NEVADA DIVISION OF
ENVIRONMENTAL PROTECTION

STATE OF NEVADA
Department of Conservation & Natural Resources

Steve Sisolak, *Governor*
Bradley Crowell, *Director*
Greg Lovato, *Administrator*

March 23, 2020

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: *In-Situ Bioelectrochemical Laboratory-Scale Treatability Study Report*

Dated: February 26, 2020

Dear Mr. Steinberg,

The NDEP has received and reviewed the Trust's above-identified Deliverable and provides comments in Attachment A. A revised Deliverable should be submitted by **04/30/2020** based on the comments found in Attachment A. The Trust should additionally provide an annotated response-to-comments letter as part of the revised Deliverable. Please include the recommendation when the reversion is submitted.

Please contact the undersigned with any questions at wdong@ndep.nv.gov or 702-486-2850 x252.

Sincerely,

Dong Weiquan

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

WD:cp

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Attachment

1. Specific Comment #1 Section 1.1, Page 6. The report states that one of the objectives of the study is to provide understanding of the technology in several field applications as shown on Figure 1.1. Please comment on how the results of the study would inform a decision about the approaches shown on Figure 1.1. The simulations in the study appear to be more applicable to setup "C" in Figure 1.1 than to the other applications.
2. Specific Comment #2 Section 2.1, First Paragraph. Literature research performed in support of this study showed that heterotrophic bacteria reduced perchlorate twice as fast as autotrophic bacteria. In this study, there is some use of heterotrophic bacteria when carbon sources such as acetate are used; however, the study focuses primarily on autotrophic bacteria. What is the rationale for focusing on stimulation of this class of bacteria?
3. Specific Comment #3 Section 2.2. The equations in this section as well as Figure 2 show oxygen being generated from the hydrolysis of water as well as hydrogen. Was this oxygen added along with the hydrogen to the tests in this study and was any effect from the oxygen observed?
4. Specific Comment #4 Section 2.2, Top of Page 10. This section states that a benefit of in situ hydrogen generation is enhanced efficiency due to avoiding the growth of non-target bacteria competing for electron donor. Do the microbial analyses performed in support of this study show this?
5. Specific Comment #5 Section 3.2.1. Please provide the rationale for using a synthetic groundwater rather than using site groundwater for these tests. Would the presence of inorganic carbon that may have been reduced to acetate by the electrode have made a difference to the study? Were potential interactions with other chemical contaminants in site groundwater considered?
6. Specific Comment #6 Section 3.3.2. What was the recipe used for the synthetic water used for the electrochemical batch testing? Is the synthetic water used here same as it in the Table 3 (Synthetic groundwater recipe for initial column testing)?
7. Specific Comment #7. The high TDS water is common at the NERT project area and it is a challenge for the service life of electrodes. What are the solution for this challenge if the field application is conducted?
8. Specific Comment #8 Section 3.3.3.2. Please speculate on the nature of the gelatinous precipitate and on whether it would be likely to form if this treatment was performed in situ and what would be the effect on the groundwater if it did form.
9. Specific Comment #9 Section 3.3.3.2, Page 20. Please discuss the differences observed between the results of the electrochemical batch tests between the site groundwater and the synthetic groundwater and comment on what this might mean for an in situ application.

10. Specific Comment #10 Section 3.4.3, Figure 13. Perchlorate and chlorate show a sharp decrease from greater than baseline levels to non-detect levels between days 37 and 57. Additional data points between these days would have been interesting to see.
11. Specific Comment #11 Section 3.4.3, Figure 13. Concentrations of chlorate, perchlorate, nitrate, and nitrite are very high on day 10. Was there any issue with the analytical run on that day?
12. Specific Comment #12 Section 3.5.2. Please discuss the expected effect of electrochemical treatment on groundwater pH if applied in situ.
13. Specific Comments #13 Section 3.5.3. Please explain some inconsistence between the results from the Batch Microcosm Testing and the Column Testing.
14. Specific Comment #14, Figure 27. To what extent was the hydrogen consumed by the column vs being lost to the atmosphere?
15. Specific Comment #15, Figure 31. Why did the influent pH in the Electrochemical Treatment column jump around so much?
16. Specific Comment #16, Figure 38. The hydrogen in the water pumped into the sand tank was largely consumed within the first 6 inches of the tank. Does this imply that if water is infused with hydrogen gas and then pumped into the groundwater that the hydrogen will be gone very quickly?
17. Specific Comment #17, Section 3.6.3. This soil-sand mixture was inoculated with de-watered sludge obtained from functioning FBRs at the NERT site prior to being placed into the sand tank and the ORP ranged from -240 mV to -277 mV during the recirculation mode. This condition is enough for the perchlorate reduction without introducing hydrogen. How do you quantify the perchlorate reduction from the biodegradation only and the electrochemical degradation?
18. Specific Comment #18, Section 3.6.3. The perchlorate, chlorate and nitrate reduction mostly occurred in the first 24 inch from the influent side of the sand tank. It is unlikely that the layout for the field implementation is different from the sand tank laboratory setup. How to count for this potential difference if the field pilot test is planned?
19. Specific Comment #19, Section 3.6.3. “The microbial community appeared to become less diverse and more enriched with respect to certain microbial families with distance along the flow path”. It would be nice to see that this observation is confirmed in the field application.
20. Minor Correction Specific Comment #20 Section 3.6.3, Paragraph below Figure 41. The statement "In light of the excellent perchlorate reduction achieved at the 7-day residence time with perchlorate as the primary electron donor" should be revised to read "In light of the excellent perchlorate reduction achieved at the 7-day residence time with perchlorate as the primary electron acceptor"