ARIZONA DEPARTMENT
OF
ENVIRONMENTAL QUALITY

Douglas A. Ducey
Governor

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Director

Sent via U.S. Mail

August 18, 2016
VRP 17-068

Mr. David Rhoades
President and General Manager
Freeport-McMoRan Sierrita Inc.
PO Box 527
Green Valley, AZ 85614-0527

RE: Review of *Baseline Human Health Risk Assessment*
Freeport Sierrita Inc.
6200 W. Duvall Mine Rd.
Green Valley, Arizona
VRP Site Code: 100073-03

Dear Mr. Rhoades:

The Arizona Department of Environmental Quality (ADEQ) Voluntary Remediation Program (VRP) has reviewed the June 7, 2016 *Baseline Human Health Risk Assessment* (BHHRA), prepared by ARCADIS on behalf of Freeport-McMoRan Inc. Sierrita Operations (FMI) for the FMI Sierrita Mine, located at 6200 West Duval Mine Road in Green Valley, Arizona (the Site).

VRP has reviewed the BHHRA and has separated its comments into two areas, comments and/or concerns which must be resolved and/or addressed to satisfy site characterization for the purpose of pursuing a No Further Action (NFA); and comments and/or concerns which must be resolved and/or addressed to satisfy the requirements of a risk assessment utilized to support an NFA.

Site Characterization

Under Arizona Revised Statutes (A.R.S.) §§ 49-171, 49-175, and 49-181, a Volunteer may evaluate a full site, or may choose to evaluate smaller areas of a site, referred to in statute as "a portion of a site". The BHHRA refers to the evaluation of portions of the Site as "exposure areas" (EAs), and VRP will use this term herein.

1. The VRP has determined the nature and extent of all source areas within the EAs were not fully characterized for the nature and extent of source contamination, pursuant to A.R.S. § 49-175(A), before the areas were evaluated for potential risks to receptors[1]. The process of completing characterization for any area for which an NFA is sought should be completed before the submittal of a remedial action document or any document which seeks VRP concurrence that no further characterization and/or remediation is warranted.

[1] In VRP's November 18, 2014 review of the February 2013 BHHRA Work Plan, VRP noted that information was not provided in the work plan to show characterization and spatial distribution of data was appropriate to support a BHHRA. In the

2. The VRP does not concur with the incorporation of the Demetrie Wash within the boundaries of the CLEAR Plant EA (BHHRA Figure 5-2a). The Demetrie Wash has not been characterized, and should not be included in other release areas identified in the CLEAR Plant EA. The Demetrie Wash should be characterized separately and should be isolated as its own EA in future risk evaluations.

3. The VRP cannot accept the inclusion of facilities which are currently under the authority of another program into an EA which will be used to support an NFA area[2]. For example, section 2.3 of the BHHRA states that the EAs "*encompass nine subareas identified as the focus of VRP site investigations because they are… operations identified as "to be closed" under the A[quifer] P[rotection] P[rogram]*". The VRP does not have the authority to issue an NFA for areas currently overseen by another program in the agency. In addition, VRP will not issue an NFA for areas which are still actively utilized by the mine for purposes which may continue to contribute to soil impacts. This includes areas such as "*active operations with the potential to releases mining-related constituents to groundwater*", as cited in section 2.3 of the BHHRA.

4. As indicated in an August 29, 2013 letter from the VRP for this Site, FMI should not compare the 95% Upper Confidence Limit (UCL) to Groundwater Protection Levels (GPLs). The GPLs are screening levels treated as not-to-exceed values, based on the consideration that individual, isolated areas may contribute to groundwater contamination. As such, samples within each EA must be compared to the default GPL and/or compared to an EA-specific alternate GPL that has been developed based on data collected within that EA.

5. Pursuant to A.R.S. § 49-152(B) and (C), and Arizona Administrative Code (A.A.C.) R18-7-208, a Declaration of Environmental Use Restriction (DEUR) is **required** for an NFA determination *in any instance, regardless of current land use or zoning*, where characterization and/or compliance data used in support of closure exceeds the residential soil remediation levels (SRLs) or when a site-specific (ss)-SRL is developed for any receptor other than a residential scenario. If FMI is seeking an NFA for the EAs without conditions, as indicated in the June 7, 2016 cover letter for the BHHRA, then FMI must submit a risk assessment that adequately and appropriately evaluates a residential scenario for each EA. All other risk-based scenarios will require a DEUR and result in a conditional NFA for any EA not evaluated to a residential scenario. In addition, any NFA issued with conditions will supersede prior unconditional NFAs for areas incorporated into the EAs[3].

