FREEPORT-McMoRAN 333 North Central Ave., Phoenix, AZ 85004-2306 (602) 366-7818

Todd Weaver
Senior Counsel

January 10, 2019

Ms. Maria Galanti
Site Coordinator, Ohio EPA
Division of Environmental Response and Revitalization
2195 E. Front Street
Logan, OH 44138

Re: *<u>Former Satralloy Site—Response to Anonymous Letters</u>*

Dear Ms. Galanti:

By this letter Cyprus Amax Minerals Company ("CAMC") provides the Ohio Environmental Protection Agency ("OEPA") responses to a series of five letters sent to OEPA by an anonymous author who wrote under the pseudonyms "Mingo Junction Anonymous" and then "Friends of Kolmont" (collectively referred to here as "FOK"). FOK wrote the five letters to OEPA between July 19 and September 5, 2018.

The letters rarely if ever refer to CAMC, which is the company that actually owns the Site, has provided the relevant draft reports to OEPA, and is named in the consent order with OEPA; instead FOK incorrectly refers to "Freeport McMoRan," a parent corporation.

In the first letter, the author presents himself as a neighbor with limited knowledge (*e.g.*, "I talked to people that have recently done work at Satralloy and they said the owners of the property, Freeport McMoRan, has done a big report called a Remedial Investigation."). Two weeks later, the author mentions the assistance of anonymous "friends and . . . people who have concerns" and assumes the role of an adverse expert who then lectures OEPA and accuses CAMC's consultants of bias.

FOK's anonymous claims of bias are false. In contrast to the mystery surrounding FOK, the qualifications and experience of CAMC's experts are public and substantial. Attachment A to this letter summarizes their qualifications. These men and woman have built their careers with decades of training, detailed work, and professional interaction with governmental agencies in their fields of expertise.

Scientists and technical experts may not always agree, but they are trained to engage in fair and professional discussions of differing opinions. This continues to be the attitude and track record of CAMC's experts on this project, which is documented in

OEPA's files as CAMC has responded to OEPA's comments on CAMC's 2016 draft Remedial Investigation report ("RI") and risk assessments, and as demonstrated by this letter.

The format of FOK's letters follows a pattern of quoting excerpts from either CAMC's 2016 draft report or a June 29, 2018 letter from Ms. Kristy Hunt of OEPA to Jefferson County Commissioner Tom Gentile, and then asking questions or making accusations. Attachment B to this letter is a review of FOK's principal questions or claims (paraphrased) and CAMC's detailed responses. Of course, OEPA already is aware of most of the information in Attachment B. CAMC is providing its responses so that FOK's accusations do not stand unanswered in the public record.

Below is an overview of the comments and responses:

- FOK questioned the thoroughness of the RI and sufficiency of the sampling program. The RI presents an extensive, thorough investigation of the results of chromium smelting operations at the Site, including chromium-containing dust. Sampling locations were picked to represent the Site conditions; no areas were intentionally avoided. The RI Workplan was reviewed and approved by OEPA, and the RI work conducted with OEPA oversight.

- FOK alleges that water and sediment in Cross Creek poses risks to humans. The effects of discharges from the Site into Cross Creek have been very extensively studied, as reported in the RI. Studies include two biocriteria studies and a mixing zone study. The risk assessments (human and ecological) address potential risks to Cross Creek, including discharges to Cross Creek regardless of origin. The draft human health risk assessment ("HHRA") evaluated risks qualitatively, and it is being revised to provide a quantitative risk assessment, supporting the original conclusion that there is negligible risk for recreational use of Cross Creek.

- FOK alleges that the RI does an inadequate job of estimating slag and dust quantities. This is simply not true. The quantity of slag at the Site was thoroughly studied, and a best estimate is provided. The quantity of dust collected will be added to the RI.

- FOK alleges that the components of slag and dust, and the toxicity of these components, was inadequately addressed. To the contrary, all components of the slag and dust matrices are addressed. All differences in transport mechanisms and exposure pathways relevant to components are addressed. There is extensive quantitative data on Cr(VI) in the RI (Sections 2, 4, and 5); it is the COPC given the greatest attention. The RI estimates the quantity of slag at the Site (Section 3.3.1) and presents the concentrations of Cr and Cr(VI) in the slag (Section 4.1) and chromium-containing dust (Section 4.2). There was no need in the RI, HHRA, or environmental risk assessment ("ERA") evaluations to estimate the quantity of Cr specifically.

- FOK alleges that evaluation of migration and natural attenuation of hexavalent chromium was incorrect and/or inadequate. Based on the factual errors in the FOK comments, FOK has practically no understanding of chromium geochemistry. The RI provides a detailed correct discussion of chromium geochemistry as it applies to the Site. Detailed responses in Attachment B demonstrate the correctness and adequacy of the RI evaluation of geochemistry and migration (fate and transport).

- FOK had several comments related to interim actions. CAMC performed interim actions in accordance with the workplan approved by OEPA to address immediate threats.

CAMC's responses are founded on its experts' knowledge and the extensive data collected and work performed by them for over a decade at the site under OEPA's approved workplans and oversight. Please let us know if OEPA has questions or wants additional detail.

Sincerely,

Todd Weaver

ATTACHMENT A

GOLDER TEAM QUALIFICATIONS

The authors of the Remedial Investigation (RI), Human Health Risk Assessment (HHRA), and Ecological Risk Assessment (ERA) are distinguished and respected environmental professionals with extensive experience in site investigation and remediation. Qualifications of key individuals are presented below (in alphabetical order).

Dr. Nicole DeNovio (Golder Associates) is a senior hydrogeologist specializing in water resources and water quality issues. Dr. DeNovio has groundwater flow and contaminant transport experience for projects, including the largest contaminated site in the United States, a Superfund Mega Site and groundwater supply, hydrologic assessment and modeling, water right planning and implementation, groundwater modelling, vadose zone characterization, geochemical characterization, emerging contaminants, and water quality contamination and transport. Dr. DeNovio develops conceptual models of complex systems and implements these into quantitative models of reservoirs and aquifer systems. She has extensive experience in using advanced calibration tools in models to achieve high-quality history matches that are subject to extensive peer- and regulatory-review. She is a member of the Water Quality Committee for the American Society of Civil Engineers, a Scientific Advisory Committee member since 2011 for the industry-leading MODFLOW & More Conference sponsored by the Integrated Groundwater Modeling Centre, and member of EPA's Modeling Technical Advisory Committee for the San Fernando Valley Basin (the primary source of groundwater for the City of Los Angeles). Nicole also leads Golder's global technical community of groundwater modelers.

