NEVADA DIVISION OF
ENVIRONMENTAL PROTECTION

STATE OF NEVADA
Department of Conservation & Natural Resources
Brian Sandoval, Governor
Bradley Crowell, Director
Greg Lovato, Administrator

May 2, 2017

Jay A. Steinberg
Nevada Environmental Response Trust
35 East Wacker Drive, Suite 1550
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: *Soil Flushing Treatability Study Report, Nevada Environmental Response Trust Site Henderson, Nevada*

Dated: February 15, 2017

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 07/3/2017** 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 contact the undersigned with any questions at wdong@ndep.nv.gov or 702-486-2850 x252.

Sincerely,

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

WD:cp

EC:
James Dotchin, NDEP BISC Las Vegas
Carlton Parker, NDEP BISC Las Vegas
Allan Delorme, Ramboll Environ
Alison Fong, U.S. Environmental Protection Agency, Region 9
Andrew Barnes, Geosyntec
Andrew Steinberg, Nevada Environmental Response Trust
Anna Springsteen, Neptune & Company Inc.
Betty Kuo Brinton, MWDH2O

Brenda Pohlmann, City of Henderson
Brian Waggle, Hargis + Associates
Carol Nagai, MWDH2O
Chris Ritchie, Ramboll Environ
Chuck Elmendorf, Stauffer Management Company, LLC
Dave Share, Olin
David Johnson, Central Arizona Water Conservation District
Dave Johnson, LVVWD
Derek Amidon, Tetratech
Ebrahim Juma, Clean Water Team
Ed Modiano, de maximis, inc.
Eric Fordham, Geopentech
Dan Pastor, P.E. TretraTech
Gary Carter, Endeavour
George Crouse, Syngenta Crop Protection, Inc.
Harry Van Den Berg, AECOM
Jay Steinberg, Nevada Environmental Response Trust
Jeff Gibson, Endeavour
Jill Teraoka, MWDH2O
Joanne Otani
Joe Kelly, Montrose Chemical Corporation of CA
Joe Leedy, Clean Water Team
John Edgcomb, Edgcomb Law Group
John Pekala, Ramboll Environ
Kelly McIntosh, GEI Consultants
Kevin Fisher, LV Valley Water District
Kirk Stowers, Broadbent & Associates
Kirsten Lockhart, Neptune & Company Inc.
Kim Kuwabara, Ramboll Environ
Kurt Fehling, The Fehling Group
Kyle Gadley, Geosyntec
Kyle.Hansen, Tetratech
Lee Farris, BRC
Marcia Scully, Metropolitan Water District of Southern California
Maria Lopez, Water District of Southern California
Mark Paris, Landwell
Michael J. Bogle, Womble Carlyle Sandridge & Rice, LLP
Michael Long, Hargis + Associates
Micheline Fairbank, AG Office
Mickey Chaudhuri, Metropolitan Water District of Southern California
Nicholas Pogoncheff, PES Environmental, Inc.
Paul Black, Neptune and Company, Inc.
Paul Hackenberry, Hackenberry Associates, LLC
Patti Meeks, Neptune & Company Inc.
Peggy Roefer, CRC
Ranajit Sahu, BRC
Rick Perdomo, AG Office
Richard Pfarrer, TIMET
Rick Kellogg, BRC
Scott Bryan, Central Arizona Project
Steve Clough, Nevada Environmental Response Trust
Steven Anderson, LVVWD
Tanya O'Neill, Foley & Lardner L
Todd Tietjen, SNWA

Attachment A

1. Treatability Study Work Plan Soil Flushing Pilot Test Revision 3 states that the report will include the following:
    a. Evaluation of the effectiveness of soil flushing for reducing perchlorate mass in the vadose zone, including a comparison of the results from the high flow, reduced flow, substrate-amended and unamended test plots
    b. Assessment of perchlorate mobilization into groundwater during system operations
    c. Evaluation of the effects of the substrate-amended water in inducing biodegradation in the vadose zone and groundwater
    d. A preliminary cost-benefit analysis to determine the technology's feasibility and cost effectiveness for full-scale application

There is no any discussion about the preliminary cost-benefit analysis (#4 above) to determine the technology's feasibility and cost effectiveness for full-scale application in this report. NDEP requires that all reporting items stated in the work plan are reported in this treatability result report.

