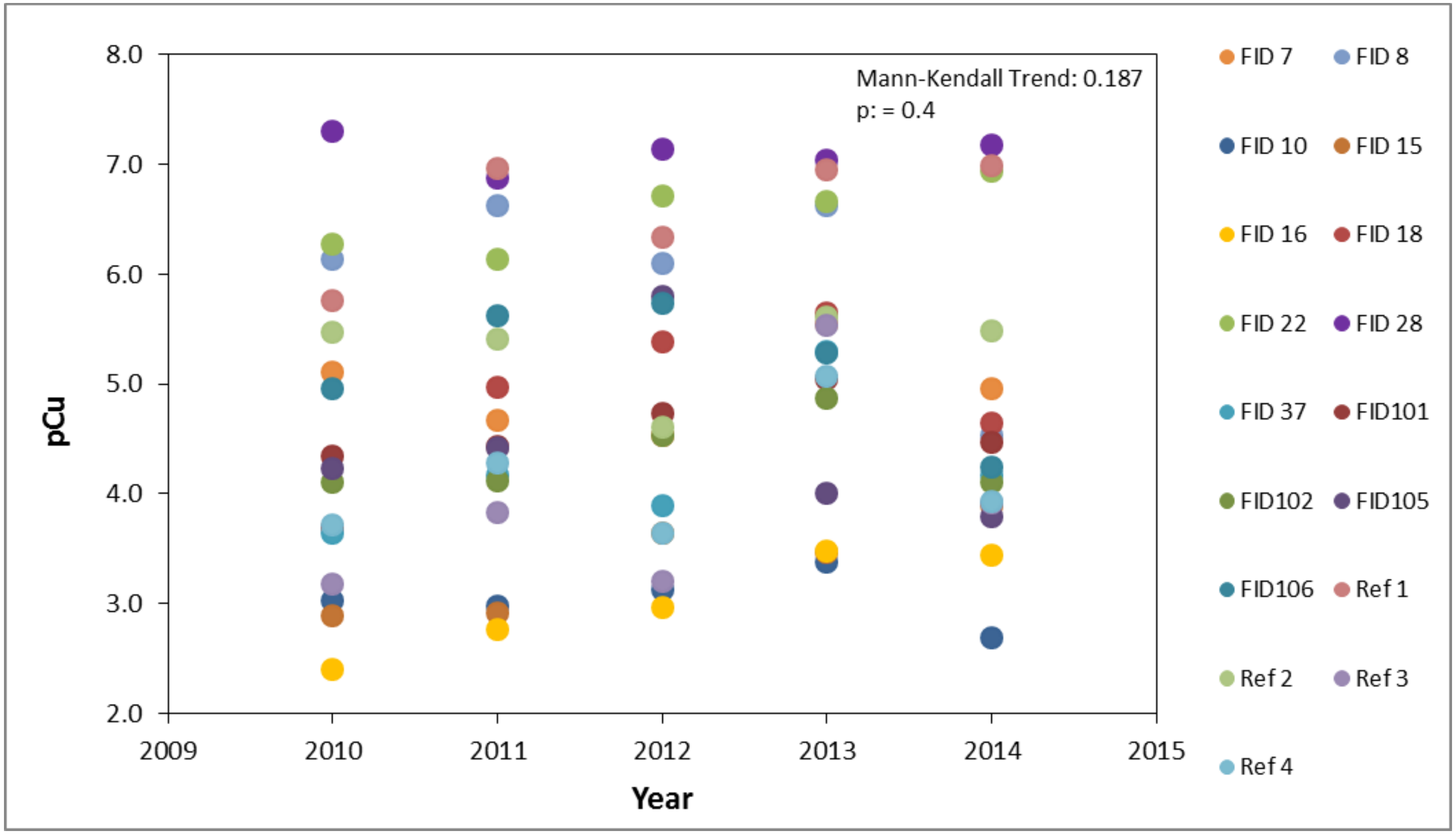


Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico
Year 5 pH Monitoring Report

pCu of Soils (0 to 6 inches) on All Long-Term Monitoring Sites from 2010 to 2014

ARCADIS

FIGURE
14



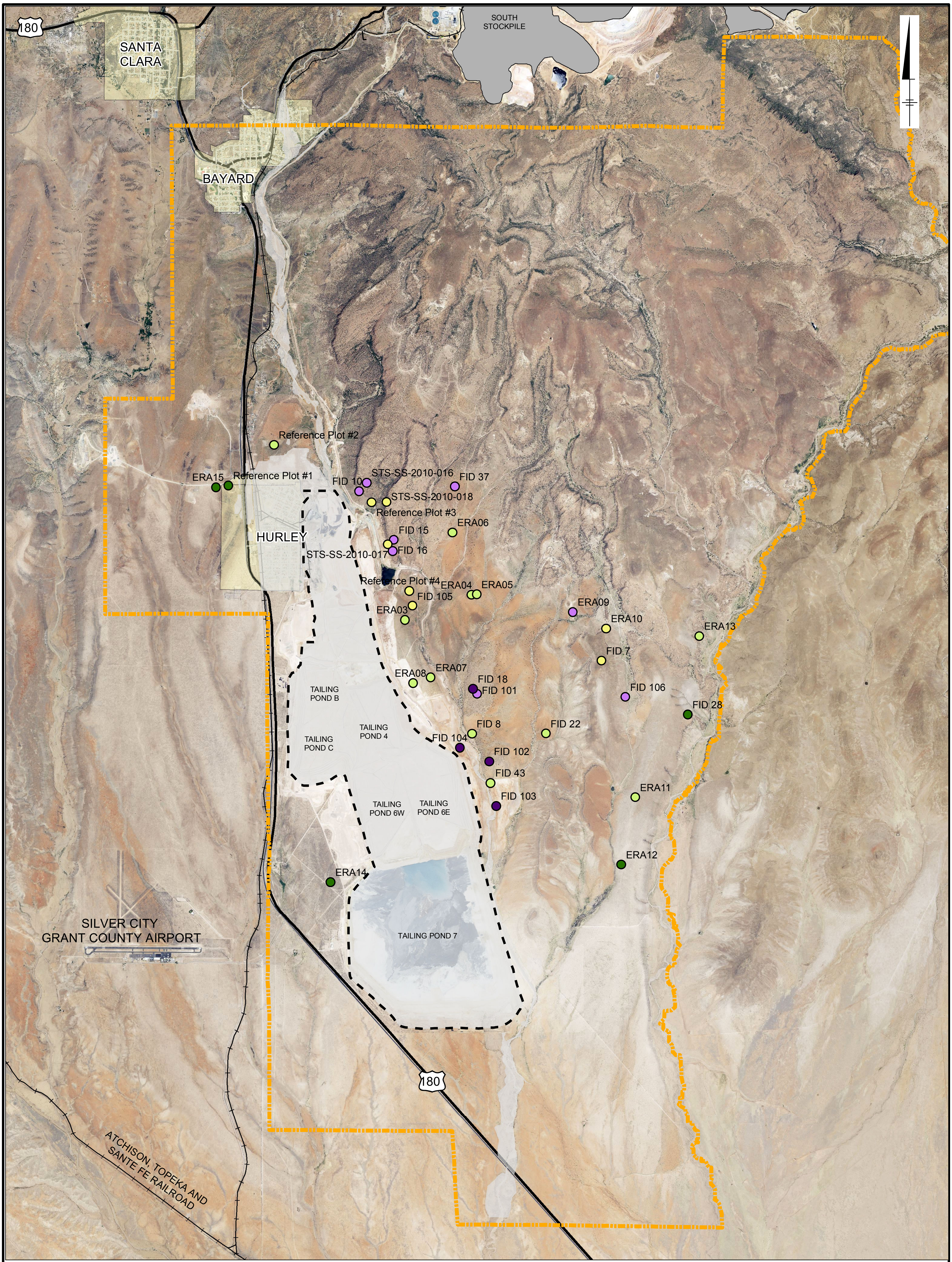
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico
Year 5 pH Monitoring Report

pCu Trend of Soils (0 to 6 inches) on 17 Permanence Monitoring Sites from 2010 to 2014

ARCADIS

FIGURE
15

OFFICE: LAKEWOOD DB: MEB TM: MB PM: AT
PROJECT# B0063543.0000 9/4/2015 4:09:19 PM
\\corparcgis\Data\ArcGisData\GISPROJECTS_ENV\Chino\2015\MXDs\2010_pH_NN1.mxd



LEGEND:

pH 2010

● 3 - 4
● 4 - 5
● 5 - 6
● 6 - 7
● > 7
▭ STSIU Boundary

0 5,000 10,000 Feet
GRAPHIC SCALE

Notes:
1. Aerial orthophotography: USDA, NAIP, 2014.

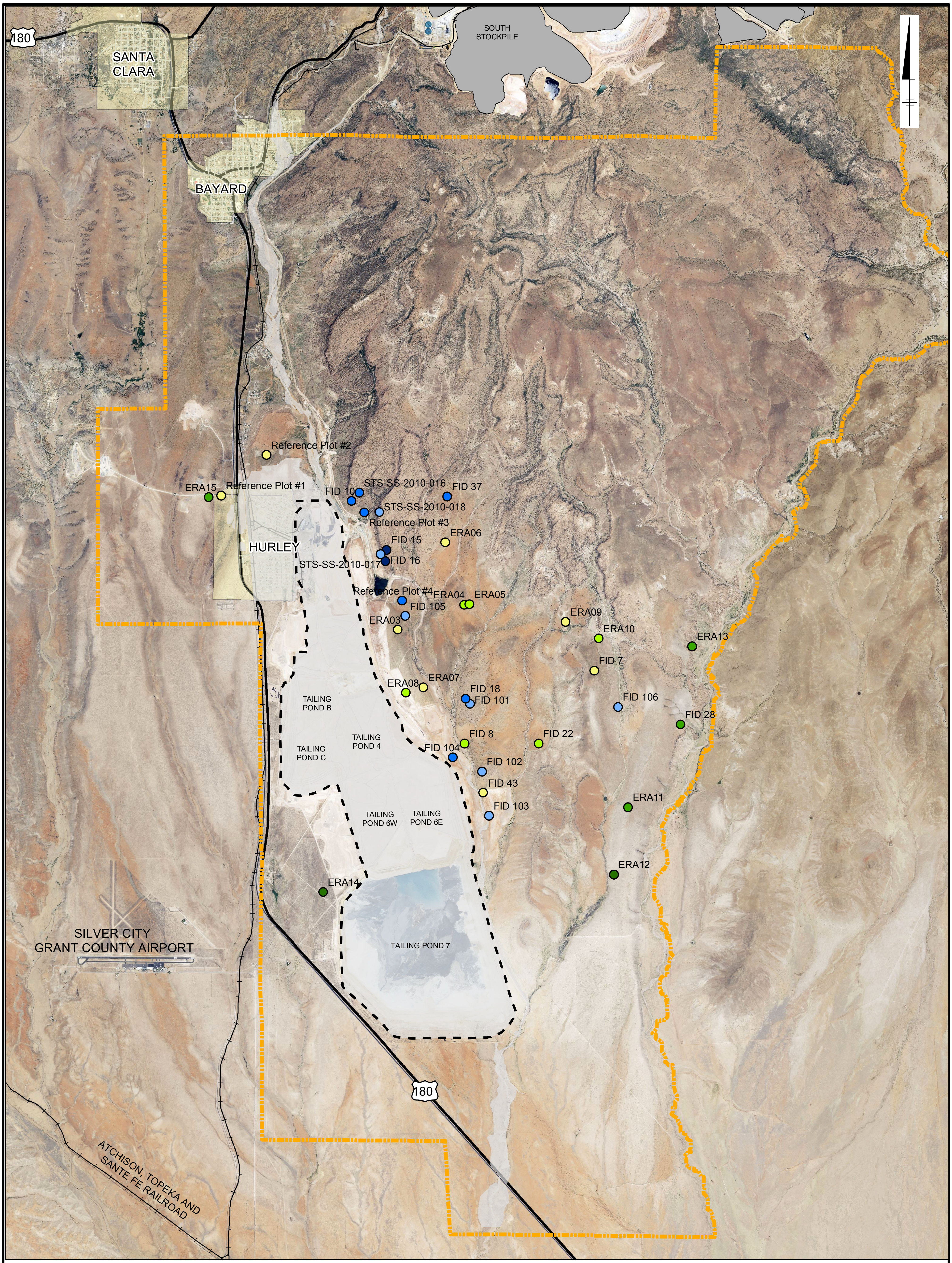
FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO
YEAR 5 pH MONITORING REPORT

pH AT SAMPLE LOCATIONS IN 2010

ARCADIS

FIGURE
16

OFFICE: LAKEWOOD DB: MEB TM: MB PM: AT
PROJECT# B0063543.0000 9/4/2015 4:13:27 PM
\\corparcgis\Data\ArcGisData\GISPROJECTS_ENV\Chino\2015\MXDs\2010_pCu_NN.mxd



LEGEND:

2010 pCu

●	< 3
●	3 - 4
●	4 - 5
●	5 - 6
●	6 - 7
●	7 - 8
●	> 8
▭	STSIU Boundary

Notes:
1. pCu = 7.34 + 0.93*[pH] - 1.15*ln[Cu]
2. Aerial orthophotography: USDA, NAIP, 2014.

0 5,000 10,000
Feet
GRAPHIC SCALE

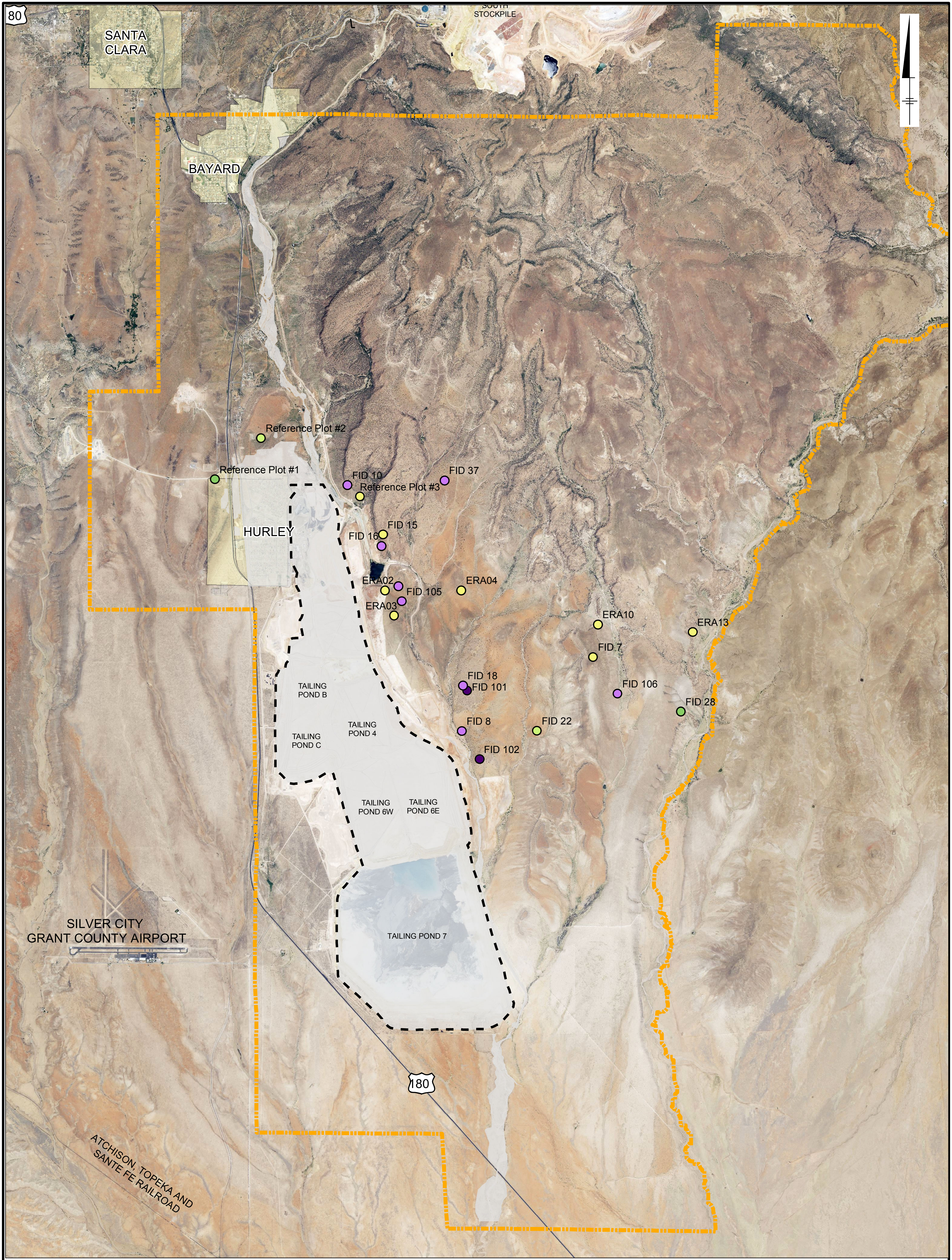
FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO
YEAR 5 pH MONITORING REPORT

pCu AT SAMPLE LOCATIONS IN 2010

ARCADIS

FIGURE
17

OFFICE: LAKEWOOD DB: MLM TM: MB PM: AT
PROJECT# B0063543.0000 9/4/2015 4:04:08 PM
Document Path: \\corparcgis\Data\ArcGisData\GISPROJECTS_ENV\Chino\2015\MXDs\2014_pH_NN11.mxd



LEGEND:

2014 pH

● 3 - 4

● 4 - 5

● 5 - 6

● 6 - 7

● 7 - 8

● > 8

▭ STSIU Boundary

0 5,000 10,000 Feet

GRAPHIC SCALE

Notes:
1. Aerial orthophotography: USDA, NAIP, 2014.

FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

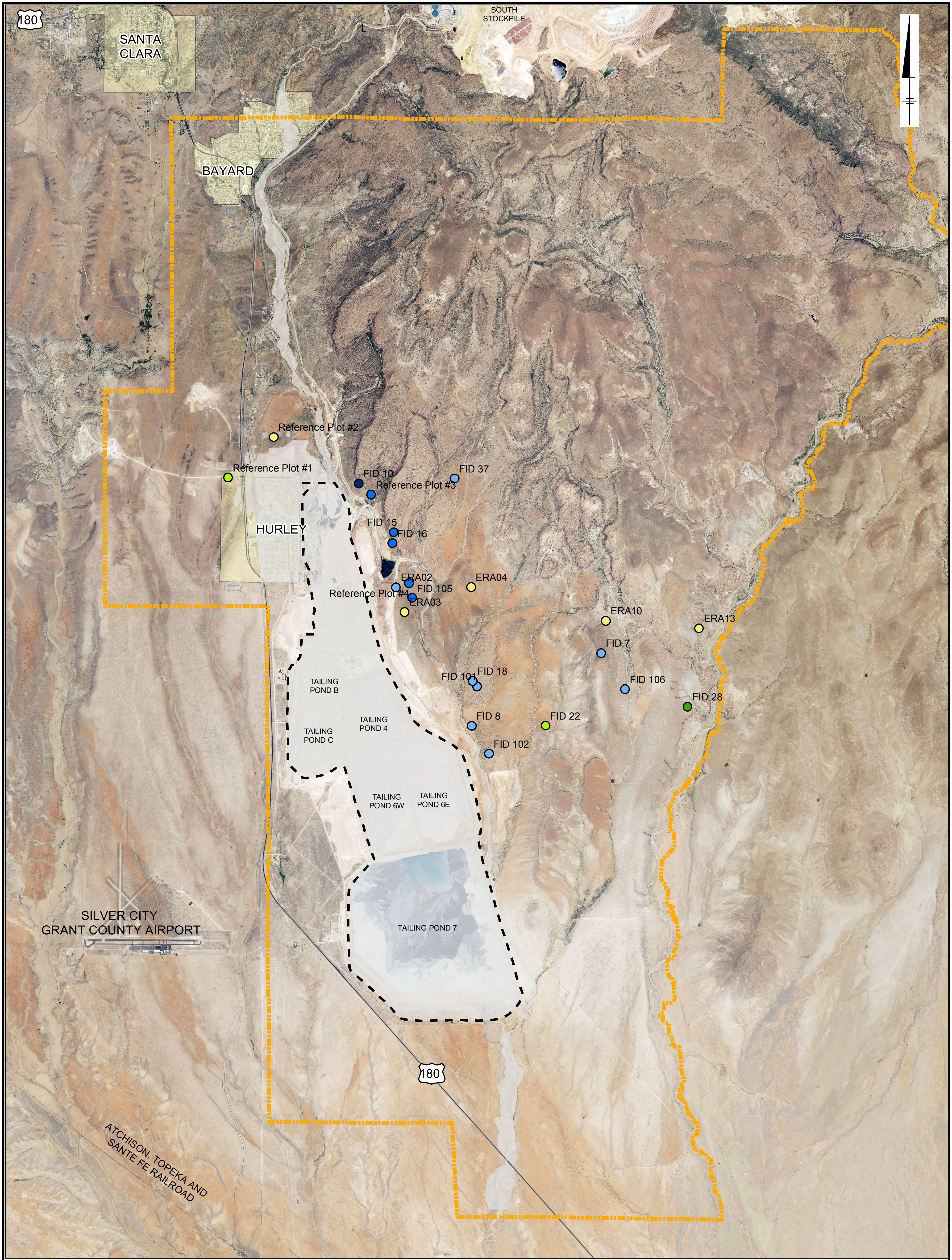
YEAR 5 pH MONITORING REPORT

pH AT SAMPLE LOCATIONS IN 2014

ARCADIS

FIGURE
18

OFFICE: LAKEWOOD DB: MLM TM: MB PM: AT
PROJECT# B0063543.0000 9/4/2015 3:45:53 PM
Document Path: \\corparcgis\Data\ArcGisData\GISPROJECTS_ENV\Chino\2015\MXDs\2014_pCu_NN.mxd



LEGEND:

2014_pCu

●	< 3
●	3 - 4
●	4 - 5
○	5 - 6
●	6 - 7
●	7 - 8
●	> 8
▭	STSIU Boundary

0 5,000 10,000 Feet

GRAPHIC SCALE

Notes:
1. $pCu = 7.34 + 0.93*[pH] - 1.15*\ln[Cu]$
2. Aerial orthophotography: USDA, NAIP, 2014.

FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

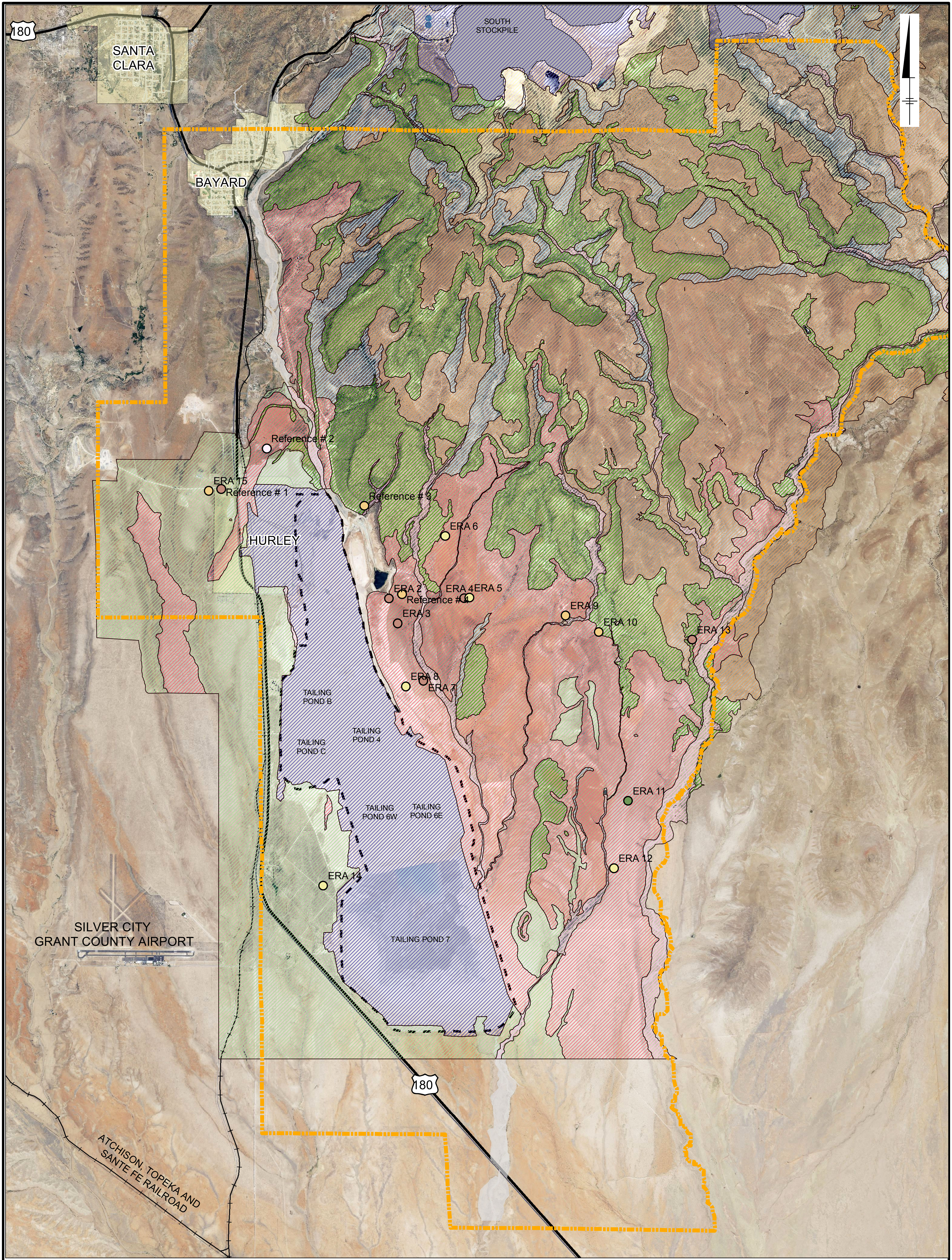
YEAR 5 pH MONITORING REPORT

pCu AT SAMPLE LOCATIONS IN 2014

ARCADIS

FIGURE
19

OFFICE: LAKEWOOD DB: MEB TM: MB PM: AT
PROJECT# B0063543.0000 9/9/2015 4:18:49 PM
Document Path: \\corparcgis\Data\ArcGisData\GISPROJECTS_ENV\Chino\2015\MXDs\Fig20b_PostWR_VegAlliances.mxd



LEGEND:

POST-WHITE RAIN pH MINUS PRE WHITE-RAIN pH

Symbol	Range
●	< -0.5
●	-0.5 - 0
●	0 - 1
●	1 - 2
○	> 2

Vegetation Alliances

- ▨ Alligator Juniper-Oak Woodland Alliance
- ▨ Alligator Juniper-Oak/Grama Woodland Alliance
- ▨ Fluvial Forest and Shrubland Alliance
- ▨ Mesquite/Mixed Grama Shrubland Alliance
- ▨ Mine Facilities/Urban
- ▨ Mixed-Grama Herbacious Alliance
- ▨ Mountain Mahogany Shrubland Alliance
- ▨ Pondrosa Pine-Oak Forest Alliance
- ▭ STSIU Boundary

0 5,000 10,000
Feet

GRAPHIC SCALE

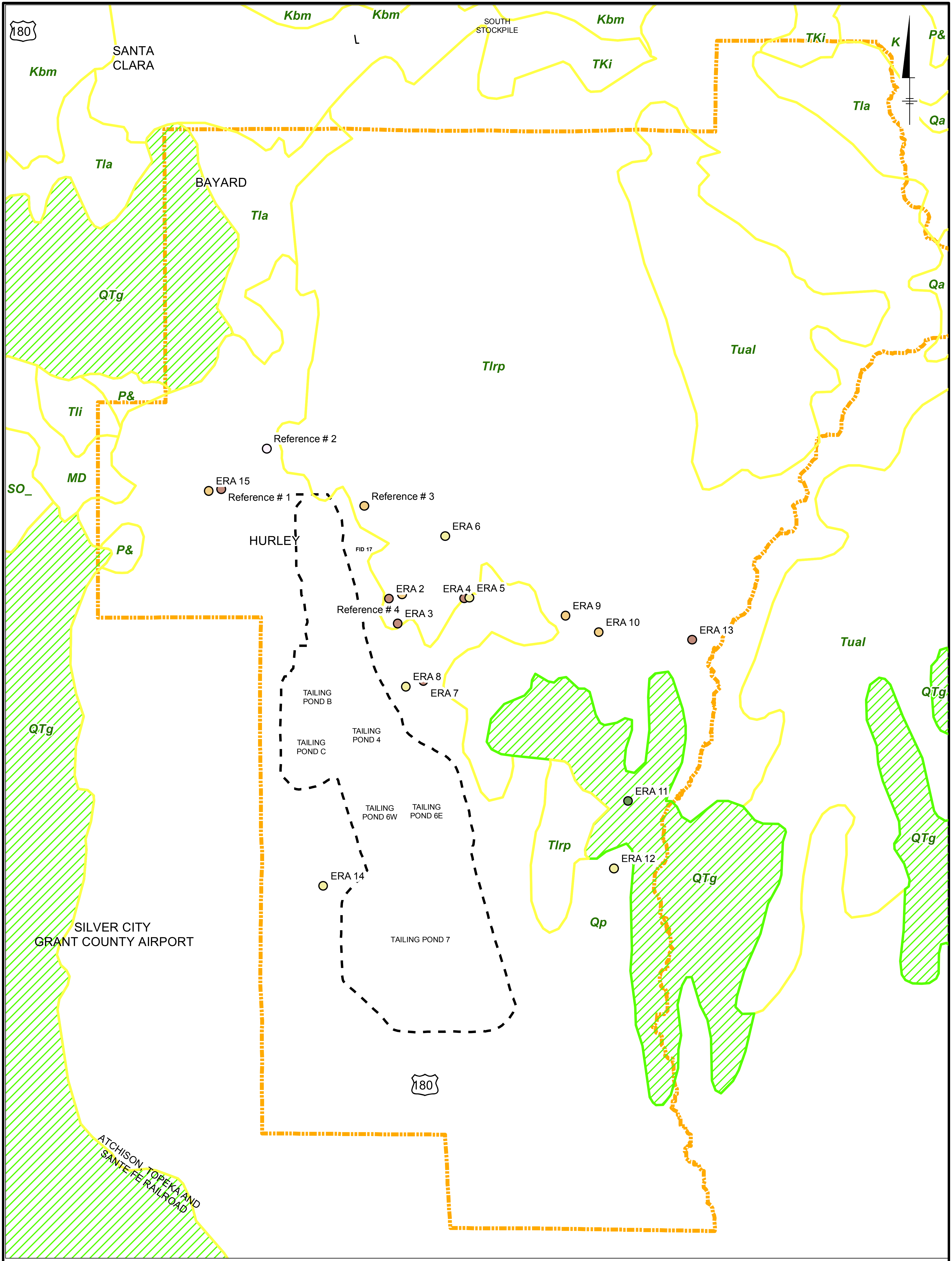
Notes:
1. Aerial orthophotography: USDA, NAIP, 2014.

FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO
2014 pH MONITORING REPORT

pH INCREASE FROM WHITE RAIN IN VEGETATION ALLIANCES

ARCADIS

FIGURE
20



LEGEND:

POST-WHITE RAIN pH MINUS PRE-WHITE RAIN pH

- ● < -0.5
- ● -0.5 - 0
- ● 0 - 1
- ● 1 - 2
- ○ > 2

Geologic Units

- ▨ Gila Group
- ☐ Other Geologic Units
- ☐ STSIU Boundary

0 5,000 10,000 Feet

GRAPHIC SCALE

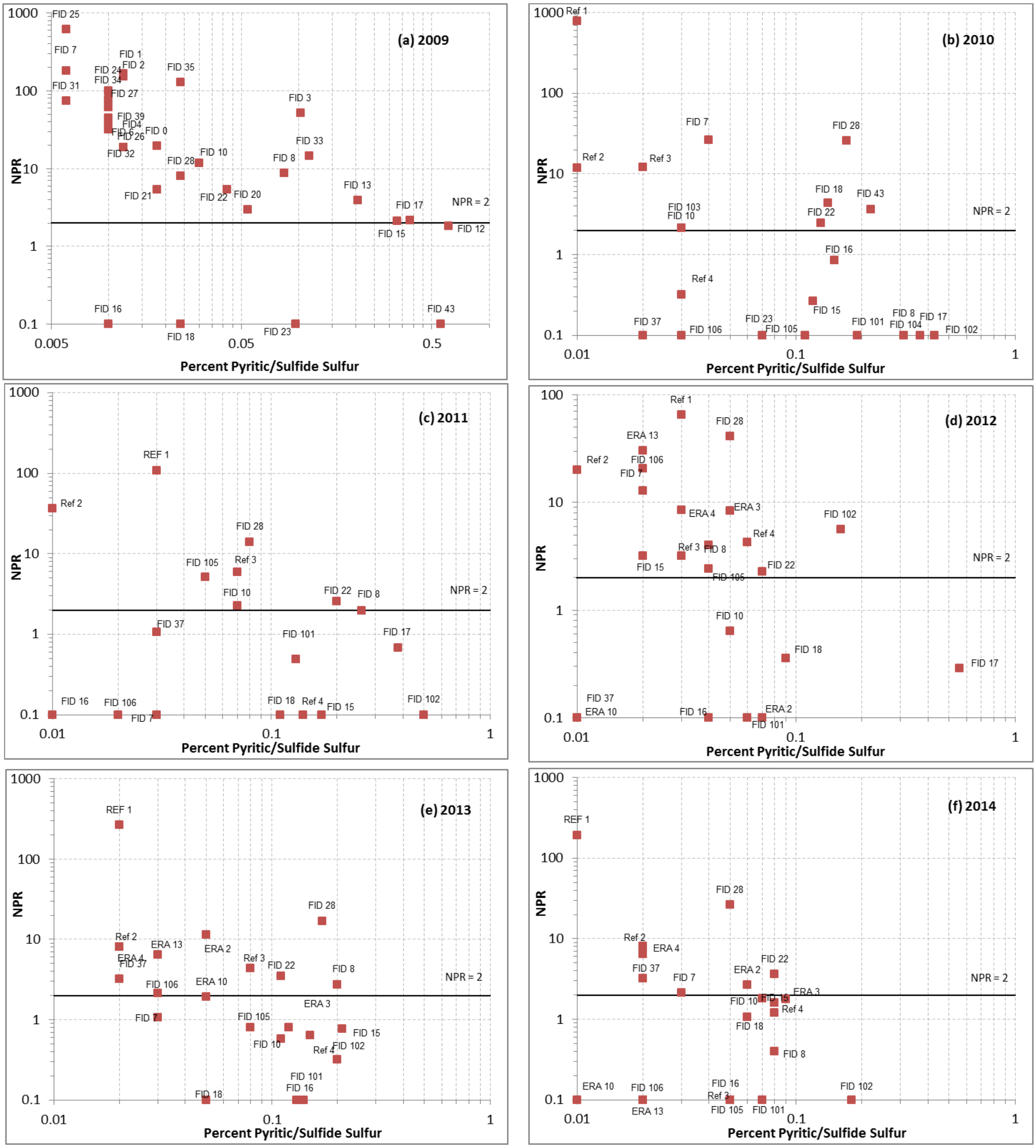
Notes:
1. Aerial orthophotography: USDA, NAIP, 2014.

FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO
YEAR 5 pH MONITORING REPORT

pH INCREASE FROM WHITE RAIN IN GEOLOGIC UNITS

[redacted]

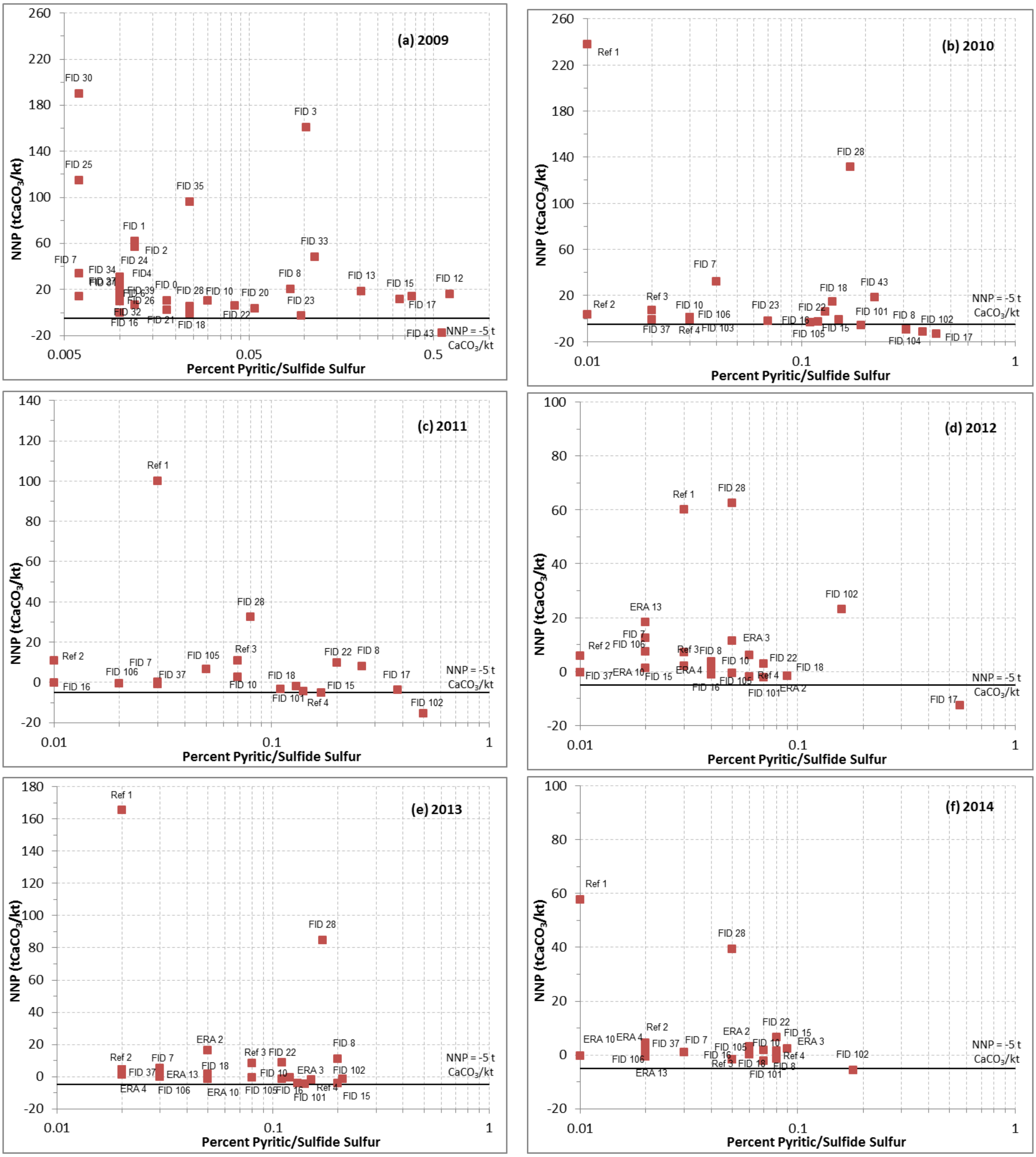
FIGURE
21



Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico
Year 5 pH Monitoring Report

Relationship of Percent Sulfide Sulfur and NPR

FIGURE
22

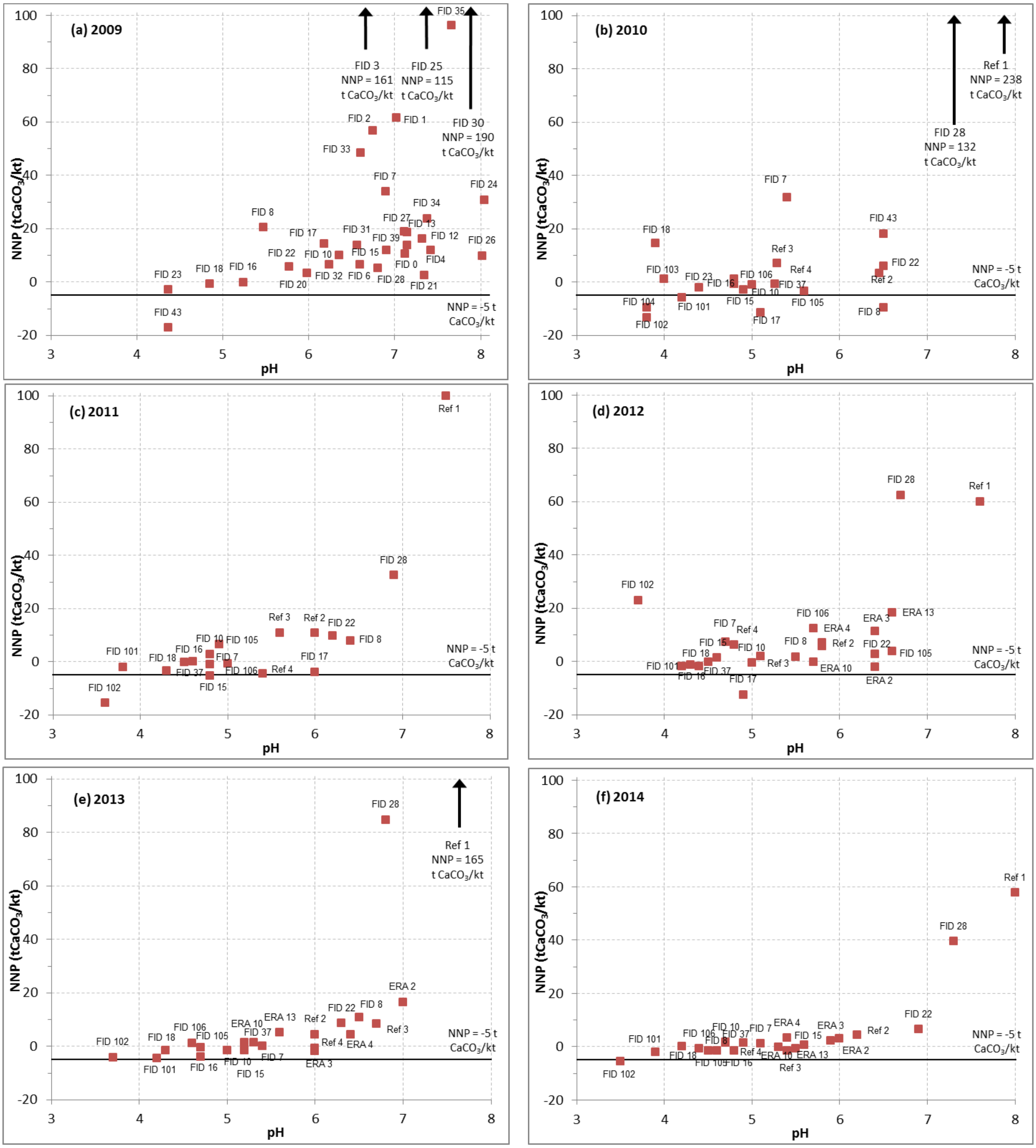


Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico
Year 5 pH Monitoring Report

Relationship of Percent Sulfide Sulfur and NNP

ARCADIS

FIGURE
23

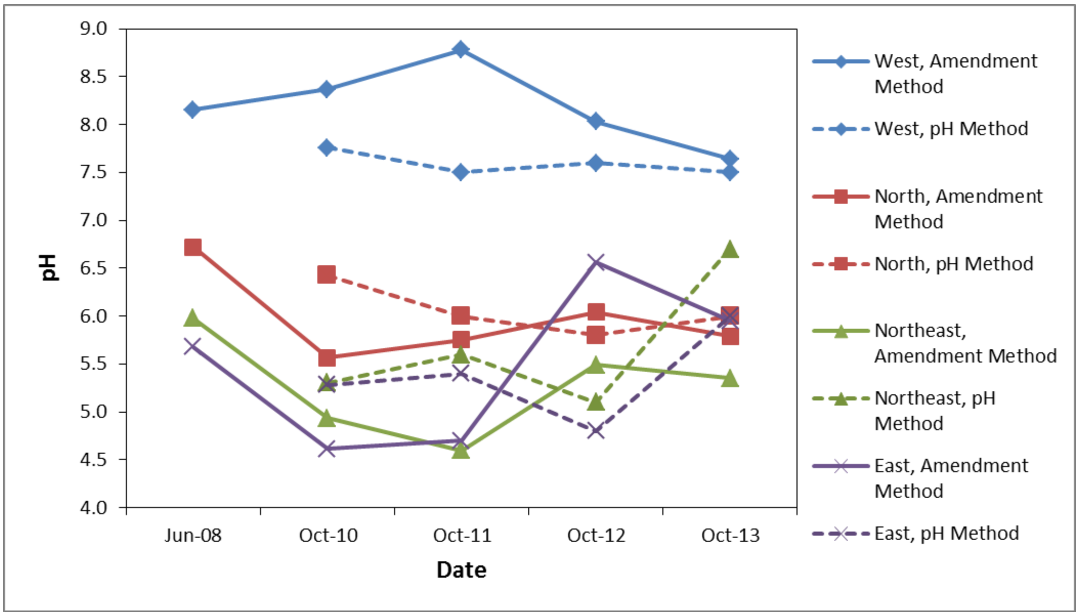


Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico
Year 5 pH Monitoring Report

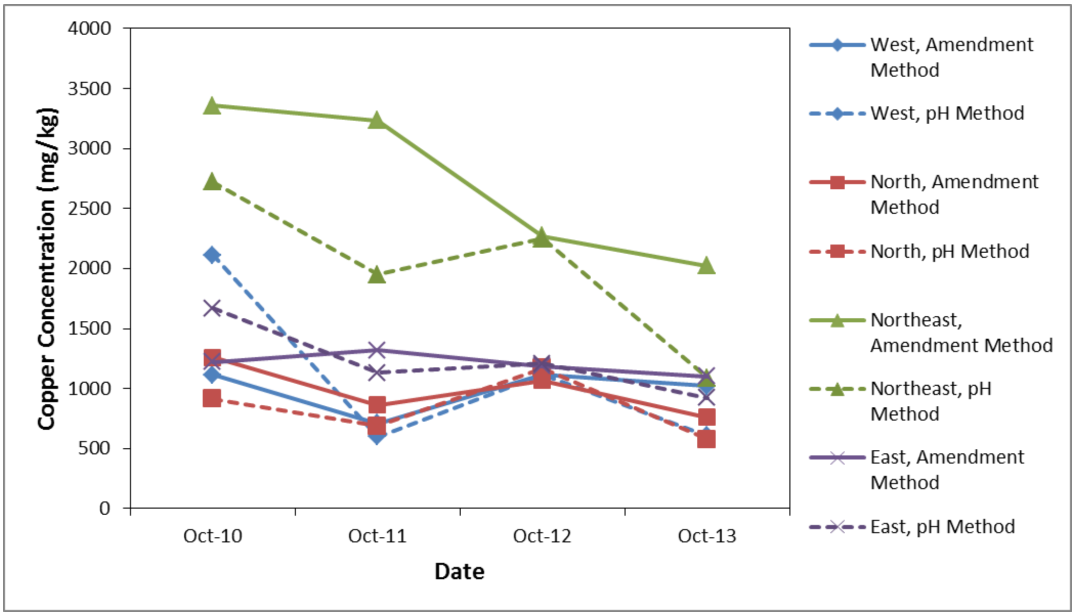
Relationship of pH and NNP

ARCADIS

FIGURE
24



a. Effect of sampling method on pH results collected from 2010 to 2013



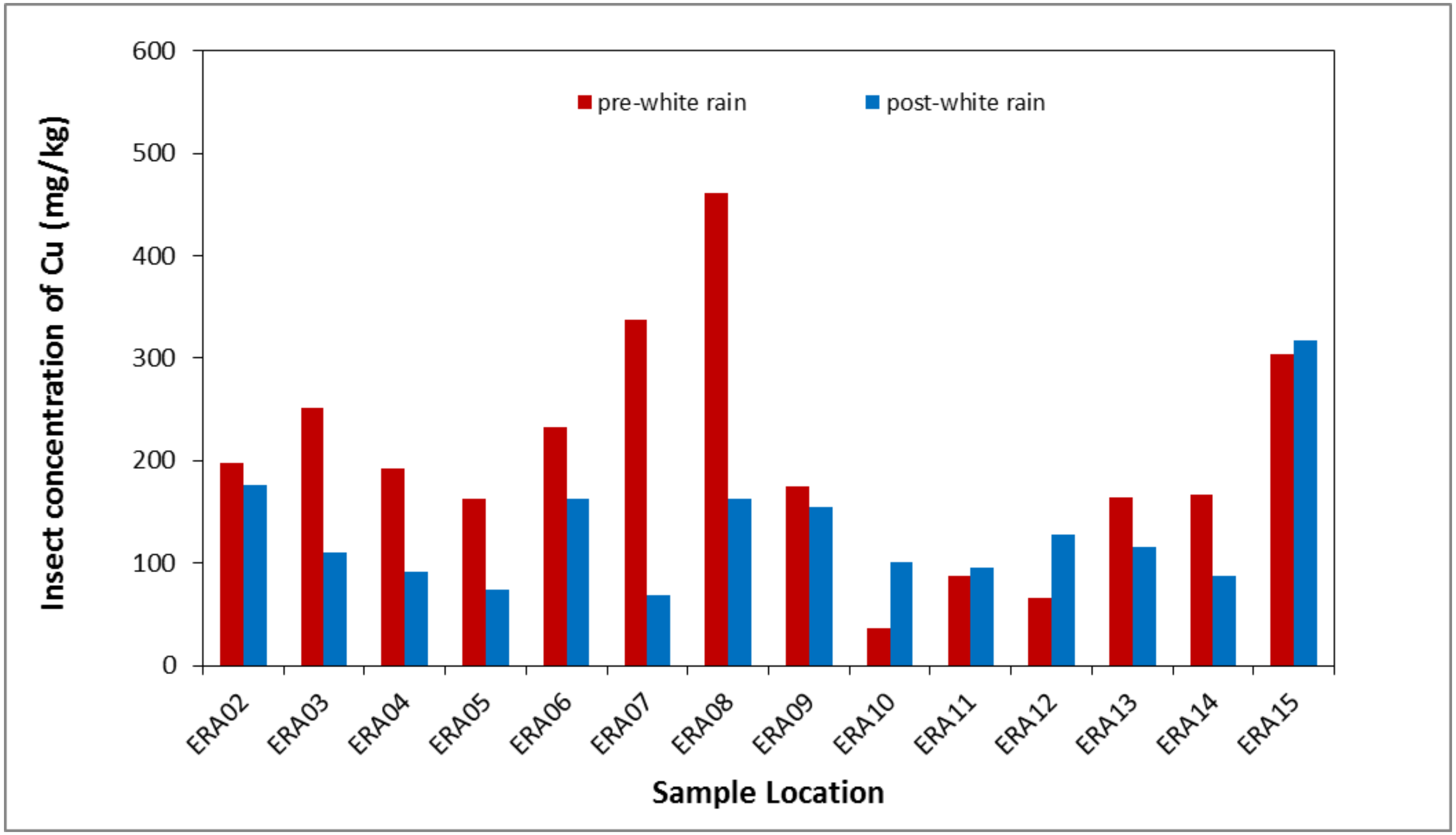
a. Effect of sampling method on copper results collected from 2010 to 2013

Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico
Year 5 pH Monitoring Report

Effect of Sampling Method on pH and Copper Results Collected from 2010 to 2013

ARCADIS

FIGURE
25



Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico
Year 5 pH Monitoring Report

Comparison of Copper Concentration in Insect Tissue Before and After the White Rain

ARCADIS

FIGURE
26

ARCADIS

Appendix A

Initial 2008 Investigation of the
“White Rain” at Chino

Appendix A – Initial 2008 Investigation of the “White Rain” at Chino

Introduction

Soil within the upland Smelter and Tailing Soil Investigation Units (STSIU) is impacted by historical mineral processing activities including smelter emissions and windblown tailings. The soil pH is variable but can be acidic, and the main constituent of concern is copper, which becomes more mobile under acidic conditions. The STSIU has undergone remedial investigation (RI) and ecological risk assessments, with soil, insect, and plant tissue data collected before the white rain from throughout the Investigation Unit (IU) from 1995 to 2005 (Chino Mines Company 1995, Newfields 2005, 2008; SRK 2008). Chino conducted an Amendment Study to understand whether calcium carbonate/oxides delivered as lime is a possible remediation approach (ARCADIS 2014). On January 7, 2008, prior to implementing the Amendment Study, rain with a high content of suspended solids left a layer of white precipitate in the region (white rain) that may act similar to lime or calcium carbonate. Chino had collected two rounds of pre-Amendment Study data that bookend the event, one round in July 2006 before the white rain event, and one round in May and June 2008 after the white rain event. This appendix discusses the white rain precipitation event and the precipitation and soil data available before and immediately after the event to evaluate the composition of the rain, source of constituents in the rain, and immediate effect on the soil within the STSIU. The objectives of this evaluation are as follows.

Objectives

1) Evaluate all initial 2008 data associated with the white rain event.

2) Assemble a geochemical conceptual site model (CSM) that describes the possible effect of the white rain on the STSIU.

3) Evaluate the potential longevity of soil pH neutralization provided by the event.

STSIU Conceptual Site Model

The CSM presented in the revised RI for the STSIU report prepared by SRK (2008) identifies two sources for copper and depressed pH including emissions from the former smelter stacks and fugitive emissions from mineral processing activities, such as crushing and milling operations, and windblown tailings from the old tailings ponds that have impacted the surficial soils. The Hurley smelter ceased operations in January 2002; demolition and salvage of a number of the facilities within the Hurley operational area began in late 2005, and the stacks were demolished in June 2007.

The soils acidification at the STSIU, therefore, occurs via two mechanisms – acidification by sulfur dioxide (SO_2) present in the former emissions and by dust from mineral processing and tailings. During smelting of sulfidic ore, SO_2, which forms sulfuric acid (H_2SO_4) upon contact with water, was released to the atmosphere via the former smelter stacks. In the gas phase, SO_2 is oxidized by reaction with the hydroxyl radical via an intermolecular reaction as follows:

$$SO_2 + OH\cdot \rightarrow HOSO_2\cdot$$

followed by: $HOSO_2\cdot + O_2 \rightarrow HO_2\cdot + SO_3$

In the presence of water, sulfur trioxide (SO_3) is converted rapidly to sulfuric acid:

$$SO_3(g) + H_2O(l) \rightarrow H_2SO_4(l)$$

The soil was then acidified during emission fallout, mixing with soil pore water and rainfall.

The second process contributing to soils acidification may be due to windblown dust from the old tailings ponds. Soils adjacent to the tailings are extremely variable in pH ranging from 2.92 to higher than 8 before the white rain. Windblown tailings contain sulfide minerals, such as pyrite, and when introduced to oxygen and water, catalyze to form iron(II) ions, sulfate ions, and hydrogen ions, according to the main reaction below:

$$2FeS_2(s) + 7O_2(g) + 2H_2O(l) \rightarrow 2Fe^{2+}(aq) + 4SO_4^{2-}(aq) + 4H^+(aq)$$

The hydrogen and sulfate ions represent the disassociated form of sulfuric acid. The smelter also released some sulfidic minerals and slag that survived the smelting process and were deposited on the soils. The copper and iron sulfide minerals would undergo a similar acidifying reaction as shown above.

The Site-Wide Ecological Risk Assessment (Newfields 2005) depicts the concentrations of pH throughout the IU as highly variable. The pH variability is largely due to soil geochemistry, wind patterns, and the variable ability of the soil to buffer acid over long periods of time. Soil samples were collected prior to and after the white rain event near shallow soil in the test areas identified for an Amendment Study. The change in pH during these two events alerted Chino to the possibility that the white rain event affected soils within STSIU. The data are summarized in **Table 1** of the main report.

The pH and calcium concentration in the soils increased after the white rain event, most strongly in the northernmost plot (north plot). This increase after the January 2008 white rain event was potentially due to deposition of alkaline calcium-rich minerals resulting in the neutralization of the acidic soils.

Neutralization of Acidic Soils

One of the treatments used for acid rock drainage reversal is the amendment of soils by alkaline minerals resulting in neutralization of the acidic conditions. If the pH of the soil is increased, as would happen during contact with basic minerals such as lime (CaO), calcite ($CaCO_3$), or dolomite ($Ca,MgCO_3$) or entry into a soil water of higher pH, then metallic ions such as Fe^{3+} and Cu^{2+}, Zn^{2+}, Pb^{2+}, and As^{3+} will react to eventually form hydroxide precipitates.

White Rain Precipitation Event

On January 7, 2008, “white” rainfall occurred in Grant and Catron Counties, New Mexico. The rainwater was not clear but contained a large amount of suspended solids resulting in a “white” appearance. One plausible explanation of this occurrence points toward windblown dust particles seeding clouds, resulting in white precipitation. The source of the dust particles was initially theorized to be the salt playas in southern Arizona. A high-resolution National Aeronautics and Space Administration (NASA) photograph taken during this period of a large cloud of dust blowing northeast off the Willcox playa toward Silver City supports this explanation (**Figure A-1**, also, see news story in **Attachment A**). The storm track carrying the white rain was back-calculated from the most reliable rainwater sample location (NM01) by University of California San Diego (UCSD) using an air mass trajectory model called Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPIT). The air mass carrying the white rain crossed through the Chino site **(Figure A-2**).

Willcox Playa, a source of the dust in the white rain, is located approximately 100 miles southeast of the Chino Mine and covers approximately 40 square miles (mi^2) in its core area and nearly 200 mi^2 in overall area. Willcox playa is floored with white silt and clay material and is well known for its winds and relatively large sand dunes around its margins. A playa is a dry lakebed containing large amounts of evaporative minerals such as alkali salts. Commonly encountered minerals include calcite, gypsum, halite, trona, and hydroxides of sodium, potassium, and magnesium.

Similar dust storm-related white rain precipitation events have been documented in South Africa in 2003 (Resane et al. 2004) and Zimbabwe in 1992 (Nyika et al. 1996). The probable source of the dust in Johannesburg, South Africa was the Makgadikgadi saltpans in the Kalahari Desert of central Botswana, which are similar to the saltpan playas of Arizona. Based on the evaluation of the weather patterns and composition of the white rain (only a dried sample of fine dust was available for the analysis), the Kalahari Desert was identified as a likely source for the white rain in Bulawayo, Zimbabwe (Nyika et al. 1996).

Data Summary: UTEP and NADP

Samples of the rainwater runoff from rooftops and at various locations, including Hurley and Tyrone, were collected by people living in the area and provided to New Mexico Institute of Mining and Technology (NMT) and the University of Texas El Paso (UTEP). In addition, the National Atmospheric Deposition Program (NADP) maintains a rainwater collection monitoring location at Gila Cliff Dwellings National Monument (Station NM01) which is about 40 miles north of Chino. A total of approximately 10 mm (~0.4 inch) of precipitation was recorded by the NADP at NM01.

Because the NMT/UTEP samples were collected by people living in the area and off rooftops, collection and preservation procedures were not rigorous, whereas NADP maintained rigorous sampling and preservation procedures to assure data quality. Therefore, the most reliable data with respect to water chemistry are the NADP data. For the NADP data, samples were filtered into pre-washed 60-mL high-density polyethylene (HDPE) round bottles using 0.45-micron pore-size polyethersulfone filters following pH and conductivity measurements. Major and trace elements were analyzed by inductively coupled plasma optical emission spectrometry (ICP-OES). Additional information about the analytical procedures is provided in NADP 1999 and 2003 and at http://nadp.sws.uiuc.edu. **Table A-1** provides a summary of all results from UTEP and NADP, including control samples collected immediately after the white rain event. Samples were collected at locations called NM01, AZ99, Rusty's Rooftop (RRR, white rain), Sample #1 at Tyrone, New Mexico (white rain MR1r and control MR1c), and Sample #5 at Hurley, New Mexico (white rain MR5r and control MR5c) and shown on **Figure A-2.** The suspended solids content of the rainwater was not determined (were filtered out), but additional analyses were performed on the whole rainwater samples (unfiltered) by UCSD on samples provided by UTEP. These analyses, however, did not provide information on the total content of calcium and other important cations that would be helpful to this evaluation.

At the three sampling locations evaluated (Rusty's rooftop was not included because it lacked a control sample), pH was more alkaline in the samples collected on January 7, 2008, which contained water from the "white rain" event, than control samples. The most pronounced effect on pH occurred in the samples collected at Gila Cliffs, where background pH of 5.0 increased to 7.2 in the white rain sample. The background pH has historically been close to 5.0, as shown on **Figure 2b** of the main text; the pH recorded here during this event was a very significant departure from the average annual pH. Historical data collected weekly for the period 1985 through 2008 (**Figure 2a** of the main text) show that the white rain event on January 7, 2008 was in fact significant relative to the concentration of calcium and pH, even after the smelter operations were discontinued. The concentration of ions increased in two of the samples, but appeared to remain unchanged at Tyrone. It is unclear why the Hurley and Tyrone locations do not show a similar large magnitude of change in pH compared to Gila Cliffs, but it may be because sample collection procedures were as not rigorous. The total dissolved solids (TDS) estimates appear incorrect for those samples, which makes those samples suspect (plus those samples were collected off rooftops that may contain contaminants other than the white rain). The NM01 data are most reliable and should be the primary data interpreted to evaluate the effect of the white rain. Overall, the rainwater data indicate that the RI data and conclusions of the Site-Wide and STSIU Ecological Risk Assessments may no longer be representative of the nature and extent of pH in the STSIU.

Greater concentrations of calcium could result from dissolution of calcium carbonate or calcium oxide and would indicate that the suspended solids in the rain were partially made up of these minerals. The TDS content was fairly low in all samples; however, the white appearance and the dusty precipitate encountered on surfaces after the rain event suggest that suspended solids were present in the rain. The limited TDS content indicates that only a small amount of the solids was dissolved. Naiman et al. (2000) identified carbonates in soil samples from Willcox playa in the late 1990s. These findings conceptually support the concept that dust from the Willcox playa can provide buffering capacity to the acid-impacted soils.

Data Summary: UCSD

Rainwater collected on January 7, 2008 by UTEP was sent to UCSD for identification of the solids in the white rain. The locations of the samples that Dr. Kerri Pratt analyzed are shown on **Figure A-2**. The analysis was performed using a single-particle aerosol time-of-flight mass spectrometer (ATOFMS); this instrument is unique to UCSD and is capable of measuring the size of submicron particulates in rainwater samples, and can identify the elemental composition of the particulates. Additional information about this method is provided by Holecek et al. (2007). Whole (unfiltered) rainwater samples were analyzed by this instrument for the purpose of identifying the source of the precipitates (e.g., the playa lakes) in the white rain and to understand if the submicron precipitates in the white rain could be significant cloud condensation nuclei.

The results of this analysis are summarized in **Attachment B** and as follows.

- The size of the solids in the white rain are dust-sized nanoparticles (**Figure A-3**). Almost all were < 1 micron. The majority of particles were clustered around 0.040 microns [40 nanometers].

- All of the white rain water samples had positive matches to the Lordsburg and Willcox playa samples, indicating that these are the sources of the particulates. The positive match was achieved by comparing the mass spectrometry results for the white rain samples with samples of precipitates recovered from the surface of the playa lakes. Specifically, 75 percent of insoluble residues in the most reliable rainwater sample (NM01) were characterized by a chemical signature matching the Lordsburg and Willcox playa dust samples. The control samples did not have residues matching the Lordsburg or Willcox playa samples. Comparison of the mass spectral signatures of the rainwater dust residues with the playa dust samples showed high similarity using mass spectral dot products ranging from 0.71 to 0.97 (a value of 1 indicates an exact match; a value of 0 indicates no similarity). Similar results were found with the other white rain samples, but lower similarity, and Rusty's Rooftop had the least similarity (**Attachment B**), possibly due to contamination from the roof.

- The representative particle chemical composition (of white rain residues and playa samples) was as follows: sodium, potassium, calcium, magnesium, aluminosilicates, chloride, some organic nitrogen, phosphate, and nitrate. Ion chromatography analysis also showed sulfate was present (not picked up by ATOFMS in the residues, Pratt 2009). The particle chemistry matches well with the results of the rainwater analyses of dissolved constituents in **Table A-1**.

- A significant fraction of the solids contained CaO and calcium hydroxide ($CaOH_2$).[24]

The peaks of the ATOFMS were typical of playa signatures (e.g., typical signature from other playas shown in **Figure A-4**), for western playas in the United States that have abundant salts and carbonates (Pratt et al. 2010).The significance of these results is discussed further below.

Conceptual Model for Buffering of Soil pH Due to Deposition of White Rain

One of the treatments used for acidic soils is amendment with alkaline minerals, which neutralizes the acid and binds copper. If the pH of the soil is increased, as would happen with contact with alkaline minerals such as CaO, $CaCO_3$, or $CaMg(CO_3)_2$ or entry into a water system of higher pH, then metallic ions such as Fe^{3+} and Cu^{2+}, Zn^{2+}, Pb^{2+}, and As^{3+} will react to eventually form hydroxides as precipitates by the general reaction:

$$M^{n+} + nOH^{-} = M(OH)_n$$

where OH^- is the hydroxyl ion, M^{n+} represents the free metal ion, and $M(OH)_n$ is the metal hydroxide precipitate.

Figure 3 in the main text provides a graphical depiction of the conceptual model for the interaction of the white rain precipitation with the STSIU soils. Calcium-rich minerals from the Willcox and Lordsburg playas were deposited in the soil at the Chino STSIU and were partially dissolved but also present as micro- and nanoparticulates. Deposition of these minerals in the soil resulted in an increased pH; the presence of the nanoparticulates in the soil, with very high specific surface area, resulted in an increase in the buffering capacity of the soil. Dissolution of the minerals is not expected to reach equilibrium in the atmosphere due to the short

---

[24] Carbonate is not usually directly detected by ATOFMS.

contact time between the playa deposits and the rainwater. After the nanoparticulate minerals were deposited on the soil surface during the “white rain” event, some of the minerals would likely have dissolved during subsequent rain events and others would have moved further into the soil during these events.

Dissolution of calcite ($CaCO_3$) or dolomite ($CaMg(CO_3)_2$), and trona ($Na_3H[CO_3]_2{\cdot}2H_2O$) results in formation of carbonate ions, and dissolution of calcium hydroxides ($Ca(OH)_2$) forms hydroxyl ions, both of which subsequently neutralize acid. The following pH buffering reactions can occur in the soil due to the deposition of these alkaline solids from the white rain. Dissolution of calcium oxide, calcium hydroxide, calcite, and trona takes up acidity and provides dissolved alkaline species:

$$CaO + H_2O = Ca(OH)_2$$

$$Ca(OH)_2 + 2H+ = Ca^{2+} + 2H_2O$$

$$CaCO_3 = Ca^{2+} + CO_3^{2-}$$

$$Na_3H(CO_3)_2{\cdot}2H_2O = 3Na^{+} + HCO_3^{--} + CO_3^{2-} + 2\ H_2O$$

These alkaline species in turn consume more acidity from the soil:

$$CO_3^{2-} + H^{+} = HCO_3^{-}$$

$$HCO_3^{-} + H^{+} = H_2CO_3$$

$$OH^{-} + H^{+} = H_2O$$

The pH buffering capacity supplied by the white rain depends on the composition and the amount of suspended solids in the rain; this is currently unknown because the total suspended solids in the rainwater was not measured. However, it is clear that the deposition of these minerals in the surficial soil will provide buffering capacity over time. The potential for a sustained buffering capacity can be confirmed by monitoring pH, calcium content, and acid-base accounting at various locations over a period of time.

Conclusion

Longevity of the pH increase depends on reaction rates, buffering capacity, and residual acidity of the soil. Alkaline mineral dissolution is expected to be fairly rapid because of the nanoparticles present in the white rain. The buffering capacity supplied by the precipitation event must be determined from longer-term monitoring to see if pH has stabilized at pH > 5 or if the soil acidity produced by sulfide minerals is able to overcome the buffering capacity imparted by the newly deposited alkaline minerals. The 5 years of monitoring data discussed in the main text support that the buffering capacity is sufficient because pH has remained high on locations monitored, and averaged about 5.3.

In addition to providing sustained pH buffering capacity, the calcium, sodium, magnesium, and aluminum hydroxides and silicates deposited in the soil have the ability to bind metals in the soil, specifically copper, through the creation of copper hydroxides. The nanoparticulate minerals can also sorb copper, coat the surfaces of existing copper-containing soil particles, and decrease the leaching of copper from the soil. Finally, the calcium can react with sulfate to form gypsum; this results in passivation of acidic minerals and decreases future releases of acidity (see passivation discussion in **Appendix B**).

In summary, the January 7, 2008 white rain event had the following initial effect on the soil in the STSIU:

- The rainwater had near-neutral pH, significantly higher than historical rainwater pH, resulting in a pH increase in the upper part of the soil.

- The rainwater contained micro- and nanoparticulate suspended solids originating from alkaline playa lakes; these solids have now been deposited into the soil and will react with soil acidity.

The additional 5 years of data support that the higher pH has been sustained, providing a higher buffering capacity of the soil (following the conceptual chemical model) due to the deposition of the alkaline minerals in the soil. Additionally, it has decreased leachability of copper due to reactions of copper- and sulfide minerals in the soil with the alkaline minerals. This information supports a long-term strategy for the soils within the STSIU, and the natural reactions that have had a positive effect on soil pH should be considered as part of the overall stabilization approach.

References

ARCADIS. 2014. Year 5 pH Monitoring Report for Smelter/Tailing Soils Investigation Unit Amendment Study Plots. Draft. Prepared for Freeport-McMoRan Chino Mines Company, Vanadium, New Mexico.

Chino Mines Company. 1995. Administrative Order on Consent Investigation Area. Remedial Investigation Background Report. Chino Mine Investigation Area. Volume I, II. Prepared for New Mexico Environmental Department.

Holecek, J.C., Spencer, M.T., and Prather, K.A. 2007. Analysis of rainwater samples: comparison of single particle residues with ambient particle chemistry from the northeast Pacific and Indian oceans. Journal of Geophysical Research, 112.

National Atmospheric Deposition Program (NADP). 1999. National Trends Network Site Operation Manual. National Atmospheric Deposition Program, Manual 1999-01c, Champaign, IL.

NADP. 2003. Quality Management Plan. National Atmospheric Deposition Program. QA Plan 2003-01. Champaign, IL.

Naiman, Z., Quade, J., and P.J. Patchett. 2000. Isotopic evidence for eolian recycling of pedogenic carbonate and variations in carbonate dust sources throughout the southwest United States. Geochimica et Cosmochimica Acta, 64, pp. 3099-3109.

Newfields. 2005. *Chino Mines Administrative Order on Consent Site-wide Ecological Risk Assessment.* Prepared for Chino Mines Company in November 2005.

Newfields. 2008. Chino Mines Administrative Order on Consent, STSIU Ecological Risk Assessment, April.

Nyika, D., Zhande, E., Zhakata, W., Kosmus, W., and S.B. Jonnalagadda. 1996. Rainwater quality during 1991-1993 and constituents of white rain (November 1992) in Bulawayo, Zimbabwe. Science of the Total Environment 186: 273-281.

Pratt, K. 2009. New insights into single-particle mixing state using aircraft aerosol time-of-flight mass Spectrometry. PhD Dissertation. U.C. San Diego.

Pratt, K., C.H. Twohy, S.M. Murphy, R.C. Moffet, A. J. Heymsfield, C. J. Gaston, P. J. DeMott, P. R. Field, T. R. Henn, D. C. Rogers, M. K. Gilles, J. H.

Seinfeld,and K. A. Prather. 2010. Observation of playa salts as rain nuclei in orographic wave clouds. Journal of Geophysical Research 115:D15301.

Resane, T., H. Annegarn, and T. Freiman. 2004. The day of the white rain: origin of unusual dust deposition in Johannesburg, South Africa. South African Journal of Science 100:483-487.

SRK. 2008. Administrative Order on Consent Remedial Investigation Report for the Smelter/Tailing Soils Investigation Unit, Revision 2. February 2.

Table A-1
Summary of UTEP and NADP Results

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Location		**Tyrone**		**Hurley**		**Gila Cliffs**	
		NMT		**NMT**		**NADP**	
		Sample 1		**Sample 5**		**NM01**	
Constituent	**Units**	**White Rain**	**Control**	**White rain**	**Control**	**White Rain**	**Control**
pH	s.u.	6.6	5.8	6.6	6.1	7.2	5
Conductivity	uS/cm	91	62	115	85	6.8	47
TDS*	mg/L	43	40	57	45	14.3	1.5
Hardness	mg/L	28	26	37	31	16.1	0.29
Carbonate	mg/L	--	--	--	--	--	--
Bicarbonate	mg/L	36	31	43	39	--	--
Sodium	mg/L	4.4	2.7	5.6	2	3.41	0.022
Potassium	mg/L	<0.5	1.1	<0.5	0.36	0.2	0.017
Magnesium	mg/L	0.89	0.89	0.56	0.97	0.37	0.007
Calcium	mg/L	9.8	9	14	11	5.84	0.104
Bromide	mg/L	<0.1	<0.1	<0.1	<0.1	--	--
Chloride	mg/L	3.3	1.2	4.9	1.6	2.32	0.045
Fluoride	mg/L	0.13	<0.1	0.12	0.099	--	--
Nitrite	mg/L	<0.1	<0.1	<0.1	<0.1	--	--
Nitrate	mg/L	0.95	4	2.1	3.1	--	--
Phosphate	mg/L	<0.5	<0.5	<0.5	<0.5	--	--
Sulfate	mg/L	4.3	4.2	6.6	3.2	2.09	0.457
Total cations	meq/L	0.77	0.67	1	0.76	0.48	0.0084
Total anions	meq/L	0.79	0.69	1.02	0.81	0.11	0.023
% Difference**		-1.77	-1.5	-0.95	-2.78	63*	-46*

Notes:

*TDS and possibly rest of data are unreliable for Sample Locations 1 and 5 because TDS is not sum of ions; NM01 is more reliable, though missing bicarbonate ion data.

*Anion analysis incomplete because carbonate/bicarbonate was not analyzed.

**Percent difference calculated as (cations – anions)/2]/[(cations + anions)/2

NMT = New Mexico Institute of Mining and Technology

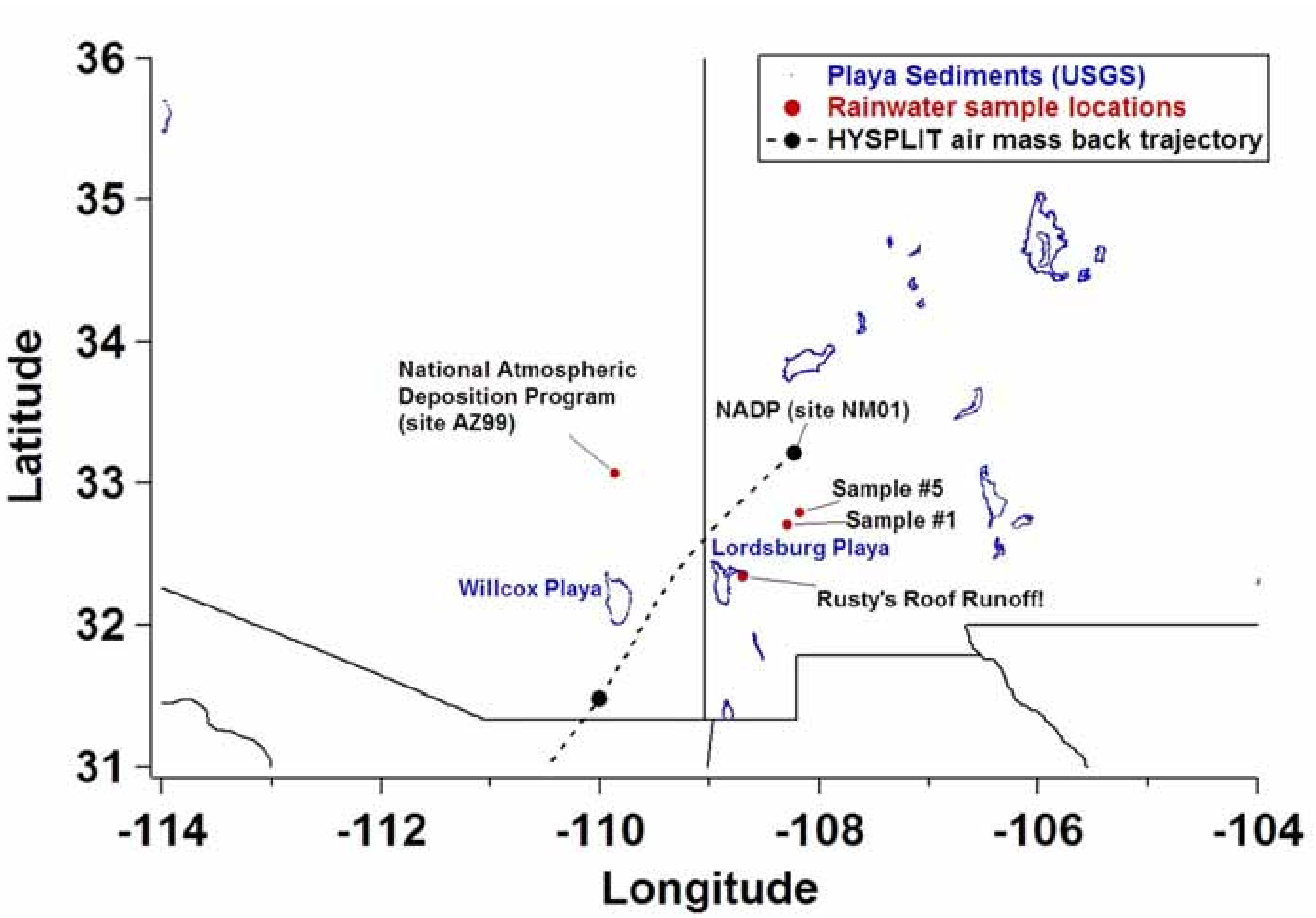
NADP = National Atmospheric Deposition Program

Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico
Year 5 pH Monitoring Report

High-Resolution NASA Photograph Taken During the Time Period of the White Rain, Showing Dust Storm Over Willcox Playa (in circle)

ARCADIS

FIGURE
A-1



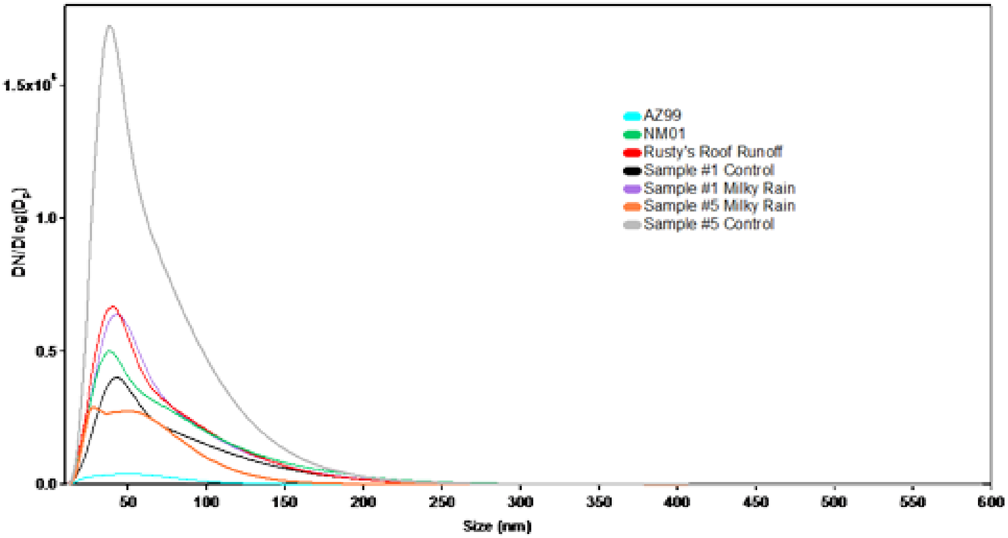
Note:
Dashed line shows the Hybrid Single Particle Lagrangian Integrated Trajectory Model (HYSPLIT) of the air mass and particle track during the early January white rain event.

Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico
Year 5 pH Monitoring Report

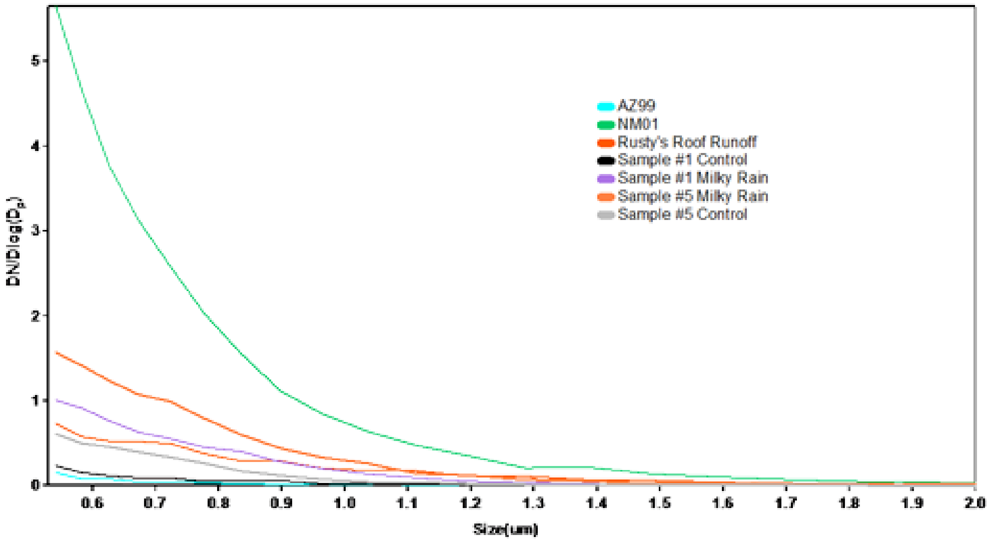
Sample Locations for Analyses Performed by UCSD to Examine the Solid Phase Composition

ARCADIS

FIGURE
A-2



a. Size distributions of 10-600 nanometer particles from Scanning Particle Mobility Sizer.



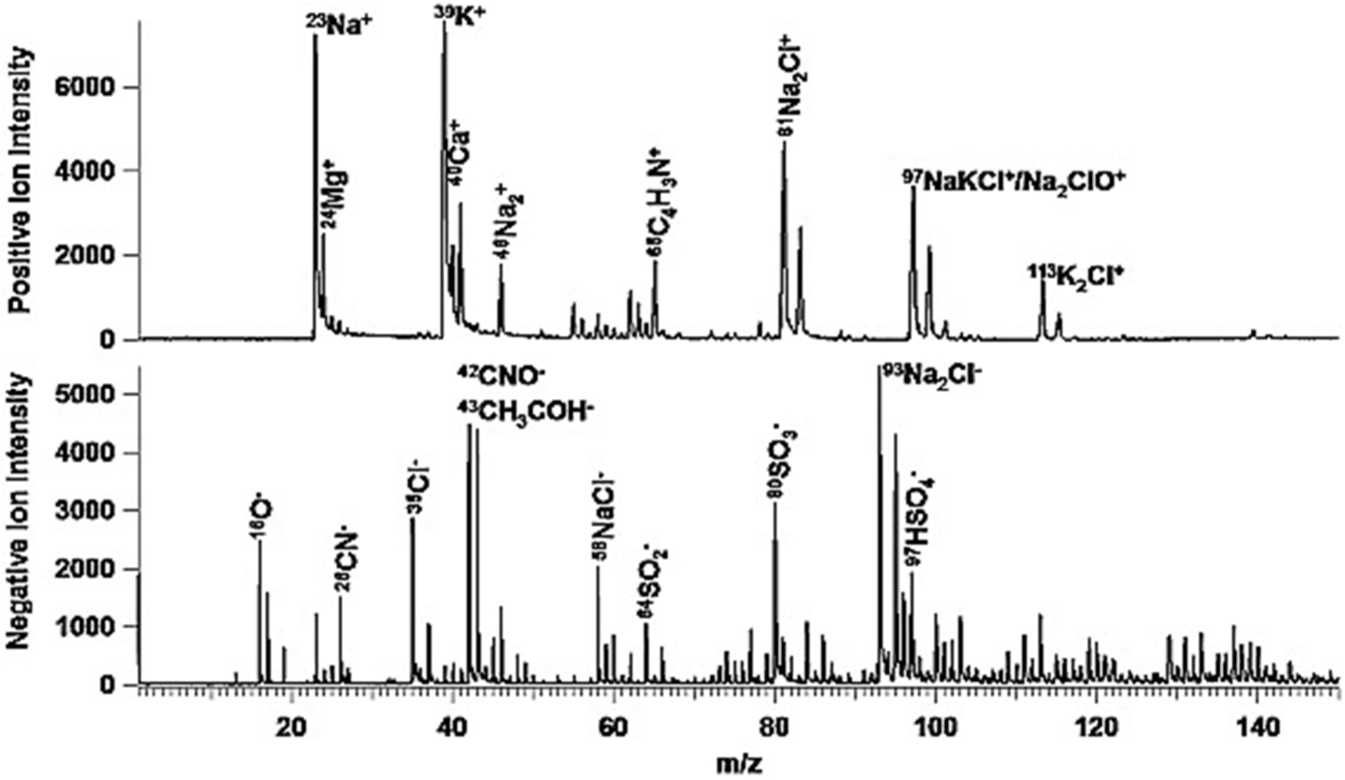
b. Size distributions of 0.53-2.0 micrometer particles from Aerodynamic Particle Sizer.

Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico
Year 5 pH Monitoring Report

Size Distributions of Rainwater Particles in White Rain Samples

ARCADIS

FIGURE
A-3



Note:
Figure taken from Pratt et al. (2010).

Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico
Year 5 pH Monitoring Report

Typical Playa Dust Signature in Rain Clouds

ARCADIS

FIGURE
A-4

Attachment A: News Story on White Rain

Silver City's White Rain? Dust, Maybe
http://www.abqjournal.com/news/state/279587nm01-24-08.htm

By Rene Romo
Copyright © 2008 Albuquerque Journal; Journal Southern Bureau

LAS CRUCES— A NASA photograph taken from space might be a key to unlocking the meteorological mystery of Silver City's milky rain.
The image taken by a NASA satellite on Jan. 7— the same day the mysterious rain doused much of Grant County— shows a whitish plume of material flowing under the cloud layer over a large dry lake bed south of Willcox, Ariz., according to Joel Gilbert of the University of Texas at El Paso.

The lakebed, known as the Willcox playa, covers 50 to 60 square miles and is about 120 miles southwest of Silver City. A high-wind advisory was in effect in the Willcox area on Jan. 7, and dust was blowing across the area, according to the Arizona Department of Public Safety.

"It looks like there's a plume of dust coming off the Willcox playa, and the Willcox playa has been a significant source of dust in the past," said Gilbert, an environmental science coordinator who is part of a group of scientists studying the milky rain.

"The plume looks like it was blowing in the right direction to Silver City. It's possible the dust seeded the rain clouds and caused the precipitation in the first place."

Finding the cause of the white rainfall appears weeks away, but the NASA image "is the best evidence we have so far," said Gilbert.

Courtesy Max Bleiweiss, NMSU

A NASA satellite image shows a dust plume rising from a dry lake bed near Willcox, Ariz., on the same day Grant County, N.M., about 120 miles to the northeast, was doused with milky-white rainfall.

Cars and homes across Grant County were drenched with the milky white rain that locals said they had never seen before.

Concerns about what the strange rain contained prompted some Silver City area residents to launch an investigation that has drawn in researchers from the New Mexico Tech, New Mexico State University, UTEP and the state Environment Department.

Gilbert said his analysis of six rain samples gathered from Silver City showed high levels of calcium, which is "not too unusual" given the geology of the Southwest.

Additional tests still must still be conducted.

Gilbert said he and other researchers are awaiting the arrival of samples of residue left behind by the milky rain for testing.

New Mexico Environment Department spokeswoman Marissa Stone said that it will be perhaps two weeks before material collected in air quality monitoring devices is analyzed.

In addition, Gilbert said, getting soil samples from the Willcox playa will be an important part of the effort to establish a link between the lakebed and the rain that fell on Silver City.

The investigation, Gilbert noted, could be compromised by one other factor— the quality of the rain samples collected from Silver City.

Some of the rain samples were collected from rooftop run-off, others from rain gauges. Because the rainfall probably mixed with other material while it was collected, the samples might not accurately reflect what fell from the sky that day.

"The data we are getting is still going to be questionable," Gilbert said.

Attachment B: Milky Rain Residual Analysis

The following powerpoint presentation from Dr. Kerry Pratt and associates summarizes the findings on the source of the residue in the white rain. Aerosol Time-of-flight Mass Spectrometer (ATOMFS) analysis was used to obtain spectral signatures (a chemical fingerprint) for each individual particle of the white rain residue. Particle number concentrations obtained from a collocated Aerodynamic Particle Sizer (APS) for coarse particles and from the Scanning Mobility Particle Sizer for finer particles were used to scale the ATOFMS particle counts in order to obtain more accurate particle number concentrations of the ATOFMS particle types (number could not be converted to concentration, however, because the water had evaporated).

Due to the large number of particles present (i.e., millions) a cluster analysis algorithm (called ART-2a, see Rehbein et al. 2012) was used to cluster the spectra into fewer groups. This process was applied to white rain residue and to the Willcox Playa dust and Lordsburg Playa dust. These playas were suspected sources of the residue in the white rain. The average spectral signature of the white rain residue was compared with the average spectra of the Willcox Playa dust and Lordsburg Playa dust. Correlations using mass spectral dot products were performed and the higher the correlation (ranges between 0 and 1), the closer the match. The spectra comparisons are shown for different cluster groups of the five rainwater sample locations in the presentation. The spectra were also evaluated to identify the chemistry of the residues. Lastly, the potential for the dust or salts from the playas to cause cloud condensation nuclei (CCN) was evaluated following methods of Petters and Krendenweis (2007). Dust generally is inactive, whereas salts may activate CCN. The samples from the playa were found to be fairly inactive in regard to forming condensation. The cause of the condensation as the dust cloud rose from the playa and was incorporated into clouds is uncertain.

A summary of the results is as follows:

- 75% of insoluble residues in the NM01 rainwater sample were characterized by a chemical signature matching the Lordsburg & Willcox playa dust samples. The control samples did not have residues matching the Lordsburg or Willcox playa samples.
- Comparison of the mass spectral signatures of the rainwater dust residues with the playa dust samples showed high similarity with mass spectral dot products ranging from 0.71-0.97 (a value of 1 indicates an exact match; a value of 0 indicates no similarity).
- Measured rainwater individual dust residue chemistry included sodium, potassium, calcium, magnesium, aluminosilicates, chloride, organic nitrogen, phosphate, and nitrate.

References:

Petters, M.D. and S.M. Krendenweis. 2007. A single parameter representation of hygroscopic growth and cloud condensation nucleus activity. Atmos. Chem. Phys.7:1961–1971.

Rehbein, G.J.G., Jeong, C.H., M.L. McGuire, and G.J. Evans. 2012. Strategies to enhance the interpretation of single-particle ambient aerosol data. Aerosol Science and Technology 46:584-595.

Milky Rain Analysis

Dec. 2, 2008

Kerri Pratt, Cassandra Gaston, Kim Prather
UCSD

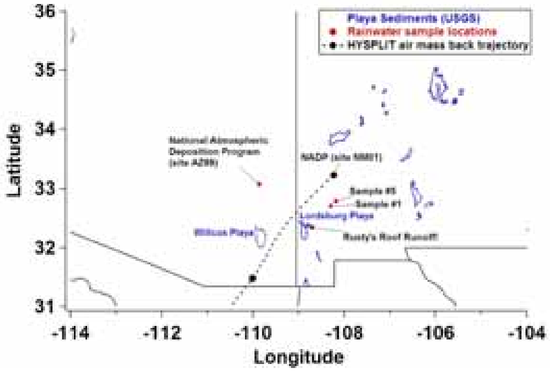
Take-home Points

- All milky rainwater samples (except AZ99) have positive matches to the Lordsburg and Willcox playa samples
- AZ99 appears to be influenced by a different source (also fewer residues present), which makes sense based on location and the HYSPLIT air mass back trajectories
- Control rainwater samples do not have residues that match the Lordsburg or Willcox Playa samples
- Lordsburg & Willcox Playa samples have similar dust signatures in general
- More supermicron particles in the milky rainwater samples compared to controls (also indicating the increased presence of dust in the milky rain
- Representative particle chemical composition (of milky rain residues & playa samples): sodium, potassium, calcium, magnesium, aluminosilicates, chloride, some organic nitrogen and phosphate

Kerri Pratt, Cassie Gaston,
Kim Prather (UCSD)

Some Abbreviations

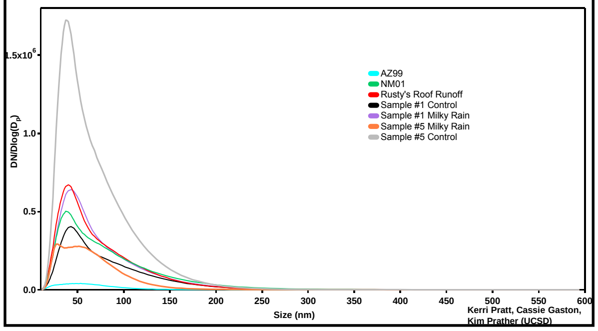
- Rusty's Roof Run-off (RRR)
- Rainwater Sample #1 (Allyson Siwik) milky rain (MR1r)
- Rainwater Sample #1 (Allyson Siwik) control (MR1c)
- Rainwater Sample #5 (Tricia Hurley) milky rain (MR5r)
- Rainwater Sample #5 (Tricia Hurley) control (MR5c)



USGS playa sediments map courtesy of
David Soller & Marith Reheis

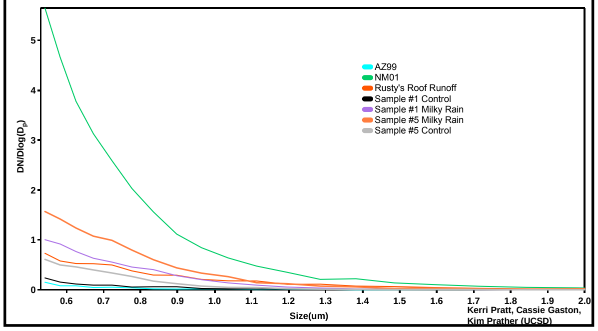
Kerri Pratt, Cassie Gaston,
Kim Prather (UCSD)

SMPS – Size distributions and relative concentrations of residues ~10-600 nm



Kerri Pratt, Cassie Gaston,
Kim Prather (UCSD)

APS – Size distributions and relative concentrations of residues ~0.53-20 μm



Kerri Pratt, Cassie Gaston,
Kim Prather (UCSD)

Residue size distribution notes

- Greatest concentration of supermicron particles: NM01 (consistent with presence of dust)
  - AZ99 = lowest
  - MR1r & MR5r were higher than MR1c & MR5c
- <600 nm residues:
  - Highest MR5c
  - Lowest AZ99

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)

ATOFMS Analysis

- Characteristic residues of NM01, AZ99, MR1r & MR1c, MR5r & MR5c, RRR
- Characteristic chemical composition of Lordsburg & Willcox Playas
- Spectra shown are groups of individual residues (rather than bulk average composition)
- Mass spectral signatures of playa samples and rainwater residues were compared

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)

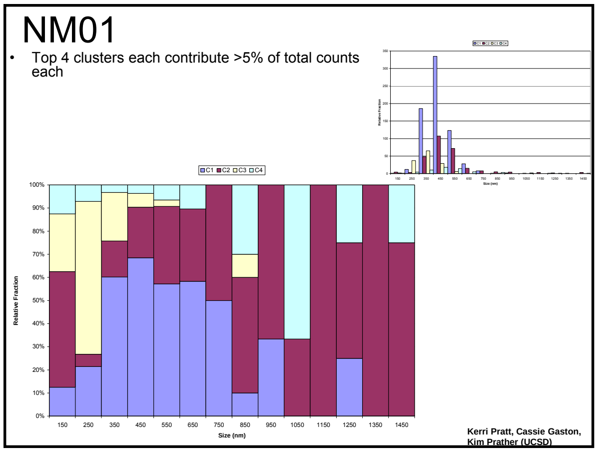
ATOFMS Analysis Methods

- Ran ART-2a on separate samples to cluster together individual mass spectra from single particles (except combined data from MR1r & MR1c, MR5r & MR5c)
  - Intersected samples for MR1 and MR5 to see which clusters were primarily control vs. milky rain
  - Compared top clusters of different samples using mass spectral dot products (defined a match as dot product > 0.70)
- Compared average bulk mass spectra of MR1r vs. MR1c and MR5r vs. MR5c

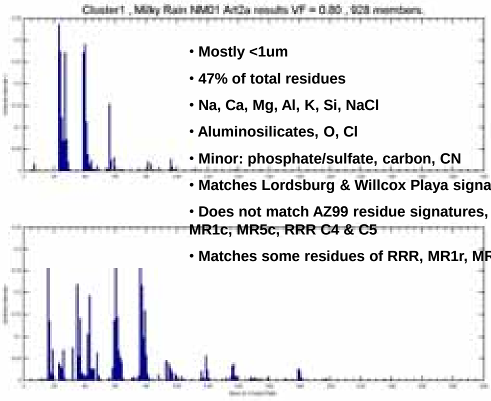
Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)

NM01

- Top 4 clusters each contribute >5% of total counts each

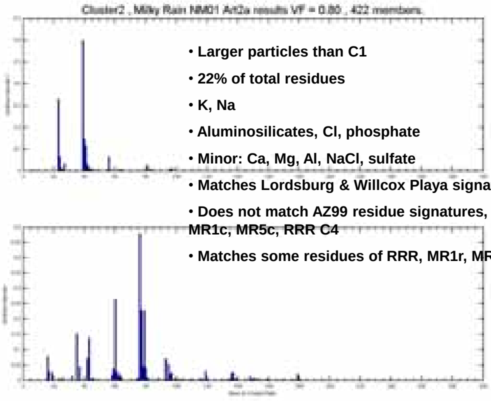


Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



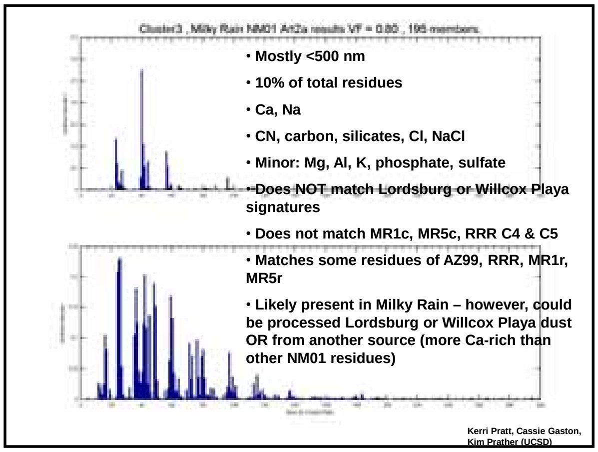
- **Mostly <1um**
- **47% of total residues**
- **Na, Ca, Mg, Al, K, Si, NaCl**
- **Aluminosilicates, O, Cl**
- **Minor: phosphate/sulfate, carbon, CN**
- **Matches Lordsburg & Willcox Playa signatures**
- **Does not match AZ99 residue signatures, MR1c, MR5c, RRR C4 & C5**
- **Matches some residues of RRR, MR1r, MR5r**

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



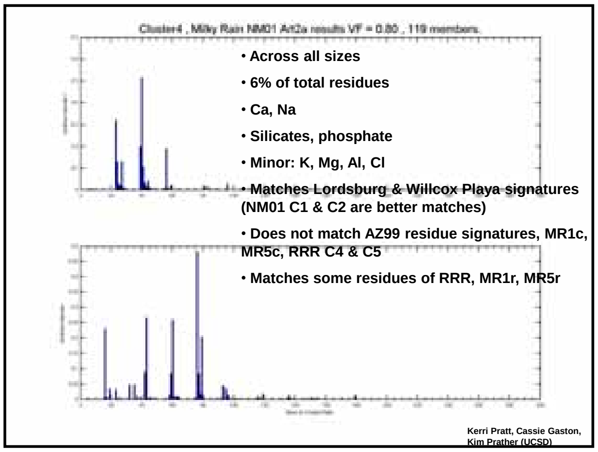
- **Larger particles than C1**
- **22% of total residues**
- **K, Na**
- **Aluminosilicates, Cl, phosphate**
- **Minor: Ca, Mg, Al, NaCl, sulfate**
- **Matches Lordsburg & Willcox Playa signatures**
- **Does not match AZ99 residue signatures, MR1c, MR5c, RRR C4**
- **Matches some residues of RRR, MR1r, MR5r**

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



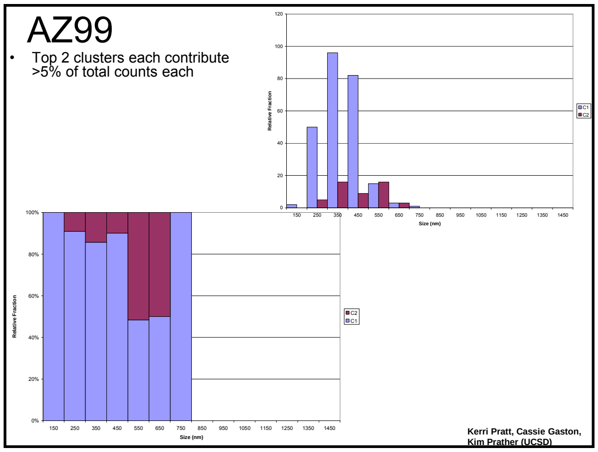
- Mostly <500 nm
- 10% of total residues
- Ca, Na
- CN, carbon, silicates, Cl, NaCl
- Minor: Mg, Al, K, phosphate, sulfate
- Does NOT match Lordsburg or Willcox Playa signatures
- Does not match MR1c, MR5c, RRR C4 & C5
- Matches some residues of AZ99, RRR, MR1r, MR5r
- Likely present in Milky Rain – however, could be processed Lordsburg or Willcox Playa dust OR from another source (more Ca-rich than other NM01 residues)

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



- Across all sizes
- 6% of total residues
- Ca, Na
- Silicates, phosphate
- Minor: K, Mg, Al, Cl
- Matches Lordsburg & Willcox Playa signatures (NM01 C1 & C2 are better matches)
- Does not match AZ99 residue signatures, MR1c, MR5c, RRR C4 & C5
- Matches some residues of RRR, MR1r, MR5r

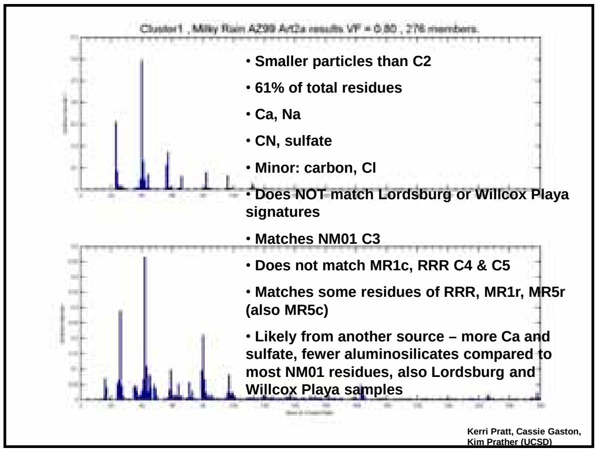
Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



AZ99

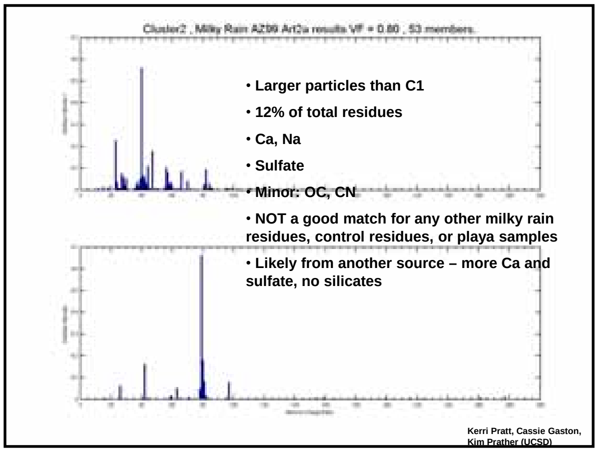
- Top 2 clusters each contribute >5% of total counts each

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



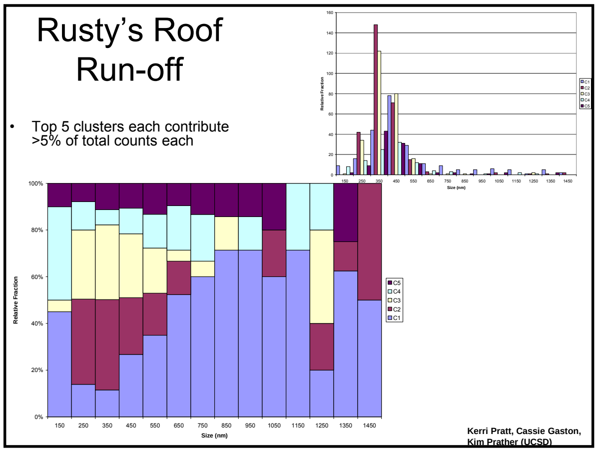
- Smaller particles than C2
- 61% of total residues
- Ca, Na
- CN, sulfate
- Minor: carbon, Cl
- Does NOT match Lordsburg or Willcox Playa signatures
- Matches NM01 C3
- Does not match MR1c, RRR C4 & C5
- Matches some residues of RRR, MR1r, MR5r (also MR5c)
- Likely from another source – more Ca and sulfate, fewer aluminosilicates compared to most NM01 residues, also Lordsburg and Willcox Playa samples

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



- Larger particles than C1
- 12% of total residues
- Ca, Na
- Sulfate
- Minor: OC, CN
- NOT a good match for any other milky rain residues, control residues, or playa samples
- Likely from another source – more Ca and sulfate, no silicates

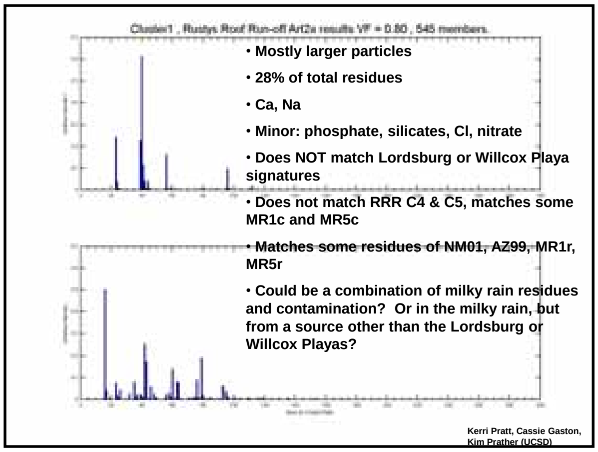
Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



Rusty's Roof Run-off

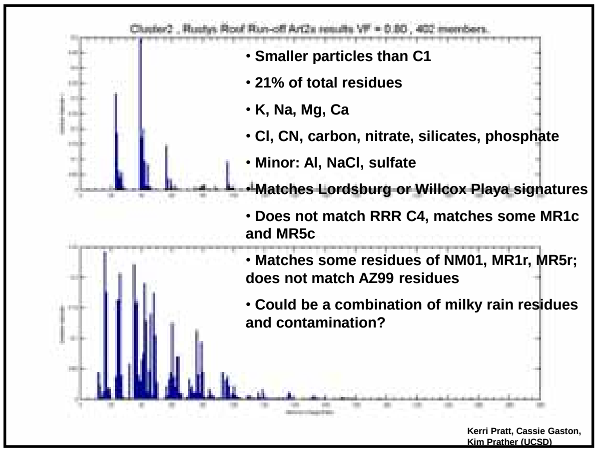
- Top 5 clusters each contribute >5% of total counts each

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



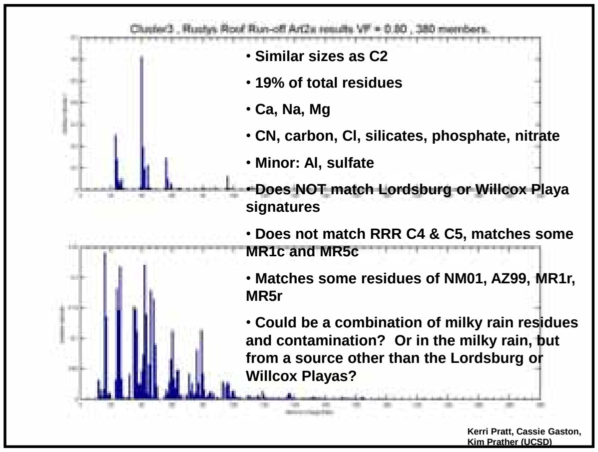
- Mostly larger particles
- 28% of total residues
- Ca, Na
- Minor: phosphate, silicates, Cl, nitrate
- Does NOT match Lordsburg or Willcox Playa signatures
- Does not match RRR C4 & C5, matches some MR1c and MR5c
- Matches some residues of NM01, AZ99, MR1r, MR5r
- Could be a combination of milky rain residues and contamination? Or in the milky rain, but from a source other than the Lordsburg or Willcox Playas?

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



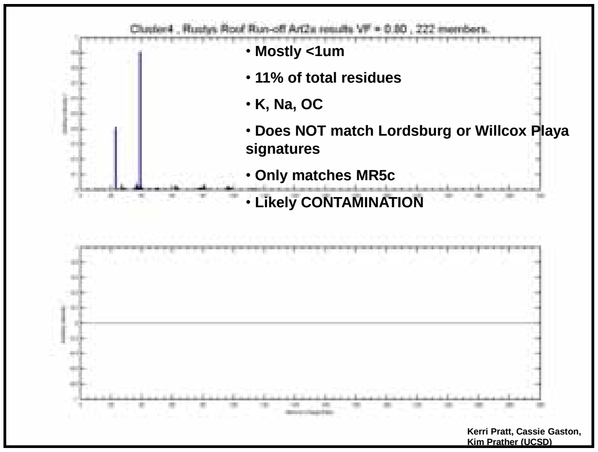
- Smaller particles than C1
- 21% of total residues
- K, Na, Mg, Ca
- Cl, CN, carbon, nitrate, silicates, phosphate
- Minor: Al, NaCl, sulfate
- Matches Lordsburg or Willcox Playa signatures
- Does not match RRR C4, matches some MR1c and MR5c
- Matches some residues of NM01, MR1r, MR5r; does not match AZ99 residues
- Could be a combination of milky rain residues and contamination?

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



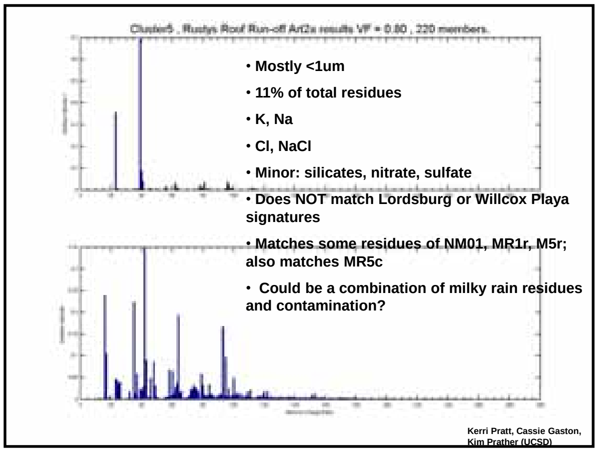
- Similar sizes as C2
- 19% of total residues
- Ca, Na, Mg
- CN, carbon, Cl, silicates, phosphate, nitrate
- Minor: Al, sulfate
- Does NOT match Lordsburg or Willcox Playa signatures
- Does not match RRR C4 & C5, matches some MR1c and MR5c
- Matches some residues of NM01, AZ99, MR1r, MR5r
- Could be a combination of milky rain residues and contamination? Or in the milky rain, but from a source other than the Lordsburg or Willcox Playas?

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



- Mostly <1um
- 11% of total residues
- K, Na, OC
- Does NOT match Lordsburg or Willcox Playa signatures
- Only matches MR5c
- Likely CONTAMINATION

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



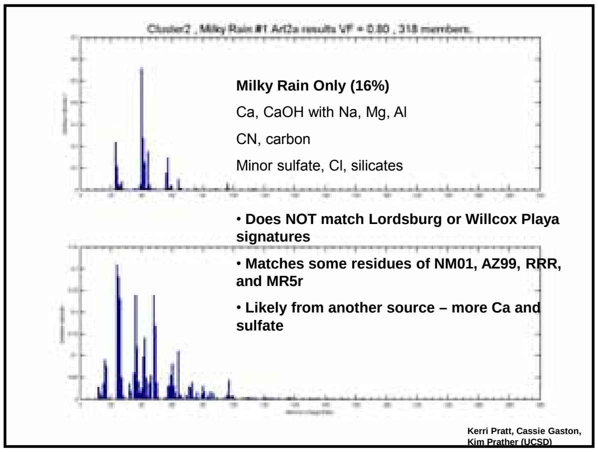
- Mostly <1um
- 11% of total residues
- K, Na
- Cl, NaCl
- Minor: silicates, nitrate, sulfate
- Does NOT match Lordsburg or Willcox Playa signatures
- Matches some residues of NM01, MR1r, M5r; also matches MR5c
- Could be a combination of milky rain residues and contamination?

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)

MR1r vs. MR1c Notes

- Neither contain ammonium
- Subtraction plots are for all particles
- ART-2a clusters (>5% each)
  - Only Milky Rain: C2, C4
  - Only Control: C6, C7
  - Both: C1, C3, C5

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



Milky Rain Only (16%)

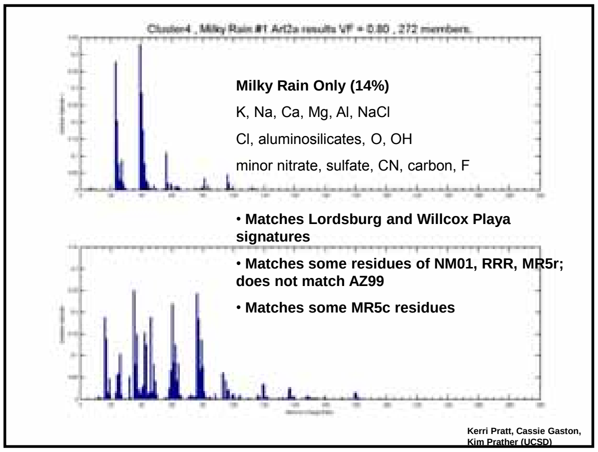
Ca, CaOH with Na, Mg, Al

CN, carbon

Minor sulfate, Cl, silicates

- **Does NOT match Lordsburg or Willcox Playa signatures**
- **Matches some residues of NM01, AZ99, RRR, and MR5r**
- **Likely from another source – more Ca and sulfate**

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



Milky Rain Only (14%)

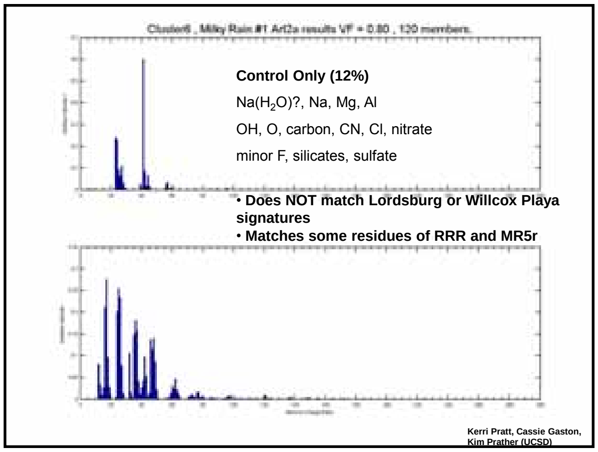
K, Na, Ca, Mg, Al, NaCl

Cl, aluminosilicates, O, OH

minor nitrate, sulfate, CN, carbon, F

- **Matches Lordsburg and Willcox Playa signatures**
- **Matches some residues of NM01, RRR, MR5r; does not match AZ99**
- **Matches some MR5c residues**

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



Control Only (12%)

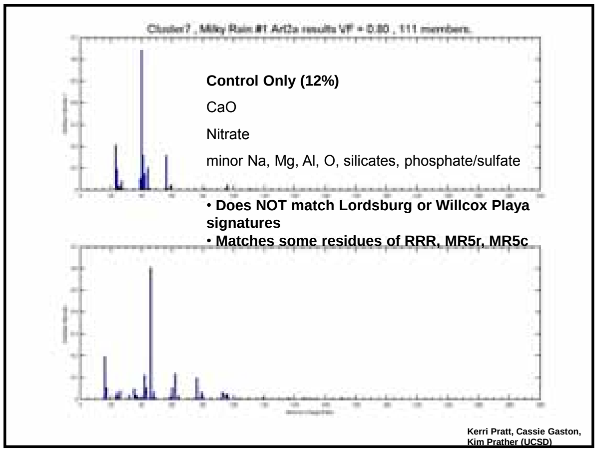
$Na(H_2O)$?, Na, Mg, Al

OH, O, carbon, CN, Cl, nitrate

minor F, silicates, sulfate

- **Does NOT match Lordsburg or Willcox Playa signatures**
- **Matches some residues of RRR and MR5r**

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



Control Only (12%)

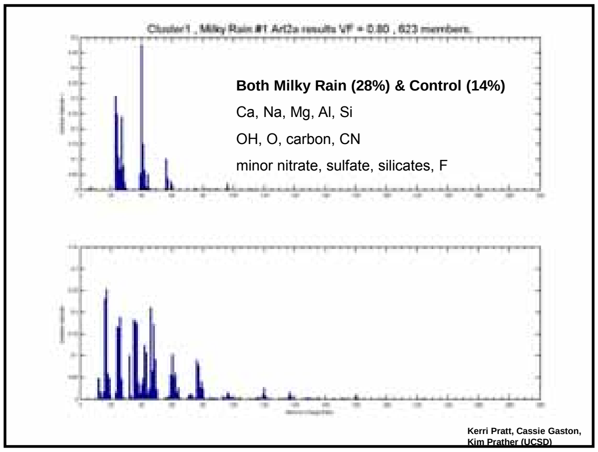
CaO

Nitrate

minor Na, Mg, Al, O, silicates, phosphate/sulfate

- **Does NOT match Lordsburg or Willcox Playa signatures**
- **Matches some residues of RRR, MR5r, MR5c**

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



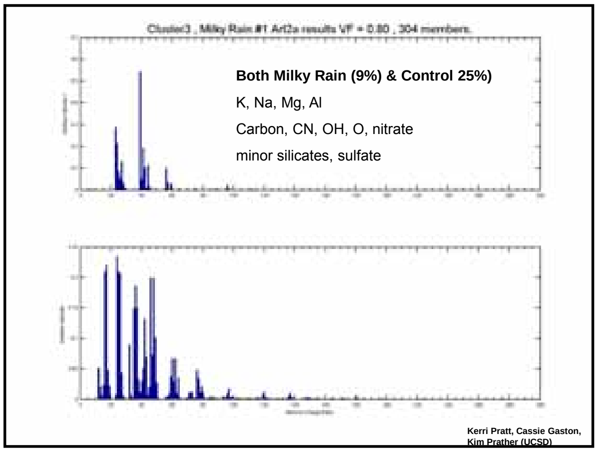
Both Milky Rain (28%) & Control (14%)

Ca, Na, Mg, Al, Si

OH, O, carbon, CN

minor nitrate, sulfate, silicates, F

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



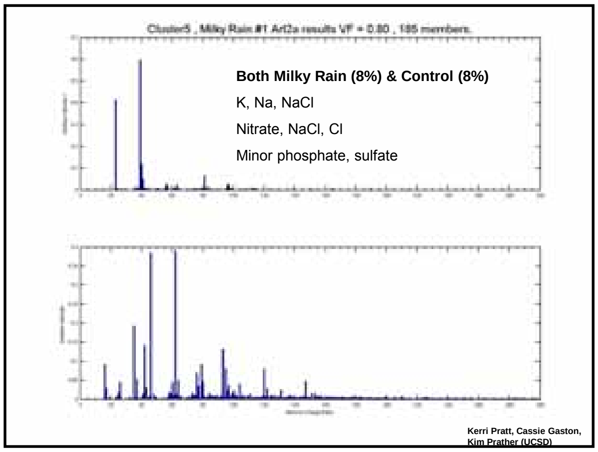
Both Milky Rain (9%) & Control 25%)

K, Na, Mg, Al

Carbon, CN, OH, O, nitrate

minor silicates, sulfate

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



Both Milky Rain (8%) & Control (8%)

K, Na, NaCl

Nitrate, NaCl, Cl

Minor phosphate, sulfate

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)

MR1r vs. MR1c – Positive Ions

- Enhanced in Milky Rain
  - Significant peaks: Li, Na, Mg, Al, Si, Ca, AlO, Ti, CaO, CaOH, TiO, Na_2Cl, Ba, BaOH
  - Minor peaks: C_3, C_3H, Fe
- Enhanced in Control Rainwater
  - Significant peaks: K, KO
  - Minor peaks: C

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)

MR1r vs. MR1c – Negative Ions

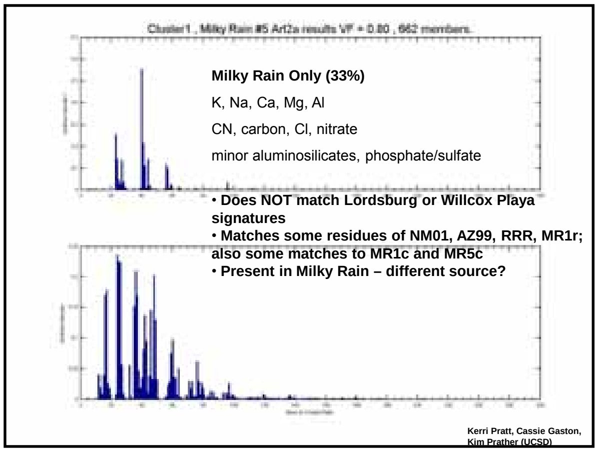
- Enhanced in Milky Rain
  - Significant peaks: many carbonaceous, O, OH, F, CN, Cl, CNO, AlO/CH_3COH, SiO, CHOO/HCO_2, NaCl, SiO_2, Si_2O, SiO_3, Si_2O_2, $NaCl_2$, $AlSiO_4$, Si_2O_5, HSi_2O_5, Si_3O_4, $AlSi_2O_6$
  - Minor peaks: $AlSiO_3$, Si_2O_3
- Enhanced in Control Rainwater
  - Significant peaks: none
  - Minor peaks: none

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)

MR5r vs. MR5c Notes

- Neither contain ammonium
- Subtraction plots are for all particles
- ART-2a clusters (>5% each)
  - Only Milky Rain: C1, C2, C4, C6
  - Only Control: C3, C5, C7, C11

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



Milky Rain Only (33%)

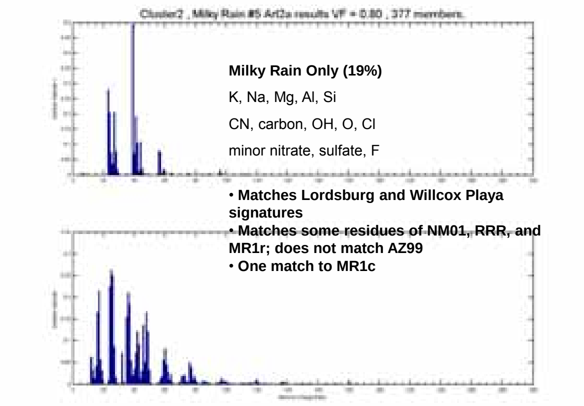
K, Na, Ca, Mg, Al

CN, carbon, Cl, nitrate

minor aluminosilicates, phosphate/sulfate

- **Does NOT match Lordsburg or Willcox Playa signatures**
- **Matches some residues of NM01, AZ99, RRR, MR1r; also some matches to MR1c and MR5c**
- **Present in Milky Rain – different source?**

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



Milky Rain Only (19%)

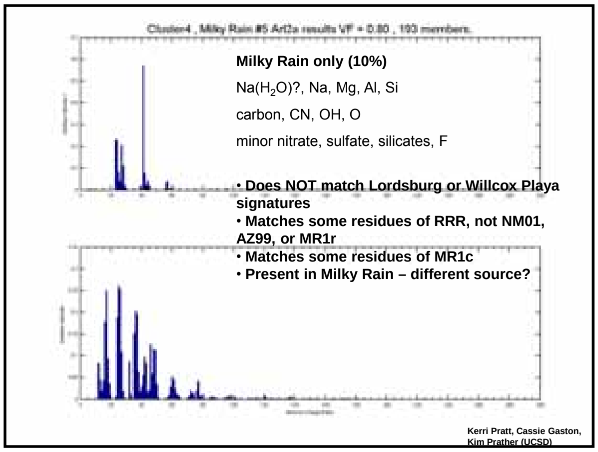
K, Na, Mg, Al, Si

CN, carbon, OH, O, Cl

minor nitrate, sulfate, F

- **Matches Lordsburg and Willcox Playa signatures**
- **Matches some residues of NM01, RRR, and MR1r; does not match AZ99**
- **One match to MR1c**

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



Milky Rain only (10%)

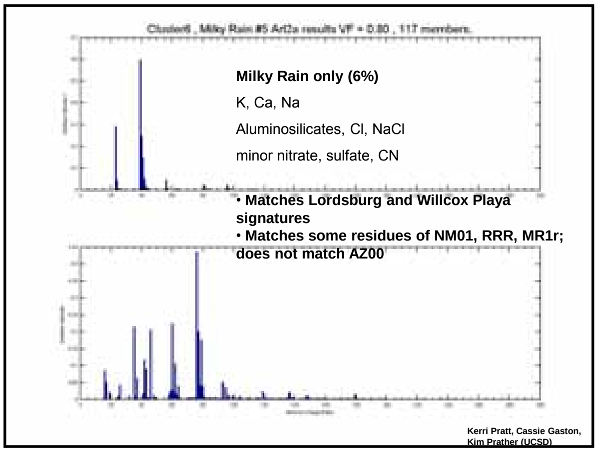
$Na(H_2O)$?, Na, Mg, Al, Si

carbon, CN, OH, O

minor nitrate, sulfate, silicates, F

- **Does NOT match Lordsburg or Willcox Playa signatures**
- **Matches some residues of RRR, not NM01, AZ99, or MR1r**
- **Matches some residues of MR1c**
- **Present in Milky Rain – different source?**

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



Milky Rain only (6%)

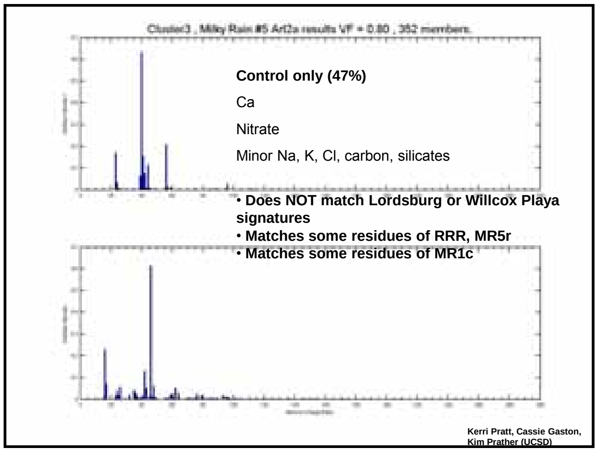
K, Ca, Na

Aluminosilicates, Cl, NaCl

minor nitrate, sulfate, CN

- **Matches Lordsburg and Willcox Playa signatures**
- **Matches some residues of NM01, RRR, MR1r; does not match AZ00**

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



Control only (47%)

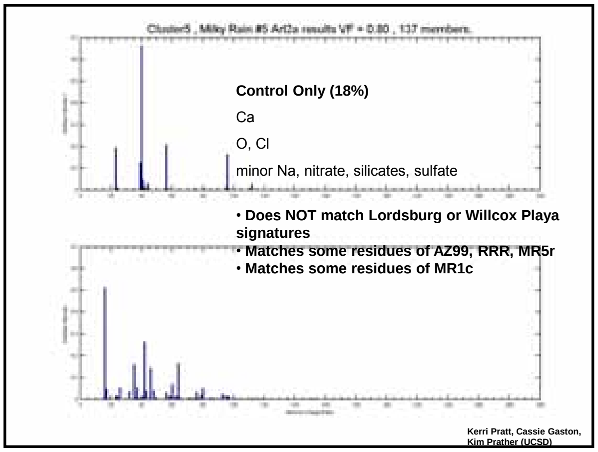
Ca

Nitrate

Minor Na, K, Cl, carbon, silicates

- **Does NOT match Lordsburg or Willcox Playa signatures**
- **Matches some residues of RRR, MR5r**
- **Matches some residues of MR1c**

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



Control Only (18%)

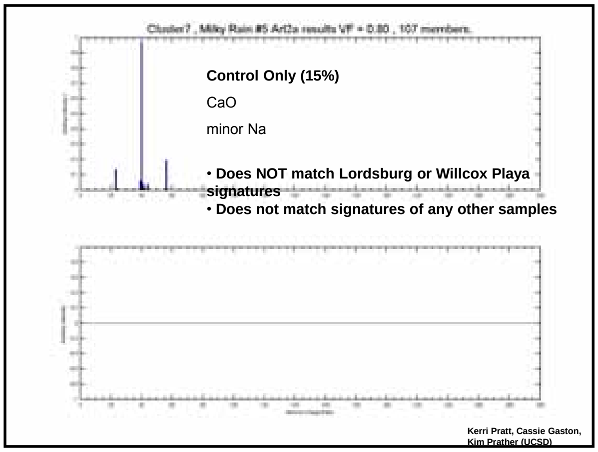
Ca

O, Cl

minor Na, nitrate, silicates, sulfate

- **Does NOT match Lordsburg or Willcox Playa signatures**
- **Matches some residues of AZ99, RRR, MR5r**
- **Matches some residues of MR1c**

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



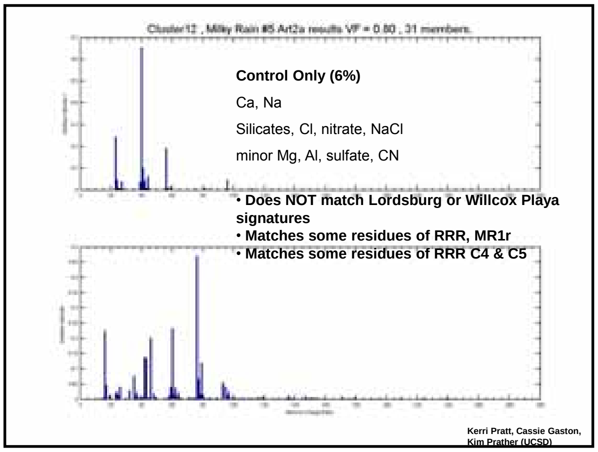
Control Only (15%)

CaO

minor Na

- **Does NOT match Lordsburg or Willcox Playa signatures**
- **Does not match signatures of any other samples**

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



Control Only (6%)

Ca, Na

Silicates, Cl, nitrate, NaCl

minor Mg, Al, sulfate, CN

- **Does NOT match Lordsburg or Willcox Playa signatures**
- **Matches some residues of RRR, MR1r**
- **Matches some residues of RRR C4 & C5**

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)

MR5r vs. MR5c – Positive Ions

- Enhanced in Milky Rain
  - Significant peaks: Li, Na, Mg, Al, Si, Ca, AlO, Ti, CaO, CaOH, TiO, CaCl, Na_2Cl,
  - Minor peaks: C, C_3, C_3H, K_2Cl, Ba
- Enhanced in Control Rainwater
  - Significant peaks: none
  - Minor peaks: none

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)

MR5r vs. MR5c – Negative Ions

- Enhanced in Milky Rain
  - Significant peaks: many carbonaceous, O, OH, F, CN, Cl, CNO, AlO/CH_3COH, SiO, CHOO/HCO_2, nitrate (-46, -62), NaCl, SiO_2, Si_2O, SiO_3, Si_2O_2, $NaCl_2$, $AlSiO_4$, Si_2O_5, HSi_2O_5, Si_3O_4, $AlSi_2O_6$
  - Minor peaks: $AlSiO_3$, Si_2O_3
- Enhanced in Control Rainwater
  - Significant peaks: none
  - Minor peaks: none

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)

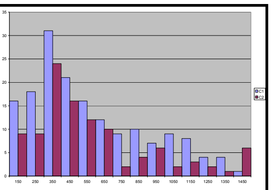
Comparison with Playa Samples from Tom Gill

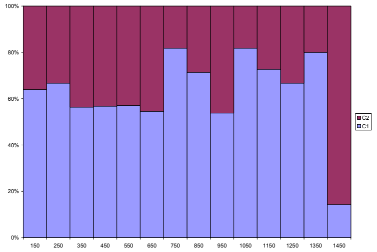
Descriptions:

- Lordsburg Sample #2:
  - Lordsburg Playa (usually dry lake bed of Pleistocene Lake Animas), western New Mexico, Joel Gilbert's site WP18, northwest of Lordsburg, New Mexico: surface material from 2nd playa north of Interstate 10. Known dust source area. Possible but unlikely source area of the "Milky Rain" of January 2008.
- Lordsburg Sample #8:
  - Lordsburg Playa (usually dry lake bed of Pleistocene Lake Animas), western New Mexico, Joel Gilbert's site 4145, northwest of Lordsburg, New Mexico: surface material collected from south playa just north of Interstate 10. North 32.280 latitude by West 108.885 longitude. Known dust source area. Possible but unlikely source area of the "Milky Rain" of January 2008.
- Willcox Playa
  - Surface sediment from the Willcox Playa (Pleistocene Lake Cochise, now a usually-dry lake), Cochise County, Arizona. Known dust source area. Collected in May 2008. Potential source of the "Milky Rain" of January 2008.

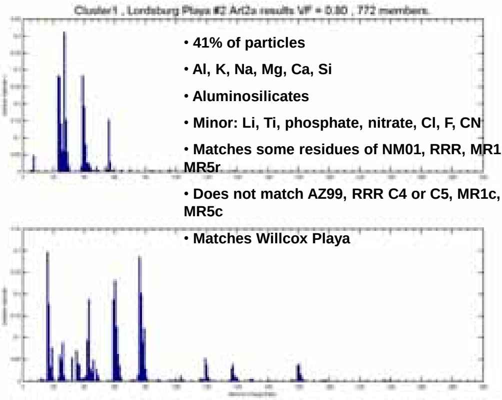
Lordsburg Playa #2

- Top 2 clusters each contribute >5% of total counts each
- Each have similar size range



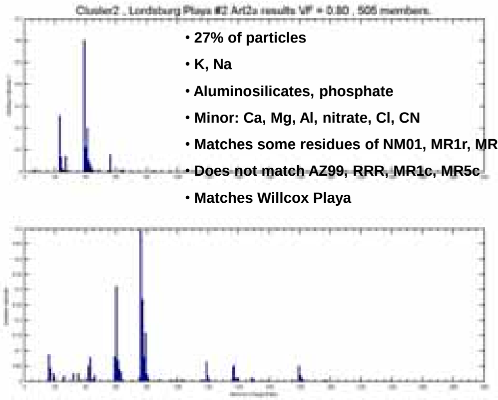


Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



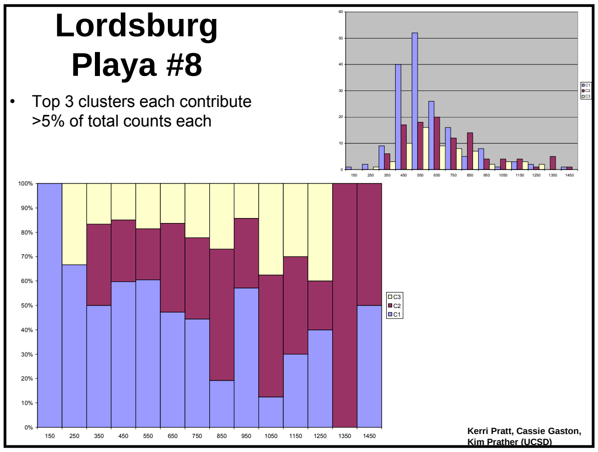
- 41% of particles
- Al, K, Na, Mg, Ca, Si
- Aluminosilicates
- Minor: Li, Ti, phosphate, nitrate, Cl, F, CN
- Matches some residues of NM01, RRR, MR1r, MR5r
- Does not match AZ99, RRR C4 or C5, MR1c, MR5c
- Matches Willcox Playa

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



- 27% of particles
- K, Na
- Aluminosilicates, phosphate
- Minor: Ca, Mg, Al, nitrate, Cl, CN
- Matches some residues of NM01, MR1r, MR5r
- Does not match AZ99, RRR, MR1c, MR5c
- Matches Willcox Playa

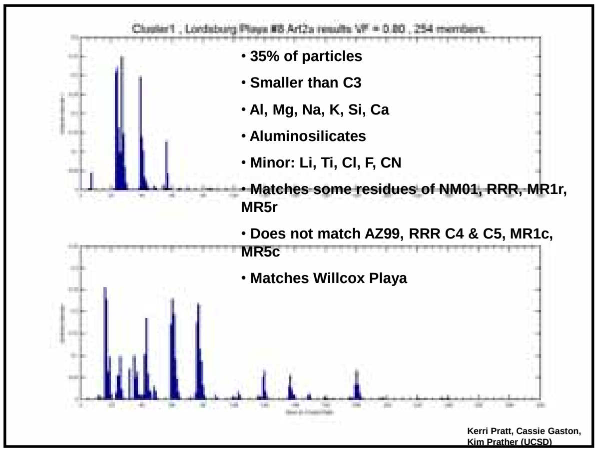
Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



Lordsburg Playa #8

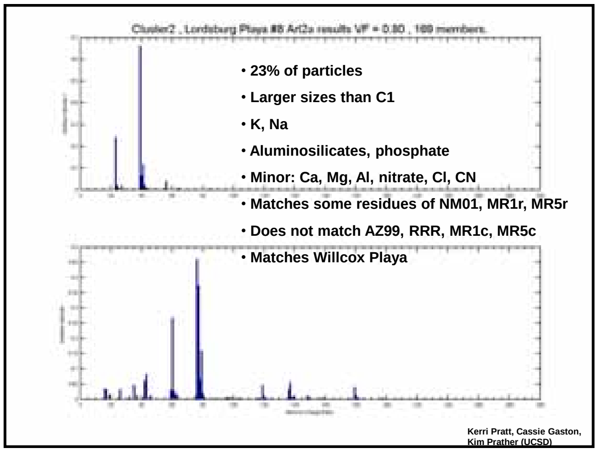
- Top 3 clusters each contribute >5% of total counts each

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



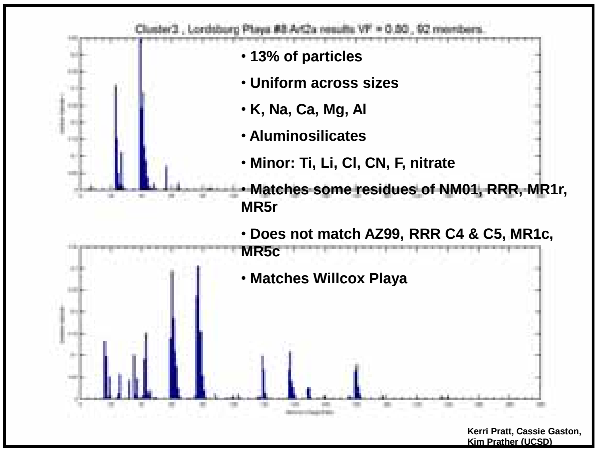
- 35% of particles
- Smaller than C3
- Al, Mg, Na, K, Si, Ca
- Aluminosilicates
- Minor: Li, Ti, Cl, F, CN
- Matches some residues of NM01, RRR, MR1r, MR5r
- Does not match AZ99, RRR C4 & C5, MR1c, MR5c
- Matches Willcox Playa

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



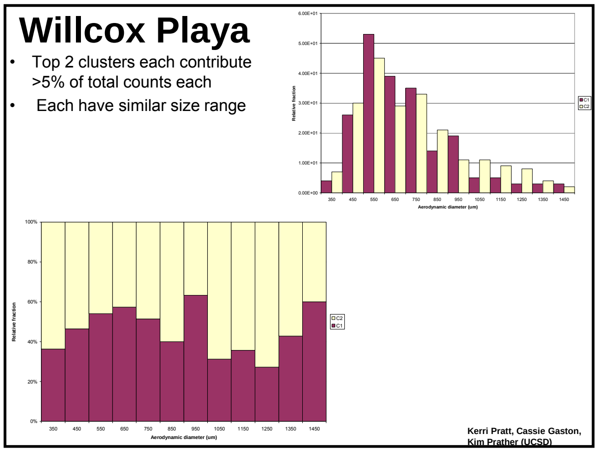
- 23% of particles
- Larger sizes than C1
- K, Na
- Aluminosilicates, phosphate
- Minor: Ca, Mg, Al, nitrate, Cl, CN
- Matches some residues of NM01, MR1r, MR5r
- Does not match AZ99, RRR, MR1c, MR5c
- Matches Willcox Playa

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



- 13% of particles
- Uniform across sizes
- K, Na, Ca, Mg, Al
- Aluminosilicates
- Minor: Ti, Li, Cl, CN, F, nitrate
- Matches some residues of NM01, RRR, MR1r, MR5r
- Does not match AZ99, RRR C4 & C5, MR1c, MR5c
- Matches Willcox Playa

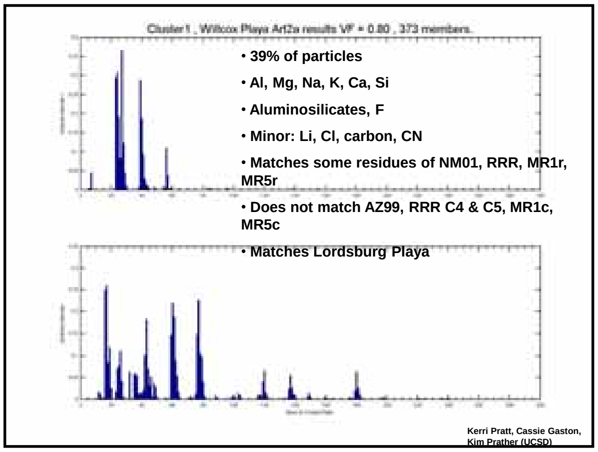
Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



Willcox Playa

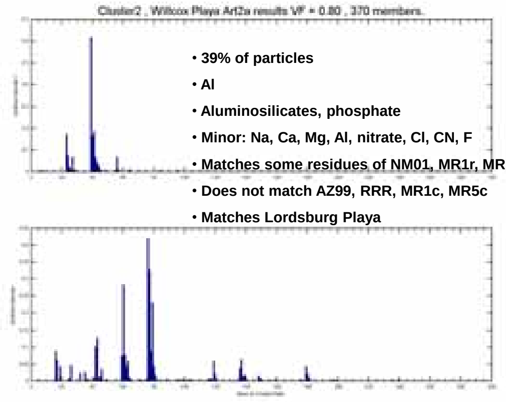
- Top 2 clusters each contribute >5% of total counts each
- Each have similar size range

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



- 39% of particles
- Al, Mg, Na, K, Ca, Si
- Aluminosilicates, F
- Minor: Li, Cl, carbon, CN
- Matches some residues of NM01, RRR, MR1r, MR5r
- Does not match AZ99, RRR C4 & C5, MR1c, MR5c
- Matches Lordsburg Playa

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)



- 39% of particles
- Al
- Aluminosilicates, phosphate
- Minor: Na, Ca, Mg, Al, nitrate, Cl, CN, F
- Matches some residues of NM01, MR1r, MR5r
- Does not match AZ99, RRR, MR1c, MR5c
- Matches Lordsburg Playa

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)

CCN activation of playa samples following Petters & Kreidenweis 2007

- More CCN-active = higher κ (NaCl = ~1.2)
- Dust generally assumed to be κ = 0
- However, some playa salts can be CCN-active (up to κ ~0.95) (Koehler et al 2007; Pratt et al, in prep.)

- Lordsburg & Willcox playa samples were found to be fairly CCN in-active:
  - Lordsburg Playa #2: κ = 0.0023 (0.0020-0.0027)
  - Lordsburg Playa #8: κ = 0.0035 (0.0034-0.0036)
  - Willcox Playa: κ = 0.0016 (0.0014-0.0017)

Kerri Pratt, Cassie Gaston, Kim Prather (UCSD)

ARCADIS

Appendix B

Precipitation Contribution of Alkalinity and Acidity to STSIU Soils

Appendix B: Precipitation Contribution of Alkalinity and Acidity to STSIU Soils

This appendix details the chemistry of rainfall, both the white rain and typical acidic rains, and its possible chemical interactions with STSIU soils that produced the results observed in this report. The "passivation" of sulfide minerals in the soil, which is the ability of alkaline minerals to form protective iron oxyhydroxide (FeOOH) coatings on the sulfides when sulfide and alkaline minerals come in contact and react, is also discussed. The coatings decrease reactivity of the sulfides and resulting acid generation, thereby facilitating persistence of pH increases.

"White Rain" Contribution

To assess whether the white rain carried enough calcium carbonate to achieve observed pH increases of 1 or 2 S.U. in the soil, the following "ballpark" calculations were performed.

Question: How much calcium carbonate ($CaCO_3$) solids would be needed in rainfall to increase alkalinity and thus, the pH of a saturated paste of a soil sample (paste pH) from pH 3.5 to 5.5?

Assumptions:

1. 1 cm rainfall, which is the amount of 2008 white rain precipitation (i.e., 10 liters [L] of rainfall on a 1 square meter [m^2] plot of soil].

2. 6 inch (15 cm) soil depth (based on depth sampled for soil chemistry).

3. Soil paste prepared by mixing 20 mL of water with 20 grams (g) of soil (or 0.01 L/0.01 kg), which could mimic some soil water.

4. 240 kilograms (kg) soil in a 1-m^2 plot of soil that is 15 cm deep (assumes a soil bulk density of 1.6 g per cubic centimeter [g/cm^3]).

5. Increasing pH by 2 S.U. effectively neutralizes all the acidity as protons (H^+) (i.e., 99% of H^+ neutralized).

Calculations:

240 kg soil x ($10^{-3.5}$ moles H^+/L soil paste water) x (0.01 L soil paste water/0.01 kg soil) = $7.59x10^{-2}$ moles H^+

$7.59x10^{-2}$ moles H^+ x (1 mole CO_3^{2-}/2 moles H^+) = $3.79x10^{-2}$ moles carbonate ($CO_3^{2-)}$

$3.79x10^{-2}$ moles CO_3^{2-} x (1 mole $CaCO_3$/1 mole CO_3^{2-}) x (40.08 g Ca^{2+}/1 mole $CaCO_3$) = 1.52 g calcium ions (Ca^{2+})

1.52 g Ca^{2+}/10 L of rain = 0.152 g Ca/L rain = 152 mg Ca^{2+}/L of rain

152 mg Ca^{2+}/L of rain x (100 mg $CaCO_3$/40 mg Ca^{2+}) = 380 mg $CaCO_3$/L of rain

Answer: In order to raise the pH of a saturated paste from 3.5 to 5.5, 1 L of rain requires 380 mg of calcium carbonate (or 152 mg Ca^{2+}).

Interpretation:

To neutralize a 6-inch deep, 1-m^2 volume of soil, with a paste pH of 3.5 up to a pH of 5.5, a 1-cm rainfall would require 152 mg Ca^{2+}/L, assuming all the Ca^{2+} is from $CaCO_3$. If dissolved in the rainwater or soil water, that would mean its alkalinity and hardness would be 380 mg/L as $CaCO_3$ -- which would be a hard-water, alkaline rain.

However, that soil-paste pH increase might be transitory, because only active acidity would be neutralized. Acid-generating components and minerals in the soil might gradually produce additional H^+ that may need more $CaCO_3$ to avoid a subsequent pH decrease. Therefore, likely the rain carried much more calcium carbonate residue to maintain a longer-term elevated soil paste pH.

Though sampling produces variable results, Figure B-1 shows total calcium concentrations increased in the soil (0-6" depth) for some of the amendment study locations after the white rain. The magnitude of the increase probably was lower than the natural variability produced from sampling error, explaining why some plots do not show an increase. Nonetheless, assume the soils increased in Ca^{2+} concentration by at least 50 mg/kg (and thus calcium carbonate increased by 125 mg/L), which is much lower than natural variability and the magnitude of increases seen in the Northeast and North plots in Figure B-1. This amount should offset the active acidity as discussed below.

Question: How much total calcium (Ca, dissolved and particulate) would the rainwater have to carry to increase total calcium concentration in the soil by 50 mg/kg?

Calculations:

Using assumptions above:

50 mg Ca/kg soil = 0.05 g Ca/kg soil

If 10 L of water percolates into 240 kg of soil, 240 kg soil/10 L of rain = 24 kg soil/L of rain

0.05 g Ca/kg soil x 24 kg soil/L of rain = 1.2 g Ca/L of rain

Assuming all the Ca was present as $CaCO_3$ particles, and dried $CaCO_3$ has a bulk density of 1.09 g/cm^3 (the bulk density of limestone dust, http://www.engineeringtoolbox.com/density-materials-d_1652.html), the 10 L of rain falling on 1 m^2 would have left an approximately 0.028-mm-thick layer of $CaCO_3$ dust after the rain dried, based on the following calculation:

1.2 g Ca/L x 10 L rain/m^2 x 2.5 g $CaCO_3$/g Ca = 30 g $CaCO_3$/m^2

30 g $CaCO_3$/m^2 x 1 cm^3 $CaCO_3$ dust/1.09 g $CaCO_3$ x 1 m^2/10^4 cm^2 x 10 mm/cm = 0.028 mm $CaCO_3$ dust

Answer:

To add an additional 0.05 g of calcium to 1 kg of soil (equivalent to 50 mg Ca/kg soil), 1.2 g Ca/L of rain is required (i.e., 1,200 mg of calcium per liter of rainwater).

Interpretation:

1,200 mg Ca/L in rain is high but not an inconceivable suspended solids load, considering the rain was described by locals as leaving residue like a thin film of liquid white paper on cars. That observation is consistent with the calculated thin layer of $CaCO_3$ (approximately 0.028 mm) that would have been left on surfaces after the rain dried. For comparison, suspended solids concentrations in urban rainstorm runoff have ranged from 500 to 3,000 mg/L (Field et al. 2000), which is turbid to muddy water. Other particles were in the "white" rainwater in addition to calcium (see Appendix A identifying the other dissolved constituents, most of which would have originated from dissolution of particles), but calcium content in undissolved particles probably was still greater than the 152 mg Ca/L that might be needed to neutralize the active acidity in the soil water/paste. The calculations above suggest that the rainwater could carry much more than 152 mg/L and had enough particles dissolve in the soil to neutralize the potential acidity released over time. In conclusion, there could be enough calcium carbonate in suspended solids of the white rain to consume active acidity in the soil water as well as the potential acidity produced by the more oxidizing soil sulfide minerals to raise the pH by 1 or 2 S.U. and then sustain the increased pH.

Dissolved Alkalinity in the "White Rain"

Question: What is the tons/acre of dissolved alkalinity delivered by the white rain (referred to in Section 1.1 of the main text of this report), and its effect on soil pH?

Based on Table A-1 in Appendix A, average dissolved bicarbonate concentration is (36+43)/2 = 39.5 mg HCO_3^-/L, which is converted to alkalinity as 39.5/1.22 = 32.4 mg/L as $CaCO_3$.

Assumptions:

0.4 inches of precipitation (0.0333 ft)

Alkalinity in white rain of 32.4 mg/L as $CaCO_3$

Rain falls on 0.25 acre amendment study plot = 10,890 ft^2

Liters of total rainwater per plot = 10,890 ft^2 x 0.0333 ft precipitation = 362.64 ft^3 = 10,269 L

Calculations:

mg $CaCO_3$/acre = (32.4 mg $CaCO_3$/L x 10,269 L) / 0.25 acre = 1.33x 10^6 mg/acre

Tons $CaCO_3$/acre = 1.33x10^6 mg x (1 short ton/ 9.072x10^8 mg) = 0.00147 T/acre

Answer: Tons as $Ca(OH)_2$ = 0.00147/1.35 = 0.00109 T/acre ($Ca(OH)_2$ has 135% $CaCO_3$ equivalent)

Interpretation: This dissolved bicarbonate concentration would increase the pH of the saturated paste water from 3.50 to 3.54, because it is only 8.5 percent of the alkalinity needed to increase pH by 2 units from 3.5 to 5.5 (see above). However, the control rain samples had only slightly lower dissolved bicarbonate concentrations (average = 35 mg/L). Therefore, the dissolved bicarbonate increase due to white rain above the control concentration would be 4.5 mg/L instead of 39.5 mg/L, thus decreasing this small effect further to practically no effect. Moreover, at 25ºC and a CO_2 partial pressure of 0.00038 atmospheres (current average at sea level), the theoretical dissolved bicarbonate concentration would be 5.5 mg/L (calculated with Equation 8a on page 160 in Stumm and Morgan 1996). In the elevation range at the STSIU (approximately 1,800-2,000 m), the atmospheric and CO_2 partial pressures would be approximately 80% of the sea-level pressures, thus making the theoretical dissolved bicarbonate concentration approximately 4.4 mg/L. That concentration is much lower than the estimates in Table A-1 and makes the dissolved bicarbonate concentrations of the two white rain and control samples at Tyrone and Hurley suspect. Unfortunately, bicarbonate concentrations were not reported for the more reliable National Acid Deposition Program (NADP) NM01 sample in Table A-1. In conclusion, even with the elevated bicarbonate concentration estimates, the dissolved alkalinity contribution is very small, suggesting the suspended solid load is the driver that is affecting pH changes.

Typical "Acidic" Rains

Another important question is whether over time the acidity of the rainfall will reduce the benefit from the white rain.

Question: Can the pool of H^+ ions and ions contributing to alkalinity in annual loading of rainwater to the soils reduce the soil pH elevated by white rain?

Calculations:

To answer this question requires looking at local precipitation data and the ABA results for the soils. Precipitation data from the NADP monitoring site at Gila Cliff Dwellings National Monument (NADP Site NM01; http://nadp.sws.uiuc.edu/data/sites/siteDetails.aspx?net=NTN&id=NM01) include the annual precipitation amounts and precipitation-volume-weighted average H^+ concentrations in the rainfall (Tables B-1 and B-2). These values and the calculated precipitation-volume-weighted average pH of the rainfall for calendar years 2006 through 2012 are listed in Table B-3. From the annual precipitation amounts and volume-weighted average H^+ concentrations in the rainfall, the annual loading of H^+ per acre can be estimated. These values are only estimates, because pH was not measured in all rainfall events; thus, the annual volume-weighted average H^+ concentrations in the rainfall might be biased slightly upward or downward, depending on the pH of the unmeasured rainfall.

From the weekly precipitation-volume-weighted average concentrations of Ca, Mg, Na, K, Cl, NO_3, and SO_4 reported by NADP, the weekly precipitation-volume-weighted average alkalinity of the rainfall can be calculated using Equation 14 on page 165 in Stumm and Morgan (1996); and from those weekly values and the NADP-reported weekly precipitation amounts, the annual loading of alkalinity per acre can be estimated. For these calculations, only weeks that had positive alkalinity values were included, thus reflecting addition of alkalinity that could neutralize acid. These annual alkalinity loadings are underestimates of the actual alkalinity loadings because Ca, Mg, Na, K, Cl, NO_3, and SO_4 were not measured in all rainfall events, thus precluding inclusion of those individual alkalinity loadings in the annual estimates. The annual alkalinity loading estimates are listed in Table B-3, and shown in Figure B-2. Note that a rain can be considered alkaline when pH > 6.5 (Figure B-2), which is not common. The white rain had a very high pH of 7.2.

The net H^+ loading ranged from 3 to 18 equivalents per acre per year and the net alkalinity loading ranged from 0.5 to 16 equivalents per acre per year. For comparison, the average net neutralizing potential (NNP) of soils measured at sites in the vicinity of the STSIU ranged from -298,000 to 3,704,000 equivalents per acre, with most values in the positive or negative 10,000-100,000 equivalents per acre range (Table B-4). Therefore, the annual H^+ and alkalinity loadings from rainfall are very small percentages of the NNP in all of the soils, even if added up over 100 years. The addition of H^+ in rainfall will not change the potential acidity of the soils because acidity likely is driven mainly by weathering of sulfide minerals, which overwhelms the contribution from the rain.

Answer: It is unlikely the rainwater annually falling on the STSIU will reduce the pH of the soil because the soil's potential acidity from sulfide minerals is orders of magnitude larger than the contribution from the rainwater.

"White Rain" Passivating Sulfide Minerals: The Chemistry of a Permanent pH Change

In addition to direct neutralization of hydrogen ions produced by the sulfide minerals, the white rain may be decreasing the reactivity of the sulfide minerals through "passivation", reducing acid production in the soil. The chemical explanation is as follows.

The oxidation of iron and copper sulfide minerals occurs at the mineral surface, with the release of acid (i.e., H^+ ions) and oxidized forms of sulfur into the soil solution. Other oxidation products also accumulate at the surface of the iron and copper sulfide minerals and affect the reactivity of the minerals. The oxidation products have been studied at pH 2 to 10 using analytical methods sensitive enough to probe the atoms present at the pyrite and chalcopyrite surface (Todd et al., 2003a, 2003b). At low pH (<4), ferric (hydroxyl)sulfate is the predominant oxidation product; however, at higher pH, ferric (oxy)hydroxide (FeOOH) forms. These products accumulate at the surface of the metal sulfide and affect the reactivity of the metal sulfide. The alkaline minerals in the white rain were comprised of a range of particle sizes including submicron particles; due to their high surface area, these would have reacted rapidly in the soil but the larger particles would have reacted more slowly. Oxidation of the metal sulfides in soil in the presence of the alkaline minerals likely resulted in the accumulation of ferric iron minerals at the metal sulfide mineral surfaces. In the neutral-pH soil environment (and likely alkaline micro-environment) conferred by the white rain particles, the oxidation products such as goethite (α-FeOOH) and hematite (Fe_2O_3) can passivate the metal sulfide surface resulting in decreased reactivity of the metal sulfides. The formation of these oxidation products results in acid-generating reactions being slowed significantly due to the surface "coating" on the metal sulfides created by the oxidation products (Nicholson et al., 1990). This passive coating that forms at circumneutral pH has been shown in pure systems using chalcopyrite and electrochemical methods (Yin et al., 1995). The reaction between metal sulfides and alkaline minerals and the accumulation of oxidation products at the surface of the sulfides occurs at a microscopic scale. At the field scale, oxidation products have been observed in sulfidic tailings, and include metal hydroxides, gypsum, siderite and other mineral phases (Lindsay et al., 2015). FeOOH are very abundant in STSIU soils (see Appendix D) and are sorbed onto copper sulfides (John Drexler, personal communication). Therefore, alkaline minerals deposited into the soil by the white rain can limit realization of acid generating potential and result in sustained maintenance of elevated soil pH.

References

Field R., J.P. Heany, and R. Pitt. 2000. Innovative urban wet weather flow management systems. Technomic Publishing Company, PA. http://books.google.com/books?id=g8k9GIL40TYC&q=3%2C000#v=snippet&q=3%2C000&f=false

Lindsay, M.B.J., Moncur, M.C., Bain, J.C., Jambor, J.L., Ptacek, C.J., and Blowes, D.W. 2015. Geochemical and mineralogical aspects of sulfide mine tailings. Applied Geochemistry (in press).

Nicholson, R.V., Gilham, R.V., Reardon, E.J. 1990. Pyrite oxidation in carbonate-buffered solutions: 2. rate control by oxide coatings. Geochimica et Cosmochimica Acta. 54: 395-402.

Stumm, W. and J.J. Morgan. 1996. Aquatic Chemistry: Chemical Equilibria and Rates in Natural Waters. Third Edition. John Wiley and Sons, Inc., New York.

Todd, E.C., Sherman, D.M., and Purton, J.A. 2003a. Surface oxidation of pyrite under ambient atmospheric and aqueous (pH 2 to 10) conditions: Electronic structure and mineralogy from X-ray absorption spectroscopy. Geochimica et Cosmochimica Acta, 67 (5): 881–893.

Todd, E.C., Sherman, D.M., and Purton, J.A. 2003b. Surface oxidation of chalcopyrite ($CuFeS_2$) under ambient atmospheric and aqueous (pH 2-10) conditions: Cu, Fe L- and O K-edge X-ray spectroscopy. Geochimica et Cosmochimica Acta, 67 (12): 2137–2146.

Yin, Q., Kelsall, G.H., Vaughan, D.J., and England, K.E.R. 1995. Atmospheric and electrochemical oxidation of the surface of chalcopyrite (CuFeS2). Geochimica et Cosmochimica Acta 59 (6): 1091-1100.

Table B-1
Rainwater Chemistry at Gila Cliffs Dwelling National Monument, Station NM01

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

			Ca	Mg	K	Na	NH4	NO3	Cl	SO4	pH			Conductivity			Sample Vol.	Precip	sub_ppt					Calc. Ca	Calc. Mg	Calc. K	Calc. Na	Calc. NH4	Calc. NO3
Site ID	Date On	Date Off	mg/L								Lab	Field	FV	Lab	Field	FV	ml	mm	mm	Lab Type	Val Code	Inval code	Notes	(mN)	(mN)	(mN)	(mN)	(mN)	(mN)
NM01	12/27/05	01/03/06	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	01/03/06	01/11/06	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	01/11/06	01/18/06	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	01/18/06	01/24/06	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	01/24/06	01/31/06	0.09	0.006	0.007	0.023	0.069	0.503	0.053	0.346	5.04	--	-	7	--	-	733	10.67	10.668	w	w			0.004491242	0.000493726	0.000179037	0.001000435	0.003833333	0.008112249
NM01	01/31/06	02/07/06	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	02/07/06	02/14/06	0.749	0.074	0.074	0.072	< 0.007	< 0.029	0.148	1.346	5.82	--	-	7.1	--	-	32.5	0.51	0.508	wd	wd			0.037377115	0.006089282	0.00189268	0.003131796	0.000194444	0.000233852
NM01	02/14/06	02/21/06	--	--	--	--	--	--	--	--	--	--	-	--	--	-	3.4	-7	0.127	t	t			NA	NA	NA	NA	NA	NA
NM01	02/21/06	02/28/06	0.091	0.008	0.024	0.023	0.211	0.587	0.057	0.649	5	--	-	7.6	--	-	287.8	4.32	4.318	w	w			0.004541145	0.000658301	0.000613842	0.001000435	0.011722222	0.009466978
NM01	02/28/06	03/07/06	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	03/07/06	03/14/06	1.076	0.119	0.143	0.577	0.142	0.571	1.029	1.138	6.52	--	-	12.6	--	-	491	7.11	7.112	w	w			0.053695294	0.009792224	0.003657476	0.025097869	0.007888889	0.009208935
NM01	03/14/06	03/21/06	0.66	0.105	0.099	0.644	0.583	1.775	1.063	2.025	5.75	--	-	16.2	--	-	51.7	0.76	0.762	w	w			0.032935775	0.008640197	0.002532099	0.028012179	0.032388889	0.028626724
NM01	03/21/06	03/28/06	--	--	--	--	--	--	--	--	--	--	-	--	--	-	1.9	-7	0.127	t	t			NA	NA	NA	NA	NA	NA
NM01	03/28/06	04/04/06	0.065	0.008	0.003	0.014	0.004	0.161	0.054	0.161	5.16	--	-	4.3	--	-	70.4	1.02	1.016	w	w			0.003243675	0.000658301	7.67303E-05	0.00060896	0.000222222	0.002596565
NM01	04/04/06	04/11/06	1.499	0.097	0.11	0.087	0.039	2.982	0.325	2.07	4.94	--	-	18.3	--	-	169.1	2.54	2.54	w	w			0.074804132	0.007981897	0.002813443	0.003784254	0.002166667	0.048092896
NM01	04/11/06	04/18/06	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	04/18/06	04/25/06	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	04/25/06	05/02/06	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	-7	0.127	d	t			NA	NA	NA	NA	NA	NA
NM01	05/02/06	05/08/06	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	05/08/06	05/16/06	--	--	--	--	--	--	--	--	--	--	-	--	--	-	219	3.05	3.048	w		c	ns	NA	NA	NA	NA	NA	NA
NM01	05/16/06	05/23/06	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	05/23/06	05/30/06	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	05/30/06	06/06/06	--	--	--	--	--	--	--	--	--	--	-	--	--	-	1.8	-7	0.127	t	t			NA	NA	NA	NA	NA	NA
NM01	06/06/06	06/13/06	--	--	--	--	--	--	--	--	--	--	-	--	--	-	82.1	1.27	1.27	w		c	ns	NA	NA	NA	NA	NA	NA
NM01	06/13/06	06/20/06	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	06/20/06	06/27/06	0.849	0.058	0.069	0.068	0.849	2.436	0.117	1.487	6.1	--	-	14.2	--	-	355	5.08	5.08	w	w			0.042367384	0.004772681	0.001764796	0.002957808	0.047166667	0.039287154
NM01	06/27/06	07/03/06	--	--	--	--	--	--	--	--	6.14	--	-	29.2	--	-	16.1	-7	0.127	t	t			NA	NA	NA	NA	NA	NA
NM01	07/03/06	07/11/06	0.067	0.005	0.009	0.007	0.377	0.88	0.025	0.6	5.14	--	-	6.8	--	-	2546.6	37.59	37.592	w	w			0.00334348	0.000411438	0.000230191	0.00030448	0.020944444	0.014192404
NM01	07/11/06	07/19/06	0.687	0.072	0.043	0.26	3.156	4.053	0.298	1.919	6.62	--	-	29	--	-	49.8	0.76	0.762	w	w			0.034283148	0.005924707	0.001099801	0.011309265	0.175333333	0.065365696
NM01	07/19/06	07/25/06	0.38	0.02	0.012	0.044	0.296	1.339	0.075	0.671	5.3	--	-	7.9	--	-	542.2	7.87	7.874	w	w			0.018963022	0.001645752	0.000306921	0.001913876	0.016444444	0.021595033
NM01	07/25/06	08/01/06	0.04	0.005	0.009	0.017	0.171	0.918	0.041	0.33	4.93	--	-	7.4	--	-	2137.2	31.5	31.496	w	w			0.001996108	0.000411438	0.000230191	0.000739452	0.0095	0.014805258
NM01	08/01/06	08/09/06	0.073	0.007	0.009	0.031	0.208	0.997	0.074	0.471	4.89	--	-	8.2	--	-	1762.4	25.91	25.908	w	w			0.003642896	0.000576013	0.000230191	0.001348412	0.011555556	0.016079348
NM01	08/09/06	08/15/06	0.036	0.004	0.007	0.01	0.078	0.928	0.038	0.331	4.77	--	-	8.6	--	-	1803.5	26.16	26.162	w	w			0.001796497	0.00032915	0.000179037	0.000434972	0.004333333	0.014966535
NM01	08/15/06	08/23/06	0.043	0.003	0.006	0.015	0.075	0.953	0.043	0.337	4.79	--	-	8.8	--	-	1924	28.19	28.194	w	w			0.002145816	0.000246863	0.000153461	0.000652458	0.004166667	0.015369728
NM01	08/23/06	08/29/06	0.157	0.018	0.024	0.059	0.273	1.66	0.115	0.862	4.61	--	-	14	--	-	423.4	6.1	6.096	w	w			0.007834722	0.001481177	0.000613842	0.002566333	0.015166667	0.026772035
NM01	08/29/06	09/12/06	--	--	--	--	--	--	--	--	--	--	-	--	--	-	3862	56.9	56.896	w		e		NA	NA	NA	NA	NA	NA
NM01	09/12/06	09/21/06	--	--	--	--	--	--	--	--	--	--	-	--	--	-	2072.5	29.21	29.21	w		e		NA	NA	NA	NA	NA	NA
NM01	09/21/06	09/26/06	--	--	--	--	--	--	--	--	--	--	-	--	--	-	6.5	-7	0.127	t	t			NA	NA	NA	NA	NA	NA
NM01	09/26/06	10/03/06	--	--	--	--	--	--	--	--	--	--	-	--	--	-	--	0	0	q	d			NA	NA	NA	NA	NA	NA
NM01	10/03/06	10/10/06	0.222	0.012	0.015	0.064	0.186	0.475	0.076	0.534	5.61	--	-	4.4	--	-	1575.9	36.83	36.83	w	w			0.011078397	0.000987451	0.000383651	0.002783819	0.010333333	0.007660673
NM01	10/10/06	10/17/06	0.103	0.01	0.008	0.033	0.239	0.56	0.074	0.499	5.37	--	-	5.5	--	-	132.6	1.78	1.778	w	w			0.005139977	0.000822876	0.000204614	0.001435407	0.013277778	0.00903153
NM01	10/17/06	10/24/06	0.064	0.008	0.025	0.071	0.131	0.265	0.108	0.344	5.53	--	-	3.7	--	-	185.5	2.54	2.54	w	w			0.003193772	0.000658301	0.000639419	0.003088299	0.007277778	0.004273849
NM01	10/24/06	10/30/06	0.05	0.003	0.003	0.003	0.161	0.386	0.018	0.194	5.51	--	-	3.3	--	-	474.3	6.86	6.858	w	w			0.002495134	0.000246863	7.67303E-05	0.000130492	0.008944444	0.006225304
NM01	10/30/06	11/07/06	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	11/07/06	11/14/06	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	11/14/06	11/21/06	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	11/21/06	11/29/06	0.436	0.094	0.09	0.664	0.345	1.317	1.103	1.584	5.33	--	-	14	--	-	63.4	2.03	2.032	w	w			0.021757573	0.007735034	0.002301908	0.028882123	0.019166667	0.021240223
NM01	11/29/06	12/05/06	--	--	--	--	--	--	--	--	--	--	-	--	--	-	2.3	-7	0.127	t	t			NA	NA	NA	NA	NA	NA
NM01	12/05/06	12/12/06	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	12/12/06	12/19/06	0.179	0.037	0.03	0.262	0.228	0.817	0.346	1.398	4.83	--	-	12	--	-	581.3	8.38	8.382	w	w			0.008932581	0.003044641	0.000767303	0.011396259	0.012666667	0.013176357
NM01	12/19/06	12/26/06	--	--	--	--	--	--	--	--	--	--	-	--	--	-	5.8	-7	0.127	t	t			NA	NA	NA	NA	NA	NA
NM01	12/26/06	01/02/07	0.187	0.019	0.034	0.062	0.148	0.69	0.101	0.271	5.71	--	-	4.1	--	-	130.4	1.78	1.778	w	w			0.009331803	0.001563464	0.00086961	0.002696825	0.008222222	0.011128135
NM01	01/02/07	01/09/07	0.073	0.007	0.046	0.041	0.036	0.521	0.082	0.283	5.02	--	-	5.6	--	-	129.6	1.78	1.778	w	w			0.003642896	0.000576013	0.001176531	0.001783384	0.002	0.008402548
NM01	01/09/07	01/16/07	0.511	0.059	0.086	0.386	0.534	1.093	0.395	1.258	6.23	--	-	10.4	--	-	111.6	1.52	1.524	w	w			0.025500274	0.004854968	0.002199601	0.016789909	0.029666667	0.017627611
NM01	01/16/07	01/25/07	--	--	--	--	--	--	--	--	--	--	-	--	--	-	1777	24.89	24.892	w		e		NA	NA	NA	NA	NA	NA
NM01	01/25/07	01/30/07	0.033	0.002	0.004	0.005	0.061	0.25	0.017	0.199	5.16	--	-	3.8	--	-	206.3	3.05	3.048	w	w			0.001646789	0.000164575	0.000102307	0.000217486	0.003388889	0.004031933
NM01	01/30/07	02/06/07	0.035	0.003	0.006	0.021	0.079	0.321	0.045	0.319	5.14	--	-	4.4	--	-	504.7	7.37	7.366	w	w			0.001746594	0.000246863	0.000153461	0.000913441	0.004388889	0.005177002
NM01	02/06/07	02/13/07	0.078	0.01	0.011	0.056	0.263	0.66	0.081	0.747	4.86	--	-	9.5	--	-	557	8.13	8.128	w	w			0.00389241	0.000822876	0.000281344	0.002435842	0.014611111	0.010644303
NM01	02/13/07	02/19/07	0.128	0.016	0.016	0.088	0.271	0.963	0.155	0.882	4.99	--	-	8.8	--	-	94.2	1.27	1.27	w	w			0.006387544	0.001316602	0.000409228	0.003827751	0.015055556	0.015531006
NM01	02/19/07	02/27/07	0.748	0.097	0.06	0.556	0.281	1.681	0.638	1.33	6.03	--	-	11.7	--	-	114.3	1.52	1.524	w	w			0.037327212	0.007981897	0.001534605	0.024184428	0.015611111	0.027110717
NM01	02/27/07	03/05/07	--	--	--	--	--	--	--	--	--	--	-	--	--	-	1.7	0	0	t	d			NA	NA	NA	NA	NA	NA
NM01	03/05/07	03/13/07	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	03/13/07	03/20/07	--	--	--	--	--	--	--	--	--	--	-	--	--	-	--	0	0	q	d			NA	NA	NA	NA	NA	NA
NM01	03/20/07	03/27/07	0.176	0.016	0.025	0.036	0.083	1.009	0.105	0.399	4.88	--	-	7.8	--	-	1130.8	16.51	16.51	w	w			0.008782873	0.001316602	0.000639419	0.001565898	0.004611111	0.016272881
NM01	03/27/07	04/03/07	--	--	--	--	--	--	--	--	--	--	-	--	--	-	9.6	0.25	0.254	t		v		NA	NA	NA	NA	NA	NA
NM01	04/03/07	04/10/07	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	04/10/07	04/17/07	0.563	0.074	0.044	0.313	0.05	0.606	0.501	0.682	6.04	--	-	6.9	--	-	276.4	4.06	4.064	w	w			0.028095214	0.006089282	0.001125377	0.013614615	0.002777778	0.009773405
NM01	04/17/07	04/23/07	--	--	--	--	--	--	--	--	--	--	-	--	--	-	2.5	0	0	t	d			NA	NA	NA	NA	NA	NA

Table B-1
Rainwater Chemistry at Gila Cliffs Dwelling National Monument, Station NM01

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

			Ca	Mg	K	Na	NH4	NO3	Cl	SO4	pH			Conductivity			Sample Vol.	Precip	sub_ppt					Calc. Ca	Calc. Mg	Calc. K	Calc. Na	Calc. NH4	Calc. NO3
Site ID	Date On	Date Off	mg/L								Lab	Field	FV	Lab	Field	FV	ml	mm	mm	Lab Type	Val Code	Inval code	Notes	(mN)	(mN)	(mN)	(mN)	(mN)	(mN)
NM01	04/23/07	05/01/07	0.268	0.028	0.03	0.052	0.193	0.819	0.068	0.822	5.1	--	-	7.5	--	-	1042.2	15.24	15.24	w	w			0.013373921	0.002304053	0.000767303	0.002261853	0.010722222	0.013208612
NM01	05/01/07	05/08/07	--	--	--	--	--	--	--	--	4.45	--	-	44.4	--	-	10.7	-7	0.127	t	t			NA	NA	NA	NA	NA	NA
NM01	05/08/07	05/15/07	0.626	0.053	0.109	0.077	0.412	1.989	0.168	1.385	4.88	--	-	14.3	--	-	174	2.54	2.54	w	w			0.031239084	0.004361243	0.002787866	0.003349282	0.022888889	0.032078058
NM01	05/15/07	05/23/07	0.218	0.022	0.029	0.046	0.279	0.914	0.086	0.733	5.1	--	-	7.5	--	-	1874.9	27.43	27.432	w	w			0.010878786	0.001810327	0.000741726	0.00200087	0.0155	0.014740747
NM01	05/23/07	05/29/07	--	--	--	--	--	--	--	--	--	--	-	--	--	-	45.5	0.51	0.508	w		c	ns	NA	NA	NA	NA	NA	NA
NM01	05/29/07	06/05/07	--	--	--	--	--	--	--	--	4.53	--	-	51.9	--	-	6.5	-7	0.127	t	t			NA	NA	NA	NA	NA	NA
NM01	06/05/07	06/12/07	0.12	0.012	0.021	0.045	0.156	0.455	0.077	0.605	5.1	--	-	5.9	--	-	541.3	7.87	7.874	w	w			0.005988323	0.000987451	0.000537112	0.001957373	0.008666667	0.007338118
NM01	06/12/07	06/19/07	0.179	0.026	0.034	0.084	0.005	0.674	0.124	0.589	4.79	--	-	8.8	--	-	944.1	13.72	13.716	w	w			0.008932581	0.002139477	0.00086961	0.003653763	0.000277778	0.010870091
NM01	06/19/07	06/26/07	1.315	0.098	0.084	0.152	0.168	2.011	0.205	1.509	5.76	--	-	12.3	--	-	492.1	7.11	7.112	w	w			0.065622037	0.008064184	0.002148447	0.00661157	0.009333333	0.032432868
NM01	06/26/07	07/10/07	--	--	--	--	--	--	--	--	--	--	-	--	--	-	1915	26.92	26.924	w		e		NA	NA	NA	NA	NA	NA
NM01	07/10/07	07/17/07	0.556	0.061	0.068	0.084	0.699	3.062	0.193	1.546	4.68	--	-	19.5	--	-	285.5	4.06	4.064	w	w			0.027745896	0.005019543	0.001739219	0.003653763	0.038833333	0.049383114
NM01	07/17/07	07/24/07	0.506	0.028	0.073	0.102	0.392	1.158	0.086	0.955	5.58	--	-	8.1	--	-	359.3	5.08	5.08	w	w			0.025250761	0.002304053	0.001867103	0.004436712	0.021777778	0.018675913
NM01	07/24/07	07/31/07	0.158	0.01	0.047	0.028	0.426	0.964	0.058	0.469	5.73	--	-	5.5	--	-	1116.3	14.48	14.478	w	w			0.007884625	0.000822876	0.001202108	0.001217921	0.023666667	0.015547133
NM01	07/31/07	08/07/07	0.098	0.006	0.013	0.019	0.166	0.813	0.056	0.375	4.99	--	-	6.4	--	-	759.8	7.62	7.62	w	w			0.004890464	0.000493726	0.000332498	0.000826446	0.009222222	0.013111846
NM01	08/07/07	08/14/07	0.623	0.04	0.068	0.125	2.718	5.215	0.272	1.772	5.77	--	-	28.2	--	-	17.9	0.25	0.254	wd	wd			0.031089376	0.003291504	0.001739219	0.005437147	0.151	0.08410612
NM01	08/14/07	08/20/07	0.445	0.028	0.036	0.037	0.662	1.718	0.081	2.285	4.63	--	-	18.8	--	-	319.1	4.57	4.572	w	w			0.022206697	0.002304053	0.000920763	0.001609395	0.036777778	0.027707443
NM01	08/20/07	08/28/07	0.172	0.028	0.014	0.059	0.181	1.263	0.09	0.725	4.82	--	-	10	--	-	1537.9	22.35	22.352	w	w			0.008583263	0.002304053	0.000358075	0.002566333	0.010055556	0.020369325
NM01	08/28/07	09/04/07	0.251	0.014	0.01	0.029	0.231	1.134	0.074	0.697	4.91	--	-	9	--	-	703.7	7.87	7.874	w	w			0.012525575	0.001152026	0.000255768	0.001261418	0.012833333	0.018288848
NM01	09/04/07	09/11/07	0.167	0.019	0.015	0.051	0.183	1.185	0.079	0.57	4.83	--	-	9	--	-	1089.6	16	16.002	w	w			0.008333749	0.001563464	0.000383651	0.002218356	0.010166667	0.019111362
NM01	09/11/07	09/18/07	0.44	0.06	0.069	0.189	0.713	2.979	0.338	1.362	4.71	--	-	18.9	--	-	79.8	1.02	1.016	w	w			0.021957183	0.004937256	0.001764796	0.008220966	0.039611111	0.048044513
NM01	09/18/07	09/25/07	0.081	0.007	0.012	0.031	0.257	0.527	0.057	0.636	5.29	--	-	5.4	--	-	1221.3	16.76	16.764	w	w			0.004042118	0.000576013	0.000306921	0.001348412	0.014277778	0.008499315
NM01	09/25/07	10/02/07	0.431	0.03	0.037	0.076	0.592	1.469	0.147	1.595	5.23	--	-	12.1	--	-	31.7	0.51	0.508	wd	wd			0.021508059	0.002468628	0.00094634	0.003305785	0.032888889	0.023691638
NM01	10/02/07	10/16/07	--	--	--	--	--	--	--	--	--	--	-	--	--	-	160.9	2.29	2.286	w		e		NA	NA	NA	NA	NA	NA
NM01	10/16/07	10/23/07	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	10/23/07	10/30/07	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	10/30/07	11/06/07	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	11/06/07	11/13/07	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	11/13/07	11/20/07	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	11/20/07	11/27/07	0.081	0.004	0.014	0.018	0.055	0.414	0.04	0.212	5.19	--	-	4	--	-	371.2	5.33	5.334	w	w			0.004042118	0.00032915	0.000358075	0.000782949	0.003055556	0.006676881
NM01	11/27/07	12/04/07	0.011	0.001	0.004	0.005	0.015	0.048	0.012	0.032	5.51	--	-	1.6	--	-	3114.4	46.74	46.736	w	w			0.00054893	8.22876E-05	0.000102307	0.000217486	0.000833333	0.000774131
NM01	12/04/07	12/12/07	0.024	0.01	0.153	0.034	0.018	0.036	0.06	0.126	5.52	--	-	2.6	--	-	1568.8	23.11	23.114	w	w			0.001197665	0.000822876	0.003913244	0.001478904	0.001	0.000580598
NM01	12/12/07	12/18/07	0.329	0.018	0.018	0.039	0.279	1.795	0.074	0.502	4.93	--	-	10.7	--	-	22.9	0.25	0.254	wd	wd			0.016417985	0.001481177	0.000460382	0.00169639	0.0155	0.028949278
NM01	12/18/07	12/24/07	0.104	0.007	0.017	0.022	0.082	0.736	0.045	0.457	4.96	--	-	6.8	--	-	71.9	1.02	1.016	w	w			0.00518988	0.000576013	0.000434805	0.000956938	0.004555556	0.01187001
NM01	12/24/07	12/31/07	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	12/31/07	01/08/08	5.842	0.37	0.201	3.41	< 0.004	0.05	2.32	2.087	7.2	--	-	46.5	--	-	790.1	10.16	10.16	w	w			0.291531514	0.03044641	0.005140928	0.148325359	0.000111111	0.000806387
NM01	01/08/08	01/16/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	01/16/08	01/22/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	--	0	d	d			NA	NA	NA	NA	NA	NA
NM01	01/22/08	02/05/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	1893.6	26.67	26.67	w		e		NA	NA	NA	NA	NA	NA
NM01	02/05/08	02/12/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	--	0	0	q	d			NA	NA	NA	NA	NA	NA
NM01	02/12/08	02/19/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	451.2	5.84	5.842	w		u	ns	NA	NA	NA	NA	NA	NA
NM01	02/19/08	02/26/08	0.314	0.031	0.018	0.132	0.172	1.245	0.146	0.627	4.73	--	-	13.8	--	-	34.8	0.51	0.508	wd	wd			0.015669445	0.002550915	0.000460382	0.005741627	0.009555556	0.020079026
NM01	02/26/08	03/04/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	03/04/08	03/11/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0.3	-7	0.127	t	t			NA	NA	NA	NA	NA	NA
NM01	03/11/08	03/18/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	03/18/08	03/25/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	03/25/08	04/01/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	04/01/08	04/08/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	04/08/08	04/15/08	0.575	0.088	0.024	0.27	0.07	0.995	0.427	1.253	4.97	--	-	12.1	--	-	120	1.78	1.778	w	w			0.028694047	0.007241308	0.000613842	0.011744237	0.003888889	0.016047093
NM01	04/15/08	04/22/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	04/22/08	04/29/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	04/29/08	05/06/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	05/06/08	05/13/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	05/13/08	05/20/08	0.371	0.047	0.034	0.054	0.007	0.763	0.159	0.879	4.81	--	-	9.8	--	-	144.6	2.03	2.032	w	w			0.018513898	0.003867517	0.00086961	0.002348847	0.000388889	0.012305459
NM01	05/20/08	05/27/08	0.674	0.107	0.088	0.656	0.077	0.616	1.131	0.974	6.07	--	-	10.3	--	-	898.9	12.95	12.954	w	w			0.033634413	0.008804773	0.002250755	0.028534145	0.004277778	0.009934683
NM01	05/27/08	06/03/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	06/03/08	06/10/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	06/10/08	06/17/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0.7	-7	0.127	t	t			NA	NA	NA	NA	NA	NA
NM01	06/17/08	06/24/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	106.6	1.52	1.524	w		c	ns	NA	NA	NA	NA	NA	NA
NM01	06/24/08	07/01/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	07/01/08	07/08/08	0.331	0.027	0.038	0.047	0.483	1.578	0.082	1.05	5.18	--	-	9.7	--	-	683.1	11.18	11.176	w	w			0.01651779	0.002221765	0.000971917	0.002044367	0.026833333	0.025449561
NM01	07/08/08	07/15/08	0.042	0.004	0.009	0.016	0.124	0.602	0.033	0.287	5.05	--	-	5.5	--	-	2397.2	35.31	35.306	w	w			0.002095913	0.00032915	0.000230191	0.000695955	0.006888889	0.009708894
NM01	07/15/08	07/22/08	0.115	0.013	0.033	0.02	0.073	0.664	0.044	0.339	5	--	-	6.3	--	-	2096	30.73	30.734	w	w			0.005738809	0.001069739	0.000844033	0.000869943	0.004055556	0.010708814
NM01	07/22/08	07/29/08	0.157	0.017	0.014	0.049	0.14	0.761	0.072	0.484	5.06	--	-	6.2	--	-	3039.5	56.39	56.388	w	w			0.007834722	0.001398889	0.000358075	0.002131361	0.007777778	0.012273204
NM01	07/29/08	08/05/08	0.765	0.078	0.054	0.045	0.606	2.113	0.182	1.342	5.48	--	-	12.3	--	-	78.2	1.02	1.016	w	w			0.038175558	0.006418432	0.001381145	0.001957373	0.033666667	0.034077897
NM01	08/05/08	08/12/08	0.082	0.008	0.009	0.02	0.145	0.913	0.048	0.492	4.78	--	-	8.6	--	-	3289.5	48.26	48.26	w	w			0.004092021	0.000658301	0.000230191	0.000869943	0.008055556	0.014724619
NM01	08/12/08	08/18/08	0.148	0.015	0.011	0.03	0.174	1.106	0.064	0.483	4.87	--	-	8.5	--	-	2690.2	37.59	37.592	w	w			0.007385598	0.001234314	0.000281344	0.001304915	0.009666667	0.017837271
NM01	08/18/08	09/02/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	2070.6	28.45	28.448	w		e		NA	NA	NA	NA	NA	NA
NM01	09/02/08	09/08/08	0.151	0.013	0.011	0.013	0.119	0.689	0.048	0.444	5.09	--	-	5.9	--	-	711.5	10.41	10.414	w	w			0.007535306	0.001069739	0.000281344	0.000565463	0.006611111	0.011112007
NM01	09/08/08	09/16/08	0.041	0.003	0.006	0.007	0.083	0.35	0.026	0.248	5.13	--	-	4.2	--	-	1201.9	17.78	17.78	w	w			0.00204601	0.000246863	0.000153461	0.00030448	0.004611111	0.005644706

Table B-1
Rainwater Chemistry at Gila Cliffs Dwelling National Monument, Station NM01

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

			Ca	Mg	K	Na	NH4	NO3	Cl	SO4	pH			Conductivity			Sample Vol.	Precip	sub_ppt					Calc. Ca	Calc. Mg	Calc. K	Calc. Na	Calc. NH4	Calc. NO3
Site ID	Date On	Date Off	mg/L								Lab	Field	FV	Lab	Field	FV	ml	mm	mm	Lab Type	Val Code	Inval code	Notes	(mN)	(mN)	(mN)	(mN)	(mN)	(mN)
NM01	09/16/08	09/29/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	178.1	2.54	2.54	w		e		NA	NA	NA	NA	NA	NA
NM01	09/29/08	10/14/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	3450.4	50.8	50.8	w		e		NA	NA	NA	NA	NA	NA
NM01	10/14/08	10/28/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	--	0	d	d			NA	NA	NA	NA	NA	NA
NM01	10/28/08	11/03/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	11/03/08	11/12/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	83.6	2.29	2.286	w		e		NA	NA	NA	NA	NA	NA
NM01	11/12/08	11/19/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	11/19/08	11/25/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	11/25/08	12/03/08	0.044	0.003	0.005	0.012	0.071	0.145	0.027	0.245	5.4	--	-	2.9	--	-	1090	16	16.002	w	w			0.002195718	0.000246863	0.000127884	0.000521966	0.003944444	0.002338521
NM01	12/03/08	12/10/08	0.042	0.006	0.003	0.018	0.144	0.9	0.055	0.278	4.97	--	-	6.5	--	-	415.3	--	6.117	w	w			0.002095913	0.000493726	7.67303E-05	0.000782949	0.008	0.014514958
NM01	12/10/08	12/15/08	0.423	0.087	0.072	0.662	0.286	1.036	0.847	1.063	6.31	--	-	9.9	--	-	207.7	3.05	3.048	w	w			0.021108838	0.007159021	0.001841526	0.028795128	0.015888889	0.01670833
NM01	12/15/08	12/30/08	--	--	--	--	--	--	--	--	--	--	-	--	--	-	1952.3	28.7	28.702	w		e		NA	NA	NA	NA	NA	NA
NM01	12/30/08	01/06/09	0.158	0.01	0.007	0.026	0.075	0.37	0.046	0.258	5.43	--	-	3.5	--	-	83.4	1.27	1.27	w	w			0.007884625	0.000822876	0.000179037	0.001130926	0.004166667	0.005967261
NM01	01/06/09	01/14/09	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	01/14/09	01/20/09	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	01/20/09	01/27/09	0.064	0.006	0.038	0.007	0.022	0.355	0.037	0.152	5.25	--	-	4	--	-	192.8	2.79	2.794	w	w			0.003193772	0.000493726	0.000971917	0.00030448	0.001222222	0.005725345
NM01	01/27/09	02/03/09	--	--	--	--	--	--	--	--	--	--	-	--	--	-	--	0	0	q	d			NA	NA	NA	NA	NA	NA
NM01	02/03/09	02/11/09	0.073	0.01	0.018	0.061	0.048	0.213	0.094	0.243	5.37	--	-	3.5	--	-	72.9	1.02	1.016	w	w			0.003642896	0.000822876	0.000460382	0.002653328	0.002666667	0.003435207
NM01	02/11/09	02/17/09	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	02/17/09	02/24/09	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	02/24/09	03/03/09	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	03/03/09	03/10/09	0.041	0.003	0.006	0.009	0.024	0.171	0.021	0.137	5.33	--	-	3	--	-	320.2	4.57	4.572	w	w			0.00204601	0.000246863	0.000153461	0.000391475	0.001333333	0.002757842
NM01	03/10/09	03/17/09	0.219	0.023	0.035	0.094	0.44	0.987	0.117	1.066	5.31	--	-	8.1	--	-	782.1	8.89	8.89	w	w			0.010928689	0.001892615	0.000895186	0.004088734	0.024444444	0.015918071
NM01	03/17/09	03/25/09	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	03/25/09	03/31/09	2.659	0.174	0.124	0.388	< 0.03	2.311	0.422	1.153	6.69	--	-	20.3	--	-	21.3	0.25	0.254	wd	wd			0.132691252	0.014318042	0.003171518	0.016876903	0.000833333	0.037271188
NM01	03/31/09	04/08/09	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	04/08/09	04/14/09	--	--	--	--	--	--	--	--	--	--	-	--	--	-	81.8	1.02	1.016	w		c	ns	NA	NA	NA	NA	NA	NA
NM01	04/14/09	04/28/09	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	04/28/09	05/05/09	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	05/05/09	05/12/09	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	05/12/09	05/19/09	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	05/19/09	05/26/09	0.222	0.02	0.019	0.032	0.228	0.93	0.066	0.545	5.29	--	-	6.1	--	-	669.6	9.91	9.906	w	w			0.011078397	0.001645752	0.000485958	0.00139191	0.012666667	0.01499879
NM01	05/26/09	06/02/09	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	7.87	7.874	d		vf	ns	NA	NA	NA	NA	NA	NA
NM01	06/02/09	06/09/09	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	06/09/09	06/16/09	0.088	0.011	0.055	0.034	0.489	0.872	0.092	0.954	5.29	--	-	7.8	--	-	918.1	13.21	13.208	w	w			0.004391437	0.000905164	0.001406722	0.001478904	0.027166667	0.014063382
NM01	06/16/09	06/23/09	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	06/23/09	06/30/09	0.414	0.034	0.04	0.109	0.527	1.833	0.152	0.843	5.65	--	-	9.1	--	-	758.9	11.43	11.43	w	w			0.020659714	0.002797778	0.00102307	0.004741192	0.029277778	0.029562132
NM01	06/30/09	07/07/09	0.174	0.018	0.068	0.048	0.452	1.337	0.082	0.747	5.19	--	-	8.2	--	-	702.7	10.16	10.16	w	w			0.008683068	0.001481177	0.001739219	0.002087864	0.025111111	0.021562777
NM01	07/07/09	07/14/09	--	--	--	--	--	--	--	--	--	--	-	--	--	-	23.5	0.25	0.254	t		v		NA	NA	NA	NA	NA	NA
NM01	07/14/09	07/22/09	--	--	--	--	--	--	--	--	--	--	-	--	--	-	112.7	1.52	1.524	w		c	ns	NA	NA	NA	NA	NA	NA
NM01	07/22/09	07/28/09	0.108	0.013	0.01	0.036	0.157	0.965	0.053	0.418	5.05	--	-	7.3	--	-	2198	30.73	30.734	w	w			0.00538949	0.001069739	0.000255768	0.001565898	0.008722222	0.015563261
NM01	07/28/09	08/05/09	--	--	--	--	--	--	--	--	--	--	-	--	--	-	22.9	0.25	0.254	t		v		NA	NA	NA	NA	NA	NA
NM01	08/05/09	08/11/09	0.187	0.02	0.015	0.039	0.162	1.258	0.068	0.485	4.86	--	-	9.1	--	-	260.3	3.81	3.81	w	w			0.009331803	0.001645752	0.000383651	0.00169639	0.009	0.020288686
NM01	08/11/09	08/18/09	0.103	0.008	0.006	0.018	0.143	0.736	0.034	0.363	5.08	--	-	5.8	--	-	972	13.97	13.97	w	w			0.005139977	0.000658301	0.000153461	0.000782949	0.007944444	0.01187001
NM01	08/18/09	08/25/09	0.158	0.01	0.01	0.026	0.169	0.492	0.038	0.405	5.49	--	-	4	--	-	2091.1	30.73	30.734	w	w			0.007884625	0.000822876	0.000255768	0.001130926	0.009388889	0.007934844
NM01	08/25/09	09/01/09	--	--	--	--	--	--	--	--	--	--	-	--	--	-	1.2	-7	0.127	t	t			NA	NA	NA	NA	NA	NA
NM01	09/01/09	09/08/09	0.354	0.026	0.062	0.022	0.618	1.492	0.076	1.172	5.35	--	-	10.1	--	-	544.5	7.87	7.874	w	w			0.017665552	0.002139477	0.001585759	0.000956938	0.034333333	0.024062576
NM01	09/08/09	09/16/09	0.186	0.016	0.017	0.016	0.187	1.656	0.086	0.749	4.63	--	-	14.8	--	-	117.2	1.52	1.524	w	w			0.0092819	0.001316602	0.000434805	0.000695955	0.010388889	0.026707524
NM01	09/16/09	09/22/09	0.22	0.017	0.012	0.053	0.422	1.148	0.078	0.978	5.16	--	-	8.3	--	-	1187.9	17.53	17.526	w	w			0.010978592	0.001398889	0.000306921	0.00230535	0.023444444	0.018514636
NM01	09/22/09	09/29/09	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	09/29/09	10/07/09	0.395	0.079	0.031	0.401	0.425	1.558	0.61	1.189	5.18	--	-	12.3	--	-	71.4	1.02	1.016	w	w			0.019711562	0.00650072	0.000792879	0.017442366	0.023611111	0.025127006
NM01	10/07/09	10/13/09	0.848	0.077	0.032	0.407	0.191	1.207	0.567	1.684	5.94	--	-	11.3	--	-	140.2	2.03	2.032	w	w			0.042317481	0.006336145	0.000818456	0.017703349	0.010611111	0.019466172
NM01	10/13/09	10/20/09	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	10/20/09	10/27/09	0.402	0.038	0.023	0.137	0.241	0.94	0.219	0.958	5.49	--	-	7.9	--	-	249.2	--	3.67	w	w			0.020060881	0.003126929	0.000588265	0.005959113	0.013388889	0.015160068
NM01	10/27/09	11/02/09	2.663	0.337	0.142	0.86	0.07	1.305	1.116	1.188	7.07	--	-	22	--	-	314.6	4.57	4.572	w	w			0.132890863	0.02773092	0.003631899	0.037407569	0.003888889	0.02104669
NM01	11/02/09	11/10/09	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	11/10/09	11/17/09	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	11/17/09	11/24/09	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	11/24/09	12/02/09	0.222	0.024	0.031	0.118	0.338	0.882	0.185	0.938	5.16	--	-	8.8	--	-	1424.6	20.83	20.828	w	w			0.011078397	0.001974902	0.000792879	0.005132666	0.018777778	0.014224659
NM01	12/02/09	12/09/09	0.263	0.023	0.031	0.09	0.157	0.247	0.124	0.386	6.15	--	-	3.9	--	-	2163.6	31.75	31.75	w	w			0.013124407	0.001892615	0.000792879	0.003914746	0.008722222	0.00398355
NM01	12/09/09	12/15/09	0.022	0.002	0.001	0.007	0.017	0.177	0.023	0.089	5.18	--	-	3.3	--	-	154.9	2.29	2.286	w	w			0.001097859	0.000164575	2.55768E-05	0.00030448	0.000944444	0.002854608
NM01	12/15/09	12/21/09	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	12/21/09	12/30/09	--	--	--	--	--	--	--	--	--	--	-	--	--	-	270	3.81	3.81	w		e		NA	NA	NA	NA	NA	NA
NM01	12/30/09	01/05/10	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	01/05/10	01/12/10	0.086	0.005	0.003	0.009	0.049	0.806	0.028	0.092	4.97	--	-	6.8	--	-	148.2	2.03	2.032	w	w			0.004291631	0.000411438	7.67303E-05	0.000391475	0.002722222	0.012998952
NM01	01/12/10	01/19/10	0.163	0.011	0.013	0.025	0.129	1.077	0.087	0.439	4.88	--	-	8.6	--	-	251.4	3.56	3.556	w	w			0.008134138	0.000905164	0.000332498	0.001087429	0.007166667	0.017369567
NM01	01/19/10	01/26/10	0.104	0.011	0.014	0.047	0.06	0.114	0.077	0.123	5.88	--	-	2.5	--	-	4642.4	68.33	68.326	w	w			0.00518988	0.000905164	0.000358075	0.002044367	0.003333333	0.001838561
NM01	01/26/10	02/02/10	0.011	0.003	0.003	0.023	0.066	0.138	0.04	0.195	5.3	--	-	3.5	--	-	1461.4	20.83	20.828	w	w			0.00054893	0.000246863	7.67303E-05	0.001000435	0.003666667	0.002225627
NM01	02/02/10	02/09/10	0.027	0.002	0.003	0.012	0.104	0.35	0.021	0.172	5.16	--	-	3.6	--	-	728.7	10.67	10.668	w	w			0.001347373	0.000164575	7.67303E-05	0.000521966	0.005777778	0.005644706
NM01	02/09/10	02/16/10	0.278	0.049	0.029	0.318	0.55	1.539	0.398	2.016	4.72	--	-	17.8	--	-	66.6	0.76	0.762	w	w			0.013872948	0.004032092	0.000741726	0.013832101	0.030555556	0.024820579

Table B-1
Rainwater Chemistry at Gila Cliffs Dwelling National Monument, Station NM01

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

			Ca	Mg	K	Na	NH4	NO3	Cl	SO4	pH			Conductivity			Sample Vol.	Precip	sub_ppt					Calc. Ca	Calc. Mg	Calc. K	Calc. Na	Calc. NH4	Calc. NO3
Site ID	Date On	Date Off	mg/L								Lab	Field	FV	Lab	Field	FV	ml	mm	mm	Lab Type	Val Code	Inval code	Notes	(mN)	(mN)	(mN)	(mN)	(mN)	(mN)
NM01	02/16/10	02/23/10	0.021	0.002	0.002	0.008	0.023	0.106	0.013	0.07	5.19	--	-	2.5	--	-	465.2	6.86	6.858	w	w			0.001047956	0.000164575	5.11535E-05	0.000347977	0.001277778	0.00170954
NM01	02/23/10	03/02/10	0.132	0.018	0.008	0.105	0.047	0.654	0.201	0.315	5.3	--	-	5.8	--	-	141.7	2.03	2.032	w	w			0.006587155	0.001481177	0.000204614	0.004567203	0.002611111	0.010547536
NM01	03/02/10	03/09/10	0.299	0.046	0.036	0.31	0.148	0.525	0.388	0.671	5.73	--	-	6.2	--	-	189.4	2.54	2.54	w	w			0.014920904	0.003785229	0.000920763	0.013484124	0.008222222	0.008467059
NM01	03/09/10	03/16/10	4.378	0.221	0.148	2.458	0.118	0.983	1.321	2.363	6.54	--	-	40.9	--	-	25.9	0.25	0.254	wd	wd			0.218473976	0.018185559	0.00378536	0.10691605	0.006555556	0.01585356
NM01	03/16/10	03/23/10	0.147	0.014	0.008	0.026	0.202	0.937	0.052	0.539	5.01	--	-	7.9	--	-	147.9	--	2.178	w	w			0.007335695	0.001152026	0.000204614	0.001130926	0.011222222	0.015111685
NM01	03/23/10	03/30/10	0.234	0.025	0.004	0.036	< 0.01	0.481	0.057	0.426	5.29	--	-	4.8	--	-	140.9	2.03	2.032	w	w			0.011677229	0.00205719	0.000102307	0.001565898	0.000277778	0.007757439
NM01	03/30/10	04/06/10	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	--	0	d	d			NA	NA	NA	NA	NA	NA
NM01	04/06/10	04/13/10	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	04/13/10	04/20/10	0.341	0.05	0.018	0.061	0.205	0.784	0.093	0.598	5.86	--	-	5.6	--	-	2031	--	29.916	w	w			0.017016817	0.00411438	0.000460382	0.002653328	0.011388889	0.012644142
NM01	04/20/10	04/27/10	0.191	0.028	0.009	0.101	0.024	0.348	0.169	0.42	5.29	--	-	4.8	--	-	413.7	--	6.093	w	w			0.009531414	0.002304053	0.000230191	0.004393214	0.001333333	0.005612451
NM01	04/27/10	05/10/10	--	--	--	--	--	--	--	--	--	--	-	--	--	-	246.8	--	3.635	w		ec	ns	NA	NA	NA	NA	NA	NA
NM01	05/10/10	05/11/10	--	--	--	--	--	--	--	--	--	--	-	--	--	-	--	--	--			np	nn	NA	NA	NA	NA	NA	NA
NM01	05/11/10	05/18/10	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	05/18/10	05/25/10	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	05/25/10	06/01/10	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	06/01/10	06/08/10	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	06/08/10	06/15/10	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	06/15/10	06/22/10	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	06/22/10	06/29/10	0.38	0.03	0.033	0.044	0.261	1.405	0.12	0.92	4.93	--	-	10.8	--	-	999.5	15.24	15.24	w	w			0.018963022	0.002468628	0.000844033	0.001913876	0.0145	0.022659463
NM01	06/29/10	07/06/10	0.123	0.012	0.006	0.009	0.368	0.937	0.059	0.568	5.11	--	-	7.5	--	-	659.8	--	9.718	w	w			0.006138031	0.000987451	0.000153461	0.000391475	0.020444444	0.015111685
NM01	07/06/10	07/12/10	0.488	0.046	0.035	0.131	0.282	1.599	0.235	0.785	5.18	--	-	10	--	-	408.8	6.1	6.096	w	w			0.024352513	0.003785229	0.000895186	0.00569813	0.015666667	0.025788243
NM01	07/12/10	07/20/10	0.24	0.025	0.031	0.06	0.305	1.527	0.112	0.754	4.85	--	-	10.8	--	-	483.1	7.11	7.112	w	w			0.011976646	0.00205719	0.000792879	0.00260983	0.016944444	0.024627046
NM01	07/20/10	07/27/10	--	--	--	--	--	--	--	--	--	--	-	--	--	-	1962	--	28.899	w		c	ns	NA	NA	NA	NA	NA	NA
NM01	07/27/10	08/03/10	0.07	0.014	0.065	0.03	0.238	0.867	0.088	0.383	5.19	--	-	5.9	--	-	1425.7	--	21	w	w			0.003493188	0.001152026	0.001662489	0.001304915	0.013222222	0.013982743
NM01	08/03/10	08/10/10	0.625	0.039	0.052	0.044	0.742	1.882	0.107	0.928	6.47	--	-	11.5	--	-	149.9	--	2.207	wd	wd			0.031189181	0.003209216	0.001329991	0.001913876	0.041222222	0.030352391
NM01	08/10/10	08/17/10	0.192	0.012	0.013	0.033	0.257	0.903	0.058	0.891	4.94	--	-	9	--	-	2161.3	34.04	34.036	w	w			0.009581316	0.000987451	0.000332498	0.001435407	0.014277778	0.014563342
NM01	08/17/10	08/24/10	0.104	0.01	0.012	0.014	0.111	1.438	0.073	0.405	4.57	--	-	12.2	--	-	195.7	--	2.882	w	w			0.00518988	0.000822876	0.000306921	0.00060896	0.006166667	0.023191678
NM01	08/24/10	08/31/10	0.105	0.013	0.023	0.05	0.339	1.671	0.114	0.791	4.67	--	-	13.7	--	-	248.8	3.56	3.556	w	w			0.005239782	0.001069739	0.000588265	0.002174859	0.018833333	0.02694944
NM01	08/31/10	09/07/10	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	09/07/10	09/15/10	--	--	--	--	--	--	--	--	--	--	-	--	--	-	227.1	3.3	3.302	w		e		NA	NA	NA	NA	NA	NA
NM01	09/15/10	09/22/10	0.13	0.012	0.012	0.016	0.161	0.577	0.041	0.449	5.17	--	-	5.6	--	-	1073.6	15.75	15.748	w	w			0.00648735	0.000987451	0.000306921	0.000695955	0.008944444	0.009305701
NM01	09/22/10	09/28/10	0.014	0.001	0.006	0.008	< 0.01	0.098	0.023	0.052	5.33	--	-	2.3	--	-	641.8	9.4	9.398	w	w			0.000698638	8.22876E-05	0.000153461	0.000347977	0.000277778	0.001580518
NM01	09/28/10	10/05/10	0.312	0.02	0.018	0.015	0.406	1.231	0.077	1.198	4.95	--	-	10.6	--	-	83.8	1.02	1.016	w	w			0.015569639	0.001645752	0.000460382	0.000652458	0.022555556	0.019853238
NM01	10/05/10	10/12/10	0.227	0.025	0.024	0.027	0.395	0.82	0.062	0.796	5.58	--	-	6.4	--	-	183.7	2.54	2.54	w	w			0.011327911	0.00205719	0.000613842	0.001174424	0.021944444	0.01322474
NM01	10/12/10	10/19/10	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	10/19/10	10/26/10	0.033	0.006	0.019	0.03	0.055	0.19	0.054	0.116	5.42	--	-	2.6	--	-	186.8	2.54	2.54	w	w			0.001646789	0.000493726	0.000485958	0.001304915	0.003055556	0.003064269
NM01	10/26/10	11/02/10	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	11/02/10	11/09/10	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	11/09/10	11/16/10	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	-7	0.127	d	t			NA	NA	NA	NA	NA	NA
NM01	11/16/10	11/23/10	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	11/23/10	11/30/10	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	11/30/10	12/07/10	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	12/07/10	12/14/10	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	12/14/10	12/21/10	0.072	0.006	0.011	0.021	0.1	0.429	0.043	0.25	5.28	--	-	4	--	-	330.4	4.83	4.826	w	w			0.003592994	0.000493726	0.000281344	0.000913441	0.005555556	0.006918797
NM01	12/21/10	12/28/10	0.129	0.015	0.014	0.037	0.313	0.644	0.101	0.845	5.06	--	-	8.4	--	-	29.3	0.25	0.254	wd	wd			0.006437447	0.001234314	0.000358075	0.001609395	0.017388889	0.010386259
NM01	12/28/10	01/04/11	0.053	0.005	0.011	0.023	0.039	0.16	0.032	0.134	5.53	--	-	2.6	--	-	1081.4	17.02	17.018	w	w			0.002644843	0.000411438	0.000281344	0.001000435	0.002166667	0.002580437
NM01	01/04/11	01/11/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	01/11/11	01/18/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	--	0	0	q	d			NA	NA	NA	NA	NA	NA
NM01	01/18/11	01/25/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	01/25/11	02/01/11	0.072	0.01	0.011	0.045	0.184	0.521	0.054	0.448	5.08	--	-	6	--	-	61.1	0.76	0.762	w	w			0.003592994	0.000822876	0.000281344	0.001957373	0.010222222	0.008402548
NM01	02/01/11	02/09/11	1.168	0.088	0.077	0.099	0.04	0.971	0.094	0.365	6.63	--	-	8.4	--	-	85.9	--	1.265	w	w			0.058286342	0.007241308	0.00196941	0.00430622	0.002222222	0.015660027
NM01	02/09/11	02/16/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	2	-7	0.127	t	t			NA	NA	NA	NA	NA	NA
NM01	02/16/11	02/22/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	02/22/11	03/01/11	0.562	0.065	0.077	0.335	0.084	0.717	0.52	0.537	6.16	--	-	7.3	--	-	141.1	2.03	2.032	w	w			0.028045312	0.005348694	0.00196941	0.014571553	0.004666667	0.011563584
NM01	03/01/11	03/09/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	03/09/11	03/15/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	03/15/11	03/22/11	0.671	0.088	0.125	0.119	0.013	0.375	0.181	0.499	6.24	--	-	6.5	--	-	97.1	1.52	1.524	w	w			0.033484705	0.007241308	0.003197094	0.005176164	0.000722222	0.006047899
NM01	03/22/11	03/28/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	03/28/11	04/05/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	04/05/11	04/12/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	84	1.02	1.016	w		c	ns	NA	NA	NA	NA	NA	NA
NM01	04/12/11	04/19/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	04/19/11	04/26/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	04/26/11	05/03/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	05/03/11	05/18/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	05/18/11	05/24/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	05/24/11	05/31/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	05/31/11	06/07/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	63	0.76	0.762	w		c	ns	NA	NA	NA	NA	NA	NA
NM01	06/07/11	06/21/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	06/21/11	06/28/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA

Table B-1
Rainwater Chemistry at Gila Cliffs Dwelling National Monument, Station NM01

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

			Ca	Mg	K	Na	NH4	NO3	Cl	SO4	pH			Conductivity			Sample Vol.	Precip	sub_ppt					Calc. Ca	Calc. Mg	Calc. K	Calc. Na	Calc. NH4	Calc. NO3
Site ID	Date On	Date Off	mg/L								Lab	Field	FV	Lab	Field	FV	ml	mm	mm	Lab Type	Val Code	Inval code	Notes	(mN)	(mN)	(mN)	(mN)	(mN)	(mN)
NM01	06/28/11	07/05/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	160.3	2.29	2.286	w		c	ns	NA	NA	NA	NA	NA	NA
NM01	07/05/11	07/12/11	0.762	0.041	0.05	0.069	0.788	2.523	0.136	1.368	5.94	--	-	12.9	--	-	449.9	6.6	6.604	w	w			0.03802585	0.003373791	0.001278838	0.003001305	0.043777778	0.040690267
NM01	07/12/11	07/19/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	235.5	3.3	3.302	w		c	ns	NA	NA	NA	NA	NA	NA
NM01	07/19/11	07/26/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	--	3.81	3.81	w		c	ns	NA	NA	NA	NA	NA	NA
NM01	07/26/11	08/02/11	0.242	0.016	0.014	0.054	0.511	1.609	0.078	0.614	5.72	--	-	7.3	--	-	2274.6	33.02	33.02	w	w			0.012076451	0.001316602	0.000358075	0.002348847	0.028388889	0.02594952
NM01	08/02/11	08/09/11	0.213	0.021	0.023	0.042	0.491	3.275	0.101	0.821	4.5	--	-	20.8	--	-	342.6	--	5.046	w	w			0.010629273	0.001728039	0.000588265	0.001826881	0.027277778	0.052818321
NM01	08/09/11	08/16/11	0.11	0.024	0.024	0.049	0.291	1.188	0.128	0.396	5.08	--	-	7.5	--	-	3332	--	49.079	w	w			0.005489296	0.001974902	0.000613842	0.002131361	0.016166667	0.019159745
NM01	08/16/11	08/23/11	0.134	0.01	0.017	0.02	0.353	1.947	0.061	0.574	4.7	--	-	13.1	--	-	380.4	--	5.603	w	w			0.00668696	0.000822876	0.000434805	0.000869943	0.019611111	0.031400693
NM01	08/23/11	08/30/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	599.6	--	8.831	w		f	ns	NA	NA	NA	NA	NA	NA
NM01	08/30/11	09/06/11	1.271	0.072	0.052	0.064	0.669	2.092	0.121	1.809	6.41	--	-	14.5	--	-	994.1	--	14.642	w	w			0.063426319	0.005924707	0.001329991	0.002783819	0.037166667	0.033739215
NM01	09/06/11	09/13/11	0.322	0.02	0.021	0.023	0.427	1.149	0.059	0.859	5.57	--	-	7.3	--	-	1001.5	14.99	14.986	w	w			0.016068666	0.001645752	0.000537112	0.001000435	0.023722222	0.018530764
NM01	09/13/11	09/20/11	0.139	0.018	0.022	0.078	0.377	1.542	0.177	1.185	4.61	--	-	14.9	--	-	152.4	2.03	2.032	w	w			0.006936474	0.001481177	0.000562689	0.003392779	0.020944444	0.024868962
NM01	09/20/11	09/27/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	09/27/11	10/11/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	830.4	12.19	12.192	w		e		NA	NA	NA	NA	NA	NA
NM01	10/11/11	10/18/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	10/18/11	10/25/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	10/25/11	11/01/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	11/01/11	11/08/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	175.9	--	2.59	w		c	ns	NA	NA	NA	NA	NA	NA
NM01	11/08/11	11/15/11	0.094	0.01	0.107	0.343	0.106	0.226	0.504	0.238	5.82	--	-	4.8	--	-	71.4	1.02	1.016	w	w			0.004690853	0.000822876	0.002736713	0.01491953	0.005888889	0.003644867
NM01	11/15/11	11/22/11	0.048	0.015	0.014	0.118	0.221	0.959	0.185	0.486	5.02	--	-	8.1	--	-	96.8	1.27	1.27	w	w			0.002395329	0.001234314	0.000358075	0.005132666	0.012277778	0.015466495
NM01	11/22/11	11/30/11	0.017	0.006	0.019	0.041	0.012	0.136	0.07	0.1	5.37	--	-	2.7	--	-	391.3	--	5.763	w	w			0.000848346	0.000493726	0.000485958	0.001783384	0.000666667	0.002193372
NM01	11/30/11	12/13/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	2958.8	--	43.582	w		e		NA	NA	NA	NA	NA	NA
NM01	12/13/11	12/27/11	--	--	--	--	--	--	--	--	--	--	-	--	--	-	911.7	13.21	13.208	w		e		NA	NA	NA	NA	NA	NA
NM01	12/27/11	01/03/12	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	01/03/12	01/10/12	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	01/10/12	01/17/12	0.018	0.004	0.009	0.02	0.049	0.132	0.038	0.098	5.34	--	-	3	--	-	352.7	5.08	5.08	w	w			0.000898248	0.00032915	0.000230191	0.000869943	0.002722222	0.002128861
NM01	01/17/12	01/24/12	0.182	0.013	0.015	0.034	0.105	0.578	0.056	0.261	5.57	--	-	3.8	--	-	148.6	2.03	2.032	w	w			0.00908229	0.001069739	0.000383651	0.001478904	0.005833333	0.009321829
NM01	01/24/12	01/31/12	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	01/31/12	02/07/12	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	02/07/12	02/14/12	--	--	--	--	--	--	--	--	--	--	-	--	--	-	91	1.27	1.27	t		v		NA	NA	NA	NA	NA	NA
NM01	02/14/12	02/22/12	0.514	0.041	0.032	0.195	0.454	1.244	0.185	0.844	6	--	-	8.2	--	-	454.3	6.6	6.604	w	w			0.025649983	0.003373791	0.000818456	0.008481949	0.025222222	0.020062898
NM01	02/22/12	02/28/12	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	02/28/12	03/07/12	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	03/07/12	03/13/12	1.171	0.072	0.072	0.19	0.198	0.754	0.215	1.115	6.61	--	-	10.6	--	-	170	2.54	2.54	w	w			0.05843605	0.005924707	0.001841526	0.008264463	0.011	0.01216031
NM01	03/13/12	03/20/12	--	--	--	--	--	--	--	--	--	--	-	--	--	-	29.3	0.25	0.254	t		v		NA	NA	NA	NA	NA	NA
NM01	03/20/12	03/27/12	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	03/27/12	04/10/12	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	--	0	d	d			NA	NA	NA	NA	NA	NA
NM01	04/10/12	04/16/12	--	--	--	--	--	--	--	--	--	--	-	--	--	-	8.1	--	0.119	t	t			NA	NA	NA	NA	NA	NA
NM01	04/16/12	04/24/12	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	--	0	d	d			NA	NA	NA	NA	NA	NA
NM01	04/24/12	05/08/12	--	--	--	--	--	--	--	--	--	--	-	--	--	-	61.5	--	0.906	w		e		NA	NA	NA	NA	NA	NA
NM01	05/08/12	05/15/12	0.108	0.011	0.013	0.013	0.458	0.696	0.032	0.56	5.95	--	-	5.1	--	-	509.4	7.37	7.366	w	w			0.00538949	0.000905164	0.000332498	0.000565463	0.025444444	0.011224901
NM01	05/15/12	05/25/12	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	05/25/12	05/29/12	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	05/29/12	06/05/12	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0.1	0	0	t	d			NA	NA	NA	NA	NA	NA
NM01	06/05/12	06/12/12	--	--	--	--	--	--	--	--	--	--	-	--	--	-	0	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	06/12/12	06/18/12	--	--	--	--	--	--	--	--	--	--	-	--	--	-	143.9	2.03	2.032	w		c	ns	NA	NA	NA	NA	NA	NA
NM01	06/18/12	06/26/12	2.202	0.128	0.096	0.195	< 0.009	1.638	0.236	1.466	6.68	--	-	15.6	--	-	184.9	--	2.724	w	w			0.109885723	0.010532812	0.002455369	0.008481949	0.00025	0.026417224
NM01	06/26/12	07/03/12	--	--	--	--	--	--	--	--	--	--	-	--	--	-	43.7	--	0.644	wd		c	ns	NA	NA	NA	NA	NA	NA
NM01	07/03/12	07/11/12	0.125	0.032	0.14	0.038	0.856	1.191	0.08	0.483	6.34	--	-	8.1	--	-	2778.2	--	40.922	w	w			0.006237836	0.002633203	0.003580746	0.001652893	0.047555556	0.019208128
NM01	07/11/12	07/17/12	0.132	0.013	0.023	0.021	0.391	1.825	0.083	0.525	4.75	--	-	10.4	--	-	409	6.1	6.096	w	w			0.006587155	0.001069739	0.000588265	0.000913441	0.021722222	0.02943311
NM01	07/17/12	07/24/12	--	--	--	--	--	--	--	--	--	--	-	--	--	-	562.2	--	8.281	w		c	ns	NA	NA	NA	NA	NA	NA
NM01	07/24/12	07/31/12	0.3	0.025	0.021	0.058	0.405	1.423	0.096	0.717	5.47	--	-	7.5	--	-	998.9	--	14.713	w	w			0.014970807	0.00205719	0.000537112	0.002522836	0.0225	0.022949762
NM01	07/31/12	08/06/12	0.228	0.027	0.022	0.068	0.382	1.837	0.097	1.143	4.68	--	-	14.7	--	-	252.7	3.81	3.81	w	w			0.011377813	0.002221765	0.000562689	0.002957808	0.021222222	0.029626643
NM01	08/06/12	08/13/12	0.445	0.033	0.017	0.101	0.208	1.052	0.144	0.74	5.64	--	-	6.6	--	-	465	6.86	6.858	w	w			0.022206697	0.002715491	0.000434805	0.004393214	0.011555556	0.016966374
NM01	08/13/12	08/21/12	0.376	0.029	0.075	0.043	0.798	2.108	0.103	0.881	5.72	--	-	10.4	--	-	1216.9	--	17.925	w	w			0.018763411	0.00238634	0.001918257	0.001870378	0.044333333	0.033997258
NM01	08/21/12	08/28/12	0.099	0.007	0.019	0.011	0.232	0.807	0.041	0.352	5.22	--	-	5.5	--	-	2048.6	31.75	31.75	w	w			0.004940366	0.000576013	0.000485958	0.000478469	0.012888889	0.013015079
NM01	08/28/12	09/04/12	--	--	--	--	--	--	--	--	--	--	-	--	--	-	--	0	0	d	d			NA	NA	NA	NA	NA	NA
NM01	09/04/12	09/11/12	0.755	0.034	0.107	0.127	0.522	2.012	0.204	1.272	5.95	--	-	10.8	--	-	608.1	8.89	8.89	w	w			0.037676531	0.002797778	0.002736713	0.005524141	0.029	0.032448996
NM01	09/11/12	09/17/12	0.13	0.011	0.016	0.032	0.249	0.924	0.066	0.841	4.92	--	-	9.5	--	-	548.6	6.86	6.858	w	w			0.00648735	0.000905164	0.000409228	0.00139191	0.013833333	0.014902024
NM01	09/17/12	09/25/12	--	--	--	--	--	--	--	--	--	--	-	--	--	-	--	0	0	d	d			NA	NA	NA	NA	NA	NA

Table B-1
Rainwater Chemistry at Gila Cliffs Dwelling National Monument, Station NM01

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Site ID	Date On	Date Off	Calc. Cl (mN)	Calc. SO4 (mN)	Calc. alkal. (meq/L)	pH (lab)	Calc. H+ (meq/L)	H+ load per event (eq/acre)	H+ load per year (eq/acre)	Precip x H+	Calc precip (mm)	SCalc precip (mm)	Annual ave H+ (meq/L)	NADP annual ave H+ (meq/L)	Alkal. load per event (eq/acre)	Net alkal. load per year (eq/acre)	Pos. alkal. load per event (eq/acre)	Pos. alkal. load per year (eq/acre)	Plot alk. (meq/L)	Plot pH (lab)
NM01	12/27/05	01/03/06	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	01/03/06	01/11/06	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	01/11/06	01/18/06	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	01/18/06	01/24/06	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	01/24/06	01/31/06	0.001494937	0.007203981	-0.0106	5.04	0.0091	0.394		0.097	10.668				-0.460		NA		-0.0106	5.04
NM01	01/31/06	02/07/06	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	02/07/06	02/14/06	0.004174541	0.028024735	0.0161	5.82	0.0015	0.003		0.001	0.508				0.033		0.033		0.0161	5.82
NM01	02/14/06	02/21/06	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	02/21/06	02/28/06	0.001607762	0.013512669	-0.0178	5.00	0.0100	0.175		0.043	4.318				-0.311		NA		-0.0178	5.00
NM01	02/28/06	03/07/06	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	03/07/06	03/14/06	0.029024342	0.023694018	0.0303	6.52	0.0003	0.009		0.002	7.112				0.873		0.873		0.0303	6.52
NM01	03/14/06	03/21/06	0.029983358	0.042162027	-0.0287	5.75	0.0018	0.005		0.001	0.762				-0.088		NA		-0.0287	5.75
NM01	03/21/06	03/28/06	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	03/28/06	04/04/06	0.001523143	0.003352141	-0.0029	5.16	0.0069	0.028		0.007	1.016				-0.012		NA		-0.0029	5.16
NM01	04/04/06	04/11/06	0.009167066	0.043098961	-0.0110	4.94	0.0115	0.118		0.029	2.54				-0.113		NA		-0.0110	4.94
NM01	04/11/06	04/18/06	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	04/18/06	04/25/06	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	04/25/06	05/02/06	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	05/02/06	05/08/06	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	05/08/06	05/16/06	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	05/16/06	05/23/06	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	05/23/06	05/30/06	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	05/30/06	06/06/06	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	06/06/06	06/13/06	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	06/13/06	06/20/06	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	06/20/06	06/27/06	0.003300144	0.030960461	-0.0217	6.10	0.0008	0.016		0.004	5.08				-0.446		NA		-0.0217	6.10
NM01	06/27/06	07/03/06	NA	NA	NA	6.14	0.0007	0.000		0.000	0.127				NA		NA			6.14
NM01	07/03/06	07/11/06	0.000705159	0.012492452	-0.0231	5.14	0.0072	1.102		0.272	37.592				-3.514		NA		-0.0231	5.14
NM01	07/11/06	07/19/06	0.008405495	0.039955027	-0.0611	6.62	0.0002	0.001		0.000	0.762				-0.188		NA		-0.0611	6.62
NM01	07/19/06	07/25/06	0.002115477	0.013970726	-0.0149	5.30	0.0050	0.160		0.039	7.874				-0.473		NA		-0.0149	5.30
NM01	07/25/06	08/01/06	0.001156461	0.006870849	-0.0195	4.93	0.0117	1.498		0.370	31.496				-2.480		NA		-0.0195	4.93
NM01	08/01/06	08/09/06	0.00208727	0.009806575	-0.0222	4.89	0.0129	1.351		0.334	25.908				-2.325		NA		-0.0222	4.89
NM01	08/09/06	08/15/06	0.001071842	0.00689167	-0.0202	4.77	0.0170	1.798		0.444	26.162				-2.138		NA		-0.0202	4.77
NM01	08/15/06	08/23/06	0.001212873	0.007016594	-0.0204	4.79	0.0162	1.850		0.457	28.194				-2.328		NA		-0.0204	4.79
NM01	08/23/06	08/29/06	0.003243731	0.01794749	-0.0355	4.61	0.0245	0.606		0.150	6.096				-0.875		NA		-0.0355	4.61
NM01	08/29/06	09/12/06	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	09/12/06	09/21/06	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	09/21/06	09/26/06	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	09/26/06	10/03/06	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	10/03/06	10/10/06	0.002143683	0.011118283	-0.0057	5.61	0.0025	0.366		0.090	36.83				-0.848		NA		-0.0057	5.61
NM01	10/10/06	10/17/06	0.00208727	0.010389556	-0.0139	5.37	0.0043	0.031		0.008	1.778				-0.100		NA		-0.0139	5.37
NM01	10/17/06	10/24/06	0.003046287	0.007162339	-0.0069	5.53	0.0030	0.030		0.007	2.54				-0.071		NA		-0.0069	5.53
NM01	10/24/06	10/30/06	0.000507714	0.004039226	-0.0078	5.51	0.0031	0.086		0.021	6.858				-0.217		NA		-0.0078	5.51
NM01	10/30/06	11/07/06	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	11/07/06	11/14/06	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	11/14/06	11/21/06	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	11/21/06	11/29/06	0.031111613	0.032980075	-0.0247	5.33	0.0047	0.038		0.010	2.032				-0.203		NA		-0.0247	5.33
NM01	11/29/06	12/05/06	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	12/05/06	12/12/06	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	12/12/06	12/19/06	0.0097594	0.029107414	-0.0279	4.83	0.0148	0.502		0.124	8.382				-0.946		NA		-0.0279	4.83
NM01	12/19/06	12/26/06	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	12/26/06	01/02/07	0.002848842	0.005642424	-0.0052	5.71	0.0019	0.014	10.18	0.003	1.778	256.413	9.811	9.818	-0.037	-17.27	NA	0.91	-0.0052	5.71
NM01	01/02/07	01/09/07	0.002312921	0.005892273	-0.0094	5.02	0.0095	0.069		0.017	1.778				-0.068		NA		-0.0094	5.02
NM01	01/09/07	01/16/07	0.011141511	0.026192509	-0.0056	6.23	0.0006	0.004		0.001	1.524				-0.035		NA		-0.0056	6.23
NM01	01/16/07	01/25/07	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	01/25/07	01/30/07	0.000479508	0.00414333	-0.0065	5.16	0.0069	0.085		0.021	3.048				-0.080		NA		-0.0065	5.16
NM01	01/30/07	02/06/07	0.001269286	0.006641821	-0.0100	5.14	0.0072	0.216		0.053	7.366				-0.299		NA		-0.0100	5.14
NM01	02/06/07	02/13/07	0.002284715	0.015553103	-0.0210	4.86	0.0138	0.454		0.112	8.128				-0.692		NA		-0.0210	4.86
NM01	02/13/07	02/19/07	0.004371985	0.018363905	-0.0263	4.99	0.0102	0.053		0.013	1.27				-0.135		NA		-0.0263	4.99
NM01	02/19/07	02/27/07	0.017995656	0.027691603	-0.0018	6.03	0.0009	0.006		0.001	1.524				-0.011		NA		-0.0018	6.03
NM01	02/27/07	03/05/07	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	03/05/07	03/13/07	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	03/13/07	03/20/07	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	03/20/07	03/27/07	0.002961668	0.008307481	-0.0152	4.88	0.0132	0.881		0.218	16.51				-1.018		NA		-0.0152	4.88
NM01	03/27/07	04/03/07	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	04/03/07	04/10/07	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	04/10/07	04/17/07	0.014131385	0.014199754	0.0108	6.04	0.0009	0.015		0.004	4.064				0.178		0.178		0.0108	6.04
NM01	04/17/07	04/23/07	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			

Table B-1
Rainwater Chemistry at Gila Cliffs Dwelling National Monument, Station NM01

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Site ID	Date On	Date Off	Calc. Cl (mN)	Calc. SO4 (mN)	Calc. alkal. (meq/L)	pH (lab)	Calc. H+ (meq/L)	H+ load per event (eq/acre)	H+ load per year (eq/acre)	Precip x H+	Calc precip (mm)	SCalc precip (mm)	Annual ave H+ (meq/L)	NADP annual ave H+ (meq/L)	Alkal. load per event (eq/acre)	Net alkal. load per year (eq/acre)	Pos. alkal. load per event (eq/acre)	Pos. alkal. load per year (eq/acre)	Plot alk. (meq/L)	Plot pH (lab)
NM01	04/23/07	05/01/07	0.001918032	0.01711466	-0.0135	5.10	0.0079	0.490		0.121	15.24				-0.835		NA		-0.0135	5.10
NM01	05/01/07	05/08/07	NA	NA	NA	4.45	0.0355	0.018		0.005	0.127				NA		NA			4.45
NM01	05/08/07	05/15/07	0.004738668	0.028836744	-0.0239	4.88	0.0132	0.136		0.033	2.54				-0.246		NA		-0.0239	4.88
NM01	05/15/07	05/23/07	0.002425747	0.015261613	-0.0170	5.10	0.0079	0.882		0.218	27.432				-1.887		NA		-0.0170	5.10
NM01	05/23/07	05/29/07	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	05/29/07	06/05/07	NA	NA	NA	4.53	0.0295	0.015		0.004	0.127				NA		NA			4.53
NM01	06/05/07	06/12/07	0.00217189	0.012596556	-0.0126	5.10	0.0079	0.253		0.063	7.874				-0.403		NA		-0.0126	5.10
NM01	06/12/07	06/19/07	0.003497588	0.012263424	-0.0110	4.79	0.0162	0.900		0.222	13.716				-0.613		NA		-0.0110	4.79
NM01	06/19/07	06/26/07	0.005782303	0.031418518	0.0128	5.76	0.0017	0.050		0.012	7.112				0.369		0.369		0.0128	5.76
NM01	06/26/07	07/10/07	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	07/10/07	07/17/07	0.005443827	0.032188886	-0.0489	4.68	0.0209	0.344		0.085	4.064				-0.804		NA		-0.0489	4.68
NM01	07/17/07	07/24/07	0.002425747	0.01988382	-0.0071	5.58	0.0026	0.054		0.013	5.08				-0.147		NA		-0.0071	5.58
NM01	07/24/07	07/31/07	0.001635969	0.009764934	-0.0158	5.73	0.0019	0.109		0.027	14.478				-0.927		NA		-0.0158	5.73
NM01	07/31/07	08/07/07	0.001579556	0.007807783	-0.0160	4.99	0.0102	0.316		0.078	7.62				-0.492		NA		-0.0160	4.99
NM01	08/07/07	08/14/07	0.007672129	0.036894376	-0.0871	5.77	0.0017	0.002		0.000	0.254				-0.090		NA		-0.0871	5.77
NM01	08/14/07	08/20/07	0.002284715	0.047575423	-0.0505	4.63	0.0234	0.434		0.107	4.572				-0.935		NA		-0.0505	4.63
NM01	08/20/07	08/28/07	0.002538572	0.015095047	-0.0242	4.82	0.0151	1.369		0.338	22.352				-2.188		NA		-0.0242	4.82
NM01	08/28/07	09/04/07	0.00208727	0.014512066	-0.0197	4.91	0.0123	0.392		0.097	7.874				-0.628		NA		-0.0197	4.91
NM01	09/04/07	09/11/07	0.002228302	0.01186783	-0.0207	4.83	0.0148	0.958		0.237	16.002				-1.341		NA		-0.0207	4.83
NM01	09/11/07	09/18/07	0.009533749	0.028357867	-0.0491	4.71	0.0195	0.080		0.020	1.016				-0.202		NA		-0.0491	4.71
NM01	09/18/07	09/25/07	0.001607762	0.013242	-0.0171	5.29	0.0051	0.348		0.086	16.764				-1.158		NA		-0.0171	5.29
NM01	09/25/07	10/02/07	0.004146335	0.033209103	-0.0328	5.23	0.0059	0.012		0.003	0.508				-0.067		NA		-0.0328	5.23
NM01	10/02/07	10/16/07	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	10/16/07	10/23/07	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	10/23/07	10/30/07	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	10/30/07	11/06/07	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	11/06/07	11/13/07	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	11/13/07	11/20/07	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	11/20/07	11/27/07	0.001128254	0.004414	-0.0067	5.19	0.0065	0.139		0.034	5.334				-0.145		NA		-0.0067	5.19
NM01	11/27/07	12/04/07	0.000338476	0.000666264	-0.0008	5.51	0.0031	0.584		0.144	46.736				-0.157		NA		-0.0008	5.51
NM01	12/04/07	12/12/07	0.001692381	0.002623415	0.0025	5.52	0.0030	0.282		0.070	23.114				0.235		0.235		0.0025	5.52
NM01	12/12/07	12/18/07	0.00208727	0.010452019	-0.0214	4.93	0.0117	0.012		0.003	0.254				-0.022		NA		-0.0214	4.93
NM01	12/18/07	12/24/07	0.001269286	0.009515085	-0.0155	4.96	0.0110	0.045		0.011	1.016				-0.064		NA		-0.0155	4.96
NM01	12/24/07	12/31/07	NA	NA	NA	NA	NA	NA	10.01	NA	NA	296.418	8.342	8.318	NA	-14.90	NA	0.78		
NM01	12/31/07	01/08/08	0.06543875	0.043452914	0.3657	7.20	0.0001	0.003		0.001	10.16				15.038		15.038		0.3657	7.20
NM01	01/08/08	01/16/08	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	01/16/08	01/22/08	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	01/22/08	02/05/08	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	02/05/08	02/12/08	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	02/12/08	02/19/08	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	02/19/08	02/26/08	0.004118128	0.013054613	-0.0128	4.73	0.0186	0.038		0.009	0.508				-0.026		NA		-0.0128	4.73
NM01	02/26/08	03/04/08	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	03/04/08	03/11/08	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	03/11/08	03/18/08	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	03/18/08	03/25/08	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	03/25/08	04/01/08	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	04/01/08	04/08/08	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	04/08/08	04/15/08	0.012044115	0.026088405	-0.0059	4.97	0.0107	0.077		0.019	1.778				-0.042		NA		-0.0059	4.97
NM01	04/15/08	04/22/08	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	04/22/08	04/29/08	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	04/29/08	05/06/08	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	05/06/08	05/13/08	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	05/13/08	05/20/08	0.004484811	0.018301443	-0.0095	4.81	0.0155	0.127		0.031	2.032				-0.078		NA		-0.0095	4.81
NM01	05/20/08	05/27/08	0.031901391	0.020279415	0.0111	6.07	0.0009	0.045		0.011	12.954				0.582		0.582		0.0111	6.07
NM01	05/27/08	06/03/08	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	06/03/08	06/10/08	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	06/10/08	06/17/08	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	06/17/08	06/24/08	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	06/24/08	07/01/08	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	07/01/08	07/08/08	0.002312921	0.021861792	-0.0279	5.18	0.0066	0.299		0.074	11.176				-1.260		NA		-0.0279	5.18
NM01	07/08/08	07/15/08	0.00093081	0.005975556	-0.0133	5.05	0.0089	1.273		0.315	35.306				-1.895		NA		-0.0133	5.05
NM01	07/15/08	07/22/08	0.00124108	0.007058236	-0.0105	5.00	0.0100	1.244		0.307	30.734				-1.304		NA		-0.0105	5.00
NM01	07/22/08	07/29/08	0.002030858	0.010077245	-0.0127	5.06	0.0087	1.987		0.491	56.388				-2.889		NA		-0.0127	5.06
NM01	07/29/08	08/05/08	0.005133557	0.027941452	-0.0192	5.48	0.0033	0.014		0.003	1.016				-0.079		NA		-0.0192	5.48
NM01	08/05/08	08/12/08	0.001353905	0.010243811	-0.0205	4.78	0.0166	3.241		0.801	48.26				-3.998		NA		-0.0205	4.78
NM01	08/12/08	08/18/08	0.001805207	0.010056424	-0.0195	4.87	0.0135	2.052		0.507	37.592				-2.965		NA		-0.0195	4.87
NM01	08/18/08	09/02/08	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	09/02/08	09/08/08	0.001353905	0.009244415	-0.0123	5.09	0.0081	0.343		0.085	10.414				-0.517		NA		-0.0123	5.09
NM01	09/08/08	09/16/08	0.000733365	0.005163547	-0.0088	5.13	0.0074	0.533		0.132	17.78				-0.633		NA		-0.0088	5.13

Table B-1
Rainwater Chemistry at Gila Cliffs Dwelling National Monument, Station NM01

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Site ID	Date On	Date Off	Calc. Cl (mN)	Calc. SO4 (mN)	Calc. alkal. (meq/L)	pH (lab)	Calc. H+ (meq/L)	H+ load per event (eq/acre)	H+ load per year (eq/acre)	Precip x H+	Calc precip (mm)	SCalc precip (mm)	Annual ave H+ (meq/L)	NADP annual ave H+ (meq/L)	Alkal. load per event (eq/acre)	Net alkal. load per year (eq/acre)	Pos. alkal. load per event (eq/acre)	Pos. alkal. load per year (eq/acre)	Plot alk. (meq/L)	Plot pH (lab)
NM01	09/16/08	09/29/08	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	09/29/08	10/14/08	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	10/14/08	10/28/08	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	10/28/08	11/03/08	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	11/03/08	11/12/08	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	11/12/08	11/19/08	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	11/19/08	11/25/08	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	11/25/08	12/03/08	0.000761572	0.005101085	-0.0051	5.40	0.0040	0.258		0.064	16.002				-0.331		NA		-0.0051	5.40
NM01	12/03/08	12/10/08	0.00155135	0.00578817	-0.0184	4.97	0.0107	0.265		0.066	6.117				-0.456		NA		-0.0184	4.97
NM01	12/10/08	12/15/08	0.023890785	0.022132462	-0.0038	6.31	0.0005	0.006		0.001	3.048				-0.047		NA		-0.0038	6.31
NM01	12/15/08	12/30/08	NA	NA	NA	NA	NA	NA	11.81	NA	NA	301.265	9.683	9.683	NA	-0.90	NA	15.62		
NM01	12/30/08	01/06/09	0.001297492	0.005371755	-0.0026	5.43	0.0037	0.019		0.005	1.27				-0.013		NA		-0.0026	5.43
NM01	01/06/09	01/14/09	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	01/14/09	01/20/09	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	01/20/09	01/27/09	0.001043635	0.003164755	-0.0050	5.25	0.0056	0.064		0.016	2.794				-0.056		NA		-0.0050	5.25
NM01	01/27/09	02/03/09	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	02/03/09	02/11/09	0.002651398	0.005059443	-0.0036	5.37	0.0043	0.018		0.004	1.016				-0.015		NA		-0.0036	5.37
NM01	02/11/09	02/17/09	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	02/17/09	02/24/09	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	02/24/09	03/03/09	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	03/03/09	03/10/09	0.000592334	0.002852443	-0.0034	5.33	0.0047	0.087		0.021	4.572				-0.062		NA		-0.0034	5.33
NM01	03/10/09	03/17/09	0.003300144	0.022194924	-0.0236	5.31	0.0049	0.176		0.044	8.89				-0.849		NA		-0.0236	5.31
NM01	03/17/09	03/25/09	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	03/25/09	03/31/09	0.011903083	0.02400633	0.0939	6.69	0.0002	0.000		0.000	0.254				0.096		0.096		0.0939	6.69
NM01	03/31/09	04/08/09	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	04/08/09	04/14/09	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	04/14/09	04/28/09	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	04/28/09	05/05/09	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	05/05/09	05/12/09	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	05/12/09	05/19/09	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	05/19/09	05/26/09	0.00186162	0.011347311	-0.0136	5.29	0.0051	0.206		0.051	9.906				-0.545		NA		-0.0136	5.29
NM01	05/26/09	06/02/09	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	06/02/09	06/09/09	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	06/09/09	06/16/09	0.002594985	0.019862999	-0.0283	5.29	0.0051	0.274		0.068	13.208				-1.515		NA		-0.0283	5.29
NM01	06/16/09	06/23/09	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	06/23/09	06/30/09	0.004287366	0.017551896	-0.0222	5.65	0.0022	0.104		0.026	11.43				-1.026		NA		-0.0222	5.65
NM01	06/30/09	07/07/09	0.002312921	0.015553103	-0.0254	5.19	0.0065	0.265		0.066	10.16				-1.046		NA		-0.0254	5.19
NM01	07/07/09	07/14/09	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	07/14/09	07/22/09	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	07/22/09	07/28/09	0.001494937	0.008703075	-0.0175	5.05	0.0089	1.109		0.274	30.734				-2.174		NA		-0.0175	5.05
NM01	07/28/09	08/05/09	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	08/05/09	08/11/09	0.001918032	0.010098066	-0.0192	4.86	0.0138	0.213		0.053	3.81				-0.297		NA		-0.0192	4.86
NM01	08/11/09	08/18/09	0.000959016	0.007557934	-0.0137	5.08	0.0083	0.470		0.116	13.97				-0.772		NA		-0.0137	5.08
NM01	08/18/09	08/25/09	0.001071842	0.008432405	-0.0073	5.49	0.0032	0.402		0.099	30.734				-0.914		NA		-0.0073	5.49
NM01	08/25/09	09/01/09	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	09/01/09	09/08/09	0.002143683	0.024401924	-0.0283	5.35	0.0045	0.142		0.035	7.874				-0.901		NA		-0.0283	5.35
NM01	09/08/09	09/16/09	0.002425747	0.015594745	-0.0330	4.63	0.0234	0.145		0.036	1.524				-0.204		NA		-0.0330	4.63
NM01	09/16/09	09/22/09	0.002200096	0.020362698	-0.0261	5.16	0.0069	0.491		0.121	17.526				-1.850		NA		-0.0261	5.16
NM01	09/22/09	09/29/09	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	09/29/09	10/07/09	0.017205878	0.024755877	-0.0226	5.18	0.0066	0.027		0.007	1.016				-0.093		NA		-0.0226	5.18
NM01	10/07/09	10/13/09	0.015993005	0.03506215	-0.0033	5.94	0.0011	0.009		0.002	2.032				-0.028		NA		-0.0033	5.94
NM01	10/13/09	10/20/09	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	10/20/09	10/27/09	0.006177192	0.019946282	-0.0115	5.49	0.0032	0.048		0.012	3.67				-0.172		NA		-0.0115	5.49
NM01	10/27/09	11/02/09	0.031478295	0.024735056	0.1244	7.07	0.0001	0.002		0.000	4.572				2.302		2.302		0.1244	7.07
NM01	11/02/09	11/10/09	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	11/10/09	11/17/09	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	11/17/09	11/24/09	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	11/24/09	12/02/09	0.005218176	0.019529867	-0.0200	5.16	0.0069	0.583		0.144	20.828				-1.685		NA		-0.0200	5.16
NM01	12/02/09	12/09/09	0.003497588	0.008036811	0.0042	6.15	0.0007	0.091		0.022	31.75				0.541		0.541		0.0042	6.15
NM01	12/09/09	12/15/09	0.000648746	0.001853047	-0.0038	5.18	0.0066	0.061		0.015	2.286				-0.035		NA		-0.0038	5.18
NM01	12/15/09	12/21/09	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	12/21/09	12/30/09	NA	NA	NA	NA	NA	NA	5.01	NA	NA	235.826	5.244	5.248	NA	-11.31	NA	2.94		
NM01	12/30/09	01/05/10	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	01/05/10	01/12/10	0.000789778	0.001915509	-0.0105	4.97	0.0107	0.088		0.022	2.032				-0.087		NA		-0.0105	4.97
NM01	01/12/10	01/19/10	0.002453953	0.009140311	-0.0185	4.88	0.0132	0.190		0.047	3.556				-0.266		NA		-0.0185	4.88
NM01	01/19/10	01/26/10	0.00217189	0.002560953	0.0019	5.88	0.0013	0.365		0.090	68.326				0.533		0.533		0.0019	5.88
NM01	01/26/10	02/02/10	0.001128254	0.004060047	-0.0055	5.30	0.0050	0.422		0.104	20.828				-0.467		NA		-0.0055	5.30
NM01	02/02/10	02/09/10	0.000592334	0.00358117	-0.0077	5.16	0.0069	0.299		0.074	10.668				-0.333		NA		-0.0077	5.16
NM01	02/09/10	02/16/10	0.01122613	0.04197464	-0.0455	4.72	0.0191	0.059		0.015	0.762				-0.140		NA		-0.0455	4.72

Table B-1
Rainwater Chemistry at Gila Cliffs Dwelling National Monument, Station NM01

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Site ID	Date On	Date Off	Calc. Cl (mN)	Calc. SO4 (mN)	Calc. alkal. (meq/L)	pH (lab)	Calc. H+ (meq/L)	H+ load per event (eq/acre)	H+ load per year (eq/acre)	Precip x H+	Calc precip (mm)	SCalc precip (mm)	Annual ave H+ (meq/L)	NADP annual ave H+ (meq/L)	Alkal. load per event (eq/acre)	Net alkal. load per year (eq/acre)	Pos. alkal. load per event (eq/acre)	Pos. alkal. load per year (eq/acre)	Plot alk. (meq/L)	Plot pH (lab)
NM01	02/16/10	02/23/10	0.000366683	0.001457453	-0.0019	5.19	0.0065	0.179		0.044	6.858				-0.053		NA		-0.0019	5.19
NM01	02/23/10	03/02/10	0.005669478	0.006558538	-0.0099	5.30	0.0050	0.041		0.010	2.032				-0.082		NA		-0.0099	5.30
NM01	03/02/10	03/09/10	0.010944067	0.013970726	-0.0003	5.73	0.0019	0.019		0.005	2.54				-0.003		NA		-0.0003	5.73
NM01	03/09/10	03/16/10	0.037260599	0.049199442	0.2450	6.54	0.0003	0.000		0.000	0.254				0.252		0.252		0.2450	6.54
NM01	03/16/10	03/23/10	0.001466731	0.011222386	-0.0180	5.01	0.0098	0.086		0.021	2.178				-0.158		NA		-0.0180	5.01
NM01	03/23/10	03/30/10	0.001607762	0.008869641	-0.0028	5.29	0.0051	0.042		0.010	2.032				-0.023		NA		-0.0028	5.29
NM01	03/30/10	04/06/10	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	04/06/10	04/13/10	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	04/13/10	04/20/10	0.002623191	0.012450811	-0.0035	5.86	0.0014	0.167		0.041	29.916				-0.420		NA		-0.0035	5.86
NM01	04/20/10	04/27/10	0.004766874	0.008744717	-0.0027	5.29	0.0051	0.126		0.031	6.093				-0.066		NA		-0.0027	5.29
NM01	04/27/10	05/10/10	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	05/10/10	05/11/10	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	05/11/10	05/18/10	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	05/18/10	05/25/10	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	05/25/10	06/01/10	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	06/01/10	06/08/10	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	06/08/10	06/15/10	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	06/15/10	06/22/10	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	06/22/10	06/29/10	0.003384763	0.019155094	-0.0210	4.93	0.0117	0.725		0.179	15.24				-1.296		NA		-0.0210	4.93
NM01	06/29/10	07/06/10	0.001664175	0.011826188	-0.0209	5.11	0.0078	0.305		0.075	9.718				-0.823		NA		-0.0209	5.11
NM01	07/06/10	07/12/10	0.006628494	0.016344292	-0.0140	5.18	0.0066	0.163		0.040	6.096				-0.346		NA		-0.0140	5.18
NM01	07/12/10	07/20/10	0.003159112	0.015698849	-0.0260	4.85	0.0141	0.407		0.100	7.112				-0.750		NA		-0.0260	4.85
NM01	07/20/10	07/27/10	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	07/27/10	08/03/10	0.002482159	0.007974349	-0.0168	5.19	0.0065	0.549		0.136	21				-1.430		NA		-0.0168	5.19
NM01	08/03/10	08/10/10	0.00301808	0.01932166	-0.0150	6.47	0.0003	0.003		0.001	2.207				-0.134		NA		-0.0150	6.47
NM01	08/10/10	08/17/10	0.001635969	0.018551292	-0.0224	4.94	0.0115	1.581		0.391	34.036				-3.087		NA		-0.0224	4.94
NM01	08/17/10	08/24/10	0.002059064	0.008432405	-0.0268	4.57	0.0269	0.314		0.078	2.882				-0.312		NA		-0.0268	4.57
NM01	08/24/10	08/31/10	0.003215525	0.016469217	-0.0376	4.67	0.0214	0.308		0.076	3.556				-0.541		NA		-0.0376	4.67
NM01	08/31/10	09/07/10	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	09/07/10	09/15/10	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	09/15/10	09/22/10	0.001156461	0.009348519	-0.0113	5.17	0.0068	0.431		0.106	15.748				-0.722		NA		-0.0113	5.17
NM01	09/22/10	09/28/10	0.000648746	0.001082679	-0.0020	5.33	0.0047	0.178		0.044	9.398				-0.077		NA		-0.0020	5.33
NM01	09/28/10	10/05/10	0.00217189	0.024943263	-0.0286	4.95	0.0112	0.046		0.011	1.016				-0.118		NA		-0.0286	4.95
NM01	10/05/10	10/12/10	0.001748794	0.01657332	-0.0164	5.58	0.0026	0.027		0.007	2.54				-0.168		NA		-0.0164	5.58
NM01	10/12/10	10/19/10	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	10/19/10	10/26/10	0.001523143	0.002415207	-0.0031	5.42	0.0038	0.039		0.010	2.54				-0.032		NA		-0.0031	5.42
NM01	10/26/10	11/02/10	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	11/02/10	11/09/10	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	11/09/10	11/16/10	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	11/16/10	11/23/10	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	11/23/10	11/30/10	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	11/30/10	12/07/10	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	12/07/10	12/14/10	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	12/14/10	12/21/10	0.001212873	0.005205189	-0.0081	5.28	0.0052	0.102		0.025	4.826				-0.157		NA		-0.0081	5.28
NM01	12/21/10	12/28/10	0.002848842	0.017593537	-0.0212	5.06	0.0087	0.009	7.27	0.002	0.254	296.244	6.065	6.067	-0.022	-11.33	NA	0.78	-0.0212	5.06
NM01	12/28/10	01/04/11	0.000902603	0.002789981	-0.0019	5.53	0.0030	0.203		0.050	17.018				-0.133		NA		-0.0019	5.53
NM01	01/04/11	01/11/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	01/11/11	01/18/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	01/18/11	01/25/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	01/25/11	02/01/11	0.001523143	0.009327698	-0.0126	5.08	0.0083	0.026		0.006	0.762				-0.039		NA		-0.0126	5.08
NM01	02/01/11	02/09/11	0.002651398	0.007599575	0.0459	6.63	0.0002	0.001		0.000	1.265				0.235		0.235		0.0459	6.63
NM01	02/09/11	02/16/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	02/16/11	02/22/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	02/22/11	03/01/11	0.014667306	0.011180745	0.0125	6.16	0.0007	0.006		0.001	2.032				0.103		0.103		0.0125	6.16
NM01	03/01/11	03/09/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	03/09/11	03/15/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	03/15/11	03/22/11	0.005105351	0.010389556	0.0276	6.24	0.0006	0.004		0.001	1.524				0.170		0.170		0.0276	6.24
NM01	03/22/11	03/28/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	03/28/11	04/05/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	04/05/11	04/12/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	04/12/11	04/19/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	04/19/11	04/26/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	04/26/11	05/03/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	05/03/11	05/18/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	05/18/11	05/24/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	05/24/11	05/31/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	05/31/11	06/07/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	06/07/11	06/21/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	06/21/11	06/28/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			

Table B-1
Rainwater Chemistry at Gila Cliffs Dwelling National Monument, Station NM01

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Site ID	Date On	Date Off	Calc. Cl (mN)	Calc. SO4 (mN)	Calc. alkal. (meq/L)	pH (lab)	Calc. H+ (meq/L)	H+ load per event (eq/acre)	H+ load per year (eq/acre)	Precip x H+	Calc precip (mm)	SCalc precip (mm)	Annual ave H+ (meq/L)	NADP annual ave H+ (meq/L)	Alkal. load per event (eq/acre)	Net alkal. load per year (eq/acre)	Pos. alkal. load per event (eq/acre)	Pos. alkal. load per year (eq/acre)	Plot alk. (meq/L)	Plot pH (lab)
NM01	06/28/11	07/05/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	07/05/11	07/12/11	0.003836065	0.028482792	-0.0273	5.94	0.0011	0.031		0.008	6.604				-0.730		NA		-0.0273	5.94
NM01	07/12/11	07/19/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	07/19/11	07/26/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	07/26/11	08/02/11	0.002200096	0.012783943	-0.0248	5.72	0.0019	0.255		0.063	33.02				-3.318		NA		-0.0248	5.72
NM01	08/02/11	08/09/11	0.002848842	0.017093839	-0.0580	4.50	0.0316	0.646		0.160	5.046				-1.184		NA		-0.0580	4.50
NM01	08/09/11	08/16/11	0.003610414	0.008245019	-0.0208	5.08	0.0083	1.652		0.408	49.079				-4.132		NA		-0.0208	5.08
NM01	08/16/11	08/23/11	0.001720588	0.011951113	-0.0363	4.70	0.0200	0.452		0.112	5.603				-0.822		NA		-0.0363	4.70
NM01	08/23/11	08/30/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	08/30/11	09/06/11	0.003412969	0.037664744	-0.0014	6.41	0.0004	0.023		0.006	14.642				-0.080		NA		-0.0014	6.41
NM01	09/06/11	09/13/11	0.001664175	0.017885028	-0.0188	5.57	0.0027	0.163		0.040	14.986				-1.142		NA		-0.0188	5.57
NM01	09/13/11	09/20/11	0.004992525	0.024672594	-0.0422	4.61	0.0245	0.202		0.050	2.032				-0.347		NA		-0.0422	4.61
NM01	09/20/11	09/27/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	09/27/11	10/11/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	10/11/11	10/18/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	10/18/11	10/25/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	10/25/11	11/01/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	11/01/11	11/08/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	11/08/11	11/15/11	0.014216004	0.004955339	0.0004	5.82	0.0015	0.006		0.002	1.016				0.001		0.001		0.0004	5.82
NM01	11/15/11	11/22/11	0.005218176	0.010118887	-0.0217	5.02	0.0095	0.049		0.012	1.27				-0.111		NA		-0.0217	5.02
NM01	11/22/11	11/30/11	0.001974445	0.002082075	-0.0026	5.37	0.0043	0.099		0.025	5.763				-0.062		NA		-0.0026	5.37
NM01	11/30/11	12/13/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	12/13/11	12/27/11	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	12/27/11	01/03/12	NA	NA	NA	NA	NA	NA	3.82	NA	NA	161.662	5.836	5.835	NA	-11.59	NA	0.51		
NM01	01/03/12	01/10/12	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	01/10/12	01/17/12	0.001071842	0.002040434	-0.0029	5.34	0.0046	0.094		0.023	5.08				-0.060		NA		-0.0029	5.34
NM01	01/17/12	01/24/12	0.001579556	0.005434217	-0.0043	5.57	0.0027	0.022		0.005	2.032				-0.036		NA		-0.0043	5.57
NM01	01/24/12	01/31/12	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	01/31/12	02/07/12	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	02/07/12	02/14/12	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	02/14/12	02/22/12	0.005218176	0.017572716	-0.0045	6.00	0.0010	0.027		0.007	6.604				-0.121		NA		-0.0045	6.00
NM01	02/22/12	02/28/12	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	02/28/12	03/07/12	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	03/07/12	03/13/12	0.006064367	0.023215141	0.0330	6.61	0.0002	0.003		0.001	2.54				0.339		0.339		0.0330	6.61
NM01	03/13/12	03/20/12	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	03/20/12	03/27/12	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	03/27/12	04/10/12	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	04/10/12	04/16/12	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	04/16/12	04/24/12	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	04/24/12	05/08/12	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	05/08/12	05/15/12	0.000902603	0.011659622	-0.0166	5.95	0.0011	0.033		0.008	7.366				-0.495		NA		-0.0166	5.95
NM01	05/15/12	05/25/12	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	05/25/12	05/29/12	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	05/29/12	06/05/12	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	06/05/12	06/12/12	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	06/12/12	06/18/12	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	06/18/12	06/26/12	0.0066567	0.030523226	0.0678	6.68	0.0002	0.002		0.001	2.724				0.747		0.747		0.0678	6.68
NM01	06/26/12	07/03/12	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	07/03/12	07/11/12	0.002256509	0.010056424	-0.0174	6.34	0.0005	0.076		0.019	40.922				-2.884		NA		-0.0174	6.34
NM01	07/11/12	07/17/12	0.002341128	0.010930896	-0.0335	4.75	0.0178	0.439		0.108	6.096				-0.828		NA		-0.0335	4.75
NM01	07/17/12	07/24/12	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	07/24/12	07/31/12	0.00270781	0.014928481	-0.0205	5.47	0.0034	0.202		0.050	14.713				-1.220		NA		-0.0205	5.47
NM01	07/31/12	08/06/12	0.002736017	0.023798122	-0.0390	4.68	0.0209	0.322		0.080	3.81				-0.602		NA		-0.0390	4.68
NM01	08/06/12	08/13/12	0.004061716	0.015407358	-0.0067	5.64	0.0023	0.064		0.016	6.858				-0.186		NA		-0.0067	5.64
NM01	08/13/12	08/21/12	0.002905255	0.018343084	-0.0303	5.72	0.0019	0.138		0.034	17.925				-2.198		NA		-0.0303	5.72
NM01	08/21/12	08/28/12	0.001156461	0.007328905	-0.0150	5.22	0.0060	0.774		0.191	31.75				-1.930		NA		-0.0150	5.22
NM01	08/28/12	09/04/12	NA	NA	NA	NA	NA	NA		NA	NA				NA		NA			
NM01	09/04/12	09/11/12	0.005754097	0.026483999	-0.0160	5.95	0.0011	0.040		0.010	8.89				-0.574		NA		-0.0160	5.95
NM01	09/11/12	09/17/12	0.00186162	0.017510254	-0.0251	4.92	0.0120	0.334		0.082	6.858				-0.696		NA		-0.0251	4.92
NM01	09/17/12	09/25/12	NA	NA	NA	NA	NA	NA	2.57	NA	NA	164.168	3.868	3.864	NA	-10.74	NA	1.09		

Table B-2
Calculation of H+ and Alkalinity Loads in Rainwater at Gila Cliff Dwelling National Monument

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Site ID	Period	Year	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Ca	Mg	K	Na	NH4	NO3	Cl	SO4	Lab H+	Lab Cond.	Field H+	Field Cond.	Cation/ Anion	Sample Volume	Precip	Precipitation Represented by Field Chemistry %	Valid Samples		Days	Date On	Date Off
			%				ueq/L									uS/cm	ueq/L	uS/cm	Ratio	ml	cm		Lab	Field			
NM01	Annual	1985	39	43	97	85	5.19	2.55	2.352	2.132	1.719	6.581	2.99	23.538	16.8655	10.39	--	--	0.93	16032.9	28.59	0	16	0	155	7/29/1985	12/31/1985
NM01	Annual	1986	81	100	88	96	6.188	1.974	0.614	2.654	3.493	9.597	7.194	20.58	20.7014	12.13	0.7079	6.5	0.95	29956.1	52.51	2	26	1	364	12/31/1985	12/30/1986
NM01	Annual	1987	41	100	6	69	19.361	4.607	1.841	14.312	4.047	13.904	9.225	34.203	6.5464	11.75	--	--	0.88	1093.3	35.9	0	5	0	364	12/30/1986	12/29/1987
NM01	Annual	1988	87	100	90	101	7.435	1.316	0.409	2.871	3.437	12.323	2.652	23.892	19.1426	11.38	17.2982	12.2	0.89	30669.2	49.78	44	30	13	371	12/29/1987	1/3/1989
NM01	Annual	1989	93	100	90	100	9.381	1.727	0.793	3.785	6.431	13.001	3.554	22.746	14.7911	10.95	18.197	10.9	0.94	16176.3	26.64	32	23	11	364	1/3/1989	1/2/1990
NM01	Annual	1990	86	100	84	96	11.627	1.81	0.665	3.611	9.979	12.888	3.978	21.288	11.1686	10.09	16.3305	11.7	1.02	20364.5	36.92	69	32	22	365	1/2/1990	1/2/1991
NM01	Annual	1991	95	100	96	95	4.94	0.905	1.074	2.262	4.324	9.275	3.329	15.581	12.1899	7.95	15.9221	9.5	0.91	27869.4	44.64	94	32	27	363	1/2/1991	12/31/1991
NM01	Annual	1992	88	100	85	99	5.639	1.152	0.46	2.306	7.928	9.855	2.031	19.039	10.617	8.14	15.7398	10.5	0.91	26702.2	46.67	81	32	25	365	12/31/1991	12/30/1992
NM01	Annual	1993	93	100	94	100	7.335	1.316	0.384	2.697	7.263	11.21	2.116	20.518	11.695	8.61	13.3045	9.9	0.91	29779.3	46.91	94	26	24	370	12/30/1992	1/4/1994
NM01	Annual	1994	92	100	93	100	8.084	1.727	0.563	4.263	7.041	12.162	3.696	18.351	14.6893	8.83	13.8676	9.7	1.06	24292.3	38.46	80	27	21	364	1/4/1994	1/3/1995
NM01	Annual	1995	92	100	98	101	5.489	0.905	0.332	2.001	9.369	11.823	1.777	16.768	17.2584	10.09	20.9894	11.7	1.16	20315.9	30.38	97	23	21	364	1/3/1995	1/2/1996
NM01	Annual	1996	98	100	99	100	9.331	1.645	0.588	4.437	11.31	14.243	4.147	18.101	12.6474	9.75	13.4276	9.1	1.1	24752	36.83	95	25	21	363	1/2/1996	12/30/1996
NM01	Annual	1997	82	100	79	99	13.523	1.81	1.253	3.306	8.205	13.501	3.385	22.767	14.5881	10.6	13.3352	10.1	1.08	22541.9	42.52	79	29	26	365	12/30/1996	12/30/1997
NM01	Annual	1998	88	100	89	99	7.635	1.152	0.384	1.74	6.819	12.614	2.172	17.685	15.7398	9.92	18.1552	10.5	1.03	17319.1	28.73	89	31	28	364	12/30/1997	12/29/1998
NM01	Annual	1999	96	100	98	101	11.677	1.563	0.793	1.523	9.092	17.114	2.257	19.33	17.8238	12.24	18.6209	11.8	1.1	19518.4	29.25	90	23	17	364	12/29/1998	12/28/1999
NM01	Annual	2000	76	98	61	100	10.379	1.398	0.409	2.871	8.482	12.694	2.426	15.227	9.9312	8.46	10.2802	9	1.1	12974.1	31.35	60	17	14	371	12/28/1999	1/2/2001
NM01	Annual	2001	88	100	93	100	14.77	1.727	1.253	2.871	13.361	19.13	3.413	23.1	13.0617	11.18	15.1008	9.8	1.03	17486.9	27.83	74	28	22	364	1/2/2001	1/1/2002
NM01	Annual	2002	90	100	92	108	16.717	1.892	0.665	2.219	17.242	21.211	2.454	18.31	7.9616	9.78	9.5719	9.8	1.11	16816.3	24.94	89	24	18	364	1/1/2002	12/31/2002
NM01	Annual	2003	84	100	79	100	20.409	2.057	0.588	2.088	18.184	19.291	2.398	17.685	4.5499	8.74	6.9024	8.5	1.22	15190.3	28.13	78	21	17	364	12/31/2002	12/30/2003
NM01	Annual	2004	82	100	70	101	9.78	1.316	0.486	2.61	10.423	13.275	2.482	13.06	7.3961	7.22	9.6828	8.3	1.11	17715	36.86	69	27	22	365	12/30/2003	12/29/2004
NM01	Annual	2005	89	100	95	99	6.537	0.905	1.151	1.784	9.314	9.791	2.144	12.79	7.6033	6.91	--	--	1.1	22251.3	34.79	0	26	0	370	12/29/2004	1/3/2006
NM01	Annual	2006	90	100	74	95	8.184	1.152	0.46	2.567	11.809	14.388	2.962	11.644	9.8175	7.88	--	--	1.17	16560.8	34.77	0	23	0	364	1/3/2006	1/2/2007
NM01	Annual	2007	88	100	84	104	9.281	1.563	0.869	2.175	9.702	12.339	2.341	11.623	8.3176	6.77	--	--	1.21	20895.6	35.13	0	32	0	363	1/2/2007	12/31/2007
NM01	Annual	2008	74	100	67	97	16.966	2.386	0.614	7.656	7.54	12.146	5.247	10.977	9.6828	8.3	--	--	1.58	19889.5	44.83	0	17	0	365	12/31/2007	12/30/2008
NM01	Annual	2009	92	100	94	103	12.525	2.057	0.716	3.306	14.747	13.775	3.244	13.415	5.2481	7	--	--	1.27	16459.1	25.07	0	24	0	365	12/30/2008	12/30/2009
NM01	Annual	2010	92	100	89	100	8.134	1.398	0.46	1.914	8.981	10.001	2.257	9.144	6.0674	5.73	--	--	1.26	20116.4	33.22	0	30	0	363	12/30/2009	12/28/2010
NM01	Annual	2011	76	100	64	100	15.07	2.057	0.665	2.306	20.346	21.469	2.934	13.435	5.8345	8.29	--	--	1.22	10955.6	25.34	0	16	0	371	12/28/2010	1/3/2012
NM01	Annual	2012	62	73	93	100	13.772	2.057	1.585	2.262	27.554	20.066	2.567	13.269	3.8637	8	--	--	1.42	11183.4	17.77	0	15	0	362	1/3/2012	9/25/2012

Note:
Rainwater chemistry at Gila Cliffs Dwelling National Monument, station NM01, averaged by year and calculated microequivalents to obtain alkalinity, following Stumm and Morgan (1996).

Table B-3
Precipitation Data from the NADP Monitoring Site at Gila Cliff Dwellings National Monument, Volume-Weighted Average pH and Annual H+ Loading

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Year	NADP-reported annual precipitation (cm)	NADP-reported annual volume-weighted average H^+ conc. (meq/L)	Calculated annual volume-weighted average pH	Estimated annual H^+ loading	Estimated annual alkalinity loading
				(eq H^+/acre)	(eq alk/acre)
2006	34.77	9.8175	5.008	13.81	0.91
2007	35.13	8.3176	5.08	11.82	0.78
2008	44.83	9.6828	5.014	17.57	15.62
2009	25.07	5.2481	5.28	5.32	2.94
2010	33.22	6.0674	5.217	8.16	0.78
2011	25.34	5.8345	5.234	5.98	0.51
2012	17.77	3.8637	5.413	2.78	1.09

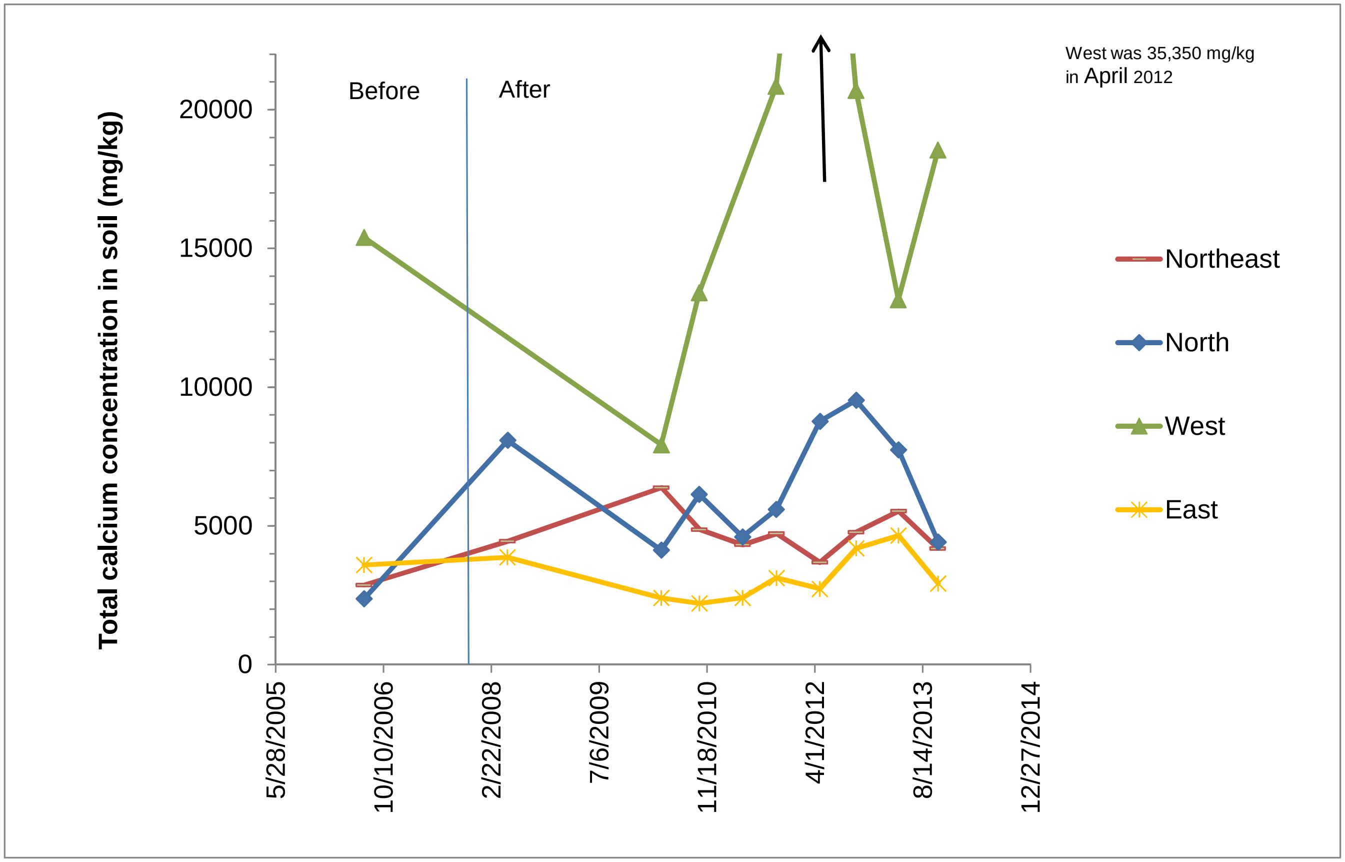
Note:
Data from NADP Site NM01

Table B-4
Average Net Neutralization Potential (NNP) converted to equivalents (eq) per acre.

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

NNP (tCaCO3/k5)						
Year					**Average**	**Average**
2010	**2011**	**2012**	**2013**	**2014**	**(t CaCO3/kt)**	**(eq/acre)**
31.75	-0.9375	7.375	0.0625	1.0625	7.86	242,165
-9.6875	7.875	1.75	10.75	-1.5	1.84	56,595
1.0625	2.8125	-0.5625	-1.4375	1.8125	0.74	22,715
-2.75	-5.3125	1.375	-1.5625	0.5	-1.55	-47,740
-0.6875	-0.3	-1.25	-4.0625	-1.5625	-1.57	-48,433
-11.5625	-3.875	-12.5	--	--	-9.31	-286,825
14.625	-3.4375	-1.8125	-1.5625	0.125	1.59	48,895
5.9375	9.75	2.8125	8.5625	6.5	6.71	206,745
-2.1875	--	--	--	--	-2.19	-67,375
131.6875	32.5	62.4375	84.6875	39.4375	70.15	2,160,620
-0.625	0.0625	-0.3125	1.375	1.375	0.38	11,550
18.125	--	--	--	--	18.13	558,250
-5.9375	-2.0625	-1.875	-4.375	-2.1875	-3.29	-101,255
-13.4375	-15.625	23	-4.25	-5.625	-3.19	-98,175
1.0625	--	--	--	--	1.06	32,725
-9.6875	--	--	--	--	-9.69	-298,375
-3.4375	6.4375	3.75	-0.5	-1.5625	0.94	28,875
-0.9375	-0.625	12.375	1.0625	-0.625	2.25	69,300
--	--	-2.1875	16.4375	3.125	5.79	178,383
--	--	11.4375	-0.75	2.1875	4.29	132,183
--	--	7.0625	4.375	3.375	4.94	152,075
--	--	-0.3125	1.4375	-0.3	0.28	8,470
--	--	18.375	5.0625	-0.625	7.60	234,208
237.7	100.0625	60.0625	165.375	57.7	124.18	3,824,744
3.3	10.7	5.7	4.375	4.375	5.69	175,252
6.975	10.8125	2.0625	8.5	-1.5625	5.36	165,011
-0.6375	-4.375	6.125	-1.6875	1.5	0.19	5,698

Note:
Average net neutralizing potential (acid neutralizing potential minus acid generating potential) in soils in the vicinity of the STSIU. Averages were calculated for 2010 through 2014, but not all sample locations were analyzed in each year. Per-acre values were calculated for a 6-inch-deep soil having a density of 2.5 g/cm^3.



Note:
West plot is influenced by Gila Conglomerate Formation and thus has patchy calcium, resulting in high variability.
This graph assumes adjacent plots have similar calcium concentrations (2006 and 2008 is for plot to be treated, and 2010 to 2014 for adjacent reference plots). Data are from Table 1 and ARCADIS (2014a).

FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

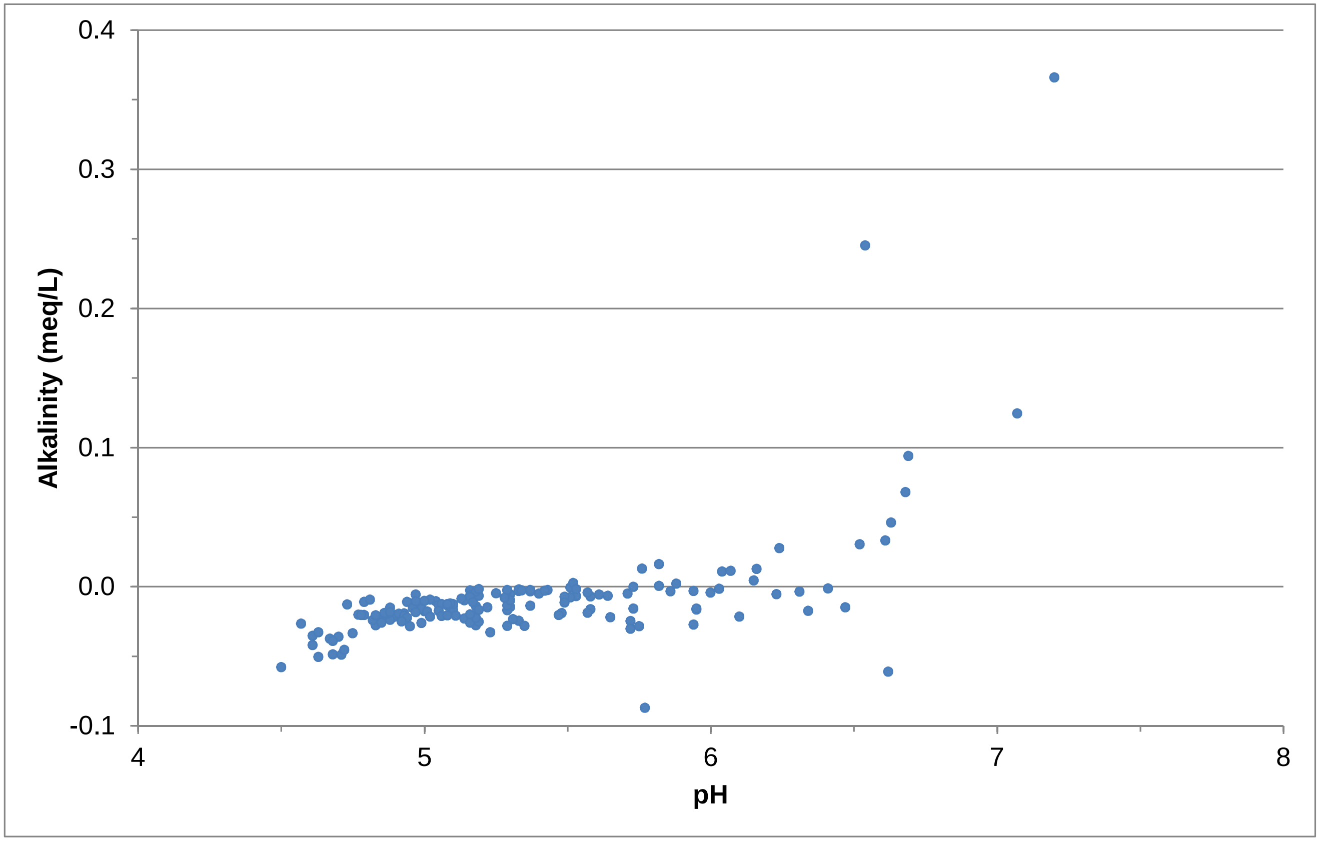
YEAR 5 REPORT - PH MONITORING

Change in Soil Calcium Concentration after White Rain in Amendment Study Plots

ARCADIS

FIGURE

B-1



Note:
Alkalinity is fairly constant from pH of 4.5 to 6.5. Rainwater becomes high in alkalinity at pH > 6.5.

FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

YEAR 5 REPORT - PH MONITORING

Relationship of Alkalinity to pH in Rainwater at NM01 Station

ARCADIS

FIGURE
B-2

ARCADIS

Appendix C

Early Post-White Rain Results in 2008 and 2009 and Long-term Trends

Table C-1
Data Collected in 2009 to Evaluate Effect of White Rain

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Soil Sample Location	Sieved field pH (0-6") S.U. 0 m on transect	Sieved field pH (0-6") S.U. 25 m on transect	Sieved field pH (0-6") S.U. 50 m on transect	Average Field Soil Sieved pH (0-6") S.U.[1,2]	Lab Sieved pH (0-6") S.U. 25 m on transect[2]	Soil Cu (0-6") mg/kg (unsieved) 25 m on transect	Soil Cu (0-6") mg/kg (sieved) 25 m on transect[3]	Average Sieved Calculated pCu (0-6")	Total Sulfur (0-6") (%)[4]	Pyritic/Sulfide Sulfur (0-6") (%)[5]	AGP (0-6") ($tCaCO_3/kt$)[6] (calculated)	ANP (0-6") ($tCaCO_3/kt$)[4]	NNP (0-6") ($tCaCO_3/kt$)[6] (calculated)	NPR (0-6") (ANP/AGP)[6] (calculated)
FID 0	7.2	6.8	7.4	7.1	6.6	329	566	6.68	0.03	0.018	0.56	11	10.4	19.6
FID 1	7.2	7.0	6.9	7.0	6.2	143	377	7.05	0.02	0.012	0.38	62	61.6	165.3
FID 2	7.1	6.3	6.9	6.8	5.6	405	643	6.18	0.02	0.012	0.38	57	56.6	152.0
FID 3	7.6	8.0	8.3	8.0	7.6	236	471	7.66	0.17	0.102	3.19	164	160.8	51.5
FID 4	6.1	8.1	8.1	7.4	6.0	599	839	6.50	< 0.01	0.006	0.19	12	11.8	64.0
FID 6*	6.1	7.0	6.7	6.6	6.4	182	561	6.20	0.02	0.012	0.38	7	6.6	18.7
FID 7	7.8	6.0	6.9	6.9	5.2	242	478	6.66	0.01	0.006	0.19	34	33.8	181.3
FID 8*	3.8	5.9	6.8	5.5	6.1	430	450	5.40	0.14	0.084	2.63	23	20.4	8.8
FID 10*	6.5	6.2	6.3	6.4	6.0	1020	1137	5.16	0.05	0.030	0.94	11	10.1	11.7
FID 12*	7.5	7.8	6.6	7.3	7.5	4260	4757	4.41	1.02	0.612	19.13	35	15.9	1.8
FID 13	5.6	7.8	8.1	7.1	7.4	1970	2228	5.12	0.34	0.204	6.38	25	18.6	3.9
FID 15	6.4	6.9	7.4	6.9	8.0	1360	1610	5.27	0.55	0.330	10.31	22	11.7	2.1
FID 16	5.7	4.9	5.1	5.2	4.3	512	751	4.60	< 0.01	0.006	0.19	0	-0.2	0.0
FID 17*	6.3	6.5	5.8	6.2	6.6	4680	7262	2.87	0.64	0.384	12.00	26	14.0	2.2
FID 18*	4.6	5.0	5.0	4.9	4.3	326	367	5.06	0.04	0.024	0.75	0	-0.8	0.0
FID 20*	7.7	5.5	4.8	6.0	4.9	790	860	5.13	0.09	0.054	1.69	5	3.3	3.0
FID 21*	6.8	7.4	7.8	7.3	6.3	131	139	8.49	0.03	0.018	0.56	3	2.4	5.3
FID 22	7.0	5.7	4.6	5.8	5.1	285	521	5.52	0.07	0.042	1.31	7	5.7	5.3
FID 23	4.2	4.4	4.5	4.4	3.7	252	488	4.28	0.16	0.096	3.00	0	-3.0	0.0
FID 24	8.1	8.1	8.0	8.0	7.7	121	355	8.07	< 0.01	0.006	0.19	31	31	165.3
FID 25	8.2	8.4	7.9	8.2	7.8	66	299	8.38	0.01	0.006	0.19	115	114.8	613.3
FID 26*	8.2	8.2	7.7	8.0	7.9	75	70	9.91	< 0.01	0.006	0.19	10	9.8	53.3
FID 27*	6.5	7.4	7.4	7.1	6.2	206	347	7.23	< 0.01	0.006	0.19	19	18.8	101.3
FID 28	7.4	5.3	7.7	6.8	5.4	348	585	6.34	0.04	0.024	0.75	6	5.3	8.0
FID 30	7.9	8.5	7.9	8.1	7.7	90	324	8.23	0.01	0.006	0.19	190	189.8	1013.3
FID 31	6.3	6.5	6.9	6.6	6.1	187	422	6.50	0.01	0.006	0.19	14	13.8	74.7
FID 32	6.6	6.3	5.8	6.2	5.7	2120	2380	4.21	0.02	0.012	0.38	7	6.6	18.7
FID 33	8.2	7.9	3.7	6.6	7.5	308	544	6.24	0.19	0.114	3.56	52	48.4	14.6
FID 34*	7.8	7.6	6.7	7.4	7.0	209	371	7.40	< 0.01	0.006	0.19	24	23.8	128.00
FID 35	7.4	8.0	7.6	7.7	7.8	210	445	7.45	0.04	0.024	0.75	97	96.3	129.33
FID 37[7]	5.4	5.3	5.4	5.4	-	373	610	4.98	--	--	--	--	--	--
FID 39	6.4	7.1	7.9	7.1	5.5	414	652	6.53	< 0.01	0.006	0.19	14	13.8	74.67
FID 43	5.2	4.0	3.9	4.4	4.2	466	704	3.86	0.93	0.558	17.44	0	-17.4	0.00

Notes:

*Also sampled for mineralogical analysis, which reported sieved copper concentrations < 2 mm.

[1] Average of 3 soil samples on 50-m transect and analyzed using the soil paste method for pH in the field.

[2] Field samples were sieved to 2 mm for pH, and lab pH samples were sieved to 0.25 mm.

[3] Samples for copper analysis were adjusted to being sieved using regressions in main report, unless sampled in mineralogical analysis, where sieved <2 mm estimates were available (shown with asterisk).

[4] Sulfur and ABA results for data throughout this report were always sieved to < 0.25 mm.

[5] Pyritic Sulfide Sulfur was calculated as 60% of Total Sulfur, based on 2010-2014 data. Pyritic Sulfide Sulfur was calculated using the detection limit when Total Sulfur was less than 0.1%.

[6] AGP is calculated from Pyritic Sulfide Sulfur where S(%)*31.25 = AGP. NNP = ANP - AGP, NPR = ANP/AGP

[7] FID 37 was not sampled in the 0-6" depth (too shallow); therefore was estimated from the 0-1" range. The 0-6" pH has been found to be the same as the 0-1" pH, and the 0-6" Cu is calculated as follows: [0-1" Cu]*0.7.

0-6" = zero to six inch, mm = millimeters

AGP = acid generation potential

ANP = acid neutralization potential

mg/kg - milligram per kilogram

NNP = Net Neutralization Potential

NPR = Neutralization Potential Ratio

S.U. = standard units

-- = not applicable

Table C-2

Comparison of Lab Estimates of Copper, pH, Calculated pCu, and Acid Base Accounting Results in 2009 (ACZ) and 2010 (SVL)[1] Soil Samples

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Soil Sample ID	**Lab Soil pH (0-6") SU (2009 adj unsieved, 2010 unsieved)**		**Unsieved Soil Cu (0-6") mg/kg**		**Unsieved Soil pCu (0-6") calculated**		**Total Sulfur (%)**		**Pyritic/Sulfide Sulfur (%)[2]**		**AGP (tCaCO3/kt) (calculated)**		**ANP (tCaCO3/kt)**		**NNP (tCaCO3/kt) (calculated)**		**NPR (ANP/AGP) (calculated)**	
	2009	**2010**	**2009**	**2010**	**2009**	**2010**	**2009**	**2010**	**2009**	**2010**	**2009**	**2010**	**2009**	**2010**	**2009**	**2010**	**2009**	**2010**
FID 7	5.69	5.86	242	503	6.32	5.64	0.01	0.03	0.006	0.02	0.2	0.7	34	12.30	33.8	11.7	181.3	18.9
FID 8	6.45	7.00	430	470	6.36	6.77	0.14	0.28	0.084	0.08	3	2.3	23	17.94	20	15.6	8.8	7.6
FID 10	6.36	5.26	1020	1776	5.29	3.63	0.05	0.04	0.030	0.02	1	0.6	11	15.09	10	14.5	11.7	23.5
FID 15	8.04	5.62	1360	1442	6.52	4.20	0.55	0.06	0.330	0.02	10	0.6	22	2.57	12	1.9	2.1	4.0
FID 16	4.94	5.56	512	2603	4.76	3.47	< 0.01	0.11	0.006	0.05	0.2	1.6	0	4.03	0	2.4	0.0	2.5
FID 17	6.87	5.95	4680	5119	4.01	3.05	0.64	0.28	0.384	0.18	12	5.5	26	10.16	14	4.7	2.2	1.8
FID 18	4.94	4.47	326	445	5.28	4.48	0.04	0.17	0.024	0.04	1	1.3	0	2.96	-1	1.7	0.0	2.3
FID 22	5.61	7.20	285	388	6.05	7.18	0.07	0.12	0.042	0.05	1	1.6	7	14.95	6	13.3	5.3	9.1
FID 23	4.43	4.88	252	199	5.10	5.79	0.16	0.07	0.096	0.02	3	0.6	0	4.03	-3	3.4	0.0	6.2
FID 28	5.86	8.01	348	338	6.06	8.09	0.04	0.06	0.024	0.03	1	1.0	6	100.63	5	99.6	8.0	102.0
FID 37	--	5.23	373	810	--	4.50	--	0.03	--	0.01	--	0.3	--	2.56	--	2.2	--	8.0
FID 43	4.85	6.86	466	489	4.79	6.60	0.93	0.39	0.558	0.11	17	3.3	0	28.07	-17	24.8	0.0	8.5
FID 101	--	4.78	--	282	--	5.30	--	0.14	--	0.04	--	1.3	--	2.04	--	0.8	--	1.6
FID 102	--	4.64	--	280	--	5.17	--	0.28	--	0.07	--	2.2	--	1.03	--	-1.2	--	0.5
FID 103	--	4.84	--	323	--	5.20	--	0.05	--	0.00	--	0.0	--	7.22	--	7.2	--	--
FID 104	--	4.07	--	461	--	4.07	--	0.74	--	0.24	--	7.4	--	< 0.3	--	-7.1	--	0.0
FID 105	--	6.08	--	1255	--	4.79	--	0.09	--	0.04	--	1.3	--	9.89	--	8.6	--	7.4
FID 106	--	5.86	--	441	--	5.79	--	0.03	--	0.01	--	0.3	--	9.25	--	8.9	--	28.2
Reference #1 (West)	--	7.84	--	1857	--	5.98	--	0.03	--	< 0.01	--	0.3	--	246.89	--	246.6	--	823.0
Reference #2 (North)	--	6.72	--	672	--	6.10	--	0.02	--	< 0.01	--	0.3	--	3.85	--	3.6	--	12.8
Reference #3 (North East)	--	5.78	--	2457	--	3.74	--	0.08	--	0.02	--	0.7	--	8.26	--	7.6	--	12.2
Reference #4 (East)	--	5.76	--	1418	--	4.35	--	0.15	--	0.03	--	1.0	--	< 0.3	--	-0.7	--	0.3

Notes:

[1] SVL 2010 data not used in analysis in this report because not sieved for pH and Cu. ACZ samples were sieved to < 2mm and were used. However, SVL data shown here to compare to 2009 unsieved samples. 2009 samples were at one location (25 m on 50 m transect); 2010 samples were a composite of 5 locations in 50 m x 50 m plot

[2] See footnotes of Table C-1 to describe ABA and sulfur calculations.

0-6" = zero to six inch

ABA - Acid base accounting (note all soils were sieved to <0.25 mm for ABA in all years)

AGP - Acid generating potential

ANP - Acid neutralizing potential

NNP = Net Neutralization Potential

NPR = Neutralization Potential Ratio

SU - Standard units

mg/kg - milligram per kilogram

-- = not applicable

Cu = copper

Bolded = influenced by Gila Conglomerate Formation (providing high buffering capacity)

🟦 highlighted in blue means 2010 value is higher than 2009 value, and shows no consistent pattern except an increase in copper and NPR in 2010.

Table C-3
Sieved Soil pH, Copper, and pCu Data used in Figure C-1

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Soil Sample Location	Soil pH (0 to 6 inches) [1] (S.U.)							Soil Cu (0 to 6 inches) [1] (mg/kg)							Soil pCu (0 to 6 inches) (calculated)						
	2008	2009	2010	2011	2012	2013	2014	2008	2009	2010	2011	2012	2013	2014	2008	2009	2010	2011	2012	2013	2014
FID 7	--	6.89	5.40	4.80	4.70	5.40	5.10	--	478	550	494	514	375	491	--	6.66	5.11	4.67	4.53	5.55	4.96
FID 8	--	5.47	6.50	6.40	5.50	6.50	4.60	--	668	545	332	252	358	473	--	4.95	6.14	6.62	6.10	6.62	4.54
FID 10	--	6.35	4.80	4.80	5.00	5.00	4.70	--	1137	2060	2140	2210	1780	2550	--	5.16	3.03	2.99	3.13	3.38	2.69
FID 15	--	6.91	4.90	4.80	4.60	5.20	5.60	--	1610	2520	2260	1030	1950	1850	--	5.27	2.89	2.92	3.64	3.46	3.90
FID 16	--	5.24	4.80	4.50	4.30	4.70	4.80	--	751	3550	2020	1450	1290	1440	--	4.60	2.40	2.77	2.97	3.47	3.44
FID 17*	--	6.18	5.10	6.00	4.90	--	--	--	7262	4550	4220	5150	--	--	--	2.87	2.40	3.32	2.07	--	--
FID 18	--	4.85	3.90	4.30	4.40	4.30	4.20	--	367	559	254	192	141	310	--	5.06	3.69	4.97	5.39	5.65	4.65
FID 22	--	5.78	6.50	6.20	6.40	6.30	6.90	--	521	488	430	308	296	378	--	5.52	6.27	6.13	6.70	6.66	6.93
FID 23*	--	4.36	4.40	--	--	--	--	--	488	202	--	--	--	--	--	4.28	5.33	--	--	--	--
FID 28	--	6.81	7.70	6.90	6.70	6.80	7.30	--	585	527	400	271	318	423	--	6.34	7.29	6.87	7.13	7.04	7.17
FID 37	--	5.40	4.80	4.60	4.50	5.30	4.70	--	610	1210	654	765	432	708	--	4.98	3.64	4.16	3.89	5.29	4.16
FID 43*	--	4.37	6.50	--	--	--	--	--	704	636	--	--	--	--	--	3.86	5.96	--	--	--	--
Reference #2 (North)	6.6	--	6.43	6.00	5.80	6.00	6.20	1946	--	913	687	1170	578	760	4.77	--	5.48	5.41	4.61	5.61	5.48
Reference #3 (Northeast)	5.9	--	5.31	5.60	5.10	6.70	5.40	2714	--	2721	1950	2250	1090	1540	3.76	--	3.18	3.84	3.21	5.53	3.92
Reference #4 (East)	5.7	--	5.28	5.40	4.80	6.00	4.90	1099	--	1669	1130	1210	923	1020	4.57	--	3.72	4.28	3.64	5.07	3.93

Notes:

[1] 2008 reference samples and 2009 samples were tested using unsieved soil and were adjusted to sieved values using equation in main report when necessary (see sieve adjusted values in Table C-1 for 2009).

2011 to 2014 data are from the "permanence monitoring" dataset

mg/kg = milligrams per kilogram

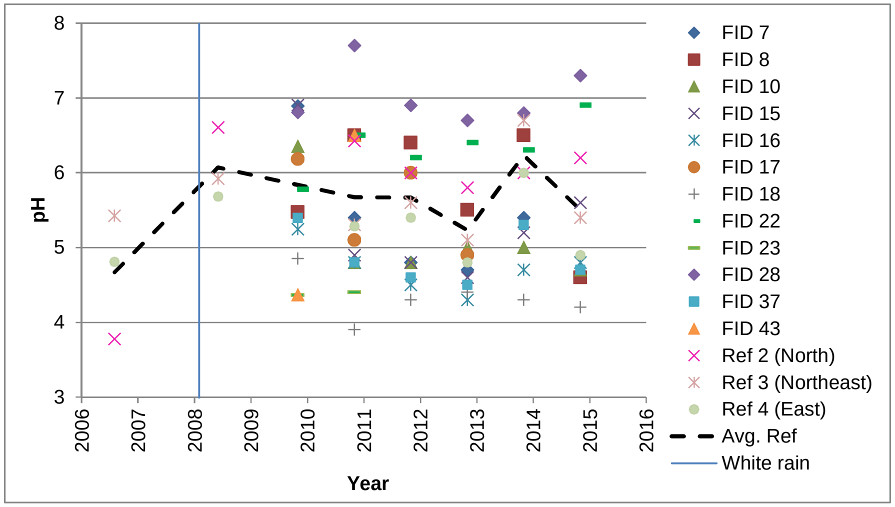
pCu = -log (cupric ion activity)

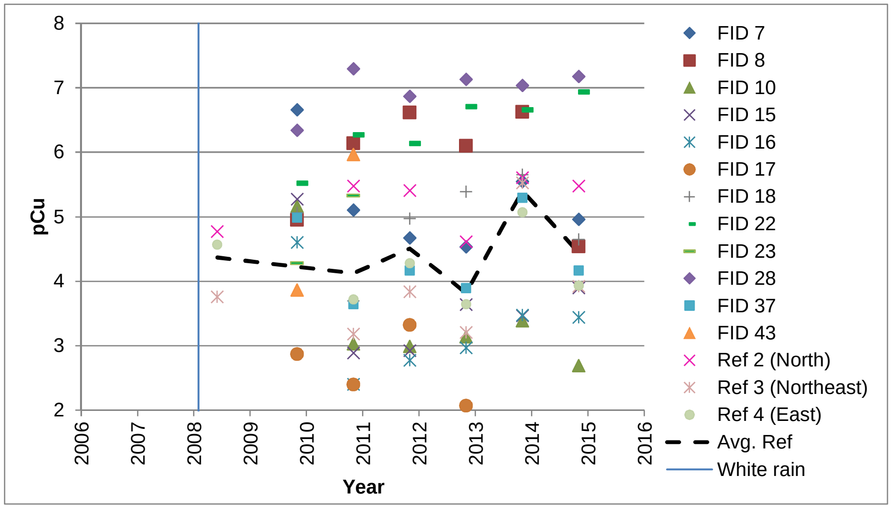
S.U. = standard units

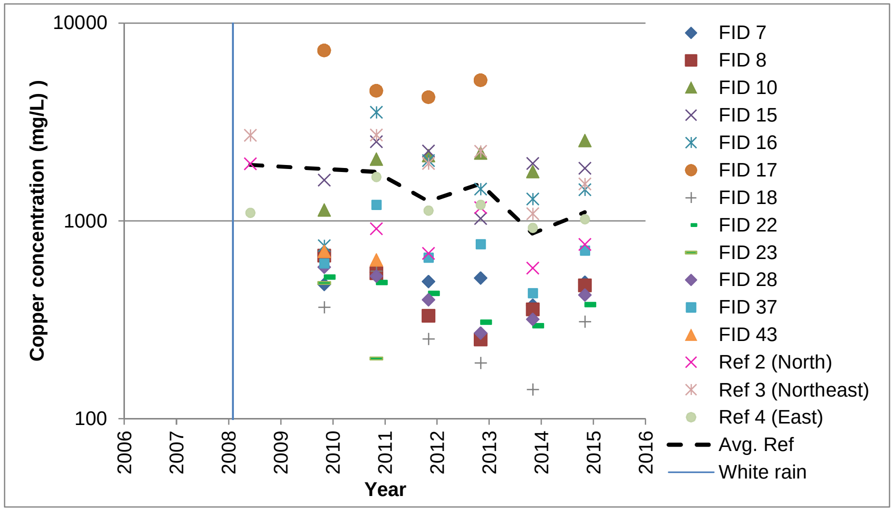
-- = not applicable

*Locations FID 17, FID 23, and FID 43 were excavated and not sampled in later years.

🟦 highlighted in blue means 2010 value is higher than 2009 value (or than 2008 value for reference locations) and shows no consistent pattern of increase or decrease (compare to Table C-2 unsieved dataset)







Note:
All data were from soils sieved to < 2 mm or adjusted as if sieved. Includes 2006, 2008 and 2009 unsieved data (adjusted as if sieved). 2006 pH data are from amendment plot adjacent to reference plot. Year tick mark shown on plot represents January (e.g., 2014 data sampled in fall are closer to Jan. 2015 than Jan. 2014 on graph).

FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

YEAR 5 REPORT - PH MONITORING

Long-Term (>5 years) Change in pH, Copper, and pCu

ARCADIS

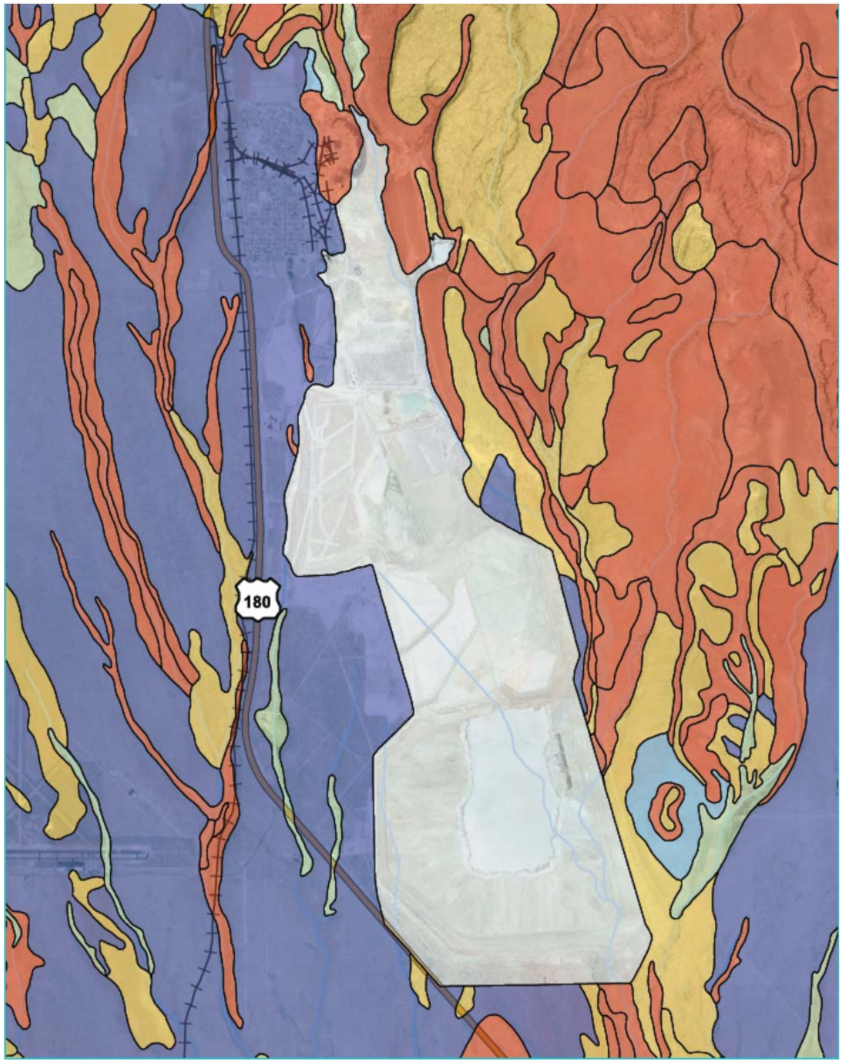
FIGURE

C-1

ARCADIS

Appendix D

Mineralogical Analysis



Soil Rating Polygons

- 🟥 <= 1
- 🟨 > 1 and <= 3
- 🟩 > 3 and <= 5
- 🟦 > 5 and <= 13
- 🟪 > 13 and <= 25
- ⬜ Not rated or not available

Note: concentrations in percent (kg/kg)
NRCS = Natural Resources Conservation Service.

FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

YEAR 5 REPORT - PH MONITORING

NRCS Calcium Carbonate Concentrations in Chino Surface (0-6") Soil

ARCADIS

FIGURE
D-1

Table D-1
Summary of Speciation Test Results from Drexler's Laboratory on 2009 FID Samples

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Sample	Soil Cu sieved to < 2mm ppm	Soil pH sieved to < 2 mm (field)	Cu (mg/kg)	CuNi[2]	Cu-FeO	CuM[3]	Cubanite ($CuFe_2S_3$)[4]	Chalcopyrite ($CuFeS_2$)	Covellite (CuS)	Cuprite (Cu2O)	Bornite (Cu_5FeS_4)	CuMO	Slag[5]	FeOOH[6]	FeSO4	SnMO	MnOOH	Brass	CuSO4	Calculated Soil pCu
FID 34	371	7.38	682	0	34.75	0	25.12	0	0	0	0	0	0	39.32	0.81	0	0	0	0	7.40
FID 26	70	8.02	75	0	10.51	0	0	29.31	0	10.08	0	0	0	37.48	12.62	0	0	0	0	9.92
FID 8	450	5.47	430	22.75	3.11	2.26	0	0	0	0	0	0	0	11.09	0	0.05	0	60.74	0	5.40
FID 6	561	6.6	650	0	20.42	30.4	10.35	0	0	0	0	0	0.73	38.11	0	0	0	0	0	6.20
FID 27	347	7.11	322	1.24	50.32	0	6.71	0	0	0	0	0	0.19	31.2	0	0	0	10.35	0	7.23
FID 20	860	5.98	755	0	8.09	0	4.5	0	0	0	15.98	0	0.75	68.13	0	0	2.56	0	0	5.13
FID 12	4757	7.32	5580	0	4.6	3.08	35.1	7.96	0	11.76	19.01	0	0	8.84	0.39	0.03	0	0	9.24	4.41
FID 10	1137	6.35	1050	0	13.99	28.9	35.67	4.61	6.77	0.87	0	0	0.69	6.61	1.6	0.3	0	0	0	5.15
FID 17	7262	6.18	9150	0	4.84	0	35.03	6.2	0	0	41.64	0	0.34	9.2	2.57	0	0.18	0	0	2.86
FID 21	139	7.34	131	0	55.55	0	14.41	0	0	0	0	0	0	30.05	0	0	0	0	0	8.49
FID 37	606	5.4	533	0	35.6	0	20.87	5.75	0	0	0	0	0.42	37.36	0	0	0	0	0	4.99
FID 18	367	4.85	215	0	0	0	0	0	0	0	0	38.61	0.92	58.91	1.56	0	0	0	0	5.06

Notes:

[1] Details on Bioavailability test methods for birds and speciation of copper-containing minerals are in LEGS (2009) in Appendix G.

[2] Mineral results are in relative mass percentage for phase.

[3] CuM is tectogenic (M = unknown metal)

[4] Most sulfides are geogenic (survived smelting unaltered or from tailings; not converted to H_2SO4).

[5] Slag may contain CaO, MgO,SiO, Fe_2SiO_4, $Al_2$03, glass-like substances (globules are technogenic)

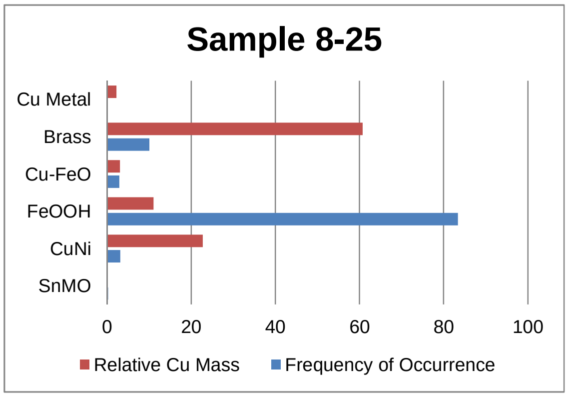
[6] FeOOH contains 2.6% copper--adsorbed onto surface

FID 8 Laboratory Output

Form	**Association**	**Size (microns)**
snmo	Liberated	3
cuni	Liberated	5
cuni	Liberated	2
Fe	Cemented	7
Fe	Liberated	15
cuni	Liberated	7
cuni	Liberated	7
cuni	Liberated	6
Fe	Liberated	32
Fe	Liberated	40
cuFe	Liberated	22
Fe	Cemented	32
Fe	Liberated	17
Fe	Rimming	16
Fe	Liberated	20
Fe	Liberated	31
cufe	Liberated	8
Fe	Cemented	42
Fe	Liberated	10
Fe	Liberated	13
Fe	Liberated	60
Fe	Liberated	32
cuni	Liberated	1
cuni	Liberated	1
Fe	Liberated	80
brass	Rimming	9
Fe	Liberated	24
Fe	Liberated	10
Fe	Liberated	28
cuni	Cemented	3
Fe	Liberated	11
Fe	Liberated	9
Fe	Cemented	4
Fe	Liberated	11
Fe	Liberated	32
Fe	Liberated	10
Fe	Liberated	42
Fe	Liberated	9
Fe	Liberated	28
Fe	Liberated	28
brass	Liberated	7
Fe	Liberated	3
cu	Liberated	2
Fe	Liberated	21
Fe	Liberated	23
Fe	Liberated	9
Fe	Liberated	5
Fe	Cemented	4
Fe	Cemented	4
Fe	Cemented	4
Fe	Cemented	4
Fe	Cemented	4
Fe	Cemented	4
Fe	Cemented	4
Fe	Cemented	4
Fe	Liberated	5
brass	Liberated	3
Fe	Rimming	8
Fe	Liberated	31
brass	Cemented	13
Fe	Liberated	8
brass	Liberated	5
brass	Liberated	3
brass	Liberated	62
Fe	Liberated	9

Form	**Number**	**Mean**	**Std-Dev**	**Range low**	**Range high**
total	65	15.63	16.14	1	80
SnMO	1	3	ND	3	3
CuNi	8	4	2.56	1	7
FeOOH	46	18.41	16.35	3	80
Cu-FeO	2	21	ND	8	22
Brass	7	14.57	21.21	3	62
Cu Metal	1	2	ND	2	2

Form	**(linear) freq**	**Rm Cu**	**Error-95%**
%	%	%	
SnMO	0.3	0.05	1.32
CuNi	3.15	22.75	4.25
FeOOH	83.37	11.09	9.05
Cu-FeO	2.96	3.11	3.54
Brass	10.04	60.74	7.31
Cu Metal	0.2	2.26	1.08

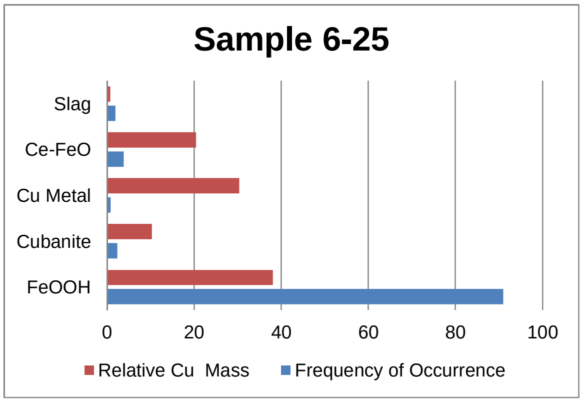


FID 6 Laboratory Output

Form	Association	Size (microns)
Fe	Liberated	12
Fe	Liberated	3
Fe	Cemented	9
Fe	Cemented	2
Fe	Cemented	2
Fe	Cemented	2
Fe	Cemented	2
Fe	Rimming	10
Fe	Liberated	4
Fe	Liberated	12
Fe	Cemented	7
cub	Liberated	6
Fe	Cemented	5
Fe	Liberated	6
Fe	Liberated	5
Fe	Cemented	4
Fe	Cemented	4
Fe	Liberated	12
Fe	Liberated	8
Fe	Liberated	9
Fe	Cemented	15
Fe	Cemented	12
Fe	Cemented	110
Fe	Liberated	7
Fe	Rimming	100
Fe	Cemented	8
Fe	Liberated	8
cub	Liberated	8
cu	Liberated	9
Fe	Cemented	4
Fe	Cemented	4
Fe	Cemented	4
cufe	Liberated	42
Fe	Liberated	15
Fe	Liberated	21
Fe	Liberated	55
Fe	Rimming	8
Slag	Liberated	21
Fe	Cemented	5
Fe	Cemented	5
Fe	Cemented	5
Fe	Cemented	5
Fe	Rimming	6
Fe	Rimming	14
Fe	Rimming	14
Fe	Cemented	11
Fe	Cemented	7
Fe	Cemented	12
Fe	Cemented	13
Fe	Liberated	48
Fe	Liberated	13
cub	Inclusion	6
cub	Inclusion	3
cub	Inclusion	1
cub	Inclusion	1
cub	Inclusion	1
Fe	Liberated	30
Fe	Cemented	8
Fe	Liberated	3
Fe	Liberated	10
Fe	Liberated	10
Fe	Liberated	10
Fe	Liberated	10
Fe	Cemented	6
Fe	Cemented	6
Fe	Cemented	6
Fe	Cemented	6
Fe	Cemented	6
Fe	Cemented	4

Form	**Number**	**Mean**	**Std-Dev**	**Range low**	**Range high**
total	103	10.54	15.95	1	110
FeOOH	93	10.62	16.31	2	110
Cubanite (CuFe2S	7	3.71	2.93	1	8
Cu Metal	1	9	ND	9	9
Ce-FeO	1	42	ND	42	42
Slag	1	21	ND	21	21

Form	**(linear) freq**	**Rm Cu**	**Error-95%**	
%	%	%		
FeOOH	90.98	38.11	5.53	
Cubanite	2.39	10.35	2.95	74.22360248
Cu Metal	0.83	30.4	1.75	25.77639752
Ce-FeO	3.87	20.42	3.72	
Slag	1.93	0.73	2.66	



FID 6 Laboratory Output

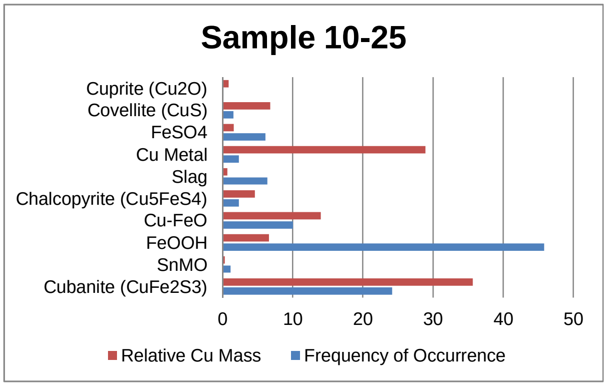
Form	**Association**	**Size (microns)**
Fe	Cemented	4
Fe	Cemented	4
Fe	Cemented	4
Fe	Cemented	4
Fe	Cemented	4
Fe	Cemented	4
Fe	Liberated	11
Fe	Liberated	3
Fe	Cemented	7
Fe	Liberated	9
Fe	Liberated	12
Fe	Liberated	6
Fe	Liberated	25
Fe	Liberated	8
Fe	Liberated	9
Fe	Liberated	13
Fe	Cemented	8
Fe	Cemented	6
Fe	Liberated	4
Fe	Cemented	7
Fe	Rimming	22
Fe	Liberated	14
Fe	Cemented	2
Fe	Cemented	2
Fe	Cemented	2
Fe	Liberated	8
Fe	Liberated	5
Fe	Rimming	7
Fe	Cemented	2
Fe	Cemented	2
Fe	Cemented	2
Fe	Cemented	2
Fe	Cemented	2
Fe	Cemented	2

FID 10 Laboratory Output

Form	Association	Size (microns)
cub	Liberated	11
snmo	Liberated	11
cub	Liberated	23
cub	Liberated	4
Fe	Cemented	7
cub	Liberated	7
snmo	Liberated	9
cub	Liberated	21
cufe	Liberated	12
cub	Liberated	16
cp	Liberated	20
Fe	Rimming	27
Fe	Liberated	9
Slag	Liberated	90
cub	Liberated	11
Fe	Liberated	12
Fe	Liberated	13
cub	Cemented	8
cu	Liberated	28
Fe	Liberated	19
Fe	Liberated	15
Fe	Liberated	14
cub	Liberated	19
Fe	Liberated	8
Fe	Rimming	29
cub	Liberated	8
Fe	Rimming	32
Fe	Liberated	11
cub	Liberated	35
cufe	Liberated	50
Slag	Liberated	21
Fe	Liberated	14
cub	Liberated	14
Fe	Liberated	22
cub	Liberated	22
cub	Liberated	15
cufe	Liberated	40
Fe	Liberated	5
cufe	Liberated	8
cufe	Liberated	9
cub	Liberated	14
Fe	Liberated	15
Fe	Liberated	15
Fe	Liberated	34
cu	Liberated	12
Sulf	Cemented	35
Fe	Rimming	35
cub	Liberated	10
cufe	Liberated	28
cub	Liberated	11
Fe	Liberated	19
Sulf	Liberated	12
Fe	Cemented	4
Fe	Cemented	4
Fe	Cemented	4
Fe	Cemented	4
Sulf	Rimming	9
Fe	Rimming	13
Fe	Liberated	12
cub	Liberated	11
Fe	Liberated	31
Fe	Liberated	20
Fe	Rimming	36
Fe	Liberated	4
cub	Liberated	33
Fe	Rimming	12
Fe	Liberated	9
cub	Liberated	11
cus	Liberated	13
Fe	Cemented	11
Fe	Liberated	9
Fe	Liberated	7
Fe	Liberated	7

Form	Number	Mean	Std-Dev	Range low	Range high
total	116	14.95	12.57	1	90
Cubanite	33	12.7	8.6	1	35
SnMO	2	10	1.41	9	11
FeOOH	50	15.9	10.94	4	45
Cu-FeO	10	17.4	16.19	3	50
Chalcopyrite	4	10	8.91	2	20
Slag	2	55.5	48.79	21	90
Cu Metal	2	20	11.31	12	28
FeSO4	8	13.25	8.83	9	35
Covellite	4	6.75	4.5	3	13
Cuprite	1	2	ND	2	2

Form	(linear) freq	Rm Cu	Error-95%
%	%	%	
Cubanite (CuFe2S3)	24.16	35.67	7.79
SnMO	1.15	0.3	1.94
FeOOH	45.85	6.61	9.07
Cu-FeO	10.03	13.99	5.47
Chalcopyrite (Cu5FeS4	2.31	4.61	2.73
Slag	6.4	0.69	4.45
Cu Metal	2.31	28.9	2.73
FeSO4	6.11	1.6	4.36
Covellite (CuS)	1.56	6.77	2.25
Cuprite (Cu2O)	0.12	0.87	0.62
		100.01	



FID 10 Laboratory Output

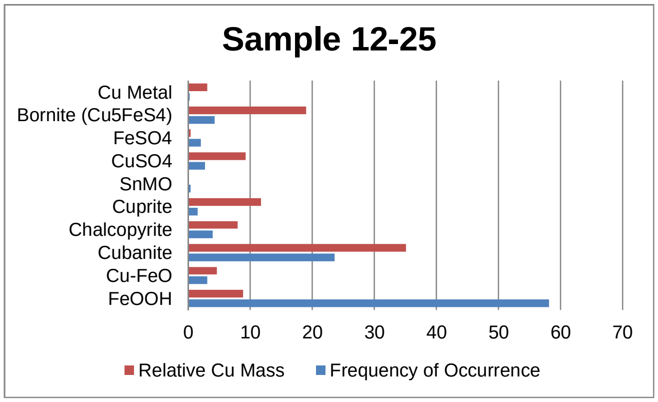
Form	**Association**	**Size (microns)**
Fe	Liberated	12
cuo	Cemented	2
Fe	Liberated	9
Fe	Liberated	40
Fe	Liberated	45
Fe	Liberated	4
Fe	Liberated	29
Sulf	Liberated	10
Sulf	Liberated	10
Sulf	Liberated	10
Sulf	Liberated	10
Sulf	Liberated	10
cub	Liberated	13
Fe	Cemented	10
cub	Cemented	4
cub	Cemented	7
cufe	Liberated	11
cus	Rimming	4
cub	Rimming	1
cub	Liberated	32
cp	Cemented	3
cub	Liberated	3
cufe	Liberated	6
cp	Liberated	2
cub	Cemented	4
Fe	Liberated	7
cus	Liberated	7
cus	Liberated	3
Fe	Liberated	8
Fe	Liberated	8
Fe	Liberated	32
cub	Liberated	11
cub	Liberated	13
cub	Liberated	7
cub	Liberated	6
Fe	Liberated	13
cufe	Liberated	3
cub	Liberated	3
cub	Liberated	11
cp	Liberated	15
Fe	Cemented	28
cufe	Liberated	7
Fe	Liberated	8

FID 12 Laboratory Output

Form	Association	Size (microns)
Fe	Liberated	13
Fe	Cemented	220
Fe	Liberated	14
cufe	Liberated	8
cub	Liberated	16
cufe	Liberated	6
Fe	Liberated	60
Fe	Liberated	45
Fe	Liberated	90
Fe	Rimming	22
cub	Liberated	8
cub	Liberated	58
Fe	Liberated	32
cp	Rimming	28
Fe	Liberated	11
Fe	Cemented	46
Fe	Liberated	23
cub	Liberated	17
Fe	Liberated	7
Fe	Liberated	13
Fe	Liberated	9
cub	Liberated	8
cp	Liberated	20
cuo	Liberated	19
Fe	Rimming	29
Fe	Cemented	35
cub	Liberated	42
cub	Liberated	6
Fe	Cemented	44
cub	Liberated	13
cub	Liberated	7
Fe	Rimming	48
Fe	Liberated	35
Fe	Liberated	25
Fe	Rimming	17
Fe	Liberated	40
cp	Liberated	20
Fe	Rimming	23
cub	Liberated	25
Fe	Liberated	14
snmo	Liberated	15
Fe	Liberated	35
Fe	Liberated	80
cufe	Liberated	21
Fe	Liberated	25
Fe	Cemented	23
cuo	Liberated	7
Fe	Liberated	8
cub	Liberated	10
cub	Liberated	19
Fe	Cemented	13
cub	Liberated	26
Fe	Liberated	15
cufe	Liberated	14
Fe	Liberated	11
cub	Liberated	8
cuo	Rimming	10
cufe	Rimming	15
cub	Liberated	9
cub	Liberated	44
Fe	Liberated	22
cub	Liberated	15
cub	Liberated	8
cp	Liberated	23
Fe	Liberated	8
cub	Liberated	24
Fe	Cemented	65
cub	Liberated	42
Fe	Liberated	15

Form	Number	Mean	Std-Dev	Range low	Range high
total	112	32.97	33.24	5	220
FeOOH	54	39.76	41.88	5	220
Cu-FeO	7	16.29	11.59	6	40
Cubanite	34	25.62	16.9	6	62
Chalcopyrite	5	29.2	14.79	20	55
Cuprite	5	11.4	5.5	6	19
SnMO	1	15	ND	15	15
CuSO4	2	50.5	41.72	21	80
FeSO4	1	76	ND	76	76
Bornite	2	78.5	23.33	62	95
Cu Metal	1	9	ND	9	9

Form	(linear) freq	Rm Cu		Error-95%
%	%	%		
FeOOH	58.14	8.84	x	9.14
Cu-FeO	3.09	4.6		3.2
Cubanite	23.59	35.1	x	7.86
Chalcopyrite	3.95	7.96	x	3.61
Cuprite	1.54	11.76	x	2.28
SnMO	0.41	0.03	x	1.18
CuSO4	2.73	9.24	x	3.02
FeSO4	2.06	0.39	x	2.63
Bornite (Cu5FeS4)	4.25	19.01	x	3.74
Cu Metal	0.24	3.08	x	0.91
		100.01		



FID 12 Laboratory Output

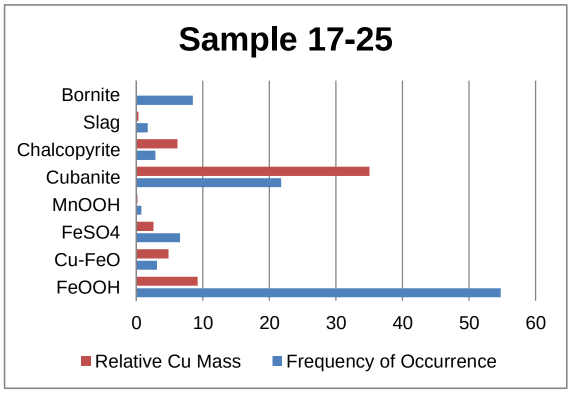
Form	Association	Size (microns)
Fe	Liberated	5
cub	Liberated	35
Fe	Cemented	22
Fe	Cemented	15
Fe	Rimming	22
Fe	Rimming	45
cufe	Liberated	10
Fe	Liberated	36
cub	Liberated	28
cub	Liberated	15
Fe	Liberated	55
cub	Liberated	22
cub	Liberated	37
Fe	Liberated	15
Fe	Liberated	8
cub	Liberated	17
cub	Rimming	35
cuso4	Liberated	21
Fe	Liberated	16
Fe	Liberated	11
cub	Liberated	22
Fe	Cemented	75
cub	Liberated	10
cub	Liberated	23
Sulf	Liberated	76
Fe	Liberated	42
cuo	Liberated	15
cuo	Liberated	6
cuso4	Liberated	80
cufe	Liberated	40
Fe	Cemented	100
Fe	Cemented	100
Fe	Cemented	100
cub	Liberated	60
Fe	Cemented	195
cub	Liberated	45
cub	Liberated	62
born	Liberated	62
cp	Liberated	55
cu	Inclusion	9
cub	Liberated	55
born	Liberated	95
Fe	Liberated	50

FID 17 Laboratory Output

Form	Association	Size (microns)
Fe	Liberated	18
cufe	Liberated	6
Sulf	Liberated	48
Fe	Liberated	10
Sulf	Rimming	14
Fe	Liberated	6
Fe	Cemented	2
Fe	Cemented	2
Fe	Cemented	2
Fe	Cemented	2
Fe	Cemented	2
Sulf	Cemented	3
Mn	Liberated	23
Fe	Liberated	6
Fe	Liberated	14
cufe	Liberated	23
Fe	Liberated	11
cub	Cemented	29
cp	Liberated	13
Fe	Liberated	14
Fe	Liberated	14
cufe	Liberated	23
Fe	Liberated	10
cufe	Liberated	29
Fe	Liberated	5
Fe	Cemented	4
Fe	Liberated	13
Fe	Cemented	4
Fe	Liberated	25
Fe	Liberated	15
cub	Liberated	6
Fe	Rimming	50
Fe	Liberated	9
Fe	Rimming	35
Fe	Liberated	8
Fe	Liberated	11
Fe	Liberated	42
Fe	Liberated	4
cub	Cemented	5
cub	Inclusion	3
Fe	Liberated	28
Fe	Rimming	16
Fe	Rimming	85
cub	Liberated	12
cub	Liberated	17
Fe	Rimming	36
Fe	Cemented	22
Fe	Liberated	19
Fe	Liberated	11
Fe	Rimming	28
cp	Liberated	9
cp	Liberated	16
Fe	Liberated	14
Fe	Liberated	23
cub	Liberated	5
Fe	Liberated	29
cub	Liberated	25
Fe	Liberated	20
Fe	Rimming	24
Fe	Rimming	27
Fe	Liberated	65
cub	Liberated	24
Fe	Rimming	15
Fe	Rimming	15
cub	Liberated	22
cufe	Liberated	3
Fe	Liberated	19
Fe	Liberated	14
Fe	Cemented	86

Form	Number	Mean	Std-Dev	Range low	Range high
total	118	25.88	30.92	2	210
FeOOH	68	24.57	29.51	2	210
Cu-FeO	6	15.83	10.59	3	29
FeSO4	4	50	59.82	3	135
MnOOH	1	23	ND	23	23
Cubanite	27	24.63	19.41	2	80
Chalcopyrite	5	17.4	10.16	9	35
Slag	3	17.67	9.61	9	28
Bornite	4	65	85.76	9	190

Form	(linear) freq	Rm Cu	Error-95%
%	%	%	
FeOOH	54.72	9.2	8.98
Cu-FeO	3.11	4.84	3.13
FeSO4	6.55	2.57	4.46
MnOOH	0.75	0.18	1.56
Cubanite	21.77	35.03	7.45
Chalcopyrite	2.85	6.2	3
Slag	1.74	0.34	2.36
Bornite	8.51	41.64	5.04



FID 17 Laboratory Output

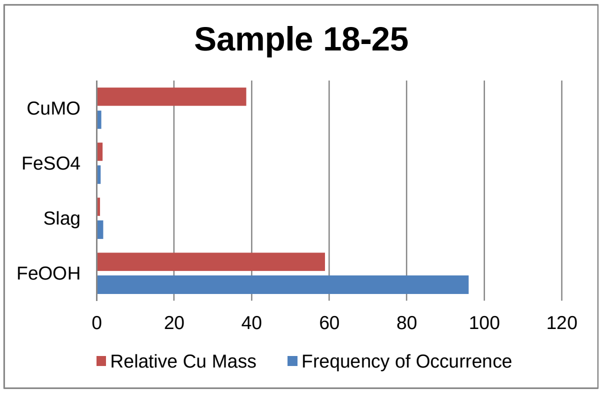
Form	**Association**	**Size (microns)**
Fe	Liberated	44
Fe	Liberated	30
cub	Liberated	22
Fe	Liberated	9
Slag	Liberated	9
Fe	Liberated	4
Fe	Liberated	26
Fe	Liberated	11
cub	Liberated	42
cp	Liberated	35
Slag	Liberated	16
Fe	Liberated	17
Fe	Rimming	32
cub	Liberated	24
cub	Liberated	12
Fe	Liberated	9
Fe	Liberated	10
cub	Liberated	32
born	Liberated	52
born	Liberated	9
born	Liberated	9
cp	Liberated	14
Fe	Liberated	23
Fe	Liberated	50
cub	Cemented	22
Fe	Liberated	70
born	Liberated	190
cub	Liberated	11
Fe	Liberated	16
Fe	Rimming	10
cub	Liberated	30
Fe	Liberated	23
Slag	Liberated	28
Fe	Rimming	55
cub	Liberated	17
Fe	Liberated	21
cufe	Liberated	11
cub	Liberated	31
cub	Liberated	30
cub	Liberated	80
cub	Liberated	14
cub	Liberated	2
cub	Liberated	25
cub	Liberated	43
Fe	Liberated	43
Fe	Liberated	24
Sulf	Liberated	135
cub	Liberated	80
Fe	Liberated	210

FID 18 Laboratory Output

Form	Association	Size (microns)
Fe	Liberated	7
Fe	Liberated	4
Fe	Liberated	7
Fe	Liberated	13
Fe	Liberated	15
Fe	Liberated	7
Fe	Liberated	4
Fe	Cemented	7
Fe	Liberated	4
Fe	Liberated	22
Fe	Rimming	4
Fe	Liberated	7
Fe	Liberated	40
Fe	Liberated	12
Fe	Liberated	28
Fe	Liberated	29
Fe	Liberated	6
Fe	Liberated	60
Slag	Liberated	29
Fe	Liberated	26
Fe	Liberated	25
Fe	Liberated	32
Fe	Liberated	5
Fe	Cemented	3
Fe	Liberated	20
Fe	Liberated	23
Fe	Liberated	30
Fe	Liberated	9
Fe	Rimming	9
Fe	Liberated	9
Fe	Liberated	8
Fe	Liberated	13
Fe	Liberated	13
Fe	Liberated	7
Fe	Liberated	4
Sulf	Liberated	18
Fe	Liberated	7
Fe	Rimming	23
Fe	Liberated	6
Fe	Liberated	4
Fe	Liberated	14
Fe	Liberated	7
Fe	Liberated	42
Fe	Liberated	15
Fe	Liberated	23
Fe	Liberated	4
Fe	Rimming	31
Fe	Liberated	7
Fe	Liberated	3
Fe	Liberated	20
Fe	Liberated	4
Fe	Rimming	75
Fe	Liberated	19
Fe	Liberated	8
Fe	Liberated	21
Fe	Liberated	21
Fe	Liberated	3
Fe	Liberated	9
Fe	Liberated	2
Fe	Liberated	145
Fe	Liberated	5
Fe	Liberated	6
Fe	Liberated	4
Fe	Liberated	20
Fe	Cemented	9
cumo	Liberated	20
Fe	Liberated	7
Fe	Cemented	35
Fe	Liberated	13

Form	Number	Mean	Std-Dev	Range low	Range high
total	100	16.91	20.57	1	145
FeOOH	96	16.91	20.9	2	145
Slag	1	29	ND	29	29
FeSO4	1	18	ND	18	18
CuMO	2	10.5	13.44	1	20

Form	(linear) freq	Rm Cu	Error-95%
%	%	%	
FeOOH	95.98	58.91	3.85
Slag	1.71	0.92	2.54
FeSO4	1.06	1.56	2.01
CuMO	1.24	38.61	2.17



FID 18 Laboratory Output

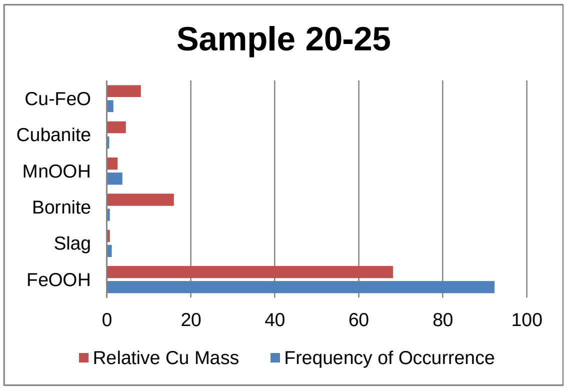
Form	**Association**	**Size (microns)**
Fe	Liberated	12
Fe	Liberated	27
Fe	Liberated	48
Fe	Liberated	33
Fe	Liberated	4
Fe	Liberated	6
Fe	Liberated	18
Fe	Liberated	42
Fe	Liberated	23
Fe	Liberated	7
Fe	Cemented	14
Fe	Liberated	32
Fe	Liberated	13
Fe	Liberated	4
Fe	Liberated	13
Fe	Cemented	5
Fe	Cemented	2
Fe	Rimming	8
Fe	Cemented	3
Fe	Liberated	5
Fe	Liberated	10
Fe	Liberated	105
Fe	Liberated	7
Fe	Liberated	6
Fe	Cemented	5
Fe	Cemented	4
Fe	Cemented	3
cumo	Cemented	1
Fe	Cemented	4
Fe	Liberated	5
Fe	Liberated	31

FID 20 Laboratory Output

Form	Association	Size (microns)
Fe	Liberated	35
Fe	Liberated	6
Fe	Liberated	31
Fe	Liberated	40
Fe	Liberated	55
Fe	Liberated	38
Fe	Liberated	26
Fe	Liberated	32
Fe	Liberated	9
Fe	Liberated	16
Fe	Rimming	14
Fe	Cemented	7
Fe	Liberated	23
Fe	Liberated	8
Fe	Liberated	16
Fe	Liberated	21
Fe	Liberated	7
Fe	Cemented	8
Fe	Liberated	30
Fe	Cemented	16
Fe	Rimming	30
Fe	Cemented	22
Slag	Liberated	6
Slag	Liberated	15
Fe	Rimming	30
Fe	Cemented	7
Fe	Cemented	9
Fe	Rimming	14
Fe	Cemented	4
Fe	Rimming	10
Fe	Liberated	7
Fe	Liberated	15
Fe	Rimming	14
Fe	Rimming	19
Fe	Liberated	14
Fe	Liberated	12
Fe	Liberated	19
Fe	Liberated	58
Fe	Cemented	7
Fe	Cemented	7
Fe	Cemented	7
Fe	Cemented	7
Fe	Cemented	7
Fe	Liberated	10
Fe	Liberated	15
born	Cemented	13
Fe	Liberated	23
Fe	Cemented	33
Fe	Liberated	12
Fe	Liberated	8
Fe	Liberated	32
Fe	Liberated	13
Fe	Liberated	15
Mn	Liberated	36
Fe	Rimming	45
Fe	Liberated	9
cub	Cemented	11
Fe	Rimming	19
Fe	Cemented	14
Fe	Rimming	14
Fe	Cemented	7
Fe	Cemented	4
Fe	Liberated	9
Mn	Liberated	4
Mn	Liberated	11
Fe	Liberated	25
Fe	Liberated	32
Fe	Liberated	7
Fe	Liberated	10
Fe	Rimming	12

Form	Number	Mean	Std-Dev	Range low	Range high
total	100	18.28	13.03	4	70
FeOOH	90	18.74	13.34	4	70
Slag	2	10.5	6.36	6	15
Bornite	1	13	ND	13	13
MnOOH	4	17	13.74	4	36
Cubanite	1	11	ND	11	11
Cu-FeO	2	14	9.9	7	21

Form	(linear) freq	Rm Cu	Error-95%
%	%	%	
FeOOH	92.29	68.13	5.23
Slag	1.15	0.75	2.09
Bornite	0.71	15.98	1.65
MnOOH	3.72	2.56	3.71
Cubanite	0.6	4.5	1.52
Cu-FeO	1.53	8.09	2.41



FID 20 Laboratory Output

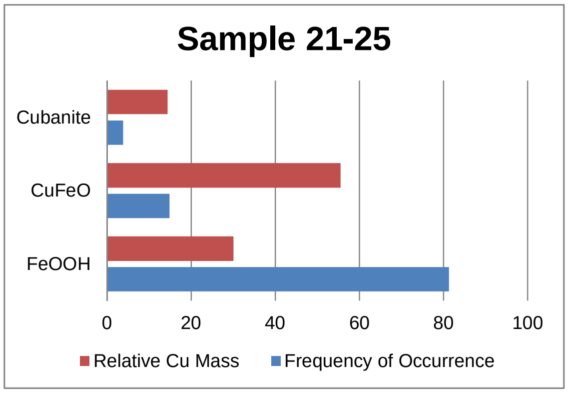
Form	Association	Size (microns)
Fe	Liberated	11
Fe	Cemented	9
Fe	Cemented	10
Fe	Liberated	42
Fe	Liberated	7
Fe	Liberated	8
Fe	Liberated	18
Fe	Liberated	11
Fe	Liberated	32
cufe	Liberated	21
Fe	Liberated	14
Fe	Liberated	20
Fe	Liberated	22
Fe	Liberated	8
Fe	Cemented	13
Fe	Liberated	11
cufe	Cemented	7
Fe	Liberated	32
Mn	Liberated	17
Fe	Liberated	5
Fe	Liberated	12
Fe	Liberated	12
Fe	Rimming	42
Fe	Cemented	47
Fe	Liberated	18
Fe	Liberated	28
Fe	Liberated	25
Fe	Rimming	30
Fe	Liberated	5
Fe	Liberated	70

FID 21 Laboratory Output

Form	Association	Size (microns)
Fe	Liberated	7
Fe	Liberated	8
Fe	Liberated	18
Fe	Liberated	13
cufe	Liberated	23
Fe	Liberated	11
Fe	Liberated	7
Fe	Liberated	3
Fe	Liberated	3
Fe	Liberated	8
Fe	Liberated	8
Fe	Liberated	13
Fe	Rimming	12
Fe	Liberated	22
Fe	Liberated	8
Fe	Liberated	10
Fe	Liberated	11
Fe	Liberated	5
Fe	Liberated	6
Fe	Cemented	4
Fe	Cemented	3
Fe	Cemented	1
Fe	Cemented	1
Fe	Cemented	1
Fe	Cemented	1
Fe	Cemented	1
Fe	Liberated	25
Fe	Rimming	12
Fe	Rimming	27
Fe	Liberated	13
Fe	Cemented	4
cufe	Liberated	23
cufe	Liberated	24
Fe	Liberated	20
Fe	Liberated	18
Fe	Rimming	10
Fe	Rimming	21
Fe	Rimming	5
Fe	Rimming	9
Fe	Liberated	5
Fe	Rimming	27
cufe	Liberated	8
Fe	Liberated	7
cub	Liberated	20
Fe	Liberated	16
Fe	Liberated	22

Form	Number	Mean	Std-Dev	Range low	Range high
total	46	11.39	7.92	1	27
FeOOH	41	10.39	7.53	1	27
CuFeO	4	19.5	7.68	8	24
Cunanite	1	20	ND	20	20

Form	(linear) freq	Rm Cu	Error-95%
%	%	%	
FeOOH	81.3	30.05	11.27
CuFeO	14.89	55.55	10.29
Cubanite	3.82	14.41	5.54

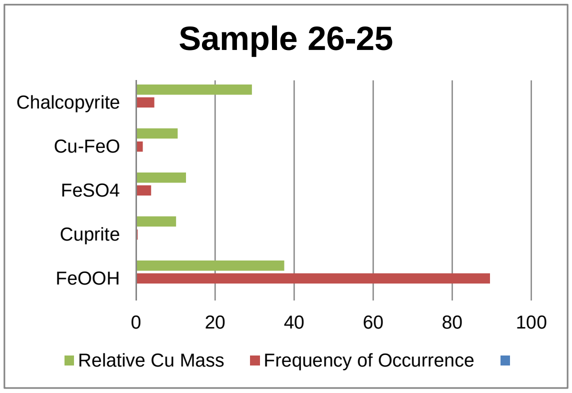


FID 26 Laboratory Output

Form	**Association**	**Size (microns)**
Fe	Liberated	7
cuo	Liberated	1
Fe	Rimming	14
Fe	Liberated	4
Fe	Liberated	5
Fe	Liberated	11
Fe	Liberated	7
Fe	Liberated	7
Fe	Liberated	7
Fe	Liberated	7
Fe	Liberated	7
Fe	Rimming	14
Fe	Liberated	4
Sulf	Liberated	9
Fe	Liberated	4
Fe	Liberated	10
Fe	Rimming	6
Fe	Liberated	4
Fe	Liberated	8
Fe	Liberated	11
Fe	Liberated	14
Fe	Liberated	5
Fe	Liberated	6
Cufe	Liberated	4
Fe	Liberated	4
Fe	Rimming	7
Fe	Cemented	2
Fe	Cemented	2
Fe	Cemented	2
Fe	Cemented	2
Fe	Liberated	6
Fe	Liberated	9
Fe	Liberated	4
cp	Liberated	11
Fe	Liberated	13

Form	**Number**	**Mean**	**Std-Dev**	**Range low**	**Range high**
total	35	6.8	3.67	1	14
FeOOH	31	6.87	3.62	2	14
Cuprite	1	1	-1.#J	1	1
FeSO4	1	9	-1.#J	9	9
Cu-FeO	1	4	-1.#J	4	4
Chalcopyrite	1	11	-1.#J	11	11

Form	**(linear) freq**	**Rm Cu**	**Error-95%**
%	%	%	
FeOOH	89.5	37.48	10.16
Cuprite	0.42	10.08	2.14
FeSO4	3.78	12.62	6.32
Cu-FeO	1.68	10.51	4.26
Chalcopyrite	4.62	29.31	6.96

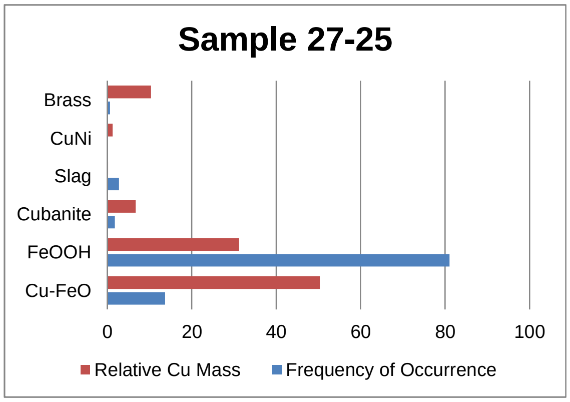


FID 27 Laboratory Output

Form	Association	Size (microns)
cufe	Liberated	13
Fe	Liberated	13
Fe	Rimming	21
Fe	Cemented	65
cub	Liberated	3
cufe	Liberated	12
Fe	Liberated	13
Fe	Liberated	9
cufe	Liberated	10
Fe	Liberated	22
cub	Inclusion	10
Slag	Liberated	45
cub	Inclusion	1
Fe	Liberated	7
cub	Liberated	9
Fe	Liberated	48
Fe	Liberated	28
Fe	Liberated	40
Fe	Liberated	12
Fe	Liberated	30
Fe	Liberated	25
Fe	Liberated	8
Fe	Liberated	41
cufe	Liberated	42
Fe	Rimming	24
Fe	Liberated	10
Fe	Liberated	15
Fe	Liberated	12
Fe	Liberated	23
Fe	Liberated	22
cufe	Liberated	11
cufe	Liberated	10
Fe	Liberated	13
Fe	Liberated	13
Fe	Liberated	11
Fe	Cemented	20
Fe	Liberated	6
Fe	Liberated	40
cub	Liberated	6
cufe	Cemented	22
Fe	Liberated	23
cufe	Liberated	8
cufe	Liberated	10
cuni	Liberated	1
Fe	Liberated	4
Fe	Cemented	8
Fe	Liberated	23
Fe	Liberated	10
cufe	Liberated	32
Fe	Liberated	33
Fe	Cemented	9
Fe	Cemented	4
Fe	Cemented	4
Fe	Cemented	4
Fe	Cemented	4
Fe	Cemented	4
Fe	Cemented	14
Fe	Cemented	25
Fe	Rimming	8
Fe	Cemented	4
Fe	Liberated	24
Fe	Liberated	4
Fe	Liberated	9
Fe	Cemented	11
Fe	Cemented	7
Fe	Rimming	21
Fe	Liberated	13
Fe	Cemented	2
Fe	Cemented	2

Form	Number	Mean	Std-Dev	Range low	Range high
total	103	15.64	13.03	1	65
Cu-FeO	12	18.33	13.02	8	42
FeOOH	83	15.73	12.93	2	65
Cubanite	5	5.8	3.83	1	10
Slag	1	45	ND	45	45
CuNi	1	1	ND	1	1
Brass	1	10	ND	10	10

Form	(linear) freq	Rm Cu	Error-95%
%	%	%	
Cu-FeO	13.66	50.32	6.63
FeOOH	81.07	31.2	7.57
Cubanite	1.8	6.71	2.57
Slag	2.79	0.19	3.18
CuNi	0.06	1.24	0.48
Brass	0.62	10.35	1.52



FID 27 Laboratory Output

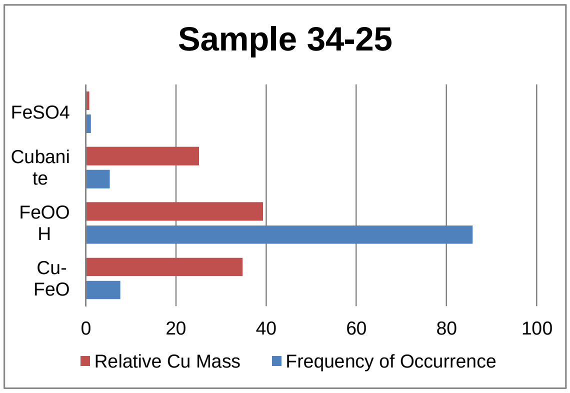
Form	Association	Size (microns)
Fe	Cemented	2
Fe	Cemented	2
Fe	Cemented	2
Fe	Liberated	33
Fe	Liberated	6
Fe	Liberated	5
Fe	Rimming	11
Fe	Cemented	3
Fe	Cemented	3
Fe	Cemented	3
Fe	Cemented	3
Fe	Liberated	27
Fe	Liberated	25
Fe	Cemented	10
Fe	Cemented	4
Fe	Cemented	17
Fe	Inclusion	14
Fe	Liberated	9
cufe	Liberated	42
cufe	Liberated	8
Fe	Cemented	10
Fe	Cemented	10
Fe	Cemented	16
Fe	Cemented	55
Fe	Liberated	21
Fe	Liberated	9
Fe	Liberated	8
Fe	Rimming	23
Fe	Cemented	14
Fe	Cemented	32
Fe	Liberated	41
Fe	Liberated	8
brass	Rimming	10
Fe	Liberated	15

FID 34 Laboratory Output

Form	**Association**	**Size (microns)**
cufe	Liberated	7
Fe	Cemented	12
Fe	Liberated	7
Fe	Liberated	13
Fe	Liberated	14
Fe	Rimming	7
Fe	Cemented	25
Fe	Cemented	6
Fe	Cemented	13
cufe	Liberated	10
Fe	Liberated	35
Fe	Cemented	7
Fe	Rimming	3
Fe	Liberated	16
Fe	Cemented	6
Fe	Cemented	10
Fe	Liberated	8
Fe	Liberated	6
cub	Liberated	60
Fe	Liberated	28
cufe	Liberated	5
Fe	Cemented	11
Fe	Liberated	13
cufe	Liberated	9
Fe	Liberated	40
Fe	Liberated	7
Fe	Liberated	13
Fe	Cemented	4
Fe	Cemented	9
Fe	Liberated	100
Fe	Liberated	11
Fe	Cemented	10
Fe	Cemented	7
Fe	Liberated	9
Fe	Liberated	9
Fe	Liberated	7
cufe	Liberated	9
Fe	Liberated	8
Fe	Liberated	15
Fe	Liberated	7
Fe	Cemented	25
Fe	Cemented	6
Fe	Liberated	12
Fe	Liberated	32
Fe	Cemented	2
Fe	Cemented	2
Fe	Cemented	2
Fe	Cemented	2
Fe	Cemented	2
Fe	Cemented	2
Fe	Cemented	2
Fe	Cemented	7
Fe	Cemented	36
Fe	Liberated	48
Fe	Liberated	4
Fe	Liberated	5
Fe	Liberated	42
Fe	Liberated	9
cufe	Liberated	30
Fe	Cemented	12
cufe	Liberated	7
Fe	Cemented	1
Fe	Cemented	1
Fe	Cemented	1
Fe	Cemented	1
Fe	Cemented	1
Fe	Cemented	1
Fe	Cemented	1
Fe	Cemented	1

Form	**Number**	**Mean**	**Std-Dev**	**Range low**	**Range high**
total	100	11.21	13.92	1	100
Cu-FeO	8	10.75	7.94	5	30
FeOOH	89	10.81	13.61	1	100
Cubanite	1	60	ND	60	60
FeSO4	2	6.5	3.54	4	9

Form	**(linear) freq**	**Rm Cu**	**Error-95%**
%	%	%	
Cu-FeO	7.67	34.75	5.22
FeOOH	85.82	39.32	6.84
Cubanite	5.35	25.12	4.41
FeSO4	1.16	0.81	2.1



FID 34 Laboratory Output

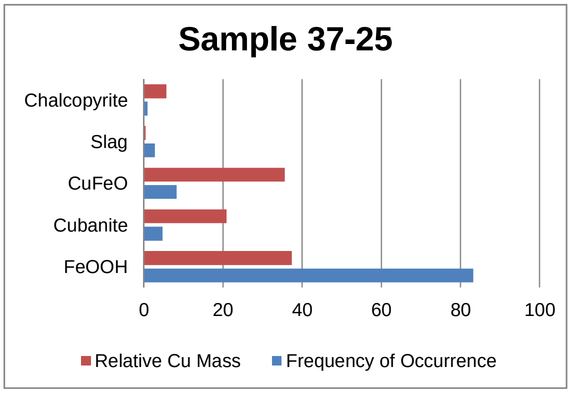
Form	Association	Size (microns)
Fe	Cemented	1
Fe	Cemented	1
Fe	Cemented	1
Fe	Liberated	7
Fe	Cemented	5
Fe	Liberated	8
Fe	Liberated	7
Fe	Cemented	19
Fe	Liberated	3
Fe	Liberated	12
Fe	Cemented	13
Fe	Liberated	11
Fe	Cemented	10
cufe	Liberated	9
Fe	Liberated	15
Fe	Liberated	7
Fe	Cemented	9
Fe	Cemented	13
Sulf	Liberated	9
Fe	Cemented	1
Fe	Cemented	4
Fe	Rimming	13
Sulf	Cemented	4
Fe	Rimming	5
Fe	Liberated	3
Fe	Cemented	2
Fe	Liberated	9
Fe	Cemented	9
Fe	Cemented	4
Fe	Rimming	5
Fe	Cemented	9

FID 37 Laboratory Output

Form	Association	Size (microns)
Fe	Liberated	10
Fe	Liberated	6
Fe	Rimming	25
cub	Liberated	1
Fe	Rimming	13
Fe	Cemented	5
Fe	Liberated	9
Fe	Liberated	12
Fe	Liberated	10
Fe	Liberated	15
Fe	Liberated	5
Fe	Cemented	1
cufe	Liberated	4
cub	Liberated	8
Fe	Liberated	8
Fe	Liberated	9
Fe	Liberated	20
cufe	Cemented	6
Fe	Cemented	11
Slag	Liberated	24
Fe	Liberated	4
Fe	Liberated	14
Fe	Cemented	9
cufe	Liberated	15
Fe	Liberated	9
Fe	Liberated	8
Fe	Liberated	3
Fe	Cemented	16
cufe	Cemented	6
Fe	Cemented	7
Fe	Liberated	21
Fe	Liberated	7
Fe	Rimming	5
Fe	Liberated	9
Fe	Cemented	22
Fe	Liberated	14
Fe	Liberated	18
cub	Liberated	5
cub	Liberated	3
cub	Rimming	4
cufe	Liberated	6
Fe	Liberated	5
Fe	Liberated	9
Fe	Liberated	11
Fe	Liberated	12
Fe	Liberated	11
Fe	Liberated	12
Fe	Rimming	10
Fe	Liberated	14
Fe	Liberated	30
Fe	Cemented	7
Fe	Cemented	5
Fe	Cemented	5
Fe	Cemented	5
Fe	Cemented	5
Fe	Liberated	7
Fe	Liberated	4
Fe	Liberated	5
Fe	Liberated	9
cufe	Liberated	20
Fe	Liberated	25
Fe	Cemented	5
cufe	Cemented	6
cufe	Liberated	7
Fe	Liberated	13
Fe	Liberated	22
Fe	Cemented	7
Fe	Liberated	8
cufe	Liberated	17

Form	Number	Mean	Std-Dev	Range low	Range high
total	101	11.32	7.22	1	40
FeOOH	81	11.74	7.33	1	40
Cubanite	7	7.71	7.39	1	23
CuFeO	10	9.5	5.62	4	20
Slag	2	16	11.31	8	24
Chalcopyrite	1	11	ND	11	11

Form	(linear) freq	Rm Cu	Error-95%
%	%	%	
FeOOH	83.2	37.36	7.29
Cubanite	4.72	20.87	4.14
CuFeO	8.31	35.6	5.38
Slag	2.8	0.42	3.22
Chalcopyrite	0.96	5.75	1.9



FID 37 Laboratory Output

Form	Association	Size (microns)
Fe	Liberated	6
Fe	Cemented	10
Fe	Liberated	14
Fe	Liberated	12
Fe	Rimming	13
Fe	Liberated	40
cp	Cemented	11
Fe	Liberated	24
Fe	Liberated	22
Fe	Liberated	15
Fe	Liberated	10
Fe	Liberated	13
Fe	Liberated	7
Fe	Liberated	14
Fe	Liberated	19
Fe	Liberated	15
Fe	Liberated	9
Fe	Cemented	7
Fe	Liberated	16
Slag	Liberated	8
cufe	Liberated	8
Fe	Liberated	32
Fe	Liberated	7
Fe	Liberated	10
Fe	Liberated	5
Fe	Liberated	4
Fe	Liberated	5
Fe	Liberated	7
Fe	Rimming	28
cub	Liberated	23
cub	Liberated	10
Fe	Liberated	16

Appendix E

Geographic Coordinates and pH
and pCu of Sample Locations

Table E-1
2010 to 2014 Long-Term Sample Locations

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Soil Sample Location	Latitude	Longitude
FID 7	32.67855053	-108.0674777
FID 8	32.66682	-108.092
FID 10	32.7056407	-108.1135094
FID 15	32.69782613	-108.1068607
FID 16	32.69603826	-108.1070997
FID 18	32.67401869	-108.0918219
FID 22	32.66688318	-108.0779728
FID 28	32.66998379	-108.0510906
FID 37	32.70642178	-108.0953737
FID 43	32.65894	-108.08845
FID 101	32.67318231	-108.090994
FID 102	32.66236805	-108.088698
FID 103	32.65527085	-108.0873456
FID 104	32.6645904	-108.0942524
FID 105	32.68730007	-108.1033105
FID 106	32.67276866	-108.0629348
ERA 2	32.68901327	-108.1063857
ERA 3	32.68504508	-108.1047095
ERA 4	32.68905991	-108.0921652
ERA 10	32.68372263	-108.0666094
ERA 13	32.68252837	-108.0489154
Reference Plot #1 (West)	32.70648237	-108.1382839
Reference Plot #2 (North)	32.71301138	-108.1296714
Reference Plot #3 (Northeast)	32.70383081	-108.1111335
Reference Plot #4 (East)	32.68969036	-108.1039554

Notes:
Coordinate System: NAD 1983 State Plane New Mexico West

Table E-2
Coordinates of Sample Locations Included in Interpolations and Maps

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

									Pre-White Rain (pre-2008)				2009	2010		2014	
Location ID	Alternate ID	Source	Year Collected	Original Soil depth (if not 0-6" were converted to 0-6")[1]	Sieving Status	"Yes" if inside WB tailings	Latitude	Longitude	Original Cu value	Final Adjusted Cu	pH	pCu	pH	pH	pCu	pH	pCu
U04-1131	S96	SRK, 2008	2004	0-6"	2 mm sieve	No	32.66540229	-108.055882	237	237	7.61	8.13					
U04-1132	SS97	SRK, 2008	2006	0-1"	.25 sieve	No	32.75191978	-108.1471355	412	288	5.97	6.38					
U04-1133	SS98	SRK, 2008	2006	0-1"	.25 sieve	No	32.74742739	-108.1249598	475	333	5.97	6.21					
U04-1138	SS103	SRK, 2008	2006	0-1"	.25 sieve	No	32.74429383	-108.1389187	497	348	4.52	4.81					
U04-1139	SS104	SRK, 2008	2006	0-1"	.25 sieve	No	32.75110133	-108.1129991	407	285	5.70	6.14					
U04-1140	SS105	SRK, 2008	2006	0-1"	.25 sieve	No	32.73268075	-108.1381274	226	158	5.49	6.62					
U04-1141	SS106	SRK, 2008	2006	0-1"	.25 sieve	No	32.73144587	-108.124364	531	372	5.50	5.65					
U04-1142	SS107	SRK, 2008	2006	0-1"	.25 sieve	No	32.73323295	-108.0753661	194	136	5.53	6.84					
U04-1144	SS109	SRK, 2008	2006	0-1"	.25 sieve	No	32.72196351	-108.1378727	597	418	6.77	6.70					
U04-1146	SS111	SRK, 2008	2006	0-1"	.25 sieve	No	32.72214363	-108.1025637	551	386	4.80	4.96					
U04-1147	SS112	SRK, 2008	2006	0-1"	.25 sieve	No	32.71713174	-108.0870592	558	391	5.62	5.70					
U04-1150	SS115	SRK, 2008	2006	0-1"	.25 sieve	No	32.7112231	-108.1401569	3800	2660	7.78	5.51					
U04-1151	SS116	SRK, 2008	2006	0-1"	.25 sieve	No	32.71105615	-108.1198787	1460	1022	7.09	5.96					
U04-1152	SS117	SRK, 2008	2006	0-1"	.25 sieve	No	32.70334288	-108.1110735	4450	3115	4.87	2.62					
U04-1154	SS118D	SRK, 2008	2006	0-6"	.25 sieve	No	32.70237095	-108.0936065	259	259	4.99	5.59					
U04-1158	SS121	SRK, 2008	2006	0-1"	.25 sieve	No	32.69413949	-108.0884663	896	627	4.62	4.23					
U04-1159	SS122	SRK, 2008	2006	0-1"	.25 sieve	No	32.69847542	-108.0676521	119	83	5.78	7.63					
U04-1160	SS123	SRK, 2008	2006	0-1"	.25 sieve	No	32.69948724	-108.0381803	449	314	5.74	6.07					
U04-1162	SS124D	SRK, 2008	2006	0-6"	2 mm sieve	No	32.68527714	-108.0920925	523	523	7.56	7.17					
U04-1164	SS125D	SRK, 2008	2006	0-6"	2 mm sieve	No	32.68882207	-108.0809109	166	166	5.22	6.32					
U04-1166	SS127	SRK, 2008	2006	0-1"	.25 sieve	Yes	32.68067489	-108.1055569	1020	1530	6.97	5.39					
U04-1167	SS128	SRK, 2008	2006	0-1"	.25 sieve	No	32.67729767	-108.0909229	454	318	3.97	4.41					
U04-1169	SS129D	SRK, 2008	2006	0-6"	2 mm sieve	No	32.677299	-108.0805078	337	337	4.07	4.43					
U04-1170	SS130	SRK, 2008	2006	0-1"	.25 sieve	No	32.67623991	-108.0749139	227	159	4.81	5.98					
U04-1172	SS131D	SRK, 2008	2006	0-6"	2 mm sieve	No	32.67349226	-108.0622866	444	444	4.76	4.76					
U04-1173	SS132	SRK, 2008	2006	0-1"	.25 sieve	No	32.67638362	-108.0506471	740	518	4.85	4.66					
U04-1175	SS134	SRK, 2008	2006	0-1"	.25 sieve	No	32.67028508	-108.0980149	334	234	3.83	4.63					
U04-1176	SS135	SRK, 2008	2006	0-1"	.25 sieve	No	32.67014008	-108.0828301	325	228	4.10	4.91					
U04-1178	SS137	SRK, 2008	2006	0-1"	.25 sieve	No	32.6623217	-108.083937	309	216	3.62	4.52					
U04-1179	SS138	SRK, 2008	2006	0-1"	.25 sieve	No	32.66069495	-108.0752254	297	208	5.05	5.90					
U04-1180	SS139	SRK, 2008	2006	0-1"	.25 sieve	No	32.66013963	-108.0553804	696	487	4.57	4.47					
U04-1182	SS141	SRK, 2008	2006	0-1"	.25 sieve	Yes	32.65009382	-108.0846326	320	480	3.56	3.55					
U04-1183	SS142	SRK, 2008	2006	0-1"	.25 sieve	No	32.64934479	-108.0746562	392	274	3.69	4.31					
U04-1184	SS143	SRK, 2008	2006	0-1"	.25 sieve	No	32.64831161	-108.0600417	738	517	8.16	7.74					
U04-1186	SS145	SRK, 2008	2006	0-1"	.25 sieve	No	32.63583166	-108.0866406	413	289	2.92	3.54					
U04-1187	SS146	SRK, 2008	2006	0-1"	.25 sieve	No	32.63982697	-108.0812578	710	497	5.58	5.39					
U04-1189	SS148	SRK, 2008	2006	0-1"	.25 sieve	No	32.62556509	-108.0813376	632	442	3.96	4.02					
U04-1197	SS156	SRK, 2008	2006	0-1"	.25 sieve	No	32.59932169	-108.0860226	196	137	5.06	6.39					
U04-1200	ERA159D	SRK, 2008	2006	0-6"	2 mm sieve	No	32.70756028	-108.1384823	809	809	7.59	6.70					
U04-1201	ERA160D	SRK, 2008	2006	0-6"	2 mm sieve	No	32.69849133	-108.1381535	34	34	7.60	10.35					
U04-1202	ERA161D	SRK, 2008	2006	0-6"	2 mm sieve	No	32.6897467	-108.1382089	556	556	7.85	7.37					
U04-1203	ERA162	SRK, 2008	2006	0-1"	.25 sieve	No	32.76541334	-108.1026024	218	153	6.49	7.59					
U04-1204	ERA163	SRK, 2008	2006	0-1"	.25 sieve	No	32.76906989	-108.1082783	208	146	6.95	8.08					
U04-1205	ERA164	SRK, 2008	2006	0-1"	.25 sieve	No	32.74354342	-108.0095505	136	95	5.62	7.33					
U04-1206	ERA165	SRK, 2008	2006	0-1"	.25 sieve	No	32.74909591	-108.0257729	177	124	6.90	8.21					
U05-4001	HR-01	Chino, 1995	1995	0-1"	not sieved	No	32.76440757	-108.1714475	318	286	5.51	5.96					
U05-4004	HR-02	Chino, 1995	1995	0-1"	not sieved	No	32.75980088	-108.1823783	216	194	5.07	5.99					

Notes:

[1] All sieved 0-6" soils were sieved to < 2 mm. All sieved 0-1" soils were sieved to < 0.25 mm. Ratio used to convert Cu concentration of 0-1" sieved at <0.25 mm soils to 0-6" sieved at < 2 mm soils is from Appendix A (median ratio of SS samples) of ARCADIS (2011)(note: no conversion needed for pH since median ratio and slope = 1.0). Multiplied Cu concentration by 0.7 if outside windblown tailings and by 1.5 if inside windblown tailings. If unsieved, multiplied by 0.9 if outside windblown tailings and by 1.3 if inside windblown tailings. The 0.9 and 1.3 are from median ratios of unsieved 0-1" soil in 2009 lab reports (at 25 m on transect) compared to sieved 0-6" co-located soil in Drexler lab report in Appendix D for soils in and outside of windblown tailings, respectively (FID 8, 18, 20 in tailings). If have pH from unsieved soil, multiply by 1.06 to convert from 0 to 1" to 0 to 6" unsieved soils (using Hurley data in Chino 1995), and then used equation in Figure 6 to adjust unsieved 0-6" to 2 mm sieved fraction of 0-6" soil: Sieved = 1.19*unsieved - 1.5781.

