

TECHNICAL MEMORANDUM

To: Nevada Environmental Response Trust

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

From: Arul Ayyaswami and Dan Pastor

Date: January 28, 2019

Subject: Unit 4 Source Area In-Situ Bioremediation Treatability 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 December 2018 toward successfully implementing the Unit 4 Source Area In-Situ Bioremediation Treatability Study. The location of the treatability study is depicted on Figure 1 and the well locations are depicted on Figure 2.

Task Progress Update: December 2018

Task M21 – Unit 4 Source Area In-situ Bioremediation (ISB) Treatability Study

- Task Leader – Arul Ayyaswami
- Current Status
 - The University of Nevada – Las Vegas (UNLV) continued microcosm testing with a combination of molasses, molasses with acetate, mixed microbial cultures, and soil and groundwater collected from boring and well locations near the Unit 4 Building. Hexavalent chromium concentrations reduced from 38 milligrams per liter (mg/L) to 0.6 mg/L within 15 days and to less than 0.1 mg/L within 35 days in microcosms containing molasses and TDS concentrations as high as 21,000 mg/L. Hexavalent chromium concentrations also reduced in microcosms containing molasses and acetate, but at a slower rate than molasses alone. Nitrate concentrations reduced from 100 mg/L to less than 0.1 mg/L within 49 days in all the microcosms, with only slightly slower degradation rates observed with microcosms containing higher TDS concentrations. Chlorate degradation started to occur in several of the microcosms and has completely degraded in one set of microcosms within 42 days. Perchlorate degradation has not yet been observed. Additional sampling will be conducted as microcosm testing continues, and the results will be summarized in future progress reports.
 - The initial columns packed with soil from boring locations near the Unit 4 Building did not produce the sufficient water flowrate to perform column testing. UNLV constructed five smaller columns packed with varying percentages of soil and sand to evaluate which mixture will achieve the

- desired flowrate that simulates site conditions. Four larger columns will then be constructed and packed with the determined mixture of soil and sand for testing.
- The extended groundwater extraction test started on December 5, 2018, as outlined in the NDEP-approved Treatability / Pilot Study Modification No. 4 for the Unit 4 Source Area In-Situ Bioremediation Treatability Study Work Plan. The December 2018 groundwater extraction rate for U4-E-01I was approximately 2.9 gallons per minute (gpm) and the December 2018 groundwater extraction rate for U4-E-05D was approximately 1.3 gpm. Samples were collected from the two groundwater extraction wells (U4-E-01I and U4-E-05D) and five observation wells (U4-E-01D, U4-E-02I, U4-E-04D, U4-IS-MW-02I, and U4-IS-MW-02D), in accordance with the performance monitoring sampling protocol provided in Treatability / Pilot Study Modification No. 4., to evaluate the change in groundwater concentrations over time. The analytical results are provided in Table 1. Total Dissolved Solids (TDS) concentrations at U4-E-01I significantly reduced from 31,000 mg/L at Day 0 to 5,000 mg/L at Day 1 and has generally remained steady around 5,000 mg/L through Day 21. This decrease in TDS concentrations at U4-E-01I was more rapid than expected, but confirms that groundwater extraction can lower TDS concentrations in the intermediate zone to levels at which bioremediation has been successful in the bench-scale testing. TDS concentrations at U4-E-05D have generally remained steady around 40,000 mg/L for 12 days and then decreased in concentration to 34,000 mg/L on Day 21. While the TDS concentrations at U4-E-05D did not decrease as rapidly as at U4-E-01I, the decreasing trend is a promising result that groundwater extraction can lower TDS concentrations in the deep zone to levels at which bioremediation has been successful in the bench-scale testing. Water elevations are being recorded at the extraction wells and nearby observation wells throughout the test using pressure transducers and water level indicators. The data collected will be used to calibrate the groundwater model for the Unit 4 Source Area.
- Schedule and Progress Updates
 - The following activities are scheduled to be conducted in January 2019:
 - Continued UNLV microcosm and column testing in accordance with the Unit 4 Source Area In-Situ Bioremediation Treatability Study Bench-Scale Work Plan and Treatability Study Modification No. 1.
 - Continued operation of the groundwater extraction test as part of the NDEP-approved Treatability / Pilot Study Modification No. 4. Since TDS concentrations at U4-E-01I have declined to less than 20,000 mg/L, Tetra Tech will confer with the Trust on whether to continue the extended groundwater extraction test at U4-E-01I or transfer the extraction pump to U4-E-01D to evaluate TDS concentration decline at this well (as specified in the NDEP-approved Treatability / Pilot Study Modification No. 4). The groundwater extraction rate for U4-E-05D will be increased to observe the changes in TDS concentrations near the maximum groundwater extraction rate.
 - Preparation of the Unit 4 Source Area In-Situ Bioremediation Treatability Study Work Plan Addendum that is currently anticipated to be submitted in the Second Quarter of 2019.
 - Health and Safety
 - There were no health and safety incidents related to Task M21 during December 2018.