Dr. Deborah L. Gray, DABT (Stantec), is a Principal Toxicologist with over 30 years of experience in the areas of environmental health, toxicology, environmental epidemiology, and human health and ecological risk assessment. She earned a Ph.D. in Physiology and Pharmacology (1990) from The Ohio State University, specializing in toxicology and epidemiology, and has maintained certification as a Diplomate of the American Board of Toxicology (DABT) since 1996. She has a wide range of experience in government, private sector consulting, and academia, and has worked on a variety of projects in the field of environmental and occupational health. Prior to joining Stantec, she held positions with other environmental consulting firms, the Ohio Department of Health, the Ohio Environmental Protection Agency, and The Ohio State University (OSU) College of Public Health. Deborah has conducted risk assessments under CERCLA, RCRA, TSCA, and other regulatory programs for a wide variety of Sites and contaminants of concern. Dr. Gray's experience in public health, academia, and private sector consulting have given her an unusually varied background in environmental and occupational exposure assessment and risk communication.

Mr. Lee Holder, PE (Golder Associates), is an environmental engineer with over 40 years of experience. Mr. Holder has extensive experience in all aspects of site investigation and remediation including: evaluating remedial alternatives, planning and performing treatability studies, preparing remedial action plans, performing remedial design, conducting competitive bidding, and selecting and managing contractors. He has managed and performed numerous remediation projects conducted under CERCLA, RCRA, various state cleanup programs, and other federal and state regulations.

Dr. Andrew Madison (Golder Associates) is a Senior Geochemist with over 10 years of applied research and consulting experience in environmental remediation. He received a doctorate in Geochemistry from the University of Delaware. Dr. Madison is one of the technical leaders of Golder's investigation and remediation practice where he works with a team of professionals to identify, manage, investigate and remediate organic and inorganic contaminants including chromium and arsenic. Dr. Madison is the lead geochemist for sites around the world for which inorganic species including arsenic, cadmium, chromium, lead, molybdenum and selenium are the focus of evaluation and/or remediation. His technical leadership for these projects ranges from natural attenuation evaluations to design and implementation of *in situ* and *ex situ* remediation systems to mitigate impacts in soil, groundwater and surface water. Prior to joining Golder, Dr. Madison was a researcher working on the geochemical and biological aspects that govern the cycling of metals in the environment. Dr. Madison has published over 20 peer-reviewed articles and book chapters in the environmental chemistry and microbiology fields. Dr. Madison has presented research and projects at conferences and workshops around the globe.

ATTACHMENT A

GOLDER TEAM QUALIFICATIONS

Ms. Anne Thatcher (Arcadis) is an environmental scientist with Arcadis with 30 years of professional experience in environmental consulting. Her areas of expertise include human health and ecological risk assessment, data collection in support of risk assessment, natural resource damages assessment negotiation and strategy, risk communication, community relations, project management, and closure strategy. Ms. Thatcher's strength lies in her ability to proactively identify key issues associated with environmental liability and strategically develop creative solutions to resolve issues. Her project experience ranges from small petroleum contaminated sites to large industrial facilities including mines, tank farms and landfills.

Dr. Rens Verburg (Golder Associates) is a Principal Geochemist with over 25 years of experience in geochemical evaluation of environmental issues related to mining and mineral processing, including chromium. He received a doctorate in Geochemistry and Mineralogy from the Pennsylvania State University. Rens has been involved in numerous geochemical studies at proposed, operating, and closed mining and mineral processing operations in North, Central and South America, Europe, Africa, Asia, and Australia. He is a frequent speaker at conferences and short courses, and has provided testimony as an expert witness. Rens was the Project Director for the development of the Global Acid Rock Drainage (GARD) Guide on behalf of INAP (International Network for Acid Prevention). The GARD Guide is a world-wide reference for acid prevention and identifies Best Practice in the field of ARD and metal leaching.

ATTACHMENT B

DETAILED COMMENT RESPONSES

This document presents responses to comments in five letters from an individual or group styling itself "Mingo Junction Anonymous" and "Friends of Kolmont". These letters are dated July 19, July 23, August 1, August 4, and September 5, 2018. The comments in the letters are repetitive and not organized by topic. To respond, we have grouped similar comments together. Because the comments were not numbered in the letters, we have identified them by paragraph number by letter.

Comment Group 1: Several comments questioned the thoroughness of the Remedial Investigation (RI) and sufficiency of the sampling program (August 4, paragraphs 9-10, 16-21, 28-34, 40-44; September 5 letter, paragraphs 15 & 37).

Response: The RI presents an extensive, thorough investigation of the results of chromium smelting operations at the Site, including chromium-containing dust. Sampling locations were picked to represent the Site conditions; no areas were intentionally avoided. The RI Workplan was reviewed and approved by OEPA, and the RI work conducted with OEPA oversight.

Regarding prior data reported by USEPA and OEPA, sampling locations and data QA/QC were not provided for these prior data. It was deemed inappropriate to include such data because it is not possible to evaluate the representativeness of data for a sample when the location and the quality of the data are unknown. In addition, the data in the RI is more recent, extensive, and thorough, providing sufficient data for risk assessment and remediation decisions.

Slag borings were advanced to the entire depth of slag in representative locations. No Toxicity Characteristic Leaching Procedure (TCLP) results for dust or slag are presented in the RI. Instead, dust and slag were analyzed by SPLP, as this method was developed by USEPA specifically to mimic leaching from materials due to precipitation, and thus is the appropriate test for evaluating leaching potential of Cr(VI) from slag or dust. TCLP, as its name indicates, was developed for determining the toxicity characteristic for off-site disposal, and uses a pH considered typical for sanitary landfills. TCLP is not an appropriate test for on-site management because it does not represent Site conditions.

The RI Workplan (approved by OEPA) was designed to provide representative sampling of materials at the Site. No areas were intentionally avoided.

The RI never states that all dust sources are the same. To the contrary, Section 4.2 presents dust results by area, identifying the differences in analytical results. Dust samples were analyzed for COPCs and SPLP, as appropriate for environmental investigation.

During interim action, some trash was put into bags and stored along with bags of dust. There was no pattern of mixing trash and dust. Regardless, the aliquots of dust samples collected from the bags for analysis contained no trash. As appropriate to ensure that all dust was collected, some soil underlying the dust was removed. This soil will be managed along with the dust, and the samples collected are representative of the material to be managed during final remediation.

Comment Group 2: Several comments concerned COPC concentrations in and toxicity of Cross Creek water and sediment (July 19 letter, paragraphs 2, 3-5, & 7; July 23 letter, paragraphs 2 & 3; August 1 letter, paragraphs 9-10, 11, 23, 15, 21, 25; August 4 letter, paragraph 13-14; September 5 letter, paragraphs 25, 27, 29, 44 & 45).