Darker shaded 0-1" depths were inside windblown tailings.

References

ARCADIS. 2010. AOC Terrestrial Invertebrate Copper Bioaccumulation and Bioavailability Study. Smelter/Tailing Soils Investigation Unit. Prepared for Freeport-McMoRan Chino Mines Company, Vanadium, New Mexico. (composite of 15 samples in 100-m radius plot).

Chino, 1995. Administrative Order on Consent, Investigation Area, Remedial Investigation Background Report, Chino Mines Investigation Area. Prepared by Chino Mines Company, Hurley, New Mexico. Department received 28 October 1995. (one grab sample).

Newfields. 2005. Chino Mines Administrative Order on Consent Site-wide Ecological Risk Assessment. Prepared for Chino Mines Company. November. (average of 3 samples on 50-m transect).

SRK, Inc. 2008. "Chino Mines Company, Hurley, New Mexico Administrative Order on Consent,Revised Remedial Investigation Report, Smelter/Tailing Soils Investigation Unit." Revision 2. February 6. (method was composite of 6 random subsamples in 100' x 100' area)

Table E-2
Coordinates of Sample Locations Included in Interpolations and Maps

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

									Pre-White Rain (pre-2008)				2009	2010		2014	
Location ID	Alternate ID	Source	Year Collected	Original Soil depth (if not 0-6" were converted to 0-6")[1]	Sieving Status	"Yes" if inside WB tailings	Latitude	Longitude	Original Cu value	Final Adjusted Cu	pH	pCu	pH	pH	pCu	pH	pCu
2001	U01-2001	Chino 1995	1995	0-1"	not sieved	No	32.80008016	-108.0435679	170	153	6.10	7.23					
2002	U01-2002	Chino 1995	1995	0-1"	not sieved	No	32.80119161	-108.0298614	186	167	8.95	9.78					
2003	U01-2003	Chino 1995	1995	0-1"	not sieved	No	32.79586031	-108.0268491	294	265	4.87	5.45					
2004	U01-2004	Chino 1995	1995	0-1"	not sieved	No	32.79775953	-108.0290338	172	155	4.74	5.95					
2005	U01-2005	Chino 1995	1995	0-1"	not sieved	No	32.79125757	-108.0264252	152	137	8.61	9.69					
2006	U01-2006	Chino 1995	1995	0-1"	not sieved	No	32.78816381	-108.0257992	150	135	4.12	5.53					
2007	U01-2007	Chino 1995	1995	0-1"	not sieved	No	32.78334987	-108.0259998	88	79	6.85	8.68					
2008	U01-2008	Chino 1995	1995	0-1"	not sieved	No	32.78334146	-108.0260041	214	193	5.69	6.58					
2009	U01-2009	Chino 1995	1995	0-1"	not sieved	No	32.78001897	-108.0443108	204	184	6.67	7.55					
2010	U01-2010	Chino 1995	1995	0-1"	not sieved	No	32.79412138	-108.0249325	199	179	4.72	5.76					
2011	U01-2011	Chino 1995	1995	0-1"	not sieved	No	32.7907745	-108.0233733	146	131	5.18	6.55					
2012	U01-2012	Chino 1995	1995	0-1"	not sieved	No	32.79980341	-108.0243482	69	62	7.30	9.38					
ERA01		Newfields 2005	2005	0-6"	2 mm sieve	No	32.69852048	-108.114054	3517	3517	4.47	2.10					
ERA02		Newfields 2005 (pre 2008)/ARCADIS 2010 (2010)/this report (2014)	1999, 2010, 2014	0-6"	2 mm sieve	Yes	32.68901327	-108.1063857	811	811	4.80	4.10				6.00	4.98
ERA03		Newfields 2005 (pre 2008)/ARCADIS 2010 (2010)/this report (2014)	1999, 2010, 2014	0-6"	2 mm sieve	Yes	32.68504508	-108.1047095	709	709	4.97	4.41		6.50	6.00	5.90	5.37
ERA04		Newfields 2005 (pre 2008)/ARCADIS 2010 (2010)/this report (2014)	1999, 2010, 2014	0-6"	2 mm sieve	Yes	32.68905991	-108.0921652	541	541	4.83	4.60		6.30	6.03	5.40	5.08
ERA05		Newfields 2005 (pre 2008)/ARCADIS 2010 (2010)	1999, 2010	0-6"	2 mm sieve	No	32.68915546	-108.0911448	421	421	6.54	6.48		6.40	7.00		
ERA06		Newfields 2005 (pre 2008)/ARCADIS 2010 (2010)	1999, 2010	0-6"	2 mm sieve	No	32.69904658	-108.0957667	499	499	6.67	6.40		6.30	5.80		
ERA07		Newfields 2005 (pre 2008)/ARCADIS 2010 (2010)	1999, 2010	0-6"	2 mm sieve	Yes	32.67583102	-108.0998132	789	789	5.47	4.75		6.70	5.90		
ERA08		Newfields 2005 (pre 2008)/ARCADIS 2010 (2010)	1999, 2010	0-6"	2 mm sieve	Yes	32.67493886	-108.1031287	710	710	6.97	6.27		7.00	6.40		
ERA09		Newfields 2005 (pre 2008)/ARCADIS 2010 (2010)	1999, 2010	0-6"	2 mm sieve	No	32.68635775	-108.0728992	562	562	4.35	4.10		4.60	5.10		
ERA10		Newfields 2005 (pre 2008)/ARCADIS 2010 (2010)/this report (2014)	1999, 2010, 2014	0-6"	2 mm sieve	No	32.68372263	-108.0666094	485	485	4.53	4.45		5.40	6.30	5.30	5.67
ERA11		Newfields 2005 (pre 2008)/ARCADIS 2010 (2010)	1999, 2010	0-6"	2 mm sieve	No	32.65669417	-108.0609862	276	276	7.73	8.07		7.00	7.40		
ERA12		Newfields 2005 (pre 2008)/ARCADIS 2010 (2010)	1999, 2010	0-6"	2 mm sieve	No	32.64590072	-108.0636424	204	204	7.77	8.44		7.80	8.40		
ERA13		Newfields 2005 (pre 2008)/ARCADIS 2010 (2010)/this report (2014)	1999, 2010, 2014	0-6"	2 mm sieve	No	32.68252837	-108.0489154	126	126	4.78	6.22		6.30	7.20	5.50	5.97
ERA14		Newfields 2005 (pre 2008)/ARCADIS 2010 (2010)	1999, 2010	0-6"	2 mm sieve	No	32.64297845	-108.1187113	109	109	7.73	9.14		7.50	8.70		
ERA15		Newfields 2005 (pre 2008)/ARCADIS 2010 (2010)	1999, 2010	0-6"	2 mm sieve	No	32.7061957	-108.1406131	712	712	7.73	6.98		7.80	7.40		
ERA16		Newfields 2005	1999	0-6"	2 mm sieve	No	32.61082558	-108.1969186	77	77	6.10	8.02					
ERA17		Newfields 2005	1999	0-6"	2 mm sieve	No	32.61311818	-108.1920758	57	57	5.63	7.93					
ERA18		Newfields 2005	1999	0-6"	2 mm sieve	No	32.61412551	-108.1867633	73	73	6.07	8.04					
ERA19		Newfields 2005	1999	0-6"	2 mm sieve	No	32.60926575	-108.1838475	62	62	6.68	8.80					
ERA20		Newfields 2005	1999	0-6"	2 mm sieve	No	32.60891223	-108.1854341	45	45	7.73	10.15					
ERA21		Newfields 2005	1999	0-6"	2 mm sieve	No	32.60798024	-108.1874537	48	48	6.20	8.65					
ERA22		Newfields 2005	1999	0-6"	2 mm sieve	No	32.71254866	-108.1217547	1120	1120	7.50	6.24					
ERA23		Newfields 2005	1999	0-6"	2 mm sieve	Yes	32.68665743	-108.1001054	973	973	5.27	4.33					
ERA24		Newfields 2005	1999	0-6"	2 mm sieve	No	32.68975703	-108.0660367	63	63	5.33	7.54					
ERA25		Newfields 2005	1999	0-6"	2 mm sieve	No	32.6728881	-108.0460747	70	70	7.73	9.64					
ERA26		Newfields 2005	1999	0-6"	2 mm sieve	Yes	32.67710086	-108.0985397	535	535	4.23	4.05					
ERA27		Newfields 2005	1999	0-6"	2 mm sieve	No	32.61827975	-108.0861412	328	328	5.77	6.04					
ERA28		Newfields 2005	1999	0-6"	2 mm sieve	No	32.74719308	-108.1298187	1060	1060	7.53	6.34					
ERA29		Newfields 2005	1999	0-6"	2 mm sieve	No	32.79689403	-108.100408	460	460	7.43	7.20					
ERA30		Newfields 2005	1999	0-6"	2 mm sieve	No	32.7793464	-108.0220581	102	102	7.53	9.02					
ERA31		Newfields 2005	1999	0-6"	2 mm sieve	No	32.57969114	-108.0457504	78	78	7.73	9.53					
ERA32		Newfields 2005	1999	0-6"	2 mm sieve	No	32.77698681	-108.1075358	419	419	7.60	7.46					
ERA33		Newfields 2005	1999	0-6"	2 mm sieve	No	32.76545661	-108.1160531	176	176	6.60	7.53					
ERA34		Newfields 2005	1999	0-6"	2 mm sieve	No	32.77744919	-108.0296384	57	57	6.20	8.46					
FID 0		this report	2009	0-6"	2 mm sieve		32.6953	-108.14707					7.12				
FID 1		this report	2009	0-6"	2 mm sieve		32.71892	-108.02474					7.02				
FID 10		this report	2009	0-6"	2 mm sieve		32.7056407	-108.1135094					6.35	4.8	3.03	4.70	2.69
FID 101		this report	2009, 2010, 2014	0-6"	2 mm sieve		32.67318231	-108.090994						4.2	4.34	3.90	4.47
FID 102		this report	2009, 2010, 2014	0-6"	2 mm sieve		32.66236805	-108.088698						3.8	4.11	3.50	4.11
FID 103		this report	2009, 2010	0-6"	2 mm sieve		32.65527085	-108.0873456						4	4.05		
FID 104		this report	2009, 2010	0-6"	2 mm sieve		32.6645904	-108.0942524						3.8	3.83		
FID 105		this report	2009, 2010, 2014	0-6"	2 mm sieve		32.68730007	-108.1033105						5.6	4.23	4.50	3.79
FID 106		this report	2009, 2010, 2014	0-6"	2 mm sieve		32.67276866	-108.0629348						5	4.95	4.40	4.25
FID 12		this report	2009	0-6"	2 mm sieve		32.69557	-108.11226					7.32				
FID 13		this report	2009	0-6"	2 mm sieve		32.69598	-108.11115					7.14				

Table E-2
Coordinates of Sample Locations Included in Interpolations and Maps

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

									Pre-White Rain (pre-2008)				2009	2010		2014	
Location ID	Alternate ID	Source	Year Collected	Original Soil depth (if not 0-6" were converted to 0-6")[1]	Sieving Status	"Yes" if inside WB tailings	Latitude	Longitude	Original Cu value	Final Adjusted Cu	pH	pCu	pH	pH	pCu	pH	pCu
FID 15		this report	2009, 2010, 2014	0-6"	2 mm sieve		32.69782613	-108.1068607					6.91	4.9	2.89	5.60	3.90
FID 16		this report	2009, 2010, 2014	0-6"	2 mm sieve		32.69603826	-108.1070997					5.24	4.8	2.40	4.80	3.44
FID 17		this report	2009	0-6"	2 mm sieve		32.6978	-108.11351					6.18				
FID 18		this report	2009, 2010, 2014	0-6"	2 mm sieve		32.67401869	-108.0918219					4.85	3.9	3.69	4.20	4.65
FID 2		this report	2009	0-6"	2 mm sieve		32.700015	-108.04933					6.75				
FID 20		this report	2009	0-6"	2 mm sieve		32.68451	-108.10315					5.98				
FID 21		this report	2009	0-6"	2 mm sieve		32.686856	-108.07329					7.34				
FID 22		this report	2009, 2010, 2014	0-6"	2 mm sieve		32.66688318	-108.0779728					5.78	6.5	6.27	6.90	6.93
FID 23		this report	2009	0-6"	2 mm sieve		32.6568	-108.08405					4.36				
FID 24		this report	2009	0-6"	2 mm sieve		32.59025	-108.04998					8.05				
FID 25		this report	2009	0-6"	2 mm sieve		32.59951	-108.06337					8.17				
FID 26		this report	2009	0-6"	2 mm sieve		32.58858	-108.0474					8.02				
FID 27		this report	2009	0-6"	2 mm sieve		32.73268	-108.132					7.11				
FID 28		this report	2009, 2010, 2014	0-6"	2 mm sieve		32.66998379	-108.0510906					6.81	7.7	7.29	7.30	7.17
FID 3		this report	2009	0-6"	2 mm sieve		32.64739	-108.11628					7.96				
FID 30		this report	2009	0-6"	2 mm sieve		32.68964	-108.14886					8.11				
FID 31		this report	2009	0-6"	2 mm sieve		32.61116	-108.06492					6.57				
FID 32		this report	2009	0-6"	2 mm sieve		32.71212	-108.14642					6.24				
FID 33		this report	2009	0-6"	2 mm sieve		32.64202	-108.07249					6.61				
FID 34		this report	2009	0-6"	2 mm sieve		32.7047	-108.15557					7.38				
FID 35		this report	2009	0-6"	2 mm sieve		32.69806	-108.03871					7.66				
FID 37		this report	2009, 2010, 2014	0-6"	2 mm sieve		32.70642178	-108.0953737					5.40	4.8	3.64	4.70	4.16
FID 39		this report	2009	0-6"	2 mm sieve		32.72701	-108.12251					7.14				
FID 4		this report	2009	0-6"	2 mm sieve		32.73449	-108.12495					7.42				
FID 43		this report	2009, 2010	0-6"	2 mm sieve		32.65894	-108.08845					4.37	6.5	5.96		
FID 6		this report	2009	0-6"	2 mm sieve		32.70373	-108.14667					6.60				
FID 7		this report	2009, 2010, 2014	0-6"	2 mm sieve		32.67855053	-108.0674777					6.89	5.4	5.11	5.10	4.96
FID 8		this report	2009, 2010, 2014	0-6"	2 mm sieve		32.66682	-108.092					5.47	6.5	6.14	4.60	4.54
R-01	U06-3016	Chino, 1995	1995	0-1"	not sieved	No	32.65301589	-108.2049927	79	71	5.95	7.97					
R-03	U06-3026	Chino, 1995	1995	0-1"	not sieved	No	32.68638036	-108.1923896	170	153	8.30	9.27					
R-05	U06-3015	Chino, 1995	1995	0-1"	not sieved	No	32.66953229	-108.2051172	186	167	6.56	7.55					
R-07	U06-3024	Chino, 1995	1995	0-1"	not sieved	No	32.66477181	-108.1606266	207	186	8.51	9.25					
R-08	U06-3028	Chino, 1995	1995	0-1"	not sieved	No	32.65742282	-108.1905159	114	103	6.81	8.35					
R-12	U06-3030	Chino, 1995	1995	0-1"	not sieved	No	32.6330853	-108.1786698	73	66	7.72	9.71					
R-14	U06-3037	Chino, 1995	1995	0-1"	not sieved	No	32.62964588	-108.1538365	43	39	7.96	10.54					
Reference Plot #1		this report	2009, 2010, 2014	0-6"	2 mm sieve		32.70648237	-108.1382839					7.61	7.76	5.75	8.00	6.98
Reference Plot #2		this report	2010, 2014	0-6"	2 mm sieve		32.71301138	-108.1296714						6.43	5.48	6.20	5.48
Reference Plot #3		this report	2010, 2014	0-6"	2 mm sieve		32.70383081	-108.1111335						5.31	3.18	5.40	3.92
Reference Plot #4		this report	2010, 2014	0-6"	2 mm sieve		32.68969036	-108.1039554						5.28	3.72	4.90	3.93
S78	U04-1113	SRK 2008	2004	0-6"	2 mm sieve	No	32.62222938	-108.1270725	207	207	7.79	8.45					
S79	U04-1114	SRK 2008	2004	0-6"	2 mm sieve	No	32.62209147	-108.1108193	157	157	7.95	8.92					
SS100	U04-1135	SRK 2008	2006	0-1"	.25 sieve	No	32.76321419	-108.0650925	234	164	6.17	7.21					
SS101	U04-1136	SRK 2008	2006	0-1"	.25 sieve	No	32.76084825	-108.0469138	206	144	6.95	8.09					
SS102	U04-1137	SRK 2008	2006	0-1"	.25 sieve	No	32.7708121	-108.0241219	201	141	5.76	7.01					
SS108	U04-1143	SRK 2008	2006	0-1"	.25 sieve	No	32.73496501	-108.0302108	252	176	6.62	7.55					
SS110	U04-1145	SRK 2008	2006	0-1"	.25 sieve	No	32.72500445	-108.1269495	692	484	7.39	7.10					
SS113	U04-1148	SRK 2008	2006	0-1"	.25 sieve	No	32.73708481	-108.0612137	209	146	6.93	8.05					
SS114	U04-1149	SRK 2008	2006	0-1"	.25 sieve	No	32.72776321	-108.0339913	119	83	6.92	8.69					
SS119D	U04-1148	SRK 2008	2006	0-6"	2 mm sieve	No	32.72237092	-108.0570041	125	125	6.10	7.46					
SS120	U04-1149	SRK 2008	2006	0-1"	.25 sieve	No	32.70660545	-108.0349796	119	83	7.18	8.93					
SS149	U04-1190	SRK 2008	2006	0-1"	.25 sieve	No	32.62478889	-108.0724029	628	440	8.16	7.93					
SS150	U04-1191	SRK 2008	2006	0-1"	.25 sieve	No	32.62480828	-108.0589678	605	424	8.06	7.88					
SS151	U04-1192	SRK 2008	2006	0-1"	.25 sieve	No	32.61697541	-108.1193069	259	181	7.97	8.77					
SS152	U04-1193	SRK 2008	2006	0-1"	.25 sieve	No	32.61314892	-108.1027049	237	166	8.24	9.13					
SS153	U04-1194	SRK 2008	2006	0-1"	.25 sieve	No	32.61154015	-108.0861817	438	307	6.78	7.06					
SS154	U04-1195	SRK 2008	2006	0-1"	.25 sieve	No	32.61334764	-108.073191	372	260	7.75	8.15					
SS155	U04-1196	SRK 2008	2006	0-1"	.25 sieve	No	32.61358271	-108.0593351	387	271	8.10	8.43					
SS157	U04-1198	SRK 2008	2006	0-1"	.25 sieve	No	32.59897344	-108.0725214	141	99	8.09	9.58					

Table E-2
Coordinates of Sample Locations Included in Interpolations and Maps

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

									Pre-White Rain (pre-2008)				2009	2010		2014	
Location ID	**Alternate ID**	**Source**	**Year Collected**	**Original Soil depth (if not 0-6" were converted to 0-6")^1**	**Sieving Status**	**"Yes" if inside WB tailings**	**Latitude**	**Longitude**	**Original Cu value**	**Final Adjusted Cu**	**pH**	**pCu**	**pH**	**pH**	**pCu**	**pH**	**pCu**
SS158	U04-1199	SRK 2008	2006	0-1"	.25 sieve	No	32.59929209	-108.0581835	247	173	7.98	8.84					
SS99	U04-1134	SRK 2008	2006	0-1"	.25 sieve	No	32.75855967	-108.092432	93	65	5.77	7.91					
STS-SS-2010-016		this report	2010	0-6"	2 mm sieve		32.706988	-108.112068						4.90	3.80		
STS-SS-2010-017		this report	2010	0-6"	2 mm sieve		32.697138	-108.108012						6.00	4.10		
STS-SS-2010-018		this report	2010	0-6"	2 mm sieve		32.703877	-108.10829						6.00	4.90		
T-01	U06-3007	Chino, 1995	1995	0-1"	not sieved	Yes	32.68030028	-108.104904	1330	1729	5.90	4.26					
T-03	U06-3022	Chino, 1995	1995	0-1"	not sieved	No	32.6424394	-108.0839285	554	499	5.84	5.63					
T-04	U06-3008	Chino, 1995	1995	0-1"	not sieved	Yes	32.66282815	-108.093958	549	714	2.31	1.93					
T-05	U06-3018	Chino, 1995	1995	0-1"	not sieved	No	32.65977257	-108.0840418	543	489	3.47	3.44					
T-08	U06-3012	Chino, 1995	1995	0-1"	not sieved	No	32.63507853	-108.0852333	647	582	6.73	6.28					
T-09	U06-3013	Chino, 1995	1995	0-1"	not sieved	No	32.62830215	-108.0801244	645	581	7.14	6.66					
T-12	U06-3003	Chino, 1995	1995	0-1"	not sieved	No	32.60805227	-108.0947345	216	194	7.78	8.52					
T-15	U06-3001	Chino, 1995	1995	0-1"	not sieved	No	32.65513424	-108.1251809	773	696	7.92	7.18					
U04-1001		Chino, 1995	1995	0-1"	not sieved	No	32.70333294	-108.111166	3560	3204	5.28	2.97					
U04-1002		Chino, 1995	1995	0-1"	not sieved	No	32.69477762	-108.1099717	5240	4716	4.75	2.03					
U04-1003		Chino, 1995	1995	0-1"	not sieved	Yes	32.68838883	-108.1093604	1880	2444	7.38	5.23					
U04-1004		Chino, 1995	1995	0-1"	not sieved	No	32.69391643	-108.1023049	1140	1140	5.12	4.01					
U04-1007		Chino, 1995	1995	0-1"	not sieved	No	32.7046106	-108.0926108	845	761	3.69	3.15					
U04-1008		Chino, 1995	1995	0-1"	not sieved	No	32.70130525	-108.1008324	644	580	4.40	4.12					
U04-1009		Chino, 1995	1995	0-1"	not sieved	No	32.69730516	-108.0936941	803	723	3.75	3.25					
U04-1010		Chino, 1995	1995	0-1"	not sieved	No	32.68911098	-108.0918883	1230	1107	5.31	4.22					
U04-1011		Chino, 1995	1995	0-1"	not sieved	No	32.68824992	-108.1002775	990	891	3.40	2.69					
U04-1012		Chino, 1995	1995	0-1"	not sieved	No	32.69574066	-108.0661595	309	278	6.23	6.66					
U04-1013		Chino, 1995	1995	0-1"	not sieved	No	32.69708305	-108.0746109	521	469	4.49	4.44					
U04-1014		Chino, 1995	1995	0-1"	not sieved	No	32.7046385	-108.0741387	504	454	4.53	4.52					
U04-1015		Chino, 1995	1995	0-1"	not sieved	No	32.69051559	-108.057494	330	297	5.85	6.23					
U04-1016		Chino, 1995	1995	0-1"	not sieved	No	32.6878586	-108.0740262	922	830	4.04	3.36					
U04-1017		Chino, 1995	1995	0-1"	not sieved	No	32.70256947	-108.0531671	216	194	6.05	6.91					
U04-1018		Chino, 1995	1995	0-1"	not sieved	No	32.77809698	-108.1069584	175	158	5.31	6.46					
U04-1019		Chino, 1995	1995	0-1"	not sieved	No	32.69572173	-108.0365271	245	221	5.94	6.66					
U04-1020		Chino, 1995	1995	0-1"	not sieved	No	32.69772166	-108.0456939	436	392	4.63	4.78					
U04-1021		Chino, 1995	1995	0-1"	not sieved	No	32.68863839	-108.0381111	280	252	5.76	6.34					
U04-1022		Chino, 1995	1995	0-1"	not sieved	No	32.72119372	-108.1184431	1790	1611	5.20	3.68					
U04-1023		Chino, 1995	1995	0-1"	not sieved	No	32.71041593	-108.1254436	3410	3069	8.25	5.78					
U04-1024		Chino, 1995	1995	0-1"	not sieved	No	32.70486094	-108.1386937	2040	1836	7.87	6.02					
U04-1025		Chino, 1995	1995	0-1"	not sieved	No	32.69891646	-108.1375552	2490	2241	7.19	5.15					
U04-1028		Chino, 1995	1995	0-1"	not sieved	No	32.68936124	-108.1391106	1340	1206	6.66	5.37					
U04-1029		Chino, 1995	1995	0-1"	not sieved	No	32.68866687	-108.1446941	372	335	8.64	8.69					
U04-1030		Chino, 1995	1995	0-1"	not sieved	No	32.69616692	-108.1475271	837	753	8.27	7.42					
U04-1031		Chino, 1995	1995	0-1"	not sieved	No	32.70513876	-108.1473049	1740	1566	6.99	5.38					
U04-1032		Chino, 1995	1995	0-1"	not sieved	No	32.70483316	-108.1561661	1040	936	7.92	6.84					
U04-1033		Chino, 1995	1995	0-1"	not sieved	No	32.69758348	-108.1559994	562	506	8.78	8.34					
U04-1034		Chino, 1995	1995	0-1"	not sieved	No	32.68923044	-108.1566113	424	382	8.65	8.55					
U04-1035	S1	SRK, 2008	2004	0-1"	.25 sieve	No	32.71733691	-108.1269036	1240	868	4.65	3.88					
U04-1036	S2	SRK, 2008	2004	0-1"	.25 sieve	No	32.71663325	-108.1236833	625	438	6.03	5.95					
U04-1037	S3	SRK, 2008	2004	0-1"	.25 sieve	No	32.71386667	-108.1301655	2110	1477	4.89	3.50					
U04-1038	S4	SRK, 2008	2004	0-1"	.25 sieve	No	32.71387737	-108.1269181	7990	5593	5.36	2.40					
U04-1039	S5	SRK, 2008	2004	0-1"	.25 sieve	No	32.71388795	-108.1236708	1140	798	4.22	3.58					
U04-1040	S6	SRK, 2008	2004	0-1"	.25 sieve	No	32.71109975	-108.1366473	3670	2569	6.72	4.56					
U04-1041	S7	SRK, 2008	2004	0-1"	.25 sieve	No	32.71111059	-108.1334001	4760	3332	7.83	5.29					
U04-1042	S8	SRK, 2008	2004	0-1"	.25 sieve	No	32.71112137	-108.1301528	6100	4270	7.30	4.52					
U04-1043	S9	SRK, 2008	2004	0-1"	.25 sieve	No	32.71113206	-108.1269055	4950	3465	7.57	5.01					
U04-1044	S10	SRK, 2008	2004	0-1"	.25 sieve	No	32.71114267	-108.1236583	6090	4263	7.30	4.52					
U04-1045	S11	SRK, 2008	2004	0-1"	.25 sieve	No	32.70834351	-108.1398816	3880	2716	7.92	5.61					
U04-1046	S12	SRK, 2008	2004	0-1"	.25 sieve	No	32.70835445	-108.1366344	3160	2212	7.84	5.77					
U04-1047	S13	SRK, 2008	2004	0-1"	.25 sieve	No	32.70908851	-108.1332847	5920	4144	7.73	4.95					
U04-1048	S14	SRK, 2008	2004	0-1"	.25 sieve	No	32.7085135	-108.1301406	8030	5621	7.87	4.73					

Table E-2
Coordinates of Sample Locations Included in Interpolations and Maps

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

									Pre-White Rain (pre-2008)				2009	2010		2014	
Location ID	**Alternate ID**	**Source**	**Year Collected**	**Original Soil depth (if not 0-6" were converted to 0-6")[1]**	**Sieving Status**	**"Yes" if inside WB tailings**	**Latitude**	**Longitude**	**Original Cu value**	**Final Adjusted Cu**	**pH**	**pCu**	**pH**	**pH**	**pCu**	**pH**	**pCu**
U04-1049	S15	SRK, 2008	2004	0-1"	.25 sieve	No	32.70852419	-108.1268934	12100	8470	7.94	4.32					
U04-1050	S16	SRK, 2008	2004	0-1"	.25 sieve	No	32.70839737	-108.1236458	8310	5817	7.08	3.96					
U04-1051	S17	SRK, 2008	2004	0-1"	.25 sieve	No	32.70559821	-108.1398686	4650	3255	7.84	5.33					
U04-1052	S18	SRK, 2008	2004	0-1"	.25 sieve	No	32.70560915	-108.1366215	3670	2569	7.92	5.68					
U04-1053	S19	SRK, 2008	2004	0-1"	.25 sieve	No	32.70561885	-108.1338621	5660	3962	7.72	4.99					
U04-1054	S20	SRK, 2008	2004	0-1"	.25 sieve	No	32.70285291	-108.1398556	4240	2968	7.89	5.48					
U04-1055	S21	SRK, 2008	2004	0-1"	.25 sieve	No	32.70286385	-108.1366086	6670	4669	7.92	4.99					
U04-1056	S22	SRK, 2008	2004	0-1"	.25 sieve	No	32.70287354	-108.1338493	5210	3647	7.68	5.05					
U04-1057	S23	SRK, 2008	2004	0-1"	.25 sieve	No	32.70010763	-108.1398426	3030	2121	7.08	5.12					
U04-1058	S24	SRK, 2008	2004	0-1"	.25 sieve	No	32.70011855	-108.1365958	3910	2737	6.87	4.63					
U04-1059	S25	SRK, 2008	2004	0-1"	.25 sieve	No	32.70012761	-108.1340966	4630	3241	7.84	5.34					
U04-1060	S26	SRK, 2008	2004	0-1"	.25 sieve	No	32.69736233	-108.1398296	2600	1820	6.59	4.84					
U04-1061	S27	SRK, 2008	2004	0-1"	.25 sieve	No	32.69737327	-108.1365829	3150	2205	7.29	5.27					
U04-1062	S28	SRK, 2008	2004	0-1"	.25 sieve	No	32.69778781	-108.1337556	5840	4088	7.99	5.21					
U04-1063	S29	SRK, 2008	2004	0-1"	.25 sieve	No	32.69461702	-108.1398167	1690	1183	7.34	6.03					
U04-1064	S30	SRK, 2008	2004	0-1"	.25 sieve	No	32.69462796	-108.13657	2350	1645	7.87	6.14					
U04-1065	S31	SRK, 2008	2004	0-1"	.25 sieve	No	32.69463988	-108.1328682	3120	2184	7.94	5.88					
U04-1066	S32	SRK, 2008	2004	0-1"	.25 sieve	No	32.68959262	-108.13104	2440	1708	7.97	6.19					
U04-1067	S33	SRK, 2008	2004	0-6"	2 mm sieve	No	32.68982493	-108.1274216	2570	1799	7.94	6.10					
U04-1068	S34	SRK, 2008	2004	0-1"	.25 sieve	No	32.68928766	-108.1242792	4340	3038	8.02	5.58					
U04-1069	S35	SRK, 2008	2004	0-1"	.25 sieve	No	32.70387193	-108.1129101	3270	2289	4.47	2.60					
U04-1070	S36	SRK, 2008	2004	0-1"	.25 sieve	No	32.70437429	-108.1101669	3970	2779	5.29	3.14					
U04-1071	S37	SRK, 2008	2004	0-1"	.25 sieve	No	32.70177084	-108.1134075	1900	1330	7.67	6.20					
U04-1072	S38	SRK, 2008	2004	0-1"	.25 sieve	No	32.70167006	-108.1099717	4280	2996	4.70	2.51					
U04-1073	S39	SRK, 2008	2004	0-1"	.25 sieve	No	32.70195507	-108.1067256	2470	1729	4.46	2.91					
U04-1074	S40	SRK, 2008	2004	0-1"	.25 sieve	No	32.70163255	-108.1035219	3610	2527	4.50	2.51					
U04-1075	S41	SRK, 2008	2004	0-1"	.25 sieve	No	32.69891449	-108.1132064	8170	5719	4.58	1.65					
U04-1076	S42	SRK, 2008	2004	0-1"	.25 sieve	No	32.69892675	-108.1090494	5780	4046	4.61	2.08					
U04-1077	S43	SRK, 2008	2004	0-1"	.25 sieve	No	32.69893492	-108.1067128	2230	1561	4.42	2.99					
U04-1078	S44	SRK, 2008	2004	0-1"	.25 sieve	No	32.69894497	-108.103466	908	636	5.17	4.73					
U04-1080	S45	SRK, 2008	2004	0-1"	.25 sieve	No	32.69618733	-108.1138419	8270	5789	4.91	1.94					
U04-1081	S56	SRK, 2008	2004	0-1"	.25 sieve	No	32.69070905	-108.1034304	1490	1043	5.70	4.65					
U04-1082	S46	SRK, 2008	2004	0-1"	.25 sieve	No	32.6960246	-108.1116732	9000	6300	5.89	2.76					
U04-1083	S47	SRK, 2008	2004	0-1"	.25 sieve	No	32.6959845	-108.1073659	7990	5593	4.85	1.93					
U04-1084	S48	SRK, 2008	2004	0-1"	.25 sieve	No	32.69619966	-108.1034541	2520	1764	4.40	2.84					
U04-1085	S49	SRK, 2008	2004	0-1"	.25 sieve	No	32.69342387	-108.1131821	5430	3801	6.56	3.96					
U04-1086	S50	SRK, 2008	2004	0-1"	.25 sieve	No	32.69458855	-108.1099391	272	190	7.38	8.17					
U04-1087	S51	SRK, 2008	2004	0-1"	.25 sieve	No	32.69363315	-108.1066761	3790	2653	4.92	2.85					
U04-1088	S52	SRK, 2008	2004	0-1"	.25 sieve	No	32.69375562	-108.1034324	1540	1078	4.69	3.67					
U04-1089	S53	SRK, 2008	2004	0-1"	.25 sieve	No	32.69110526	-108.1125128	7880	5516	7.36	4.28					
U04-1090	S54	SRK, 2008	2004	0-1"	.25 sieve	No	32.69069946	-108.1095763	2220	1554	5.60	4.10					
U04-1091	S55	SRK, 2008	2004	0-1"	.25 sieve	Yes	32.68974483	-108.1061962	1740	2610	5.69	3.58					
U04-1092	S57	SRK, 2008	2004	0-1"	.25 sieve	Yes	32.68794351	-108.1099113	1300	1950	5.20	3.46					
U04-1093	S58	SRK, 2008	2004	0-1"	.25 sieve	Yes	32.68795224	-108.107315	1590	2385	5.04	3.08					
U04-1094	S59	SRK, 2008	2004	0-1"	.25 sieve	No	32.70316191	-108.1242624	14100	9870	7.33	3.58					
U04-1095	S60	SRK, 2008	2004	0-1"	.25 sieve	No	32.70215863	-108.1246637	18300	12810	7.36	3.31					
U04-1096	S61	SRK, 2008	2004	0-1"	.25 sieve	No	32.69884392	-108.1242907	30500	21350	7.53	2.88					
U04-1097	S62	SRK, 2008	2004	0-1"	.25 sieve	No	32.69792003	-108.1237389	20100	14070	7.64	3.46					
U04-1098	S63	SRK, 2008	2004	0-1"	.25 sieve	No	32.69667772	-108.1238164	10500	7350	7.59	4.16					
U04-1099	S64	SRK, 2008	2004	0-1"	.25 sieve	No	32.74940305	-108.1322771	689	482	7.49	7.20					
U04-1100	S65	SRK, 2008	2004	0-1"	.25 sieve	No	32.74369462	-108.1310412	660	462	4.78	4.73					
U04-1101	S66	SRK, 2008	2004	0-1"	.25 sieve	No	32.73870439	-108.131451	789	552	6.61	6.23					
U04-1102	S67	SRK, 2008	2004	0-1"	.25 sieve	No	32.73292465	-108.1308801	899	629	4.74	4.34					
U04-1103	S68	SRK, 2008	2004	0-1"	.25 sieve	No	32.72817366	-108.1334221	846	592	5.83	5.42					
U04-1104	S69	SRK, 2008	2004	0-1"	.25 sieve	No	32.72267541	-108.1339438	710	497	4.95	4.80					
U04-1105	S70	SRK, 2008	2004	0-1"	.25 sieve	No	32.71626544	-108.1356252	2280	1596	7.38	5.72					
U04-1106	S71	SRK, 2008	2004	0-1"	.25 sieve	No	32.70960523	-108.1344573	5350	3745	7.21	4.58					

Table E-2
Coordinates of Sample Locations Included in Interpolations and Maps

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

									Pre-White Rain (pre-2008)				2009	2010		2014	
Location ID	Alternate ID	Source	Year Collected	Original Soil depth (if not 0-6" were converted to 0-6")[1]	Sieving Status	"Yes" if inside WB tailings	Latitude	Longitude	Original Cu value	Final Adjusted Cu	pH	pCu	pH	pH	pCu	pH	pCu
U04-1107	S72	SRK, 2008	2004	0-6"	2 mm sieve	No	32.68180304	-108.1289454	1160	1160	7.85	6.53					
U04-1108	S73	SRK, 2008	2004	0-6"	2 mm sieve	No	32.67078256	-108.1281301	1290	1290	7.72	6.28					
U04-1109	S74	SRK, 2008	2004	0-6"	2 mm sieve	No	32.66028472	-108.1286239	529	529	7.71	7.30					
U04-1110	S75	SRK, 2008	2004	0-6"	2 mm sieve	No	32.6498925	-108.1182743	940	940	7.75	6.67					
U04-1111	S76	SRK, 2008	2004	0-6"	2 mm sieve	No	32.64490744	-108.1293188	278	278	7.78	8.10					
U04-1112	S77	SRK, 2008	2004	0-6"	2 mm sieve	No	32.63482403	-108.1222914	267	267	7.86	8.22					
U04-1115	S80	SRK, 2008	2004	0-6"	2 mm sieve	Yes	32.68114702	-108.1055324	1440	1440	6.69	5.20					
U04-1116	S81	SRK, 2008	2004	0-6"	2 mm sieve	Yes	32.6811605	-108.0992466	875	875	6.80	5.87					
U04-1117	S82	SRK, 2008	2004	0-6"	2 mm sieve	No	32.68117784	-108.0909384	455	455	3.93	3.96					
U04-1118	S83	SRK, 2008	2004	0-6"	2 mm sieve	No	32.68119748	-108.0811834	358	358	3.96	4.26					
U04-1119	S84	SRK, 2008	2004	0-6"	2 mm sieve	Yes	32.67407385	-108.104917	362	362	7.30	7.35					
U04-1120	S85	SRK, 2008	2004	0-6"	2 mm sieve	Yes	32.6740384	-108.0992255	451	451	3.88	3.92					
U04-1121	S86	SRK, 2008	2004	0-6"	2 mm sieve	Yes	32.67401869	-108.0918219	513	513	3.79	3.69					
U04-1122	S87	SRK, 2008	2004	0-6"	2 mm sieve	No	32.67315474	-108.0815894	309	309	4.33	4.77					
U04-1123	S88	SRK, 2008	2004	0-6"	2 mm sieve	No	32.67389726	-108.0719324	484	484	7.70	7.39					
U04-1124	S89	SRK, 2008	2004	0-6"	2 mm sieve	No	32.67375257	-108.0632721	399	399	4.48	4.62					
U04-1125	S90	SRK, 2008	2004	0-6"	2 mm sieve	No	32.67681553	-108.0558675	255	255	7.86	8.28					
U04-1126	S91	SRK, 2008	2004	0-6"	2 mm sieve	Yes	32.66741787	-108.0986987	926	926	7.05	6.04					
U04-1127	S92	SRK, 2008	2004	0-6"	2 mm sieve	Yes	32.66682079	-108.0920031	581	581	3.78	3.54					
U04-1128	S93	SRK, 2008	2004	0-6"	2 mm sieve	No	32.6659985	-108.0810463	308	308	4.22	4.67					
U04-1129	S94	SRK, 2008	2004	0-6"	2 mm sieve	No	32.66564599	-108.0728144	313	313	4.28	4.71					
U04-1130	S95	SRK, 2008	2004	0-6"	2 mm sieve	No	32.66538892	-108.0632983	494	494	5.96	5.75					
U04-1131	S96	SRK, 2008	2004	0-6"	2 mm sieve	No	32.66540229	-108.055882	237	237	7.61	8.13					
U04-1132	SS97	SRK, 2008	2006	0-1"	.25 sieve	No	32.75191978	-108.1471355	412	288	5.97	6.38					
U04-1133	SS98	SRK, 2008	2006	0-1"	.25 sieve	No	32.74742739	-108.1249598	475	333	5.97	6.21					
U04-1138	SS103	SRK, 2008	2006	0-1"	.25 sieve	No	32.74429383	-108.1389187	497	348	4.52	4.81					
U04-1139	SS104	SRK, 2008	2006	0-1"	.25 sieve	No	32.75110133	-108.1129991	407	285	5.70	6.14					
U04-1140	SS105	SRK, 2008	2006	0-1"	.25 sieve	No	32.73268075	-108.1381274	226	158	5.49	6.62					
U04-1141	SS106	SRK, 2008	2006	0-1"	.25 sieve	No	32.73144587	-108.124364	531	372	5.50	5.65					
U04-1142	SS107	SRK, 2008	2006	0-1"	.25 sieve	No	32.73323295	-108.0753661	194	136	5.53	6.84					
U04-1144	SS109	SRK, 2008	2006	0-1"	.25 sieve	No	32.72196351	-108.1378727	597	418	6.77	6.70					
U04-1146	SS111	SRK, 2008	2006	0-1"	.25 sieve	No	32.72214363	-108.1025637	551	386	4.80	4.96					

Table E-2
Coordinates of Sample Locations Included in Interpolations and Maps

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

									Pre-White Rain (pre-2008)				2009	2010		2014	
Location ID	Alternate ID	Source	Year Collected	Original Soil depth (if not 0-6" were converted to 0-6")[1]	Sieving Status	"Yes" if inside WB tailings	Latitude	Longitude	Original Cu value	Final Adjusted Cu	pH	pCu	pH	pH	pCu	pH	pCu
U04-1147	SS112	SRK, 2008	2006	0-1"	.25 sieve	No	32.71713174	-108.0870592	558	391	5.62	5.70					
U04-1150	SS115	SRK, 2008	2006	0-1"	.25 sieve	No	32.7112231	-108.1401569	3800	2660	7.78	5.51					
U04-1151	SS116	SRK, 2008	2006	0-1"	.25 sieve	No	32.71105615	-108.1198787	1460	1022	7.09	5.96					
U04-1152	SS117	SRK, 2008	2006	0-1"	.25 sieve	No	32.70334288	-108.1110735	4450	3115	4.87	2.62					
U04-1154	SS118D	SRK, 2008	2006	0-6"	.25 sieve	No	32.70237095	-108.0936065	259	259	4.99	5.59					
U04-1158	SS121	SRK, 2008	2006	0-1"	.25 sieve	No	32.69413949	-108.0884663	896	627	4.62	4.23					
U04-1159	SS122	SRK, 2008	2006	0-1"	.25 sieve	No	32.69847542	-108.0676521	119	83	5.78	7.63					
U04-1160	SS123	SRK, 2008	2006	0-1"	.25 sieve	No	32.69948724	-108.0381803	449	314	5.74	6.07					
U04-1162	SS124D	SRK, 2008	2006	0-6"	2 mm sieve	No	32.68527714	-108.0920925	523	523	7.56	7.17					
U04-1164	SS125D	SRK, 2008	2006	0-6"	2 mm sieve	No	32.68882207	-108.0809109	166	166	5.22	6.32					
U04-1166	SS127	SRK, 2008	2006	0-1"	.25 sieve	Yes	32.68067489	-108.1055569	1020	1530	6.97	5.39					
U04-1167	SS128	SRK, 2008	2006	0-1"	.25 sieve	No	32.67729767	-108.0909229	454	318	3.97	4.41					
U04-1169	SS129D	SRK, 2008	2006	0-6"	2 mm sieve	No	32.677299	-108.0805078	337	337	4.07	4.43					
U04-1170	SS130	SRK, 2008	2006	0-1"	.25 sieve	No	32.67623991	-108.0749139	227	159	4.81	5.98					
U04-1172	SS131D	SRK, 2008	2006	0-6"	2 mm sieve	No	32.67349226	-108.0622866	444	444	4.76	4.76					
U04-1173	SS132	SRK, 2008	2006	0-1"	.25 sieve	No	32.67638362	-108.0506471	740	518	4.85	4.66					
U04-1175	SS134	SRK, 2008	2006	0-1"	.25 sieve	No	32.67028508	-108.0980149	334	234	3.83	4.63					
U04-1176	SS135	SRK, 2008	2006	0-1"	.25 sieve	No	32.67014008	-108.0828301	325	228	4.10	4.91					
U04-1178	SS137	SRK, 2008	2006	0-1"	.25 sieve	No	32.6623217	-108.083937	309	216	3.62	4.52					
U04-1179	SS138	SRK, 2008	2006	0-1"	.25 sieve	No	32.66069495	-108.0752254	297	208	5.05	5.90					
U04-1180	SS139	SRK, 2008	2006	0-1"	.25 sieve	No	32.66013963	-108.0553804	696	487	4.57	4.47					
U04-1182	SS141	SRK, 2008	2006	0-1"	.25 sieve	Yes	32.65009382	-108.0846326	320	480	3.56	3.55					
U04-1183	SS142	SRK, 2008	2006	0-1"	.25 sieve	No	32.64934479	-108.0746562	392	274	3.69	4.31					
U04-1184	SS143	SRK, 2008	2006	0-1"	.25 sieve	No	32.64831161	-108.0600417	738	517	8.16	7.74					
U04-1186	SS145	SRK, 2008	2006	0-1"	.25 sieve	No	32.63583166	-108.0866406	413	289	2.92	3.54					
U04-1187	SS146	SRK, 2008	2006	0-1"	.25 sieve	No	32.63982697	-108.0812578	710	497	5.58	5.39					
U04-1189	SS148	SRK, 2008	2006	0-1"	.25 sieve	No	32.62556509	-108.0813376	632	442	3.96	4.02					
U04-1197	SS156	SRK, 2008	2006	0-1"	.25 sieve	No	32.59932169	-108.0860226	196	137	5.06	6.39					
U04-1200	ERA159D	SRK, 2008	2006	0-6"	2 mm sieve	No	32.70756028	-108.1384823	809	809	7.59	6.70					
U04-1201	ERA160D	SRK, 2008	2006	0-6"	2 mm sieve	No	32.69849133	-108.1381535	34	34	7.60	10.35					
U04-1202	ERA161D	SRK, 2008	2006	0-6"	2 mm sieve	No	32.6897467	-108.1382089	556	556	7.85	7.37					
U04-1203	ERA162	SRK, 2008	2006	0-1"	.25 sieve	No	32.76541334	-108.1026024	218	153	6.49	7.59					
U04-1204	ERA163	SRK, 2008	2006	0-1"	.25 sieve	No	32.76906989	-108.1082783	208	146	6.95	8.08					
U04-1205	ERA164	SRK, 2008	2006	0-1"	.25 sieve	No	32.74354342	-108.0095505	136	95	5.62	7.33					
U04-1206	ERA165	SRK, 2008	2006	0-1"	.25 sieve	No	32.74909591	-108.0257729	177	124	6.90	8.21					
U05-4001	HR-01	Chino, 1995	1995	0-1"	not sieved	No	32.76440757	-108.1714475	318	286	5.51	5.96					
U05-4004	HR-02	Chino, 1995	1995	0-1"	not sieved	No	32.75980088	-108.1823783	216	194	5.07	5.99					

Notes:

[1] All sieved 0-6" soils were sieved to < 2 mm. All sieved 0-1" soils were sieved to < 0.25 mm. Ratio used to convert Cu concentration of 0-1" sieved at <0.25 mm soils to 0-6" sieved at < 2 mm soils is from Appendix A (median ratio of SS samples) of ARCADIS (2011)(note: no conversion needed for pH since median ratio and slope = 1.0). Multiplied Cu concentration by 0.7 if outside windblown tailings and by 1.5 if inside windblown tailings. If unsieved, multiplied by 0.9 if outside windblown tailings and by 1.3 if inside windblown tailings. The 0.9 and 1.3 are from median ratios of unsieved 0-1" soil in 2009 lab reports (at 25 m on transect) compared to sieved 0-6" co-located soil in Drexler lab report in Appendix D for soils in and outside of windblown tailings, respectively (FID 8, 18, 20 in tailings). If have pH from unsieved soil, multiply by 1.06 to convert from 0 to 1" to 0 to 6" unsieved soils (using Hurley data in Chino 1995), and then used equation in Figure 6 to adjust unsieved 0-6" to 2 mm sieved fraction of 0-6" soil: Sieved = 1.19*unsieved - 1.5781.

Darker shaded 0-1" depths were inside windblown tailings.

References

ARCADIS. 2010. AOC Terrestrial Invertebrate Copper Bioaccumulation and Bioavailability Study. Smelter/Tailing Soils Investigation Unit. Prepared for Freeport-McMoRan Chino Mines Company, Vanadium, New Mexico. (composite of 15 samples in 100-m radius plot).

Chino, 1995. Administrative Order on Consent, Investigation Area, Remedial Investigation Background Report, Chino Mines Investigation Area. Prepared by Chino Mines Company, Hurley, New Mexico. Department received 28 October 1995. (one grab sample).

Newfields. 2005. Chino Mines Administrative Order on Consent Site-wide Ecological Risk Assessment. Prepared for Chino Mines Company. November. (average of 3 samples on 50-m transect).

SRK, Inc. 2008. "Chino Mines Company, Hurley, New Mexico Administrative Order on Consent,Revised Remedial Investigation Report, Smelter/Tailing Soils Investigation Unit." Revision 2. February 6. (method was composite of 6 random subsamples in 100' x 100' area)

ARCADIS

Appendix F

Statistical ANOVA Output Tables and Subsets Data Figure

Table F-1
Comparison of pH, Copper, and pCu before (1999) and after (2010, 2012-2014) the White Rain using "Subset of White Rain Effects" Dataset

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Year	pH	Copper	pCu
Subset of primary white rain effects dataset (n = 5. all have pH ≤ 5.5)			
1999	4.78^{a}	541^{ac}	4.70^{a}
2010	6.14^{b}	475^{ab}	6.17^{b}
2012	6.18^{b}	538^{ac}	5.98^{b}
2013	6.04^{bc}	353^{ac}	6.5^{bc}
2014	5.62^{c}	561^{c}	5.41^{c}
Subset of validation-plus white rain effects dataset (n = 9)			
1999	4.93^{a}	--	--
2010	6.34^{b}	--	--
2012	6.02^{bc}	--	--
2013	6.27^{bc}	--	--
2014	5.84^{c}	--	--
Subset of validation-plus white rain effects dataset with pH ≤ 5.5, (n = 8)			
1999	4.74^{a}	--	--
2010	6.11^{b}	--	--
2012	5.83^{bc}	--	--
2013	6.11^{b}	--	--
2014	5.58^{c}	--	--

[1] Similarly suprerscripted values are not significantly different (see pairwise results of Tables F-2 to F-4.

Table F-2
Repeated Measures ANOVA and Post-hoc Comparisons Test for pH on Subset of White Rain Effects Dataset

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Repeated Measures Analysis of Variance (ANOVA): pH (subset of primary white rain effects dataset)
All 5 datapoints are pH $\leq$ 5.5

N of Cases Processed: 5

Dependent Variable Means

PH_PREWR1999	H_POSTWR2010	PH_2012	PH_2013	PH_2014
4.78	6.14	6.18	6.04	5.62

Repeated Measures Factors and Levels of Dependent Variables

Within Factor	1	2	3	4	5
Year	1	2	3	4	5

Univariate and Multivariate Repeated Measures Analysis

Within Subjects

Source	SS	df	Mean Squares	F-Ratio	p-Value	G-G	H-F
Year	6.8944	4	1.7236	16.4387	<0.0001	0.0022	0.0001
Error	1.6776	16	0.1049				

Greenhouse-Geisser Epsilon	0.4566
Huynh-Feldt Epsilon	0.8204

Within Subjects - Corrected

Source	SS	df	Mean Squares	F-Ratio	p-Value	G-G	H-F
year	6.8944	1.8264	3.774857643	16.4387	0.0048	0.0022	0.0001
Error	1.6776	7.3056	0.229632063				

Table F-2
Repeated Measures ANOVA and Post-hoc Comparisons Test for pH on Subset of White Rain Effects Dataset
Continued
Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Multivariate Repeated Measures Analysis

Test of: Year

Statistic	Value	Hypothesis df	Error df	F-Ratio	p-Value
Wilks's Lambda	0.0151	4	1	16.3346	0.1832
Pillai Trace	0.9849	4	1	16.3346	0.1832
Hotelling-Lawley Trace	65.3384	4	1	16.3346	0.1832

▼Hypothesis Tests

Pairwise comparisons between levels of within-subjects factor: Year

Within Subjects Factor		Mean Difference Between Levels	Stdandard Error of Difference	p-Value	95% Confidence Interval	
Comparing Levels					Lower	Upper
1	2	-1.36	0.1166	0.0003	-1.6838	-1.0362
1	3	-1.4	0.1414	0.0006	-1.7926	-1.0074
1	4	-1.26	0.2821	0.0111	-2.0433	-0.4767
1	5	-0.84	0.103	0.0012	-1.1259	-0.5541
2	3	-0.04	0.1536	0.8074	-0.4665	0.3865
2	4	0.1	0.2627	0.7228	-0.6293	0.8293
2	5	0.52	0.1594	0.031	0.0775	0.9625
3	4	0.14	0.3187	0.6832	-0.745	1.025
3	5	0.56	0.1364	0.0148	0.1813	0.9387
4	5	0.42	0.2396	0.1545	-0.2452	1.0852

*No correction applied for multiple comparisons.

Repeated Measures Analysis of Variance (ANOVA): pH (subset of validation plus white rain effects dataset)

N of Cases Processed: 9

Dependent Variable Means

PH_PREWR	PH_POSTWR	PH_2012	PH_2013	PH_2014
4.9293	6.3403	6.0222	6.2667	5.8444

Repeated Measures Factors and Levels of Dependent Variables

Within Factor	1	2	3	4	5
Year	1	2	3	4	5

Residuals have been saved.

Univariate and Multivariate Repeated Measures Analysis

Within Subjects

Source	SS	df	Mean Squares	F-Ratio	p-Value	G-G	H-F
Year	11.5808	4	2.8952	14.3097	0	0.0001	0
Error	6.4744	32	0.2023				

Greenhouse-Geisser Epsilon	0.5966
Huynh-Feldt Epsilon	0.8675

Within Subjects - Corrected

Source	SS	df	Mean Squares	F-Ratio	p-Value	G-G	H-F
year	11.5808	2.3864	4.852832719	14.3097	0.0001619	0.0001	0
Error	6.4744	19.0912	0.33913007				

Table F-2
Repeated Measures ANOVA and Post-hoc Comparisons Test for pH on Subset of White Rain Effects Dataset
Continued
Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Multivariate Repeated Measures Analysis (pH: Subset of Validation Plus Dataset)

Test of: Year

Statistic	Value	Hypothesis df	Error df	F-Ratio	p-Value
Wilks's Lambda	0.0763	4	5	15.1353	0.0053
Pillai Trace	0.9237	4	5	15.1353	0.0053
Hotelling-Lawley Trace	12.1082	4	5	15.1353	0.0053

▼Hypothesis Tests

Pairwise comparisons between levels of within-subjects factor: Year

Within Subjects Factor		Mean Difference	Stdandard Error	p-Value	95% Confidence Interval	
Comparing Levels		Between Levels	of Difference		Lower	Upper
1	2	-1.411	0.2206	0.0002	-1.9197	-0.9023
1	3	-1.093	0.2626	0.0032	-1.6985	-0.4875
1	4	-1.3374	0.1871	0.0001	-1.7688	-0.906
1	5	-0.9152	0.2493	0.0063	-1.4901	-0.3402
2	3	0.318	0.1657	0.0911	-0.064	0.7
2	4	0.0736	0.2001	0.7226	-0.3879	0.5351
2	5	0.4958	0.0997	0.0011	0.2659	0.7258
3	4	-0.2444	0.2799	0.408	-0.89	0.4011
3	5	0.1778	0.1698	0.3257	-0.2137	0.5693
4	5	0.4222	0.2241	0.0963	-0.0945	0.939

Table F-2
Repeated Measures ANOVA and Post-hoc Comparisons Test for pH on Subset of White Rain Effects Dataset

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Repeated Measures Analysis of Variance (ANOVA): pH (subset of validation plus white rain effects, pH$\leq$5.5)

N of Cases Processed: 8

Dependent Variable Means

PH_PREWR	PH_POSTWR	PH_2012	PH_2013	PH_2014
4.7385	6.1133	5.825	6.1125	5.575

Repeated Measures Factors and Levels of Dependent Variables

Within Factor	1	2	3	4	5
Year	1	2	3	4	5

Residuals have been saved.

Univariate and Multivariate Repeated Measures Analysis

Within Subjects

Source	SS	df	Mean Squares	F-Ratio	p-Value	G-G	H-F
Year	10.344	4	2.586	12.1935	0	0.0005	0
Error	5.9382	28	0.2121				

Greenhouse-Geisser Epsilon	0.5634
Huynh-Feldt Epsilon	0.8443

Within Subjects - Corrected

Source	SS	df	Mean Squares	F-Ratio	p-Value	G-G	H-F
year	10.344	2.2536	4.58998935	12.1935	0.000717	0.0005	0
Error	5.9382	15.7752	0.376426289				

Table F-2
Repeated Measures ANOVA and Post-hoc Comparisons Test for pH on Subset of White Rain Effects Dataset

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Multivariate Repeated Measures Analysis (pH: subset of validation plus dataset, pH≤5.5)

Test of: Year

Statistic	Value	Hypothesis df	Error df	F-Ratio	p-Value
Wilks's Lambda	0.0608	4	4	15.4466	0.0106
Pillai Trace	0.9392	4	4	15.4466	0.0106
Hotelling-Lawley Trace	15.4466	4	4	15.4466	0.0106

▼Hypothesis Tests

Pairwise comparisons between levels of within-subjects factor: Year

Within Subjects Factor		Mean Difference	Stdandard Error	p-Value	95% Confidence Interval	
Comparing Levels		Between Levels	of Difference		Lower	Upper
1	2	-1.3748	0.2467	0.0008	-1.9582	-0.7913
1	3	-1.0865	0.2976	0.0082	-1.7903	-0.3827
1	4	-1.374	0.208	0.0003	-1.8659	-0.8821
1	5	-0.8365	0.2683	0.0169	-1.4708	-0.2022
2	3	0.2883	0.1848	0.1627	-0.1486	0.7252
2	4	0.0008	0.2114	0.9971	-0.499	0.5006
2	5	0.5383	0.1023	0.0012	0.2964	0.7802
3	4	-0.2875	0.3136	0.3898	-1.0291	0.4541
3	5	0.25	0.1742	0.1945	-0.162	0.662
4	5	0.5375	0.2179	0.043	0.0223	1.0527

*No correction applied for multiple comparisons.

Table F-3
Repeated Measures ANOVA and Post-hoc Comparisons Test for pCu on Subset of White Rain Effects Dataset

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Repeated Measures Analysis of Variance (ANOVA): pCu (subset of primary white rain effects dataset)
All are pH $\leq$ 5.5

N of Cases Processed: 5

Dependent Variable Means

PCU_PREWR1999	CU_POSTWR2010	PCU_2012	PCU_2013	PCU_2014
4.69713	6.16535	5.97522	6.50298	5.41411

Repeated Measures Factors and Levels of Dependent Variables

Within Factor	1	2	3	4	5
Year	1	2	3	4	5

Residuals have been saved.

Univariate and Multivariate Repeated Measures Analysis

Within Subjects

Source	SS	df	Mean Squares	F-Ratio	p-Value	G-G	H-F
Year	10.05794	4	2.51448	11.85393	0.00011	0.01323	0
Error	3.39396	16	0.21212				

Greenhouse-Geisser Epsilon	0.34003
Huynh-Feldt Epsilon	0.45462

Within Subjects - Corrected

Source	SS	df	Mean Squares	F-Ratio	p-Value	G-G	H-F
year	10.05794	1.36012	7.394891627	11.85393	0.01838	0.01323	0
Error	3.39396	5.44048	0.623834662				

Table F-3
Repeated Measures ANOVA and Post-hoc Comparisons Test for pCu on Subset of White Rain Effects Dataset
Continued
Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Multivariate Repeated Measures Analysis

Test of: Year

Statistic	Value	Hypothesis df	Error df	F-Ratio	p-Value
Wilks's Lambda	0.00236	4	1	105.50116	0.07287
Pillai Trace	0.99764	4	1	105.50116	0.07287
Hotelling-Lawley Trace	422.00466	4	1	105.50116	0.07287

▼Hypothesis Tests

Pairwise comparisons between levels of within-subjects factor: Year

Within Subjects Factor		Mean Difference	Stdandard Error	p-Value	95% Confidence Interval	
Comparing Levels		Between Levels	of Difference		Lower	Upper
1	2	-1.46823	0.11859	0.00024	-1.79749	-1.13896
1	3	-1.2781	0.1328	0.00065	-1.6468	-0.9094
1	4	-1.80586	0.37807	0.0088	-2.85554	-0.75618
1	5	-0.71698	0.21381	0.02848	-1.31061	-0.12336
2	3	0.19013	0.08884	0.09906	-0.05652	0.43678
2	4	-0.33763	0.43616	0.48208	-1.5486	0.87334
2	5	0.75124	0.15101	0.00763	0.33197	1.17052
3	4	-0.52776	0.44512	0.30138	-1.76362	0.7081
3	5	0.56111	0.10711	0.00635	0.26372	0.85851
4	5	1.08887	0.44453	0.07048	-0.14533	2.32307

*No correction applied for multiple comparisons.

Table F-4
Repeated Measures ANOVA and Post-hoc Comparisons Test for Copper on Subset of White Rain Effects Dataset

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Repeated Measures Analysis of Variance (ANOVA): Copper (subset of primary white rain effects dataset All 5 dataspoints are pH $\leq$ 5.5

Dependent Variable Means

U_PREWR1999	POSTWR2010	CU_2012	CU_2013	CU_2014
541.328	475.2	537.8	353	561.2

Repeated Measures Factors and Levels of Dependent Variables

Within Factor	1	2	3	4	5
Year	1	2	3	4	5

Residuals have been saved.

Univariate and Multivariate Repeated Measures Analysis

Within Subjects

Source	SS	df	lean Squares	F-Ratio	p-Value	G-G	H-F
Year	144,541.13	4	36,135.28	2.28951	0.1047	0.18907	0.2
Error	252,527.63	16	15,782.98				

Greenhouse-Ge	0.34149
Huynh-Feldt Ep	0.45841

Within Subjects - Corrected

Source	SS	df	lean Squares	F-Ratio	p-Value	G-G	H-F
year	144,541.13	1.36596	105,816.52	2.28951	0.1907	0.18907	0.2
Error	252,527.63	5.46384	46,217.98				

Table F-4
Repeated Measures ANOVA and Post-hoc Comparisons Test for Copper on Subset of White Rain Effects Dataset
Continued
Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Multivariate Repeated Measures Analysis

Test of: Year

Statistic	Value	Hypothesis df	Error df	F-Ratio	p-Value
Wilks's Lambda	0.05408	4	1	4.37235	0.34255
Pillai Trace	0.94592	4	1	4.37235	0.34255
Hotelling-Lawle	17.48942	4	1	4.37235	0.34255

▼Hypothesis Tests

Pairwise comparisons between levels of within-subjects factor: Year

Within Subjects Factor		Mean Difference	tandard Error	p-Value	95% Confidence Interval	
Comparing Levels		Between Levels	of Difference		Lower	Upper
1	2	66.128	60.01838	0.33239	-100.5097	232.76574
1	3	3.528	63.92226	0.95863	-173.9486	181.00464
1	4	188.328	89.54741	0.10329	-60.29547	436.95147
1	5	-19.872	64.24458	0.77252	-198.2436	158.49955
2	3	-62.6	24.57967	0.06352	-130.8441	5.64409
2	4	122.2	111.39093	0.33423	-187.0708	431.47081
2	5	-86	20.3101	0.01332	-142.3899	-29.61013
3	4	184.8	120.1301	0.19879	-148.7346	518.33462
3	5	-23.4	10.41921	0.08805	-52.32837	5.52837
4	5	-208.2	123.82706	0.16798	-551.999	135.59903

*No correction applied for multiple comparisons.

Table F-5
Repeated Measures ANOVA and Post-Hoc Comparisons for pH on Long-Term (>5 Years) Dataset

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Repeated Measures Analysis of Variance (ANOVA): pH for 2009 to 2014
(Using 9 samples from Figure C-1 in Appendix C sampled every year from 2009 to 2014)

N of Cases Processed: 9

Dependent Variable Means

PH_2009	PH_2010	PH_2011	PH_2012	PH_2013	PH_2014
5.96667	5.47778	5.25556	5.12222	5.5	5.32222

Repeated Measures Factors and Levels of Dependent Variables

Within Factor	1	2	3	4	5	6
Year	2009	2010	2011	2012	2013	2014

Residuals have been saved.

Univariate and Multivariate Repeated Measures Analysis

Within Subjects

Source	SS	df	Mean Squares	F-Ratio	p-Value	G-G	H-F
Year	3.88148	5	0.7763	2.85146	0.02707	0.08195	0.05904
Error	10.88981	40	0.27225				

Greenhouse-Geisser Epsilon	0.43117
Huynh-Feldt Epsilon	0.59556

Within Subjects - Corrected

Source	SS	df	Mean Squares	F-Ratio	p-Value	G-G	H-F
year	3.88148	2.15585	1.800440661	2.85146	0.08553	0.08195	0.05904
Error	10.88981	17.2468	0.631410465				

Table F-5
Repeated Measures ANOVA and Post-Hoc Comparisons for pH on Long-Term (>5 Years) Dataset Continued
Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Multivariate Repeated Measures Analysis

Test of: Year

Statistic	Value	Hypothesis df	Error df	F-Ratio	p-Value
Wilks's Lambda	0.3805	5	4	1.30252	0.41058
Pillai Trace	0.6195	5	4	1.30252	0.41058
Hotelling-Lawley Trace	1.62815	5	4	1.30252	0.41058

▼Hypothesis Tests

Pairwise comparisons between levels of within-subjects factor: Year

Within Subjects Factor		Mean Difference Between Levels	Stdandard Error of Difference	p-Value	95% Confidence Interval	
Comparing Levels					Lower	Upper
2009	2010	0.48889	0.37912	0.23324	-0.38537	1.36315
2009	2011	0.71111	0.35781	0.08211	-0.11401	1.53623
2009	2012	0.84444	0.33003	0.03372	0.0834	1.60549
2009	2013	0.46667	0.31067	0.17147	-0.24975	1.18308
2009	2014	0.64444	0.31823	0.07745	-0.0894	1.37829
2010	2011	0.22222	0.1152	0.08986	-0.04344	0.48788
2010	2012	0.35556	0.17006	0.06993	-0.0366	0.74771
2010	2013	-0.02222	0.13922	0.87714	-0.34327	0.29882
2010	2014	0.15556	0.24727	0.54683	-0.41465	0.72576
2011	2012	0.13333	0.11055	0.26225	-0.12161	0.38827
2011	2013	-0.24444	0.08992	0.02632	-0.45181	-0.03708
2011	2014	-0.06667	0.2555	0.80074	-0.65584	0.52251
2012	2013	-0.37778	0.13922	0.02651	-0.69882	-0.05673
2012	2014	-0.2	0.19149	0.3268	-0.64157	0.24157
2013	2014	0.17778	0.25428	0.50429	-0.4086	0.76416

*No correction applied for multiple comparisons.

Table F-6
Repeated Measures ANOVA and Post-Hoc Comparisons for Copper on Long-Term (>5 Years) Dataset

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Repeated Measures Analysis of Variance (ANOVA): Copper for 2009 to 2014

(Using 9 samples from Figure C-1 in Appendix C sampled every year from 2009 to 2014)

N of Cases Processed: 9

Box-Cox Transformed Copper, lambda = -0.5

Dependent Variable Means

BC_CU_2009	BC_CU_2010	BC_CU_2011	BC_CU_2012	BC_CU_2013	C_CU_2014
0.03928	0.03379	0.04054	0.04576	0.04725	0.03944

Repeated Measures Factors and Levels of Dependent Variables

Within Factor	1	2	3	4	5	6
Year	2009	2010	2011	2012	2013	2014

Residuals have been saved.

Univariate and Multivariate Repeated Measures Analysis

Within Subjects

Source	SS	df	Mean Squares	F-Ratio	p-Value	G-G	H-F
Year	0.00107	5	0.00021	5.80683	0.0004	0.0115	0
Error	0.00148	40	0.00004				

Greenhouse-Geisser Epsilon	0.41684
Huynh-Feldt Epsilon	0.56654

Within Subjects - Corrected

Source	SS	df	Mean Squares	F-Ratio	p-Value	G-G	H-F
year	0.00107	2.0842	0.000513386	5.80683	0.0127048	0.0115	0
Error	0.00148	16.6736	8.87631E-05				

Table F-6
Repeated Measures ANOVA and Post-Hoc Comparisons for Copper on Long-Term (>5 Years) Dataset Continued
Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Multivariate Repeated Measures Analysis

Test of: Year

Statistic	Value	Hypothesis df	Error df	F-Ratio	p-Value
Wilks's Lambda	0.21454	5	4	2.92893	0.15996
Pillai Trace	0.78546	5	4	2.92893	0.15996
Hotelling-Lawley Trace	3.66117	5	4	2.92893	0.15996

▼Hypothesis Tests

Pairwise comparisons between levels of within-subjects factor: Year

Within Subjects Factor Comparing Levels		Mean Difference Between Levels	Stdandard Error of Difference	p-Value	95% Confidence Interval	
					Lower	Upper
2009	2010	0.00549	0.00256	0.06458	-0.00042	0.01141
2009	2011	-0.00126	0.0032	0.70475	-0.00865	0.00613
2009	2012	-0.00648	0.00441	0.17962	-0.01664	0.00368
2009	2013	-0.00797	0.00422	0.09579	-0.0177	0.00177
2009	2014	-0.00016	0.00235	0.94795	-0.00558	0.00526
2010	2011	-0.00675	0.0022	0.01525	-0.01182	-0.00169
2010	2012	-0.01197	0.00315	0.00524	-0.01924	-0.00471
2010	2013	-0.01346	0.00398	0.00956	-0.02263	-0.00429
2010	2014	-0.00565	0.00162	0.00813	-0.00938	-0.00192
2011	2012	-0.00522	0.00179	0.01916	-0.00934	-0.0011
2011	2013	-0.00671	0.00223	0.01695	-0.01185	-0.00156
2011	2014	0.0011	0.00141	0.45802	-0.00215	0.00435
2012	2013	-0.00149	0.00272	0.59966	-0.00775	0.00478
2012	2014	0.00632	0.00239	0.02954	0.00081	0.01184
2013	2014	0.00781	0.00269	0.0199	0.0016	0.01402

*No correction applied for multiple comparisons.

Table F-7
Repeated Measures ANOVA and Post-Hoc Comparisons for pCu on Long-Term (>5 Years) Dataset

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Repeated Measures Analysis of Variance (ANOVA): pCu for 2009 to 2014

(Using 9 samples from Figure C-1 in Appendix C sampled every year from 2009 to 2014)

N of Cases Processed: 9

Dependent Variable Means

PCU_2009	PCU_2010	PCU_2011	PCU_2012	PCU_2013	PCU_2014
5.39447	4.49551	4.6778	4.83073	5.23563	4.71551

Repeated Measures Factors and Levels of Dependent Variables

Within Factor	1	2	3	4	5	6
Year	2009	2010	2011	2012	2013	2014

Residuals have been saved.

Univariate and Multivariate Repeated Measures Analysis

Within Subjects

Source	SS	df	Mean Squares	F-Ratio	p-Value	G-G	H-F
Year	5.47695	5	1.09539	2.37465	0.05607	0.12231	0.09986
Error	18.45142	40	0.46129				

Greenhouse-Geisser Epsilon	0.41602
Huynh-Feldt Epsilon	0.56491

Within Subjects - Corrected

Source	SS	df	Mean Squares	F-Ratio	p-Value	G-G	H-F
year	5.47695	2.0801	2.633022451	2.37465	0.12501	0.12231	0.09986
Error	18.45142	16.6408	1.108806067				

Table F-7
Repeated Measures ANOVA and Post-Hoc Comparisons for pCu on Long-Term (>5 Years) Dataset Continued
Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Multivariate Repeated Measures Analysis

Test of: Year

Statistic	Value	Hypothesis df	Error df	F-Ratio	p-Value
Wilks's Lambda	0.0466	5	4	16.36613	0.00906
Pillai Trace	0.9534	5	4	16.36613	0.00906
Hotelling-Lawley Trace	20.45766	5	4	16.36613	0.00906

▼Hypothesis Tests

Pairwise comparisons between levels of within-subjects factor: Year

Within Subjects Factor		Mean Difference	Stdandard Error	p-Value	95% Confidence Interval	
Comparing Levels		Between Levels	of Difference		Lower	Upper
2009	2010	0.89896	0.48219	0.09927	-0.21296	2.01089
2009	2011	0.71667	0.48629	0.17877	-0.4047	1.83805
2009	2012	0.56374	0.46746	0.26228	-0.51422	1.64171
2009	2013	0.15884	0.43619	0.72518	-0.84701	1.1647
2009	2014	0.67896	0.40448	0.13175	-0.25377	1.6117
2010	2011	-0.18229	0.18124	0.34395	-0.60023	0.23564
2010	2012	-0.33522	0.21602	0.15932	-0.83337	0.16293
2010	2013	-0.74012	0.23163	0.0127	-1.27426	-0.20598
2010	2014	-0.22	0.28893	0.46825	-0.88628	0.44628
2011	2012	-0.15293	0.13408	0.28703	-0.46211	0.15625
2011	2013	-0.55783	0.11435	0.00123	-0.82152	-0.29414
2011	2014	-0.03771	0.30549	0.90481	-0.74217	0.66676
2012	2013	-0.4049	0.17562	0.05004	-0.80988	0.00008
2012	2014	0.11522	0.22539	0.62301	-0.40453	0.63497
2013	2014	0.52012	0.27127	0.09149	-0.10542	1.14567

*No correction applied for multiple comparisons.

Table F-8
Repeated Measures ANOVA and Post-Hoc Comparisons for pH on "Permanance Monitoring" Dataset

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Repeated Measures Analysis of Variance (ANOVA) : pH

Permanence Monitoring Dataset

N of Cases Processed: 17

Natural log-transformed pH

Dependent Variable Means

LN_PH_2010	LN_PH_2011	LN_PH_2012	LN_PH_2013	LN_PH_2014
1.67482	1.63749	1.64384	1.68031	1.62796

Repeated Measures Factors and Levels of Dependent Variables

Within Factor	1	2	3	4	5
Year	2010	2011	2012	2013	2014

Univariate and Multivariate Repeated Measures Analysis

Within Subjects

Source	SS	df	Mean Squares	F-Ratio	p-Value	G-G	H-F
Year	0.03694	4	0.00923	1.52679	0.20499	0.22596	0.21862
Error	0.38708	64	0.00605				

Greenhouse-Geisser Epsilon	0.63612
Huynh-Feldt Epsilon	0.76652

Within Subjects - Corrected

Source	SS	df	Mean Squares	F-Ratio	p-Value	G-G	H-F
year	0.03694	2.54448	0.014517701	1.52679	0.2296	0.22596	0.21862
Error	0.38708	40.71168	0.009507837				

Table F-8
Repeated Measures ANOVA and Post-Hoc Comparisons for pH on "Permanance Monitoring" Dataset Continued
Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Multivariate Repeated Measures Analysis

Test of: Year

Statistic	Value	Hypothesis df	Error df	F-Ratio	p-Value
Wilks's Lambda	0.4524	4	13	3.93391	0.02629
Pillai Trace	0.5476	4	13	3.93391	0.02629
Hotelling-Lawley Trace	1.21043	4	13	3.93391	0.02629

Pairwise comparisons between levels of within-subjects factor: Year

Within Subjects Factor		Mean Difference	Stdandard Error	p-Value	95% Confidence Interval	
Comparing Levels		Between Levels	of Difference		Lower	Upper
2010	2011	0.03732	0.01493	0.02371	0.00567	0.06898
2010	2012	0.03097	0.02375	0.21069	-0.01938	0.08133
2010	2013	-0.00549	0.02393	0.82142	-0.05622	0.04524
2010	2014	0.04685	0.02716	0.10379	-0.01073	0.10444
2011	2012	-0.00635	0.02513	0.80376	-0.05962	0.04692
2011	2013	-0.04281	0.01673	0.02104	-0.07829	-0.00734
2011	2014	0.00953	0.02686	0.72729	-0.04741	0.06648
2012	2013	-0.03646	0.03649	0.33248	-0.11381	0.04088
2012	2014	0.01588	0.03531	0.65886	-0.05896	0.09073
2013	2014	0.05235	0.02841	0.08399	-0.00788	0.11257

*No correction applied for multiple comparisons.

Table F-9
Repeated Measures ANOVA and Post-Hoc Comparisons for Copper on "Permanence Monitoring" Dataset

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Repeated Measures Analysis of Variance : Copper
Permanence Monitoring Dataset

N of Cases Processed: 17

Box-Cox Transformed Copper, lambda = -0.16

Dependent Variable Means

BC_CU_2010	BC_CU_2011	BC_CU_2012	BC_CU_2013	BC_CU_2014
0	1	2	3	4
0.33429	0.35778	0.35925	0.37214	0.35296

Repeated Measures Factors and Levels of Dependent Variables

Within Factor	1	2	3	4	5
Year	2010	2011	2012	2013	2014

Univariate and Multivariate Repeated Measures Analysis

Within Subjects

Source	SS	df	Mean Squares	F-Ratio	p-Value	G-G	H-F
Year	0.01279	4	0.0032	20.05364	< 0.0001	0	0
Error	0.01021	64	0.00016				

Greenhouse-Geisser Epsilon	0.82935
Huynh-Feldt Epsilon	1

Within Subjects - Corrected

Source	SS	df	Mean Squares	F-Ratio	p-Value	G-G	H-F
year	0.01279	4	0.0031975	20.05364	< 0.0001	0	0
Error	0.01021	64	0.000159531				

Table F-9
Repeated Measures ANOVA and Post-Hoc Comparisons for Copper on "Permanence Monitoring" Dataset Continued
Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Multivariate Repeated Measures Analysis

Test of: Year

Statistic	Value	Hypothesis df	Error df	F-Ratio	p-Value
Wilks's Lambda	0.20302	4	13	12.75812	0.0002
Pillai Trace	0.79698	4	13	12.75812	0.0002
Hotelling-Lawley Trace	3.92558	4	13	12.75812	0.0002

Pairwise comparisons between levels of within-subjects factor: Year

Within Subjects Factor		Mean Difference	Stdandard Error	p-Value	95% Confidence Interval	
Comparing Levels		Between Levels	of Difference		Lower	Upper
2010	2011	-0.0235	0.00424	0.00004	-0.03248	-0.01451
2010	2012	-0.02496	0.00497	0.00013	-0.03551	-0.01442
2010	2013	-0.03785	0.00488	< 0.00001	-0.0482	-0.02751
2010	2014	-0.01867	0.00368	0.00011	-0.02647	-0.01088
2011	2012	-0.00147	0.00506	0.77532	-0.01219	0.00925
2011	2013	-0.01436	0.00346	0.00075	-0.02169	-0.00703
2011	2014	0.00482	0.00362	0.20149	-0.00285	0.0125
2012	2013	-0.01289	0.00498	0.01987	-0.02346	-0.00233
2012	2014	0.00629	0.00441	0.17271	-0.00305	0.01564
2013	2014	0.01918	0.00356	0.00006	0.01164	0.02673

*No correction applied for multiple comparisons.

Table F-10
Repeated Measures ANOVA and Post-Hoc Comparisons for pCu on "Permanence Monitoring" Dataset

Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Repeated Measures Analysis of Variance (ANOVA) : pCu
Permanence Monitoring Dataset

N of Cases Processed: 17

Dependent Variable Means

PCU_2010	PCU_2011	PCU_2012	PCU_2013	PCU_2014
4.48346	4.77468	4.8259	5.26245	4.66834

Repeated Measures Factors and Levels of Dependent Variables

Within Factor	1	2	3	4	5
Year	2010	2011	2012	2013	2014

Univariate and Multivariate Repeated Measures Analysis

Within Subjects

Source	SS	df	Mean Squares	F-Ratio	p-Value	G-G	H-F
Year	5.65526	4	1.41382	5.73631	0.00052	0.00213	0.00081
Error	15.77393	64	0.24647				

Greenhouse-Geisser Epsilon	0.73282
Huynh-Feldt Epsilon	0.91501

Within Subjects - Corrected

Source	SS	df	Mean Squares	F-Ratio	p-Value	G-G	H-F
year	5.65526	2.93128	1.929280041	5.73631	0.00597	0.00213	0.00081
Error	15.77393	46.90048	0.336327688				

Table F-10
Repeated Measures ANOVA and Post-Hoc Comparisons for pCu on "Permanence Monitoring" Dataset Continued
Year 5 pH Monitoring Report
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Multivariate Repeated Measures Analysis

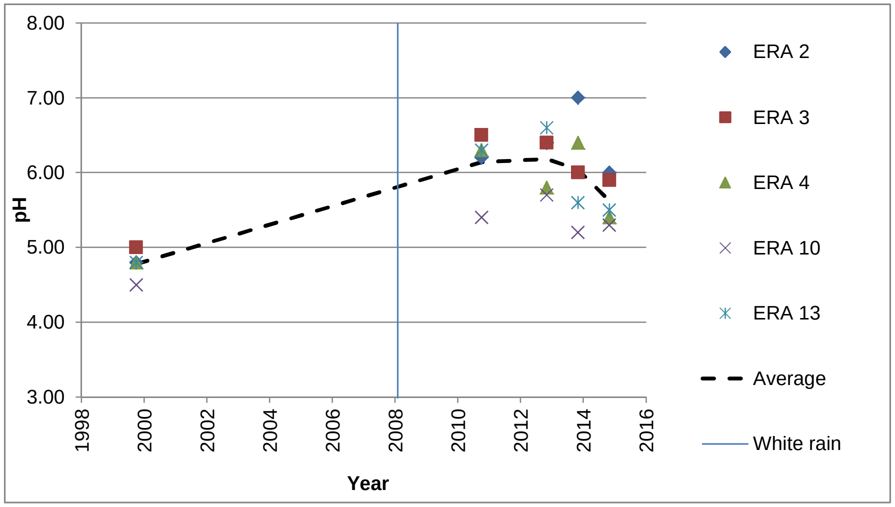
Test of: Year

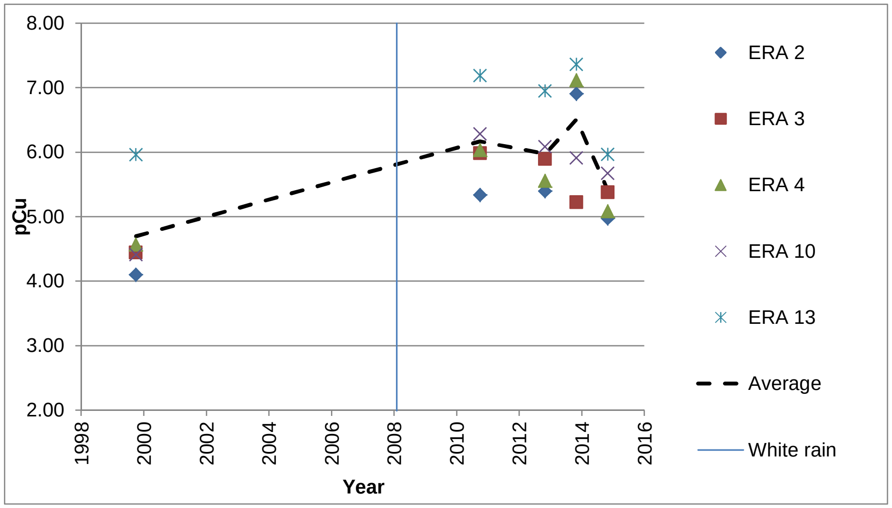
Statistic	Value	Hypothesis df	Error df	F-Ratio	p-Value
Wilks's Lambda	0.32526	4	13	6.74196	0.00364
Pillai Trace	0.67474	4	13	6.74196	0.00364
Hotelling-Lawley Trace	2.07445	4	13	6.74196	0.00364

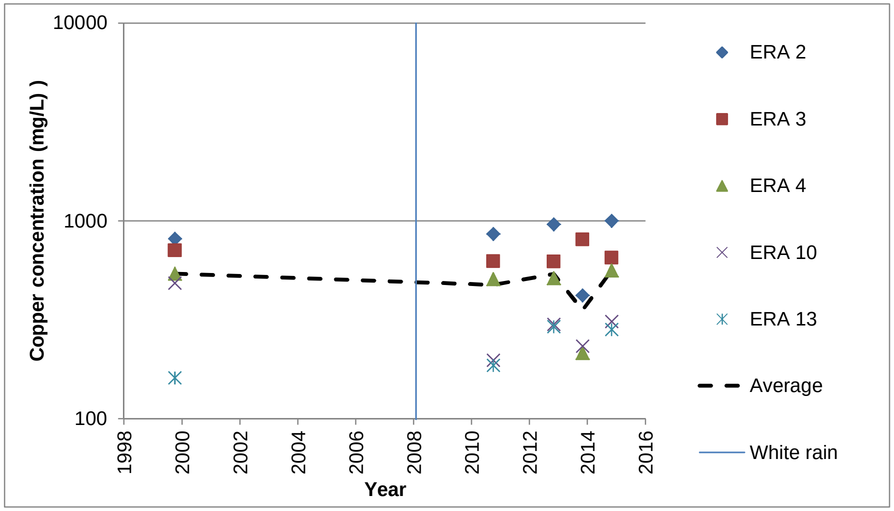
Pairwise comparisons between levels of within-subjects factor: Year

Within Subjects Factor		Mean Difference	Stdandard Error	p-Value	95% Confidence Interval	
Comparing Levels		Between Levels	of Difference		Lower	Upper
2010	2011	-0.29123	0.12019	0.02763	-0.54603	-0.03642
2010	2012	-0.34244	0.15867	0.04645	-0.6788	-0.00608
2010	2013	-0.779	0.17654	0.00044	-1.15324	-0.40475
2010	2014	-0.18489	0.17856	0.31587	-0.56342	0.19365
2011	2012	-0.05122	0.14163	0.72237	-0.35145	0.24902
2011	2013	-0.48777	0.12791	0.00153	-0.75893	-0.21661
2011	2014	0.10634	0.18143	0.56598	-0.27828	0.49095
2012	2013	-0.43655	0.21758	0.06202	-0.8978	0.02469
2012	2014	0.15755	0.20618	0.4559	-0.27953	0.59464
2013	2014	0.59411	0.16764	0.0027	0.23873	0.94949

*No correction applied for multiple comparisons.







Note:
Year tick mark shown on plot represents January (e.g., 2014 data sampled in fall are closer to Jan. 2015 than Jan. 2014 on graph).

FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

YEAR 5 REPORT - PH MONITORING

Subset of Primary White Rain effects Dataset Change in pH, Copper, and pCu

ARCADIS

FIGURE

F-1

ARCADIS

Appendix G

2009 to 2014 Laboratory Reports

L78388-01

LABID	CLIENTID	PROJECTID	DEPTNAME	COLLECTDATE	RECEIVEDATE	ANALYTE	MATRIX	METHOD	RESULT	TEXTRESULT	QUAL	UNITS	MDL	PQL	ANALYZEDATE	ANALYST	CAS
L78388-01	FID 20-25 0-6"	PR553454	Metals Analysis	6/19/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	790	790		mg/Kg	1	5	10/12/2009	aeh	7440-50-8
L78388-01	FID 20-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	3	3	B	t CaCO3/K	1	5	10/21/2009	calc	
L78388-01	FID 20-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	5	5		t CaCO3/K	1	5	10/21/2009	calc	
L78388-01	FID 20-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	2	2		t CaCO3/K	1	5	10/21/2009	calc	
L78388-01	FID 20-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3	0.5	0.5		%	0.1	0.5	10/13/2009	itk	
L78388-01	FID 20-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	4.9	4.9		units	0.1	0.1	10/9/2009	itk	
L78388-01	FID 20-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Solids, Percent	SO	CLPSOW390, PART F, D	94.4	94.4		%	0.1	0.5	10/15/2009	brd	
L78388-01	FID 20-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC	0.09	0.09	B	%	0.01	0.1	10/12/2009	bsu/brd	
L78388-02	FID 21-25 0-6"	PR553454	Metals Analysis	6/19/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	131	131		mg/Kg	1	5	10/12/2009	aeh	7440-50-8
L78388-02	FID 21-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3			U	t CaCO3/K	1	5	10/21/2009	calc	
L78388-02	FID 21-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	3	3		t CaCO3/K	1	5	10/21/2009	calc	
L78388-02	FID 21-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	3	3		t CaCO3/K	1	5	10/21/2009	calc	
L78388-02	FID 21-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3	0.3	0.3	B	%	0.1	0.5	10/13/2009	itk	
L78388-02	FID 21-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	6.3	6.3		units	0.1	0.1	10/9/2009	itk	
L78388-02	FID 21-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Solids, Percent	SO	CLPSOW390, PART F, D	98.6	98.6		%	0.1	0.5	10/15/2009	brd	
L78388-02	FID 21-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC	0.03	0.03	B	%	0.01	0.1	10/12/2009	bsu/brd	
L78388-03	FID 22-25 0-6"	PR553454	Metals Analysis	6/19/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	285	285		mg/Kg	1	5	10/12/2009	aeh	7440-50-8
L78388-03	FID 22-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	2	2	B	t CaCO3/K	1	5	10/21/2009	calc	
L78388-03	FID 22-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	7	7		t CaCO3/K	1	5	10/21/2009	calc	
L78388-03	FID 22-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	5	5		t CaCO3/K	1	5	10/21/2009	calc	
L78388-03	FID 22-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3	0.7	0.7		%	0.1	0.5	10/13/2009	itk	
L78388-03	FID 22-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	5.1	5.1		units	0.1	0.1	10/9/2009	itk	
L78388-03	FID 22-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Solids, Percent	SO	CLPSOW390, PART F, D	96.9	96.9		%	0.1	0.5	10/15/2009	brd	
L78388-03	FID 22-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC	0.07	0.07	B	%	0.01	0.1	10/12/2009	bsu/brd	
L78388-04	FID 24-25 0-6"	PR553454	Metals Analysis	6/19/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	121	121		mg/Kg	1	5	10/12/2009	aeh	7440-50-8
L78388-04	FID 24-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3			U	t CaCO3/K	1	5	10/21/2009	calc	
L78388-04	FID 24-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	31	31		t CaCO3/K	1	5	10/21/2009	calc	
L78388-04	FID 24-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	31	31		t CaCO3/K	1	5	10/21/2009	calc	
L78388-04	FID 24-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3	3.1	3.1		%	0.1	0.5	10/13/2009	itk	
L78388-04	FID 24-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	7.7	7.7		units	0.1	0.1	10/9/2009	itk	
L78388-04	FID 24-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Solids, Percent	SO	CLPSOW390, PART F, D	96.1	96.1		%	0.1	0.5	10/15/2009	brd	
L78388-04	FID 24-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC			U	%	0.01	0.1	10/12/2009	bsu/brd	
L78388-05	FID 25-25 0-6"	PR553454	Metals Analysis	6/19/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	66	66		mg/Kg	1	5	10/12/2009	aeh	7440-50-8
L78388-05	FID 25-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3			U	t CaCO3/K	1	5	10/21/2009	calc	
L78388-05	FID 25-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	115	115		t CaCO3/K	1	5	10/21/2009	calc	
L78388-05	FID 25-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	115	115		t CaCO3/K	1	5	10/21/2009	calc	
L78388-05	FID 25-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3	11.5	11.5		%	0.1	0.5	10/14/2009	itk	
L78388-05	FID 25-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	7.8	7.8		units	0.1	0.1	10/9/2009	itk	
L78388-05	FID 25-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Solids, Percent	SO	CLPSOW390, PART F, D	97.8	97.8		%	0.1	0.5	10/15/2009	brd	
L78388-05	FID 25-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC	0.01	0.01	B	%	0.01	0.1	10/12/2009	bsu/brd	
L78388-06	FID 26-25 0-6"	PR553454	Metals Analysis	6/19/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	75	75		mg/Kg	1	5	10/12/2009	aeh	7440-50-8
L78388-06	FID 26-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3			U	t CaCO3/K	1	5	10/21/2009	calc	
L78388-06	FID 26-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	10	10		t CaCO3/K	1	5	10/21/2009	calc	
L78388-06	FID 26-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	10	10		t CaCO3/K	1	5	10/21/2009	calc	
L78388-06	FID 26-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3	1	1.0		%	0.1	0.5	10/13/2009	itk	
L78388-06	FID 26-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	7.9	7.9		units	0.1	0.1	10/9/2009	itk	
L78388-06	FID 26-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Solids, Percent	SO	CLPSOW390, PART F, D	98.5	98.5		%	0.1	0.5	10/15/2009	brd	
L78388-06	FID 26-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC			U	%	0.01	0.1	10/12/2009	bsu/brd	
L78388-07	FID 27-25 0-6"	PR553454	Metals Analysis	6/18/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	206	206		mg/Kg	1	5	10/12/2009	aeh	7440-50-8
L78388-07	FID 27-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3			U	t CaCO3/K	1	5	10/21/2009	calc	
L78388-07	FID 27-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	19	19		t CaCO3/K	1	5	10/21/2009	calc	
L78388-07	FID 27-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	19	19		t CaCO3/K	1	5	10/21/2009	calc	
L78388-07	FID 27-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3	1.9	1.9		%	0.1	0.5	10/13/2009	itk	
L78388-07	FID 27-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	6.2	6.2		units	0.1	0.1	10/9/2009	itk	
L78388-07	FID 27-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC			U	%	0.01	0.1	10/12/2009	bsu/brd	
L78388-08	FID 28-25 0-6"	PR553454	Metals Analysis	6/22/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	348	348		mg/Kg	1	5	10/12/2009	aeh	7440-50-8
L78388-08	FID 28-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	1	1	B	t CaCO3/K	1	5	10/21/2009	calc	
L78388-08	FID 28-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	6	6		t CaCO3/K	1	5	10/21/2009	calc	
L78388-08	FID 28-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	5	5		t CaCO3/K	1	5	10/21/2009	calc	
L78388-08	FID 28-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3	0.6	0.6		%	0.1	0.5	10/13/2009	itk	
L78388-08	FID 28-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	5.4	5.4		units	0.1	0.1	10/10/2009	itk	
L78388-08	FID 28-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC	0.04	0.04	B	%	0.01	0.1	10/12/2009	bsu/brd	
L78388-09	FID 30-25 0-6"	PR553454	Metals Analysis	6/18/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	90	90		mg/Kg	1	5	10/12/2009	aeh	7440-50-8
L78388-09	FID 30-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3			U	t CaCO3/K	1	5	10/21/2009	calc	
L78388-09	FID 30-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	190	190		t CaCO3/K	1	5	10/21/2009	calc	
L78388-09	FID 30-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	190	190		t CaCO3/K	1	5	10/21/2009	calc	
L78388-09	FID 30-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3	19	19.0		%	0.1	0.5	10/14/2009	itk	
L78388-09	FID 30-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	7.7	7.7		units	0.1	0.1	10/10/2009	itk	
L78388-09	FID 30-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Solids, Percent	SO	CLPSOW390, PART F, D	96.7	96.7		%	0.1	0.5	10/15/2009	brd	
L78388-09	FID 30-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC	0.01	0.01	B	%	0.01	0.1	10/12/2009	bsu/brd	
L78388-10	FID 31-25 0-6"	PR553454	Metals Analysis	6/19/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	187	187		mg/Kg	1	5	10/12/2009	aeh	7440-50-8
L78388-10	FID 31-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3			U	t CaCO3/K	1	5	10/21/2009	calc	
L78388-10	FID 31-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	14	14		t CaCO3/K	1	5	10/21/2009	calc	
L78388-10	FID 31-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	14	14		t CaCO3/K	1	5	10/21/2009	calc	
L78388-10	FID 31-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3	1.4	1.4		%	0.1	0.5	10/13/2009	itk	
L78388-10	FID 31-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	6.1	6.1		units	0.1	0.1	10/10/2009	itk	
L78388-10	FID 31-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Solids, Percent	SO	CLPSOW390, PART F, D	97.3	97.3		%	0.1	0.5	10/15/2009	brd	
L78388-10	FID 31-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC	0.01	0.01	B	%	0.01	0.1	10/12/2009	bsu/brd	
L78388-11	FID 32-25 0-6"	PR553454	Metals Analysis	6/18/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	2120	2120		mg/Kg	5	30	10/13/2009	ear	7440-50-8
L78388-11	FID 32-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3			U	t CaCO3/K	1	5	10/21/2009	calc	
L78388-11	FID 32-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	7	7		t CaCO3/K	1	5	10/21/2009	calc	
L78388-11	FID 32-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	7	7		t CaCO3/K	1	5	10/21/2009	calc	
L78388-11	FID 32-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3	0.7	0.7		%	0.1	0.5	10/14/2009	itk	
L78388-11	FID 32-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	5.7	5.7		units	0.1	0.1	10/10/2009	itk	
L78388-11	FID 32-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Solids, Percent	SO	CLPSOW390, PART F, D	98.5	98.5		%	0.1	0.5	10/15/2009	brd	
L78388-11	FID 32-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC	0.02	0.02	B	%	0.01	0.1	10/12/2009	bsu/brd	
L78388-12	FID 33-25 0-6"	PR553454	Metals Analysis	6/19/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	308	308		mg/Kg	1	5	10/12/2009	aeh	7440-50-8
L78388-12	FID 33-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	6	6		t CaCO3/K	1	5	10/21/2009	calc	
L78388-12	FID 33-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	52	52		t CaCO3/K	1	5	10/21/2009	calc	
L78388-12	FID 33-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	46	46		t CaCO3/K	1	5	10/21/2009	calc	
L78388-12	FID 33-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3	5.2	5.2		%	0.1	0.5	10/13/2009	itk	
L78388-12	FID 33-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	7.5	7.5		units	0.1	0.1	10/10/2009	itk	
L78388-12	FID 33-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Solids, Percent	SO	CLPSOW390, PART F, D	96	96.0		%	0.1	0.5	10/15/2009	brd	
L78388-12	FID 33-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC	0.19	0.19		%	0.01	0.1	10/12/2009	bsu/brd	
L78388-13	FID 34-25 0-6"	PR553454	Metals Analysis	6/18/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	209	209		mg/Kg	1	5	10/12/2009	aeh	7440-50-8
L78388-13	FID 34-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3			U	t CaCO3/K	1	5	10/21/2009	calc	
L78388-13	FID 34-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	24	24		t CaCO3/K	1	5	10/21/2009	calc	
L78388-13	FID 34-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	24	24		t CaCO3/K	1	5	10/21/2009	calc	
L78388-13	FID 34-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3	2.4	2.4		%	0.1	0.5	10/14/2009	itk	
L78388-13	FID 34-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	7	7.0		units	0.1	0.1	10/10/2009	itk	
L78388-13	FID 34-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Solids, Percent	SO	CLPSOW390, PART F, D	95	95.0		%	0.1	0.5	10/15/2009	brd	
L78388-13	FID 34-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC			U	%	0.01	0.1	10/12/2009	bsu/brd	
L78388-14	FID 35-25 0-6"	PR553454	Metals Analysis	6/22/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	210	210		mg/Kg	1	5	10/12/2009	aeh	7440-50-8
L78388-14	FID 35-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	1	1	B	t CaCO3/K	1	5	10/21/2009	calc	
L78388-14	FID 35-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	97	97		t CaCO3/K	1	5	10/21/2009	calc	
L78388-14	FID 35-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	96	96		t CaCO3/K	1	5	10/21/2009	calc	
L78388-14	FID 35-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3	9.7	9.7		%	0.1	0.5	10/14/2009	itk	
L78388-14	FID 35-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	7.8	7.8		units	0.1	0.1	10/10/2009	itk	
L78388-14	FID 35-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Solids, Percent	SO	CLPSOW390, PART F, D	97.7	97.7		%	0.1	0.5	10/15/2009	brd	
L78388-14	FID 35-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC	0.04	0.04	B	%	0.01	0.1	10/12/2009	bsu/brd	
L78388-15	FID 39-25 0-6"	PR553454	Metals Analysis	6/19/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	414	414		mg/Kg	1	5	10/12/2009	aeh	7440-50-8
L78388-15	FID 39-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3			U	t CaCO3/K	1	5	10/21/2009	calc	
L78388-15	FID 39-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	14	14		t CaCO3/K	1	5	10/21/2009	calc	
L78388-15	FID 39-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	14	14		t CaCO3/K	1	5	10/21/2009	calc	
L78388-15	FID 39-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3	1.4	1.4		%	0.1	0.5	10/14/2009	itk	
L78388-15	FID 39-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	5.5	5.5		units	0.1	0.1	10/10/2009	itk	
L78388-15	FID 39-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Solids, Percent	SO	CLPSOW390, PART F, D	95.2	95.2		%	0.1	0.5	10/15/2009	brd	
L78388-15	FID 39-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC			U	%	0.01	0.1	10/12/2009	bsu/brd	

L76592-01

LABID	CLIENTID	PROJECTID	DEPTNAME	COLLECTDATE	RECEIVEDATE	ANALYTE	MATRIX	METHOD	RESULT	TEXTRESULT	QUAL	UNITS	MDL	PQL	ANALYZEDATE	ANALYST	CAS
L76592-01	FID 0-25 0-1"	PR553454	Metals Analysis	6/18/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	538	538		mg/Kg	1	5	10/21/2009	ear	7440-50-8
L76592-01	FID 0-25 0-1"	PR553454	Soil Analysis	6/18/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	1.2	1.2		%	0.1	0.5	10/19/2009	jjg	
L76592-01	FID 0-25 0-1"	PR553454	Soil Analysis	6/18/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	98.8	98.8		%	0.1	0.5	10/19/2009	jjg	
L76592-03	FID 1-25 0-1"	PR553454	Metals Analysis	6/22/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	175	175		mg/Kg	1	5	10/21/2009	ear	7440-50-8
L76592-03	FID 1-25 0-1"	PR553454	Soil Analysis	6/22/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	1.8	1.8		%	0.1	0.5	10/19/2009	jjg	
L76592-03	FID 1-25 0-1"	PR553454	Soil Analysis	6/22/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	98.2	98.2		%	0.1	0.5	10/19/2009	jjg	
L76592-05	FID 2-25 0-1"	PR553454	Metals Analysis	6/22/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	453	453		mg/Kg	1	5	10/21/2009	ear	7440-50-8
L76592-05	FID 2-25 0-1"	PR553454	Soil Analysis	6/22/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	2.3	2.3		%	0.1	0.5	10/19/2009	jjg	
L76592-05	FID 2-25 0-1"	PR553454	Soil Analysis	6/22/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	97.7	97.7		%	0.1	0.5	10/19/2009	jjg	
L76592-07	FID 3-25 0-1"	PR553454	Metals Analysis	6/18/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	377	377		mg/Kg	1	5	10/21/2009	ear	7440-50-8
L76592-07	FID 3-25 0-1"	PR553454	Soil Analysis	6/18/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	1	1.0		%	0.1	0.5	10/20/2009	jjg	
L76592-07	FID 3-25 0-1"	PR553454	Soil Analysis	6/18/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	99	99.0		%	0.1	0.5	10/20/2009	jjg	
L76592-09	FID 4-25 0-1"	PR553454	Metals Analysis	6/18/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	676	676		mg/Kg	1	5	10/22/2009	ear	7440-50-8
L76592-09	FID 4-25 0-1"	PR553454	Soil Analysis	6/18/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	4.7	4.7		%	0.1	0.5	10/20/2009	jjg	
L76592-09	FID 4-25 0-1"	PR553454	Soil Analysis	6/18/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	95.3	95.3		%	0.1	0.5	10/20/2009	jjg	
L76592-11	FID 6-25 0-1"	PR553454	Metals Analysis	6/18/2009	6/24/2009	Arsenic, total (3050)	SO	M6020 ICP-MS	6.4	6.4		mg/Kg	0.3	1	10/21/2009	scp	7440-38-2
L76592-11	FID 6-25 0-1"	PR553454	Metals Analysis	6/18/2009	6/24/2009	Cadmium, total (3050)	SO	M6020 ICP-MS	1.2	1.20		mg/Kg	0.05	0.3	10/21/2009	scp	7440-43-9
L76592-11	FID 6-25 0-1"	PR553454	Metals Analysis	6/18/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	650	650		mg/Kg	10	50	10/22/2009	ear	7440-50-8
L76592-11	FID 6-25 0-1"	PR553454	Metals Analysis	6/18/2009	6/24/2009	Iron, total (3050)	SO	M6010B ICP	96100	96100		mg/Kg	20	50	10/22/2009	ear	7439-89-6
L76592-11	FID 6-25 0-1"	PR553454	Soil Analysis	6/18/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	1.8	1.8		%	0.1	0.5	10/20/2009	jjg	
L76592-11	FID 6-25 0-1"	PR553454	Soil Analysis	6/18/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	98.2	98.2		%	0.1	0.5	10/20/2009	jjg	
L76592-13	FID 7-25 0-1"	PR553454	Metals Analysis	6/19/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	192	192		mg/Kg	1	5	10/22/2009	ear	7440-50-8
L76592-13	FID 7-25 0-1"	PR553454	Soil Analysis	6/19/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	4.7	4.7		%	0.1	0.5	10/20/2009	jjg	
L76592-13	FID 7-25 0-1"	PR553454	Soil Analysis	6/19/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	95.3	95.3		%	0.1	0.5	10/20/2009	jjg	

L76593-01

LABID	CLIENTID	PROJECTID	DEPTNAME	COLLECTDATE	RECEIVEDATE	ANALYTE	MATRIX	METHOD	RESULT	TEXTRESULT	QUAL	UNITS	MDL	PQL	ANALYZEDATE	ANALYST	CAS
L76593-01	FID 10-25 0-1"	PR553454	Metals Analysis	6/19/2009	6/24/2009	Arsenic, total (3050)	SO	M6020 ICP-MS	3.6	3.6		mg/Kg	0.3	1	10/26/2009	erf	7440-38-2
L76593-01	FID 10-25 0-1"	PR553454	Metals Analysis	6/19/2009	6/24/2009	Cadmium, total (3050)	SO	M6020 ICP-MS	2.07	2.07		mg/Kg	0.05	0.3	10/26/2009	erf	7440-43-9
L76593-01	FID 10-25 0-1"	PR553454	Metals Analysis	6/19/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	1050	1050		mg/Kg	1	5	10/22/2009	ear	7440-50-8
L76593-01	FID 10-25 0-1"	PR553454	Metals Analysis	6/19/2009	6/24/2009	Iron, total (3050)	SO	M6010B ICP	15300	15300		mg/Kg	2	5	10/22/2009	ear	7439-89-6
L76593-01	FID 10-25 0-1"	PR553454	Soil Analysis	6/19/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	4.7	4.7		%	0.1	0.5	7/5/2009	bjl	
L76593-01	FID 10-25 0-1"	PR553454	Soil Analysis	6/19/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	95.3	95.3		%	0.1	0.5	7/5/2009	bjl	
L76593-03	FID 12-25 0-1"	PR553454	Metals Analysis	6/18/2009	6/24/2009	Arsenic, total (3050)	SO	M6020 ICP-MS	6	6.0		mg/Kg	0.3	1	10/27/2009	erf	7440-38-2
L76593-03	FID 12-25 0-1"	PR553454	Metals Analysis	6/18/2009	6/24/2009	Cadmium, total (3050)	SO	M6020 ICP-MS	6.13	6.13		mg/Kg	0.05	0.3	10/27/2009	erf	7440-43-9
L76593-03	FID 12-25 0-1"	PR553454	Metals Analysis	6/18/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	5580	5580		mg/Kg	1	5	10/22/2009	ear	7440-50-8
L76593-03	FID 12-25 0-1"	PR553454	Metals Analysis	6/18/2009	6/24/2009	Iron, total (3050)	SO	M6010B ICP	42500	42500		mg/Kg	2	5	10/22/2009	ear	7439-89-6
L76593-03	FID 12-25 0-1"	PR553454	Soil Analysis	6/18/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	1.1	1.1		%	0.1	0.5	7/5/2009	bjl	
L76593-03	FID 12-25 0-1"	PR553454	Soil Analysis	6/18/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	98.9	98.9		%	0.1	0.5	7/5/2009	bjl	
L76593-05	FID 13-25 0-1"	PR553454	Metals Analysis	6/18/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	1280	1280		mg/Kg	1	5	10/22/2009	ear	7440-50-8
L76593-05	FID 13-25 0-1"	PR553454	Soil Analysis	6/18/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	2.4	2.4		%	0.1	0.5	7/6/2009	bjl	
L76593-05	FID 13-25 0-1"	PR553454	Soil Analysis	6/18/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	97.6	97.6		%	0.1	0.5	7/6/2009	bjl	
L76593-07	FID 15-25 0-1"	PR553454	Metals Analysis	6/22/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	1530	1530		mg/Kg	1	5	10/22/2009	ear	7440-50-8
L76593-07	FID 15-25 0-1"	PR553454	Soil Analysis	6/22/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	1	1.0		%	0.1	0.5	7/6/2009	bjl	
L76593-07	FID 15-25 0-1"	PR553454	Soil Analysis	6/22/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	99	99.0		%	0.1	0.5	7/6/2009	bjl	
L76593-09	FID 16-25 0-1"	PR553454	Metals Analysis	6/22/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	362	362		mg/Kg	1	5	10/22/2009	ear	7440-50-8
L76593-09	FID 16-25 0-1"	PR553454	Soil Analysis	6/22/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	0.6	0.6		%	0.1	0.5	7/2/2009	bjl	
L76593-09	FID 16-25 0-1"	PR553454	Soil Analysis	6/22/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	99.4	99.4		%	0.1	0.5	7/2/2009	bjl	
L76593-11	FID 17-25 0-1"	B0063538.000	Metals Analysis	6/18/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	9150	9150		mg/Kg	1	5	10/22/2009	ear	7440-50-8
L76593-11	FID 17-25 0-1"	B0063538.000	Soil Analysis	6/18/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	2.7	2.7		%	0.1	0.5	7/3/2009	bjl	
L76593-11	FID 17-25 0-1"	B0063538.000	Soil Analysis	6/18/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	97.3	97.3		%	0.1	0.5	7/3/2009	bjl	
L76593-13	FID 18-25 0-1"	B0063538.000	Metals Analysis	6/22/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	215	215		mg/Kg	1	5	10/22/2009	ear	7440-50-8
L76593-13	FID 18-25 0-1"	B0063538.000	Soil Analysis	6/22/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	0.5	0.5		%	0.1	0.5	7/3/2009	bjl	
L76593-13	FID 18-25 0-1"	B0063538.000	Soil Analysis	6/22/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	99.5	99.5		%	0.1	0.5	7/3/2009	bjl	

L76594-01

LABID	CLIENTID	PROJECTID	DEPTNAME	COLLECTDATE	RECEIVEDATE	ANALYTE	MATRIX	METHOD	RESULT	TEXTRESULT	QUAL	UNITS	MDL	PQL	ANALYZEDATE
L76594-01	FID 20-25 0-1"	B0063538.000	Metals Analysis	6/19/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	755	755		mg/Kg	1	5	10/22/2009
L76594-01	FID 20-25 0-1"	B0063538.000	Soil Analysis	6/19/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	3.4	3.4		%	0.1	0.5	7/4/2009
L76594-01	FID 20-25 0-1"	B0063538.000	Soil Analysis	6/19/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	96.6	96.6		%	0.1	0.5	7/4/2009
L76594-03	FID 21-25 0-1"	B0063538.000	Metals Analysis	6/19/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	153	153		mg/Kg	1	5	10/22/2009
L76594-03	FID 21-25 0-1"	B0063538.000	Soil Analysis	6/19/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	0.6	0.6		%	0.1	0.5	7/4/2009
L76594-03	FID 21-25 0-1"	B0063538.000	Soil Analysis	6/19/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	99.4	99.4		%	0.1	0.5	7/4/2009
L76594-05	FID 22-25 0-1"	B0063538.000	Metals Analysis	6/19/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	347	347		mg/Kg	1	5	10/22/2009
L76594-05	FID 22-25 0-1"	B0063538.000	Soil Analysis	6/19/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	1.2	1.2		%	0.1	0.5	7/4/2009
L76594-05	FID 22-25 0-1"	B0063538.000	Soil Analysis	6/19/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	98.8	98.8		%	0.1	0.5	7/4/2009
L76594-07	FID 24-25 0-1"	B0063538.000	Metals Analysis	6/19/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	222	222		mg/Kg	1	5	10/22/2009
L76594-07	FID 24-25 0-1"	B0063538.000	Soil Analysis	6/19/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	4.2	4.2		%	0.1	0.5	7/5/2009
L76594-07	FID 24-25 0-1"	B0063538.000	Soil Analysis	6/19/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	95.8	95.8		%	0.1	0.5	7/5/2009
L76594-09	FID 25-25 0-1"	B0063538.000	Metals Analysis	6/19/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	89	89		mg/Kg	1	5	10/22/2009
L76594-09	FID 25-25 0-1"	B0063538.000	Soil Analysis	6/19/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	1.5	1.5		%	0.1	0.5	7/5/2009
L76594-09	FID 25-25 0-1"	B0063538.000	Soil Analysis	6/19/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	98.5	98.5		%	0.1	0.5	7/5/2009
L76594-11	FID 26-25 0-1"	B0063538.000	Metals Analysis	6/19/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	134	134		mg/Kg	1	5	10/22/2009
L76594-11	FID 26-25 0-1"	B0063538.000	Soil Analysis	6/19/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	1.3	1.3		%	0.1	0.5	7/6/2009
L76594-11	FID 26-25 0-1"	B0063538.000	Soil Analysis	6/19/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	98.7	98.7		%	0.1	0.5	7/6/2009
L76594-13	FID 27-25 0-1"	B0063538.000	Metals Analysis	6/18/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	322	322		mg/Kg	1	5	10/22/2009
L76594-13	FID 27-25 0-1"	B0063538.000	Soil Analysis	6/18/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	3.7	3.7		%	0.1	0.5	7/6/2009
L76594-13	FID 27-25 0-1"	B0063538.000	Soil Analysis	6/18/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	96.3	96.3		%	0.1	0.5	7/6/2009
L76594-15	FID 28-25 0-1"	B0063538.000	Metals Analysis	6/22/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	426	426		mg/Kg	1	5	10/22/2009
L76594-15	FID 28-25 0-1"	B0063538.000	Soil Analysis	6/22/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	2.1	2.1		%	0.1	0.5	10/20/2009
L76594-15	FID 28-25 0-1"	B0063538.000	Soil Analysis	6/22/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	97.9	97.9		%	0.1	0.5	10/20/2009

L76595-01

LABID	CLIENTID	PROJECTID	DEPTNAME	COLLECTDATE	RECEIVEDATE	ANALYTE	MATRIX	METHOD	RESULT	TEXTRESULT	QUAL	UNITS	MDL	PQL	ANALYZEDATE	ANALYST	CAS
L76595-01	FID 30-25 0-1"	B0063538.000	Metals Analysis	6/18/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	291	291		mg/Kg	1	5	10/22/2009	ear	7440-50-8
L76595-01	FID 30-25 0-1"	B0063538.000	Soil Analysis	6/18/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	2	2.0		%	0.1	0.5	6/30/2009	itk/brd	
L76595-01	FID 30-25 0-1"	B0063538.000	Soil Analysis	6/18/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	98	98.0		%	0.1	0.5	6/30/2009	itk/brd	
L76595-03	FID 31-25 0-1"	B0063538.000	Metals Analysis	6/19/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	294	294		mg/Kg	1	5	10/22/2009	ear	7440-50-8
L76595-03	FID 31-25 0-1"	B0063538.000	Soil Analysis	6/19/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	1.5	1.5		%	0.1	0.5	6/30/2009	itk/brd	
L76595-03	FID 31-25 0-1"	B0063538.000	Soil Analysis	6/19/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	98.5	98.5		%	0.1	0.5	6/30/2009	itk/brd	
L76595-05	FID 32-25 0-1"	B0063538.000	Metals Analysis	6/18/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	2250	2250		mg/Kg	1	5	10/22/2009	ear	7440-50-8
L76595-05	FID 32-25 0-1"	B0063538.000	Soil Analysis	6/18/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	1.6	1.6		%	0.1	0.5	6/30/2009	itk/brd	
L76595-05	FID 32-25 0-1"	B0063538.000	Soil Analysis	6/18/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	98.4	98.4		%	0.1	0.5	6/30/2009	itk/brd	
L76595-07	FID 33-25 0-1"	B0063538.000	Metals Analysis	6/19/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	785	785		mg/Kg	1	5	10/22/2009	ear	7440-50-8
L76595-07	FID 33-25 0-1"	B0063538.000	Soil Analysis	6/19/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	1.9	1.9		%	0.1	0.5	7/1/2009	itk/brd	
L76595-07	FID 33-25 0-1"	B0063538.000	Soil Analysis	6/19/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	98.2	98.2		%	0.1	0.5	7/1/2009	itk/brd	
L76595-09	FID 34-25 0-1"	B0063538.000	Metals Analysis	6/18/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	682	682		mg/Kg	1	5	10/22/2009	ear	7440-50-8
L76595-09	FID 34-25 0-1"	B0063538.000	Soil Analysis	6/18/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	1.4	1.4		%	0.1	0.5	7/1/2009	itk/brd	
L76595-09	FID 34-25 0-1"	B0063538.000	Soil Analysis	6/18/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	98.6	98.6		%	0.1	0.5	7/1/2009	itk/brd	
L76595-11	FID 35-25 0-1"	B0063538.000	Metals Analysis	6/22/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	219	219		mg/Kg	1	5	10/23/2009	ear	7440-50-8
L76595-11	FID 35-25 0-1"	B0063538.000	Soil Analysis	6/22/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	1.6	1.6		%	0.1	0.5	7/1/2009	itk/brd	
L76595-11	FID 35-25 0-1"	B0063538.000	Soil Analysis	6/22/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	98.4	98.4		%	0.1	0.5	7/1/2009	itk/brd	
L76595-13	FID 37-25 0-1"	B0063538.000	Metals Analysis	6/22/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	533	533		mg/Kg	1	5	10/23/2009	ear	7440-50-8
L76595-13	FID 37-25 0-1"	B0063538.000	Soil Analysis	6/22/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	1.3	1.3		%	0.1	0.5	7/1/2009	itk/brd	
L76595-13	FID 37-25 0-1"	B0063538.000	Soil Analysis	6/22/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	98.7	98.7		%	0.1	0.5	7/1/2009	itk/brd	
L76595-14	FID 39-25 0-1"	B0063538.000	Metals Analysis	6/19/2009	6/24/2009	Copper, total (3050)	SO	M6010B ICP	590	590		mg/Kg	1	5	10/23/2009	ear	7440-50-8
L76595-14	FID 39-25 0-1"	B0063538.000	Soil Analysis	6/19/2009	6/24/2009	Moisture Content	SO	M209F, Gravimetric -	3.9	3.9		%	0.1	0.5	7/1/2009	itk/brd	
L76595-14	FID 39-25 0-1"	B0063538.000	Soil Analysis	6/19/2009	6/24/2009	Solids, Percent	SO	CLPSOW390, PART F, D	96.1	96.1		%	0.1	0.5	7/1/2009	itk/brd	

L78892-01

LABID	CLIENTID	PROJECTID	DEPTNAME	COLLECTDATE	RECEIVEDATE	ANALYTE	MATRIX	METHOD	RESULT	TEXTRESULT	QUAL	UNITS	MDL	PQL	ANALYZEDATE	ANALYST	CAS
L78892-01	FID 08-25 0-1"		Metals Analysis	10/7/2009	10/19/2009	Copper, total (3050)	SO	M6010B ICP	328	328		mg/Kg	1	5	40128.77111	aeh	7440-50-8
L78892-01	FID 08-25 0-1"		Soil Analysis	10/7/2009	10/19/2009	Moisture Content	SO	M209F, Gravimetric -	6.9	6.9		%	0.1	0.5	40125.79167	itk	
L78892-01	FID 08-25 0-1"		Soil Analysis	10/7/2009	10/19/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	4.4	4.4		units	0.1	0.1	40126.91667	itk	
L78892-02	FID 08-25 0-6"		Metals Analysis	10/7/2009	10/19/2009	Copper, total (3050)	SO	M6010B ICP	430	430		mg/Kg	1	5	40128.77795	aeh	7440-50-8
L78892-02	FID 08-25 0-6"		Soil Analysis	10/7/2009	10/19/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	4	4	B	t CaCO3/K	1	5	40129.72029	calc	
L78892-02	FID 08-25 0-6"		Soil Analysis	10/7/2009	10/19/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	23	23		t CaCO3/K	1	5	40129.72029	calc	
L78892-02	FID 08-25 0-6"		Soil Analysis	10/7/2009	10/19/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	19	19		t CaCO3/K	1	5	40129.72029	calc	
L78892-02	FID 08-25 0-6"		Soil Analysis	10/7/2009	10/19/2009	Moisture Content	SO	M209F, Gravimetric -	12.7	12.7		%	0.1	0.5	40125.875	itk	
L78892-02	FID 08-25 0-6"		Soil Analysis	10/7/2009	10/19/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3	2.3	2.3		%	0.1	0.5	40126.62917	itk	
L78892-02	FID 08-25 0-6"		Soil Analysis	10/7/2009	10/19/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	6.1	6.1		units	0.1	0.1	40127.08333	itk	
L78892-02	FID 08-25 0-6"		Soil Analysis	10/7/2009	10/19/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC	0.14	0.14		%	0.01	0.1	40126.69444	bsu	
L78892-03	FID 23-25 0-1"		Metals Analysis	10/7/2009	10/19/2009	Copper, total (3050)	SO	M6010B ICP	168	168		mg/Kg	1	5	40128.7848	aeh	7440-50-8
L78892-03	FID 23-25 0-1"		Soil Analysis	10/7/2009	10/19/2009	Moisture Content	SO	M209F, Gravimetric -	8.1	8.1		%	0.1	0.5	40125.91667	itk	
L78892-03	FID 23-25 0-1"		Soil Analysis	10/7/2009	10/19/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	3.8	3.8		units	0.1	0.1	40127.16667	itk	
L78892-04	FID 23-25 0-6"		Metals Analysis	10/7/2009	10/19/2009	Copper, total (3050)	SO	M6010B ICP	252	252		mg/Kg	1	5	40128.78709	aeh	7440-50-8
L78892-04	FID 23-25 0-6"		Soil Analysis	10/7/2009	10/19/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	5	5		t CaCO3/K	1	5	40129.72042	calc	
L78892-04	FID 23-25 0-6"		Soil Analysis	10/7/2009	10/19/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	0	0		t CaCO3/K	1	5	40129.72042	calc	
L78892-04	FID 23-25 0-6"		Soil Analysis	10/7/2009	10/19/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	-5	-5		t CaCO3/K	1	5	40129.72042	calc	
L78892-04	FID 23-25 0-6"		Soil Analysis	10/7/2009	10/19/2009	Moisture Content	SO	M209F, Gravimetric -	5.5	5.5		%	0.1	0.5	40125.95833	itk	
L78892-04	FID 23-25 0-6"		Soil Analysis	10/7/2009	10/19/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3			U	%	0.1	0.5	40126.70417	itk	
L78892-04	FID 23-25 0-6"		Soil Analysis	10/7/2009	10/19/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	3.7	3.7		units	0.1	0.1	40127.25	itk	
L78892-04	FID 23-25 0-6"		Soil Analysis	10/7/2009	10/19/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC	0.16	0.16		%	0.01	0.1	40126.70833	bsu	
L78892-05	FID 43-25 0-1"		Metals Analysis	10/7/2009	10/19/2009	Copper, total (3050)	SO	M6010B ICP	229	229		mg/Kg	1	5	40128.79167	aeh	7440-50-8
L78892-05	FID 43-25 0-1"		Soil Analysis	10/7/2009	10/19/2009	Moisture Content	SO	M209F, Gravimetric -	1.8	1.8		%	0.1	0.5	40126	itk	
L78892-05	FID 43-25 0-1"		Soil Analysis	10/7/2009	10/19/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	3.7	3.7		units	0.1	0.1	40127.33333	itk	
L78892-06	FID 43-25 0-6"		Metals Analysis	10/7/2009	10/19/2009	Copper, total (3050)	SO	M6010B ICP	466	466		mg/Kg	1	5	40128.79395	aeh	7440-50-8
L78892-06	FID 43-25 0-6"		Soil Analysis	10/7/2009	10/19/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	29	29		t CaCO3/K	1	5	40129.72054	calc	
L78892-06	FID 43-25 0-6"		Soil Analysis	10/7/2009	10/19/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	0	0		t CaCO3/K	1	5	40129.72054	calc	
L78892-06	FID 43-25 0-6"		Soil Analysis	10/7/2009	10/19/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	-29	-29		t CaCO3/K	1	5	40129.72054	calc	
L78892-06	FID 43-25 0-6"		Soil Analysis	10/7/2009	10/19/2009	Moisture Content	SO	M209F, Gravimetric -	5.9	5.9		%	0.1	0.5	40126.04167	itk	
L78892-06	FID 43-25 0-6"		Soil Analysis	10/7/2009	10/19/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3			U	%	0.1	0.5	40126.85417	itk	
L78892-06	FID 43-25 0-6"		Soil Analysis	10/7/2009	10/19/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	4.2	4.2		units	0.1	0.1	40127.41667	itk	
L78892-06	FID 43-25 0-6"		Soil Analysis	10/7/2009	10/19/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC	0.93	0.93		%	0.01	0.1	40126.73611	bsu	

L78387

LABID	CLIENTID	PROJECTID	DEPTNAME	COLLECTDATE	RECEIVEDATE	ANALYTE	MATRIX	METHOD	RESULT	TEXTRESULT	QUAL	UNITS	MDL	PQL	ANALYZEDATE	ANALYST	CAS
L78387-09	FID 12-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	3	3		t CaCO3/Kt	1	5	40105.53543	calc	
L78387-09	FID 12-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3	3.5	3.5		%	0.1	0.5	40100.5	itk	
L78387-09	FID 12-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	7.5	7.5		units	0.1	0.1	40096.18156	itk	
L78387-09	FID 12-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Solids, Percent	SO	CLPSOW390, PART F, D	98.4	98.4		%	0.1	0.5	40101	jjg	
L78387-09	FID 12-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC	1.02	1.02		%	0.01	0.1	40093.60245	brd/bsu	
L78387-10	FID 13-25 0-6"	PR553454	Metals Analysis	6/18/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	1970	1970		mg/Kg	1	5	40098.5078	ear	7440-50-8
L78387-10	FID 13-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	11	11		t CaCO3/Kt	1	5	40105.53545	calc	
L78387-10	FID 13-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	25	25		t CaCO3/Kt	1	5	40105.53545	calc	
L78387-10	FID 13-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	14	14		t CaCO3/Kt	1	5	40105.53545	calc	
L78387-10	FID 13-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3	2.5	2.5		%	0.1	0.5	40099.60231	itk	
L78387-10	FID 13-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	7.4	7.4		units	0.1	0.1	40096.26192	itk	
L78387-10	FID 13-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Solids, Percent	SO	CLPSOW390, PART F, D	97.6	97.6		%	0.1	0.5	40101.14167	jjg	
L78387-10	FID 13-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC	0.34	0.34		%	0.01	0.1	40093.60903	brd/bsu	
L78387-11	FID 15-25 0-6"	PR553454	Metals Analysis	6/22/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	1360	1360		mg/Kg	1	5	40098.51008	ear	7440-50-8
L78387-11	FID 15-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	17	17		t CaCO3/Kt	1	5	40105.53547	calc	
L78387-11	FID 15-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	22	22		t CaCO3/Kt	1	5	40105.53547	calc	
L78387-11	FID 15-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	5	5		t CaCO3/Kt	1	5	40105.53547	calc	
L78387-11	FID 15-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3	2.2	2.2		%	0.1	0.5	40099.62505	itk	
L78387-11	FID 15-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	8	8.0		units	0.1	0.1	40096.34228	itk	
L78387-11	FID 15-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Solids, Percent	SO	CLPSOW390, PART F, D	98.7	98.7		%	0.1	0.5	40101.28333	jjg	
L78387-11	FID 15-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC	0.55	0.55		%	0.01	0.1	40093.6156	brd/bsu	
L78387-12	FID 16-25 0-6"	PR553454	Metals Analysis	6/22/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	512	512		mg/Kg	1	5	40098.51693	ear	7440-50-8
L78387-12	FID 16-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3			U	t CaCO3/Kt	1	5	40105.53549	calc	
L78387-12	FID 16-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	0	0		t CaCO3/Kt	1	5	40105.53549	calc	
L78387-12	FID 16-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3				t CaCO3/Kt	1	5	40105.53549	calc	
L78387-12	FID 16-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3			U	%	0.1	0.5	40099.64778	itk	
L78387-12	FID 16-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	4.3	4.3		units	0.1	0.1	40096.42264	itk	
L78387-12	FID 16-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Solids, Percent	SO	CLPSOW390, PART F, D	98.9	98.9		%	0.1	0.5	40101.425	jjg	
L78387-12	FID 16-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC			U	%	0.01	0.1	40093.62218	brd/bsu	
L78387-13	FID 17-25 0-6"	PR553454	Metals Analysis	6/18/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	4680	4680		mg/Kg	1	5	40098.51921	ear	7440-50-8
L78387-13	FID 17-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	20	20		t CaCO3/Kt	1	5	40105.5355	calc	
L78387-13	FID 17-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	26	26		t CaCO3/Kt	1	5	40105.5355	calc	
L78387-13	FID 17-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	6	6		t CaCO3/Kt	1	5	40105.5355	calc	
L78387-13	FID 17-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3	2.6	2.6		%	0.1	0.5	40100.53472	itk	
L78387-13	FID 17-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	6.6	6.6		units	0.1	0.1	40096.503	itk	
L78387-13	FID 17-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Solids, Percent	SO	CLPSOW390, PART F, D	98	98.0		%	0.1	0.5	40101.56667	jjg	
L78387-13	FID 17-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC	0.64	0.64		%	0.01	0.1	40093.62875	brd/bsu	
L78387-14	FID 18-25 0-6"	PR553454	Metals Analysis	6/22/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	326	326		mg/Kg	1	5	40098.52149	ear	7440-50-8
L78387-14	FID 18-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	1	1	B	t CaCO3/Kt	1	5	40105.53552	calc	
L78387-14	FID 18-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	0	0		t CaCO3/Kt	1	5	40105.53552	calc	
L78387-01	FID 0-25 0-6"	PR553454	Metals Analysis	6/18/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	329	329		mg/Kg	1	5	40098.47586	ear	7440-50-8
L78387-01	FID 0-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3			U	t CaCO3/Kt	1	5	40105.53529	calc	
L78387-01	FID 0-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	11	11		t CaCO3/Kt	1	5	40105.53529	calc	
L78387-01	FID 0-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	11	11		t CaCO3/Kt	1	5	40105.53529	calc	
L78387-01	FID 0-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3	1.1	1.1		%	0.1	0.5	40099.42046	itk	
L78387-01	FID 0-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	6.6	6.6		units	0.1	0.1	40095.45833	itk	
L78387-01	FID 0-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Solids, Percent	SO	CLPSOW390, PART F, D	97.6	97.6		%	0.1	0.5	40099.725	jjg	
L78387-01	FID 0-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC	0.03	0.03	B	%	0.01	0.1	40093.54329	brd/bsu	
L78387-02	FID 1-25 0-6"	PR553454	Metals Analysis	6/22/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	143	143		mg/Kg	1	5	40098.48955	ear	7440-50-8
L78387-02	FID 1-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3			U	t CaCO3/Kt	1	5	40105.53531	calc	
L78387-02	FID 1-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	62	62		t CaCO3/Kt	1	5	40105.53531	calc	
L78387-02	FID 1-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	62	62		t CaCO3/Kt	1	5	40105.53531	calc	
L78387-02	FID 1-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3	6.2	6.2		%	0.1	0.5	40099.46593	itk	
L78387-02	FID 1-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	6.2	6.2		units	0.1	0.1	40095.53869	itk	
L78387-02	FID 1-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Solids, Percent	SO	CLPSOW390, PART F, D	96.6	96.6		%	0.1	0.5	40100.00833	jjg	
L78387-02	FID 1-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC	0.02	0.02	B	%	0.01	0.1	40093.54986	brd/bsu	
L78387-03	FID 2-25 0-6"	PR553454	Metals Analysis	6/22/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	405	405		mg/Kg	1	5	40098.49183	ear	7440-50-8
L78387-03	FID 2-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3			U	t CaCO3/Kt	1	5	40105.53534	calc	
L78387-03	FID 2-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	57	57		t CaCO3/Kt	1	5	40105.53534	calc	
L78387-03	FID 2-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	57	57		t CaCO3/Kt	1	5	40105.53534	calc	
L78387-03	FID 2-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3	5.7	5.7		%	0.1	0.5	40099.48866	itk	
L78387-03	FID 2-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	5.6	5.6		units	0.1	0.1	40095.61905	itk	
L78387-03	FID 2-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Solids, Percent	SO	CLPSOW390, PART F, D	96.8	96.8		%	0.1	0.5	40100.15	jjg	
L78387-03	FID 2-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC	0.02	0.02	B	%	0.01	0.1	40093.55644	brd/bsu	
L78387-04	FID 3-25 0-6"	PR553454	Metals Analysis	6/18/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	236	236		mg/Kg	1	5	40098.4941	ear	7440-50-8
L78387-04	FID 3-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	5	5		t CaCO3/Kt	1	5	40105.53535	calc	
L78387-04	FID 3-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	164	164		t CaCO3/Kt	1	5	40105.53535	calc	
L78387-04	FID 3-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	159	159		t CaCO3/Kt	1	5	40105.53535	calc	
L78387-04	FID 3-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3	16.4	16.4		%	0.1	0.5	40100.46528	itk	
L78387-04	FID 3-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	7.6	7.6		units	0.1	0.1	40095.69941	itk	
L78387-04	FID 3-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Solids, Percent	SO	CLPSOW390, PART F, D	98.7	98.7		%	0.1	0.5	40100.29167	jjg	
L78387-04	FID 3-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC	0.17	0.17		%	0.01	0.1	40093.56301	brd/bsu	
L78387-05	FID 4-25 0-6"	PR553454	Metals Analysis	6/18/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	599	599		mg/Kg	1	5	40098.49638	ear	7440-50-8
L78387-05	FID 4-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3			U	t CaCO3/Kt	1	5	40105.53536	calc	
L78387-05	FID 4-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	12	12		t CaCO3/Kt	1	5	40105.53536	calc	
L78387-05	FID 4-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	12	12		t CaCO3/Kt	1	5	40105.53536	calc	
L78387-05	FID 4-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3	1.2	1.2		%	0.1	0.5	40099.51139	itk	
L78387-05	FID 4-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	6	6.0		units	0.1	0.1	40095.77977	itk	
L78387-05	FID 4-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Solids, Percent	SO	CLPSOW390, PART F, D	94.5	94.5		%	0.1	0.5	40100.43333	jjg	
L78387-05	FID 4-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC			U	%	0.01	0.1	40093.56958	brd/bsu	
L78387-06	FID 6-25 0-6"	PR553454	Metals Analysis	6/18/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	182	182		mg/Kg	1	5	40098.49866	ear	7440-50-8
L78387-06	FID 6-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3			U	t CaCO3/Kt	1	5	40105.53538	calc	
L78387-06	FID 6-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	7	7		t CaCO3/Kt	1	5	40105.53538	calc	
L78387-06	FID 6-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	7	7		t CaCO3/Kt	1	5	40105.53538	calc	
L78387-06	FID 6-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3	0.7	0.7		%	0.1	0.5	40099.53412	itk	
L78387-06	FID 6-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	6.4	6.4		units	0.1	0.1	40095.86013	itk	
L78387-06	FID 6-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Solids, Percent	SO	CLPSOW390, PART F, D	97.3	97.3		%	0.1	0.5	40100.575	jjg	
L78387-06	FID 6-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC	0.02	0.02	B	%	0.01	0.1	40093.57616	brd/bsu	
L78387-07	FID 7-25 0-6"	PR553454	Metals Analysis	6/19/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	242	242		mg/Kg	1	5	40098.50095	ear	7440-50-8
L78387-07	FID 7-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3			U	t CaCO3/Kt	1	5	40105.53539	calc	
L78387-07	FID 7-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	34	34		t CaCO3/Kt	1	5	40105.53539	calc	
L78387-07	FID 7-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	34	34		t CaCO3/Kt	1	5	40105.53539	calc	
L78387-07	FID 7-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3	3.4	3.4		%	0.1	0.5	40099.55685	itk	
L78387-07	FID 7-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	5.2	5.2		units	0.1	0.1	40096.02084	itk	
L78387-07	FID 7-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Solids, Percent	SO	CLPSOW390, PART F, D	95.8	95.8		%	0.1	0.5	40100.71667	jjg	
L78387-07	FID 7-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC	0.01	0.01	B	%	0.01	0.1	40093.58931	brd/bsu	
L78387-08	FID 10-25 0-6"	PR553454	Metals Analysis	6/19/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	1020	1020		mg/Kg	1	5	40098.50323	ear	7440-50-8
L78387-08	FID 10-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	2	2	B	t CaCO3/Kt	1	5	40105.53542	calc	
L78387-08	FID 10-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	11	11		t CaCO3/Kt	1	5	40105.53542	calc	
L78387-08	FID 10-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	9	9		t CaCO3/Kt	1	5	40105.53542	calc	
L78387-08	FID 10-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3	1.1	1.1		%	0.1	0.5	40099.57958	itk	
L78387-08	FID 10-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	6	6.0		units	0.1	0.1	40096.1012	itk	
L78387-08	FID 10-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Solids, Percent	SO	CLPSOW390, PART F, D	96.4	96.4		%	0.1	0.5	40100.85833	jjg	
L78387-08	FID 10-25 0-6"	PR553454	Soil Analysis	6/19/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC	0.05	0.05	B	%	0.01	0.1	40093.59588	brd/bsu	
L78387-09	FID 12-25 0-6"	PR553454	Metals Analysis	6/18/2009	9/25/2009	Copper, total (3050)	SO	M6010B ICP	4260	4260		mg/Kg	1	5	40098.50552	ear	7440-50-8
L78387-09	FID 12-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid Generation Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	32	32		t CaCO3/Kt	1	5	40105.53543	calc	
L78387-09	FID 12-25 0-6"	PR553454	Soil Analysis	6/18/2009	9/25/2009	Acid Neutralization Potential (calc)	SO	M600/2-78-054 1.3	35	35		t CaCO3/Kt	1	5	40105.53543	calc	
L78387-14	FID 18-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Acid-Base Potential (calc on Sulfur total)	SO	M600/2-78-054 1.3	-1	-1		t CaCO3/Kt	1	5	40105.53552	calc	
L78387-14	FID 18-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Neutralization Potential as CaCO3	SO	M600/2-78-054 3.2.3			U	%	0.1	0.5	40099.67051	itk	
L78387-14	FID 18-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	pH, Saturated Paste	SO	USDA No. 60 (21A)	4.3	4.3		units	0.1	0.1	40096.58336	itk	
L78387-14	FID 18-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Solids, Percent	SO	CLPSOW390, PART F, D	99.1	99.1		%	0.1	0.5	40101.70833	jjg	
L78387-14	FID 18-25 0-6"	PR553454	Soil Analysis	6/22/2009	9/25/2009	Sulfur, total	SO	ASTM D-4239-85C, LEC	0.04	0.04	B	%	0.01	0.1	40093.63532	brd/bsu	

ACZ Laboratories, Inc.
2773 Downhill Drive   Steamboat Springs, CO 80487   (800) 334-5493

Analytical Report

October 26, 2009

Report to:	Bill to:
Pam Pinson	Accounts Payable
Freeport-McMoRan - Chino Mines Company	Freeport-McMoRan - Chino Mines Company
210 Cortez Ave. Box 7	P.O. Box 13308
Hurley, NM 88043	Phoenix, AZ 85002-3308

cc: Rebecca Lindeman

Project ID: PR553454
ACZ Project ID: L76592

Pam Pinson:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on June 24, 2009. This project has been assigned to ACZ's project number, L76592. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan, version 12.0. The enclosed results relate only to the samples received under L76592. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all requirements of NELAC.

This report shall be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after November 26, 2009. If the samples are determined to be hazardous, additional charges apply for disposal (typically less than $10/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical reports for five years.

If you have any questions or other needs, please contact your Project Manager.

S. Habermehl

Scott Habermehl has reviewed
and approved this report.

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company
Project ID: PR553454
Sample ID: FID 0-25 0-1"

ACZ Sample ID: ***L76592-01***
Date Sampled: *06/18/09 10:25*
Date Received: *06/24/09*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	538		*	mg/Kg	1	5	10/21/09 21:05	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	1.2		*	%	0.1	0.5	10/19/09 14:30	jjg
Solids, Percent	CLPSOW390, PART F, D-98	98.8		*	%	0.1	0.5	10/19/09 14:30	jjg

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							06/30/09 8:50	itk/brd
Crush and Pulverize	USDA No. 1, 1972							10/15/09 12:00	bsu
Digestion - Hot Plate	M3050B ICP							10/19/09 18:36	itk

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID: PR553454
Sample ID: FID 1-25 0-1"

ACZ Sample ID: ***L76592-03***
Date Sampled: *06/22/09 09:38*
Date Received: *06/24/09*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	175		*	mg/Kg	1	5	10/21/09 21:14	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	1.8		*	%	0.1	0.5	10/19/09 19:16	jjg
Solids, Percent	CLPSOW390, PART F, D-98	98.2		*	%	0.1	0.5	10/19/09 19:16	jjg

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							06/30/09 8:58	itk/brd
Crush and Pulverize	USDA No. 1, 1972							10/15/09 12:08	bsu
Digestion - Hot Plate	M3050B ICP							10/19/09 21:27	itk

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L76592-05***
Project ID:	PR553454	Date Sampled:	*06/22/09 10:45*
Sample ID:	FID 2-25 0-1"	Date Received:	*06/24/09*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	453		*	mg/Kg	1	5	10/21/09 21:20	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	2.3		*	%	0.1	0.5	10/19/09 21:40	jjg
Solids, Percent	CLPSOW390, PART F, D-98	97.7		*	%	0.1	0.5	10/19/09 21:40	jjg

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							06/30/09 9:06	itk/brd
Crush and Pulverize	USDA No. 1, 1972							10/15/09 12:17	bsu
Digestion - Hot Plate	M3050B ICP							10/20/09 0:19	itk

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L76592-07***
Project ID:	PR553454	Date Sampled:	*06/18/09 14:45*
Sample ID:	FID 3-25 0-1"	Date Received:	*06/24/09*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	377		*	mg/Kg	1	5	10/21/09 21:23	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	1.0		*	%	0.1	0.5	10/20/09 0:03	jjg
Solids, Percent	CLPSOW390, PART F, D-98	99.0		*	%	0.1	0.5	10/20/09 0:03	jjg

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							06/30/09 9:14	itk/brd
Crush and Pulverize	USDA No. 1, 1972							10/15/09 12:25	bsu
Digestion - Hot Plate	M3050B ICP							10/20/09 1:16	itk

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID: PR553454
Sample ID: FID 4-25 0-1"

ACZ Sample ID: ***L76592-09***
Date Sampled: *06/18/09 17:07*
Date Received: *06/24/09*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	676		*	mg/Kg	1	5	10/22/09 12:05	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	4.7		*	%	0.1	0.5	10/20/09 2:26	jjg
Solids, Percent	CLPSOW390, PART F, D-98	95.3		*	%	0.1	0.5	10/20/09 2:26	jjg

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							06/30/09 9:23	itk/brd
Crush and Pulverize	USDA No. 1, 1972							10/15/09 12:34	bsu
Digestion - Hot Plate	M3050B ICP							10/20/09 2:13	itk

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID:	PR553454	ACZ Sample ID:	***L76592-11***
Sample ID:	FID 6-25 0-1"	Date Sampled:	*06/18/09 09:50*
		Date Received:	*06/24/09*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Arsenic, total (3050)	M6020 ICP-MS	6.4			mg/Kg	0.3	1	10/21/09 19:47	scp
Cadmium, total (3050)	M6020 ICP-MS	1.20			mg/Kg	0.05	0.3	10/21/09 19:47	scp
Copper, total (3050)	M6010B ICP	650		*	mg/Kg	10	50	10/22/09 12:08	ear
Iron, total (3050)	M6010B ICP	96100		*	mg/Kg	20	50	10/22/09 12:08	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	1.8		*	%	0.1	0.5	10/20/09 4:50	jjg
Solids, Percent	CLPSOW390, PART F, D-98	98.2		*	%	0.1	0.5	10/20/09 4:50	jjg

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							06/30/09 9:31	itk/brd
Crush and Pulverize	USDA No. 1, 1972							10/15/09 12:42	bsu
Digestion - Hot Plate	M3050B ICP							10/20/09 3:10	itk
Digestion - Hot Plate	M3050B ICP-MS							10/20/09 3:10	itk

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID: PR553454
Sample ID: FID 7-25 0-1"

ACZ Sample ID: ***L76592-13***
Date Sampled: *06/19/09 14:15*
Date Received: *06/24/09*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	192		*	mg/Kg	1	5	10/22/09 12:11	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	4.7		*	%	0.1	0.5	10/20/09 7:13	jjg
Solids, Percent	CLPSOW390, PART F, D-98	95.3		*	%	0.1	0.5	10/20/09 7:13	jjg

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							06/30/09 9:39	itk/brd
Crush and Pulverize	USDA No. 1, 1972							10/15/09 12:51	bsu
Digestion - Hot Plate	M3050B ICP							10/20/09 4:07	itk

** Please refer to Qualifier Reports for details.*

Report Header Explanations

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit, typically 5 times the MDL.
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Amount of the true value or spike added recovered, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of interest

QC Sample Types

AS	Analytical Spike (Post Digestion)	LCSWD	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	LFB	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	LFM	Laboratory Fortified Matrix
CCV	Continuing Calibration Verification standard	LFMD	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	LRB	Laboratory Reagent Blank
ICB	Initial Calibration Blank	MS	Matrix Spike
ICV	Initial Calibration Verification standard	MSD	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	PBS	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	PBW	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	PQV	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	SDL	Serial Dilution

QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

ACZ Qualifiers (Qual)

B	Analyte concentration detected at a value between MDL and PQL. The associated value is an estimated quantity.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Method References

(1)	EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
(2)	EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.
(3)	EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.
(5)	EPA SW-846. Test Methods for Evaluating Solid Waste, Third Edition with Update III, December 1996.
(6)	Standard Methods for the Examination of Water and Wastewater, 19th edition, 1995 & 20th edition (1998).

Comments

(1)	QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
(2)	Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.
(3)	Animal matrices for Inorganic analyses are reported on an "as received" basis.

For a complete list of ACZ's Extended Qualifiers, please click: http://www.acz.com/public/extquallist.pdf

Freeport-McMoRan - Chino Mines Company
Project ID: PR553454

ACZ Project ID: ***L76592***

Arsenic, total (3050) M6020 ICP-MS

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG272631													
WG272631ICV	ICV	10/21/09 18:22	MS091020-3	.05		.05096	mg/L	101.9	90	110			
WG272631ICB	ICB	10/21/09 18:28				U	mg/L		-0.0015	0.0015			
WG272468PBS	PBS	10/21/09 18:50				.33	mg/Kg		-0.9	0.9			
WG272468LCSS	LCSS	10/21/09 18:56	PCN33395	88.3		82.7	mg/Kg		69	108			
WG272468LCSSD	LCSSD	10/21/09 19:02	PCN33395	88.3		88	mg/Kg		69	108	6.2	20	
L76592-03MS	MS	10/21/09 19:24	MS090915-5	25.025	2.9	23.26	mg/Kg	81.4	75	125			
L76592-03MSD	MSD	10/21/09 19:30	MS090915-5	25.025	2.9	23.24	mg/Kg	81.3	75	125	0.09	20	

Cadmium, total (3050) M6020 ICP-MS

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG272631													
WG272631ICV	ICV	10/21/09 18:22	MS091020-3	.05		.05029	mg/L	100.6	90	110			
WG272631ICB	ICB	10/21/09 18:28				U	mg/L		-0.0003	0.0003			
WG272468PBS	PBS	10/21/09 18:50				U	mg/Kg		-0.15	0.15			
WG272468LCSS	LCSS	10/21/09 18:56	PCN33395	91		86.65	mg/Kg		74.1	108			
WG272468LCSSD	LCSSD	10/21/09 19:02	PCN33395	91		92.55	mg/Kg		74.1	108	6.6	20	
L76592-03MS	MS	10/21/09 19:24	MS090915-5	25	1.24	25.125	mg/Kg	95.5	75	125			
L76592-03MSD	MSD	10/21/09 19:30	MS090915-5	25	1.24	25.775	mg/Kg	98.1	75	125	2.55	20	

Copper, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG272615													
WG272615ICV	ICV	10/21/09 20:41	II091007-3	2		2.014	mg/L	100.7	90	110			
WG272615ICB	ICB	10/21/09 20:44				U	mg/L		-0.03	0.03			
WG272468PBS	PBS	10/21/09 20:56				U	mg/Kg		-3	3			
WG272468LCSS	LCSS	10/21/09 20:59	PCN33395	237		209.3	mg/Kg		198	275			
WG272468LCSSD	LCSSD	10/21/09 21:02	PCN33395	237		230.3	mg/Kg		198	275	9.6	20	
L76592-01MS	MS	10/21/09 21:08	II091016-2	50	538	615.5	mg/Kg	155	75	125			M3
L76592-01MSD	MSD	10/21/09 21:11	II091016-2	50	538	610.3	mg/Kg	144.6	75	125	0.85	20	M3
WG272702													
WG272702ICV	ICV	10/22/09 11:19	II091007-3	2		1.925	mg/L	96.3	90	110			
WG272702ICB	ICB	10/22/09 11:22				U	mg/L		-0.03	0.03			
L76592-01MS	MS	10/22/09 11:51	II091016-2	50	534	597.1	mg/Kg	126.2	75	125			M3
L76592-01MSD	MSD	10/22/09 11:55	II091016-2	50	534	585.4	mg/Kg	102.8	75	125	1.98	20	

Iron, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG272702													
WG272702ICV	ICV	10/22/09 11:19	II091007-3	2		1.944	mg/L	97.2	90	110			
WG272702ICB	ICB	10/22/09 11:22				U	mg/L		-0.06	0.06			
L76592-01MS	MS	10/22/09 11:51	II091016-2	100	46000	48619.3	mg/Kg	2619.3	75	125			M3
L76592-01MSD	MSD	10/22/09 11:55	II091016-2	100	46000	43723.3	mg/Kg	-2276.7	75	125	10.6	20	M3

Moisture Content M209F, Gravimetric - 105 C

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG272453													
L76592-01DUP	DUP	10/19/09 16:53			1.2	1.44	%				18.2	20	
WG272453PBS	PBS	10/20/09 12:00				100	%		99.9	100.1			

Solids, Percent CLPSOW390, PART F, D-98

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG272453													
L76592-01DUP	DUP	10/19/09 16:53			98.8	98.56	%				0.2	20	
WG272453PBS	PBS	10/20/09 12:00				U	%		99.9	100.1			

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L76592-01	WG272615	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L76592-03	WG272615	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L76592-05	WG272615	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L76592-07	WG272615	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L76592-09	WG272702	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L76592-11	WG272702	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
		Iron, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
L76592-13	WG272702	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.

Soil Analysis

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Moisture Content	M209F, Gravimetric - 105 C
Solids, Percent	CLPSOW390, PART F, D-98

Sample Receipt

Freeport-McMoRan - Chino Mines Company
B0063538.0002.00003

ACZ Project ID: L76592
Date Received: 6/24/2009
Received By:
Date Printed: 6/24/2009

Receipt Verification

	YES	NO	NA
1) Does this project require special handling procedures such as CLP protocol?			X
2) Are the custody seals on the cooler intact?	X		
3) Are the custody seals on the sample containers intact?			X
4) Is there a Chain of Custody or other directive shipping papers present?	X		
5) Is the Chain of Custody complete?	X		
6) Is the Chain of Custody in agreement with the samples received?	X		
7) Is there enough sample for all requested analyses?	X		
8) Are all samples within holding times for requested analyses?	X		
9) Were all sample containers received intact?	X		
10) Are the temperature blanks present?			X
11) Is the trip blank for Cyanide present?			X
12) Is the trip blank for VOA present?			X
13) Are samples requiring no headspace, headspace free?			X
14) Do the samples that require a Foreign Soils Permit have one?			X

Exceptions: If you answered no to any of the above questions, please describe

N/A

Contact (For any discrepancies, the client must be contacted)

N/A

Shipping Containers

Cooler Id	Temp (°C)	Rad (µR/hr)
NA8701	18.4	13

Client must contact ACZ Project Manager if analysis should not proceed for samples received outside of thermal preservation acceptance criteria.

Notes

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Sample Receipt

Freeport-McMoRan - Chino Mines Company
B0063538.0002.00003

ACZ Project ID: L76592
Date Received: 6/24/2009
Received By:

Sample Container Preservation

SAMPLE	CLIENT ID	R < 2	G < 2	BK < 2	Y< 2	YG< 2	B< 2	O < 2	T >12	N/A	RAD	ID
L76592-01	FID 0-25 0-1"									X		☐
L76592-02	FID 0-25 0-6"									X		☐
L76592-03	FID 1-25 0-1"									X		☐
L76592-04	FID 1-25 0-6"									X		☐
L76592-05	FID 2-25 0-1"									X		☐
L76592-06	FID 2-25 0-6"									X		☐
L76592-07	FID 3-25 0-1"									X		☐
L76592-08	FID 3-25 0-6"									X		☐
L76592-09	FID 4-25 0-1"									X		☐
L76592-10	FID 4-25 0-6"									X		☐
L76592-11	FID 6-25 0-1"									X		☐
L76592-12	FID 6-25 0-6"									X		☐
L76592-13	FID 7-25 0-1"									X		☐
L76592-14	FID 7-25 0-6"									X		☐

Sample Container Preservation Legend

Abbreviation	Description	Container Type	Preservative/Limits
R	Raw/Nitric	RED	pH must be < 2
B	Filtered/Sulfuric	BLUE	pH must be < 2
BK	Filtered/Nitric	BLACK	pH must be < 2
G	Filtered/Nitric	GREEN	pH must be < 2
O	Raw/Sulfuric	ORANGE	pH must be < 2
P	Raw/NaOH	PURPLE	pH must be > 12 *
T	Raw/NaOH Zinc Acetate	TAN	pH must be > 12
Y	Raw/Sulfuric	YELLOW	pH must be < 2
YG	Raw/Sulfuric	YELLOW GLASS	pH must be < 2
N/A	No preservative needed	Not applicable	
RAD	Gamma/Beta dose rate	Not applicable	must be < 250 µR/hr

* pH check performed by analyst prior to sample preparation

Sample IDs Reviewed By: ____________________

ACZ Laboratories, Inc. L76592
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: FMI - Chino Mine
E-mail: pamela_pinson@fmi.com
Address: 210 Cortez Avenue
Hurley, NM 88043
Telephone: 575-537-4213

Copy of Report to:

Name: Rebecca Lindeman
Company: ARCADIS
E-mail: rebecca.lindeman@arcadis-us.com
Telephone: 303-231-9115

Invoice to:

Name: Pam Pinson
Company: FMI - Chino Mine
E-mail: pamela_pinson@fmi.com
Address: 210 Cortez Avenue
Hurley, NM 88043
Telephone: 575-537-4213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐ NO ☒
If yes, please include state forms. Results will be reported to PQL.

PROJECT INFORMATION

Quote #: CHINO-SOIL-ANALYSIS
Project/PO #: B0063538.0002.00003
Reporting state for compliance testing:
Sampler's Name: K. Thompson/ARCADIS
Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED *(attach list or use quote number)*

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	Total Copper	% moisture	Total Arsenic, Cadmium, Copper, Iron	Cation Exchange Capacity	Calcium	Acid-Base Accounting		
FID 0-25 0-1"	6/18/09 1025	SO	1	x	x						
FID 0-25 0-6"	6/18/09 1026	SO	1	x	x						
FID 1-25 0-1"	6/22/09 0938	SO	1	x	x						
FID 1-25 0-6"	6/22/09 0940	SO	1	x	x						
FID 2-25 0-1"	6/22/09 1045	SO	1	x	x						
FID 2-25 0-6"	6/22/09 1047	SO	1	x	x						
FID 3-25 0-1"	6/18/09 1445	SO	1	x	x						
FID 3-25 0-6"	6/18/09 1447	SO	1	x	x						
FID 4-25 0-1"	6/18/09 1707	SO	1	x	x						
FID 4-25 0-6"	6/18/09 1710	SO	1	x	x						

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

FMI purchase requisition PR553454 (1) COPPER-SOIL

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
Karen Thompson	6/23/09 1200		6-24-09 10:11

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

6/23/09 1200

ACZ Laboratories, Inc. L76592
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: FMI - Chino Mine
E-mail: pamela_pinson@fmi.com
Address: 210 Cortez Avenue
Hurley, NM 88043
Telephone: 575-537-4213

Copy of Report to:

Name: Rebecca Lindeman
Company: ARCADIS
E-mail: rebecca.lindeman@arcadis-us.com
Telephone: 303-231-9115

Invoice to:

Name: Pam Pinson
Company: FMI - Chino Mine
E-mail: pamela_pinson@fmi.com
Address: 210 Cortez Avenue
Hurley, NM 88043
Telephone: 575-537-4213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐ NO ☒
If yes, please include state forms. Results will be reported to PQL.

PROJECT INFORMATION

Quote #: CHINO-SOIL-ANALYSIS
Project/PO #: B0063538.0002.00003
Reporting state for compliance testing:
Sampler's Name: K. Thompson/ARCADIS
Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED *(attach list or use quote number)*

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	Total Copper	% moisture	Total Arsenic, Cadmium, Copper, Iron	Cation Exchange Capacity	Calcium	Acid-Base Accounting		
~~FID 5-25 0-1"~~	~~NOT SAMPLED~~	~~SO~~	~~1~~	~~x~~	~~x~~						
~~FID 5-25 0-6"~~	~~NOT SAMPLED~~	~~SO~~	~~1~~	~~x~~	~~x~~						
FID 6-25 0-1"	6/18/09 0950	SO	1		x	x	(2)				
FID 6-25 0-6"	6/18/09 0955	SO	1	x	x		x	x	x	(3)	
FID 7-25 0-1"	6/19/09 1415	SO	1	x	x						
FID 7-25 0-6"	6/19/09 1417	SO	1	x	x						
~~FID 8-25 0-1"~~	~~NOT SAMPLED~~	~~SO~~	~~1~~		~~x~~	~~x~~					
~~FID 8-25 0-6"~~	~~NOT SAMPLED~~	~~SO~~	~~1~~	~~x~~	~~x~~		~~x~~	~~x~~	~~x~~		
~~FID 9-25 0-1"~~	~~NOT SAMPLED~~	~~SO~~	~~1~~		~~x~~	~~x~~					
~~FID 9-25 0-6"~~	~~NOT SAMPLED~~	~~SO~~	~~1~~	~~x~~	~~x~~		~~x~~	~~x~~	~~x~~		

[illegible]

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

FMI purchase requisition PR 553454
(2) SOIL-METALS
(3) CHINO-SOIL-ANALYSIS

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
Kara Thompson	6/23/09 1200		6·24·09 10:11

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Analytical Report

October 29, 2009

Report to:	Bill to:
Pam Pinson	Accounts Payable
Freeport-McMoRan - Chino Mines Company	Freeport-McMoRan - Chino Mines Company
210 Cortez Ave. Box 7	P.O. Box 13308
Hurley, NM 88043	Phoenix, AZ 85002-3308

cc: Rebecca Lindeman

Project ID: PR553454
ACZ Project ID: L76593

Pam Pinson:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on June 24, 2009. This project has been assigned to ACZ's project number, L76593. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan, version 12.0. The enclosed results relate only to the samples received under L76593. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all requirements of NELAC.

This report shall be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after November 29, 2009. If the samples are determined to be hazardous, additional charges apply for disposal (typically less than $10/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical reports for five years.

If you have any questions or other needs, please contact your Project Manager.

S. Habermehl

Scott Habermehl has reviewed
and approved this report.

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID:	PR553454	ACZ Sample ID:	***L76593-01***
Sample ID:	FID 10-25 0-1"	Date Sampled:	*06/19/09 09:35*
		Date Received:	*06/24/09*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Arsenic, total (3050)	M6020 ICP-MS	3.6			mg/Kg	0.3	1	10/26/09 23:55	erf
Cadmium, total (3050)	M6020 ICP-MS	2.07			mg/Kg	0.05	0.3	10/26/09 23:55	erf
Copper, total (3050)	M6010B ICP	1050		*	mg/Kg	1	5	10/22/09 23:05	ear
Iron, total (3050)	M6010B ICP	15300		*	mg/Kg	2	5	10/22/09 23:05	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	4.7		*	%	0.1	0.5	07/05/09 4:00	bjl
Solids, Percent	CLPSOW390, PART F, D-98	95.3		*	%	0.1	0.5	07/05/09 4:00	bjl

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/19/09 12:00	brd
Crush and Pulverize	USDA No. 1, 1972							10/15/09 12:59	bsu
Digestion - Hot Plate	M3050B ICP							10/21/09 11:30	jjg
Digestion - Hot Plate	M3050B ICP-MS							10/21/09 11:30	jjg

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID:	PR553454
Sample ID:	FID 12-25 0-1"
ACZ Sample ID:	***L76593-03***
Date Sampled:	*06/18/09 15:25*
Date Received:	*06/24/09*
Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Arsenic, total (3050)	M6020 ICP-MS	6.0			mg/Kg	0.3	1	10/27/09 0:01	erf
Cadmium, total (3050)	M6020 ICP-MS	6.13			mg/Kg	0.05	0.3	10/27/09 0:01	erf
Copper, total (3050)	M6010B ICP	5580		*	mg/Kg	1	5	10/22/09 23:17	ear
Iron, total (3050)	M6010B ICP	42500		*	mg/Kg	2	5	10/22/09 23:17	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	1.1		*	%	0.1	0.5	07/05/09 15:10	bjl
Solids, Percent	CLPSOW390, PART F, D-98	98.9		*	%	0.1	0.5	07/05/09 15:10	bjl

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/19/09 12:02	brd
Crush and Pulverize	USDA No. 1, 1972							10/15/09 13:08	bsu
Digestion - Hot Plate	M3050B ICP							10/21/09 12:30	jjg
Digestion - Hot Plate	M3050B ICP-MS							10/21/09 12:30	jjg

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company
Project ID: PR553454
Sample ID: FID 13-25 0-1"

ACZ Sample ID: ***L76593-05***
Date Sampled: *06/18/09 16:10*
Date Received: *06/24/09*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	1280		*	mg/Kg	1	5	10/22/09 23:26	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	2.4		*	%	0.1	0.5	07/06/09 2:20	bjl
Solids, Percent	CLPSOW390, PART F, D-98	97.6		*	%	0.1	0.5	07/06/09 2:20	bjl

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/19/09 12:05	brd
Crush and Pulverize	USDA No. 1, 1972							10/15/09 13:17	bsu
Digestion - Hot Plate	M3050B ICP							10/21/09 13:30	jjg

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company
Project ID: PR553454
Sample ID: FID 15-25 0-1"

ACZ Sample ID: ***L76593-07***
Date Sampled: *06/22/09 15:23*
Date Received: *06/24/09*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	1530		*	mg/Kg	1	5	10/22/09 23:29	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	1.0		*	%	0.1	0.5	07/06/09 13:30	bjl
Solids, Percent	CLPSOW390, PART F, D-98	99.0		*	%	0.1	0.5	07/06/09 13:30	bjl

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/19/09 12:08	brd
Crush and Pulverize	USDA No. 1, 1972							10/15/09 13:25	bsu
Digestion - Hot Plate	M3050B ICP							10/21/09 13:50	jjg

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	PR553454	ACZ Sample ID:	***L76593-09***
Sample ID:	FID 16-25 0-1"	Date Sampled:	*06/22/09 14:55*
		Date Received:	*06/24/09*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	362		*	mg/Kg	1	5	10/22/09 23:32	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	0.6		*	%	0.1	0.5	07/02/09 23:42	bjl
Solids, Percent	CLPSOW390, PART F, D-98	99.4		*	%	0.1	0.5	07/02/09 23:42	bjl

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/19/09 12:11	brd
Crush and Pulverize	USDA No. 1, 1972							10/15/09 13:34	bsu
Digestion - Hot Plate	M3050B ICP							10/21/09 14:10	jjg

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	B0063538.0002.00003
Sample ID:	FID 17-25 0-1"
ACZ Sample ID:	***L76593-11***
Date Sampled:	*06/18/09 15:39*
Date Received:	*06/24/09*
Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	9150		*	mg/Kg	1	5	10/22/09 23:35	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	2.7		*	%	0.1	0.5	07/03/09 8:51	bjl
Solids, Percent	CLPSOW390, PART F, D-98	97.3		*	%	0.1	0.5	07/03/09 8:51	bjl

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/19/09 12:14	brd
Crush and Pulverize	USDA No. 1, 1972							10/15/09 13:42	bsu
Digestion - Hot Plate	M3050B ICP							10/21/09 14:30	jjg

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID:	B0063538.0002.00003
Sample ID:	FID 18-25 0-1"
ACZ Sample ID:	***L76593-13***
Date Sampled:	*06/22/09 14:05*
Date Received:	*06/24/09*
Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	215		*	mg/Kg	1	5	10/22/09 23:38	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	0.5		*	%	0.1	0.5	07/03/09 17:59	bjl
Solids, Percent	CLPSOW390, PART F, D-98	99.5		*	%	0.1	0.5	07/03/09 17:59	bjl

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/19/09 12:17	brd
Crush and Pulverize	USDA No. 1, 1972							10/15/09 13:51	bsu
Digestion - Hot Plate	M3050B ICP							10/21/09 14:50	jjg

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Reference

Report Header Explanations

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit, typically 5 times the MDL.
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Amount of the true value or spike added recovered, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of interest

QC Sample Types

AS	Analytical Spike (Post Digestion)	LCSWD	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	LFB	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	LFM	Laboratory Fortified Matrix
CCV	Continuing Calibration Verification standard	LFMD	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	LRB	Laboratory Reagent Blank
ICB	Initial Calibration Blank	MS	Matrix Spike
ICV	Initial Calibration Verification standard	MSD	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	PBS	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	PBW	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	PQV	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	SDL	Serial Dilution

QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

ACZ Qualifiers (Qual)

B	Analyte concentration detected at a value between MDL and PQL. The associated value is an estimated quantity.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Method References

(1) EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
(2) EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.
(3) EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.
(5) EPA SW-846. Test Methods for Evaluating Solid Waste, Third Edition with Update III, December 1996.
(6) Standard Methods for the Examination of Water and Wastewater, 19th edition, 1995 & 20th edition (1998).

Comments

(1) QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
(2) Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.
(3) Animal matrices for Inorganic analyses are reported on an "as received" basis.

For a complete list of ACZ's Extended Qualifiers, please click: http://www.acz.com/public/extquallist.pdf

Freeport-McMoRan - Chino Mines Company
Project ID: B0063538.0002.00003

ACZ Project ID: ***L76593***

Arsenic, total (3050) M6020 ICP-MS

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG272902													
WG272902ICV	ICV	10/26/09 23:13	MS091020-3	.05		.04949	mg/L	99	90	110			
WG272902ICB	ICB	10/26/09 23:18				U	mg/L		-0.0015	0.0015			
WG272605PBS	PBS	10/26/09 23:40				U	mg/Kg		-0.9	0.9			
WG272605LCSS	LCSS	10/26/09 23:45	PCN33395	88.3		89.4	mg/Kg		69	108			
WG272605LCSSD	LCSSD	10/26/09 23:50	PCN33395	88.3		88.6	mg/Kg		69	108	0.9	20	
L76593-03MS	MS	10/27/09 0:06	MS090915-5	25.27525	6	29.24	mg/Kg	91.9	75	125			
L76593-03MSD	MSD	10/27/09 0:11	MS090915-5	25.27525	6	35.47	mg/Kg	116.6	75	125	19.26	20	

Cadmium, total (3050) M6020 ICP-MS

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG272902													
WG272902ICV	ICV	10/26/09 23:13	MS091020-3	.05		.04739	mg/L	94.8	90	110			
WG272902ICB	ICB	10/26/09 23:18				U	mg/L		-0.0003	0.0003			
WG272605PBS	PBS	10/26/09 23:40				U	mg/Kg		-0.15	0.15			
WG272605LCSS	LCSS	10/26/09 23:45	PCN33395	91		93.4	mg/Kg		74.1	108			
WG272605LCSSD	LCSSD	10/26/09 23:50	PCN33395	91		88.5	mg/Kg		74.1	108	5.4	20	
L76593-03MS	MS	10/27/09 0:06	MS090915-5	25.25	6.13	30.058	mg/Kg	94.8	75	125			
L76593-03MSD	MSD	10/27/09 0:11	MS090915-5	25.25	6.13	33.012	mg/Kg	106.5	75	125	9.37	20	

Copper, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG272720													
WG272720ICV	ICV	10/22/09 22:40	II091007-3	2		2.004	mg/L	100.2	90	110			
WG272720ICB	ICB	10/22/09 22:43				U	mg/L		-0.03	0.03			
WG272605PBS	PBS	10/22/09 22:56				U	mg/Kg		-3	3			
WG272605LCSS	LCSS	10/22/09 22:59	PCN33395	237		255.6	mg/Kg		198	275			
WG272605LCSSD	LCSSD	10/22/09 23:02	PCN33395	237		242.9	mg/Kg		198	275	5.1	20	
L76593-01MS2	MS	10/22/09 23:11	II091016-2	51.5	1050	1201.4	mg/Kg	294	75	125			M3
L76593-01MSD2	MSD	10/22/09 23:14	II091016-2	51.5	1050	1023.1	mg/Kg	-52.2	75	125	16.03	20	M3

Iron, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG272720													
WG272720ICV	ICV	10/22/09 22:40	II091007-3	2		1.905	mg/L	95.3	90	110			
WG272720ICB	ICB	10/22/09 22:43				U	mg/L		-0.06	0.06			
WG272605PBS	PBS	10/22/09 22:56				2.3	mg/Kg		-6	6			
WG272605LCSS	LCSS	10/22/09 22:59	PCN33395	18900		18570.3	mg/Kg		9550	28200			
WG272605LCSSD	LCSSD	10/22/09 23:02	PCN33395	18900		18516.7	mg/Kg		9550	28200	0.3	20	
L76593-01MS2	MS	10/22/09 23:11	II091016-2	103	15300	16598.2	mg/Kg	1260.4	75	125			M3
L76593-01MSD2	MSD	10/22/09 23:14	II091016-2	103	15300	16601.4	mg/Kg	1263.5	75	125	0.02	20	M3

Freeport-McMoRan - Chino Mines Company
Project ID: B0063538.0002.00003

ACZ Project ID: ***L76593***

Moisture Content M209F, Gravimetric - 105 C

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG266298													
WG266298PBS	PBS	07/02/09 9:00				100.05	%		99.9	100.1			
L76440-06DUP	DUP	07/02/09 20:10			11.4	10.99	%				3.7	20	
WG266307													
WG266307PBS	PBS	07/02/09 10:00				100	%		99.9	100.1			
L76593-08DUP	DUP	07/02/09 19:08			1.6	1.37	%				15.5	20	

Solids, Percent CLPSOW390, PART F, D-98

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG266298													
WG266298PBS	PBS	07/02/09 9:00				U	%		99.9	100.1			
L76440-06DUP	DUP	07/02/09 20:10			88.6	89.01	%				0.5	20	
WG266307													
WG266307PBS	PBS	07/02/09 10:00				U	%		99.9	100.1			
L76593-08DUP	DUP	07/02/09 19:08			98.4	98.63	%				0.2	20	

Freeport-McMoRan - Chino Mines Company

ACZ Project ID: ***L76593***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L76593-01	WG272720	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
		Iron, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L76593-03	WG272720	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
		Iron, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L76593-05	WG272720	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L76593-07	WG272720	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L76593-09	WG272720	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L76593-11	WG272720	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L76593-13	WG272720	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.

Certification Qualifiers

Soil Analysis

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Moisture Content	M209F, Gravimetric - 105 C
Solids, Percent	CLPSOW390, PART F, D-98

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Sample Receipt

Freeport-McMoRan - Chino Mines Company
B0063538.0002.00003

ACZ Project ID: L76593
Date Received: 6/24/2009
Received By:
Date Printed: 6/24/2009

Receipt Verification

	YES	NO	NA
1) Does this project require special handling procedures such as CLP protocol?			X
2) Are the custody seals on the cooler intact?	X		
3) Are the custody seals on the sample containers intact?			X
4) Is there a Chain of Custody or other directive shipping papers present?	X		
5) Is the Chain of Custody complete?	X		
6) Is the Chain of Custody in agreement with the samples received?	X		
7) Is there enough sample for all requested analyses?	X		
8) Are all samples within holding times for requested analyses?	X		
9) Were all sample containers received intact?	X		
10) Are the temperature blanks present?			X
11) Is the trip blank for Cyanide present?			X
12) Is the trip blank for VOA present?			X
13) Are samples requiring no headspace, headspace free?			X
14) Do the samples that require a Foreign Soils Permit have one?			X

Exceptions: If you answered no to any of the above questions, please describe

N/A

Contact (For any discrepancies, the client must be contacted)

N/A

Shipping Containers

Cooler Id	Temp (°C)	Rad (µR/hr)
NA8701	18.4	13

Client must contact ACZ Project Manager if analysis should not proceed for samples received outside of thermal preservation acceptance criteria.

Notes

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Sample Receipt

Freeport-McMoRan - Chino Mines Company
B0063538.0002.00003

ACZ Project ID: L76593
Date Received: 6/24/2009
Received By:

Sample Container Preservation

SAMPLE	CLIENT ID	R < 2	G < 2	BK < 2	Y< 2	YG< 2	B< 2	O < 2	T >12	N/A	RAD	ID
L76593-01	FID 10-25 0-1"									X		☐
L76593-02	FID 10-25 0-6"									X		☐
L76593-03	FID 12-25 0-1"									X		☐
L76593-04	FID 12-25 0-6"									X		☐
L76593-05	FID 13-25 0-1"									X		☐
L76593-06	FID 13-25 0-6"									X		☐
L76593-07	FID 15-25 0-1"									X		☐
L76593-08	FID 15-25 0-6"									X		☐
L76593-09	FID 16-25 0-1"									X		☐
L76593-10	FID 16-25 0-6"									X		☐
L76593-11	FID 17-25 0-1"									X		☐
L76593-12	FID 17-25 0-6"									X		☐
L76593-13	FID 18-25 0-1"									X		☐
L76593-14	FID 18-25 0-6"									X		☐

Sample Container Preservation Legend

Abbreviation	**Description**	**Container Type**	**Preservative/Limits**
R	Raw/Nitric	RED	pH must be < 2
B	Filtered/Sulfuric	BLUE	pH must be < 2
BK	Filtered/Nitric	BLACK	pH must be < 2
G	Filtered/Nitric	GREEN	pH must be < 2
O	Raw/Sulfuric	ORANGE	pH must be < 2
P	Raw/NaOH	PURPLE	pH must be > 12 *
T	Raw/NaOH Zinc Acetate	TAN	pH must be > 12
Y	Raw/Sulfuric	YELLOW	pH must be < 2
YG	Raw/Sulfuric	YELLOW GLASS	pH must be < 2
N/A	No preservative needed	Not applicable	
RAD	Gamma/Beta dose rate	Not applicable	must be < 250 µR/hr

* pH check performed by analyst prior to sample preparation

Sample IDs Reviewed By: ______________________

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

176593

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: FMI - Chino Mine
E-mail: pamela_pinson@fmi.com

Address: 210 Cortez Avenue
Hurley , NM 88043
Telephone: 575-537-4213

Copy of Report to:

Name: Rebecca Lindeman
Company: ARCADIS

E-mail: rebecca.lindeman@arcadis-us.com
Telephone: 303-231-9115

Invoice to:

Name: Pam Pinson
Company: FMI - Chino Mine
E-mail: pamela_pinson@fmi.com

Address: 210 Cortez Avenue
Hurley , NM 88043
Telephone: 575-537-4213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐
If yes, please include state forms. Results will be reported to PQL. NO ☒

PROJECT INFORMATION — ANALYSES REQUESTED *(attach list or use quote number)*

Quote #: CHINO-SOIL-ANALYSIS
Project/PO #: B0063538.0002.00003
Reporting state for compliance testing:
Sampler's Name: K. Thompson/ARCADIS
Are any samples NRC licensable material? Yes No

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	Total Copper	% moisture	Total Arsenic, Cadmium, Copper, Iron	Cation Exchange Capacity	Calcium	Acid-Base Accounting		
FID 10-25 0-1"	6/19/09 0935	SO	1		x	x					
FID 10-25 0-6"	6/19/09 0938	SO	1	x	x		x	x	x		
~~FID 11-25 0-1"~~	~~NOT SAMPLED~~	~~SO~~	~~1~~	~~x~~	~~x~~						
~~FID 11-25 0-6"~~	~~NOT SAMPLED~~	~~SO~~	~~1~~	~~x~~	~~x~~						
FID 12-25 0-1"	6/18/09 1525	SO	1		x	x					
FID 12-25 0-6"	6/18/09 1527	SO	1	x	x		x	x	x		
FID 13-25 0-1"	6/18/09 1610	SO	1	x	x						
FID 13-25 0-6"	6/18/09 1613	SO	1	x	x						
~~FID 14-25 0-1"~~	~~NOT SAMPLED~~	~~SO~~	~~1~~		~~x~~	~~x~~					
~~FID 14-25 0-6"~~	~~NOT SAMPLED~~	~~SO~~	~~1~~	~~x~~	~~x~~		~~x~~	~~x~~	~~x~~		

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

CCC 6·24·09

CCC 6·24·09

REMARKS

FMI purchase requisition PR553454

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
Karen Thompson	6/23/09 1200	CCC	6-24-09 10:11

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

L76593

CHAIN of CUSTODY

Report to:

Name: Pam Pinson	Address: 210 Cortez Avenue
Company: FMI - Chino Mine	Hurley, NM 88043
E-mail: pamela_pinson@fmi.com	Telephone: 575-537-4213

Copy of Report to:

Name: Rebecca Lindeman	E-mail: rebecca.lindeman@arcadis-us.com
Company: ARCADIS	Telephone: 303-231-9115

Invoice to:

Name: Pam Pinson	Address: 210 Cortez Avenue
Company: FMI - Chino Mine	Hurley, NM 88043
E-mail: pamela_pinson@fmi.com	Telephone: 575-537-4213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐ NO ☒
If yes, please include state forms. Results will be reported to PQL.

PROJECT INFORMATION

Quote #: CHINO-SOIL-ANALYSIS
Project/PO #: B0063538.0002.00003
Reporting state for compliance testing:
Sampler's Name: K. Thompson/ARCADIS
Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED *(attach list or use quote number)*

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	Total Copper	% moisture	Total Arsenic, Cadmium, Copper, Iron	Cation Exchange Capacity	Calcium	Acid-Base Accounting		
FID 15-25 0-1"	6/22/09 1523	SO	1	x	x						
FID 15-25 0-6"	6/22/09 1525	SO	1	x	x						
FID 16-25 0-1"	6/22/09 1455	SO	1	x	x						
FID 16-25 0-6"	6/22/09 1457	SO	1	x	x						
FID 17-25 0-1"	6/18/09 1539	SO	1		x	x					
FID 17-25 0-6"	6/18/09 1545	SO	1	x	x		x	x	x		
FID 18-25 0-1"	6/22/09 1405	SO	1		x	x					
FID 18-25 0-6"	6/22/09 1407	SO	1	x	x		x	x	x		
~~FID 19-25 0-1"~~	~~NOT SAMPLED~~	~~SO~~	~~1~~		~~x~~	~~x~~					
~~FID 19-25 0-6"~~	~~NOT SAMPLED~~	~~SO~~	~~1~~	~~x~~	~~x~~		~~x~~	~~x~~	~~x~~		

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

6·24·09

REMARKS

FMI purchase requisition PR553454

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
Karen Thompson	6/23/09 1200		6·24·09 10:11

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Analytical Report

October 26, 2009

Report to:
Pam Pinson
Freeport-McMoRan - Chino Mines Company
210 Cortez Ave. Box 7
Hurley, NM 88043

cc: Rebecca Lindeman

Bill to:
Accounts Payable
Freeport-McMoRan - Chino Mines Company
P.O. Box 13308
Phoenix, AZ 85002-3308

Project ID: B0063538.0002.00003
ACZ Project ID: L76594

Pam Pinson:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on June 24, 2009. This project has been assigned to ACZ's project number, L76594. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan, version 12.0. The enclosed results relate only to the samples received under L76594. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all requirements of NELAC.

This report shall be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after November 26, 2009. If the samples are determined to be hazardous, additional charges apply for disposal (typically less than $10/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical reports for five years.

If you have any questions or other needs, please contact your Project Manager.

S. Habermehl

Scott Habermehl has reviewed
and approved this report.

Freeport-McMoRan - Chino Mines Company

Project ID:	B0063538.0002.00003	ACZ Sample ID:	***L76594-01***
Sample ID:	FID 20-25 0-1"	Date Sampled:	*06/19/09 10:23*
		Date Received:	*06/24/09*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	755		*	mg/Kg	1	5	10/22/09 12:14	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	3.4		*	%	0.1	0.5	07/04/09 3:08	bjl
Solids, Percent	CLPSOW390, PART F, D-98	96.6		*	%	0.1	0.5	07/04/09 3:08	bjl

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/19/09 12:19	brd
Crush and Pulverize	USDA No. 1, 1972							10/15/09 13:59	bsu
Digestion - Hot Plate	M3050B ICP							10/20/09 5:04	itk

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company
Project ID: B0063538.0002.00003
Sample ID: FID 21-25 0-1"

ACZ Sample ID: ***L76594-03***
Date Sampled: *06/19/09 14:52*
Date Received: *06/24/09*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	153		*	mg/Kg	1	5	10/22/09 12:18	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	0.6		*	%	0.1	0.5	07/04/09 12:17	bjl
Solids, Percent	CLPSOW390, PART F, D-98	99.4		*	%	0.1	0.5	07/04/09 12:17	bjl

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/19/09 12:22	brd
Crush and Pulverize	USDA No. 1, 1972							10/15/09 14:08	bsu
Digestion - Hot Plate	M3050B ICP							10/20/09 6:01	itk

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company
Project ID: B0063538.0002.00003
Sample ID: FID 22-25 0-1"

ACZ Sample ID: ***L76594-05***
Date Sampled: *06/19/09 15:47*
Date Received: *06/24/09*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	347		*	mg/Kg	1	5	10/22/09 12:21	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	1.2		*	%	0.1	0.5	07/04/09 21:25	bjl
Solids, Percent	CLPSOW390, PART F, D-98	98.8		*	%	0.1	0.5	07/04/09 21:25	bjl

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/19/09 12:25	brd
Crush and Pulverize	USDA No. 1, 1972							10/15/09 14:17	bsu
Digestion - Hot Plate	M3050B ICP							10/20/09 6:58	itk

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID: B0063538.0002.00003
Sample ID: FID 24-25 0-1"

ACZ Sample ID: ***L76594-07***
Date Sampled: *06/19/09 11:47*
Date Received: *06/24/09*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	222		*	mg/Kg	1	5	10/22/09 12:24	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	4.2		*	%	0.1	0.5	07/05/09 6:34	bjl
Solids, Percent	CLPSOW390, PART F, D-98	95.8		*	%	0.1	0.5	07/05/09 6:34	bjl

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/19/09 12:28	brd
Crush and Pulverize	USDA No. 1, 1972							10/15/09 14:25	bsu
Digestion - Hot Plate	M3050B ICP							10/20/09 7:55	itk

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L76594-09***
Project ID:	B0063538.0002.00003	Date Sampled:	*06/19/09 12:05*
Sample ID:	FID 25-25 0-1"	Date Received:	*06/24/09*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	89		*	mg/Kg	1	5	10/22/09 12:28	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	1.5		*	%	0.1	0.5	07/05/09 15:42	bjl
Solids, Percent	CLPSOW390, PART F, D-98	98.5		*	%	0.1	0.5	07/05/09 15:42	bjl

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/19/09 12:31	brd
Crush and Pulverize	USDA No. 1, 1972							10/19/09 8:00	itk
Digestion - Hot Plate	M3050B ICP							10/20/09 8:53	itk

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	B0063538.0002.00003	ACZ Sample ID:	***L76594-11***
Sample ID:	FID 26-25 0-1"	Date Sampled:	*06/19/09 11:27*
		Date Received:	*06/24/09*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	134		*	mg/Kg	1	5	10/22/09 12:31	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	1.3		*	%	0.1	0.5	07/06/09 0:51	bjl
Solids, Percent	CLPSOW390, PART F, D-98	98.7		*	%	0.1	0.5	07/06/09 0:51	bjl

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/19/09 12:34	brd
Crush and Pulverize	USDA No. 1, 1972							10/19/09 8:07	itk
Digestion - Hot Plate	M3050B ICP							10/20/09 9:50	itk

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID: B0063538.0002.00003
Sample ID: FID 27-25 0-1"

ACZ Sample ID: ***L76594-13***
Date Sampled: *06/18/09 14:05*
Date Received: *06/24/09*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	322		*	mg/Kg	1	5	10/22/09 12:34	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	3.7		*	%	0.1	0.5	07/06/09 9:59	bjl
Solids, Percent	CLPSOW390, PART F, D-98	96.3		*	%	0.1	0.5	07/06/09 9:59	bjl

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/19/09 12:37	brd
Crush and Pulverize	USDA No. 1, 1972							10/19/09 8:15	itk
Digestion - Hot Plate	M3050B ICP							10/20/09 10:47	itk

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID:	B0063538.0002.00003	ACZ Sample ID:	***L76594-15***
Sample ID:	FID 28-25 0-1"	Date Sampled:	*06/22/09 12:05*
		Date Received:	*06/24/09*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	426		*	mg/Kg	1	5	10/22/09 12:44	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	2.1		*	%	0.1	0.5	10/20/09 9:36	jjg
Solids, Percent	CLPSOW390, PART F, D-98	97.9		*	%	0.1	0.5	10/20/09 9:36	jjg

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/19/09 12:39	brd
Crush and Pulverize	USDA No. 1, 1972							10/19/09 8:22	itk
Digestion - Hot Plate	M3050B ICP							10/20/09 11:44	itk

** Please refer to Qualifier Reports for details.*

Report Header Explanations

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit, typically 5 times the MDL.
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Amount of the true value or spike added recovered, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of interest

QC Sample Types

AS	Analytical Spike (Post Digestion)	LCSWD	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	LFB	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	LFM	Laboratory Fortified Matrix
CCV	Continuing Calibration Verification standard	LFMD	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	LRB	Laboratory Reagent Blank
ICB	Initial Calibration Blank	MS	Matrix Spike
ICV	Initial Calibration Verification standard	MSD	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	PBS	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	PBW	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	PQV	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	SDL	Serial Dilution

QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

ACZ Qualifiers (Qual)

B	Analyte concentration detected at a value between MDL and PQL. The associated value is an estimated quantity.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Method References

(1) EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
(2) EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.
(3) EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.
(5) EPA SW-846. Test Methods for Evaluating Solid Waste, Third Edition with Update III, December 1996.
(6) Standard Methods for the Examination of Water and Wastewater, 19th edition, 1995 & 20th edition (1998).

Comments

(1) QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
(2) Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.
(3) Animal matrices for Inorganic analyses are reported on an "as received" basis.

For a complete list of ACZ's Extended Qualifiers, please click: http://www.acz.com/public/extquallist.pdf

Copper, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG272702													
WG272702ICV	ICV	10/22/09 11:19	II091007-3	2		1.925	mg/L	96.3	90	110			
WG272702ICB	ICB	10/22/09 11:22				U	mg/L		-0.03	0.03			
L76592-01MS	MS	10/22/09 11:51	II091016-2	50	534	597.1	mg/Kg	126.2	75	125			M3
L76592-01MSD	MSD	10/22/09 11:55	II091016-2	50	534	585.4	mg/Kg	102.8	75	125	1.98	20	

Moisture Content M209F, Gravimetric - 105 C

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG266307													
WG266307PBS	PBS	07/02/09 10:00				100	%		99.9	100.1			
L76593-08DUP	DUP	07/02/09 19:08			1.6	1.37	%				15.5	20	
WG272453													
L76592-01DUP	DUP	10/19/09 16:53			1.2	1.44	%				18.2	20	
WG272453PBS	PBS	10/20/09 12:00				100	%		99.9	100.1			

Solids, Percent CLPSOW390, PART F, D-98

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG266307													
WG266307PBS	PBS	07/02/09 10:00				U	%		99.9	100.1			
L76593-08DUP	DUP	07/02/09 19:08			98.4	98.63	%				0.2	20	
WG272453													
L76592-01DUP	DUP	10/19/09 16:53			98.8	98.56	%				0.2	20	
WG272453PBS	PBS	10/20/09 12:00				U	%		99.9	100.1			

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L76594-01	WG272702	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L76594-03	WG272702	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L76594-05	WG272702	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L76594-07	WG272702	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L76594-09	WG272702	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L76594-11	WG272702	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L76594-13	WG272702	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L76594-15	WG272702	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.

Certification Qualifiers

Freeport-McMoRan - Chino Mines Company

ACZ Project ID: ***L76594***

Soil Analysis

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Moisture Content	M209F, Gravimetric - 105 C
Solids, Percent	CLPSOW390, PART F, D-98

Sample Receipt

Freeport-McMoRan - Chino Mines Company
B0063538.0002.00003

ACZ Project ID: L76594
Date Received: 6/24/2009
Received By:
Date Printed: 6/24/2009

Receipt Verification

	YES	NO	NA
1) Does this project require special handling procedures such as CLP protocol?			X
2) Are the custody seals on the cooler intact?	X		
3) Are the custody seals on the sample containers intact?			X
4) Is there a Chain of Custody or other directive shipping papers present?	X		
5) Is the Chain of Custody complete?	X		
6) Is the Chain of Custody in agreement with the samples received?	X		
7) Is there enough sample for all requested analyses?	X		
8) Are all samples within holding times for requested analyses?	X		
9) Were all sample containers received intact?	X		
10) Are the temperature blanks present?			X
11) Is the trip blank for Cyanide present?			X
12) Is the trip blank for VOA present?			X
13) Are samples requiring no headspace, headspace free?			X
14) Do the samples that require a Foreign Soils Permit have one?			X

Exceptions: If you answered no to any of the above questions, please describe

N/A

Contact (For any discrepancies, the client must be contacted)

N/A

Shipping Containers

Cooler Id	Temp (°C)	Rad (µR/hr)
NA8701	18.4	13

Client must contact ACZ Project Manager if analysis should not proceed for samples received outside of thermal preservation acceptance criteria.

Notes

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Sample Receipt

Freeport-McMoRan - Chino Mines Company
B0063538.0002.00003

ACZ Project ID: L76594
Date Received: 6/24/2009
Received By:

Sample Container Preservation

SAMPLE	CLIENT ID	R < 2	G < 2	BK < 2	Y< 2	YG< 2	B< 2	O < 2	T >12	N/A	RAD	ID
L76594-01	FID 20-25 0-1"									X		☐
L76594-02	FID 20-25 0-6"									X		☐
L76594-03	FID 21-25 0-1"									X		☐
L76594-04	FID 21-25 0-6"									X		☐
L76594-05	FID 22-25 0-1"									X		☐
L76594-06	FID 22-25 0-6"									X		☐
L76594-07	FID 24-25 0-1"									X		☐
L76594-08	FID 24-25 0-6"									X		☐
L76594-09	FID 25-25 0-1"									X		☐
L76594-10	FID 25-25 0-6"									X		☐
L76594-11	FID 26-25 0-1"									X		☐
L76594-12	FID 26-25 0-6"									X		☐
L76594-13	FID 27-25 0-1"									X		☐
L76594-14	FID 27-25 0-6"									X		☐
L76594-15	FID 28-25 0-1"									X		☐
L76594-16	FID 28-25 0-6"									X		☐

Sample Container Preservation Legend

Abbreviation	Description	Container Type	Preservative/Limits
R	Raw/Nitric	RED	pH must be < 2
B	Filtered/Sulfuric	BLUE	pH must be < 2
BK	Filtered/Nitric	BLACK	pH must be < 2
G	Filtered/Nitric	GREEN	pH must be < 2
O	Raw/Sulfuric	ORANGE	pH must be < 2
P	Raw/NaOH	PURPLE	pH must be > 12 *
T	Raw/NaOH Zinc Acetate	TAN	pH must be > 12
Y	Raw/Sulfuric	YELLOW	pH must be < 2
YG	Raw/Sulfuric	YELLOW GLASS	pH must be < 2
N/A	No preservative needed	Not applicable	
RAD	Gamma/Beta dose rate	Not applicable	must be < 250 µR/hr

* pH check performed by analyst prior to sample preparation

Sample IDs Reviewed By: ______________________

ACZ Laboratories, Inc. L76594

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: FMI - Chino Mine
E-mail: pamela_pinson@fmi.com
Address: 210 Cortez Avenue
Hurley, NM 88043
Telephone: 575-537-4213

Copy of Report to:

Name: Rebecca Lindeman
Company: ARCADIS
E-mail: rebecca.lindeman@arcadis-us.com
Telephone: 303-231-9115

Invoice to:

Name: Pam Pinson
Company: FMI - Chino Mine
E-mail: pamela_pinson@fmi.com
Address: 210 Cortez Avenue
Hurley, NM 88043
Telephone: 575-537-4213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐

If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐ NO ☒

If yes, please include state forms. Results will be reported to PQL.

PROJECT INFORMATION

Quote #: CHINO-SOIL-ANALYSIS
Project/PO #: B0063538.0002.00003
Reporting state for compliance testing:
Sampler's Name: K. Thompson/ARCADIS
Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED *(attach list or use quote number)*

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	Total Copper	% moisture	Total Arsenic, Cadmium, Copper, Iron	Cation Exchange Capacity	Calcium	Acid-Base Accounting		
FID 20-25 0-1"	6/19/09 1023	SO	1		X	X					
FID 20-25 0-6"	6/19/09 1025	SO	1	X	X		X	X	X		
FID 21-25 0-1"	6/19/09 1452	SO	1		X	X					
FID 21-25 0-6"	6/19/09 1455	SO	1	X	X		X	X	X		
FID 22-25 0-1"	6/19/09 1547	SO	1	X	X						
FID 22-25 0-6"	6/19/09 1550	SO	1	X	X						
~~FID 23-25 0-1"~~	~~NOT SAMPLED~~	~~SO~~	~~1~~	~~X~~	~~X~~						
~~FID 23-25 0-6"~~	~~NOT SAMPLED~~	~~SO~~	~~1~~	~~X~~	~~X~~						
FID 24-25 0-1"	6/19/09 1147	SO	1	X	X						
FID 24-25 0-6"	6/19/09 1150	SO	1	X	X						

Matrix SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

FMI purchase requisition PR553454

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
Kate Thompson	6/23/09 1200		6.24.09 10:11

6.24.09

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

ACZ Laboratories, Inc. L76594

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: FMI - Chino Mine
E-mail: pamela_pinson@fmi.com
Address: 210 Cortez Avenue
Hurley, NM 88043
Telephone: 575-537-4213

Copy of Report to:

Name: Rebecca Lindeman
Company: ARCADIS
E-mail: rebecca.lindeman@arcadis-us.com
Telephone: 303-231-9115

Invoice to:

Name: Pam Pinson
Company: FMI - Chino Mine
E-mail: pamela_pinson@fmi.com
Address: 210 Cortez Avenue
Hurley, NM 88043
Telephone: 575-537-4213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐ NO ☒
If yes, please include state forms. Results will be reported to PQL.

PROJECT INFORMATION

Quote #: CHINO-SOIL-ANALYSIS
Project/PO #: B0063538.0002.00003
Reporting state for compliance testing:
Sampler's Name: K. Thompson/ARCADIS
Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED *(attach list or use quote number)*

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	Total Copper	% moisture	Total Arsenic, Cadmium, Copper, Iron	Cation Exchange Capacity	Calcium	Acid-Base Accounting		
FID 25-25 0-1"	6/19/09 1205	SO	1	X	X						
FID 25-25 0-6"	6/19/09 1207	SO	1	X	X						
FID 26-25 0-1"	6/19/09 1127	SO	1		X	X					
FID 26-25 0-6"	6/19/09 1130	SO	1	X	X		X	X	X		
FID 27-25 0-1"	6/18/09 1405	SO	1		X	X					
FID 27-25 0-6"	6/18/09 1408	SO	1	X	X		X	X	X		
FID 28-25 0-1"	6/22/09 1205	SO	1	X	X						
FID 28-25 0-6"	6/22/09 1208	SO	1	X	X						
~~FID 29-25 0-1"~~	~~NOT SAMPLED~~	~~SO~~	~~1~~	~~X~~	~~X~~						
~~FID 29-25 0-6"~~	~~NOT SAMPLED~~	~~SO~~	~~1~~	~~X~~	~~X~~						

6.24.09

Matrix SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

FMI purchase requisition PR553454

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY	DATE:TIME	RECEIVED BY:	DATE:TIME
Kare Thompson	6/23/09 1200		6.24.09 1011

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Analytical Report

October 26, 2009

Report to:
Pam Pinson
Freeport-McMoRan - Chino Mines Company
210 Cortez Ave. Box 7
Hurley, NM 88043

Bill to:
Accounts Payable
Freeport-McMoRan - Chino Mines Company
P.O. Box 13308
Phoenix, AZ 85002-3308

cc: Rebecca Lindeman

Project ID: B0063538.0002.00003
ACZ Project ID: L76595

Pam Pinson:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on June 24, 2009. This project has been assigned to ACZ's project number, L76595. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan, version 12.0. The enclosed results relate only to the samples received under L76595. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all requirements of NELAC.

This report shall be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after November 26, 2009. If the samples are determined to be hazardous, additional charges apply for disposal (typically less than $10/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical reports for five years.

If you have any questions or other needs, please contact your Project Manager.

S. Habermehl

Scott Habermehl has reviewed
and approved this report.

Freeport-McMoRan - Chino Mines Company

Project ID:	B0063538.0002.00003
Sample ID:	FID 30-25 0-1"
ACZ Sample ID:	***L76595-01***
Date Sampled:	*06/18/09 10:58*
Date Received:	*06/24/09*
Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	291		*	mg/Kg	1	5	10/22/09 23:41	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	2.0		*	%	0.1	0.5	06/30/09 12:11	itk/brd
Solids, Percent	CLPSOW390, PART F, D-98	98.0		*	%	0.1	0.5	06/30/09 12:11	itk/brd

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							06/30/09 9:47	itk/brd
Crush and Pulverize	USDA No. 1, 1972							10/15/09 14:34	bsu
Digestion - Hot Plate	M3050B ICP							10/21/09 15:10	jjg

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	B0063538.0002.00003	ACZ Sample ID:	***L76595-03***
Sample ID:	FID 31-25 0-1"	Date Sampled:	*06/19/09 12:27*
		Date Received:	*06/24/09*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	294		*	mg/Kg	1	5	10/22/09 23:44	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	1.5		*	%	0.1	0.5	06/30/09 18:01	itk/brd
Solids, Percent	CLPSOW390, PART F, D-98	98.5		*	%	0.1	0.5	06/30/09 18:01	itk/brd

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							06/30/09 9:55	itk/brd
Crush and Pulverize	USDA No. 1, 1972							10/15/09 14:42	bsu
Digestion - Hot Plate	M3050B ICP							10/21/09 15:30	jjg

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	B0063538.0002.00003	ACZ Sample ID:	***L76595-05***
Sample ID:	FID 32-25 0-1"	Date Sampled:	*06/18/09 12:00*
		Date Received:	*06/24/09*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	2250		*	mg/Kg	1	5	10/22/09 23:47	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	1.6		*	%	0.1	0.5	06/30/09 21:54	itk/brd
Solids, Percent	CLPSOW390, PART F, D-98	98.4		*	%	0.1	0.5	06/30/09 21:54	itk/brd

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							06/30/09 10:03	itk/brd
Crush and Pulverize	USDA No. 1, 1972							10/15/09 14:51	bsu
Digestion - Hot Plate	M3050B ICP							10/21/09 15:50	jjg

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID:	B0063538.0002.00003	ACZ Sample ID:	***L76595-07***
Sample ID:	FID 33-25 0-1"	Date Sampled:	*06/19/09 13:15*
		Date Received:	*06/24/09*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	785		*	mg/Kg	1	5	10/22/09 23:50	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	1.9		*	%	0.1	0.5	07/01/09 1:47	itk/brd
Solids, Percent	CLPSOW390, PART F, D-98	98.2		*	%	0.1	0.5	07/01/09 1:47	itk/brd

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							06/30/09 10:12	itk/brd
Crush and Pulverize	USDA No. 1, 1972							10/15/09 14:59	bsu
Digestion - Hot Plate	M3050B ICP							10/21/09 16:10	jjg

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company
Project ID: B0063538.0002.00003
Sample ID: FID 34-25 0-1"

ACZ Sample ID: ***L76595-09***
Date Sampled: *06/18/09 12:28*
Date Received: *06/24/09*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	682		*	mg/Kg	1	5	10/22/09 23:53	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	1.4		*	%	0.1	0.5	07/01/09 5:40	itk/brd
Solids, Percent	CLPSOW390, PART F, D-98	98.6		*	%	0.1	0.5	07/01/09 5:40	itk/brd

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							06/30/09 10:20	itk/brd
Crush and Pulverize	USDA No. 1, 1972							10/15/09 15:08	bsu
Digestion - Hot Plate	M3050B ICP							10/21/09 16:30	jjg

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	B0063538.0002.00003	ACZ Sample ID:	***L76595-11***
Sample ID:	FID 35-25 0-1"	Date Sampled:	*06/22/09 10:28*
		Date Received:	*06/24/09*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	219		*	mg/Kg	1	5	10/23/09 0:02	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	1.6		*	%	0.1	0.5	07/01/09 9:33	itk/brd
Solids, Percent	CLPSOW390, PART F, D-98	98.4		*	%	0.1	0.5	07/01/09 9:33	itk/brd

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							06/30/09 10:28	itk/brd
Crush and Pulverize	USDA No. 1, 1972							10/15/09 15:17	bsu
Digestion - Hot Plate	M3050B ICP							10/21/09 16:50	jjg

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	B0063538.0002.00003	ACZ Sample ID:	***L76595-13***
Sample ID:	FID 37-25 0-1"	Date Sampled:	*06/22/09 15:47*
		Date Received:	*06/24/09*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	533		*	mg/Kg	1	5	10/23/09 0:05	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	1.3		*	%	0.1	0.5	07/01/09 13:26	itk/brd
Solids, Percent	CLPSOW390, PART F, D-98	98.7		*	%	0.1	0.5	07/01/09 13:26	itk/brd

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							06/30/09 10:36	itk/brd
Crush and Pulverize	USDA No. 1, 1972							10/15/09 15:25	bsu
Digestion - Hot Plate	M3050B ICP							10/21/09 17:10	jjg

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company
Project ID: B0063538.0002.00003
Sample ID: FID 39-25 0-1"

ACZ Sample ID: ***L76595-14***
Date Sampled: *06/19/09 08:48*
Date Received: *06/24/09*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	590		*	mg/Kg	1	5	10/23/09 0:08	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	3.9		*	%	0.1	0.5	07/01/09 15:23	itk/brd
Solids, Percent	CLPSOW390, PART F, D-98	96.1		*	%	0.1	0.5	07/01/09 15:23	itk/brd

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							06/30/09 10:40	itk/brd
Crush and Pulverize	USDA No. 1, 1972							10/15/09 15:34	bsu
Digestion - Hot Plate	M3050B ICP							10/21/09 17:30	jjg

** Please refer to Qualifier Reports for details.*

Report Header Explanations

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit, typically 5 times the MDL.
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Amount of the true value or spike added recovered, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of interest

QC Sample Types

AS	Analytical Spike (Post Digestion)	LCSWD	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	LFB	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	LFM	Laboratory Fortified Matrix
CCV	Continuing Calibration Verification standard	LFMD	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	LRB	Laboratory Reagent Blank
ICB	Initial Calibration Blank	MS	Matrix Spike
ICV	Initial Calibration Verification standard	MSD	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	PBS	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	PBW	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	PQV	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	SDL	Serial Dilution

QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

ACZ Qualifiers (Qual)

B	Analyte concentration detected at a value between MDL and PQL. The associated value is an estimated quantity.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Method References

(1) EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
(2) EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.
(3) EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.
(5) EPA SW-846. Test Methods for Evaluating Solid Waste, Third Edition with Update III, December 1996.
(6) Standard Methods for the Examination of Water and Wastewater, 19th edition, 1995 & 20th edition (1998).

Comments

(1) QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
(2) Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.
(3) Animal matrices for Inorganic analyses are reported on an "as received" basis.

For a complete list of ACZ's Extended Qualifiers, please click: http://www.acz.com/public/extquallist.pdf

Inorganic QC Summary

Freeport-McMoRan - Chino Mines Company
Project ID: B0063538.0002.00003

ACZ Project ID: ***L76595***

Copper, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG272720													
WG272720ICV	ICV	10/22/09 22:40	II091007-3	2		2.004	mg/L	100.2	90	110			
WG272720ICB	ICB	10/22/09 22:43				U	mg/L		-0.03	0.03			
WG272605PBS	PBS	10/22/09 22:56				U	mg/Kg		-3	3			
WG272605LCSS	LCSS	10/22/09 22:59	PCN33395	237		255.6	mg/Kg		198	275			
WG272605LCSSD	LCSSD	10/22/09 23:02	PCN33395	237		242.9	mg/Kg		198	275	5.1	20	
L76593-01MS2	MS	10/22/09 23:11	II091016-2	51.5	1050	1201.4	mg/Kg	294	75	125			M3
L76593-01MSD2	MSD	10/22/09 23:14	II091016-2	51.5	1050	1023.1	mg/Kg	-52.2	75	125	16.03	20	M3

Moisture Content M209F, Gravimetric - 105 C

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG266128													
WG266128PBS	PBS	06/30/09 10:15				100	%		99.9	100.1			
L76595-01DUP	DUP	06/30/09 14:08			2	1.75	%				13.3	20	

Solids, Percent CLPSOW390, PART F, D-98

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG266128													
WG266128PBS	PBS	06/30/09 10:15				U	%		99.9	100.1			
L76595-01DUP	DUP	06/30/09 14:08			98	98.25	%				0.3	20	

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L76595-01	WG272720	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L76595-03	WG272720	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L76595-05	WG272720	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L76595-07	WG272720	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L76595-09	WG272720	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L76595-11	WG272720	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L76595-13	WG272720	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L76595-14	WG272720	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.

Certification Qualifiers

Freeport-McMoRan - Chino Mines Company

ACZ Project ID: ***L76595***

Soil Analysis

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Moisture Content	M209F, Gravimetric - 105 C
Solids, Percent	CLPSOW390, PART F, D-98

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Sample Receipt

Freeport-McMoRan - Chino Mines Company
B0063538.0002.00003

ACZ Project ID: L76595
Date Received: 6/24/2009
Received By:
Date Printed: 6/24/2009

Receipt Verification

	YES	NO	NA
1) Does this project require special handling procedures such as CLP protocol?			X
2) Are the custody seals on the cooler intact?	X		
3) Are the custody seals on the sample containers intact?			X
4) Is there a Chain of Custody or other directive shipping papers present?	X		
5) Is the Chain of Custody complete?	X		
6) Is the Chain of Custody in agreement with the samples received?	X		
7) Is there enough sample for all requested analyses?	X		
8) Are all samples within holding times for requested analyses?	X		
9) Were all sample containers received intact?	X		
10) Are the temperature blanks present?			X
11) Is the trip blank for Cyanide present?			X
12) Is the trip blank for VOA present?			X
13) Are samples requiring no headspace, headspace free?			X
14) Do the samples that require a Foreign Soils Permit have one?			X

Exceptions: If you answered no to any of the above questions, please describe

N/A

Contact (For any discrepancies, the client must be contacted)

N/A

Shipping Containers

Cooler Id	Temp (°C)	Rad (µR/hr)
NA8701	18.4	13

Client must contact ACZ Project Manager if analysis should not proceed for samples received outside of thermal preservation acceptance criteria.

Notes

Sample Receipt

Freeport-McMoRan - Chino Mines Company
B0063538.0002.00003

ACZ Project ID: L76595
Date Received: 6/24/2009
Received By:

Sample Container Preservation

SAMPLE	CLIENT ID	R < 2	G < 2	BK < 2	Y< 2	YG< 2	B< 2	O < 2	T >12	N/A	RAD	ID
L76595-01	FID 30-25 0-1"									X		☐
L76595-02	FID 30-25 0-6"									X		☐
L76595-03	FID 31-25 0-1"									X		☐
L76595-04	FID 31-25 0-6"									X		☐
L76595-05	FID 32-25 0-1"									X		☐
L76595-06	FID 32-25 0-6"									X		☐
L76595-07	FID 33-25 0-1"									X		☐
L76595-08	FID 33-25 0-6"									X		☐
L76595-09	FID 34-25 0-1"									X		☐
L76595-10	FID 34-25 0-6"									X		☐
L76595-11	FID 35-25 0-1"									X		☐
L76595-12	FID 35-25 0-6"									X		☐
L76595-13	FID 37-25 0-1"									X		☐
L76595-14	FID 39-25 0-1"									X		☐
L76595-15	FID 39-25 0-6"									X		☐

Sample Container Preservation Legend

Abbreviation	Description	Container Type	Preservative/Limits
R	Raw/Nitric	RED	pH must be < 2
B	Filtered/Sulfuric	BLUE	pH must be < 2
BK	Filtered/Nitric	BLACK	pH must be < 2
G	Filtered/Nitric	GREEN	pH must be < 2
O	Raw/Sulfuric	ORANGE	pH must be < 2
P	Raw/NaOH	PURPLE	pH must be > 12 *
T	Raw/NaOH Zinc Acetate	TAN	pH must be > 12
Y	Raw/Sulfuric	YELLOW	pH must be < 2
YG	Raw/Sulfuric	YELLOW GLASS	pH must be < 2
N/A	No preservative needed	Not applicable	
RAD	Gamma/Beta dose rate	Not applicable	must be < 250 µR/hr

* pH check performed by analyst prior to sample preparation

Sample IDs Reviewed By: ______________________

ACZ Laboratories, Inc. L76595

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: FMI - Chino Mine
E-mail: pamela_pinson@fmi.com

Address: 210 Cortez Avenue
Hurley, NM 88043
Telephone: 575-537-4213

Copy of Report to:

Name: Rebecca Lindeman
Company: ARCADIS

E-mail: rebecca.lindeman@arcadis-us.com
Telephone: 303-231-9115

Invoice to:

Name: Pam Pinson
Company: FMI - Chino Mine
E-mail: pamela_pinson@fmi.com

Address: 210 Cortez Avenue
Hurley, NM 88043
Telephone: 575-537-4213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐ NO ☒
If yes, please include state forms. Results will be reported to PQL.

PROJECT INFORMATION

Quote #: CHINO-SOIL-ANALYSIS
Project/PO #: B0063538.0002.00003
Reporting state for compliance testing:
Sampler's Name: K. Thompson/ARCADIS
Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED *(attach list or use quote number)*

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	Total Copper	% moisture	Total Arsenic, Cadmium, Copper, Iron	Cation Exchange Capacity	Calcium	Acid-Base Accounting
FID 30-25 0-1"	6/18/09 1058	SO	1	x	x				
FID 30-25 0-6"	6/18/09 1100	SO	1	x	x				
FID 31-25 0-1"	6/19/09 1227	SO	1	x	x				
FID 31-25 0-6"	6/19/09 1230	SO	1	x	x				
FID 32-25 0-1"	6/18/09 1200	SO	1	x	x				
FID 32-25 0-6"	6/18/09 1203	SO	1	x	x				
FID 33-25 0-1"	6/19/09 1315	SO	1	x	x				
FID 33-25 0-6"	6/19/09 1317	SO	1	x	x				
FID 34-25 0-1"	6/18/09 1228	SO	1		x	x			
FID 34-25 0-6"	6/18/09 1230	SO	1	x	x		x	x	x

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

FMI purchase requisition PR553454

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
Kase Thompson	6/23/09 1200		6-24-09 10:11

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

ACZ Laboratories, Inc.

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson	Address: 210 Cortez Avenue
Company: FMI - Chino Mine	Hurley, NM 88043
E-mail: pamela_pinson@fmi.com	Telephone: 575-537-4213

Copy of Report to:

Name: Rebecca Lindeman	E-mail: rebecca.lindeman@arcadis-us.com
Company: ARCADIS	Telephone: 303-231-9115

Invoice to:

Name: Pam Pinson	Address: 210 Cortez Avenue
Company: FMI - Chino Mine	Hurley, NM 88043
E-mail: pamela_pinson@fmi.com	Telephone: 575-537-4213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐

If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐ NO ☒

If yes, please include state forms. Results will be reported to PQL.

PROJECT INFORMATION

Quote #: CHINO-SOIL-ANALYSIS

Project/PO #: B0063538.0002.00003

Reporting state for compliance testing:

Sampler's Name: K. Thompson/ARCADIS

Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED (attach list or use quote number)

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	Total Copper	% moisture	Total Arsenic, Cadmium, Copper, Iron	Cation Exchange Capacity	Calcium	Acid-Base Accounting		
FID 35-25 0-1"	6/22/09 1028	SO	1	x	x						
FID 35-25 0-6"	6/22/09 1030	SO	1	x	x						
~~FID 36-25 0-1"~~	~~NOT SAMPLED~~	~~SO~~	~~1~~		~~x~~	~~x~~					
~~FID 36-25 0-6"~~	~~NOT SAMPLED~~	~~SO~~	~~1~~	~~x~~	~~x~~		~~x~~	~~x~~	~~x~~		
FID 37-25 0-1"	6/22/09 1547	SO	1		x	x					
~~FID 37-25 0-6"~~	~~NOT SAMPLED~~	~~SO~~	~~1~~	~~x~~	~~x~~		~~x~~	~~x~~	~~x~~		
~~FID 38-25 0-1"~~	~~NOT SAMPLED~~	~~SO~~	~~1~~	~~x~~	~~x~~						
~~FID 38-25 0-6"~~	~~NOT SAMPLED~~	~~SO~~	~~1~~	~~x~~	~~x~~						
FID 39-25 0-1"	6/19/09 0848	SO	1	x	x						
FID 39-25 0-6"	6/19/09 0850	SO	1	x	x						

LCG 6.2409

Matrix SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

FMI purchase requisition PR553454

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
Kare Thompson	6/23/09 1200	LCG	6.24.09 10:11

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Analytical Quote

Karen Thompson
Arcadis U.S., Inc.
1610 B Street Suite 100
Helena, MT 59601

Page 1 of 2
6/15/2009

Quote Number: CHINO-SOIL-ANALYSIS

Matrix: Soil Analysis of Freeport-McMoRan Chino Mine Soil Samples

Parameter	Method	Detection Limit	Cost/Sample
Metals Analysis			
Arsenic, total (3050)	M6020 ICP-MS	0.05 mg/Kg	$16.20
Cadmium, total (3050)	M6020 ICP-MS	0.01 mg/Kg	$16.20
Calcium, total (3050)	M6010B ICP	20 mg/Kg	$8.10
Cation Exchange Capacity (CEC)	USDA No. 60 (19)	0.3 meq/100g	$19.80
Copper, total (3050)	M6010B ICP	1 mg/Kg	$8.10
Iron, total (3050)	M6010B ICP	2 mg/Kg	$8.10
Misc.			
Electronic Data Deliverable			$0.00
Quality Control Summary			$0.00
Setup charge for ICP, total			$18.00
Setup Charge for ICPMS			$18.00
Sample Preparation			
Air Dry at 34 Degrees C	USDA No. 1, 1972		$6.30
Cation Exchange Capacity Extractio	USDA No. 60 (19)		$0.00
Crush and Pulverize	USDA No. 1, 1972		$9.90
Digestion - Hot Plate	M3050B ICP-MS		$13.50
Digestion - Hot Plate	M3050B ICP		$13.50
Saturated Paste Extraction	USDA No. 60 (2)		$14.40
Soil Analysis			
Acid Generation Potential (calc on S	M600/2-78-054 1.3	Calculation	$0.00
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	Calculation	$0.00
Acid-Base Potential (calc on Sulfur t	M600/2-78-054 1.3	Calculation	$0.00
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	0.1 %	$12.60
pH, Saturated Paste	USDA No. 60 (21A)	0.1 units	$6.30
Solids, Percent	CLPSOW390, PART F, D-98	0.1 %	$6.30
Sulfur, total	ASTM D-4239-85C, LECO Furnace	0.01 %	$15.30
		Cost/Sample:	**$210.60**

Prices are based on a standard turnaround time of 3 weeks or 15 working days and reflect a 10% discount.

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Analytical Quote

Karen Thompson
Arcadis U.S., Inc.
1610 B Street Suite 100
Helena, MT 59601

Page 2 of 2
6/15/2009

Quote Number: CHINO-SOIL-ANALYSIS

Pricing includes shipment of all standard sample containers and related paperwork by UPS Ground Service. Please allow three to five days for delivery when ordering containers. ACZ must be notified prior to receiving samples of all special requests such as electronic data deliverables or special reporting reqirements. The client will be charged for special sample containers or express shipping and additional charges may apply for non-standard requests.

This quotation is valid for six months from the bid date unless specified otherwise in the bid. All bids must be signed and returned to ACZ before project(s) is received. The authorized signature represents acceptance of the pricing as well as the general terms and conditions of ACZ Laboratories, Inc. Our general terms and conditions can be downloaded from our web site at http://www.acz.com/eservices/download.html. Please note that MDL's in this quote may possibly increase due to sample matrix or samples with high TDS.

All orders that require shipping of coolers are subject to a minimum charge of $200.00. Local orders without shipping are subject to a minimum charge of $125.00. Samples may incur a $10.00/sample disposal fee for any samples deemed to be hazardous.

ACZ Representative (Authorized signature and date) ______________________

Client Representative (Authorized signature and date) Karen Thompson, ARCADIS 6/16/09

Please invoice:

Pam Pinson
FMI - Chino Mines
210 Cortez Ave
Hurley, NM 88043

Reference purchase requisition PR 553454 on invoice.

ACZ Laboratories, Inc.
2773 Downhill Drive   Steamboat Springs, CO 80487   (800) 334-5493

Analytical Report

October 19, 2009

Report to:
Pam Pinson
Freeport-McMoRan - Chino Mines Company
210 Cortez Ave.   Box 7
Hurley, NM 88043

Bill to:
Accounts Payable
Freeport-McMoRan - Chino Mines Company
P.O. Box 13308
Phoenix, AZ 85002-3308

cc: Rebecca Lindeman

Project ID: PR553454
ACZ Project ID: L78387

Pam Pinson:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on September 25, 2009. This project has been assigned to ACZ's project number, L78387. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan, version 12.0. The enclosed results relate only to the samples received under L78387. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all requirements of NELAC.

This report shall be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after November 19, 2009. If the samples are determined to be hazardous, additional charges apply for disposal (typically less than $10/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical reports for five years.

If you have any questions or other needs, please contact your Project Manager.

S. Habermehl

Scott Habermehl has reviewed
and approved this report.

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID:	PR553454	ACZ Sample ID:	***L78387-01***
Sample ID:	FID 0-25 0-6"	Date Sampled:	*06/18/09 10:26*
		Date Received:	*09/25/09*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	329		*	mg/Kg	1	5	10/12/09 11:25	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	0			t CaCO3/Kt	1	5	10/19/09 12:49	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	11			t CaCO3/Kt	1	5	10/19/09 12:49	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	11			t CaCO3/Kt	1	5	10/19/09 12:49	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	1.1		*	%	0.1	0.5	10/13/09 10:05	itk
pH, Saturated Paste	USDA No. 60 (21A)	6.6		*	units	0.1	0.1	10/09/09 11:00	itk
Solids, Percent	CLPSOW390, PART F, D-98	97.6		*	%	0.1	0.5	10/13/09 17:24	jjg
Sulfur, total	ASTM D-4239-85C, LECO Furnace	0.03	B	*	%	0.01	0.1	10/07/09 13:02	brd/bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/06/09 15:00	itk
Crush and Pulverize	USDA No. 1, 1972							10/15/09 15:42	bsu
Digestion - Hot Plate	M3050B ICP							10/09/09 12:00	itk
Saturated Paste Extraction	USDA No. 60 (2)							10/09/09 11:00	itk
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2							10/15/09 9:00	itk

Note: This report is for additional analysis of the sample previously reported as ACZ project L76592-02.

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L78387-02***
Project ID:	PR553454	Date Sampled:	*06/22/09 09:40*
Sample ID:	FID 1-25 0-6"	Date Received:	*09/25/09*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	143		*	mg/Kg	1	5	10/12/09 11:44	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	0			t CaCO3/Kt	1	5	10/19/09 12:49	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	62			t CaCO3/Kt	1	5	10/19/09 12:49	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	62			t CaCO3/Kt	1	5	10/19/09 12:49	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	6.2		*	%	0.1	0.5	10/13/09 11:10	itk
pH, Saturated Paste	USDA No. 60 (21A)	6.2		*	units	0.1	0.1	10/09/09 12:55	itk
Solids, Percent	CLPSOW390, PART F, D-98	96.6		*	%	0.1	0.5	10/14/09 0:12	jjg
Sulfur, total	ASTM D-4239-85C, LECO Furnace	0.02	B	*	%	0.01	0.1	10/07/09 13:11	brd/bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/06/09 15:01	itk
Crush and Pulverize	USDA No. 1, 1972							10/06/09 15:49	itk
Digestion - Hot Plate	M3050B ICP							10/09/09 13:01	itk
Saturated Paste Extraction	USDA No. 60 (2)							10/09/09 12:55	itk

Note: This report is for additional analysis of the sample previously reported as ACZ project L76592-04.

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	PR553454	ACZ Sample ID:	***L78387-03***
Sample ID:	FID 2-25 0-6"	Date Sampled:	*06/22/09 10:47*
		Date Received:	*09/25/09*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	405		*	mg/Kg	1	5	10/12/09 11:48	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	0			t CaCO3/Kt	1	5	10/19/09 12:49	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	57			t CaCO3/Kt	1	5	10/19/09 12:49	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	57			t CaCO3/Kt	1	5	10/19/09 12:49	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	5.7		*	%	0.1	0.5	10/13/09 11:43	itk
pH, Saturated Paste	USDA No. 60 (21A)	5.6		*	units	0.1	0.1	10/09/09 14:51	itk
Solids, Percent	CLPSOW390, PART F, D-98	96.8		*	%	0.1	0.5	10/14/09 3:36	jjg
Sulfur, total	ASTM D-4239-85C, LECO Furnace	0.02	B	*	%	0.01	0.1	10/07/09 13:21	brd/bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/06/09 15:02	itk
Crush and Pulverize	USDA No. 1, 1972							10/06/09 16:38	itk
Digestion - Hot Plate	M3050B ICP							10/09/09 13:21	itk
Saturated Paste Extraction	USDA No. 60 (2)							10/09/09 14:51	itk

Note: This report is for additional analysis of the sample previously reported as ACZ project L76592-06.

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company
Project ID: PR553454
Sample ID: FID 3-25 0-6"

ACZ Sample ID: ***L78387-04***
Date Sampled: *06/18/09 14:47*
Date Received: *09/25/09*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	236		*	mg/Kg	1	5	10/12/09 11:51	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	5			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	164			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	159			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	16.4		*	%	0.1	0.5	10/14/09 11:10	itk
pH, Saturated Paste	USDA No. 60 (21A)	7.6		*	units	0.1	0.1	10/09/09 16:47	itk
Solids, Percent	CLPSOW390, PART F, D-98	98.7		*	%	0.1	0.5	10/14/09 7:00	jjg
Sulfur, total	ASTM D-4239-85C, LECO Furnace	0.17		*	%	0.01	0.1	10/07/09 13:30	brd/bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/06/09 15:03	itk
Crush and Pulverize	USDA No. 1, 1972							10/06/09 17:27	itk
Digestion - Hot Plate	M3050B ICP							10/09/09 13:41	itk
Saturated Paste Extraction	USDA No. 60 (2)							10/09/09 16:47	itk

Note: This report is for additional analysis of the sample previously reported as ACZ project L76592-08.

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L78387-05***
Project ID:	PR553454	Date Sampled:	*06/18/09 17:10*
Sample ID:	FID 4-25 0-6"	Date Received:	*09/25/09*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	599		*	mg/Kg	1	5	10/12/09 11:54	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	0			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	12			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	12			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	1.2		*	%	0.1	0.5	10/13/09 12:16	itk
pH, Saturated Paste	USDA No. 60 (21A)	6.0		*	units	0.1	0.1	10/09/09 18:42	itk
Solids, Percent	CLPSOW390, PART F, D-98	94.5		*	%	0.1	0.5	10/14/09 10:24	jjg
Sulfur, total	ASTM D-4239-85C, LECO Furnace		U	*	%	0.01	0.1	10/07/09 13:40	brd/bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/06/09 15:04	itk
Crush and Pulverize	USDA No. 1, 1972							10/06/09 18:17	itk
Digestion - Hot Plate	M3050B ICP							10/09/09 14:01	itk
Saturated Paste Extraction	USDA No. 60 (2)							10/09/09 18:42	itk

Note: This report is for additional analysis of the sample previously reported as ACZ project L76592-10.

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L78387-06***
Project ID:	PR553454	Date Sampled:	*06/18/09 09:55*
Sample ID:	FID 6-25 0-6"	Date Received:	*09/25/09*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	182		*	mg/Kg	1	5	10/12/09 11:58	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	0			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	7			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	7			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	0.7		*	%	0.1	0.5	10/13/09 12:49	itk
pH, Saturated Paste	USDA No. 60 (21A)	6.4		*	units	0.1	0.1	10/09/09 20:38	itk
Solids, Percent	CLPSOW390, PART F, D-98	97.3		*	%	0.1	0.5	10/14/09 13:48	jjg
Sulfur, total	ASTM D-4239-85C, LECO Furnace	0.02	B	*	%	0.01	0.1	10/07/09 13:49	brd/bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/06/09 15:05	itk
Crush and Pulverize	USDA No. 1, 1972							10/06/09 19:06	itk
Digestion - Hot Plate	M3050B ICP							10/09/09 14:21	itk
Saturated Paste Extraction	USDA No. 60 (2)							10/09/09 20:38	itk

Note: This report is for additional analysis of the sample previously reported as ACZ project L76592-12.

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L78387-07***
Project ID:	PR553454	Date Sampled:	*06/19/09 14:17*
Sample ID:	FID 7-25 0-6"	Date Received:	*09/25/09*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	242		*	mg/Kg	1	5	10/12/09 12:01	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	0			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	34			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	34			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	3.4		*	%	0.1	0.5	10/13/09 13:21	itk
pH, Saturated Paste	USDA No. 60 (21A)	5.2		*	units	0.1	0.1	10/10/09 0:30	itk
Solids, Percent	CLPSOW390, PART F, D-98	95.8		*	%	0.1	0.5	10/14/09 17:12	jjg
Sulfur, total	ASTM D-4239-85C, LECO Furnace	0.01	B	*	%	0.01	0.1	10/07/09 14:08	brd/bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/06/09 15:06	itk
Crush and Pulverize	USDA No. 1, 1972							10/06/09 19:55	itk
Digestion - Hot Plate	M3050B ICP							10/09/09 14:41	itk
Saturated Paste Extraction	USDA No. 60 (2)							10/10/09 0:29	itk

Note: This report is for additional analysis of the sample previously reported as ACZ project L76592-14.

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L78387-08***
Project ID:	PR553454	Date Sampled:	*06/19/09 09:38*
Sample ID:	FID 10-25 0-6"	Date Received:	*09/25/09*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	1020		*	mg/Kg	1	5	10/12/09 12:04	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	2	B		t CaCO3/Kt	1	5	10/19/09 12:50	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	11			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	9			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	1.1		*	%	0.1	0.5	10/13/09 13:54	itk
pH, Saturated Paste	USDA No. 60 (21A)	6.0		*	units	0.1	0.1	10/10/09 2:25	itk
Solids, Percent	CLPSOW390, PART F, D-98	96.4		*	%	0.1	0.5	10/14/09 20:36	jjg
Sulfur, total	ASTM D-4239-85C, LECO Furnace	0.05	B	*	%	0.01	0.1	10/07/09 14:18	brd/bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/06/09 15:07	itk
Crush and Pulverize	USDA No. 1, 1972							10/06/09 20:44	itk
Digestion - Hot Plate	M3050B ICP							10/09/09 15:02	itk
Saturated Paste Extraction	USDA No. 60 (2)							10/10/09 2:25	itk

Note: This report is for additional analysis of the sample previously reported as ACZ project L76593-02.

Freeport-McMoRan - Chino Mines Company
Project ID: PR553454
Sample ID: FID 12-25 0-6"

ACZ Sample ID: ***L78387-09***
Date Sampled: *06/18/09 15:27*
Date Received: *09/25/09*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	4260		*	mg/Kg	1	5	10/12/09 12:07	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	32			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	35			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	3			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	3.5		*	%	0.1	0.5	10/14/09 12:00	itk
pH, Saturated Paste	USDA No. 60 (21A)	7.5		*	units	0.1	0.1	10/10/09 4:21	itk
Solids, Percent	CLPSOW390, PART F, D-98	98.4		*	%	0.1	0.5	10/15/09 0:00	jjg
Sulfur, total	ASTM D-4239-85C, LECO Furnace	1.02		*	%	0.01	0.1	10/07/09 14:27	brd/bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/06/09 15:08	itk
Crush and Pulverize	USDA No. 1, 1972							10/06/09 21:34	itk
Digestion - Hot Plate	M3050B ICP							10/09/09 15:22	itk
Saturated Paste Extraction	USDA No. 60 (2)							10/10/09 4:21	itk

Note: This report is for additional analysis of the sample previously reported as ACZ project L76593-04.

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID:	PR553454	ACZ Sample ID:	***L78387-10***
Sample ID:	FID 13-25 0-6"	Date Sampled:	*06/18/09 16:13*
		Date Received:	*09/25/09*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	1970		*	mg/Kg	1	5	10/12/09 12:11	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	11			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	25			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	14			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	2.5		*	%	0.1	0.5	10/13/09 14:27	itk
pH, Saturated Paste	USDA No. 60 (21A)	7.4		*	units	0.1	0.1	10/10/09 6:17	itk
Solids, Percent	CLPSOW390, PART F, D-98	97.6		*	%	0.1	0.5	10/15/09 3:24	jjg
Sulfur, total	ASTM D-4239-85C, LECO Furnace	0.34		*	%	0.01	0.1	10/07/09 14:37	brd/bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/06/09 15:09	itk
Crush and Pulverize	USDA No. 1, 1972							10/06/09 22:23	itk
Digestion - Hot Plate	M3050B ICP							10/09/09 15:42	itk
Saturated Paste Extraction	USDA No. 60 (2)							10/10/09 6:17	itk

Note: This report is for additional analysis of the sample previously reported as ACZ project L76593-06.

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L78387-11***
Project ID:	PR553454	Date Sampled:	*06/22/09 15:25*
Sample ID:	FID 15-25 0-6"	Date Received:	*09/25/09*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	1360		*	mg/Kg	1	5	10/12/09 12:14	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	17			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	22			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	5			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	2.2		*	%	0.1	0.5	10/13/09 15:00	itk
pH, Saturated Paste	USDA No. 60 (21A)	8.0		*	units	0.1	0.1	10/10/09 8:12	itk
Solids, Percent	CLPSOW390, PART F, D-98	98.7		*	%	0.1	0.5	10/15/09 6:48	jjg
Sulfur, total	ASTM D-4239-85C, LECO Furnace	0.55		*	%	0.01	0.1	10/07/09 14:46	brd/bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/06/09 15:10	itk
Crush and Pulverize	USDA No. 1, 1972							10/06/09 23:12	itk
Digestion - Hot Plate	M3050B ICP							10/09/09 16:02	itk
Saturated Paste Extraction	USDA No. 60 (2)							10/10/09 8:12	itk

Note: This report is for additional analysis of the sample previously reported as ACZ project L76593-08.

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L78387-12***
Project ID:	PR553454	Date Sampled:	*06/22/09 14:57*
Sample ID:	FID 16-25 0-6"	Date Received:	*09/25/09*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	512		*	mg/Kg	1	5	10/12/09 12:24	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	0			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	0			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	0			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3		U	*	%	0.1	0.5	10/13/09 15:32	itk
pH, Saturated Paste	USDA No. 60 (21A)	4.3		*	units	0.1	0.1	10/10/09 10:08	itk
Solids, Percent	CLPSOW390, PART F, D-98	98.9		*	%	0.1	0.5	10/15/09 10:12	jjg
Sulfur, total	ASTM D-4239-85C, LECO Furnace		U	*	%	0.01	0.1	10/07/09 14:55	brd/bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/06/09 15:11	itk
Crush and Pulverize	USDA No. 1, 1972							10/07/09 0:02	itk
Digestion - Hot Plate	M3050B ICP							10/09/09 16:22	itk
Saturated Paste Extraction	USDA No. 60 (2)							10/10/09 10:08	itk

Note: This report is for additional analysis of the sample previously reported as ACZ project L76593-10.

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID: PR553454
Sample ID: FID 17-25 0-6"

ACZ Sample ID: ***L78387-13***
Date Sampled: *06/18/09 15:45*
Date Received: *09/25/09*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	4680		*	mg/Kg	1	5	10/12/09 12:27	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	20			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	26			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	6			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	2.6		*	%	0.1	0.5	10/14/09 12:50	itk
pH, Saturated Paste	USDA No. 60 (21A)	6.6		*	units	0.1	0.1	10/10/09 12:04	itk
Solids, Percent	CLPSOW390, PART F, D-98	98.0		*	%	0.1	0.5	10/15/09 13:36	jjg
Sulfur, total	ASTM D-4239-85C, LECO Furnace	0.64		*	%	0.01	0.1	10/07/09 15:05	brd/bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/06/09 15:12	itk
Crush and Pulverize	USDA No. 1, 1972							10/07/09 0:51	itk
Digestion - Hot Plate	M3050B ICP							10/09/09 16:42	itk
Saturated Paste Extraction	USDA No. 60 (2)							10/10/09 12:04	itk

Note: This report is for additional analysis of the sample previously reported as ACZ project L76593-12.

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company
Project ID: PR553454
Sample ID: FID 18-25 0-6"

ACZ Sample ID: ***L78387-14***
Date Sampled: *06/22/09 14:07*
Date Received: *09/25/09*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	326		*	mg/Kg	1	5	10/12/09 12:30	ear

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	1	B		t CaCO3/Kt	1	5	10/19/09 12:50	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	0			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-1			t CaCO3/Kt	1	5	10/19/09 12:50	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3		U	*	%	0.1	0.5	10/13/09 16:05	itk
pH, Saturated Paste	USDA No. 60 (21A)	4.3		*	units	0.1	0.1	10/10/09 14:00	itk
Solids, Percent	CLPSOW390, PART F, D-98	99.1		*	%	0.1	0.5	10/15/09 17:00	jjg
Sulfur, total	ASTM D-4239-85C, LECO Furnace	0.04	B	*	%	0.01	0.1	10/07/09 15:14	brd/bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/06/09 15:13	itk
Crush and Pulverize	USDA No. 1, 1972							10/07/09 1:40	itk
Digestion - Hot Plate	M3050B ICP							10/09/09 17:03	itk
Saturated Paste Extraction	USDA No. 60 (2)							10/10/09 13:59	itk

Note: This report is for additional analysis of the sample previously reported as ACZ project L76593-14.

** Please refer to Qualifier Reports for details.*

Inorganic Reference

Report Header Explanations

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit, typically 5 times the MDL.
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Amount of the true value or spike added recovered, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of interest

QC Sample Types

AS	Analytical Spike (Post Digestion)	LCSWD	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	LFB	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	LFM	Laboratory Fortified Matrix
CCV	Continuing Calibration Verification standard	LFMD	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	LRB	Laboratory Reagent Blank
ICB	Initial Calibration Blank	MS	Matrix Spike
ICV	Initial Calibration Verification standard	MSD	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	PBS	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	PBW	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	PQV	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	SDL	Serial Dilution

QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

ACZ Qualifiers (Qual)

B	Analyte concentration detected at a value between MDL and PQL. The associated value is an estimated quantity.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Method References

(1) EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
(2) EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.
(3) EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.
(5) EPA SW-846. Test Methods for Evaluating Solid Waste, Third Edition with Update III, December 1996.
(6) Standard Methods for the Examination of Water and Wastewater, 19th edition, 1995 & 20th edition (1998).

Comments

(1) QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
(2) Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.
(3) Animal matrices for Inorganic analyses are reported on an "as received" basis.

For a complete list of ACZ's Extended Qualifiers, please click: http://www.acz.com/public/extquallist.pdf

Freeport-McMoRan - Chino Mines Company
Project ID: PR553454

ACZ Project ID: ***L78387***

Copper, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG272001													
WG272001ICV	ICV	10/12/09 10:58	II091007-3	2		1.944	mg/L	97.2	90	110			
WG272001ICB	ICB	10/12/09 11:02				U	mg/L		-0.03	0.03			
WG271900PBS	PBS	10/12/09 11:15				U	mg/Kg		-3	3			
WG271900LCSS	LCSS	10/12/09 11:18	PCN33158	237		218	mg/Kg		198	275			
WG271900LCSSD	LCSSD	10/12/09 11:21	PCN33158	237		240	mg/Kg		198	275	9.6	20	
L78387-01MS	MS	10/12/09 11:31	II091001-2	50.5	329	406.6	mg/Kg	153.7	75	125			M3
L78387-01MSD	MSD	10/12/09 11:35	II091001-2	50.5	329	421.7	mg/Kg	183.6	75	125	3.65	20	M3

Neutralization Potential as CaCO3 M600/2-78-054 3.2.3

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG272036													
WG272036PBS	PBS	10/13/09 9:00				U	%		-0.1	0.1			
WG272036LCSS	LCSS	10/13/09 9:32	PCN20880	100		96.98	%	97	80	120			
L78387-01DUP	DUP	10/13/09 10:38			1.1	1.01	%				8.5	20	
WG272037													
WG272037LCSS	LCSS	10/14/09 10:20	PCN20880	100		97.26	%	97.3	80	120			
L78415-01DUP	DUP	10/14/09 19:30			6.6	7.37	%				11	20	

pH, Saturated Paste USDA No. 60 (21A)

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG271894													
L78387-06DUP	DUP	10/09/09 22:34			6.4	6.45	units				0.8	20	

Solids, Percent CLPSOW390, PART F, D-98

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG272103													
WG272103PBS	PBS	10/13/09 14:00				U	%		99.9	100.1			
L78387-01DUP	DUP	10/13/09 20:48			97.6	97.83	%				0.2	20	

Sulfur, total ASTM D-4239-85C, LECO Furnace

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG271713													
WG271713PBS	PBS	10/07/09 12:15				U	%		-0.03	0.03			
WG271713LCSS	LCSS	10/07/09 12:24	PCN33366	4.24		4.24	%	100	80	120			
L78387-06DUP	DUP	10/07/09 13:59			.02	U	%				200	20	RA

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L78387-01	WG272001	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG271713	Sulfur, total	ASTM D-4239-85C, LECO Furnace	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L78387-02	WG272001	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG271713	Sulfur, total	ASTM D-4239-85C, LECO Furnace	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L78387-03	WG272001	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG271713	Sulfur, total	ASTM D-4239-85C, LECO Furnace	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L78387-04	WG272001	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG271713	Sulfur, total	ASTM D-4239-85C, LECO Furnace	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L78387-05	WG272001	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG271713	Sulfur, total	ASTM D-4239-85C, LECO Furnace	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L78387-06	WG272001	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG271713	Sulfur, total	ASTM D-4239-85C, LECO Furnace	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L78387-07	WG272001	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG271713	Sulfur, total	ASTM D-4239-85C, LECO Furnace	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L78387-08	WG272001	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG271713	Sulfur, total	ASTM D-4239-85C, LECO Furnace	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L78387-09	WG272001	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG271713	Sulfur, total	ASTM D-4239-85C, LECO Furnace	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L78387-10	WG272001	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG271713	Sulfur, total	ASTM D-4239-85C, LECO Furnace	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L78387-11	WG272001	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG271713	Sulfur, total	ASTM D-4239-85C, LECO Furnace	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L78387-12	WG272001	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG271713	Sulfur, total	ASTM D-4239-85C, LECO Furnace	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L78387-13	WG272001	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG271713	Sulfur, total	ASTM D-4239-85C, LECO Furnace	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L78387-14	WG272001	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG271713	Sulfur, total	ASTM D-4239-85C, LECO Furnace	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

Soil Analysis

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Neutralization Potential as CaCO3	M600/2-78-054 3.2.3
pH, Saturated Paste	USDA No. 60 (21A)
Solids, Percent	CLPSOW390, PART F, D-98
Sulfur, total	ASTM D-4239-85C, LECO Furnace

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Sample Receipt

Freeport-McMoRan - Chino Mines Company
B0063538.0002.00003

ACZ Project ID: L76592
Date Received: 6/24/2009
Received By:
Date Printed: 6/24/2009

Receipt Verification

	YES	NO	NA
1) Does this project require special handling procedures such as CLP protocol?			X
2) Are the custody seals on the cooler intact?	X		
3) Are the custody seals on the sample containers intact?			X
4) Is there a Chain of Custody or other directive shipping papers present?	X		
5) Is the Chain of Custody complete?	X		
6) Is the Chain of Custody in agreement with the samples received?	X		
7) Is there enough sample for all requested analyses?	X		
8) Are all samples within holding times for requested analyses?	X		
9) Were all sample containers received intact?	X		
10) Are the temperature blanks present?			X
11) Is the trip blank for Cyanide present?			X
12) Is the trip blank for VOA present?			X
13) Are samples requiring no headspace, headspace free?			X
14) Do the samples that require a Foreign Soils Permit have one?			X

Exceptions: If you answered no to any of the above questions, please describe

N/A

Contact (For any discrepancies, the client must be contacted)

N/A

Shipping Containers

Cooler Id	Temp (°C)	Rad (µR/hr)
NA8701	18.4	13

Client must contact ACZ Project Manager if analysis should not proceed for samples received outside of thermal preservation acceptance criteria.

Notes

Sample Receipt

Freeport-McMoRan - Chino Mines Company
B0063538.0002.00003

ACZ Project ID: L76592
Date Received: 6/24/2009
Received By:

Sample Container Preservation

SAMPLE	CLIENT ID	R < 2	G < 2	BK < 2	Y< 2	YG< 2	B< 2	O < 2	T >12	N/A	RAD	ID
L76592-01	FID 0-25 0-1"									X		☐
L76592-02	FID 0-25 0-6"									X		☐
L76592-03	FID 1-25 0-1"									X		☐
L76592-04	FID 1-25 0-6"									X		☐
L76592-05	FID 2-25 0-1"									X		☐
L76592-06	FID 2-25 0-6"									X		☐
L76592-07	FID 3-25 0-1"									X		☐
L76592-08	FID 3-25 0-6"									X		☐
L76592-09	FID 4-25 0-1"									X		☐
L76592-10	FID 4-25 0-6"									X		☐
L76592-11	FID 6-25 0-1"									X		☐
L76592-12	FID 6-25 0-6"									X		☐
L76592-13	FID 7-25 0-1"									X		☐
L76592-14	FID 7-25 0-6"									X		☐

Sample Container Preservation Legend

Abbreviation	Description	Container Type	Preservative/Limits
R	Raw/Nitric	RED	pH must be < 2
B	Filtered/Sulfuric	BLUE	pH must be < 2
BK	Filtered/Nitric	BLACK	pH must be < 2
G	Filtered/Nitric	GREEN	pH must be < 2
O	Raw/Sulfuric	ORANGE	pH must be < 2
P	Raw/NaOH	PURPLE	pH must be > 12 *
T	Raw/NaOH Zinc Acetate	TAN	pH must be > 12
Y	Raw/Sulfuric	YELLOW	pH must be < 2
YG	Raw/Sulfuric	YELLOW GLASS	pH must be < 2
N/A	No preservative needed	Not applicable	
RAD	Gamma/Beta dose rate	Not applicable	must be < 250 µR/hr

* pH check performed by analyst prior to sample preparation

Sample IDs Reviewed By: ______________________

L78387

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: FMI - Chino Mines
E-mail: pamela_pinson@fmi.com
Address: 210 Cortez Avenue
Hurley, NM 88043
Telephone: 575-537-4213

Copy of Report to:

Name: Rebecca Lindeman
Company: ARCADIS
E-mail: rebecca.lindeman@arcadis-us.com
Telephone: 303-231-9115

Invoice to:

Name: Pam Pinson
Company: FMI - Chino Mines
E-mail: pamela_pinson@fmi.com
Address: 210 Cortez Avenue
Hurley, NM 88043
Telephone: 575-537-4213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.
YES ☒
NO ☐

Are samples for CO DW Compliance Monitoring? If yes, please include state forms. Results will be reported to PQL.
YES ☐
NO ☒

PROJECT INFORMATION

Quote #: CHINO-SOIL-ANALYSIS
Project/PO #: B0063538.0002.00003
Reporting state for compliance testing:
Sampler's Name: K. Thompson/ARCADIS
Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED *(attach list or use quote number)*

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	Total Copper (dry weight)	% moisture	Acd-Base Accounting					
FID 0-25 0-1"	6/18/09 1025	SO	1	x	x						
FID 0-25 0-6"	6/18/09 1026	SO	1	x	x	x	L76592-02				
FID 1-25 0-1"	6/22/09 0938	SO	1	x	x						
FID 1-25 0-6"	6/22/09 0940	SO	1	x	x	x				-04	
FID 2-25 0-1"	6/22/09 1045	SO	1	x	x						
FID 2-25 0-6"	6/22/09 1047	SO	1	x	x	x				-06	
FID 3-25 0-1"	6/18/09 1445	SO	1	x	x						
FID 3-25 0-6"	6/18/09 1447	SO	1	x	x	x				-08	
FID 4-25 0-1"	6/18/09 1707	SO	1	x	x						
FID 4-25 0-6"	6/18/09 1710	SO	1	x	x	x				-10	

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

FMI purchase requisition PR553454

NOTE: COC revised on 09-10-09 and resubmitted.

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: FMI - Chino Mines
E-mail: pamela_pinson@fmi.com

Address: 210 Cortez Avenue
Hurley, NM 88043
Telephone: 575-537-4213

Copy of Report to:

Name: Rebecca Lindeman
Company: ARCADIS

E-mail: rebecca.lindeman@arcadis-us.com
Telephone: 303-231-9115

Invoice to:

Name: Pam Pinson
Company: FMI - Chino Mines
E-mail: pamela_pinson@fmi.com

Address: 210 Cortez Avenue
Hurley, NM 88043
Telephone: 575-537-4213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified. YES ☒ NO ☐

Are samples for CO DW Compliance Monitoring? If yes, please include state forms. Results will be reported to PQL. YES ☐ NO ☒

PROJECT INFORMATION

Quote #: CHINO-SOIL-ANALYSIS
Project/PO #: B0063538.0002.00003
Reporting state for compliance testing:
Sampler's Name: K. Thompson/ARCADIS
Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED *(attach list or use quote number)*

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	Total Copper (dry weight)	% moisture	Acd-Base Accounting					
FID 5-25 0-1"	Not Sampled										
FID 5-25 0-6"	Not Sampled										
FID 6-25 0-1"	6/18/09 0950	SO	1	x	x						
FID 6-25 0-6"	6/18/09 0955	SO	1	x	x	x	L76592				-12
FID 7-25 0-1"	6/19/09 1415	SO	1	x	x						
FID 7-25 0-6"	6/19/09 1417	SO	1	x	x	x					-14
FID 8-25 0-1"	Not Sampled										
FID 8-25 0-6"	Not Sampled										
FID 9-25 0-1"	Not Sampled										
FID 9-25 0-6"	Not Sampled										

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

FMI purchase requisition PR553454

NOTE: COC revised on 09-10-09 and resubmitted.

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: FMI - Chino Mines
E-mail: pamela_pinson@fmi.com

Address: 210 Cortez Avenue
Hurley, NM 88043
Telephone: 575-537-4213

Copy of Report to:

Name: Rebecca Lindeman
Company: ARCADIS

E-mail: rebecca.lindeman@arcadis-us.com
Telephone: 303-231-9115

Invoice to:

Name: Pam Pinson
Company: FMI - Chino Mines
E-mail: pamela_pinson@fmi.com

Address: 210 Cortez Avenue
Hurley, NM 88043
Telephone: 575-537-4213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified. YES ☒ NO ☐

Are samples for CO DW Compliance Monitoring? If yes, please include state forms. Results will be reported to PQL. YES ☐ NO ☒

PROJECT INFORMATION

Quote #: CHINO-SOIL-ANALYSIS
Project/PO #: B0063538.0002.00003
Reporting state for compliance testing:
Sampler's Name: K. Thompson/ARCADIS
Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED *(attach list or use quote number)*

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	Total Copper (dry weight)	% moisture	Acd-Base Accounting					
FID 10-25 0-1"	6/19/09 0935	SO	1	×	×						
FID 10-25 0-6"	6/19/09 0938	SO	1	×	×	×					L76593-02
FID 11-25 0-1"	Not Sampled										
FID 11-25 0-6"	Not Sampled										
FID 12-25 0-1"	6/18/09 1525	SO	1	×	×						
FID 12-25 0-6"	6/18/09 1527	SO	1	×	×	×					-04
FID 13-25 0-1"	6/18/09 1610	SO	1	×	×						
FID 13-25 0-6"	6/18/09 1613	SO	1	×	×	×					-06
FID 14-25 0-1"	Not Sampled										
FID 14-25 0-6"	Not Sampled										

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

FMI purchase requisition PR553454

NOTE: COC revised on 09-10-09 and resubmitted.

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: FMI - Chino Mines
E-mail: pamela_pinson@fmi.com

Address: 210 Cortez Avenue
Hurley, NM 88043
Telephone: 575-537-4213

Copy of Report to:

Name: Rebecca Lindeman
Company: ARCADIS

E-mail: rebecca.lindeman@arcadis-us.com
Telephone: 303-231-9115

Invoice to:

Name: Pam Pinson
Company: FMI - Chino Mines
E-mail: pamela_pinson@fmi.com

Address: 210 Cortez Avenue
Hurley, NM 88043
Telephone: 575-537-4213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐
If yes, please include state forms. Results will be reported to PQL. NO ☒

PROJECT INFORMATION

Quote #: CHINO-SOIL-ANALYSIS
Project/PO #: B0063538.0002.00003
Reporting state for compliance testing:
Sampler's Name: K. Thompson/ARCADIS
Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED *(attach list or use quote number)*

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	Total Copper (dry weight)	% moisture	Acd-Base Accounting					
FID 15-25 0-1"	6/22/09 1523	SO	1	×	×						
FID 15-25 0-6"	6/22/09 1525	SO	1	×	×	×					L76593-08
FID 16-25 0-1"	6/22/09 1455	SO	1	×	×						
FID 16-25 0-6"	6/22/09 1457	SO	1	×	×	×					-10
FID 17-25 0-1"	6/18/09 1539	SO	1	×	×						
FID 17-25 0-6"	6/18/09 1545	SO	1	×	×	×					-12
FID 18-25 0-1"	6/22/09 1405	SO	1	×	×						
FID 18-25 0-6"	6/22/09 1407	SO	1	×	×	×					-14
FID 19-25 0-1"	Not Sampled										
FID 19-25 0-6"	Not Sampled										

Matrix SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

FMI purchase requisition PR553454

NOTE: COC revised on 09-10-09 and resubmitted.

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

ACZ Laboratories, Inc.
2773 Downhill Drive   Steamboat Springs, CO 80487   (800) 334-5493

Analytical Report

November 13, 2009

Report to:
Pam Pinson
Freeport-McMoRan - Chino Mines Company
210 Cortez Ave.   Box 7
Hurley, NM 88043

cc: Rebecca Lindeman

Bill to:
Accounts Payable
Freeport-McMoRan - Chino Mines Company
P.O. Box 13308
Phoenix, AZ 85002-3308

Project ID:
ACZ Project ID: L78892

Pam Pinson:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on October 19, 2009. This project has been assigned to ACZ's project number, L78892. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan. The enclosed results relate only to the samples received under L78892. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all requirements of NELAC.

This report shall be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after December 13, 2009. If the samples are determined to be hazardous, additional charges apply for disposal (typically less than $10/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical reports for five years.

If you have any questions or other needs, please contact your Project Manager.

S. Habermehl

Scott Habermehl has reviewed
and approved this report.

ACCREDITED IN ACCORDANCE WITH nelac

ACIL

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company
Project ID:
Sample ID: FID 08-25 0-1"

ACZ Sample ID: ***L78892-01***
Date Sampled: *10/07/09 12:54*
Date Received: *10/19/09*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	328		*	mg/Kg	1	5	11/11/09 18:30	aeh

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	6.9		*	%	0.1	0.5	11/08/09 19:00	itk
pH, Saturated Paste	USDA No. 60 (21A)	4.4		*	units	0.1	0.1	11/09/09 22:00	itk

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/07/09 11:00	itk
Crush and Pulverize	USDA No. 1, 1972							11/11/09 7:15	brd
Digestion - Hot Plate	M3050B ICP							11/09/09 22:30	jjg
Saturated Paste Extraction	USDA No. 60 (2)							11/09/09 22:00	itk
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/09/09 10:00	bsu
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2							11/09/09 10:00	bsu

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID:		ACZ Sample ID:	***L78892-02***
Sample ID:	FID 08-25 0-6"	Date Sampled:	*10/07/09 12:55*
		Date Received:	*10/19/09*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	430		*	mg/Kg	1	5	11/11/09 18:40	aeh

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	4	B		t CaCO3/Kt	1	5	11/12/09 17:16	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	23			t CaCO3/Kt	1	5	11/12/09 17:16	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	19			t CaCO3/Kt	1	5	11/12/09 17:16	calc
Moisture Content	M209F, Gravimetric - 105 C	12.7		*	%	0.1	0.5	11/08/09 21:00	itk
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	2.3		*	%	0.1	0.5	11/09/09 15:06	itk
pH, Saturated Paste	USDA No. 60 (21A)	6.1		*	units	0.1	0.1	11/10/09 2:00	itk
Sulfur, total	ASTM D-4239-85C, LECO Furnace	0.14		*	%	0.01	0.1	11/09/09 16:40	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/07/09 11:48	itk
Crush and Pulverize	USDA No. 1, 1972							11/11/09 7:18	brd
Digestion - Hot Plate	M3050B ICP							11/10/09 6:00	jjg
Saturated Paste Extraction	USDA No. 60 (2)							11/09/09 22:05	itk
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/09/09 10:18	bsu
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2							11/09/09 10:18	bsu

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L78892-03***
Project ID:		Date Sampled:	*10/07/09 15:56*
Sample ID:	FID 23-25 0-1"	Date Received:	*10/19/09*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	168		*	mg/Kg	1	5	11/11/09 18:50	aeh

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	8.1		*	%	0.1	0.5	11/08/09 22:00	itk
pH, Saturated Paste	USDA No. 60 (21A)	3.8		*	units	0.1	0.1	11/10/09 4:00	itk

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/07/09 12:36	itk
Crush and Pulverize	USDA No. 1, 1972							11/11/09 7:21	brd
Digestion - Hot Plate	M3050B ICP							11/10/09 8:30	jjg
Saturated Paste Extraction	USDA No. 60 (2)							11/09/09 22:07	itk
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/09/09 10:36	bsu
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2							11/09/09 10:36	bsu

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company
Project ID:
Sample ID: FID 23-25 0-6"

ACZ Sample ID: ***L78892-04***
Date Sampled: *10/07/09 15:58*
Date Received: *10/19/09*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	252		*	mg/Kg	1	5	11/11/09 18:53	aeh

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	5			t CaCO3/Kt	1	5	11/12/09 17:16	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	0			t CaCO3/Kt	1	5	11/12/09 17:16	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-5			t CaCO3/Kt	1	5	11/12/09 17:16	calc
Moisture Content	M209F, Gravimetric - 105 C	5.5		*	%	0.1	0.5	11/08/09 23:00	itk
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3		U	*	%	0.1	0.5	11/09/09 16:54	itk
pH, Saturated Paste	USDA No. 60 (21A)	3.7		*	units	0.1	0.1	11/10/09 6:00	itk
Sulfur, total	ASTM D-4239-85C, LECO Furnace	0.16		*	%	0.01	0.1	11/09/09 17:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/07/09 13:24	itk
Crush and Pulverize	USDA No. 1, 1972							11/11/09 7:24	brd
Digestion - Hot Plate	M3050B ICP							11/10/09 11:00	jjg
Saturated Paste Extraction	USDA No. 60 (2)							11/09/09 22:10	itk
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/09/09 10:54	bsu
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2							11/09/09 10:54	bsu

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company
Project ID:
Sample ID: FID 43-25 0-1"

ACZ Sample ID: ***L78892-05***
Date Sampled: *10/07/09 00:00*
Date Received: *10/19/09*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	229		*	mg/Kg	1	5	11/11/09 19:00	aeh

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Moisture Content	M209F, Gravimetric - 105 C	1.8		*	%	0.1	0.5	11/09/09 0:00	itk
pH, Saturated Paste	USDA No. 60 (21A)	3.7		*	units	0.1	0.1	11/10/09 8:00	itk

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/07/09 14:12	itk
Crush and Pulverize	USDA No. 1, 1972							11/11/09 7:27	brd
Digestion - Hot Plate	M3050B ICP							11/10/09 13:30	jjg
Saturated Paste Extraction	USDA No. 60 (2)							11/09/09 22:12	itk
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/09/09 11:12	bsu
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2							11/09/09 11:12	bsu

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L78892-06***
Project ID:		Date Sampled:	*10/07/09 00:00*
Sample ID:	FID 43-25 0-6"	Date Received:	*10/19/09*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	466		*	mg/Kg	1	5	11/11/09 19:03	aeh

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	29			t CaCO3/Kt	1	5	11/12/09 17:16	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	0			t CaCO3/Kt	1	5	11/12/09 17:16	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-29			t CaCO3/Kt	1	5	11/12/09 17:16	calc
Moisture Content	M209F, Gravimetric - 105 C	5.9		*	%	0.1	0.5	11/09/09 1:00	itk
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3		U	*	%	0.1	0.5	11/09/09 20:30	itk
pH, Saturated Paste	USDA No. 60 (21A)	4.2		*	units	0.1	0.1	11/10/09 10:00	itk
Sulfur, total	ASTM D-4239-85C, LECO Furnace	0.93		*	%	0.01	0.1	11/09/09 17:40	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/07/09 15:00	itk
Crush and Pulverize	USDA No. 1, 1972							11/11/09 7:30	brd
Digestion - Hot Plate	M3050B ICP							11/10/09 16:00	jjg
Saturated Paste Extraction	USDA No. 60 (2)							11/09/09 22:15	itk
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/09/09 11:30	bsu
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2							11/09/09 11:30	bsu

** Please refer to Qualifier Reports for details.*

Inorganic Reference

Report Header Explanations

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit, typically 5 times the MDL.
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Amount of the true value or spike added recovered, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of interest

QC Sample Types

AS	Analytical Spike (Post Digestion)	LCSWD	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	LFB	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	LFM	Laboratory Fortified Matrix
CCV	Continuing Calibration Verification standard	LFMD	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	LRB	Laboratory Reagent Blank
ICB	Initial Calibration Blank	MS	Matrix Spike
ICV	Initial Calibration Verification standard	MSD	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	PBS	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	PBW	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	PQV	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	SDL	Serial Dilution

QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

ACZ Qualifiers (Qual)

B	Analyte concentration detected at a value between MDL and PQL. The associated value is an estimated quantity.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Method References

(1)	EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
(2)	EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.
(3)	EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.
(5)	EPA SW-846. Test Methods for Evaluating Solid Waste, Third Edition with Update III, December 1996.
(6)	Standard Methods for the Examination of Water and Wastewater, 19th edition, 1995 & 20th edition (1998).

Comments

(1) QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
(2) Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.
(3) Animal matrices for Inorganic analyses are reported on an "as received" basis.

For a complete list of ACZ's Extended Qualifiers, please click: http://www.acz.com/public/extquallist.pdf

Freeport-McMoRan - Chino Mines Company
Project ID:

ACZ Project ID: ***L78892***

Copper, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG273958													
WG273958ICV	ICV	11/11/09 18:04	II091007-3	2		1.919	mg/L	96	90	110			
WG273958ICB	ICB	11/11/09 18:07				U	mg/L		-0.03	0.03			
WG273816PBS	PBS	11/11/09 18:20				U	mg/Kg		-3	3			
WG273816LCSS	LCSS	11/11/09 18:23	PCN33547	65.3		65.6	mg/Kg		52.5	78.1			
WG273816LCSSD	LCSSD	11/11/09 18:27	PCN33547	65.3		63.5	mg/Kg		52.5	78.1	3.3	20	
L78892-01MS	MS	11/11/09 18:33	II091023-7	50.5	328	362.3	mg/Kg	67.9	75	125			M3
L78892-01MSD	MSD	11/11/09 18:36	II091023-7	50.5	328	368.6	mg/Kg	80.4	75	125	1.72	20	

Moisture Content M209F, Gravimetric - 105 C

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG273745													
WG273745PBS	PBS	11/08/09 18:00				100	%		99.9	100.1			
L78892-01DUP	DUP	11/08/09 20:00			6.9	7.13	%				3.3	20	

Neutralization Potential as CaCO3 M600/2-78-054 3.2.3

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG273779													
WG273779PBS	PBS	11/09/09 11:30				U	%		-0.1	0.1			
WG273779LCSS	LCSS	11/09/09 13:18	PCN33453	100		110.37	%	110.4	80	120			RA
L78892-04DUP	DUP	11/09/09 18:42			U	U	%				0	20	RA

pH, Saturated Paste USDA No. 60 (21A)

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG273833													
L78892-01DUP	DUP	11/10/09 0:00			4.4	4.64	units				5.3	20	

Sulfur, total ASTM D-4239-85C, LECO Furnace

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG273776													
WG273776PBS	PBS	11/09/09 16:00				U	%		-0.03	0.03			
WG273776LCSS	LCSS	11/09/09 16:20	PCN33366	4.24		4.27	%	100.7	80	120			
L78892-04DUP	DUP	11/09/09 17:20			.16	.15	%				6.5	20	

Freeport-McMoRan - Chino Mines Company

ACZ Project ID: ***L78892***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L78892-01	WG273958	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L78892-02	WG273958	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG273779	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L78892-03	WG273958	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L78892-04	WG273958	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG273779	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L78892-05	WG273958	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L78892-06	WG273958	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG273779	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

Soil Analysis

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Moisture Content	M209F, Gravimetric - 105 C
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3
pH, Saturated Paste	USDA No. 60 (21A)
Sulfur, total	ASTM D-4239-85C, LECO Furnace

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Sample Receipt

Freeport-McMoRan - Chino Mines Company

ACZ Project ID: L78892
Date Received: 11:12:18 AM
Received By:
Date Printed: 10/19/2009

Receipt Verification

	YES	NO	NA
1) Does this project require special handling procedures such as CLP protocol?			X
2) Are the custody seals on the cooler intact?			X
3) Are the custody seals on the sample containers intact?			X
4) Is there a Chain of Custody or other directive shipping papers present?	X		
5) Is the Chain of Custody complete?		X	
6) Is the Chain of Custody in agreement with the samples received?	X		
7) Is there enough sample for all requested analyses?	X		
8) Are all samples within holding times for requested analyses?	X		
9) Were all sample containers received intact?	X		
10) Are the temperature blanks present?			X
11) Is the trip blank for Cyanide present?			X
12) Is the trip blank for VOA present?			X
13) Are samples requiring no headspace, headspace free?			X
14) Do the samples that require a Foreign Soils Permit have one?			X

Exceptions: If you answered no to any of the above questions, please describe

The Chain of Custody was not reliquished. There was no contact information for the sampler regarding the un-relinquished COC.

Contact (For any discrepancies, the client must be contacted)

N/A

Shipping Containers

Cooler Id	Temp (°C)	Rad (µR/hr)
na9543	18	15

Client must contact ACZ Project Manager if analysis should not proceed for samples received outside of thermal preservation acceptance criteria.

Notes

Freeport-McMoRan - Chino Mines Company

ACZ Project ID: L78892
Date Received: 11:12:18 AM
Received By:

Sample Container Preservation

SAMPLE	CLIENT ID	R < 2	G < 2	BK < 2	Y< 2	YG< 2	B< 2	O < 2	T >12	N/A	RAD	ID
L78892-01	FID 08-25 0-1"									X		☐
L78892-02	FID 08-25 0-6"									X		☐
L78892-03	FID 23-25 0-1"									X		☐
L78892-04	FID 23-25 0-6"									X		☐
L78892-05	FID 43-25 0-1"									X		☐
L78892-06	FID 43-25 0-6"									X		☐

Sample Container Preservation Legend

Abbreviation	Description	Container Type	Preservative/Limits
R	Raw/Nitric	RED	pH must be < 2
B	Filtered/Sulfuric	BLUE	pH must be < 2
BK	Filtered/Nitric	BLACK	pH must be < 2
G	Filtered/Nitric	GREEN	pH must be < 2
O	Raw/Sulfuric	ORANGE	pH must be < 2
P	Raw/NaOH	PURPLE	pH must be > 12 *
T	Raw/NaOH Zinc Acetate	TAN	pH must be > 12
Y	Raw/Sulfuric	YELLOW	pH must be < 2
YG	Raw/Sulfuric	YELLOW GLASS	pH must be < 2
N/A	No preservative needed	Not applicable	
RAD	Gamma/Beta dose rate	Not applicable	must be < 250 µR/hr

* pH check performed by analyst prior to sample preparation

Sample IDs Reviewed By: ______________________

ACZ Laboratories, Inc. L78890

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: FMI - Chino Mines
E-mail: pamela_pinson@fmi.com

Address: 210 Cortez Avenue
Hurley, NM 88043
Telephone: 575-537-4213

Copy of Report to:

Name: Rebecca Lindeman
Company: ARCADIS

E-mail: rebecca.lindeman@arcadis-us.com
Telephone: 303-231-9115

Invoice to:

Name: Pam Pinson
Company: FMI - Chino Mines
E-mail: pamela_pinson@fmi.com

Address: 210 Cortez Avenue
Hurley, NM 88043
Telephone: 575-537-4213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐ NO ☒
If yes, please include state forms. Results will be reported to PQL.

PROJECT INFORMATION — **ANALYSES REQUESTED (attach list or use quote number)**

Quote #: CHINO-SOIL-ANALYSIS
Project/PO #:
Reporting state for compliance testing:
Sampler's Name: C. Meyer, ARCADIS
Are any samples NRC licensable material? Yes No

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	Total Copper (dry weight)	% moisture	Acid-Base Accounting					
FID 08-25 0-1"	10/7/09 1254	SO	1	X	X						
FID 08-25 0-6"	10/7/09 1255	SO	1	X	X	X					
FID 23-25 0-1"	10/7/09 356	SO	1	X	X						
FID 23-25 0-6"	10/7/09 358	SO	1	X	X	X					
FID 43-25 0-1"	10/7/09	SO	1	X	X						
FID 43-25 0-6"	10/7/09	SO	1	X	X	X					

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
			10·19·09 11:12

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Analytical Report

April 06, 2011

Report to:	Bill to:
Pam Pinson	Pam Pinson
Freeport-McMoRan - Chino Mines Company	Freeport-McMoRan - Chino Mines Company
PO Box 10	P.O. Box 13308
Bayard, NM 88023	Phoenix, AZ 85002-3308

cc: Matthew Barkley

Project ID: ZN01CC
ACZ Project ID: L87074

Pam Pinson:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on March 22, 2011. This project has been assigned to ACZ's project number, L87074. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan. The enclosed results relate only to the samples received under L87074. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all requirements of NELAC.

This report shall be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after May 06, 2011. If the samples are determined to be hazardous, additional charges apply for disposal (typically less than $10/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical reports for five years.

If you have any questions or other needs, please contact your Project Manager.

Sue Webber

Sue Webber has reviewed and approved this report.

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN01CC	ACZ Sample ID:	***L87074-01***
Sample ID:	FID7	Date Sampled:	*11/04/10 12:00*
		Date Received:	*03/22/11*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	550			mg/Kg	1	5	04/04/11 12:43	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	2	B		t CaCO3/Kt	1	5	04/06/11 9:12	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	33			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	31			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	3.3		*	%	0.1	0.5	03/31/11 11:02	nrc
pH, Corrosivity	M9045D/M9040C								
pH		5.4			units	0.1	0.1	04/05/11 0:00	nrc
pH measured at		21.9			C	0.1	0.1	04/05/11 0:00	nrc
Sieve- 250 um (60 mesh)	ASA No.9, 15-4.2.2	33.8		*	% Passing	0.1	0.5	03/28/11 10:00	meg/zsh
Solids, Percent	CLPSOW390, PART F, D-98	97.3		*	%	0.1	0.5	03/24/11 12:11	bsu
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.04	B	*	%	0.01	0.1	03/31/11 0:00	bsu
Sulfur HNO3 Residue			U	*	%	0.01	0.1	03/31/11 0:00	bsu
Sulfur Organic Residual Mod			U	*	%	0.01	0.1	03/31/11 0:00	bsu
Sulfur Pyritic Sulfide		0.04	B	*	%	0.01	0.1	03/31/11 0:00	bsu
Sulfur Sulfate		0.01	B	*	%	0.01	0.1	03/31/11 0:00	bsu
Sulfur Total		0.05	B	*	%	0.01	0.1	03/31/11 0:00	bsu
Total Sulfur minus Sulfate		0.04	B	*	%	0.01	0.1	03/31/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							03/24/11 8:00	meg
Digestion - Hot Plate	M3050B ICP							03/30/11 15:24	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							03/24/11 13:00	brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN01CC	ACZ Sample ID:	***L87074-02***
Sample ID:	FID8	Date Sampled:	*11/05/10 09:30*
		Date Received:	*03/22/11*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	545			mg/Kg	1	5	04/04/11 12:46	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	21			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	0.0			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-21			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)		U	*	%	0.1	0.5	03/31/11 11:15	nrc
pH, Corrosivity	M9045D/M9040C								
pH		6.5			units	0.1	0.1	04/05/11 0:00	nrc
pH measured at		21.7			C	0.1	0.1	04/05/11 0:00	nrc
Sieve- 250 um (60 mesh)	ASA No.9, 15-4.2.2	29.2		*	% Passing	0.1	0.5	03/28/11 10:02	meg/zsh
Solids, Percent	CLPSOW390, PART F, D-98	92.8		*	%	0.1	0.5	03/24/11 14:33	bsu
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.37		*	%	0.01	0.1	04/01/11 0:00	bsu
Sulfur HNO3 Residue		0.06	B	*	%	0.01	0.1	04/01/11 0:00	bsu
Sulfur Organic Residual Mod		0.06	B	*	%	0.01	0.1	04/01/11 0:00	bsu
Sulfur Pyritic Sulfide		0.31		*	%	0.01	0.1	04/01/11 0:00	bsu
Sulfur Sulfate		0.31		*	%	0.01	0.1	04/01/11 0:00	bsu
Sulfur Total		0.68		*	%	0.01	0.1	04/01/11 0:00	bsu
Total Sulfur minus Sulfate		0.37		*	%	0.01	0.1	04/01/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							03/24/11 8:03	meg
Digestion - Hot Plate	M3050B ICP							03/30/11 16:32	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							03/24/11 13:00	brd

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN01CC	ACZ Sample ID:	***L87074-03***
Sample ID:	FID10	Date Sampled:	*11/03/10 11:30*
		Date Received:	*03/22/11*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	2060			mg/Kg	1	5	04/04/11 12:49	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	1	B		t CaCO3/Kt	1	5	04/06/11 9:12	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	2			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	1			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	0.2	B	*	%	0.1	0.5	03/31/11 11:27	nrc
pH, Corrosivity	M9045D/M9040C								
pH		4.8			units	0.1	0.1	04/05/11 0:00	nrc
pH measured at		21.6			C	0.1	0.1	04/05/11 0:00	nrc
Sieve- 250 um (60 mesh)	ASA No.9, 15-4.2.2	40.0		*	% Passing	0.1	0.5	03/28/11 10:03	meg/zsh
Solids, Percent	CLPSOW390, PART F, D-98	98.1		*	%	0.1	0.5	03/24/11 15:44	bsu
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.03	B	*	%	0.01	0.1	04/01/11 0:00	bsu
Sulfur HNO3 Residue			U	*	%	0.01	0.1	04/01/11 0:00	bsu
Sulfur Organic Residual Mod			U	*	%	0.01	0.1	04/01/11 0:00	bsu
Sulfur Pyritic Sulfide		0.03	B	*	%	0.01	0.1	04/01/11 0:00	bsu
Sulfur Sulfate		0.01	B	*	%	0.01	0.1	04/01/11 0:00	bsu
Sulfur Total		0.04	B	*	%	0.01	0.1	04/01/11 0:00	bsu
Total Sulfur minus Sulfate		0.03	B	*	%	0.01	0.1	04/01/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							03/24/11 8:07	meg
Digestion - Hot Plate	M3050B ICP							03/30/11 17:40	bsu

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN01CC	ACZ Sample ID:	***L87074-04***
Sample ID:	FID15	Date Sampled:	*11/03/10 10:00*
		Date Received:	*03/22/11*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	2520			mg/Kg	1	5	04/04/11 12:52	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	3	B		t CaCO3/Kt	1	5	04/06/11 9:12	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	1			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-2			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	0.1	B	*	%	0.1	0.5	03/31/11 11:40	nrc
pH, Corrosivity	M9045D/M9040C								
pH		4.9			units	0.1	0.1	04/05/11 0:00	nrc
pH measured at		21.7			C	0.1	0.1	04/05/11 0:00	nrc
Sieve- 250 um (60 mesh)	ASA No.9, 15-4.2.2	24.2		*	% Passing	0.1	0.5	03/28/11 10:04	meg/zsh
Solids, Percent	CLPSOW390, PART F, D-98	97.8		*	%	0.1	0.5	03/24/11 16:55	bsu
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.13		*	%	0.01	0.1	04/01/11 0:00	bsu
Sulfur HNO3 Residue		0.01	B	*	%	0.01	0.1	04/01/11 0:00	bsu
Sulfur Organic Residual Mod		0.01	B	*	%	0.01	0.1	04/01/11 0:00	bsu
Sulfur Pyritic Sulfide		0.12		*	%	0.01	0.1	04/01/11 0:00	bsu
Sulfur Sulfate			U	*	%	0.01	0.1	04/01/11 0:00	bsu
Sulfur Total		0.11		*	%	0.01	0.1	04/01/11 0:00	bsu
Total Sulfur minus Sulfate		0.11		*	%	0.01	0.1	04/01/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							03/24/11 8:10	meg
Digestion - Hot Plate	M3050B ICP							03/30/11 18:49	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							03/24/11 13:00	brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L87074-05***
Project ID:	ZN01CC	Date Sampled:	*11/03/10 09:30*
Sample ID:	FID16	Date Received:	*03/22/11*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	3550			mg/Kg	1	5	04/04/11 12:55	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	8			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	4			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-4			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	0.4	B	*	%	0.1	0.5	03/31/11 11:52	nrc
pH, Corrosivity	M9045D/M9040C								
pH		4.8			units	0.1	0.1	04/05/11 0:00	nrc
pH measured at		21.7			C	0.1	0.1	04/05/11 0:00	nrc
Sieve- 250 um (60 mesh)	ASA No.9, 15-4.2.2	40.5		*	% Passing	0.1	0.5	03/28/11 10:05	meg/zsh
Solids, Percent	CLPSOW390, PART F, D-98	97.3		*	%	0.1	0.5	03/24/11 18:06	bsu
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.22		*	%	0.01	0.1	04/01/11 0:00	bsu
Sulfur HNO3 Residue		0.07	B	*	%	0.01	0.1	04/01/11 0:00	bsu
Sulfur Organic Residual Mod		0.07	B	*	%	0.01	0.1	04/01/11 0:00	bsu
Sulfur Pyritic Sulfide		0.15		*	%	0.01	0.1	04/01/11 0:00	bsu
Sulfur Sulfate		0.05	B	*	%	0.01	0.1	04/01/11 0:00	bsu
Sulfur Total		0.27		*	%	0.01	0.1	04/01/11 0:00	bsu
Total Sulfur minus Sulfate		0.22		*	%	0.01	0.1	04/01/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							03/24/11 8:14	meg
Digestion - Hot Plate	M3050B ICP							03/30/11 19:57	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							03/24/11 13:00	brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L87074-06***
Project ID:	ZN01CC	Date Sampled:	*11/03/10 08:40*
Sample ID:	FID17	Date Received:	*03/22/11*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	4550			mg/Kg	1	5	04/04/11 12:59	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	18			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	0.0			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-18			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)		U	*	%	0.1	0.5	03/31/11 12:05	nrc
pH, Corrosivity	M9045D/M9040C								
pH		5.1			units	0.1	0.1	04/05/11 0:00	nrc
pH measured at		21.5			C	0.1	0.1	04/05/11 0:00	nrc
Sieve- 250 um (60 mesh)	ASA No.9, 15-4.2.2	28.2		*	% Passing	0.1	0.5	03/28/11 10:06	meg/zsh
Solids, Percent	CLPSOW390, PART F, D-98	98.0		*	%	0.1	0.5	03/24/11 19:17	bsu
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.45		*	%	0.01	0.1	04/02/11 0:00	bsu
Sulfur HNO3 Residue		0.08	B	*	%	0.01	0.1	04/02/11 0:00	bsu
Sulfur Organic Residual Mod		0.08	B	*	%	0.01	0.1	04/02/11 0:00	bsu
Sulfur Pyritic Sulfide		0.37		*	%	0.01	0.1	04/02/11 0:00	bsu
Sulfur Sulfate		0.12		*	%	0.01	0.1	04/02/11 0:00	bsu
Sulfur Total		0.57		*	%	0.01	0.1	04/02/11 0:00	bsu
Total Sulfur minus Sulfate		0.45		*	%	0.01	0.1	04/02/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							03/24/11 8:17	meg
Digestion - Hot Plate	M3050B ICP							03/30/11 21:05	bsu

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN01CC	ACZ Sample ID:	***L87074-07***
Sample ID:	FID18	Date Sampled:	*11/04/10 14:30*
		Date Received:	*03/22/11*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	559			mg/Kg	1	5	04/04/11 13:11	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	9			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	19			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	10			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1.9		*	%	0.1	0.5	03/31/11 12:17	nrc
pH, Corrosivity	M9045D/M9040C								
pH		3.9			units	0.1	0.1	04/05/11 0:00	nrc
pH measured at		21.6			C	0.1	0.1	04/05/11 0:00	nrc
Sieve- 250 um (60 mesh)	ASA No.9, 15-4.2.2	51.1		*	% Passing	0.1	0.5	03/28/11 10:07	meg/zsh
Solids, Percent	CLPSOW390, PART F, D-98	98.6		*	%	0.1	0.5	03/24/11 20:28	bsu
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.16		*	%	0.01	0.1	04/02/11 0:00	bsu
Sulfur HNO3 Residue		0.02	B	*	%	0.01	0.1	04/02/11 0:00	bsu
Sulfur Organic Residual Mod		0.02	B	*	%	0.01	0.1	04/02/11 0:00	bsu
Sulfur Pyritic Sulfide		0.14		*	%	0.01	0.1	04/02/11 0:00	bsu
Sulfur Sulfate		0.14		*	%	0.01	0.1	04/02/11 0:00	bsu
Sulfur Total		0.30		*	%	0.01	0.1	04/02/11 0:00	bsu
Total Sulfur minus Sulfate		0.16		*	%	0.01	0.1	04/02/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							03/24/11 8:21	meg
Digestion - Hot Plate	M3050B ICP							03/30/11 22:13	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							03/24/11 13:00	brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L87074-08***
Project ID:	ZN01CC	Date Sampled:	*11/05/10 11:45*
Sample ID:	FID23	Date Received:	*03/22/11*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	202			mg/Kg	1	5	04/04/11 13:14	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	3	B		t CaCO3/Kt	1	5	04/06/11 9:12	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	0.0			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-3			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)		U	*	%	0.1	0.5	03/31/11 12:30	nrc
pH, Corrosivity	M9045D/M9040C								
pH		4.4			units	0.1	0.1	04/05/11 0:00	nrc
pH measured at		21.3			C	0.1	0.1	04/05/11 0:00	nrc
Sieve- 250 um (60 mesh)	ASA No.9, 15-4.2.2	38.5		*	% Passing	0.1	0.5	03/28/11 10:08	meg/zsh
Solids, Percent	CLPSOW390, PART F, D-98	97.2		*	%	0.1	0.5	03/24/11 21:39	bsu
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.07	B	*	%	0.01	0.1	04/02/11 0:00	bsu
Sulfur HNO3 Residue			U	*	%	0.01	0.1	04/02/11 0:00	bsu
Sulfur Organic Residual Mod			U	*	%	0.01	0.1	04/02/11 0:00	bsu
Sulfur Pyritic Sulfide		0.07	B	*	%	0.01	0.1	04/02/11 0:00	bsu
Sulfur Sulfate		0.04	B	*	%	0.01	0.1	04/02/11 0:00	bsu
Sulfur Total		0.11		*	%	0.01	0.1	04/02/11 0:00	bsu
Total Sulfur minus Sulfate		0.07	B	*	%	0.01	0.1	04/02/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							03/24/11 8:24	meg
Digestion - Hot Plate	M3050B ICP							03/30/11 23:21	bsu

Freeport-McMoRan - Chino Mines Company
Project ID: ZN01CC
Sample ID: FID22

ACZ Sample ID: ***L87074-09***
Date Sampled: *11/04/10 13:00*
Date Received: *03/22/11*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	488			mg/Kg	1	5	04/04/11 13:17	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	6			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	10			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	4			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1.0		*	%	0.1	0.5	03/31/11 12:42	nrc
pH, Corrosivity	M9045D/M9040C								
pH		6.5			units	0.1	0.1	04/05/11 0:00	nrc
pH measured at		21.7			C	0.1	0.1	04/05/11 0:00	nrc
Sieve- 250 um (60 mesh)	ASA No.9, 15-4.2.2	44.9		*	% Passing	0.1	0.5	03/28/11 10:09	meg/zsh
Solids, Percent	CLPSOW390, PART F, D-98	95.6		*	%	0.1	0.5	03/24/11 22:50	bsu
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.15		*	%	0.01	0.1	04/02/11 0:00	bsu
Sulfur HNO3 Residue		0.02	B	*	%	0.01	0.1	04/02/11 0:00	bsu
Sulfur Organic Residual Mod		0.02	B	*	%	0.01	0.1	04/02/11 0:00	bsu
Sulfur Pyritic Sulfide		0.13		*	%	0.01	0.1	04/02/11 0:00	bsu
Sulfur Sulfate		0.05	B	*	%	0.01	0.1	04/02/11 0:00	bsu
Sulfur Total		0.20		*	%	0.01	0.1	04/02/11 0:00	bsu
Total Sulfur minus Sulfate		0.15		*	%	0.01	0.1	04/02/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							03/24/11 8:28	meg
Digestion - Hot Plate	M3050B ICP							03/31/11 0:30	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							03/24/11 13:00	brd

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN01CC	ACZ Sample ID:	***L87074-10***
Sample ID:	FID28	Date Sampled:	*11/04/10 10:30*
		Date Received:	*03/22/11*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	527			mg/Kg	1	5	04/04/11 13:20	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	6			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	137			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	131			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	13.7		*	%	0.1	0.5	03/31/11 12:55	nrc
pH, Corrosivity	M9045D/M9040C								
pH		7.7			units	0.1	0.1	04/05/11 0:00	nrc
pH measured at		21.6			C	0.1	0.1	04/05/11 0:00	nrc
Sieve- 250 um (60 mesh)	ASA No.9, 15-4.2.2	22.7		*	% Passing	0.1	0.5	03/28/11 10:10	meg/zsh
Solids, Percent	CLPSOW390, PART F, D-98	96.4		*	%	0.1	0.5	03/25/11 0:01	bsu
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.18		*	%	0.01	0.1	04/02/11 0:00	bsu
Sulfur HNO3 Residue		0.01	B	*	%	0.01	0.1	04/02/11 0:00	bsu
Sulfur Organic Residual Mod		0.01	B	*	%	0.01	0.1	04/02/11 0:00	bsu
Sulfur Pyritic Sulfide		0.17		*	%	0.01	0.1	04/02/11 0:00	bsu
Sulfur Sulfate			U	*	%	0.01	0.1	04/02/11 0:00	bsu
Sulfur Total		0.18		*	%	0.01	0.1	04/02/11 0:00	bsu
Total Sulfur minus Sulfate		0.18		*	%	0.01	0.1	04/02/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							03/24/11 8:31	meg
Digestion - Hot Plate	M3050B ICP							03/31/11 1:38	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							03/24/11 13:00	brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN01CC	ACZ Sample ID:	***L87074-11***
Sample ID:	FID37	Date Sampled:	*11/03/10 15:30*
		Date Received:	*03/22/11*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	1210			mg/Kg	1	5	04/04/11 13:24	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	2	B		t CaCO3/Kt	1	5	04/06/11 9:12	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	0.0			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-2			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)		U	*	%	0.1	0.5	03/31/11 13:07	nrc
pH, Corrosivity	M9045D/M9040C								
pH		4.8			units	0.1	0.1	04/05/11 0:00	nrc
pH measured at		21.6			C	0.1	0.1	04/05/11 0:00	nrc
Sieve- 250 um (60 mesh)	ASA No.9, 15-4.2.2	38.2		*	% Passing	0.1	0.5	03/28/11 10:11	meg/zsh
Solids, Percent	CLPSOW390, PART F, D-98	98.4		*	%	0.1	0.5	03/25/11 1:12	bsu
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.03	B	*	%	0.01	0.1	04/03/11 0:00	bsu
Sulfur HNO3 Residue		0.01	B	*	%	0.01	0.1	04/03/11 0:00	bsu
Sulfur Organic Residual Mod		0.01	B	*	%	0.01	0.1	04/03/11 0:00	bsu
Sulfur Pyritic Sulfide		0.02	B	*	%	0.01	0.1	04/03/11 0:00	bsu
Sulfur Sulfate		0.04	B	*	%	0.01	0.1	04/03/11 0:00	bsu
Sulfur Total		0.07	B	*	%	0.01	0.1	04/03/11 0:00	bsu
Total Sulfur minus Sulfate		0.03	B	*	%	0.01	0.1	04/03/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							03/24/11 8:35	meg
Digestion - Hot Plate	M3050B ICP							03/31/11 2:46	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							03/24/11 13:00	brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN01CC
Sample ID:	FID43

ACZ Sample ID:	***L87074-12***
Date Sampled:	*11/05/10 12:15*
Date Received:	*03/22/11*
Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	636			mg/Kg	1	5	04/04/11 13:27	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	18			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	25			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	7			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	2.5		*	%	0.1	0.5	03/31/11 13:20	nrc
pH, Corrosivity	M9045D/M9040C								
pH		6.5			units	0.1	0.1	04/05/11 0:00	nrc
pH measured at		21.5			C	0.1	0.1	04/05/11 0:00	nrc
Sieve- 250 um (60 mesh)	ASA No.9, 15-4.2.2	32.0		*	% Passing	0.1	0.5	03/28/11 10:12	meg/zsh
Solids, Percent	CLPSOW390, PART F, D-98	95.3		*	%	0.1	0.5	03/25/11 2:23	bsu
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.22		*	%	0.01	0.1	04/03/11 0:00	bsu
Sulfur HNO3 Residue			U	*	%	0.01	0.1	04/03/11 0:00	bsu
Sulfur Organic Residual Mod			U	*	%	0.01	0.1	04/03/11 0:00	bsu
Sulfur Pyritic Sulfide		0.22		*	%	0.01	0.1	04/03/11 0:00	bsu
Sulfur Sulfate		0.37		*	%	0.01	0.1	04/03/11 0:00	bsu
Sulfur Total		0.59		*	%	0.01	0.1	04/03/11 0:00	bsu
Total Sulfur minus Sulfate		0.22		*	%	0.01	0.1	04/03/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							03/24/11 8:38	meg
Digestion - Hot Plate	M3050B ICP							03/31/11 3:54	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							03/24/11 13:00	brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L87074-13***
Project ID:	ZN01CC	Date Sampled:	*11/04/10 14:00*
Sample ID:	FID101	Date Received:	*03/22/11*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	405			mg/Kg	1	5	04/04/11 13:30	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	9			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	0.0			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-9			t CaCO3/Kt	1	5	04/06/11 9:12	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)		U	*	%	0.1	0.5	03/31/11 13:32	nrc
pH, Corrosivity	M9045D/M9040C								
pH		4.2			units	0.1	0.1	04/05/11 0:00	nrc
pH measured at		21.6			C	0.1	0.1	04/05/11 0:00	nrc
Sieve- 250 um (60 mesh)	ASA No.9, 15-4.2.2	37.6		*	% Passing	0.1	0.5	03/28/11 10:13	meg/zsh
Solids, Percent	CLPSOW390, PART F, D-98	98.4		*	%	0.1	0.5	03/25/11 3:34	bsu
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.22		*	%	0.01	0.1	04/03/11 0:00	bsu
Sulfur HNO3 Residue		0.03	B	*	%	0.01	0.1	04/03/11 0:00	bsu
Sulfur Organic Residual Mod		0.03	B	*	%	0.01	0.1	04/03/11 0:00	bsu
Sulfur Pyritic Sulfide		0.19		*	%	0.01	0.1	04/03/11 0:00	bsu
Sulfur Sulfate		0.06	B	*	%	0.01	0.1	04/03/11 0:00	bsu
Sulfur Total		0.28		*	%	0.01	0.1	04/03/11 0:00	bsu
Total Sulfur minus Sulfate		0.22		*	%	0.01	0.1	04/03/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							03/24/11 8:42	meg
Digestion - Hot Plate	M3050B ICP							03/31/11 5:02	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							03/24/11 13:00	brd

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID: ZN01CC
Sample ID: FID102

ACZ Sample ID: ***L87074-14***
Date Sampled: *11/05/10 13:15*
Date Received: *03/22/11*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	358			mg/Kg	1	5	04/04/11 13:33	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	19			t CaCO3/Kt	1	5	04/06/11 9:13	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	0.0			t CaCO3/Kt	1	5	04/06/11 9:13	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-19			t CaCO3/Kt	1	5	04/06/11 9:13	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)		U	*	%	0.1	0.5	03/31/11 13:45	nrc
pH, Corrosivity	M9045D/M9040C								
pH		3.8			units	0.1	0.1	04/05/11 0:00	nrc
pH measured at		21.5			C	0.1	0.1	04/05/11 0:00	nrc
Sieve- 250 um (60 mesh)	ASA No.9, 15-4.2.2	30.3		*	% Passing	0.1	0.5	03/28/11 10:14	meg/zsh
Solids, Percent	CLPSOW390, PART F, D-98	98.6		*	%	0.1	0.5	03/25/11 4:45	bsu
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.48		*	%	0.01	0.1	04/03/11 0:00	bsu
Sulfur HNO3 Residue		0.05	B	*	%	0.01	0.1	04/03/11 0:00	bsu
Sulfur Organic Residual Mod		0.05	B	*	%	0.01	0.1	04/03/11 0:00	bsu
Sulfur Pyritic Sulfide		0.43		*	%	0.01	0.1	04/03/11 0:00	bsu
Sulfur Sulfate		0.14		*	%	0.01	0.1	04/03/11 0:00	bsu
Sulfur Total		0.62		*	%	0.01	0.1	04/03/11 0:00	bsu
Total Sulfur minus Sulfate		0.48		*	%	0.01	0.1	04/03/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							03/24/11 8:45	meg
Digestion - Hot Plate	M3050B ICP							03/31/11 6:10	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							03/24/11 13:00	brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN01CC	ACZ Sample ID:	***L87074-15***
Sample ID:	FID103	Date Sampled:	*11/05/10 11:30*
		Date Received:	*03/22/11*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	443			mg/Kg	1	5	04/04/11 13:36	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	2	B		t CaCO3/Kt	1	5	04/06/11 9:13	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	2			t CaCO3/Kt	1	5	04/06/11 9:13	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	0			t CaCO3/Kt	1	5	04/06/11 9:13	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	0.2	B	*	%	0.1	0.5	03/31/11 13:57	nrc
pH, Corrosivity	M9045D/M9040C								
pH		4.0			units	0.1	0.1	04/05/11 0:00	nrc
pH measured at		21.7			C	0.1	0.1	04/05/11 0:00	nrc
Sieve- 250 um (60 mesh)	ASA No.9, 15-4.2.2	46.5		*	% Passing	0.1	0.5	03/28/11 10:15	meg/zsh
Solids, Percent	CLPSOW390, PART F, D-98	96.3		*	%	0.1	0.5	03/25/11 5:56	bsu
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.03	B	*	%	0.01	0.1	04/04/11 0:00	bsu
Sulfur HNO3 Residue			U	*	%	0.01	0.1	04/04/11 0:00	bsu
Sulfur Organic Residual Mod			U	*	%	0.01	0.1	04/04/11 0:00	bsu
Sulfur Pyritic Sulfide		0.03	B	*	%	0.01	0.1	04/04/11 0:00	bsu
Sulfur Sulfate		0.03	B	*	%	0.01	0.1	04/04/11 0:00	bsu
Sulfur Total		0.06	B	*	%	0.01	0.1	04/04/11 0:00	bsu
Total Sulfur minus Sulfate		0.03	B	*	%	0.01	0.1	04/04/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							03/24/11 8:49	meg
Digestion - Hot Plate	M3050B ICP							03/31/11 7:19	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							03/24/11 13:00	brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L87074-16***
Project ID:	ZN01CC	Date Sampled:	*11/05/10 09:00*
Sample ID:	FID104	Date Received:	*03/22/11*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	459			mg/Kg	1	5	04/04/11 13:39	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	31			t CaCO3/Kt	1	5	04/06/11 9:13	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	0.0			t CaCO3/Kt	1	5	04/06/11 9:13	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-31			t CaCO3/Kt	1	5	04/06/11 9:13	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)		U	*	%	0.1	0.5	03/31/11 14:10	nrc
pH, Corrosivity	M9045D/M9040C								
pH		3.8			units	0.1	0.1	04/05/11 0:00	nrc
pH measured at		21.7			C	0.1	0.1	04/05/11 0:00	nrc
Sieve- 250 um (60 mesh)	ASA No.9, 15-4.2.2	64.3		*	% Passing	0.1	0.5	03/28/11 10:16	meg/zsh
Solids, Percent	CLPSOW390, PART F, D-98	93.3		*	%	0.1	0.5	03/25/11 7:07	bsu
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.37		*	%	0.01	0.1	04/04/11 0:00	bsu
Sulfur HNO3 Residue		0.06	B	*	%	0.01	0.1	04/04/11 0:00	bsu
Sulfur Organic Residual Mod		0.06	B	*	%	0.01	0.1	04/04/11 0:00	bsu
Sulfur Pyritic Sulfide		0.31		*	%	0.01	0.1	04/04/11 0:00	bsu
Sulfur Sulfate		0.61		*	%	0.01	0.1	04/04/11 0:00	bsu
Sulfur Total		0.98		*	%	0.01	0.1	04/04/11 0:00	bsu
Total Sulfur minus Sulfate		0.37		*	%	0.01	0.1	04/04/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							03/24/11 8:53	meg
Digestion - Hot Plate	M3050B ICP							03/31/11 8:27	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							03/24/11 13:00	brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN01CC	ACZ Sample ID:	***L87074-17***
Sample ID:	FID105	Date Sampled:	*11/03/10 14:30*
		Date Received:	*03/22/11*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	1390			mg/Kg	1	5	04/04/11 13:49	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	5			t CaCO3/Kt	1	5	04/06/11 9:13	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	0.0			t CaCO3/Kt	1	5	04/06/11 9:13	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-5			t CaCO3/Kt	1	5	04/06/11 9:13	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)		U	*	%	0.1	0.5	03/31/11 14:22	nrc
pH, Corrosivity	M9045D/M9040C								
pH		5.6			units	0.1	0.1	04/05/11 0:00	nrc
pH measured at		21.6			C	0.1	0.1	04/05/11 0:00	nrc
Sieve- 250 um (60 mesh)	ASA No.9, 15-4.2.2	41.3		*	% Passing	0.1	0.5	03/28/11 10:17	meg/zsh
Solids, Percent	CLPSOW390, PART F, D-98	95.1		*	%	0.1	0.5	03/25/11 8:18	bsu
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.14		*	%	0.01	0.1	04/04/11 0:00	bsu
Sulfur HNO3 Residue		0.03	B	*	%	0.01	0.1	04/04/11 0:00	bsu
Sulfur Organic Residual Mod		0.03	B	*	%	0.01	0.1	04/04/11 0:00	bsu
Sulfur Pyritic Sulfide		0.11		*	%	0.01	0.1	04/04/11 0:00	bsu
Sulfur Sulfate		0.03	B	*	%	0.01	0.1	04/04/11 0:00	bsu
Sulfur Total		0.17		*	%	0.01	0.1	04/04/11 0:00	bsu
Total Sulfur minus Sulfate		0.14		*	%	0.01	0.1	04/04/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							03/24/11 8:56	meg
Digestion - Hot Plate	M3050B ICP							03/31/11 9:35	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							03/24/11 13:00	brd

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN01CC	ACZ Sample ID:	***L87074-18***
Sample ID:	FID106	Date Sampled:	*11/04/10 11:30*
		Date Received:	*03/22/11*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	454			mg/Kg	1	5	04/04/11 13:52	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	1	B		t CaCO3/Kt	1	5	04/06/11 9:13	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	0.0			t CaCO3/Kt	1	5	04/06/11 9:13	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-1			t CaCO3/Kt	1	5	04/06/11 9:13	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)		U	*	%	0.1	0.5	03/31/11 14:35	nrc
pH, Corrosivity	M9045D/M9040C								
pH		5.0			units	0.1	0.1	04/05/11 0:00	nrc
pH measured at		21.5			C	0.1	0.1	04/05/11 0:00	nrc
Sieve- 250 um (60 mesh)	ASA No.9, 15-4.2.2	61.2		*	% Passing	0.1	0.5	03/28/11 10:18	meg/zsh
Solids, Percent	CLPSOW390, PART F, D-98	95.8		*	%	0.1	0.5	03/25/11 9:29	bsu
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.03	B	*	%	0.01	0.1	04/04/11 0:00	bsu
Sulfur HNO3 Residue			U	*	%	0.01	0.1	04/04/11 0:00	bsu
Sulfur Organic Residual Mod			U	*	%	0.01	0.1	04/04/11 0:00	bsu
Sulfur Pyritic Sulfide		0.03	B	*	%	0.01	0.1	04/04/11 0:00	bsu
Sulfur Sulfate		0.01	B	*	%	0.01	0.1	04/04/11 0:00	bsu
Sulfur Total		0.04	B	*	%	0.01	0.1	04/04/11 0:00	bsu
Total Sulfur minus Sulfate		0.03	B	*	%	0.01	0.1	04/04/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							03/24/11 9:00	meg
Digestion - Hot Plate	M3050B ICP							03/31/11 10:43	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							03/24/11 13:00	brd

Inorganic Reference

Report Header Explanations

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit, typically 5 times the MDL.
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Amount of the true value or spike added recovered, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of interest

QC Sample Types

AS	Analytical Spike (Post Digestion)	LCSWD	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	LFB	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	LFM	Laboratory Fortified Matrix
CCV	Continuing Calibration Verification standard	LFMD	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	LRB	Laboratory Reagent Blank
ICB	Initial Calibration Blank	MS	Matrix Spike
ICV	Initial Calibration Verification standard	MSD	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	PBS	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	PBW	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	PQV	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	SDL	Serial Dilution

QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

ACZ Qualifiers (Qual)

B	Analyte concentration detected at a value between MDL and PQL. The associated value is an estimated quantity.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Method References

(1) EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
(2) EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.
(3) EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.
(5) EPA SW-846. Test Methods for Evaluating Solid Waste, Third Edition with Update III, December 1996.
(6) Standard Methods for the Examination of Water and Wastewater, 19th edition, 1995 & 20th edition (1998).

Comments

(1) QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
(2) Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.
(3) Animal matrices for Inorganic analyses are reported on an "as received" basis.
(4) An asterisk in the "XQ" column indicates there is an extended qualifier and/or certification qualifier associated with the result.

For a complete list of ACZ's Extended Qualifiers, please click: http://www.acz.com/public/extquallist.pdf

Freeport-McMoRan - Chino Mines Company
Project ID: ZN01CC

ACZ Project ID: ***L87074***

Copper, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG299269													
WG299269ICV	ICV	04/04/11 12:18	II110104-3	2		1.986	mg/L	99.3	90	110			
WG299269ICB	ICB	04/04/11 12:21				U	mg/L		-0.03	0.03			
WG299161PBS	PBS	04/04/11 12:34				U	mg/Kg		-3	3			
WG299161LCSS	LCSS	04/04/11 12:37	PCN36182	187		182.1	mg/Kg		157	218			
WG299161LCSSD	LCSSD	04/04/11 12:40	PCN36182	187		191.1	mg/Kg		157	218	4.8	20	
L87074-18MS	MS	04/04/11 13:55	II110321-2	51	454	499.1	mg/Kg	88.4	75	125			
L87074-18MSD	MSD	04/04/11 13:58	II110321-2	51	454	500.6	mg/Kg	91.4	75	125	0.3	20	

Neutralization Potential as CaCO3 M600/2-78-054 3.2.3 - Modified (No Heat)

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG299160													
WG299160PBS	PBS	03/31/11 10:37				U	%		-0.1	0.1			
WG299160LCSS	LCSS	03/31/11 10:50	PCN33453	100		92.98	%	93	80	120			
L87074-18DUP	DUP	03/31/11 15:00			U	.25	%				200	20	RA

Ph M9045D/M9040C

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG299342													
WG299342ICV	ICV	04/05/11 10:22	PCN36402	4		4.03	units	100.8	90	110			
L87074-18DUP	DUP	04/05/11 12:52			5	4.98	units				0.4	20	

Sieve- 250 um (60 mesh) ASA No.9, 15-4.2.2

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG299031													
L87074-01DUP	DUP	03/28/11 10:01			33.8	40.9	% Passing				19	35	

Solids, Percent CLPSOW390, PART F, D-98

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG298891													
WG298891PBS	PBS	03/24/11 11:00				U	%		99.9	100.1			
L87074-01DUP	DUP	03/24/11 13:22			97.3	96.72	%				0.6	20	

Sulfur Organic Residual Mod M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG299217													
L87074-01DUP	DUP	04/01/11 1:39			U	U	%				0	20	RA

Sulfur Pyritic Sulfide M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG299217													
L87074-01DUP	DUP	04/01/11 1:39			.04	.03	%				28.6	20	RA

Freeport-McMoRan - Chino Mines Company
Project ID: ZN01CC

ACZ Project ID: ***L87074***

Sulfur Sulfate M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG299217													
L87074-01DUP	DUP	04/01/11 1:39			.01	.02	%				66.7	20	RA

Sulfur Total M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG299217													
WG299217PBS	PBS	03/31/11 10:30				U	%		-0.03	0.03			
WG299217LCSS	LCSS	03/31/11 15:33	PCN36956	4.24		4.74	%	111.8	3.392	5.088			
L87074-01DUP	DUP	04/01/11 1:39			.05	.05	%				0	20	RA

Total Sulfur Minus Sulfate M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG299217													
L87074-01DUP	DUP	04/01/11 1:39			.04	.03	%				28.6	20	RA

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L87074-01	WG299160	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG299217	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L87074-02	WG299160	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG299217	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L87074-03	WG299160	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG299217	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L87074-04	WG299160	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG299217	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L87074-05	WG299160	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG299217	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L87074-06	WG299160	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG299217	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L87074-07	WG299160	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG299217	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L87074-08	WG299160	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG299217	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L87074-09	WG299160	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG299217	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L87074-10	WG299160	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG299217	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L87074-11	WG299160	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG299217	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L87074-12	WG299160	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG299217	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L87074-13	WG299160	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG299217	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L87074-14	WG299160	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG299217	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L87074-15	WG299160	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG299217	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L87074-16	WG299160	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG299217	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L87074-17	WG299160	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG299217	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L87074-18	WG299160	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG299217	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

Certification Qualifiers

Freeport-McMoRan - Chino Mines Company

ACZ Project ID: ***L87074***

Soil Analysis

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)
Sieve- 250 um (60 mesh)	ASA No.9, 15-4.2.2
Solids, Percent	CLPSOW390, PART F, D-98
Sulfur HCl Residue	M600/2-78-054 3.2.4-MOD
Sulfur HNO3 Residue	M600/2-78-054 3.2.4-MOD
Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD
Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD
Sulfur Sulfate	M600/2-78-054 3.2.4-MOD
Sulfur Total	M600/2-78-054 3.2.4-MOD
Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD

Sample Receipt

Freeport-McMoRan - Chino Mines Company
ZN01CC

ACZ Project ID: L87074
Date Received: 03/22/2011 13:15
Received By: gac
Date Printed: 3/23/2011

Receipt Verification

	YES	NO	NA
1) Does this project require special handling procedures such as CLP protocol?			X
2) Are the custody seals on the cooler intact?			X
3) Are the custody seals on the sample containers intact?			X
4) Is there a Chain of Custody or other directive shipping papers present?	X		
5) Is the Chain of Custody complete?		X	
6) Is the Chain of Custody in agreement with the samples received?	X		
7) Is there enough sample for all requested analyses?	X		
8) Are all samples within holding times for requested analyses?	X		
9) Were all sample containers received intact?	X		
10) Are the temperature blanks present?			X
11) Are the trip blanks (VOA and/or Cyanide) present?			X
12) Are samples requiring no headspace, headspace free?			X
13) Do the samples that require a Foreign Soils Permit have one?			X

Exceptions: If you answered no to any of the above questions, please describe

The Chain of Custody was not reliquished.

Contact (For any discrepancies, the client must be contacted)

Matthew Barkley was contacted on 3/22/2011. The client emailed a signed copy of the chain of custody.

Shipping Containers

Cooler Id		Temp (°C)	Rad (µR/hr)
Na12613		15.6	30
Na12614		16.6	24

Client must contact ACZ Project Manager if analysis should not proceed for samples received outside of thermal preservation acceptance criteria.

Notes

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Sample Receipt

Freeport-McMoRan - Chino Mines Company
ZN01CC

ACZ Project ID:	L87074
Date Received:	03/22/2011 13:15
Received By:	gac
Date Printed:	3/23/2011

Sample Container Preservation

SAMPLE	CLIENT ID	R < 2	G < 2	BK < 2	Y< 2	YG< 2	B< 2	O < 2	T >12	N/A	RAD	ID
L87074-01	FID7									X		▣
L87074-02	FID8									X		▣
L87074-03	FID10									X		▣
L87074-04	FID15									X		▣
L87074-05	FID16									X		▣
L87074-06	FID17									X		▣
L87074-07	FID18									X		▣
L87074-08	FID23									X		▣
L87074-09	FID22									X		▣
L87074-10	FID28									X		▣
L87074-11	FID37									X		▣
L87074-12	FID43									X		▣
L87074-13	FID101									X		▣
L87074-14	FID102									X		▣
L87074-15	FID103									X		▣
L87074-16	FID104									X		▣
L87074-17	FID105									X		▣
L87074-18	FID106									X		▣

Sample Container Preservation Legend

Abbreviation	**Description**	**Container Type**	**Preservative/Limits**
R	Raw/Nitric	RED	pH must be < 2
B	Filtered/Sulfuric	BLUE	pH must be < 2
BK	Filtered/Nitric	BLACK	pH must be < 2
G	Filtered/Nitric	GREEN	pH must be < 2
O	Raw/Sulfuric	ORANGE	pH must be < 2
P	Raw/NaOH	PURPLE	pH must be > 12 *
T	Raw/NaOH Zinc Acetate	TAN	pH must be > 12
Y	Raw/Sulfuric	YELLOW	pH must be < 2
YG	Raw/Sulfuric	YELLOW GLASS	pH must be < 2
N/A	No preservative needed	Not applicable	
RAD	Gamma/Beta dose rate	Not applicable	must be < 250 µR/hr

* pH check performed by analyst prior to sample preparation

Sample IDs Reviewed By: gac

ACZ Laboratories, Inc. L87074
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: Chino Mines
E-mail: Pamela.Pinson @ FMI.com
Address: 1 Santa Rita Mine Rd
Vanadium, NM
Telephone: 575-912-5213

Copy of Report to:

Name: Matthew Barkley
Company: ARCADIS
E-mail: Matthew.barkley @ arcadis-us.com
Telephone: 303-231-9115 x 157

Invoice to:

Name: Pam Pinson
Company: Chino Mines
E-mail: Pamela-Pinson @ FMI.com
Address: 1 Santa Rita Mine Rd
Vanadium, NM
Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☐ NO ☐

If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for SDWA Compliance Monitoring? Yes ☐ No ☐
If yes, please include state forms. Results will be reported to PQL for Colorado.

Sampler's Name: MDLB Sampler's site Information State CO Zip code 804 Time Zone MST

PROJECT INFORMATION

Quote #:
Project/PO #:
Reporting state for compliance testing:
Check box if samples include NRC licensed material? ☐

ANALYSES REQUESTED *(attach list or use quote number)*

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	pH(9045c)	ABA (Modified Sobek)	Cu (6020)					
FID7	11/4/10 1200	SO	1	X	X	X					
FID8	11/5/10 0930	│	1	│	│	│					
FID10	11/3/10 1130	│	1	│	│	│					
FID 15	11/3/10 1000	│	1	│	│	│					
FID 16	11/3/10 0930	│	1	│	│	│					
FID17	11/3/10 0840	│	1	│	│	│					
FID18	11/4/10 1430	│	1	│	│	│					
FID23	11/5/10 1145	│	1	│	│	│					
FID22	11/4/10 1300	│	1	│	│	│					
FID 28	11/4/10 1030	SO	1	X	X	X					

Matrix SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

Please report samples in dry weight and sieve to 2000um
Please run FID17, 23, & 10 for the above analyses without sieving.

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
			3.20.11 13:10

FRMAD050.02.11.11 White - Return with sample. Yellow - Retain for your records.

L87074 Chain of Custody

ACZ Laboratories, Inc. L87074

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: Chino Mines
E-mail: Pamela.Pinson @ FMI.com

Address: 1 Santa Rita Mine Rd
Vanadium, NM
Telephone: 575-912-5213

Copy of Report to:

Name: Matthew Barkley
Company: ARCADIS

E-mail: Matthew.barkley @ arcadis-us.com
Telephone: 303-231-9115 x 157

Invoice to:

Name: Pam Pinson
Company: Chino Mines
E-mail: Pamela.Pinson @ FMI.com

Address: 1 Santa Rita Mine Rd
Vanadium, NM
Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☐ NO ☐

If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for SDWA Compliance Monitoring? Yes ☐ No ☐

If yes, please include state forms. Results will be reported to PQL for Colorado.

Sampler's Name: MDLB Sampler's site Information State CO Zip code 8040 Time Zone MST

PROJECT INFORMATION — ANALYSES REQUESTED *(attach list or use quote number)*

Quote #:
Project/PO #:
Reporting state for compliance testing:
Check box if samples include NRC licensed material? ☐

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	pH (9045c)	ABA (Modified Sobek)	Cu (6020c)					
FID37	11/3/10 1530	SO	1	X	X	X					
FID43	11/5/10 1215	SO	1								
FID101	11/4/10 1400	SO	1								
FID102	11/5/10 1315	SO	1								
FID103	11/5/10 1130	SO	1								
FID104	11/5/10 0900	SO	1								
FID105	11/3/10 1430	SO	1								
FID106	11/4/10 1130	SO	1	X	X	X					

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

Please report samples in dry weight and sieve to 2000um

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
			322·11 13 10

FRMAD050.02.11.11 White - Return with sample. Yellow - Retain for your records.

ACZ Laboratories, Inc. L87074

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: Chino Mines
E-mail: Pamela.Pinson@FMI.com

Address: 1 Santa Rita Mine Rd
Vanadium, NM
Telephone: 575-912-5213

Copy of Report to:

Name: Matthew Barkley
Company: ARCADIS

E-mail: matthew.barkley@arcadis-us.com
Telephone: 303-231-9115 x 157

Invoice to:

Name: Pam Pinson
Company: Chino Mines
E-mail: Pamela.Pinson@FMI.com

Address: 1 Santa Rita Mine Rd
Vanadium, NM
Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☐ NO ☐

If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for SDWA Compliance Monitoring? Yes ☐ No ☐

If yes, please include state forms. Results will be reported to PQL for Colorado.

Sampler's Name: MDLB Sampler's site information State CO Zip code 804 Time Zone MST

PROJECT INFORMATION

Quote #:

Project/PO #:

Reporting state for compliance testing:

Check box if samples include NRC licensed material? ☐

ANALYSES REQUESTED *(attach list or use quote number)*

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	pH(9045C)	ABA (modified Sobek)	Cu(6020)					
FID7	11/4/10 1200	SO	1	X	X	X					
FID8	11/5/10 0930		1								
FID10	11/3/10 1130		1								
FID 15	11/3/10 1000		1								
FID 16	11/3/10 0930		1								
FID17	11/5/10 0840		1								
FID18	11/4/10 1430		1								
FID23	11/5/10 1145		1								
FID22	11/4/10 1300		1								
FID 28	11/4/10 1030	SO	1	X	X	X					

Matrix: SW (Surface Water) · GW (Ground Water) WW (Waste Water) · DW (Drinking Water) · SL (Sludge) SO (Soil) OL (Oil) · Other (Specify)

REMARKS

Please report samples in dry weight and sieve to 2000um

Please run FID17, 23, & 10 for the above analyses without sieving.

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
Matt	3/21/11 0930		3-22-11 13:10

FRMAD050.02.11.11 White - Return with sample. Yellow - Retain for your records.

1

ACZ Laboratories, Inc. L87074

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: Chino Mines
E-mail: Pamela.Pinson @ FMI.com
Address: 1 Santa Rita Mine Rd
Vanadium, NM
Telephone: 575-912-5213

Copy of Report to:

Name: Matthew Barkley
Company: ARCADIS
E-mail: Matthew.barkley @ arcadis-us.com
Telephone: 303-231-9115 x 157

Invoice to:

Name: Pam Pinson
Company: Chino Mines
E-mail: Pamela-Pinson @ FMI.com
Address: 1 Santa Rita Mine Rd
Vanadium, NM
Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☐ NO ☐

If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for SDWA Compliance Monitoring? Yes ☐ No ☐

If yes, please include state forms. Results will be reported to PQL for Colorado.

Sampler's Name. MDLB Sampler's site information State CO Zip code 804 Time Zone MST

PROJECT INFORMATION

ANALYSES REQUESTED *(attach list or use quote number)*

Quote #:
Project/PO #:
Reporting state for compliance testing:
Check box if samples include NRC licensed material? ☐

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	pH(9045C)	ABA (Modified Sobek)	Cu(6020)						
FID37	11/3/10 1530	SO	1	X	X	X						
FID43	11/5/10 1215	SO	1									
FID101	11/4/10 1400	SO	1									
FID102	11/5/10 1315	SO	1									
FID103	11/5/10 1130	SO	1									
FID104	11/5/10 0900	SO	1									
FID105	11/3/10 1430	SO	1									
FID106	11/4/10 1130	SO	1	X	X	X						

Matrix SW (Surface Water) · GW (Ground Water) · WW (Waste Water) DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

Please report samples in dry weight and sieve to 2000um

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
	3/21/11 0930		3.22.11 1310

FRMAD050.02.11 11 White - Return with sample. Yellow - Retain for your records.

2

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Analytical Quote

Pam Pinson
Freeport-McMoRan - Chino Mines Company
PO Box 10
Bayard, NM 88023

Page 1 of 2
3/21/2011

Quote Number: TOTAL-CU-ABA

Matrix: Soil   Analysis of Freeport-McMoRan Chino Mine Soil Samples

Parameter	Method	Detection Limit	Cost/Sample
Metals Analysis			
Copper, total (3050)	M6010B ICP	1 mg/Kg	$9.00
Misc.			
Electronic Data Deliverable			$0.00
Quality Control Summary			$0.00
Setup charge for ICP, total			$18.00
Sample Preparation			
Air Dry at 34 Degrees C	USDA No. 1, 1972		$7.20
Crush and Pulverize	USDA No. 1, 1972		$10.80
Digestion - Hot Plate	M3050B ICP		$14.40
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2		$10.80
Soil Analysis			
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	Calculation	$0.00
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	Calculation	$0.00
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	Calculation	$0.00
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No	0.1 %	$41.40
pH, Corrosivity	M9045D/M9040C	0.1 C	$16.20
Sieve- 250 um (60 mesh)	ASA No.9, 15-4.2.2	0.1 % Passing	$13.50
Solids, Percent	CLPSOW390, PART F, D-98	0.1 %	$7.20
Sulfur Forms	M600/2-78-054 3.2.4-MOD	0.01 %	$66.60
		Cost/Sample:	**$215.10**

Prices are based on a standard turnaround time of 3 weeks or 15 working days and reflect a 10% discount.

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Analytical Quote

Pam Pinson
Freeport-McMoRan - Chino Mines Company
PO Box 10
Bayard, NM 88023

3/21/2011

Quote Number: TOTAL-CU-ABA

Pricing includes shipment of all standard sample containers and related paperwork by UPS Ground Service. Please allow three to five days for delivery when ordering containers. ACZ must be notified prior to receiving samples of all special requests such as electronic data deliverables or special reporting reqirements. The client will be charged for special sample containers or express shipping and additional charges may apply for non-standard requests.

This quotation is valid for six months from the bid date unless specified otherwise in the bid. All bids must be signed and returned to ACZ before project(s) is received. The authorized signature represents acceptance of the pricing as well as the general terms and conditions of ACZ Laboratories, Inc. Our general terms and conditions can be downloaded from our web site at http://www.acz.com/PDF/termsconditions.pdf. Please note that MDL's in this quote may possibly increase due to sample matrix or samples with high TDS.
All orders that require shipping of coolers are subject to a minimum charge of $200.00. Local orders without shipping are subject to a minimum charge of $125.00. Samples may incur a $10.00/sample disposal fee for any samples deemed to be hazardous.

ACZ Representative (Authorized signature and date) ________________________________

Client Representative (Authorized signature and date) ________________________________

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Analytical Report

May 17, 2011

Report to:	Bill to:
Pam Pinson	Accounts Payable
Freeport-McMoRan - Chino Mines Company	Freeport-McMoRan - Chino Mines Company
PO Box 10	P.O. Box 13308
Bayard, NM 88023	Phoenix, AZ 85002-3308

cc: Matthew Barkley

Project ID: ZN01CC
ACZ Project ID: L87617

Pam Pinson:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on April 27, 2011. This project has been assigned to ACZ's project number, L87617. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan. The enclosed results relate only to the samples received under L87617. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all requirements of NELAC.

This report shall be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after June 17, 2011. If the samples are determined to be hazardous, additional charges apply for disposal (typically less than $10/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical reports for five years.

If you have any questions or other needs, please contact your Project Manager.

S. Habermehl

Scott Habermehl has reviewed
and approved this report.

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN01CC	ACZ Sample ID:	***L87617-01***
Sample ID:	FID17	Date Sampled:	*11/03/10 08:40*
		Date Received:	*04/27/11*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	3900	H	*	mg/Kg	1	5	05/10/11 21:52	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	20			t CaCO3/Kt	1	5	05/16/11 16:46	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	3			t CaCO3/Kt	1	5	05/16/11 16:46	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-17			t CaCO3/Kt	1	5	05/16/11 16:46	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	0.3	B	*	%	0.1	0.5	05/03/11 5:12	bsu
pH, Corrosivity	M9045D/M9040C								
pH		5.3	H		units	0.1	0.1	05/06/11 0:00	nrc
pH measured at		25.1			C	0.1	0.1	05/06/11 0:00	nrc
Solids, Percent	CLPSOW390, PART F, D-98	97.7	H	*	%	0.1	0.5	05/10/11 4:06	zsh
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.58	H	*	%	0.01	0.1	05/11/11 0:00	bsu
Sulfur HNO3 Residue		0.07	BH	*	%	0.01	0.1	05/11/11 0:00	bsu
Sulfur Organic Residual Mod		0.07	BH	*	%	0.01	0.1	05/11/11 0:00	bsu
Sulfur Pyritic Sulfide		0.51	H	*	%	0.01	0.1	05/11/11 0:00	bsu
Sulfur Sulfate		0.07	BH	*	%	0.01	0.1	05/11/11 0:00	bsu
Sulfur Total		0.65	H	*	%	0.01	0.1	05/11/11 0:00	bsu
Total Sulfur minus Sulfate		0.58	H	*	%	0.01	0.1	05/11/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Crush and Pulverize	USDA No. 1, 1972							05/02/11 10:00	bsu
Digestion - Hot Plate	M3050B ICP		H					05/09/11 14:11	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							05/02/11 10:00	bsu

Note: This report is for the re-analysis of the sample previously reported as ACZ project L87074-06.

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L87617-02***
Project ID:	ZN01CC	Date Sampled:	*11/05/10 11:45*
Sample ID:	FID23	Date Received:	*04/27/11*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	182	H	*	mg/Kg	1	5	05/10/11 22:02	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	4	B		t CaCO3/Kt	1	5	05/16/11 16:46	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	0.0			t CaCO3/Kt	1	5	05/16/11 16:46	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-4			t CaCO3/Kt	1	5	05/16/11 16:46	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)		U	*	%	0.1	0.5	05/03/11 12:29	bsu
pH, Corrosivity	M9045D/M9040C								
pH		4.4	H		units	0.1	0.1	05/06/11 0:00	nrc
pH measured at		24.5			C	0.1	0.1	05/06/11 0:00	nrc
Solids, Percent	CLPSOW390, PART F, D-98	97.7	H	*	%	0.1	0.5	05/10/11 5:42	zsh
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.08	BH	*	%	0.01	0.1	05/11/11 0:00	bsu
Sulfur HNO3 Residue		0.01	BH	*	%	0.01	0.1	05/11/11 0:00	bsu
Sulfur Organic Residual Mod		0.01	BH	*	%	0.01	0.1	05/11/11 0:00	bsu
Sulfur Pyritic Sulfide		0.07	BH	*	%	0.01	0.1	05/11/11 0:00	bsu
Sulfur Sulfate		0.05	BH	*	%	0.01	0.1	05/11/11 0:00	bsu
Sulfur Total		0.13	H	*	%	0.01	0.1	05/11/11 0:00	bsu
Total Sulfur minus Sulfate		0.08	BH	*	%	0.01	0.1	05/11/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Crush and Pulverize	USDA No. 1, 1972							05/02/11 10:30	bsu
Digestion - Hot Plate	M3050B ICP		H					05/09/11 16:52	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							05/02/11 10:30	bsu

Note: This report is for the re-analysis of the sample previously reported as ACZ project L87074-08.

** Please refer to Qualifier Reports for details.*

Inorganic Reference

Report Header Explanations

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit, typically 5 times the MDL.
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Amount of the true value or spike added recovered, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of interest

QC Sample Types

AS	Analytical Spike (Post Digestion)	LCSWD	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	LFB	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	LFM	Laboratory Fortified Matrix
CCV	Continuing Calibration Verification standard	LFMD	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	LRB	Laboratory Reagent Blank
ICB	Initial Calibration Blank	MS	Matrix Spike
ICV	Initial Calibration Verification standard	MSD	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	PBS	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	PBW	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	PQV	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	SDL	Serial Dilution

QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

ACZ Qualifiers (Qual)

B	Analyte concentration detected at a value between MDL and PQL. The associated value is an estimated quantity.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Method References

(1) EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
(2) EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.
(3) EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.
(5) EPA SW-846. Test Methods for Evaluating Solid Waste, Third Edition with Update III, December 1996.
(6) Standard Methods for the Examination of Water and Wastewater, 19th edition, 1995 & 20th edition (1998).

Comments

(1) QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
(2) Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.
(3) Animal matrices for Inorganic analyses are reported on an "as received" basis.
(4) An asterisk in the "XQ" column indicates there is an extended qualifier and/or certification qualifier associated with the result.

For a complete list of ACZ's Extended Qualifiers, please click: http://www.acz.com/public/extquallist.pdf

Freeport-McMoRan - Chino Mines Company
Project ID: ZN01CC

ACZ Project ID: ***L87617***

Copper, total (3050) M6010B ICP

WG301213

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG301213ICV	ICV	05/10/11 21:25	II110104-3	2		1.99	mg/L	99.5	90	110			
WG301213ICB	ICB	05/10/11 21:28				U	mg/L		-0.03	0.03			
WG301106PBS	PBS	05/10/11 21:42				U	mg/Kg		-3	3			
WG301106LCSS	LCSS	05/10/11 21:45	PCN36183	187		186.8	mg/Kg		157	218			
WG301106LCSSD	LCSSD	05/10/11 21:49	PCN36183	187		189.5	mg/Kg		157	218	1.4	20	
L87617-01MS	MS	05/10/11 21:56	II110421-4	50.5	3900	3841.4	mg/Kg	-116	75	125			M3
L87617-01MSD	MSD	05/10/11 21:59	II110421-4	50.5	3900	3563	mg/Kg	-667.3	75	125	7.52	20	M3

Neutralization Potential as CaCO3 M600/2-78-054 3.2.3 - Modified (No Heat)

WG300734

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG300734PBS	PBS	05/02/11 21:55				U	%		-0.1	0.1			
WG300734LCSS	LCSS	05/03/11 1:34	PCN33453	100		97.84	%	97.8	80	120			
L87617-01DUP	DUP	05/03/11 8:51			.3	.3	%				0	20	RA

Ph M9045D/M9040C

WG301073

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG301073ICV	ICV	05/06/11 13:20	PCN36402	4		4.03	units	100.8	97	103			
L87521-01DUP	DUP	05/06/11 14:13			7.5	7.52	units				0.3	20	

Solids, Percent CLPSOW390, PART F, D-98

WG301179

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG301179PBS	PBS	05/10/11 2:30				U	%		99.9	100.1			
L87712-01DUP	DUP	05/10/11 8:55			75.7	79.59	%				5	20	

Sulfur Organic Residual Mod M600/2-78-054 3.2.4-MOD

WG301184

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
L87617-01DUP	DUP	05/11/11 10:00			.07	.07	%				0	20	RA

Sulfur Pyritic Sulfide M600/2-78-054 3.2.4-MOD

WG301184

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
L87617-01DUP	DUP	05/11/11 10:00			.51	.49	%				4	20	

Sulfur Sulfate M600/2-78-054 3.2.4-MOD

WG301184

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
L87617-01DUP	DUP	05/11/11 10:00			.07	.09	%				25	20	RA

Sulfur Total M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG301184													
L87617-01DUP	DUP	05/11/11 10:00			.65	.65	%				0	20	
WG301184LCSS	LCSS	05/11/11 10:00	PCN36956	4.24		4.79	%	113	3.392	5.088			
WG301184PBS	PBS	05/11/11 10:00				U	%		-0.03	0.03			

Total Sulfur Minus Sulfate M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG301184													
L87617-01DUP	DUP	05/11/11 10:00			.58	.56	%				3.5	20	

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L87617-01	WG301213	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG300734	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG301184	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L87617-02	WG301213	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG300734	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG301184	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

Soil Analysis

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)
Solids, Percent	CLPSOW390, PART F, D-98
Sulfur HCl Residue	M600/2-78-054 3.2.4-MOD
Sulfur HNO3 Residue	M600/2-78-054 3.2.4-MOD
Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD
Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD
Sulfur Sulfate	M600/2-78-054 3.2.4-MOD
Sulfur Total	M600/2-78-054 3.2.4-MOD
Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Sample Receipt

Freeport-McMoRan - Chino Mines Company
ZN01CC

ACZ Project ID: L87074
Date Received: 03/22/2011 13:15
Received By: gac
Date Printed: 3/23/2011

Receipt Verification

	YES	NO	NA
1) Does this project require special handling procedures such as CLP protocol?			X
2) Are the custody seals on the cooler intact?			X
3) Are the custody seals on the sample containers intact?			X
4) Is there a Chain of Custody or other directive shipping papers present?	X		
5) Is the Chain of Custody complete?		X	
6) Is the Chain of Custody in agreement with the samples received?	X		
7) Is there enough sample for all requested analyses?	X		
8) Are all samples within holding times for requested analyses?	X		
9) Were all sample containers received intact?	X		
10) Are the temperature blanks present?			X
11) Are the trip blanks (VOA and/or Cyanide) present?			X
12) Are samples requiring no headspace, headspace free?			X
13) Do the samples that require a Foreign Soils Permit have one?			X

Exceptions: If you answered no to any of the above questions, please describe

The Chain of Custody was not reliquished.

Contact (For any discrepancies, the client must be contacted)

Matthew Barkley was contacted on 3/22/2011. The client emailed a signed copy of the chain of custody.

Shipping Containers

Cooler Id		Temp (°C)	Rad (µR/hr)
Na12613		15.6	30
Na12614		16.6	24

Client must contact ACZ Project Manager if analysis should not proceed for samples received outside of thermal preservation acceptance criteria.

Notes

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Sample Receipt

Freeport-McMoRan - Chino Mines Company
ZN01CC

ACZ Project ID: L87074
Date Received: 03/22/2011 13:15
Received By: gac
Date Printed: 3/23/2011

Sample Container Preservation

SAMPLE	CLIENT ID	R < 2	G < 2	BK < 2	Y< 2	YG< 2	B< 2	O < 2	T >12	N/A	RAD	ID
L87074-01	FID7									X		☐
L87074-02	FID8									X		☐
L87074-03	FID10									X		☐
L87074-04	FID15									X		☐
L87074-05	FID16									X		☐
L87074-06	FID17									X		☐
L87074-07	FID18									X		☐
L87074-08	FID23									X		☐
L87074-09	FID22									X		☐
L87074-10	FID28									X		☐
L87074-11	FID37									X		☐
L87074-12	FID43									X		☐
L87074-13	FID101									X		☐
L87074-14	FID102									X		☐
L87074-15	FID103									X		☐
L87074-16	FID104									X		☐
L87074-17	FID105									X		☐
L87074-18	FID106									X		☐

Sample Container Preservation Legend

Abbreviation	Description	Container Type	Preservative/Limits
R	Raw/Nitric	RED	pH must be < 2
B	Filtered/Sulfuric	BLUE	pH must be < 2
BK	Filtered/Nitric	BLACK	pH must be < 2
G	Filtered/Nitric	GREEN	pH must be < 2
O	Raw/Sulfuric	ORANGE	pH must be < 2
P	Raw/NaOH	PURPLE	pH must be > 12 *
T	Raw/NaOH Zinc Acetate	TAN	pH must be > 12
Y	Raw/Sulfuric	YELLOW	pH must be < 2
YG	Raw/Sulfuric	YELLOW GLASS	pH must be < 2
N/A	No preservative needed	Not applicable	
RAD	Gamma/Beta dose rate	Not applicable	must be < 250 µR/hr

* pH check performed by analyst prior to sample preparation

Sample IDs Reviewed By: gac

L87617-Relog

ACZ Laboratories, Inc. ~~L87074~~ ~~L86427~~

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: Chino Mines
E-mail: Pamela_Pinson @ FMI.com
Address: 1 Santa Rita Mine Rd
Vanadium, NM
Telephone: 575-912-5213

Copy of Report to:

Name: Matthew Barkley
Company: ARCADIS
E-mail: Matthew.barkley @ arcadis-us.com
Telephone: 303-231-9115 x 157

Invoice to:

Name: Pam Pinson
Company: Chino Mines
E-mail: Pamela_Pinson @ FMI.com
Address: 1 Santa Rita Mine Rd
Vanadium, NM
Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☐ NO ☐

If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for SDWA Compliance Monitoring? Yes ☐ No ☐

If yes, please include state forms. Results will be reported to PQL for Colorado.

Sampler's Name: MDLB Sampler's site Information State CO Zip code 804 Time Zone MST

PROJECT INFORMATION

Quote #:
Project/PO #:
Reporting state for compliance testing:
Check box if samples include NRC licensed material? ☐

ANALYSES REQUESTED *(attach list or use quote number)*

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	pH(9045c)	ABA (Modified Sobek)	Cu (6020)					
FID7	11/4/10 1200	SO	1	X	X	X					
FID8	11/5/10 0930	│	1	│	│	│					
FID10	11/3/10 1130	│	1	│	│	│					
FID 15	11/3/10 1000	│	1	│	│	│					
FID 16	11/3/10 0930	│	1	│	│	│					
FID17	11/3/10 0840	│	1	│	│	│					
FID18	11/4/10 1430	│	1	│	│	│					
FID23	11/5/10 1145	│	1	│	│	│					
FID22	11/4/10 1300	│	1	│	│	│					
FID 28	11/4/10 1030	SO	1	X	X	X					

Matrix SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

Please report samples in dry weight and sieve to 2000um
Please run FID17, 23, & 10 for the above analyses without sieving.

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
			3.22.11 13:10

FRMAD050.02.11.11 White - Return with sample. Yellow - Retain for your records.

L87617 Chain of Custod

~~L87074 Chain of Custody~~

L86427

1

ACZ Laboratories, Inc.
2773 Downhill Drive   Steamboat Springs, CO 80487   (800) 334-5493

Analytical Report

November 30, 2011

Report to:	Bill to:
Pam Pinson	Pam Pinson
Freeport-McMoRan - Chino Mines Company	Freeport-McMoRan - Chino Mines Company
PO Box 10	P.O. Box 13308
Bayard, NM 88023	Phoenix, AZ 85002-3308

cc: Matthew Barkley, Sheri Fling

Project ID: ZN000000J8
ACZ Project ID: L91358

Pam Pinson:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on October 18, 2011. This project has been assigned to ACZ's project number, L91358. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan. The enclosed results relate only to the samples received under L91358. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all requirements of NELAC.

This report shall be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after December 30, 2011. If the samples are determined to be hazardous, additional charges apply for disposal (typically less than $10/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical reports for five years.

If you have any questions or other needs, please contact your Project Manager.

S. Habermehl

Scott Habermehl has reviewed
and approved this report.