2. Executive Summary, Paragraph 3, Page 1. "The difference in mass reduction between Test Plot 2 and Test Plot 3 is likely due at least in part to in situ biodegradation occurring in Test Plot 2." There is no post-treatment field measurement on dissolved oxygen (DO), and oxidation-reduction potential (ORP) to support this conclusion. For all future field work with groundwater NDEP requests that DO and OPR measurements be obtained and presented. Section 4.3 Baseline Soil Sampling, Page 9. soil samples collected at randomly selected depth intervals were analyzed for the following:
    a. Metals, including boron, iron, manganese, and titanium (Method SW6010B); antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, molybdenum, nickel, selenium, silver, and zinc (Method 6020); and mercury (Method SW7471A);
    b. Hexavalent chromium (Method SW7199);
    c. Total organic carbon (Method SW9060);
    d. Soil pH (Method SW9045); and
    e. Soluble cations and anions (analysis of leachate), including calcium, magnesium, potassium, and sodium (Method SW6010B); chloride, sulfate, and nitrate (Method E300.0); chlorate (USEPA Method E300.1); and carbonate alkalinity (Method SM2320B).

But there is no discussion about these analytic data. NDEP requires that all laboratory analytic results are discussed in the result report. In this case, arsenic, chromium, hexavlent chromium, chlorate, nitrate, sulfate and total organic carbon require at least a brief discussion of their mobilization and biodegradaion.

3. Section 4.5.4 Microcosom Test Conclusions, Page 12 and Section 4 Results and Discussion of Appendix F UNLV Microcosm Study Report, Page 17. "The biodegradation of perchlorate over time using EOS-100 and glycerol (100 times stoichiometric ratios) as the electron donors is shown in Figure 6." The cost of electron donors is counted for most of the cost for operating GWETS, so NDEP requires that more accuate dosage of electron donors is first obtained from the microcosm study in future treatibility study. The field dosage of electon donors should be adjsuted based on the laboratory dosage of electron donors, groundwater

velocity, duration of treatibability study, and number of the injection times. Please make sure that these comments are considered in the future study.

4. Section 4.5.3 Results, page 12. The Deliverable states that "The microcosm test results show a clear increase of hardness as the experiment progressed, indicating dissolution of hardness from the soils." Hardness is a property not attributable to any single constituent. Thus, hardness is typically reported in terms of an equivalent concentration of calcium carbonate. This comment applies to Appendix F, UNLV Microcosm Study Report, page 35 (page 1285 of 1306). Please consider to use the total dissolved solids (TDS) in future report.
5. Section 4.6 Infiltration Tests, Page 13. "Infiltration rates ranged from 0.10 inches per hour (in/hr) in Test Plot 2 to 1.84 in/hr in Test Plot 1, and vary across the treatability study area by well over an order of magnitude.". These infiltration rates don't match them in Table of Apendix G GES Double-Ring Infiltrometer Test report, Page 2. Please explain why the different infiltration rates from the field measurements were used;
6. Section 6.1 Geology and Hydrogeology. Most of critical hydrogeology information here was referred to the Ramboll's work. A total of 20 soil borings (five per test plot) were drilled and sampled during the baseline sampling event. This represents a relatively high sampling density of one boring per 180 square feet, given that each test plot is 30 by 30 feet in plan dimension. NDEP expects much more detail geology and hydrogeology information from these soil borings. For example, why are the infiltration rates of the 4 plots so much different within about 200 ft of the distance? Do the maximum infiltration rates (for Test Plot 2 and Test Plot 3) correspond to expected values based on soil types (silty sands)?
7. Section 6.2 Baseline Soil Sampling, Page 17. "These data indicate that the hexavalent chromium mass in soil in the treatability study area was relatively small and not of concern with respect to impacting the GWETS or retarding the rate of in-situ biodegradation." This lumped conclusion about hexavalent chromium is not consistent with one in Appendix D. NDEP suggests more detail discussions about both chromium and hexavalent chromium of soil, pore water and groundwater of the 4 plots;
8. Section 6.2 Baseline Soil Sampling, page 17 and Appendix B Field Data Sheets. The Deliverable states that "In the Treatability Study Work Plan, hexavalent chromium in the vadose zone was identified as a potential concern because hexavalent chromium compounds are water soluble and could potentially be mobilized during the treatability study." Test Plots 1 and 2 had carbon substrate added to the infiltration system and Test Plots 3 and 4 received stabilized Lake Mead water. There is no discussion of the redox environment as evidenced on the Sampling Logs that recorded low ORP values of 100± mV and coupled with low DO values. NDEP requests consideration of potential for mobilization of other multivalent metals that occur at the BMI Industrial Complex, e.g., arsenic, manganese, and molybdenum.
9. Section 6.3 Water Application Rates, Page 18. The infiltration rate of Plot 2 and Plot 3 from Appendix G is 0.3 inch/h and 1.61 in/h, respectively, instead of 0.1 in/h and 1.2 in/h used as comparison here. NDEP requires a clarification for using different infiltration rates from Appendix G--GES Double-Ring Infiltrttaion Test Repport.
10. Section 6.5 Pore Water Sampling. Provide calculations to support the statement that application of 5 to 10 pore volumes may be enough to achieve up to 98% mass reduction. NDEP would like to see the mass reductions in terms of dimensional time (e.g., days, weeks, months) as well as dimensionless time (i.e., pore volumes).
11. Table 3 Water application Data. The pore volume calculation assumes 30% porosity. The infiltration rates from the field double-ring infiltartion test confirm big difference among 4

