FREEPORT-McMoRan COPPER & GOLD

Copper Queen Branch/Freeport-McMoRan Corporation
36 West Highway 92
Bisbee, Arizona 85603

July 3, 2008

Mr. Robert Casey
Water Quality Enforcement Unit Manager
Arizona Department of Environmental Quality
1110 West Washington Street
Phoenix, Arizona 857007

Re: **Mitigation Order on Consent No. P-121-07**
Response to ADEQ Comments on the Mitigation Order Work Plan

Dear Mr. Casey:

On December 17, 2007, Phelps Dodge Corporation, Copper Queen Branch submitted to Arizona Department of Environmental Quality (ADEQ) a Work Plan[1] to investigate sulfate with respect to drinking water supplies on the vicinity of the Concentrator Tailing Storage Area pursuant to Mitigation Order, Docket No. P-50-06. In April 2008, Phelps Dodge Corporation changed its name to Freeport-McMoRan Corporation, and the facility is now known as the Freeport-McMoRan Copper Queen Branch (CQB). ADEQ provided written comments on the Work Plan in a letter dated March 12, 2008[2]. This letter contains CQB's response to ADEQ's comments on the Work Plan.

ADEQ and CQB met on April 10, 2008 to review and discuss the Work Plan comments. At the meeting, ADEQ asked the Copper Queen Branch (CQB) for additional descriptions of (1) the rationale and materials for well design and construction, and (2) the aquifer test method. The descriptions were supplied to ADEQ on April 21, 2008[3]. ADEQ[4] reviewed the descriptions and indicated they were satisfactory for use in a revised Work Plan. CQB herein submits a revised Work Plan based on ADEQ comments and our discussion. CQB's responses to ADEQ's general and specific written comments are provided in Attachment 1 and the revised Work Plan.

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[1] Hydro Geo Chem., Inc. 2007. Work Plan to Characterize and Mitigate Sulfate with Respect to Drinking Water Supplies in the Vicinity of the Concentrator Tailing Storage Area, Cochise County, Arizona. December 17, 2008, revised July 3, 2008.

[2] Correspondence from Robert Casey, ADEQ, to Michael Jaworski, CQB, Regarding: Mitigation Order, Docket No: P-121-07-Work Plan. March 12, 2008.

[3] Correspondence from Michael Jaworski, CQB, to Robert Casey, ADEQ, Regarding: Mitigation Order on Consent No. P-121-07, Interim Deliverable for Work Plan. April 21, 2008.

[4] Correspondence from Robert Casey, ADEQ to Michael Jaworski, CQB, Regarding: Mitigation Order, Docket No: P-121-07 – Work Plan Amendment. June 3, 2008.

Please do not hesitate to contact Mr. Stuart Brown at (503) 675-5252 or myself at (520) 473-6209 if you have any questions regarding this submittal.

Sincerely,

Michael Jaworski
Site Manager
Copper Queen Branch

cc: Joan Card, Arizona Department of Environmental Quality
Cynthia Campbell, Arizona Department of Environmental Quality
Rebecca Sawyer, Copper Queen Branch
Sheila Deeley, Freeport- McMoRan Copper & Gold Inc.
Stuart Brown, Bridgewater Group, Inc.
James Norris, Hydro Geo Chem, Inc.

ATTACHMENT 1

RESPONSE TO COMMENTS

In the following responses to comments by Arizona Department of Environmental Quality (ADEQ), ADEQ's original comment is reproduced in normal font and the Freeport McMoRan Copper Queen Branch (CQB) response is provided in bold, italicized text.

General Comments

1. Freeport should add language to the Work Plan stating that upon assessment of gathered data, if it is deemed necessary to perform a task at variance with the Work Plan, Freeport will seek ADEQ's approval in writing prior to performing the task.

   CQB Response: Section 1.2 is modified to address this comment.

2. Freeport should include in the Work Plan a description of how and where monitoring well installation, groundwater sampling, and aquifer testing will be performed.

   CQB Response: How monitoring well installation, groundwater sampling, and aquifer testing will be performed is described in the Sections 4.3, 4.2, and 4.3.8, respectively, of the QAPP (Work Plan Appendix F). Where well installation, groundwater sampling, and aquifer testing will be performed as described in Sections 3.3.3, 3.3.2, and 3.3.4, respectively, of the Work Plan.

3. Freeport should submit electronically to ADEQ, all groundwater data collected, for inclusion into the ADEQ Water Quality Database using *Groundwater Data Submittal Guidance Document, version 3.3, dated March 2005*. This document is downloadable from ADEQ's web site using the following links:

   http://www.azdeq.gov/environ/waste/sps/download/version33.pdf; and,
   http://www.azdeq.gov/environ/waste/sps/download/tables33.pdf

   CQB Response: Section 3.3.2 is modified to address this comment.