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000000J8	ACZ Sample ID:	***L91358-01***
Sample ID:	STS-PH-2011-FID37	Date Sampled:	*10/11/11 09:45*
		Date Received:	*10/18/11*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	654		*	mg/Kg	1	5	11/17/11 9:42	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	1	B		t CaCO3/Kt	1	5	11/30/11 10:13	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	1			t CaCO3/Kt	1	5	11/30/11 10:13	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	0			t CaCO3/Kt	1	5	11/30/11 10:13	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	0.1	B	*	%	0.1	0.5	11/17/11 0:07	brd
pH, Saturated Paste	USDA No. 60 (21A)	4.6		*	units	0.1	0.1	11/21/11 19:53	bsu
Solids, Percent	CLPSOW390, PART F, D-98	93.6		*	%	0.1	0.5	11/16/11 16:00	ndj
Sulfur Forms	M600/2-78-054 3.2.4								
Sulfur Organic Residual		0.03	B	*	%	0.01	0.1	11/16/11 0:00	bsu
Sulfur Pyritic Sulfide		0.01	B	*	%	0.01	0.1	11/16/11 0:00	bsu
Sulfur Sulfate			U	*	%	0.01	0.1	11/16/11 0:00	bsu
Sulfur Total		0.04	B	*	%	0.01	0.1	11/16/11 0:00	bsu
Total Sulfur minus Sulfate		0.04	B	*	%	0.01	0.1	11/16/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/11/11 11:26	zsh
Crush and Pulverize	USDA No. 1, 1972							11/15/11 13:00	cra
Digestion - Hot Plate	M3050B ICP							11/16/11 11:00	mss2
Saturated Paste Extraction	USDA No. 60 (2)							11/21/11 17:00	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/15/11 15:48	cra/thf
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2							11/15/11 15:48	cra/thf

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000000J8	ACZ Sample ID:	***L91358-03***
Sample ID:	STS-PH-2011-FID101	Date Sampled:	*10/12/11 16:45*
		Date Received:	*10/18/11*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	272		*	mg/Kg	1	5	11/17/11 10:01	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	6			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	2			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-4			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	0.2	B	*	%	0.1	0.5	11/17/11 4:37	brd
pH, Saturated Paste	USDA No. 60 (21A)	3.8		*	units	0.1	0.1	11/21/11 21:19	bsu
Solids, Percent	CLPSOW390, PART F, D-98	93.8		*	%	0.1	0.5	11/16/11 16:00	ndj
Sulfur Forms	M600/2-78-054 3.2.4								
Sulfur Organic Residual		0.11		*	%	0.01	0.1	11/16/11 0:00	bsu
Sulfur Pyritic Sulfide		0.02	B	*	%	0.01	0.1	11/16/11 0:00	bsu
Sulfur Sulfate		0.06	B	*	%	0.01	0.1	11/16/11 0:00	bsu
Sulfur Total		0.19		*	%	0.01	0.1	11/16/11 0:00	bsu
Total Sulfur minus Sulfate		0.13		*	%	0.01	0.1	11/16/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/11/11 11:31	zsh
Crush and Pulverize	USDA No. 1, 1972							11/15/11 13:17	cra
Digestion - Hot Plate	M3050B ICP							11/16/11 12:20	mss2
Saturated Paste Extraction	USDA No. 60 (2)							11/21/11 17:08	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/15/11 15:59	cra/thf
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2							11/15/11 15:59	cra/thf

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000000J8
Sample ID: STS-PH-2011-REFPLOT3

ACZ Sample ID: ***L91358-04***
Date Sampled: *10/07/11 11:50*
Date Received: *10/18/11*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	1950		*	mg/Kg	1	5	11/17/11 10:04	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	3	B		t CaCO3/Kt	1	5	11/30/11 10:14	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	13			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	10			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	1.3		*	%	0.1	0.5	11/17/11 2:26	brd
pH, Saturated Paste	USDA No. 60 (21A)	5.6		*	units	0.1	0.1	11/21/11 22:02	bsu
Solids, Percent	CLPSOW390, PART F, D-98	91.2		*	%	0.1	0.5	11/16/11 16:00	ndj
Sulfur Forms	M600/2-78-054 3.2.4								
Sulfur Organic Residual		0.07	B	*	%	0.01	0.1	11/16/11 0:00	bsu
Sulfur Pyritic Sulfide		0.01	B	*	%	0.01	0.1	11/16/11 0:00	bsu
Sulfur Sulfate		0.02	B	*	%	0.01	0.1	11/16/11 0:00	bsu
Sulfur Total		0.10		*	%	0.01	0.1	11/16/11 0:00	bsu
Total Sulfur minus Sulfate		0.08	B	*	%	0.01	0.1	11/16/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/11/11 11:33	zsh
Crush and Pulverize	USDA No. 1, 1972							11/15/11 13:35	cra
Digestion - Hot Plate	M3050B ICP							11/16/11 12:40	mss2
Saturated Paste Extraction	USDA No. 60 (2)							11/21/11 17:13	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/15/11 16:05	cra/thf
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2							11/15/11 16:05	cra/thf

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000000J8
Sample ID: STS-PH-2011-REFPLOT4

ACZ Sample ID: ***L91358-05***
Date Sampled: *10/06/11 10:39*
Date Received: *10/18/11*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	1130		*	mg/Kg	1	5	11/17/11 10:07	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	7			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	0.0			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-7			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3		U	*	%	0.1	0.5	11/28/11 14:33	mss2
pH, Saturated Paste	USDA No. 60 (21A)	5.4		*	units	0.1	0.1	11/21/11 22:46	bsu
Solids, Percent	CLPSOW390, PART F, D-98	90.8		*	%	0.1	0.5	11/16/11 16:00	ndj
Sulfur Forms	M600/2-78-054 3.2.4								
Sulfur Organic Residual		0.13		*	%	0.01	0.1	11/16/11 0:00	bsu
Sulfur Pyritic Sulfide		0.03	B	*	%	0.01	0.1	11/16/11 0:00	bsu
Sulfur Sulfate		0.05	B	*	%	0.01	0.1	11/16/11 0:00	bsu
Sulfur Total		0.21		*	%	0.01	0.1	11/16/11 0:00	bsu
Total Sulfur minus Sulfate		0.16		*	%	0.01	0.1	11/16/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/11/11 11:35	zsh
Crush and Pulverize	USDA No. 1, 1972							11/15/11 13:52	cra
Digestion - Hot Plate	M3050B ICP							11/16/11 13:00	mss2
Saturated Paste Extraction	USDA No. 60 (2)							11/21/11 17:17	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/15/11 16:10	cra/thf
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2							11/15/11 16:10	cra/thf

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000000J8
Sample ID: DUP11

ACZ Sample ID: ***L91358-06***
Date Sampled: *10/12/11 00:00*
Date Received: *10/18/11*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	341		*	mg/Kg	1	5	11/17/11 10:14	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	6			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	0.0			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-6			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3		U	*	%	0.1	0.5	11/17/11 6:35	brd
pH, Saturated Paste	USDA No. 60 (21A)	3.9		*	units	0.1	0.1	11/21/11 23:29	bsu
Solids, Percent	CLPSOW390, PART F, D-98	93.7		*	%	0.1	0.5	11/16/11 16:00	ndj
Sulfur Forms	M600/2-78-054 3.2.4								
Sulfur Organic Residual		0.13		*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Pyritic Sulfide			U	*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Sulfate		0.06	B	*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Total		0.19		*	%	0.01	0.1	11/17/11 0:00	bsu
Total Sulfur minus Sulfate		0.13		*	%	0.01	0.1	11/17/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/11/11 11:37	zsh
Crush and Pulverize	USDA No. 1, 1972							11/15/11 14:10	cra
Digestion - Hot Plate	M3050B ICP							11/16/11 13:20	mss2
Saturated Paste Extraction	USDA No. 60 (2)							11/21/11 17:22	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/15/11 16:16	cra/thf
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2							11/15/11 16:16	cra/thf

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000000J8
Sample ID: STS-PH-2011-FID105

ACZ Sample ID: ***L91358-07***
Date Sampled: *10/06/11 13:30*
Date Received: *10/18/11*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	668		*	mg/Kg	1	5	11/17/11 10:17	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	3	B		t CaCO3/Kt	1	5	11/30/11 10:14	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	8			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	5			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	0.8		*	%	0.1	0.5	11/17/11 8:32	brd
pH, Saturated Paste	USDA No. 60 (21A)	4.9		*	units	0.1	0.1	11/22/11 0:12	bsu
Solids, Percent	CLPSOW390, PART F, D-98	91.1		*	%	0.1	0.5	11/16/11 16:00	ndj
Sulfur Forms	M600/2-78-054 3.2.4								
Sulfur Organic Residual		0.07	B	*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Pyritic Sulfide		0.01	B	*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Sulfate		0.02	B	*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Total		0.10		*	%	0.01	0.1	11/17/11 0:00	bsu
Total Sulfur minus Sulfate		0.08	B	*	%	0.01	0.1	11/17/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/11/11 11:39	zsh
Crush and Pulverize	USDA No. 1, 1972							11/15/11 14:27	cra
Digestion - Hot Plate	M3050B ICP							11/16/11 13:40	mss2
Saturated Paste Extraction	USDA No. 60 (2)							11/21/11 17:26	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/15/11 16:22	cra/thf
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2							11/15/11 16:22	cra/thf

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID: ZN000000J8
Sample ID: DUP12

ACZ Sample ID: ***L91358-08***
Date Sampled: *10/13/11 00:00*
Date Received: *10/18/11*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	467		*	mg/Kg	1	5	11/17/11 10:20	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	6			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	26			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	20			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	2.6		*	%	0.1	0.5	11/17/11 10:30	brd
pH, Saturated Paste	USDA No. 60 (21A)	6.3		*	units	0.1	0.1	11/22/11 0:55	bsu
Solids, Percent	CLPSOW390, PART F, D-98	95.3		*	%	0.1	0.5	11/16/11 16:00	ndj
Sulfur Forms	M600/2-78-054 3.2.4								
Sulfur Organic Residual		0.12		*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Pyritic Sulfide		0.03	B	*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Sulfate		0.04	B	*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Total		0.19		*	%	0.01	0.1	11/17/11 0:00	bsu
Total Sulfur minus Sulfate		0.15		*	%	0.01	0.1	11/17/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/11/11 11:42	zsh
Crush and Pulverize	USDA No. 1, 1972							11/15/11 14:45	cra
Digestion - Hot Plate	M3050B ICP							11/16/11 14:00	mss2
Saturated Paste Extraction	USDA No. 60 (2)							11/21/11 17:30	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/15/11 16:27	cra/thf
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2							11/15/11 16:27	cra/thf

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000000J8
Sample ID: STS-PH-2011-REFPLOT1

ACZ Sample ID: ***L91358-09***
Date Sampled: *10/04/11 11:09*
Date Received: *10/18/11*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	597		*	mg/Kg	1	5	11/17/11 10:23	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	2	B		t CaCO3/Kt	1	5	11/30/11 10:14	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	101			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	99			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	10.1		*	%	0.1	0.5	11/17/11 7:05	brd
pH, Saturated Paste	USDA No. 60 (21A)	7.5		*	units	0.1	0.1	11/22/11 1:39	bsu
Solids, Percent	CLPSOW390, PART F, D-98	92.7		*	%	0.1	0.5	11/16/11 16:00	ndj
Sulfur Forms	M600/2-78-054 3.2.4								
Sulfur Organic Residual		0.06	B	*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Pyritic Sulfide			U	*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Sulfate			U	*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Total		0.05	B	*	%	0.01	0.1	11/17/11 0:00	bsu
Total Sulfur minus Sulfate		0.05	B	*	%	0.01	0.1	11/17/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/11/11 11:44	zsh
Crush and Pulverize	USDA No. 1, 1972							11/15/11 15:02	cra
Digestion - Hot Plate	M3050B ICP							11/16/11 14:20	mss2
Saturated Paste Extraction	USDA No. 60 (2)							11/21/11 17:35	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/15/11 16:33	cra/thf
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2							11/15/11 16:33	cra/thf

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L91358-10***
Project ID:	ZN000000J8	Date Sampled:	*10/05/11 12:30*
Sample ID:	STS-PH-2011-REFPLOT2	Date Received:	*10/18/11*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	687		*	mg/Kg	1	5	11/17/11 10:26	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	0			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	11			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	11			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	1.1		*	%	0.1	0.5	11/17/11 12:27	brd
pH, Saturated Paste	USDA No. 60 (21A)	6.0		*	units	0.1	0.1	11/22/11 2:22	bsu
Solids, Percent	CLPSOW390, PART F, D-98	91.9		*	%	0.1	0.5	11/16/11 16:00	ndj
Sulfur Forms	M600/2-78-054 3.2.4								
Sulfur Organic Residual		0.02	B	*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Pyritic Sulfide			U	*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Sulfate			U	*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Total		0.02	B	*	%	0.01	0.1	11/17/11 0:00	bsu
Total Sulfur minus Sulfate		0.02	B	*	%	0.01	0.1	11/17/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/11/11 11:46	zsh
Crush and Pulverize	USDA No. 1, 1972							11/15/11 15:20	cra
Digestion - Hot Plate	M3050B ICP							11/16/11 14:40	mss2
Saturated Paste Extraction	USDA No. 60 (2)							11/21/11 17:39	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/15/11 16:39	cra/thf
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2							11/15/11 16:39	cra/thf

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000000J8	ACZ Sample ID:	***L91358-11***
Sample ID:	STS-PH-2011-FID22	Date Sampled:	*10/13/11 16:40*
		Date Received:	*10/18/11*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	430			mg/Kg	1	5	11/17/11 10:29	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	6			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	16			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	10			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	1.6		*	%	0.1	0.5	11/17/11 16:22	brd
pH, Saturated Paste	USDA No. 60 (21A)	6.2		*	units	0.1	0.1	11/22/11 3:49	bsu
Solids, Percent	CLPSOW390, PART F, D-98	95.4		*	%	0.1	0.5	11/16/11 16:00	ndj
Sulfur Forms	M600/2-78-054 3.2.4								
Sulfur Organic Residual		0.11		*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Pyritic Sulfide		0.04	B	*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Sulfate		0.04	B	*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Total		0.19		*	%	0.01	0.1	11/17/11 0:00	bsu
Total Sulfur minus Sulfate		0.15		*	%	0.01	0.1	11/17/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/11/11 11:48	zsh
Crush and Pulverize	USDA No. 1, 1972							11/15/11 15:37	cra
Digestion - Hot Plate	M3050B ICP							11/16/11 15:00	mss2
Saturated Paste Extraction	USDA No. 60 (2)							11/21/11 17:44	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/15/11 16:44	cra/thf
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2							11/15/11 16:44	cra/thf

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000000J8	ACZ Sample ID:	***L91358-12***
Sample ID:	STS-PH-2011-FID10	Date Sampled:	*10/07/11 14:35*
		Date Received:	*10/18/11*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	2140		*	mg/Kg	1	5	11/17/11 10:38	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	3	B		t CaCO3/Kt	1	5	11/30/11 10:14	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	5			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	2			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	0.5	B	*	%	0.1	0.5	11/17/11 18:20	brd
pH, Saturated Paste	USDA No. 60 (21A)	4.8		*	units	0.1	0.1	11/22/11 4:32	bsu
Solids, Percent	CLPSOW390, PART F, D-98	91.5		*	%	0.1	0.5	11/16/11 16:00	ndj
Sulfur Forms	M600/2-78-054 3.2.4								
Sulfur Organic Residual		0.07	B	*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Pyritic Sulfide		0.02	B	*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Sulfate		0.01	B	*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Total		0.10		*	%	0.01	0.1	11/17/11 0:00	bsu
Total Sulfur minus Sulfate		0.09	B	*	%	0.01	0.1	11/17/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/11/11 11:50	zsh
Crush and Pulverize	USDA No. 1, 1972							11/15/11 15:55	cra
Digestion - Hot Plate	M3050B ICP							11/16/11 15:20	mss2
Saturated Paste Extraction	USDA No. 60 (2)							11/21/11 17:48	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/15/11 16:50	cra/thf
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2							11/15/11 16:50	cra/thf

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000000J8
Sample ID: STS-PH-2011-FID15

ACZ Sample ID: ***L91358-13***
Date Sampled: *10/10/11 11:50*
Date Received: *10/18/11*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	2260		*	mg/Kg	1	5	11/17/11 10:41	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	6			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	0.0			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-6			t CaCO3/Kt	1	5	11/30/11 10:14	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3		U	*	%	0.1	0.5	11/17/11 20:17	brd
pH, Saturated Paste	USDA No. 60 (21A)	4.8		*	units	0.1	0.1	11/22/11 5:15	bsu
Solids, Percent	CLPSOW390, PART F, D-98	92.8		*	%	0.1	0.5	11/16/11 16:00	ndj
Sulfur Forms	M600/2-78-054 3.2.4								
Sulfur Organic Residual		0.13		*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Pyritic Sulfide		0.04	B	*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Sulfate		0.02	B	*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Total		0.19		*	%	0.01	0.1	11/17/11 0:00	bsu
Total Sulfur minus Sulfate		0.17		*	%	0.01	0.1	11/17/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/11/11 11:53	zsh
Crush and Pulverize	USDA No. 1, 1972							11/15/11 16:12	cra
Digestion - Hot Plate	M3050B ICP							11/16/11 15:40	mss2
Saturated Paste Extraction	USDA No. 60 (2)							11/21/11 17:53	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/15/11 16:56	cra/thf
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2							11/15/11 16:56	cra/thf

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L91358-14***
Project ID:	ZN000000J8	Date Sampled:	*10/10/11 12:30*
Sample ID:	STS-PH-2011-FID16	Date Received:	*10/18/11*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	2020		*	mg/Kg	1	5	11/17/11 10:44	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	5	B		t CaCO3/Kt	1	5	11/30/11 10:15	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	0.0			t CaCO3/Kt	1	5	11/30/11 10:15	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-5			t CaCO3/Kt	1	5	11/30/11 10:15	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3		U	*	%	0.1	0.5	11/17/11 22:15	brd
pH, Saturated Paste	USDA No. 60 (21A)	4.5		*	units	0.1	0.1	11/22/11 5:58	bsu
Solids, Percent	CLPSOW390, PART F, D-98	90.9		*	%	0.1	0.5	11/16/11 16:00	ndj
Sulfur Forms	M600/2-78-054 3.2.4								
Sulfur Organic Residual		0.16		*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Pyritic Sulfide			U	*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Sulfate		0.02	B	*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Total		0.15		*	%	0.01	0.1	11/17/11 0:00	bsu
Total Sulfur minus Sulfate		0.13		*	%	0.01	0.1	11/17/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/11/11 11:55	zsh
Crush and Pulverize	USDA No. 1, 1972							11/15/11 16:30	cra
Digestion - Hot Plate	M3050B ICP							11/16/11 16:00	mss2
Saturated Paste Extraction	USDA No. 60 (2)							11/21/11 17:57	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/15/11 17:01	cra/thf
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2							11/15/11 17:01	cra/thf

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000000J8
Sample ID: STS-PH-2011-FID17

ACZ Sample ID: ***L91358-15***
Date Sampled: *10/11/11 17:35*
Date Received: *10/18/11*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	4220		*	mg/Kg	1	5	11/17/11 10:48	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	14			t CaCO3/Kt	1	5	11/30/11 10:15	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	8			t CaCO3/Kt	1	5	11/30/11 10:15	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-6			t CaCO3/Kt	1	5	11/30/11 10:15	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	0.8		*	%	0.1	0.5	11/18/11 0:12	brd
pH, Saturated Paste	USDA No. 60 (21A)	6.0		*	units	0.1	0.1	11/22/11 6:42	bsu
Solids, Percent	CLPSOW390, PART F, D-98	94.0		*	%	0.1	0.5	11/16/11 16:00	ndj
Sulfur Forms	M600/2-78-054 3.2.4								
Sulfur Organic Residual		0.21		*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Pyritic Sulfide		0.18		*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Sulfate		0.06	B	*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Total		0.45		*	%	0.01	0.1	11/17/11 0:00	bsu
Total Sulfur minus Sulfate		0.39		*	%	0.01	0.1	11/17/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/11/11 11:57	zsh
Crush and Pulverize	USDA No. 1, 1972							11/15/11 16:47	cra
Digestion - Hot Plate	M3050B ICP							11/16/11 16:20	mss2
Saturated Paste Extraction	USDA No. 60 (2)							11/21/11 18:01	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/15/11 17:07	cra/thf
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2							11/15/11 17:07	cra/thf

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000000J8	ACZ Sample ID:	***L91358-16***
Sample ID:	STS-PH-2011-FID18	Date Sampled:	*10/12/11 15:55*
		Date Received:	*10/18/11*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	254		*	mg/Kg	1	5	11/17/11 10:51	aeb

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	5			t CaCO3/Kt	1	5	11/30/11 10:15	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	0.0			t CaCO3/Kt	1	5	11/30/11 10:15	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-5			t CaCO3/Kt	1	5	11/30/11 10:15	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3		U	*	%	0.1	0.5	11/18/11 2:10	brd
pH, Saturated Paste	USDA No. 60 (21A)	4.3		*	units	0.1	0.1	11/22/11 7:25	bsu
Solids, Percent	CLPSOW390, PART F, D-98	96.5		*	%	0.1	0.5	11/16/11 16:00	ndj
Sulfur Forms	M600/2-78-054 3.2.4								
Sulfur Organic Residual		0.10		*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Pyritic Sulfide		0.06	B	*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Sulfate		0.01	B	*	%	0.01	0.1	11/17/11 0:00	bsu
Sulfur Total		0.17		*	%	0.01	0.1	11/17/11 0:00	bsu
Total Sulfur minus Sulfate		0.16		*	%	0.01	0.1	11/17/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/11/11 11:59	zsh
Crush and Pulverize	USDA No. 1, 1972							11/15/11 17:05	cra
Digestion - Hot Plate	M3050B ICP							11/16/11 16:40	mss2
Saturated Paste Extraction	USDA No. 60 (2)							11/21/11 18:06	bsu
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/15/11 17:13	cra/thf
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2							11/15/11 17:13	cra/thf

** Please refer to Qualifier Reports for details.*

Inorganic Reference

Report Header Explanations

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit, typically 5 times the MDL.
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Amount of the true value or spike added recovered, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of interest

QC Sample Types

AS	Analytical Spike (Post Digestion)	*LCSWD*	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	*LFB*	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	*LFM*	Laboratory Fortified Matrix
CCV	Continuing Calibration Verification standard	*LFMD*	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	*LRB*	Laboratory Reagent Blank
ICB	Initial Calibration Blank	*MS*	Matrix Spike
ICV	Initial Calibration Verification standard	*MSD*	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	*PBS*	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	*PBW*	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	*PQV*	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	*SDL*	Serial Dilution

QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

ACZ Qualifiers (Qual)

B	Analyte concentration detected at a value between MDL and PQL. The associated value is an estimated quantity.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
L	Target analyte response was below the laboratory defined negative threshold.
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Method References

(1)	EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
(2)	EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.
(3)	EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.
(4)	EPA SW-846. Test Methods for Evaluating Solid Waste, Third Edition with Update III, December 1996.
(5)	Standard Methods for the Examination of Water and Wastewater, 19th edition, 1995 & 20th edition (1998).

Comments

(1) QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.

(2) Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.

(3) Animal matrices for Inorganic analyses are reported on an "as received" basis.

(4) An asterisk in the "XQ" column indicates there is an extended qualifier and/or certification qualifier associated with the result.

For a complete list of ACZ's Extended Qualifiers, please click: http://www.acz.com/public/extquallist.pdf

Inorganic QC Summary

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000000J8

ACZ Project ID: ***L91358***

Copper, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG313764													
WG313764ICV	ICV	11/17/11 9:08	II111012-2	2		1.983	mg/L	99.2	90	110			
WG313764ICB	ICB	11/17/11 9:11				U	mg/L		-0.03	0.03			
WG313764PQV	PQV	11/17/11 9:15	II111024-4	.05		.052	mg/L	104	70	130			
WG313764ICSAB	ICSAB	11/17/11 9:18	II110922-1	.255		.244	mg/L	95.7	80	120			
WG313678PBS	PBS	11/17/11 9:24				U	mg/Kg		-3	3			
WG313678LCSS1	LCSS	11/17/11 9:27	PCN38231	117		120.3	mg/Kg		98	136			
WG313678LCSSD1	LCSSD	11/17/11 9:30	PCN38231	117		122	mg/Kg		98	136	1.4	20	
L91358-01MS	MS	11/17/11 9:46	II111115-2	50.5	654	690.1	mg/Kg	71.5	75	125			M3
L91358-01MSD	MSD	11/17/11 9:49	II111115-2	50.5	654	729.8	mg/Kg	150.1	75	125	5.59	20	M3
WG313764CCV1	CCV	11/17/11 9:55	II111031-1	1		.995	mg/L	99.5	90	110			
WG313764CCB1	CCB	11/17/11 9:58				U	mg/L		-0.03	0.03			
L91358-05SDL	SDL	11/17/11 10:10			1130	1187.5	mg/Kg				5.1	10	
WG313764CCV2	CCV	11/17/11 10:32	II111031-1	1		.989	mg/L	98.9	90	110			
WG313764CCB2	CCB	11/17/11 10:35				U	mg/L		-0.03	0.03			
WG313764CCV3	CCV	11/17/11 10:57	II111031-1	1		.989	mg/L	98.9	90	110			
WG313764CCB3	CCB	11/17/11 11:00				U	mg/L		-0.03	0.03			

Neutralization Potential as CaCO3 M600/2-78-054 3.2.3

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG313690													
WG313690PBS	PBS	11/16/11 18:50				U	%		-0.1	0.1			
WG313690LCSS	LCSS	11/16/11 20:47	PCN33453	100		111.12	%	111.1	80	120			
L91597-04DUP	DUP	11/18/11 8:02			U	.13	%				200	20	RA
WG313692													
L91597-05DUP	DUP	11/17/11 16:23			5.1	5.07	%				0.6	20	
WG313692LCSS	LCSS	11/18/11 8:40	PCN33453	100		113.44	%	113.4	80	120			
WG313692PBS	PBS	11/18/11 11:00				U	%		-0.1	0.1			
WG314263													
L91350-09DUP	DUP	11/28/11 13:51			12.3	12.32	%				0.2	20	
WG314263LCSS	LCSS	11/28/11 16:39	PCN33453	100		108.26	%	108.3	80	120			
WG314263PBS	PBS	11/28/11 17:00				U	%		-0.1	0.1			

pH, Saturated Paste USDA No. 60 (21A)

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG314045													
WG314045ICV	ICV	11/21/11 19:09	PCN36616	4		4.01	units	100.3	97	103			
WG314045CCV1	CCV	11/22/11 3:05	PCN36616	4		4.02	units	100.5	97	103			
L91396-01DUP	DUP	11/22/11 8:51			7.2	7.67	units				6.3	20	
WG314045CCV2	CCV	11/22/11 9:35	PCN36616	4		4.09	units	102.3	97	103			

Solids, Percent CLPSOW390, PART F, D-98

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG313740													
WG313740PBS	PBS	11/16/11 16:00				U	%		99.9	100.1			
L91358-13DUP	DUP	11/16/11 16:00			92.8	92.93	%				0.1	20	

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000000J8

ACZ Project ID: ***L91358***

Sulfur Organic Residual M600/2-78-054 3.2.4

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG313719													
L91358-01DUP	DUP	11/16/11 18:17			.03	.04	%				28.6	20	RA

Sulfur Pyritic Sulfide M600/2-78-054 3.2.4

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG313719													
L91358-01DUP	DUP	11/16/11 18:17			.01	.02	%				66.7	20	RA

Sulfur Sulfate M600/2-78-054 3.2.4

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG313719													
L91358-01DUP	DUP	11/16/11 18:17			U	U	%				0	20	RA

Sulfur Total M600/2-78-054 3.2.4

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG313719													
WG313719PBS	PBS	11/16/11 14:00				U	%		-0.03	0.03			
WG313719LCSS	LCSS	11/16/11 15:25	PCN38174	4.07		4.13	%	101.5					
L91358-01DUP	DUP	11/16/11 18:17			.04	.05	%				22.2	20	RA

Total Sulfur Minus Sulfate M600/2-78-054 3.2.4

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG313719													
L91358-01DUP	DUP	11/16/11 18:17			.04	.05	%				22.2	20	RA

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L91358-01	WG313764	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG313719	Sulfur Organic Residual	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L91358-02	WG313764	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L91358-03	WG313764	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG313690	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG313719	Sulfur Organic Residual	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L91358-04	WG313764	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG313719	Sulfur Organic Residual	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L91358-05	WG313764	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG313719	Sulfur Organic Residual	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L91358-06	WG313764	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG313690	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG313719	Sulfur Organic Residual	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L91358-07	WG313764	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG313690	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG313719	Sulfur Organic Residual	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L91358-08	WG313764	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG313690	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG313719	Sulfur Organic Residual	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L91358-09	WG313764	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG313719	Sulfur Organic Residual	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L91358-10	WG313764	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG313690	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG313719	Sulfur Organic Residual	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L91358-11	WG313690	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG313719	Sulfur Organic Residual	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L91358-12	WG313764	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG313690	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG313719	Sulfur Organic Residual	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L91358-13	WG313764	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG313690	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG313719	Sulfur Organic Residual	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L91358-14	WG313764	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG313690	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG313719	Sulfur Organic Residual	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L91358-15	WG313764	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG313690	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG313719	Sulfur Organic Residual	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

Freeport-McMoRan - Chino Mines Company

ACZ Project ID: ***L91358***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L91358-16	WG313764	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG313690	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG313719	Sulfur Organic Residual	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

Soil Analysis

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Neutralization Potential as CaCO3	M600/2-78-054 3.2.3
pH, Saturated Paste	USDA No. 60 (21A)
Solids, Percent	CLPSOW390, PART F, D-98
Sulfur Organic Residual	M600/2-78-054 3.2.4
Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4
Sulfur Sulfate	M600/2-78-054 3.2.4
Sulfur Total	M600/2-78-054 3.2.4
Total Sulfur minus Sulfate	M600/2-78-054 3.2.4

Sample Receipt

Freeport-McMoRan - Chino Mines Company
ZN000000J8

ACZ Project ID: L91358
Date Received: 10/18/2011 09:23
Received By: ksj
Date Printed: 10/19/2011

Receipt Verification

	YES	NO	NA
1) Does this project require special handling procedures such as CLP protocol?			X
2) Are the custody seals on the cooler intact?	X		
3) Are the custody seals on the sample containers intact?			X
4) Is there a Chain of Custody or other directive shipping papers present?	X		
5) Is the Chain of Custody complete?	X		
6) Is the Chain of Custody in agreement with the samples received?	X		
7) Is there enough sample for all requested analyses?	X		
8) Are all samples within holding times for requested analyses?	X		
9) Were all sample containers received intact?	X		
10) Are the temperature blanks present?			X
11) Are the trip blanks (VOA and/or Cyanide) present?			X
12) Are samples requiring no headspace, headspace free?			X
13) Do the samples that require a Foreign Soils Permit have one?			X

Exceptions: If you answered no to any of the above questions, please describe

N/A

Contact (For any discrepancies, the client must be contacted)

N/A

Shipping Containers

Cooler Id		Temp (°C)	Rad (µR/hr)
3282		9.2	18
3164		10.4	18
3045		13.6	20

Client must contact ACZ Project Manager if analysis should not proceed for samples received outside of thermal preservation acceptance criteria.

Notes

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Sample Receipt

Freeport-McMoRan - Chino Mines Company
ZN000000J8

ACZ Project ID:	L91358
Date Received:	10/18/2011 09:23
Received By:	ksj
Date Printed:	10/19/2011

Sample Container Preservation

SAMPLE	CLIENT ID	R < 2	G < 2	BK < 2	Y< 2	YG< 2	B< 2	O < 2	T >12	N/A	RAD	ID
L91358-01	STS-PH-2011-FID37									X		☐
L91358-02	STS-PCUG-2011-40									X		☐
L91358-03	STS-PH-2011-FID101									X		☐
L91358-04	STS-PH-2011-REFPLOT3									X		☐
L91358-05	STS-PH-2011-REFPLOT4									X		☐
L91358-06	DUP11									X		☐
L91358-07	STS-PH-2011-FID105									X		☐
L91358-08	DUP12									X		☐
L91358-09	STS-PH-2011-REFPLOT1									X		☐
L91358-10	STS-PH-2011-REFPLOT2									X		☐
L91358-11	STS-PH-2011-FID22									X		☐
L91358-12	STS-PH-2011-FID10									X		☐
L91358-13	STS-PH-2011-FID15									X		☐
L91358-14	STS-PH-2011-FID16									X		☐
L91358-15	STS-PH-2011-FID17									X		☐
L91358-16	STS-PH-2011-FID18									X		☐

Sample Container Preservation Legend

Abbreviation	**Description**	**Container Type**	**Preservative/Limits**
R	Raw/Nitric	RED	pH must be < 2
B	Filtered/Sulfuric	BLUE	pH must be < 2
BK	Filtered/Nitric	BLACK	pH must be < 2
G	Filtered/Nitric	GREEN	pH must be < 2
O	Raw/Sulfuric	ORANGE	pH must be < 2
P	Raw/NaOH	PURPLE	pH must be > 12 *
T	Raw/NaOH Zinc Acetate	TAN	pH must be > 12
Y	Raw/Sulfuric	YELLOW	pH must be < 2
YG	Raw/Sulfuric	YELLOW GLASS	pH must be < 2
N/A	No preservative needed	Not applicable	
RAD	Gamma/Beta dose rate	Not applicable	must be < 250 µR/hr

* pH check performed by analyst prior to sample preparation

Sample IDs Reviewed By: ksj

ACZ Laboratories, Inc. L91358

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson	Address: P.O. Box 10
Company: Chino Mines Company	Bayard, NM 88023
E-mail: Pamela_Pinson@FMI.com	Telephone: 575-912-5213

Copy of Report to:

Name: Matthew Barkley	E-mail: Matthew.Barkley@arcadis-us.com
Company: ARCADIS	Telephone: 303-231-9115 ext 157

Invoice to:

Name: Pam Pinson	Address: P.O. Box 10
Company: Chino Mines Company	Bayard, NM 88023
E-mail: Pamela_Pinson@FMI.com	Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐

If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐ NO ☒

If yes, please include state forms. Results will be reported to PQL.

PROJECT INFORMATION

Quote #:

Project/PO #:

Reporting state for compliance testing:

Sampler's Name: Carolyn Meyer

Are any samples NRC licensable material? Yes No

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	soil sieved to < 2mm	pH	Total CU	ABA				
STS-PH-2011-FID37	10.11.11 : 09:45	SO	1	X	X	X	X				
STS-PCUG-2011-40	10.13.11 : 13:55	SO	1	X	X	X					
STS-PH-2011-FID101	10.12.11 : 16:45	SO	1	X	X	X	X				
STS-PH-2011-REFPLOT3	10.7.11 : 11:50	SO	1	X	X	X	X				
STS-PH-2011-REFPLOT4	10.6.11 : 10:39	SO	1	X	X	X	X				
DUP11	10.12.11 : ---	SO	1	X	X	X	X				
STS-PH-2011-FID105	10.6.11 : 13:30	SO	1	X	X	X	X				
DUP12	10.13.11 : ---	SO	1	X	X	X	X				
STS-PH-2011-REFPLOT1	10.4.11 : 11:09	SO	1	X	X	X	X				
STS-PH-2011-REFPLOT2	10.5.11 : 12:30	SO	1	X	X	X	X				

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

Please send to Sheri Fling at URS for validation. Sieve all soil samples to <2 mm prior to analysis. Soil should be reported on a dry weight basis.
Methods:
pH - 9045C, Total Copper - 6010B

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY	DATE:TIME	RECEIVED BY	DATE:TIME
	10.14.11 10:30		
			[illegible]-11 9:38

①

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

L91358 Chain of Custody

ACZ Laboratories, Inc. L91358

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to

Name: Pam Pinson	Address: P.O. Box 10
Company: Chino Mines Company	Bayard, NM 88023
E-mail: Pamela_Pinson@FMI.com	Telephone: 575-912-5213

Copy of Report to

Name: Matthew Barkley	E-mail: Matthew.Barkley@arcadis-us.com
Company: ARCADIS	Telephone: 303-231-9115 ext 157

Invoice to

Name: Pam Pinson	Address: P.O. Box 10
Company: Chino Mines Company	Bayard, NM 88023
E-mail: Pamela_Pinson@FMI.com	Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐

If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐

If yes, please include state forms. Results will be reported to PQL. NO ☒

PROJECT INFORMATION — ANALYSES REQUESTED (attach list or use quote number)

Quote #:

Project/PO #:

Reporting state for compliance testing:

Sampler's Name: Carolyn Meyer

Are any samples NRC licensable material? Yes No

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	soil sieved to < 2mm	pH	Total CU	ABA				
STS-PH-2011-FID22	10.13.11 : 16:40	SO	1	x	x	x	x				
MB ~~STS-PH-2011-FID8~~	~~10.12.11 : 15:55~~	~~SO~~	~~1~~	~~x~~	~~x~~	~~x~~	~~x~~				
STS-PH-2011-FID10	10.7.11 : 14:35	SO	1	x	x	x	x				
STS-PH-2011-FID15	10.10.11 : 11:50	SO	1	x	x	x	x				
STS-PH-2011-FID16	10.10.11 : 12:30	SO	1	x	x	x	x				
STS-PH-2011-FID17	10.11.11 : 17:35	SO	1	x	x	x	x				
- STS-PH-2011-FID18	10.12.11 : 15:55	SO	1	x	x	x	x				

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

Please send to Sheri Fling at URS for validation. Sieve all soil samples to <2 mm prior to analysis. Soil should be reported on a dry weight basis.

Methods:

pH - 9045C, Total Copper - 6010B

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY	DATE:TIME	RECEIVED BY	DATE:TIME
	10.14.11 10:30		
			10-18-11 9:12

②

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Analytical Report

December 05, 2011

Report to:	Bill to:
Pam Pinson	Pam Pinson
Freeport-McMoRan - Chino Mines Company	Freeport-McMoRan - Chino Mines Company
PO Box 10	P.O. Box 13308
Bayard, NM 88023	Phoenix, AZ 85002-3308

cc: Matthew Barkley, Sheri Fling

Project ID: ZN000000J8
ACZ Project ID: L91526

Pam Pinson:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on October 26, 2011. This project has been assigned to ACZ's project number, L91526. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan. The enclosed results relate only to the samples received under L91526. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all requirements of NELAC.

This report shall be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after January 05, 2012. If the samples are determined to be hazardous, additional charges apply for disposal (typically less than $10/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical reports for five years.

If you have any questions or other needs, please contact your Project Manager.

S. Habermehl

Scott Habermehl has reviewed
and approved this report.

Freeport-McMoRan - Chino Mines Company

Project ID: ZN000000J8
Sample ID: STS-PH-2011-FID106

ACZ Sample ID: ***L91526-09***
Date Sampled: *10/18/11 12:05*
Date Received: *10/26/11*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	254			mg/Kg	1	5	11/28/11 22:19	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	1	B		t CaCO3/Kt	1	5	12/05/11 13:30	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	0.0			t CaCO3/Kt	1	5	12/05/11 13:30	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-1			t CaCO3/Kt	1	5	12/05/11 13:30	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)		U	*	%	0.1	0.5	11/29/11 7:48	bsu
pH, Corrosivity	M9045D/M9040C								
pH		5.0			units	0.1	0.1	11/29/11 0:00	mss2
pH measured at		22.2			C	0.1	0.1	11/29/11 0:00	mss2
Solids, Percent	CLPSOW390, PART F, D-98	96.4		*	%	0.1	0.5	11/29/11 21:25	nrc
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.03	B	*	%	0.01	0.1	11/28/11 0:00	bsu
Sulfur HNO3 Residue		0.03	B	*	%	0.01	0.1	11/28/11 0:00	bsu
Sulfur Organic Residual Mod		0.03	B	*	%	0.01	0.1	11/28/11 0:00	bsu
Sulfur Pyritic Sulfide			U	*	%	0.01	0.1	11/28/11 0:00	bsu
Sulfur Sulfate		0.01	B	*	%	0.01	0.1	11/28/11 0:00	bsu
Sulfur Total		0.04	B	*	%	0.01	0.1	11/28/11 0:00	bsu
Total Sulfur minus Sulfate		0.03	B	*	%	0.01	0.1	11/28/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/15/11 16:12	ndj
Crush and Pulverize	USDA No. 1, 1972							11/22/11 0:57	mfm/thf
Digestion - Hot Plate	M3050B ICP							11/23/11 13:47	nrc
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/22/11 0:57	mfm/thf
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2							11/22/11 0:57	mfm/thf

** Please refer to Qualifier Reports for details.*

Report Header Explanations

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit, typically 5 times the MDL.
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Amount of the true value or spike added recovered, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of interest

QC Sample Types

AS	Analytical Spike (Post Digestion)	*LCSWD*	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	*LFB*	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	*LFM*	Laboratory Fortified Matrix
CCV	Continuing Calibration Verification standard	*LFMD*	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	*LRB*	Laboratory Reagent Blank
ICB	Initial Calibration Blank	*MS*	Matrix Spike
ICV	Initial Calibration Verification standard	*MSD*	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	*PBS*	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	*PBW*	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	*PQV*	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	*SDL*	Serial Dilution

QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

ACZ Qualifiers (Qual)

B	Analyte concentration detected at a value between MDL and PQL. The associated value is an estimated quantity.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
L	Target analyte response was below the laboratory defined negative threshold.
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Method References

(1) EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
(2) EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.
(3) EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.
(4) EPA SW-846. Test Methods for Evaluating Solid Waste, Third Edition with Update III, December 1996.
(5) Standard Methods for the Examination of Water and Wastewater, 19th edition, 1995 & 20th edition (1998).

Comments

(1) QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
(2) Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.
(3) Animal matrices for Inorganic analyses are reported on an "as received" basis.
(4) An asterisk in the "XQ" column indicates there is an extended qualifier and/or certification qualifier associated with the result.

For a complete list of ACZ's Extended Qualifiers, please click: http://www.acz.com/public/extquallist.pdf

Copper, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG314273													
WG314273ICV	ICV	11/28/11 21:16	II111012-2	2		1.944	mg/L	97.2	90	110			
WG314273ICB	ICB	11/28/11 21:19				U	mg/L		-0.03	0.03			
WG314273PQV	PQV	11/28/11 21:22	II111128-2	.05		.051	mg/L	102	70	130			
WG314273ICSAB	ICSAB	11/28/11 21:25	II110922-1	.255		.261	mg/L	102.4	80	120			
WG314166PBS	PBS	11/28/11 21:31				U	mg/Kg		-3	3			
WG314166LCSS	LCSS	11/28/11 21:34	PCN38811	82.8		89.6	mg/Kg		64.2	101			
WG314166LCSSD	LCSSD	11/28/11 21:37	PCN38811	82.8		84.4	mg/Kg		64.2	101	6	20	
L91526-01MS	MS	11/28/11 21:43	II111115-2	50.5	438	496	mg/Kg	114.9	75	125			
L91526-01MSD	MSD	11/28/11 21:46	II111115-2	50.5	438	484.2	mg/Kg	91.5	75	125	2.41	20	
L91526-04SDL	SDL	11/28/11 21:58			458	498	mg/Kg				8.7	10	
WG314273CCV1	CCV	11/28/11 22:01	II111031-1	1		.991	mg/L	99.1	90	110			
WG314273CCB1	CCB	11/28/11 22:04				U	mg/L		-0.03	0.03			
WG314273CCV2	CCV	11/28/11 22:37	II111031-1	1		.997	mg/L	99.7	90	110			
WG314273CCB2	CCB	11/28/11 22:40				U	mg/L		-0.03	0.03			
WG314273CCV3	CCV	11/28/11 23:01	II111031-1	1		1.018	mg/L	101.8	90	110			
WG314273CCB3	CCB	11/28/11 23:04				.023	mg/L		-0.03	0.03			

Neutralization Potential as CaCO3 M600/2-78-054 3.2.3 - Modified (No Heat)

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG314242													
WG314242PBS	PBS	11/29/11 4:42				U	%		-0.1	0.1			
WG314242LCSS	LCSS	11/29/11 6:15	PCN33453	100		100.04	%	100	80	120			
L91526-09DUP	DUP	11/29/11 9:21			U	U	%				0	20	RA

Ph M9045D/M9040C

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG314357													
WG314357ICV	ICV	11/29/11 16:18	PCN37501	4		4.06	units	101.5	97	103			
L91526-01DUP	DUP	11/29/11 16:30			6.9	6.89	units				0.1	20	
WG314357CCV1	CCV	11/29/11 17:24	PCN37501	4		4.04	units	101	97	103			
WG314357CCV2	CCV	11/29/11 18:00	PCN37501	4		4.03	units	100.8	97	103			

Solids, Percent CLPSOW390, PART F, D-98

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG314188													
WG314188PBS	PBS	11/29/11 12:00				U	%		99.9	100.1			
L91526-20DUP	DUP	11/30/11 9:59			95.2	95.64	%				0.5	20	

Sulfur Organic Residual Mod M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG314230													
L91526-09DUP	DUP	11/29/11 0:19			.03	.01	%				100	20	RA

Sulfur Pyritic Sulfide M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG314230													
L91526-09DUP	DUP	11/29/11 0:19			U	.03	%				200	20	RA

Sulfur Sulfate M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG314230													
L91526-09DUP	DUP	11/29/11 0:19			.01	.01	%				0	20	RA

Sulfur Total M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG314230													
WG314230PBS	PBS	11/28/11 12:00				U	%		-0.03	0.03			
WG314230LCSS	LCSS	11/28/11 16:06	PCN38175	4.07		3.98	%	97.8					
L91526-09DUP	DUP	11/29/11 0:19			.04	.05	%				22.2	20	RA

Total Sulfur Minus Sulfate M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG314230													
L91526-09DUP	DUP	11/29/11 0:19			.03	.04	%				28.6	20	RA

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L91526-09	WG314242	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG314230	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

Soil Analysis

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)
Solids, Percent	CLPSOW390, PART F, D-98
Sulfur HCl Residue	M600/2-78-054 3.2.4-MOD
Sulfur HNO3 Residue	M600/2-78-054 3.2.4-MOD
Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD
Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD
Sulfur Sulfate	M600/2-78-054 3.2.4-MOD
Sulfur Total	M600/2-78-054 3.2.4-MOD
Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD

Sample Receipt

Freeport-McMoRan - Chino Mines Company
ZN000000J8

ACZ Project ID: L91526
Date Received: 10/26/2011 09:47
Received By: ksj
Date Printed: 10/27/2011

Receipt Verification

	YES	NO	NA
1) Does this project require special handling procedures such as CLP protocol?			X
2) Are the custody seals on the cooler intact?	X		
3) Are the custody seals on the sample containers intact?			X
4) Is there a Chain of Custody or other directive shipping papers present?	X		▨
5) Is the Chain of Custody complete?	X		▨
6) Is the Chain of Custody in agreement with the samples received?	X		▨
7) Is there enough sample for all requested analyses?	X		▨
8) Are all samples within holding times for requested analyses?	X		▨
9) Were all sample containers received intact?	X		▨
10) Are the temperature blanks present?			X
11) Are the trip blanks (VOA and/or Cyanide) present?			X
12) Are samples requiring no headspace, headspace free?			X
13) Do the samples that require a Foreign Soils Permit have one?			X

Exceptions: If you answered no to any of the above questions, please describe

N/A

Contact (For any discrepancies, the client must be contacted)

N/A

Shipping Containers

Cooler Id		Temp (°C)	Rad (µR/hr)
3139		6.4	20
2638		8.5	23
3325		8.4	19

Client must contact ACZ Project Manager if analysis should not proceed for samples received outside of thermal preservation acceptance criteria.

Notes

Sample Receipt

Freeport-McMoRan - Chino Mines Company
ZN000000J8

ACZ Project ID: L91526
Date Received: 10/26/2011 09:47
Received By: ksj
Date Printed: 10/27/2011

Sample Container Preservation

SAMPLE	CLIENT ID	R < 2	G < 2	BK < 2	Y< 2	YG< 2	B< 2	O < 2	T >12	N/A	RAD	ID
L91526-01	STS-PCUG-2011-27									X		☐
L91526-02	STS-PCUG-2011-31									X		☐
L91526-03	DUP4									X		☐
L91526-04	STS-PCUG-2011-5									X		☐
L91526-05	STS-PCUG-2011-6									X		☐
L91526-06	STS-PCUG-2011-8									X		☐
L91526-07	STS-PCUG-2011-9									X		☐
L91526-08	STS-PCUG-2011-15									X		☐
L91526-09	STS-PH-2011-FID106									X		☐
L91526-10	STS-PCUG-2011-32									X		☐
L91526-11	STS-PCUG-2011-34									X		☐
L91526-12	STS-PCUG-2011-35									X		☐
L91526-13	STS-PCUG-2011-36									X		☐
L91526-14	STS-PCUG-2011-37									X		☐
L91526-15	DUP10									X		☐
L91526-16	STS-CG-2011-44									X		☐
L91526-17	STS-CG-2011-47									X		☐
L91526-18	STS-CG-2011-48									X		☐
L91526-19	STS-CG-2011-16									X		☐
L91526-20	STS-CG-2011-7									X		☐

Sample Container Preservation Legend

Abbreviation	Description	Container Type	Preservative/Limits
R	Raw/Nitric	RED	pH must be < 2
B	Filtered/Sulfuric	BLUE	pH must be < 2
BK	Filtered/Nitric	BLACK	pH must be < 2
G	Filtered/Nitric	GREEN	pH must be < 2
O	Raw/Sulfuric	ORANGE	pH must be < 2
P	Raw/NaOH	PURPLE	pH must be > 12 *
T	Raw/NaOH Zinc Acetate	TAN	pH must be > 12
Y	Raw/Sulfuric	YELLOW	pH must be < 2
YG	Raw/Sulfuric	YELLOW GLASS	pH must be < 2
N/A	No preservative needed	Not applicable	
RAD	Gamma/Beta dose rate	Not applicable	must be < 250 µR/hr

* pH check performed by analyst prior to sample preparation

Sample IDs Reviewed By: ksj

ACZ Laboratories, Inc. L91526

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

Name: Matthew Barkley
Company: ARCADIS

E-mail: Matthew.Barkley@arcadis-us.com
Telephone: 303-231-9115 ext 157

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐ NO ☒
If yes, please include state forms. Results will be reported to PQL.

PROJECT INFORMATION

Quote #:
Project/PO #:
Reporting state for compliance testing:
Sampler's Name: Carolyn Meyer
Are any samples NRC licensable material? Yes No

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	soil sieved to < 2mm	pH	Total CU					
STS-PCUG-2011-27	10.20.11 - 16:05'	SO	1	✕	✕	✕					
STS-PCUG-2011-31	10.19.11 - 10:50'	SO	1	✕	✕	✕					
DUP4	10.19.11 - ---'	SO	1	✕	✕	✕					
STS-PCUG-2011-5	10.20.11 - 13:25'	SO	1	✕	✕	✕					
STS-PCUG-2011-6	10.18.11 - 10:55'	SO	1	✕	✕	✕					
STS-PCUG-2011-8	10.20.11 - 12:15'	SO	1	✕	✕	✕					
STS-PCUG-2011-9	10.18.11 - 14:05'	SO	1	✕	✕	✕					
STS-PCUG-2011-15	10.18.11 - 10:15'	SO	1	✕	✕	✕					

Matrix SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

Please send to Sheri Fling at URS for validation. Sieve all soil samples to <2 mm prior to analysis. Soil should be reported on a dry weight basis.
Methods:
pH - 9045C and Copper - 6010B

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
	10.24.11 1500		
		26	11 9:47

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

L91526 Chain of Custody

ACZ Laboratories, Inc. L91526

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

Name: Matthew Barkley
Company: ARCADIS

E-mail: Matthew.Barkley@arcadis-us.com
Telephone: 303-231-9115 ext 157

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐ NO ☒
If yes, please include state forms. Results will be reported to PQL.

PROJECT INFORMATION

Quote #:
Project/PO #:
Reporting state for compliance testing:
Sampler's Name: Carolyn Meyer
Are any samples NRC licensable material? Yes No

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	soil sieved to < 2mm	pH	Total CU	ABA				
STS-PH-2011-FID106	10.18.11 - 12:05'	SO	1	x	x	x	x				
STS-PCUG-2011-32	10.19.11 - 11:25'	SO	1	x	x	x					
STS-PCUG-2011-34	10.19.11 - 12:00'	SO	1	x	x	x					
STS-PCUG-2011-35	10.18.11 - 13:30'	SO	1	x	x	x					
STS-PCUG-2011-36	10.18.11 - 12:40'	SO	1	x	x	x					
STS-PCUG-2011-37	10.19.11 - 10:05'	SO	1	x	x	x					

Matrix SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

Please send to Sheri Fling at URS for validation. Sieve all soil samples to <2 mm prior to analysis. Soil should be reported on a dry weight basis.
Methods:
pH - 9045C and Copper - 6010B

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY	DATE:TIME	RECEIVED BY	DATE:TIME
10.24.11	1500		
		10.26.11	9:47

2

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

ACZ Laboratories, Inc. L91526

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

Copy of Report to:

Name: Matthew Barkley
Company: ARCADIS

E-mail: Matthew.Barkley@arcadis-us.com
Telephone: 303-231-9115 ext 157

Invoice to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐
If yes, please include state forms. Results will be reported to PQL. NO ☒

PROJECT INFORMATION

Quote #:
Project/PO #:
Reporting state for compliance testing:
Sampler's Name: Carolyn Meyer
Are any samples NRC licensable material? Yes No

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	soil sieved to < 2mm	Total Copper						
DUP10	10.19.11 - ---'	SO	1	x	x						
STS-CG-2011-44	10.20.11 - 11:25'	SO	1	x	x						
STS-CG-2011-47	10.20.11 - 14:30'	SO	1	x	x						
STS-CG-2011-48	10.20.11 - 09:30'	SO	1	x	x						
STS-CG-2011-16	10.19.11 - 17:40'	SO	1	x	x						
STS-CG-2011-7	10.19.11 - 15:30'	SO	1	x	x						

Matrix SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

Please send to Sheri Fling at URS for validation. Sieve all soil samples to <2 mm prior to analysis. Soil should be reported on a dry weight basis.

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
	10-24-11 1500		
			10-26-11 9:40

3

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

ACZ Laboratories, Inc.
2773 Downhill Drive   Steamboat Springs, CO 80487   (800) 334-5493

Analytical Report

December 02, 2011

Report to:	Bill to:
Pam Pinson	Pam Pinson
Freeport-McMoRan - Chino Mines Company	Freeport-McMoRan - Chino Mines Company
PO Box 10	P.O. Box 13308
Bayard, NM 88023	Phoenix, AZ 85002-3308

cc: Matthew Barkley, Sheri Fling

Project ID: ZN000000J8
ACZ Project ID: L91528

Pam Pinson:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on October 26, 2011. This project has been assigned to ACZ's project number, L91528. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan. The enclosed results relate only to the samples received under L91528. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all requirements of NELAC.

This report shall be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after January 02, 2012. If the samples are determined to be hazardous, additional charges apply for disposal (typically less than $10/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical reports for five years.

If you have any questions or other needs, please contact your Project Manager.

S. Habermehl

Scott Habermehl has reviewed
and approved this report.

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000000J8	ACZ Sample ID:	***L91528-01***
Sample ID:	STS-PH-2011-FID102	Date Sampled:	*10/19/11 09:15*
		Date Received:	*10/26/11*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	303		*	mg/Kg	1	5	11/30/11 13:43	scp

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	23			t CaCO3/Kt	1	5	12/01/11 11:12	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	0.0			t CaCO3/Kt	1	5	12/01/11 11:12	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-23			t CaCO3/Kt	1	5	12/01/11 11:12	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)		U	*	%	0.1	0.5	11/29/11 10:54	bsu
pH, Corrosivity	M9045D/M9040C								
pH		3.6			units	0.1	0.1	11/15/11 0:00	mss2
pH measured at		22.5			C	0.1	0.1	11/15/11 0:00	mss2
Solids, Percent	CLPSOW390, PART F, D-98	95.8		*	%	0.1	0.5	11/22/11 4:08	bsu
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.48		*	%	0.01	0.1	11/29/11 0:00	bsu
Sulfur HNO3 Residue		0.04	B	*	%	0.01	0.1	11/29/11 0:00	bsu
Sulfur Organic Residual Mod		0.04	B	*	%	0.01	0.1	11/29/11 0:00	bsu
Sulfur Pyritic Sulfide		0.44		*	%	0.01	0.1	11/29/11 0:00	bsu
Sulfur Sulfate		0.27		*	%	0.01	0.1	11/29/11 0:00	bsu
Sulfur Total		0.75		*	%	0.01	0.1	11/29/11 0:00	bsu
Total Sulfur minus Sulfate		0.48		*	%	0.01	0.1	11/29/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/05/11 12:34	nrc
Crush and Pulverize	USDA No. 1, 1972							11/09/11 10:00	mss2
Digestion - Hot Plate	M3050B ICP							11/29/11 12:40	mss2
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/09/11 11:52	lwt
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2							11/09/11 11:52	lwt

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000000J8	ACZ Sample ID:	***L91528-02***
Sample ID:	STS-PH-2011-FID7	Date Sampled:	*10/18/11 11:45*
		Date Received:	*10/26/11*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	494		*	mg/Kg	1	5	11/30/11 13:53	scp

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	4	B		t CaCO3/Kt	1	5	12/01/11 11:12	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	0.0			t CaCO3/Kt	1	5	12/01/11 11:12	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-4			t CaCO3/Kt	1	5	12/01/11 11:12	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)		U	*	%	0.1	0.5	11/29/11 12:27	bsu
pH, Corrosivity	M9045D/M9040C								
pH		4.8			units	0.1	0.1	11/15/11 0:00	mss2
pH measured at		22.4			C	0.1	0.1	11/15/11 0:00	mss2
Solids, Percent	CLPSOW390, PART F, D-98	97.4		*	%	0.1	0.5	11/22/11 5:08	bsu
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.06	B	*	%	0.01	0.1	11/29/11 0:00	bsu
Sulfur HNO3 Residue		0.02	B	*	%	0.01	0.1	11/29/11 0:00	bsu
Sulfur Organic Residual Mod		0.02	B	*	%	0.01	0.1	11/29/11 0:00	bsu
Sulfur Pyritic Sulfide		0.04	B	*	%	0.01	0.1	11/29/11 0:00	bsu
Sulfur Sulfate		0.07	B	*	%	0.01	0.1	11/29/11 0:00	bsu
Sulfur Total		0.13		*	%	0.01	0.1	11/29/11 0:00	bsu
Total Sulfur minus Sulfate		0.06	B	*	%	0.01	0.1	11/29/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/05/11 12:42	nrc
Crush and Pulverize	USDA No. 1, 1972							11/09/11 10:20	mss2
Digestion - Hot Plate	M3050B ICP							11/29/11 15:20	mss2
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/09/11 11:55	lwt
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2							11/09/11 11:55	lwt

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000000J8
Sample ID:	STS-PH-2011-FID8

ACZ Sample ID:	***L91528-03***
Date Sampled:	*10/19/11 17:00*
Date Received:	*10/26/11*
Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	332		*	mg/Kg	1	5	11/30/11 13:56	scp

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	15			t CaCO3/Kt	1	5	12/01/11 11:12	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	16			t CaCO3/Kt	1	5	12/01/11 11:12	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	1			t CaCO3/Kt	1	5	12/01/11 11:12	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1.6		*	%	0.1	0.5	11/29/11 9:42	bsu
pH, Corrosivity	M9045D/M9040C								
pH		6.4			units	0.1	0.1	11/15/11 0:00	mss2
pH measured at		22.2			C	0.1	0.1	11/15/11 0:00	mss2
Solids, Percent	CLPSOW390, PART F, D-98	92.9		*	%	0.1	0.5	11/22/11 6:09	bsu
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.25		*	%	0.01	0.1	11/29/11 0:00	bsu
Sulfur HNO3 Residue		0.03	B	*	%	0.01	0.1	11/29/11 0:00	bsu
Sulfur Organic Residual Mod		0.03	B	*	%	0.01	0.1	11/29/11 0:00	bsu
Sulfur Pyritic Sulfide		0.22		*	%	0.01	0.1	11/29/11 0:00	bsu
Sulfur Sulfate		0.22		*	%	0.01	0.1	11/29/11 0:00	bsu
Sulfur Total		0.47		*	%	0.01	0.1	11/29/11 0:00	bsu
Total Sulfur minus Sulfate		0.25		*	%	0.01	0.1	11/29/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/05/11 12:51	nrc
Crush and Pulverize	USDA No. 1, 1972							11/09/11 10:40	mss2
Digestion - Hot Plate	M3050B ICP							11/29/11 16:13	mss2
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/09/11 11:57	lwt
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2							11/09/11 11:57	lwt

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000000J8	ACZ Sample ID:	***L91528-04***
Sample ID:	STS-PH-2011-FID28	Date Sampled:	*10/18/11 15:35*
		Date Received:	*10/26/11*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	400		*	mg/Kg	1	5	11/30/11 13:59	scp

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	4	B		t CaCO3/Kt	1	5	12/01/11 11:12	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	35			t CaCO3/Kt	1	5	12/01/11 11:12	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	31			t CaCO3/Kt	1	5	12/01/11 11:12	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	3.5		*	%	0.1	0.5	11/29/11 12:36	bsu
pH, Corrosivity	M9045D/M9040C								
pH		6.9			units	0.1	0.1	11/15/11 0:00	mss2
pH measured at		22.2			C	0.1	0.1	11/15/11 0:00	mss2
Solids, Percent	CLPSOW390, PART F, D-98	97.5		*	%	0.1	0.5	11/22/11 7:10	bsu
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.12		*	%	0.01	0.1	11/29/11 0:00	bsu
Sulfur HNO3 Residue		0.04	B	*	%	0.01	0.1	11/29/11 0:00	bsu
Sulfur Organic Residual Mod		0.04	B	*	%	0.01	0.1	11/29/11 0:00	bsu
Sulfur Pyritic Sulfide		0.08	B	*	%	0.01	0.1	11/29/11 0:00	bsu
Sulfur Sulfate		0.01	B	*	%	0.01	0.1	11/29/11 0:00	bsu
Sulfur Total		0.13		*	%	0.01	0.1	11/29/11 0:00	bsu
Total Sulfur minus Sulfate		0.12		*	%	0.01	0.1	11/29/11 0:00	bsu

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/05/11 12:59	nrc
Crush and Pulverize	USDA No. 1, 1972							11/09/11 11:00	mss2
Digestion - Hot Plate	M3050B ICP							11/29/11 17:06	mss2
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/09/11 12:00	lwt
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2							11/09/11 12:00	lwt

** Please refer to Qualifier Reports for details.*

Report Header Explanations

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit, typically 5 times the MDL.
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Amount of the true value or spike added recovered, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of interest

QC Sample Types

AS	Analytical Spike (Post Digestion)	*LCSWD*	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	*LFB*	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	*LFM*	Laboratory Fortified Matrix
CCV	Continuing Calibration Verification standard	*LFMD*	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	*LRB*	Laboratory Reagent Blank
ICB	Initial Calibration Blank	*MS*	Matrix Spike
ICV	Initial Calibration Verification standard	*MSD*	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	*PBS*	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	*PBW*	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	*PQV*	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	*SDL*	Serial Dilution

QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

ACZ Qualifiers (Qual)

B	Analyte concentration detected at a value between MDL and PQL. The associated value is an estimated quantity.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
L	Target analyte response was below the laboratory defined negative threshold.
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Method References

(1) EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
(2) EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.
(3) EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.
(4) EPA SW-846. Test Methods for Evaluating Solid Waste, Third Edition with Update III, December 1996.
(5) Standard Methods for the Examination of Water and Wastewater, 19th edition, 1995 & 20th edition (1998).

Comments

(1) QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
(2) Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.
(3) Animal matrices for Inorganic analyses are reported on an "as received" basis.
(4) An asterisk in the "XQ" column indicates there is an extended qualifier and/or certification qualifier associated with the result.

For a complete list of ACZ's Extended Qualifiers, please click: http://www.acz.com/public/extquallist.pdf

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000000J8

ACZ Project ID: **L91528**

Copper, total (3050) M6010B ICP

WG314417

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG314417ICV	ICV	11/30/11 13:19	II111025-1	2		1.979	mg/L	99	90	110			
WG314417ICB	ICB	11/30/11 13:22				U	mg/L		-0.03	0.03			
WG314417PQV	PQV	11/30/11 13:25	II111128-2	.05		.052	mg/L	104	70	130			
WG314417ICSAB	ICSAB	11/30/11 13:28	II111129-1	.255		.259	mg/L	101.6	80	120			
WG314320PBS	PBS	11/30/11 13:34				U	mg/Kg		-3	3			
WG314320LCSS	LCSS	11/30/11 13:37	PCN38811	82.8		77	mg/Kg		64.2	101			
WG314320LCSSD	LCSSD	11/30/11 13:40	PCN38811	82.8		77.9	mg/Kg		64.2	101	1.2	20	
L91528-01MS	MS	11/30/11 13:46	II111115-2	50.5	303	350.7	mg/Kg	94.5	75	125			
L91528-01MSD	MSD	11/30/11 13:49	II111115-2	50.5	303	345.2	mg/Kg	83.6	75	125	1.58	20	
L91528-04SDL	SDL	11/30/11 14:02			400	447	mg/Kg				11.8	10	ZH
WG314417CCV1	CCV	11/30/11 14:05	II111021-2	1		1.011	mg/L	101.1	90	110			
WG314417CCB1	CCB	11/30/11 14:08				U	mg/L		-0.03	0.03			
WG314417CCV2	CCV	11/30/11 14:41	II111021-2	1		1.006	mg/L	100.6	90	110			
WG314417CCB2	CCB	11/30/11 14:45				U	mg/L		-0.03	0.03			
WG314417CCV3	CCV	11/30/11 15:19	II111021-2	1		.995	mg/L	99.5	90	110			
WG314417CCB3	CCB	11/30/11 15:22				U	mg/L		-0.03	0.03			
L91603-20SDL	SDL	11/30/11 15:47			2380	2537	mg/Kg				6.6	10	
WG314417CCV4	CCV	11/30/11 15:50	II111021-2	1		.992	mg/L	99.2	90	110			
WG314417CCB4	CCB	11/30/11 15:53				U	mg/L		-0.03	0.03			

Neutralization Potential as CaCO3 M600/2-78-054 3.2.3 - Modified (No Heat)

WG314241

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG314241PBS	PBS	11/28/11 22:06				U	%		-0.1	0.1			
WG314241LCSS	LCSS	11/29/11 1:00	PCN33453	100		82.5	%	82.5	80	120			
L91396-01DUP	DUP	11/29/11 6:48			2.9	2.88	%				0.7	20	

WG314242

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG314242PBS	PBS	11/29/11 4:42				U	%		-0.1	0.1			
WG314242LCSS	LCSS	11/29/11 6:15	PCN33453	100		100.04	%	100	80	120			
L91526-09DUP	DUP	11/29/11 9:21			U	U	%				0	20	RA

Ph M9045D/M9040C

WG313577

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
L91817-01DUP	DUP	11/15/11 10:25			7.5	7.5	units				0	20	
WG313577CCV	CCV	11/15/11 10:32	PCN36616	4		4.07	units	101.8	97	103			
WG313577ICV	ICV	11/15/11 10:59	PCN36616	4		4.06	units	101.5	97	103			

Solids, Percent CLPSOW390, PART F, D-98

WG314028

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG314028PBS	PBS	11/21/11 16:00				U	%		99.9	100.1			
L91360-01DUP	DUP	11/21/11 18:01			90.6	90.08	%				0.6	20	

Sulfur Organic Residual Mod — M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG314230													
L91526-09DUP	DUP	11/29/11 0:19			.03	.01	%				100	20	RA

Sulfur Pyritic Sulfide — M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG314230													
L91526-09DUP	DUP	11/29/11 0:19			U	.03	%				200	20	RA

Sulfur Sulfate — M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG314230													
L91526-09DUP	DUP	11/29/11 0:19			.01	.01	%				0	20	RA

Sulfur Total — M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG314230													
WG314230PBS	PBS	11/28/11 12:00				U	%		-0.03	0.03			
WG314230LCSS	LCSS	11/28/11 16:06	PCN38175	4.07		3.98	%	97.8					
L91526-09DUP	DUP	11/29/11 0:19			.04	.05	%				22.2	20	RA

Total Sulfur Minus Sulfate — M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG314230													
L91526-09DUP	DUP	11/29/11 0:19			.03	.04	%				28.6	20	RA

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L91528-01	WG314417	Copper, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG314242	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG314230	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L91528-02	WG314417	Copper, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG314242	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG314230	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L91528-03	WG314417	Copper, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG314230	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L91528-04	WG314417	Copper, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG314230	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

Soil Analysis

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.	
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)
Solids, Percent	CLPSOW390, PART F, D-98
Sulfur HCl Residue	M600/2-78-054 3.2.4-MOD
Sulfur HNO3 Residue	M600/2-78-054 3.2.4-MOD
Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD
Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD
Sulfur Sulfate	M600/2-78-054 3.2.4-MOD
Sulfur Total	M600/2-78-054 3.2.4-MOD
Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD

Sample Receipt

Freeport-McMoRan - Chino Mines Company
ZN000000J8

ACZ Project ID: L91528
Date Received: 10/26/2011 09:46
Received By: ksj
Date Printed: 10/27/2011

Receipt Verification

	YES	NO	NA
1) Does this project require special handling procedures such as CLP protocol?			X
2) Are the custody seals on the cooler intact?	X		
3) Are the custody seals on the sample containers intact?			X
4) Is there a Chain of Custody or other directive shipping papers present?	X		
5) Is the Chain of Custody complete?	X		
6) Is the Chain of Custody in agreement with the samples received?	X		
7) Is there enough sample for all requested analyses?	X		
8) Are all samples within holding times for requested analyses?	X		
9) Were all sample containers received intact?	X		
10) Are the temperature blanks present?			X
11) Are the trip blanks (VOA and/or Cyanide) present?			X
12) Are samples requiring no headspace, headspace free?			X
13) Do the samples that require a Foreign Soils Permit have one?			X

Exceptions: If you answered no to any of the above questions, please describe

N/A

Contact (For any discrepancies, the client must be contacted)

N/A

Shipping Containers

Cooler Id		Temp (°C)	Rad (µR/hr)
2638		8.5	23
3325		8.4	19

Client must contact ACZ Project Manager if analysis should not proceed for samples received outside of thermal preservation acceptance criteria.

Notes

Sample Receipt

Freeport-McMoRan - Chino Mines Company
ZN000000J8

ACZ Project ID:	L91528
Date Received:	10/26/2011 09:46
Received By:	ksj
Date Printed:	10/27/2011

Sample Container Preservation

SAMPLE	CLIENT ID	R < 2	G < 2	BK < 2	Y< 2	YG< 2	B< 2	O < 2	T >12	N/A	RAD	ID
L91528-01	STS-PH-2011-FID102									X		☐
L91528-02	STS-PH-2011-FID7									X		☐
L91528-03	STS-PH-2011-FID8									X		☐
L91528-04	STS-PH-2011-FID28									X		☐

Sample Container Preservation Legend

Abbreviation	Description	Container Type	Preservative/Limits
R	Raw/Nitric	RED	pH must be < 2
B	Filtered/Sulfuric	BLUE	pH must be < 2
BK	Filtered/Nitric	BLACK	pH must be < 2
G	Filtered/Nitric	GREEN	pH must be < 2
O	Raw/Sulfuric	ORANGE	pH must be < 2
P	Raw/NaOH	PURPLE	pH must be > 12 *
T	Raw/NaOH Zinc Acetate	TAN	pH must be > 12
Y	Raw/Sulfuric	YELLOW	pH must be < 2
YG	Raw/Sulfuric	YELLOW GLASS	pH must be < 2
N/A	No preservative needed	Not applicable	
RAD	Gamma/Beta dose rate	Not applicable	must be < 250 µR/hr

* pH check performed by analyst prior to sample preparation

Sample IDs Reviewed By: ksj

ACZ Laboratories, Inc. L91528

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com
Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

Copy of Report to:

Name: Matthew Barkley
Company: ARCADIS
E-mail: Matthew.Barkley@arcadis-us.com
Telephone: 303-231-9115 ext 157

Invoice to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com
Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐ NO ☒
If yes, please include state forms. Results will be reported to PQL.

PROJECT INFORMATION

Quote #:
Project/PO #:
Reporting state for compliance testing:
Sampler's Name: Carolyn Meyer
Are any samples NRC licensable material? Yes No

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	soil sieved to < 2mm	pH	Total CU	ABA				
STS-PH-2011-FID102	10.19.11 - 09:15'	SO	1	✗	✗	✗	✗				
STS-PH-2011-FID7	10.18.11 - 11:45'	SO	1	✗	✗	✗	✗				
STS-PH-2011-FID8	10.19.11 - 17:00'	SO	1	✗	✗	✗	✗				
STS-PH-2011-FID28	10.18.11 - 15:35'	SO	1	✗	✗	✗	✗				

Matrix SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

Please send to Sheri Fling at URS for validation. Sieve all soil samples to <2 mm prior to analysis. Soil should be reported on a dry weight basis.
Methods:
pH - 9045C, Total Copper - 6010B

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
	10.24.11 15:00		10-26-11

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

L91528 Chain of Custody

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Analytical Report

December 15, 2011

Report to:	Bill to:
Pam Pinson	Accounts Payable
Freeport-McMoRan - Chino Mines Company	Freeport-McMoRan - Chino Mines Company
PO Box 10	P.O. Box 13308
Bayard, NM 88023	Phoenix, AZ 85002-3308

cc: Matthew Barkley, Sheri Fling

Project ID: ZN000000J8
ACZ Project ID: L92172

Pam Pinson:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on December 02, 2011. This project has been assigned to ACZ's project number, L92172. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan. The enclosed results relate only to the samples received under L92172. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all requirements of NELAC.

This report shall be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after January 15, 2012. If the samples are determined to be hazardous, additional charges apply for disposal (typically less than $10/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical reports for five years.

If you have any questions or other needs, please contact your Project Manager.

S. Habermehl

Scott Habermehl has reviewed
and approved this report.

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000000J8	ACZ Sample ID:	***L92172-01***
Sample ID:	STS-PH-2011-FID37	Date Sampled:	*10/11/11 09:45*
		Date Received:	*12/02/11*
		Sample Matrix:	*Soil*

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.05	B	*	%	0.01	0.1	12/12/11 0:00	bsu/brd
Sulfur HNO3 Residue		0.02	B	*	%	0.01	0.1	12/12/11 0:00	bsu/brd
Sulfur Organic Residual Mod		0.02	B	*	%	0.01	0.1	12/12/11 0:00	bsu/brd
Sulfur Pyritic Sulfide		0.03	B	*	%	0.01	0.1	12/12/11 0:00	bsu/brd
Sulfur Sulfate			U	*	%	0.01	0.1	12/12/11 0:00	bsu/brd
Sulfur Total		0.05	B	*	%	0.01	0.1	12/12/11 0:00	bsu/brd
Total Sulfur minus Sulfate		0.05	B	*	%	0.01	0.1	12/12/11 0:00	bsu/brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L92172-02***
Project ID:	ZN000000J8	Date Sampled:	*10/12/11 16:45*
Sample ID:	STS-PH-2011-FID101	Date Received:	*12/02/11*
		Sample Matrix:	*Soil*

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.15		*	%	0.01	0.1	12/12/11 0:00	bsu/brd
Sulfur HNO3 Residue		0.02	B	*	%	0.01	0.1	12/12/11 0:00	bsu/brd
Sulfur Organic Residual Mod		0.02	B	*	%	0.01	0.1	12/12/11 0:00	bsu/brd
Sulfur Pyritic Sulfide		0.13		*	%	0.01	0.1	12/12/11 0:00	bsu/brd
Sulfur Sulfate		0.06	B	*	%	0.01	0.1	12/12/11 0:00	bsu/brd
Sulfur Total		0.21		*	%	0.01	0.1	12/12/11 0:00	bsu/brd
Total Sulfur minus Sulfate		0.15		*	%	0.01	0.1	12/12/11 0:00	bsu/brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID: ZN000000J8
Sample ID: STS-PH-2011-REFPLOT3

ACZ Sample ID: ***L92172-03***
Date Sampled: *10/07/11 11:50*
Date Received: *12/02/11*
Sample Matrix: *Soil*

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.09	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur HNO3 Residue		0.02	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Organic Residual Mod		0.02	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Pyritic Sulfide		0.07	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Sulfate		0.07	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Total		0.16		*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Total Sulfur minus Sulfate		0.09	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID: ZN000000J8
Sample ID: STS-PH-2011-REFPLOT4

ACZ Sample ID: ***L92172-04***
Date Sampled: *10/06/11 10:39*
Date Received: *12/02/11*
Sample Matrix: *Soil*

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.18		*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur HNO3 Residue		0.04	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Organic Residual Mod		0.04	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Pyritic Sulfide		0.14		*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Sulfate		0.05	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Total		0.23		*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Total Sulfur minus Sulfate		0.18		*	%	0.01	0.1	12/13/11 0:00	bsu/brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L92172-05***
Project ID:	ZN000000J8	Date Sampled:	*10/06/11 13:30*
Sample ID:	STS-PH-2011-FID105	Date Received:	*12/02/11*
		Sample Matrix:	*Soil*

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.09	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur HNO3 Residue		0.04	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Organic Residual Mod		0.04	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Pyritic Sulfide		0.05	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Sulfate		0.01	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Total		0.10		*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Total Sulfur minus Sulfate		0.09	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000000J8	ACZ Sample ID:	***L92172-06***
Sample ID:	STS-PH-2011-REFPLOT1	Date Sampled:	*10/04/11 11:09*
		Date Received:	*12/02/11*
		Sample Matrix:	*Soil*

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.05	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur HNO3 Residue		0.02	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Organic Residual Mod		0.02	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Pyritic Sulfide		0.03	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Sulfate		0.04	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Total		0.09	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Total Sulfur minus Sulfate		0.05	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000000J8
Sample ID: STS-PH-2011-REFPLOT2

ACZ Sample ID: ***L92172-07***
Date Sampled: *10/05/11 12:30*
Date Received: *12/02/11*
Sample Matrix: *Soil*

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.02	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur HNO3 Residue		0.05	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Organic Residual Mod		0.05	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Pyritic Sulfide			U	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Sulfate			U	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Total		0.02	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Total Sulfur minus Sulfate		0.02	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000000J8	ACZ Sample ID:	***L92172-08***
Sample ID:	STS-PH-2011-FID22	Date Sampled:	*10/13/11 16:40*
		Date Received:	*12/02/11*
		Sample Matrix:	*Soil*

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.23		*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur HNO3 Residue		0.03	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Organic Residual Mod		0.03	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Pyritic Sulfide		0.20		*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Sulfate		0.05	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Total		0.28		*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Total Sulfur minus Sulfate		0.23		*	%	0.01	0.1	12/13/11 0:00	bsu/brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000000J8	ACZ Sample ID:	***L92172-09***
Sample ID:	STS-PH-2011-FID10	Date Sampled:	*10/07/11 14:35*
		Date Received:	*12/02/11*
		Sample Matrix:	*Soil*

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.09	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur HNO3 Residue		0.02	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Organic Residual Mod		0.02	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Pyritic Sulfide		0.07	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Sulfate		0.02	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Total		0.11		*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Total Sulfur minus Sulfate		0.09	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000000J8	ACZ Sample ID:	***L92172-10***
Sample ID:	STS-PH-2011-FID15	Date Sampled:	*10/10/11 11:50*
		Date Received:	*12/02/11*
		Sample Matrix:	*Soil*

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.19		*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur HNO3 Residue		0.02	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Organic Residual Mod		0.02	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Pyritic Sulfide		0.17		*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Sulfate		0.02	B	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Total		0.21		*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Total Sulfur minus Sulfate		0.19		*	%	0.01	0.1	12/13/11 0:00	bsu/brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000000J8	ACZ Sample ID:	***L92172-11***
Sample ID:	STS-PH-2011-FID16	Date Sampled:	*10/10/11 12:30*
		Date Received:	*12/02/11*
		Sample Matrix:	*Soil*

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.13		*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur HNO3 Residue		0.14		*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Organic Residual Mod		0.14		*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Pyritic Sulfide			U	*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Sulfate		0.13		*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Sulfur Total		0.26		*	%	0.01	0.1	12/13/11 0:00	bsu/brd
Total Sulfur minus Sulfate		0.13		*	%	0.01	0.1	12/13/11 0:00	bsu/brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L92172-12***
Project ID:	ZN000000J8	Date Sampled:	*10/11/11 17:35*
Sample ID:	STS-PH-2011-FID17	Date Received:	*12/02/11*
		Sample Matrix:	*Soil*

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.43		*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur HNO3 Residue		0.05	B	*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur Organic Residual Mod		0.05	B	*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur Pyritic Sulfide		0.38		*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur Sulfate		0.05	B	*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur Total		0.48		*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Total Sulfur minus Sulfate		0.43		*	%	0.01	0.1	12/14/11 0:00	bsu/brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000000J8	ACZ Sample ID:	***L92172-13***
Sample ID:	STS-PH-2011-FID18	Date Sampled:	*10/12/11 15:55*
		Date Received:	*12/02/11*
		Sample Matrix:	*Soil*

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.13		*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur HNO3 Residue		0.02	B	*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur Organic Residual Mod		0.02	B	*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur Pyritic Sulfide		0.11		*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur Sulfate		0.03	B	*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur Total		0.16		*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Total Sulfur minus Sulfate		0.13		*	%	0.01	0.1	12/14/11 0:00	bsu/brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000000J8	ACZ Sample ID:	***L92172-14***
Sample ID:	STS-PH-2011-FID106	Date Sampled:	*10/18/11 12:05*
		Date Received:	*12/02/11*
		Sample Matrix:	*Soil*

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.04	B	*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur HNO3 Residue		0.02	B	*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur Organic Residual Mod		0.02	B	*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur Pyritic Sulfide		0.02	B	*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur Sulfate		0.01	B	*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur Total		0.05	B	*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Total Sulfur minus Sulfate		0.04	B	*	%	0.01	0.1	12/14/11 0:00	bsu/brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000000J8
Sample ID:	STS-PH-2011-FID102
ACZ Sample ID:	***L92172-15***
Date Sampled:	*10/19/11 09:15*
Date Received:	*12/02/11*
Sample Matrix:	*Soil*

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.56		*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur HNO3 Residue		0.06	B	*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur Organic Residual Mod		0.06	B	*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur Pyritic Sulfide		0.50		*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur Sulfate		0.36		*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur Total		0.92		*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Total Sulfur minus Sulfate		0.56		*	%	0.01	0.1	12/14/11 0:00	bsu/brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID: ZN000000J8
Sample ID: STS-PH-2011-FID7

ACZ Sample ID: ***L92172-16***
Date Sampled: *10/18/11 11:45*
Date Received: *12/02/11*
Sample Matrix: *Soil*

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.06	B	*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur HNO3 Residue		0.03	B	*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur Organic Residual Mod		0.03	B	*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur Pyritic Sulfide		0.03	B	*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur Sulfate		0.01	B	*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur Total		0.07	B	*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Total Sulfur minus Sulfate		0.06	B	*	%	0.01	0.1	12/14/11 0:00	bsu/brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID: ZN000000J8
Sample ID: STS-PH-2011-FID8

ACZ Sample ID: ***L92172-17***
Date Sampled: *10/19/11 17:00*
Date Received: *12/02/11*
Sample Matrix: *Soil*

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.32		*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur HNO3 Residue		0.06	B	*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur Organic Residual Mod		0.06	B	*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur Pyritic Sulfide		0.26		*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur Sulfate		0.27		*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur Total		0.59		*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Total Sulfur minus Sulfate		0.32		*	%	0.01	0.1	12/14/11 0:00	bsu/brd

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L92172-18***
Project ID:	ZN000000J8	Date Sampled:	*10/18/11 15:35*
Sample ID:	STS-PH-2011-FID28	Date Received:	*12/02/11*
		Sample Matrix:	*Soil*

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.12		*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur HNO3 Residue		0.04	B	*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur Organic Residual Mod		0.04	B	*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur Pyritic Sulfide		0.08	B	*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur Sulfate		0.07	B	*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Sulfur Total		0.19		*	%	0.01	0.1	12/14/11 0:00	bsu/brd
Total Sulfur minus Sulfate		0.12		*	%	0.01	0.1	12/14/11 0:00	bsu/brd

** Please refer to Qualifier Reports for details.*

Inorganic Reference

Report Header Explanations

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit, typically 5 times the MDL.
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Amount of the true value or spike added recovered, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of interest

QC Sample Types

AS	Analytical Spike (Post Digestion)	*LCSWD*	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	*LFB*	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	*LFM*	Laboratory Fortified Matrix
CCV	Continuing Calibration Verification standard	*LFMD*	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	*LRB*	Laboratory Reagent Blank
ICB	Initial Calibration Blank	*MS*	Matrix Spike
ICV	Initial Calibration Verification standard	*MSD*	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	*PBS*	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	*PBW*	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	*PQV*	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	*SDL*	Serial Dilution

QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

ACZ Qualifiers (Qual)

B	Analyte concentration detected at a value between MDL and PQL. The associated value is an estimated quantity.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
L	Target analyte response was below the laboratory defined negative threshold.
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Method References

(1) EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
(2) EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.
(3) EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.
(4) EPA SW-846. Test Methods for Evaluating Solid Waste, Third Edition with Update III, December 1996.
(5) Standard Methods for the Examination of Water and Wastewater, 19th edition, 1995 & 20th edition (1998).

Comments

(1) QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
(2) Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.
(3) Animal matrices for Inorganic analyses are reported on an "as received" basis.
(4) An asterisk in the "XQ" column indicates there is an extended qualifier and/or certification qualifier associated with the result.

For a complete list of ACZ's Extended Qualifiers, please click: http://www.acz.com/public/extquallist.pdf

Sulfur Organic Residual Mod M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG315136													
L92172-01DUP	DUP	12/12/11 19:20			.02	.03	%				40	20	RA

Sulfur Pyritic Sulfide M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG315136													
L92172-01DUP	DUP	12/12/11 19:20			.03	.04	%				28.6	20	RA

Sulfur Sulfate M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG315136													
L92172-01DUP	DUP	12/12/11 19:20			U	U	%				0	20	RA

Sulfur Total M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG315136													
WG315136PBS	PBS	12/12/11 10:45				U	%		-0.03	0.03			
WG315136LCSS	LCSS	12/12/11 13:36	PCN38175	4.07		3.93	%	96.6					
L92172-01DUP	DUP	12/12/11 19:20			.05	.05	%				0	20	RA

Total Sulfur Minus Sulfate M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG315136													
L92172-01DUP	DUP	12/12/11 19:20			.05	.05	%				0	20	RA

Freeport-McMoRan - Chino Mines Company ACZ Project ID: ***L92172***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L92172-01	WG315136	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L92172-02	WG315136	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L92172-03	WG315136	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L92172-04	WG315136	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L92172-05	WG315136	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L92172-06	WG315136	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L92172-07	WG315136	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L92172-08	WG315136	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L92172-09	WG315136	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L92172-10	WG315136	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L92172-11	WG315136	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L92172-12	WG315136	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L92172-13	WG315136	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L92172-14	WG315136	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L92172-15	WG315136	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L92172-16	WG315136	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L92172-17	WG315136	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L92172-18	WG315136	Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

Soil Analysis

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Sulfur HCl Residue	M600/2-78-054 3.2.4-MOD
Sulfur HNO3 Residue	M600/2-78-054 3.2.4-MOD
Sulfur Organic Residual Mod	M600/2-78-054 3.2.4-MOD
Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD
Sulfur Sulfate	M600/2-78-054 3.2.4-MOD
Sulfur Total	M600/2-78-054 3.2.4-MOD
Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD

Sample Receipt

Freeport-McMoRan - Chino Mines Company
ZN000000J8

ACZ Project ID: L91358
Date Received: 10/18/2011 09:23
Received By: ksj
Date Printed: 10/19/2011

Receipt Verification

	YES	NO	NA
1) Does this project require special handling procedures such as CLP protocol?			X
2) Are the custody seals on the cooler intact?	X		
3) Are the custody seals on the sample containers intact?			X
4) Is there a Chain of Custody or other directive shipping papers present?	X		
5) Is the Chain of Custody complete?	X		
6) Is the Chain of Custody in agreement with the samples received?	X		
7) Is there enough sample for all requested analyses?	X		
8) Are all samples within holding times for requested analyses?	X		
9) Were all sample containers received intact?	X		
10) Are the temperature blanks present?			X
11) Are the trip blanks (VOA and/or Cyanide) present?			X
12) Are samples requiring no headspace, headspace free?			X
13) Do the samples that require a Foreign Soils Permit have one?			X

Exceptions: If you answered no to any of the above questions, please describe

N/A

Contact (For any discrepancies, the client must be contacted)

N/A

Shipping Containers

Cooler Id		Temp (°C)	Rad (µR/hr)
3282		9.2	18
3164		10.4	18
3045		13.6	20

Client must contact ACZ Project Manager if analysis should not proceed for samples received outside of thermal preservation acceptance criteria.

Notes

Sample Receipt

Freeport-McMoRan - Chino Mines Company
ZN000000J8

ACZ Project ID:	L91358
Date Received:	10/18/2011 09:23
Received By:	ksj
Date Printed:	10/19/2011

Sample Container Preservation

SAMPLE	CLIENT ID	R < 2	G < 2	BK < 2	Y< 2	YG< 2	B< 2	O < 2	T >12	N/A	RAD	ID
L91358-01	STS-PH-2011-FID37									X		☐
L91358-02	STS-PCUG-2011-40									X		☐
L91358-03	STS-PH-2011-FID101									X		☐
L91358-04	STS-PH-2011-REFPLOT3									X		☐
L91358-05	STS-PH-2011-REFPLOT4									X		☐
L91358-06	DUP11									X		☐
L91358-07	STS-PH-2011-FID105									X		☐
L91358-08	DUP12									X		☐
L91358-09	STS-PH-2011-REFPLOT1									X		☐
L91358-10	STS-PH-2011-REFPLOT2									X		☐
L91358-11	STS-PH-2011-FID22									X		☐
L91358-12	STS-PH-2011-FID10									X		☐
L91358-13	STS-PH-2011-FID15									X		☐
L91358-14	STS-PH-2011-FID16									X		☐
L91358-15	STS-PH-2011-FID17									X		☐
L91358-16	STS-PH-2011-FID18									X		☐

Sample Container Preservation Legend

Abbreviation	Description	Container Type	Preservative/Limits
R	Raw/Nitric	RED	pH must be < 2
B	Filtered/Sulfuric	BLUE	pH must be < 2
BK	Filtered/Nitric	BLACK	pH must be < 2
G	Filtered/Nitric	GREEN	pH must be < 2
O	Raw/Sulfuric	ORANGE	pH must be < 2
P	Raw/NaOH	PURPLE	pH must be > 12 *
T	Raw/NaOH Zinc Acetate	TAN	pH must be > 12
Y	Raw/Sulfuric	YELLOW	pH must be < 2
YG	Raw/Sulfuric	YELLOW GLASS	pH must be < 2
N/A	No preservative needed	Not applicable	
RAD	Gamma/Beta dose rate	Not applicable	must be < 250 µR/hr

* pH check performed by analyst prior to sample preparation

Sample IDs Reviewed By: ksj

L92172-Relog

ACZ Laboratories, Inc. ~~L91358~~
LSO 12.2.11

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Name: Pam Pinson	Address: P.O. Box 10
Company: Chino Mines Company	Bayard, NM 88023
E-mail: Pamela_Pinson@FMI.com	Telephone: 575-912-5213

Name: Matthew Barkley	E-mail: Matthew.Barkley@arcadis-us.com
Company: ARCADIS	Telephone: 303-231-9115 ext 157

Name: Pam Pinson	Address: P.O. Box 10
Company: Chino Mines Company	Bayard, NM 88023
E-mail: Pamela_Pinson@FMI.com	Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐ NO ☒
If yes, please include state forms. Results will be reported to PQL.

Quote #:
Project/PO #:
Reporting state for compliance testing:
Sampler's Name: Carolyn Meyer
Are any samples NRC licensable material? Yes No

			# of Containers	soil sieved to < 2mm	pH	Total CU	ABA				
STS-PH-2011-FID37	10.11.11 : 09:45"	SO	1	x	x	x	x	L91358-01			
STS-PCUG-2011-40	10.13.11 : 13:55"	SO	1	x	x	x					
STS-PH-2011-FID101	10.12.11 : 16:45"	SO	1	x	x	x	x	191358-~~02~~03			
STS-PH-2011-REFPLOT3	10.7.11 : 11:50"	SO	1	x	x	x	x	L91358-~~03~~04			
STS-PH-2011-REFPLOT4	10.6.11 : 10:39"	SO	1	x	x	x	x	191358-05			
DUP11	10.12.11 : ---"	SO	1	x	x	x	x				
STS-PH-2011-FID105	10.6.11 : 13:30"	SO	1	x	x	x	x	L91358-07			
DUP12	10.13.11 : --- "	SO	1	x	x	x	x				
STS-PH-2011-REFPLOT1	10.4.11 : 11:09"	SO	1	x	x	x	x	L91358-~~08~~09			
STS-PH-2011-REFPLOT2	10.5.11 : 12:30"	SO	1	x	x	x	x	L91358-10			

LSO 12.2.11

LSO 12.2.11

LSO 12.2.11

Matrix SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

Please send to Sheri Fling at URS for validation. Sieve all soil samples to <2 mm prior to analysis. Soil should be reported on a dry weight basis.
Methods:
pH - 9045C, Total Copper - 6010B

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

	10.14.11 10:50		
			[illegible] 9:22

①

L92172 Chain of Custody
~~L91358 Chain of Custody~~

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

ACZ Laboratories, Inc. L91358

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Name: Pam Pinson	Address: P.O. Box 10
Company: Chino Mines Company	Bayard, NM 88023
E-mail: Pamela_Pinson@FMI.com	Telephone: 575-912-5213

Name: Matthew Barkley	E-mail: Matthew.Barkley@arcadis-us.com
Company: ARCADIS	Telephone: 303-231-9115 ext 157

Name: Pam Pinson	Address: P.O. Box 10
Company: Chino Mines Company	Bayard, NM 88023
E-mail: Pamela_Pinson@FMI.com	Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐

If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐

If yes, please include state forms. Results will be reported to PQL. NO ☒

Quote #:

Project/PO #:

Reporting state for compliance testing:

Sampler's Name: Carolyn Meyer

Are any samples NRC licensable material? Yes No

			# of Containers	soil sieved to < 2mm	pH	Total CU	ABA	
STS-PH-2011-FID22	10.13.11 : 16:40	SO	1	x	x	x	x	L91358-11
nb ~~STS-PH-2011-FID8~~	~~10.12.11 : 15:55~~	~~SO~~	~~1~~	~~x~~	~~x~~	~~x~~	~~x~~	
STS-PH-2011-FID10	10.7.11 : 14:35	SO	1	x	x	x	x	L91358-12
STS-PH-2011-FID15	10.10.11 : 11:50	SO	1	x	x	x	x	-13
STS-PH-2011-FID16	10.10.11 : 12:30	SO	1	x	x	x	x	-14
STS-PH-2011-FID17	10.11.11 : 17:35	SO	1	x	x	x	x	-15
STS-PH-2011-FID18	10.12.11 : 15:55	SO	1	x	x	x	x	-16

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

Please send to Sheri Fling at URS for validation. Sieve all soil samples to <2 mm prior to analysis. Soil should be reported on a dry weight basis.

Methods:

pH - 9045C, Total Copper - 6010B

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

	10.24.11 10:50		
			-11 9:[illegible]

②

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

ACZ Laboratories, Inc. ~~L91526~~
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493 L[illegible]

CHAIN OF CUSTODY

Name: Pam Pinson	Address: P.O. Box 10
Company: Chino Mines Company	Bayard, NM 88023
E-mail: Pamela_Pinson@FMI.com	Telephone: 575-912-5213

Name: Matthew Barkley	E-mail: Matthew.Barkley@arcadis-us.com
Company: ARCADIS	Telephone: 303-231-9115 ext 157

Name: Pam Pinson	Address: P.O. Box 10
Company: Chino Mines Company	Bayard, NM 88023
E-mail: Pamela_Pinson@FMI.com	Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐ NO ☒
If yes, please include state forms. Results will be reported to PQL.

Quote #:
Project/PO #:
Reporting state for compliance testing:
Sampler's Name: Carolyn Meyer
Are any samples NRC licensable material? Yes No

			# of Containers	soil sieved to < 2mm	pH	Total CU	ABA				
STS-PH-2011-FID106	10.18.11 - 12:05'	SO	1	x	x	x	x	L91526-09			
STS-PCUG-2011-32	10.19.11 - 11:25'	SO	1	x	x	x					
STS-PCUG-2011-34	10.19.11 - 12:00'	SO	1	x	x	x					
STS-PCUG-2011-35	10.18.11 - 13:30'	SO	1	x	x	x					
STS-PCUG-2011-36	10.18.11 - 12:40'	SO	1	x	x	x					
STS-PCUG-2011-37	10.19.11 - 10:05'	SO	1	x	x	x					

Matrix SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

Please send to Sheri Fling at URS for validation. Sieve all soil samples to <2 mm prior to analysis. Soil should be reported on a dry weight basis.
Methods:
pH - 9045C and Copper - 6010B

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

10.24.11	1500		
		10.26.11	9:47

2

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

ACZ Laboratories, Inc. L91528

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Name: Pam Pinson	Address: P.O. Box 10
Company: Chino Mines Company	Bayard, NM 88023
E-mail: Pamela_Pinson@FMI.com	Telephone: 575-912-5213

Name: Matthew Barkley	E-mail: Matthew.Barkley@arcadis-us.com
Company: ARCADIS	Telephone: 303-231-9115 ext 157

Name: Pam Pinson	Address: P.O. Box 10
Company: Chino Mines Company	Bayard, NM 88023
E-mail: Pamela_Pinson@FMI.com	Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐

If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐ NO ☒

If yes, please include state forms. Results will be reported to PQL.

Quote #:

Project/PO #:

Reporting state for compliance testing:

Sampler's Name: Carolyn Meyer

Are any samples NRC licensable material? Yes No

			# of Containers	soil sieved to < 2mm	pH	Total CU	ABA				
STS-PH-2011-FID102	10.19.11 - 09:15'	SO	1	x	x	x	x	L91528-01			
STS-PH-2011-FID7	10.18.11 - 11:45'	SO	1	x	x	x	x				-02
STS-PH-2011-FID8	10.19.11 - 17:00'	SO	1	x	x	x	x				-03
STS-PH-2011-FID28	10.18.11 - 15:35'	SO	1	x	x	x	x				-04

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

Please send to Sheri Fling at URS for validation. Sieve all soil samples to <2 mm prior to analysis. Soil should be reported on a dry weight basis.

Methods:

pH - 9045C, Total Copper - 6010B

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

	10.24.11 15:00		10-26-11

L91528 Chain of Custody

10.21.11

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Analytical Report

November 21, 2012

Report to:
Pam Pinson
Freeport-McMoRan - Chino Mines Company
PO Box 10
Bayard, NM 88023

Bill to:
Pam Pinson
Freeport-McMoRan - Chino Mines Company
P.O. Box 13308
Phoenix, AZ 85002-3308

cc: Matthew Barkley

Project ID: ZN000001M5
ACZ Project ID: L97383

Pam Pinson:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on October 16, 2012. This project has been assigned to ACZ's project number, L97383. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan. The enclosed results relate only to the samples received under L97383. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all requirements of NELAC.

This report shall be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after December 21, 2012. If the samples are determined to be hazardous, additional charges apply for disposal (typically $11/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical raw data reports for ten years.

If you have any questions or other needs, please contact your Project Manager.

S. Habermehl

Scott Habermehl has reviewed
and approved this report.

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001M5	ACZ Sample ID:	***L97383-09***
Sample ID:	DUP5	Date Sampled:	*10/09/12 00:00*
		Date Received:	*10/16/12*
		Sample Matrix:	*Soil*

Inorganic Prep

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Total Hot Plate Digestion	M3010A ICP							11/19/12 17:49	aeb

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper (1312)	M6010B ICP		U		mg/L	0.01	0.05	11/20/12 15:08	aeb
Copper, total (3050)	M6010B ICP	159		*	mg/Kg	1	5	11/13/12 15:28	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
pH, Saturated Paste	USDA No. 60 (21A)	7.6		*	units	0.1	0.1	11/13/12 10:50	mss2
Solids, Percent	CLPSOW390, PART F, D-98	83.5		*	%	0.1	0.5	11/13/12 12:00	mjj

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/08/12 2:15	mjj
Digestion - Hot Plate	M3050B ICP							11/12/12 15:26	mjj
Saturated Paste Extraction	USDA No. 60 (2)							11/12/12 16:52	mss2
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/12/12 9:50	brd
Synthetic Precip. Leaching Procedure	M1312							11/16/12 7:09	cdb

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L97383-10***
Project ID:	ZN000001M5	Date Sampled:	*10/10/12 00:00*
Sample ID:	DUP6	Date Received:	*10/16/12*
		Sample Matrix:	*Soil*

Inorganic Prep

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Total Hot Plate Digestion	M3010A ICP							11/19/12 18:10	aeb

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper (1312)	M6010B ICP		U		mg/L	0.01	0.05	11/20/12 15:11	aeb
Copper, total (3050)	M6010B ICP	52		*	mg/Kg	1	5	11/13/12 15:38	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
pH, Saturated Paste	USDA No. 60 (21A)	7.9		*	units	0.1	0.1	11/13/12 10:55	mss2
Solids, Percent	CLPSOW390, PART F, D-98	81.5		*	%	0.1	0.5	11/13/12 14:00	mjj

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/08/12 4:11	mjj
Digestion - Hot Plate	M3050B ICP							11/12/12 16:22	mjj
Saturated Paste Extraction	USDA No. 60 (2)							11/12/12 16:56	mss2
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/12/12 9:56	brd
Synthetic Precip. Leaching Procedure	M1312							11/16/12 9:34	cdb

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L97383-11***
Project ID:	ZN000001M5	Date Sampled:	*10/11/12 15:15*
Sample ID:	STS-PH-2012-FID7	Date Received:	*10/16/12*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	514		*	mg/Kg	1	5	11/13/12 15:41	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4	0			t CaCO3/Kt	1	5	11/21/12 9:48	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	8			t CaCO3/Kt	1	5	11/21/12 9:48	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	8			t CaCO3/Kt	1	5	11/21/12 9:48	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	0.8		*	%	0.1	0.5	11/14/12 9:00	nrc
pH, Corrosivity	M9045D/M9040C								
pH		4.7			units	0.1	0.1	11/14/12 0:00	nrc
pH measured at		22.7			C	0.1	0.1	11/14/12 0:00	nrc
Solids, Percent	CLPSOW390, PART F, D-98	95.6		*	%	0.1	0.5	11/13/12 16:00	mjj
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.02	B	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur HNO3 Residue			U	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur Organic Residual			U	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur Pyritic Sulfide		0.02	B	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur Sulfate			U	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur Total		0.02	B	*	%	0.01	0.1	11/12/12 0:00	cra
Total Sulfur minus Sulfate		0.02	B	*	%	0.01	0.1	11/12/12 0:00	cra

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/08/12 6:07	mjj
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3							11/12/12 9:36	brd
Digestion - Hot Plate	M3050B ICP							11/12/12 16:41	mjj
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/12/12 10:03	brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001M5	ACZ Sample ID:	***L97383-12***
Sample ID:	STS-PH-2012-FID8	Date Sampled:	*10/12/12 10:40*
		Date Received:	*10/16/12*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	252		*	mg/Kg	1	5	11/13/12 15:44	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4	3	B		t CaCO3/Kt	1	5	11/21/12 9:48	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	3			t CaCO3/Kt	1	5	11/21/12 9:48	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	0			t CaCO3/Kt	1	5	11/21/12 9:48	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	0.3	B	*	%	0.1	0.5	11/14/12 12:03	nrc
pH, Corrosivity	M9045D/M9040C								
pH		5.5			units	0.1	0.1	11/14/12 0:00	nrc
pH measured at		22.7			C	0.1	0.1	11/14/12 0:00	nrc
Solids, Percent	CLPSOW390, PART F, D-98	94.9		*	%	0.1	0.5	11/13/12 18:00	mjj
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.04	B	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur HNO3 Residue			U	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur Organic Residual			U	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur Pyritic Sulfide		0.04	B	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur Sulfate		0.07	B	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur Total		0.11		*	%	0.01	0.1	11/12/12 0:00	cra
Total Sulfur minus Sulfate		0.04	B	*	%	0.01	0.1	11/12/12 0:00	cra

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/08/12 8:02	mjj
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3							11/12/12 9:46	brd
Digestion - Hot Plate	M3050B ICP							11/12/12 17:00	mjj
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/12/12 10:09	brd

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000001M5
Sample ID: STS-PH-2012-FID10

ACZ Sample ID: ***L97383-13***
Date Sampled: *10/11/12 08:20*
Date Received: *10/16/12*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	2210		*	mg/Kg	1	5	11/13/12 15:50	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4	2	B		t CaCO3/Kt	1	5	11/21/12 9:48	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	1			t CaCO3/Kt	1	5	11/21/12 9:48	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-1			t CaCO3/Kt	1	5	11/21/12 9:48	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	0.1	B	*	%	0.1	0.5	11/14/12 13:35	nrc
pH, Corrosivity	M9045D/M9040C								
pH		5.0			units	0.1	0.1	11/14/12 0:00	nrc
pH measured at		22.7			C	0.1	0.1	11/14/12 0:00	nrc
Solids, Percent	CLPSOW390, PART F, D-98	95.5		*	%	0.1	0.5	11/13/12 20:00	mjj
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.05	B	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur HNO3 Residue			U	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur Organic Residual			U	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur Pyritic Sulfide		0.05	B	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur Sulfate			U	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur Total		0.05	B	*	%	0.01	0.1	11/12/12 0:00	cra
Total Sulfur minus Sulfate		0.05	B	*	%	0.01	0.1	11/12/12 0:00	cra

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/08/12 9:58	mjj
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3							11/12/12 9:55	brd
Digestion - Hot Plate	M3050B ICP							11/12/12 17:18	mjj
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/12/12 10:15	brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L97383-14***
Project ID:	ZN000001M5	Date Sampled:	*10/11/12 17:00*
Sample ID:	STS-PH-2012-FID15	Date Received:	*10/16/12*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	1030		*	mg/Kg	1	5	11/13/12 15:53	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4	0			t CaCO3/Kt	1	5	11/21/12 9:48	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	2			t CaCO3/Kt	1	5	11/21/12 9:48	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	2			t CaCO3/Kt	1	5	11/21/12 9:48	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	0.2	B	*	%	0.1	0.5	11/14/12 15:07	nrc
pH, Corrosivity	M9045D/M9040C								
pH		4.6			units	0.1	0.1	11/14/12 0:00	nrc
pH measured at		22.7			C	0.1	0.1	11/14/12 0:00	nrc
Solids, Percent	CLPSOW390, PART F, D-98	96.2		*	%	0.1	0.5	11/13/12 22:00	mjj
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.02	B	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur HNO3 Residue			U	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur Organic Residual			U	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur Pyritic Sulfide		0.02	B	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur Sulfate		0.01	B	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur Total		0.03	B	*	%	0.01	0.1	11/12/12 0:00	cra
Total Sulfur minus Sulfate		0.02	B	*	%	0.01	0.1	11/12/12 0:00	cra

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/08/12 11:54	mjj
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3							11/12/12 10:04	brd
Digestion - Hot Plate	M3050B ICP							11/12/12 17:37	mjj
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/12/12 10:22	brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L97383-15***
Project ID:	ZN000001M5	Date Sampled:	*10/11/12 17:45*
Sample ID:	STS-PH-2012-FID16	Date Received:	*10/16/12*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	1450		*	mg/Kg	1	5	11/13/12 16:02	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4	2	B		t CaCO3/Kt	1	5	11/21/12 9:49	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	0.0			t CaCO3/Kt	1	5	11/21/12 9:49	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-2			t CaCO3/Kt	1	5	11/21/12 9:49	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)		U	*	%	0.1	0.5	11/14/12 16:38	nrc
pH, Corrosivity	M9045D/M9040C								
pH		4.3			units	0.1	0.1	11/14/12 0:00	nrc
pH measured at		22.7			C	0.1	0.1	11/14/12 0:00	nrc
Solids, Percent	CLPSOW390, PART F, D-98	96.0		*	%	0.1	0.5	11/14/12 0:00	mjj
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.04	B	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur HNO3 Residue			U	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur Organic Residual			U	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur Pyritic Sulfide		0.04	B	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur Sulfate		0.02	B	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur Total		0.06	B	*	%	0.01	0.1	11/12/12 0:00	cra
Total Sulfur minus Sulfate		0.04	B	*	%	0.01	0.1	11/12/12 0:00	cra

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/08/12 13:50	mjj
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3							11/12/12 10:13	brd
Digestion - Hot Plate	M3050B ICP							11/12/12 17:56	mjj
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/12/12 10:28	brd

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L97383-16***
Project ID:	ZN000001M5	Date Sampled:	*10/11/12 09:05*
Sample ID:	STS-PH-2012-FID17	Date Received:	*10/16/12*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	5150		*	mg/Kg	1	5	11/13/12 16:05	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4	21			t CaCO3/Kt	1	5	11/21/12 9:49	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	5			t CaCO3/Kt	1	5	11/21/12 9:49	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-16			t CaCO3/Kt	1	5	11/21/12 9:49	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	0.5	B	*	%	0.1	0.5	11/14/12 18:10	nrc
pH, Corrosivity	M9045D/M9040C								
pH		4.9			units	0.1	0.1	11/14/12 0:00	nrc
pH measured at		22.7			C	0.1	0.1	11/14/12 0:00	nrc
Solids, Percent	CLPSOW390, PART F, D-98	95.9		*	%	0.1	0.5	11/14/12 2:00	mjj
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.61		*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur HNO3 Residue		0.05	B	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur Organic Residual		0.05	B	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur Pyritic Sulfide		0.56		*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur Sulfate		0.07	B	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur Total		0.68		*	%	0.01	0.1	11/12/12 0:00	cra
Total Sulfur minus Sulfate		0.61		*	%	0.01	0.1	11/12/12 0:00	cra

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/08/12 15:46	mjj
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3							11/12/12 10:23	brd
Digestion - Hot Plate	M3050B ICP							11/12/12 18:15	mjj
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/12/12 10:34	brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001M5	ACZ Sample ID:	***L97383-17***
Sample ID:	STS-PH-2012-FID18	Date Sampled:	*10/12/12 09:00*
		Date Received:	*10/16/12*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	192		*	mg/Kg	1	5	11/13/12 16:08	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4	5	B		t CaCO3/Kt	1	5	11/21/12 9:49	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	1			t CaCO3/Kt	1	5	11/21/12 9:49	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-4			t CaCO3/Kt	1	5	11/21/12 9:49	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	0.1	B	*	%	0.1	0.5	11/14/12 19:42	nrc
pH, Corrosivity	M9045D/M9040C								
pH		4.4			units	0.1	0.1	11/14/12 0:00	nrc
pH measured at		22.7			C	0.1	0.1	11/14/12 0:00	nrc
Solids, Percent	CLPSOW390, PART F, D-98	96.6		*	%	0.1	0.5	11/14/12 4:00	mjj
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.09	B	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur HNO3 Residue			U	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur Organic Residual			U	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur Pyritic Sulfide		0.09	B	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur Sulfate		0.06	B	*	%	0.01	0.1	11/12/12 0:00	cra
Sulfur Total		0.15		*	%	0.01	0.1	11/12/12 0:00	cra
Total Sulfur minus Sulfate		0.09	B	*	%	0.01	0.1	11/12/12 0:00	cra

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/08/12 17:42	mjj
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3							11/12/12 10:32	brd
Digestion - Hot Plate	M3050B ICP							11/12/12 18:33	mjj
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/12/12 10:41	brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L97383-18***
Project ID:	ZN000001M5	Date Sampled:	*10/11/12 13:45*
Sample ID:	STS-PH-2012-FID22	Date Received:	*10/16/12*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	308		*	mg/Kg	1	5	11/13/12 16:11	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4	3	B		t CaCO3/Kt	1	5	11/21/12 9:49	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	5			t CaCO3/Kt	1	5	11/21/12 9:49	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	2			t CaCO3/Kt	1	5	11/21/12 9:49	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	0.5	B	*	%	0.1	0.5	11/14/12 21:14	nrc
pH, Corrosivity	M9045D/M9040C								
pH		6.4			units	0.1	0.1	11/14/12 0:00	nrc
pH measured at		22.7			C	0.1	0.1	11/14/12 0:00	nrc
Solids, Percent	CLPSOW390, PART F, D-98	95.7		*	%	0.1	0.5	11/14/12 6:00	mjj
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.07	B	*	%	0.01	0.1	11/13/12 0:00	cra
Sulfur HNO3 Residue			U	*	%	0.01	0.1	11/13/12 0:00	cra
Sulfur Organic Residual			U	*	%	0.01	0.1	11/13/12 0:00	cra
Sulfur Pyritic Sulfide		0.07	B	*	%	0.01	0.1	11/13/12 0:00	cra
Sulfur Sulfate		0.03	B	*	%	0.01	0.1	11/13/12 0:00	cra
Sulfur Total		0.10		*	%	0.01	0.1	11/13/12 0:00	cra
Total Sulfur minus Sulfate		0.07	B	*	%	0.01	0.1	11/13/12 0:00	cra

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/08/12 19:37	mjj
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3							11/12/12 10:41	brd
Digestion - Hot Plate	M3050B ICP							11/12/12 18:52	mjj
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/12/12 10:47	brd

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000001M5
Sample ID: STS-PH-2012-ERA2

ACZ Sample ID: ***L97383-19***
Date Sampled: *10/10/12 14:40*
Date Received: *10/16/12*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	960		*	mg/Kg	1	5	11/13/12 16:14	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4	5	B		t CaCO3/Kt	1	5	11/21/12 9:49	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	0.0			t CaCO3/Kt	1	5	11/21/12 9:49	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-5			t CaCO3/Kt	1	5	11/21/12 9:49	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)		U	*	%	0.1	0.5	11/14/12 22:45	nrc
pH, Corrosivity	M9045D/M9040C								
pH		6.4			units	0.1	0.1	11/14/12 0:00	nrc
pH measured at		22.7			C	0.1	0.1	11/14/12 0:00	nrc
Solids, Percent	CLPSOW390, PART F, D-98	95.9		*	%	0.1	0.5	11/14/12 8:00	mjj
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.09	B	*	%	0.01	0.1	11/13/12 0:00	cra
Sulfur HNO3 Residue		0.02	B	*	%	0.01	0.1	11/13/12 0:00	cra
Sulfur Organic Residual		0.02	B	*	%	0.01	0.1	11/13/12 0:00	cra
Sulfur Pyritic Sulfide		0.07	B	*	%	0.01	0.1	11/13/12 0:00	cra
Sulfur Sulfate		0.06	B	*	%	0.01	0.1	11/13/12 0:00	cra
Sulfur Total		0.15		*	%	0.01	0.1	11/13/12 0:00	cra
Total Sulfur minus Sulfate		0.09	B	*	%	0.01	0.1	11/13/12 0:00	cra

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/08/12 21:33	mjj
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3							11/12/12 10:50	brd
Digestion - Hot Plate	M3050B ICP							11/12/12 19:11	mjj
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/12/12 10:53	brd

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L97383-20***
Project ID:	ZN000001M5	Date Sampled:	*10/11/12 11:10*
Sample ID:	STS-PH-2012-FID28	Date Received:	*10/16/12*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	271		*	mg/Kg	1	5	11/13/12 16:17	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4	0			t CaCO3/Kt	1	5	11/21/12 9:49	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	64			t CaCO3/Kt	1	5	11/21/12 9:49	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	64			t CaCO3/Kt	1	5	11/21/12 9:49	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	6.4		*	%	0.1	0.5	11/14/12 9:00	nrc
pH, Corrosivity	M9045D/M9040C								
pH		6.7			units	0.1	0.1	11/14/12 0:00	nrc
pH measured at		22.7			C	0.1	0.1	11/14/12 0:00	nrc
Solids, Percent	CLPSOW390, PART F, D-98	96.9		*	%	0.1	0.5	11/14/12 10:00	mjj
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.05	B	*	%	0.01	0.1	11/13/12 0:00	cra
Sulfur HNO3 Residue			U	*	%	0.01	0.1	11/13/12 0:00	cra
Sulfur Organic Residual			U	*	%	0.01	0.1	11/13/12 0:00	cra
Sulfur Pyritic Sulfide		0.05	B	*	%	0.01	0.1	11/13/12 0:00	cra
Sulfur Sulfate			U	*	%	0.01	0.1	11/13/12 0:00	cra
Sulfur Total			U	*	%	0.01	0.1	11/13/12 0:00	cra
Total Sulfur minus Sulfate			U	*	%	0.01	0.1	11/13/12 0:00	cra

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							11/08/12 23:29	mjj
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3							11/12/12 11:00	brd
Digestion - Hot Plate	M3050B ICP							11/12/12 19:30	mjj
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/12/12 11:00	brd

** Please refer to Qualifier Reports for details.*

Inorganic Reference

Report Header Explanations

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit, typically 5 times the MDL.
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Recovered amount of the true value or spike added, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of interest

QC Sample Types

AS	Analytical Spike (Post Digestion)	*LCSWD*	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	*LFB*	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	*LFM*	Laboratory Fortified Matrix
CCV	Continuing Calibration Verification standard	*LFMD*	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	*LRB*	Laboratory Reagent Blank
ICB	Initial Calibration Blank	*MS*	Matrix Spike
ICV	Initial Calibration Verification standard	*MSD*	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	*PBS*	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	*PBW*	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	*PQV*	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	*SDL*	Serial Dilution

QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

ACZ Qualifiers (Qual)

B	Analyte concentration detected at a value between MDL and PQL. The associated value is an estimated quantity.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
L	Target analyte response was below the laboratory defined negative threshold.
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Method References

(1) EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.

(2) EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.

(3) EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.

(4) EPA SW-846. Test Methods for Evaluating Solid Waste.

(5) Standard Methods for the Examination of Water and Wastewater.

Comments

(1) QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.

(2) Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.

(3) Animal matrices for Inorganic analyses are reported on an "as received" basis.

(4) An asterisk in the "XQ" column indicates there is an extended qualifier and/or certification qualifier associated with the result.

(5) If the MDL equals the PQL or the MDL column is omitted, the PQL is the reporting limit.

For a complete list of ACZ's Extended Qualifiers, please click: http://www.acz.com/public/extquallist.pdf

Calcium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG334022													
WG334022ICV	ICV	11/13/12 14:33	II120914-3	100		98.44	mg/L	98.4	90	110			
WG334022ICB	ICB	11/13/12 14:36				U	mg/L		-0.6	0.6			
WG333921PBS	PBS	11/13/12 14:49				U	mg/Kg		-60	60			
WG333921LCSS	LCSS	11/13/12 14:52	PCN41127	6160		6452	mg/Kg		5070	7240			
WG333921LCSSD	LCSSD	11/13/12 14:55	PCN41127	6160		6268	mg/Kg		5070	7240	2.9	20	
L97383-09MS	MS	11/13/12 15:31	II121029-3	7069.45616	8320	14789	mg/Kg	91.5	75	125			
L97383-09MSD	MSD	11/13/12 15:34	II121029-3	7069.45616	8320	14945	mg/Kg	93.7	75	125	1.05	20	

Carbon, total (TC) ASA No.9 29-2.2.4 Combustion/IR

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG333902													
WG333902PBS	PBS	11/12/12 9:30				U	%		-0.3	0.3			
WG333902LCSS	LCSS	11/12/12 9:55	PCN41310	4.19		4.3	%		80	120			
L97382-05DUP	DUP	11/12/12 10:47			.5	.5	%				0	20	RA

Carbon, total organic (TOC) ASA No.9 29-2.2.4 Combustion/IR

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG333902													
WG333902PBS	PBS	11/12/12 9:30				U	%		-0.3	0.3			
L97382-05DUP	DUP	11/12/12 10:47			.5	.5	%				0	20	RA ZQ

Copper (1312) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG334432													
WG334432ICV	ICV	11/20/12 13:59	II120914-3	2		1.939	mg/L	97	90	110			
WG334432ICB	ICB	11/20/12 14:02				U	mg/L		-0.03	0.03			
WG334099PBS	PBS	11/20/12 14:15				U	mg/L		-0.03	0.03			
WG334099LFB	LFB	11/20/12 14:18	II121029-3	.5		.496	mg/L	99.2	85	115			
L97383-01DUP	DUP	11/20/12 14:24			.22	.193	mg/L				13.1	20	
L97383-02MS	MS	11/20/12 14:30	II121029-3	.5	.15	.649	mg/L	99.8	75	125			
L97383-02MSD	MSD	11/20/12 14:33	II121029-3	.5	.15	.613	mg/L	92.6	75	125	5.71	20	

Copper, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG334022													
WG334022ICV	ICV	11/13/12 14:33	II120914-3	2		1.936	mg/L	96.8	90	110			
WG334022ICB	ICB	11/13/12 14:36				U	mg/L		-0.03	0.03			
WG333921PBS	PBS	11/13/12 14:49				U	mg/Kg		-3	3			
WG333921LCSS	LCSS	11/13/12 14:52	PCN41127	78		80.5	mg/Kg		65.3	90.6			
WG333921LCSSD	LCSSD	11/13/12 14:55	PCN41127	78		80.7	mg/Kg		65.3	90.6	0.2	20	
L97383-09MS	MS	11/13/12 15:31	II121029-3	52	159	196.6	mg/Kg	72.3	75	125			M3
L97383-09MSD	MSD	11/13/12 15:34	II121029-3	52	159	200	mg/Kg	78.8	75	125	1.71	20	

Neutralization Potential as CaCO3 M600/2-78-054 3.2.3 - Modified (No Heat)

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG334080													
L97383-11DUP	DUP	11/14/12 10:31			.8	.8	%				0	20	RA
WG334080LCSS	LCSS	11/15/12 9:28	PCN33453	100		99	%	99	80	120			
WG334080PBS	PBS	11/15/12 11:00				U	%		-0.1	0.1			
WG334082													
L97383-20DUP	DUP	11/14/12 11:21			6.4	6.5	%				1.6	20	
WG334082LCSS	LCSS	11/15/12 8:38	PCN33453	100		95	%	95	80	120			
WG334082PBS	PBS	11/15/12 10:59				U	%		-0.1	0.1			

Nitrate/Nitrite as N, soluble (Water) M353.2 - Automated Cadmium Reduction

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG334061													
WG334061ICV	ICV	11/13/12 20:37	WI121009-1	2.416		2.448	mg/L	101.3	90	110			
WG334061ICB	ICB	11/13/12 20:38				U	mg/L		-0.06	0.06			
WG334065													
WG334065LFB	LFB	11/13/12 22:12	WI120814-9	2		1.994	mg/Kg	99.7	90	110			
WG333946PBS	PBS	11/13/12 22:13				.12	mg/Kg		-0.3	0.3			
L97380-03AS	AS	11/13/12 22:15	WI120814-9	50	40.6	89.76	mg/Kg	98.3	90	110			
L97383-08DUP	DUP	11/13/12 22:37			17.7	18.12	mg/Kg				2.3	20	

Nitrite as N, soluble (Water) M353.2 - Automated Cadmium Reduction

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG334061													
WG334061ICV	ICV	11/13/12 20:37	WI121009-1	.609		.62	mg/L	101.8	90	110			
WG334061ICB	ICB	11/13/12 20:38				U	mg/L		-0.03	0.03			
WG334065													
WG334065LFB	LFB	11/13/12 22:12	WI120814-9	1		1.002	mg/Kg	100.2	90	110			
WG333946PBS	PBS	11/13/12 22:13				U	mg/Kg		-0.15	0.15			
L97380-03AS	AS	11/13/12 22:15	WI120814-9	25	.7	26.3	mg/Kg	102.4	90	110			
L97383-08DUP	DUP	11/13/12 22:37			.13	.116	mg/Kg				11.4	20	RA

Nitrogen, ammonia (Water) M350.1 - Automated Phenate

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG334103													
WG334103ICV	ICV	11/14/12 12:02	WI121105-5	1.003		.995	mg/L	99.2	90	110			
WG334103ICB	ICB	11/14/12 12:03				U	mg/L		-0.15	0.15			
WG334114													
WG334114LFB	LFB	11/14/12 13:32	WI111101-3	1		.967	mg/L	96.7	90	110			
WG333946PBS	PBS	11/14/12 13:33				U	mg/Kg		-0.9	0.9			
L97380-03MS	MS	11/14/12 13:35	NH3-WE50X	2500	U	53.3	mg/Kg	106.6	75	125			
L97383-08DUP	DUP	11/14/12 13:55			3	4.8	mg/Kg				46.2	20	RA

Nitrogen, total Kjeldahl

M351.2 - TKN by Block Digester

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG333403													
WG333403ICV	ICV	11/02/12 11:48	WI121005-1	4		4.03	mg/L	100.8	90	110			
WG333403ICB	ICB	11/02/12 11:49				U	mg/L		-0.3	0.3			
WG333336PBS	PBS	11/02/12 11:50				.00032	%		-0.0006	0.0006			
WG333336LFB	LFB	11/02/12 11:51	WI120814-2	2.5		2.66	%	106.4	85	115			
L97382-08DUP	DUP	11/02/12 12:13			.052	.0426	%				19.9	20	
L97382-07MS	MS	11/02/12 12:25	10XPTSTKN	.0055	.034	.0468	%	232.7	75	125			M3

Ph

M9045D/M9040C

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG334125													
WG334125ICV	ICV	11/14/12 13:22	PCN38642	4		4.04	units	101	97	103			
L97383-20DUP	DUP	11/14/12 14:52			6.7	6.69	units				0.1	20	

pH, Saturated Paste

USDA No. 60 (21A)

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG333994													
WG333994ICV	ICV	11/13/12 9:36	PCN38642	4		3.98	units	99.5	97	103			
L97383-10DUP	DUP	11/13/12 10:57			7.9	7.84	units				0.8	20	

Potassium, total (3050)

M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG334022													
WG334022ICV	ICV	11/13/12 14:33	II120914-3	20		19.76	mg/L	98.8	90	110			
WG334022ICB	ICB	11/13/12 14:36				U	mg/L		-0.9	0.9			
WG333921PBS	PBS	11/13/12 14:49				U	mg/Kg		-90	90			
WG333921LCSS	LCSS	11/13/12 14:52	PCN41127	3820		4242	mg/Kg		2810	4830			
WG333921LCSSD	LCSSD	11/13/12 14:55	PCN41127	3820		4353	mg/Kg		2810	4830	2.6	20	
L97383-09MS	MS	11/13/12 15:31	II121029-3	10390.50272	5470	16172	mg/Kg	103	75	125			
L97383-09MSD	MSD	11/13/12 15:34	II121029-3	10390.50272	5470	15995	mg/Kg	101.3	75	125	1.1	20	

Solids, Percent

CLPSOW390, PART F, D-98

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG333963													
WG333963PBS	PBS	11/12/12 16:00				U	%		99.9	100.1			
L97383-01DUP	DUP	11/12/12 20:00			92.6	93.04	%				0.5	20	

Sulfur Organic Residual

M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG333901													
L97383-11DUP	DUP	11/12/12 14:27			U	U	%				0	20	RA

Sulfur Pyritic Sulfide

M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG333901													
L97383-11DUP	DUP	11/12/12 14:27			.02	.02	%				0	20	RA

Sulfur Sulfate M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG333901													
L97383-11DUP	DUP	11/12/12 14:27			U	U	%				0	20	RA

Sulfur Total M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG333901													
WG333901PBS	PBS	11/12/12 10:00				U	%		-0.03	0.03			
WG333901LCSS	LCSS	11/12/12 11:29	PCN41310	4.07		4.34	%	106.6					
L97383-11DUP	DUP	11/12/12 14:27			.02	.02	%				0	20	RA

Total Sulfur Minus Sulfate M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG333901													
L97383-11DUP	DUP	11/12/12 14:27			.02	.02	%				0	20	RA

Freeport-McMoRan - Chino Mines Company ACZ Project ID: ***L97383***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L97383-01	WG334022	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L97383-02	WG334022	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L97383-03	WG334022	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L97383-04	WG334022	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L97383-05	WG334022	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG333902	Carbon, total (TC)	ASA No.9 29-2.2.4 Combustion/IR	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Carbon, total organic (TOC)	ASA No.9 29-2.2.4 Combustion/IR	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
			ASA No.9 29-2.2.4 Combustion/IR	ZQ	Analyte was not evaluated in the laboratory control standard. Either the analyte is not included in the scope of the analytical method or a commercial standard containing the analyte is not available.
	WG334065	Nitrate/Nitrite as N, soluble (Water)	M353.2 - Automated Cadmium Reduction	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
		Nitrite as N, soluble (Water)	M353.2 - Automated Cadmium Reduction	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			M353.2 - Automated Cadmium Reduction	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG334114	Nitrogen, ammonia (Water)	M350.1 - Automated Phenate	DD	Sample required dilution due to matrix color or odor.
			M350.1 - Automated Phenate	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			M350.1 - Automated Phenate	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG333403	Nitrogen, total Kjeldahl	M351.2 - TKN by Block Digester	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M351.2 - TKN by Block Digester	Q6	Sample was received above recommended temperature.

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L97383-06	WG334022	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG333902	Carbon, total (TC)	ASA No.9 29-2.2.4 Combustion/IR	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Carbon, total organic (TOC)	ASA No.9 29-2.2.4 Combustion/IR	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
			ASA No.9 29-2.2.4 Combustion/IR	ZQ	Analyte was not evaluated in the laboratory control standard. Either the analyte is not included in the scope of the analytical method or a commercial standard containing the analyte is not available.
	WG334065	Nitrate/Nitrite as N, soluble (Water)	M353.2 - Automated Cadmium Reduction	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
		Nitrite as N, soluble (Water)	M353.2 - Automated Cadmium Reduction	D1	Sample required dilution due to matrix.
			M353.2 - Automated Cadmium Reduction	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			M353.2 - Automated Cadmium Reduction	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG334114	Nitrogen, ammonia (Water)	M350.1 - Automated Phenate	DD	Sample required dilution due to matrix color or odor.
			M350.1 - Automated Phenate	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			M350.1 - Automated Phenate	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG333403	Nitrogen, total Kjeldahl	M351.2 - TKN by Block Digester	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M351.2 - TKN by Block Digester	Q6	Sample was received above recommended temperature.

Inorganic Extended Qualifier Report

Freeport-McMoRan - Chino Mines Company

ACZ Project ID: ***L97383***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L97383-07	WG334022	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG333902	Carbon, total (TC)	ASA No.9 29-2.2.4 Combustion/IR	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Carbon, total organic (TOC)	ASA No.9 29-2.2.4 Combustion/IR	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
			ASA No.9 29-2.2.4 Combustion/IR	ZQ	Analyte was not evaluated in the laboratory control standard. Either the analyte is not included in the scope of the analytical method or a commercial standard containing the analyte is not available.
	WG334065	Nitrate/Nitrite as N, soluble (Water)	M353.2 - Automated Cadmium Reduction	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
		Nitrite as N, soluble (Water)	M353.2 - Automated Cadmium Reduction	D1	Sample required dilution due to matrix.
			M353.2 - Automated Cadmium Reduction	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			M353.2 - Automated Cadmium Reduction	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG334114	Nitrogen, ammonia (Water)	M350.1 - Automated Phenate	DD	Sample required dilution due to matrix color or odor.
			M350.1 - Automated Phenate	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			M350.1 - Automated Phenate	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG333403	Nitrogen, total Kjeldahl	M351.2 - TKN by Block Digester	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L97383-08	WG334022	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG333902	Carbon, total (TC)	ASA No.9 29-2.2.4 Combustion/IR	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Carbon, total organic (TOC)	ASA No.9 29-2.2.4 Combustion/IR	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
			ASA No.9 29-2.2.4 Combustion/IR	ZQ	Analyte was not evaluated in the laboratory control standard. Either the analyte is not included in the scope of the analytical method or a commercial standard containing the analyte is not available.
	WG334065	Nitrate/Nitrite as N, soluble (Water)	M353.2 - Automated Cadmium Reduction	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
		Nitrite as N, soluble (Water)	M353.2 - Automated Cadmium Reduction	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			M353.2 - Automated Cadmium Reduction	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG334114	Nitrogen, ammonia (Water)	M350.1 - Automated Phenate	DD	Sample required dilution due to matrix color or odor.
			M350.1 - Automated Phenate	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			M350.1 - Automated Phenate	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG333403	Nitrogen, total Kjeldahl	M351.2 - TKN by Block Digester	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M351.2 - TKN by Block Digester	Q6	Sample was received above recommended temperature.
L97383-09	WG334022	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L97383-10	WG334022	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L97383-11	WG334022	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG334080	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG333901	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L97383-12	WG334022	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG334080	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG333901	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L97383-13	WG334022	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG334080	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG333901	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L97383-14	WG334022	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG334080	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG333901	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L97383-15	WG334022	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG334080	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG333901	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L97383-16	WG334022	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG334080	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG333901	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

Inorganic Extended Qualifier Report

Freeport-McMoRan - Chino Mines Company

ACZ Project ID: ***L97383***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L97383-17	WG334022	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG334080	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG333901	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L97383-18	WG334022	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG334080	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG333901	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L97383-19	WG334022	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG334080	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG333901	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L97383-20	WG334022	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG333901	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

Soil Analysis

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Carbon, total (TC)	ASA No.9 29-2.2.4 Combustion/IR
Carbon, total organic (TOC)	ASA No.9 29-2.2.4 Combustion/IR
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)
pH, Saturated Paste	USDA No. 60 (21A)
Solids, Percent	CLPSOW390, PART F, D-98
Sulfur HCl Residue	M600/2-78-054 3.2.4-MOD
Sulfur HNO3 Residue	M600/2-78-054 3.2.4-MOD
Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD
Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD
Sulfur Sulfate	M600/2-78-054 3.2.4-MOD
Sulfur Total	M600/2-78-054 3.2.4-MOD
Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD

Wet Chemistry

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Nitrate/Nitrite as N, soluble (Water)	M353.2 - Automated Cadmium Reduction
Nitrite as N, soluble (Water)	M353.2 - Automated Cadmium Reduction
Nitrogen, ammonia (Water)	M350.1 - Automated Phenate
Nitrogen, total Kjeldahl	M351.2 - TKN by Block Digester

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Sample Receipt

Freeport-McMoRan - Chino Mines Company
ZN000001M5

ACZ Project ID: L97383
Date Received: 10/16/2012 10:18
Received By: ksj
Date Printed: 10/16/2012

Receipt Verification

	YES	NO	NA
1) Is a foreign soil permit included for applicable samples?			X
2) Is the Chain of Custody or other directive shipping papers present?	X		▨
3) Does this project require special handling procedures such as CLP protocol?			X
4) Are any samples NRC licensable material?			X
5) If samples are received past hold time, proceed with requested short hold time analyses?	X		
6) Is the Chain of Custody complete and accurate?	X		▨
7) Were any changes made to the Chain of Custody prior to ACZ receiving the samples?		X	▨

Samples/Containers

	YES	NO	NA
8) Are all containers intact and with no leaks?	X		▨
9) Are all labels on containers and are they intact and legible?	X		▨
10) Do the sample labels and Chain of Custody match for Sample ID, Date, and Time?	X		▨
11) For preserved bottle types, was the pH checked and within limits?			X
12) Is there sufficient sample volume to perform all requested work?	X		▨
13) Is the custody seal intact on all containers?			X
14) Are samples that require zero headspace acceptable?			X
15) Are all sample containers appropriate for analytical requirements?	X		▨
16) Is there an Hg-1631 trip blank present?			X
17) Is there a VOA trip blank present?			X
18) Were all samples received within hold time?	X		▨

Chain of Custody Related Remarks

Client Contact Remarks

Shipping Containers

```
Cooler Id     Temp (°C)     Rad (µR/Hr)     Custody Seal Intact?
---------     ---------     -----------     --------------------
2392          14.9          17              Yes
3181          14.4          15              Yes
3638          14.6          15              Yes
3742          15.1          15              Yes
NA16404       14.4          16              Yes
NA16405       13.8          15              Yes
NA16406       14.7          15              Yes
NA16408       14.6          16              Yes
```

Client must contact an ACZ Project Manager if analysis should not proceed for samples received outside of their thermal preservation acceptance criteria.

ACZ Laboratories, Inc. L97383

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

Copy of Report to:

Name: Matthew Barkley
Company: ARCADIS

E-mail: Matthew.Barkley@arcadis-us.com
Telephone: 303-231-9115 ext 157

Invoice to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐ NO ☒
If yes, please include state forms. Results will be reported to PQL.

PROJECT INFORMATION

Quote #:
Project/PO #:
Reporting state for compliance testing:
Sampler's Name: Garett Ferguson
Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED (attach list or use quote number)

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	soil sieved to < 2mm	Copper (Total and SPLP)	pH	Calcium, Potassium, Total Organic Carbom	TKN (see below)	Nitrate/nitrite as N (see below)	Ammonia (see below)	
STS-AMD-2012F-NEREF5 0-6	10/9/12 : 1545	SO	1	X	X	X					
STS-AMD-2012F-NEREF6 0-6	10/9/12 : 1550	SO	1	X	X	X					
STS-AMD-2012F-NEREF7 0-6	10/9/12 : 1600	SO	1	X	X	X					
STS-AMD-2012F-NEREF8 0-6	10/9/12 : 1605	SO	1	X	X	X					
DUP1	10/8/12	SO	1	X	X	X	X	X	X	X	
DUP2	10/9/12	SO	1	X	X	X	X	X	X	X	
DUP3	10/9/12	SO	1	X	X	X	X	X	X	X	
DUP4	10/9/12	SO	1	X	X	X	X	X	X	X	
DUP5	10/9/12	SO	1	X	X	X					
DUP6	10/10/12	SO	1	X	X	X					

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

Please send to Sheri Fling at URS for validation. Sieve all soil samples to <2 mm prior to analysis. Soil should be reported on a dry weight basis.
Methods:
pH - 9045C, Calcium - 6010B, Potassium - 6010B, Ammonia - 350.1, TKN - SM4500 (organic), Nitrate/Nitrite - 353.2, Total Organic Carbon - 9060, Copper - Modified 1312 extraction, 3010A digestion, 6010B analysis

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
	10/12/12 : 1300		10.16.12 10:00

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

L97383 Chain of Custody

ACZ Laboratories, Inc. L97383

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

Copy of Report to:

Name: Matthew Barkley
Company: ARCADIS

E-mail: Matthew.Barkley@arcadis-us.com
Telephone: 303-231-9115 ext 157

Invoice to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐ NO ☒
If yes, please include state forms. Results will be reported to PQL.

PROJECT INFORMATION

Quote #:
Project/PO #:
Reporting state for compliance testing:
Sampler's Name: Garett Ferguson
Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED (attach list or use quote number)

	SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	soil sieved to < 2mm	pH	Total CU	ABA				
✓	STS-PH-2012-FID7	10/11/12 : 1515	SO	1	☒	☒	☒	☒				
✓	STS-PH-2012-FID8	10/12/12 : 1040	SO	1	☒	☒	☒	☒				
✓	STS-PH-2012-FID10	10/11/12 : 0820	SO	1	☒	☒	☒	☒				
✓	STS-PH-2012-FID15	10/11/12 : 1700	SO	1	☒	☒	☒	☒				
✓	STS-PH-2012-FID16	10/11/12 : 1745	SO	1	☒	☒	☒	☒				
✓	STS-PH-2012-FID17	10/11/12 : 0905	SO	1	☒	☒	☒	☒				
✓	STS-PH-2012-FID18	10/12/12 : 0900	SO	1	☒	☒	☒	☒				
✓	STS-PH-2012-FID22	10/11/12 : 1345	SO	1	☒	☒	☒	☒				
	STS-PH-2012-ERA2	10/10/12 : 1440	SO	1	☒	☒	☒	☒				
✓	STS-PH-2012-FID28	10/11/12 : 1110	SO	1	☒	☒	☒	☒				

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

Please send to Sheri Fling at URS for validation. Sieve all soil samples to <2 mm prior to analysis. Soil should be reported on a dry weight basis.
Methods:
pH - 9045C, Total Copper - 6010B

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
	10/12/12 1300		10.16.12 10:00

2

White - Return with sample. Yellow - Retain for your records.

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Analytical Report

November 15, 2012

Report to:	Bill to:
Pam Pinson	Pam Pinson
Freeport-McMoRan - Chino Mines Company	Freeport-McMoRan - Chino Mines Company
PO Box 10	P.O. Box 13308
Bayard, NM 88023	Phoenix, AZ 85002-3308

cc: Matthew Barkley

Project ID: ZN000001M5
ACZ Project ID: L97384

Pam Pinson:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on October 16, 2012. This project has been assigned to ACZ's project number, L97384. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan. The enclosed results relate only to the samples received under L97384. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all requirements of NELAC.

This report shall be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after December 15, 2012. If the samples are determined to be hazardous, additional charges apply for disposal (typically $11/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical raw data reports for ten years.

If you have any questions or other needs, please contact your Project Manager.

S. Habermehl

Scott Habermehl has reviewed
and approved this report.

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000001M5
Sample ID: STS-PH-2012-FID37

ACZ Sample ID: ***L97384-01***
Date Sampled: *10/12/12 08:15*
Date Received: *10/16/12*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	765			mg/Kg	1	5	11/09/12 10:12	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4	0			t CaCO3/Kt	1	5	11/15/12 14:57	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	0.0			t CaCO3/Kt	1	5	11/15/12 14:57	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	0			t CaCO3/Kt	1	5	11/15/12 14:57	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)		U	*	%	0.1	0.5	11/12/12 18:54	nrc
pH, Corrosivity	M9045D/M9040C								
pH		4.5			units	0.1	0.1	11/10/12 0:00	cdb
pH measured at		20.5			C	0.1	0.1	11/10/12 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	95.8		*	%	0.1	0.5	10/30/12 19:25	cdb
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.01	B	*	%	0.01	0.1	11/03/12 0:00	mss2
Sulfur HNO3 Residue			U	*	%	0.01	0.1	11/03/12 0:00	mss2
Sulfur Organic Residual			U	*	%	0.01	0.1	11/03/12 0:00	mss2
Sulfur Pyritic Sulfide		0.01	B	*	%	0.01	0.1	11/03/12 0:00	mss2
Sulfur Sulfate		0.01	B	*	%	0.01	0.1	11/03/12 0:00	mss2
Sulfur Total		0.02	B	*	%	0.01	0.1	11/03/12 0:00	mss2
Total Sulfur minus Sulfate		0.01	B	*	%	0.01	0.1	11/03/12 0:00	mss2

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/26/12 15:36	cdb
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3							11/02/12 9:33	cdb
Digestion - Hot Plate	M3050B ICP							11/08/12 9:57	cra
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/02/12 9:33	cdb

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000001M5
Sample ID: STS-PH-2012-ERA3

ACZ Sample ID: ***L97384-02***
Date Sampled: *10/10/12 15:20*
Date Received: *10/16/12*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	624			mg/Kg	1	5	11/09/12 10:15	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4	6			t CaCO3/Kt	1	5	11/15/12 14:57	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	13			t CaCO3/Kt	1	5	11/15/12 14:57	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	7			t CaCO3/Kt	1	5	11/15/12 14:57	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1.3		*	%	0.1	0.5	11/14/12 13:43	nrc
pH, Corrosivity	M9045D/M9040C								
pH		6.4			units	0.1	0.1	11/10/12 0:00	cdb
pH measured at		20.5			C	0.1	0.1	11/10/12 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	93.1		*	%	0.1	0.5	10/30/12 20:12	cdb
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.08	B	*	%	0.01	0.1	11/03/12 0:00	mss2
Sulfur HNO3 Residue		0.03	B	*	%	0.01	0.1	11/03/12 0:00	mss2
Sulfur Organic Residual		0.03	B	*	%	0.01	0.1	11/03/12 0:00	mss2
Sulfur Pyritic Sulfide		0.05	B	*	%	0.01	0.1	11/03/12 0:00	mss2
Sulfur Sulfate		0.11		*	%	0.01	0.1	11/03/12 0:00	mss2
Sulfur Total		0.19		*	%	0.01	0.1	11/03/12 0:00	mss2
Total Sulfur minus Sulfate		0.08	B	*	%	0.01	0.1	11/03/12 0:00	mss2

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/26/12 15:40	cdb
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3							11/02/12 16:26	cdb
Digestion - Hot Plate	M3050B ICP							11/08/12 10:16	cra
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/02/12 15:34	cdb

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001M5	ACZ Sample ID:	***L97384-03***
Sample ID:	STS-PH-2012-FID101	Date Sampled:	*10/12/12 09:30*
		Date Received:	*10/16/12*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	290			mg/Kg	1	5	11/09/12 10:18	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4	5	B		t CaCO3/Kt	1	5	11/15/12 14:57	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	0.0			t CaCO3/Kt	1	5	11/15/12 14:57	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	-5			t CaCO3/Kt	1	5	11/15/12 14:57	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)		U	*	%	0.1	0.5	11/12/12 22:12	nrc
pH, Corrosivity	M9045D/M9040C								
pH		4.2			units	0.1	0.1	11/10/12 0:00	cdb
pH measured at		20.5			C	0.1	0.1	11/10/12 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	96.4		*	%	0.1	0.5	10/30/12 21:00	cdb
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.06	B	*	%	0.01	0.1	11/04/12 0:00	mss2
Sulfur HNO3 Residue			U	*	%	0.01	0.1	11/04/12 0:00	mss2
Sulfur Organic Residual			U	*	%	0.01	0.1	11/04/12 0:00	mss2
Sulfur Pyritic Sulfide		0.06	B	*	%	0.01	0.1	11/04/12 0:00	mss2
Sulfur Sulfate		0.09	B	*	%	0.01	0.1	11/04/12 0:00	mss2
Sulfur Total		0.15		*	%	0.01	0.1	11/04/12 0:00	mss2
Total Sulfur minus Sulfate		0.06	B	*	%	0.01	0.1	11/04/12 0:00	mss2

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/26/12 15:44	cdb
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3							11/02/12 23:19	cdb
Digestion - Hot Plate	M3050B ICP							11/08/12 10:35	cra
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/02/12 21:36	cdb

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000001M5
Sample ID: STS-PH-2012-FID102

ACZ Sample ID: ***L97384-04***
Date Sampled: *10/12/12 11:15*
Date Received: *10/16/12*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	230			mg/Kg	1	5	11/09/12 10:27	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4	15			t CaCO3/Kt	1	5	11/15/12 14:57	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	28			t CaCO3/Kt	1	5	11/15/12 14:57	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	13			t CaCO3/Kt	1	5	11/15/12 14:57	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	2.8		*	%	0.1	0.5	11/12/12 23:51	nrc
pH, Corrosivity	M9045D/M9040C								
pH		3.7			units	0.1	0.1	11/10/12 0:00	cdb
pH measured at		20.5			C	0.1	0.1	11/10/12 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	97.2		*	%	0.1	0.5	10/30/12 21:47	cdb
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.18		*	%	0.01	0.1	11/04/12 0:00	mss2
Sulfur HNO3 Residue		0.02	B	*	%	0.01	0.1	11/04/12 0:00	mss2
Sulfur Organic Residual		0.02	B	*	%	0.01	0.1	11/04/12 0:00	mss2
Sulfur Pyritic Sulfide		0.16		*	%	0.01	0.1	11/04/12 0:00	mss2
Sulfur Sulfate		0.29		*	%	0.01	0.1	11/04/12 0:00	mss2
Sulfur Total		0.47		*	%	0.01	0.1	11/04/12 0:00	mss2
Total Sulfur minus Sulfate		0.18		*	%	0.01	0.1	11/04/12 0:00	mss2

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/26/12 15:48	cdb
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3							11/03/12 6:13	cdb
Digestion - Hot Plate	M3050B ICP							11/08/12 11:32	cra
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/03/12 3:38	cdb

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001M5	ACZ Sample ID:	***L97384-05***
Sample ID:	STS-PH-2012-ERA4	Date Sampled:	*10/10/12 17:48*
		Date Received:	*10/16/12*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	514			mg/Kg	1	5	11/09/12 10:30	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4	2	B		t CaCO3/Kt	1	5	11/15/12 14:58	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	8			t CaCO3/Kt	1	5	11/15/12 14:58	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	6			t CaCO3/Kt	1	5	11/15/12 14:58	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	0.8		*	%	0.1	0.5	11/13/12 1:30	nrc
pH, Corrosivity	M9045D/M9040C								
pH		5.8			units	0.1	0.1	11/10/12 0:00	cdb
pH measured at		20.5			C	0.1	0.1	11/10/12 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	97.6		*	%	0.1	0.5	10/30/12 22:34	cdb
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.03	B	*	%	0.01	0.1	11/04/12 0:00	mss2
Sulfur HNO3 Residue			U	*	%	0.01	0.1	11/04/12 0:00	mss2
Sulfur Organic Residual			U	*	%	0.01	0.1	11/04/12 0:00	mss2
Sulfur Pyritic Sulfide		0.03	B	*	%	0.01	0.1	11/04/12 0:00	mss2
Sulfur Sulfate		0.02	B	*	%	0.01	0.1	11/04/12 0:00	mss2
Sulfur Total		0.05	B	*	%	0.01	0.1	11/04/12 0:00	mss2
Total Sulfur minus Sulfate		0.03	B	*	%	0.01	0.1	11/04/12 0:00	mss2

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/26/12 15:52	cdb
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3							11/03/12 13:06	cdb
Digestion - Hot Plate	M3050B ICP							11/08/12 11:51	cra
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/03/12 9:39	cdb

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001M5	ACZ Sample ID:	***L97384-06***
Sample ID:	STS-PH-2012-ERA10	Date Sampled:	*10/11/12 14:30*
		Date Received:	*10/16/12*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	299			mg/Kg	1	5	11/09/12 10:39	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4	0			t CaCO3/Kt	1	5	11/15/12 14:58	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	0.0			t CaCO3/Kt	1	5	11/15/12 14:58	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	0			t CaCO3/Kt	1	5	11/15/12 14:58	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)		U	*	%	0.1	0.5	11/13/12 3:09	nrc
pH, Corrosivity	M9045D/M9040C								
pH		5.7			units	0.1	0.1	11/10/12 0:00	cdb
pH measured at		20.5			C	0.1	0.1	11/10/12 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	94.9		*	%	0.1	0.5	10/30/12 23:21	cdb
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.01	B	*	%	0.01	0.1	11/04/12 0:00	mss2
Sulfur HNO3 Residue			U	*	%	0.01	0.1	11/04/12 0:00	mss2
Sulfur Organic Residual			U	*	%	0.01	0.1	11/04/12 0:00	mss2
Sulfur Pyritic Sulfide		0.01	B	*	%	0.01	0.1	11/04/12 0:00	mss2
Sulfur Sulfate			U	*	%	0.01	0.1	11/04/12 0:00	mss2
Sulfur Total		0.01	B	*	%	0.01	0.1	11/04/12 0:00	mss2
Total Sulfur minus Sulfate		0.01	B	*	%	0.01	0.1	11/04/12 0:00	mss2

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/26/12 15:56	cdb
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3							11/03/12 19:59	cdb
Digestion - Hot Plate	M3050B ICP							11/08/12 12:10	cra
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/03/12 15:41	cdb

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001M5	ACZ Sample ID:	***L97384-07***
Sample ID:	STS-PH-2012-FID105	Date Sampled:	*10/10/12 16:00*
		Date Received:	*10/16/12*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	799			mg/Kg	1	5	11/09/12 10:42	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4	3	B		t CaCO3/Kt	1	5	11/15/12 14:58	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	5			t CaCO3/Kt	1	5	11/15/12 14:58	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	2			t CaCO3/Kt	1	5	11/15/12 14:58	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	0.5		*	%	0.1	0.5	11/13/12 4:48	nrc
pH, Corrosivity	M9045D/M9040C								
pH		6.6			units	0.1	0.1	11/10/12 0:00	cdb
pH measured at		20.5			C	0.1	0.1	11/10/12 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	94.1		*	%	0.1	0.5	10/31/12 0:08	cdb
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.05	B	*	%	0.01	0.1	11/05/12 0:00	mss2
Sulfur HNO3 Residue		0.01	B	*	%	0.01	0.1	11/05/12 0:00	mss2
Sulfur Organic Residual		0.01	B	*	%	0.01	0.1	11/05/12 0:00	mss2
Sulfur Pyritic Sulfide		0.04	B	*	%	0.01	0.1	11/05/12 0:00	mss2
Sulfur Sulfate		0.05	B	*	%	0.01	0.1	11/05/12 0:00	mss2
Sulfur Total		0.10		*	%	0.01	0.1	11/05/12 0:00	mss2
Total Sulfur minus Sulfate		0.05	B	*	%	0.01	0.1	11/05/12 0:00	mss2

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/26/12 16:00	cdb
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3							11/04/12 2:53	cdb
Digestion - Hot Plate	M3050B ICP							11/08/12 12:29	cra
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/03/12 21:43	cdb

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L97384-08***
Project ID:	ZN000001M5	Date Sampled:	*10/11/12 15:50*
Sample ID:	STS-PH-2012-FID106	Date Received:	*10/16/12*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	408			mg/Kg	1	5	11/09/12 10:45	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4	0			t CaCO3/Kt	1	5	11/15/12 14:58	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	13			t CaCO3/Kt	1	5	11/15/12 14:58	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	13			t CaCO3/Kt	1	5	11/15/12 14:58	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1.3		*	%	0.1	0.5	11/13/12 6:27	nrc
pH, Corrosivity	M9045D/M9040C								
pH		5.7			units	0.1	0.1	11/10/12 0:00	cdb
pH measured at		20.5			C	0.1	0.1	11/10/12 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	96.4		*	%	0.1	0.5	10/31/12 0:55	cdb
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.02	B	*	%	0.01	0.1	11/05/12 0:00	mss2
Sulfur HNO3 Residue			U	*	%	0.01	0.1	11/05/12 0:00	mss2
Sulfur Organic Residual			U	*	%	0.01	0.1	11/05/12 0:00	mss2
Sulfur Pyritic Sulfide		0.02	B	*	%	0.01	0.1	11/05/12 0:00	mss2
Sulfur Sulfate		0.01	B	*	%	0.01	0.1	11/05/12 0:00	mss2
Sulfur Total		0.03	B	*	%	0.01	0.1	11/05/12 0:00	mss2
Total Sulfur minus Sulfate		0.02	B	*	%	0.01	0.1	11/05/12 0:00	mss2

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/26/12 15:30	cdb
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3							11/04/12 9:46	cdb
Digestion - Hot Plate	M3050B ICP							11/08/12 12:49	cra
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/04/12 3:44	cdb

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001M5	ACZ Sample ID:	***L97384-09***
Sample ID:	STS-PH-2012-REFPLOT1	Date Sampled:	*10/08/12 18:20*
		Date Received:	*10/16/12*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	1120			mg/Kg	1	5	11/09/12 10:48	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4	0			t CaCO3/Kt	1	5	11/15/12 14:58	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	61			t CaCO3/Kt	1	5	11/15/12 14:58	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	61			t CaCO3/Kt	1	5	11/15/12 14:58	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	6.1		*	%	0.1	0.5	11/14/12 16:05	nrc
pH, Corrosivity	M9045D/M9040C								
pH		7.6			units	0.1	0.1	11/10/12 0:00	cdb
pH measured at		20.5			C	0.1	0.1	11/10/12 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	96.6		*	%	0.1	0.5	10/31/12 1:42	cdb
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.03	B	*	%	0.01	0.1	11/05/12 0:00	mss2
Sulfur HNO3 Residue			U	*	%	0.01	0.1	11/05/12 0:00	mss2
Sulfur Organic Residual			U	*	%	0.01	0.1	11/05/12 0:00	mss2
Sulfur Pyritic Sulfide		0.03	B	*	%	0.01	0.1	11/05/12 0:00	mss2
Sulfur Sulfate			U	*	%	0.01	0.1	11/05/12 0:00	mss2
Sulfur Total			U	*	%	0.01	0.1	11/05/12 0:00	mss2
Total Sulfur minus Sulfate			U	*	%	0.01	0.1	11/05/12 0:00	mss2

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/26/12 15:33	cdb
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3							11/04/12 16:39	cdb
Digestion - Hot Plate	M3050B ICP							11/08/12 13:08	cra
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/04/12 9:46	cdb

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000001M5
Sample ID: STS-PH-2012-REFPLOT2

ACZ Sample ID: ***L97384-10***
Date Sampled: *10/09/12 10:55*
Date Received: *10/16/12*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	1170			mg/Kg	1	5	11/09/12 10:51	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4	0			t CaCO3/Kt	1	5	11/15/12 14:58	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	6			t CaCO3/Kt	1	5	11/15/12 14:58	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	6			t CaCO3/Kt	1	5	11/15/12 14:58	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	0.6		*	%	0.1	0.5	11/13/12 9:45	nrc
pH, Corrosivity	M9045D/M9040C								
pH		5.8			units	0.1	0.1	11/10/12 0:00	cdb
pH measured at		20.5			C	0.1	0.1	11/10/12 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	97.2		*	%	0.1	0.5	10/31/12 2:30	cdb
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue			U	*	%	0.01	0.1	11/06/12 0:00	mss2
Sulfur HNO3 Residue			U	*	%	0.01	0.1	11/06/12 0:00	mss2
Sulfur Organic Residual			U	*	%	0.01	0.1	11/06/12 0:00	mss2
Sulfur Pyritic Sulfide			U	*	%	0.01	0.1	11/06/12 0:00	mss2
Sulfur Sulfate			U	*	%	0.01	0.1	11/06/12 0:00	mss2
Sulfur Total			U	*	%	0.01	0.1	11/06/12 0:00	mss2
Total Sulfur minus Sulfate			U	*	%	0.01	0.1	11/06/12 0:00	mss2

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/26/12 15:36	cdb
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3							11/04/12 23:33	cdb
Digestion - Hot Plate	M3050B ICP							11/08/12 13:27	cra
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/04/12 15:48	cdb

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID: ZN000001M5
Sample ID: DUP7

ACZ Sample ID: ***L97384-11***
Date Sampled: *10/10/12 00:00*
Date Received: *10/16/12*
Sample Matrix: *Soil*

Inorganic Prep

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Total Hot Plate Digestion	M3010A ICP							11/12/12 17:19	jjc

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper (1312)	M6010B ICP	0.05	B	*	mg/L	0.01	0.05	11/13/12 12:48	jjc
Copper, total (3050)	M6010B ICP	609			mg/Kg	1	5	11/09/12 10:54	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
pH, Saturated Paste	USDA No. 60 (21A)	6.9		*	units	0.1	0.1	11/10/12 11:25	cdb
Solids, Percent	CLPSOW390, PART F, D-98	91.7		*	%	0.1	0.5	10/31/12 3:17	cdb

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/26/12 15:40	cdb
Digestion - Hot Plate	M3050B ICP							11/08/12 13:46	cra
Saturated Paste Extraction	USDA No. 60 (2)							11/10/12 8:00	cdb
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/04/12 21:49	cdb
Synthetic Precip. Leaching Procedure	M1312							11/10/12 3:32	cdb

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001M5	ACZ Sample ID:	***L97384-12***
Sample ID:	DUP8	Date Sampled:	*10/10/12 00:00*
		Date Received:	*10/16/12*
		Sample Matrix:	*Soil*

Inorganic Prep

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Total Hot Plate Digestion	M3010A ICP							11/12/12 18:56	jjc

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper (1312)	M6010B ICP	0.03	B	*	mg/L	0.01	0.05	11/13/12 12:58	jjc
Copper, total (3050)	M6010B ICP	949			mg/Kg	1	5	11/09/12 10:57	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
pH, Saturated Paste	USDA No. 60 (21A)	6.6		*	units	0.1	0.1	11/10/12 12:17	cdb
Solids, Percent	CLPSOW390, PART F, D-98	93.8		*	%	0.1	0.5	10/31/12 4:04	cdb

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/26/12 15:43	cdb
Digestion - Hot Plate	M3050B ICP							11/08/12 14:05	cra
Saturated Paste Extraction	USDA No. 60 (2)							11/10/12 11:00	cdb
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/05/12 3:51	cdb
Synthetic Precip. Leaching Procedure	M1312							11/10/12 7:43	cdb

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L97384-13***
Project ID:	ZN000001M5	Date Sampled:	*10/09/12 17:55*
Sample ID:	STS-PH-2012-REFPLOT3	Date Received:	*10/16/12*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	2250			mg/Kg	1	5	11/09/12 11:03	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4	2	B		t CaCO3/Kt	1	5	11/15/12 14:58	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	3			t CaCO3/Kt	1	5	11/15/12 14:58	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	1			t CaCO3/Kt	1	5	11/15/12 14:58	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	0.3	B	*	%	0.1	0.5	11/13/12 11:24	nrc
pH, Corrosivity	M9045D/M9040C								
pH		5.1			units	0.1	0.1	11/10/12 0:00	cdb
pH measured at		20.5			C	0.1	0.1	11/10/12 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	92.4		*	%	0.1	0.5	10/31/12 4:51	cdb
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.03	B	*	%	0.01	0.1	11/06/12 0:00	mss2
Sulfur HNO3 Residue			U	*	%	0.01	0.1	11/06/12 0:00	mss2
Sulfur Organic Residual			U	*	%	0.01	0.1	11/06/12 0:00	mss2
Sulfur Pyritic Sulfide		0.03	B	*	%	0.01	0.1	11/06/12 0:00	mss2
Sulfur Sulfate		0.03	B	*	%	0.01	0.1	11/06/12 0:00	mss2
Sulfur Total		0.06	B	*	%	0.01	0.1	11/06/12 0:00	mss2
Total Sulfur minus Sulfate		0.03	B	*	%	0.01	0.1	11/06/12 0:00	mss2

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/26/12 15:46	cdb
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3							11/05/12 6:26	cdb
Digestion - Hot Plate	M3050B ICP							11/08/12 14:24	cra
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/05/12 9:53	cdb

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000001M5
Sample ID: STS-PH-2012-REFPLOT4

ACZ Sample ID: ***L97384-14***
Date Sampled: *10/10/12 13:10*
Date Received: *10/16/12*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	1210			mg/Kg	1	5	11/09/12 11:06	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4	3	B		t CaCO3/Kt	1	5	11/15/12 14:58	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	8			t CaCO3/Kt	1	5	11/15/12 14:58	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	5			t CaCO3/Kt	1	5	11/15/12 14:58	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	0.8		*	%	0.1	0.5	11/13/12 13:03	nrc
pH, Corrosivity	M9045D/M9040C								
pH		4.8			units	0.1	0.1	11/10/12 0:00	cdb
pH measured at		20.5			C	0.1	0.1	11/10/12 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	94.6		*	%	0.1	0.5	10/31/12 5:38	cdb
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.06	B	*	%	0.01	0.1	11/06/12 0:00	mss2
Sulfur HNO3 Residue			U	*	%	0.01	0.1	11/06/12 0:00	mss2
Sulfur Organic Residual			U	*	%	0.01	0.1	11/06/12 0:00	mss2
Sulfur Pyritic Sulfide		0.06	B	*	%	0.01	0.1	11/06/12 0:00	mss2
Sulfur Sulfate		0.04	B	*	%	0.01	0.1	11/06/12 0:00	mss2
Sulfur Total		0.10		*	%	0.01	0.1	11/06/12 0:00	mss2
Total Sulfur minus Sulfate		0.06	B	*	%	0.01	0.1	11/06/12 0:00	mss2

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/26/12 15:50	cdb
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3							11/05/12 13:19	cdb
Digestion - Hot Plate	M3050B ICP							11/08/12 14:43	cra
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/05/12 15:54	cdb

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000001M5
Sample ID: STS-PH-2012-ERA13

ACZ Sample ID: ***L97384-15***
Date Sampled: *10/11/12 11:55*
Date Received: *10/16/12*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	292			mg/Kg	1	5	11/09/12 11:16	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4	0			t CaCO3/Kt	1	5	11/15/12 14:59	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	19			t CaCO3/Kt	1	5	11/15/12 14:59	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	19			t CaCO3/Kt	1	5	11/15/12 14:59	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1.9		*	%	0.1	0.5	11/13/12 14:42	nrc
pH, Corrosivity	M9045D/M9040C								
pH		6.6			units	0.1	0.1	11/10/12 0:00	cdb
pH measured at		20.5			C	0.1	0.1	11/10/12 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	95.9		*	%	0.1	0.5	10/31/12 6:25	cdb
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.02	B	*	%	0.01	0.1	11/07/12 0:00	mss2
Sulfur HNO3 Residue			U	*	%	0.01	0.1	11/07/12 0:00	mss2
Sulfur Organic Residual			U	*	%	0.01	0.1	11/07/12 0:00	mss2
Sulfur Pyritic Sulfide		0.02	B	*	%	0.01	0.1	11/07/12 0:00	mss2
Sulfur Sulfate			U	*	%	0.01	0.1	11/07/12 0:00	mss2
Sulfur Total			U	*	%	0.01	0.1	11/07/12 0:00	mss2
Total Sulfur minus Sulfate			U	*	%	0.01	0.1	11/07/12 0:00	mss2

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/26/12 15:53	cdb
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3							11/05/12 20:13	cdb
Digestion - Hot Plate	M3050B ICP							11/08/12 15:02	cra
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/05/12 21:56	cdb

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001M5	ACZ Sample ID:	***L97384-16***
Sample ID:	DUP9	Date Sampled:	*10/10/12 00:00*
		Date Received:	*10/16/12*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	953			mg/Kg	1	5	11/09/12 11:19	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4	0			t CaCO3/Kt	1	5	11/15/12 14:59	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	15			t CaCO3/Kt	1	5	11/15/12 14:59	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	15			t CaCO3/Kt	1	5	11/15/12 14:59	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1.5		*	%	0.1	0.5	11/14/12 18:27	nrc
pH, Corrosivity	M9045D/M9040C								
pH		6.4			units	0.1	0.1	11/10/12 0:00	cdb
pH measured at		20.5			C	0.1	0.1	11/10/12 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	95.8		*	%	0.1	0.5	10/31/12 7:13	cdb
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.05	B	*	%	0.01	0.1	11/07/12 0:00	mss2
Sulfur HNO3 Residue			U	*	%	0.01	0.1	11/07/12 0:00	mss2
Sulfur Organic Residual			U	*	%	0.01	0.1	11/07/12 0:00	mss2
Sulfur Pyritic Sulfide		0.05	B	*	%	0.01	0.1	11/07/12 0:00	mss2
Sulfur Sulfate			U	*	%	0.01	0.1	11/07/12 0:00	mss2
Sulfur Total			U	*	%	0.01	0.1	11/07/12 0:00	mss2
Total Sulfur minus Sulfate			U	*	%	0.01	0.1	11/07/12 0:00	mss2

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/26/12 15:56	cdb
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3							11/06/12 3:06	cdb
Digestion - Hot Plate	M3050B ICP							11/08/12 15:21	cra
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/06/12 3:58	cdb

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000001M5
Sample ID: DUP10

ACZ Sample ID: ***L97384-17***
Date Sampled: *10/11/12 00:00*
Date Received: *10/16/12*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	257			mg/Kg	1	5	11/09/12 11:22	jjc

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4	0			t CaCO3/Kt	1	5	11/15/12 14:59	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	13			t CaCO3/Kt	1	5	11/15/12 14:59	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	13			t CaCO3/Kt	1	5	11/15/12 14:59	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1.3		*	%	0.1	0.5	11/13/12 16:21	nrc
pH, Corrosivity	M9045D/M9040C								
pH		5.7			units	0.1	0.1	11/10/12 0:00	cdb
pH measured at		20.5			C	0.1	0.1	11/10/12 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	94.6		*	%	0.1	0.5	10/31/12 8:00	cdb
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.01	B	*	%	0.01	0.1	11/07/12 0:00	mss2
Sulfur HNO3 Residue			U	*	%	0.01	0.1	11/07/12 0:00	mss2
Sulfur Organic Residual			U	*	%	0.01	0.1	11/07/12 0:00	mss2
Sulfur Pyritic Sulfide		0.01	B	*	%	0.01	0.1	11/07/12 0:00	mss2
Sulfur Sulfate			U	*	%	0.01	0.1	11/07/12 0:00	mss2
Sulfur Total			U	*	%	0.01	0.1	11/07/12 0:00	mss2
Total Sulfur minus Sulfate			U	*	%	0.01	0.1	11/07/12 0:00	mss2

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							10/26/12 16:00	cdb
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3							11/06/12 9:59	cdb
Digestion - Hot Plate	M3050B ICP							11/08/12 15:40	cra
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2							11/06/12 9:59	cdb

** Please refer to Qualifier Reports for details.*

Inorganic Reference

Report Header Explanations

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit, typically 5 times the MDL.
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Recovered amount of the true value or spike added, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of interest

QC Sample Types

AS	Analytical Spike (Post Digestion)	*LCSWD*	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	*LFB*	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	*LFM*	Laboratory Fortified Matrix
CCV	Continuing Calibration Verification standard	*LFMD*	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	*LRB*	Laboratory Reagent Blank
ICB	Initial Calibration Blank	*MS*	Matrix Spike
ICV	Initial Calibration Verification standard	*MSD*	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	*PBS*	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	*PBW*	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	*PQV*	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	*SDL*	Serial Dilution

QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

ACZ Qualifiers (Qual)

B	Analyte concentration detected at a value between MDL and PQL. The associated value is an estimated quantity.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
L	Target analyte response was below the laboratory defined negative threshold.
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Method References

(1) EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
(2) EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.
(3) EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.
(4) EPA SW-846. Test Methods for Evaluating Solid Waste.
(5) Standard Methods for the Examination of Water and Wastewater.

Comments

(1) QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
(2) Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.
(3) Animal matrices for Inorganic analyses are reported on an "as received" basis.
(4) An asterisk in the "XQ" column indicates there is an extended qualifier and/or certification qualifier associated with the result.
(5) If the MDL equals the PQL or the MDL column is omitted, the PQL is the reporting limit.

For a complete list of ACZ's Extended Qualifiers, please click: http://www.acz.com/public/extquallist.pdf

Freeport-McMoRan - Chino Mines Company ACZ Project ID: ***L97384***

Copper (1312) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG333999													
WG333999ICV	ICV	11/13/12 12:27	II120914-3	2		1.947	mg/L	97.4	90	110			
WG333999ICB	ICB	11/13/12 12:30				U	mg/L		-0.03	0.03			
WG333869PBS	PBS	11/13/12 12:42				U	mg/L		-0.03	0.03			
WG333869LFB	LFB	11/13/12 12:45	II121029-3	.5		.509	mg/L	101.8	85	115			
L97384-11DUP	DUP	11/13/12 12:55			.05	.048	mg/L				4.1	20	RA
L97384-12MS	MS	11/13/12 13:01	II121029-3	.5	.03	.541	mg/L	102.2	75	125			
L97384-12MSD	MSD	11/13/12 13:04	II121029-3	.5	.03	.544	mg/L	102.8	75	125	0.55	20	

Copper, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG333809													
WG333809ICV	ICV	11/09/12 9:47	II120914-3	2		1.927	mg/L	96.4	90	110			
WG333809ICB	ICB	11/09/12 9:50				U	mg/L		-0.03	0.03			
WG333717PBS	PBS	11/09/12 10:02				U	mg/Kg		-3	3			
WG333717LCSS	LCSS	11/09/12 10:06	PCN41127	78		77.7	mg/Kg		65.3	90.6			
WG333717LCSSD	LCSSD	11/09/12 10:09	PCN41127	78		77.9	mg/Kg		65.3	90.6	0.3	20	
L97384-03MS	MS	11/09/12 10:21	II121029-3	50.5	290	340.7	mg/Kg	100.4	75	125			
L97384-03MSD	MSD	11/09/12 10:24	II121029-3	50.5	290	344.9	mg/Kg	108.7	75	125	1.23	20	

Neutralization Potential as CaCO3 M600/2-78-054 3.2.3 - Modified (No Heat)

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG333730													
WG333730PBS	PBS	11/12/12 15:36				U	%		-0.1	0.1			
WG333730LCSS	LCSS	11/12/12 17:15	PCN33453	100		102	%	102	80	120			
L97384-01DUP	DUP	11/12/12 20:33			U	U	%				0	20	RA
WG334082													
L97383-20DUP	DUP	11/14/12 11:21			6.4	6.5	%				1.6	20	
WG334082LCSS	LCSS	11/15/12 8:38	PCN33453	100		95	%	95	80	120			
WG334082PBS	PBS	11/15/12 10:59				U	%		-0.1	0.1			

Ph M9045D/M9040C

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG333868													
WG333868ICV	ICV	11/10/12 8:51	PCN38642	4		3.98	units	99.5	97	103			
L97384-01DUP	DUP	11/10/12 9:25			4.5	4.54	units				0.9	20	

pH, Saturated Paste USDA No. 60 (21A)

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG333867													
WG333867ICV	ICV	11/10/12 10:34	PCN38642	4		3.98	units	99.5	97	103			
L97384-12DUP	DUP	11/10/12 13:08			6.6	6.64	units				0.6	20	

Solids, Percent CLPSOW390, PART F, D-98

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG333178													
WG333178PBS	PBS	10/30/12 15:30				U	%		99.9	100.1			
L97307-01DUP	DUP	10/30/12 17:04			98.5	98.48	%				0	20	

Sulfur Organic Residual M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG333442													
L97384-01DUP	DUP	11/03/12 12:10			U	U	%				0	20	RA

Sulfur Pyritic Sulfide M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG333442													
L97384-01DUP	DUP	11/03/12 12:10			.01	.01	%				0	20	RA

Sulfur Sulfate M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG333442													
L97384-01DUP	DUP	11/03/12 12:10			.01	.01	%				0	20	RA

Sulfur Total M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG333442													
WG333442LCSS	LCSS	11/02/12 22:03	PCN41310	4.07		4.47	%	109.8					
L97384-01DUP	DUP	11/03/12 12:10			.02	.02	%				0	20	RA

Total Sulfur Minus Sulfate M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG333442													
L97384-01DUP	DUP	11/03/12 12:10			.01	.01	%				0	20	RA

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L97384-01	WG333730	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG333442	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L97384-02	WG333442	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L97384-03	WG333730	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG333442	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L97384-04	WG333730	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG333442	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L97384-05	WG333730	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG333442	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L97384-06	WG333730	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG333442	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L97384-07	WG333730	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG333442	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L97384-08	WG333730	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG333442	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L97384-09	WG333442	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L97384-10	WG333730	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG333442	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L97384-11	WG333999	Copper (1312)	M6010B ICP	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L97384-12	WG333999	Copper (1312)	M6010B ICP	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L97384-13	WG333730	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG333442	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L97384-14	WG333730	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG333442	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L97384-15	WG333730	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG333442	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L97384-16	WG333442	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L97384-17	WG333730	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG333442	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

Soil Analysis

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)
pH, Saturated Paste	USDA No. 60 (21A)
Solids, Percent	CLPSOW390, PART F, D-98
Sulfur HCl Residue	M600/2-78-054 3.2.4-MOD
Sulfur HNO3 Residue	M600/2-78-054 3.2.4-MOD
Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD
Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD
Sulfur Sulfate	M600/2-78-054 3.2.4-MOD
Sulfur Total	M600/2-78-054 3.2.4-MOD
Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Sample Receipt

Freeport-McMoRan - Chino Mines Company
ZN000001M5

ACZ Project ID: L97384
Date Received: 10/16/2012 10:17
Received By: ksj
Date Printed: 10/16/2012

Receipt Verification

	YES	NO	NA
1) Is a foreign soil permit included for applicable samples?			X
2) Is the Chain of Custody or other directive shipping papers present?	X		▨
3) Does this project require special handling procedures such as CLP protocol?			X
4) Are any samples NRC licensable material?			X
5) If samples are received past hold time, proceed with requested short hold time analyses?	X		
6) Is the Chain of Custody complete and accurate?	X		▨
7) Were any changes made to the Chain of Custody prior to ACZ receiving the samples?	X		▨

A change was made in the page 2 lines 3-6 and page 3 lines 4-7 section prior to ACZ custody.

Samples/Containers

	YES	NO	NA
8) Are all containers intact and with no leaks?	X		▨
9) Are all labels on containers and are they intact and legible?	X		▨
10) Do the sample labels and Chain of Custody match for Sample ID, Date, and Time?	X		▨
11) For preserved bottle types, was the pH checked and within limits?			X
12) Is there sufficient sample volume to perform all requested work?	X		▨
13) Is the custody seal intact on all containers?			X
14) Are samples that require zero headspace acceptable?			X
15) Are all sample containers appropriate for analytical requirements?	X		▨
16) Is there an Hg-1631 trip blank present?			X
17) Is there a VOA trip blank present?			X
18) Were all samples received within hold time?	X		▨

Chain of Custody Related Remarks

Client Contact Remarks

Shipping Containers

Cooler Id	Temp (°C)	Rad (µR/Hr)	Custody Seal Intact?
3181	14.4	15	Yes
3742	15.1	15	Yes
NA16404	14.4	16	Yes
NA16405	13.8	15	Yes

Client must contact an ACZ Project Manager if analysis should not proceed for samples received outside of their thermal preservation acceptance criteria.

ACZ Laboratories, Inc. L97384

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson	Address: P.O. Box 10
Company: Chino Mines Company	Bayard, NM 88023
E-mail: Pamela_Pinson@FMI.com	Telephone: 575-912-5213

Copy of Report to:

Name: Matthew Barkley	E-mail: Matthew.Barkley@arcadis-us.com
Company: ARCADIS	Telephone: 303-231-9115 ext 157

Invoice to:

Name: Pam Pinson	Address: P.O. Box 10
Company: Chino Mines Company	Bayard, NM 88023
E-mail: Pamela_Pinson@FMI.com	Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐

If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐ NO ☒

If yes, please include state forms. Results will be reported to PQL.

PROJECT INFORMATION

Quote #:

Project/PO #:

Reporting state for compliance testing:

Sampler's Name: Garett Ferguson

Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED (attach list or use quote number)

	SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	soil sieved to < 2mm	pH	Total CU	ABA				
✓	STS-PH-2012-FID37	10/12/12 : 0815	SO	1	x	x	x	x				
✓	STS-PH-2012-ERA3	10/10/12 : 1520	SO	1	x	x	x	x				
✓	STS-PH-2012-FID101	10/12/12 : 0930	SO	1	x	x	x	x				
✓	STS-PH-2012-FID102	10/12/12 : 1115	SO	1	x	x	x	x				
✓	STS-PH-2012-ERA4	10/10/12 : 1148	SO	1	x	x	x	x				
✓	STS-PH-2012-ERA10	10/11/12 : 1430	SO	1	x	x	x	x				
✓	STS-PH-2012-FID105	10/10/12 : 1600	SO	1	x	x	x	x				
✓	STS-PH-2012-FID106	10/11/12 : 1550	SO	1	x	x	x	x				
✓	STS-PH-2012-REFPLOT1	10/8/12 : 1820	SO	1	x	x	x	x				
✓	STS-PH-2012-REFPLOT2	10/9/12 : 1055	SO	1	x	x	x	x				

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

Please send to Sheri Fling at URS for validation. Sieve all soil samples to <2 mm prior to analysis. Soil should be reported on a dry weight basis.

Methods:

pH - 9045C, Total Copper - 6010B

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
	10/12/12 : 1200		10.16.12 10:00

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

L97384 Chain of Custody

ACZ Laboratories, Inc. L97384

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

Copy of Report to

Name: Matthew Barkley
Company: ARCADIS

E-mail: Matthew.Barkley@arcadis-us.com
Telephone: 303-231-9115 ext 157

Invoice to

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐
If yes, please include state forms. Results will be reported to PQL. NO ☒

PROJECT INFORMATION

Quote #:
Project/PO #:
Reporting state for compliance testing:
Sampler's Name: Garett Ferguson
Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED (attach list or use quote number)

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	soil sieved to < 2mm	Copper (Total and SPLP)	pH	Total Copper				
DUP7	10/10/12	SO	1	x	x	x					
DUP8	10/10/12	SO	1	x	x	x					
~~RINSATE1~~	~~10/10/12 : 0915~~	~~W~~	~~1~~				~~x~~				
~~RINSATE2~~	~~10/10/12 : 1000~~	~~W~~	~~1~~				~~x~~				
~~RINSATE3~~	~~10/10/12 : 1115~~	~~W~~	~~1~~				~~x~~				
~~RINSATE4~~	~~10/10/12 : 1315~~	~~W~~	~~1~~				~~x~~				

Matrix SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

Please send to Sheri Fling at URS for validation. Sieve all soil samples to <2 mm prior to analysis. Soil should be reported on a dry weight basis.
Methods:
pH - 9045C, Calcium - 6010B, Potassium - 6010B, Total Organic Carbon - 9060, Copper - Modified 1312 extraction, 3010A digestion, 6010B analysis

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
	10/12/12 :1300		10-16-12 10:00

2

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

ACZ Laboratories, Inc. L97384
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

Copy of Report to:

Name: Matthew Barkley
Company: ARCADIS

E-mail: Matthew.Barkley@arcadis-us.com
Telephone: 303-231-9115 ext 157

Invoice to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐
If yes, please include state forms. Results will be reported to PQL. NO ☒

PROJECT INFORMATION

Quote #:
Project/PO #:
Reporting state for compliance testing:
Sampler's Name: Garett Ferguson
Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED (attach list or use quote number)

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	soil sieved to < 2mm	pH	Total CU	ABA				
✓ STS-PH-2012-REFPLOT3	10/9/12 : 1755	SO	1	x	x	x	x				
✓ STS-PH-2012-REFPLOT4	10/10/12 : 1310	SO	1	x	x	x	x				
✓ STS-PH-2012-ERA13	10/11/12 : 1155	SO	1	x	x	x	x				
~~DUP11~~ DUP9	10/11/12	SO	1	x	x	x	x				
~~DUP12~~ DUP10	10/11/12 SO	~~SW~~	1	X	X	x	X	LEB 10-10-12			
[redacted]											
(6P) ~~STS-PH-2012-ERA02~~	~~10/10/12 1440~~	~~SO~~	~~1~~								

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

Please send to Sheri Fling at URS for validation. Sieve all soil samples to <2 mm prior to analysis. Soil should be reported on a dry weight basis.
Methods:
pH - 9045C, Total Copper - 6010B

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
	10/12/12 :1300	LEB	10·10·12 10:00

3

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Analytical Report

November 15, 2013

Report to:
Pam Pinson
Freeport-McMoRan - Chino Mines Company
PO Box 10
Bayard, NM 88023

cc: Matthew Barkley

Bill to:
Pam Pinson
Freeport-McMoRan - Chino Mines Company
P.O. Box 13308
Phoenix, AZ 85002-3308

Project ID: ZN000001M5
ACZ Project ID: L15301

Pam Pinson:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on October 30, 2013. This project has been assigned to ACZ's project number, L15301. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan. The enclosed results relate only to the samples received under L15301. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all requirements of NELAC.

This report shall be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after December 15, 2013. If the samples are determined to be hazardous, additional charges apply for disposal (typically $11/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical raw data reports for ten years.

If you have any questions or other needs, please contact your Project Manager.

S. Habermehl

Scott Habermehl has reviewed
and approved this report.

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L15301-01***
Project ID:	ZN000001M5	Date Sampled:	*10/25/13 13:10*
Sample ID:	STS-PH-2013-FID7	Date Received:	*10/30/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	375			mg/Kg	1	5	11/07/13 19:06	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		2	B		t CaCO3/Kt	1	5	11/14/13 17:01	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		1			t CaCO3/Kt	1	5	11/14/13 17:01	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		-1			t CaCO3/Kt	1	5	11/14/13 17:01	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	0.1	B	*	%	0.1	0.5	11/12/13 16:41	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	5.4			units	0.1	0.1	11/13/13 0:00	mss2
pH measured at		1	22			C	0.1	0.1	11/13/13 0:00	mss2
Solids, Percent	CLPSOW390, PART F, D-98	1	96.2		*	%	0.1	0.5	10/31/13 20:16	spl
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.04	B	*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur HNO3 Residue		1	0.01	B	*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur Organic Residual		1	0.01	B	*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur Pyritic Sulfide		1	0.03	B	*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur Sulfate		1	0.01	B	*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur Total		1	0.05	B	*	%	0.01	0.1	11/06/13 0:00	mss2
Total Sulfur minus Sulfate		1	0.04	B	*	%	0.01	0.1	11/06/13 0:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				10/31/13 16:10	spl
Crush and Pulverize	EPA-600/2-78-054 3.1.3								11/05/13 14:35	spl
Digestion - Hot Plate	M3050B ICP								11/06/13 10:20	mss2
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/05/13 15:00	spl
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2								11/05/13 15:00	spl

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000001M5
Sample ID: STS-PH-2013-FID8

ACZ Sample ID: ***L15301-02***
Date Sampled: *10/24/13 11:00*
Date Received: *10/30/13*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	102	358			mg/Kg	1	5	11/07/13 19:16	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		11			t CaCO3/Kt	1	5	11/14/13 17:01	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		17			t CaCO3/Kt	1	5	11/14/13 17:01	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		6			t CaCO3/Kt	1	5	11/14/13 17:01	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	1.7		*	%	0.1	0.5	11/12/13 18:35	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	6.5			units	0.1	0.1	11/13/13 0:00	mss2
pH measured at		1	21.7			C	0.1	0.1	11/13/13 0:00	mss2
Solids, Percent	CLPSOW390, PART F, D-98	1	94.2		*	%	0.1	0.5	10/31/13 22:49	spl
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.23		*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur HNO3 Residue		1	0.03	B	*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur Organic Residual		1	0.03	B	*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur Pyritic Sulfide		1	0.20		*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur Sulfate		1	0.11		*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur Total		1	0.34		*	%	0.01	0.1	11/06/13 0:00	mss2
Total Sulfur minus Sulfate		1	0.23		*	%	0.01	0.1	11/06/13 0:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				10/31/13 16:14	spl
Crush and Pulverize	EPA-600/2-78-054 3.1.3								11/05/13 14:53	spl
Digestion - Hot Plate	M3050B ICP								11/06/13 11:11	mss2
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/05/13 15:16	spl
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2								11/05/13 15:16	spl

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001M5	ACZ Sample ID:	***L15301-03***
Sample ID:	STS-PH-2013-FID10	Date Sampled:	*10/23/13 15:15*
		Date Received:	*10/30/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	1780			mg/Kg	1	5	11/07/13 19:22	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		4	B		t CaCO3/Kt	1	5	11/14/13 17:01	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		2			t CaCO3/Kt	1	5	11/14/13 17:01	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		-2			t CaCO3/Kt	1	5	11/14/13 17:01	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	0.2	B	*	%	0.1	0.5	11/12/13 19:32	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	5			units	0.1	0.1	11/13/13 0:00	mss2
pH measured at		1	21.9			C	0.1	0.1	11/13/13 0:00	mss2
Solids, Percent	CLPSOW390, PART F, D-98	1	94.6		*	%	0.1	0.5	11/01/13 0:06	spl
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.13		*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur HNO3 Residue		1	0.02	B	*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur Organic Residual		1	0.02	B	*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur Pyritic Sulfide		1	0.11		*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur Sulfate		1		U	*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur Total		1	0.13		*	%	0.01	0.1	11/06/13 0:00	mss2
Total Sulfur minus Sulfate		1	0.13		*	%	0.01	0.1	11/06/13 0:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				10/31/13 16:18	spl
Crush and Pulverize	EPA-600/2-78-054 3.1.3								11/05/13 15:11	spl
Digestion - Hot Plate	M3050B ICP								11/06/13 11:28	mss2
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/05/13 15:33	spl
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2								11/05/13 15:33	spl

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000001M5
Sample ID: STS-PH-2013-FID15

ACZ Sample ID: ***L15301-04***
Date Sampled: *10/23/13 10:50*
Date Received: *10/30/13*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	1950			mg/Kg	1	5	11/07/13 19:25	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		9			t CaCO3/Kt	1	5	11/14/13 17:02	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		5			t CaCO3/Kt	1	5	11/14/13 17:02	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		-4			t CaCO3/Kt	1	5	11/14/13 17:02	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	0.5		*	%	0.1	0.5	11/12/13 20:29	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	5.2			units	0.1	0.1	11/13/13 0:00	mss2
pH measured at		1	21.8			C	0.1	0.1	11/13/13 0:00	mss2
Solids, Percent	CLPSOW390, PART F, D-98	1	96.8		*	%	0.1	0.5	11/01/13 1:22	spl
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.24		*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur HNO3 Residue		1	0.03	B	*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur Organic Residual		1	0.03	B	*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur Pyritic Sulfide		1	0.21		*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur Sulfate		1	0.04	B	*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur Total		1	0.28		*	%	0.01	0.1	11/06/13 0:00	mss2
Total Sulfur minus Sulfate		1	0.24		*	%	0.01	0.1	11/06/13 0:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				10/31/13 16:23	spl
Crush and Pulverize	EPA-600/2-78-054 3.1.3								11/05/13 15:29	spl
Digestion - Hot Plate	M3050B ICP								11/06/13 11:45	mss2
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/05/13 15:50	spl
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2								11/05/13 15:50	spl

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001M5	ACZ Sample ID:	***L15301-05***
Sample ID:	STS-PH-2013-FID16	Date Sampled:	*10/23/13 11:10*
		Date Received:	*10/30/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	100	1290			mg/Kg	1	5	11/07/13 19:34	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		7			t CaCO3/Kt	1	5	11/14/13 17:02	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		0.0			t CaCO3/Kt	1	5	11/14/13 17:02	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		-7			t CaCO3/Kt	1	5	11/14/13 17:02	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1		U	*	%	0.1	0.5	11/12/13 21:25	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	4.7			units	0.1	0.1	11/13/13 0:00	mss2
pH measured at		1	21.7			C	0.1	0.1	11/13/13 0:00	mss2
Solids, Percent	CLPSOW390, PART F, D-98	1	96.9		*	%	0.1	0.5	11/01/13 2:39	spl
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.16		*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur HNO3 Residue		1	0.03	B	*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur Organic Residual		1	0.03	B	*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur Pyritic Sulfide		1	0.13		*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur Sulfate		1	0.06	B	*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur Total		1	0.22		*	%	0.01	0.1	11/06/13 0:00	mss2
Total Sulfur minus Sulfate		1	0.16		*	%	0.01	0.1	11/06/13 0:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				10/31/13 16:27	spl
Crush and Pulverize	EPA-600/2-78-054 3.1.3								11/05/13 15:47	spl
Digestion - Hot Plate	M3050B ICP								11/06/13 12:02	mss2
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/05/13 16:06	spl
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2								11/05/13 16:06	spl

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L15301-06***
Project ID:	ZN000001M5	Date Sampled:	*10/24/13 15:35*
Sample ID:	STS-PH-2013-FID18	Date Received:	*10/30/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	100	141			mg/Kg	1	5	11/07/13 19:37	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		3	B		t CaCO3/Kt	1	5	11/14/13 17:02	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		0.0			t CaCO3/Kt	1	5	11/14/13 17:02	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		-3			t CaCO3/Kt	1	5	11/14/13 17:02	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1		U	*	%	0.1	0.5	11/12/13 22:22	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	4.3			units	0.1	0.1	11/13/13 0:00	mss2
pH measured at		1	21.8			C	0.1	0.1	11/13/13 0:00	mss2
Solids, Percent	CLPSOW390, PART F, D-98	1	96.6		*	%	0.1	0.5	11/01/13 3:55	spl
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.06	B	*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur HNO3 Residue		1	0.01	B	*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur Organic Residual		1	0.01	B	*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur Pyritic Sulfide		1	0.05	B	*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur Sulfate		1	0.02	B	*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur Total		1	0.08	B	*	%	0.01	0.1	11/06/13 0:00	mss2
Total Sulfur minus Sulfate		1	0.06	B	*	%	0.01	0.1	11/06/13 0:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				10/31/13 16:32	spl
Crush and Pulverize	EPA-600/2-78-054 3.1.3								11/05/13 16:05	spl
Digestion - Hot Plate	M3050B ICP								11/06/13 12:19	mss2
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/05/13 16:23	spl
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2								11/05/13 16:23	spl

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001M5	ACZ Sample ID:	***L15301-07***
Sample ID:	STS-PH-2013-FID22	Date Sampled:	*10/25/13 15:00*
		Date Received:	*10/30/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	296			mg/Kg	1	5	11/07/13 19:40	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		6			t CaCO3/Kt	1	5	11/14/13 17:02	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		12			t CaCO3/Kt	1	5	11/14/13 17:02	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		6			t CaCO3/Kt	1	5	11/14/13 17:02	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	1.2		*	%	0.1	0.5	11/12/13 23:19	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	6.3			units	0.1	0.1	11/13/13 0:00	mss2
pH measured at		1	21.7			C	0.1	0.1	11/13/13 0:00	mss2
Solids, Percent	CLPSOW390, PART F, D-98	1	95.9		*	%	0.1	0.5	11/01/13 5:12	spl
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.13		*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur HNO3 Residue		1	0.02	B	*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur Organic Residual		1	0.02	B	*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur Pyritic Sulfide		1	0.11		*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur Sulfate		1	0.06	B	*	%	0.01	0.1	11/06/13 0:00	mss2
Sulfur Total		1	0.19		*	%	0.01	0.1	11/06/13 0:00	mss2
Total Sulfur minus Sulfate		1	0.13		*	%	0.01	0.1	11/06/13 0:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				10/31/13 16:36	spl
Crush and Pulverize	EPA-600/2-78-054 3.1.3								11/05/13 16:23	spl
Digestion - Hot Plate	M3050B ICP								11/06/13 12:36	mss2
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/05/13 16:40	spl
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2								11/05/13 16:40	spl

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001M5	ACZ Sample ID:	***L15301-08***
Sample ID:	STS-PH-2013-FID28	Date Sampled:	*10/22/13 09:30*
		Date Received:	*10/30/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	318			mg/Kg	1	5	11/07/13 19:43	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		6			t CaCO3/Kt	1	5	11/14/13 17:02	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		90			t CaCO3/Kt	1	5	11/14/13 17:02	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		84			t CaCO3/Kt	1	5	11/14/13 17:02	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	9		*	%	0.1	0.5	11/13/13 2:16	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	6.8			units	0.1	0.1	11/13/13 0:00	mss2
pH measured at		1	21.3			C	0.1	0.1	11/13/13 0:00	mss2
Solids, Percent	CLPSOW390, PART F, D-98	1	97.1		*	%	0.1	0.5	11/01/13 6:28	spl
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.19		*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur HNO3 Residue		1	0.02	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Organic Residual		1	0.02	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Pyritic Sulfide		1	0.17		*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Sulfate		1		U	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Total		1	0.18		*	%	0.01	0.1	11/07/13 0:00	mss2
Total Sulfur minus Sulfate		1	0.18		*	%	0.01	0.1	11/07/13 0:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				10/31/13 16:41	spl
Crush and Pulverize	EPA-600/2-78-054 3.1.3								11/05/13 16:41	spl
Digestion - Hot Plate	M3050B ICP								11/06/13 12:53	mss2
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/05/13 16:56	spl
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2								11/05/13 16:56	spl

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001M5	ACZ Sample ID:	***L15301-09***
Sample ID:	STS-PH-2013-FID37	Date Sampled:	*10/24/13 17:00*
		Date Received:	*10/30/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	432			mg/Kg	1	5	11/07/13 19:46	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		0			t CaCO3/Kt	1	5	11/14/13 17:02	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		2			t CaCO3/Kt	1	5	11/14/13 17:02	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		2			t CaCO3/Kt	1	5	11/14/13 17:02	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	0.2	B	*	%	0.1	0.5	11/13/13 1:13	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	5.3			units	0.1	0.1	11/13/13 0:00	mss2
pH measured at		1	21.8			C	0.1	0.1	11/13/13 0:00	mss2
Solids, Percent	CLPSOW390, PART F, D-98	1	95.2		*	%	0.1	0.5	11/01/13 7:45	spl
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.02	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur HNO3 Residue		1		U	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Organic Residual		1		U	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Pyritic Sulfide		1	0.02	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Sulfate		1		U	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Total		1	0.02	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Total Sulfur minus Sulfate		1	0.02	B	*	%	0.01	0.1	11/07/13 0:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				10/31/13 16:45	spl
Crush and Pulverize	EPA-600/2-78-054 3.1.3								11/05/13 16:59	spl
Digestion - Hot Plate	M3050B ICP								11/06/13 13:10	mss2
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/05/13 17:13	spl
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2								11/05/13 17:13	spl

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001M5	ACZ Sample ID:	***L15301-10***
Sample ID:	STS-PH-2013-FID101	Date Sampled:	*10/24/13 14:35*
		Date Received:	*10/30/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	100	221			mg/Kg	1	5	11/07/13 19:49	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		9			t CaCO3/Kt	1	5	11/14/13 17:02	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		0.0			t CaCO3/Kt	1	5	11/14/13 17:02	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		-9			t CaCO3/Kt	1	5	11/14/13 17:02	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1		U	*	%	0.1	0.5	11/13/13 2:10	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	4.2			units	0.1	0.1	11/13/13 0:00	mss2
pH measured at		1	21.6			C	0.1	0.1	11/13/13 0:00	mss2
Solids, Percent	CLPSOW390, PART F, D-98	1	97.1		*	%	0.1	0.5	11/01/13 9:01	spl
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.18		*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur HNO3 Residue		1	0.04	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Organic Residual		1	0.04	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Pyritic Sulfide		1	0.14		*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Sulfate		1	0.12		*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Total		1	0.30		*	%	0.01	0.1	11/07/13 0:00	mss2
Total Sulfur minus Sulfate		1	0.18		*	%	0.01	0.1	11/07/13 0:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				10/31/13 16:50	spl
Crush and Pulverize	EPA-600/2-78-054 3.1.3								11/05/13 17:17	spl
Digestion - Hot Plate	M3050B ICP								11/06/13 13:27	mss2
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/05/13 17:30	spl
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2								11/05/13 17:30	spl

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001M5	ACZ Sample ID:	***L15301-11***
Sample ID:	STS-PH-2013-FID102	Date Sampled:	*10/24/13 13:00*
		Date Received:	*10/30/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	171			mg/Kg	1	5	11/07/13 19:52	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		15			t CaCO3/Kt	1	5	11/14/13 17:02	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		2			t CaCO3/Kt	1	5	11/14/13 17:02	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		-13			t CaCO3/Kt	1	5	11/14/13 17:02	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	0.2	B	*	%	0.1	0.5	11/13/13 3:07	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	3.7			units	0.1	0.1	11/13/13 0:00	mss2
pH measured at		1	21.5			C	0.1	0.1	11/13/13 0:00	mss2
Solids, Percent	CLPSOW390, PART F, D-98	1	96.1		*	%	0.1	0.5	11/01/13 10:18	spl
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.23		*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur HNO3 Residue		1	0.03	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Organic Residual		1	0.03	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Pyritic Sulfide		1	0.20		*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Sulfate		1	0.25		*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Total		1	0.48		*	%	0.01	0.1	11/07/13 0:00	mss2
Total Sulfur minus Sulfate		1	0.23		*	%	0.01	0.1	11/07/13 0:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				10/31/13 16:54	spl
Crush and Pulverize	EPA-600/2-78-054 3.1.3								11/05/13 17:35	spl
Digestion - Hot Plate	M3050B ICP								11/06/13 13:44	mss2
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/05/13 17:46	spl
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2								11/05/13 17:46	spl

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L15301-12***
Project ID:	ZN000001M5	Date Sampled:	*10/23/13 18:00*
Sample ID:	STS-PH-2013-FID105	Date Received:	*10/30/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	816			mg/Kg	1	5	11/07/13 19:56	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		5			t CaCO3/Kt	1	5	11/14/13 17:03	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		2			t CaCO3/Kt	1	5	11/14/13 17:03	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		-3			t CaCO3/Kt	1	5	11/14/13 17:03	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	0.2	B	*	%	0.1	0.5	11/13/13 4:04	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	4.7			units	0.1	0.1	11/13/13 0:00	mss2
pH measured at		1	21.4			C	0.1	0.1	11/13/13 0:00	mss2
Solids, Percent	CLPSOW390, PART F, D-98	1	94.9		*	%	0.1	0.5	11/01/13 11:34	spl
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.12		*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur HNO3 Residue		1	0.04	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Organic Residual		1	0.04	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Pyritic Sulfide		1	0.08	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Sulfate		1	0.04	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Total		1	0.16		*	%	0.01	0.1	11/07/13 0:00	mss2
Total Sulfur minus Sulfate		1	0.12		*	%	0.01	0.1	11/07/13 0:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				10/31/13 16:58	spl
Crush and Pulverize	EPA-600/2-78-054 3.1.3								11/05/13 17:53	spl
Digestion - Hot Plate	M3050B ICP								11/06/13 14:01	mss2
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/05/13 18:03	spl
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2								11/05/13 18:03	spl

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L15301-13***
Project ID:	ZN000001M5	Date Sampled:	*10/25/13 13:40*
Sample ID:	STS-PH-2013-FID106	Date Received:	*10/30/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	247			mg/Kg	1	5	11/07/13 19:59	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		0			t CaCO3/Kt	1	5	11/14/13 17:03	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		2			t CaCO3/Kt	1	5	11/14/13 17:03	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		2			t CaCO3/Kt	1	5	11/14/13 17:03	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	0.2	B	*	%	0.1	0.5	11/13/13 5:01	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	4.6			units	0.1	0.1	11/13/13 0:00	mss2
pH measured at		1	21.1			C	0.1	0.1	11/13/13 0:00	mss2
Solids, Percent	CLPSOW390, PART F, D-98	1	96.0		*	%	0.1	0.5	11/01/13 12:51	spl
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.03	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur HNO3 Residue		1		U	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Organic Residual		1		U	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Pyritic Sulfide		1	0.03	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Sulfate		1		U	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Total		1	0.02	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Total Sulfur minus Sulfate		1	0.02	B	*	%	0.01	0.1	11/07/13 0:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				10/31/13 17:03	spl
Crush and Pulverize	EPA-600/2-78-054 3.1.3								11/05/13 18:11	spl
Digestion - Hot Plate	M3050B ICP								11/06/13 14:18	mss2
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/05/13 18:20	spl
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2								11/05/13 18:20	spl

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L15301-14***
Project ID:	ZN000001M5	Date Sampled:	*10/24/13 14:30*
Sample ID:	STS-PH-2013-REFPLOT1	Date Received:	*10/30/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	605			mg/Kg	1	5	11/07/13 20:02	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		0			t CaCO3/Kt	1	5	11/14/13 17:03	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		166			t CaCO3/Kt	1	5	11/14/13 17:03	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		166			t CaCO3/Kt	1	5	11/14/13 17:03	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	16.6		*	%	0.1	0.5	11/13/13 7:21	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	7.5			units	0.1	0.1	11/13/13 0:00	mss2
pH measured at		1	21.1			C	0.1	0.1	11/13/13 0:00	mss2
Solids, Percent	CLPSOW390, PART F, D-98	1	97.2		*	%	0.1	0.5	11/01/13 14:07	spl
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.04	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur HNO3 Residue		1	0.02	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Organic Residual		1	0.02	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Pyritic Sulfide		1	0.02	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Sulfate		1		U	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Total		1		U	*	%	0.01	0.1	11/07/13 0:00	mss2
Total Sulfur minus Sulfate		1		U	*	%	0.01	0.1	11/07/13 0:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				10/31/13 17:07	spl
Crush and Pulverize	EPA-600/2-78-054 3.1.3								11/05/13 18:29	spl
Digestion - Hot Plate	M3050B ICP								11/06/13 14:35	mss2
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/05/13 18:36	spl
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2								11/05/13 18:36	spl

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L15301-15***
Project ID:	ZN000001M5	Date Sampled:	*10/25/13 15:50*
Sample ID:	STS-PH-2013-REFPLOT2	Date Received:	*10/30/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	578			mg/Kg	1	5	11/07/13 20:11	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		0			t CaCO3/Kt	1	5	11/14/13 17:03	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		5			t CaCO3/Kt	1	5	11/14/13 17:03	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		5			t CaCO3/Kt	1	5	11/14/13 17:03	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	0.5		*	%	0.1	0.5	11/13/13 5:58	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	6			units	0.1	0.1	11/13/13 0:00	mss2
pH measured at		1	21.3			C	0.1	0.1	11/13/13 0:00	mss2
Solids, Percent	CLPSOW390, PART F, D-98	1	96.6		*	%	0.1	0.5	11/01/13 15:24	spl
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.02	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur HNO3 Residue		1		U	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Organic Residual		1		U	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Pyritic Sulfide		1	0.02	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Sulfate		1		U	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Total		1		U	*	%	0.01	0.1	11/07/13 0:00	mss2
Total Sulfur minus Sulfate		1		U	*	%	0.01	0.1	11/07/13 0:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				10/31/13 17:12	spl
Crush and Pulverize	EPA-600/2-78-054 3.1.3								11/05/13 18:47	spl
Digestion - Hot Plate	M3050B ICP								11/06/13 14:52	mss2
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/05/13 18:53	spl
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2								11/05/13 18:53	spl

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000001M5
Sample ID: STS-PH-2013-REFPLOT3

ACZ Sample ID: ***L15301-16***
Date Sampled: *10/24/13 11:20*
Date Received: *10/30/13*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	102	1090			mg/Kg	1	5	11/07/13 20:14	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		4	B		t CaCO3/Kt	1	5	11/14/13 17:03	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		11			t CaCO3/Kt	1	5	11/14/13 17:03	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		7			t CaCO3/Kt	1	5	11/14/13 17:03	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	1.1		*	%	0.1	0.5	11/13/13 6:54	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	6.7			units	0.1	0.1	11/13/13 0:00	mss2
pH measured at		1	21.3			C	0.1	0.1	11/13/13 0:00	mss2
Solids, Percent	CLPSOW390, PART F, D-98	1	91.3		*	%	0.1	0.5	11/01/13 16:40	spl
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.10		*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur HNO3 Residue		1	0.02	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Organic Residual		1	0.02	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Pyritic Sulfide		1	0.08	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Sulfate		1	0.02	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Total		1	0.12		*	%	0.01	0.1	11/07/13 0:00	mss2
Total Sulfur minus Sulfate		1	0.10		*	%	0.01	0.1	11/07/13 0:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				10/31/13 17:16	spl
Crush and Pulverize	EPA-600/2-78-054 3.1.3								11/05/13 19:05	spl
Digestion - Hot Plate	M3050B ICP								11/06/13 15:09	mss2
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/05/13 19:10	spl
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2								11/05/13 19:10	spl

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001M5	ACZ Sample ID:	***L15301-17***
Sample ID:	STS-PH-2013-REFPLOT4	Date Sampled:	*10/25/13 13:00*
		Date Received:	*10/30/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	923			mg/Kg	1	5	11/07/13 20:17	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		7			t CaCO3/Kt	1	5	11/14/13 17:03	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		3			t CaCO3/Kt	1	5	11/14/13 17:03	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		-4			t CaCO3/Kt	1	5	11/14/13 17:03	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	0.3	B	*	%	0.1	0.5	11/13/13 7:51	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	6			units	0.1	0.1	11/13/13 0:00	mss2
pH measured at		1	21.4			C	0.1	0.1	11/13/13 0:00	mss2
Solids, Percent	CLPSOW390, PART F, D-98	1	92.6		*	%	0.1	0.5	11/01/13 17:57	spl
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.18		*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur HNO3 Residue		1	0.03	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Organic Residual		1	0.03	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Pyritic Sulfide		1	0.15		*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Sulfate		1	0.05	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Total		1	0.23		*	%	0.01	0.1	11/07/13 0:00	mss2
Total Sulfur minus Sulfate		1	0.18		*	%	0.01	0.1	11/07/13 0:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				10/31/13 17:21	spl
Crush and Pulverize	EPA-600/2-78-054 3.1.3								11/05/13 19:23	spl
Digestion - Hot Plate	M3050B ICP								11/06/13 15:25	mss2
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/05/13 19:26	spl
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2								11/05/13 19:26	spl

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000001M5
Sample ID: STS-PH-2013-ERA02

ACZ Sample ID: ***L15301-18***
Date Sampled: *10/24/13 10:00*
Date Received: *10/30/13*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	420			mg/Kg	1	5	11/07/13 20:20	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		0			t CaCO3/Kt	1	5	11/14/13 17:03	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		18			t CaCO3/Kt	1	5	11/14/13 17:03	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		18			t CaCO3/Kt	1	5	11/14/13 17:03	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	1.8		*	%	0.1	0.5	11/13/13 9:54	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	7			units	0.1	0.1	11/13/13 0:00	mss2
pH measured at		1	21.2			C	0.1	0.1	11/13/13 0:00	mss2
Solids, Percent	CLPSOW390, PART F, D-98	1	94.2		*	%	0.1	0.5	11/01/13 19:13	spl
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.07	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur HNO3 Residue		1	0.02	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Organic Residual		1	0.02	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Pyritic Sulfide		1	0.05	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Sulfate		1		U	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Total		1		U	*	%	0.01	0.1	11/07/13 0:00	mss2
Total Sulfur minus Sulfate		1		U	*	%	0.01	0.1	11/07/13 0:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				10/31/13 17:25	spl
Crush and Pulverize	EPA-600/2-78-054 3.1.3								11/05/13 19:41	spl
Digestion - Hot Plate	M3050B ICP								11/06/13 15:42	mss2
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/05/13 19:43	spl
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2								11/05/13 19:43	spl

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001M5	ACZ Sample ID:	***L15301-19***
Sample ID:	STS-PH-2013-ERA03	Date Sampled:	*10/23/13 17:00*
		Date Received:	*10/30/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	807			mg/Kg	1	5	11/07/13 20:23	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		9			t CaCO3/Kt	1	5	11/14/13 17:03	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		3			t CaCO3/Kt	1	5	11/14/13 17:03	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		-6			t CaCO3/Kt	1	5	11/14/13 17:03	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	0.3	B	*	%	0.1	0.5	11/13/13 8:48	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	6			units	0.1	0.1	11/13/13 0:00	mss2
pH measured at		1	21.1			C	0.1	0.1	11/13/13 0:00	mss2
Solids, Percent	CLPSOW390, PART F, D-98	1	95.6		*	%	0.1	0.5	11/01/13 20:30	spl
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.18		*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur HNO3 Residue		1	0.06	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Organic Residual		1	0.06	B	*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Pyritic Sulfide		1	0.12		*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Sulfate		1	0.10		*	%	0.01	0.1	11/07/13 0:00	mss2
Sulfur Total		1	0.28		*	%	0.01	0.1	11/07/13 0:00	mss2
Total Sulfur minus Sulfate		1	0.18		*	%	0.01	0.1	11/07/13 0:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				10/31/13 17:30	spl
Crush and Pulverize	EPA-600/2-78-054 3.1.3								11/05/13 19:59	spl
Digestion - Hot Plate	M3050B ICP								11/06/13 15:59	mss2
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/05/13 20:00	spl
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2								11/05/13 20:00	spl

** Please refer to Qualifier Reports for details.*

Inorganic Reference

Report Header Explanations

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit, typically 5 times the MDL.
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Recovered amount of the true value or spike added, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of interest

QC Sample Types

AS	Analytical Spike (Post Digestion)	*LCSWD*	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	*LFB*	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	*LFM*	Laboratory Fortified Matrix
CCV	Continuing Calibration Verification standard	*LFMD*	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	*LRB*	Laboratory Reagent Blank
ICB	Initial Calibration Blank	*MS*	Matrix Spike
ICV	Initial Calibration Verification standard	*MSD*	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	*PBS*	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	*PBW*	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	*PQV*	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	*SDL*	Serial Dilution

QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

ACZ Qualifiers (Qual)

B	Analyte concentration detected at a value between MDL and PQL. The associated value is an estimated quantity.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
L	Target analyte response was below the laboratory defined negative threshold.
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Method References

(1) EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
(2) EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.
(3) EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.
(4) EPA SW-846. Test Methods for Evaluating Solid Waste.
(5) Standard Methods for the Examination of Water and Wastewater.

Comments

(1) QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
(2) Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.
(3) Animal matrices for Inorganic analyses are reported on an "as received" basis.
(4) An asterisk in the "XQ" column indicates there is an extended qualifier and/or certification qualifier associated with the result.
(5) If the MDL equals the PQL or the MDL column is omitted, the PQL is the reporting limit.

For a complete list of ACZ's Extended Qualifiers, please click: http://www.acz.com/public/extquallist.pdf

Copper, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG354475													
WG354475ICV	ICV	11/07/13 18:42	II130820-1	2		1.968	mg/L	98.4	90	110			
WG354475ICB	ICB	11/07/13 18:45				U	mg/L		-0.03	0.03			
WG354384PBS	PBS	11/07/13 18:57				U	mg/Kg		-3	3			
WG354384LCSS	LCSS	11/07/13 19:00	PCN42472	162		162.6	mg/Kg		135	190			
WG354384LCSSD	LCSSD	11/07/13 19:03	PCN42472	162		164.1	mg/Kg		135	190	0.9	20	
L15301-01MS	MS	11/07/13 19:09	II131029-2	50.5	375	436.1	mg/Kg	121	75	125			
L15301-01MSD	MSD	11/07/13 19:13	II131029-2	50.5	375	429.9	mg/Kg	108.7	75	125	1.43	20	

Neutralization Potential as CaCO3 M600/2-78-054 3.2.3 - Modified (No Heat)

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG354638													
WG354638PBS	PBS	11/12/13 14:47				U	%		-0.1	0.1			
WG354638LCSS	LCSS	11/12/13 15:44	PCN33453	100		100	%	100	80	120			
L15301-01DUP	DUP	11/12/13 17:38			.1	.15	%				40	20	RA
WG354635													
WG354635PBS	PBS	11/12/13 21:10				U	%		-0.1	0.1			
WG354635LCSS	LCSS	11/12/13 23:43	PCN33453	100		102.5	%	102.5	80	120			
L15301-08DUP	DUP	11/13/13 4:49			9	9	%				0	20	

Ph M9045D/M9040C

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG354823													
WG354823ICV	ICV	11/13/13 16:01	PCN42578	4		3.95	units	98.8	97	103			
L15301-01DUP	DUP	11/13/13 16:12			5.4	5.37	units				0.6	20	

Solids, Percent CLPSOW390, PART F, D-98

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG354097													
WG354097PBS	PBS	10/31/13 19:00				U	%		99.9	100.1			
L15301-01DUP	DUP	10/31/13 21:33			96.2	96.02	%				0.2	20	

Sulfur Organic Residual M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG354385													
L15301-01DUP	DUP	11/06/13 14:17			.01	.01	%				0	20	RA

Sulfur Pyritic Sulfide M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG354385													
L15301-01DUP	DUP	11/06/13 14:17			.03	.03	%				0	20	RA

Sulfur Sulfate M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG354385													
L15301-01DUP	DUP	11/06/13 14:17			.01	U	%				200	20	RA

Sulfur Total M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG354385													
WG354385LCSS	LCSS	11/06/13 11:25	PCN42346	4.07		4.57	%	112.3					
L15301-01DUP	DUP	11/06/13 14:17			.05	.04	%				22.2	20	RA

Total Sulfur Minus Sulfate M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG354385													
L15301-01DUP	DUP	11/06/13 14:17			.04	.04	%				0	20	RA

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L15301-01	WG354638	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG354385	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L15301-02	WG354638	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG354385	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L15301-03	WG354638	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG354385	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L15301-04	WG354638	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG354385	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L15301-05	WG354638	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG354385	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L15301-06	WG354638	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG354385	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L15301-07	WG354638	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG354385	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L15301-08	WG354385	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L15301-09	WG354638	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG354385	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L15301-10	WG354638	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG354385	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L15301-11	WG354638	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG354385	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L15301-12	WG354638	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG354385	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L15301-13	WG354638	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG354385	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L15301-14	WG354385	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L15301-15	WG354638	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG354385	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L15301-16	WG354638	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG354385	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L15301-17	WG354638	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG354385	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L15301-18	WG354385	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L15301-19	WG354638	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG354385	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

Soil Analysis

The following parameters are not offered for certification or are not covered by AZ certificate #AZ0102.	
Solids, Percent	CLPSOW390, PART F, D-98

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.	
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)
Solids, Percent	CLPSOW390, PART F, D-98
Sulfur HCl Residue	M600/2-78-054 3.2.4-MOD
Sulfur HNO3 Residue	M600/2-78-054 3.2.4-MOD
Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD
Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD
Sulfur Sulfate	M600/2-78-054 3.2.4-MOD
Sulfur Total	M600/2-78-054 3.2.4-MOD
Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Sample Receipt

Freeport-McMoRan - Chino Mines Company
ZN000001M5

ACZ Project ID: L15301
Date Received: 10/30/2013 10:02
Received By: mtb
Date Printed: 10/30/2013

Receipt Verification

	YES	NO	NA
1) Is a foreign soil permit included for applicable samples?			X
2) Is the Chain of Custody or other directive shipping papers present?	X		▨
3) Does this project require special handling procedures such as CLP protocol?			X
4) Are any samples NRC licensable material?			X
5) If samples are received past hold time, proceed with requested short hold time analyses?	X		
6) Is the Chain of Custody complete and accurate?	X		▨
7) Were any changes made to the Chain of Custody prior to ACZ receiving the samples?	X		▨

```
A change was made in the ID Line 6 section prior to ACZ
custody.
```

Samples/Containers

	YES	NO	NA
8) Are all containers intact and with no leaks?	X		▨
9) Are all labels on containers and are they intact and legible?	X		▨
10) Do the sample labels and Chain of Custody match for Sample ID, Date, and Time?	X		▨
11) For preserved bottle types, was the pH checked and within limits?			X
12) Is there sufficient sample volume to perform all requested work?	X		▨
13) Is the custody seal intact on all containers?			X
14) Are samples that require zero headspace acceptable?			X
15) Are all sample containers appropriate for analytical requirements?	X		▨
16) Is there an Hg-1631 trip blank present?			X
17) Is there a VOA trip blank present?			X
18) Were all samples received within hold time?	X		▨

Chain of Custody Related Remarks

Client Contact Remarks

Shipping Containers

```
Cooler Id       Temp (°C)      Rad (µR/Hr)     Custody Seal Intact?
---------       ---------      -----------     --------------------
4057            10.8           13              Yes
NA18647         10.6           15              N/A
```

Was ice present in the shipment container(s)?

```
No - Wet or gel ice was not present in the shipment container(s).
```

Client must contact an ACZ Project Manager if analysis should not proceed for samples received outside of their thermal preservation acceptance criteria.

L15301

ACZ Laboratories, Inc.

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

Copy of Report to:

Name: Matthew Barkley
Company: ARCADIS

E-mail: Matthew.Barkley@arcadis-us.com
Telephone: 303-231-9115 ext 157

Invoice to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐
If yes, please include state forms. Results will be reported to PQL. NO ☒

PROJECT INFORMATION | **ANALYSES REQUESTED** *(attach list or use quote number)*

Quote #:
Project/PO #:
Reporting state for compliance testing:
Sampler's Name: Patrick Quinn
Are any samples NRC licensable material? Yes No

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	soil sieved to < 2mm	pH	Total CU	ABA				
STS-PH-2013-FID7	10/25/13 1310	SO	1	x	x	x	x				
STS-PH-2013-FID8	10/24/13 1100	SO	1	x	x	x	x				
STS-PH-2013-FID10	10/23/13 1515	SO	1	x	x	x	x				
STS-PH-2013-FID15	10/23/13 1050	SO	1	x	x	x	x				
STS-PH-2013-FID16	10/23/13 1110	SO	1	x	x	x	x				
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]				
STS-PH-2013-FID18	10/24/13 1535	SO	1	x	x	x	x				
STS-PH-2013-FID22	10/25/13 1500	SO	1	x	x	x	x				
STS-PH-2013-FID28	10/22/13 0930	SO	1	x	x	x	x				
STS-PH-2013-FID37	10/24/13 1700	SO	1	x	x	x	x				

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

Please send to Sheri Fling at URS for validation. Sieve all soil samples to <2 mm prior to analysis. Soil should be reported on a dry weight basis.
Methods:
pH - 9045C, Total Copper - 6010B
Please include sulfur forms for ABA

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
	10/25/13 1940		
		10-30-13 10:02	

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

L15301 Chain of Custody

①

C15301

ACZ Laboratories, Inc.

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

Copy of Report to:

Name: Matthew Barkley
Company: ARCADIS

E-mail: Matthew.Barkley@arcadis-us.com
Telephone: 303-231-9115 ext 157

Invoice to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐
If yes, please include state forms. Results will be reported to PQL. NO ☒

PROJECT INFORMATION

Quote #:
Project/PO #:
Reporting state for compliance testing:
Sampler's Name: Patrick Quinn
Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED *(attach list or use quote number)*

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	soil sieved to < 2mm	pH	Total CU	ABA				
STS-PH-2013-FID101	10/24/13 1435	SO	1	x	x	x	x				
STS-PH-2013-FID102	10/24/13 1300	SO	1	x	x	x	x				
STS-PH-2013-FID105	10/23/13 1800	SO	1	x	x	x	x				
STS-PH-2013-FID106	10/25/13 1340	SO	1	x	x	x	x				
STS-PH-2013-REFPLOT1	10/24/13 1430	SO	1	x	x	x	x				
STS-PH-2013-REFPLOT2	10/25/13 1550	SO	1	x	x	x	x				
STS-PH-2013-REFPLOT3	10/24/13 1920	SO	1	x	x	x	x				
STS-PH-2013-REFPLOT4	10/25/13 1300	SO	1	x	x	x	x				
STS-PH-2013-ERA02	10/24/13 1000	SO	1	x	x	x	x				
STS-PH-2013-ERA03	10/23/13 1700	SO	1	x	x	x	x				

Matrix SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

Please send to Sheri Fling at URS for validation. Sieve all soil samples to <2 mm prior to analysis. Soil should be reported on a dry weight basis.
Methods:
pH - 9045C, Total Copper - 6010B
Please include sulfur forms for ABA

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
		10-30-13 10:02	

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

②

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Analytical Report

November 20, 2013

Report to:	Bill to:
Pam Pinson	Pam Pinson
Freeport-McMoRan - Chino Mines Company	Freeport-McMoRan - Chino Mines Company
PO Box 10	P.O. Box 13308
Bayard, NM 88023	Phoenix, AZ 85002-3308

cc: Matthew Barkley

Project ID: ZN000001M5
ACZ Project ID: L15302

Pam Pinson:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on October 30, 2013. This project has been assigned to ACZ's project number, L15302. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan. The enclosed results relate only to the samples received under L15302. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all requirements of NELAC.

This report shall be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after December 20, 2013. If the samples are determined to be hazardous, additional charges apply for disposal (typically $11/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical raw data reports for ten years.

If you have any questions or other needs, please contact your Project Manager.

S. Habermehl

Scott Habermehl has reviewed
and approved this report.

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001M5	ACZ Sample ID:	***L15302-01***
Sample ID:	STS-PH-2013-ERA04	Date Sampled:	*10/24/13 16:30*
		Date Received:	*10/30/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	215		*	mg/Kg	1	5	11/11/13 14:41	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		0			t CaCO3/Kt	1	5	11/19/13 13:22	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		5			t CaCO3/Kt	1	5	11/19/13 13:22	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		5			t CaCO3/Kt	1	5	11/19/13 13:22	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	0.5		*	%	0.1	0.5	11/13/13 9:45	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	6.4			units	0.1	0.1	11/15/13 0:00	cra
pH measured at		1	22			C	0.1	0.1	11/15/13 0:00	cra
Solids, Percent	CLPSOW390, PART F, D-98	1	97.3		*	%	0.1	0.5	11/13/13 2:22	spl
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.04	B	*	%	0.01	0.1	11/11/13 0:00	mss2
Sulfur HNO3 Residue		1	0.02	B	*	%	0.01	0.1	11/11/13 0:00	mss2
Sulfur Organic Residual		1	0.02	B	*	%	0.01	0.1	11/11/13 0:00	mss2
Sulfur Pyritic Sulfide		1	0.02	B	*	%	0.01	0.1	11/11/13 0:00	mss2
Sulfur Sulfate		1		U	*	%	0.01	0.1	11/11/13 0:00	mss2
Sulfur Total		1		U	*	%	0.01	0.1	11/11/13 0:00	mss2
Total Sulfur minus Sulfate		1		U	*	%	0.01	0.1	11/11/13 0:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				11/02/13 11:30	spl
Crush and Pulverize	EPA-600/2-78-054 3.1.3								11/06/13 12:50	spl
Digestion - Hot Plate	M3050B ICP								11/07/13 20:21	spl
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/06/13 12:45	spl
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2								11/06/13 12:45	spl

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L15302-02***
Project ID:	ZN000001M5	Date Sampled:	*10/25/13 12:30*
Sample ID:	STS-PH-2013-ERA10	Date Received:	*10/30/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	102	232		*	mg/Kg	1	5	11/11/13 14:50	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		1	B		t CaCO3/Kt	1	5	11/19/13 13:23	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		3			t CaCO3/Kt	1	5	11/19/13 13:23	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		2			t CaCO3/Kt	1	5	11/19/13 13:23	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	0.3	B	*	%	0.1	0.5	11/13/13 11:39	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	5.2			units	0.1	0.1	11/15/13 0:00	cra
pH measured at		1	21.4			C	0.1	0.1	11/15/13 0:00	cra
Solids, Percent	CLPSOW390, PART F, D-98	1	93.9		*	%	0.1	0.5	11/13/13 17:07	spl
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.06	B	*	%	0.01	0.1	11/12/13 0:00	mss2
Sulfur HNO3 Residue		1	0.01	B	*	%	0.01	0.1	11/12/13 0:00	mss2
Sulfur Organic Residual		1	0.01	B	*	%	0.01	0.1	11/12/13 0:00	mss2
Sulfur Pyritic Sulfide		1	0.05	B	*	%	0.01	0.1	11/12/13 0:00	mss2
Sulfur Sulfate		1		U	*	%	0.01	0.1	11/12/13 0:00	mss2
Sulfur Total		1	0.04	B	*	%	0.01	0.1	11/12/13 0:00	mss2
Total Sulfur minus Sulfate		1	0.04	B	*	%	0.01	0.1	11/12/13 0:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				11/02/13 11:36	spl
Crush and Pulverize	EPA-600/2-78-054 3.1.3								11/06/13 13:03	spl
Digestion - Hot Plate	M3050B ICP								11/08/13 3:42	spl
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/06/13 13:00	spl
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2								11/06/13 13:00	spl

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000001M5
Sample ID: STS-PH-2013-ERA13

ACZ Sample ID: ***L15302-03***
Date Sampled: *10/22/13 14:00*
Date Received: *10/30/13*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	91		*	mg/Kg	1	5	11/11/13 14:56	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		0			t CaCO3/Kt	1	5	11/19/13 13:23	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		6			t CaCO3/Kt	1	5	11/19/13 13:23	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		6			t CaCO3/Kt	1	5	11/19/13 13:23	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	0.6		*	%	0.1	0.5	11/13/13 12:36	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	5.6			units	0.1	0.1	11/15/13 0:00	cra
pH measured at		1	21.9			C	0.1	0.1	11/15/13 0:00	cra
Solids, Percent	CLPSOW390, PART F, D-98	1	93.7		*	%	0.1	0.5	11/14/13 0:30	spl
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.03	B	*	%	0.01	0.1	11/12/13 0:00	mss2
Sulfur HNO3 Residue		1		U	*	%	0.01	0.1	11/12/13 0:00	mss2
Sulfur Organic Residual		1		U	*	%	0.01	0.1	11/12/13 0:00	mss2
Sulfur Pyritic Sulfide		1	0.03	B	*	%	0.01	0.1	11/12/13 0:00	mss2
Sulfur Sulfate		1		U	*	%	0.01	0.1	11/12/13 0:00	mss2
Sulfur Total		1	0.02	B	*	%	0.01	0.1	11/12/13 0:00	mss2
Total Sulfur minus Sulfate		1	0.02	B	*	%	0.01	0.1	11/12/13 0:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				11/02/13 11:42	spl
Crush and Pulverize	EPA-600/2-78-054 3.1.3								11/06/13 13:17	spl
Digestion - Hot Plate	M3050B ICP								11/08/13 8:36	spl
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/06/13 13:15	spl
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2								11/06/13 13:15	spl

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000001M5
Sample ID: DUP PH 1

ACZ Sample ID: ***L15302-04***
Date Sampled: *10/24/13 00:00*
Date Received: *10/30/13*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	365		*	mg/Kg	1	5	11/11/13 14:59	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		0			t CaCO3/Kt	1	5	11/19/13 13:23	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		3			t CaCO3/Kt	1	5	11/19/13 13:23	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		3			t CaCO3/Kt	1	5	11/19/13 13:23	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	0.3	B	*	%	0.1	0.5	11/13/13 13:33	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	5.2			units	0.1	0.1	11/15/13 0:00	cra
pH measured at		1	21.5			C	0.1	0.1	11/15/13 0:00	cra
Solids, Percent	CLPSOW390, PART F, D-98	1	95.6		*	%	0.1	0.5	11/14/13 7:52	spl
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.02	B	*	%	0.01	0.1	11/12/13 0:00	mss2
Sulfur HNO3 Residue		1		U	*	%	0.01	0.1	11/12/13 0:00	mss2
Sulfur Organic Residual		1		U	*	%	0.01	0.1	11/12/13 0:00	mss2
Sulfur Pyritic Sulfide		1	0.02	B	*	%	0.01	0.1	11/12/13 0:00	mss2
Sulfur Sulfate		1		U	*	%	0.01	0.1	11/12/13 0:00	mss2
Sulfur Total		1	0.01	B	*	%	0.01	0.1	11/12/13 0:00	mss2
Total Sulfur minus Sulfate		1	0.01	B	*	%	0.01	0.1	11/12/13 0:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				11/02/13 11:49	spl
Crush and Pulverize	EPA-600/2-78-054 3.1.3								11/06/13 13:31	spl
Digestion - Hot Plate	M3050B ICP								11/08/13 11:03	spl
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/06/13 13:30	spl
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2								11/06/13 13:30	spl

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001M5	ACZ Sample ID:	***L15302-05***
Sample ID:	DUP PH 2	Date Sampled:	*10/24/13 00:00*
		Date Received:	*10/30/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	230		*	mg/Kg	1	5	11/11/13 15:09	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		6			t CaCO3/Kt	1	5	11/19/13 13:23	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		81			t CaCO3/Kt	1	5	11/19/13 13:23	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		75			t CaCO3/Kt	1	5	11/19/13 13:23	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	8.1		*	%	0.1	0.5	11/13/13 12:27	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	6.8			units	0.1	0.1	11/15/13 0:00	cra
pH measured at		1	21.4			C	0.1	0.1	11/15/13 0:00	cra
Solids, Percent	CLPSOW390, PART F, D-98	1	97.1		*	%	0.1	0.5	11/14/13 15:15	spl
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.22		*	%	0.01	0.1	11/12/13 0:00	mss2
Sulfur HNO3 Residue		1	0.03	B	*	%	0.01	0.1	11/12/13 0:00	mss2
Sulfur Organic Residual		1	0.03	B	*	%	0.01	0.1	11/12/13 0:00	mss2
Sulfur Pyritic Sulfide		1	0.19		*	%	0.01	0.1	11/12/13 0:00	mss2
Sulfur Sulfate		1		U	*	%	0.01	0.1	11/12/13 0:00	mss2
Sulfur Total		1	0.19		*	%	0.01	0.1	11/12/13 0:00	mss2
Total Sulfur minus Sulfate		1	0.19		*	%	0.01	0.1	11/12/13 0:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				11/02/13 11:55	spl
Crush and Pulverize	EPA-600/2-78-054 3.1.3								11/06/13 13:45	spl
Digestion - Hot Plate	M3050B ICP								11/08/13 13:30	spl
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/06/13 13:45	spl
Sieve-250 um (60 mesh)	ASA No.9, 15-4.2.2								11/06/13 13:45	spl

** Please refer to Qualifier Reports for details.*

Report Header Explanations

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit, typically 5 times the MDL.
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Recovered amount of the true value or spike added, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of interest

QC Sample Types

AS	Analytical Spike (Post Digestion)	*LCSWD*	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	*LFB*	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	*LFM*	Laboratory Fortified Matrix
CCV	Continuing Calibration Verification standard	*LFMD*	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	*LRB*	Laboratory Reagent Blank
ICB	Initial Calibration Blank	*MS*	Matrix Spike
ICV	Initial Calibration Verification standard	*MSD*	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	*PBS*	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	*PBW*	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	*PQV*	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	*SDL*	Serial Dilution

QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

ACZ Qualifiers (Qual)

B	Analyte concentration detected at a value between MDL and PQL. The associated value is an estimated quantity.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
L	Target analyte response was below the laboratory defined negative threshold.
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Method References

(1) EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
(2) EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.
(3) EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.
(4) EPA SW-846. Test Methods for Evaluating Solid Waste.
(5) Standard Methods for the Examination of Water and Wastewater.

Comments

(1) QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
(2) Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.
(3) Animal matrices for Inorganic analyses are reported on an "as received" basis.
(4) An asterisk in the "XQ" column indicates there is an extended qualifier and/or certification qualifier associated with the result.
(5) If the MDL equals the PQL or the MDL column is omitted, the PQL is the reporting limit.

For a complete list of ACZ's Extended Qualifiers, please click: http://www.acz.com/public/extquallist.pdf

Copper, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG354640													
WG354640ICV	ICV	11/11/13 14:17	II130820-1	2		1.951	mg/L	97.6	90	110			
WG354640ICB	ICB	11/11/13 14:20				U	mg/L		-0.03	0.03			
WG354486PBS	PBS	11/11/13 14:32				U	mg/Kg		-3	3			
WG354486LCSS	LCSS	11/11/13 14:35	PCN42472	162		149.9	mg/Kg		135	190			
WG354486LCSSD	LCSSD	11/11/13 14:38	PCN42472	162		158.1	mg/Kg		135	190	5.3	20	
L15302-01MS	MS	11/11/13 14:44	II131029-2	50.5	215	261.2	mg/Kg	91.5	75	125			
L15302-01MSD	MSD	11/11/13 14:47	II131029-2	50.5	215	292.6	mg/Kg	153.7	75	125	11.34	20	M3

Neutralization Potential as CaCO3 M600/2-78-054 3.2.3 - Modified (No Heat)

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG354638													
WG354638PBS	PBS	11/12/13 14:47				U	%		-0.1	0.1			
WG354638LCSS	LCSS	11/12/13 15:44	PCN33453	100		100	%	100	80	120			
L15301-01DUP	DUP	11/12/13 17:38			.1	.15	%				40	20	RA
WG354635													
WG354635PBS	PBS	11/12/13 21:10				U	%		-0.1	0.1			
WG354635LCSS	LCSS	11/12/13 23:43	PCN33453	100		102.5	%	102.5	80	120			
L15301-08DUP	DUP	11/13/13 4:49			9	9	%				0	20	

Ph M9045D/M9040C

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG354951													
WG354951ICV	ICV	11/15/13 13:10	PCN42578	4		3.97	units	99.3	97	103			
L15302-01DUP	DUP	11/15/13 13:37			6.4	6.54	units				2.2	20	

Solids, Percent CLPSOW390, PART F, D-98

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG354758													
WG354758PBS	PBS	11/12/13 19:00				U	%		99.9	100.1			
L15302-01DUP	DUP	11/13/13 9:45			97.3	97.39	%				0.1	20	

Sulfur Organic Residual M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG354653													
L15302-01DUP	DUP	11/11/13 23:45			.02	.02	%				0	20	RA

Sulfur Pyritic Sulfide M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG354653													
L15302-01DUP	DUP	11/11/13 23:45			.02	.03	%				40	20	RA

Sulfur Sulfate M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG354653													
L15302-01DUP	DUP	11/11/13 23:45			U	U	%				0	20	RA

Sulfur Total   M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG354653													
WG354653LCSS	LCSS	11/11/13 15:55	PCN42350	4.07		4.43	%	108.8					
L15302-01DUP	DUP	11/11/13 23:45			U	U	%				0	20	RA

Total Sulfur Minus Sulfate   M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG354653													
L15302-01DUP	DUP	11/11/13 23:45			U	U	%				0	20	RA

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L15302-01	WG354640	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG354638	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG354653	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L15302-02	WG354640	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG354638	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG354653	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L15302-03	WG354640	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG354638	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG354653	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L15302-04	WG354640	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG354638	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG354653	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L15302-05	WG354640	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG354653	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

Certification Qualifiers

Freeport-McMoRan - Chino Mines Company

ACZ Project ID: ***L15302***

Soil Analysis

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)
Solids, Percent	CLPSOW390, PART F, D-98
Sulfur HCl Residue	M600/2-78-054 3.2.4-MOD
Sulfur HNO3 Residue	M600/2-78-054 3.2.4-MOD
Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD
Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD
Sulfur Sulfate	M600/2-78-054 3.2.4-MOD
Sulfur Total	M600/2-78-054 3.2.4-MOD
Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Sample Receipt

Freeport-McMoRan - Chino Mines Company
ZN000001M5

ACZ Project ID: L15302
Date Received: 10/30/2013 10:04
Received By: mtb
Date Printed: 10/30/2013

Receipt Verification

	YES	NO	NA
1) Is a foreign soil permit included for applicable samples?			X
2) Is the Chain of Custody or other directive shipping papers present?	X		▨
3) Does this project require special handling procedures such as CLP protocol?			X
4) Are any samples NRC licensable material?			X
5) If samples are received past hold time, proceed with requested short hold time analyses?	X		
6) Is the Chain of Custody complete and accurate?	X		▨
7) Were any changes made to the Chain of Custody prior to ACZ receiving the samples?	X		▨

```
A change was made in the ID Lines 4-6 section prior to ACZ
custody.
```

Samples/Containers

	YES	NO	NA
8) Are all containers intact and with no leaks?	X		▨
9) Are all labels on containers and are they intact and legible?	X		▨
10) Do the sample labels and Chain of Custody match for Sample ID, Date, and Time?	X		▨
11) For preserved bottle types, was the pH checked and within limits?			X
12) Is there sufficient sample volume to perform all requested work?	X		▨
13) Is the custody seal intact on all containers?			X
14) Are samples that require zero headspace acceptable?			X
15) Are all sample containers appropriate for analytical requirements?	X		▨
16) Is there an Hg-1631 trip blank present?			X
17) Is there a VOA trip blank present?			X
18) Were all samples received within hold time?	X		▨

Chain of Custody Related Remarks

Client Contact Remarks

Shipping Containers

```
Cooler Id      Temp (°C)      Rad (µR/Hr)      Custody Seal Intact?
---------      ---------      -----------      --------------------
4057           10.8           13               Yes
NA18647        10.6           15               N/A
```

Was ice present in the shipment container(s)?

```
No - Wet or gel ice was not present in the shipment container(s).
```

Client must contact an ACZ Project Manager if analysis should not proceed for samples received outside of their thermal preservation acceptance criteria.

ACZ Laboratories, Inc. L15302

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

Copy of Report to:

Name: Matthew Barkley
Company: ARCADIS

E-mail: Matthew.Barkley@arcadis-us.com
Telephone: 303-231-9115 ext 157

Invoice to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐
If yes, please include state forms. Results will be reported to PQL. NO ☒

PROJECT INFORMATION

Quote #:
Project/PO #:
Reporting state for compliance testing:
Sampler's Name: Patrick Quinn
Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED *(attach list or use quote number)*

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	soil sieved to < 2mm	pH	Total CU	ABA					
STS-PH-2013-ERA04	10/24/13 1630	SO	1	X	X	X	X					
STS-PH-2013-ERA10	10/25/13 1230	SO	1	X	X	X	X					
STS-PH-2013-ERA13	10/22/13 1400	SO	1	X	X	X	X					
[redacted] DupPH1	———	SO	1	X	X	X	X					
[redacted] DupPH2	———	SO	1	X	X	X	X					
[redacted]		[redacted]				[redacted]						
Rinsate PH		SW	1			X						

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

Please send to Sheri Fling at URS for validation. Sieve all soil samples to <2 mm prior to analysis. Soil should be reported on a dry weight basis.
Methods:
pH - 9045C, Total Copper - 6010B
Please include sulfur forms for ABA

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
Matth Bark	10/25/13 1940		
		10-30-13 10:02	

L15302 Chain of Custody

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Analytical Report

December 01, 2014

Report to:
Pam Pinson
Freeport-McMoRan - Chino Mines Company
PO Box 10
Bayard, NM 88023

cc: Matthew Barkley

Bill to:
Pam Pinson
Freeport-McMoRan - Chino Mines Company
P.O. Box 13308
Phoenix, AZ 85002-3308

Project ID: ZN0000036K
ACZ Project ID: L21500

Pam Pinson:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on November 11, 2014. This project has been assigned to ACZ's project number, L21500. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan. The enclosed results relate only to the samples received under L21500. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all requirements of NELAC.

This report shall be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after December 31, 2014. If the samples are determined to be hazardous, additional charges apply for disposal (typically $11/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical raw data reports for ten years.

If you have any questions or other needs, please contact your Project Manager.

S. Habermehl

Scott Habermehl has reviewed
and approved this report.

ACCREDITED IN ACCORDANCE WITH nelac

ACIL

Freeport-McMoRan - Chino Mines Company

Project ID: ZN0000036K
Sample ID: STS-PH-2014-FID37

ACZ Sample ID: ***L21500-01***
Date Sampled: *11/05/14 15:15*
Date Received: *11/11/14*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	708		*	mg/Kg	1	5	11/21/14 14:20	aeb

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		0.9	B		t CaCO3/Kt	0.31	3.1	12/01/14 8:14	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		2.0			t CaCO3/Kt	1	5	12/01/14 8:14	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		1.1			t CaCO3/Kt			12/01/14 8:14	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	0.2	B	*	%	0.1	0.5	11/20/14 22:28	spl
pH, Corrosivity	M9045D/M9040C									
pH		1	4.7			units	0.1	0.1	11/21/14 0:00	pta
pH measured at		1	20.4			C	0.1	0.1	11/21/14 0:00	pta
Solids, Percent	D2216-80	1	90.9		*	%	0.1	0.5	11/19/14 15:03	mns
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.02	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur HNO3 Residue		1		U	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Organic Residual		1		U	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Pyritic Sulfide		1	0.02	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Sulfate		1	0.01	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Total		1	0.03	B	*	%	0.01	0.1	11/24/14 0:00	cra
Total Sulfur minus Sulfate		1	0.02	B	*	%	0.01	0.1	11/24/14 0:00	cra

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				11/18/14 11:30	pta
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3				*				11/19/14 11:00	mns
Digestion - Hot Plate	M3050B ICP								11/19/14 12:33	pta
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2				*				11/18/14 11:30	pta

Arizona license number: AZ0102

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company
Project ID: ZN0000036K
Sample ID: STS-PH-2014-ERA3

ACZ Sample ID: ***L21500-02***
Date Sampled: *11/04/14 11:00*
Date Received: *11/11/14*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	102	652		*	mg/Kg	1	5	11/21/14 14:30	aeb

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		7.8			t CaCO3/Kt	0.31	3.1	12/01/14 8:14	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		5.0			t CaCO3/Kt	1	5	12/01/14 8:14	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		-2.8			t CaCO3/Kt			12/01/14 8:14	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	0.5		*	%	0.1	0.5	11/21/14 1:52	spl
pH, Corrosivity	M9045D/M9040C									
pH		1	5.9			units	0.1	0.1	11/21/14 0:00	pta
pH measured at		1	20.1			C	0.1	0.1	11/21/14 0:00	pta
Solids, Percent	D2216-80	1	90.1		*	%	0.1	0.5	11/19/14 17:09	mns
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.16		*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur HNO3 Residue		1	0.07	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Organic Residual		1	0.07	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Pyritic Sulfide		1	0.09	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Sulfate		1	0.09	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Total		1	0.25		*	%	0.01	0.1	11/24/14 0:00	cra
Total Sulfur minus Sulfate		1	0.16		*	%	0.01	0.1	11/24/14 0:00	cra

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				11/18/14 11:43	pta
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3				*				11/19/14 11:13	mns
Digestion - Hot Plate	M3050B ICP								11/19/14 15:37	pta
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2				*				11/18/14 11:43	pta

Arizona license number: AZ0102

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN0000036K	ACZ Sample ID:	***L21500-03***
Sample ID:	STS-PH-2014-FID101	Date Sampled:	*11/06/14 08:43*
		Date Received:	*11/11/14*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	100	285		*	mg/Kg	1	5	11/21/14 14:33	aeb

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		5.6			t CaCO3/Kt	0.31	3.1	12/01/14 8:14	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		0.0			t CaCO3/Kt	1	5	12/01/14 8:14	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		-5.6			t CaCO3/Kt			12/01/14 8:14	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1		U	*	%	0.1	0.5	11/21/14 5:17	spl
pH, Corrosivity	M9045D/M9040C									
pH		1	3.9			units	0.1	0.1	11/21/14 0:00	pta
pH measured at		1	20.2			C	0.1	0.1	11/21/14 0:00	pta
Solids, Percent	D2216-80	1	91.7		*	%	0.1	0.5	11/19/14 18:12	mns
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.10		*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur HNO3 Residue		1	0.03	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Organic Residual		1	0.03	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Pyritic Sulfide		1	0.07	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Sulfate		1	0.08	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Total		1	0.18		*	%	0.01	0.1	11/24/14 0:00	cra
Total Sulfur minus Sulfate		1	0.10		*	%	0.01	0.1	11/24/14 0:00	cra

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				11/18/14 11:56	pta
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3				*				11/19/14 11:27	mns
Digestion - Hot Plate	M3050B ICP								11/19/14 16:39	pta
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2				*				11/18/14 11:56	pta

Arizona license number: AZ0102

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN0000036K	ACZ Sample ID:	***L21500-04***
Sample ID:	STS-PH-2014-FID102	Date Sampled:	*11/06/14 11:00*
		Date Received:	*11/11/14*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	282		*	mg/Kg	1	5	11/21/14 14:36	aeb

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		16.9			t CaCO3/Kt	0.31	3.1	12/01/14 8:14	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		0.0			t CaCO3/Kt	1	5	12/01/14 8:14	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		-16.9			t CaCO3/Kt			12/01/14 8:14	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1		U	*	%	0.1	0.5	11/21/14 6:59	spl
pH, Corrosivity	M9045D/M9040C									
pH		1	3.5			units	0.1	0.1	11/21/14 0:00	pta
pH measured at		1	19.8			C	0.1	0.1	11/21/14 0:00	pta
Solids, Percent	D2216-80	1	92.4		*	%	0.1	0.5	11/19/14 19:15	mns
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.21		*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur HNO3 Residue		1	0.03	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Organic Residual		1	0.03	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Pyritic Sulfide		1	0.18		*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Sulfate		1	0.33		*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Total		1	0.54		*	%	0.01	0.1	11/24/14 0:00	cra
Total Sulfur minus Sulfate		1	0.21		*	%	0.01	0.1	11/24/14 0:00	cra

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				11/18/14 12:10	pta
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3				*				11/19/14 11:41	mns
Digestion - Hot Plate	M3050B ICP								11/19/14 17:40	pta
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2				*				11/18/14 12:10	pta

Arizona license number: AZ0102

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company
Project ID: ZN0000036K
Sample ID: STS-PH-2014-ERA4

ACZ Sample ID: ***L21500-05***
Date Sampled: *11/05/14 14:30*
Date Received: *11/11/14*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	562		*	mg/Kg	1	5	11/21/14 14:40	aeb

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		2.2	B		t CaCO3/Kt	0.31	3.1	12/01/14 8:15	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		4.0			t CaCO3/Kt	1	5	12/01/14 8:15	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		1.8			t CaCO3/Kt			12/01/14 8:15	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	0.4	B	*	%	0.1	0.5	11/21/14 8:41	spl
pH, Corrosivity	M9045D/M9040C									
pH		1	5.4			units	0.1	0.1	11/21/14 0:00	pta
pH measured at		1	19.6			C	0.1	0.1	11/21/14 0:00	pta
Solids, Percent	D2216-80	1	94.3		*	%	0.1	0.5	11/19/14 20:18	mns
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.04	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur HNO3 Residue		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Organic Residual		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Pyritic Sulfide		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Sulfate		1	0.03	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Total		1	0.07	B	*	%	0.01	0.1	11/25/14 0:00	cra
Total Sulfur minus Sulfate		1	0.04	B	*	%	0.01	0.1	11/25/14 0:00	cra

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				11/18/14 12:23	pta
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3				*				11/19/14 11:55	mns
Digestion - Hot Plate	M3050B ICP								11/19/14 18:41	pta
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2				*				11/18/14 12:23	pta

Arizona license number: AZ0102

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN0000036K	ACZ Sample ID:	***L21500-06***
Sample ID:	STS-PH-2014-ERA10	Date Sampled:	*11/05/14 12:35*
		Date Received:	*11/11/14*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	102	310		*	mg/Kg	1	5	11/21/14 14:49	aeb

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		0.9	B		t CaCO3/Kt	0.31	3.1	12/01/14 8:15	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		0.0			t CaCO3/Kt	1	5	12/01/14 8:15	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		-0.9			t CaCO3/Kt			12/01/14 8:15	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1		U	*	%	0.1	0.5	11/21/14 10:23	spl
pH, Corrosivity	M9045D/M9040C									
pH		1	5.3			units	0.1	0.1	11/21/14 0:00	pta
pH measured at		1	19.6			C	0.1	0.1	11/21/14 0:00	pta
Solids, Percent	D2216-80	1	87.7		*	%	0.1	0.5	11/19/14 21:21	mns
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur HNO3 Residue		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Organic Residual		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Pyritic Sulfide		1		U	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Sulfate		1	0.01	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Total		1	0.03	B	*	%	0.01	0.1	11/25/14 0:00	cra
Total Sulfur minus Sulfate		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				11/18/14 12:36	pta
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3				*				11/19/14 12:09	mns
Digestion - Hot Plate	M3050B ICP								11/19/14 19:43	pta
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2				*				11/18/14 12:36	pta

Arizona license number: AZ0102

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN0000036K	ACZ Sample ID:	***L21500-07***
Sample ID:	STS-PH-2014-FID105	Date Sampled:	*11/04/14 11:34*
		Date Received:	*11/11/14*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	102	834		*	mg/Kg	1	5	11/21/14 14:52	aeb

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		4.7			t CaCO3/Kt	0.31	3.1	12/01/14 8:15	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		0.0			t CaCO3/Kt	1	5	12/01/14 8:15	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		-4.7			t CaCO3/Kt			12/01/14 8:15	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1		U	*	%	0.1	0.5	11/21/14 13:48	spl
pH, Corrosivity	M9045D/M9040C									
pH		1	4.5			units	0.1	0.1	11/21/14 0:00	pta
pH measured at		1	19.5			C	0.1	0.1	11/21/14 0:00	pta
Solids, Percent	D2216-80	1	89.6		*	%	0.1	0.5	11/19/14 22:24	mns
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.10		*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur HNO3 Residue		1	0.05	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Organic Residual		1	0.05	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Pyritic Sulfide		1	0.05	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Sulfate		1	0.05	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Total		1	0.15		*	%	0.01	0.1	11/25/14 0:00	cra
Total Sulfur minus Sulfate		1	0.10		*	%	0.01	0.1	11/25/14 0:00	cra

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				11/18/14 12:50	pta
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3				*				11/19/14 12:23	mns
Digestion - Hot Plate	M3050B ICP								11/19/14 20:44	pta
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2				*				11/18/14 12:50	pta

Arizona license number: AZ0102

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN0000036K
Sample ID:	STS-PH-2014-FID106
ACZ Sample ID:	***L21500-08***
Date Sampled:	*11/05/14 11:30*
Date Received:	*11/11/14*
Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	102	516		*	mg/Kg	1	5	11/21/14 14:55	aeb

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		1.9	B		t CaCO3/Kt	0.31	3.1	12/01/14 8:15	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		0.0			t CaCO3/Kt	1	5	12/01/14 8:15	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		-1.9			t CaCO3/Kt			12/01/14 8:15	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1		U	*	%	0.1	0.5	11/21/14 15:30	spl
pH, Corrosivity	M9045D/M9040C									
pH		1	4.4			units	0.1	0.1	11/21/14 0:00	pta
pH measured at		1	19.7			C	0.1	0.1	11/21/14 0:00	pta
Solids, Percent	D2216-80	1	92.9		*	%	0.1	0.5	11/19/14 23:27	mns
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.04	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur HNO3 Residue		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Organic Residual		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Pyritic Sulfide		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Sulfate		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Total		1	0.06	B	*	%	0.01	0.1	11/25/14 0:00	cra
Total Sulfur minus Sulfate		1	0.04	B	*	%	0.01	0.1	11/25/14 0:00	cra

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				11/18/14 13:03	pta
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3				*				11/19/14 12:37	mns
Digestion - Hot Plate	M3050B ICP								11/19/14 21:45	pta
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2				*				11/18/14 13:03	pta

Arizona license number: AZ0102

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L21500-09***
Project ID:	ZN0000036K	Date Sampled:	*11/04/14 08:55*
Sample ID:	STS-PH-2014-REFPLOT1	Date Received:	*11/11/14*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	882		*	mg/Kg	1	5	11/21/14 14:59	aeb

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		1.3	B		t CaCO3/Kt	0.31	3.1	12/01/14 8:15	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		58.0			t CaCO3/Kt	1	5	12/01/14 8:15	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		56.8			t CaCO3/Kt			12/01/14 8:15	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	5.8		*	%	0.1	0.5	11/20/14 12:15	spl
pH, Corrosivity	M9045D/M9040C									
pH		1	8.0			units	0.1	0.1	11/21/14 0:00	pta
pH measured at		1	19.9			C	0.1	0.1	11/21/14 0:00	pta
Solids, Percent	D2216-80	1	90.8		*	%	0.1	0.5	11/20/14 0:30	mns
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.01	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur HNO3 Residue		1	0.03	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Organic Residual		1	0.03	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Pyritic Sulfide		1		U	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Sulfate		1	0.03	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Total		1	0.04	B	*	%	0.01	0.1	11/25/14 0:00	cra
Total Sulfur minus Sulfate		1	0.01	B	*	%	0.01	0.1	11/25/14 0:00	cra

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				11/18/14 13:16	pta
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3				*				11/19/14 12:51	mns
Digestion - Hot Plate	M3050B ICP								11/19/14 22:46	pta
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2				*				11/18/14 13:16	pta

Arizona license number: AZ0102

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L21500-10***
Project ID:	ZN0000036K	Date Sampled:	*11/04/14 15:45*
Sample ID:	STS-PH-2014-REFPLOT2	Date Received:	*11/11/14*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	760		*	mg/Kg	1	5	11/21/14 15:05	aeb

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		0.6	B		t CaCO3/Kt	0.31	3.1	12/01/14 8:15	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		5.0			t CaCO3/Kt	1	5	12/01/14 8:15	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		4.4			t CaCO3/Kt			12/01/14 8:15	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	0.5		*	%	0.1	0.5	11/21/14 17:12	spl
pH, Corrosivity	M9045D/M9040C									
pH		1	6.2			units	0.1	0.1	11/21/14 0:00	pta
pH measured at		1	20.0			C	0.1	0.1	11/21/14 0:00	pta
Solids, Percent	D2216-80	1	90.7		*	%	0.1	0.5	11/20/14 1:33	mns
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.04	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur HNO3 Residue		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Organic Residual		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Pyritic Sulfide		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Sulfate		1		U	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Total		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra
Total Sulfur minus Sulfate		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				11/18/14 13:30	pta
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3				*				11/19/14 13:05	mns
Digestion - Hot Plate	M3050B ICP								11/19/14 23:48	pta
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2				*				11/18/14 13:30	pta

Arizona license number: AZ0102

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company
Project ID: ZN0000036K
Sample ID: STS-PH-2014-FID7

ACZ Sample ID: ***L21500-11***
Date Sampled: *11/05/14 12:00*
Date Received: *11/11/14*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	491		*	mg/Kg	1	5	11/21/14 15:08	aeb

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		1.3	B		t CaCO3/Kt	0.31	3.1	12/01/14 8:15	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		2.0			t CaCO3/Kt	1	5	12/01/14 8:15	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		0.8			t CaCO3/Kt			12/01/14 8:15	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	0.2	B	*	%	0.1	0.5	11/21/14 18:54	spl
pH, Corrosivity	M9045D/M9040C									
pH		1	5.1			units	0.1	0.1	11/21/14 0:00	pta
pH measured at		1	19.4			C	0.1	0.1	11/21/14 0:00	pta
Solids, Percent	D2216-80	1	92.5		*	%	0.1	0.5	11/20/14 2:36	mns
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.03	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur HNO3 Residue		1		U	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Organic Residual		1		U	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Pyritic Sulfide		1	0.03	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Sulfate		1	0.01	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Total		1	0.04	B	*	%	0.01	0.1	11/25/14 0:00	cra
Total Sulfur minus Sulfate		1	0.03	B	*	%	0.01	0.1	11/25/14 0:00	cra

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				11/18/14 13:43	pta
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3				*				11/19/14 13:19	mns
Digestion - Hot Plate	M3050B ICP								11/20/14 0:49	pta
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2				*				11/18/14 13:43	pta

Arizona license number: AZ0102

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L21500-12***
Project ID:	ZN0000036K	Date Sampled:	*11/06/14 10:00*
Sample ID:	STS-PH-2014-FID8	Date Received:	*11/11/14*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	103	473		*	mg/Kg	1	5	11/21/14 15:11	aeb

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		4.1			t CaCO3/Kt	0.31	3.1	12/01/14 8:15	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		1.0			t CaCO3/Kt	1	5	12/01/14 8:15	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		-3.1			t CaCO3/Kt			12/01/14 8:15	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	0.1	B	*	%	0.1	0.5	11/21/14 20:37	spl
pH, Corrosivity	M9045D/M9040C									
pH		1	4.6			units	0.1	0.1	11/21/14 0:00	pta
pH measured at		1	19.3			C	0.1	0.1	11/21/14 0:00	pta
Solids, Percent	D2216-80	1	87.9		*	%	0.1	0.5	11/20/14 3:39	mns
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.09	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur HNO3 Residue		1	0.01	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Organic Residual		1	0.01	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Pyritic Sulfide		1	0.08	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Sulfate		1	0.04	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Total		1	0.13		*	%	0.01	0.1	11/25/14 0:00	cra
Total Sulfur minus Sulfate		1	0.09	B	*	%	0.01	0.1	11/25/14 0:00	cra

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				11/18/14 13:56	pta
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3				*				11/19/14 13:33	mns
Digestion - Hot Plate	M3050B ICP								11/20/14 1:50	pta
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2				*				11/18/14 13:56	pta

Arizona license number: AZ0102

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN0000036K	ACZ Sample ID:	***L21500-13***
Sample ID:	STS-PH-2014-FID10	Date Sampled:	*11/04/14 15:00*
		Date Received:	*11/11/14*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	2550		*	mg/Kg	1	5	11/21/14 15:15	aeb

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		3.1			t CaCO3/Kt	0.31	3.1	12/01/14 8:15	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		4.0			t CaCO3/Kt	1	5	12/01/14 8:15	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		0.9			t CaCO3/Kt			12/01/14 8:15	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	0.4	B	*	%	0.1	0.5	11/21/14 22:19	spl
pH, Corrosivity	M9045D/M9040C									
pH		1	4.7			units	0.1	0.1	11/21/14 0:00	pta
pH measured at		1	19.4			C	0.1	0.1	11/21/14 0:00	pta
Solids, Percent	D2216-80	1	89.1		*	%	0.1	0.5	11/20/14 4:42	mns
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.07	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur HNO3 Residue		1		U	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Organic Residual		1		U	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Pyritic Sulfide		1	0.07	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Sulfate		1	0.03	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Total		1	0.10		*	%	0.01	0.1	11/24/14 0:00	cra
Total Sulfur minus Sulfate		1	0.07	B	*	%	0.01	0.1	11/24/14 0:00	cra

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				11/18/14 14:10	pta
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3				*				11/19/14 13:47	mns
Digestion - Hot Plate	M3050B ICP								11/20/14 2:52	pta
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2				*				11/18/14 14:10	pta

Arizona license number: AZ0102

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN0000036K		ACZ Sample ID:	***L21500-14***
Sample ID:	STS-PH-2014-FID15		Date Sampled:	*11/04/14 12:38*
			Date Received:	*11/11/14*
			Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	1850		*	mg/Kg	1	5	11/21/14 15:18	aeb

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		3.8			t CaCO3/Kt	0.31	3.1	12/01/14 8:15	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		3.0			t CaCO3/Kt	1	5	12/01/14 8:15	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		-0.7			t CaCO3/Kt			12/01/14 8:15	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	0.3	B	*	%	0.1	0.5	11/22/14 0:01	spl
pH, Corrosivity	M9045D/M9040C									
pH		1	5.6			units	0.1	0.1	11/21/14 0:00	pta
pH measured at		1	19.6			C	0.1	0.1	11/21/14 0:00	pta
Solids, Percent	D2216-80	1	90.1		*	%	0.1	0.5	11/20/14 5:45	mns
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.09	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur HNO3 Residue		1	0.01	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Organic Residual		1	0.01	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Pyritic Sulfide		1	0.08	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Sulfate		1	0.03	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Total		1	0.12		*	%	0.01	0.1	11/24/14 0:00	cra
Total Sulfur minus Sulfate		1	0.09	B	*	%	0.01	0.1	11/24/14 0:00	cra

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				11/18/14 14:23	pta
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3				*				11/19/14 14:00	mns
Digestion - Hot Plate	M3050B ICP								11/20/14 3:53	pta
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2				*				11/18/14 14:23	pta

Arizona license number: AZ0102

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L21500-15***
Project ID:	ZN0000036K	Date Sampled:	*11/04/14 13:06*
Sample ID:	STS-PH-2014-FID16	Date Received:	*11/11/14*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	1440		*	mg/Kg	1	5	11/21/14 15:27	aeb

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		3.1			t CaCO3/Kt	0.31	3.1	12/01/14 8:16	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		0.0			t CaCO3/Kt	1	5	12/01/14 8:16	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		-3.1			t CaCO3/Kt			12/01/14 8:16	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1		U	*	%	0.1	0.5	11/22/14 1:43	spl
pH, Corrosivity	M9045D/M9040C									
pH		1	4.8			units	0.1	0.1	11/21/14 0:00	pta
pH measured at		1	19.8			C	0.1	0.1	11/21/14 0:00	pta
Solids, Percent	D2216-80	1	88.1		*	%	0.1	0.5	11/20/14 6:48	mns
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.07	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur HNO3 Residue		1	0.02	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Organic Residual		1	0.02	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Pyritic Sulfide		1	0.05	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Sulfate		1	0.03	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Total		1	0.10		*	%	0.01	0.1	11/24/14 0:00	cra
Total Sulfur minus Sulfate		1	0.07	B	*	%	0.01	0.1	11/24/14 0:00	cra

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				11/18/14 14:36	pta
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3				*				11/19/14 14:14	mns
Digestion - Hot Plate	M3050B ICP								11/20/14 4:54	pta
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2				*				11/18/14 14:36	pta

Arizona license number: AZ0102

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN0000036K	ACZ Sample ID:	***L21500-16***
Sample ID:	STS-PH-2014-FID18	Date Sampled:	*11/06/14 09:00*
		Date Received:	*11/11/14*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	310		*	mg/Kg	1	5	11/21/14 15:30	aeb

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		2.8	B		t CaCO3/Kt	0.31	3.1	12/01/14 8:16	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		2.0			t CaCO3/Kt	1	5	12/01/14 8:16	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		-0.8			t CaCO3/Kt			12/01/14 8:16	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	0.2	B	*	%	0.1	0.5	11/22/14 3:25	spl
pH, Corrosivity	M9045D/M9040C									
pH		1	4.2			units	0.1	0.1	11/21/14 0:00	pta
pH measured at		1	19.7			C	0.1	0.1	11/21/14 0:00	pta
Solids, Percent	D2216-80	1	92.4		*	%	0.1	0.5	11/20/14 7:51	mns
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.07	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur HNO3 Residue		1	0.01	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Organic Residual		1	0.01	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Pyritic Sulfide		1	0.06	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Sulfate		1	0.02	B	*	%	0.01	0.1	11/24/14 0:00	cra
Sulfur Total		1	0.09	B	*	%	0.01	0.1	11/24/14 0:00	cra
Total Sulfur minus Sulfate		1	0.07	B	*	%	0.01	0.1	11/24/14 0:00	cra

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				11/18/14 14:50	pta
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3				*				11/19/14 14:28	mns
Digestion - Hot Plate	M3050B ICP								11/20/14 5:56	pta
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2				*				11/18/14 14:50	pta

Arizona license number: AZ0102

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN0000036K	ACZ Sample ID:	***L21500-17***
Sample ID:	STS-PH-2014-FID22	Date Sampled:	*11/05/14 13:30*
		Date Received:	*11/11/14*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	378		*	mg/Kg	1	5	11/21/14 15:34	aeb

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		4.1			t CaCO3/Kt	0.31	3.1	12/01/14 8:16	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		9.0			t CaCO3/Kt	1	5	12/01/14 8:16	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		4.9			t CaCO3/Kt			12/01/14 8:16	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	0.9		*	%	0.1	0.5	11/22/14 5:08	spl
pH, Corrosivity	M9045D/M9040C									
pH		1	6.9			units	0.1	0.1	11/21/14 0:00	pta
pH measured at		1	19.9			C	0.1	0.1	11/21/14 0:00	pta
Solids, Percent	D2216-80	1	92.3		*	%	0.1	0.5	11/20/14 8:54	mns
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.10		*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur HNO3 Residue		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Organic Residual		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Pyritic Sulfide		1	0.08	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Sulfate		1	0.03	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Total		1	0.13		*	%	0.01	0.1	11/25/14 0:00	cra
Total Sulfur minus Sulfate		1	0.10		*	%	0.01	0.1	11/25/14 0:00	cra

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				11/18/14 15:03	pta
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3				*				11/19/14 14:42	mns
Digestion - Hot Plate	M3050B ICP								11/20/14 6:57	pta
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2				*				11/18/14 15:03	pta

Arizona license number: AZ0102

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company
Project ID: ZN0000036K
Sample ID: STS-PH-2014-ERA2

ACZ Sample ID: ***L21500-18***
Date Sampled: *11/04/14 09:50*
Date Received: *11/11/14*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	1000		*	mg/Kg	1	5	11/21/14 15:37	aeb

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		3.8			t CaCO3/Kt	0.31	3.1	12/01/14 8:16	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		5.0			t CaCO3/Kt	1	5	12/01/14 8:16	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		1.3			t CaCO3/Kt			12/01/14 8:16	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	0.5		*	%	0.1	0.5	11/22/14 8:32	spl
pH, Corrosivity	M9045D/M9040C									
pH		1	6.0			units	0.1	0.1	11/21/14 0:00	pta
pH measured at		1	19.7			C	0.1	0.1	11/21/14 0:00	pta
Solids, Percent	D2216-80	1	90.1		*	%	0.1	0.5	11/20/14 9:57	mns
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.08	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur HNO3 Residue		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Organic Residual		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Pyritic Sulfide		1	0.06	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Sulfate		1	0.04	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Total		1	0.12		*	%	0.01	0.1	11/25/14 0:00	cra
Total Sulfur minus Sulfate		1	0.08	B	*	%	0.01	0.1	11/25/14 0:00	cra

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				11/18/14 15:16	pta
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3				*				11/19/14 14:56	mns
Digestion - Hot Plate	M3050B ICP								11/20/14 7:58	pta
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2				*				11/18/14 15:16	pta

Arizona license number: AZ0102

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L21500-19***
Project ID:	ZN0000036K	Date Sampled:	*11/05/14 09:10*
Sample ID:	STS-PH-2014-FID28	Date Received:	*11/11/14*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	423		*	mg/Kg	1	5	11/21/14 15:40	aeb

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		1.9	B		t CaCO3/Kt	0.31	3.1	12/01/14 8:16	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		41.0			t CaCO3/Kt	1	5	12/01/14 8:16	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		39.1			t CaCO3/Kt			12/01/14 8:16	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	4.1		*	%	0.1	0.5	11/20/14 12:15	spl
pH, Corrosivity	M9045D/M9040C									
pH		1	7.3			units	0.1	0.1	11/21/14 0:00	pta
pH measured at		1	19.8			C	0.1	0.1	11/21/14 0:00	pta
Solids, Percent	D2216-80	1	90.1		*	%	0.1	0.5	11/20/14 11:00	mns
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.06	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur HNO3 Residue		1	0.01	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Organic Residual		1	0.01	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Pyritic Sulfide		1	0.05	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Sulfate		1		U	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Total		1	0.06	B	*	%	0.01	0.1	11/25/14 0:00	cra
Total Sulfur minus Sulfate		1	0.06	B	*	%	0.01	0.1	11/25/14 0:00	cra

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972				*				11/18/14 15:30	pta
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3				*				11/19/14 15:10	mns
Digestion - Hot Plate	M3050B ICP								11/20/14 8:59	pta
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2				*				11/18/14 15:30	pta

Arizona license number: AZ0102

Inorganic Reference

Report Header Explanations

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit, typically 5 times the MDL.
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Recovered amount of the true value or spike added, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of interest

QC Sample Types

AS	Analytical Spike (Post Digestion)	*LCSWD*	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	*LFB*	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	*LFM*	Laboratory Fortified Matrix
CCV	Continuing Calibration Verification standard	*LFMD*	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	*LRB*	Laboratory Reagent Blank
ICB	Initial Calibration Blank	*MS*	Matrix Spike
ICV	Initial Calibration Verification standard	*MSD*	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	*PBS*	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	*PBW*	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	*PQV*	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	*SDL*	Serial Dilution

QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

ACZ Qualifiers (Qual)

B	Analyte concentration detected at a value between MDL and PQL. The associated value is an estimated quantity.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
L	Target analyte response was below the laboratory defined negative threshold.
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Method References

(1) EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
(2) EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.
(3) EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.
(4) EPA SW-846. Test Methods for Evaluating Solid Waste.
(5) Standard Methods for the Examination of Water and Wastewater.

Comments

(1) QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
(2) Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.
(3) Animal matrices for Inorganic analyses are reported on an "as received" basis.
(4) An asterisk in the "XQ" column indicates there is an extended qualifier and/or certification qualifier associated with the result.
(5) If the MDL equals the PQL or the MDL column is omitted, the PQL is the reporting limit.

For a complete list of ACZ's Extended Qualifiers, please click: http://www.acz.com/public/extquallist.pdf

Freeport-McMoRan - Chino Mines Company

ACZ Project ID: ***L21500***

Copper, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG375105													
WG375105ICV	ICV	11/21/14 13:55	II141028-4	2		1.977	mg/L	99	90	110			
WG375105ICB	ICB	11/21/14 13:58				U	mg/L		-0.03	0.03			
WG374918PBS	PBS	11/21/14 14:11				U	mg/Kg		-3	3			
WG374918LCSS	LCSS	11/21/14 14:14	PCN46662	268		237.5	mg/Kg		219	317			
WG374918LCSSD	LCSSD	11/21/14 14:17	PCN46662	268		252.6	mg/Kg		219	317	6	20	
L21500-01MS	MS	11/21/14 14:24	II141030-2	50.4495	708	781.7	mg/Kg	146	75	125			M3
L21500-01MSD	MSD	11/21/14 14:27	II141030-2	50.4495	708	729.7	mg/Kg	43	75	125	7	20	M3

Neutralization Potential as CaCO3 M600/2-78-054 3.2.3 - Modified (No Heat)

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG375042													
L21500-09DUP	DUP	11/20/14 12:15			5.8	5.75	%				1	20	
WG375042PBS	PBS	11/20/14 12:15				U	%		-0.2	0.2			
L21500-19MS	MS	11/20/14 12:15	SI141024-2	3	4.1	7.13	%	101	70	130			
WG375042LCSS	LCSS	11/20/14 12:15	PCN45869	5.23		5.13	%	98	80	120			
WG375050													
WG375050PBS	PBS	11/20/14 19:03				U	%		-0.2	0.2			M1
WG375050LCSS	LCSS	11/20/14 20:46	PCN45868	4.66		4.7	%	101	80	120			M1
L21500-01DUP	DUP	11/21/14 0:10			.2	.23	%				14	20	M1 RA
L21500-02MS	MS	11/21/14 3:34	SI141024-1	1	.5	3.23	%	273	70	130			M1

Ph M9045D/M9040C

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG375075													
WG375075ICV	ICV	11/21/14 10:58	PCN45365	4		4	units	100	3.9	4.1			
L21500-01DUP	DUP	11/21/14 11:18			4.7	4.7	units				0	20	

Solids, Percent D2216-80

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG374886													
WG374886PBS	PBS	11/19/14 14:00				U	%		-0.1	0.1			
L21500-01DUP	DUP	11/19/14 16:06			90.9	90.86	%				0	20	

Sulfur Organic Residual M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG375163													
L21500-01DUP	DUP	11/24/14 16:36			U	U	%				0	20	RA
WG375164													
L21500-13DUP	DUP	11/24/14 16:48			U	.01	%				200	20	RA

Sulfur Pyritic Sulfide M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG375163													
L21500-01DUP	DUP	11/24/14 16:36			.02	.02	%				0	20	RA
WG375164													
L21500-13DUP	DUP	11/24/14 16:48			.07	.06	%				15	20	RA

Sulfur Sulfate M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG375163													
L21500-01DUP	DUP	11/24/14 16:36			.01	.01	%				0	20	RA
WG375164													
L21500-13DUP	DUP	11/24/14 16:48			.03	.03	%				0	20	RA

Sulfur Total M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG375163													
WG375163PBS	PBS	11/24/14 8:00				U	%		-0.03	0.03			
WG375163LCSS	LCSS	11/24/14 10:09	PCN45915	4.07		3.91	%	96	80	120			
L21500-01MS	MS	11/24/14 14:27	PCN45351	1.1	.03	1.05	%	93	80	120			
L21500-01DUP	DUP	11/24/14 16:36			.03	.03	%				0	20	RA
WG375164													
WG375164PBS	PBS	11/24/14 8:00				U	%		-0.03	0.03			
WG375164LCSS	LCSS	11/24/14 10:12	PCN45915	4.07		4.16	%	102	80	120			
L21500-13MS	MS	11/24/14 14:36	PCN45351	1.1	.1	1.16	%	96	80	120			
L21500-13DUP	DUP	11/24/14 16:48			.1	.1	%				0	20	

Total Sulfur Minus Sulfate M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG375163													
L21500-01DUP	DUP	11/24/14 16:36			.02	.02	%				0	20	RA
WG375164													
L21500-13DUP	DUP	11/24/14 16:48			.07	.07	%				0	20	RA

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L21500-01	WG375105	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG375050	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG375163	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L21500-02	WG375105	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG375050	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG375163	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L21500-03	WG375105	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG375050	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG375163	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L21500-04	WG375105	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG375050	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG375163	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L21500-05	WG375105	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG375050	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG375163	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L21500-06	WG375105	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG375050	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG375163	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L21500-07	WG375105	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG375050	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG375163	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L21500-08	WG375105	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG375050	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG375163	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L21500-09	WG375105	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG375163	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L21500-10	WG375105	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG375050	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG375163	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L21500-11	WG375105	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG375050	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG375163	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L21500-12	WG375105	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG375050	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG375163	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Total	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L21500-13	WG375105	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG375050	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG375164	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L21500-14	WG375105	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG375050	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG375164	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L21500-15	WG375105	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG375050	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG375164	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L21500-16	WG375105	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG375050	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG375164	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L21500-17	WG375105	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG375050	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG375164	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L21500-18	WG375105	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG375050	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG375164	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

Inorganic Extended Qualifier Report

Freeport-McMoRan - Chino Mines Company

ACZ Project ID: ***L21500***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L21500-19	WG375105	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG375164	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

Soil Analysis

The following parameters are not offered for certification or are not covered by AZ certificate #AZ0102.

Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)
Solids, Percent	D2216-80
Sulfur HCl Residue	M600/2-78-054 3.2.4-MOD
Sulfur HNO3 Residue	M600/2-78-054 3.2.4-MOD
Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD
Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD
Sulfur Sulfate	M600/2-78-054 3.2.4-MOD
Sulfur Total	M600/2-78-054 3.2.4-MOD
Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)
Solids, Percent	D2216-80
Sulfur HCl Residue	M600/2-78-054 3.2.4-MOD
Sulfur HNO3 Residue	M600/2-78-054 3.2.4-MOD
Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD
Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD
Sulfur Sulfate	M600/2-78-054 3.2.4-MOD
Sulfur Total	M600/2-78-054 3.2.4-MOD
Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Sample Receipt

Freeport-McMoRan - Chino Mines Company
ZN0000036K

ACZ Project ID: L21500
Date Received: 11/11/2014 09:58
Received By: ddp
Date Printed: 11/11/2014

Receipt Verification

	YES	NO	NA
1) Is a foreign soil permit included for applicable samples?			X
2) Is the Chain of Custody or other directive shipping papers present?	X		▨
3) Does this project require special handling procedures such as CLP protocol?			X
4) Are any samples NRC licensable material?			X
5) If samples are received past hold time, proceed with requested short hold time analyses?	X		
6) Is the Chain of Custody complete and accurate?	X		▨
7) Were any changes made to the Chain of Custody prior to ACZ receiving the samples?		X	▨

Samples/Containers

	YES	NO	NA
8) Are all containers intact and with no leaks?	X		▨
9) Are all labels on containers and are they intact and legible?	X		▨
10) Do the sample labels and Chain of Custody match for Sample ID, Date, and Time?	X		▨
11) For preserved bottle types, was the pH checked and within limits?			X
12) Is there sufficient sample volume to perform all requested work?	X		▨
13) Is the custody seal intact on all containers?			X
14) Are samples that require zero headspace acceptable?			X
15) Are all sample containers appropriate for analytical requirements?	X		▨
16) Is there an Hg-1631 trip blank present?			X
17) Is there a VOA trip blank present?			X
18) Were all samples received within hold time?	X		▨

Chain of Custody Related Remarks

Client Contact Remarks

Shipping Containers

```
Cooler Id      Temp (°C)      Rad (µR/Hr)      Custody Seal Intact?
---------      ---------      -----------      --------------------
NA20759        4.8            17               Yes
```

Was ice present in the shipment container(s)?

```
No - Wet or gel ice was not present in the shipment container(s).
```

Client must contact an ACZ Project Manager if analysis should not proceed for samples received outside of their thermal preservation acceptance criteria.

ACZ Laboratories, Inc. L21500
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

Copy of Report to:

Name: Matthew Barkley
Company: ARCADIS

E-mail: Matthew.Barkley@arcadis-us.com
Telephone: 303-231-9115 ext 157

Invoice to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐ NO ☒
If yes, please include state forms. Results will be reported to PQL.

PROJECT INFORMATION — **ANALYSES REQUESTED** *(attach list or use quote number)*

Quote #:
Project/PO #:
Reporting state for compliance testing:
Sampler's Name: Garett Ferguson
Are any samples NRC licensable material? Yes No

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	soil sieved to < 2mm	pH	Total CU	ABA				
STS-PH-2014-FID37	11/5/14 1515	SO	1	x	x	x	x				
STS-PH-2014-ERA3	11/4/14 1100	SO	1	x	x	x	x				
STS-PH-2014-FID101	11/6/14 0843	SO	1	x	x	x	x				
STS-PH-2014-FID102	11/6/14 1100	SO	1	x	x	x	x				
STS-PH-2014-ERA4	11/5/14 1430	SO	1	x	x	x	x				
STS-PH-2014-ERA10	11/5/14 1235	SO	1	x	x	x	x				
STS-PH-2014-FID105	11/4/14 1534	SO	1	x	x	x	x				
STS-PH-2014-FID106	11/5/14 1130	SO	1	x	x	x	x				
STS-PH-2014-REFPLOT1	11/4/14 0855	SO	1	x	x	x	x				
STS-PH-2014-REFPLOT2	11/4/14 1545	SO	1	x	x	x	x				

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

Please send to Sheri Fling at URS for validation. Sieve all soil samples to <2 mm prior to analysis. Soil should be reported on a dry weight basis.
Methods:
pH - 9045C, Total Copper - 6010B

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
Matt	11/6/14 1700		11.11.14 9:50

1/2

L21500 Chain of Custody

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

ACZ Laboratories, Inc. L21500

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

Copy of Report to:

Name: Matthew Barkley
Company: ARCADIS

E-mail: Matthew.Barkley@arcadis-us.com
Telephone: 303-231-9115 ext 157

Invoice to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐
If yes, please include state forms. Results will be reported to PQL. NO ☒

PROJECT INFORMATION | **ANALYSES REQUESTED** *(attach list or use quote number)*

Quote #:
Project/PO #:
Reporting state for compliance testing:
Sampler's Name: Garett Ferguson
Are any samples NRC licensable material? Yes No

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	soil sieved to < 2mm	pH	Total CU	ABA					
STS-PH-2014-FID7	11/5/14 1200	SO	1	x	x	x	x					
STS-PH-2014-FID8	11/6/14 1000	SO	1	x	x	x	x					
STS-PH-2014-FID10	11/9/14 1500	SO	1	x	x	x	x					
STS-PH-2014-FID15	11/4/14 1238	SO	1	x	x	x	x					
STS-PH-2014-FID16	11/4/14 1306	SO	1	x	x	x	x					
~~STS-PH-2014-FID17~~			~~1~~	~~x~~	~~x~~	~~x~~	~~x~~					
STS-PH-2014-FID18	11/6/14 0900	SO	1	x	x	x	x					
STS-PH-2014-FID22	11/5/14 1330	SO	1	x	x	x	x					
STS-PH-2014-ERA2	11/4/14 0950	SO	1	x	x	x	x					
STS-PH-2014-FID28	11/5/14 0910	SO	1	x	x	x	x					

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

Please send to Sheri Fling at URS for validation. Sieve all soil samples to <2 mm prior to analysis. Soil should be reported on a dry weight basis.
Methods:
pH - 9045C, Total Copper - 6010B

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
	11/6/14 1700		11.11.14 9:50

2/2

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Analytical Report

December 01, 2014

Report to:
Pam Pinson
Freeport-McMoRan - Chino Mines Company
PO Box 10
Bayard, NM 88023

cc: Matthew Barkley

Bill to:
Pam Pinson
Freeport-McMoRan - Chino Mines Company
P.O. Box 13308
Phoenix, AZ 85002-3308

Project ID: ZN0000036K
ACZ Project ID: L21501

Pam Pinson:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on November 11, 2014. This project has been assigned to ACZ's project number, L21501. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan. The enclosed results relate only to the samples received under L21501. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all requirements of NELAC.

This report shall be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after December 31, 2014. If the samples are determined to be hazardous, additional charges apply for disposal (typically $11/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical raw data reports for ten years.

If you have any questions or other needs, please contact your Project Manager.

S. Habermehl

Scott Habermehl has reviewed
and approved this report.

Freeport-McMoRan - Chino Mines Company
Project ID: ZN0000036K
Sample ID: STS-PH-2014-REFPLOT3

ACZ Sample ID: ***L21501-01***
Date Sampled: *11/04/14 14:05*
Date Received: *11/11/14*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	102	1540		*	mg/Kg	1	5	11/22/14 2:40	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		1.9	B		t CaCO3/Kt	0.31	3.1	12/01/14 8:25	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		0.0			t CaCO3/Kt	1	5	12/01/14 8:25	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		-1.9			t CaCO3/Kt			12/01/14 8:25	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1		U	*	%	0.1	0.5	11/20/14 12:15	spl
pH, Corrosivity	M9045D/M9040C									
pH		1	5.4			units	0.1	0.1	11/21/14 0:00	pta
pH measured at		1	20.0			C	0.1	0.1	11/21/14 0:00	pta
Solids, Percent	D2216-80	1	87.8		*	%	0.1	0.5	11/18/14 19:40	pta
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.05	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur HNO3 Residue		1		U	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Organic Residual		1		U	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Pyritic Sulfide		1	0.05	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Sulfate		1	0.01	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Total		1	0.06	B	*	%	0.01	0.1	11/25/14 0:00	cra
Total Sulfur minus Sulfate		1	0.05	B	*	%	0.01	0.1	11/25/14 0:00	cra

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								11/18/14 15:00	pta
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3								11/19/14 15:24	mns
Digestion - Hot Plate	M3050B ICP								11/19/14 22:41	pta
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/18/14 15:00	pta

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company
Project ID: ZN0000036K
Sample ID: STS-PH-2014-REFPLOT4

ACZ Sample ID: ***L21501-02***
Date Sampled: *11/04/14 10:25*
Date Received: *11/11/14*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	1020		*	mg/Kg	1	5	11/22/14 2:46	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		3.4			t CaCO3/Kt	0.31	3.1	12/01/14 8:25	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		4.0			t CaCO3/Kt	1	5	12/01/14 8:25	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		0.6			t CaCO3/Kt			12/01/14 8:25	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	0.4	B	*	%	0.1	0.5	11/20/14 12:15	spl
pH, Corrosivity	M9045D/M9040C									
pH		1	4.9			units	0.1	0.1	11/21/14 0:00	pta
pH measured at		1	19.9			C	0.1	0.1	11/21/14 0:00	pta
Solids, Percent	D2216-80	1	88.9		*	%	0.1	0.5	11/18/14 22:50	pta
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.10		*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur HNO3 Residue		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Organic Residual		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Pyritic Sulfide		1	0.08	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Sulfate		1	0.01	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Total		1	0.11		*	%	0.01	0.1	11/25/14 0:00	cra
Total Sulfur minus Sulfate		1	0.10		*	%	0.01	0.1	11/25/14 0:00	cra

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								11/18/14 15:07	pta
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3								11/19/14 15:38	mns
Digestion - Hot Plate	M3050B ICP								11/20/14 0:34	pta
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/18/14 15:07	pta

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company
Project ID: ZN0000036K
Sample ID: STS-PH-2014-ERA13

ACZ Sample ID: ***L21501-03***
Date Sampled: *11/05/14 10:00*
Date Received: *11/11/14*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	282		*	mg/Kg	1	5	11/22/14 2:56	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		0.6	B		t CaCO3/Kt	0.31	3.1	12/01/14 8:25	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		0.0			t CaCO3/Kt	1	5	12/01/14 8:25	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		-0.6			t CaCO3/Kt			12/01/14 8:25	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1		U	*	%	0.1	0.5	11/20/14 12:15	spl
pH, Corrosivity	M9045D/M9040C									
pH		1	5.5			units	0.1	0.1	11/21/14 0:00	pta
pH measured at		1	20.2			C	0.1	0.1	11/21/14 0:00	pta
Solids, Percent	D2216-80	1	92.2		*	%	0.1	0.5	11/19/14 5:10	pta
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur HNO3 Residue		1		U	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Organic Residual		1		U	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Pyritic Sulfide		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Sulfate		1		U	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Total		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra
Total Sulfur minus Sulfate		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								11/18/14 15:15	pta
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3								11/19/14 15:52	mns
Digestion - Hot Plate	M3050B ICP								11/20/14 6:13	pta
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/18/14 15:15	pta

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN0000036K	ACZ Sample ID:	***L21501-04***
Sample ID:	DUP1	Date Sampled:	*11/04/14 00:00*
		Date Received:	*11/11/14*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	685		*	mg/Kg	1	5	11/22/14 2:59	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		0.6	B		t CaCO3/Kt	0.31	3.1	12/01/14 8:25	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		0.0			t CaCO3/Kt	1	5	12/01/14 8:25	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		-0.6			t CaCO3/Kt			12/01/14 8:25	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1		U	*	%	0.1	0.5	11/20/14 12:15	spl
pH, Corrosivity	M9045D/M9040C									
pH		1	4.9			units	0.1	0.1	11/21/14 0:00	pta
pH measured at		1	19.9			C	0.1	0.1	11/21/14 0:00	pta
Solids, Percent	D2216-80	1	90.9		*	%	0.1	0.5	11/19/14 8:20	pta
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur HNO3 Residue		1		U	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Organic Residual		1		U	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Pyritic Sulfide		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Sulfate		1		U	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Total		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra
Total Sulfur minus Sulfate		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								11/18/14 15:22	pta
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3								11/19/14 16:06	mns
Digestion - Hot Plate	M3050B ICP								11/20/14 8:07	pta
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/18/14 15:22	pta

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company
Project ID: ZN0000036K
Sample ID: DUP2

ACZ Sample ID: ***L21501-05***
Date Sampled: *11/04/14 00:00*
Date Received: *11/11/14*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total (3050)	M6010B ICP	101	291		*	mg/Kg	1	5	11/22/14 3:08	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 3.2.4		6.6			t CaCO3/Kt	0.31	3.1	12/01/14 8:26	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3		2.0			t CaCO3/Kt	1	5	12/01/14 8:26	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3		-4.6			t CaCO3/Kt			12/01/14 8:26	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	1	0.2	B	*	%	0.1	0.5	11/20/14 12:15	spl
pH, Corrosivity	M9045D/M9040C									
pH		1	3.9			units	0.1	0.1	11/21/14 0:00	pta
pH measured at		1	19.9			C	0.1	0.1	11/21/14 0:00	pta
Solids, Percent	D2216-80	1	91.8		*	%	0.1	0.5	11/19/14 11:30	pta
Sulfur Forms	M600/2-78-054 3.2.4-MOD									
Sulfur HCl Residue		1	0.12		*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur HNO3 Residue		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Organic Residual		1	0.02	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Pyritic Sulfide		1	0.10		*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Sulfate		1	0.09	B	*	%	0.01	0.1	11/25/14 0:00	cra
Sulfur Total		1	0.21		*	%	0.01	0.1	11/25/14 0:00	cra
Total Sulfur minus Sulfate		1	0.12		*	%	0.01	0.1	11/25/14 0:00	cra

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								11/18/14 15:30	pta
Crush and Pulverize (Ring & Puck)	EPA-600/2-78-054 3.1.3								11/19/14 16:20	mns
Digestion - Hot Plate	M3050B ICP								11/20/14 10:00	pta
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								11/18/14 15:30	pta

** Please refer to Qualifier Reports for details.*

Report Header Explanations

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit, typically 5 times the MDL.
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Recovered amount of the true value or spike added, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of interest

QC Sample Types

AS	Analytical Spike (Post Digestion)	*LCSWD*	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	*LFB*	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	*LFM*	Laboratory Fortified Matrix
CCV	Continuing Calibration Verification standard	*LFMD*	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	*LRB*	Laboratory Reagent Blank
ICB	Initial Calibration Blank	*MS*	Matrix Spike
ICV	Initial Calibration Verification standard	*MSD*	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	*PBS*	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	*PBW*	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	*PQV*	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	*SDL*	Serial Dilution

QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

ACZ Qualifiers (Qual)

B	Analyte concentration detected at a value between MDL and PQL. The associated value is an estimated quantity.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
L	Target analyte response was below the laboratory defined negative threshold.
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Method References

(1) EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.

(2) EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.

(3) EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.

(4) EPA SW-846. Test Methods for Evaluating Solid Waste.

(5) Standard Methods for the Examination of Water and Wastewater.

Comments

(1) QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.

(2) Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.

(3) Animal matrices for Inorganic analyses are reported on an "as received" basis.

(4) An asterisk in the "XQ" column indicates there is an extended qualifier and/or certification qualifier associated with the result.

(5) If the MDL equals the PQL or the MDL column is omitted, the PQL is the reporting limit.

For a complete list of ACZ's Extended Qualifiers, please click: http://www.acz.com/public/extquallist.pdf

Copper, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG375135													
WG375135ICV	ICV	11/22/14 2:14	II141028-4	2		1.965	mg/L	98	90	110			
WG375135ICB	ICB	11/22/14 2:17				U	mg/L		-0.03	0.03			
WG374928PBS	PBS	11/22/14 2:30				U	mg/Kg		-3	3			
WG374928LCSS	LCSS	11/22/14 2:34	PCN46662	268		245.4	mg/Kg		219	317			
WG374928LCSSD	LCSSD	11/22/14 2:37	PCN46662	268		240.6	mg/Kg		219	317	2	20	
L21501-02MS	MS	11/22/14 2:49	II141030-2	50.4495	1020	1039.3	mg/Kg	38	75	125			M3
L21501-02MSD	MSD	11/22/14 2:52	II141030-2	50.4495	1020	996.9	mg/Kg	-46	75	125	4	20	M3

Neutralization Potential as CaCO3 M600/2-78-054 3.2.3 - Modified (No Heat)

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG375051													
WG375051PBS	PBS	11/20/14 12:15				U	%		-0.2	0.2			
L21501-01DUP	DUP	11/20/14 12:15			U	U	%				0	20	RA
L21501-02MS	MS	11/20/14 12:15	SI141024-1	1	.4	1.2	%	80	70	130			
WG375051LCSS	LCSS	11/20/14 12:15	PCN45868	4.66		4.75	%	102	80	120			

Ph M9045D/M9040C

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG375076													
WG375076ICV	ICV	11/21/14 11:00	PCN45365	4		4	units	100	3.9	4.1			
L21501-03DUP	DUP	11/21/14 13:00			5.5	5.5	units				0	20	

Solids, Percent D2216-80

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG374888													
WG374888PBS	PBS	11/18/14 16:30				U	%		-0.1	0.1			
L21501-02DUP	DUP	11/19/14 2:00			88.9	88.93	%				0	20	

Sulfur Organic Residual M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG375164													
L21500-13DUP	DUP	11/24/14 16:48			U	.01	%				200	20	RA

Sulfur Pyritic Sulfide M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG375164													
L21500-13DUP	DUP	11/24/14 16:48			.07	.06	%				15	20	RA

Sulfur Sulfate M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG375164													
L21500-13DUP	DUP	11/24/14 16:48			.03	.03	%				0	20	RA

Sulfur Total M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG375164													
WG375164PBS	PBS	11/24/14 8:00				U	%		-0.03	0.03			
WG375164LCSS	LCSS	11/24/14 10:12	PCN45915	4.07		4.16	%	102	80	120			
L21500-13MS	MS	11/24/14 14:36	PCN45351	1.1	.1	1.16	%	96	80	120			
L21500-13DUP	DUP	11/24/14 16:48			.1	.1	%				0	20	

Total Sulfur Minus Sulfate M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG375164													
L21500-13DUP	DUP	11/24/14 16:48			.07	.07	%				0	20	RA

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L21501-01	WG375135	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG375051	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG375164	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L21501-02	WG375135	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG375051	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG375164	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L21501-03	WG375135	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG375051	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG375164	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L21501-04	WG375135	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG375051	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG375164	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L21501-05	WG375135	Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG375051	Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG375164	Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Sulfur Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
		Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

Soil Analysis

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Neutralization Potential as CaCO3	M600/2-78-054 3.2.3 - Modified (No Heat)
Solids, Percent	D2216-80
Sulfur HCl Residue	M600/2-78-054 3.2.4-MOD
Sulfur HNO3 Residue	M600/2-78-054 3.2.4-MOD
Sulfur Organic Residual	M600/2-78-054 3.2.4-MOD
Sulfur Pyritic Sulfide	M600/2-78-054 3.2.4-MOD
Sulfur Sulfate	M600/2-78-054 3.2.4-MOD
Sulfur Total	M600/2-78-054 3.2.4-MOD
Total Sulfur minus Sulfate	M600/2-78-054 3.2.4-MOD

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Sample Receipt

Freeport-McMoRan - Chino Mines Company
ZN0000036K

ACZ Project ID: L21501
Date Received: 11/11/2014 09:58
Received By: ddp
Date Printed: 11/11/2014

Receipt Verification

	YES	NO	NA
1) Is a foreign soil permit included for applicable samples?			X
2) Is the Chain of Custody or other directive shipping papers present?	X		▨
3) Does this project require special handling procedures such as CLP protocol?			X
4) Are any samples NRC licensable material?			X
5) If samples are received past hold time, proceed with requested short hold time analyses?	X		
6) Is the Chain of Custody complete and accurate?	X		▨
7) Were any changes made to the Chain of Custody prior to ACZ receiving the samples?		X	▨

Samples/Containers

	YES	NO	NA
8) Are all containers intact and with no leaks?	X		▨
9) Are all labels on containers and are they intact and legible?	X		▨
10) Do the sample labels and Chain of Custody match for Sample ID, Date, and Time?	X		▨
11) For preserved bottle types, was the pH checked and within limits?			X
12) Is there sufficient sample volume to perform all requested work?	X		▨
13) Is the custody seal intact on all containers?			X
14) Are samples that require zero headspace acceptable?			X
15) Are all sample containers appropriate for analytical requirements?	X		▨
16) Is there an Hg-1631 trip blank present?			X
17) Is there a VOA trip blank present?			X
18) Were all samples received within hold time?	X		▨

Chain of Custody Related Remarks

Client Contact Remarks

Shipping Containers

```
Cooler Id      Temp (°C)      Rad (µR/Hr)      Custody Seal Intact?
---------      ---------      -----------      --------------------
NA20759        4.8            17               Yes
```

Was ice present in the shipment container(s)?

```
No - Wet or gel ice was not present in the shipment container(s).
```

Client must contact an ACZ Project Manager if analysis should not proceed for samples received outside of their thermal preservation acceptance criteria.

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

L21501

CHAIN of CUSTODY

L21501 Chain of Custody

Report to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

Copy of Report to:

Name: Matthew Barkley
Company: ARCADIS

E-mail: Matthew.Barkley@arcadis-us.com
Telephone: 303-231-9115 ext 157

Invoice to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐ NO ☒
If yes, please include state forms. Results will be reported to PQL.

PROJECT INFORMATION

Quote #:
Project/PO #:
Reporting state for compliance testing:
Sampler's Name: Garett Ferguson
Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED *(attach list or use quote number)*

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	soil sieved to < 2mm	pH	Total CU	ABA				
1. STS-PH-2014-REFPLOT3	11/4/14 1405	SO	1	x	x	x	x				
2. STS-PH-2014-REFPLOT4	11/4/14 1025	SO	1	x	x	x	x				
3. STS-PH-2014-ERA13	11/5/14 1000	SO	1	x	x	x	x				
4. DUP1	—	SO	1	x	x	x	x				
5. DUP2	—	SO	1			x					
RINSATE	—	SW			X	X					

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

Please send to Sheri Fling at URS for validation. Sieve all soil samples to <2 mm prior to analysis. Soil should be reported on a dry weight basis.
Methods:
pH - 9045C, Total Copper - 6010B

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
	11/6/14 1700		11.11.14 9:58

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Analytical Report

November 24, 2014

Report to:
Pam Pinson
Freeport-McMoRan - Chino Mines Company
PO Box 10
Bayard, NM 88023

cc: Matthew Barkley

Bill to:
Pam Pinson
Freeport-McMoRan - Chino Mines Company
P.O. Box 13308
Phoenix, AZ 85002-3308

Project ID: ZN0000036K
ACZ Project ID: L21502

Pam Pinson:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on November 11, 2014. This project has been assigned to ACZ's project number, L21502. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan. The enclosed results relate only to the samples received under L21502. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all requirements of NELAC.

This report shall be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after December 24, 2014. If the samples are determined to be hazardous, additional charges apply for disposal (typically $11/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical raw data reports for ten years.

If you have any questions or other needs, please contact your Project Manager.

S. Habermehl

Scott Habermehl has reviewed
and approved this report.

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN0000036K	ACZ Sample ID:	***L21502-01***
Sample ID:	RINSATE1	Date Sampled:	*11/05/14 00:00*
		Date Received:	*11/11/14*
		Sample Matrix:	*Surface Water*

Inorganic Prep

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Total Hot Plate Digestion	M200.2 ICP-MS				*				11/19/14 20:00	scp

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Copper, total	M200.8 ICP-MS	1	0.0072			mg/L	0.0005	0.003	11/21/14 1:26	msh

Arizona license number: AZ0102

** Please refer to Qualifier Reports for details.*

Inorganic Reference

Report Header Explanations

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit, typically 5 times the MDL.
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Recovered amount of the true value or spike added, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of interest

QC Sample Types

AS	Analytical Spike (Post Digestion)	*LCSWD*	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	*LFB*	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	*LFM*	Laboratory Fortified Matrix
CCV	Continuing Calibration Verification standard	*LFMD*	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	*LRB*	Laboratory Reagent Blank
ICB	Initial Calibration Blank	*MS*	Matrix Spike
ICV	Initial Calibration Verification standard	*MSD*	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	*PBS*	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	*PBW*	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	*PQV*	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	*SDL*	Serial Dilution

QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

ACZ Qualifiers (Qual)

B	Analyte concentration detected at a value between MDL and PQL. The associated value is an estimated quantity.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
L	Target analyte response was below the laboratory defined negative threshold.
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Method References

(1) EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
(2) EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.
(3) EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.
(4) EPA SW-846. Test Methods for Evaluating Solid Waste.
(5) Standard Methods for the Examination of Water and Wastewater.

Comments

(1) QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
(2) Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.
(3) Animal matrices for Inorganic analyses are reported on an "as received" basis.
(4) An asterisk in the "XQ" column indicates there is an extended qualifier and/or certification qualifier associated with the result.
(5) If the MDL equals the PQL or the MDL column is omitted, the PQL is the reporting limit.

For a complete list of ACZ's Extended Qualifiers, please click: http://www.acz.com/public/extquallist.pdf

Copper, total M200.8 ICP-MS

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG375082													
WG375082ICV	ICV	11/21/14 0:15	MS141027-2	.05		.05143	mg/L	103	90	110			
WG375082ICB	ICB	11/21/14 0:17				U	mg/L		-0.0015	0.0015			
WG374983LRB	LRB	11/21/14 0:20				U	mg/L		-0.0011	0.0011			
WG374983LFB	LFB	11/21/14 0:22	MS141103-2	.05		.04864	mg/L	97	85	115			
L21496-04LFM	LFM	11/21/14 0:59	MS141103-2	.05	.0009	.04516	mg/L	89	70	130			
L21496-04LFMD	LFMD	11/21/14 1:01	MS141103-2	.05	.0009	.04596	mg/L	90	70	130	2	20	

Inorganic Extended Qualifier Report

Freeport-McMoRan - Chino Mines Company

ACZ Project ID: ***L21502***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L21502-01	WG374983	Total Hot Plate Digestion	M200.2 ICP-MS	Q5	Sample received with inadequate chemical preservation. Additional preservation performed by the laboratory.

Certification Qualifiers

Freeport-McMoRan - Chino Mines Company

ACZ Project ID: ***L21502***

No certification qualifiers associated with this analysis

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Sample Receipt

Freeport-McMoRan - Chino Mines Company
ZN0000036K

ACZ Project ID:	L21502
Date Received:	11/11/2014 09:58
Received By:	ddp
Date Printed:	11/11/2014

Receipt Verification

	YES	NO	NA
1) Is a foreign soil permit included for applicable samples?			X
2) Is the Chain of Custody or other directive shipping papers present?	X		▨
3) Does this project require special handling procedures such as CLP protocol?			X
4) Are any samples NRC licensable material?			X
5) If samples are received past hold time, proceed with requested short hold time analyses?	X		
6) Is the Chain of Custody complete and accurate?	X		▨
7) Were any changes made to the Chain of Custody prior to ACZ receiving the samples?		X	▨

Samples/Containers

	YES	NO	NA
8) Are all containers intact and with no leaks?	X		▨
9) Are all labels on containers and are they intact and legible?	X		▨
10) Do the sample labels and Chain of Custody match for Sample ID, Date, and Time?	X		▨
11) For preserved bottle types, was the pH checked and within limits?	X		
12) Is there sufficient sample volume to perform all requested work?	X		▨
13) Is the custody seal intact on all containers?			X
14) Are samples that require zero headspace acceptable?			X
15) Are all sample containers appropriate for analytical requirements? `L21502-01 : A Red container not received and a new container created from the White .`		X	▨
16) Is there an Hg-1631 trip blank present?			X
17) Is there a VOA trip blank present?			X
18) Were all samples received within hold time?	X		▨

Chain of Custody Related Remarks

Client Contact Remarks

Shipping Containers

```
Cooler Id      Temp (°C)      Rad (µR/Hr)      Custody Seal Intact?
---------      ---------      -----------      --------------------
NA20759        4.8            17               Yes
```

Was ice present in the shipment container(s)?

```
No - Wet or gel ice was not present in the shipment container(s).
```

Client must contact an ACZ Project Manager if analysis should not proceed for samples received outside of their thermal preservation acceptance criteria.

Sample Receipt

Freeport-McMoRan - Chino Mines Company
ZN0000036K

ACZ Project ID:	L21502
Date Received:	11/11/2014 09:58
Received By:	ddp
Date Printed:	11/11/2014

ACZ Laboratories, Inc.

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

21502

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

Copy of Report to:

Name: Matthew Barkley
Company: ARCADIS

E-mail: Matthew.Barkley@arcadis-us.com
Telephone: 303-231-9115 ext 157

Invoice to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐

If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐ NO ☒

If yes, please include state forms. Results will be reported to PQL.

PROJECT INFORMATION

Quote #:
Project/PO #:
Reporting state for compliance testing:
Sampler's Name: Garett Ferguson
Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED *(attach list or use quote number)*

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	soil sieved to < 2mm	pH	Total CU	ABA					
STS-PH-2014-REFPLOT3	11/4/14 1405	SO	1	x	x	x	x					
STS-PH-2014-REFPLOT4	11/4/14 1025	SO	1	x	x	x	x					
STS-PH-2014-ERA13	11/5/14 1000	SO	1	x	x	x	x					
DUP1	—	SO	1	x	x	x	x					
DUP2	—	SO	1			x						
RINSATE	—	SW			X	X						

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

Please send to Sheri Fling at URS for validation. Sieve all soil samples to <2 mm prior to analysis. Soil should be reported on a dry weight basis.
Methods:
pH - 9045C, Total Copper - 6010B

COPY

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
Mat	11/6/14 1700	LB	11.11.14 9:58

L21502 Chain of Custody

FRMAD050.01.15.09

White - Return with sample. Yellow - Retain for your records.

Laboratory Data Package

November 30, 2009

Prepared for:

ARCADIS

Prepared by:
Laboratory for Environmental and Geological Studies (LEGS)
University of Colorado
Benson Earth Science
2200 Colorado Ave.
Boulder, CO 80309

Table of Contents

Appendix A. Chain-of-Custody

CD ROM All raw data files, backscatter photomicrographs, and spectra.

Statement of Work

ARCADIS provided LEGS with 24 samples on 10/20/09 (see attached COC). From these, 12 samples were selected by the client for As-Cd-Cu-Fe *in vitro* analyses and EMPA Cu speciation. Another 12 samples were selected for a "bird *in vitro*" analyses for copper. All data is provided on enclosed CD along with a brief review of the methodology used.

Speciation Methodology

The Laboratory for Environmental and Geological Studies (LEGS) at the University of Colorado, Department of Geological Sciences contains the following equipment was used for this project:

> A JOEL 8600 electron microprobe, with four wavelength dispersive detectors (TAP, LIF, PET, LdB, LdC and Ld1 crystals) and an energy dispersive detector. The system includes backscatter and secondary detectors for imaging and can produce both x-ray spectra and photomicrographs in TIF format. Certified mineral standards for all elements of concern are available for EMPA standardization. SOP for metal speciation is available at our website:
>
> http://www.colorado.edu/GeolSci/legs/speciation.html

Representative backscatter photomicrographs (BSPM) illustrating sample characteristics were acquired and EDS spectra acquired and it is recommended the client review these images. Data from EMPA will be summarized using two methods as illustrated below.

The first method is the determination of **FREQUENCY OF OCCURRENCE**. This is calculated by summing the longest dimension of all the copper-bearing phases observed and then dividing each phase by the total.

Equation 1.0 will serve as an example to the calculation for an copper-bearing compound. Other metals follow a similar calculation.

F_{Cu} - Frequency of occurrence of copper
in a single phase.

PLD - An individual particles longest dimension

$$F_{Cu} \text{ in phase-1} = \frac{3\ (PLD)_{\text{phase-1}}}{3\ (PLD)_{\text{phase-1}} + 3\ (PLD)_{\text{phase-2}} + 3\ (PLD)_{\text{phase-n}}}$$

$$\%F_{Cu} \text{ in phase-1} = F_{Cu} \text{ in phase-1} * 100$$

This data thus illustrates which copper-bearing phase(s) are the most commonly observed in the sample or relative volume percent.

The second calculation used in this report is the determination of **RELATIVE COPPER MASS** of a metal-bearing phase. These data are calculated (using arsenic as an example) by substituting the PLD term in the equation above with the value of M_{Cu}. This term is calculated as defined below.

M_{Cu} - Mass of copper in a phase

SG - Specific Gravity of a phase

ppm_{Cu} - Concentration in ppm of copper in phase

$$M_{Cu} = F_{Cu} * SG * ppm_{Cu}$$

The advantage in reviewing the RELATIVE COPPER MASS determinations is that it gives one information as to which metal-bearing phase(s) in a sample are likely to control the total bulk concentration for copper. As an example, PHASE-1 may by relative volume comprise 98% of the sample, however it has a low specific gravity and contains only 1000 ppm copper, while PHASE-2 comprises 2% of the sample, has a high specific gravity and contains 850000 ppm of copper. In this example it is PHASE-2 that is the dominant source of copper to the sample.

Sample Preparation

1) Logging the samples of which polished mounts will be prepared

2) Inspection of all plastic cups, making sure each is clean and dry

3) Labeling each "mold" with its corresponding sample number.

4) All samples will be split to produce a homogeneous 1-4 gram sample.

5) Mixing epoxy resin and hardener according to manufacturer's directions.

6) Pour 1 gram of sample into mold. Double checking to make sure sample numbers on mold and sample match. Pouring epoxy into mold to just cover sample grains.

7) Using a new wood stirring stick with each sample, carefully blend epoxy and grains so as to coat all grains with epoxy.

8) Setting molds to cure at ROOM TEMPERATURE in a clean restricted area. Adding labels with sample numbers and covering with more epoxy resin. Leaving to cure completely at room temperature.

9) One at a time, removing each sample from its mold and grinding flat the back side of the mount.

10) Using 600 grit wet abrasive paper stretched across a grinding wheel for removing the bottom layer and exposing as many mineral grains as possible. Follow with 1000 grit paper.

11) Start polishing with 15µ oil based diamond paste on a polishing paper fixed to a lap. Using paper instead of cloth minimizes relief.

12) Next use 6 µ diamond polish on a similar lap.

13) Finally polish the sample with 1µ oil based diamond past on polishing paper. Followed by .05 µ alumina in water suspension. The quality should be checked after each step. Typical polishing times are 30 minutes for 15µ, 20 minutes for 6µ, 15 minutes for 1µ and 10 minutes for.05µ.

NOTE: use low speed on the polishing laps to avoid "plucking"
of sample grains.

14) Samples should be completely cleaned in an ultrasonic cleaner with isopropyl alcohol or similar solvent to remove oil and finger prints.

15) To insure that no particles of lead are being cross contaminated with sample preparation procedures, a blank epoxy only) mold will be made every 50th sample following all of the above procedures. This mold will then be speciated along with the other samples.

16) Each sample be carbon coated. Once coated the samples should be stored in a clean, dry environment with the carbon surface protected from scratches or handling.

POINT COUNTING

Counts are made by traversing each sample from left-to-right and top-to-bottom. The amount of vertical movement for each traverse would depend on magnification and CRT (cathode-ray tube) size. This movement should be minimized so that NO portion of the sample is missed when the end of a traverse is reached. Two magnification settings should be used. One ranging from 40-100X and a second from 300-600X. The last setting will allow one to find the smallest identifiable (1-2 micron) phases.

The portion of the sample examined in the second pass, under the higher magnification, will depend on the time available, the number of copper-bearing particles, and the complexity of metal mineralogy. A maximum of 8 hours will be spent per sample.

Speciation Results

There is no single species of copper that dominates the samples studied. However, four species of copper are found more often; FeOOH, Cu-FeO, Cubanite ($CuFe_2S_3$) and Bornite (Cu_5FeS_4) in the studied samples, Figures 1-6. The FeOOH phases ranges in size from 7 to 19 microns with an average copper concentration of 2.6 wt.%. The Cu-FeO phases ranges in size from 10 to 42 microns with an average copper concentration of 22 wt.%. Cubanite ranges in size from 4 to 60 microns with a copper concentration of 23.3 wt.% , while bornite ranges in size from 13 to 78 microns with a copper concentration of 63 wt.%.

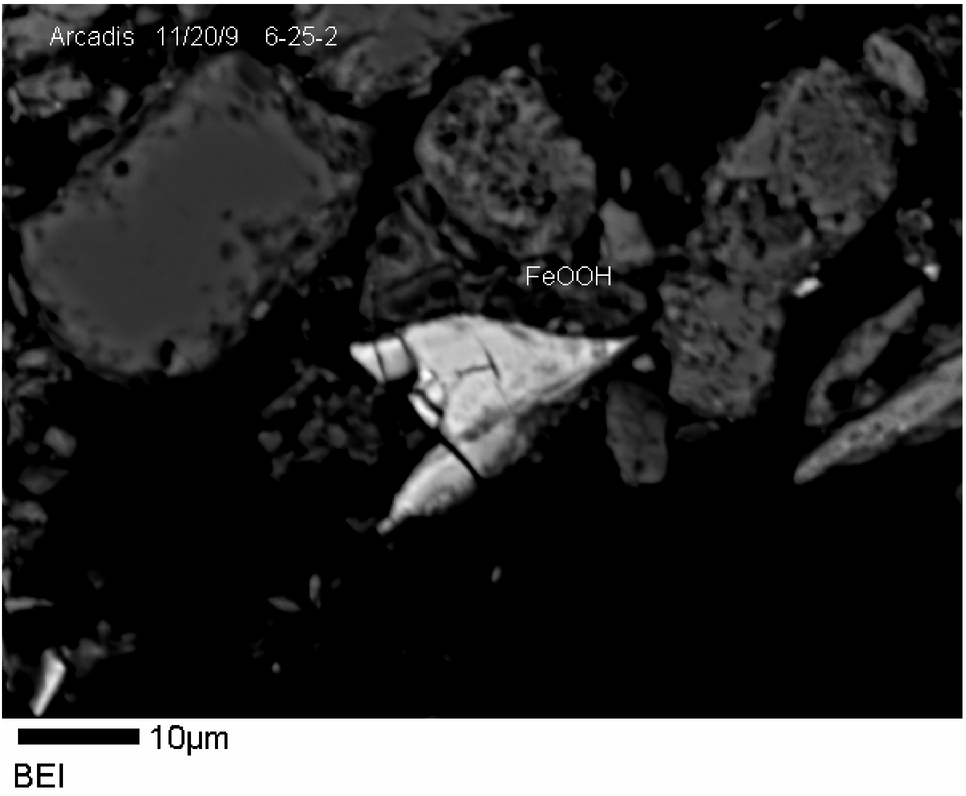
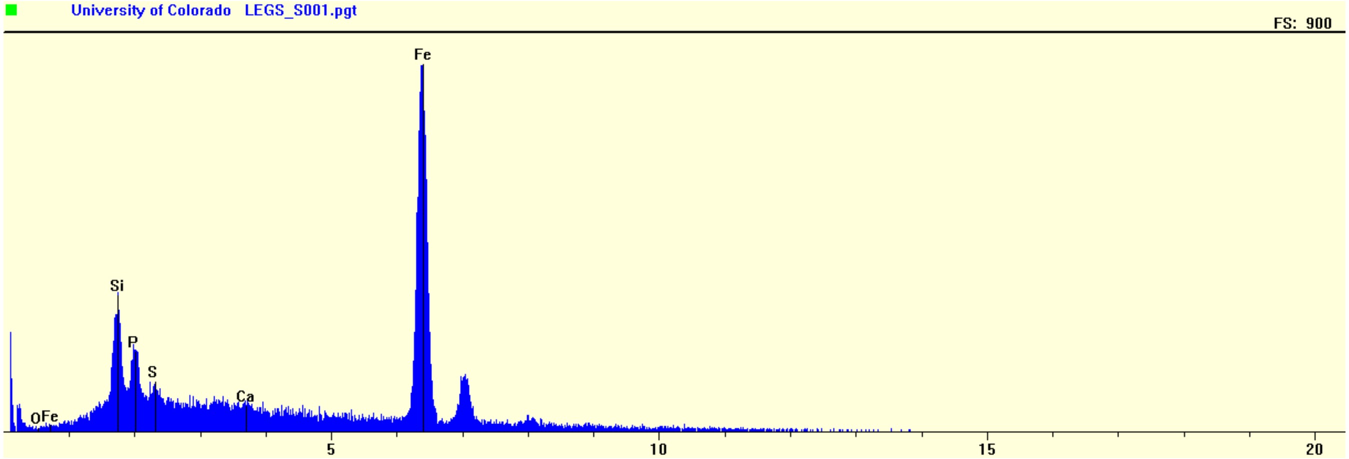

Arcadis 11/20/9 6-25-2
FeOOH
10µm
BEI

Figure 1.


University of Colorado LEGS_S001.pgt
FS: 900
Fe
Si
P
S
Ca
OFe
5
10
15
20

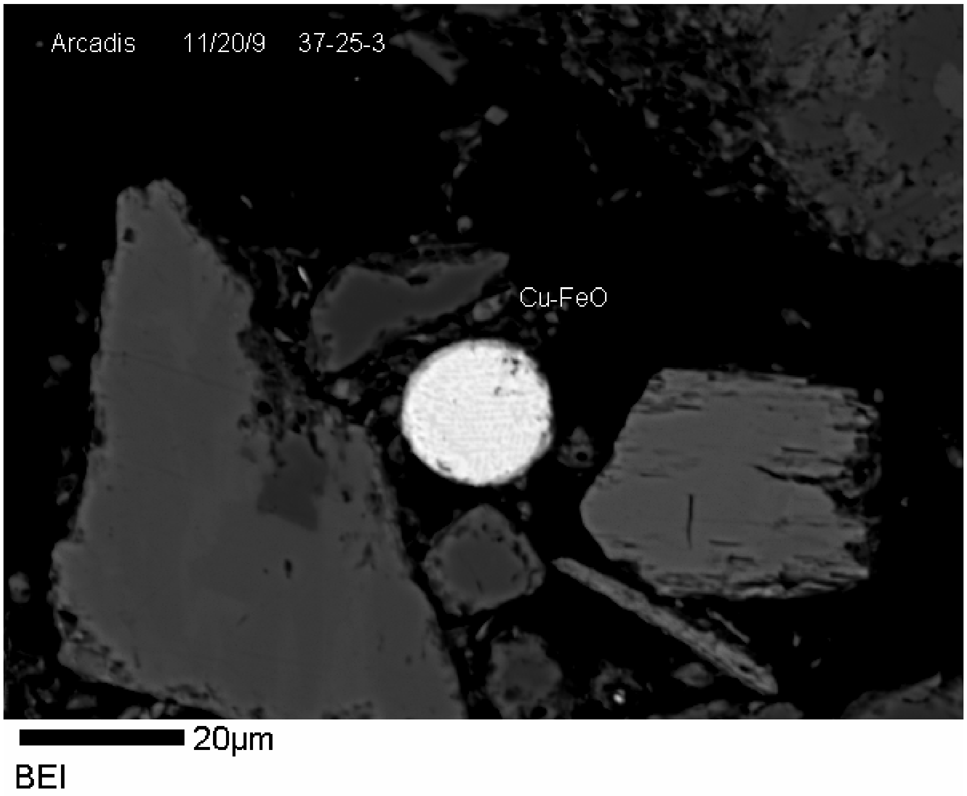
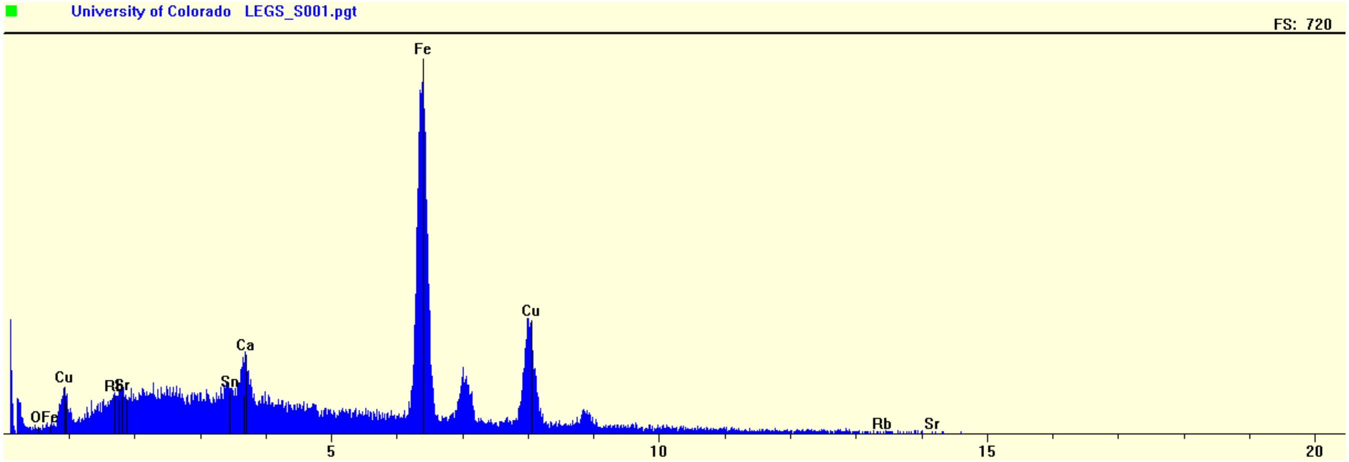

Arcadis 11/20/9 37-25-3
Cu-FeO
20µm
BEI

Figure 2.


University of Colorado LEGS_S001.pgt
FS: 720
Fe
Cu
Ca
Cu
RbSr
Sn
OFe
Rb
Sr
5
10
15
20

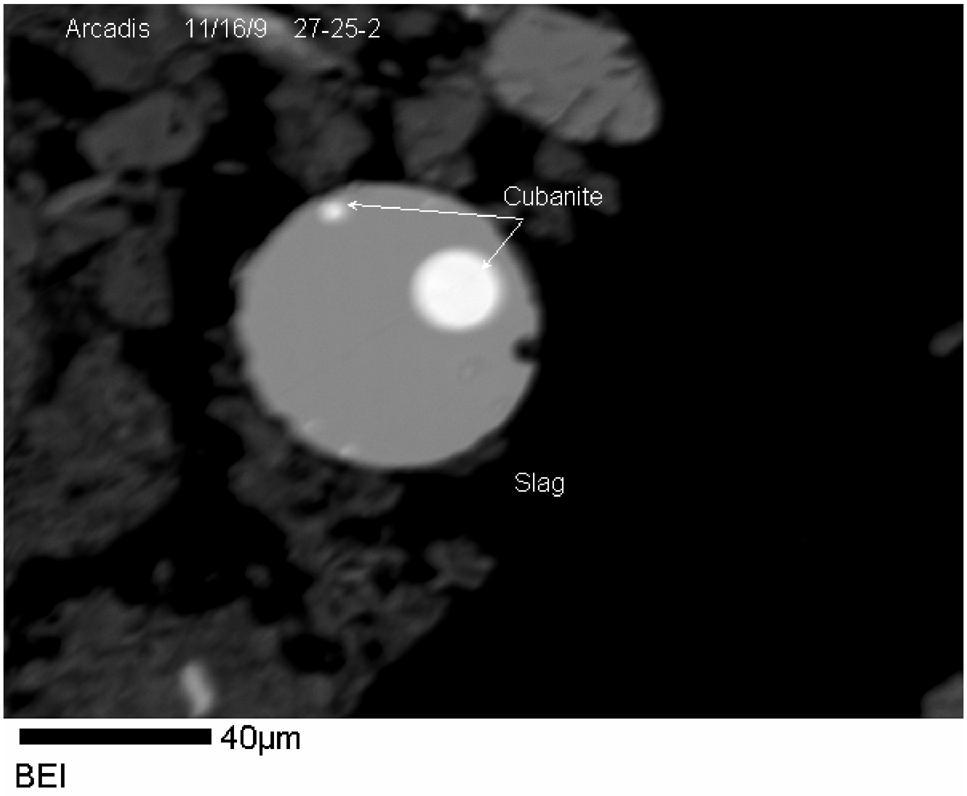
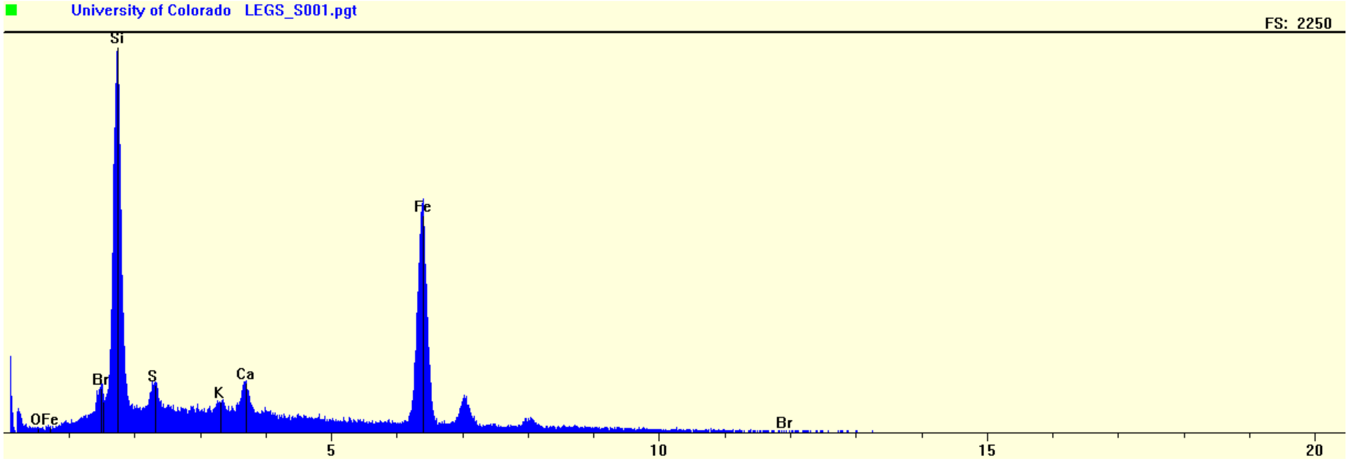

Arcadis 11/16/9 27-25-2
Cubanite
Slag
40µm
BEI

Figure 3.


University of Colorado LEGS_S001.pgt
FS: 2250
Si
Fe
Br
S
K
Ca
OFe
Br
5
10
15
20

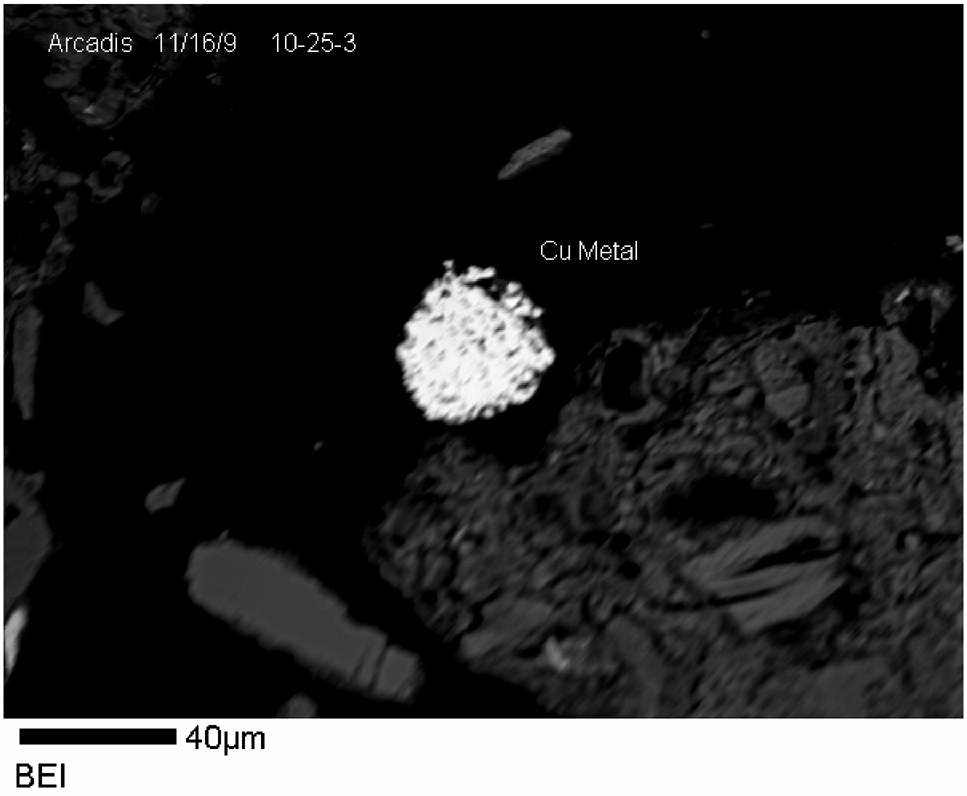
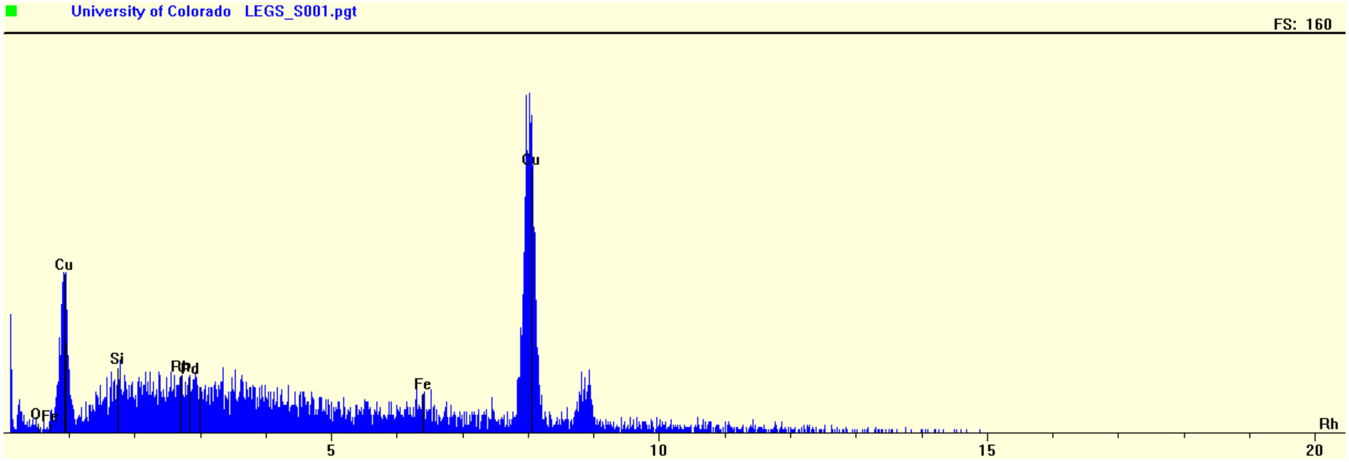

Arcadis 11/16/9 10-25-3
Cu Metal
40µm
BEI

Figure 4.


University of Colorado LEGS_S001.pgt
FS: 160
Cu
Cu
Si
Rh
Pd
Fe
O
Fe
Rh
5
10
15
20

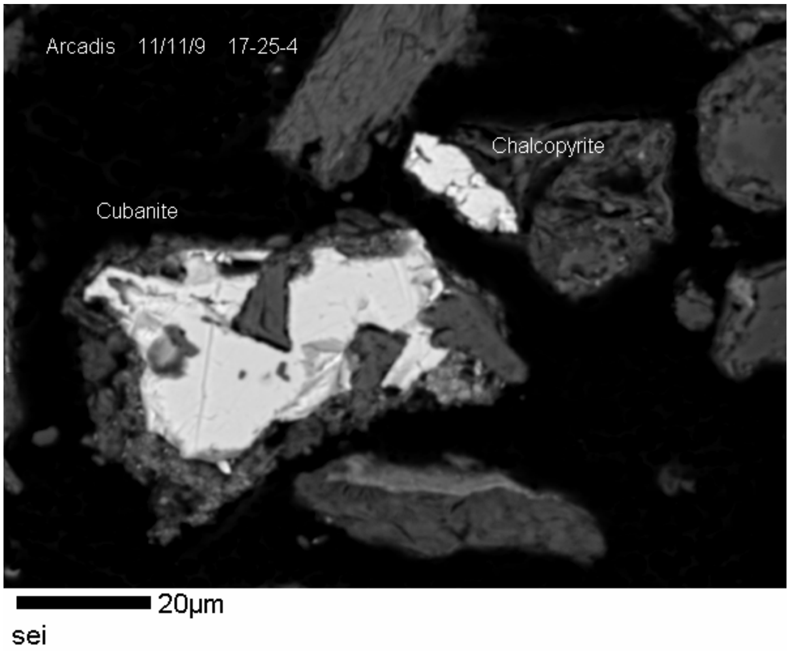
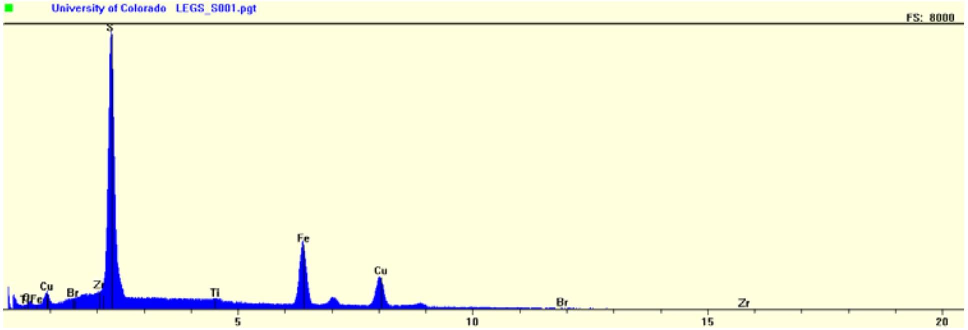
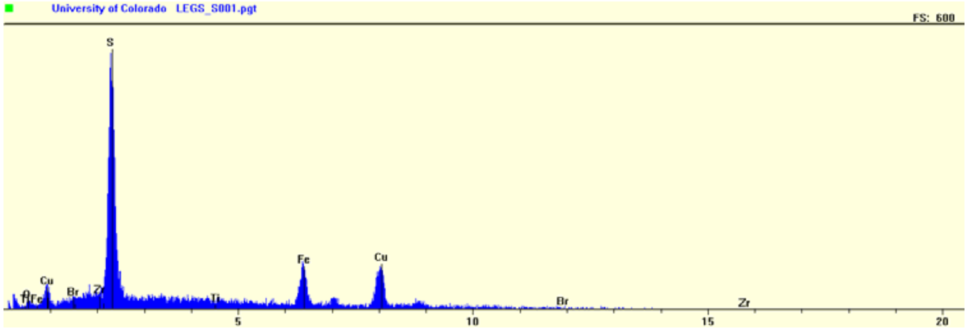

Arcadis 11/11/9 17-25-4
Chalcopyrite
Cubanite
20µm
sei

Figure 5.


University of Colorado LEGS_S001.pgt
FS: 8000
S
Fe
Cu
Cu
Ti
Br
Zr
Br
Zr
5
10
15
20


University of Colorado LEGS_S001.pgt
FS: 600
S
Fe
Cu
Cu
Ti
Br
Zr
Br
Zr
5
10
15
20

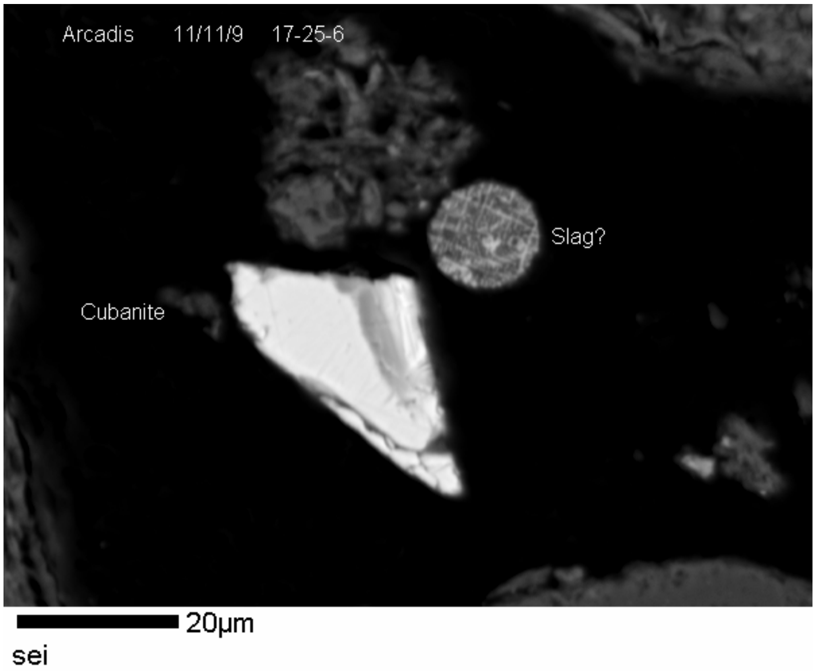
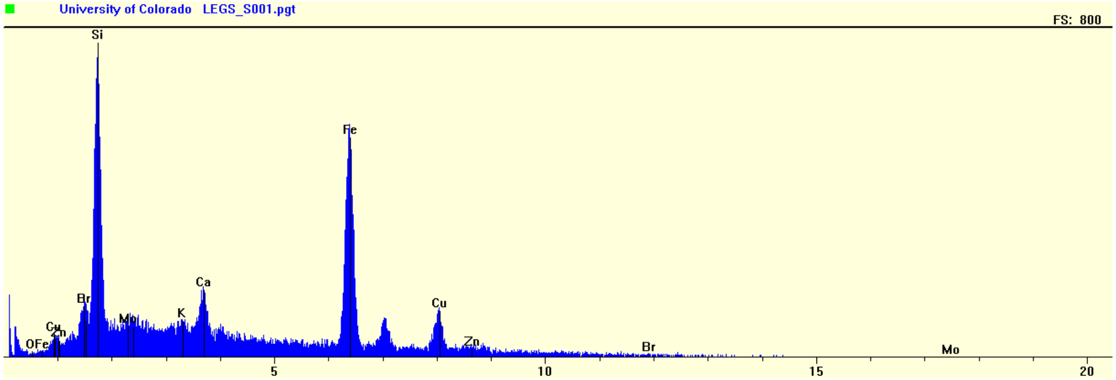
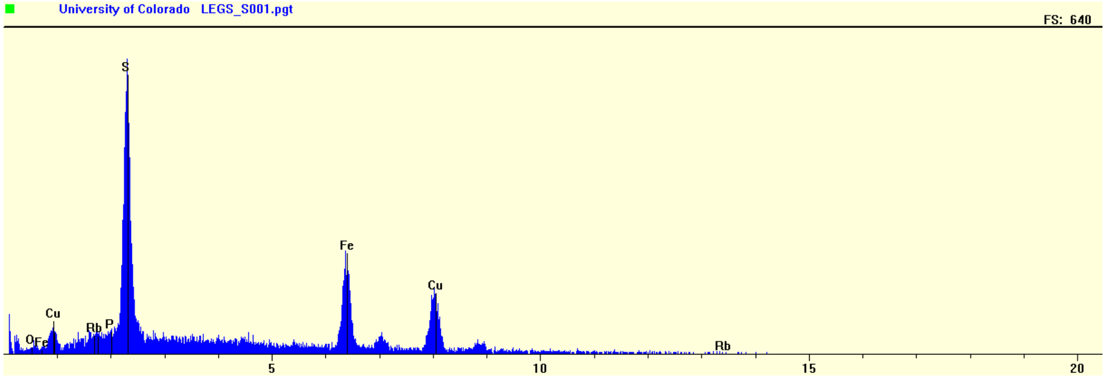

Arcadis 11/11/9 17-25-6
Slag?
Cubanite
20µm
sei

Figure 6.


University of Colorado LEGS_S001.pgt
FS: 800
Si
Fe
Ca
Br
Cu
Zn
O
Fe
Mo
K
Cu
Zn
Br
Mo
5
10
15
20


University of Colorado LEGS_S001.pgt
FS: 640
S
Fe
Cu
Cu
O
Fe
Rb
P
Rb
5
10
15
20

In Vitro Bioassay

Arsenic relative bioavailabilty, was determined using the method developed at the University of Colorado, Boulder and calibrated to EPA's Region VIII Swine Model Medlin and Drexler, 1996, Medlin, 1997, Drexler and Brattin 2007. The method has a high level of correlation to the Swine Model for lead (r=0.96) however, at present the correlation for arsenic is not as good (r=0.76). Based on these data it is recommended that one interpret arsenic bioavailability results with greater caution. All additional metals requested by ARCADIS have NO animal data for calibration. The "bird *in vitro*" method was provided by ARCADIS.

The method follows a carefully designed laboratory SOP, which is available on request. The procedure uses 1.0 grams of the <250µm size fraction, this material is placed in 125ml wide-mouth HDPE bottles along with 100ml of 1.5 pH stomach solution. The mixture is rotated end-on-end at 37ºC in a water bath for one hour. After one hour 10ml of sample is removed, filtered (0.45µm), and analyzed for lead and/or arsenic following Methods 6010B, 6020, or 7061A. Results from this extraction procedure are then used to calculated bioavailable lead and/or arsenic from the bulk <250µm concentrations.

