

# TECHNICAL MEMORANDUM

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**To:** Nevada Environmental Response Trust

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**Cc:** Nevada Division of Environmental Protection  
United States Environmental Protection Agency

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**From:** Katie Hendrickson

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**Date:** June 15, 2021

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**Subject:** Hydrogen-Based Gas Permeable Membrane Pilot Study Monthly Progress Report

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At the direction of the Nevada Environmental Response Trust (NERT or Trust), Tetra Tech, Inc. (Tetra Tech) has prepared this memorandum that summarizes Tetra Tech's progress made during April 2021 toward successfully implementing the Hydrogen-Based Gas Permeable Membrane Pilot Study.

## Task Progress Update: April 2021

### Task M26 – Hydrogen-Based Gas Permeable Membrane Pilot Study

- Current Status
  - Test Scenario 2, which uses a blend of water from the AWF and IWF after chromium pre-treatment, began on February 17, 2021 and continued through April 2021. The system was operated in steady state at 0.75 gallons per minute from March 4, 2021 to April 15, 2021. Consistent with the technical status update call with NDEP on April 15, 2021, and beginning on the same day, additional testing was performed to evaluate the upper limits of treatment capacity of the pilot unit including the post reactor. The additional testing phase is still in progress and will be discussed in future reporting.
  - Operational samples from March 4, 2021 to April 15, 2021 show the perchlorate concentrations from the lag membrane reactor were below the detection limit (<5 ppb) as shown on Figure 1. Influent perchlorate concentrations during this period ranged from 67,100 ppb to 111,000 ppb indicating over 99.99% removal of perchlorate.
  - Steady state performance samples were collected multiple times in March 2021 and on April 2, 2021 and April 12, 2021. The available results are shown on the attached table. Some key observations from the performance samples collected in April include:
    - Influent perchlorate concentrations ranged from 83,200 ppb to 89,900 ppb.
    - Perchlorate concentrations for samples from the lag membrane reactor on April 2, 2021 and April 12, 2021 were 11.9 ppb and 14.7 ppb, respectively.
    - Perchlorate concentrations for samples from the post reactor tank effluent were below the detection limit (<0.3 ppb).

- Chlorate and nitrate concentrations for samples from the lag membrane reactor and post reactor column were below detection limits.
- Schedule and Progress Updates
  - Scenario 2 is anticipated to run for up to 12 weeks – currently anticipated to end in early May. Scenario 3 will commence upon completion of Scenario 2 as agreed upon during the April 15, 2021 call with NDEP.
- Health and Safety
  - There were no health and safety incidents related to Task M26 during April 2021. Safety measures continue to be implemented to minimize potential exposure to COVID-19, including the use of face coverings, gloves, and hand sanitizer, as well as protocols for monitoring temperatures, minimizing the number of people on site at one time, and evaluating tasks to increase physical distance between personnel.

## CERTIFICATION

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### Hydrogen-Based Gas Permeable Membrane Pilot Study Monthly Progress Report

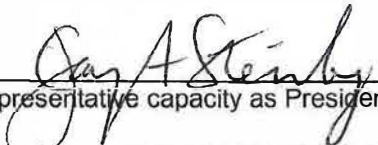
**Nevada Environmental Response Trust Site  
(Former Tronox LLC Site)  
Henderson, Nevada**

**Nevada Environmental Response Trust (NERT) Representative Certification**

I certify that this document and all attachments submitted to the Division were prepared at the request of, or under the direction or supervision of NERT. Based on my own involvement and/or my inquiry of the person or persons who manage the systems(s) or those directly responsible for gathering the information or preparing the document, or the immediate supervisor of such person(s), the information submitted and provided herein is, to the best of my knowledge and belief, true, accurate, and complete in all material respects.

Office of the Nevada Environmental Response Trust

Le Petomane XXVII, not individually, but solely in its representative capacity as the Nevada Environmental Response Trust Trustee

**Signature:**  **Not Individually, but Solely as President of the Trustee**, not individually, but solely in his representative capacity as President of the Nevada Environmental Response Trust Trustee

**Name:** Jay A. Steinberg, not individually, but solely in his representative capacity as President of the Nevada Environmental Response Trust Trustee

**Title:** Solely as President and not individually

**Company:** Le Petomane XXVII, Inc., not individually, but solely in its representative capacity as the Nevada Environmental Response Trust Trustee

**Date:** 6/15/21

## CERTIFICATION

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I hereby certify that I am responsible for the services described in this document and for the preparation of this document. The services described in this document have been prepared in a manner consistent with the current standards of the profession, and to the best of my knowledge, comply with all applicable federal, state, and local statutes, regulations, and ordinances. I hereby certify that all laboratory analytical data was generated by a laboratory certified by the NDEP for each constituent and media presented herein.