4. Freeport should include in the Work Plan a Field Sampling Plan for the work to be conducted.

   CQB Response: Section 4 of the QAPP describes procedures for field operations and data collection activities for the Mitigation Order. Section III.A.2 of the Mitigation Order states that the QAPP will describe "methods, organization, analyses, and quality assurance and quality control". Thus, Section 4 of the QAPP constitutes the field sampling plan.

5. Freeport should discuss the co-mingled total dissolved solids (TDS) plume and how it may relate to the sulfate plume, and the potential of TDS to impact any mitigation action.

CQB Response: Section 2.5.2 is modified to address this comment.

6. Freeport should reconstruct the groundwater elevation contour maps. The contour maps provided in the Work Plan were constructed using data from different sampling events which is not acceptable practice. The geologic cross-sections should also be reconstructed using wells that currently exist and sampled, and the sulfate and other contaminant data should be plotted and contoured.

CQB Response: Per discussion with ADEQ, this comment will be addressed by providing additional geologic cross-sections in the Aquifer Characterization Report and, to the extent possible, by collecting groundwater elevation data within a 30-day period.

7. During groundwater sampling, for at least the first couple of rounds, groundwater should be sampled for the following parameters: total and dissolved metals, sulfate, TDS, general chemistry, pH, and VOCs.

CQB Response: Per discussion with ADEQ, metals and VOCs are not constituents of concern for the Mitigation Order.

8. Freeport should revisit and revise the conceptual site model (CSM) for the site. Included in the CSM should be a discussion of potential receptors, a block diagram that shows source, receptors, geology and hydrogeology, and potential data gaps. Based upon groundwater elevation data, there appears to be a downward vertical gradient, therefore, the CSM should include a discussion that the sulfate plume may no longer be at the top of the Basin Fill aquifer.

CQB Response: Section 2.6 is modified to address this comment.

9. Freeport should state in the well inventory discussion that additional methods in addition to using ADWR and ADEQ records will be used to identify wells within a mile of the sulfate plume.

CQB Response: Section 3.2 of the Work Plan describes the well inventory and states that Cochise County, Arizona Water Company, and Naco Water Company will be consulted to identify information on potential drinking water supply wells in addition to use of the ADWR Well Registry and Water Providers databases and the ADEQ files on public and semi-public water systems. Section3.2 is modified to state that the well inventory will also interview local residents and the ADEQ public water system inspector regarding potential drinking water wells.

10. Regional groundwater sampling of twice may not provide adequate information for input into a numeric groundwater flow and transport model. Additionally, groundwater elevation data should be collected monthly. Freeport should include language stating that depending on results of monitoring well installation, additional monitoring wells may be installed to meet the objectives of the

Mitigation Order, full horizontal and vertical characterization of sulfate plume in the aquifer.

CQB Response: Per discussion with ADEQ, two regional sampling events are adequate, and CQB will endeavor to collect water level data within a 30-day period. Section 3.3.2 is modified to address the first parts of this comment. As stated in Section 3.3.3, "If during this task, newly installed wells are determined to be within the plume, a determination will be made as to whether additional wells need to be installed to meet the data quality objective of defining the extent of the plume.

11. It is not adequate to conduct only a step-drawdown aquifer test to obtain hydraulic conductivity. Step-drawdown tests are conducted to determine sustainable pumping rates from a well. Once the sustainable pumping rate is determined, a constant-discharge aquifer test to determine aquifer parameters typically follows.

CQB Response: Appendix F.2 is modified to address this comment.

12. For potential interim actions, Freeport should state that samples will be collected from, at a minimum, both the well head and point of entry (POE) into the drinking water system. If a modification to the drinking water system is necessary, it may be necessary to obtain approvals to construct and of construction from ADEQ.

CQB Response: Section 4 is modified to address this comment.

13. Freeport should note that the Bisbee-Naco aquifer is classified as a drinking water aquifer and has been designated a sole-source aquifer by the U.S. EPA.

CQB Response: Section 1 is modified to address this comment.

14 Freeport should modify the Quality Assurance Project Plan (QAPP) to address the following:

- State which laboratory and drilling company will be conducting the work;
  CQB Response: Sections 5 and 4.3.2 of the QAPP are modified to address this comment.
- Indicate that all water levels will be collected within 72 hours;
  CQB Response: (see response to comment 10)
- For the first two rounds, groundwater will be sampled for total and dissolved metals, sulfate, TDS, general chemistry, pH, and VOCs;
  CQB Response: (see response to comment 7)
- Equipment blanks would be collected for any reusable sampling equipment;
  CQB Response: Section 4.2.1.5 of the QAPP is modified to address this comment.
- Discuss how depth specific groundwater samples will be collected;
  CQB Response: Section 4.3.4 of the QAPP is modified to address this comment.
- Provide the construction details of the proposed groundwater monitoring wells;
  CQB Response: Appendix E is modified to address this comment.