Quality assurance and a more complete SOP can be obtained at our web site:

http://www.colorado.edu/geolsci/legs

APPENDIX I

30065538.200_ .0000 3
FMI Chino, Hurley NM
Drexler
Rebecca Lindeman, ARCADIS
K. Thompson ARCADIS
C. Meyer, ARCADIS

			Human test for Cd, As, Cu, Pb	Bird test for Cu
• FID 06-25 0-6"	S	6/18/09 0955		X
• FID 34-25 0-1"	S	6/18/09 1228	X	
• FID 34-25 0-6"	S	6/18/09 1230		X
• FID [illegible]	[illegible]	[illegible]	X	
• [illegible]	[illegible]	[illegible]		X
• FID [illegible]	S	[illegible]	X	
• FID [illegible]	[illegible]	[illegible]		X
• FID 08-25 0-1"	S	10/7/09 1256	X	
• FID 08-25 0-6"	S	10/7/09 1258		X

sieve bird samples to <2,000 μm; sieve human samples to <250 μm
Call Carolyn Meyer, ARCADIS at 303-231-9115 ext 124 if questions on analysis
X FedEx

B0063538.0002.00003
FMI Chino, Hurley NM
Drexler
Rebecca Lindeman, ARCADIS
K. Thompson, ARCADIS

			Human test for Cd, As, Cu, Fe	Bird test for Cu
• FID 21-25 0-1"	S	6/19/09 1452	X	
• FID 21-25 0-6"	S	6/19/09 1455		X
• FID 20-25 0-6"	S	6/19/09 1025		X
• FID 20-25 0-1"	S	6/19/09 1023	X	
• FID 26-25 0-1"	S	6/19/09 1127	X	
• FID 26-25 0-6"	S	6/19/09 1130		X
• FID 10-25 0-1"	S	6/19/09 0935	X	
• FID 10-25 0-6"	S	6/19/09 0938		X
• FID 17-25 0-1"	S	6/18/09 1539	X	
• FID 17-25 0-6"	S	6/18/09 1545		X
• FID 27-25 0-1"	S	6/18/09 1405	X	
• FID 27-25 0-6"	S	6/18/09 1408		X
• FID 12-25 0-1"	S	6/18/09 1525	X	
• FID 12-25 0-6"	S	6/18/09 1527		X
• FID 06-25 0-1"	S	6/18/09 0950	X	

sieve bird samples to <2,000 um ; sieve human samples to <250 um
Call Carolyn Meyer, ARCADIS at 303-231-9115 ext 124 if questions on analysis
X FedEx

SPECIATION FIGURES

Figure No.
1a

Sample:
FID 6

Description:
Micrograph 1

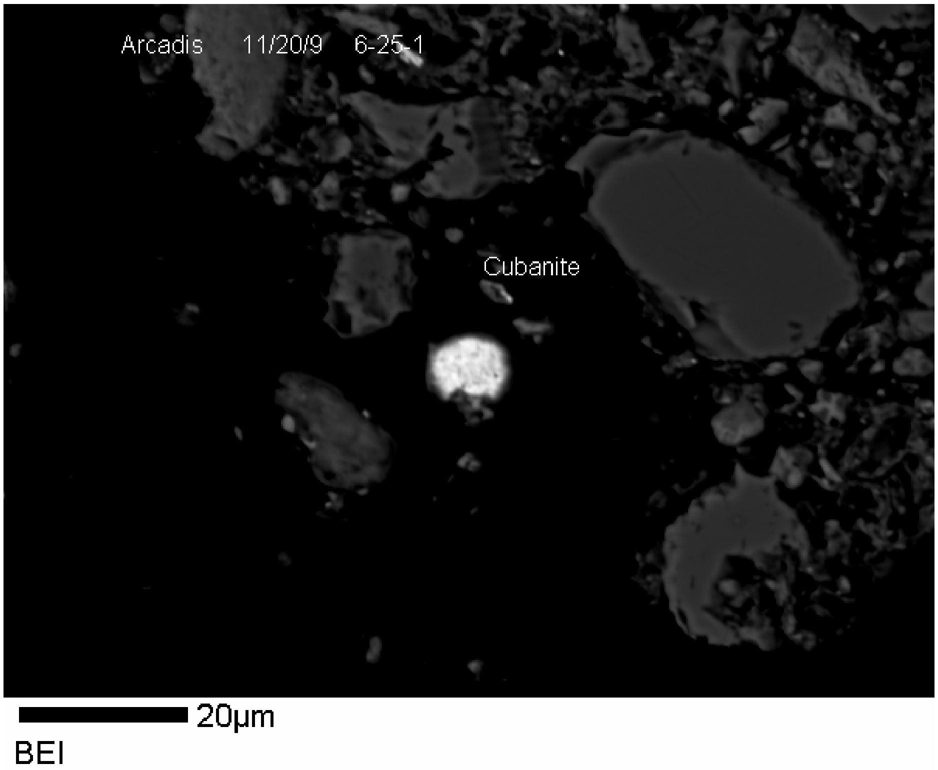
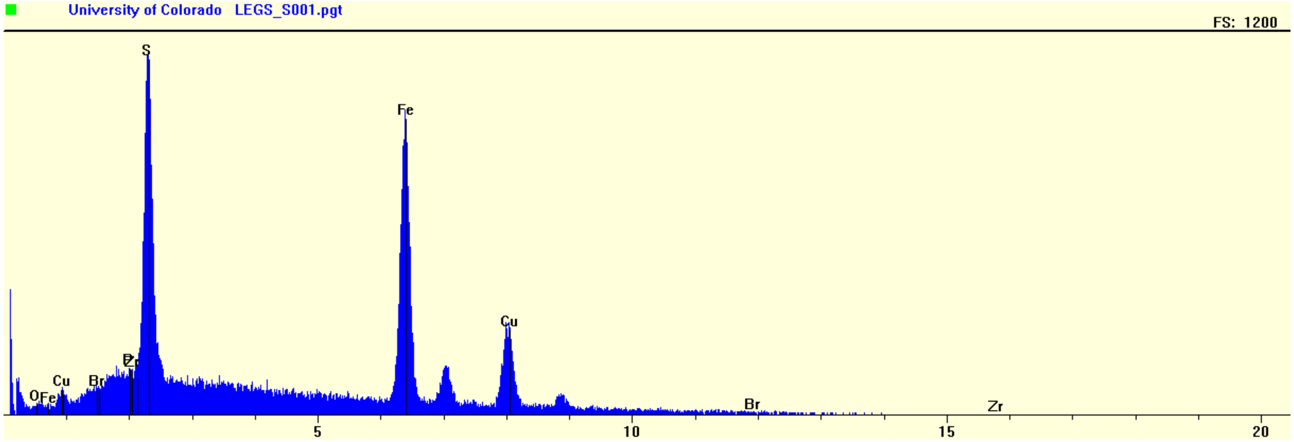


Figure No.
1b

Sample:
FID 6

Description:
Histogram 1



SPECIATION FIGURES

Figure No.
1c

Sample:
FID 6

Description:
Micrograph 2

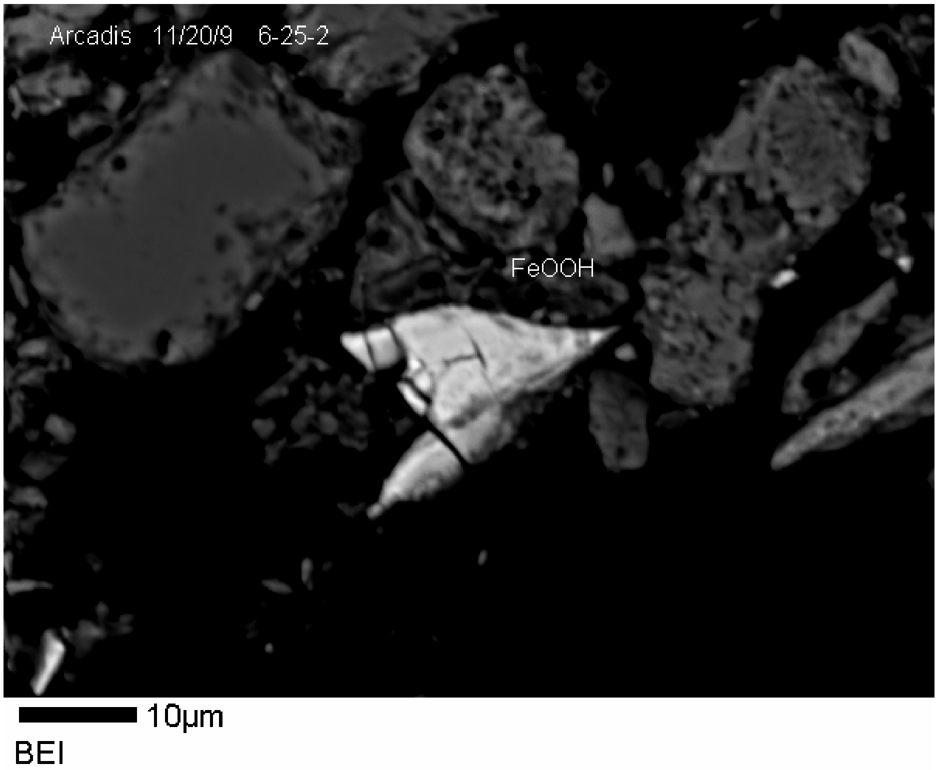
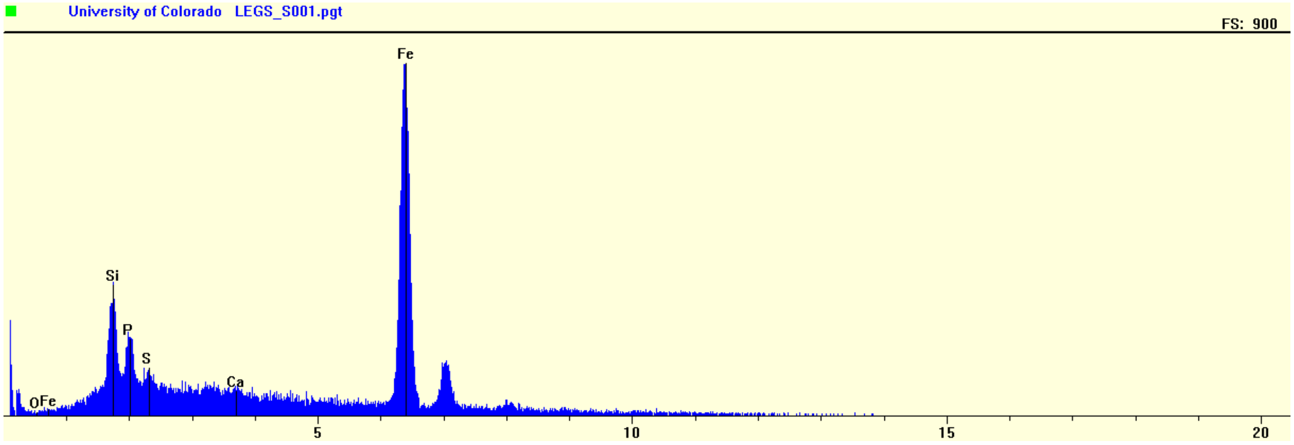


Figure No.
1d

Sample:
FID 6

Description:
Histogram 2



SPECIATION FIGURES

Figure No.
1e

Sample:
FID 6

Description:
Micrograph 3

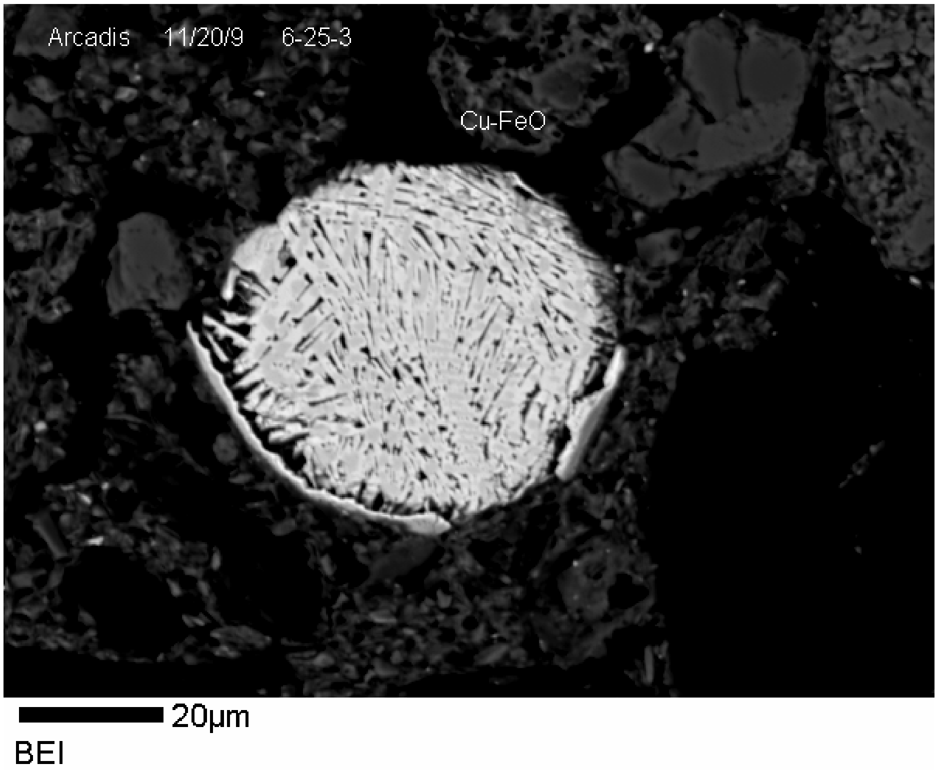
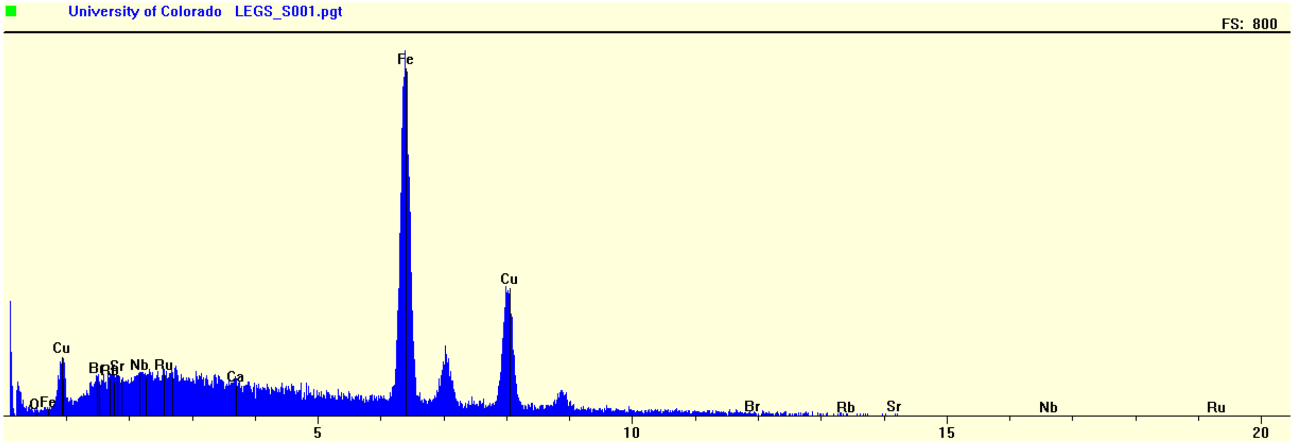


Figure No.
1f

Sample:
FID 6

Description:
Histogram 3



SPECIATION FIGURES

Figure No.
1g

Sample:
FID 6

Description:
Micrograph 4

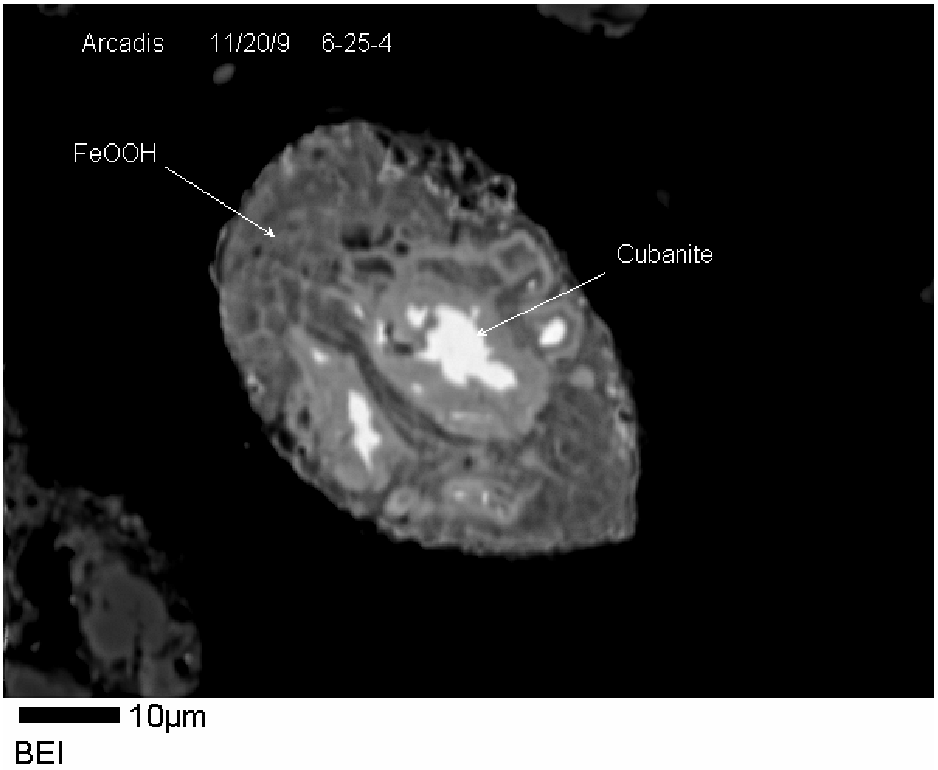
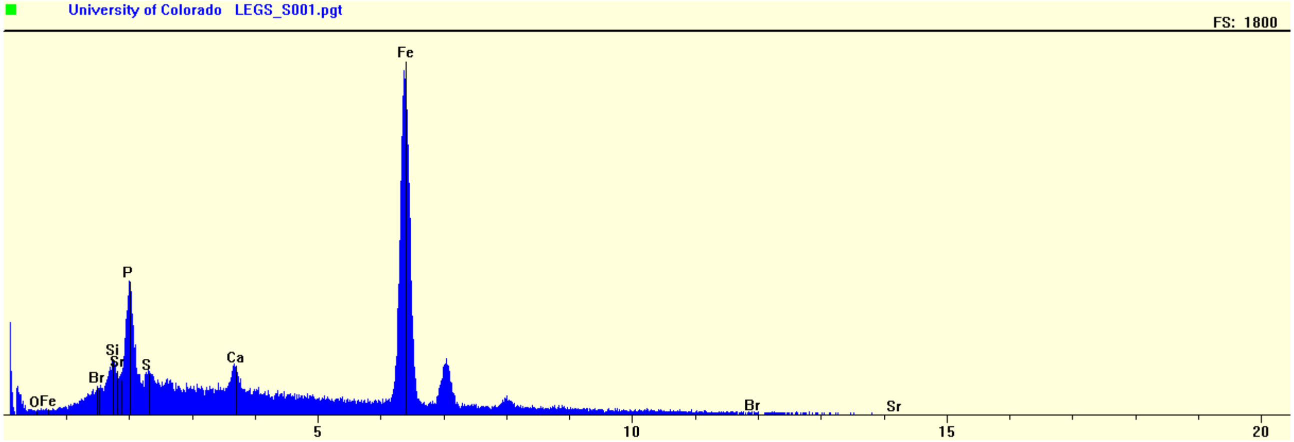


Figure No.
1h

Sample:
FID 6

Description:
Histogram 4



SPECIATION FIGURES

Figure No.
1i

Sample:
FID 6

Description:
Micrograph 5

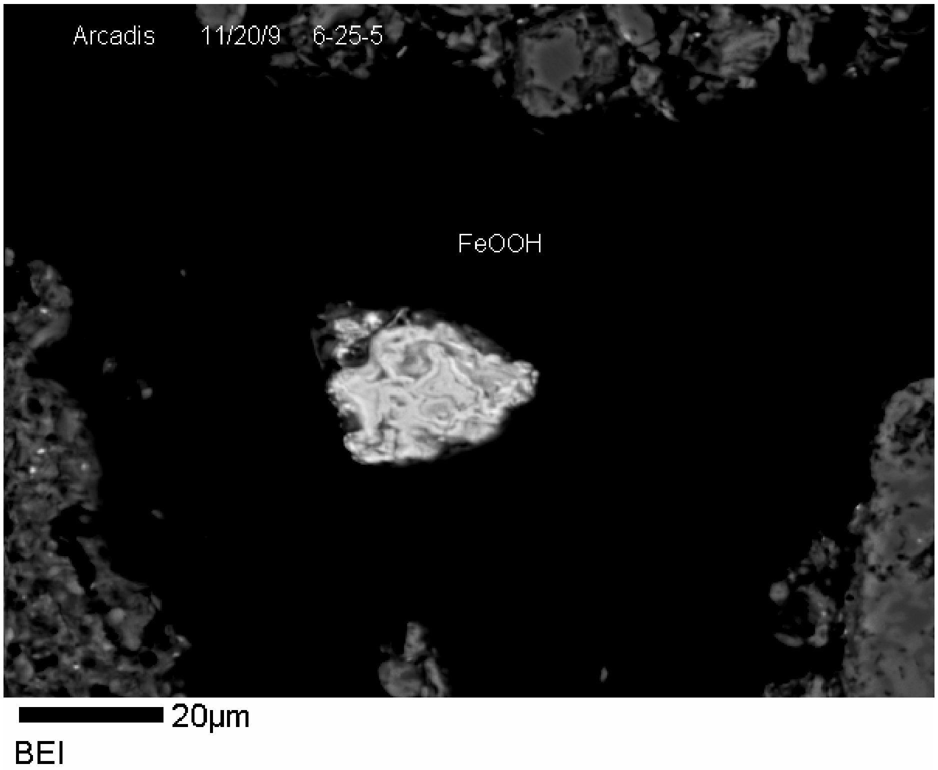
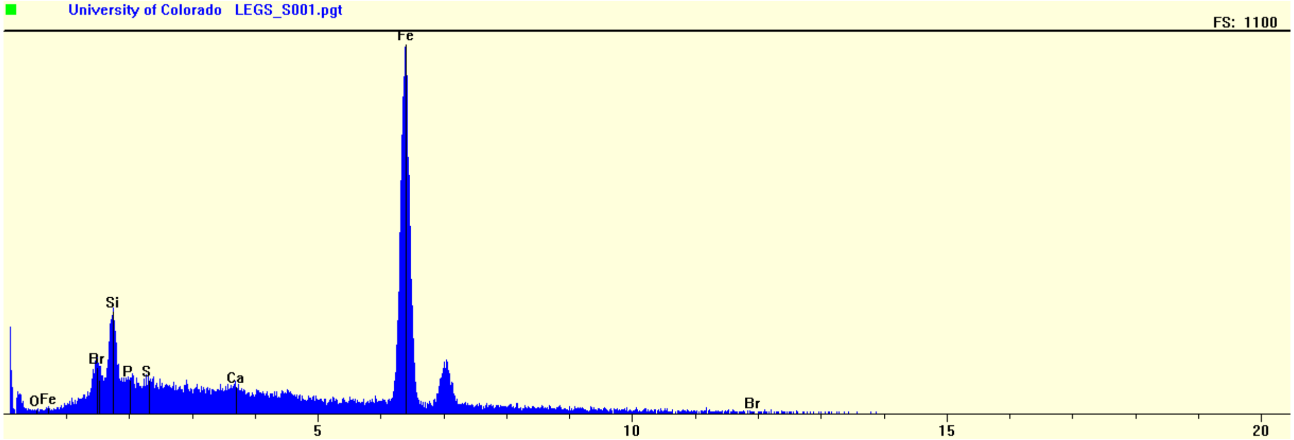


Figure No.
1j

Sample:
FID 6

Description:
Histogram 5



SPECIATION FIGURES

Figure No.
2a

Sample:
FID 8

Description:
Micrograph 1

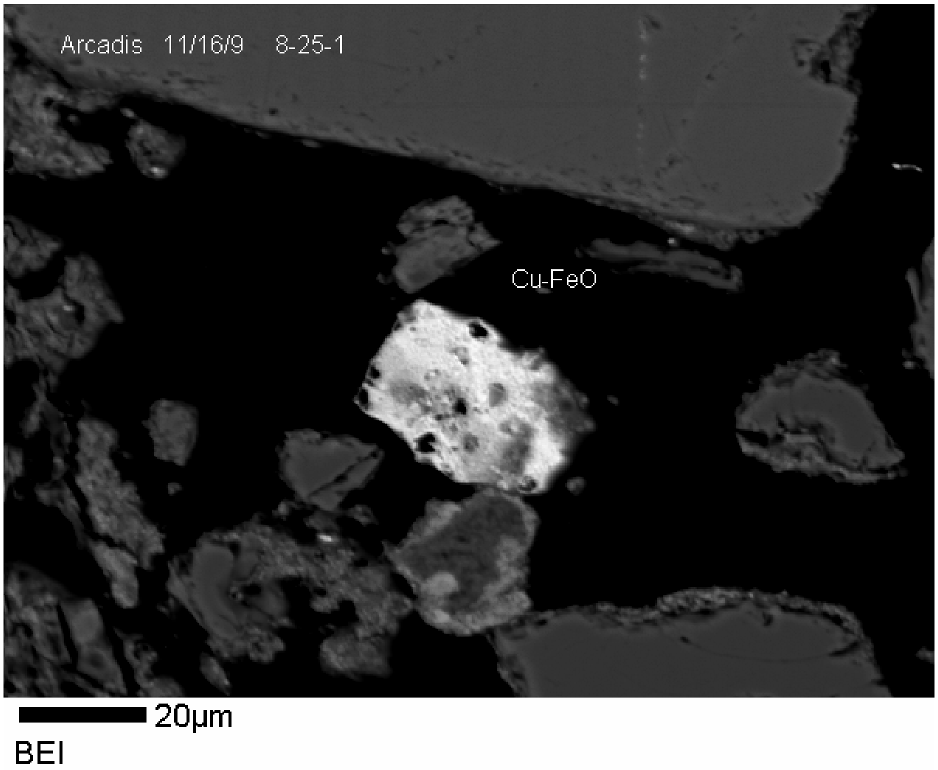
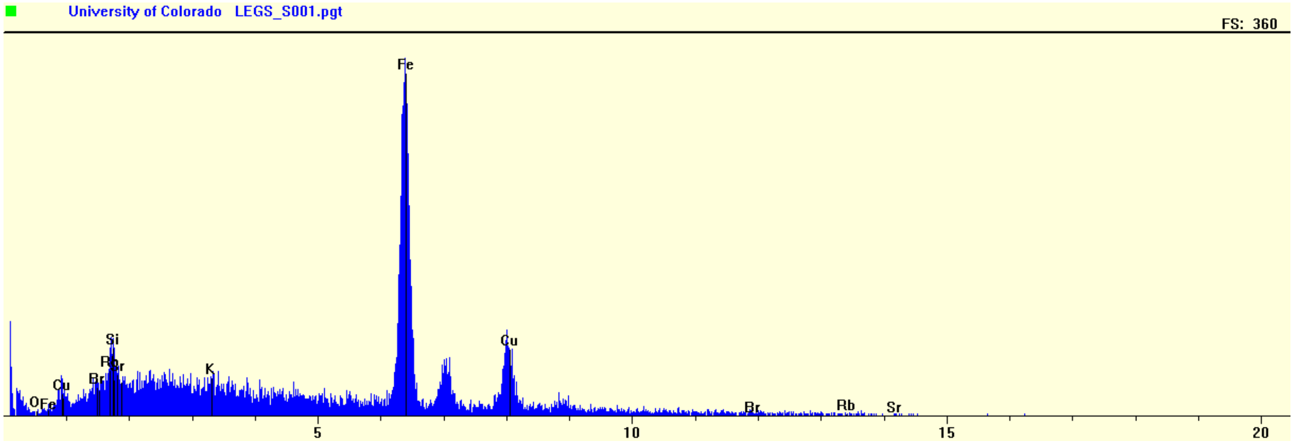


Figure No.
2b

Sample:
FID 8

Description:
Histogram 1



SPECIATION FIGURES

Figure No.
2c

Sample:
FID 8

Description:
Micrograph 2

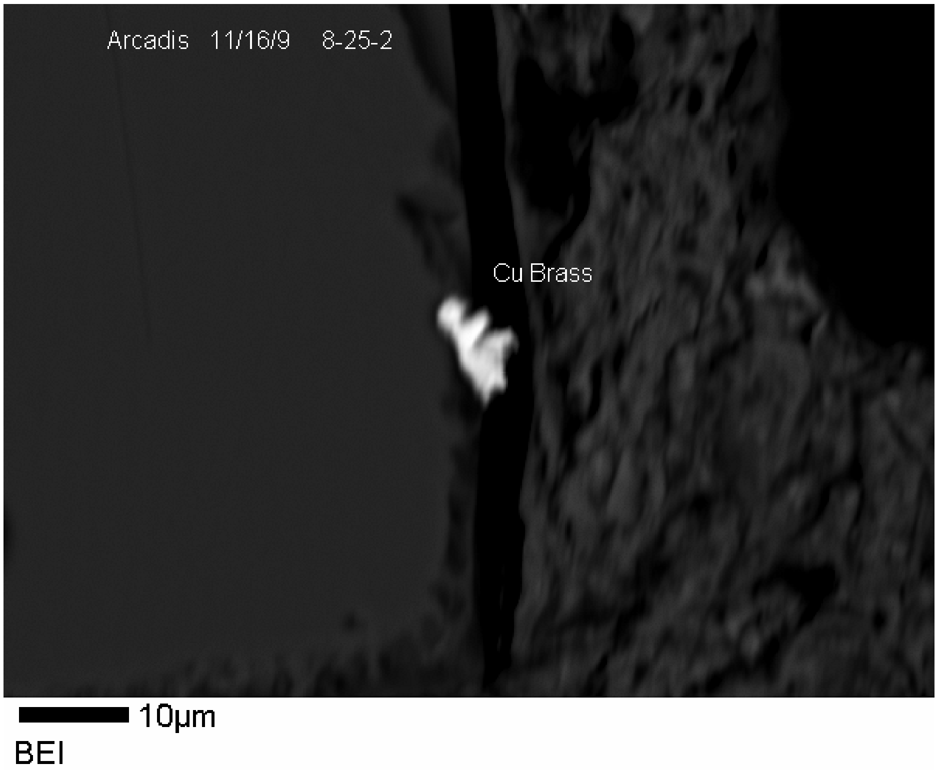
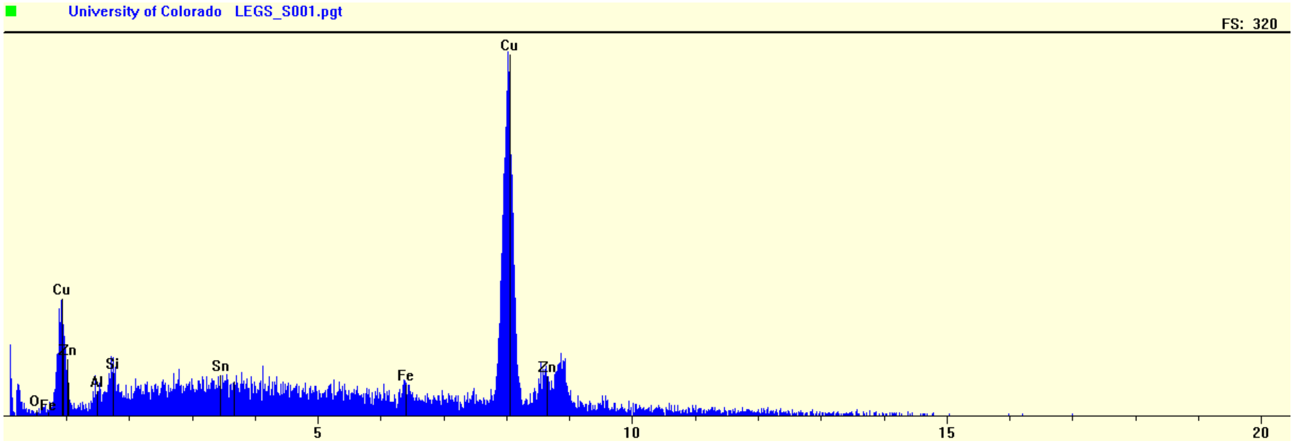


Figure No.
2d

Sample:
FID 8

Description:
Histogram 2



SPECIATION FIGURES

Figure No.
2e

Sample:
FID 8

Description:
Micrograph 3

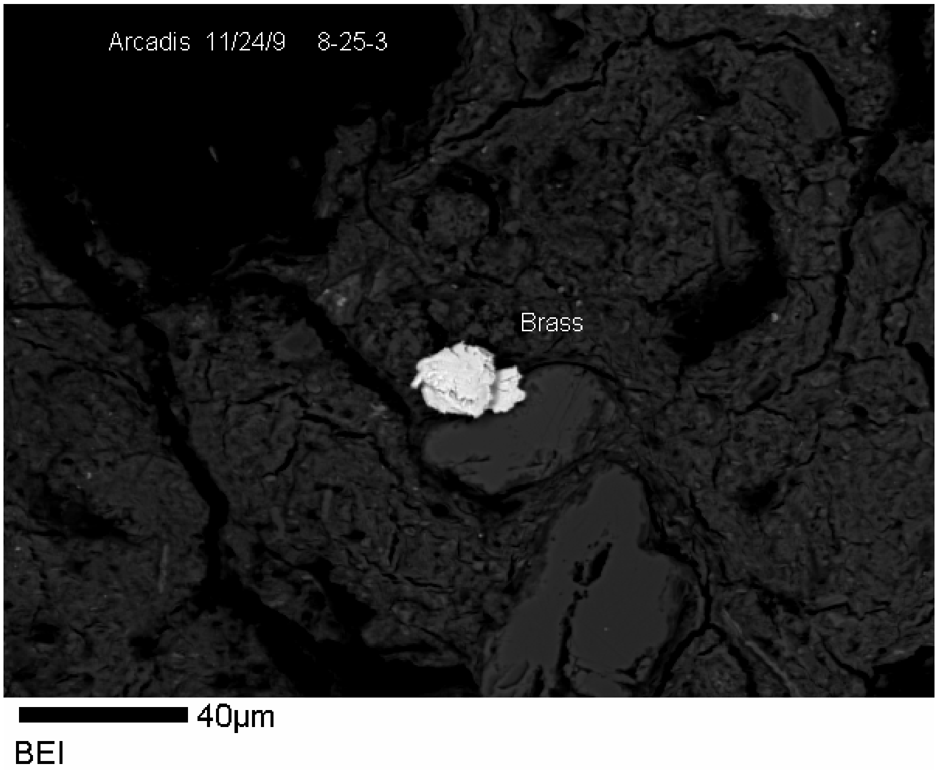
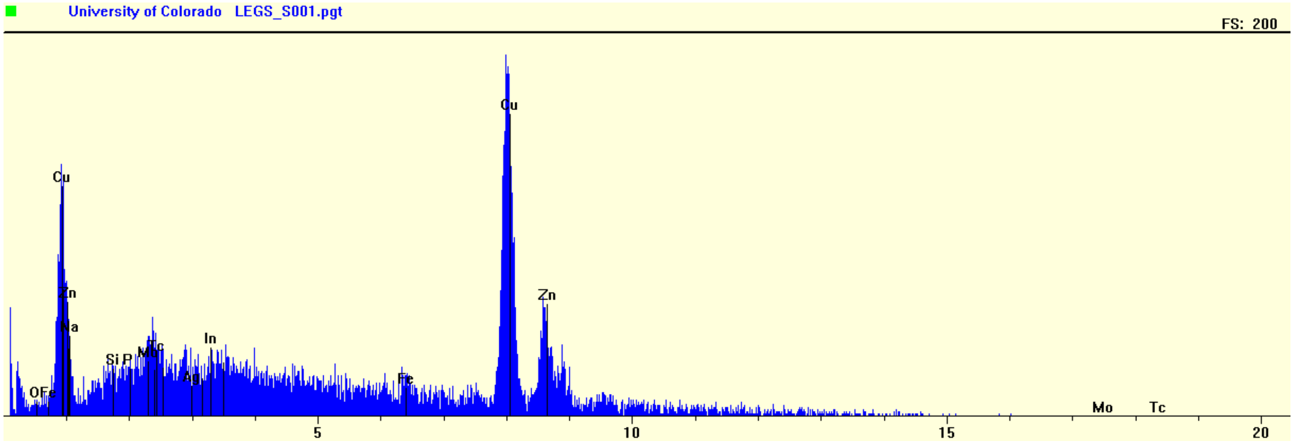


Figure No.
2f

Sample:
FID 8

Description:
Histogram 3



SPECIATION FIGURES

Figure No.
2g

Sample:
FID 8

Description:
Micrograph 4

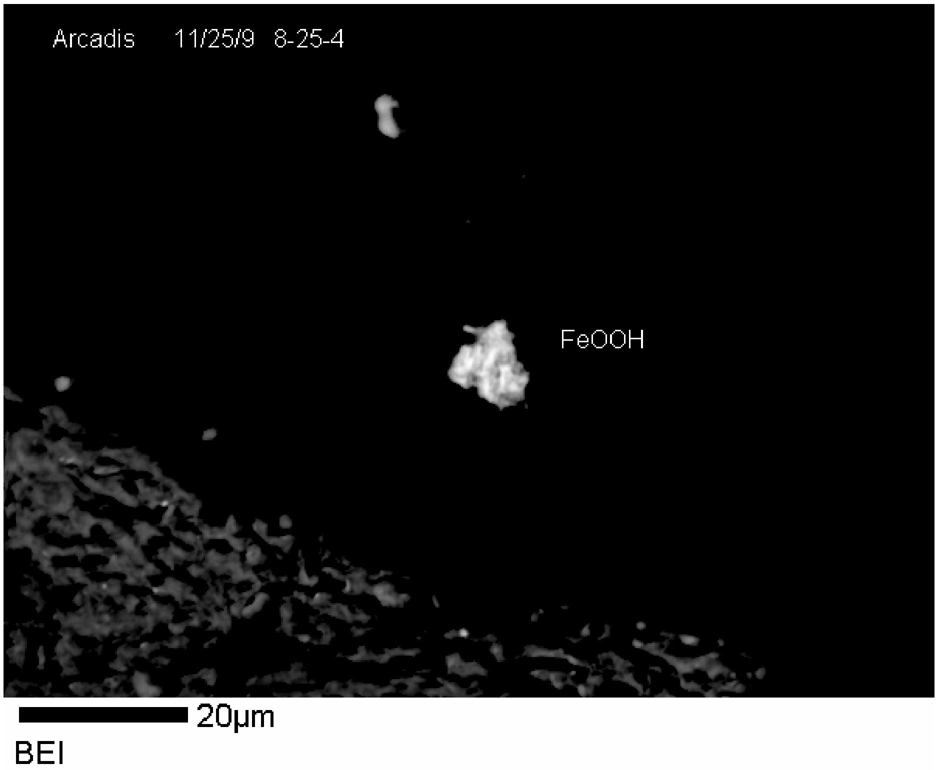
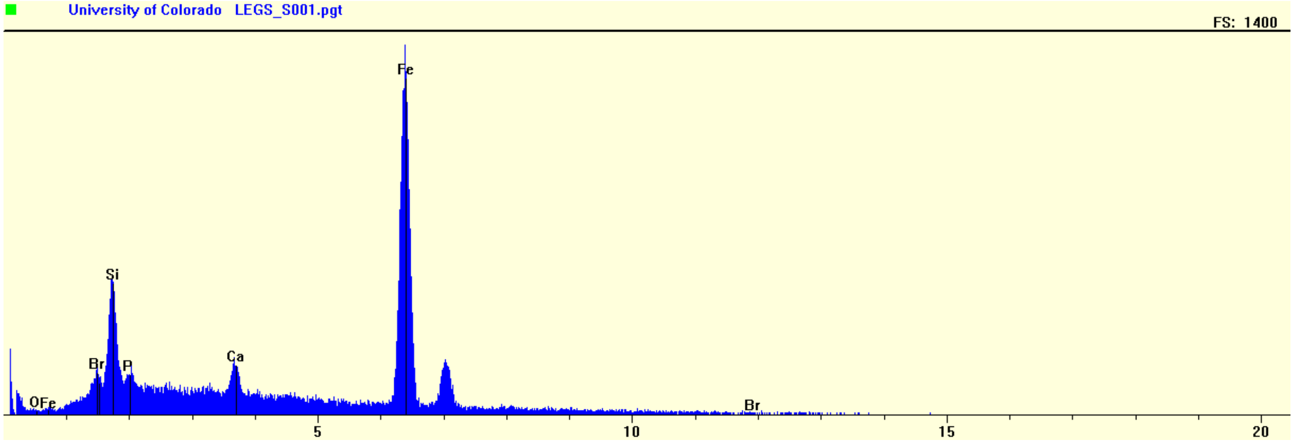


Figure No.
2h

Sample:
FID 8

Description:
Histogram 4



SPECIATION FIGURES

Figure No.
3a

Sample:
FID 10

Description:
Micrograph 1

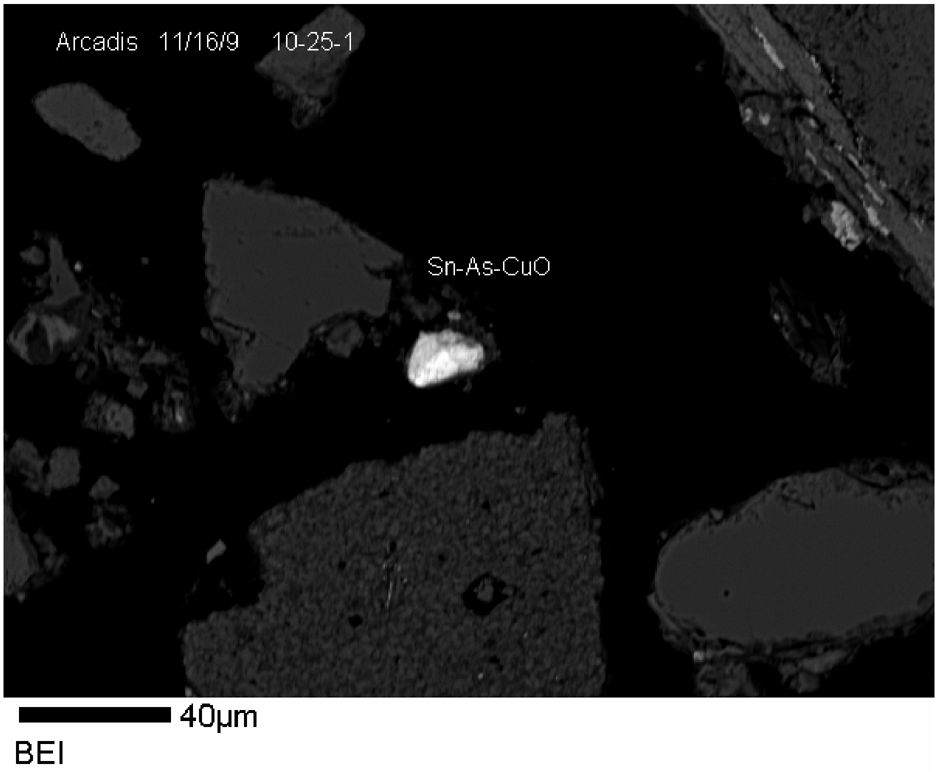
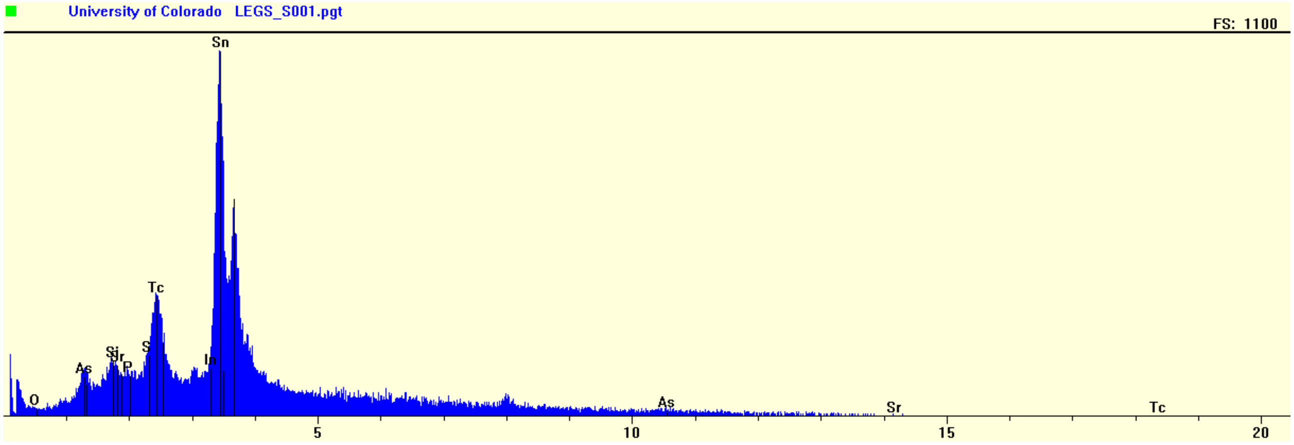


Figure No.
3b

Sample:
FID 10

Description:
Histogram 1



SPECIATION FIGURES

Figure No.
3c

Sample:
FID 10

Description:
Micrograph 2

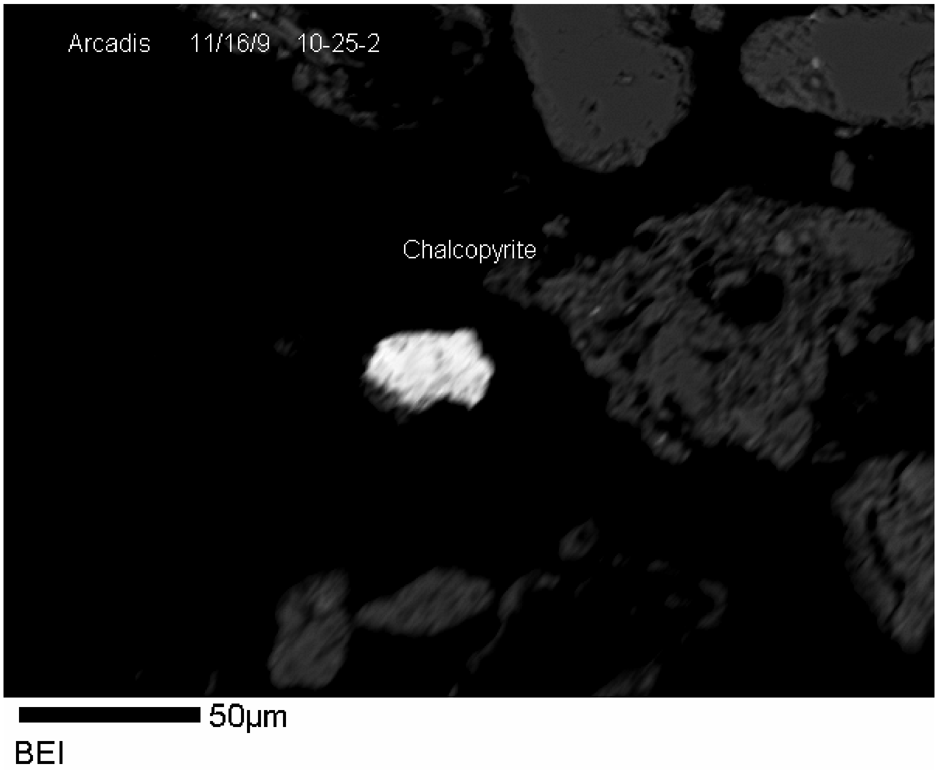
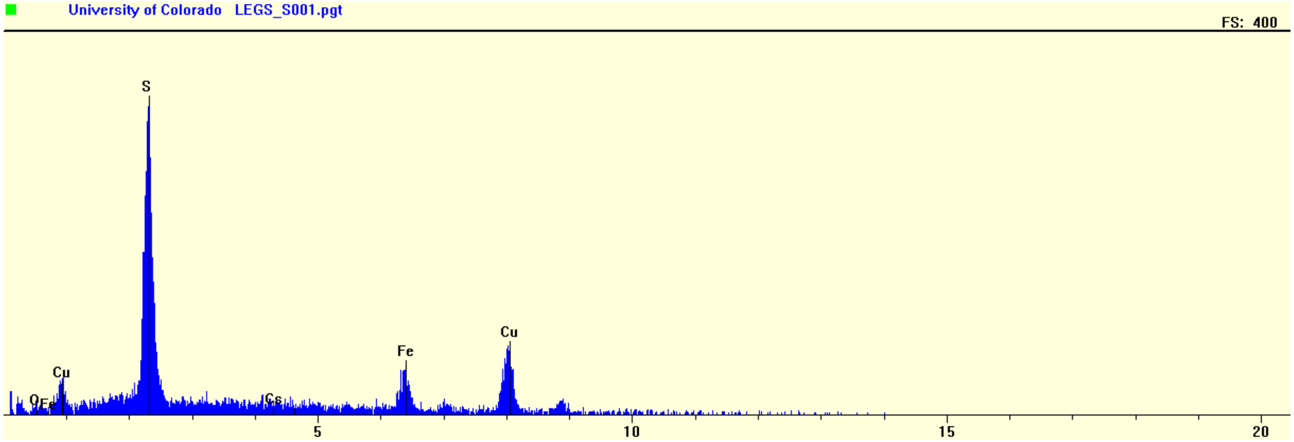


Figure No.
3d

Sample:
FID 10

Description:
Histogram 2



SPECIATION FIGURES

Figure No.
3e

Sample:
FID 10

Description:
Micrograph 3

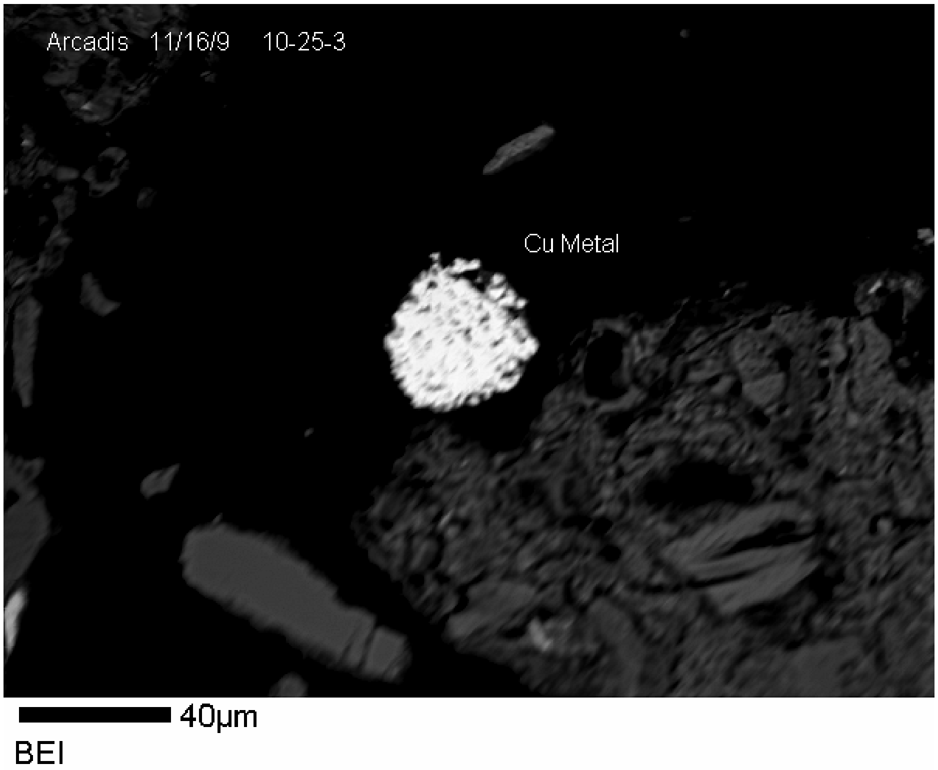
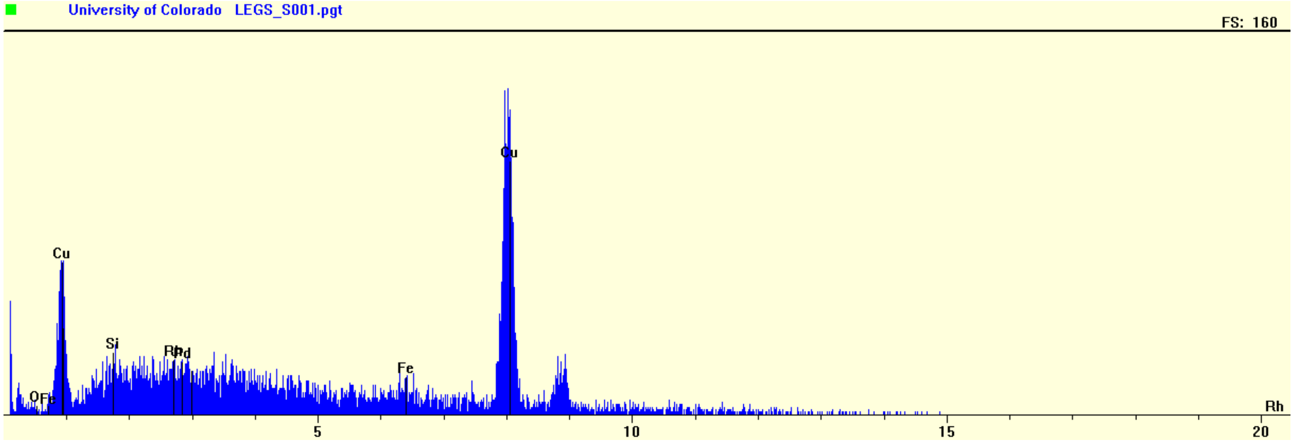


Figure No.
3f

Sample:
FID 10

Description:
Histogram 3



SPECIATION FIGURES

Figure No.
3g

Sample:
FID 10

Description:
Micrograph 4

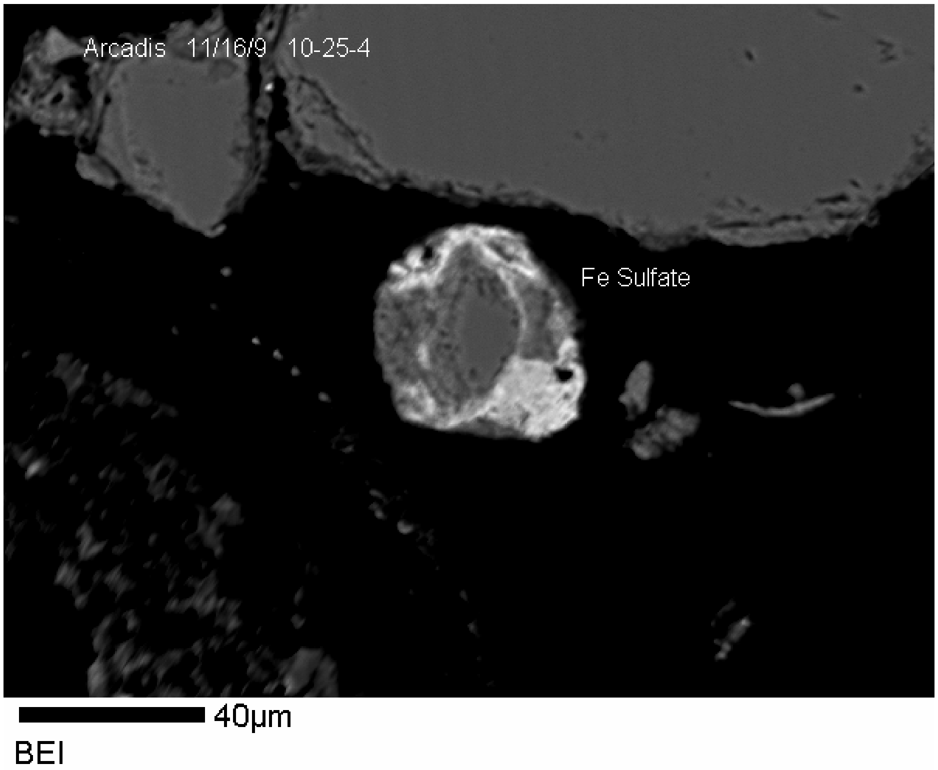
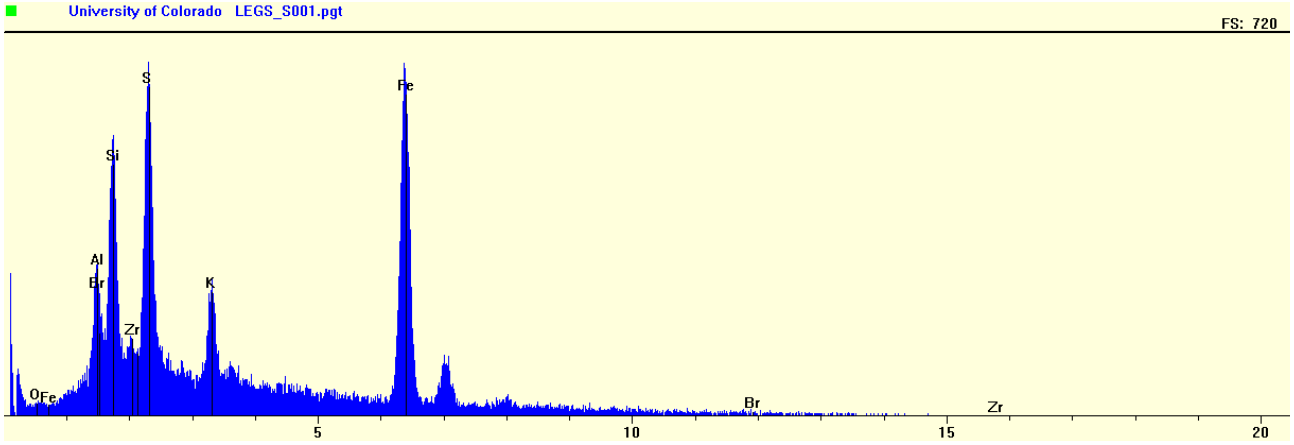


Figure No.
3h

Sample:
FID 10

Description:
Histogram 4



SPECIATION FIGURES

Figure No.
3i

Sample:
FID 10

Description:
Micrograph 5

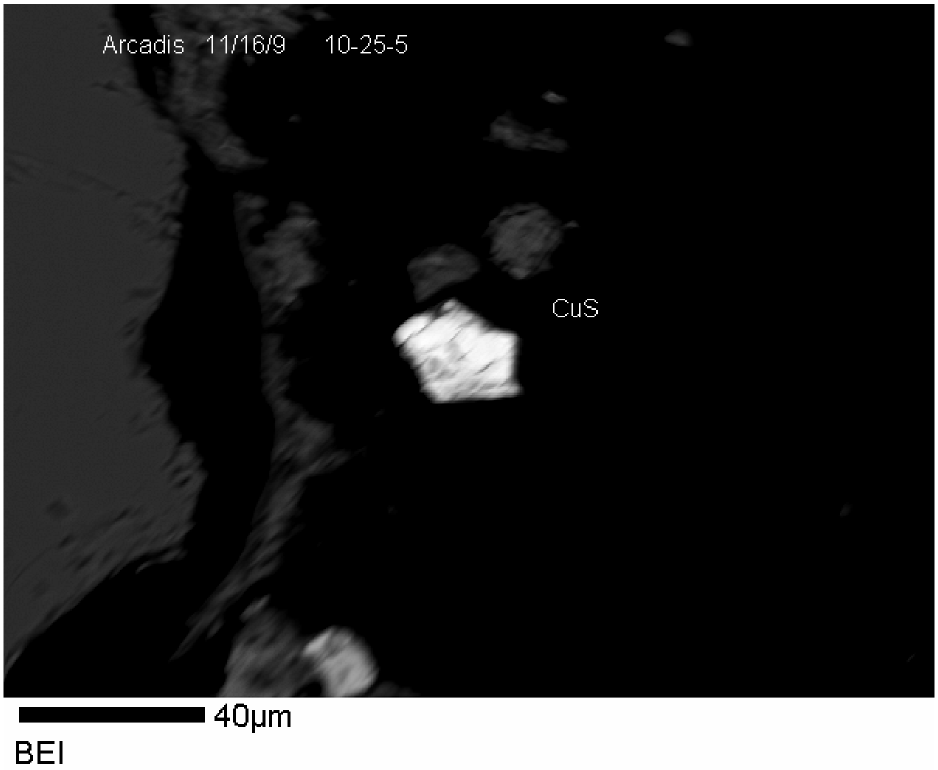
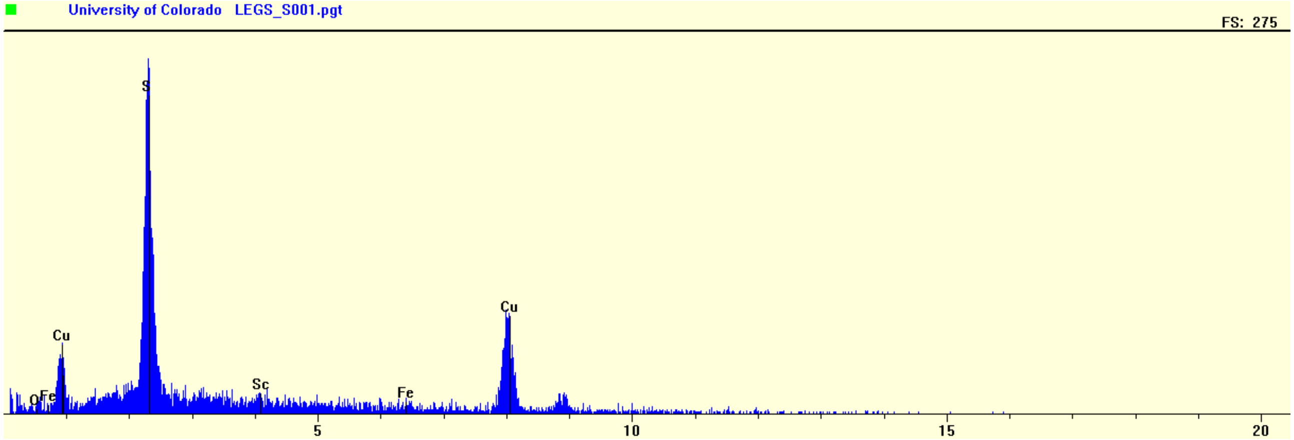


Figure No.
3j

Sample:
FID 10

Description:
Histogram 5



SPECIATION FIGURES

Figure No.
4a

Sample:
FID 12

Description:
Micrograph 1

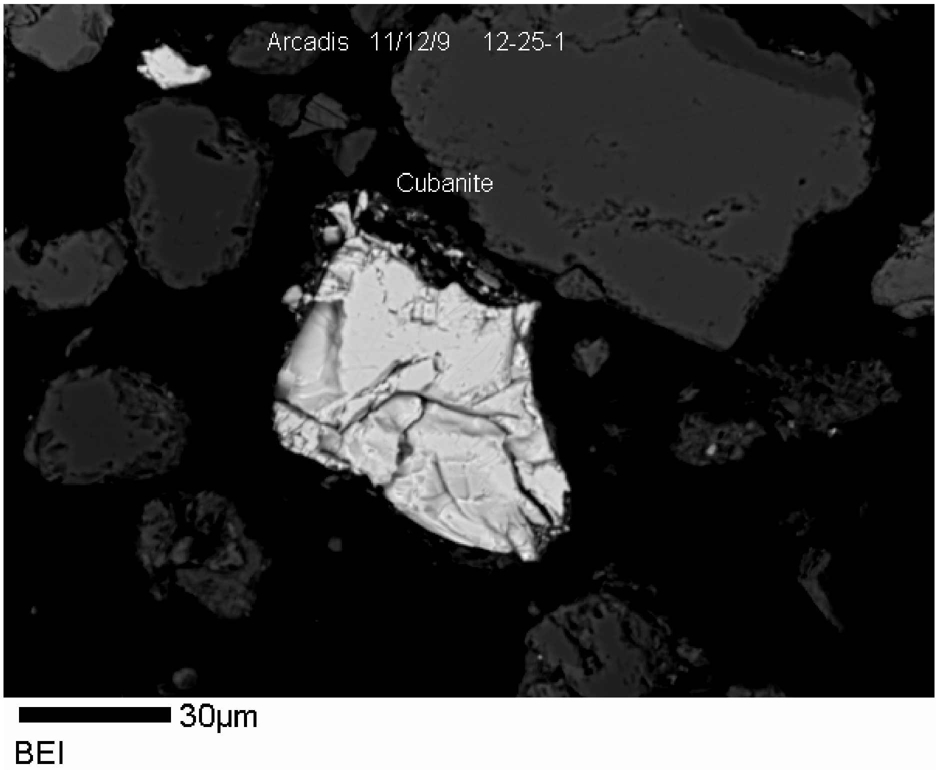
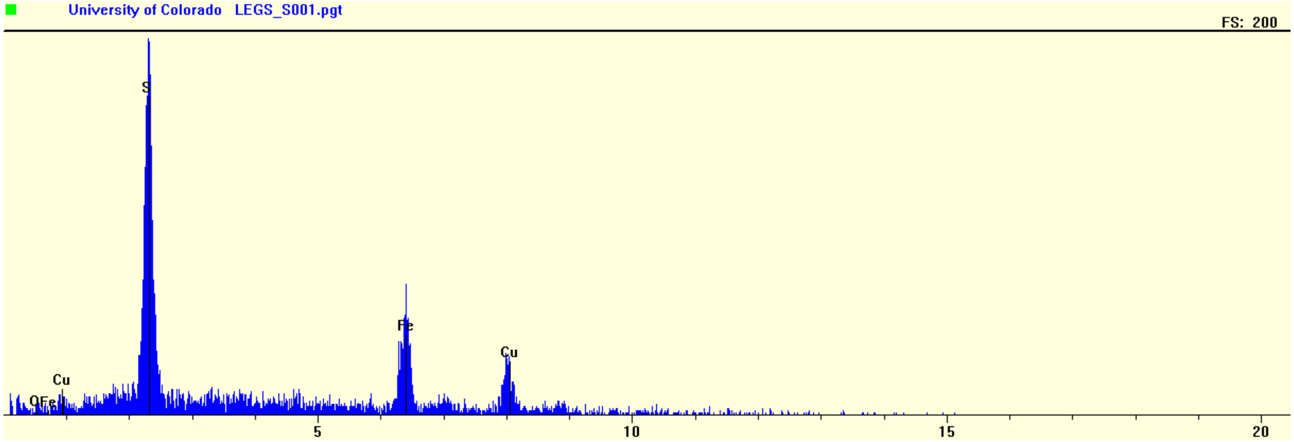


Figure No.
4b

Sample:
FID 12

Description:
Histogram 1



SPECIATION FIGURES

Figure No.
4c

Sample:
FID 12

Description:
Micrograph 2

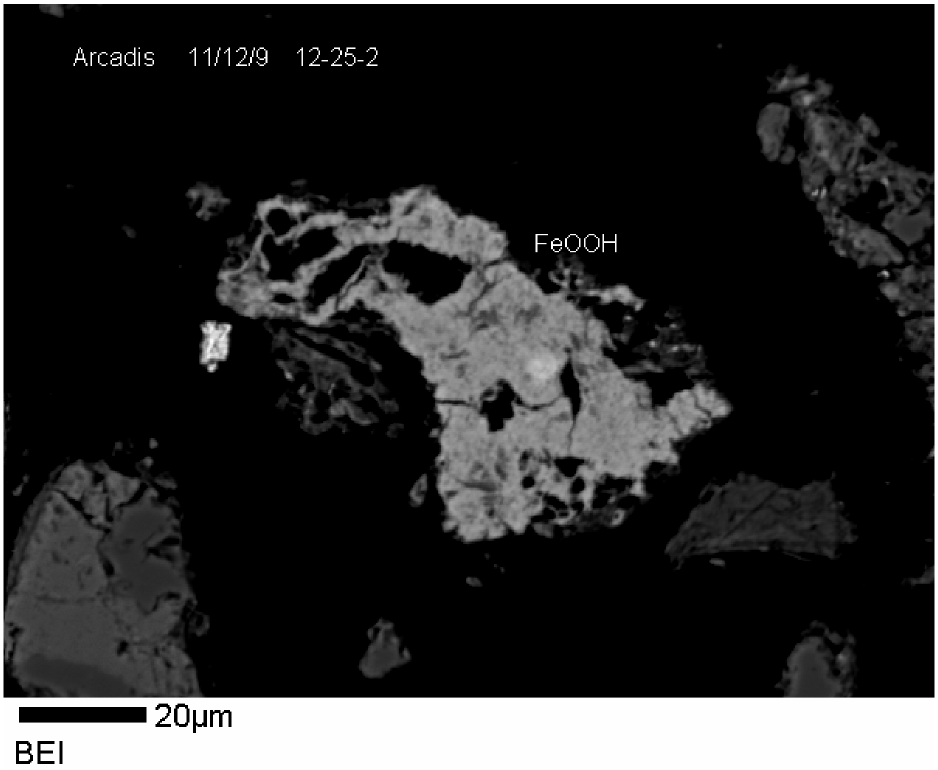
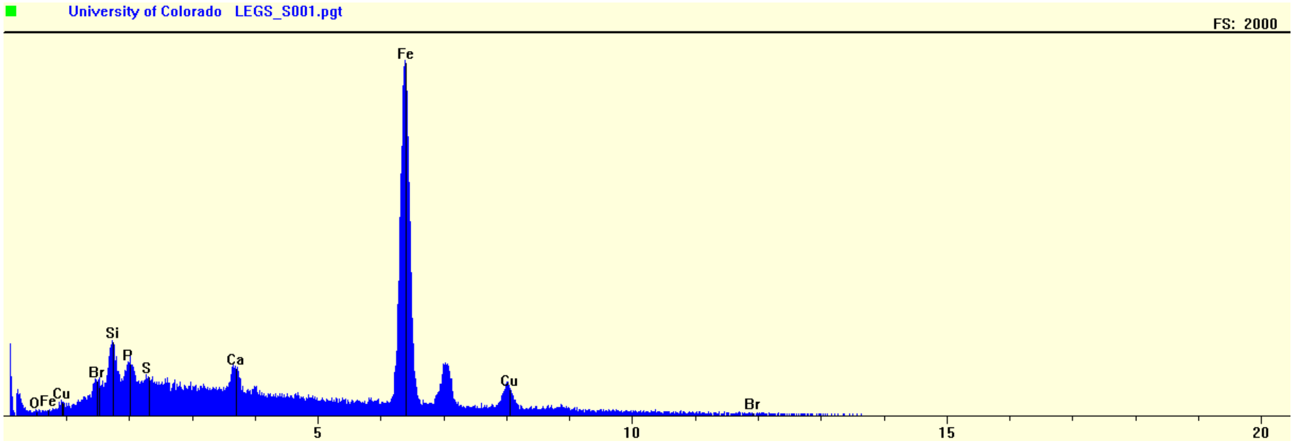


Figure No.
4d

Sample:
FID 12

Description:
Histogram 2



SPECIATION FIGURES

Figure No.
4e

Sample:
FID 12

Description:
Micrograph 3

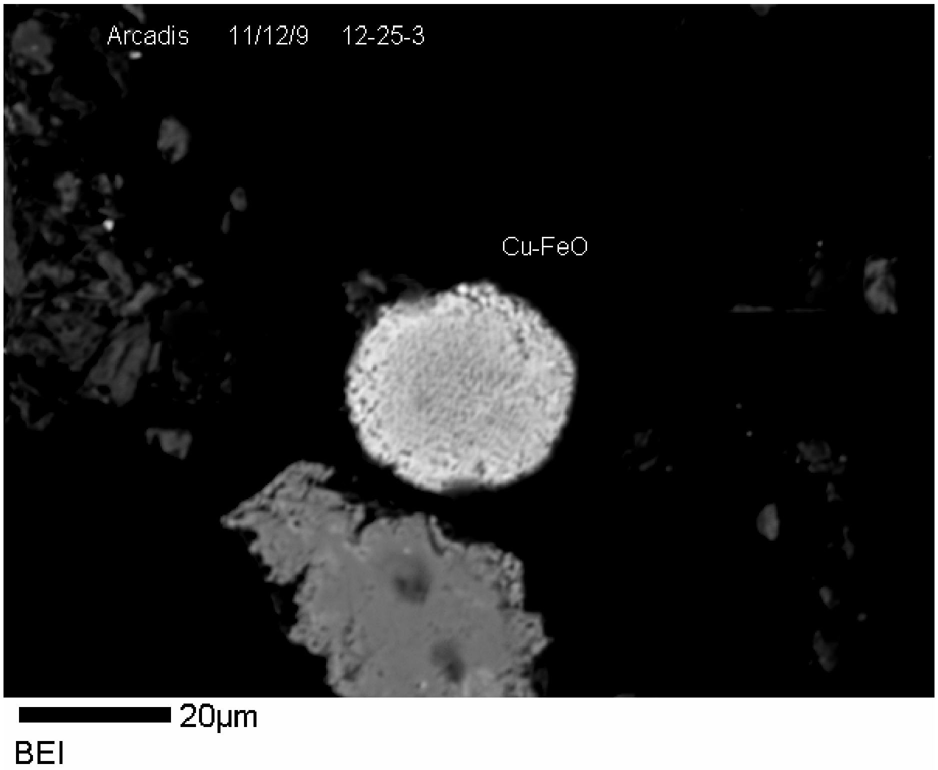
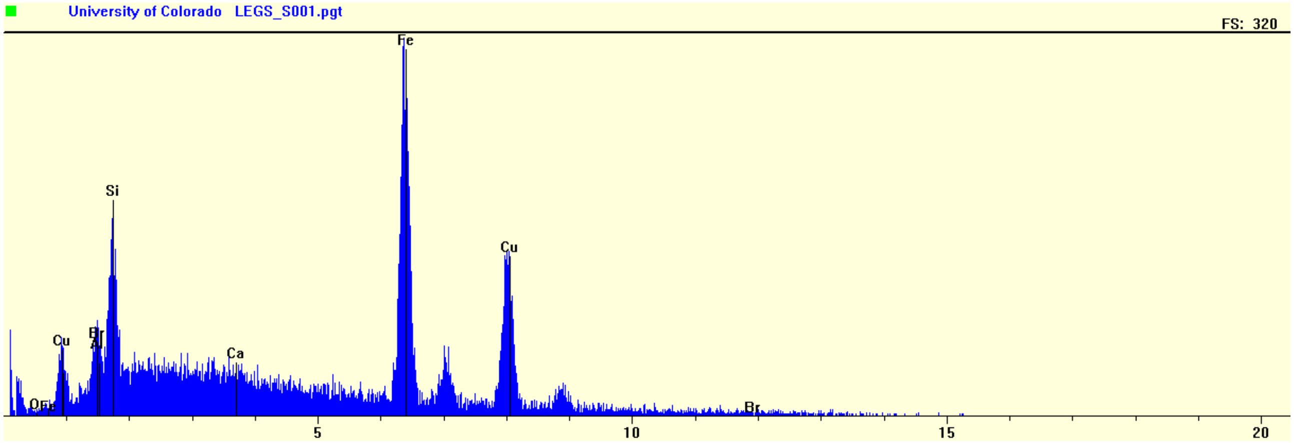


Figure No.
4f

Sample:
FID 12

Description:
Histogram 3



SPECIATION FIGURES

Figure No.
4g

Sample:
FID 12

Description:
Micrograph 4

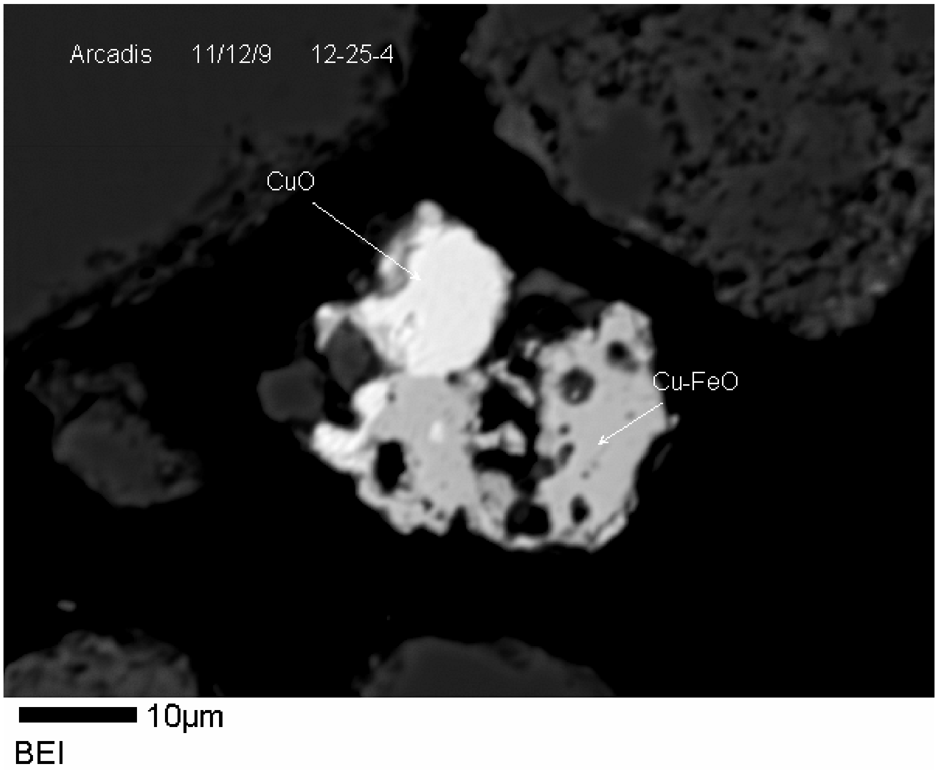
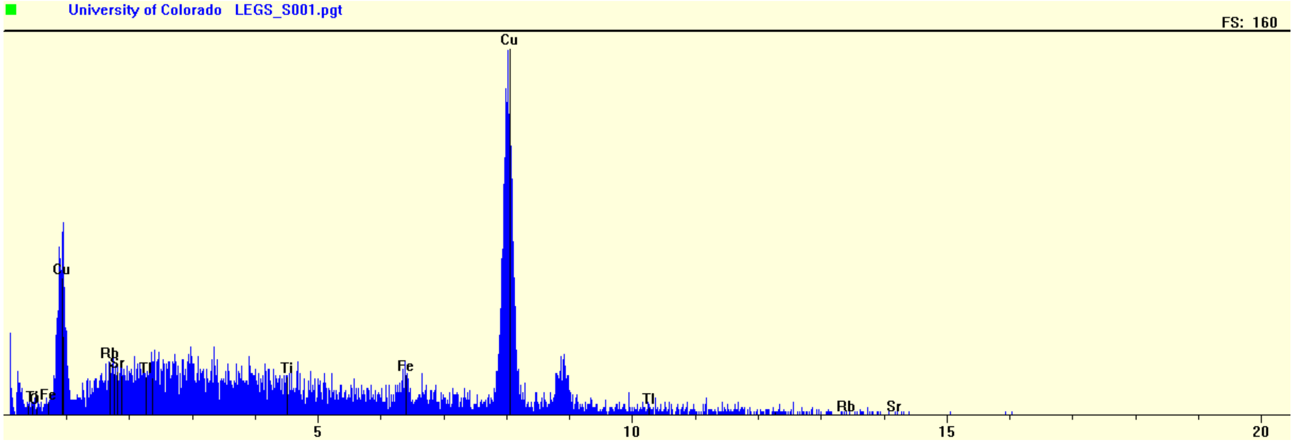


Figure No.
4h

Sample:
FID 12

Description:
Histogram 4



SPECIATION FIGURES

Figure No.
4i

Sample:
FID 12

Description:
Micrograph 5

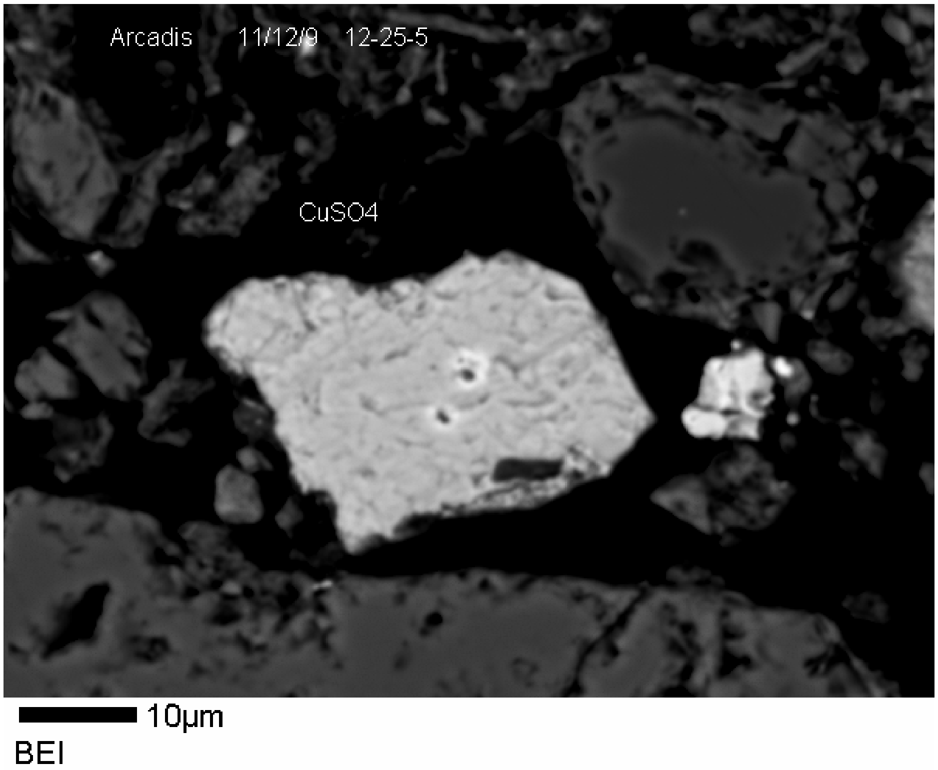
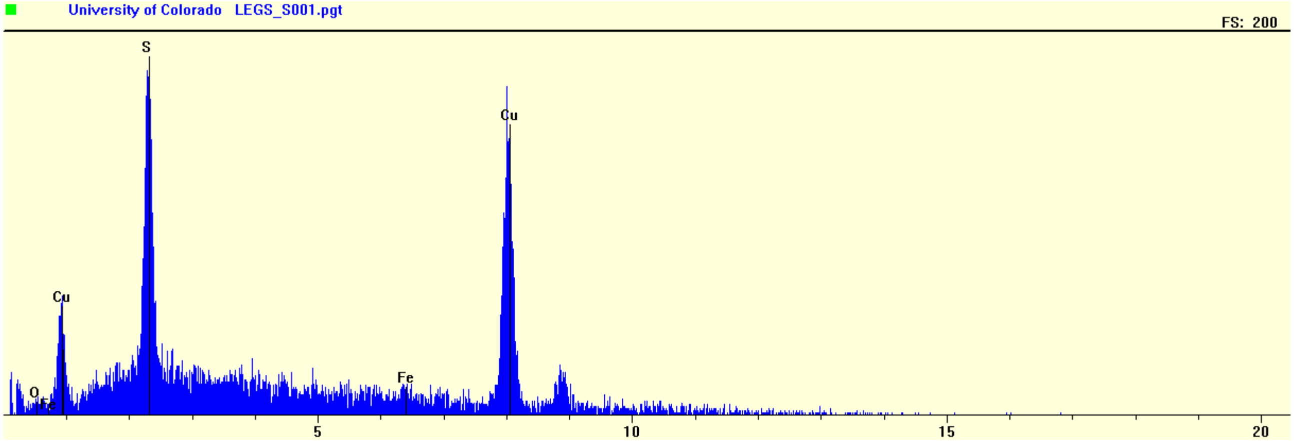


Figure No.
4j

Sample:
FID 12

Description:
Histogram 5



SPECIATION FIGURES

Figure No.
5a

Sample:
FID 17

Description:
Micrograph 1

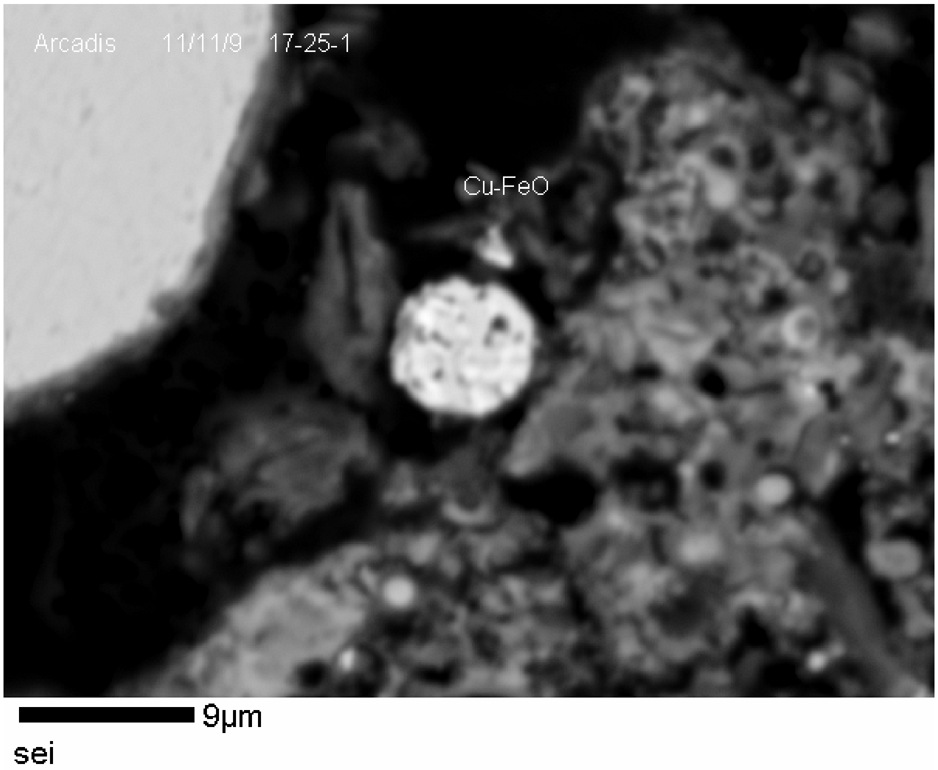
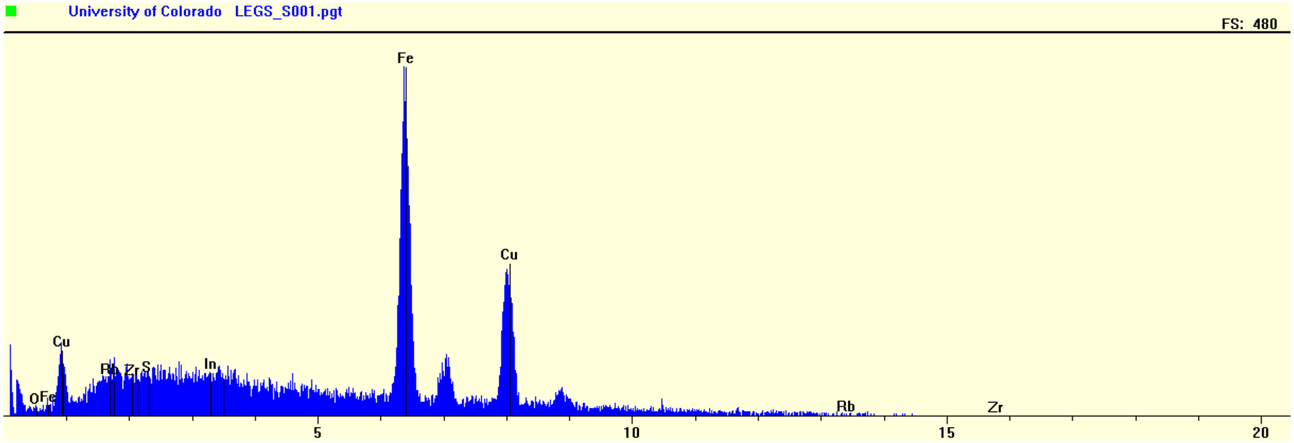


Figure No.
5b

Sample:
FID 17

Description:
Histogram 1



SPECIATION FIGURES

Figure No.
5c

Sample:
FID 17

Description:
Micrograph 2

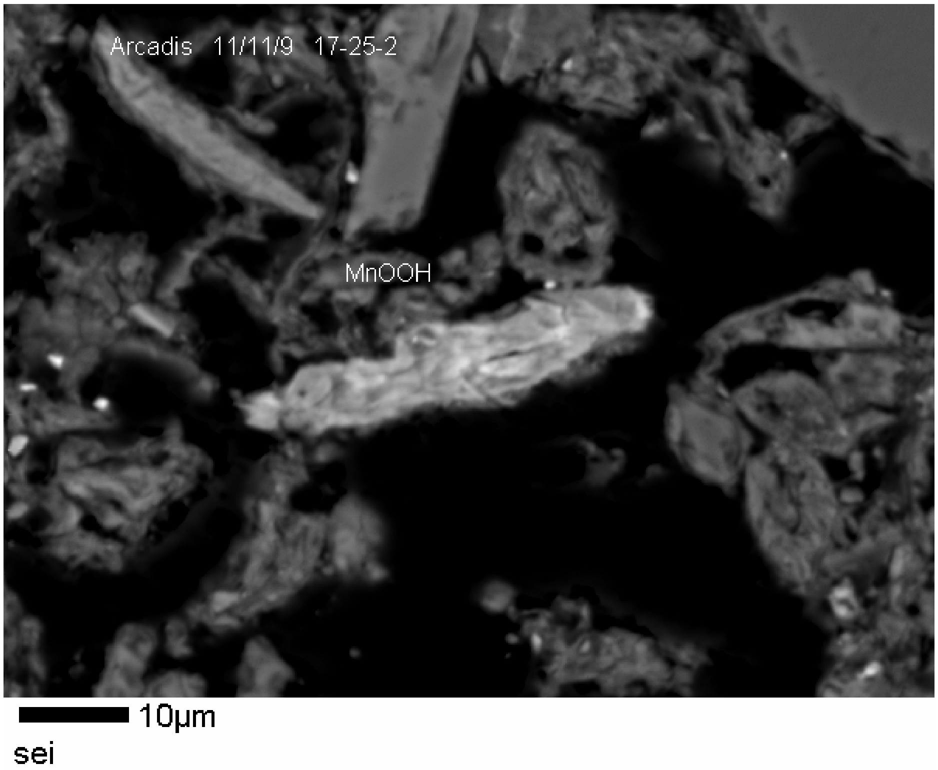
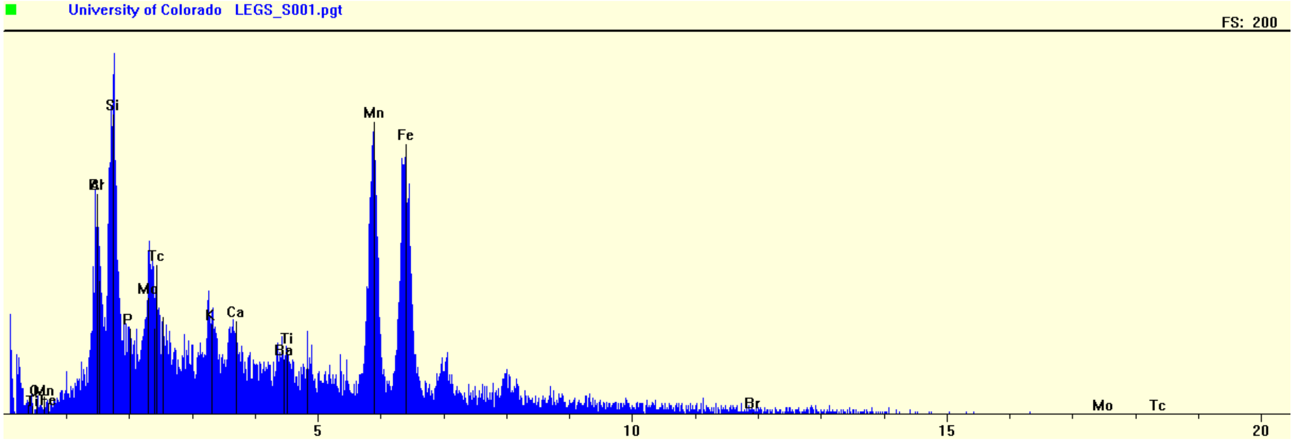


Figure No.
5d

Sample:
FID 17

Description:
Histogram 2



SPECIATION FIGURES

Figure No.
5e

Sample:
FID 17

Description:
Micrograph 3

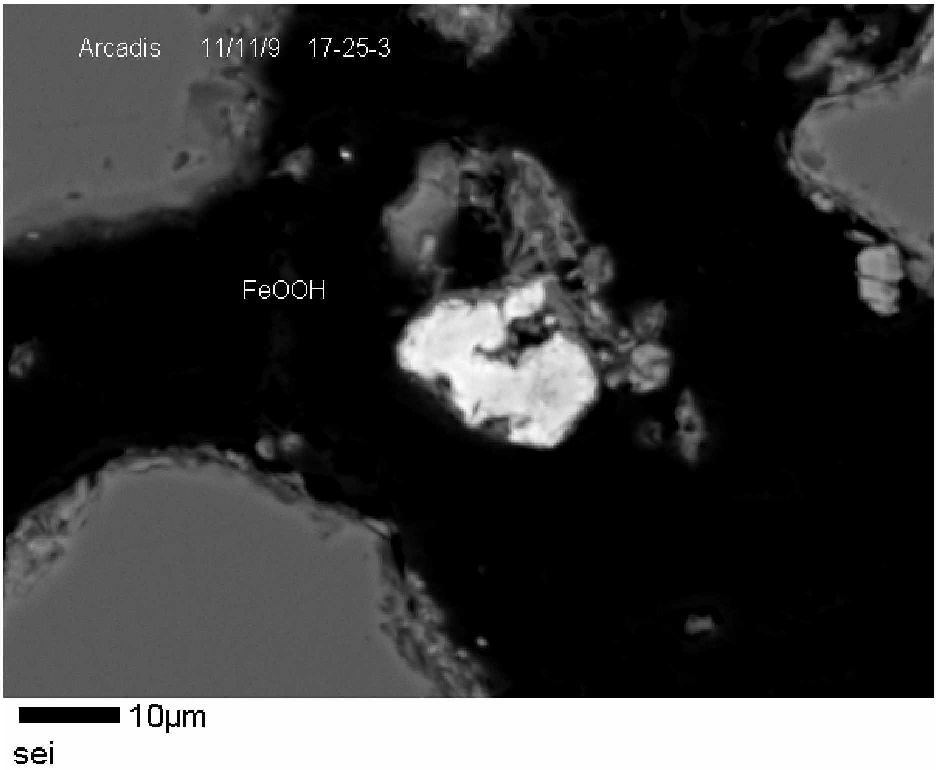
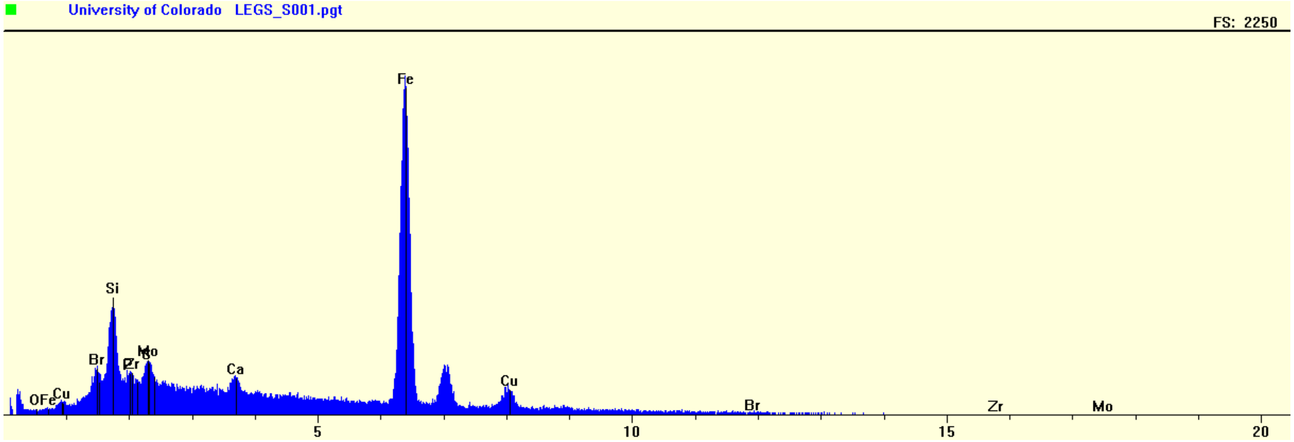


Figure No.
5f

Sample:
FID 17

Description:
Histogram 3



SPECIATION FIGURES

Figure No.
5g

Sample:
FID 17

Description:
Micrograph 4

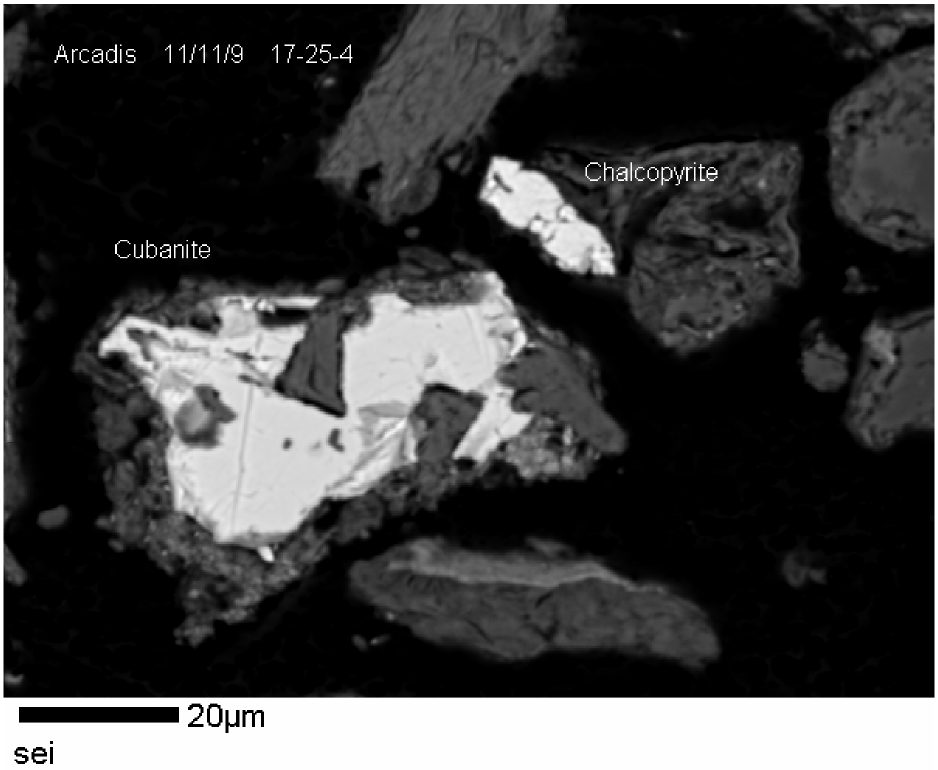
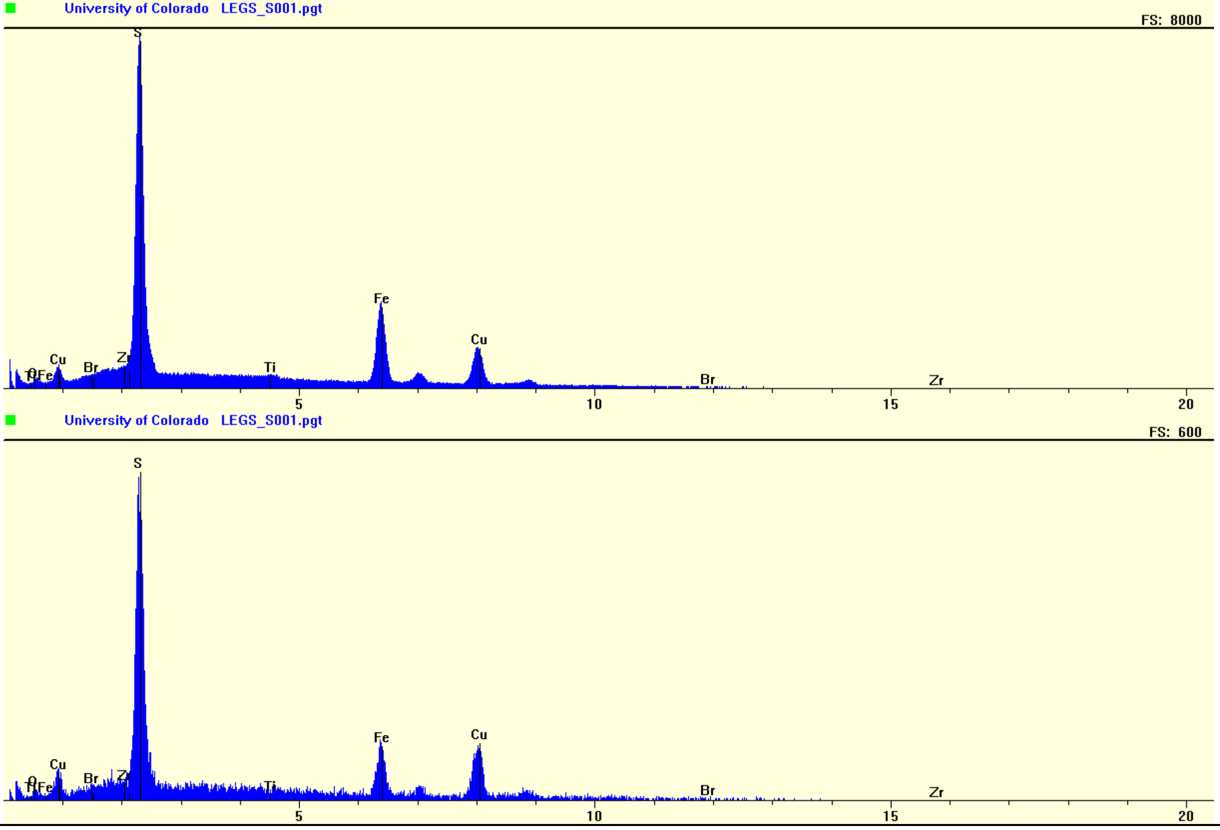


Figure No.
5h

Sample:
FID 17

Description:
Histogram 4



SPECIATION FIGURES

Figure No.
5i

Sample:
FID 17

Description:
Micrograph 5

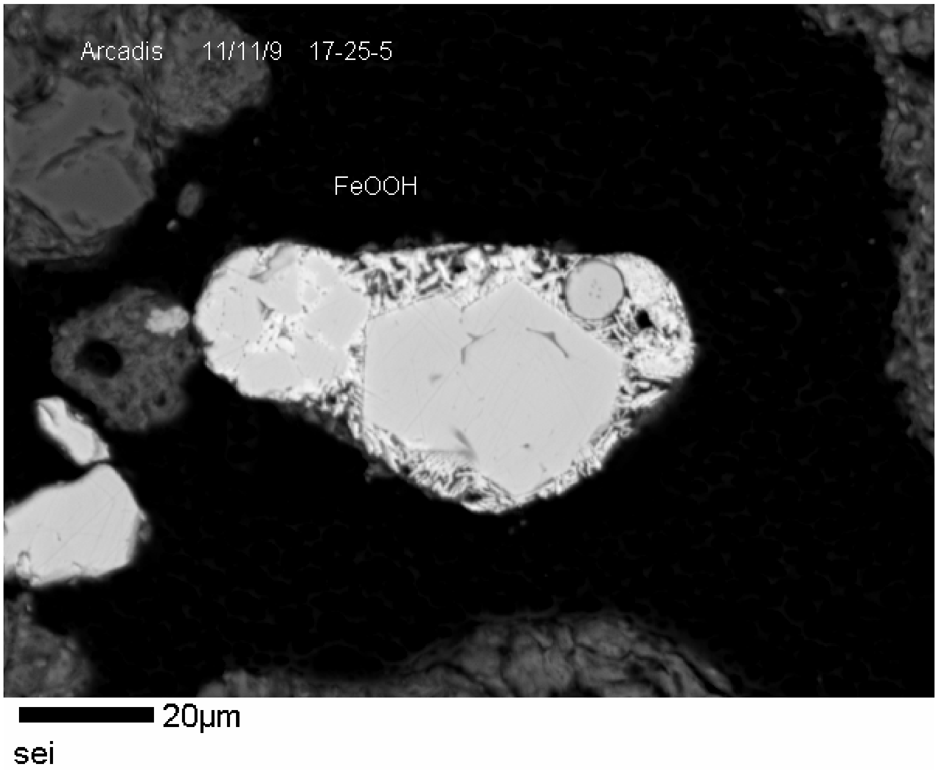
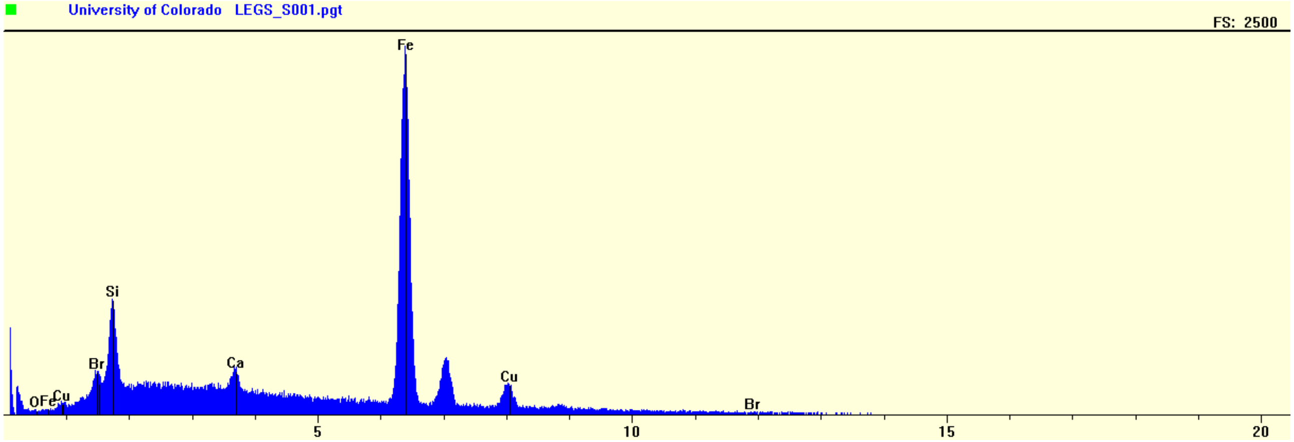


Figure No.
5j

Sample:
FID 17

Description:
Histogram 5



SPECIATION FIGURES

Figure No.
5k

Sample:
FID 17

Description:
Micrograph 6

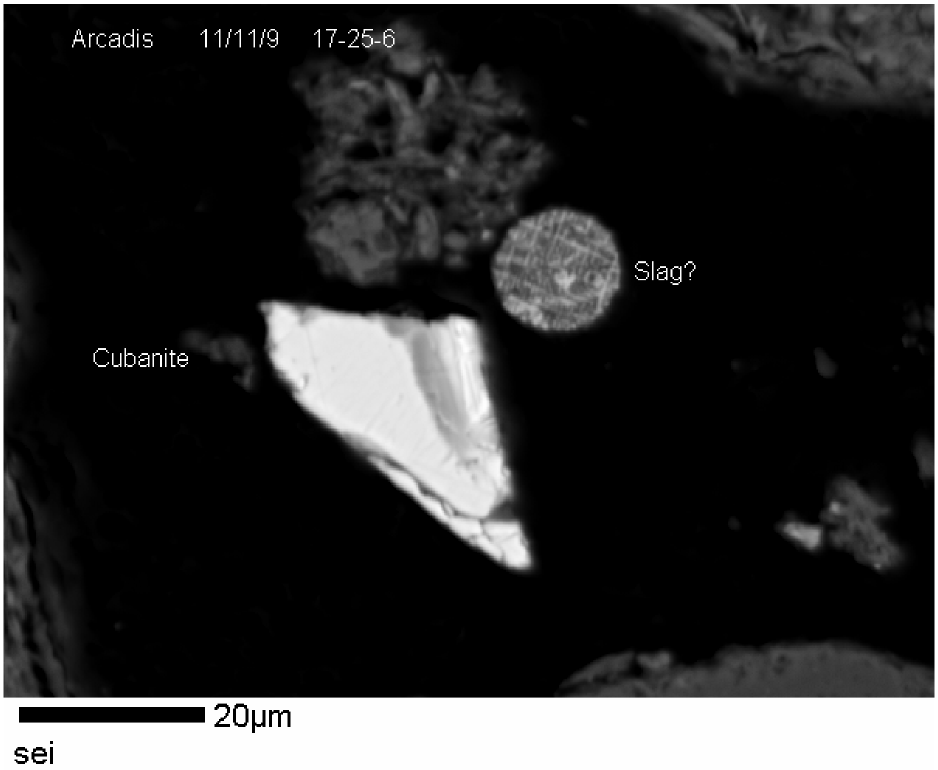
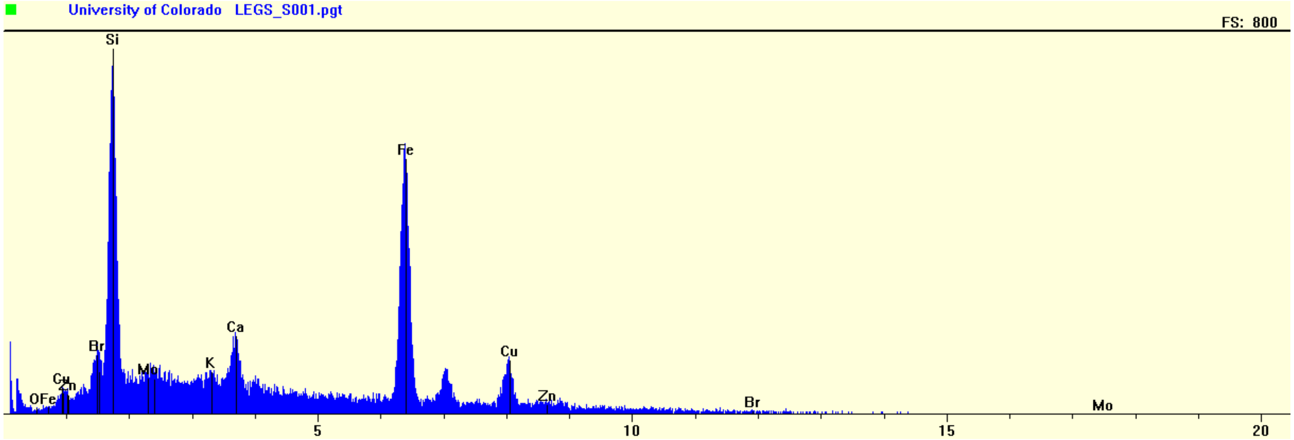


Figure No.
5l

Sample:
FID 17

Description:
Histogram 6



SPECIATION FIGURES

Figure No.
5m

Sample:
FID 17

Description:
Micrograph 7

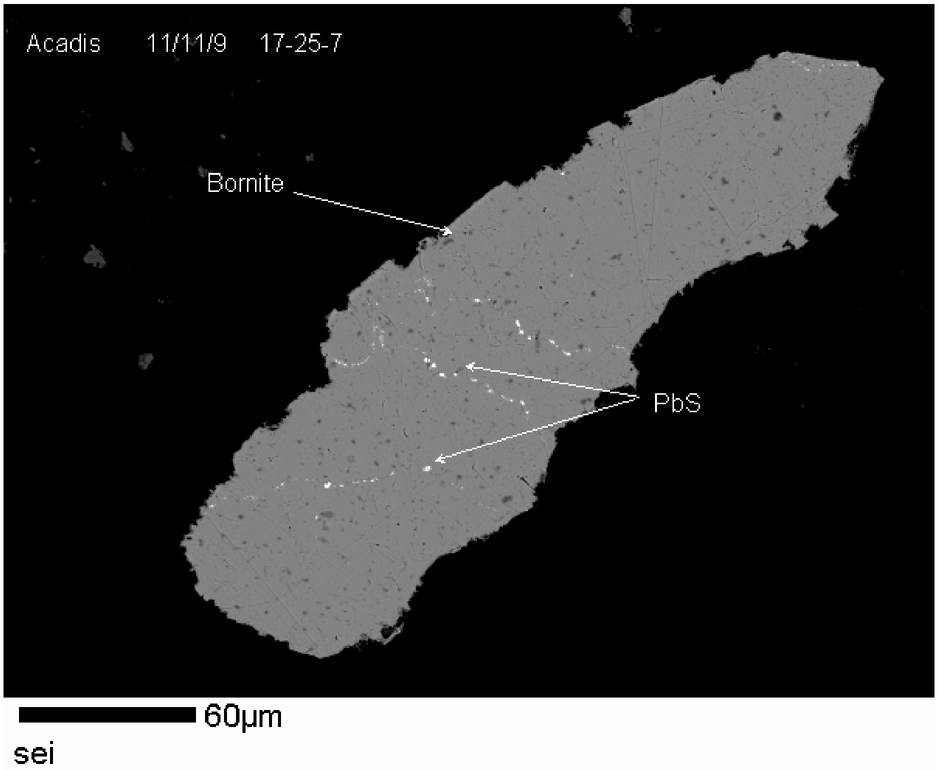
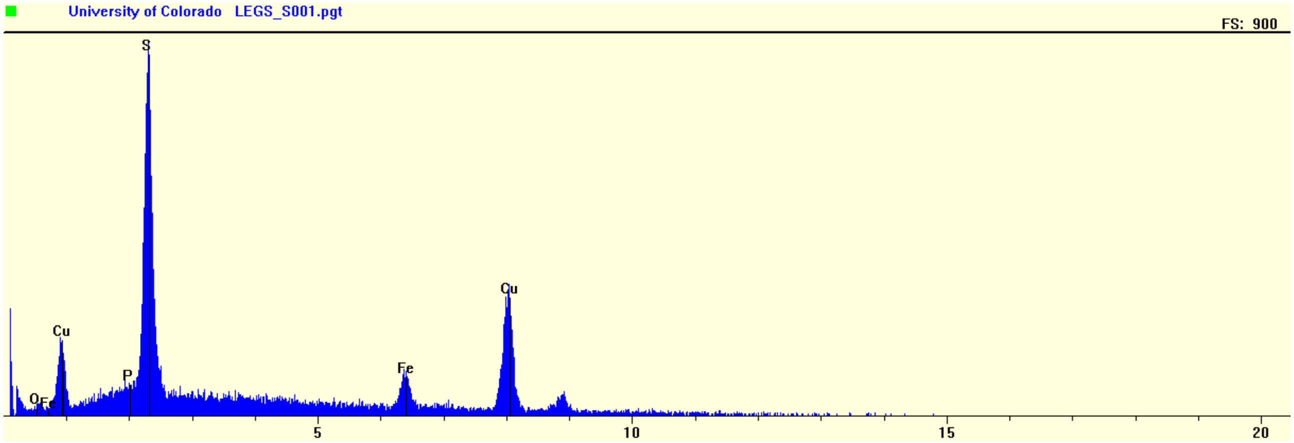


Figure No.
5n

Sample:
FID 17

Description:
Histogram 7



SPECIATION FIGURES

Figure No.
6a

Sample:
FID 18

Description:
Micrograph 1

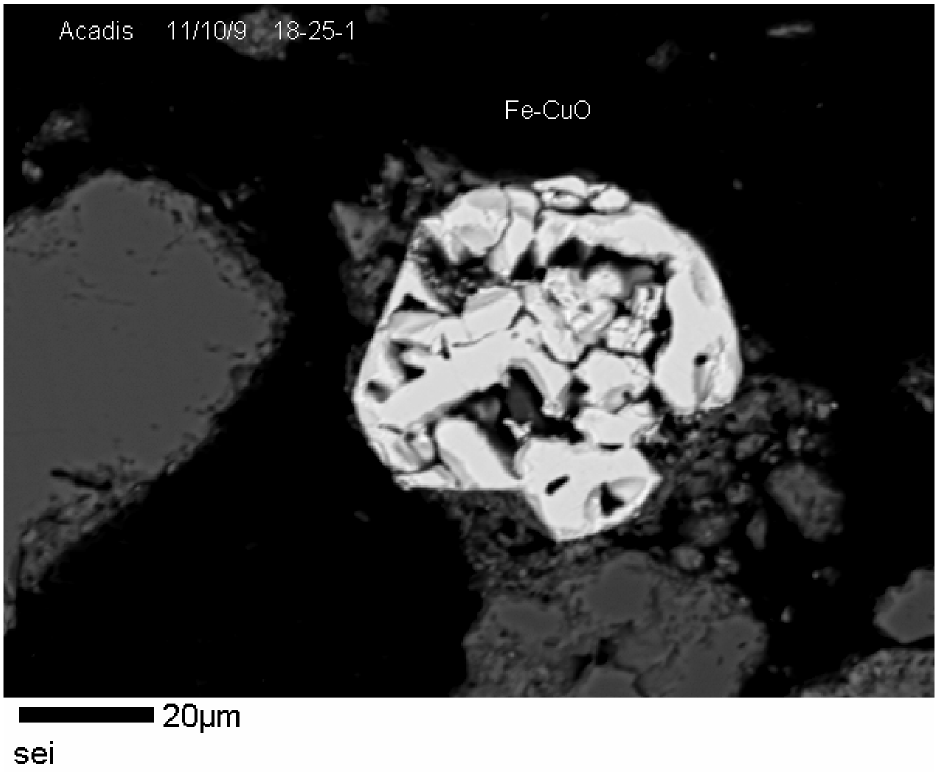
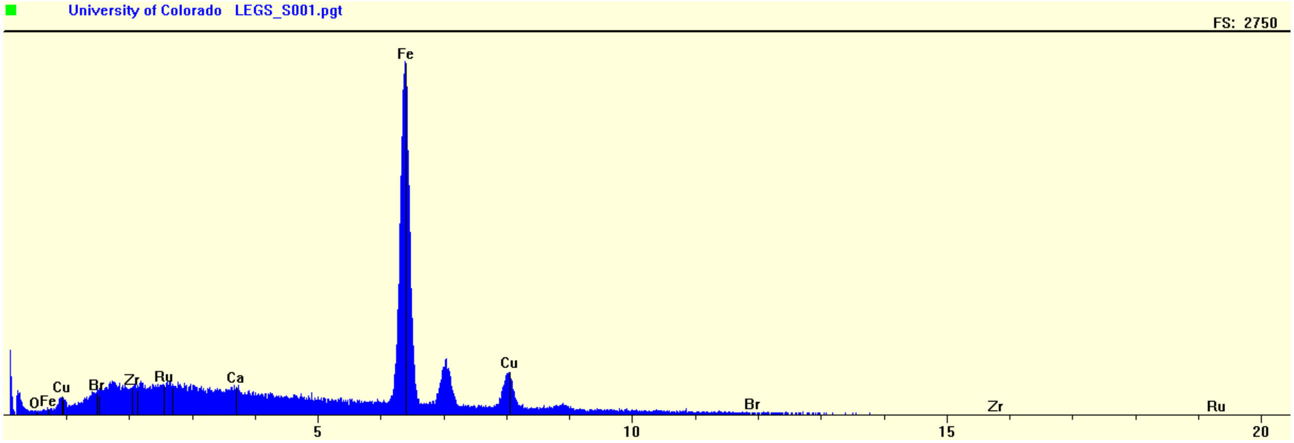


Figure No.
6b

Sample:
FID 18

Description:
Histogram 1



SPECIATION FIGURES

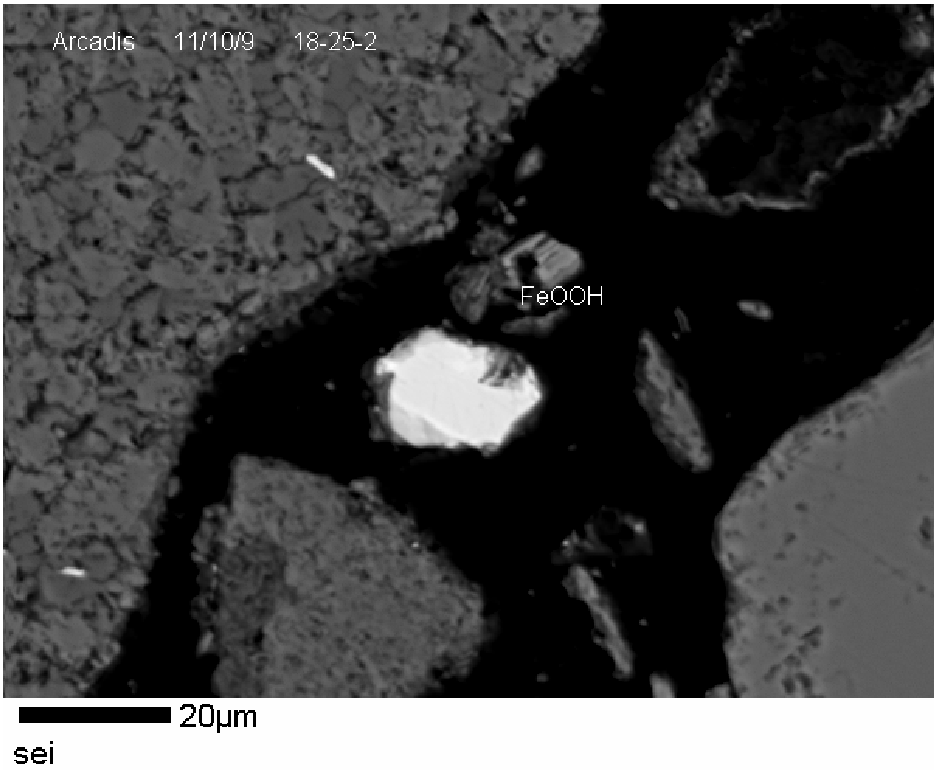
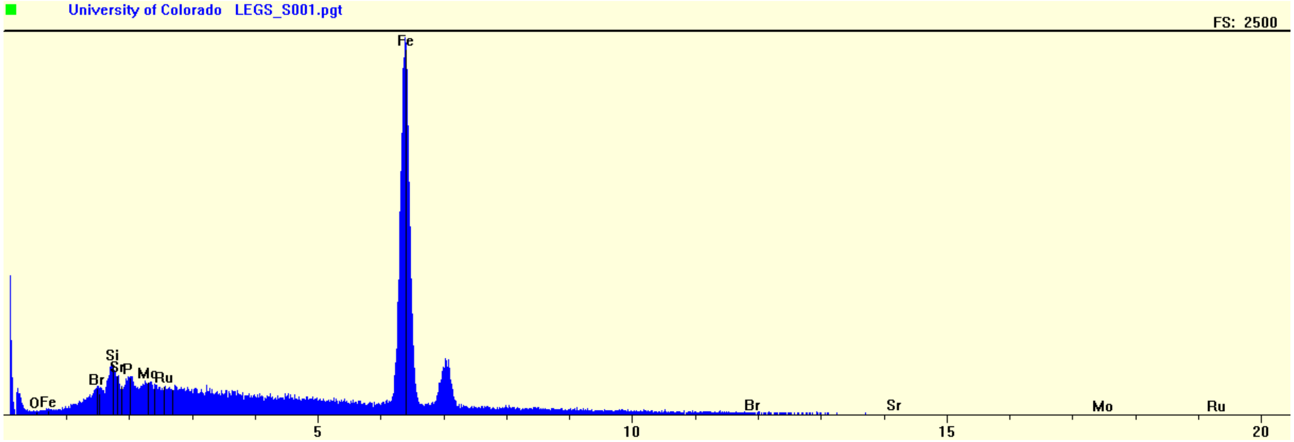
Figure No. **6c**	
Sample: FID 18 **Description:** Micrograph 2	

Figure No. **6d**	
Sample: FID 18 **Description:** Histogram 2	

SPECIATION FIGURES

Figure No.
6e

Sample:
FID 18

Description:
Micrograph 3

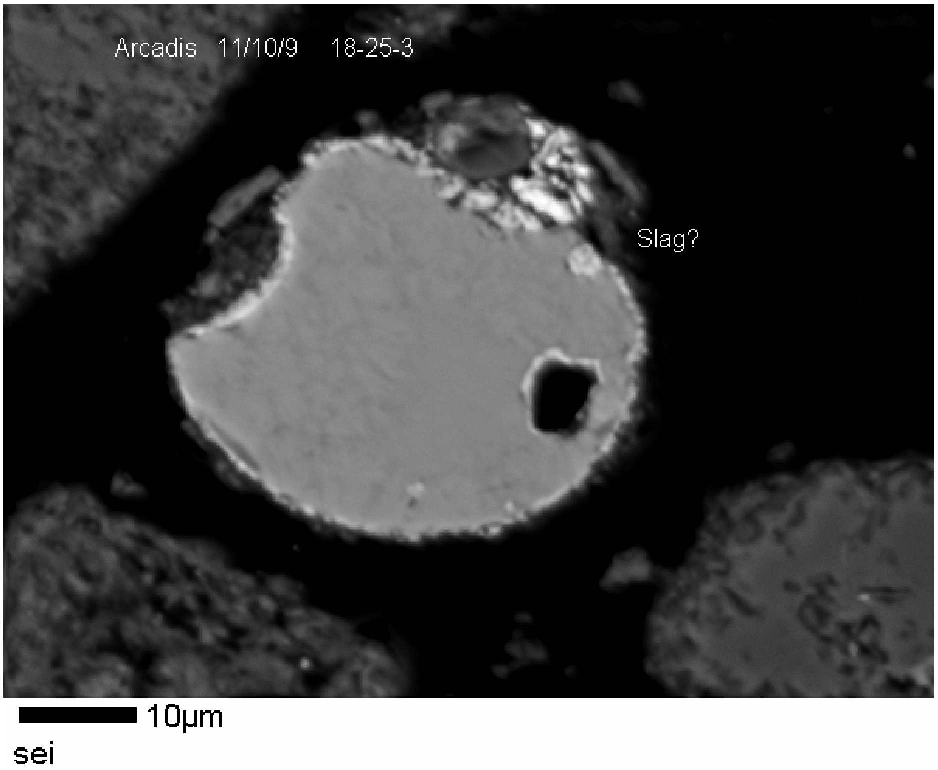


Figure No.
6f

Sample:
FID 18

Description:
Histogram 3

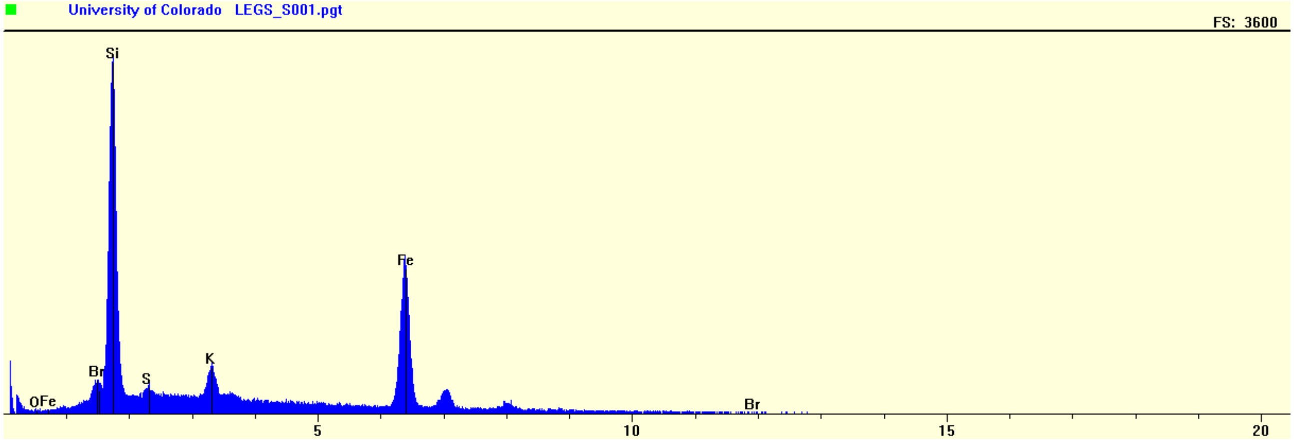


Figure No.
6g

Sample:
FID 18

Description:
Micrograph 4

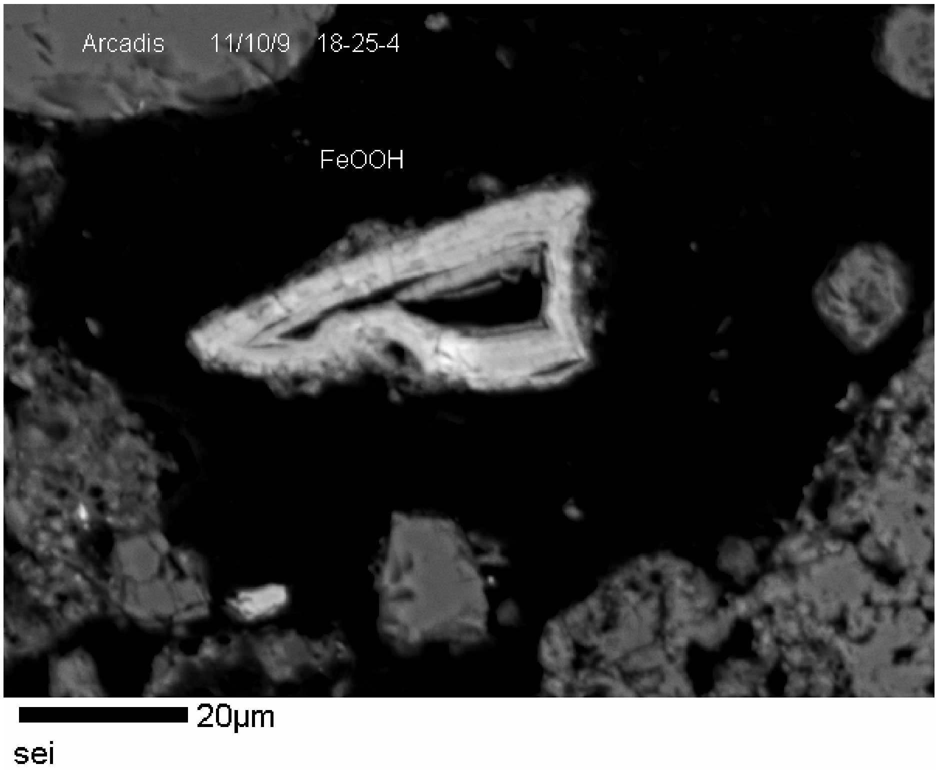
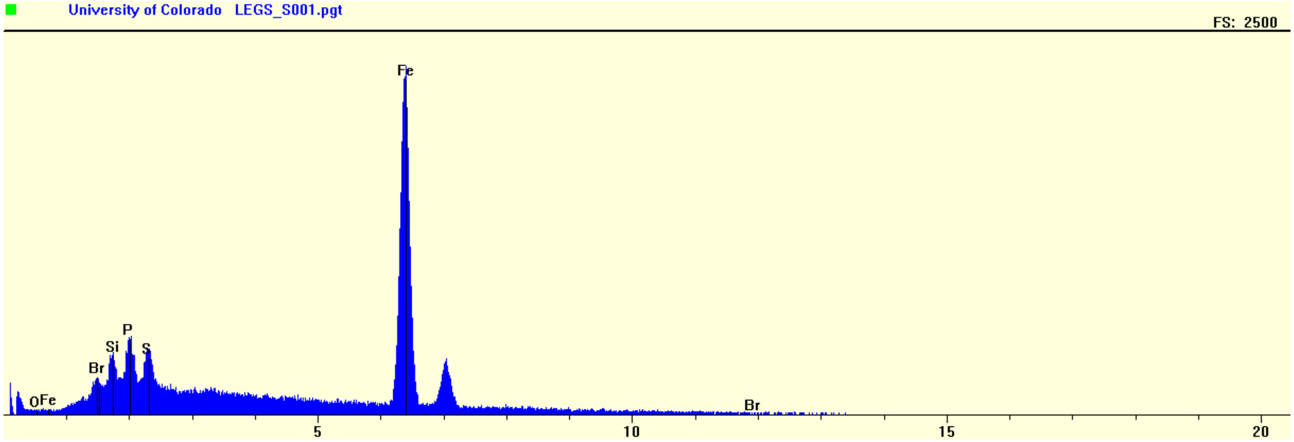


Figure No.
6h

Sample:
FID 18

Description:
Histogram 4



SPECIATION FIGURES

Figure No.
6i

Sample:
FID 18

Description:
Micrograph 5

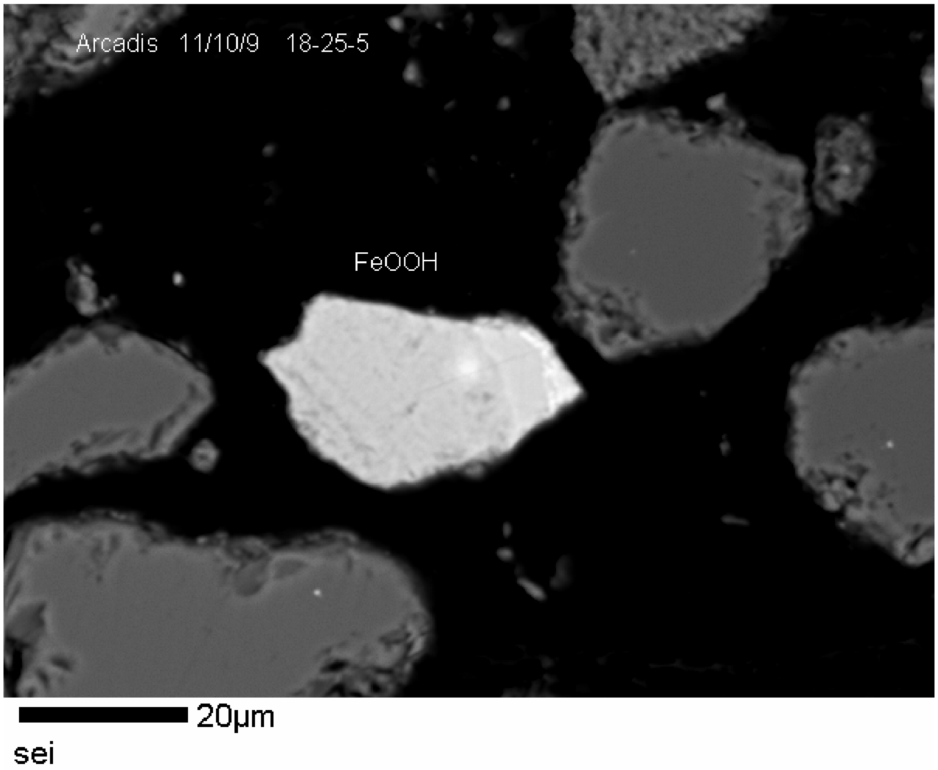
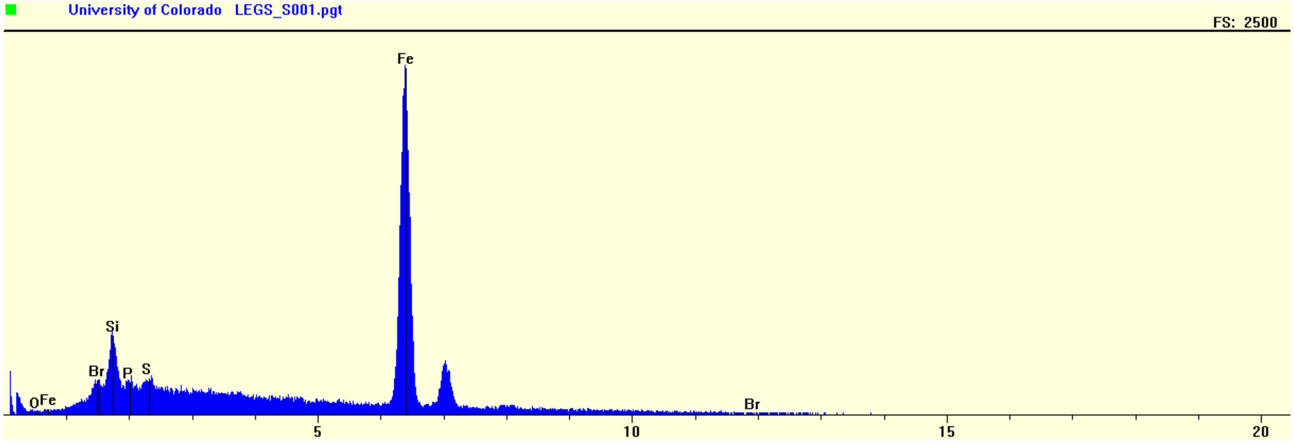


Figure No.
6j

Sample:
FID 18

Description:
Histogram 5



SPECIATION FIGURES

Figure No.
6k

Sample:
FID 18

Description:
Micrograph 6

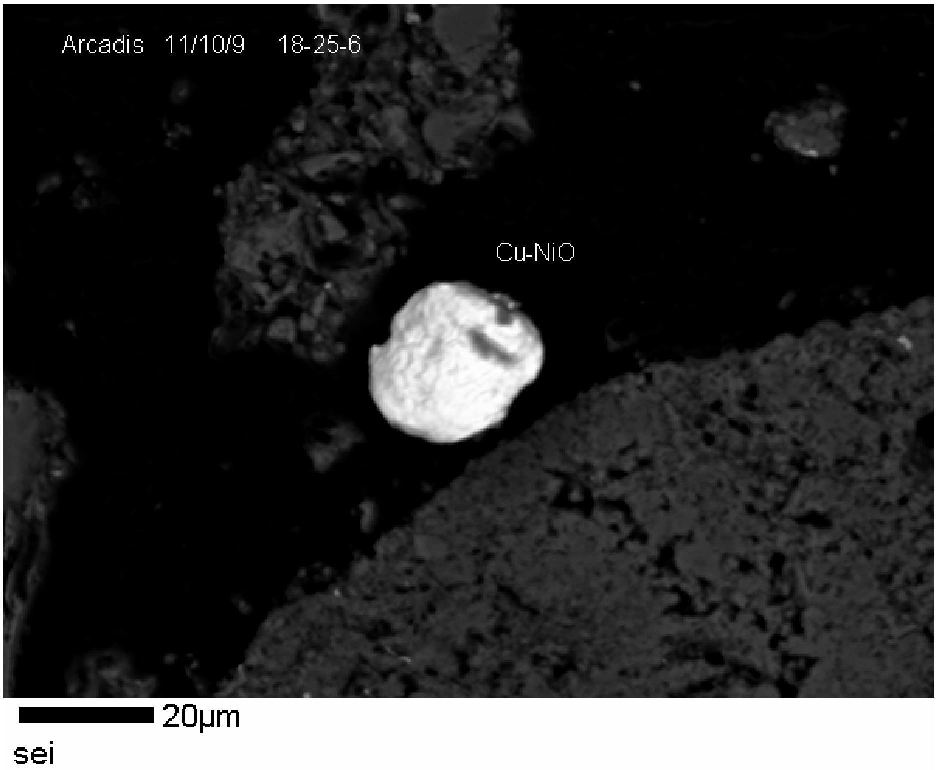
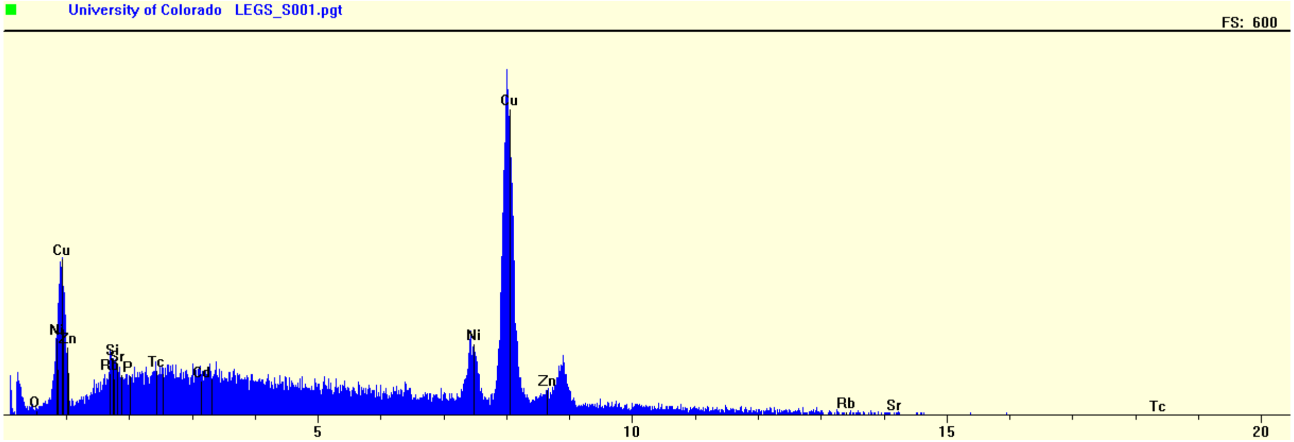


Figure No.
6l

Sample:
FID 18

Description:
Histogram 6



SPECIATION FIGURES

Figure No.
7a

Sample:
FID 20

Description:
Micrograph 1

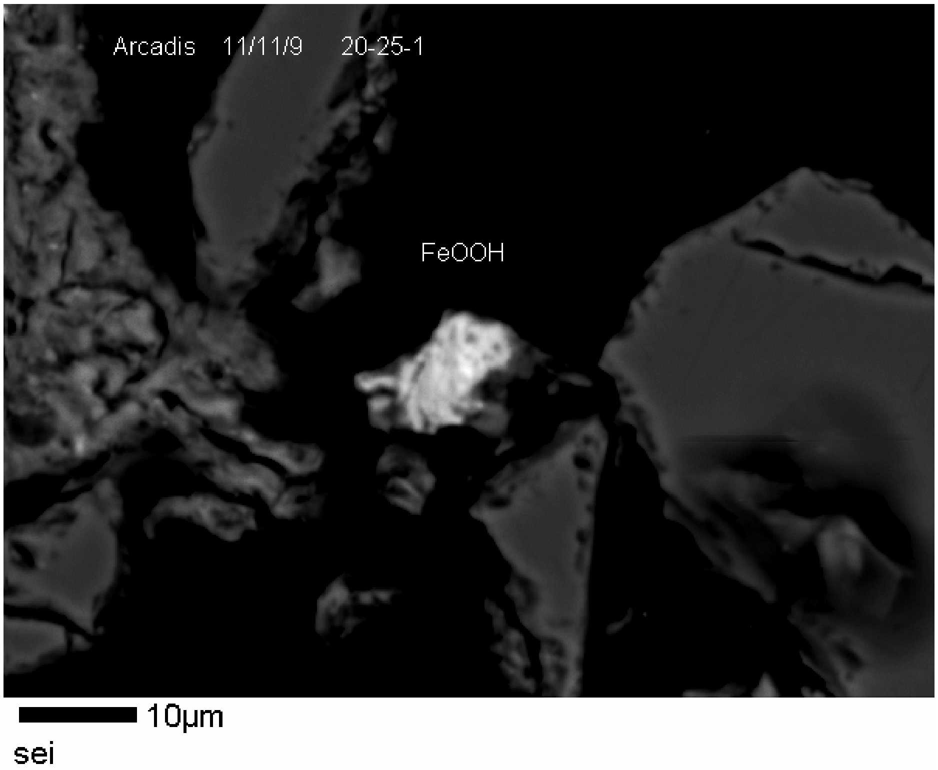
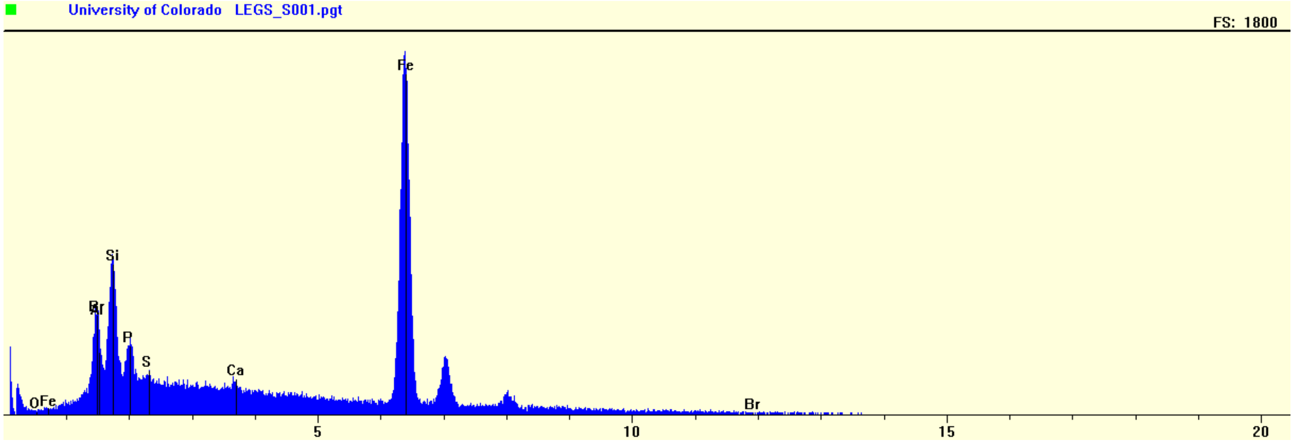


Figure No.
7b

Sample:
FID 20

Description:
Histogram 1



SPECIATION FIGURES

Figure No.
7c

Sample:
FID 20

Description:
Micrograph 2

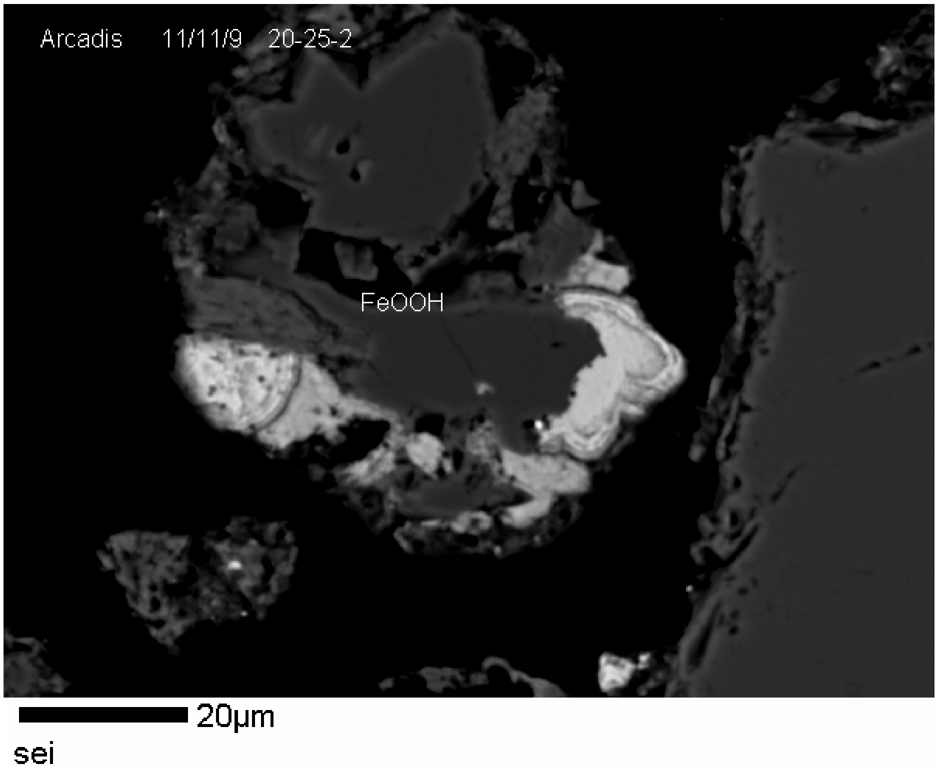
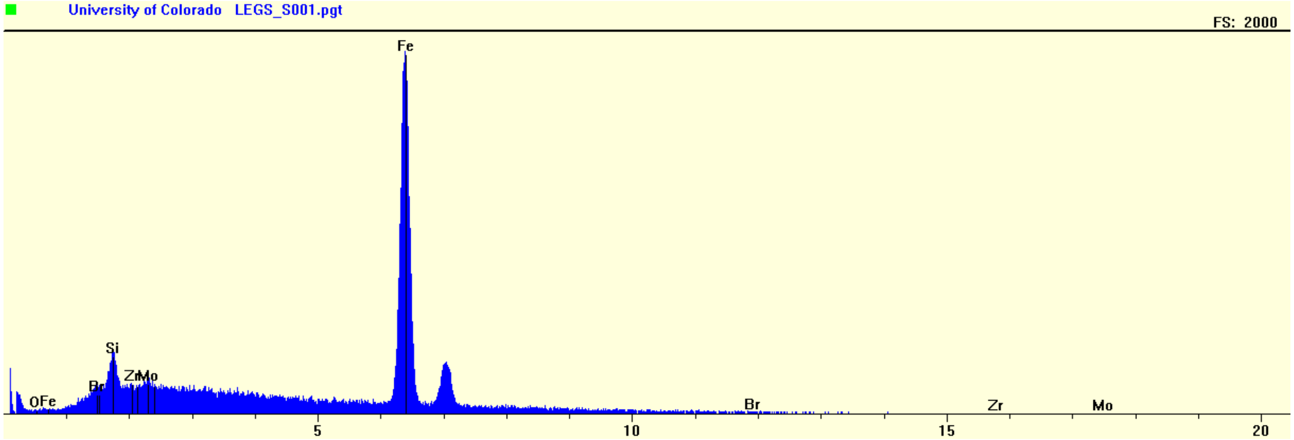


Figure No.
7d

Sample:
FID 20

Description:
Histogram 2



SPECIATION FIGURES

Figure No.
7e

Sample:
FID 20

Description:
Micrograph 3

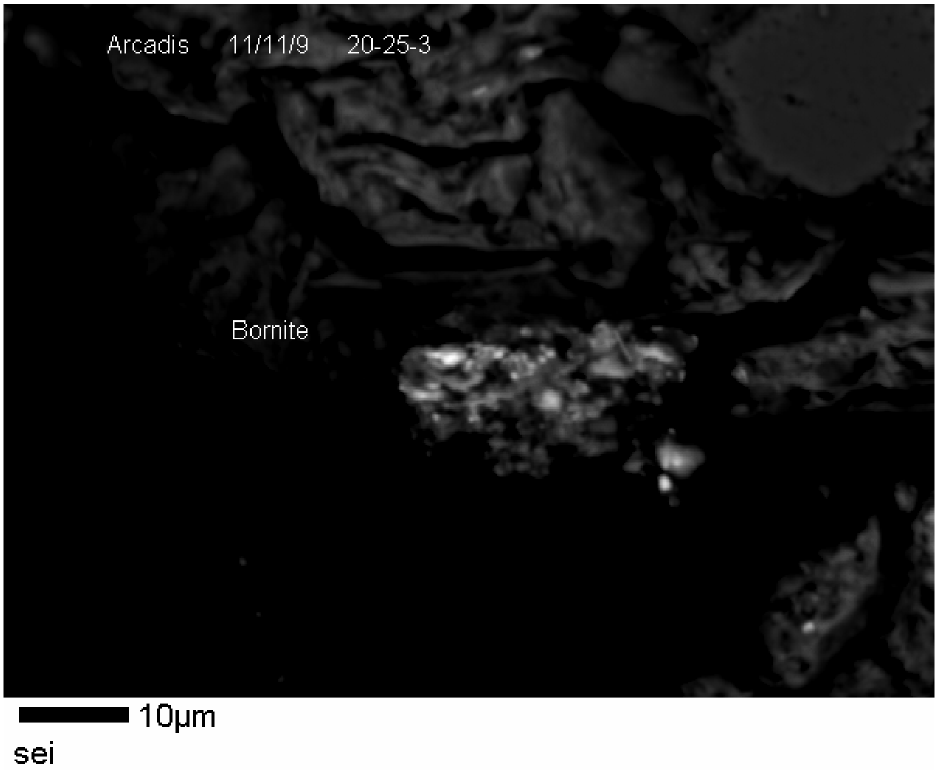
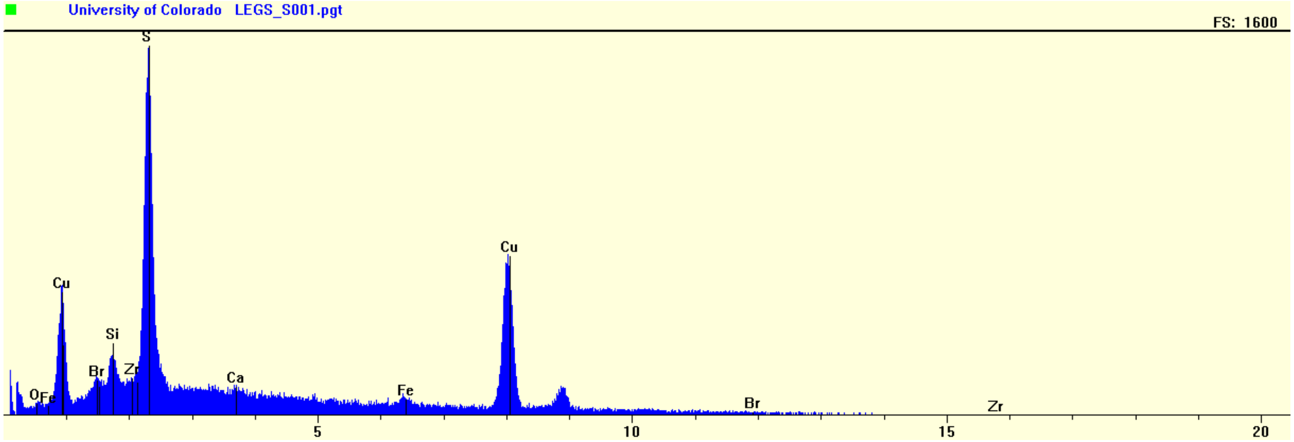


Figure No.
7f

Sample:
FID 20

Description:
Histogram 3



SPECIATION FIGURES

Figure No.
7g

Sample:
FID 20

Description:
Micrograph 4

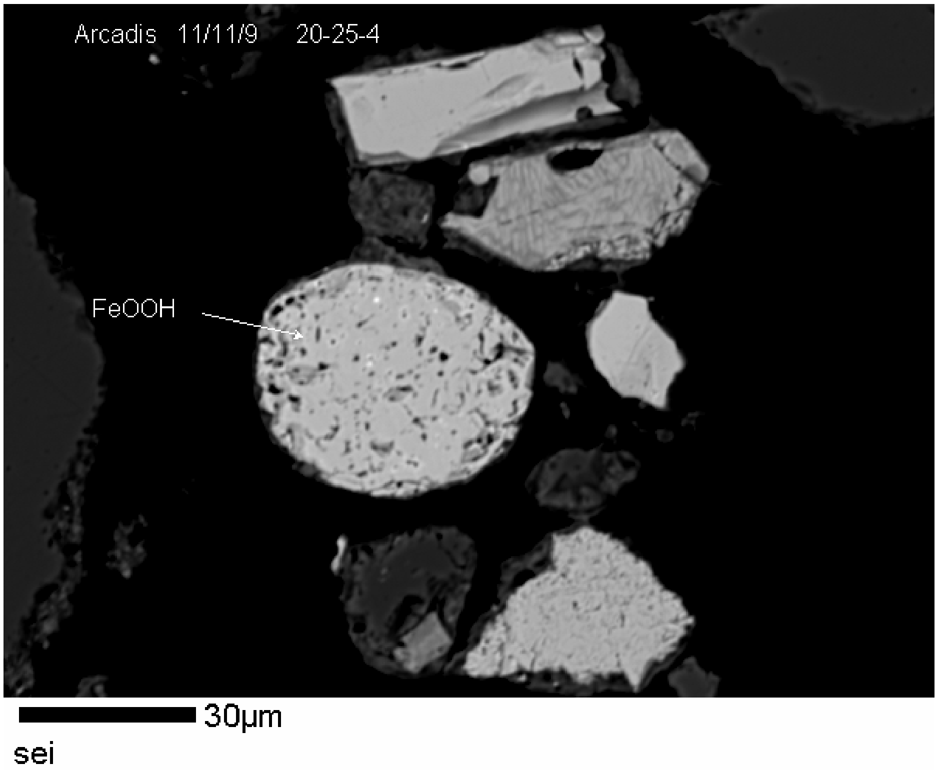
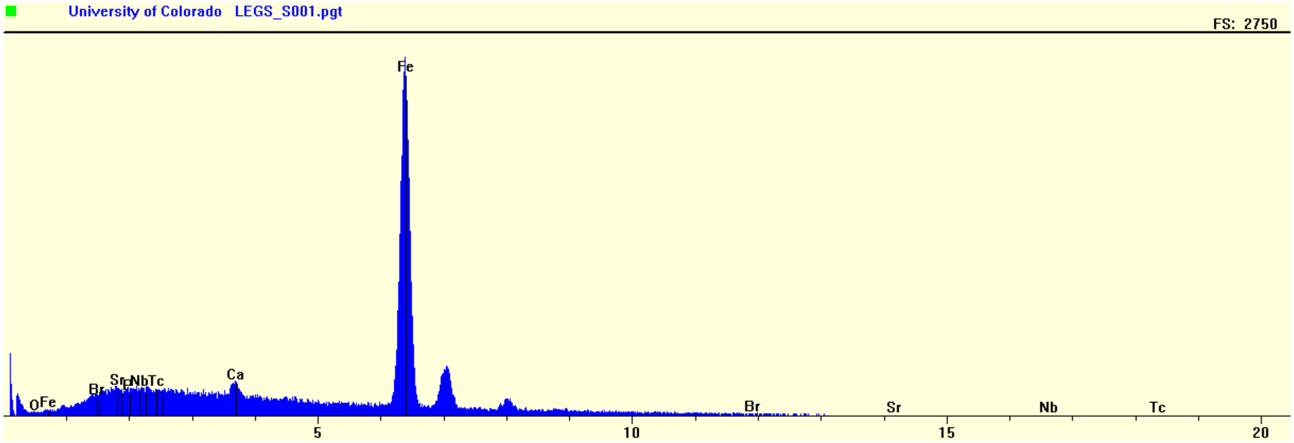


Figure No.
7h

Sample:
FID 20

Description:
Histogram 4



SPECIATION FIGURES

Figure No.
7i

Sample:
FID 20

Description:
Micrograph 5

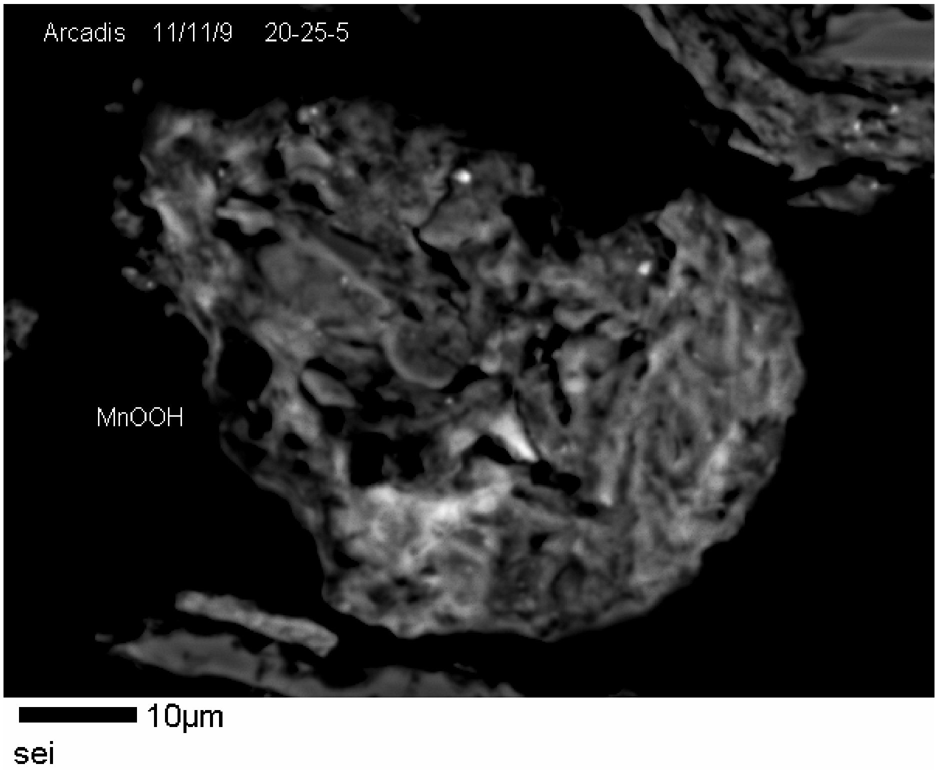
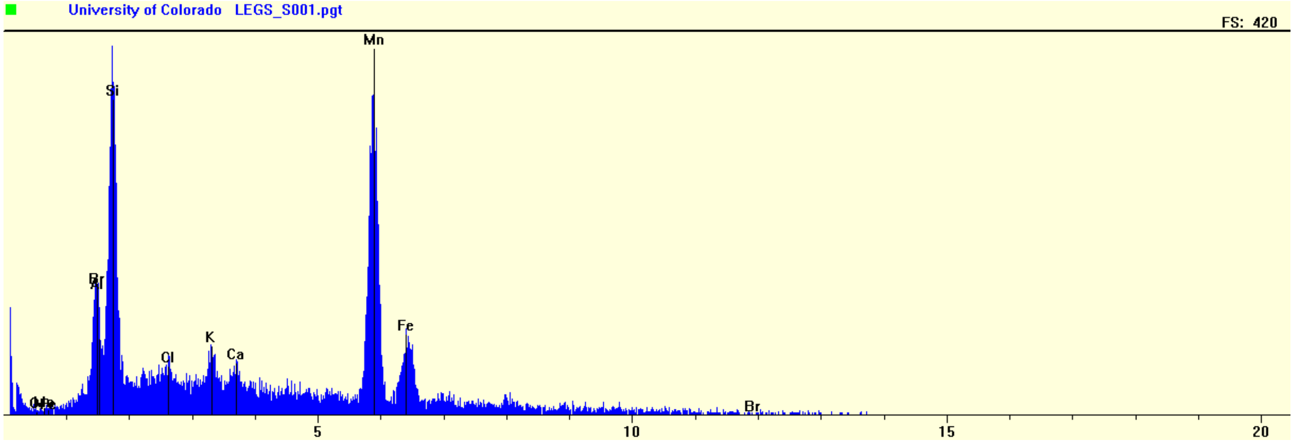


Figure No.
7j

Sample:
FID 20

Description:
Histogram 5



SPECIATION FIGURES

Figure No.
8a

Sample:
FID 21

Description:
Micrograph 1

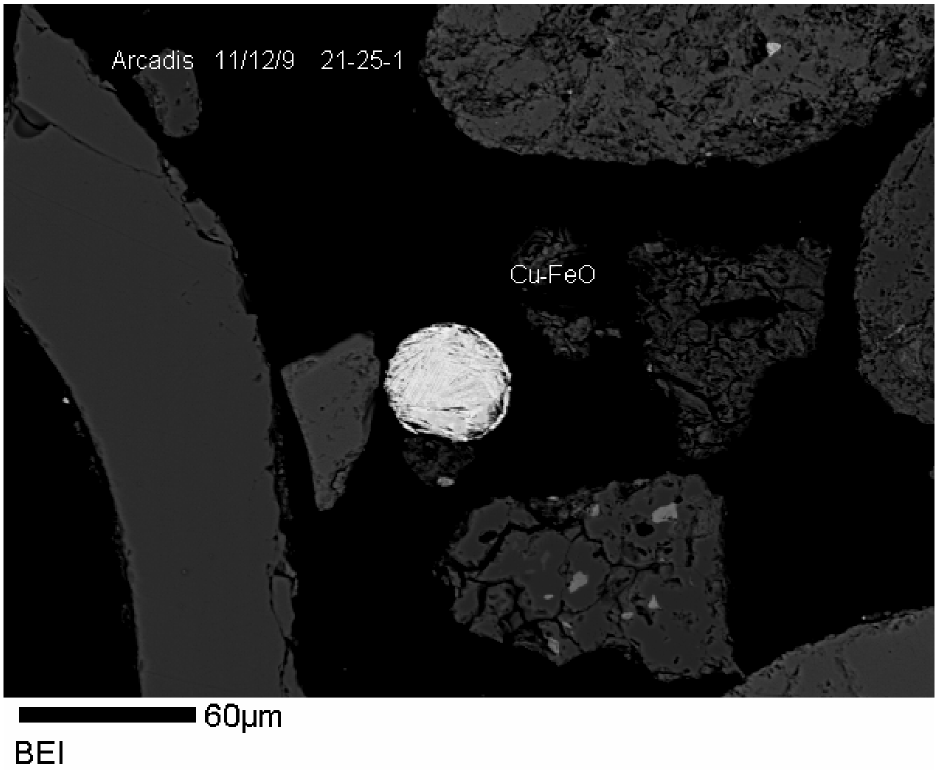
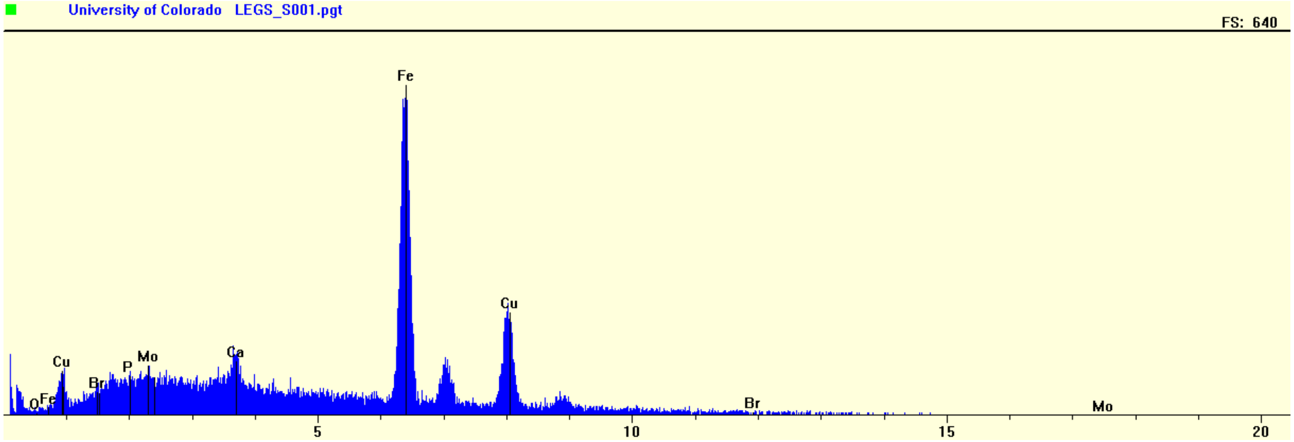


Figure No.
8b

Sample:
FID 21

Description:
Histogram 1



SPECIATION FIGURES

Figure No.
8c

Sample:
FID 21

Description:
Micrograph 2

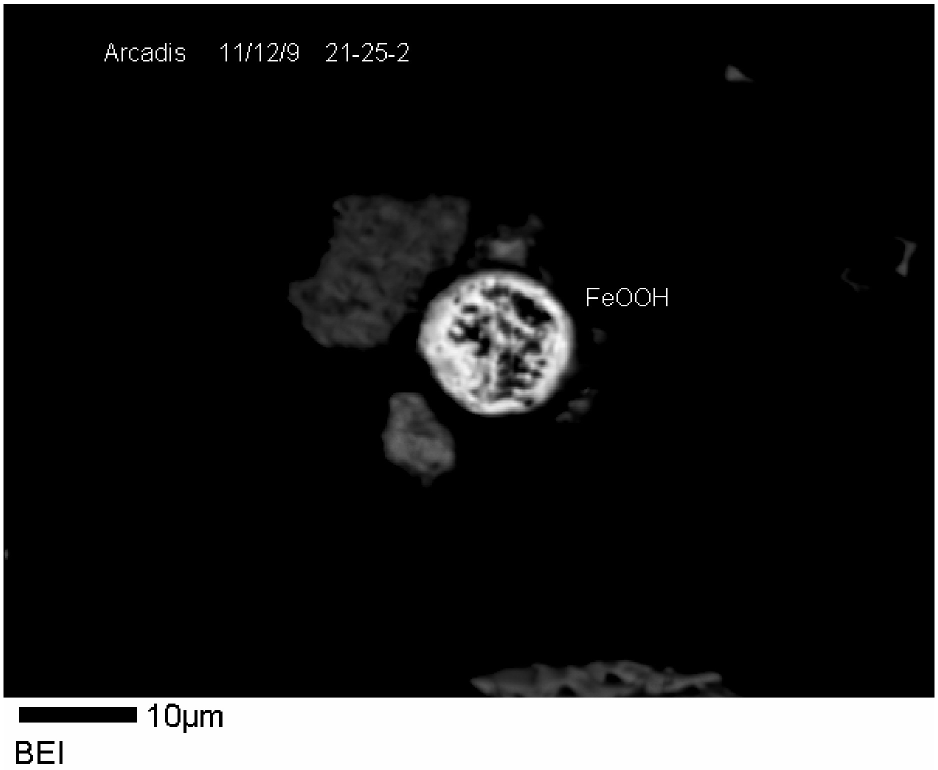
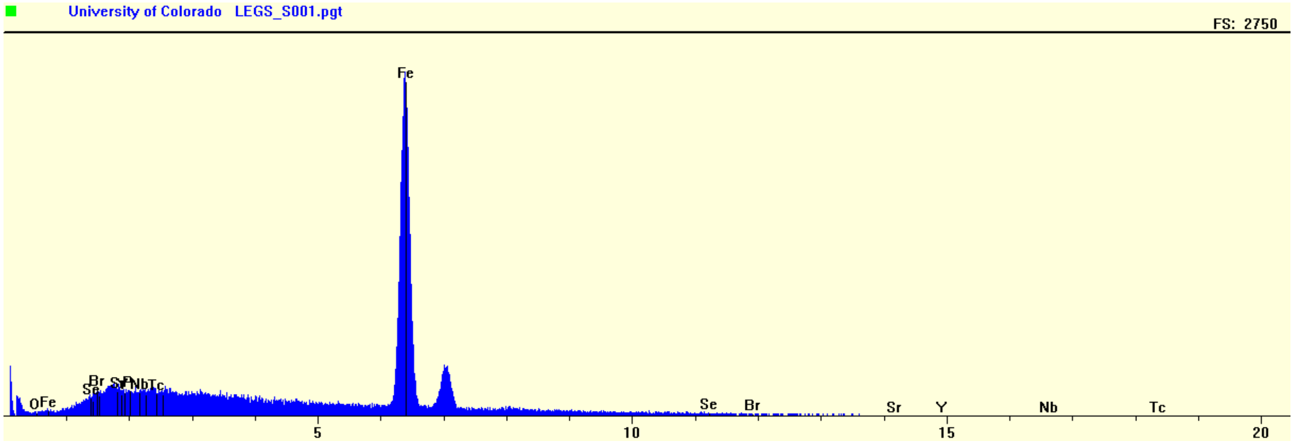


Figure No.
8d

Sample:
FID 21

Description:
Histogram 2



SPECIATION FIGURES

Figure No.
8e

Sample:
FID 21

Description:
Micrograph 3

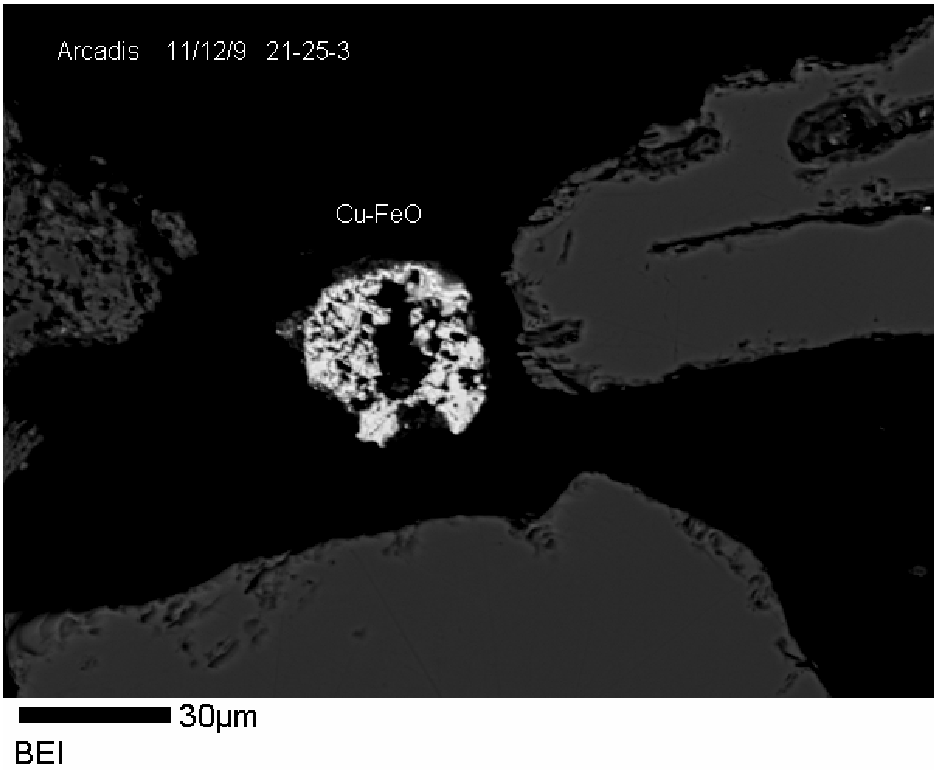
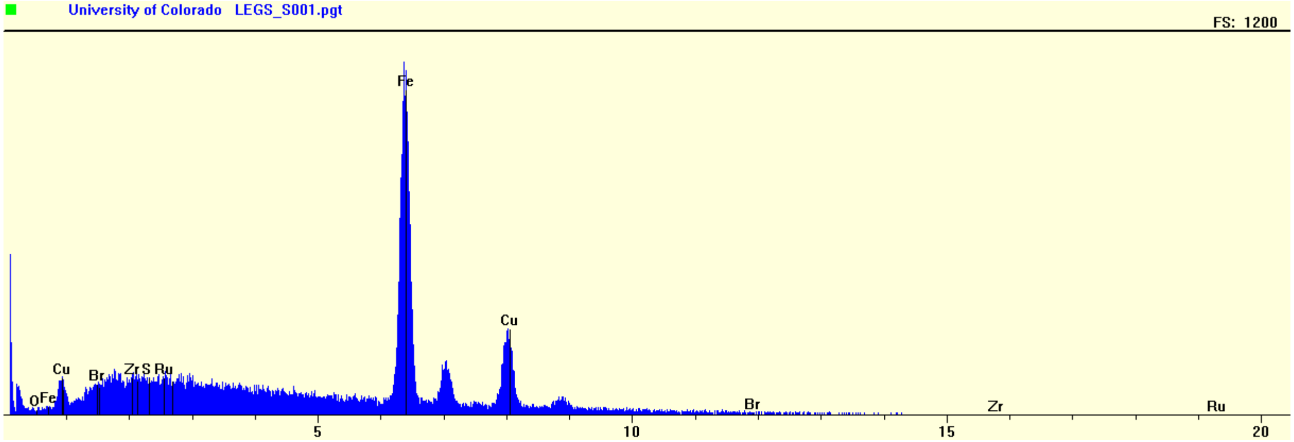


Figure No.
8f

Sample:
FID 21

Description:
Histogram 3



SPECIATION FIGURES

Figure No.
8g

Sample:
FID 21

Description:
Micrograph 4

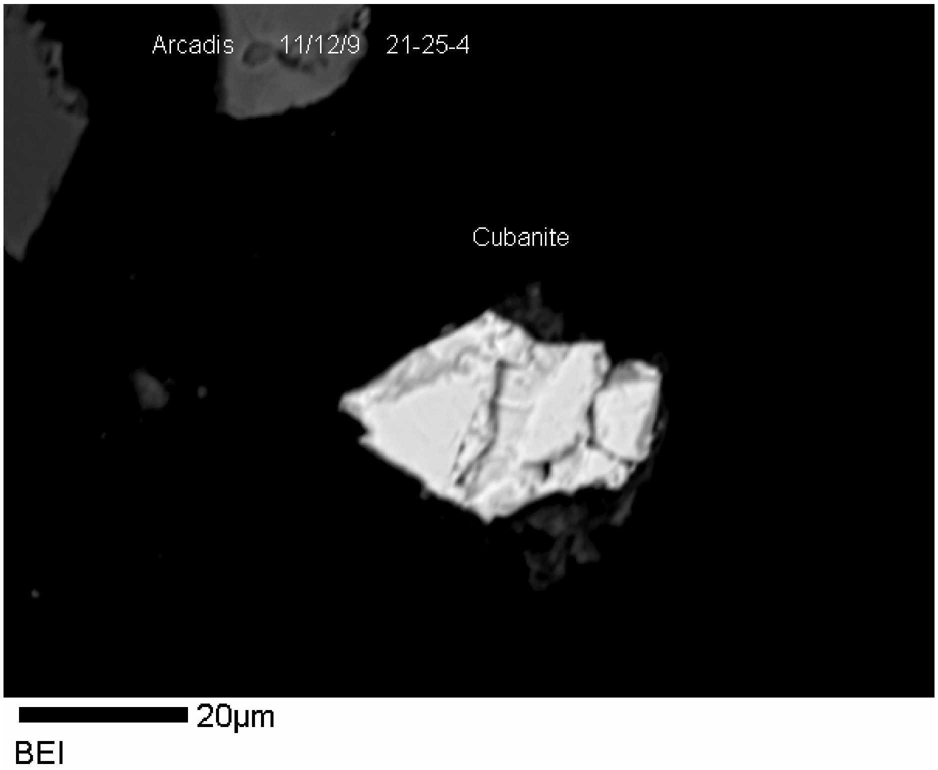
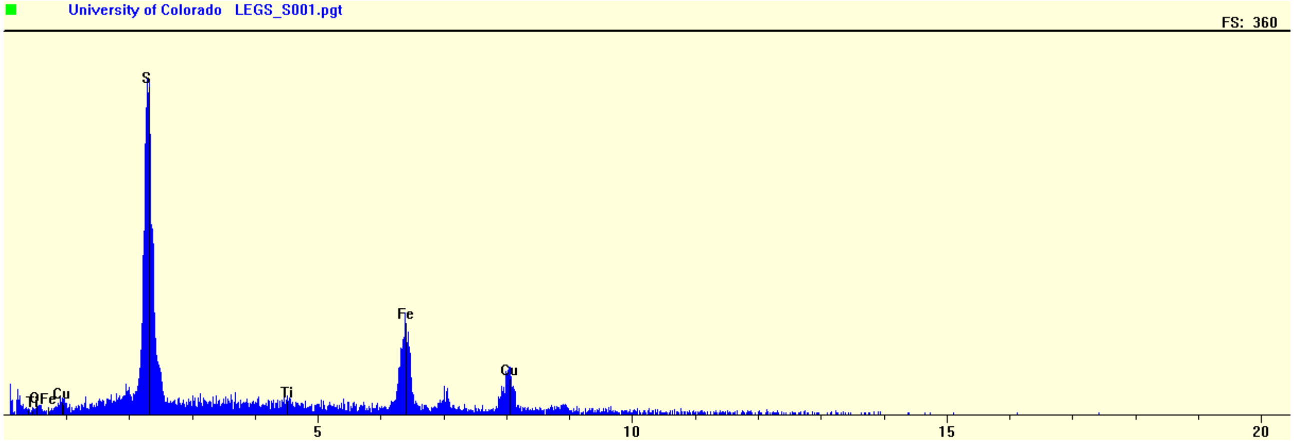


Figure No.
8h

Sample:
FID 21

Description:
Histogram 4



SPECIATION FIGURES

Figure No.
9a

Sample:
FID 26

Description:
Micrograph 1

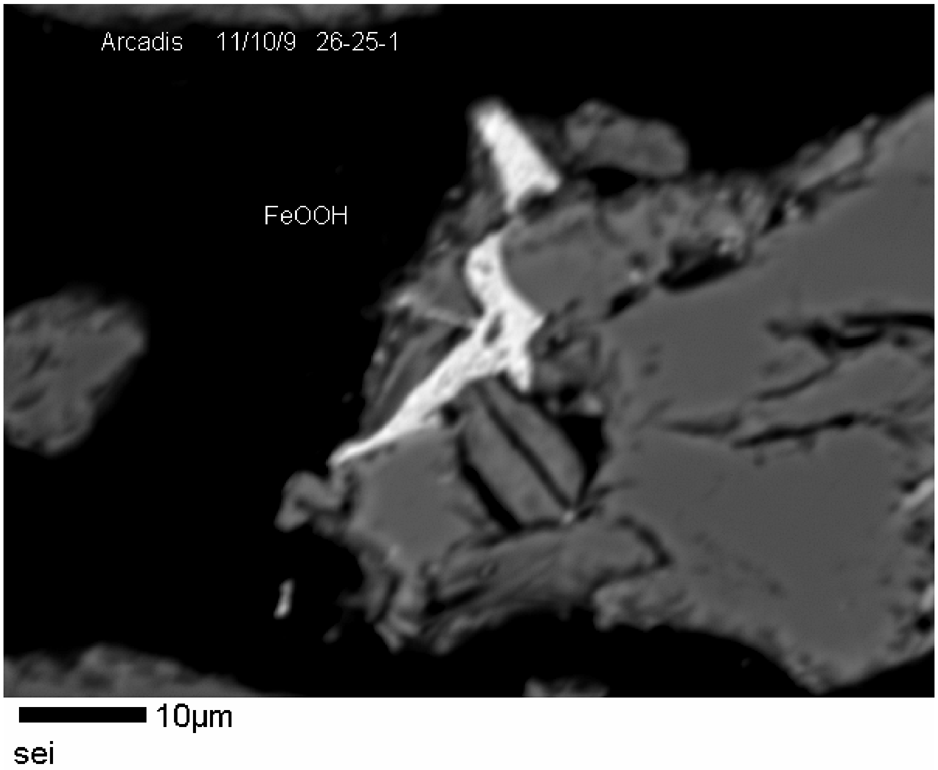
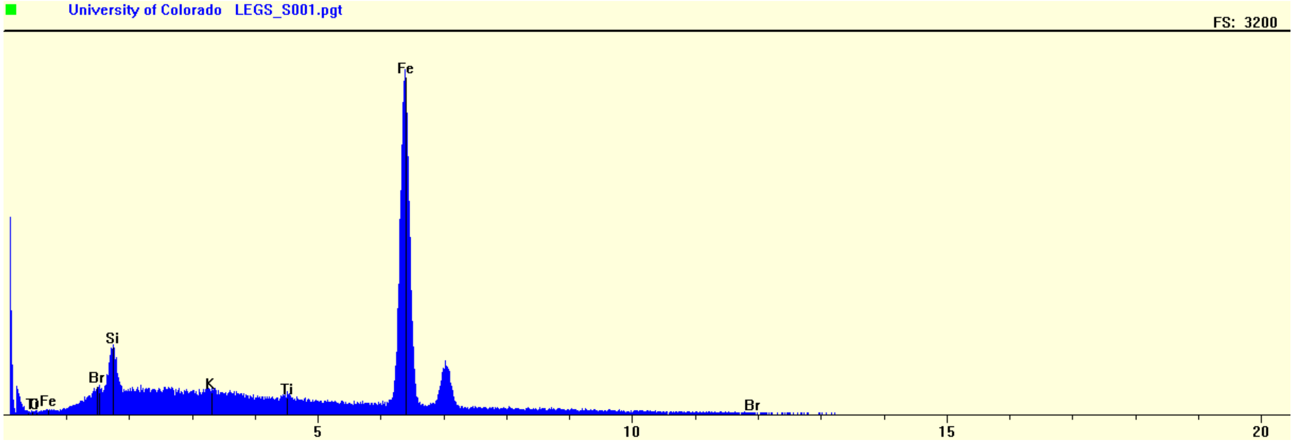


Figure No.
9b

Sample:
FID 26

Description:
Histogram 1



SPECIATION FIGURES

Figure No.
9c

Sample:
FID 26

Description:
Micrograph 2

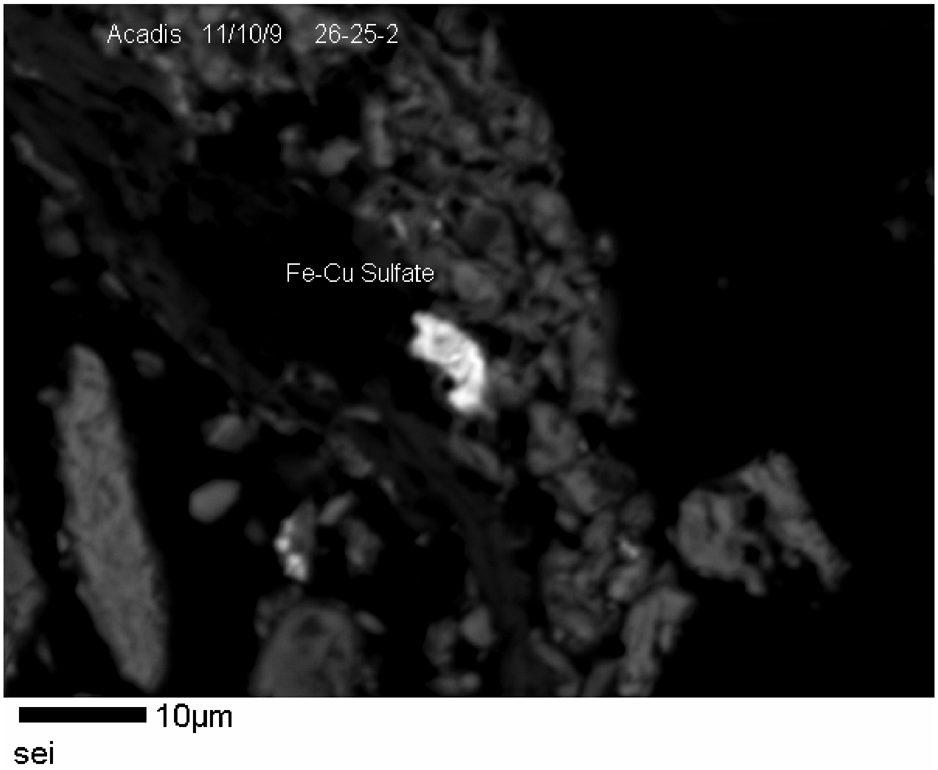
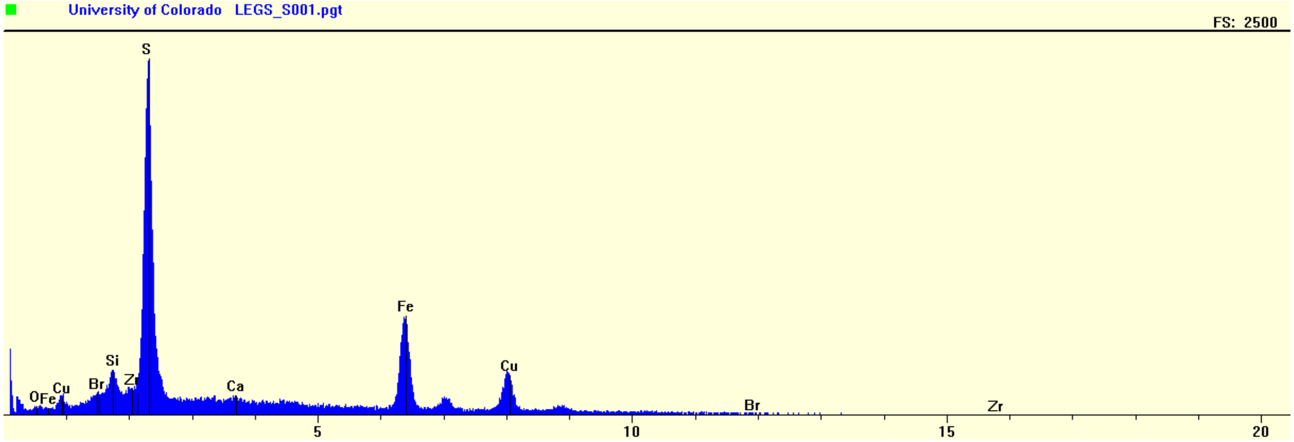


Figure No.
9d

Sample:
FID 26

Description:
Histogram 2



SPECIATION FIGURES

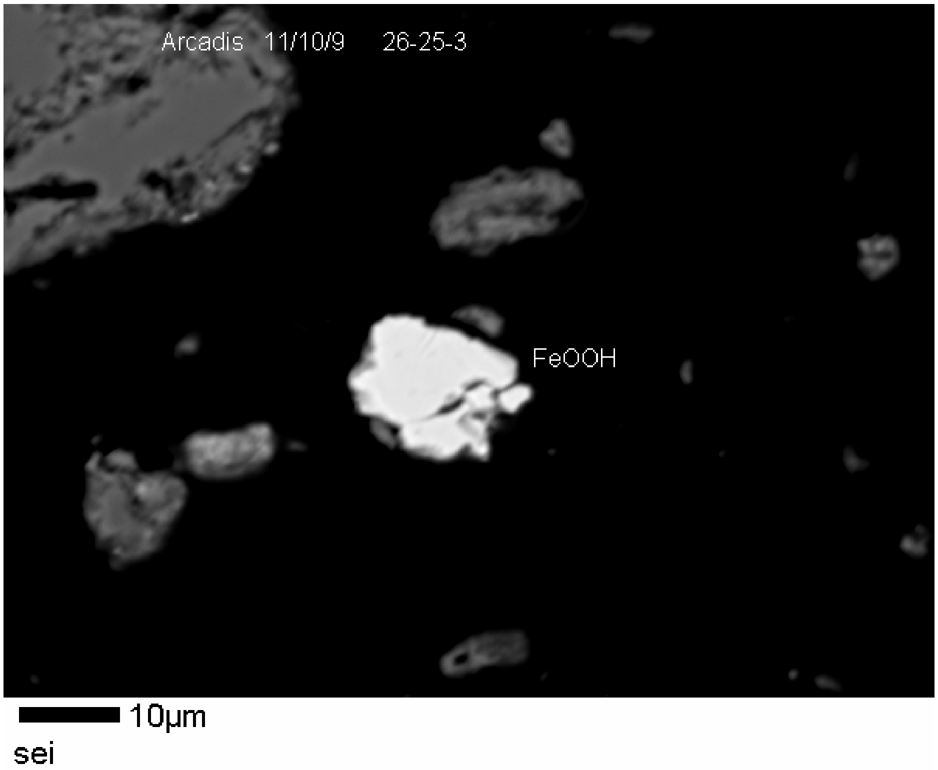
Figure No. **9e**	
Sample: FID 26 **Description:** Micrograph 3	

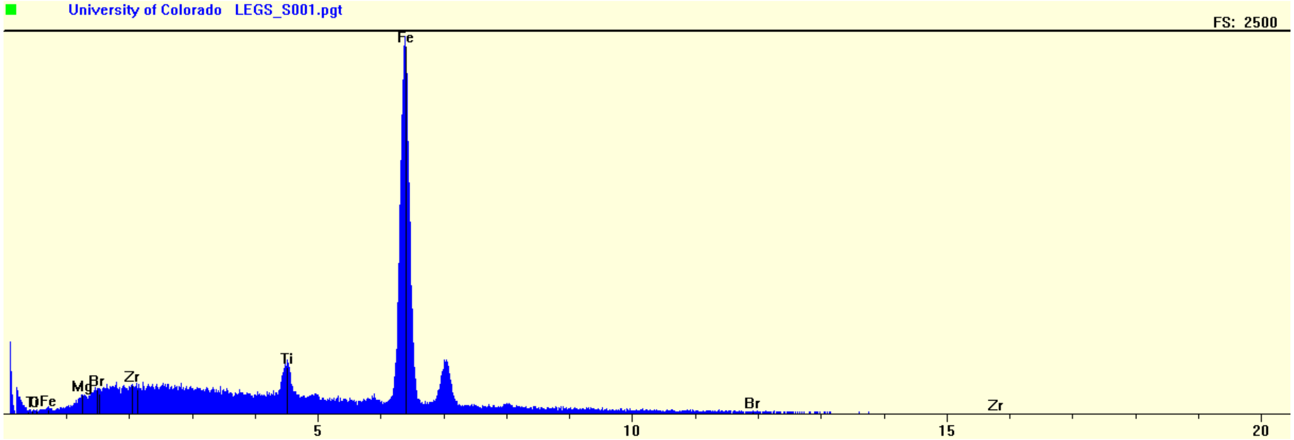
Figure No. **9f**	
Sample: FID 26 **Description:** Histogram 3	

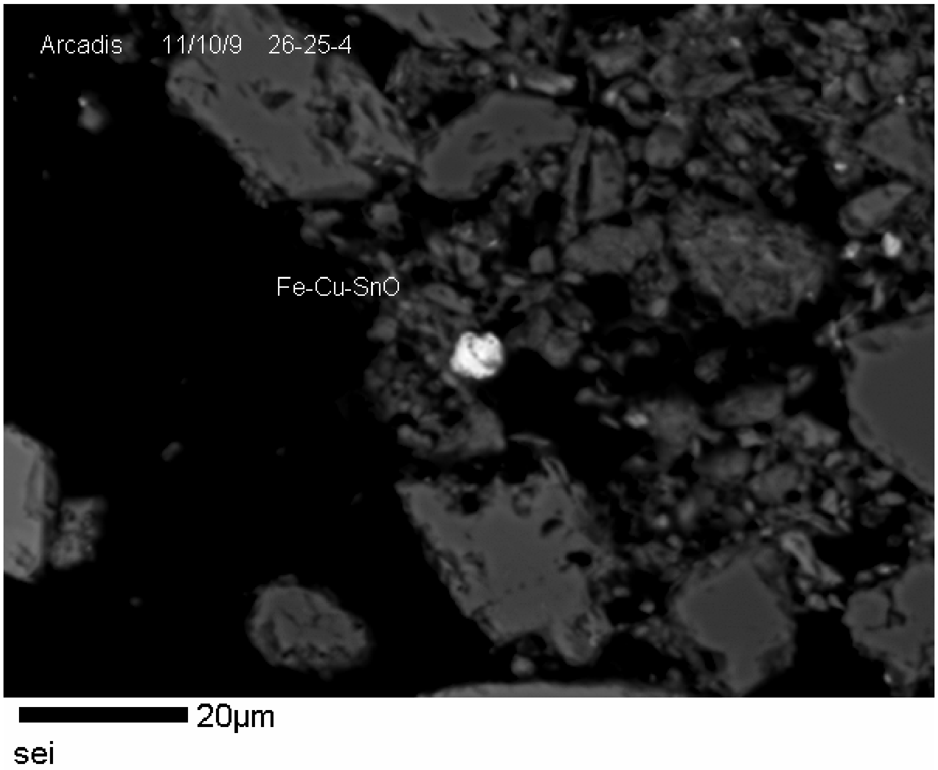
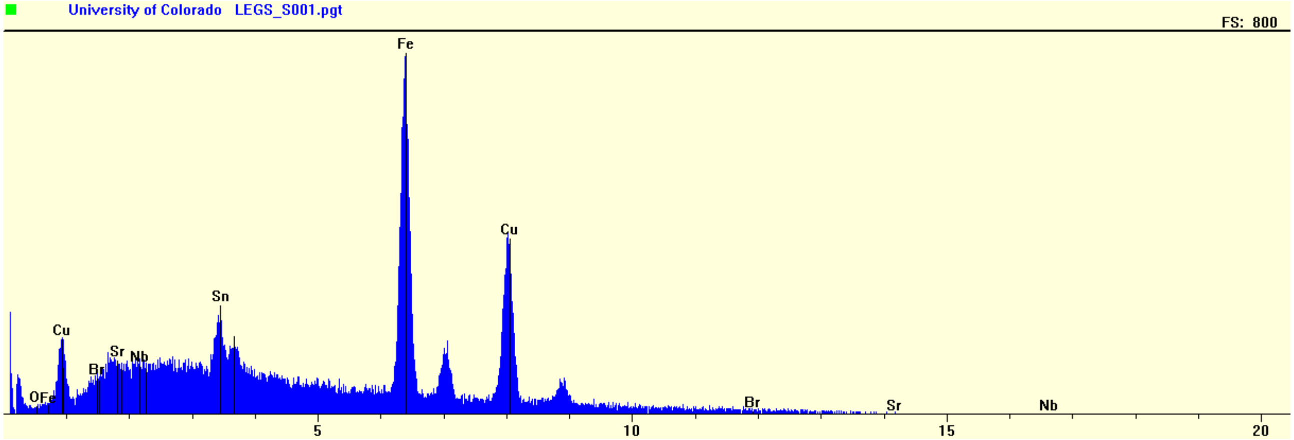
Figure No. **9g**	
Sample: FID 26 **Description:** Micrograph 4	

Figure No. **9h**	
Sample: FID 26 **Description:** Histogram 4	

SPECIATION FIGURES

Figure No.
9i

Sample:
FID 26

Description:
Micrograph 5

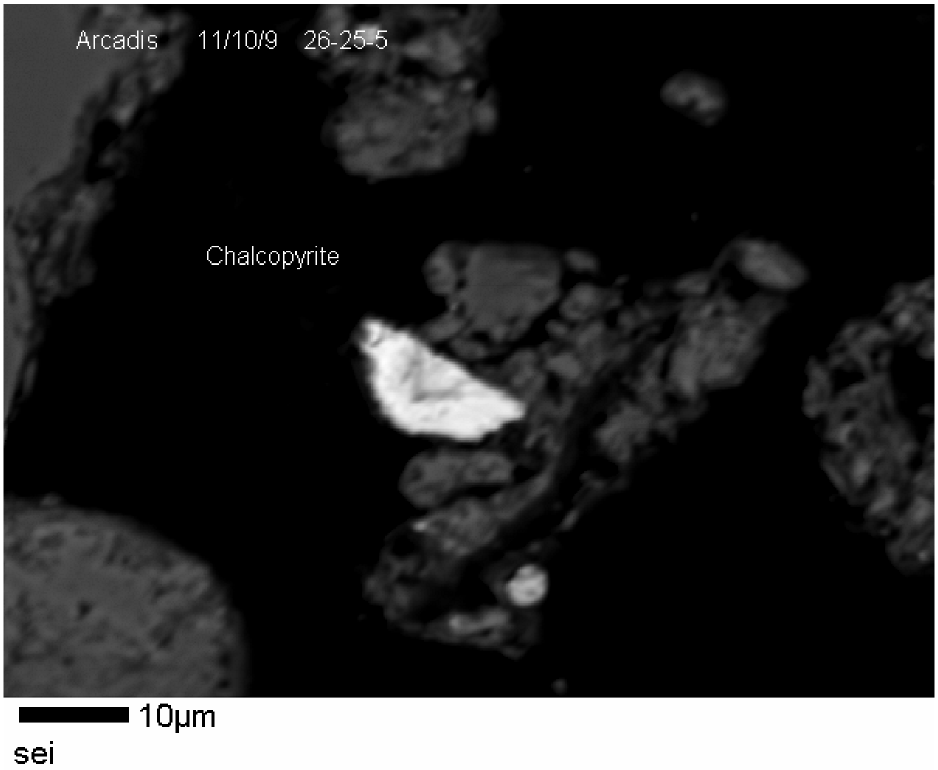
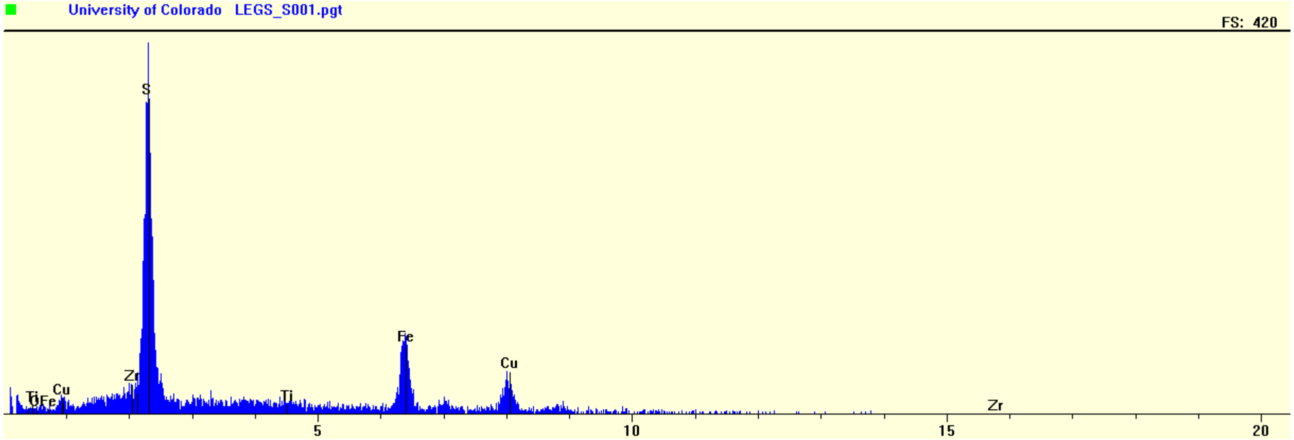


Figure No.
9j

Sample:
FID 26

Description:
Histogram 5



SPECIATION FIGURES

Figure No.
10a

Sample:
FID 27

Description:
Micrograph 1

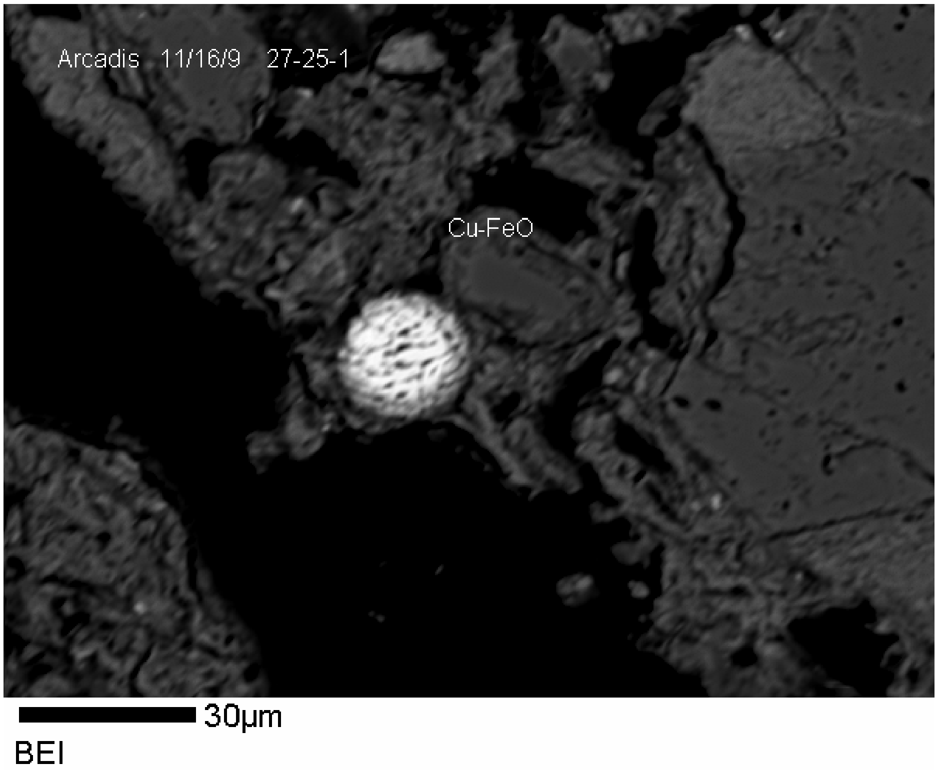
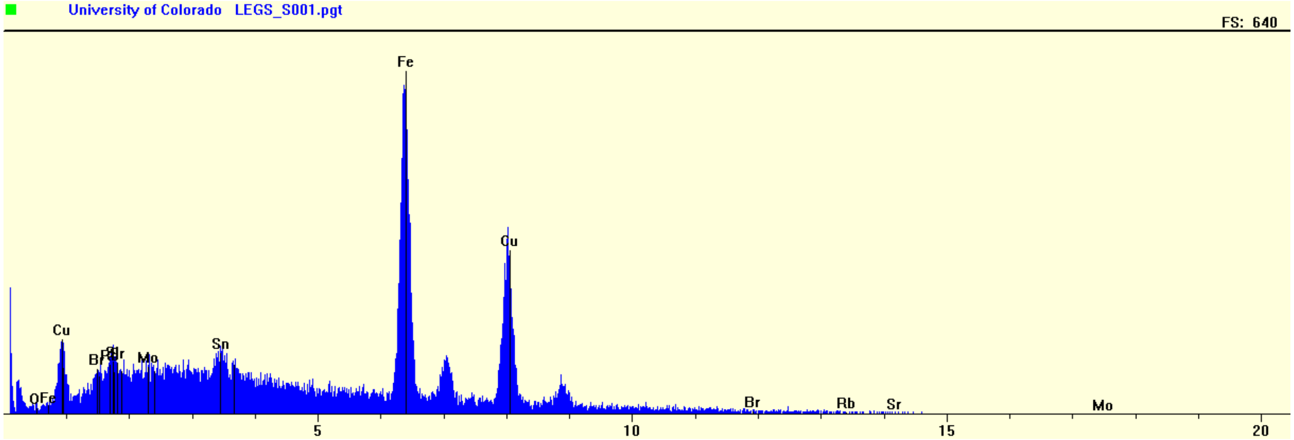


Figure No.
10b

Sample:
FID 27

Description:
Histogram 1



SPECIATION FIGURES

Figure No.
10c

Sample:
FID 27

Description:
Micrograph 2

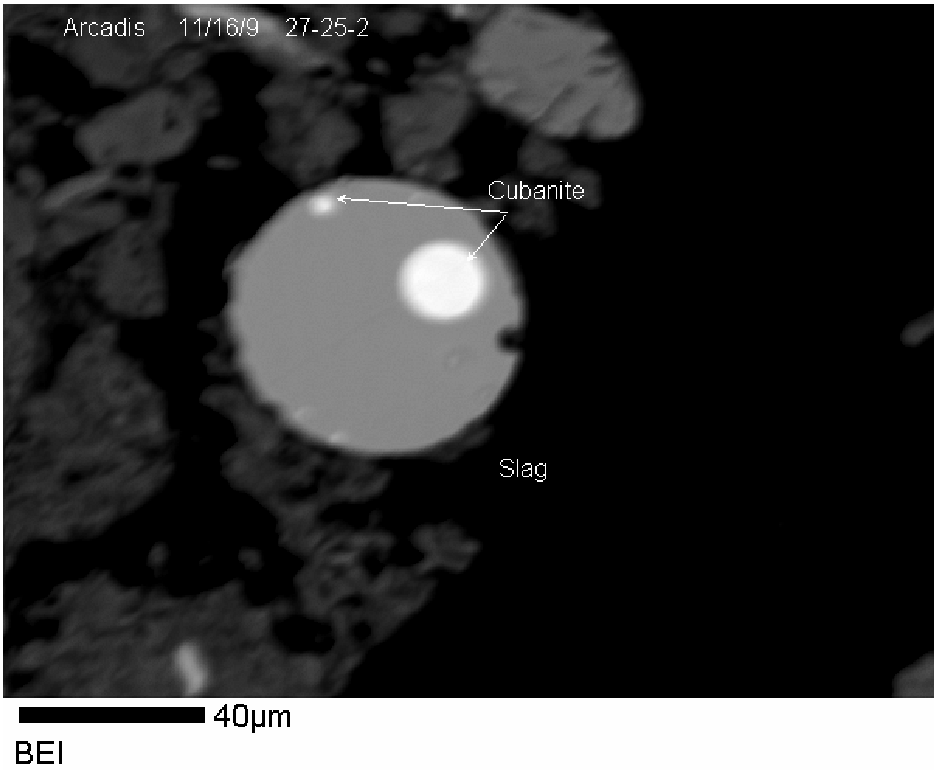
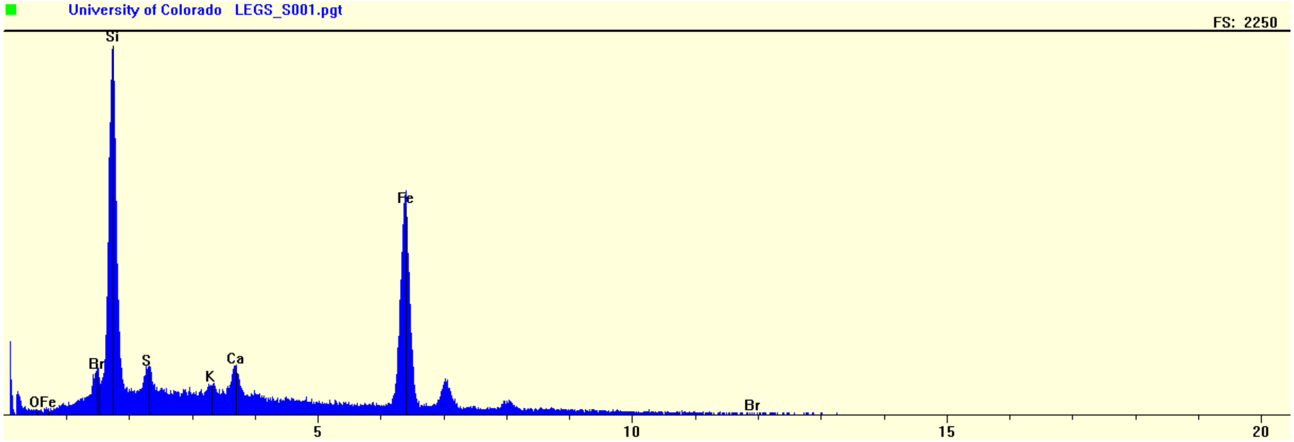


Figure No.
10d

Sample:
FID 27

Description:
Histogram 2



SPECIATION FIGURES

Figure No.
10e

Sample:
FID 27

Description:
Micrograph 3

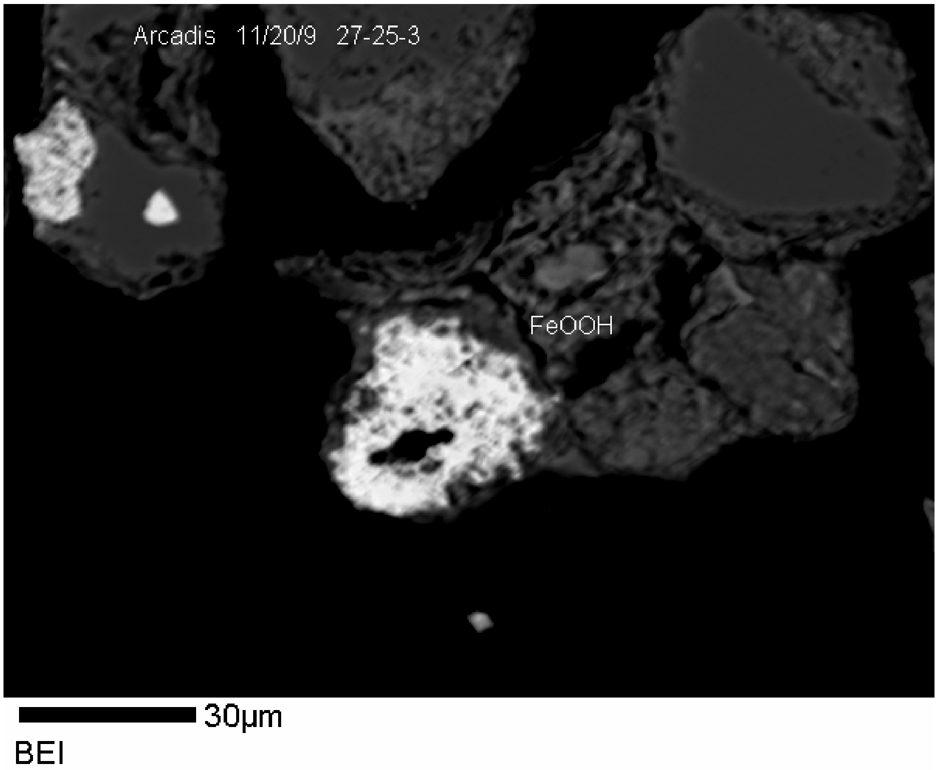
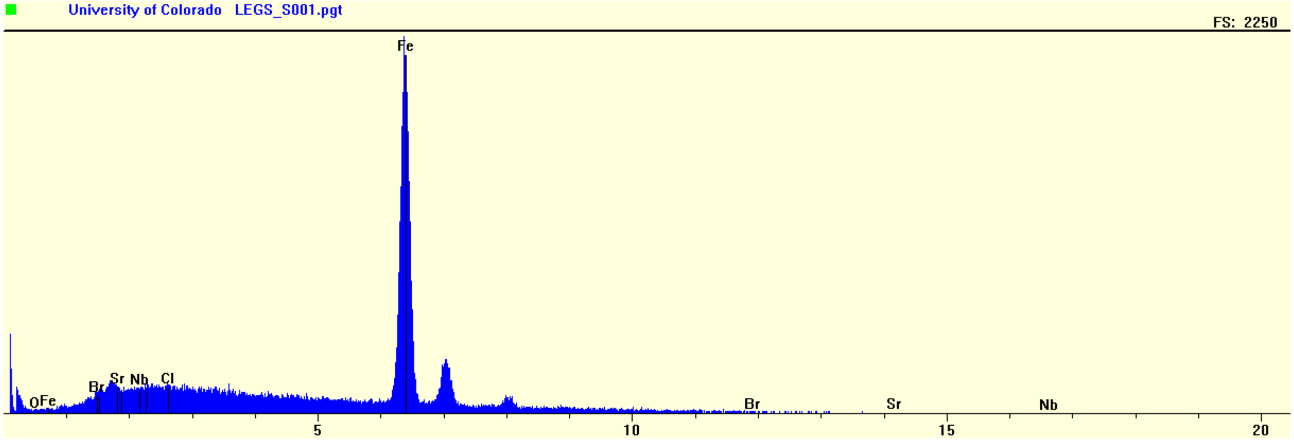


Figure No.
10f

Sample:
FID 27

Description:
Histogram 3



SPECIATION FIGURES

Figure No.
10g

Sample:
FID 27

Description:
Micrograph 4

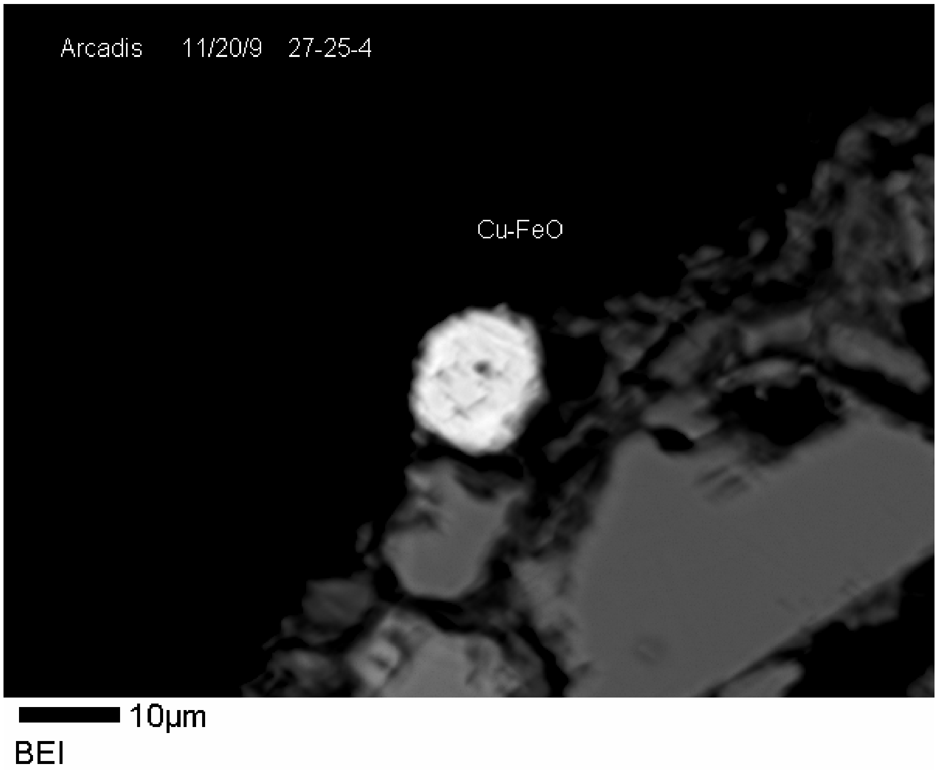


Figure No.
10h

Sample:
FID 27

Description:
Histogram 4

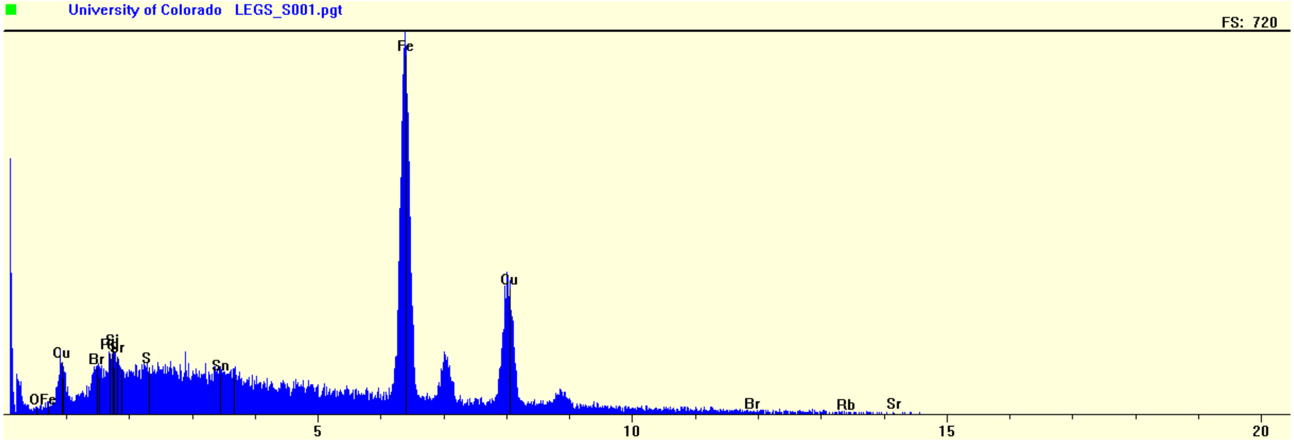


Figure No.
10i

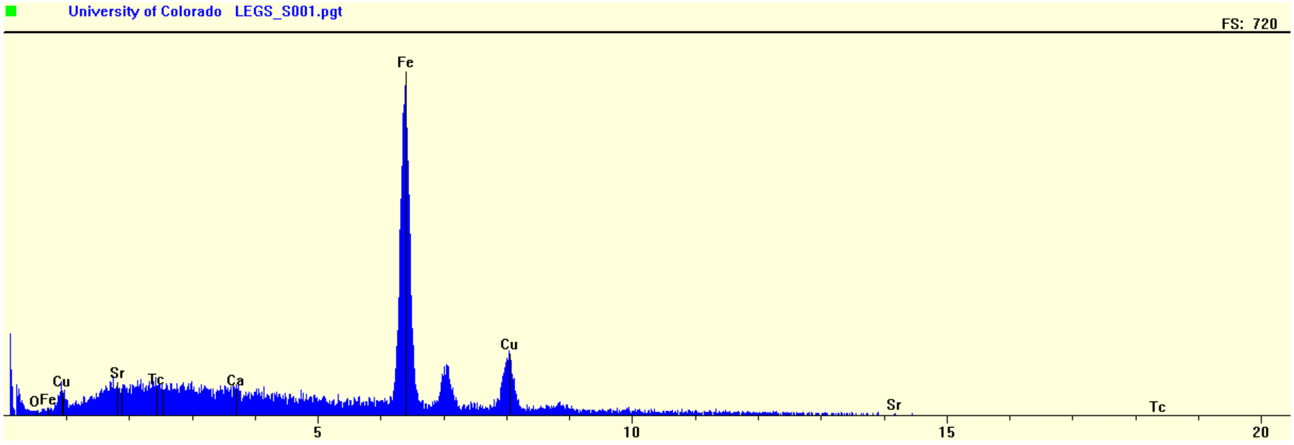
Sample:
FID 27

Description:
Micrograph 5

Figure No.
10j

Sample:
FID 27

Description:
Histogram 5



SPECIATION FIGURES

Figure No.
11a

Sample:
FID 34

Description:
Micrograph 1

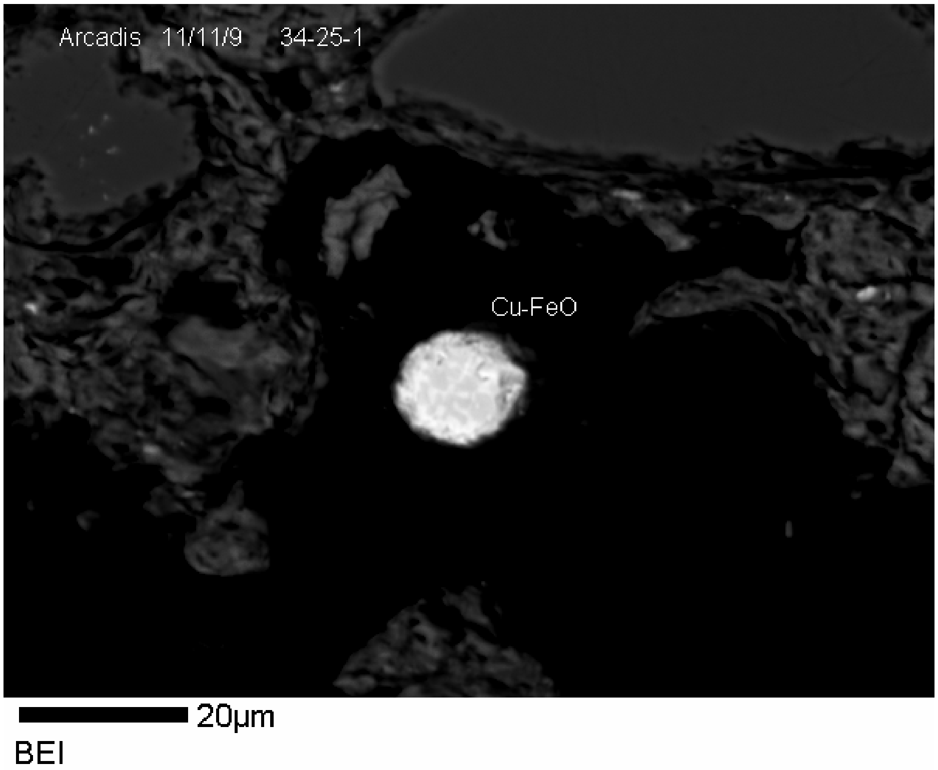
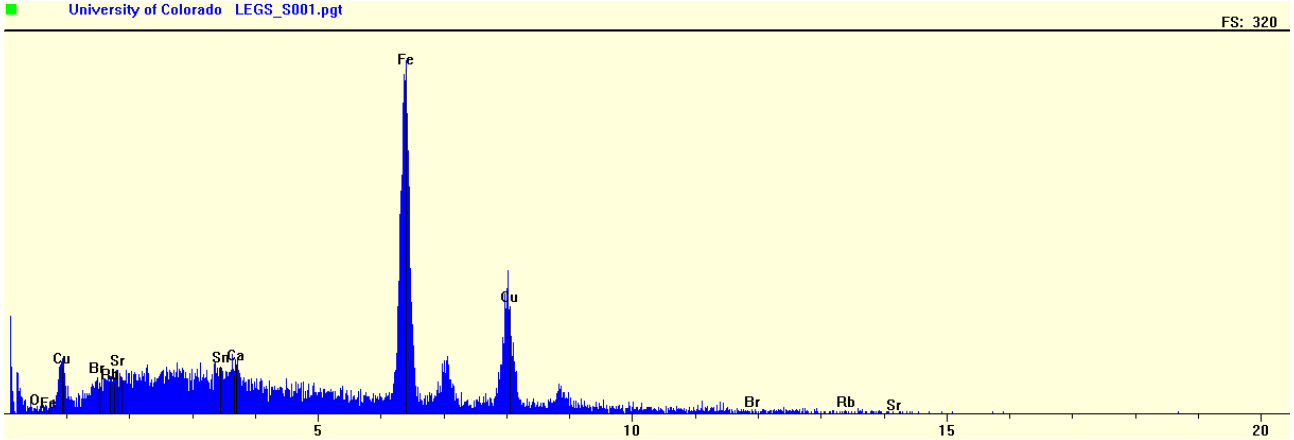


Figure No.
11b

Sample:
FID 34

Description:
Histogram 1



SPECIATION FIGURES

Figure No.
11c

Sample:
FID 34

Description:
Micrograph 2

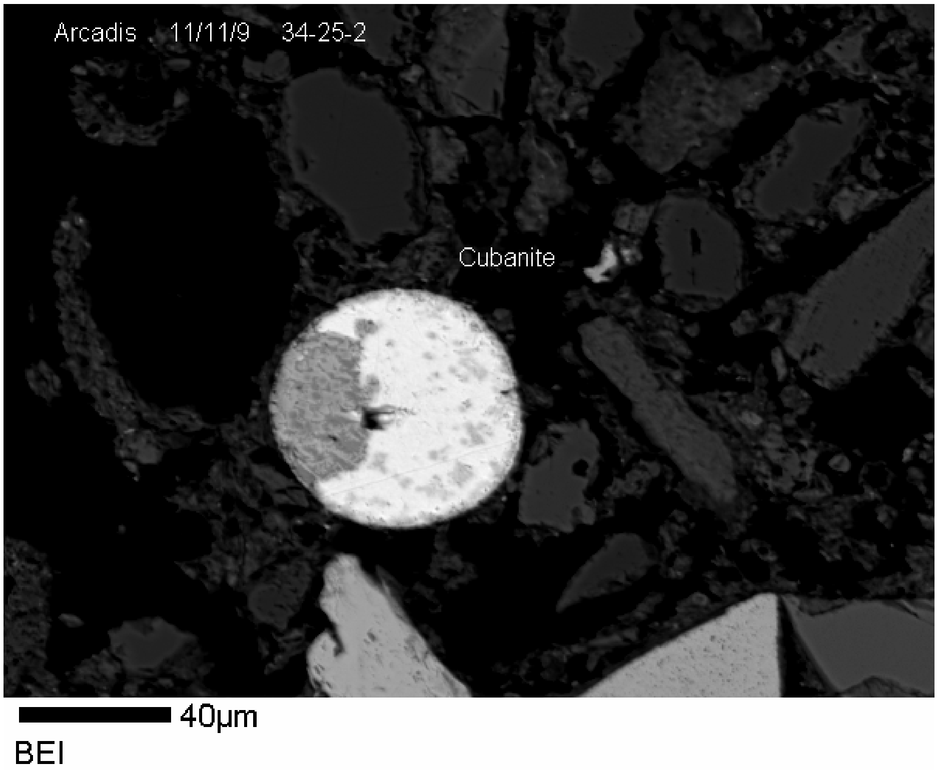
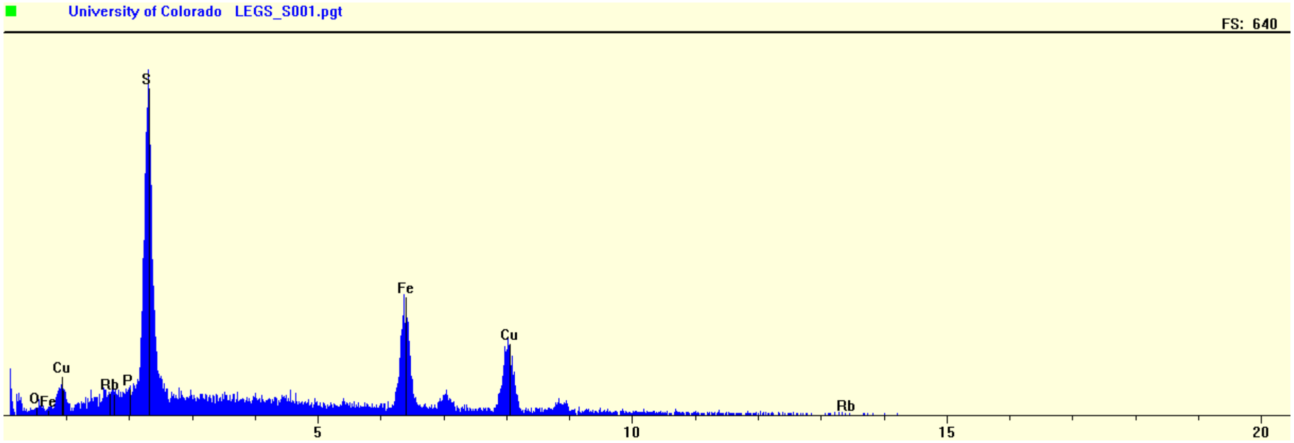


Figure No.
11d

Sample:
FID 34

Description:
Histogram 2



SPECIATION FIGURES

Figure No.
11e

Sample:
FID 34

Description:
Micrograph 3

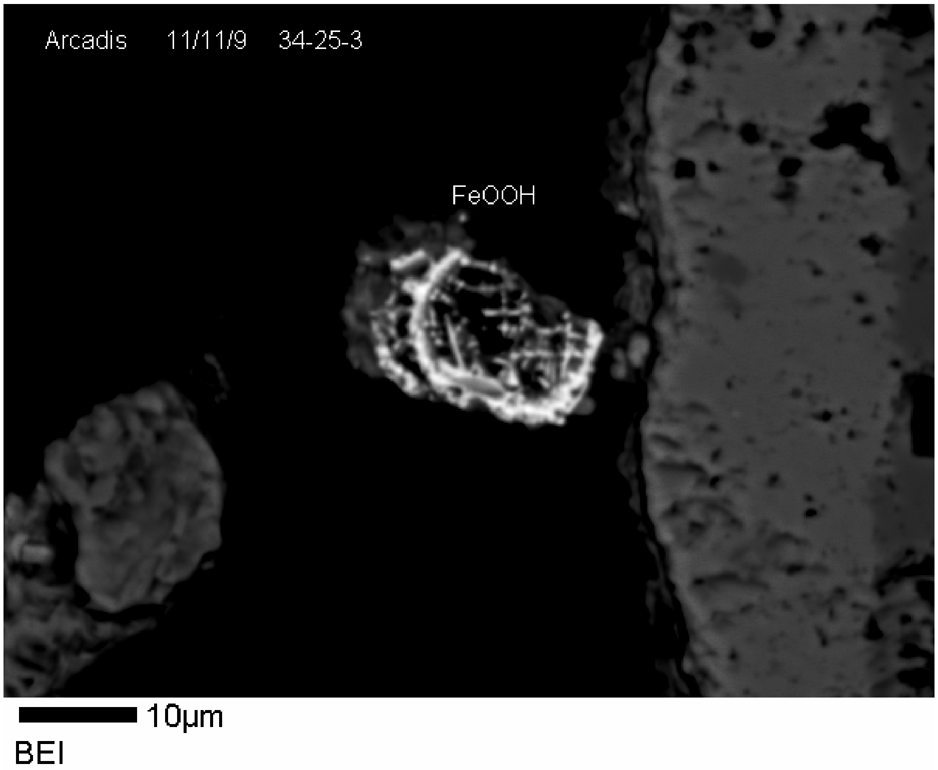
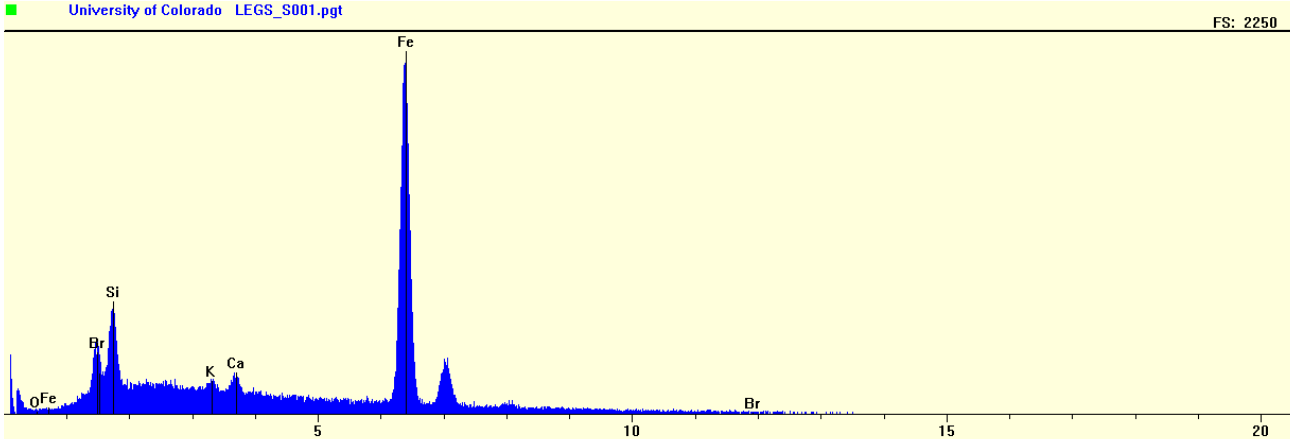


Figure No.
11f

Sample:
FID 34

Description:
Histogram 3



SPECIATION FIGURES

Figure No.
11g

Sample:
FID 34

Description:
Micrograph 4

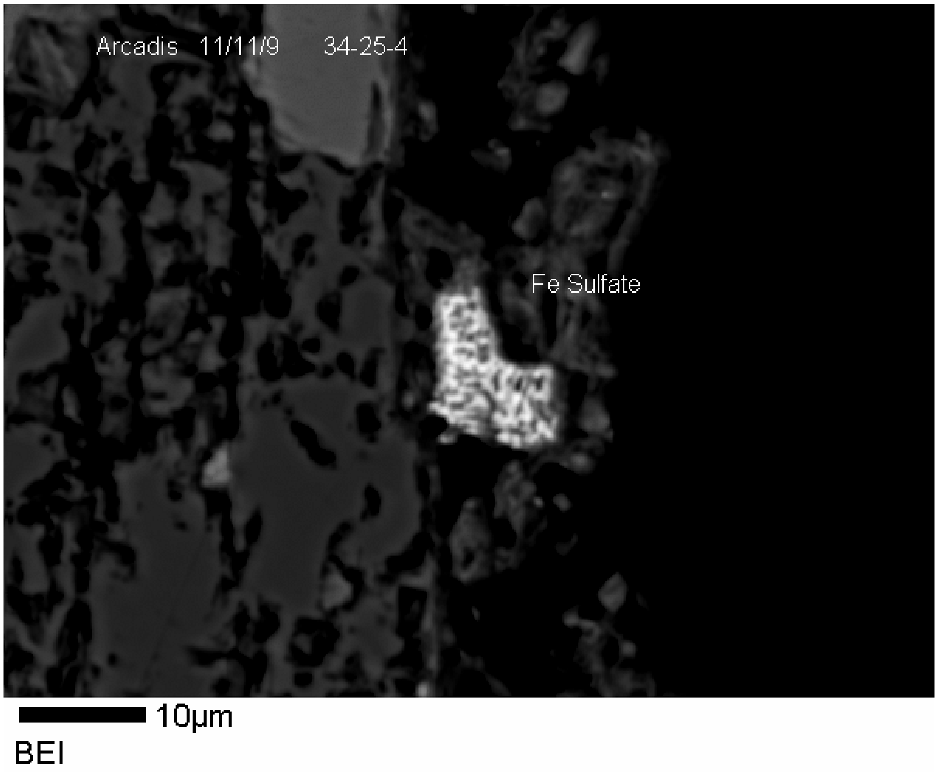
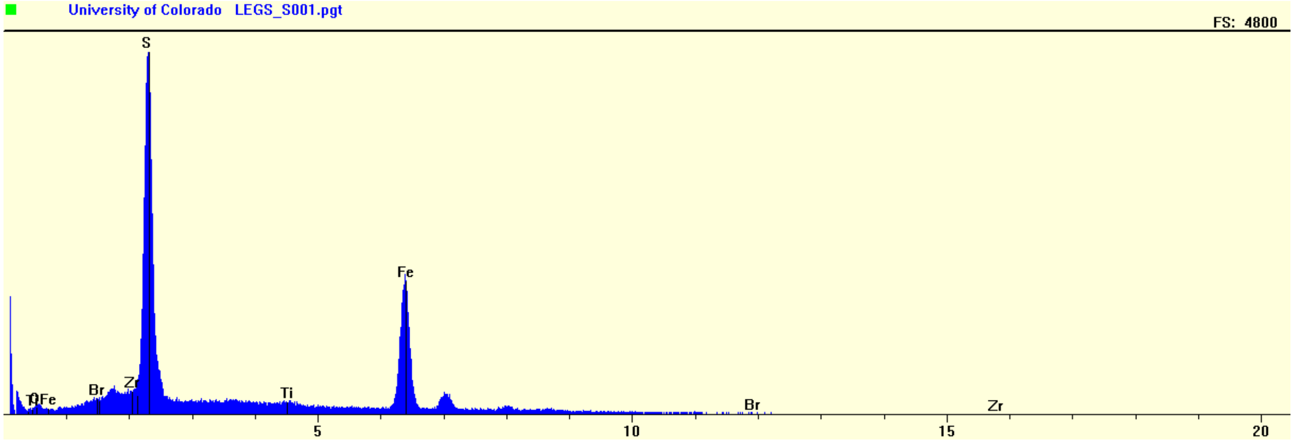


Figure No.
11h

Sample:
FID 34

Description:
Histogram 4



SPECIATION FIGURES

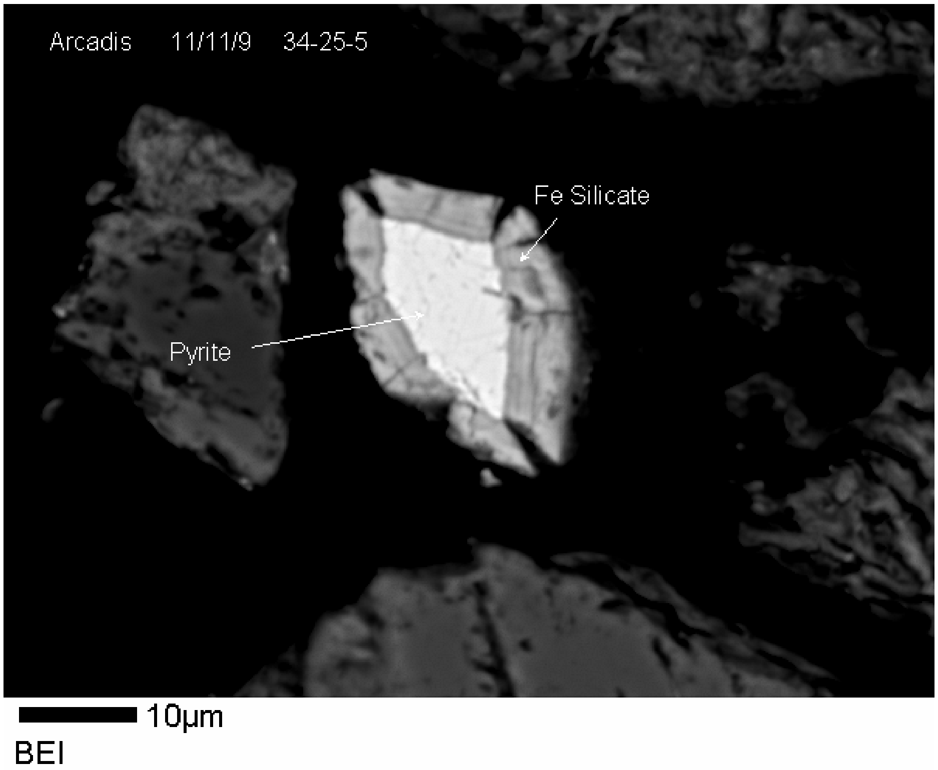
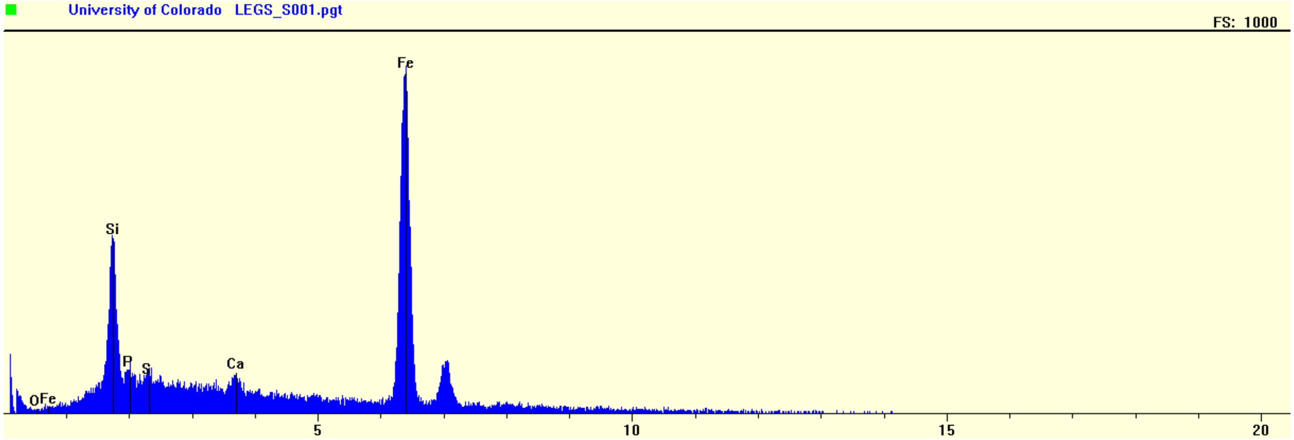
Figure No. **11i**	
Sample: FID 34 **Description:** Micrograph 5	

Figure No. **11j**	
Sample: FID 34 **Description:** Histogram 5	

SPECIATION FIGURES

Figure No.
12a

Sample:
FID 37

Description:
Micrograph 1

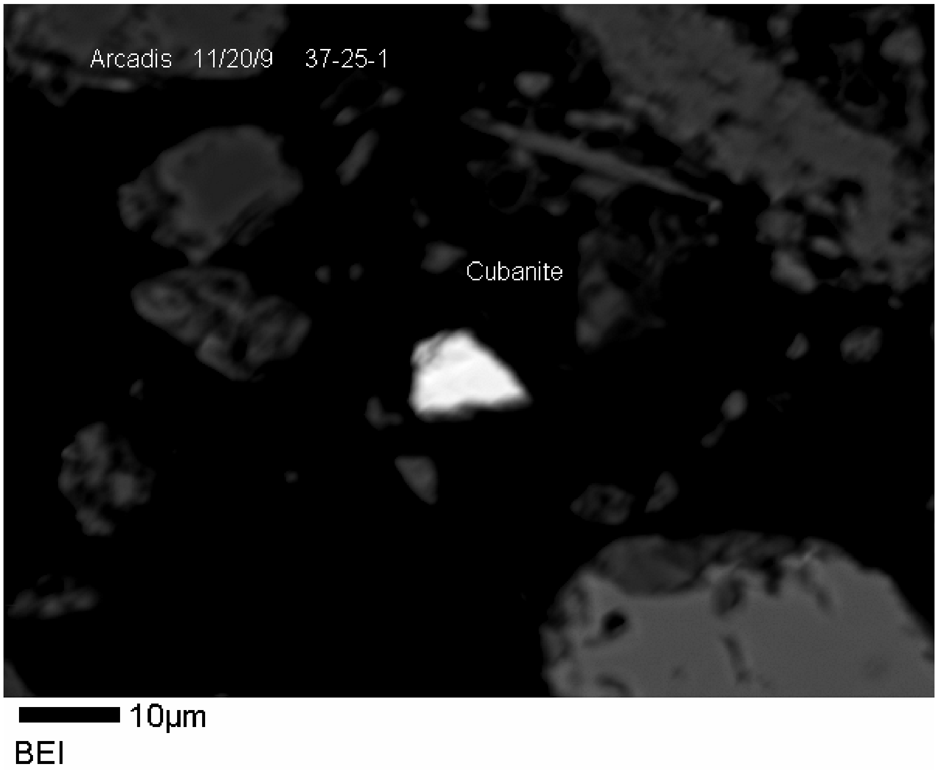
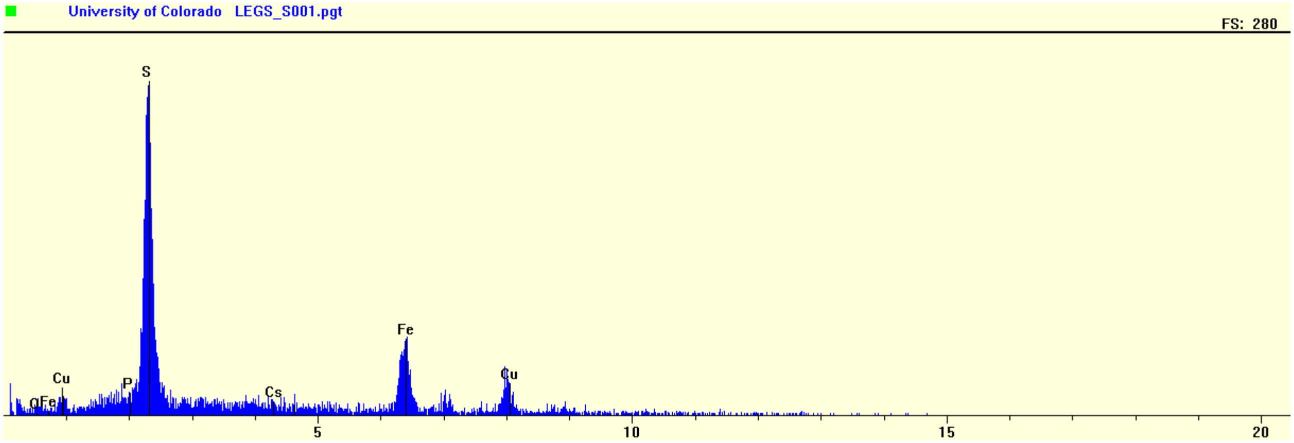


Figure No.
12b

Sample:
FID 37

Description:
Histogram 1



SPECIATION FIGURES

Figure No.
12c

Sample:
FID 37

Description:
Micrograph 2

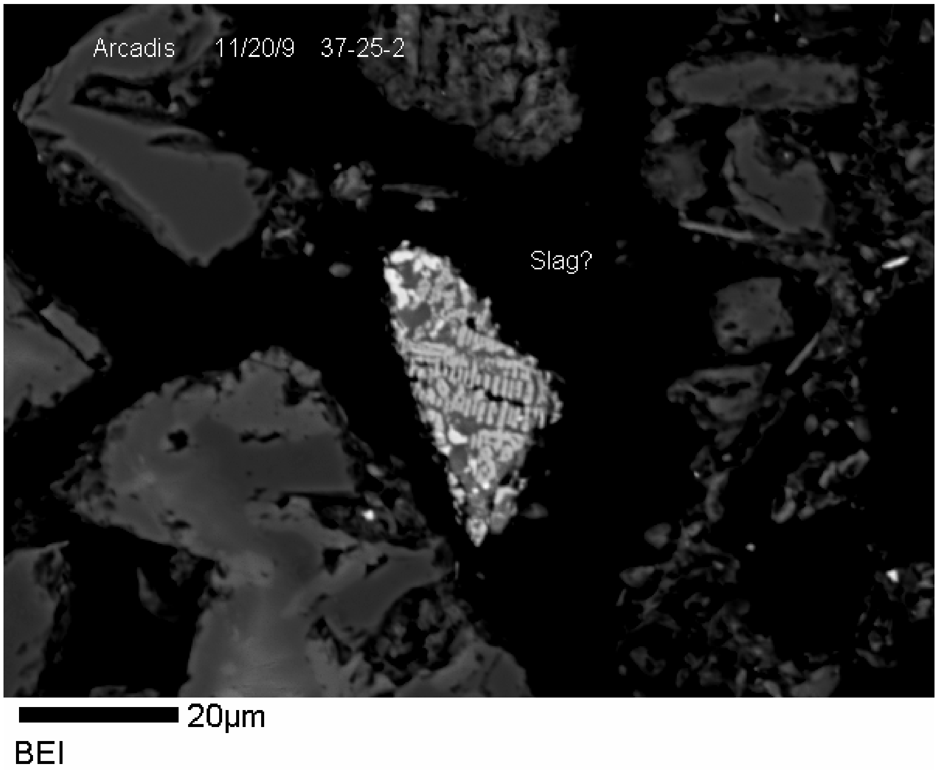
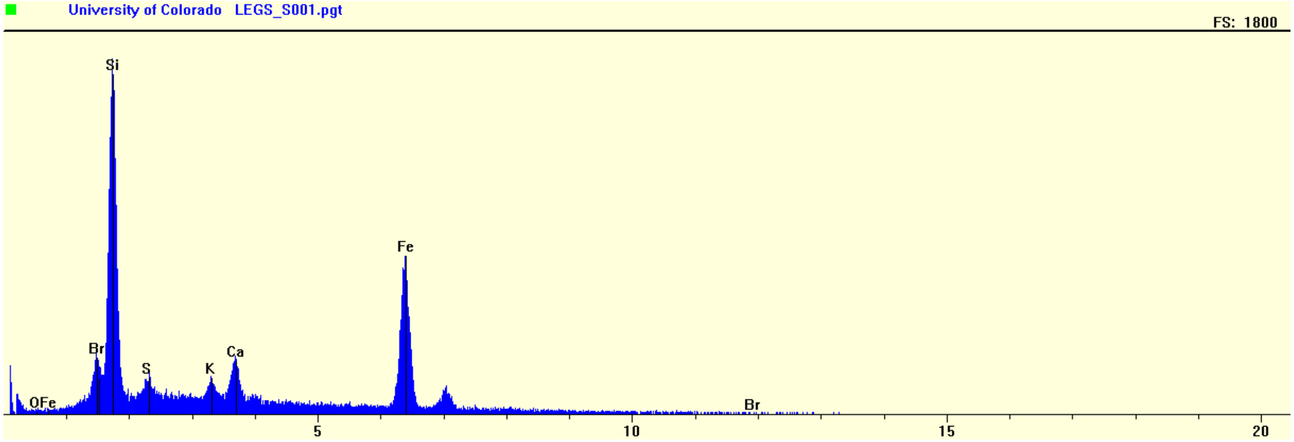


Figure No.
12d

Sample:
FID 37

Description:
Histogram 2



SPECIATION FIGURES

Figure No.
12e

Sample:
FID 37

Description:
Micrograph 3

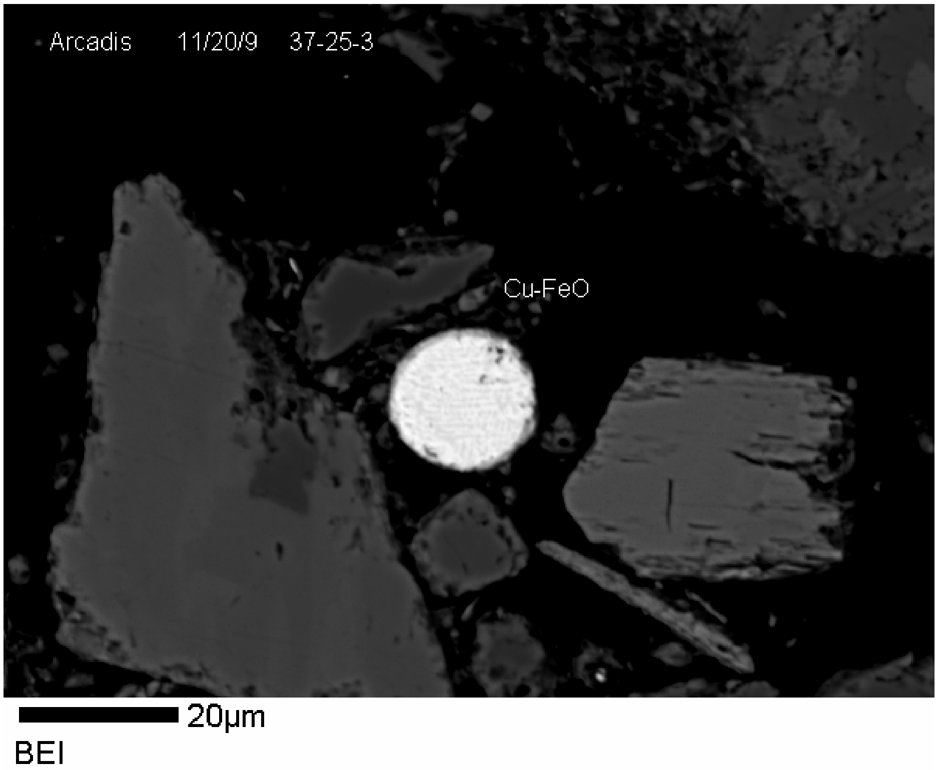
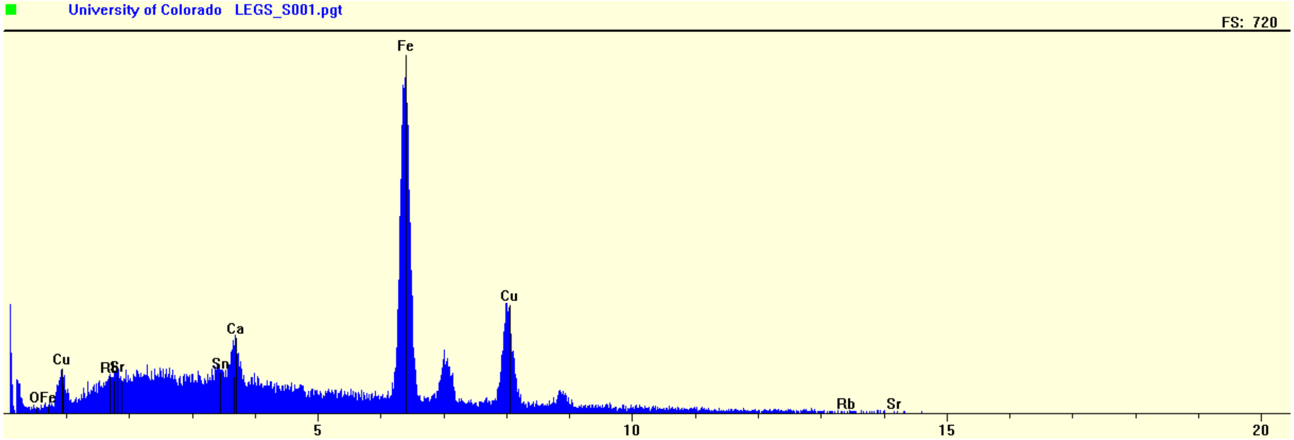


Figure No.
12f

Sample:
FID 37

Description:
Histogram 3



SPECIATION FIGURES

Figure No.
12g

Sample:
FID 37

Description:
Micrograph 4

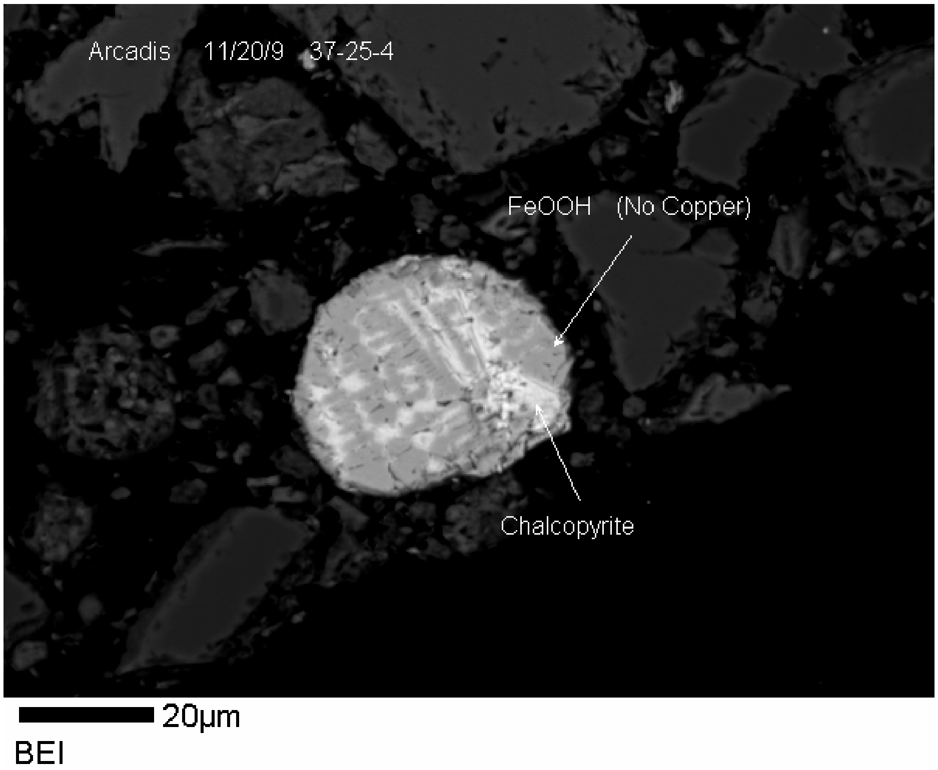
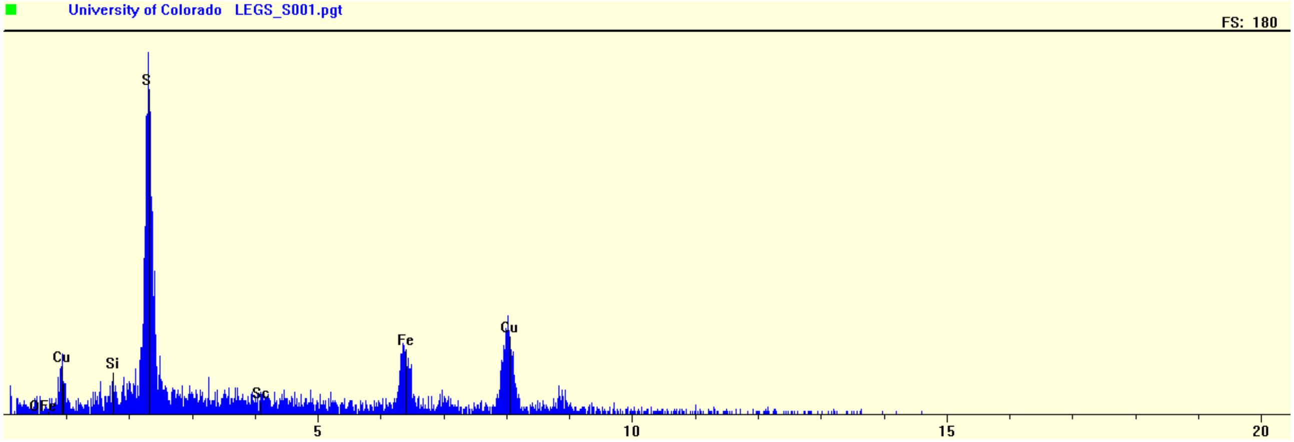


Figure No.
12h

Sample:
FID 37

Description:
Histogram 4



SPECIATION FIGURES

Figure No.
12i

Sample:
FID 37

Description:
Micrograph 5

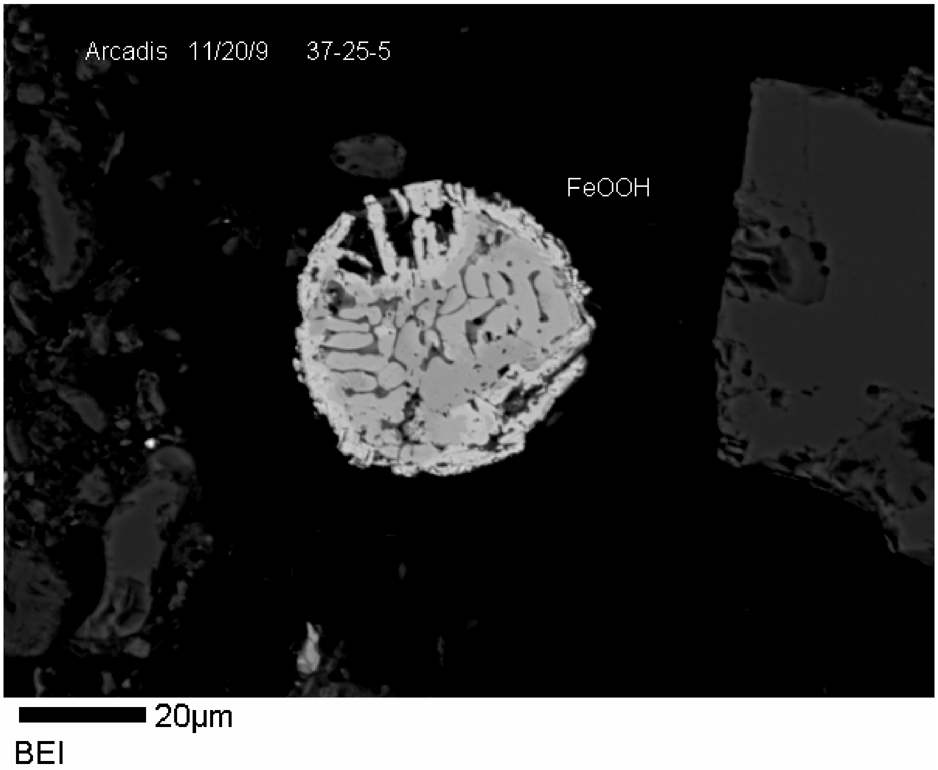
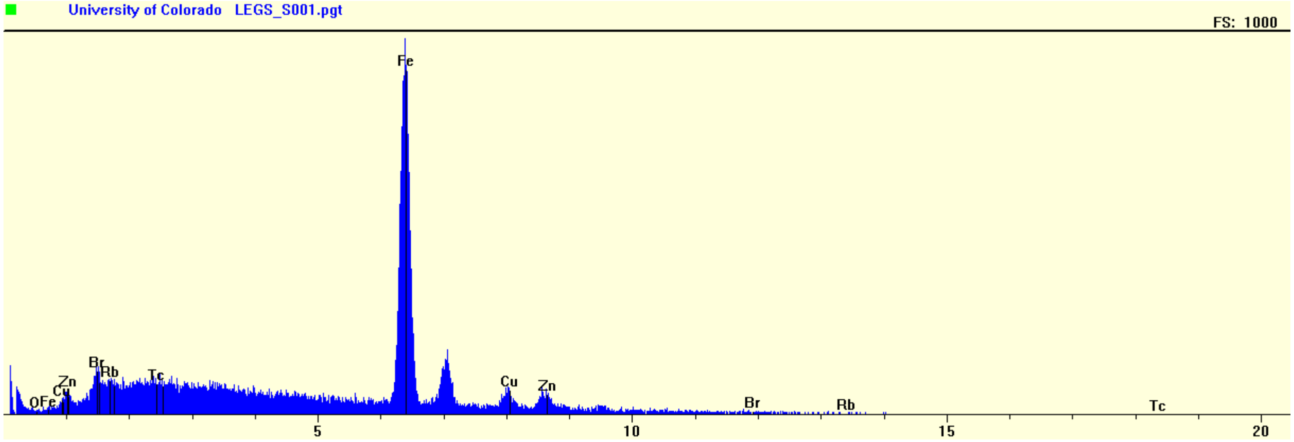


Figure No.
12j

Sample:
FID 37

Description:
Histogram 5



Laboratory of Environment and Geological Sciences, University of Colorado, Boulder

Project Name: Arcadis

Run #: 1 Date: 10/28/2009 Operater: DREXLER

Postion in rack	Sample name	Lab#	Wt. Grams	pH start	Starting time	Stopping time	pH stop
1	8-25 <250um	8-25-A	1.00369	1.575	11:05	12:05	1.602
2	10-25 <250um	10-25-A	1.0083	1.575	11:05	12:05	1.611
3	37-25	37-25-A	1.00242	1.575	11:05	12:05	1.6
4	21-25	21-25-A	1.00856	1.575	11:05	12:05	1.602
5	34-25	34-25-A	1.00633	1.575	11:05	12:05	1.609
6	12-25 <250um	12-25-A	1.00028	1.575	11:05	12:05	1.631
7	17-25	17-25-A	1.00431	1.575	11:05	12:05	1.646
8	27-25	27-25-A	0.99772	1.575	11:05	12:05	1.616
9	26-25	26-25-A	1.00515	1.575	11:05	12:05	1.613
10	18-25	18-25-A	0.99833	1.575	11:05	12:05	1.607

Run #: 2 Date: 10/28/2009 Operater: DREXLER

Postion in rack	Sample name	Lab#	Wt. Grams	pH start	Starting time	Stopping time	pH stop
1	BLANK	BLANK		1.575	12:25	1:25	1.580
2	BLANK SPIKE	BLK SPK		1.575	12:25	1:25	1.6
3	18-25 DUP	18-25-A DUP	1.00387	1.575	12:25	1:25	1.598
4	18-25 SPIKE	18-25-A-SPK	1.00731	1.575	12:25	1:25	1.598
5	6-25 <250um	6-25-A	0.99998	1.575	12:25	1:25	1.609
6	20-25	20-25-A	1.00366	1.575	12:25	1:25	1.606
7							
8							
9							
10							

TABLE 2 . Preliminary Summary Of In Vitro Bioassay Results

NO animal calibration for

Sample	ID	Cu in <250u bulk soil ppb	mass soil (g)	calc Cu #1	Bio Cu (ug/l)	solution amt (l)	% Relative Cu Bioavailability
8-25 <250um		322818.04	1.00369	3.2401E+02	719.0823	0.1	22
10-25 <250um		3825769.7	1.0083	3.8575E+03	25000.29	0.1	65
37-25		887445.89	1.00242	8.8959E+02	4108.522	0.1	46
21-25		271423.73	1.00856	2.7375E+02	1546.129	0.1	56
34-25		973813.18	1.00633	9.7998E+02	4985.396	0.1	51
12-25 <250um		8886898.5	1.00028	8.8894E+03	54123.84	0.1	61
17-25		9864535.2	1.00431	9.9071E+03	70734.16	0.1	71
27-25		632084.26	0.99772	6.3064E+02	2517.077	0.1	40
26-25		161368.98	1.00515	1.6220E+02	594.9847	0.1	37
18-25		340517.21	0.99833	3.3995E+02	1038.681	0.1	31
6-25 <250um		1267410.1	0.99998	1.2674E+03	7463.583	0.1	59
20-25		879580.6	1.00366	8.8280E+02	3323.686	0.1	38
QA/QC							
BLANK					0.00		
BLANK SPIKE					2340		
18-25 DUP		350150.56	1.00387	3.5151E+02	1033.866	0.1	29
18-25 SPIKE (2500 ppb Cu)		11458.293	1.00731	1.1542E+01	3453		

Cu

TABLE 3. Preliminary Summary Of In Vitro Bioassay Results

Sample	ID	Pb in <250u bulk soil ppb	mass soil (g)	calc Pb #1	Bio Pb (ug/l)	solution amt (l)
8-25 <250um		12542	1.00369	1.2588E+01	DL	0.1
10-25 <250um		63976	1.0083	6.4507E+01	288.24	0.1
37-25		26171	1.00242	2.6235E+01	35.48	0.1
21-25		11825	1.00856	1.1927E+01	29.72	0.1
34-25		27346	1.00633	2.7519E+01	109.61	0.1
12-25 <250um		106923	1.00028	1.0695E+02	684.32	0.1
17-25		94089	1.00431	9.4494E+01	596.10	0.1
27-25		39132	0.99772	3.9042E+01	66.18	0.1
26-25		17464	1.00515	1.7553E+01	54.87	0.1
18-25		16216	0.99833	1.6189E+01	12.51	0.1
6-25 <250um		33151	0.99998	3.3151E+01	84.31	0.1
20-25		16464	1.00366	1.6525E+01	65.06	0.1
QA/QC						
BLANK					0	
BLANK SPIKE 2500 ppb					2344	
18-25 DUP		16216	1.00387	1.6279E+01	DL	0.1
18-25 SPIKE (2500 ppb Pb)					2266	

% Relative Pb Bioavailability
ND
45
14
25
40
64
63
17
31
8
25
39
ND

TABLE 4 . Preliminary Summary Of In Vitro Bioassay Results

NO animal calibration for Cd

Sample	ID	Cd in <250u bulk soil ppb	mass soil (g)	calc Cd #1	Bio Cd (ug/l)	solution amt (l)	% Relative Cd Bioavailability
8-25 <250um		1337	1.00369	1.3417E+00	DL	0.1	ND
10-25 <250um		2510	1.0083	2.5313E+00	13.50	0.1	53
37-25		776	1.00242	7.7749E-01	DL	0.1	ND
21-25		285	1.00856	2.8733E-01	DL	0.1	ND
34-25		942	1.00633	9.4767E-01	7.80	0.1	82
12-25 <250um		7773	1.00028	7.7749E+00	74.91	0.1	96
17-25		10819	1.00431	1.0866E+01	94.48	0.1	87
27-25		722	0.99772	7.2037E-01	DL	0.1	ND
26-25		481	1.00515	4.8344E-01	DL	0.1	ND
18-25		127	0.99833	1.2708E-01	DL	0.1	ND
6-25 <250um		1402	0.99998	1.4021E+00	7.11	0.1	51
20-25		635	1.00366	6.3780E-01	DL	0.1	ND
QA/QC							
BLANK					0		
BLANK SPIKE					2341		
18-25 DUP		127	1.00387	1.2779E-01	DL	0.1	ND
18-25 SPIKE (2500 ppb Cd)					2290		

TABLE 5 . Preliminary Summary Of In Vitro Bioassay Results

Sample	ID	As in <250u bulk soil ppb	mass soil (g)	calc As #1	Bio As (ug/l)	solution amt (l)	% Relative As Bioavailability
8-25 <250um		4978	1.00369	4.9966E+00	63.82	0.1	ND
10-25 <250um		7080	1.0083	7.1392E+00	65.96	0.1	92
37-25		4197	1.00242	4.2067E+00	39.82	0.1	95
21-25		2455	1.00856	2.4765E+00	50.81	0.1	205
34-25		4715	1.00633	4.7444E+00	50.41	0.1	106
12-25 <250um		8023	1.00028	8.0248E+00	79.43	0.1	99
17-25		11638	1.00431	1.1688E+01	85.64	0.1	73
27-25		5147	0.99772	5.1349E+00	18.83	0.1	37
26-25		2852	1.00515	2.8671E+00	34.15	0.1	119
18-25		2962	0.99833	2.9571E+00	27.24	0.1	92
6-25 <250um		5533	0.99998	5.5327E+00	20.82	0.1	38
20-25		4148	1.00366	4.1631E+00	25.24	0.1	61
QA/QC							
BLANK					1		
BLANK SPIKE 2500 ppb					2497		
18-25 DUP		2962	1.00387	2.9735E+00	21.52	0.1	72
18-25 SPIKE (2500 ppb As					2387		

TABLE 6. Preliminary Summary Of In Vitro Bioassay Results

NO Animal Calibration for Zn

Sample	ID	Zn in <250u bulk soil ppb	mass soil (g)	calc Zn #1	Bio Zn (ug/l)	solution amt (l)	% Relative Zn Bioavailability
8-25 <250um		45209	1.00369	4.5376E+01	DL	0.1	ND
10-25 <250um		142841	1.0083	1.4403E+02	324.13	0.1	23
37-25		60833	1.00242	6.0980E+01	DL	0.1	ND
21-25		35656	1.00856	3.5961E+01	7.79	0.1	2
34-25		119292	1.00633	1.2005E+02	234.62	0.1	20
12-25 <250um		424547	1.00028	4.2467E+02	2810.76	0.1	66
17-25		305363	1.00431	3.0668E+02	1588.69	0.1	52
27-25		147976	0.99772	1.4764E+02	55.91	0.1	4
26-25		77749	1.00515	7.8150E+01	59.17	0.1	8
18-25		31360	0.99833	3.1307E+01	DL	0.1	ND
6-25 <250um		121764	0.99998	1.2176E+02	141.69	0.1	12
20-25		80159	1.00366	8.0452E+01	54.97	0.1	7
QA/QC							
BLANK					0.00		
BLANK SPIKE 2500 ppb					2451		
18-25 DUP		31360	1.00387	3.1481E+01	DL	0.1	ND
18-25 SPIKE (2500 ppb Zn)					2475		

Standard In Vitro < 250 micron	**Zn ppb**	**Cu ppb**	**As ppb**	**Cd ppb**	**Pb ppb**
8-25 LT250um	DL	719.08	63.82	DL	DL
10-25 LT250um	324.13	25000.29	65.96	13.50	288.24
37-25	DL	4108.52	39.82	DL	35.48
21-25	7.79	1546.13	50.81	DL	29.72
34-25	234.62	4985.40	50.41	7.80	109.61
12-25 LT250um	2810.76	54123.84	79.43	74.91	684.32
17-25	1588.69	70734.16	85.64	94.48	596.10
27-25	55.91	2517.08	18.83	DL	66.18
26-25	59.17	594.98	34.15	DL	54.87
18-25	DL	1038.68	27.24	DL	12.51
18-25 DUP	DL	1033.87	21.52	DL	DL
6-25 LT250um	141.69	7463.58	20.82	7.11	84.31
20-25	54.97	3323.69	25.24	DL	65.06

BIO QA/QC

18-25	DL	1038.68	27.24	DL	12.51	
18-25 DUP	DL	1033.87	21.52	DL	DL	
RPD	NA	0.46	23.45	NA	NA	
BLANK	0.00	0.00	1	0	0	not dilution corrected
BLANK SPIKE 2500 ppb	2451	2340	2497	2341	2344	
% Recovery	98	94	100	94	94	
18-25	0	1039	27	0	13	
18-25 SPIKE 2500 ppb	2475	3453	2387	2290	2266	
% Recovery	99	97	94	92	90	

3050 < 250 micron

	Zn ppb	Cu ppb	As ppb	Cd ppb	Pb ppb
8-25-A	45209	322818	4978	1337	12542
10-25-A	142841	3825770	7080	2510	63976
37-25-A	60833	887446	4197	776	26171
21-25-A	35656	271424	2455	285	11825
34-25-A	119292	973813	4715	942	27346
12-25-A	424547	8886898	8023	7773	106923
17-25-A	305363	9864535	11638	10819	94089
27-25-A	147976	632084	5147	722	39132
26-25-A	77749	161369	2852	481	17464
18-25-A	31360	340517	2962	127	16216
18-25-A DUP	32274	350151	2971	136	12899
18-25-A-SPK	5304	11458	4899	4539	4824
6-25-A	121764	1267410	5533	1402	33151
20-25-A	80159	879581	4148	635	16464

3050 QA/QC

BLANK	-0.27	-0.04	0	0	-1	Not dilution corrected
BLK SPK 5000 ppb	4900	5255	5150	4694	4691	
% Recovery	98	105	103	94	94	

18-25-A	31360	340517	2962	127	16216
18-25-A DUP	32274	350151	2971	136	12899
RPD	2.87	2.79	0.31	6.83	22.78

BLANK	0	0	0	0	-1	Not dilution corrected
BLK SPK 5000 ppb	4846	5150	5004	4631	4597	
% Recovery	97	103	100	93	92	

18-25-A	630	6839	59	3	326	Not digest corrected
18-25-A-SPK 5000 ppb	5304	11458	4899	4539	4824	Not digest corrected
% Recovery	93	92	97	91	90	

	0	Zn ppb	Cu ppb	As ppb	Cd ppb	Pb ppb
8-25 LT250um all 50x		DL	719.082	63.817	DL	DL
10-25 LT250um		324.129	25000.285	65.960	13.504	288.244
37-25		DL	4108.522	39.824	DL	35.478
21-25		7.787	1546.129	50.806	DL	29.723
34-25		234.624	4985.396	50.408	7.796	109.609
12-25 LT250um		2810.761	54123.835	79.428	74.905	684.316
17-25		1588.688	70734.161	85.641	94.477	596.103
	0	0.000	0.000	0.000	0.000	0.000
	0	DL	DL	DL	DL	DL
27-25		55.913	2517.077	18.827	DL	66.185
26-25		59.172	594.985	34.154	DL	54.868
18-25		DL	1038.681	27.239	DL	12.513
BLANK		DL	DL	0.687	DL	DL
BLANK SPIKE		2450.776	2339.568	2496.696	2341.091	2343.545
18-25 DUP		DL	1033.866	21.523	DL	DL
18-25 SPIKE		2474.603	3452.528	2387.372	2290.081	2266.310
6-25 LT250um		141.694	7463.583	20.816	7.111	84.309
20-25		54.968	3323.686	25.241	DL	65.056

0	Zn ppb	Cu ppb	As ppb	Cd ppb	Pb ppb	
8-25 LT250um all 50x	-8.452	719.082	63.817	-3.328	-23.638	
10-25 LT250um	324.129	25000.285	65.960	13.504	288.244	
37-25	4.144	4108.522	39.824	-0.599	35.478	
21-25	7.787	1546.129	50.806	-2.395	29.723	
34-25	234.624	4985.396	50.408	7.796	109.609	
12-25 LT250um	2810.761	54123.835	79.428	74.905	684.316	
17-25	1588.688	70734.161	85.641	94.477	596.103	
27-25	55.913	2517.077	18.827	-1.273	66.185	
26-25	59.172	594.985	34.154	-1.231	54.868	
18-25	-14.176	1038.681	27.239	-4.481	12.513	
BLANK	-1.183	-3.670	0.687	-0.098	-0.419	Not dilution corrected
BLANK SPIKE	2450.776	2339.568	2496.696	2341.091	2343.545	
18-25 DUP	-25.635	1033.866	21.523	-3.924	-30.294	
18-25 SPIKE	2474.603	3452.528	2387.372	2290.081	2266.310	
6-25 LT250um	141.694	7463.583	20.816	7.111	84.309	
20-25	54.968	3323.686	25.241	-1.036	65.056	

0	Zn ppb	Cu ppb	As ppb	Cd ppb	Pb ppb	Zn ppb	Cu ppb	As ppb	Cd ppb	Pb ppb
Standard 1	100.000	100.000	100.000	100.000	100.000					
Standard 2	499.994	500.584	499.511	500.219	500.330					
Standard 3	1004.439	1005.122	999.169	1004.763	1025.064					
Blank	0.000	0.000	0.000	0.000	0.000					
stan check	156.215	152.922	153.290	154.914	150.643					
interfer	338.920	442.098	178.772	91.807	52.419					
int	373.008	487.337	199.844	97.478	55.860					
8-25 LT250um all 50x	-0.169	14.382	1.276	-0.067	-0.473					
10-25 LT250um	6.483	500.006	1.319	0.270	5.765					
37-25	0.083	82.170	0.796	-0.012	0.710					
21-25	0.156	30.923	1.016	-0.048	0.594					
34-25	4.692	99.708	1.008	0.156	2.192					
12-25 LT250um	56.215	1082.477	1.589	1.498	13.686					
17-25	31.774	1414.683	1.713	1.890	11.922					
Standard Check 150 ppb	156.684	160.293	150.286	157.080	152.085					
Blank	0.050	-0.025	-0.010	0.012	0.012					
27-25	1.118	50.342	0.377	-0.025	1.324					
26-25	1.183	11.900	0.683	-0.025	1.097					
18-25	-0.284	20.774	0.545	-0.090	0.250					
BLANK	-1.183	-3.670	0.687	-0.098	-0.419					
BLANK SPIKE	49.016	46.791	49.934	46.822	46.871					
18-25 DUP	-0.513	20.677	0.430	-0.078	-0.606					
18-25 SPIKE	49.492	69.051	47.747	45.802	45.326	50.005	48.373	47.317	45.880	45.932
6-25 LT250um	2.834	149.272	0.416	0.142	1.686					
20-25	1.099	66.474	0.505	-0.021	1.301					
Standard Check 150 ppb	152.138	156.343	147.241	152.878	149.039					
Standard Check 150 ppb	154.835	158.940	146.299	152.729	150.400					
Blank	0.082	0.005	0.095	0.011	-0.019					
Interference Check	382.628	511.733	194.365	101.150	57.209					
Machine Detection Limit	0.130	0.051	0.182	0.020	0.049					

0	Zn ppb	Cu ppb	As ppb	Cd ppb	Pb ppb		Zn ppb	Cu ppb	As ppb	Cd ppb	Pb ppb
Standard 1	100	100	100	100	100						
Standard 2	499.9937	500.5844	499.5114	500.2194	500.3302						
Standard 3	1004.439	1005.122	999.1694	1004.763	1025.064						
Blank	0	0	0	0	0						
stan check	138.2432	142.9177	143.262	144.7798	134.5024	1					
interfer	299.9291	413.1755	167.0769	85.80069	46.80237	2					
int	330.0953	455.4555	186.7698	91.10074	49.87511	3					
8-25 LT250um all 50x	-0.1496	13.44079	1.19284	-0.0622	-0.4221	4					
10-25 LT250um	5.7368	467.2951	1.23289	0.25241	5.14721	5					
37-25	0.07334	76.79481	0.74438	-0.0112	0.63354	6					
21-25	0.13782	28.89961	0.94964	-0.04477	0.53076	7					
34-25	4.15263	93.18498	0.94221	0.14572	1.95731	8					
12-25 LT250um	49.74799	1011.66	1.48463	1.4001	12.21992	9					
17-25	28.11837	1322.134	1.60077	1.76592	10.64469	10					
Standard Check 150 pp	138.6587	149.8068	140.454	146.8041	135.7903	11					
Blank	0.04409	-0.02339	-0.00931	0.01081	0.01059	12					
27-25	0.98961	47.04816	0.3519	-0.02379	1.18187	13					
26-25	1.04729	11.12121	0.6384	-0.023	0.97979	14					
18-25	-0.2509	19.41459	0.50914	-0.08375	0.22344	15					
BLANK	-1.04653	-3.43031	0.6423	-0.09136	-0.37387	16					
BLANK SPIKE	43.37656	43.73024	46.66721	43.75871	41.84901	17					
18-25 DUP	-0.45371	19.32459	0.40229	-0.07334	-0.54097	18					
18-25 SPIKE	43.79829	64.53324	44.62377	42.80525	40.46982	19					
6-25 LT250um	2.50785	139.5062	0.38908	0.13291	1.50551	20					
20-25	0.97288	62.12498	0.47179	-0.01936	1.16171	21					
Standard Check 150 pp	134.6354	146.1149	137.6082	142.8771	133.0704	22					
Standard Check 150 pp	137.0225	148.542	136.7281	142.7376	134.2855	23					
Blank	0.07253	0.00507	0.08895	0.00991	-0.0168	24			0.025		-0.002
Interference Check	338.6092	478.2549	181.6499	94.53259	51.07903	25					
	0.115	0.048	0.170	0.019	0.043						

	Zn ppb	Cu ppb	As ppb	Cd ppb	Pb ppb
Standard 1	100	100	100	100	100
Standard 2	499.9937	500.5844	499.5114	500.2194	500.3302
Standard 3	1004.439	1005.122	999.1694	1004.763	1025.064
Blank					
stan check	138.2432	142.9177	143.237	144.7798	134.5044
interfer	299.9291	413.1755	167.0269	85.80069	46.80637
int	330.0953	455.4555	186.6948	91.10074	49.88111
8-25 LT250um all 50x	-0.1496	13.44079	1.09284	-0.0622	-0.4141
10-25 LT250um	5.7368	467.2951	1.10789	0.25241	5.15721
37-25	0.07334	76.79481	0.59438	-0.0112	0.64554
21-25	0.13782	28.89961	0.77464	-0.04477	0.54476
34-25	4.15263	93.18498	0.74221	0.14572	1.97331
12-25 LT250um	49.74799	1011.66	1.25963	1.4001	12.23792
17-25	28.11837	1322.134	1.35077	1.76592	10.66469
Standard Check 150 ppb	138.6587	149.8068	140.179	146.8041	135.8123
Blank	0.04409	-0.02339	-0.30931	0.01081	0.03459
27-25	0.98961	47.04816	0.0269	-0.02379	1.20787
26-25	1.04729	11.12121	0.2884	-0.023	1.00779
18-25	-0.2509	19.41459	0.13414	-0.08375	0.25344
BLANK	-1.04653	-3.43031	0.2423	-0.09136	-0.34187
BLANK SPIKE	43.37656	43.73024	46.24221	43.75871	41.88301
18-25 DUP	-0.45371	19.32459	-0.04771	-0.07334	-0.50497
18-25 SPIKE	43.79829	64.53324	44.14877	42.80525	40.50782
6-25 LT250um	2.50785	139.5062	-0.11092	0.13291	1.54551
20-25	0.97288	62.12498	-0.05321	-0.01936	1.20371
Standard Check 150 ppb	134.6354	146.1149	137.0582	142.8771	133.1144
Standard Check 150 ppb	137.0225	148.542	136.1531	142.7376	134.3315
Blank	0.07253	0.00507	-0.51105	0.00991	0.0312
Interference Check	338.6092	478.2549	181.0249	94.53259	51.12903

Table 1
Laboratory of Environment and Geological Sciences, University of Colorado, Boulder

Project Name: Arcadis

Run #: 1 FOR BIRD W/ GIZARD SOL
Date: 10/28/2009
Operater: Drexler

Postion in rack	Sample name	Lab#	Wt. Grams	pH start	Starting time	Stopping time	pH stop
1	37-25	37-25-B	3.60122	2.602	10:30	11:30	2.971
2	26-25	26-25-B	3.60415	2.602	10:30	11:30	3.776
3	10-25 <2mm	10-25-B	3.59982	2.602	10:30	11:30	3.412
4	08-25 <2mm	08-25-B	3.60222	2.602	10:30	11:30	4.3
5	18-25	18-25-B	3.59918	2.602	10:30	11:30	2.877
6	21-25	21-25-B	3.59892	2.602	10:30	11:30	2.952
7	12-25 <2mm	12-25-B	3.60295	2.602	10:30	11:30	6.006
8	17-25	17-25-B	3.60306	2.602	10:30	11:30	4.781
9	06-25 <2mm	06-25-B	3.59974	2.602	10:30	11:30	3.528
10	34-25	34-25-B	3.60092	2.602	10:30	11:30	3.713

Run #: 2 FOR BIRD
Date: 10/28/2009
Operater: Drexler

Postion in rack	Sample name	Lab#	Wt. Grams	pH start	Starting time	Stopping time	pH stop
1	BLANK	BLANK		2.602	10:30	11:30	2.738
2	BLANK SPIKE	BLK SPK		2.602	10:30	11:30	3.563
3	34-25	34-25-B DUP	3.60388	2.602	10:30	11:30	3.7
4	34-25	34-25-B SPK	3.59949	2.602	10:30	11:30	2.591
5	27-25	27-25-B	3.60295	2.602	10:30	11:30	3.291
6	20-25	20-25-B	3.60009	2.602	10:30	11:30	3.205
7							
8							
9							
10							

TABLE 2 . Preliminary Summary Of In Vitro Bioassay Results

Sample	ID	Cu in <250u bulk soil ppb	mass soil (g)	calc Cu #1	Bio Cu (ug/l)	solution amt (l)	% Relative Cu Bioavailability
37-25		606468.2832	3.60122	2184.0257	27610	0.03	38
26-25		69523.3613	3.60415	250.5726	460	0.03	6
10-25 <2mm		1136938.15	3.59982	4092.7727	34080	0.03	25
08-25 <2mm		449907.0999	3.60222	1620.6644	3280	0.03	6
18-25		367481.4415	3.59918	1322.6319	17560	0.03	40
21-25		139061.2363	3.59892	500.4703	5410	0.03	32
12-25 <2mm		4756993.406	3.60295	17139.2094	100710	0.03	18
17-25		7262104.16	3.60306	26165.7970	223400	0.03	26
06-25 <2mm		560552.2812	3.59974	2017.8425	5380	0.03	8
34-25		370834.2838	3.60092	1335.3446	2340	0.03	5
27-25		346560.987	3.60295	1248.6419	6200	0.03	15
20-25		860146.533	3.60009	3096.6049	16630	0.03	16
AVERAGE							20
BLANK					0.000300006		
BLK SPK 1000 ppb					1010		
34-25-B DUP		366574.1537	3.60388	1321.0893	2070	0.03	5
34-25-B SPK (2500 ppb Cu)		366574.1537	3.59949	1319.4800	4760		

3050	Zn ppb	Cu ppb	As ppb	Cd ppb	Pb ppb
37-25-B	48420.27	606468.3	3642.441	542.5549	17464.26
26-25-B	64029.35	69523.36	2672.807	263.6032	358964.6
10-25-B	84299.06	1136938	3254.99	1461.938	20269.89
08-25-B	73938.21	449907.1	4770.638	327.2133	11442.54
18-25-B	30635.27	367481.4	2072.203	113.4522	7639.164
21-25-B	20964.31	139061.2	1630.336	130.2317	6875.585
12-25-B	311579.6	4756993	7121.13	4596.636	74445.02
17-25-B	211067.9	7262104	8636.445	6248.741	63552.91
06-25-B	121532.9	560552.3	5591.573	743.63	27420.72
34-25-B	107143.5	370834.3	5849.856	478.6854	20330.23
34-25-B DUP	104390.3	366574.2	6484.573	692.1727	21256.55
27-25-B	142280.7	346561	5338.284	625.4143	34315.82
20-25-B	86962.51	860146.5	4532.858	438.7998	15433.46

3050 QA/QC

34-25-B	107143.5	370834.3	5849.856	478.6854	20330.23
34-25-B DUP	104390.3	366574.2	6484.573	692.1727	21256.55
RPD	2.603035	1.155433	10.29181	36.46681	4.45486
BLANK	-0.26833	-0.042	0.014402	-0.02335	-1.03006
BLK SPK	4899.699	5255.35	5149.72	4693.757	4690.96
% Recovery	97.99935	105.1078	102.9941	93.8756	93.83979
34-25-B	2160.506	7477.725	117.96	9.6525	409.951
34-25-B SPK	6818.113	13778.68	5000.545	4589.773	5011.12
% Recovery	93.15214	126.0191	97.6517	91.6024	92.02338
BLANK	-0.06373	-0.09347	-0.14636	-0.03331	-0.9795
BLK SPK	4846.305	5149.546	5004.259	4630.957	4597.159
% Recovery	96.92737	102.9928	100.0881	92.61981	91.96277

	OES Cu ppm	MS Cu ppm	
BLANK *	0.00		
Blank-Spike 1 PPM	1.01		
BLANK	0.00		
BLANK B BIO ALL 10X	DL	0.02	
BLANK SPIKE	8.61	9.27	This blank spike appears to be contaminated
34-25B	2.34	3.39	
6-25B	5.38	7.83	
17-25B	223.40	220.99	
12-25B	100.71	92.51	
21-25B	5.41	3.86	
18-25B	17.56	15.54	
STAND 1ppm	0.99	0.00	
8-25B	3.28	3.77	
10-25B	34.08	33.32	
26-25B	0.46	1.22	
37-25B	27.61	26.05	
20-25-B	16.63	16.99	
27-25B	6.20	5.82	
34-25B SPK 2.5 ppm	4.76	5.62	
34-25-DUP	2.07	2.88	

*Standards and blanks prepared with matrix blank.

	Zn ppb	Cu ppb	As ppb	Cd ppb	Pb ppb	
3050 < 2mm						
37-25-B	48420	606468	3642	543	17464	
26-25-B	64029	69523	2673	264	358965	
10-25-B	84299	1136938	3255	1462	20270	
08-25-B	73938	449907	4771	327	11443	
18-25-B	30635	367481	2072	113	7639	
21-25-B	20964	139061	1630	130	6876	
12-25-B	311580	4756993	7121	4597	74445	
17-25-B	211068	7262104	8636	6249	63553	
06-25-B	121533	560552	5592	744	27421	
34-25-B	107143	370834	5850	479	20330	
34-25-B DUP	104390	366574	6485	692	21257	
27-25-B	142281	346561	5338	625	34316	
20-25-B	86963	860147	4533	439	15433	
3050 <250 micron						
8-25-A	45209	322818	4978	1337	12542	
10-25-A	142841	3825770	7080	2510	63976	
37-25-A	60833	887446	4197	776	26171	
21-25-A	35656	271424	2455	285	11825	
34-25-A	119292	973813	4715	942	27346	
12-25-A	424547	8886898	8023	7773	106923	
17-25-A	305363	9864535	11638	10819	94089	
27-25-A	147976	632084	5147	722	39132	
26-25-A	77749	161369	2852	481	17464	
18-25-A	31360	340517	2962	127	16216	
18-25-A DUP	32274	350151	2971	136	12899	
18-25-A-SPK	5304	11458	4899	4539	4824	
6-25-A	121764	1267410	5533	1402	33151	
20-25-A	80159	879581	4148	635	16464	
3050 QA/QC						
34-25-B	107143	370834	5850	479	20330	
34-25-B DUP	104390	366574	6485	692	21257	
RPD	2.60	1.16	10.29	36.47	4.45	
BLANK	-0.27	-0.04	0	0	-1	Not dilution corrected
BLK SPK 5000 ppb	4900	5255	5150	4694	4691	
% Recovery	98	105	103	94	94	
34-25-B	2161	7478	118	10	410	Not digest corrected
34-25-B SPK 5000 ppb	6818	13779	5001	4590	5011	Not digest corrected
% Recovery	93	126	98	92	92	
18-25-A	31360	340517	2962	127	16216	
18-25-A DUP	32274	350151	2971	136	12899	
RPD	2.87	2.79	0.31	6.83	22.78	
BLANK	0	0	0	0	-1	Not dilution corrected
BLK SPK 5000 ppb	4846	5150	5004	4631	4597	
% Recovery	97	103	100	93	92	
18-25-A	630	6839	59	3	326	Not digest corrected
18-25-A-SPK 5000 ppb	5304	11458	4899	4539	4824	Not digest corrected
% Recovery	93	92	97	91	90	

0	Zn ppb	Cu ppb	As ppb	Cd ppb	Pb ppb
37-25-B all 50x 3050	48420.269	606468.283	3642.441	542.555	17464.255
26-25-B	64029.349	69523.361	2672.807	263.603	358964.613
10-25-B	84299.058	1136938.150	3254.990	1461.938	20269.895
08-25-B	73938.213	449907.100	4770.638	327.213	11442.539
18-25-B	30635.267	367481.441	2072.203	113.452	7639.164
21-25-B	20964.312	139061.236	1630.336	130.232	6875.585
12-25-B	311579.606	4756993.406	7121.130	4596.636	74445.023
17-25-B	211067.896	7262104.160	8636.445	6248.741	63552.915
06-25-B	121532.885	560552.281	5591.573	743.630	27420.718
34-25-B	107143.484	370834.284	5849.856	478.685	20330.232
BLANK	DL	DL	DL	DL	DL
BLK SPK	4899.699	5255.350	5149.720	4693.757	4690.960
34-25-B DUP	104390.334	366574.154	6484.573	692.173	21256.549
34-25-B SPK	6818.113	13778.678	5000.545	4589.773	5011.120
27-25-B	142280.672	346560.987	5338.284	625.414	34315.824
20-25-B	86962.513	860146.533	4532.858	438.800	15433.456
8-25-A	45208.863	322818.035	4978.270	1336.806	12542.162
10-25-A	142841.007	3825769.701	7080.398	2510.433	63975.960
37-25-A	60833.077	887445.888	4196.536	775.614	26171.252
21-25-A	35655.942	271423.729	2455.476	284.890	11825.392
34-25-A	119292.497	973813.181	4714.547	941.706	27346.178
12-25-A	424547.097	8886898.492	8022.588	7772.675	106922.977
17-25-A	305362.936	9864535.218	11637.969	10819.071	94088.797
27-25-A	147976.012	632084.259	5146.675	722.020	39131.530
26-25-A	77749.330	161368.981	2852.452	480.964	17463.516
18-25-A	31359.741	340517.213	2962.044	127.293	16216.117
BLANK	DL	DL	DL	DL	DL
BLK SPK	4846.305	5149.546	5004.259	4630.957	4597.159
18-25-A DUP	32273.655	350150.556	2971.196	136.291	12899.247
18-25-A-SPK	5304.407	11458.293	4898.584	4539.135	4823.923
6-25-A	121764.178	1267410.053	5532.839	1402.101	33151.325
20-25-A	80158.649	879580.605	4147.883	635.469	16464.452

0	Zn ppb	Cu ppb	As ppb	Cd ppb	Pb ppb	digest facto	wt g	
37-25-B all 50x 3050	48420.27	606468.28	3642.441	542.5549	17464.26	49.85343	1.00294	37-25-B
26-25-B	64029.35	69523.361	2672.807	263.6032	358964.6	50.06709	0.99866	26-25-B
10-25-B	84299.06	1136938.1	3254.99	1461.938	20269.89	49.63124	1.00743	10-25-B
08-25-B	73938.21	449907.1	4770.638	327.2133	11442.54	50.0135	0.99973	08-25-B
18-25-B	30635.27	367481.44	2072.203	113.4522	7639.164	50.02301	0.99954	18-25-B
21-25-B	20964.31	139061.24	1630.336	130.2317	6875.585	49.80179	1.00398	21-25-B
12-25-B	311579.6	4756993.4	7121.13	4596.636	74445.02	50.29473	0.99414	12-25-B
17-25-B	211067.9	7262104.2	8636.445	6248.741	63552.91	49.85393	1.00293	17-25-B
06-25-B	121532.9	560552.28	5591.573	743.63	27420.72	49.86288	1.00275	06-25-B
34-25-B	107143.5	370834.28	5849.856	478.6854	20330.23	49.59186	1.00823	34-25-B
BLANK	-0.24617	-0.042	0.01412	-0.02224	-0.93642	Not dilution corrected		
BLK SPK	4899.699	5255.35	5149.72	4693.757	4690.96	0		
34-25-B DUP	104390.3	366574.15	6484.573	692.1727	21256.55	49.989	1.00022	34-25-B DUP
34-25-B SPK	6818.113	13778.678	5000.545	4589.773	5011.12	not digest corrected		
27-25-B	142280.7	346560.99	5338.284	625.4143	34315.82	50.224	0.99554	27-25-B
20-25-B	86962.51	860146.53	4532.858	438.7998	15433.46	49.94306	1.00114	20-25-B
8-25-A	45208.86	322818.04	4978.27	1336.806	12542.16	49.89572	1.00209	8-25-A
10-25-A	142841	3825769.7	7080.398	2510.433	63975.96	49.68055	1.00643	10-25-A
37-25-A	60833.08	887445.89	4196.536	775.6138	26171.25	49.64405	1.00717	37-25-A
21-25-A	35655.94	271423.73	2455.476	284.8901	11825.39	49.77551	1.00451	21-25-A
34-25-A	119292.5	973813.18	4714.547	941.7063	27346.18	49.92611	1.00148	34-25-A
12-25-A	424547.1	8886898.5	8022.588	7772.675	106923	49.91764	1.00165	12-25-A
17-25-A	305362.9	9864535.2	11637.97	10819.07	94088.8	49.69339	1.00617	17-25-A
27-25-A	147976	632084.26	5146.675	722.0205	39131.53	50.01701	0.99966	27-25-A
26-25-A	77749.33	161368.98	2852.452	480.964	17463.52	49.63765	1.0073	26-25-A
18-25-A	31359.74	340517.21	2962.044	127.2929	16216.12	49.79187	1.00418	18-25-A
BLANK	-0.05847	-0.09347	-0.14349	-0.03172	-0.89045	Not dilution corrected		
BLK SPK	4846.305	5149.5455	5004.259	4630.957	4597.159	0		
18-25-A DUP	32273.65	350150.56	2971.196	136.2911	12899.25	49.8778	1.00245	18-25-A DUP
18-25-A-SPK	5304.407	11458.293	4898.584	4539.135	4823.923	Not digest corrected		
6-25-A	121764.2	1267410.1	5532.839	1402.101	33151.32	49.76313	1.00476	6-25-A
20-25-A	80158.65	879580.6	4147.883	635.4693	16464.45	49.91315	1.00174	20-25-A

ARCADIS	10/28/2009	
	WT (g)	SAMPLE ID
	1.00209	8-25-A
	1.00643	10-25-A
	1.00717	37-25-A
	1.00451	21-25-A
	1.00148	34-25-A
	1.00165	12-25-A
	1.00617	17-25-A
	0.99966	27-25-A
	1.0073	26-25-A
	1.00418	18-25-A
		BLANK
		BLANK SPK
	1.00245	18-25-A DUP
	0.99954	18-25-A SPK
	1.00476	6-25-A
	1.00174	20-25-A

ARCADIS	########	BIRD 3050 note B<2mm
	WT (g)	SAMPLE ID
	1.00294	37-25-B
	0.99866	26-25-B
	1.00743	10-25-B
	0.99973	08-25-B
	0.99954	18-25-B
	1.00398	21-25-B
	0.99414	12-25-B
	1.00293	17-25-B
	1.00275	06-25-B
	1.00823	34-25-B
		BLANK
		BLANK SPK
	1.00022	34-25-B DUP
	1.00408	34-25-B SPK
	0.99554	27-25-B
	1.00114	20-25-B

0	Zn ppb	Cu ppb	As ppb	Cd ppb	Pb ppb	
37-25-B all 50x 3050	971.253	12165.026	73.063	10.883	350.312	
26-25-B	1278.871	1388.604	53.385	5.265	7169.672	
10-25-B	1698.508	22907.712	65.584	29.456	408.410	
08-25-B	1478.365	8995.713	95.387	6.543	228.789	
18-25-B	612.424	7346.248	41.425	2.268	152.713	
21-25-B	420.955	2792.294	32.737	2.615	138.059	
12-25-B	6195.075	94582.349	141.588	91.394	1480.176	
17-25-B	4233.727	145667.643	173.235	125.341	1274.783	
06-25-B	2437.342	11241.876	112.139	14.914	549.923	
34-25-B	2160.506	7477.725	117.960	9.653	409.951	
Standard Check 150 ppb	142.00082	154.08208	147.36984	145.35943	138.05773	
Blank	0.19622	0.02948	-0.04979	-0.00727	-0.04712	
BLANK	-0.24617	-0.042	0.01412	-0.02224	-0.93642	Not dilution corrected
BLK SPK	4899.699	5255.350	5149.720	4693.757	4690.960	
34-25-B DUP	2088.266	7333.096	129.720	13.847	425.225	
34-25-B SPK	6818.113	13778.678	5000.545	4589.773	5011.120	
27-25-B	2832.922	6900.307	106.290	12.453	683.256	
20-25-B	1741.233	17222.542	90.761	8.786	309.021	
8-25-A	906.067	6469.855	99.774	26.792	251.368	
10-25-A	2875.190	77007.388	142.519	50.532	1287.747	
37-25-A	1225.385	17876.178	84.533	15.624	527.178	
21-25-A	716.335	5452.957	49.331	5.724	237.575	
Standard Check 150 ppb	141.58071	152.29621	145.0091	143.93822	138.96128	
Blank	-0.01711	-0.01031	-0.00167	-0.00937	-0.03378	
34-25-A	2389.381	19505.089	94.431	18.862	547.733	
12-25-A	8504.952	178031.238	160.717	155.710	2141.988	
17-25-A	6144.941	198507.988	234.196	217.717	1893.387	
27-25-A	2958.514	12637.387	102.899	14.436	782.365	
26-25-A	1566.338	3250.940	57.466	9.690	351.820	
18-25-A	629.817	6838.812	59.489	2.557	325.678	
BLANK	-0.05847	-0.09347	-0.14349	-0.03172	-0.89045	Not dilution corrected
BLK SPK	4846.305	5149.546	5004.259	4630.957	4597.159	
18-25-A DUP	647.055	7020.169	59.570	2.733	258.617	
18-25-A-SPK	5304.407	11458.293	4898.584	4539.135	4823.923	
Standard Check 150 ppb	144.71397	156.60075	149.66784	148.20705	142.02166	
Blank	-0.11936	-0.03022	-0.10081	-0.01582	-0.0259	
6-25-A	2446.876	25468.859	111.184	28.176	666.183	
20-25-A	1605.963	17622.222	83.102	12.732	329.862	
Standard Check 150 ppb	141.84379	153.13697	147.57547	145.93005	135.68312	
Blank	0.02497	2.55813	-0.0314	0.00313	-0.03834	

0	Zn ppb	Cu ppb	As ppb	Cd ppb	Pb ppb	Zn ppb	Cu ppb	As ppb	Cd ppb	Pb ppb
Standard 1	100	100	100	100	100					
Standard 2	500.342	500.41226	499.733	500.6682	500.5496					
Standard 3	989.7011	983.31738	994.9584	992.4083	1006.978					
Standard Check 150 ppb	142.9177	153.076	147.077	147.9618	154.8497					
Blank	0	0	0.000	0	0					
Interference Check	377.145	477.056	197.319	100.545	58.246					
37-25-B all 50x 3050	21.173	243.301	1.490	0.229	7.707					
26-25-B	27.879	27.772	1.089	0.111	157.733					
10-25-B	37.027	458.154	1.338	0.619	8.985					
08-25-B	32.228	179.914	1.946	0.137	5.033					
18-25-B	13.351	146.925	0.845	0.048	3.360					
21-25-B	9.177	55.846	0.668	0.055	3.037					
12-25-B	135.053	1891.647	2.888	1.919	32.564					
17-25-B	92.295	2913.353	3.534	2.632	28.045					
06-25-B	53.134	224.838	2.288	0.313	12.098					
34-25-B	47.099	149.555	2.406	0.203	9.019					
Standard Check 150 ppb	154.781	154.082	150.317	152.627	151.864					
Blank	0.214	0.029	-0.051	-0.008	-0.052					
BLANK	-0.268	-0.042	0.014	-0.023	-1.030					
BLK SPK	106.813	105.107	105.054	98.569	103.201					
34-25-B DUP	45.524	146.662	2.646	0.291	9.355					
34-25-B SPK	148.635	275.574	102.011	96.385	110.245	103	129	99	96	101
27-25-B	61.758	138.006	2.168	0.262	15.032					
20-25-B	37.959	344.451	1.852	0.185	6.798					
8-25-A	19.752	129.397	2.035	0.563	5.530					
10-25-A	62.679	1540.148	2.907	1.061	28.330					
37-25-A	26.713	357.524	1.724	0.328	11.598					
21-25-A	15.616	109.059	1.006	0.120	5.227					
Standard Check 150 ppb	154.323	152.296	147.909	151.135	152.857					
Blank	-0.019	-0.010	-0.002	-0.010	-0.037					
34-25-A	52.089	390.102	1.926	0.396	12.050					
12-25-A	185.408	3560.625	3.279	3.270	47.124					
17-25-A	133.960	3970.160	4.778	4.572	41.655					
27-25-A	64.496	252.748	2.099	0.303	17.212					
26-25-A	34.146	65.019	1.172	0.203	7.740					
18-25-A	13.730	136.776	1.214	0.054	7.165					
BLANK	-0.064	-0.093	-0.146	-0.033	-0.979					
BLK SPK	105.649	102.991	102.087	97.250	101.137					
18-25-A DUP	14.106	140.403	1.215	0.057	5.690					
18-25-A-SPK	115.636	229.166	99.931	95.322	106.126					
Standard Check 150 ppb	157.738	156.601	152.661	155.617	156.224					
Blank	-0.130	-0.250	-0.103	-0.017	-0.028					
6-25-A	53.342	508.937	2.268	0.592	14.656					
20-25-A	35.010	351.784	1.695	0.267	7.257					
Standard Check 150 ppb	154.610	150.497	150.527	153.227	149.251					
Blank	0.027	-0.302	-0.032	0.003	-0.042					
						0	0	0	0	0
2000 ppb Cu	1.140	2028.938	0.134	-0.024	-0.967					
5000 ppb Cu	0.870	5124.959	-0.065	-0.027	-0.996					
Standard Check 150 ppb	153.111	146.623	146.925	149.804	145.758					
Standard Check 150 ppb	151.311	145.115	147.323	150.741	145.743					
Blank	-0.049	0.355	0.003	0.001	-0.037					
Interference Check	371.280	462.642	193.785	97.324	53.840					
	410	510	210	105	60					
	0.36032	0.73736086	0.129886	0.024131	0.055791					
	369	459	189	94.5	54					

0	Zn ppb	Cu ppb	As ppb	Cd ppb	Pb ppb		Zn ppb	Cu ppb	As ppb	Cd ppb	Pb ppb
Standard 1	100	100	100	100	100						
Standard 2	500.342	500.4123	499.733	500.6682	500.5496						
Standard 3	989.7011	983.3174	994.9584	992.4083	1006.978						
Standard Check 150 ppb	142.9177	153.076	144.1936	147.9618	140.7724						
Blank	0	0	0	0	0						
Interference Check	346.0045	477.0565	193.4505	95.75691	52.95051						
37-25-B all 50x 3050	19.42505	243.3005	1.46126	0.21766	7.00624						
26-25-B	25.57742	27.77208	1.06769	0.1053	143.3934						
10-25-B	33.97016	458.1542	1.31167	0.58912	8.1682						
08-25-B	29.5673	179.9143	1.90774	0.13085	4.57578						
18-25-B	12.24847	146.925	0.8285	0.04536	3.05426						
21-25-B	8.4191	55.84588	0.65473	0.0523	2.76118						
12-25-B	123.9015	1891.647	2.83176	1.82788	29.60351						
17-25-B	84.67453	2913.353	3.4647	2.50682	25.49565						
06-25-B	48.74684	224.8375	2.24278	0.29827	10.99845						
34-25-B	43.21011	149.5545	2.3592	0.19305	8.19902						
Standard Check 150 ppb	142.0008	154.0821	147.3698	145.3594	138.0577						
Blank	0.19622	0.02948	-0.04979	-0.00727	-0.04712						
BLANK	-0.24617	-0.042	0.01412	-0.02224	-0.93642						
BLK SPK	97.99398	105.107	102.9944	93.87513	93.81919						
34-25-B DUP	41.76532	146.6619	2.5944	0.27693	8.50449						
34-25-B SPK	136.3623	275.5736	100.0109	91.79545	100.2224						
27-25-B	56.65844	138.0061	2.12579	0.24905	13.66511						
20-25-B	34.82466	344.4508	1.81521	0.17572	6.18042						
8-25-A	18.12134	129.3971	1.99547	0.53584	5.02735						
10-25-A	57.50379	1540.148	2.85037	1.01063	25.75493						
37-25-A	24.5077	357.5236	1.69065	0.31247	10.54356						
21-25-A	14.3267	109.0591	0.98662	0.11447	4.75149						
Standard Check 150 ppb	141.5807	152.2962	145.0091	143.9382	138.9613						
Blank	-0.01711	-0.01031	-0.00167	-0.00937	-0.03378						
34-25-A	47.78762	390.1018	1.88861	0.37724	10.95466						
12-25-A	170.099	3560.625	3.21433	3.1142	42.83976						
17-25-A	122.8988	3970.16	4.68391	4.35433	37.86773						
27-25-A	59.17028	252.7477	2.05797	0.28871	15.64729						
26-25-A	31.32676	65.01879	1.14931	0.19379	7.0364						
18-25-A	12.59633	136.7762	1.18977	0.05113	6.51356						
BLANK	-0.05847	-0.09347	-0.14349	-0.03172	-0.89045						
BLK SPK	96.9261	102.9909	100.0852	92.61914	91.94318						
18-25-A DUP	12.94109	140.4034	1.19139	0.05465	5.17234						
18-25-A-SPK	106.0881	229.1659	97.97168	90.7827	96.47846						
Standard Check 150 ppb	144.714	156.6008	149.6678	148.2071	142.0217						
Blank	0	0	0	0	0	1					
6-25-A	49	509	2	1	13	2					
20-25-A	32	352	2	0	7	3					
						4					
						5					
						6					
						7					
						8					
						9					
						10					
						11					
Standard Check 150 ppb	142	150	148	146	136	12					
Blank	0	-0.30	0	0	0	13		-0.22			
						13					
						13					
						13					
						13					
						13					
						13					
						13					
						13					
2000 ppb Cu	1	2028.94	0	0	-1	13					
5000 ppb Cu	1	5124.96	0	0	-1	13					
Standard Check 150 ppb	140	146.62	144	143	133	13					
Standard Check 150 ppb	139	145.11	144	144	132	13					
Blank	0	0.36	0	0	0	13					
Interference Check	341	462.64	190	93	49	13					
	0.330569	0.737361	0.127339	0.022982	0.050719						

0	Zn ppb	Cu ppb	As ppb	Cd ppb	Pb ppb		Zn ppb	Cu ppb	As ppb	Cd ppb	Pb ppb
Standard 1	100.000	100.000	100.000	100.000	100.000						
Standard 2	500.342	500.412	499.733	500.668	500.550						
Standard 3	989.7011	983.3174	994.9584	992.4083	1006.978						
Standard Check 150 ppb	142.9177	153.076	144.1936	147.9618	140.7724						
Blank	0	0	0	0	0						
Interference Check	346.0045	477.0565	193.4505	95.75691	52.95051	1					
37-25-B all 50x 3050	19.42505	243.3005	1.46126	0.21766	7.00624	2					
26-25-B	25.57742	27.77208	1.06769	0.1053	143.3934	3					
10-25-B	33.97016	458.1542	1.31167	0.58912	8.1682	4					
08-25-B	29.5673	179.9143	1.90774	0.13085	4.57578	5					
18-25-B	12.24847	146.925	0.8285	0.04536	3.05426	6					
21-25-B	8.4191	55.84588	0.65473	0.0523	2.76118	7					
12-25-B	123.9015	1891.647	2.83176	1.82788	29.60351	8					
17-25-B	84.67453	2913.353	3.4647	2.50682	25.49565	9					
06-25-B	48.74684	224.8375	2.24278	0.29827	10.99845	10					
34-25-B	43.21011	149.5545	2.3592	0.19305	8.19902	11					
Standard Check 150 ppb	142.0008	154.0821	147.3698	145.3594	138.0577	12					
Blank	0.19622	0.02948	-0.04979	-0.00727	-0.04712	13	0.01	0.02	0.04		
BLANK	-0.24617	-0.042	0.01412	-0.02224	-0.93642	13					
BLK SPK	97.99398	105.107	102.9944	93.87513	93.81919	13					
34-25-B DUP	41.76532	146.6619	2.5944	0.27693	8.50449	13					
34-25-B SPK	136.3623	275.5736	100.0109	91.79545	100.2224	13					
27-25-B	56.65844	138.0061	2.12579	0.24905	13.66511	13					
20-25-B	34.82466	344.4508	1.81521	0.17572	6.18042	13					
8-25-A	18.12134	129.3971	1.99547	0.53584	5.02735	13					
10-25-A	57.50379	1540.148	2.85037	1.01063	25.75493	13					
37-25-A	24.5077	357.5236	1.69065	0.31247	10.54356	13					
21-25-A	14.3267	109.0591	0.98662	0.11447	4.75149	13					
Standard Check 150 ppb	141.5807	152.2962	145.0091	143.9382	138.9613	13					
Blank	-0.01711	-0.01031	-0.00167	-0.00937	-0.03378	13					
34-25-A	47.78762	390.1018	1.88861	0.37724	10.95466	13					
12-25-A	170.099	3560.625	3.21433	3.1142	42.83976	13					
17-25-A	122.8988	3970.16	4.68391	4.35433	37.86773	13					
27-25-A	59.17028	252.7477	2.05797	0.28871	15.64729	13					
26-25-A	31.32676	65.01879	1.14931	0.19379	7.0364	13					
18-25-A	12.59633	136.7762	1.18977	0.05113	6.51356	13					
BLANK	-0.05847	-0.09347	-0.14349	-0.03172	-0.89045	13					
BLK SPK	96.9261	102.9909	100.0852	92.61914	91.94318	13					
18-25-A DUP	12.94109	140.4034	1.19139	0.05465	5.17234	13					
18-25-A-SPK	106.0881	229.1659	97.97168	90.7827	96.47846	13					
Standard Check 150 ppb	144.714	156.6008	149.6678	148.2071	142.0217	13					
Blank	-0.11936	-0.03022	-0.10081	-0.01582	-0.0259	13					
6-25-A	48.93751	509.3772	2.22367	0.56351	13.32365	13					
20-25-A	32.11925	352.4444	1.66204	0.25463	6.59724	13					
						13					
						13					
						13					
						13					
						13					
						13					
						13					
						13					
Standard Check 150 ppb	141.8438	153.137	147.5755	145.9301	135.6831	13					
Blank	0.02497	2.55813	-0.0314	0.00313	-0.03834	13					
						13					
						13					
						13					
						13					
						13					
						13					
						13					
						13					
2000 ppb Cu	1.04618	2031.798	0.131	-0.02332	-0.87939	13					
5000 ppb Cu	0.79843	5127.819	-0.06354	-0.02606	-0.90572	13					
Standard Check 150 ppb	140.4691	149.4829	144.0442	142.6708	132.5075	13					
Standard Check 150 ppb	138.8174	147.9747	144.434	143.5626	132.4934	13					
Blank	-0.04489	3.21534	0.00336	0.00099	-0.03334	13					
Interference Check	340.624	465.5023	189.9851	92.68911	48.94535	13					
	0.330569	4.730904	0.127339	0.022982	0.050719						

0	Zn ppb	Cu ppb	As ppb	Cd ppb	Pb ppb	Zn ppb	Cu ppb	As ppb	Cd ppb	Pb ppb
Standard 1	100	100	100	100	100					
Standard 2	500.342	500.4123	499.733	500.6682	500.5496					
Standard 3	989.7011	983.3174	994.9584	992.4083	1006.978					
Standard Check 150 ppb	142.9177	153.076	144.1936	147.9618	140.7724					
Blank	0.00	0.00	0.00	0.00	0.00					
Interference Check	345.99	477.04	193.41	95.76	52.95					
37-25-B all 50x 3050	19.41	243.26	1.38	0.22	7.01					
26-25-B	25.55	27.71	0.95	0.11	143.39					
10-25-B	33.93	458.07	1.15	0.59	8.17					
08-25-B	29.52	179.81	1.71	0.13	4.58					
18-25-B	12.19	146.80	0.59	0.05	3.05					
21-25-B	8.35	55.71	0.37	0.05	2.76					
12-25-B	123.82	1891.49	2.51	1.83	29.60					
17-25-B	84.58	2913.17	3.10	2.51	25.50					
06-25-B	48.65	224.64	1.84	0.30	11.00					
34-25-B	43.10	149.33	1.92	0.19	8.20					
Standard Check 150 ppb	141.88	153.84	146.89	145.36	138.06					
Blank	0.07	-0.23	-0.57	-0.01	-0.05					
BLANK	-0.38	-0.30	-0.51	-0.02	-0.94					
BLK SPK	97.86	104.85	102.47	93.88	93.82					
34-25-B DUP	41.64	146.40	2.07	0.28	8.50					
34-25-B SPK	136.23	275.31	99.49	91.80	100.22					
27-25-B	56.53	137.75	1.61	0.25	13.67					
20-25-B	34.69	344.19	1.30	0.18	6.18					
8-25-A	17.99	129.14	1.48	0.54	5.03					
10-25-A	57.37	1539.89	2.33	1.01	25.75					
37-25-A	24.38	357.26	1.17	0.31	10.54					
21-25-A	14.20	108.80	0.47	0.11	4.75					
Standard Check 150 ppb	141.45	152.04	144.49	143.94	138.96					
Blank	-0.15	-0.27	-0.52	-0.01	-0.03					
34-25-A	47.66	389.84	1.37	0.38	10.95					
12-25-A	169.97	3560.36	2.69	3.11	42.84					
17-25-A	122.77	3969.90	4.16	4.35	37.87					
27-25-A	59.04	252.49	1.54	0.29	15.65					
26-25-A	31.20	64.76	0.63	0.19	7.04					
18-25-A	12.47	136.52	0.67	0.05	6.51					
BLANK	-0.19	-0.35	-0.66	-0.03	-0.89					
BLK SPK	96.80	102.73	99.57	92.62	91.94					
18-25-A DUP	12.81	140.14	0.67	0.05	5.17					
18-25-A-SPK	105.96	228.91	97.45	90.78	96.48					
Standard Check 150 ppb	144.58	156.34	149.15	148.21	142.02					
Blank	-0.25	-0.29	-0.62	-0.02	-0.03					
6-25-A	48.81	509.12	1.70	0.56	13.32					
20-25-A	31.99	352.18	1.14	0.25	6.60					
Standard Check 150 ppb	141.71	152.88	147.06	145.93	135.68					
Blank	-0.11	2.30	-0.55	0.00	-0.04					
2000 ppb Cu	0.92	2031.54	-0.39	-0.02	-0.88					
5000 ppb Cu	0.67	5127.56	-0.58	-0.03	-0.91					
Standard Check 150 ppb	140.34	149.22	143.52	142.67	132.51					
Standard Check 150 ppb	138.69	147.71	143.91	143.56	132.49					
Blank	-0.17	2.96	-0.52	0.00	-0.03					
Interference Check	340.49	465.24	189.47	92.69	48.95					

	Zn ppb	Cu ppb	As ppb	Cd ppb	Pb ppb
Standard 1	100.00	100.00	100.00	100.00	100.00
Standard 2	500.34	500.41	499.73	500.67	500.55
Standard 3	989.70	983.32	994.96	992.41	1006.98
Standard Check 150 ppb	142.92	153.08	144.19	147.96	140.77
Blank	0.02	0.19	0.34	0.03	0.06
Interference Check	346.02	477.23	193.75	95.78	53.01
37-25-B all 50x 3050	19.43	243.45	1.72	0.24	7.07
26-25-B	25.57	27.90	1.28	0.13	143.46
10-25-B	33.95	458.27	1.49	0.61	8.23
08-25-B	29.54	180.01	2.04	0.16	4.64
18-25-B	12.21	147.00	0.92	0.07	3.12
21-25-B	8.37	55.90	0.71	0.08	2.82
12-25-B	123.84	1891.68	2.85	1.85	29.67
17-25-B	84.61	2913.37	3.44	2.53	25.56
06-25-B	48.67	224.83	2.18	0.32	11.06
34-25-B	43.12	149.53	2.25	0.22	8.26
Standard Check 150 ppb	141.90	154.03	147.23	145.38	138.12
Blank	0.09	-0.04	-0.23	0.02	0.02
BLANK	-0.35	-0.11	-0.17	0.00	-0.87
BLK SPK	97.89	105.04	102.81	93.90	93.88
34-25-B DUP	41.66	146.59	2.41	0.30	8.57
34-25-B SPK	136.26	275.51	99.83	91.82	100.29
27-25-B	56.55	137.94	1.94	0.27	13.73
20-25-B	34.72	344.38	1.63	0.20	6.24
8-25-A	18.01	129.33	1.81	0.56	5.09
10-25-A	57.40	1540.08	2.67	1.04	25.82
37-25-A	24.40	357.46	1.51	0.34	10.61
21-25-A	14.22	108.99	0.80	0.14	4.81
Standard Check 150 ppb	141.47	152.23	144.82	143.96	139.02
Blank	-0.12	-0.08	-0.19	0.02	0.03
34-25-A	47.68	390.03	1.70	0.40	11.02
12-25-A	169.99	3560.56	3.03	3.14	42.90
17-25-A	122.79	3970.09	4.50	4.38	37.93
27-25-A	59.06	252.68	1.87	0.31	15.71
26-25-A	31.22	64.95	0.96	0.22	7.10
18-25-A	12.49	136.71	1.01	0.08	6.58
BLANK	-0.17	-0.16	-0.33	-0.01	-0.83
BLK SPK	96.82	102.92	99.90	92.64	92.01
18-25-A DUP	12.83	140.34	1.01	0.08	5.24
18-25-A-SPK	105.98	229.10	97.79	90.81	96.54
Standard Check 150 ppb	144.61	156.53	149.48	148.23	142.08
Blank	-0.23	-0.10	-0.29	0.01	0.04
6-25-A	48.83	509.31	2.04	0.59	13.39
20-25-A	32.01	352.38	1.48	0.28	6.66

Standard Check 150 ppb	141.74	153.07	147.39	145.96	135.75
Blank	-0.08	2.49	-0.22	0.03	0.02

2000 ppb Cu	0.94	2031.73	-0.05	0.00	-0.82
5000 ppb Cu	0.69	5127.75	-0.25	0.00	-0.84
Standard Check 150 ppb	140.36	149.42	143.86	142.70	132.57
Standard Check 150 ppb	138.71	147.91	144.25	143.59	132.56
Blank	-0.15	3.15	-0.18	0.03	0.03

Interference Check	340.52	465.43	189.80	92.71	49.01

Appendix H

Photographic Log

Photo No. 1	
Location: FID 0 **Year:** 2009	

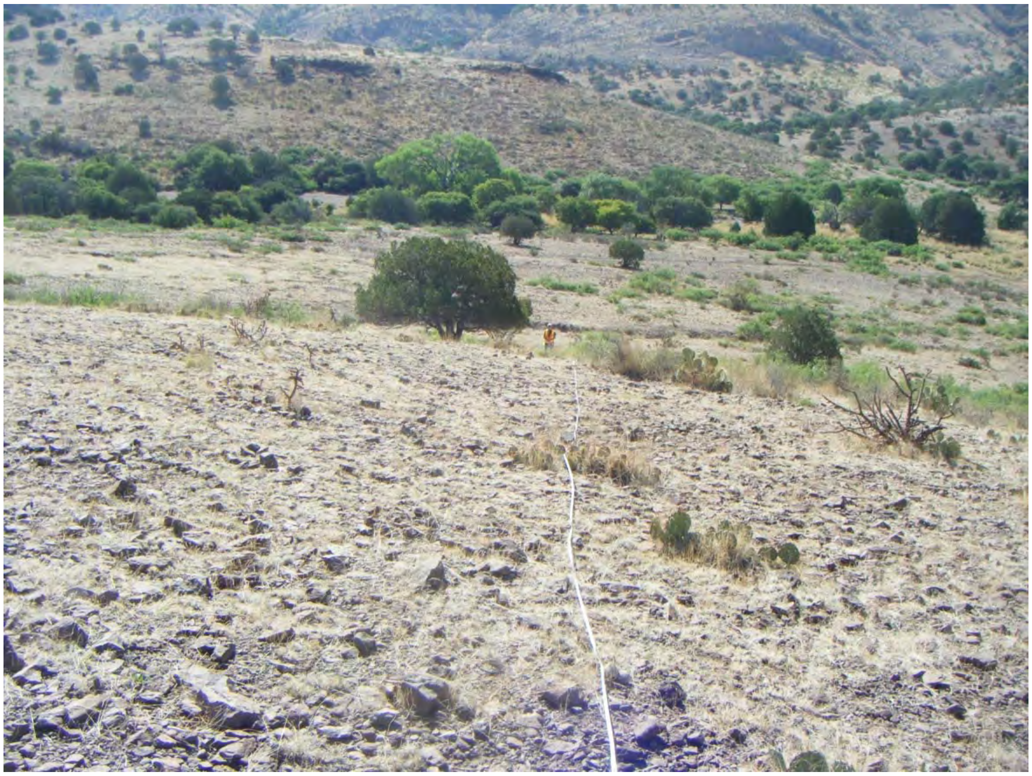
Photo No. 2	
Location: FID 1 **Year:** 2009	

Photo No.
3

Location:
FID 3

Year:
2009

Photo No.
4

Location:
FID 6

Year:
2009

Photo No.
5

Location:
FID 12

Year:
2009

Photo No.
6

Location:
Near FID 15

Year:
2009

Photo No. 7	
Location: Near FID 16 **Year:** 2009	

Photo No. 8	
Location: FID 20 **Year:** 2009	

Photo No.
9

Location:
FID 27

Year:
2009

Photo No.
10

Location:
FID 30

Year:
2009

Photo No.
11

Location:
FID 32

Year:
2009

Photo No.
12

Location:
FID 34

Year:
2009

Photo No.
13

Location:
FID 37

Year:
2009

Photo No.
14

Location:
FID 39

Year:
2009

Photo No. **1**

Location:
ERA 2

Year:
2012

Photo No. **2**

Location:
ERA 3

Year:
2012

Photo No.
3

Location:
ERA 4

Year:
2012

Photo No.
4

Location:
ERA 10

Year:
2012

Photo No.
5

Location:
ERA 13

Year:
2012

Photo No.
6

Location:
FID 7

Year:
2012

Photo No.
7

Location:
FID 8

Year:
2012

Photo No.
8

Location:
FID 10

Year:
2012

Photo No. **9**

Location:
FID 15

Year:
2012

Photo No. **10**

Location:
FID 16

Year:
2012

Photo No.
11

Location:
FID 17

Year:
2012

Photo No.
12

Location:
FID 18

Year:
2012

Photo No.
13

Location:
FID 22

Year:
2012

Photo No.
14

Location:
FID 28

Year:
2012

Photo No. **15**	
Location: FID 37 **Year:** 2012	

Photo No. **16**	
Location: FID 101 **Year:** 2012	

Photo No.
17

Location:
FID 102

Year:
2012

Photo No.
18

Location:
FID 105

Year:
2012

Photo No. **19**	
Location: FID 106 **Year:** 2012	

Photo No.
1

Location:
ERA 2

Year:
2014

Photo No.
2

Location:
ERA 3

Year:
2014

Photo No.
3

Location:
ERA 4

Year:
2014

Photo No.
4

Location:
ERA 13

Year:
2014

Photo No.
5

Location:
ERA 13

Year:
2014

Photo No.
6

Location:
ERA 13

Year:
2014

Photo No.
7

Location:
FID 7

Year:
2014

Photo No.
8

Location:
FID 8

Year:
2014

Photo No. 9	
Location: FID 18 **Year:** 2014	

Photo No. 10	
Location: FID 22 **Year:** 2014	

Photo No. 11	
Location: FID 28 **Year:** 2014	

Photo No. 12	
Location: FID 37 **Year:** 2014	

Photo No.
13

Location:
FID 101

Year:
2014

Photo No.
14

Location:
FID 102

Year:
2014

Photo No.
15

Location:
FID 105

Year:
2014

Photo No.
16

Location:
FID 106

Year:
2014

Photo No.
17

Location:
Reference #1

Year:
2014

Photo No.
18

Location:
Reference #4

Year:
2014

ARCADIS

Appendix I

New Mexico Environment
Department Comments on Report
and Chino Response to Comments

Subject: **NMED Informal Comments on Chino White Rain Year 5 Monitoring Report**
Date: **March 16, 2017, updated from February 17, 2017**

Chino responses to NMED informal comments are in bold text below. NMED comments are in regular text as provided in an email received November 2, 2016 from David Mercer, NMED AOC Project Manager.

General Response:

Chino acknowledges NMED's concern of using the White Rain Study results to demonstrate a permanent increase in soil pH from pre-2008 to current levels. In the context of this report, the use of the word "permanence" may have been misleading as neither Chino, nor NMED, have a complete understanding of the future. There are potential atmospheric events or other potential events that could increase or decrease the soil pH outside of the scope of this report. The text will be updated to reflect that the white rain event appeared to add sufficient buffering capacity to the STSIU soils to neutralize any increased acidity as a result of anthropogenic sources (i.e., the Chino smelter), but permanence of higher pH is not possible to predict with certainty. The following points will be included in the report:

- **All acid soils (pH ≤ 5.5) whose pH increased to > 5.1 from the white rain have NNP values which meet the MMD topsoil suitability requirement of "Good" for plant establishment (> -5 kg $CaCO_3$/t), and thus present little risk of acid generation (Fig. 24). These data are variable but the consistently positive NNP values measured since 2009 continue to meet MMD criteria.**
- **White rain increased the pH of acid soils (pH ≤ 5.5) by about 1.2 pH units (on average from 4.8 to 6.0) indicating that the active soil acidity generated by oxidation of SO_2 and metal sulfides has been mostly neutralized (above pH = 5.5, active acidity is essentially gone, Thomas 1996).**
- **Future sources of potential acidity from smelting and windblown tailings have largely been eliminated by shutting down the smelter stack in 2002, decommissioning the historic smelter stacks and reclaiming the historic mineral processing operations in Hurley in 2007, and reclamation of historic tailing ponds (including Lake One) and adjacent areas. The active Tailing Pond 7 is covered under operational discharge and air permits.**
- **Natural pedogenic (soil-forming) processes will continue to function and soil pH is expected to recover to baseline levels for soils of the area (pH = 6.1 to 8.4, NRCS 1983).**
- **Periodic monitoring (e.g., element of the 5 Year Reviews that will be included in the FS) can be used to confirm this assessment.**

Specific Responses:

1. Sampling imprecision due to soil heterogeneity is a complicating factor for year-to-year comparisons of soil characteristics at individual locations. The effects of soil heterogeneity, and related sampling issues, have not been appropriately considered in making conclusions from the monitoring data. Issues with sampling and analysis precision were identified in Section 3.4 of the report and then forgotten or dismissed.
    - Measurement of soil pH appears more precise, relative to the range of values measured, than measurement of the other parameters monitored over time (e.g., see Figure 25a).

    As discussed in previous STSIU reports and in Section 3.4 of this report, there is significant heterogeneity in the STSIU soils. The field duplicates are different soil samples, not laboratory duplicates of the same soil sample. This natural heterogeneity creates variability in the soil

parameter results and uncertainty in their results interpretation but is not unexpected (see AOC QAPP). Chino will include additional discussion and clarification addressing this known heterogeneity and uncertainty in Sections 3.2 and Section 4 where sample results and conclusions are discussed.

- Tests for trend on the "permanence monitoring" data (Table 6) for copper, pCu, net-neutralization potential (NNP), and neutralization potential ratio (NPR) are meaningless due to the poor precision of these measurements relative to the magnitude of changes over time.

As discussed in Section 3.4, field duplicate pH results varied between 0 and 15 percent and field duplicate copper results varied between 0 and 32 percent, well within the AOC QAPP acceptable limits. Additionally, if copper concentrations are on a log scale, similar to pH log scale (and often the scale of statistical analyses on copper), then the variability of copper is only 0 to 6%. Given both copper and pH are well within acceptable limits, and pCu is calculated using these two parameters (with variability of only 0 to 14%), the precision of these measurements is adequate to evaluate trends for pH, copper, and pCu. Section 3.4 also addresses the large variability in ABA and sulfur results. Additional text will be added when discussing the ABA and sulfur trend analyses to highlight the level of uncertainty in these results. The main point is that, despite the variability, in almost every year, almost all the samples meet the MMD criteria of "Good" and acceptable for topsoil suitability where the majority of NNP values are > -5 T $CaCO_3$/Kt (Figure 24). As stated in Section 3.2.2, with only one exception, all acid soils (pH < 5.5) where pH increased to >5.1 by the White Rain have NNP values > the MMD criteria of -5 T $CaCO_3$/Kt required for suitable plant establishment. Despite variability shown in Figure 24, soil NNP values never changed their classification over 6 years of monitoring with respect to acid generation. Also, the variability is in part due to the near-detection levels of sulfide-S, which in itself speaks for a very limited capacity of the soils to generate acid regardless of their NNP.

- The report indicates that copper concentrations increased over time yet no mechanism for this increase was indicated. What is the source of copper to soil during the monitoring period? The changes in reported copper concentrations over time are small relative to precision of repeat samples and analyses, and therefore, the apparent change in copper concentrations in soil appears to be due to sampling and analysis uncertainties/errors (refer to report Figures 13, 15, 25). For this reason, conclusions made regarding temporal trends for copper concentrations, and the related parameter pCu, are questionable.

The State's third bullet indicating that soil copper increased over time appears to be an error. Section 3.2 states that:

> ***"Over the 5-year monitoring period, however, soil copper concentrations for the same "permanence monitoring" dataset changed significantly (repeated measures ANOVA, p< 0.0001) (Table 5, Figure 12). Total copper concentrations were significantly lower in 2011, 2012, 2013, and 2014 than in 2010 (post-hoc comparisons test, p < 0.05)."***

There is no indication that soil concentrations are increasing, outside of normal sample variability, in STSIU soils. Rather the data indicate a decrease, which is likely due to the cessation of smelter activities and erosional processes over time.

2. The mass-balance calculations in Appendix B appear correct and can be relied on for evaluations of the effects of future white-rain (i.e., alkaline-rain) events on existing soil conditions. However, the data and analyses presented in Appendix B do not characterize, or demonstrate, how long the pH increase associated with an alkaline-rain event (i.e., 1.2 pH units) will persist.

   Please see General Response above. The ABA results and the pH monitoring data support that the majority of the STSIU soils have had the anthropogenic acidity neutralized by the white rain, which means, through natural pedogenic processes over time, the soil pH should be able to recover to the background values of pH = 6.1 or greater, depending on the soil type of the location. The pH from non-impacted soils ranges from 6.1 to 7.3 in Luzena soils, 6.6 to 7.3 in Muzzler soil, 7.9 to 8.4 in Plack soils, and 6.1 to 8.4 in Lonti soils (NRCS 1983).

3. The acid-base accounting (ABA) data are valuable to the goals of the study, especially for evaluating the permanence of white-rain effects on soil conditions, but these data were poorly utilized. For example, there is no cross referencing of the ABA results with the copper-mineralogy data presented in Appendix D of the report. When both of these types of data are available, they can (and should) be used together to verify conclusions regarding the mineral forms present in soil and their potential contribution to the soil's acid generation or neutralization potential.

   Chino agrees that the ABA data are an essential component in evaluating the permanence of the white rain effects on the increased soil pH. Chino will include a more detailed discussion in Section 5 of the report regarding the ABA results and their implication related to the ability of soils to maintain the increased pH. A stronger utilization of the ABA results (NNP) in this context are summarized in Chino's General Response above. Chino also agrees it is important to relate the static ABA results for sulfide-S content to the actual mineralogy of the sulfide minerals present, in order to better understand the relative rates of acid generation, depending on whether sulfide-S occurs primarily as pure iron sulfide minerals (e.g., pyrite), or as copper-bearing sulfides (e.g., cubanite). Cross-referencing of ABA results with the copper mineralogy data is actually presented in Section 3.2.3, which provides a discussion of the mineralogic forms of sulfide-S present in copper sulfides and their relative rates of oxidation. For example, Section 3.2.3 describes the pure iron sulfide minerals as being more rapidly oxidized and possibly less abundant in the soils compared to the copper-bearing sulfide minerals. Copper sulfides are expected to be more abundant than iron sulfides for two reasons:

   1. **The smelter was processing copper ore (assuming copper in the ore was present as sulfides), and**
   2. **Iron sulfides are more reactive and tend to weather and become depleted more quickly than copper sulfides in the receiving soils.**

   Section 3.2.3 discusses that sulfide-S measured by ABA could include some iron sulfide minerals (e.g., pyrite) with rapid oxidation rates, in addition to copper-bearing sulfide minerals with slower oxidation rates. Section 3.2.3 further points out that the ABA calculations conservatively assume that all sulfide-S occurs as pyrite; whereas, in reality, the copper species identified in Appendix D have relatively slower oxidation rates than pyrite. This means the ABA analysis that supports neutralization of most active acidity is conservative. For this reason, Chino believes the evidence supports that persistence of the increased pH from the white rain is likely. However, only future

periodic monitoring will bear this out. This uncertainty will be discussed in the revision of the report.

4. The permanence of the change in soil pH depends critically on the soil mineralogy at each of the study's monitoring locations. The discussion of mineralogical data included in Appendix D was over simplified and too general to provide a comprehensive description of the types of mineral/water interactions that could take place over time. For example:
   - The mineralogical data reported in Appendix D do not indicate "passivation" of copper-sulfide mineral forms (potentially acid generating), as stated in the report. Most of the copper sulfide particles were described as "liberated," and therefore, they are exposed to weathering processes. Therefore, conclusions in Appendix B about the permanence of soil neutralization due to "passivation" of sulfides have not been supported by the mineralogical data collected for the study.

   Passivation has been proposed as only one of several possible mechanisms for persistence of the pH increase in soils affected by the White Rain, serving to provide an additional level of protection against net acid generation. Chino recognizes that a large proportion of the copper-bearing sulfides are liberated, and passivation may not be very important, as there is no clear evidence of it in the micrographs. Chino will delete discussion of passivation.

   - In some samples, copper is predominantly present in secondary mineral phases. The copper associated with secondary minerals has the potential for release to plant-available forms under certain soil conditions. For example, when soil pH is low, copper can be released from secondary minerals, such as iron hydroxides, by desorption from the surface or by dissolution. These types of reactions have not been considered in the report's discussion of the potential mineralogical controls on copper availability in soil.

   Chino agrees based on the fact that the entire premise of work conducted under the site-wide and STSIU-specified ecological risk assessments is based on the link between activity of copper in the soil solution and the toxicity of copper to plants, both of which tend to increase with decreasing pH. The ERA and recent reports by Chino (amendment report) have developed empirical relationships demonstrating the associations between total soil copper and pH on cupric ion activity (as expressed by pCu) and subsequent bioavailability of copper to plants. The results show that at any given total soil copper concentration, the cupric ion activity increases (decreasing pCu) with decreasing pH, regardless of the specific mineralogic controls on copper concentration. The effect of increasing pH on reduced copper bioavailability to plants is discussed throughout the report, and Chino believes the specific mineralogic forms of copper as they relate to copper availability are somewhat immaterial given these strong relationships.

5. Further, it appears that the mineral-identification effort was restricted to copper-bearing phases, with no attempt to identify or count other minerals potentially present that can control acid generation and neutralization in soil.
   - It appears that no mineralogical data were collected to confirm the presence of non-copper-bearing minerals — including sulfides and carbonates. Therefore, the available mineral data are insufficient to make conclusions regarding the anticipated rate of future acid generation.

   Although identification of copper-bearing minerals, especially copper sulfides, was a primary focus of the investigation, Chino recognizes that other sulfide minerals such as pyrite (iron sulfide)

could contribute to the acid generating capacity of the soils. The sulfide-sulfur component of ABA testing includes all sulfide minerals and does not distinguish the type of sulfide mineral present. Chino agrees that rates of acid generation vs. rates of acid neutralization are mineralogy dependent and are potentially-critical components in the interpretation of static ABA test results.

The specific mineralogic forms of the acid-generating minerals are primarily those copper-bearing sulfides which persist following ore processing and smelting as described in Section 3.2.3. The nearby Hurley IU investigation of speciation of minerals indicates that the pure iron-bearing sulfides (e.g., pyrite) are present but, as stated above, are likely less abundant relative to the copper-bearing sulfides (e.g., cubanite) in the STSIU soils. Regardless, the relative rates of acid neutralization are still greater than rates of acid generation even if all acid-generating minerals were present as pyrite. The specific mineralogic forms of the acid-neutralizing minerals contributed by the white rain have been identified as calcium-rich oxide, hydroxide, and carbonate minerals (Appendix A), all of which have high rates of acid neutralization relative to rates of acid generation from sulfide minerals.

To demonstrate, a soil with positive NNP values could still potentially generate acid if the rate of acid generation exceeds the rate of acid neutralization. Considering the specific soil mineralogy at the site, the generation of acid can be conservatively described by pyrite oxidation as shown in Appendix A (rather than copper-bearing sulfide oxidation whose rates are slower):

$$\mathbf{2FeS_2(s) + 7O_2(g) + 2H_2O(l) \rightarrow 2Fe^{2+}(aq) + 4SO_4^{2-}(aq) + 4H^+(aq)}$$

Again, considering the site-specific mineralogy of minerals introduced into the soil from the white rain (calcite, dolomite, trona, calcium oxide), these minerals will neutralize the acidity (H^+) produced by sulfide mineral oxidation; e.g., for calcite:

$$\mathbf{CaCO_3(s) + 2H^+(aq) = Ca^{2+}(aq) + CO_2(g) + 2H_2O(l)}$$

The relative rates of these weathering reactions ultimately determines whether a soil with positive NNP will become net acidic or net alkaline. A compilation of weathering rate data normalized to mineral surface area indicates that calcite dissolves much more rapidly than pyrite (or chalcopyrite) under oxic conditions (Herbert and Kova, 1998). These relative rates suggest that if calcite or other soluble acid-neutralizing minerals are present in sufficient amounts, as demonstrated by the positive NNP values in soils with pH ≥ 5.1 (Figure 24), the acid-neutralizing minerals will dissolve rapidly enough to consume the acidity released from sulfide minerals and thus maintain net alkaline conditions (Herbert and Kovar 1998). Therefore, Chino believes that adequate mineralogic data from both past and current studies have been collected to demonstrate the current sustainability of the pH increase.

- The report authors indicated that the expected future rate of copper sulfide oxidation, and related acid generation, is relatively slow due to the presence of copper sulfides instead of iron sulfide (pyrite). However, chalcopyrite was identified in some soil samples, and it can oxidize to produce acid. In addition, if pyrite, chalcopyrite, or other acid-generating minerals are present, then the stabilities/solubilities of the copper sulfides found are not relevant to discussion of longer-term acid generation.

Chino believes that it is important to consider the specific mineralogy of sulfide minerals in the overall assessment of potential future acid generation rates, which is in agreement with NMED's initial comments in the first bullet of Comment No. 5 above, and Chino will add a discussion of chalcopyrite acid generating properties. Chino also agrees that the stabilities/solubilities of the copper sulfides are somewhat irrelevant to discussion of acid generation, because regardless of the sulfide mineral forms, the rates of acid neutralization will exceed the rates of acid generation (assuming all sulfides are pyrite) and, therefore, no net acid generation will occur as explained in Chino's response to the first bullet of Comment No. 5 above.

6. Certain statements in the report's summary (Section 5) regarding potential future conditions are not supported by the data and analyses presented in the report.
   - Discussion of possible future acid-production is weak because it does not fully utilize available information regarding the mineralogical content and acid-generating potential of soil.

Chino will strengthen the discussion in Section 5 by synthesizing all existing information relating to mineralogical content and acid generating potential of the soils. This will include a discussion of relative rates of acid generation vs. acid neutralization as they relate to site-specific mineralogy, the positive NNP values of soils whose pH increased to >5.1 from the white rain, and the subsequent elimination of the majority of the future sources of acidity, which in combination supports the persistence of the pH changes induced by the white rain.

- In general, statements regarding the expected future soil conditions are speculative (e.g., page 37) because they anticipate future alkaline rain events at a frequency that would maintain higher soil pH over time. Such frequency cannot be determined without characterization of the rate of in situ acid generation by ongoing weathering of minerals in soil.

Chino agrees the frequency of future white rain events cannot be predicted with a high degree of certainty; however, unless the Willcox Playa becomes completely inundated with water and /or unless localized wind patterns were to change dramatically, white rain events are still likely to occur in the future (rain events with elevated calcium and pH have occurred in the region since 2008).

The frequency of atmospheric events has no relation to rates of in situ acid generation by weathering of soil minerals discussed above. Even in the absence of future white rain events, the increased pH shift, which resulted from the 2008 White Rain event, will likely persist as described in Chino's General Comments and response to the first bullet of Comment No. 6 above. However, monitoring periodically, during the 5 year reviews, is recommended to verify persistence because permanence cannot be predicted with certainty.

- Permanence of the pH increase has not been demonstrated beyond the 5-year study period.

Acidic soils whose pH increased by 1.2 units no longer contain significant active acidity or acid generating potential, and the majority of potential future smelter/tailings acidity sources have been eliminated as described in the General Comments above. Therefore, there is no major mechanism such as the smelter to counteract the permanence of the pH increase beyond the 5-year study period. Tailings Pond 7, Chino's current operational pond, produces some windblown tailings which are curtailed via operational controls per best management practices and as

regulated under NMED air and discharge permits. Periodic monitoring (e.g., element of the 5 Year Reviews that will be included in the FS) can be used to confirm this assessment.

7. Only one of the three study objectives, as stated in Section 1.2 of the report, was achieved.
   - The data presented in the report demonstrate that post-rain soil-pH conditions remained higher, on average, than pre-rain for a period of 5 years. This finding meets the first objective of the study.

   Comment noted.

   - The data collected to determine whether the effect of the rain event is permanent were insufficient to meet this objective, as explained in more detail above. The permanence of the pH effect has not been demonstrated.

   Please see Chino's General Response above which addresses NMED's concern on "permanence" of the pH change.

   - The third objective – to evaluate the effects of the rain event on uptake of copper by plants and insects – was addressed, but the data available for evaluation were limited. In addition, confounding factors, such as changes in mine operations over the period of observation (e.g., 1999 to 2010), make interpretation of these data difficult. As a result, the finding of reduced uptake of copper by plants and insect due to increased soil pH, following the rain event, remains uncertain.

   Chino will add a discussion on the uncertainty of these plant and insect results, given the dataset is not large. However, the soil pCu data would predict what was observed in the plants and insects (higher pCu after the white rain leading to lower copper uptake), which lends the results some additional credibility.

   In the Feasibility Study, Chino is evaluating white rain benefits in terms of reducing copper and acidity effects from the mine, in addition to improvements gained from removing the smelter and windblown tailing impacts via interim remedial actions and reclamation. The Feasibility Study will evaluate these changes and then recommend best remedial alternatives for the soil in its current condition. Though both factors likely contributed to soil changes, teasing apart white rain effects from changes in mine operations is not necessary to evaluate the path forward when starting with the soil's current condition.

<u>**References**</u>

Herbert M. and K. Kovar. 1998. Groundwater Quality: Remediation and Protection. Proceedings of the GQ98 Conference, Tubingen, Germany. September 21-25.

NRCS (Natural Resources Conservation Service). 1983. Soil Survey of Grant County, New Mexico – Central and Southern Parts. October. Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture.
https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/new_mexico/NM662/0/grant.pdf

Thomas, G.W. 1996. Soil pH and Soil Acidity. pp.475-490. In Methods of Soil Analysis, Part 3 – Chemical Methods. (D.L. Sparks et al. (eds.),Soil Science Society of America, Madison, WI, 390 pp.

20170925-001

SUSANA MARTINEZ
Governor

JOHN A. SANCHEZ
Lieutenant Governor

NEW MEXICO
ENVIRONMENT DEPARTMENT

Ground Water Quality Bureau
1190 South St. Francis Drive (87505)
P.O. Box 5469, Santa Fe, New Mexico 87502-5469
Phone (505) 827-2900 Fax (505) 827-2965
www.env.nm.gov

BUTCH TONGATE
Cabinet Secretary

J.C. BORREGO
Deputy Secretary

RECEIVED
SEP 25 REC'D
CHINO MINES COMPANY
ENVIRONMENT, LAND & WATER DEPT

September 18, 2017

Ms. Sherry Burt-Kested, Manager
Environment Services
Freeport-McMoRan Chino Mines Company
P.O. Box 10
Bayard, New Mexico 88023

RE: Request for Revision, Year 5 Report on pH Monitoring to Evaluate the Effect of the White Rain on the Smelter/Tailing Soil Investigation Unit (STSIU) dated April 14, 2017, Chino Administrative Order on Consent

Dear Ms. Burt-Kested:

The New Mexico Environment Department (NMED) has reviewed the above referenced report. While the report addressed many of NMED's previous concerns expressed via informal review and teleconference (11/2/2016 and 03/03/17, respectively), there are still issues that need to be addressed before NMED can consider the report Final. The public comment period closed on June 28, 2017 and concluded without any public feedback or comments.

The following comments provided to FMI-Chino Mines on 11/2/16 during the informal review process have not been addressed in the revised report.

1. Sampling imprecision due to soil heterogeneity is a complicating factor for year-to-year comparisons of soil characteristics at individual locations. The effects of soil heterogeneity, and related sampling issues, have not been appropriately considered in making conclusions from the monitoring data. Issues with sampling and analysis precision were identified in Section 3.4 of the report but were not addressed.

   - Measurement of soil pH appears more precise, relative to the range of values measured, than measurement of the other parameters monitored over time (e.g., see Figure 25a in the report).
   - Tests for trend on the "permanence monitoring" data (Table 6) for copper, pCu, net-neutralization potential (NNP), and neutralization potential ratio (NPR) are unsupported due to the poor precision of these measurements relative to the magnitude of changes over time.

8. Only one of the three study objectives, as stated in Section 1.2 of the report, was achieved.

- The data presented in the report demonstrate that post-rain soil-pH conditions remained higher, on average, than pre-white rain for a period of five years. This finding meets the first objective of the study.
- The data collected to determine whether the effect of the rain event is permanent were insufficient to meet this objective. The permanence of the pH effect has not been demonstrated.
- The third objective – to evaluate the effects of the rain event on uptake of copper by plants and insects – was addressed, but the data available for evaluation were limited. In addition, confounding factors, such as changes in mine operations over the period of observation (e.g., 1999 to 2010), make interpretation of these data difficult. As a result, the finding of reduced uptake of copper by plants and insect due to increased soil pH, following the white rain event, remains uncertain.

Based on previous comments, discussions during the March 3, 2017, conference call, and review of the April 2017 revision of the report, NMED requires that the conclusions of the study be revised before the report is considered final. The following revisions should be incorporated into Section 5 and the Executive Summary of the revised report to eliminate unsupported conclusions and more accurately present the results of the study. The text below is being provided in track changes to show requested edits to Section 5, with comments from NMED as to why the changes are necessary. Please note that NMED considers conclusions made regarding a change in acid neutralizing potential highly uncertain due to the variability of those results over time.

Conclusions and Recommendations

The results show that the white rain increased soil pH initially by approximately 1.2 S.U. on average for locations in the STSIU with low pH (< 5.5); it had little to no effect on higher pH soils. For soils originally with pH > 5.5, some natural buffering capacity may have existed before the white rain, conferring resistance in those soils to pH changes. In contrast, the originally acidic soils (pH < 5.5) had lower buffering capacity, and the white rain resulted in an increased soil pH. ~~this capacity, as shown by their current relatively high acid neutralization potential (ANP).~~ The pH shift was generally sustained through 2014 and future ~~is expected to be~~ persistence is benefitted by the following~~t in the future because~~:

~~1. White rain increased the pH of acid soils (pH ≤ 5.5) by about 1.2 pH units (on average from 4.8 to 6.0) indicating that the active soil acidity generated by oxidation of SO2 and metal sulfides has been completely neutralized.~~

Commented [---1]: Conclusions made regarding a change in acid neutralizing potential are highly uncertain due to the variability of those results over time. Refer to discussion of these data in Section 3.2.2.

Commented [---2]: Change in pH has already been described above, and data do not support "complete neutralization" of active soil acidity.

~~2.~~1. Future sources of potential acidity from smelting and windblown tailings have largely been eliminated by decommissioning the smelter and reclaiming most of the tailing ponds.

~~3.~~2. ~~Almost every~~ Typically, the acid soil (pH ≤ 5.5) whose pH increased to > 5.1 from the white rain had~~ve~~ either positive NNP values or those that ~~which~~ meet the MMD topsoil suitability requirement of "Good" for plant establishment (> -5 kg CaCO3/t).~~, and thus present little risk of future acid generation.~~

~~4.~~3. Evaluation of soil mineralogy indicate a proportion of total sulfide occurs as copper sulfides with lower reactivity relative to pyrite~~, and that the overall rate of acid neutralization will be greater than the rate of acid generation~~.

~~5. Natural precipitation has dilute acidity that is expected to continue decreasing over time and will not overcome the neutralization of soil pH by the white rain event.~~

~~6.~~4. White rain events of various magnitude will likely occur in the future (one occurred in eastern Washington, eastern Oregon, and parts of Idaho in February 2015). The likelihood of such future events occurring in the project area is not known however.

~~7.~~5. Natural pedogenic (soil-forming) processes will continue to function and soil pH is expected to ~~fully~~ recover to baseline levels for soils of the area (pH = 6.1 to 8.4) at some time in the future.

However, persistence in the future cannot be predicted with certainty, nor the ~~frequency~~likelihood of future white rain events, if any. This study ~~only~~ evaluated persistence of a change in soil pH over a five-year period and the report will be considered during the development of remedies in the Feasibility Study (FS) for the STSIU. It is recommended that ~~F~~future periodic monitoring of soil pH, as a component of the overall STSIU site remedy, be included ~~during the 5 Year Reviews as part of the FS is recommended~~ to confirm ~~this prediction of ongoing~~ persistence of the generally higher soil pH. The frequency of pH monitoring will be determined during the FS process.

As a result of the pH increase, pCu also increased, and the increase was persistent during the study. In contrast to pH, total copper present in shallow soil is not expected to change as a result of the white rain, though other causes of natural attenuation (source reduction or source removal, clean dust deposition, and erosion) may result in decreases in soil copper concentrations over time. Current data suggest that soil copper concentrations decreased over time during the 5-year duration of this study~~, particularly between 2010 and 2011~~. This copper decrease is uncertain due to high variability of copper in the STSIU soils. The apparent decrease in total copper, in addition to increases in pH, increased pCu as well because pCu is calculated from pH and copper concentrations.

Chino assessed the effect of the pH shift from the white rain on plant and wildlife communities by evaluating copper concentrations in tissues of plants and terrestrial invertebrates before and after the white rain event. These data had been collected during other investigations (ARCADIS 2010b, 2014a). In locations showing an improvement (increase) in soil pH, the tissue copper concentrations decreased after the white rain by an estimated 60 percent or more for the plants and up to 40 percent for the insects. Also, plant richness improved after the white rain on the untreated plots associated with an Amendment Study conducted for the STSIU (ARCADIS 2014a).

Commented [---3]: This is only relevant for soils with copper sulfides only. No mineralogical data were collected to confirm either the presence or absence of pyrite in soil (based on microscopic identification); therefore, conclusion regarding the anticipated rate of future acid generation are unsupported.

Commented [---4]: This study did not provide data regarding changes in acidity of natural precipitation over time.

In conclusion, the white rain event of January 7, 2008 greatly benefitted the STSIU soils by increasing the pH and pCu of the acidic soils, making copper less bioavailable due to the increase in copper adsorption by secondary soil minerals, such as iron hydroxide, at higher pH values. This increase in pCu has led to a decrease in the uptake of copper into living organisms. The ultimate result appears to be reduced toxicity to wildlife and their food sources and improved wildlife and rangeland habitat. Based on MMD guidelines and mineralogical analysis, the potential of STSIU soils to generate acid is consistently low in most areas. Persistence in the future cannot be predicted with certainty, and continued ~~five-year~~ monitoring as part of the STSIU FS and for the site remedy is recommended to confirm the prediction that the pH increase should be sustained.

As NMED (2011) indicated, new information can be used to refine the pCu RAC and selection of remedial alternatives. This report provides new information on the current~~change and persistence of the change in the~~ soil pH and pCu across the STSIU that should be evaluated further in the FS. These results suggest that the nature and extent of depressed pH and elevated copper~~metals~~ has ~~fundamentally~~ changed since the Remedial Investigation and ERA reports approved by NMED (SRK 2008; Newfields 2005, 2008).

Please submit the revised report for NMED review within thirty days of receipt of this letter. If you have any questions, please contact me at (575) 956-1550.

Sincerely,

David W Mercer

David Mercer, Chino AOC Project Manager
Mining Environmental Compliance Section
Ground Water Quality Bureau
New Mexico Environment Department
Silver City Field Office

DWM: dwm

cc: Petra Sanchez, USEPA (via email)
Michelle Hunter, NMED (via email)
Kurt Vollbrecht, NMED (via email)
Joe Fox, NMED (via email)
Alicia Voss, Freeport-McMoRan Inc. (via email)
Pam Pinson, Freeport-McMoRan Chino Mines Company (via email)
Brian McCall, Freeport-McMoRan Chino Mines Company (via email)
Joe Allen, Formation Inc. (via email)
Mark Lewis, Formation, Inc. (via email)

FREEPORT-McMoRAN

Freeport-McMoRan Chino Mines Company
P.O. Box 10
Bayard, NM 88023

Sherry Burt-Kested
Manger, Environmental Services
Telephone: 575-912-5927
e-mail: sburtkest@fmi.com

October 9, 2017

Certified Mail #70160750001133927331
Return Receipt Requested

Mr. Bruce Yurdin, Director
New Mexico Environment Department
Water Protection Division
P.O. Box 5469
Santa Fe, New Mexico 87502

Dear Mr. Yurdin:

Re: Year 5 Report on pH Monitoring to Evaluate the Effect of the White Rain on the Smelter Tailing Soils Investigative Unit – Chino AOC

Freeport-McMoRan Chino Mines Company (Chino) received the New Mexico Environment Department (NMED) comment letter dated September 18, 2017 on the *Year 5 Report on pH monitoring to Evaluate the Effect of the White Rain on the Smelter Tailing Soils Investigative Unit (STSIU) under the Chino Administrative Order on Consent (AOC)*. Chino submitted the White Rain Report to NMED on April 14, 2017 following an informal review process and two teleconference discussions on November 2, 2016 and March 3, 2017.

Following the last teleconference, Chino updated the informal review process via our responses to the comments provided by NMED and inadvertently omitted providing the updated response to NMED comments and apologizes for this lapse. The responses to comments document was provided by email today to Mr. David Mercer and hopefully will address NMED's concerns.

Please contact Ms. Alicia Voss at (602) 366-8049 with any questions or comments concerning this report.

Sincerely,

Sherry Burt-Kested

Sherry Burt-Kested
Manager, Environmental Services

SBK:pp
20171009-002

c: David Mercer, NMED (email)
Joseph Fox, NMED (email)
Petra Sanchez, US EPA (email)
Alicia Voss, FCX (email)

FREEPORT-McMoRAN

Freeport-McMoRan Chino Mines Company
P.O. Box 10
Bayard, NM 88023

Sherry Burt-Kested
Manager, Environmental Services
Telephone: 575-912-5927
e-mail: sburtkest@fmi.com

January 19, 2018

Certified Mail #70171000000085315927
Return Receipt Requested

Mr. Bruce Yurdin, Director
New Mexico Environment Department
Water Protection Division
P.O. Box 5469
Santa Fe, New Mexico 87502

Dear Mr. Yurdin:

Re: Year 5 Report on pH Monitoring to Evaluate the Effect of the White Rain on the Smelter Tailing Soils Investigative Unit – Chino AOC

Freeport-McMoRan Chino Mines Company (Chino) received the New Mexico Environment Department (NMED) comment letter dated November 16, 2017 on the *Year 5 Report on pH Monitoring to Evaluate the Effect of the White Rain on the Smelter Tailing Soils Investigative Unit (STSIU) under the Chino Administrative Order on Consent (AOC)*. Chino requested an additional 30 day extension to review NMED comments in order to respond in a letter dated December 20, 2017. NMED approved the extension request in a letter dated January 9, 2018.

Chino agrees with NMED's general comments that there is considerable uncertainty of the long term effects of the white rain event and that this uncertainty concerning persistence will be addressed by additional monitoring under the STSIU Feasibility Study (FS). Rather than revising the draft report again, Chino will include the draft report and NMED's comments as appendices to the FS and acknowledge that there are differences of opinion on data interpretation.

Please contact Ms. Alicia Voss at (602) 366-8049 with any questions or comments concerning this report.

Sincerely,

Sherry Burt-Kested

Sherry Burt-Kested
Manager, Environmental Services

SBK:pp
20180119-001

c: David Mercer, NMED (email)
Joseph Fox, NMED (email)
Petra Sanchez, US EPA (email)
Alicia Voss, FCX (email)

Addendum to letter dated January 19, 2018 sent to NMED.

Because the Feasibility Study Report preparation can quickly accommodate making the changes suggested by NMED in the letter dated September 18, 2017, the suggested changes were made to the Executive Summary and Conclusions of this version of the Report titled "Year 5 Report on pH Monitoring to Evaluate the Effect of the White Rain on the Smelter/Tailings Soils Investigation Unit". This version is included as part of the FS report.

Appendix C

Phytotoxicity and Vegetation Community Study

Freeport-McMoRan Chino Mines Company

PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

Smelter Tailings Soils Investigation Unit

September 2018

,

PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

Smelter Tailings Soils Investigation Unit

Prepared for:

Freeport-McMoRan Chino Mines Company

Vanadium, New Mexico

Prepared by:
Arcadis U.S., Inc.
11001 W. 120th Avenue
Suite 200
Broomfield
Colorado 80021
Tel +1 303 544 0043
Fax +1 720 887 6051

Our Ref.:

B0063543.0014

Date:

September 2018

CONTENTS

TABLES

FIGURES

APPENDICES

ACRONYMS AND ABBREVIATIONS

AICc	corrected Akaike information criterion
AOC	Administrative Order on Consent
AOSA	Association of Official Seed Analysis
ASTM	ASTM International
bgs	below ground surface
$CaCl_2$	calcium chloride
Chino	Freeport-McMoRan Chino Mines Company
DEL	*de minimis* effects level
EC	effects concentration
ECx	effects concentration that reduces plant viability by x%
ERA	Ecological Risk Assessment
FS	Feasibility Study
IA	Investigation Area
LTL	lower tolerance limit
mg/kg	milligrams per kilogram
mm	millimeter
NDVI	Normalized Difference Vegetation Index
NLIN	non-linear regression
NMED	New Mexico Environment Department
NRCS	Natural Resources Conservation Service
OAT	observed apparent trend
OECD	Organization for Economic Cooperation and Development
pCu	cupric ion activity
PEL	probable effects level
PLS	pure live seed
QAPP	Quality Assurance Project Plan
RAC	Remedial Action Criterion
RI	Remedial Investigation
ROD	Record of Decision

RPD	relative percent difference
Site	Chino Mine
SOP	Standard Operating Procedure
STSIU	Smelter and Tailing Soils Investigation Unit
Study	Phytotoxicity and Vegetation Community Study
USEPA	United States Environmental Protection Agency
Work Plan	Phytotoxicity and Vegetation Community Study Work Plan

EXECUTIVE SUMMARY

This Technical Report on the Phytotoxicity and Vegetation Community Study (Study) for the Smelter and Tailing Soils Investigation Unit (STSIU) at the Chino Mine Investigation Area, Grant County, New Mexico (the Site) has been prepared in accordance with the Administrative Order on Consent (AOC) between Freeport-McMoRan Chino Mines Company (Chino) and the New Mexico Environment Department (NMED). Based on site-specific greenhouse phytotoxicity studies and plant community surveys conducted in the field in 1999 (Schafer and Associates 1999), the site-wide and STSIU-specific Ecological Risk Assessments (ERAs, NewFields 2005, 2008) linked the mobilization and bioavailability of total copper detected in shallow soil to cupric ion activity, quantified as pCu[1]. Because the field and laboratory effects were best correlated with pCu, risk criteria for remedies based on pCu were proposed. NMED issued a pre-Feasibility Study (FS) Remedial Action Criterion (RAC) for shallow soil within STSIU of pCu ≥ 5, where the total copper concentration in soil is > 327 milligrams per kilogram (mg/kg), to reduce soil toxicity to plants from copper. In setting the pre-FS RAC, NMED (2011) noted:

> *New information can be used to refine RACs and selection of alternatives, if sufficient information becomes available that all parties agree upon. This is supported by the NCP in §300.430(e)(2)(i) which states "establish remedial action objectives specifying contaminants and media of concern, potential exposure pathways, and remediation goals. Initially, preliminary remediation goals are developed based on readily available information….and should be modified, as necessary, as more information becomes available during the RI/FS."*

This report provides new information that may be useful for interpreting the pCu RAC and selecting remedial alternatives.

Consistent with the Phytotoxicity and Vegetation Community Study Work Plan (Arcadis 2014), Chino implemented greenhouse phytotoxicity and field vegetation community studies to address limitations and uncertainties identified in similar studies conducted in 1999 for the ERAs, as well as changes in site conditions since 1999. The objective of both studies is to refine the ERA estimates of site-specific *de minimis* effects level (DEL) and probable effects level (PEL) thresholds for pCu. The specific objective of the greenhouse phytotoxicity study is to identify thresholds for adverse effects of pCu on ecologically relevant plant emergence, survival, and growth endpoints after accounting for any confounding physical and chemical factors in the soils. The objective of the field community study is to evaluate the adverse effects thresholds of pCu on plant species richness (hereafter called richness), cover, and rangeland conditions in the field after accounting for confounding environmental factors.

The greenhouse phytotoxicity study design was improved from 1999 by including larger sample sizes and native, locally adapted plant species rather than agricultural species. The native grass and forb species used in the greenhouse experiment were sideoats grama (*Bouteloua curtipendula*) and tansyleaf tansyaster (*Machaeranthera tanacetifolia*), respectively. To evaluate the effect of local adaptation, seeds for these species were collected from the Site and purchased from a nursery that cultivated these

---

[1] pCu = -log{Cu^{2+}}. Note that pCu is negatively correlated to cupric ion activity {Cu^{2+}}.

species' seeds. The results from the locally adapted seeds were compared to the results from nursery seeds not adapted to the area. Alfalfa was also included to test the repeatability of the alfalfa test in the 1999 study. Overall, five seed types were evaluated: alfalfa seeds, sideoats grama site seeds, sideoats grama nursery seeds, tansyaster site seeds, and tansyaster nursery seeds. The greenhouse and community study designs were also improved by including more representative (1) reference locations not impacted by the smelter and windblown tailings, (2) *de minimis* locations defined as locations with background copper concentrations that are far from but downwind of the smelter and tailings, and (3) locations exhibiting the variety of habitats with elevated copper and depressed pH on the STSIU. The reference locations represent background conditions for both pH and copper concentrations, and the *de minimis* locations represent background conditions for copper concentrations.

Dose-response curves for pCu were developed in both the laboratory and field studies to identify the DEL and PEL of measured plant and community endpoints (i.e., emergence, survival, shoot height, shoot weight, and root length). The DEL is the pCu where effects on endpoints are detectable relative to background effects. The PEL is the pCu associated with a 50% reduction (EC50) of endpoint values relative to background effects. The DEL and PEL were identified using two methods. The DEL and PEL for each endpoint first were selected to be the EC10 and EC50, respectively, of the dose-response curve. Because some reference locations showed pCu effects greater than the EC10 level, the DEL was also estimated as the predicted pCu of the minimum of the background endpoints, and the PEL was estimated as the predicted pCu at half the minimum of these background endpoints. Though this minimum represents background conditions, and therefore is technically higher and more conservative than the point at which effects are detectable (definition of DEL), it was used to predict the DEL to be conservative. The first approach for identifying the DEL and PEL is referred to as the ECx method, while the second approach is referred to as the minimum reference method. Sets of DELs and PELs were developed and ranges of these estimates reported using both methods.

Though analyzed, the tansyaster results were not included in the final estimate of the greenhouse study PEL and DEL because the performance of the control plants fell far short of success criteria and the results were highly variable. Similarly, the root length dose-response curves for alfalfa were greatly different from the curves for alfalfa in 1999, and were not included in the final interpretation because of their unreliability. The other greenhouse endpoints were included because they produced alfalfa dose-response curves similar to those observed in the 1999 study.

The results for the greenhouse study are summarized from all analyses and methods as follows:

- The non-linear S-shaped dose-response model that combined all five seed types fit the data well ($R^2 \geq 0.74$).
- The DEL for pCu ranged from 3.8 to 7.7 across endpoints and seed types.
- The PEL for pCu ranged from 3.7 to 5.7 across endpoints and seed types.
- Site-collected seeds of native species were no more tolerant of low pCu than agricultural or nursery-acquired seeds when PELs were compared.
- Site-collected and nursery seeds of native species performed similarly.

For the plant community data, dose-response curves on pCu were developed for species richness, percent cover, and the rangeland condition (via observed apparent trend [OAT] score; Arcadis 2011), the three endpoints measured in the field. These curves fit the data best with multiple linear regressions that accounted for soil category (steep slopes, relatively flat rocky areas, relatively flat granular areas, and bedrock areas). Soil category was more related to richness and rangeland condition (OAT) than pCu. An EC10 and EC50 could not be calculated from a linear regression (no threshold); therefore, the DEL and PEL pCu of the community endpoints were based on the predicted pCu of the minimum of the reference and half the minimum of the reference endpoints, respectively. The DEL and PELs were estimated only from regressions that were significant, where significance is defined as $p \leq 0.05$.

The results for the community study were:

- The linear model fit the pCu and richness data well for all soil categories ($R^2 = 0.83$).
- The linear model fit the pCu and cover data well only for bedrock and flat granular soils with $R^2 = 0.84$.
- The linear model fit the pCu and OAT score data poorly and only for bedrock with $R^2 = 0.47$.
- The DEL ranged from 5.6 (based on cover) to 7.5 (based on richness) for flat granular soils.
- The PEL ranged from 2.1 (based on richness) to 3.4 (based on cover) for flat granular soils.

No DEL or PEL is available for the other soil categories because the *de minimis* areas sampled that were far but downwind from the smelter and tailings in other categories appeared to have lower pH than background and could not be used as reference soils needed for the analysis. When restricted to the flat granular soil category, the results for the PEL were generally consistent between the greenhouse phytotoxicity and field community studies conducted in 2013 and 2014. The PEL ranged from about 2 to 3.5 for both studies in the flat granular category.

The results show that several plant community parameters in the STSIU appear to respond to pCu. At the individual plant scale, plant emergence, survival, and growth appear to respond to different levels of pCu. At the community scale, pCu is correlated to richness and, for some soil type categories, to cover (bedrock and flat granular soils) and rangeland condition (bedrock locations). Cupric ion activity is not correlated to plant cover or rangeland condition for steeper slopes and flat rocky areas. Because pCu reflects the interactions among hydrogen ions, soil solution ionic strength, ligand availability, and total copper, it is a better predictor of plant response than pH or copper alone.

The findings from this study further show that the DEL and PEL for smelter and windblown tailing effects are highly variable, depending on the soil category, plant species, endpoint, and soil properties, including the pH of its parent material and buffering capacity of the soil. Selection of remedial options in the FS should consider the site-specific conditions for these factors when evaluating cleanup criteria based on pCu.

Information from both studies will help inform decisions on remedial goals for pCu and remedial technologies useful for the STSIU. This study and its conclusions will be reported in the STSIU FS as a line of evidence to assist the NMED and stakeholders in making final decisions for the STSIU, which will ultimately be documented in the record of decision (ROD).

1 INTRODUCTION

This Technical Report on the Phytotoxicity and Vegetation Community Study (Study) for the Smelter and Tailing Soils Investigation Unit (STSIU) at the Chino Mine Investigation Area, Grant County, New Mexico (the Site) has been prepared in accordance with the Administrative Order on Consent (AOC) between Freeport-McMoRan Chino Mines Company (Chino) and the New Mexico Environment Department (NMED). An approved Remedial Investigation (RI) Report for STSIU summarized results for investigations showing depressed pH and elevated copper concentrations in shallow (0- to 6-inch depth) soils in parts of the STSIU (Chino 1995, SRK 2008).

The Site is one of the Investigation Units identified within the Investigation Area (IA) of the AOC. The IA includes all areas in which environmental media may have been affected by historical operations at Chino's copper mining and processing facilities. The STSIU is located approximately 12 miles southeast of Silver City, and includes historical smelting facilities, mineral processing facilities, tailing impoundments, and surrounding areas. The STSIU is located east of the Town of Hurley, New Mexico (which contained the Hurley Smelter), and has previously been defined as all areas containing and proximal to Chino's former copper smelter and ancillary facilities, including the tailings disposal facility.

Studies in the literature have shown that copper has a toxic effect on plants at high concentrations (Loneragan et al. 1981, Paschke and Redente 2002, Kopittke et al. 2010), though it has beneficial effects at low concentrations, as it is an essential plant nutrient. Based on site-specific greenhouse phytotoxicity studies and plant community surveys conducted in 1999 (Schafer and Associates 1999), the site-wide and STSIU-specific Ecological Risk Assessments (ERAs) stated that elevated concentrations of copper and other metals, combined with depressed soil pH, have led to a risk of phytotoxicity for some areas of the Site (NewFields 2005, 2008). For plants, these ERAs linked the mobilization and bioavailability of total copper in the shallow surface layer of the soil to cupric ion activity, quantified as pCu[2]. Because the field and laboratory effects were best correlated with pCu, risk criteria for remedies based on pCu were proposed. NMED issued a pre-Feasibility Study (FS) Remedial Action Criterion (RAC) for shallow soil within the STSIU of pCu ≥ 5, where total copper in soil is > 327 milligrams per kilogram (mg/kg) to reduce soil toxicity to plants from copper (327 mg/kg is background threshold for copper). In setting the pre-FS RAC, NMED (2011) noted:

> *New information can be used to refine RACs and selection of alternatives, if sufficient information becomes available that all parties agree upon. This is supported by the NCP in §300.430(e)(2)(i) which states "establish remedial action objectives specifying contaminants and media of concern, potential exposure pathways, and remediation goals. Initially, preliminary remediation goals are developed based on readily available information….and should be modified, as necessary, as more information becomes available during the RI/FS."*

This report provides new information that may be useful for interpreting the pCu RAC and selecting remedial alternatives. Though the pre-FS RAC was established using 1999 results in the site-wide ERA, those 1999 studies had low sample sizes of representative locations and plant species. The studies were

---

[2] pCu = –log{Cu^{2+}}. Note that pCu is inversely correlated to cupric ion activity {Cu^{2+}}.

repeated in 2013 and 2014 to improve upon the associated knowledge base for decision-making. Repeating the studies with improvements addresses concerns that the 1999 greenhouse phytotoxicity studies, which used agricultural species, did not adequately identify cause-and-effect relationships at the Site (MFG 2004). Limitations and uncertainties associated with the 1999 greenhouse tests and vegetation community study include the following:

- For the phytotoxicity greenhouse study of pCu effects:
  - The greenhouse phytotoxicity tests were conducted using non-native, naïve plant species that may not be representative of species present at the Site.
  - Physical and chemical factors that vary among site soils and between the Site and reference (unimpacted) soils used in the study were not fully considered. If correlated to pCu, these factors could be confounding the interpretation of the phytotoxicity results with respect to pCu.
  - The reference soils collected at the Grant County Airport on the west side of the STSIU were not representative of most site soils.
  - Sample size was limited for low pCu (i.e., high cupric ion activity) treatments and reference locations (e.g., only one reference location was used for the alfalfa test).
- For the vegetation community study of pCu effects:
  - ERA sample locations for soils and vegetation did not represent some of the areas with low pCu, such as bedrock, slopes, and tops of ridges, nor did they account for the effect of such substrate or topographic differences.
  - The vegetation communities of reference locations with background copper concentrations at the Grant County Airport were not representative of communities on the east side of the STSIU.

Specifically, more representative species in the greenhouse study are required because plant species can adapt and thrive in unique ecosystems, such as high-altitude, semi-arid environments, as well as in soils with naturally elevated metals concentrations (Chino 2004, 2007). Such adapted plants are expected to be more resilient than the naïve plants or agricultural species used in 1999, both of which are generally not adapted to the local environmental conditions. As such, plant toxicity tests on naïve species are unlikely to represent the potential phytotoxic effects experienced by locally adapted plants (Loneragan et al. 1981, Bradshaw et al. 1990, MacNair 1990, Paschke and Redente 2002, MFG 2004, Haque 2008). Genetic strains of native plant species growing at the Site may be more tolerant of local conditions than nursery strains (MacNair 1990, Haque 2008) and agricultural species (Paschke and Redente 2002) because natural unexposed populations often have a low frequency of plants with tolerant genes; natural selection can increase the frequency of these alleles when the plant population is exposed to high metal concentrations (MacNair 1997, MacNair et al. 2000). Native species are known to develop this increased tolerance over a relatively short time frame (< 50 years [Bradshaw et al. 1990]; 70 years for copper [Bondada and Qiyingma 2003]).

