

# 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:** Dana Grady

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**Date:** January 16, 2023

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**Subject:** Las Vegas Wash ZVI-Enhanced Bioremediation Treatability 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 to summarize Tetra Tech's progress during November 2023 toward successfully implementing the Las Vegas Wash Zero-Valent Iron (ZVI)-Enhanced Bioremediation Treatability Study.

## Task Progress Update: November 2023

### Task M18 – Las Vegas Wash ZVI-Enhanced Bioremediation Treatability Study

- Current Status –

The Las Vegas Wash ZVI-Enhanced Bioremediation Treatability Study is being conducted to evaluate the effectiveness of ZVI-enhanced bioremediation of perchlorate-contaminated groundwater that has migrated downgradient of the NERT site toward the Las Vegas Wash. The general treatability study layout, including locations of the continuous and discontinuous ZVI walls and associated injection well and monitoring well network, is presented on Figures 1, 2a, and 2b. Well construction details are provided in Table 1. The construction phase of the treatability study was completed on April 24, 2023 and the performance monitoring phase is ongoing.

- Performance Monitoring – The performance monitoring program included a pre-construction, baseline groundwater sampling event completed in October 2022 prior to installation of the continuous and discontinuous ZVI walls and performance monitoring network. Following construction of the ZVI walls, installation of the performance monitoring network, and injection of biological inoculum and nutrient solution, the performance monitoring program began in May 2023 and is ongoing. The performance monitoring program is being implemented in accordance with the NDEP-approved Work Plan Addendum, which includes monthly synoptic gauging events to evaluate hydrologic changes over time and groundwater sampling events approximately one month after completion of the construction phase and quarterly thereafter for a total of 16 months. The latest monthly synoptic gauging event was conducted from November 16 to November 17, 2023. The Month 1 monitoring groundwater sampling event was performed from May 22 to May 30, 2023, approximately one month after completion of the construction phase of the treatability

- study. The first quarterly performance monitoring event was conducted from August 21 to August 31, 2023, which is approximately four months after completion of the construction phase. Due to a laboratory error, four monitoring wells were resampled for perchlorate on October 11, 2023, and field split samples were submitted to a separate analytical laboratory to confirm resample concentrations. Available draft groundwater analytical results from the baseline sampling event, and the subsequent monitoring events performed in May 2023 and August 2023, including the October 2023 resampling event were presented in the October 2023 monthly progress report. The second quarterly performance monitoring event was conducted from November 27 through December 6, 2023. Results from the November/December 2023 sampling event will be summarized in future reports once the laboratory data have been received.
- Monthly Synoptic Monitoring – Monthly synoptic monitoring is being performed to evaluate any changes in horizontal and vertical gradients, assess for potential groundwater mounding upgradient of the ZVI reactive zone, assess hydraulic effects of seasonal precipitation, and evaluate potential non-uniform flow. Results of the November 2023 monthly synoptic monitoring event do not indicate any significant changes to groundwater elevations in monitoring wells located upgradient, within, and downgradient of ZVI reactive zones.
  - Microbial Sampling – To evaluate the microbial community present in the treatability study area, both Bio-Trap® samplers and groundwater samples were collected in August/September 2023 from 23 monitoring wells, which were located both upgradient, within, and downgradient of the continuous and discontinuous ZVI walls. Both Bio-Trap® samplers and groundwater samples were sent to microbial analytical laboratories for analysis of microbial parameters listed in the NDEP-approved Work Plan Addendum. Microbial analytical results will be provided in future monthly progress reports once data have been received.
- **Schedule and Progress Updates**
    - Groundwater levels will be measured on a monthly basis for the duration of the treatability study. The next monthly synoptic event is scheduled for December 18 through December 20, 2023.
    - Groundwater samples will continue to be collected on a quarterly basis to generate time-series data to evaluate the treatment effectiveness of the ZVI installations with respect to the design performance criteria. The next quarterly groundwater sampling event is planned for February 19 through 23, 2024.
  - **Health and Safety**
    - There were no health and safety incidents related to Task M18 during November 2023.