- State that step-drawdown testing will be conducted to determine sustainable pumping rates and then constant-discharge aquifer tests conducted to determine aquifer parameters. It may be necessary to install piezometers to evaluate the aquifer using distance-drawdown equations.

  CQB Response: (see response to comment 11).

SPECIFIC COMMENTS

1. Section 2.1.1 Description of the CTSA

   The last sentence of the second paragraph states "collected stormwater is periodically pumped from the Horseshoe Pond to the South Tailing Impoundment." Freeport should state whether the North and South Tailing Impoundments are capped to prevent infiltration of the CTSA, and whether the impoundments are lined to prevent discharge to the vadose zone and aquifer.

   CQB Response: Section 2.1.1 is modified to address this comment.

2. Section 2.1.4 Location of the Sulfate Plume

a. This section provides an estimation of the current extent of the sulfate plume based upon limited 2005 groundwater sampling and inferences from the 1996 groundwater sampling. It estimates the sulfate plume as being "approximately 3.5 miles long in a southwesterly direction and 2.5 miles wide, with its northern boundary located at the southern margin of the South Tailing Impoundment and its southern edge south of Naco Water Company (NWC) well 3 (NWC-3) (Figure 4)." Based upon data presented in Figure 4 "Sulfate Plume, 2005 Approximate Boundary of 250 mg/L Sulfate Concentration, Bisbee, Arizona," Attachment #1, ADEQ believes that the sulfate plume is probably slightly longer than depicted. Well NWC-3 had a sulfate concentration of 390 mg/L, while the work plan shows the 250 mg/L contour as being right next to the well. The contour should be at some distance beyond well NWC-3. See Attachment #1 for ADEQ's reconfiguration of the maximum extent of sulfate contamination. This is based upon the limited data collected and reviewing data presented in Figure 14, "Sulfate Concentration Map – July 1989," and Figure 15, "Sulfate Concentration Map – Summer 1996," Attachments #2 and #3, respectively.

   CQB Response: Comment noted - Installation of proposed monitoring wells along the western and southwestern margins of the plume will allow better definition of plume extent.

b. The third and fourth bullets on Page 11should provide the full explanation of the statute as provided in Arizona Revised Statute (A.R.S.) §49-286.
   a. Economically and technically practicable treatment before ingesting the water.
   b. Such other mutually agreeable mitigation measures as are necessary to achieve the purposes of this section.

CQB Response: Section 2.1.4 is modified to address this comment.

c. Freeport should present information on other potential contaminants that may affect the mitigation. For example, in the reference *"Ground-water Resources of the Bisbee-Naco Area, Cochise County, Arizona"* by G.R. Littin, dated June 1987, and Table 4, "Analytical Results for 1996 Groundwater Samples Used for Trilinear Diagrams," indicate that high concentrations of TDS are co-located with the sulfate contamination.

The maximum concentration of TDS in 1996 was 3,800 mg/L. The secondary standard for TDS is 500 mg/L.

CQB Response: Sections 2.1.4 and 2.5.2 are modified to address this comment.

3. Section 2.2 Current Sulfate Mitigation Actions

Freeport should state which drinking water well was replaced due to sulfate contamination, and should provide a list of domestic wells that have been impacted by the sulfate contamination.

CQB Response: As required by the Mitigation Order, CQB submitted a report to ADEQ on May 22, 2008 that describes previously implemented interim actions.

4. Section 2.3 Geologic Setting

The second to last sentence in this section states "Figures 6 and 7 are geologic cross sections based on borings in the CTSA," however, ADEQ notes that the wells that create the cross-sections, for the most part, have not been sampled. Freeport should construct additional cross-sections that utilize wells containing sulfate data. Also, the lithologic logs for all of the borings and wells completed within, and if available, wells completed outside of the sulfate plume, should be included as an appendix in the work plan.

CQB Response: Per discussion with ADEQ, additional geologic cross-sections will be provided in the Aquifer Characterization report and geologic logs will be compiled for Task 2.1.

5. Section 2.3.3.1 Cretaceous Sedimentary Rocks

Freeport should describe the depositional environment associated with the Morita Formation, and should also describe the lateral continuity of the fine-grained interbeds.

CQB Response: Section 2.3.3.1 is modified to address this comment.

6. Section 2.4.1.2 Bedrock Complex

The first sentence states "The bedrock complex generally has low permeability unless the permeability is enhanced by faulting and fracturing or dissolution." ADEQ notes that there can be fracturing that is not associated with faulting which can also be dependent on the type of sedimentary rock. ADEQ recommends this sentence be rephrased as follow; "The bedrock complex generally has low *intrinsic* permeability unless *secondary* permeability *has been* enhanced by faulting, fracturing, and/or dissolution *in the case of limestone*."

CQB Response: Section 2.4.1.2 is modified to address this comment.

7. Section 2.4.2 Hydraulic Properties

Freeport should provide a brief discussion on how previous aquifer tests were conducted, and should provide a figure which shows the results of aquifer tests at each well an aquifer test was conducted.

