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Supplemental Surface Water Investigation Technical Memorandum

NERT Remedial Investigation – Downgradient Study Area
Nevada Environmental Response Trust Site
Henderson, Nevada

Final Draft

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Responsible Certified Environmental Manager (CEM) for this project

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 provided 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.

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February 27, 2019

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List of Abbreviations

°C	degrees Celsius
cfs	cubic feet per second
COA	Certificate of Authorization
CSM	Conceptual Site Model
CTEMPs	Center for Transformative Environmental Monitoring Programs
DVSR	Data Validation Summary Report
EB	equipment blank
ECS	Erosion Control Structure
EPA	United States Environmental Protection Agency
FAA	Federal Aviation Administration
FB	field blank
FD	field duplicate
FODTS	fiber-optic distributed temperature sensing
GMT	Greenwich Mean Time
GPS	Global Positioning System
JPEG	joint photographic experts group
lb/day	pounds per day
LVW	Las Vegas Wash
mg/L	milligrams per liter
MS	matrix spike
MSD	matrix spike duplicate
NDEP	Nevada Division of Environmental Protection
NERT	Nevada Environmental Response Trust
QAPP	Quality Assurance Project Plan
RI	Remedial Investigation
RGB	red, green, blue

RM	river mile
SSWIP	Supplemental Surface Water Investigation Plan
TDS	total dissolved solids
TIR	thermal infrared
UAS	Unmanned Aircraft System
µg/L	micrograms per liter
µm	micron
µS/cm	micro-siemens per centimeter
USGS	United States Geological Survey

Definition of Key Terms

Groundwater discharge: approximate location where groundwater is entering the surface, either on land or under water. The groundwater may or may not contain perchlorate.

Groundwater flux: measurement of the amount of groundwater discharging per unit of time (for example gallons per minute or cubic feet per second).

Perchlorate discharge: approximate location where groundwater containing perchlorate is discharging to the surface, either on land or under water.

Perchlorate flux: measurement of the amount of perchlorate discharging per unit of time (e.g. pounds per day).

Potential discharge: a location where discharge may be occurring, but where there is still uncertainty.

Seep: an area of slow discharge of groundwater on land or into a body of water.

Spring: a discrete place where groundwater actively discharges on land or into a body of water. Springs often create small rivulets on the ground surface, and may be visible underwater as sand boils or areas of reduced cloudiness.

Sump: a manmade collection structure used to manage surface runoff.

1.0 Introduction

This technical memorandum (memo) describes the supplemental surface water investigation conducted in 2018 for the Nevada Environmental Response Trust (NERT) Remedial Investigation (RI) - Downgradient Study Area in Henderson, Nevada (**Figure 1**). This supplemental surface water investigation consisted of a two-phase temperature survey to discern potential groundwater inputs by temperature differences, maintenance of the water level gages installed in 2017, and surface water sampling along various reaches of the Las Vegas Wash (LVW) within the Downgradient Study Area. Determination of the seasonal patterns of perchlorate concentrations is not the intent of the sampling events described in this memo. Although the concentrations in the LVW may vary significantly with time, both diurnally (from wastewater reclamation discharge) and seasonally (due to sporadic rain events, evapotranspiration, etc.), the sampling design described in this memo is intended to provide an indication as to which reaches in the LVW are currently receiving significant perchlorate influxes from groundwater discharges. The locations sampled are based on results of previous sampling conducted by AECOM (AECOM 2016, 2017a), and refined based on the two-phase temperature survey performed as part of this supplemental surface water investigation. This memo has been prepared as in interim deliverable in advance of the forthcoming NERT RI Report for Operable Unit 3. The work was conducted per the procedures and methods described in the Supplemental Surface Water Investigation Plan (SSWIP; AECOM 2018b), except as noted in this memo.

The objective of the RI of the Downgradient Study Area is to identify subsurface pathways through which perchlorate-impacted groundwater is entering the LVW (**Figure 1**). The surface water sampling program is being conducted to aid in meeting that objective. This surface water investigation consisted of several tiers of sampling to characterize surface water concentrations of key constituents under a variety of flow conditions.

The reaches where perchlorate is entering the LVW have broadly been defined during the surface water investigation in 2016 and 2017 (AECOM 2016, 2017a), but additional data were required to refine and confirm the loci of perchlorate discharge. The data gaps include:

- What general reaches within the LVW have potential loci of discharge of perchlorate to the LVW?
- What are these potential loci of groundwater discharge, regardless of perchlorate concentration, to the LVW?
- Can high-resolution spatial and temporal temperature data along the LWV streambed identify loci of groundwater discharge?
- Are perchlorate concentrations measured in 2017 consistent with 2018?
- Does the construction of the Sunrise Mountain Weir and Historical Lateral Weir Expansion have an impact on localized or overall perchlorate flux in the LVW?
- Confirm the perchlorate flux estimates at the Northshore Road station (downstream of Lake Las Vegas) for comparison to perchlorate flux estimates within the Downgradient Study Area.

The two-phase temperature survey, sampling and analytical results of the samples collected during this investigation are summarized in this technical memorandum. The data collected during this field effort have been used to revise estimates of perchlorate flux in the LVW and update the Conceptual Site Model (CSM) for the LVW, previously presented in the Surface Water Investigation Technical Memorandum (AECOM 2017a). The pattern of perchlorate concentration and flux throughout most of the Downgradient Study Area during the 2018 surface water investigation was significantly impacted by dewatering activities for the then-ongoing construction of the Sunrise Mountain Weir and the Historic Lateral Weir Expansion. That expansion represents an addition to the existing Historic Lateral Weir.

As an interim deliverable, this document presents the sampling and analytical results of the samples collected per the SSWIP. All surface water data will be further evaluated by NERT during the preparation of the RI report.

1.1 Technical Memorandum Organization

The organization of this technical memorandum follows the investigative sequence of the 2018 surface water sampling event. The first stage of the investigation consisted of the thermal infrared (TIR) survey of surface-water temperatures in the LVW (Section 2). The results of the TIR survey helped to pinpoint potential additional sources of groundwater input to the LVW that may be contributing perchlorate to the system. That information, along with previous surface-water investigations performed by AECOM, guided the placement of a number of fiber-optic distributed temperature sensing cables (FODTS) to verify and further characterize those potential inputs (Section 3). Those findings then helped to guide the 2018 transect and grab sampling efforts (Section 4), the results of which were then used to help characterize perchlorate distribution and inputs along the study area and update the CSM for the LVW (Sections 5 and 6). Conclusions and recommendations based on the results of this Supplemental Surface Water Investigation are provided in Sections 7 and 8, respectively.

2.0 Aerial Thermal Infrared

While some perchlorate mass may be entering the LVW upstream of the Downgradient Study Area, ongoing sampling by NERT upstream of the Duck Creek Confluence Weir have shown those contributions to be transient and relatively minor compared to other perchlorate discharges. To evaluate more significant perchlorate flux to the LVW, the sources of perchlorate discharge must be located. These sources are likely contaminated groundwater discharging as seeps or springs that may be entering via overland flow or, more likely, discharging to the LVW under the water surface. The complex geology and hydrology described in the CSM included in Section 2 of the SSWIP (AECOM 2018b), together with the construction of weir structures, the magnitude of flow, and the scale of the study area, confound locating perchlorate-impacted groundwater discharge locations by traditional means (e.g. visual reconnaissance, water-quality probing, and piezometer installation and sampling).

An aerial TIR survey is a method sensitive to discerning temperature differences in surface water. Differences in temperature between surface water and groundwater often occur in summer and winter where groundwater is cooler or warmer than surface water, respectively. This “out-of-phase” relationship between groundwater and surface water temperatures is the basis for successful implementation of the TIR method and identification of potential groundwater discharge locations within a surface water body. Based on historic temperature data, the expectation was that groundwater would be warmer than the surface water in the LVW during winter and groundwater discharge locations could be identified by observing warm anomalies in cooler LVW surface water during February 2018. TIR is a reconnaissance-scale method of evaluating the distribution of potential groundwater discharge locations in the LVW within the limits of the entire Downgradient Study Area. To help refine understanding of the perchlorate discharge for the entire stream reach of interest, the TIR data were collected from an Unmanned Aircraft System (UAS) in the LVW from Duck Creek Confluence Weir to the inlet of the two culverts which convey LVW water under Lake Las Vegas. Coupling the TIR to UAS allowed for efficient data collection along the entire study area. In addition to TIR, high-resolution aerial imagery (visual light spectrum, also known as RGB for red, green, and blue) was collected from the entire survey area as well. Both types of imagery were used to locate potential seeps/springs and plan additional phases of work to evaluate potential perchlorate sources and flux into the LVW.

2.1 Field Procedures

2.1.1 Equipment/Software

The TIR and aerial imagery were collected by coupling the cameras to UAS. The TIR/UAS platforms used for this survey were the DJI Matrice 100 UAS and Inspire 1 Pro UAS outfitted with the DJI-FLIR® Zenmuse XTR 640 Radiometric 19mm 30hz camera. The camera captured images at 640 x 480 pixel resolution. The visual spectrum/RGB imagery was captured with a DJI Phantom 4 Pro UAS outfitted with a 20-megapixel 4K camera capable of both still and video images. DJI GIS Pro, Drone Deploy, and Pix4D were used to fly, mission plan, and control the UAS-based image collection.

2.1.2 Pre-Mobilization Planning

The project was completed under Federal Aviation Administration (FAA) part 107 UAS regulations. Prior to conducting aerial surveys, pre-mobilization planning was completed to get appropriate authorization and to notify appropriate authorities. Prior to mobilization, AECOM flight personnel reviewed the anticipated site conditions and site objectives from existing site data, maps, and information to identify potential hazards, particularly those that may increase the risk of an incident affecting people, property, or the environment. The identified risks and associated risk abatement measures were reviewed and considered for initial flight plans. Additional health and safety requirements are necessary for operating UAS equipment, and particular attention was paid to addressing all federal, state, local, and client requirements, communications and standard operating procedures. All UAS requirements were the responsibility of the AECOM UAS pilot and visual observer; however, all on-site personnel were responsible for reviewing all flight plan details and requirements for the purpose of evaluating whether the documents meet the objectives of the work. AECOM was responsible for developing and submitting the FAA Certificate of Authorization (COA), and was the official COA holder. A copy of the FAA COA is included in **Appendix A**. AECOM operates only FAA-certified UAS with a FAA Flight Authorization. AECOM operates the UAS in strict compliance with established technical operating instructions and with FAA-mandated emergency procedures. In addition, an application for use of Clark County Wetlands Park was submitted for use of the UAS. Permission was granted by Clark County Wetlands Park for the proposed flight plans and is included in **Appendix A**.

2.1.3 Field Procedures

Field activities occurred during the six-day period from February 5, 2018, and February 10, 2018. Prior to conducting aerial operations, the pilots, visual observer, and field crew performed visual reconnaissance to identify suitable launch/landing locations for the UAS program along the length of the LVW survey area. Test flights were completed over the LVW near the Three Kids Weir to perform initial calibrations and to determine appropriate flight parameters in a region with known groundwater discharge. The initial test flights/calibrations were conducted to test the flight system components and flight functionality and to determine if inertial measurement unit and compass calibrations were necessary (initial flights determined these were not required). Initial test flights were also used to identify altitude options for thermal flights and determine flight parameters for establishing overlap settings. Test flights were conducted to establish the expected thermal window for flight operations (low flow, lower light conditions) to capture high-quality data and as a means to establish and finalize mission planning. The initial flights were also completed to ensure thermal accuracy based on manual temperature readings taken concurrently from the river with those of the airborne thermal sensor.

During UAS data collection operations, the UAS was held within "visual line-of-sight" of the pilots. The aerial survey team was comprised of an UAS operator and visual observer, the latter maintaining visual contact with the air vehicle at all times. During flight operations, the aerial survey team launched and recovered the UAS in such a manner to present no hazards to persons or property. Flights occurred from 75 pre-determined locations with pre-programmed flight paths. Flights returned to the same take-off location, collecting data for approximately 10 to 20 minutes based on battery power consumption and subsequent charge time.

TIR flights were flown with a bank to bank geometry at an altitude of 165 feet above the ground surface. Images were captured to generate approximately 90% front overlap and 90% side overlap in adjacent images resulting in 3.74-inch pixel resolution. The standard visual imagery was flown in a similar bank to bank geometry at an altitude of 390 feet above the ground surface. Images were captured to generate a 75% front and side overlap, resulting in 1.4-inch pixel resolution. TIR flights generally occurred between 0600 and 1200 each day, which coincided with low-flow conditions in the LVW and lower daylight/temperature interferences. Visual imagery was collected during 1230 and 1600 each day. Data were recorded and downloaded during the day and uploaded to the AECOM server daily. A summary of the LVW reaches, date/time of flights, flight times, and number of images collected is summarized in **Table 1**. Individual flight paths/planning images are included in **Appendix B**. Daily weather summaries are included in **Appendix C**. Daily field reports are provided in **Appendix D** and Daily Health and Safety Sheets are provided in **Appendix E**.

During TIR flights, a team of AECOM staff collected water quality measurements using a hand-held water quality meter for the duration of the fly-over time. These data were collected near the UAS activity. Temperature was the primary measurement of concern, but additional water quality data were recorded (specific conductivity, pH, and dissolved oxygen). The team walked along shallow portions of the LVW. Water temperature and water quality measurements from the TIR survey are included as **Table 2**.

The aerial TIR and high-resolution aerial image surveys covered approximately 642 acres, which included the entire reach of the LVW within the Downgradient Study Area from upstream of the Duck Creek Confluence Weir to the overflow inlet to Lake Las Vegas. This work was conducted from the pre-determined 75 launch points over six days to capture both TIR and high-resolution aerial imagery of the LVW and immediately surrounding area within the Downgradient Study Area. The TIR survey resulted in approximately 15,000 images, and the high-resolution aerial imagery was approximately 5,000 images. The overall flight coverage is presented in **Figure 2**.

2.1.4 Deviations from SSWIP

Due to circumstances beyond control, and conditions encountered in the field, the following deviations were noted for the TIR survey:

- One objective of the TIR flights was to collect and stitch the infrared images into a mosaic. An attempt was made to create a mosaic from infrared images, but that task is technically difficult and time consuming. The data collected in an infrared image are influenced by multiple factors which may change at a high frequency in the field. These factors include, but are not limited to: moisture content of atmosphere between the subject of the image and the infrared sensor, overall temperature range of each individual image footprint, altitude of sensor, insolation, angle of insolation, and emissivity of subjects within image footprint. Attempts were made to limit those variables; however, discrepancies in one or more of them make stitching even adjacent infrared images imperfect due to the time difference between the two images (typically collected several seconds apart). While the goal of mosaicking the infrared images was not met due to the aforementioned processing issues, it did not impact the overall goal of using infrared imagery as a screening method to identify thermal anomalies. Instead, groups of images were analyzed individually to identify anomalies.
- It was stated in the SSWIP (AECOM 2018b) that a calibration ice bath would be used in the TIR flights. This was modified in the field to collecting in-situ measurements of the LVW during the TIR flights. The point of a calibration ice bath is to provide a known thermal signal within the infrared imagery; this objective was met by collecting in-situ temperatures during the flights as well. Over the course of the TIR flights the temperature measurements of the LVW (**Table 2**) did not vary much outside of the thermal window of 18 to 21 degrees Celsius (°C). Temperature measurements ranged from 16.34 to 21.35°C, with 19 of the 79 readings (24%) varying more than 0.5 °C outside the 18 to 21°C thermal window range (rounding to the nearest degree Celsius).

2.2 Data Analysis

The output from the UAS TIR and aerial imagery survey is a series of sequential images collected along the flight path of the UAS, which were collected perpendicular to the direction of stream flow. Both TIR and standard visual imagery were collected over the extent of the survey area from Duck Creek Confluence Weir to the overflow inlet to Lake Las Vegas.

2.2.1 Standard Visual Image Processing

Standard visual imagery was georeferenced to form a single image of the entire LVW survey area. The standard visual imagery, when combined, provides a high-resolution update of the current physical conditions in the LVW. This imagery aided in further evaluation of TIR datasets by correlating temperature anomalies to stream features. To complete the processing of the standard visual imagery survey, 5,189 RGB photos collected on February 6, 7, 8, and 9, 2018, were imported and processed. Imagery was flown in flightpaths that ran perpendicular to the stream flow and captured in a manner such that each image overlapped its adjacent partner by 70 to 80%. Each image contained three bands (RGB) having a pixel dimension of 4608 x 3456 and stored in joint photographic experts group (JPEG) format. Imagery was flown at an altitude to capture a resolution of approximately 3.5 centimeters. UAS processing software was AgiSoft PhotoScan.

Leveraging the image overlap, the imported imagery was aligned together in three-dimensional space. As a result of this process, the orientation (roll, pitch, yaw) and location (x, y, z) of each image was calculated. Thousands of discrete connections built between overlapping images were used to define and build a terrain model that contained millions of elevation point locations. An orthomosaic is produced by incorporating the calculated exterior orientation of each image and performing orthorectification using the terrain model. Through the orthorectification process, the slightly varying radiometry of the individual images is balanced and adjacent images are digitally combined together to produce a seamless orthomosaic.

Orthoimagery was delivered in World Geodetic System S84 Geographic Coordinate System in tiled GeoTIFF format having a pixel resolution of approximately 3.5 centimeters. The positional accuracy was derived from the drones onboard the Global Navigation Satellite System, which equates to a range of 2 to 10 meters.

2.2.2 Thermal Infrared Image Processing

To identify thermal anomalies, individual TIR images were evaluated for each flight using FLIR® Tools Version 6.4.17317.1002. Over 15,000 TIR images were collected in a bank-to-bank configuration perpendicular to stream flow, generating images with sufficient overlap to visually trace features from image to image. The software allows the user to perform basic post-processing tasks related to optimizing color scales and measuring the pixel-based temperature of adjacent features within the image to understand temperature gradients and identify thermal anomalies.

The TIR technology has limitations that are taken into consideration when evaluating the data. Following summarizes the main limitations:

- TIR, as with any heat-tracing methods, relies on the distinct temperature differences between groundwater and surface water to detect exchange patterns. Therefore, for successful application of thermal methods, the temperature difference between the two reservoirs (i.e., surface water and groundwater) must be greater than the resolution. Like most sites, temperature differences can vary seasonally, and the most optimal times to perform the survey at the LVW are between January and March, or July and September. This is the main reason why the TIR survey was performed in February when groundwater discharges are considerably warmer than the surface water in the LVW. During the TIR survey, the temperature of surface water in the LVW was typically 17 to 22°C, while groundwater at observed discharge locations to the LVW ranged from 24 to 27°C. Also channel temperature can vary spatially, particularly downgradient around the wastewater input at Pabco Road Erosion Control Structure, or ECS (commonly referred to in this report and elsewhere as the Pabco Road Weir), and after large wastewater inputs to the Downgradient Study Area.
- TIR data only account for the surface 'skin' temperature; therefore, only processes that affect the temperature of the water's surface can be visualized (Anderson & Wilson 1984; Atwell et al. 1971; Robinson, Wells & Charnock 1984). Skin in this context refers to approximately the top 0.1 millimeters of surface water. Also, additional processes affect the surface temperature more so than the water column, such as exposure to the sun, wind, and waves (the latter unlikely to be a concern in the LVW). To minimize these effects, images during the LWV TIR survey were captured during early day hours when the sunlight impacts and wind disturbances were low.
- The thermal stratification effects on data collection occurs due to the buoyancy effects of warmer versus cooler waters when not compensated by vertical mixing. For example, a cool seep may not express its thermal signature on the surface of a relatively warmer, stagnant pool or stream. This limitation is addressed by performing the TIR survey in the winter months when groundwater discharges are generally warmer than overlying surface water.
- Emissivity (i.e., efficiency of thermal radiation based on temperature) variability can occur within a single image or over multiple images, due to water roughness, suspended sediment, or other physical effects. To minimize these effects, images during the LVW TIR survey were captured during early day hours when temperatures were steady and wind disturbances were low.
- Reflection interferences:

- o Near-bank TIR radiation reflection – radiated TIR wavelengths from an object may reflect off an adjacent surface (i.e. water); thus, the radiant signal from the reflecting surface may be masked. This includes reflections from clouds, which was not a significant concern in the Downgradient Study Area during the TIR survey when skies were mostly cloudless.
- o Ambient reflection – solar radiation is minimized within the TIR wavelength range (8-14 micron [µm]); however, this can cause spectral distortions within imagery. That potential was counteracted by performing the surveys in the morning.

- The wider the observation angle of the TIR sensor, the higher the likelihood for spectral distortions; therefore, the data in the center of the image are the most accurate and decreases away from the center. Remote sensing practice dictates that 35% of the image, either side of nadir (i.e., lowest point), is the most reliable. Overlap between adjacent survey areas avoided the use of fringe areas from any of the collected images.
- Atmospheric interference – TIR wavelengths are absorbed and emitted from water vapor; therefore, changes in humidity may have a significant effect on the data recorded by the sensor. This is unlikely to have been a factor during the Downgradient Study Area survey. Temperature and humidity were consistent throughout the survey so the data would have been comparable. In general, temperature anomalies were defined by plume-shaped features or locations in the stream that exhibited large temperature gradients with sharp boundaries as compared to other adjacent pixels/features. With the limitations of TIR technology as listed above taken into consideration, observed skin temperature measurements with differences greater than 1°C were recorded as temperature/thermal anomalies.

TIR images are spatially represented by recording a spatial coordinate at the image centroid during image capture. In the case of broader thermal anomalies and/or when the images did not have sufficient distinctive features to estimate a more precise location, image centroids were used to map thermal anomalies (approximately 50% of the images). For stronger, more definitive anomalies, more precise location coordinates were made by matching features in the TIR image with the high-resolution aerial orthomosaic.

2.3 Summary of TIR Results

A general overview of thermal anomalies observed during manual TIR image processing is depicted on **Figure 3.** More detailed TIR results are presented in **Figures 4 through 7**, which are arranged from upstream to downstream along the investigated reaches of the LVW. TIR imagery is included as a digital appendix (**Appendix F**).

While most thermal anomalies observed during the TIR survey (and subsequent FODTS survey discussed in Section 3) did represent locations of relatively warm water, several cool anomalies were also discovered. There may be several mechanisms that created pockets of relatively cool water relative to the surrounding surface water. One is the potential for locations where groundwater discharge was relatively cool. During the TIR survey, groundwater discharging into the dewatering trenches at the Sunrise Mountain Weir construction area (SMT-1 in Table 2) was observed to have a temperature of 17.4°C, or about 1 to 2°C cooler than nearby surface water (SBM-15, SBM-16, and SBM-17 in Table 2), and 6°C cooler than groundwater emanating downstream of the Three Kids Weir (LWC3.7 in Table 2). In slower and deeper regions of the LVW, thermal stratification may develop wherein cooler, denser water collects below warmer water at the surface. Thermal anomalies from stratification are not likely to show up on the surface during the TIR survey, but they would be observed during the FODTS survey if the submerged cable was suspended within a stratified section of the river. In slow-moving water near the shore, shading by riparian vegetation may also have created regions of cooler water. Some of the TIR detected anomalies may have been the result of shading; however, the camera cannot view water-surface temperatures underneath denser vegetation. Some of the FODTS detected anomalies may also have resulted from shading, especially where the cable was placed within vegetation rooted below the water surface along the more shaded north shore.

Following is a summary of the observations for each reach investigated:

Upstream of Duck Creek Confluence Weir – **Figure 4**

Several thermal anomalies were identified along the south and north banks of this reach, along with one mid-channel anomaly. Additional investigations (FODTS and sampling) were not planned for this area due to the historically low concentrations of perchlorate noted here.

Duck Creek Confluence Weir to Upper Narrows Weir – **Figure 4**

Nine thermal anomalies were identified in the reach between Duck Creek Confluence Weir and the Upper Narrows Weir. Low perchlorate concentrations were noted in this reach historically; therefore, subsequent investigations (FODTS and sampling) were not planned.

Upper Narrows Weir to Sunrise Mountain Weir – **Figure 4**

A large portion of this reach is currently undergoing construction. The stream channel has been reworked substantially to allow rehabilitation/reconstruction of the Sunrise Mountain Weir. Thermal anomalies were observed on both north and south banks upstream of the construction area, proximal to Upper Narrows Weir. With a small increase in historic perchlorate concentrations in this location, additional high-resolution temperature surveys (FODTS) were planned for a portion of this reach from Upper Narrows Weir to the start of construction activities along the south and north banks. High-resolution temperature survey methods and results are discussed in Section 3. Seven thermal anomalies were also observed downstream of the construction zone on the north bank, proximal to the Pabco Road Weir.

Sunrise Mountain Weir to Pabco Road Weir – **Figure 4**

Seven thermal anomalies were identified in the reach between the Upper Narrows Weir and Pabco Road Weir. . Previous sampling indicated no significant gain in perchlorate occurred in this area; therefore, subsequent investigations (FODTS) were not planned.

Pabco Road Weir to Historic Lateral Weir Expansion– **Figure 5**

The channel becomes very narrow along this reach. Several thermal anomalies were observed in the narrow channel downstream from Pabco Road Weir to the construction zone in the vicinity of the Historic Lateral Weir and the Historic Lateral Weir Expansion. Additional high-resolution temperature surveys were not planned for this reach due to the ongoing/active construction.

Historic Lateral Weir to Bostick Weir – **Figure 5**

Between Historic Lateral Weir and Bostick Weir, the LVW bifurcates into two narrow channels. Two thermal anomalies are located within the construction area immediately downstream of Historic Lateral Weir. One thermal anomaly was observed in the southern channel near Bostick Weir. No additional high-resolution temperature surveys were planned for this reach due to low frequency of anomalies and the ongoing/active construction.

Bostick Weir to Calico Ridge Weir – **Figure 6**

Between Bostick Weir and Calico Ridge Weir two channels are still present. Three thermal anomalies were identified on the south bank within the south channel. No additional high-resolution temperature surveys were planned for this reach because of the relatively minor changes in perchlorate loading observed along this reach.

Calico Ridge Weir to Lower Narrows Weir – **Figure 6**

Thermal anomalies were identified on both the north and south banks of the LVW within this reach. Thermal anomalies were present on the north and south banks proximal to Calico Ridge Weir where, historically, elevated perchlorate concentrations have been identified. Additional thermal anomalies were observed more sparsely spaced along both north and south banks. To gain a better understanding of this reach and the potential for groundwater discharge areas, additional high-resolution temperature surveys were planned along the north and south banks.

Lower Narrows Weir to Homestead Weir – **Figure 6**

Several thermal anomalies were observed on both the north and south banks of the LVW between Lower Narrows Weir and Homestead Weir. Based on the prevalence of the thermal anomalies observed, additional high-resolution temperature surveys were planned for this reach.

Homestead Weir to Three Kids Weir – **Figure 7**

This reach is approximately $^{3}/_{10}$ of a mile long where 14 thermal anomalies were identified, 6 along the south bank and 8 along the north bank. Due to the low density of thermal anomalies observed here and decreasing/steady perchlorate concentrations observed historically within this reach, no additional thermal surveys were planned for this reach.

Three Kids Weir to Rainbow Gardens Weir – **Figure 7**

The reach between Three Kids Weir and Rainbow Gardens Weir has a two-channel configuration for the majority of the reach. Historic perchlorate concentrations were elevated on the downstream side of the Three Kids Weir along the north and south banks. Somewhat higher concentrations of perchlorate have been observed in previous sampling upstream of the Rainbow Gardens Weir. Several TIR thermal anomalies were identified along the north and south channels and within a small peninsula upstream of the Rainbow Gardens Weir. High-resolution temperature surveys were planned for this reach along the north and south banks based on the historic perchlorate concentrations and prevalence of TIR anomalies.

Rainbow Gardens Weir to Powerline Crossing Weir – **Figure 7**

Perchlorate sampling has not been conducted here previously by AECOM, but aerial TIR indicated the presence of several thermal anomalies along the south bank and within the main channel. Only three thermal anomalies were identified along the north bank. Additional high-resolution temperature surveys were planned for the south bank of the reach between the Rainbow Gardens Weir and Powerline Crossing Weir. This deployment was combined with the downstream reach (which is discussed below).

Powerline Crossing Weir to Fire Station Weir – **Figure 7**

Eight thermal anomalies were identified in the reach between Powerline Crossing Weir and Fire Station Weir. There were no historic perchlorate data in this reach, but based on the number of thermal anomalies identified in the TIR images from this location, a high-resolution temperature survey was planned for the south bank of this reach.

Fire Station Weir to Lake Las Vegas Inlet – **Figure 7**

One potential thermal anomaly was noted between the Fire Station Weir and the overflow inlet to Lake Las Vegas. No samples were historically collected this far downstream. Based on the low density of thermal anomalies, and the lack of perchlorate data, high-resolution temperature surveys were not planned along this portion of the LVW.

2.4 Recommendations for Next Phase

In summary, 195 thermal anomalies were observed in the TIR images from upstream of the Duck Creek Confluence Weir to the overflow inlet to Lake Las Vegas. These thermal anomalies represent potential groundwater discharge locations or seeps that exhibit a surface expression observable as a temperature gradient on the water's surface in the TIR images. While the method has proven to be effective in a wide variety of applications, it does have limitations. Those limitations were minimized by the timing of the LVW TIR survey in February, when thermal contrasts were strong. The limitations of the TIR method are largely due to the fact that the results only provide a measure of surface temperature (i.e. “skin” temperature from the surface of the water body). It is possible that in specific circumstances, groundwater discharge may not display a surface temperature expression, particularly in some of the deep or fast flowing sections of the LVW.

Thermal anomalies identified during the aerial TIR survey were compared to historic perchlorate data collected along transects in the LVW. High-resolution temperature surveys were performed based on the prevalence of thermal anomalies observed in the aerial TIR images and the correlation of thermal anomalies with historic transect sampling results. Those surveys were implemented using FODTS techniques to more accurately locate potential groundwater discharge zones along the LVW. The FODTS surveys were executed in the reaches showing a high prevalence of thermal anomalies and/or where historic perchlorate data indicated a high probability of impacted groundwater entering the LVW. Five reaches were considered for FODTS surveys, which are discussed in Section 3.

3.0 Fiber-optic Distributed Temperature Survey

The aerial TIR survey discussed in Section 2 provided a reconnaissance-level snapshot of the entire Downgradient Study Area. Where TIR relies on the surface expression of groundwater discharge, FODTS is a method that provides a more reliable measurement of temperature differences for detection of potential groundwater discharge locations since the sensor (a fiber-optic cable) is installed at the water/sediment boundary along the streambed.

FODTS provides a closer evaluation of groundwater discharge compared to TIR, which relies on surface 'skin' temperature. While the measurement is limited to the location of the fiber-optic cable only, FODTS allows for collection of temperature time-series data. In addition to providing a time series of measurements, FODTS measures temperature at locations along the cable at the sediment/surface water boundary simultaneously, providing a more representative temperature signature to detect groundwater discharge patterns. Since the fiber-optic method is measuring at the streambed where groundwater discharge occurs, locations of temperature anomalies are more accurate as they are not affected as much as with skin temperature detection of the TIR method.

Deployment locations were chosen based on historic sampling results (e.g. reaches where elevated perchlorate concentrations were observed) and where TIR methods indicated a high prevalence of temperature anomalies in the LVW. FODTS surveys were completed at five reaches, using six separate cable deployments. Each deployment had an active measurement time period of multiple diurnal cycles. The field activities occurred between February 26 and March 24, 2018. Deployment notes and field reports are provided in **Appendix D**. Daily Health and Safety sheets are provided in **Appendix E.** In general, the fiber-optic cables were installed in the shallow waters adjacent to the LVW banks/shoreline. Water-quality sampling along transects in 2017 (AECOM 2017a) revealed higher perchlorate concentrations near the banks, indicating that potential sources of perchlorate impacted groundwater are likely to be encountered near the shore. Additionally, the majority of TIR thermal anomalies were also found along the banks (Section 2.0). Some of those regions, where water temperatures vary significantly from those of nearby surface waters, were inferred to potentially represent zones of groundwater discharge to the LVW.

The objective of the FODTS survey was to refine locations of potential groundwater discharge for further investigation and subsequent transect sampling. FODTS surveys have provided information to supplement the understanding of perchlorate distribution in the surface waters of the LVW. The surveys were conducted to provide:

- High-resolution spatial and temporal temperature data along the LWV streambed to further investigate the TIR anomalies ,
- Confirmation and refinement of the inferred groundwater discharge locations based on previous perchlorate sampling and analyses ; and
- Potential loci of groundwater discharges to the LVW that may not have been detected during previous investigations.

Based on the recent TIR survey and perchlorate concentration data obtained during 2017 sampling event (AECOM 2017a), it was determined that locations of high-resolution temperature surveys would be completed at Upper Narrows Weir, Calico Ridge Weir to Lower Narrows Weir, Lower Narrows Weir to Homestead Weir, Three Kids Weir to Rainbow Gardens Weir, and Rainbow Gardens Weir to Fire Station Weir. **Figure 8** identifies the locations of the FODTS deployments relative to the entire study area.

3.1 Field Procedures

3.1.1 Instrumentation and Software

Two complete fiber-optic sensing systems (Sensornet Oryx Distributed Temperature Sensing units and fiber-optic cables) were leased from the Center for Transformative Environmental Monitoring Programs (CTEMPs), a consortium supporting the application of FODTS to environmental monitoring programs. The units were deployed in a staggered fashion, allowing for ongoing temperature measurements from one unit during the installation or extraction of the other unit. The spatial/sampling resolution was approximately 1 temperature measurement per meter of cable. Temperature measurements were collected along the entire length of the cable every five minutes. During each five-minute recording interval, the laser is pulsed down the length of the cable for one minute to average the temperature along the length of cable. This generates more stable/accurate temperature measurements as instrument noise and variability is averaged out over the 1-minute measurement time, which is recorded at five-minute intervals. The fiber-optic cable had two glass fibers which allowed for installation of a minibend splice at one end of the cable that was used to connect the two fibers. Each fiber had a connector, which was connected and measured by the instrument in channel 1 and channel 2 of the Oryx Distributed Temperature Sensing unit. This configuration creates redundancy as the measurement starts and ends at each connector for an “out and back” measurement configuration, which enhances data calibration. It also ensures redundancy if one of the fibers breaks during deployment.

Data processing was performed by CTEMPs’ data parsing and calibration utility, Distributed Temperature Sensing Toolbox. Data visualization and additional statistical calculations were performed in Octave version 4.2.1.

3.1.2 Field Procedures

FODTS surveys were completed at five locations, using six cable deployments in the Downgradient Study Area where TIR and historic concentration data indicated potential groundwater discharges and/or elevated perchlorate concentrations in surface water. Deployment and extraction required up to six field personnel wading in the water or deploying from canoes where the water depth was too deep to continue to safely wade. To deploy the cable, the end of the fiber optic cable was anchored in place and deployment occurred by pulling fiber optic cable off a spool. Deployment and extraction used two canoes, one holding a fiber optic cable/spool management crew, and the other holding cable anchoring supplies and a crew using a global positioning system (GPS) to mark locations. Cable anchoring was achieved by affixing the cable to natural anchoring features (e.g. plant bases, logs, rocks) or by attaching small concrete blocks to the cable to ensure that it stayed on the stream bottom. Anchor points were installed every 3 to 4 meters along the length of the deployment to ensure that the cable stayed anchored on the bottom and did not move in the LVW current given the large changes in flow from the daily release of waste water. Appropriate strain relief was deployed at sharp inflection points (e.g. turning 90 degrees to cross the LVW at weirs, etc.) in the deployment geometry. Location coordinates were recorded with a field GPS unit. Depending on location, up to 1 kilometer of cable was deployed.

Upon reaching the end of the deployment, the cable and spool were extracted from the canoe and placed in a stable location on the bank of the LVW. The instrument, associated calibration baths, and job box were brought to the same location on the bank. Approximately 15 meters of cable were coiled and placed into each of the two calibration baths, with approximately 5 meters of cable in between. One calibration bath contained ice water to serve as a lower known, nearly static temperature. The other calibration bath contained water that was allowed to fluctuate in response to air temperature changes. High-resolution thermistors were placed in each calibration bath and recorded at the same frequency as the FODTS measurements. These temperatures were used to calibrate the FODTS-derived temperature data. The calibration sequence is discussed in Section 3.2, below. The instrument was placed into the job box for security with the fiber optic cable connectors passed through an access point in the steel enclosure.

Following connection to the fiber-optic cable, the instrument was powered and initialized. The field staff checked for initial cable continuity prior to starting measurements to evaluate any potential fiber breaks/kinks that may have occurred during deployment. Once the cable was checked for continuity, the instrument was set to measure and the measurement cycle began. The instrument was left at each location to measure for at least two days, but generally on the order of approximately 72 or more hours to capture multiple diurnal temperature cycles. In general, two days provides the necessary data to evaluate temperature variations, but three days allows for more certainty. The instrument was powered by two deep-cycle, marine-type batteries and, therefore, required daily trips to ensure the instrument was still operating and to change out power. In addition to changing out power, ice was replenished in the ice calibration bath and data were offloaded from the instrument on a daily basis. Once the deployment was complete, the extraction process occurred in the opposite direction of deployment. All anchoring hardware was removed from the LVW.

3.1.3 Deviations from the SSWIP

The following deviations from the SSWIP (AECOM 2018b) were noted for the FODTS survey:

- Final locations for FODTS deployment were not defined in the SSWIP (AECOM 2018b). AECOM reviewed the TIR data from the TIR survey with the Nevada Division of Environmental Protection (NDEP) and NERT on February 22, 2018 via WebEx to discuss proposed deployment locations for the FODTS. This discussion led to the selection of the FODTS locations shown on **Figure 8**.
- CTEMPs was consulted to ensure the instruments were operating correctly in the field. During the consultation, CTEMPs recommended that the instrument measurement settings be adjusted to less frequent measurement cycles with longer averaging time during the measurement cycle than was specified in the SSWIP (every three minutes, or within best management practices of the method), which would increase signal reliability. Based on CTEMPs recommendation, the measurement averaging time was set to one minute intervals and the instrument was set to record measurements every five minutes. This measurement frequency also ensured that there was sufficient power available to power the instruments between battery change outs.
- Based on conditions in the field, deployments required at least four people to safely handle equipment and canoes instead of the planned two to three-person crews. To maintain productive use of two complete measurement systems, the field crew was focused on deployments and extractions with limited time for additional water quality measurements along the fiber-optic cable deployments.

3.2 Data Analysis

The instrument saves a separate data file for each measurement time creating up to 864 files for a full 72-hour deployment. CTEMPs provides access to a utility to load data files, calibrate FODTS data, and parse the data for the relevant portions of the deployment (e.g. extract out data from the cable on the spool or on land and only include data from the LVW).

Calibration of the FODTS data is required to correct temperatures measured by laser backscatter in the fiber optic cable. Calibration applies offsets to the FODTS-derived data to known temperatures and to extract linear trends in FODTS temperature data due to light attenuation mechanisms inherent in the cable. High-resolution thermistors installed in the calibration baths with the coiled fiber optic cable are used to calibrate the FODTS data. The coiled portions of the fiber optic cable that are in the calibration baths can be used to scale and apply linear corrections to the FODTS data. As mentioned previously, the minibend splice installed at the fiber endpoint (which effectively joins two fibers to double the dataset) for an out and back measurement profile, is used to detrend the measurement profile. This is necessary since the laser light pulse will experience attenuation as it travels the length of the deployment configuration, manifesting as an anomalous linear trend in the temperature profile. The calibration is an automated sequence that is completed with the CTEMPs data utility. The calibration sequence outputs a calibration report, which is included for each deployment. The calibration reports generated by the utility are included in **Appendix G**. Calibration reports are included for each deployment. It should be noted that the times noted in the calibrations sheets are in Greenwich Mean Time (GMT).

Once the FODTS data are calibrated, the dataset is parsed using meter marks on the fiber-optic cable and GPS coordinates indicating the fiber lengths of interest. These data are output to a file that is read by scripts generated in Octave to perform additional visualization and basic statistical calculations. Color images (e.g. "colormaps") are generated by stitching together each temperature profile for the duration of the deployment. A color scheme is chosen for each deployment to accentuate features such that coherent patterns in the data can be identified. In addition to color maps, average temperature and standard deviation of the time series at each location are calculated. These data aid in interpreting color images to pick thermal anomalies. Finally, the meter marks printed on the cable and the GPS coordinates recorded for several meter marks are interpolated for every location along the length of the cable for plotting in the project coordinate system. Thermal anomalies (identified as vertical features of low-variability temperature) are identified relative to the color maps. Locations with groundwater discharge of more constant temperature will have a modulating effect on temperature variability, which is subject to large diurnal swings without the influence of the nearly constant groundwater temperature. The basic statistics calculated from the time series at each location, and the location/setting along the length of the deployment aid in identification of thermal anomalies.

3.3 Summary of FODTS Results

Based on TIR and historic perchlorate results and following discussions with NDEP and NERT, the following reaches were identified for FODTS work:

- Downstream of Upper Narrows Weir – north and south banks – prior to the Sunrise Mountain Weir construction zone.
- Calico Ridge Weir to Lower Narrows Weir – north and south banks
- Lower Narrows Weir to Homestead Weir – north and south banks
- Three Kids Weir to Rainbow Gardens Weir – north and south banks
- Rainbow Gardens Weir to Fire Station Weir – south bank

The locations of the fiber-optic cables and general installation geometry for all reaches are illustrated on **Figure 8**. Temperature data from FODTS surveys are presented as a colormap (time versus distance along cable, with color being temperature) in **Appendix H**. It should be noted that the times noted in **Appendix H** are in Greenwich Mean Time (GMT). Basic statistical information is calculated and plotted for each meter location along the cable beneath the colormap plot (e.g. standard deviation and average temperature). Temperature anomalies are generally identified as vertical features showing low variability in temperature readings in the colormap image. Basic statistics may aid in interpretation where these areas are expected to have lower variability where groundwater inputs at more constant temperature acts to modulate the diurnal signal. **Table 3** summarizes each deployment and the location of the anomalies identified in the FODTS data.

While the working hypothesis was that warmer groundwater would be entering the LVW during this time of year, several cool anomalies were also observed throughout the LVW during the FODTS survey. The hydrogeologic mechanism for creating those cool thermal anomalies in the LVW is not known. In some areas, the LVW was deep and slow enough to perhaps allow some thermal stratification to develop. Near the banks, shading of the water surface by riparian vegetation may have also contributed to some cooler temperatures in protected, slow-moving areas.

The cool anomalies, representing portions of the FODTS cable where water temperature readings were cooler and had lower variability than in surrounding areas, may also have resulted from the discharge of relatively cool groundwater. During the TIR survey in February, groundwater in the dewatering sumps at the Sunrise Mountain Weir construction area was found to be cool relative to surface waters. In contrast, to the 17°C measured at the Sunrise Mountain Weir, the temperature of surface water in the LVW was generally closer to 18 to 20°C, and groundwater emanating downstream of the Three Kids Weir was measured at 23.5°C. There is evidence of cooler groundwater temperatures in the vicinity of the Sunrise Mountain Weir construction area from nearby monitoring wells. The temperature of water measured by the recording pressure transducers in wells near the Sunrise Mountain Weir was generally 20 to 22°C in February and March, while monitoring wells near downstream portions of the LVW generally indicated a temperature of 23 to 25°C. The temperature of groundwater in the upper reaches of the Downgradient Study Area may naturally be cooler, or that temperature may be impacted by pumping activities. Drawdown from pumping for construction dewatering and as part of NERT's ongoing groundwater extraction and treatment from the nearby Seep Well Field may result in a migration of cooler water from different horizons of the source aquifer. Due to the incomplete understanding of the mechanisms behind the cool anomalies, both warm and cool thermal anomalies were considered during the design of the subsequent sampling program.

Results for each reach are summarized in the sections below and anomalous zones are plotted on **Figures 9 through 13**.

<u>Upper Narrows Weir Downstream Deployment</u>

The deployment downstream of the Upper Narrows Weir was configured in a loop-style deployment. The fiber-optic cable was placed on the south bank of the LVW, adjacent to the ongoing construction area. The fiber was installed in an upstream direction, reaching the Upper Narrows Weir where it crossed the LVW to the north bank. The fiber-optic cable was then installed in a downstream direction in the shallow waters of the north bank. Prior to reaching the construction zone on the north bank, the cable was pulled back across the LVW and up the south bank to the location of the instrument and job box. The configuration of the fiber-optic cable and location of temperature anomalies identified along the length of the deployment are shown on **Figure 9**.

Data were collected from February 28, 2018, at 11:25 Pacific Time (PT) to March 3, 2018, at 8:46 PT. Data were collected at six-minute intervals due to a setup issue on this deployment. All other deployments were collected at five-minute intervals. Data were collected with these settings for approximately 69 hours, which achieved nearly three full diurnal cycles. Two warm and one cool anomaly were identified in this reach.

<u>Calico Ridge Weir to Lower Narrows Weir</u>

The fiber-optic cable was installed on the north bank in an upstream direction, crossing at Calico Ridge Weir and continuing downstream along the south bank. The installation geometry formed a U-shaped deployment within the LVW. The instrument was located adjacent to Lower Narrows Weir on the south bank. The configuration of the fiber-optic cable and location of temperature anomalies identified along the length of the deployment are presented in **Figure 10**.

Data collection began on March 14, 2018, at 17:22 PT and ended March 18, 2018, at 8:22 PT. Data were averaged for each channel for one minute and collected at five-minute intervals. The total deployment duration was approximately 87 hours, completing more than three diurnal cycles.

Warm anomalies (temperature greater than the LVW) were noted in the immediate downstream locations from the Calico Ridge Weir on both north and south banks. The warm anomalies on the southern bank appear to be broader/larger in size and a portion may even exhibit some transient behavior related to LVW stage. As the stage, or height of water, in the LVW rises during its diurnal cycle, groundwater discharging near the sides of the channel where velocity is lower sometimes pools up, effectively expanding the area of warmer, groundwater influenced water. This mechanism has been visually observed by AECOM near the Three Kids Weir, where the region of low turbidity (clear) groundwater could be seen to expand during high-flow periods and contract during low-flow periods. In the case of the thermal anomalies near the Calico Ridge Weir, the size of the thermal anomaly changed on a daily, repeating basis. Smaller cool anomalies (temperatures generally cooler than the LVW) were identified along the north and south banks moving downstream toward Lower Narrows Weir.

Lower Narrows Weir to Homestead Weir

The Lower Narrows deployment was installed along the north bank starting at Lower Narrows Weir, progressing downstream to the Homestead Weir where the fiber-optic cable crossed the LVW. The cable was then installed along the south bank moving upstream. The instrument was left in the same location as the Calico deployment (upstream side of the Lower Narrows Weir on the south bank). The layout of the fiber-optic cable and the location of the temperature anomalies are presented on **Figure 11**.

Data were collected between March 20, 2018, at 16:44 PT and March 24, 2018, at 7:24 PT. The total deployment duration was approximately 86 hours, with data collection occurring over three diurnal cycles. Data were averaged for each channel for one minute and collected at five-minute intervals.

In general, this reach can be characterized as having several smaller discrete cool anomalies along both the north and south banks. The larger swath of cool features in the 5052 to 5173 range are presented as a zone, but in reality appear as several discrete cool anomalies in the data. The mechanism contributing to those cool anomalies is uncertain. Between the Calico Ridge and Lower Narrows Weirs, the LVW may be deep and slow enough to cause some thermal stratification; however, the thermal anomalies downstream of the Lower Narrows Weir are located in a very shallow section.

Three Kids Weir to Rainbow Gardens Weir

The Three Kids reach was completed in two separate deployments along the north and south banks. The south bank deployment was completed first and was installed from the Three Kids Weir to Rainbow Gardens Weir. Field conditions (rapid water flow adjacent to the Rainbow Gardens Weir) and safety concerns regarding water depth dictated that the deployment exit the water in a swath of vegetation upstream of the weir. The north bank deployment was installed from Three Kids Weir to the upstream side of Rainbow Gardens Weir. Similar safety concerns were mitigated by exiting the water upstream of the Rainbow Gardens Weir. The layout of the fiber-optic cable and the location of the temperature anomalies are presented on **Figure 12**.

Data were collected at each deployment by averaging each channel for one minute and collecting at five-minute intervals:

- South bank deployment – Data were collected between March 1, 2018, at17:27 PT and March 3, 2018, at 2:02 PT and from March 6, 2018, at 13:45 PT to March 8, 2018, at 13:50:50 P for a total deployment of approximately 80 hours.
- North bank deployment – Data were collected between March 10, 2018, at 15:59 PT and March 15, 2018, at 9:24 PT for a total duration of 112 hours including four full diurnal cycles. The extended deployment on the north bank was due to a rainstorm on March 11, 2018. Sufficient data was collected to insure that the thermal effects of stormflow could be accounted for.

Data collection was temporarily halted in the south bank deployment due to the cable being severed by a rodent. Once the cable was repaired, data collection was restarted. Based on inspection of the data, a total of three diurnal cycles were collected, albeit discontinuously. Despite the discontinuity, the data were sufficient to meet the project goals (consistent anomalous areas were visible in both data sets).

Warm thermal anomalies were identified along the south bank, with broader features identified downstream of the Three Kids Weir. Smaller warm anomalies are also identified in more widely spaced locations in downstream areas on the south bank.

On the north bank, one warm anomaly was identified immediately downstream to the Three Kids Weir. Moving downstream, several smaller, more discrete cool anomalies were identified until the location where the two channels join and the north bank appears to jut out into the LVW. No anomalies were observed on the north bank between this location and the downstream location where the cable exits the water (approximately 2930 to 2610).

Rainbow Gardens Weir to Fire Station Weir

The Rainbow to Fire Station deployment was installed in a linear geometry along the south bank. The deployment was installed upstream from Fire Station Weir to Rainbow Garden Weir. Near the pedestrian bridge spanning the LVW near Power Line Crossing Weir, the cable was stabilized above water over a short span of land (approximately 100 feet). The velocity and depth of the water in that region prevented the safe access for attachment of the cable to the stream channel. The layout of the fiber-optic cable and the location of the temperature anomalies are presented on **Figure 13.**

Data were collected between March 6, 2018, at 01:22 GMT and March 11, 2018, at 00:30 GMT. A small gap in data collection occurred on March 8, 2018, between 18:07 and 18:55 GMT while troubleshooting a power/battery connection issue. DTS data from the first run prior to the power issue were analyzed independently from the second data run after the power issue was troubleshooted. The total deployment length was approximately 118 hours, with data collection occurring over five diurnal cycles. Data were averaged for each channel for one minute and collected at five-minute intervals.

Five cool anomalies were identified along the southern bank of the LVW in the Rainbow Gardens to Fire Station reach. In general, the anomalies appear broader downstream of Three Kids prior to reaching the pedestrian bridge/Power Line Crossing Weir. Consistent with cool anomalies identified in other portions of the LVW, these were generally smaller, more discrete, and lower magnitude in temperature modulation.

3.4 Recommendations for Next Phase

In summary, several cool and warm anomalies were identified with the FODTS deployments across all the reaches that were studied. When comparing locations of historic sampling transects with locations of thermal anomalies in the reaches studied, warm thermal anomalies appear to correlate with elevated perchlorate concentrations (e.g. adjacent to Calico Ridge Weir and Three Kids Weir in Figures 10 and 12, respectively). As discussed in Section 3.3, there may be several mechanisms that resulted in cool anomalies, including the potential for regions of relatively cool groundwater discharge. Due to the incomplete understanding of the mechanisms behind the cool anomalies, both warm and cool thermal anomalies were considered during the design of the subsequent sampling program.

Thermal anomalies identified with aerial TIR and FODTS do not always correlate for a study area of this size where conditions vary from reach to reach. TIR should be considered a reconnaissance tool since it relies on remote sensing and the surface expression of discharge (i.e. skin temperature) to detect processes occurring below the surface in the LVW. Flowing water may obscure the signal or move the surface expression of the discharge signal downstream or to another location in the LVW. FODTS, while not a direct measurement of temperature itself, is more reliable since it is measuring temperature at the sediment interface near where the groundwater discharge occurs and is measured over several days (thus, repeated). TIR represents a broad spatial snapshot at one time, FODTS represents a high resolution (both linearly and temporally), more accurate temperature dataset.

Using the entire temperature dataset (both TIR and FODTS), and historic perchlorate concentrations, surface water sampling locations along proposed transects were adjusted to be located adjacent to strong warm anomalies and to test (via grab samples) cool anomalies. Surface water sampling was conducted between April 30 and May 7, 2018and is discussed in Section 4.

4.0 Surface Water Sampling

Surface water sampling for this investigation was conducted consistent with the SSWIP (AECOM 2018b) and sampling locations were refined based on the findings of the TIR and FODTS data and a discussion with NDEP and NERT. A technical memorandum was prepared to present the recommended modifications to the approved SSWIP (AECOM 2018a). Sampling was conducted in April and May 2018. Daily field reports are provided in **Appendix D**. Daily Health and Safety sheets are provided in **Appendix E**. Details recorded when the samples were obtained are contained in the Log Books provided in **Appendix I**. **Appendix I** also contains the calibration logs for the field equipment used for recording water quality readings.

AECOM's field teams for each of the efforts consisted of two environmental scientists per team. The sampling was performed using three teams (six staff total) collecting surface water samples over a one-week period. The teams collected 66 surface water samples from locations along the 13 transects ("transect sampling") and 18 grab samples from 15 locations.

The location names for the sampling event were consistent with previous sampling programs conducted by AECOM in the LVW in April-May and December 2016, and February 2017. The digits following "LW" (grab samples) or "T" (for transects) indicate the estimated river mile (RM), which is measured from the high pool elevation of Lake Mead (i.e., the elevation [1,221 feet above mean sea level] when the water in Lake Mead reaches the top of the spillway crest of Hoover Dam) (Shanahan and Zhou 2013). RMs and 0.1-mile markers are shown on **Figure 3**.

4.1 Selection of Sample Locations

During the development of the SSWIP, sample locations were proposed based on the results of perchlorate sampling from previous sampling events (AECOM 2017a). However, it was noted that the sampling locations may be modified based on the results of the thermal work (i.e., TIR and FODTS). These data were evaluated, and new locations were proposed. In addition, some locations could not be sampled due to construction activities at Sunrise Mountain Weir. Locations for analytical sampling were selected based on the results of the thermal anomalies identified in the first two phases of the Supplemental Surface Water Investigation program. Locations targeted included both warm and cool thermal anomalies, as well as areas downstream where perchlorate concentration data were generally lacking.

AECOM presented the selection of sample locations results to NDEP and NERT on April 17, 2018. The changes to the SSWIP were documented in a Remedial Investigation Modification technical memorandum dated April 24, 2018, which is provided in **Appendix J**.

4.2 Field Procedures

4.2.1 Procedures

A total of 13 transects were staked and sampled between April 30 and May 7, 2018, within the Downgradient Study Area (**Figure 14**).Teams conducted the field work both on foot and by canoe, as conditions required. Flow periods were forecasted using available United States Geological Survey (USGS) data (https://waterwatch.usgs.gov/?id=ww_current). The alignment of each transect was finalized in the field based on location-specific conditions and health-and-safety considerations. Working generally from the south bank of the LVW, the field teams first staked a sampling location near the bank then proceeded cross-gradient to the direction of surface flow by foot or canoe. A series of mid-channel sampling locations were staked as the teams moved to a sampling location near the opposite bank. The number and location of mid-channel sample locations were based upon a number of factors including: previous observations of cross-sectional perchlorate variability in nearby regions of the LVW; proximity to known or suspected sources of perchlorate inputs; and logistical factors such as water-current strength and health and safety concerns. Between two and six mid-channel sampling locations were selected, for a total of four to eight samples at each transect. Approximately every 5 to 10 feet along each transect, depending on the channel width, a depth to streambed from water surface was measured and recorded. Grab samples were collected at the pre-determined locations. During the sampling event, water was present in the C-1 Channel, which was therefore sampled. Location LW0.9, located approximately 600 feet downstream from where the LVW resurfaces below Lake Las Vegas, was sampled three times to collect samples representative of a variety of concentrations and flows (low, mid, and high flow conditions) that spanned a period of several days.

Surface water samples were collected from grab locations and from locations along transects including near the north and south banks, as well as within the channel along the alignment of each transect. Water quality parameters (temperature, specific conductivity, turbidity, dissolved oxygen, and pH) were measured using a YSI multi-parameter sonde (**Table 4**) prior to sample collection at each location. A minimum of three locations along each transect were sampled and a total of 66 locations were sampled during the transect sampling (**Figure 14**). Coordinates of each sample location were collected in Arc Pad using a hand-held Trimble.

At sample locations with less than 3 feet of water, surface water samples were collected by direct immersion of unpreserved dedicated sample bottles. Bottles were filled from near bottom depth in order to capture any potential seep inputs. For sample locations with 3 feet of water or deeper, a peristaltic pump with dedicated tubing was used to collect samples at one third the total water depth in addition to near the bottom (within several tenths of a foot above the streambed). A total of 84 samples, not including quality control, were collected during the program (**Table 5**). Quality control samples (including field duplicates) were collected in compliance with the Quality Assurance Project Plan (QAPP) (AECOM 2017b). After collection, samples were stored on ice, and transported that day to the local Test America facility for shipment to their Irvine, California, laboratory for analyses of perchlorate, chlorate and total dissolved solids (TDS).

4.2.2 Deviations from SSWIP

Due to conditions encountered in the field, the following deviations from the SSWIP as modified in the RI Modification technical memorandum (**Appendix J**) were noted during the surface water sampling:

- The coordinates for some sample locations were not recorded in the GPS unit at the time of sampling: At two locations along transects (T4.85A and T3.8E), stakes that had been placed at the time of sampling were missing when the team returned to collect GPS data. Those coordinates of those two locations could be accurately approximated along the transect from landmarks observed in the field and on mapping. At a third location (C-1 Channel), the coordinates were not saved correctly to the unit; however, the location of that sample could be accurately mapped relative to nearby features on that tributary stream.
- Samples were not all collected from near-bottom.
- A total of three samples were collected at LW-0.9 instead of the planned five to ten samples. Fewer samples were collected due to time constraints, limited access, and health-and-safety concerns.
- Field water-quality data were not collected for the shallow sample at T4.7B (2.0 feet), the C-1 Channel, or at LW0.9 on May 3 or 5, 2018 (data were collected at LW0.9 on May 4, 2018). In the case of the C-1 Channel and LW0.9, all meters were in use elsewhere at the time of sampling. In the case of T4.7B (2.0), water quality was not recorded for the shallower sample, but was recorded for the deeper sample (5.8 feet).
- At several locations, dissolved oxygen was not recorded in both concentration (milligrams per liter [mg/L]) and percent saturation. At these locations, percent saturation data were estimated using

recorded water temperature and dissolved oxygen concentration assuming an elevation of 1,450 feet NAVD88.

- LW4.45S was not collected. The intended location of this sample was immediately downstream of a cool thermal anomaly observed during the FODTS. During the sampling efforts, attempts to locate that thermal anomaly using water-quality instruments that might indicate the location of groundwater input revealed no appreciable changes in water quality (temperature, DO, pH, specific conductivity, etc.). Instead, the planned grab sample was moved upstream to LW4.48S. Similarly, the intended location for sample LW4.45N was not collected. Instead it was moved upstream and relabeled LW4.48N to indicate pairing with LW4.48S. That pairing allowed a comparison of perchlorate concentrations near both banks close to several zones of cool anomalies

4.3 Analytical Program

The analytical program was focused on Downgradient Study Area groundwater constituents that may affect water quality in the LVW (**Table 6**), with refinements made based on the results of the May 2016 Surface Water Sampling Program. Surface water samples were analyzed for the following constituents:

- Perchlorate (United States Environmental Protection Agency [EPA] Method 314.0);
- Chlorate (EPA Method 300.1); and
- TDS (Standard Method 2540C).

As directed by NDEP, field-filtering of water samples for perchlorate analysis was not required (AECOM 2017b). Copies of the analytical results and chain-of-custody records are provided in **Appendix K**.

4.4 Data Validation

Consistent with the recently revised NDEP requirements (NDEP, 2018), all samples were validated according to Stage 2A data validation procedures (AECOM 2017b). As presented in the Data Validation Summary Report (DVSR; **Appendix L**), there were 84 discrete surface water samples, nine field duplicates (FDs), five equipment blanks (EBs) and five field blanks (FBs).

All surface water samples, FDs and FBs were analyzed for three constituents (chlorate, perchlorate, and TDS). Three EBs were analyzed for three constituents (chlorate, perchlorate, and TDS). At the end of the program, bottleware was limited, so two later EBs were collected and analyzed for perchlorate and TDS only. The equipment used to collect these parameters was all disposable equipment; therefore there is no impact on QAPP objectives or data quality. There were a total of 307 results. Of these, 38 results were qualified by either the laboratory or during data validation. No results were rejected. Based upon the Stage 2A data validation all other results are considered valid and usable for all purposes.

The frequency of qualified results for each component of the surface water investigation was as follows:

- Of the 252 results from the discrete surface water samples, 38 results (15.0 percent) were qualified.

The overall project requirements and completeness levels were met.

4.5 Summary of Staff Gage Maintenance and Transect Cross Sections

Staff gages were installed at eight locations along the LVW in 2017. These staff gages were used primarily during previous sampling periods to fill in gaps in flow record from the five USGS stations present in the Downgradient Study Area.

4.5.1 Staff Gage Maintenance

Of the eight total stations installed by AECOM as part of the February 2017 sampling efforts, one station was buried by the Sunrise Mountain Weir construction (S6.35), three stations required new or re-secured staff gages (S3.75, S4.65, and S4.75), and two stations experienced significant hydraulic changes either as a result of construction at the Historic Lateral Weir Expansion construction (S5.3), or erosion and deposition during peak storm events in 2018 (S3.5). In addition to performing these maintenance activities, all remaining stations were surveyed and downloaded during the May 2018 sampling event. The locations of AECOM surface-water stations and USGS stations are shown in Figure 1.

4.5.2 Cross Sections

Transects were established at 13 locations. To determine where best to collect samples, water depths along each transect were measured at regular intervals. Cross sections were created by plotting these data against the sample locations along each transect and are presented in **Appendix M**.

4.6 Summary of Surface Water Data

Surface water samples were collected from 64 locations along 13 transects (**Table 5** and **Figure 14**). Two surface water locations (T4.7B and T3.5E) were sampled at two depths. **Table 7** presents the analytical results of surface water sampling. The majority of transect samples were collected at or near the daily low within the diurnal flow cycle. At one transect (T4.7) samples were collected at a more moderate flow level during the rise from the daily low. Similarly, most of the grab samples were also collected under low-flow conditions. Many of the grab locations targeted regions of suspected groundwater discharge; therefore, the timing was less critical. However, an attempt was made to collect near the low-flow period to “normalize” the flow condition for all samples. The one exception being the grab samples collected where the LVW resurfaces downstream of Lake Las Vegas. At that location (LW-0.9) a series of grab samples targeted different flow regimes over a series of days.

Surface water samples were collected near the south bank, near the north bank, and at locations along the transects determined during the field event to represent the flow and channelization of the LVW. **Appendix M** shows the sampling locations along the transects with cross sections of depth.

A total of 18 surface water samples were collected from 15 grab sample locations (**Table 5** and **Figure 14**). The locations were generally selected to provide a better spatial representation of the concentrations (i.e., samples downstream of the Downgradient Study Area), to help demonstrate general mixing downstream of previously detected elevated perchlorate concentrations, or were located near thermal anomalies. One location (LW3.2) was sampled at two depths. **Table 7** presents the analytical results of the grab samples.

4.6.1 Field Water Quality Parameters

At each location, a meter was used to measure pH, specific conductivity, dissolved oxygen, turbidity and temperature in the field (**Table 4**). In the transect samples only, temperature ranged from 18.69 to 27.00°C. The water temperature was generally coolest in the samples collected in the morning. Samples in the LVW collected later in the day tended to be warmer. Specific conductivity ranged from 1,320 to 5,040 micro-Siemens per centimeter (µS/cm). The highest conductivity was measured at T4.7 along the south bank, and every sample location along the T4.7 transect had conductivity measurements exceeding 4,800 µS/cm. The pH measurements were generally near neutral to slightly alkaline, ranging from 6.33 to 8.52. Dissolved oxygen readings in the surface water ranged from 2.16 to 13.86 mg/L, and most locations were near or exceeded 100%saturation (saturation was corrected for temperature and atmospheric pressure). Dissolved oxygen was lowest (less than 4 mg/L) in samples T6.55A, T4.8A and B along the south bank of transects; dissolved oxygen was at <50% saturation at these locations. At transects T3.3, T3.9, T4.7, and T6.8, percent saturation of dissolved oxygen was not recorded. Percent saturation data at those transects were estimated using dissolved oxygen concentrations along with water-temperature data and an assumed elevation of 1,450 feet NAVD88. Turbidity ranged from 0.0 to 95.9 Nephelometric Turbidity Units. Higher turbidity was noted along the south bank of T6.8 and T3.5.

In the grab samples only, temperature ranged from 23.21 to 26.48°C. Specific conductivity ranged from 1,970 to 4,130 µS/cm. The highest conductivity was measured at LWC3.7, the location of the historic seep near the Three Kids Weir. The pH measurements were generally near neutral to slightly alkaline, ranging from 7.10 to 8.79. Dissolved oxygen in the surface water ranged from 0.44 to 11.64 mg/L, and most locations were near or exceeded 100% saturation (saturation was corrected for temperature and atmospheric pressure). Dissolved oxygen was lowest in samples from the seep at LWC3.7 (5.70% saturation) and was also low at LW3.5S (30.30% saturation). Turbidity ranged from 0.0 to 18.1 Nephelometric Turbidity Units. The higher turbidity was noted along the south bank at LW4.48S.

4.6.2 Laboratory Analyses Results: Perchlorate

Perchlorate data from the grab samples are presented on **Figure 15**. An overview of the perchlorate data from the transect samples obtained throughout the Downgradient Study Area are presented on **Figure 16.** Thermal anomalies and the perchlorate data, including transect and grab sample data are presented by reach on **Figures 17** through **27**. This section is organized by reach, and presented from upstream to downstream. When comparing the data collected during 2018 to transect sampling efforts in 2017, the impacts of construction dewatering efforts at the Sunrise Mountain Weir and Historic Lateral Weir Expansion construction areas need to be accounted for. During 2018, a large volume of groundwater was being pumped from those weir construction sites to a temporary treatment facility where perchlorate was removed prior to discharge back to the LVW upstream of the Pabco Road Weir. At locations immediately downstream of the Sunrise Mountain Weir construction area, perchlorate concentrations were approximately 13 micrograms per liter (µg/L) lower in 2018. Downstream of the additional dewatering activities at the Historic Lateral Weir Expansion construction area, perchlorate concentrations were approximately 17 µg/L lower in 2018. Further downstream of the construction zones, the rate of change in perchlorate concentration increased such that concentrations at the Rainbow Gardens Weir were very similar during both the 2017 and 2018 sampling events.

4.6.2.1 *Above Duck Creek Confluence*

The data for this reach are presented in **Figure 17**.

<u>Transect T6.8:</u> A total of six samples, including one FD were collected along transect T6.8. Perchlorate was not detected (<0.95 µg/L) in three of five sample locations across the transect upstream of the Duck Creek Confluence Weir. Perchlorate was detected at two mid-channel samples at low concentrations (1.6 J and 1.9 J µg/L). Very similar results were found at Transect T6.8 during the 2017 surface water sampling event (<0.95 µg/L at all but a mid-channel location which had a concentration of 1.6 J µg/L).

4.6.2.2 *Upper Narrows Weir to Sunrise Mountain Weir*

The data for this reach are presented in **Figure 18.**

<u>Transect T6.55:</u> Perchlorate was not detected (<0.95 µg/L) in the two samples on the northern half of the transect immediately downstream of the Upper Narrows Weir. At the south bank, a sample collected at a warm

temperature anomaly was found to contain perchlorate at a concentration of 690 µg/L. A mid-channel sample collected north of the temperature anomaly contained a low perchlorate concentration of 1.3 J µg/L.

Transect T6.5: Perchlorate was not detected (<0.95 µg/L) in three of the four samples collected along the transect upstream of the Sunrise Mountain Weir construction area. A sample collected at the south bank contained perchlorate at a concentration of 13 µg/L. That concentration is likely the result of groundwater discharging (i.e., warm temperature anomaly) along the south bank of the upstream T6.55 transect.

4.6.2.3 *Near Pabco Road Weir*

The data for this reach are presented in **Figure 19**.

Transect T6: Perchlorate was detected in the five samples collected from the transect upstream of the Pabco Road Weir. Concentrations from the south bank to the mid-channel island (1.2 J to 1.4 J µg/L) were lower than concentrations from the island to the north bank (2.7 J to 3 J µg/L). Near the Pabco Road Weir, a series of wastewater discharges forms a complex channel whose main outlet to the LVW is between transect T6 and the weir/ECS (**Figure 19**). The upstream construction of the Sunrise Mountain Weir completely reconfigured the channel morphology near this transect, nearly doubling the channel width and eroding areas near the wastewater discharge channel. As a result, a secondary point of discharge opened upstream of T6. The low concentrations of perchlorate within the treated wastewater are thought to contribute to the relatively diluted concentrations found in the southern portions of the channel. T6 was also sampled during the 2017 sampling event, when it was found to have perchlorate concentrations of 15 to 16 µg/L (AECOM 2016). The reduction in perchlorate concentration between the two events is attributed to the upstream construction of the Sunrise Mountain Weir during the 2018 sampling event, during which a large volume of groundwater containing high concentrations of perchlorate was being pumped from the construction footprint.

4.6.2.4 *C-1 Channel*

The data for the C-1 Channel are presented in **Figure 20**.

C-1 Channel: Perchlorate was detected in one grab sample from the C-1 Channel upstream of its confluence with the LVW. During the 2018 sampling event, an approximately ¼-inch storm resulted in a short-duration flow event in the normally dry C-1 Channel. According to data from the USGS station near the sampling location (USGS 09419745 C-1 CHANNEL ABV MOUTH NR HENDERSON, NV, Figure 1; downloaded July 18, 2018), flow occurred in the channel over a 4-hour period during the evening of May 1, peaking at approximately 92 cubic feet per second (cfs) and ending near midnight. A sample was collected from a pool upstream of the culvert under the dirt access road approximately 61 hours after the cessation of flow. Water in that pool during sampling represented the late-storm flow that had been experiencing evaporation/concentration over a 2.5-day period. Perchlorate was detected in the C-1 sample at a concentration of 1,800 µg/L.

4.6.2.5 *Bostick Weir*

The data collected immediately downstream of Bostic Weir are presented in **Figure 21**.

Transect T4.85: Perchlorate was detected in the five samples collected at the transect immediately downstream of the Bostick Weir. Four of the samples contained similar concentrations (4.7 to 5.3 µg/L), while the sample closest to the southern bank contained a moderately elevated concentration (7.3 µg/L). This finding is consistent with findings during the 2017 sampling event (AECOM 2016), when elevated levels of perchlorate were consistently detected along the southern bank in samples collected from the upstream transect near the proposed Historic Lateral Weir Expansion (transect T5.3, not sampled during the 2018 event due to construction of Historic Lateral Expansion) all the way to the most downstream transect of 2017 (T3.5A). Higher concentrations along the south bank are attributed to both contributions from groundwater along the southern bank, and the downstream mixing of that water into the surface waters of the LVW. In areas with perchlorate gains from near-bank sources, the concentration of perchlorate in mid-channel samples can be considered representative of background concentrations entering those areas. Perchlorate from those near-bank sources then mixes in with the waters of the LVW concentrations of downstream areas.

4.6.2.6 *Calico Ridge Weir to Lower Narrows Weir*

The data for this reach are presented in **Figure 22**.

Transect T4.8: Perchlorate was detected in the five of the samples collected at the transect immediately downstream of the Calico Ridge Weir. The two samples near the middle of the channel contained perchlorate concentrations of 5.4 and 5.8 µg/L while the samples close to the banks were relatively elevated. The sample near the north bank had a concentration of 31 µg/L (five to six times higher than the center of the channel), and two samples near the south bank had concentrations of 1,800 to 3,200 µg/L (30 to 60 times higher than the center of the channel). Transect T4.8 is located a short distance upstream of transect T4.75 sampled during the 2017 event (AECOM, 2017a). In 2017, mid-stream samples at T4.75 had significantly higher perchlorate concentrations (22 J and 23 J µg/L). The reduction of background perchlorate concentrations in mid-channel samples, from 22 J to 23 J µg/L in 2017 to 5 to 6 µg/L in 2018, is largely attributed to groundwater dewatering and treatment activities at the Sunrise Mountain and Historic Lateral Weir Expansion construction areas. Elevated concentrations near the banks relative to mid channel were also found in this area in 2017. A sample from the north bank of T4.75 in 2017 had a concentration of 420 J µg/L, while a sample from the south bank had a concentration of 820 J µg/L. Highly elevated concentrations near the banks relative to mid channel likely reflect a zone of groundwater discharge, as confirmed by the anomalies encountered in the 2018 TIR study and the warm anomaly near this location in the FODTS study (Sections 2.0 and 3.0).

LW4.73S: Perchlorate was detected at this grab location centered in a series of warm temperature anomalies on the southern bank downstream of the Calico Ridge Weir. The concentration of 1,500 µg/L was similar to those detected in two southern bank samples at upstream transect T4.8 in 2018 (1,800 to 3,200 µg/L), and the south bank concentration at transect T4.75 in 2017 (820 J µg/L). LW4.73S is located in a small cove where only limited mixing with upstream waters of the LVW is thought to occur. Together with the strong temperature anomalies from the TIR and FODTS studies, this indicates that the groundwater discharge contributing perchlorate occurs over a relatively broad area (200 feet plus along the south bank).

LW4.73N: Perchlorate was detected at this grab location within of a series of warm temperature anomalies on the northern bank downstream of the Calico Ridge Weir. The concentration of 93 µg/L was 3 times higher than detected in the north bank sample at upstream transect T4.8 in 2018 (31 µg/L), but significantly lower than detected at the north bank at transect T4.75 in 2017 (420 J µg/L). The mechanisms for groundwater discharge along both banks of the LVW below the Calico Ridge Weir are thought to be connected, and may be related to a fault in underlying bedrock. Geologic maps of the area show a mapped fault just north of the Calico Ridge Weir (AECOM, 2019)

Transect T4.7: Perchlorate was detected at the eight sample locations at the transect between the Calico Ridge and Lower Narrows Weirs. A total of nine samples were collected, including both a shallow and deep sample at T4.7B. At T4.7, streamflow in the LVW converges downstream of a large island that splits the channel in two. Samples collected downstream of the southern sub-channel had higher concentrations of perchlorate (21 to 23 µg/L). Samples collected downstream of the northern sub-channel had lower concentrations (10 to 12 µg/L); however, the sample collected close to the north bank was somewhat elevated at 15 µg/L. Samples collected downstream of the island generally had intermediate concentrations (12 to 16 µg/L). Water passing through the Calico Ridge Weir had a perchlorate concentration of approximately 6 µg/L (an average of 5.6 µg/L at T4.8C and T4.8D). After passing along the discharge zones near the south bank, perchlorate concentrations increased to 21 to 23 µg/L (T4.7A, T4.7B1, T4.7B2, and T4.7C). Along the north bank, perchlorate concentrations increased to 10 to 12 µg/L (T4.7F and T4.7G). The elevated reading at the north bank (15 at T4.7H) is thought to reflect continued mixing of nearby groundwater. It should be noted that many of the sample locations at Transect T4.7 were not collected until later in the daily streamflow cycle. Samples from the southern half of the channel were collected under moderate flow conditions, when the daily increase in flow may have caused a dilution of perchlorate concentration as more wastewater entered the channel.

Transect T4.65: Perchlorate was detected in the four samples collected at the transect upstream of the Lower Narrows Weir. The two samples collected in the southern half of the channel had higher concentrations (35 µg/L) than samples collected in the northern half (11 and 14 µg/L). The southernmost samples at T4.65 (35 µg/L) had significantly higher concentrations than samples collected near the south within the transect immediately upstream (21 to 23 µg/L at T4.7). That difference is thought to be related to the timing of sampling, with southern samples at T4.7 being collected under a higher flow period, resulting in increased dilution from wastewater inputs. Based upon results for grab samples collected downstream of the Lower Narrow Weir (discussed below), the higher concentrations at T4.65 (35 µg/L) may better reflect concentrations along this portion of the southern bank of the LVW. Transect T4.65 was also sampled during the 2017 event when it had significantly higher concentrations of 51 and 57 J µg/L near the south bank, and 30 and 31 µg/L near the near the north bank. The reduction in concentrations at T4.65 from 2017 to 2018 (by between 16 to 22 µg/L) is similar in magnitude to the reduction observed in mid-channel concentrations below Transect T4.8 (by between 16 to 18 µg/L). That year-to-year reduction of approximately 17 µg/L is largely attributed to the dewatering activities at the Sunrise Mountain Weir and the Historic Lateral Weir Expansion construction areas during 2018.

LW4.5S: Perchlorate was detected in this grab sample downstream of the Lower Narrows Weir at a concentration of 29 µg/L. That concentration is similar in magnitude to concentrations observed near the south shore in the upstream transect T4.6 (35 µg/L at T4.65A).

LW4.48S: Perchlorate was detected in this grab sample collected within a cool temperature anomaly on the southern bank, downstream of the Lower Narrows Weir. A sample (LW4.45S) had been planned near the terminus of the cool thermal feature; however, field water-quality measurements at that planned location did not indicate anomalous readings and the sample (LW4.48S) was moved upstream within the mapped feature where field observations indicated somewhat anomalous measurements. The concentration of 33 µg/L at LW4.48S was similar to other samples collected at nearby locations near the southern bank (35 µg/L at T4.65, and 29 µg/L at LW4.5S).

LW4.48N: Perchlorate was detected at this grab location cross gradient from the large cool anomaly, downstream of the Lower Narrows Weir. The concentration of 8.9 µg/L was similar to samples collected in 2018 near the northern bank at two transects upstream of the Lower Narrows Weir (10 and 15 µg/L at T4.7 and 11 and 14 µg/L at T4.65).

4.6.2.7 *Homestead Weir*

The data collected immediately downstream of Homestead Weir are presented in **Figure 23**.

Transect T3.9: Perchlorate was detected at the four sample locations immediately downstream of the Homestead Weir. Samples collected in the southern half of the channel had higher concentrations (39 to 44 µg/L) than samples collected in the northern half (23 to 29 µg/L). These concentrations represent a general increase from upstream transect T4.65, which was not expected due to only moderate changes in concentrations observed in the vicinity of the Homestead Weir along this reach during the 2017 sampling event. Based upon flow conditions visible on the recent photo coverage for the Homestead Weir (**Figure 23**), three of the four samples collected at transect T3.9 represent the southern third of the flow entering the Homestead Weir. As such, the higher concentrations from those samples (29 to 44 µg/L at T3.9A, T3.9B, and T3.9C) all reflect the higher concentrations typically observed along the south bank. Only the northernmost sample (T3.9D) reflects the more moderate perchlorate concentrations expected from the middle and northern portions of the channel.

4.6.2.8 *Three Kids Weir*

The data collected immediately upstream and downstream of Three Kids Weir are presented in **Figure 24**.

Transect T3.8: Perchlorate was detected in the five samples collected at the transect upstream of the Three Kids Weir. Samples collected near the south bank had concentrations of 32 and 36 µg/L, while mid-channel samples had concentrations of 19 and 25 µg/L, and a sample collected near the north bank had a concentration of 41 µg/L. T3.8 was also sampled during the 2017 sampling event, when concentrations of 57 J µg/L were found near the south bank, 32 J and 45 J µg/L were found in mid channel, and a sample near the north bank had a concentration of 46 J µg/L. The changes in concentration between events reflect a reduction in overall concentration attributable to groundwater dewatering and treatment efforts associated with the Historic Lateral Weir Expansion and Sunrise Mountain Weir construction areas (approximately 1.7 miles and 2.6 miles upstream, respectively). The relatively high concentrations near the north bank during both the 2017 and 2018 sampling events indicates that some of the thermal anomalies observed during the TIR survey may represent a minor groundwater/perchlorate input.

Transect T3.75: Perchlorate was detected in the five samples collected at the transect immediately downstream of the Three Kids Weir. A sample near the south bank had a concentration of 53 µg/L, while three mid-channel samples had concentrations of 19, 26, and 40 µg/L, and a sample near the north bank had a concentration of 200 µg/L. T3.75 was also sampled in 2017, when concentration of 63 J µg/L was detected near the south bank, 31 and 51 J µg/L were detected in mid channel, and a sample near the north bank had a concentration of 85 µg/L. Mid-channel concentrations and changes between years are similar to those observed at the transect above the weir (T3.8). The relatively high concentration near the north bank of T3.75 (200 µg/L) is further evidence of some perchlorate gains near the weir that exhibited both a TIR and FODTS anomaly (the sample marker for T3.75-E directly overlays the warm FODTS anomaly in **Figure 24**). The relatively high concentration near the south bank (53 µg/L) is likely impacted by the large warm groundwater contribution observed immediately downstream.

LWC3.7: Perchlorate was detected at this grab location downstream of the Three Kids Weir at the KM-67 seep, which was confirmed through TIR and FODTS studies to represent a large, warm temperature anomaly. The concentration during the 2018 sampling program (1,600 µg/L) was similar to the concentration observed during the May 2016 sampling program (1,500 µg/L), and higher than observed during the 2017 sampling event (1,100 µg/L). Groundwater discharging in the region of LWC3.7 enters the LVW below the water surface. Some of the variability between samples may be attributed to the mixing of surface water and groundwater.

LW3.68: Perchlorate was detected at this grab location downstream of the KM-67 seep. TIR and FODTS studies found a second large, warm anomaly immediately downstream of that seep. Observations in the field indicate that the second anomaly is contiguous with the KM-67 anomaly, with the intervening area being masked by wetland vegetation. The sample collected at LW3.68 had a concentration of 980 µg/L.

LW3.5S: Perchlorate was detected in the grab sample collected in the southern sub-channel that passes along the groundwater discharge zone sampled at LWC3.7 and LW3.68. Sample LW3.5S contained a perchlorate concentration of 96 µg/L, or approximately twice the concentration of water upstream of the discharge zone (40 and 53 µg/L in samples collected near the southern bank of transect T3.75).

4.6.2.9 *Upstream of Rainbow Gardens Weir*

The data collected from upstream of the Rainbow Gardens Weir are presented in **Figure 25**.

Transect T3.5: Perchlorate was detected at the five sampling locations at the transect midway between the Three Kids Weir and Rainbow Gardens Weirs. A total of seven samples were collected along this transect, including a FD and a deeper sample at one location. Perchlorate concentrations were highest along the southern half of the channel where the LVW passes through a series of small channels separated by small islands (85, 90, and 91 µg/L). This flow pattern limits the northward mixing of perchlorate added by groundwater discharge downstream of the Three Kids Weir. In the northern portion of the channel, perchlorate concentrations were between 33 and 38 µg/L. The transect was also sampled in 2017 when similar concentrations were found along the southern half (73, 98, and 140 µg/L) and higher concentrations in the mid-to-northern portions of the channel (37 to 66 µg/L).

Transect T3.3: Perchlorate was detected at the five samples collected at the transect upstream of the Rainbow Gardens Weir. Between the upstream transect at T3.5 and transect T3.3, flow in the LVW is largely split into a northern and southern channel, separated by several islands and shallow alluvial deposits in the middle. Along transect T3.3, the southern channel turns northward to join the northern channel in its northeast course to the Rainbow Gardens Weir. As a consequence of that channel configuration, the flow path of surface waters runs parallel to transect T3.3 along its southern half. Perchlorate concentration was highest at the southernmost sample location (96 µg/L) then gradually reduced along the bank (89 and 81 µg/L) as more surface water flow converges and mixes. Those concentrations are similar to samples collected near the southern half of the upstream transect T3.5 (90 to 85 µg/L). The somewhat elevated concentration in the southernmost sample at T3.3 (96 µg/L) may be an indication of some minor perchlorate contribution from a small, warm anomaly detected during the FODTS survey near the southern bank of the transect. A sample collected near the north bank had a concentration of 33 µg/L, which is similar to the concentration observed in the northern half of T3.5. A mid-channel sample collected at T3.3 where the northern and southern flow paths converge had a perchlorate concentration of 72 µg/L.

4.6.2.10 *Rainbow Gardens Weir to Fire Station Weir*

The data for this reach are presented in **Figure 26**.

LW3.4: Perchlorate was detected in the grab sample collected immediately downstream of the Rainbow Gardens Weir. The perchlorate concentration of 52 µg/L during the 2018 sampling event was similar to the concentration observed during a May 2016 sampling event (52 µg/L during low-flow conditions), and under low-to moderate flow conditions during the 2017 sampling event (42 to 57 µg/L). The 2018 sample was collected during the daily low-flow. Samples collected by AECOM under higher flow conditions have been found to contain lower concentrations of perchlorate (38 J to 39 during the afternoon high-flow periods of the 2017 sampling event, and 33 during the morning recession from high flows in December 2016).

LW3.2: Perchlorate was detected in the grab samples collected near the southern bank downstream of a series of anomalies between the Rainbow Gardens and Powerline Crossing Weirs. Two samples were collected at LW3.2: a deep sample near the bottom of the channel (3.9 feet); a shallow sample closer to the surface (1.33 feet). The results for the samples, which were collected during a low-flow period, were similar (50 µg/L in the shallow sample and 49 µg/L in the deep sample). The similarity of those results and in comparison to upstream results at LW3.4 (52 µg/L) indicate that the cool anomaly does not represent a potential groundwater pathway for additional perchlorate.

LW3.15: Perchlorate was detected (50 µg/L) in the grab sample collected near the southern bank downstream of a series of cool anomalies above the Powerline Crossing Weir. The similarity of this result to upstream samples (49 to 50 and 52 µg/L at LW3.2 and LW 3.4, respectively) further indicates that the cool anomalies in this area do not represent an inflow of perchlorate-laden groundwater. The samples at LW3.15 were collected under more moderate flow conditions. The results from the 2017 sampling event indicate that perchlorate concentrations in this portion of the LVW may not vary significantly between low and moderate flows.

LW3.11: Perchlorate was detected (47 µg/L) in the grab sample collected near mid channel immediately upstream of the Powerline Crossing Weir. This concentration is similar to those found in the other upstream grab samples below the Rainbow Garden Weir (49 to 52 µg/L at LW3.4, LW3.2, and LW3.15).

LW3.1: Perchlorate was detected in the grab sample collected upstream of the Fire Station Weir. The perchlorate concentration of 45 µg/L was somewhat lower than the concentration found in other samples downstream of the Rainbow Gardens Weir (47 to 52 µg/L). LW3.1 was also sampled during the 2016 sampling event under low-flow conditions when a concentration of 51 µg/L was detected.

4.6.2.11 *Below Lake Las Vegas*

These data are presented in **Figure 27**.

LW0.9: Perchlorate was detected in the grab samples collected downstream of the outlet below Lake Las Vegas. Three samples were collected over a three-day period under varying flow conditions. Perchlorate concentrations were detected between 38 and 49 µg/L. Under low-flow conditions (one sample), perchlorate was detected at a concentration of 49 µg/L, which is very similar to concentrations detected in other grab samples downstream of Rainbow Gardens Weir (45 to 52 µg/L). The sample collected under more moderate flow conditions during the morning recession from peak flows contained perchlorate at somewhat lower concentrations (40 µg/L). The sample collected during the afternoon peak flow contained even lower perchlorate concentrations (38 µg/L).

In the absence of dewatering activities at the upstream construction areas for the Sunrise Mountain Weir and Historic Lateral Weir Expansion, perchlorate concentrations would have been higher at all downstream sampling locations. Between the 2017 sampling event (prior to construction) and the 2018 sampling event (during construction), perchlorate concentrations immediately below the construction areas decreased by approximately 17 µg/L. Assuming that concentrations during 2018 in the absence of dewatering would have been similar to concentrations observed during 2017, perchlorate concentrations at LW0.9 would have been 52 to 66 µg/L (35 to 49% higher).

4.6.3 Laboratory Analyses Results: Chlorate

The chlorate data from the grab samples is presented on **Figure 28**. An overview of the chlorate data from the transect samples is presented on **Figure 29**. The thermal anomalies and the chlorate data by reach, including transect and grab sample data are presented on **Figures 30 through 40**. This section is organized by reach, and presented from upstream to downstream.

