



Douglas A. Ducey  
Governor

# ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY



Misael Cabrera  
Director

*Sent via U.S. Mail*

October 2, 2019  
VRP 20-049

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

**RE: Review of August 2019 Baseline Human Health Risk Assessment**  
Freeport Sierrita Mine, 6200 W. Duvall Mine Road, 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 *Baseline Human Health Risk Assessment* (BHHRA), dated August 2019. The BHHRA was prepared by Arcadis U.S., Inc. (Arcadis) on behalf of Freeport-McMoRan Inc. Sierrita Operations (FMI) for the FMI Sierrita Mine (the Site), located at 6200 West Duval Mine Road in Green Valley, Arizona. The comments presented herein were prepared by the VRP and ADEQ's third party risk assessor, The Fehling Group, LLC, (TFG), with support from Neptune and Company, Inc.

The August 2019 revision of the BHHRA (August 2019 BHHRA) was prepared in response to ADEQ's March 5, 2019 comments on the November 2018 version of the BHHRA (November 2018 BHHRA). The "Status of Overarching Comments from November 2018", presented below, addresses the main concerns identified in the March 5, 2019 letter, as well as the concerns raised in follow-up meetings, and discusses whether the August 2019 BHHRA adequately addressed these concerns. That section is followed by "Specific Comments from August 2019 BHHRA", which addresses minor comments specific to the August 2019 submittal.

## **Status of Overarching Comments from November 2018**

- A. Concern 1: Identify site-related contamination, using statistical and graphical background comparisons to identify site-related chemicals of interest (COIs). This concern has not been addressed in the August 2019 BHHRA. COIs are still identified based solely on comparison of metals soil concentrations to Arizona soil remediation levels (SRLs) and comparison of radionuclide soil concentrations to United States Environmental Protection Agency (USEPA) Preliminary Remediation Goals (PRGs) (Ref: BHHRA Section 5.6). Background soil data are not employed to identify site-related COIs. Note, statistical and graphical comparisons of radionuclide soil data from the CLEAR Plant and Esperanza Mill exposure areas versus background soil data were conducted by Neptune and Company to support comment resolution. A memorandum summarizing this analysis and presenting box-and-whisker plots was provided to FMI through ADEQ, but no such analyses for metals or radionuclides are provided or referenced in the BHHRA.

Further, text in BHHRA Section 2.4.1.4 discussing site radionuclide concentrations in relation to background levels provides information suggesting radionuclides in Site soils are consistent with natural background. This text is inconsistent with comparisons of radionuclide soil data from the CLEAR Plant and Esperanza Mill exposure areas with the background soil data and should be revised.

- B. Concern 2: Evaluate potential radionuclide risks for all radionuclides in the uranium and thorium decay series if radionuclides in the series are identified as COIs. This concern has been addressed in the August 2019 BHHRA (in Section 5.7.1).
- C. Concern 3: Correct the inappropriate use of the 95UCL to represent background soil concentrations when comparing site and background risks. This concern has been addressed in the August 2019 BHHRA (in Section 5.7.3).
- D. Concern 4: Provide an evaluation of the comparability of data from the different sampling campaigns that are used to characterize Site soil concentrations. This concern has not been addressed in the August 2019 BHHRA. Section 5.3 of the BHHRA cites several factors that are claimed to contribute to the representativeness of the data, and references Table 5-1 for supporting information. However, Table 5-1 provides incomplete information for evaluating data representativeness. Specifically, Table 5-1 indicates that in some field campaigns soil samples were field sieved to 2 millimeter (12 mesh) and in other cases no field sieving was done. No information is provided regarding instructions for sample preparation (sieving) by the analytical laboratories to determine whether samples are comparable with respect to limits on grain size. No information is provided on sample mass. Information on radiological analyses is provided only for the Esperanza Mill exposure area sampling in 2008; no comparable information is provided for radiological analysis for the CLEAR Plant exposure area.
- E. Concern 5: Clarify which UCLs were selected from the ProUCL software. This concern has been addressed in the August 2019 BHHRA (in Section 5.7.1).
- F. Concern 6: Provide spatial data evaluation supporting how data were aggregated to estimate the average soil concentrations used in the risk assessments. This concern was not addressed in the August 2019 BHHRA. However, a posting plot of a subset of the Esperanza Mill exposure area radionuclide results was provided to support this review<sup>1</sup>. Posting plots with results for risk-driving COIs (radionuclides; arsenic) should be provided in the final revision of the BHHRA for all sampling subareas of the Esperanza Mill and CLEAR Plant. Boxplots comparing subarea results within the Esperanza Mill exposure area, and subarea results within the CLEAR Plant exposure area, should also be provided. These plots should be reviewed and the revised BHHRA should document whether there are significant differences in soil concentrations among the subareas included within a larger exposure area. If this is the case, exposure point concentrations for the larger industrial worker exposure area should be calculated as an area-weighted mean of the subarea concentrations.

### Specific Comments from August 2019 BHHRA

1. **Section 2.4.1:** The last sentence of this section is somewhat misleading. ADEQ recommended that either a new background study be conducted, or that the Ra-226 background data be ignored and the uranium-238 and uranium-234 data be used to represent soil concentrations of uranium decay series radionuclides in secular equilibrium. No action is required.

---

<sup>1</sup> In follow-up meetings to discuss comment resolution, ADEQ's risk assessment consultants expressed concern regarding the lack of spatial data evaluation in the BHHRA. Subsequently, a posting plot of Esperanza Mill radionuclide soil concentrations from samples outside of specific subareas where judgmental samples were located (Former C Pond and C Pond Spoils, Former Raffinate Pond, Former Laydown Yard) was provided by Arcadis to support this review.

2. **Section 5.7.1; 3<sup>rd</sup> paragraph:** In Section 2.4.1.4, the BHHRA notes soil concentrations of U-238, U-234 and Ra-226 from the former CLEAR Plant and former Esperanza Mill exposure areas are in secular equilibrium. However, as stated in Section 5.7.1, calculation of exposure point concentrations was done separately for U-238, U-234 and Ra-226. In principle, if a decay series is in secular equilibrium, the same activity should be used for all members of the series. For example, an average concentration could be calculated across these radionuclides, and that average applied to the entire decay series. These calculations should be compared, and this comparison should be discussed in Section 10.3 (uncertainty analysis) of the BHHRA.
3. **Section 5.7.1; 3<sup>rd</sup> paragraph:** The following text should be added to the end of this paragraph: “*For the actinide series, it was assumed the long-lived parent U-235 is in secular equilibrium with all subsequent radionuclides in the series.*”
4. **Section 9, 2<sup>nd</sup> paragraph:** The comparison of site and background risks using the mean should be supplemented with at least a subjective comparison of the site and background variance to address whether uncertainty in the mean for risk-driving COIs is substantially different between site and background. If the site variance is greater and positively skewed, it can be surmised that a comparison of site and background risks using the simple average might underestimate incremental site risk.

Upon review of the comments presented herein, FMI and Arcadis are urged to bring any questions or concerns to the VRP’s attention for clarification. If FMI and Arcadis concur with the comments made herein, a response to comments is not necessary. A final version of the BHHRA may be prepared based on these comments. Revisions and responses to the BHHRA may be made on a schedule developed by FMI, and can be provided to the VRP in future communications.

Regards,



Joey Pace, Project Manager  
Voluntary Remediation Program

cc: Dave Gosen, FMI – *sent via email*  
William Hart, FMI – *sent via email*  
Katy Brantingham, ARCADIS – *sent via email*  
Anne Thatcher, ARCADIS – *sent via email*