Response: The effects of discharges from the Site into Cross Creek have been very extensively studied, as reported in the RI. RI investigations and conclusions regarding surface water used best available science, and are not "tenuous". Distinctions between samples were not inexact. Studies include two biocriteria studies and a mixing zone study. The human health assessment risk (HHRA) and the environmental risk assessment (ERA) address potential risks to Cross Creek, including discharges to Cross

Creek regardless of origin. The HHRA is being revised to provide a quantitative risk assessment, supporting the conclusion that there is negligible risk for recreational use of Cross Creek. See also response to comments on COPC migration (Comment Group 5).

Recreational User of Cross Creek and Exposure to Surface Water

The HHRA examined potential risks due to recreational use of Cross Creek, and concluded there is no cause for concern. With specific respect to the bridge, CCW-08 is immediately upstream of the bridge and CCW-09 immediately downstream of the bridge. In samples from CCW-08, total Cr was detected in only 1 sample (0.67 ug/L, less than the typical detection limit of 2 ug/L), and Cr(VI) was not detected 94% of the time (the only 2 samples with detections were 2.8 and 4.1 ug/L, barely above the 2 ug/L detection limit). In CCW-09, Cr(VI) was not detected in any sample and total Cr was detected in only 2 samples (0.73 and 0.52 ug/L, below the typical detection limit of 2 ug/L) (87% non-detect). These concentrations do not represent a risk to human health.

To put this number into perspective, the Oak Ridge National Laboratory Risk Assessment Information System (ORNL-RAIS) Preliminary Remediation Goals (PRGs) Calculator was used to estimate a site-specific screening level for a recreational user (swimmer) of Cross Creek. The screening level for Cr(VI) of 5.25 ug/L is based on the following USEPA exposure assumptions:

■ Target Risk:	1E-05
■ Exposure Frequency:	45 days/year
■ Exposure Duration (Child):	6 years
■ Exposure Duration (Adult):	20 years
■ Exposure Time:	1 hour/event
■ Events:	1 event/day

This screening level assumes that the swimmer is exposed to that concentration every time they are swimming in Cross Creek. This is a very conservative assumption that is more likely to over-estimate rather than under-estimate potential exposures. No sample collected at sample location CCW-08 (immediately upstream of bridge) exceeded the site-specific screening level (5.25 ug/L) for a recreational user of Cross Creek.

For comparison to the screening level, we calculated an exposure point concentration (EPC) using the surface water data for hexavalent chromium presented in Table 4.10-1A of the RIFS. An EPC is a conservative estimate of the average chemical concentration in an environmental medium and is typically represented as the 95% upper confidence limit on the mean chemical concentration. The USEPA ProUCL software (version 5.1.1) was used to estimate an EPC for hexavalent chromium for surface water samples collected from CCW-02, CCW-03, CCW-05, CCW-06, CCW-07, CCW-08, CCW-09 and CCW-10. Laboratory results from samples CCW-01 and CCW-04 were excluded as these locations are “upgradient” of the Satralloy site and thus are not representative of potential site impacts.

The EPC for hexavalent chromium was estimated to be 2.33 ug/L, a concentration that is less than ½ the screening level (5.25 ug/L) for a recreational user of Cross Creek. There is no excess cancer risk associated with the recreational use of Cross Creek.

Cr(VI) was only detected in 7 out of 119 Cross Creek surface water samples (frequency of detection 5.9%). Five of the seven detections occurred during the same sampling event conducted on August 20, 2013. On this day, no dissolved total chromium was identified in any sample. Since Cr(VI) is soluble in water, one would expect if there was a detection of Cr(VI) in a sample, then there would also be a detection of dissolved total chromium in the same sample. This was not observed, which casts doubt on the validity of these hexavalent chromium detections reported by the laboratory for Cross Creek. However, these data were not excluded from this analysis.

ATTACHMENT B

DETAILED COMMENT RESPONSES

Recreational User of Cross Creek and Exposure to Sediment

The USEPA Risk Assessment Information Service (RAIS) Preliminary Remediation Goals (PRGs) Calculator was used to estimate the Site-Specific Screening Level for exposure to Cross Creek sediment by a recreational user of Cross Creek (23.8 mg/kg) based on the following USEPA exposure assumptions:

■ Target Risk:	1E-05
■ Exposure Frequency:	45 days/year
■ Exposure Duration (Child):	6 years
■ Exposure Duration (Adult):	20 years
■ Exposure Time:	1 hour/event
■ Events:	1 event/day

The concentrations of Cr(VI) detected in samples of sediment from Cross Creek are presented in Table 4.10-4A of the RIFS. Cr(VI) was detected in 44 out of 45 sediment samples, the maximum detected concentration was 1.9 mg/kg. An exposure point concentration (0.504 mg/kg) was estimated using all available data.

The maximum detected concentration and the EPC are an order of magnitude lower than the estimated site-specific screening level of 23.8 mg/kg for a recreational user of Cross Creek exposure to sediment. There is no excess cancer risk associated with the exposure to hexavalent chromium in sediment by a recreational user of Cross Creek.

Sediment porewater is not an environmental media of concern that is evaluated for risks to human health. There are only applicable screening criteria for ecological receptors. Sediment is the environmental media of concern for risk to human health.

OEPA Technical Report

The referenced OEPA report summarized results for any exceedances of Ohio water quality criteria for chemical or physical parameters sampled in Cross Creek in Table 4, and there were no detected chromium concentrations exceeding OEPA ambient water quality criteria reported, including at sampling stations upgradient, adjacent, and downstream of Satralloy. In the RI samples, upgradient sample location on Cross Creek CCW-01 (see Figure 4.10-1 and Table 4-10.1A) did not detect total Cr in 100% of the samples; Cr(VI) was detected in 1 sample (98% non-detect) at 2.8 ug/l (detection limit 2 ug/L). Upgradient sample location on McIntyre Creek CCW-04 did not detect total chromium or Cr(VI) in any sample.

Only three of the 28 fish sampled showed concentrations of chromium slightly above the detection limit (i.e., 0.48 mg/kg fish tissue vs 0.40 mg/kg detection limit). Additionally, while detection may indicate migration of chromium from the Site, it is not indicative of harm to the fish.

According to the Ohio EPA Fish Tissue Collection Manual, Cooperative Fish Tissue Monitoring Program, State of Ohio (2012), Method Reporting Limits (MRLs-referred to as MDLs in Table 1) and concentrations of total metals are reported in µg/kg wet weight (page 15, Table 1). The results reported in Table 11 of the OEPA Technical Report are for total chromium.

RM 4.9 is the stretch of Cross Creek that runs along the former manufacturing area on the Site Lowlands along Gould Road. There are five identified discharges to Cross Creek between RM 5.0 and RM 4.6. RM 1.3 at County Road 74 is in Lower Cross Creek at Rocky’s Junk Yard.