Except for sample locations with close proximity to known groundwater inputs, chlorate results during the 2018 sampling event were generally steady throughout the LVW on any given day; however, the chlorate concentrations appear to vary significantly from day to day. At transects that were sampled on May 1 and 3 (T6.8, T6.55, T6.5, T6, T4.8, T4.7, T4.65, and T3.8), chlorate concentrations ranged from 48 to 200 µg/L (ignoring the concentrations near south bank inputs at T6.55 and T4.8, which were 460 to 13,000 µg/L, respectively). At transects that were sampled on May 4 and 5 (T4.85, T3.9, T3.75, T3.5, and T3.3), chlorate concentrations were generally much higher at 370 to 690 µg/L. This change in chlorate concentration cannot be explained by dilution from stormflow during the May 1 and 3 sampling dates. Approximately ¼ inch of rain fell in the region mid-day on May 1, at which point sampling was temporarily halted. Sampling was resumed on May 3, and no further precipitation was recorded during the sampling event. Some grab samples were collected on May 6 (LW3.2, LW3.15, LW3.11, and LW3.1), and chlorate results indicate concentrations had dropped to 220 to 240 µg/L. In contrast, a grab sample collected immediately upstream of those locations (LW3.4) had a chlorate concentration of 630 µg/L on May 4. Laboratory results for other sample parameters (perchlorate in Section 4.6.3 and TDS in Section 4.6.5) did not reflect this day-to-day pattern of concentration fluctuations.

4.6.3.1 *Above Duck Creek Confluence*

These data are presented in **Figure 30**.

Transect T6.8: Chlorate was detected in the five sample locations across the transect upstream of the Duck Creek Confluence Weir. A total of five samples were collected along the transect. Chlorate was detected at two samples near the south bank (both at 100 µg/L), and at similar, but slightly lower concentrations moving north (90 J, 88 J and 90 J µg/L) from mid-channel to the north bank.

4.6.3.2 *Upper Narrows Weir to Sunrise Mountain Weir*

These data are presented in **Figure 31.**

Transect T6.55: Chlorate was detected in the four sample locations across the transect downstream of the Upper Narrows Weir. Chlorate was detected at low concentrations immediately downstream of the Upper Narrows Weir, similar to upstream samples from the northern half of the transect T6.8. Concentrations from north to south at T6.55 were 91 J, 85 J and 94 J µg/L. At the south bank, a sample collected at a warm temperature anomaly was found to contain chlorate at a concentration of 460 µg/L. The nearest mid-channel sample contained a low concentration (94 J µg/L).

Transect T6.5: Chlorate was detected in the four samples from the transect upstream of the Sunrise Mountain Weir construction area. Concentrations from south bank to north bank were similar (110, 81 J, 130, and 94 J µg/L).

4.6.3.3 *Near Pabco Road Weir*

These data are presented in **Figure 32**.

Transect T6: Chlorate was detected in the five samples collected from the transect upstream of the Pabco Road Weir. Concentrations from the south bank to the mid-channel island (150, 200 and 150 µg/L) were higher than concentrations from the mid-channel island to the north bank (64 J and 71 J µg/L). As described in Section 4.6.3.3, the upstream construction of the Sunrise Mountain Weir had completely reconfigured the channel morphology at this transect. Surface water can be seen mixing into the area of treated wastewater through a secondary channel southwest of the transect in **Figure 19**. T6 was also sampled during the 2017 program, when it was found to have chlorate concentrations of 49 to 50 µg/L. This increase in chlorate concentration between the two sampling events is attributed to the construction of the Sunrise Mountain Weir and the Historic Lateral Weir Extension during the 2018 event. The large volume of groundwater containing high concentrations of perchlorate was being pumped from the construction areas was treated for perchlorate, and discharged to the LVW through the wastewater treatment channel upstream of the Pabco Road Weir. Groundwater in that area likely had elevated chlorate concentrations as well, with the treatment process focused on removing perchlorate, not chlorate, although concentrations of other anions (such as chlorate) may be affected by the treatment as well.

4.6.3.4 *C-1 Channel*

These data are presented in **Figure 33**.

C-1 Channel: Chlorate was detected in a grab sample from the C-1 channel upstream of its confluence with the LVW at a concentration of 3,100 µg/L.

4.6.3.5 *Bostick Weir*

These data are presented in **Figure 34**.

Transect T4.85: Chlorate was detected in the five samples collected at the transect immediately downstream of the Bostick Weir. Most of the samples contained similar concentrations (560 to 590 µg/L), while the sample closest to the southern bank contained a moderately lower concentration (400 µg/L). That south bank sample was located in a backwater channel isolated from the main flow of the LVW.

4.6.3.6 *Calico Ridge Weir to Lower Narrows Weir*

These data are presented in **Figure 35**.

Transect T4.8: Chlorate was detected in the five samples collected within the transect immediately downstream of the Calico Ridge Weir. Samples near the middle of the channel and the north bank contained chlorate concentrations of 48 J to 87 µg/L, while the samples close to the south bank were much higher at 6,500 and 13,000 µg/L. Transect T4.8 is located a short distance upstream of transect T4.75 from the 2017 sampling event. In 2017, chlorate showed the same pattern, with lowest concentration on the north bank and highest on the south bank.

LW4.73S: Chlorate was detected at this grab location centered in a series of warm temperature anomalies on the southern bank, downstream of the Calico Ridge Weir. The concentration of 6,700 µg/L was high, similar to those detected in two southern bank stations at the nearby upstream transect T4.8, and the south bank concentration at transect T4.75 in 2017 (3,100 J µg/L).

LW4.73N: Chlorate was detected at this grab sample near the downstream end of a series of warm temperature anomalies on the northern bank, downstream of the Calico Ridge Weir. The concentration of 440 µg/L was almost 10 times higher than detected in the north bank sample at the nearby upstream transect T4.8 and at the north bank at transect T4.75 in 2017 (35 J µg/L).

Transect T4.7: Chlorate was detected at the eight sample locations within the transect between the Calico Ridge and Lower Narrows Weirs. A total of nine samples, including a deeper sample at one location were collected. At T4.7, streamflow in the LVW reconvenes below a large island that splits the channel in two. The concentrations of chlorate are overall similar compared to those at T4.8, and vary by a factor of approximately 2. Concentrations are lower on the north bank to mid-stream (75 J to 83 J µg/L), and increase from mid-channel to the south bank (140 to 160 µg/L). There was little difference in the “B” sample collected at two depths; 170 µg/L in the shallow sample (2 feet) and 160 µg/L in the deep sample (5.8 feet).

Transect T4.65: Chlorate was detected in the four samples collected within the transect upstream of the Lower Narrows Weir. Samples collected in the southern half of the channel (both at 200 µg/L) had higher concentrations than samples collected in the northern half (68 J and 77 J µg/L). This pattern is similar to T4.7.

LW4.5S: Chlorate was detected at this grab sample location at the southern bank, downstream of the Lower Narrows Weir. The concentration of 170 µg/L was generally consistent with the concentrations measured in samples near the southern bank of upstream transects (160 and 200 at T4.7A and T4.65A).

LW4.48S: Chlorate was detected at this grab location within a cool temperature anomaly on the southern bank, downstream of the Lower Narrows Weir. The concentration of 180 µg/L was similar to the sample collected upstream of the cool anomaly (170 at LW4.5S).

LW4.48N: Chlorate was detected at this grab location cross gradient from the cool anomaly, downstream of the Lower Narrows Weir. The concentration of 81 J µg/L was similar to samples collected in 2018 near the northern bank at two transects upstream of the Lower Narrows Weir (75 J and 68 J µg/L at T4.7H and T 4.65D, respectively).

4.6.3.7 *Homestead Weir*

These data are presented in **Figure 36**.

Transect T3.9: Chlorate was detected at the four sample locations immediately downstream of the Homestead Weir. Samples collected near the south and north banks (390 and 450 µg/L, respectively) had lower concentrations than samples collected in mid-channel (580 and 590 µg/L). These concentrations represent an approximate fourfold increase in chlorate from upstream transect T4.65, which was not expected due to only moderate changes observed between transects T4.65, T4.6, T4.2, and T3.8 during the 2017 sampling event.

The increase in chlorate concentrations between transect T4.65 and T3.9 in 2018 is related to a general shift in chlorate concentrations within the LVW between the sampling days (T4.65 on May 3, and T3.9 on May 4, 2018).

4.6.3.8 *Three Kids Weir*

These data are presented in **Figure 37**.

Transect T3.8: Chlorate was detected in the five samples collected at the transect upstream of the Three Kids Weir. Samples collected near the south bank had concentrations of 190 and 180 µg/L, while mid-channel samples had slightly lower concentrations (140 and 130 µg/L). The north bank sample was similar to the near south bank samples (170 µg/L). T3.8 was also sampled during the 2017 transect event, when concentrations of 270 µg/L were found near the south bank and 210 µg/L was detected in-stream from the south bank. The concentrations detected in 2018 have a similar pattern as those detected during the 2017 sampling event.

Transect T3.75: Chlorate was detected in the five samples collected within the transect immediately downstream of the Three Kids Weir. A sample near the south bank had a concentration of 510 µg/L, while mid-channel samples had concentrations of 440 to 490 µg/L, and a sample near the north bank had a concentration of 690 µg/L. T3.75 was also sampled in 2017, when a concentration of 270 µg/L was found near the south bank, 210 and 110 µg/L were found in mid channel, and a sample near the north bank had a concentration of 260 µg/L. The concentrations from the 2018 sampling event are two to three times higher than measured concentrations at the transect in 2017, and results from T3.8 in 2018.

LWC3.7: Chlorate was detected at this grab sample location downstream of the Three Kids Weir at the KM-67 seep, which was confirmed through TIR and FODTS studies to represent a large, warm temperature anomaly. The concentration measured during the 2018 sampling program was 4,400 µg/L. Similar high concentrations have been detected previously.

LW3.68: Chlorate was detected at this grab sample location downstream of the KM-67 seep. TIR and FODTS studies found a second large, warm anomaly immediately downstream of that seep. Observations in the field indicate that the second anomaly is contiguous with the KM-67 anomaly, with the intervening area being masked by wetland vegetation. The sample collected at LW3.68 had a perchlorate concentration of 3,100 µg/L.

LW3.5S: Chlorate was detected in the grab sample collected in the southern sub-channel that passes along the groundwater discharge zone sampled at LWC3.7 and LW3.68. Sample LW3.5S contained a chlorate concentration of 740 µg/L, which is approximately 50% higher than the concentration of chlorate upstream of the discharge zone (460 to 510 µg/L in samples collected near the southern bank of transect T3.75, sampled on the same day and at a similar flow as LW3.5S). The increase in concentration is attributed to the warm discharge zone along the southern bank near the grab samples collected at LWC3.7 and LW3.68.

4.6.3.9 *Upstream of Rainbow Gardens Weir*

These data are presented in **Figure 38**.

Transect T3.5: Chlorate was detected at the five sampling locations within the transect approximately midway between the Three Kids and Rainbow Gardens Weirs. A total of seven samples were collected, including a field duplicate and a deeper sample at the T3.5E location). Chlorate concentrations closest to the southern bank were lowest at 370 µg/L, then increased to 450 and 520 µg/L before mixing with flow from the northern half of the LVW. Samples collected from the middle of the channel and near the north bank contained relatively moderate levels of perchlorate (390 to 450 µg/L). This transect was also sampled in 2017, with a similar pattern of concentrations observed. During 2017, however, samples from the north bank were significantly lower than at other locations along the transect (140 to 190 µg/L at the north bank versus 270 to 430 µg/L in mid and southern samples).

Transect T3.3: Chlorate was detected in the five samples collected within the transect upstream of the Rainbow Gardens Weir. Between the upstream transect at T3.5 and transect T3.3, flow in the LVW is largely split into a northern and southern channel, separated by several islands and shallow alluvial deposits in the middle. Along transect T3.3, the southern channel turns northward to join the northern channel in its northeast course to the Rainbow Gardens Weir. As a consequence of that channel configuration, the flow path of surface waters runs parallel to transect T3.3 along its southern half. Chlorate concentration was highest at the southernmost sample location (620 µg/L), relatively moderate along other southern samples and in the middle of the channel (500 to 560 µg/L), and were lowest near the north shore (450 µg/L). The somewhat elevated concentration in the southernmost sample at T3.3 (620 µg/L) may be an indication of some minor chlorate contribution from a small, warm anomaly near the southern bank of the transect.

4.6.3.10 *Rainbow Gardens Weir to Fire Station Weir*

These data are presented in **Figure 39**.

LW3.4: Chlorate was detected in the grab sample collected immediately downstream of the Rainbow Gardens Weir at a concentration of 630 µg/L. The sample was collected on May 4, when chlorate results from other samples also indicated a general increase in concentration throughout the LVW. Other grab samples in this section of the stream (discussed below) were collected on May 6 when chlorate concentrations were significantly lower.

LW3.2: Chlorate was detected in the grab samples collected near the southern bank downstream of a series of cool anomalies between the Rainbow Gardens and Powerline Crossing Weirs. Two samples were collected at LW3.2, with all containing a similar concentration of chlorate: a deep sample (3.9 feet) near the bottom of the channel (220 µg/L) and a shallow sample (1.33 feet) closer to the surface (240 µg/L);.

LW3.15: Chlorate was detected (220 µg/L) in the grab sample collected near the southern bank downstream of a series of cool anomalies upstream of the Powerline Crossing Weir. It should be noted that the samples at LW3.15 were collected under more moderate flow conditions, while other nearby samples were collected closer to the daily low flow.

LW3.11: Chlorate was detected (230 µg/L) in the grab sample collected near mid channel immediately upstream of the Powerline Crossing Weir.

LW3.1: Chlorate was detected in the grab sample collected upstream of the Fire Station Weir at a concentration of 240 µg/L.

4.6.3.11 *Below Lake Las Vegas*

These data are presented in **Figure 40**.

LW0.9: Chlorate was detected in the grab samples collected downstream of the outlet below Lake Las Vegas. Three samples were collected over a three-day period under varying flow conditions. Chlorate was detected at concentrations ranging between 150 to 510 µg/L. Under low-flow conditions (collected on May 4), chlorate was detected at a concentration of 510 µg/L. Under more moderate flow conditions during the morning recession from peak flows, the grab sample contained chlorate at a relatively moderate level (270 µg/L). The sample collected on May 3 during the afternoon peak flow contained a lower chlorate concentration (150 µg/L).

4.6.4 Laboratory Analyses Results: Total Dissolved Solids

The TDS data from the grab samples is presented on **Figure 41**. An overview of the TDS data from the transect samples is presented on **Figure 42**. The thermal anomalies and the TDS data by reach, including transect and grab sample data are presented on **Figures 43 through 53**. This section is organized by reach, and presented from upstream to downstream.

4.6.4.1 *Above Duck Creek Confluence*

These data are presented in **Figure 43**.

Transect T6.8: Five samples were collected along this transect upstream of the Duck Creek Confluence Weir. TDS was highest in the three sampled toward southern half of the channel (1,600 to 1,700 mg/L) and lower in the two samples collected towards the north shore (1,100 to 1,200 mg/L).

4.6.4.2 *Upper Narrows Weir to Sunrise Mountain Weir*

These data are presented in **Figure 44.**

Transect T6.55: TDS near the south bank was highest at 3,800 mg/L within the transect immediately downstream of the Upper Narrows Weir. That location was within a warm temperature anomaly encountered during the thermal studies conducted earlier in the year. TDS decreased to 1,500 mg/L towards mid-channel, and 1,200 mg/L towards the north bank.

Transect T6.5: TDS near the south bank of the transect upstream of the Sunrise Mountain Weir construction area remained somewhat elevated at 1,600 mg/L. Samples collected from the middle of the channel and close to the north bank contained 1,100 to 1,200 mg/L of TDS.

4.6.4.3 *Near Pabco Road Weir*

These data are presented in **Figure 45**.

Transect T6: At the transect upstream of the Pabco Road Weir, TDS was slightly higher on the south bank of the mid-channel island (1,500 mg/L), and lower on the north bank (1,300 mg/L).

4.6.4.4 *C-1 Channel*

These data are presented **Figure 46**.

C-1 Channel: TDS was detected in a grab sample from the C-1 channel upstream of its confluence with the LVW at a concentration of 3,100 mg/L.

4.6.4.5 *Bostick Weir*

These data are presented in **Figure 47**.

Transect T4.85: Five samples were collected within the transect immediately downstream of the Bostick Weir and all contained similar concentrations of TDS (1,300 and 1,400 mg/L).

4.6.4.6 *Calico Ridge Weir to Lower Narrows Weir*

These data are presented in **Figure 48**.

Transect T4.8: Five samples were collected within the transect immediately downstream of the Calico Ridge Weir. Samples near the middle of the channel had the lowest concentration of TDS (1,300 mg/L), a sample near the north bank had a somewhat higher concentration (1,500 mg/L), and samples close to the south bank were much higher (2,700 to 3,800 mg/L). Samples collected near the north and south banks were within warm thermal anomalies and close to potential groundwater discharge zones.

LW4.73S: A short distance downstream of transect T4.8, a sample was collected within a warm temperature anomaly on the south bank. Sample LW4.73S contained the same concentration of TDS to a south bank sample at transect T4.8 (2,700 mg/L).

LW4.73N: Similarly, a short distance downstream of transect T4.8, a sample was collected within a warm temperature anomaly on the north bank. Sample LW4.73N contained the same concentration of TDS to a north bank sample at transect T4.8 (1,500 mg/L).

Transect T4.7: A total of nine samples were collected at eight sample locations at the transect between the Calico Ridge and Lower Narrows Weirs. All samples contained similar concentrations of TDS (1,300 and 1,400 mg/L). No difference was detected between a shallow and a deep sample at location T4.7B.

Transect T4.65: Four samples were collected at the transect upstream of the Lower Narrows Weir. All samples contained a similar concentration of TDS (1,300 and 1,400 mg/L).

LW4.5S: A grab sample was collected upstream from a series of cool thermal anomalies downstream of the Lower Narrows Weir. TDS was detected at LW4.5S at a concentration of 1,400 mg/L.

LW4.48S: A grab sample was also collected within the series of anomalies downstream of the Lower Narrows Weir. TDS was detected at LW4.48S at a concentration of 1,400 mg/L.

LW4.48N: At a grab location cross gradient from the series of cool anomalies, downstream of the Lower Narrows Weir, the concentration of TDS was also 1,400 mg/L.

4.6.4.7 *Homestead Weir*

These data are presented in **Figure 49**.

Transect T3.9: TDS was detected at a similar concentration at the four sample locations immediately downstream of the Homestead Weir (1,300 and 1,400 mg/L).

4.6.4.8 *Three Kids Weir*

These data are presented in **Figure 50**.

Transect T3.8: TDS was detected at the same concentration in the five samples collected within the transect upstream of the Three Kids Weir (1,300 mg/L).

Transect T3.75: Downstream of the Three Kids Weir, a sample on the north bank had a slightly elevated level of TDS (1,600 mg/L), while samples collected at the other four locations contained TDS at a concentration of 1,300 mg/L.

LWC3.7: TDS was detected at this grab sample location downstream of the Three Kids Weir at the KM-67 seep, which was confirmed through TIR and FODTS studies to represent a large, warm temperature anomaly. The concentration measured during the 2018 sampling program was 3,200 µg/L. Similar high concentrations were detected at this groundwater discharge area in 2017 at 3,300 mg/L.

LW3.68: TDS was elevated at this grab sample location downstream of the KM-67 seep. TIR and FODTS studies found a second large, warm anomaly immediately downstream of that seep. Observations in the field indicate that the second anomaly is contiguous with the KM-67 anomaly, with the intervening area being masked by wetland vegetation. The sample collected at LW3.68 had a concentration of 2,500 mg/L.

LW3.5S: A sample was collected in the southern sub-channel that passes along the groundwater discharge zone sampled at LWC3.7 and LW3.68. Sample LW3.55 contained a TDS concentration of 1,400 mg/L, similar to the concentration of water upstream of the discharge zone (1,300 mg/L in samples collected near the southern bank of transect T3.75).

4.6.4.9 *Upstream of Rainbow Gardens Weir*

These data are presented in **Figure 51**.

Transect T3.5: TDS was detected at similar concentrations at the five sampling locations along the transect midway between the Three Kids Weir and Rainbow Gardens Weirs. A total of six samples, including a deeper sample location at one location, were collected. Five of the six samples contained a TDS concentration of TDS 1,500 mg/L, while the deeper sample (6.4 feet) at location T3.5E contained a slightly lower concentration of 1,400 mg/L.

Transect T3.3: TDS was detected at a concentration of 1,400 mg/L in the five samples collected at the transect upstream of the Rainbow Gardens Weir.

4.6.4.10 *Rainbow Gardens Weir to Fire Station Weir*

These data are presented in **Figure 52**.

LW3.4: TDS was detected in the grab sample collected immediately downstream of the Rainbow Gardens Weir at a concentration of 1,400 mg/L.

LW3.2: Shallow (1.33 feet) and deep (3.9 feet) grab samples were collected near the southern bank downstream of a series of cool anomalies between the Rainbow Gardens and Powerline Crossing Weirs. Both samples contained a TDS concentration of 1,400 mg/L.

LW3.15: TDS was detected in the grab samples collected near the southern bank downstream of a series of cool anomalies upstream of the Powerline Crossing Weir at a concentration of 1,400 mg/L.

LW3.11: TDS was detected in the grab sample collected near mid channel immediately upstream of the Powerline Crossing Weir at a concentration of 1,400 mg/L.

LW3.1: TDS was detected at a concentration of 1,400 mg/L in the grab sample collected upstream of the Fire Station Weir.

4.6.4.11 *Below Lake Las Vegas*

These data are presented in **Figure 53**.

LW0.9: TDS was detected at a concentration of 1,400 mg/L in the three grab samples collected downstream of the outlet below Lake Las Vegas. These samples were collected over a three-day period under flow conditions that ranged from the daily low-flow (228 cfs at the nearby USGS gaging station), to a moderate flow (256 cfs), to the daily high-flow (365 cfs).

4.7 Quality Control Samples

Field quality control samples collected during this sampling event included nine FDs, five FBs, and five EBs. The EBs and FBs were analyzed for perchlorate and TDS, and four EBs and four FBs were analyzed for chlorate. In addition, laboratory quality control samples included method blanks, laboratory control sample, matrix spike/matrix spike duplicate (MS/MSD), and laboratory duplicate analyses. A detailed discussion of quality control and data validation is included in the DVSR (**Appendix L**).

The FD samples were collected for nine primary samples (DVSR Table 5). Acceptable field and analytical precision was demonstrated for all analytes for the FD pairs (relative percent difference <30% between the primary and duplicate sample as specified the QAPP, AECOM 2017b [DVSR Table 5]). In addition, acceptable analytical precision was demonstrated for all TDS laboratory duplicate analyses.

Five EB samples and five FB samples were collected and analyzed. Target analytes were not detected in EBs and FBs. Target analytes were not detected in the method blanks. All laboratory control samples and MS/MSD recoveries reported by the laboratory were within control criteria with one exception. The recoveries for one MS/MSD pair for chlorate were outside of control criteria. Consequently, the results for chlorate for eight samples were qualified as estimated ("J-"). Details of these qualifications are provided in DVSR.

5.0 Perchlorate Flux Estimates

The perchlorate results were converted from concentrations (in µg/L) to estimates of perchlorate mass (“flux” in pound per day [lb/day]) along reaches of the LVW within and downstream of the Downgradient Study Area using estimates of streamflow in the LVW at the time of sampling. The estimation of perchlorate flux was not a primary goal of the sampling program; however, much of the data collected during the 2018 sampling event allows for a comparison to the mass flux estimated from the 2017 sampling event to evaluate for changes over time. One significant change between sampling events is the construction of the Sunrise Mountain Weir and the Historic Lateral Weir Expansion during the 2018 event. During construction, a large volume of groundwater was being pumped, treated for perchlorate contamination, and discharged along with other wastewater discharges near the Pabco Road Weir. That action significantly reduced perchlorate concentrations in those portions of the Downgradient Study Area that were downstream of the dewatering operations.

5.1 Screening of Samples

The transect and grab sampling data both had a wide range of perchlorate concentrations and did not show a consistent curve of increase with distance downstream. The transect sampling was designed to identify loci across the LVW that may be contributing to perchlorate inputs. During the grab sampling, many of the samples collected near suspected or previously unknown perchlorate inputs show up as “anomalously” high concentrations. In order to insure that such anomalously high sample point results did not skew the mass flux estimates for the LVW along the Downgradient Study Area, sample data were evaluated and sub-sets of transect and grab data were selected for analysis that were deemed to be more representative of nearby reaches of the LVW as a whole. The interpretation and reduction of sample data for the purposes of calculating flux estimates is described in Sections 5.3 and 5.4.

5.2 Estimates of Flow

AECOM estimated streamflow at the transects and the grab sample locations using the six permanent and temporary stream gaging stations operated by the USGS. The locations of the following USGS stations along the LVW within the Downgradient Study Area are shown on **Figure 54**:

- Below Duck Creek Confluence Near Henderson, NV (USGS Station No. 09419698, upstream of the Duck Creek Confluence Weir);
- At Pabco Road Near Henderson, NV (USGS Station No. 09419700, upstream of the Pabco Road Weir);
- Above Bostic Weir Near Henderson, NV (USGS Station No. 09419747);
- Above Homestead Weir Near Henderson, NV (USGS station No. 09419749);
- Above Three Kids Wash Below Henderson, NV (USGS Station No. 09419753, upstream of the Rainbow Gardens Weir in **Figure 1**); and
- Below Lake Las Vegas Near Boulder City, NV (USGS Station No. 09419800, east of map extent for report figures).

Stream stage and estimated streamflow are reported by the USGS on a 15-minute frequency. Those data are available from the USGS on their “WaterWatch” webpage (USGS 2018). The temporary staff gages installed by AECOM in 2017 could not be used to estimate flow as they have not been calibrated for flow and record only the height of water level at each staff gage.

Streamflow data demonstrate the daily pattern of highs and lows related to the release of wastewater from upstream wastewater treatment plants. The timing of those highs and lows vary from station to station, arriving later in the day with distance downstream. Between the stations at the Duck Creek Confluence Weir and above the Three Kids Wash (essentially representing the study reach), the daily highs and lows are separated by approximately three hours. Below the Three Kids Wash station, the LVW is piped under Lake Las Vegas, emerging a short distance upstream of the Lake Las Vegas station. While the distance between those two stations is relatively long (approximately 2.5 miles apart), the timing of streamflow highs and lows is very similar due to the lower friction of the channel/pipeline (generally arriving on the order of only 15 minutes later at the Lake Las Vegas station that at the Three Kids Wash station).

Stream channels are highly dynamic environments, and the relationship between stream height and streamflow often changes. That relationship is commonly referred to as a rating equation, which allows streamflow to be estimated from staff gage readings. Through periodic direct measurements of streamflow at their stream gaging stations, the USGS evaluates that relationship and makes changes to the rating equation (and streamflow estimates) as needed. Until data are officially approved by the USGS, reported streamflow data are considered provisional in nature and may be subject to later revision. The USGS data used in this analysis were downloaded on July 18, 2018. At that time, only data from the station below Lake Las Vegas had been finalized and approved (USGS Station No.09419800), while data for the stations near Duck Creek confluence (USGS Station No.09419698), at Pabco Road (USGS Station No.09419700), the Bostick Weir (USGS Station No.09419747), the Homestead Weir (USGS Station No.09419749), and the above the Three Kids Wash (USGS Station No.09419753) remained categorized as provisional.

After those data are approved, streamflow data retain a level of uncertainty. The USGS categorizes the quality of their data based upon various station characteristics. Data that are categorized as “excellent” indicate that 95% of the daily data are expected to be within 5% of true streamflow. Data categorized as “good” or “fair” indicate that 95% of daily data are expected to be within 10% and 15% of true streamflow, respectively. For higher frequency data (generally recorded by the USGS at a 15-minute frequency) and provisional data, higher levels of uncertainty may be expected. The USGS characterizes streamflow records from station No. 09419800 (below Lake Las Vegas) and No. 09419749 (above Homestead Weir) as “good”, and records from the four other stations (below Duck Creek Confluence, at Pabco Road, above Bostick Weir, and above Three Kids Wash) as “fair”. During the 2018 sampling program, the daily average flow data in the LVW was on the order of 250 cfs at the Duck Creek station and on the order of 300 cfs at all other stations, downstream of the inputs of treated wastewater near the Pabco Road station. A 10% to 20% level of uncertainty is thus equivalent to 25 to 50 cfs at the Duck Creek station, and 30 to 60 cfs at other stations.

Based on USGS data downloaded on July 18, 2017, streamflow at stations between the Pabco Road Weir and the Lake Las Vegas outlet during the 2018 sampling event could be segregated into two different groups, as described below. Provisional streamflow data from above the Homestead Weir were in close agreement with approved streamflow data from the station below Lake Las Vegas (approximately averaging 320 cfs between a daily low of 220 cfs and a daily high of 385 cfs). The provisional data from stations at Pabco Road, above the Bostick Weir, and above the Three Kids Wash were approximately 35 cfs lower (approximately averaging 285 cfs between a daily low of 195 cfs and a daily high of 350 cfs). Real differences in streamflow are likely to occur between each subsequent station due to interaction with groundwater systems (inflow and outflow) and the atmosphere (evaporation); however, the magnitude of those changes are likely to be much smaller than the approximately 35 cfs (16,000 gallons per minute) difference in data between the higher flow data stations and the lower flow data stations. The magnitudes of those natural factors are likely to be too small to be detected between stations given the level of streamflow measurement uncertainty. Instead, it is anticipated that the actual daily average streamflow in the LVW between the Pabco Road and the Lake Las Vegas stations remains relatively constant in the absence of stormflow during rain events.

The large release of treated wastewater above the Pabco Road Weir is significant enough to be detected. During the 2018 sampling event, wastewater releases were augmented by construction dewatering activities at two weirs straddling the Pabco Road Weir (Sunrise Mountain Weir and Historic Lateral Weir Expansion). Dewatering activities removed groundwater that contained perchlorate at higher levels than the surface waters of the LVW, so a temporary treatment plant was constructed to remove perchlorate. That temporary plant had a combined capacity of 6,900 gallons per minute (15 cfs) from the two construction sites and released treated water upstream of the Pabco Road Weir. While the pumping of groundwater is likely to reduce streamflow in nearby sections of the LVW (through a reduction of groundwater discharge to the stream and potentially by inducing seepage of surface flow through the streambed), that loss is likely lower than the rate of pumping. The subsequent release of treated water directly impacts streamflow from the Pabco Road station to where the LVW discharges into Lake Mead.

Despite these uncertainties in streamflow data, the rate of streamflow during sample collection was estimated for the purposes of this investigation by using the preliminary and approved data available from one or more of the nearby USGS stations. In the case of a sampling location very near a USGS station, streamflow data at that station during the time of sampling (in cfs) was used to estimate the total perchlorate load (in lb/day) from the perchlorate concentration (in µg/L) detected at that sampling location or across that transect. At sampling locations located midway between stations, data from both stations were generally used to estimate streamflow at the time of sampling.

5.3 Flux Estimates: Transect Samples

Where sampling results along an individual transect indicated the potential for the inflow of contaminated groundwater, a “representative” concentration was selected in an attempt to characterize the average level of perchlorate entering the transect (**Table 8**). It was assumed that any inputs observed near the transect, which generally show up as higher concentrations near the banks, would become integrated with the representative concentrations at downstream transects as surface waters continued to mix. In the case of the transect below the Calico Ridge Weir (T4.8), the perchlorate results for the sample collected near the south bank was almost 600 times higher than samples collected near the middle of the channel. Without knowing the perchlorate concentration and flow rate of that groundwater inflow, higher concentrations from one or more samples along the transect could not be integrated into a representative concentration for T4.8 without introducing significant error to the subsequent flux calculations. Therefore, an average concentration from samples collected near the middle of the transect was calculated to estimate the flux entering the Calico Ridge Weir.

The perchlorate flux estimates at the transect sections are shown in **Table 8**. In the case of sample locations with multiple depth samples, the value thought to be most representative of nearby waters of the LVW was selected for inclusion in calculations. For instance, near the south bank of Transect T4.7, three samples were found to contain very similar levels of perchlorate: 23 µg/L in T4.7A-20180503-2.3; 22 µg/L in T4.7B1-20180503-5.8; and 21 µg/L in T4.7B2-20180503-2.0 (Table 7). The concentration of 22 µg/L in the deeper sample from T4.7_B (B_d in Table 8) was used in perchlorate load calculations.

As discussed in Section 5.2, two groups of data were used in the estimation of streamflow that generally differed by 35 cfs. As used in flux estimation, streamflow data from one or another of those stations could result in a 5 lb/day difference for concentrations used in the flux calculation at transect T3.9. Where possible, the potential for this discrepancy was minimized by using the average flow at two different USGS stations. Sample results from the primary sample sometimes differed by several µg/L from FD samples collected at a similar time (generally within a minute or two) and depth (within a few inches). For instance, a grab sample collected at LW0.9 on May 3 was 3 µg/L higher than the FD collected at the same time (38 µg/L vs. 35 µg/L, similar to concentrations at T3.9). A perchlorate flux calculated from those two different concentrations would vary by 3 lb/day at the flow rate used to estimate flux at T3.9. How much of this variation in concentrations is attributable to laboratory testing procedures or to actual variation in perchlorate concentrations is unknown. Significant variation in concentrations is known to occur throughout the day, but it is assumed that short-term variation is relatively minor. Lastly, if the location and number of samples across a transect does not provide enough data to effectively characterize the average concentration of perchlorate entering a transect, the resulting perchlorate flux estimate would be skewed one way or the other.

The estimated perchlorate flux at any given location needs to be interpreted within these limitations.

Upstream of Duck Creek Confluence Weir (**Figure 17**): Near the Duck Creek Confluence Weir (Transect T6.8), samples were mostly below the 0.95 µg/L detection limit. At two sample locations near the middle of the channel (T6.8B and T6.8C), perchlorate was detected at concentrations of approximately 1.6 J to 1.9 J µg/L. Assuming the concentration below the detection limit were equal to the detection limit, a conservative approach (0.95 µg/L), the average perchlorate concentration is estimated at up to 1.3 µg/L, with an estimated perchlorate flux of up to 1.0 lb/day at the time of sampling (149 cfs at the Duck Creek confluence station). Due to the inclusion of results below the detection limit as being present at the detection limit, the actual mass flux at T6.8 is likely to be less than 1.0 lb/day.

Upper Narrows Weir to Sunrise Mountain Weir (**Figure 18**): At Transect T6.55, the LVW begins to pick up perchlorate at a groundwater discharge area immediately downstream of the Upper Narrows Weir. That discharge was identified during the recent TIR and FODTS studies, and confirmed by the sample collected at T6.55A (690 µg/L). In the absence of more information on the perchlorate concentration and the rate of flow from that groundwater discharge zone, the concentration of perchlorate in the LVW entering Transect T6.55 was estimated from the concentration found in the other transect samples. Those ranged from below 0.95 µg/L at T6.55C and T6.55D, to an estimated 1.3 J µg/L at T6.55B. Assuming the concentrations at sample locations with perchlorate below the detection limit were 0.95 µg/L, the average perchlorate concentration is estimated to be up to 1.1 µg/L with an estimated perchlorate flux of up to 0.88 lb/day at the time of sampling. That result is essentially identical to the upstream Transect T6.8. Perchlorate is entering the LVW near this transect; however, that mass input cannot be quantified at T6.55. As the LVW flows downstream, that perchlorate mixes with the surface water flow and becomes part of the perchlorate flux estimated at subsequent transects. At Transect T6.5, that contribution is reflected in the near shore sample on the south bank (13 µg/L at T6.5A); however, that concentration is also not likely to reflect a significant portion of the total flow through the transect and would thus artificially elevate subsequent flux estimates. Instead the perchlorate concentration at T6.5 was estimated at up to 0.95 µg/L (below detection in all other transect samples) with a flux of up to 0.82 lb/day (essentially unchanged from estimates at T6.8 and T6.55). The actual flux at T6.55 and T6.5 may be higher due to the contributions from groundwater sampled at T6.55A.

Upstream of Pabco Road Weir (**Figure 19**): Near Pabco Road (Transect T6), the perchlorate concentration was estimated as the average of two samples collected on either side of a mid-channel island (an average of 2.1 µg/L between T6C and T6D). Unlike elsewhere in the downgradient study area, perchlorate concentrations where lower in the southern half of the transect (1.2 J to 1.4 J µg/L) than in the northern half (2.7 J to 3.0 J µg/L). That is thought to be related to the mixing of low-perchlorate discharge from the wastewater channel southwest of the transect (as shown in figure 19 and discussed in Section 4.6.3.3). Due to that potential mixing, the rate of streamflow at T6 was estimated as the average between the Duck Creek confluence and Pabco Road stations (187 cfs), for an estimated perchlorate flux of 2.1 lb/day. A portion of that 1 to 2 pound change in flux estimated between Duck Creek Confluence Weir (T6.8) and Pabco Road Weir (T6) is derived from the groundwater discharge observed at sample T6.55A and detected at T6.5A (**Figure 18**). It is unknown if more groundwater is adding to perchlorate along that reach, but no other significant temperature anomalies were detected during the TIR and FODTS studies.

During the 2017 transect sampling event, the perchlorate flux had been estimated to rise from less than 1 lb/day at Transect 6.8 to 15 lb/day at T6. At nearby transects T6.35 and T5.3 (not sampled in 2018), the perchlorate flux in 2017 had been estimated at 17 to 18 lb/day. The 13 to 16 lb/day reduction in perchlorate flux in this area from 2017 (15 to 18 lb/day) to 2018 (2.1 lb/day) is attributed largely to the pumping and treatment of groundwater from the Sunrise Mountain Weir construction area. That pumping has reduced the rate of discharge from the groundwater systems associated with sample T6.55A and a formerly sampled seep (KM-71). Transect T6.35 from

2017, buried during the 2018 sampling event within the Sunrise Mountain Weir construction area, had been located near seep KM-71 that was found to contain 3,400 µg/L of perchlorate during a 2000 sampling event conducted by Kerr McGee. More recent attempts by AECOM to find KM-71 were unsuccessful. If the groundwater seep was active during the 2018 sampling event (and the TIR and FODTS studies that preceded it), it was likely captured by construction dewatering activities.

Bostick Weir (**Figure 21**): Below the Bostick Weir, perchlorate concentrations in four of the five samples collected at Transect T4.85 ranged from 4.7 to 5.3 µg/L, with an average concentration of 5.0 µg/L. At the time of sampling, the average concentration corresponds to a perchlorate flux of 5.3 lb/day (195 cfs at the Bostick Weir station). A somewhat elevated concentration was detected in the southernmost sample of the transect (7.3 µg/L at T4.85A, or approximately 40% higher). That sample was collected in a low-flow channel that was isolated from the main series of channels conveying flow below the weir. Elevated perchlorate concentrations along the south bank were common during the 2017 and 2018 sampling events starting at Transect T5.3 (2017) downstream towards the eastern end of the Downgradient Study Area. Between Pabco Road Weir (T6) and Bostick Weir (T4.85), groundwater with elevated perchlorate concentrations along the south bank may have been contributing approximately 3.2 lb/day of perchlorate. Significant thermal anomalies were not observed between the Pabco Road and Bostick weirs; however, a portion of that channel was within the construction area for the Historic Lateral Weir Expansion. The channelization of flow around the construction area may have impacted the ability to detect potential groundwater inputs using TIR methods.

Calico Ridge Weir to Lower Narrow Weir (**Figure 22**): At the Calico Ridge Weir (Transect T4.8), the estimated perchlorate flux near the center of the LVW is estimated at 7.0 lb/day. An average concentration of 5.6 µg/L during an estimated flow of 231 cfs was used to calculate the flux, with significant increases in perchlorate concentrations coming in from the south and north banks (1,800 to 3,200 µg/L at samples T4.8A and T4.8B near the south bank and 31 µg/L at T4.8E near the north bank). An estimated 1.7 lb/day gain between Bostick Weir (average estimated concentration of 5.0 µg/L at T4.85) and Calico Ridge Weir (average estimated concentration 5.6 µg/L at T4.8) may be attributed to the uncertainty of streamflow estimates. Streamflow at T4.85 was estimated from the Bostick Weir station and streamflow at T4.8 was estimated as the average from the Bostick Weir and the generally higher flows at the Homestead Weir. The perchlorate flux in this area was estimated to be 25 lb/day in 2017 at nearby Transect T4.75. Of that apparent 18 lb/day drop between the 2017 and 2018 sampling events, 13 to 16 lb/day is attributed to groundwater pumping and treatment from the Sunrise Mountain Weir construction area, and the additional 2 to 5 lb/day reduction is attributed to groundwater pumping and treatment at the Historic Lateral Weir Expansion construction area.

Between the Calico Ridge and Lower Narrows Weir, the estimated perchlorate flux increased from 7.0 lb/day at T4.8 to 26 lb/day at T4.7 and 29 lb/day at T4.65. That downstream gain in flux is attributed to the mixing of groundwater discharge near the bottom of the Calico Ridge Weir into the main channel of the LVW. It should be noted that many of the samples collected at T4.7 occurred during a more moderate flow period (an estimated flow of 300 cfs versus the 231 to 235 cfs at T4.8 and T4.65). The addition of larger volumes of treated wastewater from upstream dischargers during the higher flow periods is thought to have caused a dilution of perchlorate during the collection of samples at T4.7. Such effects have been noticed elsewhere in the study area where flow near the sides of the channel (where groundwater inputs are strongest) begins to back up as the velocity and height of water picks up in the main channel. The estimated flux of 29 lb/day at transect T4.65 is likely to be more representative of the LVW as it entered the Lower Narrows Weir during the 2018 sampling period.

Transect T4.65 was also sampled during the 2017 sampling event along with Transect T4.6 downstream of the Lower Narrows Weir. The perchlorate flux during 2018 (29 lb/day) was significantly lower than the 35 lb/day estimated for both transects during the 2017 event; however, the gain between the Calico Ridge Weir and Lower Narrow Weir was much higher in 2018 (from 7 to 29 lb/day, or by 22 lb/day) than it was in 2017 (from 25 to 35 lb/day or by 10 lb/day). The higher gain in perchlorate flux in 2018 may be related to an increased perchlorate concentration in groundwater discharge and/or a higher rate of groundwater discharge. Samples collected from the south bank of Transect T4.8 in 2018 were found to have perchlorate concentrations of 1,800 to 3,200 µg/L, or two to four times higher than the 820 µg/L concentration in the south bank sample of T4.75 in 2017. In contrast, samples from the north bank were lower in 2018 (31 to 93 µg/L at T4.8E and a nearby grab sample) than they were in 2017 (420 J µg/L). The north bank samples in 2018 straddled the north bank sample location from 2017, and that apparent change in transect location may be related to being further from a concentrated zone of groundwater discharge.

Downstream of Homestead Weir (**Figure 23**): Based upon the recent photo-based map coverage in **Figure 23**, three of the four samples at this transect (T3.9A, T3.9B, and T3.9C) consist of streamflow from the southern third of the LVW above the weir. As such, the average concentration of the two northern samples (26 µg/L average for T3.9C and T3.9D) are thought to be more representative of total flow in the LVW than the mid-channel sample used in that estimation (35 µg/L average for T3.9B and T3.9C). The average concentration of the two northern samples (26 µg/L) would indicate a perchlorate flux of 32 lb/day at the estimated flow rate of 228 cfs.

Three Kids Weir (**Figure24**): A flux of 32 lb/day at the Homestead Weir is in good agreement with the flux estimated at the Three Kids Weir (32 lb/day at T3.8 upstream of the weir and 33 lb/day at T3.75 downstream of the weir). A flux of 32 to 33 lb/day in the vicinity of the Three Kids Weir indicates a potential change in flux of 3 to 4 lb/day from the Lower Narrows Weir (T4.65). In contrast, data from the 2017 sampling event indicated a gain of between 0 to 2 lb/day from the Lower Narrows Weir (35 lb/day at transects T4.65 and T4.6) to the Three Kids Weir (35 to 37 lb/day at transects T3.8 and T3.75). The larger apparent flux gain in 2018 may be related to higher perchlorate concentrations in groundwater seeping into the LVW (as observed at the Calico Ridge Weir).

Near the Three Kids Weir, the influence of groundwater can be seen near the north bank (samples T3.8E at 41 µg/L and T3.75E at 200 µg/L). At the downstream sampling location T3.75E, a small volume of water was observed entering the LVW along the north bank. Immediately downstream of T3.75, a large spring enters the LVW on the south bank. That spring is inferred to be the current point of discharge for *what used to be referred to as "Seep KM-67*, which had been sampled prior to the construction of the Three Kids Weir. During the grab sampling events in 2018 and May 2016, discharge from KM-67 was found to contain 1,500 to 1,600 µg/L of perchlorate. A sampled collected during the 2017 sampling event indicated a somewhat lower concentration of perchlorate (1,100 µg/L).

Three Kids Weir to Rainbow Gardens Weir (**Figures 25**): Flow from the seep KM-67 enters the LVW below the Three Kids Weir in a somewhat braided area of the stream. Most of the discharge from KM-67 is confined to several smaller channels along the south bank, while the majority of flow in the LVW passes to the north. Transect T3.5 (2018) crossed this braided area, and samples demonstrate the expected high variability in perchlorate concentration. Due to that high variability, accurately estimating an average concentration for the transect from a limited number of samples is very difficult.

The average concentration of perchlorate from the two mid-channel sample locations in 2018 was 59 µg/L (85 µg/L at T3.5C, and 33 µg/L at T3.5D), for an estimated perchlorate flux of 63 lb/day. The sample collected at T3.5C (85 µg/L) was found to have a perchlorate concentration similar to other samples closer to the south bank (90 and 91 µg/L). Using this sample in an average of two sample results is likely to over-represent the upstream contribution from KM-67 resulting in an overestimation of the perchlorate flux at Transect T3.5. Using the 52 µg/l average concentration for the three northernmost samples (85 µg/L at T3.5C, 33 µg/L at T3.5D, and 37.5 µg/L average for the deep and shallow samples at T3.5E) results in an estimated flux of 55 lb/day.

The final transect of the 2018 sampling program crosses the LVW where all channels re-converge upstream of the Rainbow Gardens Weir (**Figure 25**). Many of the samples at Transect T3.3 were collected along the heavily vegetated shore of an island complex that abruptly forces the majority of the flow in the southern channel to the northern channel. The average concentration of two samples near the merging of flow was 53 µg/L, for an estimated perchlorate flux of 54 lb/day at the time of sampling.

Some minor contributions of perchlorate may be entering the LVW near a warm temperature anomaly along the south bank near T3.3. Samples closest to the south bank of T3.3 had somewhat higher concentrations than southern samples collected upstream at Transect T3.5 (96 µg/L at T3.3A versus 90 to 91 µg/L at T3.5A and T3.5B, respectively). This potential source of additional perchlorate is thought to be minor in comparison to the larger sources, such as KM-67. The addition of perchlorate from this relatively large groundwater inflow is estimated to have resulted in the 21 to 23 lb/day gain in perchlorate flux between the Three Kids Weir (32 to 33 lb/day at T3.8 and T3.75) and the transect upstream of the Rainbow Gardens Weir (54 to 55 lb/day at T3.5 and T3.3).

During the 2017 sampling event, the perchlorate flux estimates increased by 6 to 8 lb/day between the Three Kids Weir (35 to 37 lb/day) and Transect T3.5 (43 lb/day at the most downstream transect of the 2017 sampling event); however, that downstream flux may have been underestimated. Flow dynamics and perchlorate concentrations are highly dynamic in this region, greatly complicating the estimation of average perchlorate concentration from a small series of samples. Assuming that flux at T3.5 in 2017 was closer to nearby estimates from grab samples collected below the Rainbow Gardens Weir that year, where surface water is much better mixed, the actual perchlorate load during 2017 was closer to 55 lb/day, for a gain in perchlorate load of 18 to 20 lb/day (from 35 to 37 lb/day at Three Kids to 55 lb/day at LW3.4 at Rainbow Gardens Weir). A somewhat larger gain during 2018 could be attributed to a higher concentration of perchlorate at KM-67 (1,600 µg/L during 2018 versus 1,100 µg/L during 2017).

Despite the reduction in perchlorate flux attributed to construction dewatering at the Sunrise Mountain Weir and Historic Lateral Weir Expansion, the estimated perchlorate flux at the downstream end of the Downgradient Study Area was nearly identical during the 2017 and 2018 sampling events. The data indicate that dewatering efforts resulted in a 13 to 16 lb/day reduction from dewatering at the Sunrise Mountain Weir construction area, and an additional 2 to 5 lb/day reduction from dewatering at the Historic Lateral Weir Expansion construction area, for a net reduction of approximately 18 lb/day. Much of that indicated reduction in perchlorate flux appears to be made up for by a 12 lb/day increased contribution from groundwater entering the LVW along the south bank downstream of the Calico Ridge Weir. Smaller, additional gains during 2018 may have occurred from groundwater seepage between the Lower Narrows and Three Kids Weirs, and from the KM67 seep below the Three Kids Weir. Those increased contributions could be derived from both a higher concentration of perchlorate in groundwater, and from a higher rate of groundwater inflow.

5.4 Flux Estimates: Discrete Samples

Many of the grab samples collected during the 2018 transect sampling program targeted regions of observed temperature anomalies to determine if those anomalies represented an influx of perchlorate-impacted groundwater. Other grab samples were located to evaluate the perchlorate concentrations within particular reaches or to compare current concentration and flux with findings from previous sampling events by AECOM and others. Perchlorate fluxes were calculated for the subset of grab sample locations where results indicated that concentrations were not significantly impacted by any potential nearby groundwater inputs. Those grab sample locations were located between the Rainbow Gardens Weir and a sampling location downstream of the Lake Las Vegas outlet.

Most grab sample locations were sampled once near the daily low-flow period. Downstream of the Lake Las Vegas area, several samples were collected from the LVW to evaluate how perchlorate concentrations and flux estimates may vary under different flow regimes. The perchlorate flux estimates at select discrete sampling locations are shown in **Table 9**. In the case of sample LW3.2, where samples were collected at two different depths, the value thought to be most representative of nearby waters of the LVW was selected for inclusion in calculations. As shown in Table 7, the shallow sample (LW3.2-20180506-1.33) had a concentration of 50 µg/L, a shallow sample field duplicate (LW3.2-20180506-1.33-FD) had a concentration of 48 µg/L, and the deeper sample (LW3.2-20180506-3.9) had a concentration of 49 µg/L. The concentration of 49 µg/L at the deeper sample from LW3.2 ($LW3.2_d$ µg/L in Table 9) was used in perchlorate load calculations.

At the grab sample locations upstream of the Rainbow Gardens Weir, samples were either collected near a suspected or confirmed groundwater input contributing perchlorate (LW4.73 N, LW4.73S, LW4.48S, LWC3.7, LW3.68, and LW3.5), were impacted by mixing factors near the stream banks (LW4.48N and LW4.5S), or were collected from a separate tributary stream (C-1 Channel) (**Figure 15**).

At the grab sample locations between the Rainbow Gardens and Fire Station Weirs (**Figure 26**), sample results were in close agreement with the 54 to 55 lb/day perchlorate flux estimates for transects T3.5 and T3.3 upstream of the Rainbow Gardens Weir. Estimated fluxes for samples collected under low-flow conditions averaged 55 lb/day, and ranged from 49 lb/day at LW3.1 to 57 lb/day at LW3.2. Without any evidence of perchlorate inputs at the various temperature anomalies targeted by some of these grab sampling locations, the perchlorate flux through this reach is likely to remain constant for short duration periods under any given flow regime. Only one of the grab sampling locations during the 2018 event was also sampled during the 2017 event. During both events, the perchlorate concentration and flux estimates at LW3.4 were very similar (52 µg/L and 55 lb/day in 2018 versus median values of 51 µg/L and 57 lb/day in 2017 during low-flow periods).

Downstream of the Fire Station Weir, the LVW is conveyed via two culverts under Lake Las Vegas. A series of samples were collected in the LVW downstream of the outlet below Lake Las Vegas at location LW0.9 (**Figure 27**). A sample collected at LW0.9 during low-flow conditions (49 µg/L) contained a similar concentration of perchlorate as the samples collected at upstream grab locations (45 to 52 µg/L at LW3.4, LW3.2, LW3.11, and LW3.1). However, the estimated perchlorate flux of 60 lb/day at LW0.9 was 9% higher than at the upstream grab sampling locations. That elevated flux is directly related to the streamflow estimates used in the flux estimates. For grab samples located upstream of the Fire Station Weir, preliminary streamflow data from the Three Kids station (located immediately upstream of the Rainbow Gardens Weir) was used to derive perchlorate flux estimates. Perchlorate fluxes for samples collected at LW0.9 were estimated using approved streamflow data for the nearby Lake Las Vegas outlet station. As discussed in Section 5.2, the preliminary streamflow data used in this analysis at the Three Kids Station were approximately 35 cfs lower than approved streamflow data from the Lake Las Vegas station.

While the approved data from the more accurate Lake Las Vegas station may better represent the actual magnitude of daily average flow in the lower reaches of the LVW, the difference in flow (35 cfs) is close to the 10% level of uncertainty associated with daily data from a station characterized as having "good" data (approximately 32 cfs at the Lake Las Vegas outlet station). Higher levels of uncertainty may be associated with higher frequency data, which were used in estimating perchlorate flux. To allow for uncertainty in flow data, a range of perchlorate flux estimates are provided for grab sample locations downstream of the Rainbow Gardens Weir. As such, the perchlorate flux estimated under the daily low-flow conditions downstream of all significant inputs was on the order of 55 to 60 lb/day during the 2018 sampling event.

The concentration and flux varies significantly under different flow regimes. During the 2017 sampling event, grab samples were collected over a multiple-day period under varying flow conditions to evaluate how concentrations change during the day and between days. During that event, the concentration and flux at LW3.4 changed under different flows:

- late-morning low-flow period - 51 µg/L and 57 lb/day;
- early afternoon moderate-flow period - 52 µg/L and 75 lb/day; and
- late afternoon high-flow period - 38 µg/L and 71 lb/day.

In contrast to the higher flux estimate at LW3.4 under moderate flow in 2017, a sample collected at LW0.9 under moderate-flow conditions in 2018 indicated a lower flux than at low flow (55 lb/day versus 60 lb/day at low-flow conditions). The change in flux behavior relative to low-flow estimates (lower at LW0.9 during moderate flows in 2018 versus being higher at LW3.4 during moderate flows in 2017) is likely related to the timing of moderate-flow sample collection. During 2017, moderate-flow samples were collected between the morning-low and afternoon-peak flows. During 2018, the moderate-flow sample at LW0.9 was collected in the morning while streamflow was receding from the overnight peak.

Perchlorate concentrations vary significantly in time and space within the LVW depending upon distance from both dilution factors, such as wastewater release, and contributing factors, such as groundwater discharge. An afternoon high-flow sample collected from LW0.9 in 2018 indicated a significant rise in flux (72 lb/day) from low-flow conditions (60 lb/day). That rise is similar to the change in flux estimates observed at LW3.4 in 2017 (from 57 lb/day at low-flow to 71 lb/day at high-flow).

6.0 Revised Conceptual Site Model for LVW

A CSM of the LVW and potential inputs of perchlorate was developed for the SSWIP (AECOM 2018b). This section updates the CSM based on the data collected during the May 2018 sampling event. A diagram of the updated CSM is provided in **Figure 54**.

6.1 Anthropogenic Sources of Discharge to the LVW

Discharges from the four major wastewater treatment plants in the valley represent the vast majority of flow in the LVW (Clark County Water Reclamation District, City of Las Vegas Water Pollution and Control Facility, City of Henderson Water Reclamation Facilities, and City of North Las Vegas Water Reclamation Facility). Outfalls from groundwater treatment plants (NERT, Endeavour, and TIMET) join the channel conveying treated wastewater from the City of Henderson, entering LVW above Pabco Road Weir (**Figure 54**). The remaining surface water flow in the LVW comes from Duck Creek and the C-1 Channel, as well as non-point sources including urban and stormwater runoff and shallow groundwater discharge. It is expected that portions of LVW are below the groundwater table and, therefore, receive groundwater discharge. Other parts of LVW are above the groundwater, which cause infiltration (loss) of the surface water. This condition is dynamic and changes depending on a wide variety of variables including, but not limited to, increases in flow rates from the wastewater treatment plants due to increased land development, diurnal fluctuations in wastewater flows, and seasonal fluctuations of the groundwater table.

The treatment plants contribute a relatively steady daily supply of water to the LVW throughout the year. The outfalls discharge continuously but at a predictably cyclic rate. That cycling causes a diurnal flow pattern similar to a tidal pattern, with daily high and daily low flows. Unless disrupted by rain storm events, daily high flows are on the order of 100 % higher than the daily low. However, the constant daily discharge represents the vast majority of flow in LVW, and the natural, seasonal variability in streamflow has largely been eliminated. On average, streamflow tends to be somewhat higher from October through March (290 to 340 cfs) and lower from April through September (260 to 310 cfs) (USGS 2018).

Along with the general increase in streamflow in the LVW through the years, there has also been an increase in the magnitude of stormwater runoff draining into the LVW. Fifty years ago, the annual peak flow at Pabco Road was on the order of 300 cfs (median value of 280 cfs from 1957 to 1967), or similar to the current average annual flow (298 cfs). More recently, annual peak flows are on the order of 4,500 cfs (median value of 4,350 cfs from 2005 to 2015) (USGS 2018).

In an effort to protect the channel from the erosive forces of higher flows, a series of erosion control structures (weirs) have been constructed to slow the water velocities in the LVW. Where erosional forces have been allowed to run their course, the stream channel within the Downgradient Study Area is generally 40 feet or less in width. Near some of the weirs, the width increases to 300 feet or more.

The channel materials consist of loose, unconsolidated sediments that have been shifted and sorted by the energy of the flowing water. Most of the underlying material is alluvium that consists of both fine-grained materials (silts and clays) and courser materials (sands and gravels). As the water carries those deposits downstream, sand and gravel are deposited in areas with higher velocity, providing a more solid streambed. Where streamflow slows down in natural pools and behind some of the weir structures, silts and clays are deposited, creating a soft bottom. The Horse Springs Formation is present in the southern streambank east of Calico Ridge Weir, and the Thumb Formation is present on the northern and southern streambanks between the Lower Narrows and Three Kids Weirs.

6.2 Known Sources of Perchlorate

The former Kerr McGee/Tronox site (NERT Site) (**Figure 1**) has been the location of industrial operations since 1942 when it was developed by the U.S. government as a magnesium plant to support World War II operations. Following the war, this area continued to be used for industrial activities, including production of perchlorate, boron, and manganese compounds. Former industrial and waste management activities conducted at the NERT Site, as well as those conducted at adjacent properties, resulted in contamination of environmental media, including soil, groundwater, and surface water. There are two known sites that are major sources of perchlorate to the LVW: the former operations at the PEPCON site (AMPAC/Endeavour site) (Endeavour, 2017) and the former operations at the Kerr McGee site (NERT Site). Both sources have impacted groundwater that is undergoing remediation; however, some fraction of uncaptured or untreated groundwater flows through subsurface pathways downgradient from the sites and affects water quality in the LVW. A detailed discussion regarding the history and contribution of each source is outside the scope of this Supplemental Surface Water Investigation and will be included in NERT's forthcoming RI Report. Since 1979, the NERT Site has been the subject of numerous investigations and removal actions. Soil removal actions were conducted in 2010 and 2011 from the NERT Site to minimize potential health risks from impacted soil. Additional soil removal was performed in 2013 when the eastern end of the Beta Ditch was excavated. The soil removal activities and post-removal conditions are described in detail in the Revised Interim Soil Removal Action Completion Report (ENVIRON International Corporation 2012), and Excavation of Beta Ditch at NERT-TIMET Property Line (ENVIRON International Corporation, 2014). On-site and off-site groundwater removal actions include the installation of the groundwater extraction and treatment system, designed to capture and treat perchlorate and hexavalent chromium in shallow groundwater.

In the spring of 1999, Southern Nevada Water Authority (SNWA) hydrologists discovered a seep ("the original seep") discharging to the LVW at approximately 400 gallons per minute. Perchlorate concentrations in the seep exceeded 100,000 µg/L in 1999. The results of the seep samples indicated that a significant mass flux of perchlorate was entering the LVW. Kerr McGee subsequently implemented a capture system at the seep in November 1999 to reduce the migration of perchlorate to the LVW. In 2001, Kerr McGee started extraction from three wells (referred to as the Seep Well Field) located approximately 600 feet upgradient from the original seep capture system (ENSR International 2005). Additional extraction wells were added over time and the ongoing extraction and treatment from the Seep Well Field (currently operated by NERT) has contained and treated a substantial mass of perchlorate that otherwise would have entered the LVW. To support the Downgradient Study Area investigation, surface water samples were collected from several locations in and near the LVW in May 2016. As part of that sampling program, a sample was collected from the sump immediately downgradient of the seep discovered by SNWA in 1999. The capture system that was subsequently implemented has significantly reduced both the perchlorate concentration and volume of groundwater discharging at the location. A 2016 sample of surface water at that original seep had a perchlorate concentration of 85 µg/L, three orders of magnitude lower than samples collected in 1999. At that time, the seep was reported to be active only seasonally, with the small volume of flow terminating a short distance downstream in a topographic low where it seeped back into the ground and/or evaporated into the air upgradient of its historic confluence with the LVW. Currently, the seep is buried under land surface from construction activities associated with Sunrise Mountain Weir construction.

6.3 Perchlorate Patterns and Suspected Discharges

During the May 2016 sampling program (AECOM 2016), an attempt was made to locate the seeps that were sampled by Kerr McGee in 2000. Seeps that were successfully located, accessible, and flowing were subsequently sampled. It is surmised that weir construction, onshore riparian zone restoration, flooding and vegetative growth during intervening years, and the ongoing regional drought conditions may have affected the occurrence and, if present, the flow from the previously identified seeps. Because the installation of the weirs likely changed the seep locations, attempts were made to relocate the seeps and, if possible, sample them. Of the 18 historic seep locations, only three (KM-45, KM-67 and KM-71) could be located in the field. All other historic seeps may have been buried by weir and bank construction, submerged by the expanded stream channel and associated sediments, temporarily dried up under the drought conditions of the time, or obscured by dense vegetation. Two of those located seeps (KM-67 and KM-71) were sampled in 2016. The concentrations of perchlorate in the seeps were lower in 2016 than in 2000. At KM-71, the concentration in 2016 (1.4 J µg/L) was substantially lower than in 2000 (3,400 µg/L). In 2000, KM-71 was located downgradient of the proposed location of the Sunrise Mountain Weir. The seep was located in 2016 immediately upstream of this location in a backwater channel. While unknown from existing information, the seep that was sampled in May 2016 could be a different seep than that sampled in 2000. At KM-67, located near the Three Kids Weir, the concentration (1,500 µg/L) in 2016 was slightly lower than in 2000 (2,100 µg/L). Construction of Three Kids Weir was completed in July 2015. A riprap weir referred to as “Demonstration Weir” was constructed near this location in 1999. The Demonstration Weir was relocated and rebuilt in 2007 and was eventually dismantled in 2013 and replaced by the Three Kids Weir (LVW Coordination Committee 2016). Although a weir was in place in this location during both the 2000 and 2016 sampling events, it is not clear to what extent, if any, each weir affected the stream flow and sample results during the 2000 and 2016 sampling events.

During the January and February 2017 sampling event, sampling locations and methodology were designed to further refine the understanding of where perchlorate enters the LVW, and what impact the varying flow regime has on perchlorate concentrations in surface water samples. Known and suspected regions of perchlorate discharge were selected to help pinpoint loci of discharge and where, along transects, that discharge may be occurring. By characterizing the flow regime during sample collection, estimates of actual perchlorate flux were calculated to represent flow-weighted sampling results.

Following intensive water-temperature studies in the LVW earlier in the year, a number of new and previously sampled locations were selected for a sampling round in May 2018. Locations were selected to target new potential locations of groundwater inputs identified as temperature anomalies during the TIR and FODTS surveys, refine the understanding of perchlorate contributions in areas where perchlorate additions were suspected, and resample previous locations to evaluate for changes over time. Perchlorate flux estimates from the 2018 transect samples are shown in **Table 8**. Flux estimates from the 2018 grab samples are shown in **Table 9**.

The results of surface-water and seep sampling conducted by Kerr McGee in 2000 (Kerr McGee, 2001) and by AECOM in May and December 2016 (AECOM, 2016), January and February 2017 (AECOM, 2017A), and May 2018 indicate that there may be perchlorate discharge to the LVW, particularly in the areas between the Upper Narrows Weir and Sunrise Mountain Weir (under construction during the 2018 sampling event), between the Historic Lateral Weir Expansion (under construction in 2018) and the Calico Ridge Weir, downstream of the Calico Ridge Weir, between the Lower Narrows and Homestead Weirs, and downstream of the Three Kids Weir.

Surface-water sampling results indicate the potential for small, cumulative gains of perchlorate along the southern bank of the LVW from the region near the Historic Lateral Weir Expansion down to the Three Kids Weir, where perchlorate was generally found to be approximately twice as high as samples collected from mid-channel locations. Along much of that bank, the slow, relatively minor seepage of groundwater may be contributing to a slow general increase in perchlorate flux. Larger, observable gains observed in sample results are more likely to be attributed to more focused discharge of groundwater with higher concentrations of perchlorate, such as the 690 µg/L results for sample T6.55A near the toe of the Upper Narrows Weir, the 3,200 µg/L results for samples collected near the toe of the Calico Ridge Weir, and the 1,600 µg/L results for KM-67 near the toe of the Three Kids Weir.

During the May 2018 sampling event, samples were collected from sampling points across 13 transects, along with grab samples from 14 locations on or near the LVW, including one location within the C-1 tributary channel. The LVW locations ranged from the upstream portion of the Downgradient Study Area (near the Duck Creek Confluence Weir) to downstream of Lake Las Vegas (LW0.9, located outside of the Downgradient Study Area). The perchlorate concentrations from these transect and grab samples are provided in **Figure 15** through **Figure 27**.

Data indicates that the rate of streamflow in the LVW has a significant impact on perchlorate concentrations. At stations upstream of the Calico Ridge Weir, the perchlorate flux is generally in good agreement across the range of observed flow conditions. Downstream of the Lower Narrows Weir, differences in perchlorate flux become more pronounced, with higher flux under high-flow conditions. For results under mid-flow conditions, the flux may be higher or lower than under low-flow conditions depending on if mid-flow samples were collected during the decline from overnight high flows or during the rise from late morning low flows. Laboratory results from a series of samples collected at the Rainbow Gardens Weir in 2017, and from below the Lake Las Vegas outlet in 2018, indicate that perchlorate concentrations under different flow regimes can easily vary by 12 to 13 µg/L (33%) and resulting perchlorate fluxes can easily vary by 17 to 18 lb/day (32%). Those differences complicate the general characterization of perchlorate flux at those lower stations. During the 2018 sampling event, most samples were collected during low-flow periods in an effort to normalize conditions at the time of sampling. Perchlorate flux at various reaches along the LVW are discussed in detail below.

<u>Upper Narrows to Pabco Road Weir:</u> Near the Upper Narrows Weir, perchlorate levels during 2018 were mostly below the method detection limit of 0.95 µg/L (eight of the thirteen sample locations along transects T6.8, T6.55, and T6.5). Three of the thirteen sample locations along these transects contained low levels of perchlorate, (1.3 J to 1.9 J µg/L). A sample collected at the south bank below the Upper Narrows Weir contained a relatively high perchlorate concentration of 690 µg/L (T6.55A). Downstream of that influx, a sample from the south bank contained a diluted concentration of 13 µg/L (T6.5A) as the higher concentration influx mixed with the surface waters of the LVW. Near the Pabco Road Weir, the estimated perchlorate flux increased from less than 1 lb/day to 2.1 lb/day, with much of that gain attributed to the groundwater discharge sampled at T6.55A. The groundwater system feeding that discharge may be related to the larger gain in perchlorate flux observed during the 2017 sampling program (from less than 1 lb/day to between 15 and 18 lb/day between the Sunrise Mountain Weir and the Historic Lateral Weir Expansion). That 13 to 16 lb/day reduction in flux in 2018 is attributed to the dewatering program for the active construction of the Sunrise Mountain Weir.

<u>Historic Lateral Weir Expansion to Calico Ridge Weir:</u> Near the Historic Lateral Weir Expansion, the perchlorate flux begins to increase slowly. During 2018, the estimated flux increased from the 2.1 lb/day estimate near the Pabco Road Weir to 5.3 lb/day below the Bostick Weir, and 7.0 lb/day as the LVW entered the Calico Ridge Weir. The slow gain in perchlorate along this reach is inferred to be related to the seepage of groundwater. In 2017, the perchlorate flux entering the Calico Ridge Weir was estimated at 25 lb/day, indicating an 18 lb/day drop in perchlorate flux during the 2018 sampling event. This drop in perchlorate flux is attributed to the dewatering at the Sunrise Mountain Weir (13 to 16 lb/day decrease in flux) and at the Historic Lateral Weir Expansion (2 to 5 lb/day decrease in flux). Sample results from the grab sample collected from the C-1 Channel after a rain event during the 2018 program may be related to groundwater conditions upgradient of this section of the LVW. The C-1 Channel sample represents post-stormflow conditions in the otherwise dry channel. The perchlorate concentration of the C-1 Channel sample was 1,800 µg/L approximately 2.5 days after flow had ceased. During that time, evaporation from the pool of standing water had likely concentrated perchlorate to some degree. Regardless, this sample result is much higher than expected within the stormflow channel.

<u>Calico Ridge Weir to Lower Narrows Weir:</u> An estimated 22 lb/day of perchlorate was gained by the time the LVW passed through the Lower Narrows Weir, for a perchlorate flux of 29 lb/day. Most of the additional flux is suspected to come from groundwater discharge near the toe of the Calico Ridge Weir. Samples collected near the south bank of that weir contained up to 3,200 µg/L of perchlorate, more than 500 times higher than samples collected near the middle of the channel. Samples collected near the north bank are also elevated (almost 20 times higher than mid-channel samples collected in 2017). The 22 lb/day gain is much higher than the 10 lb/day gain estimated during 2017. The increased gain may be related to the higher concentrations observed near the south bank of the Calico Ridge Weir in 2018, and/or an increased rate of groundwater discharge.

<u>Homestead to Three Kids Weirs:</u> Between the Homestead and Three Kids Weirs, the perchlorate flux estimates during 2018 remained relatively constant at 32 to 33 lb/day. The 32 lb/day estimated flux downstream of the Homestead Weir represents a gain of 3 lb/day from the Lower Narrows Weir. The intervening portion of the LVW

has been intensively studied with thermal techniques and through transect and grab sampling efforts, and no significant potential groundwater sources have been detected. Potential gains between the Lower Narrows Weir (29 lb/day) downstream to the Three Kids Weir (32 to 33 lb/day) may be either the result of slower, groundwater seepage gains along the bank (as opposed to a larger, more readily detected groundwater input), or the result of data limitations and the estimation of representative perchlorate concentrations along transects (as discussed in Section 5.3).

Three Kids Weir to Rainbow Gardens Weir: Downstream of the Three Kids Weir, groundwater discharge associated with Seep KM-67 enters on the south bank and begins to mix in with the waters of the LVW. That mixing occurs over a long distance due in part to the splitting of the channel by several small islands. At the most downstream transect (T3.3), higher concentrations of perchlorate attributable to spring KM-67 were still observed in the southern half of the transect. Some minor contributions from additional discharge upstream of the Rainbow Gardens Weir may have also contributed to the higher concentrations observed on the south bank of T3.3. The 54 to 55 lb/day estimated fluxes at transects T3.5 and T3.3 are similar to the estimated flux from the grab sample (LW3.4) downstream of Rainbow Gardens Weir, where the surface waters of the LVW are thought to be well mixed. Most of the 21 to 23 lb/day gain from the Three Kids Weir to Rainbow Gardens Weir is attributed to discharge from Seep KM-67 (1,600 µg/L). In addition, perchlorate concentrations near the northern bank (up to 200 µg/L near the toe of the Three Kids Weir) were also elevated relative to mid-channel samples (average of 28 µg/L).

Rainbow Gardens Weir to Lake Las Vegas Outlet: Six grab sample locations between the Rainbow Gardens Weir and the Lake Las Vegas outlet indicate perchlorate fluxes between 49 and 60 lb/day under low-flow conditions. Some variation in estimated flux is expected given small differences in sample concentration, laboratory results, and streamflow estimates used in the calculations. Given that uncertainty, the perchlorate flux in the LVW during the 2018 sampling event is estimated to have been 55 to 60 lb/day between the Rainbow Gardens Weir and the Lake Las Vegas outlet. No significant additional sources of perchlorate have been observed or are expected along this section of the LVW. Instead, this flux is assumed to remain relatively constant during low-flow periods. During other portions of the daily flow cycle, that rate of flux is likely to change. The estimated flux rates were higher following the daily low flow (67 to 72 lb/day). One sample at LW0.9 (55 lb/day) indicated that lower flux rates may occur prior to the daily low (estimated at 60 lb/day at LW0.9).

Despite the approximately 18 lb/day loss of perchlorate attributed to upstream dewatering activities at the Sunrise Mountain Weir and the Historic Lateral Weir Expansion construction areas, the 2018 estimates for the area downstream of the Rainbow Gardens Weir are similar to the 2017 estimate of 57 lb/day (under low-flow conditions). During the 2018 event, the upstream perchlorate loss appears to have been balanced by a downstream increase. That increase may be attributable to an increased perchlorate concentration in groundwater discharge and/or an increased rate of groundwater discharge. Concentrations of perchlorate increased at several sample locations between 2017 and 2018. Increased rates of groundwater discharge at those locations are not likely to be observable in the system given the large volume of total flow in the LVW and the level of uncertainty related to streamflow measurements.

7.0 Conclusions

The SSWIP was designed, in part, to address the following study questions based on the CSM.

Principal TIR Study Questions

Study Question 1. *Which reaches along the LVW have groundwater discharge zones?*

Based on the TIR data obtained during the 2018 flyover event, thermal anomalies were noted throughout the TIR study area. Assuming thermal anomalies can be equated with groundwater discharge, it can be surmised that the LVW may receive groundwater discharge at various locations throughout the entire Downgradient Study Area (Figure 3). Subsequent FODTS surveys and surface water sampling provided helped to determine which of those areas may be groundwater discharge zones.

Study Question 2. *Where are the significant groundwater discharges?*

The densest clusters of thermal anomalies identified using the TIR data were located between the Calico Ridge and Homestead Weirs, and from Three Kids Weir to the Fire Station Weir. Other anomaly clusters are noted downstream of the Pabco Road Weir and from the uppermost portions of the Downgradient Study Area (near the confluence with Duck Creek) to the Sunrise Mountain Weir construction zone.

Principal FODTS Study Questions

Study Question 3. *Within identified reaches of interest, where are the groundwater discharge locations within the LVW?*

Five reaches of the LVW within the Downgradient Study Area were investigated using FODTS. These reaches were identified using the TIR data combined with analytical (perchlorate) data from previous investigations. The FODTS data indicated likely groundwater discharge locations at several distinct areas in the LVW Downgradient Study Area, specifically downstream of the Upper Narrows, the Calico Ridge, and the Three Kids Weirs.

Study Question 4. *Are the groundwater discharge results comparable between changes in flow over the study period?*

The FODTS cables were deployed over several flow cycles in the LVW. Based on the thermal data, there was no obvious temporal difference in signature that could indicate flow impacts the groundwater discharge.

Study Question 5. *Can high-resolution spatial and temporal temperature data along the LVW streambed identify loci of groundwater discharge?*

The FODTS and TIR studies identified known loci of groundwater discharge in the LVW (near the base of the Calico Ridge and Three Kids Weir), identified additional area of groundwater discharge associated with those areas (expanded zones of discharge immediately downstream of those loci), and identified a new loci of groundwater discharge near the base of the Upper Narrows Weir.

Principal Surface Water Sampling Study Questions

Study Question 6. *Which reaches along the LVW are primary contributors of perchlorate flux within the LVW?*

Perchlorate inputs to the LVW appear to be occurring primarily in three general locations: downstream of Upper Narrows Weir (south bank), downstream of Calico Ridge Weir (primarily along the south bank, but with some contributions near the north bank), and downstream of Three Kids Weir (primarily from the region of Seep KM-67 on the south bank, but with some contributions near the north bank).

***Study Question 7** and **8.** Are the concentrations of the target constituents different along cross-sections from the northern to southern bank along the length of the LVW in the Downgradient Study Area? Can data generated by sampling along the transects refine the locations of potential seep areas (where perchlorate discharge is occurring) near the northern bank, southern bank, or mid-channel?*

Groundwater discharge to the LVW is largely focused along the south bank but has also been observed along the north bank. Some mid-channel discharge may also occur, however no direct evidence of that has been found during AECOM's investigations from 2016 to 2018. Along transects of the LVW carrying a measureable flux of perchlorate, concentrations are generally observed to be higher along the south bank of the LVW where groundwater inputs are more likely to convey perchlorate from upgradient industrial activities. At many sampling locations, higher concentrations near the south bank may reflect an upstream groundwater input that has yet to fully mix in with the surface waters of the LVW. At the Calico Ridge and Three Kids Weirs, the concentration of perchlorate has also been observed to be significantly higher near the north bank. In those regions, a fault or other geologic mechanism is thought to be conveying perchlorate laden groundwater across the LVW. Such a mechanism could also result in a release of groundwater and perchlorate into mid-channel areas; however, sampling across those regions and at downstream transects has not indicated a clear or significant signal for such discharge.

Study Question 9. *Were perchlorate concentrations measured in 2017 consistent with 2018?*

In upper portions of the Downgradient Study Area, the concentration of perchlorate in the LVW was generally higher in 2017. In lower portions, the concentration was similar between years. Samples collected at identified zones of groundwater discharge were lower in 2017.

Study Question 10. *Did the construction of the Sunrise Mountain Weir and Historical Lateral Weir Expansion have an impact of localized or overall perchlorate flux estimates within the Downgradient Discharge Area?*

As part of the weir construction activities during the 2018 sampling event, a significant volume of perchlorate-impacted groundwater was being pumped, treated, and released to the LVW. In comparison to the 2017 sampling event, this resulted in a lower perchlorate flux in upper portions of the Downgradient Study Area. Downstream of the Sunrise Mountain Weir construction area, the perchlorate flux was approximately 13 to 16 lb/day lower in 2018. An additional 2 to 5 lb/day reduction was observed downstream of the Historical Lateral Weir Expansion construction area, for a total reduction of 18 lb/day of perchlorate between the 2017 and 2018 sampling events. Significant perchlorate gains continued during 2018 at known loci of groundwater inputs downstream of the Calico Ridge Weir and Three Kids Weir. Water samples collected at those known points of discharge in 2018 indicated that the concentration of perchlorate in groundwater had increased relative to results from 2017. The net effect of the reduction in upstream perchlorate flux from construction dewatering coupled with the increased downstream gains due to fluctuations in groundwater concentrations and/or discharge rates was a very similar total perchlorate load during both sampling events.

Study Question 11. *How do perchlorate concentrations and estimated flux in the Downgradient Study Area compare to concentrations and flux observed at the Northshore Road Station?*

Perchlorate concentrations and streamflow in the LVW vary significantly throughout the day. In order to minimize the impact of those variations, samples were generally collected during the daily low flow of the diurnal cycle. While there is some expected variability in results, the perchlorate concentration and estimated flux observed near the Northshore Road Station (below Lake Las Vegas) is similar to other concentrations and estimated fluxes at transects and grab sample locations downstream of the Three Kids Weir. After allowing for some uncertainty associated with flow measurements used in the estimation of perchlorate flux during the 2018 sampling event, the flux under low-flow conditions remained stable at 55 to 60 lb/day between transects downstream of the Three Kids Weir and the grab sample location near the Northshore Road Station.

8.0 Recommendations

In summary, based on the SSWIP sampling effort described in this technical memorandum, several locations of potential perchlorate discharges have been identified:

- Near the Upper Narrows Weir, Sunrise Mountain Weir, and Pabco Road Weir, perchlorate concentrations increased slightly in 2018 indicating there may be uncaptured perchlorate entering the LVW in this area. The increase in perchlorate flux between the Duck Creek Confluence and Pabco Road weirs was estimated to be on the order of 2 lb/day. Perchlorate flux is likely to increase when the temporary water treatment plant for construction dewatering is deactivated. The increase in perchlorate could arise from both an increase in the rate of flow from discharge zones (such as the base of the Upper Narrows Weir), and as an increase in perchlorate concentrations in the groundwater. During 2017, the perchlorate flux near Pabco Road was 15 to 18 lb/day.
- An increase in perchlorate flux is noted near Calico Ridge Weir. This increase was estimated to be on the order of 10 lb/day in 2017 and 22 lb/day in 2018.
- An increase in perchlorate flux is also noted in the LVW near Three Kids Weir. This increase was on the order of 18 to 20 lb/day during in 2017 and 23 to 28 lb/day in 2018.
- Zones of potential input attributed to diffuse seepage patterns are thought to occur all along the reach from the Historic Lateral Weir Expansion downstream to the Three Kids Weir.
- The C-1 Channel may convey some perchlorate to the LVW during portions of stormflow events.

These potential perchlorate discharges have been characterized and confirmed through multiple sampling events and extensive thermal surveys. There may be other unknown sources of perchlorate, such as undetected seeps; however, if they are significant, their presence is likely masked by the presence of a larger identified source emanating from the same groundwater system. As such, the net impact of their perchlorate contribution would be accounted for within downstream samples and the resulting estimates of perchlorate flux discussed herein.

Several of the findings from the 2018 sampling event merit further investigation, including:

- Transect and discrete sampling should be repeated following the completion of construction at the Sunrise Mountain Weir and the Historic Lateral Weir Expansion. When groundwater dewatering ceases, it is anticipated that perchlorate concentrations in the LVW will increase within the reaches impacted by pumping.
- Samples of water from the three primary loci of groundwater discharge (Upper Narrows, Calico Ridge, and Three Kids Weirs) should be collected on a regular basis to determine how perchlorate concentrations vary over time.
- Appropriate hydrogeologic methods should be identified and utilized to help characterize the rate of inflow at the three primary loci of groundwater discharge.
- Perchlorate flux estimates can be refined by collecting a series of samples at USGS gaging stations using associated streamflow data on discharge distribution at the Pabco Road, Bostick, Homestead, and Rainbow Gardens weirs. By collecting samples near the middle of a prescribed proportional flow cell (such as within every 5 or 10% of total flow across the station), the methodology of perchlorate flux estimation would be less subjective and yield more accurate results. Sampling should occur during various flow regimes in the daily flow cycle to determine how flux varies with flow.

- Perchlorate flux estimates below Lake Las Vegas, where the waters of the LVW are well mixed, could be refined through the use of a programmed sampler that collects water at specified time intervals.
- Sampling efforts in the C-1 Channel should be conducted to determine where and when perchlorate enters the channel during a storm event.