More representative soils and communities in reference locations for the respective greenhouse and community field studies also are required because the reference sample locations in the original 1999 studies were near the Grant County airport; they are not truly representative of most of the vegetation types and soils present in Chino investigation units (i.e., STSIU and Hanover/Whitewater Creek). The reference locations near the airport are flat grassland areas representative only of the small western portion of the STSIU that falls within the Gila Conglomerate Formation/Plack soil type. They do not represent steep areas, eroded areas, or areas with a high percentage of bedrock found on the Site. Such areas are expected to exhibit different soil chemistry and plant communities. Arcadis (2017a) found that plant communities on the STSIU respond strongly to soil conditions and grazing, which was not considered. Representative soils with background copper concentrations in diverse topographic locations with different grazing histories that are located far from or upwind of past and present contaminant sources need to be included as reference areas.

The 1999 phytotoxicity and community studies also did not explicitly account for potentially confounding physical and chemical factors in the soils evaluated, which may need to be incorporated into the dose-response curves. The 1999 study evaluated potential confounding variables affecting the greenhouse endpoints separately (each variable independently tested for correlation to pCu), but did not use them to adjust the dose-response curves. However, to meet the purpose of the ERA, site soils were selected in 1999 that had similar slope and elevation, which is one way to reduce potential confounding factors. Subsequently, areas of potential concern have been found to occur across soils of varying topography and soil development, and the objective for the new studies is to evaluate plant emergence and growth across a range of soils, rather than to focus on a subset with similar conditions. Ideally, physical and chemical factors other than pCu should be held constant in the phytotoxicity study, but this is not possible when soils from such a broad heterogeneous area are of concern. The alternative approach is to account for physical and chemical factors that vary by incorporating covariates in dose-response curves (Larcher 1995, Plaster 2009). Further, sample sizes in the Site and reference areas of the STSIU must be larger than that of the 1999 study to statistically detect more accurate thresholds for toxic effects.

Additionally, the 1999 studies were repeated because site conditions have changed since the 1999 soil sampling, resulting in the potential reduction in bioavailable copper in site soils. The two historical smelter stacks have since been shut down and demolished. The smelter stacks historically emitted sulfuric acid and trace copper concentrations. During the 1970s, in compliance with new Clean Air Act amendments, the stacks were permitted, controls were implemented to reduce emissions, and the stacks finally ceased operating in 2002. The other historical source (windblown dust) has also been mitigated through the reclamation of Lake One and older tailing dams. Additionally, a significant upward shift in soil pH was observed at STSIU following a “white rain” precipitation event on January 7, 2008. During the event, a milky alkaline rain was deposited on the Site. The change in soil pH due to the white rain event has lowered cupric ion activity of the soil (Arcadis 2017b) and, more importantly, possibly changed the complex soil geochemistry (e.g., cation exchange capacity) in a manner that could shift the relationship between pCu and plant and community endpoints.

For these various reasons, greenhouse and community studies were initiated with the following improvements to the 1999 studies:

1. The study was conducted on ecosystems exposed to current conditions after the white rain and smelter closure.

2. More representative plant species and sample locations were incorporated.

3. Confounding physical and chemical factors were considered.

4. The sample size was increased.

The results will provide additional empirical information to evaluate the FS alternatives in relation to the pCu pre-FS RAC for plants. The information, which is new to the administrative record, will inform decisions on how to apply the current pre-FS RAC when evaluating remediation alternatives that may affect plant emergence, survival, growth, and plant community cover and diversity. The effect of pCu on the STSIU habitat and rangeland will be emphasized because any remediation is intended to protect wildlife habitat and rangeland generally, not individual plant species.

After discussing these issues with NMED, Chino submitted a Phytotoxicity and Vegetation Community Study Work Plan (Work Plan) in September 2013 for a study designed to evaluate the effects of cupric ion activity on plant germination and growth in a greenhouse laboratory and on vegetation community endpoints in the field. NMED commented on the Work Plan in October 2013, December 2013, and February 2014, and approved the Work Plan in March 2014 (Arcadis 2014).

2 OBJECTIVES AND HYPOTHESES

This report provides the results of two studies: a greenhouse phytotoxicity study and a field vegetation community study. The objective of both studies is to refine the estimate of site-specific thresholds for effects of pCu. The Work Plan states, "Similar to the approach used in the 1999 study, a DEL and PEL will be estimated from concentration/stressor-response curves developed from this study and through comparison with soils that likely have no effects because they are far or upwind from past and present contaminant sources."

Linear and non-linear regression analysis was used to quantify pCu values associated with a range of effects levels (the dose-response curve) and then to identify a *de minimis* effects level (DEL) and probable effects level (PEL), which are defined below.

1. The DEL is the lowest soil pCu above which statistically demonstrable effects from copper are unlikely. It is often the effects concentration (EC) that reduces plant viability by 10 to 20% (i.e., EC10 or EC20). This reduction can be evaluated relative to background plant viability parameters.

2. The PEL is the pCu at which effects are probable. It is defined for this study as the pCu at which effects are observed for approximately 50% of the test population. The 50% reduction in plant viability represented by the PEL can be evaluated relative to background viability.

Background viability can be defined as the plant endpoint values at the asymptote of a pCu dose-response curve or by endpoint values of reference soils. Both definitions are used in this report. The background concentration using reference soils is defined by locations with minimal exposure to the smelter or windblown tailings (far or upwind from these areas). These reference locations must meet the criteria of exhibiting copper concentrations lower than background (327 mg/kg) and should not exhibit impacts caused by smelter acidification. When potential reference locations at a far distance but downwind from the smelter and tailings were found to exhibit lower pH from the smelter but are below background copper concentrations, they were designated "*de minimis*" locations. *De minimis* locations were included in the dose-response curves (as were reference locations) but are not considered reference locations representing background conditions.

Consistent with the Work Plan, the specific objective of the greenhouse phytotoxicity study is to identify thresholds for adverse effects of pCu on ecologically relevant plant emergence, survival, and growth endpoints after accounting for any confounding physical and chemical factors in the soil. The Work Plan states that the greenhouse study will include nursery and site-collected seeds of a native grass and forb as well as alfalfa, an agricultural species. Alfalfa was included to test the repeatability of the alfalfa test in the 1999 study and to test the hypothesis that native plant species collected from the Site will demonstrate higher tolerance to low pCu than agricultural species and nursery seeds of native plant species. This assumes that agricultural species and nursery species are not as well adapted to local environmental conditions. More specifically, the dose-response curve of vegetation endpoints of native species plotted against pCu is expected to shift left from the same response curve for alfalfa developed in 1999 (S-shaped curve for the greenhouse study). The largest shift in this direction is expected to occur for the site-collected seeds. **Figure 1** illustrates the hypothesized relationship using made-up data with the hypothesized dose-response curves. This hypothesized shift is predicted to produce a lower DEL and PEL for site-collected seeds than those observed in 1999 for agricultural seeds. The new alfalfa DEL and PEL are also expected to differ from the 1999 alfalfa study when including more representative reference locations as background exposure[3]. These hypotheses can only be tested if the greenhouse staff are able to successfully germinate and grow seeds of native species on uncontaminated soils in a greenhouse setting.

The objective of the field community study is to evaluate the effects of pCu on plant species richness, cover, and rangeland conditions (via observed apparent trend [OAT] score; Arcadis 2011), after accounting for confounding environmental factors. This study is similar to the 1999 community study, except that it includes more of the habitats potentially impacted. The hypothesis is that the DEL and PEL will differ across different physical habitats and from the 1999 community study PEL and DEL when compared to more representative reference locations.

Information from both studies will help inform decisions on remedial goals for pCu and remedial technologies useful for the STSIU. The study and its conclusions will be reported in the STSIU FS as a line of evidence to assist the NMED and stakeholders in making final decisions for the STSIU, which will ultimately be documented in the record of decision (ROD).

3 METHODS

NMED requested that Chino evaluate effects of pCu on both a native grass and a native forb in the greenhouse study. The greenhouse results then could be compared to effects of pCu on species in the natural community in the field. The native grass species selected for the greenhouse experiment in the Work Plan was sideoats grama (*Bouteloua curtipendula*), and the selected native forb species was scarlet globemallow (*Sphaeralcea coccinea*). As discussed below, however, scarlet globemallow failed to adequately germinate in the control soil. Tansyleaf tansyaster (*Machaeranthera tanacetifolia*) replaced the globemallow, but it also failed to germinate in the control soil to the criteria in the approved Work Plan, though enough plants germinated to report the results. Alfalfa was included as a test species to identify if test conditions in this new study are similar to the performance of alfalfa in the 1999 greenhouse conditions. Alfalfa is an agricultural non-native species, but it provided results for another forb species, which was needed because native forb species often perform poorly in greenhouse experiments.

---

[3] Different methods for estimating the PEL are shown on Figure 1 depending on the background definition, which will be explained under Dose-Response Curve, Section 3.1.5.2.

3.1 Greenhouse Phytotoxicity Study

The greenhouse experiment was implemented in five steps:

1. Collection of 33 soils from the Site and potential reference locations for chemical analysis and for planting seeds (36 total samples were collected, but only 33 analyzed)

2. Collection of seeds from the Site

3. Purchase of nursery seeds from vendors

4. Planting of seeds in pots of the collected soils and control soil in the greenhouse

5. Measurement of desired plant endpoints in each pot at the end of the experiment.

These steps provided data needed to develop dose-response curves and site-specific pCu thresholds for plant emergence, growth, and survival endpoints.

3.1.1 Soil Collection

To develop dose-response curves, the greenhouse phytotoxicity study required four types of soil:

1. Impacted site soils (site soils) as identified in the STSIU remedial investigations

2. "*De minimis"* soils with background copper concentrations (< 327 mg/kg) far from but downwind of the smelter and tailings that did not qualify as reference soils.

3. Reference soils, which are the soils whose chemistry characterize the media as unimpacted by the smelter and/or windblown tailings

4. A control soil that is manufactured with no contaminants.

Locations sampled for the Site, *de minimis*, and reference soils are shown on **Figure 2**. All four types of soils are described in detail below.

Site Soils

To capture the pCu values required in a useful dose-response curve for each plant endpoint, site soils representing a range of pCu from 2 to >8 were obtained, using locations discussed in the Work Plan (Arcadis 2014) and shown on **Figure 2**. Chino focused on collecting an adequate number of samples in the pCu range most likely to represent the threshold for PEL effects, between pCu of 3.5 and 5.5. Soils from a total of 28 site locations, three more than proposed in the Work Plan, were initially collected. The three surplus soils collected from site locations STS-PT-2013-18, -33, and -34 were discarded from the greenhouse experiment to fit the planned greenhouse space available, resulting in 25 site locations.

De Minimis and Reference Soils

As identified in the Work Plan, eight locations upwind or far from the smelter and tailings were identified as possible reference locations and were sampled. Before designating locations as "reference," the soil chemistry of each area was investigated to identify if the location was likely impacted by the smelter. Four of the locations were identified as possibly impacted and were retained in the dataset but are referred to as *"de minimis*" soils rather than as reference soils. *De minimis* locations are assumed to have some, but minimal acidic impact from the smelter. Both *de minimis* and reference locations refer to areas with background copper concentrations < 327 mg/kg far from the smelter and tailings.

The relationship between soluble sulfate and paste pH was used to identify soil and/or bedrock locations that probably have been impacted by smelter activities (**Figure 3**). The potential reference locations were compared to their expected range in background pH from data provided in the Natural Resource Conservation Service (NRCS) Grant County Soil Survey for the area (USDA 1983; pH = 6.6 to 8.4)[4] or to the pH range for rhyolite bedrock sampled in the Chino area (pH = 5.2 to 7.5, see bedrock chemistry in Appendix A). Bedrock chemistry was included to compare to the three bedrock potential reference locations: STS-PT-2013-21, 22, and 23 (**Figure 2**). The expected pH range of site soils before being impacted by the mine, using the same NRCS database, was similar to the potential reference locations at 6.1 to 8.4[5]. All but three of the 25 site soils, all three of the potential reference locations in bedrock, and one other potential reference location not in bedrock exhibited pH values below their respective background ranges (**Figure 3**). They fall within the range where pH is controlled by either hydrogen ion (H^+) acidity (location STS-PT-2013-22) or residual aluminum (Al3+) acidity (locations STS-PT-2013-21, 23, and 27). Such acidity may be from the smelter. Soluble sulfate helps evaluate if the acidity was from the smelter because the smelter produced sulfuric acid, which dissociates into hydrogen and sulfate ions in the soil (Arcadis 2017b).

The acidity in the soils appears to be a result of the smelter activity because samples with pH < 5 contained higher sulfate concentrations than samples with pH > 5. Soils generally only attain a pH < 4 when there are free acids present (e.g., sulfuric acid) or a predominance of exchangeable H^+. When the free acid acidity is partially neutralized, acidity from Al^{3+} hydrolysis contributes residual acidity up to a pH of about 5.5 (Thomas 1996). Therefore, partial neutralization was occurring except at one bedrock location (STS-PT-2013-22). Whether partially neutralized or not, the low pH and elevated sulfate concentrations of the three bedrock locations and one soil location evaluated as potential reference areas indicates that they should be categorized as *de minimis* and are not suitable as reference locations. However, the remaining four potential reference locations (STS-PT-2013-24, 25, 26, and 28) exhibited low sulfate concentrations, high pH, and were retained as reference locations unimpacted by the smelter.

---

[4] Soils of potential reference areas and their background pH were Lonti Gravelly clay loam (6.6 to 7.8), Stellar-Mohave Association (6.6 to 8.4), Manzano loam (6.6 to 8.4), Rock Outcrop-Muzzler cobbly loam (6.6 to 7.3), and Mimbres-Arizo Riverwash Association (pH =6.6 to 8.4).

[5] Site soil background pH was as follows: Abrazo (6.6 to 7.3), Dagflat (6.1 to 7.3), Encierro (6.6 to 7.8), Lonti (25,26), Manzano (6.6 to 8.4), Oro Grande (6.6 to 8.4), Plack (7.9 to 8.4), Plack variant (7.9 to 8.4), Sampson (6.6 to 7.3), and Santana (6.1 to 7.8).

The four reference soils have copper and pH concentrations within the defined background values, resulting in a high pCu (8 to 9). The four *de minimis* soils have background copper concentrations and pH lower than defined background values, resulting in lower pCu (4 to 5). NMED and Chino selected three of the *de minimis* locations (STS-PT-2013-21 to 23) as representative of reference bedrock locations in 2012 for the STSIU FS; bedrock represents about 25% of the site locations, and representative reference areas should be included for the Site. However, due to characteristic low buffering capacity of the different rhyolite formations none were found. All three locations, although outside of the identified COC gradient and distal from the smelter (**Figure 2**), were eliminated as reference, but can be evaluated for comparison to site locations in the STSIU FS as *de minimis* locations with some acidity and no copper impacts. *De minimis* location STS-PT-2013-27 and reference locations STS-PT-2013-25, -26, and -28 are representative of relatively flat, non-bedrock areas with flat granular soil located in the eastern portion of the STSIU. In contrast, the single reference location STS-PT-2013-24 is representative of the conditions in the western portion of the STSIU (also in the flat granular soil category) that represents about 8% of the site area. The flat granular soil category is over-represented in the reference locations, which could be rectified by identifying more reference locations far off site in other soil categories.

At each soil sampling location, one approximately 60-centimeter-diameter hole was dug from 0 to 6 inches below ground surface (bgs; except where bedrock or point of refusal was encountered) to obtain 1 gallon of soil for analysis and at least 8.3 gallons of soil needed for the greenhouse experiment (**Table 1**). The soil samples were homogenized and split into one 1-gallon plastic bag and six 2-gallon canvas bags. The 1-gallon bag of soil was sent to Energy Laboratories for chemical, physical, and pCu analyses (**Table 2**). The six 2-gallon canvas bags were sent to Wildlife International Laboratory for the greenhouse phytotoxicity testing. Rocks were removed in the field, and the soil was sieved to 2 millimeters (mm) before potting in the laboratory. The soil for the globemallow experiment was re-used for the tansyaster experiment. It was re-used only after testing confirmed that pCu had not changed during the 3 weeks of watering the pots planted with the globemallow seeds (**Appendix A, Tables A-1 and A-3**).

Control Soil

The laboratory manufactured a control soil consistent with Association of Official Seed Analysis (AOSA) guidance (AOSA 2009) that was closest to the soil characteristics of the average soils in the region. The control soil was a sandy loam, with its characteristics described in **Table 3**. The control soil was included to test and compare viability of the different seed types sown on the same soil. This soil had no harmful substances added, and thus was a negative control.

3.1.2 Seed Collection

As mentioned above, seeds of representative native forb and grass species were used in the greenhouse phytotoxicity study. Species selected met the criteria of being common, obtainable as nursery seed, and potentially sensitive to pCu (i.e., not overabundant in high pCu areas based on the site-wide ERA [NewFields 2005]). Initially, a perennial grass (sideoats grama) and a winter annual forb (tansyleaf tansyaster) were selected for the experiment. When tansyaster was not found on site in 2013, the perennial forb scarlet globemallow was identified as a replacement and included in the final Work Plan. However, as discussed below, scarlet globemallow failed to adequately germinate in the greenhouse (germination rate in negative control was 0% for nursery seeds and 2% for field seeds after 35 days).

Therefore tansyaster, which returned in abundance on site the following year in 2014, was ultimately used as the representative forb.

In early 2013, Chino fenced a 10-acre area off from cattle grazing to increase availability of seed for collection. The sideoats grama and globemallow seed came from this area, an area estimated to have a pCu of about 5.5 (based on STS-PT-2013-13 data). Tansyaster was uncommon in this fenced area and was collected mostly south of the fenced area (**Figure 2**). The timing of collection, collection methods and locations, and seed processing procedures are described in detail in **Appendix B**.

Alfalfa seeds of the same cultivar (NitroPlus) used in the 1999 study were purchased from Territorial Seed Company in Cottage Grove, Oregon, with an expected germination rate of 87% (**Appendix B**). Cultivated sideoats grama seeds with a pure live seed (PLS) rating of 85% were purchased from Bamert Seed in Muleshoe, Texas. Scarlet globemallow seeds collected from the southwest corner of South Dakota with a PLS rating of 71.25% were purchased from Prairie Moon Nursery in Winona, Minnestoa. When scarlet globemallow failed to germinate in the greenhouse, cultivated tansyaster seeds with a PLS rating of 85.52% were purchased from Granite Seed and Erosion Control in Denver, Colorado. The viability of these tansyaster seeds was reported to be 68% (**Appendix B**).

3.1.3 Greenhouse Experiment

Wildlife International Laboratory in Maryland conducted the greenhouse phytotoxicity tests (**Appendix C**). The tests evaluated the following five endpoints assessed at the end of the test:

1. Seedling emergence (i.e., germination/emergence success)
2. Shoot height
3. Shoot weight (dry weight)
4. Root length
5. Seedling survival.

Rhizobium root nodules, which were tested in 1999, were not included because the native species evaluated do not have such nodules. Root weight was also not included because the greenhouse laboratory indicated that it is difficult to measure accurately, which reduces the ability to detect differences. In the 1999 study, root weight produced results similar to root length results (in the DEL and PEL), and was correlated to shoot weight (Pearson r = 0.92 and 0.82 for alfalfa and ryegrass, respectively). Thus, root length appears to be a good surrogate for root weight. Moreover, root measurements are not required by the Organization for Economic Cooperation and Development (OECD) testing guidance (OECD 2006).

The greenhouse phytotoxicity test consisted of ten 4.3-inch-diameter pot replicates for each species and each of the 33 soil samples. Following the 1999 phytotoxicity study (NewFields 2005), each replicate included 12 seeds of the selected species. Seeds were planted in site, *de minimis*, reference, and control soils. The greenhouse staff measured soil pH for each location with a Kelway probe before filling each pot and for each pot at the end of the test period to evaluate if pH changed.[6] Pots were manually watered from above using tap water from a well water source (**Appendix C**). The high pH of the well water was decreased to approximately 6 using dilute hydrogen chloride to mimic rainfall pH on the STSIU soils (Arcadis 2017b).

Tests for alfalfa were initiated March 6, 2014. Following the 1999 phytotoxicity study approach (Schafer and Associates 1999), alfalfa tests were conducted for 14 days past the time when more than 50% of plants in control soils had germinated. Tests for sideoats grama were initiated March 20, 2014 and were conducted for 21 days past the time when more than 50% of plants in control soils had germinated. Tests for scarlet globemallow were initiated on June 17, 2014 for nursery globemallow seeds and July 10, 2014 for field globemallow seeds. Despite demonstrating some successful germination in trials conducted on wet paper towels for the field seeds, both nursery and field globemallow showed poor germination (<2%) in control soils and were discontinued from the test.[7] The following year, tansyaster was selected as a representative forb to replace scarlet globemallow. Prior to planting, mycorrhizal fungi inoculum was added to the tansyaster seeds to aid growth under laboratory conditions.[8] Tests for tansyaster were initiated January 30, 2015 and were conducted for 21 days past the time when emergence rate of plants in control soils had reached a plateau. Greenhouse conditions and protocols followed by the laboratory are described in detail in **Appendix C**.

When the tests ended and endpoints were measured (raw data in **Appendix C**, summarized data in **Appendix D**), the greenhouse staff also recorded condition of the seedlings (**Appendix C**). If none of the seeds in a pot emerged, no other endpoints were reported. If none of the seedlings in a pot survived to the end of the test, no growth endpoints were reported. Percent survival was calculated as the number of surviving seedlings in each pot divided by the number of emerged seedlings. This differs from the 1999 study, which calculated survival as the number of surviving seedlings divided by the 12 seeds planted per pot. The revised calculation method ensures that survival is a measure independent of emergence. Shoot height and weight were reported as the average across all surviving seedlings in each pot, and root length was reported as the longest root of all seedlings in the pot.

Quality of the greenhouse experiment data was evaluated by comparing the germination and survival rates of seeds grown in control soil to OECD and ASTM International (ASTM) success criteria for standard test species. Specifically, the test for the field seeds was considered successful if their germination and survival in the negative control soil met the following minimum requirements:

- Alfalfa: 80% germination for crop species with a 90% survival rate for the negative control (OECD 2006)

---

[6] Because the Kelway probe produced variable and uncertain results, Wildlife International Laboratory sent the soils for the globemallow experiment to Energy Laboratories after the experiment to determine whether the pH had changed. Energy Laboratories assessed paste pH with a Ross pH meter and determined it had not substantially changed (**Appendix A**).

[7] Field globemallow showed 50% germination on paper towels, though nursery globemallow showed close to 0% germination on paper towels. When grown in control soil, the average germination rate was 0.02% and 0% for field and nursery seeds, respectively.

[8] The AM120 Basin & High Plains Suite mycorrhizal inoculum product, purchased from Granite Seed and Erosion Control and added to the tansyaster seeds, includes 50% *Glomus intraradices* (Utah), 25% *Glomus intraradices* (Arizona), and 25% *Glomus etunicatum* (Nevada).

- Sideoats grama: 65% germination for non-crop species with a 90% survival rate for the negative control (OECD 2006)
- Scarlet globemallow and tansyaster: 55% germination with 80% seedling survival for the negative control (standards for the carrot; ASTM 2009).

The native species in the greenhouse experiment are not standard test species. Because these criteria were developed on standard test species, these criteria were used as guidelines rather than absolute standards for success on the native species.

3.1.4 Soil Chemistry Analysis

Energy Laboratories performed the chemical and physical analyses of the soil (**Table 2)**, which are similar to those used in the 1999 study, but with some additional tests to better understand the soil chemistry. These soil parameters plus soil type categories (described in Section 3.2.3) were included as potential covariates with pCu. Soil pCu was estimated with an ion-selective electrode in calcium chloride ($CaCl_2$) solution (**Appendix E**). This estimated pCu for the greenhouse study is referred to herein as measured pCu to distinguish it from calculated pCu derived from soil pH and total copper using the upland plus reference equation in the site-wide ERA. All analyses with the greenhouse data used measured pCu, which follows the approach used in the site-wide ERA.

3.1.5 Data Analysis

Before plotting dose-response curves, all plant endpoint data were control-normalized (i.e., divided by average in control soil for same seed type); this facilitated comparison across seed types that demonstrate different rates of success in the negative control (Motulsky and Christopoulos 2003). Duplicate soil chemistry results were used to evaluate data variability, but only the primary soil chemistry results were used in the analysis.

3.1.5.1 Dose-Response Curves

Non-linear, S-shaped dose-response curves were fit to data using SAS statistical software to determine if plant endpoint values for the 33 locations are related to the soil's pCu. To test the hypothesis that seed type significantly affects this relationship, the significance and effect of seed type were evaluated as a categorical factor in the non-linear regression. Differences in the endpoint curves in the uncertain effects region (e.g., between IC5 and IC95; Environment Canada 2007) were considered biologically meaningful if they showed at least a 10% change relative to the alfalfa curve at $p < 0.05$. Differences of less than 10% are generally not considered biologically relevant, even if statistical significance is demonstrated (ASTM 2009). The following equation was used in the SAS non-linear regression (NLIN) procedure to evaluate the relationship between endpoint (R) values and pCu for each seed type category:

$$R = \left(\frac{R_{max}}{1 + 10^{slope(-pCu+EC50)}}\right) \qquad \text{(Equation 1)}$$

Three parameter coefficients are estimated in this equation: R_{max}, slope, and EC50. R_{max} is the threshold or maximum endpoint at the top of the S-shaped curve, slope is the steepness of the S-shaped curve, and EC50 is the pCu halfway between the top and bottom of the curve. This equation is based on an

EC50 of pCu rather than an EC50 of cupric ion activity because the study is designed to capture the range of 1-unit pCu intervals relatively evenly, and cupric ion activity is lognormally distributed (Motulsky and Christopoulos 2003). Models with up to 15 parameters were evaluated using different R_{max}, slope, and EC50 for each seed type. The simplest models with shared R_{max}, slope, and EC50 among seed types were compared to models with unshared parameters to select the best most parsimonious model with the lowest corrected Akaike Information Criterion (AICc; Motulsky and Christopoulos 2003, see **Appendix G**). If there was high bias and skewness in the parameters, or a model did not converge, the model was not used. Both three-seed models (including alfalfa, nursery sideoats, and field sideoats) and five-seed models (including all seed types) were evaluated (**Appendix G**). If the best multi-seed model for an endpoint produces significantly different EC50s for the different seed types (by at least 10%), the hypothesis of seed type being significant and important is supported.

The pCu for any endpoint value on the dose-response curve can be calculated using the following equation:

$$pCu = EC50 - \left(\frac{log10\left(\frac{R_{max}}{R} - 1\right)}{slope} \right)$$

(Equation 2)

This equation was used to calculate EC10, EC20, and minimum reference-based DEL and PEL pCu values (the minimum reference is the second method to calculate the PEL shown on **Figure 1**, discussed in Section 3.1.5.2). For example, the endpoint value (R) at 10% reduction from the maximum (R_{max}) entered into this equation provided the EC10 pCu.

To account for potential confounding factors in the test soils that might have affected plant growth, covariates were identified to include in the dose-response curve. Detailed methods for the covariate analysis are described in **Appendix G**.

The plant endpoints were also plotted against pH and total copper individually to confirm whether pCu was better than pH or total copper alone in predicting plant emergence, growth, and survival.

3.1.5.2 DEL and PEL

Two methods were used to identify a DEL and PEL for pCu in the greenhouse phytotoxicity study: an ECx-based method and a minimum reference method. For the first method, as indicated in the Work Plan, the EC10 (or possibly the EC20 if the EC10 is not significantly different from “no effect”) of the dose-response curve was identified as a potential DEL, and the EC50 as a potential PEL for the germination, survival, and growth endpoints. The percent reduction is relative to the background defined as the asymptote of the dose-response curve. The Work Plan also states: “Results from phytotoxicity tests using *de minimis* soils will be compared to site soils to evaluate the DEL” and “Differences of less than 10% are generally not considered biologically relevant even if statistical significance is demonstrated (ASTM 2009).” The eight *de minimis* soils referred to in the Work Plan have since been split into: (1) reference soils and (2) *de minimis* soils, and this statement now applies to the four reference soils that met the criteria for representing background conditions. If some reference locations demonstrated pCu effects greater than the EC10 level (endpoints lower than the EC10), indicating that such background locations naturally exhibit some pCu effects compared to threshold of “no effects” (asymptote background), then the results using the second method were also presented, where the DEL and PEL were calculated based on the minimum of the reference locations, following U.S. Environmental Protection Agency (USEPA [USEPA 2002, 2013]) guidance on background and tolerance thresholds. This method is the same as the minimum of the reference envelope method in MacDonald et al. (2014). For this second method, Chino identified the pCu that corresponds to the minimum endpoint value of reference locations on the predictive dose-response curve and called it the minimum reference-based DEL. The minimum reference-based PEL was identified as the predicted pCu of the endpoint value that is half of the minimum reference endpoint value[9] (**Figure 1**). The minimum reference-based DEL and PEL were calculated because each reference location did demonstrate effects greater than the EC10 level for one or more endpoints.

Though the lowest reference endpoint value is not technically the point at which effects are first detectable (definition of DEL), this minimum reference endpoint value was conservatively used to predict the DEL. **Figure 1** shows the process of the selection of the PEL using the ECx method (top graph) and the minimum reference method (bottom graph) using a hypothetical example.

In addition to the EC10, an EC20 was estimated for the first ECx-based method because the 95% confidence interval of the negative control endpoint overlapped some of the EC10 endpoint values (OECD 2012), indicating that the EC10 is not detectable as significantly different from “no effect” in those cases. However, some of the five endpoints for the various seed types had significant EC5 to EC15 values, and EC20 would not be conservative for those endpoints. Therefore, the EC10 was decided to be the ECx-derived DEL for all endpoints in order to use a consistent ECx and to be conservative.

The following generalized equation for the dose-response curve was programmed in SAS to estimate endpoints (R) for any ECx and the ECx 95% confidence intervals using the Wald method. The confidence intervals of EC10 and EC20 were estimated in SAS using the following equation:

$$R = \left(\frac{R_{max}}{1 + 10^{slope\left(-pCu + ECx - \left(\frac{log10\left(\frac{100-x}{x}\right)}{slope}\right)\right)}} \right) \qquad \text{(Equation 3)}$$

3.1.5.3 Comparison to 1999 Alfalfa Results

To compare the results from this study to those from the 1999 study, the 1999 alfalfa data were re-analyzed with the methods outlined above using Equation 1. Dose-response curves were fit to the 1999 plant endpoint data (standardized to the negative control), and DELs and PELs were identified following

---

[9] When sample size for reference locations is small ($\leq$ 8), calculation of the background threshold value in ProUCL defaults to the minimum reference value, rather than a lower tolerance limit (LTL), following USEPA guidance (USEPA 2002). This minimum reference envelope method was applied by McDonald et al. (2014) to compare background endpoint values to site values. The site-wide ERA also compares site soils to background in the greenhouse study, except that the 1999 ERA used a *t*-test to compare means. The minimum reference method was used instead of the *t*-test because *t*-tests using background means are currently not recommended for location-by-location comparisons to background; therefore, the method in the Work Plan was updated.

the same approach used in the 2014 study. NewFields (2005) estimated the DEL and PEL qualitatively (visually from graphs of plotted data points) as 6 to 7 and 5, respectively, using the 1999 data. This qualitative estimation method was replaced with the quantitative dose-response models described in Section 3.1.5.2, and then new DELs and PELs were calculated from the 1999 data for each endpoint. Though the one reference soil in 1999 did not show effects greater than the EC10, and therefore the minimum reference method is not needed, the minimum reference-based DELs and PELs were nevertheless calculated to compare to the 2014 DELs and PELs. The sample size of reference soils for the 1999 alfalfa test, however, was equal to one location (n = 1), which is insufficient for estimating the DEL using the minimum reference method. It is insufficient particularly for emergence, shoot height, and root length because the reference endpoint values were higher than the respective fitted curves for those endpoints (the DEL could not be calculated for these three endpoints). The minimum reference method was nonetheless used to estimate the DEL for other endpoints and the PEL for all endpoints by simply assuming that the single reference soil for alfalfa represents the minimum endpoint value for all reference soils in the area. This assumption is unlikely and conservative.

The quantitative approach using the dose-response curve to predict pCu of the minimum reference for the current study is possible due to the large sample size but is more questionable for the 1999 data. The 1999 greenhouse study plotted site and reference data without fitting curves and compared each site soil endpoint to the mean of reference soil endpoints using a *t*-test to help qualitatively identify the pCu at which significant differences begin to be identifiable (DEL). A subjective point below the DEL was then chosen for the PEL. This approach was used because of the small sample size especially in the critical region where the slope of the curve is steepest. Dose-response curves have now been fit to the 1999 data but carry more uncertainty because they are dependent on one or two points in the critical region.

To further facilitate comparisons, survival using the 1999 data was re-calculated as the percent of emerged seedlings surviving, rather than the method used in the site-wide ERA of calculating the percent of the 12 seeds planted that survived. Survival was then averaged over the five pot replicates. Of note, root length per replicate in the 1999 study was estimated slightly differently in 1999 than in the current study. The greenhouse laboratory for the 1999 study (Ecological Planning and Toxicology) calculated it as the average root length of surviving seedlings in a pot at the end of the 1999 study (Appendix B in NewFields 2005) rather than as the longest root of all seedlings in a pot. No adjustment could be made for this difference.

3.2 Community Study

The community study was implemented in three steps:

1. Community endpoint data (i.e., cover, richness, OAT score) were measured at representative site, *de minimis*, and reference locations.

2. Sampled soil pCu was determined from those same locations.

3. Environmental factors other than pCu that might affect community parameters were identified and measured.

These steps are described in greater detail below, along with the methods used to determine site-specific thresholds for community-level effects (DEL and PEL) of pCu.

3.2.1 Vegetation Data Collection

The three community endpoints—cover, richness, and rangeland condition (rangeland as an observed apparent trend, OAT)[10]—were selected for sampling because they are related to wildlife habitat and rangeland, and the site-wide ERA found that richness and cover had the strongest relationship to pCu (NewFields 2005). These vegetation parameters were sampled at 19 STSIU locations in September 2011 to calibrate remote sensing image data and ground-truth vegetation maps during the STSIU FS sampling effort (**Figure 4**). These 19 locations were sampled following the general protocol outlined in the FS Proposal (Arcadis 2011) and the Arcadis Vegetation Sampling Standard Operating Procedure (SOP) included in **Appendix F**. Slope position and aspect were also recorded. Three additional bedrock locations were sampled for the same three parameters on August 30, 2012. The 22 locations sampled in total in 2011 and 2012 were included in the community study dataset as specified in the approved Work Plan.

Five of the 22 locations sampled in 2011 and 2012 were considered as potential reference locations. Two of the locations were called Wildlife Reference Plot North and Wildlife Reference Plot South (**Figure 4**). The other three were the bedrock locations sampled in 2012. Subsequently, the soil chemistry of the three bedrock locations and the Wildlife Reference Plot South location indicated that they should be classified as *de minimis* locations, rather than reference locations[11] (though Wildlife Reference Plot South retains its name). Wildlife Reference North did not have sulfate data[12], but its pH was 6.6, which was in the background range for bedrock soils (**Figure 3**) and it was retained as a reference location. The *de minimis* bedrock locations were originally sampled in 2011 to provide bedrock community data far from the smelter to compare to the bedrock site locations for the STSIU FS, and they were included in the dose-response curves to provide additional soil data from bedrock areas for this community study.

Additional field sampling was conducted in 2014 to: (1) increase the community study sample size and (2) collect additional samples co-located with the greenhouse phytotoxicity study. NMED requested sampling some of the same locations for both studies to facilitate comparisons between the results of the two studies. To supplement the 22 locations, an additional 10 locations identified for the greenhouse phytotoxicity study[13] were visited in September 2014 to collect community data using methods similar to those for the other locations (**Appendix F**), bringing the total sample size to 32. One of these added locations (STS-PT-2013-26) was a phytotoxicity study reference location. The final dataset for the community study included 26 site locations, four *de minimis* locations, and two reference locations (**Figure 4**).

---

[10] Two of the locations (Wildlife Reference Plot North and Wildlife Reference Plot South) were not sampled for OAT scores.

[11] They are *de minimis* because the three bedrock locations of STS-RWU-2012-B1, B2, and B3 on Figure 2 are the same locations as STS-PT-2013-21, 22, and 23 on Figure 4 called *de minimis*. Also, the Wildlife Reference South location on Figure 4 is the same location as STS-PT-2013-27 on Figure 2 and is *de minimis*.

[12] Soil chemistry data were unavailable for the soils collected for the community study in 2011 and 2012 except pH, copper, and conductivity.

[13] One of the 10 sites (STS-PT-2013-33) had very low pCu due to the copper concentrate being spilled in the soil, and ultimately its soil was not used in the greenhouse phytotoxicity study. It had no vegetation cover and was originally needed in the community study to test if the lower bound of pCu predicted from the linear regression without that site was reasonable.

The weather during 2011 and 2012 was very different from 2014 because 2011 and 2012 were drought years (see precipitation graphs in **Appendix F**). Two of the original 22 locations (Wildlife Reference Plot North and South) were re-sampled for richness and cover to quantify community differences between years. Community measures were then adjusted to account for differences in weather effects on vegetation among years using the Normalized Difference Vegetation Index (NDVI; **Appendix F**), and the adjustment was validated with the two re-sampled locations. NDVI[14] for 2011 and 2014 was calculated from 30-meter pixel Landsat imagery collected on cloud-free days of September 4, 2011 and August 29, 2014, dates near the time of sampling for those years. For locations with only 2014 cover data, the cover values were adjusted by the proportional change in NDVI to estimate the cover value in 2011 and standardize all data to 2011. The NDVI adjustment was validated by comparing the percent increase on Wildlife Reference North and South in the field to the NDVI proportional increase in percent cover between years, which showed that they were very similar (Wildlife Reference South = 83% and 89% increase for NDVI and field, respectively; Wildlife Reference North = 1% and 2% increase for NDVI and field, respectively). Cover was quite different for Wildlife Reference South between years (20% and 37% for 2011 and 2014, respectively), though not for Wildlife Reference North (30% in both years of 2011 and 2014). It was assumed that no adjustment to 2011 cover conditions was needed for the three bedrock reference sites sampled in 2012 because the low precipitation in September 2012 (0.9 inch) at Hurley was similar to the dry weather that month in 2011 (1.6 inches), more so than in 2014 (3.6 inches).

Richness could not be adjusted to 2011 values because richness estimation requires high-resolution IKONOS imagery in both years (see Appendix A in the STSIU FS Work Plan), and such imagery was unavailable in fall 2014. Richness was somewhat similar between 2011 and 2014 for both Wildlife Reference North (10 and 13 species for 2011 and 2014, respectively) and Wildlife Reference South (11 and 14 species for 2011 and 2014, respectively). Not adjusting richness may increase variability or bias in the richness estimates by about 30% based on the two Wildlife Reference Plots.

The adjustment for precipitation differences among years was not necessary for the OAT score because it was already adjusted in the field. Field staff adjusted their OAT score scale relative to reference locations in the field each year (see SOP in **Appendix F**).

3.2.2 Soil Collection

As discussed in the Work Plan (Arcadis 2014), soil was collected at the first set of 22 locations in July 2013. Soil was sampled at 0- to 6-inch depths in the corners and centers of each 100 x 100 foot plot (five grab samples) in which vegetation had been sampled in 2011 and then composited. The composited soil was submitted to ACZ Laboratories for total copper (mg/kg) and pH (saturated paste) analysis. These same soil samples were submitted to Energy Laboratory to measure pCu and electrical conductivity because of concerns that salinity may be causing poor growth. Soils were collected at the second set of 10 locations; sampled later in October 2013 for the greenhouse phytotoxicity study (following that study's protocols); and sent to Energy Laboratories to measure pCu, total copper, pH, and electrical conductivity (**Section 3.1.1**).

To be consistent with the site-wide ERA approach of using calculated pCu for the community analysis, copper and pH results were used to calculate pCu for the community dataset, applying the “upland with

---

[14] NDVI is usually correlated to percent vegetation cover (Shank 2008).

reference" equation in the site-wide ERA (pCu = 7.34+0.93pH-1.15[lnCu]; NewFields 2005). Dose-response curves with measured pCu were also produced, but the final results relied on calculated pCu. This is particularly important because the FS will base decisions on the more extensive calculated pCu dataset for the STSIU.

3.2.3 Environmental Factors

Environmental factors that were covariates in the community analysis included slope, aspect, soil category, soil complex, vegetation alliance, ecotype, and electrical conductivity. Digital elevation models provided slope (in degrees) and aspect (north or south-facing slope). Soil categories were based on four visually distinct substrates in the STSIU that appeared to affect vegetation composition differently:

1. Bedrock (> 60% bedrock, referred to as Bedrock)
2. Rocky with eroded surface soil in relatively flat areas (referred to as Flat Rocky)
3. Steep, rocky slopes (> 14% slope, referred to as Slope)
4. Relatively flat areas with granular soil structure at the surface (referred to as Flat Granular).

Examples of these four substrate types are illustrated on **Figure 5**. Soil complexes in the STSIU included 11 soil associations/complexes (**Appendix F, Table F-4, Figure F-3**) grouped into three categories that separated communities well:

1. Manzano loam (1 to 3% slopes), Muzzler-Rock outcrop association (25 to 65% slopes), Plack gravelly loam (0 to 8% slopes)
2. Santana-Rock outcrop complex (1 to 25% slopes)
3. All other soils, complexes, and associations.

The five vegetation alliances were also included (mountain mahogany/shrub, fluvial forest/shrub, mesquite/mixed grama, mixed grama/herbaceous, juniper-oak; Newfields 2005) and the historic ecotype (Hills, Breaks, Loamy, Shallow, Gravelly[15]).

3.2.4 Data Analysis

The dose-response relationship between calculated pCu with each of the three community endpoints – cover, richness, and OAT score – was examined with and without covariates. Covariates were screened using the same method applied to the greenhouse study (see **Appendix G**), with the best modeled relationship being the one with the lowest AICc. The results were also compared to 1999 community data to assess how adding covariates and more appropriate reference locations affected the dose-response

---

[15] Soil complexes and ecotypes for the area are available for Grant County soils in the Natural Resources Conservation Service (NRCS) web soil survey portal at: http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/survey/

curves. As was done in NewFields (2005), the 1999 community upland data were plotted against calculated pCu, applying the “all locations” equation in the site-wide ERA to soil pH and total copper to predict pCu of each point sampled on the 50 m transect and averaging the resultant pCu of the points to obtain pCu for each location.[16]

To identify the DEL and PEL from these relationships, the data analysis approach for the community study was the same as that for the greenhouse phytotoxicity study initially, with an attempt to apply both the ECx and minimum reference methods. However, as was found during the 1999 community study, the dose-response relationship was linear rather than S-shaped, particularly after adding the covariate of soil category. The relationship that best fit the data was a general linear model (multiple regression with continuous and categorical variables). A linear model will not identify an EC10, EC20, or EC50 because no maximum threshold is reached. Therefore, only the minimum reference method was applied to identify the PEL and DEL. The minimum reference method also does a good job of approximating the DEL and PEL qualitatively obtained from 1999 community graphs in the site-wide ERA (see first graph on Figure 2.5-2 in NewFields 2005).

If a covariate is significantly affecting a community endpoint, reference locations ideally should be available for each categorical value or range of the covariate to identify DELs and PELs associated with those values. When a reference location was unavailable for a covariate value (e.g., a soil category), the PEL and DEL could not be calculated.

4 RESULTS

4.1 Greenhouse Phytotoxicity Study

The greenhouse phytotoxicity experiment was conducted between March 6, 2014 (starting with alfalfa) and March 23, 2015 (ending with tansyaster). The results of the greenhouse experiment and subsequent data analysis are discussed below.

4.1.1 Data Quality

Quality of the greenhouse experimental data was evaluated by comparing the germination and survival rates of seeds grown in control soil to OECD and ASTM success criteria (**Table 4**). Despite field scarlet globemallow seeds demonstrating successful germination (50%) in trials conducted on paper towels, both field and nursery globemallow showed poor germination (0.02% and 0% for field and nursery seeds, respectively) in control soils and were discontinued from the test. Both field and nursery tansyaster seeds also performed poorly in control soils, with germination (28% and 45% for field and nursery seeds, respectively) and survival rates (30% and 38% for field and nursery seeds, respectively) more than 10% below minimum criteria thresholds in absolute units. NMED requested that the tansyaster results be reported despite the poor performance of both field and nursery seeds in control soils. While tansyaster results are included in this report, they are considered unreliable and are therefore not used for selecting final DEL and PEL values for pCu.

---

[16] The site-wide ERA used the “all locations” pCu equation in its vegetation community analyses. This current study uses the “upland study with reference” pCu equation because it is the equation applicable to the STSIU uplands and also had the highest R^2 in the site-wide ERA. Therefore, to compare the same pCu, the 1999 data were plotted with the upland with reference equation, and little difference was observed (Figure 11).

Duplicates for the soil samples that Energy Laboratories analyzed were within 1 to 6% relative percent difference (RPD) for pH, within 3 to 31% RPD for copper, and 3 to 13% RPD for pCu. This variability is within the acceptable limits set forth in the AOC Quality Assurance Project Plan for Chino (QAPP, SRK 1997), which is an RPD of +/- 50% for soil if results are greater than five times the reporting limits.

4.1.2 Dose-Response Curves

Modelling the five-seed non-linear dose-response curves with pCu as the continuous independent predictor produced good results, with pseudo R^2 for the five-seed models ranging from 0.74 to 0.87 across the five plant endpoints. **Figure 6** shows the curves and associated ECx-based DEL (EC10) and PEL (EC50). **Figure 7** shows the same curves but with the minimum-reference-based DEL and PEL The number of parameters in each five-seed model ranged from five at the low end (for shoot height) to 12 at the high end (for survival, see **Appendix G** for details). One outlier for nursery sideoats grama seeds grown in soil collected from reference location STS-PT-2013-25 (studentized residual > 6) was excluded from the shoot height model, improving the pseudo R^2 from 0.74 to 0.79 (see shoot height on **Figures 6 and 7** for the sideoats outlier). Because the results for tansyaster are less than optimal, three-seed non-linear dose-response curves were also modeled, and the resulting models were found to be comparable to the five-seed models that included tansyaster (**Appendix G**).

It was hypothesized that native plant seeds collected from the Site would demonstrate higher tolerance to low pCu than the other seeds, which would be shown by shifting the dose-response curves for these seed types further to the left[17]. This was not found to be the case. Based on the curves alone, field-collected seeds of native species performed similar to nursery seeds, and native species did not perform better than alfalfa (the agricultural species) for all endpoints (lower DEL and PEL on **Figures 6 and 7**). Native species performed better than alfalfa only for the root length endpoint. For the other endpoints, alfalfa was more tolerant of low pCu for emergence and survival and about the same for shoot weight and height.

To account for potential confounding factors in the test soils that might also have affected plant viability and growth, soil variables were evaluated for significance as covariates in the dose-response curves. The list of soil covariates evaluated (**Table G-3**) and those that were significantly related to pCu and added to the five-seed models for each of the five endpoints are presented and discussed in **Appendix G**. The covariates that significantly affected the dose-response relationship were granular soil, extractable iron, and clay content. These covariates can shift the dose-response curve, depending on their value, as shown in the example for sideoats grama on **Figure 8**. The curves on **Figure 8** show that locations with granular soils are more tolerant of low pCu than locations without flat granular soil (results and graphs for all seed types are in **Appendix G**).

The other two significant covariates, extractable iron and clay, are continuous covariates. High extractable iron concentrations are protective (compete with copper ions), while high clay content is unfavorable for the plant communities (may slow root growth or reduce water extraction from soil) at a given pCu. The effect of the minimum, mean, and maximum values of these two continuous covariates on the Site on the dose-response curves are shown on **Figure G-1** in **Appendix G** and on the DEL and PEL

---

[17] Higher tolerance to pCu is demonstrated when the curve shifts left if the asymptote (R_{max}) of the curve does not change. If R_{max} changes, then PEL and DEL comparisons are best to illustrate which is more tolerant (lower DEL or PEL is more tolerant)

are shown in **Table G-5.** However, the minimum and maximum do not represent typical soils on site because they are the extreme ends of the range on site. Because interpretation of the continuous covariate effects is dependent on the soil properties of the site-specific locations that will be considered for remediation, yet to be determined in the STSIU FS, the continuous covariate effects of the greenhouse dose-response curves are not discussed further in this report. They can be considered in the FS.

When pH and total copper were plotted against the plant endpoints, scatter in the data increased, showing a weaker relationship than that observed when pCu was plotted against the data points (**Appendix H**). This, and the finding that pCu was the best predictor of greenhouse plant endpoints, performing better than of all the covariates evaluated in **Appendix G** (including pH and total copper), supports that pCu is the most important variable for predicting the greenhouse results. Cupric ion activity, as represented by pCu, probably best integrates the factors affecting plants including the interactions among hydrogen ions, soil solution ionic strength, ligand availability, and total copper.

4.1.3 DEL and PEL

EC10s and EC50s derived from the five-seed dose-response curves, along with their 95% confidence intervals, are shown in **Table 5**. The EC10 could represent a DEL and the EC50 a PEL. However, by definition in the Work Plan, the DEL is the lowest soil pCu above which statistically demonstrable effects from the mine’s copper are unlikely. The smallest ECx that is first statistically detectable was identified for each seed type and endpoint (**Table 6**), which showed that, for the majority of seed types and endpoints, the EC10 is too low to distinguish from the negative control. Therefore, the EC20 and its confidence intervals are also reported as a potential candidate for the DEL in **Table 5**. Depending on the endpoint, the minimum detectable ECx ranges from EC4 to EC71, indicating that even using 20 for the x in ECx (EC20) is too low for some endpoints. Ignoring tansyaster, most endpoints exhibit detectable effects at an EC35 or less (**Table 6**). The highest minimum detectable ECxs are seen for tansyaster, demonstrating that the tansyaster results are not reliable for many endpoints. For the purposes of this report, the EC10 nonetheless was planned to be conservatively used as the ECx-based DEL. The EC50 is the ECx-based PEL.

Tansyaster performed poorly in low impact *de minimis* areas as well as in control soils. Tansyaster had 0% emergence or survival in 25% of the control soil pots and only 12.5% of the seeds emerged and survived on average (**Appendices C and D**). Tansyaster had no seeds emerge and survive in 44% of the *de minimis* and reference soils combined. It is not surprising that no seeds emerged or survived in 42% of the site soils. These results, along with the wide confidence intervals for shoot weight (**Table 5**) and high variability of the negative control (**Table 6**), further demonstrate the unreliability of the tansyaster data. Due to the unreliability of the tansyaster results, the DEL and PEL based on tansyaster in **Table 5** were ignored. The conclusions of this report focus instead on alfalfa as the forb species and sideoats grama as the representative grass species. Alfalfa is used as the forb species because no other forb with reliable results is available. Alfalfa has either lower or similar tolerance (growth endpoints) or better tolerance for low pCu than the native species. Use of this non-native species as a forb in FS decisions is discussed in the uncertainty section.

The ECx-based results in **Table 5** (also **on Figure 9**), excluding tansyaster, are summarized as:

- The DEL ranged from 3.8 to 7.7 across endpoints and seed types.

- The PEL ranged from 3.7 to 6.5 across endpoints and seed types

Some of the soils of the reference sites demonstrated pCu effects on some endpoints that were greater than the EC10 level in the greenhouse phytotoxicity study, and some were not as optimum as the control soil for plant growth (standardized endpoint < 1). NewFields (2005, p. 2-17) also reported for the 1999 greenhouse study that some reference soils were significantly more toxic than laboratory controls. Therefore, the DEL was also calculated as the pCu at the endpoint value of the minimum reference, and the PEL as the pCu at half of the endpoint value of the minimum reference. This approach ensures that impacts evaluated are only attributable to the mine operations.

The DELs and PELs using the minimum reference method are summarized in **Table 7.** The results, excluding tansyaster, have the following ranges:

- The DEL ranged from 4.3 to 8.0 across endpoints and seed types.
- The PEL ranged from 3.7 to 6.4 across endpoints and seed types.

The DELs and PELs based on both the ECx and minimum reference method are shown together for comparison in **Table 8** for alfalfa and sideoats grama and **Table 9** for tansyaster. Because tansyaster results are not reliable, **Table 8** provides the summary of the final DELs and PELs for the greenhouse study.

4.1.4 Comparison to 1999 Results

The 1999 greenhouse phytotoxicity study dose-response curves for alfalfa were comparable to the 2014 results described in this report for all plant endpoints except root length (**Figure 10**). The curves are very different for root length. This inconsistency suggests that root length results were not repeatable, and that the 2014 root results may be less suitable for decision-making than the other plant endpoints. The results for root length may have differed between the two studies for a number of possible reasons, including but not limited to:

- The sample size was too small in 1999.
- Different metric was measured. The 2014 study is based on longest root of all surviving seedlings in pot, while the 1999 study measured the average length of all roots.
- Measuring the longest root in 2014 did not require washing the dirt thoroughly from the roots, whereas the 1999 study washed the roots to be able to weigh them as well as measure them. Separation of roots from dirt in 2014 may have resulted in more root breakage in soils that stick to the roots that may also have had only moderately low pCu (mid-range pCu soils tend to have more clay).

Though sample size is smaller for the 1999 study, the four locations between pCu of 4.9 and 6.9 had root length values around the asymptote of the 1999 curve (**Figure 10**), whereas most locations in the same pCu region were below the asymptote in the 2014 study. This suggests that the difference is not due to the small sample size in 1999. In 1999, root weight was also measured and produced EC50 similar to root length, which supports that the 1999 root length results may be reliable. For the 1999 study, the researchers washed and measured every root, whereas the laboratory conducting the 2014 study did not; the latter did not need to wash because they did not measure root weight. A root weight curve and EC50 were not available in 2014 to help validate the root length results in 2014. For this reason, the 2014 data are more suspect than the 1999 data.

For the survival and emergence endpoints, the 1999 results (when re-analyzed for this report) had data gaps when compared to the 2014 results. Survival and emergence dose-response curves in 1999 were very unstable due to a lack of data points in the steep part of the curve. Because a slope of 1.0 appeared to fit the data visually, the slope term was forced to be 1.0 for these two endpoints to have the 1999 model converge. The larger sample size in the 2014 study prevented this problem. The pseudo R^2 values for the 1999 dose-response curves were also weaker (poorer fit to data) than the 2014 dose-response curves for emergence and root length. However, the fit was similar for the other endpoints.

The most sensitive endpoints based on EC50 differed between the two studies. Shoot weight was the most sensitive endpoint in 1999, while shoot height was the most sensitive endpoint in 2014 (excluding 2014 root length results; **Table 10**). However, the DEL and PELs for shoot height and weight are similar. The results support that shoot growth may be most sensitive to pCu. Conversely, the least sensitive endpoints based on the EC50 were survival and emergence in both studies.

Excluding root length, the EC10 and EC50 ranges between the two studies were somewhat similar at the high end of the range of the values of the different endpoints, though more variable at the lower end. The EC10-based DEL for alfalfa in the 1999 study ranged from 5.2 to 7.5, while this DEL for alfalfa in the 2014 study ranged from 3.8 to 7.4 (**Table 10**). The EC50 PEL for the 1999 alfalfa study ranged from 4.2 to 5.2 and for the 2014 study from 3.7 to 5.7. The lower values in 2014 may be because a greater variety of site types was evaluated.

For the minimum reference method, the lower end of the DEL and PEL range was generally lower in the 2014 study, also (excluding root length, DEL: 4.0 to 7.1 vs. 5.3 to 10.8; PEL: 3.7 to 5.4 vs. 4.2 to 5.2, **Table 10**), as aforementioned, the single reference location in 1999 was inadequate for deriving reliable DEL results using this minimum reference method. In some cases, a DEL was incalculable using the minimum reference method because the reference endpoint value was higher than the modeled curve. In such cases, the top of the modelled curve (the Rmax) was used. These results support the hypothesis that the DEL and PEL are generally lower than shown in the 1999 study when more and different reference sites (east and west of the smelter) are included. These results may have differed more substantially if the reference areas in both years were not all in the same flat granular soil category.

4.2 Community Study

4.2.1 Dose-Response Curves

The field sampling methods used in the 1999 community study differed substantially from the methods of the current study[18] (**Appendix F**); therefore, it is not possible to directly compare the 1999 dose-response results to the 2011-2014 results for the community study. The methods used in 1999 (two perpendicular 50 m x 2 m transect belts [0.05 acre]) covered areas for sampling richness similar in size to those for the current study's method but may have extended across a more variable landscape because they were less compact (current study used average richness of five compact 20-foot x 20-foot blocks [0.05 acre] in a 100-foot x 100-foot area, see **Appendix F** SOP). The data were collected in 1999 using the point-

---

[18] NMED requested that the sampling for the amendment study (Arcadis 2017a) and STSIU FS (their original purpose) be similar to the reclamation monitoring methods on Chino Tailings Ponds, which differed from the site-wide ERA methods.

intercept method, whereas the current study used the Daubenmire quadrat method. Also, 1999 was a much wetter year than 2011 (see **Appendix F, Figure F-5** precipitation graph for Hurley, New Mexico). The 1999 study sampled more cover and richness at similar pCu values than the study in 2011 to 2014 (**Figure 11**). This difference may not be only from differing methodological and meteorological conditions, but also possibly because the 1999 study did not sample the sparse bedrock locations. Therefore, this report compares only the fit and direction of the dose-response relationships between the two studies, rather than comparing the absolute slope of the curves. Also, note that the 1999 community study did not evaluate rangeland condition (has no comparable OAT score).

Relationships between pCu and the three community endpoints (richness, cover, and OAT score) on the Site without any covariates were weak using the 2011 data, which included the 2014 data adjusted to 2011. A stronger modeled relationship was found for cover and richness in 1999, possibly because that study focused only on relatively level areas on the Site (**Figure 11**). Soil category, the only covariate that significantly contributed to the model (lowered the AICc), greatly improved the current overall model fit for some categories (**Figure 12**, R^2 increased from 0.16 - 0.29 to 0.66 - 0.86). The improvement resulted in a stronger relationship to pCu than for the 1999 study, most consistently for richness (1999 R^2 = 0.65 vs.2011 R^2 = 0.83), though some soil categories also showed an improved fit for cover and OAT score, as discussed below. Other soil categories showed no effect of pCu on cover or rangeland condition.

The 1999 data included six reference locations near the airport with high grass cover characteristic of the mixed grama herbaceous alliance (NewFields 2005). These locations exhibited high pCu due to high calcium carbonate concentrations in the west-side soils (Arcadis 2017b). They also exhibited high richness and cover because they were in the flat granular soil category. These reference locations were not representative of the other soil category in the 1999 study (flat rocky), a category that typically exhibits lower richness or cover, and thus probably creates some bias in the 1999 results. The 1999 results are not applicable to the soil categories not included in that study (slopes and bedrock).

Unlike the greenhouse study, two of the community study covariates were more predictive of plant community endpoints than pCu. Soil complex was the most predictive single variable of plant community endpoints (R^2 = 0.50 to 0.73), followed by soil category (R^2 = 0.36 to 0.47, **Appendix F, Figure F-3)**. Both of these categorical variables were more predictive than pCu alone (R^2 = 0.27). Because soil complex was highly correlated to pCu[19], it was screened out from consideration in models that combined covariates with pCu. Soil category was not highly correlated to pCu, however, and could be included (**Appendix F, Figure F-3**).

When combined with pCu in the regression models, pCu with soil category as the covariate provided the most predictive model. **Table 11** shows the output for these general linear regression models. Other covariates did not significantly affect the community endpoints once pCu was in the model or else they were highly correlated to pCu and screened out from consideration. Details concerning these relationships for each endpoint are discussed below.

Richness

As pCu increased, species richness linearly increased. Of the soil categories, this dose-response relationship for richness was shifted left and upward on the pCu axis (plants performed better at same

---

[19] High correlation creates multicollinearity and unstable coefficients (see Appendix G).

pCu) in stable flat granular locations, followed by the slope locations; it shifted to the right and downward (representing the poorest performance) in bedrock locations, followed by flat rocky locations (**Figure 12(a)**).This best richness model met the linear regression assumptions of normality and homogeneity of variance only after removing two outliers (**Table 11**), which produced a good fit to the data (adjusted R^2 = 0.83). It was appropriate to remove the outliers because they were not typical. One outlier was STS-RWU-2011-8, the only plot in the juniper-oak vegetation alliance. This alliance exhibited much higher richness than the other vegetation alliances at this location. The second outlier was STS-RWU-2011-13, a flat site that was unusually heavily overgrazed; even the mesquite was trampled (see photograph of this site in **Appendix I**).

Percent Cover

To meet regression assumptions, percent cover was square-root transformed. With or without the two outliers (data points on **Figure 12(b)** include outliers but regression lines do not), pCu did not predict cover of flat rocky and slope locations, only the flat granular and bedrock locations. When the general linear regression model was fit to all locations irrespective of soil category, it violated assumptions of the regression due to these differences among soil categories (heterogenous variances). The best model that met assumptions and produced a significant effect of soil category and pCu was the model with only the flat granular and bedrock locations included (**Table 11**, R^2 = 0.84). This fitted model (**Figure 12(b)**) was back-transformed and plotted on **Figure 12(c)** showing that, as pCu increased, percent cover increased in a non-linear fashion in the flat granular and bedrock locations.

OAT Score

A general linear model for OAT score with soil category as a covariate produced heterogenous variances (violating test assumptions), requiring each soil category to have a separate regression. Only the bedrock soil category showed a significant relationship between OAT score and pCu (**Table 11**, **Figure 12(d)**, R^2 = 0.57). The two outliers for richness were also outliers for the OAT score and were removed. If the outliers were included, the other three categories still did not exhibit a predictive relationship between pCu and OAT score.

Notably, the “slope” soil category demonstrates the least amount of support for strong effects of pCu on plant communities, with no relationship to pCu for cover and OAT score, and a relationship with pCu for richness only if an outlier is removed.

4.2.2 DEL and PEL

Reference locations needed to calculate the DEL were only available for the flat granular soil category (no sampled areas at bedrock, flat rocky, or slope locations qualified as “reference”). Therefore, the DEL and PEL could be calculated only for the flat granular category, and only with the two reference locations that met the criteria for being reference locations. **Table 11** shows the minimum reference-based DEL and PEL for the flat granular soil category for the community dose-response curves that were significant.

The PEL of 5 and DEL of 6 to 7 that NewFields (2005) estimated from the 1999 site-wide community data in the ERA were higher than or similar to the PEL and DEL estimated from the current community data, depending on the endpoint and soil category. Specifically, the current study data indicate no adverse effects of pCu on cover or OAT score for some soil categories (flat rocky and slope for cover and flat granular, flat rocky, and slope for OAT), which was not reported in 1999. For the flat granular category, the range of effects levels is 2.1 to 3.4 for PEL, lower than 1999, and from 5.6 to 7.5 for DEL, which is more similar to 1999 (**Table 11**). When measured pCu was substituted for calculated pCu in the community analysis (**Appendix J, Figure J-2**), the range of the PEL and DEL for flat granular soils ranged from 1.3 to 3.6 and 5.5 to 7.8, respectively (**Appendix J, Table J-1**)[20].

4.3 Final Range of DEL and PEL from Both Studies

To identify the range of the final DEL and PEL estimated from the combined ECx and minimum reference methods for the recent greenhouse phytotoxicity studies, only the most unequivocal results were included. The tansyaster test fell far short of the greenhouse quality standards and was not included. Root length dose-response curves were highly inconsistent between the 1999 and 2014 alfalfa tests, and were not included. Alfalfa was included to replace tansyaster as the forb because alfalfa did not show an overall greater sensitivity in its endpoints to pCu than the native species based on the dose-response curve; its EC50 was about the same, or lower than the native species (depending on the endpoint, **Table 5**). As was done in 1999, the alfalfa data were included to represent a forb, given that no native forb test succeeded.

All other endpoints were included for the final range of the DEL and PEL. Because field and nursery sideoats grama EC50 results were not significantly different for all endpoints, the PEL and DEL for the field and nursery seeds was averaged when identifying the final range of the PEL and DEL (**Table 8**). The final greenhouse ranges for the average condition that does not consider the effect of covariates (**Table 8**) are as follows[21]:

- The greenhouse DEL ranged from 3.8 to 7.7.
- The greenhouse PEL ranged from 3.7 to 5.7

For the community studies, a PEL and DEL could only be identified for the flat granular soil category for richness and cover. The other three soil categories without estimates were not included in the final range because their DEL and PEL are unknown. The final ranges for the flat granular soil category for the community study are 2.1 to 3.4 for the PEL and 5.6 to 7.5 for the DEL (**Table 11**).

Combining both the greenhouse and community study results (latter representing only one of the four types of soil category), the final range of estimates are:

- The DEL across both studies ranged from 3.8 to 7.7.
- The PEL across both studies ranged from 2.1 to 5.7.

The value within the range depends on the endpoint, seed type, or soil category, which should be considered in the STSIU FS. These values exhibit more variability than the PEL of 5 and DEL of 6 to 7 derived from the 1999 greenhouse phytotoxicity and community studies, probably because of the greater variability in soil types and categories.

---

[20] Measured pCu DEL and PEL are provided but not used in the interpretation of the community data, as explained in Section 3.2.2.

[21] Unlike the community study, pCu is the most important predictor for the greenhouse results, and covariate results for the greenhouse study are less important for summarizing the PEL and DEL. Covariate effects on these thresholds can be evaluated in the STSIU FS.

5 DISCUSSION

5.1 Effect of Cupric Ion Activity on Native Plants in the STSIU

The results show that one or more plant community parameters appear to respond to pCu in the STSIU, and that adverse effects relative to background may occur at different pCu values, depending on the species and soil category of the location. Soil pCu was related at the individual plant scale to plant emergence, survival, and growth and, if soil category is considered, at the community scale for plant species richness and to a lesser extent cover and rangeland condition (OAT score). Rangeland condition and cover are probably more strongly influenced by grazing history than pCu in the soil categories with no significant relationship of these endpoints to pCu (e.g., rocky flat areas and steep slopes). As was found in the site-wide ERA, cupric ion activity integrates the toxic effect of pH and copper, and is a better predictor of copper effects from mine operations on individual plants and community richness than pH or total copper alone. The current results suggest that selection of remedial options in the FS should also consider the soil category of a location (flat granular, flat rocky, slope, or bedrock) and rangeland condition (OAT score) when applying cleanup criteria based on pCu. Arcadis (2017a) also discusses that the rangeland condition, geology, and pH of the parent material and buffering capacity of the soil strongly influence the community endpoints evaluated and should be considered when selecting the cleanup criteria. If an area naturally has low background pH (e.g., rhyolite bedrock areas on **Figure 3**), the threshold for effects from the smelter and tailings could be adjusted to account for this natural variability.

Some of the study hypotheses on tolerance of species on **Figure 1** were rejected (hypotheses numbered as H# in **Table 12**). Overall, native species (sideoats grama) were not more acclimated to low pCu than agricultural species (alfalfa) in terms of their EC50-based PEL (see H1a in **Table 12**, root length being an exception) or their minimum reference-based PEL (see H1b in **Table 12**, root length and shoot height being exceptions). Paschke and Redente (2002) found that native species were less sensitive to copper than agricultural species, but they did not evaluate sensitivity to pCu, which is strongly affected by pH. This is the first greenhouse study comparing the response to pCu of native species relative to agricultural species. The hypothesis that field-collected seeds would be more adapted to low pCu conditions than nursery-cultivated seeds of the same species also was rejected in terms of the EC50-based PEL (H2a). When compared to reference locations using the minimum reference method, most endpoints for field-collected seeds had lower PELs for sideoats grama but higher for tansyaster (H2b). The endpoint exceptions tended to be less reliable (e.g., root length, **Table 12**). The latter result from the minimum reference method is not because the field-collected sideoats grama seeds are more tolerant of low pCu than nursery seeds. The result is because field-collected seeds did not perform quite as well in reference areas as the nursery-cultivated seeds, though they had higher emergence in the manufactured control soil (but lower survival, **Table 4**). If sample sizes had been large enough to conduct a statistical comparison, likely the differences, which are slight, would not be statistically or biologically significant. Overall, whether the seeds were collected in the field or cultivated in the nursery, the results were similar.

These results suggest that the nursery seed results may be substituted for site-collected seeds when evaluating cupric ion activity effects. However, study results are inconclusive as to how well alfalfa, the only forb that met the successful test standards, represents a native forb on the Site. The tansyaster experiment fell far below desired success standards for the negative control, and it failed to germinate on *de minimis* soils from bedrock areas. Without this native forb experiment, no recommendations are possible on whether alfalfa is a good replacement for a native forb, though this report includes alfalfa results in the final broad ranges reported for the DEL and PEL.

The current studies show that the range for the final DEL and PEL is different than in 1999 due to the inclusion of more representative reference and variable site locations, as hypothesized (H3 in **Table 12**). The final range of DEL and PEL estimates for alfalfa in the greenhouse study was generally less than estimates in 1999 for the greenhouse study for emergence, survival, and shoot weight, but greater for shoot height and root length (root length is unreliable, however) (H3 in **Table 12**). For the community data, the hypothesis was supported that by including physical habitat (soil categories) and more representative reference locations would alter the PEL (H4 in **Table 12**). The PEL ranged from 2 to 3 for the flat granular soils compared to 5 reported for the 1999 community study. However, the DEL of 6 to 7.5 for the flat granular soils in the community study was similar to the 1999 DEL of 6 to 7, which did not support the hypothesis of a difference (H4 in **Table 12**). The 1999 studies derived a PEL of 5 and DEL of 6 to 7 based on results for all endpoints of the greenhouse and community study. In contrast, the current study derived a PEL of 2 to 6 and a DEL of 4 to 8. These ranges are based on average soil properties in the STSIU, and the covariate analysis showed that these ranges can change depending on the specific texture (clay content), chemistry (extractable iron), and surface condition (granular or rocky) of a soil. Also, these ranges may change if more information is obtained to estimate a community PEL and DEL for other soil categories than flat granular soils.

The most important outcome of this study is that these thresholds vary depending on soil category, soil properties, plant species, and endpoints. These factors should be considered in the STSIU FS when weighing the benefits of various remediation options relative to the harm caused to the habitat by those remedial options. Some remedial options are more destructive than beneficial to the plant community and may not be warranted in a semi-desert area with slow recovery times, even if the pCu of an area is below the pre-RAC value. Balancing those factors, and considering the results from this study, as well as the Amendment, and White Rain studies in the FS will help ensure sound remedial decisions beneficial to the environment are made (Arcadis 2017a, 2017b).

5.2 Comparison between Greenhouse and Community Studies

One way of evaluating the quality of the current PEL results is to compare the final PEL for emergence in the greenhouse study to richness and cover of the same soil category from the community study. Emergence is the best greenhouse endpoint to compare because often it was the endpoint most correlated to community richness and cover endpoints ($R^2 = 0.30$ to 0.58, **Figures 13 to 16**). Such a comparison shows that flat granular soil locations have PELs for the greenhouse and community study that are both low—specifically, a PEL of 2.3 to 3.7 (**Appendix G**, **Table G-5**, range for both methods, excluding tansyaster) for emergence and a PEL of 2.1 for richness and 3.4 for cover (**Table 11**). The DEL is more variable between the studies on flat granular soil (3.0 to 5.2 for emergence vs. 5.6 to 7.5 for cover and richness), and thus is more difficult to interpret[22]. This may be because the community DEL is based on the minimum endpoint of only two reference locations, a dataset missing some of the flat granular reference locations observed a long distance from the smelter (~40 miles) that appear (based on photos)

---

[22] Without tansyaster, the non-flat granular soil category ranges are 4.5 to 6.6 for the DEL and 3.7 to 5.2 for the PEL (Appendix G)

to have low richness and cover (mostly mesquite) but probably have high pCu. This is a problem of having too low of a sample size for reference for the community study, as mentioned previously. The PEL of the community study is more consistent between the greenhouse and community studies and is best for establishing effect levels of concern, as was done when NMED established the pre-FS RAC for pCu (which was set equal to the PEL of the 1999 studies when above background copper concentrations of 327 mg/kg).

Because emergence is most strongly correlated to community endpoints, such as richness or cover (**Figures 13 to 16**), it is probably the most ecologically relevant greenhouse endpoint. Community endpoints also are the most relevant because they measure actual condition of the plant community on the Site. Field studies often have many more confounding factors, however, such as soil type and category influenced by slope, aspect, and amount of bedrock. These factors can be difficult to tease apart from effects of cupric ion activity. This study tested and accounted for the most strongly confounding factors as covariates, making the community results more reliable. Some uncertainty still remains because of differences in weather between years 2011 and 2014 that may not have been fully considered when adjusting conditions to 2011, given that precipitation can be highly localized. Nonetheless, the two lines of evidence—the greenhouse and community studies—support similar ranges of PELs for one soil category type (flat granular) for the most relevant endpoints. This validates the quality of the results.

Emergence may be most important individual plant endpoint affecting communities because the top inch of the soil has the lowest pCu, except for of four windblown tailing locations (STS-PT-2013-1, STS-PT-2013-2, STS-PT-2013-17, and STS-PT-2013-19; Arcadis 2017b). The inability of a seedling to emerge in this top inch may alter the community richness or cover, more than changes in the seedling's growth. Adverse effects on growth and survival of the seedling may diminish once roots are past the top inch, making the growth parameters less predictive of community effects. The community study captured this stratification in the soil pCu, but the greenhouse phytotoxicity study did not because the soil in the greenhouse study was homogenized over the 6-inch depth. The homogenization diluted the greenhouse soils in the top inch, possibly biasing the PEL low for emergence (affected by top inch) and high for growth endpoints (affected by deeper soil). The community study PEL is probably more ecologically relevant and is based on calculated pCu, which will be used to identify areas for remediation rather than measured pCu. Measured pCu will not be used because it is available for fewer locations compared to the extensive dataset available for copper and pH across the STSIU. Therefore, the community PELs may be the most accurate estimate of the threshold to apply for probable effects based on calculated pCu estimated throughout the STSIU for the FS. However, PELs from the community study are unavailable for the bedrock, slope, and flat rocky soil categories because reference areas were not sampled in these categories. The community study did show that communities in bedrock locations have lower amounts of richness, cover, and OAT scores than in flat granular soils at the same pCu, but likely this is because of bedrock limiting the growth medium, not necessarily because such communities are more sensitive to pCu. The greenhouse study showed that plants growing in soils from non-flat granular locations have lower emergence at the same low pCu than flat, granular soils. The emergence endpoint (because it is most similar to the community endpoints) for the greenhouse results for non-flat granular areas could be used to substitute and fill in the data gap for non-granular flat areas or else future sampling of other categories could be planned to develop more category-specific community PELs.

5.3 Uncertainty

The reference locations have a strong effect on the minimum reference-based DEL and PEL. It is uncertain whether the reference locations completely represent background in the area. Sample size for the reference dataset is low (four for the greenhouse study, two for the community study), and background locations with lower pCu potentially could be present but not included in the dataset. If missed, the PEL and DEL may actually be lower than estimated. This may be particularly true of the community DEL for flat granular soil areas, which only had two reference areas.

Alternatively, the minimum reference-based PEL and DEL may be higher than estimated if the reference sites are more impacted by the smelter or windblown tailings than expected. However, the proposed locations for *de minimis* were screened to identify which ones met criteria as reference using the background pH and sulfate information on **Figure 3**. The four identified for the greenhouse study and two for the community study likely are not impacted by the smelter or tailings. The copper concentrations in the selected reference areas were well below the background threshold of 327 mg/kg at 88 mg/kg, with a range of 56 to 130 mg/kg for greenhouse study and an average of 161 mg/kg with a range of 109 to 213 mg/kg for the community study. Furthermore, pH is high for the reference locations (6.9 to 7.7 for the greenhouse study and 5.9 to 7.6 for the community study), which results in a high pCu (8.2 to 9.2) for all greenhouse study reference locations and for all community study reference locations (6.7 to 9.0, Appendix A and Appendix F).

Of note, the reference locations are all in the flat granular soil category, and the minimum of these was entered into the dose-response equation developed with all site locations when using the minimum reference method for identification of the adverse effects thresholds. This could overestimate the thresholds (DEL and PEL) because the flat granular category of the reference locations generally has higher values of the endpoints, resulting in a higher corresponding pCu than if another reference soil category was used.

Another uncertainty is exclusion of root length and tansyaster data from the final estimated PEL and DEL range. The root length data are equivocal because they gave very different results for the same alfalfa cultivar when the test was repeated. However, if included, the final greenhouse PEL would change to a range of 3.7 to 6.5 (**Figure 9**) instead of 3.7 to 5.7. The high end of the range is much higher than the highest community PEL of 3.4 for flat granular soils. Root length (unlike emergence, shoot weight, and height) is unaffected by whether or not a soil is a flat granular soil (not significant covariate, **Appendix G**) and is often weakly related to community data (**Figures 13** to **16**). The weak correlations further suggest that root length data are too uncertain to rely upon.

If tansyaster is included, the data would provide a greenhouse PEL of 3.7 to 7.0 (**Figure 9 or Tables 8 and 9**). The EC50 for tansyaster is not detectable for survival because the confidence interval of the negative control overlaps the EC50 (**Table 6**). Additionally, the confidence interval for the shoot weight EC50 of 7.0 shows that the data are not useful because the interval has an extremely broad range of 3.8 to 10.2, which covers almost the entire range of pCu found on the STSIU. The failure of the tansyaster data leaves a data gap in knowledge about the response of native forbs to pCu at the individual scale. However, the community data include forbs, which contribute to richness; therefore, the effect of pCu on forbs, at least for flat granular soils, is indirectly included in the final DEL and PEL range.

The tansyaster data were problematic because non-standard test species often grow poorly in a greenhouse setting. Non-standard species often cannot meet standards developed for agricultural species or for thoroughly tested species recommended for phytotoxicity tests by OECD and ASTM. Though the seeds were stratified and grown in cool temperatures in the greenhouse, tansyaster may require natural stratification via a cold winter to have good germination (**Appendix B**), and it may take a long time to germinate in a greenhouse. Like the tansyaster, scarlet globemallow failed to germinate adequately. Possibly more of the globemallow would have germinated given a longer study time or if they had been germinated on paper towels and then planted. Using native forbs, as NMED requested, posed a high risk of failure, and subsequently did not succeed. In contrast, native rangeland grasses have performed satisfactorily as seen by Canadian guidelines that include them. Though no native forb could be used, this report includes the sideoats grama results and used the non-native alfalfa species to represent the forb, which creates uncertainty in the results. Field evidence indicates that native forbs are established on the low pCu sites and influence the richness results. The richness results are included in the DEL and PEL range, indicating that the uncertainty of the greenhouse study in not including a native forb DEL and PEL is probably of minimal concern.

Finally, the community results carry uncertainty because confounding factors unrelated to the evaluated parameters can create artifacts in the results. All efforts were made to adjust the data to remove possible artifacts and biases (e.g., adjust for effects of different weather conditions between years on the percent cover), but some factors affecting the results may have been missed. The controlled greenhouse studies do not carry as many confounding factors, but also lack the realism represented by the field study that includes the natural stratified soil structure, larger-scale environmental conditions, and disturbance history affecting plant communities.

6 CONCLUSIONS AND RECOMMENDATIONS FOR FEASIBILITY STUDY

The results were generally consistent between field and greenhouse studies conducted in 2013 and 2014 when similar soil categories were compared. The results from these two lines of evidence support the conclusion that the pCu DEL (range was 4 to 8) and PEL (range was 2 to 6) are variable and depend on the soil category, soil properties, plant species, and endpoints. The DELs and PELs are more variable than in the 1999 studies because the current study included a greater number of different macro- and micro-environments for plant communities. The use of agricultural crops or seeds cultivated in nurseries for the greenhouse study was not as important as the four types of soil categories found to affect the community DEL and PEL: (1) flat granular soils, (2) steep slopes, (3) flat rocky soils, and (4) bedrock-dominated areas. The rangeland condition (OAT) was not affected by pCu for three of the four soil categories, but the rangeland condition and soil complex of each type (rocky flat areas are generally poor rangeland) affects the plant community condition as well as the parent material and buffering capacity of the soil and should also be considered when selecting remedial measures and a cleanup level for specific locations. Of the greenhouse endpoints, emergence is the most correlated to the community parameters. The DEL and PELs for that endpoint and the community endpoints possibly should be given more weight than the other greenhouse endpoints.

This study results produced some data gaps, such as unknown DELs and PELs for the community study in three of the four soil categories and unknown results for a native forb in the greenhouse study. Future collection of reference soil and vegetation data in the slope, rocky flat, and bedrock categories could allow development of DELs and PELs for the other soil categories to assist in FS decisions. The ECx-based DEL and PEL for emergence was developed using all four soil categories, and its DEL and PEL for non-flat granular categories could also substitute for the missing community effect thresholds for soil categories.

In summary, the variable DEL and PEL values that are the outcome of this study create uncertainty around the pre-FS RAC. Ignoring this uncertainty could create more harm than good to the plant community and wildlife habitat. The uncertainty can be reduced by developing site-specific cleanup levels and remediation strategies that incorporate information from this report, the amendment report (Arcadis 2017a), and the white rain report (Arcadis 2017b) to ensure sound decision-making in the FS. This study and its conclusions will assist in preparing the STSIU FS and be an appendage to that same submittal. Furthermore, this study and its conclusions provide a line of evidence to assist the NMED and stakeholders in making final decisions for the STSIU, which will ultimately be documented in the ROD.

7 REFERENCES

Arcadis. 2011. Feasibility Proposal for Smelter/Tailings Soils Investigation Unit. Prepared for Chino Mines Company, Hurley, New Mexico.

Arcadis. 2012. SOP for Vegetation Monitoring for Smelter/Tailings Soils Investigation Unit. Prepared for Chino Mines Company, Hurley, New Mexico.

Arcadis. 2014. Work Plan: Smelter Tailing Soils Investigation Unit (STSIU) – Phytotoxicity and Vegetation Community Study. Prepared for Freeport-McMoRan Chino Mines Company, Administrative Order on Consent, Smelter/Tailing Soils Investigation Unit, Vanadium, New Mexico.

Arcadis. 2017a. Year 5 Monitoring Report for Smelter/Tailing Soils Investigation Unit Amendment Study Plots. June 2015. Prepared for Freeport-McMoRan Chino Mines Company, Vanadium, New Mexico.

Arcadis. 2017b. Year 5 Report on pH Monitoring to Evaluate the Effect of White Rain on Smelter/Tailing Soils. Sept 2015. Prepared for Freeport-McMoRan Chino Mines Company, Vanadium, New Mexico.

Association of Official Seed Analysis (AOSA). 2009. Seed vigor testing handbook.

ASTM International (ASTM). 2009. Standard guide for conducting terrestrial plant toxicity tests. Prepared by the American Society of Testing and Materials. Designation: E1963-09. Philadelphia, Pennsylvania.

Bestelmeyer, B.T., J.E. Herrick, D.A. Trujillo, and K.M. Havstad. 2004. Land management in the American southwest: a state-and-transition approach to ecosystem complexity. Environmental Management 34:38-51.

Belsley, D.A., K. Kuh, and R.E. Welsch. 1980. Regression diagnostics: Identifying influential data and sources of collinearity. John Wiley & Sons, New York.

Bondada, B., and L. Qiyingma. 2003. In S. Chandra & M. Srivastava (eds.), Pteridology in The New Millennium, 397-420. Kluwer Academic Publishers. Printed in the Netherlands

Bradshaw, A., T. McNeilly, and P. Putwain. 1990. The essential qualities. In: Heavy Metal Tolerance in Plants: Evolutional Aspects, J. Shaw (ed.). CRC Press, Boca Raton, Florida.

Chino. 1995. Administrative Order on Consent, Investigation Area, Remedial Investigation Background Report, Chino Mines Company, Prepared by Chino Mines Company, Hurley, New Mexico, October 5.

Chino. 2004. Comments on Site-wide Ecological Risk Assessment. March.

Chino. 2007. Comments on Smelter Tailings Soils Investigation Unit Ecological Risk Assessment. September.

Environment Canada. 2007. Guidance document on statistical methods for environmental toxicity tests. Methods Development and Applications Section. Environment Canada, Ottawa, ON. Report EPS I/RM/46 (with June 2007 amendments).

Haque. MD N. 2008. Screening the phytoremediation potential of native plants growing on mine tailings in Arizona, USA. PhD Dissertation, University of Texas, El Paso, Texas.

Hosmer, D. W., and S. Lemeshow. 2000. Applied logistic regression. Second edition. Wiley-Interscience Publication, John Wiley and Sons, New York, New York, USA.

Kopittke, P.M., Blamey, F.P.C., Asher, C.J., and N.W. Menzies. 2010. Trace metal phytotoxicity in solution culture: a review. Journal of Experimental Botany 61(4): 945-954.

Larcher, W. 1995. Physiological plant ecology. 3rd edition. Springer. New York.

Loneragan, J.F., A.D. Robson, and R.D. Graham. 1981. Copper in soils and plants. American Press.

MacDonald, D.D., C.G. Ingersoll, J. A. Sinclair, J. A. Steevens, J. K. Stanley, J. D. Farrar, N. E. Kemble, J. L. Kunz, W. G. Brumbaugh, and M. R. Coady. 2014. Evaluation of Relations Between Sediment Toxicity and Sediment Chemistry at the Anniston PCB Site. Chapter 5 in Ingersoll, C.G., Steevens, J.A., and MacDonald, D.D., eds., 2014, Evaluation of toxicity to the amphipod, *Hyalella azteca*, and to the midge, *Chironomus dilutus*; and bioaccumulation by the oligochaete, *Lumbriculus variegatus*, with exposure to PCB-contaminated sediments from Anniston, Alabama: U.S. Geological Survey Scientific Investigations Report 2013–5125, 122 p., *http://dx.doi.org/10.3133/sir20135125*.

MacNair, M.R. 1990. The genetics of metal tolerance in natural populations. In: Heavy Metal Tolerance in Plants: Evolutional Aspects. J. Shaw (ed.). CRC Press, Boca Raton, Florida.

MacNair, M.R. 1997. The evolution of plants in metal-contaminated environments. Pp. 3-24. In: Bijlsma, R. and V. Loeschcke (eds.) Environmental Stress, Adaptation and Evolution. Birkhauser Ver1ag:Bostn. of contaminated soil and water. Lewis Publishers: London, UK.

MacNair, M. R., G. H. Relston, and S. E. Smith. 2000. The genetics of metal tolerance and accumulation in higher plants. Pp. 235-248. In: Terry, N. and G. Banueoles (eds.) Phytoremediation

MFG. 2004. Letter to Mr. Chris Eustice from Ed Redente on January 9, 2004.

Motulsky, H. and A. Christopoulos. 2003. GraphPad PRISM. Version 4.0 Fitting models to biological data using linear and non-linear regression: a practical guide to curve fitting. GraphPad software. http://www.graphpad.com/manuals/prism4/RegressionBook.pdf

Nagelkerke N. 1991. A note on a general definition of the coefficient of determination. Biometrika, 78: 691-692.

NewFields. 2005. Chino Mines Administrative Order on Consent Site-wide Ecological Risk Assessment. Prepared for Chino Mines Company in November 2005

NewFields. 2008. Chino Mines Administrative Order on Consent, STSIU Ecological Risk Assessment, April.

New Mexico Environment Department (NMED). 2011. Letter to Mr. Ned Hall from Mr. Bill Olsen Regarding Resolution of Information Dispute Resolution. March 3.

Organization for Economic Cooperation and Development (OECD). 2006. Guidelines 208: Terrestrial Plant Test: Seedling Emergence and Seedling Growth Test. Adopted 19 July 2006.

OECD. 2012. Fish toxicity testing framework. Series on testing and assessment No. 171. Environment Directorate. Joint Meeting of Chemicals Committee and Working Party of Chemicals, Pesticides, and Biotechnology.IOMC. ENV/JM/MONO 2012 (16).

Paschke, M.W., and E.F. Redente. 2002. Copper toxicity thresholds for important restoration grass species of the Western United States. Environmental Toxicology and Chemistry 21(12) : 2692-2697.

Patsikka, E., M. Kairavuo, F. Sersen, E-M Aro, and E. Ty7ystjarvi. 2002. Excess copper predisposes photosystem II to photoinhibition in vivo by outcompeting iron and causing decrease in leaf chlorophyll. Plant Physiology 129:1359-1367.

Plaster, C.J. 2009. Soil science and management. 5th edition. Cengage Learning, New York.

Schafer and Associates. 1999. Chino Administrative Order of Consent – Sitewide Ecological Risk Assessment Technical Memorandum No. 1: ERA Workplan. CMC Agreement No. C59938.

Shank, M. 2008. Using Remote Sensing to Map Vegetation Density on a Reclaimed Surface Mine. Paper presented at the 2008 conference on “Incorporating Geospatial Technologies into SMCRA Business Processes”, March 25 – 27, 2008, Atlanta, GA. http://tagis.dep.wv.gov/tagis/projects/percent_cover_paper.pdf

Spiess, A-N, and N. Neumeyer. 2010. An evaluation of R2 as an inadequate measure for nonlinear models in pharmacological and biochemical research: a Monte Carlo approach. BMC Pharmacology. 10: 6.

SRK. 1997. Administrative Order on Consent Quality Assurance Project Plan.

SRK. 2008. Administrative Order on Consent Remedial Investigation Report for Smelter/Tailings Soils Investigation Unit. June 25.

Thomas, G.W. 1996. Soil pH and Soil Acidity. pp. 475-490. In D.L. Sparks et al. (eds.) Methods of Soil Analysis – Part 3, Chemical Methods. American Society of Agronomy, Madison, WI.

U.S. Department of Agriculture (USDA). 1983. Soil Survey of Grant County, New Mexico Central and Southern Parts. Soil Conservation Service and Forest Service, in cooperation with New Mexico Agricultural Experiment Station. Available at: https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/new_mexico/NM662/0/grant.pdf.

U.S. Environmental Protection Agency (USEPA). 2002. Guidance for comparing background and chemical concentrations in soil for CERCLA sites. Office of Emergency and Remedial Response U.S. Environmental Protection Agency Washington, DC. EPA 540-R-01-003 OSWER 9285.7-41

USEPA. 2013. ProUCL Version 5.0.00 Technical Guide. Statistical Software for Environmental Applications for Datasets with and without Nondetect Observations. Prepared for Felicia Barnett, ORD Site Characterization and Monitoring Technical Support Center, U.S. Environmental Protection Agency by Singh, A., and A. K. Singh. EPA/600/R-07/041

Zappala, M.N., JT. Ellzey, J. Bader, J. R. Peralta-Videa, J. Gardea-Torresday. 2013. *Prosopsis pubescens* (screw bean mesquite) seedlings are hyperaccumulators of copper. Arch. Environ. Contam. Toxicol. 65:212-223.

TABLES

Table 1
Soil Sample Size and Quantities for Greenhouse Experiment
Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailings Soils IU Phytotoxicity and Vegetation Community Study

	Native Grass per Location		Native Forb per Location		Alfalfa per Location	Total per Location	Total of all Locations[a]	Total Soil Collected (gallons)[b]
	Wild	Nursery	Wild	Nursery	Nursery			
Site Soil								
Pot replicates (#)	10	10	10	10	10	50	1250	--
Seeds (#)[c]	120	120	120	120	120	600	15000	--
Soil per location (cups)	30	30	30	30	30	150	3750	234
***De Minimis* Soil**								
Pot replicates (#)	10	10	10	10	10	50	400	--
Seeds (#)[c]	120	120	120	120	120	600	4800	--
Soil (cups)	30	30	30	30	30	150	1200	75
Control Soil								
Pot replicates (#)	10	10	10	10	10	50	50	--
Seeds(#)[c]	120	120	120	120	120	600	600	--
Soil(cups)	30	30	30	30	30	150	150	9
Total								
Pots	30	30	30	30	30	150	**1700**	--
Seeds (Collected)	360	--	360	--	--	720	**8160**	--
Seeds (Purchased)	--	360	--	360	360	1080	**12240**	--
Soil Collected (no artificial soil)	90	90	90	90	90	450	**5100**	**319**

Notes:

a. Multiplied total replicates per location by number of locations: 25 site locations, four *de minimis* locations, four reference locations, and one sample for control s
b. 4.3-inch diameter pots required 3 cups of soil each
c. 12 seeds were planted per pot

Table 2
Soil Sample Analyses for Greenhouse Experiment
Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phototoxicity and Vegetation Community Study

Parameter	Extraction Method	Analytical Method
Alkalinity (total)	ASA Mono #9, Part 2, 10-2.3.1	A 2320B
Chloride	ASA Mono #9, Part 2, 10-3.2	E300.0
Fluoride	ASA Mono #9, Part 2, 10-3.2	A 4500 F-C/Technicon 380-7WE
Exchangeable Calcium (NH_4OAc) [a]	ASA Mono #9, Part 2, 13-4	6010/6020
Exchangeable Copper (NH_4OAc) [a]	ASA Mono #9, Part 2, 13-4	6010/6020
Exchangeable Magnesium (NH_4OAc) [a]	ASA Mono #9, Part 2, 13-4	6010/6020
Exchangeable Potassium (NH_4OAc) [a]	ASA Mono #9, Part 2, 13-4	6010/6020
Exchangeable Sodium (NH4OAc) [a]	ASA Mono #9, Part 2, 13-4	6010/6020
Sulfate (soluble)	ASA Mono #9, Part 2, 10-3.2	6010/6020
Copper (total)	3050	6010B
Copper (soluble), $CaCl_2$	Arcadis SOP	Arcadis SOP
Aluminum (soluble)	ASA Mono. #9, Part 2, Method 19-3.3	6010/6020
Iron (soluble)	ASA Mono. #9, Part 2, Method 19-3.3	6010/6020
Manganese (soluble)	ASA Mono. #9, Part 2, Method 19-3.3	6010/6020
Nitrate/Nitrite, in $CaCl_2$	ASA Mono. #9, Part 2, Method 38-8.1	350.1, 353.2, 351.4
pH (saturated paste with saturated %)	ASA Mono #9, Part 2, 10-3.2	9045C
pH, $CaCl_2$	Arcadis SOP	Arcadis SOP
Plant Available Phosphorus (Bray/Olsen)	ASA Mono. #9, Part 2,Method 24-5.1	365.1
Phosphate	ASA Mono. #9, Part 2, Method 24-5.3	365.1
Electrical Conductivity, saturated paste	ASA Mono. #9, Part 2,Method 10-3.3	ASA Mono #9 Part 2
Electrical Conductivity, $CaCl_2$	Arcadis SOP	Arcadis SOP
Total Organic Matter	ASA Mono. #9, Part 2,Method 29-3.5.2	Handbook 60
DOC	ASA Mono. #9, Part 2, Method 10-3	ASA Mono #9 Part 2
Soil Texture	ASA Mono. #9, Part 1, Method 15-4	NAPT S-10.101
$CaCO_3$	USDA Handbook 60, Method 23C	Handbook 60
Measured pCu in $CaCl_2$	Arcadis SOP in Work Plan	Arcadis SOP
Moisture (dry basis)	USDA Handbook 60,Method 26	

Acronyms/Abbreviations:

ASA Mono #9 = American Society of Agronomy Monograph #9
$CaCl_2$ = calcium chloride
$CaCO_3$ = calcium carbonate
DOC = dissolved organic carbon
NAPT = North American Proficiency Testing
NH_4OAc = ammonium acetate
SOP = standard operating procedure
USDA = United States Department of Agriculture

Notes:

a. NH_4OAc-exchangeable plus water soluble (saturated paste) concentrations produces the NH_4OAc-extractable concentration that is most available to plants, and the extractable concentrations are used in the covariate analysis.

Table 3
Manufactured Control Soil Characterization
Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

ARCADIS Design & Consultancy for natural and built assets

Parameter	Result	
Sand, Percent	89	
Silt, Percent	3	
Clay, Percent	8	
USDA Textural Class	Loamy Sand	
Bulk Density, disturbed (g/cm^3)	1.23	
Cation Exchange Capacity (meq/100 g)	3.9	
Moisture at 1/3 Bar (%)	8.5	
Moisture at 15 Bar (%)	4.5	
Organic Carbon - Walkley Black (%)	0.56	
Organic Matter - Walkley Black (%)	0.96	
pH in 1:1 soil:water ratio	7.2	
pH in 0.01M $CaCl_2$ (1:2)	6.7	
Olsen Phosphorus (ppm)	21	
Total Nitrogen (Analyzer) (%)	<0.01	
Soluble Salts (mmhos/cm)	0.49	
Base Saturation Data by Cation:	**(%)**	**(ppm)**
Calcium	70.4	546
Magnesium	10.3	48
Sodium	1.6	14
Potassium	3.3	50
Hydrogen	14.5	6

Acronyms/Abbreviations:

g/cm^3 = grams per cubic centimeter

meq/100 g = millequivalents per 100 grams

mmhos/cm = millimhos per centimeter

ppm = parts per million

USDA = United States Department of Agriculture

Table 4
Quality of Greenhouse Phytotoxicity Results Based on Performance of Control
Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Species	Germination (%)	Survival (%)
Minimum Criteria Threshold		
Alfalfa	80	90
Sideoats Grama	65	90
Tansyaster	55	80
Results		
Alfalfa	80	96
Field Sideoats Grama	*64*	*82*
Nursery Sideoats Grama	*55*	*88*
Field Tansyaster	**28**	**30**
Nursery Tansyaster	**45**	**38**

Notes:

Italicized results were below criteria threshold by ≤ 10% in absolute units.
Bolded results in red were below criteria threshold by > 10% in absolute units.
Criteria are based on agricultural or rangeland grass species known to perform well in the laboratory (see text).
Survival was calculated for each negative control pot and then averaged across the pots. Wildlife International summed the number of survived seedlings across all pots and divided that by the number of emerged seedlings across all pots, resulting in a slightly different estimate.

Table 5
Summary of Calculated EC10s, EC20s, and EC50s with 95% Confidence Intervals for Greenhouse Study
Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailings Soils IU Phytotoxicity and Community Study

Species	Emergence	Survival	Root Length	Shoot Weight	Shoot Height[a]
EC10					
Alfalfa					
EC10 (lower 95%)	3.87	3.55	6.92	5.91	6.68
EC10	4.33	3.75	7.44	7.18	7.35
EC10 (upper 95%)	4.79	3.95	7.95	8.45	8.01
Field Sideoats Grama					
EC10 (lower 95%)	6.10	5.37	6.71	6.57	6.68
EC10	6.72	6.76	7.10	7.74	7.35
EC10 (upper 95%)	7.34	8.15	7.49	8.91	8.01
Nursery Sideoats Grama					
EC10 (lower 95%)	6.10	5.37	6.71	6.57	6.68
EC10	6.72	6.76	7.10	7.74	7.35
EC10 (upper 95%)	7.34	8.15	7.49	8.91	8.01
Field Tansyaster					
EC10 (lower 95%)	5.81	5.20	5.16	5.66	6.68
EC10	6.91	5.34	6.07	9.07	7.35
EC10 (upper 95%)	8.01	5.47	6.98	12.5	8.01
Nursery Tansyaster					
EC10 (lower 95%)	5.81	4.92	5.16	5.66	6.68
EC10	6.91	5.02	6.07	9.07	7.35
EC10 (upper 95%)	8.01	5.13	6.98	12.5	8.01
EC20					
Alfalfa					
EC20 (lower 95%)	3.81	3.60	6.63	5.37	6.22
EC20	4.13	3.72	7.07	6.42	6.73
EC20 (upper 95%)	4.45	3.85	7.52	7.46	7.24
Field Sideoats Grama					
EC20 (lower 95%)	5.65	5.11	6.44	6.07	6.22
EC20	6.13	6.15	6.74	6.97	6.73
EC20 (upper 95%)	6.60	7.20	7.03	7.88	7.24
Nursery Sideoats Grama					
EC20 (lower 95%)	5.65	5.11	6.44	6.07	6.22
EC20	6.13	6.15	6.74	6.97	6.73
EC20 (upper 95%)	6.60	7.20	7.03	7.88	7.24
Field Tansyaster					
EC20 (lower 95%)	5.30	5.18	4.82	4.98	6.22
EC20	6.32	5.30	5.71	8.31	6.73
EC20 (upper 95%)	7.34	5.42	6.59	11.6	7.24
Nursery Tansyaster					
EC20 (lower 95%)	5.30	4.90	4.82	4.98	6.22
EC20	6.32	4.98	5.71	8.31	6.73
EC20 (upper 95%)	7.34	5.07	6.59	11.6	7.24
EC50					
Alfalfa					
EC50 (lower 95%)	3.58	3.61	6.10	4.34	5.40
EC50	3.79	3.68	6.46	5.10	5.67
EC50 (upper 95%)	4.00	3.75	6.82	5.86	5.95
Field Sideoats Grama					
EC50 (lower 95%)	4.85	4.57	5.95	5.17	5.40
EC50	5.11	5.11	6.12	5.66	5.67
EC50 (upper 95%)	5.37	5.66	6.29	6.16	5.95
Nursery Sideoats Grama					
EC50 (lower 95%)	4.85	4.57	5.95	5.17	5.40
EC50	5.11	5.11	6.12	5.66	5.67
EC50 (upper 95%)	5.37	5.66	6.29	6.16	5.95
Field Tansyaster					
EC50 (lower 95%)	4.37	5.13	4.22	3.77	5.40
EC50	5.30	5.23	5.09	6.99	5.67
EC50 (upper 95%)	6.24	5.33	5.96	10.2	5.95
Nursery Tansyaster					
EC50 (lower 95%)	4.37	4.84	4.22	3.77	5.40
EC50	5.30	4.92	5.09	6.99	5.67
EC50 (upper 95%)	6.24	4.99	5.96	10.2	5.95

Acronyms/Abbreviations:

ECx = Effect concentration of x%, which is pCu when endpoint is reduced by x% from the modeled no effect threshold, R_{max}

pCu = cupric ion activity

R_{max} = Upper endpoint threshold of S-shaped dose-response curve (where curve plateaus)

Notes:

a. One nursery sideoats grama outlier excluded.

Table 6
Approximation of Minimum Effect Detectable Based on Negative Control Variability
Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Parameter	Half the 95% Confidence Interval of Negative Control					
	Alfalfa 1999	Alfalfa 2014	Field Sideoats Grama	Nursery Sideoats Grama	Field Tansyaster	Nursery Tansyaster
Emergence (%)	12	13	20	24	16	17
Survival (%)	14	4	16	13	71	39
Root Length (cm)	13	10	20	21	37	20
Shoot Weight (g dw)	4	16	33	29	47	24
Shoot Height (cm)	12	10	12	12	31	8
Detectable ECx range	EC5 - EC15	EC5 - EC20	EC15 - EC35	EC15 - EC30	EC20 - EC75	EC10 - EC40

Acronyms/Abbreviations:

cm = centimeters
ECx = effect concentration of x%, which is pCu when endpoint is reduced by x% from the modeled no effect threshold (R_{max})
g dw = grams dry weight
pCu = cupric ion activity
R_{max} = upper endpoint threshold of S-shaped dose-response curve (where curve plateaus)

Notes:

Values in table are 2*standard error/mean of negative control's endpoint, converted to percent (x 100), where 2 approximates a t value (OECD 2012). This value approximates half the 95% confidence interval of the negative control.

Table 7
Summary of Greenhouse DELs and PELs based on Minimum of Reference Locations
Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailings Soils IU Phytotoxicity and Vegetation Community Study

Species	Emergence	Survival	Root Length	Shoot Weight	Shoot Height
Alfalfa					
DEL	4.33	3.96	7.73	7.11	6.88
PEL	3.74	3.69	6.41	4.90	5.41
Field Sideoats Grama					
DEL	5.86	6.72	8.01	6.60	6.57
PEL	4.71	4.96	6.11	5.13	5.31
Nursery Sideoats Grama					
DEL	6.61	7.17	7.18	6.79	6.60
PEL	4.94	5.02	6.04	5.21	5.32
Field Tansyaster					
DEL	4.87	5.31	4.62	6.21	6.24
PEL	4.18	5.22	4.24	5.37	5.17
Nursery Tansyaster					
DEL	5.37	5.06	5.13	5.81	5.55
PEL	4.54	4.91	4.63	5.02	4.75

Acronyms/Abbreviations:

DEL = *de minimis* effect level = pCu at endpoint that is the minimum of reference locations
PEL = probable effect level = pCu at half the endpoint that is the minimum of reference locations
When minimum reference was >Rmax, Rmax was the endpoint value for the DEL (the case for alfalfa survival)
pCu = cupric ion activity

Table 8
Summary of Greenhouse Final DELs and PELs for Alfalfa and Sideoats Grama
Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailings Soils IU Phytotoxicity and Vegetation Community Study

Species	Emergence	Survival	Shoot Weight	Shoot Height
Alfalfa				
DEL based on minimum of reference	4.33	3.96	7.11	6.88
PEL based on minimum of reference	3.74	3.69	4.90	5.41
EC10 (DEL)	4.33	3.75	7.18	7.35
EC50 (PEL)	3.79	3.68	5.10	5.67
Average Sideoats Grama				
DEL based on minimum of reference	6.24	6.94	6.69	6.58
PEL based on minimum of reference	4.83	4.99	5.17	5.31
EC10 (DEL)	6.72	6.76	7.74	7.35
EC50 (PEL)	5.11	5.11	5.66	5.67

Notes:

DEL = *de minimis* effect level in pCu units
PEL = probable effect level in pCu units
ECx = Effect concentration of x%, which is pCu when endpoint is reduced by x% from the modeled no effect threshold, R_{max}
pCu = cupric ion activity
R_{max} = Upper endpoint threshold of S-shaped dose-response curve (where curve plateaus)
When minimum reference was >Rmax, Rmax was the endpoint value for the DEL (the case for alfalfa survival)

Table 9
Summary of Greenhouse DELs and PELs for Tansyaster
Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailings Soils IU Phytotoxicity and Vegetation Community Study

Species	Emergence	Survival	Root Length	Shoot Weight	Shoot Height
Field Tansyaster					
DEL based on minimum of reference	4.87	5.31	4.62	6.21	6.24
PEL based on minimum of reference	4.18	5.22	4.24	5.37	5.17
EC10 (DEL)	6.91	5.34	6.07	9.07	7.35
EC50 (PEL)	5.30	5.23	5.09	6.99	5.67
Nursery Tansyaster					
DEL based on minimum of reference	5.37	5.06	5.13	5.81	5.55
PEL based on minimum of reference	4.54	4.91	4.63	5.02	4.75
EC10 (DEL)	6.91	5.02	6.07	9.07	7.35
EC50 (PEL)	5.30	4.92	5.09	6.99	5.67

Notes:

DEL = *de minimis* effect level in pCu units
PEL = probable effect level in pCu units
ECx = Effect concentration of x%, which is pCu when endpoint is reduced by x% from the modeled no effect threshold, R_{max}
pCu = cupric ion activity
R_{max} = Upper endpoint threshold of S-shaped dose-response curve (where curve plateaus)

Notes:

Tansyaster results separated from other results in Table 9 because results are considered unreliable.

Table 10
Comparison of Greenhouse DEL and PEL of Alfalfa Test in 1999 to Alfalfa Test in 2014
Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Species	Emergence	Survival[a]	Root Length	Shoot Weight	Shoot Height
1999 Alfalfa					
EC10 (DEL)	5.19	5.26	4.97	7.52	6.52
EC50 (PEL)	4.23	4.30	4.89	5.23	5.08
DEL based on minimum of reference	8.26	5.34	5.24	8.58	10.82
PEL based on minimum of reference	4.32	4.23	4.89	5.15	5.10
2014 Alfalfa					
EC10 (DEL)	4.33	3.75	7.44	7.18	7.35
EC50 (PEL)	3.79	3.68	6.46	5.10	5.67
DEL based on minimum of reference	4.33	3.96	7.73	7.11	6.88
PEL based on minimum of reference	3.74	3.69	6.41	4.90	5.41

Acronyms/Abbreviations:

DEL = *de minimis* effect level in pCu units
PEL = probable effect level in pCu units
pCu = cupric ion activity
ECx = Effect concentration of x%, which is pCu when endpoint is reduced by x% from the modeled no effect threshold, R_{max}
R_{max} = Upper endpoint threshold of S-shaped dose-response curve (where curve plateaus)

Notes:

a. Survival was originally calculated as number surviving divided by total seeds planted in 1999, whereas in 2014, it was calculated as number surviving divided by total that emerged. All 1999 data were re-calculated using same 2014 methods in this report and table for comparison.

Table 11
General Linear Model Results for Richness, Cover, OAT Scores, and Community DEL and P
Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxocity and Vegetation Community Study

Effect	Coefficient	Standard Error	Standardized Coefficient	t-value	p-value	DEL	PEL
Richness (n = 30[a], R^2=0.83)[a]: All categories							
Constant	0.97	1.36	0	0.7151	0.4812		
Calculated pCu	1.23	0.18	0.52	6.7616	**<0.0001**		
Bedrock	-4.43	1.11	-0.46	-3.9827	**0.0005**	NA	NA
Flat Granular	3.05	1.09	0.32	2.7967	**0.0098**	7.47	2.10
Flat Rocky	-2.90	1.16	-0.28	-2.4986	**0.0194**	NA	NA
Cover (n = 19, R^2 = 0.84) for flat granular and bedrock locations only[b]							
Constant	-3.70	1.25	0	-2.9508	0.0094		
Calculated pCu	1.28	0.21	0.54	6.0412	**<0.0001**		
Flat Granular	7.46	0.95	0.71	7.8829	**<0.0001**	5.64	3.42
OAT score (n = 9, R^2 = 0.57) for only bedrock locations							
Constant	-2.65	4.748	0	-0.558	0.5944		
Calculated pCu	2.86	0.935	0.76	3.055	**0.0185**		

Notes:

a. Excludes two outliers

b. Excludes one outlier

OAT = Observed apparent trend

Slope is the reference group for the "indicator" variable of soil category (includes bedrock, flat granular, flat rocky, slope) in the multiple regression. R^2 is adjusted for number of variables in model.

Bolded P values have $p < 0.05$.

NA = not available because no reference locations were available for that soil category; only flat granular had reference locations.

pCu = cupric ion activity

Table 12
Hypotheses Tested for Greenhouse and Community Studies
Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity Vegetation Community Study

Hypothesis	Outcome
H1a. Native species will have a lower EC50 of each greenhouse study endpoint than agricultural species	H1a. Rejected for all endpoints except root length (Figure 9)[a].
H1b. Native species will have lower minimum reference PEL for each greenhouse study endpoint than agricultural species	H1b. Rejected for all endpoints except root length[a] and shoot height (Figure 9).
H2a. Field-collected site seeds of native species will have a lower EC50 than nursery seeds of the same species in greenhouse study	H2a. Rejected for all endpoints (Figure 9).
H2b. Field-collected site seeds of native species will have a lower minimum reference PEL than nursery seeds of same species in greenhouse study	H2b. Supported except for root length of sideoats grama. Not supported for tansyaster except for emergence and root length[a] (Figure 9). Unlikely the slight differences for either species are significant.
H3. The DEL and PEL of the alfalfa study will differ from the 1999 alfalfa study DEL and PEL with the inclusion of more representative reference and site locations[b].	H3. Supported. Lower than 1999 for three endpoints (average difference across all PELs and DELs of 0.6 to 0.8 pCu units), and higher for shoot height and root length (average difference of 0.6 to 1.9[a], respectively, Table 8) .
H4. The DEL and PEL from the community study will differ by physical habitat type and differ from the 1999 study with the inclusion of more representative reference locations.	H4. Supported. The four soil categories affected richness, and to a less extent cover and OAT score. The PEL (but not the DEL) for the only category with a PEL, flat granular soil, was lower than the final PEL of the soils in relatively flat areas in the 1999 study (Table 9).

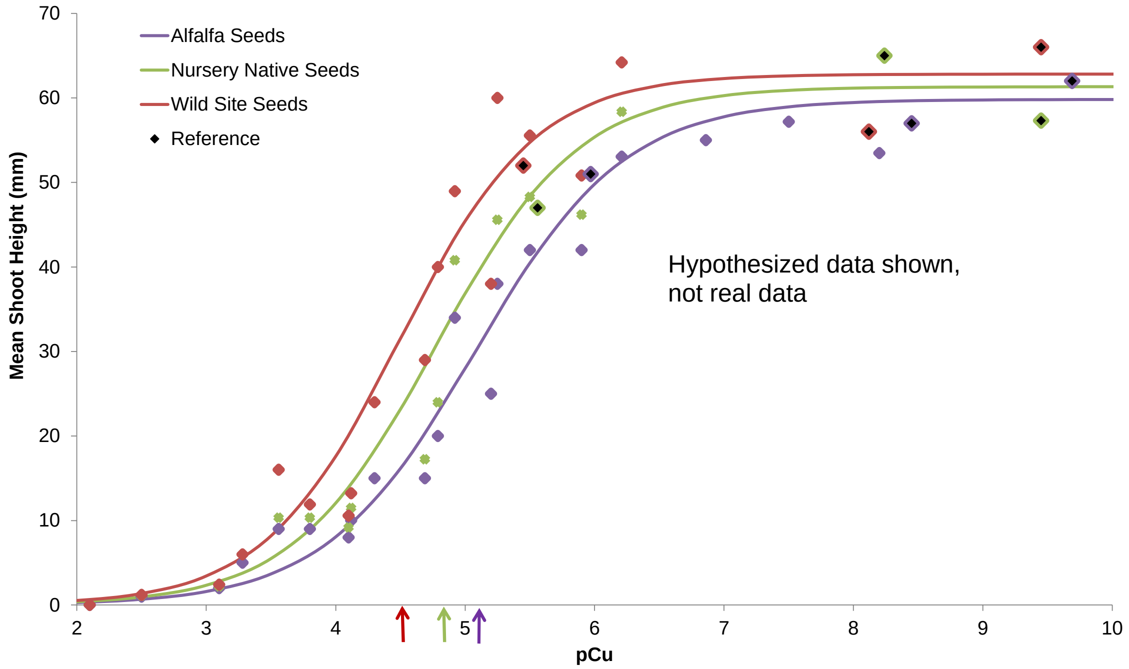
Notes:

[a] Root length data are not reliable in 2014 study, nor are the tansyaster results.

[b] Though including east-side locations for reference is more representative than the one west-side reference in 1999, the 2014 reference locations only represented the flat, granular soil category.

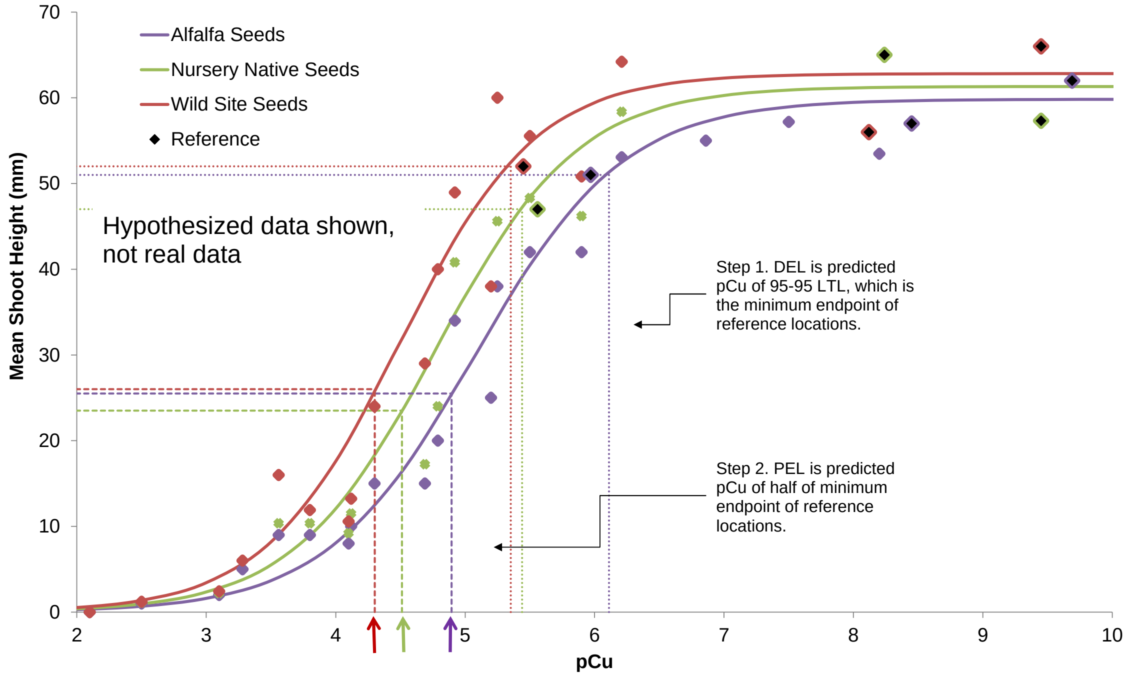
DEL = *de minimis* effect level
PEL = probable effect level
pCu = cupric ion activity
OAT = observed apparent trend
ECx = Effect concentration of x%, which is pCu when endpoint is reduced by x% from the modeled no effect threshold, R_{max}
R_{max} = Upper endpoint threshold of S-shaped dose-response curve (where curve plateaus)

FIGURES



Hypothesized data shown, not real data

a. ECx method, where the PEL is the pCu associated with a 50% reduction (modeled EC50) of endpoint values.



Hypothesized data shown, not real data

Step 1. DEL is predicted pCu of 95-95 LTL, which is the minimum endpoint of reference locations.

Step 2. PEL is predicted pCu of half of minimum endpoint of reference locations.

b. Minimum of reference locations method, where the PEL is estimated as the predicted pCu at half the minimum of reference endpoints.

Notes:

DEL = *de minimis* effects level
PEL = probable effects level

Shown is the hypothesized leftward shift in pCu relationship with shoot height if native, wild site seeds are used instead of nursery or agricultural (alfalfa) seeds. Symbols with black centers are reference (color represents seed type). Arrows represent the PEL for each curve.

FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

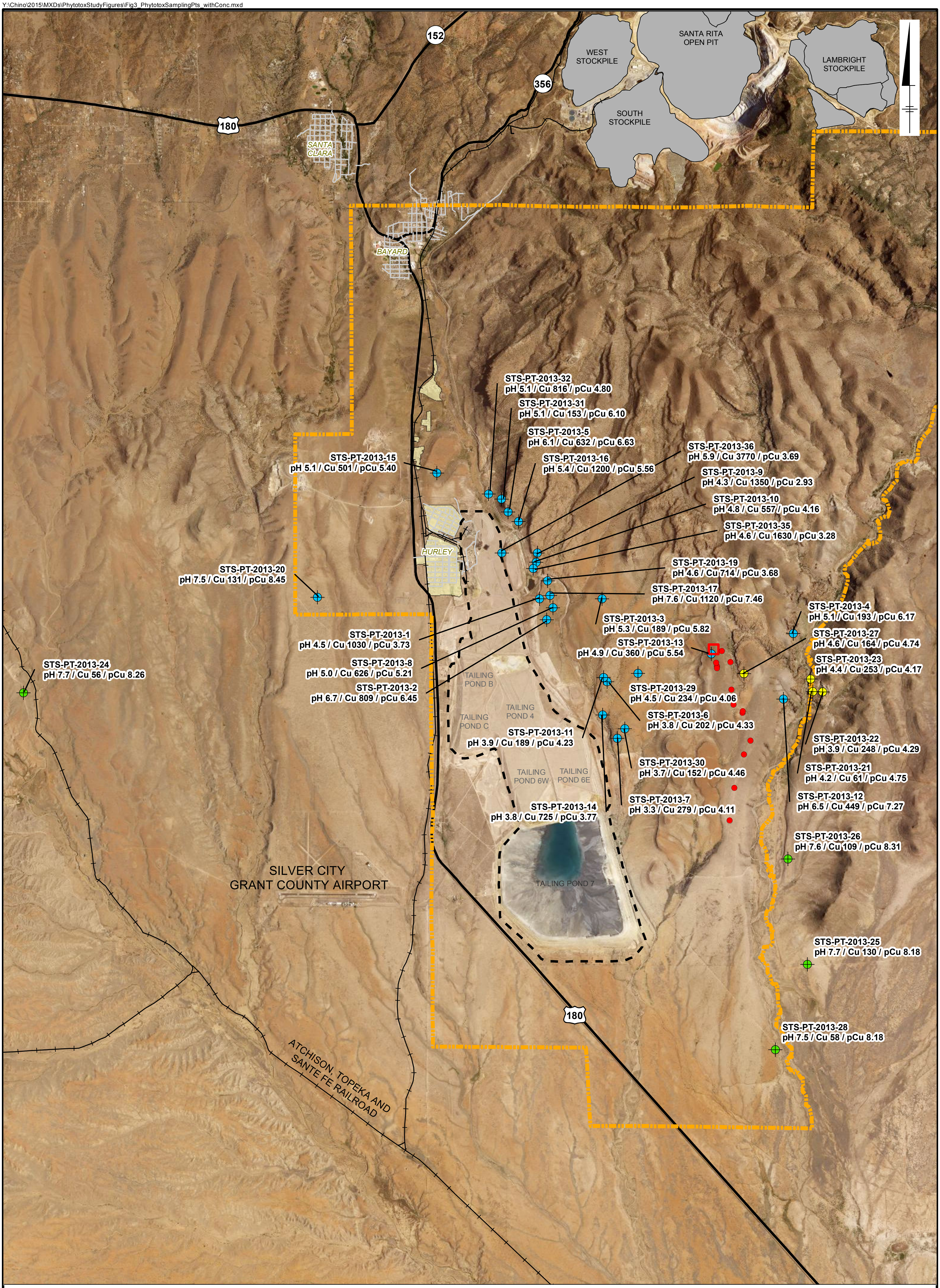
PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

Hypothesized Relationship between pCu and Shoot Height by Seed Type with Made-up Data

ARCADIS

FIGURE
1

OFFICE: LAKEWOOD DB: MEB TM: MB PM: AT
PROJECT# B0063543.0000 6/28/2017 12:37:58 PM
Y:\Chino\2015\MXDs\PhytotoxStudyFigures\Fig3_PhytotoxSamplingPts_withConc.mxd



Legend

⊕	Site soil sample location
⊕	De minimus soil sample location
⊕	Reference soil sample location
●	Tansyaster seed collection location
☐	Seed collection area for sideoats grama protected from grazing
▭	STSIU Boundary
▭	Smelter Tailings Boundary

Copper (Cu) units are mg/kg
pH and pCu units are s.u.

0 0.5 1 2 Miles
GRAPHIC SCALE

Service Layer Credits: USDA, N AIP 2016

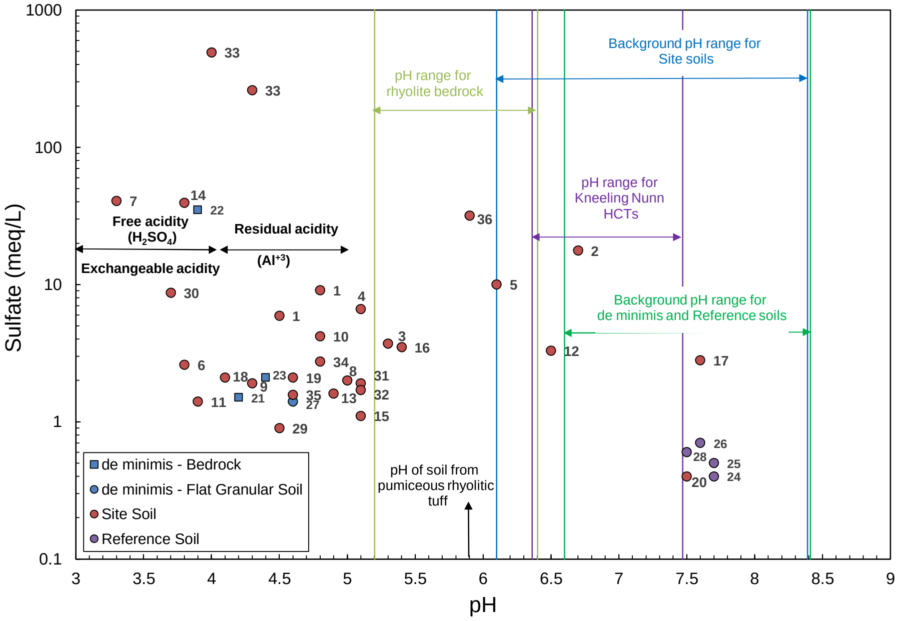
FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

SMELTER TAILING SOILS IU PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

GREENHOUSE PHYTOTOXICITY STUDY SAMPLING LOCATIONS

ARCADIS

FIGURE
2



Notes:
Numbers represent the last number of the location IDs on Figure 2.
HCTs = Humidity Cell Tests for kinetic testing of rock

FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

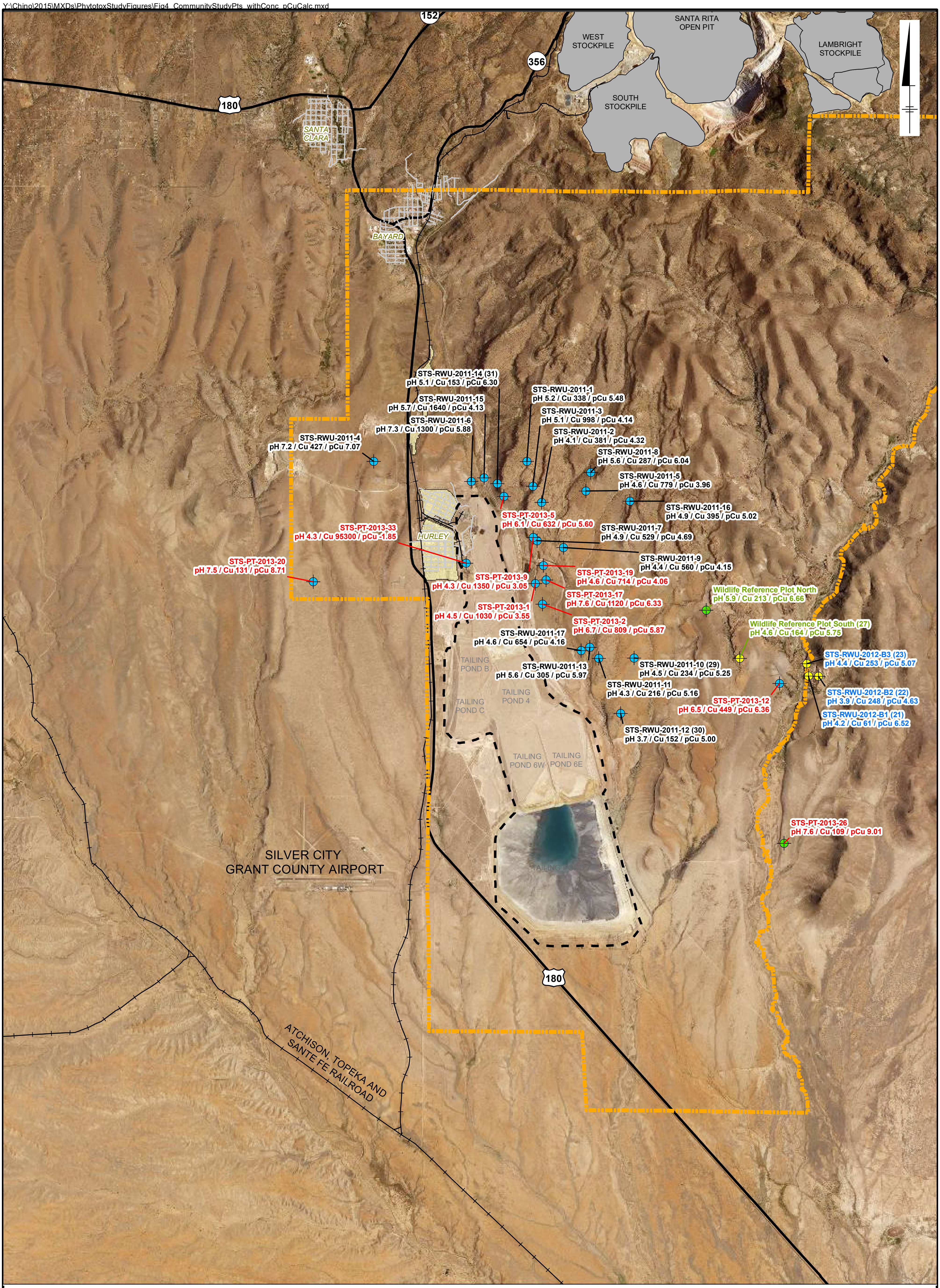
PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

Relationship between Soluble Sulfate and pH used to Identify Impacted Locations

ARCADIS

FIGURE
3

OFFICE: LAKEWOOD DB:MEB TM: MB PM: AT
PROJECT# B0063543.0000 8/3/2017 1:43:11 PM
Y:\Chino\2015\MXDs\PhytotoxStudyFigures\Fig4_CommunityStudyPts_withConc_pCuCalc.mxd



Legend

- ⊕ Site vegetation survey and soil sampling location
- ⊕ De minimus vegetation survey and soil sampling location
- ⊕ Reference vegetation survey and soil sampling location
- ▭ STSIU Boundary
- ▭ Smelter Tailings Boundary

0 0.5 1 2 Miles

GRAPHIC SCALE

Notes:

Black labels denote sites sampled for vegetation only in 2011
Blue labels denote sites sampled for vegetation only in 2012
Red labels denote sites sampled for vegetation only in 2014
Green labels denote sites sampled for vegetation in 2011 and 2014

Soil samples taken at all locations in 2013.

Location labels with a number in parenthesis are for locations also sampled in the laboratory phytotoxicity study (Figure 3) and indicate the X in that study's STS-PT-2013-X label.

Copper (Cu) units are mg/kg
pH and pCu units are s.u.

Service Layer Credits: USDA, NAIP 2016

FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

SMELTER TAILING SOILS IU PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

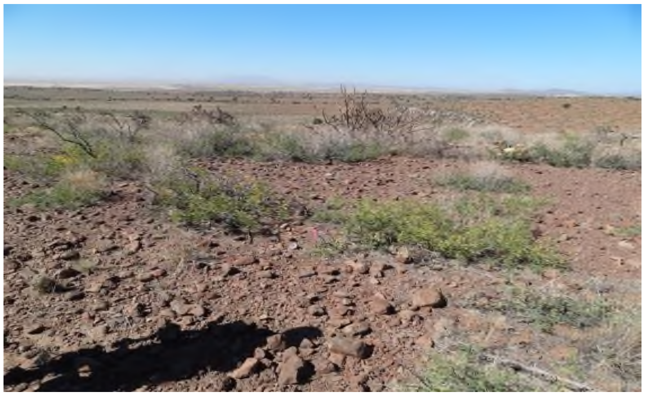
VEGETATION COMMUNITY STUDY SAMPLING LOCATIONS

ARCADIS

FIGURE
4

Bedrock (≥ 60%)

Flat Rocky (with eroded topsoil as shown by rocks sitting on top)



Slope (>14%)

Flat Granular Soil (rocks embedded)

Notes:
Photographs show areas that are an example of the four soil categories used in the Community Study.

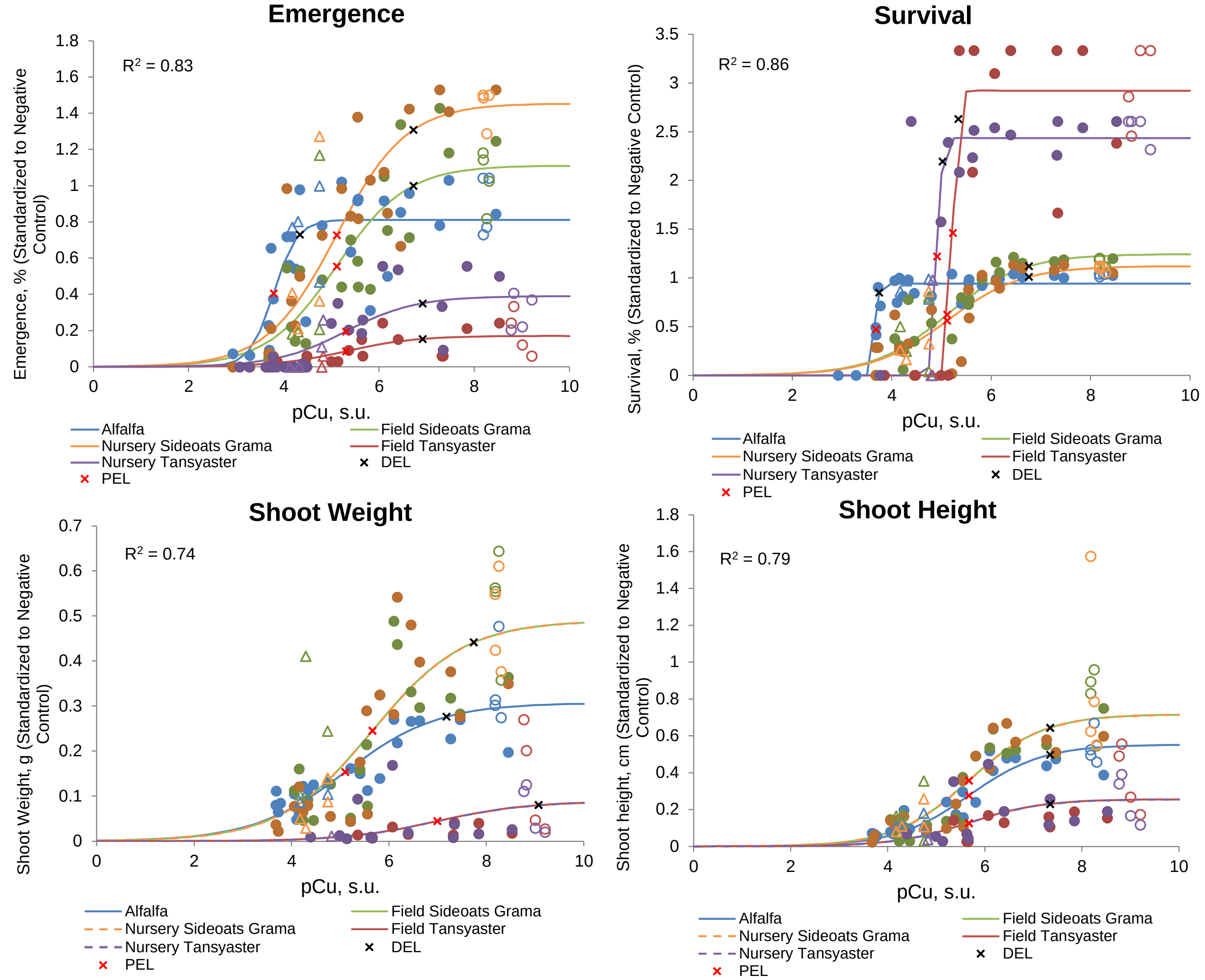
FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

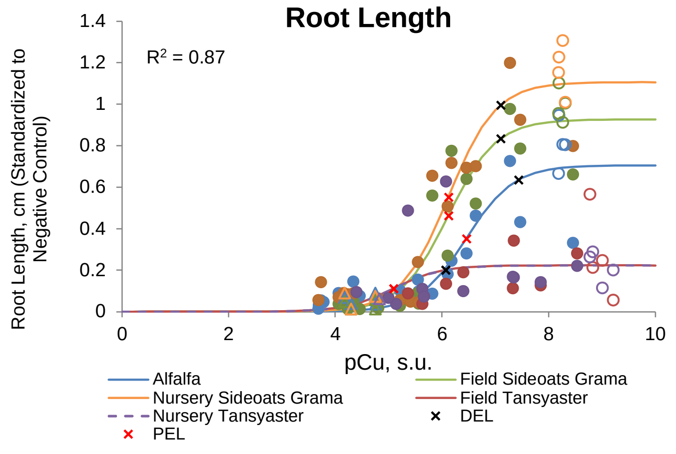
PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

Four Soil Categories

ARCADIS

FIGURE
5





● Site

△ *De Minimus*

○ Reference

Notes: The DEL and PEL in this figure is based on the ECx method, where the DEL is the EC10 and the PEL is EC50 (pCu at which there is a10 and 50% reduction of endpoint values, respectively).

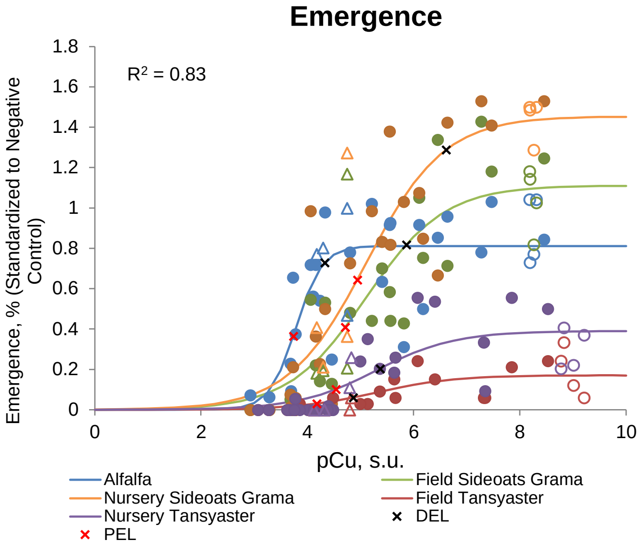
FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

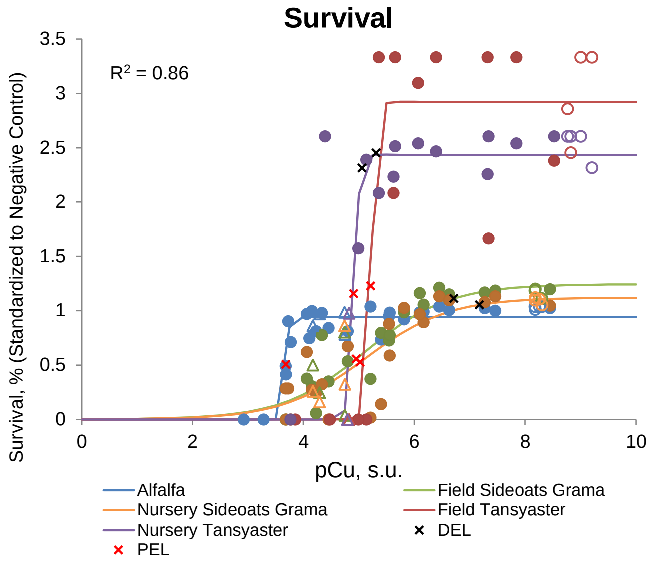
PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

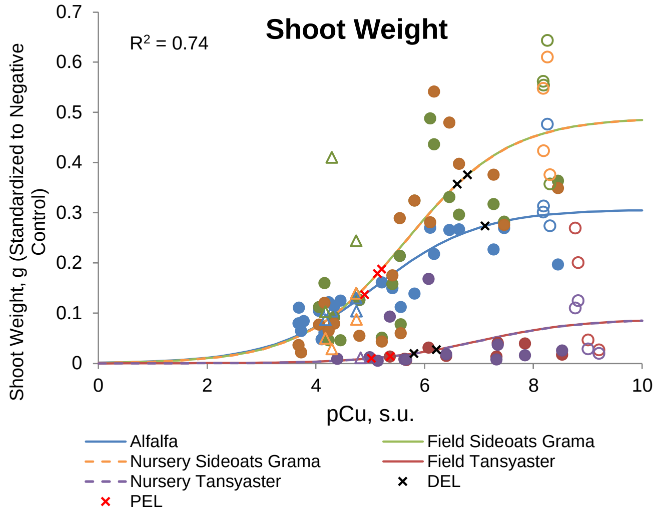
Dose-Response Curves from Greenhouse Study with DEL and PEL based on ECx Method

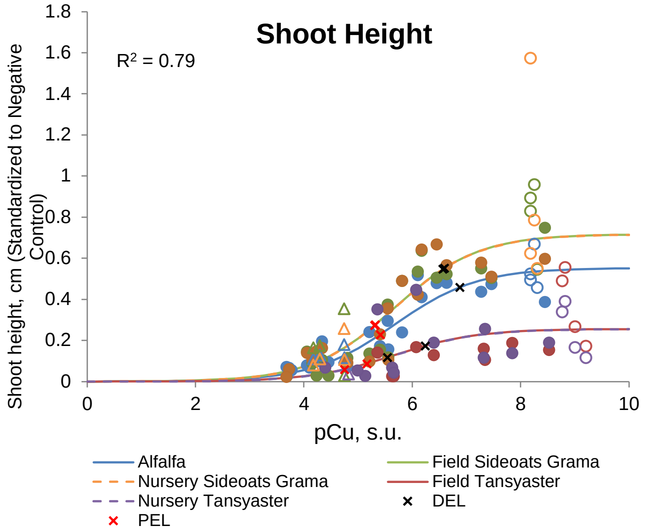
ARCADIS

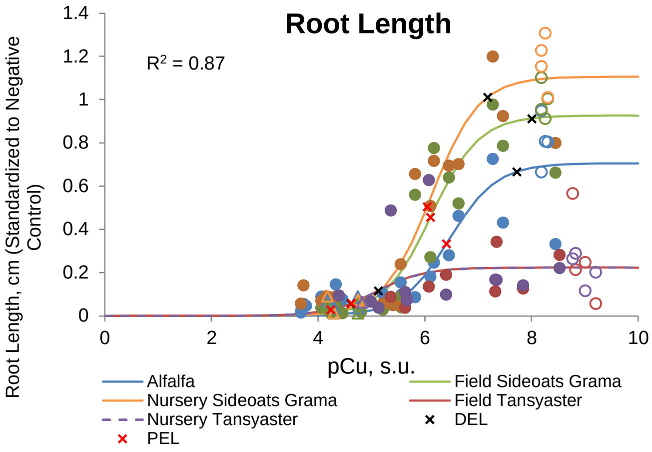
FIGURE
6











● Site

△ *De Minimus*

○ Reference

DEL and PEL based on minimum of reference locations method, where the DEL is estimated as the predicted pCu at the minimum of reference endpoints and the PEL is the predicted pCu at half the minimum of reference endpoints.

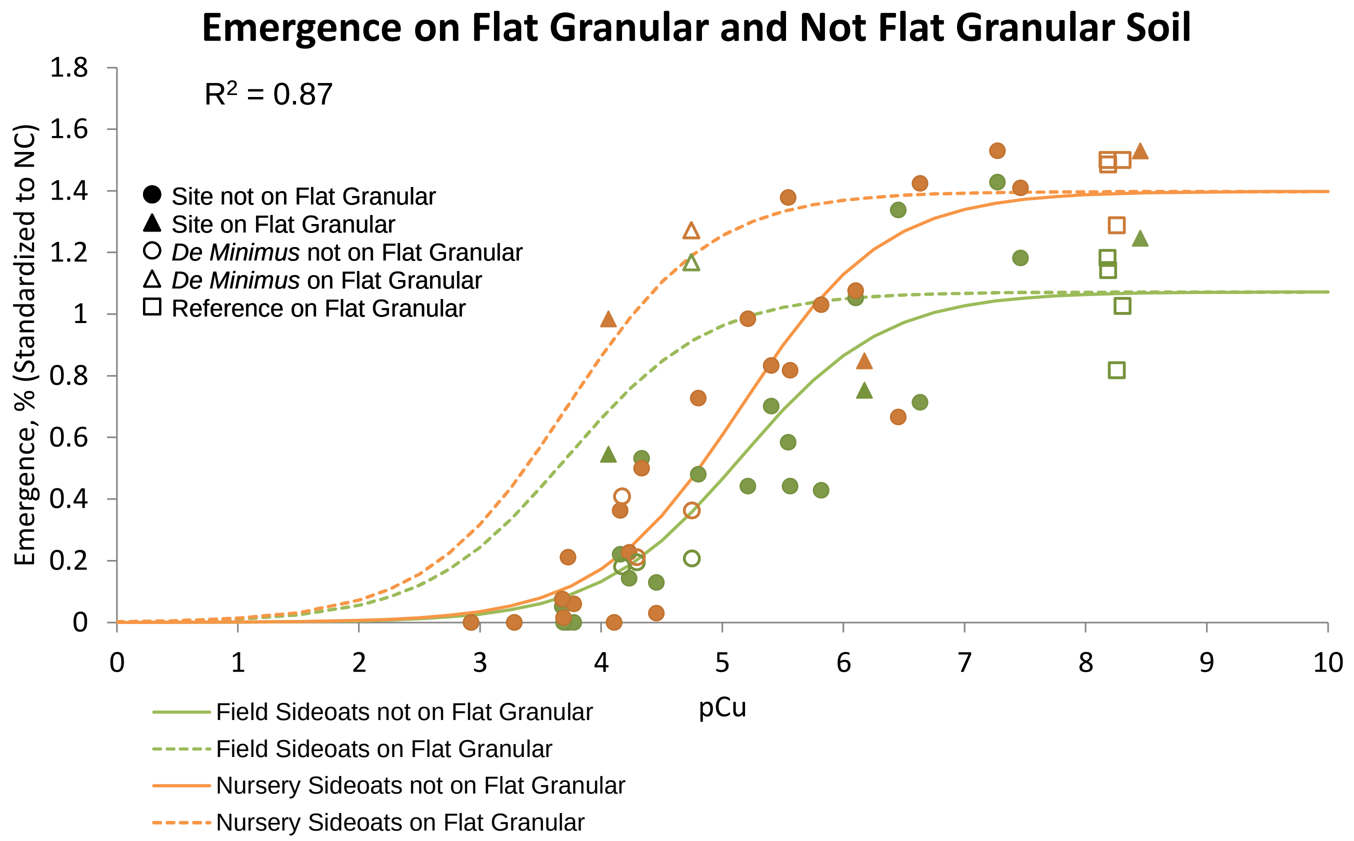
FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

Dose-Response Curves from Greenhouse Study with DEL and PEL based on Minimum Reference Method

ARCADIS

FIGURE
7



Notes:
All reference areas were on flat granular and therefore no points represent reference areas on non-flat granular soils.

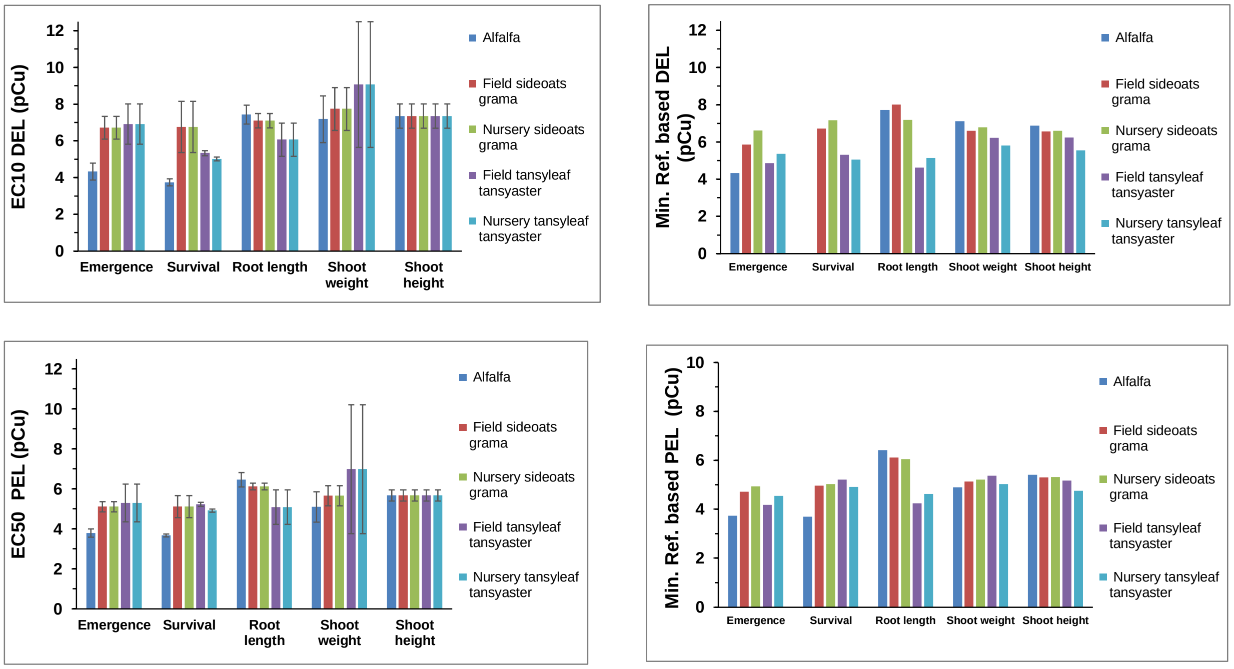
FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

One Example of a Greenhouse Dose-Response Curve for Sideoats Grama with Flat Granular Covariate

ARCADIS

FIGURE
8



Notes:

Graphs to left are ECx-based DEL (EC10) and PEL (EC50)
Graphs to right are minimum-reference (Min. Ref.) based DEL and PEL
Confidence intervals are from Table 5, available only for ECx-based DEL and PEL.

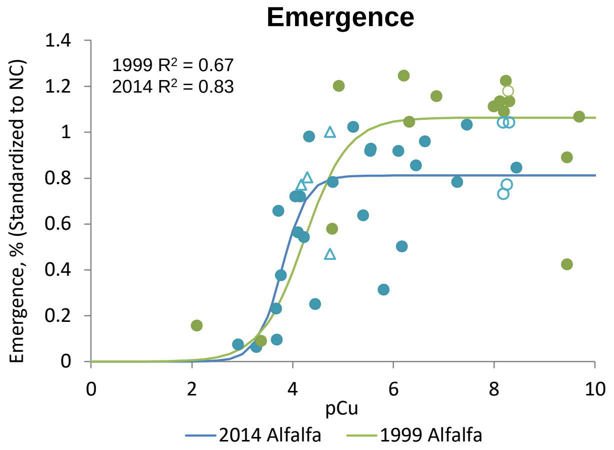
FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

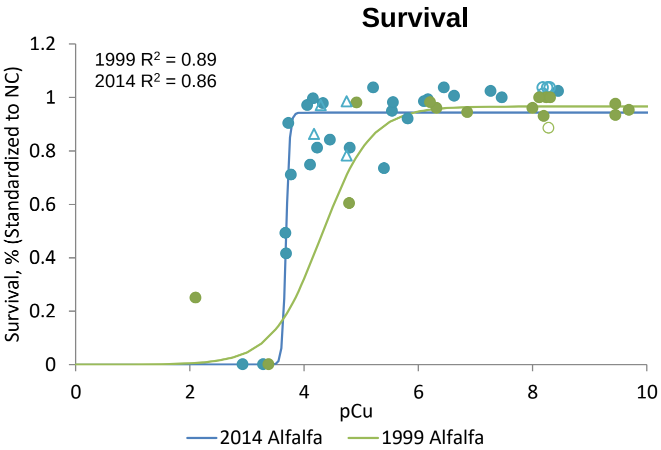
PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

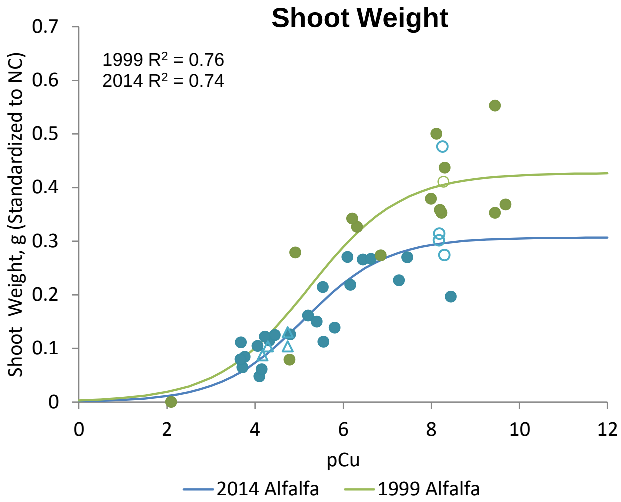
DELs and PELs by Endpoint, Seed type, and Method for Greenhouse Study

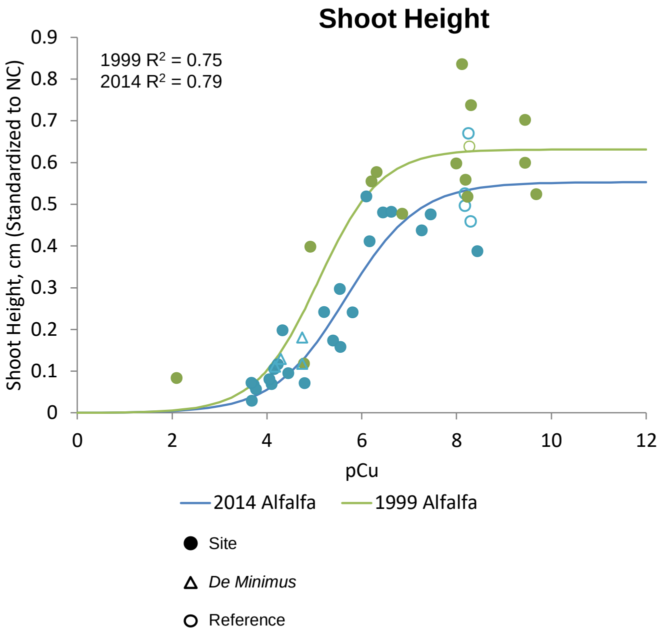
ARCADIS

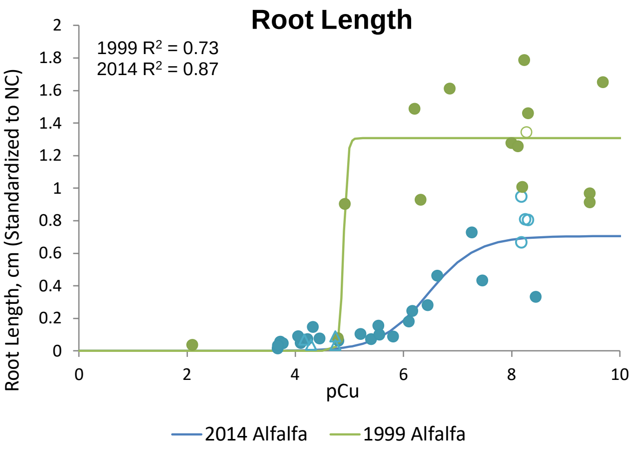
FIGURE
9











Notes:
1999 estimates are based on 2014 study methods, not Site-wide ERA methods. Slope for 1999 emergence and survival data was unstable in model due to too few points and a slope of 1.0 was used.

FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

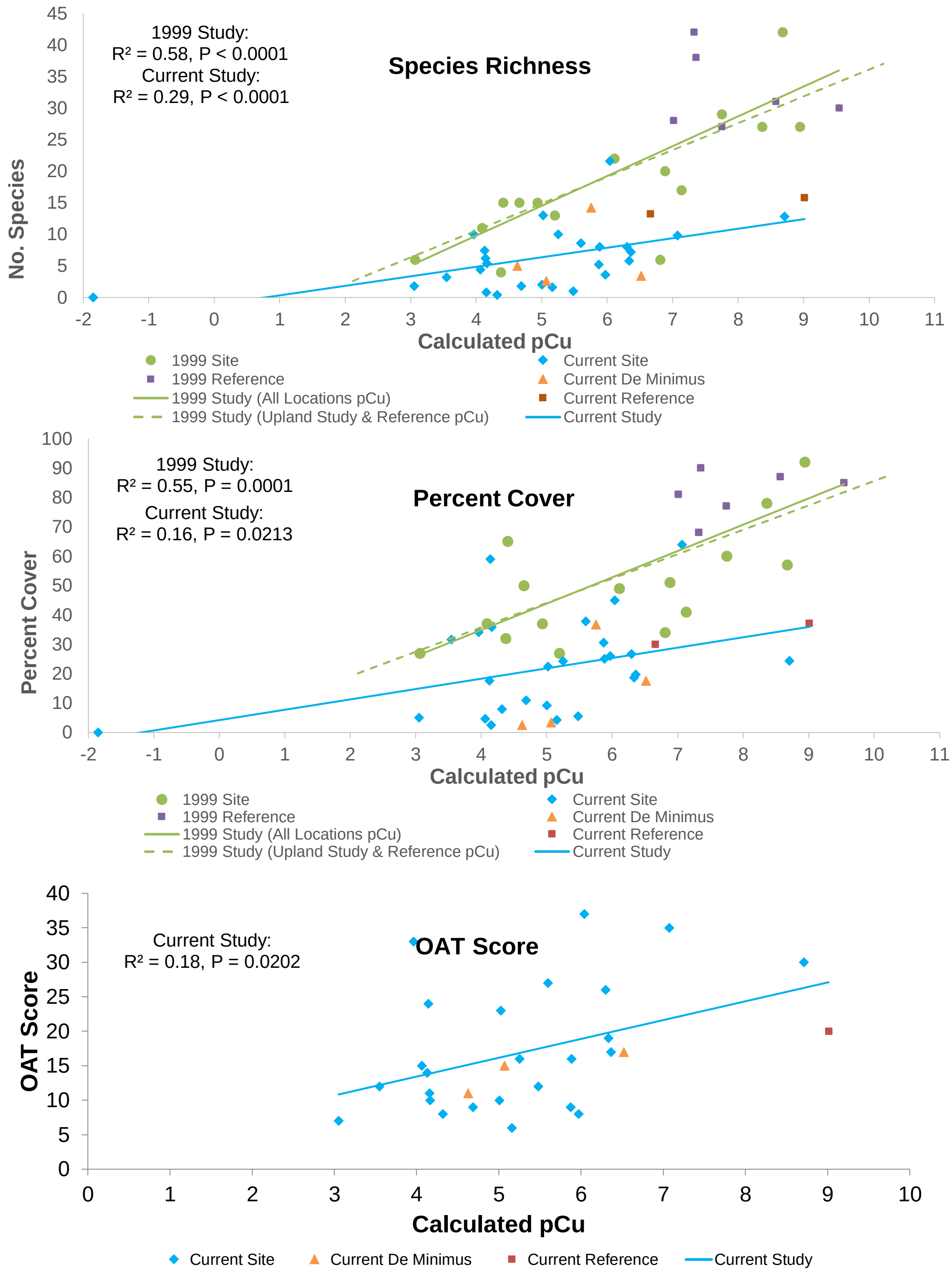
PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

Comparison of Alfalfa Test Results in 1999 to Afalfa Test Results in 2014

ARCADIS

FIGURE

10



Notes:

1999 study used "All Locations" ERA equation to calculate pCu while current study used "Upland Study & Reference" ERA equation to calculate pCu. 1999 study points plotted here use "All Locations" equation, though alternate trendline (dashed line) is shown for 1999 study points using "Upland Study & Reference" equation.

OAT score was not assessed at ERA locations in 1999 and unavailable in two locations of current study. Percent cover and richness are not directly comparable between the two studies because of different sampling methods and higher precipitation in 1999. The two 50-m point transects in 1999 at each location are more likely to traverse heterogenous habitats, creating higher richness than the more compact 20'x20' blocks averaged within the 100' x 100' plots placed in homogeneous areas. Other reasons for differences are the current study used Daubenmire method for cover (rather than point intercept), and the current study includes a greater variety of habitats (bedrock, slopes).

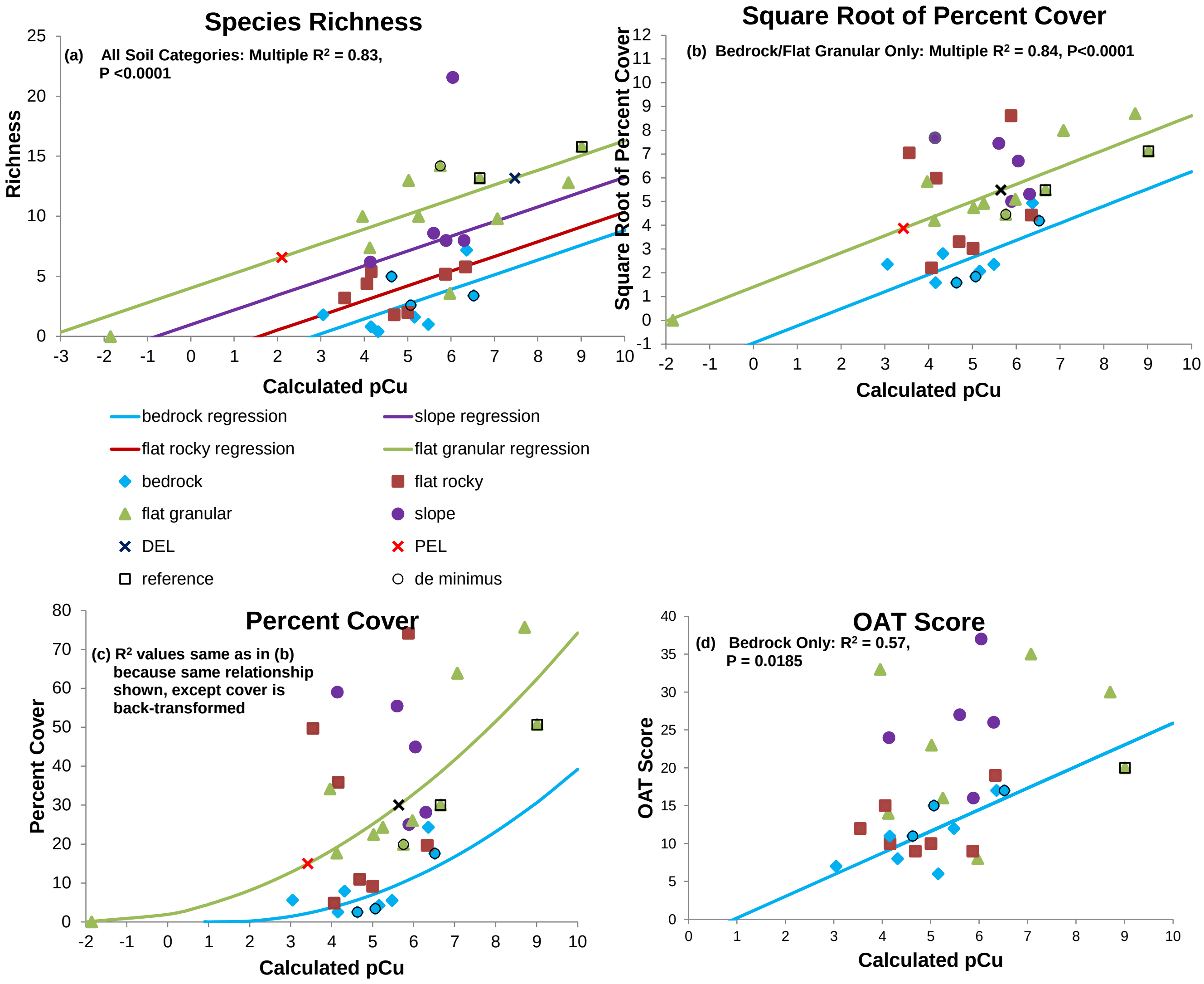
FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

Comparison of Community Results in 1999 to Community Results in Current Study

ARCADIS

FIGURE
11



Notes:

(a) Regression lines for richness exclude the high "slope" (purple) outlier and low "flat granular" (green) outlier. (b) The square root of percent cover was modeled to meet assumption of homogeneous variance for regression (backcalculated curve also shown in (c) and had the "flat granular" outlier removed). (d) Relationship between calculated pCu and OAT score is significant only for bedrock locations, and no reference locations were available for bedrock (only for flat granular, which had no significant relationship with pCu). OAT score was not obtained on Wildlife Reference North (reference plot) or Wildlife Reference South (de minimus plot). Note, the lowest calculated pCu of -1.85 had no plant cover and generally fell near the linear line projected through the other locations for richness and cover in flat granular locations (and thus was included in the model), further supporting the linear model. R^2 represents R^2 adjusted for number of variables in model.

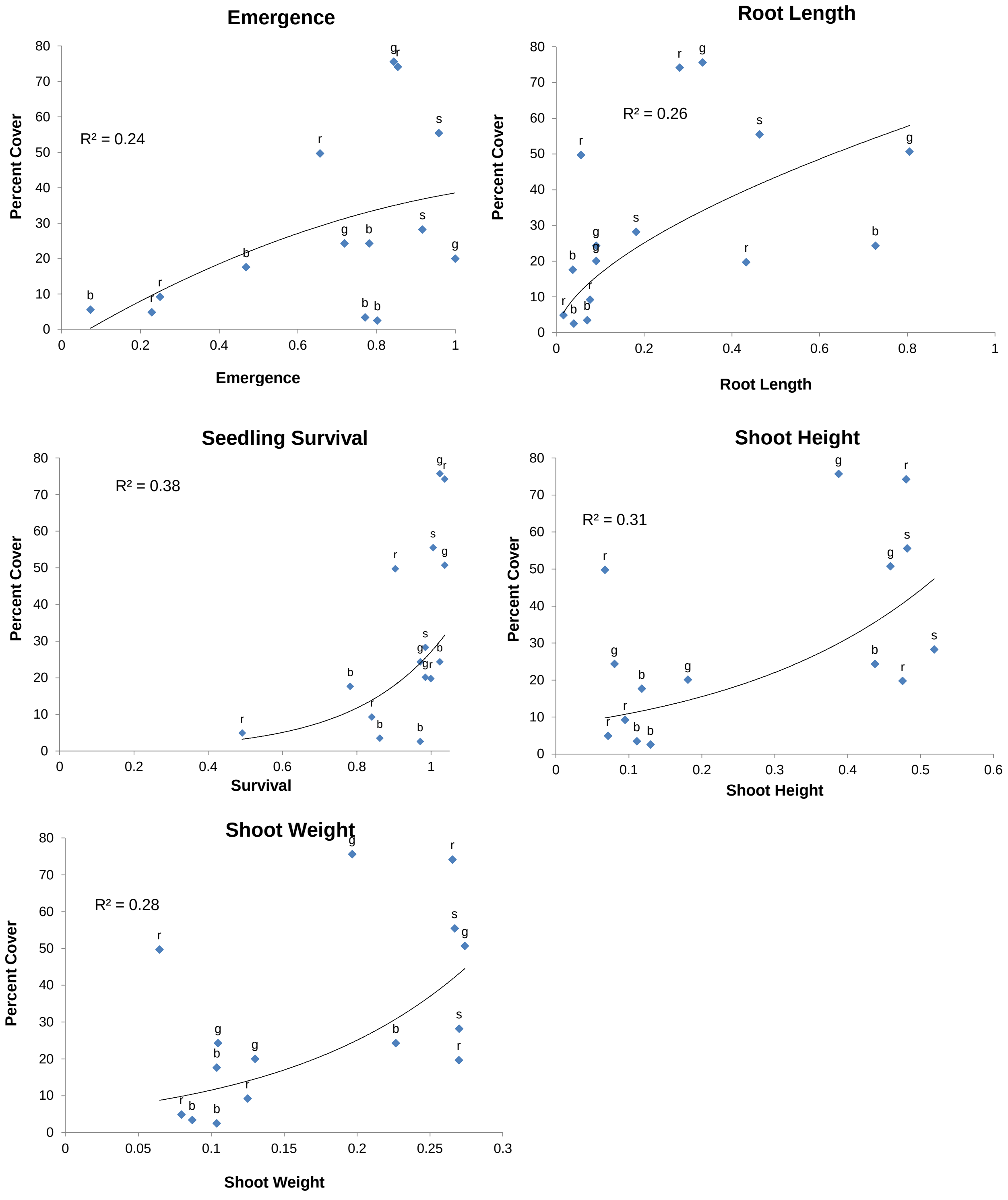
FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

Relationship between pCu and Community Endpoints with Soil Category Covariate

ARCADIS

FIGURE
12



Notes:
All relationships were statistically significant at $P < 0.05$. Letters above points represent soil category, where b = bedrock, r = flat rocky, g = flat granular, and s = slope.

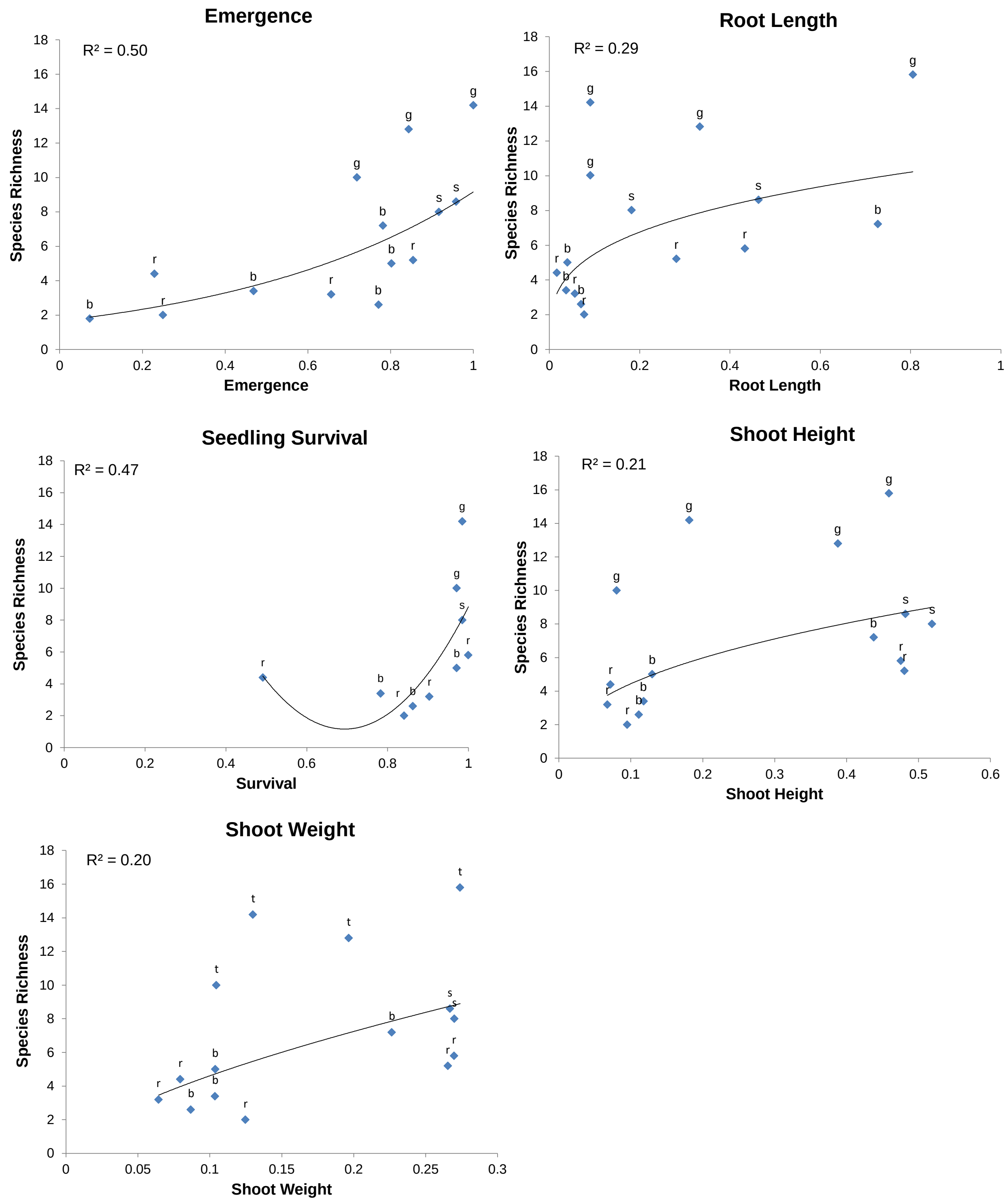
FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

Relationship between Greenhouse Study and Community Endpoints for Alfalfa: Canopy Cover

ARCADIS

FIGURE
13



Notes:
All relationships were statistically significant at $P < 0.05$. Letters above points represent soil category, where b = bedrock, r = flat rocky, g = flat granular, and s = slope.

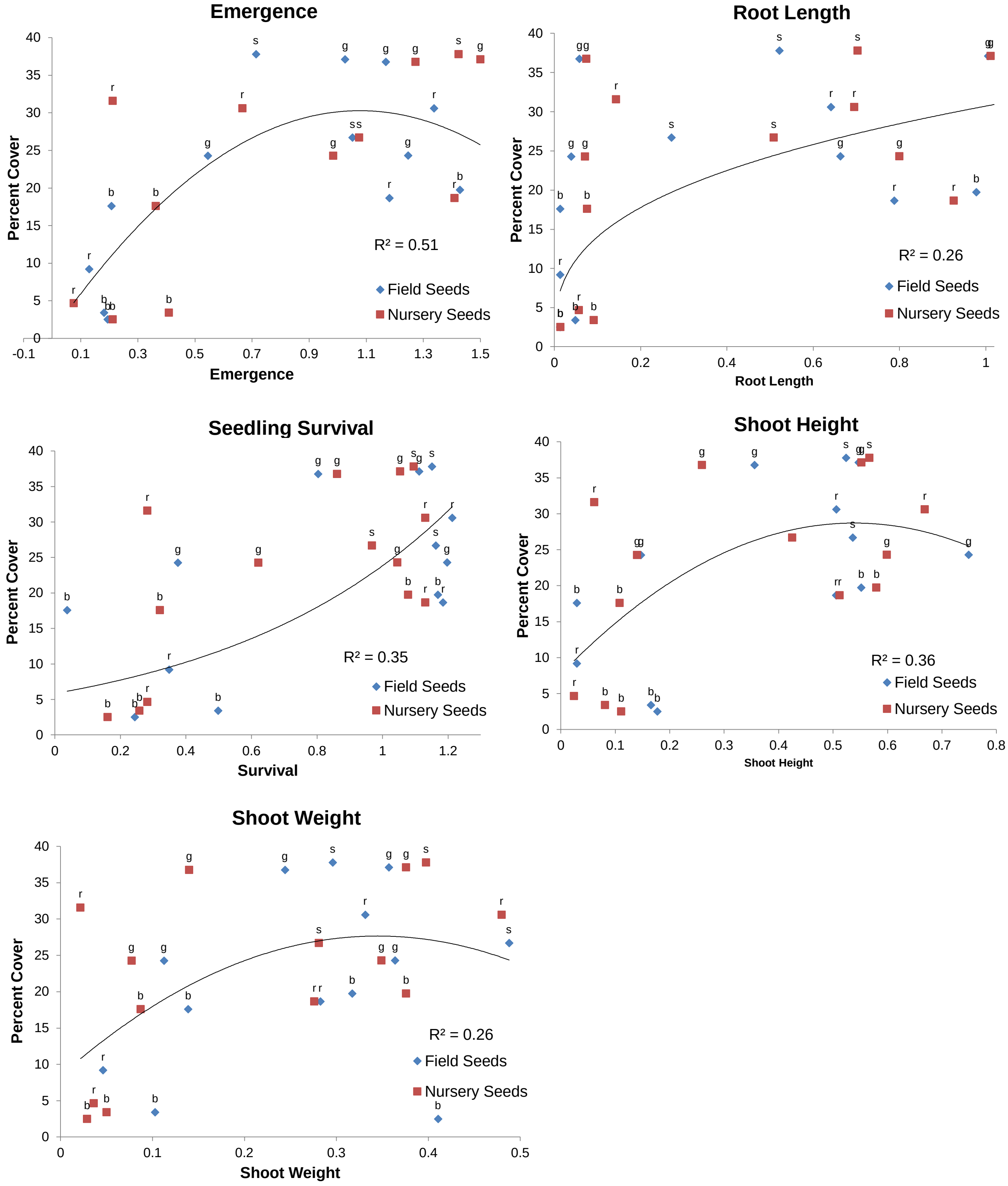
FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

Relationship between Greenhouse Study and Community Endpoints for Alfalfa: Species Richness

ARCADIS

FIGURE
14



Notes:
All relationships were statistically significant at $P < 0.05$. Letters above points represent soil category, where b = bedrock, r = flat rocky, g = flat granular, and s = slope.

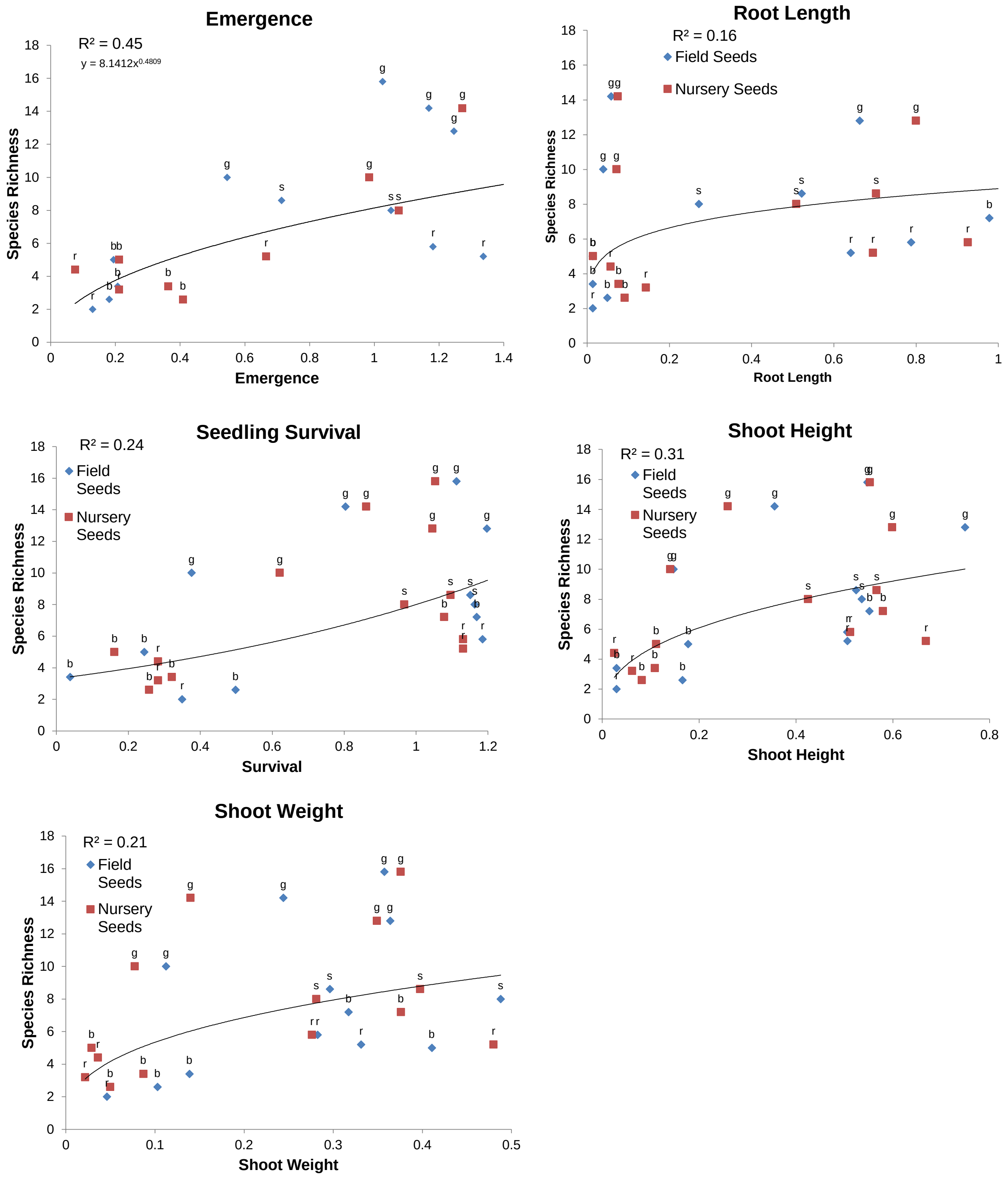
FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

Relationship between Greenhouse Study and Community Endpoints for Sideoats: Canopy Cover

ARCADIS

FIGURE
15



Notes:
All relationships were statistically significant at $P < 0.05$. Letters above points represent soil category, where b = bedrock, r = flat rocky, g = flat granular, and s = slope.

FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

Relationship between Greenhouse Study and Community Endpoints for Sideoats: Species Richness

ARCADIS

FIGURE
16

APPENDIX A

Soil Chemistry

Arcadis U.S., Inc.

1687 Cole Blvd.

Suite 200

Lakewood

Colorado 80401

Tel +1 303 231 9115

Fax +1 303 231 9571

APPENDIX A

Soil Chemistry

Table A-1. Measured pCu

Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Location ID	Type of Site	pCu, measured (s.u.) 2013 Data	pCu, measured (s.u.) 2015 Data
STS-PT-2013-1	Site	3.73	3.67
STS-PT-2013-2	Site	6.45	7.34
STS-PT-2013-3	Site	5.82	5.63
STS-PT-2013-4	Site	6.17	6.07
STS-PT-2013-5	Site	6.63	6.40
STS-PT-2013-6	Site	4.33	4.39
STS-PT-2013-7	Site	4.11	4.01
STS-PT-2013-8	Site	5.21	5.13
STS-PT-2013-9	Site	2.93	3.07
STS-PT-2013-10	Site	4.16	3.77
STS-PT-2013-11	Site	4.23	4.20
STS-PT-2013-12	Site	7.27	7.32
STS-PT-2013-13	Site	5.54	5.36
STS-PT-2013-14	Site	3.77	3.85
STS-PT-2013-15	Site	5.40	4.99
STS-PT-2013-16	Site	5.56	4.48
STS-PT-2013-17	Site	7.46	7.85
STS-PT-2013-18	Site (dup. not used)	3.75	NA
STS-PT-2013-19	Site	3.68	3.62
STS-PT-2013-20	Site	8.45	8.53
STS-PT-2013-21	De Minimus	4.75	4.79
STS-PT-2013-22	De Minimus	4.29	4.13
STS-PT-2013-23	De Minimus	4.17	4.32
STS-PT-2013-24	Reference	8.26	8.82
STS-PT-2013-25	Reference	8.18	8.77
STS-PT-2013-26	Reference	8.31	9.20
STS-PT-2013-27	De Minimus	4.74	4.83
STS-PT-2013-28	Reference	8.18	9.00
STS-PT-2013-29	Site	4.06	4.44
STS-PT-2013-30	Site	4.46	4.38
STS-PT-2013-31	Site	6.10	5.66
STS-PT-2013-32	Site	4.80	4.12
STS-PT-2013-33	Site (comm. study)	1.98	NA
STS-PT-2013-34	Site (dup, not used)	3.79	NA
STS-PT-2013-35	Site	3.28	3.27
STS-PT-2013-36	Site	3.69	3.75

Notes:
See Appendix E for derivation of measured pCu.
2015 data used for tansyaster 2015 experiments, 2013 for other plant species in earlier tests.

Table A-2. 2013 Soil Results (0-6 inch depth) for Greenhouse Phytotoxicity Study

Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Location ID	Moisture (wt%)	Sand (%)	Silt (%)	Clay (%)	Texture	Saturation (%)	pH Saturated Paste (s.u.)	Copper Total (mg/kg)	Alkalinity Saturated Paste (mg/L)	Bicarbonate Saturated Paste (mg/L)	Conductivity Saturated Paste (mmhos/cm)	Calcium Saturated Paste (meq/L)	Magnesium Saturated Paste (meq/L)	Potassium Saturated Paste (meq/L)	Sodium Saturated Paste (meq/L)	Alkalinity Saturated Paste (meq/L)	Bicarbonate Saturated Paste (meq/L)	Fluoride (mg/L)	Sulfate Saturated Paste (meq/L)	Chloride Saturated Paste (meq/L)	Calcium NH$_4$OAc (mg/kg)	Copper NH$_4$OAc (mg/kg)	Magnesium NH$_4$OAc (mg/kg)	Sodium NH$_4$OAc (mg/kg)	Calcium Extractable, NH$_4$OAc (meq/100g)
STS-PT-2013-1	4.3	51	31	18	L	30.2	4.5	1030	--	--	0.7	4.14	1.19	0.24	0.69	0.44	0.44	<2	5.9	0.2	1180	227	168	20	5.87
Dup1 for STS-PT-2013-1	3.9	50	31	19	L	29	4.8	879	--	--	0.8	4.51	1.25	0.25	0.82	0.44	0.44	<2	9.1	0.3	1070	291	145	21	5.34
STS-PT-2013-2	5.5	48	28	24	L	41.7	6.7	809	--	--	1.8	16.8	2.74	0.24	0.66	3.53	3.53	<2	17.7	0.3	5790	38	343	20	28.9
STS-PT-2013-3	2.2	54	24	22	SCL	30.5	5.3	189	--	--	0.7	3.46	1.46	0.42	0.61	0.56	0.56	<2	3.7	0.2	1610	16	312	18	8.01
STS-PT-2013-4	4.2	60	18	22	SCL	32.3	5.1	193	--	--	1.5	7.77	3.59	0.69	1.04	0.62	0.62	<2	6.6	0.8	1840	8	422	23	9.21
STS-PT-2013-5	7.4	34	20	46	C	67.8	6.1	632	--	--	1.3	8.21	2.62	0.21	1.47	1.75	1.75	<2	10	0.3	6140	41	999	84	30.6
STS-PT-2013-6	2.5	52	40	8	L	38	3.8	202	--	--	0.4	1.72	0.34	0.26	0.33	0.11	0.11	<2	2.6	0.2	212	5	26	10	1.06
STS-PT-2013-7	1.9	48	42	10	L	45.4	3.3	279	--	--	3	25.1	4.08	0.1	0.81	<0.02	<0.02	6	40.6	0.2	745	8	55	17	3.72
STS-PT-2013-8	8.3	28	30	42	C	46.2	5	626	--	--	0.4	1.16	0.5	0.15	1.1	0.64	0.64	<2	2	0.4	3380	53	752	46	16.9
STS-PT-2013-9	3.5	52	26	22	SCL	26.1	4.3	1350	--	--	0.4	1.45	0.4	0.17	0.59	0.43	0.43	<2	1.9	0.2	688	452	110	12	3.44
STS-PT-2013-10	3.5	73	17	10	SL	25	4.8	557	--	--	0.6	2.86	0.7	0.18	0.81	0.44	0.44	<2	4.2	0.3	672	109	78	19	3.35
STS-PT-2013-11	3.1	64	24	12	SL	29.6	3.9	189	--	--	0.3	0.94	0.18	0.14	0.5	0.41	0.41	<2	1.4	0.2	176	11	21	12	0.876
STS-PT-2013-12	2.3	60	26	14	SL	27.9	6.5	449	--	--	0.7	4.51	0.76	0.14	0.8	2.92	2.91	<2	3.3	0.2	2100	15	161	22	10.5
STS-PT-2013-13	3.9	42	34	24	L	32.2	4.9	360	--	--	0.4	1.07	0.58	0.33	0.95	0.58	0.58	<2	1.6	0.3	1600	19	403	20	7.99
STS-PT-2013-14	10.9	34	26	40	C	53.4	3.8	725	--	--	3	24.6	10.5	0.33	1.32	<0.02	<0.02	5	39.3	0.2	3930	100	728	46	19.6
STS-PT-2013-15	5.9	40	28	32	CL	36.1	5.1	501	--	--	0.3	0.35	0.18	0.08	0.63	0.55	0.55	<2	1.1	0.4	2410	44	463	69	12
STS-PT-2013-16	6	33	23	44	C	62.4	5.4	1200	--	--	0.6	2.46	1.01	0.19	1.21	0.85	0.85	<2	3.5	0.5	4590	95	945	51	22.9
STS-PT-2013-17	5.9	32	28	40	C	48.8	7.6	1120	--	--	0.6	4.6	0.65	0.23	0.71	3.03	3.02	<2	2.8	0.4	6830	43	354	21	34.1
STS-PT-2013-18	4.7	54	24	22	SCL	30.4	4.1	311	--	--	0.3	1.14	0.29	0.1	0.75	0.41	0.41	<2	2.1	0.2	281	34	39	20	1.4
STS-PT-2013-19	3.2	62	22	16	SL	26.9	4.6	714	--	--	0.4	1.79	0.44	0.13	0.79	0.43	0.43	<2	2.1	0.2	888	163	106	18	4.43
STS-PT-2013-20	5.3	46	34	20	L	41.4	7.5	131	--	--	0.5	3.67	0.37	0.09	0.94	4.24	4.24	<2	<0.4	0.8	5940	2	135	34	29.6
Dup3 for STS-PT-2013-20	3.8	48	31	21	L	38.4	7.6	174	--	--	0.5	3.68	0.37	0.13	0.37	3.66	3.66	<2	4.4	0.5	5680	10	129	15	28.3
STS-PT-2013-21	5.7	48	20	32	SCL	38.1	4.2	61	--	--	0.2	0.71	0.24	0.11	0.71	0.43	0.43	<2	1.5	0.2	390	2	61	18	1.95
STS-PT-2013-22	4	58	26	16	SL	35.1	3.9	248	--	--	2.7	22.4	5.78	0.33	1.89	<0.02	<0.02	7	35	0.4	1230	19	114	36	6.14
STS-PT-2013-23	2.6	68	20	12	SL	24.1	4.4	253	--	--	0.4	1.52	0.35	0.17	0.61	0.41	0.41	<2	2.1	0.2	330	17	46	14	1.65
STS-PT-2013-24	3.6	64	18	18	SL	33.6	7.7	56	--	--	0.5	3.73	0.31	0.23	0.52	4.5	4.49	<2	<0.4	0.3	5060	<1	155	11	25.3
STS-PT-2013-25	1.3	74	18	8	SL	22.8	7.7	130	--	--	0.6	3.57	0.46	0.8	0.55	4.85	4.85	<2	0.5	0.4	7500	2	216	14	37.4
STS-PT-2013-26	5.5	42	30	28	CL	40	7.6	109	--	--	0.4	2.74	0.23	0.26	0.61	3.08	3.08	<2	0.7	0.3	1190	8	226	20	5.94
STS-PT-2013-27	4.9	58	20	22	SCL	30	4.6	164	--	--	0.3	0.78	0.33	0.16	0.87	0.48	0.48	<2	1.4	0.3	4360	<1	403	17	21.8
STS-PT-2013-28	5.7	44	23	33	CL	40	7.5	58	--	--	0.4	2.02	0.42	0.15	0.84	2.74	2.74	<2	0.6	0.4	489	48	73	17	2.44
STS-PT-2013-29	2.1	66	19	15	SL	21.4	4.5	234	--	--	0.2	0.56	0.16	0.25	0.61	0.46	0.46	<2	0.9	0.3	391	4	44	12	1.95
STS-PT-2013-30	2.2	67	20	13	SL	23.6	3.7	152	--	--	1	5.8	0.94	0.27	0.61	<0.02	<0.02	<2	8.7	0.3	376	4	41	12	1.88
STS-PT-2013-31	11.8	32	23	45	C	56.4	5.1	153	--	--	0.4	1.53	0.6	0.09	1.2	0.46	0.46	<2	1.9	0.5	4300	7	797	123	21.5
STS-PT-2013-32	7	42	33	25	L	35.3	5.1	816	--	--	0.4	1.89	0.58	0.32	0.44	0.63	0.63	<2	1.7	0.3	1300	119	166	32	6.5
STS-PT-2013-33	3.2	46	45	9	L	29	4.3	95300	--	--	12.8	18.8	35.4	<0.03	1.33	0.64	0.64	44	260	4.9	20500	16100	190	26	102
Dup2 for STS-PT-2013-33	3	46	45	9	L	27.2	4	92500	--	--	21.8	18.1	42.6	0.03	1.23	0.59	0.59	64	491	5.5	20600	16800	211	18	103
STS-PT-2013-34	7.5	60	21	19	SL	24.1	4.8	1200	22	27	0.4	2.74	0.86	0.31	0.31	0.44	0.44	<0.1	2.74	0.16	552	266	61	17	2.76
STS-PT-2013-35	11.1	34	41	25	L	33.8	4.6	1630	21	26	0.4	1.7	0.61	0.16	0.24	0.42	0.42	<0.1	1.57	0.13	1290	648	145	23	6.46
STS-PT-2013-36	7.6	56	23	21	SCL	33	5.9	3770	211	258	2.6	31.2	5.02	0.18	0.56	4.23	4.22	<1	31.7	0.22	2700	1040	170	28	13.5
Negative Control	--	89	3	8	LS	--	7.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:

a. Olsen method used if pH > 6.5, otherwise Bray method

Soil Texture Codes:

C = clay
CL = clay loam
L = loam
LS = loamy sand
SCL = sandy clay loam
SL = sandy loam
LOI = loss on ignition
DTPA = diethylene triamine pentaacetic acid extraction
For locations with duplicates, original used in the analysis
Locations STS-PT-2013-18, 33, and 34 were not used in phytotoxicity study

Table A-2. 2013 Soil Results (0-6 inch depth) for Greenhouse Phytotoxicity Study

Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Location ID	Magnesium Extractable, NH_4OAc (meq/100g)	Potassium Extractable, NH_4OAc (meq/100g)	Potassium NH_4OAc (mg/kg)	Sodium Extractable, NH_4OAc (meq/100g)	Calcium Exchangeable (meq/100g)	Magnesium Exchangeable (meq/100g)	Potassium Exchangeable (meq/100g)	Sodium Exchangeable (meq/100g)	Copper Exchangeable (meq/100g)	Organic Matter LOI (%)	Lime (%)	Phosphorus Olsen-Bray (mg/kg)[a]	Phosphate (mg/kg)	Nitrate + Nitrite (mg/kg)	Copper $CaCl_2$ (mg/kg)	Aluminum DTPA (mg/kg)	Iron DTPA (mg/kg)	Manganese DTPA (mg/kg)	Dissolved Organic Carbon (DOC) (mg/kg)	Conductivity $CaCl_2$ (mmhos/cm)	Millivolts (mV)	pH $CaCl_2$ (s.u.)	Soil Category
STS-PT-2013-1	1.39	0.496	194	0.087	5.8	1.4	0.5	<0.1	0.6	1.1	0.53	68.4	0.2	4	27.9	5.2	37	24.3	6	1.5	101	4	Flat Rocky
Dup1 for STS-PT-2013-1	1.21	0.465	182	0.09	5.2	1.2	0.5	<0.1	0.8	0.8	0.57	72	<1	4	31.8	6.2	39	23	5	1.7	110	4.6	Flat Rocky
STS-PT-2013-2	2.85	0.65	254	0.086	28.2	2.7	0.6	<0.1	0.1	1.4	2.07	16	<0.1	2	0.3	1.7	26	2.9	12	1.8	17	7.1	Flat Rocky
STS-PT-2013-3	2.59	0.786	307	0.08	7.9	2.6	0.8	<0.1	<0.1	0.9	0.58	17.7	<0.2	8	0.4	1.4	18	31	10	1.4	37	5.6	Flat Rocky
STS-PT-2013-4	3.5	0.806	315	0.101	8.6	3.1	0.8	<0.1	<0.1	1.6	0.66	30.2	<0.2	23	0.3	1.4	38	18.9	24	1.6	26	5.1	Flat Granular
STS-PT-2013-5	8.29	1.21	473	0.368	30.1	8.1	1.2	0.3	0.1	2.6	1.99	16	<0.1	9	0.4	1.3	13	7.9	18	1.7	12	6.1	Slope
STS-PT-2013-6	0.215	0.165	65	0.042	1	0.2	0.2	<0.1	<0.1	2	<0.01	6.3	<0.1	<1	3.5	27.6	252	3.4	14	1.5	82	3.4	Bedrock
STS-PT-2013-7	0.453	0.062	24	0.073	2.5	0.2	<0.1	<0.1	<0.1	3.9	<0.01	16.2	<1	2	10.9	27.3	314	16.8	14	2.4	89	3.2	Bedrock
STS-PT-2013-8	6.24	0.942	368	0.201	16.8	6.2	0.9	0.2	0.2	1.6	1.41	52.3	0.9	3	0.5	1.9	32	34	15	1.7	55	5.5	Flat Rocky
STS-PT-2013-9	0.912	0.356	139	0.051	3.4	0.9	0.4	<0.1	1.1	1	0.24	15.1	<0.1	3	114	5	9	8.7	4	1.6	125	4	Bedrock
STS-PT-2013-10	0.651	<1	91	0.083	3.3	0.6	<0.1	<0.1	0.3	0.8	0.24	5.2	<0.2	1	9.9	12.8	29	8	8	1.7	95	4.5	Bedrock
STS-PT-2013-11	0.173	0.174	68	0.054	0.8	0.2	0.2	<0.1	<0.1	1.3	0.06	20.3	<1	1	8.4	79.2	58	2.4	5	1.5	92	3.7	Bedrock
STS-PT-2013-12	1.33	0.335	131	0.097	10.4	1.3	0.3	<0.1	<0.1	1.3	0.75	6	<0.2	<1	0.2	1	24	7.3	15	1.5	4	6.2	Bedrock
STS-PT-2013-13	3.35	1.11	435	0.088	8	3.3	1.1	<0.1	<0.1	1.6	0.84	56.9	2	3	0.4	2.6	53	23.2	11	1.5	54	5	Flat Rocky
STS-PT-2013-14	6.04	0.691	270	0.202	18.3	5.5	0.7	0.1	0.2	1.2	0.86	57.7	<0.1	17	36.3	57.4	24	43.4	10	2.8	106	3.7	Flat Rocky
STS-PT-2013-15	3.85	0.885	346	0.298	12	3.8	0.9	0.3	0.1	1.6	0.97	41.7	3	<5	0.6	2.2	31	19.2	17	1.5	58	5.5	Flat Rocky
STS-PT-2013-16	7.84	1.34	523	0.222	22.7	7.8	1.3	0.1	0.3	3	1.66	22.3	0.9	4	1	1.3	27	19.4	23	1.6	54	5.4	Slope
STS-PT-2013-17	2.94	1.22	477	0.09	33.8	2.9	1.2	<0.1	0.1	1.5	3.69	9	0.2	6	0.4	1.5	9	2.8	14	1.5	-2	6.8	Flat Rocky
STS-PT-2013-18	0.326	0.184	72	0.088	1.4	0.3	0.2	<0.1	<0.1	1	0.09	2.9	<0.1	<1	25.3	34.5	37	4.3	6	1.5	106	3.8	Bedrock
STS-PT-2013-19	0.883	0.393	154	0.078	4.4	0.9	0.4	<0.1	0.4	0.7	0.3	8.9	<0.1	3	28	5.2	30	16.6	4	1.5	109	4.3	Flat Rocky
STS-PT-2013-20	1.12	0.5	195	0.149	29	1.1	0.5	<0.1	<0.1	2.3	22.3	5	0.1	2	0.2	0.7	3	4.5	22	1.5	-30	6.5	Flat Granular
Dup3 for STS-PT-2013-20	1.07	0.6	234	0.064	27.8	1	0.6	<0.1	<0.1	2	21.7	7	<0.1	1	1.6	1.1	4	5.4	19	2.1	4	7.5	Flat Granular
STS-PT-2013-21	0.51	0.275	108	0.078	1.8	0.4	0.3	<0.1	<0.1	1.2	0.1	6.3	<1	<1	2.3	93.9	18	3.3	7	1.6	78	3.5	Bedrock
STS-PT-2013-22	0.946	0.255	100	0.158	5.4	0.8	0.2	<0.1	<0.1	3.3	0.24	11.8	<0.1	<1	10.7	46.9	95	18.8	27	2.6	91	3.6	Bedrock
STS-PT-2013-23	0.381	0.235	92	0.06	1.6	0.3	0.2	<0.1	<0.1	0.8	0.16	30.9	<0.1	2	9.1	53.8	55	6.1	4	1.6	94	3.8	Bedrock
STS-PT-2013-24	1.29	0.713	278	0.049	25.2	1.3	0.7	<0.1	<0.1	1.4	2.41	7	0.7	2	<0.1	1.3	6	4.2	11	1.7	-25	6.7	Flat Granular
STS-PT-2013-25	1.79	1.89	737	0.061	37.5	1.8	1.9	<0.1	<0.1	1.1	0.91	9	1.4	2	0.2	1.4	4	3.9	12	1.6	-22	6.6	Flat Granular
STS-PT-2013-26	1.88	0.562	220	0.086	5.9	1.9	0.6	<0.1	<0.1	2.3	18.1	7	<0.2	2	0.1	0.9	4	3.9	15	1.6	-26	6.7	Flat Granular
STS-PT-2013-27	3.34	1.15	449	0.074	21.5	3.4	1.1	<0.1	<0.1	1.3	0.45	9.5	1	1	2.4	3.5	34	23.6	12	1.6	78	4.9	Flat Granular
STS-PT-2013-28	0.609	0.472	184	0.073	2.3	0.5	0.5	<0.1	0.1	1	1.68	6	<0.2	3	0.2	0.9	6	4	12	1.6	-22	6.6	Flat Granular
STS-PT-2013-29	0.361	0.149	58	0.054	1.9	0.3	0.2	<0.1	<0.1	0.3	0.2	27.9	1	1	11.2	6.5	26	48.3	6	1.6	98	4.1	Flat Granular
STS-PT-2013-30	0.341	0.156	61	0.053	1.8	0.3	0.2	<0.1	<0.1	0.5	<0.01	11.2	<0.1	3	4	18.2	137	4.5	7	1.8	86	3.4	Flat Rocky
STS-PT-2013-31	6.62	0.759	297	0.537	21.7	7	0.7	0.4	<0.1	1.2	1.39	11	5	10	0.2	1.2	20	6.8	23	1.7	38	5.4	Slope
STS-PT-2013-32	1.38	1.77	692	0.139	6.4	1.4	1.8	0.1	0.4	1.9	0.6	20.9	1	7	2.4	11.3	38	16.4	15	1.6	76	5.4	Flat Rocky
STS-PT-2013-33	1.57	0.018	7	0.113	114	0.5	<0.1	<0.1	75.4	2.4	<0.01	5.5	1.7	2	3410	0.9	<1	67.8	13	5	152	4.3	Flat Granular
Dup2 for STS-PT-2013-33	1.75	0.02	8	0.078	114	0.4	<0.1	<0.1	68.2	2.2	<0.01	5.7	1	2	5620	1.5	<1	66.6	13	5.8	154	4.2	Flat Granular
STS-PT-2013-34	0.506	0.429	168	0.075	2.7	0.5	0.4	<0.1	0.8	1.8	0.33	55.4	3	2	22.4	10.5	91	28.3	10	1.6	105	4.7	Flat Rocky
STS-PT-2013-35	1.21	0.732	286	0.098	6.4	1.2	0.7	<0.1	1.8	1.9	0.51	21.8	2	2	73.6	0.7	7	11.4	10	1.6	120	4.3	Flat Rocky
STS-PT-2013-36	1.41	0.329	129	0.12	12.4	1.2	0.3	0.1	3.2	1.4	1.38	12.9	<1	3	30.7	0.8	3	2.7	6	1.8	108	6.1	Flat Rocky
Negative Control	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.7	--

Notes:

a. Olsen method used if pH > 6.5, otherwise Bray method

Soil Texture Codes:

C = clay
CL = clay loam
L = loam
LS = loamy sand
SCL = sandy clay loam
SL = sandy loam
LOI = loss on ignition
DTPA = diethylene triamine pentaacetic acid extraction
For locations with duplicates, original used in the analysis
Locations STS-PT-2013-18, 33, and 34 were not used in phytotoxicity study

Table A-3. 2015 Soil Results for Soils that had been Used for Scarlet Globemallow Experiment, Re-Used for Tansyaster Experiment

Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Location ID	Copper $CaCl_2$ (mg/kg)	Conductivity $CaCl_2$ (mmhos/cm)	Millivolts (mV)	pH $CaCl_2$ (s.u.)
STS-PT-2013-1	33.5	2.3	44	4.5
STS-PT-2013-2	0.2	2.2	-58	6.8
STS-PT-2013-3	0.4	2.4	-10	5.1
STS-PT-2013-4	0.4	2.4	-22	5.0
STS-PT-2013-5	0.2	2.6	-31	5.7
STS-PT-2013-6	8.8	3.1	24	3.5
STS-PT-2013-7	36.1	3.9	35	3.0
STS-PT-2013-8	1.4	2.5	4	4.7
STS-PT-2013-9	145	2.3	61	4.1
STS-PT-2013-10	31.9	2.5	42	4.5
STS-PT-2013-11	12.1	2.6	30	3.7
STS-PT-2013-12	0.1	3.1	-57	6.2
STS-PT-2013-13	0.9	2.4	-2	4.6
STS-PT-2013-14	37.4	3.6	40	3.6
STS-PT-2013-15	2.0	2.5	8	4.8
STS-PT-2013-16	6.9	2.7	22	4.8
STS-PT-2013-17	0.2	2.7	-72	6.9
STS-PT-2013-19	45.3	2.4	46	4.3
STS-PT-2013-20	0.2	2.5	-91	7.2
STS-PT-2013-21	3.3	2.4	13	3.8
STS-PT-2013-22	16.1	2.3	32	4.0
STS-PT-2013-23	9.9	2.4	27	3.9
STS-PT-2013-24	<0.1	2.6	-99	6.9
STS-PT-2013-25	<0.1	2.4	-98	6.9
STS-PT-2013-26	<0.1	2.5	-110	7.3
STS-PT-2013-27	3.1	2.4	12	4.4
STS-PT-2013-28	<0.1	2.5	-104	7.1
STS-PT-2013-29	7.5	2.3	23	4.4
STS-PT-2013-30	10.7	2.7	25	3.4
STS-PT-2013-31	0.7	2.5	-11	4.7
STS-PT-2013-32	16.2	2.4	32	4.6
STS-PT-2013-35	133	2.5	56	4.0
STS-PT-2013-36	52.3	2.9	42	4.8

Table A-4. Chemical analysis of rock samples from rhyolite bedrock at Lampbright Draw.

Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Sample ID	pH (s.u.) 2016 Data	Copper (mg/kg) 2016 data
Lambright Draw #1	6.4	167
Lambright Draw #2	5.2	53
Lambright Draw #3	5.2	72
Lambright Draw #4	5.3	93
Lambright Draw #5	5.7	105
Notes:		
See laboratory report.		

Also, soil from rhyolitic pumiceous tuff had pH of 5.9 from Golder (1998).
Golder. 1998. An Assessment of Soil in the Chino Mine Proposed Action Area.
Prepared for Chino Mines Company. May 28, 1998

Table A-5. Chemical analysis of rock samples from bedrock at Rustler Canyon from Kinetic Test.

Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Week	Composite A	Composite A	Composite B	Composite B
	pH units (s.u.)	Copper (mg/kg)	pH units (s.u.)	Copper (mg/kg)
0	6.96	0.08	6.71	0.021
1	7.02	0.014	7.19	<0.005
2	7.17		7.19	
3	7.06		7.04	
4	7.25		7.18	
5	7.14	<0.005	7.17	<0.005
6	7.34		7.19	
7	7.33		7.28	
8	6.80		7.12	
9	6.93		6.96	
10	7.47	<0.005	7.24	<0.005
11	6.77		7.07	
12	6.7		6.8	
13	6.69		6.36	
14	6.59		6.58	
15	6.61		6.77	
16	6.92		6.59	
17	6.93		6.92	
18	6.95		6.74	
19	6.58		6.77	
20	6.86	<0.005	6.59	<0.005

Notes:

Sulfate was 10 mg/kg for Composite A for week 0 and was <10 mg/kg for the rest of the weeks and in Composite B.

Data from Golder. 2000. Rustler Canyon Waste Rock Characterization. Memorandum to Ned Hall, Chino Mines Company.

APPENDIX B

Field Seed Collection SOP

Infrastructure · Water · Environment · Buildings

Imagine the result

Freeport McMoRan Copper and Gold
Chino Mines Company
Grant County, New Mexico

Standard Operating Procedures for Seed Collection and Storage

November 2015

Standard Operating Procedures for Seed Collection and Storage

Mary Carroll

Mary Carroll
Senior Ecologist

Carolyn Meyer

Carolyn Meyer
Technical Expert/Ecologist

Prepared for:
Chino Mines Company
Grant County, New Mexico

Prepared by:
ARCADIS U.S., Inc.
Suite 200
Lakewood
Colorado 80401
Tel 303 231 9115

Date:
November 2015

Figure

Standard Operating Procedures for Seed Collection and Storage

Chino Mines Company
Grant County, New Mexico

1. Introduction

This document outlines Standard Operating Procedures (SOPs) used for seed collection and storage in support of phytotoxicity studies used to evaluate the effects of copper on native vegetation at the Chino Mines Site (Site) located in Grant County, New Mexico (the Site, Figure 2 in main text). The Site is located east of the town of Hurley and approximately 12 miles southeast of Silver City; it includes historical smelting facilities, mineral processing facilities, tailing impoundments, and surrounding areas.

This SOP document outlines the timing and quality and quantity of seed material collected, documentation procedures, collection procedures, and storage procedures for seed material used in the phytotoxicity study.

Sideoats grama (*Bouteloua curtipendula*)) and scarlet globemallow (*Sphaeraclea coccinea*) seeds were collected in 2013 and planted in the greenhouse pots in spring and summer 2014, respectively (see Appendix C). The scarlet globemallow failed to adequately germinate at the greenhouse (0 of 12 nursery seeds and 2 of site-collected seeds emerged of 120 seeds planted each in the control soil). Tansyleaf tansyaster (*Machaeranthera tanacetifolia*) seed was collected in the fall of 2014 to replace the scarlet globemallow seed.

2. Seed Collection Procedures

Native seeds at the Chino Mines Site were collected per requirements outlined in the Smelter Tailing Soils Investigation Unit (STSIU) – Phytotoxicity and Vegetation Community Study Work Plan (ARCADIS 2014). The phytotoxicity tests evaluated sideoats grama (*Bouteloua curtipendula*) and tansyaster (*Machaeranthera tanacetifolia*), which are herbaceous species common and native to the Site.

2.1 Seed Collection Localities

Sideoats grama (and scarlet globemallow seeds) were collected from one ten-acre location (Seed Collection Area, Figure 2 in main text). That location was protected from grazing in September 2013 to increase the potential for seed availability. Due to limited availability of tansyaster in the Seed Collection Area, tansyaster seeds were collected from twelve sites around and south of the Seed Collection Area in the late August (8/27) of 2014 (Figure 2 in main text).

2.2 Seed Viability and Quantity

In order to reduce the variables in the phytotoxicity study, healthy seeds were collected and seed viability was tested to ensure standard results. Seeds were sent to Growing Solutions Restoration Education Institute in Santa Barbara, California to cull potentially non-viable seeds (based on appearance), clean, dry, and store the seeds until the seeds were provided for the phytotoxicity tests that were performed in spring and summer 2014 (sideoats grama) and January 2015 (tansyaster, note: globemallow tests that failed were in June 2013 for nursery seeds and July 2013 for field seeds, completed by July 31, 2013). Seed germination viability was obtained during the phytotoxicity tests on the control pots with manufactured potting soil. Methods that were used to ensure mostly pure, healthy seed were collected in the field are described in more detail below in Section 2.4.

The phytotoxicity tests conducted at Wildlife International Laboratory required a minimum of 4,080 seeds per species collected on site (34 soils x 10 pots x 12 seeds/pot, ARCADIS 2014, Table 1 of main text). To protect against loss and account for culling, > 8,000 seeds of sideoats grama and > 8,000 seeds of tansyaster were collected. These species were confirmed to be available from nursery or commercial seed suppliers with germination requirements compatible with Wildlife International Laboratory capabilities, had reported high germination rates (≥80 percent for the grass and ~ 70% for the forb) in greenhouses and were abundant in or around the Seed Collection Area. Other species were considered but were problematic. Vine mesquite (*Panicum obtusum*) and purple threeawn (*Aristida purpurea*) were common on the Site but are reported as difficult to germinate in a greenhouse at high rates. Plains bristlegrass (*Setaria macrostachya*) is also common but nursery strains are purportedly often a mix of several species (*S*. *macrostachya*, S. *leucopila*, S. *texana*) and the species hybridize.

2.3 Seed Collection Timing

Seed collection occurred after the monsoon season, when seeds of target species had ripened. Sideoats grama seeds were collected the first week in October 2013 and tansyaster seeds were collected in late August 2014. During collection the seeds were examined in the field for viability, as described below.

2.4 Field Collection Guidelines

Maximum seed viability is achieved when fully ripened, pest-free seeds are collected. Seed viability can be affected by lack of pollinators, parasitism, and a range of environmental conditions and there can be a fairly high percentage of unviable seeds. Healthy seeds are generally filled internally from edge to edge with white moist endosperm or embryo tissue (Wall 2012). The following recommendations were used to enhance the likelihood of collecting viable seed from diverse maternal lines:

- Hand lenses were used in the field to check the condition of the seeds. Fully developed, mature, viable seeds generally turn dark in color with maturity (vs. green), separate from the ovary wall, and/or are easily detached from the plant. A cut test was used in the field on representative seeds by using a single edge razor, a small wood block, and a hand lens or microscope. Plump seeds were indicators of mature seeds for each species (Section 4).

- Seeds were collected from multiple parent plants. This diversification allowed for a better representation of Site seeds and it allowed the species to reseed.
- Seeds were not collected from parent plants with observed pests, fungus, or other illness.
- Seeds were hand collected or knocked from the parent plant and placed in large paper bags for drying. Paper bags were taped on bottom to prevent seeds from falling through.
- Seeds were not collected from the ground as this increases the likelihood of mixed species and soil and seed pathogens.
- Seeds or fruits were loosely placed in sturdy paper bags. Air circulation was essential to maintain seed health.
- Cursory cleaning was performed in the field to maximize the number of seeds in the bags.

Each collection bag was labeled with the initials of the collector, the date, and the species, location, and estimated number of seeds in the bag.

Field data were recorded to detail the areas from which seeds were collected that had the target population in bloom and/or fruiting. Additionally, species growing with these species which look similar to the target species were noted and checked against herbarium specimens to ensure accurate species identification. Site, soil type, slope exposure, elevation, and global positioning system (GPS) waypoint of the Seed Collection Area was recorded from the NRCS database and GIS slope/aspect maps prior to collection activities commenced. Given the lack of tansyaster seeds in the Seed Collection Area, tansyaster seeds were collected from multiple areas outside of the Seed Collection Area and were marked with a GPS waypoint to allow similar information to be obtained. Field observations were recorded to confirm the information recorded from the GIS and soil database. Soil and site characteristics observed in the field fenced collection area were described (presence of A horizon, if armored with rock, percent bedrock in area) and photographs taken (e.g., Figure B-1). A voucher specimen of each species was collected, dried, and labeled to demonstrate the correct species was sampled. The voucher specimen consisted of a typical plant or portions of a plant with stems, leaves, and reproductive structures. Each dried specimen was carefully stored in a dry location and sent to the local herbarium at Western New Mexico University.

3. Seed Drying and Storage Guidelines

For all seeds provided for drying and storage, the collection identification information was provided with each seed lot.

Seeds were dried to reduce seed moisture and facilitate seed ripening. Seeds were sent to Growing Solutions Restoration Education Institute in Santa Barbara, California for drying, cleaning, culling, and processing. The sideoats grama seeds were stored for a few days prior to shipping to this laboratory in labeled paper bags or envelopes containing a small amount of desiccant (silica gel). Desiccant packs were commercially purchased through Amazon.com. The paper seed containers containing sideoats grama were placed in refrigerator prior to shipping to Santa Barbara. Tansyaster seeds were also placed in paper seed containers with desiccant, but they were shipped to Growing Solutions the same day they were collected.

The protocol for the Santa Barbara laboratory is described below.

The seed heads were processed to remove as much non-seed material (i.e., “chaff” and/or other plant material) as possible prior to drying. Seed processing was performed manually by sifting collected materials over ½ inch hardware cloth to separate seed from stems and flower heads. Seeds were dried on an open screen at room temperature (~ 65-70ºF) with low humidity until there is no clear sign of moisture. The seeds were stirred every day during the drying process.

After seed drying and processing, seeds were examined for uniformity, health, and plumpness. Malformed or diseased seeds were culled. The largest seeds were retained and the smallest seeds culled (accomplished with a sieve). The tansyaster seeds have a pappus that was have actively removed before planting but seeds that lost the pappus were fine to plant.

Because humidity changes are easily transferred through paper, seeds were placed in a tightly closing sealed container with a dessicant pack in each container prior to shipping to Wildlife International. At the laboratory, these stored seeds were inspected every few weeks for any signs of decay or degradation, and decaying seeds were removed. Desiccant packs were changed if necessary.

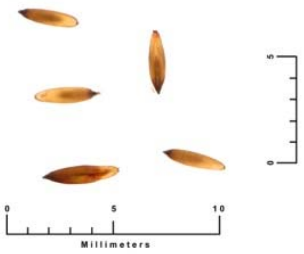
4. Species Descriptions

Seeds of sideoats grama (*Bouteloua curtipendula*) and tansyaster (*Machaeranthera tanacetifolia*) were selected for this study as both species are common and native to the Chino site. A brief description of each species and its seed characteristics and germination requirements is provided below, and was provided to the greenhouse laboratory. In addition, alfalfa (*Medicago sativa*), an agricultural species used in previous phytotoxicity studies, and scarlet globemallow, which did not germinate successfully in the greenhouse, are discussed below.

<u>Sideoats Grama (*Bouteloua curtipendula*)—grass species</u>

Sideoats grama is a widely distributed warm season perennial grass in the Grass Family. Most plants either arise singly, in clumps, or form large patches, depending on the variety. The variety *caespitosa* occurs from the southwestern United States to South America in prairies and arid grasslands, desert scrub, pine-oak and pinyon-juniper woodlands, and Ponderosa pine forests, whereas the variety *curtipendula* extends from the southwestern United States north to Canada in prairies, hardwood savannas, and other habitats; a third variety is confined to Mexico. Sideoats grama occurs at a range of elevations, from near sea level to over 8,000 feet. Due to the importance of this grass in rangelands and habitat restoration, considerable information is available on its biology and several horticultural forms have been developed.

The elongate flower spikes produce pendulous spikelets from mid-summer to fall, with seed ripening following several weeks later. The elliptical seeds (caryopsis) are 4.5 mm long by 1.5 mm wide. There are 160,000 seeds/ per pound (USDA 2013). Seeds are generally collected while still retain surrounding flowering structures, which are removed during cleaning. Germination rates vary with place of seed origin, temperature, timing of rainfall, and other environmental conditions and have ranged from 18 to 96 percent in various studies, with common values of 30 to 70 percent. Germination is favored when floral parts are removed from the caryopses; when seeds are planted one-inch deep vs. shallower or deeper; when seeds are relatively plump and heavy; and under various experimental temperatures that tended to be warm, between 50 and 86ºF (USDA 2013). Germination may occur within 2 to 7 days in moist soil (Wasser 1982, Jordan and Haferkamp 1989).



<u>Tansyaster (*Machaeranthera tanacetifolia*)—first choice forb species</u>

Tansyaster, also known as prairie aster, is an annual or biennial forb in the Sunflower Family with highly dissected gray-green leaves that occurs in arid grasslands, desert scrub, and pine-oak and pinyon-juniper woodlands from sea level to 5,600 feet in many western states, from California, Nevada, Arizona and New Mexico north to Montana, South Dakota, and Alberta, Canada and south to Texas into Mexico.

Tansyaster produces showy flowers comprised of narrow purple ray flowers surrounding a central yellow disk of many disk flowers. It blooms in late spring from May to October, depending on location, with seeds ripening a few weeks later. The flattened seed-containing structures (achenes) are 2-4 mm in length, narrowly obovate in shape, and covered in silky hairs; the pappus on top of the seed is 2-8 mm in length and comprised of 30-80 tawny barbed bristles. There are 400,000 to 490,000 seeds/pound (USDA 2013). Seeds can easily be collected once the seed heads spread wide, revealing the tawny pappus atop each achene. Average seed weight is 1 gram and seed viability is high if seed is stored in a precise way (orthodox seed method, drying seed to low moisture content [<15 percent relative humidity] and then freezing for 16 days at -20ºC, based on data from the Royal Botanic Garden at Kew Seed Information Database (2013)]. However, seed viability of many members of the Sunflower Family quickly drops under normal temperatures and humidity conditions. All *Machaeranthera* species are easily grown in any rich, well drained soil in a sunny spot (needs full sun outdoors). About 30 seeds (within achene called a cypsela) are in a seed head.

Germination Requirements: The diaspore (dispersal unit) of *Machaeranthera tanacetifolia* is not the “seed” but the fruit called a cypsela, which is indehiscent (does not open upon drying) and is derived from the ripened ovary surrounding the matured ovule or “seed”. Hence, germination of the seed inside the fruit (cypsela) may require conditions different than seeds dispersed outside of the protective covering of the fruit. This can be important regarding issues of dormancy (structural or physiological). The pappus falls off naturally if stored overwinter (e.g., or more ideally outdoors in its environment where it undergoes vernalization over the winter). If not, it can be removed before planting to increase speed of planting and reduce chance of seed drying out *but it does not need to be removed. It is critical that the seeds remain moist during planting or else they will return to being dormant and not germinate.*

The vendor seed purchased is Prairie aster (aka Tansyaster) (Machaeranthera tanacetifolia) and is commercially grown – not wildland harvested. The Tansyaster seed lot is 85.52% pure X 68% viable.

- Pre-treatment requirements
  - “Seed” germination is improved indoors after 2 weeks of cold treatment (stratification) in a moist medium before germination. If seeds are to be sown indoors, they should be stored in a moistened medium in the refrigerator for 2 weeks prior to sowing or sow outdoors in early spring. http://www.wildflowermix.com/info/180+common/aster-prairie.html
  - BLM studies found 50-60% germination with no stratification (cold treatment) and 50 - 70% with stratification, with the best results obtained from treatment at 57 - 68 degrees F (14 – 20 degrees C).

  www.blm.gov/pgdata/etc/medialib/blm/ut/natural_resources/Colorado_Plateau/2012meeting.Par.13246.File.dat?Kramer.pdf
  - KEW found 98% germination at 59 and 68 degrees F (15 - 20 degrees C) pre-treatment and 95% with 77 degrees F (25 degrees C) pre-treatment.
  - Deno (1993, p. 197) found 20 - 30% germination in 3 – 10 days with 70 degrees F (21 degrees C) pretreatment, (unknown if higher percent germination over more days), using fresh or dry-stored seed (stored 6 months at 70 or 40 degrees F., better germination at 40 degrees)
  - If grown outside, “seeds” should be sown in early spring for best results. Seeds require a prolonged cooling period prior to germination in late spring. However, “seeds” will germinate in winter, spring, or summer with varying results. Germination time is 15 - 45 days, depending on weather conditions. www.seedman.com/GoodCentsFlowers.htm
  - Others say pre-treatment should include
  - Scarification: Soak in water, let stand in water for 24 hours. https://sheffields.com/seeds/Machaeranthera/tanacetifolia
  - Stratification: cold stratify for 14 days.
- Germination: surface sow flat and keep moist. https://sheffields.com/seeds/Machaeranthera/tanacetifolia/9401
- The vendor of the tansyaster seeds purchased for the greenhouse experiment (Granite Seed) said:
  The germination protocol is: top of blotters in a plastic box (BB), germinated at 15 degrees C for 10 days. The seeds are sensitive to temperatures above 18 degrees C, and Wildlife International Laboratories kept the temperature below this level during the germination period.

Soil temperature: optimum soil temperature after planted is 55 – 65 degrees F (12.8 – 18.3 degrees C). https://aggie-horticulture.tamu.edu/wildseed/38/38.5.html The species is sensitive to temperatures above 18*C.

Depth: 1/16 – 1/8th inches is recommended. https://aggie-horticulture.tamu.edu/wildseed/38/38.5.html
www.seedman.com/GoodCentsFlowers.htm

Soils: preferred soils are well-drained sands and gravels with neutral pH; plants are not adapted to fine and acidic soils and are marginal in basic soils.
www.graniteseed.com/products/seeds/machaeranthera-tanacetifoliawww.easywildflowers.com/quality/mac.tan.htm

Mycorrhizae: plant survival is dependent upon mycorrhizae in the soil, as noted by at least two sources. https://wild.its.utexas/expert/show.php?id=9472, www.graniteseed.com/products/seeds/machaeranthera-tanacetifolia

Recommendation: Based on the information at hand, it seems the best indoor (lab) germination results are provided when seeds are stratified in a moist medium for at least two weeks under temperatures between 59 and 68 degrees F (15 and 20 degrees C). Outdoor sowing in late winter or early spring also overcomes dormancy. The seeds should be stored outside over winter and then germinated to achieve best results.

Alfalfa (*Medicago sativa*)—agricultural species

Alfalfa is a deep-rooted herbaceous perennial forb in the Pea Family that is cultivated for forage in many regions of the world. Multiple stems arise from a narrow woody crown and reach up to 1 m (3 feet) in height at maturity, bearing alternate leaves divided into three lance-shaped to ovoid leaflets. Flowers appear in spring, summer, and early fall and range in color from violet to yellow-green; the small legume fruits are spiraled in two to three turns and each contains 10 to 20 seeds. Alfalfa is considered a species complex, with nine facies classified as subspecies and hundreds of cultivars; there are both diploid and tetraploid forms. It originated in Southeast Asia and was first cultivated in Iran.

There are approximately 200,000 seeds per pound; viable seeds are bright olive-green. On average, about 45 to 73 percent of seeds have a hard seed coat that requires scarification for germination (USDA 1982); hard seed coats are produced more frequently on plants in cold climates (northern latitudes or higher elevations) compared with warm climates such as southern California or lower latitudes. Long-lived seeds have exhibited 81 percent germination after 19 years of seed storage (Watts et. al 1992). Seeds can be pretreated by mechanical scarification or by heating in hot water (219ºF) for 4 minutes. Recommended planting depth for alfalfa seeds is ¼ to ½ inch (5-10 mm). Optimal germination rates are obtained with ambient temperatures between 65 and 77ºF and seedlings appear within three to four days (Horton 1989).

The alfalfa variety Nitro Plus was obtained from Territorial Seed Company in Cottage Grove OR for this study (Lot # 18041). This variety exhibits germination rates of 87 percent during laboratory testing.

Scarlet globemallow (*Sphaeralcea coccinea*)—collected but not analyzed due to poor germination

Scarlet globemallow is a low-spreading, warm season, long-lived perennial forb to half-shrub in the Mallow Family. Stems emerge from a woody caudex located just under the soil surface and reach a height of 10-40 cm (4-16 inches). Plants are densely covered with stellate hairs. Leaves are alternate, palmately lobed, 1-3.7 cm long and 1-5 cm wide. The deep orange to pinkish colored flowers are clustered in dense, short racemes. There are 5 distinct petals, 5 united sepals, and 5 to numerous styles. Stamens are joined by their stalks into a tube and several pistils united in a ring. The fruit is an indehiscent schizocarp with 1-seeded carpels. Plants are rhizomatous. Growth begins in March and April, flowering in May to July and seed matures unevenly between July and August throughout much of its range. There are approximately 500,000 seeds per pound. The seed has a hard seed coat that must be scarified in order for germination to occur.

Eight species of Sphaeralcea occur at Chino (Newfields 2005) and care should be taken to ensure that the seeds of the correct species are collected. About 15 percent of the seeds of a plant are ripe at any one time (indeterminate seed ripener; St. Johns and Ogle 2009); one must ensure ripe seeds are harvested. In addition, seed may be subject to insect predation while still on the parent plant. Globemallow should be harvested when lower capsules begin to dry (St. Johns and Ogle 2009). Seed capsules can be cut from the parent plant and placed in seed collection bags to save time, and cleaning can be done later. Care should be used to wear gloves and safety glasses when handling seed because the stellate hairs on the seed and surrounding capsules can be a severe eye irritant. Fruit is a wedge-shaped capsule held in a ring of ten or more seeds. Avoid collecting seeds exhibiting seed predation.

Scarlet globemallow germinates best after 30-day stratification (cold period) and mechanical (or acid) scarification of the seed coat to germinate (Dunn 2011, St Johns and Ogle 2009). Recommended planting depth is 6.4 mm (Rawlins et. al 2009), though Prairie Moon Nursery said the seed should be on top of the soil, not buried. Seeds germinate rapidly with scarification, sometimes within 1 day (Deno 1993). The greenhouse study results showing 50% of sites germinated on paper towels (though none of the nursery seeds germinated) suggests seeds should probably not be buried in any future experiments.

5. References

ARCADIS. 2014. *Work Plan: Smelter Tailing Soils Investigation Unit (STSIU) – Phytotoxicity and Vegetation Community Study*. Prepared for Chino Mines Company, Hurley, New Mexico.

Deno, N. C. 1993. *Seed germination theory and practice.* International Board for Plant Genetic Resources. State College, PA.

Dunn, B. 2011. *Improved germination of two Sphaeralcea A. St.-Hil (Malvaceae) species with scarification plus stratification treatments*. Native Plants 12(1):13-17. [Web Page]. Located at http://npj.uwpress.org/content/12/1/13.refs

Horton, H., ed. and compiler. 1989. *Interagency forage and conservation planting guide for Utah.* Extension Circular 433. Logan, UT: Utah State University, Cooperative Extension Service. 67 p.

Jordan, G. L.; Haferkamp, M. R. 1989. *Temperature responses and calculated heat units for germination of several range grasses and shrubs*. Journal of Range Management. 42(1): 41-45.

Newfields. 2005. Chino Mines Administrative Order on Consent Site-wide Ecological Risk Assessment. Prepared for Chino Mines Company in November 2005.

Rawlins, J. K.; Anderson V.J.; Johnson R.; T. Krebs. 2009. *Optimal seeding depth of five forb species from the Great Basin*. Native Plants Journal 10:32-42

St. Johns, L., and D.G. Ogle. 2009. *Plant guide: scarlet globemallow (Sphaeralcea coccinea Nutt. Ryd)*. USDA-Natural Resources Conservation Service, ID Plant Materials Center, Aberdeen, ID 83210.

United States Department of Agriculture (USDA), Soil Conservation Service. 1982. *National list of scientific plant names. Vol. 1. List of plant names*. SCS-TP-159. Washington, DC. 416 p.

United States Department of Agriculture (USDA). 2013. *Fire Effects Information System*. [Web Page]. Located at http://www.fs.fed.us/database/feis/plants/. Accessed: August 27, 2013.

Wall, M. 2012. *Seed Collection and Storage Guidelines*. Rancho Santa Ana Botanic Garden. 25 pp.

Wasser, C. H. 1982. *Ecology and culture of selected species useful in revegetating disturbed lands in the West*. FWS/OBS-82/56. Washington, DC: U.S. Department of the Interior, Fish and Wildlife Service, Office of Biological Services, Western Energy and Land Use Team. 347 p.

Watts, W.A.; B.C.S. Hansen, and E.C. Grimm. 1992. *Camel Lake: A 40,000-yr record of vegetational and forest history from northwest Florida.* Ecology. 73(3): 1056-1066. [18727]

Figure B-1. Photographs of fenced 10-acre seed collection area in 2013, situated at about 5700’ on east-facing slope with slopes < 15 degrees (flat granular category). Area has topsoil with some rocky armoring, and pCu is expected to be about 5.5 based on nearby sampled areas (minimally impacted but probably above background copper concentrations).

APPENDIX C

Wildlife International Greenhouse Report on Test Methods and Results

A TEST TO DETERMINE THE SEEDLING EMERGENCE AND GROWTH OF TERRESTRIAL PLANTS IN VARIOUS FIELD-COLLECTED SOILS

WILDLIFE INTERNATIONAL PROJECT NUMBER: 757P-101

AUTHOR:

John R. Porch, M.S.

STUDY INITIATION DATE: February 28, 2014

STUDY COMPLETION DATE:

SUBMITTED TO:

ARCADIS U.S., Inc.

Wildlife International
EVANS ANALYTICAL GROUP

8598 Commerce Drive
Easton, Maryland 21601 USA
1-(410) 822-8600

REPORT APPROVAL

SPONSOR: Arcadis U.S., Inc.

TITLE: A Test to Determine the Seedling Emergence and Growth of Terrestrial Plants in Various Field-Collected Soils

WILDLIFE INTERNATIONAL PROJECT NUMBER: 757P-101

STUDY DIRECTOR:

John R. Porch, M.S. Manager of Plant and Invertebrate Toxicology	Date

TABLE OF CONTENTS

TABLE

APPENDICES

TABLE OF CONTENTS
(continued)

APPENDICES
(continued)

INTRODUCTION

This seedling emergence study was conducted for Arcadis U.S., Inc. at the Wildlife International plant testing facility in Easton, Maryland. The test species were sideoats grama, scarlet globemallow, tansy aster and alfalfa. The study was based on procedures in OECD Guideline for Testing of Chemicals, Guideline 208: *Terrestrial Plant Test: Seedling Emergence and Seedling Growth Test* (1) and ASTM Standard Guide for Conducting Terrestrial Plant Toxicity Tests (2), with some modifications to allow use of natural Chino soils and replicate aspects of a 1999 phytotoxicity study in the Ecological Risk Assessment (e.g., measure root length). The test with alfalfa was conducted between March 6 and 24, 2014. Testing with sideoats grama was conducted between March 20 and April 21, 2014. Testing with scarlet globemallow was conducted between June 17 and July 31, 2014. Testing with tansy aster was conducted from January 30 to March 23, 2015. Raw data generated by Wildlife International, the study protocol, and the final report are filed in archives located on the Wildlife International site. Key personnel involved in the study are listed in Appendix 1.

OBJECTIVE

The objective of this study was to determine the emergence and growth of four species of terrestrial non-target higher plants in various field-collected soils.

EXPERIMENTAL DESIGN

For each of the species tested, seeds were planted in each of thirty-four test soils. Thirty-three soils were provided to the laboratory by the sponsor, and one greenhouse-prepared soil mixture was used as a reference. No test substance was incorporated into the soil used for planting. There were ten replicate pots for each soil type, with twelve seeds planted per replicate. The replicates were placed on a benchtop in a greenhouse according to a randomized design. The test duration was 14 days after 50% control emergence for alfalfa, 21 days after 50% control emergence for sideoats grama, and 21 days after the control emergence reached a plateau for tansy aster. Possible effects of the various soils on seedling emergence and growth of emerged seedlings were evaluated when appropriate. Data collected from all replicates within a soil type were pooled for calculating group means.

MATERIALS AND METHODS

Species Tested

The four species of plants planned for use in this study are listed below:

Family	Scientific Name	Common Name	Planting Depth
	Monocot		
Poaceae	*Bouteloua curtipendula*	Sideoats grama	20 mm
	Dicots		
Malvaceae	*Sphaeralcea coccinea*	Scarlet globemallow	10 mm
Asteraceae	*Machaeranthera tanacetifolia*	Tansy Aster	10 mm
Fabaceae	*Medicago sativa*	Alfalfa	10 mm

Sideoats grama, tansy aster and scarlet globemallow were tested as two distinct populations: one consisting of field-collected seeds and the other consisting of seeds provided by a plant nursery or seed supplier. One seed source of alfalfa was tested. Seeds were planted at the species specific depths shown in the above table. Seeds used in this study were not treated with fungicides, insecticides or repellents prior to test initiation. Seeds were provided by the Sponsor. Documentation provided by the supplier concerning the identification and history of the seeds used is filed with the study data.

Test Soils

Test soils were received in plastic buckets from the sponsor. A standard, artificial greenhouse soil was prepared and used as a reference substrate. The field-collected soils were sieved to 2 mm prior to receipt at the laboratory. Soils were used as received for tests with alfalfa, scarlet globemallow and sideoats grama. Due to the limited supply, soils reclaimed from these initial tests were used for the test with tansy aster. Prior to planting and at the conclusion of each test, the pH of each soil type was measured with a Kelway soil probe and/or a laboratory pH meter.

Environmental Conditions

The test was conducted within a greenhouse. Relative humidity, light intensity and temperature within the greenhouse were measured continuously with a Campbell CR10 datalogger. The lights were controlled by a combination of a timer and light meter. Each day, the lights come on at 5 AM and remained on until the ambient light level outdoors reached the set-point, at which time they were turned off. During the day, when the sunlight fell below the set-point, the lights were turned on to supplement the natural sunlight. Each evening, as the light fell below the set-point, the lights were again turned on, and stayed on until 9 PM. A photoperiod of at least 16 hours of light was maintained in the greenhouse. Artificial lighting was used to supplement natural sunlight on short days or on overcast days. The temperature within the greenhouse was controlled by a Wadsworth Micro/Step 50 Control System at a set-point temperature of ~20 degrees Celsius. Greenhouse side vents were left open during testing with tansy aster in order to maintain the ambient temperature as low as possible.

Test Procedure

Test plants were grown in plastic pots approximately 11 cm in diameter and 10 cm in depth. Fifty growth pots were filled with each test soil, and twelve seeds of one species (either wild or nursery population as warranted) were planted per replicate, following Table 3 in the study plan. Scarification and stratification were not required for alfalfa or sideoats grama. For scarlet globemallow, the seeds were scarified and then cold stratified using the following procedure:

1. Seeds were scarified by rubbing sand paper by nicking each seed with a tiny cut through seed coat. Seeds were washed after scarification.
2. Then, seeds were cold stratified for approximately 30 days. Seeds were placed in a sealed container and stored in a refrigerator at a temperature of 35 – 41°F. Seeds were kept moist during the entire length of the treatment. Stratification was ended on the day of planting to begin the test.

Tansy aster seeds were prepared for use in the test in the following manner:

1. An inoculum provided by the sponsor was added to seeds according to instructions provided.
2. Sand was placed in clean petri dishes, inoculated seeds were placed on the sand and covered with moist filter paper. Petri dishes were covered with lids.
3. Petri dishes were placed on trays, which were enclosed in plastic bags and moved to a walk-in refrigerator for cold stratification (14 days at a temperature of 35 – 41°F). Stratification was ended on the day of planting to begin the test.

Seeds were planted at the species appropriate depth and were approximately equally spaced. Pots were uniquely identified with the species name, project number, designation of soil type, and replicate. For the species other than alfalfa, the pots were also labeled as wild or nursery seed. After planting, the growth pots were placed on benches in the greenhouse in a randomized configuration to minimize bias from microclimates that may exist within the greenhouse. Water was supplied to the growth pots by watering from the top to keep the soil evenly moist, simulate natural conditions and reduce leaching of metals and salts in the soil column. The pH of irrigation water was adjusted to approximately 6 using HCl before it is used to water plants. Records of the days that watering occurs and the source of water used were kept in the study data.

The control growth pots were observed for germination daily in order to determine the day on which 50% emergence is reached. The in-life portion of the test terminated not less than after 50% of the control plants grown from nursery seed in the greenhouse mixture have germinated for the grass and alfalfa species. The tests were terminated for each species at least 14 days after 50% of the seeds had emerged. On the day of test termination, the pH of each soil type was measured prior to planting using a soil probe. At the termination of the in-life portion of the test, percent germination, height of plant shoots, length and weight measurements of the shoot and length of the root, and the condition and survival of the emerged seedlings was recorded. On the day of test termination, seedlings in each replicate were observed for symptoms of toxicity and assigned a rating score to describe the severity of any observed effects (Table 1). After shoot heights and observations were complete, well water (not pH adjusted) was added to the pots to loosen the soil and facilitate the removal of seedlings. When seedlings were removed from the pot, root masses were rinsed to clean away attached soil and placed on a paper towel. The length of the longest root for each replicate pot was measured with a ruler. The plants were placed in bags by replicate, dried, and weighed. The total replicate weight was divided by the number of plants weighed in order to determine the mean (per plant) dry weight for each replicate.

Data Analyses

The mean number of emerged seedlings, surviving seedlings as the percentage of those that emerged, shoot height, total plant dry weight and root length for each treatment group (soil type) were calculated.

RESULTS

Observations and Measurements

Time to 50% emergence in the controls, the final control emergence and survival, and duration of the test with each species are presented in the table below.

Species	Days Until 50% Control Emergence	Final Control Emergence (%)	Control Survival (% of emerged)	Duration of Test (days after 50% control emergence)
Alfalfa	4	80	97	14
Sideoats grama (Nursery-Provided)	10	55	92	21
Sideoats grama (Field-Collected)	7	64	83	21
Scarlet Globemallow (Nursery-Provided)	>21	0	-	-
Scarlet Globemallow (Field-Collected)	>21	0	-	-
Tansy Aster (Nursery-Provided)	reached 45% on day 19, remained 45% until day 38 and afterwards	45	41	14
Tansy Aster (Field-Collected)	reached 28% on day 19, remained 28% until day 43 and afterwards	28	24	14

Environmental conditions during the test period are provided in Appendix 2. Daily counts of control emergence are provided by species in Appendices 3.1 through 3.7. Complete results of the tests with alfalfa, sideoats grama and tansy aster are provided by species in Appendices 4 through 8.

Validity Criteria

Compliance with the OECD criteria for control survival was evaluated based on the following criteria:

- Alfalfa: 80% germination was obtained, and 90% of emerged seeds survived until test termination. The test with alfalfa was considered valid.
- Sideoats Grama: Control emergence (55% for nursery-provided seeds and 64% for field-collected seeds) and survival (92% for nursery-provided seeds and 83% for field-collected seeds) were less than desired, but were considered adequate for the test.
- Scarlet globemallow: Control emergence was substantially less than 55%, and the test was not valid.
- Tansy aster: Control emergence for the field-collected and nursery-provided seeds were 28% and 45%, respectively, and survival of the emerged seedlings was 24% and 41%, respectively. The test was considered marginally acceptable.

Integrity of the Data

The data and observations that were made are accurately reported. However, the following circumstances may have affected the quality of the data:

- The probes used to measure soil pH in test pots were not validated. However, they were used according to directions.
- It is not known whether the use of reclaimed soils for tansy aster affected results.
- It is not known whether copper in the irrigation lines had an adverse effect on the test.
- It is not known if the species that were used in the test (with the exception of alfalfa) are suitable to be raised in a greenhouse under the conditions of the study.

REFERENCES

1 **OECD Guideline for the Testing of Chemicals.** 2006. Guideline 208: Terrestrial Plant Test: Seedling Emergence and Seedling Growth Test.

2 **ASTM. 2009.** Standard guide for conducting terrestrial plant toxicity tests. Prepared by the American Society of Testing and Materials. Designation: E1963-09. Philadelphia, Pennsylvania.

Table 1

Seedling Condition Rating System

Rating	Category	Description
0	No Effect	No noticeable effect
10	Slight Effect	Effect barely noticeable
20		Some effect, not apparently detrimental
30		Effect more pronounced, not obviously detrimental
40	Moderate Effect	Effect moderate, plants appear able to recover
50		More lasting effect, recovery doubtful
60		Lasting effect, recovery doubtful
70	Severe Effect	Heavy injury, loss of individual leaves
80		Plant nearly destroyed, a few surviving leaves
90		Occasional surviving leaves
100	Complete Effect	Death of entire plant

Rating scale adapted from:
Frans, Robert E. and Ronald E. Talbert. 1977. Design of Field Experiments and the Measurement and Analysis of Plant Responses. Pages 15-23 in B. Truelove, ed. Research Methods in Weed Science. Southern Weed Science Society, Auburn University, Alabama.

Appendix 1

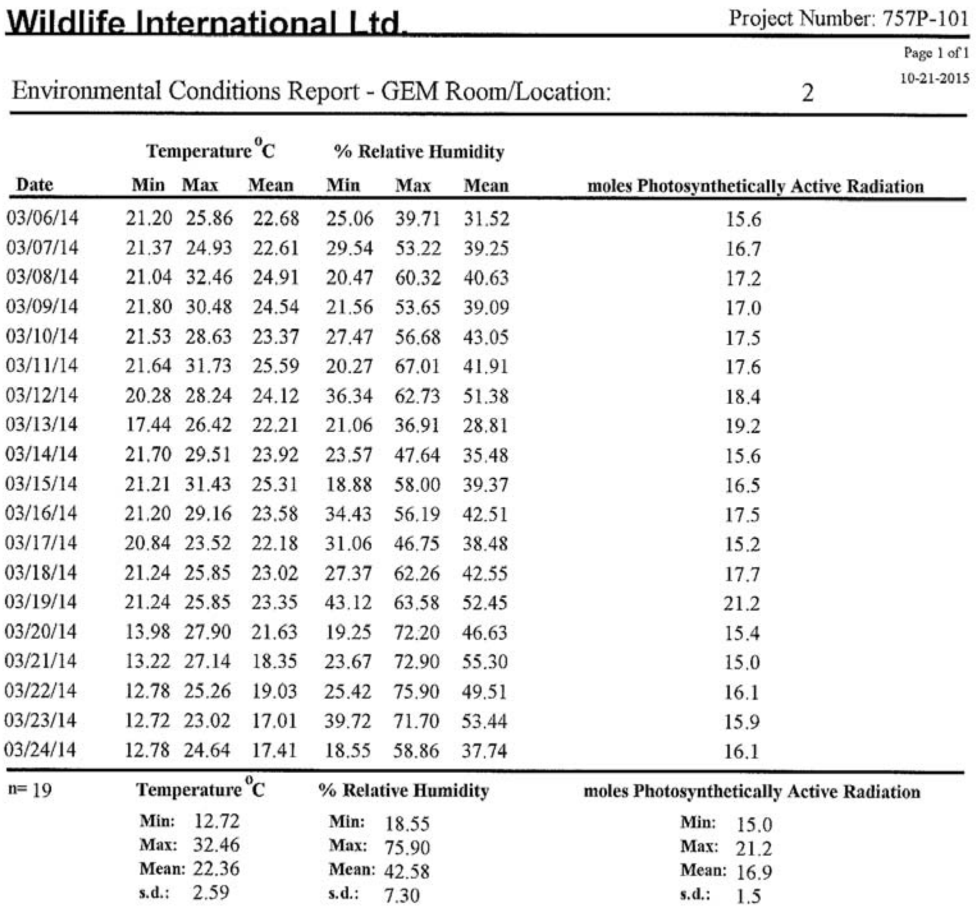
Personnel Involved in the Study

The following key personnel were involved in the conduct or management of this study:

(2) John R. Porch, Manager of Plant and Invertebrate Toxicology
(3) Joshua T. Oakes, Greenhouse Supervisor
(4) Eric W. Peterson, Biologist
(5) Kathryn P. Jenson, Biologist

Appendix 2

Environmental Conditions
Alfalfa



Wildlife International Ltd. Project Number: 757P-101

Page 1 of 1
10-21-2015

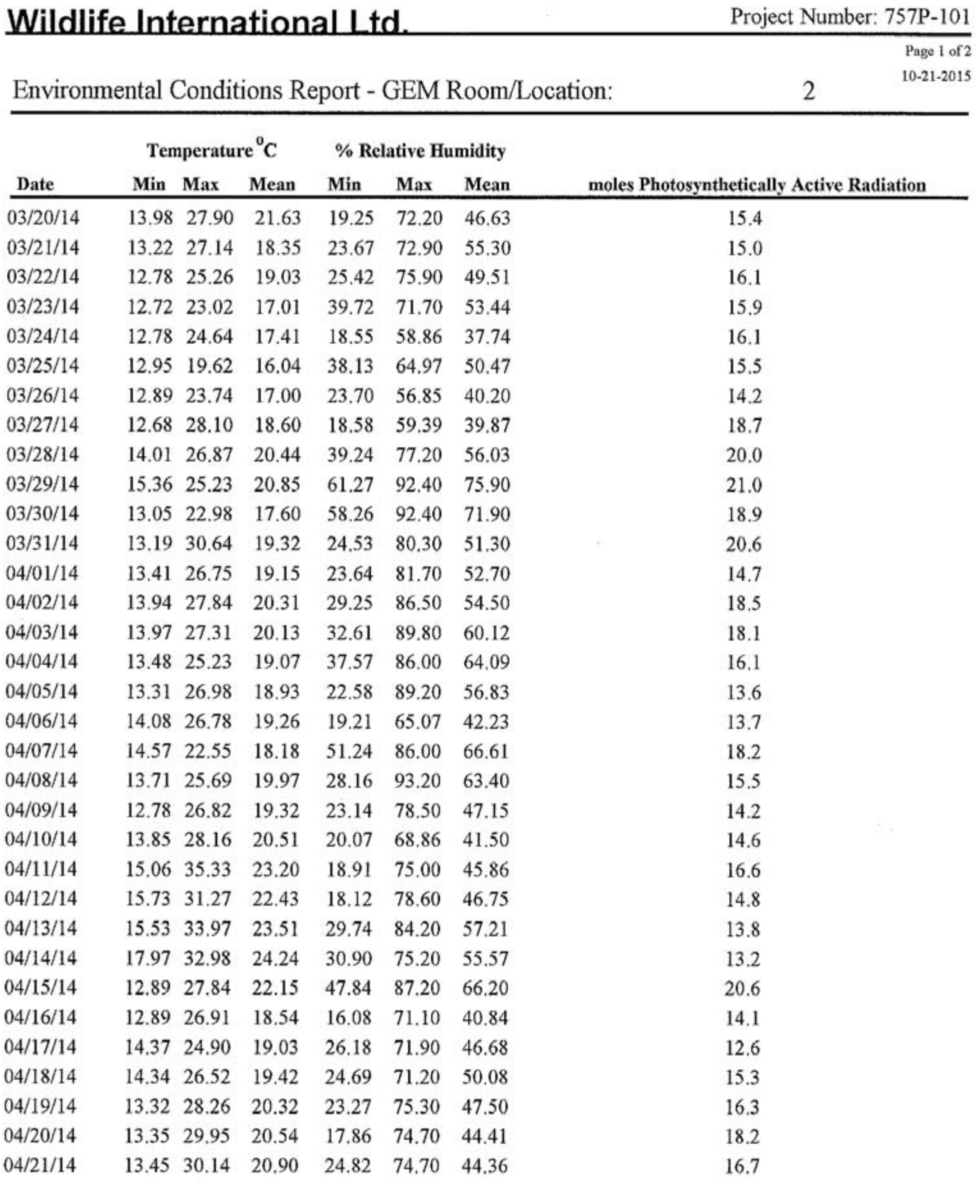
Environmental Conditions Report - GEM Room/Location: 2

	Temperature °C			% Relative Humidity			
Date	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**moles Photosynthetically Active Radiation**
03/06/14	21.20	25.86	22.68	25.06	39.71	31.52	15.6
03/07/14	21.37	24.93	22.61	29.54	53.22	39.25	16.7
03/08/14	21.04	32.46	24.91	20.47	60.32	40.63	17.2
03/09/14	21.80	30.48	24.54	21.56	53.65	39.09	17.0
03/10/14	21.53	28.63	23.37	27.47	56.68	43.05	17.5
03/11/14	21.64	31.73	25.59	20.27	67.01	41.91	17.6
03/12/14	20.28	28.24	24.12	36.34	62.73	51.38	18.4
03/13/14	17.44	26.42	22.21	21.06	36.91	28.81	19.2
03/14/14	21.70	29.51	23.92	23.57	47.64	35.48	15.6
03/15/14	21.21	31.43	25.31	18.88	58.00	39.37	16.5
03/16/14	21.20	29.16	23.58	34.43	56.19	42.51	17.5
03/17/14	20.84	23.52	22.18	31.06	46.75	38.48	15.2
03/18/14	21.24	25.85	23.02	27.37	62.26	42.55	17.7
03/19/14	21.24	25.85	23.35	43.12	63.58	52.45	21.2
03/20/14	13.98	27.90	21.63	19.25	72.20	46.63	15.4
03/21/14	13.22	27.14	18.35	23.67	72.90	55.30	15.0
03/22/14	12.78	25.26	19.03	25.42	75.90	49.51	16.1
03/23/14	12.72	23.02	17.01	39.72	71.70	53.44	15.9
03/24/14	12.78	24.64	17.41	18.55	58.86	37.74	16.1

n= 19	Temperature °C	% Relative Humidity	moles Photosynthetically Active Radiation
Min:	12.72	18.55	15.0
Max:	32.46	75.90	21.2
Mean:	22.36	42.58	16.9
s.d.:	2.59	7.30	1.5

Pots were top-watered using pH-adjusted water on the following days :
07 Mar 14
10 Mar 14
13 Mar 14
16 Mar 14
19 Mar 14
21 Mar 14

Appendix 2
(continued)
Environmental Conditions
Sideoats Grama



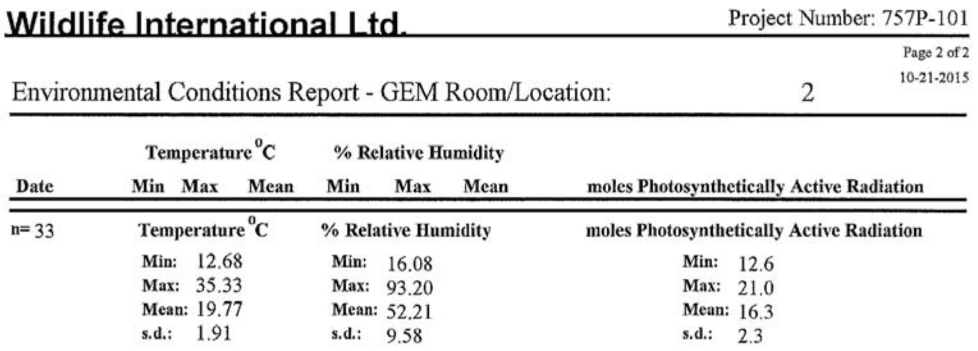
Wildlife International Ltd. Project Number: 757P-101

Page 1 of 2
10-21-2015

Environmental Conditions Report - GEM Room/Location: 2

Date	Temperature °C			% Relative Humidity			moles Photosynthetically Active Radiation
	Min	Max	Mean	Min	Max	Mean	
03/20/14	13.98	27.90	21.63	19.25	72.20	46.63	15.4
03/21/14	13.22	27.14	18.35	23.67	72.90	55.30	15.0
03/22/14	12.78	25.26	19.03	25.42	75.90	49.51	16.1
03/23/14	12.72	23.02	17.01	39.72	71.70	53.44	15.9
03/24/14	12.78	24.64	17.41	18.55	58.86	37.74	16.1
03/25/14	12.95	19.62	16.04	38.13	64.97	50.47	15.5
03/26/14	12.89	23.74	17.00	23.70	56.85	40.20	14.2
03/27/14	12.68	28.10	18.60	18.58	59.39	39.87	18.7
03/28/14	14.01	26.87	20.44	39.24	77.20	56.03	20.0
03/29/14	15.36	25.23	20.85	61.27	92.40	75.90	21.0
03/30/14	13.05	22.98	17.60	58.26	92.40	71.90	18.9
03/31/14	13.19	30.64	19.32	24.53	80.30	51.30	20.6
04/01/14	13.41	26.75	19.15	23.64	81.70	52.70	14.7
04/02/14	13.94	27.84	20.31	29.25	86.50	54.50	18.5
04/03/14	13.97	27.31	20.13	32.61	89.80	60.12	18.1
04/04/14	13.48	25.23	19.07	37.57	86.00	64.09	16.1
04/05/14	13.31	26.98	18.93	22.58	89.20	56.83	13.6
04/06/14	14.08	26.78	19.26	19.21	65.07	42.23	13.7
04/07/14	14.57	22.55	18.18	51.24	86.00	66.61	18.2
04/08/14	13.71	25.69	19.97	28.16	93.20	63.40	15.5
04/09/14	12.78	26.82	19.32	23.14	78.50	47.15	14.2
04/10/14	13.85	28.16	20.51	20.07	68.86	41.50	14.6
04/11/14	15.06	35.33	23.20	18.91	75.00	45.86	16.6
04/12/14	15.73	31.27	22.43	18.12	78.60	46.75	14.8
04/13/14	15.53	33.97	23.51	29.74	84.20	57.21	13.8
04/14/14	17.97	32.98	24.24	30.90	75.20	55.57	13.2
04/15/14	12.89	27.84	22.15	47.84	87.20	66.20	20.6
04/16/14	12.89	26.91	18.54	16.08	71.10	40.84	14.1
04/17/14	14.37	24.90	19.03	26.18	71.90	46.68	12.6
04/18/14	14.34	26.52	19.42	24.69	71.20	50.08	15.3
04/19/14	13.32	28.26	20.32	23.27	75.30	47.50	16.3
04/20/14	13.35	29.95	20.54	17.86	74.70	44.41	18.2
04/21/14	13.45	30.14	20.90	24.82	74.70	44.36	16.7

Appendix 2
(continued)
Environmental Conditions
Sideoats Grama



Wildlife International Ltd. Project Number: 757P-101

Page 2 of 2
10-21-2015

Environmental Conditions Report - GEM Room/Location: 2

Date	Temperature °C Min	Temperature °C Max	Temperature °C Mean	% Relative Humidity Min	% Relative Humidity Max	% Relative Humidity Mean	moles Photosynthetically Active Radiation

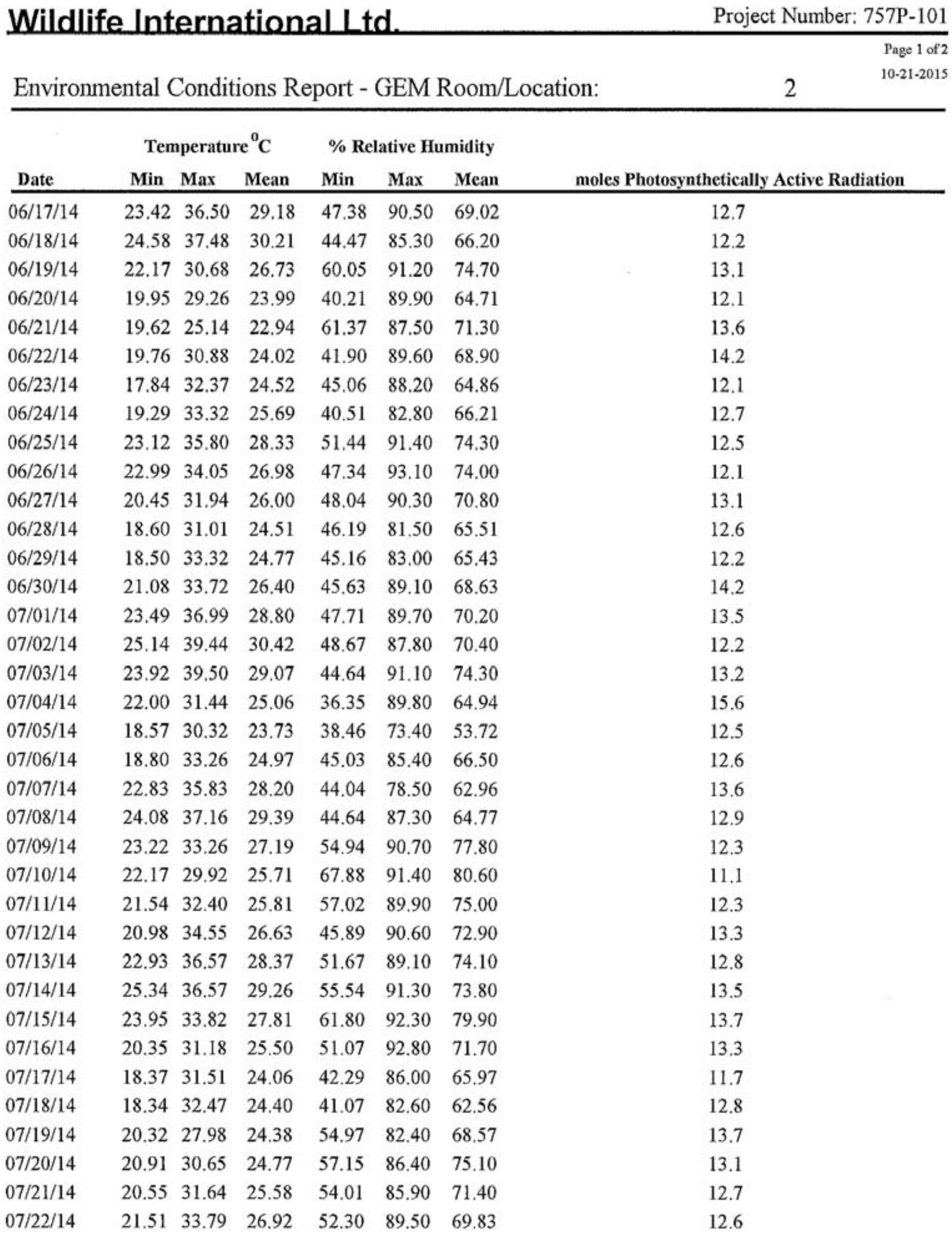
n= 33	Temperature °C	% Relative Humidity	moles Photosynthetically Active Radiation
Min:	12.68	16.08	12.6
Max:	35.33	93.20	21.0
Mean:	19.77	52.21	16.3
s.d.:	1.91	9.58	2.3

Pots were top-watered using pH-adjusted water on the following days :

Field-Collected	Nursery-Provided
20 Mar 14	21 Mar 14
24 Mar 14	25 Mar 14
28 Mar 14	31 Mar 14
31 Mar 14	03 Apr 14
03 Apr 14	05 Apr 14
05 Apr 14	07 Apr 14
07 Apr 14	10 Apr 14
10 Apr 14	12 Apr 14
12 Apr 14	14 Apr 14
14 Apr 14	17 Apr 14
16 Apr 14	20 Apr 14

Appendix 2

(continued)
Environmental Conditions
Scarlet Globemallow



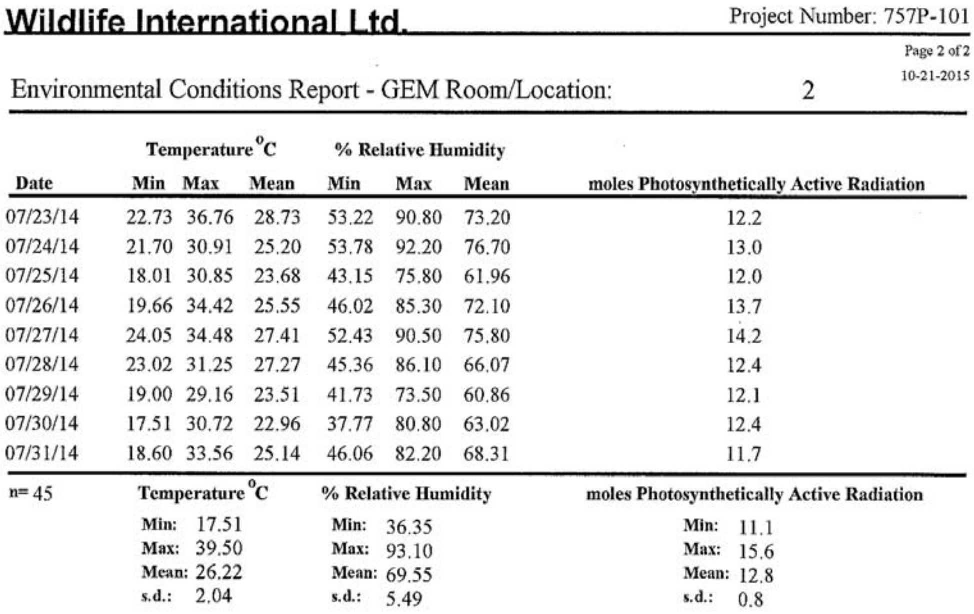
Wildlife International Ltd. Project Number: 757P-101

Page 1 of 2
10-21-2015

Environmental Conditions Report - GEM Room/Location: 2

	Temperature °C			% Relative Humidity			
Date	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**moles Photosynthetically Active Radiation**
06/17/14	23.42	36.50	29.18	47.38	90.50	69.02	12.7
06/18/14	24.58	37.48	30.21	44.47	85.30	66.20	12.2
06/19/14	22.17	30.68	26.73	60.05	91.20	74.70	13.1
06/20/14	19.95	29.26	23.99	40.21	89.90	64.71	12.1
06/21/14	19.62	25.14	22.94	61.37	87.50	71.30	13.6
06/22/14	19.76	30.88	24.02	41.90	89.60	68.90	14.2
06/23/14	17.84	32.37	24.52	45.06	88.20	64.86	12.1
06/24/14	19.29	33.32	25.69	40.51	82.80	66.21	12.7
06/25/14	23.12	35.80	28.33	51.44	91.40	74.30	12.5
06/26/14	22.99	34.05	26.98	47.34	93.10	74.00	12.1
06/27/14	20.45	31.94	26.00	48.04	90.30	70.80	13.1
06/28/14	18.60	31.01	24.51	46.19	81.50	65.51	12.6
06/29/14	18.50	33.32	24.77	45.16	83.00	65.43	12.2
06/30/14	21.08	33.72	26.40	45.63	89.10	68.63	14.2
07/01/14	23.49	36.99	28.80	47.71	89.70	70.20	13.5
07/02/14	25.14	39.44	30.42	48.67	87.80	70.40	12.2
07/03/14	23.92	39.50	29.07	44.64	91.10	74.30	13.2
07/04/14	22.00	31.44	25.06	36.35	89.80	64.94	15.6
07/05/14	18.57	30.32	23.73	38.46	73.40	53.72	12.5
07/06/14	18.80	33.26	24.97	45.03	85.40	66.50	12.6
07/07/14	22.83	35.83	28.20	44.04	78.50	62.96	13.6
07/08/14	24.08	37.16	29.39	44.64	87.30	64.77	12.9
07/09/14	23.22	33.26	27.19	54.94	90.70	77.80	12.3
07/10/14	22.17	29.92	25.71	67.88	91.40	80.60	11.1
07/11/14	21.54	32.40	25.81	57.02	89.90	75.00	12.3
07/12/14	20.98	34.55	26.63	45.89	90.60	72.90	13.3
07/13/14	22.93	36.57	28.37	51.67	89.10	74.10	12.8
07/14/14	25.34	36.57	29.26	55.54	91.30	73.80	13.5
07/15/14	23.95	33.82	27.81	61.80	92.30	79.90	13.7
07/16/14	20.35	31.18	25.50	51.07	92.80	71.70	13.3
07/17/14	18.37	31.51	24.06	42.29	86.00	65.97	11.7
07/18/14	18.34	32.47	24.40	41.07	82.60	62.56	12.8
07/19/14	20.32	27.98	24.38	54.97	82.40	68.57	13.7
07/20/14	20.91	30.65	24.77	57.15	86.40	75.10	13.1
07/21/14	20.55	31.64	25.58	54.01	85.90	71.40	12.7
07/22/14	21.51	33.79	26.92	52.30	89.50	69.83	12.6

Appendix 2
(continued)
Environmental Conditions
Scarlet Globemallow



Wildlife International Ltd. Project Number: 757P-101

Page 2 of 2
10-21-2015

Environmental Conditions Report - GEM Room/Location: 2

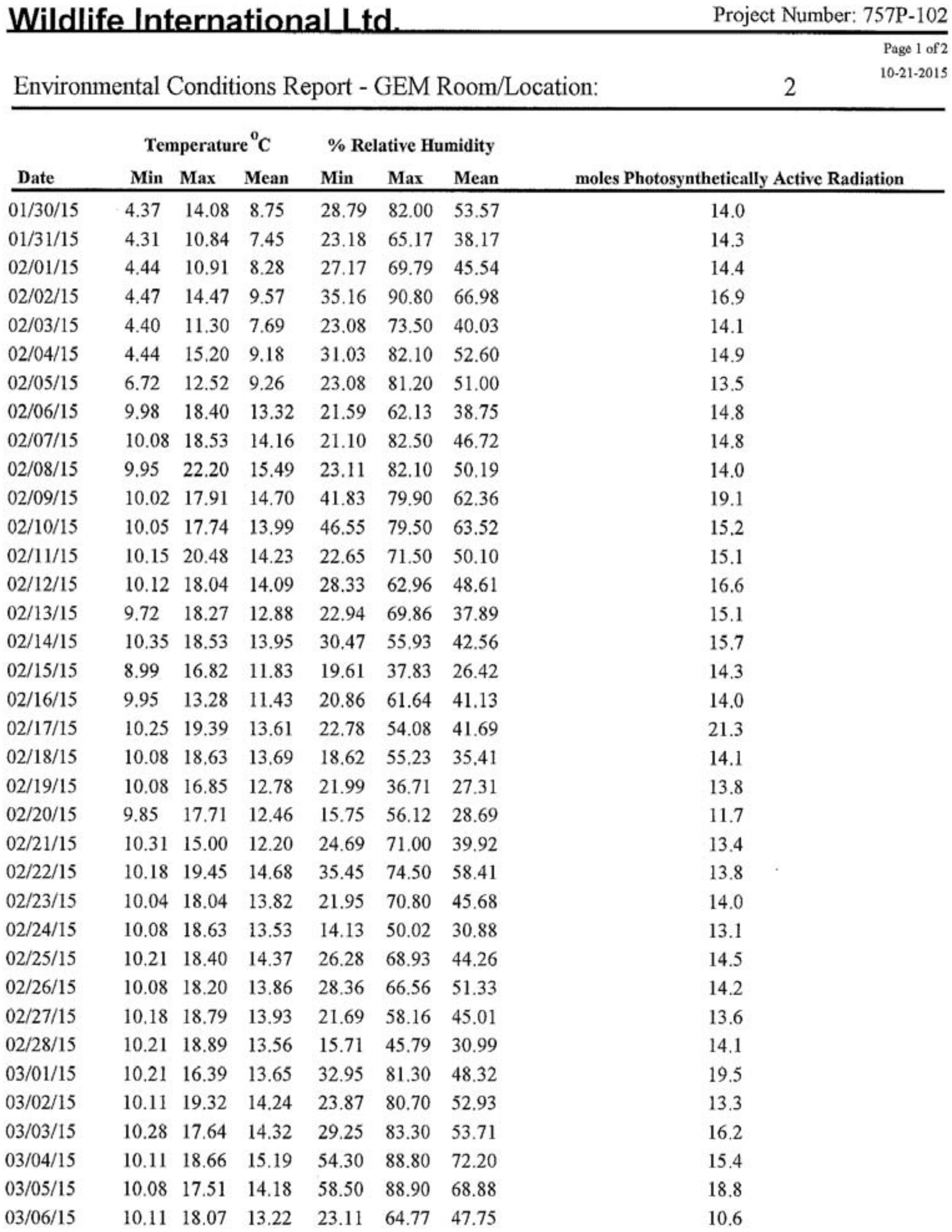
	Temperature °C			% Relative Humidity			
Date	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**moles Photosynthetically Active Radiation**
07/23/14	22.73	36.76	28.73	53.22	90.80	73.20	12.2
07/24/14	21.70	30.91	25.20	53.78	92.20	76.70	13.0
07/25/14	18.01	30.85	23.68	43.15	75.80	61.96	12.0
07/26/14	19.66	34.42	25.55	46.02	85.30	72.10	13.7
07/27/14	24.05	34.48	27.41	52.43	90.50	75.80	14.2
07/28/14	23.02	31.25	27.27	45.36	86.10	66.07	12.4
07/29/14	19.00	29.16	23.51	41.73	73.50	60.86	12.1
07/30/14	17.51	30.72	22.96	37.77	80.80	63.02	12.4
07/31/14	18.60	33.56	25.14	46.06	82.20	68.31	11.7

n= 45	Temperature °C	% Relative Humidity	moles Photosynthetically Active Radiation
	Min: 17.51	**Min:** 36.35	**Min:** 11.1
	Max: 39.50	**Max:** 93.10	**Max:** 15.6
	Mean: 26.22	**Mean:** 69.55	**Mean:** 12.8
	s.d.: 2.04	**s.d.:** 5.49	**s.d.:** 0.8

Pots were top-watered using pH-adjusted water on the following days :

Field-Collected	Nursery-Provided
14 Jul 14	17 Jun 14
17 Jul 14	20 Jun 14
20 Jul 14	21 Jun 14
23 Jul 14	23 Jun 14
25 Jul 14	25 Jun 14
29 Jul 14	27 Jun 14
	29 Jun 14
	30 Jun 14
	01 Jul 14
	03 Jul 14
	06 Jul 14

Appendix 2
(continued)
Environmental Conditions
Tansy Aster



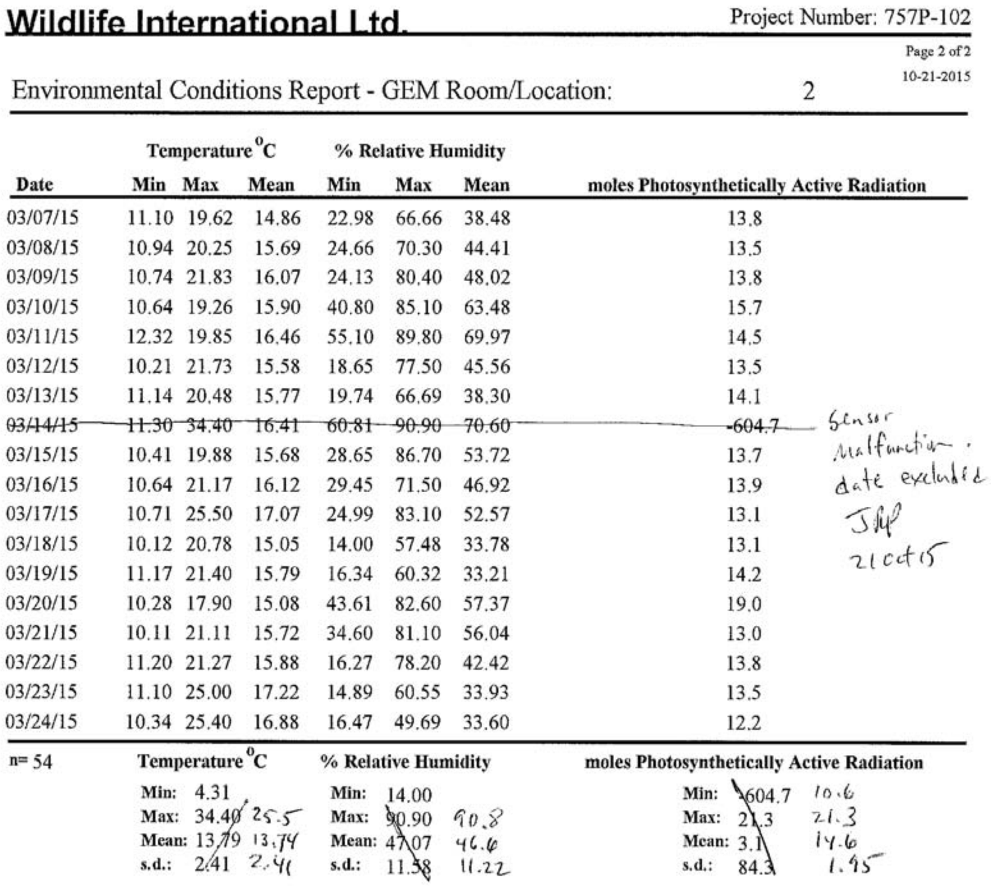
Wildlife International Ltd. Project Number: 757P-102

Page 1 of 2
10-21-2015

Environmental Conditions Report - GEM Room/Location: 2

Date	Temperature °C Min	Temperature °C Max	Temperature °C Mean	% Relative Humidity Min	% Relative Humidity Max	% Relative Humidity Mean	moles Photosynthetically Active Radiation
01/30/15	4.37	14.08	8.75	28.79	82.00	53.57	14.0
01/31/15	4.31	10.84	7.45	23.18	65.17	38.17	14.3
02/01/15	4.44	10.91	8.28	27.17	69.79	45.54	14.4
02/02/15	4.47	14.47	9.57	35.16	90.80	66.98	16.9
02/03/15	4.40	11.30	7.69	23.08	73.50	40.03	14.1
02/04/15	4.44	15.20	9.18	31.03	82.10	52.60	14.9
02/05/15	6.72	12.52	9.26	23.08	81.20	51.00	13.5
02/06/15	9.98	18.40	13.32	21.59	62.13	38.75	14.8
02/07/15	10.08	18.53	14.16	21.10	82.50	46.72	14.8
02/08/15	9.95	22.20	15.49	23.11	82.10	50.19	14.0
02/09/15	10.02	17.91	14.70	41.83	79.90	62.36	19.1
02/10/15	10.05	17.74	13.99	46.55	79.50	63.52	15.2
02/11/15	10.15	20.48	14.23	22.65	71.50	50.10	15.1
02/12/15	10.12	18.04	14.09	28.33	62.96	48.61	16.6
02/13/15	9.72	18.27	12.88	22.94	69.86	37.89	15.1
02/14/15	10.35	18.53	13.95	30.47	55.93	42.56	15.7
02/15/15	8.99	16.82	11.83	19.61	37.83	26.42	14.3
02/16/15	9.95	13.28	11.43	20.86	61.64	41.13	14.0
02/17/15	10.25	19.39	13.61	22.78	54.08	41.69	21.3
02/18/15	10.08	18.63	13.69	18.62	55.23	35.41	14.1
02/19/15	10.08	16.85	12.78	21.99	36.71	27.31	13.8
02/20/15	9.85	17.71	12.46	15.75	56.12	28.69	11.7
02/21/15	10.31	15.00	12.20	24.69	71.00	39.92	13.4
02/22/15	10.18	19.45	14.68	35.45	74.50	58.41	13.8
02/23/15	10.04	18.04	13.82	21.95	70.80	45.68	14.0
02/24/15	10.08	18.63	13.53	14.13	50.02	30.88	13.1
02/25/15	10.21	18.40	14.37	26.28	68.93	44.26	14.5
02/26/15	10.08	18.20	13.86	28.36	66.56	51.33	14.2
02/27/15	10.18	18.79	13.93	21.69	58.16	45.01	13.6
02/28/15	10.21	18.89	13.56	15.71	45.79	30.99	14.1
03/01/15	10.21	16.39	13.65	32.95	81.30	48.32	19.5
03/02/15	10.11	19.32	14.24	23.87	80.70	52.93	13.3
03/03/15	10.28	17.64	14.32	29.25	83.30	53.71	16.2
03/04/15	10.11	18.66	15.19	54.30	88.80	72.20	15.4
03/05/15	10.08	17.51	14.18	58.50	88.90	68.88	18.8
03/06/15	10.11	18.07	13.22	23.11	64.77	47.75	10.6

Appendix 2
(continued)
Environmental Conditions
Tansy Aster



Wildlife International Ltd. Project Number: 757P-102

Page 2 of 2
10-21-2015

Environmental Conditions Report - GEM Room/Location: 2

Date	Temperature °C Min	Temperature °C Max	Temperature °C Mean	% Relative Humidity Min	% Relative Humidity Max	% Relative Humidity Mean	moles Photosynthetically Active Radiation
03/07/15	11.10	19.62	14.86	22.98	66.66	38.48	13.8
03/08/15	10.94	20.25	15.69	24.66	70.30	44.41	13.5
03/09/15	10.74	21.83	16.07	24.13	80.40	48.02	13.8
03/10/15	10.64	19.26	15.90	40.80	85.10	63.48	15.7
03/11/15	12.32	19.85	16.46	55.10	89.80	69.97	14.5
03/12/15	10.21	21.73	15.58	18.65	77.50	45.56	13.5
03/13/15	11.14	20.48	15.77	19.74	66.69	38.30	14.1
~~03/14/15~~	~~11.30~~	~~34.40~~	~~16.41~~	~~60.81~~	~~90.90~~	~~70.60~~	~~-604.7~~
03/15/15	10.41	19.88	15.68	28.65	86.70	53.72	13.7
03/16/15	10.64	21.17	16.12	29.45	71.50	46.92	13.9
03/17/15	10.71	25.50	17.07	24.99	83.10	52.57	13.1
03/18/15	10.12	20.78	15.05	14.00	57.48	33.78	13.1
03/19/15	11.17	21.40	15.79	16.34	60.32	33.21	14.2
03/20/15	10.28	17.90	15.08	43.61	82.60	57.37	19.0
03/21/15	10.11	21.11	15.72	34.60	81.10	56.04	13.0
03/22/15	11.20	21.27	15.88	16.27	78.20	42.42	13.8
03/23/15	11.10	25.00	17.22	14.89	60.55	33.93	13.5
03/24/15	10.34	25.40	16.88	16.47	49.69	33.60	12.2

Sensor malfunction. date excluded JMP 21Oct15

n= 54	Temperature °C		% Relative Humidity		moles Photosynthetically Active Radiation	
Min:	4.31		14.00		~~-604.7~~	10.6
Max:	~~34.40~~	25.5	~~90.90~~	90.8	~~21.3~~	21.3
Mean:	~~13.79~~	13.74	~~47.07~~	46.6	~~3.1~~	14.6
s.d.:	~~2.41~~	2.41	~~11.58~~	11.22	~~84.3~~	1.95

Pots were top-watered using pH-adjusted water on the following days :

Field-Collected		Nursery-Provided	
30 Jan 15	01 Mar 15	29 Jan 15	01 Mar 15
02 Feb 15	03 Mar 15	02 Feb 15	03 Mar 15
05 Feb 15	09 Mar 15	05 Feb 15	09 Mar 15
07 Feb 15	12 Mar 15	07 Feb 15	12 Mar 15
09 Feb 15	16 Mar 15	09 Feb 15	16 Mar 15
13 Feb 15	20 Mar 15	13 Feb 15	20 Mar 15
16 Feb 15	23 Mar 15	16 Feb 15	
20 Feb 15		20 Feb 15	
25 Feb 15		25 Feb 15	

Appendix 3.1

Alfalfa Negative Control Emergence

Day	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	% Emergence
3	2	3	2	1	2	3	3	2	2	3	19
4	6	7	7	4	6	6	7	6	10	8	56

Appendix 3.2

Sideoats Grama (Nursery-Provided) Negative Control Emergence

Day	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	% Emergence
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0
5	2	2	2	0	0	0	1	0	2	1	8
6	2	4	2	6	3	1	1	2	2	1	20
7	5	9	7	8	6	2	4	5	2	2	42
8	5	10	7	8	7	2	4	5	2	2	43
10	6	11	7	8	8	3	5	7	4	5	53

Appendix 3.3

Sideoats Grama (Field-Collected) Negative Control Emergence

Day	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	% Emergence
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0
5	2	0	1	3	3	4	0	2	3	1	16
6	8	1	4	5	6	10	3	4	12	4	48
7	8	3	4	8	8	10	5	5	12	7	58

Appendix 3.4

Tansy Aster (Nursery-Provided) Negative Control Emergence

Day	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	% Emergence
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0
10	1	0	1	0	2	1	0	0	1	1	6
11	3	1	2	7	3	2	0	1	3	2	20
12	4	2	4	7	3	3	0	2	5	3	28
13	5	2	4	7	5	4	2	4	5	4	35
14	6	5	4	7	6	5	2	4	5	4	40
15	6	5	5	7	7	5	2	4	7	4	43

Appendix 3.4
(continued)
Tansy Aster (Nursery-Provided) Negative Control Emergence

Day	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	% Emergence
16	6	5	5	7	7	5	2	4	7	4	43
17	6	5	5	7	7	5	3	4	7	4	44
18	6	5	5	7	7	5	3	4	7	4	44
19	6	5	5	7	7	5	3	4	7	4	44
20	6	6	5	7	7	5	3	4	7	4	45
21	6	6	5	7	7	5	3	4	7	4	45
22	6	6	5	7	7	5	3	4	7	4	45
23	6	6	5	7	7	5	3	4	7	4	45
24	6	6	5	7	7	5	3	4	7	4	45
25	6	6	5	7	7	5	3	4	7	4	45
26	6	6	5	7	7	5	3	4	7	4	45
27	6	6	5	7	7	5	3	4	7	4	45
28	6	6	5	7	7	5	3	4	7	4	45
29	6	6	5	7	7	5	3	4	7	4	45
30	6	6	5	7	7	5	3	4	7	4	45

Appendix 3.4

(continued)

Tansy Aster (Nursery-Provided) Negative Control Emergence

Day	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	% Emergence
31	6	6	5	7	7	5	3	4	7	4	45
32	6	6	5	7	7	5	3	4	7	4	45
33	6	6	5	7	7	5	3	4	7	4	45
34	6	6	5	7	7	5	3	4	7	4	45
35	6	6	5	7	7	5	3	4	7	4	45
36	6	6	5	7	7	5	3	4	7	4	45
37	6	6	5	7	7	5	3	4	7	4	45
38	6	6	5	7	7	5	3	4	7	4	45[1]
39	6	6	5	7	7	5	3	4	7	4	45
40	6	6	5	7	7	5	3	4	7	4	45
41	6	6	5	7	7	5	3	4	7	4	45
42	6	6	5	7	7	5	3	4	7	4	45
43	6	6	5	7	7	5	3	4	7	4	45
44	6	6	5	7	7	5	3	4	7	4	45

[1] Day 38 (March 9, 2015) was designated to be Day 0 after determining that additional emergence was not likely. Collection of the plants was made 14 days later, on March 23, 2015.

Appendix 3.5

Tansy Aster (Field-Collected) Negative Control Emergence

Day	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	% Emergence
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	1	1	0	1	1	3
10	2	1	1	2	2	2	3	2	2	2	16
11	2	2	1	2	3	2	3	2	2	2	18
12	3	4	1	3	3	2	3	2	2	2	21
13	3	4	3	3	3	3	3	2	2	2	23
14	3	4	4	3	3	3	4	2	4	2	27
15	3	4	4	3	3	3	4	2	4	2	27

Appendix 3.5
(continued)
Tansy Aster (Field-Collected) Negative Control Emergence

Day	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	% Emergence
16	3	4	4	3	3	3	4	2	4	2	27
17	3	4	4	3	3	3	4	2	4	2	27
18	3	4	4	3	3	3	4	2	4	2	27
19	4	4	4	3	3	3	4	2	4	2	28
20	4	4	4	3	3	3	4	2	4	2	28
21	4	4	4	3	3	3	4	2	4	2	28
22	4	4	4	3	3	3	4	2	4	2	28
23	4	4	4	3	3	3	4	2	4	2	28
24	4	4	4	3	3	3	4	2	4	2	28
25	4	4	4	3	3	3	4	2	4	2	28
26	4	4	4	3	3	3	4	2	4	2	28
27	4	4	4	3	3	3	4	2	4	2	28
28	4	4	4	3	3	3	4	2	4	2	28
29	4	4	4	3	3	3	4	2	4	2	28
30	4	4	4	3	3	3	4	2	4	2	28

Appendix 3.5
(continued)
Tansy Aster (Field-Collected) Negative Control Emergence

Day	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	% Emergence
31	4	4	4	3	3	3	4	2	4	2	28
32	4	4	4	3	3	3	4	2	4	2	28
33	4	4	4	3	3	3	4	2	4	2	28
34	4	4	4	3	3	3	4	2	4	2	28
35	4	4	4	3	3	3	4	2	4	2	28
36	4	4	4	3	3	3	4	2	4	2	28
37	4	4	4	3	3	3	4	2	4	2	28
38	4	4	4	3	3	3	4	2	4	2	28[1]
39	4	4	4	3	3	3	4	2	4	2	28
40	4	4	4	3	3	3	4	2	4	2	28
41	4	4	4	3	3	3	4	2	4	2	28
42	4	4	4	3	3	3	4	2	4	2	28
43	4	4	4	3	3	3	4	2	4	2	28

[1] Day 38 (March 10, 2015) was designated to be Day 0 after determining that additional emergence was not likely. Collection of the plants was made 14 days later, on March 24, 2015.

Appendix 3.6

Scarlet Globemallow (Nursery-Provided) Negative Control Emergence

Day	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	% Emergence
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0

Appendix 3.6
(continued)
Scarlet Globemallow (Nursery-Provided) Negative Control Emergence

Day	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	% Emergence
12	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0

Appendix 3.7

Scarlet Globemallow (Field-Collected) Negative Control Emergence

Day	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	% Emergence
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	1	1	0	0	0
4	0	0	0	0	0	0	1	1	0	0	0
5	0	0	0	0	0	0	1	1	0	0	0
6	0	0	0	0	0	0	1	1	0	0	0
7	0	0	0	0	0	0	1	1	0	0	0
8	0	0	0	0	0	0	1	1	0	0	0
9	0	0	0	0	0	0	1	1	0	0	0
10	0	0	0	0	0	0	1	1	0	0	0
11	0	0	0	0	0	0	1	1	0	0	0

Appendix 3.7
(continued)
Scarlet Globemallow (Field-Collected) Negative Control Emergence

Day	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	% Emergence
12	0	0	0	0	0	0	1	1	0	0	0
13	0	0	0	0	0	0	1	1	0	0	0
14	0	0	0	0	0	0	1	1	0	0	0
15	0	0	0	0	0	0	1	1	0	0	0
16	0	0	0	0	0	0	1	1	0	0	0
17	0	0	0	0	0	0	1	1	0	0	0
18	0	0	0	0	0	0	1	1	0	0	0
19	0	0	0	0	0	0	1	1	0	0	0
20	0	0	0	0	0	0	1	1	0	0	0
21	0	0	0	0	0	0	1	1	0	0	0

Appendix 4.1

Alfalfa Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
NC	A	5.9	5.6	6	10	10	18	0.335	0.0335
NC	B	5.9	5.4	7	11	11	28	0.766	0.0696
NC	C	5.9	5.4	7	12	12	28	0.809	0.0674
NC	D	5.9	5.4	4	11	11	22	0.457	0.0415
NC	E	5.9	5.4	6	9	8	22	0.358	0.0448
NC	F	5.9	5.5	6	9	9	22	0.496	0.0551
NC	G	5.9	5.2	7	7	6	22	0.347	0.0578
NC	H	5.9	5.3	6	6	6	18	0.226	0.0377
NC	I	5.9	5.3	10	10	9	26	0.372	0.0413
NC	J	5.9	5.5	8	11	11	25	0.667	0.0606
					9.60	9.30	23.1		0.0509
					1.90	2.11	3.60		0.0128
SOIL 1	A	4.5	5.2	6	8	8	1	0.034	0.0043
SOIL 1	B	4.5	4.8	2	7	6	1	0.023	0.0038
SOIL 1	C	4.5	4.5	4	7	6	1	0.011	0.0018
SOIL 1	D	4.5	4.6	1	5	5	2	0.011	0.0022
SOIL 1	E	4.5	4.6	1	1	1	1	0.003	0.0030
SOIL 1	F	4.5	4.6	1	8	7	2	0.017	0.0024
SOIL 1	G	4.5	5.2	6	9	7	2	0.026	0.0037
SOIL 1	H	4.5	5.1	3	6	5	1	0.016	0.0032
SOIL 1	I	4.5	5.6	2	7	5	1	0.017	0.0034
SOIL 1	J	4.5	5.8	3	5	4	1	0.020	0.0050
					6.30	5.40	1.3		0.0033
					2.26	1.96	0.48		0.0010

Appendix 4.1
(continued)
Alfalfa Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 2	A	5.8	5.4	9	9	9	6	0.153	0.0170
SOIL 2	B	5.8	5.4	10	10	10	7	0.168	0.0168
SOIL 2	C	5.8	5.2	10	10	10	10	0.168	0.0168
SOIL 2	D	5.8	5.4	7	9	9	5	0.122	0.0136
SOIL 2	E	5.8	4.6	5	9	9	7	0.165	0.0183
SOIL 2	F	5.8	6.1	8	8	8	6	0.103	0.0129
SOIL 2	G	5.8	5.4	7	7	7	5	0.094	0.0134
SOIL 2	H	5.8	5.2	2	5	5	9	0.052	0.0104
SOIL 2	I	5.8	5.4	2	8	8	4	0.035	0.0044
SOIL 2	J	5.8	5.6	5	7	7	6	0.082	0.0117
					8.20	8.20	6.5		0.0135
					1.55	1.55	1.84		0.0041
SOIL 3	A	5.2	5.2	3	5	5	5	0.048	0.0096
SOIL 3	B	5.2	5.2	8	8	7	3	0.077	0.0110
SOIL 3	C	5.2	5.2	0	1	0	.	.	.
SOIL 3	D	5.2	4.9	0	3	3	3	0.024	0.0080
SOIL 3	E	5.2	4	1	2	2	1	0.020	0.0100
SOIL 3	F	5.2	3.8	2	3	3	1	0.015	0.0050
SOIL 3	G	5.2	3.7	0	2	2	3	0.017	0.0085
SOIL 3	H	5.2	3.6	0	2	2	1	0.009	0.0045
SOIL 3	I	5.2	3.7	0	1	1	0.25	0.002	0.0020
SOIL 3	J	5.2	3.6	0	3	3	1	0.015	0.0050
					3.00	2.80	2.0		0.0071
					2.11	1.99	1.54		0.0030

Appendix 4.1

(continued)

Alfalfa Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 4	A	4.5	3	0	2	2	3	0.008	0.0040
SOIL 4	B	4.5	3.9	2	8	7	4	0.090	0.0129
SOIL 4	C	4.5	3.6	1	2	2	4	0.029	0.0145
SOIL 4	D	4.5	3.8	1	4	4	5	0.041	0.0103
SOIL 4	E	4.5	3.8	2	7	7	5	0.085	0.0121
SOIL 4	F	4.5	3.8	1	5	5	4	0.047	0.0094
SOIL 4	G	4.5	3.8	2	5	5	4	0.052	0.0104
SOIL 4	H	4.5	3.9	3	6	5	7	0.098	0.0196
SOIL 4	I	4.5	3.8	0	2	2	2	0.011	0.0055
SOIL 4	J	4.5	3.8	2	7	6	19	0.075	0.0125
					4.80	4.50	5.7		0.0111
					2.25	1.96	4.85		0.0044
SOIL 5	A	5.4	5.4	10	10	10	14	0.136	0.0136
SOIL 5	B	5.4	5	10	11	11	18	0.147	0.0134
SOIL 5	C	5.4	4.6	10	11	11	14	0.228	0.0207
SOIL 5	D	5.4	5.8	8	8	8	5	0.057	0.0071
SOIL 5	E	5.4	5.2	9	9	9	10	0.094	0.0104
SOIL 5	F	5.4	5.2	10	10	8	16	0.110	0.0138
SOIL 5	G	5.4	5	9	10	10	9	0.162	0.0162
SOIL 5	H	5.4	4.8	9	10	9	7	0.121	0.0134
SOIL 5	I	5.4	4.8	3	4	4	6	0.057	0.0143
SOIL 5	J	5.4	5.2	9	9	9	8	0.118	0.0131
					9.20	8.90	10.7		0.0136
					2.04	2.02	4.50		0.0035

Appendix 4.1

(continued)

Alfalfa Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 6	A	4.8	4.6	10	10	10	7	0.050	0.0050
SOIL 6	B	4.8	4.2	6	8	6	2	0.031	0.0052
SOIL 6	C	4.8	4.4	6	10	10	7	0.056	0.0056
SOIL 6	D	4.8	4.4	6	10	10	3	0.078	0.0078
SOIL 6	E	4.8	4.5	5	10	10	3	0.064	0.0064
SOIL 6	F	4.8	4	10	11	10	3	0.060	0.0060
SOIL 6	G	4.8	4	7	10	9	3	0.050	0.0056
SOIL 6	H	4.8	4	5	8	7	2	0.035	0.0050
SOIL 6	I	4.8	4.2	2	9	9	2	0.047	0.0052
SOIL 6	J	4.8	4.3	6	8	8	2	0.052	0.0065
					9.40	8.90	3.4		0.0058
					1.07	1.45	1.96		0.0009
SOIL 7	A	5.0	4.3	3	3	3	2	0.011	0.0037
SOIL 7	B	5.0	3.7	6	10	6	1	0.012	0.0020
SOIL 7	C	5.0	3.7	2	7	6	1	0.016	0.0027
SOIL 7	D	5.0	3.8	3	7	4	2	0.015	0.0038
SOIL 7	E	5.0	3.5	4	8	6	1	0.004	0.0007
SOIL 7	F	5.0	3	0	1	1	1	0.003	0.0030
SOIL 7	G	5.0	3.5	0	5	3	1	0.009	0.0030
SOIL 7	H	5.0	3.5	2	6	4	1	0.010	0.0025
SOIL 7	I	5.0	3	1	3	2	1	0.004	0.0020
SOIL 7	J	5.0	3.7	0	4	2	0.25	0.002	0.0010
					5.40	3.70	1.1		0.0024
					2.72	1.83	0.52		0.0010

Appendix 4.1
(continued)
Alfalfa Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 8	A	4.6	3.7	6	9	9	2	0.055	0.0061
SOIL 8	B	4.6	4	12	12	12	2	0.086	0.0072
SOIL 8	C	4.6	3.7	10	10	10	3	0.082	0.0082
SOIL 8	D	4.6	4.1	11	11	11	3	0.090	0.0082
SOIL 8	E	4.6	3.6	9	10	10	2	0.085	0.0085
SOIL 8	F	4.6	3.6	6	8	8	2	0.046	0.0058
SOIL 8	G	4.6	3.5	7	9	9	2	0.075	0.0083
SOIL 8	H	4.6	3.8	5	9	9	3	0.150	0.0167
SOIL 8	I	4.6	3.7	8	9	9	3	0.065	0.0072
SOIL 8	J	4.6	3.8	11	11	11	2	0.067	0.0061
					9.80	9.80	2.4		0.0082
					1.23	1.23	0.52		0.0031
SOIL 9	A	5.7	5.8	1	1	0	.	.	.
SOIL 9	B	5.7	5.6	0	0	.	.	.	.
SOIL 9	C	5.7	5.2	0	1	0	.	.	.
SOIL 9	D	5.7	5.2	0	1	0	.	.	.
SOIL 9	E	5.7	5.4	0	1	0	.	.	.
SOIL 9	F	5.7	5.4	1	1	0	.	.	.
SOIL 9	G	5.7	5.6	1	1	0	.	.	.
SOIL 9	H	5.7	5.3	0	0	.	.	.	.
SOIL 9	I	5.7	5.2	0	0	.	.	.	.
SOIL 9	J	5.7	5	0	1	0	.	.	.
					0.70	0.00	.		.
					0.48	0.00	.		.

Appendix 4.1
(continued)
Alfalfa Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 10	A	5.2	4.5	5	7	7	1	0.012	0.0017
SOIL 10	B	5.2	4.5	4	8	8	1	0.016	0.0020
SOIL 10	C	5.2	5.4	5	9	8	1	0.028	0.0035
SOIL 10	D	5.2	5.2	3	9	8	2	0.029	0.0036
SOIL 10	E	5.2	5.6	3	7	7	1	0.019	0.0027
SOIL 10	F	5.2	5.5	1	8	8	2	0.036	0.0045
SOIL 10	G	5.2	5	3	6	5	2	0.018	0.0036
SOIL 10	H	5.2	5.7	0	7	7	2	0.024	0.0034
SOIL 10	I	5.2	5.8	0	7	7	2	0.028	0.0040
SOIL 10	J	5.2	6.3	0	1	1	1	0.002	0.0020
					6.90	6.60	1.5		0.0031
					2.28	2.17	0.53		0.0009
SOIL 11	A	5.6	6.2	3	4	3	2	0.025	0.0083
SOIL 11	B	5.6	6.2	4	4	3	2	0.011	0.0037
SOIL 11	C	5.6	5.8	3	9	9	1	0.036	0.0040
SOIL 11	D	5.6	5.4	3	7	4	2	0.021	0.0053
SOIL 11	E	5.6	5.5	0	6	1	1	0.017	0.0170
SOIL 11	F	5.6	5.7	1	4	4	2	0.018	0.0045
SOIL 11	G	5.6	6	2	4	3	3	0.014	0.0047
SOIL 11	H	5.6	5.4	0	4	4	2	0.012	0.0030
SOIL 11	I	5.6	5.9	0	4	4	1	0.024	0.0060
SOIL 11	J	5.6	5.6	1	6	5	1	0.028	0.0056
					5.20	4.00	1.7		0.0062
					1.75	2.05	0.67		0.0041

Appendix 4.1

(continued)

Alfalfa Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 12	A	6.2	3.8	8	9	9	14	0.120	0.0133
SOIL 12	B	6.2	3.6	8	8	8	20	0.080	0.0100
SOIL 12	C	6.2	4.8	7	8	8	15	0.121	0.0151
SOIL 12	D	6.2	4.4	2	5	5	5	0.054	0.0108
SOIL 12	E	6.2	4.6	3	6	6	18	0.065	0.0108
SOIL 12	F	6.2	5	6	8	7	18	0.094	0.0134
SOIL 12	G	6.2	5.2	6	7	7	19	0.057	0.0081
SOIL 12	H	6.2	4.8	4	7	7	18	0.060	0.0086
SOIL 12	I	6.2	5.9	7	8	8	21	0.096	0.0120
SOIL 12	J	6.2	5.2	8	9	9	20	0.119	0.0132
					7.50	7.40	16.8		0.0115
					1.27	1.26	4.69		0.0023
SOIL 13	A	5.8	5	6	10	10	4	0.098	0.0098
SOIL 13	B	5.8	4.6	6	6	6	5	0.062	0.0103
SOIL 13	C	5.8	5	8	10	9	3	0.081	0.0090
SOIL 13	D	5.8	4.6	9	10	8	3	0.079	0.0099
SOIL 13	E	5.8	5.6	9	10	9	3	0.108	0.0120
SOIL 13	F	5.8	5.1	7	8	8	4	0.087	0.0109
SOIL 13	G	5.8	5	6	11	9	3	0.100	0.0111
SOIL 13	H	5.8	5.2	5	7	6	4	0.075	0.0125
SOIL 13	I	5.8	5.4	7	8	7	4	0.099	0.0141
SOIL 13	J	5.8	4.5	7	8	8	3	0.077	0.0096
					8.80	8.00	3.6		0.0109
					1.62	1.33	0.70		0.0016

Appendix 4.1
(continued)
Alfalfa Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 14	A	5.0	3.5	3	4	4	1	0.020	0.0050
SOIL 14	B	5.0	3.6	1	2	1	1	0.007	0.0070
SOIL 14	C	5.0	3.5	0	5	3	1	0.010	0.0033
SOIL 14	D	5.0	3	1	1	1	1	0.004	0.0040
SOIL 14	E	5.0	3.8	1	2	2	1	0.008	0.0040
SOIL 14	F	5.0	3.4	2	4	2	1	0.002	0.0010
SOIL 14	G	5.0	3.8	0	4	2	1	0.007	0.0035
SOIL 14	H	5.0	3.2	1	5	3	2	0.009	0.0030
SOIL 14	I	5.0	3.6	0	5	2	1	0.020	0.0100
SOIL 14	J	5.0	3.7	3	4	3	1	0.006	0.0020
					3.60	2.30	1.1		0.0043
					1.43	0.95	0.32		0.0026
SOIL 15	A	5.3	4.2	3	4	1	1	0.006	0.0060
SOIL 15	B	5.3	3.9	7	7	5	2	0.023	0.0046
SOIL 15	C	5.3	3.8	6	6	3	2	0.014	0.0047
SOIL 15	D	5.3	4.2	2	2	1	1	0.018	0.0180
SOIL 15	E	5.3	5.2	7	7	3	2	0.029	0.0097
SOIL 15	F	5.3	4	9	9	8	2	0.045	0.0056
SOIL 15	G	5.3	3.8	10	12	11	2	0.085	0.0077
SOIL 15	H	5.3	3.9	5	9	8	2	0.042	0.0053
SOIL 15	I	5.3	3.7	0	2	2	1	0.011	0.0055
SOIL 15	J	5.3	3.8	3	3	3	2	0.028	0.0093
					6.10	4.50	1.7		0.0076
					3.35	3.41	0.48		0.0041

Appendix 4.1
(continued)
Alfalfa Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 16	A	6.2	3.6	8	9	9	2	0.053	0.0059
SOIL 16	B	6.2	3.4	7	10	9	3	0.053	0.0059
SOIL 16	C	6.2	4	3	8	6	2	0.029	0.0048
SOIL 16	D	6.2	3.5	8	9	9	2	0.054	0.0060
SOIL 16	E	6.2	3.8	6	8	8	2	0.043	0.0054
SOIL 16	F	6.2	3.4	9	9	9	2	0.052	0.0058
SOIL 16	G	6.2	3.6	5	7	7	2	0.048	0.0069
SOIL 16	H	6.2	3	9	11	9	3	0.054	0.0060
SOIL 16	I	6.2	3.5	9	10	10	2	0.048	0.0048
SOIL 16	J	6.2	3.6	3	8	8	3	0.047	0.0059
					8.90	8.40	2.3		0.0057
					1.20	1.17	0.48		0.0006
SOIL 17	A	5.8	5.9	5	10	9	3	0.125	0.0139
SOIL 17	B	5.8	6	1	7	7	6	0.075	0.0107
SOIL 17	C	5.8	5.8	8	11	11	12	0.152	0.0138
SOIL 17	D	5.8	5.8	7	8	8	8	0.119	0.0149
SOIL 17	E	5.8	5.8	7	8	8	8	0.116	0.0145
SOIL 17	F	5.8	5.8	6	12	11	17	0.123	0.0112
SOIL 17	G	5.8	5.8	6	11	10	18	0.105	0.0105
SOIL 17	H	5.8	6.4	11	12	11	9	0.161	0.0146
SOIL 17	I	5.8	5.5	8	9	9	10	0.136	0.0151
SOIL 17	J	5.8	6	11	11	11	9	0.201	0.0183
					9.90	9.50	10.0		0.0137
					1.79	1.51	4.62		0.0024

Appendix 4.1
(continued)
Alfalfa Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 19	A	4.1	5.6	2	2	0	.	.	.
SOIL 19	B	4.1	6.2	0	3	0	.	.	.
SOIL 19	C	4.1	6.6	0	0	0	.	.	.
SOIL 19	D	4.1	6.2	0	2	1	0.25	0.003	0.0030
SOIL 19	E	4.1	6.4	1	1	0	.	.	.
SOIL 19	F	4.1	6	1	5	3	0.25	0.007	0.0023
SOIL 19	G	4.1	6.3	1	3	2	0.25	0.012	0.0060
SOIL 19	H	4.1	6.4	1	2	1	0.25	0.004	0.0040
SOIL 19	I	4.1	6	1	3	3	1	0.015	0.0050
SOIL 19	J	4.1	6.4	0	1	1	0.25	0.004	0.0040
					2.20	1.10	0.4		0.0041
					1.40	1.20	0.31		0.0013
SOIL 20	A	6.5	5.8	6	8	8	18	0.070	0.0088
SOIL 20	B	6.5	5.4	8	9	9	8	0.107	0.0119
SOIL 20	C	6.5	6.4	7	9	9	10	0.108	0.0120
SOIL 20	D	6.5	5.8	1	8	8	4	0.040	0.0050
SOIL 20	E	6.5	5.7	0	4	4	2	0.016	0.0040
SOIL 20	F	6.5	5.6	4	8	7	7	0.079	0.0113
SOIL 20	G	6.5	6.4	11	11	11	9	0.145	0.0132
SOIL 20	H	6.5	5.8	6	8	8	8	0.084	0.0105
SOIL 20	I	6.5	6.5	9	9	9	8	0.121	0.0134
SOIL 20	J	6.5	5.8	2	7	7	3	0.071	0.0101
					8.10	8.00	7.7		0.0100
					1.79	1.83	4.50		0.0032

Appendix 4.1
(continued)
Alfalfa Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 21	A	5.5	5.5	4	4	1	0.25	0.002	0.0020
SOIL 21	B	5.5	5.7	5	5	0	.	.	.
SOIL 21	C	5.5	5.4	2	4	4	1	0.016	0.0040
SOIL 21	D	5.5	5.4	4	4	4	1	0.018	0.0045
SOIL 21	E	5.5	5.4	0	1	1	2	0.007	0.0070
SOIL 21	F	5.5	5	3	8	6	1	0.031	0.0052
SOIL 21	G	5.5	5.2	5	5	4	1	0.025	0.0063
SOIL 21	H	5.5	5.2	2	4	3	0.25	0.014	0.0047
SOIL 21	I	5.5	4.9	1	3	3	0.25	0.015	0.0050
SOIL 21	J	5.5	5.4	2	7	7	1	0.063	0.0090
					4.50	3.30	0.9		0.0053
					1.96	2.21	0.56		0.0020
SOIL 22	A	6.3	4.2	8	9	7	1	0.014	0.0020
SOIL 22	B	6.3	4.6	8	8	7	1	0.059	0.0084
SOIL 22	C	6.3	4.6	7	7	5	0.25	0.002	0.0004
SOIL 22	D	6.3	4.8	7	10	10	1	0.055	0.0055
SOIL 22	E	6.3	5.7	3	5	5	1	0.028	0.0056
SOIL 22	F	6.3	6.1	6	11	11	1	0.068	0.0062
SOIL 22	G	6.3	5.4	4	8	8	1	0.043	0.0054
SOIL 22	H	6.3	5	3	4	4	1	0.027	0.0068
SOIL 22	I	6.3	5.7	3	7	7	1	0.045	0.0064
SOIL 22	J	6.3	5.6	5	8	8	1	0.050	0.0063
					7.70	7.20	0.9		0.0053
					2.11	2.20	0.24		0.0024

Appendix 4.1

(continued)

Alfalfa Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 23	A	6.2	6.8	3	5	3	0.25	0.008	0.0027
SOIL 23	B	6.2	6.2	5	8	2	1	0.012	0.0060
SOIL 23	C	6.2	6.7	3	6	6	1	0.024	0.0040
SOIL 23	D	6.2	6.7	5	7	7	3	0.030	0.0043
SOIL 23	E	6.2	6.8	1	7	6	3	0.028	0.0047
SOIL 23	F	6.2	6.3	6	9	8	2	0.033	0.0041
SOIL 23	G	6.2	6.7	6	7	7	2	0.029	0.0041
SOIL 23	H	6.2	6	5	9	8	2	0.037	0.0046
SOIL 23	I	6.2	6.2	4	6	5	1	0.027	0.0054
SOIL 23	J	6.2	5.9	8	10	10	1	0.044	0.0044
					7.40	6.20	1.6		0.0044
					1.58	2.39	0.92		0.0009
SOIL 24	A	4.8	3.5	6	10	10	10	0.223	0.0223
SOIL 24	B	4.8	3.4	4	8	8	16	0.189	0.0236
SOIL 24	C	4.8	3.8	4	8	8	21	0.155	0.0194
SOIL 24	D	4.8	3.6	6	7	7	23	0.171	0.0244
SOIL 24	E	4.8	4.1	6	10	10	24	0.233	0.0233
SOIL 24	F	4.8	3.8	8	8	8	23	0.224	0.0280
SOIL 24	G	4.8	4.1	5	8	8	13	0.214	0.0268
SOIL 24	H	4.8	4.2	0	0	.	.	.	.
SOIL 24	I	4.8	4.4	1	7	7	18	0.129	0.0184
SOIL 24	J	4.8	4.2	8	8	8	20	0.258	0.0323
					7.40	8.22	18.7		0.0243
					2.80	1.09	4.85		0.0043

Appendix 4.1

(continued)

Alfalfa Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 25	A	6.0	4.8	8	9	9	18	0.145	0.0161
SOIL 25	B	6.0	5.1	7	10	10	13	0.146	0.0146
SOIL 25	C	6.0	6	10	12	12	16	0.173	0.0144
SOIL 25	D	6.0	6.2	3	9	9	15	0.101	0.0112
SOIL 25	E	6.0	5.9	7	11	11	11	0.222	0.0202
SOIL 25	F	6.0	6.4	9	9	9	16	0.131	0.0146
SOIL 25	G	6.0	6	9	11	11	18	0.186	0.0169
SOIL 25	H	6.0	6.7	4	9	9	21	0.122	0.0136
SOIL 25	I	6.0	6.3	7	9	9	19	0.141	0.0157
SOIL 25	J	6.0	6.7	6	11	11	7	0.179	0.0163
					10.00	10.00	15.4		0.0153
					1.15	1.15	4.14		0.0023
SOIL 26	A	6.3	5.4	10	11	11	20	0.156	0.0142
SOIL 26	B	6.3	4.9	9	12	12	17	0.137	0.0114
SOIL 26	C	6.3	5.5	7	9	9	20	0.122	0.0136
SOIL 26	D	6.3	5.4	8	9	9	15	0.142	0.0158
SOIL 26	E	6.3	6	8	11	11	19	0.116	0.0105
SOIL 26	F	6.3	5.4	8	11	11	18	0.146	0.0133
SOIL 26	G	6.3	5.9	6	8	8	21	0.114	0.0143
SOIL 26	H	6.3	5.8	7	10	10	21	0.150	0.0150
SOIL 26	I	6.3	6.2	8	9	9	12	0.135	0.0150
SOIL 26	J	6.3	6.1	10	10	10	23	0.166	0.0166
					10.00	10.00	18.6		0.0140
					1.25	1.25	3.24		0.0019

Appendix 4.1
(continued)
Alfalfa Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 27	A	6.0	4.9	7	10	10	3	0.070	0.0070
SOIL 27	B	6.0	5.5	5	10	10	2	0.083	0.0083
SOIL 27	C	6.0	4.9	6	9	9	2	0.070	0.0078
SOIL 27	D	6.0	5.8	1	5	4	2	0.023	0.0058
SOIL 27	E	6.0	4.2	4	11	11	3	0.073	0.0066
SOIL 27	F	6.0	5.4	9	11	11	2	0.083	0.0075
SOIL 27	G	6.0	4.6	8	9	9	1	0.060	0.0067
SOIL 27	H	6.0	4.7	3	12	12	2	0.072	0.0060
SOIL 27	I	6.0	4.1	6	9	9	2	0.058	0.0064
SOIL 27	J	6.0	5	5	10	7	2	0.029	0.0041
					9.60	9.20	2.1		0.0066
					1.90	2.30	0.57		0.0012
SOIL 28	A	7.0	5.8	7	7	6	6	0.096	0.0160
SOIL 28	B	7.0	5.4	8	8	8	9	0.156	0.0195
SOIL 28	C	7.0	6	10	10	10	26	0.104	0.0104
SOIL 28	D	7.0	5.8	9	9	9	35	0.137	0.0152
SOIL 28	E	7.0	6	3	4	4	25	0.073	0.0183
SOIL 28	F	7.0	6	10	11	10	26	0.171	0.0171
SOIL 28	G	7.0	6.1	2	3	3	15	0.051	0.0170
SOIL 28	H	7.0	6.4	5	7	7	30	0.098	0.0140
SOIL 28	I	7.0	6.4	4	4	4	19	0.066	0.0165
SOIL 28	J	7.0	6.4	7	7	7	28	0.111	0.0159
					7.00	6.80	21.9		0.0160
					2.67	2.53	9.39		0.0025

Appendix 4.1
(continued)
Alfalfa Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 29	A	5.0	6.2	8	9	8	2	0.042	0.0053
SOIL 29	B	5.0	6.4	7	7	5	2	0.020	0.0040
SOIL 29	C	5.0	5.9	8	9	9	2	0.052	0.0058
SOIL 29	D	5.0	6	5	9	8	2	0.031	0.0039
SOIL 29	E	5.0	5.8	8	8	7	1	0.038	0.0054
SOIL 29	F	5.0	5.5	4	7	7	3	0.029	0.0041
SOIL 29	G	5.0	5.6	2	5	5	3	0.034	0.0068
SOIL 29	H	5.0	5.4	5	7	7	2	0.040	0.0057
SOIL 29	I	5.0	5.2	3	6	6	2	0.032	0.0053
SOIL 29	J	5.0	5.2	1	2	2	2	0.014	0.0070
					6.90	6.40	2.1		0.0053
					2.18	2.01	0.57		0.0011
SOIL 30	A	4.6	4.8	1	3	3	1	0.024	0.0080
SOIL 30	B	4.6	4.8	2	3	3	2	0.022	0.0073
SOIL 30	C	4.6	4.4	3	5	4	2	0.017	0.0043
SOIL 30	D	4.6	4.2	2	4	3	2	0.013	0.0043
SOIL 30	E	4.6	4.4	3	4	3	2	0.018	0.0060
SOIL 30	F	4.6	4.4	1	1	1	3	0.004	0.0040
SOIL 30	G	4.6	3.9	1	1	0	.	.	.
SOIL 30	H	4.6	3.9	0	2	2	2	0.020	0.0100
SOIL 30	I	4.6	4	0	0	.	.	.	.
SOIL 30	J	4.6	4.8	1	1	1	0.25	0.007	0.0070
					2.40	2.22	1.8		0.0064
					1.65	1.30	0.82		0.0021

Appendix 4.1

(continued)

Alfalfa Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 31	A	6.4	4.1	4	5	4	5	0.074	0.0185
SOIL 31	B	6.4	4.6	7	10	9	5	0.099	0.0110
SOIL 31	C	6.4	3.7	9	9	9	4	0.123	0.0137
SOIL 31	D	6.4	4.3	9	9	9	5	0.137	0.0152
SOIL 31	E	6.4	4.1	6	8	8	4	0.098	0.0123
SOIL 31	F	6.4	4.2	9	11	11	4	0.075	0.0068
SOIL 31	G	6.4	4.1	9	11	11	3	0.129	0.0117
SOIL 31	H	6.4	4.9	4	5	5	4	0.097	0.0194
SOIL 31	I	6.4	4.2	10	10	10	4	0.149	0.0149
SOIL 31	J	6.4	4.4	10	10	8	4	0.113	0.0141
					8.80	8.40	4.2		0.0138
					2.20	2.32	0.63		0.0037
SOIL 32	A	6.0	5.6	0	4	3	1	0.006	0.0020
SOIL 32	B	6.0	6.5	1	4	2	2	0.066	0.0330
SOIL 32	C	6.0	5.4	5	7	5	0.25	0.018	0.0036
SOIL 32	D	6.0	6	4	9	7	2	0.023	0.0033
SOIL 32	E	6.0	4.9	6	11	10	2	0.033	0.0033
SOIL 32	F	6.0	6.2	3	8	7	2	0.019	0.0027
SOIL 32	G	6.0	5	0	6	5	1	0.014	0.0028
SOIL 32	H	6.0	5.8	2	7	4	0.25	0.020	0.0050
SOIL 32	I	6.0	5.2	8	9	8	2	0.037	0.0046
SOIL 32	J	6.0	6	8	10	10	2	0.039	0.0039
					7.50	6.10	1.5		0.0064
					2.37	2.77	0.75		0.0094

Appendix 4.1
(continued)
Alfalfa Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 35	A	4.8	3.7	0	0	.	.	.	.
SOIL 35	B	4.8	3.6	0	0	.	.	.	.
SOIL 35	C	4.8	4.1	1	1	0	.	.	.
SOIL 35	D	4.8	3.7	0	1	0	.	.	.
SOIL 35	E	4.8	4.2	0	1	0	.	.	.
SOIL 35	F	4.8	5.1	0	0	.	.	.	.
SOIL 35	G	4.8	6.1	0	1	0	.	.	.
SOIL 35	H	4.8	5.1	0	2	0	.	.	.
SOIL 35	I	4.8	5.5	0	0	.	.	.	.
SOIL 35	J	4.8	5	0	0	.	.	.	.
					0.60	0.00	#DIV/0!		#DIV/0!
					0.70	0.00	#DIV/0!		#DIV/0!
SOIL 36	A	5.5	4.3	1	1	0	.	.	.
SOIL 36	B	5.5	4.2	0	0	.	.	.	.
SOIL 36	C	5.5	3.9	0	0	.	.	.	.
SOIL 36	D	5.5	5	2	2	1	1	0.007	0.0070
SOIL 36	E	5.5	4	1	1	0	.	.	.
SOIL 36	F	5.5	3.8	0	0	.	.	.	.
SOIL 36	G	5.5	3.9	0	1	1	1	0.006	0.0060
SOIL 36	H	5.5	3.8	0	0	.	.	.	.
SOIL 36	I	5.5	4.4	2	4	2	0.25	0.008	0.0040
SOIL 36	J	5.5	4.4	0	0	.	.	.	.
					0.90	0.80	0.8		0.0057
					1.29	0.84	0.43		0.0015

Appendix 4.2

Alfalfa Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
NC	A	7.6	13	9	11	6	7	6	8	3	6	7	.	.
NC	B	8.0	12	9	10	7	11	7	4	6	4	7	11	.
NC	C	7.6	10	6	7	6	8	7	5	6	12	8	4	12
NC	D	10.7	10	8	10	4	8	6	9	5	43	9	6	.
NC	E	9.1	13	12	3	12	12	7	6	8	.	.	.	.
NC	F	7.4	6	6	8	6	6	11	7	4	13	.	.	.
NC	G	11.2	11	8	11	14	10	13	.	.	.	.	.	.
NC	H	7.2	8	6	7	10	6	6	.	.	.	.	.	.
NC	I	8.8	11	8	6	7	8	10	12	5	12	.	.	.
NC	J	9.5	13	11	13	15	5	8	9	9	7	6	9	.
		8.7												
		1.41												
SOIL 1	A	0.3	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	.	.	.	.
SOIL 1	B	0.3	0.25	0.25	0.25	0.25	0.25	0.25	.	.	.	.	.	.
SOIL 1	C	0.5	0.25	0.25	0.25	0.25	1	1	.	.	.	.	.	.
SOIL 1	D	1.1	0.25	1	1	1	2	.	.	.	.	.	.	.
SOIL 1	E	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	F	0.5	0.25	0.25	0.25	0.25	0.25	1	1	.	.	.	.	.
SOIL 1	G	0.8	0.25	0.25	0.25	1	2	1	1	.	.	.	.	.
SOIL 1	H	0.7	0.25	0.25	1	1	1	.	.	.	.	.	.	.
SOIL 1	I	0.4	0.25	0.25	0.25	0.25	1	.	.	.	.	.	.	.
SOIL 1	J	0.4	0.25	0.25	0.25	1	.	.	.	.	.	.	.	.
		0.6												
		0.29												

Appendix 4.2
(continued)
Alfalfa Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 2	A	5.1	7	4	5	4	7	7	3	6	3	.	.	.
SOIL 2	B	5.2	7	5	3	6	3	5	4	6	6	7	.	.
SOIL 2	C	4.7	6	5	6	4	5	3	3	4	6	5	.	.
SOIL 2	D	4.2	6	5	4	5	4	5	4	3	2	.	.	.
SOIL 2	E	4.6	5	6	4	5	3	2	6	5	5	.	.	.
SOIL 2	F	4.0	5	6	4	4	5	1	2	5	.	.	.	.
SOIL 2	G	4.3	4	4	4	5	4	5	4	.	.	.	.	.
SOIL 2	H	4.0	5	4	6	2	3	.	.	.	.	.	.	.
SOIL 2	I	1.8	2	1	2	0.25	1	3	2	3	.	.	.	.
SOIL 2	J	4.0	4	4	3	3	5	4	5	.	.	.	.	.
		4.2												
		0.95												
SOIL 3	A	2.6	5	1	2	4	1	.	.	.	.	.	.	.
SOIL 3	B	3.1	3	3	3	3	3	3	4	.	.	.	.	.
SOIL 3	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 3	D	2.8	3	5	0.25	.	.	.	.	.	.	.	.	.
SOIL 3	E	2.0	2	2	.	.	.	.	.	.	.	.	.	.
SOIL 3	F	1.4	1	0.25	3	.	.	.	.	.	.	.	.	.
SOIL 3	G	3.5	2	5	.	.	.	.	.	.	.	.	.	.
SOIL 3	H	1.1	2	0.25	.	.	.	.	.	.	.	.	.	.
SOIL 3	I	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 3	J	1.3	2	1	1	.	.	.	.	.	.	.	.	.
		2.1												
		0.93												

Appendix 4.2

(continued)

Alfalfa Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 4	A	1.0	1	1	.	.	.	.	.	.	.	.	.	.
SOIL 4	B	4.3	5	4	5	3	5	3	5	.	.	.	.	.
SOIL 4	C	6.0	5	7	.	.	.	.	.	.	.	.	.	.
SOIL 4	D	4.5	4	5	6	3	.	.	.	.	.	.	.	.
SOIL 4	E	4.1	4	9	5	5	2	2	2	.	.	.	.	.
SOIL 4	F	3.4	7	1	3	5	1	.	.	.	.	.	.	.
SOIL 4	G	2.3	4	5	1	0.25	1	.	.	.	.	.	.	.
SOIL 4	H	4.6	5	6	1	6	5	.	.	.	.	.	.	.
SOIL 4	I	1.5	2	1	.	.	.	.	.	.	.	.	.	.
SOIL 4	J	4.2	6	4	4	3	2	6	.	.	.	.	.	.
		3.6												
		1.55												
SOIL 5	A	4.1	3	5	4	4	3	4	5	3	5	5	.	.
SOIL 5	B	4.0	4	4	4	3	4	6	3	4	4	5	3	.
SOIL 5	C	4.3	4	5	5	4	3	4	6	4	5	3	4	.
SOIL 5	D	4.3	6	3	4	5	4	6	4	2	.	.	.	.
SOIL 5	E	4.9	5	5	4	5	4	4	5	6	6	.	.	.
SOIL 5	F	3.9	3	3	5	4	4	3	5	4	.	.	.	.
SOIL 5	G	4.7	5	4	4	6	5	4	5	5	3	6	.	.
SOIL 5	H	3.8	4	4	2	3	4	5	3	4	5	.	.	.
SOIL 5	I	4.0	3	3	5	5	.	.	.	.	.	.	.	.
SOIL 5	J	4.1	4	4	3	4	3	6	4	5	4	.	.	.
		4.2												
		0.35												

Appendix 4.2
(continued)
Alfalfa Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 6	A	1.7	2	1	2	2	2	2	1	2	2	1	.	.
SOIL 6	B	1.7	2	1	1	2	2	2	.	.	.	.	.	.
SOIL 6	C	1.8	2	2	2	2	1	2	3	1	1	2	.	.
SOIL 6	D	1.9	2	2	2	2	2	2	1	2	2	2	.	.
SOIL 6	E	1.6	2	1	2	1	2	2	1	2	2	1	.	.
SOIL 6	F	1.7	3	1	1	2	1	2	1	2	2	2	.	.
SOIL 6	G	1.8	2	1	2	2	2	1	2	2	2	.	.	.
SOIL 6	H	1.4	1	2	1	1	2	2	1	.	.	.	.	.
SOIL 6	I	1.9	2	2	2	1	2	2	2	2	2	.	.	.
SOIL 6	J	1.8	1	2	2	2	1	3	1	2	.	.	.	.
		1.7												
		0.14												
SOIL 7	A	0.8	2	0.25	0.25	.	.	.	.	.	.	.	.	.
SOIL 7	B	0.4	1	0.25	0.25	0.25	0.25	0.25	.	.	.	.	.	.
SOIL 7	C	0.6	1	1	0.25	0.25	1	0.25	.	.	.	.	.	.
SOIL 7	D	0.9	2	0.25	1	0.25	.	.	.	.	.	.	.	.
SOIL 7	E	0.5	1	1	0.25	0.25	0.25	0.25	.	.	.	.	.	.
SOIL 7	F	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	G	0.5	1	0.25	0.25	.	.	.	.	.	.	.	.	.
SOIL 7	H	0.4	1	0.25	0.25	0.25	.	.	.	.	.	.	.	.
SOIL 7	I	1.0	1	1	.	.	.	.	.	.	.	.	.	.
SOIL 7	J	0.6	1	0.25	.	.	.	.	.	.	.	.	.	.
		0.6												
		0.24												

Appendix 4.2
(continued)
Alfalfa Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 8	A	1.6	.	.	.	2	2	2	2	1	1	2	1	1
SOIL 8	B	2.1	2	2	2	2	1	2	2	3	2	2	2	3
SOIL 8	C	2.1	.	.	1	2	3	1	3	2	2	3	2	2
SOIL 8	D	2.4	.	2	2	2	2	2	2	2	2	3	4	3
SOIL 8	E	2.2	2	2	3	3	3	2	2	1	2	2	.	.
SOIL 8	F	2.3	.	.	.	.	3	3	3	2	2	2	2	1
SOIL 8	G	2.1	.	.	.	3	2	2	2	2	3	1	3	1
SOIL 8	H	2.2	.	.	.	2	3	2	2	2	2	2	3	2
SOIL 8	I	2.3	.	.	.	2	3	2	2	3	1	3	3	2
SOIL 8	J	1.8	.	3	2	1	1	2	2	2	1	1	2	3
		2.1												
		0.25												
SOIL 9	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												

Appendix 4.2
(continued)
Alfalfa Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 10	A	0.8	.	.	.	.	.	0.25	0.25	0.25	1	1	1	2
SOIL 10	B	1.1	.	.	.	.	0.25	0.25	2	1	2	1	1	1
SOIL 10	C	0.9	.	.	.	.	2	1	0.25	0.25	1	1	1	1
SOIL 10	D	0.7	.	.	.	.	0.25	0.25	1	1	1	1	1	0.25
SOIL 10	E	0.9	.	.	.	.	.	2	1	0.25	1	1	1	0.25
SOIL 10	F	1.4	.	.	.	.	1	2	2	1	1	2	2	0.25
SOIL 10	G	1.1	.	.	.	.	.	.	.	0.25	1	1	2	1
SOIL 10	H	1.0	.	.	.	.	.	2	1	2	0.25	1	0.25	0.25
SOIL 10	I	1.0	.	.	.	.	.	1	2	1	0.25	1	1	1
SOIL 10	J	0.3	.	.	.	.	.	.	.	.	.	.	.	0.25
		0.9												
		0.30												
SOIL 11	A	1.0	.	.	.	.	.	.	.	.	.	1	1	1
SOIL 11	B	1.0	.	.	.	.	.	.	.	.	.	1	1	1
SOIL 11	C	1.0	.	.	.	1	0.25	1	1	1	1	2	1	1
SOIL 11	D	0.6	.	.	.	.	.	.	.	.	1	1	0.25	0.25
SOIL 11	E	1.0	.	.	.	.	.	.	.	.	.	.	.	1
SOIL 11	F	1.1	.	.	.	.	.	.	.	.	1	2	1	0.25
SOIL 11	G	0.8	.	.	.	.	.	.	.	.	.	1	0.25	1
SOIL 11	H	1.3	.	.	.	.	.	.	.	.	1	1	2	1
SOIL 11	I	1.0	.	.	.	.	.	.	.	.	1	1	1	1
SOIL 11	J	1.4	.	.	.	.	.	.	.	1	2	2	1	1
		1.0												
		0.22												

Appendix 4.2

(continued)

Alfalfa Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 12	A	4.2	.	.	.	4	4	4	4	5	2	4	5	6
SOIL 12	B	4.1	.	.	.	.	4	4	4	4	5	3	4	5
SOIL 12	C	4.3	.	.	.	.	5	5	5	3	4	4	4	4
SOIL 12	D	3.4	.	.	.	.	.	.	.	3	3	5	3	3
SOIL 12	E	3.5	.	.	.	.	.	.	4	3	2	4	3	5
SOIL 12	F	3.9	.	.	.	.	.	4	4	4	4	4	4	3
SOIL 12	G	4.1	.	.	.	.	.	6	5	4	3	3	4	4
SOIL 12	H	3.4	.	.	.	.	.	3	3	3	3	4	4	4
SOIL 12	I	3.8	.	.	.	.	4	4	2	4	4	5	4	3
SOIL 12	J	3.4	.	.	.	3	3	3	4	3	3	3	5	4
		3.8												
		0.35												
SOIL 13	A	2.8	3	2	3	2	4	3	4	2	3	2	.	.
SOIL 13	B	2.7	3	2	3	3	3	2	.	.	.	.	.	.
SOIL 13	C	1.9	2	2	2	1	2	2	2	2	2	.	.	.
SOIL 13	D	2.3	2	2	1	3	2	3	3	2	.	.	.	.
SOIL 13	E	2.6	4	2	2	3	2	2	3	2	3	.	.	.
SOIL 13	F	2.9	4	3	0.25	3	3	3	4	3	.	.	.	.
SOIL 13	G	2.7	2	3	2	2	3	2	3	4	3	.	.	.
SOIL 13	H	3.0	3	4	3	2	3	3	.	.	.	.	.	.
SOIL 13	I	2.9	3	2	3	3	3	3	3	.	.	.	.	.
SOIL 13	J	2.3	2	3	3	2	0.25	1	4	3	.	.	.	.
		2.6												
		0.35												

Appendix 4.2

(continued)

Alfalfa Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 14	A	0.4	.	.	.	.	.	.	.	.	1	0.25	0.25	0.25
SOIL 14	B	1.0	.	.	.	.	.	.	.	.	.	.	.	1
SOIL 14	C	0.3	.	.	.	.	.	.	.	.	.	0.25	0.25	0.25
SOIL 14	D	1.0	.	.	.	.	.	.	.	.	.	.	.	1
SOIL 14	E	0.3	.	.	.	.	.	.	.	.	.	.	0.25	0.25
SOIL 14	F	0.3	.	.	.	.	.	.	.	.	.	.	0.25	0.25
SOIL 14	G	0.6	.	.	.	.	.	.	.	.	.	.	1	0.25
SOIL 14	H	0.3	.	.	.	.	.	.	.	.	.	0.25	0.25	0.25
SOIL 14	I	0.6	.	.	.	.	.	.	.	.	.	.	1	0.25
SOIL 14	J	0.3	.	.	.	.	.	.	.	.	.	0.25	0.25	0.25
		0.5												
		0.31												
SOIL 15	A	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 15	B	0.9	2	1	1	0.25	0.25	.	.	.	.	.	.	.
SOIL 15	C	1.3	2	1	1	.	.	.	.	.	.	.	.	.
SOIL 15	D	2.0	2	.	.	.	.	.	.	.	.	.	.	.
SOIL 15	E	1.1	2	1	0.25	.	.	.	.	.	.	.	.	.
SOIL 15	F	1.8	1	2	3	2	1	1	2	2	.	.	.	.
SOIL 15	G	2.3	2	3	3	2	2	2	3	2	2	2	2	.
SOIL 15	H	1.3	2	2	2	1	1	2	0.25	0.25	.	.	.	.
SOIL 15	I	2.5	3	2	.	.	.	.	.	.	.	.	.	.
SOIL 15	J	1.7	2	2	1	.	.	.	.	.	.	.	.	.
		1.5												
		0.67												

Appendix 4.2
(continued)
Alfalfa Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 16	A	0.9	1	1	0.25	1	0.25	0.25	1	1	2	.	.	.
SOIL 16	B	1.5	1	1	2	0.25	1	1	2	2	3	.	.	.
SOIL 16	C	1.0	1	1	1	2	1	0.25	.	.	.	.	.	.
SOIL 16	D	1.4	1	2	1	1	1	2	1	2	2	.	.	.
SOIL 16	E	1.3	1	1	2	0.25	1	2	1	2	.	.	.	.
SOIL 16	F	1.7	1	2	2	1	3	2	1	1	2	.	.	.
SOIL 16	G	1.3	1	2	2	2	1	1	0.25	.	.	.	.	.
SOIL 16	H	1.9	3	1	1	2	2	2	2	2	2	.	.	.
SOIL 16	I	1.2	1	1	1	1	2	1	2	1	2	0.25	.	.
SOIL 16	J	1.5	3	1	1	2	2	2	1	0.25	.	.	.	.
		1.4												
		0.30												
SOIL 17	A	4.0	5	5	4	5	5	3	4	4	1	.	.	.
SOIL 17	B	3.4	1	3	3	4	5	5	3	.	.	.	.	.
SOIL 17	C	4.0	4	4	4	4	4	4	5	5	5	5	0.25	.
SOIL 17	D	4.6	5	4	5	4	4	6	5	4	.	.	.	.
SOIL 17	E	4.5	5	5	5	4	4	5	5	3	.	.	.	.
SOIL 17	F	3.8	5	3	4	3	4	3	3	5	4	4	4	.
SOIL 17	G	3.6	4	3	4	3	4	3	4	5	1	5	.	.
SOIL 17	H	4.3	4	4	5	4	6	4	4	3	4	4	5	.
SOIL 17	I	4.3	5	5	5	4	5	4	5	5	0.25	.	.	.
SOIL 17	J	4.9	5	5	5	4	4	4	5	5	6	5	6	.
		4.1												
		0.46												

Appendix 4.2

(continued)

Alfalfa Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 19	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	D	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	F	0.3	0.25	0.25	0.25	.	.	.	.	.	.	.	.	.
SOIL 19	G	0.3	0.25	0.25	.	.	.	.	.	.	.	.	.	.
SOIL 19	H	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	I	1.0	1	1	1	.	.	.	.	.	.	.	.	.
SOIL 19	J	1.0	1	.	.	.	.	.	.	.	.	.	.	.
		0.6												
		0.41												
SOIL 20	A	3.4	4	4	0.25	3	3	4	4	5	.	.	.	.
SOIL 20	B	4.0	3	3	4	3	3	4	6	5	5	.	.	.
SOIL 20	C	4.0	4	4	4	5	3	4	5	3	4	.	.	.
SOIL 20	D	1.9	1	1	0.25	4	2	2	3	2	.	.	.	.
SOIL 20	E	1.1	0.25	0.25	1	3	.	.	.	.	.	.	.	.
SOIL 20	F	3.9	5	6	5	5	1	1	4	.	.	.	.	.
SOIL 20	G	3.9	5	4	4	4	4	4	3	3	4	4	4	.
SOIL 20	H	4.5	4	5	6	3	4	4	5	5	.	.	.	.
SOIL 20	I	4.3	4	5	4	5	4	3	5	4	5	.	.	.
SOIL 20	J	2.8	3	4	0.25	2	5	1	4	.	.	.	.	.
		3.4												
		1.11												

Appendix 4.2
(continued)
Alfalfa Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 21	A	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	C	0.4	1	0.25	0.25	0.25	.	.	.	.	.	.	.	.
SOIL 21	D	0.4	1	0.25	0.25	0.25	.	.	.	.	.	.	.	.
SOIL 21	E	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	F	0.9	1	1	1	1	1	0.25	.	.	.	.	.	.
SOIL 21	G	1.5	1	2	1	2	.	.	.	.	.	.	.	.
SOIL 21	H	1.7	2	1	2	.	.	.	.	.	.	.	.	.
SOIL 21	I	0.8	1	1	0.25	.	.	.	.	.	.	.	.	.
SOIL 21	J	1.6	1	2	1	1	3	1	2	.	.	.	.	.
		1.0												
		0.46												
SOIL 22	A	1.1	1	1	1	1	1	2	1	.	.	.	.	.
SOIL 22	B	1.2	2	0.25	2	1	1	1	1	.	.	.	.	.
SOIL 22	C	0.9	1	1	1	0.25	1	.	.	.	.	.	.	.
SOIL 22	D	1.2	1	1	1	1	2	1	2	1	1	1	.	.
SOIL 22	E	1.2	2	1	1	1	1	.	.	.	.	.	.	.
SOIL 22	F	1.0	1	2	1	1	1	1	1	1	0.25	0.25	2	.
SOIL 22	G	1.1	1	2	1	0.25	1	1	2	0.25	.	.	.	.
SOIL 22	H	1.3	2	1	1	1	.	.	.	.	.	.	.	.
SOIL 22	I	1.3	1	2	2	2	1	1	0.25	.	.	.	.	.
SOIL 22	J	1.1	2	1	2	1	1	0.25	0.25	1	.	.	.	.
		1.1												
		0.13												

Appendix 4.2

(continued)

Alfalfa Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 23	A	0.8	1	0.25	1	.	.	.	.	.	.	.	.	.
SOIL 23	B	1.0	1	1	.	.	.	.	.	.	.	.	.	.
SOIL 23	C	0.4	1	0.25	0.25	0.25	0.25	0.25	.	.	.	.	.	.
SOIL 23	D	1.1	2	1	1	1	1	1	1	.	.	.	.	.
SOIL 23	E	0.9	1	1	1	1	0.25	1	.	.	.	.	.	.
SOIL 23	F	1.0	2	1	1	1	1	1	0.25	1	.	.	.	.
SOIL 23	G	0.9	1	0.25	1	1	1	0.25	2	.	.	.	.	.
SOIL 23	H	1.5	2	1	2	1	1	1	2	2	.	.	.	.
SOIL 23	I	1.2	2	1	1	1	1	.	.	.	.	.	.	.
SOIL 23	J	0.9	1	1	2	0.25	0.25	0.25	1	1	1	1	.	.
		1.0												
		0.30												
SOIL 24	A	5.6	6	6	5	5	5	1	8	6	7	7	.	.
SOIL 24	B	6.3	6	5	5	5	7	8	6	8	.	.	.	.
SOIL 24	C	4.9	7	2	4	6	5	9	1	5	.	.	.	.
SOIL 24	D	6.4	4	10	8	6	5	5	7	.	.	.	.	.
SOIL 24	E	6.0	6	6	5	6	2	8	7	6	6	8	.	.
SOIL 24	F	5.8	5	3	6	5	6	6	8	7	.	.	.	.
SOIL 24	G	5.2	8	0.25	1	9	7	7	8	1	.	.	.	.
SOIL 24	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 24	I	5.6	6	7	3	4	6	9	4	.	.	.	.	.
SOIL 24	J	6.9	6	7	8	5	8	6	8	7	.	.	.	.
		5.8												
		0.63												

Appendix 4.2

(continued)

Alfalfa Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 25	A	4.2	4	4	3	4	4	4	4	6	5	.	.	.
SOIL 25	B	3.9	3	3	4	3	4	5	4	4	5	4	.	.
SOIL 25	C	4.4	5	5	4	3	5	5	4	3	3	5	7	4
SOIL 25	D	4.4	5	4	7	2	5	3	5	4	5	.	.	.
SOIL 25	E	4.5	6	4	4	4	5	4	5	4	5	5	4	.
SOIL 25	F	4.4	4	5	4	5	4	5	5	3	5	.	.	.
SOIL 25	G	4.3	6	5	4	4	3	4	5	3	5	4	4	.
SOIL 25	H	4.1	4	3	3	4	3	4	6	5	5	.	.	.
SOIL 25	I	4.3	4	4	4	5	4	5	5	4	4	.	.	.
SOIL 25	J	4.5	6	4	4	4	5	5	3	4	5	5	5	.
		4.3												
		0.20												
SOIL 26	A	3.6	.	4	4	5	4	3	1	4	3	3	4	5
SOIL 26	B	3.9	5	5	4	4	4	4	3	3	2	5	4	4
SOIL 26	C	3.9	.	.	.	4	4	5	4	4	4	4	3	3
SOIL 26	D	3.9	.	.	.	4	2	3	5	3	4	4	6	4
SOIL 26	E	3.5	.	3	4	4	4	4	3	3	3	4	3	4
SOIL 26	F	3.8	.	6	3	1	4	5	3	3	4	4	5	4
SOIL 26	G	4.4	.	.	.	.	5	5	5	5	3	5	3	4
SOIL 26	H	4.0	.	.	6	4	4	3	3	4	3	5	4	4
SOIL 26	I	4.1	.	.	.	3	4	3	4	5	4	5	5	4
SOIL 26	J	4.8	.	.	4	4	5	5	5	6	6	5	4	4
		4.0												
		0.36												

Appendix 4.2

(continued)

Alfalfa Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 27	A	1.4	1	2	2	1	2	1	0.25	2	2	1	.	.
SOIL 27	B	2.0	3	2	1	2	2	2	2	2	2	2	.	.
SOIL 27	C	1.4	1	2	1	0.25	2	1	2	1	2	.	.	.
SOIL 27	D	2.0	3	1	2	2	.	.	.	.	.	.	.	.
SOIL 27	E	1.6	2	2	1	2	2	0.25	2	2	1	1	2	.
SOIL 27	F	1.6	2	2	1	1	2	0.25	2	1	2	2	2	.
SOIL 27	G	1.5	2	1	1	2	2	0.25	2	2	1	.	.	.
SOIL 27	H	1.5	1	2	1	1	2	2	0.25	2	2	1	2	2
SOIL 27	I	1.4	2	1	1	1	2	1	2	2	1	.	.	.
SOIL 27	J	1.4	1	1	2	1	2	2	1	.	.	.	.	.
		1.6												
		0.23												
SOIL 28	A	4.3	.	.	.	.	.	.	3	4	5	3	5	6
SOIL 28	B	5.0	.	.	.	.	4	6	4	7	4	5	5	5
SOIL 28	C	4.1	.	.	5	6	4	2	2	5	5	4	4	4
SOIL 28	D	5.4	.	.	.	6	7	4	5	5	8	5	6	3
SOIL 28	E	4.5	.	.	.	.	.	.	.	.	3	4	5	6
SOIL 28	F	4.3	.	.	5	4	5	5	3	4	3	4	6	4
SOIL 28	G	4.7	.	.	.	.	.	.	.	.	.	4	5	5
SOIL 28	H	4.3	.	.	.	.	.	4	4	5	4	5	5	3
SOIL 28	I	4.8	.	.	.	.	.	.	.	.	5	5	4	5
SOIL 28	J	4.4	.	.	.	.	.	4	4	6	3	5	5	4
		4.6												
		0.40												

Appendix 4.2
(continued)
Alfalfa Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 29	A	0.9	.	.	.	.	1	1	1	0.25	1	1	1	1
SOIL 29	B	0.7	.	.	.	.	.	.	.	1	1	1	0.25	0.25
SOIL 29	C	0.8	.	.	.	1	1	1	0.25	0.25	1	0.25	1	1
SOIL 29	D	0.6	.	.	.	.	1	0.25	0.25	0.25	0.25	1	1	1
SOIL 29	E	0.3	.	.	.	.	.	0.25	0.25	0.25	0.25	0.25	0.25	0.25
SOIL 29	F	0.7	.	.	.	.	.	2	1	1	0.25	0.25	0.25	0.25
SOIL 29	G	0.8	.	.	.	.	.	.	.	2	1	0.25	0.25	0.25
SOIL 29	H	0.7	.	.	.	.	.	1	1	1	1	0.25	0.25	0.25
SOIL 29	I	0.6	.	.	.	.	.	.	1	1	1	0.25	0.25	0.25
SOIL 29	J	1.0	.	.	.	.	.	.	.	.	.	.	1	1
		0.7												
		0.20												
SOIL 30	A	1.0	1	1	1	.	.	.	.	.	.	.	.	.
SOIL 30	B	0.5	0.25	0.25	1	.	.	.	.	.	.	.	.	.
SOIL 30	C	1.0	1	1	1	1	.	.	.	.	.	.	.	.
SOIL 30	D	0.5	1	0.25	0.25	.	.	.	.	.	.	.	.	.
SOIL 30	E	1.0	1	1	1	.	.	.	.	.	.	.	.	.
SOIL 30	F	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	H	0.6	0.25	1	.	.	.	.	.	.	.	.	.	.
SOIL 30	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	J	1.0	1	.	.	.	.	.	.	.	.	.	.	.
		0.8												
		0.24												

Appendix 4.2
(continued)
Alfalfa Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 31	A	5.0	.	.	.	.	.	.	.	.	5	6	5	4
SOIL 31	B	4.0	.	.	.	5	4	3	4	4	4	5	4	3
SOIL 31	C	4.8	.	.	.	5	5	5	4	3	5	5	6	5
SOIL 31	D	4.2	.	.	.	5	4	5	3	6	4	4	4	3
SOIL 31	E	4.3	.	.	.	.	5	3	3	5	4	5	4	5
SOIL 31	F	4.7	.	6	2	4	4	5	5	4	4	5	7	6
SOIL 31	G	4.1	.	3	2	5	3	5	5	4	4	6	4	4
SOIL 31	H	4.6	.	.	.	.	.	.	.	5	4	4	5	5
SOIL 31	I	4.9	.	.	4	5	6	6	5	3	5	5	5	5
SOIL 31	J	4.6	.	.	.	.	5	4	3	3	4	8	5	5
		4.5												
		0.35												
SOIL 32	A	0.3	.	.	.	.	.	.	.	.	.	0.25	0.25	0.25
SOIL 32	B	0.6	.	.	.	.	.	.	.	.	.	.	1	0.25
SOIL 32	C	0.9	.	.	.	.	.	.	.	1	0.25	0.25	1	2
SOIL 32	D	0.8	.	.	.	.	.	2	1	1	1	0.25	0.25	0.25
SOIL 32	E	0.7	.	.	2	1	1	1	1	0.25	0.25	0.25	0.25	0.25
SOIL 32	F	0.4	.	.	.	.	.	1	0.25	0.25	0.25	0.25	0.25	0.25
SOIL 32	G	0.4	.	.	.	.	.	.	.	1	0.25	0.25	0.25	0.25
SOIL 32	H	0.4	.	.	.	.	.	.	.	.	1	0.25	0.25	0.25
SOIL 32	I	1.1	.	.	.	.	2	2	1	1	1	1	0.25	0.25
SOIL 32	J	0.7	.	.	1	1	1	2	0.25	0.25	0.25	0.25	0.25	0.25
		0.6												
		0.26												

Appendix 4.2

(continued)

Alfalfa Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 35	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												
SOIL 36	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	D	0.3	.	.	.	.	.	.	.	.	.	.	.	0.25
SOIL 36	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	G	0.3	.	.	.	.	.	.	.	.	.	.	.	0.25
SOIL 36	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	I	0.3	.	.	.	.	.	.	.	.	.	.	0.25	0.25
SOIL 36	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		0.3												
		0.00												

Appendix 4.3

Alfalfa Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed
NC	A	0	none		SOIL 2	A	0	none		SOIL 4	A	30	N
NC	B	0	none		SOIL 2	B	0	none		SOIL 4	B	10	N
NC	C	0	none		SOIL 2	C	0	none		SOIL 4	C	10	CL
NC	D	0	none		SOIL 2	D	10	N		SOIL 4	D	20	CL
NC	E	10	M		SOIL 2	E	10	CL		SOIL 4	E	20	CL,N
NC	F	0	none		SOIL 2	F	10	N		SOIL 4	F	20	CL,N
NC	G	10	M		SOIL 2	G	0	none		SOIL 4	G	40	CL,N
NC	H	0	none		SOIL 2	H	0	none		SOIL 4	H	20	N,M
NC	I	10	M		SOIL 2	I	0	none		SOIL 4	I	60	CL,N
NC	J	0	none		SOIL 2	J	0	none		SOIL 4	J	30	CL,N,M
SOIL 1	A	80	CL,N		SOIL 3	A	40	CL,N		SOIL 5	A	0	none
SOIL 1	B	80	CL,N,M		SOIL 3	B	30	CL,N		SOIL 5	B	0	none
SOIL 1	C	80	CL,N,M		SOIL 3	C	100	M		SOIL 5	C	10	CL
SOIL 1	D	70	N		SOIL 3	D	10	N		SOIL 5	D	0	none
SOIL 1	E	80	N		SOIL 3	E	30	CL,N		SOIL 5	E	0	none
SOIL 1	F	80	CL,N,M		SOIL 3	F	60	CL,N		SOIL 5	F	20	CL,M
SOIL 1	G	80	CL,N,M		SOIL 3	G	20	CL		SOIL 5	G	0	none
SOIL 1	H	80	CL,N,M		SOIL 3	H	60	CL,N		SOIL 5	H	30	CL,N,M
SOIL 1	I	80	CL,N,M		SOIL 3	I	80	N		SOIL 5	I	10	CL
SOIL 1	J	80	CL,N,M		SOIL 3	J	60	N		SOIL 5	J	20	CL

M – Mortality; CL – Chlorosis; N – Necrosis

Appendix 4.3
(continued)
Alfalfa Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed
SOIL 6	A	60	CL,N		SOIL 8	A	60	CL,N		SOIL 10	A	80	CL,N,CC
SOIL 6	B	70	CL,N,M		SOIL 8	B	70	CL,N,CC		SOIL 10	B	70	CL,N
SOIL 6	C	60	CL,N		SOIL 8	C	80	CL,N,CC		SOIL 10	C	80	CL,N,CC,M
SOIL 6	D	70	CL,N		SOIL 8	D	70	CL,N,CC		SOIL 10	D	80	CL,N,M
SOIL 6	E	70	CL,N		SOIL 8	E	70	CL,N		SOIL 10	E	80	CL,N
SOIL 6	F	70	CL,N,M		SOIL 8	F	80	CL,N		SOIL 10	F	70	CL,N
SOIL 6	G	70	CL,N,M		SOIL 8	G	80	CL,N,CC		SOIL 10	G	80	CL,N,M
SOIL 6	H	80	CL,N,CC		SOIL 8	H	80	CL,N,CC		SOIL 10	H	80	CL,N
SOIL 6	I	80	CL,N		SOIL 8	I	80	CL,N,CC		SOIL 10	I	80	CL,N
SOIL 6	J	80	CL,N,CC		SOIL 8	J	70	CL,N		SOIL 10	J	90	N
SOIL 7	A	80	CL,N,CC		SOIL 9	A	100	M		SOIL 11	A	80	CL,N,M
SOIL 7	B	80	CL,N,M		SOIL 9	B	.	NE		SOIL 11	B	80	CL,N,M
SOIL 7	C	90	CL,N,M		SOIL 9	C	100	M		SOIL 11	C	80	CL,N,M
SOIL 7	D	80	CL,N,M		SOIL 9	D	100	M		SOIL 11	D	90	CL,N,M
SOIL 7	E	80	CL,N,M		SOIL 9	E	100	M		SOIL 11	E	80	CL,N,M
SOIL 7	F	90	CL,N		SOIL 9	F	100	M		SOIL 11	F	80	CL,N
SOIL 7	G	90	CL,N,M		SOIL 9	G	100	M		SOIL 11	G	80	CL,N,M
SOIL 7	H	80	CL,N,M		SOIL 9	H	.	NE		SOIL 11	H	80	CL,N
SOIL 7	I	80	CL,N,M		SOIL 9	I	.	NE		SOIL 11	I	90	CL,N
SOIL 7	J	90	CL,N,M		SOIL 9	J	100	M		SOIL 11	J	80	CL,N,M

M – Mortality; CL – Chlorosis; N – Necrosis; CC – Color Change; NE – None Emerged

Appendix 4.3

(continued)

Alfalfa Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed
SOIL 12	A	10	CL		SOIL 14	A	90	CL,N		SOIL 16	A	90	CL,N,CC
SOIL 12	B	10	CL		SOIL 14	B	90	N,M		SOIL 16	B	80	CL,N,M
SOIL 12	C	0	none		SOIL 14	C	90	CL.N,CC,M		SOIL 16	C	90	CL,N,M
SOIL 12	D	0	none		SOIL 14	D	90	CL,N		SOIL 16	D	80	CL,N
SOIL 12	E	10	CL		SOIL 14	E	90	CL,N		SOIL 16	E	80	CL,N,CC
SOIL 12	F	10	CL		SOIL 14	F	90	N,M,CC		SOIL 16	F	80	CL,N,CC
SOIL 12	G	10	CL		SOIL 14	G	90	CL,N,M		SOIL 16	G	80	CL,N,CC
SOIL 12	H	10	CL		SOIL 14	H	90	CL.N,CC,M		SOIL 16	H	80	CL,N,M
SOIL 12	I	10	CL		SOIL 14	I	90	CL,N,M		SOIL 16	I	80	CL,N,CC
SOIL 12	J	20	CL,N		SOIL 14	J	90	CL,N,M		SOIL 16	J	80	CL,N,CC
SOIL 13	A	30	CL,N		SOIL 15	A	70	CL,N,M		SOIL 17	A	20	CL,M
SOIL 13	B	30	CL,N,CC		SOIL 15	B	70	CL,N,M		SOIL 17	B	10	CL,M
SOIL 13	C	60	CL,N,CC,M		SOIL 15	C	80	CL,N,M		SOIL 17	C	10	CL,N
SOIL 13	D	60	CL,N,CC,M		SOIL 15	D	80	CL,N,M		SOIL 17	D	10	CL
SOIL 13	E	50	CL,N,CC,M		SOIL 15	E	80	CL,N,M		SOIL 17	E	0	none
SOIL 13	F	60	CL,N		SOIL 15	F	70	CL,N,M,CC		SOIL 17	F	10	CL,M
SOIL 13	G	60	CL,N,M		SOIL 15	G	70	CL,N,M,CC		SOIL 17	G	20	CL,M
SOIL 13	H	60	CL,N,M		SOIL 15	H	80	CL,N,M		SOIL 17	H	10	CL,N,M
SOIL 13	I	60	CL,N,M		SOIL 15	I	70	CL,N		SOIL 17	I	20	CL
SOIL 13	J	60	CL,N,CC		SOIL 15	J	80	CL,N		SOIL 17	J	0	none

M – Mortality; CL – Chlorosis; N – Necrosis; CC – Color Change; NE – None Emerged

Appendix 4.3

(continued)

Alfalfa Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed
SOIL 19	A	100	M		SOIL 21	A	90	N,M		SOIL 23	A	90	CL,N,M
SOIL 19	B	100	M		SOIL 21	B	100	M		SOIL 23	B	80	CL,N,M
SOIL 19	C	.	NE		SOIL 21	C	90	CL,N,CC		SOIL 23	C	90	N
SOIL 19	D	90	CL,N		SOIL 21	D	90	CL,N,CC		SOIL 23	D	80	CL,N,CC
SOIL 19	E	100	M		SOIL 21	E	90	N,M		SOIL 23	E	80	CL,N,M
SOIL 19	F	90	CL,N,CC		SOIL 21	F	90	CL,N,M,CC		SOIL 23	F	80	CL,N,M,CC
SOIL 19	G	90	CL,N,M,CC		SOIL 21	G	80	CL,N,M,CC		SOIL 23	G	80	CL,N,CC
SOIL 19	H	90	N,M,CC		SOIL 21	H	80	CL,N,M,CC		SOIL 23	H	80	CL,N,M,CC
SOIL 19	I	90	CL,N,CC		SOIL 21	I	90	CL,N,CC		SOIL 23	I	80	CL,N,M,CC
SOIL 19	J	80	CL,N,CC		SOIL 21	J	80	CL,N		SOIL 23	J	80	CL,N,CC
SOIL 20	A	40	CL,N		SOIL 22	A	80	CL,N,M,CC		SOIL 24	A	0	none
SOIL 20	B	30	CL,N		SOIL 22	B	90	CL,N,M,CC		SOIL 24	B	0	none
SOIL 20	C	30	CL,N		SOIL 22	C	90	CL,N,M,CC		SOIL 24	C	20	N,CC
SOIL 20	D	20	N		SOIL 22	D	80	CL,N,CC		SOIL 24	D	0	none
SOIL 20	E	40	CL,N		SOIL 22	E	80	CL,N,CC		SOIL 24	E	0	none
SOIL 20	F	30	CL,N,M		SOIL 22	F	90	CL,N,CC		SOIL 24	F	20	N,CC
SOIL 20	G	30	CL,N		SOIL 22	G	90	CL,N,CC		SOIL 24	G	20	CL,N
SOIL 20	H	10	CL		SOIL 22	H	90	CL,N,CC		SOIL 24	H	.	NE
SOIL 20	I	20	CL		SOIL 22	I	90	CL,N,CC		SOIL 24	I	10	CL
SOIL 20	J	30	CL,N		SOIL 22	J	80	CL,N		SOIL 24	J	0	none

M – Mortality; CL – Chlorosis; N – Necrosis; CC – Color Change; NE – None Emerged

Appendix 4.3
(continued)
Alfalfa Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed
SOIL 25	A	20	CL		SOIL 27	A	70	CL,N,CC		SOIL 29	A	80	CL,N,CC,M
SOIL 25	B	10	CL		SOIL 27	B	70	CL,N,CC		SOIL 29	B	90	CL,N,CC,M
SOIL 25	C	10	CL		SOIL 27	C	80	CL,N,CC		SOIL 29	C	90	CL,N,CC
SOIL 25	D	0	none		SOIL 27	D	80	CL,N,M		SOIL 29	D	90	CL,N,M
SOIL 25	E	0	none		SOIL 27	E	80	CL,N,CC		SOIL 29	E	90	CL,N,M
SOIL 25	F	20	CL		SOIL 27	F	80	CL,N,CC		SOIL 29	F	90	CL,N,CC
SOIL 25	G	0	none		SOIL 27	G	80	CL,N,CC		SOIL 29	G	90	CL,N
SOIL 25	H	0	none		SOIL 27	H	70	CL,N,CC		SOIL 29	H	80	CL,N,CC
SOIL 25	I	0	none		SOIL 27	I	80	CL,N,CC		SOIL 29	I	90	CL,N,CC
SOIL 25	J	10	CL		SOIL 27	J	80	CL,N,CC,M		SOIL 29	J	90	CL,N,CC
SOIL 26	A	10	CL		SOIL 28	A	10	M		SOIL 30	A	90	CL,N
SOIL 26	B	0	none		SOIL 28	B	10	CL		SOIL 30	B	90	CL,N
SOIL 26	C	0	none		SOIL 28	C	20	CL,N		SOIL 30	C	90	CL,N,M
SOIL 26	D	10	CL		SOIL 28	D	20	CL		SOIL 30	D	90	CL,N,M,CC
SOIL 26	E	20	CL		SOIL 28	E	10	CL		SOIL 30	E	80	CL,N,M,CC
SOIL 26	F	10	CL,N		SOIL 28	F	20	CL,M		SOIL 30	F	90	CL,N,CC
SOIL 26	G	10	CL		SOIL 28	G	10	CL		SOIL 30	G	100	M
SOIL 26	H	10	CL		SOIL 28	H	10	CL		SOIL 30	H	90	CL,N
SOIL 26	I	20	CL		SOIL 28	I	10	CL		SOIL 30	I	.	NE
SOIL 26	J	0	none		SOIL 28	J	10	CL		SOIL 30	J	80	CL,N,CC

M – Mortality; CL – Chlorosis; N – Necrosis; CC – Color Change; NE – None Emerged

Appendix 4.3
(continued)
Alfalfa Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed
SOIL 31	A	20	CL,M		SOIL 35	A	.	NE
SOIL 31	B	40	CL,N,M		SOIL 35	B	.	NE
SOIL 31	C	30	CL		SOIL 35	C	100	M
SOIL 31	D	30	CL,N		SOIL 35	D	100	M
SOIL 31	E	30	CL,N		SOIL 35	E	100	M
SOIL 31	F	30	CL,N		SOIL 35	F	.	NE
SOIL 31	G	30	CL,N		SOIL 35	G	100	M
SOIL 31	H	30	N		SOIL 35	H	100	M
SOIL 31	I	30	CL,N		SOIL 35	I	.	NE
SOIL 31	J	30	CL,N,M		SOIL 35	J	.	NE
SOIL 32	A	90	N,M,CC		SOIL 36	A	100	M
SOIL 32	B	90	N,M,CC		SOIL 36	B	.	NE
SOIL 32	C	90	CL,N,M,CC		SOIL 36	C	.	NE
SOIL 32	D	80	CL,N,M,CC		SOIL 36	D	90	N,M
SOIL 32	E	90	CL,N,M,CC		SOIL 36	E	100	M
SOIL 32	F	90	N,M,CC		SOIL 36	F	.	NE
SOIL 32	G	90	N,M		SOIL 36	G	90	N
SOIL 32	H	90	CL,N,M,CC		SOIL 36	H	.	NE
SOIL 32	I	80	CL,N,M		SOIL 36	I	90	N,M
SOIL 32	J	90	CL,N,CC		SOIL 36	J	.	NE

M – Mortality; CL – Chlorosis; N – Necrosis; CC – Color Change; NE – None Emerged

Appendix 5.1

Sideoats Grama (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
NC	A	5.9	3.4	6	7	7	17	0.0433	0.0062
NC	B	5.9	3.8	11	12	12	25	0.1838	0.0153
NC	C	5.9	3.8	7	7	7	14	0.0875	0.0125
NC	D	5.9	3.8	8	8	8	25	0.2141	0.0268
NC	E	5.9	4	8	8	7	20	0.1432	0.0205
NC	F	5.9	3	3	3	2	11	0.0332	0.0166
NC	G	5.9	3	5	5	4	13	0.0449	0.0112
NC	H	5.9	3.4	7	7	7	12	0.0684	0.0098
NC	I	5.9	3.5	4	4	2	13	0.0123	0.0062
NC	J	5.9	4.2	5	5	5	25	0.0636	0.0127
					6.60	6.10	17.5		0.0138
					2.55	3.00	5.78		0.0064
SOIL 1	A	5.6	3.9	0	0	.	.	.	.
SOIL 1	B	5.6	5.1	0	1	0	.	.	.
SOIL 1	C	5.6	4	1	1	0	.	.	.
SOIL 1	D	5.6	4.3	0	2	0	.	.	.
SOIL 1	E	5.6	4	0	1	1	3	0.0004	0.0004
SOIL 1	F	5.6	5.2	2	4	0	.	.	.
SOIL 1	G	5.6	4.7	0	1	0	.	.	.
SOIL 1	H	5.6	3.8	0	1	1	2	0.0002	0.0002
SOIL 1	I	5.6	4.2	1	3	0	.	.	.
SOIL 1	J	5.6	4.4	0	0	.	.	.	.
					1.40	0.25	2.5		0.0003
					1.26	0.46	0.71		0.0001

Appendix 5.1

(continued)

Sideoats Grama (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 2	A	6.1	4.8	0	0	.	.	.	.
SOIL 2	B	6.1	4.3	0	0	.	.	.	.
SOIL 2	C	6.1	4.4	2	2	2	9	0.0071	0.0036
SOIL 2	D	6.1	4.2	0	0	.	.	.	.
SOIL 2	E	6.1	4	9	9	9	13	0.0573	0.0064
SOIL 2	F	6.1	4.7	12	12	12	14	0.1035	0.0086
SOIL 2	G	6.1	4.7	8	9	9	12	0.0577	0.0064
SOIL 2	H	6.1	5	8	8	8	12	0.0631	0.0079
SOIL 2	I	6.1	5.1	4	4	4	13	0.0272	0.0068
SOIL 2	J	6.1	4.7	0	0	.	.	.	.
					4.40	7.33	12.2		0.0066
					4.67	3.67	1.72		0.0017
SOIL 3	A	5.4	3.6	3	3	2	4	0.0045	0.0023
SOIL 3	B	5.4	3.6	7	8	7	21	0.0440	0.0063
SOIL 3	C	5.4	3.4	6	6	4	7	0.0227	0.0057
SOIL 3	D	5.4	3.4	7	8	8	15	0.0413	0.0052
SOIL 3	E	5.4	3.5	5	5	5	8	0.0200	0.0040
SOIL 3	F	5.4	3.7	4	8	7	12	0.0362	0.0052
SOIL 3	G	5.4	4	4	7	7	4	0.0201	0.0029
SOIL 3	H	5.4	3.5	7	10	10	15	0.0355	0.0036
SOIL 3	I	5.4	3.5	6	7	7	15	0.0304	0.0043
SOIL 3	J	5.4	3.6	5	6	6	14	0.0320	0.0053
					6.80	6.30	11.5		0.0045
					1.93	2.21	5.56		0.0013

Appendix 5.1

(continued)

Sideoats Grama (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 4	A	4.9	3.5	2	2	1	7	0.0034	0.0034
SOIL 4	B	4.9	3.5	4	4	0	.	.	.
SOIL 4	C	4.9	3.4	5	5	5	11	0.0418	0.0084
SOIL 4	D	4.9	3.6	2	2	2	12	0.0068	0.0034
SOIL 4	E	4.9	3.5	1	2	1	16	0.0111	0.0111
SOIL 4	F	4.9	4.4	9	10	10	19	0.0900	0.0090
SOIL 4	G	4.9	3.5	10	10	9	13	0.0838	0.0093
SOIL 4	H	4.9	3.4	7	7	7	21	0.0655	0.0094
SOIL 4	I	4.9	3.5	6	7	7	6	0.0390	0.0056
SOIL 4	J	4.9	3.9	7	7	7	8	0.0534	0.0076
					5.60	4.90	12.6		0.0075
					3.10	3.63	5.27		0.0027
SOIL 5	A	5.8	3.5	9	10	9	12	0.0531	0.0059
SOIL 5	B	5.8	3.5	10	10	10	13	0.0632	0.0063
SOIL 5	C	5.8	3.4	11	11	11	13	0.0721	0.0066
SOIL 5	D	5.8	3.4	7	8	8	12	0.0335	0.0042
SOIL 5	E	5.8	3.6	8	8	8	12	0.0565	0.0071
SOIL 5	F	5.8	3.5	8	10	9	13	0.0585	0.0065
SOIL 5	G	5.8	3.5	8	9	8	13	0.0350	0.0044
SOIL 5	H	5.8	3.5	8	8	8	14	0.0413	0.0052
SOIL 5	I	5.8	3.4	8	10	10	12	0.0514	0.0051
SOIL 5	J	5.8	3.6	8	10	10	9	0.0355	0.0036
					9.40	9.10	12.3		0.0055
					1.07	1.10	1.34		0.0012

Appendix 5.1
(continued)
Sideoats Grama (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 6	A	6.0	3.7	0	3	1	1	0.0016	0.0016
SOIL 6	B	6.0	5.1	1	3	0	.	.	.
SOIL 6	C	6.0	4.4	0	1	0	.	.	.
SOIL 6	D	6.0	5.6	1	2	1	2	0.0003	0.0003
SOIL 6	E	6.0	4.8	1	3	2	2	0.0015	0.0008
SOIL 6	F	6.0	5	2	5	1	2	0.0017	0.0017
SOIL 6	G	6.0	5.4	1	4	2	2	0.0031	0.0016
SOIL 6	H	6.0	5.4	1	4	1	1	0.0011	0.0011
SOIL 6	I	6.0	5.6	2	3	0	.	.	.
SOIL 6	J	6.0	5.8	4	5	2	1	0.0012	0.0006
					3.30	1.00	1.6		0.0011
					1.25	0.82	0.53		0.0006
SOIL 7	A	5.5	3.6	0	0	0	.	.	.
SOIL 7	B	5.5	5.3	0	0	0	.	.	.
SOIL 7	C	5.5	3.6	0	0	0	.	.	.
SOIL 7	D	5.5	3.6	0	0	0	.	.	.
SOIL 7	E	5.5	6	0	0	0	.	.	.
SOIL 7	F	5.5	3.8	0	0	0	.	.	.
SOIL 7	G	5.5	5.1	0	0	0	.	.	.
SOIL 7	H	5.5	5.1	0	0	0	.	.	.
SOIL 7	I	5.5	4.2	0	0	0	.	.	.
SOIL 7	J	5.5	5.6	0	0	0	.	.	.
					0.00	0.00	.		.
					0.00	0.00	.		.