Table 11 in the OEPA Technical Report indicates the MDLs for the tissue samples ranged from 0.39 to 0.40 mg of chromium/kg of fish tissue (mg/kg). Total chromium was reported at a concentration of 0.48 mg/kg in the composite sample of white sucker filets collected at RM 4.9. Chromium was not detected in the other nine tissue samples (results reported as <0.39 or <0.40) on Table 11. For an analytical procedure, the laboratory Method Detection Limit is defined as the “minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results.” (US EPA, Definition and Procedure for the Determination of the Method Detection Limit, Revision 2. December 2016. EPA 821-R-16-006). The concentration of chromium reported in the white sucker composite, 0.48 mg/kg, only slightly exceeded the OEPA laboratory MDL referenced in the report (OEPA 2013).

Assuming the result for white suckers is accurate, the source of the chromium cannot be determined with any certainty as no reference samples were collected upstream of the Satralloy Site in 2010. Consequently, it is not known if white suckers or comparable trophic level fish in Cross Creek could have detectable concentrations of chromium from other local or background sources.

OEPA reported concentrations of total metals in fish tissue (OEPA 2012). It is more likely than not that the total chromium reported in the white sucker filet composite was in the trivalent form based on the toxicokinetics of hexavalent chromium. Hexavalent chromium enters the cells of living organisms more readily than trivalent chromium. However, once inside the cell the hexavalent chromium is rapidly reduced to trivalent chromium by normal cellular processes (USEPA 2010, Toxicological Review of Hexavalent Chromium (CAS No. 18540-29-9) In Support of Summary Information on the Integrated Risk Information System; and ATSDR September 2012, Toxicological Profile for Chromium).

Cr(III) is not carcinogenic and is an essential trace element in glucose metabolism associated with the oligopeptide chromodulin, also referred to as Glucose Tolerance Factor (ATSDR 2012, US EPA 2010). The potential risks to people consuming the reported concentration of total chromium detected in the white sucker filet composite was evaluated based on the toxicity of trivalent chromium.

To put the concentration of total chromium detected in the white sucker filet composite into perspective, the United States Environmental Protection Agency Risk Assessment Information Service (RAIS) Preliminary Remediation Goals (PRGs) Calculator was used to estimate a screening level (2,320 mg/kg) for a resident consuming fish caught and harvested from Cross Creek based on the following USEPA exposure assumptions:

■ Exposure Duration	26 years
■ Target Hazard Quotient:	1
■ Exposure Frequency:	350 days/year
■ Ingestion Rate (Fish)	54,000 mg/day
■ Lifetime	70 years

The screening level represents the concentration of chromium in fish tissue that could be eaten 350 days/year (54,000 mg/day) for 26 years that is not expected to cause adverse health effects. The chromium concentration of 0.48 mg/kg reported in the white sucker filet composite is 4 orders of magnitude below the screening level.

Mixing Zone Concentrations of Cr(VI)

The OEPA inside mixing zone criteria for Cr(VI) is 31 µg/L and, therefore, the data presented in the mixing zone study (Appendix D of the RI) showing three Cr(VI) samples taken at discharge locations from the “mixed” area of Cross Creek (15, 22 and 12 µg/L) and three Cr(VI) samples taken from the “mixing” area (31, 38 and 17 µg/L) are equal to or less than the inside mixing zone criteria, except one which was slightly above (38 µg/L). There is a distinction between discharge-water samples (ranging from 30 to 2,300 µg/L), mixing-area samples, and Cross Creek water samples and the distinction is defined by OAC 3745-1-06 Mixing zone demonstration and sizing requirements where "mixing zone" means:

> an area of a water body contiguous to a discharge. This discharge is in transit and progressively diluted from the source concentration to the receiving system concentration. The mixing zone shall be considered a place where wastewater and receiving water mix and not as a place where wastes are treated) and
>
> “Inside mixing zone maximum criteria" means the criteria that cannot be exceeded within the mixing zone. It is identical to final acute value (FAV), as defined in Chapter 3745-1 of the Administrative Code [Cr(VI) = 31 µg/L].

Sediment and Pore Water Concentration Uncertainties

We agree there are uncertainties related to the interpretation of Cross Creek sediment and sediment porewater data presented in the RI. The reason for Cr(VI) detection in upstream sediment samples from Cross Creek and McIntyre Creek is unclear. One interpretation of the sediment data is that some Cr(VI) is naturally occurring. Sediment pore samples taken in Cross Creek at the Satralloy Site contain Cr(VI) at concentrations in the range of 24 to 540 ug/L; however, these concentrations are in two very localized areas and the mass of Cr(VI) is very tiny; if the Cr(VI) moves into Cross Creek, it does not cause exceedances of OEPA ambient water criteria. Benthic invertebrates may be exposed to pore water and the BERA discussed possible ecological risk to organisms at these locations. The ERA addresses risk to benthic invertebrates. The ERA concluded that the results for on-site surface water for Cr(VI) indicate a potential for risk to aquatic life; however, due to the additional line of evidence provided by the biocriteria assessments, potential risk for Cr(VI) for off-site surface water is unlikely. Additionally, the biocriteria assessments did not find any potential risk to aquatic life and benthic invertebrates based on exposure to site-related COPCs. The 2006 and 2012 surveys indicated that the sampling reaches and outfall locations near the site meet and/or exceed the regulatory requirements for aquatic life in the Ohio Administrative Code (OAC). Sediment porewater was sampled prior to any release to the creek but when the creek was sampled in these areas, Cr(VI) was detected at or below inside and outside mixing zone criteria except one sample which was slightly elevated at 38 µg/L (compared to inside mixing zone criteria of 31 µg/L).

It may be a possible explanation that AVS capacity has been exceeded in sediment to a point where further reduction of Cr(VI) to trivalent chromium cannot occur in those localized areas that were sampled for sediment and sediment porewater. However, it is unclear what connection the detection in sediment background has to do with this because, in our analysis, sediment background is due to other sources, not the Site. We do not agree about the future potential for increasing Cr(VI) in porewater, because Cross Creek has met Ohio water quality criteria over the past two decades since monitoring began.

OEPA Biocriteria Study

At the time RI Section 2.1.6 was written, the OEPA report was not available. While the draft RI is dated 2016, portions were written prior to release and not updated because a need to update was not identified. Now that the report is available, the OEPA results will be incorporated into the RI. Preliminary review of OEPA data indicates that it is consistent with existing RI data and findings.

Hellbender Salamander

There is no evidence of the Hellbender Salamander at the Site.

There is very limited information about the exposure of the Eastern Hellbender because none has been seen at the Site. There is very limited information about the toxicity of chromium to reptiles and amphibians, in general, and the Eastern Hellbender, specifically. ERA Section 5.4.1.1 discusses results for the aquatic life, which includes the broader Functional Group of amphibians, of which the Eastern Hellbender is a representative species. The Level III BERA concluded that the results for on-site surface water for aluminum and Cr(VI) indicate a potential for risk to aquatic life. Due to the additional line of evidence provided by the biocriteria assessments, however, potential risk for aluminum and Cr(VI) for off-site surface water is unlikely. Additionally, the biocriteria assessments did not find any potential risk to aquatic life and benthic invertebrates based on exposure to site-related COPCs. The 2006 and 2012 surveys indicated that the sampling reaches and outfall locations near the site meet and/or exceed Ohio regulatory requirements for aquatic life.