9.0 References

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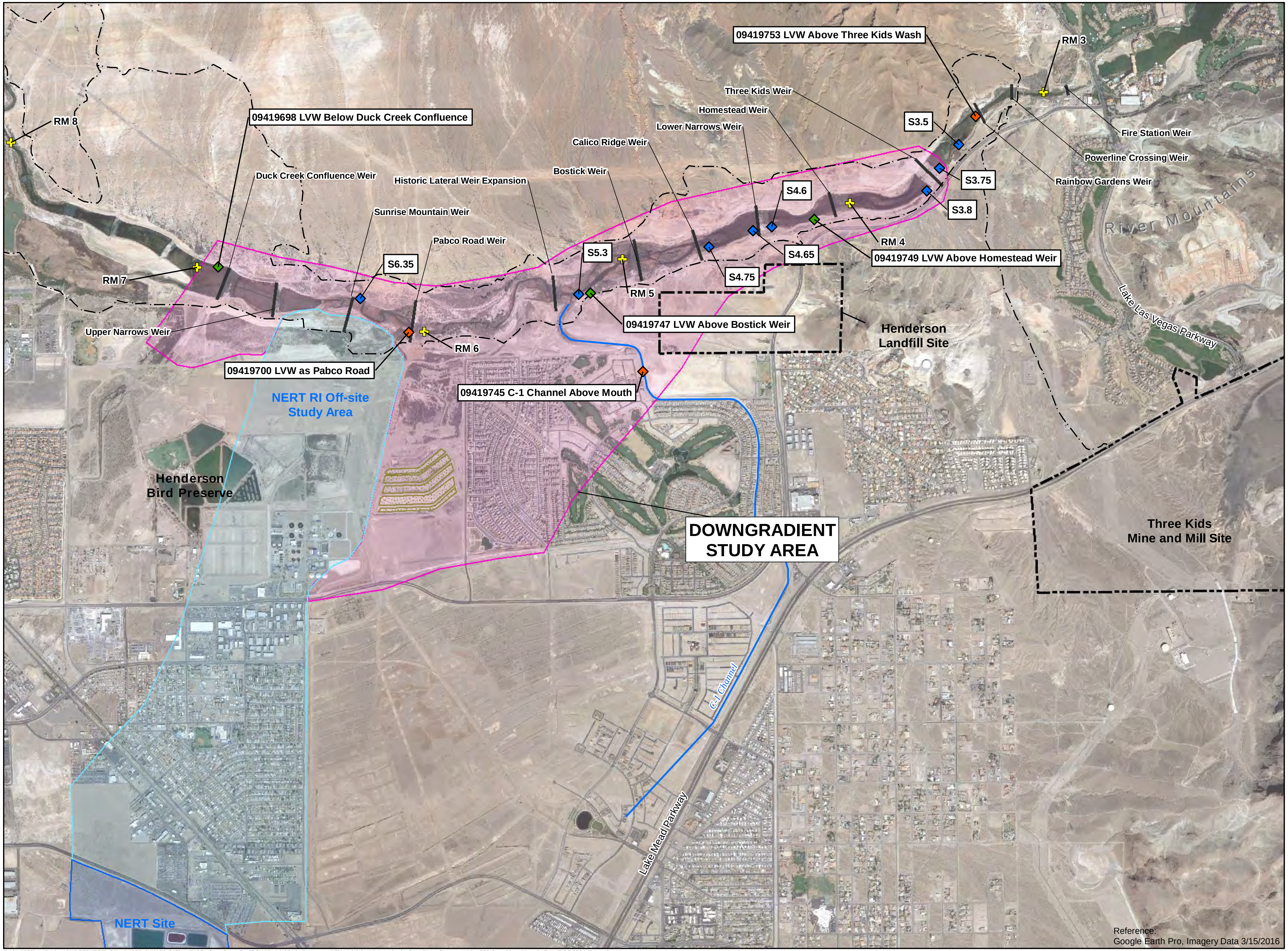
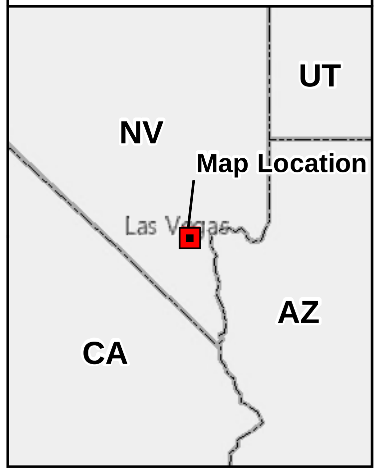
Figures



OVERVIEW MAP



Legend

- Weir
- Wetlands Trail
- Channels
- Staff Gage Location
- Permanent USGS Gage Location
- Temporary USGS Gage Location
- Northern Rapid Infiltration Basins
- River Mile (RM)
- NERT RI Downgradient Study Area
- NERT RI Off-site Study Area
- NERT Site

NORTH

0 2,000
Feet

Scale 1:24,000
1 inch = 2,000 feet

NERT RI
Downgradient Study Area

DOWNGRADIENT STUDY AREA LOCATION MAP

Date: 8/14/2018 Project: 60477365

AECOM

Figure 1

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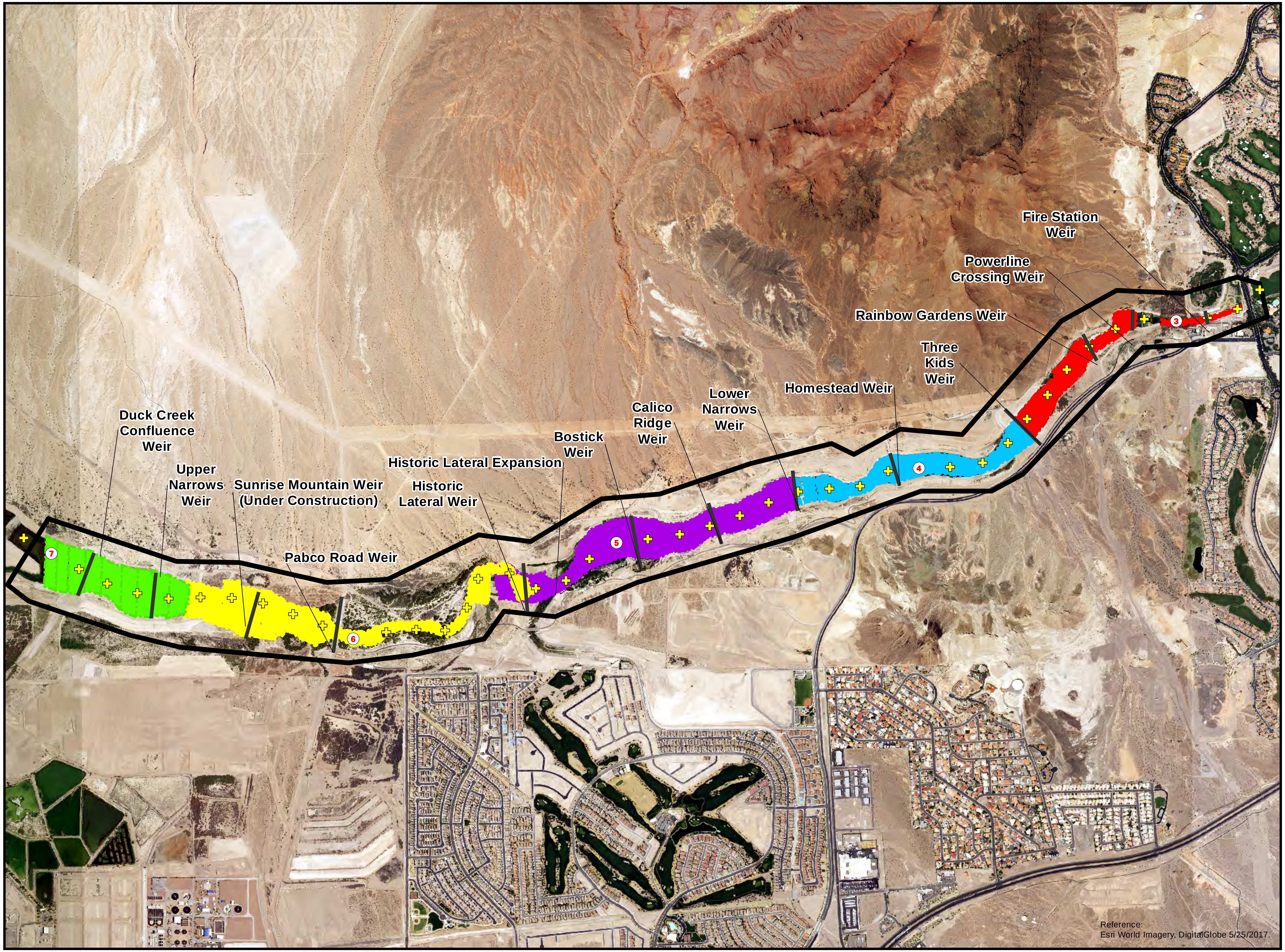
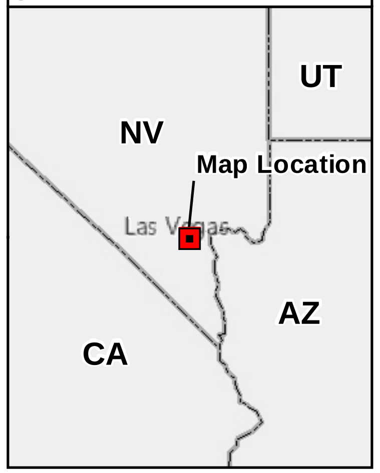


OVERVIEW MAP



Legend

- Mile Marker
- Tenth of a Mile
- Weir
- Aerial Photo Flight Extent
- TIR Day 1
- TIR Day 2
- TIR Day 3
- TIR Day 4
- TIR Day 5

NORTH

0 1,500
Feet

Scale 1:18,000
1 inch = 1,500 feet

NERT RI
Downgradient Study Area

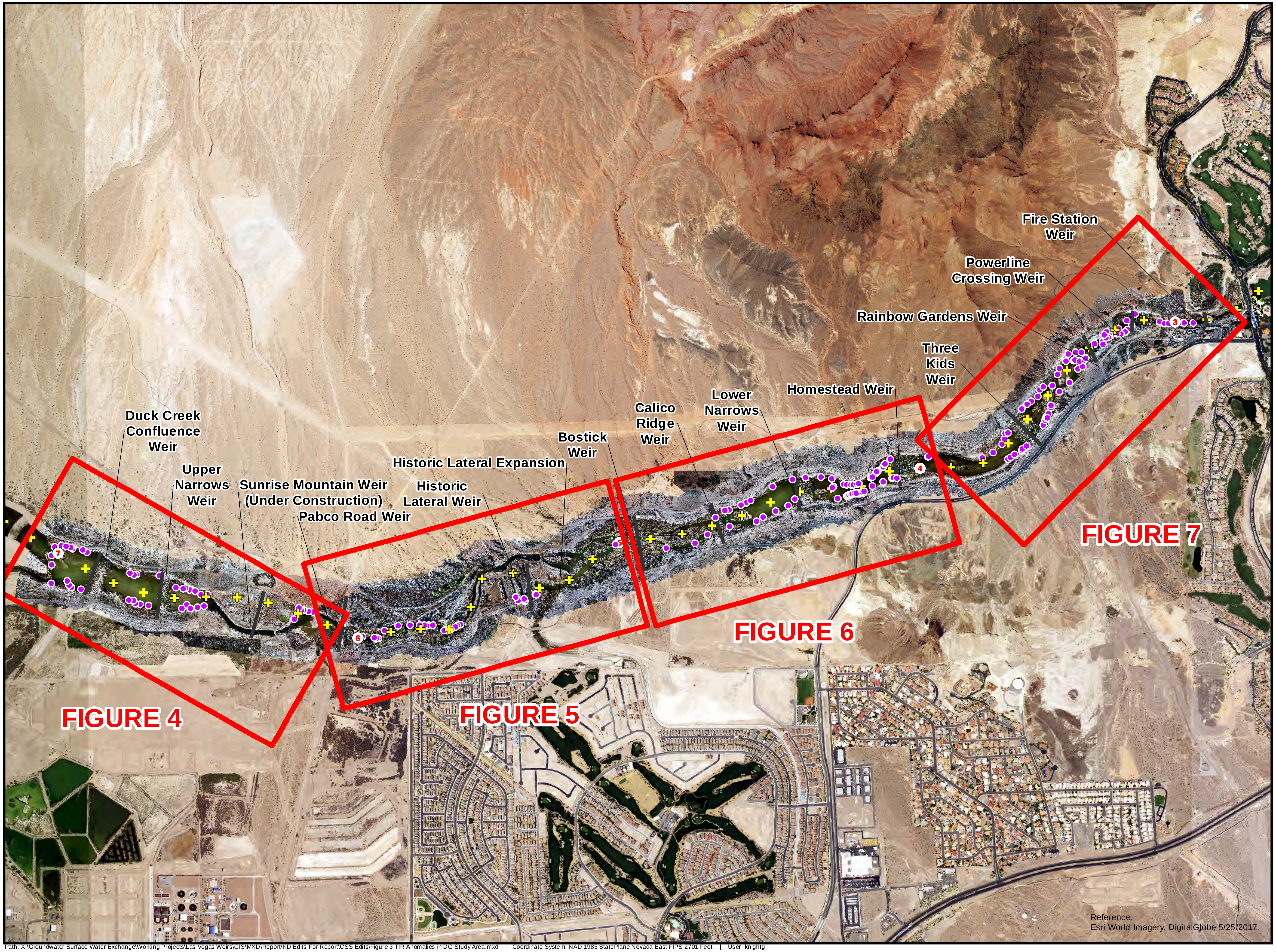
THERMAL INFRARED / AERIAL FLIGHT COVERAGE

Date: 10/12/2018 Project: 60477365

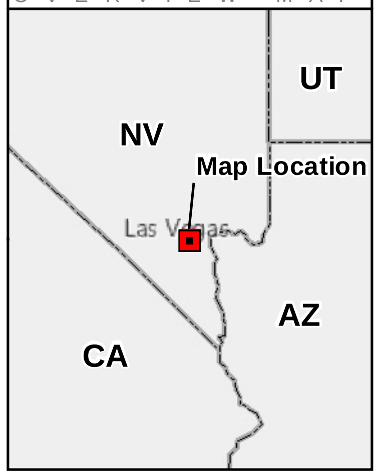
AECOM

Figure 2

Path: X:\Groundwater Surface Water Exchange\Working Projects\Las Vegas Weirs\GIS\MXD\Report\KD Edits For Report\CSS Edits\Figure 2 _ Flight Extents.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: knightg



OVERVIEW MAP



Legend

- Mile Marker
- Tenth of a Mile
- Weir
- TIR Anomaly

NORTH

0 1,500
Feet

Scale 1:18,000
1 inch = 1,500 feet

NERT RI
Downgradient Study Area

TIR ANOMALIES IN DOWNGRADIENT STUDY AREA

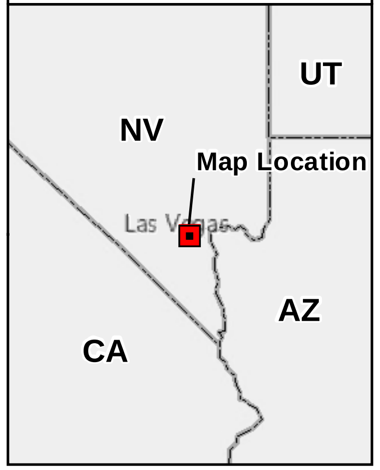
Date: 10/12/2018 Project: 60477365

AECOM

Figure 3

Path: X:\Groundwater Surface Water Exchange\Working Projects\Las Vegas Weirs\GIS\MXD\Report\KD Edits For Report\CSS Edits\Figure 3 TIR Anomalies in DG Study Area.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: knightg

OVERVIEW MAP



Legend

- Mile Marker
- Tenth of a Mile
- Weir
- TIR Anomaly

0 600
Feet

Scale 1:7,200
1 inch = 600 feet

NERT RI
Downgradient Study Area

TIR ANOMALIES DUCK CREEK CONFLUENCE TO PABCO ROAD ECS

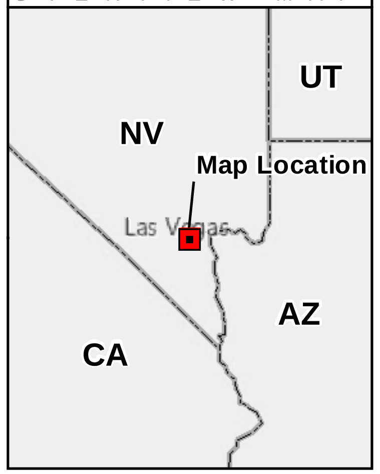
Date: 10/12/2018 Project: 60477365

AECOM

Figure 4

Path: X:\Groundwater Surface Water Exchange\Working Projects\Las Vegas Weirs\GIS\MXD\Report\KD Edits For Report\CSS Edits\Figure 4 TIR Anom Duck Creek to Pabco.mxd | Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere | User: knightg

OVERVIEW MAP



Legend

- Mile Marker
- Tenth of a Mile
- Weir
- TIR Anomaly

0 600
Feet

Scale 1:7,200
1 inch = 600 feet

NERT RI
Downgradient Study Area

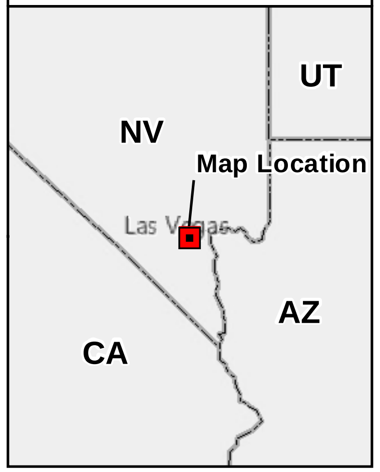
TIR ANOMALIES PABCO ROAD WEIR TO BOSTICK WEIR

Date: 10/16/2018 Project: 60477365

AECOM **Figure 5**

Path: X:\Groundwater Surface Water Exchange\Working Projects\Las Vegas Weirs\GIS\MXD\Report\KD Edits For Report\CSS Edits\Figure 5 TIR Anom Pabco to Bostick.mxd | Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere | User: knightg

OVERVIEW MAP



Legend

- Mile Marker
- Tenth of a Mile
- TIR Anomaly
- Weir

NORTH

0 600

Feet

Scale 1:7,200

1 inch = 600 feet

NERT RI
Downgradient Study Area

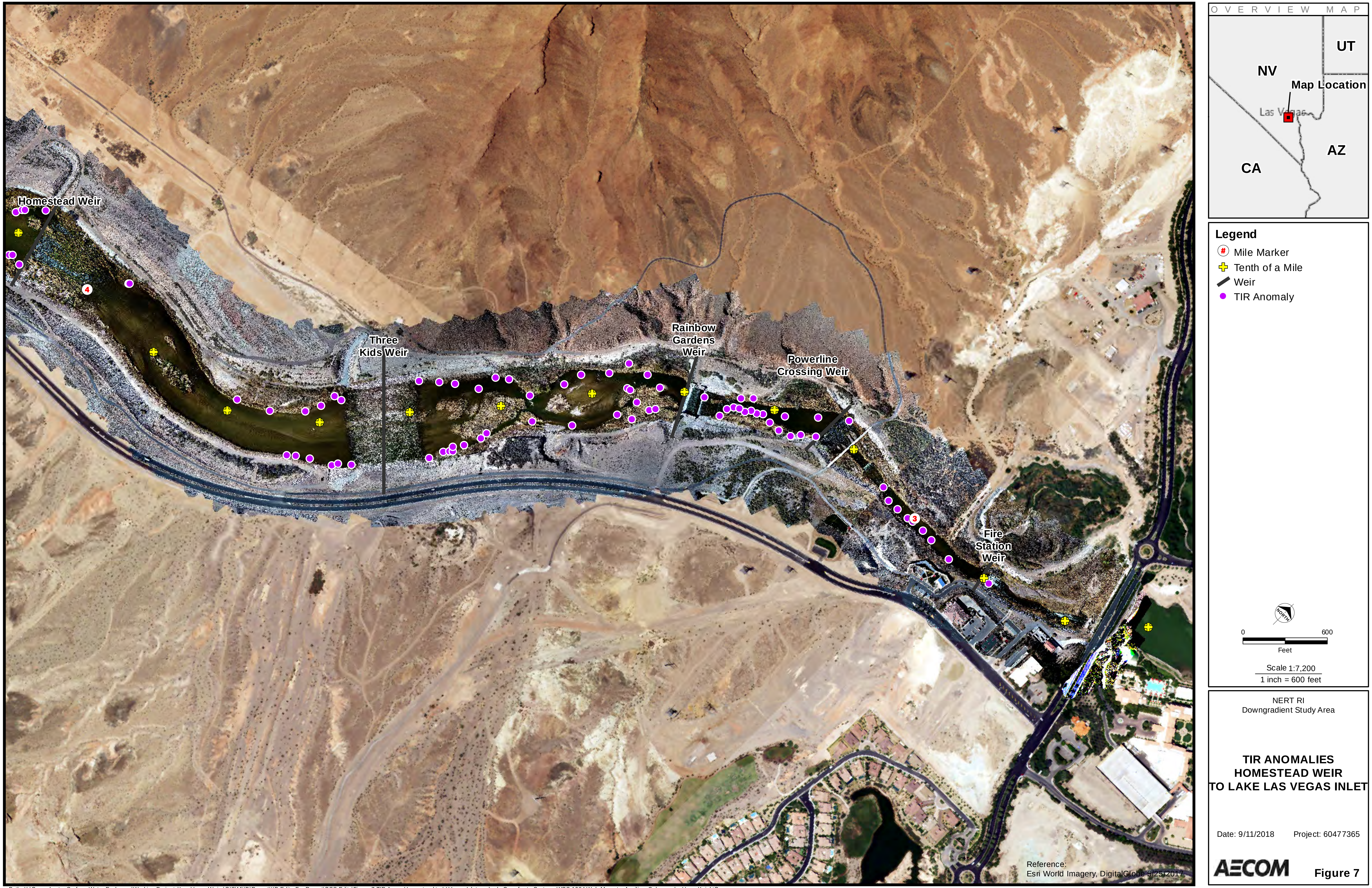
TIR ANOMALIES BOSTICK WEIR TO HOMESTEAD WEIR

Date: 9/11/2018 Project: 60477365

AECOM

Figure 6

Path: X:\Groundwater Surface Water Exchange\Working Projects\Las Vegas Weirs\GIS\MXD\Report\KD Edits For Report\CSS Edits\Figure 6 TIR Anom Bostick to Homestead.mxd | Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere | User: KnightG



NERT RI
Downgradient Study Area

TIR ANOMALIES HOMESTEAD WEIR TO LAKE LAS VEGAS INLET

Date: 9/11/2018 Project: 60477365

AECOM Figure 7

Path: X:\Groundwater Surface Water Exchange\Working Projects\Las Vegas Weirs\GIS\MXD\Report\KD Edits For Report\CSS Edits\Figure 7 TIR Anom Homestead to LLVegas Inlet.mxd | Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere | User: KnightG

NERT RI
Downgradient Study Area

LOCATIONS OF FIBER OPTIC DISTRIBUTED TEMPERATURE SENSING STUDY

Date: 10/12/2018 Project: 60477365

AECOM

Figure 8

Path: X:\Groundwater Surface Water Exchange\Working Projects\Las Vegas Weirs\GIS\MXD\Report\KD Edits For Report\CSS Edits\Figure 8 Locations of FODTS Study.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: knightg

Legend

- Cool DTS Anomaly
- Warm DTS Anomaly
- TIR Anomaly
- Approximate DTS Cable

Cable Meter Mark

0 50
Feet

Scale 1:600
1 inch = 50 feet

NERT RI
Downgradient Study Area

FODTS DEPLOYMENT AND THERMAL ANOMALIES UPPER NARROWS WEIR

Date: 1/3/2019 Project: 60477365

AECOM **Figure 9**

NERT RI
Downgradient Study Area

FODTS DEPLOYMENT AND THERMAL ANOMALIES CALICO RIDGE WEIR TO LOWER NARROWS WEIR

Date: 9/11/2018 Project: 60477365

AECOM

Figure 10

Path: X:\Groundwater Surface Water Exchange\Working Projects\Las Vegas Weirs\GIS\MXD\Report\KD Edits For Report\CSS Edits\Figure 10 Calico Ridge to Upper Narrows.mxd | Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere | User: KnightG

NERT RI
Downgradient Study Area

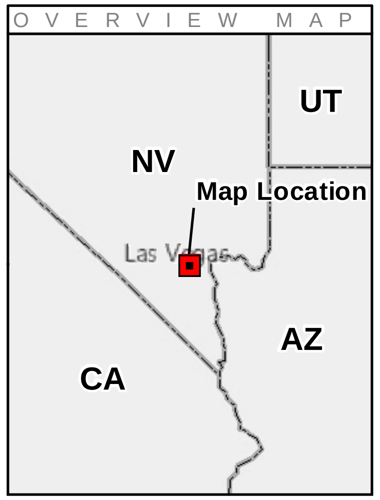
FODTS DEPLOYMENT AND THERMAL ANOMALIES LOWER NARROWS WEIR TO HOMESTEAD WEIR

Date: 9/11/2018 Project: 60477365

AECOM

Figure 11

Path: X:\Groundwater Surface Water Exchange\Working Projects\Las Vegas Weirs\GIS\MXD\Report\KD Edits For Report\CSS Edits\Figure 11 Lower Narrows to Homestead DTS.mxd | Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere | User: KnightG



Legend

- Cool DTS Anomaly
- Warm DTS Anomaly
- TIR Anomaly
- Approximate DTS Cable
- Cable Meter Mark

NORTH

0 100
Feet

Scale 1:1,200
1 inch = 100 feet

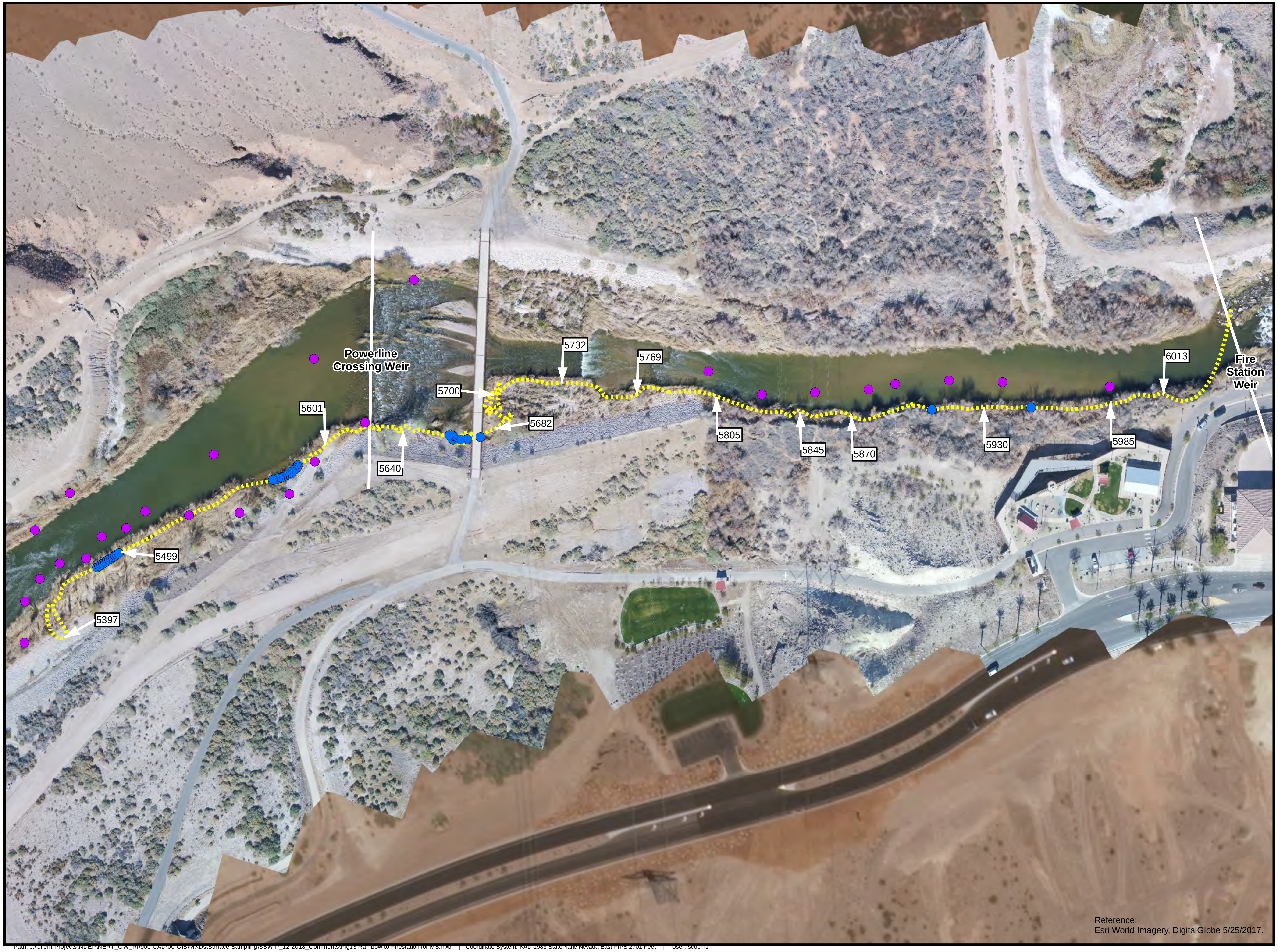
NERT RI
Downgradient Study Area

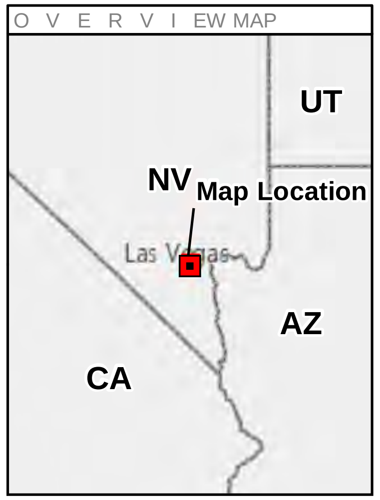
FODTS DEPLOYMENT AND THERMAL ANOMALIES THREE KIDS WEIR TO RAINBOW GARDENS WEIR

Date: 9/11/2018 Project: 60477365

AECOM **Figure 12**

Path: X:\Groundwater Surface Water Exchange\Working Projects\Las Vegas Weirs\GIS\MXD\Report\KD Edits For Report\CSS Edits\Figure 12 Three Kids to Rainbow Gardens.mxd | Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere | User: KnightG





Legend
- Cool DTS Anomaly
- TIR Anomaly
- Approximate DTS Cable

Cable Meter Mark

0 125
Feet

Scale 1:1,500
1 inch = 125 feet

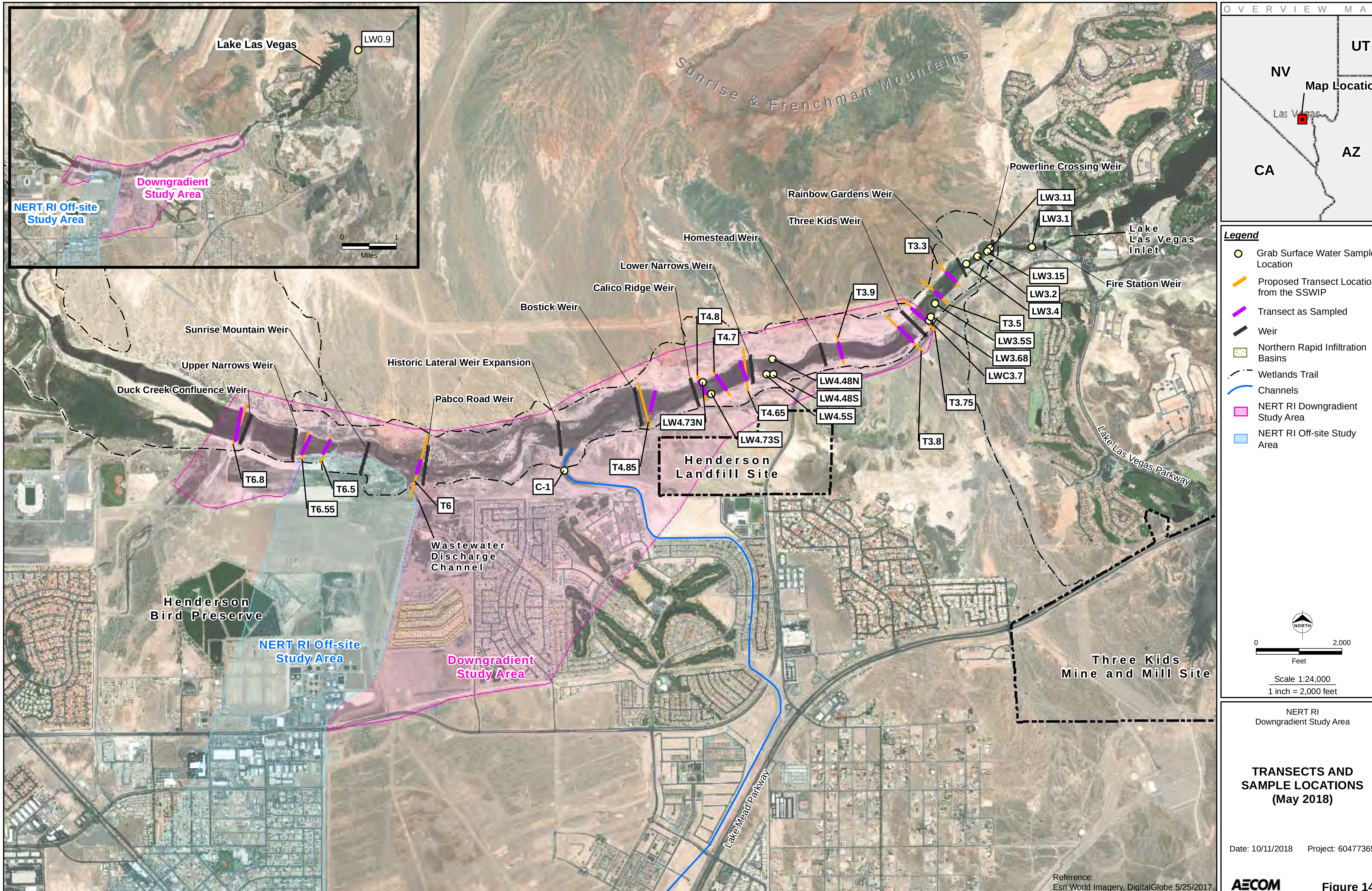
NERT RI
Downgradient Study Area

FODTS DEPLOYMENT AND THERMAL ANOMALIES RAINBOW GARDENS WEIR TO FIRE STATION WEIR

Date: 1/3/2019 Project: 60477365

AECOM **Figure 13**

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_12-2018_Comments\Fig13 Rainbow to Firestation for MS.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1



NERT RI
Downgradient Study Area

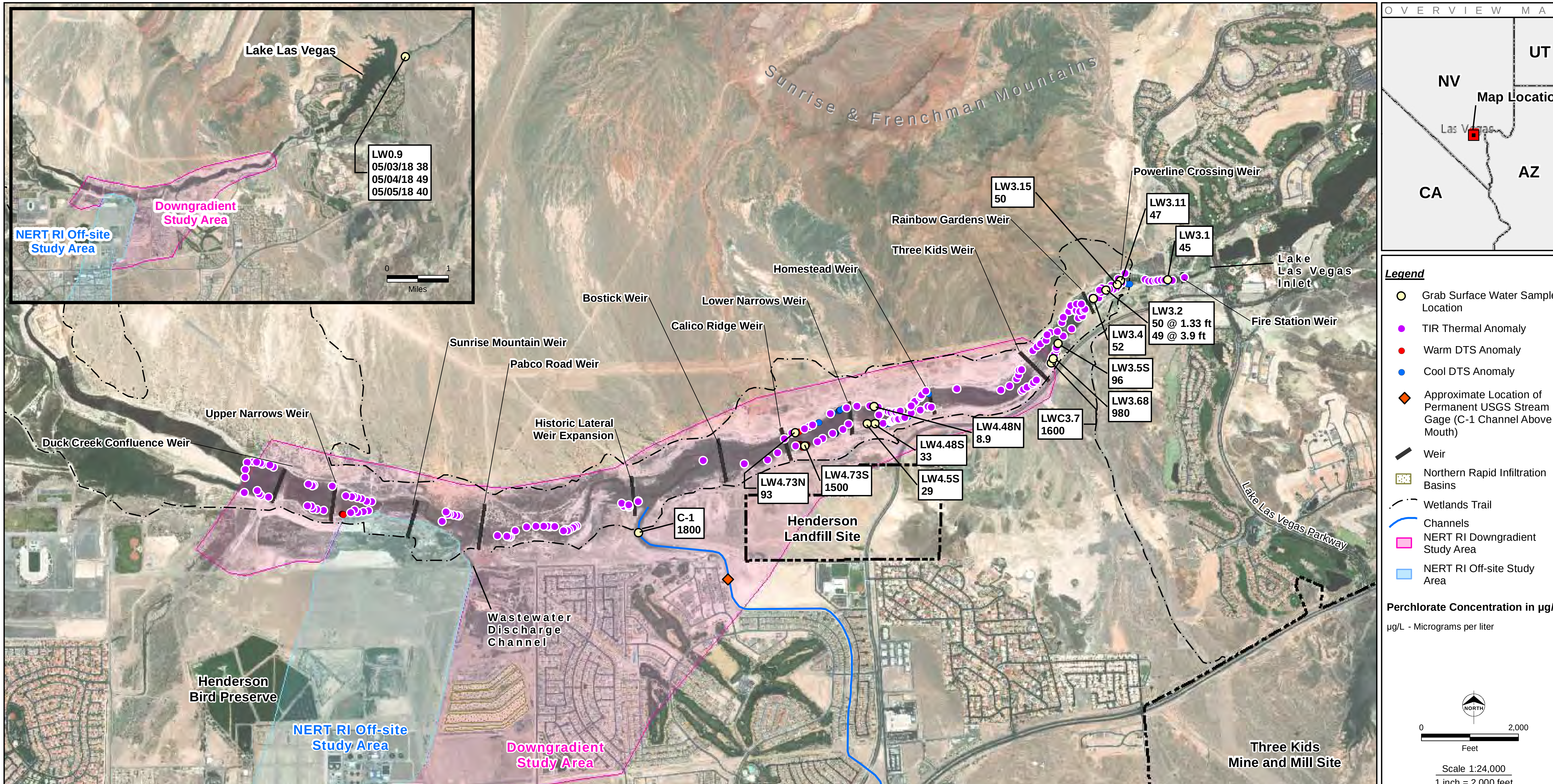
TRANSECTS AND SAMPLE LOCATIONS (May 2018)

Date: 10/11/2018 Project: 60477365

AECOM

Figure 14

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_9-2018\Fig14_SampleLocations -Transect-Grab.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1



NERT RI
Downgradient Study Area

PERCHLORATE CONCENTRATIONS IN SURFACE WATER SAMPLES - GRAB SAMPLING (May 2018)

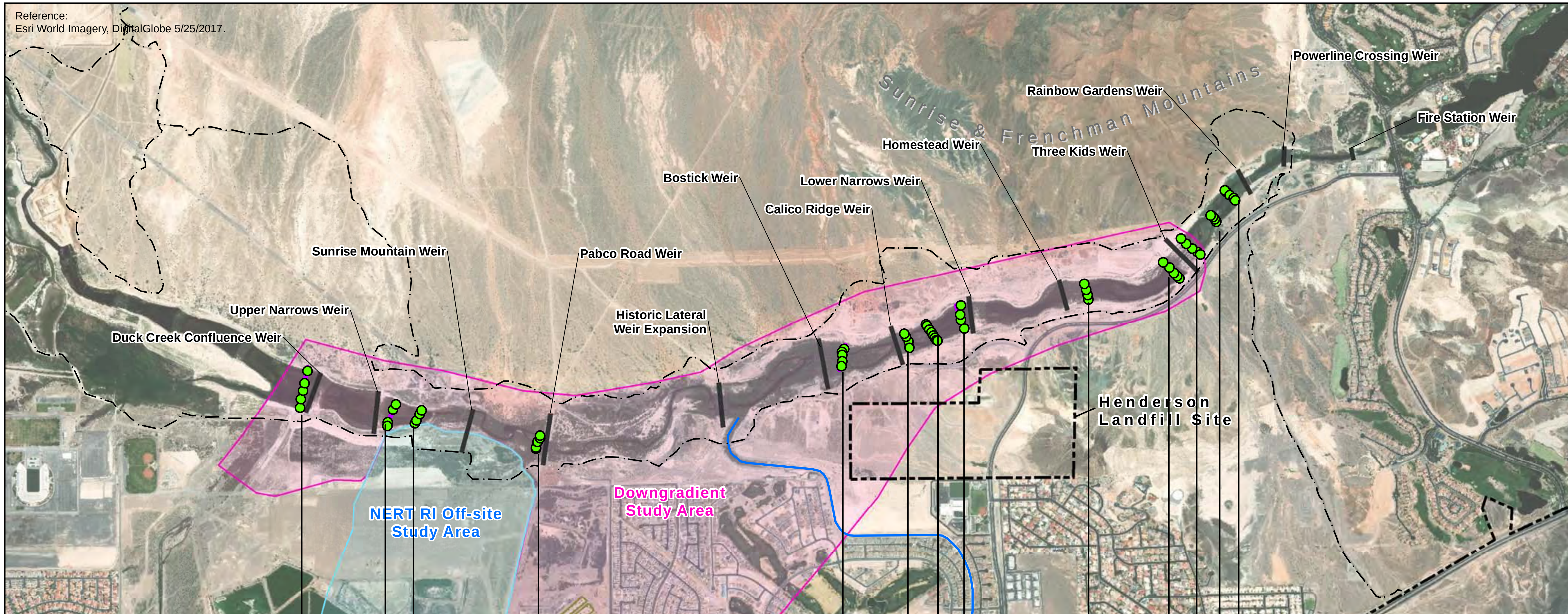
Date: 5/3-7/2018 Project: 60477365

AECOM

Figure 15

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_12-2018_Comments\Fig15_PerchlorateConcsInSW_GrabSamples.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1

Reference:
Esri World Imagery, DigitalGlobe 5/25/2017.



Transect ID	North Bank							South Bank
T6.8	<0.95	<0.95	1.9 J	1.6 J	<0.95			
T6.55	<0.95	<0.95	1.3 J	690				
T6.5	<0.95	<0.95	<0.95	13				
T6	2.7 J	3 J	1.2 J	1.2 J	1.4 J			
T4.85	4.7	5.3	5.1	5	7.3			
T4.8	31	5.4	5.8	1800	3200			
T4.7	15	10	12	12	16	23	21 / 22	23
T4.65	14	11	35	35				
T3.9	23	29	39	44				
T3.8	41	19	25	36	32			
T3.75	200	19	26	40	53			
T3.5	37 / 38	33	85	91	90			
T3.3	33	72	81	89	96			

Color Scale Perchlorate (µg/L)

Color Scale Perchlorate (µg/L)
>90
80
70
60
50
40
30
20
10
0

Legend

- Surface Water Sample Location Along Transect
- Transects
- Weir
- Northern Rapid Infiltration Basins
- Wetlands Trail
- Channels
- NERT RI Downgradient Study Area
- NERT RI Off-site Study Area

Perchlorate Concentration in µg/L

J - Associated concentration is estimate
µg/L - Micrograms per liter

Note:
1. Field duplicates are not presented.
2. Two concentrations for one location indicates sampling conducted at two depths. Shallow depth on left and deep depth on right.

NORTH

0 2,000
Feet

Scale 1:24,000
1 inch = 2,000 feet

NERT RI
Downgradient Study Area

PERCHLORATE CONCENTRATIONS IN SURFACE WATER SAMPLES - TRANSECT SAMPLING (May 2018)

Date: 10/11/2018 Project: 60477365

AECOM

Figure 16

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWP_9-2018\Fig16_Transects-Perchlorate.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1

NERT RI
Downgradient Study Area

PERCHLORATE CONCENTRATIONS IN SURFACE WATER SAMPLES - ABOVE DUCK CREEK CONFLUENCE WEIR (May 2018)

Date: 10/11/2018 Project: 60477365

AECOM

Figure 17

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_9-2018\Fig17_Perchlorate_SL8_T6_8 Trans Samples.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1

Legend

- Surface Water Sample Location Along Transect
- Grab Surface Water Sample Location
- TIR Thermal Anomaly
- Warm DTS Anomaly
- Cool DTS Anomaly
- Proposed Transect Location from the SSWIP
- Transect as Sampled
- Weir
- Wetlands Trail

Perchlorate Concentration in µg/L

J - Associated concentration is estimate
µg/L - Micrograms per liter
ND - Not detected above method detection limit

NORTH

0 150
Feet

Scale 1:1,800
1 inch = 150 feet

NERT RI
Downgradient Study Area

PERCHLORATE CONCENTRATIONS IN SURFACE WATER SAMPLES - UPPER NARROWS WEIR TO SUNRISE MOUNTAIN WEIR (May 2018)

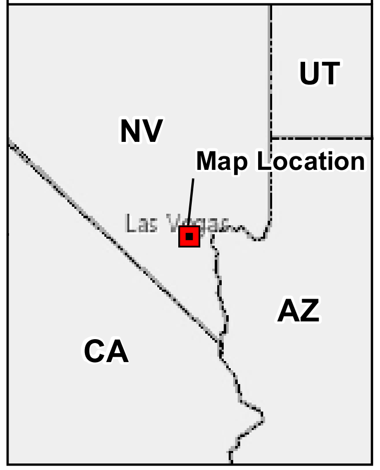
Date: 10/11/2018 Project: 60477365

AECOM

Figure 18

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_9-2018\Fig18_Perchlorate_SL9_T6_55-Sunrise Samples.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1

OVERVIEW MAP



Legend

- Surface Water Sample Location Along Transect
- TIR Thermal Anomaly
- Proposed Transect Location from the SSWIP
- Transect as Sampled
- Weir
- Wetlands Trail

Perchlorate Concentration in μg/L

J - Associated concentration is estimate
μg/L - Micrograms per liter

NORTH

0 100
Feet

Scale 1:1,200
1 inch = 100 feet

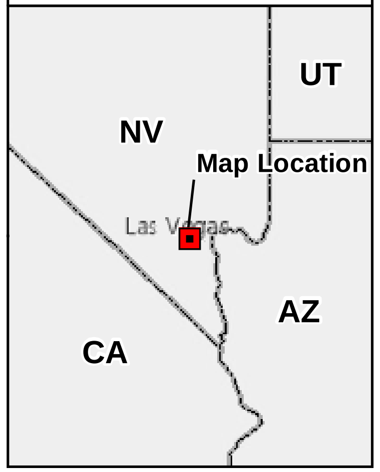
NERT RI
Downgradient Study Area

PERCHLORATE CONCENTRATIONS IN SURFACE WATER SAMPLES - NEAR PABCO ROAD WEIR (May 2018)

Date: 12/27/2018 Project: 60477365

AECOM **Figure 19**

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_12-2018_Comments\Fig19_Perchlorate_SL7_T6 Trans Samples1.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1



Legend

- Grab Surface Water Sample Location
- TIR Thermal Anomaly
- Weir
- Wetlands Trail

Perchlorate Concentration in µg/L

µg/L - Micrograms per liter

NORTH

0 100
Feet

Scale 1:1,200
1 inch = 100 feet

NERT RI
Downgradient Study Area

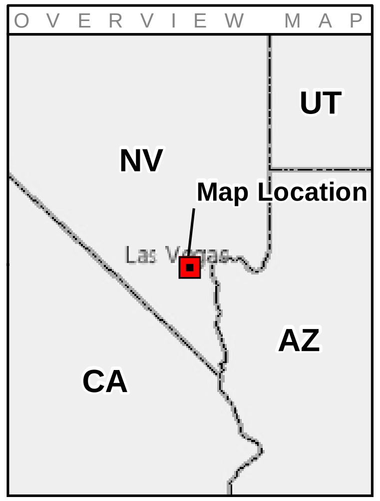
PERCHLORATE CONCENTRATIONS IN SURFACE WATER SAMPLES - C-1 CHANNEL (May 2018)

Date: 10/11/2018 Project: 60477365

AECOM

Figure 20

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_9-2018\Fig20_Perchlorate_SL11_C-1 Sample.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1



Legend

- Surface Water Sample Location Along Transect
- TIR Thermal Anomaly
- Proposed Transect Location from the SSWIP
- Transect as Sampled
- Weir
- Wetlands Trail

Perchlorate Concentration in µg/L

µg/L - Micrograms per liter

NORTH

0 100

Feet

Scale 1:1,200

1 inch = 100 feet

NERT RI
Downgradient Study Area

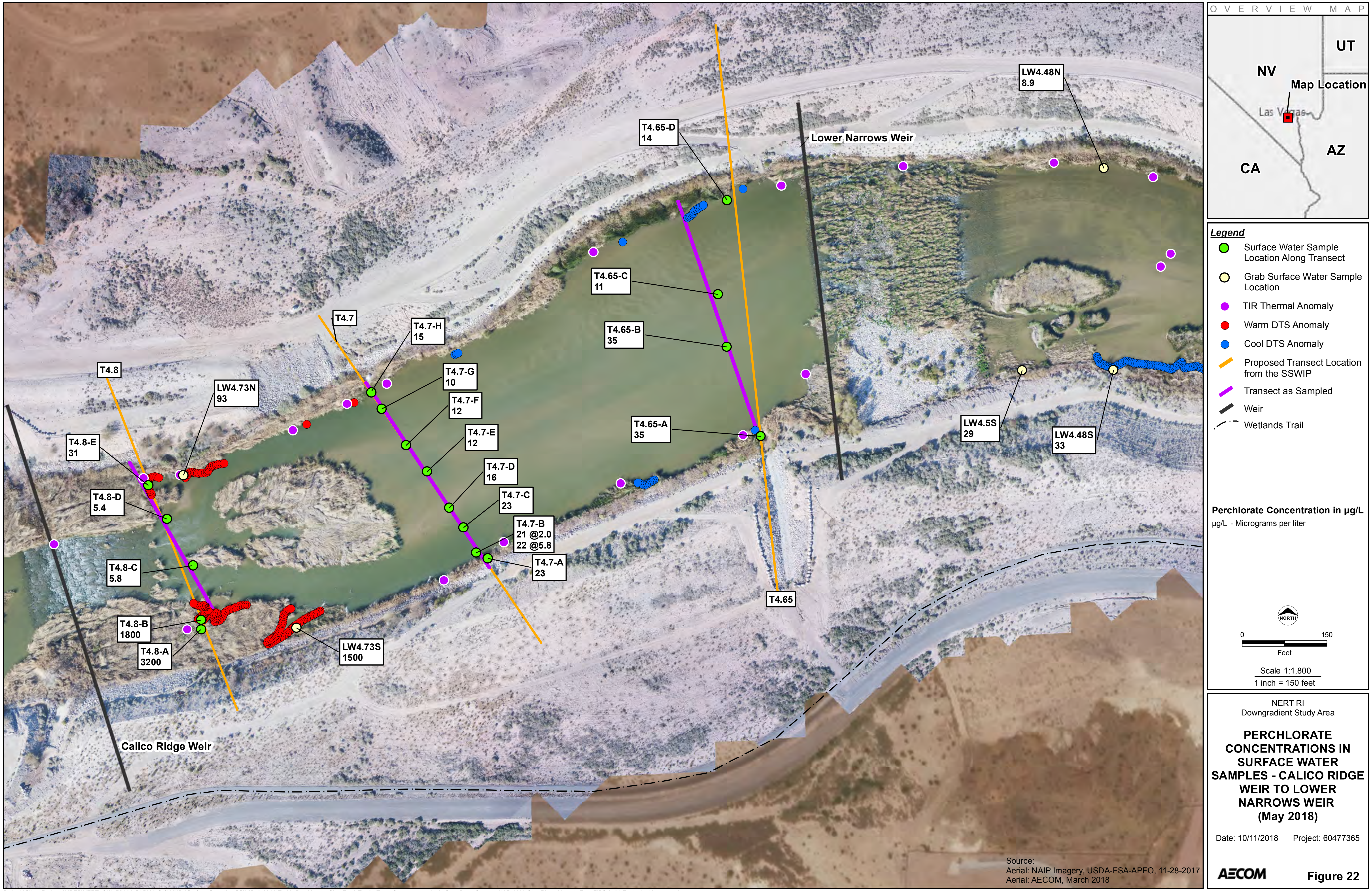
PERCHLORATE CONCENTRATIONS IN SURFACE WATER SAMPLES - BOSTICK WEIR (May 2018)

Date: 10/11/2018 Project: 60477365

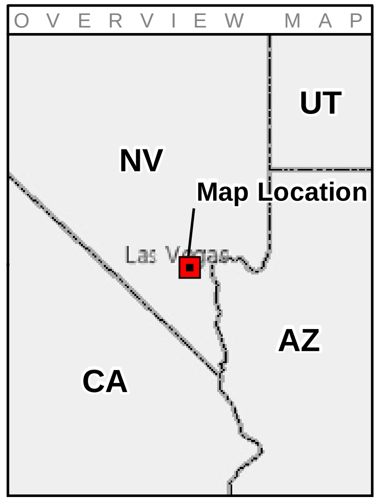
AECOM

Figure 21

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_9-2018\Fig21_Perchlorate_SL6_T4_85 Trans Samples.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1



Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_9-2018\Fig22_Perchlorate_SL5_T4_8-T4_65 Trans Samples1.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: angela.mcmurtry



Legend

- Surface Water Sample Location Along Transect
- TIR Thermal Anomaly
- Cool DTS Anomaly
- Proposed Transect Location from the SSWIP
- Transect as Sampled
- Weir
- Wetlands Trail

Perchlorate Concentration in µg/L

µg/L - Micrograms per liter

NORTH

0 100
Feet

Scale 1:1,200
1 inch = 100 feet

NERT RI
Downgradient Study Area

PERCHLORATE CONCENTRATIONS IN SURFACE WATER SAMPLES - HOMESTEAD WEIR (May 2018)

Date: 10/11/2018 Project: 60477365

AECOM

Figure 23

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_9-2018\Fig23_Perchlorate_SL4_T3_9 Trans Samples.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_9-2018\Fig24_Perchlorate_SL3_T3_8-T3_75 Trans Samples.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1

NERT RI
Downgradient Study Area

PERCHLORATE CONCENTRATIONS IN SURFACE WATER SAMPLES - UPSTREAM OF RAINBOW GARDENS WEIR (May 2018)

Date: 12/27/2018 Project: 60477365

AECOM

Figure 25

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_12-2018_Comments\Fig25_Perchlorate_SL2_T3_5-T3_3 Trans Samples.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1

Legend

- Grab Surface Water Sample Location
- TIR Thermal Anomaly
- Cool DTS Anomaly
- Weir
- Wetlands Trail

Perchlorate Concentration in µg/L

µg/L - Micrograms per liter

NORTH

0 150

Feet

Scale 1:1,800

1 inch = 150 feet

NERT RI
Downgradient Study Area

PERCHLORATE CONCENTRATIONS IN SURFACE WATER SAMPLES - RAINBOW GARDENS WEIR TO FIRE STATION WEIR (May 2018)

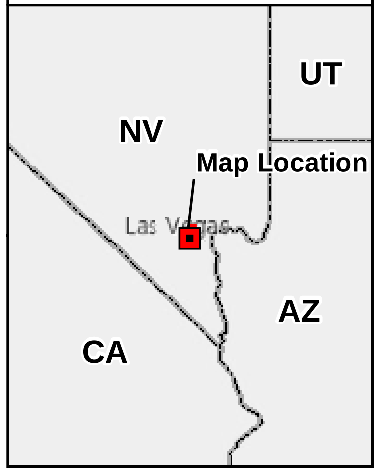
Date: 12/27/2018 Project: 60477365

AECOM

Figure 26

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_12-2018_Comments\Fig26_Perchlorate_SL1_Rainbow-Fire Samples.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1

OVERVIEW MAP



Legend

Grab Surface Water Sample Location

Perchlorate Concentration in µg/L

µg/L - Micrograms per liter

NORTH

0 150

Feet

Scale 1:1,200

1 inch = 100 feet

NERT RI
Downgradient Study Area

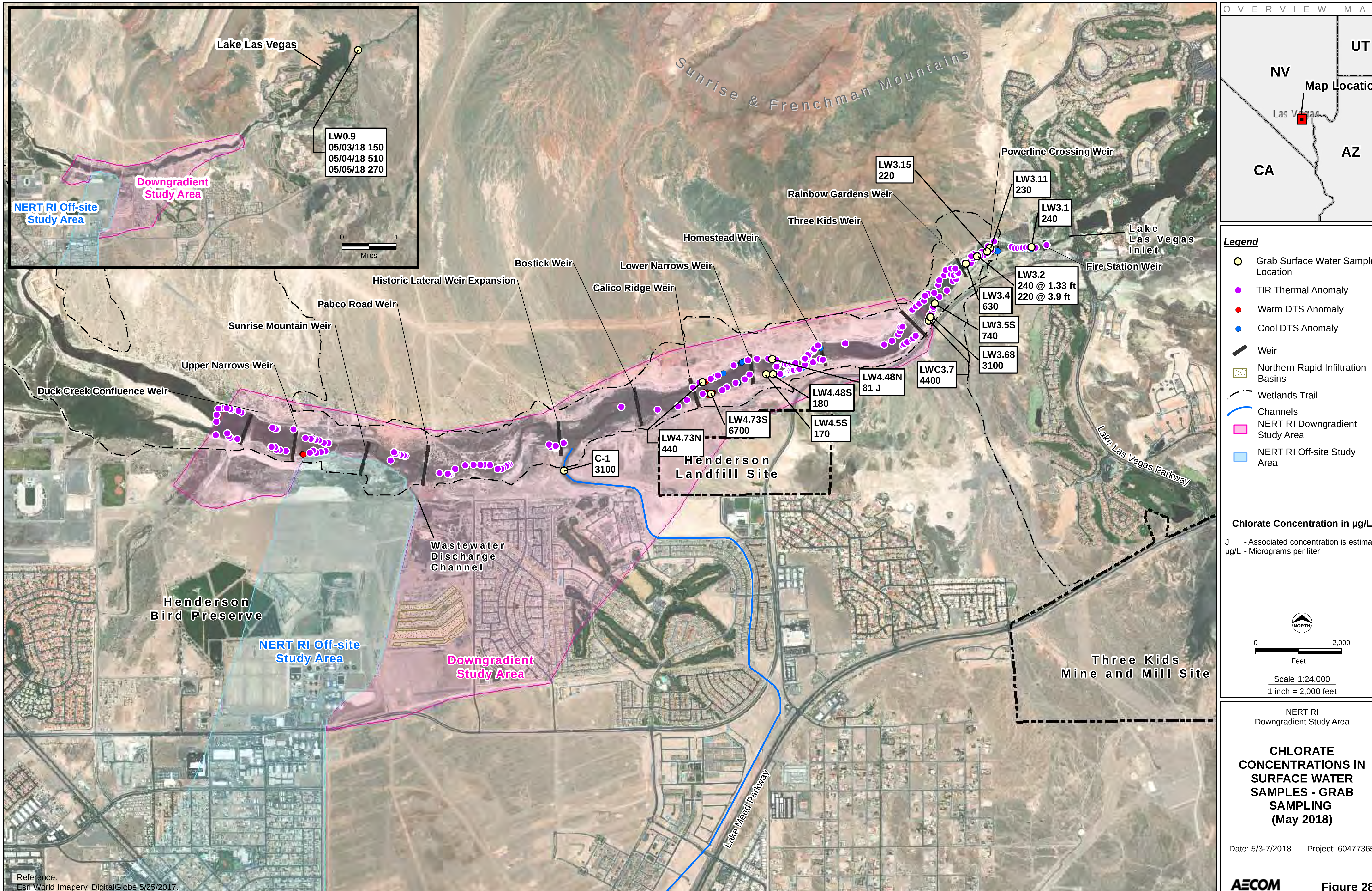
PERCHLORATE CONCENTRATIONS IN SURFACE WATER SAMPLES - LW0.9 BELOW LAKE LAS VEGAS (May 2018)

Date: 10/11/2018 Project: 60477365

AECOM

Figure 27

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_9-2018\Fig27_Perchlorate_SL10_LW0_9 Sample.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1



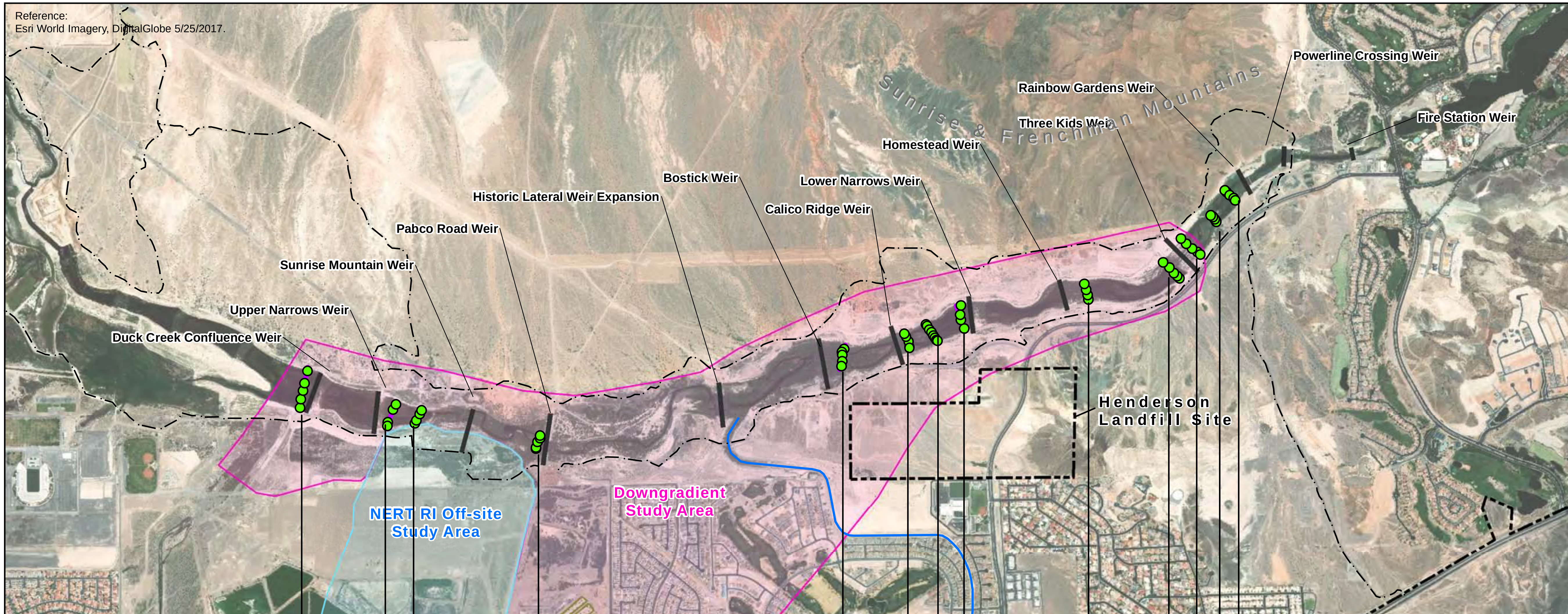
NERT RI
Downgradient Study Area

CHLORATE CONCENTRATIONS IN SURFACE WATER SAMPLES - GRAB SAMPLING (May 2018)

Date: 5/3-7/2018 Project: 60477365

AECOM **Figure 28**

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_9-2018\Fig28_ChlorateConcsInSW_GrabSamples.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1



Transect ID	North Bank → South Bank
T6.8	90 J, 88 J, 90 J, 100, 100
T6.55	91 J, 85 J, 94 J, 460
T6.5	94 J, 130, 81 J, 110
T6	71 J, 64 J, 150, 200, 150
T4.85	560, 580, 590, 570, 400
T4.8	48 J, 87 J, 83 J, 6500, 13000
T4.7	75 J, 80 J, 76 J, 83 J, 140, 160, 160 / 170, 160
T4.65	68 J, 77 J, 200, 200
T3.9	450, 580, 590, 390
T3.8	170, 130, 140, 180, 190
T3.75	690, 440, 490, 460, 510
T3.5	450 / 410, 390, 520, 450, 370
T3.3	450, 520, 560, 500, 620

Color Scale Chlorate (µg/L)
>1000
500
400
300
200
150
100
<50

Legend

- Surface Water Sample Location Along Transect
- Transects
- Weir
- Northern Rapid Infiltration Basins
- Wetlands Trail
- Channels
- NERT RI Downgradient Study Area
- NERT RI Off-site Study Area

Chlorate Concentration in µg/L

J - Associated concentration is estimate
µg/L - Micrograms per liter

Note:
1. Field duplicates are not presented.
2. Two concentrations for one location indicates sampling conducted at two depths. Shallow depth on left and deep depth on right.

NORTH
0 2,000
Feet
Scale 1:24,000
1 inch = 2,000 feet

NERT RI
Downgradient Study Area

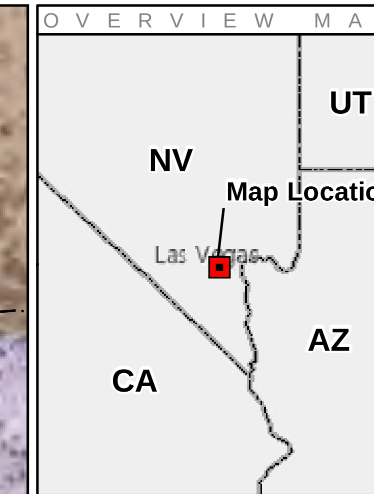
CHLORATE CONCENTRATIONS IN SURFACE WATER SAMPLES - TRANSECT SAMPLING (May 2018)

Date: 10/11/2018 Project: 60477365

AECOM

Figure 29

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_9-2018\Fig29_Transects-Chlorate.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1



Legend

- Surface Water Sample Location Along Transect
- TIR Thermal Anomaly
- Proposed Transect Location from the SSWIP
- Transect as Sampled
- Weir
- Wetlands Trail

Chlorate Concentration in µg/L

J - Associated concentration is estimate
µg/L - Micrograms per liter

NORTH

0 150
Feet

Scale 1:1,800
1 inch = 150 feet

NERT RI
Downgradient Study Area

CHLORATE CONCENTRATIONS IN SURFACE WATER SAMPLES - ABOVE DUCK CREEK CONFLUENCE WEIR (May 2018)

Date: 10/11/2018 Project: 60477365

AECOM

Figure 30

Reference:
Google Earth Pro, Imagery Data 11/4/2016

Source:
Aerial: NAIP Imagery, USDA-FSA-APFO, 11-28-2017
Aerial: AECOM, March 2018

OVERVIEW MAP

Legend

- Surface Water Sample Location Along Transect
- Grab Surface Water Sample Location
- TIR Thermal Anomaly
- Warm DTS Anomaly
- Cool DTS Anomaly
- Proposed Transect Location from the SSWIP
- Transect as Sampled
- Weir
- Wetlands Trail

Chlorate Concentration in µg/L

J - Associated concentration is estimate
µg/L - Micrograms per liter

NORTH

0 150
Feet

Scale 1:1,800
1 inch = 150 feet

NERT RI
Downgradient Study Area

CHLORATE CONCENTRATIONS IN SURFACE WATER SAMPLES - UPPER NARROWS WEIR TO SUNRISE MOUNTAIN WEIR (May 2018)

Date: 10/11/2018 Project: 60477365

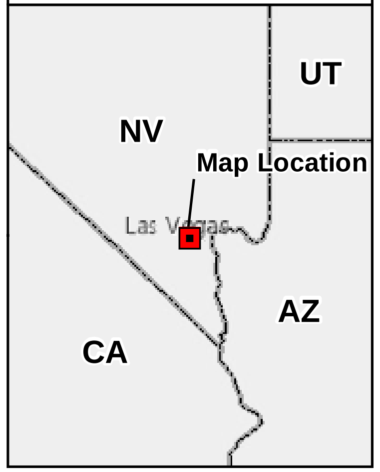
AECOM

Figure 31

Reference:
Google Earth Pro, Imagery Data 11/4/2016

Source:
Aerial: NAIP Imagery, USDA-FSA-APFO, 11-28-2017
Aerial: AECOM, March 2018

OVERVIEW MAP



Legend

- Surface Water Sample Location Along Transect
- TIR Thermal Anomaly
- Proposed Transect Location from the SSWIP
- Transect as Sampled
- Weir
- Wetlands Trail

Chlorate Concentration in µg/L

J - Associated concentration is estimate
µg/L - Micrograms per liter

NORTH

0 100
Feet

Scale 1:1,200
1 inch = 100 feet

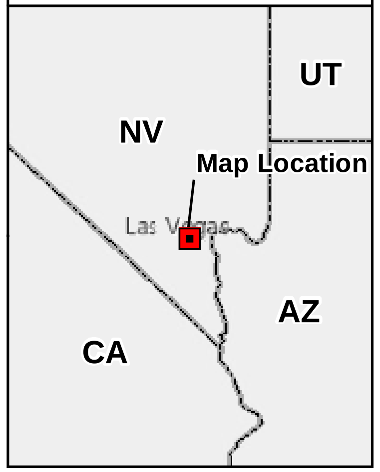
NERT RI
Downgradient Study Area

CHLORATE CONCENTRATIONS IN SURFACE WATER SAMPLES - NEAR PABCO ROAD WEIR (May 2018)

Date: 10/16/2018 Project: 60477365

AECOM **Figure 32**

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_9-2018\Fig32_Chlorate_SL7_T6 Trans Samples1.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1



Legend

- Grab Surface Water Sample Location
- TIR Thermal Anomaly
- Weir
- Wetlands Trail

Chlorate Concentration in µg/L

µg/L - Micrograms per liter

NORTH

0 100
Feet

Scale 1:1,200
1 inch = 100 feet

NERT RI
Downgradient Study Area

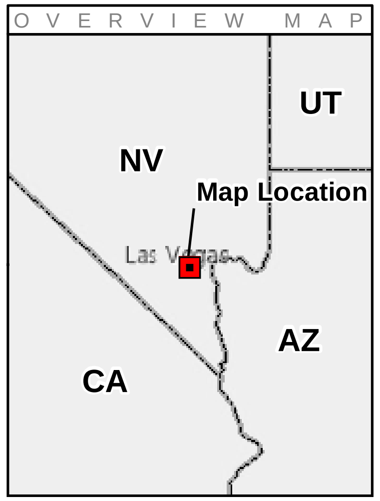
CHLORATE CONCENTRATIONS IN SURFACE WATER SAMPLES - C-1 CHANNEL (May 2018)

Date: 10/11/2018 Project: 60477365

AECOM

Figure 33

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_9-2018\Fig33_Chlorate_SL11_C-1 Sample.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1



Legend

- Surface Water Sample Location Along Transect
- TIR Thermal Anomaly
- Proposed Transect Location from the SSWIP
- Transect as Sampled
- Weir
- Wetlands Trail

Chlorate Concentration in µg/L

µg/L - Micrograms per liter

NORTH

0 100
Feet

Scale 1:1,200
1 inch = 100 feet

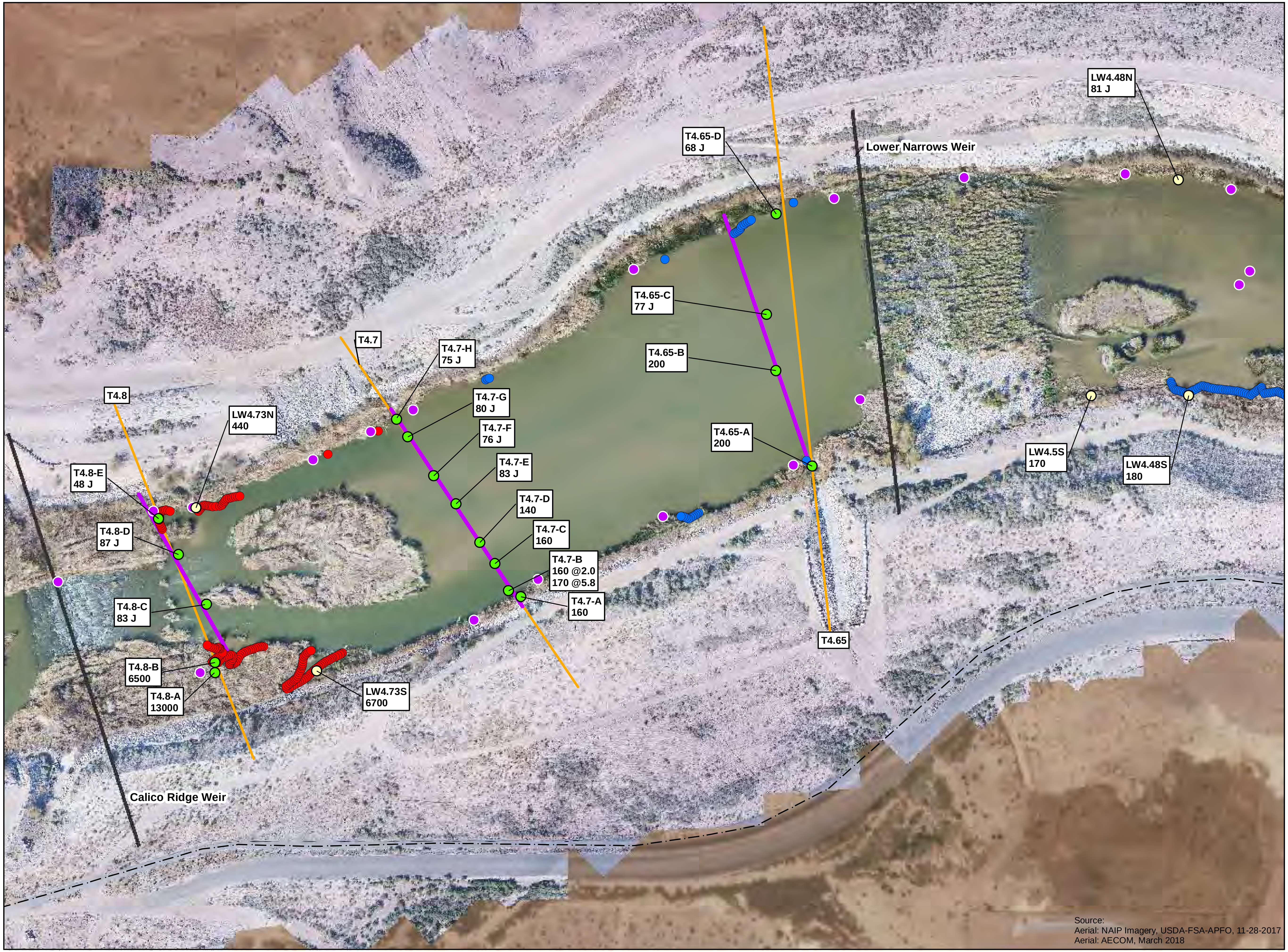
NERT RI
Downgradient Study Area

CHLORATE CONCENTRATIONS IN SURFACE WATER SAMPLES - BOSTICK WEIR (May 2018)

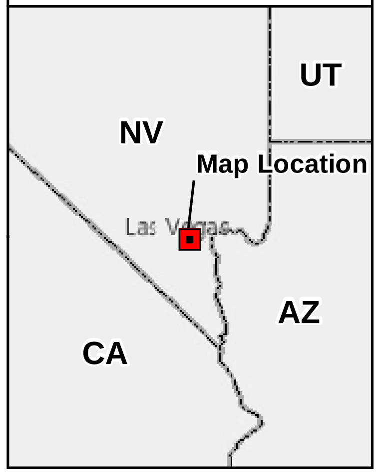
Date: 10/11/2018 Project: 60477365

AECOM **Figure 34**

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_9-2018\Fig34_Chlorate_SL6_T4_85 Trans Samples.mxd | Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere | User: scopm1



OVERVIEW MAP



Legend

- Surface Water Sample Location Along Transect
- Grab Surface Water Sample Location
- TIR Thermal Anomaly
- Warm DTS Anomaly
- Cool DTS Anomaly
- Proposed Transect Location from the SSWIP
- Transect as Sampled
- Weir
- Wetlands Trail

Chlorate Concentration in µg/L

J - Associated concentration is estimate
µg/L - Micrograms per liter

NORTH

0 150
Feet

Scale 1:1,800
1 inch = 150 feet

NERT RI
Downgradient Study Area

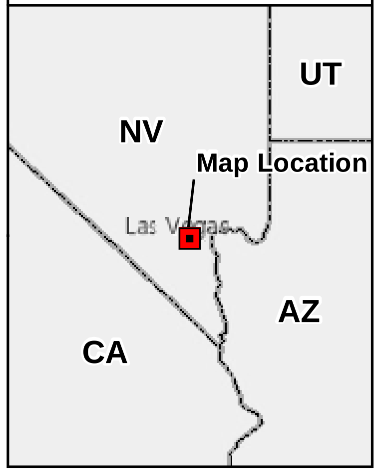
CHLORATE CONCENTRATIONS IN SURFACE WATER SAMPLES - CALICO RIDGE WEIR TO LOWER NARROWS WEIR (May 2018)

Date: 10/11/2018 Project: 60477365

AECOM **Figure 35**

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_9-2018\Fig35_Chlorate_SL5_T4_8-T4_65 Trans Samples.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1

OVERVIEW MAP



Legend

- Surface Water Sample Location Along Transect
- TIR Thermal Anomaly
- Cool DTS Anomaly
- Proposed Transect Location from the SSWIP
- Transect as Sampled
- Weir
- Wetlands Trail

Chlorate Concentration in μg/L

μg/L - Micrograms per liter

NORTH

0 100

Feet

Scale 1:1,200

1 inch = 100 feet

NERT RI
Downgradient Study Area

CHLORATE CONCENTRATIONS IN SURFACE WATER SAMPLES - HOMESTEAD WEIR (May 2018)

Date: 10/11/2018 Project: 60477365

AECOM

Figure 36

NERT RI
Downgradient Study Area

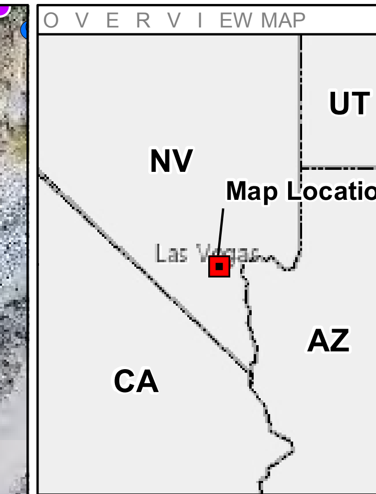
CHLORATE CONCENTRATIONS IN SURFACE WATER SAMPLES - THREE KIDS WEIR (May 2018)

Date: 10/11/2018 Project: 60477365

AECOM

Figure 37

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_9-2018\Fig37_Chlorate_SL3_T3_8-T3_75 Trans Samples.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1



Legend

- Surface Water Sample Location Along Transect
- Grab Surface Water Sample Location
- TIR Thermal Anomaly
- Warm DTS Anomaly
- Cool DTS Anomaly
- Proposed Transect Location from the SSWIP
- Transect as Sampled
- Weir
- Wetlands Trail

Chlorate Concentration in µg/L

µg/L - Micrograms per liter

NORTH

0 100
Feet

Scale 1:1,200
1 inch = 100 feet

NERT RI
Downgradient Study Area

CHLORATE CONCENTRATIONS IN SURFACE WATER SAMPLES - UPSTREAM OF RAINBOW GARDENS WEIR (May 2018)

Date: 12/27/2018 Project: 60477365

AECOM **Figure 38**

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_12-2018_Comments\Fig38_Chlorate_SL2_T3_5-T3_3 Trans Samples.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1

Legend

- Grab Surface Water Sample Location
- TIR Thermal Anomaly
- Cool DTS Anomaly
- Weir
- Wetlands Trail

Chlorate Concentration in µg/L

µg/L - Micrograms per liter

NORTH

0 150
Feet

Scale 1:1,800
1 inch = 150 feet

NERT RI
Downgradient Study Area

CHLORATE CONCENTRATIONS IN SURFACE WATER SAMPLES - RAINBOW GARDENS WEIR TO FIRE STATION WEIR (May 2018)

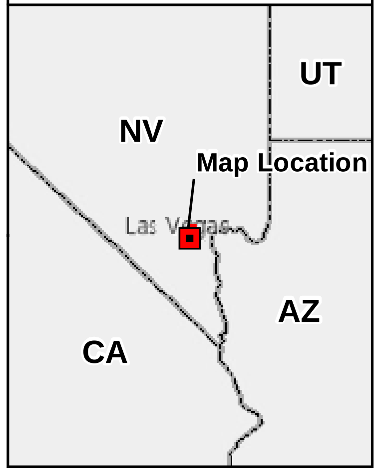
Date: 12/27/2018 Project: 60477365

AECOM

Figure 39

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_12-2018_Comments\Fig39_Chlorate_SL1_Rainbow-Fire Samples.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1

OVERVIEW MAP



Legend

Grab Surface Water Sample Location

Chlorate Concentration in µg/L

µg/L - Micrograms per liter

NORTH

0 150

Feet

Scale 1:1,200

1 inch = 100 feet

NERT RI
Downgradient Study Area

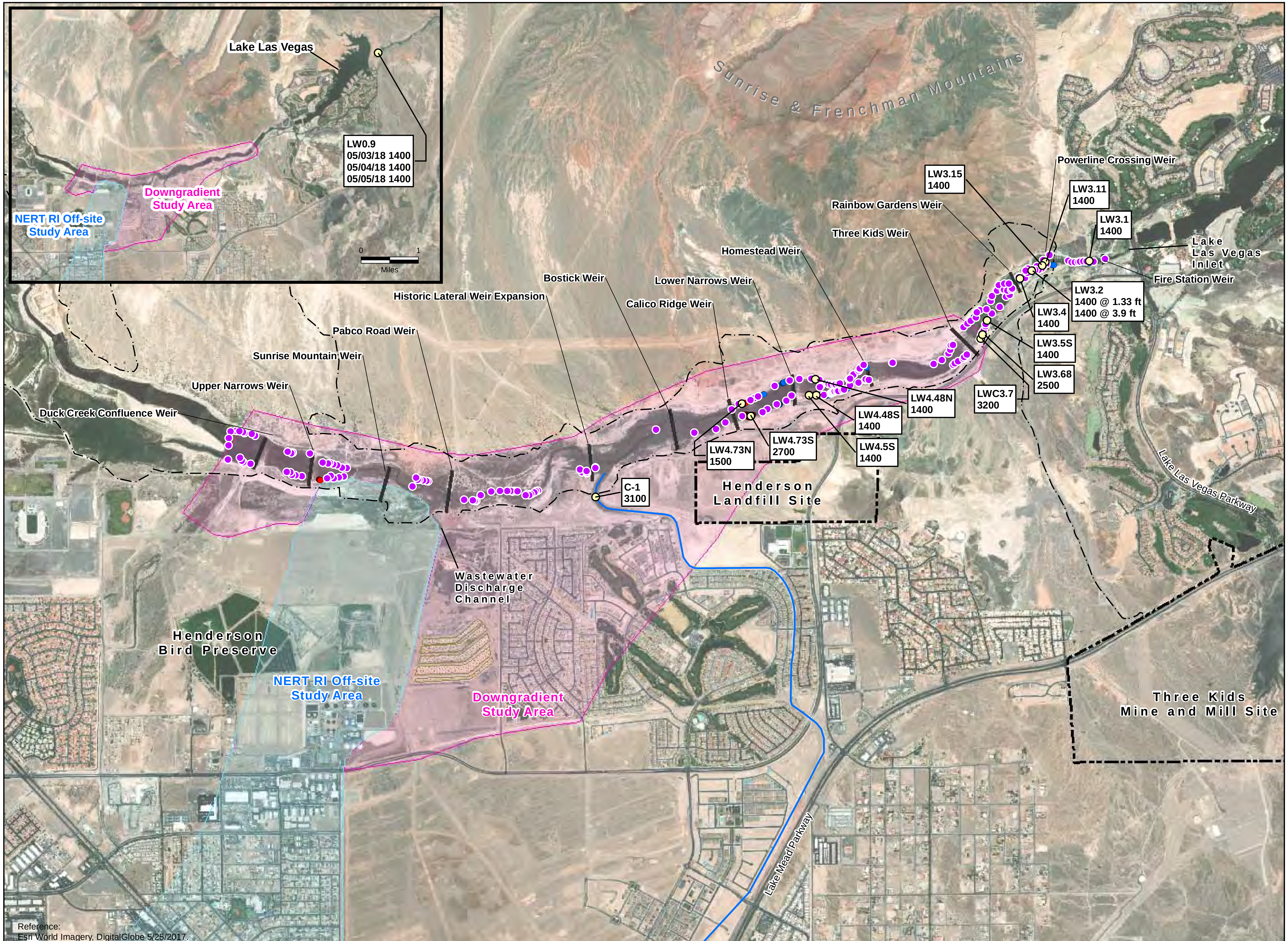
CHLORATE CONCENTRATIONS IN SURFACE WATER SAMPLES - LW0.9 BELOW LAKE LAS VEGAS (May 2018)

Date: 10/11/2018 Project: 60477365

AECOM

Figure 40

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_9-2018\Fig40_Chlorate_SL10_LW0_9 Sample.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1



OVERVIEW MAP

Legend

- Grab Surface Water Sample Location
- TIR Thermal Anomaly
- Warm DTS Anomaly
- Cool DTS Anomaly
- Weir
- Northern Rapid Infiltration Basins
- Wetlands Trail
- Channels
- NERT RI Downgradient Study Area
- NERT RI Off-site Study Area

Total Dissolved Solids Concentration in mg/L

mg/L - Milligrams per liter

NORTH

0 2,000

Feet

Scale 1:24,000

1 inch = 2,000 feet

NERT RI
Downgradient Study Area

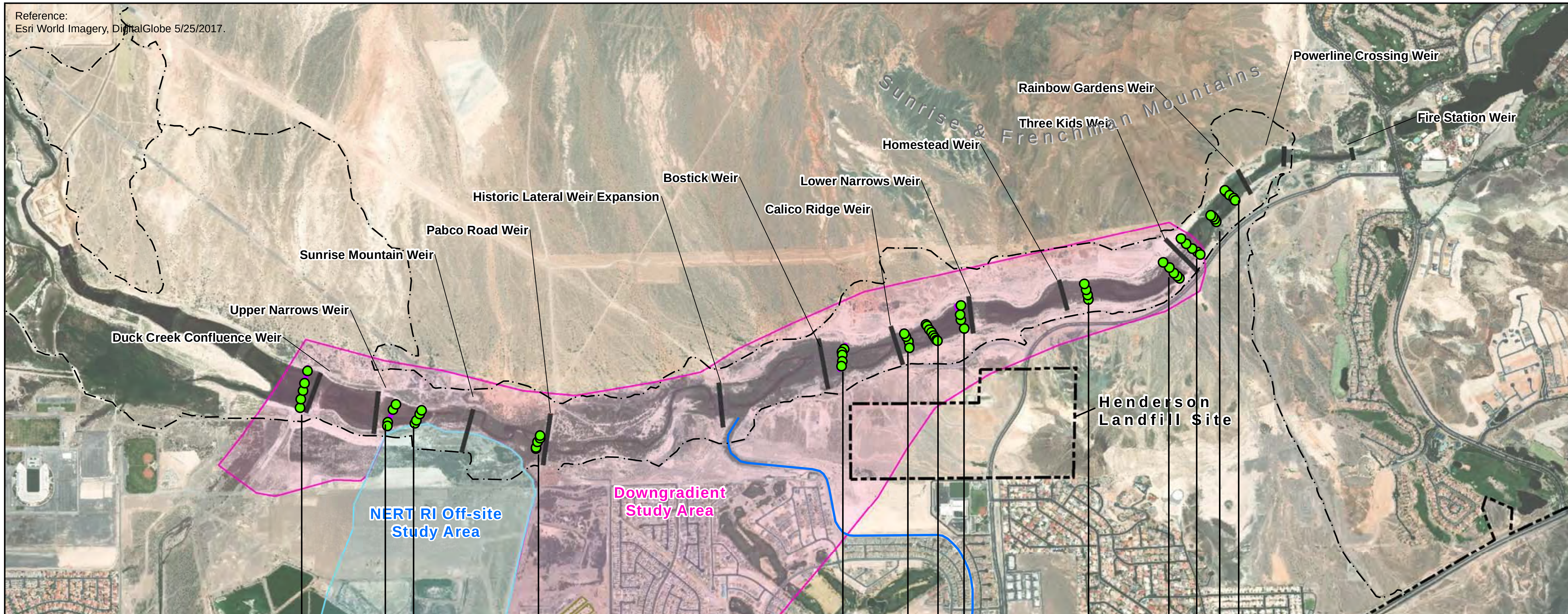
TOTAL DISSOLVED SOLIDS CONCENTRATIONS IN SURFACE WATER SAMPLES - GRAB SAMPLING (May 2018)

Date: 5/3-7/2018 Project: 60477365

AECOM **Figure 41**

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_9-2018\Fig41_TotalDsslvdSolidsConcsInSW_GrabSamples.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1

Reference:
Esri World Imagery, DigitalGlobe 5/25/2017.



Transect ID	North Bank → South Bank
T6.8	1100, 1200, 1700, 1700, 1600
T6.55	1200, 1200, 1500, 3800
T6.5	1200, 1100, 1200, 1600
T6	1300, 1300, 1500, 1500, 1500
T4.85	1300, 1300, 1400, 1300, 1300
T4.8	1500, 1300, 1300, 2700, 3800
T4.7	1300, 1400, 1400, 1300, 1400, 1400, 1400 / 1400, 1400
T4.65	1300, 1300, 1400, 1300
T3.9	1300, 1300, 1400, 1300
T3.8	1300, 1300, 1300, 1300, 1300
T3.75	1600, 1300, 1300, 1300, 1300
T3.5	1500 / 1400, 1500, 1500, 1500, 1500
T3.3	1400, 1400, 1400, 1400, 1400

Color Scale TDS (mg/L)

- >2,400
- 2200
- 2000
- 1800
- 1600
- 1400
- <1200

Legend

- Surface Water Sample Location Along Transect
- Transects
- Weir
- Northern Rapid Infiltration Basins
- Wetlands Trail
- Channels
- NERT RI Downgradient Study Area
- NERT RI Off-site Study Area

Total Dissolved Solids Concentration in mg/L

mg/L - Milligrams per liter

Note:
1. Field duplicates are not presented.
2. Two concentrations for one location indicates sampling conducted at two depths. Shallow depth on left and deep depth on right.