CQB Response: Section 2.4.2 of the Work Plan references the source of aquifer test data. The original reference contains 45 graphs depicting drawdown and recovery data from these constant rate pumping tests. We recommend review of the original reference for a presentation of the test data and their analysis. A summary of the salient results is adequate for the purpose of the Work Plan.

8. Section 2.4.3 Potentiometric Relationships

a. Freeport should provide a discussion as to why water level contours cross the Black Gap Fault south of the tailings impoundments. Does the Black Gap Fault cease acting as a barrier south of the tailings impoundments?

CQB Response: Section 2.4.3 is modified to address this comment.

b. Freeport should include groundwater hydrographs from all wells at which groundwater elevations over time have been determined.

CQB Response: The work plan provides hydrographs for wells in key areas such as the former evaporation pond, the downgradient edge of the plume, and across the major faults. The hydrographs were provided to illustrate potentiometric relations temporally, laterally, and vertically in the key areas. Water elevation data over time for a larger group of wells is provided in Appendix B and can be inspected to evaluate the time trend of water elevations at wells with available data.

c. The fourth paragraph in this section states that to construct the 1989 water level map, 1988 and 1990 data from Naco Water Company (NWC) and American Water Company (AWC) wells were used. Freeport should provide information on whether the domestic well, if water levels were collected, and NWC and AWC wells were pumping prior and/or were pumping during the time water levels were being collected. It is not acceptable practice for the construction of groundwater

elevation contour maps to use data collected during other sampling events. That data should be removed from the 1989 water level contour map and the maps re-contoured.

CQB Response: Static water levels are preferable to dynamic water levels. As described in Appendix B, the water level data were compiled from previous reports. In particular, the source of information for the AWC and NWC wells was the ADWR GWSI database, consisting of field data collected, verified and maintained by ADWR's Basic Data Unit or the U.S. Geological Survey. To the best of our knowledge, the GWSI data used were for static conditions as GWSI data denoted as collected under pumping conditions were excluded from the compilation.

We agree that ideally water elevation contour maps should be based on approximately contemporaneous measurements. Work Plan Figures 8, 9, 10, and 11 show water elevation contours in 1989, 1996, 1999, and 2005. The majority of data depicted in these figures are for the year indicated. Only a few data points on Figures 8 and 9 are from years other than the year indicated. As stated in Section 2.4.3 of the Work Plan, data from other years were used to provide geographic coverage when other data were not available. The data from other years are clearly identified in the Work Plan so that readers may qualify the data if they choose to do so. Given the sparseness of historical measurements, we believe that showing data from different sampling events is preferable to showing a data gap, particularly when the data from other events are clearly identified.

d. Freeport should provide a more detailed discussion on the connectivity between the Glance Conglomerate, Morita Formation and the Basin Fill in the area south of the Abrigo Fault and east of the Black Gap Fault.

CQB Response: The last paragraph of Section 2.4.3 addresses the issue of connectivity between hydrostratigraphic units.

9. Section 2.4.4 <u>Groundwater Flow</u>

a. The last sentence of the first paragraph on Page 28 in this section states, "The hydraulic conductivity from the calibrated model of 23 ft/day for silty sand was used to estimate flow velocity because it is the material type used in modeling flow between these wells." Freeport should provide an explanation for this statement. Based upon lithologic description of the Basin Fill provided in Section 2.3.2 Basin Fill Deposits and the estimates of hydraulic conductivity for Basin Fill provided in Section 2.4.2 Hydraulic Properties, the estimate of hydraulic conductivity appears to be low. Freeport should provide an appendix which provides input parameters and equations used to calculate groundwater velocity.

CQB Response: The section to which ADEQ's comment pertains is an evaluation of potential groundwater pore velocities. As explained in the text of Section 2.4.4, range of potential pore velocities was calculated

using the average hydraulic conductivity estimated by field aquifer tests and the hydraulic conductivity estimated by numerical modeling by Savci Environmental Technologies (1998). The hydraulic conductivity value of 23 feet/day was used as the low range of the hydraulic conductivity for basin fill in the area between TM-2 and TM-11. The value of 23 feet/day was the value used in the calibrated numerical model for this portion of the basin fill. A high range hydraulic conductivity of 49 feet/day, based on field testing, was used to estimate the high range of hydraulic conductivity. The input parameters and equations used to calculate the groundwater velocity are identified in Table 3 of the Work Plan.

b. The first sentence in the last paragraph of this section states, "In summary, pore velocities based on the ELMA (SRK, 1997) hydraulic conductivity estimates are greater than those based on the SET (1998c) model estimates by a factor of approximately three in the Morita Formation and a factor of two in the basin fill." Freeport should explain this discrepancy, and describe how the company plans to determine groundwater velocity in the area.