## CERTIFICATION

### Las Vegas Wash ZVI-Enhanced 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

Not Individually, but Solely  
as President of the Trustee

**Signature:** Jay A Steinberg, President, 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:** 1/16/24

## 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 Las Vegas Wash ZVI-Enhanced Bioremediation Treatability Study Monthly Progress Report.



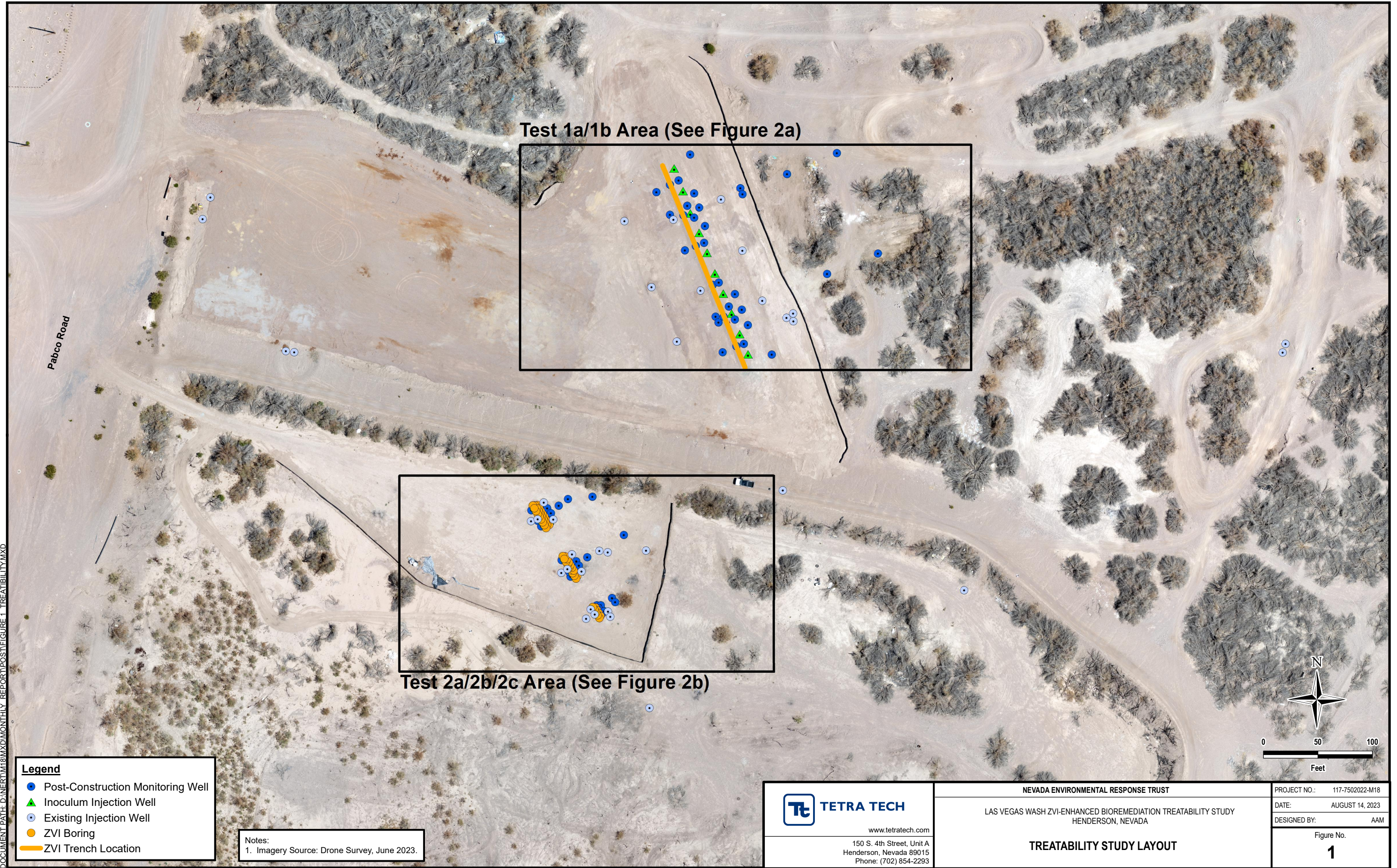
**Christopher Hayes, CEM**  
Environmental Engineer  
Tetra Tech, Inc.

