

From: Deni Chambers, Principal
Mark Gage, P.E.

Date: May 27, 2010

To: Shannon Harbour
Nevada Division of Environmental Protection (NDEP)

RE: Response to April 16, 2010 Nevada Division of Environmental Protection
Comments on *Work Plan to Evaluate In-Situ Soil Flushing of Perchlorate-Impacted Soil*, dated March 29, 2010

1. *Section 1, page 1, footnote, TRX should consider how the effectiveness of the field pilot test will be evaluated if caliche is encountered in any of the monitor wells because caliche is present under much of the Site. Additionally, please clarify how soil heterogeneities will be evaluated in terms of the effectiveness of perchlorate flushing.*

Response: Soil heterogeneities, including discontinuous caliche layers, are present at the Site. Based on the groundwater monitoring results at the Site, the caliche does not appear to have significantly impeded the downward migration of perchlorate to the saturated alluvial sediments. Thus, it is unlikely that the caliche will significantly impede the use of soil flushing to remediate vadose soils at the Site. However, it is possible that soil heterogeneities and caliche deposits may reduce the effectiveness of perchlorate flushing in localized areas of the Site.

As discussed in Section 3.2 of the work plan, the final selection of the pilot study area will require additional soil sampling. Four borings are going to be advanced within the proposed pilot test area and sampled to confirm that the location contains perchlorate concentrations within the desired range and over the depth intervals desired for the pilot test. We will also be logging these soil borings, and will create cross sections to evaluate the continuity and distribution of low permeability zones, if any, within the proposed pilot test area.

If caliche lenses are identified within the vadose zone of the proposed pilot test area, we will endeavor to install a pair of leachate collection points above and below the caliche deposit. Comparing the change in perchlorate concentrations in soil and leachate volumes produced from a pair of sampling points above and below a caliche lens will provide information about the potential impact of the lens on soil flushing effectiveness.

If the pilot test results indicate that the presence of caliche significantly impacts the use of soil flushing, we will map caliche deposits over regions of the Site with elevated perchlorate concentrations in soil, based on an examination of existing boring logs. We intend to use this information to identify portions of the Site that may be less favorable to remediation by soil flushing.

2. *Section 2, page 2, 1st bullet, Section 3.1, page 4, top of page, and Table 1, NDEP is concerned with the methodology described for the column tests. Column leaching*



studies are typically run by applying input solution at a constant and continuous rate, and sampling the effluent as a function of time. When conducted in this way the solute concentration can be plotted versus time or cumulative effluent volume. The introduction of the “step” in application of input solution described in the TRX methodology will result in a test that does not yield optimum results. If TRX is interested in running a percolation test of 150% of the average annual rainfall, then additional columns should be prepared for this purpose. Additionally, please provide what quantitative data are expected from the percolation test. Please revise the Work Plan as necessary.

Response: Per this comment, we have updated the Work Plan to add one additional soil column to the testing program. This column will be dedicated to measuring the percolation rate and assessing the retention capacity of water applied in one 6-inch application. A description of the quantitative data expected from the percolation test is included in Section 3.1 of the revised Work Plan.

The Work Plan has also been revised to delete the initial percolation test condition from the three soil columns that will be tested via continuous application. As described in the Work Plan, these columns will be tested with a constant and continuous application of water.

3. *Section 3.1, page 3, please submit the qualifications of the laboratory, specific to conducting the column leaching tests.*

Response: The qualifications of Prima Environmental of El Dorado Hills, CA are included as Appendix A to the revised Work Plan.

4. *Section 3.2, p 5, 2nd paragraph, 2nd sentence, TRX states that “This area was selected because: (1) it is near the interceptor well field, and therefore hydraulic control of the demonstration area will be maintained...” Please revise this sentence to include “to the degree afforded by the Interceptor Well Field” after the word “maintained”.*

Response: The Work Plan has been revised to include this wording.