CQB Response: The difference in calculated pore velocities is not a discrepancy, it is a range of potential values estimated using the range of previously published hydraulic conductivity estimates for basin fill. Unfortunately, hydraulic properties are seldom uniform in space. Therefore, as the magnitude of the hydraulic conductivity varies, the calculated groundwater pore velocity varies because it is directly proportional to the assumed value of hydraulic conductivity (see equation at the bottom of Table 3). The Aquifer Characterization Plan will install wells and conduct aquifer tests to estimate the hydraulic conductivity of various geologic units in the vicinity of the sulfate plume. Groundwater velocity will be estimated based on the hydraulic conductivity of aquifer materials.

10. Section 2.4.5 Recharge Sources

The last sentence in the second paragraph references the wrong figure. The work plan should reference Figure 2 Facilities in the Vicinity of the Concentrator Tailing Storage Area, Bisbee Naco Area, Arizona, 2007.

CQB Response: Section 2.4.5 is modified to address this comment.

11. Section 2.5 Water Quality

a. The last paragraph on Page 32 states that five organic compounds have been detected in the past in approximately 1989. Freeport should list the organic compounds that were detected and their concentration; even though the work plan states that the detections were the result of analytical error.

CQB Response: Section 2.5 is modified to address this comment.

b. Freeport states in the third and fourth sentences in the first full paragraph on Page 34 "However, decreasing concentrations at NWC-4, located approximately 2500 feet south (and down gradient) of TM-16, indicate that the sulfate plume has contracted slightly. NWC-4 was within the plume with a concentration of 255 mg/L in August 1996, and is now outside the plume with October and November 2005 concentrations of 220 mg/L and 200 mg/L, respectively." Freeport should state whether NWC-4 continued serving water during that time period and if so, state whether the pumping rates remain consistent.

CQB Response: Freeport will determine the operational status of NWC-4 between 1996 and 2005 for development of the numerical model for Task 3.

12. Section 2.5.1.1 Areal Distribution

The last sentence in this section states, "The post-1989 drop in sulfate concentrations in TM-2 probably reflects a lack of further sulfate source loading when mine water discharge to the evaporation pond stopped in 1987." Freeport should also add that the sulfate concentrations in TM-2 have also probably migrated down-gradient since 1987 since the next closest down-gradient well appears to be approximately 1.5 miles.

CQB Response: Section 2.6 indicates that sulfate-bearing seepage at the former evaporation ponds infiltrated to the subsurface, mixed with groundwater, and migrated downgradient in the Basin Fill and Morita Formation aquifers.

13. Section 2.5.1.2 Vertical Distribution

The first three sentences in the second paragraph state, "Sulfate is vertically stratified within the basin fill at the location of GW-47. Depth-specific sampling during drilling indicated that sulfate concentrations in the basin fill decreased from 632 mg/L to 25.8 mg/L between the depths of 280 feet and 345 feet below land surface (Wright, 2001). These data indicate that the sulfate plume is localized in the upper portion of the total 360-foot thickness of the basin fill." In the description of this data, Freeport should provide the depth to water where sampling began, the total depth of the Basin Fill at this location, i.e., feet below land surface (ft bgs), and should provide the results of the depth specific sampling as an appendix.

CQB Response: Section 2.5.1.2 is modified to address this comment.

14. Section 2.5.2 Major Element Chemistry

Freeport should discuss in detail the relationship between sulfate contamination and high TDS concentrations, which is above the secondary standard of 500 mg/L.

CQB Response: Section 2.5.2 is modified to address this comment.

15. Section 2.5.3 Metals

CQB Response: Section 2.5.3 and Appendix D are modified to address this comment.

16. Section 2.6 Preliminary Conceptual Model for the Groundwater Sulfate Plume

a. Freeport should use the following guidance in constructing a conceptual site model (CSM):

a. ASTM E1689-95 *Guide for Developing Conceptual Site Models for Contaminated Sites* (See Attachment #4); and,
b. Interim Final *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*, EPA/540/G-89/004, October 1988.

While this site is not a CERCLA site, these two pieces of guidance provide a good road map on constructing a CSM that can be used to create a successful numeric groundwater flow and fate and transport model and evaluate potential receptors. Additionally, the work plan should provide a relative block diagram that simply portrays the CSM.

CQB Response: Section 2.6 is revised and Figure 21 is added to address this comment.

b. The CSM should contain a discussion of potential receptors.

CQB Response: Section 2.6 is revised to address this comment.

c. Freeport should include in the CSM a discussion and table that describes the efforts that have been made to identify all domestic/drinking water wells that are currently within the sulfate plume.