January 16, 2024

Date

Nevada CEM Certificate Number: EM2499  
Nevada CEM Expiration Date: December 15, 2024

## Figures



DOCUMENT PATH: D:\NERT\18\MONTHLY REPORT\POST\FIGURE 1\_TREATABILITY.MXD

Legend	
	Post-Construction Monitoring Well
	Inoculum Injection Well
	Existing Injection Well
	ZVI Boring
	ZVI Trench Location

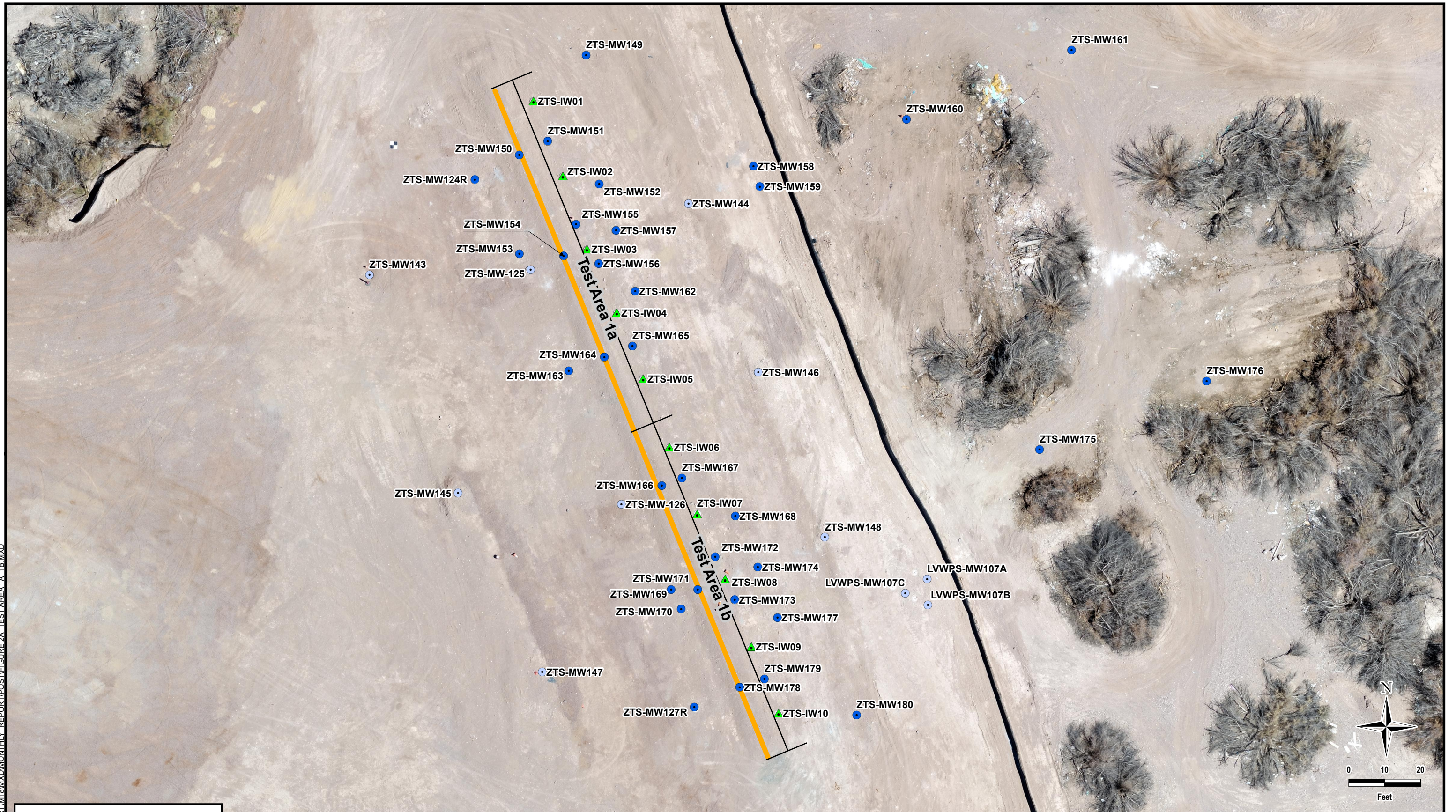
Notes:  
 1. Imagery Source: Drone Survey, June 2023.