Appendix 5.1
(continued)
Sideoats Grama (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 8	A	6.3	3	6	6	0	.	.	.
SOIL 8	B	6.3	3.6	8	8	0	.	.	.
SOIL 8	C	6.3	3.5	3	3	0	.	.	.
SOIL 8	D	6.3	3	7	7	0	.	.	.
SOIL 8	E	6.3	3.4	7	7	1	1	0.0006	0.0006
SOIL 8	F	6.3	3	7	7	0	.	.	.
SOIL 8	G	6.3	3.8	7	9	0	.	.	.
SOIL 8	H	6.3	3.4	4	6	0	.	.	.
SOIL 8	I	6.3	3.2	7	7	0	.	.	.
SOIL 8	J	6.3	3.5	5	5	0	.	.	.
					6.50	0.10	1.0		0.0006
					1.65	0.32	.		.
SOIL 9	A	6.0	5.4	0	0	0	.	.	.
SOIL 9	B	6.0	5	0	0	0	.	.	.
SOIL 9	C	6.0	3.6	0	0	0	.	.	.
SOIL 9	D	6.0	3.8	0	0	0	.	.	.
SOIL 9	E	6.0	4	0	0	0	.	.	.
SOIL 9	F	6.0	3.8	0	0	0	.	.	.
SOIL 9	G	6.0	5.6	0	0	0	.	.	.
SOIL 9	H	6.0	5.2	0	0	0	.	.	.
SOIL 9	I	6.0	4.4	0	0	0	.	.	.
SOIL 9	J	6.0	5.4	0	0	0	.	.	.
					0.00	0.00	.		#DIV/0!
					0.00	0.00	.		#DIV/0!

Appendix 5.1
(continued)

Sideoats Grama (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 10	A	5.8	6.2	0	2	1	1	0.0004	0.0004
SOIL 10	B	5.8	6.1	0	3	1	2	0.0028	0.0028
SOIL 10	C	5.8	4.8	0	4	0	.	.	.
SOIL 10	D	5.8	4.8	1	4	2	2	0.0048	0.0024
SOIL 10	E	5.8	5.1	0	3	0	.	.	.
SOIL 10	F	5.8	5.4	2	2	0	.	.	.
SOIL 10	G	5.8	5	1	2	1	2	0.0006	0.0006
SOIL 10	H	5.8	3.7	0	0	.	.	.	.
SOIL 10	I	5.8	4.1	1	1	0	.	.	.
SOIL 10	J	5.8	5.1	3	3	1	1	0.0021	0.0021
					2.40	0.67	1.6		0.0017
					1.26	0.71	0.55		0.0011
SOIL 11	A	5.7	6.1	1	1	1	1	0.0004	0.0004
SOIL 11	B	5.7	5.9	1	2	1	2	0.0014	0.0014
SOIL 11	C	5.7	5	0	3	0	.	.	.
SOIL 11	D	5.7	5.6	0	0	.	.	.	.
SOIL 11	E	5.7	5.8	0	0	.	.	.	.
SOIL 11	F	5.7	5.2	1	1	0	.	.	.
SOIL 11	G	5.7	5.4	1	4	0	.	.	.
SOIL 11	H	5.7	4.9	0	2	0	.	.	.
SOIL 11	I	5.7	5	0	2	0	.	.	.
SOIL 11	J	5.7	5.8	0	0	.	.	.	.
					1.50	0.29	1.5		0.0009
					1.35	0.49	0.71		0.0007

Appendix 5.1

(continued)

Sideoats Grama (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 12	A	6.0	4.4	10	10	10	21	0.0570	0.0057
SOIL 12	B	6.0	4.3	10	10	10	23	0.0481	0.0048
SOIL 12	C	6.0	4	10	10	9	21	0.0575	0.0064
SOIL 12	D	6.0	4.2	11	11	11	19	0.0513	0.0047
SOIL 12	E	6.0	4.2	9	11	9	22	0.0509	0.0057
SOIL 12	F	6.0	4.9	10	11	11	22	0.0454	0.0041
SOIL 12	G	6.0	5.1	8	9	9	20	0.0499	0.0055
SOIL 12	H	6.0	4.8	9	11	9	21	0.0494	0.0055
SOIL 12	I	6.0	5	7	10	10	23	0.0466	0.0047
SOIL 12	J	6.0	4.6	8	8	8	18	0.0378	0.0047
					10.10	9.60	21.0		0.0052
					0.99	0.97	1.63		0.0007
SOIL 13	A	5.5	3	4	6	5	6	0.0165	0.0033
SOIL 13	B	5.5	3.8	9	11	9	4	0.0501	0.0056
SOIL 13	C	5.5	3.5	10	11	9	3	0.0377	0.0042
SOIL 13	D	5.5	3.5	12	12	11	4	0.0563	0.0051
SOIL 13	E	5.5	3.5	7	10	9	6	0.0327	0.0036
SOIL 13	F	5.5	3.6	6	7	3	4	0.0107	0.0036
SOIL 13	G	5.5	3.6	6	6	3	3	0.0081	0.0027
SOIL 13	H	5.5	3.4	11	11	9	4	0.0404	0.0045
SOIL 13	I	5.5	3.5	8	8	6	4	0.0219	0.0037
SOIL 13	J	5.5	3.6	8	9	9	4	0.0328	0.0036
					9.10	7.30	4.2		0.0040
					2.23	2.83	1.03		0.0009

Appendix 5.1

(continued)

Sideoats Grama (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 14	A	5.4	3	0	0	.	.	.	.
SOIL 14	B	5.4	3	0	1	0	.	.	.
SOIL 14	C	5.4	3.4	0	0	.	.	.	.
SOIL 14	D	5.4	3	0	0	.	.	.	.
SOIL 14	E	5.4	3	0	0	.	.	.	.
SOIL 14	F	5.4	3	0	1	0	.	.	.
SOIL 14	G	5.4	3	0	1	0	.	.	.
SOIL 14	H	5.4	3.4	1	1	0	.	.	.
SOIL 14	I	5.4	3	0	0	.	.	.	.
SOIL 14	J	5.4	3	0	0	.	.	.	.
					0.40	0.00	.		.
					0.52	0.00	.		.
SOIL 15	A	5.7	3.7	0	1	0	.	.	.
SOIL 15	B	5.7	3.6	7	9	2	1	0.0022	0.0011
SOIL 15	C	5.7	3.4	7	8	0	.	.	.
SOIL 15	D	5.7	3.8	11	12	1	1	0.0034	0.0034
SOIL 15	E	5.7	3.5	9	9	1	0.25	0.0022	0.0022
SOIL 15	F	5.7	3.6	5	5	1	1	0.0021	0.0021
SOIL 15	G	5.7	3.8	5	6	1	1	0.0044	0.0044
SOIL 15	H	5.7	3.9	4	5	1	1	0.0013	0.0013
SOIL 15	I	5.7	4.2	0	0	.	.	.	.
SOIL 15	J	5.7	3.5	0	0	.	.	.	.
					5.50	0.88	0.9		0.0024
					4.14	0.64	0.31		0.0013

Appendix 5.1
(continued)
Sideoats Grama (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 16	A	5.8	3.4	1	2	0	.	.	.
SOIL 16	B	5.8	3	2	3	2	0.25	0.0008	0.0004
SOIL 16	C	5.8	3.4	4	7	3	1	0.0026	0.0009
SOIL 16	D	5.8	3.4	2	6	3	1	0.0022	0.0007
SOIL 16	E	5.8	3	3	8	3	1	0.0025	0.0008
SOIL 16	F	5.8	3	5	9	6	1	0.0075	0.0013
SOIL 16	G	5.8	3	5	6	4	1	0.0037	0.0009
SOIL 16	H	5.8	3.4	5	7	5	0.25	0.0034	0.0007
SOIL 16	I	5.8	3.4	3	6	4	1	0.0036	0.0009
SOIL 16	J	5.8	3	0	0	.	.	.	.
					5.40	3.33	0.8		0.0008
					2.84	1.73	0.35		0.0002
SOIL 17	A	5.3	4.6	10	10	10	18	0.0309	0.0031
SOIL 17	B	5.3	4.3	9	9	9	19	0.0324	0.0036
SOIL 17	C	5.3	4.4	10	10	10	5	0.0539	0.0054
SOIL 17	D	5.3	4.4	11	12	12	11	0.0480	0.0040
SOIL 17	E	5.3	4.6	8	8	8	9	0.0419	0.0052
SOIL 17	F	5.3	4.8	8	8	8	21	0.0288	0.0036
SOIL 17	G	5.3	4.4	5	8	8	20	0.0232	0.0029
SOIL 17	H	5.3	4.4	6	7	7	23	0.0313	0.0045
SOIL 17	I	5.3	4.6	10	10	10	15	0.0275	0.0028
SOIL 17	J	5.3	4.4	10	11	11	21	0.0329	0.0030
					9.30	9.30	16.2		0.0038
					1.57	1.57	6.00		0.0010

Appendix 5.1

(continued)

Sideoats Grama (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 19	A	6.3	5.1	0	0	.	.	.	.
SOIL 19	B	6.3	5.8	0	2	0	.	.	.
SOIL 19	C	6.3	5.2	0	0	.	.	.	.
SOIL 19	D	6.3	5.6	0	1	0	.	.	.
SOIL 19	E	6.3	5.6	0	0	.	.	.	.
SOIL 19	F	6.3	4.7	0	0	.	.	.	.
SOIL 19	G	6.3	5.2	0	1	0	.	.	.
SOIL 19	H	6.3	4.5	0	0	.	.	.	.
SOIL 19	I	6.3	3.8	0	1	1	1	0.0005	0.0005
SOIL 19	J	6.3	5.4	0	0	.	.	.	.
					0.50	0.25	1.0		0.0005
					0.71	0.50	.		.
SOIL 20	A	6.2	5.2	7	8	6	6	0.0234	0.0039
SOIL 20	B	6.2	5.2	10	11	10	12	0.0433	0.0043
SOIL 20	C	6.2	5.2	9	10	9	17	0.0381	0.0042
SOIL 20	D	6.2	5.2	10	10	10	14	0.0426	0.0043
SOIL 20	E	6.2	5	7	10	9	11	0.0313	0.0035
SOIL 20	F	6.2	5.4	7	11	11	13	0.0601	0.0055
SOIL 20	G	6.2	5.4	7	8	7	15	0.0294	0.0042
SOIL 20	H	6.2	5	10	10	10	13	0.0574	0.0057
SOIL 20	I	6.2	5.2	10	11	10	23	0.0697	0.0070
SOIL 20	J	6.2	5.4	10	12	12	16	0.0660	0.0055
					10.10	9.40	14.0		0.0048
					1.29	1.78	4.40		0.0011

Appendix 5.1

(continued)

Sideoats Grama (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 21	A	6.0	4.2	0	2	0	.	.	.
SOIL 21	B	6.0	5.2	2	11	3	2	0.0042	0.0014
SOIL 21	C	6.0	4.2	0	1	0	.	.	.
SOIL 21	D	6.0	4.5	0	4	0	.	.	.
SOIL 21	E	6.0	4.2	0	1	1	1	0.0006	0.0006
SOIL 21	F	6.0	4.8	0	1	0	.	.	.
SOIL 21	G	6.0	5.8	0	2	0	.	.	.
SOIL 21	H	6.0	5.8	0	0	.	.	.	.
SOIL 21	I	6.0	4.4	0	2	2	1	0.0032	0.0016
SOIL 21	J	6.0	4.6	0	0	.	.	.	.
					2.40	0.75	1.3		0.0012
					3.24	1.16	0.58		0.0005
SOIL 22	A	6.1	4.3	0	1	0	.	.	.
SOIL 22	B	6.1	5.8	0	2	1	0.25	0.0005	0.0005
SOIL 22	C	6.1	5.4	0	2	0	.	.	.
SOIL 22	D	6.1	5.2	2	3	0	.	.	.
SOIL 22	E	6.1	4.8	0	1	0	.	.	.
SOIL 22	F	6.1	6	0	0	.	.	.	.
SOIL 22	G	6.1	4.9	0	0	.	.	.	.
SOIL 22	H	6.1	5.9	0	2	1	0.25	0.0003	0.0003
SOIL 22	I	6.1	4.7	1	3	0	.	.	.
SOIL 22	J	6.1	5.7	0	0	.	.	.	.
					1.40	0.29	0.3		0.0004
					1.17	0.49	0.00		0.0001

Appendix 5.1

(continued)

Sideoats Grama (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 23	A	6.4	6.4	1	2	1	2	0.0008	0.0008
SOIL 23	B	6.4	5.8	2	5	1	2	0.0010	0.0010
SOIL 23	C	6.4	6.5	1	2	0	.	.	.
SOIL 23	D	6.4	6.2	0	2	0	.	.	.
SOIL 23	E	6.4	6.4	1	3	1	2	0.0010	0.0010
SOIL 23	F	6.4	6.6	0	4	1	1	0.0001	0.0001
SOIL 23	G	6.4	6	0	3	0	.	.	.
SOIL 23	H	6.4	6.2	0	2	0	.	.	.
SOIL 23	I	6.4	6.1	0	2	2	1	0.0011	0.0006
SOIL 23	J	6.4	6.2	0	2	0	.	.	.
					2.70	0.60	1.6		0.0007
					1.06	0.70	0.55		0.0004
SOIL 24	A	6.0	4.3	9	10	10	31	0.0841	0.0084
SOIL 24	B	6.0	4.6	7	9	9	23	0.0594	0.0066
SOIL 24	C	6.0	5	4	8	8	24	0.0504	0.0063
SOIL 24	D	6.0	4.4	6	6	6	25	0.0652	0.0109
SOIL 24	E	6.0	4.6	8	10	10	26	0.0728	0.0073
SOIL 24	F	6.0	5.1	8	9	8	26	0.0931	0.0116
SOIL 24	G	6.0	5	6	10	10	13	0.0786	0.0079
SOIL 24	H	6.0	5.1	5	5	5	27	0.0364	0.0073
SOIL 24	I	6.0	4.7	7	8	8	19	0.0676	0.0085
SOIL 24	J	6.0	5.1	9	10	9	15	0.0841	0.0093
					8.50	8.30	22.9		0.0084
					1.78	1.70	5.61		0.0018

Appendix 5.1
(continued)
Sideoats Grama (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 25	A	5.3	5.3	11	11	11	24	0.0890	0.0081
SOIL 25	B	5.3	5.4	8	9	9	15	0.1022	0.0114
SOIL 25	C	5.3	5.6	10	10	10	22	0.0579	0.0058
SOIL 25	D	5.3	5.8	7	8	8	19	0.0623	0.0078
SOIL 25	E	5.3	5.4	8	9	9	16	0.0456	0.0051
SOIL 25	F	5.3	5.8	10	11	10	20	0.0958	0.0096
SOIL 25	G	5.3	5.2	11	11	10	12	0.0725	0.0073
SOIL 25	H	5.3	5.6	11	11	11	18	0.0783	0.0071
SOIL 25	I	5.3	5.7	8	9	8	32	0.0531	0.0066
SOIL 25	J	5.3	5.4	10	10	10	24	0.0678	0.0068
					9.90	9.60	20.2		0.0075
					1.10	1.07	5.67		0.0018
SOIL 26	A	6.0	4	10	11	11	15	0.0385	0.0035
SOIL 26	B	6.0	4.2	11	11	9	24	0.0456	0.0051
SOIL 26	C	6.0	4	9	9	8	11	0.0338	0.0042
SOIL 26	D	6.0	3.8	10	10	9	18	0.0551	0.0061
SOIL 26	E	6.0	3.7	10	10	9	19	0.0683	0.0076
SOIL 26	F	6.0	5.2	8	8	8	21	0.0405	0.0051
SOIL 26	G	6.0	5.2	9	9	9	22	0.0427	0.0047
SOIL 26	H	6.0	5.2	10	10	10	13	0.0489	0.0049
SOIL 26	I	6.0	5	10	11	10	20	0.0538	0.0054
SOIL 26	J	6.0	4.8	9	10	9	14	0.0466	0.0052
					9.90	9.20	17.7		0.0052
					0.99	0.92	4.27		0.0011

Appendix 5.1
(continued)
Sideoats Grama (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 27	A	6.2	5.8	3	6	5	1	0.0058	0.0012
SOIL 27	B	6.2	4.8	3	7	6	1	0.0135	0.0023
SOIL 27	C	6.2	4.4	4	10	8	1	0.0126	0.0016
SOIL 27	D	6.2	4.3	6	9	7	2	0.0143	0.0020
SOIL 27	E	6.2	5.1	7	10	8	2	0.0163	0.0020
SOIL 27	F	6.2	5.8	8	10	9	1	0.0235	0.0026
SOIL 27	G	6.2	4	4	5	3	1	0.0035	0.0012
SOIL 27	H	6.2	4.3	6	9	5	1	0.0101	0.0020
SOIL 27	I	6.2	4.2	9	11	7	1	0.0160	0.0023
SOIL 27	J	6.2	5.4	7	7	6	2	0.0127	0.0021
					8.40	6.40	1.3		0.0019
					2.01	1.78	0.48		0.0005
SOIL 28	A	6.8	4	10	10	10	23	0.0555	0.0056
SOIL 28	B	6.8	4	6	8	8	24	0.0500	0.0063
SOIL 28	C	6.8	4.2	9	9	9	22	0.0517	0.0057
SOIL 28	D	6.8	3.8	7	8	8	12	0.0408	0.0051
SOIL 28	E	6.8	4	9	10	10	27	0.0554	0.0055
SOIL 28	F	6.8	4.6	9	10	10	24	0.0800	0.0080
SOIL 28	G	6.8	5	10	11	10	22	0.0593	0.0059
SOIL 28	H	6.8	4.3	9	10	10	22	0.0533	0.0053
SOIL 28	I	6.8	4.3	11	11	11	21	0.0543	0.0049
SOIL 28	J	6.8	4.6	11	11	11	18	0.0659	0.0060
					9.80	9.70	21.5		0.0058
					1.14	1.06	4.06		0.0009

Appendix 5.1
(continued)
Sideoats Grama (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 29	A	5.4	5.5	1	8	6	1	0.0074	0.0012
SOIL 29	B	5.4	6.2	3	7	6	1	0.0038	0.0006
SOIL 29	C	5.4	5.6	3	4	4	2	0.0070	0.0018
SOIL 29	D	5.4	5.3	5	7	4	1	0.0038	0.0010
SOIL 29	E	5.4	5.7	6	7	5	2	0.0052	0.0010
SOIL 29	F	5.4	6	5	8	4	1	0.0033	0.0008
SOIL 29	G	5.4	5.2	6	8	4	1	0.0049	0.0012
SOIL 29	H	5.4	5.1	0	3	0	.	.	.
SOIL 29	I	5.4	5.4	4	5	3	1	0.0026	0.0009
SOIL 29	J	5.4	6.5	6	8	0	.	.	.
					6.50	3.60	1.3		0.0011
					1.84	2.12	0.46		0.0003
SOIL 30	A	4.2	6.8	0	0	.	.	.	.
SOIL 30	B	4.2	6	0	0	.	.	.	.
SOIL 30	C	4.2	6.2	0	0	.	.	.	.
SOIL 30	D	4.2	6	0	1	0	.	.	.
SOIL 30	E	4.2	6.2	0	0	.	.	.	.
SOIL 30	F	4.2	6.5	0	0	.	.	.	.
SOIL 30	G	4.2	6	0	1	0	.	.	.
SOIL 30	H	4.2	5.8	0	0	.	.	.	.
SOIL 30	I	4.2	5	0	0	.	.	.	.
SOIL 30	J	4.2	5.4	0	0	.	.	.	.
					0.20	0.00	.		.
					0.42	0.00	.		.

Appendix 5.1
(continued)
Sideoats Grama (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 31	A	6.3	5	6	8	8	15	0.0369	0.0046
SOIL 31	B	6.3	4	4	5	4	6	0.0194	0.0049
SOIL 31	C	6.3	4.4	6	8	7	9	0.0198	0.0028
SOIL 31	D	6.3	4.2	6	6	4	6	0.0146	0.0037
SOIL 31	E	6.3	4.3	8	8	7	11	0.0280	0.0040
SOIL 31	F	6.3	4.7	7	7	5	4	0.0174	0.0035
SOIL 31	G	6.3	3.7	5	8	7	10	0.0294	0.0042
SOIL 31	H	6.3	4.2	5	8	7	13	0.0271	0.0039
SOIL 31	I	6.3	4	4	5	5	8	0.0229	0.0046
SOIL 31	J	6.3	4.2	7	8	7	7	0.0184	0.0026
					7.10	6.10	8.9		0.0039
					1.29	1.45	3.41		0.0007
SOIL 32	A	6.6	4	1	3	3	1	0.0034	0.0011
SOIL 32	B	6.6	3.6	3	6	5	2	0.0048	0.0010
SOIL 32	C	6.6	4.4	0	5	5	1	0.0017	0.0003
SOIL 32	D	6.6	4.6	1	2	1	1	0.0018	0.0018
SOIL 32	E	6.6	5.2	1	5	2	1	0.0016	0.0008
SOIL 32	F	6.6	3.5	4	6	0	.	.	.
SOIL 32	G	6.6	3.5	2	5	4	1	0.0028	0.0007
SOIL 32	H	6.6	3.6	1	6	1	0.25	0.0002	0.0002
SOIL 32	I	6.6	3.8	0	2	2	2	0.0005	0.0003
SOIL 32	J	6.6	4	4	8	2	1	0.0012	0.0006
					4.80	2.50	1.1		0.0008
					1.93	1.72	0.55		0.0005

Appendix 5.1
(continued)
Sideoats Grama (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 35	A	4.9	3.9	0	0	.	.	.	.
SOIL 35	B	4.9	4.1	0	0	.	.	.	.
SOIL 35	C	4.9	3	0	0	.	.	.	.
SOIL 35	D	4.9	3.9	0	0	.	.	.	.
SOIL 35	E	4.9	3.4	0	0	.	.	.	.
SOIL 35	F	4.9	4.7	0	0	.	.	.	.
SOIL 35	G	4.9	4.5	0	0	.	.	.	.
SOIL 35	H	4.9	3.9	0	0	.	.	.	.
SOIL 35	I	4.9	3.9	0	0	.	.	.	.
SOIL 35	J	4.9	3.5	0	0	.	.	.	.
					0.00	.	.		.
					0.00	.	.		.
SOIL 36	A	5.1	5	0	0	.	.	.	.
SOIL 36	B	5.1	4.6	0	1	0	.	.	.
SOIL 36	C	5.1	4.8	0	0	.	.	.	.
SOIL 36	D	5.1	5.4	0	0	.	.	.	.
SOIL 36	E	5.1	5.7	0	0	.	.	.	.
SOIL 36	F	5.1	5.9	0	0	.	.	.	.
SOIL 36	G	5.1	6	0	0	.	.	.	.
SOIL 36	H	5.1	5	0	0	.	.	.	.
SOIL 36	I	5.1	6.2	0	0	.	.	.	.
SOIL 36	J	5.1	4.6	0	0	.	.	.	.
					0.10	0.00	.		.
					0.32	.	.		.

Appendix 5.2

Sideoats Grama (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
NC	A	7.7	10	20	3	4	7	7	3	.	.	.	.	.
NC	B	11.5	21	12	11	10	14	14	11	15	11	4	8	7
NC	C	10.7	4	13	12	13	15	11	7	.	.	.	.	.
NC	D	13.0	15	11	15	7	12	13	24	7	.	.	.	.
NC	E	12.4	11	14	14	14	6	9	19	.	.	.	.	.
NC	F	10.0	5	15	.	.	.	.	.	.	.	.	.	.
NC	G	10.0	7	12	12	9	.	.	.	.	.	.	.	.
NC	H	9.1	8	11	10	8	4	14	9	.	.	.	.	.
NC	I	7.0	8	6	.	.	.	.	.	.	.	.	.	.
NC	J	9.8	14	10	13	8	4	.	.	.	.	.	.	.
		10.1												
		1.90												
SOIL 1	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	E	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	H	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		0.6												
		0.53												

Appendix 5.2
(continued)
Sideoats Grama (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 2	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 2	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 2	C	6.0	5	7	.	.	.	.	.	.	.	.	.	.
SOIL 2	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 2	E	5.7	8	3	5	5	6	6	8	4	6	.	.	.
SOIL 2	F	7.1	3	9	7	8	6	5	8	8	9	6	7	9
SOIL 2	G	7.6	8	7	8	10	7	7	7	7	.	.	.	.
SOIL 2	H	7.8	5	8	7	6	8	9	11	8	.	.	.	.
SOIL 2	I	6.5	7	10	6	3	.	.	.	.	.	.	.	.
SOIL 2	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		6.8												
		0.86												
SOIL 3	A	4.5	1	8	.	.	.	.	.	.	.	.	.	.
SOIL 3	B	6.7	7	7	4	5	6	9	9	.	.	.	.	.
SOIL 3	C	4.5	4	6	4	4	.	.	.	.	.	.	.	.
SOIL 3	D	5.3	7	5	4	5	6	8	5	2	.	.	.	.
SOIL 3	E	4.8	5	7	4	2	6	.	.	.	.	.	.	.
SOIL 3	F	5.6	4	6	6	5	7	5	6	.	.	.	.	.
SOIL 3	G	4.1	4	4	4	4	5	4	4	.	.	.	.	.
SOIL 3	H	3.8	3	4	4	2	1	2	6	5	5	6	.	.
SOIL 3	I	5.0	6	4	5	4	5	5	6	.	.	.	.	.
SOIL 3	J	5.5	4	5	4	9	5	6	.	.	.	.	.	.
		5.0												
		0.84												

Appendix 5.2
(continued)
Sideoats Grama (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 4	A	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 4	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 4	C	8.0	7	8	8	11	6	.	.	.	.	.	.	.
SOIL 4	D	4.0	6	2	.	.	.	.	.	.	.	.	.	.
SOIL 4	E	9.0	9	.	.	.	.	.	.	.	.	.	.	.
SOIL 4	F	6.8	12	6	3	7	6	6	8	7	5	8	.	.
SOIL 4	G	8.2	6	5	10	12	7	9	8	7	10	.	.	.
SOIL 4	H	9.1	5	11	8	10	12	12	6	.	.	.	.	.
SOIL 4	I	6.0	6	9	2	4	4	7	10	.	.	.	.	.
SOIL 4	J	6.6	10	5	6	6	4	10	5	.	.	.	.	.
		6.5												
		2.63												
SOIL 5	A	6.2	7	6	6	8	4	5	7	6	7	.	.	.
SOIL 5	B	6.1	4	5	8	6	7	7	5	6	5	8	.	.
SOIL 5	C	6.0	5	6	4	4	7	8	6	7	5	8	6	.
SOIL 5	D	5.6	7	4	6	2	6	10	5	5	.	.	.	.
SOIL 5	E	7.1	5	11	6	9	6	7	6	7	.	.	.	.
SOIL 5	F	5.1	6	6	4	3	6	6	4	7	4	.	.	.
SOIL 5	G	5.5	7	6	6	3	5	5	7	5	.	.	.	.
SOIL 5	H	5.1	4	5	7	5	5	5	4	6	.	.	.	.
SOIL 5	I	6.0	7	2	4	8	5	8	8	7	8	3	.	.
SOIL 5	J	4.6	4	6	4	4	7	4	4	4	4	5	.	.
		5.7												
		0.71												

Appendix 5.2
(continued)
Sideoats Grama (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 6	A	2.0	2	.	.	.	.	.	.	.	.	.	.	.
SOIL 6	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 6	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 6	D	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 6	E	1.1	0.25	2	.	.	.	.	.	.	.	.	.	.
SOIL 6	F	3.0	3	.	.	.	.	.	.	.	.	.	.	.
SOIL 6	G	2.0	2	2	.	.	.	.	.	.	.	.	.	.
SOIL 6	H	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 6	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 6	J	1.5	2	1	.	.	.	.	.	.	.	.	.	.
		1.7												
		0.73												
SOIL 7	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												

Appendix 5.2

(continued)

Sideoats Grama (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 8	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 8	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 8	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 8	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 8	E	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 8	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 8	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 8	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 8	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 8	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		1.0												
		.												
SOIL 9	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		#DIV/0!												
		#DIV/0!												

Appendix 5.2
(continued)
Sideoats Grama (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 10	A	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	B	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	D	1.5	2	1	.	.	.	.	.	.	.	.	.	.
SOIL 10	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	G	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	J	1.0	1	.	.	.	.	.	.	.	.	.	.	.
		1.1												
		0.22												
SOIL 11	A	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	B	2.0	2	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		1.5												
		0.71												

Appendix 5.2

(continued)

Sideoats Grama (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 12	A	5.6	8	3	4	5	7	5	7	8	4	5	.	.
SOIL 12	B	5.8	8	6	6	4	2	7	5	8	7	5	.	.
SOIL 12	C	5.8	5	5	7	5	5	7	7	6	5	.	.	.
SOIL 12	D	5.9	5	7	6	7	5	4	7	6	7	6	5	.
SOIL 12	E	5.4	9	5	6	6	4	6	5	3	5	.	.	.
SOIL 12	F	5.6	8	5	7	5	5	2	5	6	6	7	6	.
SOIL 12	G	6.6	6	6	4	9	6	7	7	9	5	.	.	.
SOIL 12	H	6.8	8	8	6	7	6	5	8	6	7	.	.	.
SOIL 12	I	5.1	7	7	6	2	7	4	5	6	6	1	.	.
SOIL 12	J	6.1	7	2	6	6	7	6	8	7	.	.	.	.
		5.9												
		0.50												
SOIL 13	A	2.8	2	5	4	1	2	.	.	.	.	.	.	.
SOIL 13	B	4.6	3	5	5	5	4	5	5	5	4	.	.	.
SOIL 13	C	3.7	4	3	2	3	5	3	4	5	4	.	.	.
SOIL 13	D	3.9	3	6	4	4	2	5	2	5	4	5	3	.
SOIL 13	E	4.1	3	2	3	4	2	4	7	3	9	.	.	.
SOIL 13	F	3.3	4	4	2	.	.	.	.	.	.	.	.	.
SOIL 13	G	2.3	2	1	4	.	.	.	.	.	.	.	.	.
SOIL 13	H	3.8	4	3	5	3	6	2	4	3	4	.	.	.
SOIL 13	I	4.0	4	4	4	5	3	4	.	.	.	.	.	.
SOIL 13	J	3.7	3	3	2	3	4	7	4	4	3	.	.	.
		3.6												
		0.65												

Appendix 5.2

(continued)

Sideoats Grama (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 14	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												
SOIL 15	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 15	B	2.0	1	3	.	.	.	.	.	.	.	.	.	.
SOIL 15	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 15	D	3.0	3	.	.	.	.	.	.	.	.	.	.	.
SOIL 15	E	2.0	2	.	.	.	.	.	.	.	.	.	.	.
SOIL 15	F	2.0	2	.	.	.	.	.	.	.	.	.	.	.
SOIL 15	G	3.0	3	.	.	.	.	.	.	.	.	.	.	.
SOIL 15	H	2.0	2	.	.	.	.	.	.	.	.	.	.	.
SOIL 15	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 15	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		2.3												
		0.52												

Appendix 5.2
(continued)
Sideoats Grama (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 16	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 16	B	1.0	1	1	.	.	.	.	.	.	.	.	.	.
SOIL 16	C	1.0	1	1	1	.	.	.	.	.	.	.	.	.
SOIL 16	D	0.5	1	0.25	0.25	.	.	.	.	.	.	.	.	.
SOIL 16	E	1.1	2	0.25	1	.	.	.	.	.	.	.	.	.
SOIL 16	F	1.4	1	1	0.25	2	2	2	.	.	.	.	.	.
SOIL 16	G	1.3	1	1	1	2	.	.	.	.	.	.	.	.
SOIL 16	H	0.9	0.25	1	0.25	2	1	.	.	.	.	.	.	.
SOIL 16	I	1.5	2	1	1	2	.	.	.	.	.	.	.	.
SOIL 16	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		1.1												
		0.31												
SOIL 17	A	6.2	7	6	7	6	5	6	7	7	7	4	.	.
SOIL 17	B	5.7	8	5	6	5	5	9	4	3	6	.	.	.
SOIL 17	C	5.9	5	5	6	7	4	5	6	7	6	8	.	.
SOIL 17	D	5.0	6	3	6	5	4	5	6	6	5	6	5	3
SOIL 17	E	4.6	4	5	7	2	2	5	6	6	.	.	.	.
SOIL 17	F	5.3	7	4	4	4	5	6	7	5	.	.	.	.
SOIL 17	G	4.3	3	6	4	5	3	4	5	4	.	.	.	.
SOIL 17	H	5.6	6	5	4	6	6	8	4	.	.	.	.	.
SOIL 17	I	4.5	4	2	7	2	6	4	7	3	4	6	.	.
SOIL 17	J	4.9	6	5	2	5	4	7	2	8	6	4	5	.
		5.2												
		0.64												

Appendix 5.2

(continued)

Sideoats Grama (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 19	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	I	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		0.3												
		.												
SOIL 20	A	5.7	5	4	5	9	6	5	.	.	.	.	.	.
SOIL 20	B	5.9	3	7	4	6	7	7	5	8	6	6	.	.
SOIL 20	C	6.8	7	4	7	4	8	5	10	8	8	.	.	.
SOIL 20	D	5.9	8	5	5	6	5	9	6	5	5	5	.	.
SOIL 20	E	5.6	7	2	4	6	6	6	5	8	6	.	.	.
SOIL 20	F	5.7	7	8	6	5	4	8	5	6	6	6	2	.
SOIL 20	G	4.7	4	3	6	6	2	4	8	.	.	.	.	.
SOIL 20	H	6.6	10	6	8	7	2	6	6	8	5	8	.	.
SOIL 20	I	6.8	5	10	7	3	9	7	9	8	6	4	.	.
SOIL 20	J	7.0	7	8	8	8	7	7	6	8	5	8	8	4
		6.1												
		0.72												

Appendix 5.2
(continued)
Sideoats Grama (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 21	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	B	1.7	1	2	2	.	.	.	.	.	.	.	.	.
SOIL 21	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	E	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	I	0.6	1	0.25	.	.	.	.	.	.	.	.	.	.
SOIL 21	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		1.1												
		0.53												
SOIL 22	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	B	2.0	2	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	H	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		1.1												
		1.24												

Appendix 5.2
(continued)
Sideoats Grama (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 23	A	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	B	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	E	2.0	2	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	F	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	I	0.6	1	0.25	.	.	.	.	.	.	.	.	.	.
SOIL 23	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		0.8												
		0.73												
SOIL 24	A	8.9	10	10	6	5	9	8	10	7	6	18	.	.
SOIL 24	B	5.8	9	5	4	9	5	2	5	7	6	.	.	.
SOIL 24	C	8.3	10	8	5	9	10	8	8	8	.	.	.	.
SOIL 24	D	11.0	15	6	11	9	10	15	.	.	.	.	.	.
SOIL 24	E	8.8	10	2	10	11	7	12	9	11	3	13	.	.
SOIL 24	F	6.5	8	8	3	10	8	7	7	1	.	.	.	.
SOIL 24	G	7.0	10	4	9	8	7	10	1	8	6	7	.	.
SOIL 24	H	7.2	7	4	8	5	12	.	.	.	.	.	.	.
SOIL 24	I	8.3	10	8	9	9	8	7	7	8	.	.	.	.
SOIL 24	J	8.1	8	5	8	11	4	8	9	10	10	.	.	.
		8.0												
		1.47												

Appendix 5.2
(continued)
Sideoats Grama (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 25	A	8.2	10	7	10	12	8	6	9	6	2	11	9	.
SOIL 25	B	9.6	7	7	11	9	11	12	11	10	8	.	.	.
SOIL 25	C	7.6	9	8	5	9	4	8	8	6	10	9	.	.
SOIL 25	D	8.1	8	12	10	7	7	8	9	4	.	.	.	.
SOIL 25	E	5.6	1	9	6	6	5	5	5	8	5	.	.	.
SOIL 25	F	11.0	8	9	10	12	13	11	13	11	10	13	.	.
SOIL 25	G	8.0	10	8	5	9	7	6	9	5	10	11	.	.
SOIL 25	H	8.0	8	8	11	7	9	7	5	9	10	7	7	.
SOIL 25	I	7.4	11	5	7	8	4	7	10	7	.	.	.	.
SOIL 25	J	8.3	11	9	5	9	10	7	7	9	6	10	.	.
		8.2												
		1.41												
SOIL 26	A	5.0	6	3	8	1	3	3	6	6	8	7	4	.
SOIL 26	B	5.0	5	6	6	2	4	8	2	7	5	.	.	.
SOIL 26	C	4.8	3	6	6	6	5	1	5	6	.	.	.	.
SOIL 26	D	6.2	6	10	6	4	5	7	4	7	7	.	.	.
SOIL 26	E	5.8	7	5	6	3	6	7	7	6	5	.	.	.
SOIL 26	F	5.3	2	7	2	5	7	7	7	5	.	.	.	.
SOIL 26	G	5.0	7	6	6	5	5	3	3	5	5	.	.	.
SOIL 26	H	5.9	8	6	5	6	6	5	4	6	6	7	.	.
SOIL 26	I	6.4	6	7	6	4	7	6	6	6	9	7	.	.
SOIL 26	J	6.7	5	6	7	8	7	5	9	6	7	.	.	.
		5.6												
		0.68												

Appendix 5.2
(continued)
Sideoats Grama (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 27	A	2.1	0.25	2	2	4	2	.	.	.	.	.	.	.
SOIL 27	B	2.8	3	2	3	2	2	5	.	.	.	.	.	.
SOIL 27	C	2.5	4	4	1	3	1	3	2	2	.	.	.	.
SOIL 27	D	2.7	4	1	2	2	3	3	4	.	.	.	.	.
SOIL 27	E	3.0	4	4	1	2	3	3	4	3	.	.	.	.
SOIL 27	F	2.6	3	3	2	4	2	1	2	3	3	.	.	.
SOIL 27	G	2.3	3	2	2	.	.	.	.	.	.	.	.	.
SOIL 27	H	2.4	2	3	2	3	2	.	.	.	.	.	.	.
SOIL 27	I	3.0	4	3	3	0.25	3	4	4	.	.	.	.	.
SOIL 27	J	2.8	4	1	2	2	4	4	.	.	.	.	.	.
		2.6												
		0.31												
SOIL 28	A	6.2	10	5	5	7	4	6	7	4	7	7	.	.
SOIL 28	B	6.9	7	7	12	3	9	5	5	7	.	.	.	.
SOIL 28	C	5.6	3	4	6	8	4	5	6	9	5	.	.	.
SOIL 28	D	6.8	6	8	10	4	5	8	9	4	.	.	.	.
SOIL 28	E	6.7	3	8	7	6	7	6	7	9	6	8	.	.
SOIL 28	F	5.9	7	8	8	2	6	8	6	1	3	10	.	.
SOIL 28	G	6.1	4	7	6	5	5	5	6	6	7	10	.	.
SOIL 28	H	6.5	0.25	8	7	8	8	6	7	7	9	5	.	.
SOIL 28	I	6.5	12	3	10	8	6	5	4	4	6	6	8	.
SOIL 28	J	6.2	5	7	6	3	6	9	6	5	6	8	7	.
		6.3												
		0.42												

Appendix 5.2

(continued)

Sideoats Grama (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 29	A	1.5	2	3	1	0.25	1	2	.	.	.	.	.	.
SOIL 29	B	1.1	2	0.25	0.25	1	1	2	.	.	.	.	.	.
SOIL 29	C	1.8	2	0.25	2	3	.	.	.	.	.	.	.	.
SOIL 29	D	1.3	2	2	0.25	1	.	.	.	.	.	.	.	.
SOIL 29	E	1.1	0.25	0.25	1	2	2	.	.	.	.	.	.	.
SOIL 29	F	1.5	2	1	1	2	.	.	.	.	.	.	.	.
SOIL 29	G	2.0	2	2	2	2	.	.	.	.	.	.	.	.
SOIL 29	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 29	I	1.0	1	1	1	.	.	.	.	.	.	.	.	.
SOIL 29	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		1.4												
		0.36												
SOIL 30	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												

Appendix 5.2

(continued)

Sideoats Grama (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 31	A	5.0	5	3	5	6	5	6	5	5	.	.	.	.
SOIL 31	B	5.3	5	6	6	4	.	.	.	.	.	.	.	.
SOIL 31	C	4.0	3	3	5	5	2	6	4	.	.	.	.	.
SOIL 31	D	4.3	5	4	4	4	.	.	.	.	.	.	.	.
SOIL 31	E	4.6	4	5	5	4	6	3	5	.	.	.	.	.
SOIL 31	F	3.0	2	3	5	2	3	.	.	.	.	.	.	.
SOIL 31	G	5.0	3	4	7	7	4	7	3	.	.	.	.	.
SOIL 31	H	4.3	7	5	6	2	2	3	5	.	.	.	.	.
SOIL 31	I	4.4	5	4	2	5	6	.	.	.	.	.	.	.
SOIL 31	J	3.3	5	2	4	6	3	1	2	.	.	.	.	.
		4.3												
		0.73												
SOIL 32	A	0.8	0.25	0.25	2	.	.	.	.	.	.	.	.	.
SOIL 32	B	1.1	1	0.25	1	1	2	.	.	.	.	.	.	.
SOIL 32	C	1.3	2	1	2	1	0.25	.	.	.	.	.	.	.
SOIL 32	D	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 32	E	1.0	1	1	.	.	.	.	.	.	.	.	.	.
SOIL 32	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 32	G	0.6	1	1	0.25	0.25	.	.	.	.	.	.	.	.
SOIL 32	H	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 32	I	1.0	1	1	.	.	.	.	.	.	.	.	.	.
SOIL 32	J	0.6	0.25	1	.	.	.	.	.	.	.	.	.	.
		0.9												
		0.20												

Appendix 5.2

(continued)

Sideoats Grama (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 35	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												
SOIL 36	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												

Appendix 5.3

Sideoats Grama (Nursery-Provided) Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed
NC	A	10	N		SOIL 2	A	.	NE		SOIL 4	A	80	N,M
NC	B	0	none		SOIL 2	B	.	NE		SOIL 4	B	100	M
NC	C	0	none		SOIL 2	C	10	CL,N		SOIL 4	C	10	N
NC	D	0	none		SOIL 2	D	.	NE		SOIL 4	D	40	N,LC
NC	E	10	M		SOIL 2	E	10	N,LC		SOIL 4	E	50	M
NC	F	30	M		SOIL 2	F	10	N		SOIL 4	F	30	N,CL
NC	G	10	M		SOIL 2	G	10	N		SOIL 4	G	10	N,M
NC	H	0	none		SOIL 2	H	20	N,LC		SOIL 4	H	0	none
NC	I	50	M		SOIL 2	I	10	CL,N		SOIL 4	I	20	N,CC
NC	J	0	none		SOIL 2	J	.	NE		SOIL 4	J	10	N
SOIL 1	A	.	NE		SOIL 3	A	50	CL,N,M		SOIL 5	A	10	N,M
SOIL 1	B	100	M		SOIL 3	B	20	N,M,CC		SOIL 5	B	10	N,CL
SOIL 1	C	100	M		SOIL 3	C	40	CL,N,M		SOIL 5	C	20	N,CL
SOIL 1	D	100	M		SOIL 3	D	30	CL,N,CC		SOIL 5	D	20	CL,LC
SOIL 1	E	90	N		SOIL 3	E	30	N,CC		SOIL 5	E	20	CL,N,CC
SOIL 1	F	100	M		SOIL 3	F	20	N,M,CC		SOIL 5	F	20	CL,M
SOIL 1	G	100	M		SOIL 3	G	30	N,CC		SOIL 5	G	30	CL,N,M,CC
SOIL 1	H	80	CL,N		SOIL 3	H	40	N,CC		SOIL 5	H	20	CL,N,CC
SOIL 1	I	100	M		SOIL 3	I	20	N		SOIL 5	I	20	CL,N
SOIL 1	J	.	.		SOIL 3	J	20	CL,N		SOIL 5	J	40	CL,N

M – Mortality; CL – Chlorosis; N – Necrosis; CC – Color Change; NE – None Emerged; LC – Leaf Curl

Appendix 5.3
(continued)
Sideoats Grama (Nursery-Provided) Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed
SOIL 6	A	90	CL,N,M		SOIL 8	A	100	M		SOIL 10	A	90	N,M
SOIL 6	B	100	M		SOIL 8	B	100	M		SOIL 10	B	90	N,M
SOIL 6	C	100	M		SOIL 8	C	100	M		SOIL 10	C	100	M
SOIL 6	D	90	N,M		SOIL 8	D	100	M		SOIL 10	D	90	CL,N,M
SOIL 6	E	90	N,M		SOIL 8	E	90	N,M,CC		SOIL 10	E	100	M
SOIL 6	F	90	N,M,CC		SOIL 8	F	100	M		SOIL 10	F	100	M
SOIL 6	G	80	N,M,CC		SOIL 8	G	100	M		SOIL 10	G	90	N,M
SOIL 6	H	90	N,M		SOIL 8	H	100	M		SOIL 10	H	.	NE
SOIL 6	I	100	M		SOIL 8	I	100	M		SOIL 10	I	100	M
SOIL 6	J	90	CL,N,M,CC		SOIL 8	J	100	M		SOIL 10	J	90	N,M,CC
SOIL 7	A	.	NE		SOIL 9	A	.	NE		SOIL 11	A	90	CL,N
SOIL 7	B	.	NE		SOIL 9	B	.	NE		SOIL 11	B	90	N,M
SOIL 7	C	.	NE		SOIL 9	C	.	NE		SOIL 11	C	100	M
SOIL 7	D	.	NE		SOIL 9	D	.	NE		SOIL 11	D	.	NE
SOIL 7	E	.	NE		SOIL 9	E	.	NE		SOIL 11	E	.	NE
SOIL 7	F	.	NE		SOIL 9	F	.	NE		SOIL 11	F	100	M
SOIL 7	G	.	NE		SOIL 9	G	.	NE		SOIL 11	G	100	M
SOIL 7	H	.	NE		SOIL 9	H	.	NE		SOIL 11	H	100	M
SOIL 7	I	.	NE		SOIL 9	I	.	NE		SOIL 11	I	100	M
SOIL 7	J	.	NE		SOIL 9	J	.	NE		SOIL 11	J	.	NE

M – Mortality; CL – Chlorosis; N – Necrosis; CC – Color Change; NE – None Emerged

Appendix 5.3
(continued)
Sideoats Grama (Nursery-Provided) Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed
SOIL 12	A	0	none		SOIL 14	A	.	NE		SOIL 16	A	100	M
SOIL 12	B	10	N		SOIL 14	B	100	M		SOIL 16	B	90	N,M
SOIL 12	C	20	N,M		SOIL 14	C	.	NE		SOIL 16	C	90	N,M
SOIL 12	D	0	none		SOIL 14	D	.	NE		SOIL 16	D	90	N,M
SOIL 12	E	20	N,M		SOIL 14	E	.	NE		SOIL 16	E	90	N,M
SOIL 12	F	10	N		SOIL 14	F	100	M		SOIL 16	F	80	CL,N,M
SOIL 12	G	10	N		SOIL 14	G	100	M		SOIL 16	G	90	N,M
SOIL 12	H	20	N,M		SOIL 14	H	100	M		SOIL 16	H	90	N,M
SOIL 12	I	20	CL,N		SOIL 14	I	.	NE		SOIL 16	I	90	N,M,CC
SOIL 12	J	20	CL,N,LC		SOIL 14	J	.	NE		SOIL 16	J	.	NE
SOIL 13	A	60	CL,N,M		SOIL 15	A	100	M		SOIL 17	A	10	CL,N
SOIL 13	B	40	CL,N,M		SOIL 15	B	90	N,M		SOIL 17	B	10	CL,N
SOIL 13	C	50	CL,N,M,CC		SOIL 15	C	100	M		SOIL 17	C	20	CL,CC
SOIL 13	D	40	CL,N,M,CC		SOIL 15	D	90	N,M		SOIL 17	D	10	CL,CC
SOIL 13	E	40	CL,N,M		SOIL 15	E	90	N,M		SOIL 17	E	10	CL,N
SOIL 13	F	60	N,M,CC		SOIL 15	F	90	N,M		SOIL 17	F	0	none
SOIL 13	G	70	N,M,CC		SOIL 15	G	80	CL,N,M		SOIL 17	G	10	CL,N
SOIL 13	H	40	CL,N,M,CC		SOIL 15	H	90	CL,N,M		SOIL 17	H	10	N
SOIL 13	I	40	CL,N,M		SOIL 15	I	.	NE		SOIL 17	I	20	CL,N
SOIL 13	J	50	CL,N		SOIL 15	J	.	NE		SOIL 17	J	20	CL,N

M – Mortality; CL – Chlorosis; N – Necrosis; CC – Color Change; NE – None Emerged; LC – Leaf Curl

Appendix 5.3

(continued)

Sideoats Grama (Nursery-Provided) Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed
SOIL 19	A	.	NE		SOIL 21	A	100	M		SOIL 23	A	90	N,M
SOIL 19	B	100	M		SOIL 21	B	80	N,M,CC		SOIL 23	B	90	N,M
SOIL 19	C	.	NE		SOIL 21	C	100	M		SOIL 23	C	100	M
SOIL 19	D	100	M		SOIL 21	D	100	M		SOIL 23	D	100	M
SOIL 19	E	100	M		SOIL 21	E	90	N		SOIL 23	E	90	N,M
SOIL 19	F	.	NE		SOIL 21	F	100	M		SOIL 23	F	90	N,M
SOIL 19	G	100	M		SOIL 21	G	100	M		SOIL 23	G	100	M
SOIL 19	H	.	NE		SOIL 21	H	.	NE		SOIL 23	H	100	M
SOIL 19	I	90	N		SOIL 21	I	90	N		SOIL 23	I	90	N
SOIL 19	J	.	NE		SOIL 21	J	.	NE		SOIL 23	J	100	M
SOIL 20	A	20	CL,N,M		SOIL 22	A	100	M		SOIL 24	A	0	none
SOIL 20	B	10	CL,N,M		SOIL 22	B	90	N,M		SOIL 24	B	0	none
SOIL 20	C	10	CL,N,M		SOIL 22	C	100	M		SOIL 24	C	0	none
SOIL 20	D	10	CL,N		SOIL 22	D	100	M		SOIL 24	D	10	M
SOIL 20	E	20	CL,N,M		SOIL 22	E	100	M		SOIL 24	E	0	none
SOIL 20	F	0	none		SOIL 22	F	.	NE		SOIL 24	F	20	N,LC,M
SOIL 20	G	30	CL,N,M		SOIL 22	G	.	NE		SOIL 24	G	10	LC
SOIL 20	H	10	N		SOIL 22	H	90	N,M		SOIL 24	H	0	none
SOIL 20	I	10	CL,N,M		SOIL 22	I	100	M		SOIL 24	I	0	none
SOIL 20	J	0	none		SOIL 22	J	.	NE		SOIL 24	J	10	M

M – Mortality; CL – Chlorosis; N – Necrosis; CC – Color Change; NE – None Emerged; LC – Leaf Curl

Appendix 5.3
(continued)
Sideoats Grama (Nursery-Provided) Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed
SOIL 25	A	0	none		SOIL 27	A	70	CL,N,M		SOIL 29	A	70	CL,N,M
SOIL 25	B	0	none		SOIL 27	B	50	CL,N,M		SOIL 29	B	80	CL,N,M
SOIL 25	C	0	none		SOIL 27	C	50	CL,N,M		SOIL 29	C	70	CL,N
SOIL 25	D	0	none		SOIL 27	D	60	CL,N,M		SOIL 29	D	80	CL,N,M
SOIL 25	E	10	N		SOIL 27	E	60	CL,N,M		SOIL 29	E	80	CL,N,M
SOIL 25	F	10	M		SOIL 27	F	60	CL,N,M,CC		SOIL 29	F	80	CL,N,M
SOIL 25	G	10	M		SOIL 27	G	60	CL,N,M		SOIL 29	G	80	CL,N,M
SOIL 25	H	0	none		SOIL 27	H	70	CL,N,M		SOIL 29	H	100	M
SOIL 25	I	10	N,M		SOIL 27	I	60	CL,N,M		SOIL 29	I	90	CL,N,M
SOIL 25	J	0	none		SOIL 27	J	60	CL,N,M		SOIL 29	J	100	M
SOIL 26	A	30	CL,N		SOIL 28	A	10	N		SOIL 30	A	.	NE
SOIL 26	B	30	N,LC,M		SOIL 28	B	0	none		SOIL 30	B	.	NE
SOIL 26	C	30	CL,N,LC,M		SOIL 28	C	10	N		SOIL 30	C	.	NE
SOIL 26	D	10	N,M		SOIL 28	D	10	N		SOIL 30	D	100	M
SOIL 26	E	10	N,M		SOIL 28	E	10	N,CC		SOIL 30	E	.	NE
SOIL 26	F	30	CL,N		SOIL 28	F	10	N		SOIL 30	F	.	NE
SOIL 26	G	20	N		SOIL 28	G	10	N,M		SOIL 30	G	100	M
SOIL 26	H	10	N		SOIL 28	H	10	N		SOIL 30	H	.	NE
SOIL 26	I	10	N,M		SOIL 28	I	10	N		SOIL 30	I	.	NE
SOIL 26	J	10	N,M		SOIL 28	J	0	none		SOIL 30	J	.	NE

M – Mortality; CL – Chlorosis; N – Necrosis; CC – Color Change; NE – None Emerged; LC – Leaf Curl

Appendix 5.3

(continued)

Sideoats Grama (Nursery-Provided) Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed
SOIL 31	A	30	N,CC		SOIL 35	A	.	NE
SOIL 31	B	30	N,M		SOIL 35	B	.	NE
SOIL 31	C	40	CL,N,M		SOIL 35	C	.	NE
SOIL 31	D	40	CL,N,M		SOIL 35	D	.	NE
SOIL 31	E	60	CL,N,M,CC		SOIL 35	E	.	NE
SOIL 31	F	50	CL,N,M,CC		SOIL 35	F	.	NE
SOIL 31	G	60	CL,N,M		SOIL 35	G	.	NE
SOIL 31	H	40	CL,N,M		SOIL 35	H	.	NE
SOIL 31	I	30	CL,N,CC		SOIL 35	I	.	NE
SOIL 31	J	40	CL,N,M		SOIL 35	J	.	NE
SOIL 32	A	90	N		SOIL 36	A	.	NE
SOIL 32	B	80	CL,N,M		SOIL 36	B	100	M
SOIL 32	C	90	N		SOIL 36	C	.	NE
SOIL 32	D	90	N,M		SOIL 36	D	.	NE
SOIL 32	E	90	N,M		SOIL 36	E	.	NE
SOIL 32	F	100	M		SOIL 36	F	.	NE
SOIL 32	G	90	N,M		SOIL 36	G	.	NE
SOIL 32	H	90	N,M		SOIL 36	H	.	NE
SOIL 32	I	90	N		SOIL 36	I	.	NE
SOIL 32	J	90	N,M		SOIL 36	J	.	NE

M – Mortality; CL – Chlorosis; N – Necrosis; CC – Color Change; NE – None Emerged

Appendix 6.1

Sideoats Grama (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
NC	A	5.9	5.8	8	8	5	16	0.0853	0.0171
NC	B	5.9	5.1	3	5	4	10	0.0162	0.0041
NC	C	5.9	5.7	4	4	4	23	0.0261	0.0065
NC	D	5.9	6.4	8	8	8	19	0.1209	0.0151
NC	E	5.9	6.2	8	9	9	23	0.0915	0.0102
NC	F	5.9	4.8	10	10	6	25	0.0362	0.0060
NC	G	5.9	4	5	5	2	9	0.0062	0.0031
NC	H	5.9	5.6	5	8	7	15	0.0490	0.0070
NC	I	5.9	5.6	12	12	12	25	0.1016	0.0085
NC	J	5.9	5.2	7	8	7	19	0.0625	0.0089
					7.70	6.40	18.4		0.0086
					2.45	2.88	5.83		0.0045
SOIL 1	A	6.0	4	0	0	.	.	.	.
SOIL 1	B	6.0	3.6	0	0	.	.	.	.
SOIL 1	C	6.0	3.6	0	0	.	.	.	.
SOIL 1	D	6.0	3.6	0	0	.	.	.	.
SOIL 1	E	6.0	4.4	0	0	.	.	.	.
SOIL 1	F	6.0	3.6	0	0	.	.	.	.
SOIL 1	G	6.0	5.4	0	0	.	.	.	.
SOIL 1	H	6.0	5.8	0	0	.	.	.	.
SOIL 1	I	6.0	3.5	0	0	.	.	.	.
SOIL 1	J	6.0	5.6	0	0	.	.	.	.
					0.00	.	.		.
					0.00	.	.		.

Appendix 6.1

(continued)

Sideoats Grama (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 2	A	6.2	4.5	8	10	10	10	0.0377	0.0038
SOIL 2	B	6.2	4.5	5	12	12	11	0.0303	0.0025
SOIL 2	C	6.2	4.3	3	12	12	12	0.0307	0.0026
SOIL 2	D	6.2	4.2	4	12	11	12	0.0225	0.0020
SOIL 2	E	6.2	4.2	4	9	9	12	0.0242	0.0027
SOIL 2	F	6.2	4.2	5	11	11	11	0.0356	0.0032
SOIL 2	G	6.2	4.8	2	11	11	11	0.0300	0.0027
SOIL 2	H	6.2	3.8	3	9	9	13	0.0233	0.0026
SOIL 2	I	6.2	4.6	2	8	8	11	0.0232	0.0029
SOIL 2	J	6.2	4.6	2	9	9	15	0.0325	0.0036
					10.30	10.20	11.8		0.0029
					1.49	1.40	1.40		0.0005
SOIL 3	A	5.6	3.5	3	4	3	13	0.0136	0.0045
SOIL 3	B	5.6	3	2	4	2	6	0.0048	0.0024
SOIL 3	C	5.6	3.9	3	4	3	8	0.0064	0.0021
SOIL 3	D	5.6	3.9	0	1	1	4	0.0013	0.0013
SOIL 3	E	5.6	3.6	2	3	3	5	0.0053	0.0018
SOIL 3	F	5.6	3.7	3	4	3	14	0.0098	0.0033
SOIL 3	G	5.6	3.6	0	0	.	.	.	.
SOIL 3	H	5.6	3.9	1	4	4	17	0.0104	0.0026
SOIL 3	I	5.6	3.8	1	4	2	12	0.0060	0.0030
SOIL 3	J	5.6	3.6	3	5	5	14	0.0212	0.0042
					3.30	2.89	10.3		0.0028
					1.57	1.17	4.66		0.0011

Appendix 6.1

(continued)

Sideoats Grama (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 4	A	5.2	3.2	5	5	5	14	0.0105	0.0021
SOIL 4	B	5.2	3	3	6	5	16	0.0213	0.0043
SOIL 4	C	5.2	4.5	0	5	5	17	0.0198	0.0040
SOIL 4	D	5.2	3.7	2	5	4	7	0.0091	0.0023
SOIL 4	E	5.2	4.6	0	5	5	19	0.0170	0.0034
SOIL 4	F	5.2	3.6	5	7	6	13	0.0301	0.0050
SOIL 4	G	5.2	3.5	3	6	5	14	0.0206	0.0041
SOIL 4	H	5.2	4.6	4	7	3	18	0.0141	0.0047
SOIL 4	I	5.2	4	1	4	4	11	0.0113	0.0028
SOIL 4	J	5.2	3.7	4	8	7	14	0.0354	0.0051
					5.80	4.90	14.3		0.0038
					1.23	1.10	3.53		0.0011
SOIL 5	A	5.8	3.8	1	4	4	9	0.0146	0.0037
SOIL 5	B	5.8	3.6	1	5	5	10	0.0068	0.0014
SOIL 5	C	5.8	4.7	1	7	6	9	0.0202	0.0034
SOIL 5	D	5.8	4.2	1	4	3	14	0.0088	0.0029
SOIL 5	E	5.8	3.9	4	9	9	12	0.0165	0.0018
SOIL 5	F	5.8	3.7	0	5	5	11	0.0082	0.0016
SOIL 5	G	5.8	3.6	3	4	4	7	0.0098	0.0025
SOIL 5	H	5.8	4.4	4	9	9	12	0.0278	0.0031
SOIL 5	I	5.8	4.2	1	5	4	6	0.0118	0.0030
SOIL 5	J	5.8	3.9	0	3	3	6	0.0070	0.0023
					5.50	5.20	9.6		0.0026
					2.12	2.20	2.72		0.0008

Appendix 6.1
(continued)
Sideoats Grama (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 6	A	6.6	3.5	0	6	4	0.25	0.0053	0.0013
SOIL 6	B	6.6	3	0	2	2	0.25	0.0013	0.0007
SOIL 6	C	6.6	3.7	1	7	0	.	.	.
SOIL 6	D	6.6	3.4	0	3	2	0.25	0.0012	0.0006
SOIL 6	E	6.6	3.4	0	1	0	.	.	.
SOIL 6	F	6.6	5.2	1	6	3	1	0.0007	0.0002
SOIL 6	G	6.6	5.8	0	4	3	1	0.0025	0.0008
SOIL 6	H	6.6	5.8	0	4	4	2	0.0028	0.0007
SOIL 6	I	6.6	4.2	0	4	4	2	0.0036	0.0009
SOIL 6	J	6.6	4	1	4	3	1	0.0033	0.0011
					4.10	2.50	1.0		0.0008
					1.85	1.51	0.73		0.0003
SOIL 7	A	5.9	3.5	0	0	.	.	.	.
SOIL 7	B	5.9	5.6	0	0	.	.	.	.
SOIL 7	C	5.9	3.6	0	0	.	.	.	.
SOIL 7	D	5.9	4.5	0	0	.	.	.	.
SOIL 7	E	5.9	4.8	0	0	.	.	.	.
SOIL 7	F	5.9	3.4	0	0	.	.	.	.
SOIL 7	G	5.9	3.5	0	0	.	.	.	.
SOIL 7	H	5.9	4.4	0	0	.	.	.	.
SOIL 7	I	5.9	3.5	0	0	.	.	.	.
SOIL 7	J	5.9	3.4	0	0	.	.	.	.
					0.00	.	.		.
					0.00	.	.		.

Appendix 6.1
(continued)
Sideoats Grama (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 8	A	6.0	3.2	1	7	5	2	0.0025	0.0005
SOIL 8	B	6.0	3.4	0	3	0	.	.	.
SOIL 8	C	6.0	3.7	0	3	1	0.25	0.0004	0.0004
SOIL 8	D	6.0	3.5	0	1	0	.	.	.
SOIL 8	E	6.0	3.2	2	4	1	0.25	0.0003	0.0003
SOIL 8	F	6.0	3	0	2	2	0.25	0.0006	0.0003
SOIL 8	G	6.0	3	1	1	0	.	.	.
SOIL 8	H	6.0	3.5	1	4	2	0.25	0.0007	0.0004
SOIL 8	I	6.0	3.2	2	4	1	0.25	0.0008	0.0008
SOIL 8	J	6.0	3.2	0	5	0	.	.	.
					3.40	1.20	0.5		0.0004
					1.84	1.55	0.71		0.0002
SOIL 9	A	6.4	3.4	0	0	.	.	.	.
SOIL 9	B	6.4	3	0	0	.	.	.	.
SOIL 9	C	6.4	3.5	0	0	.	.	.	.
SOIL 9	D	6.4	3.4	0	0	.	.	.	.
SOIL 9	E	6.4	3	0	0	.	.	.	.
SOIL 9	F	6.4	3.5	0	0	.	.	.	.
SOIL 9	G	6.4	5.3	0	0	.	.	.	.
SOIL 9	H	6.4	5.1	0	0	.	.	.	.
SOIL 9	I	6.4	3.4	0	0	.	.	.	.
SOIL 9	J	6.4	3.8	0	0	.	.	.	.
					0.00	.	.		.
					0.00	.	.		.

Appendix 6.1

(continued)

Sideoats Grama (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 10	A	6.0	3	0	1	0	.	.	.
SOIL 10	B	6.0	3	0	1	0	.	.	.
SOIL 10	C	6.0	3.9	0	1	1	1	0.0007	0.0007
SOIL 10	D	6.0	3.4	0	2	0	.	.	.
SOIL 10	E	6.0	3.5	0	4	2	1	0.0015	0.0008
SOIL 10	F	6.0	3.5	0	0	.	.	.	.
SOIL 10	G	6.0	3.6	0	0	.	.	.	.
SOIL 10	H	6.0	3.9	0	4	2	1	0.0054	0.0027
SOIL 10	I	6.0	3	0	2	0	.	.	.
SOIL 10	J	6.0	3.5	0	2	0	.	.	.
					1.70	0.63	1.0		0.0014
					1.42	0.92	0.00		0.0011
SOIL 11	A	4.4	5	0	0	.	.	.	.
SOIL 11	B	4.4	5.8	1	2	0	.	.	.
SOIL 11	C	4.4	7	1	2	0	.	.	.
SOIL 11	D	4.4	5.6	1	1	0	.	.	.
SOIL 11	E	4.4	5.2	0	1	0	.	.	.
SOIL 11	F	4.4	5	0	0	.	.	.	.
SOIL 11	G	4.4	4.3	0	3	1	0.25	0.0004	0.0004
SOIL 11	H	4.4	5.3	0	1	0	.	.	.
SOIL 11	I	4.4	4	1	1	0	.	.	.
SOIL 11	J	4.4	5.5	0	0	.	.	.	.
					1.10	0.14	0.3		0.0004
					0.99	0.38	.		.

Appendix 6.1
(continued)
Sideoats Grama (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 12	A	5.8	4	4	9	8	22	0.0253	0.0032
SOIL 12	B	5.8	4.2	4	8	8	14	0.0260	0.0033
SOIL 12	C	5.8	4	6	11	11	20	0.0282	0.0026
SOIL 12	D	5.8	4.1	9	12	12	20	0.0302	0.0025
SOIL 12	E	5.8	3.8	4	10	10	17	0.0237	0.0024
SOIL 12	F	5.8	4.6	3	12	12	13	0.0272	0.0023
SOIL 12	G	5.8	5	8	12	12	20	0.0293	0.0024
SOIL 12	H	5.8	4.9	8	12	10	18	0.0314	0.0031
SOIL 12	I	5.8	4	7	12	12	19	0.0360	0.0030
SOIL 12	J	5.8	4.7	4	12	10	17	0.0272	0.0027
					11.00	10.50	18.0		0.0027
					1.49	1.58	2.83		0.0004
SOIL 13	A	5.4	3.6	3	3	0	.	.	.
SOIL 13	B	5.4	3.7	2	2	1	1	0.0015	0.0015
SOIL 13	C	5.4	3.5	2	5	3	2	0.0071	0.0024
SOIL 13	D	5.4	3.6	3	4	3	1	0.0015	0.0005
SOIL 13	E	5.4	4	4	4	1	1	0.0032	0.0032
SOIL 13	F	5.4	3.5	1	3	2	3	0.0048	0.0024
SOIL 13	G	5.4	3.5	4	4	3	2	0.0059	0.0020
SOIL 13	H	5.4	3.6	2	7	6	1	0.0087	0.0015
SOIL 13	I	5.4	3.5	3	5	4	2	0.0047	0.0012
SOIL 13	J	5.4	3.9	4	8	6	2	0.0125	0.0021
					4.50	2.90	1.7		0.0018
					1.84	2.02	0.71		0.0008

Appendix 6.1

(continued)

Sideoats Grama (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 14	A	5.4	3	0	0	.	.	.	.
SOIL 14	B	5.4	3.2	0	0	.	.	.	.
SOIL 14	C	5.4	3	0	0	.	.	.	.
SOIL 14	D	5.4	3	0	0	.	.	.	.
SOIL 14	E	5.4	3.6	0	0	.	.	.	.
SOIL 14	F	5.4	3	0	0	.	.	.	.
SOIL 14	G	5.4	3	0	0	.	.	.	.
SOIL 14	H	5.4	3	0	0	.	.	.	.
SOIL 14	I	5.4	3	0	0	.	.	.	.
SOIL 14	J	5.4	3	0	0	.	.	.	.
					0.00	.	.		.
					0.00	.	.		.
SOIL 15	A	5.8	3	1	5	4	0.25	0.0017	0.0004
SOIL 15	B	5.8	3.4	1	5	3	0.25	0.0020	0.0007
SOIL 15	C	5.8	3.5	3	9	7	0.25	0.0115	0.0016
SOIL 15	D	5.8	3	2	4	2	0.25	0.0075	0.0038
SOIL 15	E	5.8	3.6	1	6	5	3	0.0052	0.0010
SOIL 15	F	5.8	3.4	1	4	3	1	0.0019	0.0006
SOIL 15	G	5.8	3.4	2	5	2	2	0.0021	0.0011
SOIL 15	H	5.8	3.5	1	7	7	2	0.0092	0.0013
SOIL 15	I	5.8	3.4	1	7	6	2	0.0108	0.0018
SOIL 15	J	5.8	3.6	0	2	0	.	.	.
					5.40	3.90	1.2		0.0014
					1.96	2.33	1.05		0.0010

Appendix 6.1

(continued)

Sideoats Grama (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 16	A	5.6	3	1	4	3	1	0.0025	0.0008
SOIL 16	B	5.6	3.2	3	5	1	0.25	0.0008	0.0008
SOIL 16	C	5.6	3	1	6	3	1	0.0022	0.0007
SOIL 16	D	5.6	3.2	0	1	0	.	.	.
SOIL 16	E	5.6	3.5	0	5	4	1	0.0027	0.0007
SOIL 16	F	5.6	3	1	2	2	1	0.0006	0.0003
SOIL 16	G	5.6	3.4	0	5	3	1	0.0029	0.0010
SOIL 16	H	5.6	3.6	1	2	2	1	0.0007	0.0004
SOIL 16	I	5.6	3.4	0	2	1	0.25	0.0005	0.0005
SOIL 16	J	5.6	3.5	1	2	2	0.25	0.0018	0.0009
					3.40	2.10	0.8		0.0007
					1.78	1.20	0.38		0.0002
SOIL 17	A	5.3	3.8	6	8	8	13	0.0242	0.0030
SOIL 17	B	5.3	4	1	11	11	11	0.0235	0.0021
SOIL 17	C	5.3	4.2	3	10	10	14	0.0270	0.0027
SOIL 17	D	5.3	3.8	2	4	4	12	0.0098	0.0025
SOIL 17	E	5.3	3.6	8	10	9	15	0.0209	0.0023
SOIL 17	F	5.3	4	5	11	10	17	0.0247	0.0025
SOIL 17	G	5.3	4	3	8	8	16	0.0136	0.0017
SOIL 17	H	5.3	4	1	8	7	15	0.0132	0.0019
SOIL 17	I	5.3	4	3	10	10	17	0.0279	0.0028
SOIL 17	J	5.3	3.7	7	11	11	15	0.0325	0.0030
					9.10	8.80	14.5		0.0024
					2.18	2.15	2.01		0.0004

Appendix 6.1
(continued)
Sideoats Grama (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 19	A	5.6	3.8	1	2	0	.	.	.
SOIL 19	B	5.6	4	0	0	.	.	.	.
SOIL 19	C	5.6	4	0	1	0	.	.	.
SOIL 19	D	5.6	3.6	0	0	.	.	.	.
SOIL 19	E	5.6	5	0	1	0	.	.	.
SOIL 19	F	5.6	3.9	0	0	.	.	.	.
SOIL 19	G	5.6	3.6	0	0	.	.	.	.
SOIL 19	H	5.6	3.8	0	0	.	.	.	.
SOIL 19	I	5.6	3.6	0	0	.	.	.	.
SOIL 19	J	5.6	4.4	0	0	.	.	.	.
					0.40	0.00	.		.
					0.70	0.00	.		.
SOIL 20	A	5.9	6.2	6	10	10	18	0.0327	0.0033
SOIL 20	B	5.9	5.4	5	8	8	10	0.0281	0.0035
SOIL 20	C	5.9	6	4	9	9	8	0.0276	0.0031
SOIL 20	D	5.9	6.2	4	9	9	7	0.0269	0.0030
SOIL 20	E	5.9	4.2	5	8	8	17	0.0300	0.0038
SOIL 20	F	5.9	5.5	7	11	10	13	0.0353	0.0035
SOIL 20	G	5.9	5.8	4	8	7	9	0.0220	0.0031
SOIL 20	H	5.9	5.8	8	12	12	10	0.0228	0.0019
SOIL 20	I	5.9	5.8	6	10	10	14	0.0253	0.0025
SOIL 20	J	5.9	4.8	7	11	11	16	0.0414	0.0038
					9.60	9.40	12.2		0.0031
					1.43	1.51	3.94		0.0006

Appendix 6.1

(continued)

Sideoats Grama (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 21	A	6.1	3.7	0	1	0	.	.	.
SOIL 21	B	6.1	3.7	0	3	0	.	.	.
SOIL 21	C	6.1	3.8	0	3	0	.	.	.
SOIL 21	D	6.1	3.7	0	0	.	.	.	.
SOIL 21	E	6.1	3.8	0	0	.	.	.	.
SOIL 21	F	6.1	4	0	1	0	.	.	.
SOIL 21	G	6.1	3.5	0	4	1	0.25	0.0012	0.0012
SOIL 21	H	6.1	3.5	0	1	0	.	.	.
SOIL 21	I	6.1	3.6	0	1	0	.	.	.
SOIL 21	J	6.1	3.8	0	2	0	.	.	.
					1.60	0.13	0.3		0.0012
					1.35	0.35	.		.
SOIL 22	A	5.9	4	0	1	1	0.25	0.0009	0.0009
SOIL 22	B	5.9	3.6	0	1	0	.	.	.
SOIL 22	C	5.9	3.5	0	1	1	0.25	0.0062	0.0062
SOIL 22	D	5.9	3.6	0	1	0	.	.	.
SOIL 22	E	5.9	3.6	0	2	0	.	.	.
SOIL 22	F	5.9	4.6	0	2	0	.	.	.
SOIL 22	G	5.9	3.6	0	2	0	.	.	.
SOIL 22	H	5.9	3.8	0	2	0	.	.	.
SOIL 22	I	5.9	3.8	0	2	0	.	.	.
SOIL 22	J	5.9	3.8	0	1	0	.	.	.
					1.50	0.20	0.3		0.0036
					0.53	0.42	0.00		0.0037

Appendix 6.1

(continued)

Sideoats Grama (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 23	A	6.4	5.8	0	2	0	.	.	.
SOIL 23	B	6.4	6.1	0	0	0	.	.	.
SOIL 23	C	6.4	6.7	1	2	1	1	0.0006	0.0006
SOIL 23	D	6.4	4.8	1	1	0	.	.	.
SOIL 23	E	6.4	5	0	1	0	.	.	.
SOIL 23	F	6.4	3.8	1	2	1	0.25	0.0008	0.0008
SOIL 23	G	6.4	4.6	1	1	1	1	0.0014	0.0014
SOIL 23	H	6.4	3.9	0	3	2	0.25	0.0015	0.0008
SOIL 23	I	6.4	4.4	0	1	1	2	0.0009	0.0009
SOIL 23	J	6.4	4	0	1	0	.	.	.
					1.40	0.60	0.9		0.0009
					0.84	0.70	0.72		0.0003
SOIL 24	A	6.0	4	2	8	6	12	0.0348	0.0058
SOIL 24	B	6.0	4.3	3	8	8	20	0.0482	0.0060
SOIL 24	C	6.0	4.2	0	5	5	23	0.0224	0.0045
SOIL 24	D	6.0	4.3	2	7	6	23	0.0317	0.0053
SOIL 24	E	6.0	4.2	3	4	2	14	0.0131	0.0066
SOIL 24	F	6.0	5.4	3	6	6	26	0.0287	0.0048
SOIL 24	G	6.0	5.3	1	5	5	8	0.0335	0.0067
SOIL 24	H	6.0	5.6	2	5	5	6	0.0280	0.0056
SOIL 24	I	6.0	5.1	1	9	9	10	0.0403	0.0045
SOIL 24	J	6.0	5	1	6	6	26	0.0357	0.0060
					6.30	5.80	16.8		0.0056
					1.64	1.87	7.66		0.0008

Appendix 6.1
(continued)
Sideoats Grama (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 25	A	5.2	5.6	10	10	10	20	0.0605	0.0061
SOIL 25	B	5.2	5.6	7	8	8	10	0.0390	0.0049
SOIL 25	C	5.2	5.3	7	9	9	11	0.0375	0.0042
SOIL 25	D	5.2	5.7	4	8	8	21	0.0360	0.0045
SOIL 25	E	5.2	5.2	8	11	10	14	0.0403	0.0040
SOIL 25	F	5.2	4.8	9	10	9	21	0.0555	0.0062
SOIL 25	G	5.2	5.2	7	10	10	23	0.0470	0.0047
SOIL 25	H	5.2	5	3	7	7	13	0.0277	0.0040
SOIL 25	I	5.2	5.2	7	9	8	19	0.0358	0.0045
SOIL 25	J	5.2	5.2	7	9	9	24	0.0510	0.0057
					9.10	8.80	17.6		0.0049
					1.20	1.03	5.13		0.0008
SOIL 26	A	6.0	5.3	4	9	8	20	0.0237	0.0030
SOIL 26	B	6.0	5.9	4	7	7	14	0.0162	0.0023
SOIL 26	C	6.0	5.4	4	5	4	21	0.0109	0.0027
SOIL 26	D	6.0	5.9	4	8	7	21	0.0214	0.0031
SOIL 26	E	6.0	5.8	5	8	8	17	0.0284	0.0036
SOIL 26	F	6.0	5.3	6	10	10	16	0.0318	0.0032
SOIL 26	G	6.0	5.2	6	8	8	21	0.0243	0.0030
SOIL 26	H	6.0	5.3	4	5	4	21	0.0136	0.0034
SOIL 26	I	6.0	5.1	6	8	8	22	0.0282	0.0035
SOIL 26	J	6.0	5.1	6	11	8	12	0.0251	0.0031
					7.90	7.20	18.5		0.0031
					1.91	1.87	3.50		0.0004

Appendix 6.1

(continued)

Sideoats Grama (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 27	A	6.2	4.4	6	9	5	1	0.0118	0.0024
SOIL 27	B	6.2	3.7	4	12	8	0.25	0.0176	0.0022
SOIL 27	C	6.2	4	5	8	8	1	0.0159	0.0020
SOIL 27	D	6.2	4	3	8	4	0.25	0.0087	0.0022
SOIL 27	E	6.2	4.2	6	11	11	2	0.0303	0.0028
SOIL 27	F	6.2	4.4	2	7	3	2	0.0061	0.0020
SOIL 27	G	6.2	3.6	2	8	5	0.25	0.0102	0.0020
SOIL 27	H	6.2	3.6	4	10	6	1	0.0135	0.0023
SOIL 27	I	6.2	3.5	5	8	6	2	0.0122	0.0020
SOIL 27	J	6.2	3.6	3	9	4	1	0.0051	0.0013
					9.00	6.00	1.1		0.0021
					1.56	2.40	0.72		0.0004
SOIL 28	A	6.7	4.8	5	8	8	16	0.0388	0.0049
SOIL 28	B	6.7	4.2	5	8	8	25	0.0339	0.0042
SOIL 28	C	6.7	4.9	5	10	10	22	0.0594	0.0059
SOIL 28	D	6.7	4.8	4	8	8	26	0.0402	0.0050
SOIL 28	E	6.7	4.2	5	9	8	15	0.0300	0.0038
SOIL 28	F	6.7	4.9	6	11	10	17	0.0423	0.0042
SOIL 28	G	6.7	4.8	6	7	7	20	0.0299	0.0043
SOIL 28	H	6.7	5	9	9	9	28	0.0568	0.0063
SOIL 28	I	6.7	4.9	4	8	8	9	0.0355	0.0044
SOIL 28	J	6.7	5.2	9	10	10	25	0.0486	0.0049
					8.80	8.60	20.3		0.0048
					1.23	1.07	6.00		0.0008

Appendix 6.1

(continued)

Sideoats Grama (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 29	A	5.4	4.2	2	3	1	0.25	0.0008	0.0008
SOIL 29	B	5.4	4	2	4	1	1	0.0009	0.0009
SOIL 29	C	5.4	3.8	1	4	2	1	0.0027	0.0014
SOIL 29	D	5.4	4.2	0	1	0	.	.	.
SOIL 29	E	5.4	4.4	1	4	1	0.25	0.0013	0.0013
SOIL 29	F	5.4	5	3	8	3	1	0.0030	0.0010
SOIL 29	G	5.4	5.2	2	5	3	1	0.0018	0.0006
SOIL 29	H	5.4	5.4	0	2	0	.	.	.
SOIL 29	I	5.4	6	1	5	3	1	0.0034	0.0011
SOIL 29	J	5.4	5.6	0	6	1	0.25	0.0007	0.0007
					4.20	1.50	0.7		0.0010
					1.99	1.18	0.39		0.0003
SOIL 30	A	4.0	4.9	0	1	1	0.25	0.0004	0.0004
SOIL 30	B	4.0	4.2	0	0	.	.	.	.
SOIL 30	C	4.0	4.2	0	1	0	.	.	.
SOIL 30	D	4.0	3.8	1	1	1	0.25	0.0004	0.0004
SOIL 30	E	4.0	4.8	0	1	0	.	.	.
SOIL 30	F	4.0	3.8	1	3	0	.	.	.
SOIL 30	G	4.0	3.5	1	1	0	.	.	.
SOIL 30	H	4.0	3.5	0	0	.	.	.	.
SOIL 30	I	4.0	3	0	2	0	.	.	.
SOIL 30	J	4.0	3.6	0	0	.	.	.	.
					1.00	0.29	0.3		0.0004
					0.94	0.49	0.00		0.0000

Appendix 6.1

(continued)

Sideoats Grama (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 31	A	6.4	3.6	5	6	5	6	0.0236	0.0047
SOIL 31	B	6.4	3.6	2	7	7	5	0.0436	0.0062
SOIL 31	C	6.4	3.6	4	10	10	7	0.0492	0.0049
SOIL 31	D	6.4	3.6	3	8	8	10	0.0358	0.0045
SOIL 31	E	6.4	3.6	2	7	7	5	0.0241	0.0034
SOIL 31	F	6.4	3.6	8	10	10	4	0.0459	0.0046
SOIL 31	G	6.4	3.5	8	10	8	4	0.0270	0.0034
SOIL 31	H	6.4	3.4	4	8	7	3	0.0254	0.0036
SOIL 31	I	6.4	3.5	5	7	7	3	0.0251	0.0036
SOIL 31	J	6.4	3.4	7	8	8	3	0.0257	0.0032
					8.10	7.70	5.0		0.0042
					1.45	1.49	2.21		0.0009
SOIL 32	A	6.6	3.6	2	6	3	0.25	0.0025	0.0008
SOIL 32	B	6.6	3.5	1	3	1	0.25	0.0019	0.0019
SOIL 32	C	6.6	3.7	2	5	0	.	.	.
SOIL 32	D	6.6	3.7	0	3	0	.	.	.
SOIL 32	E	6.6	3.8	0	6	3	1	0.0050	0.0017
SOIL 32	F	6.6	3.6	1	5	3	0.25	0.0030	0.0010
SOIL 32	G	6.6	3.8	0	3	2	0.25	0.0011	0.0006
SOIL 32	H	6.6	3.5	1	3	3	0.25	0.0015	0.0005
SOIL 32	I	6.6	3.5	0	0	.	.	.	.
SOIL 32	J	6.6	3.6	0	3	1	0.25	0.0012	0.0012
					3.70	1.78	0.4		0.0011
					1.83	1.30	0.28		0.0005

Appendix 6.1

(continued)

Sideoats Grama (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 35	A	4.8	3	0	0	.	.	.	.
SOIL 35	B	4.8	3.7	0	0	.	.	.	.
SOIL 35	C	4.8	3.5	0	0	.	.	.	.
SOIL 35	D	4.8	3.5	0	0	.	.	.	.
SOIL 35	E	4.8	4.4	0	0	.	.	.	.
SOIL 35	F	4.8	4.2	0	0	.	.	.	.
SOIL 35	G	4.8	3.6	0	0	.	.	.	.
SOIL 35	H	4.8	3.4	0	0	.	.	.	.
SOIL 35	I	4.8	3	0	0	.	.	.	.
SOIL 35	J	4.8	4.2	0	0	.	.	.	.
					0.00	.	.		.
					0.00	.	.		.
SOIL 36	A	5.0	3.5	0	0	.	.	.	.
SOIL 36	B	5.0	4	0	0	.	.	.	.
SOIL 36	C	5.0	3.4	0	0	.	.	.	.
SOIL 36	D	5.0	3.5	0	0	.	.	.	.
SOIL 36	E	5.0	3	0	0	.	.	.	.
SOIL 36	F	5.0	3.9	0	0	.	.	.	.
SOIL 36	G	5.0	3.4	0	0	.	.	.	.
SOIL 36	H	5.0	3.4	0	0	.	.	.	.
SOIL 36	I	5.0	3	0	0	.	.	.	.
SOIL 36	J	5.0	3	0	0	.	.	.	.
					0.00	.	.		.
					0.00	.	.		.

Appendix 6.2

Sideoats Grama (Nursery Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
NC	A	12.6	20	13	11	13	6	.	.	.	.	.	.	.
NC	B	6.0	6	4	9	5	.	.	.	.	.	.	.	.
NC	C	6.5	4	8	5	9	.	.	.	.	.	.	.	.
NC	D	12.9	13	17	13	15	14	10	13	8	.	.	.	.
NC	E	9.8	13	9	3	14	6	11	10	13	9	.	.	.
NC	F	6.2	12	4	4	5	8	4	.	.	.	.	.	.
NC	G	5.0	5	5	.	.	.	.	.	.	.	.	.	.
NC	H	7.1	12	5	4	15	9	2	3	.	.	.	.	.
NC	I	9.3	12	11	12	14	11	9	10	8	3	7	4	10
NC	J	9.3	10	7	7	17	10	12	2	.	.	.	.	.
		8.5												
		2.76												
SOIL 1	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												

Appendix 6.2
(continued)
Sideoats Grama (Nursery Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 2	A	4.7	6	5	3	4	4	6	3	5	7	4	.	.
SOIL 2	B	3.8	5	4	2	4	6	3	6	4	2	1	4	4
SOIL 2	C	3.7	2	6	5	3	6	3	4	2	2	2	6	3
SOIL 2	D	3.6	3	5	3	5	3	2	4	5	2	3	5	.
SOIL 2	E	4.2	4	4	4	6	4	5	4	6	1	.	.	.
SOIL 2	F	4.5	1	6	6	2	8	4	3	6	2	5	7	.
SOIL 2	G	4.1	2	5	2	4	4	2	6	6	4	5	5	.
SOIL 2	H	4.3	3	7	3	4	5	3	4	6	4	.	.	.
SOIL 2	I	4.9	6	2	4	6	6	5	7	3	.	.	.	.
SOIL 2	J	5.0	4	6	6	8	5	5	3	3	5	.	.	.
		4.3												
		0.50												
SOIL 3	A	5.0	6	4	5	.	.	.	.	.	.	.	.	.
SOIL 3	B	3.5	3	4	.	.	.	.	.	.	.	.	.	.
SOIL 3	C	3.7	6	1	4	.	.	.	.	.	.	.	.	.
SOIL 3	D	4.0	4	.	.	.	.	.	.	.	.	.	.	.
SOIL 3	E	3.3	5	4	1	.	.	.	.	.	.	.	.	.
SOIL 3	F	5.0	5	6	4	.	.	.	.	.	.	.	.	.
SOIL 3	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 3	H	3.8	1	5	4	5	.	.	.	.	.	.	.	.
SOIL 3	I	4.0	5	3	.	.	.	.	.	.	.	.	.	.
SOIL 3	J	5.2	6	1	7	6	6	.	.	.	.	.	.	.
		4.2												
		0.71												

Appendix 6.2

(continued)

Sideoats Grama (Nursery Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 4	A	3.4	4	2	3	3	5	.	.	.	.	.	.	.
SOIL 4	B	5.8	8	3	4	8	6	.	.	.	.	.	.	.
SOIL 4	C	5.4	5	4	4	7	7	.	.	.	.	.	.	.
SOIL 4	D	3.3	4	3	2	4	.	.	.	.	.	.	.	.
SOIL 4	E	4.4	7	1	5	4	5	.	.	.	.	.	.	.
SOIL 4	F	7.7	8	8	12	10	7	1	.	.	.	.	.	.
SOIL 4	G	5.2	3	7	5	8	3	.	.	.	.	.	.	.
SOIL 4	H	7.3	9	4	9	.	.	.	.	.	.	.	.	.
SOIL 4	I	4.0	10	2	3	1	.	.	.	.	.	.	.	.
SOIL 4	J	7.4	4	8	11	9	9	9	2	.	.	.	.	.
		5.4												
		1.66												
SOIL 5	A	4.8	4	6	5	4	.	.	.	.	.	.	.	.
SOIL 5	B	3.6	4	4	3	5	2	.	.	.	.	.	.	.
SOIL 5	C	5.2	4	6	7	3	7	4	.	.	.	.	.	.
SOIL 5	D	5.3	4	6	6	.	.	.	.	.	.	.	.	.
SOIL 5	E	4.3	3	6	4	6	3	4	3	5	5	.	.	.
SOIL 5	F	2.9	3	3	4	4	0.25	.	.	.	.	.	.	.
SOIL 5	G	4.8	4	4	5	6	.	.	.	.	.	.	.	.
SOIL 5	H	5.6	6	4	6	4	5	6	7	6	6	.	.	.
SOIL 5	I	4.0	3	5	4	4	.	.	.	.	.	.	.	.
SOIL 5	J	4.0	3	4	5	.	.	.	.	.	.	.	.	.
		4.4												
		0.84												

Appendix 6.2
(continued)
Sideoats Grama (Nursery Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 6	A	0.6	1	1	0.25	0.25	.	.	.	.	.	.	.	.
SOIL 6	B	1.0	1	1	.	.	.	.	.	.	.	.	.	.
SOIL 6	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 6	D	0.3	0.25	0.25	.	.	.	.	.	.	.	.	.	.
SOIL 6	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 6	F	0.8	1	1	0.25	.	.	.	.	.	.	.	.	.
SOIL 6	G	0.5	1	0.25	0.25	.	.	.	.	.	.	.	.	.
SOIL 6	H	1.6	3	2	1	0.25	.	.	.	.	.	.	.	.
SOIL 6	I	0.9	0.25	0.25	1	2	.	.	.	.	.	.	.	.
SOIL 6	J	1.7	2	1	2	.	.	.	.	.	.	.	.	.
		0.9												
		0.50												
SOIL 7	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												

Appendix 6.2

(continued)

Sideoats Grama (Nursery Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 8	A	1.7	2	1	2	3	0.25	.	.	.	.	.	.	.
SOIL 8	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 8	C	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 8	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 8	E	2.0	2	.	.	.	.	.	.	.	.	.	.	.
SOIL 8	F	0.6	1	0.25	.	.	.	.	.	.	.	.	.	.
SOIL 8	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 8	H	1.5	2	1	.	.	.	.	.	.	.	.	.	.
SOIL 8	I	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 8	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		1.2												
		0.66												
SOIL 9	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												

Appendix 6.2
(continued)
Sideoats Grama (Nursery Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 10	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	C	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	E	0.6	1	0.25	.	.	.	.	.	.	.	.	.	.
SOIL 10	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	H	0.6	1	0.25	.	.	.	.	.	.	.	.	.	.
SOIL 10	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		0.8												
		0.22												
SOIL 11	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	G	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		0.3												
		.												

Appendix 6.2

(continued)

Sideoats Grama (Nursery Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 12	A	4.3	4	8	6	4	2	3	3	4	.	.	.	.
SOIL 12	B	5.0	5	7	6	7	5	4	6	0.25	.	.	.	.
SOIL 12	C	4.6	5	6	2	5	6	4	6	4	5	4	4	.
SOIL 12	D	4.7	5	4	6	5	6	5	3	3	4	5	5	5
SOIL 12	E	4.7	5	4	5	5	3	3	3	6	4	9	.	.
SOIL 12	F	4.3	1	2	5	3	6	3	5	7	5	7	6	2
SOIL 12	G	4.7	5	0.25	6	5	5	5	5	8	4	6	5	2
SOIL 12	H	5.2	6	5	3	7	6	7	5	4	5	4	.	.
SOIL 12	I	4.6	6	5	2	6	6	4	5	2	5	4	5	5
SOIL 12	J	4.6	5	4	5	4	6	5	4	4	4	5	.	.
		4.7												
		0.28												
SOIL 13	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 13	B	4.0	4	.	.	.	.	.	.	.	.	.	.	.
SOIL 13	C	3.3	6	3	1	.	.	.	.	.	.	.	.	.
SOIL 13	D	3.0	3	.	.	.	.	.	.	.	.	.	.	.
SOIL 13	E	5.0	5	.	.	.	.	.	.	.	.	.	.	.
SOIL 13	F	3.5	1	6	.	.	.	.	.	.	.	.	.	.
SOIL 13	G	2.7	4	1	3	.	.	.	.	.	.	.	.	.
SOIL 13	H	2.5	4	3	1	3	2	2	.	.	.	.	.	.
SOIL 13	I	1.8	1	1	3	2	.	.	.	.	.	.	.	.
SOIL 13	J	2.9	6	1	3	4	3	0.25	.	.	.	.	.	.
		3.2												
		0.94												

Appendix 6.2
(continued)
Sideoats Grama (Nursery Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 14	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												
SOIL 15	A	0.8	1	1	1	0.25	.	.	.	.	.	.	.	.
SOIL 15	B	1.0	1	1	1	.	.	.	.	.	.	.	.	.
SOIL 15	C	2.4	3	3	4	2	2	2	1	.	.	.	.	.
SOIL 15	D	2.0	2	2	.	.	.	.	.	.	.	.	.	.
SOIL 15	E	1.1	0.25	1	1	0.25	3	.	.	.	.	.	.	.
SOIL 15	F	1.1	2	1	0.25	.	.	.	.	.	.	.	.	.
SOIL 15	G	1.5	2	1	.	.	.	.	.	.	.	.	.	.
SOIL 15	H	0.9	2	2	1	0.25	0.25	0.25	0.25	.	.	.	.	.
SOIL 15	I	1.2	2	1	1	1	1	1	.	.	.	.	.	.
SOIL 15	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		1.3												
		0.55												

Appendix 6.2

(continued)

Sideoats Grama (Nursery Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 16	A	1.1	2	1	0.25	.	.	.	.	.	.	.	.	.
SOIL 16	B	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 16	C	1.0	1	1	1	.	.	.	.	.	.	.	.	.
SOIL 16	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 16	E	0.6	0.25	0.25	1	1	.	.	.	.	.	.	.	.
SOIL 16	F	2.0	2	2	.	.	.	.	.	.	.	.	.	.
SOIL 16	G	1.3	2	1	1	.	.	.	.	.	.	.	.	.
SOIL 16	H	0.6	1	0.25	.	.	.	.	.	.	.	.	.	.
SOIL 16	I	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 16	J	1.1	2	0.25	.	.	.	.	.	.	.	.	.	.
		1.0												
		0.50												
SOIL 17	A	4.9	4	6	4	5	6	4	6	4	.	.	.	.
SOIL 17	B	3.7	6	0.25	4	2	3	2	5	5	4	4	5	.
SOIL 17	C	4.2	4	3	4	4	3	6	5	3	5	5	.	.
SOIL 17	D	4.5	5	5	4	4	.	.	.	.	.	.	.	.
SOIL 17	E	4.0	5	6	3	3	0.25	5	4	5	5	.	.	.
SOIL 17	F	4.9	6	4	6	3	4	4	6	4	6	6	.	.
SOIL 17	G	3.5	5	3	3	2	2	5	5	3	.	.	.	.
SOIL 17	H	4.0	4	4	4	2	5	5	4	.	.	.	.	.
SOIL 17	I	4.4	6	3	4	2	4	5	5	6	4	5	.	.
SOIL 17	J	4.7	3	4	5	3	6	5	7	6	3	5	5	.
		4.3												
		0.49												

Appendix 6.2
(continued)
Sideoats Grama (Nursery Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 19	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												
SOIL 20	A	6.2	8	8	5	5	6	6	3	7	9	5	.	.
SOIL 20	B	5.6	6	6	7	4	6	5	6	5	.	.	.	.
SOIL 20	C	6.4	8	4	7	6	8	5	5	8	7	.	.	.
SOIL 20	D	5.9	8	6	5	4	4	4	9	8	5	.	.	.
SOIL 20	E	7.3	7	9	9	5	6	8	7	7	.	.	.	.
SOIL 20	F	6.8	5	5	4	6	10	9	7	5	9	8	.	.
SOIL 20	G	6.3	8	7	9	3	7	6	4	.	.	.	.	.
SOIL 20	H	6.6	9	4	7	6	3	5	8	11	10	6	6	4
SOIL 20	I	5.3	5	5	6	7	3	4	5	7	6	5	.	.
SOIL 20	J	7.0	5	9	5	9	9	7	5	5	6	9	8	.
		6.3												
		0.61												

Appendix 6.2
(continued)
Sideoats Grama (Nursery Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 21	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	G	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		0.3												
		.												
SOIL 22	A	2.0	2	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	C	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		1.5												
		0.71												

Appendix 6.2
(continued)
Sideoats Grama (Nursery Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 23	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	C	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	F	2.0	2	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	G	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	H	1.0	1	1	.	.	.	.	.	.	.	.	.	.
SOIL 23	I	2.0	2	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		1.4												
		0.55												
SOIL 24	A	9.3	9	11	10	11	8	7	.	.	.	.	.	.
SOIL 24	B	8.6	12	11	9	9	11	6	1	10	.	.	.	.
SOIL 24	C	6.4	9	7	2	7	7	.	.	.	.	.	.	.
SOIL 24	D	7.7	11	6	9	10	8	2	.	.	.	.	.	.
SOIL 24	E	10.0	9	11	.	.	.	.	.	.	.	.	.	.
SOIL 24	F	7.2	5	11	3	11	5	8	.	.	.	.	.	.
SOIL 24	G	8.4	11	7	5	9	10	.	.	.	.	.	.	.
SOIL 24	H	8.4	6	9	8	10	9	.	.	.	.	.	.	.
SOIL 24	I	6.7	7	5	8	9	9	7	3	7	5	.	.	.
SOIL 24	J	8.5	11	8	10	8	6	8	.	.	.	.	.	.
		8.1												
		1.14												

Appendix 6.2
(continued)
Sideoats Grama (Nursery Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 25	A	8.5	11	8	10	7	6	7	8	10	11	7	.	.
SOIL 25	B	7.6	5	8	10	3	8	10	6	11	.	.	.	.
SOIL 25	C	6.9	8	5	7	5	7	7	9	8	6	.	.	.
SOIL 25	D	7.6	7	6	10	9	8	6	7	8	.	.	.	.
SOIL 25	E	5.8	8	3	4	5	4	7	8	7	2	10	.	.
SOIL 25	F	9.3	10	11	12	10	9	8	8	8	8	.	.	.
SOIL 25	G	7.1	5	6	7	10	5	10	7	8	10	3	.	.
SOIL 25	H	6.9	0.25	12	6	7	10	7	6	.	.	.	.	.
SOIL 25	I	7.6	7	8	3	9	6	12	9	7	.	.	.	.
SOIL 25	J	8.3	9	10	9	3	9	10	10	9	6	.	.	.
		7.6												
		0.99												
SOIL 26	A	4.6	5	5	5	5	5	5	5	2	.	.	.	.
SOIL 26	B	3.4	4	5	3	2	5	4	1	.	.	.	.	.
SOIL 26	C	5.3	5	6	5	5	.	.	.	.	.	.	.	.
SOIL 26	D	4.3	5	1	4	4	6	5	5	.	.	.	.	.
SOIL 26	E	4.8	4	5	4	5	5	7	8	0.25	.	.	.	.
SOIL 26	F	5.3	6	6	4	7	4	7	5	4	6	4	.	.
SOIL 26	G	4.6	3	4	5	2	5	8	5	5	.	.	.	.
SOIL 26	H	4.8	3	5	4	7	.	.	.	.	.	.	.	.
SOIL 26	I	4.9	5	7	4	5	5	5	4	4	.	.	.	.
SOIL 26	J	4.4	5	2	4	6	4	6	5	3	.	.	.	.
		4.6												
		0.53												

Appendix 6.2

(continued)

Sideoats Grama (Nursery Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 27	A	3.4	3	4	4	2	4	.	.	.	.	.	.	.
SOIL 27	B	2.9	3	3	3	4	3	2	3	2	.	.	.	.
SOIL 27	C	3.1	4	3	4	4	3	4	1	2	.	.	.	.
SOIL 27	D	3.0	4	3	4	1	.	.	.	.	.	.	.	.
SOIL 27	E	4.0	5	6	4	4	6	2	4	5	4	2	2	.
SOIL 27	F	1.7	2	2	1	.	.	.	.	.	.	.	.	.
SOIL 27	G	3.2	4	2	3	3	4	.	.	.	.	.	.	.
SOIL 27	H	3.2	5	4	3	2	2	3	.	.	.	.	.	.
SOIL 27	I	3.2	3	3	4	1	4	4	.	.	.	.	.	.
SOIL 27	J	2.5	2	3	3	2	.	.	.	.	.	.	.	.
		3.0												
		0.61												
SOIL 28	A	6.5	11	9	3	6	3	3	10	7	.	.	.	.
SOIL 28	B	8.3	10	11	2	9	8	7	11	8	.	.	.	.
SOIL 28	C	7.1	10	9	6	7	7	9	8	5	6	4	.	.
SOIL 28	D	7.5	10	4	6	8	6	8	10	8	.	.	.	.
SOIL 28	E	6.6	8	8	1	9	8	8	4	7	.	.	.	.
SOIL 28	F	7.0	8	5	6	8	6	7	6	9	9	6	.	.
SOIL 28	G	6.7	6	9	8	1	11	7	5	.	.	.	.	.
SOIL 28	H	7.2	9	6	8	8	7	3	8	10	6	.	.	.
SOIL 28	I	5.8	7	0.25	7	6	7	5	6	8	.	.	.	.
SOIL 28	J	7.6	8	8	6	9	7	9	8	2	10	9	.	.
		7.0												
		0.68												

Appendix 6.2

(continued)

Sideoats Grama (Nursery Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 29	A	2.0	2	.	.	.	.	.	.	.	.	.	.	.
SOIL 29	B	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 29	C	1.6	3	0.25	.	.	.	.	.	.	.	.	.	.
SOIL 29	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 29	E	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 29	F	0.8	1	1	0.25	.	.	.	.	.	.	.	.	.
SOIL 29	G	2.0	1	3	2	.	.	.	.	.	.	.	.	.
SOIL 29	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 29	I	1.3	1	2	1	.	.	.	.	.	.	.	.	.
SOIL 29	J	1.0	1	.	.	.	.	.	.	.	.	.	.	.
		1.2												
		0.61												
SOIL 30	A	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	D	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		0.3												
		0.00												

Appendix 6.2

(continued)

Sideoats Grama (Nursery Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 31	A	5.2	5	6	4	5	6	.	.	.	.	.	.	.
SOIL 31	B	5.3	6	7	4	5	5	5	5	.	.	.	.	.
SOIL 31	C	5.0	5	6	5	3	6	5	5	6	5	4	.	.
SOIL 31	D	4.5	4	4	3	5	8	3	4	5	.	.	.	.
SOIL 31	E	4.4	5	4	4	4	4	4	6	.	.	.	.	.
SOIL 31	F	4.8	5	5	4	5	5	5	4	4	6	5	.	.
SOIL 31	G	3.7	3	0.25	6	4	0.25	5	5	6	.	.	.	.
SOIL 31	H	4.2	5	7	6	1	4	6	0.25	.	.	.	.	.
SOIL 31	I	4.1	4	3	5	5	5	4	3	.	.	.	.	.
SOIL 31	J	4.1	4	4	4	3	6	3	4	5	.	.	.	.
		4.5												
		0.52												
SOIL 32	A	0.8	0.25	1	1	.	.	.	.	.	.	.	.	.
SOIL 32	B	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 32	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 32	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 32	E	1.7	1	2	2	.	.	.	.	.	.	.	.	.
SOIL 32	F	1.3	1	2	1	.	.	.	.	.	.	.	.	.
SOIL 32	G	1.1	2	0.25	.	.	.	.	.	.	.	.	.	.
SOIL 32	H	0.8	1	1	0.25	.	.	.	.	.	.	.	.	.
SOIL 32	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 32	J	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
		1.0												
		0.46												

Appendix 6.2

(continued)

Sideoats Grama (Nursery Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 35	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												
SOIL 36	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												

Appendix 6.3

Sideoats Grama (Nursery Provided) Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed
NC	A	20	M		SOIL 2	A	0	none		SOIL 4	A	30	N
NC	B	40	N,M		SOIL 2	B	0	none		SOIL 4	B	20	N,M
NC	C	30	CL,N		SOIL 2	C	10	N		SOIL 4	C	10	N
NC	D	0	none		SOIL 2	D	10	M		SOIL 4	D	40	CL,N,M
NC	E	0	none		SOIL 2	E	0	none		SOIL 4	E	20	CL,N
NC	F	30	N,M		SOIL 2	F	0	none		SOIL 4	F	20	N,M
NC	G	40	N,M		SOIL 2	G	0	none		SOIL 4	G	20	N,M
NC	H	10	N,M		SOIL 2	H	10	N		SOIL 4	H	40	N,M
NC	I	10	N		SOIL 2	I	0	none		SOIL 4	I	50	CL,N
NC	J	10	N		SOIL 2	J	0	none		SOIL 4	J	10	N,M
SOIL 1	A	.	NE		SOIL 3	A	40	N,M		SOIL 5	A	20	CL,N,LC,CC
SOIL 1	B	.	NE		SOIL 3	B	60	N,M,CC		SOIL 5	B	40	CL,N,LC
SOIL 1	C	.	NE		SOIL 3	C	20	M		SOIL 5	C	20	CL,N,M
SOIL 1	D	.	NE		SOIL 3	D	0	none		SOIL 5	D	30	CL,M
SOIL 1	E	.	NE		SOIL 3	E	20	N		SOIL 5	E	20	CL,N
SOIL 1	F	.	NE		SOIL 3	F	20	M		SOIL 5	F	40	CL,N,LC
SOIL 1	G	.	NE		SOIL 3	G	.	NE		SOIL 5	G	20	CL,N
SOIL 1	H	.	NE		SOIL 3	H	10	N		SOIL 5	H	20	CL,N
SOIL 1	I	.	NE		SOIL 3	I	60	N,M		SOIL 5	I	30	CL,N,M
SOIL 1	J	.	NE		SOIL 3	J	30	CL,N,CC		SOIL 5	J	20	CL,N,LC

M – Mortality; CL – Chlorosis; N – Necrosis; CC – Color Change; NE – None Emerged; LC – Leaf Curl

Appendix 6.3

(continued)

Sideoats Grama (Nursery Provided) Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed
SOIL 6	A	90	CL,N,M		SOIL 8	A	70	CL,N,M		SOIL 10	A	100	M
SOIL 6	B	90	N		SOIL 8	B	100	M		SOIL 10	B	100	M
SOIL 6	C	100	M		SOIL 8	C	90	N,M		SOIL 10	C	90	N
SOIL 6	D	90	N,M		SOIL 8	D	100	M		SOIL 10	D	100	M
SOIL 6	E	100	M		SOIL 8	E	90	CL,N,M		SOIL 10	E	90	CL,N,M
SOIL 6	F	90	CL,N,LC,M		SOIL 8	F	90	N		SOIL 10	F	.	NE
SOIL 6	G	90	CL,N,LC,M		SOIL 8	G	100	M		SOIL 10	G	.	NE
SOIL 6	H	80	CL,N,CC		SOIL 8	H	90	CL,N,M		SOIL 10	H	90	CL,N,M
SOIL 6	I	80	CL,N		SOIL 8	I	90	CL,N,M		SOIL 10	I	100	M
SOIL 6	J	90	CL,N,M		SOIL 8	J	100	M		SOIL 10	J	100	M
SOIL 7	A	.	NE		SOIL 9	A	.	NE		SOIL 11	A	.	NE
SOIL 7	B	.	NE		SOIL 9	B	.	NE		SOIL 11	B	100	M
SOIL 7	C	.	NE		SOIL 9	C	.	NE		SOIL 11	C	100	M
SOIL 7	D	.	NE		SOIL 9	D	.	NE		SOIL 11	D	100	M
SOIL 7	E	.	NE		SOIL 9	E	.	NE		SOIL 11	E	100	M
SOIL 7	F	.	NE		SOIL 9	F	.	NE		SOIL 11	F	.	NE
SOIL 7	G	.	NE		SOIL 9	G	.	NE		SOIL 11	G	90	CL,N,M
SOIL 7	H	.	NE		SOIL 9	H	.	NE		SOIL 11	H	100	M
SOIL 7	I	.	NE		SOIL 9	I	.	NE		SOIL 11	I	100	M
SOIL 7	J	.	NE		SOIL 9	J	.	NE		SOIL 11	J	.	NE

M – Mortality; CL – Chlorosis; N – Necrosis; CC – Color Change; NE – None Emerged

Appendix 6.3

(continued)

Sideoats Grama (Nursery Provided) Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed
SOIL 12	A	10	N,M		SOIL 14	A	.	NE		SOIL 16	A	90	CL,N,M
SOIL 12	B	0	none		SOIL 14	B	.	NE		SOIL 16	B	90	N,M
SOIL 12	C	10	N		SOIL 14	C	.	NE		SOIL 16	C	90	CL,N,M,CC
SOIL 12	D	10	N		SOIL 14	D	.	NE		SOIL 16	D	100	M
SOIL 12	E	10	N		SOIL 14	E	.	NE		SOIL 16	E	90	CL,N,M,CC
SOIL 12	F	20	N		SOIL 14	F	.	NE		SOIL 16	F	80	N
SOIL 12	G	0	none		SOIL 14	G	.	NE		SOIL 16	G	90	CL,N,M
SOIL 12	H	30	N,M		SOIL 14	H	.	NE		SOIL 16	H	90	CL,N
SOIL 12	I	10	N		SOIL 14	I	.	NE		SOIL 16	I	90	CL,N,M
SOIL 12	J	10	N,M,CC		SOIL 14	J	.	NE		SOIL 16	J	90	CL,N,CC
SOIL 13	A	100	M		SOIL 15	A	90	CL,N,M		SOIL 17	A	10	CL,N
SOIL 13	B	60	CL,N,M		SOIL 15	B	90	CL,N,M		SOIL 17	B	20	CL,N,LC
SOIL 13	C	60	CL,N,M,CC		SOIL 15	C	70	CL,N,M,CC		SOIL 17	C	20	CL,N,LC
SOIL 13	D	70	CL,M		SOIL 15	D	90	CL,N,M		SOIL 17	D	10	CL,LC
SOIL 13	E	60	CL,N,M		SOIL 15	E	90	CL,N,M		SOIL 17	E	20	CL,LC,M
SOIL 13	F	70	CL,N,M		SOIL 15	F	90	CL,N,M		SOIL 17	F	20	CL,N,LC,M
SOIL 13	G	60	CL,N,M		SOIL 15	G	90	CL,N,M		SOIL 17	G	20	CL,N,LC
SOIL 13	H	60	CL,N,M		SOIL 15	H	80	CL,N		SOIL 17	H	20	CL,LC,M
SOIL 13	I	80	CL,N,M		SOIL 15	I	90	CL,N,M		SOIL 17	I	20	CL,N,LC
SOIL 13	J	60	CL,N,M		SOIL 15	J	100	M		SOIL 17	J	10	CL,LC

M – Mortality; CL – Chlorosis; N – Necrosis; CC – Color Change; NE – None Emerged; LC – Leaf Curl

Appendix 6.3
(continued)
Sideoats Grama (Nursery Provided) Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed
SOIL 19	A	100	M		SOIL 21	A	100	M		SOIL 23	A	100	M
SOIL 19	B	.	NE		SOIL 21	B	100	M		SOIL 23	B	.	NE
SOIL 19	C	100	M		SOIL 21	C	100	M		SOIL 23	C	90	CL,N,M
SOIL 19	D	.	NE		SOIL 21	D	.	NE		SOIL 23	D	100	M
SOIL 19	E	100	M		SOIL 21	E	.	NE		SOIL 23	E	100	M
SOIL 19	F	.	NE		SOIL 21	F	100	M		SOIL 23	F	80	N,M
SOIL 19	G	.	NE		SOIL 21	G	90	N,M		SOIL 23	G	90	N
SOIL 19	H	.	NE		SOIL 21	H	100	M		SOIL 23	H	90	CL,N,M,CC
SOIL 19	I	.	NE		SOIL 21	I	100	M		SOIL 23	I	80	CL,N
SOIL 19	J	.	NE		SOIL 21	J	100	M		SOIL 23	J	100	M
SOIL 20	A	0	none		SOIL 22	A	70	CL,N		SOIL 24	A	20	N,M
SOIL 20	B	10	CL,LC		SOIL 22	B	100	M		SOIL 24	B	10	N
SOIL 20	C	10	CL,LC		SOIL 22	C	80	N		SOIL 24	C	10	N
SOIL 20	D	10	CL		SOIL 22	D	100	M		SOIL 24	D	20	N,M
SOIL 20	E	10	CL		SOIL 22	E	100	M		SOIL 24	E	50	M
SOIL 20	F	20	CL,N,LC,CC,M		SOIL 22	F	100	M		SOIL 24	F	10	N
SOIL 20	G	20	CL,N,LC,M		SOIL 22	G	100	M		SOIL 24	G	10	N
SOIL 20	H	10	CL		SOIL 22	H	100	M		SOIL 24	H	0	none
SOIL 20	I	20	CL,LC		SOIL 22	I	100	M		SOIL 24	I	0	none
SOIL 20	J	10	CL		SOIL 22	J	100	M		SOIL 24	J	0	none

M – Mortality; CL – Chlorosis; N – Necrosis; CC – Color Change; NE – None Emerged; LC – Leaf Curl

Appendix 6.3
(continued)
Sideoats Grama (Nursery Provided) Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed
SOIL 25	A	0	none		SOIL 27	A	60	CL,N,M		SOIL 29	A	90	CL,N,M
SOIL 25	B	10	CL,N		SOIL 27	B	70	CL,N,M,CC		SOIL 29	B	90	CL,N,M
SOIL 25	C	0	none		SOIL 27	C	60	CL,N		SOIL 29	C	90	CL,N,M
SOIL 25	D	0	none		SOIL 27	D	70	CL,N,M		SOIL 29	D	100	M
SOIL 25	E	20	CL,N,M		SOIL 27	E	60	CL,N,CC		SOIL 29	E	90	CL,N,M
SOIL 25	F	10	N,M		SOIL 27	F	80	CL,N,M		SOIL 29	F	90	CL,N,M
SOIL 25	G	10	CL,LC		SOIL 27	G	60	CL,N,M		SOIL 29	G	80	CL,N,M
SOIL 25	H	10	CL		SOIL 27	H	60	CL,N,M,CC		SOIL 29	H	100	M
SOIL 25	I	10	CL,M		SOIL 27	I	70	CL,N,M,CC		SOIL 29	I	80	CL,N,M
SOIL 25	J	0	none		SOIL 27	J	80	CL,N,M,CC		SOIL 29	J	90	CL,N,M
SOIL 26	A	20	N,LC,M		SOIL 28	A	10	LC		SOIL 30	A	90	N
SOIL 26	B	40	N,LC		SOIL 28	B	0	none		SOIL 30	B	.	NE
SOIL 26	C	40	CL,N,LC,M		SOIL 28	C	0	none		SOIL 30	C	100	M
SOIL 26	D	30	CL,N,LC,M		SOIL 28	D	0	none		SOIL 30	D	90	CL,N
SOIL 26	E	0	none		SOIL 28	E	20	N,M		SOIL 30	E	100	M
SOIL 26	F	20	CL,N,LC		SOIL 28	F	10	N,M		SOIL 30	F	100	M
SOIL 26	G	20	CL,LC		SOIL 28	G	0	none		SOIL 30	G	100	M
SOIL 26	H	20	CL,N,LC,M		SOIL 28	H	0	none		SOIL 30	H	.	NE
SOIL 26	I	20	N,LC		SOIL 28	I	0	none		SOIL 30	I	100	M
SOIL 26	J	30	N,LC,M		SOIL 28	J	10	N		SOIL 30	J	.	NE

M – Mortality; CL – Chlorosis; N – Necrosis; CC – Color Change; NE – None Emerged; LC – Leaf Curl

Appendix 6.3

(continued)

Sideoats Grama (Nursery Provided) Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed
SOIL 31	A	40	CL,N,M		SOIL 35	A	.	NE
SOIL 31	B	30	CL,N,CC		SOIL 35	B	.	NE
SOIL 31	C	30	CL,N,CC		SOIL 35	C	.	NE
SOIL 31	D	40	CL,N,CC		SOIL 35	D	.	NE
SOIL 31	E	50	CL,N,CC		SOIL 35	E	.	NE
SOIL 31	F	40	CL,N,CC		SOIL 35	F	.	NE
SOIL 31	G	50	CL,N,CC,M		SOIL 35	G	.	NE
SOIL 31	H	40	CL,N,CC,M		SOIL 35	H	.	NE
SOIL 31	I	50	CL,N,CC		SOIL 35	I	.	NE
SOIL 31	J	50	CL,N,CC		SOIL 35	J	.	NE
SOIL 32	A	90	CL,N,M		SOIL 36	A	.	NE
SOIL 32	B	90	N,M		SOIL 36	B	.	NE
SOIL 32	C	100	M		SOIL 36	C	.	NE
SOIL 32	D	100	M		SOIL 36	D	.	NE
SOIL 32	E	80	CL,N,M,CC		SOIL 36	E	.	NE
SOIL 32	F	90	CL,N,M		SOIL 36	F	.	NE
SOIL 32	G	90	CL,N,M		SOIL 36	G	.	NE
SOIL 32	H	90	CL,N		SOIL 36	H	.	NE
SOIL 32	I	.	.		SOIL 36	I	.	NE
SOIL 32	J	90	CL,N,M		SOIL 36	J	.	NE

M – Mortality; CL – Chlorosis; N – Necrosis; CC – Color Change; NE – None Emerged

Appendix 7.1

Tansy Aster (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
NC	A	5.8	5.2	6.1	6	6	2	15	0.358	0.179
NC	B	5.8	5.2	6.4	6	6	2	34	0.549	0.275
NC	C	5.8	6.1	6.7	5	5	2	16	0.539	0.270
NC	D	5.8	5.8	6.7	7	7	4	30	1.032	0.258
NC	E	5.8	6.0	6.7	7	7	2	19	0.579	0.290
NC	F	5.8	4.8	6.8	5	5	1	22	0.581	0.581
NC	G	5.8	4.8	5.6	3	3	0	.	.	.
NC	H	5.8	4.2	7.5	4	4	1	14	0.505	0.505
NC	I	5.8	4.8	6.9	7	7	5	19	1.749	0.350
NC	J	5.8	4.8	6.4	4	4	3	20	0.876	0.292
						5.40	2.20	21.0		0.333
						1.43	1.48	6.80		0.128
SOIL 1	A	4.6	4.9	4.3	0	0	0	.	.	.
SOIL 1	B	4.6	4.5	4.0	0	0	0	.	.	.
SOIL 1	C	4.6	3.6	4.2	0	0	0	.	.	.
SOIL 1	D	4.6	4.2	4.3	0	0	0	.	.	.
SOIL 1	E	4.6	4.8	4.3	0	0	0	.	.	.
SOIL 1	F	4.6	3.8	4.5	0	0	0	.	.	.
SOIL 1	G	4.6	<3.5	4.7	0	0	0	.	.	.
SOIL 1	H	4.6	3.9	4.4	0	0	0	.	.	.
SOIL 1	I	4.6	3.9	4.5	0	0	0	.	.	.
SOIL 1	J	4.6	<3.5	4.3	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.

Appendix 7.1

(continued)

Tansy Aster (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 2	A	4.6	5.5	7.5	1	1	1	3	0.005	0.005
SOIL 2	B	4.6	6.5	7.5	1	1	1	3	0.011	0.011
SOIL 2	C	4.6	6.8	7.7	2	2	2	4	0.025	0.013
SOIL 2	D	4.6	6.7	7.7	1	1	1	4	0.021	0.021
SOIL 2	E	4.6	6.3	7.5	0	0	0	.	.	.
SOIL 2	F	4.6	7.0	7.8	0	0	0	.	.	.
SOIL 2	G	4.6	7.0	7.9	0	0	0	.	.	.
SOIL 2	H	4.6	5.7	7.6	0	0	0	.	.	.
SOIL 2	I	4.6	5.9	7.6	0	0	0	.	.	.
SOIL 2	J	4.6	7.0	7.8	0	0	0	.	.	.
						0.50	0.50	3.5		0.012
						0.71	0.71	0.58		0.007
SOIL 3	A	5.2	6.8	4.9	1	1	0	.	.	.
SOIL 3	B	5.2	6.9	5.1	0	0	0	.	.	.
SOIL 3	C	5.2	7.0	5.4	2	2	2	5	0.002	0.001
SOIL 3	D	5.2	6.8	5.4	1	1	1	2	0.003	0.003
SOIL 3	E	5.2	6.7	5.0	0	0	0	.	.	.
SOIL 3	F	5.2	6.8	5.5	1	1	1	3	0.003	0.003
SOIL 3	G	5.2	6.0	5.1	1	1	1	1	0.004	0.004
SOIL 3	H	5.2	5.9	5.4	1	1	1	2	0.003	0.003
SOIL 3	I	5.2	6.2	5.2	3	3	3	1	0.005	0.002
SOIL 3	J	5.2	6.9	4.6	0	0	0	.	.	.
						1.00	0.90	2.3		0.003
						0.94	0.99	1.51		0.001

Appendix 7.1

(continued)

Tansy Aster (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 4	A	5.8	5.6	5.1	5	5	5	12	0.254	0.051
SOIL 4	B	5.8	5.6	5.3	4	4	3	17	0.191	0.064
SOIL 4	C	5.8	6.3	5.1	4	4	4	22	0.193	0.048
SOIL 4	D	5.8	6.1	5.2	3	3	3	5	0.112	0.037
SOIL 4	E	5.8	6.0	5.2	1	1	1	20	0.038	0.038
SOIL 4	F	5.8	6.0	5.5	2	2	2	13	0.169	0.085
SOIL 4	G	5.8	6.3	5.2	3	3	3	13	0.205	0.068
SOIL 4	H	5.8	5.8	5.5	3	3	3	16	0.108	0.036
SOIL 4	I	5.8	6.1	5.3	2	2	2	5	0.125	0.063
SOIL 4	J	5.8	5.8	5.0	3	3	3	9	0.213	0.071
						3.00	2.90	13.2		0.056
						1.15	1.10	5.77		0.016
SOIL 5	A	5.1	6.0	6.3	1	1	1	1	0.002	0.002
SOIL 5	B	5.1	6.9	6.4	1	1	1	2	0.009	0.009
SOIL 5	C	5.1	7.0	6.5	3	3	2	2	0.025	0.013
SOIL 5	D	5.1	5.8	6.6	4	4	4	2	0.015	0.004
SOIL 5	E	5.1	5.7	5.9	4	4	4	3	0.019	0.005
SOIL 5	F	5.1	5.7	6.1	4	4	4	3	0.019	0.005
SOIL 5	G	5.1	5.5	6.2	4	4	4	3	0.028	0.007
SOIL 5	H	5.1	5.8	6.2	4	5	4	2	0.030	0.008
SOIL 5	I	5.1	5.7	6.4	2	2	2	2	0.005	0.003
SOIL 5	J	5.1	4.8	6.3	1	1	1	1	0.005	0.005
						2.90	2.70	2.1		0.006
						1.52	1.42	0.74		0.003

Appendix 7.1
(continued)
Tansy Aster (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 6	A	4.3	6.8	4.0	0	0	0	.	.	.
SOIL 6	B	4.3	6.9	3.4	0	0	0	.	.	.
SOIL 6	C	4.3	7.0	4.0	0	0	0	.	.	.
SOIL 6	D	4.3	7.0	3.6	0	0	0	.	.	.
SOIL 6	E	4.3	6.8	3.8	0	0	0	.	.	.
SOIL 6	F	4.3	6.5	3.5	0	0	0	.	.	.
SOIL 6	G	4.3	6.3	3.5	0	0	0	.	.	.
SOIL 6	H	4.3	6.1	3.5	1	1	1	2	0.003	0.003
SOIL 6	I	4.3	7.0	3.4	0	0	0	.	.	.
SOIL 6	J	4.3	6.2	3.4	0	0	0	.	.	.
						0.10	0.10	2.0		0.003
						0.32	0.32	.		.
SOIL 7	A	4.0	5.3	2.9	0	0	0	.	.	.
SOIL 7	B	4.0	4.6	3.0	0	0	0	.	.	.
SOIL 7	C	4.0	6.2	3.0	0	0	0	.	.	.
SOIL 7	D	4.0	4.5	3.1	0	0	0	.	.	.
SOIL 7	E	4.0	4.3	3.1	0	0	0	.	.	.
SOIL 7	F	4.0	3.7	3.0	0	0	0	.	.	.
SOIL 7	G	4.0	5.6	2.9	0	0	0	.	.	.
SOIL 7	H	4.0	3.7	2.9	0	0	0	.	.	.
SOIL 7	I	4.0	4.1	2.9	0	0	0	.	.	.
SOIL 7	J	4.0	5.3	2.9	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.

Appendix 7.1

(continued)

Tansy Aster (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 8	A	5.5	6.2	4.8	2	2	2	0.25	0.002	0.001
SOIL 8	B	5.5	6.2	4.7	2	2	2	1	0.003	0.002
SOIL 8	C	5.5	5.8	4.9	2	2	2	1	0.006	0.003
SOIL 8	D	5.5	5.5	5.1	2	2	2	1	0.004	0.002
SOIL 8	E	5.5	6.6	4.7	1	1	1	1	0.001	0.001
SOIL 8	F	5.5	5.9	5.0	1	1	1	0.25	0.001	0.001
SOIL 8	G	5.5	5.9	4.8	2	2	1	0.25	0.006	0.006
SOIL 8	H	5.5	6.3	4.8	2	2	2	0.25	0.001	0.001
SOIL 8	I	5.5	6.8	4.9	2	2	2	1	0.001	0.001
SOIL 8	J	5.5	6.2	4.7	3	3	2	2	0.002	0.001
						1.90	1.70	0.8		0.002
						0.57	0.48	0.56		0.002
SOIL 9	A	6.0	3.7	4.1	0	0	0	.	.	.
SOIL 9	B	6.0	3.7	4.2	0	0	0	.	.	.
SOIL 9	C	6.0	<3.5	3.7	0	0	0	.	.	.
SOIL 9	D	6.0	3.7	3.8	0	0	0	.	.	.
SOIL 9	E	6.0	4.1	3.8	0	0	0	.	.	.
SOIL 9	F	6.0	3.7	3.9	0	0	0	.	.	.
SOIL 9	G	6.0	<3.5	4.4	0	0	0	.	.	.
SOIL 9	H	6.0	<3.5	3.9	0	0	0	.	.	.
SOIL 9	I	6.0	<3.5	4.1	0	0	0	.	.	.
SOIL 9	J	6.0	3.7	3.9	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.

Appendix 7.1
(continued)
Tansy Aster (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 10	A	4.4	6.4	5.4	1	1	0	.	.	.
SOIL 10	B	4.4	6.9	5.4	0	0	0	.	.	.
SOIL 10	C	4.4	6.8	5.4	0	0	0	.	.	.
SOIL 10	D	4.4	6.5	5.4	0	0	0	.	.	.
SOIL 10	E	4.4	6.4	5.0	1	1	0	.	.	.
SOIL 10	F	4.4	5.3	5.1	0	0	0	.	.	.
SOIL 10	G	4.4	5.1	5.2	0	0	0	.	.	.
SOIL 10	H	4.4	5.8	5.2	0	0	0	.	.	.
SOIL 10	I	4.4	5.5	5.7	1	1	0	.	.	.
SOIL 10	J	4.4	5.2	5.8	0	0	0	.	.	.
						0.30	0.00	.		.
						0.48	0.00	.		.
SOIL 11	A	5.4	6.1	3.7	0	0	0	.	.	.
SOIL 11	B	5.4	5.4	3.9	0	0	0	.	.	.
SOIL 11	C	5.4	3.7	4.0	0	0	0	.	.	.
SOIL 11	D	5.4	6.1	3.7	0	0	0	.	.	.
SOIL 11	E	5.4	6.3	3.6	0	0	0	.	.	.
SOIL 11	F	5.4	6.1	3.7	0	0	0	.	.	.
SOIL 11	G	5.4	3.9	3.9	0	0	0	.	.	.
SOIL 11	H	5.4	4.7	3.9	0	0	0	.	.	.
SOIL 11	I	5.4	3.8	3.9	0	0	0	.	.	.
SOIL 11	J	5.4	4.6	3.5	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.

Appendix 7.1

(continued)

Tansy Aster (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 12	A	4.2	6.2	6.7	3	3	3	3	0.007	0.002
SOIL 12	B	4.2	6.4	6.8	1	1	1	3	0.003	0.003
SOIL 12	C	4.2	6.6	7.0	1	1	1	4	0.002	0.002
SOIL 12	D	4.2	5.7	7.0	3	3	3	4	0.012	0.004
SOIL 12	E	4.2	6.7	7.0	3	3	2	3	0.005	0.003
SOIL 12	F	4.2	6.2	6.9	2	2	2	5	0.007	0.004
SOIL 12	G	4.2	6.1	6.7	1	1	1	3	0.001	0.001
SOIL 12	H	4.2	7.0	6.7	1	1	1	3	0.002	0.002
SOIL 12	I	4.2	7.1	6.9	1	1	0	.	.	.
SOIL 12	J	4.2	7.0	7.1	2	2	2	4	0.006	0.003
						1.80	1.60	3.6		0.003
						0.92	0.97	0.73		0.001
SOIL 13	A	5.6	6.4	5.3	0	0	0	.	.	.
SOIL 13	B	5.6	6.5	5.6	0	0	0	.	.	.
SOIL 13	C	5.6	6.2	6.0	0	0	0	.	.	.
SOIL 13	D	5.6	6.7	5.6	1	1	0	.	.	.
SOIL 13	E	5.6	6.9	6.0	0	0	0	.	.	.
SOIL 13	F	5.6	6.3	6.4	3	3	3	7	0.113	0.038
SOIL 13	G	5.6	6.0	6.1	3	3	3	20	0.114	0.038
SOIL 13	H	5.6	6.8	6.1	0	0	0	.	.	.
SOIL 13	I	5.6	6.3	6.4	2	2	2	7	0.035	0.018
SOIL 13	J	5.6	7.0	6.3	2	2	2	7	0.061	0.031
						1.10	1.00	10.3		0.031
						1.29	1.33	6.50		0.010

Appendix 7.1

(continued)

Tansy Aster (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 14	A	5.0	3.8	3.7	0	0	0	.	.	.
SOIL 14	B	5.0	3.7	3.7	0	0	0	.	.	.
SOIL 14	C	5.0	4.4	3.6	0	0	0	.	.	.
SOIL 14	D	5.0	3.9	3.6	0	0	0	.	.	.
SOIL 14	E	5.0	5.0	3.6	0	0	0	.	.	.
SOIL 14	F	5.0	4.3	3.7	0	0	0	.	.	.
SOIL 14	G	5.0	4.3	3.4	0	0	0	.	.	.
SOIL 14	H	5.0	4.5	3.6	0	0	0	.	.	.
SOIL 14	I	5.0	4.2	3.5	0	0	0	.	.	.
SOIL 14	J	5.0	4.3	3.5	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.
SOIL 15	A	5.2	6.9	4.6	1	1	0	.	.	.
SOIL 15	B	5.2	6.8	4.8	2	2	1	2	0.003	0.003
SOIL 15	C	5.2	7.0	4.2	0	0	0	.	.	.
SOIL 15	D	5.2	7.2	4.4	1	1	0	.	.	.
SOIL 15	E	5.2	7.0	4.4	1	2	2	0.25	0.003	0.002
SOIL 15	F	5.2	7.0	4.3	1	1	1	2	0.001	0.001
SOIL 15	G	5.2	7.0	4.5	2	2	2	2	0.005	0.003
SOIL 15	H	5.2	7.0	4.2	3	3	1	0.25	0.015	0.015
SOIL 15	I	5.2	7.1	4.6	0	0	0	.	.	.
SOIL 15	J	5.2	7.1	4.5	1	1	1	2	0.001	0.001
						1.30	0.80	1.4		0.004
						0.95	0.79	0.90		0.005

Appendix 7.1
(continued)
Tansy Aster (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 16	A	4.4	5.5	4.9	0	0	0	.	.	.
SOIL 16	B	4.4	5.0	5.0	0	0	0	.	.	.
SOIL 16	C	4.4	4.9	4.8	0	0	0	.	.	.
SOIL 16	D	4.4	5.0	4.9	0	0	0	.	.	.
SOIL 16	E	4.4	5.0	5.0	0	0	0	.	.	.
SOIL 16	F	4.4	6.2	4.8	0	0	0	.	.	.
SOIL 16	G	4.4	4.6	4.7	0	0	0	.	.	.
SOIL 16	H	4.4	5.0	4.8	0	0	0	.	.	.
SOIL 16	I	4.4	4.6	4.5	0	0	0	.	.	.
SOIL 16	J	4.4	4.1	4.6	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.
SOIL 17	A	4.6	7.0	7.3	3	3	3	1	0.005	0.002
SOIL 17	B	4.6	6.8	7.0	1	1	1	1	0.003	0.003
SOIL 17	C	4.6	6.4	7.3	3	3	3	5	0.033	0.011
SOIL 17	D	4.6	6.8	7.3	4	4	4	1	0.014	0.004
SOIL 17	E	4.6	6.7	7.2	4	4	3	3	0.023	0.008
SOIL 17	F	4.6	6.4	7.0	2	2	2	3	0.012	0.006
SOIL 17	G	4.6	6.5	7.0	2	3	3	4	0.010	0.003
SOIL 17	H	4.6	6.2	7.3	3	3	3	1	0.009	0.003
SOIL 17	I	4.6	6.8	7.4	3	3	3	2	0.014	0.005
SOIL 17	J	4.6	7.0	7.5	4	4	4	9	0.042	0.011
						3.00	2.90	3.0		0.005
						0.94	0.88	2.54		0.003

Appendix 7.1
(continued)
Tansy Aster (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 19	A	5.8	7.0	5.3	0	0	0	.	.	.
SOIL 19	B	5.8	6.0	4.8	0	0	0	.	.	.
SOIL 19	C	5.8	6.4	4.6	0	0	0	.	.	.
SOIL 19	D	5.8	6.0	4.8	0	0	0	.	.	.
SOIL 19	E	5.8	6.9	4.7	0	0	0	.	.	.
SOIL 19	F	5.8	5.5	4.7	0	0	0	.	.	.
SOIL 19	G	5.8	4.9	4.5	0	0	0	.	.	.
SOIL 19	H	5.8	5.2	4.3	0	0	0	.	.	.
SOIL 19	I	5.8	4.6	4.6	0	0	0	.	.	.
SOIL 19	J	5.8	5.9	4.5	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.
SOIL 20	A	5.4	6.2	7.2	3	3	3	4	0.015	0.005
SOIL 20	B	5.4	5.6	7.3	2	2	2	4	0.011	0.006
SOIL 20	C	5.4	5.0	7.4	3	3	3	5	0.016	0.005
SOIL 20	D	5.4	5.7	7.0	3	3	3	13	0.041	0.014
SOIL 20	E	5.4	6.1	7.3	5	5	5	4	0.034	0.007
SOIL 20	F	5.4	7.0	7.6	2	2	2	3	0.016	0.008
SOIL 20	G	5.4	6.0	7.5	0	0	0	.	.	.
SOIL 20	H	5.4	6.4	7.4	2	2	2	2	0.030	0.015
SOIL 20	I	5.4	6.9	7.5	3	3	3	3	0.033	0.011
SOIL 20	J	5.4	6.5	7.4	4	4	4	4	0.025	0.006
						2.70	2.70	4.7		0.009
						1.34	1.34	3.24		0.004

Appendix 7.1
(continued)
Tansy Aster (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 21	A	5.1	4.2	4.2	2	2	0	.	.	.
SOIL 21	B	5.1	5.6	3.7	0	0	0	.	.	.
SOIL 21	C	5.1	5.2	3.8	1	1	0	.	.	.
SOIL 21	D	5.1	4.8	3.7	1	1	0	.	.	.
SOIL 21	E	5.1	4.7	3.8	1	1	0	.	.	.
SOIL 21	F	5.1	6.8	3.9	0	0	0	.	.	.
SOIL 21	G	5.1	6.5	3.9	0	0	0	.	.	.
SOIL 21	H	5.1	5.2	3.9	0	0	0	.	.	.
SOIL 21	I	5.1	5.1	3.9	0	0	0	.	.	.
SOIL 21	J	5.1	5.8	3.9	1	1	0	.	.	.
						0.60	0.00	.		.
						0.70	0.00	.		.
SOIL 22	A	5.0	6.3	4.6	0	0	0	.	.	.
SOIL 22	B	5.0	6.4	4.3	0	0	0	.	.	.
SOIL 22	C	5.0	6.0	4.6	0	0	0	.	.	.
SOIL 22	D	5.0	6.0	4.4	0	0	0	.	.	.
SOIL 22	E	5.0	6.2	4.4	0	0	0	.	.	.
SOIL 22	F	5.0	6.5	4.5	0	0	0	.	.	.
SOIL 22	G	5.0	7.0	4.1	0	0	0	.	.	.
SOIL 22	H	5.0	6.5	4.4	0	0	0	.	.	.
SOIL 22	I	5.0	6.8	4.3	0	0	0	.	.	.
SOIL 22	J	5.0	6.7	4.2	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.

Appendix 7.1

(continued)

Tansy Aster (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 23	A	5.4	4.2	4.1	0	0	0	.	.	.
SOIL 23	B	5.4	5.8	4.5	0	0	0	.	.	.
SOIL 23	C	5.4	5.2	4.2	0	0	0	.	.	.
SOIL 23	D	5.4	5.5	4.3	0	0	0	.	.	.
SOIL 23	E	5.4	5.1	4.2	0	0	0	.	.	.
SOIL 23	F	5.4	5.7	4.3	0	0	0	.	.	.
SOIL 23	G	5.4	6.8	4.2	0	0	0	.	.	.
SOIL 23	H	5.4	6.0	4.3	0	0	0	.	.	.
SOIL 23	I	5.4	6.5	4.4	0	0	0	.	.	.
SOIL 23	J	5.4	6.3	4.5	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.
SOIL 24	A	5.7	6.5	6.5	1	1	1	6	0.026	0.026
SOIL 24	B	5.7	6.0	7.0	3	3	3	5	0.046	0.015
SOIL 24	C	5.7	5.9	7.3	1	1	1	5	0.024	0.024
SOIL 24	D	5.7	6.8	7.5	2	2	2	7	0.105	0.053
SOIL 24	E	5.7	6.6	7.3	4	4	4	6	0.154	0.039
SOIL 24	F	5.7	6.2	7.3	3	3	3	6	0.225	0.075
SOIL 24	G	5.7	6.5	7.5	2	2	2	7	0.097	0.049
SOIL 24	H	5.7	6.0	7.6	1	1	1	6	0.043	0.043
SOIL 24	I	5.7	6.0	7.5	2	2	2	6	0.121	0.061
SOIL 24	J	5.7	6.5	7.6	3	3	3	7	0.101	0.034
						2.20	2.20	6.1		0.042
						1.03	1.03	0.74		0.018

Appendix 7.1
(continued)
Tansy Aster (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 25	A	5.2	5.8	7.5	1	1	1	5	0.028	0.028
SOIL 25	B	5.2	6.2	7.2	1	1	1	4	0.012	0.012
SOIL 25	C	5.2	6.2	7.6	2	2	2	5	0.066	0.033
SOIL 25	D	5.2	6.9	7.0	0	0	0	.	.	.
SOIL 25	E	5.2	6.5	7.9	1	1	1	7	0.058	0.058
SOIL 25	F	5.2	6.6	7.4	1	1	1	6	0.032	0.032
SOIL 25	G	5.2	6.3	7.0	1	1	1	5	0.040	0.040
SOIL 25	H	5.2	6.3	7.6	1	1	1	5	0.023	0.023
SOIL 25	I	5.2	6.8	7.7	1	1	1	5	0.058	0.058
SOIL 25	J	5.2	6.8	7.3	2	2	2	8	0.095	0.048
						1.10	1.10	5.6		0.037
						0.57	0.57	1.24		0.016
SOIL 26	A	5.0	6.7	7.8	3	3	3	6	0.023	0.008
SOIL 26	B	5.0	6.3	7.6	3	3	3	6	0.018	0.006
SOIL 26	C	5.0	6.0	7.9	0	0	0	.	.	.
SOIL 26	D	5.0	6.6	7.8	3	3	3	2	0.011	0.004
SOIL 26	E	5.0	6.7	8.0	3	3	3	8	0.011	0.004
SOIL 26	F	5.0	6.8	7.6	1	1	0	.	.	.
SOIL 26	G	5.0	6.7	7.0	2	2	2	2	0.013	0.007
SOIL 26	H	5.0	6.9	7.6	2	2	2	2	0.010	0.005
SOIL 26	I	5.0	6.9	7.7	1	1	1	5	0.013	0.013
SOIL 26	J	5.0	6.9	7.8	2	2	2	3	0.014	0.007
						2.00	1.90	4.3		0.007
						1.05	1.20	2.31		0.003

Appendix 7.1

(continued)

Tansy Aster (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 27	A	5.0	5.9	4.3	3	3	0	.	.	.
SOIL 27	B	5.0	6.9	4.3	1	1	0	.	.	.
SOIL 27	C	5.0	6.2	4.5	0	0	0	.	.	.
SOIL 27	D	5.0	6.2	4.4	2	2	0	.	.	.
SOIL 27	E	5.0	6.2	4.4	1	1	0	.	.	.
SOIL 27	F	5.0	7.0	4.4	1	1	0	.	.	.
SOIL 27	G	5.0	5.5	4.5	2	2	2	1	0.006	0.003
SOIL 27	H	5.0	6.8	4.3	0	0	0	.	.	.
SOIL 27	I	5.0	5.2	4.3	1	1	1	1	0.004	0.004
SOIL 27	J	5.0	5.0	4.3	3	3	3	2	0.011	0.004
						1.40	0.60	1.3		0.004
						1.07	1.07	0.58		0.001
SOIL 28	A	5.3	5.5	6.5	1	1	1	2	0.017	0.017
SOIL 28	B	5.3	6.3	7.4	3	3	3	4	0.019	0.006
SOIL 28	C	5.3	5.7	7.6	1	1	1	1	0.009	0.009
SOIL 28	D	5.3	5.8	8.0	1	1	1	2	0.009	0.009
SOIL 28	E	5.3	7.0	7.3	0	0	0	.	.	.
SOIL 28	F	5.3	6.6	7.5	2	2	2	3	0.013	0.007
SOIL 28	G	5.3	6.5	7.3	1	1	1	2	0.004	0.004
SOIL 28	H	5.3	6.4	7.4	1	1	1	4	0.002	0.002
SOIL 28	I	5.3	6.4	7.5	1	1	1	3	0.031	0.031
SOIL 28	J	5.3	5.9	7.6	1	1	1	1	0.001	0.001
						1.20	1.20	2.4		0.010
						0.79	0.79	1.13		0.009

Appendix 7.1
(continued)
Tansy Aster (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 29	A	5.8	6.8	5.3	0	0	0	.	.	.
SOIL 29	B	5.8	6.3	5.3	0	0	0	.	.	.
SOIL 29	C	5.8	6.9	5.3	0	0	0	.	.	.
SOIL 29	D	5.8	5.5	5.2	0	0	0	.	.	.
SOIL 29	E	5.8	5.4	5.2	0	0	0	.	.	.
SOIL 29	F	5.8	5.3	5.0	0	0	0	.	.	.
SOIL 29	G	5.8	6.0	4.9	0	0	0	.	.	.
SOIL 29	H	5.8	6.5	4.9	0	0	0	.	.	.
SOIL 29	I	5.8	6.8	4.7	0	0	0	.	.	.
SOIL 29	J	5.8	6.5	4.8	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.
SOIL 30	A	5.4	5.7	3.8	0	0	0	.	.	.
SOIL 30	B	5.4	6.0	3.8	0	0	0	.	.	.
SOIL 30	C	5.4	5.6	3.6	0	0	0	.	.	.
SOIL 30	D	5.4	5.4	3.9	0	0	0	.	.	.
SOIL 30	E	5.4	6.4	4.0	0	0	0	.	.	.
SOIL 30	F	5.4	5.9	3.8	0	0	0	.	.	.
SOIL 30	G	5.4	6.4	3.9	0	0	0	.	.	.
SOIL 30	H	5.4	6.7	3.9	0	0	0	.	.	.
SOIL 30	I	5.4	6.8	4.1	0	0	0	.	.	.
SOIL 30	J	5.4	6.8	4.0	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.

Appendix 7.1
(continued)
Tansy Aster (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 31	A	5.2	6.5	5.7	2	2	2	1	0.002	0.001
SOIL 31	B	5.2	6.6	5.8	1	1	1	1	0.002	0.002
SOIL 31	C	5.2	6.9	5.9	4	4	3	2	0.007	0.002
SOIL 31	D	5.2	6.8	5.6	1	1	1	1	0.004	0.004
SOIL 31	E	5.2	6.3	5.6	2	2	2	2	0.003	0.002
SOIL 31	F	5.2	5.8	5.4	2	2	2	2	0.001	0.001
SOIL 31	G	5.2	6.5	5.2	0	0	0	.	.	.
SOIL 31	H	5.2	7.0	5.5	0	0	0	.	.	.
SOIL 31	I	5.2	5.5	5.8	2	2	2	2	0.013	0.007
SOIL 31	J	5.2	5.8	5.8	0	0	0	.	.	.
						1.40	1.30	1.6		0.003
						1.26	1.06	0.53		0.002
SOIL 32	A	4.2	5.0	5.3	0	0	0	.	.	.
SOIL 32	B	4.2	6.9	5.1	0	0	0	.	.	.
SOIL 32	C	4.2	5.9	5.0	0	0	0	.	.	.
SOIL 32	D	4.2	5.0	4.8	0	0	0	.	.	.
SOIL 32	E	4.2	5.8	4.8	0	0	0	.	.	.
SOIL 32	F	4.2	6.0	5.3	0	0	0	.	.	.
SOIL 32	G	4.2	6.9	5.2	0	0	0	.	.	.
SOIL 32	H	4.2	6.5	4.8	0	0	0	.	.	.
SOIL 32	I	4.2	5.7	4.8	0	0	0	.	.	.
SOIL 32	J	4.2	6.3	5.2	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.

Appendix 7.1

(continued)

Tansy Aster (Nursery-Provided) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 35	A	4.7	5.7	4.7	0	0	0	.	.	.
SOIL 35	B	4.7	5.0	4.5	0	0	0	.	.	.
SOIL 35	C	4.7	5.3	4.8	0	0	0	.	.	.
SOIL 35	D	4.7	6.0	4.8	0	0	0	.	.	.
SOIL 35	E	4.7	6.5	4.7	0	0	0	.	.	.
SOIL 35	F	4.7	6.0	4.6	0	0	0	.	.	.
SOIL 35	G	4.7	6.9	4.5	0	0	0	.	.	.
SOIL 35	H	4.7	5.5	4.4	0	0	0	.	.	.
SOIL 35	I	4.7	5.2	4.6	0	0	0	.	.	.
SOIL 35	J	4.7	5.2	4.6	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.
SOIL 36	A	5.2	6.0	5.5	0	0	0	.	.	.
SOIL 36	B	5.2	6.9	5.6	0	0	0	.	.	.
SOIL 36	C	5.2	6.8	5.6	0	0	0	.	.	.
SOIL 36	D	5.2	6.1	5.5	0	0	0	.	.	.
SOIL 36	E	5.2	6.7	5.5	0	0	0	.	.	.
SOIL 36	F	5.2	6.4	5.7	0	0	0	.	.	.
SOIL 36	G	5.2	6.0	5.6	0	0	0	.	.	.
SOIL 36	H	5.2	6.6	5.7	0	0	0	.	.	.
SOIL 36	I	5.2	5.8	5.7	0	0	0	.	.	.
SOIL 36	J	5.2	5.3	5.6	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.

Appendix 7.2

Tansy Aster (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
NC	A	12.0	17	7	.	.	.	.	.	.	.	.	.	.
NC	B	14.5	17	12	.	.	.	.	.	.	.	.	.	.
NC	C	15.5	18	13	.	.	.	.	.	.	.	.	.	.
NC	D	14.8	17	16	15	11	.	.	.	.	.	.	.	.
NC	E	16.5	16	17	.	.	.	.	.	.	.	.	.	.
NC	F	17.0	17	.	.	.	.	.	.	.	.	.	.	.
NC	G	.	.	.	.	.	.	.	.	.	.	.	.	.
NC	H	15.0	15	.	.	.	.	.	.	.	.	.	.	.
NC	I	13.8	6	14	16	15	18	.	.	.	.	.	.	.
NC	J	11.7	10	21	4	.	.	.	.	.	.	.	.	.
		14.5												
		1.81												
SOIL 1	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												

Appendix 7.2

(continued)

Tansy Aster (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 2	A	3.0	3	.	.	.	.	.	.	.	.	.	.	.
SOIL 2	B	3.0	3	.	.	.	.	.	.	.	.	.	.	.
SOIL 2	C	4.0	5	3	.	.	.	.	.	.	.	.	.	.
SOIL 2	D	5.0	5	.	.	.	.	.	.	.	.	.	.	.
SOIL 2	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 2	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 2	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 2	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 2	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 2	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		3.8												
		0.96												
SOIL 3	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 3	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 3	C	1.0	1	1	.	.	.	.	.	.	.	.	.	.
SOIL 3	D	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 3	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 3	F	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 3	G	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 3	H	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 3	I	1.0	1	1	1	.	.	.	.	.	.	.	.	.
SOIL 3	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		1.0												
		0.00												

Appendix 7.2

(continued)

Tansy Aster (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 4	A	6.2	6	7	5	5	8	.	.	.	.	.	.	.
SOIL 4	B	5.0	7	4	4	.	.	.	.	.	.	.	.	.
SOIL 4	C	6.8	7	8	5	7	.	.	.	.	.	.	.	.
SOIL 4	D	4.7	4	6	4	.	.	.	.	.	.	.	.	.
SOIL 4	E	7.0	7	.	.	.	.	.	.	.	.	.	.	.
SOIL 4	F	7.5	10	5	.	.	.	.	.	.	.	.	.	.
SOIL 4	G	7.0	9	5	7	.	.	.	.	.	.	.	.	.
SOIL 4	H	5.7	8	6	3	.	.	.	.	.	.	.	.	.
SOIL 4	I	7.5	9	6	.	.	.	.	.	.	.	.	.	.
SOIL 4	J	7.7	7	7	9	.	.	.	.	.	.	.	.	.
		6.5												
		1.07												
SOIL 5	A	2.0	2	.	.	.	.	.	.	.	.	.	.	.
SOIL 5	B	3.0	3	.	.	.	.	.	.	.	.	.	.	.
SOIL 5	C	4.0	4	4	.	.	.	.	.	.	.	.	.	.
SOIL 5	D	2.0	2	2	3	1	.	.	.	.	.	.	.	.
SOIL 5	E	2.3	2	2	2	3	.	.	.	.	.	.	.	.
SOIL 5	F	2.3	3	2	2	2	.	.	.	.	.	.	.	.
SOIL 5	G	2.8	4	3	3	1	.	.	.	.	.	.	.	.
SOIL 5	H	2.5	2	4	2	2	.	.	.	.	.	.	.	.
SOIL 5	I	3.0	4	2	.	.	.	.	.	.	.	.	.	.
SOIL 5	J	4.0	4	.	.	.	.	.	.	.	.	.	.	.
		2.8												
		0.74												

Appendix 7.2
(continued)
Tansy Aster (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 6	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 6	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 6	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 6	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 6	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 6	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 6	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 6	H	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 6	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 6	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		1.0												
		.												
SOIL 7	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												

Appendix 7.2

(continued)

Tansy Aster (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 8	A	0.3	0.25	0.25	.	.	.	.	.	.	.	.	.	.
SOIL 8	B	0.6	1	0.25	.	.	.	.	.	.	.	.	.	.
SOIL 8	C	1.1	0.25	2	.	.	.	.	.	.	.	.	.	.
SOIL 8	D	0.6	0.25	1	.	.	.	.	.	.	.	.	.	.
SOIL 8	E	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 8	F	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 8	G	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 8	H	0.3	0.25	0.25	.	.	.	.	.	.	.	.	.	.
SOIL 8	I	0.3	0.25	0.25	.	.	.	.	.	.	.	.	.	.
SOIL 8	J	0.3	0.25	0.25	.	.	.	.	.	.	.	.	.	.
		0.4												
		0.29												
SOIL 9	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												

Appendix 7.2

(continued)

Tansy Aster (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 10	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												
SOIL 11	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												

Appendix 7.2
(continued)
Tansy Aster (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 12	A	1.3	2	1	1	.	.	.	.	.	.	.	.	.
SOIL 12	B	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 12	C	3.0	3	.	.	.	.	.	.	.	.	.	.	.
SOIL 12	D	2.0	3	1	2	.	.	.	.	.	.	.	.	.
SOIL 12	E	1.5	2	1	.	.	.	.	.	.	.	.	.	.
SOIL 12	F	1.5	2	1	.	.	.	.	.	.	.	.	.	.
SOIL 12	G	2.0	2	.	.	.	.	.	.	.	.	.	.	.
SOIL 12	H	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 12	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 12	J	2.0	2	2	.	.	.	.	.	.	.	.	.	.
		1.7												
		0.63												
SOIL 13	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 13	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 13	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 13	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 13	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 13	F	6.3	7	5	7	.	.	.	.	.	.	.	.	.
SOIL 13	G	5.7	10	4	3	.	.	.	.	.	.	.	.	.
SOIL 13	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 13	I	3.5	2	5	.	.	.	.	.	.	.	.	.	.
SOIL 13	J	5.0	5	5	.	.	.	.	.	.	.	.	.	.
		5.1												
		1.21												

Appendix 7.2
(continued)
Tansy Aster (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 14	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												
SOIL 15	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 15	B	2.0	2	.	.	.	.	.	.	.	.	.	.	.
SOIL 15	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 15	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 15	E	0.3	0.25	0.25	.	.	.	.	.	.	.	.	.	.
SOIL 15	F	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 15	G	1.0	1	1	.	.	.	.	.	.	.	.	.	.
SOIL 15	H	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 15	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 15	J	1.0	1	.	.	.	.	.	.	.	.	.	.	.
		0.8												
		0.70												

Appendix 7.2
(continued)
Tansy Aster (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 16	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 16	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 16	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 16	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 16	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 16	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 16	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 16	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 16	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 16	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												
SOIL 17	A	1.3	2	1	1	.	.	.	.	.	.	.	.	.
SOIL 17	B	2.0	2	.	.	.	.	.	.	.	.	.	.	.
SOIL 17	C	4.0	3	4	5	.	.	.	.	.	.	.	.	.
SOIL 17	D	1.8	3	2	2	0.25	.	.	.	.	.	.	.	.
SOIL 17	E	2.3	2	3	2	.	.	.	.	.	.	.	.	.
SOIL 17	F	2.0	2	2	.	.	.	.	.	.	.	.	.	.
SOIL 17	G	1.2	0.25	3	0.25	.	.	.	.	.	.	.	.	.
SOIL 17	H	1.3	1	1	2	.	.	.	.	.	.	.	.	.
SOIL 17	I	1.7	2	1	2	.	.	.	.	.	.	.	.	.
SOIL 17	J	2.5	3	3	2	2	.	.	.	.	.	.	.	.
		2.0												
		0.82												

Appendix 7.2
(continued)
Tansy Aster (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 19	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												
SOIL 20	A	2.0	2	2	2	.	.	.	.	.	.	.	.	.
SOIL 20	B	2.5	1	4	.	.	.	.	.	.	.	.	.	.
SOIL 20	C	2.7	4	2	2	.	.	.	.	.	.	.	.	.
SOIL 20	D	3.7	4	3	4	.	.	.	.	.	.	.	.	.
SOIL 20	E	2.7	3	5	3	2	0.25	.	.	.	.	.	.	.
SOIL 20	F	2.5	2	3	.	.	.	.	.	.	.	.	.	.
SOIL 20	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 20	H	3.5	3	4	.	.	.	.	.	.	.	.	.	.
SOIL 20	I	3.3	4	3	3	.	.	.	.	.	.	.	.	.
SOIL 20	J	2.0	1	1	3	3	.	.	.	.	.	.	.	.
		2.8												
		0.61												

Appendix 7.2

(continued)

Tansy Aster (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 21	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												
SOIL 22	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												

Appendix 7.2
(continued)
Tansy Aster (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 23	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												
SOIL 24	A	6.0	6	.	.	.	.	.	.	.	.	.	.	.
SOIL 24	B	3.3	3	5	2	.	.	.	.	.	.	.	.	.
SOIL 24	C	5.0	5	.	.	.	.	.	.	.	.	.	.	.
SOIL 24	D	8.0	7	9	.	.	.	.	.	.	.	.	.	.
SOIL 24	E	4.3	9	4	2	2	.	.	.	.	.	.	.	.
SOIL 24	F	6.3	6	5	8	.	.	.	.	.	.	.	.	.
SOIL 24	G	5.5	6	5	.	.	.	.	.	.	.	.	.	.
SOIL 24	H	6.0	6	.	.	.	.	.	.	.	.	.	.	.
SOIL 24	I	6.5	7	6	.	.	.	.	.	.	.	.	.	.
SOIL 24	J	6.0	7	8	3	.	.	.	.	.	.	.	.	.
		5.7												
		1.28												

Appendix 7.2

(continued)

Tansy Aster (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 25	A	5.0	5	.	.	.	.	.	.	.	.	.	.	.
SOIL 25	B	3.0	3	.	.	.	.	.	.	.	.	.	.	.
SOIL 25	C	4.5	6	3	.	.	.	.	.	.	.	.	.	.
SOIL 25	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 25	E	6.0	6	.	.	.	.	.	.	.	.	.	.	.
SOIL 25	F	5.0	5	.	.	.	.	.	.	.	.	.	.	.
SOIL 25	G	5.0	5	.	.	.	.	.	.	.	.	.	.	.
SOIL 25	H	4.0	4	.	.	.	.	.	.	.	.	.	.	.
SOIL 25	I	7.0	7	.	.	.	.	.	.	.	.	.	.	.
SOIL 25	J	5.0	6	4	.	.	.	.	.	.	.	.	.	.
		4.9												
		1.13												
SOIL 26	A	1.7	1	3	1	.	.	.	.	.	.	.	.	.
SOIL 26	B	1.7	2	2	1	.	.	.	.	.	.	.	.	.
SOIL 26	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 26	D	1.7	2	2	1	.	.	.	.	.	.	.	.	.
SOIL 26	E	1.7	2	1	2	.	.	.	.	.	.	.	.	.
SOIL 26	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 26	G	2.0	3	1	.	.	.	.	.	.	.	.	.	.
SOIL 26	H	1.5	2	1	.	.	.	.	.	.	.	.	.	.
SOIL 26	I	2.0	2	.	.	.	.	.	.	.	.	.	.	.
SOIL 26	J	1.5	2	1	.	.	.	.	.	.	.	.	.	.
		1.7												
		0.19												

Appendix 7.2

(continued)

Tansy Aster (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 27	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 27	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 27	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 27	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 27	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 27	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 27	G	0.6	1	0.25	.	.	.	.	.	.	.	.	.	.
SOIL 27	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 27	I	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 27	J	0.8	1	1	0.25	.	.	.	.	.	.	.	.	.
		0.5												
		0.26												
SOIL 28	A	4.0	4	.	.	.	.	.	.	.	.	.	.	.
SOIL 28	B	2.7	4	3	1	.	.	.	.	.	.	.	.	.
SOIL 28	C	3.0	3	.	.	.	.	.	.	.	.	.	.	.
SOIL 28	D	2.0	2	.	.	.	.	.	.	.	.	.	.	.
SOIL 28	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 28	F	2.0	2	2	.	.	.	.	.	.	.	.	.	.
SOIL 28	G	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 28	H	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 28	I	6.0	6	.	.	.	.	.	.	.	.	.	.	.
SOIL 28	J	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
		2.4												
		1.76												

Appendix 7.2
(continued)
Tansy Aster (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 29	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 29	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 29	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 29	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 29	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 29	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 29	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 29	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 29	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 29	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												
SOIL 30	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												

Appendix 7.2

(continued)

Tansy Aster (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 31	A	0.3	0.25	0.25	.	.	.	.	.	.	.	.	.	.
SOIL 31	B	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 31	C	0.8	1	1	0.25	.	.	.	.	.	.	.	.	.
SOIL 31	D	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 31	E	1.0	1	1	.	.	.	.	.	.	.	.	.	.
SOIL 31	F	0.6	1	0.25	.	.	.	.	.	.	.	.	.	.
SOIL 31	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 31	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 31	I	0.6	0.25	1	.	.	.	.	.	.	.	.	.	.
SOIL 31	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		0.6												
		0.31												
SOIL 32	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 32	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 32	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 32	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 32	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 32	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 32	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 32	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 32	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 32	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												

Appendix 7.2
(continued)
Tansy Aster (Nursery-Provided) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 35	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												
SOIL 36	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												

Appendix 7.3

Tansy Aster (Nursery-Provided) Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed
NC	A	60	M		SOIL 2	A	0	none		SOIL 4	A	0	none
NC	B	60	M		SOIL 2	B	0	none		SOIL 4	B	20	M
NC	C	50	M		SOIL 2	C	0	none		SOIL 4	C	0	none
NC	D	40	M		SOIL 2	D	0	none		SOIL 4	D	0	none
NC	E	70	M		SOIL 2	E	.	NE		SOIL 4	E	0	none
NC	F	90	M		SOIL 2	F	.	NE		SOIL 4	F	0	none
NC	G	100	M		SOIL 2	G	.	NE		SOIL 4	G	0	none
NC	H	80	M		SOIL 2	H	.	NE		SOIL 4	H	0	none
NC	I	30	M		SOIL 2	I	.	NE		SOIL 4	I	0	none
NC	J	30	M		SOIL 2	J	.	NE		SOIL 4	J	0	none
SOIL 1	A	.	NE		SOIL 3	A	100	M		SOIL 5	A	0	none
SOIL 1	B	.	NE		SOIL 3	B	.	NE		SOIL 5	B	0	none
SOIL 1	C	.	NE		SOIL 3	C	50	N		SOIL 5	C	30	M
SOIL 1	D	.	NE		SOIL 3	D	20	N		SOIL 5	D	20	CL,CC
SOIL 1	E	.	NE		SOIL 3	E	.	NE		SOIL 5	E	10	N
SOIL 1	F	.	NE		SOIL 3	F	10	CL,N		SOIL 5	F	10	CL,CC
SOIL 1	G	.	NE		SOIL 3	G	20	CL,N		SOIL 5	G	10	CC
SOIL 1	H	.	NE		SOIL 3	H	20	CL,N		SOIL 5	H	30	N,M,CC
SOIL 1	I	.	NE		SOIL 3	I	30	CL,N		SOIL 5	I	20	CL,N
SOIL 1	J	.	NE		SOIL 3	J	.	NE		SOIL 5	J	10	N

M – Mortality; CL – Chlorosis; N – Necrosis; CC – Color Change; NE – None Emerged

Appendix 7.3

(continued)

Tansy Aster (Nursery-Provided) Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed
SOIL 6	A	.	NE		SOIL 8	A	60	CL,N		SOIL 10	A	100	M
SOIL 6	B	.	NE		SOIL 8	B	60	CL,N		SOIL 10	B	.	NE
SOIL 6	C	.	NE		SOIL 8	C	60	CL,N		SOIL 10	C	.	NE
SOIL 6	D	.	NE		SOIL 8	D	60	CL,N		SOIL 10	D	.	NE
SOIL 6	E	.	NE		SOIL 8	E	80	CL,N,CC		SOIL 10	E	100	M
SOIL 6	F	.	NE		SOIL 8	F	80	CL,N		SOIL 10	F	.	NE
SOIL 6	G	.	NE		SOIL 8	G	90	CL,N,M		SOIL 10	G	.	NE
SOIL 6	H	20	N		SOIL 8	H	80	CL,N,CC		SOIL 10	H	.	NE
SOIL 6	I	.	NE		SOIL 8	I	80	CL,N,CC		SOIL 10	I	100	M
SOIL 6	J	.	NE		SOIL 8	J	90	CL,N,CC,M		SOIL 10	J	.	NE
SOIL 7	A	.	NE		SOIL 9	A	.	NE		SOIL 11	A	.	NE
SOIL 7	B	.	NE		SOIL 9	B	.	NE		SOIL 11	B	.	NE
SOIL 7	C	.	NE		SOIL 9	C	.	NE		SOIL 11	C	.	NE
SOIL 7	D	.	NE		SOIL 9	D	.	NE		SOIL 11	D	.	NE
SOIL 7	E	.	NE		SOIL 9	E	.	NE		SOIL 11	E	.	NE
SOIL 7	F	.	NE		SOIL 9	F	.	NE		SOIL 11	F	.	NE
SOIL 7	G	.	NE		SOIL 9	G	.	NE		SOIL 11	G	.	NE
SOIL 7	H	.	NE		SOIL 9	H	.	NE		SOIL 11	H	.	NE
SOIL 7	I	.	NE		SOIL 9	I	.	NE		SOIL 11	I	.	NE
SOIL 7	J	.	NE		SOIL 9	J	.	NE		SOIL 11	J	.	NE

M – Mortality; CL – Chlorosis; N – Necrosis; CC – Color Change; NE – None Emerged

Appendix 7.3

(continued)

Tansy Aster (Nursery-Provided) Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed	SOIL	REP	Condition Score	Symptom(s) Observed	SOIL	REP	Condition Score	Symptom(s) Observed
SOIL 12	A	50	N	SOIL 14	A	.	NE	SOIL 16	A	.	NE
SOIL 12	B	20	N,LC	SOIL 14	B	.	NE	SOIL 16	B	.	NE
SOIL 12	C	10	N	SOIL 14	C	.	NE	SOIL 16	C	.	NE
SOIL 12	D	20	CL,N	SOIL 14	D	.	NE	SOIL 16	D	.	NE
SOIL 12	E	40	N,LC,M	SOIL 14	E	.	NE	SOIL 16	E	.	NE
SOIL 12	F	30	N,LC	SOIL 14	F	.	NE	SOIL 16	F	.	NE
SOIL 12	G	30	N	SOIL 14	G	.	NE	SOIL 16	G	.	NE
SOIL 12	H	20	LC	SOIL 14	H	.	NE	SOIL 16	H	.	NE
SOIL 12	I	100	M	SOIL 14	I	.	NE	SOIL 16	I	.	NE
SOIL 12	J	30	N,LC	SOIL 14	J	.	NE	SOIL 16	J	.	NE
SOIL 13	A	.	NE	SOIL 15	A	100	M	SOIL 17	A	50	CL,N,CC
SOIL 13	B	.	NE	SOIL 15	B	60	CL,M	SOIL 17	B	0	none
SOIL 13	C	.	NE	SOIL 15	C	.	NE	SOIL 17	C	10	CL,N
SOIL 13	D	100	M	SOIL 15	D	100	M	SOIL 17	D	10	CC
SOIL 13	E	.	NE	SOIL 15	E	80	N,LC	SOIL 17	E	20	CL,M
SOIL 13	F	0	none	SOIL 15	F	60	N	SOIL 17	F	0	none
SOIL 13	G	0	none	SOIL 15	G	60	CL,N	SOIL 17	G	10	CL
SOIL 13	H	.	NE	SOIL 15	H	90	CL,N,M	SOIL 17	H	0	none
SOIL 13	I	0	none	SOIL 15	I	.	NE	SOIL 17	I	0	none
SOIL 13	J	0	none	SOIL 15	J	50	CL,LC	SOIL 17	J	0	none

M – Mortality; CL – Chlorosis; N – Necrosis; CC – Color Change; NE – None Emerged; LC – Leaf Curl

Appendix 7.3

(continued)

Tansy Aster (Nursery-Provided) Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed
SOIL 19	A	.	NE		SOIL 21	A	100	M		SOIL 23	A	.	NE
SOIL 19	B	.	NE		SOIL 21	B	.	NE		SOIL 23	B	.	NE
SOIL 19	C	.	NE		SOIL 21	C	100	M		SOIL 23	C	.	NE
SOIL 19	D	.	NE		SOIL 21	D	100	M		SOIL 23	D	.	NE
SOIL 19	E	.	NE		SOIL 21	E	100	M		SOIL 23	E	.	NE
SOIL 19	F	.	NE		SOIL 21	F	.	NE		SOIL 23	F	.	NE
SOIL 19	G	.	NE		SOIL 21	G	.	NE		SOIL 23	G	.	NE
SOIL 19	H	.	NE		SOIL 21	H	.	NE		SOIL 23	H	.	NE
SOIL 19	I	.	NE		SOIL 21	I	.	NE		SOIL 23	I	.	NE
SOIL 19	J	.	NE		SOIL 21	J	100	M		SOIL 23	J	.	NE
SOIL 20	A	0	none		SOIL 22	A	.	NE		SOIL 24	A	0	none
SOIL 20	B	0	none		SOIL 22	B	.	NE		SOIL 24	B	0	none
SOIL 20	C	0	none		SOIL 22	C	.	NE		SOIL 24	C	0	none
SOIL 20	D	0	none		SOIL 22	D	.	NE		SOIL 24	D	0	none
SOIL 20	E	10	N		SOIL 22	E	.	NE		SOIL 24	E	0	none
SOIL 20	F	0	none		SOIL 22	F	.	NE		SOIL 24	F	0	none
SOIL 20	G	.	NE		SOIL 22	G	.	NE		SOIL 24	G	0	none
SOIL 20	H	0	none		SOIL 22	H	.	NE		SOIL 24	H	0	none
SOIL 20	I	0	none		SOIL 22	I	.	NE		SOIL 24	I	0	none
SOIL 20	J	0	none		SOIL 22	J	.	NE		SOIL 24	J	0	none

M – Mortality; N – Necrosis; NE – None Emerged

Appendix 7.3

(continued)

Tansy Aster (Nursery-Provided) Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed
SOIL 25	A	0	none		SOIL 27	A	100	M		SOIL 29	A	.	NE
SOIL 25	B	10	CL		SOIL 27	B	100	M		SOIL 29	B	.	NE
SOIL 25	C	0	none		SOIL 27	C	.	NE		SOIL 29	C	.	NE
SOIL 25	D	.	NE		SOIL 27	D	100	M		SOIL 29	D	.	NE
SOIL 25	E	0	none		SOIL 27	E	100	M		SOIL 29	E	.	NE
SOIL 25	F	0	none		SOIL 27	F	100	M		SOIL 29	F	.	NE
SOIL 25	G	0	none		SOIL 27	G	70	CL,N		SOIL 29	G	.	NE
SOIL 25	H	0	none		SOIL 27	H	.	NE		SOIL 29	H	.	NE
SOIL 25	I	0	none		SOIL 27	I	60	CL,N		SOIL 29	I	.	NE
SOIL 25	J	0	none		SOIL 27	J	50	N		SOIL 29	J	.	NE
SOIL 26	A	0	none		SOIL 28	A	0	none		SOIL 30	A	.	NE
SOIL 26	B	20	CL		SOIL 28	B	30	N		SOIL 30	B	.	NE
SOIL 26	C	.	NE		SOIL 28	C	0	none		SOIL 30	C	.	NE
SOIL 26	D	20	CL		SOIL 28	D	0	none		SOIL 30	D	.	NE
SOIL 26	E	20	N		SOIL 28	E	.	NE		SOIL 30	E	.	NE
SOIL 26	F	100	M		SOIL 28	F	20	N,LC		SOIL 30	F	.	NE
SOIL 26	G	40	N		SOIL 28	G	20	CC		SOIL 30	G	.	NE
SOIL 26	H	0	none		SOIL 28	H	20	N,LC,CC		SOIL 30	H	.	NE
SOIL 26	I	0	none		SOIL 28	I	0	none		SOIL 30	I	.	NE
SOIL 26	J	0	none		SOIL 28	J	50	N,LC		SOIL 30	J	.	NE

M – Mortality; CL – Chlorosis; N – Necrosis; CC – Color Change; NE – None Emerged; LC – Leaf Curl

Appendix 7.3

(continued)

Tansy Aster (Nursery-Provided) Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed
SOIL 31	A	90	N		SOIL 35	A	.	NE
SOIL 31	B	50	CL,N		SOIL 35	B	.	NE
SOIL 31	C	70	CL,N,M		SOIL 35	C	.	NE
SOIL 31	D	90	N		SOIL 35	D	.	NE
SOIL 31	E	60	CL,N,LC		SOIL 35	E	.	NE
SOIL 31	F	70	N,LC		SOIL 35	F	.	NE
SOIL 31	G	.	NE		SOIL 35	G	.	NE
SOIL 31	H	.	NE		SOIL 35	H	.	NE
SOIL 31	I	60	N,LC		SOIL 35	I	.	NE
SOIL 31	J	.	NE		SOIL 35	J	.	NE
SOIL 32	A	.	NE		SOIL 36	A	.	NE
SOIL 32	B	.	NE		SOIL 36	B	.	NE
SOIL 32	C	.	NE		SOIL 36	C	.	NE
SOIL 32	D	.	NE		SOIL 36	D	.	NE
SOIL 32	E	.	NE		SOIL 36	E	.	NE
SOIL 32	F	.	NE		SOIL 36	F	.	NE
SOIL 32	G	.	NE		SOIL 36	G	.	NE
SOIL 32	H	.	NE		SOIL 36	H	.	NE
SOIL 32	I	.	NE		SOIL 36	I	.	NE
SOIL 32	J	.	NE		SOIL 36	J	.	NE

M – Mortality; CL – Chlorosis; N – Necrosis; LC – Leaf Curl; NE – None Emerged

Appendix 8.1

Tansy Aster (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
NC	A	5.8	4.3	5.7	4	4	0	.	.	.
NC	B	5.8	4.8	6.0	4	4	0	.	.	.
NC	C	5.8	5.1	5.8	4	4	0	.	.	.
NC	D	5.8	4.3	6.3	3	3	1	50	0.212	0.212
NC	E	5.8	4.3	3.1	3	3	2	40	0.389	0.195
NC	F	5.8	4.3	5.7	3	3	0	.	.	.
NC	G	5.8	4.4	6.1	4	4	1	19	0.083	0.083
NC	H	5.8	4.8	6.0	2	2	1	11	0.014	0.014
NC	I	5.8	5.3	6.0	4	4	1	17	0.413	0.413
NC	J	5.8	4.6	6.0	2	2	2	20	0.824	0.412
						3.30	0.80	26.2		0.221
						0.82	0.79	15.25		0.165
SOIL 1	A	4.5	4.9	4.8	0	0	0	.	.	.
SOIL 1	B	4.5	6.0	4.7	0	0	0	.	.	.
SOIL 1	C	4.5	4.8	4.6	0	0	0	.	.	.
SOIL 1	D	4.5	5.2	4.2	0	0	0	.	.	.
SOIL 1	E	4.5	4.4	4.6	0	0	0	.	.	.
SOIL 1	F	4.5	4.8	4.5	0	0	0	.	.	.
SOIL 1	G	4.5	4.0	4.6	0	0	0	.	.	.
SOIL 1	H	4.5	4.4	4.5	0	0	0	.	.	.
SOIL 1	I	4.5	3.9	4.7	0	0	0	.	.	.
SOIL 1	J	4.5	3.6	4.6	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.

Appendix 8.1

(continued)

Tansy Aster (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 2	A	4.8	5.9	7.4	0	0	0	.	.	.
SOIL 2	B	4.8	4.6	7.4	0	0	0	.	.	.
SOIL 2	C	4.8	4.2	7.4	0	0	0	.	.	.
SOIL 2	D	4.8	4.4	7.4	0	0	0	.	.	.
SOIL 2	E	4.8	5.0	7.5	1	1	0	.	.	.
SOIL 2	F	4.8	7.0	7.6	0	0	0	.	.	.
SOIL 2	G	4.8	5.9	7.4	0	1	1	9	0.009	0.009
SOIL 2	H	4.8	5.8	7.6	0	0	0	.	.	.
SOIL 2	I	4.8	5.3	7.5	0	0	0	.	.	.
SOIL 2	J	4.8	5.8	7.7	0	0	0	.	.	.
						0.20	0.10	9.0		0.009
						0.42	0.32	.		.
SOIL 3	A	5.0	5.9	5.7	2	2	1	1	0.003	0.003
SOIL 3	B	5.0	7.0	5.6	0	0	0	.	.	.
SOIL 3	C	5.0	7.0	5.2	0	0	0	.	.	.
SOIL 3	D	5.0	7.0	5.2	0	0	0	.	.	.
SOIL 3	E	5.0	6.3	4.8	0	0	0	.	.	.
SOIL 3	F	5.0	6.3	5.8	1	1	1	1	0.001	0.001
SOIL 3	G	5.0	6.0	4.8	1	1	0	.	.	.
SOIL 3	H	5.0	7.0	4.6	0	0	0	.	.	.
SOIL 3	I	5.0	7.1	5.0	0	0	0	.	.	.
SOIL 3	J	5.0	6.6	5.0	1	1	1	1	0.002	0.002
						0.50	0.30	1.0		0.002
						0.71	0.48	0.00		0.001

Appendix 8.1

(continued)

Tansy Aster (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 4	A	5.4	4.9	5.6	2	2	1	1	0.006	0.006
SOIL 4	B	5.4	5.0	5.7	1	1	1	9	0.027	0.027
SOIL 4	C	5.4	6.1	5.4	0	0	0	.	.	.
SOIL 4	D	5.4	6.9	5.8	0	0	0	.	.	.
SOIL 4	E	5.4	5.3	6.0	0	0	0	.	.	.
SOIL 4	F	5.4	5.1	6.0	1	1	1	3	0.001	0.001
SOIL 4	G	5.4	4.6	5.6	1	1	1	2	0.004	0.004
SOIL 4	H	5.4	4.3	5.6	1	1	1	2	0.005	0.005
SOIL 4	I	5.4	4.1	5.8	1	1	1	1	0.003	0.003
SOIL 4	J	5.4	4.4	5.6	1	1	1	7	0.003	0.003
						0.80	0.70	3.6		0.007
						0.63	0.48	3.15		0.009
SOIL 5	A	5.0	5.2	6.5	1	1	1	3	0.003	0.003
SOIL 5	B	5.0	5.0	6.1	0	0	0	.	.	.
SOIL 5	C	5.0	5.6	6.0	2	2	2	9	0.007	0.004
SOIL 5	D	5.0	4.8	6.1	0	0	0	.	.	.
SOIL 5	E	5.0	5.2	6.3	2	2	2	3	0.007	0.004
SOIL 5	F	5.0	4.9	6.2	0	0	0	.	.	.
SOIL 5	G	5.0	5.1	5.9	0	0	0	.	.	.
SOIL 5	H	5.0	5.2	6.0	0	0	0	.	.	.
SOIL 5	I	5.0	4.8	6.1	0	0	0	.	.	.
SOIL 5	J	5.0	4.3	6.3	0	0	0	.	.	.
						0.50	0.50	5.0		0.003
						0.85	0.85	3.46		0.000

Appendix 8.1
(continued)
Tansy Aster (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 6	A	4.1	6.4	4.0	0	0	0	.	.	.
SOIL 6	B	4.1	5.8	4.2	0	0	0	.	.	.
SOIL 6	C	4.1	5.6	4.2	0	0	0	.	.	.
SOIL 6	D	4.1	4.4	4.5	0	0	0	.	.	.
SOIL 6	E	4.1	4.8	3.9	0	0	0	.	.	.
SOIL 6	F	4.1	4.3	4.4	0	0	0	.	.	.
SOIL 6	G	4.1	3.9	4.3	0	0	0	.	.	.
SOIL 6	H	4.1	3.9	4.2	0	0	0	.	.	.
SOIL 6	I	4.1	4.0	4.1	0	0	0	.	.	.
SOIL 6	J	4.1	3.8	4.2	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.
SOIL 7	A	4.0	3.8	3.4	0	0	0	.	.	.
SOIL 7	B	4.0	3.9	3.5	0	0	0	.	.	.
SOIL 7	C	4.0	3.5	3.5	0	0	0	.	.	.
SOIL 7	D	4.0	3.6	3.6	0	0	0	.	.	.
SOIL 7	E	4.0	3.6	3.7	0	0	0	.	.	.
SOIL 7	F	4.0	3.6	3.4	0	0	0	.	.	.
SOIL 7	G	4.0	<3.5	3.5	0	0	0	.	.	.
SOIL 7	H	4.0	<3.5	3.3	0	0	0	.	.	.
SOIL 7	I	4.0	<3.5	3.5	0	0	0	.	.	.
SOIL 7	J	4.0	3.8	3.3	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.

Appendix 8.1

(continued)

Tansy Aster (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 8	A	5.4	4.0	4.8	0	0	0	.	.	.
SOIL 8	B	5.4	3.8	4.8	0	0	0	.	.	.
SOIL 8	C	5.4	3.9	4.7	0	0	0	.	.	.
SOIL 8	D	5.4	4.1	4.9	1	1	0	.	.	.
SOIL 8	E	5.4	4.6	4.8	0	0	0	.	.	.
SOIL 8	F	5.4	5.4	4.7	0	0	0	.	.	.
SOIL 8	G	5.4	4.6	4.8	0	0	0	.	.	.
SOIL 8	H	5.4	4.1	5.0	0	0	0	.	.	.
SOIL 8	I	5.4	3.9	4.7	0	0	0	.	.	.
SOIL 8	J	5.4	4.8	5.0	0	0	0	.	.	.
						0.10	0.00	.		.
						0.32	0.00	.		.
SOIL 9	A	5.5	4.3	4.4	0	0	0	.	.	.
SOIL 9	B	5.5	4.0	4.5	0	0	0	.	.	.
SOIL 9	C	5.5	5.0	4.2	0	0	0	.	.	.
SOIL 9	D	5.5	4.2	4.2	0	0	0	.	.	.
SOIL 9	E	5.5	4.3	4.3	0	0	0	.	.	.
SOIL 9	F	5.5	3.9	4.5	0	0	0	.	.	.
SOIL 9	G	5.5	3.8	4.2	0	0	0	.	.	.
SOIL 9	H	5.5	5.0	4.2	0	0	0	.	.	.
SOIL 9	I	5.5	4.3	4.4	0	0	0	.	.	.
SOIL 9	J	5.5	3.5	4.3	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.

Appendix 8.1
(continued)
Tansy Aster (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 10	A	4.5	5.0	5.2	0	0	0	.	.	.
SOIL 10	B	4.5	5.1	5.3	0	0	0	.	.	.
SOIL 10	C	4.5	5.3	5.5	0	0	0	.	.	.
SOIL 10	D	4.5	5.1	5.4	0	0	0	.	.	.
SOIL 10	E	4.5	5.1	5.2	0	0	0	.	.	.
SOIL 10	F	4.5	5.0	5.1	0	0	0	.	.	.
SOIL 10	G	4.5	5.2	5.1	0	0	0	.	.	.
SOIL 10	H	4.5	5.6	5.4	0	0	0	.	.	.
SOIL 10	I	4.5	5.2	5.6	0	0	0	.	.	.
SOIL 10	J	4.5	5.0	5.3	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.
SOIL 11	A	5.2	4.3	3.9	0	0	0	.	.	.
SOIL 11	B	5.2	4.2	3.8	0	0	0	.	.	.
SOIL 11	C	5.2	5.3	3.9	0	0	0	.	.	.
SOIL 11	D	5.2	5.5	4.0	0	0	0	.	.	.
SOIL 11	E	5.2	5.3	4.0	0	0	0	.	.	.
SOIL 11	F	5.2	6.0	4.0	0	0	0	.	.	.
SOIL 11	G	5.2	5.2	4.1	0	0	0	.	.	.
SOIL 11	H	5.2	6.0	4.1	0	0	0	.	.	.
SOIL 11	I	5.2	5.9	4.2	0	0	0	.	.	.
SOIL 11	J	5.2	5.9	4.0	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.

Appendix 8.1

(continued)

Tansy Aster (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 12	A	5.2	6.1	6.5	0	0	0	.	.	.
SOIL 12	B	5.2	6.1	6.8	0	0	0	.	.	.
SOIL 12	C	5.2	6.3	6.8	0	0	0	.	.	.
SOIL 12	D	5.2	5.4	6.9	1	1	1	2	0.003	0.003
SOIL 12	E	5.2	6.2	7.0	0	0	0	.	.	.
SOIL 12	F	5.2	6.8	7.3	0	0	0	.	.	.
SOIL 12	G	5.2	6.4	7.3	0	0	0	.	.	.
SOIL 12	H	5.2	6.7	7.4	0	0	0	.	.	.
SOIL 12	I	5.2	6.5	7.2	0	0	0	.	.	.
SOIL 12	J	5.2	4.9	7.0	1	1	1	4	0.003	0.003
						0.20	0.20	3.0		0.003
						0.42	0.42	1.41		0.000
SOIL 13	A	5.4	5.5	5.9	1	1	1	2	0.002	0.002
SOIL 13	B	5.4	5.8	5.6	1	1	1	2	0.003	0.003
SOIL 13	C	5.4	5.3	5.4	0	0	0	.	.	.
SOIL 13	D	5.4	5.3	5.7	0	0	0	.	.	.
SOIL 13	E	5.4	5.5	5.4	0	0	0	.	.	.
SOIL 13	F	5.4	5.1	5.5	1	1	1	3	0.004	0.004
SOIL 13	G	5.4	5.7	5.8	0	0	0	.	.	.
SOIL 13	H	5.4	5.2	5.5	0	0	0	.	.	.
SOIL 13	I	5.4	5.5	5.3	0	0	0	.	.	.
SOIL 13	J	5.4	5.0	5.7	0	0	0	.	.	.
						0.30	0.30	2.3		0.003
						0.48	0.48	0.58		0.001

Appendix 8.1

(continued)

Tansy Aster (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 14	A	5.3	6.0	4.2	0	0	0	.	.	.
SOIL 14	B	5.3	5.7	3.9	0	0	0	.	.	.
SOIL 14	C	5.3	5.6	4.0	1	1	0	.	.	.
SOIL 14	D	5.3	5.3	3.8	0	0	0	.	.	.
SOIL 14	E	5.3	6.9	3.7	0	0	0	.	.	.
SOIL 14	F	5.3	4.2	4.0	0	0	0	.	.	.
SOIL 14	G	5.3	5.6	3.9	0	0	0	.	.	.
SOIL 14	H	5.3	4.6	3.9	0	0	0	.	.	.
SOIL 14	I	5.3	5.2	3.9	0	0	0	.	.	.
SOIL 14	J	5.3	4.4	3.9	0	0	0	.	.	.
						0.10	0.00	.		.
						0.32	0.00	.		.
SOIL 15	A	5.6	6.2	4.4	1	1	0	.	.	.
SOIL 15	B	5.6	7.0	4.5	0	0	0	.	.	.
SOIL 15	C	5.6	7.0	4.9	0	0	0	.	.	.
SOIL 15	D	5.6	5.2	4.9	0	0	0	.	.	.
SOIL 15	E	5.6	5.5	5.1	0	0	0	.	.	.
SOIL 15	F	5.6	6.2	4.5	0	0	0	.	.	.
SOIL 15	G	5.6	7.0	4.6	0	0	0	.	.	.
SOIL 15	H	5.6	6.9	5.0	0	0	0	.	.	.
SOIL 15	I	5.6	6.0	4.7	0	0	0	.	.	.
SOIL 15	J	5.6	5.2	4.7	0	0	0	.	.	.
						0.10	0.00	.		.
						0.32	0.00	.		.

Appendix 8.1

(continued)

Tansy Aster (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 16	A	4.8	5.3	5.2	0	0	0	.	.	.
SOIL 16	B	4.8	3.9	4.8	0	0	0	.	.	.
SOIL 16	C	4.8	4.2	4.7	0	0	0	.	.	.
SOIL 16	D	4.8	5.9	4.8	0	0	0	.	.	.
SOIL 16	E	4.8	5.5	4.7	0	0	0	.	.	.
SOIL 16	F	4.8	5.5	4.7	0	0	0	.	.	.
SOIL 16	G	4.8	4.9	4.8	0	0	0	.	.	.
SOIL 16	H	4.8	4.2	4.8	0	0	0	.	.	.
SOIL 16	I	4.8	5.7	4.7	1	1	0	.	.	.
SOIL 16	J	4.8	5.7	4.7	1	1	0	.	.	.
						0.20	0.00	.		.
						0.42	0.00	.		.
SOIL 17	A	4.8	5.7	7.1	0	0	0	.	.	.
SOIL 17	B	4.8	5.9	7.1	0	0	0	.	.	.
SOIL 17	C	4.8	5.2	7.4	2	2	2	2	0.003	0.002
SOIL 17	D	4.8	5.2	7.3	1	1	1	2	0.005	0.005
SOIL 17	E	4.8	4.8	7.4	1	1	1	3	0.003	0.003
SOIL 17	F	4.8	5.3	7.2	1	1	1	4	0.015	0.015
SOIL 17	G	4.8	5.9	7.3	1	1	1	1	0.008	0.008
SOIL 17	H	4.8	5.5	7.3	0	0	0	.	.	.
SOIL 17	I	4.8	4.8	7.3	1	1	1	8	0.02	0.020
SOIL 17	J	4.8	5.4	7.2	0	0	0	.	.	.
						0.70	0.70	3.3		0.009
						0.67	0.67	2.50		0.007

Appendix 8.1
(continued)
Tansy Aster (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 19	A	6.0	6.1	4.9	0	0	0	.	.	.
SOIL 19	B	6.0	5.9	4.9	0	0	0	.	.	.
SOIL 19	C	6.0	5.2	4.6	0	0	0	.	.	.
SOIL 19	D	6.0	5.4	4.7	0	0	0	.	.	.
SOIL 19	E	6.0	5.4	4.7	0	0	0	.	.	.
SOIL 19	F	6.0	4.8	4.7	0	0	0	.	.	.
SOIL 19	G	6.0	5.3	4.7	0	0	0	.	.	.
SOIL 19	H	6.0	5.0	4.7	0	0	0	.	.	.
SOIL 19	I	6.0	5.8	4.8	0	0	0	.	.	.
SOIL 19	J	6.0	5.4	4.7	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.
SOIL 20	A	5.2	5.5	7.6	1	1	1	11	0.005	0.005
SOIL 20	B	5.2	4.9	7.4	1	1	0	.	.	.
SOIL 20	C	5.2	4.9	7.3	0	0	0	.	.	.
SOIL 20	D	5.2	5.1	7.5	0	0	0	.	.	.
SOIL 20	E	5.2	5.0	7.3	1	1	1	3	0.001	0.001
SOIL 20	F	5.2	5.7	7.6	1	1	0	.	.	.
SOIL 20	G	5.2	5.2	7.2	0	0	0	.	.	.
SOIL 20	H	5.2	5.0	7.7	1	1	1	6	0.004	0.004
SOIL 20	I	5.2	5.5	7.5	1	1	1	8	0.003	0.003
SOIL 20	J	5.2	5.5	7.5	2	2	2	9	0.012	0.006
						0.80	0.60	7.4		0.004
						0.63	0.70	3.05		0.002

Appendix 8.1
(continued)
Tansy Aster (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 21	A	5.6	5.1	4.4	0	0	0	.	.	.
SOIL 21	B	5.6	6.8	4.6	0	0	0	.	.	.
SOIL 21	C	5.6	5.9	4.2	0	0	0	.	.	.
SOIL 21	D	5.6	5.9	4.5	0	0	0	.	.	.
SOIL 21	E	5.6	5.8	4.3	0	0	0	.	.	.
SOIL 21	F	5.6	5.3	4.4	0	0	0	.	.	.
SOIL 21	G	5.6	5.0	4.4	0	0	0	.	.	.
SOIL 21	H	5.6	5.3	4.4	0	0	0	.	.	.
SOIL 21	I	5.6	4.5	4.3	0	0	0	.	.	.
SOIL 21	J	5.6	5.6	4.4	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.
SOIL 22	A	4.8	5.1	4.7	0	0	0	.	.	.
SOIL 22	B	4.8	6.1	4.7	0	0	0	.	.	.
SOIL 22	C	4.8	5.8	4.7	0	0	0	.	.	.
SOIL 22	D	4.8	5.8	4.7	0	0	0	.	.	.
SOIL 22	E	4.8	6.4	4.7	0	0	0	.	.	.
SOIL 22	F	4.8	4.3	4.5	0	0	0	.	.	.
SOIL 22	G	4.8	4.2	4.5	0	0	0	.	.	.
SOIL 22	H	4.8	4.5	4.7	0	0	0	.	.	.
SOIL 22	I	4.8	4.0	4.5	0	0	0	.	.	.
SOIL 22	J	4.8	4.5	4.6	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.

Appendix 8.1

(continued)

Tansy Aster (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 23	A	5.8	5.6	4.4	0	0	0	.	.	.
SOIL 23	B	5.8	4.7	4.6	0	0	0	.	.	.
SOIL 23	C	5.8	4.4	4.6	0	0	0	.	.	.
SOIL 23	D	5.8	4.3	4.4	0	0	0	.	.	.
SOIL 23	E	5.8	5.4	4.4	0	0	0	.	.	.
SOIL 23	F	5.8	4.3	4.4	0	0	0	.	.	.
SOIL 23	G	5.8	3.8	4.5	0	0	0	.	.	.
SOIL 23	H	5.8	3.9	4.6	0	0	0	.	.	.
SOIL 23	I	5.8	4.8	4.4	0	0	0	.	.	.
SOIL 23	J	5.8	4.2	4.4	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.
SOIL 24	A	5.9	5.0	7.3	3	3	2	5	0.047	0.024
SOIL 24	B	5.9	4.9	7.3	1	1	0	.	.	.
SOIL 24	C	5.9	5.2	7.5	1	1	1	5	0.074	0.074
SOIL 24	D	5.9	5.5	7.3	1	1	1	5	0.028	0.028
SOIL 24	E	5.9	4.2	7.6	0	0	0	.	.	.
SOIL 24	F	5.9	5.1	7.6	4	4	3	7	0.135	0.045
SOIL 24	G	5.9	4.8	7.3	0	0	0	.	.	.
SOIL 24	H	5.9	4.5	7.3	0	0	0	.	.	.
SOIL 24	I	5.9	4.7	7.6	1	1	1	6	0.052	0.052
SOIL 24	J	5.9	5.5	7.4	0	0	0	.	.	.
						1.10	0.80	5.6		0.045
						1.37	1.03	0.89		0.020

Appendix 8.1
(continued)
Tansy Aster (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 25	A	5.5	4.8	7.6	0	0	0	.	.	.
SOIL 25	B	5.5	5.2	7.5	0	0	0	.	.	.
SOIL 25	C	5.5	5.2	7.7	1	1	1	9	0.037	0.037
SOIL 25	D	5.5	4.7	7.6	0	0	0	.	.	.
SOIL 25	E	5.5	4.9	7.6	1	1	1	31	0.092	0.092
SOIL 25	F	5.5	5.2	7.5	2	2	2	12	0.111	0.056
SOIL 25	G	5.5	5.8	7.7	1	1	1	11	0.084	0.084
SOIL 25	H	5.5	5.7	7.7	1	1	1	19	0.043	0.043
SOIL 25	I	5.5	5.5	7.7	1	1	0	.	.	.
SOIL 25	J	5.5	5.2	7.6	1	1	1	7	0.047	0.047
						0.80	0.70	14.8		0.060
						0.63	0.67	8.91		0.023
SOIL 26	A	5.0	5.4	7.8	1	1	1	1	0.001	0.001
SOIL 26	B	5.0	5.2	7.9	0	0	0	.	.	.
SOIL 26	C	5.0	5.2	7.8	1	1	1	2	0.011	0.011
SOIL 26	D	5.0	5.7	7.5	0	0	0	.	.	.
SOIL 26	E	5.0	5.5	7.7	0	0	0	.	.	.
SOIL 26	F	5.0	5.1	7.6	0	0	0	.	.	.
SOIL 26	G	5.0	5.7	7.7	0	0	0	.	.	.
SOIL 26	H	5.0	5.0	7.5	0	0	0	.	.	.
SOIL 26	I	5.0	5.3	7.8	0	0	0	.	.	.
SOIL 26	J	5.0	5.3	7.6	0	0	0	.	.	.
						0.20	0.20	1.5		0.006
						0.42	0.42	0.71		0.007

Appendix 8.1
(continued)
Tansy Aster (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 27	A	5.0	5.1	5.5	0	0	0	.	.	.
SOIL 27	B	5.0	7.0	5.0	0	0	0	.	.	.
SOIL 27	C	5.0	6.7	5.2	0	0	0	.	.	.
SOIL 27	D	5.0	6.0	4.9	1	1	0	.	.	.
SOIL 27	E	5.0	5.9	4.9	0	0	0	.	.	.
SOIL 27	F	5.0	4.7	5.0	1	1	0	.	.	.
SOIL 27	G	5.0	4.2	4.9	0	0	0	.	.	.
SOIL 27	H	5.0	4.7	4.8	0	0	0	.	.	.
SOIL 27	I	5.0	4.2	4.8	0	0	0	.	.	.
SOIL 27	J	5.0	4.4	4.8	0	0	0	.	.	.
						0.20	0.00	.		.
						0.42	0.00	.		.
SOIL 28	A	5.4	4.9	8.3	1	1	1	4	0.007	0.007
SOIL 28	B	5.4	4.2	7.5	0	0	0	.	.	.
SOIL 28	C	5.4	5.2	7.7	1	1	1	3	0.013	0.013
SOIL 28	D	5.4	5.0	7.8	1	1	1	5	0.009	0.009
SOIL 28	E	5.4	4.5	7.7	0	0	0	.	.	.
SOIL 28	F	5.4	4.4	7.7	0	0	0	.	.	.
SOIL 28	G	5.4	4.4	7.6	0	0	0	.	.	.
SOIL 28	H	5.4	5.3	8.2	1	1	1	14	0.012	0.012
SOIL 28	I	5.4	5.1	7.6	0	0	0	.	.	.
SOIL 28	J	5.4	5.2	7.8	0	0	0	.	.	.
						0.40	0.40	6.5		0.010
						0.52	0.52	5.07		0.003

Appendix 8.1
(continued)
Tansy Aster (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 29	A	5.8	4.9	5.3	0	0	0	.	.	.
SOIL 29	B	5.8	4.9	5.1	0	0	0	.	.	.
SOIL 29	C	5.8	5.6	4.9	0	0	0	.	.	.
SOIL 29	D	5.8	5.4	4.9	0	0	0	.	.	.
SOIL 29	E	5.8	5.3	4.8	0	0	0	.	.	.
SOIL 29	F	5.8	5.0	5.0	0	0	0	.	.	.
SOIL 29	G	5.8	5.3	5.0	0	0	0	.	.	.
SOIL 29	H	5.8	5.9	5.3	0	0	0	.	.	.
SOIL 29	I	5.8	5.7	5.1	0	0	0	.	.	.
SOIL 29	J	5.8	5.1	5.4	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.
SOIL 30	A	5.4	5.1	3.9	0	0	0	.	.	.
SOIL 30	B	5.4	4.9	3.9	0	0	0	.	.	.
SOIL 30	C	5.4	5.0	3.8	0	0	0	.	.	.
SOIL 30	D	5.4	5.4	3.9	0	0	0	.	.	.
SOIL 30	E	5.4	4.1	3.9	0	0	0	.	.	.
SOIL 30	F	5.4	5.2	3.9	0	0	0	.	.	.
SOIL 30	G	5.4	4.7	3.8	0	0	0	.	.	.
SOIL 30	H	5.4	5.2	3.9	0	0	0	.	.	.
SOIL 30	I	5.4	4.9	3.8	0	0	0	.	.	.
SOIL 30	J	5.4	4.9	4.0	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.

Appendix 8.1

(continued)

Tansy Aster (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 31	A	5.3	4.8	5.9	1	1	1	1	0.001	0.001
SOIL 31	B	5.3	5.5	5.4	0	0	0	.	.	.
SOIL 31	C	5.3	5.0	5.3	0	0	0	.	.	.
SOIL 31	D	5.3	5.4	5.5	0	0	0	.	.	.
SOIL 31	E	5.3	5.9	5.6	0	0	0	.	.	.
SOIL 31	F	5.3	4.7	5.4	0	0	0	.	.	.
SOIL 31	G	5.3	5.2	5.5	0	0	0	.	.	.
SOIL 31	H	5.3	4.9	5.5	0	0	0	.	.	.
SOIL 31	I	5.3	4.8	5.4	0	0	0	.	.	.
SOIL 31	J	5.3	5.2	5.3	1	1	1	3	0.002	0.002
						0.20	0.20	2.0		0.002
						0.42	0.42	1.41		0.001
SOIL 32	A	4.5	5.3	5.1	0	0	0	.	.	.
SOIL 32	B	4.5	5.4	5.1	0	0	0	.	.	.
SOIL 32	C	4.5	5.5	5.1	0	0	0	.	.	.
SOIL 32	D	4.5	5.2	5.0	0	0	0	.	.	.
SOIL 32	E	4.5	5.3	5.2	0	0	0	.	.	.
SOIL 32	F	4.5	5.3	5.1	0	0	0	.	.	.
SOIL 32	G	4.5	4.9	5.2	0	0	0	.	.	.
SOIL 32	H	4.5	5.1	5.2	0	0	0	.	.	.
SOIL 32	I	4.5	5.3	5.3	0	0	0	.	.	.
SOIL 32	J	4.5	5.0	5.3	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.

Appendix 8.1
(continued)
Tansy Aster (Field-Collected) Test Results: pH, Emergence, Survival, Root Length and Dry Weight

SOIL	REP	INIT PH	FIN PH (Soil Probe)	FIN PH (Lab Meter)	EM 0	EM 21	SURV	RT LGTH	TOT DWT	MN DWT
		pH	pH	pH	per 12	per 12	per 12	cm	g	g
SOIL 35	A	4.9	3.7	4.8	0	0	0	.	.	.
SOIL 35	B	4.9	3.8	4.7	0	0	0	.	.	.
SOIL 35	C	4.9	4.1	4.7	0	0	0	.	.	.
SOIL 35	D	4.9	4.6	4.8	0	0	0	.	.	.
SOIL 35	E	4.9	4.2	4.6	0	0	0	.	.	.
SOIL 35	F	4.9	3.8	4.7	0	0	0	.	.	.
SOIL 35	G	4.9	3.7	4.8	0	0	0	.	.	.
SOIL 35	H	4.9	3.7	4.7	0	0	0	.	.	.
SOIL 35	I	4.9	4.0	4.8	0	0	0	.	.	.
SOIL 35	J	4.9	4.9	4.6	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.
SOIL 36	A	5.2	6.2	5.4	0	0	0	.	.	.
SOIL 36	B	5.2	5.5	5.5	0	0	0	.	.	.
SOIL 36	C	5.2	5.8	5.5	0	0	0	.	.	.
SOIL 36	D	5.2	5.3	5.7	0	0	0	.	.	.
SOIL 36	E	5.2	3.8	5.9	0	0	0	.	.	.
SOIL 36	F	5.2	4.2	5.8	0	0	0	.	.	.
SOIL 36	G	5.2	3.6	5.7	0	0	0	.	.	.
SOIL 36	H	5.2	3.9	6.0	0	0	0	.	.	.
SOIL 36	I	5.2	4.2	6.1	0	0	0	.	.	.
SOIL 36	J	5.2	3.9	6.0	0	0	0	.	.	.
						0.00	0.00	.		.
						0.00	0.00	.		.

Appendix 8.2

Tansy Aster (Field-Collected) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
NC	A	.	.	.	.	.	.	.	.	.	.	.	.	.
NC	B	.	.	.	.	.	.	.	.	.	.	.	.	.
NC	C	.	.	.	.	.	.	.	.	.	.	.	.	.
NC	D	8.0	8	.	.	.	.	.	.	.	.	.	.	.
NC	E	8.5	10	7	.	.	.	.	.	.	.	.	.	.
NC	F	.	.	.	.	.	.	.	.	.	.	.	.	.
NC	G	7.0	7	.	.	.	.	.	.	.	.	.	.	.
NC	H	3.0	3	.	.	.	.	.	.	.	.	.	.	.
NC	I	15.0	15	.	.	.	.	.	.	.	.	.	.	.
NC	J	14.5	14	15	.	.	.	.	.	.	.	.	.	.
		9.3												
		4.62												
SOIL 1	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 1	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												

Appendix 8.2
(continued)
Tansy Aster (Field-Collected) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 2	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 2	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 2	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 2	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 2	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 2	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 2	G	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 2	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 2	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 2	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		1.0												
		.												
SOIL 3	A	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 3	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 3	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 3	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 3	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 3	F	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 3	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 3	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 3	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 3	J	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
		0.3												
		0.00												

Appendix 8.2
(continued)
Tansy Aster (Field-Collected) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 4	A	3.0	3	.	.	.	.	.	.	.	.	.	.	.
SOIL 4	B	6.0	6	.	.	.	.	.	.	.	.	.	.	.
SOIL 4	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 4	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 4	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 4	F	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 4	G	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 4	H	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 4	I	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 4	J	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
		1.6												
		2.20												
SOIL 5	A	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 5	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 5	C	1.5	2	1	.	.	.	.	.	.	.	.	.	.
SOIL 5	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 5	E	1.1	2	0.25	.	.	.	.	.	.	.	.	.	.
SOIL 5	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 5	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 5	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 5	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 5	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		1.2												
		0.26												

Appendix 8.2
(continued)
Tansy Aster (Field-Collected) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 6	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 6	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 6	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 6	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 6	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 6	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 6	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 6	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 6	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 6	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												
SOIL 7	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 7	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												

Appendix 8.2

(continued)

Tansy Aster (Field-Collected) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 8	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 8	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 8	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 8	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 8	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 8	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 8	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 8	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 8	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 8	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												
SOIL 9	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 9	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												

Appendix 8.2
(continued)
Tansy Aster (Field-Collected) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 10	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 10	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												
SOIL 11	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 11	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												

Appendix 8.2
(continued)
Tansy Aster (Field-Collected) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 12	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 12	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 12	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 12	D	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 12	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 12	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 12	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 12	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 12	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 12	J	2.0	2	.	.	.	.	.	.	.	.	.	.	.
		1.5												
		0.71												
SOIL 13	A	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 13	B	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 13	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 13	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 13	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 13	F	2.0	2	.	.	.	.	.	.	.	.	.	.	.
SOIL 13	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 13	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 13	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 13	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		1.3												
		0.58												

Appendix 8.2
(continued)
Tansy Aster (Field-Collected) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 14	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 14	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												
SOIL 15	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 15	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 15	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 15	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 15	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 15	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 15	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 15	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 15	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 15	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												

Appendix 8.2
(continued)
Tansy Aster (Field-Collected) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 16	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 16	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 16	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 16	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 16	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 16	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 16	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 16	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 16	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 16	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												
SOIL 17	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 17	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 17	C	0.6	1	0.25	.	.	.	.	.	.	.	.	.	.
SOIL 17	D	2.0	2	.	.	.	.	.	.	.	.	.	.	.
SOIL 17	E	2.0	2	.	.	.	.	.	.	.	.	.	.	.
SOIL 17	F	2.0	2	.	.	.	.	.	.	.	.	.	.	.
SOIL 17	G	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 17	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 17	I	3.0	3	.	.	.	.	.	.	.	.	.	.	.
SOIL 17	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		1.8												
		0.85												

Appendix 8.2
(continued)
Tansy Aster (Field-Collected) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 19	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 19	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												
SOIL 20	A	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 20	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 20	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 20	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 20	E	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 20	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 20	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 20	H	3.0	3	.	.	.	.	.	.	.	.	.	.	.
SOIL 20	I	1.0	1	.	.	.	.	.	.	.	.	.	.	.
SOIL 20	J	2.0	1	3	.	.	.	.	.	.	.	.	.	.
		1.5												
		1.07												

Appendix 8.2
(continued)
Tansy Aster (Field-Collected) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 21	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 21	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												
SOIL 22	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 22	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												

Appendix 8.2

(continued)

Tansy Aster (Field-Collected) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 23	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 23	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												
SOIL 24	A	4.0	6	2	.	.	.	.	.	.	.	.	.	.
SOIL 24	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 24	C	5.0	5	.	.	.	.	.	.	.	.	.	.	.
SOIL 24	D	5.0	5	.	.	.	.	.	.	.	.	.	.	.
SOIL 24	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 24	F	5.0	5	6	4	.	.	.	.	.	.	.	.	.
SOIL 24	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 24	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 24	I	7.0	7	.	.	.	.	.	.	.	.	.	.	.
SOIL 24	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		5.2												
		1.10												

Appendix 8.2
(continued)
Tansy Aster (Field-Collected) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 25	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 25	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 25	C	4.0	4	.	.	.	.	.	.	.	.	.	.	.
SOIL 25	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 25	E	6.0	6	.	.	.	.	.	.	.	.	.	.	.
SOIL 25	F	4.5	5	4	.	.	.	.	.	.	.	.	.	.
SOIL 25	G	5.0	5	.	.	.	.	.	.	.	.	.	.	.
SOIL 25	H	4.0	4	.	.	.	.	.	.	.	.	.	.	.
SOIL 25	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 25	J	4.0	4	.	.	.	.	.	.	.	.	.	.	.
		4.6												
		0.80												
SOIL 26	A	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 26	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 26	C	3.0	3	.	.	.	.	.	.	.	.	.	.	.
SOIL 26	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 26	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 26	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 26	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 26	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 26	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 26	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		1.6												
		1.94												

Appendix 8.2
(continued)
Tansy Aster (Field-Collected) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 27	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 27	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 27	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 27	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 27	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 27	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 27	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 27	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 27	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 27	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												
SOIL 28	A	2.0	2	.	.	.	.	.	.	.	.	.	.	.
SOIL 28	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 28	C	2.0	2	.	.	.	.	.	.	.	.	.	.	.
SOIL 28	D	2.0	2	.	.	.	.	.	.	.	.	.	.	.
SOIL 28	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 28	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 28	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 28	H	4.0	4	.	.	.	.	.	.	.	.	.	.	.
SOIL 28	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 28	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		2.5												
		1.00												

Appendix 8.2
(continued)
Tansy Aster (Field-Collected) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 29	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 29	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 29	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 29	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 29	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 29	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 29	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 29	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 29	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 29	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												
SOIL 30	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 30	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												

Appendix 8.2
(continued)
Tansy Aster (Field-Collected) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 31	A	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
SOIL 31	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 31	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 31	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 31	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 31	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 31	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 31	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 31	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 31	J	0.3	0.25	.	.	.	.	.	.	.	.	.	.	.
		0.3												
		0.00												
SOIL 32	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 32	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 32	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 32	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 32	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 32	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 32	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 32	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 32	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 32	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												

Appendix 8.2
(continued)
Tansy Aster (Field-Collected) Test Results: Height

SOIL	REP	MN HT	HT1	HT2	HT3	HT4	HT5	HT6	HT7	HT8	HT9	HT10	HT11	HT12
		cm	cm											
SOIL 35	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 35	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												
SOIL 36	A	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	B	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	C	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	D	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	E	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	F	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	G	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	H	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	I	.	.	.	.	.	.	.	.	.	.	.	.	.
SOIL 36	J	.	.	.	.	.	.	.	.	.	.	.	.	.
		.												
		.												

Appendix 8.3

Tansy Aster (Field-Collected) Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed	SOIL	REP	Condition Score	Symptom(s) Observed	SOIL	REP	Condition Score	Symptom(s) Observed
NC	A	100	M	SOIL 2	A	.	NE	SOIL 4	A	70	CL,N,M
NC	B	100	M	SOIL 2	B	.	NE	SOIL 4	B	0	none
NC	C	100	M	SOIL 2	C	.	NE	SOIL 4	C	.	NE
NC	D	20	M	SOIL 2	D	.	NE	SOIL 4	D	.	NE
NC	E	10	M	SOIL 2	E	100	M	SOIL 4	E	.	NE
NC	F	100	M	SOIL 2	F	.	NE	SOIL 4	F	90	CL,N
NC	G	70	M	SOIL 2	G	90	CL,N	SOIL 4	G	80	CL,N
NC	H	60	N,M	SOIL 2	H	.	NE	SOIL 4	H	90	CL,N
NC	I	60	M	SOIL 2	I	.	NE	SOIL 4	I	90	CL,N
NC	J	0	none	SOIL 2	J	.	NE	SOIL 4	J	90	CL,N
SOIL 1	A	.	NE	SOIL 3	A	90	CL,N,M	SOIL 5	A	80	CL,N
SOIL 1	B	.	NE	SOIL 3	B	.	NE	SOIL 5	B	.	NE
SOIL 1	C	.	NE	SOIL 3	C	.	NE	SOIL 5	C	80	CL,N
SOIL 1	D	.	NE	SOIL 3	D	.	NE	SOIL 5	D	.	NE
SOIL 1	E	.	NE	SOIL 3	E	.	NE	SOIL 5	E	80	CL,N
SOIL 1	F	.	NE	SOIL 3	F	90	CL,N	SOIL 5	F	.	NE
SOIL 1	G	.	NE	SOIL 3	G	100	M	SOIL 5	G	.	NE
SOIL 1	H	.	NE	SOIL 3	H	.	NE	SOIL 5	H	.	NE
SOIL 1	I	.	NE	SOIL 3	I	.	NE	SOIL 5	I	.	NE
SOIL 1	J	.	NE	SOIL 3	J	90	CL,N	SOIL 5	J	.	NE

M – Mortality; CL – Chlorosis; N – Necrosis; NE – None Emerged

Appendix 8.3
(continued)
Tansy Aster (Field-Collected) Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed
SOIL 6	A	.	NE		SOIL 8	A	.	NE		SOIL 10	A	.	NE
SOIL 6	B	.	NE		SOIL 8	B	.	NE		SOIL 10	B	.	NE
SOIL 6	C	.	NE		SOIL 8	C	.	NE		SOIL 10	C	.	NE
SOIL 6	D	.	NE		SOIL 8	D	100	M		SOIL 10	D	.	NE
SOIL 6	E	.	NE		SOIL 8	E	.	NE		SOIL 10	E	.	NE
SOIL 6	F	.	NE		SOIL 8	F	.	NE		SOIL 10	F	.	NE
SOIL 6	G	.	NE		SOIL 8	G	.	NE		SOIL 10	G	.	NE
SOIL 6	H	.	NE		SOIL 8	H	.	NE		SOIL 10	H	.	NE
SOIL 6	I	.	NE		SOIL 8	I	.	NE		SOIL 10	I	.	NE
SOIL 6	J	.	NE		SOIL 8	J	.	NE		SOIL 10	J	.	NE
SOIL 7	A	.	NE		SOIL 9	A	.	NE		SOIL 11	A	.	NE
SOIL 7	B	.	NE		SOIL 9	B	.	NE		SOIL 11	B	.	NE
SOIL 7	C	.	NE		SOIL 9	C	.	NE		SOIL 11	C	.	NE
SOIL 7	D	.	NE		SOIL 9	D	.	NE		SOIL 11	D	.	NE
SOIL 7	E	.	NE		SOIL 9	E	.	NE		SOIL 11	E	.	NE
SOIL 7	F	.	NE		SOIL 9	F	.	NE		SOIL 11	F	.	NE
SOIL 7	G	.	NE		SOIL 9	G	.	NE		SOIL 11	G	.	NE
SOIL 7	H	.	NE		SOIL 9	H	.	NE		SOIL 11	H	.	NE
SOIL 7	I	.	NE		SOIL 9	I	.	NE		SOIL 11	I	.	NE
SOIL 7	J	.	NE		SOIL 9	J	.	NE		SOIL 11	J	.	NE

M – Mortality; NE – None Emerged

Appendix 8.3
(continued)
Tansy Aster (Field-Collected) Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed
SOIL 12	A	.	NE		SOIL 14	A	.	NE		SOIL 16	A	.	NE
SOIL 12	B	.	NE		SOIL 14	B	.	NE		SOIL 16	B	.	NE
SOIL 12	C	.	NE		SOIL 14	C	100	M		SOIL 16	C	.	NE
SOIL 12	D	90	N		SOIL 14	D	.	NE		SOIL 16	D	.	NE
SOIL 12	E	.	NE		SOIL 14	E	.	NE		SOIL 16	E	.	NE
SOIL 12	F	.	NE		SOIL 14	F	.	NE		SOIL 16	F	.	NE
SOIL 12	G	.	NE		SOIL 14	G	.	NE		SOIL 16	G	.	NE
SOIL 12	H	.	NE		SOIL 14	H	.	NE		SOIL 16	H	.	NE
SOIL 12	I	.	NE		SOIL 14	I	.	NE		SOIL 16	I	100	M
SOIL 12	J	30	CL,N		SOIL 14	J	.	NE		SOIL 16	J	100	M
SOIL 13	A	90	CL,N		SOIL 15	A	100	M		SOIL 17	A	.	NE
SOIL 13	B	90	CL,N		SOIL 15	B	.	NE		SOIL 17	B	.	NE
SOIL 13	C	.	NE		SOIL 15	C	.	NE		SOIL 17	C	90	CL,N
SOIL 13	D	.	NE		SOIL 15	D	.	NE		SOIL 17	D	80	CL,N
SOIL 13	E	.	NE		SOIL 15	E	.	NE		SOIL 17	E	80	CL,N
SOIL 13	F	70	CL,N		SOIL 15	F	.	NE		SOIL 17	F	80	CL,N
SOIL 13	G	.	NE		SOIL 15	G	.	NE		SOIL 17	G	90	CL,N
SOIL 13	H	.	NE		SOIL 15	H	.	NE		SOIL 17	H	.	NE
SOIL 13	I	.	NE		SOIL 15	I	.	NE		SOIL 17	I	40	CL,N
SOIL 13	J	.	NE		SOIL 15	J	.	NE		SOIL 17	J	.	NE

M – Mortality; CL – Chlorosis; N – Necrosis; NE – None Emerged

Appendix 8.3

(continued)

Tansy Aster (Field-Collected) Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed
SOIL 19	A	.	NE		SOIL 21	A	.	NE		SOIL 23	A	.	NE
SOIL 19	B	.	NE		SOIL 21	B	.	NE		SOIL 23	B	.	NE
SOIL 19	C	.	NE		SOIL 21	C	.	NE		SOIL 23	C	.	NE
SOIL 19	D	.	NE		SOIL 21	D	.	NE		SOIL 23	D	.	NE
SOIL 19	E	.	NE		SOIL 21	E	.	NE		SOIL 23	E	.	NE
SOIL 19	F	.	NE		SOIL 21	F	.	NE		SOIL 23	F	.	NE
SOIL 19	G	.	NE		SOIL 21	G	.	NE		SOIL 23	G	.	NE
SOIL 19	H	.	NE		SOIL 21	H	.	NE		SOIL 23	H	.	NE
SOIL 19	I	.	NE		SOIL 21	I	.	NE		SOIL 23	I	.	NE
SOIL 19	J	.	NE		SOIL 21	J	.	NE		SOIL 23	J	.	NE
SOIL 20	A	70	N		SOIL 22	A	.	NE		SOIL 24	A	70	N
SOIL 20	B	100	M		SOIL 22	B	.	NE		SOIL 24	B	100	M
SOIL 20	C	.	NE		SOIL 22	C	.	NE		SOIL 24	C	10	CL,LC
SOIL 20	D	.	NE		SOIL 22	D	.	NE		SOIL 24	D	10	CL,LC
SOIL 20	E	90	N		SOIL 22	E	.	NE		SOIL 24	E	.	NE
SOIL 20	F	100	M		SOIL 22	F	.	NE		SOIL 24	F	30	CL,LC,M
SOIL 20	G	.	NE		SOIL 22	G	.	NE		SOIL 24	G	.	NE
SOIL 20	H	60	CL,N		SOIL 22	H	.	NE		SOIL 24	H	.	NE
SOIL 20	I	80	CL,N		SOIL 22	I	.	NE		SOIL 24	I	20	CL,LC
SOIL 20	J	70	CL,N		SOIL 22	J	.	NE		SOIL 24	J	.	NE

M – Mortality; CL – Chlorosis; N – Necrosis; LC – Leaf Curl; NE – None Emerged

Appendix 8.3
(continued)
Tansy Aster (Field-Collected) Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed
SOIL 25	A	.	NE		SOIL 27	A	.	NE		SOIL 29	A	.	NE
SOIL 25	B	.	NE		SOIL 27	B	.	NE		SOIL 29	B	.	NE
SOIL 25	C	40	CL,N		SOIL 27	C	.	NE		SOIL 29	C	.	NE
SOIL 25	D	.	NE		SOIL 27	D	100	M		SOIL 29	D	.	NE
SOIL 25	E	30	CL,LC		SOIL 27	E	.	NE		SOIL 29	E	.	NE
SOIL 25	F	30	CL,N		SOIL 27	F	100	M		SOIL 29	F	.	NE
SOIL 25	G	30	CL		SOIL 27	G	.	NE		SOIL 29	G	.	NE
SOIL 25	H	30	CL		SOIL 27	H	.	NE		SOIL 29	H	.	NE
SOIL 25	I	100	M		SOIL 27	I	.	NE		SOIL 29	I	.	NE
SOIL 25	J	30	CL,LC		SOIL 27	J	.	NE		SOIL 29	J	.	NE
SOIL 26	A	90	CL,N		SOIL 28	A	80	CL,N,LC		SOIL 30	A	.	NE
SOIL 26	B	.	NE		SOIL 28	B	.	NE		SOIL 30	B	.	NE
SOIL 26	C	50	CL,N,LC		SOIL 28	C	40	CL,N,LC		SOIL 30	C	.	NE
SOIL 26	D	.	NE		SOIL 28	D	50	CL,N,LC		SOIL 30	D	.	NE
SOIL 26	E	.	NE		SOIL 28	E	.	NE		SOIL 30	E	.	NE
SOIL 26	F	.	NE		SOIL 28	F	.	NE		SOIL 30	F	.	NE
SOIL 26	G	.	NE		SOIL 28	G	.	NE		SOIL 30	G	.	NE
SOIL 26	H	.	NE		SOIL 28	H	40	CL,N,LC		SOIL 30	H	.	NE
SOIL 26	I	.	NE		SOIL 28	I	.	NE		SOIL 30	I	.	NE
SOIL 26	J	.	NE		SOIL 28	J	.	NE		SOIL 30	J	.	NE

M – Mortality; CL – Chlorosis; N – Necrosis; NE – None Emerged; LC – Leaf Curl

Appendix 8.3

(continued)

Tansy Aster (Field-Collected) Test Results: Condition

SOIL	REP	Condition Score	Symptom(s) Observed		SOIL	REP	Condition Score	Symptom(s) Observed
SOIL 31	A	90	CL,N		SOIL 35	A	.	NE
SOIL 31	B	.	NE		SOIL 35	B	.	NE
SOIL 31	C	.	NE		SOIL 35	C	.	NE
SOIL 31	D	.	NE		SOIL 35	D	.	NE
SOIL 31	E	.	NE		SOIL 35	E	.	NE
SOIL 31	F	.	NE		SOIL 35	F	.	NE
SOIL 31	G	.	NE		SOIL 35	G	.	NE
SOIL 31	H	.	NE		SOIL 35	H	.	NE
SOIL 31	I	.	NE		SOIL 35	I	.	NE
SOIL 31	J	90	CL,N		SOIL 35	J	.	NE
SOIL 32	A	.	NE		SOIL 36	A	.	NE
SOIL 32	B	.	NE		SOIL 36	B	.	NE
SOIL 32	C	.	NE		SOIL 36	C	.	NE
SOIL 32	D	.	NE		SOIL 36	D	.	NE
SOIL 32	E	.	NE		SOIL 36	E	.	NE
SOIL 32	F	.	NE		SOIL 36	F	.	NE
SOIL 32	G	.	NE		SOIL 36	G	.	NE
SOIL 32	H	.	NE		SOIL 36	H	.	NE
SOIL 32	I	.	NE		SOIL 36	I	.	NE
SOIL 32	J	.	NE		SOIL 36	J	.	NE

CL – Chlorosis; N – Necrosis; NE – None Emerged

WATER CHEMISTRY LOG

WELL WATER

Date	pH	Meter ID#	D.O. (ppm)	Meter ID#	Conductivity (µS/cm)	Meter ID#	Temp. (°C)	Meter ID#	Initials	Comments
4-2-13	7.9	pH#1 chem	8.0	DOAQ #1	367	con #1	17.2	DOAQ#1	RW	—
4-9-13	8.0	pH chem#1	8.2	DOAQ #1	370	con #1	17.8	DOAQ#1	RW	—
4-16-13	8.0	pH chem#1	7.6	DOAQ#1	364	con #1	17.7	DOAQ #1	RW	—
4-25-13	8.1	pH chem#1	7.9	DOAQ#1	342	con #1	17.4	DOAQ#1	RW	—
4-30-13	8.0	pH chem # 1	8.0	DOAQ #1	363	con#1	17.5	DOAQ#1	RW	—
5-7-13	8.1	pH chem #1	7.9	DOAQ#1	284	Con #1	17.2	DOAQ#1	MS	—
5-16-13	8.1	pH chem #1	8.0	DOAQ#1	365	Con#1	18.0	DOAQ#1	MS	—
5-21-13	8.0	pH chem #1	8.0	DOAQ#1	357	con#1	18.0	DOAQ#1	RW	—
5-28-13	8.0	pH chem#1	7.5	DOAQ#1	373	con #1	17.8	DOAQ #1	RW	—
6-6-13	8.0	pH chem#1	7.8	DOAQ#1	342	con #1	17.7	DOAQ#1	RW	—
6-11-13	8.1	pH chem#1	8.0	DOAQ#1	323	con #1	18.2	DOAQ#1	RW	—
6-18-13	8.0	pH chem#1	7.5	DOAQ#1	377	con#1	18.3	DOAQ#1	RW	—
6-25-13	8.0	pH chem#1	7.6	DOAQ#1	361	con#1	18.1	DOAQ#1	RW	—
7-2-13	8.0	pHchem#1	7.9	DOAQ#1	372	con #1	18.2	DOAQ #1	RW	—
7-11-13	8.1	pH chem#1	8.0	DOAQ#1	347	con#1	19.5	DOAQ #1	RW	—

WATER CHEMISTRY LOG

WELL WATER

Date	Alkalinity		Hardness		Initials	Comments
	Volume Titrant (mL)	Value (mg/L as $CaCO_3$)	Volume Titrant (mL)	Value (mg/L as $CaCO_3$)		
4-2-13	8.9	178	3.4	136	RW	—
4-9-13	8.9	178	3.4	136	RW	—
4-16-13	9.0	180	3.5	140	RW	—
4-25-13	8.7	174	3.3	132	RW	—
4-30-13	8.9	178	3.5	140	RW	—
5-7-13	9.0	180	3.6	144	MS	—
5-16-13	9.0	180	3.6	144	MS	—
5-21-13	8.8	176	3.5	140	RW	—
5-28-13	8.9	178	3.5	140	RW	—
6-6-13	8.8	176	3.4	136	RW	—
6-11-13	8.8	176	3.3	132	RW	—
6-18-13	8.8	176	3.3	132	RW	—
6-25-13	8.9	178	3.3	132	RW	—
7-2-13	8.8	176	3.5	140	RW	—
7-11-13	8.8	176	3.4	136	RW	—

ANALYTICAL SUMMARY REPORT

August 28, 2015

Chino Mine Company
PO Box 10
Bayard, NM 88023

Work Order: H15080326

Project Name: WI Water Analysis

Energy Laboratories Inc Helena MT received the following 2 samples for Chino Mine Company on 8/18/2015 for analysis.

Lab ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
H15080326-001	1st Flush	08/17/15 8:00	08/18/15	Aqueous	Metals by ICP/ICPMS, Dissolved Alkalinity Conductivity Hardness as CaCO3 pH Preparation, Dissolved Filtration
H15080326-002	Cleared Lines	08/17/15 8:00	08/18/15	Aqueous	Same As Above

The analyses presented in this report were performed by Energy Laboratories, Inc., 3161 E. Lyndale Ave., Helena, MT 59604, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By:

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	Chino Mine Company	**Report Date:**	08/28/15
Project:	WI Water Analysis	**Collection Date:**	08/17/15 08:00
Lab ID:	H15080326-001	**DateReceived:**	08/18/15
Client Sample ID:	1st Flush	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL PROPERTIES							
pH	8.0	s.u.	H	0.1		A4500-H B	08/19/15 13:14 / SRW
Conductivity @ 25 C	385	umhos/cm		1		A2510 B	08/19/15 13:14 / SRW
INORGANICS							
Alkalinity, Total as CaCO3	200	mg/L		4		A2320 B	08/19/15 19:32 / SRW
Hardness as CaCO3	140	mg/L		1		A2340 B	08/27/15 14:11 / sld
METALS, DISSOLVED							
Cadmium	ND	mg/L		0.00003		E200.8	08/26/15 20:26 / dck
Calcium	35	mg/L		1		E200.8	08/26/15 20:26 / dck
Copper	0.028	mg/L		0.001		E200.8	08/26/15 20:26 / dck
Lead	0.0010	mg/L		0.0003		E200.8	08/26/15 20:26 / dck
Magnesium	13	mg/L		1		E200.8	08/26/15 20:26 / dck
Nickel	0.012	mg/L		0.005		E200.8	08/26/15 20:26 / dck
Zinc	0.04	mg/L		0.01		E200.8	08/26/15 20:26 / dck

Report Definitions:	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.
	H - Analysis performed past recommended holding time.	

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	Chino Mine Company	**Report Date:**	08/28/15
Project:	WI Water Analysis	**Collection Date:**	08/17/15 08:00
Lab ID:	H15080326-002	**DateReceived:**	08/18/15
Client Sample ID:	Cleared Lines	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL PROPERTIES							
pH	8.2	s.u.	H	0.1		A4500-H B	08/19/15 13:17 / SRW
Conductivity @ 25 C	394	umhos/cm		1		A2510 B	08/19/15 13:17 / SRW
INORGANICS							
Alkalinity, Total as CaCO3	200	mg/L		4		A2320 B	08/19/15 19:38 / SRW
Hardness as CaCO3	141	mg/L		1		A2340 B	08/27/15 14:11 / sld
METALS, DISSOLVED							
Cadmium	ND	mg/L		0.00003		E200.8	08/26/15 20:30 / dck
Calcium	35	mg/L		1		E200.8	08/26/15 20:30 / dck
Copper	0.001	mg/L		0.001		E200.8	08/26/15 20:30 / dck
Lead	ND	mg/L		0.0003		E200.8	08/26/15 20:30 / dck
Magnesium	13	mg/L		1		E200.8	08/26/15 20:30 / dck
Nickel	ND	mg/L		0.005		E200.8	08/26/15 20:30 / dck
Zinc	ND	mg/L		0.01		E200.8	08/26/15 20:30 / dck

Report Definitions:

RL - Analyte reporting limit.

QCL - Quality control limit.

H - Analysis performed past recommended holding time.

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 08/28/15
Project: WI Water Analysis **Work Order:** H15080326

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A2320 B										Batch: R108634
Lab ID: MB	Method Blank					Run: PHSC_101-H_150819A				08/19/15 18:02
Alkalinity, Total as CaCO3		2	mg/L	0.7						
Lab ID: LCS	Laboratory Control Sample					Run: PHSC_101-H_150819A				08/19/15 18:08
Alkalinity, Total as CaCO3		610	mg/L	4.0	101	90	110			
Lab ID: H15080332-001ADUP	Sample Duplicate					Run: PHSC_101-H_150819A				08/19/15 19:23
Alkalinity, Total as CaCO3		450	mg/L	4.0				1.0	10	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: WI Water Analysis

Report Date: 08/28/15
Work Order: H15080326

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A2510 B							Analytical Run: PHSC_101-H_150819A			
Lab ID: CCV - SC 1413		Continuing Calibration Verification Standard								08/19/15 10:35
Conductivity @ 25 C		1400	umhos/cm	1.0	99	90	110			
Method: A2510 B										Batch: R108634
Lab ID: SC 150		Initial Calibration Verification Standard				Run: PHSC_101-H_150819A				08/19/15 08:24
Conductivity @ 25 C		149	umhos/cm	1.0	99	90	110			
Lab ID: SC 5000		Initial Calibration Verification Standard				Run: PHSC_101-H_150819A				08/19/15 08:26
Conductivity @ 25 C		4990	umhos/cm	1.0	100	90	110			
Lab ID: SC 20000		Initial Calibration Verification Standard				Run: PHSC_101-H_150819A				08/19/15 08:29
Conductivity @ 25 C		19600	umhos/cm	1.0	98	90	110			
Lab ID: SC 2ND 1000		Laboratory Control Sample				Run: PHSC_101-H_150819A				08/19/15 08:31
Conductivity @ 25 C		1000	umhos/cm	1.0	100	90	110			
Lab ID: H15080331-001ADUP		Sample Duplicate				Run: PHSC_101-H_150819A				08/19/15 13:22
Conductivity @ 25 C		38800	umhos/cm	1.0				0.2	10	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: WI Water Analysis

Report Date: 08/28/15
Work Order: H15080326

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **A4500-H B**						Analytical Run: PHSC_101-H_150819A				
Lab ID: **pH 7**		Initial Calibration Verification Standard								08/19/15 08:21
pH		7.0	s.u.	0.1	100	98	102			
Lab ID: **CCV - pH 7**		Continuing Calibration Verification Standard								08/19/15 10:32
pH		7.0	s.u.	0.1	100	98	102			
Lab ID: **CCV - pH 7**		Continuing Calibration Verification Standard								08/19/15 13:30
pH		7.0	s.u.	0.1	100	98	102			
Method: **A4500-H B**										Batch: R108634
Lab ID: **H15080331-001ADUP**		Sample Duplicate				Run: PHSC_101-H_150819A				08/19/15 13:22
pH		7.7	s.u.	0.1				0.0	3	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: WI Water Analysis

Report Date: 08/28/15
Work Order: H15080326

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E200.8									Analytical Run: ICPMS204-B_150826B	
Lab ID: ICV STD	7	Initial Calibration Verification Standard							08/26/15 14:10	
Cadmium		0.0313	mg/L	0.0010	104	90	110			
Calcium		3.08	mg/L	0.50	103	90	110			
Copper		0.0626	mg/L	0.010	104	90	110			
Lead		0.0594	mg/L	0.010	99	90	110			
Magnesium		3.11	mg/L	0.50	104	90	110			
Nickel		0.0613	mg/L	0.010	102	90	110			
Zinc		0.0626	mg/L	0.010	104	90	110			
Lab ID: ICSA	7	Interference Check Sample A							08/26/15 14:13	
Cadmium		0.000341	mg/L	0.0010						
Calcium		119	mg/L	0.50	99	70	130			
Copper		0.000777	mg/L	0.010						
Lead		0.000254	mg/L	0.010						
Magnesium		40.6	mg/L	0.50	102	70	130			
Nickel		0.000646	mg/L	0.010						
Zinc		0.00102	mg/L	0.010						
Lab ID: ICSAB	7	Interference Check Sample AB							08/26/15 14:16	
Cadmium		0.0102	mg/L	0.0010	102	70	130			
Calcium		120	mg/L	0.50	100	70	130			
Copper		0.0215	mg/L	0.010	107	70	130			
Lead		0.000259	mg/L	0.010		0	0			
Magnesium		40.0	mg/L	0.50	100	70	130			
Nickel		0.0211	mg/L	0.010	106	70	130			
Zinc		0.0110	mg/L	0.010	110	70	130			
Method: E200.8									Batch: R108876	
Lab ID: ICB	7	Method Blank				Run: ICPMS204-B_150826B			08/26/15 14:43	
Cadmium		ND	mg/L	2E-05						
Calcium		ND	mg/L	0.010						
Copper		ND	mg/L	6E-05						
Lead		ND	mg/L	3E-05						
Magnesium		ND	mg/L	0.0003						
Nickel		0.0001	mg/L	3E-05						
Zinc		0.0008	mg/L	0.0001						
Lab ID: LFB	7	Laboratory Fortified Blank				Run: ICPMS204-B_150826B			08/26/15 14:46	
Cadmium		0.0519	mg/L	0.0010	104	85	115			
Calcium		1.07	mg/L	0.50	107	85	115			
Copper		0.0529	mg/L	0.010	106	85	115			
Lead		0.0508	mg/L	0.010	102	85	115			
Magnesium		1.04	mg/L	0.50	104	85	115			
Nickel		0.0528	mg/L	0.010	105	85	115			
Zinc		0.0534	mg/L	0.010	105	85	115			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 08/28/15

Project: WI Water Analysis **Work Order:** H15080326

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E200.8										Batch: R108876
Lab ID: H15080261-031FMS	7	Sample Matrix Spike				Run: ICPMS204-B_150826B				08/26/15 19:45
Cadmium		0.0479	mg/L	0.0010	96	70	130			
Calcium		135	mg/L	1.0		70	130			A
Copper		0.0495	mg/L	0.0050	98	70	130			
Lead		0.0491	mg/L	0.0010	98	70	130			
Magnesium		78.4	mg/L	1.0		70	130			A
Nickel		0.0503	mg/L	0.0050	98	70	130			
Zinc		0.0486	mg/L	0.010	94	70	130			
Lab ID: H15080261-031FMSD	7	Sample Matrix Spike Duplicate				Run: ICPMS204-B_150826B				08/26/15 19:48
Cadmium		0.0488	mg/L	0.0010	98	70	130	2.0	20	
Calcium		137	mg/L	1.0		70	130	1.6	20	A
Copper		0.0506	mg/L	0.0050	100	70	130	2.0	20	
Lead		0.0505	mg/L	0.0010	101	70	130	2.9	20	
Magnesium		79.5	mg/L	1.0		70	130	1.5	20	A
Nickel		0.0514	mg/L	0.0050	100	70	130	2.1	20	
Zinc		0.0506	mg/L	0.010	98	70	130	4.0	20	

Qualifiers:

RL - Analyte reporting limit.

A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.

ND - Not detected at the reporting limit.

Work Order Receipt Checklist

Chino Mine Company

H15080326

Login completed by: Skyler T. Pester

Reviewed by: BL2000\sdull

Reviewed Date: 8/27/2015

Date Received: 8/18/2015

Received by: stp

Carrier name: FedEx Express

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on all shipping container(s)/cooler(s)?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on all sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☐	No ☑	
Chain of custody signed when relinquished and received?	Yes ☐	No ☑	
Chain of custody agrees with sample labels?	Yes ☐	No ☑	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☐	No ☑	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☑	No ☐	
Temp Blank received in all shipping container(s)/cooler(s)?	Yes ☐	No ☑	Not Applicable ☐
Container/Temp Blank temperature:	10.5°C No Ice		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☑	Not Applicable ☐

Standard Reporting Procedures:

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Contact and Corrective Action Comments:

Client sample container leaked into ziplock bag during shipping, transfered to proper sealed containers upon arrival. Very low sample volume, prioritize metals, and ph/ec. then ALK, hardness, and DOC. Insufficient sample to analyze DOC. Analysis taken from emails from J. Meyer and M. Barkley. No collection times listed on sample containers - collection times estimated in laboratory.
Samples for Dissolved Metals/Hardness were subsampled, filtered, and preserved to pH <2 with 2 mL of Nitric acid per 250 mL in the laboratory. According to 40CFR136, samples for Dissolved Metals should be filtered and preserved within 15 minutes of collection. 8/19/2015 STP.

Energy Laboratories Inc
3161 East Lyndale Avenue
Helena, MT 59601
(406) 442-0711

CHAIN-OF-CUSTODY RECORD

WorkOrder: H15080326

Client:
Chino Mine Company
PO Box 10
Bayard, NM 88023

TEL:
FAX:
ProjectNo: WI Water Analys
PO:

19-Aug-15

					Requested Tests					
Sample ID	**ClientSampID**	**Matrix**	**Collection Date**	**Bottle**	**200_7_8-W-D**	**ALK-W**	**OND-PROBE-**	**DNESS-CALC**	**PH-W**	**WC REVIEW**
H15080326-001	1st Flush	Aqueous	8/17/2015 8:00:00 AM		A	B	B	A	B	A
H15080326-002	Cleared Lines	Aqueous	8/17/2015 8:00:00 AM		A	B	B	A	B	

Fedex express overnight
10.5°C
No Ice

Comments: Samples Submitted from WI, under directive of Matthew B. to be analyzed for suspected contamination. See Email in place of COC. 8/19/2015 STP. Very low sample volume, prioritize metals, and ph/ec. then ALK, hardness, and DOC.

	Date/Time		Date/Time
Relinquished by:		**Received by:**	
Relinquished by:		**Received by:**	
Relinquished by:		**Received by:**	8-18-15 9:36 AM

NOTE: Samples are discarded 60 days after results are reported unless other arrangements are made. Hazardous samples will be returned to client or disposed of at client expense.

Bottle Type: L-Liter V-Voa S-Soil Jar O-Orbo T-Tedlar B-Brass P-Plastic OT-Other

H15080326

Skyler T Pester
Soil Dept. Supervisor
Analytical Chemist
Toll free: 877.472.0711
Office: 406.442.0711
Fax: 406.442.0712
spester@energylab.com

From: Barkley, Matthew [mailto:Matthew.Barkley@arcadis.com]
Sent: Tuesday, August 18, 2015 4:43 PM
To: 'spester@energylab.com'
Cc: Meyer, Joseph (Lakewood, CO)
Subject: Dissolved Copper

Skyler-
Please run the Wildlife water for dissolved copper and pH.

Joe – anything else you would like analyzed?

Thanks

Matthew Barkley | Senior Economist - Project Manager | matthew.barkley@arcadis-us.com

ARCADIS U.S., Inc. | 1687 Cole Blvd, 2nd Floor | Lakewood, CO 80401
T. 303-231-9115 ext 157 | M. 805-450-4435 | F. 303-231-9571
www.arcadis-us.com

H15080326

Skyler Pester

From: Barkley, Matthew <Matthew.Barkley@arcadis.com>
Sent: Tuesday, August 18, 2015 4:43 PM
To: 'spester@energylab.com'
Cc: Meyer, Joseph (Lakewood, CO)
Subject: Dissolved Copper

Skyler-
Please run the Wildlife water for dissolved copper and pH.

Joe – anything else you would like analyzed?

Thanks

Matthew Barkley | Senior Economist - Project Manager | matthew.barkley@arcadis-us.com

ARCADIS U.S., Inc. | 1687 Cole Blvd, 2nd Floor | Lakewood, CO 80401
T. 303-231-9115 ext 157 | M. 805-450-4435 | F. 303-231-9571
www.arcadis-us.com

ARCADIS, Imagine the result

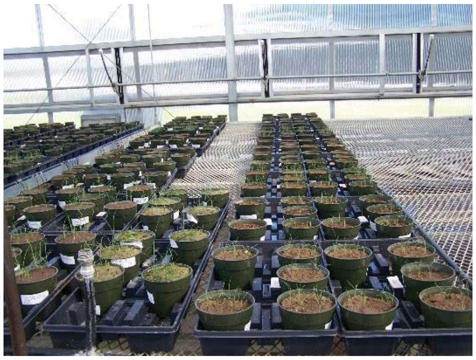
Communication with Arcadis from Wildlife International, clarifying greenhouse experiment methodology.

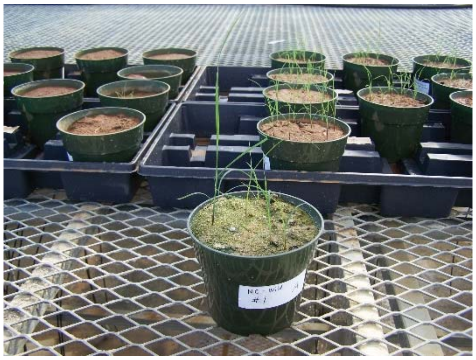
Photoperiod: Photoperiod throughout the study was maintained at least 16 hours. The lights were controlled by a combination of a timer and light meter. Each day, the lights came on at 5 AM and remained on until the ambient light level outdoors reached a setpoint and then turned off. During the day, when the sunlight fell below the setpoint the lights came on to supplement natural light. Each evening, as the light fell below the setpoint, the lights came on again and remained on until 9:00 PM.

Scarlet globemallow: The report provides germination rates for the first 21 days but the test was run for 35 days and only 2 seeds germinated in the negative control pots of 120 field-collected seeds by day 35; none germinated in the nursery seed experiment.

Photographs: Photographic documentation was requested in the Reporting section of the protocol of Attachment C of the Work Plan. However, the Test Procedure, which is typically the portion of the study protocols that specifies what tasks are to be completed, did not include specific instruction to take photographs and laboratory technicians were not instructed to take photographs. As a result, photographic documentation of the greenhouse portion of the phytotoxicity study is limited and only available for sideoats grama.

Photographs of sideoats grama experiment provided by Wildlife International are shown below.





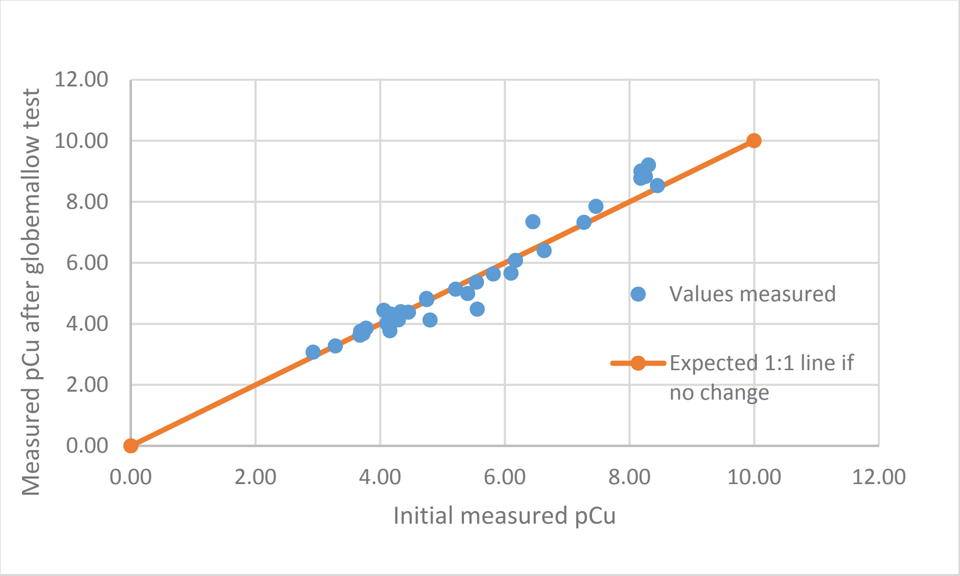
The laboratory also stated the following in their report:

Integrity of the Data

The data and observations that were made are accurately reported. However, the following circumstances may have affected the quality of the data:

> (1) The probes used to measure soil pH in test pots were not validated. However, they were used according to directions.
> (2) It is not known whether the use of reclaimed soils for tansyaster affected results.
> (3) It is not known whether copper in the irrigation lines had an adverse effect on the test.
> (4) It is not known if the species that were used in the test (with the exception of alfalfa) are suitable to be raised in a greenhouse under the conditions of the study.

1. With regard to number 1, the Kelway probe placed in the soil was found to be highly variable when compared to Ross probe paste pH results on the same soil and is not reliable (evaluated by Energy Laboratories for Chino).
2. With regard to number 2, re-using soils did not change the pCu or pH substantially as shown by the graphs below (Figure C-1) showing pCu before the soil was used for the globemallow test and just before the same soil was used for the tansyaster test were similar.



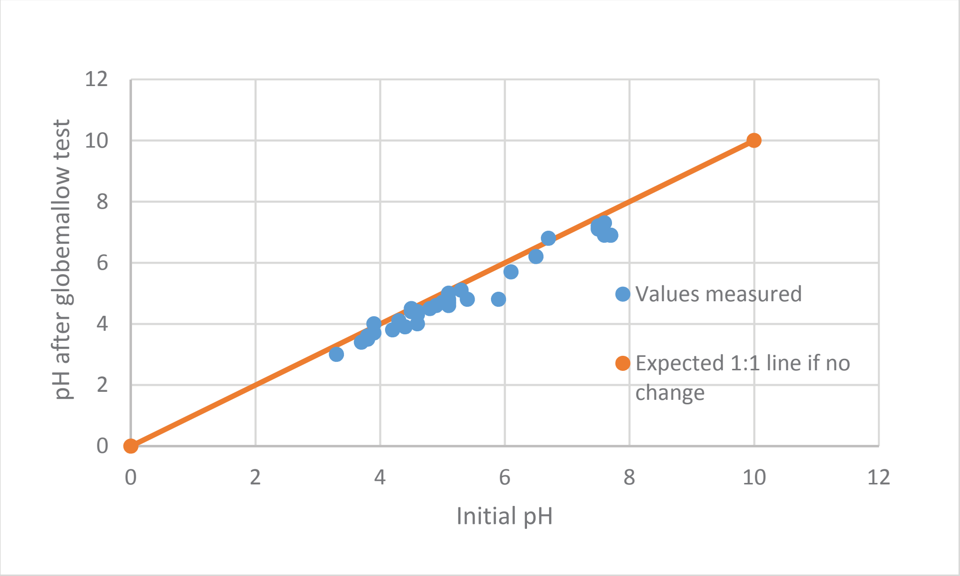


Figure C-1. Measured pCu before any experiments were conducted on the soil in 2013 compared to measured pCu after globemallow test completed on the same soils.

3. With regard to number 3, copper concentration in the Wildlife International water after first flush (tested at Energy laboratories) was low (0.001 mg/L) in the 55-gallon barrel filled with water from their faucet (well water then adjusted to pH of 6), and not of concern (see attached well water chemistry).
4. With regard to number 4, the tansyaster results often had wide confidence intervals around effect levels, much higher than for alfalfa and sideoats grama. Alfalfa had the most precise results, followed by sideoats grama. The tansyaster results are not very reliable.

APPENDIX D

Greenhouse Plant Endpoint Data

Table D-1. Summary of Alfalfa Greenhouse Results

Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Soil	Average Emergence (%)	Average Survival (%)	Average Root Length (cm)	Average Shoot Weight (g dw)	Average Shoot Height (cm)	Initial pH[a] (s.u.)	Average Final pH[a] (s.u.)
Negative Control	80	96.5	23.1	0.0509	8.71	5.9	5.4
Soil 1[b]	52.5	87.1	1.3	0.00329	0.587	4.5	5
Soil 2	68.3	100	6.5	0.0135	4.19	5.8	5.37
Soil 3	25	88.8	2.03	0.00707	2.1	5.2	4.29
Soil 4	40	95.7	5.7	0.0111	3.58	4.5	3.72
Soil 5	76.7	97	10.7	0.0136	4.2	5.4	5.1
Soil 6	78.3	94.3	3.4	0.00582	1.72	4.8	4.26
Soil 7	45	72.1	1.13	0.00243	0.602	5	3.57
Soil 8	81.7	100	2.4	0.00822	2.1	4.6	3.75
Soil 9	5.83	0	-	-	-	5.7	5.37
Soil 10	57.5	96.1	1.5	0.00311	0.918	5.2	5.35
Soil 11	43.3	78.2	1.7	0.0062	1.01	5.6	5.77
Soil 12	62.5	98.8	16.8	0.0115	3.81	6.2	4.73
Soil 13	73.3	91.5	3.6	0.0109	2.59	5.8	5
Soil 14	30	68.5	1.1	0.00428	0.494	5	3.51
Soil 15	50.8	70.9	1.7	0.00764	1.51	5.3	4.05
Soil 16	74.2	94.7	2.3	0.00573	1.37	6.2	3.54
Soil 17	82.5	96.4	10	0.0137	4.14	5.8	5.88
Soil 19	18.3	47.4	0.375	0.00406	0.625	4.1	6.21
Soil 20	67.5	98.8	7.7	0.01	3.38	6.5	5.92
Soil 21	37.5	75.5	0.861	0.00529	1.03	5.5	5.31
Soil 22	64.2	93.7	0.925	0.00529	1.13	6.3	5.17
Soil 23	61.7	83.2	1.63	0.00443	0.968	6.2	6.43
Soil 24	61.7	100	18.7	0.0243	5.83	4.8	3.91
Soil 25	83.3	100	15.4	0.0153	4.32	6	6.01
Soil 26	83.3	100	18.6	0.014	4	6.3	5.66
Soil 27	80	95	2.1	0.00663	1.58	6	4.91
Soil 28	58.3	97.7	21.9	0.016	4.58	7	6.03
Soil 29	57.5	93.7	2.1	0.00533	0.7	5	5.72
Soil 30	20	81.1	1.78	0.00636	0.828	4.6	4.36
Soil 31	73.3	95	4.2	0.0138	4.52	6.4	4.26
Soil 32	62.5	78.2	1.45	0.00642	0.623	6	5.66
Soil 35	5	0	-	-	-	4.8	4.61
Soil 36	7.5	40	0.75	0.00567	0.25	5.5	4.17

Notes:

a. Results showed that pH tended to decrease over the course of the study using the Kelway Probe. However, tests using the ROSS Electrode showed this was simply due to measurement bias in the Kelway Probe.
b. Soil 1 is abbreviated name of soil labeled STS-PT-2013-1, and the same applies for all soils in this column where Soil X = STS-PT-2013-X.

Results averaged across 10 replicates.

Table D-2. Summary of Field Sideoats Grama Greenhouse Results

Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Soil	Average Emergence (%)	Average Survival (%)	Average Root Length (cm)	Average Shoot Weight (g dw)	Average Shoot Height (cm)	Initial pH[a] (s.u.)	Average Final pH[a] (s.u.)
Negative Control	64.2	81.8	18.4	0.00864	8.46	5.9	5.44
Soil 1	0	-	-	-	-	6	4.31
Soil 2	85.8	99.2	11.8	0.00287	4.28	6.2	4.37
Soil 3	27.5	80.6	10.3	0.0028	4.16	5.6	3.65
Soil 4	48.3	86.3	14.3	0.00377	5.39	5.2	3.84
Soil 5	45.8	94.1	9.6	0.00256	4.43	5.8	4
Soil 6	34.2	63.3	0.969	0.000793	0.904	6.6	4.2
Soil 7	0	-	-	-	-	5.9	4.02
Soil 8	28.3	30.5	0.542	0.000442	1.17	6	3.29
Soil 9	0	-	-	-	-	6.4	3.74
Soil 10	14.2	25	1	0.00138	0.75	6	3.43
Soil 11	9.17	4.76	0.25	0.0004	0.25	4.4	5.27
Soil 12	91.7	95.6	18	0.00274	4.67	5.8	4.33
Soil 13	37.5	59.2	1.67	0.00185	3.18	5.4	3.64
Soil 14	0	-	-	-	-	5.4	3.08
Soil 15	45	65.2	1.22	0.00137	1.33	5.8	3.38
Soil 16	28.3	63.5	0.75	0.000673	1	5.6	3.28
Soil 17	75.8	96.8	14.5	0.00244	4.28	5.3	3.91
Soil 19	3.33	0	-	-	-	5.6	3.97
Soil 20	80	97.8	12.2	0.00315	6.34	5.9	5.57
Soil 21	13.3	3.13	0.25	0.0012	0.25	6.1	3.71
Soil 22	12.5	20	0.25	0.00355	1.5	5.9	3.79
Soil 23	11.7	40.7	0.9	0.00089	1.4	6.4	4.91
Soil 24	52.5	91.1	16.8	0.00556	8.12	6	4.74
Soil 25	75.8	97	17.6	0.00486	7.57	5.2	5.28
Soil 26	65.8	90.9	18.5	0.00309	4.63	6	5.43
Soil 27	75	65.7	1.08	0.00211	3.01	6.2	3.9
Soil 28	73.3	98	20.3	0.00479	7.03	6.7	4.77
Soil 29	35	30.8	0.719	0.000973	1.24	5.4	4.78
Soil 30	8.33	28.6	0.25	0.0004	0.25	4	3.93
Soil 31	67.5	95.1	5	0.00422	4.53	6.4	3.54
Soil 32	30.8	43.7	0.357	0.00109	0.982	6.6	3.63
Soil 35	0	-	-	-	-	4.8	3.65
Soil 36	0	-	-	-	-	5	3.41

Notes:

a. Results showed that pH tended to decrease over the course of the study using the Kelway Probe. However, tests using the ROSS Electrode showed this was simply due to measurement bias in the Kelway Probe.

Results averaged across 10 replicates.

Table D-3. Summary of Nursery Sideoats Grama Greenhouse Results

Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Soil	Average Emergence (%)	Average Survival (%)	Average Root Length (cm)	Average Dry Weight (g)	Average Height (cm)	Initial pH[a] (s.u.)	Average Final pH[a] (s.u.)
Negative Control	55	88.4	17.5	0.0138	10.1	5.9	3.59
Soil 1	11.7	25	2.5	0.0003	0.625	5.6	4.36
Soil 2	36.7	100	12.2	0.00661	6.77	6.1	4.59
Soil 3	56.7	90.8	11.5	0.00446	4.98	5.4	3.58
Soil 4	46.7	79	12.6	0.00746	6.53	4.9	3.62
Soil 5	78.3	96.9	12.3	0.00548	5.74	5.8	3.49
Soil 6	27.5	28.5	1.57	0.00109	1.66	6	5.08
Soil 7	0	-	-	-	-	5.5	4.59
Soil 8	54.2	1.43	1	0.0006	1	6.3	3.34
Soil 9	0	-	-	-	-	6	4.62
Soil 10	20	24.1	1.6	0.00166	1.1	5.8	5.03
Soil 11	12.5	21.4	1.5	0.0009	1.5	5.7	5.47
Soil 12	84.2	95.4	21	0.00518	5.87	6	4.55
Soil 13	75.8	77.8	4.2	0.00399	3.62	5.5	3.5
Soil 14	3.33	0	-	-	-	5.4	3.08
Soil 15	45.8	12.3	0.875	0.00242	2.33	5.7	3.7
Soil 16	45	52.1	0.813	0.000824	1.08	5.8	3.2
Soil 17	77.5	100	16.2	0.0038	5.19	5.3	4.49
Soil 19	4.17	25	1	0.0005	0.25	6.3	5.09
Soil 20	84.2	92.4	14	0.00481	6.06	6.2	5.22
Soil 21	20	28.4	1.33	0.0012	1.1	6	4.77
Soil 22	11.7	14.3	0.25	0.0004	1.13	6.1	5.27
Soil 23	22.5	22.8	1.6	0.00069	0.825	6.4	6.24
Soil 24	70.8	97.9	22.9	0.0084	7.98	6	4.79
Soil 25	82.5	97.1	20.2	0.00755	15.9	5.3	5.52
Soil 26	82.5	93.2	17.7	0.00518	5.6	6	4.51
Soil 27	70	76.2	1.3	0.00193	2.63	6.2	4.81
Soil 28	81.7	99.1	21.5	0.00584	6.33	6.8	4.28
Soil 29	54.2	54.9	1.25	0.00107	1.42	5.4	5.65
Soil 30	1.67	0	-	-	-	4.2	5.99
Soil 31	59.2	85.6	8.9	0.00387	4.3	6.3	4.27
Soil 32	40	59.5	1.14	0.000754	0.931	6.6	4.02
Soil 35	0	-	-	-	-	4.9	3.88
Soil 36	0.833	0	-	-	-	5.1	5.32

Notes:

a. Results showed that pH tended to decrease over the course of the study using the Kelway Probe. However, tests using the ROSS Electrode showed this was simply due to measurement bias in the Kelway Probe.

Results averaged across 10 replicates.

Table D-4. Summary of Field Tansyaster Results

Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Soil	Average Emergence (%)	Average Survival (%)	Average Root Length (cm)	Average Dry Weight (g)	Average Height (cm)	Initial pH[a] (s.u.)	Average Final pH[a], Soil Probe (s.u.)	Average Final pH[a], Lab Meter (s.u.)
Negative Control	27.5	30	26.2	0.221	9.33	5.8	4.62	5.67
Soil 1	0	-	-	-	-	4.5	4.6	4.58
Soil 2	1.67	50	9	0.009	1	4.8	5.39	7.49
Soil 3	4.17	62.5	1	0.002	0.25	5	6.62	5.17
Soil 4	6.67	92.9	3.57	0.007	1.57	5.4	5.07	5.71
Soil 5	4.17	100	5	0.00333	1.21	5	5.01	6.15
Soil 6	0	-	-	-	-	4.1	4.69	4.2
Soil 7	0	-	-	-	-	4	3.63	3.47
Soil 8	0.833	0	-	-	-	5.4	4.32	4.82
Soil 9	0	-	-	-	-	5.5	4.23	4.32
Soil 10	0	-	-	-	-	4.5	5.16	5.31
Soil 11	0	-	-	-	-	5.2	5.36	4
Soil 12	1.67	100	3	0.003	1.5	5.2	6.14	7.02
Soil 13	2.5	100	2.33	0.003	1.33	5.4	5.39	5.58
Soil 14	0.833	0	-	-	-	5.3	5.35	3.92
Soil 15	0.833	0	-	-	-	5.6	6.22	4.73
Soil 16	1.67	0	-	-	-	4.8	5.08	4.79
Soil 17	5.83	100	3.33	0.00875	1.77	4.8	5.37	7.26
Soil 19	0	-	-	-	-	6	5.43	4.74
Soil 20	6.67	71.4	7.4	0.0038	1.45	5.2	5.23	7.46
Soil 21	0	-	-	-	-	5.6	5.52	4.39
Soil 22	0	-	-	-	-	4.8	5.07	4.63
Soil 23	0	-	-	-	-	5.8	4.54	4.47
Soil 24	9.17	73.6	5.6	0.0445	5.2	5.9	4.94	7.42
Soil 25	6.67	85.7	14.8	0.0598	4.58	5.5	5.22	7.62
Soil 26	1.67	100	1.5	0.006	1.63	5	5.34	7.69
Soil 27	1.67	0	-	-	-	5	5.29	4.98
Soil 28	3.33	100	6.5	0.0103	2.5	5.4	4.82	7.79
Soil 29	0	-	-	-	-	5.8	5.31	5.08
Soil 30	0	-	-	-	-	5.4	4.94	3.88
Soil 31	1.67	100	2	0.0015	0.25	5.3	5.14	5.48
Soil 32	0	-	-	-	-	4.5	5.23	5.16
Soil 35	0	-	-	-	-	4.9	4.05	4.72
Soil 36	0	-	-	-	-	5.2	4.64	5.76

Notes:

a. Results showed that pH tended to decrease over the course of the study using the Kelway Probe. However, tests using the ROSS Electrode showed this was simply due to measurement bias in the Kelway Probe.

Results averaged across 10 replicates.

Table D-5. Summary of Nursery Tansyaster Results

Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Soil	Average Emergence (%)	Average Survival (%)	Average Root Length (cm)	Average Dry Weight (g)	Average Height (cm)	Initial pH[a] (s.u.)	Average Final pH[a], Soil Probe (s.u.)	Average Final pH[a], Lab Meter (s.u.)
Negative Control	45	38.4	21	0.333	14.5	5.8	5.17	6.58
Soil 1	0	-	-	-	-	4.6	4.06	4.35
Soil 2	4.17	100	3.5	0.0124	3.75	4.6	6.44	7.66
Soil 3	8.33	85.7	2.33	0.00261	1	5.2	6.6	5.16
Soil 4	25	97.5	13.2	0.056	6.5	5.8	5.96	5.24
Soil 5	24.2	94.7	2.1	0.00588	2.78	5.1	5.89	6.29
Soil 6	0.833	100	2	0.003	1	4.3	6.66	3.61
Soil 7	0	-	-	-	-	4	4.73	2.97
Soil 8	15.8	91.7	0.8	0.00175	0.413	5.5	6.14	4.84
Soil 9	0	-	-	-	-	6	3.66	3.98
Soil 10	2.5	0	-	-	-	4.4	5.99	5.36
Soil 11	0	-	-	-	-	5.4	5.07	3.78
Soil 12	15	86.7	3.56	0.00259	1.7	4.2	6.5	6.88
Soil 13	9.17	80	10.3	0.0309	5.13	5.6	6.51	5.98
Soil 14	0	-	-	-	-	5	4.24	3.59
Soil 15	10.8	60.4	1.42	0.004	0.792	5.2	7.01	4.45
Soil 16	0	-	-	-	-	4.4	4.99	4.8
Soil 17	25	97.5	3	0.00543	2.01	4.6	6.66	7.23
Soil 19	0	-	-	-	-	5.8	5.84	4.68
Soil 20	22.5	100	4.67	0.00851	2.76	5.4	6.14	7.36
Soil 21	5	0	-	-	-	5.1	5.39	3.87
Soil 22	0	-	-	-	-	5	6.44	4.38
Soil 23	0	-	-	-	-	5.4	5.71	4.3
Soil 24	18.3	100	6.1	0.0417	5.69	5.7	6.3	7.31
Soil 25	9.17	100	5.56	0.0368	4.94	5.2	6.44	7.42
Soil 26	16.7	88.9	4.25	0.00656	1.71	5	6.65	7.68
Soil 27	11.7	37.5	1.33	0.00356	0.542	5	6.09	4.37
Soil 28	10	100	2.44	0.00954	2.44	5.3	6.21	7.41
Soil 29	0	-	-	-	-	5.8	6.2	5.06
Soil 30	0	-	-	-	-	5.4	6.17	3.88
Soil 31	11.7	96.4	1.57	0.00255	0.643	5.2	6.37	5.63
Soil 32	0	-	-	-	-	4.2	6	5.03
Soil 35	0	-	-	-	-	4.7	5.73	4.62
Soil 36	0	-	-	-	-	5.2	6.26	5.6

Notes:

a. Results showed that pH tended to decrease over the course of the study using the Kelway Probe. However, tests using the ROSS Electrode of soils by Energy laboratories after the greenhouse experiments showed this was simply due to measurement bias in the Kelway Probe.

Results averaged across 10 replicates.

APPENDIX E

Cupric Ion Activity Methods

Appendix E: Method Used to Measure pCu in STSIU Soils

1 INTRODUCTION

The objective of the pCu analyses was to measure the chemical activity of the cupric ion (Cu^{2+}) in soils collected from the Chino Mines Smelter Tailings and Soils Investigation Unit (STSIU) and from reference sites in July 2013 as part of a vegetation-community study and in October 2013 as part of a greenhouse phytotoxicity study. The measured Cu^{2+} activities in the soils were converted to pCu values (an index of the Cu^{2+} activity, as explained below) and subsequently used in analyses of concentration-response relationships between vegetation-community endpoints (e.g., richness, cover) and pCu (vegetation-community study in the main text of this report) and between phytotoxicity endpoints (e.g., germination of seeds, and survival and growth of seedlings) and pCu (phytotoxicity study in the main text of this report).

2 METHODS

2.1 Measurement of Cu^{2+} Activity and Conversion to pCu

Details of the method used to measure Cu^{2+} activity with a cupric-ion selective electrode (Cu-ISE) are presented in the Arcadis *Standard Operating Procedures for Measurement of Cu^{2+} Activity in Soil by Ion-Selective Electrode* (Attachment A of STSIU Phytotoxicity and Vegetation Community Work Plan [Work Plan], Arcadis 2014) and are summarized below. The only deviations from that standard operating procedure were (1) to improve stability of the electrode output, all Cu-ISE analyses were performed under reduced-light conditions instead of ambient lighting, and (2) 8 (instead of 5) Cu^{2+}-activity standards were used to develop calibration curves for the Cu-ISE.

For each soil sample collected at STSIU and reference sites in July 2013 for the vegetation-community study, a 1-quart sample was shipped in a plastic bag to ACZ Laboratories, Inc. in Steamboat Springs, Colorado, where subsamples were removed for standard soil-chemistry analyses. Then the remaining soil in each bag was shipped to Energy Laboratories, Inc. in Helena, Montana. For each soil sample collected at STSIU and reference sites in October 2013 for the phytotoxicity study, a 1-gallon subsample was shipped in a plastic bag to Energy Laboratories, Inc. in Helena, Montana. Some of the soils that were used in the phytotoxicity study were collected from vegetation-community-study sites. Those soils were analyzed with the other phytotoxicity-study soils and were not separately analyzed in the batch of vegetation-community-study soils.

In the laboratory, an extract of each soil was prepared by adding 0.01 M $CaCl_2$ to the soil (15 g soil:30 ml $CaCl_2$ solution), shaking the mixture for 20 minutes, centrifuging it for 10 minutes, and filtering the supernatant through a 0.22-µm cellulose-acetate membrane filter (Whatman OE66, GE Life Sciences #10404112). That filtered soil extract was analyzed for pH, Cu^{2+} activity (expressed as pCu units), and dissolved copper concentration. The pH was analyzed by ion-selective electrode (Fisher Scientific™ Accumet™ Liquid-Filled Mercury-Free pH/ATC Epoxy Body Combination Electrode, Model 13-620-631 connected to a Fisher Scientific™ Accumet™ AR25 Dual Channel pH/Ion Meter). The Cu^{2+} activity was analyzed by ion-selective electrode (Orion Products [Thermo Scientific] Combination Cupric Ion Selective Sure-Flow® Electrode, Model 9629BNWP connected to a Fisher Scientific™ Accumet™ AR25 Dual Channel pH/Ion Meter). The dissolved copper concentration was analyzed by inductively coupled plasma emission-mass spectrometry (ICP-MS) (Agilent 7500CE ICP-MS, Model G3272A; using EPA Method 6020, ICP-MS, SW-846, Revision 0, September 1994).

The Cu-ISE does not directly output Cu^{2+} activity; instead, it outputs an electrical potential in units of mV (read on the pH meter) that must be converted to Cu^{2+} activity (or pCu in this case) via a calibration curve. A pCu value is the negative base-10 logarithm of the Cu^{2+} activity [i.e., $pCu = -\log_{10}(Cu^{2+}\ activity)$].

For these Cu^{2+} (and thus pCu) measurements, the calibration procedure developed by Sauvé et al. (1995) was used to convert electrical output of the Cu-ISE into pCu values. On the days on which soil extracts were analyzed for Cu^{2+} activity (phytotoxicity-study soils analyzed on December 11, 2013 [analyzed in two batches on that day], vegetation-community-study soils analyzed on December 16, 2013 [analyzed in one batch on that day] and phytotoxicity-study soils re-analyzed on February 5, 2015 [analyzed in one batch on that day]), eight calibration standards were prepared by adjusting the pH of separate 100-ml volumes of the Sauvé et al. (1995) iminodiacetic acid-based stock calibration solution to approximately pH 2, 3, 4, 5, 6, 8, 9, and 10 using trace-metal-grade nitric acid (HNO_3). The pH of each calibration standard was measured, and the corresponding pCu of that standard was read (or interpolated) from the list of paired pH and pCu values in Table 1 in Attachment A of the Work Plan (which is taken from Sauvé 1999).

A separate pCu calibration curve was generated for each of the two batches of soil extracts that were analyzed on December 11, 2013, for the batch of soil extracts that were analyzed on December 16, 2013, and for the batch of soil extracts that were analyzed on February 5, 2015. Least-squares regressions of pCu vs. mV were generated in Microsoft Excel for converting measured electrical potentials in the STSIU and reference-soil extracts (i.e., mV output from the Cu-ISE, as read on the pH meter) into pCu values. Three sets of regression equations were developed for each calibration data set: (1) a linear-regression fit to all 8 calibration data points, (2) a linear-regression fit to the 5 calibration data points between pCu 4 and 9, and (3) a quadratic-regression fit to all 8 calibration data points. The latter two regressions were developed because of noticeable nonlinear deviations of the calibration data at pCu values greater than 9, especially in the calibration curves developed on December 11 and 16, 2013.

2.2 pCu Calibration Curves

The pCu calibration curves generated for the STSIU and reference soils analyzed in December 2013 and February 2015 are shown in Figures E-1 to E-4; the calibration data from which those curves were generated are listed in Table E-1. The linear- and quadratic-regression equations for those calibration curves are shown in the figures.

2.3 pCu in STSIU and Reference Soils

The pCu values measured in the $CaCl_2$ extracts of the STSIU and reference soils in December 2013 and February 2015 are presented in Tables E-2 and E-3, along with the corresponding measured mV outputs from the Cu-ISE and the pH values and dissolved Cu concentrations measured in the $CaCl_2$ extracts of the soils. In Tables E-2 and E-3, pCu values are listed for each of the three candidate calibration curves that were developed for each batch of soils analyzed in December 2013 and February 2015.

2.4 Selection of Best pCu Calibration Curves

The three types of pCu vs. mV regressions used in this analysis differed in how they fit the calibration data. The first regression (panel a in Figures E-1 to E-4) was a linear fit to all 8 calibration data points; the second regression (panel b in Figures E-1 to E-4) was a linear fit to only the 5 calibration data points between pCu 4 and 9 (i.e., only 5 data points); and the third regression (panel c in Figures E-1 to E-4) was a quadratic (i.e., nonlinear) fit to all 8 calibration data points. Each type of regression provided a strong fit to the calibration data, based on the percentage of variance in pCu of the calibration standards that was accounted for (R^2 greater than 0.98 in all the regressions in 2013 and 2015; Figures E-1 to E-4). However, for the following reasons, the linear fit to only the 5 calibration data points between pCu 4 and 9 was selected as the best pCu calibration curve.

In theory, an ion-selective electrode such as a pH or a Cu-ISE electrode should have a linear relationship between mV output from the electrode and known pH or pCu values (page 14 in Thermo Fisher 2008). For a monovalent ion like H^+ that is detected by a pH electrode, the theoretical Nernstian slope at 25 °C is -59.2 mV per decade of H^+ activity (i.e., -59.2 mV/pH unit; see for example, page 773 in Brown et al. 2000). For a divalent ion like Cu^{2+} that is detected by a Cu-ISE electrode, the theoretical Nernstian slope at 25 °C is -29.6 mV per decade of Cu^{2+} activity (i.e., -29.6 mV/pCu unit; ½ the theoretical slope for monovalent ions). Demonstrating that this theoretical relationship can be manifested in practice, Sauvé et al. (1995) reported a linear relationship between Cu-ISE potential (as mV) vs. pCu for pCu values ranging from approximately 3 to 13, for which the slope was -33.4 mV/pCu unit, which is close to the theoretical value of -29.6 mv/pCu unit (i.e., -33.4 mV/pCu is the inverse of the slope of -0.02997 pCu units/mV shown in the regression equation in their Figure 1; see Figure E-5 below).

In contrast, the Cu-ISE calibration data that Energy Laboratories generated were nonlinear, especially in the three calibrations on December 11 and 16, 2013 (Figures E-1 to E-3) but also detectable in the calibration on February 5, 2015 (Figure E-4). Although Energy Laboratories used the same recipe for their Cu^{2+} calibration solution as Sauvé et al. (1995) used [i.e., containing $Cu(NO_3)_2$, iminodiacetic acid, $KHC_8H_4O_4$, $CaCl_2$, and NaOH, with pH adjusted using HNO_3; see Electrode Calibration section on page 374 in Sauvé et al. 1995], the calibration data generated by Energy Laboratories were only linear with approximately the theoretical Nernstian slope of -29.6 mV/pCu unit between pCu values of approximately 4 (the lowest pCu used for the calibrations) and 9. At pCu values greater than 9, the plots of pCu vs. electrode potential (as mV) curved upward from a straight line (i.e., the instantaneous slopes became less negative than the theoretical -29.6 mV/pCu unit as pCu increased above 9). The cause of those nonlinear deviations from theoretical and from the experimental results in Sauvé et al. (1995) is not known but might have been related to (1) inherent nonlinear electrode behavior at high pCu values (i.e., at low Cu^{2+} activities), (2) variable background electromagnetic noise, (3) contaminants in the chemicals, the Cu-ISE, or the glassware used for the pCu analyses, or (4) unidentified differences between the pCu calibration standard used by Energy Laboratories and the pCu calibration standard used by Sauvé et al. (1995) that might be important at high pCu values (i.e., at very low Cu^{2+} activities).

The nonlinearity of the pCu calibration curves at high pCu is consistent with a nonlinear calibration curve obtained by Fitch et al. (1986) (Figure E-6), which those authors attributed to possible impurities in the chemicals, glassware, or Cu-ISE. Additionally, Cu-ISE operations manuals mention a nonlinear region of the pCu calibration curve at high pCu (i.e., at low Cu^{2+} concentrations) in which low-level procedures and extra calibration points are required (page 9 in Eutech Instruments, undated; page 12 and Figure 2 in Thermo Fisher 2008).

Additionally, Dr. John Drexler (University of Colorado) obtained a similarly nonlinear pCu calibration curve when he analyzed soil extracts from the STSIU in 2000, as shown in Figure 2 in Tegtmeyer (2001) and Figure 2 in Appendix B in Newfields (2005) (reproduced here in Figure E-7). At pCu values greater than approximately 9.5 in his calibration data, the plot of pCu vs. electrode potential (as mV) curved upward from a straight line. Between pCu 4.5 and 9.5, the Nernstian slope was approximately -30 mV/pCu unit (i.e., only 1% greater than the theoretical Nernstian slope of -29.6 mV/pCu unit). Tegtmeyer (2001) did not explain exactly how the nonlinearity of the pCu calibration data was handled in Drexler's calculations, as indicated in the following quote from page 2 of her memorandum:

> "The electrode response, in mV, was recorded for the range of pH conditions to establish the response to cupric ion activity. Sauve (1999) computed the theoretical cupric ion activity of the buffered solution at various pH conditions (Table 6.2 of Sauve, 1999); these activity data were used in conjunction with the measured mV reading of the electrode to define the linear mV/activity relationship of the ion-selective electrode. These results are presented on Table 1 and Figures 1 to 3."

Therefore, it is unknown whether Drexler (1) used a calibration curve having an approximately theoretical Nernstian slope determined from the pCu calibration data between pCu 4.5 and 9.5 (and thus extrapolated that linear relationship to pCu greater than 9.5) or (2) fit a regression line to all the pCu calibration data (and thus had less than the theoretical Nernstian slope, with biased over-predictions of pCu in the intermediate pCu range and biased under-predictions of pCu in the low pCu range).

Despite the nonlinearity of the pCu calibration data, Energy Laboratories chose to fit a linear calibration curve through all the current study's data ranging from pCu 4 to 14. That caused the Nernstian slopes to decrease considerably to a range of -23.4 to -26.8 mV/pCu unit (i.e., 9 to 21% lower than the theoretical Nernstian slope of -29.6 mV/pCu unit) (Figures E-1a, E-2a, E-3a, and E-4a). Energy Laboratories' linear fits to the nonlinear pCu calibration data also caused predicted pCu values in the mid-range of the calibration curves (i.e., from approximately pCu 6 to 9) to be biased slightly higher than the pCu calibration values, and they caused predicted pCu values in the low range of the calibration curves (i.e., below approximately pCu 5) to be biased slightly lower than the pCu calibration values. Extrapolated to pCu values less than 4, that biased underestimation of pCu at a given electrode potential would become increasingly larger as pCu decreases (i.e., high Cu^{2+} activity would become increasingly overestimated as Cu^{2+} activity increases).

Because the reason for the nonlinear pCu calibration data generated by Energy Laboratories is unknown, Arcadis chose to fit a regression line to the calibration data that only lie between pCu 4 and 9 (thus having Nernstian responses near the theoretical slope of -29.6 mV/pCu unit). Arcadis chose to not fit a regression line to all the calibration data, in order to avoid overestimates of pCu in the mid-range of pCu values (i.e., between pCu values of approximately 4 to 9) and underestimates of pCu in the high range of pCu values (i.e., pCu greater than approximately 4). As a consequence, the Arcadis regressions do not fit the pCu calibration data from Energy Laboratories at pCu values between 11 and 14 (Figures E-1b, E-2b, E-3b, and E-4b). However, Arcadis decided that was an acceptable compromise, because pCu values greater than 9 are quite low (i.e., Cu^{2+} activities less than 10^{-9} moles/L) and not of interest in the reference soils and the elevated-Cu soils in the STSIU. The Nernstian slopes of Arcadis's three pCu calibration curves between pCu 4 and 9 range from -27.0 to -30.6 mV/pCu unit (i.e., less than or equal to 9% different than the theoretical Nernstian slope of -29.6 mV/pCu unit, and much closer to the theoretical slope than the linear calibration curves that Energy Laboratories fit to all the pCu calibration data). The greenhouse-study soils had pCu values less than 9, making the use a linear fit accurate below pCu 9 the best choice.

Quadratic (i.e., second-order polynomial) curves fit all the pCu calibration data from Energy Laboratories better than linear calibration curves (Figures E-1c, E-2c, E-3c, and E-4c). However, adoption of a curvilinear calibration curve assumes that the nonlinearity of the calibration data is not an artifact of an unknown difference(s) between the calibration standards prepared by Sauvé et al. (1995) and by Energy Laboratories. Moreover, the curvature of the quadratic curves at pCu less than 4 (especially noticeable in Figures E-1c, E-2c, and E-3c) tends to overestimate pCu values in the low pCu range (i.e. the Cu^{2+} activity will be underestimated in the high Cu^{2+} activity range), if the relationship between pCu and electrode potential actually is linear in that range (which electrochemical theory suggest it should be). The STSIU soils tested include samples with pCu less than 4 and such biases were potentially avoided by not using the quadratic calibration curve.

Therefore, Arcadis assumed theoretical Nernstian behavior throughout the range of pCu values of interest at the STSIU (i.e., pCu values less than 9) by using the linear fit between pCu of 4 and 9. Adoption of linear Cu-ISE potential vs. pCu calibration curves (Fitch et al. 1986, Sauvé et al. 1995, Sauvé 1999, Thermo Fischer 2008, Eutech Instruments undated) with limitation of the range of applicability of the calibration curves to avoid high pCu values (Pampura et al. 2006, Thermo Fischer 2008, Eutech

Instruments undated) is consistent with standard Cu-ISE practice and recommendations in the published literature. Extrapolation of the linear calibration curves to pCu values lower than 4 (i.e., to high Cu^{2+} concentrations) in the STSIU soil extracts is also consistent with the same standard Cu-ISE practice and recommendations in the published literature.

2.5 Final pCu Values in STSIU and Reference Soils

The pCu values measured in the $CaCl_2$ extracts of the STSIU and reference soils in December 2013 and February 2015 are presented in Tables E-2 and E-3, along with the corresponding measured mV outputs from the Cu-ISE and the pH values and dissolved Cu concentrations measured in the $CaCl_2$ extracts of the soils. In Tables E-2 and E-3, pCu values are listed for each of the three candidate calibration curves that were developed for each batch of soils analyzed in December 2013 and February 2015. The columns titled "Calculated pCu; linear curve, pCu 4-9 calibration data" contain the pCu values that were used in the final analyses of the vegetation-community-study and phytotoxicity-study results.

3 REFERENCES

ARCADIS. 2014. Smelter Tailings Soil Investigation Unit: Phytotoxicity and Vegetation Community Work Plan. Prepared for Freeport-McMoran. March 4, 2014.

Brown, T.L., H.E. LeMay, Jr., and B.E. Bursten. 2000. Chemistry: The Central Science. Eighth Edition. Prentice Hall, Upper Saddle River, NJ.

Eutech Instruments. Undated. Instruction Manual: Cupric (Copper) Ion Electrode. Eutech Instruments PTE Ltd. http://www.eutechinst.com/manuals/english/ion_selective_electrode/copper.pdf .

Fitch, A., F.J. Stevenson, and Y. Chen. 1986. Complexation of Cu(II) with a soil humic acid: Response characteristics of the Cu(II) ion-selective electrode and ligand concentration effects. *Organic Geochemistry* 9:109-116.

Newfields. 2005. Chino Mines Administrative Order on Consent Site-Wide Ecological Risk Assessment. Prepared for New Mexico Environment Department by Newfields, Boulder, Colorado.

Pampura, T., J.E. Groenenberg, and R.P.J.J. Rietra. 2006. Comparison of methods for copper free ion activity determination in soil solutions of contaminated and background soils. *Forest Snow and Landscape Research* 80:305-322.

Sauvé, S.F. 1999. Chemical Speciation, Solubility and Bioavailability of Lead, Copper and Cadmium in Contaminated Soils. Ph.D. Dissertation, Cornell University, Ithaca, NY.

Sauvé, S., M.B. McBride, and W.H. Hendershot. 1995. Ion-selective electrode measurements of copper(II) activity in contaminated soils. *Archives of Environmental Contamination and Toxicology* 29:373-379.

Tegtmeyer, K. 2001. Laboratory methods and results from cupric ion activity measurements. Memorandum to Mark Lewis dated January 20, 2001.

Thermo Fisher. 2008. User Guide: Cupric Ion Selective Electrode. Thermo Fisher Scientific Inc., Beverly, MA. https://www.instrumart.com/assets/ISEcupric_manual.pdf .

Table E-1. Calibration data used for pCu analyses in calcium chloride (CaCl2) extracts of soils from the Chino Mines Smelter Tailings and Soils Investigation Unit and references areas near Hurley, New Mexico. These data are plotted in Figures E-1 to E-3. The cupric-ion selective electrode was calibrated on December 11 and 16, 2013 and February 5, 2015.

Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Calibration date	Calibration number	Dissolved copper (mM)	Nominal pH (s.u.)	Measured pH (s.u.)	Calibration pCu (s.u.) [1]	Cu-ISE potential (mV)
12/11/13	1	0.1	2	2.20	4.34	83.0
12/11/13	1	0.1	3	3.10	5.43	46.5
12/11/13	1	0.1	4	3.95	6.40	19.8
12/11/13	1	0.1	5	5.00	7.47	-16.3
12/11/13	1	0.1	6	5.85	8.35	-39.2
12/11/13	1	0.1	8	7.95	11.34	-107.2
12/11/13	1	0.1	9	8.70	12.56	-122.6
12/11/13	1	0.1	10	9.70	13.44	-132.8
12/11/13	2	0.1	2	2.20	4.34	89.7
12/11/13	2	0.1	3	3.10	5.43	57.4
12/11/13	2	0.1	4	3.95	6.40	29.1
12/11/13	2	0.1	5	5.00	7.47	-1.8
12/11/13	2	0.1	6	5.85	8.35	-27.0
12/11/13	2	0.1	8	7.95	11.34	-101.1
12/11/13	2	0.1	9	8.70	12.56	-124.5
12/11/13	2	0.1	10	9.70	13.44	-137.5
12/11/13	3	0.1	2	2.15	4.29	81.6
12/11/13	3	0.1	3	3.00	5.31	55.4
12/11/13	3	0.1	4	3.95	6.40	27.9
12/11/13	3	0.1	5	5.00	7.47	-4.4
12/11/13	3	0.1	6	6.05	8.57	-33.1
12/11/13	3	0.1	8	7.90	11.26	-95.7
12/11/13	3	0.1	9	8.90	12.82	-117.5
12/11/13	3	0.1	10	9.70	13.44	-128.4
02/05/15	4	0.1	2	2.05	4.22	27.7
02/05/15	4	0.1	3	3.00	5.31	0.5
02/05/15	4	0.1	4	4.00	6.45	-31.8
02/05/15	4	0.1	5	4.85	7.32	-57.8
02/05/15	4	0.1	6	5.95	8.46	-89.4
02/05/15	4	0.1	8	7.65	10.82	-156.9
02/05/15	4	0.1	9	8.95	12.88	-205.9
02/05/15	4	0.1	10	9.70	13.44	-211.9

Cu-ISE = cupric-ion selective electrode
mM = millimoles per liter
mV = millivolts
s.u. = standard units

Notes:
1. The pCu of the standard was read (or interpolated) from the list of paired pH and pCu values in Table 1 in Attachment A (which is taken from Sauvé 1999).

Table E-2. Results of pCu analyses in calcium chloride ($CaCl2$) extracts of soils from the Chino Mines Smelter Tailings and Soils Investigation Unit and references areas near Hurley, New Mexico, that were used in the greenhouse phytotoxicity study. Analyzed on December 11, 2013 and February 5, 2015; however, only pCu was analyzed in 2015.

Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Soil	Sample ID	2013									2015						
		pH in $CaCl_2$ extract (s.u.)	Dissolved Cu in $CaCl_2$ extract (mg/L)	Cu-ISE potential (mV)	Estimate of measured pCu; linear curve, all calibration data	Eqn. [1,2]	Estimate of measured pCu; linear curve, pCu 4-9 calibration data [3]	Eqn. [1,2]	Estimate of measured pCu; quadratic curve, all calibration data	Eqn. [1,2]	Cu-ISE potential (mV)	Estimate of measured pCu; linear curve, all calibration data	Eqn. [1]	Estimate of measured pCu; linear curve, pCu 4-9 calibration data [3]	Eqn. [1]	Estimate of measured pCu; quadratic curve, all calibration data	Eqn. [1]
1	STS-PT-2013-1	4.0	14.0	100.6	3.11	1	3.73	3	4.11	5	44.5	3.56	7	3.67	8	3.78	9
2	STS-PT-2013-2	7.1	0.2	17.1	6.57	1	6.45	3	6.27	5	-57.8	7.38	7	7.34	8	7.28	9
3	STS-PT-2013-3	5.6	0.2	36.6	5.76	1	5.82	3	5.66	5	-10.0	5.60	7	5.63	8	5.60	9
4	STS-PT-2013-4	5.1	0.2	25.7	6.21	1	6.17	3	6.00	5	-22.4	6.06	7	6.07	8	6.03	9
5	STS-PT-2013-5	6.1	0.2	11.6	6.79	1	6.63	3	6.46	5	-31.4	6.40	7	6.40	8	6.35	9
6	STS-PT-2013-6	3.4	1.8	82.0	3.88	1	4.33	3	4.49	5	24.5	4.31	7	4.39	8	4.44	9
7	STS-PT-2013-7	3.2	5.5	88.9	3.59	1	4.11	3	4.34	5	35.2	3.91	7	4.01	8	4.09	9
8	STS-PT-2013-8	5.5	0.3	55.1	4.99	1	5.21	3	5.14	5	3.8	5.08	7	5.13	8	5.13	9
9	STS-PT-2013-9	4.0	57.0	125.1	2.09	1	2.93	3	3.71	5	61.4	2.93	7	3.07	8	3.24	9
10	STS-PT-2013-10	4.5	5.0	94.7	3.87	2	4.16	4	4.28	6	41.9	3.66	7	3.77	8	3.87	9
11	STS-PT-2013-11	3.7	4.2	92.5	3.95	2	4.23	4	4.35	6	29.8	4.11	7	4.20	8	4.26	9
12	STS-PT-2013-12	6.2	0.1	4.1	7.44	2	7.27	4	7.20	6	-57.2	7.36	7	7.32	8	7.26	9
13	STS-PT-2013-13	5.0	0.2	54.3	5.46	2	5.54	4	5.49	6	-2.5	5.32	7	5.36	8	5.35	9
14	STS-PT-2013-14	3.7	18.2	105.8	3.43	2	3.77	4	3.98	6	39.5	3.75	7	3.85	8	3.95	9
15	STS-PT-2013-15	5.5	0.3	58.4	5.30	2	5.40	4	5.36	6	7.8	4.93	7	4.99	8	5.00	9
16	STS-PT-2013-16	5.4	0.5	53.9	5.48	2	5.56	4	5.50	6	22.1	4.40	7	4.48	8	4.52	9
17	STS-PT-2013-17	6.8	0.2	-1.5	7.66	2	7.46	4	7.40	6	-71.8	7.91	7	7.85	8	7.79	9
18	STS-PT-2013-18	3.8	12.7	106.5	3.40	2	3.75	4	3.96	6	NA	NA		NA		NA	
19	STS-PT-2013-19	4.3	14.0	108.6	3.32	2	3.68	4	3.90	6	46.0	3.50	7	3.62	8	3.73	9
20	STS-PT-2013-20	6.5	0.8	-30.2	8.79	2	8.45	4	8.50	6	-90.8	8.62	7	8.53	8	8.49	9
21	STS-PT-2013-21	3.5	1.2	77.5	4.55	2	4.75	4	4.78	6	13.3	4.73	7	4.79	8	4.81	9
22	STS-PT-2013-22	3.6	5.4	90.7	4.03	2	4.29	4	4.40	6	31.9	4.03	7	4.13	8	4.19	9
23	STS-PT-2013-23	3.8	4.6	94.2	3.89	2	4.17	4	4.30	6	26.6	4.23	7	4.32	8	4.37	9
24	STS-PT-2013-24	6.7	<0.05	-24.6	8.57	2	8.26	4	8.28	6	-99.1	8.93	7	8.82	8	8.80	9
25	STS-PT-2013-25	6.6	0.1	-22.4	8.49	2	8.18	4	8.19	6	-97.6	8.87	7	8.77	8	8.74	9
26	STS-PT-2013-26	6.7	0.1	-26.0	8.63	2	8.31	4	8.33	6	-109.7	9.32	7	9.20	8	9.19	9
27	STS-PT-2013-27	4.9	1.2	77.6	4.54	2	4.74	4	4.78	6	12.4	4.76	7	4.83	8	4.84	9
28	STS-PT-2013-28	6.6	0.1	-22.5	8.49	2	8.18	4	8.20	6	-104.1	9.11	7	9.00	8	8.98	9
29	STS-PT-2013-29	4.1	5.6	97.5	3.76	2	4.06	4	4.21	6	23.2	4.36	7	4.44	8	4.48	9
30	STS-PT-2013-30	3.4	2.0	86.0	4.21	2	4.46	4	4.53	6	24.9	4.29	7	4.38	8	4.43	9
31	STS-PT-2013-31	5.4	0.1	38.1	6.10	2	6.10	4	6.02	6	-10.8	5.63	7	5.66	8	5.63	9
32	STS-PT-2013-32	5.4	1.2	75.9	4.61	2	4.80	4	4.83	6	32.1	4.02	7	4.12	8	4.19	9
33	STS-PT-2013-33	4.3	1,705.0	158.1	1.37	2	1.98	4	2.69	6	NA	NA		NA		NA	
34	STS-PT-2013-34	4.7	11.2	105.4	3.45	2	3.79	4	3.99	6	NA	NA		NA		NA	
35	STS-PT-2013-35	4.3	36.8	120.1	2.87	2	3.28	4	3.60	6	55.8	3.14	7	3.27	8	3.42	9
36	STS-PT-2013-36	6.1	15.4	108.3	3.33	2	3.69	4	3.91	6	42.3	3.64	7	3.75	8	3.85	9

Cu-ISE = cupric-ion selective electrode
mg/L = milligrams per liter
mV = millivolts
NA = not analyzed
s.u. = standard units
< = less than

Notes:
1. Calibration equations are:
1) $pCu = -0.041415*mV + 7.274719$
2) $pCu = -0.039445*mV + 7.602715$
3) $pCu = -0.032657*mV + 7.010638$
4) $pCu = -0.034374*mV + 7.411344$
5) $pCu = 0.000086*mV^2 - 0.035968*mV + 6.862677$
6) $pCu = 0.000046*mV^2 - 0.036711*mV + 7.347787$
7) $pCu = -0.037382*mV + 5.222452$
8) $pCu = -0.035860*mV + 5.270464$
9) $pCu = 0.000017*mV^2 - 0.033985*mV + 5.261436$
2. Two batches of soil extracts were analyzed for pCu on December 11, 2013 (soils 1-9, and soils 10-36), each with a separate calibration curve.
3. This column contains the pCu values used in the analysis of the phytotoxicity test results.

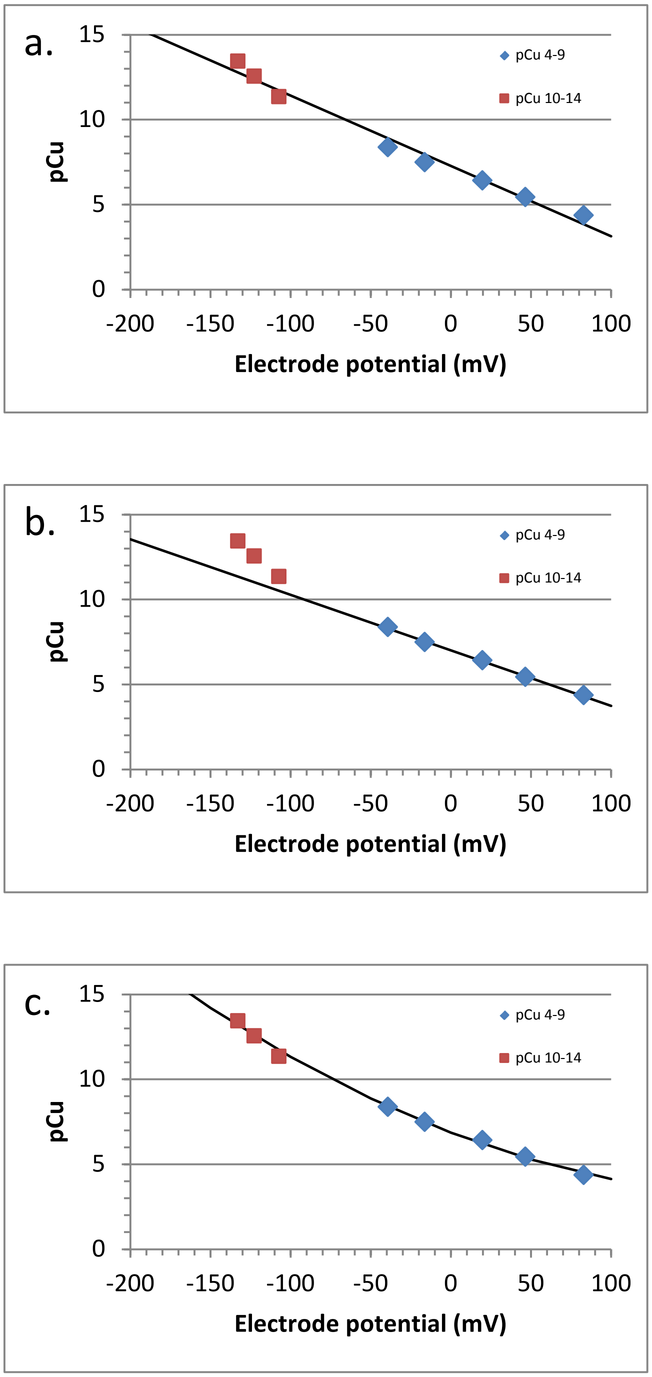
Table E-3. Results of pCu analyses in calcium chloride (CaCl2) extracts of soils from the Chino Mines Smelter Tailings and Soils Investigation Unit and references areas near Hurley, New Mexico, that were collected from the vegetation-community-study locations in 2011 and 2012 and were not also used in the greenhouse-phytotoxicity study. Analyzed on December 16, 2013.

Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Sample ID	2013						
	Cu-ISE potential (mV)	Estimate of measured pCu; linear curve, all calibration data	Eqn. [1]	Estimate of measured pCu; linear curve, pCu 4-9 calibration data [2]	Eqn. [1]	Estimate of measured pCu; quadratic curve, all calibration data	Eqn. [1]
STS-RWU-2011-4 0-6	-20.9	8.44	10	8.13	11	8.11	12
1# WEST 0-6	-13.7	8.14	10	7.86	11	7.81	12
STS-RWU-2011-15 0-6	86.6	3.84	10	4.14	11	4.28	12
STS-RWU-2011-6 0-6	17.0	6.82	10	6.72	11	6.61	12
STS-RWU-2011-1 0-6	67.3	4.67	10	4.86	11	4.87	12
STS-RWU-2011-3 0-6	85.4	3.89	10	4.19	11	4.32	12
STS-RWU-2011-14 0-6	87.3	3.81	10	4.12	11	4.26	12
STS-RWU-2011-2 0-6	100.7	3.24	10	3.62	11	3.88	12
STS-RWU-2011-8 0-6	44.3	5.65	10	5.71	11	5.63	12
STS-RWU-2011-5 0-6	104.8	3.06	10	3.47	11	3.77	12
STS-RWU-2011-16 0-6	93.6	3.54	10	3.89	11	4.08	12
STS-RWU-2011-7 0-6	112.3	2.74	10	3.19	11	3.57	12
STS-RWU-2011-9 0-6	115.0	2.63	10	3.09	11	3.50	12
STS-RWU-2011-10 0-6	69.9	4.56	10	4.76	11	4.79	12
STS-RWU-2011-11 0-6	100.3	3.25	10	3.64	11	3.89	12
STS-RWU-2011-12 0-6	93.6	3.54	10	3.9	11	4.1	12
STS-RWU-2011-13 0-6	32.7	6.15	10	6.14	11	6.03	12
STS-RWU-2011-17 0-6	89.0	3.74	10	4.06	11	4.21	12
STS-RWU-2012-B1 0-6	90.6	3.67	10	4.00	11	4.17	12
STS-RWU-2012-B2 0-6	92.0	3.61	10	3.94	11	4.13	12
STS-RWU-2012-B3 0-6	78.0	4.21	10	4.46	11	4.54	12
WILDLIFE REF NORTH 0-6	45.5	5.60	10	5.67	11	5.59	12
WILDLIFE REF SOUTH 0-6	98.7	3.32	10	3.70	11	3.94	12
DUP #1 - RWU 9	117.5	2.52	10	3.00	11	3.44	12
DUP #2 - Wildlife Ref North	50.2	5.40	10	5.49	11	5.43	12

Cu-ISE = cupric-ion selective electrode
mV = millivolts

Notes:
1. Calibration equations are:
10) pCu = -0.042810*mV + 7.548756
11) pCu = -0.037029*mV + 7.351500
12) pCu = 0.000059*mV^2 - 0.039472*mV + 7.259101
2. This column contains the pCu values used in the analysis of the phytotoxicity test results.



$pCu = -0.041415 \cdot mV + 7.274719$

$R^2 = 0.982$ (all data)

Nerstian slope = -24.1 mV/pCu unit

$pCu = -0.032657 \cdot mV + 7.010638$

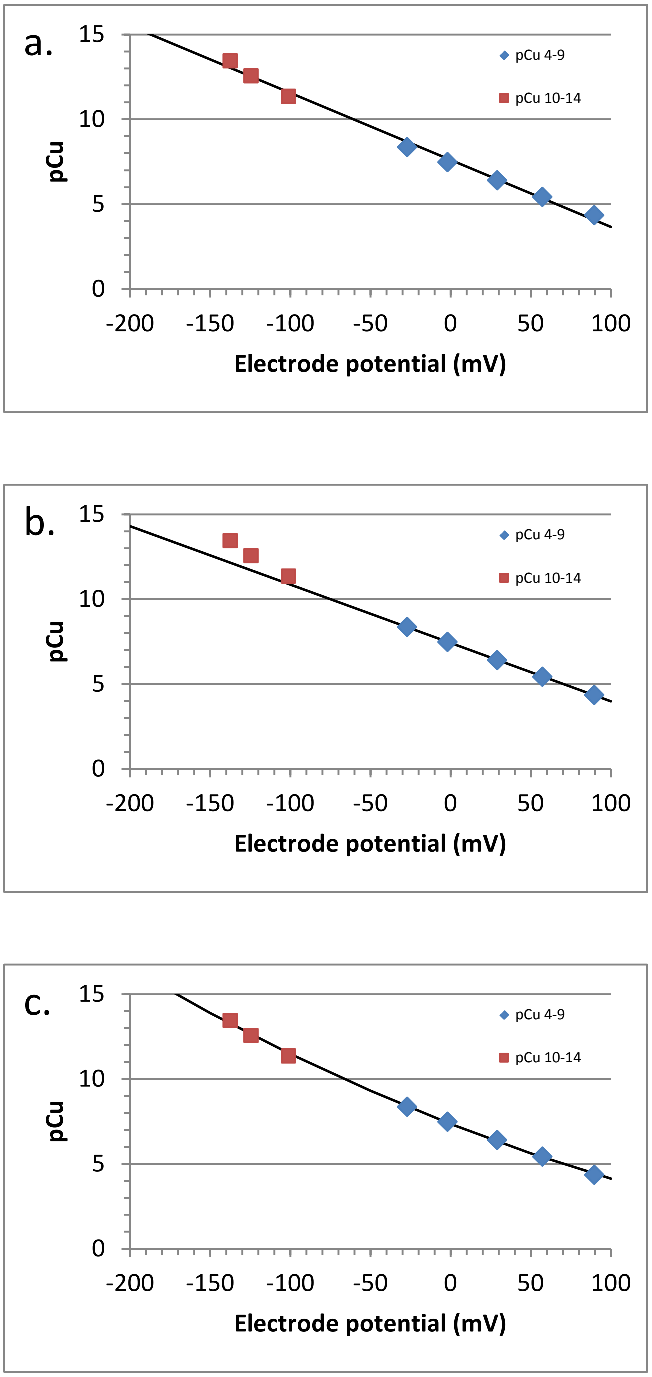
$R^2 = 0.998$ (pCu 4-9 only)

Nerstian slope = -30.6 mV/pCu unit

$pCu = 0.000086 \cdot mV^2 - 0.032657 \cdot mV + 7.010638$

$R^2 = 0.996$ (all data)

Figure E-1. Energy Laboratories' pCu calibration data on December 11, 2013 (initial calibration on that date). (a) Linear calibration curve fit to all data (pCu 4-14); (b) linear calibration curve fit to data between pCu 4 and 9; and (c) quadratic calibration curve fit to all data (pCu 4-14).



$pCu = -0.039445 \cdot mV + 7.602715$

$R^2 = 0.994$ (all data)

Nerstian slope = -25.4 mV/pCu unit

$pCu = -0.034374 \cdot mV + 7.411344$

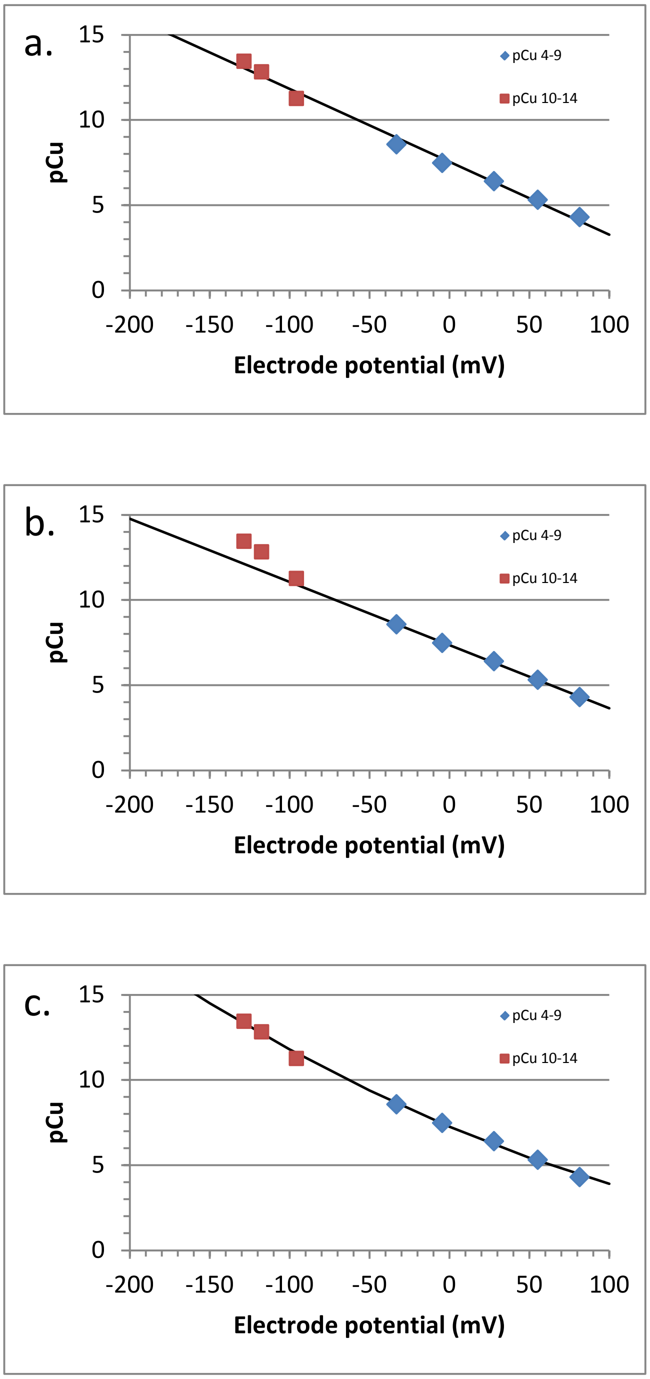
$R^2 > 0.999$ (pCu 4-9 only)

Nerstian slope = -29.1 mV/pCu unit

$pCu = 0.000046 \cdot mV^2 - 0.036711 \cdot mV + 7.347787$

$R^2 = 0.999$ (all data)

Figure E-2. Energy Laboratories' pCu calibration data on December 11, 2013 (second calibration on that date). (a) Linear calibration curve fit to all data (pCu 4-14); (b) linear calibration curve fit to data between pCu 4 and 9; and (c) quadratic calibration curve fit to all data (pCu 4-14).



pCu = -0.042810·mV + 7.548756

R^2 = 0.992 (all data)

Nerstian slope = -23.4 mV/pCu unit

pCu = -0.037029·mV + 7.351500

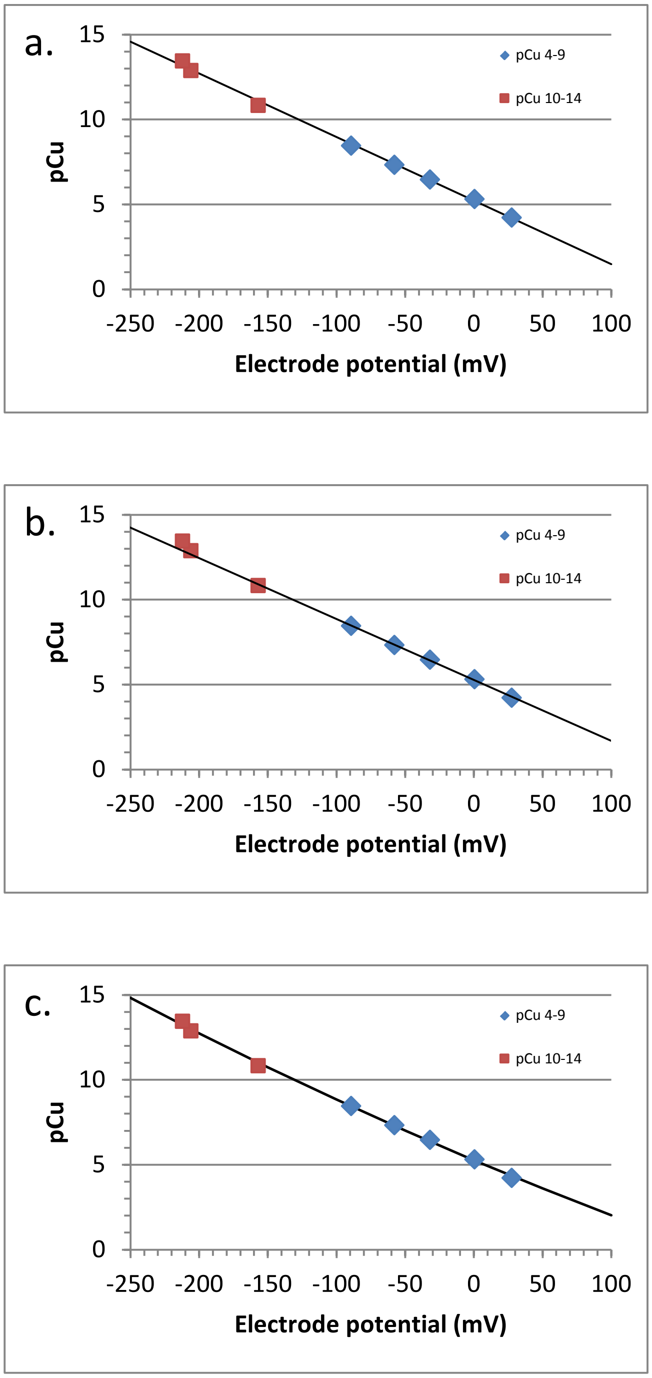
R^2 = 0.999 (pCu 4-9 only)

Nerstian slope = -27.0 mV/pCu unit

pCu = 0.000059·mV^2 - 0.039472·mV + 7.259101

R^2 = 0.998 (all data)

Figure E-3. Energy Laboratories' pCu calibration data on December 16, 2013. (a) Linear calibration curve fit to all data (pCu 4-14); (b) linear calibration curve fit to data between pCu 4 and 9; and (c) quadratic calibration curve fit to all data (pCu 4-14).



pCu = -0.037382·mV + 5.222452

R^2 = 0.998 (all data)

Nerstian slope = -26.8 mV/pCu unit

pCu = -0.035860·mV + 5.270464

R^2 = 0.999 (pCu 4-9 only)

Nerstian slope = -27.9 mV/pCu unit

pCu = 0.000017·mV^2 - 0.033985·mV + 5.261436

R^2 = 0.999 (all data)

Figure E-4. Energy Laboratories' pCu calibration data on February 5, 2015. (a) Linear calibration curve fit to all data (pCu 4-14); (b) linear calibration curve fit to data between pCu 4 and 9; and (c) quadratic calibration curve fit to all data (pCu 4-14).

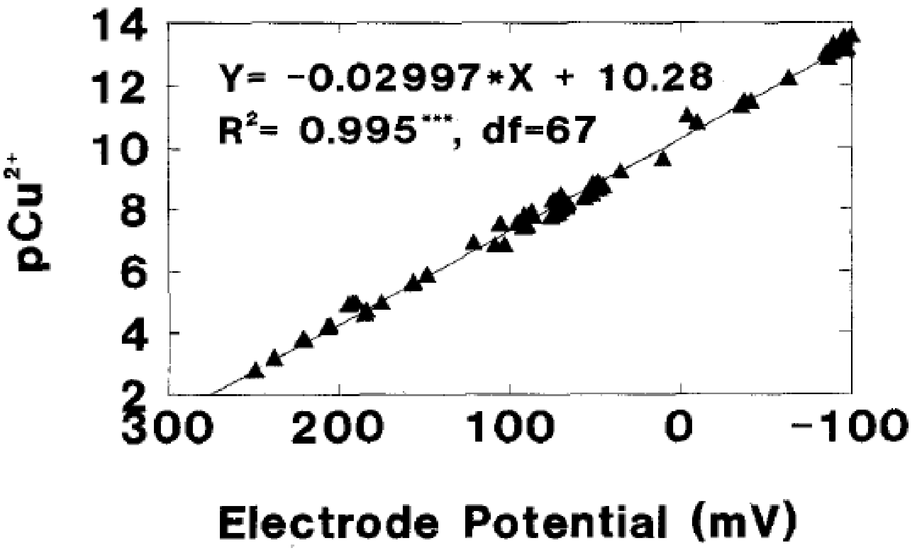


Figure E-5. Calibration curve for pCu vs. Cu-ISE electrode potential in Sauvé et al. (1995). The regression line represents the linear response of the electrode during multiple calibrations over a 6-week period.

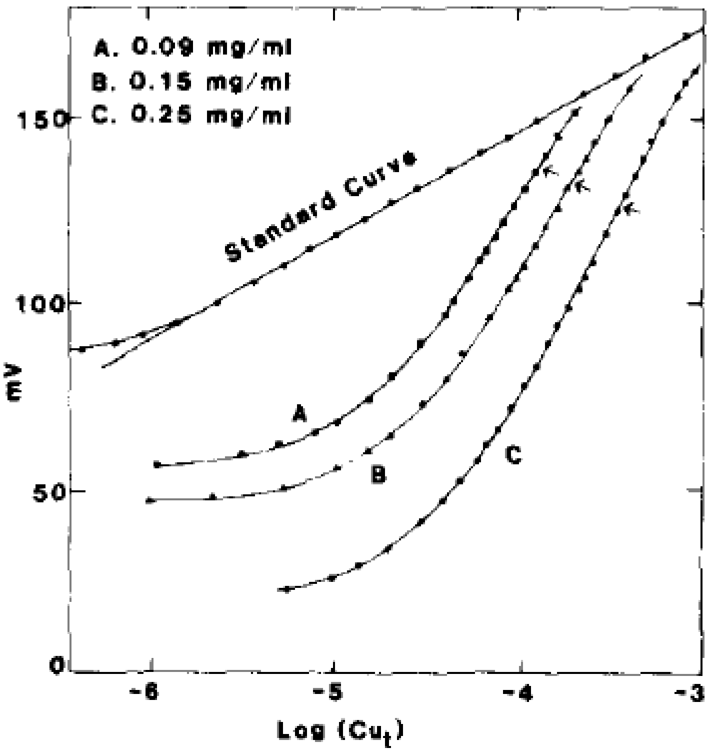


Figure E-6. Calibration curve (“Standard Curve”) and responses of a cupric-ion-selective electrode (Cu-ISE) in the presence of a humic acid at three concentrations (curves A, B, and C) (Figure 1 in Fitch et al. 1986). The standard curve and the three humic acid solutions were acidified to pH 4 for these Cu-ISE measurements, thereby converting all forms of copper to the free ion form (Cu^{2+}). Therefore, the Cu^{2+} concentration equaled the total copper concentration (indicated as Cu_t). The calibration curve labeled “Standard Curve” deviated from linearity at pCu values greater than approximately 6 (i.e., at log(Cu_t) values less than approximately -6, and thus at Cu^{2+} activities less than approximately 10^{-6} molar).

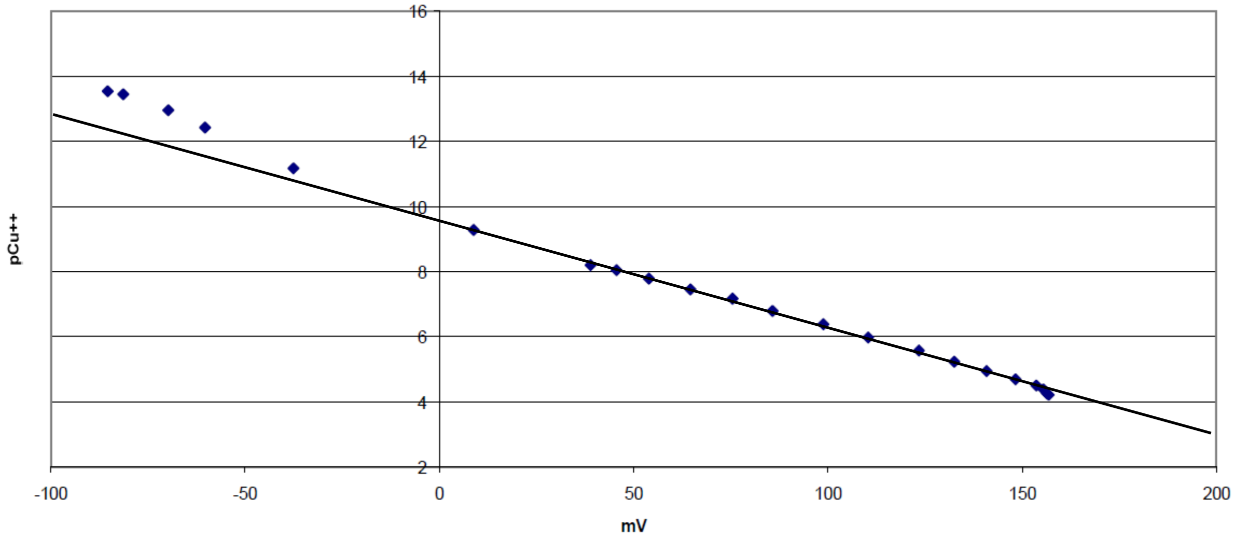


Figure E-7. The pCu calibration data used for analyses of soil extracts from the Chino Mines Smelter Tailings and Soils Investigation Unit by Dr. John Drexler (University of Colorado) in 2000 (Figure 2 in Tegtmeyer 2001, as reproduced in Appendix B in Newfields 2005). The straight line has been inserted to illustrate nonlinearity at pCu values greater than approximately 9.5. The slope of the straight line is -30 mV/pCu unit, which is close to the theoretical Nernstian slope of -29.6 mV/pCu unit.

APPENDIX F

Plant Community Methods and Results

Appendix F: Standard Operating Procedures in Field for Community Study

Years 2011, 2012, 2014

Cover and Richness

1. Proceeded to each sampling location on map (Figure 3 of main report).
2. For wildlife habitat sampling, a transect/quadrat system was used as the framework to collect percent cover and richness data. At the sampling location, a 100 foot by 100 foot plot was established and divided into twenty-five 20 foot by 20 foot blocks (Stars in Figure F-1). Random-grid coordinates were used to select five blocks to be sampled in each 100 by 100 foot area, shown on attached form. Pin flags were used to mark off the 20’ increments on each side of the 100’ plot and then to find and mark the 20’ x 20’ blocks to be sampled. Two 20-foot transects were located in each randomly selected block in a dogleg pattern. The first leg of a transect originated in the southeastern corner of each block and the direction was randomly selected. A 3.3 foot by 3.3 foot quadrat (or 1-meter square) was placed at 5 and 15 feet along each transect (Figure F-1).
3. Ocular estimates of total canopy cover (above ground) were made using percentage categories in Table F-1 below. Canopy cover estimates included the foliage and foliage interspaces of all live individual plants rooted in the quadrat. Also, canopy cover by class (shrub, grass, forb, succulent) were recorded in 2014 (not in 2011). When in the office, the class ranges were converted to their midpoints before averaging to obtain average total cover (also by life form in 2014) per block and then per plot.
4. Species richness was determined by traversing each 20 foot by 20 foot block entirely and counting all the vegetation species encountered in each block for each of the four growth forms: grass, forb, shrub, succulent. Richness was averaged across blocks for each location and by life form. Species names were listed in 2014, after keying out all species identified when counting species for richness.
5. Wildlife habitat forms with the collected information were completed for each site (see Table F-2 and its attachments with field data). Data collected for individual species in 2014 were recorded in field notebooks and summarized in Table F-3.
6. Each site was photographed (see Appendix I) with a GPS camera and the photo number recorded.

Observed Apparent Trend (OAT) Score .

7. A 200-m transect was established on the edge of the each of the above plots (corner of dogleg) and walked in the direction toward the middle of the homogeneous OAT polygon identified in the FS proposal (Appendix A) using a compass/GPS to navigate in a straight line for 200 m (656’), observing OAT variables and recording them for this transect to obtain a final score on an OAT worksheet. The team (ARCADIS, Formation, and NMED biologists) considered slope and landscape position in the rating. Information on the site’s historical/current ecological type, vegetation alliance, soil type, and expected production/condition if available, were identified before the rating to assist with the rating in the field.

Reference Locations

8. For Cover and Richness: Following steps outlined in steps 2 to 6, the team sampled reference sites for wildlife habitat on north- and south-facing slopes (specifically, Wildlife Reference Plot North and Wildlife Reference Plot South of Figure 3 of main report) in 2011 and 2014, and on STS-RWU-2012-B1,B2, and B3 in 2012. These areas were grazed to match the grazed condition

of locations on the impacted Site, but they are not expected to be impacted by copper from the smelter. Chino and the New Mexico Environment Department [NMED]) selected these reference sites in September 2011 while in the field sampling wildlife and rangeland habitat for the Feasibility Study. For the phytotoxicity and community study work plan, NMED requested the terminology of these locations be changed from reference to “de minimus” locations.

9. For Rangeland Conditions identified with OAT Score: Proceeded to “Cell Phone Hill” and “Lampbright Outcrop” (see map in Figure F-2) first to calibrate eye of team of biologists to “good” rangeland conditions for that year’s level of precipitation (performed in September 2011 and September 2014). Scoring of locations on site were relative to this calibration of “good” conditions. In 2014, the team reviewed the previous OAT score at site to re-calibrate the eye to recognizing that score as applicable to that site, even if site conditions had changed (i.e., vegetation was taller and less grazed down in 2014). Average OAT score was 39 on Cell Phone Hill in 2011 and established as the same in 2014 (average of southwest-facing slope, summit, and northeast-facing slope of cell phone hill). Lambright Outcrop OAT score was 36. OAT was also recorded on bedrock reference locations B1, B2, and B3 in 2012. An overgrazed reference was also examined for comparison before starting the site sampling.

Equipment:

Two 100’ measuring tapes

20 pin flags

1 m x 1 m PVC sampling frame (with elbows)

Water bottles and cooler with ice for drinking

Two plant field guides

1 compass

Random numbers-

1 GPS and AA batteries

1 GPS camera

Field notebook

Field forms (OAT and wildlife)

Large Map with point locations and Field IDs

Soil, OAT, and vegetation maps, NRCS historical and current production data

Pencil/pen and clipboard

PPE (level D), bug spray, sun lotion

Snake chaps

Tailgate safety forms

First aid kit including moleskin

Plastic bags for ice

Table F- 1. Vegetation Cover Class Midpoints

Percent Cover Range	Cover Class Midpoint
< 5	2.5
6 – 25	15
26 – 50	38
51 – 75	63
76 – 90	85
> 95	98

Figure F-1. Sampling design: Randomly chosen blocks (stars) were sampled for richness, small squares for cover.

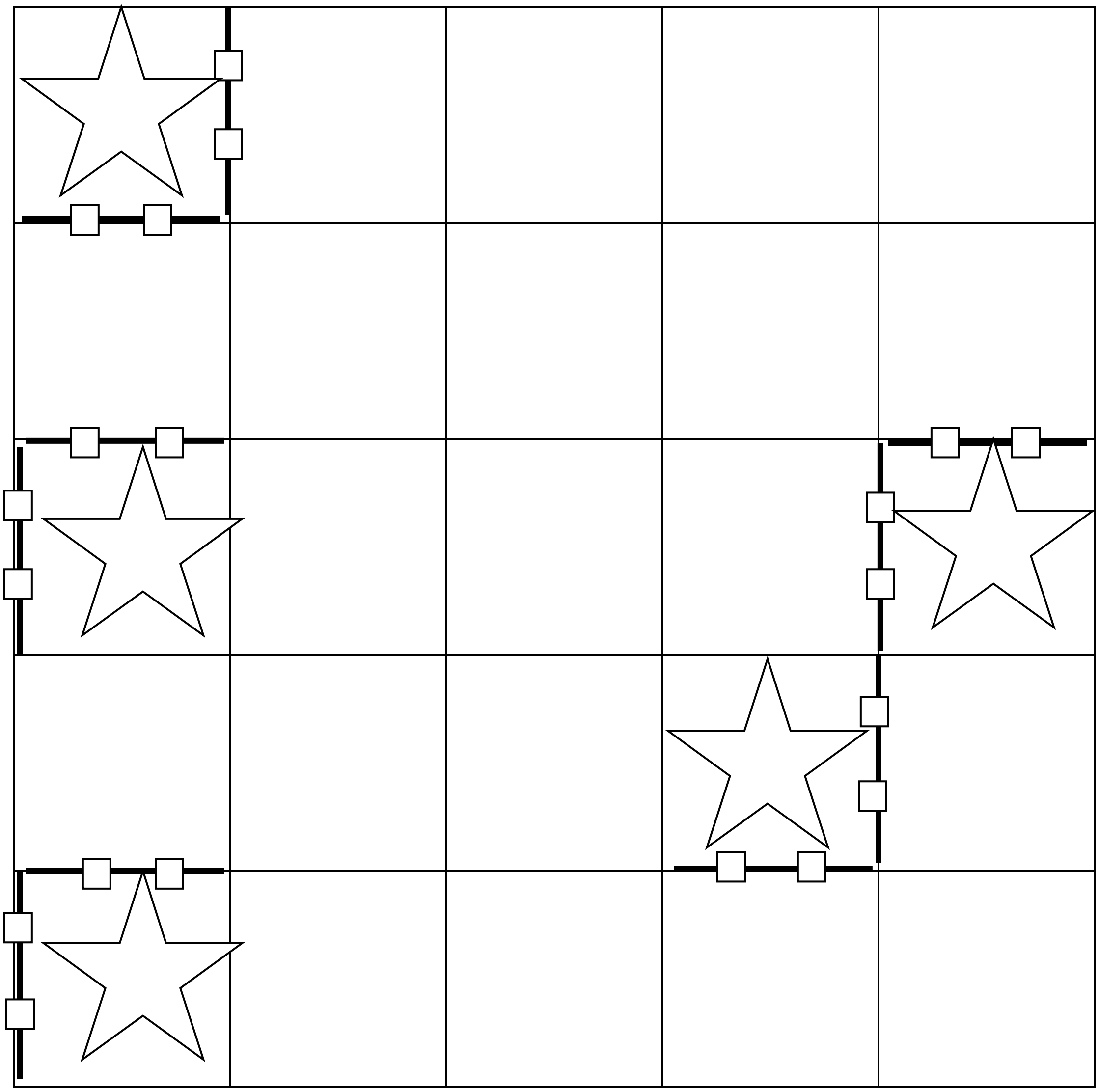


Table F-2. Summary of 2011, 2012, and 2014 Community Data (see attached typed version of field forms)

Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Site ID	Cover						Richness				
	Avg. Cover	Avg. Tree	Avg. Shrub[1]	Avg. Grass	Avg. Forb	Avg. Succ	Avg. Shrub[1]	Avg. Grass	Avg. Forb	Avg. Succ	Avg. Total sp.
2014											
STS-PT-2013-1	31.58	-	31.08	0.00	1.50	0.00	1	0.4	1.6	0.4	3.4
STS-PT-2013-2	30.58	-	29.33	3.00	1.38	0.00	1.2	1	3.2	0	5.2
STS-PT-2013-5	37.78	-	20.23	3.63	0.88	17.65	2.6	1.8	2.8	1.4	8.6
STS-PT-2013-9	5.03	-	4.90	0.00	0.13	0.00	0.6	0	1	0.2	1.8
STS-PT-2013-12	19.73	-	10.13	10.48	2.15	0.00	1.8	3.2	1.8	0.4	7.2
STS-PT-2013-17	18.65	-	18.53	0.63	1.63	0.00	1.6	1.2	3	0	5.8
STS-PT-2013-19	4.65	-	3.40	0.00	1.00	0.00	2.2	0.2	1.6	0.4	4.4
STS-PT-2013-20	24.30	-	1.75	22.00	22.00	0.13	2.2	3.8	6.2	0.6	12.8
STS-PT-2013-26	37.10	-	13.90	16.15	16.15	0.00	1	7	7.8	0	15.8
Wildlife reference plot N	30.3	-	18.35	14.53	14.53	0.00	3.2	4.2	2.8	0	10.2
Wildlife reference plot S	36.75	-	22.58	11.30	11.30	0.13	2.8	5.6	5.2	0.6	14.2
2012											
STS-RWU-2012-B1	17.58	13.20	0.00	3.00	0.13	0.75	1.4	0.6	0.2	1.2	3.4
STS-RWU-2012-B2	2.50	0.00	0.25	2.38	0.00	1.00	1.8	1	1	1.2	5
STS-RWU-2012-B3	3.40	3.28	0.13	0.00	0.00	0.00	1.2	0.8	0.2	0.4	2.6
2011											
STS-RWU-2011-1	5.53	-	-	-	-	-	0	0	0.8	0.2	1
STS-RWU-2011-2	7.90	-	-	-	-	-	0	0	0.4	0	0.4
STS-RWU-2011-3	58.98	-	-	-	-	-	0.6	2.8	1.6	1.2	6.2
STS-RWU-2011-4	63.85	-	-	-	-	-	0.8	4.4	4.4	0.2	9.8
STS-RWU-2011-5	34.10	-	-	-	-	-	2.4	4	3.2	0.4	10
STS-RWU-2011-6	25.00	-	-	-	-	-	2.2	1.4	3.8	0.6	8
STS-RWU-2011-7	10.95	-	-	-	-	-	0.2	0.2	1.2	0.2	1.8
STS-RWU-2011-8	44.95	-	-	-	-	-	4	5.8	11.3	0.4	21.6
STS-RWU-2011-9	2.50	-	-	-	-	-	0.4	0	0	0.4	0.8
STS-RWU-2011-10	24.25	-	-	-	-	-	1	2.6	5.8	0.8	10.2
STS-RWU-2011-11	4.28	-	-	-	-	-	0.8	0	0	0.8	1.6
STS-RWU-2011-12	9.18	-	-	-	-	-	1	0.2	0.4	0	1.6
STS-RWU-2011-13	25.98	-	-	-	-	-	1.4	0.2	1.8	0.2	3.6
STS-RWU-2011-14	26.68	-	-	-	-	-	1.8	2	4	0.2	8
STS-RWU-2011-15	17.63	-	-	-	-	-	1.4	0.6	5.4	0	7.4
STS-RWU-2011-16	22.43	-	-	-	-	-	2.8	5.2	4.2	0.8	13
STS-RWU-2011-17	35.81	-	-	-	-	-	2.8	0	2.6	0	5.4
Wildlife reference plot N	30.00	-	-	-	-	-	1.4	7.6	4.2	0	13.2
Wildlife reference plot S	19.98	-	-	-	-	-	0	0	0	0	0
Notes:											

[1] Shrub cover in 2014 and shrub richness represent combined tree and shrub cover. Tree and shrub cover reported separately in 2012.