That said, since the RI was submitted in 2016, additional research was conducted to see if any additional scientific literature has been published regarding the toxicology of chromium to amphibians. Gardner et al. (2017) recently studied potassium dichromate (Cr VI) in the spotted salamander. Gardner et al. (2017) reported a lethal concentration to 50 percent of the test population (LC50) of 71.92 mg Cr/L, an effective concentration resulting in malformations in 50 percent of the test population (EC50) of 26.05 mg Cr/L, a no-observed effect concentration (NOEC) for mortality/malformations of 2 mg Cr/L and a lowest observed effect concentration (LOEC) for mortality/malformations of 20 mg Cr/L. Both the maximum and average site surface water values (i.e., 0.83 and 0.15 mg Cr/L) are below the 2 mg Cr/L NOEC value from the Gardner et al. (2017) study on spotted salamander. Additionally, the pore water maximum was 0.49 mg/L, which is also below the 2 mg/L NOEC value (Gardner et al. 2017).

Comment Group 3: Several comments concerned the quantities of slag and chromium-containing dust on the Site (July 23 letter, paragraphs 5 & 6; August 4 letter, paragraphs 3, 36, & 40-44; September 5 letter, paragraphs 34-36).

Response: The RI presents an extensive, thorough investigation of the results of chromium smelting operations at the Site (Sections 3.3, 3.4, 4.1, and 4.3), including chromium-containing dust. The extent of slag on the Site, including any dust in the slag, has been extensively investigated and is shown on Figure 3.3-1. The estimated quantity of slag at the Site is estimated to be approximately between 1.3 and 1.8 million cubic yards (Section 3.3.1). The quantity in the ES was incorrectly stated as 800,000 cubic yards and will be corrected. No basis is provided for commenter's claim that "there must have been 2 times this much [dust] layered in with the slag before designated dumping of the ferrochrome/ferrochromium dust started." The quantity of dust is limited by the fact that the baghouses only operated for approximately three years. Regardless, quantities provided in the RI are based on current conditions.

There was no need in the RI/HHRA/ERA evaluations to estimate the quantity of Cr specifically.

The commenter claims that there are drawings and permits of dust placement at the Site; however, OEPA has not indicated that such documents exist. We are not aware of such documentation. The commenter should provide any documentation he has of dust placement at the Site. Regardless, the slag and dust at the Site has been extensively and thoroughly characterized.

Comment Group 4: Several comments concerned the toxicity and concentrations of Site materials and Cr(VI) (July 23 letter, paragraphs 5 & 7; August 1 letter, paragraphs 19 & 21; September 5 letter, paragraphs 15, 23 & 31).

Response: All components of the slag and dust matrices are addressed; all differences in transport mechanisms and exposure pathways relevant to components are addressed. There is extensive quantitative data on Cr(VI) in the RI (Sections 2, 4, and 5); it is the COPC given the greatest attention. The RI estimates the quantity of slag at the Site (Section 3.3.1) and presents the concentrations of Cr and Cr(VI) in the slag (Section 4.1) and chromium-containing dust (Section 4.2). There was no need in the RI/HHRA/ERA evaluations to estimate the quantity of Cr specifically.

Leaching of Cr(VI) is addressed in the RI (Sections 4.1 and 4.12.1). Chromium-containing dust was analyzed by the Synthetic Precipitation Leaching Procedure (SPLP). SPLP was developed by USEPA specifically to mimic leaching from materials due to precipitation, and thus is an appropriate test for evaluating leaching potential of Cr(VI) from slag or dust. The Toxicity Characteristic Leaching Procedure (TCLP) , as its name indicates, was developed for determining the toxicity characteristic for off-site disposal, and uses a pH considered typical for sanitary landfills. TCLP is not an appropriate test for on-site management because it does not represent Site conditions.

Future receptors on the former Satralloy Site will not be exposed to the baghouse dust that is currently stored and awaiting disposition. There are no relevant “health limits” for concentrations of chromium and hexavalent chromium in baghouse dust. The leaching test performed on the dust was SPLP, not TCLIP [sic] as stated by commenter. Quantities and concentrations Cr and Cr(VI) for dust mixed with slag and associated risks were appropriately considered together.

The toxicity of COPCs for the Site were identified and addressed in the HHRA. This includes the constituents of dust at the Site (including but not limited to Cr[VI]). Appropriate references for toxicity were consulted, as provided in the HHRA.

Comment Group 5: Several comments concerned the migration and natural attenuation of Cr(VI) (August 1 letter, paragraphs 3-8, 13, 14, 17, 20, 22, 24; September 5 letter, paragraphs 18-22, 24, 26, 28, 30)

Response:

Groundwater-seep CSM

Five general water-bearing zones have been identified and investigated in the vicinity of the Site:

- Interflow Zone, a surficial, unconfined water-bearing zone located in the Plant Area underlain by clays and silts.
- Colluvial soil water-bearing zone located at the base of and along the Site ridge.
- Valley Fill Aquifer located within the narrow, bedrock valleys underlying clays and silts in the Plant Area.
- Perched bedrock water-bearing zones in the uplands above the elevation of Cross Creek.
- Regional bedrock aquifer.

Each of these zones represents a different water-flow regime and different chromium distributions. Generally, the water in the Interflow Zone and Colluvial soil water-bearing zone are disconnected pockets of groundwater that contain water that is moving in the shallow subsurface prior to being discharged at a seep or Cross Creek. Similarly, Perched bedrock water-bearing zones above Cross Creek reflect longer, slower flow paths with limited discharge to either the Regional bedrock aquifer or Valley Fill Aquifer.

In the uplands, groundwater flow within the ridge bedrock occurs in the perched bedrock water-bearing zones and migrates vertically downward through sandstone layers until encountering the underlying finer-grained lithologic units that act as aquitards. These aquitards slow vertical groundwater migration, resulting in groundwater flow that is primarily horizontal until discharging along the ridge slope in seeps. Samples from wells RBH-01, RBH-02 and RBH-03 represent this groundwater regime. During drilling of the RBH series wells, groundwater was found to exist as multiple discrete, relatively thin, layers with underlying dry zones in wells RBH-01 and RBH-02 and the upper portions of RBH-03 (above the elevation of Cross Creek). Groundwater samples were collected and analyzed where the borehole interval yielded sufficient water. Analytical results are provided in Table 4.8-1C. Dissolved chromium and Cr(VI) were detected together in only one sample interval (RBH-03 from 32 to 40 ft bgs). There were other detections of Cr(VI) in groundwater from boreholes, but they were associated with turbid samples and these samples were non-detect for dissolved chromium; therefore, these other detections are not considered representative of Cr(VI) in the perched bedrock groundwater.