CERTIFICATION

Unit 4 Source Area Bioremediation Treatability 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, *not indiv. dually but solely as Pres Trust*, 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: 1/28/19

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 Unit 4 Source Area Bioremediation Treatability Study Monthly Progress Report, Nevada Environmental Response Trust Site, Henderson, Nevada.



Kyle Hansen, CEM
Field Operations Manager/Geologist
Tetra Tech, Inc.

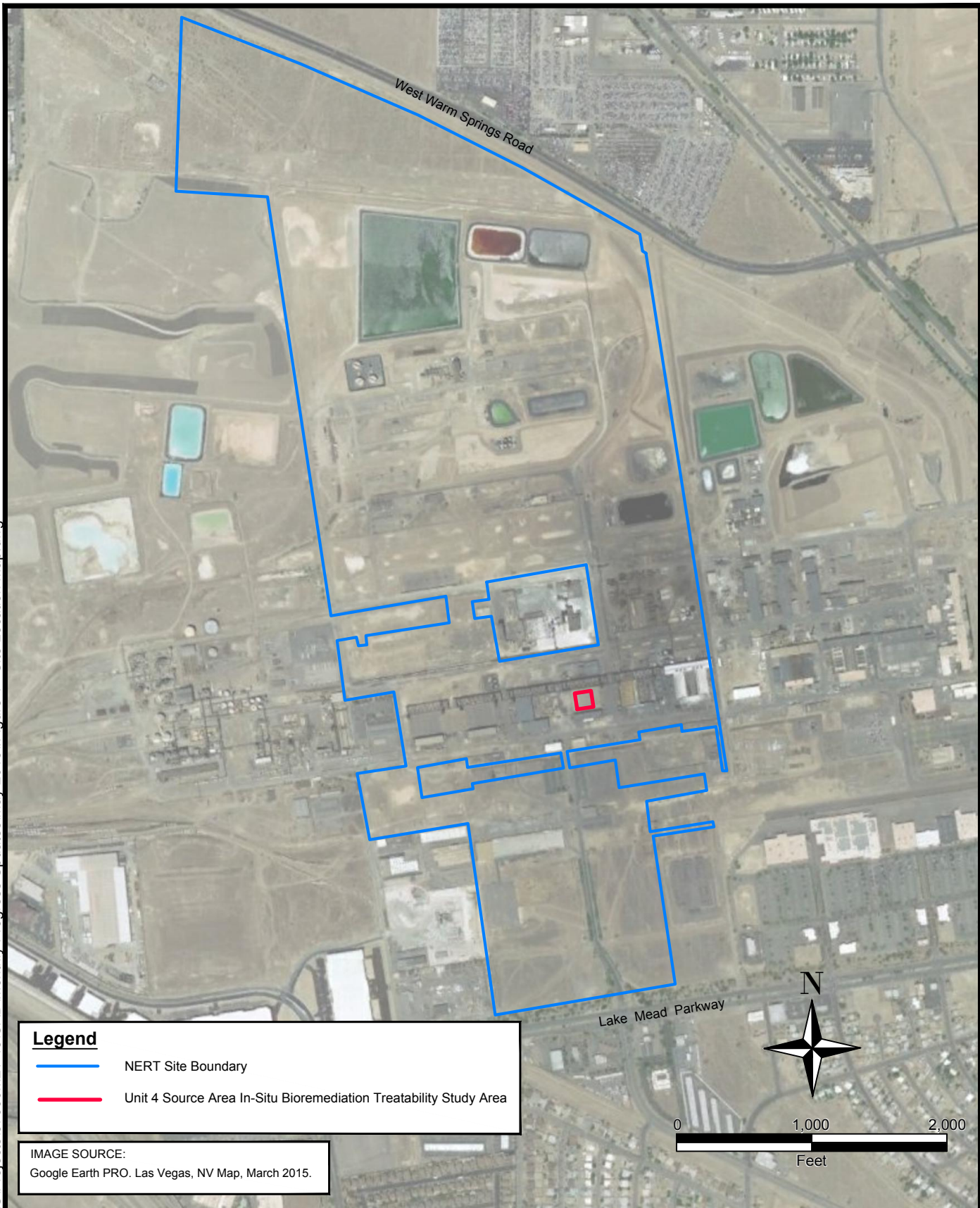
January 28, 2019

Date

Nevada CEM Certificate Number: 2167
Nevada CEM Expiration Date: September 18, 2020

Figures

tts318fs3.tt.local\CES\Projects\87600M21-18\CAD\Monthly Progress Updates\May 2018\Figure 1 - Site Location Map.dwg





Legend	
	NERT Site Boundary
	Unit 4 Source Area In-Situ Bioremediation Treatability Study Area

IMAGE SOURCE:
Google Earth PRO. Las Vegas, NV Map, March 2015.

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NEVADA ENVIRONMENTAL RESPONSE TRUST SITE
UNIT 4 SOURCE AREA IN-SITU BIOREMEDIATION TREATABILITY STUDY