**TETRA TECH**  
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 150 S. 4th Street, Unit A  
 Henderson, Nevada 89015  
 Phone: (702) 854-2293

NEVADA ENVIRONMENTAL RESPONSE TRUST  
 LAS VEGAS WASH ZVI-ENHANCED BIOREMEDIATION TREATABILITY STUDY  
 HENDERSON, NEVADA  
**TREATABILITY STUDY LAYOUT**

PROJECT NO.:	117-7502022-M18
DATE:	AUGUST 14, 2023
DESIGNED BY:	AAM
Figure No.	<b>1</b>

DOCUMENT PATH: D:\NERT\M18\MXD\MONTHLY REPORT\POST\FIGURE 2A TEST AREA 1A 1B.MXD



Legend	
<span style="color: blue;">●</span>	Post-Construction Monitoring Well
<span style="color: green;">▲</span>	Inoculum Injection Well
<span style="border: 1px solid black; border-radius: 50%; padding: 2px;">○</span>	Existing Monitoring Well
<span style="border: 2px solid orange; width: 20px; height: 5px; display: inline-block;"></span>	ZVI Trench Location

Notes:  
1. Imagery Source: Drone Survey, June 2023.

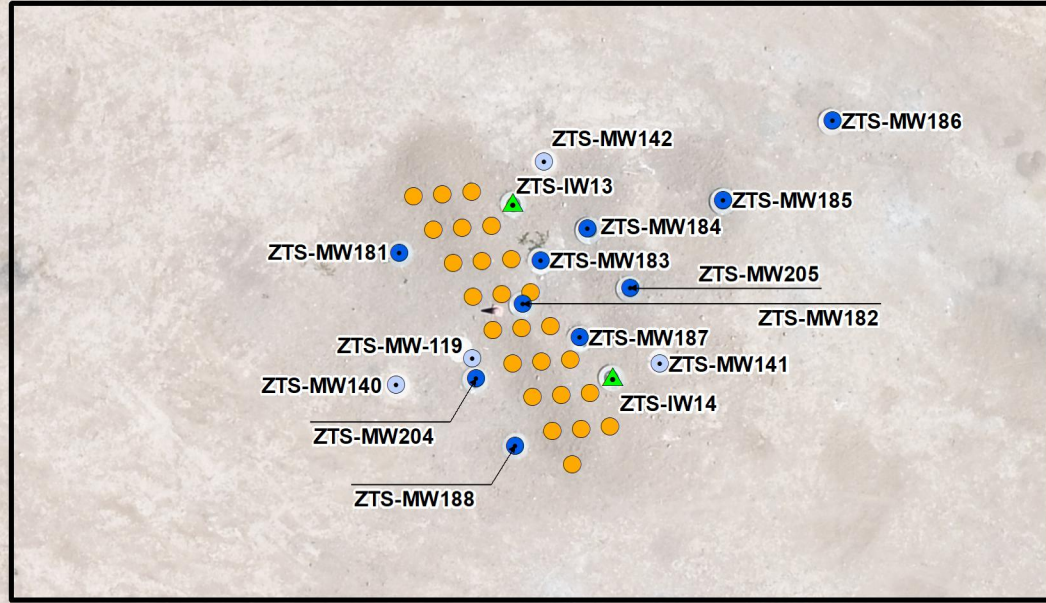
 **TETRA TECH**  
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NEVADA ENVIRONMENTAL RESPONSE TRUST  
LAS VEGAS WASH ZVI-ENHANCED BIOREMEDIATION TREATABILITY STUDY  
HENDERSON, NEVADA  
**TEST AREA 1a/1b LAYOUT**