CQB Response: The identification of drinking water supply wells impacted by the sulfate plume is the objective of the well inventory required by the Mitigation Order and included as Task 1 of the Aquifer Characterization Plan. The well inventory report will describe all the efforts made to identify drinking water supply wells within one mile of the plume.

d. Freeport should include in the CSM an evaluation of currently existing monitoring wells and provide a discussion about the potential differences in groundwater flow characteristics between the Basin Fill aquifer, which is a porous media and groundwater flow characteristics in the Morita Formation, which is indurated and may have flow characteristics that are more similar to fracture flow. Based upon this evaluation, Freeport should discuss the usefulness of wells that are screened across formation boundaries and state whether they can still be of use or whether they should be replaced by co-located wells that are screened only in each formation.

CQB Response: The characteristics of groundwater flow in both the Basin Fill and Morita Formation will be determined by executing the Aquifer Characterization Plan. Differences, if any, between

groundwater flow in the Basin Fill and Morita Formation will be described in the Aquifer Characterization Report. In general, Freeport does not recommend screening wells across geologic contacts and has not proposed to do so.

e. Included in the CSM should be a discussion of potential data gaps.

CQB Response: Section 3.2.1 of the Work Plan discusses data gaps in detail.

f. The last two sentences from the first incomplete paragraph on Page 42 states, "Slightly upward hydraulic gradients over much of the area of the plume were present in the site numerical model prepared by SET, (1998c). However, sustained upward hydraulic gradients have not been detected based on water level measurements in paired monitoring wells (Figure 12)." ADEQ does not agree with these statements. In fact, based upon data presented in Figure 11, "Water Level Map, September 2005," in the following nested wells, TM-2 and TM-2A, screened in the Basin Fill and Glance Conglomerate, respectively; and wells 588577 and GW-47, screened in the Basin Fill and Morita Formation, the vertical gradient is, in 2005, downward. The depth specific sampling conducted during the drilling of GW-47 in 2001, may no longer apply in terms of sulfate being confined to the top of the Basin Fill aquifer and may be present deeper in the Basin Fill aquifer.

CQB Response: There is no contradiction between the text in Section 2.6 and ADEQ's observations. Well installation and groundwater monitoring for Tasks 2.3 and 2.2, respectively, will develop and evaluate data on hydraulic gradients between aquifer units.

17. Section 3.2 <u>Task 1 – Well Inventory of Drinking Water Supply Wells</u>

The first sentence in the second paragraph states, "The well inventory will be based on the ADWR Well Registry Database, which contains records of all registered wells in Arizona." This may not be sufficient. Wells in rural Arizona have not all been registered for a variety of reasons. Freeport should describe additional steps it will take to conduct a comprehensive well survey, including interfacing with the local drillers, county sanitary engineers, and the U.S. Geological Survey (USGS).

CQB Response: Section 3.2 of the Work Plan describes additional steps that will be taken to identify drinking water supply wells, including review of ADEQ's filings on public and semi-public water supplies, review of the ADWR water providers database, and checking with Cochise County, Arizona Water Company, and Naco Water Company. Section 3.2 is modified to state that the well inventory will also interview local residents and the ADEQ public water system inspector regarding potential drinking water wells.

18. Section 3.3 Task 2 – Plume Characterization

At the top of Page 49, there are 5 bullets that describe the data quality objectives (DQOs) from the QAPP. The second bullet states, "Characterize the materials, structure, and permeability of water-bearing units in the CTSA through geologic analysis of cuttings from drill holes and aquifer testing to support groundwater modeling of plume migration." The determination of the location and extent of faulting may not be possible with drilling. Due to the importance of faulting on the groundwater system, ADEQ suggests that the use of surface geophysics may provide additional information for use in the CSM and numeric groundwater flow model.

CQB Response: In the absence of physical manifestations of faulting such as offset of geologic units, brecciation and fracturing, or significant differences in water elevations; it may be difficult to characterize the extent of faulting with drilling. Freeport agrees that geophysical methods may be a useful for further delineating subsurface structure in the area.

19. Section 3.3.2 Task 2.2 – Groundwater Monitoring

a. This section states that water levels and groundwater sampling will take place from private and public supply wells. As part of the information collected in Task 2.1, Freeport should obtain the following well information: well construction details, pumping details, and whether Freeport would be willing to install a sounding tube to monitor depth to water in domestic wells.

CQB Response: As part of Task 2.2, well owners will be asked about well construction and pumping information for their wells. The Work Plan does not recommend installation of sounding tubes in domestic wells because of the difficulties associated with retrofitting private party installations that are often aged and in need of repair.

b. The last full paragraph on page 51states, "Regional monitoring will be conducted twice, once in winter and once in summer, to characterize any seasonality in water elevations." This may not be sufficient if the information is to be used to input into a numeric groundwater flow model. ADEQ suggests that Freeport collect water levels data from these regional wells monthly.

CQB Response: Per discussion with ADEQ, two regional monitoring events will be conducted, one in summer and one in winter.

c. The third sentence in the only full paragraph on Page 52 states that groundwater will only be analyzed for sulfate. ADEQ recommends that for at least the first two sampling rounds, groundwater from near and in the plume should be analyzed for total and dissolved metals, sulfate, TDS, general chemistry parameters and pH. In addition, since VOCs have been detected from groundwater samples in the past, VOC groundwater samples should also be collected.