**Description of Services Provided:** Prepared Hydrogen-Based Gas Permeable Pilot Study Monthly Progress Report.



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**David S. Wilson, CEM**  
Field Operations Manager/Geologist  
Tetra Tech, Inc.

June 15, 2021

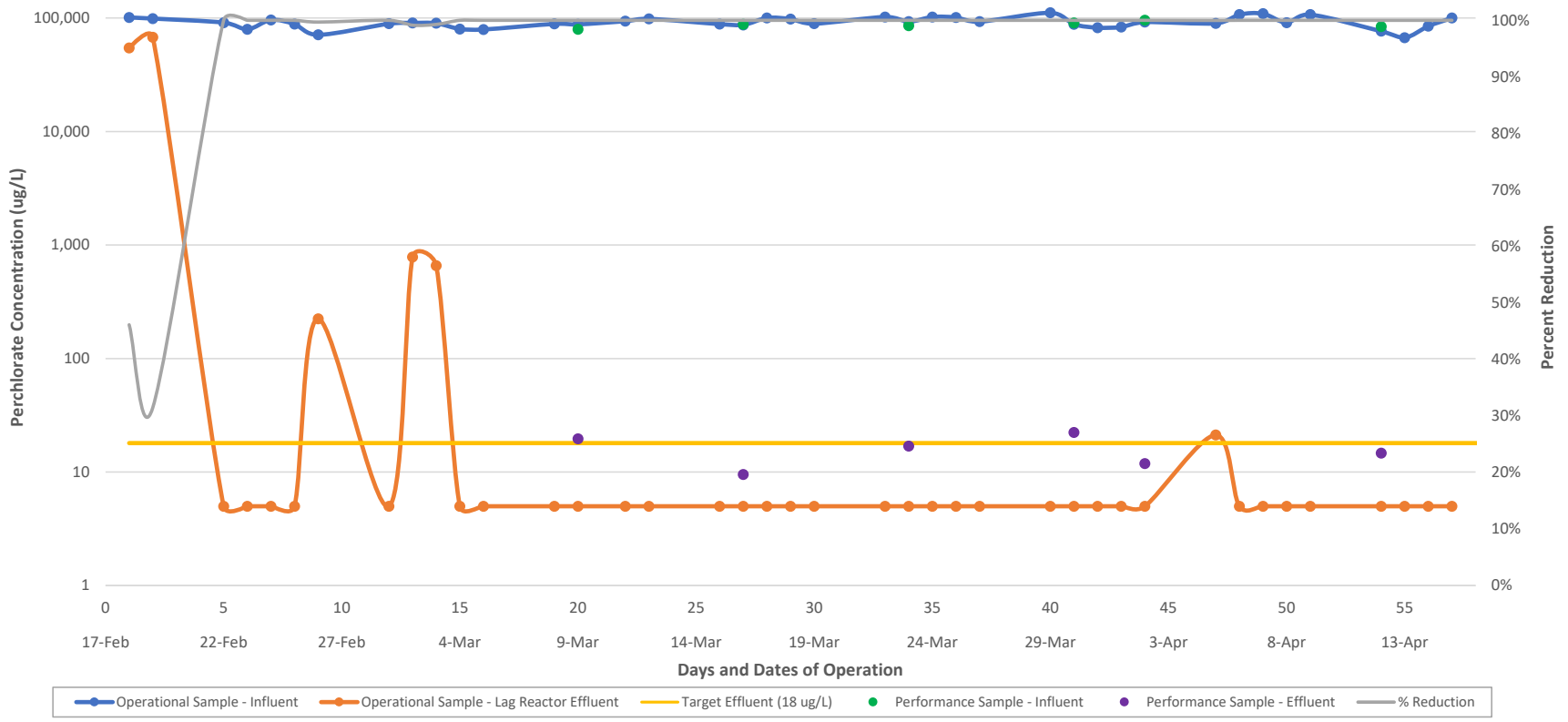
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Date

Nevada CEM Certificate Number: 2385  
Nevada CEM Expiration Date: September 19, 2022

## Figures

**Figure 1. Scenario 2 Acclimation and Steady State Phase - Perchlorate Concentrations and % Reduction**



## Tables

Table 1  
Scenario 1B Performance Monitoring Data  
Hydrogen-Gas Based Permeable Membrane Pilot Study