The RI activities identified the regional bedrock groundwater table is approximately equal to or slightly above the elevation of Cross Creek. Monitoring wells RBH-03, RBA-04D, RBA-05D, and KMW-02 were screened in the bedrock groundwater table zone to monitor regional groundwater conditions. Analytical data for groundwater samples collected from monitoring wells RBA-04D, RBA-05D, RBH-03 and KMW-02 confirm regional bedrock groundwater quality is not impacted by COPCs. Cr(VI) was not detected in wells installed to monitor regional bedrock groundwater quality. Further, the maximum detected total chromium concentration was 9.1 µg/L (KMW-02 in 2016), which is ten times lower than the MCL.

In general, COPCs are not found in the Valley Fill Aquifer. The exceptions are two wells screened in this aquifer (MW-05 and MW-16). These two wells are located in the Plant Area and are screened below slag and along the alignments of abandoned stream channels, which provide preferential flow paths. The absence of Cr(VI) in other monitoring wells screened in the Valley Fill Aquifer demonstrates that the Cr(VI) in MW-05 and MW-16 is due to isolated local occurrences, and not widespread aquifer impact.

Cr(VI) that leaches into the subsurface from the slag interacts chemically with the underlying geological and biogeochemical environment. As Cr(VI) migrates downward via infiltration from aerobic (vadose zone) to anaerobic conditions (groundwater), Cr(VI) undergoes attenuation. As a consequence of the various attenuation processes, Cr(VI) and total chromium concentrations decline prior to vertical transport downward to the regional bedrock aquifer. Cr(VI) was not detected in the bedrock aquifer.

Geochemistry Variability

The field measurements and analytical results indicate that geochemical conditions range from mildly to strongly reducing (negative ORP values) within a pH range of 6-10 S.U. These conditions are favorable to reduction of Cr(VI). Therefore, while it is true that pH can influence Cr(VI) speciation and Cr(VI) reduction by affecting the reaction thermodynamics and reaction rates, the observed groundwater pH range promotes Cr(VI) reduction. This is supported by the analytical groundwater data, which show that Cr(VI) is not present outside of a small number of localized areas.

As discussed in the RI, the geochemical composition of groundwater and some seeps/stormwater/surface water is different due to interaction of these waters with the atmosphere, which promotes aerobic conditions. While the presence of dissolved oxygen in these waters is indicative of conditions unfavorable for Cr(VI) reduction, the analytical results of surface water samples collected in Cross Creek (the end receptor) demonstrate that discharged Cr(VI) rapidly attenuates and is not found outside of the mixing zone. This is likely due to Cr(VI) reduction by mineral surfaces or organic matter suspended in Cross Creek, or due to adsorption to mineral surfaces in Cross Creek.

Natural Attenuation of Cr(VI)

The natural attenuation of Cr(VI) in groundwater and soils has been the subject of numerous peer-reviewed publications and environmental regulatory guidance documents and recommendations. A seminal review of the fate and transport of Cr(VI) in the environment was published by Stanin and Pirnie (2004[1]), and subsequent literature published since 2004 has provided the scientific community with additional understanding of Cr(VI) fate and transport. The general consensus within the scientific community and published literature is that there is no one, defined framework that should be used to establish natural attenuation of Cr(VI). Rather, evaluation of the natural attenuation of Cr(VI) should be based on a multiple lines of evidence (MLOE) approach that evaluates site-specific data to reach a conclusion.

---

[1] Stanin, F.T.. and M. Pirnie (2004). The transport and fate of chromium(VI) in the environment. Chromium (VI) Handbook. 165-214.

The MLOE approach applied at the Site included the evidence framework outlined in Palmer and Puls (1994[2]) as well as additional lines of evidence including slag leachability and site-specific hydrogeologic conditions. The following summarizes the MLOE employed at the Site:

Slag leachability

- The SPLP leachate concentrations of total chromium ranged from 0.023 to 0.54 mg/L with a median of 0.14 mg/L (12 samples), which is consistent with the non-detect to low concentrations of chromium observed in groundwater and surface water samples. Notably, the median SPLP results are near EPA's drinking water standard of 0.1 mg/L without the additional physical and chemical attenuation that would occur following the release of chromium from the slag.
- The limited leachability of the slag is consistent with literature findings, including a study by Lind et al. (2001) which determined that leaching of chromium from slag used as road base was low, resulting in non-detect to low levels (1 – 2 µg/L) of Cr(VI) in localized groundwater.

Presence of natural Cr(VI) reductants

- Cr(VI) is a strong oxidant and, therefore, can be reduced in the presence of electron donors. There are numerous natural reductants that can transform Cr(VI) to trivalent chromium [Cr(III)], including aqueous species (e.g., reduced iron, sulfide, organic matter) and interactions with the immobile aquifer matrix (e.g., desorption of reductants such as reduced iron from mineral surfaces, direct or indirect redox reactions with mineral surfaces such as pyrite, reduction by soil organic matter) and by biological processes (Stanin and Pirnie, 2004[1]; Eary and Rai, 1989[3]; Patterson et al., 1997[4]; Sedlak and Chan, 1997[5]; Kotas and Stasicka, 2000[6]; Wielinga et al., 2001[7]; Fendorf et al., 2000[8]; Loyaux-Lawniczak et al., 2001[9]).
- Coal seams containing pyrite and other metal sulfides were observed during the RI and are well documented at the Site and within the surrounding region. The coal itself, pyrite, and other metal sulfides are strong reductants of Cr(VI).
- Iron (reduced and total) is present nearly ubiquitously in the water-bearing zones at the Site. Reduced iron species are strong reductants of Cr(VI) with rapid reaction rates. The fast cycling of the oxidized iron (Fe(III)) produced during microbially-mediated respiration of organic matter

---

[2] Palmer, C.D. and R.W. Puls (1994). Natural Attenuation of Hexavalent Chromium in Groundwater and Soils. EPA Groundwater Issue.

[3] Eary, L.E. and Rai, D., 1989, Kinetics of chromate reduction by ferrous ions derived from hematite and biotite at 25°C, Am. J. Sci., Vol. 289, pp. 180–213.

[4] Patterson, R.R., S. Fendorf, and M. Fendorf, 1997. Reduction of hexavalent chromium by amorphous iron sulfide. Environmental Science and Technology, 31, 7, pp. 2039-2044.

[5] Sedlak, D.L. and P.G. Chan, 1997. Reduction of hexavalent chromium by ferrous iron. Geochmica et Cosmochimica Acta, 61, 11, pp. 2185-2192.