CQB Response: Per discussion with ADEQ, metals and VOCs are not constituents of concern for the Mitigation Order.

20. Section 3.3.3 Task 2.3 – New Monitoring Well Installation and Testing

a. This section includes language stating that some of the proposed twelve monitor well locations may not be installed if other "suitable" wells are found near the proposed locations. Freeport should also state that additional monitoring wells may be installed in addition to the proposed wells if information is obtained that indicates that additional wells are needed, and include a discussion on the maximum depth of the proposed monitoring wells and construction details.

CQB Response: As stated in Section 3.3.3, "If during this task, newly installed wells are determined to be within the plume, a determination will be made as to whether additional wells need to be installed to meet the data quality objectives of defining the extent of the plume." Section 3.3.2 of the Work Plan, Section 4.3 of the QAPP and Appendix E are modified to address well construction.

b. This section on Page 56 states that after well development, a short-duration (10-24 hour), "step rate pumping test" would be conducted in all newly installed monitoring wells. Freeport should describe in detail how the step-test would be conducted. Typically, a step-test is useful in determining sustainable pumping rates within a well. The tests can be up to 8-hours in length. However, to obtain defendable and more scientific data, a constant-discharge and recovery test should be conducted. The constant-discharge aquifer test is designed to stress the aquifer and therefore, obtain realistic hydraulic values. Without additional information, ADEQ is not convinced that the information obtained from the proposed procedure would provide useful data.

CQB Response: Appendix F.2 is modified to address this comment.

21. Section 3.3.4 Task 2.4 Additional Hydraulic Testing

Freeport should describe in detail how aquifer testing would be conducted on existing monitoring, domestic, and public supply wells.

CQB Response: The aquifer testing method is described in Appendix F.2.

22. Section 3.4 Task 3 – Sulfate Fate and Transport Evaluation

Freeport should provide information regarding which parts of the previous specific groundwater numeric and fate and transport model(s) it plans to use to conduct the proposed modeling effort, and provide a discussion on whether the use of previous modeling is appropriate. Freeport should describe the modeling grid size, the number of layers that may be used, the type of boundary conditions, etc., model calibration and the sensitivity analysis.

CQB Response: As noted in Section 3.4, use of elements from the previous model is "subject to verification of their adequacy". Because the specifics of the model to be developed for the Aquifer Characterization Plan depend on the results of water level and water quality monitoring, geologic observations during drilling, and hydraulic tests yet to be conducted, it is premature to speculate in the Work Plan about the details of the model properties. Also, it is uncertain at this time whether the input files for the previous model are actually retrievable.

23. Section 4 Potential Interim Actions

The second sentence states, "The sulfate concentrations will be determined based on discrete samples collected at the point of use or the point of entry (POE) to the supply system unless there is downstream blending." Freeport should state that if there is downstream blending, samples for sulfate determination will be collected at a location up gradient of the blending location or at the well head of the specific well in question. ADEQ recommends that samples should be collected at the well head to characterize the aquifer at that location, and at the (POE). It should be noted on Page 64 that changes to a water system infrastructure may require Freeport obtaining approvals to and of construction from ADEQ.

CQB Response: Section 4 is modified to address this comment.

24. Section 5.1 Identification and Screening of Mitigation Actions and Technologies

Freeport states on Page 69 "Additional mitigation actions to be considered include monitoring of groundwater and drinking water, institutional controls, such as restrictions on well drilling, natural attenuation, and if needed, alternatives that could reduce sulfate loading to groundwater from the CTSA." Since the Bisbee-Naco aquifer has been classified as a sole-source aquifer by the EPA and is classified by the State of Arizona as a drinking water aquifer, any attempt to restrict well drilling may be resisted.

CQB Response: Comment noted.

25. Figure 21 Proposed Well Locations for Groundwater Monitoring (Task 2.2)

Freeport should either include the proposed monitoring wells that are to be installed, or the title should change to state that this figure shows the proposed groundwater monitoring for currently installed wells. An additional figure should then be added that shows all wells, new and old, that are to be sampled during this effort.

CQB Response: Figures 21 and 22 are renumbered as Figures 22 and 23, respectively, to accommodate the figure added to address specific comment 16a. The title of Figure 22 is changed to address this comment. Figure 23 is changed to address this comment.

Appendix F – Quality Assurance Project Plan Comments

1. Section 2.8 Laboratory QA Manager

Freeport should provide in Appendix F the name of the laboratory that will be used for the project.

CQB Response: Sections 2.8 and 5 of the QAPP are modified to address this comment.

2. Section 2.9 Drilling Subcontractors

Freeport should provide the name of the drilling subcontractor(s) that will be used for the project.