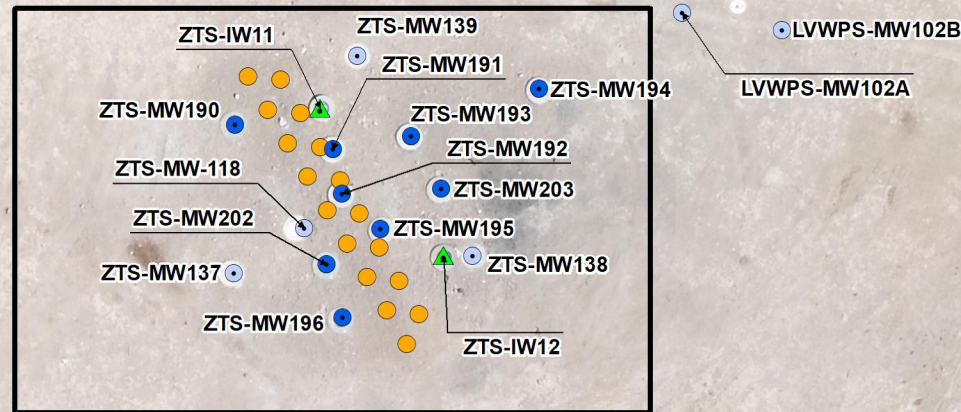
PROJECT NO.:	117-7502022-M18
DATE:	AUGUST 14, 2023
DESIGNED BY:	AAM
Figure No.	<b>2a</b>

DOCUMENT PATH: D:\NERT\M18\MD\MONTHLY REPORT\POST\FIGURE 2B TEST AREA 2A 2B 2C.MXD

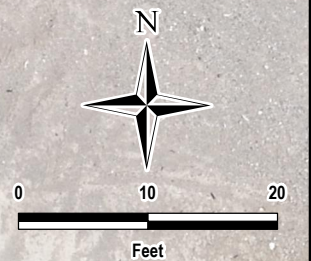
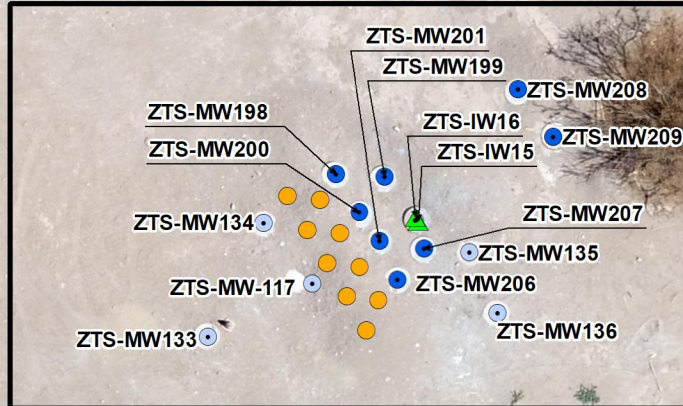
**Test 2c Area (Borings ZTS-BH01 through ZTS-BH25)**



**Test 2a Area (Borings ZTS-BH26 through ZTS-BH42)**



**Test 2b Area (Borings ZTS-BH43 through ZTS-BH51)**



**Legend**

- Post-Construction Monitoring Well
- ▲ Inoculum Injection Well
- ZVI Boring
- Existing Monitoring Well

Notes:  
1. Imagery Source: Drone Survey, June 2023.



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NEVADA ENVIRONMENTAL RESPONSE TRUST