[6] Kotas, J. and Stasicka, Z., 2000. Chromium Occurrence in the Environment and Methods of Its Speciation. Environmental Pollution, 107, 263-283.

[7] Wielinga, B., Mizuba, M., Hansel, C., and Fendorf, S., 2001. Iron promoted reduction of chromate by dissimilatory iron-reducing bacteria. Environmental Science and Technology, 35, 3, pp. 522-527.

[8] Fendorf, S., B.W. Wielinga and C.M. Hansel, 2000. Chromium Transformations in Natural Environments: The Role of Biological and Abiological Processes in Chromium(VI) Reduction. International Geology Review, 42, 8, pp. 691-701.

[9] Loyaux-Lawniczak, S., P. Lecomte, J.J. Ehrhardt, 2001. Behavior of hexavalent chromium in a polluted groundwater: redox processes and immobilization in soils. Environmental Science and Technology, 35, 7, pp. 1350-1357.

to Fe(II) catalyzes the reduction of Cr(VI) by providing a continually-regenerated source of Fe(II) (Wielienga et al., 2001[7]).

- Total organic carbon concentrations detected in samples for the water-bearing zones at the Site demonstrate there is substantial organic matter (e.g., humic and fulvic acids), which is an important reductant of Cr(VI).

Capacity of aquifers to reduce Cr(VI)

- The water-bearing zones at the Site are characterized by negative oxidation-reduction potential values, indicating that the geochemical conditions present promote the reduction of Cr(VI) and subsequent sequestration as relatively immobile Cr(III) species.
- Groundwater analytical results indicate that, with few exceptions (i.e., three isolated monitoring wells in the Valley Fill Aquifer and the Interflow Zone), Cr(VI) is absent. This demonstrates that the aquifer capacity to reduce Cr(VI) is sufficient to mitigate the flux of Cr(VI) that enters groundwater from the slag.
- Extensive coal seams containing pyrite and other metal sulfides are present to reduce Cr(VI).
- The universal presence of iron in groundwater indicates a significant amount of Cr(VI) can be reduced due to iron cycling.

Necessary time scale to reduce Cr(VI) maintains compliance

- The general absence of Cr(VI) within the Site water-bearing zones demonstrates that Cr(VI) is being effectively reduced along the flow path from the slag source.

Immobilization potential of chromium

- The absence of Cr(VI) within the Site water-bearing zones demonstrates the sequestration and immobilization of Cr(VI) largely due to reduction to immobile Cr(III).
- Cr(VI) and Cr(III) are absorbed by iron, manganese and aluminum oxides, clay minerals, particulate organic matter, and other natural solids and colloids, all of which are present in aquifer materials.

Potential for net oxidation of reduced chromium--Cr(III) to Cr(VI)

- The redox potential of the Cr(VI)/Cr(III) couple is sufficiently high that only oxygen and manganese dioxides are known to oxidize Cr(III) to Cr(VI) (Eary and Rai, 1987). However, the oxidation of Cr(III) by oxygen in the environment is of little significance because published studies have shown that oxidation of Cr(III) without any mediating species is negligible (Schroeder and Lee, 1975[10]; Eary and Rai, 1987[11]; Fendorf et al., 2000[8]) or kinetically slow (Rai et al., 1986; Schroder and Lee, 1975[10]; Nakayama et al., 1981[12]).
- Based on mineralogical testing during the RI, manganese dioxide is not present in the slag and, thus, Cr(VI) is unlikely to be produced by oxidation with manganese in the slag.

---

[10] Schroder, D.C. and G.F. Lee, 1975. Potential transformations of chromium in natural waters. Water, Air, and Soil Pollution, 4, pp. 355-365.

[11] Eary, L.E. and D. Rai, 1987. Kinetics of chromium(III) oxidation to chromium(VI) by reaction with manganese dioxide. Environmental Science and Technology, 21, pp. 1187-1193.

[12] Nakayama, E.T., T. Kuwamoto, S. Tsurubo, and T. Fujinaga, 1981. Chemical speciation of chromium in sea water Part 2. Effects of manganese oxides and reducible organic materials on the redox processes of chromium. Analytica Chimica Acta, 130, pp. 401-404.

- The presence of dissolved manganese in the Site's water-bearing units indicates that geochemical conditions are such that any manganese dioxide present in the subsurface is reductively dissolved, thereby preventing the oxidation of Cr(III) by this mineral phase.
- The general absence of Cr(VI) within the Site water-bearing zones demonstrates that Cr(VI) is not being generated at a rate higher than that of Cr(VI) reduction.

Based on the conceptual site model and the above MLOE analyses, the natural attenuation of Cr(VI) in the subsurface is well supported and documented at the Site by site-specific data and published literature.

Slag Disturbance Increasing Leaching

The RI and risk assessments are for current Site conditions, and do not evaluate the effects of remedial actions; this is done in the FS.

As demonstrated by the leach testing, the leachability of total chromium from the slag is low. This is confirmed by the literature, such as Sahu et al., 2016[13], who noted Finland declassified ferrochromium products as waste in 2005 based on research that showed potentially-hazardous constituents in slag occur in a sparingly-soluble form and did not cause any hazard or harm to health or the environment after decades of their use. Additionally, the International Agency for Research on Cancer classifies ferrochromium slag as harmless because the chromium in slags exists as Cr(III). Owing to its technical properties and low leachability, ferrochromium slag can, therefore, be used as road construction material or as aggregate in construction (Lind et al., 2001). In southeastern Ohio, steel slag with similarity alkalinity to Site slag is used to mitigate acid rock drainage (Goetz and Riefler, 2014[14]). Seep and surface water sampling in the area of the former coal mine at the Site indicates that this mitigation of acid rock drainage is occurring at the Site.

To our knowledge, there are no peer-reviewed studies that have concluded enhanced leaching of Cr(VI) occurs during disturbance of ferrochromium slag by an excavator or similar machinery. Only dry milling of chromite ore (i.e., not ferrochromium slag) has been identified in peer-reviewed studies to enhance Cr(VI) leaching (Buekes and Guest, 2001[15]). Notably, this study also demonstrated that enhanced leaching of Cr(VI) did not occur during wet milling. In addition to this study focusing on a different material, milling imparts significantly more energy to a material thereby creating finer particles than the low-energy movement of a construction excavator. Therefore, material movement via an excavator is not anticipated to enhance leaching of Cr(VI).

Comment Group 6: Several comments concerned the classification and disposal of chromium-containing dust at the Site (August 4 letter, paragraphs 35, 37-30 = B, D-F; September 5 letter, paragraphs 33 and 40-42).

Response: The RI discusses the sources of dust, but does not otherwise classify them. The appropriate disposition of dust collected in the North Mill Building will be evaluated in the FS and occur as part of final remediation (as noted in Section 5.1 of the Interim Action Workplan approved by OEPA). If the collected dust is disposed off-site, appropriate waste characterization will be performed at that time.