2011 Wildlife Habitat Data (page 1)

Date 9/12/2011

Site ID WildRefS

cover averaged over 1 m x 1 m areas

richness is in entire 20 by 20' area

	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt	# shrub	# grass	# forb	# succ	total # sp.
Block 1	15	15	2.5	2.5	8.75	0	0	0	0	0
Block 2	15	15	38	38	26.50	0	0	0	0	0
Block 3	2.5	15	63	85	41.38	0	0	0	0	0
Block 4	2.5	2.5	2.5	2.5	2.50	0	0	0	0	0
Block 5	38	15	15	15	20.75	0	0	0	0	0
average	14.6	12.5	24.2	28.6	19.98	0	0	0	0	0

Date 9/12/2011

Site ID WildRefN

	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt	# shrub	# grass	# forb	# succ	total # sp.
Block 1	15	38	38	38	32.25	1	5	5	0	11
Block 2	15	38	15	15	20.75	1	10	5	0	16
Block 3	38	38	38	38	38.00	1	7	4	0	12
Block 4	85	15	15	38	38.25	2	8	4	0	14
Block 5	38	15	15	15	20.75	2	8	3	0	13
average	38.2	28.8	24.2	28.8	30.00	1.4	7.6	4.2	0	13.2

Date 9/12/2011

Site ID 5 (For all 2011 data, Site X is abbreviation of STS-RWU-2011-X)

	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt	# shrub	# grass	# forb	# succ	total # sp.
Block 1	2.5	98	63	38	50.38	2	4	3	0	9
Block 2	2.5	38	2.5	15	14.50	3	3	4	0	10
Block 3	85	38	15	2.5	35.13	3	5	2	1	11
Block 4	38	38	38	15	32.25	3	5	5	1	14
Block 5	15	15	85	38	38.25	1	3	2	0	6
average	28.6	45.4	40.7	21.7	34.10	2.4	4	3.2	0.4	10

Date 9/12/2011

Site ID 8

	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt	# shrub	# grass	# forb	# succ	total # sp.
Block 1	63	38	38	85	56.00	6	8	14	1	29
Block 2	63	38	38	63	50.50	5	7	11	0	23
Block 3	15	38	63	38	38.50	2	6	12	1	21
Block 4	15	38	15	15	20.75	3	4	10	0	17
Block 5	38	85	15	98	59.00	4	4	10	0	18
average	38.8	47.4	33.8	59.8	44.95	4	5.8	11.4	0.4	21.6

Wildlife Habitat Data

Date 9/13/2011

Site ID 4

	midpt cove	midpt cove	midpt cove	midpt cove	avg. midpt	# shrub	# grass	# forb	# succ	total # sp.
Block 1	85	38	85	85	73.25	1	7	5	0	13
Block 2	63	98	38	85	71.00	0	4	3	1	8
Block 3	38	85	38	38	49.75	1	3	5	0	9
Block 4	63	63	85	63	68.50	1	4	5	0	10
Block 5	63	38	63	63	56.75	1	4	4	0	9
average	62.4	64.4	61.8	66.8	63.85	0.8	4.4	4.4	0.2	9.8

Date 9/13/2011

Site ID 6

	midpt cove	midpt cove	midpt cove	midpt cove	avg. midpt	# shrub	# grass	# forb	# succ	total # sp.
Block 1	38	63	63	15	44.75	1	2	4	0	7
Block 2	15	2.5	2.5	15	8.75	2	2	6	1	11
Block 3	15	15	2.5	2.5	8.75	4	2	6	0	12
Block 4	15	15	15	15	15.00	3	1	3	1	8
Block 5	98	15	63	15	47.75	1	0	0	1	2
average	36.2	22.1	29.2	12.5	25.00	2.2	1.4	3.8	0.6	8.0

Date 9/13/2011

Site ID 15

	midpt cove	midpt cove	midpt cove	midpt cove	avg. midpt	# shrub	# grass	# forb	# succ	total # sp.
Block 1	15	38	15	38	26.50	1	0	5	0	6
Block 2	15	15	38	2.5	17.63	2	0	6	0	8
Block 3	38	38	2.5	15	23.38	2	1	5	0	8
Block 4	15	2.5	15	15	11.88	1	1	6	0	8
Block 5	2.5	15	15	2.5	8.75	1	1	5	0	7
average	17.1	21.7	17.1	14.6	17.63	1.4	0.6	5.4	0.0	7.4

2011 Wildlife Habitat Data (page 2)

Date 9/13/2011
Site ID 14 (For all 2011 data, Site X is abbreviation of STS-RWU-2011-X)

	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt	# shrub	# grass	# forb	# succ	total # sp.
Block 1	63	98	15	63	59.75	3	1	2	0	6
Block 2	15	15	2.5	15	11.88	3	2	3	1	9
Block 3	15	38	38	15	26.50	1	2	7	0	10
Block 4	15	38	2.5	15	17.63	1	2	4	0	7
Block 5	2.5	2.5	2.5	63	17.63	1	3	4	0	8
average	22.1	38.3	12.1	34.2	26.68	1.8	2	4	0.2	8

Date 9/13/2011
Site ID 17

	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt	# shrub	# grass	# forb	# succ	total # sp.
Block 1	2.5	38	15	38	23.38	2	0	1	0	3
Block 2	98	38	--	2.5	46.17	4	0	11	0	15
Block 3	38	2.5	63	15	29.63	3	0	0	0	3
Block 4	15	38	2.5	2.5	14.50	2	0	0	0	2
Block 5	2.5	63	98	98	65.38	3	0	1	0	4
average	31.2	35.9	44.625	31.2	35.81	2.8	0	2.6	0	5.4

Date 9/13/2011
Site ID 13

	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt	# shrub	# grass	# forb	# succ	total # sp.
Block 1	15	2.5	2.5	2.5	5.63	3	1	5	1	10
Block 2	2.5	15	15	2.5	8.75	1	0	1	0	2
Block 3	2.5	38	63	63	41.63	1	0	0	0	1
Block 4	2.5	63	38	63	41.63	1	0	1	0	2
Block 5	38	38	38	15	32.25	1	0	2	0	3
average	12.1	31.3	31.3	29.2	25.98	1.4	0.2	1.8	0.2	3.6

Date 9/13/2011
Site ID 11 bedrock

	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt	# shrub	# grass	# forb	# succ	total # sp.
Block 1	2.5	2.5	38	2.5	11.38	0	0	0	1	1
Block 2	2.5	2.5	2.5	2.5	2.50	3	0	0	1	4
Block 3	2.5	2.5	2.5	2.5	2.50	1	0	0	0	1
Block 4	2.5	2.5	2.5	2.5	2.50	0	0	0	1	1
Block 5	2.5	2.5	2.5	2.5	2.50	0	0	0	1	1
average	2.5	2.5	9.6	2.5	4.28	0.8	0	0	0.8	1.6

illegible

Wildlife Habitat Data

Date 9/13/2011
Site ID 10

	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt	# shrub	# grass	# forb	# succ	total # sp.
Block 1	63	15	63	15	39.00	1	3	6	1	11
Block 2	2.5	15	15	15	11.88	1	1	8	1	11
Block 3	15	38	15	2.5	17.63	0	2	5	0	7
Block 4	15	2.5	15	15	11.88	2	4	5	2	13
Block 5	38	2.5	38	85	40.88	1	3	5	0	9
average	26.7	14.6	29.2	26.5	24.25	1	2.6	5.8	0.8	10.2

Date 9/13/2011
Site ID 12

	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt	# shrub	# grass	# forb	# succ	total # sp.
Block 1	2.5	2.5	2.5	2.5	2.50	1	0	1	0	2
Block 2	15	2.5	15	15	11.88	0	0	1	0	1
Block 3	2.5	2.5	2.5	2.5	2.50	1	0	0	0	1
Block 4	63	38	2.5	2.5	26.50	1	1	0	0	2
Block 5	2.5	2.5	2.5	2.5	2.50	2	0	0	0	2
average	17.1	9.6	5	5	9.18	1	0.2	0.4	0	1.6

Date 9/13/2011
Site ID 16

	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt	# shrub	# grass	# forb	# succ	total # sp.
Block 1	2.5	15	2.5	2.5	5.63	3	5	3	0	11
Block 2	38	15	38	15	26.50	3	6	2	2	13
Block 3	15	15	15	15	15.00	2	6	7	1	16
Block 4	38	38	38	15	32.25	3	4	5	0	12
Block 5	15	15	38	63	32.75	3	5	4	1	13
average	21.7	19.6	26.3	22.1	22.43	2.8	5.2	4.2	0.8	13

Date 9/13/2011
Site ID 9 bedrock

	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt	# shrub	# grass	# forb	# succ	total # sp.
Block 1	2.5	2.5	2.5	2.5	2.50	0	0	0	1	1
Block 2	2.5	2.5	2.5	2.5	2.50	1	0	0	0	1
Block 3	2.5	2.5	2.5	2.5	2.50	1	0	0	1	2
Block 4	2.5	2.5	2.5	2.5	2.50	0	0	0	0	0
Block 5	2.5	2.5	2.5	2.5	2.50	0	0	0	0	0
average	2.5	2.5	2.5	2.5	2.50	0.4	0	0	0.4	0.8

2011 Wildlife Habitat Data (page 3)

Date 9/15/2011
Site ID 3

	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt	# shrub	# grass	# forb	# succ	total # sp.
Block 1	2.5	38	2.5	15	14.50	1	2	1	2	6
Block 2	2.5	2.5	85	63	38.25	1	4	1	1	7
Block 3	85	98	98	98	94.75	1	3	2	0	6
Block 4	85	98	98	85	91.50	0	3	2	2	7
Block 5	2.5	38	98	85	55.88	0	2	2	1	5
average	35.5	54.9	76.3	69.2	58.98	0.6	2.8	1.6	1.2	6.2

Date 9/15/2011
Site ID 1 bedrock

	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt	# shrub	# grass	# forb	# succ	total # sp.
Block 1	2.5	2.5	63	2.5	17.63	0	0	1	1	2
Block 2	2.5	2.5	2.5	2.5	2.50	0	0	1	0	1
Block 3	2.5	2.5	2.5	2.5	2.50	0	0	1	0	1
Block 4	2.5	2.5	2.5	2.5	2.50	0	0	0	0	0
Block 5	2.5	2.5	2.5	2.5	2.50	0	0	1	0	1
average	2.5	2.5	14.6	2.5	5.53	0	0	0.8	0.2	1

Date 9/15/2011
Site ID 7

	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt	# shrub	# grass	# forb	# succ	total # sp.
Block 1	2.5	2.5	63	2.5	17.63	0	0	2	0	2
Block 2	38	2.5	2.5	2.5	11.38	1	0	2	1	4
Block 3	2.5	2.5	2.5	2.5	2.50	0	0	1	0	1
Block 4	15	63	2.5	2.5	20.75	0	0	1	0	1
Block 5	2.5	2.5	2.5	2.5	2.50	0	1	0	0	1
average	12.1	14.6	14.6	2.5	10.95	0.2	0.2	1.2	0.2	1.8

Date 9/15/2011
Site ID 2 bedrock

	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt	# shrub	# grass	# forb	# succ	total # sp.
Block 1	98	2.5	2.5	2.5	26.38	0	0	1	0	1
Block 2	2.5	2.5	2.5	2.5	2.50	0	0	0	0	0
Block 3	2.5	2.5	2.5	2.5	2.50	0	0	0	0	0
Block 4	2.5	15	2.5	2.5	5.63	0	0	1	0	1
Block 5	2.5	2.5	2.5	2.5	2.50	0	0	0	0	0
average	21.6	5	2.5	2.5	7.90	0	0	0.4	0	0.4

2012 Wildlife Habitat Data (page 1)

Date 8/30/2012
Site ID STS-RWU-2012-B1
Exposed
Bedrock 75%

Investigators: Carolyn Meyer, Pam Pinson, Phil Harrigan
Photos: 100-0314 (last)

TOTAL COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	15	0	0	15	7.50
Block 2	0	0	15	0	3.75
Block 3	0	0	15	15	7.50
Block 4	98	98	0	0	49.00
Block 5	63	15	0	2.5	20.13
average	35.2	22.6	6.0	6.5	17.58

TREE COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	2.5	0	2.5	0	1.25
Block 2	0	0	0	0	0.00
Block 3	0	0	0	0	0.00
Block 4	98	98	0	0	49.00
Block 5	63	0	0	0	15.75
average	32.7	19.6	0.5	0	13.20

SHRUB COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	0	0	0	0.00
Block 3	0	0	0	0	0.00
Block 4	0	0	0	0	0.00
Block 5	0	0	0	0	0.00
average	0	0	0	0	0.00

GRASS COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	15	0	0	3.75
Block 3	0	0	15	15	7.50
Block 4	0	0	0	0	0.00
Block 5	0	15	0	0	3.75
average	0	6	3	3	3.00

FORB COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	0	0	0	0.00
Block 3	0	0	0	0	0.00
Block 4	0	0	0	0	0.00
Block 5	0	0	0	2.5	0.63
average	0	0	0	0.5	0.13

SUCCULENT COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	0	0	0	0.00
Block 3	0	0	0	0	0.00
Block 4	0	15	0	0	3.75
Block 5	0	0	0	0	0.00
average	0	3	0	0	0.75

RICHNESS (# species/block)				
	Grasses	Forbs	Succulents	Shrubs/Trees
Block 1	1	1	1	2
Block 2	1	0	1	1
Block 3	0	0	2	2
Block 4	0	0	1	1
Block 5	1	0	1	1

Wildlife Habitat Data

Date 8/30/2012
Site ID STS-RWU-2012-B2
Exposed
Bedrock 85%

Investigators: Carolyn Meyer, Pam Pinson, Phil Harrigan

TOTAL COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	15	15	0	0	7.50
Block 2	2.5	0	0	0	0.63
Block 3	0	0	0	0	0.00
Block 4	0	0	0	0	0.00
Block 5	0	2.5	15	0	4.38
average	3.5	3.5	3.0	0.0	2.50

TREE COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	0	0	0	0.00
Block 3	0	0	0	0	0.00
Block 4	0	0	0	0	0.00
Block 5	0	0	0	0	0.00
average	0	0	0	0	0.00

SHRUB COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	2.5	0	0	0	0.63
Block 2	0	0	0	0	0.00
Block 3	0	0	0	0	0.00
Block 4	0	0	0	0	0.00
Block 5	0	2.5	0	0	0.63
average	0.5	0.5	0	0	0.25

GRASS COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	15	15	0	0	7.50
Block 2	0	0	0	0	0.00
Block 3	0	0	0	0	0.00
Block 4	0	0	0	0	0.00
Block 5	0	2.5	15	0	4.38
average	3	3.5	3	0	2.38

FORB COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	0	0	0	0.00
Block 3	0	0	0	0	0.00
Block 4	0	0	0	0	0.00
Block 5	0	0	0	0	0.00
average	0	0	0	0	0.00

SUCCULENT COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	15	2.5	0	0	4.38
Block 2	2.5	0	0	0	0.63
Block 3	0	0	0	0	0.00
Block 4	0	0	0	0	0.00
Block 5	0	0	0	0	0.00
average	3.5	0.5	0	0	1.00

RICHNESS (# species/block)				
	Grasses	Forbs	Succulents	Shrubs/Trees
Block 1	1	1	1	1
Block 2	1	1	1	1
Block 3	1	2	2	3
Block 4	1	0	1	2
Block 5	1	1	1	2

2012 Wildlife Habitat Data (page 2)

Date 8/30/2012

Investigators: Carolyn Meyer, Pam Pinson, Alicia Fogg, Phil Harrigan

Site ID STS-RWU-2012-B3

Exposed

Bedrock 93%

TOTAL COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	2.5	0	0	0.63
Block 2	0	0	0	0	0.00
Block 3	2.5	0	0	63	16.38
Block 4	0	0	0	0	0.00
Block 5	0	0	0	0	0.00
average	0.5	0.5	0.0	12.6	3.40

RICHNESS (# species/block)				
	Grasses	Forbs	Succulents	Shrubs/Trees
Block 1	2	0	0	1
Block 2	0	0	0	0
Block 3	1	1	1	2
Block 4	1	0	1	2
Block 5	0	0	0	1

TREE COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	0	0	0	0.00
Block 3	2.5	0	0	63	16.38
Block 4	0	0	0	0	0.00
Block 5	0	0	0	0	0.00
average	0.5	0	0	12.6	3.28

SHRUB COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	2.5	0	0	0.63
Block 2	0	0	0	0	0.00
Block 3	0	0	0	0	0.00
Block 4	0	0	0	0	0.00
Block 5	0	0	0	0	0.00
average	0	0.5	0	0	0.13

GRASS COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	0	0	0	0.00
Block 3	0	0	0	0	0.00
Block 4	0	0	0	0	0.00
Block 5	0	0	0	0	0.00
average	0	0	0	0	0.00

FORB COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	0	0	0	0.00
Block 3	0	0	0	0	0.00
Block 4	0	0	0	0	0.00
Block 5	0	0	0	0	0.00
average	0	0	0	0	0.00

SUCCULENT COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	0	0	0	0.00
Block 3	0	0	0	0	0.00
Block 4	0	0	0	0	0.00
Block 5	0	0	0	0	0.00
average	0	0	0	0	0.00

2014 Wildlife Habitat Data (page 1)

Date 9/24/2014
Site ID STS-PT-2013-1
Exposed
Bedrock 0%

Investigators: PP, CM, JA, MS
Photo: 3313-3314

TOTAL COVER

	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	2.5	15	63	20.13
Block 2	15	38	38	63	38.50
Block 3	0	2.5	2.5	2.5	1.88
Block 4	63	15	63	2.5	35.88
Block 5	38	85	38	85	61.50
average	23.2	28.6	31.3	43.2	31.58

TREE/SHRUB COVER

	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	15	63	19.50
Block 2	15	38	38	63	38.50
Block 3	0	0	0	2.5	0.63
Block 4	63	15	63	0	35.25
Block 5	38	85	38	85	61.50
average	23.2	27.6	30.8	42.7	31.08

GRASS COVER

	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	0	0	0	0.00
Block 3	0	0	0	0	0.00
Block 4	0	0	0	0	0.00
Block 5	0	0	0	0	0.00
average	0.0	0.0	0.0	0.0	0.00

FORB COVER

	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	2.5	0	0	0.63
Block 2	0	2.5	0	2.5	1.25
Block 3	0	2.5	2.5	2.5	1.88
Block 4	2.5	2.5	2.5	2.5	2.50
Block 5	0	0	2.5	2.5	1.25
average	0.5	2.0	1.5	2.0	1.50

CACTUS COVER

	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	0	0	0	0.00
Block 3	0	0	0	0	0.00
Block 4	0	0	0	0	0.00
Block 5	0	0	0	0	0.00
average	0.0	0.0	0.0	0.0	0.00

RICHNESS # of Species

	#Tree/Shru	# Grass	# Forb	# Cactus	# Species in block
Block 1	1	1	1	0	3
Block 2	1	0	3	1	5
Block 3	1	0	1	0	2
Block 4	1	1	1	1	4
Block 5	1	0	2	0	3
average	1.0	0.4	1.6	0.4	3.4

Wildlife Habitat Data

Date 9/23/2014
Site ID STS-PT-2013-20
Exposed
Bedrock 0%

Investigators CM, Matt Schultz, PP, JA
Photo: 3294-3295

TOTAL COVER

	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	15	15	15	15	15.00
Block 2	15	15	15	15	15.00
Block 3	63	15	15	38	32.75
Block 4	15	38	38	15	26.50
Block 5	15	38	38	38	32.25
average	24.6	24.2	24.2	24.2	24.30

TREE/SHRUB COVER

	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	2.5	2.5	2.5	2.5	2.50
Block 2	2.5	2.5	2.5	2.5	2.50
Block 3	2.5	2.5	2.5	2.5	2.50
Block 4	0	0	0	0	0.00
Block 5	0	2.5	2.5	0	1.25
average	1.5	2.0	2.0	1.5	1.75

GRASS COVER

	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	15	15	15	15	15.00
Block 2	15	15	15	15	15.00
Block 3	63	15	15	38	32.75
Block 4	15	38	15	15	20.75
Block 5	15	15	38	38	26.50
average	24.6	19.6	19.6	24.2	22.00

FORB COVER

	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	2.5	15	15	2.5	8.75
Block 2	15	2.5	2.5	2.5	5.63
Block 3	15	2.5	2.5	15	8.75
Block 4	2.5	2.5	15	2.5	5.63
Block 5	15	15	2.5	2.5	8.75
average	10.0	7.5	7.5	5.0	7.50

CACTUS COVER

	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	0	0	0	0.00
Block 3	0	0	0	0	0.00
Block 4	0	0	2.5	0	0.63
Block 5	0	0	0	0	0.00
average	0.0	0.0	0.5	0.0	0.13

RICHNESS # of Species

	#Tree/Shru	# Grass	# Forb	# Cactus	# Species in block
Block 1	2	3	7	1	13
Block 2	3	2	6	0	11
Block 3	2	4	6	0	12
Block 4	2	5	6	2	15
Block 5	2	5	6	0	13
average	2.2	3.8	6.2	0.6	12.8

2014 Wildlife Habitat Data (page 2)

Date 9/23/2014
Investigators CM, Matt Schultz, PP, JA
Site ID STS-PT-2013-12
Photo: 3281-3284
Exposed
Bedrock 85%

TOTAL COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	100	2.5	100	38	60.13
Block 2	38	0	63	15	29.00
Block 3	0	0	0	38	9.50
Block 4	0	0	0	0	0.00
Block 5	0	0	0	0	0.00
average	27.6	0.5	32.6	18.2	19.73

RICHNESS # of Species					
	#Tree/Shrub	# Grass	# Forb	# Cactus	# Species in block
Block 1	6	6	4	0	16
Block 2	2	5	0	1	8
Block 3	0	0	3	0	3
Block 4	0	0	0	0	0
Block 5	1	5	2	1	9
average	1.8	3.2	1.8	0.4	7.2

TREE/SHRUB COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	100	0	100	2.5	50.63
Block 2	0	0	0	0	0.00
Block 3	0	0	0	0	0.00
Block 4	0	0	0	0	0.00
Block 5	0	0	0	0	0.00
average	20.0	0.0	20.0	0.5	10.13

GRASS COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	2.5	15	38	13.88
Block 2	38	0	63	15	29.00
Block 3	0	0	0	38	9.50
Block 4	0	0	0	0	0.00
Block 5	0	0	0	0	0.00
average	7.6	0.5	15.6	18.2	10.48

FORB COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	38	2.5	10.13
Block 2	2.5	0	0	0	0.63
Block 3	0	0	0	0	0.00
Block 4	0	0	0	0	0.00
Block 5	0	0	0	0	0.00
average	0.5	0.0	7.6	0.5	2.15

CACTUS COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	0	0	0	0.00
Block 3	0	0	0	0	0.00
Block 4	0	0	0	0	0.00
Block 5	0	0	0	0	0.00
average	0.0	0.0	0.0	0.0	0.00

Wildlife Habitat Data

Date 9/24/2014
Investigators CM, Matt Schultz, PP, JA
Site ID STS-PT-2013-2
Photo: 3297-3300
Exposed
Bedrock 0%

TOTAL COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	15	85	0	63	40.75
Block 2	63	15	0	38	29.00
Block 3	38	63	15	38	38.50
Block 4	15	15	15	15	15.00
Block 5	63	38	2.5	15	29.63
average	38.8	43.2	6.5	33.8	30.58

RICHNESS # of Species					
	#Tree/Shru	# Grass	# Forb	# Cactus	# Species in block
Block 1	1	1	1	0	3
Block 2	1	0	1	0	1
Block 3	2	0	4	0	6
Block 4	1	2	8	0	11
Block 5	1	2	2	0	5
average	1.2	1.0	3.2	0.0	5.2

TREE/SHRUB COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	15	85	0	63	40.75
Block 2	63	15	0	38	29.00
Block 3	38	63	15	38	38.50
Block 4	15	2.5	2.5	15	8.75
Block 5	63	38	2.5	15	29.63
average	38.8	40.7	4.0	33.8	29.33

GRASS COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	0	0	0	0.00
Block 3	0	0	0	0	0.00
Block 4	15	15	15	15	15.00
Block 5	0	0	0	0	0.00
average	3.0	3.0	3.0	3.0	3.00

FORB COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	0	0	0	0.00
Block 3	0	0	2.5	0	0.63
Block 4	2.5	15	2.5	0	5.00
Block 5	2.5	0	0	2.5	1.25
average	1.0	3.0	1.0	0.5	1.38

CACTUS COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	0	0	0	0.00
Block 3	0	0	0	0	0.00
Block 4	0	0	0	0	0.00
Block 5	0	0	0	0	0.00
average	0.0	0.0	0.0	0.0	0.00

2014 Wildlife Habitat Data (page 3)

Date 9/25/2014
Investigators CM, Matt Schultz, PP, JA
Site ID STS-PT-2013-5
Photo: 3371-3374
Exposed Bedrock 25%

TOTAL COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	2.5	2.5	38	38	20.25
Block 2	38	63	38	38	44.25
Block 3	15	38	15	63	32.75
Block 4	85	63	15	85	62.00
Block 5	63	15	2.5	38	29.63
average	40.7	36.3	21.7	52.4	37.78
TREE/SHRUB COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	38	9.50
Block 2	38	15	15	2.5	17.63
Block 3	15	15	2.5	63	23.88
Block 4	85	38	15	15	38.25
Block 5	15	15	2.5	15	11.88
average	30.6	16.6	7.0	26.7	20.23
GRASS COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	2.5	2.5	0	0	1.25
Block 2	0	0	15	2.5	4.38
Block 3	2.5	2.5	15	0	5.00
Block 4	0	15	15	0	7.50
Block 5	0	0	0	0	0.00
average	1.0	4.0	9.0	0.5	3.63
FORB COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	2.5	2.5	0	0	1.25
Block 2	0	0	0	0	0.00
Block 3	0	2.5	2.5	2.5	1.88
Block 4	0	0	0	2.5	0.63
Block 5	2.5	0	0	0	0.63
average	1.0	1.0	0.5	1.0	0.88
CACTUS COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	2.5	2.5	38	0	10.75
Block 2	0	63	0	38	25.25
Block 3	0	38	0	15	13.25
Block 4	0	0	0	63	15.75
Block 5	63	15	0	15	23.25
average	13.1	23.7	7.6	26.2	17.65

RICHNESS # of Species					
	#Tree/Shrub	# Grass	# Forb	# Cactus	# Species in block
Block 1	2	3	3	2	10
Block 2	2	1	2	2	7
Block 3	3	2	3	1	9
Block 4	3	1	3	1	8
Block 5	3	2	3	1	9
average	2.6	1.8	2.8	1.4	8.6

Wildlife Habitat Data

Date 9/24/2014
Investigators CM, Matt Schultz, PP, JA
Site ID STS-PT-2013-9
Photo: 3342-3344
Exposed Bedrock 60%

TOTAL COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	0	0	0	0.00
Block 3	0	0	2.5	0	0.63
Block 4	0	0	0	0	0.00
Block 5	98	0	0	0	24.50
average	19.6	0.0	0.5	0.0	5.03
TREE/SHRUB COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	0	0	0	0.00
Block 3	0	0	0	0	0.00
Block 4	0	0	0	0	0.00
Block 5	98	0	0	0	24.50
average	19.6	0.0	0.0	0.0	4.90
GRASS COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	0	0	0	0.00
Block 3	0	0	0	0	0.00
Block 4	0	0	0	0	0.00
Block 5	0	0	0	0	0.00
average	0.0	0.0	0.0	0.0	0.00
FORB COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	0	0	0	0.00
Block 3	0	0	2.5	0	0.63
Block 4	0	0	0	0	0.00
Block 5	0	0	0	0	0.00
average	0.0	0.0	0.5	0.0	0.13
CACTUS COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	0	0	0	0.00
Block 3	0	0	0	0	0.00
Block 4	0	0	0	0	0.00
Block 5	0	0	0	0	0.00
average	0.0	0.0	0.0	0.0	0.00

RICHNESS # of Species					
	#Tree/Shrul	# Grass	# Forb	# Cactus	# Species in block
Block 1	0	0	1	1	2
Block 2	0	0	1	0	1
Block 3	1	0	1	0	2
Block 4	1	0	1	0	2
Block 5	1	0	1	0	2
average	0.6	0.0	1.0	0.2	1.8

2014 Wildlife Habitat Data (page 4)

Date 9/24/2014
Site ID STS-PT-2013-19
Exposed
Bedrock 67%

Investigators CM, Matt Schultz, PP, JA
Photo: 3323-3327

TOTAL COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	2.5	2.5	2.5	2.5	2.50
Block 2	2.5	2.5	15	0	5.00
Block 3	15	2.5	0	0	4.38
Block 4	2.5	0	2.5	0	1.25
Block 5	2.5	0	38	0	10.13
average	5.0	1.5	11.6	0.5	4.65

RICHNESS # of Species					
	#Tree/Shrul	# Grass	# Forb	# Cactus	# Species in block
Block 1	4	0	3	1	8
Block 2	3	0	0	1	4
Block 3	3	0	2	0	5
Block 4	0	0	2	0	2
Block 5	1	1	1	0	3
average	2.2	0.2	1.6	0.4	4.4

TREE/SHRUB COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	2.5	2.5	2.5	2.5	2.50
Block 2	2.5	0	15	0	4.38
Block 3	2.5	0	0	0	0.63
Block 4	0	0	0	0	0.00
Block 5	0	0	38	0	9.50
average	1.5	0.5	11.1	0.5	3.40

GRASS COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	0	0	0	0.00
Block 3	0	0	0	0	0.00
Block 4	0	0	0	0	0.00
Block 5	0	0	0	0	0.00
average	0.0	0.0	0.0	0.0	0.00

FORB COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	2.5	0	0	2.5	1.25
Block 2	0	2.5	0	0	0.63
Block 3	2.5	2.5	0	0	1.25
Block 4	2.5	0	2.5	0	1.25
Block 5	2.5	0	0	0	0.63
average	2.0	1.0	0.5	0.5	1.00

CACTUS COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	0	0	0	0.00
Block 3	0	0	0	0	0.00
Block 4	0	0	0	0	0.00
Block 5	0	0	0	0	0.00
average	0.0	0.0	0.0	0.0	0.00

Wildlife Habitat Data

Date 9/24/2014
Site ID STS-PT-2013-17
Exposed
Bedrock 0%

Investigators: CM, Matt Schultz, PP, JA
Photo: 3302-3304

TOTAL COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	2.5	2.5	63	17.00
Block 2	2.5	15	2.5	2.5	5.63
Block 3	63	38	15	2.5	29.63
Block 4	15	38	15	38	26.50
Block 5	2.5	15	38	2.5	14.50
average	16.6	21.7	14.6	21.7	18.65

RICHNESS # of Species					
	#Tree/Shrul	# Grass	# Forb	# Cactus	# Species in block
Block 1	1	0	1	0	2
Block 2	1	0	1	0	2
Block 3	1	2	5	0	8
Block 4	3	2	4	0	9
Block 5	2	2	4	0	8
average	1.6	1.2	3.0	0.0	5.8

TREE/SHRUB COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	2.5	2.5	63	17.00
Block 2	2.5	15	2.5	2.5	5.63
Block 3	63	38	15	2.5	29.63
Block 4	15	38	15	38	26.50
Block 5	0	15	38	2.5	13.88
average	16.1	21.7	14.6	21.7	18.53

GRASS COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	0	0	0	0.00
Block 3	0	0	0	2.5	0.63
Block 4	0	0	2.5	0	0.63
Block 5	2.5	2.5	2.5	0	1.88
average	0.5	0.5	1.0	0.5	0.63

FORB COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	2.5	0	0	0.63
Block 2	2.5	0	0	0	0.63
Block 3	2.5	0	2.5	2.5	1.88
Block 4	0	0	2.5	0	0.63
Block 5	0	15	2.5	0	4.38
average	1.0	3.5	1.5	0.5	1.63

CACTUS COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	0	0	0	0.00
Block 3	0	0	0	0	0.00
Block 4	0	0	0	0	0.00
Block 5	0	0	0	0	0.00
average	0.0	0.0	0.0	0.0	0.00

2014 Wildlife Habitat Data (page 5)

Date 9/25/2014 Investigators CM, Matt Schultz, PP, JA
Site ID STS-PT-2013-26 Photo: 3384-3388
Exposed
Bedrock 0%

TOTAL COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	15	38	85	63	50.25
Block 2	15	15	15	38	20.75
Block 3	15	38	15	15	20.75
Block 4	38	85	38	85	61.50
Block 5	38	38	38	15	32.25
average	24.2	42.8	38.2	43.2	37.10
TREE/SHRUB COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	85	2.5	21.88
Block 2	0	2.5	2.5	38	10.75
Block 3	2.5	0	0	0	0.63
Block 4	15	85	15	15	32.50
Block 5	0	0	15	0	3.75
average	3.5	17.5	23.5	11.1	13.90
GRASS COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	15	2.5	0	63	20.13
Block 2	15	2.5	2.5	0	5.00
Block 3	15	15	15	15	15.00
Block 4	15	0	15	85	28.75
Block 5	15	2.5	15	15	11.88
average	15.0	4.5	9.5	35.6	16.15
FORB COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	15	15	15	2.5	11.88
Block 2	15	15	15	15	15.00
Block 3	15	15	15	15	15.00
Block 4	15	15	15	2.5	11.88
Block 5	15	15	15	15	15.00
average	15.0	15.0	15.0	10.0	13.75
CACTUS COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	0	0	0	0.00
Block 3	0	0	0	0	0.00
Block 4	0	0	0	0	0.00
Block 5	0	0	0	0	0.00
average	0.0	0.0	0.0	0.0	0.00

RICHNESS # of Species					
	#Tree/Shrub	# Grass	# Forb	# Cactus	# Species in block
Block 1	1	7	8	0	16
Block 2	1	6	7	0	14
Block 3	1	7	9	0	17
Block 4	1	7	6	0	14
Block 5	1	8	9	0	18
average	1.0	7.0	7.8	0.0	15.8

Wildlife Habitat Data

Date 9/23/2014 Investigators CM, Matt Schultz, PP, JA
Site ID Wildlife Reference plot S Photo: 3384-3388
Exposed
Bedrock 0%

TOTAL COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	15	15	38	38	26.50
Block 2	85	63	15	15	44.50
Block 3	38	15	38	63	38.50
Block 4	63	38	15	98	53.50
Block 5	38	15	15	15	20.75
average	47.8	29.2	24.2	45.8	36.75
TREE/SHRUB COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	15	15	0	15	11.25
Block 2	85	38	15	15	38.25
Block 3	38	0	15	15	17.00
Block 4	15	15	15	85	32.50
Block 5	38	0	2.5	15	13.88
average	38.2	13.6	9.5	29.0	22.58
GRASS COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	15	2.5	38	15	17.63
Block 2	0	15	15	0	7.50
Block 3	2.5	15	15	15	11.88
Block 4	2.5	2.5	2.5	38	11.38
Block 5	2.5	15	0	15	8.13
average	4.5	10.0	14.1	16.6	11.30
FORB COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	2.5	2.5	15	2.5	5.63
Block 2	2.5	2.5	0	15	5.00
Block 3	0	15	15	15	11.25
Block 4	15	15	15	0	11.25
Block 5	0	2.5	15	0	4.38
average	4.0	7.5	12.0	6.5	7.50
CACTUS COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	0	0	0	0.00
Block 3	0	2.5	0	0	0.63
Block 4	0	0	0	0	0.00
Block 5	0	0	0	0	0.00
average	0.0	0.5	0.0	0.0	0.13

RICHNESS # of Species					
	#Tree/Shrub	# Grass	# Forb	# Cactus	# Species in block
Block 1	3	6	8	1	18
Block 2	3	5	3	1	12
Block 3	2	6	4	1	13
Block 4	3	6	6	0	15
Block 5	3	5	5	0	13
average	2.8	5.6	5.2	0.6	14.2

2014 Wildlife Habitat Data (page 6)

Date 9/23/2014
Site ID STS-PT-2013-Reference plot N
Exposed
Bedrock 0%

Investigators CM, Matt Schultz, PP, JA
Photo: 3278-3279

TOTAL COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	38	15	38	85	44.00
Block 2	15	63	15	15	27.00
Block 3	15	15	15	63	27.00
Block 4	38	63	15	15	32.75
Block 5	15	15	15	38	20.75
average	24.2	34.2	19.6	43.2	30.30
TREE/SHRUB COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	15	15	15	2.5	11.88
Block 2	15	63	2.5	2.5	20.75
Block 3	15	2.5	15	63	23.88
Block 4	38	63	2.5	2.5	26.50
Block 5	2.5	15	2.5	15	8.75
average	17.1	31.7	7.5	17.1	18.35
GRASS COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	15	2.5	38	85	35.13
Block 2	2.5	2.5	15	15	8.75
Block 3	15	15	0	2.5	8.13
Block 4	2.5	2.5	15	15	8.75
Block 5	15	2.5	15	15	11.88
average	10.0	5.0	16.6	26.5	14.53
FORB COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	15	2.5	2.5	2.5	5.63
Block 2	2.5	2.5	2.5	15	5.63
Block 3	15	2.5	15	2.5	8.75
Block 4	2.5	2.5	2.5	2.5	2.50
Block 5	2.5	15	15	2.5	8.75
average	7.5	5.0	7.5	5.0	6.25
CACTUS COVER					
	midpt cover	midpt cover	midpt cover	midpt cover	avg. midpt
Block 1	0	0	0	0	0.00
Block 2	0	0	0	0	0.00
Block 3	0	0	0	0	0.00
Block 4	0	0	0	0	0.00
Block 5	0	0	0	0	0.00
average	0.0	0.0	0.0	0.0	0.00

# of Species

	#Tree/Shrub	# Grass	# Forb	# Cactus	# Species in block
Block 1	4	4	2	0	10
Block 2	3	2	2	0	7
Block 3	3	4	4	0	11
Block 4	3	6	3	0	12
Block 5	3	5	3	0	11
average	3.2	4.2	2.8	0.0	10.2

Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation

Location Sck. # 1

UTM Coord

12pm

Picture # **Description**

934 - 744

Date/Time: 9-15-11

Observer Carolyn Meyer, Joe Allen

Soil Map Unit Name

Veg Alliance Name

Surface texture

Parent material

Slope %

Elevation (ft)

Topographic position

Aspect

Signs of Disturbance(s) observed

OAT score of 200-m transect 12

OAT score of polygon 12

Notes:

Dominant
Oak + rock outcrop

Some Yuccas

3

rara sheep

1 forb
1 tall grass } that's it!

Site 1 Cuy

Criteria used to score Observed Apparent Trend (OAT). ***Check appropriate box in each category which best fits area being observed. Points may vary within each category.***

how do you score? plants

☐ **VIGOR** (10 points)	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☐ (6 points) 7	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points)	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points)	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points)	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points) NA	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☐ **SURFACE LITTER** (5 points)	Surface litter is accumulating in place.
☐ (3 points) 2	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point)	Very little surface litter is remaining.
☐ **PEDESTALS** (5 points)	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☐ (3 points)	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point) 1	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☐ **SURFACE CRUSTING** (5 points)	There is little visual evidence of surface crusting.
☐ (3 points)	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point) 1	Severe surface crusting. (Note reason for cause)
☐ **RILLS AND GULLIES** (5 points)	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points)	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point) 1	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 12 **FIELD NOTES:**	

Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation

Location Site 2

UTM Coord

Picture # **Description**

779-783

Date/Time: 9/16/11

Observer Carolyn Meyer, Pam Pinson, Nick Lemme

Soil Map Unit Name

Veg Alliance Name

Surface texture

Parent material

Slope %

Elevation (ft)

Topographic position

Aspect

Signs of Disturbance(s) observed

Notes

OATS score Tx 8

OA~~T~~A score polygon 8

Site 2 - RWU

9/16/11

cm 2:40 pm

779-783 - as walk North 200-m

Oat - 8

Dormant - oak, some yucca - lots dead

CM

Site 2 9/6/11

Criteria used to score Observed Apparent Trend (OAT). ***Check appropriate box in each category which best fits area being observed. Points may vary within each category.***

☐ **VIGOR** (10 points)	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☐ (6 points)	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points) 2	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points)	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points)	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points) NA	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☐ **SURFACE LITTER** (5 points)	Surface litter is accumulating in place.
☐ (3 points)	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point) 1	Very little surface litter is remaining.
☐ **PEDESTALS** (5 points)	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☐ (3 points)	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point) NA	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☐ **SURFACE CRUSTING** (5 points)	There is little visual evidence of surface crusting.
☐ (3 points)	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point) 1	Severe surface crusting. (Note reason for cause)
☐ **RILLS AND GULLIES** (5 points)	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points) 4	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 8 **FIELD NOTES:**	moving sediment, litter mostly bedrock thin scattered yucca -

1.

Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation

Location site # 3

UTM Coord

Picture # **Description**

745-746

Date/Time: 9-15-11

Observer CM, [illegible], JA, [illegible]

Soil Map Unit Name

Veg Alliance Name

Surface texture

Parent material

Slope %

Elevation (ft)

Topographic position

Aspect

Signs of Disturbance(s) observed

OAT score of 200-m transect 24

OAT score of polygon 24

Notes:

dom.

Catclaw - oak - some yucca

on Slope

Site 3 cm

Criteria used to score Observed Apparent Trend (OAT). ***Check appropriate box in each category which best fits area being observed. Points may vary within each category.***

☐ **VIGOR** (10 points)		Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☑ (6 points)	6	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points)		Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points)		There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points)	4	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points)		Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☐ **SURFACE LITTER** (5 points)		Surface litter is accumulating in place.
☒ (3 points)	3	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point)		Very little surface litter is remaining.
☐ **PEDESTALS** (5 points)		There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☒ (3 points)	3	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point)		Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☑ **SURFACE CRUSTING** (5 points)	5	There is little visual evidence of surface crusting.
☐ (3 points)		There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)		Severe surface crusting. (Note reason for cause)
☐ **RILLS AND GULLIES** (5 points)		Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☒ (3 points)	3	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point)		Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 24 **FIELD NOTES:**		Sideoats grama

PM

Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation

Location Site 4

UTM Coord

Picture #	**Description**
	pictures TO 102-0635 102-0627

Date/Time: 9/13/11 9am

Observer PH, CM VM

Soil Map Unit Name see spreadsheet, maps

Veg Alliance Name

Surface texture

Parent material

Slope %

Elevation (ft)

Topographic position

Aspect

Signs of Disturbance(s) observed

past grazing moderate
many cow-weeds

OAT score of 200-m transect 35

OAT score of polygon 35

Notes:

Slight western-facing slope near to summit
- gila conglomerate

Yucca - sideoats + three awn w/ cow weed

subdom
broom snake horseweed
Fluffgrass
3-awn

very patchy,
black gramma
Side oats
3 awn
~~Rig weed~~ kochia = domi?
→ domi.

grass & Forb dominant

St 4 PH

Criteria used to score Observed Apparent Trend (OAT). ***Check appropriate box in each category which best fits area being observed. Points may vary within each category.***

☐ **VIGOR** (10 points) 9	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☐ (6 points)	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points)	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points) 7	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points)	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points)	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☑ **SURFACE LITTER** (5 points)	Surface litter is accumulating in place.
☐ (3 points)	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point)	Very little surface litter is remaining.
☐ **PEDESTALS** (5 points)	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☑ (3 points)	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point)	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☑ **SURFACE CRUSTING** (5 points)	There is little visual evidence of surface crusting.
☐ (3 points)	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)	Severe surface crusting. (Note reason for cause)
☐ **RILLS AND GULLIES** (5 points) 4	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points)	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 38 **FIELD NOTES:**	pack gravely loam rained night b4 pics to 102-0635

PH = Penny Hunter

Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation

Location Site 5

UTM Coord

Picture # Description Pam's camera

Date/Time: 9/2/11

Observer PH, CM, VM

Soil Map Unit Name

Veg Alliance Name

Surface texture

Parent material

Slope %

Elevation (ft)

Topographic position

Aspect

Signs of Disturbance(s) observed

grazing - moderate

OAT score of 200-m transect 33

OAT score of polygon 33

Notes:

rocky outcrop, ~~mahogany~~ mesquite-dominated. N-E facing.

CM

Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation

Location 5

UTM Coord

Picture #	**Description**

Date/Time: 9-12-11 3pm

Observer Penny Hunter, Carolyn Meyer, Kira Meyer

Soil Map Unit Name - 5

Veg Alliance Name

Surface texture

Parent material

Slope %

Elevation (ft)

Topographic position

Aspect

Signs of Disturbance(s) observed

OAT score of 200-m transect 33

OAT score of polygon 33

Notes: Moderate pedestaling — more than reference

Site 5 STS - 2011 - F14

Criteria used to score Observed Apparent Trend (OAT). *Check appropriate box in each category which best fits area being observed. Points may vary within each category.*

☒ **VIGOR** (10 points)	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☐ (6 points)	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points)	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points) ⑦	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points)	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points)	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☐ **SURFACE LITTER** (5 points)	Surface litter is accumulating in place.
☒ (3 points)	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point)	Very little surface litter is remaining.
☐ **PEDESTALS** (5 points)	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☒ (3 points)	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point)	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☑ **SURFACE CRUSTING** (5 points)	There is little visual evidence of surface crusting.
☐ (3 points)	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)	Severe surface crusting. (Note reason for cause)
☑ **RILLS AND GULLIES** (5 points)	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points)	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 33 **FIELD NOTES:**	28 35

PH

Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation
Location STS-RWU-2[illegible]-6 Site 6

UTM Coord

Picture # Description
-0638 to -0644
0641 = amended area nearby

Date/Time: 9/13/11 10:30 am
Observer PH, CM, VM
Soil Map Unit Name
Veg Alliance Name
Surface texture
Parent material
Slope %
Elevation (ft)
Topographic position
Aspect

Signs of Disturbance(s) observed
highly eroded, amendments to adjacent area

OAT score of 200-m transect 16
OAT score of polygon 16

Notes:

Oak dominant
~~&~~ & mtn mahog

Site 6

Criteria used to score Observed Apparent Trend (OAT). ***Check appropriate box in each category which best fits area being observed. Points may vary within each category.***

☐ **VIGOR** (10 points)	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☐ (6 points) ④	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points)	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points)	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points)	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points) ①	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☐ **SURFACE LITTER** (5 points)	Surface litter is accumulating in place.
☒ (3 points) 3	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point)	Very little surface litter is remaining.
☐ **PEDESTALS** (5 points)	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☐ (3 points) ②	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point)	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☒ **SURFACE CRUSTING** (5 points) 5	There is little visual evidence of surface crusting.
☐ (3 points)	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)	Severe surface crusting. (Note reason for cause)
☐ **RILLS AND GULLIES** (5 points)	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points)	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☒ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 16 **FIELD NOTES:**	0641 = amended area Transect < 200m, ~~habitat~~

Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation

Location Site 7

UTM Coord

75
1.50

0.75, ~~[illegible]~~
/ 150
82

Picture #	**Description**
	747-748

Date/Time: 9/16/11
Observer Carolyn Meyer, Pam Pinson, Nick Lemme
Soil Map Unit Name
Veg Alliance Name
Surface texture
Parent material
Slope %
Elevation (ft)
Topographic position
Aspect

Signs of Disturbance(s) observed

OAT score of 200-m transect 9
OAT score of polygon 8

dominant { oak
juniper

some yucca

Notes:

3.28
16
21 | 328
2
12

25
× 3.3
75
75
825

9/14/11 Site 7 Cm

Criteria used to score Observed Apparent Trend (OAT). ***Check appropriate box in each category which best fits area being observed. Points may vary within each category.***

☐ **VIGOR** (10 points)	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☐ (6 points) 1 year mesquite	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points) 6	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points)	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points)	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points) NA	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☐ **SURFACE LITTER** (5 points)	Surface litter is accumulating in place.
☐ (3 points)	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point) 1	Very little surface litter is remaining.
☐ **PEDESTALS** (5 points)	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☐ (3 points)	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point)	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☐ **SURFACE CRUSTING** (5 points)	There is little visual evidence of surface crusting.
☐ (3 points)	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point) 1	Severe surface crusting. (Note reason for cause)
☐ **RILLS AND GULLIES** (5 points) [illegible]	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points)	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point) 1	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 9 **FIELD NOTES:**	lots of moving sediment + thin gullies crusting

pH

Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation

Location Reference - Gila Complex

UTM Coord

Picture # Description 702-0636 & -0637

Date/Time: 9/13/11 10 am
Observer PU, CM, VM
Soil Map Unit Name
Veg Alliance Name
Surface texture
Parent material
Slope %
Elevation (ft)
Topographic position
Aspect

Signs of Disturbance(s) observed

grazing

OAT score of 200-m transect ~~[illegible]~~ 9, 8, 5, 5 5 5 ~~[illegible]~~ ~~[illegible]~~ 27
OAT score of polygon

1
15
17
32

Notes:

Dominant species: sideoats
~~pigweed~~ / kochia

more mesquite, less yucca than site 4.

South Fence; nearer to ~~grazi~~ stock tank

1
9 17
8 18
17 36 18
8

Reference - Gila Conglomerate - near & thru West reference plot. p 1+

Criteria used to score Observed Apparent Trend (OAT). ***Check appropriate box in each category which best fits area being observed. Points may vary within each category.***

☐ **VIGOR** (10 points) 9	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☐ (6 points)	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points)	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points) 8	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points)	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points)	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☑ **SURFACE LITTER** (5 points)	Surface litter is accumulating in place.
☐ (3 points)	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point)	Very little surface litter is remaining.
☑ **PEDESTALS** (5 points)	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☐ (3 points)	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point)	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☑ **SURFACE CRUSTING** (5 points)	There is little visual evidence of surface crusting.
☐ (3 points)	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)	Severe surface crusting. (Note reason for cause)
☑ **RILLS AND GULLIES** (5 points)	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points)	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 37 **FIELD NOTES:**	

PH

Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation

Location Site 8

UTM Coord

Picture #	**Description**
	Pam's camera

Date/Time: 9/12/11 5pm

Observer PH, CM, VM

Soil Map Unit Name

Veg Alliance Name

Surface texture

Parent material

Slope %

Elevation (ft)

Topographic position

Aspect

Signs of Disturbance(s) observed

grazing - minimal

OAT score of 200-m transect 37

OAT score of polygon 37

Notes:

oak? - common
- common

° (mtn mahogeny?) juniper woodland

steep slope

N - facing (?)

very high forb + grass abundance

Site 8 PH

Criteria used to score Observed Apparent Trend (OAT). ***Check appropriate box in each category which best fits area being observed. Points may vary within each category.***

☒ **VIGOR** (10 points)	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☐ (6 points)	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points)	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☒ **SEEDLINGS** (10 points)	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points)	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points)	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☐ **SURFACE LITTER** (5 points)	Surface litter is accumulating in place.
☐ (3 points)	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point)	Very little surface litter is remaining.
☐ **PEDESTALS** (5 points)	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☒ (3 points)	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point)	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☒ **SURFACE CRUSTING** (5 points)	There is little visual evidence of surface crusting.
☐ (3 points)	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)	Severe surface crusting. (Note reason for cause)
☒ **RILLS AND GULLIES** (5 points)	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points)	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 37 **FIELD NOTES:**	

⑩

④

End of site

Cm

Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation

Location Site 9

UTM Coord

Picture # Description 0680 - 0683

Date/Time: 9/14/11 10am
Observer
Soil Map Unit Name
Veg Alliance Name
Surface texture
Parent material
Slope %
Elevation (ft)
Topographic position
Aspect

Signs of Disturbance(s) observed

OAT score of 200-m transect 11
OAT score of polygon 11

Notes:

Oak -
Some ~~dea~~ yucca
lots dead higher up -
lower areas more live
poor vigor
no desirable forage
Soil moving - collect in holes
where oaks grow.

Site 9 Cm

Criteria used to score Observed Apparent Trend (OAT). *Check appropriate box in each category which best fits area being observed. Points may vary within each category.*

☐ **VIGOR** (10 points)	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☐ (6 points) - no desirable	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points) forage NA	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points)	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points)	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points) NA	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☐ **SURFACE LITTER** (5 points)	Surface litter is accumulating in place.
☐ (3 points)	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point) 1	Very little surface litter is remaining.
☐ **PEDESTALS** (5 points)	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☐ (3 points)	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point) NA	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☐ **SURFACE CRUSTING** (5 points) 5	There is little visual evidence of surface crusting.
☐ (3 points)	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)	Severe surface crusting. (Note reason for cause)
☐ **RILLS AND GULLIES** (5 points) 5.	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points)	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 11 **FIELD NOTES:**	lots Cn on rocks water deficiency Yucca dying oak low vigor

Soil = moving sediment

PH

Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation

Location Site 10

UTM Coord

Picture #	**Description**
0669 - 0674	

Date/Time: 9/13/11 2:30pm

Observer PH, CM, UM

Soil Map Unit Name

Veg Alliance Name

Surface texture

Parent material

Slope %

Elevation (ft)

Topographic position

Aspect

Signs of Disturbance(s) observed

erosion
manganese staining

OAT score of 200-m transect 16

OAT score of polygon 16

Notes: mesquite-juniper, w/ yucca sub-domin. patchy

Site 10 PH

Criteria used to score Observed Apparent Trend (OAT). ***Check appropriate box in each category which best fits area being observed. Points may vary within each category.***

☐ **VIGOR** (10 points)	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☐ (6 points) 5	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points)	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points)	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points) 4	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points)	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☐ **SURFACE LITTER** (5 points)	Surface litter is accumulating in place.
☐ (3 points) 2	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point)	Very little surface litter is remaining.
☐ **PEDESTALS** (5 points)	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☐ (3 points)	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☒ (1 point)	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☐ **SURFACE CRUSTING** (5 points)	There is little visual evidence of surface crusting.
☒ (3 points)	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)	Severe surface crusting. (Note reason for cause)
☐ **RILLS AND GULLIES** (5 points)	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points)	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☒ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 16 **FIELD NOTES:**	Patchy - some - lots gullies - other areas - lots small grasses - seeding

PH

Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation

Location Site 11

UTM Coord

Picture # Description 0666 - 0668

Date/Time: 9/13/11 3pm

Observer PA, CM, VM

Soil Map Unit Name

Veg Alliance Name

Surface texture

Parent material

Slope %

Elevation (ft)

Topographic position

Aspect

Signs of Disturbance(s) observed

none

OAT score of 200-m transect 6

OAT score of polygon 6

Notes:

Bedrock outcrop - mostly bedrock

Santana rock complex

mahogany/oak dominated

Site 11 P4

Criteria used to score Observed Apparent Trend (OAT). ***Check appropriate box in each category which best fits area being observed. Points may vary within each category.***

☐ **VIGOR** (10 points)	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☐ (6 points) N/A	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points)	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points)	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points) N/A	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points) 0	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☐ **SURFACE LITTER** (5 points)	Surface litter is accumulating in place.
☐ (3 points)	Moderate movement of surface litter is apparent and deposited against obstacles.
☒ (1 point)	Very little surface litter is remaining.
☐ **PEDESTALS** (5 points) N/A	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☐ (3 points)	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point) 0	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☐ **SURFACE CRUSTING** (5 points)	There is little visual evidence of surface crusting.
☐ (3 points) 4	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)	Severe surface crusting. (Note reason for cause)
☐ **RILLS AND GULLIES** (5 points)	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points)	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☒ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 6 **FIELD NOTES:**	

PH

Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation

Location Site 12

UTM Coord

Picture #	**Description**
	0675 -0677

Date/Time: 9/13/11 5:30pm

Observer PH, CM, VM

Soil Map Unit Name

Veg Alliance Name

Surface texture

Parent material

Slope %

Elevation (ft)

Topographic position

Aspect

Signs of Disturbance(s) observed

OAT score of 200-m transect 10

OAT score of polygon 10

Notes:

mesquite dominated

some juniper

yucca on far summit

E-facing

Block 1

1 Shrub

1 Forb ~~false mesquite?~~

Block 2

1 Forb

Block 3

1 Shrub

Block 4

mesquite

1 Forb

Block 5

2 shrub

Site 12 P11

Criteria used to score Observed Apparent Trend (OAT). ***Check appropriate box in each category which best fits area being observed. Points may vary within each category.***

☐ **VIGOR** (10 points)	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☐ (6 points)	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points) [✓ 1]	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points)	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points)	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points) [✓ 1]	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☐ **SURFACE LITTER** (5 points)	Surface litter is accumulating in place.
☐ (3 points)	Moderate movement of surface litter is apparent and deposited against obstacles.
☒ (1 point)	Very little surface litter is remaining.
☐ **PEDESTALS** (5 points) N/A	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☐ (3 points)	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point)	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☐ **SURFACE CRUSTING** (5 points)	There is little visual evidence of surface crusting.
☐ (3 points) [✓ 4]	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)	Severe surface crusting. (Note reason for cause)
☐ **RILLS AND GULLIES** (5 points)	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☒ (3 points)	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 10 **FIELD NOTES:**	

PH

Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation

Location Site 13

UTM Coord

Picture # Description
0662 — 0665

Date/Time: 9/13/11 7pm
Observer PH, CM, VM
Soil Map Unit Name
Veg Alliance Name
Surface texture
Parent material
Slope %
Elevation (ft)
Topographic position
Aspect

Signs of Disturbance(s) observed
grazing - ?

OAT score of 200-m transect 8
OAT score of polygon 8

Notes:

~~creo~~ mesquite w/ juniper/oak - encroaching

mesquite trampling

Site 13 pk

Criteria used to score Observed Apparent Trend (OAT). ***Check appropriate box in each category which best fits area being observed. Points may vary within each category.***

☐ **VIGOR** (10 points)	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☐ (6 points)	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points) ①	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points)	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points)	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points) ②	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☐ **SURFACE LITTER** (5 points)	Surface litter is accumulating in place.
☐ (3 points)	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point) ②	Very little surface litter is remaining.
☐ **PEDESTALS** (5 points) N/A	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☐ (3 points) 0	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point)	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☐ **SURFACE CRUSTING** (5 points)	There is little visual evidence of surface crusting.
☐ (3 points) ③	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)	Severe surface crusting. (Note reason for cause)
☐ **RILLS AND GULLIES** (5 points)	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points)	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point) ②	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 8 **FIELD NOTES:**	

PH

Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation

Location Site 14

UTM Coord

Picture # Description

-0653 to 0656

Date/Time: 9/13/11 1:30pm

Observer Penny Hunter, CM, VM

Soil Map Unit Name

Veg Alliance Name

Surface texture

Parent material

Slope %

Elevation (ft)

Topographic position

Aspect

Signs of Disturbance(s) observed

grazing occured up to 7 yrs ago. no apparent signs of grazing when at the site.

OAT score of 200-m transect 26

OAT score of polygon 26

Notes:

west slope

15-45% slope

mesquite + oak dominant

yucca subdominant

patchy.

Site 14 PH

Criteria used to score Observed Apparent Trend (OAT). *Check appropriate box in each category which best fits area being observed. Points may vary within each category.*

☐ **VIGOR** (10 points)	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☒ (6 points)	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points)	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points)	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points) (5)	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points)	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☐ **SURFACE LITTER** (5 points)	Surface litter is accumulating in place.
☐ (3 points) (4)	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point)	Very little surface litter is remaining.
☐ **PEDESTALS** (5 points)	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☒ (3 points)	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point)	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☒ **SURFACE CRUSTING** (5 points)	There is little visual evidence of surface crusting.
☐ (3 points)	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)	Severe surface crusting. (Note reason for cause)
☐ **RILLS AND GULLIES** (5 points)	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☒ (3 points)	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 26 **FIELD NOTES:**	13 0656

P14

Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation

Location Site 15

UTM Coord

Picture # Description 0645 to 0652

~~Sandstone~~.

Date/Time: 9/13/11 12pm

Observer P Hunter / C Meyer, VM

Soil Map Unit Name

Veg Alliance Name

Surface texture

Parent material

Slope %

Elevation (ft)

Topographic position

Aspect

Signs of Disturbance(s) observed

copper deposition noted

earth moving excavating

OAT score of 200-m transect 14

OAT score of polygon 14

Notes:

N-W ~~NS~~ W facing slope - ?

mesquite dominated

5, k 15 PH

Criteria used to score Observed Apparent Trend (OAT). ***Check appropriate box in each category which best fits area being observed. Points may vary within each category.***

☐ **VIGOR** (10 points)	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☐ (6 points)	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☑ (2 points)	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points)	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points)	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points) 6	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☐ **SURFACE LITTER** (5 points)	Surface litter is accumulating in place.
☐ (3 points) (2)	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point)	Very little surface litter is remaining.
☐ **PEDESTALS** (5 points)	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☑ (3 points)	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point)	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☐ **SURFACE CRUSTING** (5 points)	There is little visual evidence of surface crusting.
☐ (3 points) (4)	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)	Severe surface crusting. (Note reason for cause)
☐ **RILLS AND GULLIES** (5 points)	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☑ (3 points)	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: (14) **FIELD NOTES:**	

CM

Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation

Location Site 16

UTM Coord

Picture #	**Description**
	0678 - 0679 - at a distance forgot to take pics on plot

Date/Time: 9/14/11 9:00 am

Observer CM, VM, PH, JA, PP

Soil Map Unit Name

Veg Alliance Name

Surface texture

Parent material

Slope %

Elevation (ft)

Topographic position

Aspect

actually PP - PH did not contribute to scoring ~~the~~ any OAT

Signs of Disturbance(s) observed

OAT score of 200-m transect 23

OAT score of polygon 23

Lowest production area.

Notes: Oak - Juniper, minor mtn mohagony

Shrubs ~~Forb~~ whiteball acacia, false mesquite
half shrub - called shrub

Grasses - Vine mesquite, sideoats, cane bluestem

mesquite in open areas - sampled open area for wildlife

200 m - into oak - uphill

OAT - steep + flat - mixed.

9-14-11 Site 16 Cm

Criteria used to score Observed Apparent Trend (OAT). ***Check appropriate box in each category which best fits area being observed. Points may vary within each category.***

☐ **VIGOR** (10 points)	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☐ (6 points) 7	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points)	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points)	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points) 6	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points)	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☐ **SURFACE LITTER** (5 points)	Surface litter is accumulating in place.
☐ (3 points) 2	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point)	Very little surface litter is remaining.
☐ **PEDESTALS** (5 points)	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☐ (3 points) 2	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point)	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☐ **SURFACE CRUSTING** (5 points) 4	There is little visual evidence of surface crusting.
☐ (3 points)	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)	Severe surface crusting. (Note reason for cause)
☐ **RILLS AND GULLIES** (5 points)	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points)	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point) 2	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 23 **FIELD NOTES:**	

pit

Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation

Location Site 17

UTM Coord

Picture #	**Description**
	0657 – 0662

Date/Time: 9/13/11

Observer CM, PH, VM

Soil Map Unit Name

Veg Alliance Name

Surface texture

Parent material

Slope %

Elevation (ft)

Topographic position

Aspect

Signs of Disturbance(s) observed

OAT score of 200-m transect ~~8~~ 10

OAT score of polygon ~~8~~ 10

Notes:

South Facing

mesquite dominated

possible creosote sub-dominate.

no grasses

mesquite ~~grazing~~ trampling ?

Site 17

PH

Criteria used to score Observed Apparent Trend (OAT). ***Check appropriate box in each category which best fits area being observed. Points may vary within each category.***

☐ **VIGOR** (10 points)	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☐ (6 points)	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points) 6	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points)	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points)	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points) 6	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☐ **SURFACE LITTER** (5 points)	Surface litter is accumulating in place.
☐ (3 points)	Moderate movement of surface litter is apparent and deposited against obstacles.
☒ (1 point)	Very little surface litter is remaining.
☐ **PEDESTALS** (5 points) N/A	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☐ (3 points) 0	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point)	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☐ **SURFACE CRUSTING** (5 points)	There is little visual evidence of surface crusting.
☐ (3 points) 4	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)	Severe surface crusting. (Note reason for cause)
☐ **RILLS AND GULLIES** (5 points) 4	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points)	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 10 **FIELD NOTES:**	

Cell Phone Hill 2011 data — calibrate in 2014 to these areas to give same scores

Summit

vigor	9
seedlings	9
litter	5
pedestal	4
crusting	5
gully	5
OAT =	37

SW facing

Vigor	10
Seedlings	10
litter	5
pedestal	4
crusting	5
gully	5
OAT =	39

NE-facing

Vigor	10
Seedlings	10
litter	5
pedestal	5
crusting	5
gully	5
OAT =	40

Lamplugut Outcrop

Vigor	10
Seedling	10
litter	4
pedestal	3
crusting	4
gully	5
OAT =	36

Reference Campbell Outcrop 9/12/11. CM, VM, DH

Criteria used to score Observed Apparent Trend (OAT). ***Check appropriate box in each category which best fits area being observed. Points may vary within each category.***

☒ **VIGOR** (10 points) 10	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage. dry year - but set as best for grazed
☐ (6 points)	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points)	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☒ **SEEDLINGS** (10 points) 10	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present. dry year little but set as best for grazed
☐ (6 points)	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points)	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☒ **SURFACE LITTER** (5 points) 4 ~~6~~	Surface litter is accumulating in place.
☐ (3 points)	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point)	Very little surface litter is remaining.
☐ **PEDESTALS** (5 points)	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☒ (3 points) 3	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point)	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☐ **SURFACE CRUSTING** (5 points)	There is little visual evidence of surface crusting.
☐ (3 points) 4	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)	Severe surface crusting. (Note reason for cause)
☒ **RILLS AND GULLIES** (5 points) 5	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points)	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 36 **FIELD NOTES:**	mesquite - dominant Sideoats grama - common prickly pear cacti litter moving some w/ sheet erosion 2-3' patches minor crusting moderate pedestalling oak in drainage Mormon tea wild holly lots seed heads

Scour + deposit.

Reference cell phone hill SW facing slope 9/12 [illegible]

Criteria used to score Observed Apparent Trend (OAT). ***Check appropriate box in each category which best fits area being observed. Points may vary within each category.***

☒ **VIGOR** (10 points) 10	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage. for dry year forage levels
☐ (6 points)	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points)	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☒ **SEEDLINGS** (10 points) 10	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points)	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points)	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☒ **SURFACE LITTER** (5 points) 5	Surface litter is accumulating in place.
☐ (3 points)	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point)	Very little surface litter is remaining.
☒ **PEDESTALS** (5 points) min 5	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☐ (3 points)	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point)	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☒ **SURFACE CRUSTING** (5 points) 5	There is little visual evidence of surface crusting.
☐ (3 points)	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)	Severe surface crusting. (Note reason for cause)
☒ **RILLS AND GULLIES** (5 points) 5	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points)	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 40 **FIELD NOTES:**	Snake broomweed - dead mostly Tobosa grass - low growth relative to last year - only 1 seedhead Fluff grass ~ not great for ~~ga~~ forage [illegible]

<2' for patches is good (patches smaller than these)

Refuge Cell phone hill NE-facing 9/13/11 [illegible]

Criteria used to score Observed Apparent Trend (OAT). ***Check appropriate box in each category which best fits area being observed. Points may vary within each category.***

☒ **VIGOR** (10 points) 10	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☐ (6 points) ~~10~~	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points)	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☒ **SEEDLINGS** (10 points) 10	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points)	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points)	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☒ **SURFACE LITTER** (5 points) 5	Surface litter is accumulating in place.
☐ (3 points)	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point)	Very little surface litter is remaining.
☐ **PEDESTALS** (5 points) 4	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☐ (3 points)	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point)	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☒ **SURFACE CRUSTING** (5 points) 5	There is little visual evidence of surface crusting.
☐ (3 points)	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)	Severe surface crusting. (Note reason for cause)
☐ **RILLS AND GULLIES** (5 points) 5	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points)	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 39 **FIELD NOTES:**	↑ variety of grasses relative to SW side more Snakeweed growth Tobosa, etc. Mormon tea anthill - accumulated seed pods more pedestally than ~~Do~~ southwest side

Reference Cell phone hill summit 9/12/11 . PH, CM, VM

Criteria used to score Observed Apparent Trend (OAT). ***Check appropriate box in each category which best fits area being observed. Points may vary within each category.***

☒ **VIGOR** (10 points) 9	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☐ (6 points)	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points)	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points) 9	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points)	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points)	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☐ **SURFACE LITTER** (5 points) 5	Surface litter is accumulating in place.
☐ (3 points)	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point)	Very little surface litter is remaining.
☒ **PEDESTALS** (5 points) 4	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☐ (3 points)	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point)	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☐ **SURFACE CRUSTING** (5 points) 5	There is little visual evidence of surface crusting.
☐ (3 points)	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)	Severe surface crusting. (Note reason for cause)
☐ **RILLS AND GULLIES** (5 points) 5	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points)	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 37 **FIELD NOTES:**	Yucca added to species seen on SE cell phone slope.

B1 pics [illegible] ② in between B2 pics

B-1 8-30-12

Criteria used to score Observed Apparent Trend (OAT). ***Check appropriate box in each category which best fits area being observed. Points may vary within each category.***

	☐ **VIGOR** (10 points)	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
6.	☒ (6 points)	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
	☐ (2 points)	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
	☐ **SEEDLINGS** (10 points)	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
2	☐ (6 points)	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
	☒ (2 points)	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
	☐ **SURFACE LITTER** (5 points)	Surface litter is accumulating in place.
2	☐ (3 points) 2	Moderate movement of surface litter is apparent and deposited against obstacles.
	☐ (1 point)	Very little surface litter is remaining.
	☐ **PEDESTALS** (5 points)	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
1	☐ (3 points)	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
	☒ (1 point)	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
	☐ **SURFACE CRUSTING** (5 points)	There is little visual evidence of surface crusting.
3	☒ (3 points)	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
?,	☐ (1 point)	Severe surface crusting. (Note reason for cause)
	☐ **RILLS AND GULLIES** (5 points)	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
3	☒ (3 points)	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
?,	☐ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
	TOTAL: 17 **FIELD NOTES:**	

Phil's Pics B1 = 12 East end of OAT [illegible] looking west

3 or 4 – pedestalling [illegible] grass [illegible]

Rangeland Health Evaluation Summary Worksheet

Area of Interest Documentation

Site ID 131

Lat 32,672242 Long 108.043877

Transect Direction East

Picture #	Description

Date/Time:	8-30-12
Observer	CM, PH
Soil Map Unit Name	
Veg Alliance Name	
% Exposed Bedrock	75%
Surface texture	
Parent material	
Slope %	
Elevation (ft)	
Topographic position	
Aspect	

Signs of Disturbance(s) observed

OAT score of 200-m transect ____________________

OAT score of polygon____________________

Notes:

B2 8-30-12

Criteria used to score Observed Apparent Trend (OAT). ***Check appropriate box in each category which best fits area being observed. Points may vary within each category.***

☐ **VIGOR** (10 points)	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☐ (6 points) 4	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points)	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points)	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points)	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points) 2	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☐ **SURFACE LITTER** (5 points)	Surface litter is accumulating in place.
☐ (3 points) 2	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point)	Very little surface litter is remaining.
☐ **PEDESTALS** (5 points)	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☐ (3 points)	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point) 1	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☐ **SURFACE CRUSTING** (5 points) NA	There is little visual evidence of surface crusting.
☐ (3 points)	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)	Severe surface crusting. (Note reason for cause)
☐ **RILLS AND GULLIES** (5 points)	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points) 2	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 11 **FIELD NOTES:**	Tx length is 300' because representative patch was limited

last photo 100-0325
B2

Rangeland Health Evaluation Summary Worksheet

Area of Interest Documentation

Site ID 13-2

Lat 32.672831 **Long** 108.043059

Transect Direction [illegible]

Picture #	**Description**

Date/Time: 8-30-12 NOON
Observer CM, PH, POD, AF
Soil Map Unit Name
Veg Alliance Name
% Exposed Bedrock 85%
Surface texture
Parent material
Slope %
Elevation (ft)
Topographic position
Aspect

Signs of Disturbance(s) observed

OAT score of 200-m transect

OAT score of polygon

Notes:

B3 reference

[illegible] Tobosa

Criteria used to score Observed Apparent Trend (OAT). *Check appropriate box in each category which best fits area being observed. Points may vary within each category.*

☐ **VIGOR** (10 points)	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☒ (6 points) 6	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points)	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points)	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points)	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☒ (2 points) 2	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☐ **SURFACE LITTER** (5 points)	Surface litter is accumulating in place.
☐ (3 points)	Moderate movement of surface litter is apparent and deposited against obstacles.
☒ (1 point) 1	Very little surface litter is remaining.
☐ **PEDESTALS** (5 points)	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☐ (3 points)	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☒ (1 point)	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☐ **SURFACE CRUSTING** (5 points) 4 pts	There is little visual evidence of surface crusting.
☐ (3 points)	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)	Severe surface crusting. (Note reason for cause)
☐ **RILLS AND GULLIES** (5 points)	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points) 2	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 15 **FIELD NOTES:**	

photo 150-0~~172~~342 left of 8 of Bolton [illegible]

Rangeland Health Evaluation Summary Worksheet

Area of Interest Documentation

Site ID B3

Lat ____ **Long** ____

Transect Direction X - in saguaro plot

Picture # **Description**

Date/Time: 8-30-12
Observer CM, PH, AF
Soil Map Unit Name
Veg Alliance Name
% Exposed Bedrock
Surface texture
Parent material
Slope %
Elevation (ft)
Topographic position
Aspect

Signs of Disturbance(s) observed

OAT score of 200-m transect ____

OAT score of polygon____

Notes:

Wildlife Habitat Sampling Form

Site ID: **STS-RWU-2012-B1**

Lat: ~~32.672242~~

Long: ~~108.043877~~

Date 8-30-12

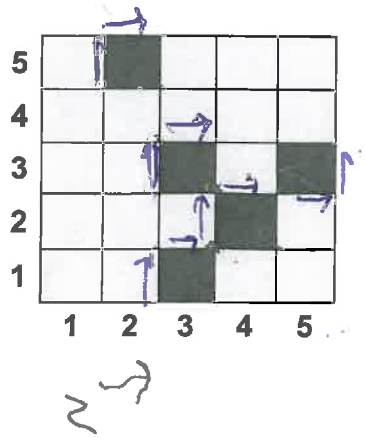
Investigators CM, AP, PH

Photo number B1 100-0344 last

% Exposed Bedrock 75%

	Total Cover	% Tree Cover	% Shrub Cover	Grass % ~~Cactus~~ Cover	Forbs % ~~Yucca~~ Cover	Succulents
Block 1 tree ↓	5-25 5-25 0 → 5-25	5-25 5-25 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
Block 2	0 0 0 5-25	0 0 0 0	0 0 0 0	0 0 5-25 0	0 0 0 0	0 0 0 0
Block 3	0 5-25 0 5-25	0 0 0 0	0 0 0 0	0 5-25 0 5-25	0 0 0 0	0 0 0 0
Block 4	100 0 100 0	100 0 100 0	0 0 0 0	0 0 0 0	0 0 0	0 0 5-25 0
Block 5	50-75 0-3 5-25 0	50-75 0 0	0 0 0	0 5-25 0	0 0-5 0 0	0 0 0 0

	Total ~~Cover~~ Species	# Trees 2 species	# Shrubs	Grass # ~~Cactus and Succulents~~	Forbs # ~~Yucca~~	~~Number of species in block~~ Succulents 2 cactus
Block 1	13	7 oak, juniper	1 species	3 species	4 species	
Block 2						
Block 3						
Block 4						
Block 5						



Wildlife Habitat Sampling Form

Site ID: STS-RWU-2012-B2

Lat: 32.672831 **Long:** 108.043059

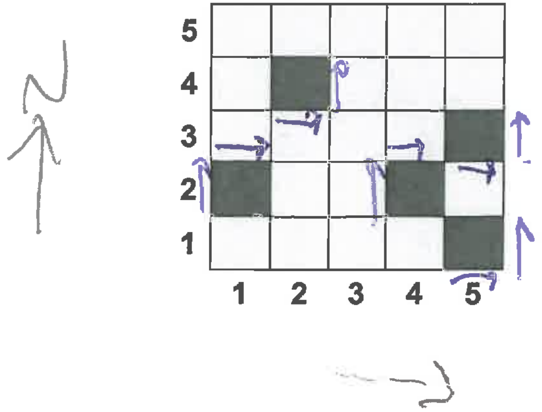
Date 8-30-12 **Investigators** CM, PH, PDP

% Exposed Bedrock 85% (83.7%)

Photo number ____________

	Total Cover	% Tree Cover	% Shrub Cover	% ~~Cactus Cover~~ Grass	% ~~Yucca Cover~~ Forbs	Succulents
Block 1	5-25 0 5-25 0	0 0 0 0	0-5 0 0 0	5-25 0 5-25 0	0 0 0 0	5-25 0 0-5 0
Block 2	0-5 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0-5 0 0 0
Block 3	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
Block 4	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
Block 5	0 0 0-5 5-25	0 0 0 0	0 0 0-5 0	0 0 0-5 5-25	0 0 0 0	0 0 0 0

	Total Species	# Trees 1 sp-oak	# Shrubs 3 species	# ~~Cactus and Succulents~~ Grass 4 grasses	# ~~Yucca~~ Forbs sp 3 Forbs	~~Number of species in block~~ Succulents cactus 3 species
Block 1	14 sp.					
Block 2						
Block 3						
Block 4						
Block 5						



Wildlife Habitat Sampling Form

Site ID: **STS-RWU-2012-B3**

Lat: 32.672103

Long: 108.042746

Date 8-30-12

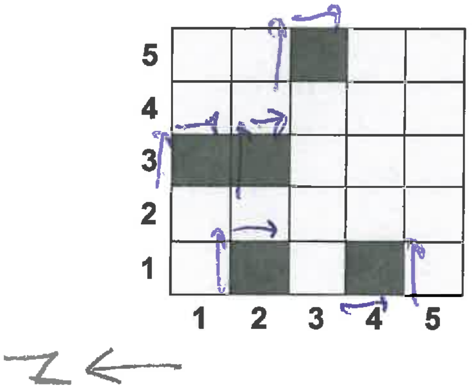
Investigators Carolyn M, Pam P, Alicia F, Phil

Photo number 100-0335 (last photo)

% Exposed Bedrock 93

	Total cover	% Tree Cover	% Shrub Cover	% ~~Cactus Cover~~ ~~Forbs~~ Grass	% ~~Yucca Cover~~ Forbs	Suc
Block 1	0 0-5 0	0 0 0 0	0 0 0-5 0	0 0 0 0	0 0 0 0	0 0 0 0
Block 2	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
Block 3	0-5 50-75 0 0	0-5 50-75 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
Block 4	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
Block 5	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0

	Total Species	# Trees 1	# Shrubs 3	# ~~Cactus and Succulents~~ Grass 2	# ~~Yucca~~ Forbs 3	~~Number of species~~ in block Succulent
Block 1	10	1	3	2	3	1 ← Yucca
Block 2						
Block 3						
Block 4						
Block 5						



Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation

Location STS - PT - 2013 — 1

UTM Coord

Picture # **Description**

Date/Time: 9-24-14 11:47 am
Observer AM, PP, MS, JA
Soil Map Unit Name
Veg Alliance Name
Surface texture
Parent material
Slope %
Elevation (ft)
Topographic position
Aspect

See Excel file w/ OAT score

Signs of Disturbance(s) observed

OAT score of 200-m transect 15
OAT score of polygon 0

Notes:

almost 100% mesquite dominated

1 or 2 grasses Aristida
Sporobolus (~~[illegible]~~ alkali sacaton)

lots forbs = cotyledons, seedlings (nightshade, woolly aster)

but fewer farther downhill

near ripped haul road — one in plot - avoided

red rock - armored

seed rain effect from ripped road ↑ score for seedlings?

15 - 3 (pedestals) = 12

STS-PT-2013-1

Criteria used to score Observed Apparent Trend (OAT). *Check appropriate box in each category which best fits area being observed. Points may vary within each category.*

☐ **VIGOR** (10 points)	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☐ (6 points)	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points) 1	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points)	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points)	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points) 2	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☐ **SURFACE LITTER** (5 points)	Surface litter is accumulating in place.
☐ (3 points)	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point) 2	Very little surface litter is remaining.
☐ **PEDESTALS** (5 points) 3	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☐ (3 points)	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point)	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☐ **SURFACE CRUSTING** (5 points)	There is little visual evidence of surface crusting.
☐ (3 points) 3	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)	Severe surface crusting. (Note reason for cause)
☐ **RILLS AND GULLIES** (5 points) 4	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points)	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 15	no diversity
FIELD NOTES:	

Skunk bush

irregular lotebush ½ to 2 feet

Even shrubs unhealthy (lotebush later?)

seems high seedling giving it seasonal bias

Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation

Location STS -PT-2013 — ~~[illegible]~~ 2

UTM Coord

Picture # Description

Date/Time: 9-24-14 9:00am

Observer JA, CM, PP, MS

Soil Map Unit Name

Veg Alliance Name

Surface texture

Parent material

Slope %

Elevation (ft)

Topographic position

Aspect

Signs of Disturbance(s) observed

OAT score of 200-m transect 12

OAT score of polygon

Mesquite dominated

a little Sporobolus

red rock armored

Notes: bristlegrass

nightshade

Portulaca ?

rocky bottom - colluvial soil accumulated

drop in colluvial soil

small spurge

~~1 mormon~~

1 mormon tea

-3 = 9? pedestals

Russian thistle

road - block - capture

STS-PT-2013-2

Criteria used to score Observed Apparent Trend (OAT). ***Check appropriate box in each category which best fits area being observed. Points may vary within each category.***

☐ **VIGOR** (10 points)	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☐ (6 points)	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☑ (2 points)	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points)	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points)	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☑ (2 points) 1	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☐ **SURFACE LITTER** (5 points)	Surface litter is accumulating in place.
☐ (3 points) 2	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point)	Very little surface litter is remaining.
☐ **PEDESTALS** (5 points)	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☑ (3 points) 3	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point)	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☐ **SURFACE CRUSTING** (5 points)	There is little visual evidence of surface crusting.
☐ (3 points) 2	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)	Severe surface crusting. (Note reason for cause)
☐ **RILLS AND GULLIES** (5 points) 4	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points)	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 12 **FIELD NOTES:**	

Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation

Location STS-PT-2013-5

UTM Coord

Picture # Description

Date/Time: 9-25-14 9:00 am
Observer CM, JA, MS, PP
Soil Map Unit Name
Veg Alliance Name
Surface texture
Parent material
Slope %
Elevation (ft)
Topographic position
Aspect

Signs of Disturbance(s) observed

OAT score of 200-m transect
OAT score of polygon

Notes: On ~50% Slope

25% bedrock

lots armoring

Oak-

Tabosa
sideoats
vine mesquite

mesquite/catclaw
lots yucca & cacti
Some surviving yucca
(cholla still dead)

2 shrub sp. dominate in patches

27

high mass(Alyosia
shrub wrightii)

STS - PT-2013-5

Criteria used to score Observed Apparent Trend (OAT). ***Check appropriate box in each category which best fits area being observed. Points may vary within each category.***

☐ **VIGOR** (10 points)	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☐ (6 points) 7	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points)	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points)	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points) 6	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points)	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☐ **SURFACE LITTER** (5 points)	Surface litter is accumulating in place.
☐ (3 points) 3	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point)	Very little surface litter is remaining.
☐ **PEDESTALS** (5 points)	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☐ (3 points) 4	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point)	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☐ **SURFACE CRUSTING** (5 points) 4	There is little visual evidence of surface crusting.
☐ (3 points)	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)	Severe surface crusting. (Note reason for cause)
☐ **RILLS AND GULLIES** (5 points)	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points) 3	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 27 **FIELD NOTES:**	

Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation

Location N

UTM Coord STS - PT - 2013 - 9

Picture # Description

Date/Time: 9-24-14 2:30pm

Observer CM, PP, JA, MS

Soil Map Unit Name

Veg Alliance Name

Surface texture

Parent material

Slope %

Elevation (ft)

Topographic position

Aspect

Signs of Disturbance(s) observed

OAT score of 200-m transect 7

OAT score of polygon

near model T road

Notes: Domi: mesquite - mostly, Some alligator juniper

Tobosa - rare - few patches

- 1 patch sacaton

Soil moving

green rocks

sick plants

shrubs

60% bedrock

STS-PT-2013-9

Criteria used to score Observed Apparent Trend (OAT). ***Check appropriate box in each category which best fits area being observed. Points may vary within each category.***

☐ **VIGOR** (10 points)	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☐ (6 points)	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points) 0	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points)	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points)	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points) 1	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☐ **SURFACE LITTER** (5 points)	Surface litter is accumulating in place.
☐ (3 points)	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point) 1	Very little surface litter is remaining.
☐ **PEDESTALS** (5 points)	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☐ (3 points)	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point) 1	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☐ **SURFACE CRUSTING** (5 points)	There is little visual evidence of surface crusting.
☐ (3 points) 2	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)	Severe surface crusting. (Note reason for cause)
☐ **RILLS AND GULLIES** (5 points)	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points) 2	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 7 **FIELD NOTES:**	

Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation

Location STS - DTS-2013 - 12

UTM Coord

Picture # Description

Date/Time: 9-23-14 1:35 pm
Observer CM, PP, JA, MS
Soil Map Unit Name
Veg Alliance Name
Surface texture
Parent material
Slope %
Elevation (ft)
Topographic position
Aspect

Signs of Disturbance(s) observed

OAT score of 200-m transect 17
OAT score of polygon

Notes:

Desirable

sideoats grama
hairy grama
Indian ricegrass
deergrass (muhlenbergia)
vine mesquite
3-awn - purple + Arizona - more spread out

85% bedrock

healthy plants

Bedrock → oak-juniper → (yucca) dominated

STJ-PI-2013-12
Site 12 9-23-14

Criteria used to score Observed Apparent Trend (OAT). ***Check appropriate box in each category which best fits area being observed. Points may vary within each category.***

☐ **VIGOR** (10 points)	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☑ (6 points) 6	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points)	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points)	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points)	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☑ (2 points) 2	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☐ **SURFACE LITTER** (5 points)	Surface litter is accumulating in place.
☐ (3 points) 2	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point)	Very little surface litter is remaining.
☐ **PEDESTALS** (5 points)	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☑ (3 points) 3	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point)	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☐ **SURFACE CRUSTING** (5 points)	There is little visual evidence of surface crusting.
☑ (3 points)	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)	Severe surface crusting. (Note reason for cause)
☐ **RILLS AND GULLIES** (5 points)	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points)	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☑ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 17 **FIELD NOTES:**	

Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation

Location STS - PT - 2013 - 17

East Reference Plot

UTM Coord

Picture # Description

Date/Time: 9-24-14 10:19am
Observer CM, MS, JA, PP
Soil Map Unit Name
Veg Alliance Name
Surface texture
Parent material
Slope %
Elevation (ft)
Topographic position
Aspect

Signs of Disturbance(s) observed

OAT score of 200-m transect 19
OAT score of polygon

Mesquite - dominated

no pedestalling
gaining soil

Notes: Setaria
Cane Bluestem, Sporobolus
~~[illegible]~~ sixweeks grama - small grama
Aristida —
golden crownbeard
Boerhavia —

lemmrant

STS-PT-2013-17

Criteria used to score Observed Apparent Trend (OAT). ***Check appropriate box in each category which best fits area being observed. Points may vary within each category.***

☐ **VIGOR** (10 points)	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☐ (6 points) 3	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points)	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points)	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points) 5	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points)	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☐ **SURFACE LITTER** (5 points)	Surface litter is accumulating in place.
☐ (3 points) 2	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point)	Very little surface litter is remaining.
☐ **PEDESTALS** (5 points) 5	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☐ (3 points)	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point)	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☐ **SURFACE CRUSTING** (5 points)	There is little visual evidence of surface crusting.
☐ (3 points)	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☑ (1 point) 1	Severe surface crusting. (Note reason for cause)
☐ **RILLS AND GULLIES** (5 points)	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☑ (3 points) 3	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 19 **FIELD NOTES:**	

Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation

Location S15AR2013 - 49

UTM Coord

Picture #	**Description**

Date/Time: 9-24-14 12:52pm

Observer MS, PM, CM, JA

Soil Map Unit Name

Veg Alliance Name

Surface texture

Parent material

Slope %

Elevation (ft)

Topographic position

Aspect

Signs of Disturbance(s) observed

OAT score of 200-m transect 15 0

OAT score of polygon

67% bedrock - large boulders/bedrock

Notes:

mesquite/juniper, catclaw
Alligator trees
~~very few~~
- lambsquarters
Portulaca
Amaranth
Yucca
trace grass - Aristida
cane ~~grama~~ bluestem

CA brickellbush under juniper

shrubs not as healthy - lots ½ dead or ¼ dead mesquite

See CA on side

15 maybe too high
2011
0 for pedestal?
0 for vigor
(10)

STS-PT-2013-19 bedrock type

Criteria used to score Observed Apparent Trend (OAT). *Check appropriate box in each category which best fits area being observed. Points may vary within each category.*

☐ **VIGOR** (10 points)		Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☐ (6 points)		Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points)	1	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points)		There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points)		Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points)	2	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☐ **SURFACE LITTER** (5 points)		Surface litter is accumulating in place.
☐ (3 points)	2	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point)		Very little surface litter is remaining.
☐ **PEDESTALS** (5 points)	4	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☐ (3 points)		There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point)		Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☐ **SURFACE CRUSTING** (5 points)		There is little visual evidence of surface crusting.
☐ (3 points)	3	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)		Severe surface crusting. (Note reason for cause)
☐ **RILLS AND GULLIES** (5 points)		Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points)	3	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point)		Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.

TOTAL: 15

FIELD NOTES:

Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation

Location STS-PT-2013 -20

UTM Coord

Picture #	**Description**

Date/Time: 4:28 9-23-14
Observer CM, PP, MS, TA
Soil Map Unit Name
Veg Alliance Name
Surface texture
Parent material
Slope %
Elevation (ft)
Topographic position
Aspect

Signs of Disturbance(s) observed

OAT score of 200-m transect 36
OAT score of polygon

West side

Notes:

Aristida ← dominant
Sideoats grama
blue grama
ring muhly ? - poor forage?

(note except
ref + amendment
are grazed —
other amendment
allots are
not
since 2008
fenced out

STS -PT-2015-20

Criteria used to score Observed Apparent Trend (OAT). ***Check appropriate box in each category which best fits area being observed. Points may vary within each category.***

☐ **VIGOR** (10 points) 8	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☐ (6 points)	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points)	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points) 8	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points)	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points)	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☐ **SURFACE LITTER** (5 points) 4	Surface litter is accumulating in place.
☐ (3 points)	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point)	Very little surface litter is remaining.
☐ **PEDESTALS** (5 points)	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☐ (3 points)	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point) 2	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☐ **SURFACE CRUSTING** (5 points)	There is little visual evidence of surface crusting.
☑ (3 points) 3	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)	Severe surface crusting. (Note reason for cause)
☑ **RILLS AND GULLIES** (5 points) 5	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points)	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 30 **FIELD NOTES:**	

Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation

Location STS-PT-2013-26

UTM Coord

Picture # **Description**

Date/Time: 9-25-14 12:55pm
Observer CM, DDP, MS, JA
Soil Map Unit Name
Veg Alliance Name
Surface texture
Parent material
Slope %
Elevation (ft)
Topographic position
Aspect

Signs of Disturbance(s) observed

OAT score of 200-m transect
OAT score of polygon

Notes: mesquite-grama- dominant

- sideoats grama
- (a little blue grama)

vine mesquite

Tobosa

less desirable → ring muhly

Aristida

less desirable → fluff grass

horse-grazed
Tobosa - less attractive

like backyard of 2 ranches

less moisture - can't sustain as much grazing?

ETS-PT-2013-26

Criteria used to score Observed Apparent Trend (OAT). *Check appropriate box in each category which best fits area being observed. Points may vary within each category.*

☐ **VIGOR** (10 points)	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☐ (6 points) 5	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points)	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points)	There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points) 4	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points)	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☐ **SURFACE LITTER** (5 points)	Surface litter is accumulating in place.
☐ (3 points)	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point) 1	Very little surface litter is remaining.
☐ **PEDESTALS** (5 points)	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☐ (3 points)	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point) 2	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☐ **SURFACE CRUSTING** (5 points)	There is little visual evidence of surface crusting.
☐ (3 points) 3	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)	Severe surface crusting. (Note reason for cause)
☐ **RILLS AND GULLIES** (5 points) 5	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points)	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 20 **FIELD NOTES:**	

Rangeland Health Evaluation Summary Worksheet

Part 1. Area of Interest Documentation

Location Cell phone Hill NE, Summit, SW
worst best

UTM Coord

Picture #	**Description**

Date/Time: 9-23-14 12:19 pm
Observer Carolyn Meyer, Dana Pilsson, Matt Schultz, Joe Allen
Soil Map Unit Name
Veg Alliance Name
Surface texture
Parent material
Slope %
Elevation (ft)
Topographic position
Aspect NE

Signs of Disturbance(s) observed

OAT score of 200-m transect 39
OAT score of polygon

Notes: Calibrated to 2011 values of 40, 39, 38

NE + SW are reversed
- so fix on map

East Amendment Plot

Criteria used to score Observed Apparent Trend (OAT). *Check appropriate box in each category which best fits area being observed. Points may vary within each category.*

☑ **VIGOR** (10 points)	Desirable grasses, forbs and shrubs are vigorous, showing good health. These plants have good size, color, and produce abundant herbage.
☐ (6 points)	Desirable grasses, forbs and shrubs have moderate vigor. They are medium size with fair color, and produce moderate amounts of herbage. Some seed stalks and seed heads are present.
☐ (2 points)	Desirable grasses, forbs and shrubs have low vigor. They appear unhealthy with small size and poor color. Portions of clumps or entire plants are dead or dying. Seed stalks and seed heads are non-existent, except in protected areas.
☐ **SEEDLINGS** (10 points) ↑ emerging seedlings not desirable	✓There is seedling establishment of desirable grasses, forbs and shrubs. Seedlings are present in open spaces between plants and along edges of soil pedestals. Few seedlings of invader or undesirable plants are present.
☐ (6 points)	Some seedlings of desirable grasses, forbs and shrubs may or may not be present in open spaces between plants. Some seedlings of invader or undesirable plant species may or may not be present.
☐ (2 points)	Few if any seedlings of desirable grasses, forbs and shrubs are being established. Seedlings of invader or undesirable plants are present in open spaces between plants.
☑ **SURFACE LITTER** (5 points)	Surface litter is accumulating in place.
☐ (3 points)	Moderate movement of surface litter is apparent and deposited against obstacles.
☐ (1 point)	Very little surface litter is remaining.
☑ **PEDESTALS** (5 points)	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounding and accumulating litter. Desirable forage grasses may be found along edges of pedestals.
☐ (3 points)	There is moderate pedestalling with no visual evidence of healing or deterioration. Small rock and plant pedestals may be occurring in flow patterns.
☐ (1 point)	Most rocks and plants are pedestalled. Pedestals are sharp-sided and eroding, often exposing grass roots.
☑ **SURFACE CRUSTING** (5 points)	There is little visual evidence of surface crusting.
☐ (3 points)	There is moderate surface crusting, with no visual evidence of healing or deterioration. (Note reason for cause)
☐ (1 point)	Severe surface crusting. (Note reason for cause)
☑ **RILLS AND GULLIES** (5 points)	Gullies (including rills) may be present in stable condition, with moderate sloping or rounded sides. Perennials are establishing themselves on bottom and sides of channel.
☐ (3 points)	Gullies are well developed, with small amounts of active erosion. Some vegetation may be present.
☐ (1 point)	Sharply incised V-shaped gullies cover most of the area, with most of the gullies actively eroding. Gullies are mostly devoid of perennial plants. They have fresh cutting on the bottom.
TOTAL: 39 **FIELD NOTES:**	

b needle grass
e: doats
↓ golden currant

Table F-3. Names of Species in Species Richness Dataset of 2014

Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Site ID	Block	Date	# Trees/ Shrub sp.	Trees/ Shrub sp. ID*	# Grass sp.	Grass sp. ID*	# Forb sp.	Forb sp. ID*	# Cactus sp.	Cactus sp. ID*	# Species in Block
STS-PT-2013-1	1	9/24/2014	1	Prosopis glandulosa Torrey	1	*Aristida purpurea* Nuttall -red three awn	1	(1) unknown forb	0		3
STS-PT-2013-1	2	9/24/2014	1	Prosopis glandulosa Torrey	0		3	*Pseudognaphalium stramineum (Kunth) W.A. Weber* *Solanum elaeagnifolium* Cavanilles (1) unknown forb	1	*Yucca elata* Engelmann	5
STS-PT-2013-1	3	9/24/2014	1	Prosopis glandulosa Torrey	0		1	*Solanum elaeagnifolium* Cavanilles	0		2
STS-PT-2013-1	4	9/24/2014	1	Prosopis glandulosa Torrey	1	*Sporobolus cryptandrus* (Torrey) A. Gray- sand dropseed	1	*Hybanthus verticillatus* (Ortega) Baillon	1	*Yucca elata* Engelmann	4
STS-PT-2013-1	5	9/24/2014	1	Prosopis glandulosa Torrey	0		2	*Pseudognaphalium stramineum* (Kunth) W.A. Weber *Sphaeralcea* sp.	0		3
STS-PT-2013-2	1	9/24/2014	1	Prosopis glandulosa Torrey	1	*Bothriochloa barbinodis* (Lagasca) Herter--cane bluestem	1	*Solanum elaeagnifolium* Cavanilles	0		3
STS-PT-2013-2	2	9/24/2014	1	Prosopis glandulosa Torrey	0		1	*Solanum elaeagnifolium* Cavanilles	0		2
STS-PT-2013-2	3	9/24/2014	2	Prosopis glandulosa Torrey *Condalia spathulata* A. Gray	0		4	*Amaranthus palmeri* S. Watson *Salsola tragus* Linnaeus *Portulaca* sp. (1) unknown forb	0		6
STS-PT-2013-2	4	9/24/2014	1	Prosopis glandulosa Torrey	2	*Bothriochloa barbinodis* (Lagasca) Herter *Setaria* sp.	8	*Amaranthus palmeri* S. Watson *Physaria* sp. *Salsola tragus* Linnaeus *Solanum elaeagnifolium* Cavanilles *Sphaeralcea coccinea* (Nuttall) Rydberg (3) unknown forbs	0		11
STS-PT-2013-2	5	9/24/2014	1	Prosopis glandulosa Torrey	2	*Bothriochloa barbinodis* (Lagasca) Herter *Setaria* sp.	2	*Solanum elaeagnifolium* Cavanilles (1) unknown forb	0		5
STS-PT-2013-5	1	9/25/2014	2	*Acourtia wrightii* (Gray) Reveal & King - brownfoot *Mimosa aculeaticarpa* Ortega var. *biuncifera* (Bentham) Barneby - catclaw mimosa	3	*Hopia obtusa* (Kunth) Zuloaga & Morrone - vine mesquite *Pleuraphis mutica* Buckley *Setaria* sp.	3	*Hybanthus verticillatus* (Ortega) Baillon *Solanum elaeagnifolium* Cavanilles (1) unknown forb	2	*Nolina microcarpa* S. Watson--sacahuista *Dasylirion wheeleri* S. Watson--desert spoon	10
STS-PT-2013-5	2	9/25/2014	2	*Acourtia wrightii* (Gray) Reveal & King *Mimosa aculeaticarpa* Ortega var. *biuncifera* (Bentham) Barneby	1	*Hopia obtusa* (Kunth) Zuloaga & Morrone	2	*Rhynchosia senna* Gillies ex Hooker *Solanum elaeagnifolium* Cavanilles	2	*Nolina microcarpa* S. Watson *Dasylirion wheeleri* S. Watson	7
STS-PT-2013-5	3	9/25/2014	3	*Acourtia wrightii* (Gray) Reveal & King *Mimosa aculeaticarpa* Ortega var. *biuncifera* (Bentham) Barneby *Prosopis glandulosa* Torrey	2	*Bouteloua curtipendula* (Michaux) Torrey - sideoats grama *Hopia obtusa* (Kunth) Zuloaga & Morrone	3	*Rhynchosia senna* Gillies ex Hooker *Solanum elaeagnifolium* Cavanilles (1) unknown forb	1	*Dasylirion wheeleri* S. Watson	9
STS-PT-2013-5	4	9/25/2014	3	*Aloysia wrightii* (Gray) Heller ex Abrams--Wright's beebrush *Mimosa aculeaticarpa* Ortega var. *biuncifera* (Bentham) Barneby *Prosopis glandulosa* Torrey	1	*Bouteloua curtipendula* (Michaux) Torrey	3	*Chenopodium album* Linnaeus *Solanum elaeagnifolium* Cavanilles (1) unknown forb	1	*Dasylirion wheeleri* S. Watson	8
STS-PT-2013-5	5	9/25/2014	3	*Acourtia wrightii* (Gray) Reveal & King *Mimosa aculeaticarpa* Ortega var. *biuncifera* (Bentham) Barneby *Prosopis glandulosa* Torrey	2	*Bouteloua curtipendula* (Michaux) Torrey *Hopia obtusa* (Kunth) Zuloaga & Morrone	3	*Rhynchosia senna* Gillies ex Hooker *Solanum elaeagnifolium* Cavanilles (1) unknown forb	1	*Dasylirion wheeleri* S. Watson	9
STS-PT-2013-9	1	9/24/2014	0		0		1	*Hybanthus verticillatus* (Ortega) Baillon	1	*Nolina microcarpa* S. Watson	2
STS-PT-2013-9	2	9/24/2014	0		0		1	*Hybanthus verticillatus* (Ortega) Baillon	0		1
STS-PT-2013-9	3	9/24/2014	1	*Mimosa aculeaticarpa* Ortega var. *biuncifera* (Bentham) Barneby	0		1	(1) unknown forb	0		2
STS-PT-2013-9	4	9/24/2014	1	*Mimosa aculeaticarpa* Ortega var. *biuncifera* (Bentham) Barneby	0		1	(1) unknown forb	0		2
STS-PT-2013-9	5	9/24/2014	1	*Juniperus deppeana* Steudel	0		1	*Amaranthus palmeri* S. Watson	0		2
STS-PT-2013-12	1	9/23/2014	6	Brickellia californica (Torrey & Gray) Gray-- California bricklebush *Brickellia lemmonii* Gray - skunkbush *Juniperus monosperma* (Engelmann) Sargent-one-seed juniper *Mimosa aculeaticarpa* Ortega var. *biuncifera* (Bentham) Barneby *Quercus emoryi* Torrey - Emory oak *Rhus trilobata* Nuttall	6	*Achnatherum hymenoides* (Roemer & J.A. Schultes) Barkworth-Indian ricegrass *Aristida purpurea* Nuttall *Bouteloua curtipendula* (Michaux) Torrey *Bouteloua hirsuta* Lagasca - hairy grama *Hopia obtusa* (Kunth) Zuloaga & Morrone *Muhlenbergia emersleyi* Vasey bullgrass	4	*Boerhavia* sp. (1) unknown Asteraceae (2) unknown forbs	0		16
STS-PT-2013-12	2	9/23/2014	2	Brickellia californica (Torrey & Gray) Gray *Brickellia lemmonii* Gray -- Lemmon's brickelbush	5	*Achnatherum hymenoides* (Roemer & J.A. Schultes) Barkworth *Aristida arizonica* Vasey--Arizona threeawn *Bothriochloa barbinodis* (Lagasca) Herter *Bouteloua curtipendula* (Michaux) Torrey *Setaria* sp. - bristlegrass	0		1	*Nolina microcarpa* S. Watson	8
STS-PT-2013-12	3	9/23/2014	0		3	*Bothriochloa barbinodis* (Lagasca) Herter *Bouteloua curtipendula* (Michaux) Torrey *Eragrostis* sp. - lovegrass	0		0		3
STS-PT-2013-12	4	9/23/2014	0	(no vegetation due to bedrock according to Pam Pinson)	0	(no vegetation due to bedrock according to Pam Pinson)	0	(no vegetation due to bedrock according to Pam Pinson)	0	(no vegetation due to bedrock according to Pam Pinson)	0
STS-PT-2013-12	5	9/23/2014	1	Brickellia lemmonii Gray	5	*Aristida adscensionis* Linnaeus - six weeks 3-awn *Aristida schiedeana* var. *orcuttiana* (Vasey) Allred & Valdes *Bothriochloa barbinodis* (Lagasca) Herter *Bouteloua curtipendula* (Michaux) Torrey *Bouteloua hirsuta* Lagasca	2	(1) unknown Asteraceae(1) unknown forb	1	*Nolina microcarpa* S. Watson	9
STS-PT-2013-17	1	9/24/2014	1	Prosopis glandulosa Torrey	0		1	Verbesina encelioides	0		2
STS-PT-2013-17	2	9/24/2014	1	Prosopis glandulosa Torrey	0		1	Verbesina encelioides	0		2
STS-PT-2013-17	3	9/24/2014	1	Prosopis glandulosa Torrey	2	*Bothriochloa barbinodis* (Lagasca) Herter *Setaria* sp.	5	*Boerhavia* sp. *Hybanthus verticillatus* (Ortega) Baillon *Salsola tragus* Linnaeus *Solanum elaeagnifolium* Cavanilles *Verbesina encelioides*	0		8

Table F-3. Names of Species in Species Richness Dataset of 2014

Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Site ID	Block	Date	# Trees/ Shrub sp.	Trees/ Shrub sp. ID*	# Grass sp.	Grass sp. ID*	# Forb sp.	Forb sp. ID*	# Cactus sp.	Cactus sp. ID*	# Species in Block
STS-PT-2013-17	4	9/24/2014	3	Gutierrezia sarothrae (Pursh) Britton & Rusby --Broom snakeweed *Mimosa aculeaticarpa* Ortega var. *biuncifera* (Bentham) Barneby *Prosopis glandulosa* Torrey	2	*Bothriochloa barbinodis* (Lagasca) Herter *Sporobolus cryptandrus* (Torrey) A. Gray	4	*Pseudognaphalium stramineum* (Kunth) W.A. Weber *Salsola tragus* Linnaeus *Solanum elaeagnifolium* Cavanilles *Verbesina encelioides*	0		9
STS-PT-2013-17	5	9/24/2014	2	Mimosa aculeaticarpa Ortega var. biuncifera (Bentham) Barneby Prosopis glandulosa Torrey	2	*Bouteloua barbata* Lagasca *Setaria* sp.	4	*Boerhavia* sp. *Salsola tragus* Linnaeus *Verbesina encelioides* (1) unknown *Euphorbiaceae*	0		8
STS-PT-2013-19	1	9/24/2014	4	*Juniperus deppeana* Steudel--Alligator juniper *Brickellia californica* (Torrey & Gray) Gray *Mimosa aculeaticarpa* Ortega var. *biuncifera* (Bentham) Barneby *Prosopis glandulosa* Torrey	0		3	*Amaranthus palmeri* S. Watson *Portulaca* sp. (1) unknown *Euphorbiaceae*	1	*Yucca* sp.	8
STS-PT-2013-19	2	9/24/2014	3	*Juniperus deppeana* Steudel *Mimosa aculeaticarpa* Ortega var. *biuncifera* (Bentham) Barneby *Prosopis glandulosa* Torrey	0		0		1	*Yucca* sp.	4
STS-PT-2013-19	3	9/24/2014	3	*Juniperus deppeana* Steudel *Brickellia californica* (Torrey & Gray) Gray (1) unknown tree/shrub	0		2	*Amaranthus palmeri* S. Watson *Chenopodium album* Linnaeus	0		5
STS-PT-2013-19	4	9/24/2014	0		0		2	*Amaranthus palmeri* S. Watson *Chenopodium album* Linnaeus	0		2
STS-PT-2013-19	5	9/24/2014	1	Mimosa aculeaticarpa Ortega var. biuncifera (Bentham) Barneby	1	(1) unknown *Poaceae*	1	*Portulaca* sp.	0		3
STS-PT-2013-20	1	9/23/2014	2	*Krascheninnikovia lanata* (Pursh) Meeuse & Smits *Mimosa aculeaticarpa* Ortega var. *biuncifera* (Bentham) Barneby	3	*Aristida purpurea* Nuttall *Dasyochloa pulchella* (Kunth) Willdenow ex Rydberg *Hopia obtusa* (Kunth) Zuloaga & Morrone	7	*Boerhavia* sp. *Convolvulus* sp. *Physaria* sp. (4) unknown forbs	1	*Opuntia* sp.	13
STS-PT-2013-20	2	9/23/2014	3	*Krascheninnikovia lanata* (Pursh) Meeuse & Smits *Mimosa aculeaticarpa* Ortega var. *biuncifera* (Bentham) Barneby (1) unknown Fabaceae	2	*Aristida purpurea* Nuttall *Dasyochloa pulchella* (Kunth) Willdenow ex Rydberg--desert fluffgrass	6	*Boerhavia* sp. *Physaria* sp. (4) unknown forbs	0		11
STS-PT-2013-20	3	9/23/2014	2	*Krascheninnikovia lanata* (Pursh) Meeuse & Smits *Mimosa aculeaticarpa* Ortega var. *biuncifera* (Bentham) Barneby	4	*Aristida purpurea* Nuttall *Bouteloua curtipendula* (Michaux) Torrey *Dasyochloa pulchella* (Kunth) Willdenow ex Rydberg *Pleuraphis mutica* Buckley	6	*Boerhavia* sp. *Physaria* sp. (1) unknown Asteraceae (3) unknown forbs	0		12
STS-PT-2013-20	4	9/23/2014	2	*Krascheninnikovia lanata* (Pursh) Meeuse & Smits -winterfat *Mimosa aculeaticarpa* Ortega var. *biuncifera* (Bentham) Barneby	5	*Aristida purpurea* Nuttall *Bouteloua curtipendula* (Michaux) Torrey *Dasyochloa pulchella* (Kunth) Willdenow ex Rydberg - desert fluffgrass *Hopia obtusa* (Kunth) Zuloaga & Morrone *Muhlenbergia torreyi* (Kunth) A.S. Hitchcock ex Bush	6	*Boerhavia* sp. *Physaria* sp. (4) unknown forbs	2	*Cylindropuntia* sp. *Opuntia* sp.	15
STS-PT-2013-20	5	9/23/2014	2	*Krascheninnikovia lanata* (Pursh) Meeuse & Smits *Mimosa aculeaticarpa* Ortega var. *biuncifera* (Bentham) Barneby	5	*Aristida purpurea* Nuttall *Bouteloua curtipendula* (Michaux) Torrey *Bouteloua gracilis* (Willdenow ex Kunth) Lagasca ex Griffiths *Dasyochloa pulchella* (Kunth) Willdenow ex Rydberg *Muhlenbergia torreyi* (Kunth) A.S. Hitchcock ex Bush	6	*Boerhavia* sp. *Physaria* sp. (4) unknown forbs	0		13
STS-PT-2013-26	1	9/25/2014	1	Prosopis glandulosa Torrey	7	*Aristida arizonica* Vasey *Aristida purpurea* Nuttall *Bouteloua curtipendula* (Michaux) Torrey *Dasyochloa pulchella* (Kunth) Willdenow ex Rydberg *Hopia obtusa* (Kunth) Zuloaga & Morrone *Muhlenbergia torreyi* (Kunth) A.S. Hitchcock ex Bush *Pleuraphis mutica* Buckley	8	*Boerhavia* sp. *Solanum elaeagnifolium* Cavanilles (1) unknown Asteraceae (5) unknown forbs	0		16
STS-PT-2013-26	2	9/25/2014	1	Prosopis glandulosa Torrey	6	*Aristida arizonica* Vasey *Aristida purpurea* Nuttall *Bouteloua curtipendula* (Michaux) Torrey *Dasyochloa pulchella* (Kunth) Willdenow ex Rydberg *Muhlenbergia torreyi* (Kunth) A.S. Hitchcock ex Bush *Pleuraphis mutica* Buckley	7	*Boerhavia* sp. *Physaria* sp. (1) unknown Asteraceae (4) unknown forbs	0		14
STS-PT-2013-26	3	9/25/2014	1	Prosopis glandulosa Torrey	7	*Aristida purpurea* Nuttall *Bouteloua curtipendula* (Michaux) Torrey *Bouteloua gracilis* (Willdenow ex Kunth) Lagasca ex Griffiths *Dasyochloa pulchella* (Kunth) Willdenow ex Rydberg *Hopia obtusa* (Kunth) Zuloaga & Morrone *Muhlenbergia torreyi* (Kunth) A.S. Hitchcock ex Bush *Pleuraphis mutica* Buckley	9	*Baileya multiradiata* Harvey & Gray ex Gray *Boerhavia* sp. *Erigeron* sp. *Physaria* sp. (5) unknown forbs	0		17
STS-PT-2013-26	4	9/25/2014	1	Prosopis glandulosa Torrey	7	*Bouteloua curtipendula* (Michaux) Torrey *Bouteloua gracilis* (Willdenow ex Kunth) Lagasca ex Griffiths *Dasyochloa pulchella* (Kunth) Willdenow ex Rydberg *Hopia obtusa* (Kunth) Zuloaga & Morrone *Muhlenbergia torreyi* (Kunth) A.S. Hitchcock ex Bush *Pleuraphis mutica* Buckley *Setaria* sp.	6	*Physaria* sp. (1) unknown Asteraceae (4) unknown forbs	0		14

Table F-3. Names of Species in Species Richness Dataset of 2014

Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Site ID	Block	Date	# Trees/ Shrub sp.	Trees/ Shrub sp. ID*	# Grass sp.	Grass sp. ID*	# Forb sp.	Forb sp. ID*	# Cactus sp.	Cactus sp. ID*	# Species in Block
STS-PT-2013-26	5	9/25/2014	1	Prosopis glandulosa Torrey	8	*Aristida purpurea* Nuttall *Bouteloua curtipendula* (Michaux) Torrey *Bouteloua gracilis* (Willdenow ex Kunth) Lagasca ex Griffiths *Dasyochloa pulchella* (Kunth) Willdenow ex Rydberg *Hopia obtusa* (Kunth) Zuloaga & Morrone *Muhlenbergia torreyi* (Kunth) A.S. Hitchcock ex Bush - ring muhly *Pleuraphis mutica* Buckley *Setaria* sp.	9	*Baileya multiradiata* Harvey & Gray ex Gray *Boerhavia* sp. *Physaria* sp. (1) unknown Asteraceae (5) unknown forbs	0		18
Wildlife reference plot N	1	9/23/2014	4	Baccharis pteronioides A.P. de Candolle *Mimosa aculeaticarpa* Ortega var. *biuncifera* (Bentham) Barneby *Prosopis glandulosa* Torrey (1) unknown Fabaceae	4	*Aristida purpurea* Nuttall *Hopia obtusa* (Kunth) Zuloaga & Morrone *Pleuraphis mutica* Buckley - tobosa *Setaria* sp.	2	*Amaranthus palmeri* S. Watson *Solanum elaeagnifolium* Cavanilles	0		10
Wildlife reference plot N	2	9/23/2014	3	Mimosa aculeaticarpa Ortega var. *biuncifera* (Bentham) Barneby *Prosopis glandulosa* Torrey (1) unknown Fabaceae	2	*Hopia obtusa* (Kunth) Zuloaga & Morrone *Setaria* sp.	2	*Amaranthus palmeri* S. Watson *Solanum elaeagnifolium* Cavanilles	0		7
Wildlife reference plot N	3	9/23/2014	3	Mimosa aculeaticarpa Ortega var. *biuncifera* (Bentham) Barneby *Prosopis glandulosa* Torrey (1) unknown Fabaceae	4	*Aristida adscensionis* Linnaeus *Bouteloua curtipendula* (Michaux) Torrey *Hopia obtusa* (Kunth) Zuloaga & Morrone *Setaria* sp.	4	*Amaranthus palmeri* S. Watson *Solanum elaeagnifolium* Cavanilles (2) unknown forbs	0		11
Wildlife reference plot N	4	9/23/2014	3	Mimosa aculeaticarpa Ortega var. *biuncifera* (Bentham) Barneby *Prosopis glandulosa* Torrey (1) unknown Fabaceae	6	*Aristida purpurea* Nuttall *Aristida adscensionis* Linnaeus *Bouteloua curtipendula* (Michaux) Torrey *Hopia obtusa* (Kunth) Zuloaga & Morrone *Pleuraphis mutica* Buckley *Setaria* sp.	3	*Amaranthus palmeri* S. Watson *Solanum elaeagnifolium* Cavanilles *Sphaeralcea coccinea* (Nuttall) Rydberg	0		12
Wildlife reference plot N	5	9/23/2014	3	Mimosa aculeaticarpa Ortega var. *biuncifera* (Bentham) Barneby *Prosopis glandulosa* Torrey (1) unknown Fabaceae	5	*Aristida purpurea* Nuttall *Bothriochloa barbinodis* (Lagasca) Herter *Hopia obtusa* (Kunth) Zuloaga & Morrone *Pleuraphis mutica* Buckley *Setaria* sp.	3	*Amaranthus palmeri* S. Watson *Dyssodia papposa* (Ventenat) Hitchcock *Solanum elaeagnifolium* Cavanilles	0		11
Wildlife reference plot S	1	9/23/2014	3	Brickellia californica (Torrey & Gray) Gray *Mimosa aculeaticarpa* Ortega var. *biuncifera* (Bentham) Barneby *Prosopis glandulosa* Torrey	5	*Aristida* sp. *Bothriochloa barbinodis* (Lagasca) Herter *Bouteloua curtipendula* (Michaux) Torrey *Hopia obtusa* (Kunth) Zuloaga & Morrone *Setaria* sp.	8	ified forbs -first block of the first sampling site so still getting	1	*Opuntia* sp.	17
Wildlife reference plot S	2	9/23/2014	3	Brickellia californica (Torrey & Gray) Gray *Mimosa aculeaticarpa* Ortega var. *biuncifera* (Bentham) Barneby *Prosopis glandulosa* Torrey	5	*Bothriochloa barbinodis* (Lagasca) Herter *Bouteloua curtipendula* (Michaux) Torrey *Hopia obtusa* (Kunth) Zuloaga & Morrone *Pleuraphis mutica* Buckley *Setaria* sp.	3	*Amaranthus palmeri* S. Watson *Solanum elaeagnifolium* Cavanilles *Sphaeralcea coccinea* (Nuttall) Rydberg	1	*Dasylirion wheeleri* S. Watson	12
Wildlife reference plot S	3	9/23/2014	2	Mimosa aculeaticarpa Ortega var. biuncifera (Bentham) Barneby Prosopis glandulosa Torrey (1) unknown Fabaceae	6	*Aristida adscensionis* Linnaeus *Aristida purpurea* Nuttall *Bothriochloa barbinodis* (Lagasca) Herter *Bouteloua curtipendula* (Michaux) Torrey *Pleuraphis mutica* Buckley *Setaria* sp.	4	*Amaranthus palmeri* S. Watson *Solanum elaeagnifolium* Cavanilles *Sphaeralcea coccinea* (Nuttall) Rydberg (1) unknown forb	1	*Cylindropuntia* sp. -- Cholla	13
Wildlife reference plot S	4	9/23/2014	3	Brickellia californica (Torrey & Gray) Gray *Mimosa aculeaticarpa* Ortega var. *biuncifera* (Bentham) Barneby *Prosopis glandulosa* Torrey	6	*Aristida adscensionis* Linnaeus *Aristida purpurea* Nuttall *Bothriochloa barbinodis* (Lagasca) Herter *Bouteloua curtipendula* (Michaux) Torrey *Hopia obtusa* (Kunth) Zuloaga & Morrone *Setaria* sp.	6	*Amaranthus palmeri* S. Watson *Physaria* sp. *Solanum elaeagnifolium* Cavanilles *Sphaeralcea coccinea* (Nuttall) Rydberg (2) unknown forbs	0		15
Wildlife reference plot S	5	9/23/2014	3	Brickellia californica (Torrey & Gray) Gray *Mimosa aculeaticarpa* Ortega var. *biuncifera* (Bentham) Barneby *Prosopis glandulosa* Torrey	6	*Aristida adscensionis* Linnaeus *Aristida purpurea* Nuttall *Bothriochloa barbinodis* (Lagasca) Herter *Hopia obtusa* (Kunth) Zuloaga & Morrone *Pleuraphis mutica* Buckley (1) unknown Poaceae	5	*Amaranthus palmeri* S. Watson *Solanum elaeagnifolium* Cavanilles *Sphaeralcea coccinea* (Nuttall) Rydberg *Tragia ramosa* Torrey (1) unknown forb	0		14

Notes:

* = All species identifications used nomenclature in Flora Neomexicana (2012) except where noted (identified by Matt Schulz of NMED)

Table F-4. Data for Community Analysis

Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Site ID	Site Type	Latitude	Longitude	Percent Cover Unadjusted	Species Richness	OAT Score	NDVI 2011	NDVI 2014	Month and Year Soil Sampled	Year Vegetation Sampled in September	Cover Adjusted to 2011 Conditions	Conductivity Sat. Paste (mmhos/cm)	Total Copper (mg/kg)	pH (sat. paste)	Calculated pCu	Measured pCu	pre-FS RAC (1= below)	Soil Category	Aspect	Slope (degrees)	Bedrock (%)	Soil Complex	Ecotype	Vegetation Alliance
STS-RWU-2011-1	Site	32.7124	-108.1083	6	1	12	14%	13%	July 2013	2011	6	0.526	338	5.2	5.48	4.86	1	bedrock	South	4.46	88	63, Santana-Rock outcrop complex, 1 to 25%	Hills	mtn mahogany/shrub
STS-RWU-2011-2	Site	32.7045	-108.1050	8	0.4	8	6%	7%	July 2013	2011	8	1.39	381	4.1	4.32	3.62	1	bedrock	South	14.57	90	63, Santana-Rock outcrop complex, 1 to 25%	Hills	mtn mahogany/shrub
STS-RWU-2011-3	Site	32.7076	-108.1070	59	6.2	24	48%	58%	July 2013	2011	59	0.789	998	5.1	4.14	4.19	1	slope	South	8.35	0	2, Abrazo-Luzena complex, 15-45%	Hills	mtn mahogany/shrub
STS-RWU-2011-4	Site	32.7123	-108.1430	64	9.8	35	35%	18%	July 2013	2011	64	0.741	427	7.2	7.07	8.13	1	flat granular	South	3.06	0	47, Plack gravelly loam, 0-8%	Shallow	mix grama/herb
STS-RWU-2011-5	Site	32.7067	-108.0950	34	10	33	26%	23%	July 2013	2011	34	0.621	779	4.6	3.96	3.47	1	flat granular	South	6.10	0	13, Encierro-Rock outcrop complex, 15-35%	Hills	mesq/mix grama
STS-RWU-2011-6	Site	32.7085	-108.1209	25	8	16	31%	17%	July 2013	2011	25	0.64	1300	7.3	5.88	6.72	1	slope	North	16.41	0	39, Oro Grande-Rock outcrop complex, 5-15%	Gravelly	mtn mahogany/shrub
STS-RWU-2011-7	Site	32.6972	-108.1060	11	1.8	9	7%	6%	July 2013	2011	11	0.388	529	4.9	4.69	3.19	1	flat rocky	South	1.70	0	63, Santana-Rock outcrop complex, 1 to 25%	Hills	mesq/mix grama
STS-RWU-2011-8	Site	32.7103	-108.0939	45	21.6	37	53%	46%	July 2013	2011	45	0.42	287	5.6	6.04	5.71	0	slope	North	12.11	0	37, Muzzler-Rock outcrop association, 25-45%	Hills	juniper-oak
STS-RWU-2011-9	Site	32.6959	-108.1000	3	0.8	11	6%	7%	July 2013	2011	3	0.614	560	4.4	4.15	3.09	1	bedrock	North	5.15	95	63, Santana-Rock outcrop complex, 1 to 25%	Hills	mtn mahogany/shrub
STS-RWU-2011-10	Site	32.6748	-108.0840	24	10	16	16%	21%	July/Oct 2013[a]	2011	24	0.874/0.2	96/234	4.6/4.5	6.37/5.25	4.76	1	flat granular	South	1.92	0	13, Encierro-Rock outcrop complex, 15-35%	Hills	mesq/mix grama
STS-RWU-2011-11	Site	32.6747	-108.0920	4	1.6	6	5%	6%	July 2013	2011	4	0.567	216	4.3	5.16	3.64	0	bedrock	South	1.76	93	63, Santana-Rock outcrop complex, 1 to 25%	Hills	mtn mahogany/shrub
STS-RWU-2011-12	Site	32.6642	-108.0870	9	2	10	NA	NA	July/Oct 2013	2011	9	1.35/1	316/152	3.9/3.7	5.00	3.89	1	flat rocky	North	2.00	0	63, Santana-Rock outcrop complex, 1 to 25%	Hills	mesq/mix grama
STS-RWU-2011-13	Site	32.6768	-108.0940	26	3.6	8	12%	11%	July 2013	2011	26	1.08	305	5.6	5.97	6.14	0	flat granular	South	5.25	0	2, Abrazo-Luzena complex, 15-45%	Hills	mesq/mix grama
STS-RWU-2011-14	Site	32.7081	-108.1150	27	8	26	34%	32%	July/Oct 2013	2014	28	0.675/0.4	1640[a]/153	5.3/5.1	6.30	4.12	1	slope	North	32.12	0	2, Abrazo-Luzena complex, 15-45%	Hills	mtn mahogany/shrub
STS-RWU-2011-15	Site	32.7092	-108.1180	18	7.4	14	16%	13%	July 2013	2011	18	1.06	1640	5.7	4.13	4.14	1	flat granular	South	4.06	0	39, Oro Grande-Rock outcrop complex, 5-15%	Gravelly	mesq/mix grama
STS-RWU-2011-16	Site	32.7048	-108.0850	22	13	23	21%	22%	July 2013	2011	22	0.471	395	4.9	5.02	3.89	1	flat granular	North	13.54	0	54, Rock outcrop-Muzzler association, 25-65%	Hills	mtn mahogany/shrub
STS-RWU-2011-17	Site	32.6762	-108.0960	36	5.4	10	11%	10%	July 2013	2011	36	1.13	654	4.6	4.16	4.06	1	flat rocky	South	3.04	0	25, Lonti gravelly loam 15-35%	Breaks	mesq/mix grama
WILDLIFE REFERENCE PLOT NORTH	Reference	32.6840	-108.0677	30	10/13.2		19%	20%	July 2013	2011/2014	30	0.681	213	5.9	6.66	5.67	0	flat granular	North	3.06	0	37, Muzzler-Rock outcrop association, 25-45%	Hills	mesq/mix grama
WILDLIFE REFERENCE PLOT SOUTH	De Minimus	32.6748	-108.0601	20/37	11/14.2		12%	22%	July/Oct 2013	2011/2014	20	0.608/0.3	288/164	4.6/4.6	5.11/5.75	3.70	1	flat granular	South	1.36	0	37, Muzzler-Rock outcrop association, 25-45%	Hills	mesq/mix grama
STS-PT-2013-1	Site	32.689013	-108.106386	32	3.2	12	26%	16%	October 2013	2014	50	0.75	1030	4.5	3.55	3.73	1	flat rocky	North	2.95	0	25, Lonti gravelly loam 15-35%	Breaks	mesq/mix grama
STS-PT-2013-2	Site	32.685045	-108.104709	31	5.2	9	29%	12%	October 2013	2014	74	1.8	809	6.7	5.87	6.45	1	flat rocky	South	8.60	0	26, Lonti gravelly loam 0-8%	Loamy	mesq/mix grama
STS-PT-2013-5	Site	32.705641	-108.113509	38	8.6	27	33%	22%	October 2013	2014	55	1.3	632	6.1	5.60	6.63	1	slope	South	27.07	25	2, Abrazo-Luzena complex, 15-45%	Hills	mtn mahogany/shrub
STS-PT-2013-9	Site	32.697826	-108.106861	5	1.8	7	8%	8%	October 2013	2014	6	0.4	1350	4.3	3.05	2.93	1	bedrock	South	2.89	60	63, Santana-Rock outcrop complex, 1 to 25%	Hills	mesq/mix grama
STS-PT-2013-12	Site	32.669984	-108.051091	20	7.2	17	11%	9%	October 2013	2014	24	0.7	449	6.5	6.36	7.27	1	bedrock	South	8.74	85	13, Encierro-Rock outcrop complex, 15-35%	Hills	mtn mahogany/shrub
STS-PT-2013-17	Site	32.6897	-108.1040	19	5.8	19	12%	11%	October 2013	2014	20	0.6	1120	7.6	6.33	7.46	1	flat rocky	North	2.29	0	13, Encierro-Rock outcrop complex, 15-35%	Hills	mesq/mix grama
STS-PT-2013-19	Site	32.6925	-108.1046	5	4.4	15	10%	10%	October 2013	2014	5	0.4	714	4.6	4.06	3.68	1	flat rocky	North	2.76	59	63, Santana-Rock outcrop complex, 1 to 25%	Hills	mesq/mix grama
STS-PT-2013-20	Site	32.6892	-108.1566	24	12.8	30	36%	12%	October 2013	2014	76	0.5	131	7.5	8.71	8.45	0	flat granular	South	0.98	0	47, Plack gravelly loam, 0-8%	Shallow	mix grama/herb
STS-RWU-2012-B1	De Minimus	32.6714	-108.0445	18	3.4	17	7%	3%	July/Oct 2013	2012	18	0.38/0.2	182/61	4.6/4.2	5.63/6.52	4.00	1	bedrock	South	5.99	75	54, Rock outcrop-Muzzler association, 25-65%	Hills	mtn mahogany/shrub
STS-RWU-2012-B2	De Minimus	32.6714	-108.0423	3	5	11	7%	7%	July/Oct 2013	2012	3	0.395/2.7	344/248	4.7/3.9	4.25/4.63	3.94	1	bedrock	South	4.90	85	54, Rock outcrop-Muzzler association, 25-65%	Hills	mtn mahogany/shrub
STS-RWU-2012-B3	De Minimus	32.6738	-108.0449	3	2.6	15	12%	6%	July/Oct 2013	2012	3	0.401/0.4	161/253	4.7/4.4	5.87/5.07	4.46	1	bedrock	North	19.76	93	54, Rock outcrop-Muzzler association, 25-65%	Hills	mtn mahogany/shrub
STS-PT-2013-26	Reference	32.6394	-108.0500	37	15.8	20	22%	16%	October 2013	2014	51	0.4	109	7.6	9.01	8.31	0	flat granular	South	4.61	0	33, Manzano loam, 1 to 3 %	Loamy	fluvial forest/shrub
STS-PT-2013-33	Site	32.6928	-108.1220	0	0		1%	1%	October 2013	2014	30	12.8	95300	4.3	-1.85	1.98	1	flat granular	South	2.70	0	47, Plack gravelly loam, 0-8%	Shallow	Mine facilities/urban

*When soil was sampled in July and October, the October value (number after the slash) was used in the analyses.

[a] This 1640 mg/kg concentration is the same as STS-RWU-2011-15 copper concentration and is probably an error. The October value of 153 that was used was not an outlier in any analyses.

Notes:

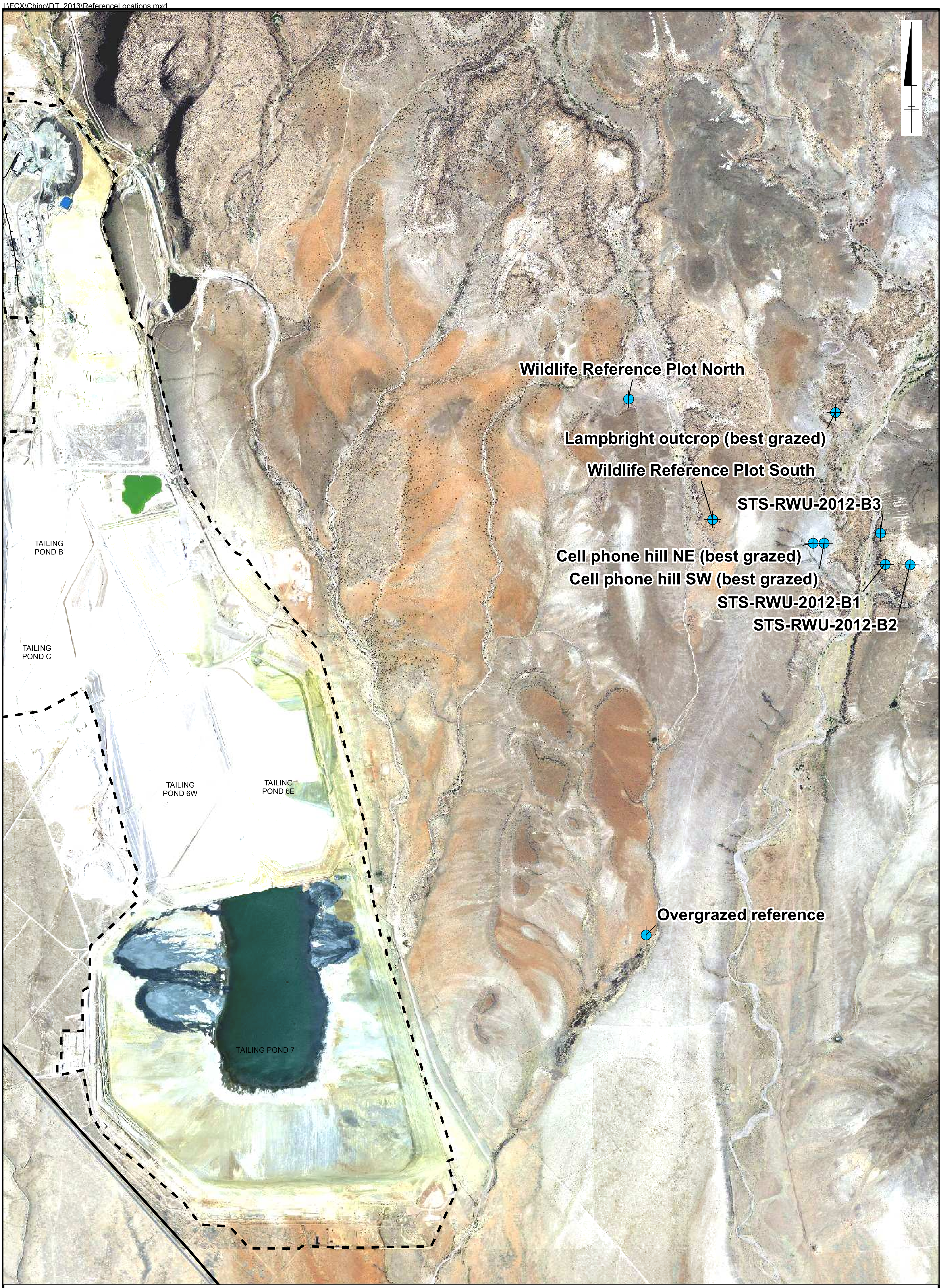
NA = not available due to too much cloud cover.

The 2011 data (adjusted if sampled in 2014) was used in all analyses

Calculated pCu is based on total copper and pH using upland with reference equation

Measured pCu is estimated with an ion-selective electrode.

OFFICE: LAKEWOOD DB: MLM TM: MB PM: AT
PROJECT# B0063543.0000
I:\FCX\Chino\DT_2013\ReferenceLocations.mxd



Legend

⊕ Reference Soil Locations
Operations Boundary
Railroad
Town Roads
Major Roads
▭ City Limits

Notes: The Wildlife Reference North and South and 3 bedrock locations were de minimus locations. The Cell phone hill and Lampbright outcrop locations were used to calibrate the OAT score to good conditions and overgrazed reference to a poor rating each year.

0 2,500 5,000 Feet
GRAPHIC SCALE

Service Layer Credits: APFO

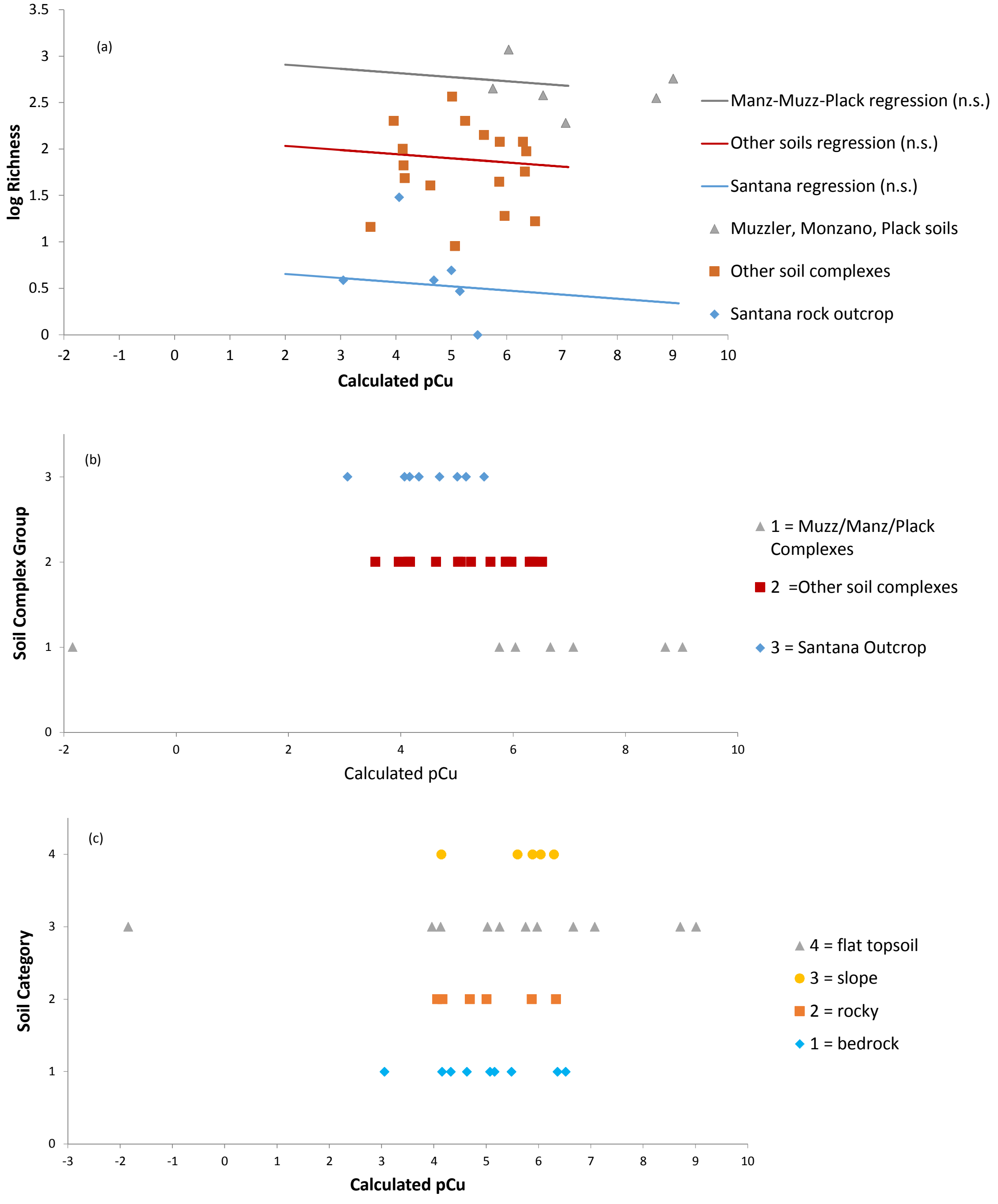
FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

SMELTER TAILINGS IU PHYTOTOXICITY STUDY

VEGETATION COMMUNITY REFERENCE LOCATIONS

ARCADIS

FIGURE
F-2



Notes:

(a) Independent of pCu, richness separates by soil complex group, with lowest richness in the Santana rock outcrop. The pCu is not significantly (n.s.) contributing to variation in richness in (a) because soil complex is correlated to pCu (b) and thus is not a valid covariate in regression models. Soil complexes named in the graph are Muzzler-Rock outcrop association, 25-45% slopes, NRCS code 37; Manzano loam, 1 to 3 % slopes, NRCS code 33; Plack gravelly loam, 0-8% slopes, NRCS code 47; Santana-Rock outcrop complex, 1 to 25% slopes, NRCS code 63. (c) Unlike soil complex, soil category is unrelated to pCu and thus is a valid covariate. Only b and c have an outlier location with negative pCu included.

FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

Relationship between pCu and Soil Complex or Soil Category, which can modify Richness

ARCADIS

FIGURE
F-3

Notes: Numbers represent Natural Resource Conservation Service (NRCS) Soil Complex identification numbers from NRCS soil web site map. 13,

Encierro-Rock outcrop complex, 15-35%

54, Rock outcrop-Muzzler association, 25-65%

63, Santana-Rock outcrop complex, 1 to 25%

26, Lonti gravelly loam 0-8%

47, Plack gravelly loam, 0-8%

2, Abrazo-Luzena complex, 15-45%

54, Rock outcrop-Muzzler association, 25-65%

37, Muzzler-Rock outcrop association, 25-45%

39, Oro Grande-Rock outcrop complex, 5-15%

33, Manzano loam, 1 to 3 %

25, Lonti gravelly loam 15-35%

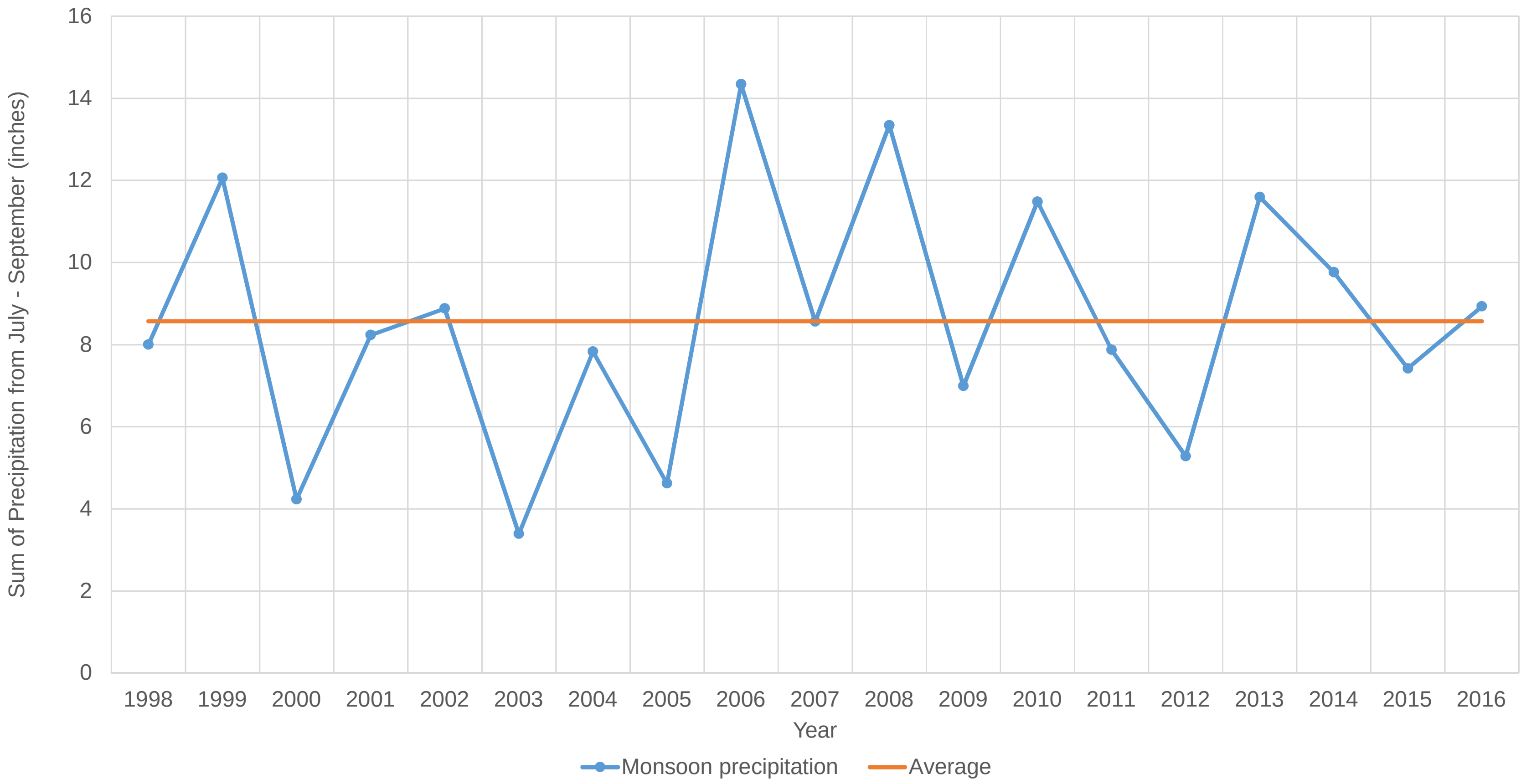
FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

Map of Soil Complexes by NRCS Code

ARCADIS

FIGURE
F-4



FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

Precipitation of Monsoon Months at Hurley, NM

ARCADIS

FIGURE
F-5

APPENDIX G

Greenhouse Phytotoxicity Dose-Response Models

ARCADIS Design & Consultancy for natural and built assets

Freeport-McMoRan Chino Mines Company

GREENHOUSE PHYTOTOXICITY DOSE-RESPONSE MODELS WITH AND WITHOUT COVARIATES

September 2018

GREENHOUSE PHYTOTOXICITY DOSE-RESPONSE MODELS WITH AND WITHOUT COVARIATES

Prepared for:

Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico

Prepared by:

Arcadis U.S., Inc.
1687 Cole Blvd.
Suite 200
Lakewood
Colorado 80401
Tel +1 303 231 9115
Fax +1 303 231 9571

Our Ref.:

B0063543.0014

Date:

July 2017

CONTENTS

TABLES

FIGURES

ACRONYMS AND ABBREVIATIONS

AICc	corrected Akaike information criterion
DEL	de minimus effects level
pCu	cupric ion activity
PEL	probable effects level

1 INTRODUCTION

The purpose of this appendix is to provide additional details relating to the greenhouse phytotoxicity dose-response models, both with and without covariates. The main report discusses the methods by which non-linear, S-shaped dose-response curves were fit to data using SAS statistical software to determine if plant endpoint values of each site, *de minimus*, and reference soil are related to the soil's pCu. This appendix presents the details of the models resulting from that analysis. To account for potential confounding factors in the test soils that might have affected plant growth, this appendix also discusses covariates identified to include in the dose-response curves and presents the methods and results for the covariate analysis.

2 FIVE AND THREE-SEED DOSE-RESPONSE MODELS

Tables G-1 and G-2 present the non-linear statistical models evaluated in SAS for the five- and three-seed models. The three-seed models omit tansyaster field and nursery seeds because of their poor performance in control soils. However, the resulting dose-response curves are almost the same, and the five seed model is most complete and presented in the main report.

The statistical models presented show the number of parameters modeled in the final best models (based on lowest AICc) to predict the various vegetation endpoints based on pCu. Also presented in **Tables G-1** and **G-2** are the sample sizes, fit of the model in terms of pseudo R^2[1] which can typically range from 0 to 1 (poor to very good, Nagelkerke 1991), and coefficients for the parameters that are used in the non-linear equation (equation 1 in main report) to plot the curves shown in Figures 6 and 7 of the main report. If parameters (slope, Rmax, EC50) are not significantly different when compared with another seed type, the parameter is represented by one value (e.g., one slope or one EC50). If it does change, the parameter is represented by a value for each seed type that differs (e.g., a separate slope for alfalfa and a separate slope for field sideoats, etc.). If all 5 seed types had separate values for all 3 parameters, the model would be a 15 parameter model (without adding covariates discussed below, which increase the number of parameters further). The large number of combinations of models tested for each of the five endpoints to find the one with the lowest AICc are not presented in this appendix to assist the reader in seeing the final

---

[1] Pseudo R^2 (calculated as 1-SSE/corrected total SS, where SS = sum of squares and SSE = sum of squares of error term) is reported as a global fit measure appropriate for use with non-linear models, but it should not be used for selecting the best model. This goodness-of-fit measure is called “pseudo” because it may exceed 1.0 when applied to non-linear regression (Spiess and Neumeyer 2010).

results important to the interpretation of the study[2]. The AICc is also not presented because it is only meaningful when compared for the same dataset (same sample size) to select the final model. It is not used to compare the final models. The fit of the final model can best be evaluated by visually examining how well the curves in the graphs in Figure 6 and 7 fit the data points, as well as the final pseudo R^2.

3 COVARIATE METHODS

To account for potential confounding factors in the test soils that might have affected plant growth, the best covariates were identified to include in the dose-response curve. Too many variables and parameters in a model can reduce power to detect trends. To meet the assumptions of non-linear regression (e.g., no multicollinearity) and reduce the variable list to the best candidate covariates to avoid reducing model power, the following steps were followed (Belsley et al. 1980, Hosmer and Lemeshow 2000):

(1) To prevent multicollinearity[3], the pairs of independent variables (physical and chemical parameters in soil including pCu) that were highly correlated with each other at $r > 0.7$ using either Pearson Product Moment and Spearman Rank correlation statistics were identified. The variable in each correlated pair that was least correlated to the dependent variables (alfalfa plant endpoints) was removed from further analysis. The exception to this removal was if the pair of variables was hypothesized to have opposite effects on the plant endpoint when combined with pCu (e.g., the micronutrient iron is hypothesized to be protective but aluminum, not a nutrient, is hypothesized to be toxic, and both were retained, though never included in the same model).

(2) The remaining independent variables were screened for a simple correlation (Pearson or Spearman[4]) with the dependent variable (plant endpoints) with $p < 0.25$. Those with no such relationship were removed from further analysis as unlikely to contribute to the dose-response curve when modeled as a non-linear S-shaped curve (Hosmer and Lemeshow 2000).

(3) The remaining independent variables were retained as potential covariates. Principal component analysis was used to combine these variables to assess if principal components as potential covariates are more predictive of endpoints than the individual variables.

All potential covariates and principal components were added to the dose-response equation one at a time using the following equation (terms defined in main text):

---

[2] Data are provided, however, allowing one to recreate them.

[3] Multicollinearity is tested between two variables because one must be able to distinguish between a unit change in one covariate and a unit change in the other. If the two variables are linearly related then a unit change in one coincides with k units increase in the other variable, where k is some constant, and then one cannot determine the separate effects of both variables. With multicollinearity in a model, the coefficients become unstable (Neter et al. 1990).

[4] Pearson product moment correlation is a linear, parametric correlation. Spearman correlation is a non-parametric rank correlation measure that looks for monotonically increasing or decreasing relationships that the Pearson correlation may miss.

$$R = \left(\frac{R_{max}}{1 + 10^{slope(-pCu+EC50+(alpha\ x\ covariate))}}\right)$$ (Equation 1)

Where R is the endpoint, alpha, slope, and EC50 are coefficients estimated to fit the data to a dose-response curve as described in the main text. Alpha is a new coefficient added to the equation to model the effect of the covariate. The data for the endpoint (R), pCu, and covariate are used to develop the model.

If one covariate improved the model, the next best covariate that also improved the model was added to the equation shown below to evaluate if two covariates improved the model. The model with the lowest AICc was selected as the best, most parsimonious model.

$$R = \left(\frac{R_{max}}{1 + 10^{slope(-pCu+EC50+(alpha1\ x\ covariate1)+(alpha2\ x\ covariate2))}}\right)$$ (Equation 2)

Confidence intervals were calculated in the same manner discussed in the main text[5]. The pCu for any endpoint value (e.g., EC10) on the dose-response curve can be calculated with covariates using the following equation:

$$pCu = (EC50 + (alpha\ x\ covariate)) - \left(\frac{log10\left(\frac{R_{max}}{R} - 1\right)}{slope}\right)$$ (Equation 3)

Equation 2 was used to calculate EC10, EC20 and minimum reference-based DEL and PEL pCu values. For example, the endpoint value, R, at 10% reduction from the maximum (R_{max}) entered into this equation provided the EC10 pCu. If more than one covariate is in the equation (true for shoot weight and shoot height), the equation is as follows:

$$pCu = (EC50 + (alpha1\ x\ covariate1) + (alpha2\ x\ covariate2)) - \left(\frac{log10\left(\frac{R_{max}}{R} - 1\right)}{slope}\right)$$

(Equation 4)

The EC50 in the equation with covariates no longer represents the EC50 of the curve with the covariate included. To calculate the EC50 with the covariates, the following equation must be used (two covariate equation shown):

---

[5] Using Equation 3 in main text except term in parenthesis after slope includes addition of alpha x covariate.

$$EC50_{covariate} = \left(EC50_{model} + (alpha1\ x\ covariate1) + (alpha2\ x\ covariate2)\right)$$

The $EC50_{model}$ is the EC50 when the covariate in the equation is assigned a value of zero (or the reference group[6] for categorical variables). Because the covariate data are influencing the structure of the model,

4 COVARIATE RESULTS

To account for potential confounding factors in the test soils that might also have affected plant viability and growth, the independent variables not screened out in **Table G-3** were evaluated for significance in the dose-response curves (significant if they lowered the AICc). None of the principal components significantly improved model fit, but several individual variables did. The significant covariates added to the five-seed models for each of the five endpoints were: granular soil present in relatively level areas, extractable iron, and percent clay. Dose-response curves for all endpoints and seed types with different levels of the covariate(s) are presented in **Figure G-1**. The effects of these covariates on the endpoints are as follows:

- **Emergence**: Granular soil present in flat areas is “protective” (i.e., lowers the DEL and PEL), possibly due to higher granular structure in which the seed can germinate. In support, roads ripped to increase granularity increased grass growth (Arcadis 2017a).
- **Survival**: Extractable iron is protective, possibly due to the ferrous or ferric ion competing with the cupric ion during plant uptake. Copper toxicity creates iron deficiency in plants, which is offset by more plant-available iron (Patsikka et al. 2002).
- **Root length:** High clay amount is detrimental (i.e., increases the DEL and PEL), possibly due to the difficulty of the roots growing through dense clay.
- **Shoot height:** High clay amount is detrimental, but granular soil present in flat areas is protective. If high clay content reduces root growth, then reduced shoot height should follow, which is observed.
- **Shoot weight**: High clay amount is detrimental, but granular soil present in flat areas is protective. If high clay content reduces root growth, then reduced shoot weight should follow, which is observed.

Modelled dose-response curves are shown in Figure G-1. The DELs and PELs based on the five-seed models with the categorical or minimum, mean, and maximum values observed of the covariates on Site included (see **Appendix A** for raw data) are presented in **Tables G-4 and G-5**, respectively. For the categorical variable of flat granular, DELs and PELs are shown for soils that are and are not flat granular.

---

[6] Categorical variables are represented by a “dummy” variable, where the reference category is assigned a value of 0. For flat granular, the “not flat granular” category is the reference category.

The minimum and maximum values are the extremes for the Site and not necessarily representative of locations that may be considered for remediation. Site-specific soil data on clay content, soil category of the location, and extractable iron concentrations can be entered into the dose-response equation 3 (if the endpoint's model has one covariate [emergence, survival, root length]) or equation 4 (if the endpoint's model has two covariates [shoot weight and height]) along with pCu (using the estimates of the equation parameters provided in **Table G-4**) in this Appendix to predict the DEL for a location for an endpoint. If a soil is in the flat, granular category, it gets a covariate value of 1, a value of 0 if not. If the pCu value for the EC50 is desired, then R is 0.5. If the pCu for the EC10 is desired, then R is 0.9[7]. If the minimum reference-based DEL is desired, the minimum of the endpoint for the reference dataset is entered into the equation as R. If the PEL using this minimum method is desired, the minimum of the endpoint for the reference dataset is divided by 2 and then entered into the equation as R.

As an example, evaluating only emergence (the most ecologically relevant greenhouse endpoint, see main text) for the flat granular soil category, the results in Table G-5 show the DEL ranges from 3.0 to 5.3 across seed types, while the PEL ranges from 2.3 to 4.0 across seed types (including tansyaster). The non-flat granular category ranges are higher at 4.5 to 6.8 for the DEL and 3.7 to 5.5 for the PEL. Without tansyaster, the flat granular soil category ranges are 3.0 to 5.2 for the DEL and 2.3 to 3.7 for the PEL. Without tansyaster, the non-flat granular soil category ranges are 4.5 to 6.6 for the DEL and 3.7 to 5.2 for the PEL (Table G-5).

The covariates associated with the endpoints in Figure G-1 are those that were significant with that endpoint. Covariates such as flat, granular soil are significant only for emergence, shoot weight, and shoot height, and therefore, different PELs and DELs can be estimated for that soil category only for those endpoints.

---

[7] To obtain the EC50, a shortcut is to add the alpha x covariate product to the EC50 provided in Table G-4 and shown in Equation 5.

TABLES

Table G-1. Five-Seed Model Results

Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Endpoint	n	SSE	Parameters	Pseudo R^2	SAS Formulation	Seed Type	Slope				Rmax				EC50				EC20				EC10			
							Estimate	S.E.	95 LCL	95UCL	Estimate	S.E.	95 LCL	95UCL	Estimate	S.E.	95 LCL	95UCL	Estimate	S.E.	95 LCL	95UCL	Estimate	S.E.	95 LCL	95UCL
Emergence																										
Emergence	165	5.884	10	0.83	if seed = 'Alfalfa' then mod = Rmax_a/(1+10**(slope_a*(-measured_pcu + ec50_a))); if seed = 'Side Oats (Field)' then mod = Rmax_fso/(1+10**(slope*(-measured_pcu + ec50_so))); if seed = 'Side Oats (Nursery)' then mod = Rmax_nso/(1+10**(slope*(-measured_pcu + ec50_so))); if seed = 'Tansyaster (Field)' then mod = Rmax_ftan/(1+10**(slope*(-measured_pcu + ec50_tan))); if seed = 'Tansyaster (Nursery)' then mod = Rmax_ntan/(1+10**(slope*(-measured_pcu + ec50_tan))); model Emergence_Std =mod;	Alfalfa	1.747	0.717	0.331	3.164	0.812	0.046	0.721	0.903	3.787	0.106	3.577	3.996	4.131	0.164	3.808	4.454	4.333	0.233	3.872	4.793
						Field Sideoats Grama	0.592	0.081	0.433	0.752	1.111	0.068	0.976	1.246	5.109	0.133	4.846	5.372	6.125	0.241	5.649	6.601	6.720	0.315	6.097	7.343
						Nursery Sideoats Grama	0.592	0.081	0.433	0.752	1.454	0.076	1.303	1.605	5.109	0.133	4.846	5.372	6.125	0.241	5.649	6.601	6.720	0.315	6.097	7.343
						Field Tansyaster	0.592	0.081	0.433	0.752	0.171	0.061	0.050	0.292	5.303	0.475	4.366	6.241	6.320	0.517	5.298	7.341	6.914	0.557	5.814	8.014
						Nursery Tansyaster	0.592	0.081	0.433	0.752	0.390	0.070	0.253	0.527	5.303	0.475	4.366	6.241	6.320	0.517	5.298	7.341	6.914	0.557	5.814	8.014
Survival																										
Survival	127	14.687	12	0.86	if seed = 'Alfalfa' then mod = Rmax_a/(1+10**(slope_a*(-measured_pcu + ec50_a))); if seed = 'Side Oats (Field)' then mod = Rmax_fso/(1+10**(slope_so*(-measured_pcu + ec50_so))); if seed = 'Side Oats (Nursery)' then mod = Rmax_nso/(1+10**(slope_so*(-measured_pcu + ec50_so))); if seed = 'Tansyaster (Field)' then mod = Rmax_ftan/(1+10**(slope_tan*(-measured_pcu + ec50_ftan))); if seed = 'Tansyaster (Nursery)' then mod = Rmax_ntan/(1+10**(slope_tan*(-measured_pcu + ec50_ntan))); model Survival_Std =mod;	Alfalfa	14.105	22.771	-31.000	59.211	0.943	0.069	0.808	1.079	3.682	0.034	3.615	3.749	3.725	0.062	3.601	3.848	3.750	0.099	3.553	3.946
						Field Sideoats Grama	0.579	0.180	0.224	0.935	1.244	0.141	0.965	1.522	5.115	0.277	4.565	5.664	6.154	0.528	5.109	7.199	6.762	0.702	5.372	8.152
						Nursery Sideoats Grama	0.579	0.180	0.224	0.935	1.121	0.134	0.857	1.386	5.115	0.277	4.565	5.664	6.154	0.528	5.109	7.199	6.762	0.702	5.372	8.152
						Field Tansyaster	8.911	2.837	3.292	14.531	2.922	0.102	2.720	3.124	5.231	0.051	5.130	5.333	5.299	0.061	5.179	5.419	5.338	0.069	5.202	5.474
						Nursery Tansyaster	8.911	2.837	3.292	14.531	2.436	0.096	2.247	2.626	4.915	0.037	4.843	4.988	4.983	0.044	4.896	5.070	5.022	0.052	4.919	5.125
Root Length																										
Root Length	114	1.801	8	0.87	if seed = 'Alfalfa' then mod = Rmax_a/(1+10**(slope*(-measured_pcu + ec50_a))); if seed = 'Side Oats (Field)' then mod = Rmax_fso/(1+10**(slope*(-measured_pcu + ec50_so))); if seed = 'Side Oats (Nursery)' then mod = Rmax_nso/(1+10**(slope*(-measured_pcu + ec50_so))); if seed = 'Tansyaster (Field)' then mod = Rmax_tan/(1+10**(slope*(-measured_pcu + ec50_tan))); if seed = 'Tansyaster (Nursery)' then mod = Rmax_tan/(1+10**(slope*(-measured_pcu + ec50_tan))); model Rootlength_Std =mod;	Alfalfa	0.974	0.144	0.688	1.260	0.705	0.058	0.591	0.820	6.456	0.182	6.096	6.816	7.074	0.224	6.631	7.518	7.436	0.261	6.919	7.953
						Field Sideoats Grama	0.974	0.144	0.688	1.260	0.926	0.050	0.827	1.026	6.121	0.085	5.952	6.291	6.739	0.149	6.445	7.034	7.101	0.196	6.712	7.490
						Nursery Sideoats Grama	0.974	0.144	0.688	1.260	1.106	0.053	1.002	1.210	6.121	0.085	5.952	6.291	6.739	0.149	6.445	7.034	7.101	0.196	6.712	7.490
						Field & Nursery Tansyaster	0.974	0.144	0.688	1.260	0.223	0.031	0.163	0.284	5.091	0.441	4.218	5.965	5.709	0.446	4.825	6.594	6.071	0.458	5.163	6.979
Shoot Weight																										
Shoot Weight	114	0.741	7	0.74	if seed = 'Alfalfa' then mod = Rmax_a/(1+10**(slope*(-measured_pcu + ec50_a))); if seed = 'Side Oats (Field)' then mod = Rmax_so/(1+10**(slope*(-measured_pcu + ec50_so))); if seed = 'Side Oats (Nursery)' then mod = Rmax_so/(1+10**(slope*(-measured_pcu + ec50_so))); if seed = 'Tansyaster (Field)' then mod = Rmax_tan/(1+10**(slope*(-measured_pcu + ec50_tan))); if seed = 'Tansyaster (Nursery)' then mod = Rmax_tan/(1+10**(slope*(-measured_pcu + ec50_tan))); model Dryweight_Std =mod;	Alfalfa	0.459	0.086	0.289	0.628	0.307	0.037	0.234	0.380	5.103	0.383	4.343	5.862	6.416	0.527	5.371	7.460	7.184	0.640	5.914	8.453
						Field & Nursery Sideoats Grama	0.459	0.086	0.289	0.628	0.490	0.040	0.410	0.570	5.662	0.251	5.165	6.159	6.975	0.456	6.072	7.878	7.743	0.590	6.574	8.912
						Field & Nursery Tansyaster	0.459	0.086	0.289	0.628	0.089	0.042	0.007	0.171	6.994	1.627	3.770	10.218	8.306	1.678	4.979	11.634	9.074	1.724	5.656	12.493
Shoot Height																										
Shoot Height	114	1.956	5	0.74	if seed = 'Alfalfa' then mod = Rmax_a/(1+10**(slope*(-measured_pcu + ec50))); if seed = 'Side Oats (Field)' then mod = Rmax_so/(1+10**(slope*(-measured_pcu + ec50))); if seed = 'Side Oats (Nursery)' then mod = Rmax_so/(1+10**(slope*(-measured_pcu + ec50))); if seed = 'Tansyaster (Field)' then mod = Rmax_tan/(1+10**(slope*(-measured_pcu + ec50))); if seed = 'Tansyaster (Nursery)' then mod = Rmax_tan/(1+10**(slope*(-measured_pcu + ec50))); model Height_Std =mod;	Alfalfa	0.518	0.087	0.345	0.690	0.581	0.057	0.468	0.694	5.857	0.197	5.467	6.247	7.021	0.361	6.305	7.737	7.701	0.469	6.772	8.630
						Field & Nursery Sideoats Grama	0.518	0.087	0.345	0.690	0.803	0.058	0.689	0.917	5.857	0.197	5.467	6.247	7.021	0.361	6.305	7.737	7.701	0.469	6.772	8.630
						Field & Nursery Tansyaster	0.518	0.087	0.345	0.690	0.266	0.035	0.197	0.336	5.857	0.197	5.467	6.247	7.021	0.361	6.305	7.737	7.701	0.469	6.772	8.630
Shoot Height, Outlier Excluded	113	1.232	5	0.79	if seed = 'Alfalfa' then mod = Rmax_a/(1+10**(slope*(-measured_pcu + ec50))); if seed = 'Side Oats (Field)' then mod = Rmax_so/(1+10**(slope*(-measured_pcu + ec50))); if seed = 'Side Oats (Nursery)' then mod = Rmax_so/(1+10**(slope*(-measured_pcu + ec50))); if seed = 'Tansyaster (Field)' then mod = Rmax_tan/(1+10**(slope*(-measured_pcu + ec50))); if seed = 'Tansyaster (Nursery)' then mod = Rmax_tan/(1+10**(slope*(-measured_pcu + ec50))); model Height_Std =mod;	Alfalfa	0.570	0.079	0.414	0.725	0.553	0.041	0.472	0.634	5.673	0.139	5.397	5.949	6.730	0.256	6.223	7.237	7.348	0.335	6.685	8.011
						Field & Nursery Sideoats Grama	0.570	0.079	0.414	0.725	0.717	0.039	0.639	0.794	5.673	0.139	5.397	5.949	6.730	0.256	6.223	7.237	7.348	0.335	6.685	8.011
						Field & Nursery Tansyaster	0.570	0.079	0.414	0.725	0.256	0.026	0.204	0.309	5.673	0.139	5.397	5.949	6.730	0.256	6.223	7.237	7.348	0.335	6.685	8.011

Notes:
SE = standard error, using Wald statistic in SAS for non-linear regression.
LCL = lower confidence limit
UCL = upper confidence limit
Rmax = upper endpoint threshold of S-shaped dose-response curve (where curve plateaus)
Slope = slope of S-shaped curve
ECx = effects concentration (in pCu units) at x% of the endpoint below Rmax
a = alfalfa, so = sideoats grama, nso = nursery seed sideoats grama, fso = field seed sideoats grama, tan = tansyaster, ftan = field seed tansyaster, ntan = nursery seed tansyasters

Table G-2. Three-Seed Model Results

Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Endpoint	n	SSE	Parameters	Pseudo R^2	SAS Formulation	Seed Type	Slope				Rmax				EC50				EC20				EC10			
							Estimate	S.E.	95 LCL	95UCL	Estimate	S.E.	95 LCL	95UCL	Estimate	S.E.	95 LCL	95UCL	Estimate	SE	95 LCL	95UCL	Estimate	SE	95 LCL	95UCL
Emergence																										
Emergence	99	5.348	7	0.74	if seed = 'Alfalfa' then mod = Rmax_a/(1+10**(slope_a*(-measured_pcu + ec50_a))); if seed = 'Side Oats (Field)' then mod = Rmax_fso/(1+10**(slope_so*(-measured_pcu + ec50_so))); if seed = 'Side Oats (Nursery)' then mod = Rmax_nso/(1+10**(slope_so*(-measured_pcu + ec50_so)));	Alfalfa	1.747	0.887	-0.015	3.510	0.812	0.057	0.698	0.925	3.787	0.131	3.526	4.047	4.131	0.202	3.729	4.533	4.333	0.288	3.760	4.906
						Field Sideoats Grama	0.562	0.098	0.368	0.756	1.125	0.088	0.951	1.300	5.147	0.176	4.797	5.497	6.218	0.324	5.574	6.862	6.845	0.425	6.001	7.689
						Nursery Sideoats Grama	0.562	0.098	0.368	0.756	1.472	0.099	1.275	1.669	5.147	0.176	4.797	5.497	6.218	0.324	5.574	6.862	6.845	0.425	6.001	7.689
Survival																										
Survival	90	2.550	7	0.80	if seed = 'Alfalfa' then mod = Rmax_a/(1+10**(slope_a*(-measured_pcu + ec50_a))); if seed = 'Side Oats (Field)' then mod = Rmax_fso/(1+10**(slope_so*(-measured_pcu + ec50_so))); if seed = 'Side Oats (Nursery)' then mod = Rmax_nso/(1+10**(slope_so*(-measured_pcu + ec50_so)));	Alfalfa	14.102	11.167	-8.108	36.312	0.943	0.034	0.876	1.010	3.682	0.017	3.649	3.715	3.725	0.031	3.664	3.785	3.750	0.049	3.653	3.847
						Field Sideoats Grama	0.579	0.088	0.404	0.755	1.244	0.069	1.107	1.381	5.115	0.136	4.844	5.385	6.154	0.259	5.639	6.669	6.762	0.344	6.077	7.447
						Nursery Sideoats Grama	0.579	0.088	0.404	0.755	1.121	0.066	0.991	1.252	5.115	0.136	4.844	5.385	6.154	0.259	5.639	6.669	6.762	0.344	6.077	7.447
Root Length																										
Root Length	84	1.213	6	0.90	if seed = 'Alfalfa' then mod = Rmax_a/(1+10**(slope*(-measured_pcu + ec50_a))); if seed = 'Side Oats (Field)' then mod = Rmax_fso/(1+10**(slope*(-measured_pcu + ec50_so))); if seed = 'Side Oats (Nursery)' then mod = Rmax_nso/(1+10**(slope*(-measured_pcu + ec50_so)));	Alfalfa	0.976	0.140	0.698	1.255	0.705	0.055	0.595	0.815	6.456	0.173	6.111	6.801	7.072	0.214	6.646	7.499	7.433	0.250	6.935	7.931
						Field Sideoats Grama	0.976	0.140	0.698	1.255	0.926	0.048	0.830	1.022	6.120	0.082	5.958	6.283	6.737	0.143	6.453	7.021	7.098	0.189	6.722	7.474
						Nursery Sideoats Grama	0.976	0.140	0.698	1.255	1.106	0.050	1.006	1.206	6.120	0.082	5.958	6.283	6.737	0.143	6.453	7.021	7.098	0.189	6.722	7.474
Shoot Weight																										
Shoot Weight	84	0.635	5	0.70	if seed = 'Alfalfa' then mod = Rmax_a/(1+10**(slope*(-measured_pcu + ec50_a))); if seed = 'Side Oats (Field)' then mod = Rmax_so/(1+10**(slope*(-measured_pcu + ec50_so))); if seed = 'Side Oats (Nursery)' then mod = Rmax_so/(1+10**(slope*(-measured_pcu + ec50_so)));	Alfalfa	0.467	0.094	0.280	0.653	0.305	0.039	0.228	0.383	5.089	0.405	4.282	5.895	6.379	0.556	5.273	7.486	7.134	0.675	5.790	8.478
						Field & Nursery Sideoats Grama	0.467	0.094	0.280	0.653	0.488	0.042	0.404	0.572	5.647	0.262	5.125	6.170	6.938	0.478	5.987	7.889	7.693	0.620	6.460	8.926
Shoot Height																										
Shoot Height	84	1.471	5	0.77	if seed = 'Alfalfa' then mod = Rmax_a/(1+10**(slope*(-measured_pcu + ec50_a))); if seed = 'Side Oats (Field)' then mod = Rmax_so/(1+10**(slope*(-measured_pcu + ec50_so))); if seed = 'Side Oats (Nursery)' then mod = Rmax_so/(1+10**(slope*(-measured_pcu + ec50_so)));	Alfalfa	0.532	0.093	0.348	0.717	0.534	0.061	0.412	0.656	5.486	0.336	4.817	6.154	6.617	0.450	5.720	7.513	7.278	0.540	6.204	8.353
						Field & Nursery Sideoats Grama	0.532	0.093	0.348	0.717	0.817	0.063	0.693	0.942	5.944	0.216	5.515	6.374	7.075	0.376	6.326	7.824	7.737	0.483	6.776	8.698
Shoot Height, Outlier Excluded	83	0.764	5	0.84	if seed = 'Alfalfa' then mod = Rmax_a/(1+10**(slope*(-measured_pcu + ec50_a))); if seed = 'Side Oats (Field)' then mod = Rmax_so/(1+10**(slope*(-measured_pcu + ec50_so))); if seed = 'Side Oats (Nursery)' then mod = Rmax_so/(1+10**(slope*(-measured_pcu + ec50_so)));	Alfalfa	0.586	0.076	0.434	0.738	0.524	0.042	0.441	0.606	5.435	0.224	4.989	5.881	6.462	0.299	5.867	7.057	7.063	0.359	6.348	7.778
						Field & Nursery Sideoats Grama	0.586	0.076	0.434	0.738	0.724	0.038	0.648	0.800	5.728	0.142	5.445	6.010	6.755	0.243	6.271	7.239	7.356	0.314	6.731	7.981

Notes:
Three seed models exclude tansyaster seeds (both field and nursery seeds)
SE = standard error, using Wald statistic in SAS for non-linear regression.
LCL = lower confidence limit
UCL = upper confidence limit
Rmax = upper endpoint threshold of S-shaped dose-response curve (where curve plateaus)
Slope = slope of S-shaped curve
ECx = effects concentration (in pCu units) at x% of the endpoint below Rmax
a = alfalfa, so = sideoats grama, nso = nursery seed sideoats grama, fso = field seed sideoats grama

Table G-3. Covariates Considered and Eliminated from Greenhouse Phytotoxicity Data Analysis

Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Parameter	Units	Remaining after multicollinearity test[a]	Remaining if $p < 0.25$ with an endpoint[b]
Lime as $CaCO_3$	%		
Organic Matter, LOI	%		
Soil category (bedrock, flat rocky, slope, flat granular)	indicator variable[d]	X	X
Soil texture (% clay, silt, sand)	%	X	X
Calcium, Extractable, NH_4OAc	meq/100g	X	X
Magnesium, Extractable, NH_4OAc	meq/100g		
Potassium, Extractable, NH_4OAc	meq/100g		
Sodium, Extractable, NH_4OAc	meq/100g	X	X
Alkalinity, Saturated Paste	meq/L		
Bicarbonate, Saturated Paste	meq/L		
Calcium, Saturated Paste	meq/L	X	X
Chloride, Saturated Paste	meq/L		
Sulfate, Saturated Paste	meq/L		
Aluminum, DTPA extraction	mg/kg	X	X
Calcium, NH_4OAc	mg/kg		
Iron, DTPA extraction	mg/kg	X[c]	X
Magnesium, NH_4OAc	mg/kg		
Manganese, DTPA extraction	mg/kg	X	X
Nitrate + nitrite	mg/kg	X	
Organic Carbon, Dissolved (DOC)	mg/kg	X	X
Phosphate	mg/kg	X	
Phosphorus, Olsen-Bray	mg/kg	X	X
Potassium, NH_4OAc	mg/kg	X	X
Sodium, NH_4OAc	mg/kg		
Fluoride	mg/L		
Conductivity, Saturated Paste	mmhos/cm		
pCu, Measured in $CaCl_2$	s.u.	X	X

Acronyms/Abbreviations:

$CaCl_2$ = calcium chloride
$CaCO_3$ = calcium carbonate
DOC = dissolved organic carbon
DTPA = diethylenetriaminepentaacetic acid
LOI = loss on ignition
meq/100 g = millequivalents per 100 grams
meq/L = millequivalents per liter
mg/kg = milligrams per kilogram
mg/L = milligrams per liter
mmhos/cm = millimhos per centimeter
NH_4OAc = ammonium acetate
s.u. = standard units

Notes:

a. Multicollinearity test involved retaining variable if not correlated (< 0.7) to another independent covariate (including pCu), and if correlated, only one of a pair of correlated variables is retained.

b. Variable was retained if significantly correlated to any of the greenhouse endpoints at $p < 0.25$.

c. Iron was correlated (>0.7) with aluminum, but retained because iron has opposite effect on plants than aluminum and could reduce iron deficiency that copper causes.

d. An indicator variable for four categories is coded by (1,0,0), (0,1,0), (0,0,1), and (0,0,0) where slope is the all 0 reference category.

Correlations were by Pearson and Spearman methods.

Table G-4. Five-Seed Model Results with Covariates

Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Endpoint (Covariate)	n	SSE	Parameters	Pseudo R^2	SAS Formulation	Seed Type	Slope				Rmax				$EC50_{model}$				Alpha				Alpha 2			
							Estimate	S.E.	95 LCL	95UCL	Estimate	S.E.	95 LCL	95UCL	Estimate	S.E.	95 LCL	95UCL	Estimate	S.E.	95 LCL	95UCL	Estimate	S.E.	95 LCL	95UCL
Emergence																										
Emergence (Flat Granular/Not Flat Granular)	165	4.363	11	0.87	if seed = 'Alfalfa' then mod = Rmax_a/(1+10**(slope_a*(-measured_pcu + ec50_a+(alpha*&covar)))); if seed = 'Side Oats (Field)' then mod = Rmax_fso/(1+10**(slope*(-measured_pcu + ec50_so+(alpha*&covar)))); if seed = 'Side Oats (Nursery)' then mod = Rmax_nso/(1+10**(slope*(-measured_pcu + ec50_so+(alpha*&covar)))); if seed = 'Tansyaster (Field)' then mod = Rmax_ftan/(1+10**(slope*(-measured_pcu + ec50_tan+(alpha*&covar)))); if seed = 'Tansyaster (Nursery)' then mod = Rmax_ntan/(1+10**(slope*(-measured_pcu + ec50_tan+(alpha*&covar)))); model Emergence_Std =mod;	Alfalfa	1.406	0.486	0.446	2.366	0.817	0.040	0.739	0.895	3.806	0.108	3.594	4.018	-1.438	0.233	-1.897	-0.978	NA	NA	NA	NA
						Field Sideoats Grama	0.737	0.089	0.562	0.912	1.072	0.051	0.971	1.173	5.155	0.096	4.965	5.345	-1.438	0.233	-1.897	-0.978	NA	NA	NA	NA
						Nursery Sideoats Grama	0.737	0.089	0.562	0.912	1.398	0.055	1.289	1.507	5.155	0.096	4.965	5.345	-1.438	0.233	-1.897	-0.978	NA	NA	NA	NA
						Field Tansyaster	0.737	0.089	0.562	0.912	0.164	0.050	0.064	0.263	5.473	0.393	4.696	6.250	-1.438	0.233	-1.897	-0.978	NA	NA	NA	NA
						Nursery Tansyaster	0.737	0.089	0.562	0.912	0.376	0.056	0.267	0.486	5.473	0.393	4.696	6.250	-1.438	0.233	-1.897	-0.978	NA	NA	NA	NA
Survival																										
Survival (Iron)	127	7.460	13	0.93	if seed = 'Alfalfa' then mod = Rmax_a/(1+10**(slope_a*(-measured_pcu + ec50_a+(alpha*&covar)))); if seed = 'Side Oats (Field)' then mod = Rmax_fso/(1+10**(slope_so*(-measured_pcu + ec50_so+(alpha*&covar)))); if seed = 'Side Oats (Nursery)' then mod = Rmax_nso/(1+10**(slope_so*(-measured_pcu + ec50_so+(alpha*&covar)))); if seed = 'Tansyaster (Field)' then mod = Rmax_ftan/(1+10**(slope_tan*(-measured_pcu + ec50_ftan+(alpha*&covar)))); if seed = 'Tansyaster (Nursery)' then mod = Rmax_ntan/(1+10**(slope_tan*(-measured_pcu + ec50_ntan+(alpha*&covar)))); model Survival_Std =mod;	Alfalfa	4.421	3.947	-3.399	12.241	0.948	0.050	0.850	1.047	3.751	0.082	3.589	3.913	-0.00448	0.00171	-0.00787	-0.00109	NA	NA	NA	NA
						Field Sideoats Grama	0.634	0.143	0.352	0.917	1.253	0.100	1.055	1.451	5.372	0.209	4.957	5.786	-0.00448	0.00171	-0.00787	-0.00109	NA	NA	NA	NA
						Nursery Sideoats Grama	0.634	0.143	0.352	0.917	1.119	0.095	0.930	1.307	5.372	0.209	4.957	5.786	-0.00448	0.00171	-0.00787	-0.00109	NA	NA	NA	NA
						Field Tansyaster	6.968	1.693	3.614	10.322	2.925	0.074	2.778	3.071	5.419	0.088	5.246	5.593	-0.00448	0.00171	-0.00787	-0.00109	NA	NA	NA	NA
						Nursery Tansyaster	6.968	1.693	3.614	10.322	2.455	0.067	2.323	2.587	5.047	0.061	4.926	5.168	-0.00448	0.00171	-0.00787	-0.00109	NA	NA	NA	NA
Root Length																										
Root Length (Clay)	114	1.506	9	0.89	if seed = 'Alfalfa' then mod = Rmax_a/(1+10**(slope*(-measured_pcu + ec50_a+(alpha*&covar)))); if seed = 'Side Oats (Field)' then mod = Rmax_fso/(1+10**(slope*(-measured_pcu + ec50_so+(alpha*&covar)))); if seed = 'Side Oats (Nursery)' then mod = Rmax_nso/(1+10**(slope*(-measured_pcu + ec50_so+(alpha*&covar)))); if seed = 'Tansyaster (Field)' then mod = Rmax_tan/(1+10**(slope*(-measured_pcu + ec50_tan+(alpha*&covar)))); if seed = 'Tansyaster (Nursery)' then mod = Rmax_tan/(1+10**(slope*(-measured_pcu + ec50_tan+(alpha*&covar)))); model Rootlength_Std =mod;	Alfalfa	0.968	0.120	0.730	1.206	0.700	0.051	0.599	0.802	5.725	0.227	5.274	6.176	0.0238	0.00510	0.0137	0.0339	NA	NA	NA	NA
						Field Sideoats Grama	0.968	0.120	0.730	1.206	0.935	0.045	0.845	1.025	5.374	0.177	5.024	5.724	0.0238	0.00510	0.0137	0.0339	NA	NA	NA	NA
						Nursery Sideoats Grama	0.968	0.120	0.730	1.206	1.110	0.047	1.017	1.202	5.374	0.177	5.024	5.724	0.0238	0.00510	0.0137	0.0339	NA	NA	NA	NA
						Field & Nursery Tansyaster	0.968	0.120	0.730	1.206	0.231	0.028	0.174	0.287	4.492	0.392	3.715	5.269	0.0238	0.00510	0.0137	0.0339	NA	NA	NA	NA
Shoot Weight																										
Shoot Weight (Clay [alpha] and Flat Granular [alpha2])	114	0.642	9	0.78	if seed = 'Alfalfa' then mod = Rmax_a/(1+10**(slope*(-measured_pcu + ec50_a+(alpha*&covar)+(alpha2*&covar2)))); if seed = 'Side Oats (Field)' then mod = Rmax_so/(1+10**(slope*(-measured_pcu + ec50_so+(alpha*&covar)+(alpha2*&covar2)))); if seed = 'Side Oats (Nursery)' then mod = Rmax_so/(1+10**(slope*(-measured_pcu + ec50_so+(alpha*&covar)+(alpha2*&covar2)))); if seed = 'Tansyaster (Field)' then mod = Rmax_tan/(1+10**(slope*(-measured_pcu + ec50_tan+(alpha*&covar)+(alpha2*&covar2)))); if seed = 'Tansyaster (Nursery)' then mod = Rmax_tan/(1+10**(slope*(-measured_pcu + ec50_tan+(alpha*&covar)+(alpha2*&covar2)))); model Dryweight_Std =mod;	Alfalfa	0.658	0.118	0.424	0.891	0.289	0.028	0.234	0.343	4.409	0.312	3.792	5.027	0.0244	0.00773	0.0091	0.0397	-0.492	0.243	-0.974	-0.00932
						Field & Nursery Sideoats Grama	0.658	0.118	0.424	0.891	0.463	0.024	0.415	0.510	4.874	0.286	4.307	5.442	0.0244	0.00773	0.0091	0.0397	-0.492	0.243	-0.974	-0.00932
						Field & Nursery Tansyaster	0.658	0.118	0.424	0.891	0.075	0.023	0.029	0.122	5.755	1.157	3.462	8.049	0.0244	0.00773	0.0091	0.0397	-0.492	0.243	-0.974	-0.00932
Shoot Height																										
Shoot Height (Clay [alpha] and Flat Granular [alpha2])	114	1.724	7	0.77	if seed = 'Alfalfa' then mod = Rmax_a/(1+10**(slope*(-measured_pcu + ec50+(alpha*&covar)+(alpha2*&covar2)))); if seed = 'Side Oats (Field)' then mod = Rmax_so/(1+10**(slope*(-measured_pcu + ec50+(alpha*&covar)+(alpha2*&covar2)))); if seed = 'Side Oats (Nursery)' then mod = Rmax_so/(1+10**(slope*(-measured_pcu + ec50+(alpha*&covar)+(alpha2*&covar2)))); if seed = 'Tansyaster (Field)' then mod = Rmax_tan/(1+10**(slope*(-measured_pcu + ec50+(alpha*&covar)+(alpha2*&covar2)))); if seed = 'Tansyaster (Nursery)' then mod = Rmax_tan/(1+10**(slope*(-measured_pcu + ec50+(alpha*&covar)+(alpha2*&covar2)))); model Height_Std =mod;	Alfalfa	0.621	0.099	0.424	0.817	0.549	0.045	0.459	0.639	5.273	0.313	4.653	5.894	0.0185	0.008380	0.001890	0.0351	-0.576	0.255	-1.082	-0.0696
						Field & Nursery Sideoats Grama	0.621	0.099	0.424	0.817	0.769	0.040	0.691	0.848	5.273	0.313	4.653	5.894	0.0185	0.008380	0.001890	0.0351	-0.576	0.255	-1.082	-0.0696
						Field & Nursery Tansyaster	0.621	0.099	0.424	0.817	0.258	0.031	0.198	0.319	5.273	0.313	4.653	5.894	0.0185	0.008380	0.001890	0.0351	-0.576	0.255	-1.082	-0.0696
Shoot Height, Outlier Excluded (Clay [alpha] and Flat Granular [alpha2])	113	0.997	7	0.83	if seed = 'Alfalfa' then mod = Rmax_a/(1+10**(slope*(-measured_pcu + ec50+(alpha*&covar)+(alpha2*&covar2)))); if seed = 'Side Oats (Field)' then mod = Rmax_so/(1+10**(slope*(-measured_pcu + ec50+(alpha*&covar)+(alpha2*&covar2)))); if seed = 'Side Oats (Nursery)' then mod = Rmax_so/(1+10**(slope*(-measured_pcu + ec50+(alpha*&covar)+(alpha2*&covar2)))); if seed = 'Tansyaster (Field)' then mod = Rmax_tan/(1+10**(slope*(-measured_pcu + ec50+(alpha*&covar)+(alpha2*&covar2)))); if seed = 'Tansyaster (Nursery)' then mod = Rmax_tan/(1+10**(slope*(-measured_pcu + ec50+(alpha*&covar)+(alpha2*&covar2)))); model Height_Std =mod;	Alfalfa	0.800	0.108	0.587	1.013	0.519	0.032	0.456	0.582	4.933	0.208	4.521	5.345	0.0226	0.00577	0.0111	0.0340	-0.501	0.176	-0.850	-0.153
						Field & Nursery Sideoats Grama	0.800	0.108	0.587	1.013	0.683	0.027	0.630	0.737	4.933	0.208	4.521	5.345	0.0226	0.00577	0.0111	0.0340	-0.501	0.176	-0.850	-0.153
						Field & Nursery Tansyaster	0.800	0.108	0.587	1.013	0.247	0.022	0.203	0.291	4.933	0.208	4.521	5.345	0.0226	0.00577	0.0111	0.0340	-0.501	0.176	-0.850	-0.153

Note: The EC50 in this table is a coefficient estimated in the model, assuming covariate values are zero, which differs from EC50 calculated in Table G-5.

Table G-5. DEL and PEL Based on Five-Seed Models with Various Combinations of the Covariates

Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Species	Emergence, not on Flat Granular	Emergence, on Flat Granular	Survival, Minimum Iron	Survival, Mean Iron	Survival, Maximum Iron	Shoot Weight, not on Flat Granular, Minimum Clay	Shoot Weight, not on Flat Granular, Mean Clay	Shoot Weight, not on Flat Granular, Maximum Clay	Shoot Weight, on Flat Granular, Minimum Clay	Shoot Weight, on Flat Granular, Mean Clay	Shoot Weight, on Flat Granular, Maximum Clay	Shoot Height, not on Flat Granular, Minimum Clay	Shoot Height, not on Flat Granular, Mean Clay	Shoot Height, not on Flat Granular, Maximum Clay	Shoot Height, on Flat Granular, Minimum Clay	Shoot Height, on Flat Granular, Mean Clay	Shoot Height, on Flat Granular, Maximum Clay	Root Length, Minimum Clay	Root Length, Mean Clay	Root Length, Maximum Clay
Alfalfa																			
EC10 (DEL)	4.48	3.05	3.95	3.77	2.56	6.06	6.41	6.98	5.56	5.92	6.49	6.31	6.63	7.17	5.81	6.13	6.66	6.90	7.25	7.81
EC50 (PEL)	3.81	2.37	3.74	3.55	2.34	4.60	4.96	5.53	4.11	4.47	5.04	5.11	5.44	5.97	4.61	4.94	5.47	5.92	6.26	6.82
DEL based on minimum of reference	4.46	3.02	4.64	4.45	3.24	6.54	6.90	7.47	6.05	6.40	6.98	6.21	6.54	7.07	5.71	6.04	6.57	7.26	7.60	8.16
PEL based on minimum of reference	3.74	2.30	3.75	3.56	2.36	4.54	4.89	5.46	4.05	4.40	4.97	4.99	5.31	5.85	4.49	4.81	5.34	5.87	6.22	6.78
Field Sideoats																			
EC10 (DEL)	6.45	5.01	6.86	6.68	5.47	6.52	6.87	7.45	6.03	6.38	6.96	6.31	6.63	7.17	5.81	6.13	6.66	6.55	6.90	7.45
EC50 (PEL)	5.15	3.72	5.36	5.17	3.96	5.07	5.42	6.00	4.58	4.93	5.50	5.11	5.44	5.97	4.61	4.94	5.47	5.56	5.91	6.47
DEL based on minimum of reference	5.84	4.41	6.77	6.59	5.38	5.88	6.23	6.80	5.38	5.74	6.31	5.87	6.20	6.73	5.37	5.70	6.23	7.24	7.58	8.14
PEL based on minimum of reference	4.87	3.43	5.20	5.02	3.81	4.76	5.12	5.69	4.27	4.63	5.20	4.89	5.22	5.75	4.39	4.72	5.25	5.54	5.89	6.45
Nursery Sideoats																			
EC10 (DEL)	6.45	5.01	6.86	6.68	5.47	6.52	6.87	7.45	6.03	6.38	6.96	6.31	6.63	7.17	5.81	6.13	6.66	6.55	6.90	7.45
EC50 (PEL)	5.15	3.72	5.36	5.17	3.96	5.07	5.42	6.00	4.58	4.93	5.50	5.11	5.44	5.97	4.61	4.94	5.47	5.56	5.91	6.47
DEL based on minimum of reference	6.60	5.17	7.27	7.08	5.87	6.04	6.39	6.96	5.55	5.90	6.47	5.90	6.22	6.75	5.39	5.72	6.25	6.61	6.96	7.52
PEL based on minimum of reference	5.06	3.62	5.28	5.09	3.89	4.82	5.17	5.75	4.33	4.68	5.25	4.90	5.23	5.76	4.40	4.73	5.26	5.48	5.83	6.39
Field Tansyaster																			
EC10 (DEL)	6.77	5.33	5.54	5.36	4.15	7.40	7.76	8.33	6.91	7.26	7.84	6.31	6.63	7.17	5.81	6.13	6.66	5.67	6.01	6.57
EC50 (PEL)	5.47	4.04	5.41	5.22	4.01	5.95	6.30	6.88	5.46	5.81	6.39	5.11	5.44	5.97	4.61	4.94	5.47	4.68	5.03	5.59
DEL based on minimum of reference	5.16	3.72	5.51	5.32	4.12	5.57	5.92	6.50	5.08	5.43	6.00	5.59	5.92	6.45	5.09	5.41	5.94	4.19	4.53	5.09
PEL based on minimum of reference	4.60	3.16	5.39	5.20	3.99	4.95	5.30	5.88	4.46	4.81	5.38	4.78	5.11	5.64	4.28	4.61	5.14	3.81	4.15	4.71
Nursery Tansyaster																			
EC10 (DEL)	6.77	5.33	5.17	4.98	3.78	7.40	7.76	8.33	6.91	7.26	7.84	6.31	6.63	7.17	5.81	6.13	6.66	5.67	6.01	6.57
EC50 (PEL)	5.47	4.04	5.03	4.85	3.64	5.95	6.30	6.88	5.46	5.81	6.39	5.11	5.44	5.97	4.61	4.94	5.47	4.68	5.03	5.59
DEL based on minimum of reference	5.57	4.13	5.21	5.02	3.82	5.26	5.62	6.19	4.77	5.13	5.70	5.06	5.39	5.92	4.56	4.89	5.42	4.69	5.04	5.59
PEL based on minimum of reference	4.89	3.45	5.03	4.84	3.63	4.70	5.05	5.63	4.21	4.56	5.13	4.48	4.81	5.34	3.98	4.31	4.84	4.19	4.54	5.10

Notes:

DEL = *de minimus* effect level in pCu units
PEL = probable effect level in pCu units
ECx = Effect concentration of x%, which is pCu when endpoint is reduced by x% from the modeled no effect threshold, R_{max}
When minimum reference was >Rmax, Rmax was the endpoint value for the DEL (the case for alfalfa survival)
EC50 in this table include the effect of the covariate at the level indicated (either minimum, mean, or maximum value of the covariate).

Table G-6. EC20 on Five-Seed Models with Various Combinations of the Covariates

Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Species	Emergence, not on Flat Granular	Emergence, on Flat Granular	Survival, Minimum Iron	Survival, Mean Iron	Survival, Maximum Iron	Shoot Weight, not on Flat Granular, Minimum Clay	Shoot Weight, not on Flat Granular, Mean Clay	Shoot Weight, not on Flat Granular, Maximum Clay	Shoot Weight, on Flat Granular, Minimum Clay	Shoot Weight, on Flat Granular, Mean Clay	Shoot Weight, on Flat Granular, Maximum Clay	Shoot Height, not on Flat Granular, Minimum Clay	Shoot Height, not on Flat Granular, Mean Clay	Shoot Height, not on Flat Granular, Maximum Clay	Shoot Height, on Flat Granular, Minimum Clay	Shoot Height, on Flat Granular, Mean Clay	Shoot Height, on Flat Granular, Maximum Clay	Root Length, Minimum Clay	Root Length, Mean Clay	Root Length, Maximum Clay
Alfalfa																				
EC20	4.23	2.80	3.87	3.69	2.48	5.52	5.87	6.45	5.03	5.38	5.96	5.87	6.19	6.73	5.37	5.69	6.22	6.54	6.88	7.44
Field Sideoats																				
EC20	5.97	4.53	6.31	6.12	4.91	5.98	6.34	6.91	5.49	5.85	6.42	5.87	6.19	6.73	5.37	5.69	6.22	6.19	6.53	7.09
Nursery Sideoats																				
EC20	5.97	4.53	6.31	6.12	4.91	5.98	6.34	6.91	5.49	5.85	6.42	5.87	6.19	6.73	5.37	5.69	6.22	6.19	6.53	7.09
Field Tansyaster																				
EC20	6.29	4.85	5.49	5.30	4.10	6.87	7.22	7.79	6.37	6.73	7.30	5.87	6.19	6.73	5.37	5.69	6.22	5.30	5.65	6.21
Nursery Tansyaster																				
EC20	6.29	4.85	5.12	4.93	3.73	6.87	7.22	7.79	6.37	6.73	7.30	5.87	6.19	6.73	5.37	5.69	6.22	5.30	5.65	6.21

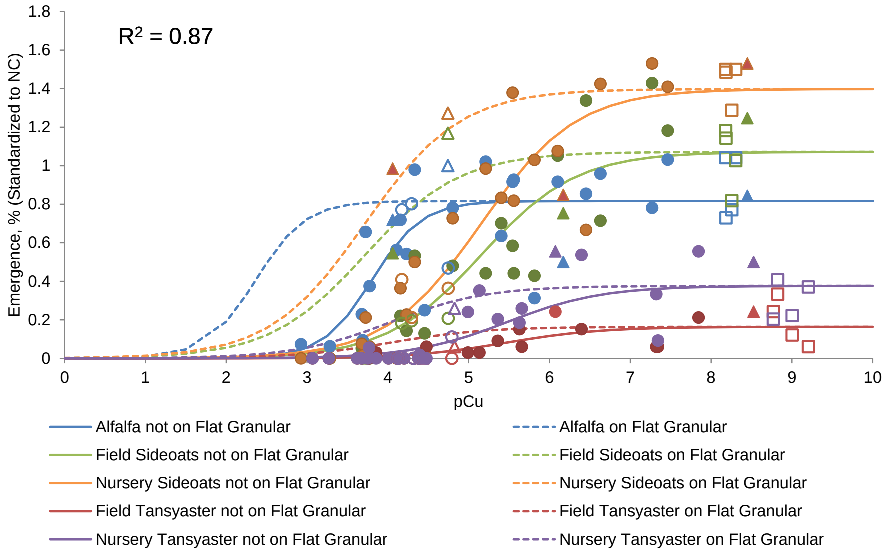
Notes:

ECx = Effect concentration of x%, which is pCu when endpoint is reduced by x% from the modeled no effect threshold, R_{max}

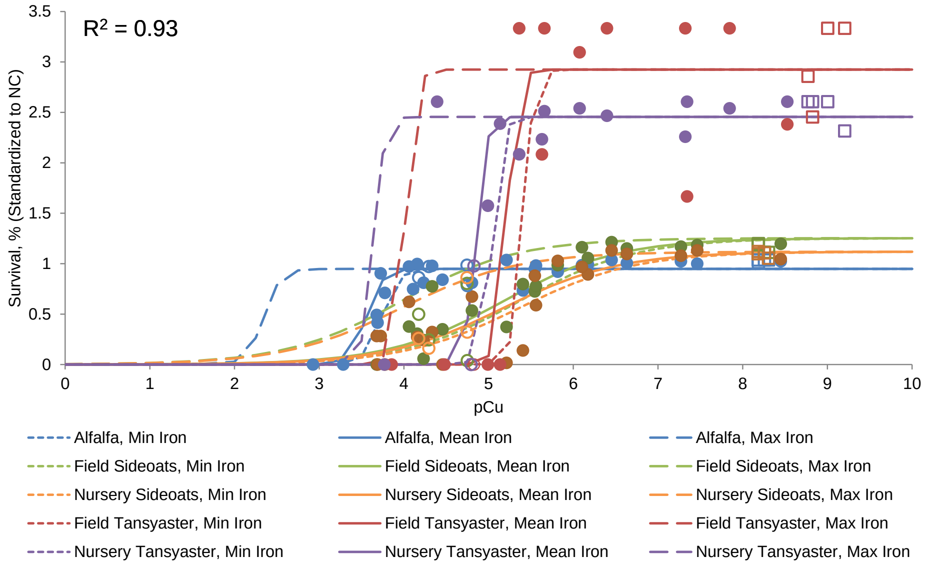
NA = not available because minimum reference above the curve.

FIGURES

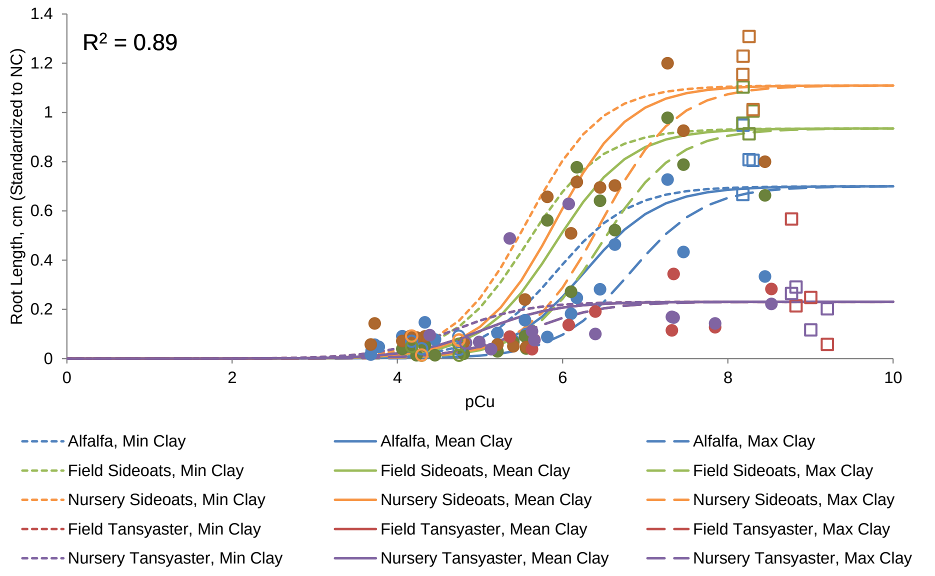
Emergence on Flat Granular and Not Flat Granular Soil



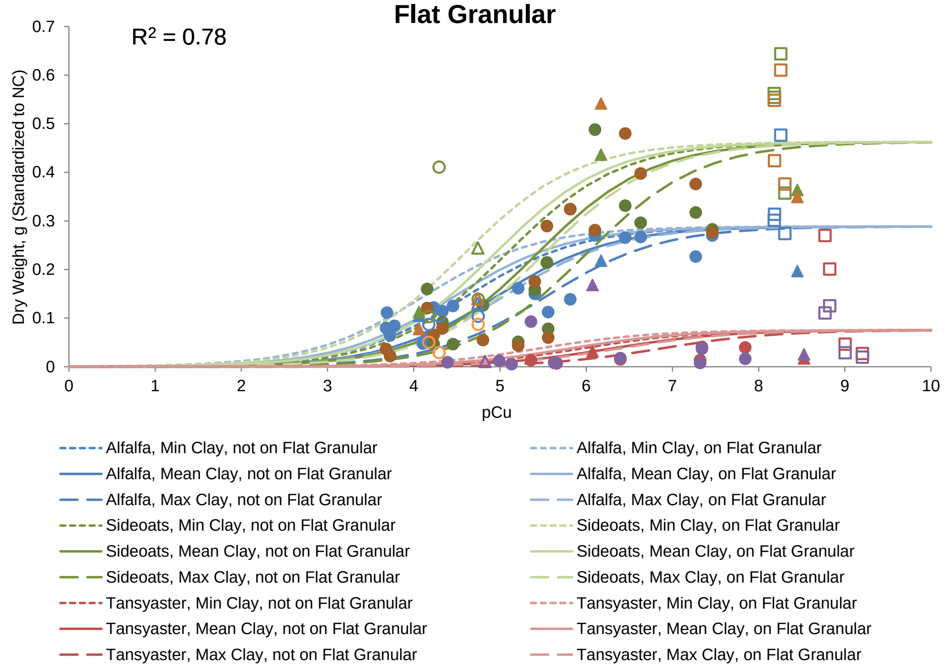
Survival with 3 Levels of Iron



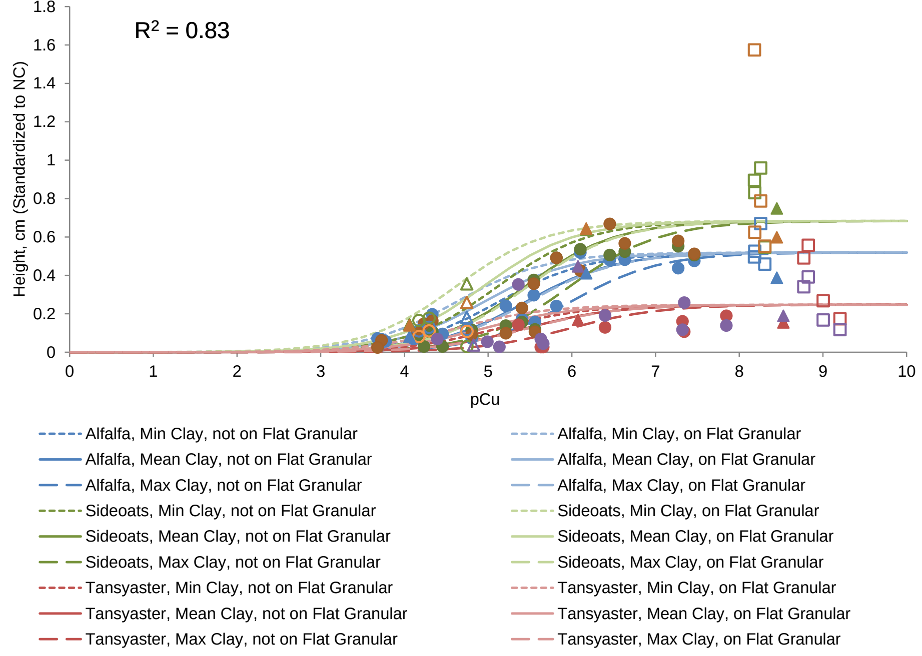
Root Length with 3 Levels of Clay



Shoot Weight with 3 Levels of Clay on Flat Granular and Not Flat Granular



Shoot Height with 3 Levels of Clay on Flat Granular and Not Flat Granular



Notes:

R^2 is calculated as 1-SSE/corrected total SS, where SS = sum of squares and SSE = sum of squares of error term.

● Alfalfa
● Field Sideoats
● Nursery Sideoats
● Field Tansyaster
● Nursery Tansyaster

Dose-Response Curves without Flat Granular as Covariate:
● Site
○ De Minimus
□ Reference

Dose-Response Curves with Flat Granular as Covariate:
● Site not on Flat Granular
▲ Site on Flat Granular
○ De Minimus not on Flat Granular
△ De Minimus on Flat Granular
□ Reference on Flat Granular

FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

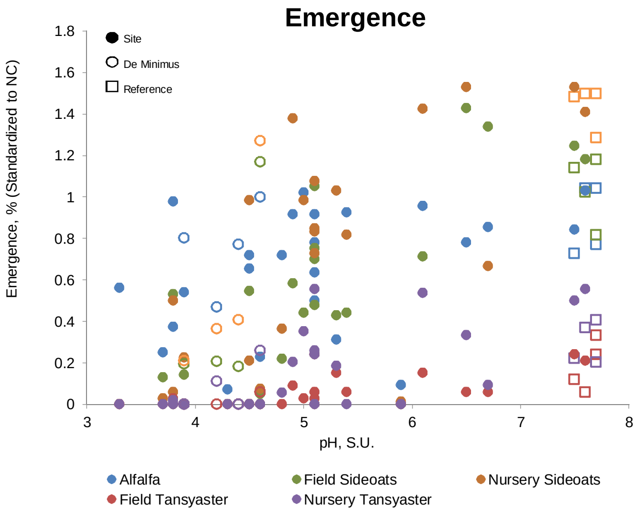
Five Seed Dose-Response Curves with Significant Soil Covariates from Greenhouse Study

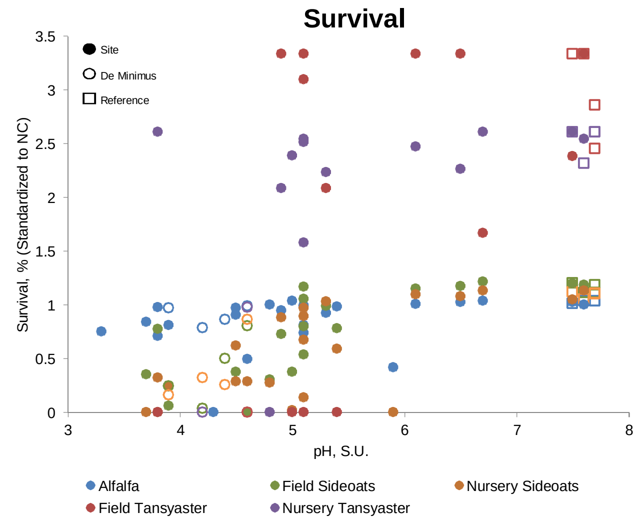
ARCADIS

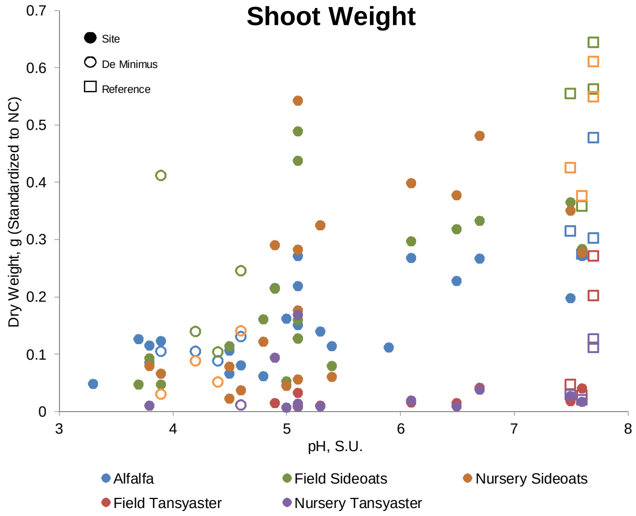
FIGURE
G-1

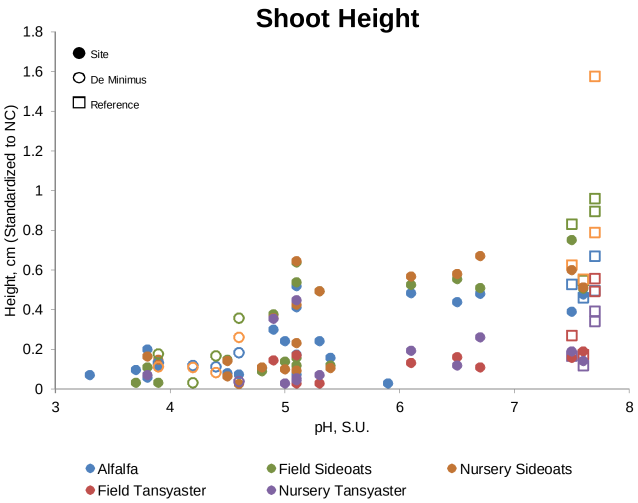
APPENDIX H

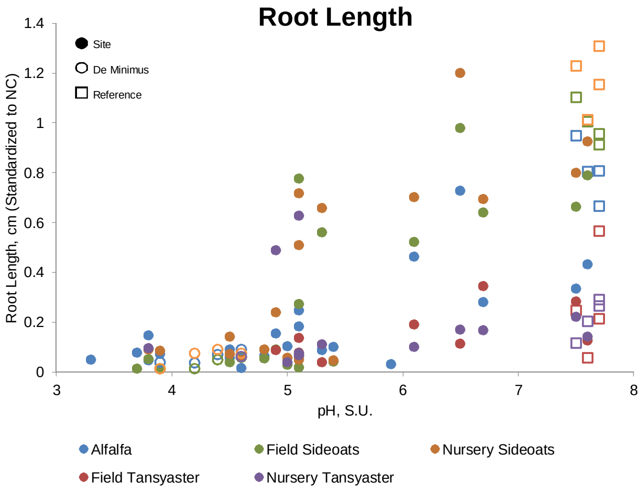
Copper and pH Plotted versus Greenhouse Study Endpoints











Notes: Emergence, growth, and survival are more related to pH than copper.

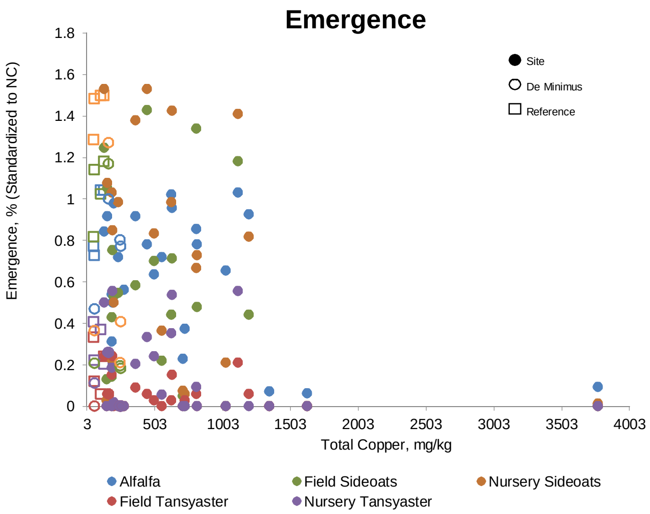
FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

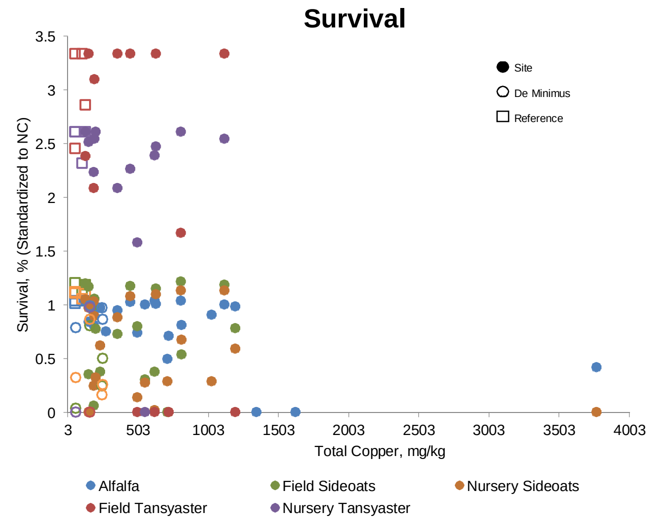
PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

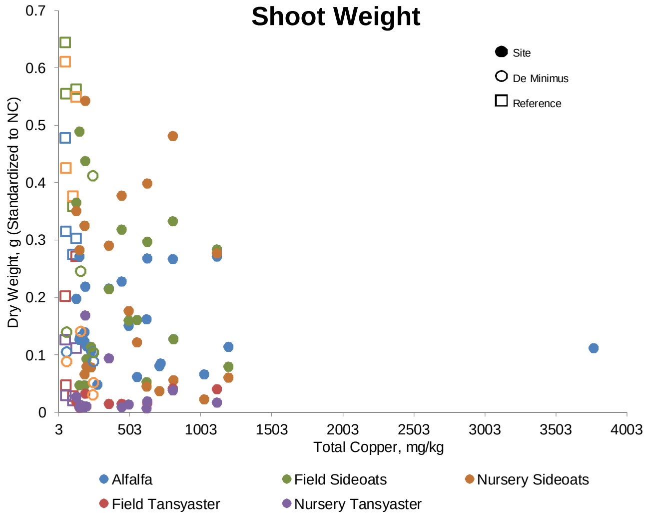
Relationship between pH and Greenhouse Study Endpoints

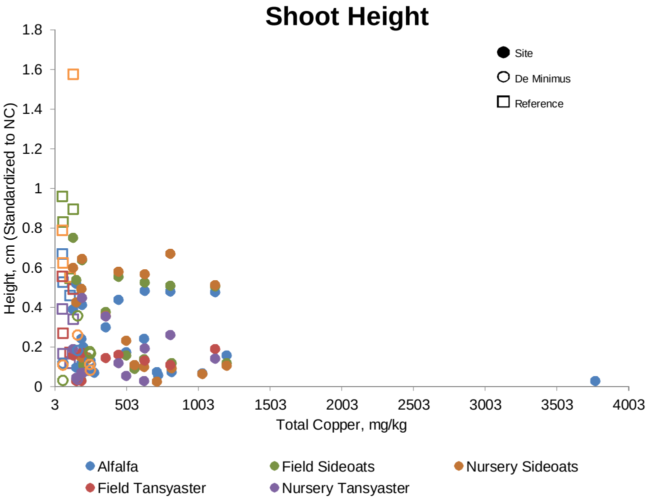
ARCADIS

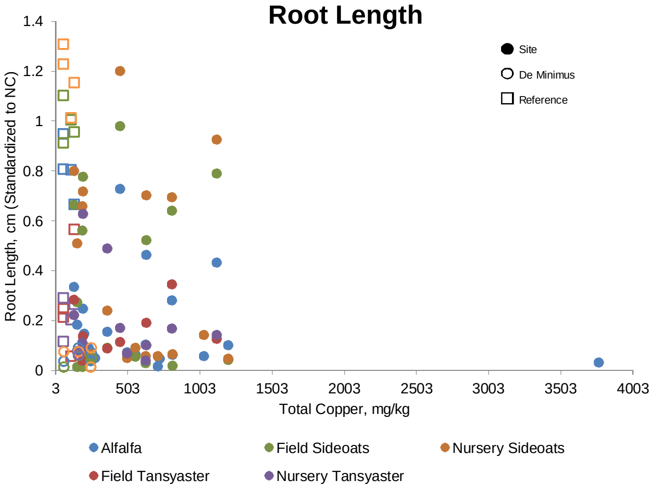
APPENDIX
H-1











Notes: Emergence, growth, and survival are more related to pH than copper.

FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

Relationship between Copper and Greenhouse Study Endpoints

ARCADIS

APPENDIX
H-2

APPENDIX I

Project Photographs

Appendix I. Phytotoxicity Study Photo Log

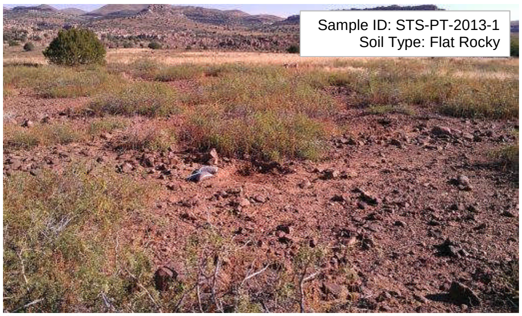
Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

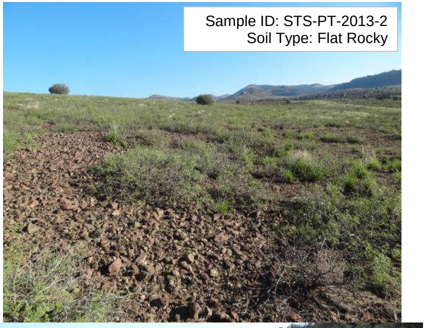
Phytotoxicity ID	Community ID	Original Location ID	Oriiginal Study	Longitude	Latitude	Soil Category
STS-PT-2013-1	STS-PT-2013-1	ERA02	Site-wide ERA	-108.106386	32.689013	Flat Rocky
STS-PT-2013-2	STS-PT-2013-2	ERA03	Site-wide ERA	-108.104709	32.685045	Flat Rocky
STS-PT-2013-3	NA	ERA04	Site-wide ERA	-108.092165	32.68906	Flat Rocky
STS-PT-2013-4	NA	ERA13	Site-wide ERA	-108.048915	32.682528	Flat Granular
STS-PT-2013-5	STS-PT-2013-5	FID 10	pH monitoring	-108.113509	32.705641	Slope
STS-PT-2013-6	NA	FID 101	pH monitoring	-108.090994	32.673182	Bedrock
STS-PT-2013-7	NA	FID 102	pH monitoring	-108.088698	32.662368	Bedrock
STS-PT-2013-8	NA	FID 105	pH monitoring	-108.10331	32.6873	Flat Rocky
STS-PT-2013-9	STS-PT-2013-9	FID 15	pH monitoring	-108.106861	32.697826	Bedrock
STS-PT-2013-10	NA	FID 16	pH monitoring	-108.1071	32.696038	Bedrock
STS-PT-2013-11	NA	FID 18	pH monitoring	-108.091822	32.674019	Bedrock
STS-PT-2013-12	STS-PT-2013-12	FID 28	pH monitoring	-108.051091	32.669984	Bedrock
STS-PT-2013-13	NA	FID 7	pH monitoring	-108.067478	32.678551	Flat Rocky
STS-PT-2013-14	NA	FID 8	pH monitoring	-108.092	32.66682	Flat Rocky
STS-PT-2013-15	NA	Reference #2 (North)	pH monitoring	-108.129671	32.713011	Flat Rocky
STS-PT-2013-16	NA	Reference #3 (Northeast)	pH monitoring	-108.111134	32.703831	Slope
STS-PT-2013-17	STS-PT-2013-17	Reference #4 (East)	pH monitoring	-108.103955	32.68969	Flat Rocky
STS-PT-2013-18*	NA	STS-PCUG-2011-17	STSIU FS	-108.102457	32.704557	Bedrock
STS-PT-2013-19	STS-PT-2013-19	STS-PCUG-2011-19	STSIU FS	-108.104566	32.692459	Flat Rocky
STS-PT-2013-20	STS-PT-2013-20	U04-1034	STSIU ERA	-108.156611	32.68923	Flat Granular
STS-PT-2013-21	STS-RWU-2012-B1	STS-RWU-2012-B1	STSIU FS	-108.044492	32.67139	Bedrock
STS-PT-2013-22	STS-RWU-2012-B2	STS-RWU-2012-B2	STSIU FS	-108.04225	32.67136	Bedrock
STS-PT-2013-23	STS-RWU-2012-B3	STS-RWU-2012-B3	STSIU FS	-108.044928	32.67379	Bedrock
STS-PT-2013-24	NA	Reference #1 (West)	pH monitoring	-108.223	32.670765	Flat Granular
STS-PT-2013-25	NA	Reference 4 (new)		-108.046	32.6192	Flat Granular
STS-PT-2013-26	STS-PT-2013-26	Reference 5 (new)		-108.05	32.6394	Flat Granular
STS-PT-2013-27	Wildlife Reference Plot South	Wildlife reference plot S	STSIU FS	-108.060065	32.674796	Flat Granular
STS-PT-2013-28	NA	Reference 6 (new)		-108.05275	32.603	Flat Granular
STS-PT-2013-29	STS-RWU-2011-10	STS-RWU-2011-10	STSIU FS	-108.084	32.6748	Flat Granular
STS-PT-2013-30	STS-RWU-2011-12	STS-RWU-2011-12	STSIU FS	-108.087	32.6642	Flat Rocky
STS-PT-2013-31	STS-RWU-2011-14	STS-RWU-2011-14	STSIU FS	-108.115	32.7081	Slope
STS-PT-2013-32	NA	new site		-108.118	32.70905	Flat Rocky
STS-PT-2013-33*[a]	NA	new site		-108.122	32.69284	Flat Granular[a]
STS-PT-2013-34*	NA	new site		-108.109	32.70495	Flat Rocky
STS-PT-2013-35	NA	new site		-108.108	32.69484	Flat Rocky
STS-PT-2013-36	NA	new site		-108.115	32.6978	Flat Rocky

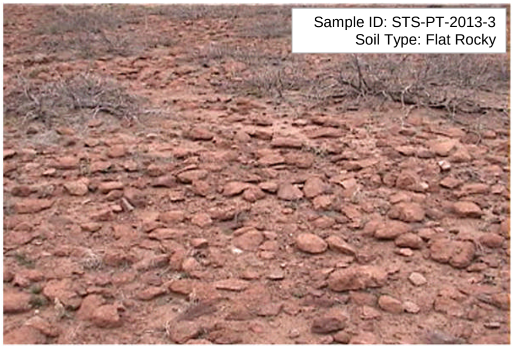
*Not used in greenhouse study

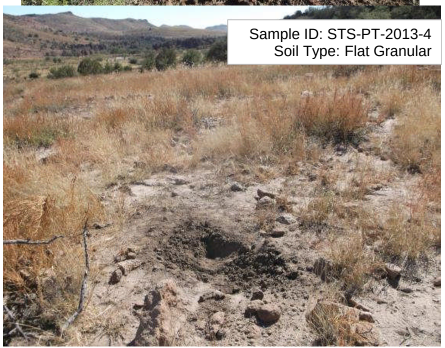
[a] Soil had copper concentrate

NA = not applicable


Sample ID: STS-PT-2013-1
Soil Type: Flat Rocky


Sample ID: STS-PT-2013-2
Soil Type: Flat Rocky


Sample ID: STS-PT-2013-3
Soil Type: Flat Rocky


Sample ID: STS-PT-2013-4
Soil Type: Flat Granular


Sample ID: STS-PT-2013-5
Soil Type: Slope


Sample ID: STS-PT-2013-6
Soil Type: Bedrock


Sample ID: STS-PT-2013-7
Soil Type: Bedrock


Sample ID: STS-PT-2013-8
Soil Type: Flat Rocky

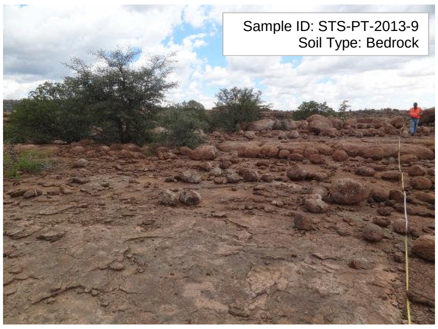
FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

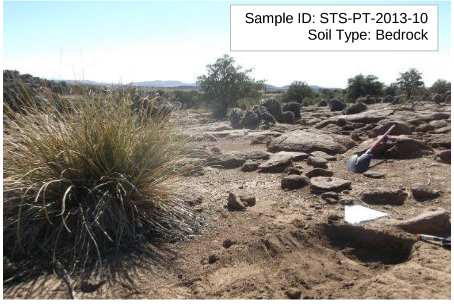
PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

PHYTOTOXICITY STUDY PHOTO LOG

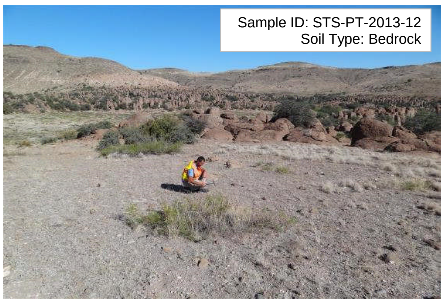
ARCADIS

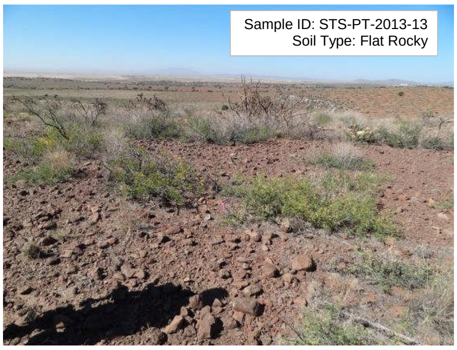
APPENDIX I

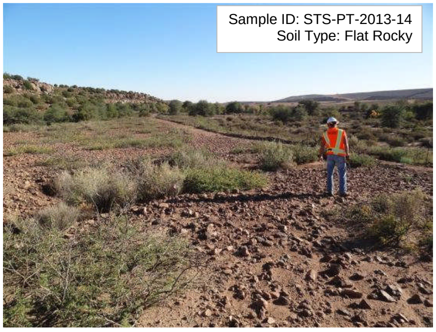

Sample ID: STS-PT-2013-9
Soil Type: Bedrock

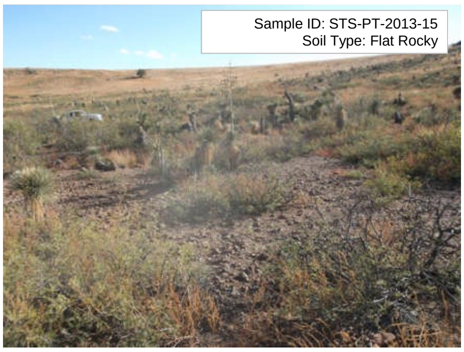

Sample ID: STS-PT-2013-10
Soil Type: Bedrock

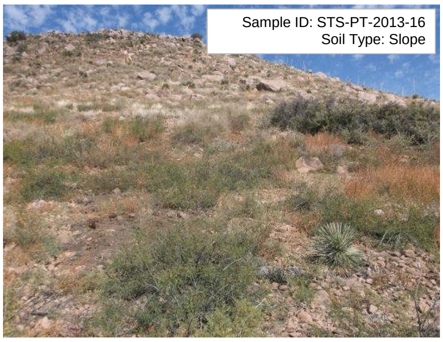

Sample ID: STS-PT-2013-11
Soil Type: Bedrock


Sample ID: STS-PT-2013-12
Soil Type: Bedrock


Sample ID: STS-PT-2013-13
Soil Type: Flat Rocky


Sample ID: STS-PT-2013-14
Soil Type: Flat Rocky


Sample ID: STS-PT-2013-15
Soil Type: Flat Rocky


Sample ID: STS-PT-2013-16
Soil Type: Slope

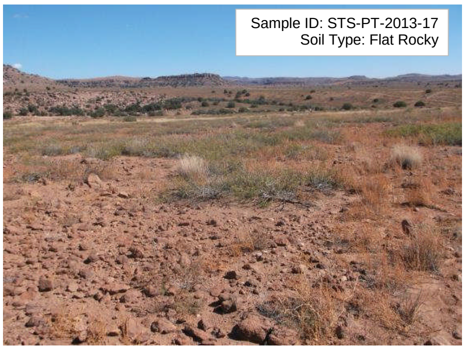
FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

PHYTOTOXICITY STUDY PHOTO LOG

ARCADIS

APPENDIX I



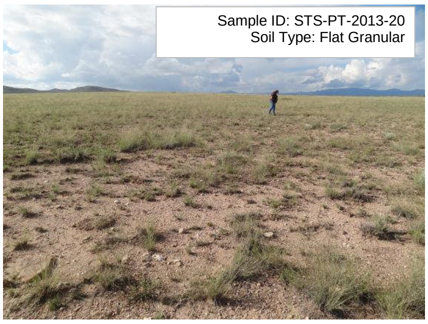
Sample ID: STS-PT-2013-17
Soil Type: Flat Rocky

Sample ID: STS-PT-2013-19
Soil Type: Flat Rocky

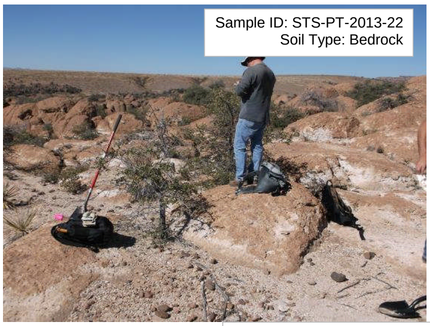
Sample ID: STS-PT-2013-21
Soil Type: Bedrock

Sample ID: STS-PT-2013-23
Soil Type: Bedrock

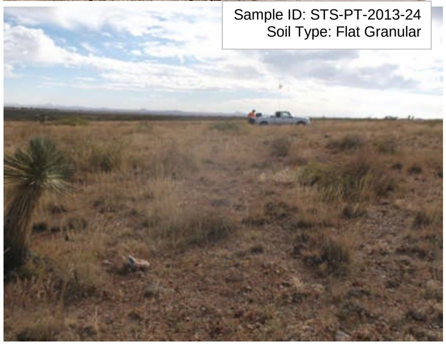
Sample ID: STS-PT-2013-18
Soil Type: Bedrock



Sample ID: STS-PT-2013-20
Soil Type: Flat Granular



Sample ID: STS-PT-2013-22
Soil Type: Bedrock



Sample ID: STS-PT-2013-24
Soil Type: Flat Granular

FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

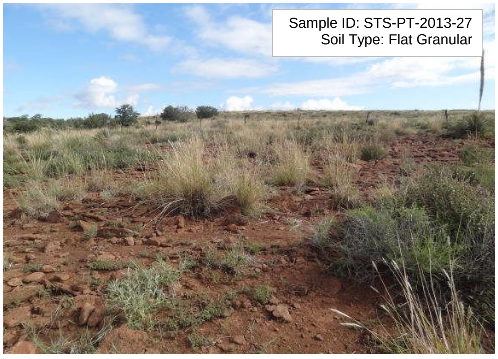
PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

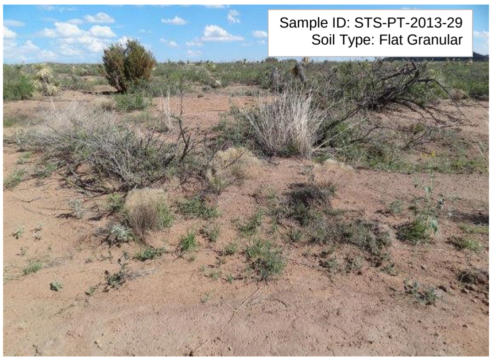
PHYTOTOXICITY STUDY PHOTO LOG

ARCADIS

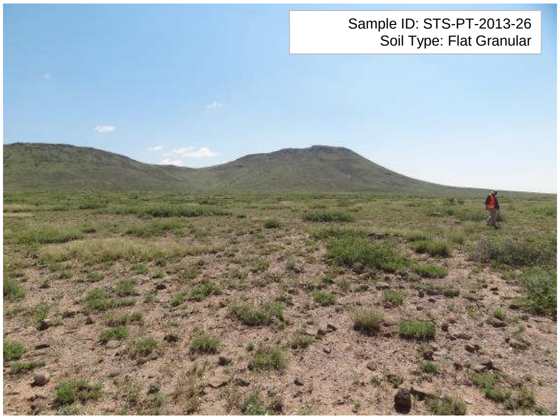
APPENDIX I


Sample ID: STS-PT-2013-25
Soil Type: Flat Granular

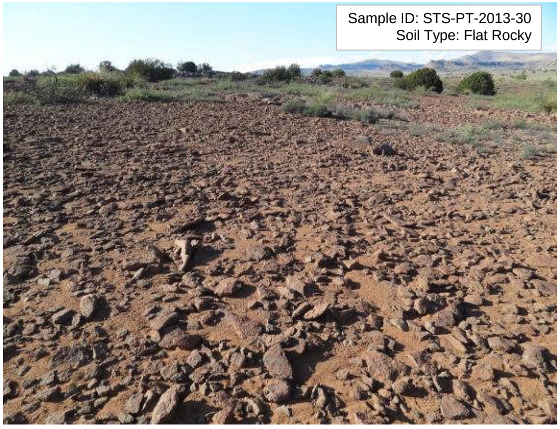

Sample ID: STS-PT-2013-27
Soil Type: Flat Granular


Sample ID: STS-PT-2013-29
Soil Type: Flat Granular


Sample ID: STS-PT-2013-31
Soil Type: Slope


Sample ID: STS-PT-2013-26
Soil Type: Flat Granular


Sample ID :STS-PT-2013-28
Soil Type: Flat Granular


Sample ID: STS-PT-2013-30
Soil Type: Flat Rocky

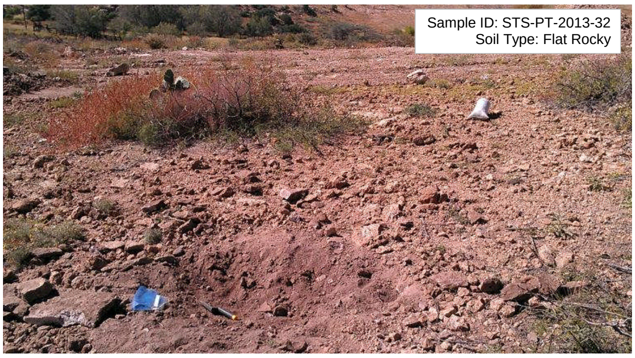
FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

PHYTOTOXICITY STUDY PHOTO LOG

ARCADIS

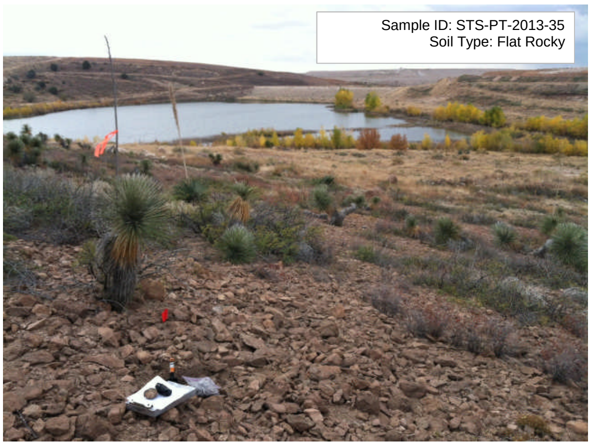
APPENDIX I
Page 4



Sample ID: STS-PT-2013-32
Soil Type: Flat Rocky

Sample ID: STS-PT-2013-33
Soil Type: Flat Granular

Sample ID: STS-PT-2013-34
Soil Type: Flat Rocky



Sample ID: STS-PT-2013-35
Soil Type: Flat Rocky

Sample ID: STS-PT-2013-36
Soil Type: Flat Rocky

FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

PHYTOTOXICITY STUDY PHOTO LOG

ARCADIS

APPENDIX I

Community Study Photo Log

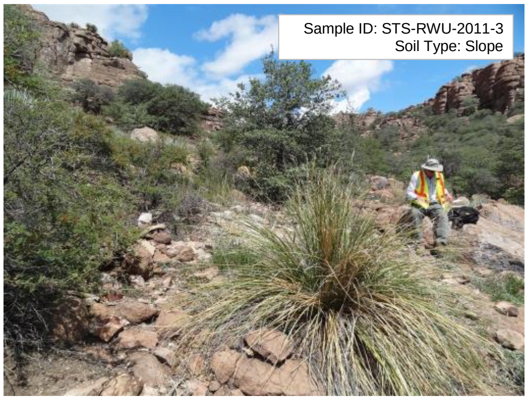
Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

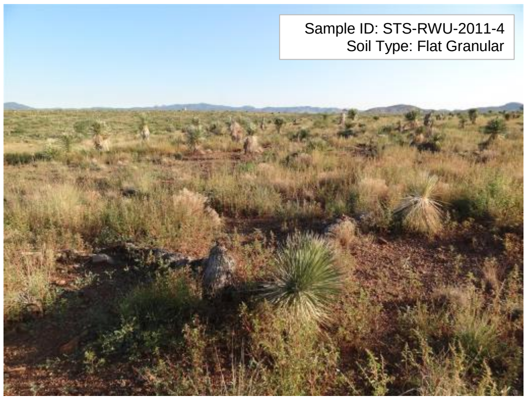
Community LocID	Phytotoxity ID	Longitude	Latitude	Soil Category
STS-RWU-2011-1	NA	-108.108342	32.71238401	Bedrock
STS-RWU-2011-2	NA	-108.105	32.7045	Bedrock
STS-RWU-2011-3	NA	-108.107	32.7076	Slope
STS-RWU-2011-4	NA	-108.143	32.7123	Flat Granular
STS-RWU-2011-5	NA	-108.095	32.7067	Flat Granular
STS-RWU-2011-6	NA	-108.120902	32.70849497	Slope
STS-RWU-2011-7	NA	-108.106	32.6972	Flat Rocky
STS-RWU-2011-8	NA	-108.093895	32.71029498	Slope
STS-RWU-2011-9	NA	-108.1	32.6959	Bedrock
STS-RWU-2011-10	STS-PT-2013-29	-108.084	32.6748	Flat Granular
STS-RWU-2011-11	NA	-108.092	32.6747	Bedrock
STS-RWU-2011-12	STS-PT-2013-30	-108.087	32.6642	Flat Rocky
STS-RWU-2011-13	NA	-108.094	32.6768	Flat Granular
STS-RWU-2011-14	STS-PT-2013-31	-108.115	32.7081	Slope
STS-RWU-2011-15	NA	-108.118	32.7092	Flat Granular
STS-RWU-2011-16	NA	-108.085	32.7048	Flat Granular
STS-RWU-2011-17	NA	-108.096	32.6762	Flat Rocky
STS-RWU-2012-B1	STS-PT-2013-21	-108.044492	32.67139	Bedrock
STS-RWU-2012-B2	STS-PT-2013-22	-108.04225	32.67136	Bedrock
STS-RWU-2012-B3	STS-PT-2013-23	-108.044928	32.67379	Bedrock
Wildlife Reference Plot North	NA	-108.067687	32.68399199	Flat Granular
Wildlife Reference Plot South	STS-PT-2013-27	-108.060065	32.674796	Flat Granular
STS-PT-2013-1	STS-PT-2013-1	-108.106386	32.689013	Flat Rocky
STS-PT-2013-2	STS-PT-2013-2	-108.104709	32.685045	Flat Rocky
STS-PT-2013-5	STS-PT-2013-5	-108.113509	32.705641	Slope
STS-PT-2013-9	STS-PT-2013-9	-108.106861	32.697826	Bedrock
STS-PT-2013-12	STS-PT-2013-12	-108.051091	32.669984	Bedrock
STS-PT-2013-17	STS-PT-2013-17	-108.103955	32.68969	Flat Rocky
STS-PT-2013-19	STS-PT-2013-19	-108.104566	32.692459	Flat Rocky
STS-PT-2013-20	STS-PT-2013-20	-108.156611	32.68923	Flat Granular
STS-PT-2013-26	STS-PT-2013-26	-108.05	32.6394	Flat Granular
STS-PT-2013-33[a]	STS-PT-2013-33	-108.122	32.69284	Flat Granular

[a] Soil had copper concentrate


Sample ID: STS-RWU-2011-1
Soil Type: Bedrock


Sample ID: STS-RWU-2011-2
Soil Type: Bedrock


Sample ID: STS-RWU-2011-3
Soil Type: Slope


Sample ID: STS-RWU-2011-4
Soil Type: Flat Granular


Sample ID: STS-RWU-2011-5
Soil Type: Flat Granular


Sample ID: STS-RWU-2011-6
Soil Type: Slope

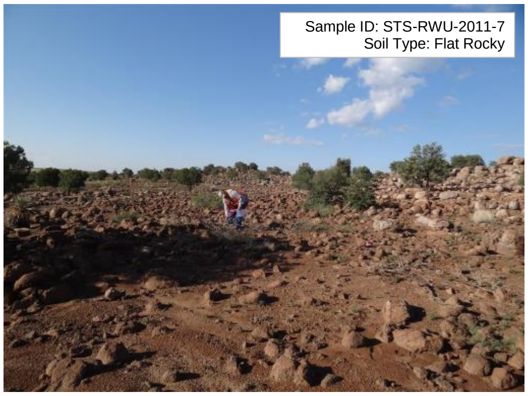
FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

COMMUNITY STUDY PHOTO LOG

ARCADIS

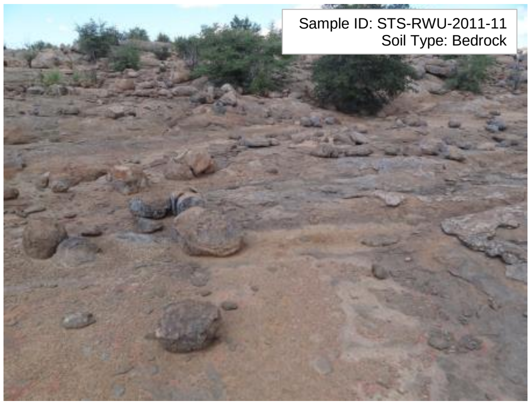
APPENDIX I


Sample ID: STS-RWU-2011-7
Soil Type: Flat Rocky


Sample ID: STS-RWU-2011-8
Soil Type: Slope


Sample ID: STS-RWU-2011-9
Soil Type: Bedrock


Sample ID: STS-RWU-2011-10
Soil Type: Flat Granular


Sample ID: STS-RWU-2011-11
Soil Type: Bedrock


Sample ID: STS-RWU-2011-12
Soil Type: Flat Rocky

FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

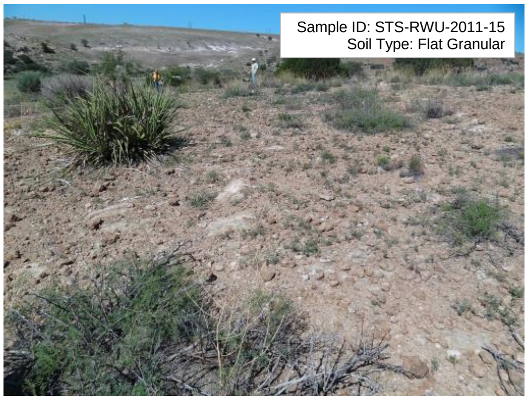
COMMUNITY STUDY PHOTO LOG

ARCADIS

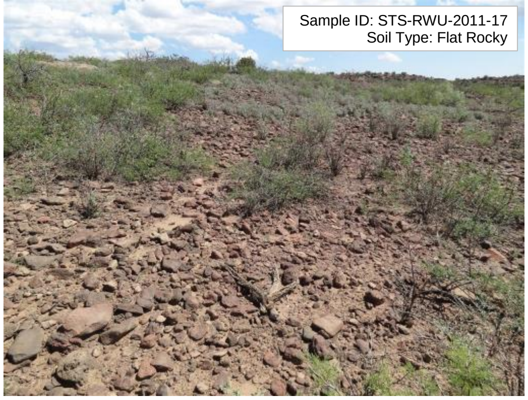
APPENDIX I


Sample ID: STS-RWU-2011-13
Soil Type: Flat Granular


Sample ID: STS-RWU-2011-14
Soil Type: Slope


Sample ID: STS-RWU-2011-15
Soil Type: Flat Granular


Sample ID: STS-RWU-2011-16
Soil Type: Flat Granular


Sample ID: STS-RWU-2011-17
Soil Type: Flat Rocky

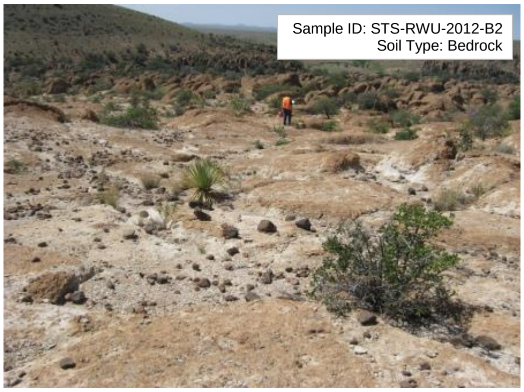

Sample ID: STS-RWU-2012-B1
Soil Type: Bedrock

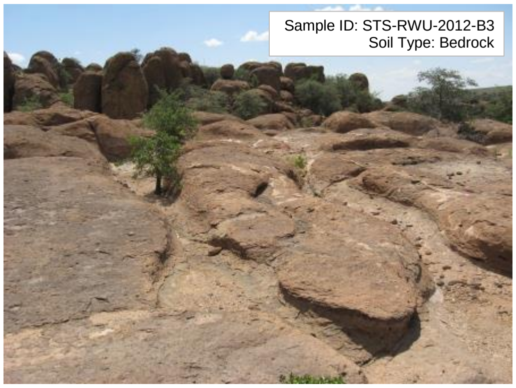
FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

COMMUNITY STUDY PHOTO LOG

ARCADIS


Sample ID: STS-RWU-2012-B2
Soil Type: Bedrock


Sample ID: STS-RWU-2012-B3
Soil Type: Bedrock


Sample ID: Wildlife Reference Plot North
Soil Type: Flat Granular


Sample ID: Wildlife Reference Plot South
Soil Type: Flat Granular


Sample ID: STS-PT-2013-1
Soil Type: Flat Granular


Sample ID: STS-PT-2013-2
Soil Type: Flat Rocky

FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

COMMUNITY STUDY PHOTO LOG

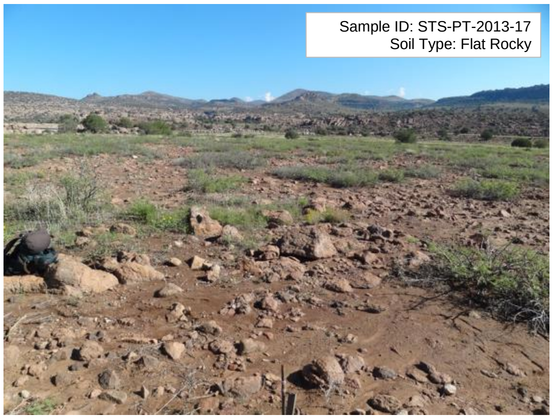
ARCADIS

APPENDIX I


Sample ID: STS-PT-2013-5
Soil Type: Slope


Sample ID: STS-PT-2013-9
Soil Type: Bedrock


Sample ID: STS-PT-2013-12
Soil Type: Bedrock


Sample ID: STS-PT-2013-17
Soil Type: Flat Rocky


Sample ID: STS-PT-2013-19
Soil Type: Flat Rocky


Sample ID: STS-PT-2013-20
Soil Type: Flat Granular

PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

COMMUNITY STUDY PHOTO LOG

ARCADIS

FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

COMMUNITY STUDY PHOTO LOG

ARCADIS

APPENDIX I

APPENDIX J

Measured versus Calculated pCu

Table J-1. Estimated Community DEL and PEL by Endpoint and Soil Category for Measured pCu

Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

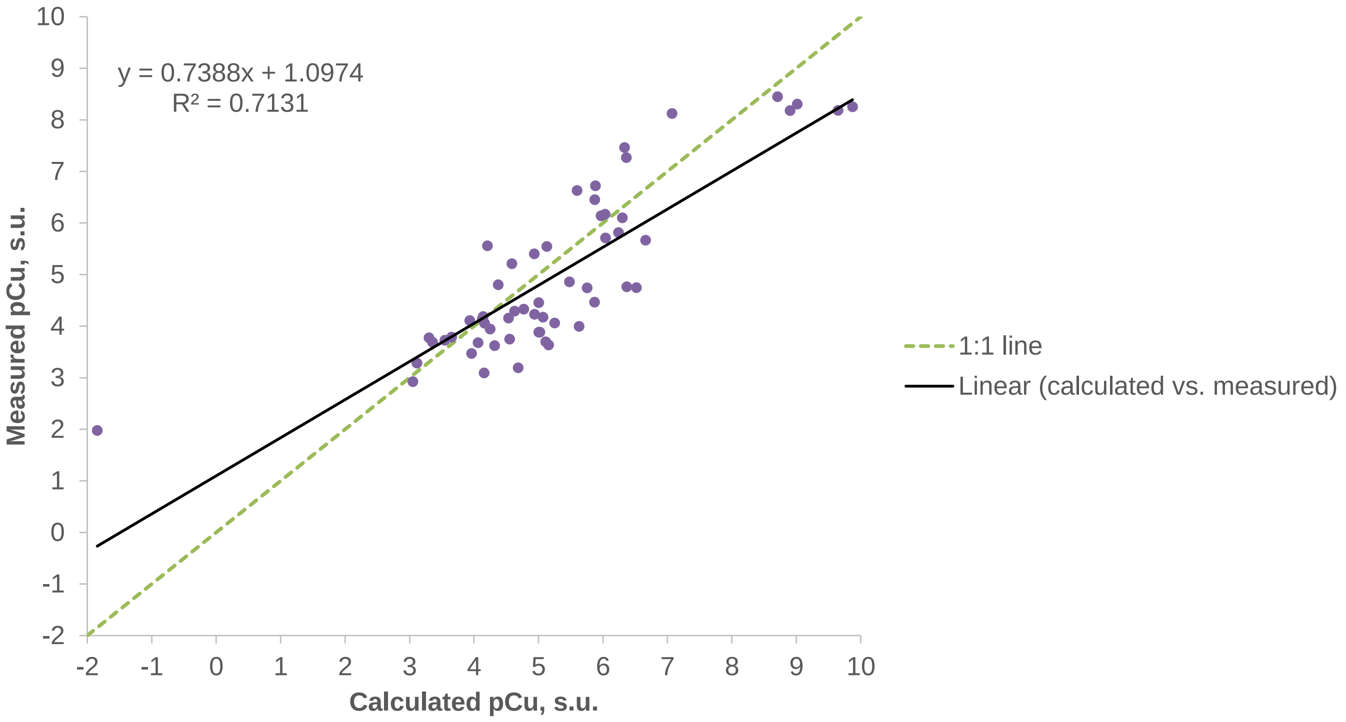
Soil Category	Richness		Cover		OAT	
	DEL	PEL	DEL	PEL	DEL	PEL
Bedrock	NA	NA	NA	NA	NA	NA
Flat Rocky	NA	NA	NR	NR	NR	NR
Slope	NA	NA	NR	NR	NR	NR
Flat Granular	7.82	1.25	5.51	3.61	NR	NR

Acronyms/Abbreviations:

DEL = *de minimus* effect level
NA = not available; no *de minimus* available and therefore no DEL or PEL calculated
NR = no relationship to pCu and therefore no DEL or PEL applies
PEL = probable effect level
OAT = observed apparent trend

Notes:

DEL is predicted pCu of minimum endpoint of reference locations.



Notes: Includes phytotoxicity and community samples

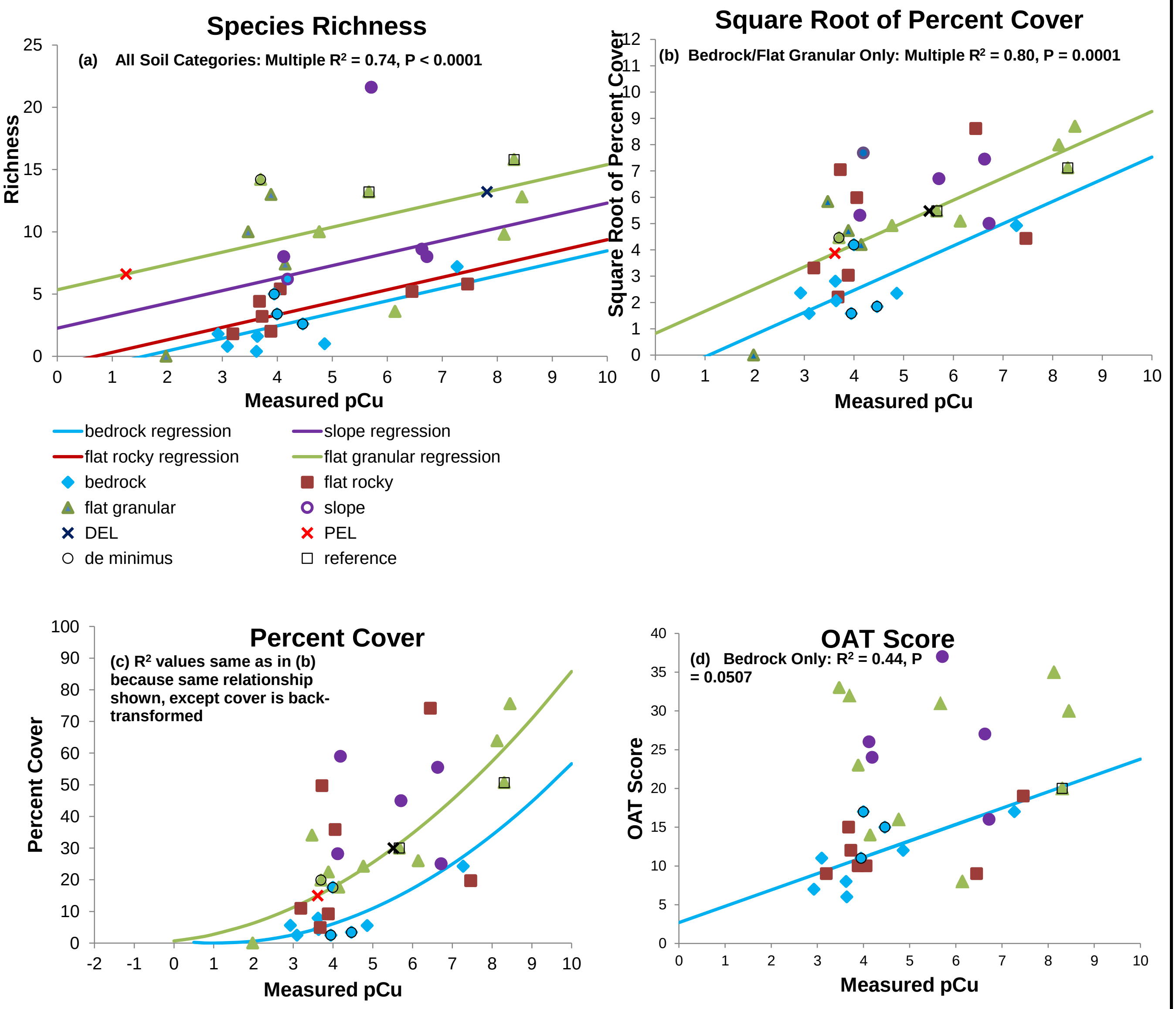
FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

Calculated pCu Prediction of Measured pCu

ARCADIS

FIGURE
J-1



Notes:
These graphs are similar to those in Figure 10, except they show results for measured pCu rather than calculated pCu.

FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO

PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

Relationship between Measured pCu and Community Endpoints with Soil Category Covariate

ARCADIS

FIGURE
J-2

APPENDIX K

Lab Reports

ANALYTICAL SUMMARY REPORT

December 18, 2013

Chino Mine Company
PO Box 10
Bayard, NM 88023

Workorder No.: H13110389
Project Name: Not Indicated

Energy Laboratories Inc Helena MT received the following 25 samples for Chino Mine Company on 11/8/2013 for analysis.

Sample ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
H13110389-001	STS-RWU-2011-4 0-6 [0-6]	07/15/13 10:15	11/08/13	Soil	Metals, Water Extractable Copper Activity CaCl2 Hot Water Soil Extraction Soil Preparation
H13110389-002	1# WEST 0-6 [0-6]	07/15/13 10:57	11/08/13	Soil	Metals, Water Extractable Copper Activity CaCl2 Hot Water Soil Extraction
H13110389-003	STS-RWU-2011-15 0-6 [0-6]	07/15/13 11:30	11/08/13	Soil	Same As Above
H13110389-004	STS-RWU-2011-6 0-6 [0-6]	07/15/13 11:57	11/08/13	Soil	Same As Above
H13110389-005	STS-RWU-2011-1 0-6 [0-6]	07/16/13 9:03	11/08/13	Soil	Same As Above
H13110389-006	STS-RWU-2011-3 0-6 [0-6]	07/16/13 8:13	11/08/13	Soil	Same As Above
H13110389-007	STS-RWU-2011-14 0-6 [0-6]	07/15/13 13:00	11/08/13	Soil	Same As Above
H13110389-008	STS-RWU-2011-2 0-6 [0-6]	07/16/13 10:15	11/08/13	Soil	Same As Above
H13110389-009	STS-RWU-2011-8 0-6 [0-6]	07/16/13 13:41	11/08/13	Soil	Same As Above
H13110389-010	STS-RWU-2011-5 0-6 [0-6]	07/16/13 12:59	11/08/13	Soil	Same As Above
H13110389-011	STS-RWU-2011-16 0-6 [0-6]	07/16/13 14:31	11/08/13	Soil	Same As Above
H13110389-012	STS-RWU-2011-7 0-6 [0-6]	07/15/13 17:27	11/08/13	Soil	Same As Above
H13110389-013	STS-RWU-2011-9 0-6 [0-6]	07/16/13 12:07	11/08/13	Soil	Same As Above
H13110389-014	STS-RWU-2011-10 0-6 [0-6]	07/16/13 18:01	11/08/13	Soil	Same As Above
H13110389-015	STS-RWU-2011-11 0-6 [0-6]	07/15/13 14:55	11/08/13	Soil	Same As Above
H13110389-016	STS-RWU-2011-12 0-6 [0-6]	07/15/13 16:30	11/08/13	Soil	Same As Above
H13110389-017	STS-RWU-2011-13 0-6 [0-6]	07/15/13 19:20	11/08/13	Soil	Same As Above
H13110389-018	STS-RWU-2011-17 0-6 [0-6]	07/15/13 14:05	11/08/13	Soil	Same As Above

ANALYTICAL SUMMARY REPORT

H13110389-019	STS-RWU-2012-B1 0-6 [0-6]	07/17/13 9:30	11/08/13	Soil	Same As Above
H13110389-020	STS-RWU-2012-B2 0-6 [0-6]	07/17/13 10:37	11/08/13	Soil	Same As Above
H13110389-021	STS-RWU-2012-B3 0-6 [0-6]	07/17/13 9:20	11/08/13	Soil	Same As Above
H13110389-022	WILDLIFE REF NORTH 0-6 [0-6]	07/16/13 17:14	11/08/13	Soil	Same As Above
H13110389-023	WILDLIFE REF SOUTH 0-6 [0-6]	07/16/13 16:40	11/08/13	Soil	Same As Above
H13110389-024	DUP #1 [0-6]	07/16/13 16:40	11/08/13	Soil	Same As Above
H13110389-025	DUP #2 [0-6]	07/16/13 16:40	11/08/13	Soil	Same As Above

The analyses presented in this report were performed by Energy Laboratories, Inc., 3161 E. Lyndale Ave., Helena, MT 59604, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By:

Jonathan D. Hager
Branch Manager - Helena, MT

Digitally signed by
Jonathan Hager
Date: 2013.12.18 12:25:51 -07:00

CLIENT: Chino Mine Company
Project: Not Indicated
Sample Delivery Group: H13110389

Report Date: 12/18/13

CASE NARRATIVE

Standard operating procedure submitted by Arcadis as "Standard Operating Procedures for Measurement of Cu2+ Activity in Soil by Ion-Selective Electrode" (ed. September 2013). Copper activity measured with a Combination Cupric Sure-Flow Ion Selective Electrode (Thermo Scientific, 9629BNWP) as per SOP. All samples and standards were filtered through 0.22µm membrane cellulose-acetate filters (Whatman, 10404112), prior to analysis. All analysis was performed under reduced light conditions.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	Chino Mine Company	**Report Date:**	12/18/13
Project:	Not Indicated	**Date Received:**	11/08/13
Workorder:	H13110389		

		Analysis		Cu	Conductivity , CaCl2	Millivolts	pCu, Measured	ph, CaCl2
		Units		mg/kg	mmhos/cm	mV	s_u_	s_u_
Sample ID	**Client Sample ID**	**Up**	**Low**	**Results**	**Results**	**Results**	**Results**	**Results**
H13110389-001	STS-RWU-2011-4 0-6	0	6	0.1	2.1	-21	8.44	7.1
H13110389-002	1# WEST 0-6	0	6	< 0.1	2.2	-14	8.14	7.2
H13110389-003	STS-RWU-2011-15 0-6	0	6	6.7	2.2	87	3.84	5.3
H13110389-004	STS-RWU-2011-6 0-6	0	6	0.3	2.2	17	6.82	7.3
H13110389-005	STS-RWU-2011-1 0-6	0	6	1.5	2.1	67	4.67	4.5
H13110389-006	STS-RWU-2011-3 0-6	0	6	5.5	2.2	85	3.89	4.7
H13110389-007	STS-RWU-2011-14 0-6	0	6	5.6	2.2	87	3.81	5.0
H13110389-008	STS-RWU-2011-2 0-6	0	6	17.2	2.3	101	3.24	4.0
H13110389-009	STS-RWU-2011-8 0-6	0	6	0.3	2.2	44	5.65	5.4
H13110389-010	STS-RWU-2011-5 0-6	0	6	21.7	2.3	105	3.06	3.9
H13110389-011	STS-RWU-2011-16 0-6	0	6	7.9	2.2	94	3.54	4.1
H13110389-012	STS-RWU-2011-7 0-6	0	6	35.0	2.2	112	2.74	4.4
H13110389-013	STS-RWU-2011-9 0-6	0	6	55.8	2.2	115	2.63	3.9
H13110389-014	STS-RWU-2011-10 0-6	0	6	1.2	2.2	70	4.56	4.1
H13110389-015	STS-RWU-2011-11 0-6	0	6	14.9	2.2	100	3.25	3.8
H13110389-016	STS-RWU-2011-12 0-6	0	6	9.0	2.5	94	3.54	3.6
H13110389-017	STS-RWU-2011-13 0-6	0	6	0.1	2.3	33	6.15	6.2
H13110389-018	STS-RWU-2011-17 0-6	0	6	5.3	2.4	89	3.74	4.2
H13110389-019	STS-RWU-2012-B1 0-6	0	6	6.5	2.2	91	3.67	3.9
H13110389-020	STS-RWU-2012-B2 0-6	0	6	7.0	2.2	92	3.61	4.1
H13110389-021	STS-RWU-2012-B3 0-6	0	6	1.9	2.2	78	4.21	4.2
H13110389-022	WILDLIFE REF NORTH 0-6	0	6	0.2	2.2	46	5.60	5.2
H13110389-023	WILDLIFE REF SOUTH 0-6	0	6	10.3	2.2	99	3.23	3.9
H13110389-024	DUP #1	0	6	50.7	2.2	118	2.52	3.9
H13110389-025	DUP #2	0	6	0.2	2.2	50	5.40	5.3

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Not Indicated

Report Date: 12/18/13
Work Order: H13110389

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: arcadis SOP									Analytical Run: MISC SOILS_131216B
Sample ID: CCV_1_131211_1	Continuing Calibration Verification Standard								12/17/13 09:12
Conductivity, CaCl2	1.42	mmhos/cm	0.10	100	90	110			
pCu, Measured	7.97	s.u.	0.010	106	90	110			
ph, CaCl2	7.02	s.u.	0.10	100	90	110			
Sample ID: CCV1_1_131211_1	Continuing Calibration Verification Standard								12/17/13 09:12
Conductivity, CaCl2	0.150	mmhos/cm	0.10	100	90	110			
pCu, Measured	12.3	s.u.	0.010		90	110			
ph, CaCl2	4.01	s.u.	0.10	100	90	110			
Sample ID: ICV_1_131211_1	Initial Calibration Verification Standard								12/17/13 09:14
ph, CaCl2	7.03	s.u.	0.10	100	90	110			
Sample ID: CCV_1_131216_1	Continuing Calibration Verification Standard								12/17/13 10:14
Conductivity, CaCl2	1.42	mmhos/cm	0.10	100	90	110			
pCu, Measured	7.50	s.u.	0.010	100	90	110			
ph, CaCl2	7.04	s.u.	0.10	101	90	110			
Sample ID: CCV1_1_131216_1	Continuing Calibration Verification Standard								12/17/13 10:15
Conductivity, CaCl2	0.152	mmhos/cm	0.10	102	90	110			
pCu, Measured	12.5	s.u.	0.010		90	110			
ph, CaCl2	4.02	s.u.	0.10	100	90	110			
Sample ID: CCV	Continuing Calibration Verification Standard								12/17/13 11:05
Conductivity, CaCl2	1.41	mmhos/cm	0.10	100	90	110			
pCu, Measured	7.30	s.u.	0.010	97	90	110			
ph, CaCl2	6.99	s.u.	0.10	100	90	110			
Method: arcadis SOP									Batch: 131216_1_PH-S-PASTE
Sample ID: LCS-22839	Laboratory Control Sample				Run: MISC SOILS_131216B				12/17/13 10:20
Conductivity, CaCl2	2.86	mmhos/cm	0.10	109	70	130			
pCu, Measured	8.43	s.u.	0.010	97	70	130			
ph, CaCl2	7.36	s.u.	0.10	101	70	130			
Sample ID: LCS-22754	Laboratory Control Sample				Run: MISC SOILS_131216B				12/17/13 10:28
Conductivity, CaCl2	2.96	mmhos/cm	0.10	113	70	130			
pCu, Measured	8.34	s.u.	0.010	96	70	130			
ph, CaCl2	7.37	s.u.	0.10	101	70	130			
Sample ID: H13110389-010Adup	Sample Duplicate				Run: MISC SOILS_131216B				12/17/13 10:42
Conductivity, CaCl2	2.29	mmhos/cm	0.10						
Millivolts	105	mV							
pCu, Measured	3.05	s.u.	0.010						
ph, CaCl2	3.91	s.u.	0.10						

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/18/13

Project: Not Indicated **Work Order:** H13110389

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: arcadis SOP							Batch: 131216_1_PH-S-PASTE		
Sample ID: H13110389-020Adup	Sample Duplicate				Run: MISC SOILS_131216B			12/17/13 10:55	
Conductivity, CaCl2	2.19	mmhos/cm	0.10						
Millivolts	91.8	mV							
pCu, Measured	3.62	s.u.	0.010						
ph, CaCl2	4.17	s.u.	0.10						
Sample ID: H13110389-025Adup	Sample Duplicate				Run: MISC SOILS_131216B			12/17/13 11:02	
Conductivity, CaCl2	2.27	mmhos/cm	0.10						
Millivolts	48.3	mV							
pCu, Measured	5.48	s.u.	0.010						
ph, CaCl2	5.08	s.u.	0.10						

Qualifiers:

RL - Analyte reporting limit. ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Not Indicated

Report Date: 12/18/13
Work Order: H13110389

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6020									Analytical Run: ICPMS204-B_131216B
Sample ID: ICV STD	Initial Calibration Verification Standard								12/16/13 11:10
Copper	0.0607	mg/L	0.0010	101	90	110			
Sample ID: ICV STD	Initial Calibration Verification Standard								12/16/13 16:27
Copper	0.0610	mg/L	0.0010	102	90	110			
Method: SW6020									Batch: 22754
Sample ID: MB-22754	Method Blank				Run: ICPMS204-B_131216B				12/17/13 02:43
Copper	0.05	mg/kg	0.003						
Sample ID: LFB-22754	Laboratory Fortified Blank				Run: ICPMS204-B_131216B				12/17/13 02:52
Copper	5.19	mg/kg	0.10	103	80	120			
Sample ID: H13110389-010Adup	Sample Duplicate				Run: ICPMS204-B_131216B				12/17/13 04:04
Copper	22.9	mg/kg	0.10						
Sample ID: H13110389-020Adup	Sample Duplicate				Run: ICPMS204-B_131216B				12/17/13 05:20
Copper	6.91	mg/kg	0.10						
Method: SW6020									Analytical Run: ICPMS204-B_131217A
Sample ID: ICV STD	Initial Calibration Verification Standard								12/17/13 10:52
Copper	0.0597	mg/L	0.0010	99	90	110			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

Workorder Receipt Checklist

Chino Mine Company

H13110389

Login completed by:	Skyler T. Pester	Date Received:	11/8/2013
Reviewed by:	BL2000\sdull	Received by:	TLL
Reviewed Date:	12/2/2013	Carrier name:	UPS Ground

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on all shipping container(s)/cooler(s)?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on all sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☐	No ☑	
Chain of custody signed when relinquished and received?	Yes ☐	No ☑	
Chain of custody agrees with sample labels?	Yes ☐	No ☑	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☑	No ☐	
Temp Blank received in all shipping container(s)/cooler(s)?	Yes ☐	No ☑	Not Applicable ☐
Container/Temp Blank temperature:	10.9°C No Ice		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☐	Not Applicable ☑

Standard Reporting Procedures:

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Contact and Corrective Action Comments:

Received from ACZ labs. No COC received. No collection date/time on sample list - date/time taken from sample bags. No sample date/time for samples: Dup1 or Dup2 - collection date and time estimated in laboratory. Contacted client to ensure samples that were received match sample list. Client wants ELI-H to process "as received" samples rather than use processed soil from ACZ. 11/19/2013 STP.

Energy Laboratories Inc
3161 East Lyndale Avenue
Helena, MT 59601
(406) 442-0711

CHAIN-OF-CUSTODY RECORD

Page 1 of 1

WorkOrder: H13110389

Client:
Chino Mine Company
PO Box 10
Bayard, NM 88023

TEL:
FAX:
ProjectNo: Not Indicated
PO:

19-Nov-13

Sample ID	ClientSampID	Matrix	Collection Date	Bottle	Requested Tests						
					010_20-S-CaCl	CU-ACTVTY-S	SOILREVIEW	WC REVIEW			
H13110389-001	STS-RWU-2011-4 0-6	Soil	7/15/2013 10:15:00 AM		A	A	A	A			
H13110389-002	1# WEST 0-6	Soil	7/15/2013 10:57:00 AM		A	A					
H13110389-003	STS-RWU-2011-15 0-6	Soil	7/15/2013 11:30:00 AM		A	A					
H13110389-004	STS-RWU-2011-6 0-6	Soil	7/15/2013 11:57:00 AM		A	A					
H13110389-005	STS-RWU-2011-1 0-6	Soil	7/16/2013 9:03:00 AM		A	A					
H13110389-006	STS-RWU-2011-3 0-6	Soil	7/16/2013 8:13:00 AM		A	A					
H13110389-007	STS-RWU-2011-14 0-6	Soil	7/15/2013 1:00:00 PM		A	A					
H13110389-008	STS-RWU-2011-2 0-6	Soil	7/16/2013 10:15:00 AM		A	A					
H13110389-009	STS-RWU-2011-8 0-6	Soil	7/16/2013 1:41:00 PM		A	A					
H13110389-010	STS-RWU-2011-5 0-6	Soil	7/16/2013 12:59:00 PM		A	A					
H13110389-011	STS-RWU-2011-16 0-6	Soil	7/16/2013 2:31:00 PM		A	A					
H13110389-012	STS-RWU-2011-7 0-6	Soil	7/15/2013 5:27:00 PM		A	A					
H13110389-013	STS-RWU-2011-9 0-6	Soil	7/16/2013 12:07:00 PM		A	A					
H13110389-014	STS-RWU-2011-10 0-6	Soil	7/16/2013 6:01:00 PM		A	A					
H13110389-015	STS-RWU-2011-11 0-6	Soil	7/15/2013 2:55:00 PM		A	A					
H13110389-016	STS-RWU-2011-12 0-6	Soil	7/15/2013 4:30:00 PM		A	A					

Comments: Part of Ammendment Study Samples (copper activity) project. No COC. No collection date/time on sample list, date/time taken from sample bags, no sample date/time for samples: Dup1 or Dup2, collection date and time estimated in laboratory 11/19/2013 STP.

	Date/Time		Date/Time
Relinquished by:		**Received by:**	
Relinquished by:		**Received by:**	
Relinquished by:		**Received by:**	11-8-13 9:37AM

NOTE: Samples are discarded 60 days after results are reported unless other arrangements are made. Hazardous samples will be returned to client or disposed of at client expense.

Bottle Type: L-Liter V-Voa S-Soil Jar O-Orbo T-Tedlar B-Brass P-Plastic OT-Other

Energy Laboratories Inc
3161 East Lyndale Avenue
Helena, MT 59601
(406) 442-0711

CHAIN-OF-CUSTODY RECORD

Page 1 of 1

WorkOrder: H13110389

Client:
Chino Mine Company
PO Box 10
Bayard, NM 88023

TEL:
FAX:
ProjectNo: Not Indicated
PO:

19-Nov-13

Sample ID	ClientSampID	Matrix	Collection Date	Bottle	Requested Tests						
					010_20-S-CaC	CU-ACTVTY-S	SOILREVIEW	WC REVIEW			
H13110389-017	STS-RWU-2011-13 0-6	Soil	7/15/2013 7:20:00 PM		A	A					
H13110389-018	STS-RWU-2011-17 0-6	Soil	7/15/2013 2:05:00 PM		A	A					
H13110389-019	STS-RWU-2012-B1 0-6	Soil	7/17/2013 9:30:00 AM		A	A					
H13110389-020	STS-RWU-2012-B2 0-6	Soil	7/17/2013 10:37:00 AM		A	A					
H13110389-021	STS-RWU-2012-B3 0-6	Soil	7/17/2013 9:20:00 AM		A	A					
H13110389-022	WILDLIFE REF NORTH 0-	Soil	7/16/2013 5:14:00 PM		A	A					
H13110389-023	WILDLIFE REF SOUTH 0-	Soil	7/16/2013 4:40:00 PM		A	A					
H13110389-024	DUP #1	Soil	7/16/2013 4:40:00 PM		A	A					
H13110389-025	DUP #2	Soil	7/16/2013 4:40:00 PM		A	A					

Comments: Part of Ammendment Study Samples (copper activity) project. No COC, No collection date/time on sample list, date/time taken from sample bags, no sample date/time for samples: Dup1 or Dup2, collection date and time estimated in laboratory 11/19/2013 STP.

	Date/Time		Date/Time
Relinquished by:		**Received by:**	
Relinquished by:		**Received by:**	
Relinquished by:		**Received by:**	11-8-13 9:37AM

NOTE: Samples are discarded 60 days after results are reported unless other arrangements are made. Hazardous samples will be returned to client or disposed of at client expense.

Bottle Type: L-Liter V-Voa S-Soil Jar O-Orbo T-Tedlar B-Brass P-Plastic OT-Other

ENERGY LABORATORIES
www.energylab.com
Analytical Excellence Since 1952
Helena, MT 877-472-0711 • Billings, MT 800-735-4489 • Casper, WY 888-235-0515
Gillette, WY 866-686-7175 • Rapid City, SD 888-672-1225 • College Station, TX 888-690-2218

ANALYTICAL SUMMARY REPORT

December 20, 2013

Chino Mine Company
PO Box 10
Bayard, NM 88023

Workorder No.: H13110098

Project Name: Phytotoxicity Soil Samples

Energy Laboratories Inc Helena MT received the following 36 samples for Chino Mine Company on 11/1/2013 for analysis.

Sample ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
H13110098-001	STS-PT-2013-1	10/24/13 10:00	11/01/13	Soil	Metals by ICP/ICPMS, Total Metals, Water Extractable DPTA extractable metals Metals, NH4Ac Metals, Saturated Paste Alkalinity, Water Extractable Carbon, Dissolved Organic Conductivity, Saturated Paste Extract Copper Activity Exchangeable Cations Anions by Ion Chromatography Lime as CaCO3 Moisture Nitrate as N, CaCL2 Extract Organic Carbon/Matter Walkley-Black Phosphorus-Bray pH, Saturated Paste Soluble Phosphate Digestion, Total Metals CaCl2 Hot Water Soil Extraction Water extraction DTPA extraction for metals Preparation, Dissolved Filtration Lime Percentage NaHCO3 Soil Extract NH4AC Soil Extraction Total Organic Matter Prep Particle Size Analysis / Texture Prep Saturated Paste Extraction Particle Size Analysis / Texture Saturation Percentage Soil Preparation

ANALYTICAL SUMMARY REPORT

H13110098-002	STS-PT-2013-2	10/23/13 16:45	11/01/13	Soil	Metals by ICP/ICPMS, Total Metals, Water Extractable DPTA extractable metals Metals, NH4Ac Metals, Saturated Paste Alkalinity, Water Extractable Carbon, Dissolved Organic Conductivity, Saturated Paste Extract Copper Activity Exchangeable Cations Anions by Ion Chromatography Lime as CaCO3 Moisture Nitrate as N, CaCL2 Extract Organic Carbon/Matter Walkley-Black pH, Saturated Paste Soluble Phosphate Phosphorus-Olsen Digestion, Total Metals CaCl2 Hot Water Soil Extraction Water extraction DTPA extraction for metals Preparation, Dissolved Filtration Lime Percentage NaHCO3 Soil Extract NH4AC Soil Extraction Total Organic Matter Prep Particle Size Analysis / Texture Prep Saturated Paste Extraction Particle Size Analysis / Texture Saturation Percentage
H13110098-003	STS-PT-2013-3	10/24/13 16:30	11/01/13	Soil	Metals by ICP/ICPMS, Total Metals, Water Extractable DPTA extractable metals Metals, NH4Ac Metals, Saturated Paste Alkalinity, Water Extractable Carbon, Dissolved Organic Conductivity, Saturated Paste Extract Copper Activity Exchangeable Cations Anions by Ion Chromatography Lime as CaCO3 Moisture Nitrate as N, CaCL2 Extract Organic Carbon/Matter Walkley-Black Phosphorus-Bray pH, Saturated Paste Soluble Phosphate Digestion, Total Metals CaCl2 Hot Water Soil Extraction Water extraction DTPA extraction for metals Preparation, Dissolved Filtration Lime Percentage NaHCO3 Soil Extract NH4AC Soil Extraction Total Organic Matter Prep Particle Size Analysis / Texture Prep Saturated Paste Extraction Particle Size Analysis / Texture Saturation Percentage

ANALYTICAL SUMMARY REPORT

H13110098-004	STS-PT-2013-4	10/22/13 14:00	11/01/13	Soil	Same As Above
H13110098-005	STS-PT-2013-5	10/23/13 14:45	11/01/13	Soil	Same As Above
H13110098-006	STS-PT-2013-6	10/24/13 14:25	11/01/13	Soil	Same As Above
H13110098-007	STS-PT-2013-7	10/24/13 13:00	11/01/13	Soil	Same As Above
H13110098-008	STS-PT-2013-8	10/23/13 17:45	11/01/13	Soil	Same As Above
H13110098-009	STS-PT-2013-9	10/23/13 10:45	11/01/13	Soil	Same As Above
H13110098-010	STS-PT-2013-10	10/23/13 11:15	11/01/13	Soil	Same As Above
H13110098-011	STS-PT-2013-11	10/24/13 15:30	11/01/13	Soil	Same As Above
H13110098-012	STS-PT-2013-12	10/22/13 9:40	11/01/13	Soil	Metals by ICP/ICPMS, Total Metals, Water Extractable DPTA extractable metals Metals, NH4Ac Metals, Saturated Paste Alkalinity, Water Extractable Carbon, Dissolved Organic Conductivity, Saturated Paste Extract Copper Activity Exchangeable Cations Anions by Ion Chromatography Lime as CaCO3 Moisture Nitrate as N, CaCL2 Extract Organic Carbon/Matter Walkley-Black pH, Saturated Paste Soluble Phosphate Phosphorus-Olsen Digestion, Total Metals CaCl2 Hot Water Soil Extraction Water extraction DTPA extraction for metals Preparation, Dissolved Filtration Lime Percentage NaHCO3 Soil Extract NH4AC Soil Extraction Total Organic Matter Prep Particle Size Analysis / Texture Prep Saturated Paste Extraction Particle Size Analysis / Texture Saturation Percentage

ANALYTICAL SUMMARY REPORT

H13110098-013	STS-PT-2013-13	10/25/13 12:10	11/01/13	Soil	Metals by ICP/ICPMS, Total Metals, Water Extractable DPTA extractable metals Metals, NH4Ac Metals, Saturated Paste Alkalinity, Water Extractable Carbon, Dissolved Organic Conductivity, Saturated Paste Extract Copper Activity Exchangeable Cations Anions by Ion Chromatography Lime as CaCO3 Moisture Nitrate as N, CaCL2 Extract Organic Carbon/Matter Walkley-Black Phosphorus-Bray pH, Saturated Paste Soluble Phosphate Digestion, Total Metals CaCl2 Hot Water Soil Extraction Water extraction DTPA extraction for metals Preparation, Dissolved Filtration Lime Percentage NaHCO3 Soil Extract NH4AC Soil Extraction Total Organic Matter Prep Particle Size Analysis / Texture Prep Saturated Paste Extraction Particle Size Analysis / Texture Saturation Percentage
H13110098-014	STS-PT-2013-14	10/24/13 10:50	11/01/13	Soil	Same As Above
H13110098-015	STS-PT-2013-15	10/25/13 16:00	11/01/13	Soil	Same As Above
H13110098-016	STS-PT-2013-16	10/23/13 17:50	11/01/13	Soil	Same As Above

ANALYTICAL SUMMARY REPORT

H13110098-017	STS-PT-2013-17	10/25/13 12:30	11/01/13	Soil	Metals by ICP/ICPMS, Total Metals, Water Extractable DPTA extractable metals Metals, NH4Ac Metals, Saturated Paste Alkalinity, Water Extractable Carbon, Dissolved Organic Conductivity, Saturated Paste Extract Copper Activity Exchangeable Cations Anions by Ion Chromatography Lime as CaCO3 Moisture Nitrate as N, CaCL2 Extract Organic Carbon/Matter Walkley-Black pH, Saturated Paste Soluble Phosphate Phosphorus-Olsen Digestion, Total Metals CaCl2 Hot Water Soil Extraction Water extraction DTPA extraction for metals Preparation, Dissolved Filtration Lime Percentage NaHCO3 Soil Extract NH4AC Soil Extraction Total Organic Matter Prep Particle Size Analysis / Texture Prep Saturated Paste Extraction Particle Size Analysis / Texture Saturation Percentage
H13110098-018	STS-PT-2013-18	10/23/13 9:45	11/01/13	Soil	Metals by ICP/ICPMS, Total Metals, Water Extractable DPTA extractable metals Metals, NH4Ac Metals, Saturated Paste Alkalinity, Water Extractable Carbon, Dissolved Organic Conductivity, Saturated Paste Extract Copper Activity Exchangeable Cations Anions by Ion Chromatography Lime as CaCO3 Moisture Nitrate as N, CaCL2 Extract Organic Carbon/Matter Walkley-Black Phosphorus-Bray pH, Saturated Paste Soluble Phosphate Digestion, Total Metals CaCl2 Hot Water Soil Extraction Water extraction DTPA extraction for metals Preparation, Dissolved Filtration Lime Percentage NaHCO3 Soil Extract NH4AC Soil Extraction Total Organic Matter Prep Particle Size Analysis / Texture Prep Saturated Paste Extraction Particle Size Analysis / Texture Saturation Percentage

ANALYTICAL SUMMARY REPORT

H13110098-019	STS-PT-2013-19	10/24/13 9:00	11/01/13	Soil	Same As Above
H13110098-020	STS-PT-2013-20	10/25/13 10:45	11/01/13	Soil	Metals by ICP/ICPMS, Total Metals, Water Extractable DPTA extractable metals Metals, NH4Ac Metals, Saturated Paste Alkalinity, Water Extractable Carbon, Dissolved Organic Conductivity, Saturated Paste Extract Copper Activity Exchangeable Cations Anions by Ion Chromatography Lime as CaCO3 Moisture Nitrate as N, CaCL2 Extract Organic Carbon/Matter Walkley-Black pH, Saturated Paste Soluble Phosphate Phosphorus-Olsen Digestion, Total Metals CaCl2 Hot Water Soil Extraction Water extraction DTPA extraction for metals Preparation, Dissolved Filtration Lime Percentage NaHCO3 Soil Extract NH4AC Soil Extraction Total Organic Matter Prep Particle Size Analysis / Texture Prep Saturated Paste Extraction Particle Size Analysis / Texture Saturation Percentage

ANALYTICAL SUMMARY REPORT

H13110098-021	STS-PT-2013-21	10/22/13 11:00	11/01/13	Soil	Metals by ICP/ICPMS, Total Metals, Water Extractable DPTA extractable metals Metals, NH4Ac Metals, Saturated Paste Alkalinity, Water Extractable Carbon, Dissolved Organic Conductivity, Saturated Paste Extract Copper Activity Exchangeable Cations Anions by Ion Chromatography Lime as CaCO3 Moisture Nitrate as N, CaCL2 Extract Organic Carbon/Matter Walkley-Black Phosphorus-Bray pH, Saturated Paste Soluble Phosphate Digestion, Total Metals CaCl2 Hot Water Soil Extraction Water extraction DTPA extraction for metals Preparation, Dissolved Filtration Lime Percentage NaHCO3 Soil Extract NH4AC Soil Extraction Total Organic Matter Prep Particle Size Analysis / Texture Prep Saturated Paste Extraction Particle Size Analysis / Texture Saturation Percentage
H13110098-022	STS-PT-2013-22	10/22/13 11:35	11/01/13	Soil	Same As Above
H13110098-023	STS-PT-2013-23	10/22/13 10:30	11/01/13	Soil	Same As Above

ANALYTICAL SUMMARY REPORT

H13110098-024	STS-PT-2013-24	10/24/13 18:30	11/01/13	Soil	Metals by ICP/ICPMS, Total Metals, Water Extractable DPTA extractable metals Metals, NH4Ac Metals, Saturated Paste Alkalinity, Water Extractable Carbon, Dissolved Organic Conductivity, Saturated Paste Extract Copper Activity Exchangeable Cations Anions by Ion Chromatography Lime as CaCO3 Moisture Nitrate as N, CaCL2 Extract Organic Carbon/Matter Walkley-Black pH, Saturated Paste Soluble Phosphate Phosphorus-Olsen Digestion, Total Metals CaCl2 Hot Water Soil Extraction Water extraction DTPA extraction for metals Preparation, Dissolved Filtration Lime Percentage NaHCO3 Soil Extract NH4AC Soil Extraction Total Organic Matter Prep Particle Size Analysis / Texture Prep Saturated Paste Extraction Particle Size Analysis / Texture Saturation Percentage
H13110098-025	STS-PT-2013-25	10/22/13 16:00	11/01/13	Soil	Same As Above
H13110098-026	STS-PT-2013-26	10/22/13 15:15	11/01/13	Soil	Same As Above

ANALYTICAL SUMMARY REPORT

H13110098-027	STS-PT-2013-27	10/25/13 14:15	11/01/13	Soil	Metals by ICP/ICPMS, Total Metals, Water Extractable DPTA extractable metals Metals, NH4Ac Metals, Saturated Paste Alkalinity, Water Extractable Carbon, Dissolved Organic Conductivity, Saturated Paste Extract Copper Activity Exchangeable Cations Anions by Ion Chromatography Lime as CaCO3 Moisture Nitrate as N, CaCL2 Extract Organic Carbon/Matter Walkley-Black Phosphorus-Bray pH, Saturated Paste Soluble Phosphate Digestion, Total Metals CaCl2 Hot Water Soil Extraction Water extraction DTPA extraction for metals Preparation, Dissolved Filtration Lime Percentage NaHCO3 Soil Extract NH4AC Soil Extraction Total Organic Matter Prep Particle Size Analysis / Texture Prep Saturated Paste Extraction Particle Size Analysis / Texture Saturation Percentage
H13110098-028	STS-PT-2013-28	10/22/13 17:15	11/01/13	Soil	Metals by ICP/ICPMS, Total Metals, Water Extractable DPTA extractable metals Metals, NH4Ac Metals, Saturated Paste Alkalinity, Water Extractable Carbon, Dissolved Organic Conductivity, Saturated Paste Extract Copper Activity Exchangeable Cations Anions by Ion Chromatography Lime as CaCO3 Moisture Nitrate as N, CaCL2 Extract Organic Carbon/Matter Walkley-Black pH, Saturated Paste Soluble Phosphate Phosphorus-Olsen Digestion, Total Metals CaCl2 Hot Water Soil Extraction Water extraction DTPA extraction for metals Preparation, Dissolved Filtration Lime Percentage NaHCO3 Soil Extract NH4AC Soil Extraction Total Organic Matter Prep Particle Size Analysis / Texture Prep Saturated Paste Extraction Particle Size Analysis / Texture Saturation Percentage

ANALYTICAL SUMMARY REPORT

H13110098-029	STS-PT-2013-29	10/25/13 16:00	11/01/13	Soil	Metals by ICP/ICPMS, Total Metals, Water Extractable DPTA extractable metals Metals, NH4Ac Metals, Saturated Paste Alkalinity, Water Extractable Carbon, Dissolved Organic Conductivity, Saturated Paste Extract Copper Activity Exchangeable Cations Anions by Ion Chromatography Lime as CaCO3 Moisture Nitrate as N, CaCL2 Extract Organic Carbon/Matter Walkley-Black Phosphorus-Bray pH, Saturated Paste Soluble Phosphate Digestion, Total Metals CaCl2 Hot Water Soil Extraction Water extraction DTPA extraction for metals Preparation, Dissolved Filtration Lime Percentage NaHCO3 Soil Extract NH4AC Soil Extraction Total Organic Matter Prep Particle Size Analysis / Texture Prep Saturated Paste Extraction Particle Size Analysis / Texture Saturation Percentage
H13110098-030	STS-PT-2013-30	10/24/13 12:40	11/01/13	Soil	Same As Above
H13110098-031	STS-PT-2013-31	10/23/13 14:00	11/01/13	Soil	Same As Above
H13110098-032	STS-PT-2013-32	10/23/13 12:55	11/01/13	Soil	Same As Above
H13110098-033	STS-PT-2013-33	10/25/13 9:20	11/01/13	Soil	Same As Above
H13110098-034	Dup1	10/23/13 17:00	11/01/13	Soil	Same As Above
H13110098-035	Dup2	10/23/13 17:00	11/01/13	Soil	Same As Above

ANALYTICAL SUMMARY REPORT

H13110098-036	Dup3	10/23/13 17:00	11/01/13	Soil	Metals by ICP/ICPMS, Total Metals, Water Extractable DPTA extractable metals Metals, NH4Ac Metals, Saturated Paste Alkalinity, Water Extractable Carbon, Dissolved Organic Conductivity, Saturated Paste Extract Copper Activity Exchangeable Cations Anions by Ion Chromatography Lime as CaCO3 Moisture Nitrate as N, CaCL2 Extract Organic Carbon/Matter Walkley-Black pH, Saturated Paste Soluble Phosphate Phosphorus-Olsen Digestion, Total Metals CaCl2 Hot Water Soil Extraction Water extraction DTPA extraction for metals Preparation, Dissolved Filtration Lime Percentage NaHCO3 Soil Extract NH4AC Soil Extraction Total Organic Matter Prep Particle Size Analysis / Texture Prep Saturated Paste Extraction Particle Size Analysis / Texture Saturation Percentage

The analyses presented in this report were performed by Energy Laboratories, Inc., 3161 E. Lyndale Ave., Helena, MT 59604, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By:

Jonathan D. Hager
Branch Manager - Helena, MT

Digitally signed by
Jonathan Hager
Date: 2013.12.20 16:22:13 -07:00

Revised Date: 12/20/13
Report Date: 12/18/13

CLIENT: Chino Mine Company
Project: Phytotoxicity Soil Samples
Sample Delivery Group: H13110098

CASE NARRATIVE

Tests associated with analyst identified as ELI-CA were subcontracted to Energy Laboratories, 2393 Salt Creek Hwy., Casper, WY, EPA Number WY00002 and WY00937.

Standard operating procedure submitted by Arcadis as "Standard Operating Procedures for Measurement of Cu2+ Activity in Soil by Ion-Selective Electrode" (ed. September 2013). Copper activity measured with a Combination Cupric Sure-Flow Ion Selective Electrode (Thermo Scientific, 9629BNWP) as per SOP. All samples and standards were filtered through 0.22µm membrane cellulose-acetate filters (Whatman, 10404112), prior to analysis. All analysis was performed under reduced light conditions.

Report corrected to properly calculate Exchangeable Copper, calculation was incorrect for the initial report and was revised 12/20/2013 by STP to report exchangeable copper in units of meq/100g.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Revised Date: 12/20/13
Report Date: 12/18/13
Date Received: 11/01/13

Client: Chino Mine Company
Project: Phytotoxicity Soil Samples
Workorder: H13110098

		Analysis		Moisture (As	Sand	Silt	Clay	Texture	Percent Sat	pH-SatPst	COND	Ca-SatPst	Mg-SatPst	K-SatPst
		Units		wt%	%	%	%	%	%	s_u_	mmhos/cm	meq/L	meq/L	meq/L
Sample ID	**Client Sample ID**	**Up**	**Low**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
H13110098-001	STS-PT-2013-1	0	0	4.3	51	31	18	L	30.2	4.5	0.7	4.14	1.19	0.24
H13110098-002	STS-PT-2013-2	0	0	5.5	48	28	24	L	41.7	6.7	1.8	16.8	2.74	0.24
H13110098-003	STS-PT-2013-3	0	0	2.2	54	24	22	SCL	30.5	5.3	0.7	3.46	1.46	0.42
H13110098-004	STS-PT-2013-4	0	0	4.2	60	18	22	SCL	32.3	5.1	1.5	7.77	3.59	0.69
H13110098-005	STS-PT-2013-5	0	0	7.4	34	20	46	C	67.8	6.1	1.3	8.21	2.62	0.21
H13110098-006	STS-PT-2013-6	0	0	2.5	52	40	8	L	38.0	3.8	0.4	1.72	0.34	0.26
H13110098-007	STS-PT-2013-7	0	0	1.9	48	42	10	L	45.4	3.3	3.0	25.1	4.08	0.10
H13110098-008	STS-PT-2013-8	0	0	8.3	28	30	42	C	46.2	5.0	0.4	1.16	0.50	0.15
H13110098-009	STS-PT-2013-9	0	0	3.5	52	26	22	SCL	26.1	4.3	0.4	1.45	0.40	0.17
H13110098-010	STS-PT-2013-10	0	0	3.5	73	17	10	SL	25.0	4.8	0.6	2.86	0.70	0.18
H13110098-011	STS-PT-2013-11	0	0	3.1	64	24	12	SL	29.6	3.9	0.3	0.94	0.18	0.14
H13110098-012	STS-PT-2013-12	0	0	2.3	60	26	14	SL	27.9	6.5	0.7	4.51	0.76	0.14
H13110098-013	STS-PT-2013-13	0	0	3.9	42	34	24	L	32.2	4.9	0.4	1.07	0.58	0.33
H13110098-014	STS-PT-2013-14	0	0	10.9	34	26	40	C	53.4	3.8	3.0	24.6	10.5	0.33
H13110098-015	STS-PT-2013-15	0	0	5.9	40	28	32	CL	36.1	5.1	0.3	0.35	0.18	0.08
H13110098-016	STS-PT-2013-16	0	0	6.0	33	23	44	C	62.4	5.4	0.6	2.46	1.01	0.19
H13110098-017	STS-PT-2013-17	0	0	5.9	32	28	40	C	48.8	7.6	0.6	4.60	0.65	0.23
H13110098-018	STS-PT-2013-18	0	0	4.7	54	24	22	SCL	30.4	4.1	0.3	1.14	0.29	0.10
H13110098-019	STS-PT-2013-19	0	0	3.2	62	22	16	SL	26.9	4.6	0.4	1.79	0.44	0.13
H13110098-020	STS-PT-2013-20	0	0	5.3	46	34	20	L	41.4	7.5	0.5	3.67	0.37	0.09
H13110098-021	STS-PT-2013-21	0	0	5.7	48	20	32	SCL	38.1	4.2	0.2	0.71	0.24	0.11
H13110098-022	STS-PT-2013-22	0	0	4.0	58	26	16	SL	35.1	3.9	2.7	22.4	5.78	0.33
H13110098-023	STS-PT-2013-23	0	0	2.6	68	20	12	SL	24.1	4.4	0.4	1.52	0.35	0.17
H13110098-024	STS-PT-2013-24	0	0	3.6	64	18	18	SL	33.6	7.7	0.5	3.73	0.31	0.23
H13110098-025	STS-PT-2013-25	0	0	1.3	74	18	8	SL	22.8	7.7	0.6	3.57	0.46	0.80
H13110098-026	STS-PT-2013-26	0	0	5.5	42	30	28	CL	40.0	7.6	0.4	2.74	0.23	0.26
H13110098-027	STS-PT-2013-27	0	0	4.9	58	20	22	SCL	30.0	4.6	0.3	0.78	0.33	0.16
H13110098-028	STS-PT-2013-28	0	0	5.7	44	23	33	CL	40.0	7.5	0.4	2.02	0.42	0.15
H13110098-029	STS-PT-2013-29	0	0	2.1	66	19	15	SL	21.4	4.5	0.2	0.56	0.16	0.25
H13110098-030	STS-PT-2013-30	0	0	2.2	67	20	13	SL	23.6	3.7	1.0	5.80	0.94	0.27
H13110098-031	STS-PT-2013-31	0	0	11.8	32	23	45	C	56.4	5.1	0.4	1.53	0.60	0.09
H13110098-032	STS-PT-2013-32	0	0	7.0	42	33	25	L	35.3	5.1	0.4	1.89	0.58	0.32
H13110098-033	STS-PT-2013-33	0	0	3.2	46	45	9	L	29.0	4.3	12.8	18.8	35.4	< 0.03
H13110098-034	Dup1	0	0	3.9	50	31	19	L	29.0	4.8	0.8	4.51	1.25	0.25
H13110098-035	Dup2	0	0	3.0	46	45	9	L	27.2	4.0	21.8	18.1	42.6	0.03
H13110098-036	Dup3	0	0	3.8	48	31	21	L	38.4	7.6	0.5	3.68	0.37	0.13

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Phytotoxicity Soil Samples
Workorder: H13110098

Revised Date: 12/20/13
Report Date: 12/18/13
Date Received: 11/01/13

		Analysis		Na-SatPst	Alk SatPst	HCO3 SatPst	Fluoride	SO4-SatPst	Cl-SatPst	Ca-NH4OAC	Cu-NH4OAC	Mg-NH4OAC	Na-NH4OAC	Ca-Ext-NH4OAC
		Units		meq/L	meq/L	meq/L	mg/L	meq/L	meq/L	mg/kg	mg/kg	mg/kg	mg/kg	meq/100g
Sample ID	**Client Sample ID**	**Up**	**Low**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
H13110098-001	STS-PT-2013-1	0	0	0.69	0.44	0.44	< 2	5.9	0.2	1180	227	168	20	5.87
H13110098-002	STS-PT-2013-2	0	0	0.66	3.53	3.53	< 2	17.7	0.3	5790	38	343	20	28.9
H13110098-003	STS-PT-2013-3	0	0	0.61	0.56	0.56	< 2	3.7	0.2	1610	16	312	18	8.01
H13110098-004	STS-PT-2013-4	0	0	1.04	0.62	0.62	< 2	6.6	0.8	1840	8	422	23	9.21
H13110098-005	STS-PT-2013-5	0	0	1.47	1.75	1.75	< 2	10.0	0.3	6140	41	999	84	30.6
H13110098-006	STS-PT-2013-6	0	0	0.33	0.11	0.11	< 2	2.6	0.2	212	5	26	10	1.06
H13110098-007	STS-PT-2013-7	0	0	0.81	< 0.02	< 0.02	6	40.6	0.2	745	8	55	17	3.72
H13110098-008	STS-PT-2013-8	0	0	1.10	0.64	0.64	< 2	2.0	0.4	3380	53	752	46	16.9
H13110098-009	STS-PT-2013-9	0	0	0.59	0.43	0.43	< 2	1.9	0.2	688	452	110	12	3.44
H13110098-010	STS-PT-2013-10	0	0	0.81	0.44	0.44	< 2	4.2	0.3	672	109	78	19	3.35
H13110098-011	STS-PT-2013-11	0	0	0.50	0.41	0.41	< 2	1.4	0.2	176	11	21	12	0.876
H13110098-012	STS-PT-2013-12	0	0	0.80	2.92	2.91	< 2	3.3	0.2	2100	15	161	22	10.5
H13110098-013	STS-PT-2013-13	0	0	0.95	0.58	0.58	< 2	1.6	0.3	1600	19	403	20	7.99
H13110098-014	STS-PT-2013-14	0	0	1.32	< 0.02	< 0.02	5	39.3	0.2	3930	100	728	46	19.6
H13110098-015	STS-PT-2013-15	0	0	0.63	0.55	0.55	< 2	1.1	0.4	2410	44	463	69	12.0
H13110098-016	STS-PT-2013-16	0	0	1.21	0.85	0.85	< 2	3.5	0.5	4590	95	945	51	22.9
H13110098-017	STS-PT-2013-17	0	0	0.71	3.03	3.02	< 2	2.8	0.4	6830	43	354	21	34.1
H13110098-018	STS-PT-2013-18	0	0	0.75	0.41	0.41	< 2	2.1	0.2	281	34	39	20	1.40
H13110098-019	STS-PT-2013-19	0	0	0.79	0.43	0.43	< 2	2.1	0.2	888	163	106	18	4.43
H13110098-020	STS-PT-2013-20	0	0	0.94	4.24	4.24	< 2	< 0.4	0.8	5940	2	135	34	29.6
H13110098-021	STS-PT-2013-21	0	0	0.71	0.43	0.43	< 2	1.5	0.2	390	2	61	18	1.95
H13110098-022	STS-PT-2013-22	0	0	1.89	< 0.02	< 0.02	7	35.0	0.4	1230	19	114	36	6.14
H13110098-023	STS-PT-2013-23	0	0	0.61	0.41	0.41	< 2	2.1	0.2	330	17	46	14	1.65
H13110098-024	STS-PT-2013-24	0	0	0.52	4.50	4.49	< 2	< 0.4	0.3	5060	< 1	155	11	25.3
H13110098-025	STS-PT-2013-25	0	0	0.55	4.85	4.85	< 2	0.5	0.4	7500	2	216	14	37.4
H13110098-026	STS-PT-2013-26	0	0	0.61	3.08	3.08	< 2	0.7	0.3	1190	8	226	20	5.94
H13110098-027	STS-PT-2013-27	0	0	0.87	0.48	0.48	< 2	1.4	0.3	4360	< 1	403	17	21.8
H13110098-028	STS-PT-2013-28	0	0	0.84	2.74	2.74	< 2	0.6	0.4	489	48	73	17	2.44
H13110098-029	STS-PT-2013-29	0	0	0.61	0.46	0.46	< 2	0.9	0.3	391	4	44	12	1.95
H13110098-030	STS-PT-2013-30	0	0	0.61	< 0.02	< 0.02	< 2	8.7	0.3	376	4	41	12	1.88
H13110098-031	STS-PT-2013-31	0	0	1.20	0.46	0.46	< 2	1.9	0.5	4300	7	797	123	21.5
H13110098-032	STS-PT-2013-32	0	0	0.44	0.63	0.63	< 2	1.7	0.3	1300	119	166	32	6.50
H13110098-033	STS-PT-2013-33	0	0	1.33	0.64	0.64	44	260	4.9	20500	16100	190	26	102
H13110098-034	Dup1	0	0	0.82	0.44	0.44	< 2	9.1	0.3	1070	291	145	21	5.34
H13110098-035	Dup2	0	0	1.23	0.59	0.59	64	491	5.5	20600	16800	211	18	103
H13110098-036	Dup3	0	0	0.37	3.66	3.66	< 2	4.4	0.5	5680	10	129	15	28.3

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Phytotoxicity Soil Samples
Workorder: H13110098

Revised Date: 12/20/13
Report Date: 12/18/13
Date Received: 11/01/13

		Analysis		Mg-Ext-NH4OAC	K-Ext-NH4OAC	K-NH4OAC	Na-Ext-NH4OAC	Exch Ca	Exch Mg	Exch K	Exch Na	Exch Cu	OM-WB	Lime
		Units		meq/100g	meq/100g	mg/kg	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g	%	%
Sample ID	**Client Sample ID**	**Up**	**Low**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
H13110098-001	STS-PT-2013-1	0	0	1.39	0.496	194	0.087	5.8	1.4	0.5	< 0.1	0.6	1.1	0.53
H13110098-002	STS-PT-2013-2	0	0	2.85	0.650	254	0.086	28.2	2.7	0.6	< 0.1	0.1	1.4	2.07
H13110098-003	STS-PT-2013-3	0	0	2.59	0.786	307	0.080	7.9	2.6	0.8	< 0.1	< 0.1	0.9	0.58
H13110098-004	STS-PT-2013-4	0	0	3.50	0.806	315	0.101	8.6	3.1	0.8	< 0.1	< 0.1	1.6	0.66
H13110098-005	STS-PT-2013-5	0	0	8.29	1.21	473	0.368	30.1	8.1	1.2	0.3	0.1	2.6	1.99
H13110098-006	STS-PT-2013-6	0	0	0.215	0.165	65	0.042	1.0	0.2	0.2	< 0.1	< 0.1	2.0	< 0.01
H13110098-007	STS-PT-2013-7	0	0	0.453	0.062	24	0.073	2.5	0.2	< 0.1	< 0.1	< 0.1	3.9	< 0.01
H13110098-008	STS-PT-2013-8	0	0	6.24	0.942	368	0.201	16.8	6.2	0.9	0.2	0.2	1.6	1.41
H13110098-009	STS-PT-2013-9	0	0	0.912	0.356	139	0.051	3.4	0.9	0.4	< 0.1	1.1	1.0	0.24
H13110098-010	STS-PT-2013-10	0	0	0.651	< 1	91	0.083	3.3	0.6	< 0.1	< 0.1	0.3	0.8	0.24
H13110098-011	STS-PT-2013-11	0	0	0.173	0.174	68	0.054	0.8	0.2	0.2	< 0.1	< 0.1	1.3	0.06
H13110098-012	STS-PT-2013-12	0	0	1.33	0.335	131	0.097	10.4	1.3	0.3	< 0.1	< 0.1	1.3	0.75
H13110098-013	STS-PT-2013-13	0	0	3.35	1.11	435	0.088	8.0	3.3	1.1	< 0.1	< 0.1	1.6	0.84
H13110098-014	STS-PT-2013-14	0	0	6.04	0.691	270	0.202	18.3	5.5	0.7	0.1	0.2	1.2	0.86
H13110098-015	STS-PT-2013-15	0	0	3.85	0.885	346	0.298	12.0	3.8	0.9	0.3	0.1	1.6	0.97
H13110098-016	STS-PT-2013-16	0	0	7.84	1.34	523	0.222	22.7	7.8	1.3	0.1	0.3	3.0	1.66
H13110098-017	STS-PT-2013-17	0	0	2.94	1.22	477	0.090	33.8	2.9	1.2	< 0.1	0.1	1.5	3.69
H13110098-018	STS-PT-2013-18	0	0	0.326	0.184	72	0.088	1.4	0.3	0.2	< 0.1	< 0.1	1.0	0.09
H13110098-019	STS-PT-2013-19	0	0	0.883	0.393	154	0.078	4.4	0.9	0.4	< 0.1	0.4	0.7	0.30
H13110098-020	STS-PT-2013-20	0	0	1.12	0.500	195	0.149	29.0	1.1	0.5	< 0.1	< 0.1	2.3	22.3
H13110098-021	STS-PT-2013-21	0	0	0.510	0.275	108	0.078	1.8	0.4	0.3	< 0.1	< 0.1	1.2	0.10
H13110098-022	STS-PT-2013-22	0	0	0.946	0.255	100	0.158	5.4	0.8	0.2	< 0.1	< 0.1	3.3	0.24
H13110098-023	STS-PT-2013-23	0	0	0.381	0.235	92	0.060	1.6	0.3	0.2	< 0.1	< 0.1	0.8	0.16
H13110098-024	STS-PT-2013-24	0	0	1.29	0.713	278	0.049	25.2	1.3	0.7	< 0.1	< 0.1	1.4	2.41
H13110098-025	STS-PT-2013-25	0	0	1.79	1.89	737	0.061	37.5	1.8	1.9	< 0.1	< 0.1	1.1	0.91
H13110098-026	STS-PT-2013-26	0	0	1.88	0.562	220	0.086	5.9	1.9	0.6	< 0.1	< 0.1	2.3	18.1
H13110098-027	STS-PT-2013-27	0	0	3.34	1.15	449	0.074	21.5	3.4	1.1	< 0.1	< 0.1	1.3	0.45
H13110098-028	STS-PT-2013-28	0	0	0.609	0.472	184	0.073	2.3	0.5	0.5	< 0.1	0.1	1.0	1.68
H13110098-029	STS-PT-2013-29	0	0	0.361	0.149	58	0.054	1.9	0.3	0.2	< 0.1	< 0.1	0.3	0.20
H13110098-030	STS-PT-2013-30	0	0	0.341	0.156	61	0.053	1.8	0.3	0.2	< 0.1	< 0.1	0.5	< 0.01
H13110098-031	STS-PT-2013-31	0	0	6.62	0.759	297	0.537	21.7	7.0	0.7	0.4	< 0.1	1.2	1.39
H13110098-032	STS-PT-2013-32	0	0	1.38	1.77	692	0.139	6.4	1.4	1.8	0.1	0.4	1.9	0.60
H13110098-033	STS-PT-2013-33	0	0	1.57	0.018	7	0.113	114	0.5	< 0.1	< 0.1	75.4	2.4	< 0.01
H13110098-034	Dup1	0	0	1.21	0.465	182	0.090	5.2	1.2	0.5	< 0.1	0.8	0.8	0.57
H13110098-035	Dup2	0	0	1.75	0.020	8	0.078	114	0.4	< 0.1	< 0.1	68.2	2.2	< 0.01
H13110098-036	Dup3	0	0	1.07	0.600	234	0.064	27.8	1.0	0.6	< 0.1	< 0.1	2.0	21.7

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Phytotoxicity Soil Samples
Workorder: H13110098

Revised Date: 12/20/13
Report Date: 12/18/13
Date Received: 11/01/13

		Analysis		Olsen Phos-Olsen	P-Bray	PO4	NO3	Cu-CACL2	Al-DTPA	Fe-DTPA	Mn-DTPA	Cu-T	Organic Carbon,	Conductivity , CaCl2
		Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mmhos/cm
Sample ID	**Client Sample ID**	**Up**	**Low**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
H13110098-001	STS-PT-2013-1	0	0		68.4	0.2	4	27.9	5.2	37	24.3	1030	6	1.5
H13110098-002	STS-PT-2013-2	0	0	16		< 0.1	2	0.3	1.7	26	2.9	809	12	1.8
H13110098-003	STS-PT-2013-3	0	0		17.7	< 0.2	8	0.4	1.4	18	31.0	189	10	1.4
H13110098-004	STS-PT-2013-4	0	0		30.2	< 0.2	23	0.3	1.4	38	18.9	193	24	1.6
H13110098-005	STS-PT-2013-5	0	0		16.0	< 0.1	9	0.4	1.3	13	7.9	632	18	1.7
H13110098-006	STS-PT-2013-6	0	0		6.3	< 0.1	< 1	3.5	27.6	252	3.4	202	14	1.5
H13110098-007	STS-PT-2013-7	0	0		16.2	< 1	2	10.9	27.3	314	16.8	279	14	2.4
H13110098-008	STS-PT-2013-8	0	0		52.3	0.9	3	0.5	1.9	32	34.0	626	15	1.7
H13110098-009	STS-PT-2013-9	0	0		15.1	< 0.1	3	114	5.0	9	8.7	1350	4	1.6
H13110098-010	STS-PT-2013-10	0	0		5.2	< 0.2	1	9.9	12.8	29	8.0	557	8	1.7
H13110098-011	STS-PT-2013-11	0	0		20.3	< 1	1	8.4	79.2	58	2.4	189	5	1.5
H13110098-012	STS-PT-2013-12	0	0	6		< 0.2	< 1	0.2	1.0	24	7.3	449	15	1.5
H13110098-013	STS-PT-2013-13	0	0		56.9	2	3	0.4	2.6	53	23.2	360	11	1.5
H13110098-014	STS-PT-2013-14	0	0		57.7	< 0.1	17	36.3	57.4	24	43.4	725	10	2.8
H13110098-015	STS-PT-2013-15	0	0		41.7	3	< 5	0.6	2.2	31	19.2	501	17	1.5
H13110098-016	STS-PT-2013-16	0	0		22.3	0.9	4	1.0	1.3	27	19.4	1200	23	1.6
H13110098-017	STS-PT-2013-17	0	0	9		0.2	6	0.4	1.5	9	2.8	1120	14	1.5
H13110098-018	STS-PT-2013-18	0	0		2.9	< 0.1	< 1	25.3	34.5	37	4.3	311	6	1.5
H13110098-019	STS-PT-2013-19	0	0		8.9	< 0.1	3	28.0	5.2	30	16.6	714	4	1.5
H13110098-020	STS-PT-2013-20	0	0	5		0.1	2	0.2	0.7	3	4.5	131	22	1.5
H13110098-021	STS-PT-2013-21	0	0		6.3	< 1	< 1	2.3	93.9	18	3.3	61	7	1.6
H13110098-022	STS-PT-2013-22	0	0		11.8	< 0.1	< 1	10.7	46.9	95	18.8	248	27	2.6
H13110098-023	STS-PT-2013-23	0	0		30.9	< 0.1	2	9.1	53.8	55	6.1	253	4	1.6
H13110098-024	STS-PT-2013-24	0	0	7		0.7	2	< 0.1	1.3	6	4.2	56	11	1.7
H13110098-025	STS-PT-2013-25	0	0	9		1.4	2	0.2	1.4	4	3.9	130	12	1.6
H13110098-026	STS-PT-2013-26	0	0	7		< 0.2	2	0.1	0.9	4	3.9	109	15	1.6
H13110098-027	STS-PT-2013-27	0	0		9.5	1	1	2.4	3.5	34	23.6	164	12	1.6
H13110098-028	STS-PT-2013-28	0	0	6		< 0.2	3	0.2	0.9	6	4.0	58	12	1.6
H13110098-029	STS-PT-2013-29	0	0		27.9	1	1	11.2	6.5	26	48.3	234	6	1.6
H13110098-030	STS-PT-2013-30	0	0		11.2	< 0.1	3	4.0	18.2	137	4.5	152	7	1.8
H13110098-031	STS-PT-2013-31	0	0		11.0	5	10	0.2	1.2	20	6.8	153	23	1.7
H13110098-032	STS-PT-2013-32	0	0		20.9	1	7	2.4	11.3	38	16.4	816	15	1.6
H13110098-033	STS-PT-2013-33	0	0		5.5	1.7	2	3410	0.9	< 1	67.8	95300	13	5.0
H13110098-034	Dup1	0	0		72.0	< 1	4	31.8	6.2	39	23.0	879	5	1.7
H13110098-035	Dup2	0	0		5.7	1	2	5620	1.5	< 1	66.6	92500	13	5.8
H13110098-036	Dup3	0	0	7		< 0.1	1	1.6	1.1	4	5.4	174	19	2.1

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Phytotoxicity Soil Samples
Workorder: H13110098

Revised Date: 12/20/13
Report Date: 12/18/13
Date Received: 11/01/13

	Analysis			Millivolts	pCu, Measured	ph, CaCl2
		Units		mV	s_u_	s_u_
Sample ID	**Client Sample ID**	**Up**	**Low**	**Results**	**Results**	**Results**
H13110098-001	STS-PT-2013-1	0	0	101	3.11	4.0
H13110098-002	STS-PT-2013-2	0	0	17	6.57	7.1
H13110098-003	STS-PT-2013-3	0	0	37	5.76	5.6
H13110098-004	STS-PT-2013-4	0	0	26	6.21	5.1
H13110098-005	STS-PT-2013-5	0	0	12	6.79	6.1
H13110098-006	STS-PT-2013-6	0	0	82	3.88	3.4
H13110098-007	STS-PT-2013-7	0	0	89	3.59	3.2
H13110098-008	STS-PT-2013-8	0	0	55	4.99	5.5
H13110098-009	STS-PT-2013-9	0	0	125	2.09	4.0
H13110098-010	STS-PT-2013-10	0	0	95	3.87	4.5
H13110098-011	STS-PT-2013-11	0	0	92	3.95	3.7
H13110098-012	STS-PT-2013-12	0	0	4	7.44	6.2
H13110098-013	STS-PT-2013-13	0	0	54	5.46	5.0
H13110098-014	STS-PT-2013-14	0	0	106	3.43	3.7
H13110098-015	STS-PT-2013-15	0	0	58	5.30	5.5
H13110098-016	STS-PT-2013-16	0	0	54	5.48	5.4
H13110098-017	STS-PT-2013-17	0	0	-2	7.66	6.8
H13110098-018	STS-PT-2013-18	0	0	106	3.40	3.8
H13110098-019	STS-PT-2013-19	0	0	109	3.32	4.3
H13110098-020	STS-PT-2013-20	0	0	-30	8.79	6.5
H13110098-021	STS-PT-2013-21	0	0	78	4.55	3.5
H13110098-022	STS-PT-2013-22	0	0	91	4.02	3.6
H13110098-023	STS-PT-2013-23	0	0	94	3.89	3.8
H13110098-024	STS-PT-2013-24	0	0	-25	8.57	6.7
H13110098-025	STS-PT-2013-25	0	0	-22	8.49	6.6
H13110098-026	STS-PT-2013-26	0	0	-26	8.63	6.7
H13110098-027	STS-PT-2013-27	0	0	78	4.54	4.9
H13110098-028	STS-PT-2013-28	0	0	-22	8.49	6.6
H13110098-029	STS-PT-2013-29	0	0	98	3.76	4.1
H13110098-030	STS-PT-2013-30	0	0	86	4.21	3.4
H13110098-031	STS-PT-2013-31	0	0	38	6.10	5.4
H13110098-032	STS-PT-2013-32	0	0	76	4.61	5.4
H13110098-033	STS-PT-2013-33	0	0	152	1.04	4.3
H13110098-034	Dup1	0	0	110	3.28	4.6
H13110098-035	Dup2	0	0	154	0.95	4.2
H13110098-036	Dup3	0	0	4	7.36	7.5

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/18/13
Project: Phytotoxicity Soil Samples **Work Order:** H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A5310 C									Analytical Run: SUB-C181718
Sample ID: ICV-7684	Initial Calibration Verification Standard								12/13/13 16:37
Organic Carbon, Dissolved (DOC)	10.1	mg/L	0.50	101	90	110			
Sample ID: CCV-7343	Continuing Calibration Verification Standard								12/13/13 21:50
Organic Carbon, Dissolved (DOC)	10.1	mg/L	0.50	101	90	110			
Method: A5310 C									Batch: C_40070
Sample ID: MBLK	Method Blank				Run: SUB-C181718				12/13/13 16:26
Organic Carbon, Dissolved (DOC)	ND	mg/L	0.04						
Sample ID: MB-22702	Method Blank				Run: SUB-C181718				12/13/13 16:47
Organic Carbon, Dissolved (DOC)	0.6	mg/kg	0.04						
Sample ID: H13110098-008A	Sample Matrix Spike				Run: SUB-C181718				12/13/13 18:31
Organic Carbon, Dissolved (DOC)	65.8	mg/kg	1.0	102	85	115			
Sample ID: H13110098-008A	Sample Matrix Spike Duplicate				Run: SUB-C181718				12/13/13 18:42
Organic Carbon, Dissolved (DOC)	66.3	mg/kg	1.0	103	85	115	0.9	10	
Sample ID: H13110098-010A	Sample Duplicate				Run: SUB-C181718				12/13/13 20:05
Organic Carbon, Dissolved (DOC)	8.30	mg/kg	1.0				1.3	10	
Sample ID: H13110098-017A	Sample Matrix Spike				Run: SUB-C181718				12/13/13 21:27
Organic Carbon, Dissolved (DOC)	65.5	mg/kg	1.0	103	85	115			
Sample ID: H13110098-017A	Sample Matrix Spike Duplicate				Run: SUB-C181718				12/13/13 21:39
Organic Carbon, Dissolved (DOC)	65.5	mg/kg	1.0	103	85	115	0.1	10	
Sample ID: H13110098-020A	Sample Duplicate				Run: SUB-C181718				12/13/13 23:02
Organic Carbon, Dissolved (DOC)	19.7	mg/kg	1.0				10	10	R
Method: A5310 C									Batch: C_40071
Sample ID: MB-22703	Method Blank				Run: SUB-C181718				12/13/13 23:11
Organic Carbon, Dissolved (DOC)	0.8	mg/kg	0.04						
Sample ID: H13110098-024A	Sample Matrix Spike				Run: SUB-C181718				12/14/13 00:14
Organic Carbon, Dissolved (DOC)	63.3	mg/kg	1.0	105	85	115			
Sample ID: H13110098-024A	Sample Matrix Spike Duplicate				Run: SUB-C181718				12/14/13 00:25
Organic Carbon, Dissolved (DOC)	63.1	mg/kg	1.0	105	85	115	0.3	10	
Sample ID: LCS-7684	Laboratory Control Sample				Run: SUB-C181718				12/14/13 00:36
Organic Carbon, Dissolved (DOC)	10.1	mg/L	0.50	101	90	110			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

R - RPD exceeds advisory limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/18/13
Project: Phytotoxicity Soil Samples **Work Order:** H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **A5310 C**									Analytical Run: SUB-C181773
Sample ID: **ICV-7684**	Initial Calibration Verification Standard								12/16/13 07:47
Organic Carbon, Dissolved (DOC)	10.2	mg/L	0.50	102	90	110			
Sample ID: **CCV-7343**	Continuing Calibration Verification Standard								12/16/13 07:58
Organic Carbon, Dissolved (DOC)	10.1	mg/L	0.50	101	90	110			
Sample ID: **CCV-7343**	Continuing Calibration Verification Standard								12/16/13 10:44
Organic Carbon, Dissolved (DOC)	10.2	mg/L	0.50	102	90	110			
Sample ID: **CCV-7343**	Continuing Calibration Verification Standard								12/16/13 13:39
Organic Carbon, Dissolved (DOC)	10.2	mg/L	0.50	102	90	110			
Method: **A5310 C**									Batch: C_40070
Sample ID: **MB-22702**	Method Blank				Run: SUB-C181773				12/16/13 14:20
Organic Carbon, Dissolved (DOC)	0.7	mg/kg	0.04						
Sample ID: **H13110098-020A**	Sample Matrix Spike				Run: SUB-C181773				12/16/13 15:03
Organic Carbon, Dissolved (DOC)	74.2	mg/kg	1.0	104	85	115			
Sample ID: **H13110098-020A**	Sample Matrix Spike Duplicate				Run: SUB-C181773				12/16/13 15:14
Organic Carbon, Dissolved (DOC)	74.5	mg/kg	1.0	104	85	115	0.4	10	
Method: **A5310 C**									Batch: C_40071
Sample ID: **MBLK**	Method Blank				Run: SUB-C181773				12/16/13 08:08
Organic Carbon, Dissolved (DOC)	ND	mg/L	0.04						
Sample ID: **MB-22703**	Method Blank				Run: SUB-C181773				12/16/13 08:39
Organic Carbon, Dissolved (DOC)	0.9	mg/kg	0.04						
Sample ID: **H13110098-030A**	Sample Duplicate				Run: SUB-C181773				12/16/13 09:59
Organic Carbon, Dissolved (DOC)	6.89	mg/kg	1.0				0.0	10	
Sample ID: **H13110098-031A**	Sample Matrix Spike				Run: SUB-C181773				12/16/13 10:21
Organic Carbon, Dissolved (DOC)	75.0	mg/kg	1.0	103	85	115			
Sample ID: **H13110098-031A**	Sample Matrix Spike Duplicate				Run: SUB-C181773				12/16/13 10:32
Organic Carbon, Dissolved (DOC)	75.5	mg/kg	1.0	104	85	115	0.6	10	
Sample ID: **H13110098-036A**	Sample Duplicate				Run: SUB-C181773				12/16/13 12:15
Organic Carbon, Dissolved (DOC)	19.5	mg/kg	1.0				0.4	10	
Sample ID: **H13120008-003A**	Sample Matrix Spike				Run: SUB-C181773				12/16/13 13:06
Organic Carbon, Dissolved (DOC)	59.2	mg/kg	1.0	106	85	115			
Sample ID: **H13120008-003A**	Sample Matrix Spike Duplicate				Run: SUB-C181773				12/16/13 13:17
Organic Carbon, Dissolved (DOC)	59.6	mg/kg	1.0	106	85	115	0.6	10	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Report Date: 12/18/13
Project: Phytotoxicity Soil Samples
Work Order: H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A5310 C									Batch: C_40071
Sample ID: LCS-7684	Laboratory Control Sample				Run: SUB-C181773				12/16/13 13:28
Organic Carbon, Dissolved (DOC)	10.3	mg/L	0.50	103	90	110			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/18/13
Project: Phytotoxicity Soil Samples **Work Order:** H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: arcadis SOP								Batch: 131211_1_PH-S-PASTE	
Sample ID: LCS-22738	Laboratory Control Sample				Run: MISC SOILS_131216B				12/17/13 09:16
Conductivity, CaCl2	2.15	mmhos/cm	0.10	82	70	130			
pCu, Measured	8.89	s.u.	0.010	102	70	130			
ph, CaCl2	7.31	s.u.	0.10	101	70	130			
Sample ID: H13110098-010Adup	Sample Duplicate				Run: MISC SOILS_131216B				12/17/13 09:29
Conductivity, CaCl2	1.65	mmhos/cm	0.10						
Millivolts	94.0	mV							
pCu, Measured	3.89	s.u.	0.010						
ph, CaCl2	4.64	s.u.	0.10						
Sample ID: H13110098-020Adup	Sample Duplicate				Run: MISC SOILS_131216B				12/17/13 09:44
Conductivity, CaCl2	1.51	mmhos/cm	0.10						
Millivolts	-32.9	mV							
pCu, Measured	8.90	s.u.	0.010						
ph, CaCl2	6.51	s.u.	0.10						
Sample ID: LCS-22739	Laboratory Control Sample				Run: MISC SOILS_131216B				12/17/13 09:47
Conductivity, CaCl2	2.49	mmhos/cm	0.10	95	70	130			
pCu, Measured	9.15	s.u.	0.010	105	70	130			
ph, CaCl2	7.02	s.u.	0.10	97	70	130			
Sample ID: H13110098-030Adup	Sample Duplicate				Run: MISC SOILS_131216B				12/17/13 09:59
Conductivity, CaCl2	1.77	mmhos/cm	0.10						
Millivolts	85.3	mV							
pCu, Measured	4.24	s.u.	0.010						
ph, CaCl2	3.43	s.u.	0.10						
Sample ID: H13110098-036Adup	Sample Duplicate				Run: MISC SOILS_131216B				12/17/13 10:07
Millivolts	-10.1	mV	0.10						
pCu, Measured	8.00	s.u.							
Method: arcadis SOP								Batch: 131216_1_PH-S-PASTE	
Sample ID: LCS-22839	Laboratory Control Sample				Run: MISC SOILS_131216B				12/17/13 10:20
Conductivity, CaCl2	2.86	mmhos/cm	0.10	109	70	130			
pCu, Measured	8.43	s.u.	0.010	97	70	130			
ph, CaCl2	7.36	s.u.	0.10	101	70	130			
Sample ID: H13110098-036Adup	Sample Duplicate				Run: MISC SOILS_131216B				12/17/13 10:22
Conductivity, CaCl2	2.10	mmhos/cm	0.10						
Millivolts	-22.8	mV							
pCu, Measured	8.52	s.u.	0.010						
ph, CaCl2	7.46	s.u.	0.10						

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Phytotoxicity Soil Samples

Report Date: 12/18/13
Work Order: H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **arcadis SOP**									Batch: 131216_1_PH-S-PASTE
Sample ID: **LCS-22754**	Laboratory Control Sample				Run: MISC SOILS_131216B				12/17/13 10:28
Conductivity, CaCl2	2.96	mmhos/cm	0.10	113	70	130			
pCu, Measured	8.34	s.u.	0.010	96	70	130			
ph, CaCl2	7.37	s.u.	0.10	101	70	130			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/18/13

Project: Phytotoxicity Soil Samples **Work Order:** H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA10-3									Batch: 22413
Sample ID: MB-22413	Method Blank				Run: MAN-TECH_131120B				11/20/13 16:36
Alkalinity, sat paste	1	mg/L	0.1						
Bicarbonate, sat paste	2	mg/L	0.5						
Alkalinity, sat. paste	0.03	meq/L	0.002						
Bicarbonate, sat. paste	0.03	meq/L	0.008						
Sample ID: LCS-22413	Laboratory Control Sample				Run: MAN-TECH_131120B				11/20/13 16:42
Alkalinity, sat paste	228	mg/L	1.0	132	70	135			
Bicarbonate, sat paste	278	mg/L	1.0	132	70	135			
Alkalinity, sat. paste	4.56	meq/L	0.020	132	70	135			
Bicarbonate, sat. paste	4.56	meq/L	0.016	132	70	135			
Sample ID: H13110098-010ADUP	Sample Duplicate				Run: MAN-TECH_131120B				11/20/13 17:33
Alkalinity, sat paste	21.1	mg/L	1.0				3.6	30	
Bicarbonate, sat paste	25.8	mg/L	1.0				3.6	30	
Alkalinity, sat. paste	0.422	meq/L	0.020				3.6	30	
Bicarbonate, sat. paste	0.422	meq/L	0.016				3.6	30	
Sample ID: H13110098-020ADUP	Sample Duplicate				Run: MAN-TECH_131120B				11/20/13 18:28
Alkalinity, sat paste	231	mg/L	1.0				8.7	30	
Bicarbonate, sat paste	282	mg/L	1.0				8.7	30	
Alkalinity, sat. paste	4.62	meq/L	0.020				8.7	30	
Bicarbonate, sat. paste	4.62	meq/L	0.016				8.7	30	
Method: ASA10-3									Batch: 22414
Sample ID: MB-22414	Method Blank				Run: MAN-TECH_131120B				11/20/13 18:40
Alkalinity, sat paste	1	mg/L	0.1						
Bicarbonate, sat paste	1	mg/L	0.5						
Alkalinity, sat. paste	0.02	meq/L	0.002						
Bicarbonate, sat. paste	0.02	meq/L	0.008						
Sample ID: LCS-22414	Laboratory Control Sample				Run: MAN-TECH_131120B				11/20/13 18:46
Alkalinity, sat paste	211	mg/L	1.0	122	70	135			
Bicarbonate, sat paste	257	mg/L	1.0	122	70	135			
Alkalinity, sat. paste	4.21	meq/L	0.020	122	70	135			
Bicarbonate, sat. paste	4.21	meq/L	0.016	122	70	135			
Sample ID: H13110098-030ADUP	Sample Duplicate				Run: MAN-TECH_131120B				11/20/13 19:40
Alkalinity, sat paste	ND	mg/L	1.0					30	
Bicarbonate, sat paste	ND	mg/L	1.0					30	
Alkalinity, sat. paste	ND	meq/L	0.020					30	
Bicarbonate, sat. paste	ND	meq/L	0.016					30	
Sample ID: H13110098-036ADUP	Sample Duplicate				Run: MAN-TECH_131120B				11/20/13 20:13
Alkalinity, sat paste	191	mg/L	1.0				3.9	30	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company

Project: Phytotoxicity Soil Samples

Report Date: 12/18/13

Work Order: H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA10-3								Batch: 22414	
Sample ID: H13110098-036ADUP	Sample Duplicate				Run: MAN-TECH_131120B			11/20/13 20:13	
Bicarbonate, sat paste	233	mg/L	1.0				3.9	30	
Alkalinity, sat. paste	3.81	meq/L	0.020				3.9	30	
Bicarbonate, sat. paste	3.81	meq/L	0.016				3.9	30	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/18/13

Project: Phytotoxicity Soil Samples **Work Order:** H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA15-5								Batch: R93367	
Sample ID: H13110098-030ADUP	Sample Duplicate				Run: SOIL HYDROMETER_131209			12/06/13 08:24	
Sand	68.0	%	1.0				1.5	20	
Silt	19.0	%	1.0				5.1	20	
Clay	13.0	%	1.0				0.0	20	
Texture	ND	%	1.0						
Sample ID: H13110098-036ADUP	Sample Duplicate				Run: SOIL HYDROMETER_131209			12/06/13 08:24	
Sand	46.0	%	1.0				4.3	20	
Silt	33.0	%	1.0				6.2	20	
Clay	21.0	%	1.0				0.0	20	
Texture	ND	%	1.0						
Sample ID: LCS-22721	Laboratory Control Sample				Run: SOIL HYDROMETER_131209			12/06/13 08:24	
Sand	36.0	%	1.0	106	70	130			
Silt	33.0	%	1.0	94	70	130			
Clay	31.0	%	1.0	100	70	130			
Sample ID: H13110098-010ADUP	Sample Duplicate				Run: SOIL HYDROMETER_131209			12/05/13 08:15	
Sand	72.0	%	1.0				1.4	20	
Silt	18.0	%	1.0				5.7	20	
Clay	10.0	%	1.0				0.0	20	
Texture	ND	%	1.0						
Sample ID: H13110098-020ADUP	Sample Duplicate				Run: SOIL HYDROMETER_131209			12/05/13 08:15	
Sand	46.0	%	1.0				0.0	20	
Silt	34.0	%	1.0				0.0	20	
Clay	20.0	%	1.0				0.0	20	
Texture	ND	%	1.0						
Sample ID: H13110098-027ADUP	Sample Duplicate				Run: SOIL HYDROMETER_131209			12/05/13 08:15	
Sand	58.0	%	1.0				0.0	20	
Silt	20.0	%	1.0				0.0	20	
Clay	22.0	%	1.0				0.0	20	
Texture	ND	%	1.0						

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/18/13

Project: Phytotoxicity Soil Samples **Work Order:** H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA24-5									Analytical Run: FIA202-HE_131115A
Sample ID: ICV	Initial Calibration Verification Standard							11/15/13 10:02	
Phosphorus, Olsen	5.0	mg/kg	1.0	99	90	110			
Sample ID: ICB	Initial Calibration Blank, Instrument Blank							11/15/13 10:06	
Phosphorus, Olsen	0.024	mg/kg	1.0		0	0			
Method: ASA24-5									Batch: 22437
Sample ID: LCS-22437	Laboratory Control Sample				Run: FIA202-HE_131115A			11/15/13 10:09	
Phosphorus, Olsen	46	mg/kg	1.0	103	70	130			
Sample ID: MB-22437	Method Blank				Run: FIA202-HE_131115A			11/15/13 10:10	
Phosphorus, Olsen	0.8	mg/kg	0.05						
Sample ID: H13110098-002AMS	Sample Matrix Spike				Run: FIA202-HE_131115A			11/15/13 10:12	
Phosphorus, Olsen	65	mg/kg	1.0	97	80	120			
Sample ID: H13110098-002AMSD	Sample Matrix Spike Duplicate				Run: FIA202-HE_131115A			11/15/13 10:13	
Phosphorus, Olsen	65	mg/kg	1.0	97	80	120	0.2	20	
Sample ID: H13110098-020ADUP	Sample Duplicate				Run: FIA202-HE_131115A			11/15/13 10:17	
Phosphorus, Olsen	5.0	mg/kg	1.0				6.5	30	
Sample ID: H13110098-036ADUP	Sample Duplicate				Run: FIA202-HE_131115A			11/15/13 10:23	
Phosphorus, Olsen	5.6	mg/kg	1.0				16	30	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Phytotoxicity Soil Samples

Report Date: 12/18/13
Work Order: H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA24-5									Analytical Run: FIA202-HE_131119B
Sample ID: ICV	Initial Calibration Verification Standard								11/19/13 16:26
Phosphorus	5.0	mg/kg	1.0	100	90	110			
Sample ID: ICB	Initial Calibration Blank, Instrument Blank								11/19/13 16:30
Phosphorus	0.012	mg/kg	1.0		0	0			
Sample ID: ICV	Initial Calibration Verification Standard								11/20/13 09:43
Phosphorus	4.9	mg/kg	1.0	98	90	110			
Sample ID: ICB	Initial Calibration Blank, Instrument Blank								11/20/13 09:47
Phosphorus	-0.00088	mg/kg	1.0		0	0			
Method: ASA24-5									Batch: 22495
Sample ID: MB-22495	Method Blank				Run: FIA202-HE_131119B				11/19/13 16:34
Phosphorus	ND	mg/kg	0.5						
Sample ID: H13110098-008AMS	Sample Matrix Spike				Run: FIA202-HE_131119B				11/19/13 16:42
Phosphorus	103	mg/kg	1.0	102	70	130			
Sample ID: H13110098-008AMSD	Sample Matrix Spike Duplicate				Run: FIA202-HE_131119B				11/19/13 16:43
Phosphorus	104	mg/kg	1.0	104	70	130			
Sample ID: H13110098-010ADUP	Sample Duplicate				Run: FIA202-HE_131119B				11/19/13 16:47
Phosphorus	5.1	mg/kg	1.0				1.7	30	
Sample ID: H13110098-023AMS	Sample Matrix Spike				Run: FIA202-HE_131119B				11/19/13 17:01
Phosphorus	79.7	mg/kg	1.0	97	70	130			
Sample ID: H13110098-023AMSD	Sample Matrix Spike Duplicate				Run: FIA202-HE_131119B				11/19/13 17:02
Phosphorus	80.3	mg/kg	1.0	99	70	130			
Sample ID: H13110098-031ADUP	Sample Duplicate				Run: FIA202-HE_131119B				11/19/13 17:09
Phosphorus	11.6	mg/kg	1.0				4.9	30	
Sample ID: H13110098-034AMS	Sample Matrix Spike				Run: FIA202-HE_131119B				11/19/13 17:13
Phosphorus	127	mg/kg	1.0	109	70	130			
Sample ID: H13110098-034AMSD	Sample Matrix Spike Duplicate				Run: FIA202-HE_131119B				11/19/13 17:14
Phosphorus	127	mg/kg	1.0	110	70	130			
Sample ID: LCS-22495	Laboratory Control Sample				Run: FIA202-HE_131119B				11/20/13 09:48
Phosphorus	98.3	mg/kg	2.0	98	80	120			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/18/13
Project: Phytotoxicity Soil Samples **Work Order:** H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA24-5.3									Analytical Run: FIA202-HE_131210A
Sample ID: ICV	Initial Calibration Verification Standard								12/10/13 13:44
Phosphate, Soluble	0.243	mg/kg	0.10	97	90	110			
Sample ID: CCV	Continuing Calibration Verification Standard								12/10/13 13:46
Phosphate, Soluble	0.0937	mg/kg	0.10	94	90	110			
Sample ID: CCV	Continuing Calibration Verification Standard								12/10/13 14:05
Phosphate, Soluble	0.0916	mg/kg	0.10	92	90	110			
Sample ID: CCV	Continuing Calibration Verification Standard								12/10/13 14:20
Phosphate, Soluble	0.0932	mg/kg	0.10	93	90	110			
Sample ID: CCV	Continuing Calibration Verification Standard								12/10/13 14:34
Phosphate, Soluble	0.0938	mg/kg	0.10	94	90	110			
Method: ASA24-5.3									Batch: 22694
Sample ID: MB-22694	Method Blank				Run: FIA202-HE_131210A				12/10/13 13:49
Phosphate, Soluble	ND	mg/kg	0.1						
Sample ID: LCS-22694	Laboratory Control Sample				Run: FIA202-HE_131210A				12/10/13 13:50
Phosphate, Soluble	0.336	mg/kg	0.10	90	70	130			
Sample ID: H13110098-007AMS	Sample Matrix Spike				Run: FIA202-HE_131210A				12/10/13 13:58
Phosphate, Soluble	3.72	mg/kg	1.0	112	70	130			
Sample ID: H13110098-007AMSD	Sample Matrix Spike Duplicate				Run: FIA202-HE_131210A				12/10/13 13:59
Phosphate, Soluble	3.59	mg/kg	1.0	108	70	130	3.7	30	
Sample ID: H13110098-010ADUP	Sample Duplicate				Run: FIA202-HE_131210A				12/10/13 14:03
Phosphate, Soluble	ND	mg/kg	0.20					30	
Sample ID: H13110098-011AMS	Sample Matrix Spike				Run: FIA202-HE_131210A				12/10/13 14:07
Phosphate, Soluble	3.99	mg/kg	1.0	120	70	130			
Sample ID: H13110098-011AMSD	Sample Matrix Spike Duplicate				Run: FIA202-HE_131210A				12/10/13 14:08
Phosphate, Soluble	3.90	mg/kg	1.0	118	70	130	2.2	30	
Sample ID: H13110098-020ADUP	Sample Duplicate				Run: FIA202-HE_131210A				12/10/13 14:19
Phosphate, Soluble	0.104	mg/kg	0.10				0.3	30	
Method: ASA24-5.3									Batch: 22695
Sample ID: MB-22695	Method Blank				Run: FIA202-HE_131210A				12/10/13 14:22
Phosphate, Soluble	ND	mg/kg	0.1						
Sample ID: LCS-22695	Laboratory Control Sample				Run: FIA202-HE_131210A				12/10/13 14:23
Phosphate, Soluble	0.359	mg/kg	0.20	96	70	130			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/18/13

Project: Phytotoxicity Soil Samples **Work Order:** H13110098

Analyte		Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA24-5.3										Batch: 22695
Sample ID: H13110098-021AMS	Sample Matrix Spike					Run: FIA202-HE_131210A				12/10/13 14:25
Phosphate, Soluble		3.97	mg/kg	1.0	120	70	130			
Sample ID: H13110098-021AMSD	Sample Matrix Spike Duplicate					Run: FIA202-HE_131210A				12/10/13 14:26
Phosphate, Soluble		3.99	mg/kg	1.0	120	70	130	0.5	30	
Sample ID: H13110098-030ADUP	Sample Duplicate					Run: FIA202-HE_131210A				12/10/13 14:38
Phosphate, Soluble		ND	mg/kg	0.10					30	
Sample ID: H13110098-034AMS	Sample Matrix Spike					Run: FIA202-HE_131210A				12/10/13 14:43
Phosphate, Soluble		4.12	mg/kg	1.0	124	70	130			
Sample ID: H13110098-034AMSD	Sample Matrix Spike Duplicate					Run: FIA202-HE_131210A				12/10/13 14:45
Phosphate, Soluble		4.19	mg/kg	1.0	126	70	130	1.8	30	
Sample ID: H13110098-036ADUP	Sample Duplicate					Run: FIA202-HE_131210A				12/10/13 14:48
Phosphate, Soluble		0.104	mg/kg	0.10					30	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Phytotoxicity Soil Samples

Report Date: 12/18/13
Work Order: H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA29-3									Batch: 22600
Sample ID: LCS-226001312020839	Laboratory Control Sample				Run: MISC SOILS_131201A				12/02/13 08:39
Organic Matter	1.43	%	0.17	104	70	130			
Sample ID: H13110098-010ADUP	Sample Duplicate				Run: MISC SOILS_131201A				12/02/13 08:39
Organic Matter	0.783	%	0.17						
Sample ID: H13110098-020ADUP	Sample Duplicate				Run: MISC SOILS_131201A				12/02/13 08:39
Organic Matter	2.50	%	0.17						
Method: ASA29-3									Batch: 22601
Sample ID: LCS-226011312020839	Laboratory Control Sample				Run: MISC SOILS_131201A				12/02/13 08:39
Organic Matter	1.34	%	0.17	98	70	130			
Sample ID: H13110098-030ADUP	Sample Duplicate				Run: MISC SOILS_131201A				12/02/13 08:39
Organic Matter	0.499	%	0.17						
Sample ID: H13110098-036ADUP	Sample Duplicate				Run: MISC SOILS_131201A				12/02/13 08:39
Organic Matter	2.03	%	0.17						

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/18/13
Project: Phytotoxicity Soil Samples **Work Order:** H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA33-8									Analytical Run: FIA203-HE_131203A
Sample ID: ICV	Initial Calibration Verification Standard								12/03/13 08:31
Nitrate as N, KCL Extract	1.0	mg/kg	1.0	104	90	110			
Sample ID: CCV	Continuing Calibration Verification Standard								12/03/13 08:33
Nitrate as N, KCL Extract	0.48	mg/kg	1.0	96	90	110			
Sample ID: ICB	Initial Calibration Blank, Instrument Blank								12/03/13 08:34
Nitrate as N, KCL Extract	-0.0096	mg/kg	1.0		0	0			
Sample ID: CCV	Continuing Calibration Verification Standard								12/03/13 08:56
Nitrate as N, KCL Extract	0.49	mg/kg	1.0	98	90	110			
Sample ID: CCV	Continuing Calibration Verification Standard								12/03/13 09:12
Nitrate as N, KCL Extract	0.49	mg/kg	1.0	99	90	110			
Sample ID: CCV	Continuing Calibration Verification Standard								12/03/13 09:30
Nitrate as N, KCL Extract	0.50	mg/kg	1.0	99	90	110			
Method: ASA33-8									Batch: 22662
Sample ID: LCS-22662	Laboratory Control Sample				Run: FIA203-HE_131203A				12/03/13 08:37
Nitrate as N, KCL Extract	3.6	mg/kg	2.0	113	70	130			
Sample ID: MB-22662	Method Blank				Run: FIA203-HE_131203A				12/03/13 08:38
Nitrate as N, KCL Extract	ND	mg/kg	0.1						
Sample ID: H13110098-003AMS	Sample Matrix Spike				Run: FIA203-HE_131203A				12/03/13 08:43
Nitrate as N, KCL Extract	19	mg/kg	5.5	103	80	120			
Sample ID: H13110098-003AMSD	Sample Matrix Spike Duplicate				Run: FIA203-HE_131203A				12/03/13 08:44
Nitrate as N, KCL Extract	19	mg/kg	5.5	104	80	120	0.5	30	
Sample ID: H13110098-010ADUP	Sample Duplicate				Run: FIA203-HE_131203A				12/03/13 08:54
Nitrate as N, KCL Extract	1.3	mg/kg	1.0				1.4	30	
Sample ID: H13110098-020ADUP	Sample Duplicate				Run: FIA203-HE_131203A				12/03/13 09:09
Nitrate as N, KCL Extract	1.7	mg/kg	1.0				0.9	30	
Method: ASA33-8									Batch: 22663
Sample ID: H13110098-023AMS	Sample Matrix Spike				Run: FIA203-HE_131203A				12/03/13 09:17
Nitrate as N, KCL Extract	4.0	mg/kg	1.1	105	80	120			
Sample ID: H13110098-023AMSD	Sample Matrix Spike Duplicate				Run: FIA203-HE_131203A				12/03/13 09:18
Nitrate as N, KCL Extract	4.0	mg/kg	1.1	105	80	120	0.1	30	
Sample ID: H13110098-030ADUP	Sample Duplicate				Run: FIA203-HE_131203A				12/03/13 09:27
Nitrate as N, KCL Extract	2.8	mg/kg	1.0				1.3	30	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/18/13
Project: Phytotoxicity Soil Samples **Work Order:** H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA33-8									Batch: 22663
Sample ID: H13110098-036ADUP	Sample Duplicate				Run: FIA203-HE_131203A				12/03/13 09:38
Nitrate as N, KCL Extract	1.5	mg/kg	1.0				6.1	30	
Sample ID: LCS-22663	Laboratory Control Sample				Run: FIA203-HE_131203A				12/03/13 09:39
Nitrate as N, KCL Extract	3.8	mg/kg	2.0	119	70	130			
Sample ID: MB-22663	Method Blank				Run: FIA203-HE_131203A				12/03/13 09:40
Nitrate as N, KCL Extract	ND	mg/kg	0.1						

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company

Project: Phytotoxicity Soil Samples

Report Date: 12/18/13

Work Order: H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASAM10-3									Analytical Run: SOIL EC_131113A
Sample ID: ICV_1_131112_1	Initial Calibration Verification Standard								11/13/13 10:25
Conductivity, sat. paste	20.0	mmhos/cm	0.10	100	90	110			
Sample ID: ICV_1_131112_1	Initial Calibration Verification Standard								11/13/13 10:35
Conductivity, sat. paste	19.9	mmhos/cm	0.10	100	90	110			
Sample ID: ICV_1_131111_1	Initial Calibration Verification Standard								11/12/13 13:49
Conductivity, sat. paste	20.0	mmhos/cm	0.10	100	90	110			
Sample ID: CCV_1_131111_1	Continuing Calibration Verification Standard								11/13/13 09:51
Conductivity, sat. paste	1.42	mmhos/cm	0.10	101	90	110			
Sample ID: CCV1_1_131111_1	Continuing Calibration Verification Standard								11/13/13 09:51
Conductivity, sat. paste	5.14	mmhos/cm	0.10	103	90	110			
Sample ID: ICV_1_131111_1	Initial Calibration Verification Standard								11/13/13 09:52
Conductivity, sat. paste	20.0	mmhos/cm	0.10	100	90	110			
Sample ID: CCV_3_131111_1	Continuing Calibration Verification Standard								11/13/13 10:00
Conductivity, sat. paste	1.44	mmhos/cm	0.10	102	90	110			
Sample ID: CCV_1_131111_1	Continuing Calibration Verification Standard								11/13/13 10:07
Conductivity, sat. paste	1.43	mmhos/cm	0.10	101	90	110			
Sample ID: CCV1_1_131111_1	Continuing Calibration Verification Standard								11/13/13 10:08
Conductivity, sat. paste	5.06	mmhos/cm	0.10	101	90	110			
Sample ID: ICV_1_131111_1	Initial Calibration Verification Standard								11/13/13 10:08
Conductivity, sat. paste	20.0	mmhos/cm	0.10	100	90	110			
Sample ID: CCV_3_131111_1	Continuing Calibration Verification Standard								11/13/13 10:18
Conductivity, sat. paste	1.41	mmhos/cm	0.10	100	90	110			
Sample ID: ICV_1_131111_1	Initial Calibration Verification Standard								11/12/13 13:33
Conductivity, sat. paste	20.5	mmhos/cm	0.10	102	90	110			
Method: ASAM10-3									Batch: 131111_1_COND-S-PASTE
Sample ID: LCS-22405	Laboratory Control Sample				Run: SOIL EC_131113A				11/12/13 13:51
Conductivity, sat. paste	5.57	mmhos/cm	0.10	92	80	120			
Sample ID: H13110098-010ADUP	Sample Duplicate				Run: SOIL EC_131113A				11/13/13 09:59
Conductivity, sat. paste	0.576	mmhos/cm	0.10				1.3	20	
Sample ID: H13110098-020ADUP	Sample Duplicate				Run: SOIL EC_131113A				11/13/13 10:06
Conductivity, sat. paste	0.532	mmhos/cm	0.10				1.0	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Phytotoxicity Soil Samples
Report Date: 12/18/13
Work Order: H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASAM10-3							Batch: 131111_1_COND-S-PASTE		
Sample ID: H13110098-030ADUP	Sample Duplicate				Run: SOIL EC_131113A			11/13/13 10:18	
Conductivity, sat. paste	1.02	mmhos/cm	0.10				1.3	20	
Sample ID: H13110098-036ADUP	Sample Duplicate				Run: SOIL EC_131113A			11/13/13 10:23	
Conductivity, sat. paste	0.479	mmhos/cm	0.10				2.0	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Phytotoxicity Soil Samples
Report Date: 12/18/13
Work Order: H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASAM10-3.2						Analytical Run: SOIL PH METER_131112A			
Sample ID: ICV_1_131111_1	Initial Calibration Verification Standard								11/12/13 08:30
pH, sat. paste	9.99	s.u.	0.10	100	99	101			
Sample ID: CCV_1_131111_1	Continuing Calibration Verification Standard								11/12/13 09:14
pH, sat. paste	7.03	s.u.	0.10	100	98.6	101.4			
Sample ID: CCV1_1_131111_1	Continuing Calibration Verification Standard								11/12/13 09:15
pH, sat. paste	4.01	s.u.	0.10	100	97.5	102.5			
Sample ID: ICV_1_131111_1	Initial Calibration Verification Standard								11/12/13 09:15
pH, sat. paste	10.0	s.u.	0.10	100	99	101			
Sample ID: CCV_3_131111_1	Continuing Calibration Verification Standard								11/12/13 09:23
pH, sat. paste	7.01	s.u.	0.10	100	98.6	101.4			
Sample ID: CCV_1_131111_1	Continuing Calibration Verification Standard								11/12/13 09:34
pH, sat. paste	7.01	s.u.	0.10	100	98.6	101.4			
Sample ID: CCV1_1_131111_1	Continuing Calibration Verification Standard								11/12/13 09:34
pH, sat. paste	4.02	s.u.	0.10	100	97.5	102.5			
Sample ID: ICV_1_131111_1	Initial Calibration Verification Standard								11/12/13 09:35
pH, sat. paste	10.0	s.u.	0.10	100	99	101			
Sample ID: CCV_3_131111_1	Continuing Calibration Verification Standard								11/12/13 09:43
pH, sat. paste	7.02	s.u.	0.10	100	98.6	101.4			
Sample ID: ICV_1_131111_1	Initial Calibration Verification Standard								11/12/13 08:02
pH, sat. paste	10.0	s.u.	0.10	100	99	101			
Method: ASAM10-3.2									Batch: 22413
Sample ID: LCS-22413	Laboratory Control Sample				Run: SOIL PH METER_131112A				11/12/13 09:16
pH, sat. paste	7.57	s.u.	0.10	99	95	105			
Sample ID: H13110098-010ADUP	Sample Duplicate				Run: SOIL PH METER_131112A				11/12/13 09:23
pH, sat. paste	4.85	s.u.	0.10				0.2	30	
Sample ID: H13110098-020ADUP	Sample Duplicate				Run: SOIL PH METER_131112A				11/12/13 09:30
pH, sat. paste	7.50	s.u.	0.10				0.0	30	
Method: ASAM10-3.2									Batch: 22414
Sample ID: LCS-22414	Laboratory Control Sample				Run: SOIL PH METER_131112A				11/12/13 09:35
pH, sat. paste	7.56	s.u.	0.10	99	95	105			
Sample ID: H13110098-030ADUP	Sample Duplicate				Run: SOIL PH METER_131112A				11/12/13 09:42
pH, sat. paste	3.70	s.u.	0.10				0.3	30	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/18/13
Project: Phytotoxicity Soil Samples **Work Order:** H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASAM10-3.2									Batch: 22414
Sample ID: H13110098-036ADUP	Sample Duplicate				Run: SOIL PH METER_131112A				11/12/13 09:47
pH, sat. paste	7.58	s.u.	0.10				0.3	30	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/18/13

Project: Phytotoxicity Soil Samples **Work Order:** H13110098

Method: **Calculation** Batch: R93628

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Sample ID: H13110098-010ADUP	Sample Duplicate				Run: MISC SOILS_131218A				11/19/13 13:06
Exchangeable Calcium	3.31	meq/100g	0.10				0.9	30	
Exchangeable Magnesium	0.650	meq/100g	0.10				3.1	30	
Exchangeable Potassium	0.230	meq/100g	0.10					30	
Exchangeable Sodium	0.0600	meq/100g	0.10					30	
Exchangeable Copper	109	meq/100g	0.10						
Sample ID: H13110098-020ADUP	Sample Duplicate				Run: MISC SOILS_131218A				11/19/13 13:06
Exchangeable Calcium	28.7	meq/100g	0.10				0.9	30	
Exchangeable Magnesium	1.07	meq/100g	0.10				0.0	30	
Exchangeable Potassium	0.500	meq/100g	0.10				2.0	30	
Exchangeable Sodium	0.0900	meq/100g	0.10					30	
Exchangeable Copper	1.75	meq/100g	0.10						
Sample ID: H13110098-030ADUP	Sample Duplicate				Run: MISC SOILS_131218A				11/19/13 13:06
Exchangeable Calcium	1.77	meq/100g	0.10				1.7	30	
Exchangeable Magnesium	0.290	meq/100g	0.10				0.0	30	
Exchangeable Potassium	0.150	meq/100g	0.10				0.0	30	
Exchangeable Sodium	0.0400	meq/100g	0.10					30	
Exchangeable Copper	3.88	meq/100g	0.10						
Sample ID: H13110098-036ADUP	Sample Duplicate				Run: MISC SOILS_131218A				11/19/13 13:06
Exchangeable Calcium	27.6	meq/100g	0.10				0.8	30	
Exchangeable Magnesium	1.01	meq/100g	0.10				1.0	30	
Exchangeable Potassium	0.600	meq/100g	0.10				0.0	30	
Exchangeable Sodium	0.0500	meq/100g	0.10					30	
Exchangeable Copper	8.96	meq/100g	0.10						

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Phytotoxicity Soil Samples

Report Date: 12/18/13
Work Order: H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **D2974**								Batch: R92803	
Sample ID: **H13110098-010ADUP**	Sample Duplicate				Run: SOIL DRYING OVEN 2_13110			11/14/13 11:44	
Moisture (As Received)	3.52	wt%	0.20				2.0	20	
Sample ID: **H13110098-020ADUP**	Sample Duplicate				Run: SOIL DRYING OVEN 2_13110			11/14/13 11:44	
Moisture (As Received)	5.38	wt%	0.20				0.9	20	
Sample ID: **H13110098-030ADUP**	Sample Duplicate				Run: SOIL DRYING OVEN 2_13110			11/14/13 11:44	
Moisture (As Received)	2.15	wt%	0.20				1.5	20	
Sample ID: **H13110098-036ADUP**	Sample Duplicate				Run: SOIL DRYING OVEN 2_13110			11/14/13 11:44	
Moisture (As Received)	4.41	wt%	0.20				15	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Phytotoxicity Soil Samples
Report Date: 12/18/13
Work Order: H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **E200.7**									Analytical Run: ICP2-HE_131112A
Sample ID: **ICV**	Initial Calibration Verification Standard								11/12/13 08:20
Copper	0.791	mg/L	0.010	99	90	110			
Sample ID: **ICSA**	Interference Check Sample A								11/12/13 08:35
Copper	0.00165	mg/L	0.010		0	0			
Sample ID: **ICSAB**	Interference Check Sample AB								11/12/13 08:39
Copper	0.482	mg/L	0.010	96	80	120			
Method: **E200.7**									Analytical Run: ICP2-HE_131122C
Sample ID: **ICV**	Initial Calibration Verification Standard								11/22/13 11:01
Calcium	39.5	mg/L	1.0	99	90	110			
Magnesium	40.1	mg/L	1.0	100	90	110			
Potassium	40.4	mg/L	1.0	101	90	110			
Sodium	40.5	mg/L	1.0	101	90	110			
Sample ID: **ICSA**	Interference Check Sample A								11/22/13 11:15
Calcium	467	mg/L	1.0	93	80	120			
Magnesium	519	mg/L	1.0	104	80	120			
Potassium	-0.127	mg/L	1.0		0	0			
Sodium	0.0276	mg/L	1.0		0	0			
Sample ID: **ICSAB**	Interference Check Sample AB								11/22/13 11:19
Calcium	459	mg/L	1.0	92	80	120			
Magnesium	504	mg/L	1.0	101	80	120			
Potassium	23.7	mg/L	1.0	118	80	120			
Sodium	23.8	mg/L	1.0	119	80	120			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/18/13
Project: Phytotoxicity Soil Samples **Work Order:** H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **E200.7**									Analytical Run: ICP2-HE_131125B
Sample ID: **ICV**	Initial Calibration Verification Standard								11/25/13 14:39
Calcium	40.9	mg/L	1.0	102	95	105			
Copper	0.802	mg/L	0.010	100	95	105			
Magnesium	41.9	mg/L	1.0	105	95	105			
Potassium	40.6	mg/L	1.0	102	95	105			
Sodium	40.5	mg/L	1.0	101	95	105			
Sample ID: **ICSA**	Interference Check Sample A								11/25/13 14:53
Calcium	493	mg/L	1.0	99	80	120			
Copper	0.00223	mg/L	0.010		0	0			
Magnesium	554	mg/L	1.0	111	80	120			
Potassium	-0.141	mg/L	1.0		0	0			
Sodium	-0.0108	mg/L	1.0		0	0			
Sample ID: **ICSAB**	Interference Check Sample AB								11/25/13 15:16
Calcium	437	mg/L	1.0	87	80	120			
Copper	0.462	mg/L	0.010	93	80	120			
Magnesium	482	mg/L	1.0	96	80	120			
Potassium	21.7	mg/L	1.0	109	80	120			
Sodium	21.7	mg/L	1.0	109	80	120			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Phytotoxicity Soil Samples

Report Date: 12/18/13
Work Order: H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **E200.7**									Analytical Run: ICP2-HE_131127A
Sample ID: **ICV**	Initial Calibration Verification Standard								11/27/13 12:30
Aluminum	4.07	mg/L	0.10	102	95	105			
Copper	0.809	mg/L	0.010	101	95	105			
Iron	3.96	mg/L	0.030	99	95	105			
Manganese	4.02	mg/L	0.010	100	95	105			
Sodium	39.1	mg/L	1.0	98	95	105			
Sample ID: **ICSA**	Interference Check Sample A								11/27/13 12:45
Aluminum	518	mg/L	0.10	104	80	120			
Copper	0.0103	mg/L	0.010		0	0			
Iron	180	mg/L	0.030	90	80	120			
Manganese	0.00596	mg/L	0.010		0	0			
Sodium	0.0415	mg/L	1.0		0	0			
Sample ID: **ICSAB**	Interference Check Sample AB								11/27/13 12:49
Aluminum	466	mg/L	0.10	93	80	120			
Copper	0.462	mg/L	0.010	92	80	120			
Iron	166	mg/L	0.030	83	80	120			
Manganese	0.437	mg/L	0.010	87	80	120			
Sodium	20.6	mg/L	1.0	103	80	120			
Sample ID: **ICSAB**	Interference Check Sample AB								11/27/13 13:04
Aluminum	477	mg/L	0.10	95	80	120			
Copper	0.473	mg/L	0.010	95	80	120			
Iron	167	mg/L	0.030	83	80	120			
Manganese	0.445	mg/L	0.010	89	80	120			
Sodium	21.0	mg/L	1.0	105	80	120			
Method: **E200.7**									Analytical Run: ICP2-HE_131218A
Sample ID: **ICV**	Initial Calibration Verification Standard								12/18/13 10:44
Copper	0.803	mg/L	0.010	100	95	105			
Sample ID: **ICSA**	Interference Check Sample A								12/18/13 10:58
Copper	0.000530	mg/L	0.010		0	0			
Sample ID: **ICSAB**	Interference Check Sample AB								12/18/13 11:02
Copper	0.517	mg/L	0.010	103	80	120			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/18/13
Project: Phytotoxicity Soil Samples **Work Order:** H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E300.0									Analytical Run: IC102-H_131114A
Sample ID: ICV	Initial Calibration Verification Standard								11/14/13 11:44
Chloride	110	mg/L	1.0	106	90	110			
Sulfate	420	mg/L	1.0	106	90	110			
Fluoride	53	mg/L	0.10	106	90	110			
Sample ID: CCV111413-1	Continuing Calibration Verification Standard								11/14/13 12:34
Chloride	100	mg/L	1.0	105	90	110			
Sulfate	420	mg/L	1.0	106	90	110			
Fluoride	53	mg/L	0.10	105	90	110			
Sample ID: CCV111413-3	Continuing Calibration Verification Standard								11/14/13 18:14
Chloride	100	mg/L	1.0	105	90	110			
Sulfate	420	mg/L	1.0	105	90	110			
Fluoride	54	mg/L	0.10	108	90	110			
Sample ID: CCV111413-4	Continuing Calibration Verification Standard								11/14/13 21:36
Chloride	100	mg/L	1.0	104	90	110			
Sulfate	420	mg/L	1.0	105	90	110			
Fluoride	53	mg/L	0.10	106	90	110			
Method: E300.0									Batch: 22413
Sample ID: MB-22413	Method Blank				Run: IC102-H_131114A				11/14/13 18:40
Chloride	ND	mg/L	0.008						
Sulfate	ND	mg/L	0.08						
Fluoride	ND	mg/L	0.002						
Sample ID: LCS-22413	Laboratory Control Sample				Run: IC102-H_131114A				11/14/13 18:52
Chloride	100	mg/L	5.0	100	80	120			
Sulfate	2500	mg/L	2.0	86	80	120			
Sample ID: H13110098-010ADUP	Sample Duplicate				Run: IC102-H_131114A				11/14/13 21:11
Fluoride	ND	mg/L	2.0					20	
Sulfate, sat. paste	4.55	meq/L	0.42				9.1	20	
Chloride, sat. paste	0.258	meq/L	0.14				1.7	20	
Sample ID: H13110098-010AMS	Sample Matrix Spike				Run: IC102-H_131114A				11/14/13 21:23
Fluoride	513	mg/L	2.3	103	90	110			
Sulfate, sat. paste	88.4	meq/L	0.47	101	90	110			
Chloride, sat. paste	28.4	meq/L	0.16	99	90	110			
Sample ID: H13110098-020ADUP	Sample Duplicate				Run: IC102-H_131114A				11/15/13 00:07
Fluoride	0.221	mg/L	2.0					20	
Sulfate, sat. paste	0.445	meq/L	0.42					20	
Chloride, sat. paste	0.817	meq/L	0.14				7.9	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/18/13

Project: Phytotoxicity Soil Samples **Work Order:** H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E300.0									Batch: 22413
Sample ID: H13110098-020AMS	Sample Matrix Spike				Run: IC102-H_131114A				11/15/13 00:20
Fluoride	511	mg/L	2.3	102	90	110			
Sulfate, sat. paste	84.2	meq/L	0.47	101	90	110			
Chloride, sat. paste	28.8	meq/L	0.16	98	90	110			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Report Date: 12/18/13
Project: Phytotoxicity Soil Samples
Work Order: H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E300.0									Analytical Run: IC102-H_131122A
Sample ID: ICV	Initial Calibration Verification Standard								11/22/13 16:38
Chloride	100	mg/L	1.0	100	90	110			
Sulfate	400	mg/L	1.0	100	90	110			
Fluoride	50	mg/L	0.10	101	90	110			
Sample ID: CCV112013-1	Continuing Calibration Verification Standard								11/22/13 20:24
Chloride	110	mg/L	1.0	106	90	110			
Sulfate	430	mg/L	1.0	107	90	110			
Fluoride	53	mg/L	0.10	107	90	110			
Sample ID: ICV	Initial Calibration Verification Standard								11/24/13 11:30
Chloride	110	mg/L	1.0	107	90	110			
Sulfate	420	mg/L	1.0	106	90	110			
Fluoride	54	mg/L	0.10	108	90	110			
Method: E300.0									Batch: 22414
Sample ID: MB-22414	Method Blank				Run: IC102-H_131122A				11/22/13 17:28
Fluoride	ND	mg/L	0.002						
Sulfate, sat. paste	ND	meq/L	0.002						
Chloride, sat. paste	0.0005	meq/L	0.0002						
Sample ID: LCS-22414	Laboratory Control Sample				Run: IC102-H_131122A				11/22/13 17:41
Sulfate, sat. paste	50.8	meq/L	0.42	85	80	120			
Chloride, sat. paste	2.89	meq/L	0.14	95	80	120			
Sample ID: H13110098-030AMS	Sample Matrix Spike				Run: IC102-H_131122A				11/22/13 19:59
Fluoride	520	mg/L	2.3	104	90	110			
Sulfate, sat. paste	93.9	meq/L	0.47	102	90	110			
Chloride, sat. paste	29.2	meq/L	0.16	101	90	110			
Sample ID: H13110098-030ADUP	Sample Duplicate				Run: IC102-H_131122A				11/22/13 20:12
Fluoride	0.638	mg/L	2.0					20	
Sulfate, sat. paste	8.24	meq/L	0.42				5.2	20	
Chloride, sat. paste	0.319	meq/L	0.14				12	20	
Sample ID: H13110098-036AMS	Sample Matrix Spike				Run: IC102-H_131122A				11/22/13 22:05
Fluoride	530	mg/L	2.3	106	90	110			
Sulfate, sat. paste	89.0	meq/L	0.47	102	90	110			
Chloride, sat. paste	30.3	meq/L	0.16	104	90	110			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/18/13

Project: Phytotoxicity Soil Samples **Work Order:** H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B									Batch: 22389
Sample ID: MB-22389	Method Blank				Run: ICP2-HE_131112A				11/12/13 08:54
Copper	ND	mg/kg	0.3						
Sample ID: LFB-22389	Laboratory Fortified Blank				Run: ICP2-HE_131112A				11/12/13 08:58
Copper	46.3	mg/kg	1.0	93	80	120			
Sample ID: LCS-22389	Laboratory Control Sample				Run: ICP2-HE_131112A				11/12/13 09:02
Copper	250	mg/kg	1.3	89	77.5	109.6			
Sample ID: H13110098-018AMS	Sample Matrix Spike				Run: ICP2-HE_131112A				11/12/13 10:33
Copper	352	mg/kg	1.3		75	125			A
Sample ID: H13110098-018AMSD	Sample Matrix Spike Duplicate				Run: ICP2-HE_131112A				11/12/13 10:44
Copper	332	mg/kg	1.3		75	125	5.9	20	A
Method: SW6010B									Batch: 22390
Sample ID: MB-22390	Method Blank				Run: ICP2-HE_131112A				11/12/13 10:47
Copper	ND	mg/kg	0.3						
Sample ID: LFB-22390	Laboratory Fortified Blank				Run: ICP2-HE_131112A				11/12/13 10:51
Copper	43.2	mg/kg	1.0	86	80	120			
Sample ID: LCS-22390	Laboratory Control Sample				Run: ICP2-HE_131112A				11/12/13 10:55
Copper	251	mg/kg	1.3	90	77.5	109.6			
Sample ID: H13110098-036AMS	Sample Matrix Spike				Run: ICP2-HE_131112A				11/12/13 12:53
Copper	212	mg/kg	1.3	77	75	125			
Sample ID: H13110098-036AMSD	Sample Matrix Spike Duplicate				Run: ICP2-HE_131112A				11/12/13 12:57
Copper	211	mg/kg	1.3	74	75	125	0.7	20	S

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.