5. *Section 3.2, page 5, 4th paragraph, TRX should consider the use of drip lines for the delivery of water to the pilot area. The application rate could be more closely controlled, evaporation would be less of a factor in the analysis, and would likely cost less.*

Response: We will revisit this suggestion prior to the conduct of the pilot test and submit our proposed pilot test design to NDEP for their review along with the results from the Column Tests. The decision of how to apply the flushing water depends to some degree on how much water we may have to deliver to the percolation area, which will be finalized after reviewing data from the Column Tests.

6. *Section 3.2, page 5, 5th paragraph, NDEP has the following comments:*

- a. *Please provide the rationale for the location of each of the four well clusters.*

Response: The four proposed well clusters were located to provide accessibility to the sampling points while the area is being actively used for water recharge. After consideration of your comment and further discussion about the likely condition of the percolation area, we have modified the locations as shown on the revised Figure 4.

- b. *Because the objectives and rationale for depth locations of the well clusters are unclear, NDEP is providing the following comments as guidance for TRX consideration and response:*



Response: The purpose of the well clusters is to collect samples of water as it percolates through the vadose zone. We believe that this will provide direct evidence of the mobilization of chemicals by flushing. Impacts in the groundwater may be masked by the migration of affected groundwater already in the saturated zone. Perchlorate concentrations in the leachate may be higher or lower than that currently in groundwater, which may make quantification of perchlorate leaching rates difficult if this were to be based only on samples taken from the saturated zone.

- i. *TRX states that “Each leachate collection well cluster will provide the ability to collect water samples from three discrete depth intervals.” Please specify the proposed depth for each well in the clusters and provide a cross-sectional diagram for test area showing soil section, well depth and construction, and the water table.*

Response: Additional details of the proposed leachate collection wells are presented in the revised Figure 4 of the work plan. We have preliminarily specified depths of 5’, 15’ and 25’ below ground surface for our leachate collection intervals, though these depths may be modified based on results of borings to be advanced within the area proposed for the pilot scale test as discussed in our response to NDEP comment number 1 and the results of the Column Tests. In addition, we will monitor groundwater in the saturated zone both upgradient and downgradient of the proposed pilot test area. We will use existing monitoring wells if possible for this purpose, though new wells may have to be installed depending on the final location of the pilot test area.

- ii. *TRX should note that for the duration of the field pilot test, water in the unsaturated zone may be under tension within the pore space. If these wells are planned for completion above the water table, they may not collect sufficient water to sample, if any at all. In the latter case lysimeters may be required to collect samples.*

Response: We agree that active collection of water in the unsaturated zone may be required to gather sufficient volumes of leachate for analysis. Note that in the leachate collection well design presented in Figure 4, we are prepared to apply vacuum to the collection points if required.

- iii. *If the goal for the intermediate wells is to determine saturation or wetting front movement, then TRX should consider neutron logging within a boring constructed for this purpose.*

Response: We agree that a neutron probe could help map the movement of the wetting front in the soil flushing area. However, this is not a primary objective of the program. We believe that we will gather adequate information on the progression of the wetting front by monitoring the volume and quality of water collected at the network of leachate collection points.

7. *Figure 3, please post perchlorate concentrations from the most recent groundwater monitoring event for wells surrounding the pilot test location.*

Response: The Work Plan has been revised accordingly.

8. *Figure 4, NDEP requests a well located mid-way between LC1 and LC2 and about 20 feet downgradient of the test plot. Please note that the location for this well may need to be adjusted based on interpretation of the revised Figure 3.*



Response: The original work plan showed three groundwater monitoring wells that would be used to monitor groundwater impacts of the pilot scale demonstration: two downgradient of the percolation area, and one upgradient. We believe that NDEP's request has already been satisfied through this proposed groundwater monitoring well network, though we will revisit this with NDEP when we present our final design for the pilot scale demonstration.

9. *Table 2, please include the physical parameter measurement per the NDEP's March 11, 2010 Soil Physical and Chemical Property Measurement and Calculation Guidance.*

Response: Table 2 of the Work Plan has been revised according to this guidance.

10. *Table 3, please include ORP and DO to the field parameters.*

Response: The Work Plan has been revised to include ORP and DO field measurements during the Pilot Test.

