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September 18, 2017

Ms. Sherry Burt-Kested, Manager
Environment Services
Freeport-McMoRan Chino Mines Company
P.O. Box 10
Bayard, New Mexico 88023

RE: Request for Revision, Year 5 Report on pH Monitoring to Evaluate the Effect of the White Rain on the Smelter/Tailing Soil Investigation Unit (STSIU) dated April 14, 2017, Chino Administrative Order on Consent

Dear Ms. Burt-Kested:

The New Mexico Environment Department (NMED) has reviewed the above referenced report. While the report addressed many of NMED's previous concerns expressed via informal review and teleconference (11/2/2016 and 03/03/17, respectively), there are still issues that need to be addressed before NMED can consider the report Final. The public comment period closed on June 28, 2017 and concluded without any public feedback or comments.

The following comments provided to FMI-Chino Mines on 11/2/16 during the informal review process have not been addressed in the revised report.

1. Sampling imprecision due to soil heterogeneity is a complicating factor for year-to-year comparisons of soil characteristics at individual locations. The effects of soil heterogeneity, and related sampling issues, have not been appropriately considered in making conclusions from the monitoring data. Issues with sampling and analysis precision were identified in Section 3.4 of the report but were not addressed.

   - Measurement of soil pH appears more precise, relative to the range of values measured, than measurement of the other parameters monitored over time (e.g., see Figure 25a in the report).
   - Tests for trend on the "permanence monitoring" data (Table 6) for copper, pCu, net-neutralization potential (NNP), and neutralization potential ratio (NPR) are unsupported due to the poor precision of these measurements relative to the magnitude of changes over time.

8. Only one of the three study objectives, as stated in Section 1.2 of the report, was achieved.

- The data presented in the report demonstrate that post-rain soil-pH conditions remained higher, on average, than pre-white rain for a period of five years. This finding meets the first objective of the study.
- The data collected to determine whether the effect of the rain event is permanent were insufficient to meet this objective. The permanence of the pH effect has not been demonstrated.
- The third objective – to evaluate the effects of the rain event on uptake of copper by plants and insects – was addressed, but the data available for evaluation were limited. In addition, confounding factors, such as changes in mine operations over the period of observation (e.g., 1999 to 2010), make interpretation of these data difficult. As a result, the finding of reduced uptake of copper by plants and insect due to increased soil pH, following the white rain event, remains uncertain.

Based on previous comments, discussions during the March 3, 2017, conference call, and review of the April 2017 revision of the report, NMED requires that the conclusions of the study be revised before the report is considered final. The following revisions should be incorporated into Section 5 and the Executive Summary of the revised report to eliminate unsupported conclusions and more accurately present the results of the study. The text below is being provided in track changes to show requested edits to Section 5, with comments from NMED as to why the changes are necessary. Please note that NMED considers conclusions made regarding a change in acid neutralizing potential highly uncertain due to the variability of those results over time.

Conclusions and Recommendations

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

~~1. White rain increased the pH of acid soils (pH ≤ 5.5) by about 1.2 pH units (on average from 4.8 to 6.0) indicating that the active soil acidity generated by oxidation of SO2 and metal sulfides has been completely neutralized.~~

~~2.~~1. Future sources of potential acidity from smelting and windblown tailings have largely been eliminated by decommissioning the smelter and reclaiming most of the tailing ponds.

~~3.~~2. ~~Almost every~~ Typically, the acid soil (pH ≤ 5.5) whose pH increased to > 5.1 from the white rain ha~~d~~ve either positive NNP values or those that ~~which~~ me~~e~~t the MMD topsoil suitability

Commented [---1]: Conclusions made regarding a change in acid neutralizing potential are highly uncertain due to the variability of those results over time. Refer to discussion of these data in Section 3.2.2.

Commented [---2]: Change in pH has already been described above, and data do not support "complete neutralization" of active soil acidity.

requirement of "Good" for plant establishment (> -5 kg CaCO3/t). ~~, and thus present little risk of future acid generation.~~

~~4.~~3. Evaluation of soil mineralogy indicate a proportion of total sulfide occurs as copper sulfides with lower reactivity relative to pyrite. ~~and that the overall rate of acid neutralization will be greater than the rate of acid generation~~.

~~5. Natural precipitation has dilute acidity that is expected to continue decreasing over time and will not overcome the neutralization of soil pH by the white rain event.~~

~~6.~~4. White rain events of various magnitude will likely occur in the future (one occurred in eastern Washington, eastern Oregon, and parts of Idaho in February 2015). The likelihood of such future events occurring in the project area is not known however.

~~7.~~5. Natural pedogenic (soil-forming) processes will continue to function and soil pH is expected to ~~fully~~ recover to baseline levels for soils of the area (pH = 6.1 to 8.4) at some time in the future.

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

As a result of the pH increase, pCu also increased, and the increase was persistent during the study. In contrast to pH, total copper present in shallow soil is not expected to change as a result of the white rain, though other causes of natural attenuation (source reduction or source removal, clean dust deposition, and erosion) may result in decreases in soil copper concentrations over time. Current data suggest that soil copper concentrations decreased over time during the 5-year duration of this study~~, particularly between 2010 and 2011~~. This copper decrease is uncertain due to high variability of copper in the STSIU soils. The apparent decrease in total copper, in addition to increases in pH, increased pCu as well because pCu is calculated from pH and copper concentrations.

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

Commented [---3]: This is only relevant for soils with copper sulfides only. No mineralogical data were collected to confirm either the presence or absence of pyrite in soil (based on microscopic identification); therefore, conclusion regarding the anticipated rate of future acid generation are unsupported.

Commented [---4]: This study did not provide data regarding changes in acidity of natural precipitation over time.

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

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

Please submit the revised report for NMED review within thirty days of receipt of this letter. If you have any questions, please contact me at (575) 956-1550.

Sincerely,

David W Mercer

David Mercer, Chino AOC Project Manager
Mining Environmental Compliance Section
Ground Water Quality Bureau
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