NORTH

0 2,000
Feet

Scale 1:24,000
1 inch = 2,000 feet

NERT RI
Downgradient Study Area

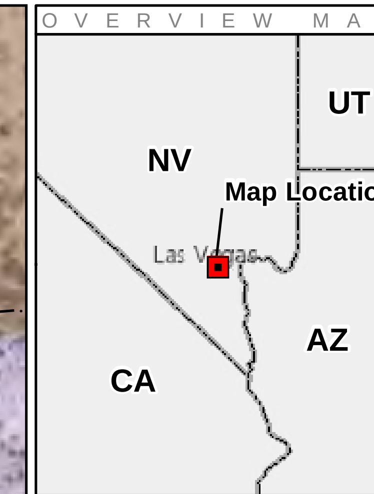
TOTAL DISSOLVED SOLIDS CONCENTRATIONS IN SURFACE WATER SAMPLES - TRANSECT SAMPLING (May 2018)

Date: 10/11/2018 Project: 60477365

AECOM

Figure 42

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWP_9-2018\Fig42_Transects-TotalDsslvdSolids.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1



Legend

- Surface Water Sample Location Along Transect
- TIR Thermal Anomaly
- Proposed Transect Location from the SSWIP
- Transect as Sampled
- Weir
- Wetlands Trail

Total Dissolved Solids Concentration in mg/L

mg/L - Milligrams per liter

NORTH

0 150

Feet

Scale 1:1,800

1 inch = 150 feet

NERT RI
Downgradient Study Area

TOTAL DISSOLVED SOLIDS CONCENTRATIONS IN SURFACE WATER SAMPLES - ABOVE DUCK CREEK CONFLUENCE WEIR (May 2018)

Date: 10/16/2018 Project: 60477365

AECOM **Figure 43**

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_9-2018\Fig43_TDS_SL8_T6_8 Trans Samples.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1

Legend

- Surface Water Sample Location Along Transect
- Grab Surface Water Sample Location
- TIR Thermal Anomaly
- Warm DTS Anomaly
- Cool DTS Anomaly
- Proposed Transect Location from the SSWIP
- Transect as Sampled
- Weir
- Wetlands Trail

Total Dissolved Solids Concentration in mg/L

mg/L - Milligrams per liter

NORTH

0 150

Feet

Scale 1:1,800

1 inch = 150 feet

NERT RI

Downgradient Study Area

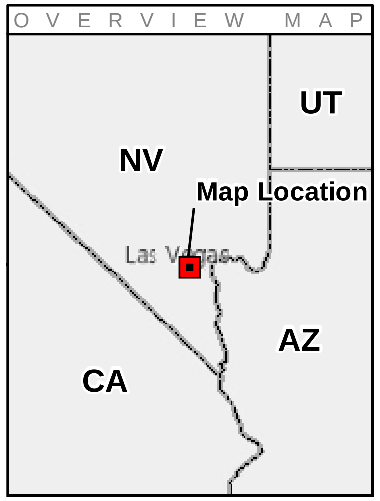
TOTAL DISSOLVED SOLIDS CONCENTRATIONS IN SURFACE WATER SAMPLES - UPPER NARROWS WEIR TO SUNRISE MOUNTAIN WEIR (May 2018)

Date: 10/11/2018 Project: 60477365

AECOM **Figure 44**

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_9-2018\Fig44_TDS_SL9_T6_55-Sunrise Samples.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_9-2018\Fig45_TDS_SL7_T6 Trans Samples1.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1



Legend

- Grab Surface Water Sample Location
- TIR Thermal Anomaly
- Weir
- Wetlands Trail

Total Dissolved Solids Concentration in mg/L

mg/L - Milligrams per liter

NORTH

0 100

Feet

Scale 1:1,200

1 inch = 100 feet

NERT RI
Downgradient Study Area

TOTAL DISSOLVED SOLIDS CONCENTRATIONS IN SURFACE WATER SAMPLES - C-1 CHANNEL (May 2018)

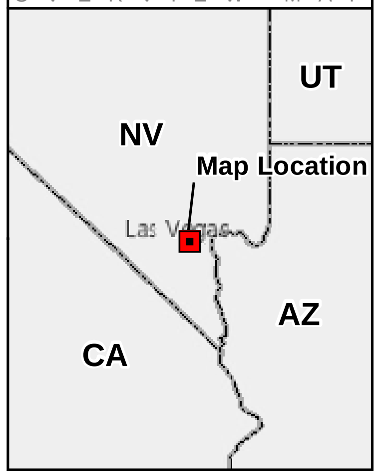
Date: 10/11/2018 Project: 60477365

AECOM

Figure 46

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_9-2018\Fig46_TDS_SL11_C-1 Sample.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1

OVERVIEW MAP



Legend

- Surface Water Sample Location Along Transect
- TIR Thermal Anomaly
- Proposed Transect Location from the SSWIP
- Transect as Sampled
- Weir
- Wetlands Trail

Total Dissolved Solids Concentration in mg/L

mg/L - Milligrams per liter

NORTH

0 100

Feet

Scale 1:1,200

1 inch = 100 feet

NERT RI
Downgradient Study Area

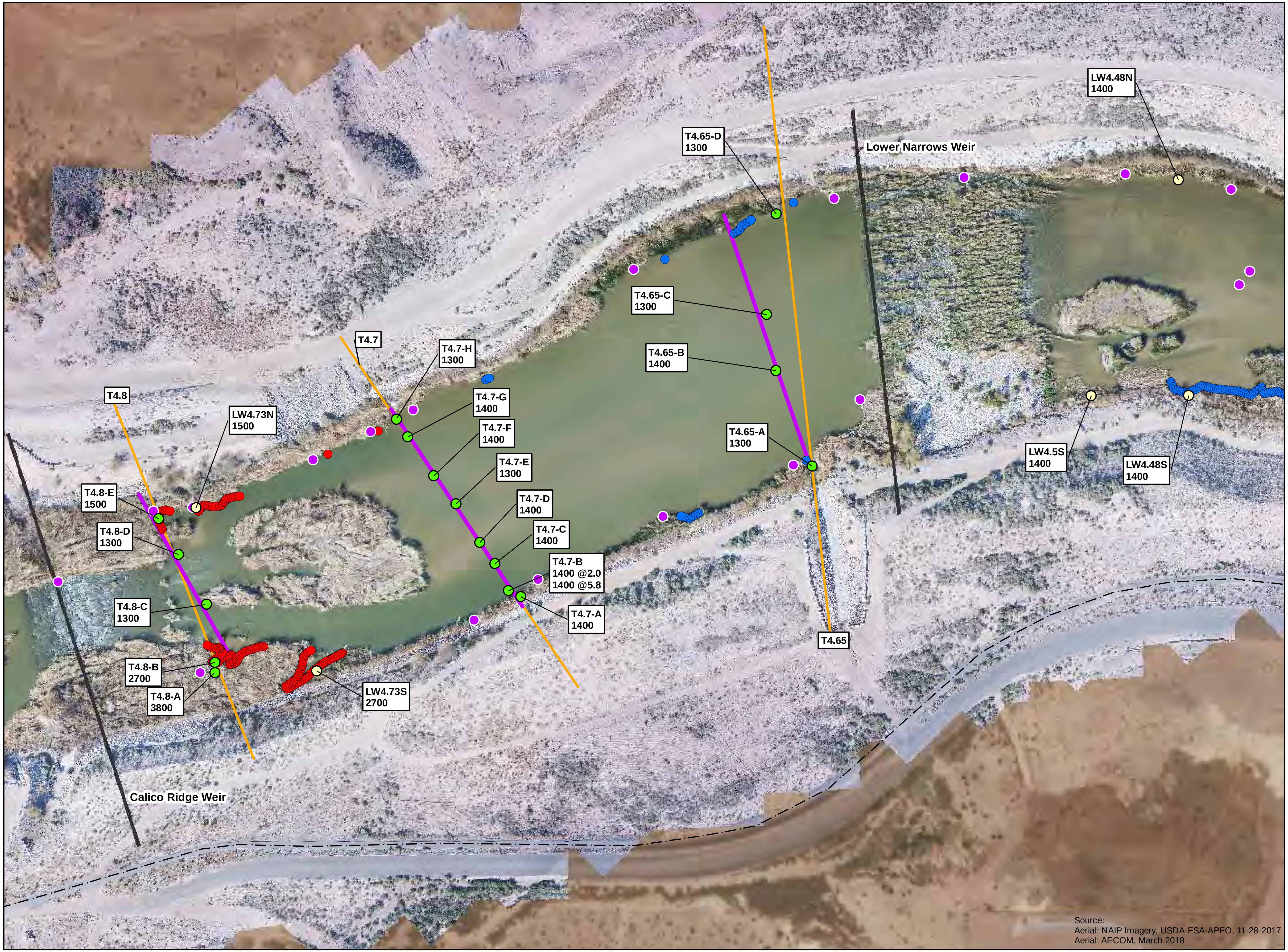
TOTAL DISSOLVED SOLIDS CONCENTRATIONS IN SURFACE WATER SAMPLES - BOSTICK WEIR (May 2018)

Date: 10/16/2018 Project: 60477365

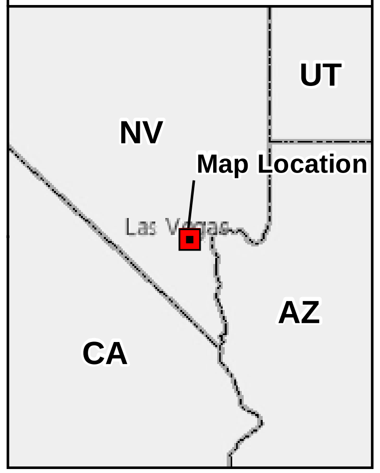
AECOM

Figure 47

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_9-2018\Fig47_TDS_SL6_T4_85 Trans Samples.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1



OVERVIEW MAP



Legend

- Surface Water Sample Location Along Transect
- Grab Surface Water Sample Location
- TIR Thermal Anomaly
- Warm DTS Anomaly
- Cool DTS Anomaly
- Proposed Transect Location from the SSWIP
- Transect as Sampled
- Weir
- Wetlands Trail

Total Dissolved Solids Concentration in mg/L

mg/L - Milligrams per liter

NORTH

0 150

Feet

Scale 1:1,800

1 inch = 150 feet

NERT RI
Downgradient Study Area

TOTAL DISSOLVED SOLIDS CONCENTRATIONS IN SURFACE WATER SAMPLES - CALICO RIDGE WEIR TO LOWER NARROWS WEIR (May 2018)

Date: 10/16/2018 Project: 60477365

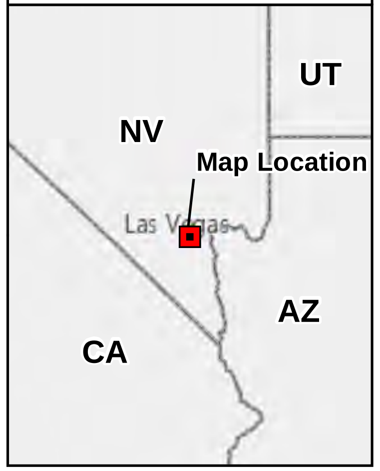
AECOM

Figure 48

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_9-2018\Fig48_TDS_SL5_T4_8-T4_65 Trans Samples.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1

Source:
Aerial: NAIP Imagery, USDA-FSA-APFO, 11-28-2017
Aerial: AECOM, March 2018

O V E R V I E W   M A P



Legend

- Surface Water Sample Location Along Transect
- TIR Thermal Anomaly
- Cool DTS Anomaly
- Proposed Transect Location from the SSWIP
- Transect as Sampled
- Weir
- Wetlands Trail

Total Dissolved Solids Concentration in mg/L

mg/L - Milligrams per liter

NORTH

0 100
Feet

Scale 1:1,200
1 inch = 100 feet

NERT RI
Downgradient Study Area

TOTAL DISSOLVED SOLIDS CONCENTRATIONS IN SURFACE WATER SAMPLES - HOMESTEAD WEIR (May 2018)

Date: 8/14/2018 Project: 60477365

AECOM

Figure 49

Path: V:\Projects\GIS_Proj\SSWIP\00-GIS\MXDs\SurfaceSampling\SSWIP_7-2018\Fig60_TDS_SL4_T3_9 Trans Samples.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: angela.mcmurtry

NERT RI
Downgradient Study Area

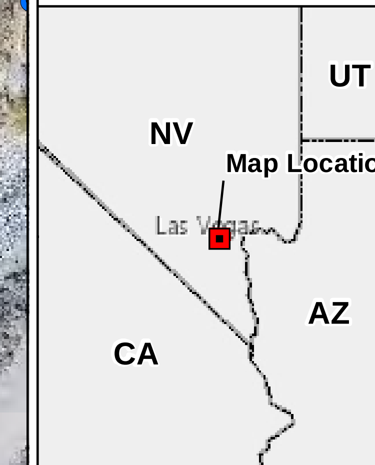
TOTAL DISSOLVED SOLIDS CONCENTRATIONS IN SURFACE WATER SAMPLES - THREE KIDS WEIR (May 2018)

Date: 8/14/2018 Project: 60477365

AECOM

Figure 50

Path: V:\Projects\GIS_Proj\SSWIP\00-GIS\MXDs\SurfaceSampling\SSWIP_7-2018\Fig61_TDS_SL3_T3_8-T3_75 Trans Samples.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: angela.mcmurtry



Legend

- Surface Water Sample Location Along Transect
- Grab Surface Water Sample Location
- TIR Thermal Anomaly
- Warm DTS Anomaly
- Cool DTS Anomaly
- Proposed Transect Location from the SSWIP
- Transect as Sampled
- Weir
- Wetlands Trail

Total Dissolved Solids Concentration in mg/L

mg/L - Milligrams per liter

NORTH

0 100

Feet

Scale 1:1,200

1 inch = 100 feet

NERT RI
Downgradient Study Area

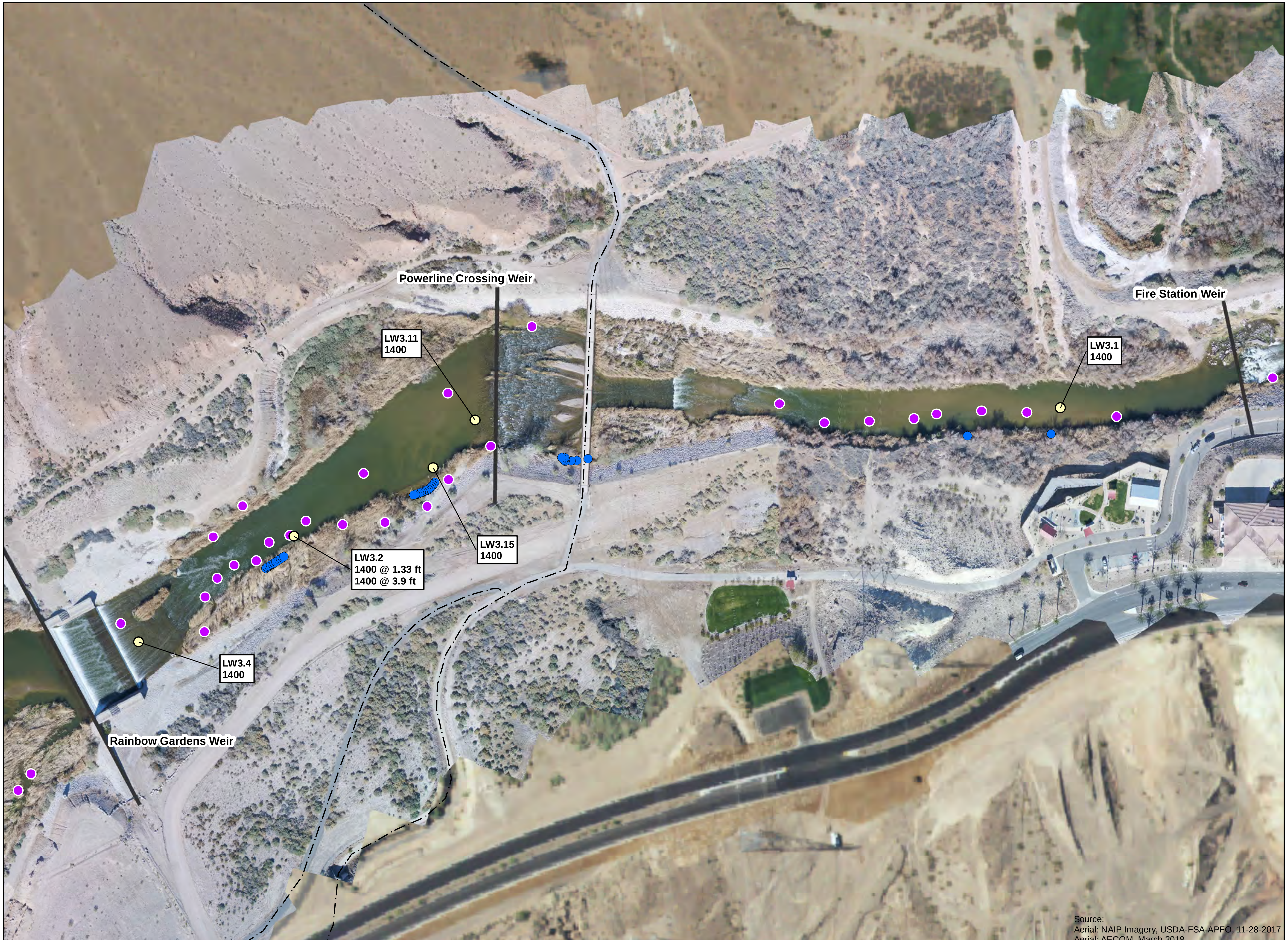
TOTAL DISSOLVED SOLIDS CONCENTRATIONS IN SURFACE WATER SAMPLES - UPSTREAM OF RAINBOW GARDENS WEIR (May 2018)

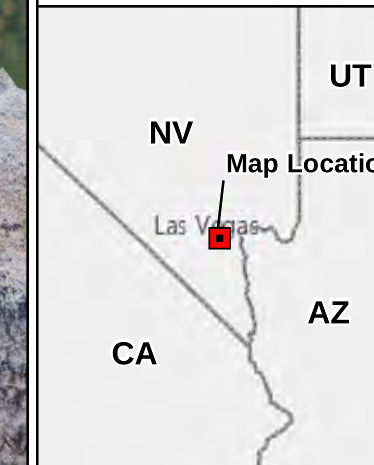
Date: 12/27/2018 Project: 60477365

AECOM

Figure 51

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\SSWIP_12-2018_Comments\Fig51_TDS_SL2_T3_5-T3_3 Trans Samples.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1





Legend

- Grab Surface Water Sample Location
- TIR Thermal Anomaly
- Cool DTS Anomaly
- Weir
- Wetlands Trail

Total Dissolved Solids Concentration in mg/L

mg/L - Milligrams per liter

NORTH

0 150

Feet

Scale 1:1,800

1 inch = 150 feet

NERT RI
Downgradient Study Area

TOTAL DISSOLVED SOLIDS CONCENTRATIONS IN SURFACE WATER SAMPLES - RAINBOW GARDENS WEIR TO FIRE STATION WEIR (May 2018)

Date: 8/14/2018 Project: 60477365

AECOM **Figure 52**

Source:
Aerial: NAIP Imagery, USDA-FSA-APFO, 11-28-2017
Aerial: AECOM, March 2018

Path: V:\Projects\GIS_Proj\SSWIP\00-GIS\MXDs\SurfaceSampling\SSWIP_7-2018\Fig63_TDS_SL1_Rainbow-Fire Samples.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: angela.mcmurtry

Legend

Grab Surface Water Sample Location

Total Dissolved Solids Concentration in mg/L

mg/L - Milligrams per liter

NORTH

0 150

Feet

Scale 1:1,200

1 inch = 100 feet

NERT RI
Downgradient Study Area

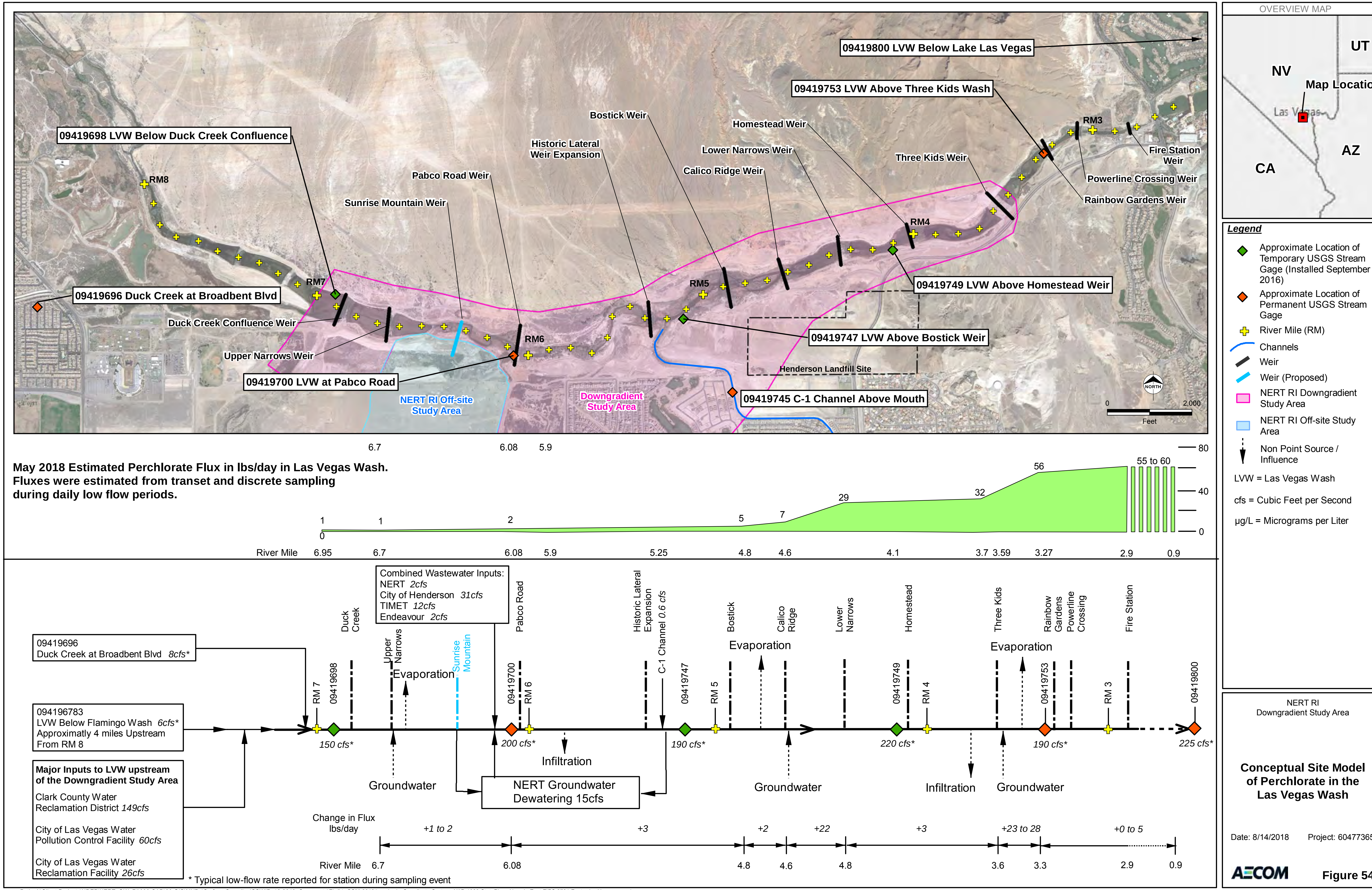
TOTAL DISSOLVED SOLIDS CONCENTRATIONS IN SURFACE WATER SAMPLES - LW0.9 BELOW LAKE LAS VEGAS (May 2018)

Date: 8/14/2018 Project: 60477365

AECOM

Figure 53

Path: V:\Projects\GIS_Proj\SSWIP\00-GIS\MXDs\SurfaceSampling\SSWIP_7-2018\Fig64_TDS_SL10_LW0_9 Sample.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: angela.mcmurtry



NERT RI
Downgradient Study Area

Conceptual Site Model of Perchlorate in the Las Vegas Wash

Date: 8/14/2018 Project: 60477365

AECOM

Figure 54

Tables

Table 1 Las Vegas Wash TIR Anomalies
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Flight Number	Image Number	Image Date	Image Time	X	Y
7	0609	2-6-18	1021	845552.571516	26739017.985800
8	0654	2-6-18	1024	845532.254073	26738986.696900
8	0712	2-6-18	1027	845531.310486	26738929.416500
8	0725	2-6-18	1028	844773.330743	26738423.766600
8	0741	2-6-18	1037	845392.586445	26738942.780400
9	0763	2-6-18	1039	844974.014223	26738289.412800
9	0782	2-6-18	1040	844801.252969	26738529.356900
9	0798	2-6-18	1041	844909.447317	26738651.451500
9	0816	2-6-18	1042	845110.650990	26738516.475200
9	0833	2-6-18	1043	845043.580052	26738662.576600
9	0851	2-6-18	1044	834241.925279	26734231.705700
9	0872	2-6-18	1045	834204.461459	26734216.588900
1	0008	2-6-18	0707	834163.213087	26734229.438400
2	0024	2-6-18	0728	834084.250372	26734231.841400
3	0135	2-6-18	0753	833926.407447	26734231.279200
3	0210	2-6-18	0758	833730.888584	26734215.357800
3	0216	2-6-18	0758	846074.002449	26739434.957200
3	0218	2-6-18	0758	833501.469645	26734138.729200
3	0229	2-6-18	0759	846005.621496	26739236.239900
3	0305	2-6-18	0803	845935.795880	26739181.517700
3	0295	2-6-18	0803	833401.508884	26734011.208700
3	0316	2-6-18	0804	845934.522451	26739324.583500
3	0315	2-6-18	0804	833363.144681	26734006.229700
3	0319	2-6-18	0805	833323.949212	26734018.931200
3	0308	2-6-18	0804	845900.576120	26739136.630600
3	0335	2-6-18	0603	834763.647804	26734237.481300
3	0120	2-6-18	0818	834719.733183	26734221.039600
3	0329	2-6-18	0805	845830.621227	26739110.120200
4	0125	2-6-18	0819	834688.769240	26734194.141800
4	0134	2-6-18	0819	845795.134204	26739191.449000
4	0133	2-6-18	0819	833129.536991	26734032.284400
4	0128	2-6-18	0819	834610.248368	26734153.115600
4	0144	2-6-18	0820	845760.372537	26739106.966600
4	0156	2-6-18	0821	834532.930909	26734160.158900
4	0159	2-6-18	0821	834570.310433	26734133.311300
4	0204	2-6-18	0824	844579.724531	26737715.812400
5	0363	2-6-18	0735	834494.859179	26734138.525900
5	0391	2-6-18	0909	834309.983520	26734222.157200
5	0382	2-6-18	0908	844330.975314	26737980.176800
4	0249	2-6-18	0827	846483.956071	26739307.084600
4	0268	2-6-18	0829	846558.587839	26739275.342300
4	0288	2-6-18	0830	844617.956683	26737769.949700
6	0320	2-6-18	0919	846633.032906	26739277.969400
5	0341	2-6-18	0906	843513.308461	26737028.335000
4	0210	2-6-18	0824	846707.391768	26739282.456800
5	0355	2-6-18	0907	846744.517502	26739289.700600
6	0338	2-6-18	0920	846819.365447	26739294.676900

Table 1 Las Vegas Wash TIR Anomalies
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Flight Number	Image Number	Image Date	Image Time	X	Y
6	0339	2-6-18	0920	846894.097596	26739292.372000
6	0360	2-6-18	0922	844659.951551	26737864.711300
6	0383	2-6-18	0923	843694.048520	26737115.940800
7	0459	2-6-18	0951	847043.220112	26739286.102200
7	0459	2-6-18	0951	844444.806813	26738055.417400
18	0002	2-7-18	1030	844659.669829	26737908.898600
18	0012	2-7-18	1031	832340.183983	26734440.867900
18	0025	2-7-18	1043	847301.583365	26739350.049300
14	0033	2-7-18	0837	844468.822935	26738168.737600
18	0055	2-7-18	1034	843944.505249	26737006.143100
14	0055	2-7-18	0838	830541.167038	26734736.031600
14	0079	2-7-18	0840	843837.832666	26737260.085000
14	0188	2-7-18	0846	832302.072342	26734449.654100
14	0204	2-7-18	0847	830474.732666	26734551.370600
14	0231	2-7-18	0848	843981.890583	26737042.011900
17	0382	2-7-18	1009	830430.594471	26734739.324700
17	0401	2-7-18	1010	844049.905510	26737086.342400
17	0433	2-7-18	1012	830362.696507	26734530.619200
17	0440	2-7-18	1012	832226.063853	26734460.311400
17	0466	2-7-18	1013	843878.966587	26737345.192900
17	0506	2-7-18	1016	844951.071644	26738771.025900
17	0516	2-7-18	1016	830323.117279	26734795.238800
17	0548	2-7-18	1018	844166.132537	26737147.319300
13	0560	2-7-18	0803	845063.256119	26738669.218000
13	0582	2-7-18	0804	845191.286880	26738557.574800
19	0585	2-7-18	1101	843893.627853	26737440.007300
19	0596	2-7-18	1102	830251.096762	26734510.963000
13	0602	2-7-18	0805	845142.024786	26738646.064000
19	0606	2-7-18	1103	844183.333854	26737181.175500
19	0616	2-7-18	1104	843939.411040	26737450.307200
19	0621	2-7-18	1104	845222.846457	26738666.354600
19	0631	2-7-18	1105	845070.858056	26738799.803300
19	0641	2-7-18	1106	844245.081922	26737232.462900
13	0648	2-7-18	0808	845243.936699	26738693.775500
19	0660	2-7-18	1107	845174.617201	26738799.929600
13	0660	2-7-18	0809	832145.287010	26734472.294600
13	0679	2-7-18	0810	832107.819298	26734476.463900
19	0696	2-7-18	1110	832070.091474	26734519.107200
13	0702	2-7-18	0811	845699.479869	26739112.369100
15	0796	2-7-18	0902	845672.717679	26739089.015900
15	0803	2-7-18	0902	845638.715518	26739077.172900
15	0811	2-7-18	0902	845594.683362	26739137.807100
15	0820	2-7-18	0903	831989.806021	26734326.055900
15	0855	2-7-18	0905	845617.012362	26739046.977000
15	0865	2-7-18	0906	845580.578280	26739039.294300
15	0885	2-7-18	0907	845545.770137	26739086.206800
15	0898	2-7-18	0907	829722.359570	26735054.754800

Table 1 Las Vegas Wash TIR Anomalies
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Flight Number	Image Number	Image Date	Image Time	X	Y
18	0952	2-7-18	1027	830240.071431	26734814.929000
18	0961	2-7-18	1028	830185.873094	26734563.756300
18	0972	2-7-18	1028	828515.424889	26735447.039600
18	0976	2-7-18	1029	830163.606263	26734847.096800
18	0981	2-7-18	1029	830123.964839	26734837.645000
18	0992	2-7-18	1030	828414.392378	26734825.941300
18	0995	2-7-18	1030	830103.983222	26734506.270200
10	0196	2-7-18	0637	829546.420890	26734552.873600
10	0174	2-7-18	0636	828441.905735	26735489.462800
13	0518	2-7-18	0800	830007.244576	26734853.299600
12	0298	2-7-18	0713	828088.992534	26735553.955700
12	0346	2-7-18	0716	827974.582928	26735539.367700
12	0353	2-7-18	0707	827930.766563	26735396.377200
13	0500	2-7-18	0759	827924.049230	26735233.637700
13	0522	2-7-18	0801	827911.046210	26734923.774000
13	0561	2-7-18	0803	829404.612216	26734573.597000
23	0413	2-8-18	0750	828279.438286	26735507.256700
21	0274	2-8-18	0711	829348.398923	26735077.667000
21	0282	2-8-18	0711	828252.509775	26734860.575200
22	0285	2-8-18	0719	828216.421682	26734893.596700
20	0068	2-8-18	0632	829328.052466	26734584.744000
20	0131	2-8-18	0635	829291.923363	26734639.292000
21	0070	2-8-18	0659	828242.273151	26735525.650000
22	0409	2-8-18	0726	829309.476622	26735063.296100
26	0965	2-8-18	0913	828181.287891	26734964.644500
24	0642	2-8-18	0814	829215.184525	26734647.505800
20	0029	2-8-18	0629	828167.914962	26735549.301400
20	0143	2-8-18	0636	829233.749211	26735094.540500
20	0212	2-8-18	0640	838696.924178	26735598.524700
20	0263	2-8-18	0643	839266.248655	26736154.246400
21	0002	2-8-18	0656	839201.381405	26736148.349400
21	0150	2-8-18	0704	839278.813117	26735880.769200
22	0476	2-8-18	0730	840262.136031	26736224.075200
31	0601	2-8-18	1104	839997.554304	26736548.366900
31	0599	2-8-18	1103	839561.389616	26736279.589600
31	0560	2-8-18	1101	839043.249299	26736031.220800
31	0559	2-8-18	1101	837371.969524	26735580.781100
30	0458	2-8-18	1043	838221.455739	26735512.754900
30	0457	2-8-18	1043	840372.864221	26736332.784300
36	0232	2-9-18	0736	840046.039740	26736139.453500
36	0241	2-9-18	0736	839838.850802	26736035.051800
36	0248	2-9-18	0737	839631.708950	26736315.932500
36	0264	2-9-18	0738	839732.660863	26735967.499700
36	0296	2-9-18	0740	839466.007330	26736233.101000
36	0337	2-9-18	0743	838908.780141	26735744.124900
36	0387	2-9-18	0746	835735.932575	26734642.035400
37	0440	2-9-18	0754	835694.873547	26734701.931300

Table 1 Las Vegas Wash TIR Anomalies
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Flight Number	Image Number	Image Date	Image Time	X	Y
37	0450	2-9-18	0755	835846.158270	26734624.136100
37	0465	2-9-18	0756	835848.588825	26734634.031900
35	0497	2-9-18	0717	835840.387436	26734671.018100
35	0505	2-9-18	0718	836029.032163	26734748.911400
35	0515	2-9-18	718	836033.589455	26734735.348000
37	0520	2-9-18	0759	840329.993767	26736665.748200
35	0533	2-9-18	0720	840545.424656	26736700.351800
35	0552	2-9-18	0721	840812.518160	26736706.323700
35	0554	2-9-18	0721	840987.673687	26736680.622000
35	0566	2-9-18	0722	841018.712460	26736545.205300
35	0581	2-9-18	0723	841001.413458	26736522.949500
39	0691	2-9-18	0851	841085.142190	26736346.336800
45	0721	2-9-18	1101	841191.162155	26736586.052500
39	0733	2-9-18	0853	841235.780211	26736385.141000
45	0739	2-9-18	1102	841258.349655	26736394.342400
45	0757	2-9-18	1103	841281.787155	26736404.238200
45	0778	2-9-18	1104	841307.481600	26736413.786900
39	0781	2-9-18	0856	841243.046198	26736577.834200
45	0797	2-9-18	1106	841326.605587	26736426.656900
45	0819	2-9-18	1107	841373.806108	26736438.050100
40	0902	2-9-18	0906	841312.731991	26736574.113300
40	0911	2-9-18	0907	841344.850046	26736580.016100
40	0947	2-9-18	0909	841434.013820	26736437.466900
40	0980	2-9-18	0911	841402.329792	26736438.769000
32	0122	2-9-18	0617	841405.802014	26736588.424600
48	0030	2-10-18	0635	841438.961736	26736601.792700
46	0054	2-10-18	0600	841498.116105	26736456.691800
46	0078	2-10-18	0601	841530.668189	26736467.325500
52	0082	2-10-18	0753	841667.150839	26736561.125700
46	0104	2-10-18	0603	841717.874798	26736767.945200
46	0118	2-10-18	0603	841754.439468	26736802.737900
52	0119	2-10-18	0756	841740.767593	26736794.534800
46	0132	2-10-18	0604	841851.087688	26736624.165900
48	0142	2-10-18	0641	841853.251317	26736881.180900
52	0144	2-10-18	0757	841870.569025	26736915.035000
46	0216	2-10-18	0609	841880.855483	26736927.925700
54	0280	2-10-18	0824	841638.900325	26736692.824200
54	0412	2-10-18	0831	841645.020116	26736697.121000
54	0434	2-10-18	0832	841667.546158	26736710.141900
54	0441	2-10-18	0832	842002.101527	26736683.729200
54	0454	2-10-18	0833	842015.122360	26736693.625100
49	0565	2-10-18	0655	841968.305230	26737010.986200
53	0591	2-10-18	0808	842080.553494	26736684.778100
49	0612	2-10-18	0657	842600.210370	26737052.608700
53	0619	2-10-18	0810	842605.627036	26737055.664300
53	0627	2-10-18	0810	844529.301057	26737575.646100
49	0633	2-10-18	0659	844172.627384	26737845.159400

Table 1 Las Vegas Wash TIR Anomalies
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Flight Number	Image Number	Image Date	Image Time	X	Y
49	0649	2-10-18	0659	844561.794056	26737657.006400
53	0654	2-10-18	0812	844529.854277	26738216.985600
49	0667	2-10-18	0700	844797.996638	26738142.654000
53	0685	2-10-18	0813	844681.959311	26738235.731300
49	0714	2-10-18	0703	844260.708788	26737923.157800
53	0724	2-10-18	0815	844584.732225	26737685.939900
49	0733	2-10-18	0704	844596.971809	26737700.002400

Coordinates of thermal anomalies are in 1983 Nevada East State Plane feet

Table 2 Las Vegas Wash Water Quality Measurements - Aerial TIR Survey
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Location ID	Date and Time of Measurement		Total Depth (ft)	Temperature (˚C)	Spec. Cond. (µS/cm)	pH	Dissolved Oxygen		Northing*	Easting*
							mg/L	% saturation		
LWC3.7	2/5/2018	13:30e	nm	23.50	4120	NR	NR	NR	26737590.08	844557.40
Location 1	2/6/2018	7:52	1.2	19.01	2082	7.55	7.57	82.0	26736584.91	840326.66
Location 2	2/6/2018	7:50	1.2	19.09	2093	7.52	7.61	82.9	26736443.63	840351.17
Location 3	2/6/2018	8:00	3.5	19.00	2082	7.59	8.14	88.3	26736587.39	840723.29
Location 4	2/6/2018	8:04	1.0	19.01	2081	7.56	8.12	88.3	26736409.39	840754.37
Location 5	2/6/2018	8:07	1.5	18.84	2055	7.55	8.10	87.5	26736652.83	840826.32
Location 6	2/6/2018	8:13	nm	18.85	2057	7.58	8.14	88.1	26736485.14	840934.95
Location 7	2/6/2018	8:18	1.2	19.01	2080	7.55	8.23	89.3	26736393.61	840950.94
Location 8	2/6/2018	8:29	>3	18.74	2088	7.53	7.69	83.3	26736572.69	841118.35
Location 9	2/6/2018	8:32	>3	18.54	2074	7.50	7.44	80.4	26736401.17	841187.39
Location 10	2/6/2018	8:37	>3	18.40	2068	7.50	7.15	77.1	26736600.79	841474.61
Location 11	2/6/2018	8:43e	1.0	18.84	2082	7.53	7.89	85.7	26736474.41	841496.72
Location 12	2/6/2018	8:49e	2.0	18.97	2080	7.54	8.10	87.8	26736552.64	841639.77
Location 13	2/6/2018	8:55e	nm	19.00	2079	7.55	8.24	89.4	26736665.03	841620.05
Location 14	2/6/2018	9:00	nm	18.97	2062	7.57	8.37	90.6	26736729.75	841712.41
Location 15	2/6/2018	9:22	1.2	19.05	2079	7.67	8.77	95.3	26736613.37	841754.75
Location 16	2/6/2018	9:28	nm	19.06	2081	7.63	8.54	92.7	26736793.20	841793.67
Location 17	2/6/2018	9:31	1.0	19.14	2076	7.70	8.95	97.3	26736677.05	841892.28
Location 18	2/6/2018	9:35	1.5	19.13	2074	7.68	8.91	96.8	26736761.89	841877.41
Location 19	2/6/2018	9:50e	0.8	19.17	2075	7.71	8.98	97.8	26736909.93	841891.21
Location 20	2/6/2018	10:12	0.7	19.37	2083	7.77	9.18	100.4	26736820.20	841975.77
Location 21	2/6/2018	10:15	0.7	19.38	2076	7.72	9.05	98.8	26736713.21	842009.22
Location 22	2/6/2018	10:18	0.5	19.45	2078	7.75	9.25	101.1	26736985.72	842048.76
Location 23	2/6/2018	10:20	0.6	19.46	2079	7.78	9.34	102.1	26736798.71	842065.70
Location 24	2/6/2018	10:25	0.5	19.77	2080	7.90	10.44	114.9	26736910.02	842405.09
Location 25	2/6/2018	10:30	nm	19.68	2084	7.84	10.02	110.2	26736995.59	842498.03
Location 26	2/6/2018	10:35	0.7	19.71	2084	7.86	10.01	109.9	26736854.82	842578.88
Location 27	2/6/2018	10:41	1.0	19.84	2081	7.92	10.72	118.2	26736983.20	843093.54
Location 28	2/6/2018	10:45e	1.0	19.92	2080	7.95	11.11	121.8	26736747.00	843128.81
Location 29	2/6/2018	10:48	0.5	19.78	2080	7.88	10.61	116.9	26736824.92	843543.95
Location 30	2/6/2018	10:52	1.0	19.88	2078	7.92	10.92	120.1	26737094.23	843706.32
Location 31	2/6/2018	10:54	1.5	20.01	2080	8.00	11.89	131.5	26737115.45	844077.39
Location 32	2/7/2018	7:27	0.8	17.00	1400	7.94	7.90	84.6	26739237.46	846046.24
Location 33	2/7/2018	7:30	1.0	17.04	1405	7.85	6.97	73.2	26739190.58	845917.77
Location 34	2/7/2018	7:49	2.0	17.04	1455	7.82	7.16	72.0	26739154.99	845845.72
Location 35	2/7/2018	8:05	1.5	16.94	1401	7.88	7.46	74.0	26739104.64	845731.13
Location 36	2/7/2018	8:15	0.2	16.70	1401	7.94	8.01	78.7	26739085.55	845698.15
Location 37	2/7/2018	8:20	0.5	16.96	1401	7.87	6.80	70.2	26739052.56	845639.99
Location 38	2/7/2018	8:25	nm	16.95	1414	7.88	6.77	70.2	26739008.29	845580.09
Location 39	2/7/2018	8:27	1.0	16.97	1414	7.89	6.77	70.5	26738930.16	845514.12
Location 40	2/7/2018	8:31	1.5	17.02	1417	7.85	7.08	73.9	26738891.97	845497.63
Location 41	2/7/2018	8:45	nm	18.32	1828	7.57	5.11	54.1	26738872.00	845467.24
Location 42	2/7/2018	9:27	>3	16.90	1438	7.91	6.80	69.1	26738641.10	845238.08
Location 43	2/7/2018	9:38	0.5	17.16	1427	8.03	7.33	76.2	26738558.64	845098.32
Location 44	2/7/2018	9:42	0.5	17.26	1425	8.08	7.51	76.8	26738511.76	844998.49
Location 45	2/7/2018	10:01	0.5	17.17	1423	8.12	7.35	76.8	26738455.34	845008.91
Location 46	2/7/2018	10:07	0.5	17.35	1423	8.15	7.89	100.1	26738355.16	844769.50
Location 47	2/7/2018	10:12	2.0	17.42	1434	8.15	7.63	80.1	26738155.16	844849.36
Location 48	2/7/2018	10:45e	NR	18.16	1463	8.11	9.45	104.3	26738215.58	844879.92
Location 49	2/7/2018	11:00e	NR	18.27	1465	NR	NR	NR	26737763.50	844516.03
Location 50	2/7/2018	11:15e	NR	18.27	1465	NR	NR	NR	26737698.91	844580.61
TAE-1	2/8/2018	7:30	1.0	18.02	1945	7.75	nm	nm	26737014.23	843952.78
TAE-2	2/8/2018	7:25	1.0	17.70	1951	7.82	6.35	66.7	26737152.25	844175.01
TAE-3	2/8/2018	7:30	1.0	18.00	1954	7.81	6.56	131.5	26737776.38	844633.34
TAE-4	2/8/2018	7:35	0.5	17.82	1958	7.82	6.79	131.9	26738142.65	844798.00
TAE-5	2/8/2018	7:45	1.0	17.52	1956	7.83	7.19	121.1	26738334.54	845046.53
TAE-6	2/8/2018	7:50	3.0	17.04	1962	7.81	6.91	72.1	26738517.16	845178.26
TAE-7	2/8/2018	7:55	1.0	16.34	1982	7.80	7.09	72.9	26738665.16	845246.40
TAE-8	2/8/2018	8:00	0.5	17.53	1943	7.82	7.08	133.2	26739133.53	845851.55
SBM-1	2/8/2018	8:11	2.0	17.89	1951	7.80	6.95	73.7	26735913.98	839463.77
SBM-2	2/8/2018	8:30	1.5	17.78	1948	7.82	7.25	76.8	26735738.20	838874.57

Table 2 Las Vegas Wash Water Quality Measurements - Aerial TIR Survey
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Location ID	Date and Time of Measurement		Total Depth (ft)	Temperature (˚C)	Spec. Cond. (µS/cm)	pH	Dissolved Oxygen		Northing*	Easting*
							mg/L	% saturation		
SBM-3	2/8/2018	8:50	1.0	17.63	1954	8.03	8.31	87.6	26735655.73	838775.83
SBM-4	2/8/2018	9:10	1.0	17.53	1951	7.98	8.01	84.3	26735526.61	838491.55
SBM-5	2/8/2018	9:23	1.5	18.13	2031	7.86	7.94	84.6	26735514.67	838291.89
SBM-6	2/8/2018	9:57	0.5	17.87	1950	7.97	8.14	86.2	26735159.85	836906.26
SBM-7	2/9/2018	7:30	3.0	18.69	2059	7.86	8.59	92.7	26734198.63	834151.98
SBM-8	2/9/2018	7:42	1.0	18.65	2094	7.86	8.00	86.3	26734213.21	833984.61
SBM-9	2/9/2018	7:50	2.5	18.57	2096	7.83	8.14	87.6	26734202.79	833835.31
SBM-10	2/9/2018	8:27	2.5	16.55	2163	7.95	9.24	95.3	26734193.07	833672.81
SBM-11	2/9/2018	9:00	4.0	18.69	2127	7.80	8.81	94.9	26734166.68	833588.78
SBM-12	2/9/2018	9:09	3.0	18.74	2129	7.80	9.16	98.8	26734067.38	833455.45
SBM-13	2/9/2018	9:20	2.5	18.54	2134	7.83	8.84	95.2	26733977.79	833304.75
SBM-14	2/9/2018	9:42	1.5	21.21	2474	7.37	8.53	96.8	26733940.84	832504.89
SBM-15	2/9/2018	10:10	4.0	18.98	2098	7.92	10.15	109.8	26733987.08	832327.36
SBM-16	2/9/2018	10:22	2.0	18.99	2311	7.91	10.10	109.7	26734132.91	832151.84
SBM-17	2/9/2018	10:35	2.0	18.99	2317	7.84	10.03	108.9	26734196.45	832050.80
SMT-1	2/9/2018	11:10e	nm	17.38	3400	NR	NR	NR	26734518.30	831453.00
SBM-18	2/10/2018	6:45	1.0	17.20	2022	7.77	5.93	62.1	26734500.45	829917.08
SBM-19	2/10/2018	6:50	nm	18.74	2066	7.67	6.68	72.1	26734470.07	829674.03
SBM-20	2/10/2018	7:05	2.0	18.67	2182	7.67	6.23	67.2	26734632.83	829233.49
INF-1	2/9/2018	9:50	2.0	21.35	3017	7.35	8.48	96.6	26733917.41	832417.22

Notes:

ID - identification
˚C - degrees Celsius
µS/cm - micro-Siemens per centimeter
% - Percent
nm - not measured, water depth not critical for TIR
ft - feet
Spec. Cond. - Specific Conductivity
mg/L - milligrams per Liter
* approximate locations
e - time estimated from field notes
NR - not recorded at potential thermal anomaly. Water temperature and specific conductivity were primary water-quality parameters of interest.

Table 3 Summary of FODTS Deployments
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Deployment Location	Measurement Dates and Times[1]	Deployment Interval and Length (in meters)[2]	Thermal Anomaly Locations (in meters)[2]	Relative Temperature[3]
Upper Narrows Downstream Deployment	2/28/2018 @ 19:25 to 3/3/2018 @ 16:46	5485 - 6012 527 meters	5602	warm
			5660 - 5665	cool
			5858 - 5870	warm
Calico Ridge Weir to Lower Narrows Weir	3/15/2018 @ 00:22 to 3/18/2018 @ 15:22	5018 - 6008 990 meters	5026	cool
			5090 - 5100	cool
			5298 - 5356	warm
			5385 - 5444	warm
			5581 - 5596	warm
			5611 - 5635	warm
			5689	warm
			5718	warm
			5785 - 5787	cool
			5911	cool
			5951 - 5962	cool
			5990	cool
Lower Narrows Weir to Homestead Weir	3/20/2018 @ 23:44 to 3/24/2018 @ 14:24	4995 - 6003 1008 meters	5052 - 5173	cool
			5300	cool
			5332	cool
			5546	cool
			5587 - 5595	cool
			5607	cool
			5651	cool
			5711	cool
			5808	cool
Three Kids Weir to Rainbow Gardens Weir - South Bank	First Deployment: 3/2/2018 @ 01:27 to 3/3/2018 @ 10:02 Second Deployment: 3/6/2018 @ 21:45 to 3/8/2018 @ 21:50	2868 - 3287 419 meters	2882 - 2887	warm
			2896	warm
			3000	warm
			3179	warm
			3188	warm
			3206	warm
			3212 - 3232	warm
			3263 - 3283	warm
Three Kids Weir to Rainbow Gardens Weir - North Bank	3/10/2018 @ 23:59 to 3/15/2018 @16:24	2610 - 3138 528 meters	3132 - 3133	warm
			3064 - 3073	cool
			3026 - 3021	cool
			2991	cool
			2978	cool
			2951	cool
			2939	cool
Rainbow to Fire Station	3/6/2018 @ 01:22 to 3/11/2018 @ 00:30	5459 - 6006 547 meters	5487 - 5498	cool
			5586 - 5573	cool
			5669 - 5663	cool
			5677	cool
			5908	cool
			5951	cool
Total Deployment Distance		**4019 meters**	**Total Thermal Anomalies**	**45 (17 warm and 28 cool)**

Notes:

1) All times reported in Greenwich Mean Time

2) Measurements reported in meters along length of cable - fiber optic cables are marked with measurements

3) Relative to temperatures along other portions of cable

Table 4 Field Collected Water Quality Data - Surface Water Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Location ID	Date and Time of Measurement		Total Depth (feet)	Sample Depth (feet)	Temperature (˚C)	Specific Conductivity (µS/cm)	pH	Turbidity (NTU)	Dissolved Oxygen	
									mg/L	% saturation
T6_E	5/3/2018	10:10	2.33	0.60	22.89	1880	7.78	1.8	8.58	102.0
T6_D	5/3/2018	9:55	1.72	1.50	22.79	1890	7.85	3.0	10.23	122.1
T6_C	5/3/2018	9:45	1.52	1.30	24.50	2240	7.17	3.5	6.29	77.7
T6_B	5/3/2018	9:35	0.96	0.80	24.76	2230	7.00	7.5	7.11	89.8
T6_A	5/3/2018	9:30	0.60	0.40	24.72	2240	6.60	22.0	7.32	90.5
T6.8_E	5/1/2018	9:30	0.90	0.40	19.61	1700	7.95	4.3	6.47	74.5 [1]
T6.8_D	5/1/2018	9:20	0.70	0.20	21.20	1690	8.00	1.1	8.05	95.7 [1]
T6.8_C	5/1/2018	9:10	0.90	0.40	20.21	2080	7.79	3.0	8.23	95.9 [1]
T6.8_B	5/1/2018	9:05	1.40	0.90	19.68	2240	7.42	5.3	7.31	84.3 [1]
T6.8_A	5/1/2018	8:55	1.70	1.20	18.69	2190	6.34	55.9	6.06	68.5 [1]
T6.55_D	5/1/2018	10:06	0.20	0.10	20.66	1880	7.53	18.5	7.54	87.8
T6.55_C	5/1/2018	9:50	0.20	0.10	21.61	1890	7.42	0.4	7.50 [2]	89.9
T6.55_B	5/1/2018	9:33	0.71	0.60	20.78	2360	7.27	0.0	9.33	108.0
T6.55_A	5/1/2018	9:16	0.50	0.40	21.04	4970	6.62	0.0	2.16	24.8
T6.5_D	5/1/2018	9:55	0.60	0.50	19.85	1730	7.82	31.1	7.41	83.6
T6.5_C	5/1/2018	9:50	1.07	1.00	20.90	1710	7.70	0.0	9.08	104.8
T6.5_B	5/1/2018	9:40	1.10	1.00	21.58	1730	7.54	0.0	8.34	94.3
T6.5_A	5/1/2018	9:10	2.00	1.20	19.62	2280	6.78	0.0	6.38	80.5
T4.85_E	5/4/2018	10:34	1.25	1.00	23.61	2210	7.68	0.3	9.57	116.0
T4.85_D	5/4/2018	10:25	0.80	0.70	24.24	2210	7.60	0.0	10.94	134.0
T4.85_C	5/4/2018	10:45	1.00	0.90	24.62	2240	8.04	1.5	12.31	152.0
T4.85_B	5/4/2018	9:55	2.29	2.20	23.98	2210	6.85	0.0	11.88	144.5
T4.85_A	5/4/2018	9:55	0.70	0.60	22.82	2160	6.38	0.0	6.03 [2]	74.0
T4.8_E	5/3/2018	11:03	2.10	2.00	23.10	2170	7.53	2.5	6.94	81.1
T4.8_D	5/3/2018	10:53	1.95	1.80	23.52	2030	7.50	0.0	9.25	111.3
T4.8_C	5/3/2018	10:45	2.36	2.20	23.43	2030	7.28	0.0	10.36	124.6
T4.8_B	5/3/2018	10:24	1.33	1.20	23.42	3650	6.33	0.0	2.94	36.4
T4.8_A	5/3/2018	10:35	0.85	0.70	23.70	4560	6.76	0.0	3.35	41.0
T4.7_H	5/3/2018	10:57	1.04	1.00	22.20	4960	6.67	1.4	8.62	104.4 [1]
T4.7_G	5/3/2018	11:11	2.17	2.20	22.49	4940	7.15	0.3	8.70	106.0 [1]
T4.7_F	5/3/2018	11:20	0.96	0.90	22.76	4930	7.20	0.2	9.08	111.2 [1]
T4.7_E	5/3/2018	11:30	2.83	2.40	22.95	4890	7.32	5.3	8.33	102.4 [1]
T4.7_D	5/3/2018	12:02	0.75	0.80	23.28	5020	7.41	0.0	8.75	108.2 [1]
T4.7_C	5/3/2018	12:13	2.83	2.40	23.39	4990	7.45	0.4	8.23	102.0 [1]

Table 4 Field Collected Water Quality Data - Surface Water Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Location ID	Date and Time of Measurement		Total Depth (feet)	Sample Depth (feet)	Temperature (˚C)	Specific Conductivity (µS/cm)	pH	Turbidity (NTU)	Dissolved Oxygen	
									mg/L	% saturation
T4.7_B (5.8 ft) [3]	5/3/2018	12:32	6.25	5.80	23.49	5040	7.38	0.0	8.16	101.4 [1]
T4.7_B (2.0 ft) [3]	5/3/2018	12:40	6.25	2.00	NR	NR	NR	NR	NR	NR
T4.7_A	5/3/2018	12:50	2.75	2.30	23.92	5040	7.54	0.0	8.76	109.7 [1]
T4.65_D	5/3/2018	11:30	1.11	0.90	23.28	1870	7.91	14.9	7.13	85.1
T4.65_C	5/3/2018	11:20	1.28	1.10	23.59	1930	8.01	4.0	9.00	109.0
T4.65_B	5/3/2018	11:10	1.72	1.50	23.27	1950	7.91	4.2	8.15	97.6
T4.65_A	5/3/2018	10:55	0.88	0.70	22.52	1910	7.79	6.2	6.51	77.2
T3.9_D	5/4/2018	10:10	0.58	0.10	22.54	2010	8.11	5.3	10.01	122.9 [1]
T3.9_C	5/4/2018	10:00	1.08	0.50	22.55	1960	8.01	5.3	10.58	129.1 [1]
T3.9_B	5/4/2018	9:50	1.13	0.50	22.40	2000	7.81	3.4	9.71	118.1 [1]
T3.9_A	5/4/2018	9:46	0.25	0.20	22.09	2010	7.43	20.1	9.48	114.6 [1]
T3.8_E	5/3/2018	11:48	0.40	0.30	25.33	2010	8.03	2.8	10.76	133.8
T3.8_D	5/3/2018	11:41	0.93	0.80	24.17	2000	8.17	7.5	11.38	138.7
T3.8_C	5/3/2018	11:38	0.83	0.70	24.72	2000	8.21	2.1	11.95	145.9
T3.8_B	5/3/2018	11:36	0.84	0.70	24.28	1990	8.25	2.7	11.36	139.1
T3.8_A	5/3/2018	11:32	1.30	1.00	23.85	1980	8.26	4.5	8.14	99.6
T3.75_E	5/4/2018	10:35	0.42	0.20	23.56	2340	7.80	3.5	7.51	90.9
T3.75_D	5/4/2018	10:25	1.50	1.30	23.80	2020	7.97	4.0	8.75	106.2
T3.75_C	5/4/2018	10:10	1.40	1.20	23.96	2000	7.64	3.3	9.19	112.6
T3.75_B	5/4/2018	10:05	1.15	1.00	23.74	2020	7.23	4.6	9.63	117.2
T3.75_A	5/4/2018	10:55	0.92	0.70	24.10	2040	8.15	2.0	9.53	116.2
T3.5_E (6.4 ft) [3]	5/5/2018	12:40	6.60	6.40	27.00	2080	8.26	1.2	9.36	149.6
T3.5_E (2.1 ft) [3]	5/5/2018	12:50	6.60	2.10	22.29	2070	8.43	1.0	10.02	123.7
T3.5_D	5/5/2018	12:13	2.50	2.40	25.61	2060	8.21	2.0	11.93	149.6
T3.5_C	5/5/2018	12:00	2.10	2.00	25.49	2120	8.04	1.7	11.88	148.2
T3.5_B	5/5/2018	11:25	0.83	0.70	25.30	2120	7.82	0.1	10.41	130.0
T3.5_A	5/5/2018	11:40	0.50	0.45	26.83	2000	7.71	95.9	9.74	123.5

Table 4 Field Collected Water Quality Data - Surface Water Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Location ID	Date and Time of Measurement		Total Depth (feet)	Sample Depth (feet)	Temperature (˚C)	Specific Conductivity (µS/cm)	pH	Turbidity (NTU)	Dissolved Oxygen	
									mg/L	% saturation
T3.3_E	5/3/2018	11:08	1.67	1.20	23.60	2000	8.39	3.9	12.61	157.0 [1]
T3.3_D	5/3/2018	10:55	1.29	0.80	23.68	2050	8.39	6.0	13.13	163.7 [1]
T3.3_C	5/3/2018	11:20	0.67	0.30	23.73	2070	8.52	2.7	13.86	172.9 [1]
T3.3_B	5/3/2018	12:20	1.25	0.80	24.15	1320	8.12	9.1	10.26	129.0 [1]
T3.3_A	5/3/2018	12:28	0.33	0.10	23.92	2110	8.40	11.0	9.57	119.8 [1]
LWC3.7	5/3/2018	12:15	1.90	1.70	23.21	4130	7.39	0.0	0.44	5.7
LW4.73_S	5/4/2018	14:30	2.63	2.40	25.81	2930	7.96	2.5	6.43	81.3
LW4.73_N	5/4/2018	15:15	2.25	2.20	26.33	2360	7.87	8.2	4.39	56.6
LW4.5S	5/3/2018	14:35	0.56	0.40	25.10	1970	8.20	10.2	6.80	84.4
LW4.48_S	5/3/2018	14:20	0.60	0.40	24.89	1980	8.21	18.1	5.82	84.5
LW4.48_N	5/3/2018	14:15	0.75	0.60	25.52	1970	8.20	3.2	7.26	90.8
LW3.68	5/6/2018	10:30	0.92	0.83	24.08	3370	7.10	0.7	5.65	67.2
LW3.5S	5/4/2018	11:50	2.00	1.80	25.04	2130	8.10	5.7	1.30	30.3
LW3.4	5/4/2018	12:20	1.32	1.10	25.48	2060	8.29	5.6	9.86	123.0
LW3.2 (3.9 ft) [3]	5/6/2018	14:00	4.12	3.90	26.48	2170	8.56	4.5	9.49	121.5
LW3.2 (1.33 ft) [3]	5/6/2018	14:15	4.12	1.33	26.03	2180	8.79	5.1	9.43	116.0
LW3.15	5/6/2018	14:50	2.66	2.40	26.15	2190	8.55	4.4	8.89	112.9
LW3.11	5/6/2018	11:18	2.00	1.90	24.98	2140	8.02	4.2	9.07	112.6
LW3.1	5/5/2018	10:12	1.95	1.80	24.21	2040	7.41	2.8	11.20	137.0
LW0.9	5/3/2018	16:28	0.90	0.80	nm	nm	nm	nm	nm	nm
LW0.9	5/4/2018	12:48	0.80	0.70	25.53	2190	8.35	4.4	11.64	146.0
LW0.9	5/5/2018	9:05	0.80	0.70	nm	nm	nm	nm	nm	nm
C-1	5/4/2018	13:30	0.40	0.30	nm	nm	nm	nm	nm	nm
Maximum Value			***6.60***	***6.40***	***27.00***	***5040***	***8.79***	***95.9***	***13.86***	***172.9***
Minimum Value			***0.20***	***0.10***	***18.69***	***1690***	***6.33***	***0.0***	***0.44***	***5.70***

Notes:

ID - Identification. Transect sample location A is located near the southern Bank and continue B, C, D,.. to the northern bank.

˚C - degrees Celsius

NTU - Nephelometric Turbidity Unit

% - Percent

µS/cm - micro-Siemens per centimeter

mg/L - milligrams per Liter

NR - Water quality not recorded for near surface sample at deep location.

nm - Water quality instrument low on batteries (5/3/18) or were all in use elsewhere (5/4/18 and 5/5/18)

1) Percent saturation of dissolved oxygen not recorded. Value calculated for 1450 ft NAVD88. http://www.waterontheweb.org/under/waterquality/DOSatCalc.html

2) Concentration of dissolved oxygen not recorded. Value calculated for 1450 ft NAVD88. http://www.waterontheweb.org/under/waterquality/DOSatCalc.html

3) Due to total depths greater than or equal to 3.0 feet, two samples were collected at sample locations T4.7_B, T3.5_E, and LW3.2.

Table 5 Surface Water Samples Collected
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Sample ID	Location on Transect	Depth	QC Type	Sample Date	Sample Time
Transect Samples					
Transect T6.8					
T6.8A-20180501-1.2	Near south bank	Near bottom		05/01/18	08:55
T6.8A-20180501-FB	N/A	N/A	Field blank	05/01/18	13:00
T6.8B-20180501-0.9	Second from south bank	Near bottom		05/01/18	09:05
T6.8B-20180501-0.9-FD	Second from south bank	Near bottom	Field duplicate	05/01/18	09:10
T6.8C-20180501-0.4	Third from south bank	Near bottom		05/01/18	09:10
T6.8D-20180501-0.2	Fourth from south bank	Near bottom	MS/MSD	05/01/18	09:20
T6.8E-20180501-0.4	Near north bank	Near bottom		05/01/18	09:30
Transect T6.55					
T6.55A-20180501-0.4	Near south bank	Near bottom		05/01/18	09:16
T6.55B-20180501-0.6	Second from south bank	Near bottom		05/01/18	09:33
T6.55C-20180501-0.1	Third from south bank	Near bottom		05/01/18	09:50
T6.55D-20180501-0.1	Near north bank	Near bottom		05/01/18	10:06
Transect T6.5					
T6.5A-20180501-1.2	Near south bank	Near bottom		05/01/18	09:10
T6.5B-20180501-1.0	Second from south bank	Near bottom		05/01/18	09:40
T6.5C-20180501-1.0	Third from south bank	Near bottom		05/01/18	09:50
T6.5D-20180501-0.5	Near north bank	Near bottom		05/01/18	09:55
Transect T6					
T6A-20180503-0.4	Near south bank	Near bottom		05/03/18	09:30
T6B-20180503-0.8	Second from south bank	Near bottom		05/03/18	09:35
T6C-20180503-1.3	Third from south bank	Near bottom		05/03/18	09:45
T6D-20180503-1.5	Fourth from south bank	Near bottom		05/03/18	09:55
T6E-20180503-0.6	Near north bank	Near bottom		05/03/18	10:10
Transect T4.85					
T4.85A-20180504-0.6	Near south bank	Near bottom		05/04/18	09:55
T4.85B-20180504-2.2	Second from south bank	Near bottom		05/04/18	09:55
T4.85C-20180504-0.9	Third from south bank	Near bottom		05/04/18	10:45
T4.85D-20180504-0.7	Fourth from south bank	Near bottom		05/04/18	10:25
T4.85E-20180504-1.0	Near north bank	Near bottom		05/04/18	10:34
Transect T4.8					
T4.8A-20180503-0.7	Near south bank	Near bottom		05/03/18	10:35
T4.8B-20180503-1.2	Second from south bank	Near bottom		05/03/18	10:24
T4.8C-20180503-2.2	Third from south bank	Near bottom		05/03/18	10:45
T4.8D-20180503-1.8	Fourth from south bank	Near bottom		05/03/18	10:53
T4.8E-20180503-2.0	Near north bank	Near bottom		05/03/18	11:03
Transect T4.7					
T4.7A-20180503-2.3	Near south bank	Near bottom		05/03/18	12:50
T4.7B1-20180503-5.8	Second from south bank	Near bottom		05/03/18	12:32
T4.7B2-20180503-2.0	Second from south bank	1/3 depth		05/03/18	12:40
T4.7C-20180503-2.4	Third from south bank	Near bottom		05/03/18	12:13
T4.7D-20180503-0.8	Fourth from south bank	Near bottom		05/03/18	12:02
T4.7E-20180503-2.4	Fifth from south bank	Near bottom		05/03/18	11:30
T4.7F-20180503-0.9	Sixth from south bank	Near bottom		05/03/18	11:20
T4.7G-20180503-2.2	Seventh from south bank	Near bottom		05/03/18	11:11
T4.7H-20180503-1.0	Near north bank	Near bottom		05/03/18	10:57

Table 5 Surface Water Samples Collected
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Sample ID	Location on Transect	Depth	QC Type	Sample Date	Sample Time
Transect T4.65					
T4.65A-20180503-0.7	Near south bank	Near bottom		05/03/18	10:55
T4.65B-20180503-1.5	Second from south bank	Near bottom		05/03/18	11:10
T4.65C-20180503-1.1	Third from south bank	Near bottom		05/03/18	11:20
T4.65D-20180503-0.9	Near north bank	Near bottom		05/03/18	11:30
Transect T3.9					
T3.9A-20180504-0.2	Near south bank	Near bottom		05/04/18	09:46
T3.9B-20180504-0.5	Second from south bank	Near bottom		05/04/18	09:50
T3.9B-20180504-0.5-FD	Second from south bank	Near bottom	Field duplicate	05/04/18	09:55
T3.9C-20180504-0.5	Third from south bank	Near bottom		05/04/18	10:00
T3.9D-20180504-0.1	Near north bank	Near bottom		05/04/18	10:10
Transect T3.8					
T3.8A-20180503-1.0	Near south bank	Near bottom		05/03/18	11:32
T3.8B-20180503-0.7	Second from south bank	Near bottom		05/03/18	11:36
T3.8C-20180503-0.7	Third from south bank	Near bottom		05/03/18	11:38
T3.8D-20180503-0.8	Fourth from south bank	Near bottom	MS/MSD	05/03/18	11:41
T3.8E-20180503-0.3	Near north bank	Near bottom		05/03/18	11:48
Transect T3.75					
T3.75A-20180504-0.7	Near south bank	Near bottom		05/04/18	10:55
T3.75B-20180504-1.0	Second from south bank	Near bottom		05/04/18	10:05
T3.75C-20180504-1.2	Third from south bank	Near bottom		05/04/18	10:10
T3.75D-20180504-1.3	Fourth from south bank	Near bottom		05/04/18	10:25
T3.75E-20180504-0.2	Near north bank	Near bottom		05/04/18	10:35
Transect T3.5					
T3.5A-20180505-0.45	Near south bank	Near bottom		05/05/18	11:40
T3.5A-20180505-FB	N/A	N/A	Field blank	05/05/18	17:00
T3.5A-20180507-EB	N/A	N/A	Equipment blank	05/07/18	11:20
T3.5B-20180505-0.7	Second from south bank	Near bottom		05/05/18	11:25
T3.5B-20180505-0.7-FD	Second from south bank	Near bottom	Field duplicate	05/05/18	11:25
T3.5C-20180505-2.0	Third from south bank	Near bottom		05/05/18	12:00
T3.5D-20180505-2.4	Fourth from south bank	Near bottom		05/05/18	12:13
T3.5E-20180505-2.1	Near north bank	1/3 depth		05/05/18	12:50
T3.5E-20180505-6.4	Near north bank	Near bottom		05/05/18	12:40
Transect T3.3					
T3.3A-20180504-0.1	Near south bank	Near bottom		05/04/18	12:28
T3.3A-20180504-0.1-FB	N/A	N/A	Field blank	05/04/18	14:15
T3.3B-20180504-0.8	Second from south bank	Near bottom		05/04/18	12:20
T3.3C-20180504-0.3	Third from south bank	Near bottom		05/04/18	11:20
T3.3D-20180504-0.8	Fourth from south bank	Near bottom		05/04/18	10:55
T3.3E-20180504-1.2	Near north bank	Near bottom		05/04/18	11:08

Table 5 Surface Water Samples Collected
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Sample ID	Location on Transect	Depth	QC Type	Sample Date	Sample Time
Grab Samples					
C-1-20180504-0.3	N/A	Mid depth		05/04/18	13:30
LW4.73S-20180504-2.4	N/A	Mid depth		05/04/18	14:50
LW4.73S-20180504-EB	N/A	N/A	Equipment blank	05/04/18	14:30
LW4.73N-20180504-2.2	N/A	Mid depth		05/04/18	15:15
LW4.5S-20180503-0.4	N/A	Mid depth		05/03/18	14:35
LW4.48S-20180503-0.4	N/A	Mid depth		05/03/18	14:20
LW4.48N-20180503-0.6	N/A	Mid depth		05/03/18	14:15
LWC3.7-20180503-1.7	N/A	Mid depth		05/03/18	12:15
LW3.68-20180506-0.83	N/A	Mid depth		05/06/18	10:30
LW3.68-20180506-0.83-FD	N/A	Mid depth	Field duplicate	05/06/18	10:30
LW3.68-20180506-0.83-FB	N/A	N/A	Field blank	05/06/18	11:05
LW3.5S-20180504-1.8	N/A	Mid depth		05/04/18	11:50
LW3.4-20180504-1.1	N/A	Mid depth		05/04/18	12:20
LW3.2-20180506-1.33	N/A	Mid depth		05/06/18	14:15
LW3.2-20180506-1.33-FD	N/A	Mid depth	Field duplicate	05/06/18	14:15
LW3.2-20180506-3.9	N/A	Mid depth		05/06/18	14:00
LW3.2-20180507-EB	N/A	N/A	Equipment blank	05/07/18	11:45
LW3.15-20180506-2.4	N/A	Mid depth		05/06/18	14:50
LW3.15-20180506-2.4-FD	N/A	Mid depth	Field duplicate	05/06/18	14:50
LW3.15-20180507-EB	N/A	N/A	Equipment blank	05/07/18	11:30
LW3.11-20180506-1.9	N/A	Mid depth		05/06/18	11:18
LW3.11-20180506-1.9-FD	N/A	Mid depth	Field duplicate	05/06/18	11:18
LW3.11-20180507-FB	N/A	N/A	Field blank	05/07/18	11:00
LW3.1-20180505-1.8	N/A	Mid depth		05/05/18	10:12
LW0.9-20180503-0.8	N/A	Mid depth		05/03/18	16:28
LW0.9-20180503-0.8-FD	N/A	Mid depth	Field duplicate	05/03/18	16:28
LW0.9-20180504-0.7	N/A	Mid depth		05/04/18	12:48
LW0.9-20180505-0.7	N/A	Mid depth		05/05/18	09:05
LW0.9-20180505-0.7-FD	N/A	Mid depth	Field duplicate	05/05/18	09:05
LW0.9-20180507-EB	N/A	N/A	Equipment blank	05/07/18	11:15

Notes:
ID - Identification
FD - field duplicate
FB - field blank
EB - equipment blank
MS - matrix spike
MSD - matrix spike duplicate
N/A - Not applicable
QC - quality control
Sample ID comprised of "Location"-"YYYYMMDD"-"Depth"-"QC type if applicable"
"LW0.9-20180503-0.8-FD" is a field duplicate collected at LW0.9 on 5/3/18

Table 6 Analytical Program for Surface Water Samples
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Analytes	Matrix	Analytical Method	Analytical Laboratory
Perchlorate	Water	EPA Method 314.0 [1]	TestAmerica (Irvine, CA)
Chlorate	Water	EPA Method 300.1	TestAmerica (Irvine, CA)
Total Dissolved Solids	Water	SM 2540C	TestAmerica (Irvine, CA)

Notes:

EPA = United States Environmental Protection Agency

SM = Standard Method

All surface water samples were analyzed for the constituents listed above.

1) For NERT RI Downgradient Study Area, field-filtering of surface water samples for perchlorate analysis is not required (NDEP 2015).

Sources:

NDEP. 2015. Email from James Dotchin, Chief Bureau of Industrial Site Cleanup, Nevada Division of Environmental Protection, re: Sterile Filtration Not Required for NERT Regional Groundwater RI Perchlorate Samples, November 18.

Table 7 Analytical Results - Surface Water Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Location	Sample ID	Sample Date	Sample Time	Chlorate (µg/L)	Perchlorate (µg/L)	Total Dissolved Solids (mg/L)
Transect Samples						
Transect T6.8						
T6.8_A	T6.8A-20180501-1.2	05/01/18	08:55	100	ND (<0.95)	1600
T6.8_B	T6.8B-20180501-0.9	05/01/18	09:05	100	1.6 J	1700
	T6.8B-20180501-0.9-FD	05/01/18	09:10	99 J	1.7 J	1700
T6.8_C	T6.8C-20180501-0.4	05/01/18	09:10	90 J	1.9 J	1700
T6.8_D	T6.8D-20180501-0.2	05/01/18	09:20	88 J	ND (<0.95)	1200
T6.8_E	T6.8E-20180501-0.4	05/01/18	09:30	90 J	ND (<0.95)	1100
Transect T6.55						
T6.55_A	T6.55A-20180501-0.4	05/01/18	09:16	460	690	3800
T6.55_B	T6.55B-20180501-0.6	05/01/18	09:33	94 J	1.3 J	1500
T6.55_C	T6.55C-20180501-0.1	05/01/18	09:50	85 J	ND (<0.95)	1200
T6.55_D	T6.55D-20180501-0.1	05/01/18	10:06	91 J	ND (<0.95)	1200
Transect T6.5						
T6.5_A	T6.5A-20180501-1.2	05/01/18	09:10	110	13	1600
T6.5_B	T6.5B-20180501-1.0	05/01/18	09:40	81 J	ND (<0.95)	1200
T6.5_C	T6.5C-20180501-1.0	05/01/18	09:50	130	ND (<0.95)	1100
T6.5_D	T6.5D-20180501-0.5	05/01/18	09:55	94 J	ND (<0.95)	1200
Transect T6						
T6_A	T6A-20180503-0.4	05/03/18	09:30	150	1.4 J	1500
T6_B	T6B-20180503-0.8	05/03/18	09:35	200	1.2 J	1500
T6_C	T6C-20180503-1.3	05/03/18	09:45	150	1.2 J	1500
T6_D	T6D-20180503-1.5	05/03/18	09:55	64 J	3 J	1300
T6_E	T6E-20180503-0.6	05/03/18	10:10	71 J	2.7 J	1300
Transect T4.85						
T4.85_A	T4.85A-20180504-0.6	05/04/18	09:55	400	7.3	1300
T4.85_B	T4.85B-20180504-2.2	05/04/18	09:55	570	5	1300
T4.85_C	T4.85C-20180504-0.9	05/04/18	10:45	590	5.1	1400
T4.85_D	T4.85D-20180504-0.7	05/04/18	10:25	580	5.3	1300
T4.85_E	T4.85E-20180504-1.0	05/04/18	10:34	560	4.7	1300

Table 7 Analytical Results - Surface Water Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Location	Sample ID	Sample Date	Sample Time	Chlorate (µg/L)	Perchlorate (µg/L)	Total Dissolved Solids (mg/L)
Transect T4.8						
T4.8_A	T4.8A-20180503-0.7	05/03/18	10:35	13000	3200	3800
T4.8_B	T4.8B-20180503-1.2	05/03/18	10:24	6500	1800	2700
T4.8_C	T4.8C-20180503-2.2	05/03/18	10:45	83 J	5.8	1300
T4.8_D	T4.8D-20180503-1.8	05/03/18	10:53	87 J	5.4	1300
T4.8_E	T4.8E-20180503-2.0	05/03/18	11:03	48 J	31	1500
Transect T4.7						
T4.7_A	T4.7A-20180503-2.3	05/03/18	12:50	160	23	1400
T4.7_B	T4.7B1-20180503-5.8	05/03/18	12:32	170	22	1400
T4.7_B	T4.7B2-20180503-2.0	05/03/18	12:40	160	21	1400
T4.7_C	T4.7C-20180503-2.4	05/03/18	12:13	160	23	1400
T4.7_D	T4.7D-20180503-0.8	05/03/18	12:02	140	16	1400
T4.7_E	T4.7E-20180503-2.4	05/03/18	11:30	83 J	12	1300
T4.7_F	T4.7F-20180503-0.9	05/03/18	11:20	76 J	12	1400
T4.7_G	T4.7G-20180503-2.2	05/03/18	11:11	80 J	10	1400
T4.7_H	T4.7H-20180503-1.0	05/03/18	10:57	75 J	15	1300
Transect T4.65						
T4.65_A	T4.65A-20180503-0.7	05/03/18	10:55	200	35	1300
T4.65_B	T4.65B-20180503-1.5	05/03/18	11:10	200	35	1400
T4.65_C	T4.65C-20180503-1.1	05/03/18	11:20	77 J	11	1300
T4.65_D	T4.65D-20180503-0.9	05/03/18	11:30	68 J	14	1300
Transect T3.9						
T3.9_A	T3.9A-20180504-0.2	05/04/18	09:46	390	44	1300
T3.9_B	T3.9B-20180504-0.5	05/04/18	09:50	590	39	1400
	T3.9B-20180504-0.5-FD	05/04/18	09:55	540	41	1400
T3.9_C	T3.9C-20180504-0.5	05/04/18	10:00	580	29	1300
T3.9_D	T3.9D-20180504-0.1	05/04/18	10:10	450	23	1300

Location	Sample ID	Sample Date	Sample Time	Chlorate (µg/L)	Perchlorate (µg/L)	Total Dissolved Solids (mg/L)
Transect T3.8						
T3.8_A	T3.8A-20180503-1.0	05/03/18	11:32	190	32	1300
T3.8_B	T3.8B-20180503-0.7	05/03/18	11:36	180	36	1300
T3.8_C	T3.8C-20180503-0.7	05/03/18	11:38	140	25	1300
T3.8_D	T3.8D-20180503-0.8	05/03/18	11:41	130	19	1300
T3.8_E	T3.8E-20180503-0.3	05/03/18	11:48	170	41	1300
Transect T3.75						
T3.75_A	T3.75A-20180504-0.7	05/04/18	10:55	510	53	1300
T3.75_B	T3.75B-20180504-1.0	05/04/18	10:05	460	40	1300
T3.75_C	T3.75C-20180504-1.2	05/04/18	10:10	490	26	1300
T3.75_D	T3.75D-20180504-1.3	05/04/18	10:25	440	19	1300
T3.75_E	T3.75E-20180504-0.2	05/04/18	10:35	690	200	1600
Transect T3.5						
T3.5_A	T3.5A-20180505-0.45	05/05/18	11:40	370	90	1500
T3.5_B	T3.5B-20180505-0.7	05/05/18	11:25	450	91	1500
T3.5_B	T3.5B-20180505-0.7-FD	05/05/18	11:25	490	86	1500
T3.5_C	T3.5C-20180505-2.0	05/05/18	12:00	520	85	1500
T3.5_D	T3.5D-20180505-2.4	05/05/18	12:13	390	33	1500
T3.5_E	T3.5E-20180505-2.1	05/05/18	12:50	450	37	1500
T3.5_E	T3.5E-20180505-6.4	05/05/18	12:40	410	38	1400
Transect T3.3						
T3.3_A	T3.3A-20180504-0.1	05/04/18	12:28	620	96	1400
T3.3_B	T3.3B-20180504-0.8	05/04/18	12:20	500	89	1400
T3.3_C	T3.3C-20180504-0.3	05/04/18	11:20	560	81	1400
T3.3_D	T3.3D-20180504-0.8	05/04/18	10:55	520	72	1400
T3.3_E	T3.3E-20180504-1.2	05/04/18	11:08	450	33	1400

Table 7 Analytical Results - Surface Water Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Location	Sample ID	Sample Date	Sample Time	Chlorate (µg/L)	Perchlorate (µg/L)	Total Dissolved Solids (mg/L)
Grab Samples						
C-1	C-1-20180504-0.3	05/04/18	13:30	3100	1800	3100
LW4.73S	LW4.73S-20180504-2.4	05/04/18	14:50	6700	1500	2700
LW4.73N	LW4.73N-20180504-2.2	05/04/18	15:15	440	93	1500
LW4.5S	LW4.5S-20180503-0.4	05/03/18	14:35	170	29	1400
LW4.48S	LW4.48S-20180503-0.4	05/03/18	14:20	180	33	1400
LW4.48N	LW4.48N-20180503-0.6	05/03/18	14:15	81 J	8.9	1400
LWC3.7	LWC3.7-20180503-1.7	05/03/18	12:15	4400	1600	3200
LW3.68	LW3.68-20180506-0.83	05/06/18	10:30	3100	980	2500
LW3.68	LW3.68-20180506-0.83-FD	05/06/18	10:30	3000	920	2500
LW3.5S	LW3.5S-20180504-1.8	05/04/18	11:50	740	96	1400
LW3.4	LW3.4-20180504-1.1	05/04/18	12:20	630	52	1400
LW3.2	LW3.2-20180506-1.33	05/06/18	14:15	240	50	1400
LW3.2	LW3.2-20180506-1.33-FD	05/06/18	14:15	230	48	1400
LW3.2	LW3.2-20180506-3.9	05/06/18	14:00	220	49	1400
LW3.15	LW3.15-20180506-2.4	05/06/18	14:50	220	50	1400
LW3.15	LW3.15-20180506-2.4-FD	05/06/18	14:50	220	54	1400
LW3.11	LW3.11-20180506-1.9	05/06/18	11:18	230	47	1400
LW3.11	LW3.11-20180506-1.9-FD	05/06/18	11:18	230	48	1400
LW3.1	LW3.1-20180505-1.8	05/05/18	10:12	240	45	1400
LW0.9	LW0.9-20180503-0.8	05/03/18	16:28	150	38	1400
LW0.9	LW0.9-20180503-0.8-FD	05/03/18	16:28	140	35	1400
LW0.9	LW0.9-20180504-0.7	05/04/18	12:48	510	49	1400
LW0.9	LW0.9-20180505-0.7	05/05/18	09:05	270	40	1400
LW0.9	LW0.9-20180505-0.7-FD	05/05/18	09:05	280	40	1400

Notes:
ND - Not Detected above associated method detection limit
J - Estimated concentration between method detection limit and method reporting limit
µg/L - Micrograms per liter
mg/L - Milligrams per liter
Sample ID comprised of "Location"-"YYYYMMDD"-"Depth"-"QC type if applicable"
"LW0.9-20180503-0.8-FD" is a field duplicate collected at LW0.9 from a depth ot 0.8 feet on 5/3/18

Table 8 Perchlorate Flux Estimates - Transect Sampling

NERT Remedial Investigation, Downgradient Study Area

Henderson, Nevada

Transect	Date/Time	Perchlorate Concentration (µg/l) [1]	Representative Samples [2]	Non-representative Samples (perchlorate in µg/l) [3]	Flow (cfs)	Perchlorate Load (Flux) (lb/day)
T6.8	5/1/18 9:15	1.3	A, B, C, D, E	-	149	1.0
T6.55	5/1/18 9:30	1.1	B, C, D	A (690)	154	0.88
T6.5	5/1/18 9:45	0.95	B, C, D	A (13)	160	0.82
T6.0	5/3/18 9:45	2.1	C, D	A (1.4), B (1.2), E (2.7)	187	2.1
T4.85	5/4/18 10:30	5.0	B, C, D, E	A (7.3)	195	5.3
T4.8	5/3/18 10:50	5.6	C, D	A (3,200), B (1,800), E (31)	231	7.0
T4.7	5/3/18 12:45	16	B_d [4], C, D, E, F, G	A (23), B_s (21), H (15)	300	26
T4.65	5/3/18 11:15	23	B, C	A (35), D (14)	235	29
T3.9	5/3/18 9:55	26	C,D	A (44), B (39, 41)	228	32
T3.8	5/3/18 11:40	27	B, C, D	A (32), E (41)	225	32
T3.75	5/4/18 10:15	28	B, C, D	A (53), E (200)	216	33
T3.5	5/5/18 12:00	52	C, D	A (90), B (91), E_s(37), E_d(38)	197	55
T3.3	5/4/18 11:00	53	D, E	A (96), B (89), C (81)	190	54

Notes:

µg/L - Micrograms per liter

cfs - cubic feet per second

lb/day - pounds per day

1) Sample concentration is representative of the mixed waters near the center of the stream channel and is an average of concentrations from representative samples.

2) Three to nine samples were collected across each transect, with sample "A" collected near the southern bank.

3) Samples not included in representative concentration due primarily to influence of nearby groundwater input.

4) The "s" and "d" subscripts denote the concentrations found in the shallower and deeper of two samples collected at that location, respectively.

Table 9 Perchlorate Flux Estimates - Grab Sampling
NERT Remedial Investigation, Downgradient Study Area
Henderson, Nevada

Grab Sample Location [1]	Date/Time	Perchlorate Concentration (µg/l)	Relative flow condition at time of sampling	Flow (cfs)	Perchlorate Load (Flux) (lb/day)
LW3.4	5/4/18 12:20	52	low	196	55
LW3.2$_d$ [2]	5/6/18 14:15	49	low	215	57
LW3.15	5/6/18 14:50	52	moderate	240	67
LW3.11	5/6/18 11:18	47	low	215	55
LW3.1	5/5/18 10:12	45	low	203	49
LW0.9	5/4/18 12:48	49	low	228	60
LW0.9	5/5/18 9:05	40	moderate	256	55
LW0.9	5/3/18 16:28	37	high	365	72

Notes:
µg/L - Micrograms per liter
cfs - cubic feet per second
lb/day - pounds per day
1) Locations where samples are thought to be representative of water quality throughout nearby portions of surrounding surface waters.
2) The **"**d" subscript denotes the concentration found in the deeper of two samples collected at that location was used in the calculation of perchlorate flux.

Appendix A

Federal Aviation Administration Certificate of Authorization

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

CERTIFICATE OF WAIVER OR AUTHORIZATION

ISSUED TO
AECOM

POC PHONE NUMBER
(702) 239-1107

ATTN: Alonso Morales
Email: alonso.morales@aecom.com

This certificate is issued for the operations specifically described hereinafter. No person shall conduct any operation pursuant to the authority of this certificate except in accordance with the standard and special provisions contained in this certificate, and such other requirements of the Federal Aviation Regulations not specifically waived by this certificate.

OPERATIONS AUTHORIZED

Operations under this certificate of authorization are limited to the maximum altitude listed below. This altitude is an absolute value and it shall not be added to the height of any structures.
Class of Airspace: B
At or Below: Altitudes in accordance with published UAS facility map
Under the Jurisdiction of: Las Vegas ATCT (LAS)
Airport Identifier: LAS

LIST OF WAIVED REGULATIONS BY SECTION AND TITLE
N/A

STANDARD PROVISIONS

1. A copy of the application made for this certificate shall be attached and become a part hereof.
2. This certificate shall be presented for inspection upon the request of any authorized representative of the Federal Aviation Administration, or of any State or municipal official charged with the duty of enforcing local laws or regulations.
3. The holder of this certificate shall be responsible for the strict observance of the terms and provisions contained herein.
4. This certificate is nontransferable.

Note-This certificate constitutes a waiver of those Federal rules or regulations specifically referred to above. It does not constitute a waiver of any State law or local ordinance.

SPECIAL PROVISIONS

Special Provisions 1 thru 4, inclusive, are set forth in this authorization.

This certificate 2017-P107-WSA-24254 is effective from February 2, 2018 to September 30, 2018, and is subject to cancellation at any time upon notice by the Administrator or his/her authorized representative.

BY DIRECTION OF THE ADMINISTRATOR

FAA Headquarters, AJV-115
(Region)

Scott J. Gardner
(Signature)

January 31, 2018
(Date)

Acting Manager, UAS Tactical Operations Section
(Title)

FAA Form 7711-1 (7-74)

SPECIAL PROVISIONS

1. **CONTACT INFORMATION:**

   a. Alonso Morales is the person designated as responsible for the overall safety of UAS operations under this Certificate of Waiver or Authorization. During UAS operations for on-site communication/recall, the Responsible Person shall be continuously available for direct contact at (702) 239-1107 by LAS or designated representative.

   b. The Responsible Person listed on this Authorization must maintain a current list of pilots by name and the remote pilot certificate number(s) associated with the Authorization holder's operation. This list must be presented for inspection upon request from the Administrator or an authorized representative.

2. **SCHEDULE OF FLIGHT OPERATIONS:**

   a. This Certificate of Waiver or Authorization and the Special Provisions shall be in effect between civil sunrise and civil sunset local time.

   b. This airspace authorization does not relieve the remote pilots from the responsibility to check the airspace they are operating in and comply with all restrictions that may be present in accordance with see 14 CFR 107.45 and 107.49 (a)(2), such as restricted and Prohibited Airspace, Temporary Flight Restrictions, etc.

   c. The facility may disapprove, terminate, restrict, or delay UAS flight operations covered by this authorization at any time.

   d. The operator is responsible for reviewing the published UASFM at http://uas-faa.opendata.arcgis.com/ **prior to each flight** to ensure that no changes have been made to the map, i.e., altitude changes, airspace modifications, etc.