CQB Response: Section 4.3 is modified to address this comment.

3. Section 3.1 Data Quality Objectives

The first bullet should be modified based upon comments provided above to the work plan.

CQB Response: No modification needed.

4. Section 4.2 Groundwater Sampling Activities

Freeport should add a sub-section that discusses decontamination procedures for the portable submersible pump and other re-useable equipment.

CQB Response: Section 4.2.1.6 is modified to address this comment.

5. Section 4.2.1.1 Depth to Water Measurements

Freeport should state that all water levels that will be used to construct groundwater elevation contour maps will be collected within 72 hours from the first well to the last well measured.

CQB Response: Per discussion with ADEQ, CQB will endeavor to collect water level data within a 30-day period.

6. Section 4.2.1.3 Groundwater Sample Collection

a. Freeport should include a discussion and appropriate changes to other portions of the QAPP when discussing the sampling of total and dissolved metals, sulfate, TDS, general chemistry parameters, pH, and VOCs for the first couple of rounds as described in Comment No. 19 c above.

CQB Response: Per discussion with ADEQ, metals and VOCs are not constituents of concern for the Mitigation Order.

b. Page F-22 of the QAPP states that all groundwater samples will be filtered using a 0.45 micron filter. While determination of dissolved constituents is important to

contaminant transport, it is equally import to sample for total constituents unless the water suppliers filter the water prior to delivering it for human consumption. This information may be necessary for the Feasibility Study to evaluate treatment technologies. Therefore, the QAPP should be modified to include collecting samples for total constituents.

CQB Response: Per discussion with ADEQ, collection of filtered samples is acceptable for the constituents to be analyzed pursuant to the Work Plan.

7. Section 4.2.1.5 Field Quality Control Samples

Freeport should state that equipment blanks will be collected, at least once per day, in addition to the field duplicate and field blank samples. Additionally, Freeport should state that field duplicate and field blank samples will be collected once every 20 samples or once a day, whichever is more.

CQB Response: Section 4.2.1.5 is modified to address this comment.

8. Section 4.2.1.6 Equipment Decontamination

Freeport should describe in detail how the equipment will be decontaminated.

CQB Response: Section 4.2.1.6 is modified to address this comment.

9. Section 4.3.4 Reconnaissance Groundwater Sampling from Boreholes

Freeport should discuss how groundwater grab samples will be collected at 40 foot intervals from when the first water is encountered. Freeport states the samples would be collected from the air rotary return, which is an inappropriate sampling technique as the precise location where the water originated is unknown and cross-contamination may occur. Freeport should state that for the QAPP and future FSP, grab samples will be collected by appropriate methods, i.e., Hydro Punch® or other sampling technology.

CQB Response: Section 4.3.4 is modified to address this comment.

10. Section 4.3.5 Well Construction

Freeport states that the well materials will be decided during drilling, but should have an idea regarding the screen size and gravel pack since the company already has monitoring wells in the area. Freeport should provide a description of the most likely well construction information, and state that all sand, bentonite seal, and cement grout seal be placed in the well with the use of a tremie pipe.

CQB Response: Section 4.3.5 and Appendix G are modified to address this comment.

11. Section 4.3.6 Well Completion

Freeport should state that the well registry number and other pertinent information will be placed per ADWR rules and guidance, rather than using a permanent black maker on the concrete.

CQB Response: Section 4.3.6 already states that "The well name and the ADWR registry number will be stamped into the vault lid or well casing."

12. Section 4.3.7 Well Development

Freeport should state how long after well installation, the well would be developed. It is typical to wait at least 72 hours.

CQB Response: Well development will begin after completion of the annular seal.

13. Section 4.3.8 Hydraulic Testing and Well Sampling

Freeport should state when a step-test and when a constant-discharge aquifer test would be conducted on the newly installed groundwater monitoring wells. ADEQ recommends that both tests be conducted on all of the newly installed wells. The step-test determines the proper pumping rate for each well and the constant-discharge test provides appropriate information about aquifer characteristics. Freeport should also describe the type of transducer to be used, vented or unvented. If unvented transducers are used, Freeport should record barometric pressure readings so the transducer values can be calibrated. Freeport should state the frequency of collecting manual water levels during the aquifer test, and indicate if additional wells will be monitored during each test. If so, the QAPP and FSP should identify which wells will be monitored. If additional wells are going to be monitored, Freeport should place a transducer into a background well to determine background conditions for the water table or potentiometric surface.

CQB Response: Appendix F.2 addresses this comment.

14 Section 5 Analytical Laboratory Procedures

Freeport discusses the analytical laboratory requirements in generalities. The QAPP is intended to provide specifics. Freeport should provide the name of the analytical laboratory and provide specifics for the work to be conducted. Additionally, Freeport should include the chosen laboratory's Quality Assurance Manual as an Attachment to the QAPP.

CQB Response: Section 5 is modified to address this comment.