September 1, 2021

Jay A. Steinberg
Nevada Environmental Response Trust
35 East Wacker Drive, Suite 690
Chicago, IL 60601

Re: **Tronox LLC (TRX) Facility**
Nevada Environmental Response Trust (Trust) Property
NDEP Facility ID #H-000539
Nevada Division of Environmental Protection (NDEP) Response to: *Unit 4 Source Area In-Situ Bioremediation Treatability Study Work Plan Addendum*

Dated: July 22, 2021

Dear Mr. Steinberg,

The NDEP has received and reviewed the Trust's above-identified Deliverable and finds that the document is acceptable with the attached comments noted for the Administrative Record.

Please contact the undersigned with any questions at wdong@ndep.nv.gov or 702-668-3929.

Sincerely,

Dong Weiquan

Weiquan Dong, P.E.
Bureau of Industrial Site Cleanup
NDEP-Las Vegas City Office

WD:cp

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William Frier, U.S. Environmental Protection Agency, Region 9

Attachment

1. **Appendix C Table C.1.** Hexavalent chromium is extremely soluble. Are the concentrations measured in the soil actually from the pore water or does it represent solid Cr^{6+}?
2. **Section 2.7.1, Page 8.** It would be helpful to comment on the ratio between Cr^{6+} and total chromium in soils. If the ISB treatment works, it will convert Cr^{6+} to Cr^{3+} and the ratio between Cr^{6+} and total chromium in soils will change. Monitoring of this changing ratio will be useful in evaluating treatment.
3. **Section 2.7.1, Page 8.** The second bullet at the bottom of this section states that Dissolved Metals were analyzed in the soil samples. Data in this same bullet is in mg/kg. Does this refer to the water extract? Please clarify. Also please clarify which of the other bullets in this section refer to the soil and which refer to the water extract.
4. **Section 2.7.3, Page 12.** Same comment as #2 above. It would be helpful to comment on the ratio between Cr^{6+} and total chromium in groundwater. If the ISB treatment works, it will convert Cr^{6+} to Cr^{3+} and the ratio between Cr^{6+} and total chromium in groundwater will change. Monitoring of this changing ratio will be useful in evaluating treatment.
5. **Section 2.7.3, Page 12.** Overall, it appears that conditions are fairly aerobic in the treatment area with nitrate and sulfate present at fairly high levels along with low levels of methane, TOC and ferrous iron. Please comment on how this will affect the demand for carbon substrate.
6. **Section 2.9.3 Summary of Results, Subsection Total Dissolved Solids**. This section states that "if the TDS concentration in groundwater extracted from U4-E-01D continued to decrease at the rate observed during the test, the TDS concentrations in the extracted groundwater could have reached 21,000 mg/L after approximately 98 days of extraction." It's important to keep in mind that the decrease in TDS concentrations could exhibit non-linear behavior over a long-enough timeframe, which is something that may need to be considered during the planning and implementation of this treatability study. The calculated the rate of decrease for TDS concentrations in the three extraction wells is quite variable, despite all of them being screened at similar depths and in similar types of soil within the UMCf-fg1. The percentage change in TDS concentrations between the end of extraction and the end of the 2-week recovery period also exhibits quite a bit of variability. Although the well with the highest extraction rate did exhibit the highest rate of decrease, some unpredictability appears to remain.
7. **Appendix E, Table 1.** Groundwater levels fell by more than 5 feet during the extraction. Please comment on whether this may pose any risk to the stability of the soil and the buildings.
8. **Section 3.3, Page 23.** The increase in biodegradation observed when the microcosms are diluted was attributed to dilution of the TDS which is toxic to bacteria at high concentrations. Please clarify if it could also be due to dilution of the Cr^{6+} which was also present at levels which may be toxic to bacteria.
9. **Section 3.3.3, Page 24-25.** The microcosms testing the effect of dilution to decrease the salinity of the microcosm are also diluting hexavalent chromium, therefore this testing does not prove that inhibition is caused by salinity alone. Please state the rationale for attributing the toxicity to salinity alone or discuss the possibility that toxicity from hexavalent chromium may be playing a role in the inhibition of biodegradation.
10. **Section 3.3.4, Page 26.** It appears that perchlorate biodegradation is the most sensitive to high salinity/chromium concentrations. This may explain the lack of perchlorate degraders found during the microbial analysis of initial samples collected from the site. These data suggest that it may be difficult to get biodegradation of perchlorate in the field. Please comment on whether treatment for perchlorate will continue after other COCs are addressed of whether an alternate strategy will be used to address residual perchlorate.
11. **Section 3.3.5, Page 28.** It should be noted that degradation by nZVI may have been by a combined abiotic/biological pathway as biological enhancements were added along with the nZVI and even in the

microcosms that did not receive a biological enhancement, the nZVI material itself was suspended in an organic material (propylene glycol). Please expand or explore this issue.

12. **Section 3.4.1, Page 29.** Please provide the hydraulic retention times for the columns in the column simulation tests.
13. **Section 3.4.5, Page 31.** For Column Simulation #5, the report states that the purpose of this test is to examine COPC reduction without bioaugmentation however the columns had already been treated with biosolids and Simulations #3 and #4 showed that once introduced, the microbial population appears to have become established in the columns therefore these columns do not represent conditions without bioaugmentation. Please expand or explore this issue.
14. **Section 3.4.6, Page 32-33**. Can the microbial populations of the columns be compared to the microbial populations of the FBR biosolids that were used to bioaugment the columns? Please clarify.
15. **Section 4.2.2, Page 37.** Based on the treatability study, solids production would be expected as salts and metals' precipitate upon contact with injected material. Has this been taken into account and is this expected to decrease flow rates and extraction rates during the Treatability Study?
16. **Section 5.1.2.1, Page 44.** Most microbial inocula used for bioaugmentation in the subsurface are typically tested and certified as being pathogen free. Please explain why or why not a pathogen screen would need to be performed for the biosolids from the FBRs?
17. **Section 5.1.2.1, Page 44.** The work plan states that nutrients, minerals, B12, biosolids and sodium bicarbonate will be blended in the carbon substrate solution "as needed". How will this need be evaluated, and how will required quantities be determined?
18. **Section 5.1.2.1, Page 44-45 / Appendix L.** The molasses doses were calculated using the stoichiometric demand from hexavalent chromium, perchlorate, chlorate, nitrate and chloroform with a 1.5X safety factor. This safety factor is very low considering the highly impacted nature of the groundwater and likelihood of the presence of competing electron acceptors. Also, oxygen was not included as an electron acceptor in the calculation of the stoichiometric demand for molasses. For these reasons, a more robust safety factor such as 5X is recommended.
19. **Section 6.1.3, Page 51.** The wells selected for the deployment of Biotraps are not shown on Figure 42. How will these wells be selected? Will they be located at different distances from injection wells?
20. **Section 3.3, Appendix H.** In the discussion of the bench scale tests, "biodegradation" of hexavalent chromium is referenced repeatedly. Hexavalent chromium does not biodegrade, it is reduced to trivalent chromium and precipitates. Please replace "biodegradation" with "reduction" as it applies to hexavalent chromium.