SITE LOCATION MAP

Project No:	117-7502018
Date:	JUNE 13, 2018
Designed By:	PK
Figure No.	1



Legend

- Geotechnical Soil Boring Location
- ⊕ Existing Third Mobilization Monitoring Well
- ⊕ Nested Monitoring Well (I - Intermediate; D - Deep)
- ⊕ UMCf Injection/Extraction Well Cluster (2 Screen Intervals; I - Intermediate; D - Deep)
- Unit 4 Treatability Study Area
- Department of Homeland Security Restricted Area
- Existing Unit 4 Building

Notes:

1. All locations are approximate.
2. Imagery Source: Aerotech Mapping, August 2016.
3. Well location source: Unit 4 Source Area In-Situ Bioremediation Treatability Study Work Plan, Tetra Tech, 2017.



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NEVADA ENVIRONMENTAL RESPONSE TRUST SITE
 UNIT 4 SOURCE AREA IN-SITU BIOREMEDIATION TREATABILITY STUDY

BORING AND WELL LOCATIONS

Project No:	117-7502018
Date:	JULY 10, 2018
Designed By:	CL
Figure No.	2

Tables

Table 1
Summary of Groundwater Analytical Results
 Unit 4 Source Area In-Situ Bioremediation Treatability Study Modification 4