3. **COORDINATION PROCEDURES:** ***Only required for flights requesting an altitude that is not in accordance with the published UASFM***

   a. Contact LAS Vegas ATCT Airspace Procedures and Programs Manager at 725-600-7068 at least 1 day prior to flight to provide exact location and obtain pre-approval

   b. Contact LAS Vegas ATCT Airspace Procedures and Programs Manager at 725-600-7068, 30 minutes prior to flight, restate exact location of operation, and obtain final approval.

   c. Contact LAS Vegas ATCT Airspace Procedures and Programs Manager at 725-600-7068 immediately upon completion of operations.

4. **EMERGENCY/CONTINGENCY PROCEDURES -** Lost Link/Lost Communications Procedures:

   a. If the UAS loses communications or loses its GPS signal, the UA must return to a pre-determined location within the operating area and land.

   b. The PIC must abort the flight in the event of unpredicted obstacles or emergencies.

Appendix B

Flight Path and Planning Images


iPad
11:01 AM
89%
Home
GSD
3.74
in/px
166
165
164
ft
START
END
0%
1443 x 436 ft
35 min : 28 s
START

iPad
11:01 AM
89%
Home
GSD
3.74
in/px
166
165
164
ft
START
END
0%
E Galleria Dr
E Galleria Dr
1443 x 436 ft
35 min : 28 s
START

iPad
11:01 AM
89%
Home
GSD 3.74 in/px
166
165
164
ft
START
END
0%
711 x 436 ft
17 min : 36 s
START


iPad
11:01 AM
89%
Home
GSD
3.74
in/px
166
165
164
ft
START
END
0%
711 x 436 ft
17 min : 36 s
START


iPad
11:02 AM
89%
Home
START
END
GSD
3.74
in/px
166
165
164
ft
0%
669 x 508 ft
19 min : 22 s
START

iPad
11:03 AM
88%
Home
GSD
3.74
in/px
166
165
164
ft
0%
START
END
603 x 715 ft
22 min : 21 s
START


iPad
11:04 AM
88%
Home
GSD
3.74
in/px
166
165
164
ft
START
END
0%
895 x 938 ft
34 min : 19 s
START


iPad
11:04 AM
88%
Home
GSD
3.74
in/px
166
165
164
ft
0%
END
START
524 x 902 ft
32 min : 32 s
START


iPad
11:04 AM
88%
Home
GSD
3.74
in/px
166
165
164
ft
0%
END
START
524 x 902 ft
32 min : 32 s
START


iPad
11:05 AM
88%
Home
GSD
3.74
in/px
166
165
164
ft
0%
END
START
610 x 761 ft
21 min : 15 s
START


iPad
11:05 AM
88%
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GSD
3.74
in/px
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165
164
ft
START
END
0%
895 x 938 ft
34 min : 19 s
START

iPad
11:05 AM
88%
Home
GSD 3.74 in/px
166
165
164
ft
0%
START
END
610 x 761 ft
23 min : 54 s
START


iPad
11:05 AM
88%
Home
GSD
3.74
in/px
166
165
164
ft
0%
START
END
715 x 613 ft
21 min : 3 s
START


iPad
11:06 AM
88%
Home
GSD
3.74
in/px
166
165
164
ft
0%
START
END
695 x 731 ft
22 min : 29 s
START

iPad
11:06 AM
88%
Home
GSD
3.74
in/px
166
165
164
ft
END
START
0%
708 x 702 ft
22 min : 24 s
START


iPad
11:06 AM
88%
Home
GSD
3.74
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166
165
164
ft
0%
START
END
1049 x 954 ft
37 min : 13 s
START

iPad
11:06 AM
87%
Home
END
GSD
3.29
in/px
146
145
144
ft
0%
START
465 x 505 ft
15 min : 49 s
START


iPad
11:06 AM
87%
Home
END
GSD
3.29
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146
145
144
ft
0%
START
465 x 505 ft
15 min : 49 s
START


iPad
11:07 AM
87%
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GSD
3.29
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146
145
144
ft
END
START
0%
626 x 633 ft
17 min : 4 s
START


iPad
11:07 AM
87%
Home
END
GSD
3.29
in/px
146
145
144
ft
0%
START
465 x 505 ft
15 min : 49 s
START


iPad
11:07 AM
87%
Home
END
START
GSD
3.29
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146
145
144
ft
0%
479 x 465 ft
17 min : 1 s
START


iPad
11:07 AM
87%
Home
GSD
3.29
in/px
146
145
144
ft
START
END
0%
616 x 429 ft
15 min : 34 s
START


iPad
11:08 AM
87%
Home
END
GSD
3.29
in/px
146
145
144
ft
0%
START
531 x 643 ft
15 min : 52 s
START


iPad
11:08 AM
87%
Home
GSD
3.29
in/px
146
145
144
ft
END
START
0%
554 x 643 ft
16 min : 24 s
START

Appendix C

Daily Weather Summaries for TIR Program

Appendix XX
Compilation of Daily Weather Information
Henderson, Nevada
February-March 2018

Date	Temperature (F)		Wind		Precipitation (in)	Cloud Cover
	High	Low	Speed(mph)	Direction		
2/1/2018	70	43	6	SSE	0	Clear
2/2/2018	72	44	6	S	0	Clear
2/3/2018	73	46	7	SSE	0	Clear
2/4/2018	72	48	6	SSE	0	Clear
2/5/2018	75	46	8	SSW	0	Clear
2/6/2018	70	46	7	E	0	Clear
2/7/2018	66	39	5	SE	0	Clear
2/8/2018	71	43	6	S	0	Clear
2/9/2018	78	48	8	SSW	0	Clear
2/10/2018	75	48	14	E	0	Clear
2/11/2018	57	41	8	E	0	Clear
2/12/2018	60	45	15	SW	0.01	Clear
2/13/2018	57	39	4	NE	0	Clear
2/14/2018	60	46	6	SSW	0	Clear
2/15/2018	62	43	8	NE	0	Clear
2/16/2018	57	39	7	ENE	0	Clear
2/17/2018	64	36	6	S	0	Clear
2/18/2018	71	48	20	SSW	0	Clear
2/19/2018	51	37	21	SWS	0	Clear
2/20/2018	48	27	5	S	0	Clear
2/21/2018	46	32	5	S	0	Clear
2/22/2018	54	32	15	SW	0	Clear
2/23/2018	48	37	11	W	0	Rain, snow
2/24/2018	53	26	6	SSW	0	Clear
2/25/2018	52	36	7	ENE	0	Clear
2/26/2018	64	28	7	SSW	0	Clear
2/27/2018	50	39	6	SSW	0	rain
2/28/2018	59	36	10	SSW	0	Clear
3/1/2018	64	45	13	S	0	Clear
3/2/2018	66	48	18	SSW	0	Clear
3/3/2018	62	46	19	SSW	0	Clear
3/4/2018	55	37	9	SW	0	Clear
3/5/2018	57	37	7	ENE	0	Clear
3/6/2018	64	37	6	E	0	Clear
3/7/2018	60	39	6	SE	0	Clear
3/8/2018	68	39	7	S	0	Clear
3/9/2018	77	44	7	S	0	Clear
3/10/2018	66	53	9	S	0.14	Rain
3/11/2018	64	51	4	NE	0.22	Rain

Date	Temperature (F)		Wind		Precipitation (in)	Cloud Cover
	High	Low	Speed(mph)	Direction		
3/12/2018	72	48	6	S	0	Clear
3/13/2018	78	51	8	S	0	Clear
3/14/2018	70	53	15	SSW	0	Clear
3/15/2018	62	46	18	SW	0.01	Rain
3/16/2018	66	45	12	SSW	0	Clear
3/17/2018	57	48	16	SSW	0	Clear
3/18/2018	60	41	6	S	0	Clear
3/19/2018	64	39	5	SE	0	Clear
3/20/2018	66	41	6	S	0	Clear
3/21/2018	73	51	12	SSW	0	Clear
3/22/2018	69	57	9	SSW	0.01	Rain
3/23/2018	73	53	15	SW	0	Clear
3/24/2018	69	53	16	SSW	0	Clear
3/25/2018	64	48	16	SSW	0	Clear
3/26/2018	62	46	13	NNE	0	Clear
3/27/2018	66	48	14	N	0	Clear
3/28/2018	78	46	6	SE	0	Clear
3/29/2018	78	51	7	SSE	0	Clear
3/30/2018	82	51	6	SSW	0	Clear
3/31/2018	87	57	9	SSW	0	Clear

Note:
source:
https://www.wunderground.com/history/airport/KHND/2018/2/1/DailyHistory.html?req_city=&req_state=&req_statename=&reqdb.zip=&reqdb.magic=&reqdb.wmo=

Appendix D

Daily Field Reports

MeterMark	Northing	Easting	Comment
3287	26737550.0740	844520.8930	
3281	26737563.5710	844531.1060	
3267	26737598.3750	844556.5510	
3259	26737617.8520	844539.5280	
3250	26737645.0010	844538.3410	
3234	26737679.2580	844574.1900	
	26737680.5700	844576.8500	arc bend
3224	26737676.7270	844590.0150	bend
3220	26737697.5000	844605.6800	
3211	26737723.2420	844617.1570	
3193	26737775.2570	844645.9600	
3179	26737815.2020	844661.4890	
	26737838.9190	844670.0770	Expossed line
	26737842.8590	844671.3440	Expossed line
3153	26737894.9140	844686.1280	
3144	26737924.4140	844695.8800	
3137	26737947.4220	844699.4110	
3130	26737970.7870	844708.0780	
3109	26738035.6340	844727.3090	
	26738063.9430	844749.9640	Out of water
3095	26738072.2160	844756.5310	Out of water
	26738155.0090	844858.5020	stream gauge 3.6
	26738055.5330	844743.7290	daily low out of water
3088	26738088.0680	844772.6750	meter mark 03088 out of water
	26738090.5170	844775.6570	daily low back into water
3078	26738111.0680	844795.2480	
	26738111.3620	844803.0200	daily low out of water
	26738115.5770	844811.0770	low flow exposed posshiflo
3066	26738126.3510	844829.1380	
3056	26738148.6130	844853.0770	
	26738152.7820	844858.1070	bend
3052	26738156.4730	844854.9160	meter mark 03052 out of water
	26738161.2860	844851.3840	back into water
	26738163.8360	844850.2090	daily low out of water
	26738169.1750	844848.8360	bend into water
3039	26738193.8980	844861.7740	
3032	26738207.5590	844879.1870	
3024	26738222.1760	844900.9630	
3007	26738254.4720	844945.1530	
3001	26738256.6200	844963.0710	
	26738245.3110	844968.1260	bend
2994	26738249.4600	844975.4350	
2981	26738279.1830	845002.3620	
2964	26738318.5650	845040.7320	
2952	26738347.6480	845067.6120	
2936	26738390.0610	845089.0880	meter mark 02936 bend water
2928	26738415.8700	845088.6090	meter mark 02928 bend water
	26738434.5940	845097.8580	small bend
	26738435.7950	845105.0660	small bend
2916	26738443.7860	845109.9760	
2909	26738461.2790	845122.7820	
	26738469.3850	845127.7660	small bend
2904	26738474.0440	845125.6890	
2898	26738494.1800	845123.0830	meter mark 02898 wet
2890	26738519.1970	845124.8240	meter mark 02890 wet
2887	26738527.3290	845126.8520	meter mark 02887 bend wet
2883	26738523.4860	845137.6120	meter mark 02883 bend wet
2877	26738505.3350	845141.9270	meter mark 02877 wet
	26738496.2260	845136.3450	small bend
2870	26738485.9290	845130.7980	
2868	26738479.6770	845129.9060	meter mark 02868 water cinder
2847	26738453.1220	845182.1150	meter mark 02847 out
	26738446.3850	845177.9580	job box

MeterMark	Northing	Easting	Comment
2610	26738563.219	845026.274	In water
2612	26738566.321	845020.641	
2616	26738575.248	845010.917	
2620	26738585.769	845006.629	
2623	26738594.306	844999.761	
2627	26738606.002	844994.863	
2629	26738611.664	844992.894	
2632	26738622.087	844990.879	
2636	26738633.556	844985.816	
2639	26738643.799	844985.341	
2642	26738652.883	844985.827	
2646	26738666.962	844992.186	
2667	26738726.400	844989.731	
2664	26738718.351	844997.593	
2668	26738727.874	844988.943	Over branch
2678	26738705.892	844966.860	
2684	26738692.679	844951.780	
2688	26738684.272	844943.535	
2697	26738667.422	844921.217	
2702	26738655.882	844909.225	
2704	26738654.860	844903.659	
2708	26738643.872	844898.742	
2716	26738631.154	844875.259	
2721	26738622.477	844862.776	
2722	26738621.723	844860.814	Out of water over rapids
2727	26738611.545	844850.255	In water
2730	26738607.579	844844.906	
2735	26738596.899	844831.870	
2739	26738588.381	844824.242	
2743	26738581.640	844814.156	
2747	26738575.482	844806.084	
2755	26738560.430	844788.741	
2758	26738549.979	844790.040	
2762	26738539.997	844780.816	
2769	26738527.386	844769.237	
2773	26738518.947	844757.092	
2778	26738503.951	844744.407	
2786	26738481.884	844740.378	
2789	26738478.354	844732.403	
2793	26738471.730	844728.519	
2795	26738464.336	844732.040	
2798	26738459.484	844727.061	
2799	26738452.192	844729.885	
2804	26738436.651	844729.480	
2806	26738428.331	844725.461	
2808	26738422.056	844727.945	Out of water over rapids
2810	26738419.507	844726.996	In water
2813	26738406.786	844725.572	
2816	26738397.803	844725.462	
2825	26738370.746	844721.660	
2829	26738358.642	844722.354	
2830	26738357.606	844720.439	Out of water with splice and 37 meters of cable
0	26738338.588	844713.453	Spool of cable
2867	26738329.485	844718.124	In water
2872	26738317.167	844720.632	
2879	26738292.994	844712.326	
2883	26738281.469	844712.322	
2887	26738270.043	844712.838	
2891	26738255.183	844710.319	
2897	26738243.221	844697.768	
2903	26738226.699	844680.292	
2906	26738220.305	844676.260	
2912	26738226.191	844657.149	
2916	26738227.418	844646.583	
2918	26738231.694	844641.078	
2920	26738230.737	844632.417	
2923	26738232.132	844625.956	
2925	26738229.356	844621.114	
2927	26738228.960	844614.257	
2930	26738228.895	844604.534	
2932	26738225.451	844599.162	
2935	26738223.227	844589.946	

MeterMark	Northing	Easting	Comment
2937	26738229.620	844587.701	
2938	26738229.536	844584.054	
2940	26738230.544	844578.081	
2943	26738226.809	844570.244	
2944	26738225.312	844565.810	
2946	26738229.218	844561.090	
2947	26738228.542	844557.464	
2949	26738231.195	844552.905	
2950	26738228.720	844549.277	
2954	26738218.771	844541.801	
2959	26738205.202	844531.965	
2961	26738206.679	844526.601	
2963	26738208.314	844521.371	
2965	26738205.435	844514.969	
2967	26738202.891	844508.857	
2972	26738194.529	844495.575	
2980	26738180.823	844476.045	
2983	26738172.573	844466.080	
2991	26738152.120	844451.405	
2994	26738147.034	844443.119	
2997	26738144.178	844435.460	
3000	26738134.440	844435.013	
3001	26738130.961	844436.185	
3010	26738108.643	844419.201	
3013	26738100.000	844411.963	
3014	26738098.338	844409.627	
3018	26738087.444	844402.780	
3022	26738076.781	844395.134	
3026	26738066.681	844386.775	
3027	26738063.604	844385.617	
3028	26738060.361	844384.137	
3029	26738059.002	844382.068	
3032	26738054.864	844372.635	
3033	26738053.167	844369.801	
3034	26738049.212	844368.772	
3036	26738044.405	844367.923	
3037	26738041.241	844365.353	
3038	26738040.182	844360.848	
3040	26738036.159	844359.356	
3042	26738032.250	844354.874	
3044	26738027.117	844351.695	
3045	26738023.899	844350.191	
3046	26738021.952	844347.716	
3047	26738018.719	844345.408	
3049	26738015.346	844340.572	
3052	26738007.215	844335.020	
3053	26738004.915	844332.144	
3057	26737996.526	844323.227	
3059	26737990.237	844321.188	
3061	26737984.134	844317.554	
3064	26737980.203	844311.297	
3072	26737956.071	844302.439	
3070	26737962.397	844301.062	Out at low flow conditions
3068	26737968.115	844302.830	Out at low flow conditions
3076	26737943.233	844298.030	
3080	26737934.713	844287.986	
3082	26737929.628	844284.384	
3084	26737926.077	844280.447	
3086	26737922.329	844275.105	
3089	26737917.371	844265.966	
3091	26737915.355	844259.777	
3095	26737911.962	844246.713	
3097	26737908.709	844241.678	
3098	26737905.600	844238.968	
3101	26737896.430	844238.409	Out at low flow conditions
3102	26737892.947	844236.239	
3103	26737892.384	844233.677	
3106	26737888.629	844224.217	
3109	26737882.252	844217.432	
3111	26737878.911	844211.926	
3114	26737874.719	844203.871	
3115	26737872.207	844207.039	Out of water

MeterMark	Northing	Easting	Comment
3122	26737853.171	844209.079	In water
3123	26737850.310	844206.510	
3126	26737845.889	844199.246	
3127	26737845.388	844196.034	
3129	26737844.356	844189.162	
3131	26737841.398	844184.582	
3133	26737842.952	844178.157	
3134	26737842.278	844174.791	
3135	26737839.037	844174.317	Out of water
3136	26737837.464	844174.003	
3137	26737835.367	844172.000	
3138	26737832.528	844171.200	Out of water at final location
3139	26737832.722	844171.218	Spool of cable

MeterMark	Northing	Easting	Comment
	26734517.0440	830382.9320	cable bend
5939	26734515.3890	830156.6500	
5877	26734481.2990	829965.5660	
	26734502.9630	829896.1670	rebar bend point
5846	26734516.5340	829899.4350	
5768	26734758.1820	829933.7920	Out of water
	26734858.7380	829958.8490	point 10 ft downstream
5693	26734873.6800	830089.3130	Out of air
5678	26734877.4500	830132.8320	In water
5652	26734867.7370	830185.4090	In water
5634	26734840.7680	830228.4570	
5620	26734809.3970	830258.8050	
5612	26734805.6540	830282.8300	
5604	26734818.6440	830304.3280	
5587	26734814.6940	830352.5560	
5582	26734805.9260	830366.0560	
5579	26734803.6750	830375.9270	
5574	26734793.1330	830389.2930	
5485	26734522.8590	830429.7920	
6012	26734525.2590	830381.8970	Out of water
	26734476.0980	830357.9980	Job box
	26734488.6850	830025.9630	cable submerged cant read MM
5458	26734489.4100	830372.4630	Out of water
5869	26734477.9870	829941.4690	Low submerged
	26734506.8410	829897.4720	Low exposed
5852	26734498.4290	829899.0620	Exposed
5846	26734516.9390	829899.4680	
5843	26734526.4060	829899.9980	
5833	26734558.8490	829902.7240	
5814	26734621.2090	829901.6630	
5798	26734669.5620	829899.2900	Low submerged
5786	26734705.7270	829908.6030	Low exposed
5779	26734725.7790	829915.7540	
5774	26734739.9110	829923.8950	
5762	26734777.8020	829937.8450	Low back in
5745	26734829.7150	829948.1930	Low exposed
5742	26734838.7730	829952.8750	
5672	26734886.1700	830149.2140	
5678	26734877.8290	830132.7190	
5684	26734880.3370	830113.6650	
5689	26734883.9900	830097.9780	Low bend
5692	26734876.1020	830092.0220	Low exposed
	26734869.5570	830082.4710	Low submerged
5700	26734864.0780	830069.3170	Low exposed
5706	26734863.2860	830050.1120	
5712	26734875.2910	830037.7210	
5715	26734875.1680	830027.0500	Low submerged
5657	26734881.1350	830173.3020	Low exposed
5648	26734860.2470	830194.4240	
5640	26734853.5200	830217.1520	Low back into water
5628	26734823.8930	830238.2640	Low exposed
5608	26734811.0960	830295.2160	Low submerged
5561	26734759.6290	830401.9570	Low cross wash

MeterMark	Northing	Easting	Comment
0	26739273.68	847122.75	splice box_start
6013	26739276.39	847118.70	Out of water near start
6006	26739273.02	847103.10	In
6000	26739275.34	847085.28	
5992	26739265.18	847062.69	
5985	26739262.89	847044.49	
5982	26739259.48	847032.71	
5976	26739259.31	847015.18	
5967	26739257.81	846985.20	
5957	26739256.41	846952.16	
5952	26739256.92	846936.27	
5949	26739257.62	846926.48	
5943	26739256.45	846907.22	
5930	26739258.19	846868.23	
5924	26739255.07	846849.19	
5916	26739257.69	846822.46	
5910	26739254.38	846803.05	
5907	26739253.74	846793.43	
5901	26739258.77	846781.99	Branches(out of water)
5895	26739258.99	846762.72	Branches(out of water)
5898	26739263.16	846770.96	Branches(out of water)
5892	26739256.40	846754.68	Branches(out of water)
5886	26739250.11	846734.65	
5874	26739240.72	846696.22	
5870	26739245.06	846683.85	
5867	26739249.94	846674.39	Tree
5862	26739249.89	846662.84	
5857	26739247.16	846644.85	
5853	26739243.96	846632.63	
5845	26739250.79	846612.13	Out
5843	26739252.55	846606.61	
5839	26739245.50	846598.26	
5834	26739251.15	846585.44	
5830	26739250.07	846573.23	
5821	26739254.35	846545.23	
5814	26739262.80	846522.93	
5805	26739271.70	846495.56	
5797	26739278.80	846471.37	
5792	26739280.13	846453.78	
5785	26739278.11	846431.31	
0	26739279.41	846426.05	1 foot on top of rock at surface
5785	26739277.92	846430.74	
5780	26739282.50	846415.43	
5777	26739283.17	846405.86	
5773	26739284.34	846393.70	
5769	26739275.32	846384.97	
5768	26739272.60	846378.98	
5763	26739272.17	846363.78	
5759	26739271.64	846351.97	
5755	26739272.73	846339.96	
5752	26739280.18	846335.25	Out
5739	26739289.08	846302.19	
5736	26739291.40	846292.98	
5732	26739291.90	846280.45	
5729	26739290.84	846270.79	
5718	26739292.95	846241.12	
5705	26739294.26	846213.77	
5700	26739274.80	846185.35	
5702	26739292.54	846193.35	
5695	26739261.44	846192.14	
5694	26739256.13	846194.18	Out at low
5692	26739257.22	846189.17	
5690	26739251.61	846175.29	Out at low
5689	26739249.18	846176.43	Out at low
5688	26739277.51	846182.82	In at low
5687	26739255.83	846173.22	Pedestrian bridge pillar
5686	26739246.89	846182.77	Pedestrian bridge pillar
5685	26739253.49	846180.16	Pedestrian bridge pillar
5684	26739241.23	846208.87	Pedestrian bridge pillar
0	26739247.82	846210.69	Arc
5682	26739227.60	846188.09	

MeterMark	Northing	Easting	Comment
5679	26739221.42	846173.11	
5677	26739214.19	846165.18	
5676	26739216.55	846155.81	
5675	26739218.94	846155.77	
5673	26739215.45	846138.06	
5672	26739222.36	846148.29	
5670	26739213.26	846155.33	
5667	26739211.62	846126.04	
5665	26739217.90	846129.11	possible seep observed
5663	26739217.94	846122.57	possible seep observed
5661	26739218.50	846116.58	possible seep observed
5660	26739218.76	846114.14	
5658	26739220.08	846107.96	
5656	26739221.87	846102.74	
0	26739221.39	846100.26	Rock
5654	26739222.25	846095.92	
5651	26739224.02	846089.69	
5650	26739226.07	846082.52	
5646	26739225.38	846071.07	
5645	26739226.79	846069.54	
5643	26739229.38	846063.80	
5642	26739231.25	846059.38	
5641	26739229.05	846058.02	
5639	26739223.58	846053.17	
5640	26739224.91	846058.78	
5638	26739225.66	846051.77	
0	26739226.22	846050.31	Out
5637	26739227.08	846049.19	Out
5636	26739229.79	846047.35	Out
5635	26739230.02	846045.27	Out
5634	26739229.95	846042.62	In
5629	26739229.06	846028.24	
5627	26739228.22	846022.61	
5628	26739226.46	846025.53	
5626	26739227.88	846019.21	
5624	26739230.17	846013.68	
5623	26739228.25	846009.20	
5621	26739230.12	846004.57	
5620	26739227.96	846001.37	
5618	26739225.54	845995.29	
5616	26739222.86	845989.72	
5614	26739226.59	845984.69	
5612	26739224.34	845976.58	
5607	26739215.56	845962.89	
5601	26739203.81	845950.05	
5596	26739193.14	845936.98	
5594	26739191.03	845930.94	
5592	26739185.60	845929.27	
5587	26739179.20	845913.88	
5584	26739172.05	845909.74	
5581	26739164.67	845901.89	
5575	26739157.59	845884.40	
5565	26739149.44	845851.61	
5559	26739145.05	845834.70	
5556	26739142.54	845823.89	
5548	26739127.72	845805.20	
5545	26739121.87	845797.47	
5537	26739113.34	845773.89	
5528	26739100.42	845748.47	
5523	26739094.42	845736.17	
5512	26739074.61	845704.17	
5499	26739056.17	845666.10	
5486	26739033.19	845630.80	
5478	26739022.46	845606.32	
5476	26739018.16	845601.22	
5469	26739005.78	845583.48	
5466	26738994.32	845581.24	
5462	26738986.01	845572.13	
5397	26738936.35	845587.04	Out of cooler B
5434	26738935.74	845582.25	In cooler A
5458	26738977.59	845563.10	Out at low

MeterMark	Northing	Easting	Comment
5459	26738980.21	845563.80	In at low(end)
0	26738979.76	845563.10	Out
5434			In cooler A
5397			Out cooler B

MeterMark	Northing	Easting	Comment
splicebox_start	26736689.51	840322.06	
06013	26736688.43	840318.74	measurement near splice box end
06010	26736678.43	840317.65	
6008	26736671.64	840317.58	Cable enters water
06004	26736670.83	840305.69	
06001	26736668.60	840296.30	
05995	26736660.79	840278.09	
05993	26736658.54	840272.42	
05990	26736659.38	840262.21	
05988	26736660.65	840256.07	
05984	26736650.59	840249.66	
05981	26736644.16	840245.43	
05977	26736638.05	840232.02	
05974	26736632.66	840224.63	
05971	26736631.69	840214.58	
05968	26736631.47	840203.47	
05965	26736635.61	840195.73	
05962	26736629.74	840190.90	
5960	26736626.68	840184.92	Potential anomoly location (feels colder)
5958	26736622.40	840179.25	Potential anomoly location (feels colder)
5957	26736620.37	840175.29	Potential anomoly location (feels colder)
05955	26736614.88	840173.55	
05952	26736609.33	840165.69	
05950	26736606.35	840159.79	
05948	26736606.83	840154.63	
05946	26736602.94	840150.44	
05944	26736601.31	840144.62	
05942	26736599.25	840137.83	
05940	26736595.44	840133.36	
05938	26736593.71	840127.00	
05936	26736594.22	840121.12	
05934	26736591.51	840114.97	
05932	26736590.41	840109.24	
05927	26736587.67	840094.61	
05925	26736586.91	840087.93	
05922	26736578.73	840081.38	
05919	26736572.42	840073.93	
05916	26736567.84	840063.79	
05913	26736566.15	840055.73	
05910	26736565.25	840046.30	
05907	26736562.07	840036.28	
05905	26736562.09	840029.80	
05902	26736554.11	840024.52	
05899	26736550.55	840015.54	
05897	26736549.87	840008.66	
05896	26736550.53	840004.35	
05894	26736549.84	840000.32	
05891	26736542.88	839994.23	
05888	26736533.72	839988.27	
05885	26736528.21	839981.34	
05883	26736522.33	839978.02	
05880	26736513.87	839972.49	
05877	26736511.39	839966.01	Out of water
5877	26736510.40	839962.75	Out
5873	26736504.41	839955.09	In
05870	26736495.76	839952.76	
05867	26736486.37	839954.24	
05865	26736479.67	839953.47	
05862	26736472.93	839947.48	
05858	26736466.28	839936.50	
05855	26736460.29	839929.71	
05854	26736456.65	839927.81	
05850	26736450.35	839918.16	
05846	26736444.68	839905.68	
05843	26736438.15	839899.18	
05841	26736435.36	839892.81	
05834	26736425.34	839873.50	
05831	26736423.25	839863.98	
05828	26736418.63	839856.02	
05824	26736411.75	839845.33	
05822	26736409.20	839839.13	
05822	26736410.56	839833.70	

MeterMark	Northing	Easting	Comment
05818	26736408.90	839827.67	
05816	26736405.49	839822.77	
05815	26736402.43	839822.41	
05813	26736398.40	839817.94	
05810	26736392.92	839807.80	
05807	26736392.15	839800.07	
5804	26736389.51	839791.67	Out
5799	26736388.40	839789.23	In
05797	26736385.95	839785.40	
05794	26736379.12	839777.06	
05791	26736375.70	839770.13	
05790	26736372.74	839766.85	
05788	26736370.13	839760.90	
05781	26736361.41	839740.25	
05780	26736359.27	839739.88	
05777	26736357.17	839731.74	
5773	26736360.15	839716.25	
05771	26736358.42	839710.35	
05769	26736360.13	839704.97	
05766	26736353.86	839695.96	
05763	26736355.76	839686.99	
05755	26736341.07	839666.20	
05752	26736333.93	839659.41	
05748	26736325.14	839650.89	
05746	26736321.08	839645.56	
05742	26736313.85	839633.52	
05739	26736316.39	839625.37	
05735	26736310.00	839614.31	
05733	26736310.72	839608.41	
05731	26736308.40	839601.87	
05728	26736300.56	839598.00	
05725	26736294.42	839591.56	
05721	26736290.55	839586.30	
05720	26736284.29	839578.56	
05718	26736281.04	839573.80	
05715	26736275.09	839565.92	
05712	26736269.57	839560.13	
05708	26736264.33	839545.43	
05705	26736263.70	839537.59	
05701	26736260.45	839527.73	
05695	26736250.63	839506.12	
05688	26736242.00	839488.32	
05685	26736237.16	839479.96	
05682	26736233.68	839470.93	
05677	26736228.40	839460.27	
05674	26736224.33	839451.04	
05666	26736214.77	839424.85	
05656	26736200.72	839400.87	
05649	26736196.34	839380.07	
05645	26736194.76	839367.83	
05641	26736188.14	839355.08	
05635	26736174.04	839344.36	
05632	26736172.20	839334.40	
05628	26736168.91	839321.21	
05623	26736157.52	839313.50	
05621	26736156.10	839300.65	
05615	26736158.97	839284.31	
05611	26736147.40	839274.20	
05608	26736144.52	839264.85	
05606	26736141.51	839258.89	
5602	26736142.64	839247.10	Tree
05600	26736144.25	839241.14	
05594	26736151.11	839220.83	
05590	26736147.58	839211.33	
05585	26736130.27	839210.26	
05581	26736118.88	839215.49	
05575	26736119.09	839230.38	
05574	26736121.58	839237.67	
05571	26736124.31	839244.57	
05567	26736120.17	839257.82	
05565	26736126.24	839261.85	
05564	26736126.90	839264.26	

MeterMark	Northing	Easting	Comment
05562	26736119.45	839268.47	
05557	26736106.07	839265.87	
05556	26736102.98	839261.80	
05553	26736103.06	839250.68	
05550	26736097.33	839242.93	
05544	26736080.31	839234.00	
05533	26736060.10	839206.19	
05531	26736057.69	839199.71	
05527	26736055.32	839187.37	
05524	26736046.70	839189.93	
05521	26736036.48	839186.98	
05519	26736031.74	839185.38	
05518	26736027.81	839185.59	
05516	26736021.51	839187.80	
05512	26736008.26	839185.63	
05511	26736005.73	839187.16	
05508	26735995.55	839188.03	
05506	26735991.09	839189.00	
05503	26735980.76	839190.16	
05500	26735971.13	839187.75	
05496	26735962.05	839178.68	
05494	26735957.12	839177.33	
05492	26735951.47	839174.36	
05491	26735948.42	839174.41	
5490	26735943.85	839174.43	Out
5485	26735928.81	839173.07	Strain Relief
5483	26735930.08	839174.91	In
05480	26735929.84	839185.52	
05475	26735929.67	839197.34	
05471	26735924.53	839212.88	
05469	26735923.71	839219.71	
05466	26735922.37	839229.26	
05464	26735919.52	839234.67	
05460	26735922.83	839247.56	
05451	26735925.35	839274.40	
05448	26735922.71	839280.95	
05445	26735928.95	839287.63	
05443	26735924.76	839292.17	
5439	26735920.66	839303.98	
05437	26735923.34	839307.10	
5433	26735919.68	839312.67	
5433	26735914.47	839315.39	
05430	26735908.39	839309.66	
05429	26735906.42	839306.10	
05428	26735903.27	839303.66	
05425	26735898.79	839297.08	
05421	26735896.63	839307.03	
05419	26735903.46	839312.03	
05414	26735909.73	839326.83	
05413	26735910.60	839328.95	
05412	26735910.13	839332.38	
05410	26735903.28	839331.25	
5408	26735898.84	839328.70	
5406	26735893.73	839325.90	
5404	26735895.28	839330.97	
5402	26735897.27	839337.10	
5398	26735910.68	839344.76	
5395	26735915.62	839352.45	Straight to cove
5388	26735923.37	839374.16	Straight to cove
5381	26735925.93	839396.35	Straight to cove
5371	26735929.07	839429.56	Straight to cove
5363	26735932.37	839454.78	Straight to cove
05360	26735928.22	839464.58	
05357	26735919.73	839464.80	
05354	26735915.12	839456.95	
05351	26735908.84	839449.99	
05348	26735897.04	839447.85	
05345	26735890.07	839446.37	
05340	26735873.69	839439.22	
05336	26735867.17	839431.20	
05332	26735858.75	839419.47	
05330	26735853.79	839422.68	

MeterMark	Northing	Easting	Comment
55329	26735856.62	839426.74	
5326	26735863.27	839437.29	
5323	26735867.99	839446.36	
5319	26735875.26	839456.22	
5314	26735887.63	839469.47	
05308	26735898.29	839484.50	
05303	26735905.16	839497.39	
05300	26735911.13	839509.93	
05294	26735918.45	839521.16	
05291	26735926.35	839530.56	
5287	26735922.87	839544.49	
05281	26735920.18	839563.69	
05275	26735907.35	839577.03	
05268	26735911.15	839599.95	
05263	26735920.95	839615.74	
05258	26735921.83	839627.64	
05253	26735927.49	839642.92	
05248	26735935.75	839657.87	
05243	26735940.40	839672.60	
05237	26735949.11	839691.25	
05230	26735958.92	839713.41	
05222	26735967.78	839736.06	
05219	26735968.13	839745.46	
05215	26735977.76	839754.61	
05209	26735987.00	839772.17	
05201	26735996.05	839790.72	
05195	26736005.78	839809.84	
05193	26736009.38	839813.42	
05188	26736021.10	839826.24	
05181	26736036.70	839842.12	
05177	26736035.93	839855.87	
05171	26736048.09	839872.67	
05165	26736050.20	839891.23	
05157	26736054.65	839915.24	
05151	26736068.47	839931.21	
05143	26736078.95	839955.78	
05137	26736085.42	839973.21	
05132	26736091.10	839988.22	
05127	26736099.73	840001.58	
05121	26736115.85	840014.86	
05116	26736124.79	840028.36	
05107	26736136.31	840054.88	
05104	26736141.69	840062.57	
05099	26736139.73	840078.95	
05096	26736135.94	840088.08	
05087	26736150.51	840112.80	
05084	26736150.75	840121.53	
05080	26736147.90	840133.74	
05075	26736149.60	840150.49	
05070	26736155.26	840163.81	
05064	26736162.00	840182.14	
05060	26736172.74	840189.80	
05051	26736187.15	840214.53	
05046	26736195.34	840227.74	
05042	26736207.15	840239.44	
05034	26736219.62	840260.97	
05025	26736233.78	840286.20	
5018	26736235.32	840305.03	Out of water
5003			Out
4998			Out
4997			In bath A
4983			Out bath A
4973			In bath B
4962			Out bath B

MeterMark	Northing	Easting	Comment
6003	26736703.37	840832.23	Start
05999	26736698.66	840844.33	
05994	26736697.52	840860.96	
1meter_knot	26736697.17	840863.26	
05593-05992	26736697.36	840863.03	Knot
05987	26736695.76	840878.11	
05981	26736700.31	840897.06	
5976	26736694.07	840909.59	
5971	26736702.54	840923.99	
5965	26736693.42	840940.51	
5958	26736686.13	840966.09	
5949	26736673.72	840991.35	
5944	26736677.66	841004.55	
5939	26736679.21	841018.53	
5935	26736677.84	841033.05	
5930	26736669.54	841045.97	
5926	26736665.23	841059.03	
5922	26736658.42	841071.19	
5913	26736645.67	841095.97	
5905	26736626.58	841113.21	
5897	26736609.55	841133.73	
5892	26736602.09	841146.17	
5885	26736592.22	841166.47	
5875	26736587.44	841202.24	
5965	26736581.34	841232.52	
5860	26736574.16	841242.72	
5857	26736578.64	841255.74	
5853	26736574.48	841268.70	
5846	26736575.21	841289.42	
5836	26736576.98	841322.33	
5830	26736575.30	841339.00	
5824	26736585.92	841355.17	
5819	26736578.18	841369.53	
5812	26736580.99	841390.47	
5806	26736585.12	841407.59	
5801	26736590.39	841426.33	
5795	26736598.03	841444.25	
5789	26736602.44	841461.74	
5782	26736614.71	841482.65	
5776	26736615.74	841496.63	
5768	26736630.66	841522.99	
5763	26736639.60	841540.82	
5757	26736647.45	841558.01	
5755	26736648.66	841565.13	
5746	26736659.49	841592.16	
5738	26736673.97	841610.22	
5731	26736684.38	841634.88	
5724	26736696.49	841654.45	
5717	26736702.65	841674.25	
5712	26736716.36	841684.30	
5706	26736731.73	841693.35	
5703	26736742.75	841693.88	
5698	26736753.40	841703.67	
5691	26736761.23	841725.99	
5686	26736777.36	841741.48	
5673	26736804.00	841768.94	
5663	26736815.95	841795.03	
5657	26736828.21	841814.78	
5648	26736854.20	841824.98	
5644	26736854.63	841835.35	
5639	26736861.90	841850.52	
5631	26736882.67	841864.75	
5627	26736887.42	841873.91	
5616	26736918.35	841893.93	
5611	26736935.71	841898.43	
5603	26736957.29	841911.89	
5598	26736972.69	841923.63	
5589	26736997.09	841933.97	
5579	26737007.97	841964.37	
5573	26737012.31	841985.64	
5568	26737025.06	841994.41	End north

MeterMark	Northing	Easting	Comment
5534	26736917.87	842027.99	Out
5531	26736909.81	842028.76	In
5463	26736689.40	842006.20	Out
5453	26736661.02	842002.38	SE Stake
5452	26736688.44	841987.28	In
5437	26736679.42	841974.98	
5434	26736678.23	841964.77	
5430	26736669.09	841953.52	
5436	26736658.23	841949.43	
5421	26736646.57	841936.50	
5417	26736648.41	841925.86	
5413	26736639.10	841914.13	
5409	26736635.77	841901.69	
5403	26736632.87	841884.38	
5398	26736625.88	841867.08	
5393	26736623.42	841851.56	
5387	26736619.12	841833.52	
5378	26736607.93	841803.92	
5371	26736602.85	841783.53	
5367	26736601.70	841772.21	
5363	26736608.44	841761.66	
5357	26736593.53	841743.33	
5350	26736587.17	841723.46	
5341	26736571.59	841695.55	
5331	26736548.91	841672.50	
5323	26736532.77	841653.01	
5315	26736511.70	841635.68	
5308	26736499.72	841619.56	
5401	26736486.47	841599.86	
5297	26736481.84	841586.44	
5294	26736477.15	841581.95	
5290	26736483.07	841571.77	
5285	26736477.43	841558.61	
5278	26736468.92	841537.62	
5275	26736460.94	841529.83	
5270	26736460.52	841518.73	
5264	26736453.74	841497.90	
5257	26736448.96	841474.09	
5246	26736437.51	841441.52	
5241	26736442.93	841428.41	
5236	26736437.60	841409.33	
5230	26736435.47	841391.28	
5224	26736434.15	841371.64	
5213	26736423.57	841337.29	
5203	26736411.25	841310.08	
5194	26736400.52	841280.03	
5183	26736385.61	841249.63	
5173	26736367.59	841223.73	
5163	26736345.29	841201.56	
5156	26736355.10	841182.27	
5152	26736347.14	841176.48	
5145	26736346.38	841150.70	
5138	26736335.40	841131.50	
5132	26736331.62	841114.09	
5126	26736332.62	841093.68	
5121	26736340.59	841077.14	
5116	26736346.51	841064.49	
5109	26736343.09	841042.00	
5105	26736353.52	841037.56	
5098	26736340.73	841020.29	
5092	26736346.69	840999.33	
5085	26736349.23	840978.57	
5079	26736351.51	840957.05	
5073	26736356.15	840939.67	
5065	26736343.55	840915.51	
5057	26736350.16	840893.36	
5052	26736363.78	840887.34	
5042	26736369.91	840856.88	
5032	26736358.50	840829.29	
5025	26736342.03	840813.25	
5021	26736350.54	840804.95	

MeterMark	Northing	Easting	Comment
5015	26736343.60	840786.71	
5007	26736344.55	840759.56	
4999	26736338.99	840733.91	
4995	26736335.47	840722.28	Out SW portion of deployment
Enter cooler	26736223.38	840344.67	

DAILY ACTIVITY REPORT

DATE:	April 29, 2018	Day:	S	M	T	W	Th	F	S
PROJECT NAME:	NERT Regional Groundwater RI	Weather:	Sunny	Partly Sunny	Cloudy	Rain	Snow		
		Temp °F:	80						
SITES / LOCATIONS:	LVW	Wind:	Still	Moderate	High	Direction:	SW		
		Humidity:	Dry	Moderate	Humid	Rain			

PERSONNEL ON-SITE	Employer	Job Title
Rick Purdy	AECOM	Field Team
C. Steve Howe	AECOM	Hydrologist/ Field Team Leader
James McCoy	AECOM	Field Team
Petros Paulos	AECOM	Field Team

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out

WORK COMPLETED

The teams arrived. Purdy and Howe arrived in the afternoon of 4/28/2018. Mobilization began 4/29/2018. Paulos and McCoy arrived in the afternoon.

The following equipment did not arrive for Saturday delivery but will arrive Monday:
YSI
2 of 3 peristaltic pumps
GPS units

Steve Howe and Kristen Durocher discussed Monday activities. The teams will develop cross-sections of transects that have easily identifiable landmarks (i.e., immediately after a weir). The two banks will be marked for the GPS to be used to identify the specific locations. The cross-sections will be used to develop sample schemes across the LVW.

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:	SAFETY REQUIREMENTS HAVE BEEN MET
The teams were not on the water.	Yes No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed

Material/Supplies Received at the Site:

Field Activities and Remarks Not Presented Above:

Name: Kristen Durocher ______________________________ Date: ________04/29/2018_________

DAILY ACTIVITY REPORT

DATE:	April 30, 2018	Day:	S	M	T	W	Th	F	S
PROJECT NAME:	NERT Regional Groundwater RI	Weather:	Sunny	Partly Sunny	Cloudy	Rain	Snow		
		Temp °F:	65 - 75						
SITES / LOCATIONS:	LVW	Wind:	Still	Moderate	High	Direction:			
		Humidity:	Dry	Moderate	Humid	Rain			

PERSONNEL ON-SITE	Employer	Job Title
Rick Purdy	AECOM	Field Team
C. Steve Howe	AECOM	Hydrologist/ Field Team Leader
Petros Paulos	AECOM	Field Team
Kevin Russell	AECOM	Field Team
Joe Caputo	AECOM	Field Team
James McCoy	AECOM	Field Team

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out

WORK COMPLETED

Collected transect profile data at T3.8 and T3.75. Selected transect sampling locations along these transects.
Visited transect stations near Duck Creek and Upper Narrows Weirs.
Checked staff gage locations for maintenance needs.
Wet to lab to retrieve the sampling bottles. Laboratory only provided one (chlorate) of two bottle types needed. Laboratory got a subset of the unpreserved bottles and field team went back to get them.
Picked up GPS units and checked coordinates, etc. GPS units were late in arriving as incorrect zip code used for shipping.
Inventoried water quality monitoring instruments and sampling equipment.
Pumps delivered late to hotel, but in working condition.

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:	SAFETY REQUIREMENTS HAVE BEEN MET
The teams discussed wildlife, hydration, sunscreen and working on/in water. Kristen Durocher monitored the weather – slight chance of rain in the forecast.	Yes No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed
3 GPS units	4/30/2018	
3 peristaltic pumps	4/30/2018	
3 YSI units	4/30/2018	

Material/Supplies Received at the Site:

Field Activities and Remarks Not Presented Above:

Name: Kristen Durocher Date: 04/30/2018

DAILY ACTIVITY REPORT

DATE:	May 1, 2018	Day:	S	M	T	W	Th	F	S
PROJECT NAME:	NERT Regional Groundwater RI	Weather:	Sunny	Partly Sunny	Cloudy	Rain	Snow		
		Temp °F:	60 - 70						
SITES / LOCATIONS:	LVW	Wind:	Still	Moderate	High	Direction:	ESE 2-6		
		Humidity:	Dry	Moderate	Humid	Rain			

PERSONNEL ON-SITE	Employer	Job Title
Rick Purdy	AECOM	Field Team
C. Steve Howe	AECOM	Hydrologist/ Field Team Leader
Petros Paulos	AECOM	Field Team
Kevin Russell	AECOM	Field Team
Joe Caputo	AECOM	Field Team
James McCoy	AECOM	Field Team

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out
Carmen Caceres-Schnell	AECOM	Management site visit		

WORK COMPLETED

The teams collected transect samples from:
T6.5
T6.8
T6.55

A field blank and a field duplicate were collected.

Additional maintenance was performed on the transducers and staff gages.

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:

The teams discussed wildlife, hydration, sunscreen and working on/in water. Kristen Durocher monitored the weather – slight chance of rain in the forecast. Due to this chance of rain, Kristen Durocher will check flows in the morning and discuss conditions for safety and achieving data quality objectives with Steve Howe in the morning.

Carmen Caceres-Schnell reported that the site visit went well, but requested that additional copies of the HASP be printed so each team has a copy. This was done.

SAFETY REQUIREMENTS HAVE BEEN MET

Yes No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed
3 GPS units	4/30/2018	
3 peristaltic pumps	4/30/2018	
3 YSI units	4/30/2018	

Material/Supplies Received at the Site:

Field Activities and Remarks Not Presented Above:

Name: Kristen Durocher Date: 05/01/2018

DAILY ACTIVITY REPORT

DATE:	May 2, 2018	Day:	S	M	T	W	Th	F	S
PROJECT NAME:	NERT Regional Groundwater RI	Weather:	Sunny	Partly Sunny	Cloudy	Rain	Snow		
		Temp °F:	60 - 70						
SITES / LOCATIONS:	LVW	Wind:	Still	Moderate	High	Direction:	S 2-6, gusts to 12		
		Humidity:	Dry	Moderate	Humid	Rain			

PERSONNEL ON-SITE	Employer	Job Title
Rick Purdy	AECOM	Field Team
C. Steve Howe	AECOM	Hydrologist/ Field Team Leader
Petros Paulos	AECOM	Field Team
Kevin Russell	AECOM	Field Team
Joe Caputo	AECOM	Field Team
James McCoy	AECOM	Field Team

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out

WORK COMPLETED

Due to flow conditions, teams were unable to collect samples.

Transects were marked and cross-sections developed for sampling planned on Thursday.

Additional maintenance was performed on the transducers and staff gages.

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:	SAFETY REQUIREMENTS HAVE BEEN MET
The teams discussed wildlife, hydration, sunscreen and working on/in water. Kristen Durocher and Steve Howe discussed the flows. Flows were not high enough to be a danger for on-water work. However, flows were elevated to mid- to high- daily flow range during the timing of daily low flows. To keep data quality objectives, no sampling was conducted.	Yes No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed
3 GPS units	4/30/2018	
3 peristaltic pumps	4/30/2018	
3 YSI units	4/30/2018	
Material/Supplies Received at the Site:		
Field Activities and Remarks Not Presented Above:		

Name: Kristen Durocher

Date: 05/02/2018

DAILY ACTIVITY REPORT

DATE:	May 3, 2018	Day:	S	M	T	W	Th	F	S
PROJECT NAME:	NERT Regional Groundwater RI	Weather:	Sunny	Partly Sunny	Cloudy	Rain	Snow		
		Temp °F:	60 - 70						
SITES / LOCATIONS:	LVW	Wind:	Still	Moderate	High	Direction:	NNW 1-5		
		Humidity:	Dry	Moderate	Humid	Rain			

PERSONNEL ON-SITE	Employer	Job Title
Rick Purdy	AECOM	Field Team
C. Steve Howe	AECOM	Hydrologist/ Field Team Leader
Petros Paulos	AECOM	Field Team
Kevin Russell	AECOM	Field Team
Joe Caputo	AECOM	Field Team
James McCoy	AECOM	Field Team

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out

WORK COMPLETED

The teams collected transect samples from:
T4.7
T3.8
T6
T4.65
T4.8

Grab samples were collected at:
LW4.48N
LW4.48S
LW4.5S (this is a new, floater location, intended to capture conditions before the cool anomalies below Lower Narrows Weir)
LWC3.7
LW0.9 (note: collected after samples transferred to laboratory, so will be on COC for 5/5/18)
A field duplicate was collected at LW0.9.

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:	SAFETY REQUIREMENTS HAVE BEEN MET
The teams discussed wildlife, hydration, sunscreen and working on/in water.	Yes No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed
3 GPS units	4/30/2018	
3 peristaltic pumps	4/30/2018	
3 YSI units	4/30/2018	

Material/Supplies Received at the Site:

Field Activities and Remarks Not Presented Above:

Name: Kristen Durocher Date: 05/03/2018

DAILY ACTIVITY REPORT

DATE:	May 4, 2018	Day:	S	M	T	W	Th	F	S
PROJECT NAME:	NERT Regional Groundwater RI	Weather:	Sunny	Partly Sunny	Cloudy	Rain	Snow		
		Temp °F:	60 - 70						
SITES / LOCATIONS:	LVW	Wind:	Still	Moderate	High	Direction:	NNW 1-5		
		Humidity:	Dry	Moderate	Humid	Rain			

PERSONNEL ON-SITE	Employer	Job Title
Rick Purdy	AECOM	Field Team
C. Steve Howe	AECOM	Hydrologist/ Field Team Leader
Petros Paulos	AECOM	Field Team
Kevin Russell	AECOM	Field Team
Joe Caputo	AECOM	Field Team
James McCoy	AECOM	Field Team

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out
Carlton Parker	NDEP	Site visit		

WORK COMPLETED

The teams collected transect samples from:
T3.3
T3.75
T3.9
T4.85

Grab samples were collected at:
LW3.4
LW3.55
LW4.73S
LW4.73N
C-1 Channel
LW0.9
A field duplicate was collected at T3.9B.
MS/MSD samples were collected at T3.9D
A FB was collected at T3.3A
An EB was collected at T4.73S

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:	SAFETY REQUIREMENTS HAVE BEEN MET
The teams discussed wildlife, hydration, sunscreen and working on/in water.	Yes No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed
3 GPS units	4/30/2018	
3 peristaltic pumps	4/30/2018	
3 YSI units	4/30/2018	

Material/Supplies Received at the Site:

Field Activities and Remarks Not Presented Above:

Name: Kristen Durocher   Date: 05/04/2018

DAILY ACTIVITY REPORT

DATE:	May 5, 2018	Day:	S	M	T	W	Th	F	S
PROJECT NAME:	NERT Regional Groundwater RI	Weather:	Sunny	Partly Sunny	Cloudy	Rain	Snow		
		Temp °F:	70 - 95						
SITES / LOCATIONS:	LVW	Wind:	Still	Moderate	High	Direction:	NNW 1-5		
		Humidity:	Dry	Moderate	Humid	Rain			

PERSONNEL ON-SITE	Employer	Job Title
C. Steve Howe	AECOM	Hydrologist/ Field Team Leader
Petros Paulos	AECOM	Field Team
James McCoy	AECOM	Field Team

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out
Carlton Parker	NDEP	Site visit		

WORK COMPLETED

The teams collected transect samples from:
T3.5

Grab samples were collected at:
LW3.4
LW3.1
LW0.9

Field duplicate samples were collected at T3.5B and LW0.9.
MS/MSD samples were collected at T3.5C and LW3.1
A FB was collected at T3.5A

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:
The teams discussed wildlife, hydration, sunscreen and working on/in water.

Steve Howe worked a half day then demobilized from the Site.

SAFETY REQUIREMENTS HAVE BEEN MET
Yes No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed
3 GPS units	4/30/2018	
3 peristaltic pumps	4/30/2018	
3 YSI units	4/30/2018	

Material/Supplies Received at the Site:

Field Activities and Remarks Not Presented Above:

Name: Kristen Durocher Date: 05/05/2018

DAILY ACTIVITY REPORT

DATE:	May 6, 2018	Day:	S	M	T	W	Th	F	S
PROJECT NAME:	NERT Regional Groundwater RI	Weather:	Sunny	Partly Sunny	Cloudy	Rain	Snow		
		Temp °F:	80 - 97						
SITES / LOCATIONS:	LVW	Wind:	Still	Moderate	High	Direction:	NNW 1-5		
		Humidity:	Dry	Moderate	Humid	Rain			

PERSONNEL ON-SITE	Employer	Job Title
Petros Paulos	AECOM	Field Team
James McCoy	AECOM	Field Team

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out
Carlton Parker	NDEP	Site visit		

WORK COMPLETED

Transect sampling was completed on Saturday. The teams needed to focus on the remaining grab samples and QC needs. In discussion with Kristen Durocher, a plan was developed to collect QC to meet project needs.

Grab samples were collected at:
LW3.68
LW3.2
LW3.15
LW3.11

Field duplicate samples were collected at LW3.68, LW3.15, LW3.11, and LW3.2
MS/MSD samples were collected at LW3.11
A field blank was collected at LW3.68

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:	SAFETY REQUIREMENTS HAVE BEEN MET
The teams discussed wildlife, hydration, sunscreen and working on/in water. Heat was the main topic.	Yes No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed
3 GPS units	4/30/2018	
3 peristaltic pumps	4/30/2018	
3 YSI units	4/30/2018	

Material/Supplies Received at the Site:

Field Activities and Remarks Not Presented Above:

Name: Kristen Durocher

Date: 05/06/2018

DAILY ACTIVITY REPORT

DATE:	May 7, 2018	Day:	S	M	T	W	Th	F	S
PROJECT NAME:	NERT Regional Groundwater RI	Weather:	Sunny	Partly Sunny	Cloudy	Rain	Snow		
		Temp °F:	80 - 97						
SITES / LOCATIONS:	LVW	Wind:	Still	Moderate	High	Direction:	NNW 1-5		
		Humidity:	Dry	Moderate	Humid	Rain			

PERSONNEL ON-SITE	Employer	Job Title
Petros Paulos	AECOM	Field Team
James McCoy	AECOM	Field Team

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out
Carlton Parker	NDEP	Site visit		

WORK COMPLETED

The teams ran out of sampling bottles. They went to TA field office and got enough to complete the following QC samples:

A field blank was collected at LW3.11
Equipment blanks were collected at LW3.15, LW0.9, LW3.2 and T3.5A. Due to lack of preserved bottles, LW3.2 and T3.5A EBs were submitted for perchlorate and TDS only (i.e., no chlorate).

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:	SAFETY REQUIREMENTS HAVE BEEN MET
The teams discussed wildlife, hydration, sunscreen and working on/in water. Heat was the main topic.	Yes No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed
3 GPS units	4/30/2018	5/7/2018
3 peristaltic pumps	4/30/2018	5/7/2018
3 YSI units	4/30/2018	5/7/2018
Material/Supplies Received at the Site:		
Field Activities and Remarks Not Presented Above:		

Name: Kristen Durocher

Date: 05/07/2018

DAILY ACTIVITY REPORT

DATE:	February 26, 2018	Day:	S	**M**	T	W	Th	F	S
PROJECT NAME:	NERT Regional Groundwater RI DTS Fieldwork	Weather:		**Sunny**					
		Temp °F:	38 - 66 °F						
SITES / LOCATIONS:	Las Vegas Wash	Wind:		**Still**		Direction:	**South**		
		Humidity:		**Dry/Moderate**					

PERSONNEL ON-SITE	Employer	Job Title
Rory Henderson	AECOM	DTS Kickoff Lead/Geophysicist
Gabe Knight	AECOM	DTS Kickoff Lead/Scientist
C. Steve Howe	AECOM	DTS Lead & SSO/Hydrologist
Clare Murphy Hagan	AECOM	DTS Lead/Environmental Scientist

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out

WORK COMPLETED

Site reconnaissance, shopping, equipment pickup and general field preparations.

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:	SAFETY REQUIREMENTS HAVE BEEN MET
Daily health and safety briefing conducted.	**Yes** No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed
DTS; Fiber Optic Cable; Ice and Water Baths	02/26/2018	
Handheld GPS Trimble	02/26/2018	
FLIR	02/26/2018	
2 YSI 556	02/26/2018	

Material/Supplies Received at the Site:

DTS and additional CTEMPS equipment arrived via FEDEX carrier by 5pm to the NERT Trailer.
Pickup Job Boxes from Home Depot.
YSI's arrived via FEDEX to Hotel.

Field Activities and Remarks Not Presented Above:

Site tour given to field members new to the Site and Downgradient Area. Access and deployment strategies discussed for tomorrow. DTS test run.

Name: Kristen Durocher   Date: 02/26/2018

DAILY ACTIVITY REPORT

DATE:	February 27, 2018	Day:	S	M	**T**	W	Th	F	S
PROJECT NAME:	NERT Regional Groundwater RI DTS Fieldwork	Weather:			**Sunny**				
		Temp °F:	48 – 56 °F						
SITES / LOCATIONS:	Las Vegas Wash	Wind:			**Still**	Direction:	**East**		
		Humidity:			**Moderate**				

PERSONNEL ON-SITE	Employer	Job Title
Rory Henderson	AECOM	DTS Kickoff Lead/Geophysicist
Gabe Knight	AECOM	DTS Kickoff Lead/Scientist
C. Steve Howe	AECOM	DTS Lead & SSO/Hydrologist
Clare Murphy Hagan	AECOM	DTS Lead/Environmental Scientist
Kevin Russel	AECOM	FO Support/Geologist
Joseph Capotrio	AECOM	FO Support/Scientist
A.J. Rodriguez	GES (Subcontractor)	FO Support/Scientist
Eric Wang	GES (Subcontractor)	FO Support/Scientist

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out
Carlton Parker	NDEP	Oversight	0730	1200
Dr. Weiquan Dong	NDEP	Oversight	0730	1200

WORK COMPLETED

Morning fieldwork kickoff meeting at Upper Narrows Weir attended by AECOM, subcontractors and client. PPE (including waders, life jackets, gloves, and walking sticks) distributed during health and safety discussion. Scope of work discussed among field team and equipment including canoes, fiber optic cable, anchors, ropes, throw bag, zip ties mobed to stream bank. The cable was successfully deployed by both foot and boat and data collection began around 2000. Cable path was recorded on handheld GPS during deployment although additional points will be collected tomorrow during low-flow.

The DTS and calibration baths were set up on the South Bank near the edge of the construction zone (located to the east.) The red annotation on the below figure indicates the approximate layout of the fiber optic cable for DTS data collection.

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:	SAFETY REQUIREMENTS HAVE BEEN MET
Daily health and safety briefing conducted.	**Yes** No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed
DTS; Fiber Optic Cable; Ice and Water Baths	02/26/2018	
Handheld GPS Trimble	02/26/2018	
FLIR	02/26/2018	
2 YSI 556	02/26/2018	

Material/Supplies Received at the Site:

NA

Field Activities and Remarks Not Presented Above:

DTS field kickoff; deployment of cable at Upper Narrows above construction zone; DTS setup and begin data collection.

Name: Kristen Durocher

Date: 02/27/2018

DAILY ACTIVITY REPORT

DATE:	February 28, 2018	Day:	S	M	T	**W**	Th	F	S
PROJECT NAME:	NERT Regional Groundwater RI DTS Fieldwork	Weather:				**Sunny**			
		Temp °F:	43 – 66 °F						
SITES / LOCATIONS:	Las Vegas Wash	Wind:				**Still**	**Direction: WSW**		
		Humidity:				**Moderate**			

PERSONNEL ON-SITE	Employer	Job Title
Rory Henderson	AECOM	DTS Kickoff Lead
Gabe Knight	AECOM	DTS Kickoff Lead
C. Steve Howe	AECOM	DTS Lead & SSO/Hydrologist
Clare Murphy Hagan	AECOM	DTS Lead/ Environmental Scientist

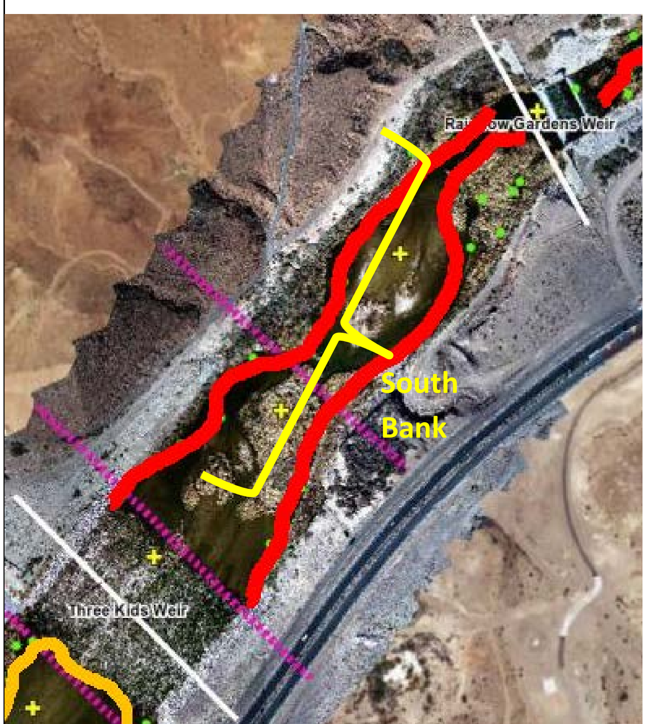
VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out

WORK COMPLETED

Returned to DTS setup at Upper Narrows to check on data collection, check calibration baths, and swap out batteries. Confered with field operations tech at CTEMPs on changing data collection parameters and update collection configuration accordingly. Additional GPS points collected of fiber optic cable along North bank capturing areas where cable is out of the water during low-flow.

Mobed second DTS setup to Three Kids Weir area and performed reconnaissance looking for access locations for deployment along South bank. Began deploying fiber optic cable beginning downstream of Three Kids Weir and working towards Rainbow Gardens Weir. Approximately half of the deployment completed today. GPS points collected along cable path during deployment.

The red annotation along the South bank on the below figure indicates the targeted approximate layout of the fiber optic cable for DTS data collection between Three Kids and Rainbow Garden Weirs.



LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:	SAFETY

Daily health and safety briefing conducted.	**REQUIREMENTS HAVE BEEN MET** **Yes** No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed
DTS; Fiber Optic Cable; Ice and Water Baths	02/26/2018	
Handheld GPS Trimble	02/26/2018	
FLIR	02/26/2018	
2 YSI 556	02/26/2018	

Material/Supplies Received at the Site:

NA

Field Activities and Remarks Not Presented Above:

None.

Name: Kristen Durocher

Date: 02/28/2018

DAILY ACTIVITY REPORT

DATE:	March 1, 2018	Day:	S	M	T	W	**Th**	F	S
PROJECT NAME:	NERT Regional Groundwater RI DTS Fieldwork	Weather:					**Sunny**		
		Temp °F:	50 – 67 °F						
SITES / LOCATIONS:	Las Vegas Wash	Wind:					**Still**	**Direction: SSW**	
		Humidity:					**Low/Moderate**		

PERSONNEL ON-SITE	Employer	Job Title
Rory Henderson	AECOM	DTS Kickoff Lead
Gabe Knight	AECOM	DTS Kickoff Lead
C. Steve Howe	AECOM	DTS Lead & SSO/Hydrologist
Clare Murphy Hagan	AECOM	DTS Lead/ Environmental Scientist

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out

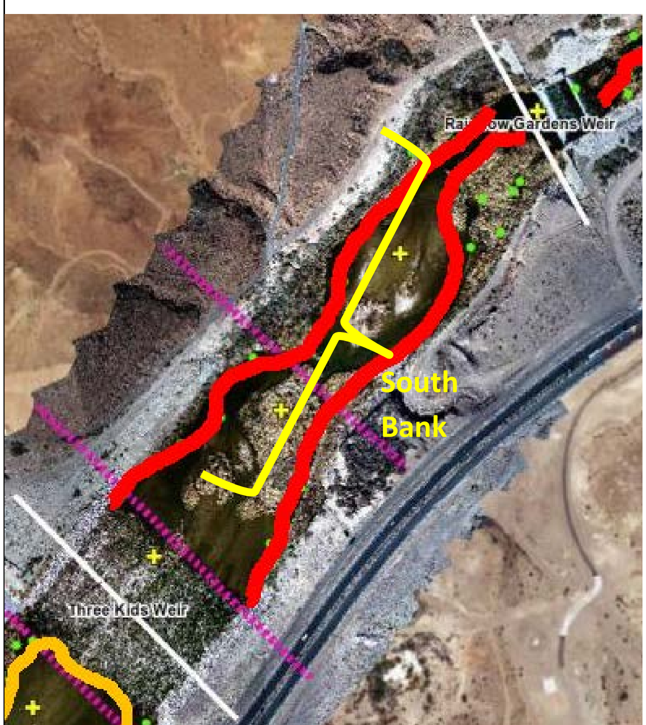
WORK COMPLETED

Visited Upper Narrows DTS setup to check on status and swap out batteries.

Continued second DTS setup/deployment from Three Kids Weir towards Rainbow Gardens Weir along South bank. GPS points collected along cable path during deployment. Finished deploying fiber optic cable and bring cable out of water to bank approximately 100 meters above Rainbow Gardens Weir to avoid safety hazards associated with Weir. Mobed DTS equipment, job boxes and calibration bath coolers to location and setup DTS for data collection. Data collection began around 1800.

Visited Upper Narrows DTS to check on status, download data and swap out batteries.

The red annotation along the South bank on the below figure indicates the targeted approximate layout of the fiber optic cable for DTS data collection between Three Kids and Rainbow Garden Weirs.



LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:	**SAFETY REQUIREMENTS HAVE BEEN MET**
Daily health and safety briefing conducted.	**Yes** No

Equipment at the Site (includes Subcontractor supplied equipment):	**Date Arrived**	**Date Removed**
DTS; Fiber Optic Cable; Ice and Water Baths	02/26/2018	
Handheld GPS Trimble	02/26/2018	
FLIR	02/26/2018	
2 YSI 556	02/26/2018	

Material/Supplies Received at the Site:

NA

Field Activities and Remarks Not Presented Above:

None.

Name: Kristen Durocher

Date: 03/01/2018

DAILY ACTIVITY REPORT

DATE:	March 2, 2018	Day:	S	M	T	W	Th	**F**	S
PROJECT NAME:	NERT Regional Groundwater RI DTS Fieldwork	Weather:						**Sunny**	
		Temp °F:	52 – 73 °F						
SITES / LOCATIONS:	Las Vegas Wash	Wind:					**Still Direction: West**		
		Humidity:					**Low/Moderate**		

PERSONNEL ON-SITE	Employer	Job Title
Rory Henderson	AECOM	DTS Kickoff Lead
Gabe Knight	AECOM	DTS Kickoff Lead
C. Steve Howe	AECOM	DTS Lead & SSO/Hydrologist
Clare Murphy Hagan	AECOM	DTS Lead/ Environmental Scientist

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out

WORK COMPLETED

Performed maintenance at Upper Narrows and Three Kids S. bank DTS setups (added ice to calibration bath, swap out batteries, download data). Returned to hotel to charge batteries. Located and purchased empty spool for cable retrieval, as well as obtained additional supplies for extraction of cable. Returned to Upper Narrows and Three Kids S. bank DTS setups to perform afternoon maintenance.

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:	SAFETY REQUIREMENTS HAVE BEEN MET
Daily health and safety briefing conducted.	**Yes** No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed
DTS; Fiber Optic Cable; Ice and Water Baths	02/26/2018	
Handheld GPS Trimble	02/26/2018	
FLIR	02/26/2018	

Material/Supplies Received at the Site:

None.

Field Activities and Remarks Not Presented Above:

None.

Name: Kristen Durocher

Date: 03/02/2018

DAILY ACTIVITY REPORT

DATE:	March 3, 2018	Day:	S	M	T	W	Th	F	**S**
PROJECT NAME:	NERT Regional Groundwater RI DTS Fieldwork	Weather:						**Sunny**	
		Temp °F:	54 – 65 °F						
SITES / LOCATIONS:	Las Vegas Wash	Wind:					**Still**	**Direction: WNW**	
		Humidity:					**Moderate**		

PERSONNEL ON-SITE	Employer	Job Title
C. Steve Howe	AECOM	DTS Lead & SSO/Hydrologist
Clare Murphy Hagan	AECOM	DTS Lead/ Environmental Scientist
Kevin Russel	AECOM	FO Support/Geologist
A.J. Rodriguez	GES (subcontractor)	FO Support

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out

WORK COMPLETED

Mobed to Upper Narrows for cable retrieval. Downloaded data and shutdown DTS. Retrieved cable from Upper Narrows deployment area using empty spool. Mobed canoes and supplies out of channel and set up main spool on spool stand to re-wind retrieved spool. Packed up DTS equipment and job box into vehicles. Upper Narrows fieldwork completed.

Mobed to DTS setup at Three Kids to Rainbow Garden S. bank to perform maintenance. Data in Oryx Viewer not normal. Consulted with R. Henderson (AECOM) and ran tests. It was determined there is a break in the cable. Further investigation revealed cable have been chewed in half not far from the DTS setup. Shutdown DTS and mobed out. No further work can be completed here until cable is fixed.

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:	SAFETY REQUIREMENTS HAVE BEEN MET
Daily health and safety briefing conducted.	**Yes** No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed
DTS; Fiber Optic Cable; Ice and Water Baths	02/26/2018	
Handheld GPS Trimble	02/26/2018	
FLIR	02/26/2018	
2 YSI 556	02/26/2018	

Material/Supplies Received at the Site:

None.

Field Activities and Remarks Not Presented Above:

None.

Name: Kristen Durocher   Date: 03/03/2018

DAILY ACTIVITY REPORT

DATE:	March 4, 2018	Day:	**S**	M	T	W	Th	F	S
PROJECT NAME:	NERT Regional Groundwater RI DTS Fieldwork	Weather:	**Sunny**						
		Temp °F:	47 – 66 °F						
SITES / LOCATIONS:	Las Vegas Wash	Wind:				**Still**	**Direction: NNW**		
		Humidity:				**Low/Moderate**			

PERSONNEL ON-SITE	Employer	Job Title
C. Steve Howe	AECOM	DTS Lead & SSO/Hydrologist
Clare Murphy Hagan	AECOM	DTS Lead/ Environmental Scientist
Kevin Russel	AECOM	FO Support/Geologist
A.J. Rodriguez	GES (subcontractor)	FO Support

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out

WORK COMPLETED

Three Kids to Rainbow Garden DTS continued to be offline while arrangements were made for CTEMPS to fix cable.

Mobed the fiber optic cable retrieved from Upper Narrows to above Fire Station Weir. Began deploying cable along South bank working upstream from approximately 50 meters above Fire Station Weir towards Rainbow Garden Weir. Cable path was recorded on handheld GPS during deployment. Stopped deployment for the day below Pedestrian Bridge and secure cable for the night.

The red annotation on the below figure indicates the targeted approximate layout of the fiber optic cable for DTS data collection.

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:	SAFETY REQUIREMENTS HAVE BEEN MET
Daily health and safety briefing conducted.	**Yes** No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed
DTS; Fiber Optic Cable; Ice and Water Baths	02/26/2018	
Handheld GPS Trimble	02/26/2018	
FLIR	02/26/2018	
2 YSI 556	02/26/2018	

Material/Supplies Received at the Site: NA
Field Activities and Remarks Not Presented Above: None

Name: Kristen Durocher   Date: 03/04/2018

DAILY ACTIVITY REPORT

DATE:	March 5, 2018	Day:	S	**M**	T	W	Th	F	S
PROJECT NAME:	NERT Regional Groundwater RI DTS Fieldwork	Weather:		**Sunny**					
		Temp °F:	46 – 68 °F						
SITES / LOCATIONS:	Las Vegas Wash	Wind:		**Still**		**Direction:**	**NNE**		
		Humidity:		**Low**					

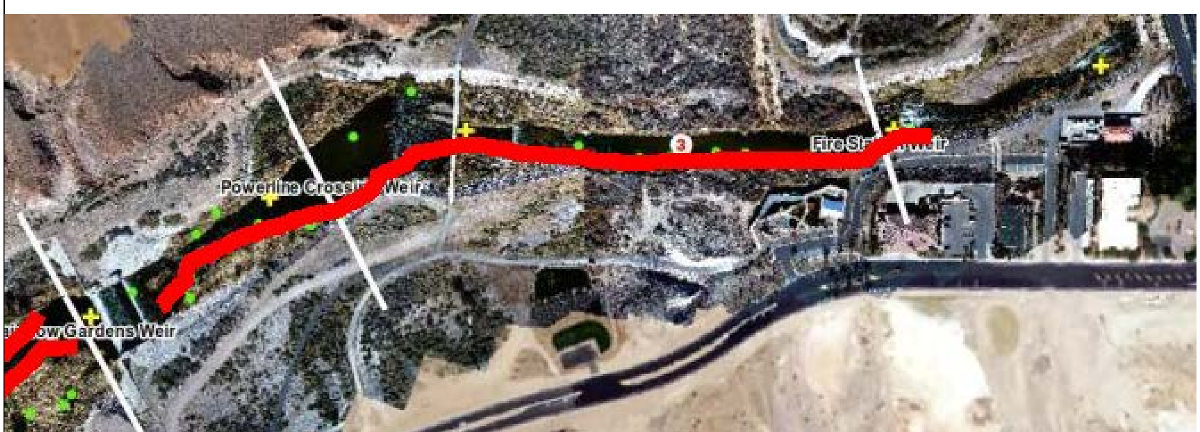
PERSONNEL ON-SITE	Employer	Job Title
C. Steve Howe	AECOM	DTS Lead & SSO/Hydrologist
Clare Murphy Hagan	AECOM	DTS Lead/ Environmental Scientist
Kevin Russel	AECOM	FO Support/Geologist
Joseph Capotrio	AECOM	FO Support/Scientist

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out

WORK COMPLETED

Three Kids to Rainbow Garden DTS continued to be offline while arrangements were made for CTEMPS to fix cable.

Continued deploying cable along South bank from Pedestrian Bridge towards Rainbow Garden Weir. Cable path was recorded on handheld GPS during deployment. Removed cable from water approximately 50 meters downstream from Rainbow Gardens Weir to avoid safety hazards associated with Weir rapids. Mobed DTS equipment, job boxes and calibration bath coolers to location and set up DTS for data collection. Data collection begins around 1720.
.
The red annotation on the below figure indicates the targeted approximate layout of the fiber optic cable for DTS data collection.



LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:	SAFETY REQUIREMENTS HAVE BEEN MET
Daily health and safety briefing conducted.	**Yes** No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed
DTS; Fiber Optic Cable; Ice and Water Baths	02/26/2018	
Handheld GPS Trimble	02/26/2018	
FLIR	02/26/2018	
2 YSI 556	02/26/2018	

Material/Supplies Received at the Site: NA
Field Activities and Remarks Not Presented Above: None.

Name: Kristen Durocher

Date: 03/05/2018

DAILY ACTIVITY REPORT

DATE:	March 6, 2018	Day:	S	M	**T**	W	Th	F	S
PROJECT NAME:	NERT Regional Groundwater RI DTS Fieldwork	Weather:			**Sunny**				
		Temp °F:	45 – 72 °F						
SITES / LOCATIONS:	Las Vegas Wash	Wind:			**Still**	**Direction:**	**NE**		
		Humidity:			**Low**				

PERSONNEL ON-SITE	Employer	Job Title
C. Steve Howe	AECOM	DTS Lead & SSO/Hydrologist
Clare Murphy Hagan	AECOM	DTS Lead/Environmental Scientist

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out
Christ Kratt	CTEMPS	DTS Equipment Service/Splice	0730	1400

WORK COMPLETED

Checked Fire Station to Rainbow Gardens S. bank DTS setup.

C. Kratt (CTEMPS) on site at Three Kids to Rainbow Gardens S. Bank DTS to splice fiber optic cable back together. Dead beaver found nearby area of broken cable. Second splice attempt was successful and tests ran on DTS were successful. DTS was re-configured for data collection. Data collection resumed at approximately 1400. Zip tied running from water to setup to the top of phragmites to avoid further damage by small mammals.

Returned to Fire Station to Rainbow Gardens S. bank DTS setup to download data and swap out batteries.

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:	SAFETY REQUIREMENTS HAVE BEEN MET
Daily health and safety briefing conducted.	**Yes** No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed
DTS; Fiber Optic Cable; Ice and Water Baths	02/26/2018	
Handheld GPS Trimble	02/26/2018	
FLIR	02/26/2018	
2 YSI 556	02/26/2018	
Splicing Kit	03/06/2018	

Material/Supplies Received at the Site:

Splicing kit received by AECOM from C. Kratt to hold on to for remainder of field program in case of another cable break.

Field Activities and Remarks Not Presented Above:

Name: Kristen Durocher

Date: 03/06/2018

DAILY ACTIVITY REPORT

DATE:	March 7, 2018	Day:	S	M	T	**W**	Th	F	S
PROJECT NAME:	NERT Regional Groundwater RI DTS Fieldwork	Weather:				**Sunny**			
		Temp °F:	46 – 64 °F						
SITES / LOCATIONS:	Las Vegas Wash	Wind:				**Still**	**Direction: NNW**		
		Humidity:				**High**			

PERSONNEL ON-SITE	Employer	Job Title
Clare Murphy-Hagan	AECOM	DTS Lead/Environmental Scientist
Joseph Capotrio	AECOM	FO Support/Scientist

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out

WORK COMPLETED

S. Howe at stake holders meeting for the day.

Performed maintenance check at Fire Station to Rainbow Gardens S. bank DTS (check calibration baths, download data and swap batteries). Performed maintenance check at Fire Station to Rainbow Gardens S. bank DTS (check calibration baths, download data and swap batteries).

Visited NERT trailer to drop off unneeded/extra supplies.

Explored some areas on foot along S. Bank near DTS setups where previous IR study indicated potential thermal anomalies. Only one historical seep confirmed by very high conductivity relative to channel.

Performed end of day maintenance check at both DTS setups (check calibration baths, download data and swap batteries).

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:	SAFETY REQUIREMENTS HAVE BEEN MET
Daily health and safety briefing conducted.	**Yes** No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed
DTS; Fiber Optic Cable; Ice and Water Baths	02/26/2018	
Handheld GPS Trimble	02/26/2018	
FLIR	02/26/2018	
2 YSI 556	02/26/2018	
Splicing Kit	03/06/2018	

Material/Supplies Received at the Site:

NA

Field Activities and Remarks Not Presented Above:

None.

Name: Kristen Durocher   Date: 03/07/2018

DAILY ACTIVITY REPORT

DATE:	March 8, 2018	Day:	S	M	T	W	**Th**	F	S
PROJECT NAME:	NERT Regional Groundwater RI DTS Fieldwork	Weather:					**Sunny**		
		Temp °F:	45 – 77 °F						
SITES / LOCATIONS:	Las Vegas Wash	Wind:					**Still Direction: ENE**		
		Humidity:					**Low**		

PERSONNEL ON-SITE	Employer	Job Title
C. Steve Howe	AECOM	DTS Lead & SSO/Hydrologist
Clare Murphy Hagan	AECOM	DTS Lead/ Environmental Scientist

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out

WORK COMPLETED

Performed maintenance check on DTS at Fire Station to Rainbow Gardens S. bank (download data and begin battery swap out). Damage caused to one of two battery connectors during swap out. Solution was to run DTS off of one battery and check batteries morning and evening. Issue occurred restarting configuration on DTS. Called CTEMPS to remote access the DTS. Issue resolved itself. DTS observed to be collecting data normally.

Checked DTS at Three Kids to Rainbow Gardens S. bank. Downloaded data and shutdown DTS. Extracted cable from reach on spare spool.

Performed maintenance check on DTS at Fire Station to Rainbow Gardens S. bank (download data and replace battery).

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:	SAFETY REQUIREMENTS HAVE BEEN MET
Daily health and safety briefing conducted.	**Yes** No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed
DTS; Fiber Optic Cable; Ice and Water Baths	02/26/2018	
Handheld GPS Trimble	02/26/2018	
FLIR	02/26/2018	
2 YSI 556	02/26/2018	
Splicing Kit	03/06/2018	

Material/Supplies Received at the Site:

NA.

Field Activities and Remarks Not Presented Above:

None.

Name: Kristen Durocher

Date: 03/08/2018

DAILY ACTIVITY REPORT

DATE:	March 9, 2018	Day:	S	M	T	W	Th	**F**	S
PROJECT NAME:	NERT Regional Groundwater RI DTS Fieldwork	Weather:						**Sunny**	
		Temp °F:	49 – 77 °F						
SITES / LOCATIONS:	Las Vegas Wash	Wind:					**Still Direction: ENE**		
		Humidity:					**Low**		

PERSONNEL ON-SITE	Employer	Job Title
C. Steve Howe	AECOM	DTS Lead & SSO/Hydrologist
Clare Murphy Hagan	AECOM	DTS Lead/ Environmental Scientist
Kevin Russel	AECOM	FO Support/Geologist
Joseph Capotrio	AECOM	FO Support/Scientist

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out

WORK COMPLETED

Performed maintenance check on DTS at Fire Station to Rainbow Gardens S. bank (download data and replace battery).

Mobed to deploy fiber optic cable along north bank between Rainbow Gardens and Three Kids Weir. DTS setup location will remain the same as the North bank deployment with the cable extending across the channel to the S. bank. Completed half of deployment distance and secure cable for the night. Cable path was recorded on handheld GPS during deployment.

Performed maintenance check on DTS at Fire Station to Rainbow Gardens S. bank (download data and replace battery).

The red annotation along the North bank on the below figure indicates the targeted approximate layout of the fiber optic cable for DTS data collection between Three Kids and Rainbow Garden Weirs.

Some erosion was caused to hillside with potential damage to one shrub near washed out road by J. Capotrio's personal vehicle. (Photo documented.)

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:	SAFETY

North

Daily health and safety briefing conducted.	**REQUIREMENTS HAVE BEEN MET** **Yes** No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed
DTS; Fiber Optic Cable; Ice and Water Baths	02/26/2018	
Handheld GPS Trimble	02/26/2018	
FLIR	02/26/2018	
2 YSI 556	02/26/2018	
Splicing Kit	03/06/2018	

Material/Supplies Received at the Site:

NA

Field Activities and Remarks Not Presented Above:

While one lunch J. Capotrio brought bring personal vehicle down washed out road. After conclusion of day's work J. Capotrio could not bring vehicle up washed out road and instead drove up a small hillside causing some soil erosion and light damage to one shrub. The damage was reported with photo documentation by S. Howe and the area was raked to remove signs of vehicle travel.

Name: Kristen Durocher

Date: 03/09/2018

DAILY ACTIVITY REPORT

DATE:	March 10, 2018	Day:	S	M	T	W	Th	F	**S**
PROJECT NAME:	NERT Regional Groundwater RI DTS Fieldwork	Weather:						**Overcast**	
		Temp °F:	64 – 59 °F						
SITES / LOCATIONS:	Las Vegas Wash	Wind:					**Still Direction: ENE**		
		Humidity:					**Low**		

PERSONNEL ON-SITE	Employer	Job Title
C. Steve Howe	AECOM	DTS Lead & SSO/Hydrologist
Clare Murphy Hagan	AECOM	DTS Lead/ Environmental Scientist
Kevin Russel	AECOM	FO Support/Geologist
Joseph Capotrio	AECOM	FO Support/Scientist

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out

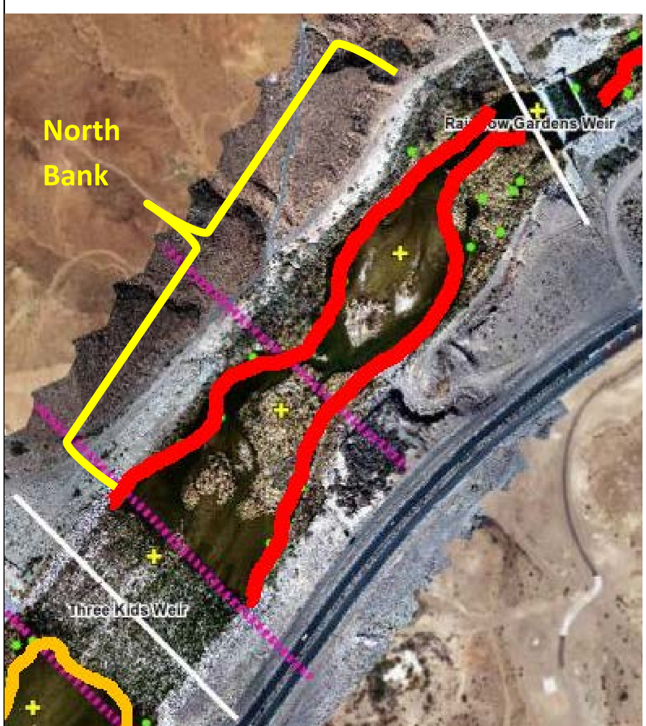
WORK COMPLETED

Performed maintenance check on DTS at Fire Station to Rainbow Gardens S. bank (download data and replace battery).

Finished cable deployment along north bank between Rainbow Gardens and Three Kids Weir. Cable path was recorded on handheld GPS during deployment. Set up a new configuration on DTS, setup calibration baths and begin data collection.

Performed maintenance check on DTS at Fire Station to Rainbow Gardens S. bank (download data and replace battery).

The red annotation along the North bank on the below figure indicates the targeted approximate layout of the fiber optic cable for DTS data collection between Three Kids and Rainbow Garden Weirs.



LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:	SAFETY REQUIREMENTS HAVE BEEN MET
Daily health and safety briefing conducted. (Prohibited off-road travel discussion added to tailgate.)	**Yes** No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed
DTS; Fiber Optic Cable; Ice and Water Baths	02/26/2018	
Handheld GPS Trimble	02/26/2018	
FLIR	02/26/2018	
2 YSI 556	02/26/2018	
Splicing Kit	03/06/2018	

Material/Supplies Received at the Site:

NA

Field Activities and Remarks Not Presented Above:

None.

Name: Kristen Durocher

Date: 03/10/2018

DAILY ACTIVITY REPORT

DATE:	March 11, 2018	Day:	**S**	M	T	W	Th	F	S
PROJECT NAME:	NERT Regional Groundwater RI DTS Fieldwork	Weather:	**Rain/Overcast**						
		Temp °F:	53 - 72 °F						
SITES / LOCATIONS:	Las Vegas Wash	Wind:	**Low**			**Direction:**	**NE**		
		Humidity:	**High**						

PERSONNEL ON-SITE	Employer	Job Title
C. Steve Howe	AECOM	DTS Lead & SSO/Hydrologist
Clare Murphy Hagan	AECOM	DTS Lead/ Environmental Scientist
Kevin Russel	AECOM	FO Support/Geologist
Joseph Capotrio	AECOM	FO Support/Scientist

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out

WORK COMPLETED

Performed maintenance check on DTS at Three Kids to Rainbow Gardens N. bank.

