

TECHNICAL MEMORANDUM

To: Nevada Environmental Response Trust

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

From: Katie Hendrickson

Date: June 30, 2021

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

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 May 2021 toward successfully implementing the Hydrogen-Based Gas Permeable Membrane Pilot Study.

Task Progress Update: May 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. The system was operated in steady state at 0.75 gallons per minute from March 4, 2021 to April 15, 2021. Additional testing under Scenario 2 was performed to evaluate the upper limits of treatment capacity of the pilot unit from April 16, 2021 through May 12, 2021. As previously discussed, and per the approved Work Plan, additional evaluation under Scenario 2 to find the maximum treatment capacity of the pilot unit by incrementally increasing the flow rate and adjusting the operational parameters as needed. As shown on Table 1, the perchlorate concentrations in the lag reactor effluent varied during this phase of Scenario 2 and often exceed 18 ppb at different times during the testing. This was expected and an important part of testing the system and data collection efforts will help identify the optimal operational parameters. Following the additional testing phase, the system was cleaned.
 - Operational and performance samples were collected for select analyses during the Scenario 2 additional testing phase and results are presented on Tables 1 and 2. These data show the system was capable of reducing a total contaminant mass load of approximately 7.6 to 9 pounds per day; however, the stability and sustainability of operating at that mass loading was not assessed due to the limited time available to continue with the higher mass loading tests before the system had to be cleaned prior to transitioning to Scenario 3.
 - Acclimation for Test Scenario 3, which uses a blend of water from the AWF and IWF prior to chromium pre-treatment, began on May 18, 2021 and is in progress. Once the system reaches steady state, performance samples will be collected.

- Schedule and Progress Updates
 - Scenario 3 is anticipated to run for up to 12 weeks. Decommissioning of the pilot system is planned for immediately after Scenario 3.
- Health and Safety
 - There were no health and safety incidents related to Task M26 during May 2021.

CERTIFICATION

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

Not Individually, but Solely
as President of the 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

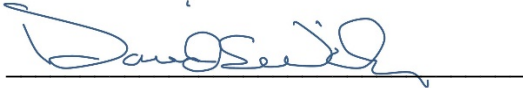
Company: Le Petomane XXVII, Inc., not individually, but solely in its representative capacity as the Nevada Environmental Response Trust Trustee

Date: 6/30/21

CERTIFICATION

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.



David S. Wilson, CEM
Principal Engineer
Tetra Tech, Inc.

June 30, 2021

Date

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

Tables

Table 1
Scenario 2 Additional Testing - Operational Data
 Hydrogen-Gas Based Permeable Membrane Pilot Study

Date	Flow Rate (gpm)	Influent Water			Lag Reactor	Post Reactor Column	Total Contaminant Mass Loading (lbs/day)	Total Contaminant Concentration (ppb)
		Perchlorate (ppb)	Chlorate (ppb)	Nitrate (ppm) ¹	Perchlorate (ppb)	Perchlorate (ppb)		
4/15/2021	0.75	100,000	180,000	10.6	<5.0	<5.0	2.6	290,600
4/16/2021	1.75	97,600	180,000	10.6¹	465	<5.0	6.1	288,210
4/19/2021	1.75	90,000	210,000	10.6¹	563	<5.0	6.5	310,610
4/20/2021	1.7	88,000	210,000	10.6¹	280	<5.0	6.3	308,610
4/21/2021	2.5	103,000	210,000	10.6 ¹	22,200	19,800	9.7	323,610
4/22/2021	2.5	102,000	227,000	12.0	7,610	5,820	10.2	341,000
4/23/2021	2.5	100,000	225,000	12.2	1,520	337	10.1	337,200
4/26/2021	1.25	140,000	387,000	12.4	1,330	1,530	8.1	539,400
4/27/2021	1.25	171,000	431,000	12.4 ¹	2,530	179	9.2	614,410
4/28/2021	1.25	168,000	430,000	12.4 ¹	1,750	319	9.2	610,410
4/30/2021	1.25	165,000	390,000	12.4 ¹	179	65	8.5	567,410
5/3/2021	1.25	143,000	341,000	14.9	335	116	7.5	498,900
5/4/2021	1.25	152,000	338,000	14.9¹	<5.0	<5.0	7.6	504,910
5/5/2021	1.25	150,000	328,000	13.6	96	<5.0	7.4	491,600
5/6/2021	2.0	154,000	348,000	13.6 ¹	1,690	139	12.4	515,610
5/7/2021	2.0	154,000	362,000	13.6 ¹	2,670	609	12.7	529,610
5/10/2021	2.0	168,000	426,000	17.6	35,500	30,100	14.7	611,600

Bold indicates results where perchlorate concentrations were less than 18 ppb in the post reactor column.

Bold and highlighted indicates results where perchlorate concentrations were less than 18 ppb in the lag membrane reactor.

¹ Nitrate analysis was not performed at the same frequency as the perchlorate and chlorate analysis so nitrate data from previous samples are presented as estimates.

Table 2
Scenario 2 Additional Testing - Performance Data
 Hydrogen-Gas Based Permeable Membrane Pilot Study

Date	Flow Rate (gpm)	Influent Water			Lag Reactor	Post Reactor Column	Total Contaminant Mass Loading (lbs/day)	Total Contaminant Concentration (ppb)
		Perchlorate (ppb)	Chlorate (ppb)	Nitrate (ppm)	Perchlorate (ppb)	Perchlorate (ppb)		
4/23/2021	2.5	105,000	197,000	11.9	1,990	346	9.4	313,900
4/26/2021	1.25	158,000	373,000	15.1	754	103	8.2	546,100
4/30/2021	1.25	173,000	411,000	17.0	<6.0	<6.0	9.0	601,000
5/4/2021	1.25	165,000	372,000	13.5	1.62	<0.3	8.3	550,500

Bold and highlighted indicates results where perchlorate concentrations were less than 18 pbb in the lag membrane reactor.