Date	Influent Water										
	Flow gpm	T °C	pH s.u.	Perchlorate ppb	Chlorate ppb	Sulfate ppm	Nitrate -N ppm	Total Cr <sup>1</sup> ppb	Cr VI <sup>1</sup> ppb	TDS ppm	TSS ppm
3/9/2021	0.75	20.5	7.72	79,400	173,000	1,930	10	NA	NA	7,180	<2.5
3/16/2021	0.75	20.7	7.51	88,100	163,000	1,860	9.36 J	NA	NA	7,200 J-	<2.5
3/23/2021	0.75	20.3	7.92	85,600	178,000	1,800	9.43	NA	NA	7,600	<2.78
3/30/2021	0.75	21.3	7.45	90,400	179,000	1,880	9.0	NA	NA	7,140	<2.5
4/2/2021	0.75	22.8	7.39	95,700	191,000	1,840	9.3	NA	NA	NA	<2.5
4/12/2021	0.75	23.3	7.85	83,900	181,000	2,160	10.3	NA	NA	6,820	<2.5

Date	Biological Reactors																												
	Perchlorate (ppb)			Chlorate (ppb)			Nitrate (ppm)			Sulfate (ppm)			Total Cr (ppb) <sup>1</sup>	Cr VI (ppb) <sup>1</sup>	TSS (ppm)			pH			T (°F)			ORP			Pressure (psig)		
	Lead	Middle	Lag	Lead	Middle	Lag	Lead	Middle	Lag	Lead	Middle	Lag	Lag	Lag	Lead	Middle	Lag	Lead	Middle	Lag	Lead	Middle	Lag	Lead	Middle	Lag	Lead	Middle	Lag
3/9/2021	79,200	1,750	19.6 J+	59,500	816	<24	<0.240	<0.240	<0.240	1,950	1,930	1,920	NA	NA	<2.5	<2.5	<2.5	7.45	7.53	7.45	73.6	75.9	78.0	11	-252	-441	10.6	5.3	9.2
3/16/2021	73,800	885	9.51	50,100	164	<24	0.79	<0.240	<0.240	1,900	1,820	1,750	NA	NA	<2.5	3.1	3.7	7.19	7.25	7.33	71.8	72.3	74.1	265	-233	-391	9.9	6.6	10.2
3/23/2021	80,800	661	16.9	51,900	<24	<24	<0.480	<0.480	<0.480	1,880	1,500	1,480	NA	NA	<2.8	4.04	3.8	7.37	7.31	7.39	74.1	78.2	81.3	54	-324	-358	9.5	7.1	10.2
3/30/2021	96,800	1,630	22.6	78,700	581	<24	1.21	<0.480	<0.480	1,780	1,870	1,750	NA	NA	2.86	2.63	3.6	7.21	6.83	7.35	79.3	83.8	84.9	388	-327	-358	9.6	8.3	9.9
4/2/2021	83,200	553	11.9	91,700	<24	<24	0.696 J	<0.480	<0.480	1,850	1,910	1,840	NA	NA	<2.5	10.6	5.3	7.25	6.73	7.33	75.6	81.3	83.1	378	-333	-378	10.1	10.0	10.3
4/12/2021	89,900	1,430	14.7	83,200	495	<24	1.22	<0.048	<0.048	2,170	2,190	2,130	NA	NA	<2.5	8.13	8.0	7.19	6.77	7.33	83.5	87.1	87.6	438	-360	-350	10.7	13.0	9.6

Date	Post Reactor Tank Effluent									
	Perchlorate ppb	Chlorate ppb	Nitrate - N ppm	Sulfate ppm	Total Cr <sup>1</sup> ppb	Cr VI <sup>1</sup> ppb	TDS ppm	TSS ppm	pH s.u.	T °C
3/9/2021	<0.3	<240	<0.048	1,910	NA	NA	7,340	<2.5	7.53	22.6
3/16/2021	<0.3	<24	<0.048	1,810	NA	NA	7,080	6.5	7.38	20.1
3/23/2021	1.39 J	<24	<0.48	1,760	NA	NA	7,370	4.49	7.56	24.0
3/30/2021	<0.3	<24	<0.48	1,810	NA	NA	7,080	<2.5	7.31	25.1
4/2/2021	<0.3	<24	<0.48	1,850	NA	NA	NA	<2.5	7.30	25.6
4/12/2021	<0.3 J	<24	<0.048	2,180	NA	NA	NA	3.1	7.33	29.6

<sup>1</sup> The chromium analysis will only be performed during Scenario #3.

NA = Not analyzed.

J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

J+ = The result is an estimated quantity, but the result may be biased high.

Reported TSS results from Biological Reactor Lag are time-based composite samples.