Downloaded data at Fire Station to Rainbow Gardens S. bank and shutdown DTS. Flows in AM were still too high to begin cable retrieval. Packed up DTS equipment and mobed to vehicles. Mobed job box to next deployment location above Lower Narrows Weir.

Began pulling cable from Rainbow Gardens Weir towards the Pedestrian Bridge. Stopped retrieval above Pedestrian Bridge rapids because conditions unfavorable for safe removal. Secured Cable for night.

Performed maintenance check on DTS at Three Kids to Rainbow Gardens N. bank (download data and swap out batteries).

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:	SAFETY REQUIREMENTS HAVE BEEN MET
Daily health and safety briefing conducted. (Overnight and AM precipitation causing high flow conditions. Will need to wait for flows to return to normal “high flow” conditions before entering Wash.)	**Yes** No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed
DTS; Fiber Optic Cable; Ice and Water Baths	02/26/2018	
Handheld GPS Trimble	02/26/2018	
FLIR	02/26/2018	
2 YSI 556	02/26/2018	
Splicing Kit	03/06/2018	

Material/Supplies Received at the Site:

NA

Field Activities and Remarks Not Presented Above:

None.

Name: Kristen Durocher

Date: 03/11/2018

DAILY ACTIVITY REPORT

DATE:	March 12, 2018	Day:	S	**M**	T	W	Th	F	S
PROJECT NAME:	NERT Regional Groundwater RI DTS Fieldwork	Weather:		**Sunny**					
		Temp °F:	49 – 76 °F						
SITES / LOCATIONS:	Las Vegas Wash	Wind:		**Low**		**Direction:**	**E**		
		Humidity:		**High/Moderate**					

PERSONNEL ON-SITE	Employer	Job Title
C. Steve Howe	AECOM	DTS Lead & SSO/Hydrologist
Clare Murphy Hagan	AECOM	DTS Lead/ Environmental Scientist
Joseph Capotrio	AECOM	FO Support/Scientist

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out

WORK COMPLETED

Performed maintenance check on DTS at Three Kids to Rainbow Gardens N. bank.

Finished extracting fiber optic cable from Pedestrian Bridge to Fire Station S. Bank. Mobed cable to next deployment area above Lower Narrows Weir. Began deploying cable along North bank from Lower Narrows toward Calico Weir. GPS points collected along cable path during deployment. Secured cable for the night.

The red annotation on the below figure indicates the targeted approximate layout of the fiber optic cable for DTS data collection between Lower Narrows and Calico Weirs.

Performed maintenance check on DTS at Three Kids to Rainbow Gardens N. bank (swap out batteries and download data)

Rental car starter issue at the end of the day. Enterprise sent road side assistance. Roadside assistance was unable to start vehicle. Rental car had to be towed back to hotel so equipment could be swapped into other vehicle.

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:	SAFETY REQUIREMENTS HAVE BEEN MET
Daily health and safety briefing conducted.	Yes No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed
DTS; Fiber Optic Cable; Ice and Water Baths	02/26/2018	
Handheld GPS Trimble	02/26/2018	
FLIR	02/26/2018	
2 YSI 556	02/26/2018	
Splicing Kit	03/06/2018	

Material/Supplies Received at the Site:

NA

Field Activities and Remarks Not Presented Above:

None.

Name: Kristen Durocher

Date: 03/12/2018

DAILY ACTIVITY REPORT

DATE:	March 13, 2018	Day:	S	M	**T**	W	Th	F	S
PROJECT NAME:	NERT Regional Groundwater RI DTS Fieldwork	Weather:			**Sunny**				
		Temp °F:	51 - 79 °F						
SITES / LOCATIONS:	Las Vegas Wash	Wind:			**Light/Moderate**	**Direction:**	**S**		
		Humidity:			**Moderate/High**				

PERSONNEL ON-SITE	Employer	Job Title
C. Steve Howe	AECOM	DTS Lead & SSO/Hydrologist
Clare Murphy Hagan	AECOM	DTS Lead/ Environmental Scientist
Kevin Russel	AECOM	FO Support/Geologist
Joseph Capotrio	AECOM	FO Support/Scientist

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out

WORK COMPLETED

Performed maintenance check on DTS at Three Kids to Rainbow Gardens N. bank.

Continued deploying cable along North bank from Lower Narrows toward Calico Weir. GPS points collected along cable path during deployment. Secured cable for the night.

The red annotation on the below figure indicates the targeted approximate layout of the fiber optic cable for DTS data collection between Lower Narrows and Calico Weirs.

Performed maintenance check on DTS at Three Kids to Rainbow Gardens N. bank (swap out batteries and download data)

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:	SAFETY REQUIREMENTS HAVE BEEN MET
Daily health and safety briefing conducted.	**Yes** No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed
DTS; Fiber Optic Cable; Ice and Water Baths	02/26/2018	
Handheld GPS Trimble	02/26/2018	
FLIR	02/26/2018	
2 YSI 556	02/26/2018	
Splicing Kit	03/06/2018	

Material/Supplies Received at the Site:

NA.

Field Activities and Remarks Not Presented Above:

None.

Name: Kristen Durocher Date: 03/13/2018

DAILY ACTIVITY REPORT

DATE:	March 14, 2018	Day:	S	M	T	**W**	Th	F	S
PROJECT NAME:	NERT Regional Groundwater RI DTS Fieldwork	Weather:				**Sunny**			
		Temp °F:	57 – 75 °F						
SITES / LOCATIONS:	Las Vegas Wash	Wind:				**Moderate**	**Direction: WSW**		
		Humidity:				**Low/Moderate**			

PERSONNEL ON-SITE	Employer	Job Title
C. Steve Howe	AECOM	DTS Lead & SSO/Hydrologist
Clare Murphy Hagan	AECOM	DTS Lead/ Environmental Scientist
Kevin Russel	AECOM	FO Support/Geologist
Joseph Capotrio	AECOM	FO Support/Scientist

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out

WORK COMPLETED

Performed maintenance check on DTS at Three Kids to Rainbow Gardens N. bank.

Finished deploying cable along North bank from Lower Narrows toward Calico Weir. GPS points collected along cable path during deployment. Set up DTS and calibration baths. Data collection began around 1730.

The red annotation on the below figure indicates the targeted approximate layout of the fiber optic cable for DTS data collection between Lower Narrows and Calico Weirs.

Performed maintenance check on DTS at Three Kids to Rainbow Gardens N. bank (swap out batteries and download data)

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:	SAFETY REQUIREMENTS HAVE BEEN MET
Daily health and safety briefing conducted.	

	Yes No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed
DTS; Fiber Optic Cable; Ice and Water Baths	02/26/2018	
Handheld GPS Trimble	02/26/2018	
FLIR	02/26/2018	
2 YSI 556	02/26/2018	
Splicing Kit	03/06/2018	

Material/Supplies Received at the Site:

NA

Field Activities and Remarks Not Presented Above:

None.

Name: Kristen Durocher

Date: 03/14/2018

DAILY ACTIVITY REPORT

DATE:	March 15, 2018	Day:	S	M	T	W	**Th**	F	S
PROJECT NAME:	NERT Regional Groundwater RI DTS Fieldwork	Weather:					**Overcast/Brief light Precip**		
		Temp °F:	48 – 67 °F						
SITES / LOCATIONS:	Las Vegas Wash	Wind:					**Moderate/High Direction: SW**		
		Humidity:					**Moderate**		

PERSONNEL ON-SITE	Employer	Job Title
C. Steve Howe	AECOM	DTS Lead & SSO/Hydrologist
Clare Murphy Hagan	AECOM	DTS Lead/ Environmental Scientist
Kevin Russel	AECOM	FO Support/Geologist
Joseph Capotrio	AECOM	FO Support/Scientist

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out

WORK COMPLETED

Performed maintenance check on DTS at Lower Narrows to Calico Weirs N and S banks (swap out batteries and download data).

Downloaded data and shutdown DTS at Three Kids to Rainbow Gardens N. bank. Extracted cable from Three Kids to Rainbow Gardens N. bank and packed up and mobed cable and DTS into vehicles.

Performed maintenance check on DTS at Lower Narrows to Calico Weirs N and S banks (swap out batteries and download data).

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:	SAFETY REQUIREMENTS HAVE BEEN MET
Daily health and safety briefing conducted.	**Yes** No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed
DTS; Fiber Optic Cable; Ice and Water Baths	02/26/2018	
Handheld GPS Trimble	02/26/2018	
FLIR	02/26/2018	
2 YSI 556	02/26/2018	
Splicing Kit	03/06/2018	

Material/Supplies Received at the Site:

NA

Field Activities and Remarks Not Presented Above:

None.

Name: Kristen Durocher

Date: 03/15/2018

DAILY ACTIVITY REPORT

DATE:	March 16, 2018	Day:	S	M	T	W	Th	**F**	S
PROJECT NAME:	NERT Regional Groundwater RI DTS Fieldwork	Weather:						**Sunny**	
		Temp °F:	42 – 73 °F						
SITES / LOCATIONS:	Las Vegas Wash	Wind:					**Moderate**	**Direction: SW**	
		Humidity:					**Low/Moderate**		

PERSONNEL ON-SITE	Employer	Job Title
C. Steve Howe	AECOM	DTS Lead & SSO/Hydrologist
Clare Murphy Hagan	AECOM	DTS Lead/ Environmental Scientist

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out

WORK COMPLETED

Performed maintenance check on DTS at Lower Narrows to Calico Weirs N and S banks (swap out batteries and download data).

Mobed DTS, fiber optic cable and additional equipment to NERT facility. Secured cable, DTS and calibration bath coolers to pallets for shipping.

Retrieved Job Box from Three Kids location and moved to NERT facility. Filled Job Box with equipment and gear. Shipped YSI's back to vendor and FLIR back to Rocky Hill office via Fedex.

Performed maintenance check on DTS at Lower Narrows to Calico Weirs N and S banks (swap out batteries and download data).

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:	SAFETY REQUIREMENTS HAVE BEEN MET
Daily health and safety briefing conducted.	**Yes** No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed
DTS; Fiber Optic Cable; Ice and Water Baths	02/26/2018	
Handheld GPS Trimble	02/26/2018	
FLIR	02/26/2018	03/16/2018
2 YSI 556	02/26/2018	03/16/2018
Splicing Kit	03/06/2018	

Material/Supplies Received at the Site:

NA.

Field Activities and Remarks Not Presented Above:

None.

Name: Kristen Durocher

Date: 03/16/2018

DAILY ACTIVITY REPORT

DATE:	March 17, 2018	Day:	S	M	T	W	Th	F	**S**	
PROJECT NAME:	NERT Regional Groundwater RI DTS Fieldwork	Weather:						Sunny		
		Temp °F:	50 – 62 °F							
SITES / LOCATIONS:	Las Vegas Wash	Wind:					**Light/Moderate Direction: SW**			
		Humidity:					**Low**			

PERSONNEL ON-SITE	Employer	Job Title
C. Steve Howe	AECOM	DTS Lead & SSO/Hydrologist
Clare Murphy Hagan	AECOM	DTS Lead/ Environmental Scientist

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out

WORK COMPLETED

Performed maintenance check on DTS at Lower Narrows to Calico Weirs N and S banks (swap out batteries and download data). Performed reconnaissance of area for add-on reach between Lower Narrows and Homestead Weirs.

Shipped additional gear back to offices. Paperwork.

Performed maintenance check on DTS at Lower Narrows to Calico Weirs N and S banks (swap out batteries and download data).

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:	SAFETY REQUIREMENTS HAVE BEEN MET
Daily health and safety briefing conducted.	**Yes** No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed
DTS; Fiber Optic Cable; Ice and Water Baths	02/26/2018	
Handheld GPS Trimble	02/26/2018	
FLIR	02/26/2018	03/16/2018
2 YSI 556	02/26/2018	03/16/2018
Splicing Kit	03/06/2018	

Material/Supplies Received at the Site:

NA

Field Activities and Remarks Not Presented Above:

None.

Name: Kristen Durocher

Date: 03/17/2018

DAILY ACTIVITY REPORT

DATE:	March 18, 2018	Day:	**S**	M	T	W	Th	F	S
PROJECT NAME:	NERT Regional Groundwater RI DTS Fieldwork	Weather:	**Sunny**						
		Temp °F:	43 - 69 °F						
SITES / LOCATIONS:	Las Vegas Wash	Wind:	**Light**			**Direction:**	**W**		
		Humidity:	**Low**						

PERSONNEL ON-SITE	Employer	Job Title
C. Steve Howe	AECOM	DTS Lead & SSO/Hydrologist
Clare Murphy Hagan	AECOM	DTS Lead/ Environmental Scientist
Kevin Russel	AECOM	FO Support/Geologist

VISITORS ON-SITE	Employer	Purpose of Visit	Time In	Time Out

WORK COMPLETED

Downloaded data from DTS at Lower Narrows to Calico Weirs N and S banks and end data collection. Went over how to use/setup the DTS equipment with K. Russel and programed the next data configuration for Lower Narrows to Homestead Weir.

Extracted fiber optic cable from north and south banks of Lower Narrows to Calico Weirs and secured for deployment tomorrow.

Went over additional details with K. Russel including notes, NERT facility, and GPS needs.

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED:	SAFETY REQUIREMENTS HAVE BEEN MET
Daily health and safety briefing conducted.	**Yes** No

Equipment at the Site (includes Subcontractor supplied equipment):	Date Arrived	Date Removed
DTS; Fiber Optic Cable; Ice and Water Baths	02/26/2018	
Handheld GPS Trimble	02/26/2018	
FLIR	02/26/2018	03/16/2018
2 YSI 556	02/26/2018	03/16/2018
Splicing Kit	03/06/2018	

Material/Supplies Received at the Site:

NA.

Field Activities and Remarks Not Presented Above:

None.

Name: Kristen Durocher   Date: 03/18/2018

Appendix E

Daily Health and Safety Sheets

Americas

S3AM-209-FM5

Daily Tailgate Meeting

Job Location:	Las Vegas Wash	Date:	2/5/18
AECOM Site Supervisor:	C. Steve Howe	Person Conducting Tailgate Meeting:	C. Steve Howe
AECOM Site Supervisor Phone:	603 520 0169	AECOM Safety Officer Name & Phone:	603 520 0169

List activities to be performed today:	Thermal IR and visible light surveys

Muster Point:	NA	Spill Kit Location:	NA
First Aid Kit Location:	Field vehicles	Fire Extinguisher Location:	NA

Have all personnel reviewed and understand the site-specific safety plan?	☑ Yes ☐ No*
Are current Pre-Job Hazard Assessments in place for each of the tasks to be performed today and understood by all?	☑ Yes ☐ No*
Does each subcontractor have hazard assessments (e.g., THA, JSA, JHA) for their activities?	☑ Yes ☐ No* ☐ N/A
Are any required permits in place for the applicable tasks to be performed today and understood by all? Identify required permits and permit #s:	☑ Yes ☐ No* ☐ N/A
Have all members of the work team confirmed understanding of the work, hazards, and controls/ mitigation?	☑ Yes ☐ No*
Have work areas been properly cordoned-off to protect workers, site staff, and the public?	☑ Yes ☐ No* ☐ N/A
Have equipment checks been completed, documented, and reviewed?	☑ Yes ☐ No* ☐ N/A
Do all site workers understand injury/ intervention reporting requirements including immediately notifying the AECOM Site Supervisor of any injury near miss, unsafe condition or hazard observation?	☑ Yes ☐ No*

** if No, then work cannot be performed until corrective action is completed and documented.*

Topics covered in today's tailgate meeting:	Basic & Specific site safety heat, hydration, wildlife, public interface, hospital, buddy system Safety issues and controls working with drones Driving safety

Other Items Discussed Today:	Stop Work Authority & Obligation
Startup and dry run day	* All employees will stop the job any time anyone is concerned or uncertain about safety. * All employees will stop the job if anyone identifies a hazard or additional mitigation not recorded on the THA. * All employees will be alerted to any changes in personnel or conditions at the worksite. * All employees will stop the job and reassess a task, hazards, and mitigations, and then amend the THA as needed.

SITE WORKERS (including AECOM Contractors and Subcontractors) ... and control measures associated with each ...

* You have been involved in reviewing the THAs and understand the hazards and control measures associated with each task you are about to perform.
* You understand the permit to work requirements applicable to the work you are about to perform (if it includes permitted activities).
* You are aware that no tasks or work (that is not risk-assessed) is to be performed.
* You are aware of your authority and obligation to 'Stop Work'.

I arrived and departed fit for duty:

* You are physically and mentally fit for duty.
* You are not under the influence of any type of medication, drugs, or alcohol that could affect your ability to work safely.
* You are aware of your responsibility to immediately report any illness, injury (regardless of where or when it occurred), or fatigue issue you may have to the AECOM Supervisor.
* You signed-out uninjured unless you have otherwise informed the AECOM Supervisor.

Print Name & Company	Signature	Initials & Sign In Time	Initials & Sign Out Time
Nick Pryor AECOM	[signature]	In & Fit 1100	Out & Fit 1600
Clare Murphy-Hagan	[signature]	In & Fit 0800	Out & Fit 1600
Gabriel Knighes	[signature]	In & Fit 0800	Out & Fit 1600
Ty Mayes	[signature]	In & Fit 1000	Out & Fit 1600
Alonso Morales	Alonso Morales	In & Fit 1000	Out & Fit 1600
		In & Fit	Out & Fit

(Attach additional Site Worker sign-in/out sheets if needed)

SITE VISITOR / SITE REPRESENTATIVE

Name	Company Name	Arrival Time	Departure Time	Signature

To be completed once activities for the day have been concluded:		
Were there any Incidents, Near Misses or Observations?	☒ ~~Yes~~ CSH ☒ No	If yes, details:
Were there any 'Stop Work' interventions?	☐ Yes ☒ No	If yes, details:
Were there any areas for improvement noted?	☐ Yes ☒ No	If yes, details:
At the conclusion of the day, the job site is being left in a safe condition and there were no reports of injury or first aid.	☒ Yes ☐ No	AECOM Supervisor Signature: [signature]

Daily Tailgate Meeting

Job Location:	Las Vegas Wash	Date:	2/6/18
AECOM Site Supervisor:	C. Steve Howe	Person Conducting Tailgate Meeting:	C. Steve Howe
AECOM Site Supervisor Phone:	603-520-0169	AECOM Safety Officer Name & Phone:	603-520-0169

List activities to be performed today:	TIR and photo surveys

Muster Point:	NA	Spill Kit Location:	NA
First Aid Kit Location:	in field vehicles	Fire Extinguisher Location:	N/A

Have all personnel reviewed and understand the site-specific safety plan?	☑ Yes ☐ No*
Are current Pre-Job Hazard Assessments in place for each of the tasks to be performed today and understood by all?	☑ Yes ☐ No*
Does each subcontractor have hazard assessments (e.g., THA, JSA, JHA) for their activities?	☑ Yes ☐ No* ☐ N/A
Are any required permits in place for the applicable tasks to be performed today and understood by all? Identify required permits and permit #s:	☑ Yes ☐ No* ☐ N/A
Have all members of the work team confirmed understanding of the work, hazards, and controls/ mitigation?	☑ Yes ☐ No*
Have work areas been properly cordoned-off to protect workers, site staff, and the public?	☑ Yes ☐ No* ☐ N/A
Have equipment checks been completed, documented, and reviewed?	☑ Yes ☐ No* ☐ N/A
Do all site workers understand injury/ intervention reporting requirements including immediately notifying the AECOM Site Supervisor of any injury near miss, unsafe condition or hazard observation?	☑ Yes ☐ No*

** if No, then work cannot be performed until corrective action is completed and documented.*

Topics covered in today's tailgate meeting:	Heat, hydration and sun protection Slips trips and falls Working on and near construction areas

Other Items Discussed Today:	Stop Work Authority & Obligation
	* All employees will stop the job any time anyone is concerned or uncertain about safety. * All employees will stop the job if anyone identifies a hazard or additional mitigation not recorded on the THA. * All employees will be alerted to any changes in personnel or conditions at the worksite. * All employees will stop the job and reassess a task, hazards, and mitigations, and then amend the THA as needed.

AECOM

E WORKERS (including AECOM Contractors and Subcontractors): By signing here, you are stating the following:
u have been involved in reviewing the THAs and understand the hazards and control measures associated with each task you are about to orm.
u understand the permit to work requirements applicable to the work you are about to perform (if it includes permitted activities).
u are aware that no tasks or work (that is not risk-assessed) is to be performed.
u are aware of your authority and obligation to 'Stop Work'.
rived and departed fit for duty:
u are physically and mentally fit for duty.
u are not under the influence of any type of medication, drugs, or alcohol that could affect your ability to work safely.
u are aware of your responsibility to immediately report any illness, injury (regardless of where or when it occurred), or fatigue issue you may e to the AECOM Supervisor.
u signed-out uninjured unless you have otherwise informed the AECOM Supervisor.

Print Name & Company	Signature	Initials & Sign In Time	Initials & Sign Out Time
Nich Payor AECOM		In & Fit 0615	Out & Fit 0215
Mike Murphy-Hagan		In & Fit 0615	Out & Fit 0215
abriel Knizhas		In & Fit 0608	Out & Fit 1500
Ty Mayes		In & Fit 0608	Out & Fit 1500
Alonso Morales	Alonso Morales	In & Fit 0608	Out & Fit 1500
		In & Fit	Out & Fit

(Attach additional Site Worker sign-in/out sheets if needed)

ITE VISITOR / SITE REPRESENTATIVE

Name	Company Name	Arrival Time	Departure Time	Signature
arlton Parker	NDEP	620	811	
Alan Pineda	NDEP	715	1030	

o be completed once activities for the day have been concluded:

Were there any Incidents, Near Misses or Observations?	☐ Yes ☑ No	If yes, details:
Were there any 'Stop Work' interventions?	☐ Yes ☑ No	If yes, details:
Were there any areas for improvement noted?	☑ Yes ☐ No	If yes, details: Wading Sticks for WQ team
At the conclusion of the day, the job site is being left in a safe condition and there were no reports of injury or first aid.	☑ Yes ☐ No	AECOM Supervisor Signature:

icas

ly Tailgate Meeting

S3AM-209-FM5

ocation:	Las Vegas Wash	Date:	2/7/18
M Site rvisor:	C. Steve Howe	Person Conducting Tailgate Meeting:	C. Steve Howe
M Site rvisor Phone:	603-520-0169	AECOM Safety Officer Name & Phone:	603-520-0169

ctivities to be performed :	TIR and photo surveys

er Point:	NA	Spill Kit Location:	NA
Aid Kit Location:	Field vehicles	Fire Extinguisher Location:	NA

e all personnel reviewed and understand the site-specific safety plan?	☑ Yes ☐ No*
current Pre-Job Hazard Assessments in place for each of the tasks to be performed today and erstood by all?	☑ Yes ☐ No*
s each subcontractor have hazard assessments (e.g., THA, JSA, JHA) for their activities?	☑ Yes ☐ No* ☐ N/A
any required permits in place for the applicable tasks to be performed today and understood by all? tify required permits and permit #s:	☑ Yes ☐ No* ☐ N/A
e all members of the work team confirmed understanding of the work, hazards, and controls/ gation?	☑ Yes ☐ No*
ve work areas been properly cordoned-off to protect workers, site staff, and the public?	☑ Yes ☐ No* ☐ N/A
ve equipment checks been completed, documented, and reviewed?	☑ Yes ☐ No* ☐ N/A
all site workers understand injury/ intervention reporting requirements including immediately ifying the AECOM Site Supervisor of any injury near miss, unsafe condition or hazard observation?	☑ Yes ☐ No*

** if No, then work cannot be performed until corrective action is completed and documented.*

pics covered oday's tailgate eting:	Heat, hydration, sun protection slips, trips, falls AND footing in soft, saturated materials bike traffic along adjacent paths

her Items Discussed Today:	Stop Work Authority & Obligation
ppropriate dialoge with public	* All employees will stop the job any time anyone is concerned or uncertain about safety. * All employees will stop the job if anyone identifies a hazard or additional mitigation not recorded on the THA. * All employees will be alerted to any changes in personnel or conditions at the worksite. * All employees will stop the job and reassess a task, hazards, and mitigations, and then amend the THA as needed.

RKERS (including AECOM Contractors and Subcontractors): By signing here, you are stating the following:

been involved in reviewing the THAs and understand the hazards and control measures associated with each task you are about to

erstand the permit to work requirements applicable to the work you are about to perform (if it includes permitted activities).
aware that no tasks or work (that is not risk-assessed) is to be performed.
aware of your authority and obligation to 'Stop Work'.

and departed fit for duty:

physically and mentally fit for duty.
not under the influence of any type of medication, drugs, or alcohol that could affect your ability to work safely.
aware of your responsibility to immediately report any illness, injury (regardless of where or when it occurred), or fatigue issue you may
he AECOM Supervisor.
gned-out uninjured unless you have otherwise informed the AECOM Supervisor.

Print Name & Company	Signature	Initials & Sign In Time	Initials & Sign Out Time
are Murphy-Hogan	[signature]	In & Fit 0630	Out & Fit 1430
Gabriel Knight	[signature]	In & Fit 0605	Out & Fit 1430
Julie Pryor AECOM	[signature]	In & Fit 0630	Out & Fit 1615
Moyes AECOM	[signature]	In & Fit 0605	Out & Fit 1615
Alonso Morales	Alonso Morales	In & Fit 0605	Out & Fit 1615
		In & Fit	Out & Fit

(Attach additional Site Worker sign-in/out sheets if needed)

SITE VISITOR / SITE REPRESENTATIVE

Name	Company Name	Arrival Time	Departure Time	Signature
C. Parker A. Pineda	N DEP	620/720	920	
J.D. Dotchin	NDEP	700	920	
Grant Evanson	NDEP	715	920	
Chad Schoop	NDEP	715	920	

To be completed once activities for the day have been concluded:		
Were there any Incidents, Near Misses or Observations?	☐ Yes ☑ No	If yes, details:
Were there any 'Stop Work' interventions?	☐ Yes ☑ No	If yes, details:
Were there any areas for improvement noted?	☐ Yes ☑ No	If yes, details:
At the conclusion of the day, the job site is being left in a safe condition and there were no reports of injury or first aid.	☑ Yes ☐ No	AECOM Supervisor Signature: [signature]

cas

S3/

y Tailgate Meeting

ocation:	Las Vegas Wash	Date:	2/8/18
OM Site rvisor:	C. Steve Howe	Person Conducting Tailgate Meeting:	C. Steve H
OM Site ervisor Phone:	603-520-0169	AECOM Safety Officer Name & Phone:	603-520-(

activities to be performed ay:	TIR & photo surveys with dron

uster Point:	NA	Spill Kit Location:	NA
rst Aid Kit Location:	in vehicles	Fire Extinguisher Location:	NA

Have all personnel reviewed and understand the site-specific safety plan?	☑ Yes ☐ No*
Are current Pre-Job Hazard Assessments in place for each of the tasks to be performed today and understood by all?	☑ Yes ☐ No*
Does each subcontractor have hazard assessments (e.g., THA, JSA, JHA) for their activities?	☑ Yes ☐ No*
Are any required permits in place for the applicable tasks to be performed today and understood by all? Identify required permits and permit #s:	☑ Yes ☐ No*
Have all members of the work team confirmed understanding of the work, hazards, and controls/ mitigation?	☑ Yes ☐ No*
Have work areas been properly cordoned-off to protect workers, site staff, and the public?	☑ Yes ☐ No*
Have equipment checks been completed, documented, and reviewed?	☑ Yes ☐ No*
Do all site workers understand injury/ intervention reporting requirements including immediately notifying the AECOM Site Supervisor of any injury near miss, unsafe condition or hazard observation?	☑ Yes ☐ No*

** if No, then work cannot be performed until corrective action is completed and documented.*

Topics covered in today's tailgate meeting:	Construction & civilian (foot & bike) traffic Heat, hydration, sun protection Eating throughout big field days

Other Items Discussed Today:	**Stop Work Authority & Obligation**
	* All employees will stop the job any time anyone is concerned or uncertain about safety. * All employees will stop the job if anyone identifies a hazard or additional mitigation not recorded on the TH * All employees will be alerted to any changes in personnel or conditions at the worksite. * All employees will stop the job and reassess a task, hazards, and mitigations, and then amend the THA as needed.

ERS (including AECOM Contractors and Subcontractors): By signing here, you are stating the following:
en involved in reviewing the THAs and understand the hazards and control measures associated with each task you are about to

and the permit to work requirements applicable to the work you are about to perform (if it includes permitted activities).
are that no tasks or work (that is not risk-assessed) is to be performed.
are of your authority and obligation to 'Stop Work'.

nd departed fit for duty:

ysically and mentally fit for duty.
t under the influence of any type of medication, drugs, or alcohol that could affect your ability to work safely.
vare of your responsibility to immediately report any illness, injury (regardless of where or when it occurred), or fatigue issue you may
AECOM Supervisor.
d-out uninjured unless you have otherwise informed the AECOM Supervisor.

rint Name & Company	Signature	Initials & Sign In Time	Initials & Sign Out Time
e Murphy Heeper	[signature]	In & Fit 0615	Out & Fit 1530
Pryor AECOM	[signature]	In & Fit 0615	Out & Fit 1530
briel Knights	[signature]	In & Fit 0605	Out & Fit 1530
Moyers	[signature]	In & Fit 0605	Out & Fit 1530
onso Morales	Alonso Morales	In & Fit 0605	Out & Fit 1530
		In & Fit	Out & Fit

(Attach additional Site Worker sign-in/out sheets if needed)

E VISITOR / SITE REPRESENTATIVE

Name	Company Name	Arrival Time	Departure Time	Signature
arlton Parker	NDEP	6:25	0855	

To be completed once activities for the day have been concluded:		
Were there any Incidents, Near Misses or Observations?	☐ Yes ☑ No	If yes, details:
Were there any 'Stop Work' interventions?	☐ Yes ☑ No	If yes, details:
Were there any areas for improvement noted?	☐ Yes ☑ No	If yes, details:
At the conclusion of the day, the job site is being left in a safe condition and there were no reports of injury or first aid.	☑ Yes ☐ No	AECOM Supervisor Signature: [signature]

AECOM

Americas

Daily Tailgate Meeting

S3AM-209-FM5

Job Location:	Las Vegas Wash	Date:	2/9/18
AECOM Site Supervisor:	C. Steve Howe	Person Conducting Tailgate Meeting:	same
AECOM Site Supervisor Phone:	603-520-0169	AECOM Safety Officer Name & Phone:	same

List activities to be performed today:	TIR & RGB surveys

Muster Point:	NA	Spill Kit Location:	NA
First Aid Kit Location:	in field vehicles	Fire Extinguisher Location:	NA

Have all personnel reviewed and understand the site-specific safety plan?	☑ Yes ☐ No*
Are current Pre-Job Hazard Assessments in place for each of the tasks to be performed today and understood by all?	☑ Yes ☐ No*
Does each subcontractor have hazard assessments (e.g., THA, JSA, JHA) for their activities?	☑ Yes ☐ No* ☐ N/A
Are any required permits in place for the applicable tasks to be performed today and understood by all? Identify required permits and permit #s:	☑ Yes ☐ No* ☐ N/A
Have all members of the work team confirmed understanding of the work, hazards, and controls/ mitigation?	☑ Yes ☐ No*
Have work areas been properly cordoned-off to protect workers, site staff, and the public?	☑ Yes ☐ No* ☐ N/A
Have equipment checks been completed, documented, and reviewed?	☑ Yes ☐ No* ☐ N/A
Do all site workers understand injury/ intervention reporting requirements including immediately notifying the AECOM Site Supervisor of any injury near miss, unsafe condition or hazard observation?	☑ Yes ☐ No*

** if No, then work cannot be performed until corrective action is completed and documented.*

Topics covered in today's tailgate meeting:	Drone Safety Hydration, sun protection, Heat Communication between teams in different locations

Other Items Discussed Today:	Stop Work Authority & Obligation
	* All employees will stop the job any time anyone is concerned or uncertain about safety. * All employees will stop the job if anyone identifies a hazard or additional mitigation not recorded on the THA. * All employees will be alerted to any changes in personnel or conditions at the worksite. * All employees will stop the job and reassess a task, hazards, and mitigations, and then amend the THA as needed.

SITE WORKERS (including AECOM Contractors and Subcontractors): By signing here, you are stating the following:
* You have been involved in reviewing the THAs and understand the hazards and control measures associated with each task you are about to perform.
* You understand the permit to work requirements applicable to the work you are about to perform (if it includes permitted activities).
* You are aware that no tasks or work (that is not risk-assessed) is to be performed.
* You are aware of your authority and obligation to 'Stop Work'.

I arrived and departed fit for duty:
* You are physically and mentally fit for duty.
* You are not under the influence of any type of medication, drugs, or alcohol that could affect your ability to work safely.
* You are aware of your responsibility to immediately report any illness, injury (regardless of where or when it occurred), or fatigue issue you may have to the AECOM Supervisor.
* You signed-out uninjured unless you have otherwise informed the AECOM Supervisor.

Print Name & Company	Signature	Initials & Sign In Time	Initials & Sign Out Time
Ty Moyers AECOM	[signature]	In & Fit 0600	Out & Fit 1345
Gabriel Knight	[signature]	In & Fit 0600	Out & Fit 1345
Clare Murphy-Fagan	[signature]	In & Fit 0600	Out & Fit 1345
C Steve Hane	[signature]	In & Fit 0620	Out & Fit 1530
Alonso Morales	Alonso Morales	In & Fit 0620	Out & Fit 1530
Nick Pryr	[signature]	In & Fit 0620	Out & Fit 1530

(Attach additional Site Worker sign-in/out sheets if needed)

SITE VISITOR / SITE REPRESENTATIVE

Name	Company Name	Arrival Time	Departure Time	Signature
Carlton Parker	NDEP	0600	0837	
Alex Pineda	NDEP	0745	0837	
Wenquan Dong	NDEP	0745	0837	

To be completed once activities for the day have been concluded:

Were there any Incidents, Near Misses or Observations?	☐ Yes ☑ No	If yes, details:
Were there any 'Stop Work' interventions?	☐ Yes ☑ No	If yes, details:
Were there any areas for improvement noted?	☐ Yes ☑ No	If yes, details:
At the conclusion of the day, the job site is being left in a safe condition and there were no reports of injury or first aid.	☑ Yes ☐ No	AECOM Supervisor Signature: [signature]

AECOM

Americas

Daily Tailgate Meeting

S3AM-209-FM5

Job Location:	Las Vegas Wash	Date:	2/10/18
AECOM Site Supervisor:	C. Steve Horne	Person Conducting Tailgate Meeting:	C. Steve Horne
AECOM Site Supervisor Phone:	603-520-0169	AECOM Safety Officer Name & Phone:	603-520-0169
List activities to be performed today:	TIR		
Muster Point:	NA	Spill Kit Location:	NA
First Aid Kit Location:	field vehicles	Fire Extinguisher Location:	NA

Have all personnel reviewed and understand the site-specific safety plan?	☑ Yes ☐ No*
Are current Pre-Job Hazard Assessments in place for each of the tasks to be performed today and understood by all?	☑ Yes ☐ No*
Does each subcontractor have hazard assessments (e.g., THA, JSA, JHA) for their activities?	☑ Yes ☐ No* ☐ N/A
Are any required permits in place for the applicable tasks to be performed today and understood by all? Identify required permits and permit #s:	☑ Yes ☐ No* ☐ N/A
Have all members of the work team confirmed understanding of the work, hazards, and controls/ mitigation?	☑ Yes ☐ No*
Have work areas been properly cordoned-off to protect workers, site staff, and the public?	☑ Yes ☐ No* ☐ N/A
Have equipment checks been completed, documented, and reviewed?	☑ Yes ☐ No* ☐ N/A
Do all site workers understand injury/ intervention reporting requirements including immediately notifying the AECOM Site Supervisor of any injury near miss, unsafe condition or hazard observation?	☑ Yes ☐ No*

* *if No, then work cannot be performed until corrective action is completed and documented.*

Topics covered in today's tailgate meeting:	Last day complacency review of general & work specific safety slips trips falls drones Saturday work - potential for recreational visitors

Other Items Discussed Today:	Stop Work Authority & Obligation
Appropriate discussion ~~today~~ points with curious civilians	* All employees will stop the job any time anyone is concerned or uncertain about safety. * All employees will stop the job if anyone identifies a hazard or additional mitigation not recorded on the THA. * All employees will be alerted to any changes in personnel or conditions at the worksite. * All employees will stop the job and reassess a task, hazards, and mitigations, and then amend the THA as needed.

AECOM

SITE WORKERS (including AECOM Contractors and Subcontractors): By signing here, you are stating the following: * You have been involved in reviewing the THAs and understand the hazards and control measures associated with each task you are about to perform. * You understand the permit to work requirements applicable to the work you are about to perform (if it includes permitted activities). * You are aware that no tasks or work (that is not risk-assessed) is to be performed. * You are aware of your authority and obligation to 'Stop Work'. **I arrived and departed fit for duty:** * You are physically and mentally fit for duty. * You are not under the influence of any type of medication, drugs, or alcohol that could affect your ability to work safely. * You are aware of your responsibility to immediately report any illness, injury (regardless of where or when it occurred), or fatigue issue you may have to the AECOM Supervisor. * You signed-out uninjured unless you have otherwise informed the AECOM Supervisor.			
Print Name & Company	**Signature**	**Initials & Sign In Time**	**Initials & Sign Out Time**
AECOM Ty Moyers	[signature]	In & Fit 0600	Out & Fit 0940
Alonso Morales	Alonso Morales	In & Fit 0600	Out & Fit 0940
Gabriel Knight	[signature]	In & Fit 0615	Out & Fit 0940
Clare Murphy Hogan	[signature]	In & Fit 0625	Out & Fit 0940
Nick [illegible]	[signature]	In & Fit 0625	Out & Fit 0940
		In & Fit	Out & Fit

(Attach additional Site Worker sign-in/out sheets if needed)

SITE VISITOR / SITE REPRESENTATIVE				
Name	**Company Name**	**Arrival Time**	**Departure Time**	**Signature**
Carlton Parker	NDEP	645	750	
Kit Parker	wife	645	750	

To be completed once activities for the day have been concluded:		
Were there any Incidents, Near Misses or Observations?	☐ Yes ☑ No	If yes, details:
Were there any 'Stop Work' interventions?	☐ Yes ☑ No	If yes, details:
Were there any areas for improvement noted?	☐ Yes ☑ No	If yes, details:
At the conclusion of the day, the job site is being left in a safe condition and there were no reports of injury or first aid.	☑ Yes ☐ No	AECOM Supervisor Signature: [signature]

Daily Float Plan

Name of vessel's operator:	Clare Murphy Hagon
Telephone Number:	503-318 5970
Name of Vessel:	Big Red
Registration No.:	
Description of Vessel: Type: Make: Color of Hull/Trim Most distinguishing identifiable feature:	Old Town Discovery AIS 18 000812 red canoe seat backs

Rafts/Dinghies: Number: __ Size: __ Color: __ NA

Radio/Communication Type: NA

Number of persons onboard: 2

Name:	Age:	Address & Telephone:
Clare Murphy Hagon		
Kevin Russel		

Engine Type: paddles H.P.:_______ Normal Fuel Supply (days):_______

Survival equipment on board: (check as appropriate)

- [x] Life Jackets
- [ ] Flares
- [ ] Smoke Signals
- [ ] Medical Kit
- [ ] EPIRB
- [x] Paddles
- [ ] Anchor
- [ ] Loran/GPS
- [ ] Life Ring

Trip: LVW around Upper Narrows Weir

Date & Time of Departure: 2/27/18 0900

Daily Float Plan

Name of vessel's operator:	C. Steve Howe
Telephone Number:	603-520-0169
Name of Vessel:	Mellow Yellow
Registration No.:	
Description of Vessel: We no nah Type: North Fork Make: Color of Hull/Trim AIS 14 R Most distinguishing identifiable feature: 031189	

Rafts/Dinghies: Number: __ Size: __ Color: __ NA

Radio/Communication Type: NA

Number of persons onboard: 2 or less

Name:	Age:	Address & Telephone:
C. Steve Howe	55	Barrington NH 603-5200169

Engine Type: paddles H.P.:______ Normal Fuel Supply (days):______

Survival equipment on board: (check as appropriate)

- [x] Life Jackets
- [ ] Flares
- [ ] Smoke Signals
- [ ] Medical Kit
- [ ] EPIRB
- [x] Paddles
- [ ] Anchor
- [ ] Loran/GPS
- [ ] Life Ring

Trip: LVW around Upper Narrows Weir

Date & Time of Departure: 2/27/18 0900

SITE WORKERS (including AECOM Contractors and Subcontractors): By signing here, you are stating the following:
* You have been involved in reviewing the THAs and understand the hazards and control measures associated with each task you are about to perform.
* You understand the permit to work requirements applicable to the work you are about to perform (if it includes permitted activities).
* You are aware that no tasks or work (that is not risk-assessed) is to be performed.
* You are aware of your authority and obligation to 'Stop Work'.

I arrived and departed fit for duty:
* You are physically and mentally fit for duty.
* You are not under the influence of any type of medication, drugs, or alcohol that could affect your ability to work safely.
* You are aware of your responsibility to immediately report any illness, injury (regardless of where or when it occurred), or fatigue issue you may have to the AECOM Supervisor.
* You signed-out uninjured unless you have otherwise informed the AECOM Supervisor.

Print Name & Company	Signature	Initials & Sign In Time	Initials & Sign Out Time
Gabriel Knight AECOM	[signature]	In & Fit 0745	Out & Fit 1915
RORY HENDERSON	[signature]	In & Fit 0745	Out & Fit 1915
Clare Murphy-Hagan	[signature]	In & Fit 0745	Out & Fit 1915
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit

(Attach additional Site Worker sign-in/out sheets if needed)

E VISITOR / SITE REPRESENTATIVE

Name	Company Name	Arrival Time	Departure Time	Signature

e completed once activities for the day have been concluded:

there any Incidents, Near Misses or Observations?	☐ Yes ☑ No	If yes, details:
there any 'Stop Work' interventions?	☐ Yes ☑ No	If yes, details:
here any areas for improvement noted?	☐ Yes ☑ No	If yes, details:
onclusion of the day, the job site is being left in a safe n and there were no reports of injury or first aid.	☑ Yes ☐ No	AECOM Supervisor Signature: [signature]

Americas

S3AM-209-FM5

Daily Tailgate Meeting

Job Location:	Las Vegas Wash	Date:	3/1/18
AECOM Site Supervisor:	C. Steve Howe	Person Conducting Tailgate Meeting:	Same
AECOM Site Supervisor Phone:	603-520-0169	AECOM Safety Officer Name & Phone:	same

List activities to be performed today:	Finish 3 Kids to Rainbow Weir & start DTS

Muster Point:	NA	Spill Kit Location:	NA
First Aid Kit Location:	Field vehicles	Fire Extinguisher Location:	NA

Have all personnel reviewed and understand the site-specific safety plan?	☑ Yes ☐ No*
Are current Pre-Job Hazard Assessments in place for each of the tasks to be performed today and understood by all?	☑ Yes ☐ No*
Does each subcontractor have hazard assessments (e.g., THA, JSA, JHA) for their activities?	~~☒ Yes~~ ☐ No* ☑ N/A CS
Are any required permits in place for the applicable tasks to be performed today and understood by all? Identify required permits and permit #s:	☐ Yes ☐ No* ☑ N/A
Have all members of the work team confirmed understanding of the work, hazards, and controls/ mitigation?	☑ Yes ☐ No*
Have work areas been properly cordoned-off to protect workers, site staff, and the public?	☐ Yes ☐ No* ☑ N/A
Have equipment checks been completed, documented, and reviewed?	☐ Yes ☐ No* ☑ N/A
Do all site workers understand injury/ intervention reporting requirements including immediately notifying the AECOM Site Supervisor of any injury near miss, unsafe condition or hazard observation?	☑ Yes ☐ No*

** if No, then work cannot be performed until corrective action is completed and documented.*

Topics covered in today's tailgate meeting:	Working with canoes and near water Revised THAs Slips Trips Falls Weather

Other Items Discussed Today:	Stop Work Authority & Obligation
	* All employees will stop the job any time anyone is concerned or uncertain about safety. * All employees will stop the job if anyone identifies a hazard or additional mitigation not recorded on the THA * All employees will be alerted to any changes in personnel or conditions at the worksite. * All employees will stop the job and reassess a task, hazards, and mitigations, and then amend the THA as needed.

Daily Float Plan

Name of vessel's operator:	Clare Murphy Hagen (red)	C. Steve Howe (yellow)
Telephone Number:		
Name of Vessel:	Big Red	Mellow Yellow
Registration No.:	AIS 18 00812	AIS14R 031189
Description of Vessel: Type: Make: Color of Hull/Trim	Old Town Discovery red canoe	We No Nah North Fork yellow canoe
Most distinguishing identifiable feature:		
Rafts/Dinghies: Number: __ Size: __ Color: __	NA	
Radio/Communication Type:	NA	
Number of persons onboard:	2	2

Name:	Age:	Address & Telephone:
Clare Murphy Hagen		C. Steve Howe
Armond Rodriguez		Kevin Russel

Engine Type:_________ H.P.:_______ Normal Fuel Supply (days):______ Na - paddles

Survival equipment on board: (check as appropriate)

- [x] Life Jackets
- [ ] Flares
- [ ] Smoke Signals
- [ ] Medical Kit
- [ ] EPIRB
- [x] Paddles
- [ ] Anchor
- [ ] Loran/GPS
- [ ] Life Ring

Trip: LVW near Upper Narrows Weir

Date & Time of Departure: 3/17/18 0900 | 3/18/18 0900

SITE WORKERS (including AECOM Contractors and Subcontractors): By signing here, you are stating ...
* You have been involved in reviewing the THAs and understand the hazards and control measures associated with each task you are about to perform.
* You understand the permit to work requirements applicable to the work you are about to perform (if it includes permitted activities).
* You are aware that no tasks or work (that is not risk-assessed) is to be performed.
* You are aware of your authority and obligation to 'Stop Work'.

I arrived and departed fit for duty:
* You are physically and mentally fit for duty.
* You are not under the influence of any type of medication, drugs, or alcohol that could affect your ability to work safely.
* You are aware of your responsibility to immediately report any illness, injury (regardless of where or when it occurred), or fatigue issue you may have to the AECOM Supervisor.
* You signed-out uninjured unless you have otherwise informed the AECOM Supervisor.

Print Name & Company	Signature	Initials & Sign In Time	Initials & Sign Out Time
Chloe Murphy-Hagan AECOM	[signature]	In & Fit 0800	Out & Fit
Armand Rodrigues GES	[signature]	In & Fit 0800	Out & Fit
Kevin Russell AECOM	[signature]	In & Fit 0800	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit

(Attach additional Site Worker sign-in/out sheets if needed)

SITE VISITOR / SITE REPRESENTATIVE

Name	Company Name	Arrival Time	Departure Time	Signature

To be completed once activities for the day have been concluded:		
Were there any Incidents, Near Misses or Observations?	☐ Yes ☐ No	If yes, details:
Were there any 'Stop Work' interventions?	☐ Yes ☐ No	If yes, details:
Were there any areas for improvement noted?	☐ Yes ☐ No	If yes, details:
At the conclusion of the day, the job site is being left in a safe condition and there were no reports of injury or first aid.	☐ Yes ☐ No	AECOM Supervisor Signature:

ricas

S3AM-209-FM5

ly Tailgate Meeting

ocation:	Las Vegas Wash	Date:	3/4/18
OM Site rvisor:	C. Steve Howe	Person Conducting Tailgate Meeting:	C. Steve Howe
OM Site rvisor Phone:	(603) - 520 - 0169	AECOM Safety Officer Name & Phone:	
ctivities to be performed y:	DTS cable run from Fire Station to Rainbow Weirs		
er Point:	Pedestrian Bridge	Spill Kit Location:	N/A
Aid Kit Location:	Field Vehicles	Fire Extinguisher Location:	NA

e all personnel reviewed and understand the site-specific safety plan?	☒ Yes ☐ No*
current Pre-Job Hazard Assessments in place for each of the tasks to be performed today and lerstood by all?	☒ Yes ☐ No*
es each subcontractor have hazard assessments (e.g., THA, JSA, JHA) for their activities?	☐ Yes ☐ No* ☒ N/A
any required permits in place for the applicable tasks to be performed today and understood by all? entify required permits and permit #s:	☐ Yes ☐ No* ☒ N/A
ve all members of the work team confirmed understanding of the work, hazards, and controls/ tigation?	☒ Yes ☐ No*
ave work areas been properly cordoned-off to protect workers, site staff, and the public?	☐ Yes ☐ No* ☒ N/A
ave equipment checks been completed, documented, and reviewed?	☐ Yes ☐ No* ☒ N/A
o all site workers understand injury/ intervention reporting requirements including immediately otifying the AECOM Site Supervisor of any injury near miss, unsafe condition or hazard observation?	☒ Yes ☐ No*

** If No, then work cannot be performed until corrective action is completed and documented.*

Topics covered n today's tailgate meeting:	Boat Safety Faster currents Slips Trips and Falls - shallow

Other Items Discussed Today:	Stop Work Authority & Obligation
Depth conditions necessitate waders. Highly variable depth and velocity may require getting into canoes with waders on for brief periods.	* All employees will stop the job any time anyone is concerned or uncertain about safety. * All employees will stop the job if anyone identifies a hazard or additional mitigation not recorded on the THA. * All employees will be alerted to any changes in personnel or conditions at the worksite. * All employees will stop the job and reassess a task, hazards, and mitigations, and then amend the THA as needed.

Daily Float Plan

Name of vessel's operator:	Clare Murphy Hagan
Telephone Number:	
Name of Vessel:	Mellow Yellow
Registration No.:	A15HR-031189
Description of Vessel: Type: Make: Color of Hull/Trim Most distinguishing identifiable feature:	We No Nah Northfork Yellow canoe

Rafts/Dinghies: Number: __ Size: __ Color: __ NA

Radio/Communication Type: NA

Number of persons onboard: 2 or less

Name:	Age:	Address & Telephone:
Clare Murphy Hagan		503 318 5970
Kevin Russell		

Engine Type:__________ H.P.:______ Normal Fuel Supply (days):______

Survival equipment on board: (check as appropriate)

- [x] Life Jackets
- [ ] Flares
- [ ] Smoke Signals
- [ ] Medical Kit
- [ ] EPIRB
- [ ] Paddles
- [x] Anchor
- [ ] Loran/GPS
- [ ] Life Ring

Trip: LVW: Pedestrian Bridge to Rainbow Garden

Date & Time of Departure: 3/5/18 0900

Daily Float Plan

Name of vessel's operator:	C Steve Howe
Telephone Number:	
Name of Vessel:	Big Red
Registration No.:	AI518 00812
Description of Vessel: Old Town Discovery Type: Make: Color of Hull/Trim	Red Canoe
Most distinguishing identifiable feature:	

Rafts/Dinghies: Number: __ Size: __ Color: __ NA

Radio/Communication Type: NA

Number of persons onboard: 2 or less

Name:	Age:	Address & Telephone:
C Steve Howe		603-520-0169
Joe Capatrio		

Engine Type:________ H.P.:______ Normal Fuel Supply (days):______

Survival equipment on board: (check as appropriate)

- [x] Life Jackets
- [ ] Flares
- [ ] Smoke Signals
- [x] Medical Kit
- [ ] EPIRB
- [ ] Paddles
- [ ] Anchor
- [ ] Loran/GPS
- [ ] Life Ring

Trip: LWW Pedestrian Bridge to Rainbow Gardens

Date & Time of Departure: 3/5/18 0900

Americas

Daily Tailgate Meeting

Job Location:	LVW Rainbow Gardens	Date:	3/5/18
AECOM Site Supervisor:	C Steve Howe	Person Conducting Tailgate Meeting:	C Steve Howe
AECOM Site Supervisor Phone:	603-520-0169	AECOM Safety Officer Name & Phone:	
List activities to be performed today:	Finish OTS cable run: Fire Stn to Rainbow		
Muster Point:	Pedestrian Bridge	Spill Kit Location:	NA
First Aid Kit Location:	Field vehicles	Fire Extinguisher Location:	NA

Have all personnel reviewed and understand the site-specific safety plan?	☒ Yes ☐ No*
Are current Pre-Job Hazard Assessments in place for each of the tasks to be performed today and understood by all?	☒ Yes ☐ No*
Does each subcontractor have hazard assessments (e.g., THA, JSA, JHA) for their activities?	☐ Yes ☐ No* ☒ N/A
Are any required permits in place for the applicable tasks to be performed today and understood by all? Identify required permits and permit #s:	☐ Yes ☐ No* ☒ N/A
Have all members of the work team confirmed understanding of the work, hazards, and controls/ mitigation?	☒ Yes ☐ No*
Have work areas been properly cordoned-off to protect workers, site staff, and the public?	☐ Yes ☐ No* ☒ N/A
Have equipment checks been completed, documented, and reviewed?	☐ Yes ☐ No* ☒ N/A
Do all site workers understand injury/ intervention reporting requirements including immediately notifying the AECOM Site Supervisor of any injury near miss, unsafe condition or hazard observation?	☒ Yes ☐ No*

* If No, then work cannot be performed until corrective action is completed and documented.

Topics covered in today's tailgate meeting:	Slips Trips Falls - changing current, depth & channel deposits Revised THAs Sunscreen, hydration

Other Items Discussed Today:	Stop Work Authority & Obligation
	* All employees will stop the job any time anyone is concerned or uncertain about safety. * All employees will stop the job if anyone identifies a hazard or additional mitigation not recorded on the THA. * All employees will be alerted to any changes in personnel or conditions at the worksite. * All employees will stop the job and reassess a task, hazards, and mitigations, and then amend the THA as needed.

SITE WORKERS (including AECOM Contractors and Subcontractors): By signing here, you are stating the following:

- You have been involved in reviewing the THAs and understand the hazards and control measures associated with each task you are about to perform.
- You understand the permit to work requirements applicable to the work you are about to perform (if it includes permitted activities).
- You are aware that no tasks or work (that is not risk-assessed) is to be performed.
- You are aware of your authority and obligation to 'Stop Work'.

I arrived and departed fit for duty:

- You are physically and mentally fit for duty.
- You are not under the influence of any type of medication, drugs, or alcohol that could affect your ability to work safely.
- You are aware of your responsibility to immediately report any illness, injury (regardless of where or when it occurred), or fatigue issue you may have to the AECOM Supervisor.
- You signed-out uninjured unless you have otherwise informed the AECOM Supervisor.

Print Name & Company	Signature	Initials & Sign In Time	Initials & Sign Out Time
Joseph Capelic AECOM		In & Fit 800	Out & Fit
Kevin Russell AECOM		In & Fit 8:00	Out & Fit
Clare Murphy Horgan		In & Fit 0800	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit

(Attach additional Site Worker sign-in/out sheets if needed)

SITE VISITOR / SITE REPRESENTATIVE

Name	Company Name	Arrival Time	Departure Time	Signature

To be completed once activities for the day have been concluded:		
Were there any Incidents, Near Misses or Observations?	☐ Yes ☐ No	If yes, details:
Were there any 'Stop Work' interventions?	☐ Yes ☐ No	If yes, details:
Were there any areas for improvement noted?	☐ Yes ☐ No	If yes, details:
At the conclusion of the day, the job site is being left in a safe condition and there were no reports of injury or first aid.	☐ Yes ☐ No	AECOM Supervisor Signature:

Daily Float Plan

Name of vessel's operator:	Clare Murphy Hagunna
Telephone Number:	503-318-5970
Name of Vessel:	Mellow Yellow
Registration No.:	A1514R -031189
Description of Vessel: Type: Make: Color of Hull/Trim Most distinguishing identifiable feature:	We No Nah Northfork Yellow Canoe

Rafts/Dinghies: Number: __ Size: __ Color: __ NA

Radio/Communication Type: NA

Number of persons onboard: 2 or less

Name:	Age:	Address & Telephone:
Clare Murphy Hagan		503-318-5970
Joe Caputo		720-376-8741

Engine Type: NA H.P.:______ Normal Fuel Supply (days):______

Survival equipment on board: (check as appropriate)

- [x] Life Jackets
- [ ] Flares
- [ ] Smoke Signals
- [x] Medical Kit
- [ ] EPIRB
- [x] Paddles
- [ ] Anchor
- [ ] Loran/GPS
- [ ] Life Ring

Trip: LVW Rainbow Gardens to 3 Kids

Date & Time of Departure: 3/19/18 0900

Daily Float Plan

Name of vessel's operator:	C. Steve Howe
Telephone Number:	603-520-0169
Name of Vessel:	Big Red
Registration No.:	A1518-00812
Description of Vessel: Type: Make: Color of Hull/Trim Most distinguishing identifiable feature:	Old Town Discovery red canoe
Rafts/Dinghies: Number: __ Size: __ Color: __ NA	
Radio/Communication Type: NA	
Number of persons onboard: 2 or less	

Name:	Age:	Address & Telephone:
C. Steve Howe		603-520-0169
Kevin Russell		714-272-1457

Engine Type:_________ H.P.:______ Normal Fuel Supply (days):_______

Survival equipment on board: (check as appropriate)

☐ Life Jackets	☐ Flares	☐ Smoke Signals
☐ Medical Kit	☐ EPIRB	☐ Paddles
☐ Anchor	☐ Loran/GPS	☐ Life Ring

Trip: LVW Rainbow Gardens to 3 Kids

Date & Time of Departure: 3/9/18 0900

Daily Tailgate Meeting

Job Location:	LVW Rainbow Garden	Date:	3/9/18
AECOM Site Supervisor:	C Steve Horne	Person Conducting Tailgate Meeting:	C. Steve Horne
AECOM Site Supervisor Phone:	603-520-0169	AECOM Safety Officer Name & Phone:	Sam
List activities to be performed today:	laying DTS 3 Kids to Rainbow North		
Muster Point:	Rainbow Garden	Spill Kit Location:	NA
First Aid Kit Location:	Add vehicles	Fire Extinguisher Location:	NA

Have all personnel reviewed and understand the site-specific safety plan?	☒ Yes ☐ No*
Are current Pre-Job Hazard Assessments in place for each of the tasks to be performed today and understood by all?	☒ Yes ☐ No*
Does each subcontractor have hazard assessments (e.g., THA, JSA, JHA) for their activities?	☐ Yes ☐ No* ☒ N/A
Are any required permits in place for the applicable tasks to be performed today and understood by all? Identify required permits and permit #s:	☐ Yes ☐ No* ☒ N/A
Have all members of the work team confirmed understanding of the work, hazards, and controls/ mitigation?	☒ Yes ☐ No*
Have work areas been properly cordoned-off to protect workers, site staff, and the public?	☐ Yes ☐ No* ☒ N/A
Have equipment checks been completed, documented, and reviewed?	☐ Yes ☐ No* ☒ N/A
Do all site workers understand injury/ intervention reporting requirements including immediately notifying the AECOM Site Supervisor of any injury near miss, unsafe condition or hazard observation?	☒ Yes ☐ No*

* if No, then work cannot be performed until corrective action is completed and documented.

Topics covered in today's tailgate meeting:	Slips Trips Falls Canoe safety Stop work Authority

Other Items Discussed Today:	Stop Work Authority & Obligation
	* All employees will stop the job any time anyone is concerned or uncertain about safety. * All employees will stop the job if anyone identifies a hazard or additional mitigation not recorded on the THA. * All employees will be alerted to any changes in personnel or conditions at the worksite. * All employees will stop the job and reassess a task, hazards, and mitigations, and then amend the THA as needed.

Daily Float Plan

Name of vessel's operator:	C Steve Howe
Telephone Number:	603 5200169
Name of Vessel:	Big Red
Registration No.:	A1518-00812
Description of Vessel: Type: Make: Color of Hull/Trim Most distinguishing identifiable feature:	Old Town Discovery red canoe
Rafts/Dinghies: Number: __ Size: __ Color: __	NA
Radio/Communication Type:	NA

Number of persons onboard: 2 or less

Name:	Age:	Address & Telephone:
C Steve Howe		603-520-0169
Kevin Russell		714-277 1457

Engine Type: NA H.P.:______ Normal Fuel Supply (days):______

Survival equipment on board: (check as appropriate)

- [x] Life Jackets
- [ ] Flares
- [ ] Smoke Signals
- [x] Medical Kit
- [ ] EPIRB
- [x] Paddles
- [x] Anchor
- [ ] Loran/GPS
- [ ] Life Ring

Trip: LWW ~~in out~~ around Rainbow Gardens Area

Date & Time of Departure: 3/10 0830

Daily Float Plan

Name of vessel's operator:	Clare Murphy Hagen
Telephone Number:	503-318-5970
Name of Vessel:	MellowYellow
Registration No.:	A15 14R-03118
Description of Vessel: Type: Make: Color of Hull/Trim Most distinguishing identifiable feature:	we NO Nah Northfolk Yellow Canoe

Rafts/Dinghies: Number: __ Size: __ Color: __ NA

Radio/Communication Type: NA

Number of persons onboard: 2 or less

Name:	Age:	Address & Telephone:
Clare Murphy Hagen		503-318-5970
Joe Caputo		720-376-8791

Engine Type: NA H.P.:______ Normal Fuel Supply (days):______

Survival equipment on board: (check as appropriate)

- [x] Life Jackets
- [ ] Flares
- [ ] Smoke Signals
- [x] Medical Kit
- [ ] EPIRB
- [x] Paddles
- [x] Anchor
- [ ] Loran/GPS
- [ ] Life Ring

Trip: LVW near Rainbow Gardens Weir

Date & Time of Departure:	3/10 0830

AECOM

Americas

S3AM-209-FM5

Daily Tailgate Meeting

Job Location:	LVW Rainbow Gardens	Date:	3/10
AECOM Site Supervisor:	C Steve Howe	Person Conducting Tailgate Meeting:	C Steve Howe
AECOM Site Supervisor Phone:	603-520-0169	AECOM Safety Officer Name & Phone:	603-520-0169

List activities to be performed today:	pulling/starting 3K-RGN, pulling RGNFS 5

Muster Point:	Rainbow Gardens	Spill Kit Location:	NA
First Aid Kit Location:	field vehicles (cars, cars)	Fire Extinguisher Location:	NA

Have all personnel reviewed and understand the site-specific safety plan?	☒ Yes ☐ No*
Are current Pre-Job Hazard Assessments in place for each of the tasks to be performed today and understood by all?	☒ Yes ☐ No*
Does each subcontractor have hazard assessments (e.g., THA, JSA, JHA) for their activities?	☐ Yes ☐ No* ☒ N/A
Are any required permits in place for the applicable tasks to be performed today and understood by all? Identify required permits and permit #s:	☐ Yes ☐ No* ☒ N/A
Have all members of the work team confirmed understanding of the work, hazards, and controls/ mitigation?	☒ Yes ☐ No*
Have work areas been properly cordoned-off to protect workers, site staff, and the public?	☐ Yes ☐ No* ☒ N/A
Have equipment checks been completed, documented, and reviewed?	☐ Yes ☐ No* ☒ N/A
Do all site workers understand injury/ intervention reporting requirements including immediately notifying the AECOM Site Supervisor of any injury near miss, unsafe condition or hazard observation?	☒ Yes ☐ No*

** if No, then work cannot be performed until corrective action is completed and documented.*

Topics covered in today's tailgate meeting:	Lifting heavy objects (canoes, batteries) boat safety slips trips and falls

Other Items Discussed Today:	Stop Work Authority & Obligation
Staying in established paths and roadways Being sensitive to vegetation & animals	• All employees will stop the job any time anyone is concerned or uncertain about safety. • All employees will stop the job if anyone identifies a hazard or additional mitigation not recorded on the THA. • All employees will be alerted to any changes in personnel or conditions at the worksite. • All employees will stop the job and reassess a task, hazards, and mitigations, and then amend the THA as needed.

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Americas

S3AM-209-FM5

Daily Tailgate Meeting

Job Location:	LVW Rainbow Gardens	Date:	3/10
AECOM Site Supervisor:	C. Steve Howe	Person Conducting Tailgate Meeting:	C. Steve Howe
AECOM Site Supervisor Phone:	603-520-0169	AECOM Safety Officer Name & Phone:	603-520-0169

List activities to be performed today:	pulling /starting 3K-RGN, pulling RGNFS 5		
Muster Point:	Rainbow Gardens	Spill Kit Location:	NA
First Aid Kit Location:	field vehicles (cars, cam)	Fire Extinguisher Location:	NA

Have all personnel reviewed and understand the site-specific safety plan?	☑ Yes ☐ No*
Are current Pre-Job Hazard Assessments in place for each of the tasks to be performed today and understood by all?	☑ Yes ☐ No*
Does each subcontractor have hazard assessments (e.g., THA, JSA, JHA) for their activities?	☐ Yes ☐ No* ☑ N/A
Are any required permits in place for the applicable tasks to be performed today and understood by all? Identify required permits and permit #s:	☐ Yes ☐ No* ☑ N/A
Have all members of the work team confirmed understanding of the work, hazards, and controls/ mitigation?	☑ Yes ☐ No*
Have work areas been properly cordoned-off to protect workers, site staff, and the public?	☐ Yes ☐ No* ☑ N/A
Have equipment checks been completed, documented, and reviewed?	☐ Yes ☐ No* ☑ N/A
Do all site workers understand injury/ intervention reporting requirements including immediately notifying the AECOM Site Supervisor of any injury near miss, unsafe condition or hazard observation?	☑ Yes ☐ No*

** if No, then work cannot be performed until corrective action is completed and documented.*

Topics covered in today's tailgate meeting:	Lifting heavy objects (canoes, batteries) boat safety slips trips and falls

Other Items Discussed Today:	Stop Work Authority & Obligation
Staying in established paths and roadways Being sensitive to vegetation & animals	* All employees will stop the job any time anyone is concerned or uncertain about safety. * All employees will stop the job if anyone identifies a hazard or additional mitigation not recorded on the THA. * All employees will be alerted to any changes in personnel or conditions at the worksite. * All employees will stop the job and reassess a task, hazards, and mitigations, and then amend the THA as needed.

AECOM

Americas

S3AM-209-FM5

Daily Tailgate Meeting

Job Location:	LVW Rainbow Gardens	Date:	3/10
AECOM Site Supervisor:	C. Steve Howe	Person Conducting Tailgate Meeting:	C. Steve Howe
AECOM Site Supervisor Phone:	603-520-0169	AECOM Safety Officer Name & Phone:	603-520-0169

List activities to be performed today:	pulling / starting 3K-RGN, pulling RGNFS 5		
Muster Point:	Rainbow Gardens	Spill Kit Location:	NA
First Aid Kit Location:	field vehicles (cars, canoes)	Fire Extinguisher Location:	NA

Have all personnel reviewed and understand the site-specific safety plan?	☒ Yes ☐ No*
Are current Pre-Job Hazard Assessments in place for each of the tasks to be performed today and understood by all?	☒ Yes ☐ No*
Does each subcontractor have hazard assessments (e.g., THA, JSA, JHA) for their activities?	☐ Yes ☐ No* ☒ N/A
Are any required permits in place for the applicable tasks to be performed today and understood by all? Identify required permits and permit #s:	☐ Yes ☐ No* ☒ N/A
Have all members of the work team confirmed understanding of the work, hazards, and controls/ mitigation?	☒ Yes ☐ No*
Have work areas been properly cordoned-off to protect workers, site staff, and the public?	☐ Yes ☐ No* ☒ N/A
Have equipment checks been completed, documented, and reviewed?	☐ Yes ☐ No* ☒ N/A
Do all site workers understand injury/ intervention reporting requirements including immediately notifying the AECOM Site Supervisor of any injury near miss, unsafe condition or hazard observation?	☒ Yes ☐ No*

** if No, then work cannot be performed until corrective action is completed and documented.*

Topics covered in today's tailgate meeting:	Lifting heavy objects (canoes, batteries) boat safety slips trips and falls

Other Items Discussed Today:	Stop Work Authority & Obligation
Staying in established paths and roadways Being sensitive to vegetation & animals	* All employees will stop the job any time anyone is concerned or uncertain about safety. * All employees will stop the job if anyone identifies a hazard or additional mitigation not recorded on the THA. * All employees will be alerted to any changes in personnel or conditions at the worksite. * All employees will stop the job and reassess a task, hazards, and mitigations, and then amend the THA as needed.

Daily Float Plan

Name of vessel's operator:	Clare Murphy Hagen
Telephone Number:	503-318-5970
Name of Vessel:	Mellow Yellow
Registration No.:	A1518R-031189
Description of Vessel: Type: Make: Color of Hull/Trim Most distinguishing identifiable feature:	We No Nah - North Fork Yellow Canoe

Rafts/Dinghies: Number: __ Size: __ Color: __ NA

Radio/Communication Type: NA

Number of persons onboard: 2 or less

Name:	Age:	Address & Telephone:
Clare Murphy Hagen		503-318-5970
Joe Caputo		720-376-8791

Engine Type: NA H.P.:______ Normal Fuel Supply (days):______

Survival equipment on board: (check as appropriate)

- ☑ Life Jackets
- ☑ Medical Kit
- ☑ Anchor
- ☐ Flares
- ☐ EPIRB
- ☐ Loran/GPS
- ☐ Smoke Signals
- ☑ Paddles
- ☐ Life Ring

Trip: LVW Rainbow Gardens towards Fire Station Weir

Date & Time of Departure: 3/11/18 1300

Daily Float Plan

Name of vessel's operator:	C. Steve Howe
Telephone Number:	603 520 0169
Name of Vessel:	Big Red
Registration No.:	A1518-00812
Description of Vessel: Type: Make: Color of Hull/Trim Most distinguishing identifiable feature:	Old Town Discovery red canoe

Rafts/Dinghies: Number: __ Size: __ Color: __ NA

Radio/Communication Type: NA

Number of persons onboard: 2 or less

Name:	Age:	Address & Telephone:
C. Steve Howe		603-520-0169
Kevin Russel		714-277-1457

Engine Type: NA H.P.:______ Normal Fuel Supply (days):______

Survival equipment on board: (check as appropriate)

- [x] Life Jackets
- [ ] Flares
- [ ] Smoke Signals
- [x] Medical Kit
- [ ] EPIRB
- [x] Paddles
- [x] Anchor
- [ ] Loran/GPS
- [ ] Life Ring

Trip: LVW - Rainbow Gardens towards Fire Station

Date & Time of Departure: 3/11/18 1300

Americas

Daily Tailgate Meeting

S3AM-209-FM5

Job Location:	Las Vegas Wash	Date:	3/11/18
AECOM Site Supervisor:	C. Steve Howe	Person Conducting Tailgate Meeting:	C. Steve Howe
AECOM Site Supervisor Phone:	603-520-0169	AECOM Safety Officer Name & Phone:	603-520-016

List activities to be performed today:	pulling DTS deployment from Rainbow towards Fre

Muster Point:	Rainbow Garden	Spill Kit Location:	NA
First Aid Kit Location:	field vehicles	Fire Extinguisher Location:	AA

Have all personnel reviewed and understand the site-specific safety plan?	☒ Yes ☐ No*
Are current Pre-Job Hazard Assessments in place for each of the tasks to be performed today and understood by all?	☒ Yes ☐ No*
Does each subcontractor have hazard assessments (e.g., THA, JSA, JHA) for their activities?	☐ Yes ☐ No* ☒ N/A
Are any required permits in place for the applicable tasks to be performed today and understood by all? Identify required permits and permit #s:	☐ Yes ☐ No* ☒ N/A
Have all members of the work team confirmed understanding of the work, hazards, and controls/ mitigation?	☒ Yes ☐ No*
Have work areas been properly cordoned-off to protect workers, site staff, and the public?	☐ Yes ☐ No* ☒ N/A
Have equipment checks been completed, documented, and reviewed?	☐ Yes ☐ No* ☒ N/A
Do all site workers understand injury/ intervention reporting requirements including immediately notifying the AECOM Site Supervisor of any injury near miss, unsafe condition or hazard observation?	☒ Yes ☐ No*

** if No, then work cannot be performed until corrective action is completed and documented.*

Topics covered in today's tailgate meeting:	Flash Floods - velocity, depth, turbidity waiting proper flow conditions Sunscreen General boat safety Stop work authority

Other Items Discussed Today:	Stop Work Authority & Obligation
	* All employees will stop the job any time anyone is concerned or uncertain about safety. * All employees will stop the job if anyone identifies a hazard or additional mitigation not recorded on the THA * All employees will be alerted to any changes in personnel or conditions at the worksite. * All employees will stop the job and reassess a task, hazards, and mitigations, and then amend the THA as needed.

Daily Float Plan

Name of vessel's operator:	Clare Murphy Hayes
Telephone Number:	503 318 5970
Name of Vessel:	Mellow Yellow
Registration No.:	A1514R-031189
Description of Vessel: Type: Make: Color of Hull/Trim Most distinguishing identifiable feature:	We no Nah Northfork Yellow Canoe

Rafts/Dinghies: Number: __ Size: __ Color: __ NA

Radio/Communication Type: NA

Number of persons onboard: 2 or less

Name:	Age:	Address & Telephone:
Clare Murphy Hayes		503-318-5970
Joe Capito		720-376-8791

Engine Type: NA H.P.:______ Normal Fuel Supply (days):______

Survival equipment on board: (check as appropriate)

- [x] Life Jackets
- [ ] Flares
- [ ] Smoke Signals
- [x] Medical Kit
- [ ] EPIRB
- [x] Paddles
- [x] Anchor
- [ ] Loran/GPS
- [ ] Life Ring

Trip: Low Pedestrian Bridge to Five Star Weir

Date & Time of Departure: 3/12/18 0830

Daily Float Plan

Name of vessel's operator:	C. Steve Howe
Telephone Number:	603-520-0169
Name of Vessel:	Big Red
Registration No.:	AI 518 00812
Description of Vessel: Type: Make: Color of Hull/Trim Most distinguishing identifiable feature:	Old Town Discover

Rafts/Dinghies: Number: __ Size: __ Color: __ NA

Radio/Communication Type: NA

Number of persons onboard: 2 or less

Name:	Age:	Address & Telephone:
C. Steve Howe		
~~CF~~ Joe Caputo		

Engine Type: NA H.P.:______ Normal Fuel Supply (days):______

Survival equipment on board: (check as appropriate)

- [x] Life Jackets
- [ ] Flares
- [ ] Smoke Signals
- [x] Medical Kit
- [ ] EPIRB
- [x] Paddles
- [x] Anchor
- [ ] Loran/GPS
- [ ] Life Ring

Trip: LVW Powerline Weir to Fire Stn Weir

Date & Time of Departure: 3/12/18 0830

AECOM

Americas

S3AM-209-FM5

Daily Tailgate Meeting

Job Location:	LVW	Date:	3/12/18
AECOM Site Supervisor:	C. Steve Home	Person Conducting Tailgate Meeting:	C Steve Home
AECOM Site Supervisor Phone:	603-520-0169	AECOM Safety Officer Name & Phone:	603-520-0169

List activities to be performed today:	DTS Extraction - RG to Fire Stn Weirs

Muster Point:	Pedestrian Bridge	Spill Kit Location:	NA
First Aid Kit Location:	Field vehicles (canoe & cars)	Fire Extinguisher Location:	NA

Have all personnel reviewed and understand the site-specific safety plan?	☑ Yes ☐ No*
Are current Pre-Job Hazard Assessments in place for each of the tasks to be performed today and understood by all?	☑ Yes ☐ No*
Does each subcontractor have hazard assessments (e.g., THA, JSA, JHA) for their activities?	☐ Yes ☐ No* ☑ N/A
Are any required permits in place for the applicable tasks to be performed today and understood by all? Identify required permits and permit #s:	☐ Yes ☐ No* ☑ N/A
Have all members of the work team confirmed understanding of the work, hazards, and controls/ mitigation?	☑ Yes ☐ No*
Have work areas been properly cordoned-off to protect workers, site staff, and the public?	☐ Yes ☐ No* ☑ N/A
Have equipment checks been completed, documented, and reviewed?	☐ Yes ☐ No* ☑ N/A
Do all site workers understand injury/ intervention reporting requirements including immediately notifying the AECOM Site Supervisor of any injury near miss, unsafe condition or hazard observation?	☑ Yes ☐ No*

** if No, then work cannot be performed until corrective action is completed and documented.*

Topics covered in today's tailgate meeting:	Slips trips falls lifting heavy objects boat/canoe safety

Other Items Discussed Today:	Stop Work Authority & Obligation
	* All employees will stop the job any time anyone is concerned or uncertain about safety. * All employees will stop the job if anyone identifies a hazard or additional mitigation not recorded on the THA. * All employees will be alerted to any changes in personnel or conditions at the worksite. * All employees will stop the job and reassess a task, hazards, and mitigations, and then amend the THA as needed.

Appendix F

TIR Imagery (DVD)

Appendix G

FODTS Calibration Records

Date Range:
02-Mar-2018 01:18:09
03-Mar-2018 10:02:54

Number of Traces:
395

Length of Fiber:
1859.29

	Z_1	Z_2	Z_1	Z_2	Tref
Ref. 1	103	108	833.5	838.6	tref 1
Ref. 2	84	88	814.3	818.3	tref 2
Ref. 3	1018	1022	1761.9	1766	tref 1
Val.	0	0	NaN	NaN	

Calibration Step Loss Data:
Step Loss:
Index Location: N/A
Fiber Distance: N/A

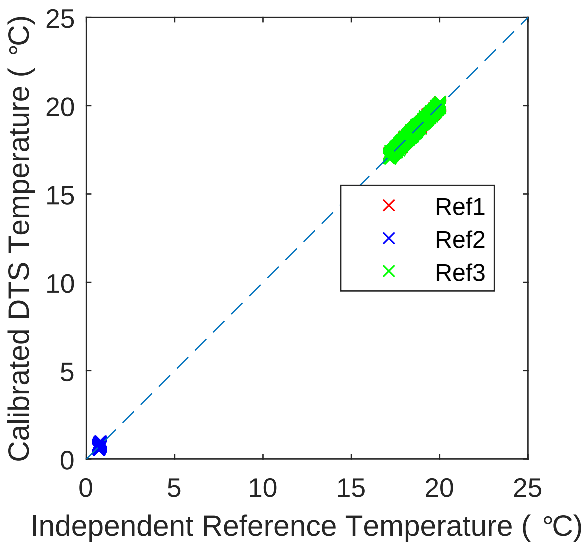
Equal Distance Temperature:
Index Location: N/A
Fiber Distance: N/A

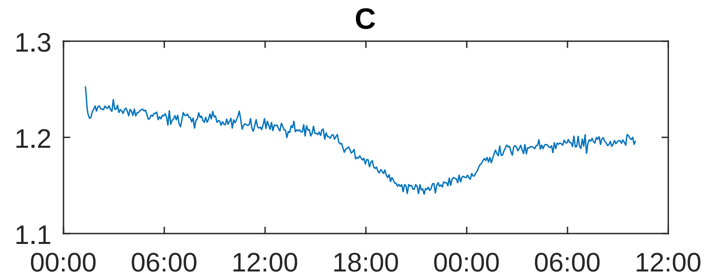
Calibration Results Summary:

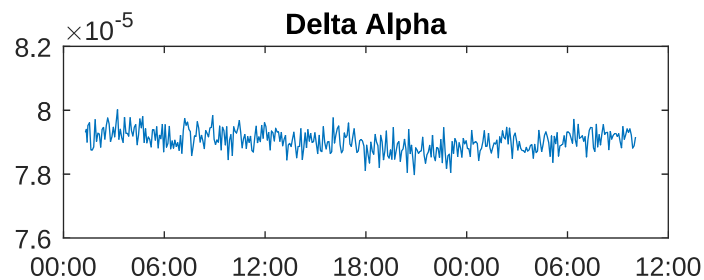
Calibration RMSE: 0.068
Calibration Bias: 0.000

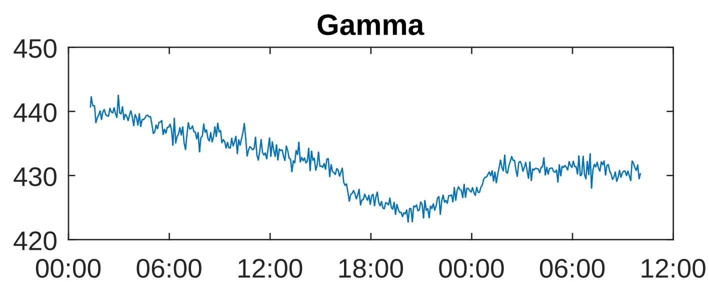
Validation RMSE: NaN
Validation Bias: NaN

	Mean	Min	Max
Ref. 1	0.059	0.016	0.144
Ref. 2	0.075	0.017	0.164
Ref. 3	0.062	0.012	0.131
Ref. Val.			









Date Range:
10-Mar-2018 23:35:38
15-Mar-2018 16:25:36

Number of Traces:
1352

Length of Fiber:
2180.92

	Z_1	Z_2	Z_1	Z_2	Tref
Ref. 1	86	92	499.7	505.8	tref 1
Ref. 2	107	113	521	527.1	tref 2
Ref. 3	1654	1661	2090.6	2097.7	tref 1
Val.	0	0	NaN	NaN	

Calibration Step Loss Data:
Step Loss:
Index Location: N/A
Fiber Distance: N/A

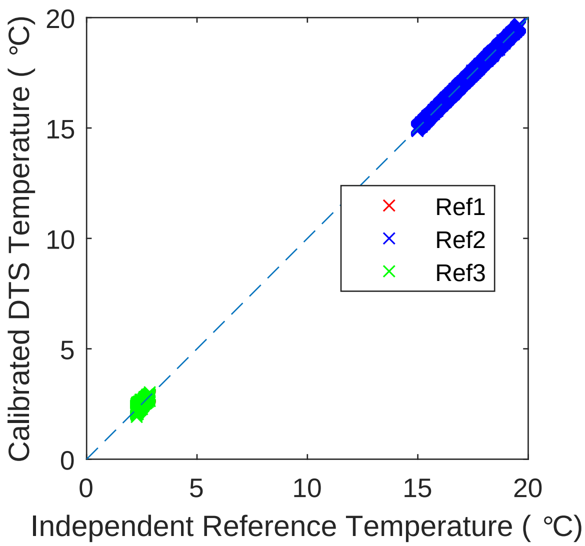
Equal Distance Temperature:
Index Location: N/A
Fiber Distance: N/A

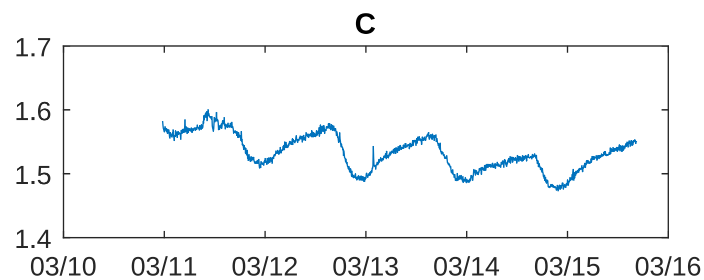
Calibration Results Summary:

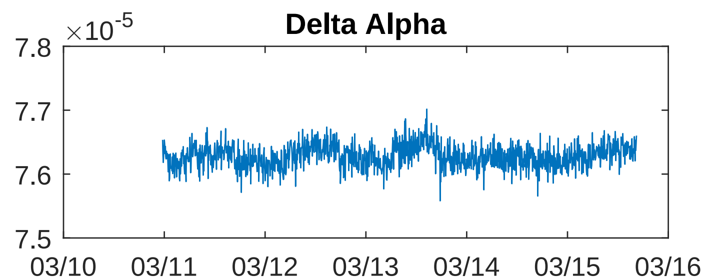
Calibration RMSE: 0.052
Calibration Bias: 0.000

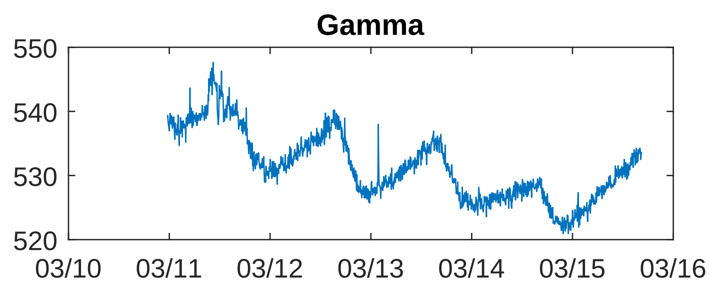
Validation RMSE: NaN
Validation Bias: NaN

	Mean	Min	Max
Ref. 1	0.034	0.006	0.068
Ref. 2	0.071	0.020	0.177
Ref. 3	0.035	0.008	0.083
Ref. Val.			









Date Range:
15-Mar-2018 00:22:36
18-Mar-2018 15:22:36

Number of Traces:
1043

Length of Fiber:
3099.83

	z_1	z_2	z_1	z_2	Tref
Ref. 1	26	33	966.1	973.2	tref 2
Ref. 2	48	54	988.5	994.5	tref 1
Ref. 3	2096	2102	3066.3	3072.4	tref 2
Val.	0	0	NaN	NaN	

Calibration Step Loss Data:
Step Loss:
Index Location: N/A
Fiber Distance: N/A

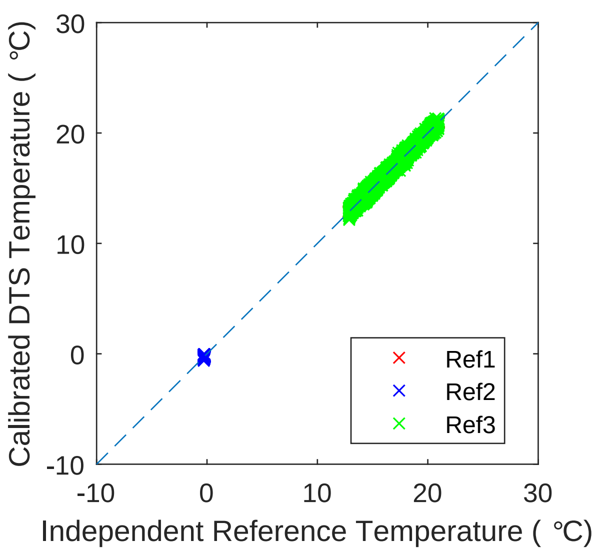
Equal Distance Temperature:
Index Location: N/A
Fiber Distance: N/A

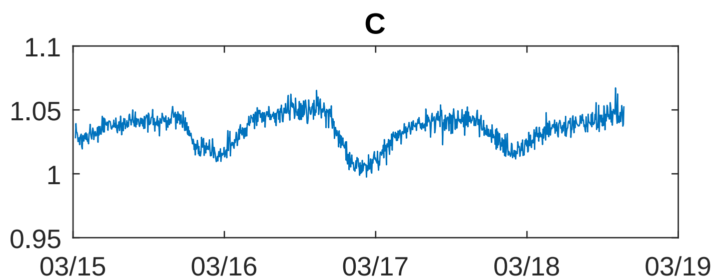
Calibration Results Summary:

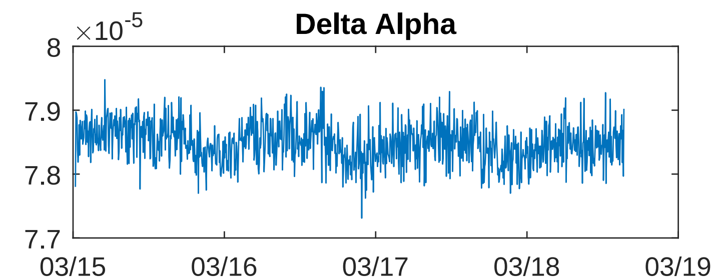
Calibration RMSE: 0.136
Calibration Bias: 0.000

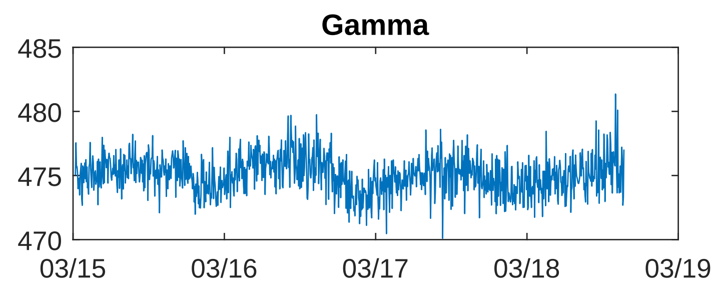
Validation RMSE: NaN
Validation Bias: NaN

	Mean	Min	Max
Ref. 1	0.069	0.022	0.149
Ref. 2	0.215	0.063	0.440
Ref. 3	0.067	0.017	0.167
Ref. Val.			