The question of applicability of hazardous waste regulations to the Site has been reviewed by OEPA in detail. Additional discussion is provided in the Interim Action Workplan for the Site.

---

[13] Sahu, N., A. Biswas, and G.U. Kapure, 2016. A short review on utilization of ferrochromium slag. Mineral Processing and Extractive Metallurgy Review, Vol. 37, No. 4, pp. 211-219

[14] Goetz, E.R. and R.G. Riefler, 2014. Performance of steel slag leach beds in acid mine drainage treatment. Chemical Engineering Journal, Vol. 240, pp. 579-588.

[15] Beukes, J.P. and R.N. Guest, 2001. Cr(VI) generation during milling. Mineralogy Engineering, Vol. 14, pp. 423.

Comment Group 7: Several comments were related to interim actions at the Site (September 5 letter, paragraphs 6-13).

Response: Cyprus Amax Minerals Company addressed immediate threats as needed by interim actions. The Site has been fenced where practical, but much of the Site has steep, heavily vegetated terrain that prevents fencing. The entire perimeter of the property boundary has “no trespassing” signs. In addition, Site security is present to prevent trespassing. Slag was not removed from off-property areas during interim actions, as it was not an interim action requirement.

A number of stormwater Best Management Practices (BMPs) have been implemented at the Site as part of compliance with the Industrial General Stormwater Permit. Stormwater management will be addressed as part of final remediation, to be developed during the FS.

General and Miscellaneous Comments

July 19 letter, paragraph 6: *I talked to people that have recently done work at Satralloy and they said the owners of the property, Freeport McMoRan, has done a big report called a Remedial Investigation. Did Freeport McMoRan address these issues brought up in this Ohio EPA Technical Report?*

Response: The RI, HHRA, and ERA prepared for the Site owner (Cyprus Amax Minerals Company) and OEPA identify and address risk and remediation concerns/issues for the Site.

August 1 letter, paragraph 2: ... *Your [OEPA’s] letters to Freeport request that the RI/FSforFSS [sic] and HHRA be revised but is that happening to your satisfaction?*

Response: The draft RI is being revised to address OEPA comments. "Friends of Kolmont" comments will be considered in the revisions as appropriate.

August 4 letter, paragraphs 5-8: *This [RI pages ES-2 and 2] is the one and only time ferrochromium is mentioned in the RI/FSforFSS [sic] ... We find it curious if not a bit puzzling that in producing a document that is supposed to represent the status of a former Ferrochromium facility that operated over 24 years producing prodigious amounts of ferrochromium products and by products, this word is only mention in a historical reference and never mentioned in any technical way. Especially since the ferrochromium slag and ferrochromium dust are the two principal generators of hexavalent chromium at the Satralloy Site. The RI/FSforFSS [sic] has also clearly stated the chromium and hexavalent chromium are the two highest ranked Constituents of Potential Concern (COPC). It seems like the authors are trying to downplay what is the 800 pound gorilla in the room.*

Response: The RI addresses the COPCs due to Site operations and the materials at the Site (including but not limited to slag and dust) in extensive detail. Repeated use of the term "ferrochrome" was not found necessary. It is important not to make the commenter’s mistake of confusing byproduct (i.e., slag) with constituents (e.g., chromium) and/or products produced (ferrochrome). For risk assessment purposes, it is the constituents and not the byproduct or product that is the key consideration.

August 4 letter, paragraph 15; September 5 letter, paragraph 32: *The technical reports that Freeport and Golder Associates reference in the RI/FSforFSS [sic] on baghouse dust are written outside the USA but they stay silent on key factors like both Canada and other European and African nations environmental regulatory agencies....*

Response: Non-US regulations do not apply in the US.

ATTACHMENT B

DETAILED COMMENT RESPONSES

August 1 letter, paragraph 16: ... *We agree with the letter comments to Freeport by the Ohio EPA that the HHRA should divide the Site into smaller exposure areas based on source areas, past use, and Site geography.*

Response: The Site has been divided into more exposure areas per discussion with OEPA and the HHRA is being revised accordingly. The four Exposure Units identified in the draft HHRA are consistent with:

- USEPA, 1989. Risk Assessment Guidance for Superfund, and
- OEPA, March 2009. Technical Guidance Compendium VA30007.09.003, Difference Between Identified Areas and Exposure Units in the VAP.

These documents define an Exposure Unit as "A geographic area within which an exposed receptor may reasonably be assumed to move at random and where contact with environmental media is equally likely at all sub-areas." According to US EPA (1989), "Assumptions on appropriate exposure unit areas should be made using site-specific information on land use patterns and likely activities for receptors being evaluated."

The risk assessment should consider current and future land use, what receptors are likely to be present, and the locations where they are likely to spend most of their time. A large site may be divided into smaller Exposure Units consistent with future land use (e.g. residential lots, commercial establishments, playground) if development plans are known.

The lowlands portion of the former Satralloy Site where the remnants of the mill buildings are located is one of the few large, and relatively level tracts of land near Steubenville that could be attractive for commercial/industrial use. But in the absence of specific development plans (e.g. subdividing into parcels, types of use, placement of buildings, etc.) there is no basis for defining smaller Exposure Units where receptor activities are likely to occur and where contact with environmental media (and chemical constituents) is equally likely at all locations within the Exposure Unit.

However, in response to OEPA comments to the 2016 RIFS report, Exposure Units were re-defined. The final HHRA will evaluate human health risk and hazard based on the following exposure units:

- Upland Slag
- Upland Soil
- Lowland Slag South
- Lowland Slag North
- Plant Area
- Mill Building
- Cross Creek

September 5 letter, paragraph 6: ... *If Freeport McMoRan had any kind of off-site slag removal program why are there slag piles and clear signs of slag in large multiple locations in their next door neighbor's property; the GKL Wildlife Association (GKL)? We know Freeport McMoRan personnel or their representatives have seen the slag on GKL's property because they have been on this property multiple times collecting well water samples and driven right past the very visible slag piles. GKL has families using this property for recreational purposes; kids are playing in the slag....*

Response: No slag was removed from off-property areas during interim actions performed by Cyprus Amax Minerals Company. Slag beyond the property boundary will be addressed as part of final remediation. To the best of our knowledge, there is no slag on GKL property in an area used for recreational purposes. If the commenter has documentation to the contrary, he should provide it to OEPA.

ATTACHMENT B

DETAILED COMMENT RESPONSES

September 5 letter, paragraph 38: *Also in reading through the OhioEPA website there is a lot of information about CERCLA (Comprehensive, Environmental, Response, Compensation, and Liability Act of 1980 (aka SuperFund)). Is the OhioEPA managing the Satralloy Site per the CERCLA criteria?*

Response: Relevant USEPA CERCLA guidance is being used for investigation and remediation of the Site.