November review, VRP asked: "*What assurance can Sierrita provide that all appropriate locations have been investigated and that the investigations upon which the risk assessment will be based have adequately addressed the nature and extent of releases associated with industrial and mining activities?*" FMI's January 2, 2015 response indicated a revised work plan would support that characterization was adequately addressed. Although the subsequent April 24, 2015 BHHRA Work Plan did not present VRP with a map showing the spatial distribution of data to indicate the EAs were fully characterized, the work plan indicated the data FMI would use in the BHHRA was sufficient to support a risk evaluation. On the basis of FMI's assertion that characterization was completed sufficiently to support a risk evaluation, VRP approved the April 2015 BHHRA Work Plan.

[2] Neither the BHHRA Work Plan, nor the BHHRA, indicate FMI's awareness that VRP is unable to provide an NFA for the APP facilities. The VRP understands FMI is aware of this fact, as it was acknowledged in FMI's November 2014 *Data Gap Work Plan*, where FMI states "…future closure and other actions for the APP facilities are governed by the APP and are not intended to be addressed under the VRP." Since the BHHRA Work Plan states "the BHHRA report, including text, tables, and figures, will be a stand-alone document", this same acknowledgement of the APP facilities should have appeared in the BHHRA. Since this acknowledgement is not made in the BHHRA, it is confusing to VRP why the "to be closed" APP facilities were included in the EAs, since the BHHRA seems to indicate the risk assessment will be used to support closure through VRP.

[3] This refers to the CLEAR Plant EA, which incorporates the Training Facility NFA Boundary (VRP13:308) and the Paving Project NFA Boundary (VRP16-204).

Risk Assessment

The following comments address the risk evaluation presented in the BHHRA:

1. Pursuant to the Arizona Department of Health Services (ADHS) 2003 *Deterministic Risk Assessment Guidance*, site-specific screening/initial remediation levels usually limit Excess Lifetime Cancer Risk (ELCR) to one-in-one million (10^{-6}) for Class A proven human carcinogens and to one-in-one-hundred-thousand (10^{-5}) for Class B probable and Class C possible human carcinogens. ADEQ will not consider a 10^{-4} ELCR without ADHS review and evaluation. Upon revision to the BHHRA, if FMI resubmits a risk assessment containing ELCR values of 10^{-4}, ADEQ will rely on ADHS for review of the document.

   FMI should note, since 1997, ADEQ has had a policy decision to use 1 x 10^{-5} as the ELCR for Class B and C carcinogens. ADEQ documented this decision in the Arizona Administrative Record, 1997 Volume 3, Issue #52, on page 3652.

2. The comments in the table below have been prepared by Kleinfelder, ADEQ's subcontractor for the BHHRA review, and have been labeled "K1" through "K41" for ease of reference:

#	Kleinfelder Comment
K1	**Executive Summary, Human Receptors and Exposure Routes**: The BHHRA notes that groundwater is not used for potable purposes. Identify current source and system supplying potable water to the site.
K2	**Executive Summary, Key Findings, last sentence on page ES-5:** Reference is made to "these data" but it's not clear what data are being invoked.
K3	**Introduction, fourth paragraph**: The BHHRA notes that the potential for exposure to site-related constituents in groundwater was not evaluated because groundwater is not a potable supply. Could site-related constituents migrate to groundwater and affect a potable supply elsewhere? A discussion about the potential to affect water supplies should be included.
K4	**Section 2 – Geology and Hydrogeology:** It would be helpful to know how this information relates to the assessment of health risk at the subject site. For example, are there characteristics of the geology known to be high in metals that might be of health concern? Are there characteristics of the geology and hydrogeology that could affect migration of COPCs within and beyond the subject site?
K5	**Section 3 – Previous Site Investigations, first paragraph:** First appearance of the acronym "COIs." How are COIs identified? How do they relate to COPCs? Is there purpose behind using the two classifications instead of one or the other?
K6	**Section 3.1.1, first paragraph: The** BHHRA states that 54 surface soil and 39 subsurface soil samples were collected but these numbers do not match up with sample numbers reported in Table 5-1. Second paragraph of this section also reports sample numbers for CLEAR and Esperanza that do not match Table 5-1.
K7	**Section 3.1.2.1, first paragraph:** Similar to preceding comment, sample numbers (n=171) do not match Table 5-1.
K8	**Section 3.1.3:** Data discussed are not referenced to a specific report.
K9	**Section 3.1.3:** Similar to preceding comments, sample numbers do not match Table 5-1.
K10	**Section 3.1.4:** Similar to preceding comments, sample numbers do not match Table 5-1.