Date Range:
06-Mar-2018 01:22:32
08-Mar-2018 18:07:32

Number of Traces:
778

Length of Fiber:
2699.06

	Z_1	Z_2	Z_1	Z_2	Tref
Ref. 1	101	110	1402.4	1411.5	tref 2
Ref. 2	124	132	1425.7	1433.9	tref 1
Ref. 3	1309	1318	2628	2637.2	tref 2
Val.	0	0	NaN	NaN	

Calibration Step Loss Data:
Step Loss:
Index Location: N/A
Fiber Distance: N/A

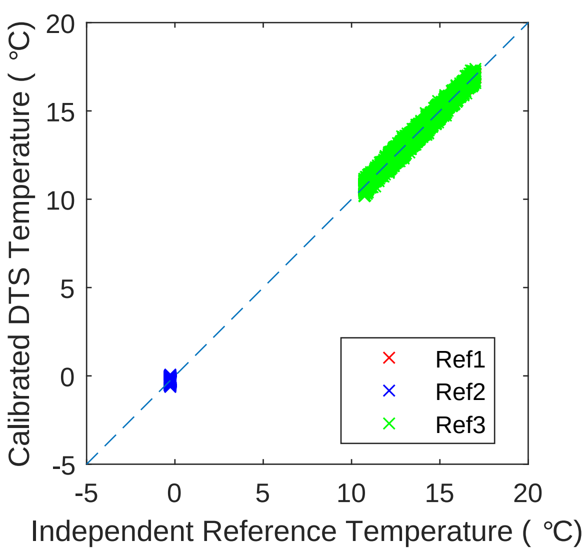
Equal Distance Temperature:
Index Location: N/A
Fiber Distance: N/A

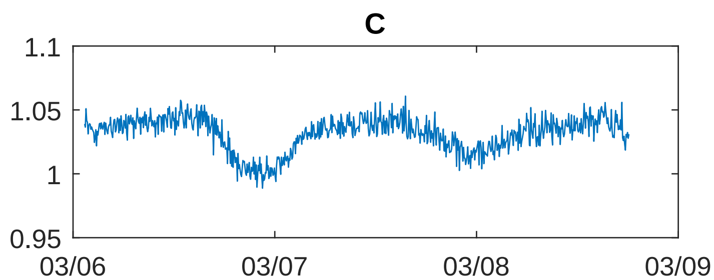
Calibration Results Summary:

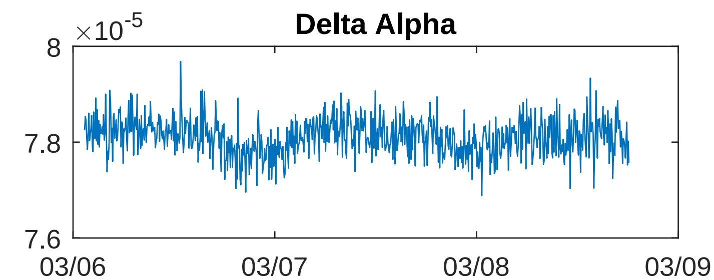
Calibration RMSE: 0.131
Calibration Bias: 0.000

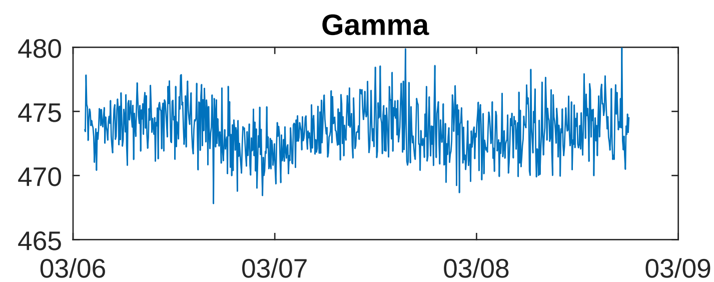
Validation RMSE: NaN
Validation Bias: NaN

	Mean	Min	Max
Ref. 1	0.091	0.037	0.160
Ref. 2	0.181	0.070	0.345
Ref. 3	0.088	0.029	0.187
Ref. Val.			









Date Range:
08-Mar-2018 18:55:06
11-Mar-2018 00:30:06

Number of Traces:
637

Length of Fiber:
2699.06

	Z_1	Z_2	Z_1	Z_2	Tref
Ref. 1	101	110	1402.4	1411.5	tref 2
Ref. 2	125	131	1426.8	1432.9	tref 1
Ref. 3	1310	1317	2629.1	2636.2	tref 2
Val.	0	0	NaN	NaN	

Calibration Step Loss Data:
Step Loss:
Index Location: N/A
Fiber Distance: N/A

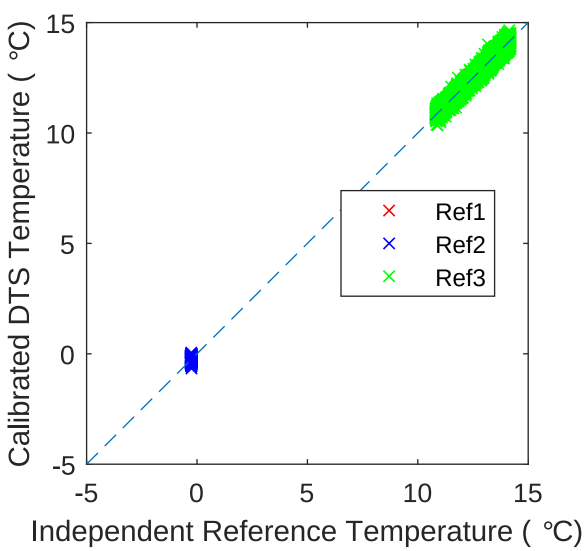
Equal Distance Temperature:
Index Location: N/A
Fiber Distance: N/A

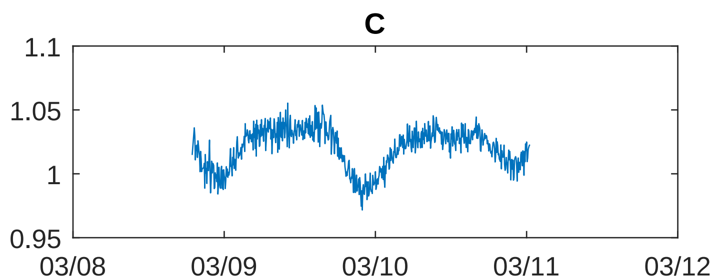
Calibration Results Summary:

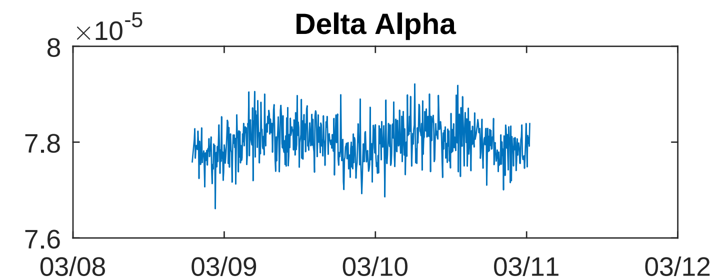
Calibration RMSE: 0.121
Calibration Bias: 0.000

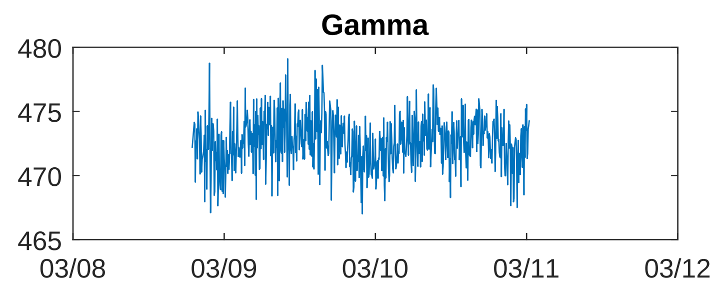
Validation RMSE: NaN
Validation Bias: NaN

	Mean	Min	Max
Ref. 1	0.090	0.032	0.163
Ref. 2	0.168	0.051	0.344
Ref. 3	0.083	0.019	0.182
Ref. Val.			









Date Range:
20-Mar-2018 23:44:07
24-Mar-2018 14:24:07

Number of Traces:
1040

Length of Fiber:
3279.41

	Z_1	Z_2	Z_1	Z_2	Tref
Ref. 1	89	96	830.2	837.3	tref 2
Ref. 2	110	118	851.5	859.6	tref 1
Ref. 3	2428	2435	3203.3	3210.4	tref 2
Val.	0	0	NaN	NaN	

Calibration Step Loss Data:
Step Loss:
Index Location: N/A
Fiber Distance: N/A

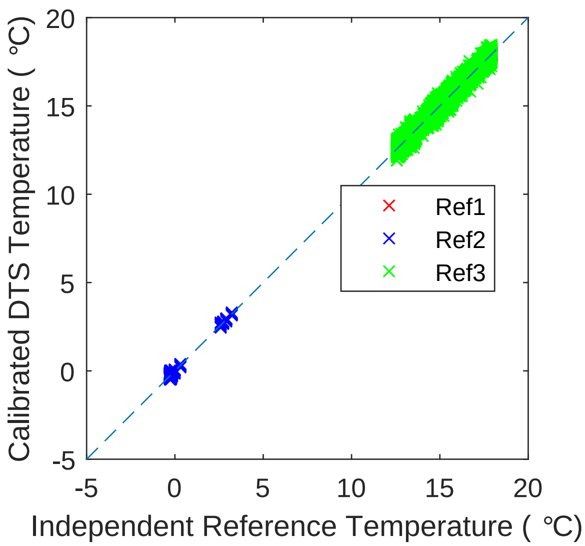
Equal Distance Temperature:
Index Location: N/A
Fiber Distance: N/A

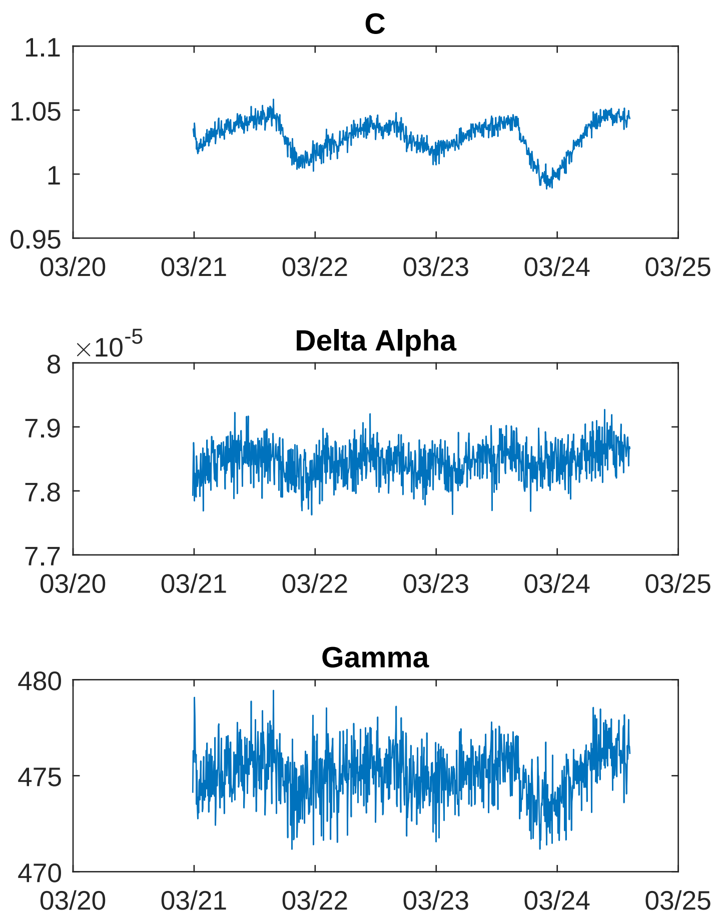
Calibration Results Summary:

Calibration RMSE: 0.144
Calibration Bias: 0.000

Validation RMSE: NaN
Validation Bias: NaN

	Mean	Min	Max
Ref. 1	0.067	0.021	0.134
Ref. 2	0.232	0.074	0.450
Ref. 3	0.068	0.021	0.125
Ref. Val.			





Date Range:
28-Feb-2018 19:25:55
03-Mar-2018 16:46:55

Number of Traces:
658

Length of Fiber:
2699.06

	Z_1	Z_2	Z_1	Z_2	Tref
Ref. 1	69	75	1444	1450.1	tref 2
Ref. 2	50	55	1424.7	1429.8	tref 1
Ref. 3	1199	1205	2590.5	2596.6	tref 2
Val.	0	0	NaN	NaN	

Calibration Step Loss Data:
Step Loss:
Index Location: N/A
Fiber Distance: N/A

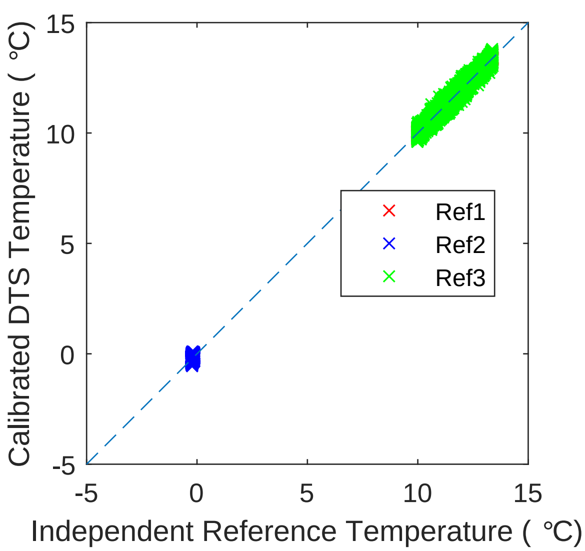
Equal Distance Temperature:
Index Location: N/A
Fiber Distance: N/A

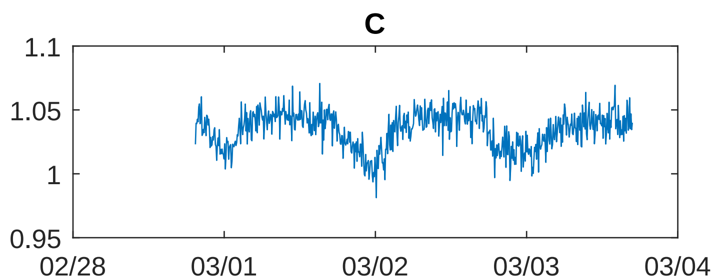
Calibration Results Summary:

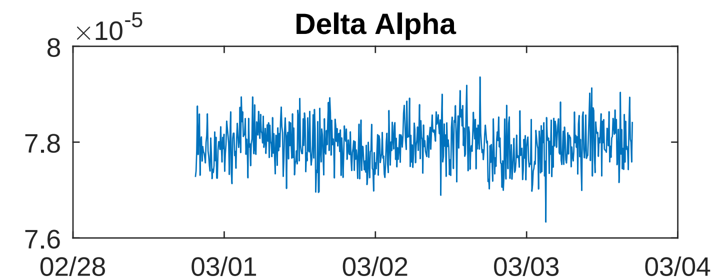
Calibration RMSE: 0.130
Calibration Bias: 0.000

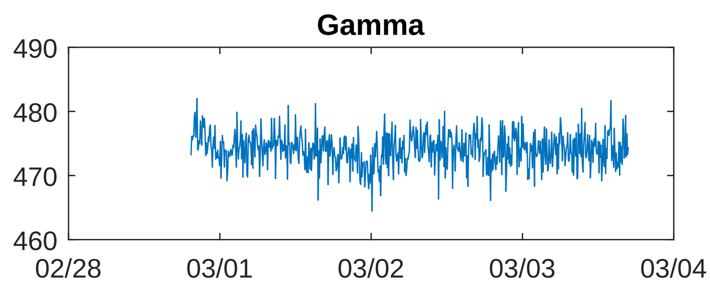
Validation RMSE: NaN
Validation Bias: NaN

	Mean	Min	Max
Ref. 1	0.097	0.022	0.171
Ref. 2	0.174	0.026	0.346
Ref. 3	0.088	0.027	0.192
Ref. Val.			





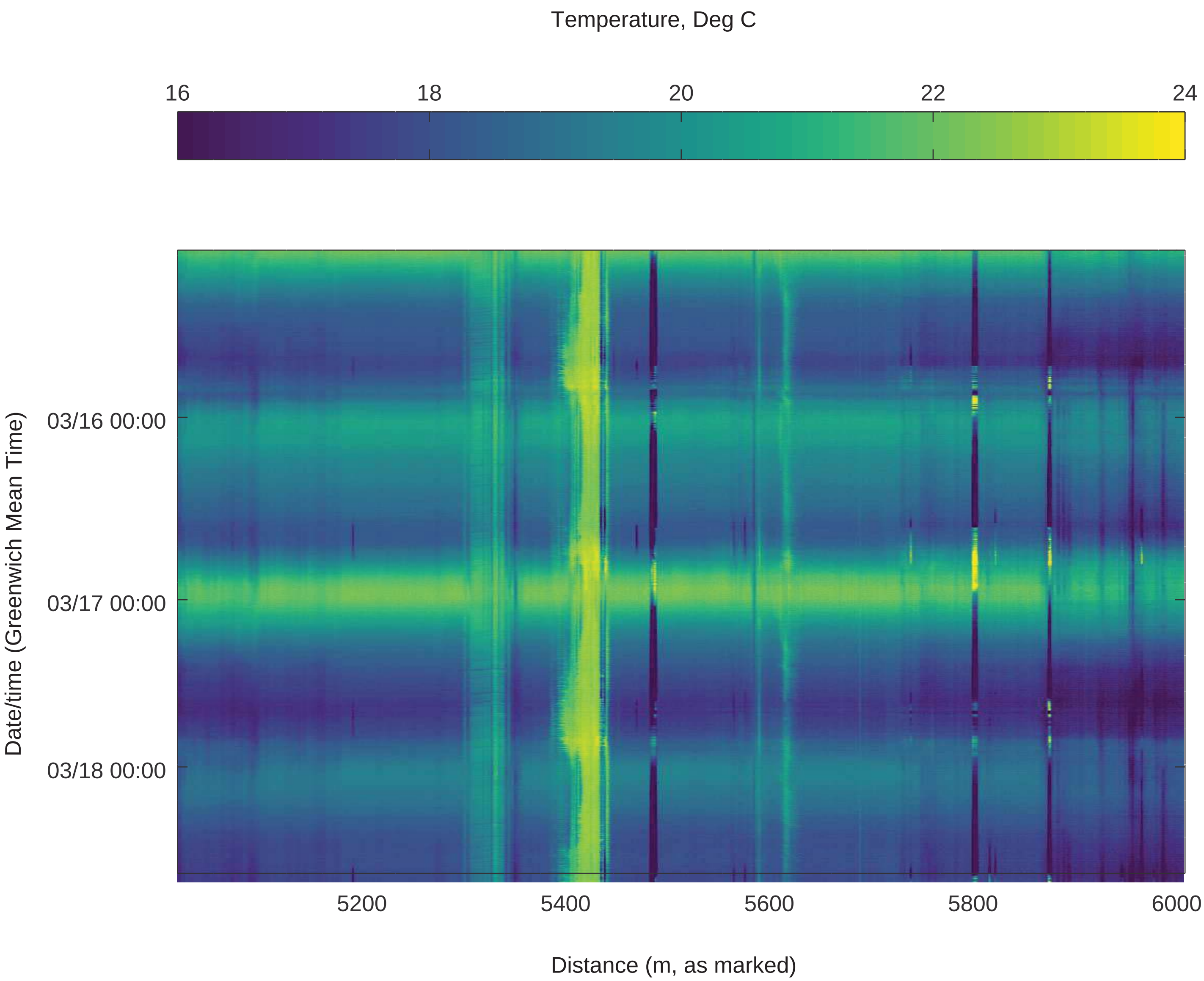




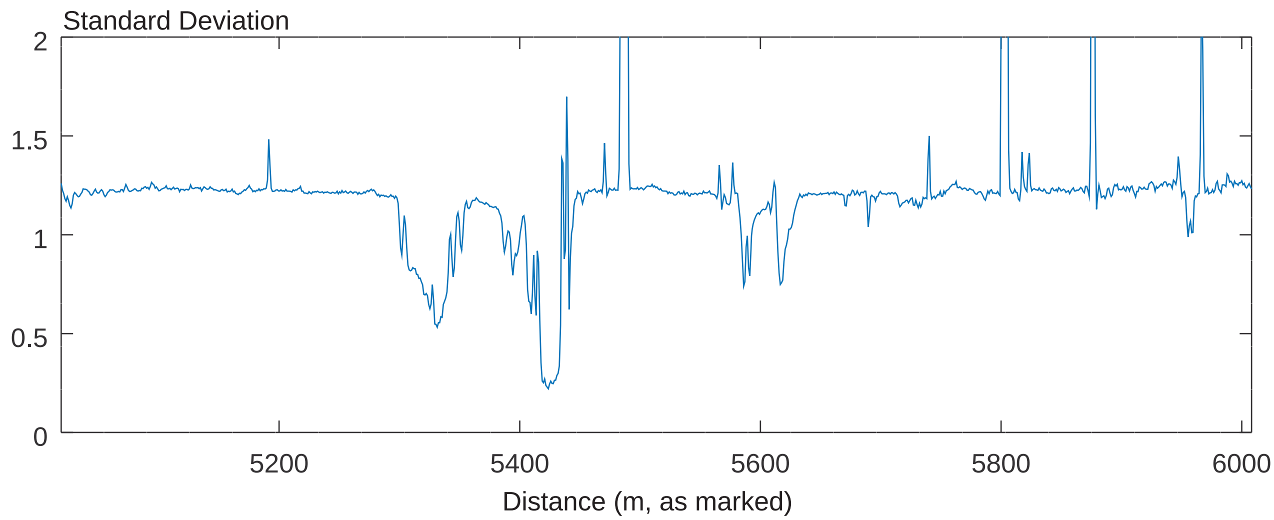
Appendix H

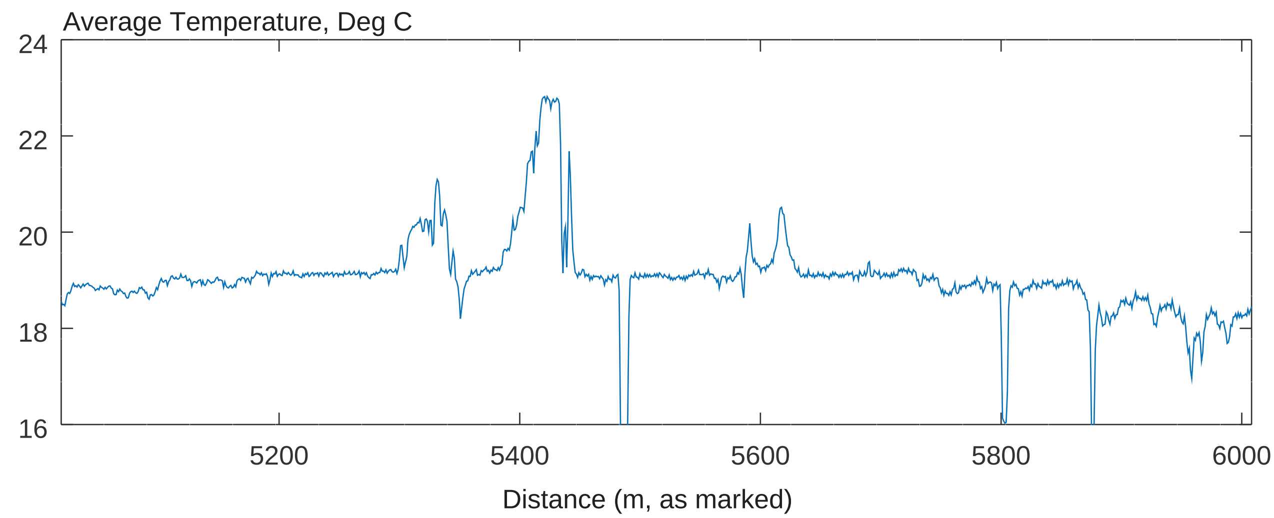
Temperature Data FODTS Survey

Calico Ridge Weir to Lower Narrows Weir
Fiber Optic Distributed Temperature Sensing
Supplemental Surface Water Investigation
July 2018

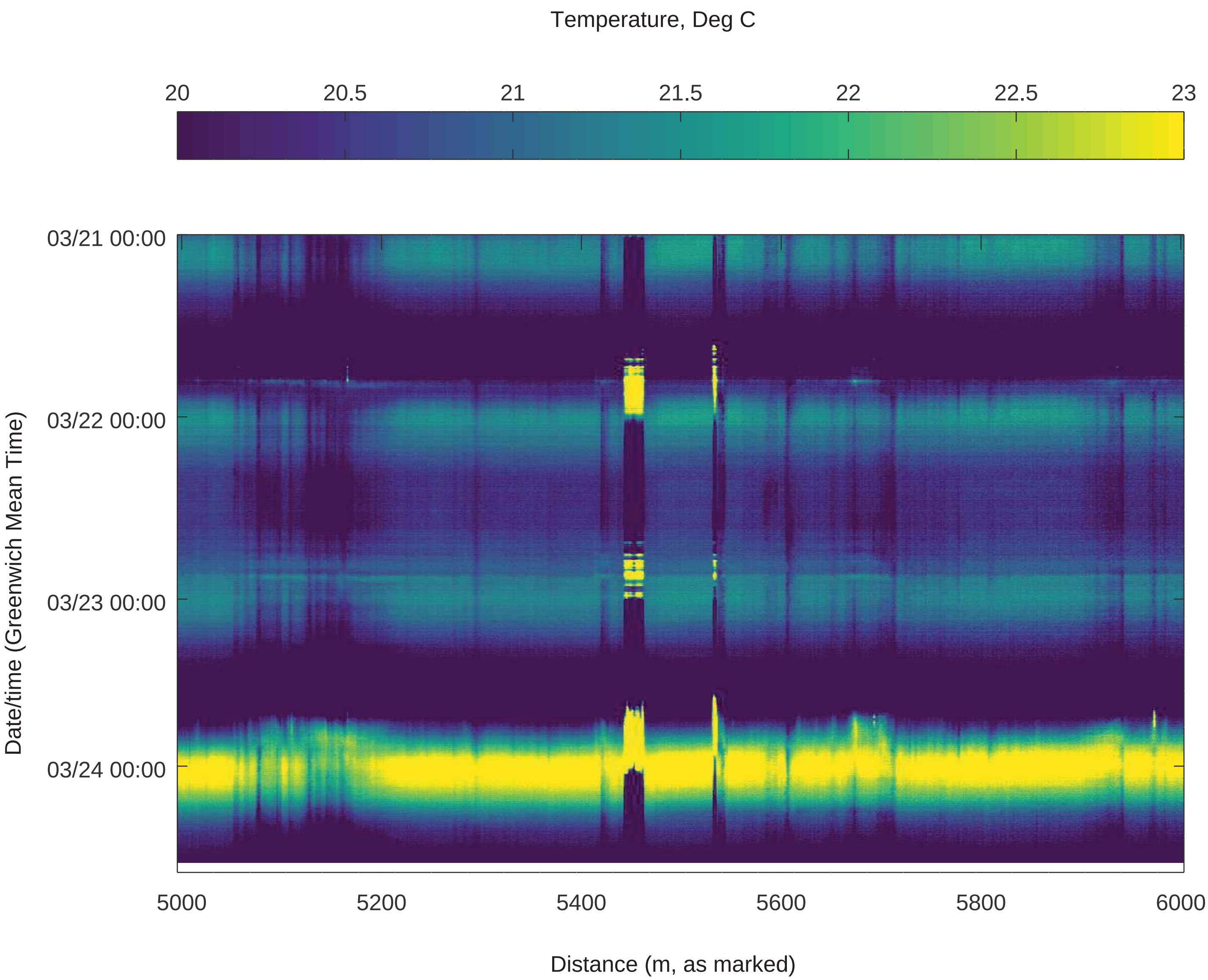


Calico Ridge Weir to Lower Narrows Weir
Fiber Optic Distributed Temperature Sensing
Supplemental Surface Water Investigation
July 2018

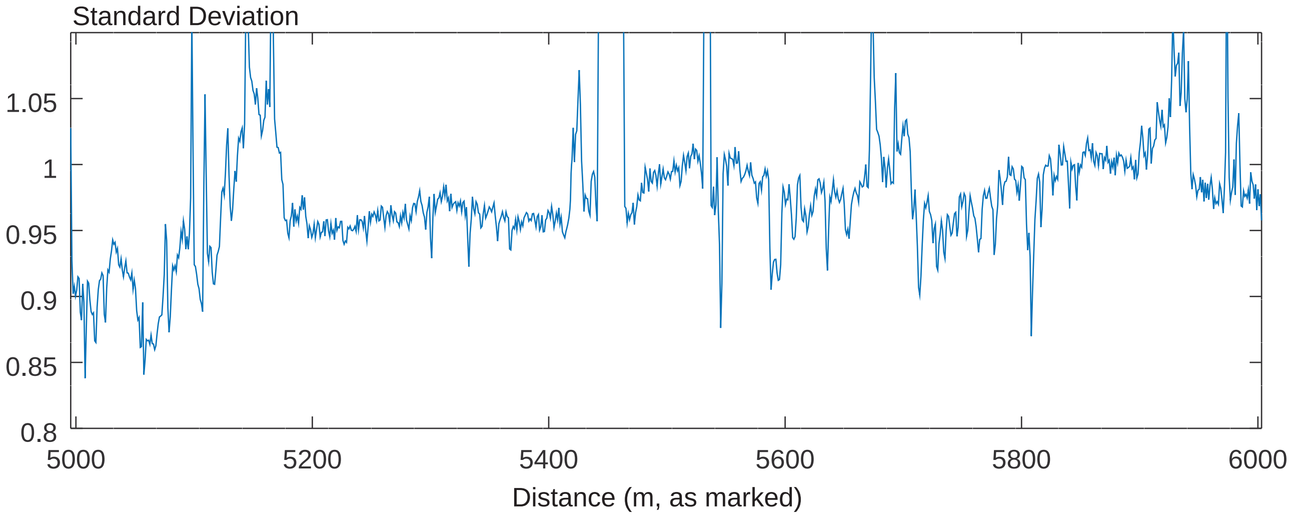


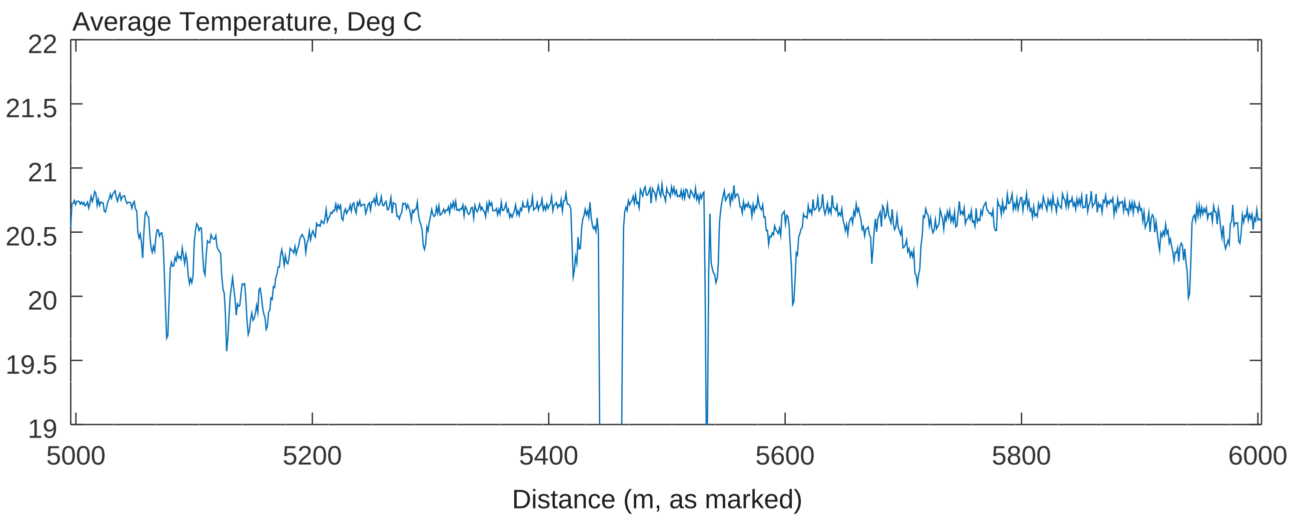


Lower Narrows Weir to Homestead Weir
Fiber Optic Distributed Temperature Sensing
Supplemental Surface Water Investigation
July 2018

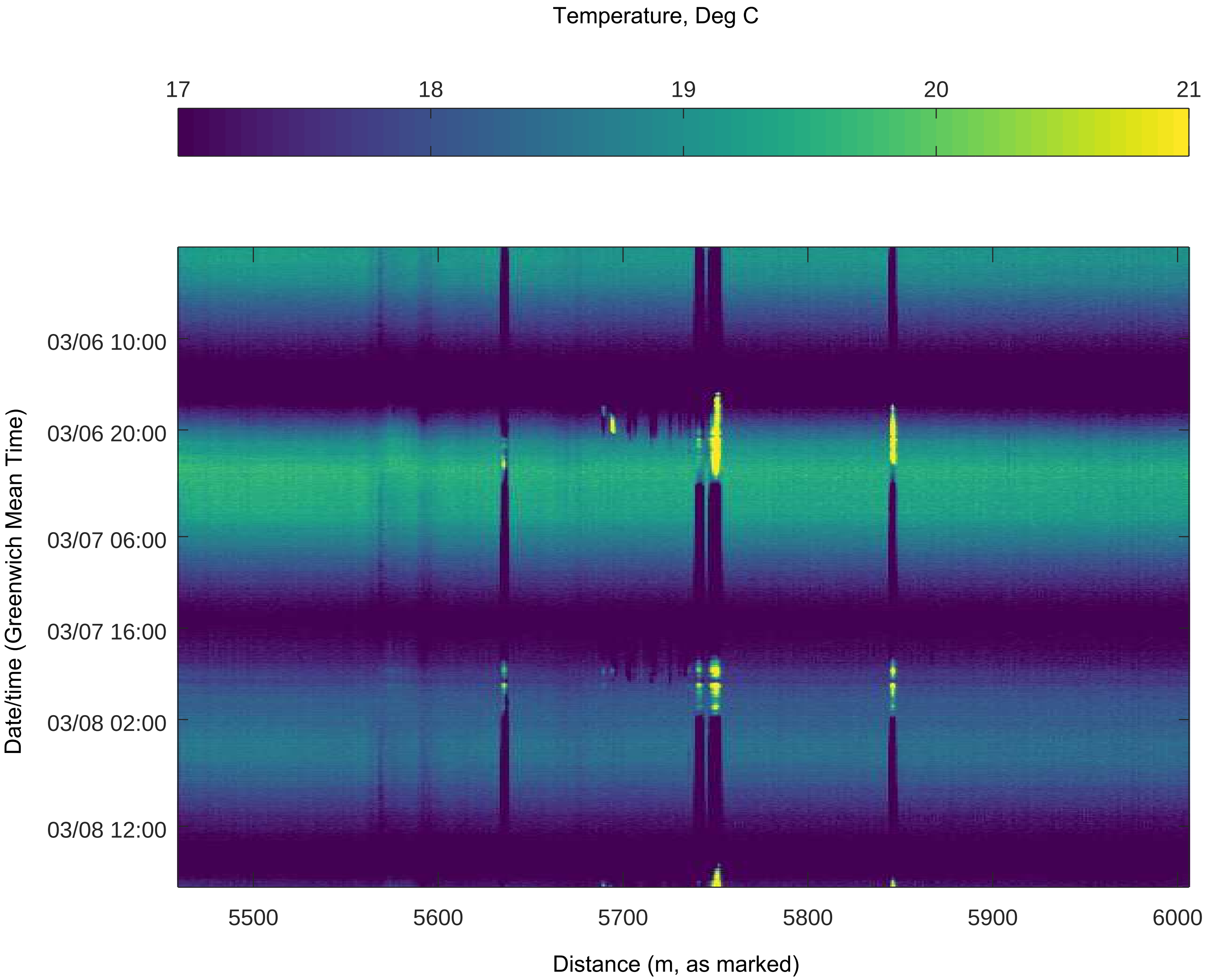


Lower Narrows Weir to Homestead Weir
Fiber Optic Distributed Temperature Sensing
Supplemental Surface Water Investigation
July 2018

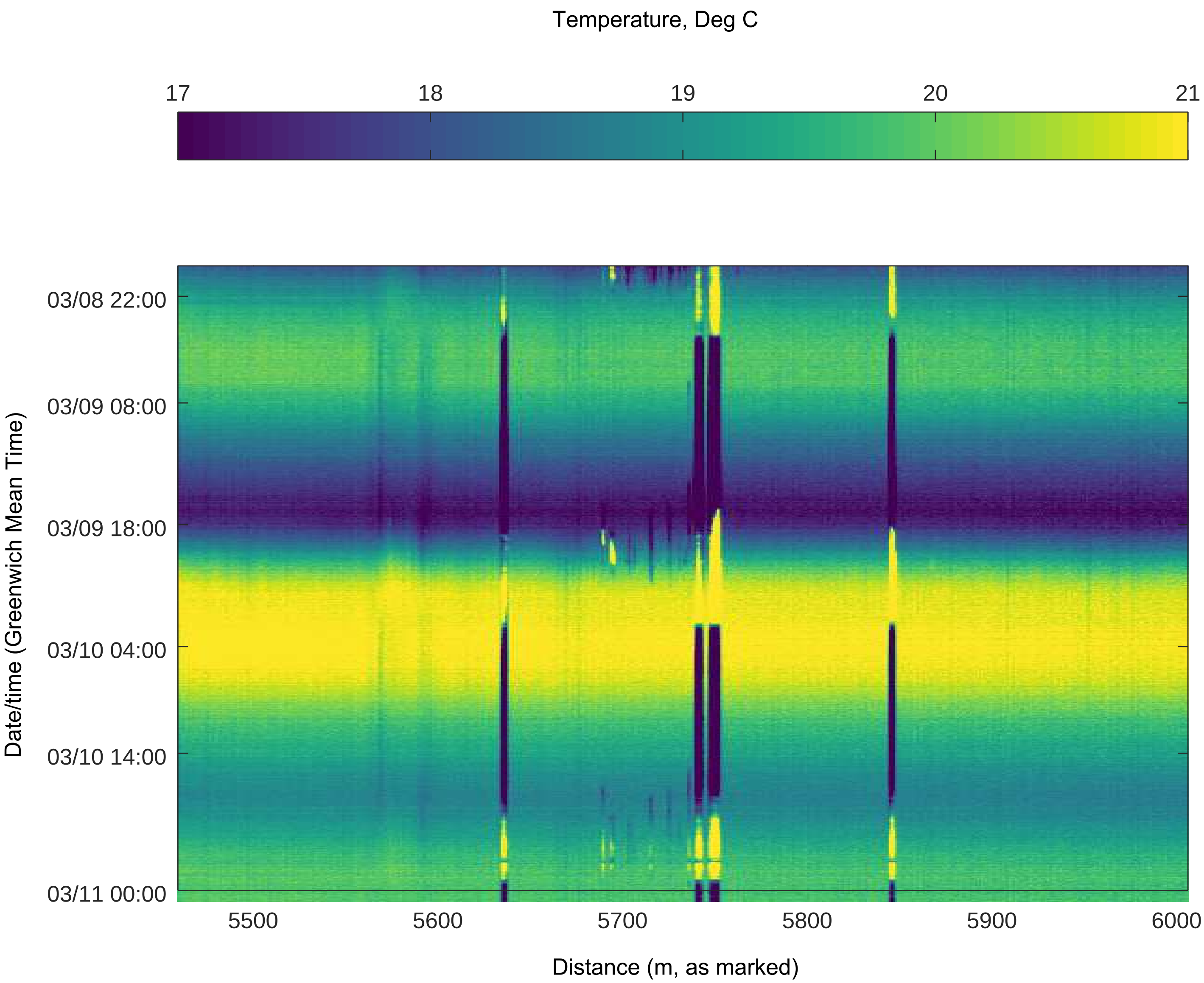




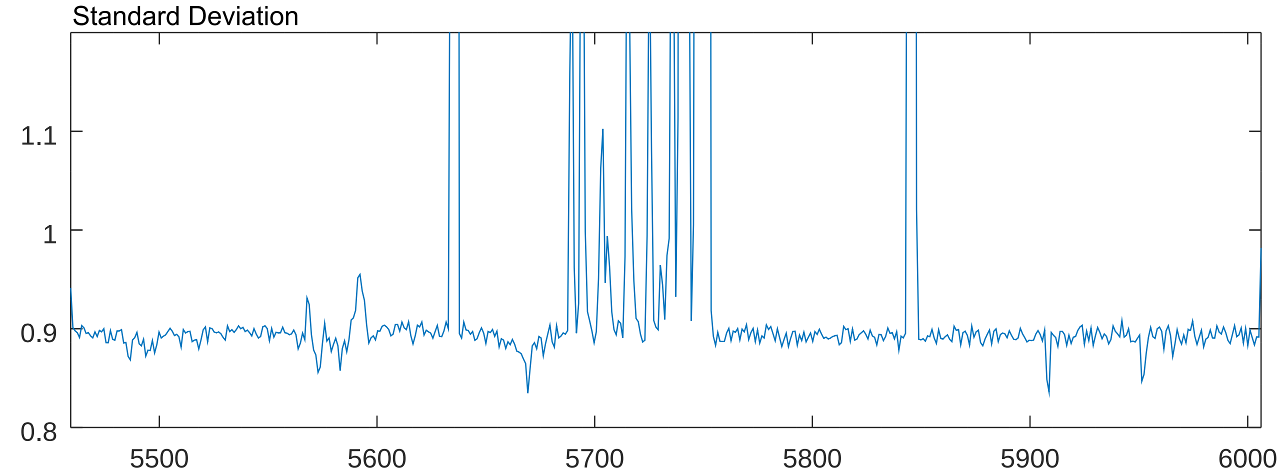
Rainbow Gardens Weir to Fire Station Weir - South Bank Run 1
Fiber Optic Distributed Temperature Sensing
Supplemental Surface Water Investigation
July 2018

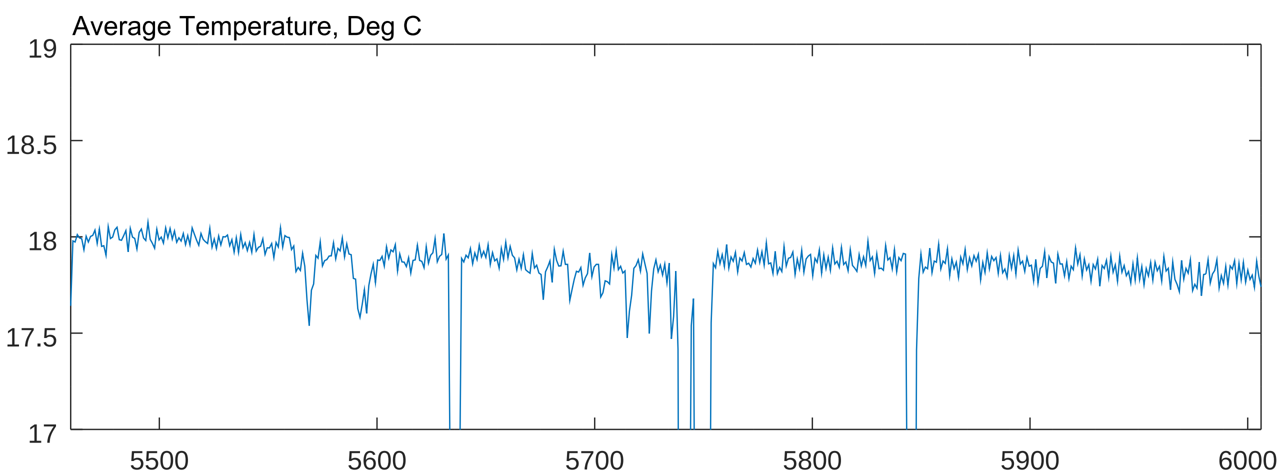


Rainbow Gardens Weir to Fire Station Weir - South Bank Run 2
Fiber Optic Distributed Temperature Sensing
Supplemental Surface Water Investigation
July 2018

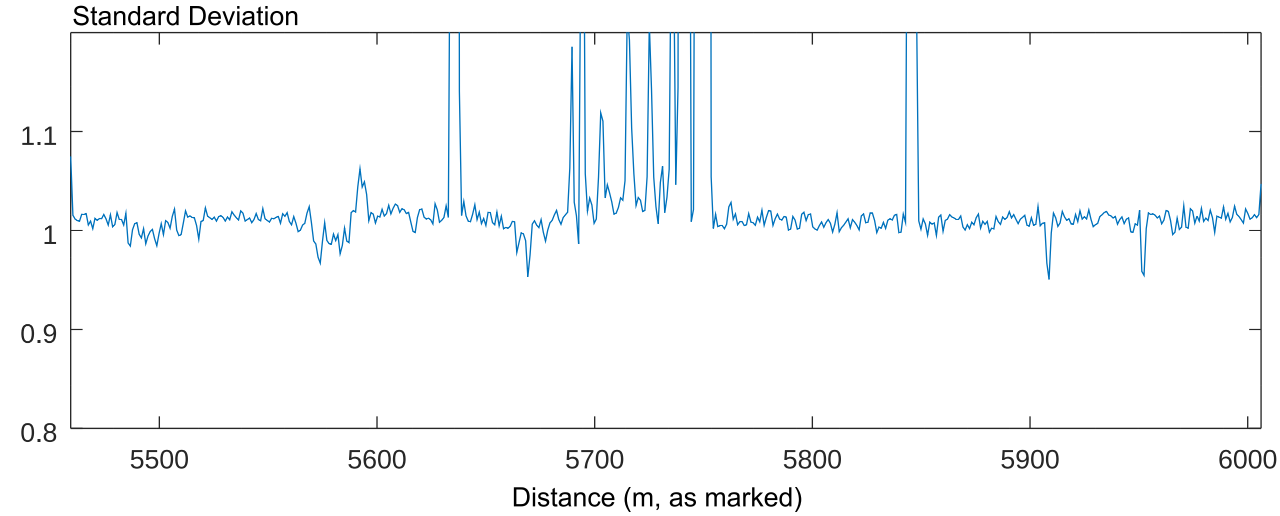


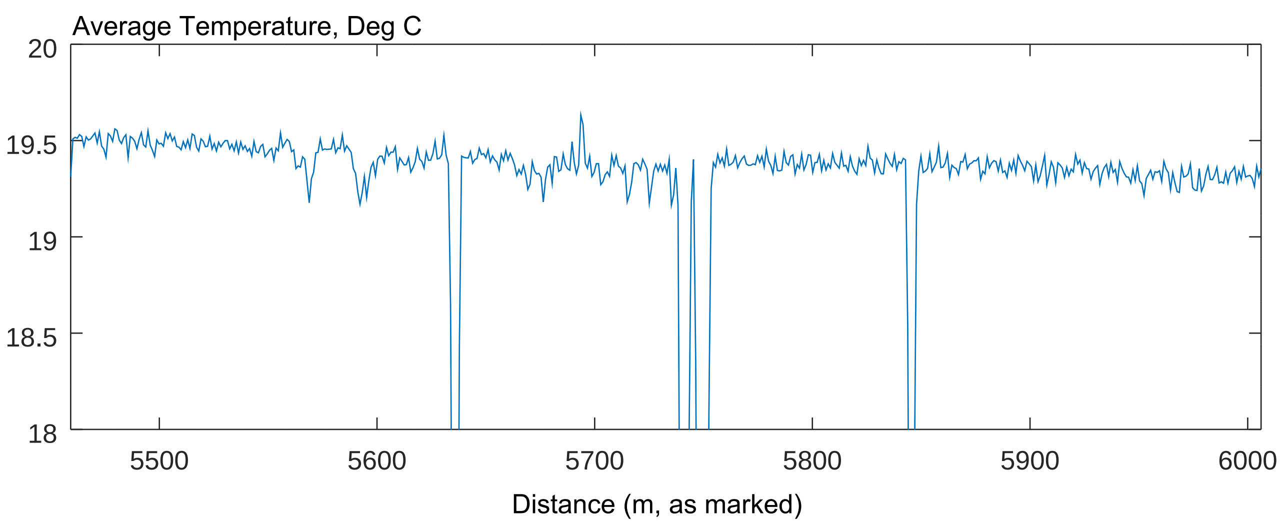
Rainbow Gardens Weir to Fire Station Weir - South Bank Run 1
Fiber Optic Distributed Temperature Sensing
Supplemental Surface Water Investigation
July 2018



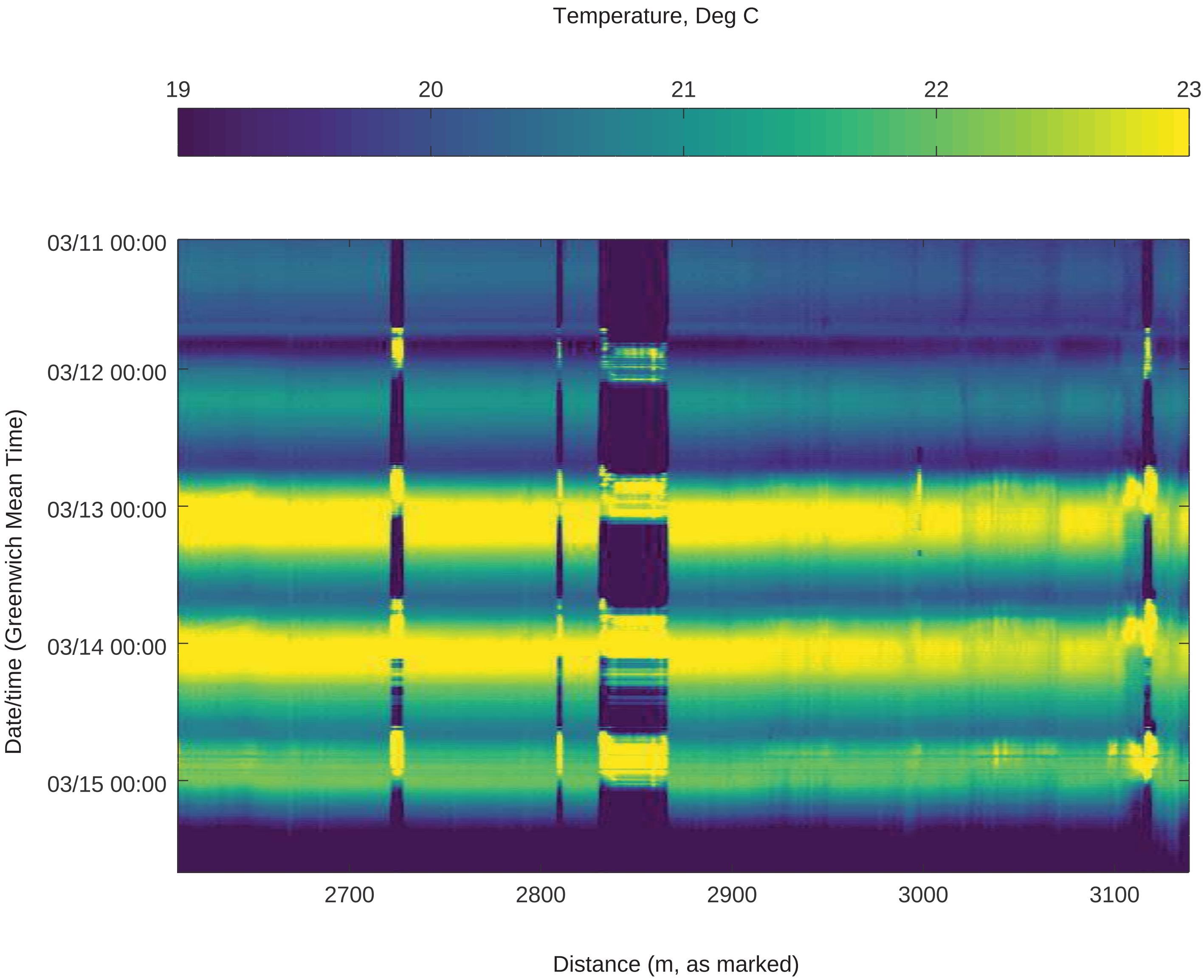


Rainbow Gardens Weir to Fire Station Weir - South Bank Run 2
Fiber Optic Distributed Temperature Sensing
Supplemental Surface Water Investigation
July 2018

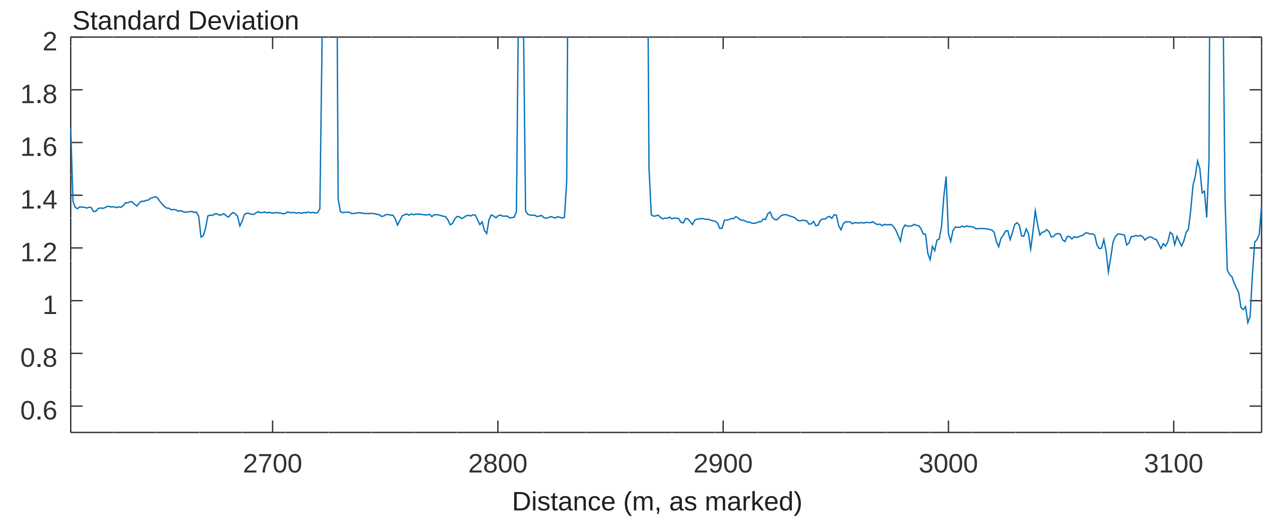


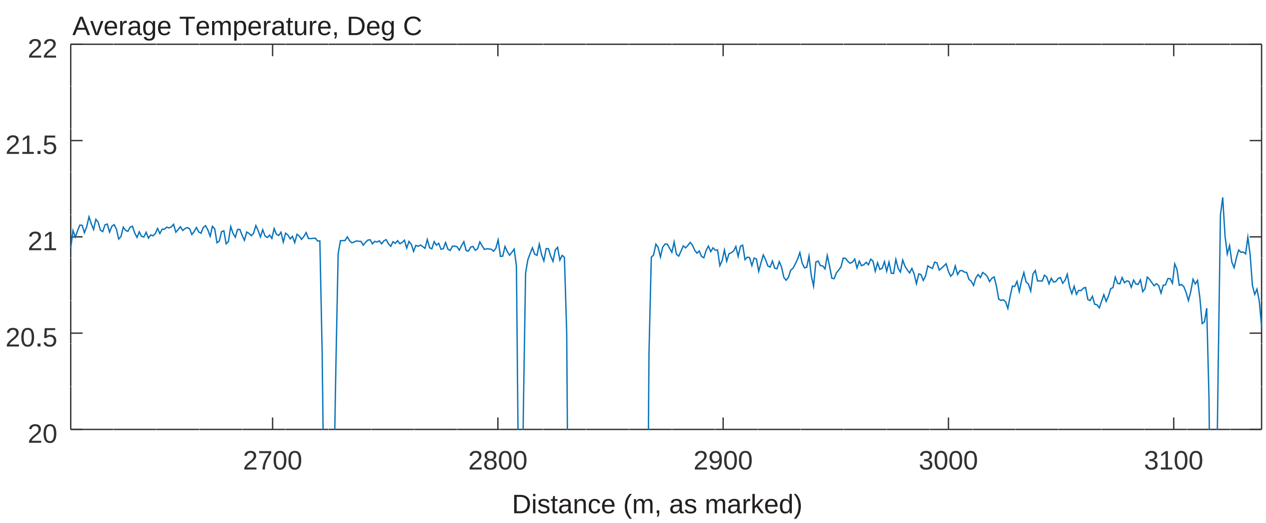


Three Kids Weir to Rainbow Gardens Weir - North Bank
Fiber Optic Distributed Temperature Sensing
Supplemental Surface Water Investigation
July 2018

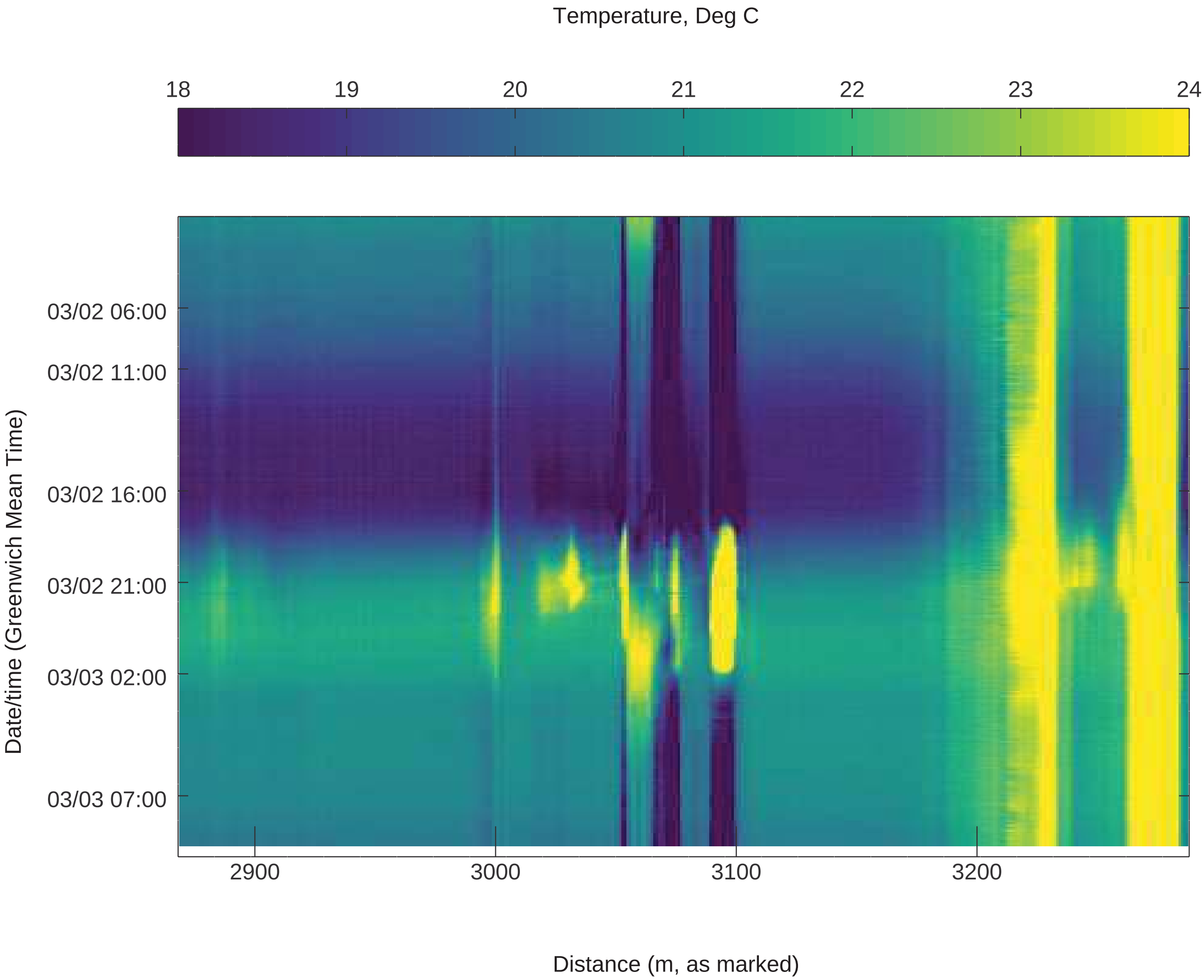


Three Kids Weir to Rainbow Gardens Weir - North Bank
Fiber Optic Distributed Temperature Sensing
Supplemental Surface Water Investigation
July 2018

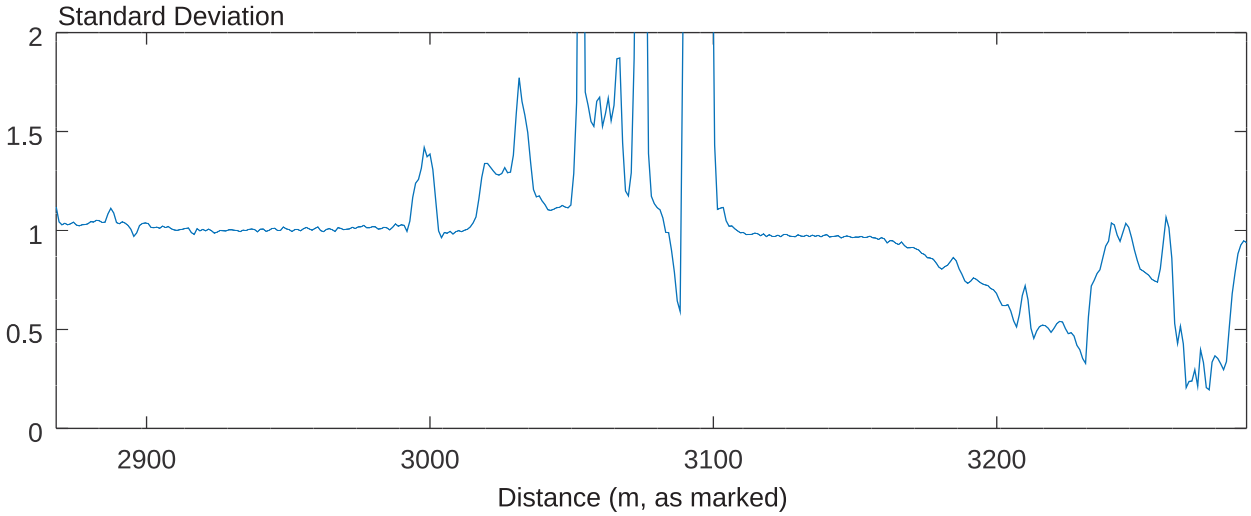


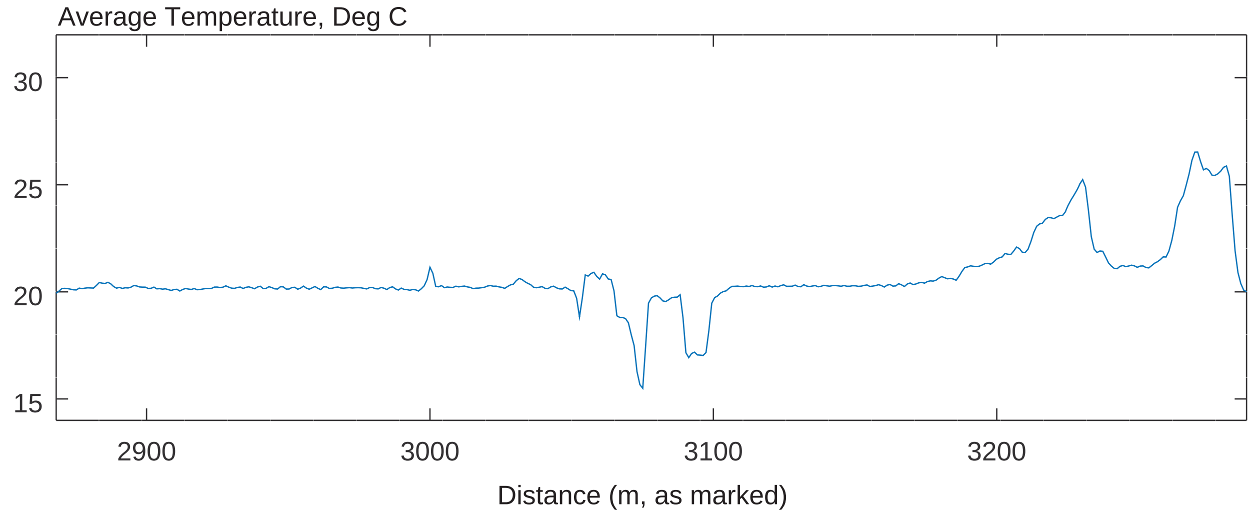


Three Kids Weir to Rainbow Gardens Weir - South Bank
Pre-Splice Deployment
Fiber Optic Distributed Temperature Sensing
Supplemental Surface Water Investigation
July 2018

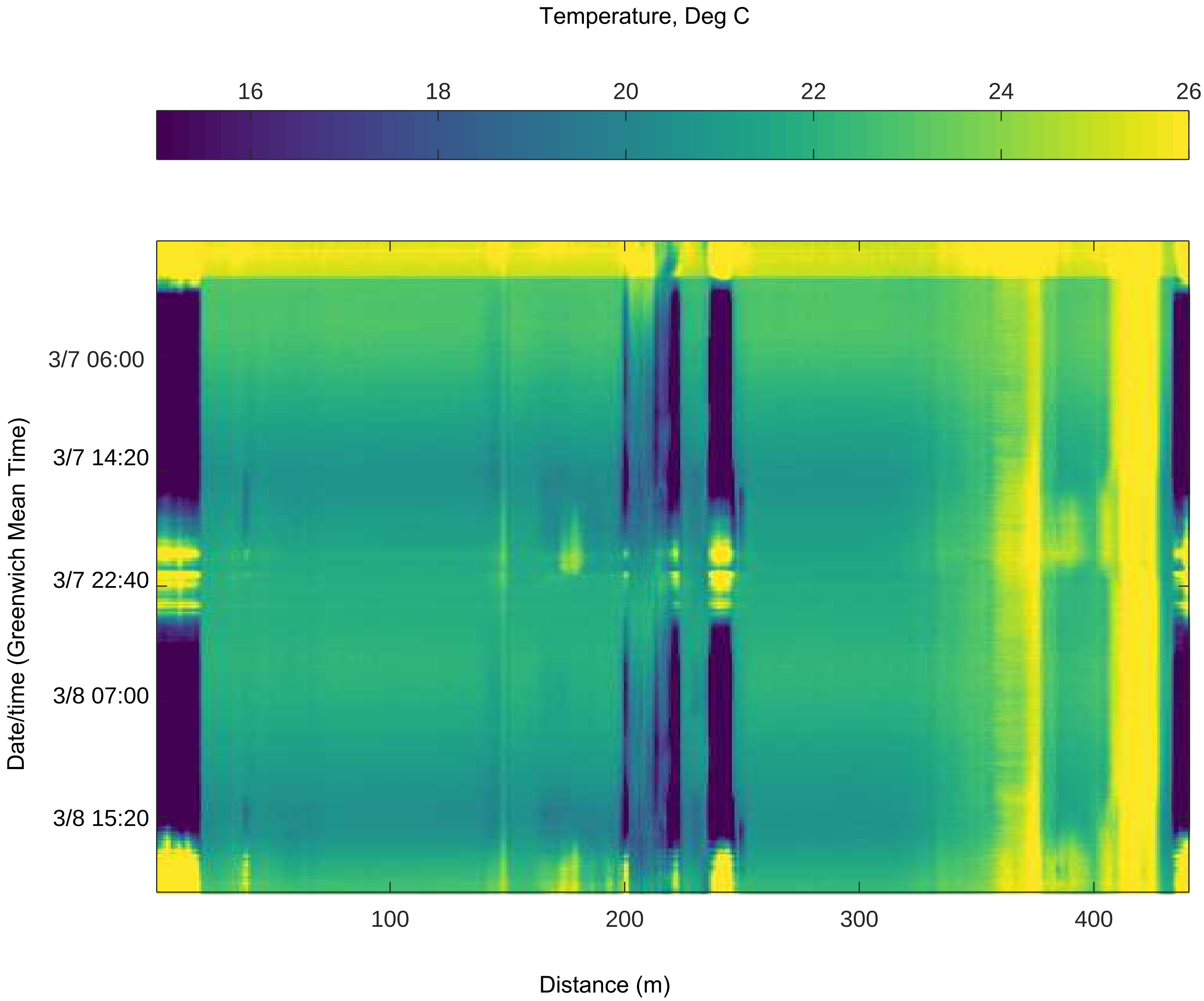


Three Kids Weir to Rainbow Gardens Weir - South Bank
Pre-Splice Deployment
Fiber Optic Distributed Temperature Sensing
Supplemental Surface Water Investigation
July 2018

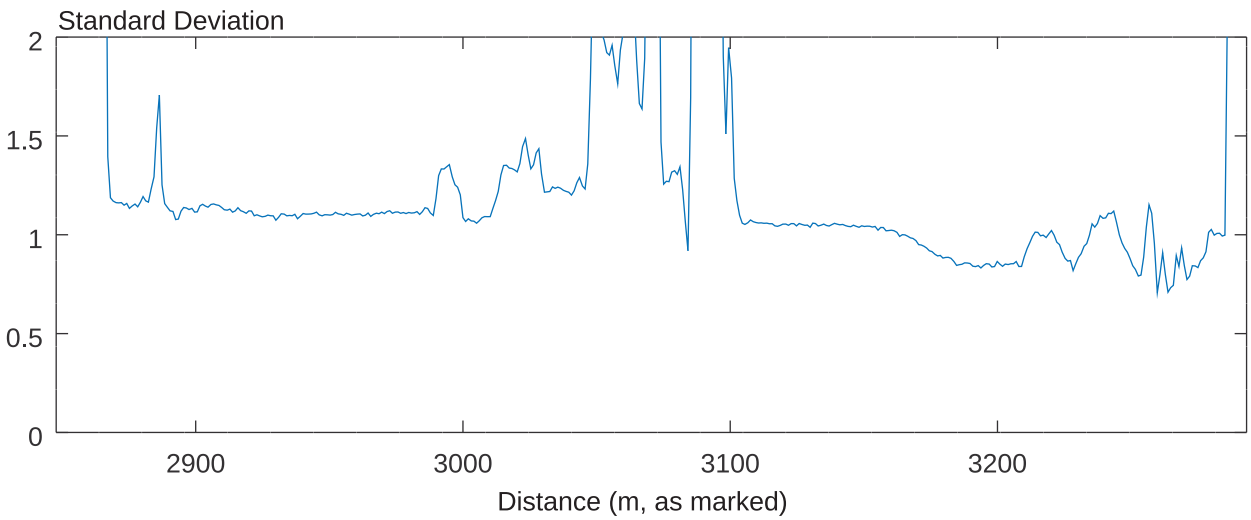


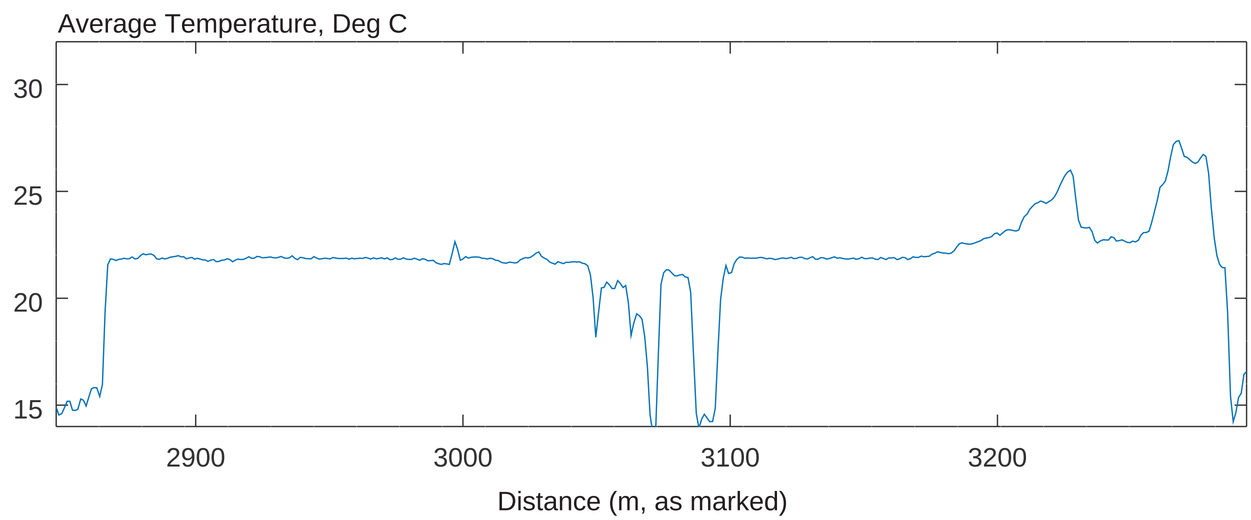


Three Kids Weir to Rainbow Gardens Weir - South Bank
Post-Splice Deployment
Fiber Optic Distributed Temperature Sensing
Supplemental Surface Water Investigation
July 2018

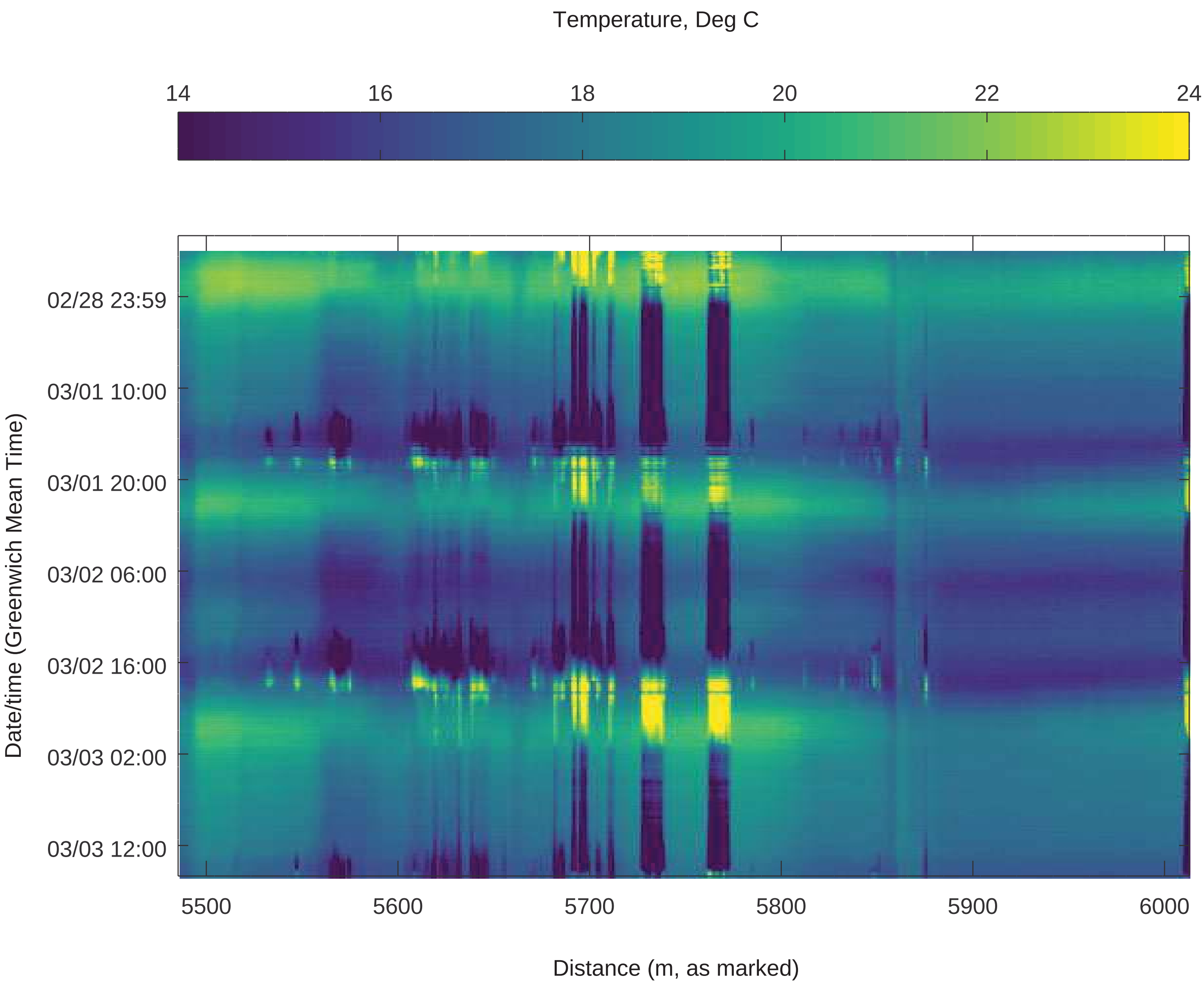


Three Kids Weir to Rainbow Gardens Weir - South Bank
Post-Splice Deployment
Fiber Optic Distributed Temperature Sensing
Supplemental Surface Water Investigation
July 2018

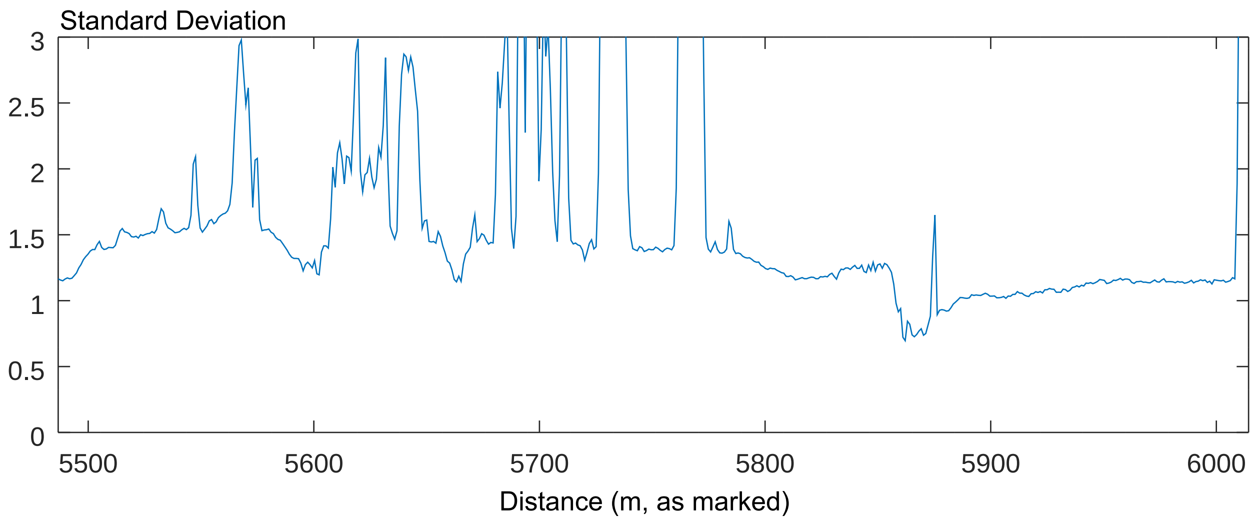


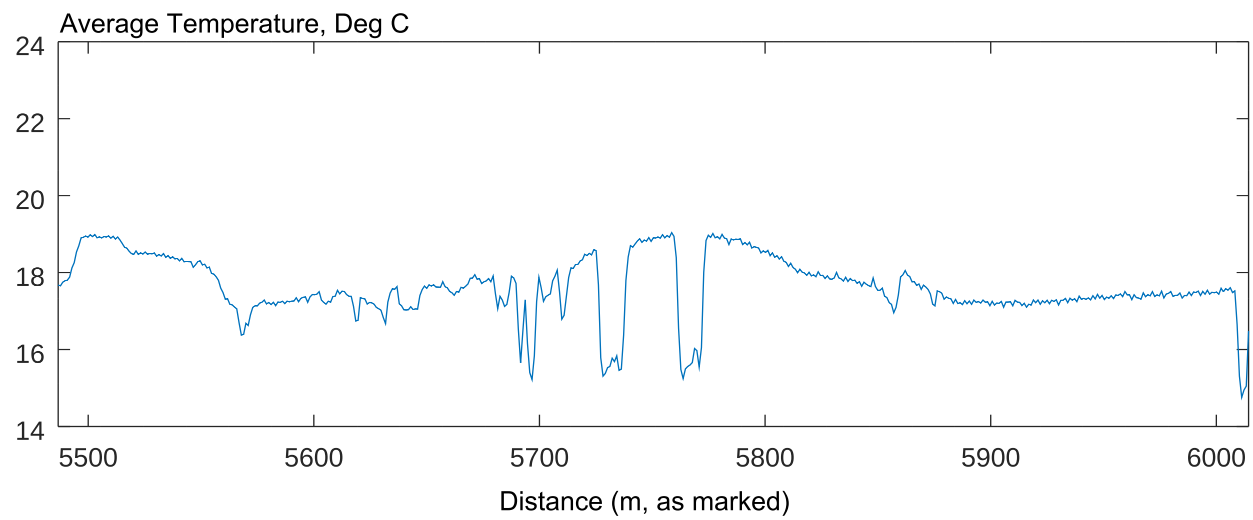


Upper Narrows Weir - Downstream
Fiber Optic Distributed Temperature Sensing
Supplemental Surface Water Investigation
July 2018



Upper Narrows Weir - Downstream
Fiber Optic Distributed Temperature Sensing
Supplemental Surface Water Investigation
July 2018





Appendix I

Log Books and Water Quality Calibration Logs

Project / Client

Preparing for Transect Sampling

0900 Team Meeting at 3 Kids Weir
Petros
James
Kevin
Joe
Rick
Steve

1025 Staff at station above 3 Kids
53.8 ~~10.22~~ feet 1.22 feet
staff and stilling well in good shape

1040 53.75 1.12
staff gage loose

1057 53.5 0.77
staff gage solid

1115 54.6 0.99
looks decent
self tapping screws

Project / Client

1121 54.65
no SG
beaver chewed up
sg attachment

1135 55.3 1.40
looks good but isolated from main flow due to construction

Location LVW Date 5/1/18
Project / Client NERT

0730 Assemble at Pasco
Joe Caputo
Kevin Russell
Rick Purdy
~~Pedro~~
James McCoy
Steve How

calibrating Horibas & GPS
trying to get on water
near Duck Creek low
at ~830
Rain showers - monitoring
weather and flow

0905 Joe and Steve at
T6.55
Used Huriba to find
Strongest WQ anomaly

T6.55-2018.A
T 21.04°C pH 6.62
SpC 4.97(?) DO 24.8%
ORP 135 2.16 mg/l
turb 0.0 ntu

Location Date 5/1/18
Project / Client

td 0.50'
Sample at 0.4'
0916

relative height 67%

0930 @ T6.55 B
Temp 20.78°C pH 7.27
SpC 2.36 m DO 108 %
ORP 68 mv 9.33 mg/L
TURB 0.0 ntu TDS 1.51 g/L
TD = 8.5" 0.71'
0933 Sample Collected @ 0.6'
0945 @ T6.55 C
Temp 21.61°C pH 7.42
SpC 1.89 ms/cm DO 89.9 %
ORP 70 mv
Turb 0.0 NTU TDS 1.21 g/L
0950 Sample Collected TD: 0.20'
Collected @ 0.10'

Rite in the Rain

Location
Date 5/1/18

Project / Client

0955 @ T6.55 D

Temp 20.66 pH 7.53
SPC 1.98 mS/cm DO 87.8 %
ORP 43 mV 7.54 mg/L
TURB 14.5 NTU TDS 1.20 g/L
Sample collected ~25' ft on
mud flat in channel
1006 TD - 0.2' collected @ 0.1'

1013 Relative depth 6 1/16
1121 Relative depth 8 1/4

6.55

5 @ 8" - 0.67' A
may be several erroneous points
nearby on GPS
6.55 Sample A
10 1.38'
15 1.60
20 ~~0.88~~ 0.21'
35 0.29
50 0.31 1137

Location
Date 5/1/18

Project / Client

65	0.54	
74	1.38	Sample B
80	1.82	
95	0.56	
110	0.63	
125	0.31	
140	0.46	1150
155	0.79	
170	0.92	
185	1.17	
200	1.52	
215	1.25	
230	0.85	
245	0.63	
260	0.54	1201
275	1.50	
290	0.27	
305	0.21	
320	0.38	
330	0.44	Sample C
345	0.31	
360	0.79	
~~375~~		
370	2.35	1215

Location

Date 5/1/18

Project / Client

375	1.35'
385	0.27'
400	0.23
415	0.19
418	0
426	0
437	0.38 Station D
	1228

actual shoreline ~40' north of 437 Sct in heavy reed growth area

sampled location (D) is in channel conveying North Sink discharge into main stream during low flows

1232 10 5/16" relative height

on south shore

Location

Date 5/1/18

Project / Client

Rain w/ tstorm started so breaking for lunch

Rick bringing samples to TA
James looking over GPS data
Pedros and Steve going to check Bostick Weir for access and flow timing
T-storms continuing, not safe to go into Bostick
Pedros and Steve going to investigate WW below Lake Las Vegas for LO.9.
T-Storms outside valley near LO.9, so limited investigation

52 Location ____ Date 5/2/18

Project / Client ____

0820 Assemble at Pasco
CSH running errands for difficult transect profiling locations.
Kevin and Joe profiling near Pasco. Channel completely different than previous transect period - expanded significantly to south and west!
Rick and Petros profiling below Calico Ridge at transect below island complex
Joe and Steve profiling toe of Bostick Weir.
May not be able to sample today due to rain.
At 6 AM flows through LVW were ~ 50 to 100 cfs above typical levels for time of day.
May be able to sample some grass later in day downstream.

Location ____ Date 5/2/18 53

Project / Client ____

1048 At Bostick Toe
very overgrown at South Bank, North Bank, and mid 'Channel Island' that butts right up against toe

Starting ~~So~~ North to South on GPS due to channel configuration

hard to define channel
small island to north w/ heavy veg, some deeper areas with flow through
Starting transect at apparent Northern bank. May sample near there if there's any low flow

Rite in the Rain

Location
Date 5/2/18
Project / Client

Station 4.85
0 feet in dense veg, looks like edge on north bank, 0.0'
7 1.10' ~ 1113 ~0.5fps
15 0.87' sample N-1 ?
16 -0.5, island of reeds
79 -0.5,
82 0.88' 0.5 fps
90 0.66' 1.0 1150
100 1.46,
107 2.43' 2+ fps
118 2.33 1211
121 -0.5
on another reed island
125 -0.5
140 1.22 sample N-2 ?
152 1.84' 1.5 fps
157 2.10 1.5 4
22 on tape 162 2.15 157 in GPS pt
164 -0.5 1240 on shore
275 -0.5 1251
* stopping on S bank of * main island. flows are

Location
Date 5/2/18
Project / Client

high and rising. v. loud high. Finish transect during low

tape is at 111

111 -

0 is at 135
111
* 256 not
* 275

Correct GPS point

left tape at

256 on south bank of by island.