Well ID	Sample ID	Sample Date	Total Dissolved Solids by Method SM 2540C (mg/L)	Perchlorate by USEPA Method 314.0 (µg/L)	Chlorate by USEPA Method 300.1B (µg/L)	Chloroform by USEPA Method 8260B (µg/L)	Hexavalent Chromium by USEPA Method 218.6 (µg/L)	Total Chromium by Method SW-6010B (mg/L)	Nitrate (as N) by USEPA Method 300.0 (mg/L)	Nitrate (as N03) by USEPA Method 300.0 (mg/L)	General Water Quality Parameters				
											pH	Temperature (°C)	Oxidation Redox Potential (mV)	Dissolved Oxygen (mg/L)	Specific Conductivity (mS/cm)
Extraction Wells															
U4-E-011	U4-E-011-D00	12/5/2018	31,000	2,200,000	10,000,000	1,400	62,000	50	41	180	7.86	24.8	293.1	6.00	6.38
	U4-E-011-D01	12/6/2018	5,000	--	--	--	--	--	--	--	7.75	24.7	267.6	6.37	5.62
	U4-E-011-D03	12/8/2018	4,700	--	--	--	--	--	--	--	7.73	24.6	241.3	6.83	5.75
	U4-E-011-D05	12/10/2018	4,700	--	--	--	--	--	--	--	7.74	24.8	237.6	6.75	5.84
	U4-E-011-D07	12/12/2018	4,800	190,000	1,400,000	330 J	5,700	5.8	5.2	23	7.71	25.2	236.1	6.61	5.89
	U4-E-011-D12	12/17/2018	5,000	--	--	--	--	--	--	--	7.71	24.7	246.2	6.26	5.86
	U4-E-011-W03	12/26/2018	4,900	--	--	--	--	--	--	--	7.65	24.9	220.4	6.47	5.87
U4-E-05D	U4-E-05D-D00	12/5/2018	36,000	3,300,000	17,000,000	4,300	88,000	84	53	240	8.32	25.2	284.5	1.45	35.0
	U4-E-05D-D01	12/6/2018	42,000	--	--	--	--	--	--	--	8.50	25.8	227.9	1.99	38.7
	U4-E-05D-D03	12/8/2018	41,000	--	--	--	--	--	--	--	8.51	25.9	255.4	2.02	38.1
	U4-E-05D-D05	12/10/2018	38,000	--	--	--	--	--	--	--	8.50	25.9	211.8	2.15	37.2
	U4-E-05D-D07	12/12/2018	40,000	3,500,000	19,000,000	6,700	93,000	90	56	250	8.47	26.0	209.4	2.19	36.5
	U4-E-05D-D12	12/17/2018	41,000	--	--	--	--	--	--	--	8.45	25.9	207.2	2.35	34.8
	U4-E-05D-W03	12/26/2018	34,000	--	--	--	--	--	--	--	8.38	25.9	221.3	2.6	32.7
Observation Wells															
U4-E-01D	U4-E-01D-D00	11/29/2018	46,000	3,600,000	26,000,000	6,400	110,000	110	63	280	9.46	15.71	62.0	5.71	42.30
	U4-E-01D-D00-DUP1	11/29/2018	46,000	3,600,000	26,000,000	6,600	100,000	100	62	280	--	--	--	--	--
	U4-E-01D-D07	12/12/2018	8,900	480,000	3,300,000	120	12,000	13	10	45	8.90	23.8	55.9	6.13	12.20
U4-E-02I	U4-E-02I-D00	11/29/2018	2,700	63,000	520,000	290	1,700	1.7	0.65	2.9	9.14	16.31	54.0	5.74	3.77
	U4-E-02I-D07	12/12/2018	2,700	61,000	400,000	120	2,100	1.9	2.0	8.6	6.47	24.7	148.7	5.78	3.91
U4-E-04D	U4-E-04D-D00	11/29/2018	15,000	840,000	6,600,000	820	27,000	26	20	88	7.11	18.16	156.0	5.78	15.40
	U4-E-04D-D07	12/12/2018	23,000	1,100,000	12,000,000	4,300	49,000	47	33	140	8.39	24.6	173.9	4.18	21.70
U4-IS-MW-02I	U4-IS-MW-02I-D00	11/29/2018	2,600	43,000	52,000	170	1,700	1.8	2.3	10	7.62	12.24	139.0	6.35	3.46
	U4-IS-MW-02I-D07	12/12/2018	2,400	20,000	200,000	80 J	1,200	1.1	2.1	9.2	7.70	24.2	120.3	5.15	3.23
	U4-IS-MW-02I-D07-DUP2	12/12/2018	2,400	21,000	200,000	75 J	1,200	1.1	2.1	9.2	--	--	--	--	--
U4-IS-MW-02D	U4-IS-MW-02D-D00	11/29/2018	30,000	2,200,000	16,000,000	5,100	70,000	72	44	190	9.17	14.03	93.0	5.46	29.90
	U4-IS-MW-02D-D07	12/12/2018	38,000	2,300,000	18,000,000	9,800	100,000	100	58	250	8.41	25.0	161.4	1.24	36.76

- Notes:**
- ID Identification
 - °C Celsius
 - DO Dissolved Oxygen
 - µg/L Microgram per liter
 - mg/L Milligram per liter
 - mV MilliVolts
 - mS/cm MilliSiemens per centimeter
 - USEPA United States Environmental Protection Agency
 - J Denotes estimated quantity.
 - Not Analyzed
 - DUP Duplicate Sample