#	Kleinfelder Comment
K11	**Section 3.1.2.2:** The BHHRA states that, "The unconsolidated deposits and parent bedrock complex at the Sierrita mine…contain natural levels of radioactivity." Where in the BHHRA are natural levels of radioactivity presented? Later in the paragraph, maximum activities for Ra-226 are reported – are these the natural levels? If so, more detail about the range of activities (not just the maximums) should be provided.
K12	**Section 3.1.4, second paragraph:** The BHHRA notes that ten percent of the grid samples were analyzed – does that mean three samples? Ten percent of 29 is about three.
K13	**Section 5.1, second paragraph:** The BHHRA notes that groundwater is not currently used or likely to be used in the future as a potable supply. Is it possible, however, that site-related constituents could migrate to groundwater and affect potable supplies off-site?
K14	**Section 5.1, third paragraph:** The BHHRA notes natural levels of radionuclides but does not provide evidence to support that statement. If such evidence appears in ARCADIS (2013a) [not (2013b) as indicated in report], then that evidence should be presented in the BHHRA.
K15	**Section 5.3:** Data usability was evaluated based on several criteria, including spatial characteristics and sampling size and density. These criteria, however, were not defined and the data were not evaluated, except in a cursory way, against these criteria. For example, the report states that randomly selected sample locations were identified based on a 200-square foot grid system in the CLEAR and Esperanza areas but no information is provided regarding how many samples were collected based on that grid or the locations of those samples on a grid. Sample location and density can be ascertained to some extent from Figures 5-2a through 5-2C, 5-3, and 5-4, however the sample locations appear clustered or of insufficient number to adequately characterize the various sites, particularly for residential land use where standard lot sizes may be in the range of 0.25 acres. Some areas also appear to have been not sampled (large swaths of the CLEAR and Esperanza areas) or minimally sampled (Former Evaporation Pond, Old D Pond, and the Former Rhenium Ponds). As an example, the Former C Pond Spoils area is approximately 1,000 feet long and as much as 350 feet wide but only four samples have been collected from that area. Also, no analysis is provided to demonstrate data sufficiency.
K16	**Section 5.5.1, second bullet:** Verify that ADEQ (2002) is the correct reference for the statement regarding future unrestricted land use.
K17	**Section 5.5.2:** Are samples presented on Figure 5-2b not actually included in the BHHRA data set used to estimate cancer risk and noncancer hazard for this location? It's not clear from Figure 5-2b which samples characterized current conditions and which characterized future conditions.
K18	**Section 5.5.3:** Was the "parent" sample used to characterize the site whether it was greater than the "duplicate" or not? Has the relative percent difference been addressed for parents and duplicates?
K19	**Section 5.6, second bullet:** Because this bullet refers to radionuclides, highest detected concentration should be "highest reported activity."