S - Spike recovery outside of advisory limits.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/18/13

Project: Phytotoxicity Soil Samples **Work Order:** H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B									Batch: 22413
Sample ID: MB-22413	Method Blank				Run: ICP2-HE_131122C				11/22/13 16:13
Calcium	0.05	mg/L	0.03						
Magnesium	ND	mg/L	0.02						
Potassium	ND	mg/L	0.03						
Sodium	ND	mg/L	0.03						
Calcium, sat. paste	0.003	meq/L	0.001						
Magnesium, sat. paste	ND	meq/L	0.001						
Potassium, sat. paste	ND	meq/L	0.0007						
Sodium, sat. paste	ND	meq/L	0.001						
Sample ID: LCS-22413	Laboratory Control Sample				Run: ICP2-HE_131122C				11/22/13 16:17
Calcium	385	mg/L	1.0	93	70	130			
Magnesium	127	mg/L	1.0	93	70	130			
Potassium	12.7	mg/L	1.0	97	70	130			
Sodium	672	mg/L	1.0	93	70	130			
Calcium, sat. paste	19.2	meq/L	0.050	93	70	130			
Magnesium, sat. paste	10.5	meq/L	0.082	93	70	130			
Potassium, sat. paste	0.324	meq/L	0.026	97	70	130			
Sodium, sat. paste	29.2	meq/L	0.043	93	70	130			
Sample ID: H13110098-007AMS2	Sample Matrix Spike				Run: ICP2-HE_131122C				11/22/13 16:58
Calcium	593	mg/L	1.0		70	130			A
Magnesium	150	mg/L	1.0	101	70	130			
Potassium	104	mg/L	1.0	100	70	130			
Sodium	119	mg/L	1.0	100	70	130			
Calcium, sat. paste	29.6	meq/L	0.050		70	130			A
Magnesium, sat. paste	12.4	meq/L	0.082	101	70	130			
Potassium, sat. paste	2.67	meq/L	0.026	100	70	130			
Sodium, sat. paste	5.17	meq/L	0.043	100	70	130			
Sample ID: H13110098-007AMSD2	Sample Matrix Spike Duplicate				Run: ICP2-HE_131122C				11/22/13 17:02
Calcium	592	mg/L	1.0		70	130	0.2	20	A
Magnesium	152	mg/L	1.0	102	70	130	0.9	20	
Potassium	107	mg/L	1.0	103	70	130	2.5	20	
Sodium	122	mg/L	1.0	103	70	130	2.5	20	
Calcium, sat. paste	29.5	meq/L	0.050		70	130	0.2	20	A
Magnesium, sat. paste	12.5	meq/L	0.082	102	70	130	0.9	20	
Potassium, sat. paste	2.74	meq/L	0.026	103	70	130	2.5	20	
Sodium, sat. paste	5.30	meq/L	0.043	103	70	130	2.5	20	
Sample ID: H13110098-010Adup	Sample Duplicate				Run: ICP2-HE_131122C				11/22/13 17:16
Calcium	63.9	mg/L	1.0				11	30	
Magnesium	9.55	mg/L	1.0				11	30	
Potassium	7.51	mg/L	1.0				8.1	30	
Sodium	19.4	mg/L	1.0				4.5	30	

Qualifiers:

RL - Analyte reporting limit.

A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/18/13
Project: Phytotoxicity Soil Samples **Work Order:** H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B									Batch: 22413
Sample ID: H13110098-010Adup	Sample Duplicate				Run: ICP2-HE_131122C				11/22/13 17:16
Calcium, sat. paste	3.19	meq/L	0.050				11	30	
Magnesium, sat. paste	0.786	meq/L	0.082				11	30	
Potassium, sat. paste	0.192	meq/L	0.026				8.1	30	
Sodium, sat. paste	0.842	meq/L	0.043				4.5	30	
Sample ID: H13110098-020Adup	Sample Duplicate				Run: ICP2-HE_131122C				11/22/13 18:05
Calcium	79.7	mg/L	1.0				7.9	30	
Magnesium	4.36	mg/L	1.0				1.6	30	
Potassium	3.45	mg/L	1.0				1.8	30	
Sodium	23.0	mg/L	1.0				6.7	30	
Calcium, sat. paste	3.98	meq/L	0.050				7.9	30	
Magnesium, sat. paste	0.359	meq/L	0.082				1.6	30	
Potassium, sat. paste	0.0882	meq/L	0.026				1.8	30	
Sodium, sat. paste	1.000	meq/L	0.043				6.7	30	
Method: SW6010B									Batch: 22414
Sample ID: MB-22414	Method Blank				Run: ICP2-HE_131122C				11/22/13 18:13
Calcium	0.04	mg/L	0.03						
Magnesium	ND	mg/L	0.02						
Potassium	ND	mg/L	0.03						
Sodium	ND	mg/L	0.03						
Calcium, sat. paste	0.002	meq/L	0.001						
Magnesium, sat. paste	ND	meq/L	0.001						
Potassium, sat. paste	ND	meq/L	0.0007						
Sodium, sat. paste	ND	meq/L	0.001						
Sample ID: LCS-22414	Laboratory Control Sample				Run: ICP2-HE_131122C				11/22/13 18:24
Calcium	361	mg/L	1.0	87	70	130			
Magnesium	118	mg/L	1.0	86	70	130			
Potassium	12.5	mg/L	1.0	96	70	130			
Sodium	664	mg/L	1.0	92	70	130			
Calcium, sat. paste	18.0	meq/L	0.050	87	70	130			
Magnesium, sat. paste	9.71	meq/L	0.082	86	70	130			
Potassium, sat. paste	0.321	meq/L	0.026	96	70	130			
Sodium, sat. paste	28.9	meq/L	0.043	92	70	130			
Sample ID: H13110098-030Adup	Sample Duplicate				Run: ICP2-HE_131122C				11/22/13 19:39
Calcium	115	mg/L	1.0				1.0	30	
Magnesium	11.2	mg/L	1.0				2.1	30	
Potassium	10.3	mg/L	1.0				2.7	30	
Sodium	13.9	mg/L	1.0				1.3	30	
Calcium, sat. paste	5.74	meq/L	0.050				1.0	30	
Magnesium, sat. paste	0.922	meq/L	0.082				2.1	30	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/18/13
Project: Phytotoxicity Soil Samples **Work Order:** H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B								Batch: 22414	
Sample ID: H13110098-030Adup	Sample Duplicate				Run: ICP2-HE_131122C			11/22/13 19:39	
Potassium, sat. paste	0.264	meq/L	0.026				2.7	30	
Sodium, sat. paste	0.606	meq/L	0.043				1.3	30	
Sample ID: H13110098-035AMS2	Sample Matrix Spike				Run: ICP2-HE_131122C			11/22/13 20:05	
Calcium	807	mg/L	1.0	89	70	130			
Magnesium	972	mg/L	1.0	91	70	130			
Potassium	500	mg/L	1.0	100	70	130			
Sodium	530	mg/L	1.0	100	70	130			
Calcium, sat. paste	40.3	meq/L	0.050	89	70	130			
Magnesium, sat. paste	80.0	meq/L	0.082	91	70	130			
Potassium, sat. paste	12.8	meq/L	0.026	100	70	130			
Sodium, sat. paste	23.0	meq/L	0.043	100	70	130			
Sample ID: H13110098-035AMSD2	Sample Matrix Spike Duplicate				Run: ICP2-HE_131122C			11/22/13 20:09	
Calcium	800	mg/L	1.0	88	70	130	0.8	20	
Magnesium	964	mg/L	1.0	89	70	130	0.9	20	
Potassium	489	mg/L	1.0	98	70	130	2.3	20	
Sodium	519	mg/L	1.0	98	70	130	2.1	20	
Calcium, sat. paste	39.9	meq/L	0.050	88	70	130	0.8	20	
Magnesium, sat. paste	79.3	meq/L	0.082	89	70	130	0.9	20	
Potassium, sat. paste	12.5	meq/L	0.026	98	70	130	2.3	20	
Sodium, sat. paste	22.6	meq/L	0.043	98	70	130	2.1	20	
Sample ID: H13110098-036Adup	Sample Duplicate				Run: ICP2-HE_131122C			11/22/13 20:24	
Calcium	73.3	mg/L	1.0				0.8	30	
Magnesium	4.17	mg/L	1.0				8.3	30	
Potassium	4.99	mg/L	1.0				0.9	30	
Sodium	8.48	mg/L	1.0				0.3	30	
Calcium, sat. paste	3.66	meq/L	0.050				0.8	30	
Magnesium, sat. paste	0.343	meq/L	0.082				8.3	30	
Potassium, sat. paste	0.128	meq/L	0.026				0.9	30	
Sodium, sat. paste	0.369	meq/L	0.043				0.3	30	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/18/13

Project: Phytotoxicity Soil Samples **Work Order:** H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B									Batch: 22591
Sample ID: MB-22591	Method Blank				Run: ICP2-HE_131125B				11/25/13 15:50
Calcium	10	mg/kg	0.1						
Copper	0.6	mg/kg	0.007						
Magnesium	2	mg/kg	0.03						
Sodium	1	mg/kg	0.6						
Potassium	0.4	mg/kg	0.3						
Calcium, Extractable	0.05	meq/100g	0.0006						
Magnesium, Extractable	0.02	meq/100g	0.0003						
Potassium, Extractable	0.0010	meq/100g	0.0009						
Sodium, Extractable	0.005	meq/100g	0.003						
Sample ID: LCS-22591	Laboratory Control Sample				Run: ICP2-HE_131125B				11/25/13 15:54
Calcium	6040	mg/kg	1.0	116	70	130			
Magnesium	780	mg/kg	1.0	119	70	130			
Sodium	829	mg/kg	1.0	106	70	130			
Potassium	218	mg/kg	1.0	103	70	130			
Calcium, Extractable	30.1	meq/100g	0.0050	116	70	130			
Magnesium, Extractable	6.48	meq/100g	0.0083	119	70	130			
Potassium, Extractable	0.558	meq/100g	0.0026	103	70	130			
Sodium, Extractable	3.61	meq/100g	0.0044	106	70	130			
Sample ID: H13110098-001AMS2	Sample Matrix Spike				Run: ICP2-HE_131125B				11/25/13 16:05
Calcium	6380	mg/kg	1.0	104	75	125			
Copper	333	mg/kg	1.0	106	75	125			
Magnesium	5550	mg/kg	1.0	108	75	125			
Sodium	5140	mg/kg	1.0	102	75	125			
Potassium	5340	mg/kg	1.0	103	75	125			
Calcium, Extractable	31.9	meq/100g	0.0050	104	75	125			
Magnesium, Extractable	46.1	meq/100g	0.0083	109	75	125			
Potassium, Extractable	13.7	meq/100g	0.0026	103	75	125			
Sodium, Extractable	22.3	meq/100g	0.0044	102	75	125			
Sample ID: H13110098-001AMSD2	Sample Matrix Spike Duplicate				Run: ICP2-HE_131125B				11/25/13 16:08
Calcium	6230	mg/kg	1.0	101	75	125	2.4	20	
Copper	337	mg/kg	1.0	110	75	125	1.3	20	
Magnesium	5190	mg/kg	1.0	100	75	125	6.7	20	
Sodium	5120	mg/kg	1.0	102	75	125	0.3	20	
Potassium	5230	mg/kg	1.0	101	75	125	2.0	20	
Calcium, Extractable	31.1	meq/100g	0.0050	101	75	125	2.4	20	
Magnesium, Extractable	43.0	meq/100g	0.0083	101	75	125	6.7	20	
Potassium, Extractable	13.4	meq/100g	0.0026	101	75	125	2.0	20	
Sodium, Extractable	22.3	meq/100g	0.0044	102	75	125	0.3	20	
Sample ID: H13110098-010ADUP	Sample Duplicate				Run: ICP2-HE_131125B				11/25/13 16:53
Calcium	680	mg/kg	1.0				1.3	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/18/13

Project: Phytotoxicity Soil Samples **Work Order:** H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B									Batch: 22591
Sample ID: H13110098-010ADUP	Sample Duplicate				Run: ICP2-HE_131125B				11/25/13 16:53
Copper	109	mg/kg	1.0				0.3	20	
Magnesium	81.0	mg/kg	1.0				3.2	20	
Sodium	17.3	mg/kg	1.0				9.5	20	
Potassium	91.2	mg/kg	1.0				0.0	20	
Calcium, Extractable	3.39	meq/100g	0.0050				1.3	20	
Magnesium, Extractable	0.672	meq/100g	0.0083				3.2	20	
Potassium, Extractable	0.234	meq/100g	0.0026					20	
Sodium, Extractable	0.0750	meq/100g	0.0044				9.5	20	
Sample ID: H13110098-011AMS2	Sample Matrix Spike				Run: ICP2-HE_131125B				11/25/13 17:12
Calcium	5250	mg/kg	1.0	101	75	125			
Copper	113	mg/kg	1.0	102	75	125			
Magnesium	5150	mg/kg	1.0	103	75	125			
Sodium	5000	mg/kg	1.0	100	75	125			
Potassium	5030	mg/kg	1.0	99	75	125			
Calcium, Extractable	26.2	meq/100g	0.0050	101	75	125			
Magnesium, Extractable	42.8	meq/100g	0.0083	104	75	125			
Potassium, Extractable	12.9	meq/100g	0.0026	99	75	125			
Sodium, Extractable	21.8	meq/100g	0.0044	100	75	125			
Sample ID: H13110098-011AMSD2	Sample Matrix Spike Duplicate				Run: ICP2-HE_131125B				11/25/13 17:15
Calcium	5160	mg/kg	1.0	100	75	125	1.6	20	
Copper	111	mg/kg	1.0	100	75	125	1.9	20	
Magnesium	5020	mg/kg	1.0	100	75	125	2.7	20	
Sodium	5020	mg/kg	1.0	100	75	125	0.4	20	
Potassium	5050	mg/kg	1.0	100	75	125	0.6	20	
Calcium, Extractable	25.8	meq/100g	0.0050	100	75	125	1.6	20	
Magnesium, Extractable	41.6	meq/100g	0.0083	101	75	125	2.7	20	
Potassium, Extractable	12.9	meq/100g	0.0026	100	75	125	0.6	20	
Sodium, Extractable	21.9	meq/100g	0.0044	100	75	125	0.4	20	
Sample ID: H13110098-020ADUP	Sample Duplicate				Run: ICP2-HE_131125B				11/25/13 18:00
Calcium	5830	mg/kg	1.0				1.9	20	
Copper	1.72	mg/kg	1.0				0.6	20	
Magnesium	132	mg/kg	1.0				2.2	20	
Sodium	33.3	mg/kg	1.0				3.1	20	
Potassium	190	mg/kg	1.0				2.7	20	
Calcium, Extractable	29.1	meq/100g	0.0050				1.9	20	
Magnesium, Extractable	1.10	meq/100g	0.0083				2.2	20	
Potassium, Extractable	0.487	meq/100g	0.0026				2.7	20	
Sodium, Extractable	0.145	meq/100g	0.0044				3.1	20	
Method: SW6010B									Batch: 22592

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Report Date: 12/18/13
Project: Phytotoxicity Soil Samples
Work Order: H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B									Batch: 22592
Sample ID: MB-22592	Method Blank				Run: ICP2-HE_131125B				11/25/13 18:08
Calcium	10	mg/kg	0.1						
Copper	0.06	mg/kg	0.007						
Magnesium	3	mg/kg	0.03						
Sodium	2	mg/kg	0.05						
Potassium	ND	mg/kg	0.06						
Calcium, Extractable	0.05	meq/100g	0.0006						
Magnesium, Extractable	0.02	meq/100g	0.0003						
Potassium, Extractable	ND	meq/100g	0.0001						
Sodium, Extractable	0.01	meq/100g	0.0002						
Sample ID: LCS-22592	Laboratory Control Sample				Run: ICP2-HE_131125B				11/25/13 18:12
Calcium	6090	mg/kg	1.0	117	70	130			
Magnesium	787	mg/kg	1.0	120	70	130			
Sodium	843	mg/kg	1.0	108	70	130			
Potassium	224	mg/kg	1.0	106	70	130			
Calcium, Extractable	30.4	meq/100g	0.0050	117	70	130			
Magnesium, Extractable	6.53	meq/100g	0.0083	120	70	130			
Potassium, Extractable	0.573	meq/100g	0.0026	106	70	130			
Sodium, Extractable	3.67	meq/100g	0.0044	108	70	130			
Sample ID: H13110098-021AMS2	Sample Matrix Spike				Run: ICP2-HE_131125B				11/25/13 18:23
Calcium	5410	mg/kg	1.0	100	75	125			
Copper	105	mg/kg	1.0	102	75	125			
Magnesium	5070	mg/kg	1.0	100	75	125			
Sodium	5000	mg/kg	1.0	100	75	125			
Potassium	5040	mg/kg	1.0	99	75	125			
Calcium, Extractable	27.0	meq/100g	0.0050	100	75	125			
Magnesium, Extractable	42.1	meq/100g	0.0083	101	75	125			
Potassium, Extractable	12.9	meq/100g	0.0026	99	75	125			
Sodium, Extractable	21.7	meq/100g	0.0044	100	75	125			
Sample ID: H13110098-030ADUP	Sample Duplicate				Run: ICP2-HE_131125B				11/25/13 19:45
Calcium	366	mg/kg	1.0				2.7	20	
Copper	4.37	mg/kg	1.0				3.1	20	
Magnesium	39.3	mg/kg	1.0				4.4	20	
Potassium	58.8	mg/kg	1.0				3.5	20	
Calcium, Extractable	1.83	meq/100g	0.0050				2.7	20	
Magnesium, Extractable	0.326	meq/100g	0.0083				4.4	20	
Potassium, Extractable	0.151	meq/100g	0.0026				3.5	20	
Sample ID: H13110098-031AMS2	Sample Matrix Spike				Run: ICP2-HE_131125B				11/25/13 19:57
Calcium	9150	mg/kg	1.0	97	75	125			
Copper	109	mg/kg	1.0	102	75	125			
Magnesium	5550	mg/kg	1.0	95	75	125			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/18/13
Project: Phytotoxicity Soil Samples **Work Order:** H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B									Batch: 22592
Sample ID: H13110098-031AMS2	Sample Matrix Spike				Run: ICP2-HE_131125B				11/25/13 19:57
Sodium	5070	mg/kg	1.0	99	75	125			
Potassium	5140	mg/kg	1.0	97	75	125			
Calcium, Extractable	45.7	meq/100g	0.0050	97	75	125			
Magnesium, Extractable	46.1	meq/100g	0.0083	96	75	125			
Potassium, Extractable	13.2	meq/100g	0.0026	97	75	125			
Sodium, Extractable	22.0	meq/100g	0.0044	99	75	125			
Sample ID: H13110098-031AMSD2	Sample Matrix Spike Duplicate				Run: ICP2-HE_131125B				11/25/13 20:00
Calcium	9240	mg/kg	1.0	99	75	125	0.9	20	
Copper	109	mg/kg	1.0	102	75	125	0.2	20	
Magnesium	5610	mg/kg	1.0	96	75	125	0.9	20	
Sodium	5090	mg/kg	1.0	99	75	125	0.4	20	
Potassium	5160	mg/kg	1.0	97	75	125	0.4	20	
Calcium, Extractable	46.1	meq/100g	0.0050	99	75	125	0.9	20	
Magnesium, Extractable	46.5	meq/100g	0.0083	97	75	125	0.9	20	
Potassium, Extractable	13.2	meq/100g	0.0026	97	75	125	0.4	20	
Sodium, Extractable	22.1	meq/100g	0.0044	99	75	125	0.4	20	
Sample ID: H13110098-036ADUP	Sample Duplicate				Run: ICP2-HE_131125B				11/25/13 20:30
Calcium	5490	mg/kg	1.0				3.4	20	
Magnesium	121	mg/kg	1.0				5.7	20	
Sodium	17.3	mg/kg	1.0				3.3	20	
Potassium	226	mg/kg	1.0				3.4	20	
Calcium, Extractable	27.4	meq/100g	0.0050				3.4	20	
Magnesium, Extractable	1.01	meq/100g	0.0083				5.7	20	
Potassium, Extractable	0.579	meq/100g	0.0026				3.4	20	
Sodium, Extractable	0.0751	meq/100g	0.0044				3.3	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/18/13
Project: Phytotoxicity Soil Samples **Work Order:** H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B									Batch: 22591
Sample ID: MB-22591	Method Blank				Run: ICP2-HE_131127A				11/27/13 17:29
Calcium	20	mg/kg	0.06						
Copper	1	mg/kg	0.007						
Magnesium	5	mg/kg	0.03						
Sodium	6	mg/kg	0.05						
Potassium	1	mg/kg	0.06						
Calcium, Extractable	0.1	meq/100g	0.0003						
Magnesium, Extractable	0.04	meq/100g	0.0003						
Potassium, Extractable	0.003	meq/100g	0.0001						
Sodium, Extractable	0.03	meq/100g	0.0002						
Sample ID: LCS-22591	Laboratory Control Sample				Run: ICP2-HE_131127A				11/27/13 17:40
Calcium	5650	mg/kg	1.0	109	70	130			
Magnesium	713	mg/kg	1.0	108	70	130			
Sodium	806	mg/kg	1.0	102	70	130			
Potassium	217	mg/kg	1.0	102	70	130			
Calcium, Extractable	28.2	meq/100g	0.0050	109	70	130			
Magnesium, Extractable	5.91	meq/100g	0.0083	108	70	130			
Potassium, Extractable	0.556	meq/100g	0.0026	102	70	130			
Sodium, Extractable	3.51	meq/100g	0.0044	102	70	130			
Sample ID: H13110098-004AMS2	Sample Matrix Spike				Run: ICP2-HE_131127A				11/27/13 17:51
Calcium	2710	mg/kg	1.0	93	75	125			
Copper	26.8	mg/kg	1.0	96	75	125			
Magnesium	1350	mg/kg	1.0	96	75	125			
Sodium	1020	mg/kg	1.0	100	75	125			
Potassium	1300	mg/kg	1.0	99	75	125			
Calcium, Extractable	13.5	meq/100g	0.0050	93	75	125			
Magnesium, Extractable	11.2	meq/100g	0.0083	97	75	125			
Potassium, Extractable	3.32	meq/100g	0.0026	99	75	125			
Sodium, Extractable	4.44	meq/100g	0.0044	100	75	125			
Sample ID: H13110098-004AMSD2	Sample Matrix Spike Duplicate				Run: ICP2-HE_131127A				11/27/13 17:55
Calcium	2700	mg/kg	1.0	92	75	125	0.2	20	
Copper	26.8	mg/kg	1.0	96	75	125	0.1	20	
Magnesium	1350	mg/kg	1.0	96	75	125	0.1	20	
Sodium	992	mg/kg	1.0	97	75	125	2.9	20	
Potassium	1260	mg/kg	1.0	95	75	125	2.7	20	
Calcium, Extractable	13.5	meq/100g	0.0050	92	75	125	0.2	20	
Magnesium, Extractable	11.2	meq/100g	0.0083	97	75	125	0.1	20	
Potassium, Extractable	3.23	meq/100g	0.0026	95	75	125	2.7	20	
Sodium, Extractable	4.32	meq/100g	0.0044	97	75	125	2.9	20	
Sample ID: H13110098-020ADUP	Sample Duplicate				Run: ICP2-HE_131127A				11/27/13 18:10
Calcium	5780	mg/kg	1.0				0.9	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Phytotoxicity Soil Samples
Report Date: 12/18/13
Work Order: H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B									Batch: 22591
Sample ID: H13110098-020ADUP	Sample Duplicate				Run: ICP2-HE_131127A				11/27/13 18:10
Copper	1.75	mg/kg	1.0				2.2	20	
Magnesium	130	mg/kg	1.0				1.0	20	
Sodium	31.0	mg/kg	1.0				1.5	20	
Potassium	195	mg/kg	1.0				1.7	20	
Calcium, Extractable	28.9	meq/100g	0.0050				0.9	20	
Magnesium, Extractable	1.08	meq/100g	0.0083				1.0	20	
Potassium, Extractable	0.499	meq/100g	0.0026				1.7	20	
Sodium, Extractable	0.135	meq/100g	0.0044				1.5	20	
Method: SW6010B									Batch: 22592
Sample ID: MB-22592	Method Blank				Run: ICP2-HE_131127A				11/27/13 18:14
Calcium	20	mg/kg	0.06						
Copper	0.2	mg/kg	0.007						
Magnesium	5	mg/kg	0.03						
Sodium	5	mg/kg	0.05						
Potassium	0.8	mg/kg	0.06						
Calcium, Extractable	0.1	meq/100g	0.0003						
Magnesium, Extractable	0.04	meq/100g	0.0003						
Potassium, Extractable	0.002	meq/100g	0.0001						
Sodium, Extractable	0.02	meq/100g	0.0002						
Sample ID: LCS-22592	Laboratory Control Sample				Run: ICP2-HE_131127A				11/27/13 18:25
Calcium	5580	mg/kg	1.0	107	70	130			
Magnesium	699	mg/kg	1.0	106	70	130			
Sodium	808	mg/kg	1.0	103	70	130			
Potassium	220	mg/kg	1.0	103	70	130			
Calcium, Extractable	27.8	meq/100g	0.0050	107	70	130			
Magnesium, Extractable	5.80	meq/100g	0.0083	106	70	130			
Potassium, Extractable	0.564	meq/100g	0.0026	103	70	130			
Sodium, Extractable	3.52	meq/100g	0.0044	103	70	130			
Sample ID: H13110098-023AMS2	Sample Matrix Spike				Run: ICP2-HE_131127A				11/27/13 18:40
Calcium	1280	mg/kg	1.0	95	75	125			
Copper	34.6	mg/kg	1.0	94	75	125			
Magnesium	994	mg/kg	1.0	95	75	125			
Sodium	994	mg/kg	1.0	98	75	125			
Potassium	1060	mg/kg	1.0	97	75	125			
Calcium, Extractable	6.38	meq/100g	0.0050	95	75	125			
Magnesium, Extractable	8.25	meq/100g	0.0083	96	75	125			
Potassium, Extractable	2.72	meq/100g	0.0026	97	75	125			
Sodium, Extractable	4.32	meq/100g	0.0044	98	75	125			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company

Project: Phytotoxicity Soil Samples

Report Date: 12/18/13

Work Order: H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B									Batch: 22592
Sample ID: H13110098-023AMSD2	Sample Matrix Spike Duplicate				Run: ICP2-HE_131127A				11/27/13 18:43
Calcium	1290	mg/kg	1.0	97	75	125	1.2	20	
Copper	35.1	mg/kg	1.0	96	75	125	1.5	20	
Magnesium	1010	mg/kg	1.0	97	75	125	1.7	20	
Sodium	1000	mg/kg	1.0	99	75	125	1.0	20	
Potassium	1080	mg/kg	1.0	98	75	125	1.3	20	
Calcium, Extractable	6.46	meq/100g	0.0050	97	75	125	1.2	20	
Magnesium, Extractable	8.39	meq/100g	0.0083	98	75	125	1.7	20	
Potassium, Extractable	2.76	meq/100g	0.0026	98	75	125	1.3	20	
Sodium, Extractable	4.37	meq/100g	0.0044	99	75	125	1.0	20	
Sample ID: H13110098-030ADUP	Sample Duplicate				Run: ICP2-HE_131127A				11/27/13 19:21
Calcium	383	mg/kg	1.0				1.4	20	
Copper	3.89	mg/kg	1.0				6.8	20	
Magnesium	36.8	mg/kg	1.0				1.8	20	
Sodium	11.8	mg/kg	1.0				3.8	20	
Potassium	61.1	mg/kg	1.0				2.9	20	
Calcium, Extractable	1.91	meq/100g	0.0050				1.4	20	
Magnesium, Extractable	0.305	meq/100g	0.0083				1.8	20	
Potassium, Extractable	0.156	meq/100g	0.0026				2.9	20	
Sodium, Extractable	0.0513	meq/100g	0.0044				3.8	20	
Sample ID: H13110098-036ADUP	Sample Duplicate				Run: ICP2-HE_131127A				11/27/13 19:37
Calcium	5560	mg/kg	1.0				0.8	20	
Magnesium	123	mg/kg	1.0				1.3	20	
Sodium	13.6	mg/kg	1.0				8.2	20	
Potassium	233	mg/kg	1.0				0.4	20	
Calcium, Extractable	27.7	meq/100g	0.0050				0.8	20	
Magnesium, Extractable	1.02	meq/100g	0.0083				1.3	20	
Potassium, Extractable	0.597	meq/100g	0.0026				0.4	20	
Sodium, Extractable	0.0592	meq/100g	0.0044				8.2	20	
Method: SW6010B									Batch: 22606
Sample ID: MB-22606	Method Blank				Run: ICP2-HE_131127A				11/27/13 20:19
Aluminum	ND	mg/kg	0.05						
Sample ID: LCS-22606	Laboratory Control Sample				Run: ICP2-HE_131127A				11/27/13 20:23
Aluminum	1.72	mg/kg	0.11	123	70	130			
Sample ID: H13110098-002AMS2	Sample Matrix Spike				Run: ICP2-HE_131127A				11/27/13 21:11
Aluminum	126	mg/kg	0.12	99	75	125			
Sample ID: H13110098-002AMSD2	Sample Matrix Spike Duplicate				Run: ICP2-HE_131127A				11/27/13 21:15
Aluminum	126	mg/kg	0.12	99	75	125	0.0	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/18/13

Project: Phytotoxicity Soil Samples **Work Order:** H13110098

Analyte		Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method:	**SW6010B**								Batch: 22606	
Sample ID:	**H13110098-009Adup**	Sample Duplicate				Run: ICP2-HE_131127A			11/27/13 21:29	
Aluminum		5.14	mg/kg	0.11				2.5	30	
Sample ID:	**H13110098-034Adup**	Sample Duplicate				Run: ICP2-HE_131127A			11/27/13 22:14	
Aluminum		6.56	mg/kg	0.11				5.3	30	
Sample ID:	**H13110098-035AMS2**	Sample Matrix Spike				Run: ICP2-HE_131127A			11/27/13 22:25	
Aluminum		124	mg/kg	0.12	98	75	125			
Sample ID:	**H13110098-035AMSD2**	Sample Matrix Spike Duplicate				Run: ICP2-HE_131127A			11/27/13 22:36	
Aluminum		124	mg/kg	0.12	98	75	125	0.0	20	
Sample ID:	**H13110098-002AMS2**	Sample Matrix Spike				Run: ICP2-HE_131127A			11/27/13 22:58	
Aluminum		50.1	mg/kg	0.10	98	75	125			
Sample ID:	**H13110098-002AMSD2**	Sample Matrix Spike Duplicate				Run: ICP2-HE_131127A			11/27/13 23:02	
Aluminum		50.1	mg/kg	0.10	98	75	125	0.0	20	
Sample ID:	**H13110098-019AMS2**	Sample Matrix Spike				Run: ICP2-HE_131127A			11/28/13 00:31	
Aluminum		49.8	mg/kg	0.10	94	75	125			
Sample ID:	**H13110098-019AMSD2**	Sample Matrix Spike Duplicate				Run: ICP2-HE_131127A			11/28/13 00:35	
Aluminum		50.1	mg/kg	0.10	95	75	125	0.6	20	
Method:	**SW6010B**								Batch: 22626	
Sample ID:	**MB-22626**	Method Blank				Run: ICP2-HE_131127A			11/27/13 22:39	
Aluminum		0.3	mg/kg	0.05						
Iron		0.04	mg/kg	0.02						
Manganese		0.007	mg/kg	0.003						
Sample ID:	**LCS-22626**	Laboratory Control Sample				Run: ICP2-HE_131127A			11/27/13 22:43	
Aluminum		0.727	mg/kg	0.10	81	70	130			
Iron		16.1	mg/kg	1.0	110	70	130			
Manganese		5.99	mg/kg	0.10	105	70	130			
Sample ID:	**H13110098-010Adup**	Sample Duplicate				Run: ICP2-HE_131127A			11/27/13 23:43	
Aluminum		5.75	mg/kg	0.10				5.8	30	
Iron		29.1	mg/kg	1.0				0.3	30	
Manganese		7.96	mg/kg	0.10				0.4	30	
Sample ID:	**H13110098-020Adup**	Sample Duplicate				Run: ICP2-HE_131127A			11/28/13 01:16	
Aluminum		1.06	mg/kg	0.10				45	30	R
Iron		3.38	mg/kg	1.0				0.1	30	
Manganese		4.53	mg/kg	0.10				0.6	30	
Method:	**SW6010B**								Batch: 22627	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

R - RPD exceeds advisory limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/18/13
Project: Phytotoxicity Soil Samples **Work Order:** H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B									Batch: 22627
Sample ID: MB-22627	Method Blank				Run: ICP2-HE_131127A				11/28/13 01:19
Aluminum	0.3	mg/kg	0.05						
Iron	0.07	mg/kg	0.02						
Manganese	0.006	mg/kg	0.003						
Sample ID: LCS-22627	Laboratory Control Sample				Run: ICP2-HE_131127A				11/28/13 01:23
Aluminum	0.852	mg/kg	0.10	101	70	130			
Iron	15.6	mg/kg	1.0	107	70	130			
Manganese	5.65	mg/kg	0.10	99	70	130			
Sample ID: H13110098-022AMS2	Sample Matrix Spike				Run: ICP2-HE_131127A				11/28/13 01:38
Aluminum	94.8	mg/kg	0.10	96	75	125			
Iron	143	mg/kg	1.0	96	75	125			
Manganese	63.6	mg/kg	0.10	90	75	125			
Sample ID: H13110098-022AMSD2	Sample Matrix Spike Duplicate				Run: ICP2-HE_131127A				11/28/13 01:42
Aluminum	96.0	mg/kg	0.10	98	75	125	1.3	20	
Iron	144	mg/kg	1.0	98	75	125	0.7	20	
Manganese	64.8	mg/kg	0.10	92	75	125	1.7	20	
Sample ID: H13110098-030Adup	Sample Duplicate				Run: ICP2-HE_131127A				11/28/13 02:23
Aluminum	18.6	mg/kg	0.10				2.2	30	
Iron	134	mg/kg	1.0				2.2	30	
Manganese	4.32	mg/kg	0.10				4.4	30	
Sample ID: H13110098-032AMS2	Sample Matrix Spike				Run: ICP2-HE_131127A				11/28/13 02:45
Aluminum	50.8	mg/kg	0.10	93	75	125			
Iron	84.5	mg/kg	1.0	94	75	125			
Manganese	61.4	mg/kg	0.10	90	75	125			
Sample ID: H13110098-032AMSD2	Sample Matrix Spike Duplicate				Run: ICP2-HE_131127A				11/28/13 02:49
Aluminum	50.6	mg/kg	0.10	93	75	125	0.4	20	
Iron	84.1	mg/kg	1.0	93	75	125	0.4	20	
Manganese	61.0	mg/kg	0.10	89	75	125	0.6	20	
Sample ID: H13110098-036Adup	Sample Duplicate				Run: ICP2-HE_131127A				11/28/13 03:07
Aluminum	0.867	mg/kg	0.10				25	30	
Iron	3.55	mg/kg	1.0				6.0	30	
Manganese	6.23	mg/kg	0.10				14	30	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Phytotoxicity Soil Samples
Report Date: 12/18/13
Work Order: H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B									Batch: 22591
Sample ID: MB-22591	Method Blank				Run: ICP2-HE_131218A				12/18/13 15:04
Calcium	40	mg/kg	0.1						
Copper	0.3	mg/kg	0.10						
Magnesium	7	mg/kg	0.08						
Sodium	6	mg/kg	2						
Potassium	ND	mg/kg	0.1						
Calcium, Extractable	0.2	meq/100g	0.0007						
Magnesium, Extractable	0.06	meq/100g	0.0007						
Potassium, Extractable	ND	meq/100g	0.0004						
Sodium, Extractable	0.02	meq/100g	0.007						
Sample ID: LFB-22591	Laboratory Fortified Blank				Run: ICP2-HE_131218A				12/18/13 15:07
Calcium	2520	mg/kg	1.0	99	85	115			
Copper	50.7	mg/kg	1.0	101	85	115			
Magnesium	2490	mg/kg	1.0	99	85	115			
Sodium	2560	mg/kg	1.0	102	85	115			
Potassium	2510	mg/kg	1.0	101	85	115			
Method: SW6010B									Batch: 22592
Sample ID: MB-22592	Method Blank				Run: ICP2-HE_131218A				12/18/13 15:11
Calcium	30	mg/kg	0.1						
Copper	0.5	mg/kg	0.02						
Magnesium	7	mg/kg	0.08						
Sodium	9	mg/kg	0.1						
Potassium	ND	mg/kg	0.1						
Calcium, Extractable	0.1	meq/100g	0.0007						
Magnesium, Extractable	0.06	meq/100g	0.0007						
Potassium, Extractable	ND	meq/100g	0.0004						
Sodium, Extractable	0.04	meq/100g	0.0006						
Sample ID: LFB-22592	Laboratory Fortified Blank				Run: ICP2-HE_131218A				12/18/13 15:15
Calcium	2550	mg/kg	1.0	101	85	115			
Copper	51.2	mg/kg	1.0	101	85	115			
Magnesium	2560	mg/kg	1.0	102	85	115			
Sodium	2540	mg/kg	1.0	101	85	115			
Potassium	2520	mg/kg	1.0	101	85	115			
Method: SW6010B									Batch: 22838
Sample ID: MB-22838	Method Blank				Run: ICP2-HE_131218A				12/18/13 11:18
Copper	0.7	mg/kg	0.02						
Sample ID: LFB-22838	Laboratory Fortified Blank				Run: ICP2-HE_131218A				12/18/13 11:25
Copper	52.9	mg/kg	1.0	104	85	115			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Phytotoxicity Soil Samples
Report Date: 12/18/13
Work Order: H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B									Batch: 22838
Sample ID: H13110098-036AMS2	Sample Matrix Spike				Run: ICP2-HE_131218A				12/18/13 11:44
Copper	61.3	mg/kg	1.0	103	75	125			
Sample ID: H13110098-036AMSD2	Sample Matrix Spike Duplicate				Run: ICP2-HE_131218A				12/18/13 11:47
Copper	62.2	mg/kg	1.0	104	75	125	1.3	20	
Sample ID: H13110098-036Adup	Sample Duplicate				Run: ICP2-HE_131218A				12/18/13 11:51
Copper	8.96	mg/kg	1.0				10	20	
Magnesium	128	mg/kg	1.0				0.5	20	
Sodium	20.0	mg/kg	1.0				5.4	20	
Potassium	267	mg/kg	1.0				2.2	20	
Magnesium, Extractable	1.06	meq/100g	0.0083				0.5	20	
Potassium, Extractable	0.685	meq/100g	0.0026				2.2	20	
Sodium, Extractable	0.0870	meq/100g	0.0044				5.4	20	
Sample ID: H13110098-036ADUP	Sample Duplicate				Run: ICP2-HE_131218A				12/18/13 12:09
Copper	8.69	mg/L	1.0						

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/18/13
Project: Phytotoxicity Soil Samples **Work Order:** H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6020					Analytical Run: ICPMS204-B_131210B				
Sample ID: ICV STD	Initial Calibration Verification Standard								12/10/13 10:13
Copper	0.0610	mg/L	0.0010	102	90	110			
Method: SW6020									Batch: 22738
Sample ID: MB-22738	Method Blank				Run: ICPMS204-B_131210B				12/11/13 01:29
Copper	0.02	mg/kg	0.0003						
Sample ID: LFB-22738	Laboratory Fortified Blank				Run: ICPMS204-B_131210B				12/11/13 01:38
Copper	0.512	mg/kg	0.10	99	80	120			
Sample ID: H13110098-001AMS	Sample Matrix Spike				Run: ICPMS204-B_131210B				12/11/13 01:51
Copper	23.3	mg/kg	0.10		0	0			A
Method: SW6020									Batch: 22739
Sample ID: MB-22739	Method Blank				Run: ICPMS204-B_131210B				12/11/13 03:55
Copper	0.08	mg/kg	0.0003						
Sample ID: LFB-22739	Laboratory Fortified Blank				Run: ICPMS204-B_131210B				12/11/13 04:04
Copper	0.548	mg/kg	0.10	93	80	120			
Sample ID: H13110098-021AMS	Sample Matrix Spike				Run: ICPMS204-B_131210B				12/11/13 04:31
Copper	2.66	mg/kg	0.10		0	0			A
Sample ID: H13110098-030Adup	Sample Duplicate				Run: ICPMS204-B_131210B				12/11/13 05:28
Copper	3.49	mg/kg	0.10						
Method: SW6020					Analytical Run: ICPMS204-B_131211B				
Sample ID: ICV STD	Initial Calibration Verification Standard								12/11/13 09:25
Copper	0.0602	mg/L	0.0010	100	90	110			
Method: SW6020									Batch: 22738
Sample ID: MB-22738	Method Blank				Run: ICPMS204-B_131211B				12/11/13 22:41
Copper	0.02	mg/kg	0.003						
Sample ID: H13110098-010Adup	Sample Duplicate				Run: ICPMS204-B_131211B				12/11/13 23:12
Copper	9.38	mg/kg	0.10						
Sample ID: H13110098-020Adup	Sample Duplicate				Run: ICPMS204-B_131211B				12/11/13 23:52
Copper	0.115	mg/kg	0.10						
Method: SW6020									Batch: 22739
Sample ID: MB-22739	Method Blank				Run: ICPMS204-B_131211B				12/12/13 00:01
Copper	0.009	mg/kg	0.0003						

Qualifiers:

RL - Analyte reporting limit.

A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company

Project: Phytotoxicity Soil Samples

Report Date: 12/18/13

Work Order: H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6020									Batch: 22739
Sample ID: H13110098-033AMS	Sample Matrix Spike				Run: ICPMS204-B_131216B				12/17/13 06:50
Copper	3140	mg/kg	0.13		75	125			A
Method: SW6020									Analytical Run: ICPMS204-B_131217A
Sample ID: ICV STD	Initial Calibration Verification Standard								12/17/13 10:52
Copper	0.0597	mg/L	0.0010	99	90	110			
Method: SW6020									Batch: 22663
Sample ID: H13110098-036Adup	Sample Duplicate				Run: ICPMS204-B_131217A				12/17/13 12:53
Copper	0.429	mg/kg	0.10						

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Report Date: 12/18/13
Project: Phytotoxicity Soil Samples
Work Order: H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: USDA23c									Batch: 22425
Sample ID: MB-22425	Method Blank				Run: MAN-TECH_131113A				11/13/13 07:23
Neutralization Potential	ND	Tons/1000T	0.05						
Lime as CaCO3	ND	%	0.005						
Sample ID: LCS-22425	Laboratory Control Sample				Run: MAN-TECH_131113A				11/13/13 07:30
Neutralization Potential	52.4	Tons/1000T	0.10	107	80	120			
Lime as CaCO3	5.24	%	0.010	107	80	120			
Sample ID: H13110098-010ADUP	Sample Duplicate				Run: MAN-TECH_131113A				11/13/13 09:05
Neutralization Potential	2.15	Tons/1000T	0.10				11	20	
Lime as CaCO3	0.215	%	0.010				11	20	
Sample ID: H13110098-020ADUP	Sample Duplicate				Run: MAN-TECH_131113A				11/13/13 10:35
Neutralization Potential	231	Tons/1000T	0.10				3.3	20	
Lime as CaCO3	23.1	%	0.010				3.3	20	
Method: USDA23c									Batch: 22426
Sample ID: MB-22426	Method Blank				Run: MAN-TECH_131113A				11/13/13 10:43
Neutralization Potential	ND	Tons/1000T	0.05						
Lime as CaCO3	ND	%	0.005						
Sample ID: LCS-22426	Laboratory Control Sample				Run: MAN-TECH_131113A				11/13/13 10:50
Neutralization Potential	56.0	Tons/1000T	0.10	114	80	120			
Lime as CaCO3	5.60	%	0.010	114	80	120			
Sample ID: H13110098-030ADUP	Sample Duplicate				Run: MAN-TECH_131113A				11/13/13 12:23
Neutralization Potential	0.210	Tons/1000T	0.10					20	
Lime as CaCO3	0.0210	%	0.010					20	
Sample ID: H13110098-036ADUP	Sample Duplicate				Run: MAN-TECH_131113A				11/13/13 13:24
Neutralization Potential	214	Tons/1000T	0.10				1.8	20	
Lime as CaCO3	21.4	%	0.010				1.8	20	
Method: USDA23c									Batch: 22480
Sample ID: MB-22480	Method Blank				Run: MAN-TECH_131115A				11/15/13 09:21
Neutralization Potential	ND	Tons/1000T	0.05						
Lime as CaCO3	ND	%	0.005						
Sample ID: LCS-22480	Laboratory Control Sample				Run: MAN-TECH_131115A				11/15/13 09:29
Neutralization Potential	52.2	Tons/1000T	0.10	106	80	120			
Lime as CaCO3	5.22	%	0.010	106	80	120			
Sample ID: H13110098-035ADUP	Sample Duplicate				Run: MAN-TECH_131115A				11/15/13 12:15
Neutralization Potential	ND	Tons/1000T	0.10					20	
Lime as CaCO3	ND	%	0.010					20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Phytotoxicity Soil Samples

Report Date: 12/18/13
Work Order: H13110098

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: USDA27a								Batch: 22413	
Sample ID: LCS-22413	Laboratory Control Sample				Run: SOIL DRYING OVEN 2_13111			11/12/13 08:29	
Saturation	43.9	%	0.10	97	80	120			
Sample ID: H13110098-010ADUP	Sample Duplicate				Run: SOIL DRYING OVEN 2_13111			11/12/13 08:30	
Saturation	25.8	%	0.10				2.9	20	
Sample ID: H13110098-020ADUP	Sample Duplicate				Run: SOIL DRYING OVEN 2_13111			11/12/13 08:32	
Saturation	40.2	%	0.10				3.1	20	
Method: USDA27a								Batch: 22414	
Sample ID: LCS-22414	Laboratory Control Sample				Run: SOIL DRYING OVEN 2_13111			11/12/13 08:44	
Saturation	43.4	%	0.10	96	80	120			
Sample ID: H13110098-030ADUP	Sample Duplicate				Run: SOIL DRYING OVEN 2_13111			11/12/13 08:46	
Saturation	23.8	%	0.10				1.0	20	
Sample ID: H13110098-036ADUP	Sample Duplicate				Run: SOIL DRYING OVEN 2_13111			11/12/13 08:47	
Saturation	37.3	%	0.10				3.1	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

Workorder Receipt Checklist

Chino Mine Company

H13110098

Login completed by:	Skyler T. Pester	Date Received:	11/1/2013
Reviewed by:	BL2000\sdull	Received by:	stp
Reviewed Date:	12/10/2013	Carrier name:	NPT

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on all shipping container(s)/cooler(s)?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on all sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☑	No ☐	
Temp Blank received in all shipping container(s)/cooler(s)?	Yes ☐	No ☑	Not Applicable ☐
Container/Temp Blank temperature:	°C See Comments		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☐	Not Applicable ☑

Standard Reporting Procedures:

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Contact and Corrective Action Comments:

No collection date or time for samples Dup1, Dup2, or Dup3. Collection date and time estimated in laboratory. Samples initially received at ELI-Billings 10/29/2013 9:30AM, via UPS NDA. Six coolers received with custody seals and not on ice. Temperatures upon arrival in Billings were cooler 1: 15.8℃, cooler 2: 15.2℃, cooler 3: 17.6℃, cooler 4: 14.0℃ (temperature taken from a temp blank), cooler 5: 13.8℃, and cooler 6: 14.6℃. Three more coolers were received at ELI-Billings before shipping to ELI-Helena, no information available for these three coolers when they were received in ELI-Billings. All nine coolers then shipped to ELI-H. Seven coolers received for the Phytotoxicity study. Cooler 1 received at 2.8℃, cooler 2: 2.9℃, cooler 3: 3.4℃, cooler 4: 3.3℃, cooler 5: 0.8℃, cooler 6: 1.5℃, and cooler 7: 1.4℃. Samples received not on ice and temperatures taken from a client sample. 11/6/2013 STP.

Chain of Custody and An~~a~~lytical Request Record

PLEASE PRINT- Provide as much information as possible.

Page 1 of 4

Company Name: ARCADIS

Project Name, PWS, Permit, Etc.: Phytotoxicity Soil Samples

Sample Origin State: NM

EPA/State Compliance: Yes ☐ No ☐

Report Mail Address: Pam Pinson -Chino Mines Company
P.O. Box 10
Bayard, NM 88023

Contact Name: Emily Schlenker

Phone/Fax: 303-231-9115 ext 114

Email: Emily.schlenker@arcadis-us.com

Sampler: (Please Print) Matthew Barkley

Invoice Address: Pam Pinson- Chino Mines Company
P.O. Box 10
Bayard, NM 88023

Invoice Contact & Phone: Pam Pinson 575-912-5213

Purchase Order:

Quote/Bottle Order:

Special Report/Formats – ELI must be notified prior to sample submittal for the following:

☐ DW
☐ GSA
☐ POTW/WWTP
☐ State: ____________
☐ Other: ____________

☐ A2LA
☐ EDD/EDT(Electronic Data)
Format: ____________
☐ LEVEL IV
☐ NELAC

SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	soil sieved to < 2mm	All Arcadis-Table 4 Analytes
1 STS-PT-2013-31	10/23/13	1400	1 S	X	X
2 STS-PT-2013-32	10/23/13	1255	1 S	X	X
3 STS-PT-2013-33	10/25/13	0920	1 S	X	X
4 Dup1	—	—	1 S	X	X
5 Dup2	—	—	1 S	X	X
6 Dup3	—	—	1 S	X	X
7					
8					
9					
10					

Number of Containers
Sample Type: A W S V B O
Air Water Soils/Solids
Vegetation Bioassay Other

ANALYSIS REQUESTED

SEE ATTACHED

Normal Turnaround (TAT)

RUSH

Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments:
Please include all analytes from ARCADIS-Table 4'
Cooler #1 · 15.8
#2 · 15.2
#3 · 17.6
#4 · 14.0 TB
#5 · 13.8
#6 · 14.6

H13110098

Shipped by: UPSNDA

Cooler ID(s):

Receipt Temp ________ °C

2.8°C
2.9°C
3.4°C
3.3°C
0.8°C
1.5°C

NPL

On Ice: Yes [✓ No]

Custody Seal [✓ Y] N
Intact C [✓ Y] N
Signature Match [✓ Y] N

LABORATORY USE ONLY

Custody Record MUST be Signed

Relinquished by (print): Pam Pinson Date/Time: 10-25-13 2100 Signature: Pam Pinson

Relinquished by (print): Date/Time: Signature:

Received by (print): Date/Time: Signature:

Received by (print): Skyles Rester Date/Time: 11-1-13 9:20AM Signature: *

Sample Disposal: Return to Client: ________ Lab Disposal: ________

Received by Laboratory: Michelle Klehammer Date/Time: 10/29/13 9:30 Signature:

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested.
This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report.
Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

PLEASE PRINT- Provide as much information as possible.

Page - 2 of 4

Company Name: ARCADIS	Project Name, PWS, Permit, Etc. Phytotoxicity Soil Samples		Sample Origin State: NM	EPA/State Compliance: Yes ☐ No ☐
Report Mail Address: Pam Pinson -Chino Mines Company P.O. Box 10 Bayard, NM 88023	Contact Name: Emily Schlenker	Phone/Fax: 303-231-9115 ext 114	Email: Emily.schlenker@arcadis-us.com	Sampler: (Please Print) Matthew Barkley
Invoice Address: Pam Pinson- Chino Mines Company P.O. Box 10 Bayard, NM 88023	Invoice Contact & Phone: Pam Pinson	575-912-5213	Purchase Order:	Quote/Bottle Order:

Special Report/Formats – ELI must be notified prior to sample submittal for the following:

- ☐ DW
- ☐ GSA
- ☐ POTW/WWTP
- ☐ State: ________
- ☐ Other: ________
- ☐ A2LA
- ☐ EDD/EDT(Electronic Data)
- Format: ________
- ☐ LEVEL IV
- ☐ NELAC

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	Number of Containers Sample Type: A W S V B O Air Water Soils/Solids Vegetation Bioassay Other MATRIX	soil sieved to < 2mm	All Arcadis-Table 4 Analytes								SEE ATTACHED	Normal Turnaround (TAT)
1	STS-PT-2013-21	10/22/13	1100	1 S	X	X									
2	STS-PT-2013-22	10/22/13	1135	1 S	X	X									
3	STS-PT-2013-23	10/22/13	1030	1 S	X	X									
4	STS-PT-2013-24	10/24/13	1830	1 S	X	X									
5	STS-PT-2013-25	10/22/13	1600	1 S	X	X									
6	STS-PT-2013-26	10/22/13	1515	1 S	X	X									
X 7	STS-PT-2013-27	10/25/13	1415	1 S	X	X									
8	STS-PT-2013-28	10/22/13	1715	1 S	X	X									
9	STS-PT-2013-29	10/25/13	1600	1 S	X	X									
X 10	STS-PT-2013-30	10/24/13	1240	1 S	X	X									

R U S H

Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments:

Please include all analytes from ARCADIS-Table 4'

cooler #1 - 15.8
#2 - 15.2
#3 - 17.6
#4 - 14.0 TB
#5 - 13.8
#6 - 14.6

H1311009B

Shipped by: UPSNDA

NPA

Cooler ID(s):

Receipt Temp ________ °C

2.8C
2.9C
3.4C
3.3C
0.8C
1.5C

On Ice: Yes [✓ No]

Custody Seal [✓ Y] N

Intact [✓ Y] N

Signature Match [✓ Y] N

LABORATORY USE ONLY

Custody Record MUST be Signed

Relinquished by (print): Pinson Pam	Date/Time: 10-25-13 2100	Signature: Pam Pinson	Received by (print):	Date/Time:	Signature:
Relinquished by (print):	Date/Time:	Signature:	Received by (print): Skyler Pester	Date/Time: 11-1-13 9:20AM	Signature: *
Sample Disposal: Return to Client: ________	Lab Disposal: ________		Received by Laboratory: Michelle Kleehammer	Date/Time: 10/29/13 9:30	Signature:

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested.
This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report.
Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

PLEASE PRINT- Provide as much information as possible.

Page = 3 of 4

Company Name: ARCADIS

Project Name, PWS, Permit, Etc.: Phytotoxicity Soil Samples

Sample Origin State: NM

EPA/State Compliance: Yes ☐ No ☐

Report Mail Address:
Pam Pinson -Chino Mines Company
P.O. Box 10
Bayard, NM 88023

Contact Name: Emily Schlenker

Phone/Fax: 303-231-9115 ext 114

Email: Emily.schlenker@arcadis-us.com

Sampler: (Please Print) Matthew Barkley

Invoice Address:
Pam Pinson- Chino Mines Company
P.O. Box 10
Bayard, NM 88023

Invoice Contact & Phone: Pam Pinson 575-912-5213

Purchase Order:

Quote/Bottle Order:

Special Report/Formats – ELI must be notified prior to sample submittal for the following:

☐ DW
☐ GSA
☐ POTW/WWTP
☐ State: ____
☐ Other: ____

☐ A2LA
☐ EDD/EDT(Electronic Data)
Format: ____
☐ LEVEL IV
☐ NELAC

Number of Containers
Sample Type: A W S V B O
Air Water Soils/Solids Vegetation Bioassay Other

ANALYSIS REQUESTED

SEE ATTACHED

Normal Turnaround (TAT)

R U S H

Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments:
Please include all analytes from ARCADIS-Table 4'
Cooler#1- 15.8
#2. 15.2
#3. 17.6
#4. 14.0 TB
#5. 13.8
#6. 14.6

H13110098

Shipped by: UPSNDA

Cooler ID(s):

Receipt Temp ____ °C

On Ice: Yes [✓ No]

Custody Seal [✓ Y] N
Intact [✓ Y] N
Signature Match [✓ Y] N

LABORATORY USE ONLY

NA

2.8C
2.9C
3.4C
3.3C
0.8C
1.5C

	SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	soil sieved to < 2mm	All Arcadis-Table 4 Analytes
X 1	STS-PT-2013-11	10/24/13	1530	1 S	X	X
2	STS-PT-2013-12	10/22/13	0940	1 S	X	X
X 3	STS-PT-2013-13	10/25/13	1210	1 S	X	X
4	STS-PT-2013-14	10/24/13	1050	1 S	X	X
5	STS-PT-2013-15	10/25/13	1600	1 S	X	X
6	STS-PT-2013-16	10/23/13	1750	1 S	X	X
7	STS-PT-2013-17	10/25/13	1230	1 S	X	X
8	STS-PT-2013-18	10/23/13	0945	1 S	X	X
X 9	STS-PT-2013-19	10/24/13	0900	1 S	X	X
10	STS-PT-2013-20	10/25/13	1045	1 S	X	X

Custody Record MUST be Signed

Relinquished by (print): Pam Pinson	Date/Time: 10-25-13 2100	Signature: Pam Pinson	Received by (print):	Date/Time:	Signature:
Relinquished by (print):	Date/Time:	Signature:	Received by (print): Skyler Tester	Date/Time: 11-1-13 9:20AM	Signature: *
Sample Disposal: Return to Client: ____	Lab Disposal: ____		Received by Laboratory: Michelle Kleehammer	Date/Time: 10/29/13 9:30	Signature:

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report. Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

Page 4 of 4

PLEASE PRINT- Provide as much information as possible.

Company Name: ARCADIS

Project Name, PWS, Permit, Etc.: Phytotoxicity Soil Samples

Sample Origin State: NM

EPA/State Compliance: Yes ☐ No ☐

Report Mail Address:
Pam Pinson -Chino Mines Company
P.O. Box 10
Bayard, NM 88023

Contact Name: Emily Schlenker

Phone/Fax: 303-231-9115 ext 114

Email: Emily.schlenker@arcadis-us.com

Sampler: (Please Print) Matthew Barkley

Invoice Address:
Pam Pinson- Chino Mines Company
P.O. Box 10
Bayard, NM 88023

Invoice Contact & Phone: Pam Pinson 575-912-5213

Purchase Order:

Quote/Bottle Order:

Special Report/Formats – ELI must be notified prior to sample submittal for the following:

☐ DW
☐ GSA
☐ POTW/WWTP
☐ State: ____
☐ Other: ____

☐ A2LA
☐ EDD/EDT(Electronic Data)
Format: ____
☐ LEVEL IV
☐ NELAC

Number of Containers
Sample Type: A W S V B O
Air Water Soils/Solids
Vegetation Bioassay Other

ANALYSIS REQUESTED

SEE ATTACHED

Normal Turnaround (TAT)

RUSH

Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments:
Please include all analytes from ARCADIS-Table 4'
Cooler#1-15.8
#2-15.2
#3-17.6
#4-14.0 TB
#5-13.8
#6-14.6

H13110098

Shipped by: UPSNDA

NPL

Cooler ID(s):

Receipt Temp ____ °C

2.8C
2.9C
3.4C
3.3C
0.8C
1.5C

On Ice: Yes [✓ No]

Custody Seal [✓ Y] N
Intact C [✓ Y] N
Signature Match [✓ Y] N

LABORATORY USE ONLY

	SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	soil sieved to < 2mm	All Arcadis-Table 4 Analytes
	1 STS-PT-2013-1	10/24/13	1000	1 S	X	X
X	2 STS-PT-2013-2	10/23/13	1645	1 S	X	X
	3 STS-PT-2013-3	10/24/13	1630	1 S	X	X
	4 STS-PT-2013-4	10/22/13	1400	1 S	X	X
X	5 STS-PT-2013-5	10/23/13	1445	1 S	X	X
	6 STS-PT-2013-6	10/24/13	1425	1 S	X	X
	7 STS-PT-2013-7	10/24/13	1300	1 S	X	X
X	8 STS-PT-2013-8	10/23/13	1745	1 S	X	X
X	9 STS-PT-2013-9	10/23/13	1045	1 S	X	X
X	10 STS-PT-2013-10	10/23/13	1115	1 S	X	X

Custody Record MUST be Signed

Relinquished by (print): Pam Pinson	Date/Time: 10-25-13 2100	Signature: Pam Pinson	Received by (print):	Date/Time:	Signature:
Relinquished by (print):	Date/Time:	Signature:	Received by (print): Skyler Rester	Date/Time: 11-1-13 9:20AM	Signature: *
Sample Disposal: Return to Client: ____	Lab Disposal: ____		Received by Laboratory: Michelle Kluchamme	Date/Time: 10/29/13 9:30	Signature:

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested.
This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report.
Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

TABLE 4
SOIL SAMPLE ANALYTICAL ANALYSES

FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO
SMELTER/TAILING SOILS IU - PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

Parameter	Extraction Method	Analytical Method
Alkalinity (total)	ASA Mono #9, Part 2, 10-2.3.1	A 2320B
Chloride	ASA Mono #9, Part 2, 10-3.2	E300.0
Fluoride	ASA Mono #9, Part 2, 10-3.2	A 4500 F-C/Technicon 380-7WE
Exchangeable Calcium (NH4Oac)	ASA Mono #9, Part 2, 13-4	6010/6020
Exchangeable Copper (NH4Oac)	ASA Mono #9, Part 2, 13-4	6010/6020
Exchangeable Magnesium (NH4Oac)	ASA Mono #9, Part 2, 13-4	6010/6020
Exchangeable Potassium (NH4Oac)	ASA Mono #9, Part 2, 13-4	6010/6020
Exchangeable Sodium (NH4Oac)	ASA Mono #9, Part 2, 13-4	6010/6020
Sulfate (soluble)	ASA Mono #9, Part 2, 10-3.2	6010/6020
Copper (total)	3050	6010B
Copper (soluble), $CaCl_2$	ARCADIS SOP	ARCADIS SOP
Aluminum (soluble)	ASA Mono. #9, Part 2, Method 19-3.3	6010/6020
Iron (soluble)	ASA Mono. #9, Part 2, Method 19-3.3	6010/6020
Manganese (soluble)	ASA Mono. #9, Part 2, Method 19-3.3	6010/6020
Nitrate/Nitrite, $CaCl_2$	ASA Mono. #9, Part 2, Method 38-8.1	350.1, 353.2, 351.4
pH (saturated paste with saturated %)	ASA Mono #9, Part 2, 10-3.2	9045C
pH, $CaCl_2$	ARCADIS SOP	ARCADIS SOP
Plant Available Phosphorus (Bray/Olsen)	ASA Mono. #9, Part 2, Method 24-5.1	365.1
Phosphate	ASA Mono. #9, Part 2, Method 24-5.3	365.1
Electrical Conductivity, saturated paste	ASA Mono. #9, Part 2,Method 10-3.3	ASA Mono #9 Part 2
Electrical Conductivity, $CaCl_2$	ARCADIS SOP	ARCADIS SOP
Total Organic Matter	ASA Mono. #9, Part 2, Method 29-3.5.2	Handbook 60
DOC	ASA Mono. #9, Part 2, Method 10-3	ASA Mono #9 Part 2
Soil Texture	ASA Mono. #9, Part 1, Method 15-4	NAPT S-10.10[1]
$CaCO_3$	USDA Handbook 60, Method 23C	Handbook 60
Measured pCu	ARCADIS SOP	ARCADIS SOP
Moisture (dry basis)	USDA Handbook 60,Method 26	

41310098

ANALYTICAL SUMMARY REPORT

December 24, 2013

Chino Mine Company
PO Box 10
Bayard, NM 88023

Workorder No.: H13120008

Project Name: Phytotoxicity

Energy Laboratories Inc Helena MT received the following 3 samples for Chino Mine Company on 11/26/2013 for analysis.

Sample ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
H13120008-001	STS-PT-2013-34	11/21/13 11:30	11/26/13	Soil	Metals by ICP/ICPMS, Total Metals, Water Extractable DPTA extractable metals Metals, NH4Ac Metals, Saturated Paste Alkalinity, Water Extractable Carbon, Dissolved Organic Conductivity, Saturated Paste Extract Copper Activity Exchangeable Cations Anions by Ion Chromatography Lime as CaCO3 Moisture Nitrate as N, CaCL2 Extract Organic Carbon/Matter Walkley-Black Phosphorus-Bray pH, Saturated Paste Soluble Phosphate Digestion, Total Metals CaCl2 Hot Water Soil Extraction Water extraction DTPA extraction for metals Preparation, Dissolved Filtration Lime Percentage NaHCO3 Soil Extract NH4AC Soil Extraction Total Organic Matter Prep Particle Size Analysis / Texture Prep Saturated Paste Extraction Particle Size Analysis / Texture Saturation Percentage Soil Preparation

ANALYTICAL SUMMARY REPORT

H13120008-002	STS-PT-2013-35	11/21/13 12:35	11/26/13	Soil	Metals by ICP/ICPMS, Total Metals, Water Extractable DPTA extractable metals Metals, NH4Ac Metals, Saturated Paste Alkalinity, Water Extractable Carbon, Dissolved Organic Conductivity, Saturated Paste Extract Copper Activity Exchangeable Cations Anions by Ion Chromatography Lime as CaCO3 Moisture Nitrate as N, CaCL2 Extract Organic Carbon/Matter Walkley-Black Phosphorus-Bray pH, Saturated Paste Soluble Phosphate Digestion, Total Metals CaCl2 Hot Water Soil Extraction Water extraction DTPA extraction for metals Preparation, Dissolved Filtration Lime Percentage NaHCO3 Soil Extract NH4AC Soil Extraction Total Organic Matter Prep Particle Size Analysis / Texture Prep Saturated Paste Extraction Particle Size Analysis / Texture Saturation Percentage
H13120008-003	STS-PT-2013-36	11/21/13 13:30	11/26/13	Soil	Same As Above

The analyses presented in this report were performed by Energy Laboratories, Inc., 3161 E. Lyndale Ave., Helena, MT 59604, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By: Jonathan D. Hager
Branch Manager - Helena, MT

Digitally signed by
Jonathan Hager
Date: 2013.12.24 14:25:35 -07:00

CLIENT: Chino Mine Company
Project: Phytotoxicity
Sample Delivery Group: H13120008

Report Date: 12/24/13

CASE NARRATIVE

Tests associated with analyst identified as ELI-CA were subcontracted to Energy Laboratories, 2393 Salt Creek Hwy., Casper, WY, EPA Number WY00002 and WY00937.
Comments imported for SUBBED Workorder: C13120442

End of comments imported for SUBBED Workorder: C13120442.

Standard operating procedure submitted by Arcadis as "Standard Operating Procedures for Measurement of Cu2+ Activity in Soil by Ion-Selective Electrode" (ed. September 2013). Copper activity measured with a Combination Cupric Sure-Flow Ion Selective Electrode (Thermo Scientific, 9629BNWP) as per SOP. All samples and standards were filtered through 0.22µm membrane cellulose-acetate filters (Whatman, 10404112), prior to analysis. All analysis was performed under reduced light conditions.
Exchangeable copper values calculated from "Copper (Soluble), CaCl2" and extractable copper results. Exchangeable Ca, Mg, Na, and K, calculated from soluble cations and extractable cation results.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Phytotoxicity
Workorder: H13120008

Report Date: 12/24/13
Date Received: 11/26/13

		Analysis		Moisture (As	Sand	Silt	Clay	Texture	Percent Sat	pH-SatPst	Alk-SatPst	HCO3-SatPst	COND	Ca-SatPst
		Units		wt%	%	%	%	%	%	s_u_	mg/L	mg/L	mmhos/cm	meq/L
Sample ID	**Client Sample ID**	**Up**	**Low**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
H13120008-001	STS-PT-2013-34	0	0	7.5	60	21	19	SL	24.1	4.8	22	27	0.4	2.74
H13120008-002	STS-PT-2013-35	0	0	11.1	34	41	25	L	33.8	4.5	21	26	0.3	1.70
H13120008-003	STS-PT-2013-36	0	0	7.6	56	23	21	SCL	33.0	5.9	211	258	2.6	31.2

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Phytotoxicity
Workorder: H13120008

Report Date: 12/24/13
Date Received: 11/26/13

		Analysis		Mg-SatPst	K-SatPst	Na-SatPst	Alk SatPst	HCO3 SatPst	Fluoride	SO4-SatPst	Cl-SatPst	Ca-NH4OAC	Cu-NH4OAC	Mg-NH4OAC
		Units		meq/L	meq/L	meq/L	meq/L	meq/L	mg/L	meq/L	meq/L	mg/kg	mg/kg	mg/kg
Sample ID	**Client Sample ID**	**Up**	**Low**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
H13120008-001	STS-PT-2013-34	0	0	0.86	0.31	0.31	0.44	0.44	< 0.1	2.74	0.16	552	266	61
H13120008-002	STS-PT-2013-35	0	0	0.61	0.16	0.24	0.42	0.42	< 0.1	1.57	0.13	1290	648	145
H13120008-003	STS-PT-2013-36	0	0	5.02	0.18	0.56	4.23	4.22	< 1	31.7	0.22	2700	1040	170

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	Chino Mine Company	**Report Date:**	12/24/13
Project:	Phytotoxicity	**Date Received:**	11/26/13
Workorder:	H13120008		

		Analysis		Na-NH4OAC	Ca-Ext-NH4OAC	Mg-Ext-NH4OAC	K-Ext-NH4OAC	K-NH4OAC	Na-Ext-NH4OAC	Exch Ca	Exch Mg	Exch K	Exch Na	Exch Cu
		Units		mg/kg	meq/100g	meq/100g	meq/100g	mg/kg	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g
Sample ID	**Client Sample ID**	**Up**	**Low**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
H13120008-001	STS-PT-2013-34	0	0	17	2.76	0.506	0.429	168	0.075	2.7	0.5	0.4	< 0.1	0.8
H13120008-002	STS-PT-2013-35	0	0	23	6.46	1.21	0.732	286	0.098	6.4	1.2	0.7	< 0.1	1.8
H13120008-003	STS-PT-2013-36	0	0	28	13.5	1.41	0.329	129	0.120	12.4	1.2	0.3	0.1	3.2

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Phytotoxicity
Workorder: H13120008

Report Date: 12/24/13
Date Received: 11/26/13

		Analysis		OM-WB	Lime	P-Bray	PO4	NO3	Cu-CACL2	Al-DTPA	Fe-DTPA	Mn-DTPA	Cu-T	Organic Carbon,
		Units		%	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Sample ID	**Client Sample ID**	**Up**	**Low**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
H13120008-001	STS-PT-2013-34	0	0	1.8	0.33	55.4	3	2	22.4	10.5	91	28.3	1200	10
H13120008-002	STS-PT-2013-35	0	0	1.9	0.51	21.8	2	2	73.6	0.7	7	11.4	1630	10
H13120008-003	STS-PT-2013-36	0	0	1.4	1.38	12.9	< 1	3	30.7	0.8	3	2.7	3770	6

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Phytotoxicity
Workorder: H13120008

Report Date: 12/24/13
Date Received: 11/26/13

		Analysis		Conductivity , CaCl2	Millivolts	pCu, Measured	ph, CaCl2
		Units		mmhos/cm	mV	s_u_	s_u_
Sample ID	**Client Sample ID**	**Up**	**Low**	**Results**	**Results**	**Results**	**Results**
H13120008-001	STS-PT-2013-34	0	0	1.6	105	3.45	4.7
H13120008-002	STS-PT-2013-35	0	0	1.6	120	2.87	4.3
H13120008-003	STS-PT-2013-36	0	0	1.8	108	3.33	6.1

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company | **Report Date:** 12/24/13

Project: Phytotoxicity | **Work Order:** H13120008

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A5310 C									Analytical Run: SUB-C181773
Sample ID: ICV-7684	Initial Calibration Verification Standard								12/16/13 07:47
Organic Carbon, Dissolved (DOC)	10.2	mg/L	0.50	102	90	110			
Sample ID: CCV-7343	Continuing Calibration Verification Standard								12/16/13 10:44
Organic Carbon, Dissolved (DOC)	10.2	mg/L	0.50	102	90	110			
Method: A5310 C									Batch: C_40071
Sample ID: MBLK	Method Blank				Run: SUB-C181773				12/16/13 08:08
Organic Carbon, Dissolved (DOC)	ND	mg/L	0.04						
Sample ID: MB-22703	Method Blank				Run: SUB-C181773				12/16/13 08:39
Organic Carbon, Dissolved (DOC)	0.9	mg/kg	0.04						
Sample ID: H13120008-003A	Sample Matrix Spike				Run: SUB-C181773				12/16/13 13:06
Organic Carbon, Dissolved (DOC)	59.2	mg/kg	1.0	106	85	115			
Sample ID: H13120008-003A	Sample Matrix Spike Duplicate				Run: SUB-C181773				12/16/13 13:17
Organic Carbon, Dissolved (DOC)	59.6	mg/kg	1.0	106	85	115	0.6	10	
Sample ID: LCS-7684	Laboratory Control Sample				Run: SUB-C181773				12/16/13 13:28
Organic Carbon, Dissolved (DOC)	10.3	mg/L	0.50	103	90	110			
Sample ID: H13120008-002A	Sample Duplicate				Run: SUB-C181773				12/16/13 12:45
Organic Carbon, Dissolved (DOC)	9.81	mg/kg	1.0				2.8	10	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company

Project: Phytotoxicity

Report Date: 12/24/13

Work Order: H13120008

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: arcadis SOP									Batch: 131211_1_PH-S-PASTE
Sample ID: LCS-22738	Laboratory Control Sample				Run: MISC SOILS_131216B				12/17/13 09:16
Conductivity, CaCl2	2.15	mmhos/cm	0.10	82	70	130			
pCu, Measured	8.89	s.u.	0.010	102	70	130			
ph, CaCl2	7.31	s.u.	0.10	101	70	130			
Sample ID: H13110098-010Adup	Sample Duplicate				Run: MISC SOILS_131216B				12/17/13 09:29
Conductivity, CaCl2	1.65	mmhos/cm	0.10						
Millivolts	94.0	mV							
pCu, Measured	3.89	s.u.	0.010						
ph, CaCl2	4.64	s.u.	0.10						
Sample ID: H13110098-020Adup	Sample Duplicate				Run: MISC SOILS_131216B				12/17/13 09:44
Conductivity, CaCl2	1.51	mmhos/cm	0.10						
Millivolts	-32.9	mV							
pCu, Measured	8.90	s.u.	0.010						
ph, CaCl2	6.51	s.u.	0.10						
Sample ID: LCS-22739	Laboratory Control Sample				Run: MISC SOILS_131216B				12/17/13 09:47
Conductivity, CaCl2	2.49	mmhos/cm	0.10	95	70	130			
pCu, Measured	9.15	s.u.	0.010	105	70	130			
ph, CaCl2	7.02	s.u.	0.10	97	70	130			
Sample ID: H13110098-030Adup	Sample Duplicate				Run: MISC SOILS_131216B				12/17/13 09:59
Conductivity, CaCl2	1.77	mmhos/cm	0.10						
Millivolts	85.3	mV							
pCu, Measured	4.24	s.u.	0.010						
ph, CaCl2	3.43	s.u.	0.10						
Sample ID: H13110098-036Adup	Sample Duplicate				Run: MISC SOILS_131216B				12/17/13 10:07
Millivolts	-10.1	mV	0.10						
pCu, Measured	8.00	s.u.							
Sample ID: H13120008-002Adup	Sample Duplicate				Run: MISC SOILS_131216B				12/17/13 10:10
Conductivity, CaCl2	1.59	mmhos/cm	0.10						
Millivolts	120	mV							
pCu, Measured	2.87	s.u.	0.010						
ph, CaCl2	4.24	s.u.	0.10						

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/24/13

Project: Phytotoxicity **Work Order:** H13120008

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA10-3									Batch: 22722
Sample ID: MB-22722	Method Blank				Run: MAN-TECH_131209B				12/09/13 19:30
Alkalinity, sat paste	1	mg/L	0.1						
Bicarbonate, sat paste	1	mg/L	0.5						
Alkalinity, sat. paste	0.02	meq/L	0.002						
Bicarbonate, sat. paste	0.02	meq/L	0.008						
Sample ID: LCS-22722	Laboratory Control Sample				Run: MAN-TECH_131209B				12/09/13 19:36
Alkalinity, sat paste	226	mg/L	1.0	96	70	130			
Bicarbonate, sat paste	276	mg/L	1.0	96	70	130			
Alkalinity, sat. paste	4.53	meq/L	0.020	96	70	130			
Bicarbonate, sat. paste	4.53	meq/L	0.016	96	70	130			
Sample ID: H13120008-003ADUP	Sample Duplicate				Run: MAN-TECH_131209B				12/09/13 19:58
Alkalinity, sat paste	211	mg/L	1.0				0.1	30	
Bicarbonate, sat paste	258	mg/L	1.0				0.1	30	
Alkalinity, sat. paste	4.22	meq/L	0.020				0.1	30	
Bicarbonate, sat. paste	4.22	meq/L	0.016				0.1	30	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/24/13
Project: Phytotoxicity **Work Order:** H13120008

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA15-5									Batch: R93500
Sample ID: H13110403-030ADUP	Sample Duplicate				Run: MISC SOILS_131212A				12/09/13 16:46
Sand	32.0	%	1.0				0.0	20	
Silt	39.0	%	1.0				0.0	20	
Clay	29.0	%	1.0				0.0	20	
Texture	ND	%	1.0						
Sample ID: LCS-22751	Laboratory Control Sample				Run: MISC SOILS_131212A				12/09/13 16:46
Sand	38.0	%	1.0	112	70	130			
Silt	33.0	%	1.0	94	70	130			
Clay	29.0	%	1.0	94	70	130			
Sample ID: H13110404-045ADUP	Sample Duplicate				Run: MISC SOILS_131212A				12/11/13 16:48
Sand	40.0	%	1.0				0.0	20	
Silt	33.0	%	1.0				0.0	20	
Clay	27.0	%	1.0				0.0	20	
Texture	ND	%	1.0						

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/24/13
Project: Phytotoxicity **Work Order:** H13120008

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA24-5						Analytical Run: FIA202-HE_131217A			
Sample ID: ICV	Initial Calibration Verification Standard								12/17/13 09:32
Phosphorus	5.1	mg/kg	1.0	102	90	110			
Sample ID: ICB	Initial Calibration Blank, Instrument Blank								12/17/13 09:35
Phosphorus	0.027	mg/kg	1.0		0	0			
Method: ASA24-5								Batch: 22789	
Sample ID: LCS-22789	Laboratory Control Sample				Run: FIA202-HE_131217A				12/17/13 09:36
Phosphorus	102	mg/kg	2.0	101	80	120			
Sample ID: MB-22789	Method Blank				Run: FIA202-HE_131217A				12/17/13 09:37
Phosphorus	ND	mg/kg	0.5						
Sample ID: H13120008-001ADUP	Sample Duplicate				Run: FIA202-HE_131217A				12/17/13 09:39
Phosphorus	55.2	mg/kg	1.0				0.3	30	
Sample ID: H13120008-002AMS	Sample Matrix Spike				Run: FIA202-HE_131217A				12/17/13 09:41
Phosphorus	62.8	mg/kg	1.0	82	70	130			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Phytotoxicity

Report Date: 12/24/13
Work Order: H13120008

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA24-5.3									Analytical Run: FIA202-HE_131221A
Sample ID: ICV	Initial Calibration Verification Standard								12/21/13 09:45
Phosphate, Soluble	0.247	mg/kg	0.10	99	90	110			
Sample ID: CCV	Continuing Calibration Verification Standard								12/21/13 09:48
Phosphate, Soluble	0.0975	mg/kg	0.10	98	90	110			
Method: ASA24-5.3									Batch: 22906
Sample ID: MB-22906	Method Blank				Run: FIA202-HE_131221A				12/21/13 09:50
Phosphate, Soluble	ND	mg/kg	0.1						
Sample ID: LCS-0812	Laboratory Control Sample				Run: FIA202-HE_131221A				12/21/13 09:51
Phosphate, Soluble	0.426	mg/kg	0.10	114	70	130			
Sample ID: H13120008-003AMS	Sample Matrix Spike				Run: FIA202-HE_131221A				12/21/13 09:57
Phosphate, Soluble	4.05	mg/kg	1.0	101	70	130			
Sample ID: H13120008-002ADUP	Sample Duplicate				Run: FIA202-HE_131221A				12/21/13 10:02
Phosphate, Soluble	2.90	mg/kg	1.0				32	30	R

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

R - RPD exceeds advisory limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Phytotoxicity

Report Date: 12/24/13
Work Order: H13120008

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA29-3									Batch: 22850
Sample ID: LCS-228501312181502	Laboratory Control Sample				Run: MISC SOILS_131216C				12/18/13 15:02
Organic Matter	1.48	%	0.17	108	70	130			
Sample ID: H13120008-003ADUP	Sample Duplicate				Run: MISC SOILS_131216C				12/18/13 15:02
Organic Matter	1.26	%	0.17						

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/24/13
Project: Phytotoxicity **Work Order:** H13120008

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA33-8									Analytical Run: FIA203-HE_131219A
Sample ID: ICV	Initial Calibration Verification Standard								12/19/13 11:44
Nitrate as N, KCL Extract	1.1	mg/kg	1.0	105	90	110			
Sample ID: CCV	Continuing Calibration Verification Standard								12/19/13 11:47
Nitrate as N, KCL Extract	0.47	mg/kg	1.0	94	90	110			
Sample ID: ICB	Initial Calibration Blank, Instrument Blank								12/19/13 11:48
Nitrate as N, KCL Extract	-0.0038	mg/kg	1.0		0	0			
Method: ASA33-8									Batch: 22739
Sample ID: LCS-22872	Laboratory Control Sample				Run: FIA203-HE_131219A				12/19/13 11:52
Nitrate as N, KCL Extract	3.4	mg/kg	1.0	107	70	130			
Sample ID: MB-22872	Method Blank				Run: FIA203-HE_131219A				12/19/13 11:53
Nitrate as N, KCL Extract	ND	mg/kg	0.1						
Sample ID: H13120008-001AMS	Sample Matrix Spike				Run: FIA203-HE_131219A				12/19/13 11:55
Nitrate as N, KCL Extract	4.0	mg/kg	1.1	101	80	120			
Sample ID: H13120008-001AMSD	Sample Matrix Spike Duplicate				Run: FIA203-HE_131219A				12/19/13 11:57
Nitrate as N, KCL Extract	4.0	mg/kg	1.1	98	80	120	1.5	30	
Sample ID: H13120008-002ADUP	Sample Duplicate				Run: FIA203-HE_131219A				12/19/13 11:59
Nitrate as N, KCL Extract	2.2	mg/kg	1.0				2.9	30	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/24/13
Project: Phytotoxicity **Work Order:** H13120008

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASAM10-3									Analytical Run: SOIL EC_131206A
Sample ID: ICV_1_131205_1	Initial Calibration Verification Standard								12/06/13 10:04
Conductivity, sat. paste	19.3	mmhos/cm	0.10	97	90	110			
Sample ID: CCV_1_131205_1	Continuing Calibration Verification Standard								12/06/13 09:53
Conductivity, sat. paste	1.44	mmhos/cm	0.10	102	90	110			
Sample ID: CCV1_1_131205_1	Continuing Calibration Verification Standard								12/06/13 09:53
Conductivity, sat. paste	4.93	mmhos/cm	0.10	99	90	110			
Sample ID: ICV_1_131205_1	Initial Calibration Verification Standard								12/06/13 09:54
Conductivity, sat. paste	19.6	mmhos/cm	0.10	98	90	110			
Method: ASAM10-3									Batch: 131205_1_COND-S-PASTE
Sample ID: LCS-22726	Laboratory Control Sample				Run: SOIL EC_131206A				12/06/13 10:05
Conductivity, sat. paste	5.14	mmhos/cm	0.10	85	80	120			
Sample ID: H13120008-003ADUP	Sample Duplicate				Run: SOIL EC_131206A				12/06/13 09:59
Conductivity, sat. paste	2.70	mmhos/cm	0.10				3.0	20	
Method: ASAM10-3									Analytical Run: SOIL EC_131213A
Sample ID: CCV_1_131211_1	Continuing Calibration Verification Standard								12/12/13 09:18
Conductivity, sat. paste	1.39	mmhos/cm	0.10	99	90	110			
Sample ID: CCV1_1_131211_1	Continuing Calibration Verification Standard								12/12/13 09:19
Conductivity, sat. paste	4.84	mmhos/cm	0.10	97	90	110			
Sample ID: ICV_1_131211_1	Initial Calibration Verification Standard								12/12/13 09:19
Conductivity, sat. paste	19.3	mmhos/cm	0.10	96	90	110			
Sample ID: ICV_1_131211_1	Initial Calibration Verification Standard								12/12/13 10:09
Conductivity, sat. paste	19.3	mmhos/cm	0.10	97	90	110			
Method: ASAM10-3									Batch: 131211_1_COND-S-PASTE
Sample ID: LCS-22793	Laboratory Control Sample				Run: SOIL EC_131213A				12/12/13 09:20
Conductivity, sat. paste	5.16	mmhos/cm	0.10	85	80	120			
Sample ID: H13120061-009ADUP	Sample Duplicate				Run: SOIL EC_131213A				12/12/13 10:17
Conductivity, sat. paste	12.6	mmhos/cm	0.10				0.3	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Phytotoxicity

Report Date: 12/24/13
Work Order: H13120008

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASAM10-3.2									Analytical Run: SOIL PH METER_131206A
Sample ID: ICV_1_131205_1	Initial Calibration Verification Standard								12/06/13 07:55
pH, sat. paste	10.0	s.u.	0.10	100	99	101			
Sample ID: CCV_1_131205_1	Continuing Calibration Verification Standard								12/06/13 07:38
pH, sat. paste	7.00	s.u.	0.10	100	98.6	101.4			
Sample ID: CCV1_1_131205_1	Continuing Calibration Verification Standard								12/06/13 07:39
pH, sat. paste	4.00	s.u.	0.10	100	97.5	102.5			
Sample ID: ICV_1_131205_1	Initial Calibration Verification Standard								12/06/13 07:40
pH, sat. paste	10.0	s.u.	0.10	100	99	101			
Method: ASAM10-3.2									Batch: 22722
Sample ID: LCS-22722	Laboratory Control Sample				Run: SOIL PH METER_131206A				12/06/13 07:40
pH, sat. paste	7.59	s.u.	0.10	100	95	105			
Sample ID: H13120008-003ADUP	Sample Duplicate				Run: SOIL PH METER_131206A				12/06/13 07:43
pH, sat. paste	5.86	s.u.	0.10				0.2	30	
Method: ASAM10-3.2									Analytical Run: SOIL PH METER_131213A
Sample ID: CCV_1_131211_1	Continuing Calibration Verification Standard								12/11/13 09:06
pH, sat. paste	7.01	s.u.	0.10	100	98.6	101.4			
Sample ID: CCV1_1_131211_1	Continuing Calibration Verification Standard								12/11/13 09:07
pH, sat. paste	4.01	s.u.	0.10	100	97.5	102.5			
Sample ID: ICV_1_131211_1	Initial Calibration Verification Standard								12/11/13 09:08
pH, sat. paste	10.0	s.u.	0.10	100	99	101			
Sample ID: ICV_1_131211_1	Initial Calibration Verification Standard								12/12/13 08:08
pH, sat. paste	10.0	s.u.	0.10	100	99	101			
Sample ID: ICV_1_131209_1	Initial Calibration Verification Standard								12/10/13 07:51
pH, sat. paste	10.0	s.u.	0.10	100	99	101			
Sample ID: ICV_1_131209_1	Initial Calibration Verification Standard								12/10/13 08:13
pH, sat. paste	10.0	s.u.	0.10	100	99	101			
Sample ID: ICV_1_131211_1	Initial Calibration Verification Standard								12/11/13 09:45
pH, sat. paste	10.0	s.u.	0.10	100	99	101			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company

Project: Phytotoxicity

Report Date: 12/24/13

Work Order: H13120008

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: Calculation								Batch: R93691	
Sample ID: H13120061-009ADUP	Sample Duplicate				Run: MISC SOILS_131220A			12/20/13 13:07	
Exchangeable Calcium	32.5	meq/100g	0.10					30	
Exchangeable Magnesium	3.12	meq/100g	0.10				2.3	30	
Exchangeable Potassium	2.42	meq/100g	0.10					30	
Exchangeable Sodium	2.18	meq/100g	0.10				8.4	30	
Sample ID: H13120008-002ADUP	Sample Duplicate				Run: MISC SOILS_131220A			11/19/13 13:19	
Exchangeable Calcium	6.41	meq/100g	0.10				0.2	30	
Exchangeable Magnesium	1.19	meq/100g	0.10				0.0	30	
Exchangeable Potassium	0.720	meq/100g	0.10				0.0	30	
Exchangeable Sodium	0.0900	meq/100g	0.10					30	
Exchangeable Copper	1.81	meq/100g	0.10						

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Phytotoxicity

Report Date: 12/24/13
Work Order: H13120008

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: D2974								Batch: R93279	
Sample ID: H13120008-003ADUP	Sample Duplicate				Run: SOIL DRYING OVEN 2_13120			12/04/13 09:50	
Moisture (As Received)	7.88	wt%	0.20				4.0	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/24/13
Project: Phytotoxicity **Work Order:** H13120008

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E200.7									Analytical Run: ICP2-HE_131209B
Sample ID: ICV	Initial Calibration Verification Standard								12/09/13 10:19
Calcium	39.5	mg/L	1.0	99	90	110			
Magnesium	40.3	mg/L	1.0	101	90	110			
Sodium	39.7	mg/L	1.0	99	90	110			
Sample ID: ICSA	Interference Check Sample A								12/09/13 10:34
Calcium	458	mg/L	1.0	92	80	120			
Magnesium	408	mg/L	1.0	82	80	120			
Sodium	0.0529	mg/L	1.0		0	0			
Sample ID: ICSAB	Interference Check Sample AB								12/09/13 10:38
Calcium	450	mg/L	1.0	90	80	120			
Magnesium	406	mg/L	1.0	81	80	120			
Sodium	19.0	mg/L	1.0	95	80	120			
Method: E200.7									Analytical Run: ICP2-HE_131210A
Sample ID: ICV	Initial Calibration Verification Standard								12/10/13 09:21
Copper	0.804	mg/L	0.010	101	90	110			
Potassium	38.3	mg/L	1.0	96	90	110			
Sample ID: ICSA	Interference Check Sample A								12/10/13 09:35
Copper	-0.00476	mg/L	0.010		0	0			
Potassium	-0.0877	mg/L	1.0		0	0			
Sample ID: ICSAB	Interference Check Sample AB								12/10/13 09:39
Copper	0.510	mg/L	0.010	102	80	120			
Potassium	18.2	mg/L	1.0	91	80	120			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/24/13
Project: Phytotoxicity **Work Order:** H13120008

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E200.7									Analytical Run: ICP2-HE_131213C
Sample ID: ICV	Initial Calibration Verification Standard								12/13/13 11:10
Calcium	39.4	mg/L	1.0	99	90	110			
Copper	0.789	mg/L	0.010	99	90	110			
Magnesium	39.6	mg/L	1.0	99	90	110			
Potassium	39.1	mg/L	1.0	98	90	110			
Sodium	39.2	mg/L	1.0	98	90	110			
Sample ID: ICSA	Interference Check Sample A								12/13/13 11:25
Calcium	478	mg/L	1.0	96	80	120			
Copper	0.00698	mg/L	0.010		0	0			
Magnesium	533	mg/L	1.0	107	80	120			
Potassium	-0.0652	mg/L	1.0		0	0			
Sodium	0.0127	mg/L	1.0		0	0			
Sample ID: ICSAB	Interference Check Sample AB								12/13/13 11:29
Calcium	473	mg/L	1.0	95	80	120			
Copper	0.502	mg/L	0.010	100	80	120			
Magnesium	520	mg/L	1.0	104	80	120			
Potassium	19.3	mg/L	1.0	96	80	120			
Sodium	19.2	mg/L	1.0	96	80	120			
Method: E200.7									Analytical Run: ICP2-HE_131224A
Sample ID: ICV	Initial Calibration Verification Standard								12/24/13 09:40
Aluminum	4.10	mg/L	0.10	102	90	110			
Sample ID: ICSA	Interference Check Sample A								12/24/13 09:55
Aluminum	524	mg/L	0.10	105	80	120			
Sample ID: ICSAB	Interference Check Sample AB								12/24/13 09:59
Aluminum	512	mg/L	0.10	102	80	120			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/24/13
Project: Phytotoxicity **Work Order:** H13120008

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E300.0						Analytical Run: IC102-H_131206A			
Sample ID: ICV	Initial Calibration Verification Standard								12/06/13 18:16
Chloride	110	mg/L	1.0	106	90	110			
Sulfate	410	mg/L	1.0	103	90	110			
Fluoride	53	mg/L	0.10	105	90	110			
Sample ID: CCB120613-1	Continuing Calibration Blank								12/06/13 21:39
Chloride	0.024	mg/L	1.0						
Sulfate	0.10	mg/L	1.0						
Fluoride	0.041	mg/L	0.10						
Sample ID: CCV120613-2	Continuing Calibration Verification Standard								12/07/13 00:10
Chloride	100	mg/L	1.0	104	90	110			
Sulfate	410	mg/L	1.0	103	90	110			
Fluoride	52	mg/L	0.10	104	90	110			
Method: E300.0									Batch: 22722
Sample ID: LCS-22722	Laboratory Control Sample				Run: IC102-H_131206A				12/06/13 20:28
Sulfate, sat. paste	56.6	meq/L	0.42	94	70	130			
Chloride, sat. paste	2.94	meq/L	0.14	95	70	130			
Sample ID: H13120008-003AMS	Sample Matrix Spike				Run: IC102-H_131206A				12/06/13 21:08
Fluoride	255	mg/L	1.1	102	90	110			
Sulfate, sat. paste	74.3	meq/L	0.24	102	90	110			
Chloride, sat. paste	14.3	meq/L	0.080	98	90	110			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Phytotoxicity

Report Date: 12/24/13
Work Order: H13120008

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B									Batch: 22678
Sample ID: MB-22678	Method Blank				Run: ICP2-HE_131209B				12/09/13 12:20
Copper	ND	mg/kg	0.3						
Sample ID: LFB-22678	Laboratory Fortified Blank				Run: ICP2-HE_131209B				12/09/13 12:23
Copper	49.1	mg/kg	1.0	98	80	120			
Sample ID: LCS-22678	Laboratory Control Sample				Run: ICP2-HE_131209B				12/09/13 12:27
Copper	248	mg/kg	1.3	88	77.5	109.6			
Sample ID: H13120008-003AMS	Sample Matrix Spike				Run: ICP2-HE_131209B				12/09/13 12:56
Copper	3330	mg/kg	1.3		75	125			A
Sample ID: H13120008-003AMSD	Sample Matrix Spike Duplicate				Run: ICP2-HE_131209B				12/09/13 12:59
Copper	3160	mg/kg	1.3		75	125	5.3	20	A
Method: SW6010B									Batch: 22722
Sample ID: MB-22722	Method Blank				Run: ICP2-HE_131209B				12/09/13 14:47
Calcium	0.05	mg/L	0.03						
Magnesium	ND	mg/L	0.02						
Potassium	ND	mg/L	0.03						
Sodium	ND	mg/L	0.03						
Calcium, sat. paste	0.002	meq/L	0.001						
Magnesium, sat. paste	ND	meq/L	0.001						
Potassium, sat. paste	ND	meq/L	0.0007						
Sodium, sat. paste	ND	meq/L	0.001						
Sample ID: H13120010-001AMS2	Sample Matrix Spike				Run: ICP2-HE_131209B				12/09/13 15:25
Calcium	167	mg/L	1.0	101	75	125			
Magnesium	120	mg/L	1.0	104	75	125			
Potassium	124	mg/L	1.0	101	75	125			
Sodium	113	mg/L	1.0	102	75	125			
Calcium, sat. paste	8.35	meq/L	0.050	101	75	125			
Magnesium, sat. paste	9.87	meq/L	0.082	104	75	125			
Potassium, sat. paste	3.16	meq/L	0.026	124	75	125			
Sodium, sat. paste	4.92	meq/L	0.044	102	75	125			
Sample ID: H13120010-001AMSD2	Sample Matrix Spike Duplicate				Run: ICP2-HE_131209B				12/09/13 15:28
Calcium	167	mg/L	1.0	101	75	125	0.0	20	
Magnesium	119	mg/L	1.0	104	75	125	0.5	20	
Potassium	122	mg/L	1.0	100	75	125	0.9	20	
Sodium	112	mg/L	1.0	101	75	125	1.0	20	
Calcium, sat. paste	8.35	meq/L	0.050	101	75	125	0.0	20	
Magnesium, sat. paste	9.82	meq/L	0.082	104	75	125	0.5	20	
Potassium, sat. paste	3.13	meq/L	0.026	122	75	125	0.9	20	
Sodium, sat. paste	4.87	meq/L	0.044	101	75	125	1.0	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company

Project: Phytotoxicity

Report Date: 12/24/13

Work Order: H13120008

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B								Batch: 22722	
Sample ID: H13120010-001AMSD2	Sample Matrix Spike Duplicate				Run: ICP2-HE_131209B			12/09/13 15:28	
Method: SW6010B								Batch: 22678	
Sample ID: MB-22678	Method Blank				Run: ICP2-HE_131210A			12/10/13 09:55	
Copper	ND	mg/kg	0.3						
Sample ID: H13120008-003AMS	Sample Matrix Spike				Run: ICP2-HE_131210A			12/10/13 10:24	
Copper	3550	mg/kg	2.6		75	125			A
Sample ID: H13120008-003AMSD	Sample Matrix Spike Duplicate				Run: ICP2-HE_131210A			12/10/13 10:27	
Copper	3440	mg/kg	2.6		75	125	3.2	20	A
Method: SW6010B								Batch: 22722	
Sample ID: MB-22722	Method Blank				Run: ICP2-HE_131210A			12/10/13 10:31	
Calcium	ND	mg/L	0.03						
Magnesium	ND	mg/L	0.02						
Potassium	ND	mg/L	0.03						
Sodium	ND	mg/L	0.03						
Calcium, sat. paste	ND	meq/L	0.001						
Magnesium, sat. paste	ND	meq/L	0.001						
Potassium, sat. paste	ND	meq/L	0.0007						
Sodium, sat. paste	ND	meq/L	0.001						
Sample ID: LCS-22722	Laboratory Control Sample				Run: ICP2-HE_131210A			12/10/13 10:35	
Calcium	473	mg/L	1.0	114	70	130			
Magnesium	152	mg/L	1.0	111	70	130			
Potassium	14.2	mg/L	1.0	108	70	130			
Sodium	730	mg/L	1.0	101	70	130			
Calcium, sat. paste	23.6	meq/L	0.050	114	70	130			
Magnesium, sat. paste	12.5	meq/L	0.082	111	70	130			
Potassium, sat. paste	0.362	meq/L	0.026	108	70	130			
Sodium, sat. paste	31.7	meq/L	0.043	101	70	130			
Sample ID: H13120008-003Adup	Sample Duplicate				Run: ICP2-HE_131210A			12/10/13 10:50	
Calcium	642	mg/L	1.0				0.7	30	
Magnesium	59.9	mg/L	1.0				1.8	30	
Potassium	7.20	mg/L	1.0				0.1	30	
Sodium	11.7	mg/L	1.0				2.3	30	
Calcium, sat. paste	32.1	meq/L	0.050				0.7	30	
Magnesium, sat. paste	4.93	meq/L	0.082				1.8	30	
Potassium, sat. paste	0.184	meq/L	0.026				0.1	30	
Sodium, sat. paste	0.510	meq/L	0.043				2.3	30	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Phytotoxicity

Report Date: 12/24/13
Work Order: H13120008

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B									Batch: 22801
Sample ID: MB-22801	Method Blank				Run: ICP2-HE_131213C				12/13/13 20:37
Calcium	30	mg/kg	0.1						
Copper	1	mg/kg	0.02						
Magnesium	7	mg/kg	0.08						
Sodium	10	mg/kg	0.1						
Potassium	ND	mg/kg	0.1						
Calcium, Extractable	0.1	meq/100g	0.0007						
Magnesium, Extractable	0.06	meq/100g	0.0007						
Potassium, Extractable	ND	meq/100g	0.0004						
Sodium, Extractable	0.05	meq/100g	0.0006						
Sample ID: LCS-22801	Laboratory Control Sample				Run: ICP2-HE_131213C				12/13/13 20:41
Calcium	6510	mg/kg	1.0	125	70	130			
Magnesium	741	mg/kg	1.0	112	70	130			
Sodium	817	mg/kg	1.0	103	70	130			
Potassium	217	mg/kg	1.0	102	70	130			
Calcium, Extractable	32.5	meq/100g	0.0050	125	70	130			
Magnesium, Extractable	6.15	meq/100g	0.0083	112	70	130			
Potassium, Extractable	0.555	meq/100g	0.0026	102	70	130			
Sodium, Extractable	3.55	meq/100g	0.0044	103	70	130			
Sample ID: H13120008-002AMS2	Sample Matrix Spike				Run: ICP2-HE_131213C				12/13/13 20:59
Calcium	3810	mg/kg	1.0	101	75	125			
Copper	721	mg/kg	1.0		75	125			A
Magnesium	2590	mg/kg	1.0	98	75	125			
Sodium	2540	mg/kg	1.0	101	75	125			
Potassium	2750	mg/kg	1.0	98	75	125			
Calcium, Extractable	19.0	meq/100g	0.0050	101	75	125			
Magnesium, Extractable	21.5	meq/100g	0.0083	99	75	125			
Potassium, Extractable	7.03	meq/100g	0.0026	99	75	125			
Sodium, Extractable	11.1	meq/100g	0.0044	101	75	125			
Sample ID: H13120008-002AMSD2	Sample Matrix Spike Duplicate				Run: ICP2-HE_131213C				12/13/13 21:03
Calcium	3990	mg/kg	1.0	108	75	125	4.4	20	
Copper	771	mg/kg	1.0		75	125	6.7	20	A
Magnesium	2690	mg/kg	1.0	102	75	125	3.7	20	
Sodium	2710	mg/kg	1.0	107	75	125	6.3	20	
Potassium	2890	mg/kg	1.0	104	75	125	5.1	20	
Calcium, Extractable	19.9	meq/100g	0.0050	108	75	125	4.4	20	
Magnesium, Extractable	22.3	meq/100g	0.0083	103	75	125	3.7	20	
Potassium, Extractable	7.40	meq/100g	0.0026	104	75	125	5.1	20	
Sodium, Extractable	11.8	meq/100g	0.0044	107	75	125	6.3	20	
Sample ID: H13120006-006AMS2	Sample Matrix Spike				Run: ICP2-HE_131213C				12/13/13 21:25
Calcium	6950	mg/L	1.0	62	75	125			S

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.

S - Spike recovery outside of advisory limits.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Phytotoxicity

Report Date: 12/24/13
Work Order: H13120008

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B									Batch: 22801
Sample ID: H13120006-006AMS2	Sample Matrix Spike				Run: ICP2-HE_131213C				12/13/13 21:25
Magnesium	2520	mg/L	1.0	77	75	125			
Sodium	2630	mg/L	1.0	102	75	125			
Potassium	2700	mg/L	1.0	97	75	125			
Calcium, Extractable	34.7	meq/100g	0.0050	62	75	125			S
Magnesium, Extractable	21.0	meq/100g	0.0083	78	75	125			
Potassium, Extractable	6.91	meq/100g	0.0026	97	75	125			
Sodium, Extractable	11.5	meq/100g	0.0044	102	75	125			
Sample ID: H13120006-006AMSD2	Sample Matrix Spike Duplicate				Run: ICP2-HE_131213C				12/13/13 21:29
Calcium	7090	mg/L	1.0	68	75	125	2.1	20	S
Magnesium	2570	mg/L	1.0	79	75	125	1.8	20	
Sodium	2650	mg/L	1.0	103	75	125	0.6	20	
Potassium	2700	mg/L	1.0	97	75	125	0.1	20	
Calcium, Extractable	35.4	meq/100g	0.0050	68	75	125	2.1	20	S
Magnesium, Extractable	21.3	meq/100g	0.0083	80	75	125	1.8	20	
Potassium, Extractable	6.92	meq/100g	0.0026	97	75	125	0.1	20	
Sodium, Extractable	11.5	meq/100g	0.0044	103	75	125	0.6	20	
Method: SW6010B									Batch: 22854
Sample ID: MB-22854	Method Blank				Run: ICP2-HE_131224A				12/24/13 11:31
Aluminum	0.05	mg/kg	0.04						
Sample ID: LCS-22854	Laboratory Control Sample				Run: ICP2-HE_131224A				12/24/13 11:35
Aluminum	0.578	mg/kg	0.10	94	70	130			
Sample ID: H13120008-001AMS2	Sample Matrix Spike				Run: ICP2-HE_131224A				12/24/13 11:49
Aluminum	113	mg/kg	0.10	103	75	125			
Sample ID: H13120008-001AMSD2	Sample Matrix Spike Duplicate				Run: ICP2-HE_131224A				12/24/13 11:53
Aluminum	113	mg/kg	0.10	103	75	125	0.1	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

S - Spike recovery outside of advisory limits.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/24/13

Project: Phytotoxicity **Work Order:** H13120008

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6020									Batch: 22739
Sample ID: MB-22739	Method Blank				Run: ICPMS204-B_131210B				12/11/13 03:55
Copper	0.08	mg/kg	0.0003						
Sample ID: LFB-22739	Laboratory Fortified Blank				Run: ICPMS204-B_131210B				12/11/13 04:04
Copper	0.548	mg/kg	0.10	93	80	120			
Sample ID: H13110098-021AMS	Sample Matrix Spike				Run: ICPMS204-B_131210B				12/11/13 04:31
Copper	2.66	mg/kg	0.10		0	0			A
Sample ID: H13110098-030Adup	Sample Duplicate				Run: ICPMS204-B_131210B				12/11/13 05:28
Copper	3.49	mg/kg	0.10						
Method: SW6020									Analytical Run: ICPMS204-B_131211B
Sample ID: ICV STD	Initial Calibration Verification Standard								12/11/13 09:25
Copper	0.0602	mg/L	0.0010	100	90	110			
Method: SW6020									Batch: 22739
Sample ID: MB-22739	Method Blank				Run: ICPMS204-B_131211B				12/12/13 00:01
Copper	0.009	mg/kg	0.0003						

Qualifiers:

RL - Analyte reporting limit.

A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/24/13
Project: Phytotoxicity **Work Order:** H13120008

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6020						Analytical Run: ICPMS204-B_131220C			
Sample ID: ICV STD	Initial Calibration Verification Standard								12/20/13 09:35
Iron	0.314	mg/L	0.0010	105	90	110			
Manganese	0.300	mg/L	0.0010	100	90	110			
Sample ID: ICV STD	Initial Calibration Verification Standard								12/20/13 09:53
Iron	0.329	mg/L	0.0010	110	90	110			
Manganese	0.288	mg/L	0.0010	96	90	110			
Sample ID: ICV STD	Initial Calibration Verification Standard								12/20/13 17:42
Iron	0.305	mg/L	0.0010	102	90	110			
Manganese	0.291	mg/L	0.0010	97	90	110			
Sample ID: ICV STD	Initial Calibration Verification Standard								12/21/13 00:52
Iron	0.310	mg/L	0.0010	103	90	110			
Manganese	0.291	mg/L	0.0010	97	90	110			
Method: SW6020									Batch: 22854
Sample ID: MB-22854	Method Blank				Run: ICPMS204-B_131220C				12/21/13 09:19
Iron	0.3	mg/kg	0.04						
Manganese	0.2	mg/kg	0.02						
Sample ID: LCS-22854	Laboratory Control Sample				Run: ICPMS204-B_131220C				12/21/13 09:24
Iron	17.9	mg/kg	1.0	120	70	130			
Manganese	6.54	mg/kg	0.10	112	70	130			
Sample ID: H13120008-001AMS	Sample Matrix Spike				Run: ICPMS204-B_131220C				12/21/13 09:46
Iron	119	mg/kg	1.0	92	70	130			
Manganese	37.4	mg/kg	0.10	91	70	130			
Sample ID: H13120008-003Adup	Sample Duplicate				Run: ICPMS204-B_131220C				12/21/13 10:04
Iron	2.71	mg/kg	1.0				0.8	30	
Manganese	2.61	mg/kg	0.10				2.3	30	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company

Report Date: 12/24/13

Project: Phytotoxicity

Work Order: H13120008

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: USDA23c									Batch: 22720
Sample ID: MB-22720	Method Blank				Run: MAN-TECH_131206A				12/06/13 07:15
Neutralization Potential	0.4	Tons/1000T	0.05						
Lime as CaCO3	0.04	%	0.005						
Sample ID: LCS-22720	Laboratory Control Sample				Run: MAN-TECH_131206A				12/06/13 07:21
Neutralization Potential	55.5	Tons/1000T	0.10	112	80	120			
Lime as CaCO3	5.55	%	0.010	112	80	120			
Sample ID: H13120008-003ADUP	Sample Duplicate				Run: MAN-TECH_131206A				12/06/13 07:59
Neutralization Potential	12.4	Tons/1000T	0.10				11	20	
Lime as CaCO3	1.24	%	0.010				11	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 12/24/13
Project: Phytotoxicity **Work Order:** H13120008

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: USDA27a								Batch: 22722	
Sample ID: LCS_1_131205_1	Laboratory Control Sample				Run: SOIL ROOM BALANCE_13121			12/06/13 07:47	
Saturation	43.1	%	0.10	95	80	120			
Sample ID: H13120008-003ADUP	Sample Duplicate				Run: SOIL ROOM BALANCE_13121			12/06/13 07:47	
Saturation	33.0	%	0.10				0.1	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

Workorder Receipt Checklist

Chino Mine Company

H13120008

Login completed by:	Skyler T. Pester	Date Received:	11/26/2013
Reviewed by:	BL2000\sdull	Received by:	SRW
Reviewed Date:	12/10/2013	Carrier name:	UPS Ground

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on all shipping container(s)/cooler(s)?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on all sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☐	No ☑	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☑	No ☐	
Temp Blank received in all shipping container(s)/cooler(s)?	Yes ☐	No ☑	Not Applicable ☐
Container/Temp Blank temperature:	11.6°C No Ice		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☐	Not Applicable ☑

Standard Reporting Procedures:

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Contact and Corrective Action Comments:

Collection times taken from sample bags. 12/1/2013 STP.

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

Page 1 of 1

PLEASE PRINT (Provide as much information as possible.)

Company Name: Chino Mines Co

Report Mail Address (Required): PO Box 10 Bayard NM 88043

❑ No Hard Copy Email:

Invoice Address (Required):

❑ No Hard Copy Email:

Project Name, PWS, Permit, Etc.: Phytotoxicity

Sample Origin State: NM

EPA/State Compliance: Yes ☐ No ☒

Contact Name: Pam Pinson

Phone/Fax: 575 912-5213

Cell:

Sampler: (Please Print) Pam Pinson

Invoice Contact & Phone:

Purchase Order: 2N00000 2U3

Quote/Bottle Order:

Special Report/Formats:

☐ DW
☐ POTW/WWTP
☐ State: ____
☐ Other: ____
☐ EDD/EDT (Electronic Data)
Format: ____
☐ LEVEL IV
☐ NELAC

Number of Containers
Sample Type: A W S V B O DW
Air Water Soils/Solids
Vegetation Bioassay Other
DW - Drinking Water

ANALYSIS REQUESTED

SEE ATTACHED

Standard Turnaround (TAT)

R U S H

Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments: Call Matthew Barkley ARCADIS 303-231-9115 ext 157

	SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	SEE ATTACHED
1	STS - PT-203-34	11-21-13	see bags	Soil	X
2	STS - PT-203 35	11-21-13		Soil	X
3	STS - PT-2013 36	11-21-13		Soil	X
4					
5					
6					
7					
8					
9					
10					

H13110008

LABORATORY USE ONLY

Shipped by: UPS G

Cooler ID(s): Y

Receipt Temp 11.6 °C

On Ice: Y [✓ N]

Custody Seal
On Bottle Y [✓ N]
On Cooler [✓ Y] N

Intact [✓ Y] N

Signature Match [✓ Y] N

Custody Record MUST be Signed

Relinquished by (print): Pam Pinson Date/Time: 11-21-13 / 3:30pm Signature: Pam Pinson

Relinquished by (print): Date/Time: Signature:

Received by (print): Date/Time: Signature:

Received by (print): Date/Time: Signature:

Received by Laboratory: Scott Wunderlich Date/Time: 11/26/13 10:15 Signature:

Sample Disposal: Return to Client: ____ Lab Disposal: ____

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report. Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

TABLE 4
SOIL SAMPLE ANALYTICAL ANALYSES

FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO
SMELTER/TAILING SOILS IU - PHYTOTOXICITY AND VEGETATION COMMUNITY STUDY

Parameter	Extraction Method	Analytical Method
Alkalinity (total)	ASA Mono #9, Part 2, 10-2.3.1	A 2320B
Chloride	ASA Mono #9, Part 2, 10-3.2	E300.0
Fluoride	ASA Mono #9, Part 2, 10-3.2	A 4500 F-C/Technicon 380-7WE
Exchangeable Calcium (NH4Oac)	ASA Mono #9, Part 2, 13-4	6010/6020
Exchangeable Copper (NH4Oac)	ASA Mono #9, Part 2, 13-4	6010/6020
Exchangeable Magnesium (NH4Oac)	ASA Mono #9, Part 2, 13-4	6010/6020
Exchangeable Potassium (NH4Oac)	ASA Mono #9, Part 2, 13-4	6010/6020
Exchangeable Sodium (NH4Oac)	ASA Mono #9, Part 2, 13-4	6010/6020
Sulfate (soluble)	ASA Mono #9, Part 2, 10-3.2	6010/6020
Copper (total)	3050	6010B
Copper (soluble), $CaCl_2$	ARCADIS SOP	ARCADIS SOP
Aluminum (soluble)	ASA Mono. #9, Part 2, Method 19-3.3	6010/6020
Iron (soluble)	ASA Mono. #9, Part 2, Method 19-3.3	6010/6020
Manganese (soluble)	ASA Mono. #9, Part 2, Method 19-3.3	6010/6020
Nitrate/Nitrite, $CaCl_2$	ASA Mono. #9, Part 2, Method 38-8.1	350.1, 353.2, 351.4
pH (saturated paste with saturated %)	ASA Mono #9, Part 2, 10-3.2	9045C
pH, $CaCl_2$	ARCADIS SOP	ARCADIS SOP
Plant Available Phosphorus (Bray/Olsen)	ASA Mono. #9, Part 2, Method 24-5.1	365.1
Phosphate	ASA Mono. #9, Part 2, Method 24-5.3	365.1
Electrical Conductivity, saturated paste	ASA Mono. #9, Part 2,Method 10-3.3	ASA Mono #9 Part 2
Electrical Conductivity, $CaCl_2$	ARCADIS SOP	ARCADIS SOP
Total Organic Matter	ASA Mono. #9, Part 2, Method 29-3.5.2	Handbook 60
DOC	ASA Mono. #9, Part 2, Method 10-3	ASA Mono #9 Part 2
Soil Texture	ASA Mono. #9, Part 1, Method 15-4	NAPT S-10.10[1]
$CaCO_3$	USDA Handbook 60, Method 23C	Handbook 60
Measured pCu	ARCADIS SOP	ARCADIS SOP
Moisture (dry basis)	USDA Handbook 60,Method 26	

H13120008

ACZ Laboratories, Inc.
2773 Downhill Drive   Steamboat Springs, CO 80487   (800) 334-5493

Analytical Report

August 14, 2013

Report to:
Pam Pinson
Freeport-McMoRan - Chino Mines Company
PO Box 10
Bayard, NM 88023

cc: Matthew Barkley

Bill to:
Pam Pinson
Freeport-McMoRan - Chino Mines Company
P.O. Box 13308
Phoenix, AZ 85002-3308

Project ID: ZN000001N6
ACZ Project ID: L13428

Pam Pinson:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on July 23, 2013. This project has been assigned to ACZ's project number, L13428. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan. The enclosed results relate only to the samples received under L13428. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all requirements of NELAC.

This report shall be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after September 13, 2013. If the samples are determined to be hazardous, additional charges apply for disposal (typically $11/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical raw data reports for ten years.

If you have any questions or other needs, please contact your Project Manager.

S. Habermehl

Scott Habermehl has reviewed
and approved this report.

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Case Narrative

Freeport-McMoRan - Chino Mines Company

August 14, 2013

Project ID: ZN000001N6
ACZ Project ID: L13428

Sample Receipt

ACZ Laboratories, Inc. (ACZ) received 20 soil samples from Freeport-McMoRan - Chino Mines Company on July 23, 2013. The samples were received in good condition. Upon receipt, the sample custodian removed the samples from the cooler, inspected the contents, and logged the samples into ACZ's computerized Laboratory Information Management System (LIMS). The samples were assigned ACZ LIMS project number L13428. The custodian verified the sample information entered into the computer against the chain of custody (COC) forms and sample bottle labels.

Holding Times

All analyses were performed within EPA recommended holding times.

Sample Analysis

These samples were analyzed for inorganic parameters. The individual methods are referenced on both, the ACZ invoice and the analytical reports. The extended qualifier reports may contain footnotes qualifying specific elements due to QC failures. In addition the following has been noted with this specific project:

1. The water extraction on L13428-07 was qualified with the N1 flag. The chemist mentioned that the sample had limited sample volume. The volume utilized was reduced to maintain the same dilution factor.

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000001N6
Sample ID: STS-RWU-2011-4 0-6

ACZ Sample ID: ***L13428-01***
Date Sampled: *07/15/13 10:15*
Date Received: *07/23/13*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, total (3050)	M6010B ICP	102	5320		*	mg/Kg	20	100	08/07/13 13:01	jjc
Copper, total (3050)	M6010B ICP	102	427		*	mg/Kg	1	5	08/07/13 13:01	jjc
Magnesium, total (3050)	M6010B ICP	102	3350		*	mg/Kg	20	100	08/07/13 13:01	jjc
Potassium, total (3050)	M6010B ICP	102	3860			mg/Kg	30	200	08/07/13 13:01	jjc
Sodium, total (3050)	M6010B ICP	102	70	B		mg/Kg	30	200	08/07/13 13:01	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Conductivity @25C	SM2510B									
Conductivity		1	0.741		*	mmhos/cm	0.001	0.01	08/08/13 0:00	cdb
Max Particle Size		1	2000		*	um			08/08/13 0:00	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	7.2			units	0.1	0.1	08/08/13 0:00	cdb
pH measured at		1	21.1			C	0.1	0.1	08/08/13 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	1	94.0		*	%	0.1	0.5	07/25/13 19:28	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								07/25/13 15:10	njj/mss
Digestion - Hot Plate	M3050B ICP								08/06/13 13:16	cdb
Saturated Paste Extraction	USDA No. 60 (2)								08/07/13 17:15	cdb
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								08/06/13 11:00	cdb
Water Extraction	ASA No. 9 10-2.3.2								08/08/13 10:17	brd

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfate, soluble (Water)	D516-02 - Turbidimetric	50	755		*	mg/Kg	50	250	08/09/13 13:21	bsu

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L13428-02***
Project ID:	ZN000001N6	Date Sampled:	*07/15/13 10:57*
Sample ID:	1# WEST 0-6	Date Received:	*07/23/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, total (3050)	M6010B ICP	102	14000		*	mg/Kg	20	100	08/07/13 13:10	jjc
Copper, total (3050)	M6010B ICP	102	372		*	mg/Kg	1	5	08/07/13 13:10	jjc
Magnesium, total (3050)	M6010B ICP	102	3810		*	mg/Kg	20	100	08/07/13 13:10	jjc
Potassium, total (3050)	M6010B ICP	102	3030			mg/Kg	30	200	08/07/13 13:10	jjc
Sodium, total (3050)	M6010B ICP	102	100	B		mg/Kg	30	200	08/07/13 13:10	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Conductivity @25C	SM2510B									
Conductivity		1	0.599		*	mmhos/cm	0.001	0.01	08/08/13 0:00	cdb
Max Particle Size		1	2000		*	um			08/08/13 0:00	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	7.8			units	0.1	0.1	08/08/13 0:00	cdb
pH measured at		1	21.1			C	0.1	0.1	08/08/13 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	1	93.6		*	%	0.1	0.5	07/26/13 4:25	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								07/25/13 15:13	njj/mss
Digestion - Hot Plate	M3050B ICP								08/06/13 14:03	cdb
Saturated Paste Extraction	USDA No. 60 (2)								08/07/13 17:17	cdb
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								08/06/13 11:03	cdb
Water Extraction	ASA No. 9 10-2.3.2								08/08/13 10:51	brd

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfate, soluble (Water)	D516-02 - Turbidimetric	50	646		*	mg/Kg	50	250	08/09/13 13:21	bsu

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L13428-03***
Project ID:	ZN000001N6	Date Sampled:	*07/15/13 11:30*
Sample ID:	STS-RWU-2011-15 0-6	Date Received:	*07/23/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, total (3050)	M6010B ICP	101	2860		*	mg/Kg	20	100	08/07/13 13:17	jjc
Copper, total (3050)	M6010B ICP	101	1640		*	mg/Kg	1	5	08/07/13 13:17	jjc
Magnesium, total (3050)	M6010B ICP	101	1850		*	mg/Kg	20	100	08/07/13 13:17	jjc
Potassium, total (3050)	M6010B ICP	101	2910			mg/Kg	30	200	08/07/13 13:17	jjc
Sodium, total (3050)	M6010B ICP	101	60	B		mg/Kg	30	200	08/07/13 13:17	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Conductivity @25C	SM2510B									
Conductivity		1	1.060		*	mmhos/cm	0.001	0.01	08/08/13 0:00	cdb
Max Particle Size		1	2000		*	um			08/08/13 0:00	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	5.7			units	0.1	0.1	08/08/13 0:00	cdb
pH measured at		1	21.1			C	0.1	0.1	08/08/13 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	1	92.7		*	%	0.1	0.5	07/26/13 8:54	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								07/25/13 15:16	njj/mss
Digestion - Hot Plate	M3050B ICP								08/06/13 14:19	cdb
Saturated Paste Extraction	USDA No. 60 (2)								08/07/13 17:19	cdb
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								08/06/13 11:06	cdb
Water Extraction	ASA No. 9 10-2.3.2								08/08/13 11:08	brd

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfate, soluble (Water)	D516-02 - Turbidimetric	50	315		*	mg/Kg	50	250	08/09/13 13:21	bsu

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001N6	ACZ Sample ID:	***L13428-04***
Sample ID:	STS-RWU-2011-6 0-6	Date Sampled:	*07/15/13 11:57*
		Date Received:	*07/23/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, total (3050)	M6010B ICP	103	7330		*	mg/Kg	20	100	08/07/13 13:20	jjc
Copper, total (3050)	M6010B ICP	103	1300		*	mg/Kg	1	5	08/07/13 13:20	jjc
Magnesium, total (3050)	M6010B ICP	103	4640		*	mg/Kg	20	100	08/07/13 13:20	jjc
Potassium, total (3050)	M6010B ICP	103	2650			mg/Kg	30	200	08/07/13 13:20	jjc
Sodium, total (3050)	M6010B ICP	103	200			mg/Kg	30	200	08/07/13 13:20	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Conductivity @25C	SM2510B									
Conductivity		1	0.640		*	mmhos/cm	0.001	0.01	08/08/13 0:00	cdb
Max Particle Size		1	2000		*	um			08/08/13 0:00	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	7.3			units	0.1	0.1	08/08/13 0:00	cdb
pH measured at		1	21.1			C	0.1	0.1	08/08/13 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	1	86.5		*	%	0.1	0.5	07/26/13 13:22	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								07/25/13 15:20	mjj/mss
Digestion - Hot Plate	M3050B ICP								08/06/13 14:34	cdb
Saturated Paste Extraction	USDA No. 60 (2)								08/07/13 17:21	cdb
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								08/06/13 11:09	cdb
Water Extraction	ASA No. 9 10-2.3.2								08/08/13 11:25	brd

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfate, soluble (Water)	D516-02 - Turbidimetric	50	1420		*	mg/Kg	50	250	08/09/13 13:21	bsu

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000001N6
Sample ID: STS-RWU-2011-1 0-6

ACZ Sample ID: ***L13428-05***
Date Sampled: *07/16/13 09:03*
Date Received: *07/23/13*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, total (3050)	M6010B ICP	101	1030		*	mg/Kg	20	100	08/07/13 13:29	jjc
Copper, total (3050)	M6010B ICP	101	338		*	mg/Kg	1	5	08/07/13 13:29	jjc
Magnesium, total (3050)	M6010B ICP	101	2050		*	mg/Kg	20	100	08/07/13 13:29	jjc
Potassium, total (3050)	M6010B ICP	101	1770			mg/Kg	30	200	08/07/13 13:29	jjc
Sodium, total (3050)	M6010B ICP	101	110	B		mg/Kg	30	200	08/07/13 13:29	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Conductivity @25C	SM2510B									
Conductivity		1	0.526		*	mmhos/cm	0.001	0.01	08/08/13 0:00	cdb
Max Particle Size		1	2000		*	um			08/08/13 0:00	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	5.2			units	0.1	0.1	08/08/13 0:00	cdb
pH measured at		1	21.1			C	0.1	0.1	08/08/13 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	1	84.1		*	%	0.1	0.5	07/26/13 17:51	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								07/25/13 15:23	njj/mss
Digestion - Hot Plate	M3050B ICP								08/06/13 14:50	cdb
Saturated Paste Extraction	USDA No. 60 (2)								08/07/13 17:24	cdb
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								08/06/13 11:12	cdb
Water Extraction	ASA No. 9 10-2.3.2								08/08/13 11:42	brd

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfate, soluble (Water)	D516-02 - Turbidimetric	50	458		*	mg/Kg	50	250	08/09/13 13:22	bsu

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001N6	ACZ Sample ID:	***L13428-06***
Sample ID:	STS-RWU-2011-3 0-6	Date Sampled:	*07/16/13 08:13*
		Date Received:	*07/23/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, total (3050)	M6010B ICP	101	1560		*	mg/Kg	20	100	08/07/13 13:32	jjc
Copper, total (3050)	M6010B ICP	101	998		*	mg/Kg	1	5	08/07/13 13:32	jjc
Magnesium, total (3050)	M6010B ICP	101	1670		*	mg/Kg	20	100	08/07/13 13:32	jjc
Potassium, total (3050)	M6010B ICP	101	1590			mg/Kg	30	200	08/07/13 13:32	jjc
Sodium, total (3050)	M6010B ICP	101	120	B		mg/Kg	30	200	08/07/13 13:32	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Conductivity @25C	SM2510B									
Conductivity		1	0.789		*	mmhos/cm	0.001	0.01	08/08/13 0:00	cdb
Max Particle Size		1	2000		*	um			08/08/13 0:00	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	5.1			units	0.1	0.1	08/08/13 0:00	cdb
pH measured at		1	21.1			C	0.1	0.1	08/08/13 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	1	84.4		*	%	0.1	0.5	07/26/13 22:19	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								07/25/13 15:26	njj/mss
Digestion - Hot Plate	M3050B ICP								08/06/13 15:06	cdb
Saturated Paste Extraction	USDA No. 60 (2)								08/07/13 17:26	cdb
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								08/06/13 11:15	cdb
Water Extraction	ASA No. 9 10-2.3.2								08/08/13 12:00	brd

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfate, soluble (Water)	D516-02 - Turbidimetric	50	204	B	*	mg/Kg	50	250	08/09/13 13:22	bsu

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000001N6
Sample ID: STS-RWU-2011-14 0-6

ACZ Sample ID: ***L13428-07***
Date Sampled: *07/15/13 13:05*
Date Received: *07/23/13*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, total (3050)	M6010B ICP	102	3600		*	mg/Kg	20	100	08/07/13 13:35	jjc
Copper, total (3050)	M6010B ICP	102	1640		*	mg/Kg	1	5	08/07/13 13:35	jjc
Magnesium, total (3050)	M6010B ICP	102	3730		*	mg/Kg	20	100	08/07/13 13:35	jjc
Potassium, total (3050)	M6010B ICP	102	2950			mg/Kg	30	200	08/07/13 13:35	jjc
Sodium, total (3050)	M6010B ICP	102	90	B		mg/Kg	30	200	08/07/13 13:35	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Conductivity @25C	SM2510B									
Conductivity		1	0.675		*	mmhos/cm	0.001	0.01	08/08/13 0:00	cdb
Max Particle Size		1	2000		*	um			08/08/13 0:00	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	5.3			units	0.1	0.1	08/08/13 0:00	cdb
pH measured at		1	21.1			C	0.1	0.1	08/08/13 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	1	89.6		*	%	0.1	0.5	07/27/13 2:48	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								07/25/13 15:30	njj/mss
Digestion - Hot Plate	M3050B ICP								08/06/13 15:21	cdb
Saturated Paste Extraction	USDA No. 60 (2)								08/07/13 17:28	cdb
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								08/06/13 11:18	cdb
Water Extraction	ASA No. 9 10-2.3.2				*				08/08/13 12:17	brd

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfate, soluble (Water)	D516-02 - Turbidimetric	50	915		*	mg/Kg	50	250	08/09/13 13:23	bsu

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000001N6
Sample ID: STS-RWU-2011-2 0-6

ACZ Sample ID: ***L13428-08***
Date Sampled: *07/16/13 10:15*
Date Received: *07/23/13*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, total (3050)	M6010B ICP	101	680		*	mg/Kg	20	100	08/07/13 13:38	jjc
Copper, total (3050)	M6010B ICP	101	381		*	mg/Kg	1	5	08/07/13 13:38	jjc
Magnesium, total (3050)	M6010B ICP	101	1760		*	mg/Kg	20	100	08/07/13 13:38	jjc
Potassium, total (3050)	M6010B ICP	101	1460			mg/Kg	30	200	08/07/13 13:38	jjc
Sodium, total (3050)	M6010B ICP	101	90	B		mg/Kg	30	200	08/07/13 13:38	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Conductivity @25C	SM2510B									
Conductivity		1	1.390		*	mmhos/cm	0.001	0.01	08/08/13 0:00	cdb
Max Particle Size		1	2000		*	um			08/08/13 0:00	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	4.1			units	0.1	0.1	08/08/13 0:00	cdb
pH measured at		1	21.1			C	0.1	0.1	08/08/13 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	1	84.5		*	%	0.1	0.5	07/27/13 7:17	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								07/25/13 15:33	njj/mss
Digestion - Hot Plate	M3050B ICP								08/06/13 15:37	cdb
Saturated Paste Extraction	USDA No. 60 (2)								08/07/13 17:30	cdb
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								08/06/13 11:22	cdb
Water Extraction	ASA No. 9 10-2.3.2								08/08/13 12:34	brd

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfate, soluble (Water)	D516-02 - Turbidimetric	25	485		*	mg/Kg	25	125	08/09/13 13:29	bsu

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000001N6
Sample ID: STS-RWU-2011-8 0-6

ACZ Sample ID: ***L13428-09***
Date Sampled: *07/16/13 13:41*
Date Received: *07/23/13*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, total (3050)	M6010B ICP	101	2360		*	mg/Kg	20	100	08/07/13 13:42	jjc
Copper, total (3050)	M6010B ICP	101	287		*	mg/Kg	1	5	08/07/13 13:42	jjc
Magnesium, total (3050)	M6010B ICP	101	2290		*	mg/Kg	20	100	08/07/13 13:42	jjc
Potassium, total (3050)	M6010B ICP	101	1970			mg/Kg	30	200	08/07/13 13:42	jjc
Sodium, total (3050)	M6010B ICP	101	90	B		mg/Kg	30	200	08/07/13 13:42	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Conductivity @25C	SM2510B									
Conductivity		1	0.420		*	mmhos/cm	0.001	0.01	08/08/13 0:00	cdb
Max Particle Size		1	2000		*	um			08/08/13 0:00	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	5.6			units	0.1	0.1	08/08/13 0:00	cdb
pH measured at		1	21.1			C	0.1	0.1	08/08/13 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	1	84.9		*	%	0.1	0.5	07/27/13 11:45	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								07/25/13 15:36	mjj/mss
Digestion - Hot Plate	M3050B ICP								08/06/13 15:52	cdb
Saturated Paste Extraction	USDA No. 60 (2)								08/07/13 17:33	cdb
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								08/06/13 11:25	cdb
Water Extraction	ASA No. 9 10-2.3.2								08/08/13 12:51	brd

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfate, soluble (Water)	D516-02 - Turbidimetric	50	1250		*	mg/Kg	50	250	08/09/13 13:23	bsu

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001N6	ACZ Sample ID:	***L13428-10***
Sample ID:	STS-RWU-2011-5 0-6	Date Sampled:	*07/16/13 12:59*
		Date Received:	*07/23/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, total (3050)	M6010B ICP	101	1250		*	mg/Kg	20	100	08/07/13 13:45	jjc
Copper, total (3050)	M6010B ICP	101	779		*	mg/Kg	1	5	08/07/13 13:45	jjc
Magnesium, total (3050)	M6010B ICP	101	1820		*	mg/Kg	20	100	08/07/13 13:45	jjc
Potassium, total (3050)	M6010B ICP	101	2170			mg/Kg	30	200	08/07/13 13:45	jjc
Sodium, total (3050)	M6010B ICP	101	80	B		mg/Kg	30	200	08/07/13 13:45	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Conductivity @25C	SM2510B									
Conductivity		1	0.621		*	mmhos/cm	0.001	0.01	08/08/13 0:00	cdb
Max Particle Size		1	2000		*	um			08/08/13 0:00	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	4.6			units	0.1	0.1	08/08/13 0:00	cdb
pH measured at		1	21.1			C	0.1	0.1	08/08/13 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	1	87.2		*	%	0.1	0.5	07/27/13 16:14	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								07/25/13 15:40	njj/mss
Digestion - Hot Plate	M3050B ICP								08/06/13 16:08	cdb
Saturated Paste Extraction	USDA No. 60 (2)								08/07/13 17:35	cdb
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								08/06/13 11:28	cdb
Water Extraction	ASA No. 9 10-2.3.2								08/08/13 13:08	brd

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfate, soluble (Water)	D516-02 - Turbidimetric	50	396		*	mg/Kg	50	250	08/09/13 13:23	bsu

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L13428-11***
Project ID:	ZN000001N6	Date Sampled:	*07/16/13 14:31*
Sample ID:	STS-RWU-2011-16 0-6	Date Received:	*07/23/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, total (3050)	M6010B ICP	101	1390		*	mg/Kg	20	100	08/07/13 13:48	jjc
Copper, total (3050)	M6010B ICP	101	395		*	mg/Kg	1	5	08/07/13 13:48	jjc
Magnesium, total (3050)	M6010B ICP	101	1840		*	mg/Kg	20	100	08/07/13 13:48	jjc
Potassium, total (3050)	M6010B ICP	101	1810			mg/Kg	30	200	08/07/13 13:48	jjc
Sodium, total (3050)	M6010B ICP	101	100	B		mg/Kg	30	200	08/07/13 13:48	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Conductivity @25C	SM2510B									
Conductivity		1	0.471		*	mmhos/cm	0.001	0.01	08/08/13 0:00	cdb
Max Particle Size		1	2000		*	um			08/08/13 0:00	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	4.9			units	0.1	0.1	08/08/13 0:00	cdb
pH measured at		1	21.1			C	0.1	0.1	08/08/13 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	1	87.1		*	%	0.1	0.5	07/27/13 20:42	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								07/25/13 15:43	mjj/mss
Digestion - Hot Plate	M3050B ICP								08/06/13 16:24	cdb
Saturated Paste Extraction	USDA No. 60 (2)								08/07/13 17:37	cdb
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								08/06/13 11:31	cdb
Water Extraction	ASA No. 9 10-2.3.2								08/08/13 13:25	brd

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfate, soluble (Water)	D516-02 - Turbidimetric	50	1050		*	mg/Kg	50	250	08/09/13 13:49	bsu

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001N6	ACZ Sample ID:	***L13428-12***
Sample ID:	STS-RWU-2011-7 0-6	Date Sampled:	*07/15/13 17:27*
		Date Received:	*07/23/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, total (3050)	M6010B ICP	100	670		*	mg/Kg	20	100	08/07/13 13:51	jjc
Copper, total (3050)	M6010B ICP	100	529		*	mg/Kg	1	5	08/07/13 13:51	jjc
Magnesium, total (3050)	M6010B ICP	100	1240		*	mg/Kg	20	100	08/07/13 13:51	jjc
Potassium, total (3050)	M6010B ICP	100	1110			mg/Kg	30	200	08/07/13 13:51	jjc
Sodium, total (3050)	M6010B ICP	100	90	B		mg/Kg	30	200	08/07/13 13:51	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Conductivity @25C	SM2510B									
Conductivity		1	0.388		*	mmhos/cm	0.001	0.01	08/08/13 0:00	cdb
Max Particle Size		1	2000		*	um			08/08/13 0:00	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	4.9			units	0.1	0.1	08/08/13 0:00	cdb
pH measured at		1	21.1			C	0.1	0.1	08/08/13 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	1	84.6		*	%	0.1	0.5	07/28/13 1:11	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								07/25/13 15:46	njj/mss
Digestion - Hot Plate	M3050B ICP								08/06/13 16:39	cdb
Saturated Paste Extraction	USDA No. 60 (2)								08/07/13 17:39	cdb
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								08/06/13 11:34	cdb
Water Extraction	ASA No. 9 10-2.3.2								08/08/13 13:42	brd

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfate, soluble (Water)	D516-02 - Turbidimetric	50	124	B	*	mg/Kg	50	250	08/09/13 13:49	bsu

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L13428-13***
Project ID:	ZN000001N6	Date Sampled:	*07/16/13 12:07*
Sample ID:	STS-RWU-2011-9 0-6	Date Received:	*07/23/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, total (3050)	M6010B ICP	101	650		*	mg/Kg	20	100	08/07/13 13:54	jjc
Copper, total (3050)	M6010B ICP	101	560		*	mg/Kg	1	5	08/07/13 13:54	jjc
Magnesium, total (3050)	M6010B ICP	101	1980		*	mg/Kg	20	100	08/07/13 13:54	jjc
Potassium, total (3050)	M6010B ICP	101	1700			mg/Kg	30	200	08/07/13 13:54	jjc
Sodium, total (3050)	M6010B ICP	101	90	B		mg/Kg	30	200	08/07/13 13:54	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Conductivity @25C	SM2510B									
Conductivity		1	0.614		*	mmhos/cm	0.001	0.01	08/08/13 0:00	cdb
Max Particle Size		1	2000		*	um			08/08/13 0:00	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	4.4			units	0.1	0.1	08/08/13 0:00	cdb
pH measured at		1	21.1			C	0.1	0.1	08/08/13 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	1	81.7		*	%	0.1	0.5	07/28/13 5:39	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								07/25/13 15:50	mjj/mss
Digestion - Hot Plate	M3050B ICP								08/06/13 16:55	cdb
Saturated Paste Extraction	USDA No. 60 (2)								08/07/13 17:44	cdb
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								08/06/13 11:37	cdb
Water Extraction	ASA No. 9 10-2.3.2								08/08/13 14:00	brd

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfate, soluble (Water)	D516-02 - Turbidimetric	5	163		*	mg/Kg	5	25	08/09/13 13:49	bsu

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000001N6
Sample ID: STS-RWU-2011-10 0-6

ACZ Sample ID: ***L13428-14***
Date Sampled: *07/16/13 18:01*
Date Received: *07/23/13*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, total (3050)	M6010B ICP	101	960		*	mg/Kg	20	100	08/07/13 13:57	jjc
Copper, total (3050)	M6010B ICP	101	96		*	mg/Kg	1	5	08/07/13 13:57	jjc
Magnesium, total (3050)	M6010B ICP	101	1620		*	mg/Kg	20	100	08/07/13 13:57	jjc
Potassium, total (3050)	M6010B ICP	101	1850			mg/Kg	30	200	08/07/13 13:57	jjc
Sodium, total (3050)	M6010B ICP	101	70	B		mg/Kg	30	200	08/07/13 13:57	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Conductivity @25C	SM2510B									
Conductivity		1	0.874		*	mmhos/cm	0.001	0.01	08/08/13 0:00	cdb
Max Particle Size		1	2000		*	um			08/08/13 0:00	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	4.6			units	0.1	0.1	08/08/13 0:00	cdb
pH measured at		1	21.1			C	0.1	0.1	08/08/13 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	1	93.5		*	%	0.1	0.5	07/28/13 10:08	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								07/25/13 15:53	njj/mss
Digestion - Hot Plate	M3050B ICP								08/06/13 17:10	cdb
Saturated Paste Extraction	USDA No. 60 (2)								08/07/13 17:46	cdb
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								08/06/13 11:40	cdb
Water Extraction	ASA No. 9 10-2.3.2								08/08/13 14:17	brd

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfate, soluble (Water)	D516-02 - Turbidimetric	50	270		*	mg/Kg	50	250	08/09/13 13:49	bsu

Freeport-McMoRan - Chino Mines Company

Project ID: ZN000001N6
Sample ID: STS-RWU-2011-11 0-6

ACZ Sample ID: ***L13428-15***
Date Sampled: *07/15/13 14:55*
Date Received: *07/23/13*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, total (3050)	M6010B ICP	101	480		*	mg/Kg	20	100	08/07/13 14:06	jjc
Copper, total (3050)	M6010B ICP	101	216		*	mg/Kg	1	5	08/07/13 14:06	jjc
Magnesium, total (3050)	M6010B ICP	101	2100		*	mg/Kg	20	100	08/07/13 14:06	jjc
Potassium, total (3050)	M6010B ICP	101	1630			mg/Kg	30	200	08/07/13 14:06	jjc
Sodium, total (3050)	M6010B ICP	101	100	B		mg/Kg	30	200	08/07/13 14:06	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Conductivity @25C	SM2510B									
Conductivity		1	0.567		*	mmhos/cm	0.001	0.01	08/08/13 0:00	cdb
Max Particle Size		1	2000		*	um			08/08/13 0:00	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	4.3			units	0.1	0.1	08/08/13 0:00	cdb
pH measured at		1	21.1			C	0.1	0.1	08/08/13 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	1	86.7		*	%	0.1	0.5	07/28/13 14:37	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								07/25/13 15:56	mjj/mss
Digestion - Hot Plate	M3050B ICP								08/06/13 17:26	cdb
Saturated Paste Extraction	USDA No. 60 (2)								08/07/13 17:48	cdb
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								08/06/13 11:44	cdb
Water Extraction	ASA No. 9 10-2.3.2								08/08/13 14:34	brd

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfate, soluble (Water)	D516-02 - Turbidimetric	5	142		*	mg/Kg	5	25	08/09/13 13:49	bsu

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001N6	ACZ Sample ID:	***L13428-16***
Sample ID:	STS-RWU-2011-12 0-6	Date Sampled:	*07/15/13 16:30*
		Date Received:	*07/23/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, total (3050)	M6010B ICP	102	2120		*	mg/Kg	20	100	08/07/13 14:10	jjc
Copper, total (3050)	M6010B ICP	102	316		*	mg/Kg	1	5	08/07/13 14:10	jjc
Magnesium, total (3050)	M6010B ICP	102	3230		*	mg/Kg	20	100	08/07/13 14:10	jjc
Potassium, total (3050)	M6010B ICP	102	3300			mg/Kg	30	200	08/07/13 14:10	jjc
Sodium, total (3050)	M6010B ICP	102	130	B		mg/Kg	30	200	08/07/13 14:10	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Conductivity @25C	SM2510B									
Conductivity		1	1.350		*	mmhos/cm	0.001	0.01	08/08/13 0:00	cdb
Max Particle Size		1	2000		*	um			08/08/13 0:00	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	3.9			units	0.1	0.1	08/08/13 0:00	cdb
pH measured at		1	21.1			C	0.1	0.1	08/08/13 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	1	87.3		*	%	0.1	0.5	07/28/13 19:05	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								07/25/13 16:00	njj/mss
Digestion - Hot Plate	M3050B ICP								08/06/13 17:42	cdb
Saturated Paste Extraction	USDA No. 60 (2)								08/07/13 17:51	cdb
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								08/06/13 11:47	cdb
Water Extraction	ASA No. 9 10-2.3.2								08/08/13 14:51	brd

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfate, soluble (Water)	D516-02 - Turbidimetric	25	597		*	mg/Kg	25	125	08/09/13 13:55	bsu

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001N6	ACZ Sample ID:	***L13428-17***
Sample ID:	STS-RWU-2011-13 0-6	Date Sampled:	*07/15/13 14:20*
		Date Received:	*07/23/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, total (3050)	M6010B ICP	103	5100		*	mg/Kg	20	100	08/07/13 14:13	jjc
Copper, total (3050)	M6010B ICP	103	305		*	mg/Kg	1	5	08/07/13 14:13	jjc
Magnesium, total (3050)	M6010B ICP	103	5270		*	mg/Kg	20	100	08/07/13 14:13	jjc
Potassium, total (3050)	M6010B ICP	103	3520			mg/Kg	30	200	08/07/13 14:13	jjc
Sodium, total (3050)	M6010B ICP	103	120	B		mg/Kg	30	200	08/07/13 14:13	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Conductivity @25C	SM2510B									
Conductivity		1	1.080		*	mmhos/cm	0.001	0.01	08/08/13 0:00	cdb
Max Particle Size		1	2000		*	um			08/08/13 0:00	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	5.6			units	0.1	0.1	08/08/13 0:00	cdb
pH measured at		1	21.1			C	0.1	0.1	08/08/13 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	1	84.7		*	%	0.1	0.5	07/28/13 23:34	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								07/25/13 16:03	njj/mss
Digestion - Hot Plate	M3050B ICP								08/06/13 17:57	cdb
Saturated Paste Extraction	USDA No. 60 (2)								08/07/13 17:53	cdb
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								08/06/13 11:50	cdb
Water Extraction	ASA No. 9 10-2.3.2								08/08/13 15:08	brd

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfate, soluble (Water)	D516-02 - Turbidimetric	25	671		*	mg/Kg	25	125	08/09/13 13:49	bsu

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L13428-18***
Project ID:	ZN000001N6	Date Sampled:	*07/15/13 14:05*
Sample ID:	STS-RWU-2011-17 0-6	Date Received:	*07/23/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, total (3050)	M6010B ICP	101	2900		*	mg/Kg	20	100	08/07/13 14:16	jjc
Copper, total (3050)	M6010B ICP	101	654		*	mg/Kg	1	5	08/07/13 14:16	jjc
Magnesium, total (3050)	M6010B ICP	101	3450		*	mg/Kg	20	100	08/07/13 14:16	jjc
Potassium, total (3050)	M6010B ICP	101	2800			mg/Kg	30	200	08/07/13 14:16	jjc
Sodium, total (3050)	M6010B ICP	101	170	B		mg/Kg	30	200	08/07/13 14:16	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Conductivity @25C	SM2510B									
Conductivity		1	1.130		*	mmhos/cm	0.001	0.01	08/08/13 0:00	cdb
Max Particle Size		1	2000		*	um			08/08/13 0:00	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	4.6			units	0.1	0.1	08/08/13 0:00	cdb
pH measured at		1	21.1			C	0.1	0.1	08/08/13 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	1	88.2		*	%	0.1	0.5	07/29/13 4:02	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								07/25/13 16:06	mjj/mss
Digestion - Hot Plate	M3050B ICP								08/06/13 18:13	cdb
Saturated Paste Extraction	USDA No. 60 (2)								08/07/13 17:55	cdb
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								08/06/13 11:53	cdb
Water Extraction	ASA No. 9 10-2.3.2								08/08/13 15:25	brd

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfate, soluble (Water)	D516-02 - Turbidimetric	25	386		*	mg/Kg	25	125	08/09/13 13:55	bsu

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID: ZN000001N6
Sample ID: STS-RWU-2012-B1 0-6

ACZ Sample ID: ***L13428-19***
Date Sampled: *07/17/13 09:30*
Date Received: *07/23/13*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, total (3050)	M6010B ICP	101	800		*	mg/Kg	20	100	08/07/13 14:19	jjc
Copper, total (3050)	M6010B ICP	101	182		*	mg/Kg	1	5	08/07/13 14:19	jjc
Magnesium, total (3050)	M6010B ICP	101	2330		*	mg/Kg	20	100	08/07/13 14:19	jjc
Potassium, total (3050)	M6010B ICP	101	1380			mg/Kg	30	200	08/07/13 14:19	jjc
Sodium, total (3050)	M6010B ICP	101	100	B		mg/Kg	30	200	08/07/13 14:19	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Conductivity @25C	SM2510B									
Conductivity		1	0.380		*	mmhos/cm	0.001	0.01	08/08/13 0:00	cdb
Max Particle Size		1	2000		*	um			08/08/13 0:00	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	4.6			units	0.1	0.1	08/08/13 0:00	cdb
pH measured at		1	21.1			C	0.1	0.1	08/08/13 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	1	82.7		*	%	0.1	0.5	07/29/13 8:31	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								07/25/13 16:10	njj/mss
Digestion - Hot Plate	M3050B ICP								08/06/13 18:28	cdb
Saturated Paste Extraction	USDA No. 60 (2)								08/07/13 17:57	cdb
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								08/06/13 11:56	cdb
Water Extraction	ASA No. 9 10-2.3.2								08/08/13 15:43	brd

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfate, soluble (Water)	D516-02 - Turbidimetric	50	281		*	mg/Kg	50	250	08/09/13 13:49	bsu

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L13428-20***
Project ID:	ZN000001N6	Date Sampled:	*07/17/13 10:37*
Sample ID:	STS-RWU-2012-B2 0-6	Date Received:	*07/23/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, total (3050)	M6010B ICP	101	1630		*	mg/Kg	20	100	08/07/13 14:22	jjc
Copper, total (3050)	M6010B ICP	101	344		*	mg/Kg	1	5	08/07/13 14:22	jjc
Magnesium, total (3050)	M6010B ICP	101	2720		*	mg/Kg	20	100	08/07/13 14:22	jjc
Potassium, total (3050)	M6010B ICP	101	1630			mg/Kg	30	200	08/07/13 14:22	jjc
Sodium, total (3050)	M6010B ICP	101	140	B		mg/Kg	30	200	08/07/13 14:22	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Conductivity @25C	SM2510B									
Conductivity		1	0.395		*	mmhos/cm	0.001	0.01	08/08/13 0:00	cdb
Max Particle Size		1	2000		*	um			08/08/13 0:00	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	4.7			units	0.1	0.1	08/08/13 0:00	cdb
pH measured at		1	21.1			C	0.1	0.1	08/08/13 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	1	90.1		*	%	0.1	0.5	07/29/13 12:59	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								07/25/13 16:13	njj/mss
Digestion - Hot Plate	M3050B ICP								08/06/13 18:44	cdb
Saturated Paste Extraction	USDA No. 60 (2)								08/07/13 18:00	cdb
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								08/06/13 11:59	cdb
Water Extraction	ASA No. 9 10-2.3.2								08/08/13 16:00	brd

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfate, soluble (Water)	D516-02 - Turbidimetric	50	160	B	*	mg/Kg	50	250	08/09/13 13:50	bsu

** Please refer to Qualifier Reports for details.*

Inorganic Reference

Report Header Explanations

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit, typically 5 times the MDL.
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Recovered amount of the true value or spike added, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of interest

QC Sample Types

AS	Analytical Spike (Post Digestion)	*LCSWD*	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	*LFB*	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	*LFM*	Laboratory Fortified Matrix
CCV	Continuing Calibration Verification standard	*LFMD*	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	*LRB*	Laboratory Reagent Blank
ICB	Initial Calibration Blank	*MS*	Matrix Spike
ICV	Initial Calibration Verification standard	*MSD*	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	*PBS*	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	*PBW*	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	*PQV*	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	*SDL*	Serial Dilution

QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

ACZ Qualifiers (Qual)

B	Analyte concentration detected at a value between MDL and PQL. The associated value is an estimated quantity.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
L	Target analyte response was below the laboratory defined negative threshold.
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Method References

(1) EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
(2) EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.
(3) EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.
(4) EPA SW-846. Test Methods for Evaluating Solid Waste.
(5) Standard Methods for the Examination of Water and Wastewater.

Comments

(1) QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
(2) Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.
(3) Animal matrices for Inorganic analyses are reported on an "as received" basis.
(4) An asterisk in the "XQ" column indicates there is an extended qualifier and/or certification qualifier associated with the result.
(5) If the MDL equals the PQL or the MDL column is omitted, the PQL is the reporting limit.

For a complete list of ACZ's Extended Qualifiers, please click: http://www.acz.com/public/extquallist.pdf

Calcium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG348991													
WG348991ICV	ICV	08/07/13 12:37	II130716-1	100		98.93	mg/L	98.9	90	110			
WG348991ICB	ICB	08/07/13 12:39				U	mg/L		-0.6	0.6			
WG348916PBS	PBS	08/07/13 12:52				U	mg/Kg		-60	60			
WG348916LCSS	LCSS	08/07/13 12:55	PCN42465	7890		8348	mg/Kg		6500	9290			
WG348916LCSSD	LCSSD	08/07/13 12:58	PCN42465	7890		8025	mg/Kg		6500	9290	3.9	20	
L13428-01MS	MS	08/07/13 13:04	II130719-2	6936.2856	5320	11761	mg/Kg	92.9	75	125			
L13428-01MSD	MSD	08/07/13 13:07	II130719-2	6936.2856	5320	11965	mg/Kg	95.8	75	125	1.72	20	

Conductivity SM2510B

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG349133													
L13428-12DUP	DUP	08/08/13 15:53			.388	.39	nmhos/cn				0.5	20	

Copper, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG348991													
WG348991ICV	ICV	08/07/13 12:37	II130716-1	2		1.921	mg/L	96.1	90	110			
WG348991ICB	ICB	08/07/13 12:39				U	mg/L		-0.03	0.03			
WG348916PBS	PBS	08/07/13 12:52				U	mg/Kg		-3	3			
WG348916LCSS	LCSS	08/07/13 12:55	PCN42465	162		170.8	mg/Kg		135	190			
WG348916LCSSD	LCSSD	08/07/13 12:58	PCN42465	162		158.7	mg/Kg		135	190	7.3	20	
L13428-01MS	MS	08/07/13 13:04	II130719-2	51	427	505.4	mg/Kg	153.7	75	125			M3
L13428-01MSD	MSD	08/07/13 13:07	II130719-2	51	427	463.5	mg/Kg	71.6	75	125	8.65	20	M3

Magnesium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG348991													
WG348991ICV	ICV	08/07/13 12:37	II130716-1	100		96.88	mg/L	96.9	90	110			
WG348991ICB	ICB	08/07/13 12:39				U	mg/L		-0.6	0.6			
WG348916PBS	PBS	08/07/13 12:52				U	mg/Kg		-60	60			
WG348916LCSS	LCSS	08/07/13 12:55	PCN42465	3520		3626	mg/Kg		2640	4410			
WG348916LCSSD	LCSSD	08/07/13 12:58	PCN42465	3520		3604	mg/Kg		2640	4410	0.6	20	
L13428-01MS	MS	08/07/13 13:04	II130719-2	5099.74704	3350	8015	mg/Kg	91.5	75	125			
L13428-01MSD	MSD	08/07/13 13:07	II130719-2	5099.74704	3350	7897	mg/Kg	89.2	75	125	1.48	20	

Ph M9045D/M9040C

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG349086													
WG349086ICV	ICV	08/08/13 10:05	PCN40669	4		3.96	units	99	97	103			
L13428-01DUP	DUP	08/08/13 10:18			7.2	7.16	units				0.6	20	

Potassium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG348991													
WG348991ICV	ICV	08/07/13 12:37	II130716-1	20		19.67	mg/L	98.4	90	110			
WG348991ICB	ICB	08/07/13 12:39				U	mg/L		-0.9	0.9			
WG348916PBS	PBS	08/07/13 12:52				U	mg/Kg		-90	90			
WG348916LCSS	LCSS	08/07/13 12:55	PCN42465	2600		2801	mg/Kg		1720	3470			
WG348916LCSSD	LCSSD	08/07/13 12:58	PCN42465	2600		2806	mg/Kg		1720	3470	0.2	20	
L13428-01MS	MS	08/07/13 13:04	II130719-2	10196.03424	3860	13556	mg/Kg	95.1	75	125			
L13428-01MSD	MSD	08/07/13 13:07	II130719-2	10196.03424	3860	13372	mg/Kg	93.3	75	125	1.37	20	

Sodium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG348991													
WG348991ICV	ICV	08/07/13 12:37	II130716-1	100		98.94	mg/L	98.9	90	110			
WG348991ICB	ICB	08/07/13 12:39				U	mg/L		-0.9	0.9			
WG348916PBS	PBS	08/07/13 12:52				U	mg/Kg		-90	90			
WG348916LCSS	LCSS	08/07/13 12:55	PCN42465	517		534	mg/Kg		381	653			
WG348916LCSSD	LCSSD	08/07/13 12:58	PCN42465	517		509	mg/Kg		381	653	4.8	20	
L13428-01MS	MS	08/07/13 13:04	II130719-2	10205.049	70	8947	mg/Kg	87	75	125			
L13428-01MSD	MSD	08/07/13 13:07	II130719-2	10205.049	70	8903	mg/Kg	86.6	75	125	0.49	20	

Solids, Percent CLPSOW390, PART F, D-98

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG348268													
WG348268PBS	PBS	07/25/13 15:00				U	%		99.9	100.1			
L13428-01DUP	DUP	07/25/13 23:57			94	94.32	%				0.3	20	

Sulfate, soluble (Water) D516-02 - Turbidimetric

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG349205													
WG349205ICB	ICB	08/09/13 10:48				U	mg/L		-3	3			
WG349205ICV	ICV	08/09/13 10:48	WI130808-1	20		20	mg/L	100	90	110			
WG349205LFB	LFB	08/09/13 13:21	WI130416-3	9.99		9.7	mg/L	97.1	90	110			
WG349095PBS	PBS	08/09/13 13:21				U	mg/L		-15	15			
L13428-01DUP	DUP	08/09/13 13:21			755	759	mg/L				0.5	20	
L13428-02AS	AS	08/09/13 13:21	WI130416-3	499.5	646	1280	mg/L	126.9	90	110			M3

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L13428-01	WG348991	Calcium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Magnesium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG349205	Sulfate, soluble (Water)	D516-02 - Turbidimetric	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			D516-02 - Turbidimetric	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L13428-02	WG348991	Calcium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Magnesium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG349205	Sulfate, soluble (Water)	D516-02 - Turbidimetric	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			D516-02 - Turbidimetric	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L13428-03	WG348991	Calcium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Magnesium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG349205	Sulfate, soluble (Water)	D516-02 - Turbidimetric	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			D516-02 - Turbidimetric	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L13428-04	WG348991	Calcium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Magnesium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG349205	Sulfate, soluble (Water)	D516-02 - Turbidimetric	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			D516-02 - Turbidimetric	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L13428-05	WG348991	Calcium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Magnesium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG349205	Sulfate, soluble (Water)	D516-02 - Turbidimetric	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			D516-02 - Turbidimetric	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L13428-06	WG348991	Calcium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Magnesium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG349205	Sulfate, soluble (Water)	D516-02 - Turbidimetric	DD	Sample required dilution due to matrix color or odor.
			D516-02 - Turbidimetric	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			D516-02 - Turbidimetric	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L13428-07	WG348991	Calcium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Magnesium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG349095	Water Extraction	ASA No. 9 10-2.3.2	N1	See Case Narrative.
	WG349205	Sulfate, soluble (Water)	D516-02 - Turbidimetric	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			D516-02 - Turbidimetric	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L13428-08	WG348991	Calcium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Magnesium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG349205	Sulfate, soluble (Water)	D516-02 - Turbidimetric	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			D516-02 - Turbidimetric	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L13428-09	WG348991	Calcium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Magnesium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG349205	Sulfate, soluble (Water)	D516-02 - Turbidimetric	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			D516-02 - Turbidimetric	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L13428-10	WG348991	Calcium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Magnesium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG349205	Sulfate, soluble (Water)	D516-02 - Turbidimetric	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			D516-02 - Turbidimetric	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L13428-11	WG348991	Calcium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Magnesium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG349205	Sulfate, soluble (Water)	D516-02 - Turbidimetric	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			D516-02 - Turbidimetric	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L13428-12	WG348991	Calcium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Magnesium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG349205	Sulfate, soluble (Water)	D516-02 - Turbidimetric	DD	Sample required dilution due to matrix color or odor.
			D516-02 - Turbidimetric	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			D516-02 - Turbidimetric	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L13428-13	WG348991	Calcium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Magnesium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG349205	Sulfate, soluble (Water)	D516-02 - Turbidimetric	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			D516-02 - Turbidimetric	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L13428-14	WG348991	Calcium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Magnesium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG349205	Sulfate, soluble (Water)	D516-02 - Turbidimetric	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			D516-02 - Turbidimetric	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L13428-15	WG348991	Calcium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Magnesium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG349205	Sulfate, soluble (Water)	D516-02 - Turbidimetric	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			D516-02 - Turbidimetric	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L13428-16	WG348991	Calcium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Magnesium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG349205	Sulfate, soluble (Water)	D516-02 - Turbidimetric	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			D516-02 - Turbidimetric	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L13428-17	WG348991	Calcium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Magnesium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG349205	Sulfate, soluble (Water)	D516-02 - Turbidimetric	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			D516-02 - Turbidimetric	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L13428-18	WG348991	Calcium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Magnesium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG349205	Sulfate, soluble (Water)	D516-02 - Turbidimetric	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			D516-02 - Turbidimetric	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L13428-19	WG348991	Calcium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Magnesium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG349205	Sulfate, soluble (Water)	D516-02 - Turbidimetric	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			D516-02 - Turbidimetric	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
L13428-20	WG348991	Calcium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Magnesium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG349205	Sulfate, soluble (Water)	D516-02 - Turbidimetric	DD	Sample required dilution due to matrix color or odor.
			D516-02 - Turbidimetric	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			D516-02 - Turbidimetric	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.

Certification Qualifiers

Freeport-McMoRan - Chino Mines Company

ACZ Project ID: ***L13428***

Soil Analysis

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Conductivity	SM2510B
Max Particle Size	SM2510B
Solids, Percent	CLPSOW390, PART F, D-98

Wet Chemistry

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Sulfate, soluble (Water)	D516-02 - Turbidimetric

Sample Receipt

Freeport-McMoRan - Chino Mines Company
ZN000001N6

ACZ Project ID: L13428
Date Received: 07/23/2013 10:06
Received By: mtb
Date Printed: 7/23/2013

Receipt Verification

	YES	NO	NA
1) Is a foreign soil permit included for applicable samples?			X
2) Is the Chain of Custody or other directive shipping papers present?	X		▨
3) Does this project require special handling procedures such as CLP protocol?			X
4) Are any samples NRC licensable material?			X
5) If samples are received past hold time, proceed with requested short hold time analyses?	X		
6) Is the Chain of Custody complete and accurate?	X		▨
7) Were any changes made to the Chain of Custody prior to ACZ receiving the samples?	X		▨

`A change was made in the sample time page 2 section prior to ACZ custody.`

Samples/Containers

	YES	NO	NA
8) Are all containers intact and with no leaks?	X		▨
9) Are all labels on containers and are they intact and legible?	X		▨
10) Do the sample labels and Chain of Custody match for Sample ID, Date, and Time?	X		▨
11) For preserved bottle types, was the pH checked and within limits?			X
12) Is there sufficient sample volume to perform all requested work?	X		▨
13) Is the custody seal intact on all containers?			X
14) Are samples that require zero headspace acceptable?			X
15) Are all sample containers appropriate for analytical requirements?	X		▨
16) Is there an Hg-1631 trip blank present?			X
17) Is there a VOA trip blank present?			X
18) Were all samples received within hold time?	X		▨

Chain of Custody Related Remarks

Client Contact Remarks

Shipping Containers

```
Cooler Id    Temp (°C)    Rad (µR/Hr)    Custody Seal Intact?
---------    ---------    -----------    --------------------
NA18035      24.6         15             Yes
```

Was ice present in the shipment container(s)?

`No - Wet or gel ice was not present in the shipment container(s).`

Client must contact an ACZ Project Manager if analysis should not proceed for samples received outside of their thermal preservation acceptance criteria.

ACZ Laboratories, Inc. L13428
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

Copy of Report to:

Name: Matthew Barkley
Company: ARCADIS

E-mail: Matthew.Barkley@arcadis-us.com
Telephone: 303-231-9115 ext 157

Invoice to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐
If yes, please include state forms. Results will be reported to PQL. NO ☒

PROJECT INFORMATION

Quote #:
Project/PO #:
Reporting state for compliance testing:
Sampler's Name: Matthew Barkley
Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED *(attach list or use quote number)*

SAMPLE IDENTIFICATION	DATE:TIME		Matrix	# of Containers	soil sieved to < 2mm	Copper (Total)	pH					
STS-RWU-2011-4 0-6	7/15/13	1015	SO	1	x	x	x					
1# West 0-6	7/15/13	1057	SO	1	x	x	x					
STS-RWU-2011-15 0-6	7/15/13	1130	SO	1	x	x	x					
STS-RWU-2011-6 0-6	7/15/13	1157	SO	1	x	x	x					
STS-RWU-2011-1 0-6	7/16/13	0903	SO	1	x	x	x					
STS-RWU-2011-3 0-6	7/16/13	0813	SO	1	x	x	x					
STS-RWU-2011-14 0-6	7/15/13	1305	SO	1	x	x	x					
STS-RWU-2011-2 0-6	7/16/13	1015	SO	1	x	x	x					
STS-RWU-2011-8 0-6	7/16/13	1341	SO	1	x	x	x					
STS-RWU-2011-5 0-6	7/16/13	1259	SO	1	x	x	x					

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

Sieve all soil samples to <2 mm prior to analysis. Soil should be reported on a dry weight basis.
Methods:
pH - 9045C, Copper - 6010B analysis

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
Pam Pinson	7-18-13-3:00pm		7-23-13 10:00

1/2

L13428 Chain of Custody

ACZ Laboratories, Inc. L13428

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

Copy of Report to:

Name: Matthew Barkley
Company: ARCADIS

E-mail: Matthew.Barkley@arcadis-us.com
Telephone: 303-231-9115 ext 157

Invoice to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐
If yes, please include state forms. Results will be reported to PQL. NO ☒

PROJECT INFORMATION

ANALYSES REQUESTED *(attach list or use quote number)*

Quote #:
Project/PO #:
Reporting state for compliance testing:
Sampler's Name: Matthew Barkley
Are any samples NRC licensable material? Yes No

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	soil sieved to < 2mm	Copper (Total)	pH					
STS-RWU-2011-16 0-6	7/16/13 1431	SO	1	x	x	x					
STSI-RWU-2011-7 0-6	7/15/13 1727	SO	1	x	x	x					
STS-RWU-2011-9 0-6	7/16/13 1207	SO	1	x	x	x					
STS-RWU-2011-10 0-6	7/16/13 1801	SO	1	x	x	x					
STS-RWU-2011-11 0-6	7/15/13 1455	SO	1	x	x	x					
STS-RWU-2011-12 0-6	7/15/13 1630	SO	1	x	x	x					
STS-RWU-2011-13 0-6	7/15/13 1420	SO	1	x	x	x					
STS-RWU-2011-17 0-6	7/15/13 1405	SO	1	x	x	x					
STS-RWU-2012-B1 0-6	7/17/13 [illegible] 930	SO	1	x	x	x					
STS-RWU-2012-B2 0-6	7/17/13 1037	SO	1	x	x	x					

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

Sieve all soil samples to <2 mm prior to analysis. Soil should be reported on a dry weight basis.
Methods:
pH - 9045C, Copper - 6010B analysis

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
Pam Pinson	7-18-13 - 3pM		7.23.13 10:00

2/2

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Analytical Report

August 14, 2013

Report to:	Bill to:
Pam Pinson	Pam Pinson
Freeport-McMoRan - Chino Mines Company	Freeport-McMoRan - Chino Mines Company
PO Box 10	P.O. Box 13308
Bayard, NM 88023	Phoenix, AZ 85002-3308

cc: Matthew Barkley

Project ID: ZN000001N6
ACZ Project ID: L13429

Pam Pinson:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on July 23, 2013. This project has been assigned to ACZ's project number, L13429. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan. The enclosed results relate only to the samples received under L13429. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all requirements of NELAC.

This report shall be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after September 13, 2013. If the samples are determined to be hazardous, additional charges apply for disposal (typically $11/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical raw data reports for ten years.

If you have any questions or other needs, please contact your Project Manager.

S. Habermehl

Scott Habermehl has reviewed
and approved this report.

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L13429-01***
Project ID:	ZN000001N6	Date Sampled:	*07/17/13 09:20*
Sample ID:	STS-RWU-2012-B3 0-6	Date Received:	*07/23/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, total (3050)	M6010B ICP	101	1530		*	mg/Kg	20	100	08/08/13 15:23	jjc
Copper, total (3050)	M6010B ICP	101	161		*	mg/Kg	1	5	08/08/13 15:23	jjc
Magnesium, total (3050)	M6010B ICP	101	2520		*	mg/Kg	20	100	08/08/13 15:23	jjc
Potassium, total (3050)	M6010B ICP	101	1790			mg/Kg	30	200	08/08/13 15:23	jjc
Sodium, total (3050)	M6010B ICP	101	140	B		mg/Kg	30	200	08/08/13 15:23	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Conductivity @25C	SM2510B									
Conductivity		1	0.401		*	mmhos/cm	0.001	0.01	08/08/13 0:00	cdb
Max Particle Size		1	2000		*	um			08/08/13 0:00	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	4.7			units	0.1	0.1	08/08/13 0:00	cdb
pH measured at		1	20.9			C	0.1	0.1	08/08/13 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	1	83.3		*	%	0.1	0.5	07/25/13 15:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								07/25/13 16:16	njj/mss
Digestion - Hot Plate	M3050B ICP								08/07/13 13:12	cdb
Saturated Paste Extraction	USDA No. 60 (2)								08/07/13 17:15	cdb
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								08/07/13 9:20	cdb
Water Extraction	ASA No. 9 10-2.3.2								08/08/13 11:00	brd

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfate, soluble (Water)	D516-02 - Turbidimetric	50	433		*	mg/Kg	50	250	08/12/13 15:19	mpb

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company		ACZ Sample ID:	***L13429-02***
Project ID:	ZN000001N6	Date Sampled:	*07/16/13 17:14*
Sample ID:	WILDLIFE REF NORTH 0-6	Date Received:	*07/23/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, total (3050)	M6010B ICP	104	3520		*	mg/Kg	20	100	08/08/13 15:32	jjc
Copper, total (3050)	M6010B ICP	104	213		*	mg/Kg	1	5	08/08/13 15:32	jjc
Magnesium, total (3050)	M6010B ICP	104	5330		*	mg/Kg	20	100	08/08/13 15:32	jjc
Potassium, total (3050)	M6010B ICP	104	3620			mg/Kg	30	200	08/08/13 15:32	jjc
Sodium, total (3050)	M6010B ICP	104	200			mg/Kg	30	200	08/08/13 15:32	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Conductivity @25C	SM2510B									
Conductivity		1	0.681		*	mmhos/cm	0.001	0.01	08/08/13 0:00	cdb
Max Particle Size		1	2000		*	um			08/08/13 0:00	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	5.9			units	0.1	0.1	08/08/13 0:00	cdb
pH measured at		1	20.9			C	0.1	0.1	08/08/13 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	1	86.5		*	%	0.1	0.5	07/25/13 15:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								07/25/13 16:20	njj/mss
Digestion - Hot Plate	M3050B ICP								08/07/13 15:18	cdb
Saturated Paste Extraction	USDA No. 60 (2)								08/07/13 17:24	cdb
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								08/07/13 9:22	cdb
Water Extraction	ASA No. 9 10-2.3.2								08/08/13 13:00	brd

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfate, soluble (Water)	D516-02 - Turbidimetric	250	3150		*	mg/Kg	250	1250	08/12/13 15:25	mpb

Freeport-McMoRan - Chino Mines Company
Project ID: ZN000001N6
Sample ID: WILDLIFE REF SOUTH 0-6

ACZ Sample ID: ***L13429-03***
Date Sampled: *07/16/13 16:40*
Date Received: *07/23/13*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, total (3050)	M6010B ICP	101	1010		*	mg/Kg	20	100	08/08/13 15:38	jjc
Copper, total (3050)	M6010B ICP	101	288		*	mg/Kg	1	5	08/08/13 15:38	jjc
Magnesium, total (3050)	M6010B ICP	101	1750		*	mg/Kg	20	100	08/08/13 15:38	jjc
Potassium, total (3050)	M6010B ICP	101	1970			mg/Kg	30	200	08/08/13 15:38	jjc
Sodium, total (3050)	M6010B ICP	101	120	B		mg/Kg	30	200	08/08/13 15:38	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Conductivity @25C	SM2510B									
Conductivity		1	0.608		*	mmhos/cm	0.001	0.01	08/08/13 0:00	cdb
Max Particle Size		1	2000		*	um			08/08/13 0:00	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	4.6			units	0.1	0.1	08/08/13 0:00	cdb
pH measured at		1	20.9			C	0.1	0.1	08/08/13 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	1	89.7		*	%	0.1	0.5	07/25/13 15:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								07/25/13 16:23	mjj/mss
Digestion - Hot Plate	M3050B ICP								08/07/13 16:00	cdb
Saturated Paste Extraction	USDA No. 60 (2)								08/07/13 17:42	cdb
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								08/07/13 9:25	cdb
Water Extraction	ASA No. 9 10-2.3.2								08/08/13 14:00	brd

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfate, soluble (Water)	D516-02 - Turbidimetric	50	1080		*	mg/Kg	50	250	08/12/13 15:19	mpb

** Please refer to Qualifier Reports for details.*

Inorganic Analytical Results

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001N6
Sample ID:	DUP #1
ACZ Sample ID:	***L13429-04***
Date Sampled:	*07/16/13 00:00*
Date Received:	*07/23/13*
Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, total (3050)	M6010B ICP	101	680		*	mg/Kg	20	100	08/08/13 15:41	jjc
Copper, total (3050)	M6010B ICP	101	578		*	mg/Kg	1	5	08/08/13 15:41	jjc
Magnesium, total (3050)	M6010B ICP	101	2070		*	mg/Kg	20	100	08/08/13 15:41	jjc
Potassium, total (3050)	M6010B ICP	101	1840			mg/Kg	30	200	08/08/13 15:41	jjc
Sodium, total (3050)	M6010B ICP	101	110	B		mg/Kg	30	200	08/08/13 15:41	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Conductivity @25C	SM2510B									
Conductivity		1	0.618		*	mmhos/cm	0.001	0.01	08/08/13 0:00	cdb
Max Particle Size		1	2000		*	um			08/08/13 0:00	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	4.3			units	0.1	0.1	08/08/13 0:00	cdb
pH measured at		1	20.9			C	0.1	0.1	08/08/13 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	1	81.4		*	%	0.1	0.5	07/25/13 15:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								07/25/13 16:26	mjj/mss
Digestion - Hot Plate	M3050B ICP								08/07/13 9:00	cdb
Saturated Paste Extraction	USDA No. 60 (2)								08/07/13 17:51	cdb
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								08/07/13 9:27	cdb
Water Extraction	ASA No. 9 10-2.3.2								08/08/13 15:00	brd

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfate, soluble (Water)	D516-02 - Turbidimetric	5	188		*	mg/Kg	5	25	08/12/13 15:19	mpb

** Please refer to Qualifier Reports for details.*

Freeport-McMoRan - Chino Mines Company

Project ID:	ZN000001N6	ACZ Sample ID:	***L13429-05***
Sample ID:	DUP #2	Date Sampled:	*07/16/13 00:00*
		Date Received:	*07/23/13*
		Sample Matrix:	*Soil*

Metals Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, total (3050)	M6010B ICP	103	3930		*	mg/Kg	20	100	08/08/13 15:50	jjc
Copper, total (3050)	M6010B ICP	103	208		*	mg/Kg	1	5	08/08/13 15:50	jjc
Magnesium, total (3050)	M6010B ICP	103	5880		*	mg/Kg	20	100	08/08/13 15:50	jjc
Potassium, total (3050)	M6010B ICP	103	3940			mg/Kg	30	200	08/08/13 15:50	jjc
Sodium, total (3050)	M6010B ICP	103	200			mg/Kg	30	200	08/08/13 15:50	jjc

Soil Analysis

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Conductivity @25C	SM2510B									
Conductivity		1	0.702		*	mmhos/cm	0.001	0.01	08/08/13 0:00	cdb
Max Particle Size		1	2000		*	um			08/08/13 0:00	cdb
pH, Corrosivity	M9045D/M9040C									
pH		1	5.6			units	0.1	0.1	08/08/13 0:00	cdb
pH measured at		1	20.9			C	0.1	0.1	08/08/13 0:00	cdb
Solids, Percent	CLPSOW390, PART F, D-98	1	88.6		*	%	0.1	0.5	07/25/13 15:00	mss2

Soil Preparation

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972								07/25/13 16:30	njj/mss
Digestion - Hot Plate	M3050B ICP								08/07/13 9:42	cdb
Saturated Paste Extraction	USDA No. 60 (2)								08/07/13 18:00	cdb
Sieve-2000 um (2.0mm)	ASA No.9, 15-4.2.2								08/07/13 9:30	cdb
Water Extraction	ASA No. 9 10-2.3.2								08/08/13 16:00	brd

Wet Chemistry

Parameter	EPA Method	Dilution	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Sulfate, soluble (Water)	D516-02 - Turbidimetric	250	2690		*	mg/Kg	250	1250	08/12/13 15:25	mpb

Inorganic Reference

Report Header Explanations

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit, typically 5 times the MDL.
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Recovered amount of the true value or spike added, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of interest

QC Sample Types

AS	Analytical Spike (Post Digestion)	*LCSWD*	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	*LFB*	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	*LFM*	Laboratory Fortified Matrix
CCV	Continuing Calibration Verification standard	*LFMD*	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	*LRB*	Laboratory Reagent Blank
ICB	Initial Calibration Blank	*MS*	Matrix Spike
ICV	Initial Calibration Verification standard	*MSD*	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	*PBS*	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	*PBW*	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	*PQV*	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	*SDL*	Serial Dilution

QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

ACZ Qualifiers (Qual)

B	Analyte concentration detected at a value between MDL and PQL. The associated value is an estimated quantity.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
L	Target analyte response was below the laboratory defined negative threshold.
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Method References

(1) EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
(2) EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.
(3) EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.
(4) EPA SW-846. Test Methods for Evaluating Solid Waste.
(5) Standard Methods for the Examination of Water and Wastewater.

Comments

(1) QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
(2) Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.
(3) Animal matrices for Inorganic analyses are reported on an "as received" basis.
(4) An asterisk in the "XQ" column indicates there is an extended qualifier and/or certification qualifier associated with the result.
(5) If the MDL equals the PQL or the MDL column is omitted, the PQL is the reporting limit.

For a complete list of ACZ's Extended Qualifiers, please click: http://www.acz.com/public/extquallist.pdf

Calcium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG349134													
WG349134ICV	ICV	08/08/13 14:58	II130716-1	100		98.06	mg/L	98.1	90	110			
WG349134ICB	ICB	08/08/13 15:01				U	mg/L		-0.6	0.6			
WG349117PBS	PBS	08/08/13 15:14				U	mg/Kg		-60	60			
WG349117LCSS	LCSS	08/08/13 15:17	PCN42465	7890		7928	mg/Kg		6500	9290			
WG349117LCSSD	LCSSD	08/08/13 15:20	PCN42465	7890		8221	mg/Kg		6500	9290	3.6	20	
L13429-01MS	MS	08/08/13 15:26	II130716-5	6868.2828	1530	7820	mg/Kg	91.6	75	125			
L13429-01MSD	MSD	08/08/13 15:29	II130716-5	6868.2828	1530	7811	mg/Kg	91.4	75	125	0.12	20	

Conductivity SM2510B

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG349132													
L13429-02DUP	DUP	08/08/13 16:24			.681	.678	nmhos/cn				0.4	20	

Copper, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG349134													
WG349134ICV	ICV	08/08/13 14:58	II130716-1	2		1.914	mg/L	95.7	90	110			
WG349134ICB	ICB	08/08/13 15:01				U	mg/L		-0.03	0.03			
WG349117PBS	PBS	08/08/13 15:14				U	mg/Kg		-3	3			
WG349117LCSS	LCSS	08/08/13 15:17	PCN42465	162		159.7	mg/Kg		135	190			
WG349117LCSSD	LCSSD	08/08/13 15:20	PCN42465	162		161.3	mg/Kg		135	190	1	20	
L13429-01MS	MS	08/08/13 15:26	II130716-5	50.5	161	193.6	mg/Kg	64.6	75	125			M3
L13429-01MSD	MSD	08/08/13 15:29	II130716-5	50.5	161	192.9	mg/Kg	63.2	75	125	0.36	20	M3

Magnesium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG349134													
WG349134ICV	ICV	08/08/13 14:58	II130716-1	100		95.79	mg/L	95.8	90	110			
WG349134ICB	ICB	08/08/13 15:01				U	mg/L		-0.6	0.6			
WG349117PBS	PBS	08/08/13 15:14				U	mg/Kg		-60	60			
WG349117LCSS	LCSS	08/08/13 15:17	PCN42465	3520		3554	mg/Kg		2640	4410			
WG349117LCSSD	LCSSD	08/08/13 15:20	PCN42465	3520		3658	mg/Kg		2640	4410	2.9	20	
L13429-01MS	MS	08/08/13 15:26	II130716-5	5049.74952	2520	6854	mg/Kg	85.8	75	125			
L13429-01MSD	MSD	08/08/13 15:29	II130716-5	5049.74952	2520	6862	mg/Kg	86	75	125	0.12	20	

Ph M9045D/M9040C

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG349085													
WG349085ICV	ICV	08/08/13 10:07	PCN40669	4		3.95	units	98.8	97	103			
L13675-01DUP	DUP	08/08/13 11:07			10.9	10.92	units				0.2	20	

Potassium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG349134													
WG349134ICV	ICV	08/08/13 14:58	II130716-1	20		19.59	mg/L	98	90	110			
WG349134ICB	ICB	08/08/13 15:01				U	mg/L		-0.9	0.9			
WG349117PBS	PBS	08/08/13 15:14				U	mg/Kg		-90	90			
WG349117LCSS	LCSS	08/08/13 15:17	PCN42465	2600		2848	mg/Kg		1720	3470			
WG349117LCSSD	LCSSD	08/08/13 15:20	PCN42465	2600		2901	mg/Kg		1720	3470	1.8	20	
L13429-01MS	MS	08/08/13 15:26	II130716-5	10096.07312	1790	10989	mg/Kg	91.1	75	125			
L13429-01MSD	MSD	08/08/13 15:29	II130716-5	10096.07312	1790	10969	mg/Kg	90.9	75	125	0.18	20	

Sodium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG349134													
WG349134ICV	ICV	08/08/13 14:58	II130716-1	100		98.01	mg/L	98	90	110			
WG349134ICB	ICB	08/08/13 15:01				U	mg/L		-0.9	0.9			
WG349117PBS	PBS	08/08/13 15:14				U	mg/Kg		-90	90			
WG349117LCSS	LCSS	08/08/13 15:17	PCN42465	517		531	mg/Kg		381	653			
WG349117LCSSD	LCSSD	08/08/13 15:20	PCN42465	517		530	mg/Kg		381	653	0.2	20	
L13429-01MS	MS	08/08/13 15:26	II130716-5	10104.9995	140	9341	mg/Kg	91.1	75	125			
L13429-01MSD	MSD	08/08/13 15:29	II130716-5	10104.9995	140	9332	mg/Kg	91	75	125	0.1	20	

Solids, Percent CLPSOW390, PART F, D-98

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG348267													
L13412-01DUP	DUP	07/25/13 15:00			95.4	95.6	%				0.2	20	
WG348267PBS	PBS	07/25/13 15:00				U	%		99.9	100.1			

Sulfate, soluble (Water) D516-02 - Turbidimetric

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG349293													
WG349293ICB	ICB	08/12/13 14:55				U	mg/L		-3	3			
WG349293ICV	ICV	08/12/13 14:55	WI130808-1	20		19.9	mg/L	99.5	90	110			
WG349293LFB	LFB	08/12/13 15:19	WI130416-3	9.99		10.2	mg/L	102.1	90	110			
WG349096PBS	PBS	08/12/13 15:19				U	mg/L		-15	15			
L13429-01DUP	DUP	08/12/13 15:19			433	399	mg/L				8.2	20	RA
L13429-05AS	AS	08/12/13 15:25	SO4TURB5X	500	2690	3000	mg/L	62	90	110			M3

Inorganic Extended Qualifier Report

Freeport-McMoRan - Chino Mines Company ACZ Project ID: ***L13429***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L13429-01	WG349134	Calcium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Magnesium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG349293	Sulfate, soluble (Water)	D516-02 - Turbidimetric	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			D516-02 - Turbidimetric	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			D516-02 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L13429-02	WG349134	Calcium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Magnesium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG349293	Sulfate, soluble (Water)	D516-02 - Turbidimetric	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			D516-02 - Turbidimetric	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			D516-02 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L13429-03	WG349134	Calcium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Magnesium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG349293	Sulfate, soluble (Water)	D516-02 - Turbidimetric	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			D516-02 - Turbidimetric	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			D516-02 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L13429-04	WG349134	Calcium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Magnesium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG349293	Sulfate, soluble (Water)	D516-02 - Turbidimetric	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			D516-02 - Turbidimetric	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			D516-02 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L13429-05	WG349134	Calcium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Copper, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Magnesium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG349293	Sulfate, soluble (Water)	D516-02 - Turbidimetric	HD	Analysis is outside the intended scope of the method, which does not provide hold time information for soil extracts. No hold time is observed for collection to extraction. The referenced method hold time is observed for extraction-to-analysis.
			D516-02 - Turbidimetric	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			D516-02 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

Soil Analysis

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Conductivity	SM2510B
Max Particle Size	SM2510B
Solids, Percent	CLPSOW390, PART F, D-98

Wet Chemistry

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Sulfate, soluble (Water)	D516-02 - Turbidimetric

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Sample Receipt

Freeport-McMoRan - Chino Mines Company
ZN000001N6

ACZ Project ID: L13429
Date Received: 07/23/2013 10:06
Received By: mtb
Date Printed: 7/23/2013

Receipt Verification

	YES	NO	NA
1) Is a foreign soil permit included for applicable samples?			X
2) Is the Chain of Custody or other directive shipping papers present?	X		▨
3) Does this project require special handling procedures such as CLP protocol?			X
4) Are any samples NRC licensable material?			X
5) If samples are received past hold time, proceed with requested short hold time analyses?	X		
6) Is the Chain of Custody complete and accurate?	X		▨
7) Were any changes made to the Chain of Custody prior to ACZ receiving the samples?	X		▨

```
A change was made in the sample lines 4-8 section prior to ACZ
custody.
```

Samples/Containers

	YES	NO	NA
8) Are all containers intact and with no leaks?	X		▨
9) Are all labels on containers and are they intact and legible?	X		▨
10) Do the sample labels and Chain of Custody match for Sample ID, Date, and Time?	X		▨
11) For preserved bottle types, was the pH checked and within limits?			X
12) Is there sufficient sample volume to perform all requested work?	X		▨
13) Is the custody seal intact on all containers?			X
14) Are samples that require zero headspace acceptable?			X
15) Are all sample containers appropriate for analytical requirements?	X		▨
16) Is there an Hg-1631 trip blank present?			X
17) Is there a VOA trip blank present?			X
18) Were all samples received within hold time?	X		▨

Chain of Custody Related Remarks

Client Contact Remarks

Shipping Containers

```
Cooler Id      Temp (°C)      Rad (µR/Hr)      Custody Seal Intact?
---------      ---------      -----------      --------------------
NA18035        24.6           15               Yes
```

Was ice present in the shipment container(s)?

```
No - Wet or gel ice was not present in the shipment container(s).
```

Client must contact an ACZ Project Manager if analysis should not proceed for samples received outside of their thermal preservation acceptance criteria.

ACZ Laboratories, Inc. L13429

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

Copy of Report to:

Name: Matthew Barkley
Company: ARCADIS

E-mail: Matthew.Barkley@arcadis-us.com
Telephone: 303-231-9115 ext 157

Invoice to:

Name: Pam Pinson
Company: Chino Mines Company
E-mail: Pamela_Pinson@FMI.com

Address: P.O. Box 10
Bayard, NM 88023
Telephone: 575-912-5213

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES ☒ NO ☐
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES ☐
If yes, please include state forms. Results will be reported to PQL. NO ☒

PROJECT INFORMATION

Quote #:
Project/PO #:
Reporting state for compliance testing:
Sampler's Name: Matthew Barkley
Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED *(attach list or use quote number)*

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	soil sieved to < 2mm	Copper (Total)	pH	Salinity				
STS-RWU-2012-B3 0-6	7/17/13 0920	SO	1	x	x	x					
Wildlife Ref North 0-6	7/16/13 1714	SO	1	x	x	x					
Wildlife Ref South 0-6	7/16/13 1640	SO	1	x	x	x					
~~FID 37 0-6~~		~~SO~~	~~1~~	~~x~~			~~x~~				
~~FID 15 0-6~~		~~SO~~	~~1~~	~~x~~			~~x~~				
~~FID 18 0-6~~		~~SO~~	~~1~~	~~x~~			~~x~~				
~~FID 16 0-6~~		~~SO~~	~~1~~	~~x~~			~~x~~				
~~FID 101 0-6~~		~~SO~~	~~1~~	~~x~~			~~x~~				
Dup #1		SO	1	X	X	X					
Dup #2		SO	1	X	X	X					

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

Sieve all soil samples to <2 mm prior to analysis. Soil should be reported on a dry weight basis.
Methods:
pH - 9045C, Copper - 6010B analysis

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
Pam Pinson	7-18-13-3pM		7·23·13 10:00

RMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

L13429 Chain of Custod

ANALYTICAL SUMMARY REPORT

February 10, 2015

Chino Mine Company
PO Box 10
Bayard, NM 88023

Work Order: H15010309
Project Name: Not Indicated

Energy Laboratories Inc Helena MT received the following 33 samples for Chino Mine Company on 1/22/2015 for analysis.

Lab ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
H15010309-001	STS-PT-1-10M	01/15/15 8:00	01/22/15	Soil	Metals, Water Extractable Copper Activity CaCl2 Hot Water Soil Extraction Soil Preparation
H15010309-002	STS-PT-2013-2-10M	01/15/15 8:00	01/22/15	Soil	Metals, Water Extractable Copper Activity CaCl2 Hot Water Soil Extraction
H15010309-003	STS-PT-2013-3-10M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-004	STS-PT-2013-4-10M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-005	STS-PT-2013-5-10M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-006	STS-PT-2013-6-10M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-007	STS-PT-2013-7-10M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-008	STS-PT-2013-8-10M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-009	STS-PT-2013-9-10M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-010	STS-PT-2013-10-10M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-011	STS-PT-2013-11-10M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-012	STS-PT-2013-12-10M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-013	STS-PT-2013-13-10M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-014	STS-PT-2013-14-10M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-015	STS-PT-2013-15-1/4"M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-016	STS-PT-2013-16-1/4"M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-017	STS-PT-2013-17-10M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-018	STS-PT-2013-19-10M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-019	STS-2013-20-10M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-020	STS-PT-2013-21-10M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-021	STS-PT-2013-22-10M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-022	STS-PT-2013-23-10M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-023	STS-PT-2013-24-10M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-024	STS-PT-2013-25-10M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-025	STS-2013-26-10M	01/15/15 8:00	01/22/15	Soil	Same As Above

ANALYTICAL SUMMARY REPORT

H15010309-026	STS-PT-2013-27-10M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-027	STS-PT-2013-28-10M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-028	STS-PT-2013-29-10M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-029	STS-PT-2013-30-10M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-030	STS-PT-2013-31-10M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-031	STS-PT-2013-32-10M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-032	STS-2013-35-10M	01/15/15 8:00	01/22/15	Soil	Same As Above
H15010309-033	STS-2013-36-10M	01/15/15 8:00	01/22/15	Soil	Same As Above

The analyses presented in this report were performed by Energy Laboratories, Inc., 3161 E. Lyndale Ave., Helena, MT 59604, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By:

CLIENT:	Chino Mine Company
Project:	Not Indicated
Work Order:	H15010309

Report Date: 02/10/15

CASE NARRATIVE

Prep Comments for Sample H15010309-001A, Test SOIL PRP: air dried-sieved to 10 mesh-after samples split

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	Chino Mine Company	**Report Date:**	02/10/15
Project:	Not Indicated	**Date Received:**	01/22/15
Workorder:	H15010309		

		Analysis		Cu-CACL2	Conductivity , CaCl2	Millivolts	pCu, Measured	ph, CaCl2
		Units		mg/kg	mmhos/cm	mV	s_u_	s_u_
Sample ID	**Client Sample ID**	**Up**	**Low**	**Results**	**Results**	**Results**	**Results**	**Results**
H15010309-001	STS-PT-1-10M	0	0	33.5	2.3	44	3.56	4.5
H15010309-002	STS-PT-2013-2-10M	0	0	0.2	2.2	-58	7.38	6.8
H15010309-003	STS-PT-2013-3-10M	0	0	0.4	2.4	-10	5.60	5.1
H15010309-004	STS-PT-2013-4-10M	0	0	0.4	2.4	-22	6.06	5.0
H15010309-005	STS-PT-2013-5-10M	0	0	0.2	2.6	-31	6.40	5.7
H15010309-006	STS-PT-2013-6-10M	0	0	8.8	3.1	24	4.31	3.5
H15010309-007	STS-PT-2013-7-10M	0	0	36.1	3.9	35	3.91	3.0
H15010309-008	STS-PT-2013-8-10M	0	0	1.4	2.5	4	5.08	4.7
H15010309-009	STS-PT-2013-9-10M	0	0	145	2.3	61	2.93	4.1
H15010309-010	STS-PT-2013-10-10M	0	0	31.9	2.5	42	3.66	4.5
H15010309-011	STS-PT-2013-11-10M	0	0	12.1	2.6	30	4.11	3.7
H15010309-012	STS-PT-2013-12-10M	0	0	0.1	3.1	-57	7.36	6.2
H15010309-013	STS-PT-2013-13-10M	0	0	0.9	2.4	-2	5.32	4.6
H15010309-014	STS-PT-2013-14-10M	0	0	37.4	3.6	40	3.75	3.6
H15010309-015	STS-PT-2013-15-1/4"M	0	0	2.0	2.5	8	4.93	4.8
H15010309-016	STS-PT-2013-16-1/4"M	0	0	6.9	2.7	22	4.40	4.8
H15010309-017	STS-PT-2013-17-10M	0	0	0.2	2.7	-72	7.91	6.9
H15010309-018	STS-PT-2013-19-10M	0	0	45.3	2.4	46	3.50	4.3
H15010309-019	STS-2013-20-10M	0	0	0.2	2.5	-91	8.62	7.2
H15010309-020	STS-PT-2013-21-10M	0	0	3.3	2.4	13	4.73	3.8
H15010309-021	STS-PT-2013-22-10M	0	0	16.1	2.3	32	4.03	4.0
H15010309-022	STS-PT-2013-23-10M	0	0	9.9	2.4	27	4.23	3.9
H15010309-023	STS-PT-2013-24-10M	0	0	< 0.1	2.6	-99	8.93	6.9
H15010309-024	STS-PT-2013-25-10M	0	0	< 0.1	2.4	-98	8.87	6.9
H15010309-025	STS-2013-26-10M	0	0	< 0.1	2.5	-110	9.32	7.3
H15010309-026	STS-PT-2013-27-10M	0	0	3.1	2.4	12	4.76	4.4
H15010309-027	STS-PT-2013-28-10M	0	0	< 0.1	2.5	-104	9.11	7.1
H15010309-028	STS-PT-2013-29-10M	0	0	7.5	2.3	23	4.36	4.4
H15010309-029	STS-PT-2013-30-10M	0	0	10.7	2.7	25	4.29	3.4
H15010309-030	STS-PT-2013-31-10M	0	0	0.7	2.5	-11	5.63	4.7
H15010309-031	STS-PT-2013-32-10M	0	0	16.2	2.4	32	4.02	4.6
H15010309-032	STS-2013-35-10M	0	0	133	2.5	56	3.14	4.0
H15010309-033	STS-2013-36-10M	0	0	52.3	2.9	42	3.64	4.8

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 02/10/15
Project: Not Indicated **Work Order:** H15010309

Method: **arcadis SOP** Batch: 27927

Lab ID: **LCS-27927** Laboratory Control Sample Run: SOIL CUPRIC ION SELECTIV 02/05/15 10:44

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Conductivity, CaCl2	4.13	mmhos/cm	0.10	100	70	130			
pCu, Measured	10.3	s.u.	0.010	103	70	130			
ph, CaCl2	7.55	s.u.	0.10	101	70	130			

Lab ID: **H15010309-010Adup** Sample Duplicate Run: SOIL CUPRIC ION SELECTIV 02/05/15 10:56

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Conductivity, CaCl2	2.50	mmhos/cm	0.10						
Millivolts	42.0	mV							
pCu, Measured	3.65	s.u.	0.010						
ph, CaCl2	4.55	s.u.	0.10						

Lab ID: **H15010309-020Adup** Sample Duplicate Run: SOIL CUPRIC ION SELECTIV 02/05/15 11:13

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Conductivity, CaCl2	2.37	mmhos/cm	0.10						
Millivolts	13.2	mV							
pCu, Measured	4.73	s.u.	0.010						
ph, CaCl2	3.71	s.u.	0.10						

Method: **arcadis SOP** Batch: 27928

Lab ID: **LCS-27928** Laboratory Control Sample Run: SOIL CUPRIC ION SELECTIV 02/05/15 11:19

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Conductivity, CaCl2	4.10	mmhos/cm	0.10	100	70	130			
pCu, Measured	9.78	s.u.	0.010	97	70	130			
ph, CaCl2	7.43	s.u.	0.10	99	70	130			

Lab ID: **H15010309-026Adup** Sample Duplicate Run: SOIL CUPRIC ION SELECTIV 02/05/15 11:28

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Conductivity, CaCl2	2.42	mmhos/cm	0.10						
Millivolts	13.9	mV							
pCu, Measured	4.70	s.u.	0.010						
ph, CaCl2	4.20	s.u.	0.10						

Lab ID: **H15010309-033ADUP** Sample Duplicate Run: SOIL CUPRIC ION SELECTIV 02/05/15 11:37

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Conductivity, CaCl2	3.01	mmhos/cm	0.10						
Millivolts	42.5	mV							
pCu, Measured	3.63	s.u.	0.010						
ph, CaCl2	4.93	s.u.	0.10						

Qualifiers:

RL - Analyte reporting limit. ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: Not Indicated

Report Date: 02/10/15
Work Order: H15010309

Analyte		Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method:	**E200.7**									Analytical Run: ICP2-HE_150206C
Lab ID:	**ICV**	Initial Calibration Verification Standard								02/06/15 09:14
Copper		0.806	mg/L	0.010	101	90	110			
Lab ID:	**ICSA**	Interference Check Sample A								02/06/15 09:29
Copper		0.00169	mg/L	0.010		0	0			
Lab ID:	**ICSAB**	Interference Check Sample AB								02/06/15 09:33
Copper		0.510	mg/L	0.010	102	80	120			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Report Date: 02/10/15
Project: Not Indicated
Work Order: H15010309

Analyte		Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method:	**SW6010B**									Batch: 27927
Lab ID:	**MB-27927**	Method Blank				Run: ICP2-HE_150206C				02/06/15 12:31
Copper		ND	mg/kg	0.006						
Lab ID:	**LCS-27927**	Laboratory Control Sample				Run: ICP2-HE_150206C				02/06/15 12:38
Copper		0.0496	mg/kg	0.10	84	70	130			
Lab ID:	**H15010309-001AMS2**	Sample Matrix Spike				Run: ICP2-HE_150206C				02/06/15 12:50
Copper		36.1	mg/kg	0.10		75	125			A
Lab ID:	**H15010309-001AMSD2**	Sample Matrix Spike Duplicate				Run: ICP2-HE_150206C				02/06/15 12:54
Copper		35.8	mg/kg	0.10		75	125	0.8	20	A
Lab ID:	**H15010309-010Adup**	Sample Duplicate				Run: ICP2-HE_150206C				02/06/15 14:06
Copper		31.3	mg/kg	0.10						
Lab ID:	**H15010309-020Adup**	Sample Duplicate				Run: ICP2-HE_150206C				02/06/15 14:56
Copper		3.48	mg/kg	0.10						
Method:	**SW6010B**									Batch: 27928
Lab ID:	**MB-27928**	Method Blank				Run: ICP2-HE_150206C				02/06/15 15:00
Copper		ND	mg/kg	0.006						
Lab ID:	**LCS-27928**	Laboratory Control Sample				Run: ICP2-HE_150206C				02/06/15 15:15
Copper		0.0461	mg/kg	0.10	78	70	130			
Lab ID:	**H15010309-021AMS2**	Sample Matrix Spike				Run: ICP2-HE_150206C				02/06/15 15:27
Copper		18.7	mg/kg	0.10		75	125			A
Lab ID:	**H15010309-021AMSD2**	Sample Matrix Spike Duplicate				Run: ICP2-HE_150206C				02/06/15 15:30
Copper		18.5	mg/kg	0.10		75	125	1.0	20	A
Lab ID:	**H15010309-026Adup**	Sample Duplicate				Run: ICP2-HE_150206C				02/06/15 16:01
Copper		3.63	mg/kg	0.10						
Lab ID:	**H15010309-033Adup**	Sample Duplicate				Run: ICP2-HE_150206C				02/06/15 16:32
Copper		55.0	mg/kg	0.10						

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.

Workorder Receipt Checklist

Chino Mine Company

H15010309

Login completed by: Tracy L. Lorash

Reviewed by: BL2000\rwilliams

Reviewed Date: 1/27/2015

Date Received: 1/22/2015

Received by: AHN

Carrier name: FedEx Express

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on all shipping container(s)/cooler(s)?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on all sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☑	No ☐	
Temp Blank received in all shipping container(s)/cooler(s)?	Yes ☐	No ☑	Not Applicable ☐
Container/Temp Blank temperature:	N/A°C No Ice		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☐	Not Applicable ☑

Standard Reporting Procedures:

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Contact and Corrective Action Comments:

No collection time on COC or sample jars. Estimated collection time in the laboratory. TI 1/26/15

H15010309

SAMPLE TRANSMITTAL LOG

Wildlife International
EVANS ANALYTICAL GROUP

PROJECT NO.: 757p-101

Box 2

Box 3

Box 1

Soil Number	Lot Number	Sample Size[1]	Date Sampled
1	STS-PT-1-10M	1 Quart	1/15/15
2	STS-PT-2013-2-10M	1 Quart	1/15/15
3	STS-PT-2013-3-10M	1 Quart	1/15/15
4	STS-PT-2013-4-10M	1 Quart	1/15/15
5	STS-PT-2013-5-10M	1 Quart	1/15/15
6	STS-PT-2013-6-10M	1 Quart	1/15/15
7	STS-PT-2013-7-10M	1 Quart	1/15/15
8	STS-PT-2013-8-10M	1 Quart	1/15/15
9	STS-PT-2013-9-10M	1 Quart	1/15/15
10	STS-PT-2013-10-10M	1 Quart	1/15/15
11	STS-PT-2013-11-10M	1 Quart	1/15/15
12	STS-PT-2013-12-10M	1 Quart	1/15/15
13	STS-PT-2013-13-10M	1 Quart	1/15/15
14	STS-PT-2013-14-10M	1 Quart	1/15/15
15	STS-PT-2013-15-1/4"M	1 Quart	1/15/15
16	STS-PT-2013-16-1/4"M	1 Quart	1/15/15
17	STS-PT-2013-17-10M	1 Quart	1/15/15
19	STS-PT-2013-19-10M	1 Quart	1/15/15
20	STS-2013-20-10M	1 Quart	1/15/15
21	STS-PT-2013-21-10M	1 Quart	1/15/15
22	STS-PT-2013-22-10M	1 Quart	1/15/15
23	STS-PT-2013-23-10M	1 Quart	1/15/15
24	STS-PT-2013-24-10M	1 Quart	1/15/15
25	STS-PT-2013-25-10M	1 Quart	1/15/15
26	STS-2013-26-10M	1 Quart	1/15/15
27	STS-PT-2013-27-10M	1 Quart	1/15/15
28	STS-PT-2013-28-10M	1 Quart	1/15/15
29	STS-PT-2013-29-10M	1 Quart	1/15/15
30	STS-PT-2013-30-10M	1 Quart	1/15/15
31	STS-PT-2013-31-10M	1 Quart	1/15/15
32	STS-PT-2013-32-10M	1 Quart	1/15/15
35	STS-2013-35-10M	1 Quart	1/15/15
36	STS-2013-36-10M	1 Quart	1/15/15

[1] Samples placed in clean quart size plastic ~~bag~~ container
ⓙ JP 1.15.15

Sampled By(Date & Initials): EWP 1-15-15 JCT 1-15-15

Received By (Date & Initials): 1/27/15 09:36
Fedex Express

Box 1
[illegible]

On Ice: Y [✓ N]
Temp Blank: Y [✓ N]

ANALYTICAL SUMMARY REPORT

August 28, 2015

Chino Mine Company
PO Box 10
Bayard, NM 88023

Work Order: H15080326
Project Name: WI Water Analysis

Energy Laboratories Inc Helena MT received the following 2 samples for Chino Mine Company on 8/18/2015 for analysis.

Lab ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
H15080326-001	1st Flush	08/17/15 8:00	08/18/15	Aqueous	Metals by ICP/ICPMS, Dissolved Alkalinity Conductivity Hardness as CaCO3 pH Preparation, Dissolved Filtration
H15080326-002	Cleared Lines	08/17/15 8:00	08/18/15	Aqueous	Same As Above

The analyses presented in this report were performed by Energy Laboratories, Inc., 3161 E. Lyndale Ave., Helena, MT 59604, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By:

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	Chino Mine Company	**Report Date:**	08/28/15
Project:	WI Water Analysis	**Collection Date:**	08/17/15 08:00
Lab ID:	H15080326-001	**DateReceived:**	08/18/15
Client Sample ID:	1st Flush	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL PROPERTIES							
pH	8.0	s.u.	H	0.1		A4500-H B	08/19/15 13:14 / SRW
Conductivity @ 25 C	385	umhos/cm		1		A2510 B	08/19/15 13:14 / SRW
INORGANICS							
Alkalinity, Total as CaCO3	200	mg/L		4		A2320 B	08/19/15 19:32 / SRW
Hardness as CaCO3	140	mg/L		1		A2340 B	08/27/15 14:11 / sld
METALS, DISSOLVED							
Cadmium	ND	mg/L		0.00003		E200.8	08/26/15 20:26 / dck
Calcium	35	mg/L		1		E200.8	08/26/15 20:26 / dck
Copper	0.028	mg/L		0.001		E200.8	08/26/15 20:26 / dck
Lead	0.0010	mg/L		0.0003		E200.8	08/26/15 20:26 / dck
Magnesium	13	mg/L		1		E200.8	08/26/15 20:26 / dck
Nickel	0.012	mg/L		0.005		E200.8	08/26/15 20:26 / dck
Zinc	0.04	mg/L		0.01		E200.8	08/26/15 20:26 / dck

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
H - Analysis performed past recommended holding time.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	Chino Mine Company	**Report Date:**	08/28/15
Project:	WI Water Analysis	**Collection Date:**	08/17/15 08:00
Lab ID:	H15080326-002	**DateReceived:**	08/18/15
Client Sample ID:	Cleared Lines	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL PROPERTIES							
pH	8.2	s.u.	H	0.1		A4500-H B	08/19/15 13:17 / SRW
Conductivity @ 25 C	394	umhos/cm		1		A2510 B	08/19/15 13:17 / SRW
INORGANICS							
Alkalinity, Total as CaCO3	200	mg/L		4		A2320 B	08/19/15 19:38 / SRW
Hardness as CaCO3	141	mg/L		1		A2340 B	08/27/15 14:11 / sld
METALS, DISSOLVED							
Cadmium	ND	mg/L		0.00003		E200.8	08/26/15 20:30 / dck
Calcium	35	mg/L		1		E200.8	08/26/15 20:30 / dck
Copper	0.001	mg/L		0.001		E200.8	08/26/15 20:30 / dck
Lead	ND	mg/L		0.0003		E200.8	08/26/15 20:30 / dck
Magnesium	13	mg/L		1		E200.8	08/26/15 20:30 / dck
Nickel	ND	mg/L		0.005		E200.8	08/26/15 20:30 / dck
Zinc	ND	mg/L		0.01		E200.8	08/26/15 20:30 / dck

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
H - Analysis performed past recommended holding time.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Report Date: 08/28/15
Project: WI Water Analysis
Work Order: H15080326

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A2320 B										Batch: R108634
Lab ID: MB		Method Blank				Run: PHSC_101-H_150819A				08/19/15 18:02
Alkalinity, Total as CaCO3		2	mg/L	0.7						
Lab ID: LCS		Laboratory Control Sample				Run: PHSC_101-H_150819A				08/19/15 18:08
Alkalinity, Total as CaCO3		610	mg/L	4.0	101	90	110			
Lab ID: H15080332-001ADUP		Sample Duplicate				Run: PHSC_101-H_150819A				08/19/15 19:23
Alkalinity, Total as CaCO3		450	mg/L	4.0				1.0	10	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company
Project: WI Water Analysis

Report Date: 08/28/15
Work Order: H15080326

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A2510 B							Analytical Run: PHSC_101-H_150819A			
Lab ID: CCV - SC 1413		Continuing Calibration Verification Standard								08/19/15 10:35
Conductivity @ 25 C		1400	umhos/cm	1.0	99	90	110			
Method: A2510 B										Batch: R108634
Lab ID: SC 150		Initial Calibration Verification Standard				Run: PHSC_101-H_150819A				08/19/15 08:24
Conductivity @ 25 C		149	umhos/cm	1.0	99	90	110			
Lab ID: SC 5000		Initial Calibration Verification Standard				Run: PHSC_101-H_150819A				08/19/15 08:26
Conductivity @ 25 C		4990	umhos/cm	1.0	100	90	110			
Lab ID: SC 20000		Initial Calibration Verification Standard				Run: PHSC_101-H_150819A				08/19/15 08:29
Conductivity @ 25 C		19600	umhos/cm	1.0	98	90	110			
Lab ID: SC 2ND 1000		Laboratory Control Sample				Run: PHSC_101-H_150819A				08/19/15 08:31
Conductivity @ 25 C		1000	umhos/cm	1.0	100	90	110			
Lab ID: H15080331-001ADUP		Sample Duplicate				Run: PHSC_101-H_150819A				08/19/15 13:22
Conductivity @ 25 C		38800	umhos/cm	1.0				0.2	10	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 08/28/15

Project: WI Water Analysis **Work Order:** H15080326

Analyte		Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method:	**A4500-H B**						Analytical Run: PHSC_101-H_150819A				
Lab ID:	**pH 7**		Initial Calibration Verification Standard								08/19/15 08:21
pH			7.0	s.u.	0.1	100	98	102			
Lab ID:	**CCV - pH 7**		Continuing Calibration Verification Standard								08/19/15 10:32
pH			7.0	s.u.	0.1	100	98	102			
Lab ID:	**CCV - pH 7**		Continuing Calibration Verification Standard								08/19/15 13:30
pH			7.0	s.u.	0.1	100	98	102			
Method:	**A4500-H B**										Batch: R108634
Lab ID:	**H15080331-001ADUP**		Sample Duplicate				Run: PHSC_101-H_150819A				08/19/15 13:22
pH			7.7	s.u.	0.1				0.0	3	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 08/28/15
Project: WI Water Analysis **Work Order:** H15080326

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E200.8										Analytical Run: ICPMS204-B_150826B
Lab ID: ICV STD	7	Initial Calibration Verification Standard								08/26/15 14:10
Cadmium		0.0313	mg/L	0.0010	104	90	110			
Calcium		3.08	mg/L	0.50	103	90	110			
Copper		0.0626	mg/L	0.010	104	90	110			
Lead		0.0594	mg/L	0.010	99	90	110			
Magnesium		3.11	mg/L	0.50	104	90	110			
Nickel		0.0613	mg/L	0.010	102	90	110			
Zinc		0.0626	mg/L	0.010	104	90	110			
Lab ID: ICSA	7	Interference Check Sample A								08/26/15 14:13
Cadmium		0.000341	mg/L	0.0010						
Calcium		119	mg/L	0.50	99	70	130			
Copper		0.000777	mg/L	0.010						
Lead		0.000254	mg/L	0.010						
Magnesium		40.6	mg/L	0.50	102	70	130			
Nickel		0.000646	mg/L	0.010						
Zinc		0.00102	mg/L	0.010						
Lab ID: ICSAB	7	Interference Check Sample AB								08/26/15 14:16
Cadmium		0.0102	mg/L	0.0010	102	70	130			
Calcium		120	mg/L	0.50	100	70	130			
Copper		0.0215	mg/L	0.010	107	70	130			
Lead		0.000259	mg/L	0.010		0	0			
Magnesium		40.0	mg/L	0.50	100	70	130			
Nickel		0.0211	mg/L	0.010	106	70	130			
Zinc		0.0110	mg/L	0.010	110	70	130			
Method: E200.8										Batch: R108876
Lab ID: ICB	7	Method Blank				Run: ICPMS204-B_150826B				08/26/15 14:43
Cadmium		ND	mg/L	2E-05						
Calcium		ND	mg/L	0.010						
Copper		ND	mg/L	6E-05						
Lead		ND	mg/L	3E-05						
Magnesium		ND	mg/L	0.0003						
Nickel		0.0001	mg/L	3E-05						
Zinc		0.0008	mg/L	0.0001						
Lab ID: LFB	7	Laboratory Fortified Blank				Run: ICPMS204-B_150826B				08/26/15 14:46
Cadmium		0.0519	mg/L	0.0010	104	85	115			
Calcium		1.07	mg/L	0.50	107	85	115			
Copper		0.0529	mg/L	0.010	106	85	115			
Lead		0.0508	mg/L	0.010	102	85	115			
Magnesium		1.04	mg/L	0.50	104	85	115			
Nickel		0.0528	mg/L	0.010	105	85	115			
Zinc		0.0534	mg/L	0.010	105	85	115			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Chino Mine Company **Report Date:** 08/28/15

Project: WI Water Analysis **Work Order:** H15080326

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E200.8										Batch: R108876
Lab ID: H15080261-031FMS	7	Sample Matrix Spike				Run: ICPMS204-B_150826B				08/26/15 19:45
Cadmium		0.0479	mg/L	0.0010	96	70	130			
Calcium		135	mg/L	1.0		70	130			A
Copper		0.0495	mg/L	0.0050	98	70	130			
Lead		0.0491	mg/L	0.0010	98	70	130			
Magnesium		78.4	mg/L	1.0		70	130			A
Nickel		0.0503	mg/L	0.0050	98	70	130			
Zinc		0.0486	mg/L	0.010	94	70	130			
Lab ID: H15080261-031FMSD	7	Sample Matrix Spike Duplicate				Run: ICPMS204-B_150826B				08/26/15 19:48
Cadmium		0.0488	mg/L	0.0010	98	70	130	2.0	20	
Calcium		137	mg/L	1.0		70	130	1.6	20	A
Copper		0.0506	mg/L	0.0050	100	70	130	2.0	20	
Lead		0.0505	mg/L	0.0010	101	70	130	2.9	20	
Magnesium		79.5	mg/L	1.0		70	130	1.5	20	A
Nickel		0.0514	mg/L	0.0050	100	70	130	2.1	20	
Zinc		0.0506	mg/L	0.010	98	70	130	4.0	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.

Work Order Receipt Checklist

Chino Mine Company H15080326

Login completed by: Skyler T. Pester
Reviewed by: BL2000\sdull
Reviewed Date: 8/27/2015

Date Received: 8/18/2015
Received by: stp
Carrier name: FedEx Express

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on all shipping container(s)/cooler(s)?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on all sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☐	No ☑	
Chain of custody signed when relinquished and received?	Yes ☐	No ☑	
Chain of custody agrees with sample labels?	Yes ☐	No ☑	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☐	No ☑	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☑	No ☐	
Temp Blank received in all shipping container(s)/cooler(s)?	Yes ☐	No ☑	Not Applicable ☐
Container/Temp Blank temperature:	10.5°C No Ice		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☑	Not Applicable ☐

Standard Reporting Procedures:

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Contact and Corrective Action Comments:

Client sample container leaked into ziplock bag during shipping, transfered to proper sealed containers upon arrival. Very low sample volume, prioritize metals, and ph/ec. then ALK, hardness, and DOC. Insufficient sample to analyze DOC. Analysis taken from emails from J. Meyer and M. Barkley. No collection times listed on sample containers - collection times estimated in laboratory.
Samples for Dissolved Metals/Hardness were subsampled, filtered, and preserved to pH <2 with 2 mL of Nitric acid per 250 mL in the laboratory. According to 40CFR136, samples for Dissolved Metals should be filtered and preserved within 15 minutes of collection. 8/19/2015 STP.

Energy Laboratories Inc
3161 East Lyndale Avenue
Helena, MT 59601
(406) 442-0711

CHAIN-OF-CUSTODY RECORD

Page 1 of 1

WorkOrder: H15080326

Client:
Chino Mine Company
PO Box 10
Bayard, NM 88023

TEL:
FAX:
ProjectNo: WI Water Analys
PO:

19-Aug-15

Sample ID	ClientSampID	Matrix	Collection Date	Bottle	Requested Tests					
					200_7_8-W-D	ALK-W	OND-PROBE-\	DNESS-CALC	PH-W	WC REVIEW
H15080326-001	1st Flush	Aqueous	8/17/2015 8:00:00 AM		A	B	B	A	B	A
H15080326-002	Cleared Lines	Aqueous	8/17/2015 8:00:00 AM		A	B	B	A	B	

Fedex express overnight
10.5°C
No Ice

Comments: Samples Submitted from WI, under directive of Matthew B. to be analyzed for suspected contamination. See Email in place of COC. 8/19/2015 STP. Very low sample volume, prioritize metals, and ph/ec. then ALK, hardness, and DOC.

	Date/Time		Date/Time
Relinquished by:		**Received by:**	
Relinquished by:		**Received by:**	
Relinquished by:		**Received by:**	8-18-15 9:36 AM

NOTE: Samples are discarded 60 days after results are reported unless other arrangements are made. Hazardous samples will be returned to client or disposed of at client expense.

Bottle Type: L-Liter V-Voa S-Soil Jar O-Orbo T-Tedlar B-Brass P-Plastic OT-Other

TECHNICAL MEMORANDUM

Golder Associates Inc.
5200 Pasadena NE, Suite C
Albuquerque, NM USA 87113
Telephone: 505-821-3043
Fax Access: 505-821-5273

TO:	**Mr. John Gearhart, Chino Mines Co.**	**DATE:**	September 11, 2006
FROM:	**Lewis Munk, Ph.D., CPSS**	**OUR REF.:**	013-1594
RE:	**UPPER SOUTH STOCKPILE- NORTH LOBE COVER SUITABILITY**		

1.0 INTRODUCTION

The Upper South Stockpile at Chino Mines Company (Chino) has been identified as a potential borrow source for cover materials to be used in the reclamation of the North Mine Area. Chino is currently placing materials mined from the South Pit Area on the Upper South Stockpile. Golder Associates Inc. (Golder) was retained by Chino to sample and analyze these materials with the intent of evaluating the suitability of the materials as soil substitutes.

This memorandum documents the results of analyses conducted on samples from the North Lobe portion of the Upper South Stockpile. This information was gathered in response to a request from the New Mexico Environment Department (NMED) and Mining and Minerals Division (MMD).

2.0 METHODS

On August 10, 2006, Golder described and collected samples from eight test pits excavated on the North Lobe (Fig. 1). The pits were excavated to a depth of about 12 feet. The volume of oversize material (fragments >7.5 cm in diameter) was estimated from the walls of the pits (Soil Survey Division Staff, 1993). The samples were collected at different depth intervals based on changes in color, dominant lithology, and/or rock fragment content. The materials were described and sampled using standard methods (Soil Survey Division Staff, 1993). Field descriptions included depth intervals, soil texture, rock fragments and Munsell color. The rock fragments were estimated from the pit exposures on a volume basis. General descriptions of the dominant lithology were also made.

The samples collected for chemical and physical characterization were placed directly in gallon-size plastic bags (5 to 10 kg). The samples were sent to Energy Laboratories in Billings, Montana for chemical and physical analysis. The bulk soil samples collected for fine-earth analysis were air-dried and passed through a 2 mm sieve at the laboratory. The less than 2 mm soil fraction was analyzed for the particle size distribution (Gee and Bauder, 1986); paste pH and electrical conductivity (Salinity Laboratory Staff, 1954); acid base account (Sobeck et al., 1978); and AB-DTPA extractable arsenic, cadmium, copper, lead, manganese, mercury, molybdenum, and nickel. Water soluble selenium and boron were evaluated to 2:1 extracts.

3.0 RESULTS

The stockpile is represented by a heterogeneous mixture of rhyolite and leach cap that occur in zones related to the dumping sequence. The leach cap is composed predominantly of Santa Rita Stock and Colorado Formation with minor amounts of intrusive dikes and sills. The rhyolite tended to be represented by near surface materials and contained some native soils and plant matter. These materials were generated from the overburden stripping operations in South Pit Area. Clasts with evidence of sulfide mineralization occurred on the stockpile surface, but were rare.

The chemical and physical properties of the samples indicate few inherent limitations for use as cover materials. In general, the materials contained moderate to high volumes of rock fragments (40 to 80% by volume). The rock fragments were angular and mostly less than 10-inches in diameter (Table 1). The leach cap-dominated zones tended to have somewhat higher volumes of rock fragment, although the fragments were generally smaller in maximum size than the zones dominated by the rhyolite. The fine-earth fraction was mostly medium- and moderately coarse-textured with clay contents ranging from 10 to 20%. The silt content was somewhat higher in the leach cap dominated materials compared to the rhyolite.

Chemically, the materials ranged from slightly acid (pH 6.1) to neutral (pH 7.4), and were universally non-saline (Table 2). Water extractable selenium and boron occurred at low concentrations.

The acid forming potential of the samples was evaluated through static sulfur speciation tests (Sobeck et al., 1978). Total sulfur in the samples ranged from 0.02 to 0.48% (Table 3). Nonetheless, the samples generally had positive acid base accounts (ABA) when evaluated on the basis of HNO_3 extractable sulfur; although 2 samples were slightly negative (Table 3). Nearly all the samples had measurable acid neutralization potentials and none had ABA's less than the MMD soil suitability guidelines. Thus, the potential for strong reductions in soil pH and excessive salinity with weathering is expected to be low.

The concentrations of the AB-DTPA extractable constituents are listed in Table 4. With the exception of copper in samples from one location, all the samples are considered acceptable with respect to the MMD soil suitability guidelines (MMD, 1996). The two samples from location CHUSNO6-8 had AB-DTPA extractable copper levels slightly above the MMD guidelines and are not considered a concern with respect to plant toxicity.

4.0 SUMMARY

Overall the materials from the North Lobe area are considered suitable for use as soil substitutes, on the basis of these data. The chemical characteristics are suitable with respect to pH, salinity, and specific ion plant toxicity. The ABA data suggest the materials are unlikely to generate excess acidity.

Physically, the majority of the material evaluated will perform adequately from a cover perspective. The combination of medium to moderately coarse textures and moderate to high rock fragments should provide adequate support for plants and water storage and good erosion protection. Some of the rhyolite zones in the stockpile will require special handling considerations to segregate the extremely large fragments (e.g., boulders). However, these oversize materials may have application for riprap.

5.0 REFERENCES

Agron 9. 1982. Methods of Soil Analysis. Soil Sci. Soc. Am., Madison, WI.

Gee, G.W., and J.W. Bauder. 1986. Particle-size analysis. In: Methods of Soil Analysis. Part 1- Physical and Mineralogical Methods, 2nd Edition. A. Klute (ed). Agron. 9. Soil Sci. Soc. Am., Madison, WI.

Mining and Minerals Division. 1996. Draft closeout plan guidelines for existing mines. Mining Act Reclamation Bureau, Santa Fe, NM. April 30.

Salinity Laboratory Staff. 1954. Diagnosis and improvement of saline and alkali soils. Agricultural Handbook No. 60. USDA-Agricultural Research Service. US Government Printing Office, Washington, D.C.

Sobek, A.A., W.A. Schuller, J.R. Freeman, and R.M. Smith. 1978. Field and laboratory methods applicable to overburdens and minesoils. EPA-600/2-78-054.

Soil Survey Staff. 1993. Soil survey manual. Handbook No. 18, 2nd ed. USDA-Soil Conservation Service. US Government Printing Office, Washington, D.C.

Tables 1 through 4
Figure 1
Attachment 1 - Laboratory Reports

TABLES

TABLE 1
SUMMARY FIELD DESCRIPTIONS FOR UPPER SOUTH STOCKPILE EXCAVATIONS

Field ID	Depth (ft.)	Munsell Color			Rock Fragments (% by Volume)					Lithology
		Hue	Value	Chroma	Gravel	Cobbles	Stones	Boulders	Total	
CHUSN06-1	0-2	2.5YR	4	8	40	5	-	-	45	LC/Tkn
CHUSN06-1	2-4	7.5YR	4	3	45	10	-	-	55	LC/Tkn
CHUSN06-1	4-11.5	7.5YR	4	3	45	15	5	1	66	LC/Tkn
CHUSN06-2	0-2	5YR	4	4	45	5	1	-	51	LC
CHUSN06-2	2-5	7.5YR	4	3	35	15	-	-	50	LC/Tkn
CHUSN06-2	5-12	5YR	4	4	50	15	1	-	66	LC
CHUSN06-3	0-1.5	*	*	*	45	5	-	-	50	Tkn
CHUSN06-3	1.5-12	10YR	4	3	40	15	5	trace	60	Tkn
CHUSN06-4	0-5	5YR	4	6	50	20	2	-	72	LC
CHUSN06-4	5-12	5YR	4	6	50	20	2	-	72	LC
CHUSN06-5	0-3.5	2.5YR	4	6	55	15	1	-	71	LC
CHUSN06-5	3.5-12	7.5YR	4	6	45	15	trace	-	60	Tkn/LC
CHUSN06-6	0-4.5	2.5YR	3	6	60	20	trace	-	80	LC
CHUSN06-6	4.5-12	7.5YR	4	8	55	20	5	-	80	LC
CHUSN06-7	0.5-10	7.5YR	4	3	30	10	5	-	45	Tkn
CHUSN06-8	0-5	-	-	-	30	10	-	-	40	LC
CHUSN06-8	5-12	7.5YR	4	3	35	10	2	-	47	Tkn

Notes:

Rock Fragments according to Soil Survey Division Staff (1993) Gravel = 2mm - 3"; Cobbles = 3" - 10"; Stones = 10" -25"; Boulders >25"

* Mixed Colors - 2.5YR 4/6 and 10YR 5/8

Lithology: LC = leach cap; Tkn = Kneeling Nun Rhyolite

TABLE 2
CHEMICAL AND PHYSICAL PROPERTIES OF THE UPPER SOUTH STOCKPILE SAMPLES

Field ID	Depth (feet)	Saturated Paste pH	Paste Extract EC (dS/m)	Saturation Percentage (% water)	Water Extractable Metals (mg/kg)		Coarse Fragments (%)	Particle Size Distribution (%)			USDA Texture
					Boron	Selenium		Sand	Silt	Clay	
North Lobe											
CHUSN06-1	0-2	6.6	1.35	27.1	0.07	<0.01	45	45	43	12	L
CHUSN06-1	2-4	7.1	1.30	35.4	<0.05	<0.01	55	55	27	18	SL
CHUSN06-1	4-11.5	7.4	1.18	38.8	0.05	<0.01	66	54	26	20	SCL
CHUSN06-2	0-2	6.9	1.61	37.5	<0.05	<0.01	56	49	31	20	L
CHUSN06-2	2-5	6.4	1.65	35.3	<0.05	<0.01	50	57	25	18	SL
CHUSN06-2	5-12	6.9	0.25	30.6	<0.05	<0.01	66	57	25	18	SL
CHUSN06-3	0-1.5	6.7	0.53	26.1	<0.05	<0.01	50	49	39	12	L
CHUSN06-3	1.5-12	6.2	1.06	29.5	<0.05	<0.01	60	65	21	14	SL
CHUSN06-4	0-5	6.1	0.99	23.9	<0.05	<0.01	72	47	42	11	L
CHUSN06-4	5-12	6.7	0.35	25.3	<0.05	<0.01	72	51	39	10	L
CHUSN06-5	0-3.5	6.3	0.79	25.7	0.06	<0.01	71	60	30	10	SL
CHUSN06-5	3.5-12	6.9	0.57	29.4	<0.05	<0.01	60	62	22	16	SL
CHUSN06-6	0-4.5	6.5	0.30	26.5	0.08	<0.01	80	57	29	14	SL
CHUSN06-6	4.5-12	6.7	0.32	25.0	<0.05	<0.01	80	59	29	12	SL
CHUSN06-7	0.5-10	6.9	1.30	31.1	<0.05	<0.01	45	59	26	15	SL
CHUSN06-8	0-5	6.3	1.70	29.7	<0.05	<0.01	40	55	29	16	SL
CHUSN06-8	5-12	6.9	0.88	35.4	<0.05	<0.01	47	59	23	18	SL

Notes:

EC = electrical conductivity

dS/m = deciSiemens per meter

mg/kg = milligrams per kilogram

USDA textural class according to Soil Survey Division Staff (1993). C = clay, S = sand or sandy, L = loam or loamy, Si = silt or silty

TABLE 3
SULFUR FORMS AND ACID-BASE ACCOUNTS OF UPPER SOUTH STOCKPILE SAMPLES

Field ID	Depth (feet)	ANP	AGP	ABA	Total Sulfur (%)	Extractable Sulfur Forms (%)				Saturated Paste pH
						Hot H_2O	HCl	HNO_3	Residual	
North Lobe										
CHUSN06-1	0-2	0.0	0.3	-0.3	0.41	0.02	< 0.01	0.01	0.37	6.6
CHUSN06-1	2-4	4.6	<0.3	4.6	0.02	< 0.01	< 0.01	< 0.01	< 0.01	7.1
CHUSN06-1	4-11.5	6.4	0.3	6.1	0.03	< 0.01	< 0.01	0.01	< 0.01	7.4
CHUSN06-2	0-2	7.0	0.9	6.1	0.15	0.03	< 0.01	0.03	0.09	6.9
CHUSN06-2	2-5	5.2	0.3	4.9	0.03	< 0.01	< 0.01	0.01	< 0.01	6.4
CHUSN06-2	5-12	3.5	<0.3	3.5	0.04	< 0.01	< 0.01	< 0.01	0.02	6.9
CHUSN06-3	0-1.5	2.9	0.9	2.0	0.14	0.02	< 0.01	0.03	0.09	6.7
CHUSN06-3	1.5-12	4.6	<0.3	4.6	0.03	0.01	< 0.01	< 0.01	< 0.01	6.2
CHUSN06-4	0-5	2.9	<0.3	2.9	0.37	0.07	< 0.01	< 0.01	0.31	6.1
CHUSN06-4	5-12	4.1	<03	4.1	0.46	0.05	< 0.01	< 0.01	0.41	6.7
CHUSN06-5	0-3.5	1.2	<0.3	1.2	0.33	0.06	< 0.01	< 0.01	0.26	6.3
CHUSN06-5	3.5-12	6.4	0.3	6.1	0.07	0.02	< 0.01	0.01	0.04	6.9
CHUSN06-6	0-4.5	1.2	<0.3	1.2	0.48	0.07	< 0.01	< 0.01	0.4	6.5
CHUSN06-6	4.5-12	4.6	5.0	-0.4	0.41	0.08	< 0.01	0.16	0.17	6.7
CHUSN06-7	0.5-10	4.6	0.6	4.0	0.04	0.02	< 0.01	0.02	< 0.01	6.9
CHUSN06-8	0-5	4.1	3.1	1.0	0.18	0.02	< 0.01	0.1	0.05	6.3
CHUSN06-8	5-12	7.0	0.9	6.1	0.06	0.01	< 0.01	0.03	0.02	6.9

Notes:

ANP = acid-neutralization potential, in tons $CaCO_3$ per 1,000 tons rock

AGP = acid-generation potential, in tons $CaCO_3$ per 1,000 tons rock (Based on HNO_3 extractable S)

ABA = acid-base accounting = ANP – AGP, in tons $CaCO_3$ per 1,000 tons rock

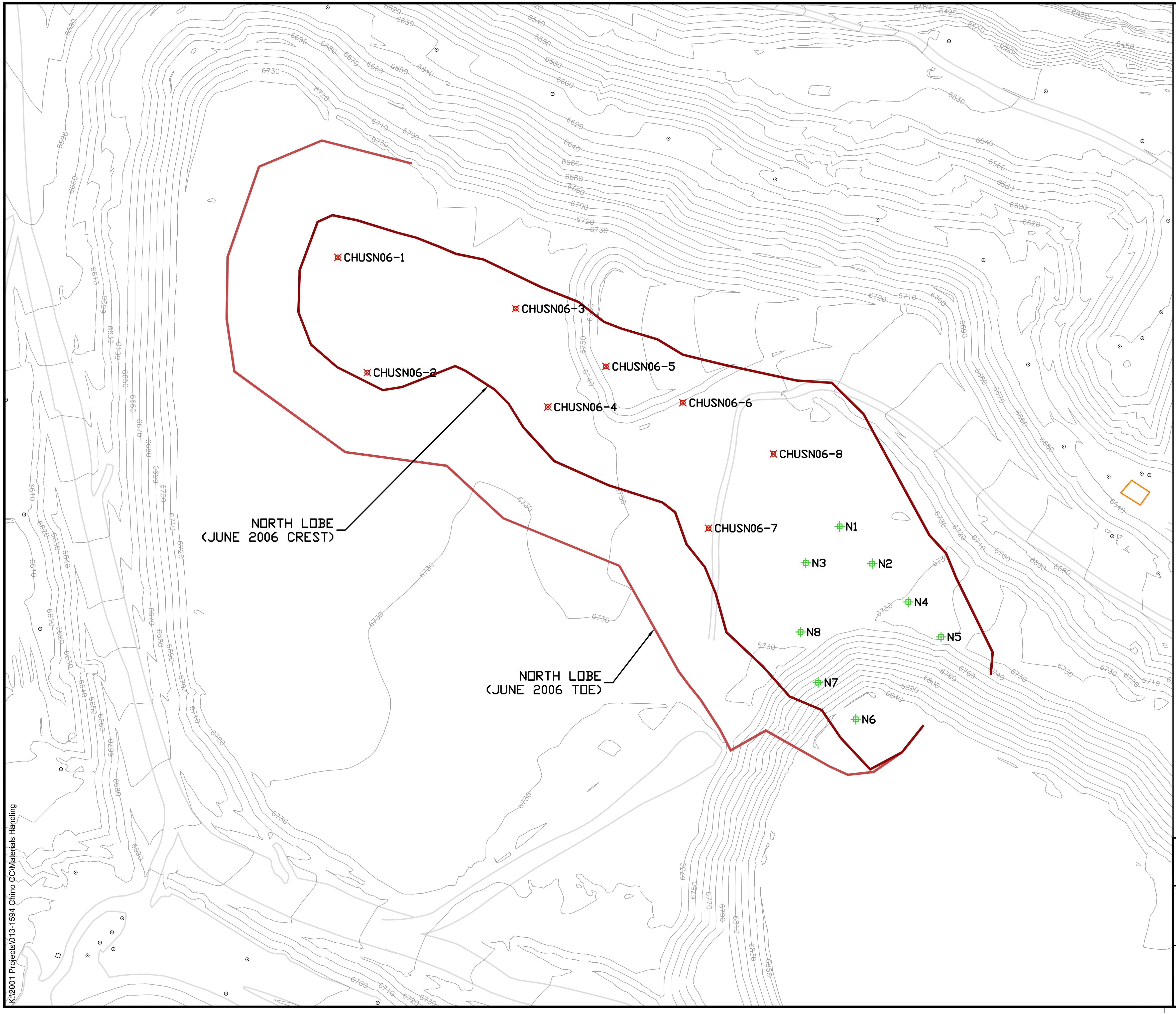
TABLE 4
AB-DTPA EXTRACTIONS FROM THE UPPER SOUTH STOCKPILE

Field ID	Depth (feet)	AB-DTPA Extractable (mg/kg)							
		Arsenic	Cadmium	Copper	Lead	Manganese	Mercury	Molybdenum	Nickel
North Lobe									
CHUSN06-1	0-2	<1.0	<0.01	2	0.1	1.54	<0.05	0.03	0.07
CHUSN06-1	2-4	<1.0	<0.01	2	1.26	3.02	<0.05	0.07	0.09
CHUSN06-1	4-11.5	<1.0	<0.01	2	0.71	1.99	<0.05	0.03	0.08
CHUSN06-2	0-2	<1.0	<0.01	9	0.34	1.74	<0.05	0.05	0.09
CHUSN06-2	2-5	<1.0	0.01	3	0.57	2.56	<0.05	0.04	0.09
CHUSN06-2	5-12	<1.0	<0.01	2	0.32	1.62	<0.05	0.05	0.05
CHUSN06-3	0-1.5	<1.0	<0.01	<1.0	0.33	0.68	<0.05	0.03	0.06
CHUSN06-3	1.5-12	<1.0	<0.01	1	0.18	1.55	<0.05	0.02	0.07
CHUSN06-4	0-5	<1.0	<0.01	2	0.08	0.46	<0.05	0.03	0.05
CHUSN06-4	5-12	<1.0	<0.01	<1.0	0.06	0.21	<0.05	0.06	0.04
CHUSN06-5	0-3.5	<1.0	<0.01	<1.0	0.1	0.57	<0.05	0.04	0.07
CHUSN06-5	3.5-12	<1.0	<0.01	9	0.19	0.88	<0.05	0.03	0.05
CHUSN06-6	0-4.5	<1.0	<0.01	<1.0	0.14	0.64	<0.05	0.03	0.05
CHUSN06-6	4.5-12	<1.0	<0.01	<1.0	2.88	0.46	<0.05	0.1	0.12
CHUSN06-7	0.5-10	<1.0	<0.01	5	0.47	2.22	<0.05	0.02	0.07
CHUSN06-8	0-5	<1.0	<0.01	49	0.23	2.32	<0.05	0.05	0.09
CHUSN06-8	5-12	<1.0	<0.01	16	0.25	0.85	<0.05	0.02	0.06

Note:

mg/kg = milligrams per kilogram

FIGURE



N1 ⊕	APPROXIMATE LOCATION OF NORTH LOBE PIT SAMPLES (OCTOBER 2005)
CNUSN06-1 ☒	LOCATION OF NORTH LOBE PIT SAMPLES (AUGUST 2006)

100 0 100 200
FEET
B SCALE: 1" = 200'
D SCALE: 1" = 400'

PROJECT

CHINO MINES COMPANY
GRANT COUNTY, NEW MEXICO

TITLE

UPPER SOUTH STOCKPILE - NORTH LOBE SAMPLE LOCATIONS

Golder Associates
Albuquerque, New Mexico

PROJECT No.		013-1594	FILE No.	USS_NL_SL
DESIGN	VM	09/07/06	SCALE AS SHOWN	REV. A
CADD	VM	09/07/06	FIGURE 1	
CHECK	LM	09/07/06		
REVIEW				

ATTACHMENT 1

LABORATORY REPORTS

LABORATORY ANALYTICAL REPORT

Client:	Golder Associates Inc	**Report Date:**	08/29/06
Project:	Chino-USSP North 013-1594	**Collection Date:**	08/10/06
Lab ID:	B06081524-001	**DateReceived:**	08/17/06
Client Sample ID:	CHUSN06-4, 0-5 ft	**Matrix:**	Soil

Analyses	**Result**	**Units**	**Qualifiers**	**RL**	**MCL/ QCL**	**Method**	**Analysis Date / By**
PHYSICAL CHARACTERISTICS							
Coarse Fragments	54	wt%		2		ASA15-5	08/23/06 16:51 / srm
Sand	47	%		1		ASA15-5	08/23/06 16:51 / srm
Silt	42	%		1		ASA15-5	08/23/06 16:51 / srm
Clay	11	%		1		ASA15-5	08/23/06 16:51 / srm
Texture	L					ASA15-5	08/23/06 16:51 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	6.10	s.u.		0.10		ASAM10-3.2	08/23/06 16:51 / srm
Conductivity, sat. paste	0.99	mmhos/cm		0.01		ASA10-3	08/24/06 16:40 / srm
Saturation	23.9	%		0.1		USDA27a	08/24/06 16:40 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	2.9	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid Potential	9.6	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid/Base Potential	-7	t/kt				Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Total	0.37	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Hot Water Extractable	0.07	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HCl Extractable	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HNO3 Extractable	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Residual	0.31	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
METALS, WATER EXTRACTABLE							
Selenium	ND	mg/kg		0.01		SW6020	08/23/06 13:17 / car
Boron	ND	mg/kg		0.05		SW6010B	08/23/06 01:29 / rlh
METALS, ABDTPA EXTRACTABLE							
Arsenic	ND	mg/kg		1		SW6020	08/23/06 19:43 / car
Cadmium	ND	mg/kg		0.01		SW6020	08/23/06 19:43 / car
Copper	2	mg/kg		1		SW6010B	08/22/06 18:28 / rlh
Lead	0.08	mg/kg	D	0.03		SW6020	08/23/06 19:43 / car
Manganese	0.46	mg/kg		0.01		SW6010B	08/22/06 18:28 / rlh
Mercury	ND	mg/kg		0.05		SW6020	08/23/06 19:43 / car
Molybdenum	0.03	mg/kg		0.01		SW6020	08/23/06 19:43 / car
Nickel	0.05	mg/kg	D	0.03		SW6020	08/23/06 19:43 / car

Report Definitions:

RL - Analyte reporting limit.

QCL - Quality control limit.

D - RL increased due to sample matrix interference.

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Client:	Golder Associates Inc	**Report Date:**	08/29/06
Project:	Chino-USSP North 013-1594	**Collection Date:**	08/10/06
Lab ID:	B06081524-002	**DateReceived:**	08/17/06
Client Sample ID:	CHUSN06-3, 1.5-12 ft	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Coarse Fragments	29	wt%		2		ASA15-5	08/23/06 16:51 / srm
Sand	65	%		1		ASA15-5	08/23/06 16:51 / srm
Silt	21	%		1		ASA15-5	08/23/06 16:51 / srm
Clay	14	%		1		ASA15-5	08/23/06 16:51 / srm
Texture	SL					ASA15-5	08/23/06 16:51 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	6.20	s.u.		0.10		ASAM10-3.2	08/23/06 16:51 / srm
Conductivity, sat. paste	1.06	mmhos/cm		0.01		ASA10-3	08/24/06 16:40 / srm
Saturation	29.5	%		0.1		USDA27a	08/24/06 16:40 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	4.6	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid/Base Potential	4	t/kt				Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Total	0.03	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Hot Water Extractable	0.01	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HCl Extractable	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HNO3 Extractable	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Residual	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
METALS, WATER EXTRACTABLE							
Selenium	ND	mg/kg		0.01		SW6020	08/23/06 13:31 / car
Boron	ND	mg/kg		0.05		SW6010B	08/23/06 01:38 / rlh
METALS, ABDTPA EXTRACTABLE							
Arsenic	ND	mg/kg		1		SW6020	08/23/06 19:57 / car
Cadmium	ND	mg/kg		0.01		SW6020	08/23/06 19:57 / car
Copper	1	mg/kg		1		SW6010B	08/22/06 18:35 / rlh
Lead	0.18	mg/kg	D	0.03		SW6020	08/23/06 19:57 / car
Manganese	1.55	mg/kg		0.01		SW6010B	08/22/06 18:35 / rlh
Mercury	ND	mg/kg		0.05		SW6020	08/23/06 19:57 / car
Molybdenum	0.02	mg/kg		0.01		SW6020	08/23/06 19:57 / car
Nickel	0.07	mg/kg	D	0.03		SW6020	08/23/06 19:57 / car

Report Definitions:

RL - Analyte reporting limit.

QCL - Quality control limit.

D - RL increased due to sample matrix interference.

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Client:	Golder Associates Inc	**Report Date:**	08/29/06
Project:	Chino-USSP North 013-1594	**Collection Date:**	08/10/06
Lab ID:	B06081524-003	**DateReceived:**	08/17/06
Client Sample ID:	CHUSN06-4, 5-12 ft	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Coarse Fragments	64	wt%		2		ASA15-5	08/23/06 16:51 / srm
Sand	51	%		1		ASA15-5	08/23/06 16:51 / srm
Silt	39	%		1		ASA15-5	08/23/06 16:51 / srm
Clay	10	%		1		ASA15-5	08/23/06 16:51 / srm
Texture	L					ASA15-5	08/23/06 16:51 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	6.70	s.u.		0.10		ASAM10-3.2	08/23/06 16:51 / srm
Conductivity, sat. paste	0.35	mmhos/cm		0.01		ASA10-3	08/24/06 16:40 / srm
Saturation	25.3	%		0.1		USDA27a	08/24/06 16:40 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	4.1	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid Potential	13	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid/Base Potential	-9	t/kt				Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Total	0.46	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Hot Water Extractable	0.05	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HCl Extractable	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HNO3 Extractable	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Residual	0.41	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
METALS, WATER EXTRACTABLE							
Selenium	ND	mg/kg		0.01		SW6020	08/23/06 13:59 / car
Boron	ND	mg/kg		0.05		SW6010B	08/23/06 01:46 / rlh
METALS, ABDTPA EXTRACTABLE							
Arsenic	ND	mg/kg		1		SW6020	08/23/06 20:54 / car
Cadmium	ND	mg/kg		0.01		SW6020	08/23/06 20:54 / car
Copper	ND	mg/kg		1		SW6010B	08/22/06 18:50 / rlh
Lead	0.06	mg/kg	D	0.03		SW6020	08/23/06 20:54 / car
Manganese	0.21	mg/kg		0.01		SW6010B	08/22/06 18:50 / rlh
Mercury	ND	mg/kg		0.05		SW6020	08/23/06 20:54 / car
Molybdenum	0.06	mg/kg		0.01		SW6020	08/23/06 20:54 / car
Nickel	0.04	mg/kg	D	0.03		SW6020	08/23/06 20:54 / car

Report Definitions:

RL - Analyte reporting limit.

QCL - Quality control limit.

D - RL increased due to sample matrix interference.

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Client:	Golder Associates Inc	**Report Date:**	08/29/06
Project:	Chino-USSP North 013-1594	**Collection Date:**	08/10/06
Lab ID:	B06081524-004	**DateReceived:**	08/17/06
Client Sample ID:	CHUSN06-3, 0-1.5 ft	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Coarse Fragments	48	wt%		2		ASA15-5	08/23/06 16:51 / srm
Sand	49	%		1		ASA15-5	08/23/06 16:51 / srm
Silt	39	%		1		ASA15-5	08/23/06 16:51 / srm
Clay	12	%		1		ASA15-5	08/23/06 16:51 / srm
Texture	L					ASA15-5	08/23/06 16:51 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	6.70	s.u.		0.10		ASAM10-3.2	08/23/06 16:51 / srm
Conductivity, sat. paste	0.53	mmhos/cm		0.01		ASA10-3	08/24/06 16:40 / srm
Saturation	26.1	%		0.1		USDA27a	08/24/06 16:40 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	2.9	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid Potential	3.8	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid/Base Potential	0	t/kt				Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Total	0.14	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Hot Water Extractable	0.02	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HCl Extractable	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HNO3 Extractable	0.03	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Residual	0.09	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
METALS, WATER EXTRACTABLE							
Selenium	ND	mg/kg		0.01		SW6020	08/23/06 14:42 / car
Boron	ND	mg/kg		0.05		SW6010B	08/23/06 01:51 / rlh
METALS, ABDTPA EXTRACTABLE							
Arsenic	ND	mg/kg		1		SW6020	08/23/06 21:08 / car
Cadmium	ND	mg/kg		0.01		SW6020	08/23/06 21:08 / car
Copper	ND	mg/kg		1		SW6010B	08/22/06 18:53 / rlh
Lead	0.33	mg/kg		0.01		SW6020	08/23/06 21:08 / car
Manganese	0.68	mg/kg		0.01		SW6010B	08/22/06 18:53 / rlh
Mercury	ND	mg/kg		0.05		SW6020	08/23/06 21:08 / car
Molybdenum	0.03	mg/kg		0.01		SW6020	08/23/06 21:08 / car
Nickel	0.06	mg/kg	D	0.03		SW6020	08/23/06 21:08 / car

Report Definitions:		
	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.
	D - RL increased due to sample matrix interference.	

LABORATORY ANALYTICAL REPORT

Client: Golder Associates Inc
Project: Chino-USSP North 013-1594
Lab ID: B06081524-005
Client Sample ID: CHUSN06-2, 5-12 ft

Report Date: 08/29/06
Collection Date: 08/10/06
DateReceived: 08/17/06
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Coarse Fragments	54	wt%		2		ASA15-5	08/23/06 16:51 / srm
Sand	57	%		1		ASA15-5	08/23/06 16:51 / srm
Silt	25	%		1		ASA15-5	08/23/06 16:51 / srm
Clay	18	%		1		ASA15-5	08/23/06 16:51 / srm
Texture	SL					ASA15-5	08/23/06 16:51 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	6.90	s.u.		0.10		ASAM10-3.2	08/23/06 16:51 / srm
Conductivity, sat. paste	0.25	mmhos/cm		0.01		ASA10-3	08/24/06 16:40 / srm
Saturation	30.6	%		0.1		USDA27a	08/24/06 16:40 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	3.5	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid/Base Potential	2	t/kt				Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Total	0.04	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Hot Water Extractable	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HCl Extractable	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HNO3 Extractable	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Residual	0.02	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
METALS, WATER EXTRACTABLE							
Selenium	ND	mg/kg		0.01		SW6020	08/23/06 14:49 / car
Boron	ND	mg/kg		0.05		SW6010B	08/23/06 01:55 / rlh
METALS, ABDTPA EXTRACTABLE							
Arsenic	ND	mg/kg		1		SW6020	08/23/06 21:16 / car
Cadmium	ND	mg/kg		0.01		SW6020	08/23/06 21:16 / car
Copper	2	mg/kg		1		SW6020	08/23/06 21:16 / car
Lead	0.32	mg/kg		0.01		SW6020	08/23/06 21:16 / car
Manganese	1.62	mg/kg		0.01		SW6010B	08/22/06 18:57 / rlh
Mercury	ND	mg/kg		0.05		SW6020	08/23/06 21:16 / car
Molybdenum	0.05	mg/kg		0.01		SW6020	08/23/06 21:16 / car
Nickel	0.05	mg/kg	D	0.03		SW6020	08/23/06 21:16 / car

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Client: Golder Associates Inc
Project: Chino-USSP North 013-1594
Lab ID: B06081524-006
Client Sample ID: CHUSN06-2, 2-5 ft

Report Date: 08/29/06
Collection Date: 08/10/06
DateReceived: 08/17/06
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Coarse Fragments	21	wt%		2		ASA15-5	08/23/06 16:51 / srm
Sand	57	%		1		ASA15-5	08/23/06 16:51 / srm
Silt	25	%		1		ASA15-5	08/23/06 16:51 / srm
Clay	18	%		1		ASA15-5	08/23/06 16:51 / srm
Texture	SL					ASA15-5	08/23/06 16:51 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	6.40	s.u.		0.10		ASAM10-3.2	08/23/06 16:51 / srm
Conductivity, sat. paste	1.65	mmhos/cm		0.01		ASA10-3	08/24/06 16:40 / srm
Saturation	35.3	%		0.1		USDA27a	08/24/06 16:40 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	5.2	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid/Base Potential	4	t/kt				Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Total	0.03	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Hot Water Extractable	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HCl Extractable	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HNO3 Extractable	0.01	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Residual	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
METALS, WATER EXTRACTABLE							
Selenium	ND	mg/kg		0.01		SW6020	08/23/06 14:56 / car
Boron	ND	mg/kg		0.05		SW6010B	08/23/06 01:59 / rlh
METALS, ABDTPA EXTRACTABLE							
Arsenic	ND	mg/kg		1		SW6020	08/23/06 21:23 / car
Cadmium	0.01	mg/kg		0.01		SW6020	08/23/06 21:23 / car
Copper	3	mg/kg		1		SW6010B	08/22/06 19:00 / rlh
Lead	0.57	mg/kg		0.01		SW6020	08/23/06 21:23 / car
Manganese	2.56	mg/kg		0.01		SW6010B	08/22/06 19:00 / rlh
Mercury	ND	mg/kg		0.05		SW6020	08/23/06 21:23 / car
Molybdenum	0.04	mg/kg		0.01		SW6020	08/23/06 21:23 / car
Nickel	0.09	mg/kg	D	0.03		SW6020	08/23/06 21:23 / car

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Client:	Golder Associates Inc	**Report Date:**	08/29/06
Project:	Chino-USSP North 013-1594	**Collection Date:**	08/10/06
Lab ID:	B06081524-007	**DateReceived:**	08/17/06
Client Sample ID:	CHUSN06-1, 0-2 ft	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Coarse Fragments	37	wt%		2		ASA15-5	08/23/06 16:51 / srm
Sand	45	%		1		ASA15-5	08/23/06 16:51 / srm
Silt	43	%		1		ASA15-5	08/23/06 16:51 / srm
Clay	12	%		1		ASA15-5	08/23/06 16:51 / srm
Texture	L					ASA15-5	08/23/06 16:51 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	6.60	s.u.		0.10		ASAM10-3.2	08/23/06 16:51 / srm
Conductivity, sat. paste	1.35	mmhos/cm		0.01		ASA10-3	08/24/06 16:40 / srm
Saturation	27.1	%		0.1		USDA27a	08/24/06 16:40 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	0	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid Potential	12	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid/Base Potential	-12	t/kt				Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Total	0.41	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Hot Water Extractable	0.02	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HCl Extractable	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HNO3 Extractable	0.01	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Residual	0.37	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
METALS, WATER EXTRACTABLE							
Selenium	ND	mg/kg		0.01		SW6020	08/23/06 15:03 / car
Boron	0.07	mg/kg		0.05		SW6010B	08/23/06 02:04 / rlh
METALS, ABDTPA EXTRACTABLE							
Arsenic	ND	mg/kg		1		SW6020	08/23/06 21:30 / car
Cadmium	ND	mg/kg		0.01		SW6020	08/23/06 21:30 / car
Copper	2	mg/kg		1		SW6010B	08/22/06 19:04 / rlh
Lead	0.10	mg/kg	D	0.03		SW6020	08/23/06 21:30 / car
Manganese	1.54	mg/kg		0.01		SW6010B	08/22/06 19:04 / rlh
Mercury	ND	mg/kg		0.05		SW6020	08/23/06 21:30 / car
Molybdenum	0.03	mg/kg		0.01		SW6020	08/23/06 21:30 / car
Nickel	0.07	mg/kg	D	0.03		SW6020	08/23/06 21:30 / car

Report Definitions:

RL - Analyte reporting limit.

QCL - Quality control limit.

D - RL increased due to sample matrix interference.

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Client:	Golder Associates Inc	**Report Date:**	08/29/06
Project:	Chino-USSP North 013-1594	**Collection Date:**	08/10/06
Lab ID:	B06081524-008	**DateReceived:**	08/17/06
Client Sample ID:	CHUSN06-2, 0-2 ft	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Coarse Fragments	60	wt%		2		ASA15-5	08/23/06 16:51 / srm
Sand	49	%		1		ASA15-5	08/23/06 16:51 / srm
Silt	31	%		1		ASA15-5	08/23/06 16:51 / srm
Clay	20	%		1		ASA15-5	08/23/06 16:51 / srm
Texture	L					ASA15-5	08/23/06 16:51 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	6.90	s.u.		0.10		ASAM10-3.2	08/23/06 16:51 / srm
Conductivity, sat. paste	1.61	mmhos/cm		0.01		ASA10-3	08/24/06 16:40 / srm
Saturation	37.5	%		0.1		USDA27a	08/24/06 16:40 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	7.0	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid Potential	3.7	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid/Base Potential	3	t/kt				Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Total	0.15	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Hot Water Extractable	0.03	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HCl Extractable	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HNO3 Extractable	0.03	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Residual	0.09	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
METALS, WATER EXTRACTABLE							
Selenium	ND	mg/kg		0.01		SW6020	08/23/06 15:11 / car
Boron	ND	mg/kg		0.05		SW6010B	08/23/06 02:08 / rlh
METALS, ABDTPA EXTRACTABLE							
Arsenic	ND	mg/kg		1		SW6020	08/23/06 21:37 / car
Cadmium	ND	mg/kg		0.01		SW6020	08/23/06 21:37 / car
Copper	9	mg/kg		1		SW6010B	08/22/06 19:08 / rlh
Lead	0.34	mg/kg		0.01		SW6020	08/23/06 21:37 / car
Manganese	1.74	mg/kg		0.01		SW6010B	08/22/06 19:08 / rlh
Mercury	ND	mg/kg		0.05		SW6020	08/23/06 21:37 / car
Molybdenum	0.05	mg/kg		0.01		SW6020	08/23/06 21:37 / car
Nickel	0.09	mg/kg	D	0.03		SW6020	08/23/06 21:37 / car

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Client:	Golder Associates Inc		**Report Date:**	08/29/06
Project:	Chino-USSP North 013-1594		**Collection Date:**	08/10/06
Lab ID:	B06081524-009		**DateReceived:**	08/17/06
Client Sample ID:	CHUSN06-1, 2-4 ft		**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Coarse Fragments	46	wt%		2		ASA15-5	08/23/06 16:51 / srm
Sand	55	%		1		ASA15-5	08/23/06 16:51 / srm
Silt	27	%		1		ASA15-5	08/23/06 16:51 / srm
Clay	18	%		1		ASA15-5	08/23/06 16:51 / srm
Texture	SL					ASA15-5	08/23/06 16:51 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	7.10	s.u.		0.10		ASAM10-3.2	08/23/06 16:51 / srm
Conductivity, sat. paste	1.30	mmhos/cm		0.01		ASA10-3	08/24/06 16:40 / srm
Saturation	35.4	%		0.1		USDA27a	08/24/06 16:40 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	4.6	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid/Base Potential	4	t/kt				Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Total	0.02	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Hot Water Extractable	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HCl Extractable	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HNO3 Extractable	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Residual	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
METALS, WATER EXTRACTABLE							
Selenium	ND	mg/kg		0.01		SW6020	08/23/06 15:18 / car
Boron	ND	mg/kg		0.05		SW6010B	08/23/06 02:20 / rlh
METALS, ABDTPA EXTRACTABLE							
Arsenic	ND	mg/kg		1		SW6020	08/23/06 21:44 / car
Cadmium	ND	mg/kg		0.01		SW6020	08/23/06 21:44 / car
Copper	2	mg/kg		1		SW6010B	08/22/06 19:11 / rlh
Lead	1.26	mg/kg		0.01		SW6020	08/23/06 21:44 / car
Manganese	3.02	mg/kg		0.01		SW6010B	08/22/06 19:11 / rlh
Mercury	ND	mg/kg		0.05		SW6020	08/23/06 21:44 / car
Molybdenum	0.07	mg/kg		0.01		SW6020	08/23/06 21:44 / car
Nickel	0.09	mg/kg	D	0.03		SW6020	08/23/06 21:44 / car

Report Definitions:	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.
	D - RL increased due to sample matrix interference.	

LABORATORY ANALYTICAL REPORT

Client:	Golder Associates Inc	**Report Date:**	08/29/06
Project:	Chino-USSP North 013-1594	**Collection Date:**	08/10/06
Lab ID:	B06081524-010	**DateReceived:**	08/17/06
Client Sample ID:	CHUSN06-1, 4-11.5 ft	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Coarse Fragments	39	wt%		2		ASA15-5	08/23/06 16:51 / srm
Sand	54	%		1		ASA15-5	08/23/06 16:51 / srm
Silt	26	%		1		ASA15-5	08/23/06 16:51 / srm
Clay	20	%		1		ASA15-5	08/23/06 16:51 / srm
Texture	SCL					ASA15-5	08/23/06 16:51 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	7.40	s.u.		0.10		ASAM10-3.2	08/23/06 16:51 / srm
Conductivity, sat. paste	1.18	mmhos/cm		0.01		ASA10-3	08/24/06 16:40 / srm
Saturation	38.8	%		0.1		USDA27a	08/24/06 16:40 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	6.4	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid/Base Potential	6	t/kt				Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Total	0.03	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Hot Water Extractable	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HCl Extractable	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HNO3 Extractable	0.01	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Residual	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
METALS, WATER EXTRACTABLE							
Selenium	ND	mg/kg		0.01		SW6020	08/23/06 15:25 / car
Boron	0.05	mg/kg		0.05		SW6010B	08/23/06 02:25 / rlh
METALS, ABDTPA EXTRACTABLE							
Arsenic	ND	mg/kg		1		SW6020	08/23/06 21:51 / car
Cadmium	ND	mg/kg		0.01		SW6020	08/23/06 21:51 / car
Copper	2	mg/kg		1		SW6010B	08/22/06 19:15 / rlh
Lead	0.71	mg/kg		0.01		SW6020	08/23/06 21:51 / car
Manganese	1.99	mg/kg		0.01		SW6010B	08/22/06 19:15 / rlh
Mercury	ND	mg/kg		0.05		SW6020	08/23/06 21:51 / car
Molybdenum	0.03	mg/kg		0.01		SW6020	08/23/06 21:51 / car
Nickel	0.08	mg/kg	D	0.03		SW6020	08/23/06 21:51 / car

Report Definitions:

RL - Analyte reporting limit.

QCL - Quality control limit.

D - RL increased due to sample matrix interference.

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Client:	Golder Associates Inc	**Report Date:**	08/29/06
Project:	Chino-USSP North 013-1594	**Collection Date:**	08/10/06
Lab ID:	B06081524-011	**DateReceived:**	08/17/06
Client Sample ID:	CHUSN06-7, 0.5-10 ft	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Coarse Fragments	39	wt%		2		ASA15-5	08/23/06 16:51 / srm
Sand	59	%		1		ASA15-5	08/23/06 16:51 / srm
Silt	26	%		1		ASA15-5	08/23/06 16:51 / srm
Clay	15	%		1		ASA15-5	08/23/06 16:51 / srm
Texture	SL					ASA15-5	08/23/06 16:51 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	6.90	s.u.		0.10		ASAM10-3.2	08/23/06 16:51 / srm
Conductivity, sat. paste	1.30	mmhos/cm		0.01		ASA10-3	08/24/06 16:40 / srm
Saturation	31.1	%		0.1		USDA27a	08/24/06 16:40 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	4.6	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid/Base Potential	4	t/kt				Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Total	0.04	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Hot Water Extractable	0.02	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HCl Extractable	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HNO3 Extractable	0.02	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Residual	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
METALS, WATER EXTRACTABLE							
Selenium	ND	mg/kg		0.01		SW6020	08/23/06 15:32 / car
Boron	ND	mg/kg		0.05		SW6010B	08/23/06 02:29 / rlh
METALS, ABDTPA EXTRACTABLE							
Arsenic	ND	mg/kg		1		SW6020	08/23/06 22:27 / car
Cadmium	ND	mg/kg		0.01		SW6020	08/23/06 22:27 / car
Copper	5	mg/kg		1		SW6010B	08/22/06 19:18 / rlh
Lead	0.47	mg/kg		0.01		SW6020	08/23/06 22:27 / car
Manganese	2.22	mg/kg		0.01		SW6010B	08/22/06 19:18 / rlh
Mercury	ND	mg/kg		0.05		SW6020	08/23/06 22:27 / car
Molybdenum	0.02	mg/kg		0.01		SW6020	08/23/06 22:27 / car
Nickel	0.07	mg/kg	D	0.03		SW6020	08/23/06 22:27 / car

Report Definitions:

RL - Analyte reporting limit.

QCL - Quality control limit.

D - RL increased due to sample matrix interference.

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Client:	Golder Associates Inc	**Report Date:**	08/29/06
Project:	Chino-USSP North 013-1594	**Collection Date:**	08/10/06
Lab ID:	B06081524-012	**DateReceived:**	08/17/06
Client Sample ID:	CHUSN06-8, 0-5 ft	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Coarse Fragments	49	wt%		2		ASA15-5	08/23/06 16:51 / srm
Sand	55	%		1		ASA15-5	08/23/06 16:51 / srm
Silt	29	%		1		ASA15-5	08/23/06 16:51 / srm
Clay	16	%		1		ASA15-5	08/23/06 16:51 / srm
Texture	SL					ASA15-5	08/23/06 16:51 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	6.30	s.u.		0.10		ASAM10-3.2	08/23/06 16:51 / srm
Conductivity, sat. paste	1.70	mmhos/cm		0.01		ASA10-3	08/24/06 16:40 / srm
Saturation	29.7	%		0.1		USDA27a	08/24/06 16:40 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	4.1	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid Potential	4.8	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid/Base Potential	0	t/kt				Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Total	0.18	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Hot Water Extractable	0.02	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HCl Extractable	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HNO3 Extractable	0.10	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Residual	0.05	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
METALS, WATER EXTRACTABLE							
Selenium	ND	mg/kg		0.01		SW6020	08/23/06 16:15 / car
Boron	ND	mg/kg		0.05		SW6010B	08/23/06 02:38 / rlh
METALS, ABDTPA EXTRACTABLE							
Arsenic	ND	mg/kg		1		SW6020	08/23/06 22:42 / car
Cadmium	ND	mg/kg		0.01		SW6020	08/23/06 22:42 / car
Copper	49	mg/kg		1		SW6010B	08/22/06 19:33 / rlh
Lead	0.23	mg/kg	D	0.03		SW6020	08/23/06 22:42 / car
Manganese	2.32	mg/kg		0.01		SW6010B	08/22/06 19:33 / rlh
Mercury	ND	mg/kg		0.05		SW6020	08/23/06 22:42 / car
Molybdenum	0.05	mg/kg		0.01		SW6020	08/23/06 22:42 / car
Nickel	0.09	mg/kg	D	0.03		SW6020	08/23/06 22:42 / car

Report Definitions:

RL - Analyte reporting limit.

QCL - Quality control limit.

D - RL increased due to sample matrix interference.

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Client:	Golder Associates Inc	**Report Date:**	08/29/06
Project:	Chino-USSP North 013-1594	**Collection Date:**	08/10/06
Lab ID:	B06081524-013	**DateReceived:**	08/17/06
Client Sample ID:	CHUSN06-8, 5-12 ft	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Coarse Fragments	23	wt%		2		ASA15-5	08/23/06 16:51 / srm
Sand	59	%		1		ASA15-5	08/23/06 16:51 / srm
Silt	23	%		1		ASA15-5	08/23/06 16:51 / srm
Clay	18	%		1		ASA15-5	08/23/06 16:51 / srm
Texture	SL					ASA15-5	08/23/06 16:51 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	6.90	s.u.		0.10		ASAM10-3.2	08/23/06 16:51 / srm
Conductivity, sat. paste	0.88	mmhos/cm		0.01		ASA10-3	08/24/06 16:40 / srm
Saturation	35.4	%		0.1		USDA27a	08/24/06 16:40 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	7.0	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid Potential	1.6	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid/Base Potential	5	t/kt				Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Total	0.06	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Hot Water Extractable	0.01	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HCl Extractable	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HNO3 Extractable	0.03	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Residual	0.02	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
METALS, WATER EXTRACTABLE							
Selenium	ND	mg/kg		0.01		SW6020	08/23/06 16:43 / car
Boron	ND	mg/kg		0.05		SW6010B	08/23/06 02:46 / rlh
METALS, ABDTPA EXTRACTABLE							
Arsenic	ND	mg/kg		1		SW6020	08/23/06 23:11 / car
Cadmium	ND	mg/kg		0.01		SW6020	08/23/06 23:11 / car
Copper	16	mg/kg		1		SW6010B	08/22/06 19:40 / rlh
Lead	0.25	mg/kg	D	0.03		SW6020	08/23/06 23:11 / car
Manganese	0.85	mg/kg		0.01		SW6010B	08/22/06 19:40 / rlh
Mercury	ND	mg/kg		0.05		SW6020	08/23/06 23:11 / car
Molybdenum	0.02	mg/kg		0.01		SW6020	08/23/06 23:11 / car
Nickel	0.06	mg/kg	D	0.03		SW6020	08/23/06 23:11 / car

Report Definitions:	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.
	D - RL increased due to sample matrix interference.	

LABORATORY ANALYTICAL REPORT

Client:	Golder Associates Inc	**Report Date:**	08/29/06
Project:	Chino-USSP North 013-1594	**Collection Date:**	08/10/06
Lab ID:	B06081524-014	**DateReceived:**	08/17/06
Client Sample ID:	CHUSN06-6, 0-4.5 ft	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Coarse Fragments	76	wt%		2		ASA15-5	08/23/06 16:51 / srm
Sand	57	%		1		ASA15-5	08/23/06 16:51 / srm
Silt	29	%		1		ASA15-5	08/23/06 16:51 / srm
Clay	14	%		1		ASA15-5	08/23/06 16:51 / srm
Texture	SL					ASA15-5	08/23/06 16:51 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	6.50	s.u.		0.10		ASAM10-3.2	08/23/06 16:51 / srm
Conductivity, sat. paste	0.30	mmhos/cm		0.01		ASA10-3	08/24/06 16:40 / srm
Saturation	26.5	%		0.1		USDA27a	08/24/06 16:40 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	1.2	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid Potential	13	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid/Base Potential	-11	t/kt				Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Total	0.48	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Hot Water Extractable	0.07	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HCl Extractable	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HNO3 Extractable	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Residual	0.40	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
METALS, WATER EXTRACTABLE							
Selenium	ND	mg/kg		0.01		SW6020	08/23/06 16:51 / car
Boron	0.08	mg/kg		0.05		SW6010B	08/23/06 02:50 / rlh
METALS, ABDTPA EXTRACTABLE							
Arsenic	ND	mg/kg		1		SW6020	08/23/06 23:18 / car
Cadmium	ND	mg/kg		0.01		SW6020	08/23/06 23:18 / car
Copper	ND	mg/kg		1		SW6010B	08/22/06 19:43 / rlh
Lead	0.14	mg/kg	D	0.03		SW6020	08/23/06 23:18 / car
Manganese	0.64	mg/kg		0.01		SW6010B	08/22/06 19:43 / rlh
Mercury	ND	mg/kg		0.05		SW6020	08/23/06 23:18 / car
Molybdenum	0.03	mg/kg		0.01		SW6020	08/23/06 23:18 / car
Nickel	0.05	mg/kg	D	0.03		SW6020	08/23/06 23:18 / car

Report Definitions:	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.
	D - RL increased due to sample matrix interference.	

LABORATORY ANALYTICAL REPORT

Client:	Golder Associates Inc	**Report Date:**	08/29/06
Project:	Chino-USSP North 013-1594	**Collection Date:**	08/10/06
Lab ID:	B06081524-015	**DateReceived:**	08/17/06
Client Sample ID:	CHUSN06-6, 4.5-12 ft	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Coarse Fragments	59	wt%		2		ASA15-5	08/23/06 16:51 / srm
Sand	59	%		1		ASA15-5	08/23/06 16:51 / srm
Silt	29	%		1		ASA15-5	08/23/06 16:51 / srm
Clay	12	%		1		ASA15-5	08/23/06 16:51 / srm
Texture	SL					ASA15-5	08/23/06 16:51 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	6.70	s.u.		0.10		ASAM10-3.2	08/23/06 16:51 / srm
Conductivity, sat. paste	0.32	mmhos/cm		0.01		ASA10-3	08/24/06 16:40 / srm
Saturation	25.0	%		0.1		USDA27a	08/24/06 16:40 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	4.6	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid Potential	10	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid/Base Potential	-6	t/kt				Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Total	0.41	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Hot Water Extractable	0.08	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HCl Extractable	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HNO3 Extractable	0.16	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Residual	0.17	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
METALS, WATER EXTRACTABLE							
Selenium	ND	mg/kg		0.01		SW6020	08/23/06 16:58 / car
Boron	ND	mg/kg		0.05		SW6010B	08/23/06 02:55 / rlh
METALS, ABDTPA EXTRACTABLE							
Arsenic	ND	mg/kg		1		SW6020	08/23/06 23:25 / car
Cadmium	ND	mg/kg		0.01		SW6020	08/23/06 23:25 / car
Copper	ND	mg/kg		1		SW6010B	08/22/06 19:47 / rlh
Lead	2.88	mg/kg		0.01		SW6020	08/23/06 23:25 / car
Manganese	0.46	mg/kg		0.01		SW6010B	08/22/06 19:47 / rlh
Mercury	ND	mg/kg		0.05		SW6020	08/23/06 23:25 / car
Molybdenum	0.10	mg/kg		0.01		SW6020	08/23/06 23:25 / car
Nickel	0.12	mg/kg	D	0.03		SW6020	08/23/06 23:25 / car

Report Definitions:	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.
	D - RL increased due to sample matrix interference.	

LABORATORY ANALYTICAL REPORT

Client:	Golder Associates Inc	**Report Date:**	08/29/06
Project:	Chino-USSP North 013-1594	**Collection Date:**	08/10/06
Lab ID:	B06081524-016	**DateReceived:**	08/17/06
Client Sample ID:	CHUSN06-5, 3.5-12 ft	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Coarse Fragments	52	wt%		2		ASA15-5	08/23/06 16:51 / srm
Sand	62	%		1		ASA15-5	08/23/06 16:51 / srm
Silt	22	%		1		ASA15-5	08/23/06 16:51 / srm
Clay	16	%		1		ASA15-5	08/23/06 16:51 / srm
Texture	SL					ASA15-5	08/23/06 16:51 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	6.90	s.u.		0.10		ASAM10-3.2	08/23/06 16:51 / srm
Conductivity, sat. paste	0.57	mmhos/cm		0.01		ASA10-3	08/24/06 16:40 / srm
Saturation	29.4	%		0.1		USDA27a	08/24/06 16:40 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	6.4	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid Potential	1.8	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid/Base Potential	5	t/kt				Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Total	0.07	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Hot Water Extractable	0.02	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HCl Extractable	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HNO3 Extractable	0.01	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Residual	0.04	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
METALS, WATER EXTRACTABLE							
Selenium	ND	mg/kg		0.01		SW6020	08/23/06 17:05 / car
Boron	ND	mg/kg		0.05		SW6010B	08/23/06 02:59 / rlh
METALS, ABDTPA EXTRACTABLE							
Arsenic	ND	mg/kg		1		SW6020	08/24/06 00:01 / car
Cadmium	ND	mg/kg		0.01		SW6020	08/24/06 00:01 / car
Copper	9	mg/kg		1		SW6010B	08/22/06 19:50 / rlh
Lead	0.19	mg/kg	D	0.03		SW6020	08/24/06 00:01 / car
Manganese	0.88	mg/kg		0.01		SW6010B	08/22/06 19:50 / rlh
Mercury	ND	mg/kg		0.05		SW6020	08/24/06 00:01 / car
Molybdenum	0.03	mg/kg		0.01		SW6020	08/24/06 00:01 / car
Nickel	0.05	mg/kg	D	0.03		SW6020	08/24/06 00:01 / car

Report Definitions:

RL - Analyte reporting limit.

QCL - Quality control limit.

D - RL increased due to sample matrix interference.

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Client:	Golder Associates Inc	**Report Date:**	08/29/06
Project:	Chino-USSP North 013-1594	**Collection Date:**	08/10/06
Lab ID:	B06081524-017	**DateReceived:**	08/17/06
Client Sample ID:	CHUSN06-5, 0-3.5 ft	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Coarse Fragments	70	wt%		2		ASA15-5	08/23/06 16:51 / srm
Sand	60	%		1		ASA15-5	08/23/06 16:51 / srm
Silt	30	%		1		ASA15-5	08/23/06 16:51 / srm
Clay	10	%		1		ASA15-5	08/23/06 16:51 / srm
Texture	SL					ASA15-5	08/23/06 16:51 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	6.30	s.u.		0.10		ASAM10-3.2	08/23/06 16:51 / srm
Conductivity, sat. paste	0.79	mmhos/cm		0.01		ASA10-3	08/24/06 16:40 / srm
Saturation	25.7	%		0.1		USDA27a	08/24/06 16:40 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	1.2	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid Potential	8.4	t/kt		1.0		Sobek Modifie	08/27/06 00:00 / srm
Acid/Base Potential	-7	t/kt				Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Total	0.33	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Hot Water Extractable	0.06	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HCl Extractable	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, HNO3 Extractable	ND	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
Sulfur, Residual	0.26	%		0.01		Sobek Modifie	08/27/06 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
METALS, WATER EXTRACTABLE							
Selenium	ND	mg/kg		0.01		SW6020	08/23/06 17:12 / car
Boron	0.06	mg/kg		0.05		SW6010B	08/23/06 03:11 / rlh
METALS, ABDTPA EXTRACTABLE							
Arsenic	ND	mg/kg		1		SW6020	08/24/06 00:08 / car
Cadmium	ND	mg/kg		0.01		SW6020	08/24/06 00:08 / car
Copper	ND	mg/kg		1		SW6010B	08/22/06 19:54 / rlh
Lead	0.10	mg/kg	D	0.03		SW6020	08/24/06 00:08 / car
Manganese	0.57	mg/kg		0.01		SW6010B	08/22/06 19:54 / rlh
Mercury	ND	mg/kg		0.05		SW6020	08/24/06 00:08 / car
Molybdenum	0.04	mg/kg		0.01		SW6020	08/24/06 00:08 / car
Nickel	0.07	mg/kg	D	0.03		SW6020	08/24/06 00:08 / car

Report Definitions:

RL - Analyte reporting limit.

QCL - Quality control limit.

D - RL increased due to sample matrix interference.

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

TECHNICAL MEMORANDUM

TO: Ned Hall - Chino Mines Company July 7, 2000

FR: Michael Klisch, Rens Verburg - Golder Associates

RE: RUSTLER CANYON WASTE ROCK CHARACTERIZATION 993-1658.002

INTRODUCTION

This technical memorandum describes the results of static and kinetic testing conducted on five samples of Tertiary volcanic rocks that may be placed in proposed waste rock stockpiles in Rustler Canyon. The testing was performed to evaluate the long-term environmental stability of these rock types, in particular their long-term leaching characteristics.

One sample from the Sugarlump Tuff and four samples of the Kneeling Nun Tuff were tested. The following testing was performed on each individual sample: acid-base accounting, paste pH, mineralogical analysis by X-ray diffraction (XRD), and major and trace element analysis by X-ray fluorescence (XRF). Long-term humidity cell testing was conducted on the Sugarlump Tuff sample and two composite Kneeling Nun Tuff samples. Sample selection and testing procedures were similar to those used in earlier waste rock characterization efforts at Chino, and are described in more detail in Golder (1998). Attachment C also contains a description of the test procedures.

SAMPLE DESCRIPTION AND SELECTION

The Sugarlump Tuff and Kneeling Nun Tuff postdate the ore mineralization at Chino. Detailed descriptions of these units are included in a geologic report of the Santa Rita Quadrangle (Jones et al., 1967) and the units have recently been mapped in detail by Chino Geological Services technical staff. The Sugarlump Tuff is a poorly consolidated gravel, sand, and pumiceous tuff. The thickness of the Sugarlump Tuff varies from about 0 to 500 feet due to deposition over an irregular, eroded land surface, and it typically forms slopes. The Kneeling Nun Tuff is a massive welded to weakly consolidated rhyolite tuff. The Kneeling Nun Tuff overlies the Sugarlump Tuff. The Kneeling Nun Tuff is about 200 to 600 feet thick south of the Chino Mine, which is easily identified because of its cliff-forming habits. Recent mapping by Chino identified four members of the Kneeling Nun Tuff based on its composition (crystal vs. lithic fragments) and degree of welding.

Samples were selected for testing by Chino Geological Services staff. One sample was selected from the Sugarlump Tuff (sample 10622) and four samples were selected from the Kneeling Nun Tuff (samples 10623 through 10626), with one sample collected from

TABLE 5

Standard Parameters - Kneeling Nun Tuff Composite A

Week	pH	Conductivity	Acidity	Alkalinity	Sulfate	Iron	Calcium	Cumulative Acidity	Cumulative Alkalinity	Cumulative Sulfate	Cumulative Iron	Cumulative Calcium
	pH units	umhos/cm	mg/L as $CaCO_3$	mg/L as $CaCO_3$	mg/L	mg/L	mg/L	g as $CaCO_3$	g as $CaCO_3$	g	mg	g
0	6.96	54	<5	10	10	0.2	2.08	0.00	0.0	0.030	0.600	0.006
1	7.02	36	<5	8	<10	<0.05	1.44	0.00	0.1	0.030	0.600	0.011
2	7.17	20	<5	5	<10	0.06	1.12	0.00	0.1	0.030	0.783	0.015
3	7.06	16	<5	8	<10	0.05	0.8	0.00	0.1	0.030	0.943	0.017
4	7.25	16	<5	8	<10	0.08	0.64	0.00	0.1	0.030	1.210	0.019
5	7.14	11	<5	6	<10	<0.05	1.12	0.00	0.1	0.030	1.210	0.023
6	7.34	14	<5	7	<10	<0.05	1.12	0.00	0.2	0.030	1.210	0.026
7	7.33	11	<5	8	<10	<0.05	0.96	0.00	0.2	0.030	1.210	0.029
8	6.8	10	<5	6	<10	<0.05	0.48	0.00	0.2	0.030	1.210	0.031
9	6.93	11	<5	6	<10	<0.05	0.48	0.00	0.2	0.030	1.210	0.032
10	7.47	10	<5	7	<10	<0.05	0.8	0.00	0.2	0.030	1.210	0.034
11	6.77	16	<5	8	<10	<0.05	1.28	0.00	0.3	0.030	1.210	0.039
12	6.71	11	<5	6	<10	<0.05	0.64	0.00	0.3	0.030	1.210	0.041
13	6.69	9	<5	6	<10	<0.05	0.8	0.00	0.3	0.030	1.210	0.044
14	6.59	9	<5	<5	<10	<0.05	0.96	0.00	0.3	0.030	1.210	0.047
15	6.61	9	<5	6	<10	<0.05	0.8	0.00	0.3	0.030	1.210	0.049
16	6.92	8	<5	6	<10	<0.05	0.8	0.00	0.4	0.030	1.210	0.052
17	6.93	9	<5	<5	<10	<0.05	0.8	0.00	0.4	0.030	1.210	0.054
18	6.95	8	<5	6	<10	<0.05	0.8	0.00	0.4	0.030	1.210	0.057
19	6.58	7	<5	<5	<10	<0.05	0.48	0.00	0.4	0.030	1.210	0.058
20	6.86	7	<5	6	<10	<0.05	0.64	0.00	0.4	0.030	1.210	0.060

Standard Parameters - Kneeling Nun Tuff Composite B

Week	pH	Conductivity	Acidity	Alkalinity	Sulfate	Iron	Calcium	Cumulative Acidity	Cumulative Alkalinity	Cumulative Sulfate	Cumulative Iron	Cumulative Calcium
	pH units	umhos/cm	mg/L as $CaCO_3$	mg/L as $CaCO_3$	mg/L	mg/L	mg/L	g as $CaCO_3$	g as $CaCO_3$	g	mg	g
0	6.71	49	<5	8	<10	<0.05	2.08	0.0	0.025	0.000	0.0	0.006
1	7.19	32	<5	8	<10	<0.05	1.76	0.0	0.053	0.000	0.0	0.013
2	7.19	19	<5	7	<10	<0.05	1.12	0.0	0.076	0.000	0.0	0.016
3	7.04	19	<5	8	<10	<0.05	0.8	0.0	0.104	0.000	0.0	0.019
4	7.18	14	<5	8	<10	<0.05	0.64	0.0	0.131	0.000	0.0	0.021
5	7.17	12	<5	6	<10	<0.05	0.96	0.0	0.151	0.000	0.0	0.025
6	7.19	10	<5	6	<10	<0.05	1.28	0.0	0.172	0.000	0.0	0.029
7	7.28	10	<5	8	<10	<0.05	0.48	0.0	0.198	0.000	0.0	0.030
8	7.12	10	<5	6	<10	<0.05	0.64	0.0	0.218	0.000	0.0	0.033
9	6.96	9	<5	7	<10	<0.05	0.32	0.0	0.242	0.000	0.0	0.034
10	7.24	8	<5	6	<10	<0.05	0.8	0.0	0.261	0.000	0.0	0.036
11	7.07	10	<5	6	<10	<0.05	0.96	0.0	0.282	0.000	0.0	0.040
12	6.8	8	<5	<5	<10	<0.05	0.64	0.0	0.282	0.000	0.0	0.042
13	6.36	7	<5	<5	<10	<0.05	0.64	0.0	0.282	0.000	0.0	0.044
14	6.58	7	<5	<5	<10	<0.05	0.96	0.0	0.282	0.000	0.0	0.047
15	6.77	7	<5	6	<10	<0.05	0.8	0.0	0.302	0.000	0.0	0.050
16	6.59	7	<5	<5	<10	<0.05	0.64	0.0	0.302	0.000	0.0	0.052
17	6.92	6	<5	6	<10	<0.05	0.96	0.0	0.323	0.000	0.0	0.055
18	6.74	6	<5	<5	<10	<0.05	0.8	0.0	0.323	0.000	0.0	0.058
19	6.77	5	<5	<5	<10	<0.05	0.48	0.0	0.323	0.000	0.0	0.059
20	6.59	6	<5	<5	<10	<0.05	0.48	0.0	0.323	0.000	0.0	0.061

TABLE 8

Comprehensive Metals Results - Kneeling Nun Tuff Composite A

PARAMETER	UNITS	WEEK 0	WEEK 1	WEEK 5	WEEK 10	WEEK 20
pH	pH units	6.96	7.02	7.14	7.47	6.86
Conductivity	umhos/cm	54	36	11	10	7
Total Acidity	mg/L as CaCO3	<5	<5	<5	<5	<5
Total Alkalinity	mg/L as CaCO3	10	8	6	7	6
Bicarbonate	mg/L	12	10	7	9	7
Carbonate	mg/L	<5	<5	<5	<5	<5
Hydroxide	mg/L	<5	<5	<5	<5	<5
Chloride	mg/L	2.6	2.0	0.5	0.7	0.7
Sulfate	mg/L	10	<10	<10	<10	<10
Fluoride (F)	mg/L	0.2	0.2	0.2	0.1	<0.1
Calcium (Ca)	mg/L	2.1	1.4	1.1	0.8	0.6
Magnesium (Mg)	mg/L	0.8	0.4	0.1	0.6	0.1
Sodium (Na)	mg/L	6.0	5.0	1.9	1.7	1.0
Potassium (K)	mg/L	0.8	0.6	0.5	0.6	<0.3
Aluminum (Al)	mg/L	0.40	0.20	0.10	3.68	0.42
Antimony (Sb)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic (As)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Barium (Ba)	mg/L	0.015	0.008	0.001	0.006	0.002
Beryllium (Be)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Boron (B)	mg/L	0.04	0.04	0.02	0.01	0.01
Cadmium (Cd)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium (Cr)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Cobalt (Co)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Copper (Cu)	mg/L	0.080	0.014	<0.005	<0.005	<0.005
Iron (Fe)	mg/L	0.20	<0.05	<0.05	<0.05	<0.05
Lead (Pb)	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003
Manganese (Mn)	mg/L	0.024	0.010	0.003	0.009	0.002
Mercury (Hg)	mg/L	<0.0002	0.0003	<0.0002	<0.0002	<0.0002
Molybdenum (Mo)	mg/L	<0.005	<0.005	<0.005	<0.005	0.007
Nickel (Ni)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Selenium (Se)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Silica (SiO2)	mg/L	6.97	13.2	11.8	28.1	12.4
Silver (Ag)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Thallium (Tl)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium (V)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc (Zn)	mg/L	<0.005	0.008	<0.005	0.005	0.005

TABLE 9

Comprehensive Metals Results - Kneeling Nun Tuff Composite B

PARAMETER	UNITS	WEEK 0	WEEK 1	WEEK 5	WEEK 10	WEEK 20
pH	pH units	6.71	7.19	7.17	7.24	6.59
Conductivity	umhos/cm	49	32	12	8	6
Total Acidity	mg/L as CaCO3	<5	<5	<5	<5	<5
Total Alkalinity	mg/L as CaCO3	8	8	6	6	<5
Bicarbonate	mg/L	10	10	7	7	6
Carbonate	mg/L	<5	<5	<5	<5	<5
Hydroxide	mg/L	<5	<5	<5	<5	<5
Chloride	mg/L	1.7	1.1	<0.5	0.5	<0.5
Sulfate	mg/L	<10	<10	<10	<10	<10
Fluoride (F)	mg/L	0.1	0.2	0.1	<0.1	<0.1
Calcium (Ca)	mg/L	2.1	1.8	0.9	0.8	0.5
Magnesium (Mg)	mg/L	0.8	0.4	0.1	0.2	0.1
Sodium (Na)	mg/L	4.90	4.30	1.60	1.20	0.90
Potassium (K)	mg/L	1.2	<0.3	<0.3	0.4000	<0.3
Aluminum (Al)	mg/L	2.02	0.14	0.170	0.690	0.360
Antimony (Sb)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic (As)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Barium (Ba)	mg/L	0.01	0.012	0.001	0.002	0.002
Beryllium (Be)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Boron (B)	mg/L	0.030	0.04	0.01	<0.01	<0.01
Cadmium (Cd)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium (Cr)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Cobalt (Co)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Copper (Cu)	mg/L	0.021	<0.005	<0.005	<0.005	<0.005
Iron (Fe)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Lead (Pb)	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003
Manganese (Mn)	mg/L	0.021	0.008	0.003	0.004	0.003
Mercury (Hg)	mg/L	<0.0002	0.0003	<0.0002	<0.0002	<0.0002
Molybdenum (Mo)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Nickel (Ni)	mg/L	<0.005	0.006	<0.005	<0.005	<0.005
Selenium (Se)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Silica (SiO2)	mg/L	12.6	11	7.18	9.96	8.27
Silver (Ag)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Thallium (Tl)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium (V)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc (Zn)	mg/L	0.012	<0.005	<0.005	<0.005	0.027

ANALYTICAL SUMMARY REPORT

October 18, 2016

Chino Mine Company
PO Box 10
Bayard, NM 88023

Work Order: B16100228

Project Name: STS1U Rock pH

Energy Laboratories Inc Billings MT received the following 5 samples for Chino Mine Company on 10/4/2016 for analysis.

Lab ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
B16100228-001	LB Draw E #1	06/29/16 9:21	10/04/16	Solid	Metals by ICP/ICPMS, Total or Soluble pH, Saturated Paste Digestion, Total Metals Saturated Paste Extraction
B16100228-002	LB Draw E #2	06/29/16 9:36	10/04/16	Solid	Same As Above
B16100228-003	LB Draw E #3	06/29/16 10:16	10/04/16	Solid	Same As Above
B16100228-004	LB Draw E #4	06/29/16 10:45	10/04/16	Solid	Same As Above
B16100228-005	LB Draw E #5	06/29/16 9:55	10/04/16	Solid	Same As Above

The analyses presented in this report were performed by Energy Laboratories, Inc., 1120 S 27th St., Billings, MT 59101, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By:

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Chino Mine Company	**Report Date:**	10/18/16
Project:	STS1U Rock pH	**Collection Date:**	06/29/16 09:21
Lab ID:	B16100228-001	**DateReceived:**	10/04/16
Client Sample ID:	LB Draw E #1	**Matrix:**	Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	6.4	s.u.		0.1		ASA10-3	10/14/16 08:55 / srm
METALS, TOTAL - EPA SW846							
Copper	167	mg/kg		1		SW6020	10/17/16 23:03 / jpv

Report Definitions:	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Chino Mine Company	**Report Date:**	10/18/16
Project:	STS1U Rock pH	**Collection Date:**	06/29/16 09:36
Lab ID:	B16100228-002	**DateReceived:**	10/04/16
Client Sample ID:	LB Draw E #2	**Matrix:**	Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	5.2	s.u.		0.1		ASA10-3	10/14/16 08:55 / srm
METALS, TOTAL - EPA SW846							
Copper	53	mg/kg		1		SW6020	10/17/16 23:06 / jpv

Report Definitions:	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Chino Mine Company	**Report Date:**	10/18/16
Project:	STS1U Rock pH	**Collection Date:**	06/29/16 10:16
Lab ID:	B16100228-003	**DateReceived:**	10/04/16
Client Sample ID:	LB Draw E #3	**Matrix:**	Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	5.2	s.u.		0.1		ASA10-3	10/14/16 08:55 / srm
METALS, TOTAL - EPA SW846							
Copper	72	mg/kg		1		SW6020	10/17/16 23:09 / jpv

Report Definitions:

RL - Analyte reporting limit.

QCL - Quality control limit.

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Chino Mine Company	**Report Date:**	10/18/16
Project:	STS1U Rock pH	**Collection Date:**	06/29/16 10:45
Lab ID:	B16100228-004	**DateReceived:**	10/04/16
Client Sample ID:	LB Draw E #4	**Matrix:**	Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	5.3	s.u.		0.1		ASA10-3	10/14/16 08:55 / srm
METALS, TOTAL - EPA SW846							
Copper	93	mg/kg		1		SW6020	10/17/16 23:12 / jpv

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Chino Mine Company	**Report Date:**	10/18/16
Project:	STS1U Rock pH	**Collection Date:**	06/29/16 09:55
Lab ID:	B16100228-005	**DateReceived:**	10/04/16
Client Sample ID:	LB Draw E #5	**Matrix:**	Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	5.7	s.u.		0.1		ASA10-3	10/14/16 08:55 / srm
METALS, TOTAL - EPA SW846							
Copper	105	mg/kg		1		SW6020	10/17/16 23:14 / jpv

Report Definitions:

RL - Analyte reporting limit.

QCL - Quality control limit.

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Chino Mine Company
Project: STS1U Rock pH

Report Date: 10/18/16
Work Order: B16100228

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **SW6020**							Analytical Run: ICPMS202-B_161017A			
Lab ID: **QCS**		Initial Calibration Verification Standard								10/17/16 12:28
Copper		0.0521	mg/L	0.0010	104	90	110			
Lab ID: **ICSA**		Interference Check Sample A								10/17/16 12:54
Copper		0.00105	mg/L	0.0010						
Lab ID: **ICSAB**		Interference Check Sample AB								10/17/16 12:57
Copper		0.0198	mg/L	0.0010	99	70	130			
Method: **SW6020**										Batch: 103506
Lab ID: **MB-103506**		Method Blank				Run: ICPMS202-B_161017A				10/17/16 22:44
Copper		ND	mg/kg	0.1						
Lab ID: **SRM2-103506**		Standard Reference Material				Run: ICPMS202-B_161017A				10/17/16 22:55
Copper		107	mg/kg	2.0	107	70	130			
Lab ID: **SRM3--103506**		Standard Reference Material				Run: ICPMS202-B_161017A				10/17/16 22:58
Copper		130	mg/kg	1.0	95	76	120			
Lab ID: **B16100799-002ADIL**		Serial Dilution				Run: ICPMS202-B_161017A				10/17/16 23:50
Copper		ND	mg/kg	10		0	0		10	
Lab ID: **B16100799-002APDS1**		Post Digestion/Distillation Spike				Run: ICPMS202-B_161017A				10/17/16 23:53
Copper		27.2	mg/kg	2.1	104	75	125			
Lab ID: **B16100799-002AMS3**		Sample Matrix Spike				Run: ICPMS202-B_161017A				10/17/16 23:56
Copper		104	mg/kg	2.0	105	75	125			
Lab ID: **B16100799-002AMSD**		Sample Matrix Spike Duplicate				Run: ICPMS202-B_161017A				10/18/16 00:07
Copper		104	mg/kg	2.0	104	75	125	0.4	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Chino Mine Company
Project: STS1U Rock pH

Report Date: 10/14/16
Work Order: B16100228

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA10-3									Batch: 103590
Lab ID: LCS-R268688	Laboratory Control Sample				Run: MISC-SOIL_161014B				10/14/16 08:55
pH, sat. paste	7.00	s.u.	0.10	99	90	110			
Lab ID: B16100228-001A DUP	Sample Duplicate				Run: MISC-SOIL_161014B				10/14/16 08:55
pH, sat. paste	6.30	s.u.	0.10				1.6	10	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

Work Order Receipt Checklist

Chino Mine Company B16100228

Login completed by: Gina McCartney
Reviewed by: BL2000\tedwards
Reviewed Date: 10/5/2016

Date Received: 10/4/2016
Received by: qej
Carrier name: UPS

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on all shipping container(s)/cooler(s)?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on all sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☑	No ☐	
Temp Blank received in all shipping container(s)/cooler(s)?	Yes ☐	No ☑	Not Applicable ☐
Container/Temp Blank temperature:	13.8°C No Ice		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	Not Applicable ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☐	Not Applicable ☑

Standard Reporting Procedures:

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Contact and Corrective Action Comments:

None

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

Page 1 of 1

PLEASE PRINT (Provide as much information as possible.)

Company Name: Chino Mines Co.

Project Name, PWS, Permit, Etc. STSIU Rock pH

Sample Origin State: NM

EPA/State Compliance: Yes ☐ No ☐

Report Mail Address (Required):
PO Box 10
Bayard NM 88023

Contact Name: Pam Pinson

Phone/Fax: 575-912-5213

Cell:

Sampler: (Please Print) Nick Lemme

☐ No Hard Copy Email: ppinson@fmi.com

Invoice Contact & Phone: same

Purchase Order: 2N00003CO

Quote/Bottle Order:

Invoice Address (Required):

☐ No Hard Copy Email:

Special Report/Formats:

☐ DW
☐ POTW/WWTP
☐ State: ____
☐ Other: ____
☐ EDD/EDT (Electronic Data) Format: ____
☐ LEVEL IV
☐ NELAC

Number of Containers
Sample Type: A W S V B O DW
Air Water Soils/Solids
Vegetation Bioassay Other
DW - Drinking Water

ANALYSIS REQUESTED

SEE ATTACHED

Standard Turnaround (TAT)

RUSH

Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments:

	SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	Total Cu	pH, Saturated Paste
1	LB Draw E #1	6-29-16	09:21	rock	X	X
2	LB Draw E #2	6-29-16	09:36	rock	X	X
3	LB Draw E #3	6-29-16	10:16	rock	X	X
4	LB Draw E #4	6-29-16	10:45	rock	X	X
5	LB Draw E #5	6-29-16	09:55	rock	X	X
6						
7						
8						
9						
10						

LABORATORY USE ONLY

Shipped by:

Cooler ID(s):

Receipt Temp ____ °C

On Ice: Y N

Custody Seal On Bottle Y N

On Cooler Y N

Intact Y N

Signature Match Y N

B16100228001
-002
-003
-004
-005

Custody Record MUST be Signed

Relinquished by (print): Pam Pinson Date/Time: 9-29-16/12:30pm Signature: Pam Pinson

Received by (print): Date/Time: Signature:

Relinquished by (print): Date/Time: Signature:

Received by (print): Date/Time: Signature:

Sample Disposal: Return to Client: ____ Lab Disposal: ____

Received by Laboratory: Date/Time: 10/4/16 09:15 Signature:

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report.

APPENDIX L

NMED Comments and Chino Response to Comments

Informal Response to Comments on the Smelter/Tailing Soils Investigative Unit (STSIU) Phytotoxicity and Vegetation Community Study, dated August 2017

September 11, 2018

Please find below Chino responses to the New Mexico Environment Department (NMED) comments on the STSIU Phytoxicity Study. Chino received the informal comments by email dated January 9, 2018 from David Mercer, NMED Chino AOC Manager. Chino's responses follow each comment. Also figures and tables are included or attached to support technical responses.

General Comments

GC-1. Reality Check on the Lower End of the PEL range.

> The report concludes in Section 6 that the pCu PEL range as from 2-6 s.u., and the lowest PEL listed for the two main endpoints (Emergence and Survival) is 2.30 s.u. (Table G-5: PEL for alfalfa, emergence/flat granular). However, these estimates of the lowest PEL are not consistent with the data for the soils tested in the study; the lowest pCu tested in greenhouse studies was 2.93 to 3.07 s.u. for Site 9 in 2013 and 2015, respectively (Table A-1). Greenhouse toxicity testing results for Site 9 soils were 5.8% emergence and 0% survival for alfalfa, and no emergence (and no survival) for sideoats gramma. The low end of the PEL range is nearly 10x lower than the pCu for this site, but these results reflect heavily affected endpoints, and are not consistent with the intent of the PEL corresponding to the EC50.
>
> The low end of the PEL range (pCu = 2) is apparently based on statistical extrapolation from field studies (Table 11). However, the lowest pCu value observed in vegetation community surveys was 3.55 s.u (Site STS-PT-2013-1) (Table F-4). [Note, this excludes Site STS-PT-2013-33, which had an extreme low pCu of -1.85 with 0 cover and 0 species richness).
>
> Overall, the low end of the PEL range recommended in the document requires extrapolation outside the range of data collected, and is inconsistent with data from sites that were tested for phytotoxicity.

Chino: The study used soils collected directly from the Site; therefore, the range of pCu in the soils tested is limited to the range available at the Site. The shape of the curve at the lower end of pCu dose-response regression models is uncertain because there are few datapoints in that range for the greenhouse (none lower than 2.3 in Table A-1) or community study (none lower than 2.93 for measured pCu or 3.05 for calculated pCu in Table F-4)[1]. Therefore, that end of the range is hypothetical and does not represent the Site nor will it affect FS decisions. Extrapolating beyond site conditions is done only to provide insight into mechanisms possibly operating at the Site and to refine conceptual models.

---

[1] The comment cites data for Site 9 incorrectly. The PEL of 2.1 for community dose-response curves or of 2.3 for greenhouse dose-response curves are predicted for flat granular areas, not for Site 9, which is on bedrock. A bedrock PEL is 3.7 to 5.1 (non-flat granular in Table G-5) and since its pCu is lower than the PEL, it is *predicted* to have the observed low endpoint responses for emergence and survival (5.8 and 0%, respectively).

GC-2. Alfalfa seems to be most tolerant species tested

> Sideoats gramma (both field and nursery) appears to be substantially more sensitive than alfalfa to low pCu. Section 5.1 indicates that the test results are unclear as to whether alfalfa represents a good replacement for a native forb species, but neglects to identify alfalfa as one of the sources for the wide range of DEL/PELs as discussed in the next to the last paragraph in Section 5.1. However, as shown in all cases where the DEL/PEL is calculated using emergence and survival endpoints (Tables 5,7, and 8), the DEL/PELs calculated for alfalfa are at the lower end of the ranges calculated and are all lower than those calculated for the grasses.
>
> Managing the site to the alfalfa toxicity thresholds could result in substantial inhibition of establishment and growth for other species.

Chino: These ranges detailed below, split out by species and by most ecologically important endpoints (survival and emergence), show alfalfa as the more tolerant species of pCu and there is no disagreement. The purpose of the phytotoxicity and community study is to provide insight into effect levels and the factors affecting the plant community and its effect levels. Alfalfa has a wider range of DELs/PELs for pCu (PEL = 3.68-5.67, DEL = 3.75-7.35) than sideoats grama (PEL = 4.83-5.67, DEL = 6.24-7.74) when estimated across *all* endpoints. The PEL ranges for only emergence and survival are tighter (i.e., 3.68-3.79 for alfalfa and 4.83-5.11 for sideoats grama). The corresponding ranges for the DEL for the two endpoints are 3.75-4.33 for alfalfa DEL and 6.24-6.84 for sideoats grama DEL. The draft FS will discuss how this information will be applied .

GC-3. Generalizations

> The presentation tends to mix results and conclusions for individual endpoints/species/soil categories with the generalization across species and soil properties. For example, the text emphasizes the effect soil category may have on results, but R-square values are presented only for data aggregated across species and soil properties. This is partially an outcome of using a multivariate analysis to discern general trends and driving factors, but it becomes important in the conclusions. For example, the overall R-square for emergence is high (>0.8)(e.g., Figs 6, 7 and G-1). But the R-square for the dose response curve for alfalfa emergence on 'non-flat granular' soils must be low (see Figure G-1), because no data points fall near the sigmoid part of the curve. This may seem like a small detail, but this is the relationship on which estimates of the low end of the PEL range are based, and so it's important to the overall interpretation.

Chino: The final report conclusions discuss that the PELs and DELs vary depending on the soil category, soil properties, plant species, and endpoints (Section 6). The ranges of the DELs and PELs in the conclusions are provided only to show the variability and uncertainty across soil types and are not meant to be interpreted in any other way. The R^2 is not needed to interpret these graphs as the relationships are visually clear. Soil category effects are clearly shown visually in Figure 12. For example, the community dose response curves for richness and cover for flat granular soils have curves shifted to the left relative to the other soil categories, indicating plants are more tolerant in flat granular soils. The response by soil/species/seed type are also shown in Appendix G, Figure G-1 (and Figure RTC-1 below) for greenhouse dose-response curves visually. The observed data points fall near each line, indicating a good fit (see RMSE discussion below).

When R^2 is shown, it is used to show that the model is accounting for much of the variability in an endpoint when seed type, species, soil category and soil properties are considered and, therefore, the R^2 does not apply to each individual curve for each seed type and soil condition. The root mean square error (RMSE) is the most important measure for evaluating prediction accuracy for each curve. RMSE measures the spread of the y values around the predicted value for a given value of x in a regression and is in units of the response variable, e.g., the endpoints. The lower it is, the better is the fit. For example, RMSE (standard deviation of unexplained variance) is 0.21 for alfalfa on non flat-granular soils and 0.19 for alfalfa on flat granular soils, which shows a reasonably good and similar fit between the two types of soils, where there are data (shown in Figure RTC-1 below).

Extrapolated areas as discussed below will not be used to estimate PELs or DELs for actual locations on the Site. Points missing along part of the curve are not captured with R^2, nor are they captured with RMSE. This is the part of the model that is extrapolated and very uncertain as discussed in response to GC-1. Fit to the hypothesized model cannot be fully determined for flat granular soils because no low pCu data are available for such soils[2]. See response to GC-1.

A low RMSE or high R^2 value is important for accurate predictions of what will happen to the community when changing pCu in the field (e.g., important for community study) but is not necessary for identifying relationships in the greenhouse study to understand mechanisms, which is the real purpose of the greenhouse study (because conditions in greenhouse are not representative of the field). For example, pCu was found to significantly and adversely affect endpoints of species in the greenhouse study, even though pCu may account for a small proportion of variability in emergence when including other factors such as the seed type and soil properties. When evaluated in the field, it is even a smaller portion because other factors such as compaction, boulders/bedrock cover and slope strongly affect the species in the field. Nonetheless, a high (poor) RMSE in the greenhouse study for a curve does not necessarily mean the relationship with pCu is not important, just that it is not a dominant factor. As pointed out, the important issue for the greenhouse results is whether the curve has enough data in the key range to identify a PEL, not whether its RMSE is low or R^2 is high. This study has enough data in the key pCu range that occurs in the Site, which the 1999 study did not have.

---

[2] **Note that it is assumed the comment meant no data points fall near the sigmoid part of the curve of the flat granular soil curve for alfalfa, which is shown in Figure RTC-1 as the dashed blue line, not the non-flat granular curve, which is solid blue and has many points around it.**

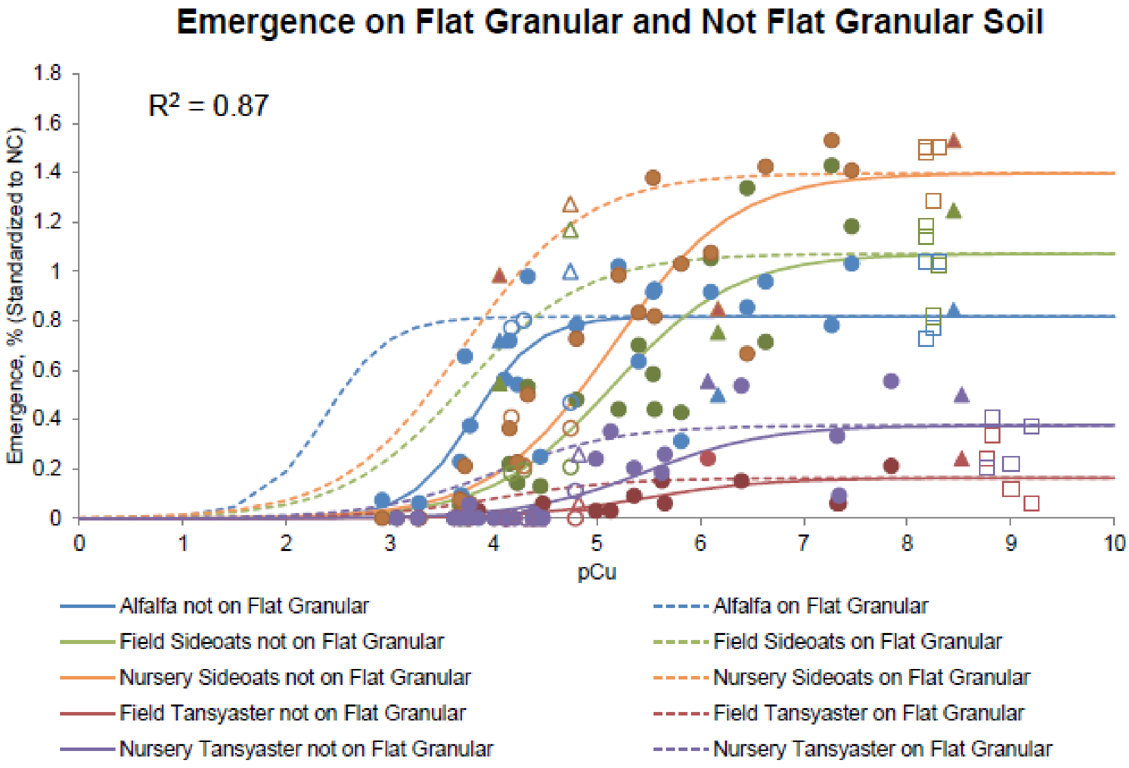


Figure RTC-1. Dose-response models on emergence with the covariate flat granular.

GC-4. Soil Categories and Risk Management Decisions

One outcome emphasized in the report is the importance of soil category associated with results. Mapping of the soil 'categories' relative to the areas where potential cleanup technologies are applicable may be an important consideration in the FS. We're not sure if setting RACs for each soil category is necessary but, as noted in the Report, this should be a consideration.

Chino: The FS will include a map of the soil categories for the STSIU that will help focus on areas where potential cleanup technologies are applicable.

1. Derivation of PEL based on Minimum Reference

A PEL was estimated as the pCu corresponding to one-half of the minimum value for the Reference R. As noted above, the resulting estimated PEL pCu is nearly 10x lower than the lowest pCu actually tested in the field. This approach seems arbitrary, and inconsistent with the results presented in the report. For example, the ratio of the EC50 to the EC10 (pCu values) for emergence in 'non-flat granular' and 'flat granular' soils for alfalfa ranges between 0.78 and 0.85, and for sideoats gramma ranges between 0.74 and 0.80 (see Table G-5). This is substantially higher than the 0.5 multiplier applied to the DEL to calculate the PEL, as reported in the document, and could result in underestimating the pCu value for the PEL using this method.

Chino : The lowest measured pCu in Table F-4 and A-1 is 2.93. The PEL based on the minimum reference method is higher than that (range of 3.69-4.94 range) in the Table 7 results for the greenhouse study without covariates and within the range in Table 11 results for the community study (range of 2.1-3.42). Based on the above, the minimum reference PEL pCu is not in the range of 10x lower than the lowest pCu actually tested in the field and the method has been used at other sites (McDonald et al. 2014). Hence Chino does not find it to be arbitrary as the minimum reference method does not involve multiplying the DEL pCu by 0.5 but rather multiplying the endpoint value at the DEL pCu by 0.5 to find the EC50 relative to background. In other words, this method uses the dose-response curve to find the PEL at the endpoint value that is a 50 percent reduction from background (assigning the DEL the background value, which is conservative because background is an EC0 or zero effect rather than EC10). The less than optimum conditions that occur in background areas for this study (the four agreed-upon flat granular reference areas for this study) should not be attributed to mine operations impact. Use of the EC50 alone without adjusting for background conditions is not a true "probable adverse effects from mine" level but rather a "probable adverse effects from mine plus background factors" level. Secondly, without comparable reference areas for the three other soil categories (which tend to have lower endpoint values), the minimum reference results are overly conservative. Additional reference areas specific to these other soil categories will be documented, but in support of the FS and not necessarily the phytotoxocity study.

The ratios of EC10/EC50 cited are from the greenhouse study, which is difficult to interpret in terms of remedial options unless placed into context of effects of pCu on the plant community in the field relative to background. The greenhouse study evaluates individual species responses, whereas the community study evaluates the integrated response of the plant community composed of many species. The report shows that greenhouse seedling emergence is the best predictor of community metrics within the STSIU. Chino performed a new regression analysis and found that emergence and soil category explain 91% (alfalfa) to 92% (sideoats grama) of the variance in richness in the field in a multiple regression (see Figures RTC-2 and RTC-3 below), leaving only 8-9 percent unexplained. If these regression equations are used to convert emergence to richness in the greenhouse dose-response curve for emergence, it becomes clear that the change of pCu from an EC10 to EC50 level would have a small effect on richness in the actual STSIU plant community, particularly for flat granular soils (see Figure RTC-4). The relative change in richness from remedial improvement from an EC50 to EC10 for richness is very small for flat granular soils, whether more tolerant alfalfa or the more sensitive sideoats grama is selected to represent the change (changes from about 13 species to 11 species/400 ft^2). For bedrock or flat rocky soils, the change is proportionally larger, from 4 species to 6 species (based on sideoats grama) or from 3 species to 5 species (based on alfalfa), but still is only about a 33 to 66 percent improvement in a community that is naturally low in richness.

Note, that sideoats grama richness curves appear to fit observed community data (plotted as squares) on Figure RTC-4 (data from Table F-4) better for all but the slope soils. Alfalfa richness curves fit the slope soils better. However, the data are too limited to assess which greenhouse curve (alfalfa or sideoats grama) best defines a community EC50 and there is much uncertainty as to which is appropriately representing the field conditions in each soil category. The conclusion for the study results is that PELs and DELs are uncertain and dependent on site-specific field conditions. Using the curves to inform management decisions may be a better use of the dose-response curves.

Figures RTC-5, RTC-6, and RTC-7 show the corresponding relationships of pCu with cover rather than richness (after converting emergence to cover). They indicate that a location may show a larger

improvement in vegetative cover when pCu is changed from the EC50 to EC10 of the more tolerant species (alfalfa) than of more sensitive species such as sideoats grama.

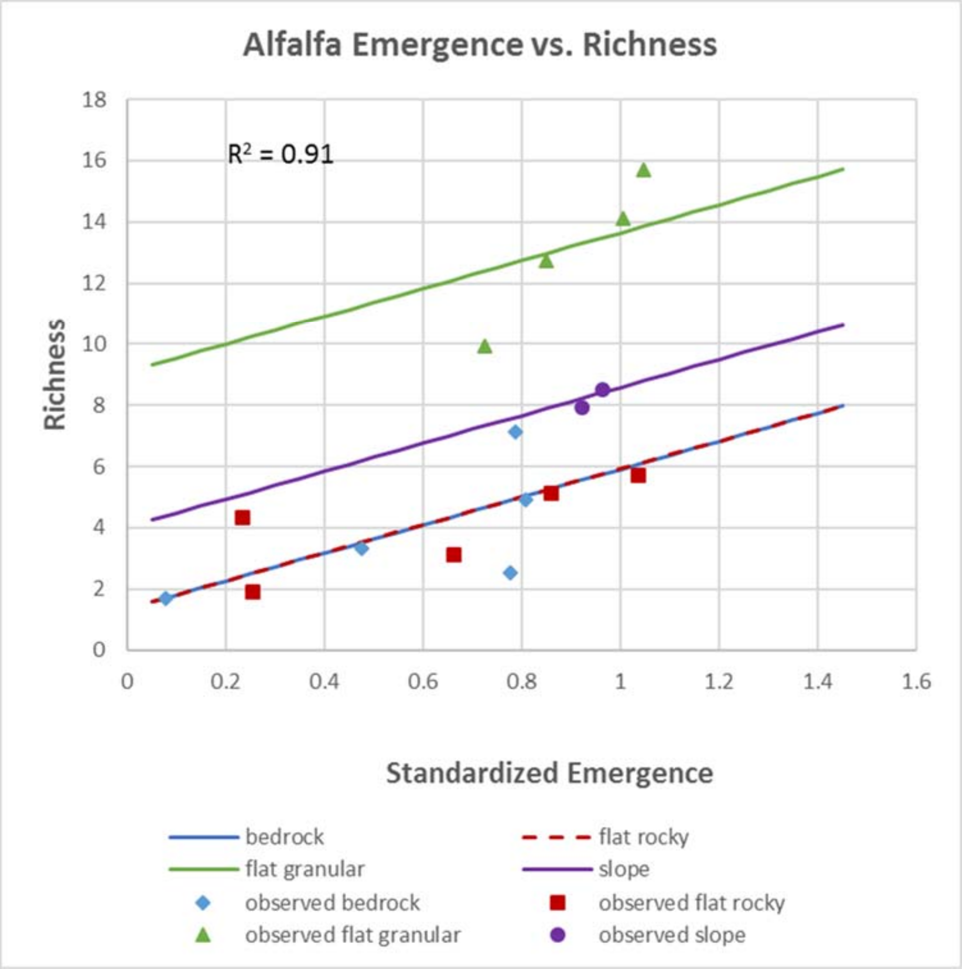


Figure RTC-2. Relationship between alfalfa emergence and richness, showing a strong correlation when separated by soil category.

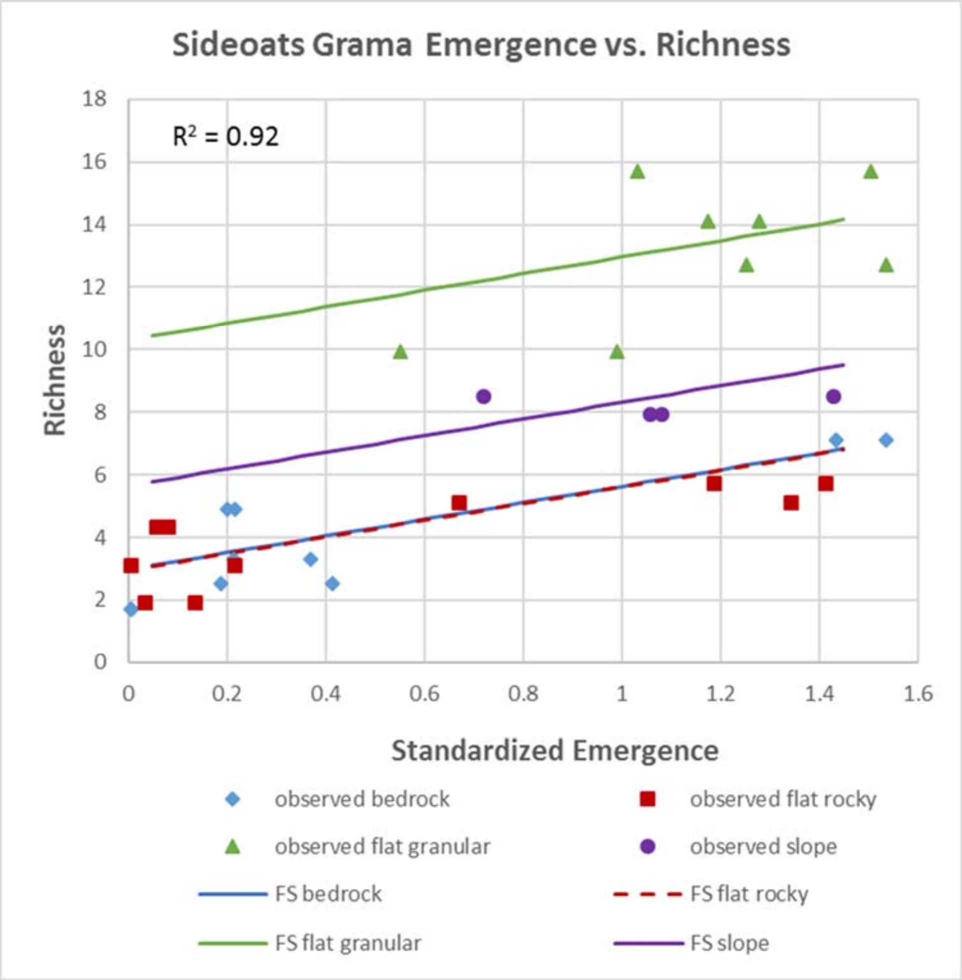


Figure RTC-3. Relationship between field sideoats (FS) grama emergence and richness, showing a strong relationship when separated by soil category. Nursery field sideoats regression line not shown (very similar to FS lines).

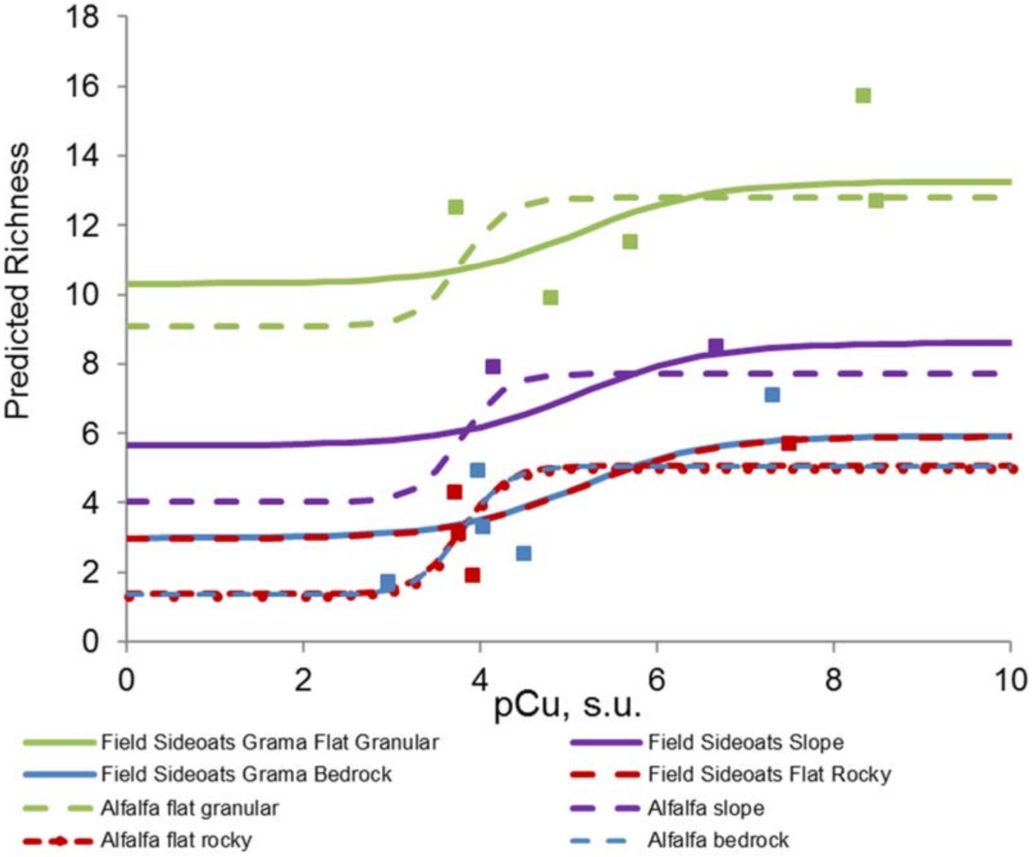


Figure RTC-4. Richness predicted by pCu when emergence replaced by richness calculated from emergence-richness relationships in Figures RTC-2 and RTC-3. Squares represent measured pCu and richness sampled in 100’ x 100’ community study plots.

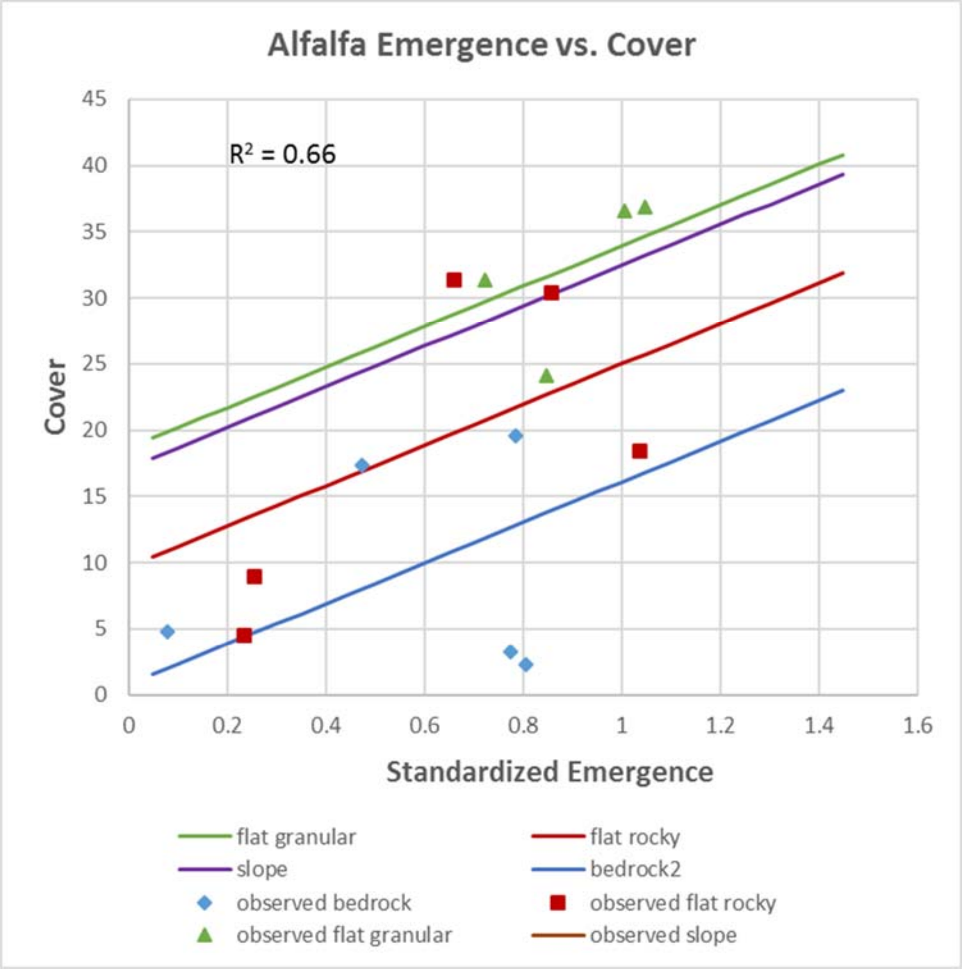


Figure RTC-5. Relationship between alfalfa emergence and percent cover by soil category.

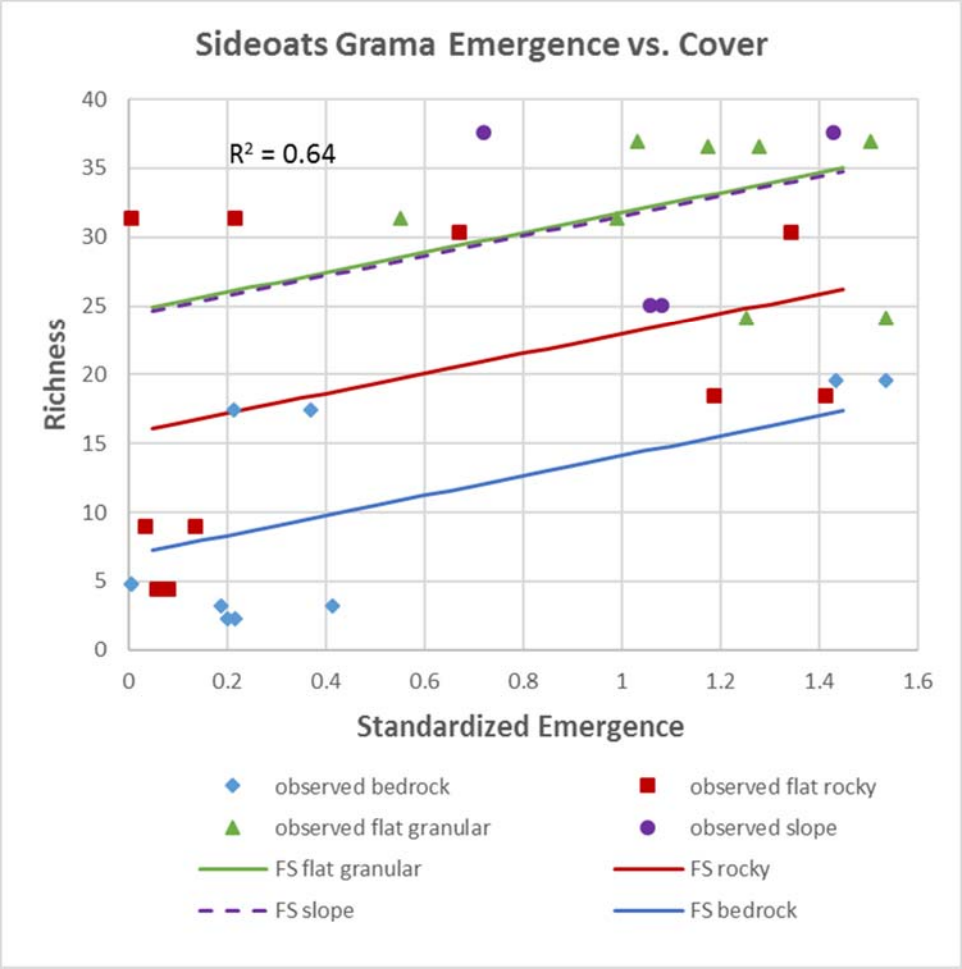


Figure RTC-6. Relationship between field sideoats (FS) grama emergence and percent cover by soil category. Nursery field sideoats regression line not shown (very similar to FS lines).

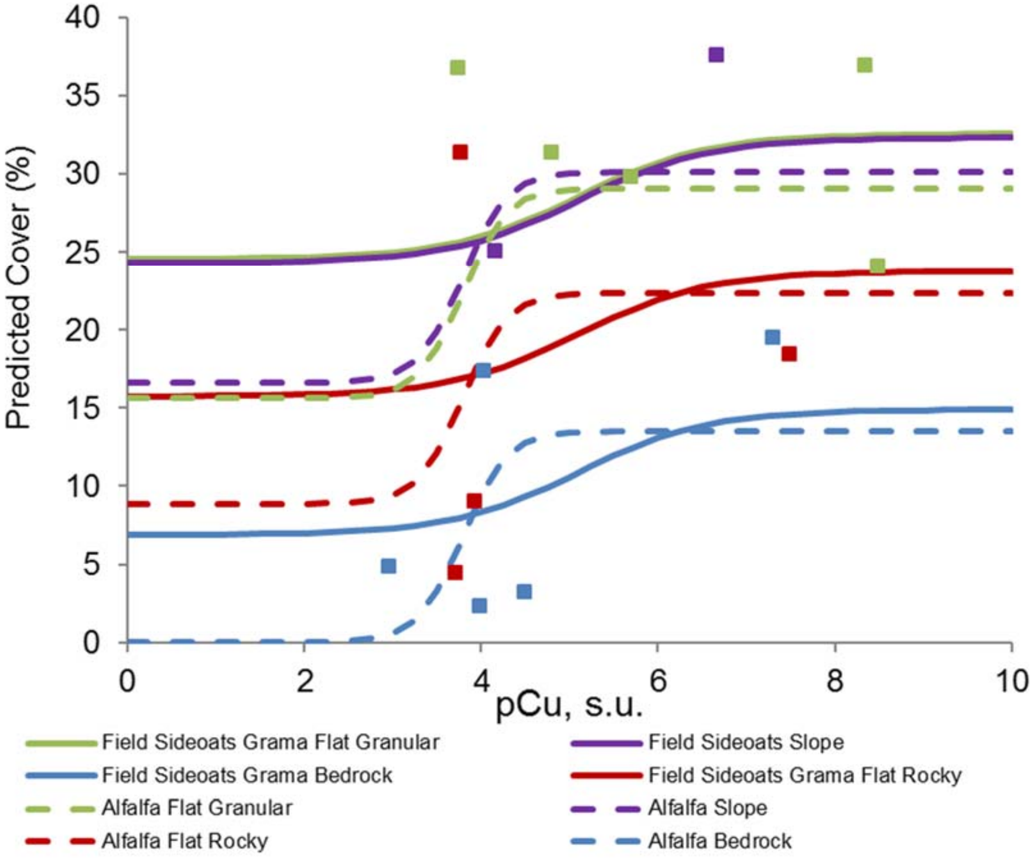


Figure RTC-7. Vegetation cover predicted by pCu when emergence replaced by cover calculated from emergence-cover relationships in Figures RTC-5 and RTC-6.

Additional Comments:

1) On Figure 1, the title notes that the figure presents a hypothetical relationship between pCu and shoot height. While the figure is a good representation of the hypotheses being tested, the figure needs to be more clear in that all of the data shown in the figure are provided to illustrate the hypotheses and are not representative of any real data collected during the study.

Chino: The figure and text associated with the figure will be revised to clarify as requested.

2) Section 5.1 (2nd paragraph) seems to confuse the content of Tables 11 & 12. Also, Table 11 contains results of the GLM for field data, but is not cited at all in the Results sections.

Chino: Table and figure numbers were off in some places when figures were moved during report revisions and will be corrected to reference correct tables or figures.

3) On Figures 11 and 12, please define the ‘t’ label placed above the symbols. It looks as if the ‘t’ values should be ‘g’ representing flat granular soils since no points are labeled with ‘g’ in either figure.

Chino: Yes, the “t” was an old symbol for flat granular soils that inadvertently was not updated to “g” in these two figures. The Figures will be corrected.

4) On Table G-2, the EC20 and EC10 values provided for the 5-seed model on Table G-1 are not provided. These values should be provided to allow for comparison with the 5-seed model results.

Chino: The EC10 and EC20 will be added to Table G-2 (see attached Table RTC-1).

5) On Table G-4, the EC20 and EC10 values provided for the 5-seed model are not provided. However, there are EC10 values provided in the summary of Table G-5. Where are these values presented prior to the summary table?

Chino: The word “summary” will be removed from the title, and the title will be revised to “DEL and PEL Based on Five-Seed Models with Various Combinations of the Covariates”. Table G-5 is not a summary of any tabular information presented before (see next response to comment 6). A footnote will be added to clarify the difference between EC50s in Tables G-4 and G-5. The EC20s were calculated for the covariate models and are presented in the attached Table RTC-2.

(6) The EC50 values presented on Table G-5 do not match those presented on Table G-4. For example, the Emergence EC50 for alfalfa on flat granular soils is shows as equal to 3.806 on Table G-4 and as 2.37 on Table G-5. Sideoats gramma are shown as 5.155 on Table G-4 and 3.72 on Table G-5 in the same example.

Chino: The models with covariates have two EC50s if the covariate has two classifications (i.e., flat granular and non-flat granular) and an infinite number of EC50s if the covariate is continuous. The EC50s in Table G-4 are part of the model equation and are needed to calculate the ECx values in Table G-5. The EC50s in Table G-4 represent values when the covariate value is zero. For the categorical variable of flat granular, the non-flat granular soils have a value of 0. The EC50s in Table G-5 represent the EC50s with the covariate values represented as minimum, mean, and maximum values observed on the Site. Thus, the numbers will not match between the tables because Table G-4 is showing the EC50 when covariates are zero, and Table G-5 is showing values when covariates are not zero. The values in Table G-4 are just examples of EC values that result when using a selected subset of covariate values of the infinite covariate values possible.

(7) On Table G-5, DEL and PEL calculations for alfalfa include values ‘based on minimum reference’. Whereas the other species show values ‘based on de minimis LTL’. We assume all were based on the minimum reference and results for non-alfalfa species are mis-labeled.

Chino: Yes, Table G-5 will be updated to show they are all based on minimum reference.

(8) Also on Table G-5, under Survival, Iron, the DEL based on minimum reference is labeled as NA. If the PEL for this method is based on 0.5x the DEL, on what basis are the PELs ‘based on minimum referenced’ calculated?).

> **Chino: For replacing “NA” with a value, the minimum was changed to the threshold of the curve per discussion below. A footnote will be added describing this change. An effect concentration at 50 percent is the concentration that reduces an endpoint, in this case survival, by 50 percent. Therefore, the PEL is based on the pCu of the endpoint that is 50 percent of the endpoint value at the DEL pCu (0.5*DEL endpoint), not 0.5 of the DEL pCu (not 0.5x* DEL pCu). The minimum of the reference values for alfalfa for survival (1.01) is higher than the Rmax threshold of the curve (0.9432) in Figure G-1 and thus a corresponding value on the curve could not be predicted unless the minimum is set to the threshold of the curve.**

Reference:

MacDonald, D.D., C.G. Ingersoll, J. A. Sinclair, J. A. Steevens, J. K. Stanley, J. D. Farrar, N. E. Kemble, J. L. Kunz, W. G. Brumbaugh, and M. R. Coady. 2014. Evaluation of Relations Between Sediment Toxicity and Sediment Chemistry at the Anniston PCB Site. Chapter 5 in Ingersoll, C.G., Steevens, J.A., and MacDonald, D.D., eds., 2014, Evaluation of toxicity to the amphipod, *Hyalella azteca*, and to the midge, *Chironomus dilutus*; and bioaccumulation by the oligochaete, *Lumbriculus variegatus*, with exposure to PCB-contaminated sediments from Anniston, Alabama: U.S. Geological Survey Scientific Investigations Report 2013–5125, 122 p., *http://dx.doi.org/10.3133/sir20135125*

Table RTC-1. Three-Seed Model Results

Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Endpoint	n	SSE	Parameters	Pseudo R^2	SAS Formulation	Seed Type	Slope				Rmax				EC50				EC20				EC10			
							Estimate	S.E.	95 LCL	95UCL	Estimate	S.E.	95 LCL	95UCL	Estimate	S.E.	95 LCL	95UCL	Estimate	SE	95 LCL	95UCL	Estimate	SE	95 LCL	95UCL
Emergence																										
Emergence	99	5.348	7	0.74	if seed = 'Alfalfa' then mod = Rmax_a/(1+10**(slope_a*(-measured_pcu + ec50_a))); if seed = 'Side Oats (Field)' then mod = Rmax_fso/(1+10**(slope_so*(-measured_pcu + ec50_so))); if seed = 'Side Oats (Nursery)' then mod = Rmax_nso/(1+10**(slope_so*(-measured_pcu + ec50_so)));	Alfalfa	1.747	0.887	-0.015	3.510	0.812	0.057	0.698	0.925	3.787	0.131	3.526	4.047	4.131	0.202	3.729	4.533	4.333	0.288	3.760	4.906
						Field Sideoats Grama	0.562	0.098	0.368	0.756	1.125	0.088	0.951	1.300	5.147	0.176	4.797	5.497	6.218	0.324	5.574	6.862	6.845	0.425	6.001	7.689
						Nursery Sideoats Grama	0.562	0.098	0.368	0.756	1.472	0.099	1.275	1.669	5.147	0.176	4.797	5.497	6.218	0.324	5.574	6.862	6.845	0.425	6.001	7.689
Survival																										
Survival	90	2.550	7	0.80	if seed = 'Alfalfa' then mod = Rmax_a/(1+10**(slope_a*(-measured_pcu + ec50_a))); if seed = 'Side Oats (Field)' then mod = Rmax_fso/(1+10**(slope_so*(-measured_pcu + ec50_so))); if seed = 'Side Oats (Nursery)' then mod = Rmax_nso/(1+10**(slope_so*(-measured_pcu + ec50_so)));	Alfalfa	14.102	11.167	-8.108	36.312	0.943	0.034	0.876	1.010	3.682	0.017	3.649	3.715	3.725	0.031	3.664	3.785	3.750	0.049	3.653	3.847
						Field Sideoats Grama	0.579	0.088	0.404	0.755	1.244	0.069	1.107	1.381	5.115	0.136	4.844	5.385	6.154	0.259	5.639	6.669	6.762	0.344	6.077	7.447
						Nursery Sideoats Grama	0.579	0.088	0.404	0.755	1.121	0.066	0.991	1.252	5.115	0.136	4.844	5.385	6.154	0.259	5.639	6.669	6.762	0.344	6.077	7.447
Root Length																										
Root Length	84	1.213	6	0.90	if seed = 'Alfalfa' then mod = Rmax_a/(1+10**(slope*(-measured_pcu + ec50_a))); if seed = 'Side Oats (Field)' then mod = Rmax_fso/(1+10**(slope*(-measured_pcu + ec50_so))); if seed = 'Side Oats (Nursery)' then mod = Rmax_nso/(1+10**(slope*(-measured_pcu + ec50_so)));	Alfalfa	0.976	0.140	0.698	1.255	0.705	0.055	0.595	0.815	6.456	0.173	6.111	6.801	7.072	0.214	6.646	7.499	7.433	0.250	6.935	7.931
						Field Sideoats Grama	0.976	0.140	0.698	1.255	0.926	0.048	0.830	1.022	6.120	0.082	5.958	6.283	6.737	0.143	6.453	7.021	7.098	0.189	6.722	7.474
						Nursery Sideoats Grama	0.976	0.140	0.698	1.255	1.106	0.050	1.006	1.206	6.120	0.082	5.958	6.283	6.737	0.143	6.453	7.021	7.098	0.189	6.722	7.474
Shoot Weight																										
Shoot Weight	84	0.635	5	0.70	if seed = 'Alfalfa' then mod = Rmax_a/(1+10**(slope*(-measured_pcu + ec50_a))); if seed = 'Side Oats (Field)' then mod = Rmax_so/(1+10**(slope*(-measured_pcu + ec50_so))); if seed = 'Side Oats (Nursery)' then mod = Rmax_so/(1+10**(slope*(-measured_pcu + ec50_so)));	Alfalfa	0.467	0.094	0.280	0.653	0.305	0.039	0.228	0.383	5.089	0.405	4.282	5.895	6.379	0.556	5.273	7.486	7.134	0.675	5.790	8.478
						Field & Nursery Sideoats Grama	0.467	0.094	0.280	0.653	0.488	0.042	0.404	0.572	5.647	0.262	5.125	6.170	6.938	0.478	5.987	7.889	7.693	0.620	6.460	8.926
Shoot Height																										
Shoot Height	84	1.471	5	0.77	if seed = 'Alfalfa' then mod = Rmax_a/(1+10**(slope*(-measured_pcu + ec50_a))); if seed = 'Side Oats (Field)' then mod = Rmax_so/(1+10**(slope*(-measured_pcu + ec50_so))); if seed = 'Side Oats (Nursery)' then mod = Rmax_so/(1+10**(slope*(-measured_pcu + ec50_so)));	Alfalfa	0.532	0.093	0.348	0.717	0.534	0.061	0.412	0.656	5.486	0.336	4.817	6.154	6.617	0.450	5.720	7.513	7.278	0.540	6.204	8.353
						Field & Nursery Sideoats Grama	0.532	0.093	0.348	0.717	0.817	0.063	0.693	0.942	5.944	0.216	5.515	6.374	7.075	0.376	6.326	7.824	7.737	0.483	6.776	8.698
Shoot Height, Outlier Excluded	83	0.764	5	0.84	if seed = 'Alfalfa' then mod = Rmax_a/(1+10**(slope*(-measured_pcu + ec50_a))); if seed = 'Side Oats (Field)' then mod = Rmax_so/(1+10**(slope*(-measured_pcu + ec50_so))); if seed = 'Side Oats (Nursery)' then mod = Rmax_so/(1+10**(slope*(-measured_pcu + ec50_so)));	Alfalfa	0.586	0.076	0.434	0.738	0.524	0.042	0.441	0.606	5.435	0.224	4.989	5.881	6.462	0.299	5.867	7.057	7.063	0.359	6.348	7.778
						Field & Nursery Sideoats Grama	0.586	0.076	0.434	0.738	0.724	0.038	0.648	0.800	5.728	0.142	5.445	6.010	6.755	0.243	6.271	7.239	7.356	0.314	6.731	7.981

Notes:
Three seed models exclude tansyaster seeds (both field and nursery seeds)
SE = standard error, using Wald statistic in SAS for non-linear regression.
LCL = lower confidence limit
UCL = upper confidence limit
Rmax = upper endpoint threshold of S-shaped dose-response curve (where curve plateaus)
Slope = slope of S-shaped curve
ECx = effects concentration (in pCu units) at x% of the endpoint below Rmax
a = alfalfa, so = sideoats grama, nso = nursery seed sideoats grama, fso = field seed sideoats grama

Table RTC-2. EC20 on Five-Seed Models with Various Combinations of the Covariates

Freeport-McMoran Chino Mines Company
Vanadium, New Mexico
Smelter/Tailing Soils IU Phytotoxicity and Vegetation Community Study

Species	Emergence, not on Flat Granular	Emergence, on Flat Granular	Survival, Minimum Iron	Survival, Mean Iron	Survival, Maximum Iron	Shoot Weight, not on Flat Granular, Minimum Clay	Shoot Weight, not on Flat Granular, Mean Clay	Shoot Weight, not on Flat Granular, Maximum Clay	Shoot Weight, on Flat Granular, Minimum Clay	Shoot Weight, on Flat Granular, Mean Clay	Shoot Weight, on Flat Granular, Maximum Clay	Shoot Height, not on Flat Granular, Minimum Clay	Shoot Height, not on Flat Granular, Mean Clay	Shoot Height, not on Flat Granular, Maximum Clay	Shoot Height, on Flat Granular, Minimum Clay	Shoot Height, on Flat Granular, Mean Clay	Shoot Height, on Flat Granular, Maximum Clay	Root Length, Minimum Clay	Root Length, Mean Clay	Root Length, Maximum Clay
Alfalfa																				
EC20	4.23	2.80	3.87	3.69	2.48	5.52	5.87	6.45	5.03	5.38	5.96	5.87	6.19	6.73	5.37	5.69	6.22	6.54	6.88	7.44
Field Sideoats																				
EC20	5.97	4.53	6.31	6.12	4.91	5.98	6.34	6.91	5.49	5.85	6.42	5.87	6.19	6.73	5.37	5.69	6.22	6.19	6.53	7.09
Nursery Sideoats																				
EC20	5.97	4.53	6.31	6.12	4.91	5.98	6.34	6.91	5.49	5.85	6.42	5.87	6.19	6.73	5.37	5.69	6.22	6.19	6.53	7.09
Field Tansyaster																				
EC20	6.29	4.85	5.49	5.30	4.10	6.87	7.22	7.79	6.37	6.73	7.30	5.87	6.19	6.73	5.37	5.69	6.22	5.30	5.65	6.21
Nursery Tansyaster																				
EC20	6.29	4.85	5.12	4.93	3.73	6.87	7.22	7.79	6.37	6.73	7.30	5.87	6.19	6.73	5.37	5.69	6.22	5.30	5.65	6.21

Notes:

ECx = Effect concentration of x%, which is pCu when endpoint is reduced by x% from the modeled no effect threshold, R_{max}

NA = not available because minimum reference above the curve.