LAS VEGAS WASH ZVI-ENHANCED BIOREMEDIATION TREATABILITY STUDY  
HENDERSON, NEVADA

**TEST AREA 2a/2b/2c LAYOUT**

PROJECT NO.:	117-7502022-M18
DATE:	AUGUST 14, 2023
DESIGNED BY:	AAM

Figure No.  
**2b**



## Tables





**Table 1**  
**Well Construction Details**  
 Las Vegas Wash ZVI-Enhanced Bioremediation Treatability Study

Well ID	Screened Lithology	Northing	Easting	Ground Surface Elevation	Top of Casing Elevation	Depth to Water <sup>1</sup>	Groundwater Elevation	Casing Material	Slot Size	Filter Pack Gradation	Nominal Borehole Diameter	Borehole Total Depth	Well Diameter	Nominal Screen Length	Well Total Depth	Bottom of Screen	Top of Screen
				feet amsl	feet amsl	ft bTOC	amsl		inches		inches	feet bgs	inches	feet	feet bgs	feet bgs	feet bgs
<b>Injection Wells</b>																	
ZTS-IW01	Alluvium	26732954.69	833038.19	1545.73	1545.62	NM	NM	Schedule 40 PVC	0.020	#3	6	40.0	2	15.0	36.0	35.5	20.8
ZTS-IW02	Alluvium	26732933.88	833046.37	1545.63	1545.70	NM	NM	Schedule 40 PVC	0.020	#3	6	37.5	2	15.0	35.5	35.0	20.3
ZTS-IW03	Alluvium	26732913.63	833053.06	1546.39	1546.35	NM	NM	Schedule 40 PVC	0.020	#3	6	40.0	2	15.0	36.0	35.5	20.8
ZTS-IW04	Alluvium	26732895.95	833061.35	1545.81	1545.64	NM	NM	Schedule 40 PVC	0.020	#3	6	38.0	2	15.0	36.0	35.5	20.8
ZTS-IW05	Alluvium	26732877.62	833068.66	1546.34	1546.32	NM	NM	Schedule 40 PVC	0.020	#3	6	37.5	2	15.0	36.0	35.5	20.8
ZTS-IW06	Alluvium	26732858.63	833075.96	1547.14	1546.96	NM	NM	Schedule 40 PVC	0.020	#3	6	35.0	2	15.0	35.0	34.5	19.8
ZTS-IW07	Alluvium	26732840.03	833083.70	1547.73	1547.48	NM	NM	Schedule 40 PVC	0.020	#3	6	30.0	2	5.0	27.5	27.0	22.3
ZTS-IW08	Alluvium	26732822.00	833091.44	1547.88	1547.75	NM	NM	Schedule 40 PVC	0.020	#3	6	31.0	2	5.0	27.5	27.0	22.3
ZTS-IW09	Alluvium	26732803.17	833098.78	1548.14	1548.30	NM	NM	Schedule 40 PVC	0.020	#3	6	27.0	2	5.0	26.5	26.0	21.3
ZTS-IW10	Alluvium	26732784.72	833106.32	1548.63	1548.48	NM	NM	Schedule 40 PVC	0.020	#3	6	25.0	2	5.0	25.0	24.5	19.8
ZTS-IW11	Alluvium	26732597.13	832941.47	1547.80	1547.86	NM	NM	Schedule 40 PVC	0.020	#3	6	25.0	2	5.0	23.5	23.0	18.3
ZTS-IW12	Alluvium	26732585.78	832951.00	1547.51	1547.54	NM	NM	Schedule 40 PVC	0.020	#3	6	26.0	2	5.0	25.0	24.5	19.8
ZTS-IW13	Alluvium	26732645.58	832916.08	1547.54	1547.64	NM	NM	Schedule 40 PVC	0.020	#3	6	30.0	2	10.0	29.5	29.0	19.3
ZTS-IW14	Alluvium	26732632.18	832923.75	1547.50	1547.55	NM	NM	Schedule 40 PVC	0.020	#3	6	30.0	2	10.0	27.3	26.8	17.1
ZTS-IW15	UMCf	26732551.24	832973.58	1547.33	1547.34	NM	NM	Schedule 40 PVC	0.010	#2/16	10	68.0	2	15.0	46.5	46.0	26.3
ZTS-IW16	UMCf	26732551.53	832973.34	1547.37	1547.44	NM	NM	Schedule 40 PVC	0.010	#2/16			2	20.0	67.5	67.0	52.3

Notes  
 amsl - above mean sea level  
 bgs - below ground surface  
 bTOC - below top of casing  
 NM - not measured  
 PVC - polyvinyl chloride  
 UMCf - Upper Muddy Creek formation  
 Semi-Cons - Semi-Consolidated  
 1. Depth to water collected on May 16-17, 2023.