#	Kleinfelder Comment
K20	**Section 6.1.2, last sentence:** Inclusion of sediment data in the 0-15 feet bgs data set is not necessarily a conservative approach if sediment concentrations tend to be lower than soil concentrations. A comparison of sediment data to soil data should be performed to verify whether combining these data is defensible. Also, it's not clear from Table 5-2, which samples are sediment samples.
K21	**Section 6.1.3.1, second paragraph:** How was the potential for radon gas evaluated?
K22	**Section 6.1.3.1, third paragraph:** Indicate the location in the BHHRA where potential indoor-related exposure to radionuclides is discussed.
K23	**Section 6.1.3.2:** Explain why a future outdoor commercial/industrial worker is not included for evaluation.
K24	**Section 6.2.2:** Site specific exposure assumptions are acceptable for use where such assumptions are consistent with current and future land use and activities. Should land use or activities change, site specific assumptions no longer apply and health risk must be re-evaluated.
K25	**Section 6.3.2:** The BHHRA notes that for exposure scenarios wherein the exposure duration is less than seven years, subchronic toxicity values were used. The exposure scenarios for which subchronic toxicity values were used should be identified here.
K26	**Section 6.3.3.1:** The relative bioavailability factor for arsenic should be noted here.
K27	**Section 6.3.3.1:** Equation 6-1 includes an "FI" factor but this factor is not defined or discussed.
K28	**Sections 6.3.4.1 and 6.3.4.2:** Equations 6-6 and 6-7 includes a factor of 10^3 (1,000) but this factor is not defined or discussed.
K29	**Section 7.2, Table 7-1:** Subchronic toxicity values are discussed (sources and uses) here, however, it does not appear that subchronic toxicity values or the surrogates mentioned (e.g., intermediate MRLs from ATSDR) were actually used in the risk assessment. Also, all subchronic toxicity values presented in Table 7-1 appear to be chronic values adopted for subchronic exposure scenarios. Please identify and discuss subchronic exposure scenarios if such scenarios were evaluated.
K30	**Section 9.1.4, third paragraph:** This discussion of radionuclides and background would be helpful in Section 2.4.
K31	**Section 9.1.4, third through sixth paragraph:** If an argument is being made that the radionuclides that account for cancer risk within the areas evaluated are background, then a formal evaluation should be provided that at a minimum compares site specific radionuclide activities to documented background activities.
K32	**Section 10.3:** The use of site specific exposure assumptions and factors (especially exposure frequency and duration) have not been addressed but are a significant source of uncertainty. The fact that these assumptions and factors address only specific exposure conditions that do not apply to other land uses or human activities should be discussed.
K33	**Section 11.1.1:** Much of this section is material that appears in Section 9.1.4 without additional analysis or interpretation particularly with regard to background radionuclides. Again, if an argument that background radionuclides account for the cancer risk associated with radionuclides, then a formal evaluation should be presented.

#	Kleinfelder Comment
K34	**Section 11.2:** There are no recommendations although this section is titled, "Conclusions and Recommendations".
K35	**Table 6-1:** Soil ingestion rate for commercial/industrial worker should be 100 mg/day, not 50 mg/day.
K36	**Appendix F, Results and Discussion, Cancer Risks:** Discussion of acceptable risk ranges is provided but an explicit discussion of the applicability of those risk ranges to the subject site is not. The applicability or appropriateness of risk management ranges other than those generally applied at other sites in Arizona is not provided. A discussion of the applicability of background radionuclide activities to the subject site is not provided.
K37	**Appendix F, Results and Discussion, Noncancer Hazards:** Although bioavailability may be a factor in the interpretation of the high hazard indices presented, a more rigorous analysis is necessary before alternative risk calculations should be considered.
K38	**Appendix F:** The cancer risk and noncancer hazard estimates presented for the residential exposure scenario do not support an unconditional no further action decision regarding radionuclide and metal contamination based on the significant exceedance of regulatory thresholds.
K39	**Appendix F, Table F-7:** Footnote 14 lists the soil ingestion rates for the child and adult incorrectly. Child should be 200 mg/day, adult should be 100 mg/day. How does the adult value presented in this footnote relate to the 50 mg/day ingestion rate presented for the adult receptor in column 6 of this table?
K40	**Appendix F, Table F-10:** Toxicity values for U234 need to be added to Table 7-2.
K41	**Cover Letter:** The results of the BHHRA do not support an unconditional no further action decision for the areas evaluated on the basis of the exceedance of cancer risk and noncancer hazard thresholds typically accepted on sites in Arizona and throughout the United States and based on the density of soil sampling which does not represent exposure units consistent with residential land use.

Required Information

VRP would like to set up a meeting to discuss the BHHRA and comments with FMI. Please contact me within the next two weeks to schedule a time and location that is amenable to all parties. VRP requests the meeting is held within 45 days from the date the meeting is set. I can be reached by electronic mail at jp8@azdeq.gov or by telephone at (602) 771-4818.

Regards,

Joey Pace, Project Manager
Voluntary Remediation Program

cc: Stuart Brown, FMI, Senior Director, Remediation Projects – *sent via email*
Deborah Chismar, FMI Sierrita Operations, Senior Environmental Specialist – *sent via email*
Diana Kelts, FMI Sierrita Operations, Chief Environmental Engineer – *sent via email*
Katy Brantingham, ARCADIS, Project Manager – *sent via email*