plots, this assumption is invalid. As a result, the number of pore volume in this table is not correct too. NDEP requires re-calculating the number of pore volume using the plot specific data.

12. The time duration of Figure 7 (Flushing Volume Vs. Time Plots) and Figure 9 (Pore Water Perchlorate vs. Time Plots) is different. NDEP suggests that Figures 7, 8 and 9 plots use same time duration.
13. Table 3 (Water application Data) shows that the total water volume used for flushing Plot 3 is 2,357,148 gallons but Figure 3 shows that the perchlorate concentration of Plot 3 reached less than 10 microgram/l in 50 days and close to zero in about 75 days. Figure 7 shows that Plot 3 was flushed about 150 days, which means that about half water applied to Plot 3 is unnecessary. There was less water used for flushing Plot 2 and the electron donor was added 2.5 weeks before terminating flushing. There was almost no change of the perchlorate concentration of Plot 2 pore water during last 2.5 weeks in Table 5 (Summary of Analytical Results: Pore Water Samples), which means that most mass change from Plot 2 was caused by the flushing. In that is case, the conclusion of "The difference in mass reduction between Test Plot 2 and Test Plot 3 is likely due at least in part to in situ biodegradation occurring in Test Plot 2." made in the excutive summary may not be correct. NDEP requires more detail analysis of all data including soil physical property, particle size, dye movement and groundwater elevation data collected from this soil flushing treatiblity study and re-calculate more accuate number of total porosity, effective porosity, perchlorate baseline mass and pore volume water that is needed to flush 90% of the flushable perchlorate mass from vadose zone and re-assess the proportional contribution of biodegaradtaion to the total mass change in the vadose zone cuased by the soil flsuhing and the biodegradation.
14. Figure 10. The figure is Pore Water TDS vs. Time Plots; however, two of the plots are labeled Perchlorate. Please correct the labels.
15. Appendix A Boring Logs. There is no discussion in the text with regards to the PID readings and potential for impact, if any. Please add some discussion on the PID readings.
16. Appendix B Field Data Sheets. Field data sheet for well TT-TP4-M3 indicates pump depth as "27?" and noted that the pump is dedicated. Review of MW construction diagrams do not indicate status of dedicated pumps. Additionally, the report tables do not present construction well detail summary. Where is the information for the depth of the dedicated pumps? It should be noted that subsequent field data sheets indicate pump is set at 30. Please clarify in the reversion.
17. Appendix F UNLV Microcosm Study Report, Section 5.0 Conclusions and Recommendations. This section provides conclusions but makes no specific recommendations. Please clarify in the reversion.
18. Appendix F UNLV Microcosm Study Report. It appears that the field duplicate samples for hexavalent chromium (Test America) and the soil samples associated with UNLV's microcosm study were reported on a dry weight basis. Were pre- and post-flushing perchlorate concentrations in soil reported by Test America on a dry or wet weight basis? Please clarify in the reversion.
19. Editorial Corrections. Section 3.3 Pore Water Sampling, first paragraph, last sentence the sentence states, "...and stored in an ice chest cooled with water ice pending shipment to the ..." Should the statement read "ice water"? Section 4.7.3 Reduced-Flow Test Plots, third sentence: There is an apparent typographic error in the statement "...spaced 18-inches apart were attached to either side of the manifold."