Location ____________ Date 5/2/18
Project / Client ____________

Heading do toe of
Calico to check transect.
May try to depth profile.
Two canoes - Kevin, James,
Joe and steve.
Rick and Petros spying out
LW 0.9 and checking on how
coordinates for sampling point
were selected
T4.8
4.8 0 point on south
Sample A
24' sample B 1.65' 1448
no velocity
no velocity at B either
but open / "bay" edge
39 1.52
54 0.63
transect profile will zig zag
along edge of water, avoiding
crossing little islands as
practical.
70 0.71
turning nw around cove

Location ____________ Date 5/2/18
Project / Client ____________

85 3.52
100 5.8
115 3.8
130 4.2
145 2.43 Sample C
near west (upstream) side
of main island, still in
"southern" chanel
158 3.54 1529
14 170 6.2
29 185 6.1
37 200 5.75 1555
52 215 8.7
67 82 230 5.45
97 240 1.90 Sample D
102 250 0.56
264 1.13
into a "reedy island"
279 1.58 out of "island"
14 water flowing through
29 now into small cove on North
44 294 1.87
309 2.23' Sample E
edge of reeds on N

Location
Date 5/3/18
Project / Client

At Pasco, 830
calibrating Horibas

Kevin and Jane sampling
above Pasco ~ 930

8:42 Pasco staff ~ 5.96'

Checked flow conditions at
USGS stations and almost
all were back on typical track
by 0600

0930 temp SG near bostick
launch area 5.24'

940 5.25 rising
sample ASAP
0955 5.26

Checked S bank near
bostick toe. Another
secondary channel

Location
Date 5/3/18
Project / Client

Will sample and transect
later

Heading to Calico area

10:24 at Calico toe T4.8

T4.8 ~~B~~ A 5/3/18 at 1030
Temp - 23.42°C Turb 0.0
pH 6.33 TDS 2.33 g/L
Cond 3.65 mS/cm ORP 135 mV
DO% 36.4
m 2.94 mg/L
TD = 1.33 ft Sampled @ 1.2 ft
1035 @ T4.8A
Temp 23.7°C Turb 0.0 NTU
pH 6.76 TDS 2.92 g/L
Cond 4.56 mS/cm ORP 105 mV
DO mg/L 3.35
% 41.0%
TD - 0.85 Sampled @ 0.70

Location

Date 5/3/18

Project / Client

T4.8C 1045
td 2.36
sample 2.2

temp 23.43
cond 2.03, 1.29 tds
pH 7.28
DO 124.6%
10.36 mg/l
ORP 84 mv
turb 0.0, but closer to 2+'

T4.8D 1052
td 1.95 sample at 1.8

Temp 23.52 ORP 45
Cond 2.03 Turb 0.0
pH 7.50 TDS 1.59
DO 111.3%
9.25 mg/l

Location

Date 5/3/18

Project / Client

A deep in cove through grassy area 0.0 fps

B In cove outside grassy area 0.0 fps

C main channel 0.5 fs

D backwater area from deep pool ~ -0.3 fps

fps visual estimates

T4.8E @ 1103
TD @ 2.16 Sampled @ 2.0
Temp 23.16 ORP 37
Cond 2.17 Turb 2.5
pH 7.53 TDS 1.39
DO % 81.1
DO mg/l 6.94

Location _______ Date 5/3/18
Project / Client _______

T3.8A @ 11:32
TD@ 1.3 ft Sampled @ 1.0 ft

SG 1.25 ft

T 3.8 B @ 11:36
TD @0.84 Collect @ 0.7

T 3.8C @ 11:38
TD 0.83 collect @ 0.7

T 3.8 D @ 11:41
TD 0.93 collect @ 0.8

T 3.8 E @ 11:48
TD @ 0.40 Sampled @ 0.30
Temp 25.33 ORP 76
pH 8.03 DO % 133.8
Cond 2.01 DO mg/L 10.76
Turb 2.8 TDS 1.18

Location _______ Date 5/3/18
Project / Client _______

T3.8 D
Temp 24.17 ORP 83
pH 8.17 DO % 138.7
Cond 2.00 DO mg/L 11.38
Turb 2.5 TDS 1.28

T3.8C
Temp 24.72 ORP 87
pH 8.21 DO % 145.8
Cond 2.05 DO mg/L 11.95
Turb 2.1 TDS 1.28

T3.8B
Temp 24.28 ORP 91
pH 8.25 DO % 139.1
Cond 1.99 DO mg/L 11.36
Turb 2.7 TDS 1.27

T 3.8A
Temp 23.85 ORP 94
pH 8.26 DO % 99.6
Cond 1.98 DO mg/L 8.14
Turb 4.5 TDS 1.27

SG - 1.26 1202

Rite in the Rain

Location ____ Date 5/3/18

Project / Client ____

LWC 3.7 1212

23.21°C
7.39 pH
4.13 ms/cm 2.65 g/l tds
DO 5.7 %
0.44 mg/l DO
ORP 122
0.0 ntu

LWC 3.28

Temp 24.82 DO% 63.4
Cond 3.17 DO mg/L 5.18
pH 7.52 TDS 2.02
ORP 102

td 0.95'
sampler at 0.8

collected at edge of reeds. Some open water in reeds had stronger WQ signal. May be more mixed with wash

Location ____ Date 5/3/18

Project / Client ____

where sampled

1335 Surveyor arrived
1422 1.29 54.6

SG at 4.75, 4.65

1512 5.3 1.66

1530 done w/surveyors

1628 Sampled ! WO.9

point mid channel of wash. GPS and Hydrolab both ran out of batteries. Will check during repeat samplings Friday

Location

Date 5/4/18

Project / Client

Sampling T4.85

will transcribe notes from temporary book

sampled A, B, D, E

4.85 C td 1.0
sd 0.8

1045 T 24.62 °C
pH 8.04
ORP 102
1.5 ntu
DO 152% 12.31 mg/l
tds 1.43
cond 2.24 mS

~~1025~~ 1+ fps

0955 @ 4.85 B

Temp 23.98
pH 6.85
ORP 109
Turb 0.0
DO% 144.5
DO mg/l 11.88
Cond 2.21
TDS 1.41

TD 2.29 ft Collected @ 2.2
1 fps

Location

Date 5/4/18

Project / Client

1000 @ 4.85 A
Temp 22.82
pH 6.38
ORP 122
Cond 2.16
Turb 0.0
DO 74%
TDS 1.38
TD @ 0.7' Collected @ 0.6'
0.2 fps

1025 @ 4.85 D
Temp 24.24
pH 7.60
ORP 86
Cond 2.21
Turb 0.0
DO% 134
mg/l 10.94
TDS 1.41

1034 @ 4.85 E
Temp 23.61
pH 7.68
ORP 106
Cond 2.21
Turb 0.3
DO% 116
mg/l 9.57
TDS 1.41
TD @ 1.25' Collected @ 1.0'
1 fps

Location

Date 5/4/18

Project / Client

1238 @ LWO.9

Temp	25.53	Turb	4.4
pH	8.35	DO%	146
ORP	69	Mg/L	11.64
Cond	2.19	TDS	1.40

TD 0.8' sampled @ 0.7'

Location

Date

Project / Client

Location NERT LWW Date 5/5/18

Project / Client

0905 LW0.9
sampling w/ FD
Horida) in another car
fd 0.9 sd 0.78

0946 SG upstream lower Narrows
4.25' new gage

1200 Signed w SG below
3 kids
1.13' before
and after

Project / Client

HENDERSON / KNIGHT

SEE HOWE NOTEBOOK FOR GENERAL/DAILY NOTES

1645 END CABLE DEPLOYMENT @ UPPER NARROWS AREA

1700 START INSTRUMENT SETUP

1945 INSTRUMENT SETUP COMPLETE

CH 1 MEAS TIME 15 sec

CH 2 MEAS TIME 15 sec

GAP OF 150 sec FOR

3 min COLLECTION INTERVAL

OTHER NOTES:

- 12m ICE BATH
- 5m AIR COIL
- 12m AMBIENT WATER BATH
- PT100S DEPLOYED IN ICE AND AMBIENT WATER BATHS
- ~2km FIBER WITH MINI BEND SPLICE AT END. FIBER HAS 2 CONNECTIONS.
- EACH CONNECTION ~~Deployed~~/CHANNEL WILL MEASURE 7 km FROM INSTRUMENT CONNECTION - MINI BEND BACK TO INSTRUMENT CONNECTION

Project / Client

HENDERSON / KNIGHT

0810 ON SITE AT UPPER NARROWS DEPLOYMENT.

- CHECK ICE AND AMBIENT BATHS
- CHANGE OUT BATTERIES
- INSTRUMENT COLLECTING
- BASED ON CONVERSATION w/ F.O. TECH @ CTEMPS RECOMMENDS INCREASING DATA COLLECTION TIME TO 1 min ON EACH CHANNEL TO INCREASE SIGNAL TO NOISE RATIO
- CHANGE INSTRUMENT DATA COLLECTION PARAMETERS TO

CHANNEL 1 60 sec

CHANNEL 2 60 sec

GAP TIME 380 sec

500 sec

5 min MEAS

- DATA COLLECTION OKAY AFTER RECONFIG
- CONFIRM SETUP w/ CTEMPS - OKAY

1130 - ~~Dep~~ @ LOCK UP EQUIPMENT, DEPART SLOPE FIRE STATION DEPLOYMENT ACCESS DIFFICULT, HEAD TO 3KIDS/RAINBOW TRAIL w/ SOUTH

Rite in the Rain

Location

Date 2/28/18

Project / Client

START DEPLOYMENT @ 3KIDS
SOUTH
GPS METER MARKS DURING
DEPLOYMENT

UPPER NARROWS DEPLOYMENT w 6012m IN
WATER FROM TURN (6014m)
2-3m ON LAND

OUT OF WATER 5486m
AMBIENT BATH 5450m - 5435
ICE BATH ~5431m - 5417
SPOOL TO INSTRUMENT

Location LAS VEGAS WASH Date 3/1/18

Project / Client

0700 MEET DISCUSS DAY'S
0830 CHANGE BATTERIES, CHECK
BATHS CHECK INSTRUMENT @
UPPER NARROWS
INSTRUMENT OPERATING +
COLLECTING DATA
0845 TO THREEKIDS DEPLOYMENT
TO WRAP UP CABLE INSTALLATION
1304 WRAP UP CABLE INSTALLATION
DEPLOY INSTRUMENT #2
@ THREE KIDS SOUTH
BANK DEPLOYMENT
SET UP JOB BOX, BATTERIES,
SPOOL, ICE BATHS, INSTRUMENT
2805-2818m ICE BATH ~~2805m - 2817m~~
2818-2823m 5m AIR 2826m - 2831m
2824-2837 AMB. WATER 2832m - 2845m
AIR FROM AMBIENT COLOR TO
WATER

1715 starting 3kidstorgs
3/2/18 @ 1:15 AM (GMT)
CABLE MAPPED DURING
DEPLOYMENT - SEE GPS DATA

Location ______ Date 3/1/18

Project / Client ______

(3 KIDS / RAINBOW GARDEN SOUTH
Deployment CONT)

1800 DEPART TO UPPER NARROWS
CHECK ICE, CHECK INSTR.
DOWNLOAD DATA

2000 DEPART FOR HOTEL

NIGHT { SEND DATA OFF TO DH,
BACKUP ON PERSONAL MACHINE

Location LAS VEGAS WASH Date 3/2/18

Project / Client ______

700 MEET DISCUSS DAYS ACTIVITIES

0815 ON SITE AT UPPER NARROWS
CHECK INSTRUMENT, ICE,
BATTERY SWAP

0900 UPPER NARROWS INSTR. All
SET, TO 3 KIDS - RAINBOW
FOR INSTR. UPDATE

0955 CHECK 3 KIDS. RE. DEPLOYMENT
INSTRUMENT OK, CHANGE BATTERIES
ICE OK
TO HOTEL FOR BATTERY CHARGE

1100 BACK TO UPPER NARROWS
HOTEL
PURCHASE SUPPLIES FOR
EXTRACTION OF CABLE

1600 HEAD OUT TO BACKUP DATA,
CHECK ICE, CHANGE POWER

1645 DEPART 3 KIDS Deployment
ICE OKAY
INSTR OKAY
POWER CHANGE

1. Check ice and Download data at
Upper Narrows
Leaving Batteries overnight

Location LVW Date 3/3/2018

Project / Client NDEP/NERT

Partly cloudy / Wind 50-60's

C. Murphy-Hogan & S. Howe

0815 Meet @ Pabco (K. Russel (AECOM); AJ Rodriguez (GES))
H & S
Mobe to Upper Narrows

0845 Check Baths
ice: -0.20
water 11.08
@ 4:45 PM GMT
Data symmetrical

0850 Last Reading ch.1 1646 ch.2 1647 GMT
Downloading Data to Flash Drive
Download successful
Shutting Down DTS
Disconnect Battery A & B
Because batteries ran overnight will leave batteries @ upper narrows running today
Removed upper narrows deployment

Check on DTS at 3kids to RG - SB
Break in Cable in frag discovered
Rory notified

1845 End Day

Location LVW Date 3/4/2018

Project / Client NDEP/NERT

~~13 Testing cable after knk found @ 0551 9 m~~
~~Symmetrical~~
~~Raw Data ch 1 & 2 looks good~~

0800 Meet at Pabco
Armand Rodriguez
Kevin Russell
Clare Murphy-Hogan
Steve Howe

- ARMand (AJ) and Steve off to drop ~~bat~~ cable spool and canoe near Fire Stn North
- Clare and Kevin paddle down to Join
- Begin run from Fire stn to Rainbow Gardens

1700 - near Pedestrian Bridge, Mobing out

1730 End of Day

Location LVW Date 3/5/18

Project / Client Pedestrian Bridge

0800 Meet near Pedestrian Bridge
Complete run upstream from
Fire station to Calico Ridge
Weirs
Joe Caputo AECOM
Kevin Russell
Clare Murphy Hagan
C. Steve Howe

1600 setting up DTS

5459 out of water
below Rainbow Gardens

5434 into first bath 15'
5419 out

7'

5412 into second bath
5397 out of second 15'

~~15~~:21
:21 AM 3/6 GMT
RGTOFSS start
~~5/2~~

Location LVW Date 3/6/18

Project / Client NDEP/NERT

Clare Murphy Hagan
C. Steve Howe
0730 C. Kratt on site at RG
H & S Tailgate
Splicing Cable back together
Dead Beaver found nearby
First Splice unsuccessful
Attempting Second Splice
1400 Second splice successful

C. Kratt & S. Howe to airport

Battery Swap and data
download at FS to RGS

1530 End Day
~~[illegible]~~

Location ____ Date 3/7/18

Project / Client ____

~~Clare Murphy Hayen~~
~~C. Steve Howe~~
CSH

Location ____ Date ~~3/8/18~~ 3/7/18

Project / Client ____

C. Steve Howe at Stakeholder meeting
Clare & Joe Caputo on site

Location

Date 3/8/18

Project / Client

Clare Murphy Hagen
C. Steve Home

Service DTS
Pull 3 kids to Rainbow
Gardens South

Location

Date 3/9/18

Project / Client

C. Steve Home
Clare Murphy Hagen
Kevin Russell
Joe Caputo

Installing DTS
3 kids to Rainbow North
bank

Arrived 0800-0830*
* Clare & Steve pipe and
data transmission

Prepping to start 0900

Location LV Wash Date 5/1/18

Project / Client NERT

0900 Begin setting up at T6.5

0910 Sample A Location:

Temp 19.62 °C
pH 6.78

pH ~~mV~~ -4 mV
ORP 190 mV
Cond. 2.28 mS/cm
Turbidity 0.0 ntu
D.O 80.5 % 6.38 mg/L
TDS 1.45 g/L
PPT 1.2
ØT 0.0

Depth: ~~1.35~~ 1.2 ft.

Collect Sample A

Location Date 5/1/18

Project / Client

0940 Collect Sample B

Horiba Readings:

Temp 21.58 °C
pH 7.54
pH -46 mV
ORP 116 mV
Cond. 1.73 mS/cm
Turb. 0.0 ntu
D.O 8.34 mg/L
D.O 94.3 %
TDS 1.11 g/L
PPT 0.9
ØT 0.0

Collect Sample B

Location Date 5/1/18

Project / Client

0950 Collect Sample C

Horiba Readings:

Temp	20.9	°C
pH	7.7	
pH	-54	mV
ORP	125	mV
Cond	1.71	mS/cm
Turb.	0.0	ntu
D.O.	9.08	mg/L
D.O. ~~TDS~~	104.8	%
TDS	1.10	g/L
PPT	0.9	
θT	0.0	

Collect Sample C

Location Date 5/1/18

Project / Client

0955 Collect Sample D

Horiba Readings

Temp	19.85	°C
pH	7.82	
pH	-61	mV
ORP	108	mV
Cond.	1.73	mS/cm
Turb.	31.1	ntu
D.O	7.41	mg/L
D.O.	83.6	%
TDS	1.11	g/L
PPT	0.9	
θT	0.0	

Collect Sample D

Location ______ Date 5/1/18

Project / Client ______

1010 Begin transect T6.5

	Length (ft.)	Depth (ft)	
	-0	0	~~Sample A~~ Shore
	-15	3.0	
	-30	40.5 in.	(Edit) 3.38 ft.
10:36	-45	2.0	
	-60	1.25	
	-67	1.1	Sample B
1103	-80	0.76	
	-95	0.92	
	-110	16 3/4 in.	1.40 ft.
	-125	0.82	
	-140	0.32	
	-155	0.50	
	-170	0.54	
	-185	0.65	
	-196	1.07	Sample C
1120	210	1.26	
	225	1.00	
	240	0.85	
	255	1.01	
	270	0.60	Sample D
	273	0.00	Shore
	5	17" (1.42)	Sample A

Location ______ Date 5/1/18

Project / Client ______

1130 Finish transect. All stakes removed.

Location LV Wash Date 5/2/18

Project / Client NLRT

0830 Arrive Site

0930 Begin Transect T6.0
Note that south side of wash is ≈ 50' wider than last time (previous sample "A" location is ≈ 50' into wash).

Length (ft.)	Depth (ft.)	
0	0	
1	0.52	(Sample A)
15	0.58	
30	1.0	(Sample B)
45	0.43	
60	0.50	
75	0.65	
90	2.83	
105	3.08	
120	2.35	
135	1.63	(Sample C)
146	0.0	Encounter island
179	0.0	End Island
194	0.9	
210	1.75	(Sample D)
225	2.0	

Location

Date 5/2/18

Project / Client

Length (ft)	Depth (ft)	
240	1.69	
257	0.7	Sample E
260	0.0	End Transect

11:00 Finish Transect
11:15 Mob to T4.65

1155 Begin transect T4.65

Length (ft)	Depth (ft)	
0	0	
3	0.42	(Sample A)
15	1.83	
30	1.25	
45	2.0	
60	2.0	
75	1.92	
90	1.88	
105	1.83	
120	1.79	
135	1.92	

Location ______ Date 5/2/18

Project / Client ______

Length (ft)	Depth (ft)
150	2.0
165	1.83
180	1.83 (Sample B)
195	2.08
210	2.0
225	1.88
240	1.67
255	1.38
270	1.42 (Sample C)
285	1.63
300	1.33
315	1.75
330	1.63
345	1.92
360	1.75
375	1.67
390	1.79
405	1.71
420	1.08 (Sample D)

Approx 20 ft to water's edge.
Cannot get through vegetation.

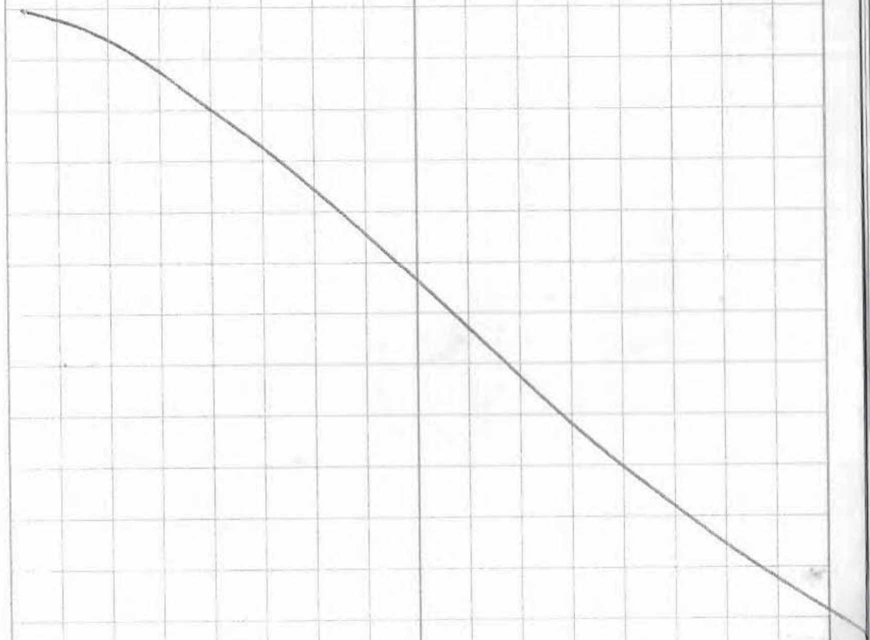
Location ______ Date 5/2/18

Project / Client ______

1:35 Finish transect T 4.65

2:30 Begin helping other team on T4.8

4:45 Finish T4.8, leave site



Location LV Wash Date 5/3/18

Project / Client NERT

.0830 Arrive at Pabco Park.

0920 Begin collecting samples A

T 6.0

0930 Collect Sample A

Total Depth = 0.6

Sample Depth = 0.4

Horiba Readings:

Temp	24.72°C
pH	6.60
pH	6 mV
ORP	191 mV
Cond.	2.24 mS/cm
Turb.	22.0 ntu
DO	7.32 mg/L
DO	90.5 %
TDS	1.43 g/L
PPT	1.1
θT	0.0

Location Date 5/3/18

Project / Client

0935 Collect Sample B

TD = 0.96

Sample Depth = 0.8

Horiba Readings:

Temp	24.76°C
pH	7.00
pH	-16 mV
ORP	160 mV
Cond.	2.23 mS/cm
Turb.	7.5 ntu
DO	7.11 mg/L
DO	89.8 %
TDS	1.42 g/L
PPT	1.1
θT	0.0

Location ______ Date 5/3/18

Project / Client ______

0945 Collect Sample C

TD = 1.52
Sample Depth = 1.3

Horiba Readings:

Temp	24.50	°C
pH	7.17	
pH	-25	mV
ORP	156	mV
Cond.	2.24	uS/cm
Turb.	3.5	ntu
D.O.	6.29	mg/L
D.O.	77.7	%
TDS	1.44	g/L
	1.1	
	0.0	

Location ______ Date 5/3/18

Project / Client ______

0955 Collect Sample D

TD = 1.72
Sample Depth = 1.5

Horiba Readings:

22.79
7.85
-64
149
1.89
3.0
10.23
122.1
1.21
1.0
0.0

Location ______ Date 5/3/18

Project / Client ______

1005 CollectA Sample "E"

TD= 2.33'

Sample Depth = 2.1'

Sample collected ≈ 20' west of prior Sample E location to line up better with transect (mapped).

Horiba Readings:

22.89
7.78
-59
151
1.88
1.8
~~1~~ 8.58
102.0
1.21
1.0
0.0

Location ______ Date 5/3/18

Project / Client ______

1010 CollectA Sample

TD= 0.82

Sample Depth= 0.6

Sample collected at yesterdays Sample E location

Horiba Readings:

22.94
8.08
-77
134
1.87
2.4
9.12
109.2
1.20
1.0
0.0

Location ______ Date 5/3/18

Project / Client ______

1050 Arrive at T 4.65

1055 Collect Sample A

TD: 0.88

Sample Depth = 0.7

Horiba Readings:

22.52
7.79
-60
139
1.91
6.2
6.51
77.2
1.22
1.0
0.0

Location ______ Date 5/3/18

Project / Client ______

11:10 Collect Sample B

TD = 1.72

Sample Depth = 1.5

Horiba Readings:

23.27
7.91
-67
144
1.95
4.2
8.15
97.6
1.25
1.0
0.0

Location Date 5/3/18

Project / Client

11:20 Collect Sample C

TD = 1.28

Sample Depth = 1.1

Horiba Readings

23.59
8.01
-73
145
1.93
4.0
9.00
109.0
1.23
1.0
0.0

Location Date 5/3/18

Project / Client

1130 Collect Sample D

TD = 1.11

Sample Depth = 0.9

Horiba Readings:

23.28
7.91
-67
153
1.87
14.9
7.13
85.1
1.19
0.9
0.0

Finish collecting samples at T4.65

Location ______ Date 5/3/18

Project / Client ______

2:15 Collect Sample at north end of wash (LW4.45N)

TD 0.75

Sample Depth 0.6

Horiba Readings:

25.52
8.20
-84
114
1.97
3.2
7.26
90.8
1.26
1.0
0.0

Location ______ Date 5/3/18

Project / Client ______

2:20 Collect Sample at South end of Wash (LW4.45S)

TD = 0.6

Sample Depth = 0.4

Horiba Readings:

24.89
8.21
-84
140
1.98
18.1
5.82
84.5
1.27
1.0
0.0

Location ______ Date 5/3/18
Project / Client ______

2:35 Collect 2nd sample on south side of wash upstream of last sample $\boxed{LW4.5S}$

TD = 0.56

Sample Depth = 0.4

Horiba Readings:

25.10
8.20
-84
124
1.97
~~#~~ 10.2
6.8
84.4
1.26
1.0
0.0

Location ______ Date 5/3/18
Project / Client ______

3:00 Meet with Rick P. Transfer samples to him for delivery to lab.
3:45 Leave site.

Location ____ Date 5/4/18

Project / Client ____

0900 Arrive at site

0930 Set up at T3.75 for sampling. Conf tim / MDEP with USV.

1000 Begin sampling T3.75
1005 Collect sample B

TD= 1.15
Sample Depth = 1.0

Horiba Readings

23.74
7.23
-32
242
2.02
4.6
9.63
117.2
1.29
1.0
0.0

Location ____ Date 5/4/18

Project / Client ____

1010 Collect Sample C

TD = 1.4
Sample Depth = 1.2

Horiba Readings:

23.96
7.64
-55
193
2.0
3.3
9.19
112.6
1.28
1.0
0.0

Location
Date 5/4/18
Project / Client

1025 Collect Sample D

TD = 1.5
Sample Depth = 1.3

Horiba Readings:

23.80
7.97
-73
174
2.02
4.0
8.75
106.2
1.29
1.0
0.0

Location
Date 5/4/18
Project / Client

1035 Collect Sample E

TD = 0.42
Sample Depth = 0.2

Horiba Readings:

23.56
7.80
-64
162
2.34
3.5
7.51
90.9
1.49
1.2
0.0

Location ______ Date 5/4/18

Project / Client ______

1035 Collect Sample A

TD = 0.92

Sample Depth = 0.7

Horiba Readings:

24.10
8.15
-83
106
2.04
2.0
9.53
116.2
1.31
1.0
0.0

1105 Finish transect 3.75

Location ______ Date 5/4/18

Project / Client ______

1150 LW3.55 - Collect Sample

TD = 2.0

Sample Depth = 1.8

Horiba Readings

25.04
8.10
-81
128
2.13
5.7
~~[illegible]~~ 130
30.3
1.36
1.1
0.0

Rite in the Rain

Location

Date 5/4/18

Project / Client

1220 Collect sample LW3.4
TD = 1.32
Sample Depth = 1.1
Hundra Readings:

25.48
8.29
-92
126
2.06
5.6
9.86
123.0
1.32
1.1
0.0

Location

Date 5/4/18

Project / Client

1450 LW 8: 4.735
TD: ~~22~~ 2.67
Sample Depth: 2.4

Temp 25.81
pH 7.96
ORP 151
Cond 2.93
DO mg/L 6.43
DO% 81.3
Turb 25 NTU

Location
Date 5/4/18

Project / Client

1515 LW 4.73 ~~0~~ N
TD: ~~2.35~~ 2.25
Sample Depth: 2.15

Temp 26.33
Ph 7.87
ORP 56.0
Cond 2.36
Turb ~~1.0~~ 8.2
DO mg/L 4.39
DO% 56.6

Location
Date 5/5/18

Project / Client
Sames McCoy & Petros Paevlos

0930 Arrived on-site & calibrated equipment

1000 $\boxed{LW 3.1}$ Firestation
12 TD = 1.95
Sample Depth = 1.80

Temp 24.21
Ph 7.41
ORP 174
Cond. 2.04
Turb 2.8
DO mg/L 11.20
DO% 137.0

$\boxed{T3.5}$ B
1125 TD = 10" = 0.83
Sample Depth = 0.70
Temp: 25.30 DO%: 130
Ph 7.82
ORP 85
Cond.: 2.12
Turb.: 0.1
DO mg/L: 10.41

Project / Client

3-5 sample E shallow sample
-12:50 sampledepth 2.1ft
temp 22.29
PH 8.43
ORP 107
Cond 2.07
Do mg/L 10.02
DO% 123.7
turb 1.0

T ~~4~~ 5.85 1530
~~29ft+38ft~~

Length	Depth
300	+3 above ground
325	+2.5 above ground
345	0.33
355	2.1 ft
365	+2ft above ground

1700 James Mcloy & Petros Palavs left site

Project / Client

0900 arrived onsite and filled out H&S plan; calibrated equipment
-Safety meeting

LW-3.68
Total depth 11 in
sample depth 10 in ≈ 0.83
temp 24.04
PH 7.10
Cond 3.37
turb 0.7
DO mg/L 5.65
DO% 67.2
ORP 92

Sample Collected 1030

Dup & Field Blank collected at 3.68

Location ____ Date 5/5/18

Project / Client ____

3.5 SAMple A - depth 0.45ft
Total depth 0.5 ft

temp 26.83 c
PH 7.71
ORP 94
Cond. 0.002
turb. 95.9
DO mg/L 9.74
DO% 123.5

- 11:40 sample time

3.5 Sample C - sample depth 2ft
Total Depth 2.1 ft
- 12:00 sample time

Temp: 25.49
Ph: 8.04
ORP: 114
Cond: 2.12
NTU 1.7
DO mg/L: 11.88
DO%: 148.2

Location ____ Date 5/5/18

Project / Client ____

3.5
Sample D 1213 - time
TD = 2.5
SD = 2.4'
Temp: 25.61
Ph: 8.21
ORP: 118
Cond. 2.06
Turb: 2.0
DO mg/L: 11.93
DO%: ~~[illegible]~~ 149.6

Sample E - 1240
total depth 6.6 ft
temp 27.00
PH 8.26
ORP 115
Cond 2.08
Turb 1.2
DO mg/L 9.36
DO% 149.6

deep sample 6.4 ft
-1240
De.

Location Date 5/5/18
Project / Client

3.5 sample E shallow sample
-12:50 smp depth 2.1 ft

temp	22.29
PH	8.43
ORP	107
Cond	2.07
Do mg/L	10.02
DO%	123.7
turb	1.0

T ~~4~~ 5.85 1530

~~2942 +38ft~~

Length	Depth
300	+3 above ground
325	+2.5 above ground
345	0.33
~~360~~	2.1 ft
365	+ 2 ft above ground

1700 James McCoy & Petros Palous left site

Location Date 5/6/18
Project / Client

0900 arrived on site and filled out H&S plan ; calibrated equipment
-Safety meeting

LW-3.68
Total depth 11 in
sample depth 10 in ≈ 0.83

Temp	24.04
PH	7.10
Cond	3.37
turb	0.7
DO mg/L	5.85
DO%	67.2
ORP	92

Sample Collected 1030

Dup & Field Blank collected at 3.68

Location
Date 5/~~6~~/18
Project / Client

LW-3.11 11:18
~~total~~ depth - 2 ft
sample - 1.9 ft

temp 24.98
PH 8.02
ORP 117
Cond 2.14
DO mg/L 9.07
DO % 112.6
turb 4.2

sample collected
11:18

~~LW 3.15 total depth 21.5~~
~~temp 25 26~~
~~PH 9.38~~
~~sample depth 1.67 ft~~
~~ORP 71~~
~~Cond 2.14~~
~~Field Dup~~
~~turb 3.2~~
~~DO mg/L 6.46~~
~~DO % 80.5~~
recollected

Location
Date
Project / Client

LW 3.2 1400 Deep
TD=49 1/2 inches 4.08
SD= 3.9
Temp= 26.48
Ph=8.56
ORP= 111
Cond.=2.17
Turb=4.5
DO mg/L=9.49
DO%= 12~~0~~.5

LW 3.2 Shallow 1415 DUP
~~TD~~ SD=1.33
Temp= 26.03
Ph=8.79
ORP=97
Cond. 2.18
Turb=5.1
DO mg/L=9.43
DO%= 116.0

Location
Date 5/6/18
Project / Client

LW3.15 1450
TP = 266
SD = 2.4
Temp = 26.15
Ph = 8.55
ORP = 119
Cond = 2.19
TDU = 4.4
DO mg/L 8.84
DO% 112.4%

Field Duplicate collected

Off water at approximately 1530

Location
Date
Project / Client
5/7/18 James & Petros

0830 Arrived on-site to collect stakes & do transect
T 3.8

Dist.	Depth
0	0' bank south
1'	0.4 Sample A
15'	1.35
30'	1.0
45'	0.9
60'	0.95 Sample B
75'	1.1
90'	1.12
105'	1.0
120	1.1
135	0.9 Sample C
150	1.0
165	0.95
180	0.97
195	0.70
210	0.85
225	0.75 ← 0320.6'
240	0.40
255	0.80 Sample D
270	0.95

→

Location ______ Date ______

Project / Client ______

Length	Depth
285	0.75
300	0.76
315	0.75
330	0.63
345	0.45
360	0.5
375	0.0

- No shape for sample E will have original transect from Terrasync sent as well. Redid this transect in ArcPad. Sample E location is on another GPS - JM

+ Left site @ 1030 am
+ Packed up equipment & shipped
+ Organized samples & dropped off
+ Dropped off supplies @ NERT

Location WERF TRANSECT Date 4-30-18

Project / Client Purdy (1/6)

0900 - teams meet @ 3 kids
~70F SUNNY
- SITE
- S/T/F
- water
- wildlife
- orientation for project & sampling

JOE JAMES
PETROS KEOW
STEVE RICK

1000 Steve & Petros - staff gauges
James & Kevin - to WERF
Joe & Rick - GPS & Bottles
1130 back @ 3 kids
demo run @ TM 3.8.

@ 3.8 SCHEME
RM - DIST (transect)
A, B, C (grabs)
start @ south bank
A = bank
ϕ = bank.

Location ~~NERr TRANSECT~~ Date 4.30.18

Project / Client Purdy 2/6

@ 3.8	FROM SHORE		TIME
SHORE	ø		
STAFF GAGE -10	10'	(1.24')	12:32
-25		1.39	
-40		1.00	
-55		0.87	
-70		0.85	
-85		0.97	
-100		0.96	12:39
-115		1.09	
-130		1.13	
-145		0.92	
-160		1.09	
-175		1.07	
-190		0.94	
205		0.68	1244
220		0.87	
235		0.81	
250		0.53	
265		0.83	
280		1.08	
295		1.06	
310		0.73	1248
325		0.71	

Location NERr TRANSECT Date 4.30.18

Project / Client Purdy 3/6

3.8	340	~~[illegible]~~ 0.67	
	355	0.55	
	370	0.52	
*	385	2" 8/16"	(0.24')
	~~400~~ 396	5.5"	0.46
	411	0' (NORTH BANK)	
		(12:55) end.	

STAFF GAGE 1.28 1310

A

B

C 0.87'

D

E

1310 finished @ 3.8
moving d/s to 3.25'

Location WEIR TRANSECT Date 4.30.18

Project / Client Purdy 4/6

3.75	Ø	10.5"	0.88'	1340
(SG - 1.22 @ 1319)				
	- 15	7.5	0.63	
	30	7 3/4	0.65	
	45	10 3/4	0.90	
	60	12 1/2	1.04	
B	75	15	1.25	
	90	17 1/2	1.46	
	105	9	0.75	
	110		0.25	
	120	7"	0.58	
	124		1.17	1350
	(SG = 1.22 @ 1350)			
	139	10 3/4	0.90	
	154	22 3/4	1.90	
	164	6"	0.50	
	174	17 1/2"	1.46	
C	184	17"	1.42	1357
	194		1.67	
	204	3 1/2	0.29	
	214	10"	0.83	
	221	0"	0.	
	224	-3"	-0.25	

Location WEIR TRANSECT Date 4.30.18

Project / Client Purdy 5/6

	226	0.25'		1402
	229	0	0	
	231		-0.25	
	234	0	0	
	237		0.75	
	240	3 1/2"	0.29	
	250	2 1/2"	0.21	
	260	5	0.42	
	270	10 1/2	0.88	
	280	12	1.0	
	290	8	0.67	
	300	11 1/2	0.96	
	310	12	1.0	
D	321	8	0.67	1412
	330	11	0.92	
	340	6	0.50	
	350	19 1/2	1.65	
	360	7 1/2	0.63	
	370		1.21	
	380	7 1/2	0.63	
	390	18	1.50	
	400	19 1/2	1.63	
	410	9 1/2	0.79	

Location NBRT TRANSECT Date ~~5-1-18~~ 4.30.18 6/6

Project / Client Purdy

3.75 -420	10½	088	
430	9	0.75	
440	1.5	0.13	
450	6	0.50	
E 455	9	0.75	1423
458	0	0	

-end-

- SG @ 1.39 14:30 -

1445 leave 3 kids for upstream
1510 @ upper narrows to recon
1530 @ duck Creek
- assess transect locations
1600 off site

R 4/30/18

Location NBRT TRANSECT Date 5.1.18

Project / Client Purdy 1/5

60477365 . 2015.1578.01
TRANSECT & GRAB SAMPLING

0845 deploy @ 6.8

A pH 6.34 ORP 200
washing stah. TEMP 18.69 COND 2190
DO 6.06 TURB 55.9
DEPTH 20.25" (1.7')
@ 08:55

0900 B 17" (1.4')
pH 7.42 ORP 159
TEMP 19.68 COND 2240
DO 7.31 TURB 5.3
W/ FD @ 0905
0910 (FD)

Location WEIR TRANSECT Date 5.1.18

Project / Client Purdy 2/5

0908 C 11.5" (0.9')

Temp	20.21	DO	8.23
pH	7.79	ORP	144
TURB	3.0	COND	2080

@ 0910

0915 D

		DO	8.05
TMP	21.20	ORP	134
pH	8.00	COND	1690
TURB	1.1	DEPTH	7.825" (0.7')

w/ MS/MSD.

@ 0920

0925 E 11" (0.9')

TMP	19.61	DO	6.47
pH	7.95	ORP	128
TURB	4.3	COND	1700

@ 0930

Location WEIR TRANSECT Date 5.1.18

Project / Client Purdy 3/5

6.8	0'	11½	0.96			
A	3.5	20"	1.67			
	15	23.5"	1.96			
	30	21.5"	1.79			
	45	23"	1.91			
	60	20"	1.67			
	75	17"	1.42			
	90	18"	1.5			
	105	18"	1.5			
	120	16"	1.33			
	135	17"	1.42	B	155'	
	150	20.5"	1.71		10:00	
	165	19.5"	1.63		20.5	1.71
	180	18"	1.5			
	195	16"	1.33			
	210	15"	1.25			
	225	13½	1.13			
	240	15"	1.25			
	255	16.5	1.375			
	270	15	1.25			
	285	13"	1.10			
	300	11½"	0.96	C	318	
	315	12	1.0		10:15	
	330	15"	1.25		12"	

Location WEST TRANSECT Date 5.1.18

Project / Client Purdy 4/5

6.8 -	345	12"	1.0	
-	360	13"	1.~~10~~08	
-	375	11"	0.92	
-	390	9"	0.75	
-	405	8"	0.67	
-	420	9.5"	0.79	
-	435	10"	0.83 D	453'
-	450	9"	0.75	10:30
-	465	11"	0.92	9"
-	480	12"	1.0	
-	495	6"	0.5	
-	510	9"	0.75	
-	525	9"	0.75	
-	540	11"	0.92	
-	555	12"	1.0	
	570	14"	1.17	
	585	10"	0.83	
	600	13.5"	1.13	
	615	19"	1.58	
	630	18"	1.5	
	645	17"	1.42 E	11 1/2
	660	~~18~~ 13"	1.08	683
	675	11"	0.92	1055
	690			

Location WEST TRANSECT Date 5.1.18

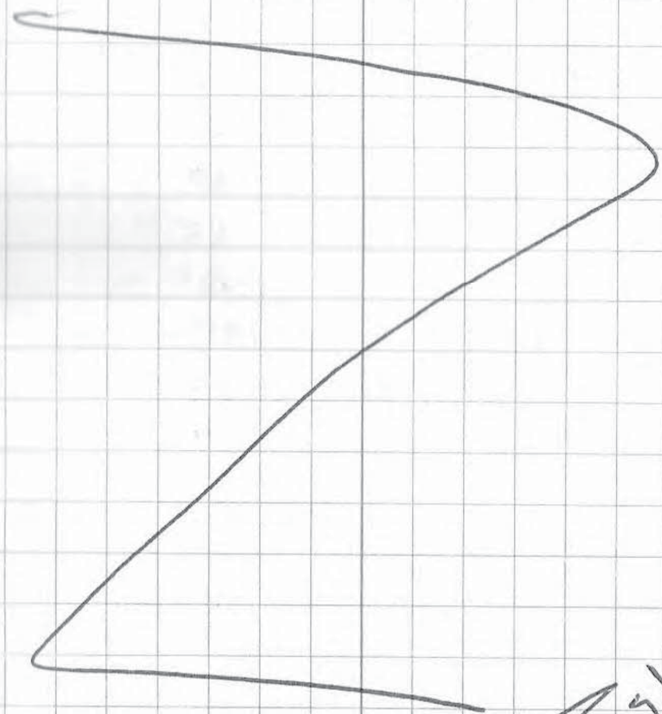
Project / Client Purdy 5/5

6.8 E is ~2' from edge of

- 685 11 1/2

could not get to bank

- Petros or Rich explain in GPS w/ points ~5 m



JC 5/1/18

Location WEIR TRANSECT Date 5.2.18

Project / Client Purdy 1/3

0830 @ PABCO PAVILION
- SHG TAILGATE
- S/T/F - FLOODS
- ON WATER - HEAT
- SCOPE:
- TRANSECTS ONLY TO START
- S/K @ T 6.0
- P/R @ 4-8

4.7	0	~~3~~ 44"
	15	6.4'
	270	19.5"
	255	15"
	240	19"
	225	21"
	210	27"
	195	24"
	180	34½"
	165	23"
	150	15"
	135	12"
	120	9"
	105	10"
	~~80~~ 65	35"

Location WEIR TRANSECT Date 5.2.18

Project / Client Purdy 2/3

80	27"	
50	39"	
25	6' 11"	
385	8"	stake
386	6'½"	bank
370	11"	
355	20"	
340	19"	
325	19"	
310	22½"	
295	22"	
285	24"	1207

1240 @ T 3.9
- recon; no canoe needed

1300 Start transect.

3.9	0	0"
	15	9½"
	30	13"
	45	5"
	60	7"
	75	13½"
	90	14"

Location WEIR TRANSFER Date 5.2.18

Project / Client Purdy 3/3

	105	13"	
	120	12"	
	135	19"	
	150	18"	
	165	10	
1318	180	13"	C
	195	16	
	210	10	
	225	13	
	240	11	
	255	8	
	270	11	
	285	9	
1330	~~300~~ 293	7"	D
	306	6"	end
	@ 90		B

1400 RECON LWOS
- south shore Rd bridge
- possible access south of bridge on wetlands trail
- USGS station under bridge

5/4/18

Location WEIR TRANSFER Date 5.3.18

Project / Client Purdy 1

0650 text from KD says LWOS is just east of outlet; access from development

0830 @ PABCO
- cal check
- plan of attack
- SHE

0930 @ TS.5

			approx position	ft.
	250	17 1/2"		
	235	8 1/2	60'	8"
	220	33"	45'	8"
	205	12"	30'	8"
	190	7"		N →
	175	7"		
	160	+3"		
1600	265'	45"		
1600	280'	31"		
1600	292'	20"		
	~130'	+6"		
	110'	3"		
1600	90'	12"		
	75'	6"		

Location ______ Date 5 3.18

2/

Project / Client Purdy

4.7 (H) ~~15"~~ 12 1/2 1057

pH 6.67 TURB 1.4

TEMP 22.20 DO 8.62

COND 4.96 ORP 173

400

350 (G) 26" 1111

275 pH 7.15 TURB 0.34

200 temp 22.49 DO 8.70

125 Cond 4.94 ORP 150

75

40 (F) 11 1/2 1120

0 pH 7.20 TURB 0.20

Temp 22.76 DO 9.08

Cond 4.93 ORP 149

(E) 34" 1130

pH 7.32 TURB 5.3

temp 22.95 DO 8.33

Cond 4.89 ORP 147

(D) 9" 1202

pH 7.41 turb 0.0

temp 23.28 DO 8.75

Cond 5.02 ORP 169

Location ______ Date 5/3/18

Project / Client ______

(C) 34" 1213

pH 7.45 turb 0.4

Temp 23.39 DO 8.23

Cond 4.99 ORP 146

(B) 6'3" 1232

pH 7.38 turb 0.0

temp 23.49 DO 8.16

Cond 5.04 ORP 140

B1 @ 5.75' ≅ 5.8

B2 @ 2.00 = 2.0

(A) 33" 1250

pH 7.54 turb 0.0

temp 23.92 DO 8.76

Cond 5.04 ORP ~~130~~ 131

1300 off water

1330 @ Rainbow Garden to

Try T3.5

Location ______ Date 5/3
Project / Client ______

T3.5	0'	+3"	A
	19'	13"	B
edge	20		
mid	30	Ø	
edge	40	4"	
back on tang	40'	8"	
	55'	30"	
flow difficulty to get point here	85'	54"	17:00
	100'	25"	
	115'	35"	
	130'	57"	
	145'	96"	
	155'	99"	
	160'	85"	

Location ______ Date ______
Project / Client ______

T3.9 A 3" 0946
pH 7.43 DO 9.48
temp 22.09 cond 2.01
ORP 176 TURB 20.1

B 13½" 0950
pH 7.81 DO 9.71
Temp 22.40 Cond 2.00
ORP 184 TURB ~~#~~ 3.4
FD @ 0955

C 13" 1000
pH 8.01 DO 10.58
Temp 22.55 Cond 1.96
ORP 185 TURB 9.5

D 7" 1010
pH 8.11 DO 10.01
Temp 22.54 Cond 2.01
ORP 186 Turb 5.3

MS 1
MSD 2

Location

Date 5/3/18

Project / Client

1050 @ T3.3

D 15½" 1055

pH 8.39 DO 13.13

temp 23.68 COND 2.05

ORP 150 TURB 6.0

E 20" 1108

pH 23.60 DO 12.61

temp 8.39 COND 2.00

ORP 148 TURB 3.9

C 8" 1120

pH 8.52 DO 13.86

temp 23.73 COND 2.07

ORP 137 TURB 2.7

B 15" 1220 DO 10.26

pH 8.12 COND 1.72

Temp 24.15 TURB 9.07

ORP 102

Location

Date 5/3/18

Project / Client

A 4" 1228

9.57

pH 8.40 DO

23.92

ORP 94 temp ~~24~~

TURB ~~95~~ 11.0 COND 2.11

Bottles

15 - 125

2 - 500

4 - 250

1415 BLANKS

T3.3 - 20180504 - 1415 - FB

Location Las Vegas Wash Date 2/9/2017

Project / Client ~~Las Vegas Wash~~ NDEP/NERT

60477365.2015-151

1615 Haul Canoe up bank @ LW5.3

1625 Post Cal and labels

1655 Car packed and ready to mobe waiting for 2nd Canoe to be picked up

1715 2nd Canoe Collected

1716 Mobing to gate @ Pabco Weir

1720 Off site (C. Murphy-Hagan & Tate Yolga)

CMH
2/9/17

Location Las Vegas Wash Date 2/6/2018

Project / Client NDEP/NERT

60477365 ~55°F Sun rising

CMH
2/6/18

0615 On Site at Three Kids Weir → Down N. Pryor and C. Murphy-Hagan

0620 Begin Calibrating YSI (one day rental from Silver State Analytical)

0645 H&S Tailgate
Carlton Onsite

0720 Complete YSI Calibration

0740 Heading out to temp gauge Beginning below Weir

Location #1 (approx 10ft RB)

Total Depth: 1.2 Probe:

Temp: 19.01°C ORP: 63.2

Spec Cond: 2082 DO%: 82.0

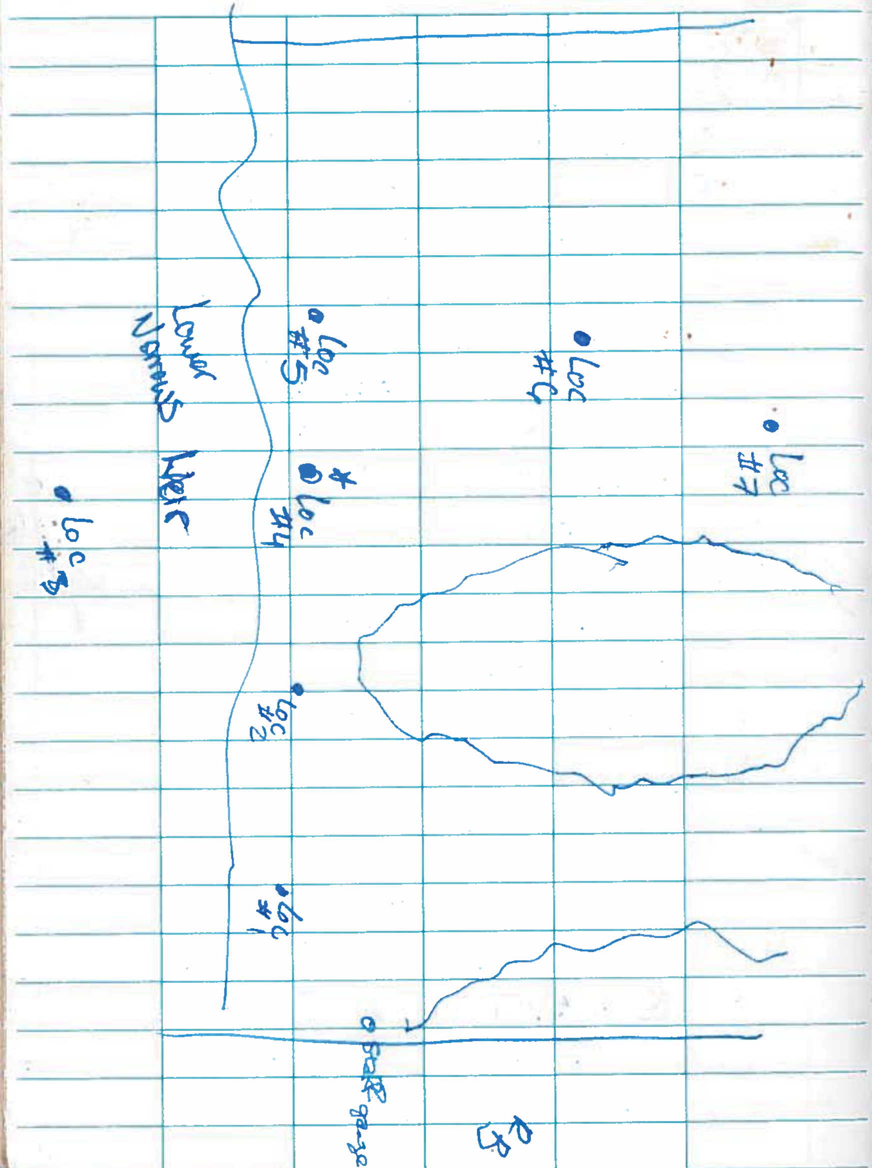
pH: 7.55 DO: 7.57

@ 7:52 AM

Location LAS VEGAS Wash Date 2/6/18

Project / Client NDEP/NERT

5



Location LAS VEGAS Wash Date 2/6/18

Project / Client NDEP/NERT

Sunny 60's

Loc #2 @ 7:50 AM

Temp:	19.09	ORP	56.0
Spec Cond:	2093	DO%	82.9
pH:	7.52	DO $\frac{mg}{L}$	7.61
Total Depth:	1.2		

Loc #3 3.5ft @ 8:00 AM

Total Depth: ~~14.00~~	ORP: 47.4
Temp: 19.00	DO: 88.3%
Spec Cond: 2082	DO $\frac{mg}{L}$: 8.14
pH: 7.59	

* Loc #4 @ 8:04 AM

Total Depth: 1.0	ORP: 45.0
Temp: 19.01	DO: 88.3%
Spec Cond: 2081	DO $\frac{mg}{L}$: 8.12
pH: 7.56	

Loc #5 @ 8:07 AM

Total Depth: 1.5ft	ORP: 42.8
Temp: 18.84	DO: 87.5
Spec Cond: 2055	DO $\frac{mg}{L}$: 8.10
pH: 7.55	

Location Los Vegas Wash   Date 2/6/18

Project / Client NDEP / NERT

Sunny 60's

Loc #6   @ 8:13 AM

Total Depth:

Temp: 18.85   ORP: 37.0

Spec Cond: 2057   DO%: 88.1

pH: 7.58   DO mg/L: 8.14

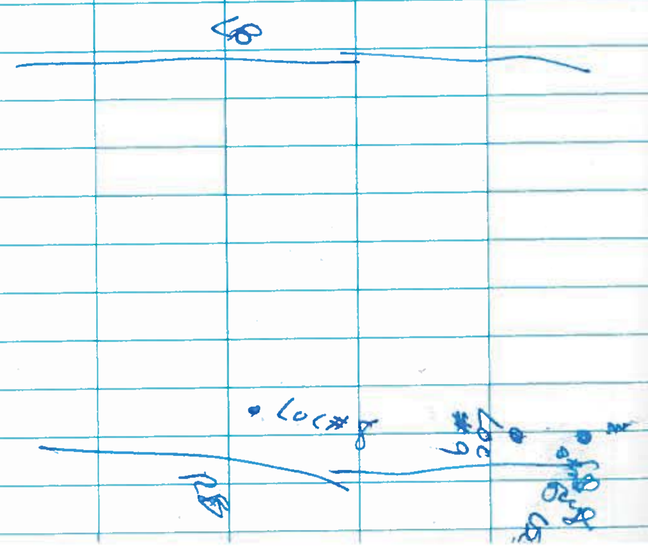
* Loc #7

Total Depth: 1.2 ft   @ 8:18 AM

Temp: 19.01   ORP: 34.6

Spec Cond: 2080   DO% 89.3

pH: 7.55   DO mg/L 8.23



Location Las Vegas Wash   Date 2/6/18

Project / Client NDEP / NERT

Sunny 60's

Loc #8   0829 AM

>3 ft

Temp: 18.74   ORP ~~7.53~~ 35.0

Spec Cond: 2088   DO% 83.3

pH: 7.53   DO mg/L 7.69

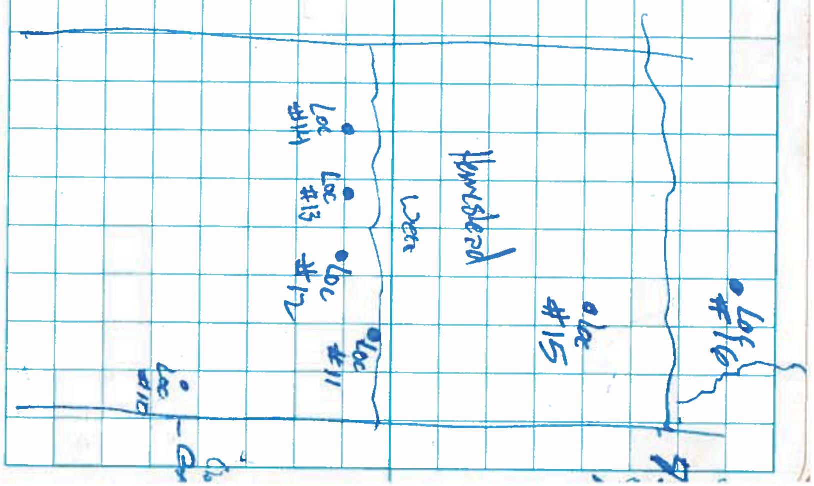
Loc #9   0832 AM

Total Depth: >3 ft   ORP: 37.0

Temp: 18.54   DO%: 80.4

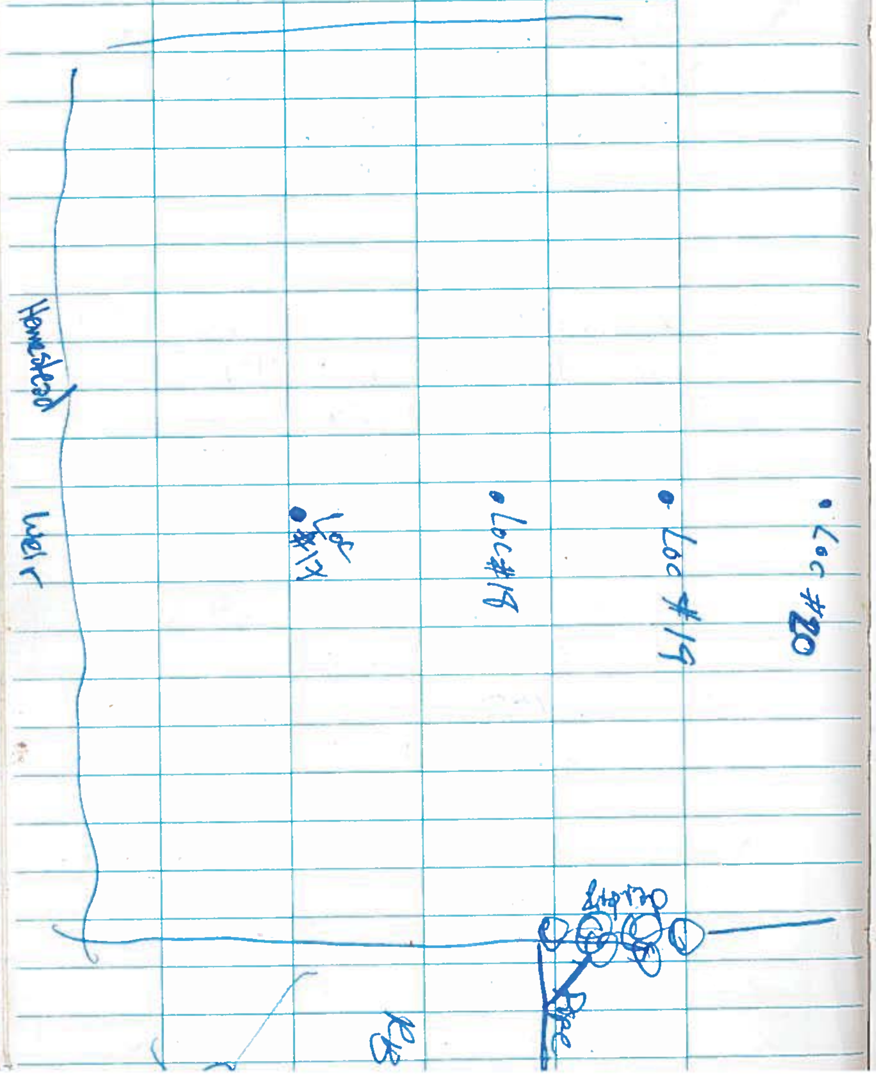
Spec Cond: 2074   DO mg/L: 7.44

pH: 7.50



Location LAS VEGAS WASH Date 2/6/18

Project / Client NDEP/NERT



Location LAS VEGAS WASH Date 2/6/18

Project / Client NDEP/NERT

Sunny 60's

Loc #10 @837AM

Total Depth >3ft

Temp: 18.40	ORP: 35.8°
Spec Con: 2068	DO%: 77.1
pH: 7.30	DO: 7.15

Loc #11 @

Total Depth: ~~18.84~~ 1ft

Temp: 18.84	ORP: 34.7
Spec Con: 2082	DO%: 85.7
pH: 7.53	DO mg/L: 7.89

Loc #12

Total Depth: 2.0ft

Temp: 18.97	ORP: 37.7
Spec Con: 2080	DO%: 87.8
pH: 7.54	DO mg/L: 8.10

Loc #13

Total Depth:

Temp: 19.00	ORP: 35.0
Spec Con: 2079	DO%: 89.4
pH: ~~[illegible]~~ 7.55	DO mg/L: 8.24

Location LAS VEGAS WASH Date 2/6/18

Project / Client NDEP/NERT

Sunny 65-70°F

Loc #14 @900 AM
Total Depth:
Temp: 18.97 ORP: 33.8
Spec Cond: 2062 DO%: 90.6
pH: 7.57 DO mg/L: 8.37

Loc # 15 @922 AM
Total Depth: 1.2 ft ORP: 35.0
Temp: 19.05 DO%: 95.3
Spec Cond: 2079 DO mg/L: 8.77
pH: 7.67

Loc # 16 @928 AM
Total Depth: ORP: 35.6
Temp: 19.06 DO%: 92.7
Spec Cond: 2081 DO mg/L: 8.54
pH: 7.63

Location LAS VEGAS WASH Date 2/6/18

Project / Client NDEP/NERT

Sunny 65-70°F

Loc #17 @ 0931 AM
Total Depth: 1.0 ORP: 30.8
Temp: 19.14 DO%: 97.3
Spec Cond: 2076 DO mg/L: 8.95
pH: 7.70

Loc #18
Total Depth: 1.5 ft @ 0935 AM
Temp: 19.13 ORP: 31.2
Spec Cond: 2074 DO% 96.8
pH 7.66 DO mg/L 8.91

Loc #19
Total Depth: 0.8 ft ORP: 29.9
Temp: 19.17 DO%: 97.8
Spec Cond: 2075 DO mg/L: 8.98
pH: 7.71

Location LAS VEGAS WASH Date 2/6/18

Project / Client NDEP/NERT

Sunny 70°F breezy

Loc #20 @ 1012

Total Depth: 0.7ft ORP: 71.1 dropping

Temp: 19.37 DO%: 100.4

Spec Cond: 2083 DO mg/L: 9.18

pH: 7.77

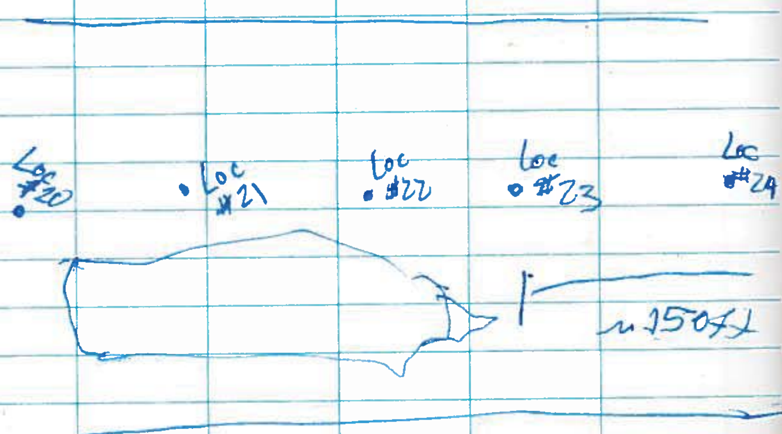
Loc #21 @ 1015

Total Depth: 0.7ft ORP: 61.1 dropping

Temp: 19.38 DO%: 98.8

Spec Cond: 2076 DO mg/L: 9.05

pH: 7.72



Location LAS VEGAS WASH Date 2/6/18

Project / Client NDEP/NERT

Sunny 70°F breezy

Loc #22 @ 1018

Total Depth: 0.5 ORP: 56.2 dropping

Temp: 19.45 DO% 101.1

Spec Con: 2078 DO mg/L: 9.25

pH: 7.75

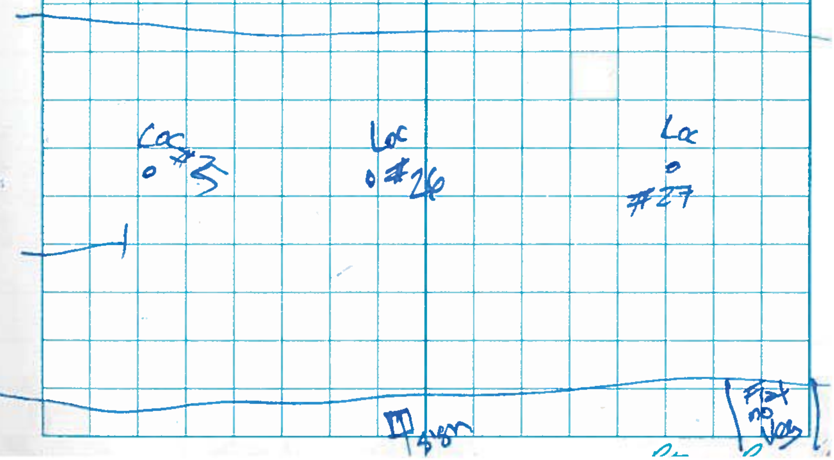
Loc #23 @ 1020

Total Depth: 0.6 ORP 47.4 dropping

Temp: 19.46 DO% 102.1

Spec Con: 2079 DO mg/L 9.34

pH: 7.78



Location LAS VEGAS WASH Date 2/6/18

Project / Client NDEP/NERT

Sunny 70°F breezy

Loc #24 @ 1025 AM

Total Depth: 0.5ft

Temp: 19.77 ORP: ~~73~~ 36.4

Spec Cond: 2080 DO%: 114.9%

pH: 7.90 DO mg/L: 10.44

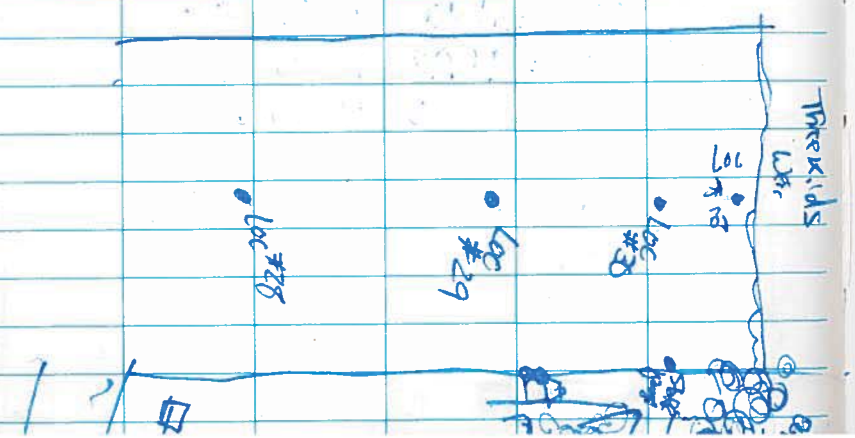
Loc #25 @ 1030 AM

Total Depth: ORP: 37.3

Temp: 19.68 DO%: 110.2

Spec Cond: 2084 DO mg/L: 10.02

pH: 7.84



Location LAS VEGAS WASH Date 2/6/18

Project / Client NDEP/NERT

Sunny 70°F breezy

Loc #26 @ 1035

Total Depth: 0.7

Temp: 19.71 ORP: 58.0

Spec Cond: 2084 DO%: 109.9

pH: 7.86 DO mg/L: 10.01

Loc #27 @ 1041

Total Depth: 1ft

Temp: 19.84 ORP: 45.0 dropping

Spec Cond: 2081 DO% 118.2

pH: 7.92 DO mg/L: 10.72

Loc #28 @

Total Depth: 1ft ORP: 39.7

Temp: 19.92 DO%: 121.8

Spec Cond: 2080 DO mg/L: 11.11

pH: 7.95

Location LAS VEGAS WASH Date 2/6/18

Project / Client NDEP/NERT

Sunny 70°F breezy

Loc #29 @ 1048 AM
Total depth: 0.5 ft
Temp: 19.78 ORP: 35.4
Spec Cond: 2080 DO%: 116.9
pH: 7.88 DO mg/L: 10.61

Loc #30 @ 1052 AM
Total Depth: 1 ft: ORP: 32.8
Temp: 19.88 DO%: 120.1
Spec Cond: 2078 DO mg/L: 10.92
pH: 7.92

Loc #31 @ 1054 AM
Total Depth: 1.5 ft ORP: 27.2
Temp: 20.01 DO%: 131.5
Cond: 2080 DO mg/L: 11.89
pH: 8.00

1100 Out of Wash @ Three Kids Weir

1110 Post Cal

1200 Post Cal Complete

Location LAS VEGAS WASH Date 2/6/18

Project / Client NDEP/NERT

73°F Sunny

1215 Mobing offsite to check for YSI delivery and drop off rental N. Pryor to work on data logger interface set up

Recieve YSI shipment from FEI

Drop off YSI rented from Silver State Analytical

CWH

2/6/17

Location LAS VEGAS WASH Date 2/7/18

Project / Client NDEP/NERT

60477365

0640 C. Murphy-Hagan and N. Pryor on site at Three Kids Weir

0645 Calibrating YSI (New YSI from FEI) Accept Out of Range Spec Con calibration

0715 Moving to below Three Kids

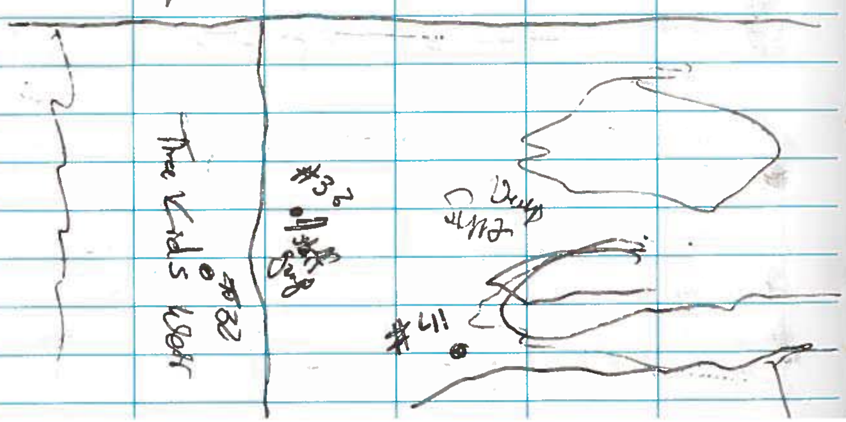
Loc# 32 @ 0727 AM

Approx Total Depth: 0.5 ft

Temp: 17.0 ORP: -96.2 [illegible]

Spec Con: 1400 DO%: 84.6

pH: ~~8.4~~ 7.94 DO mg/L: 7.90



Location LAS VEGAS WASH Date 2/7/18

Project / Client NDEP/NERT

Moving to next access point

Loc #33 @ 730 AM

Approx Total Depth: 1 ft

Temp: 17.04 ORP: -53.1 climbing

Spec Con: 1405 DO%: 73.2

pH: 7.85 DO mg/L: 6.97

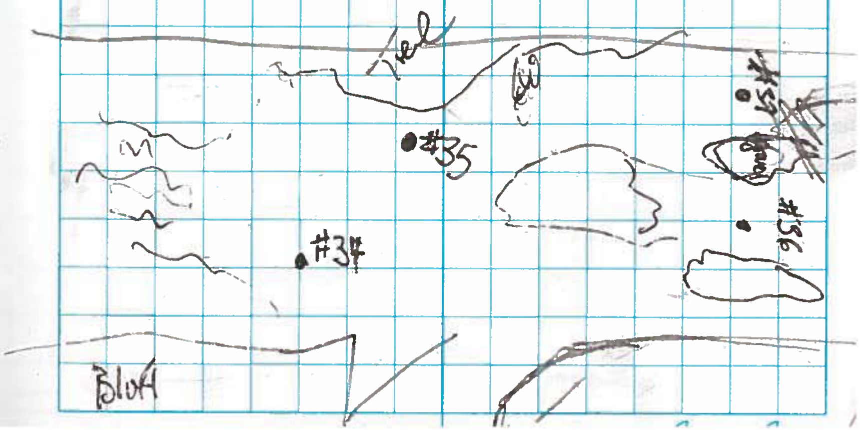
Loc #34 @ 749 AM

Approx Tot Depth: 2 ft

Temp: 17.04 ORP: -81.9

Spec Con: 1455 DO%: 72.0 climbing

pH: 7.82 DO mg/L: 7.16



Location LAS VEGAS WASH Date 2/7/18

Project / Client NDEP/NERT

Loc #35 @805

Approx Total Depth: 1.5 ft

Temp: 16.94 ORP: -120.0 Climbing

Spec Cond: 1401 DO%: 74.0

pH: 7.88 DO mg/L: 7.46

Loc #36 @ 8~~1~~5

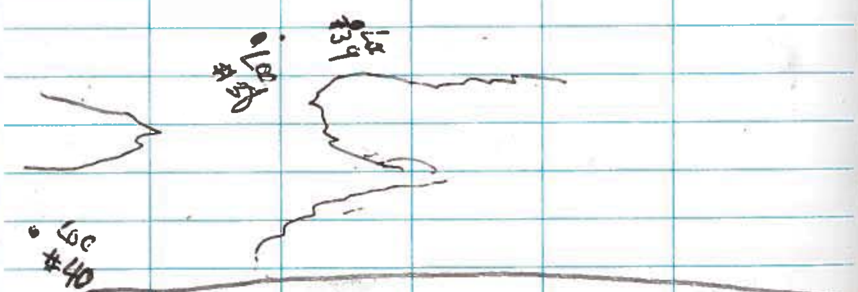
Approx Total Depth: 0.2 ft

Temp: 16.70 ORP: -99.2 Climbing

Spec Cond: 1401 DO%: 78.7

pH: 7.94 DO mg/L: 8.01

Very silty bottom



Location LAS VEGAS WASH Date 2/7/18

Project / Client NDEP/NERT

Loc #37 @82~~0~~

Approx Total Depth: 0.5 ft

Temp: 16.96 ORP: -81.5 dropping

Spec Cond: 1401 DO%: 70.2

pH: 7.87 DO mg/L: 6.80

Loc #38 @ 8~~3~~25

Approx Total Depth:

Temp: 16.95 ORP: -50.0

Spec Cond: 1414 DO%: 70.2

pH: 7.88 DO mg/L: 6.77

LEFT BLANK

CMA 2/7/18

46 Location LAS VEGAS WASH Date 2/7/18

Project / Client NDEP/NERT

Sunny

Loc #39 @827

Total Depth: 1.0ft

Temp: 16.97 ORP: -43.6

Spec Con: 1414 DO%: 70.5

pH: 7.89 DO mg/L: 6.77

Loc #40 @831

Total Depth: 1.5ft

Temp: 17.02 ORP: -35.5

Spec Con: 1417 DO%: 73.9

pH: 7.85 DO mg/L: 7.08

Loc #41 @835

Total Depth: unknown

* Temp: 18.32 ORP: -77.5

Spec Cond: 1828 DO%: 57.1

pH 7.57 DO mg/L: 5.41

Wet soil behind rip rap

* got YSI over Fragmites

Location LAS VEGAS WASH Date 2/7/18 47

Project / Client NDEP/NERT

Sunny

0910 Moburg to park above Rainbow Weir

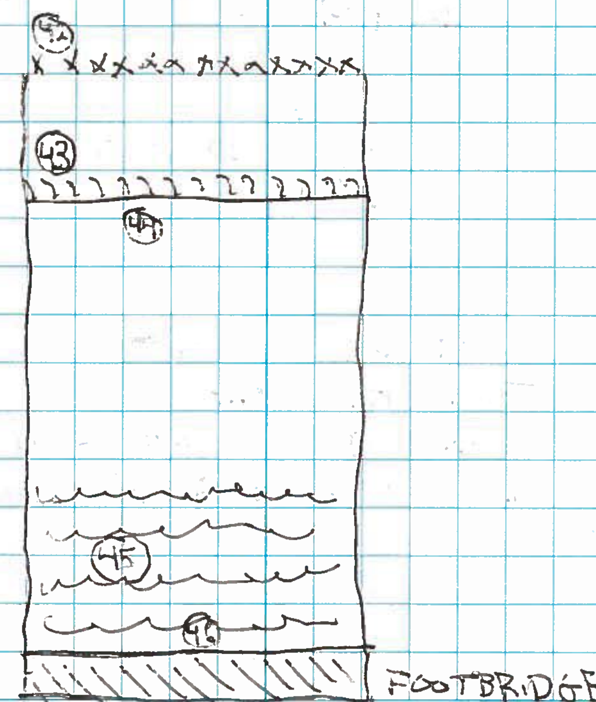
Loc 42 @ Rainbow Weir (above) @ 0927

Depth: >3ft

Temp 16.90 ORP: -33.6

Spec cond: 1438 DO%: 69.1

pH: 7.91 DO mg/L: 6.80



Location LAS VEGAS WASH Date 2/7/18

Project / Client NDEP/NERT

Sunny

Loc. 43 Below Rainbow Weir @ 0938
Depth: 0.5'
ORP: -32.1
Temp: 17.16 %DO: 76.2
Sp cond: 1427 DO mg/L: 7.33
pH: 8.03

Loc 44 @ 942 Depth 0.5'
Temp: 17.26 ORP: -28.3
Sp cond: 1425 DO%: 78.2
pH: 8.08 DO mg/L: 7.51

Loc 45 @ 10:01 0.5'
Temp 17.27 ORP: -28.9
Sp cond 1423 DO% 76.8
pH 8.12 DO mg/L 7.35

Loc 46 10:07 0.5' ~~#4/~~ ~~#7~~ reposition
Temp 17.35 ORP: -24.0
Sp cond 1423 DO% ~88.7 - 178 (rapids) 100.1
pH 8.15 DO mg/L 7.79, ker-ing

Location LAS VEGAS WASH Date 2/7/18

Project / Client NDEP/NERT

Sunny

Loc 47 10:12 @ 2'
Temp. 17.42 ORP -27.1
Sp cond. 1434 DO% 80.1
pH: 8.15 DO mg/L 7.63

~~SE~~ ~~Ane~~

Loc 48 (Anomaly investigation)
Temp: 18.16 ORP: -19.8
Spec Con 1403 DO%: 104.3
pH: 8.11 DO mg/L 9.45
→ no difference observed

Loc 49 (" ")
Temp: 18.27 Spec: 1465
→ no difference observed

Loc 50 (" ")
Temp: 18.19 Spec: 1465
→ no difference observed

Location Las Vegas Wash Date 2/7/18

Project / Client NDEP/NERT

1255 Post Cal YSI
→ DO meter off
→ recal DO and check
→ reading 98.0% and 9.41 mg/L after

Offsite

CMA
2/7/18

Location Las Vegas Wash Date 2/8/18

Project / Client NDEP/NERT

Pre Dawn 45°F

60477365

0615 On site at Calico Ridge
H&S Meeting
Objective thermal anomaly investigation and near bank flow characterization with Trimble for downstream reaches

0630 Calibrating YSI
YSI from yesterday replaced with backup due to inaccurate air temperature reading and poor DO post calibration

0700 Moving to thermal anomaly location

0705 Park down past USGS station between Homestead and Lower Narrows Weir

Location Las Vegas Wash Date 2/8/18

Project / Client NDEP / NERT

(Points today collected in GPS)

0720 Begin Thermal Anomaly Investigation
Notation on GPS:
TAE-# "Thermal Anomaly Exploration"
Spec Con in ~~ms~~ µS/cm
Temp in Celcius
Approx DTB in ft
Approx Flow in ft/s

TAE-1 @ 730 AM
Temp: 18.02
pH: 7.75
Spec Con: 1945
DTB: 1 ft
Flow: 0.25 ft/s

TAE-2 @ 725 AM
Temp: 17.70
pH: 7.82
Spec Con: 1951
DO%: 66.7
DO mg/L: 6.35
ORP: 131.3
DTB 1 ft
Flow: 0

Location Las Vegas Wash Date 2/8/18

Project / Client NDEP / NERT

TAE-3 @ 730 AM
Temp: 18.00
pH: 7.81
Spec Con: 1954
DO%: 69.8
DO mg/L: 6.56
ORP: 131.5
DTB: 1 ft (estimate)
Flow: 0
Tossed YSI over Veg

TAE-4 @ 735 AM
Temp: 17.82
pH: 7.82
Spec Con: 1958
DO%: 71.9
DO mg/L: 6.79
ORP: 131.9
DTB: 0.5 ft
Flow: < 0.25 ft/s

TAE-5 @ 745 AM
Temp: 17.52
pH: 7.83
Spec Con: 1956
DO%: 75.6
DO mg/L: 7.19
ORP: 121.1
DTB: 1 ft
Flow: 0.25 ft/s

TAE-6 @ 750 AM
Temp: 17.04 DTB: ~3ft
pH: 7.81 Approx Flow: 0
Spec Con: 1962
DO%: 72.1 Toss YSI over Veg
DO mg/L: 6.91
ORP: 123.9

TAE-7 @ 755 AM
Temp: 16.34 DTB: 1 ft
pH: 7.80 Approx Flow: 0
Spec Con: 1982
DO%: 72.9 YSI in bent over
DO mg/L: 7.09 fragmites
ORP: 126.5

TAE-8 @ 800 AM
Temp: 17.53 DTB: 0.5 ft
pH: 7.82 Approx Flow: 0
Spec Con: 1943
DO%: 74.8
DO mg/L: 7.08
ORP: 133.2

0805 End Thermal Anomaly Exploration
Begin Midpoint of Change I
Book between Weir data
Collection

@ 0811

SBM-1
Temp 17.89 DTB 2.0 ft
pH 7.80 Approx flow 0.5 ft/s
Spec. Con 1951
DO% 73.7
DO mg/L 6.95
ORP 121.5

USGS AT location to do ADV gauging

Moving to next Location

0820 Park just above Lower
Narrow's Weir

SBM-2 @ 0830
Temp: 17.78 DTB: 1.5 ft
pH: 7.82 Flow: 0.25
Spec Con: 1948
DO%: 76.8 Bank around seems
DO mg/L: 7.25 deeper along bank
ORP: 164.8

Mobing down to bottom of Wash
Park @ Firestation

0845 SBM-3 @ 0850
Temp: 17.63 DTB: 1 ft
pH: 8.03 Flow: 2 ft/s
Spec Con: 1954 fast flowing incised
DO%: 87.6 gravel loose poorly
DO mg/L: 8.31 Sorted
ORP: 167.5

Park between Rainbow Weir
and

SBM-4 @ 0910
Temp: 17.53 DTB: 1.0 ft
pH: 7.98 Flow: 0.25 ft/s
Spec Con: 1951 very
DO% 84.3 Soft near bank
DO mg/L: 8.01 before drop off
ORP: 166.0

Mobing to next location

SBM-5 @ 0923
Temp: 18.13 DTB: 1.5 ft
pH: 7.86 Flow: 0.5 ft/s
Spec Con: 2031
DO%: 84.6
DO mg/L: 7.94
ORP: 188.0 dropping

0945 Mobing to next location

0950 Park between Three Weirs
and Homestead Weir

Location LAS VEGAS WASH Date 2/8/18

Project / Client NERT/NDEP

SBM-6 @ 0957

Temp: 17.87 DTB: 0.5ft

pH: 7.97 ApparFlow: 0.5f/s

Spec Con: 1950

DO%: 86.2

DO mg/L: 8.14

ORP: 171.5

1005 Mobing to Rendavous with Field team.

Attempting to download data from Transducer @ 5.3

— Cannot Connect

Mobing to Transducer above Three Kids

— Cannot open lock

Download data from Transducer from below three Kids Weir

— use 3.75 key

Location LAS VEGAS WASH Date 2/8/18

Project / Client NERT/NDEP

1330 Begin YSI post Calibration

Complete YSI post calibration Check.

1415 Day End

CMA

2/8/18

Location: Las Vegas Wash   Date: 2/9/18

Project / Client: NDEP/NERT   60477365

Pre Dawn 50°F

0600 Begin YSI Calibration C. Murphy-Hagan and N. Pryor

0640 On site at Construction Area near Historic Lateral Weir
— Carlton on site

0700 C. Murphy-Hagan and N. Pryor mobing to begin WQ Monitoring

Park above Calico Ridge Weir

SBM-7 @ 730
Temp: 18.69   DTB: 3 ft
pH: 7.86   ~~DT~~
Spec Con: 2059   Approx Flow: 0.5 ft/s
DO%: 92.7
DO mg/L: 8.59   Poor bank access
ORP: ~~7.86~~ 134.0

Mobing to next location

Location: Las Vegas Wash   Date: 2/9/18

Project / Client: NDEP/NERT

Sunny 60°F

SBM-8 @ 742
Temp: 18.65   DTB: 1 ft
pH: 7.86   Approx Flow: 0
Spec Con: 2094
DO%: 86.3
DO mg/L: 8.00
ORP: 184.0 (dropping)

Mobing to next location

SBM-9 @ 750
Temp: 18.57   DTB: 2.5 ft
pH: 7.83   Approx Flow: 0
Spec Con: 2096
DO%: 87.6   Very bank depth due to riprap
DO mg/L: 8.14
ORP: 168.3   (not wadeable)

Mobing to ~~tech~~ next location

Park near Transducer 5.3 access

Location Las Vegas Wash Date 2/9/18

Project / Client NDEP/NERT

Sunny 60°F

SBM-10 @ 827

Temp: 16.58 DTB: 2.5ft Soft Bottom

pH: 7.95 Approx Flow: 0

Spec Con: 2163

DO% 95.3 Thick Phragmites bank

DO mg/L 9.24 Crash through veg

ORP: 183.2 at Transducer 5.3

✱ STAFF GAUGE @ 5.3 reading 1.32

0840 Downloaded Transducer @ 5.3

Moving to next location

SBM-11 @0900

Temp: 18.69 DTB: 4.4ft rip rap

pH: 7.80 Approx Flow: 0.25

Spec Con: 2127 Construction Zone!

DO%: 94.9 Rip rapped shore line

DO mg/L: 8.81 cleared veg

ORP: 178.3 dropping not represent the Channel

Location LAS VEGAS WASH Date 2/9/18

Project / Client NDEP/NERT

Sunny 65°F

SBM-12 @ 909

Temp: 18.74 DTB: 3 ft

pH: 7.80 Approx Flow: 0.5-1 ft/s

Spec Con: 2129 eddies along shore

DO%: 98.8

DO mg/L: 9.16 Construction Zone

ORP: 178.8 dropping Channel

Rip rapped South Bank

Moving to next location

SBM-13 @ 920

Temp: 18.54 DTB: 2.5 ft

pH: 7.83 Approx Flow: 0.25 ft/s

Spec Con: 2134

DO%: 95.2 Good place to put

DO mg/L: 8.84 in Canoe

ORP: 172.4 center channel faster

Moving to next location

Location LAS VEGAS WASH Date 2/9/18

Project / Client NDEP/NERT

Sunny 65°F

SBM-14 @ 9:42

Temp: 21.21
pH: 7.37 DTB: 1.5ft
Spec Con: 2474 Approx Flow: ~~0~~ ~~1ft~~ 1-3ft
DO%: 96.8 along shoreline
DO mg/L: 8.53 below weir outlet
ORP: 182.9 dropping

INF-1 @ 9:50

Temp 21.35 ORP 120.9↓
pH 7.35 DTB 2'
S. cond 3017 App flow 1.5
DO% 96.6 1st influent
DO mg/L 8.48 w. of gabion

SBM-15 @ 10:10

Temp 18.98 ORP 140.2
pH 7.92 DTB 4
S. cond 2098 App. flow 0
DO% 109.8 - downstream of upper
DO mg/L 10.15 const. area: clear of veg.

Location LAS VEGAS WASH Date 2/9/18

Project / Client NDEP/NERT

Sunny 70°F

SBM-16 @ 1022

Temp: 18.99 DTB: 2
pH: 7.91 Approx Flow: 1 ft/s
Spec Con: 2311
DO%: 109.7 Rip Rapped shoreline SB
DO mg/L: 10.10 of construction
ORP: 169.0 Channel. N/S
(dropping) Bare Soil

SBM-17 @ 1035

Temp: 18.99 DTB: 2 ft
pH: 7.84 Approx Flow: ~~0~~ 1 ft
Spec Con: 2317
DO%: 108.9
DO mg/L: 10.03
ORP: 147.9

Dewater pit
in trench: 19.01°c 3123 sp cond
@ influent: 17.38°c ~~3400~~

1130 Offsite to NERT trailer to offload gear

Location LAS VEGAS WASH Date 2/9/18

Project / Client NDEP/NERT

Sunny 77°F

1300 On site to download transducers
Key to Transducer above 3Kids lost
Post Cal YSI

1415 Collect Transducer @ key 3.60
(S. Howe & N. Pryor) (aka 3.80)

1450 Collect Transducer @ key 5.30
Calico ridge

Collect Transducer @ key 4.65

Collect Barometer

1530 Heading offsite

CMH
2/9/18

Location LAS VEGAS WASH Date 2/10/18

Project / Client NDEP/NERT

Pre Dawn 50°F

2/10/18

0530 Begin YSI calibration

0635 C. Murphy-Hogan and N. Pryor
onsite above Pabco Weir

0640 Park above Duck Creek
Confluence Weir

SBM-18 @ 0645
Temp: 17.20 DTB: 1ft
pH: 7.77 Approx Flow: 0
Spec Con: 2022
DO%: 62.1
DO mg/L: 5.93
ORP: 157.8

~~SBMD~~
Mobe to next location

Location Las Vegas Wash Date 2/10/18
Project / Client NDEP / NERT

SBM-19 @ 650
Temp: 18.74 DTB:
pH: 7.67 Approx. Flow: 0.25
Spec Con: 2066
DO%: 72.1
DO mg/L: 6.68
ORP: 161.4

Mobing to next location

SBM-20 @ 705
Temp: 18.67 DTB: 2ft
pH: 7.67 Approx Flow: 1 ft/s
Spec Con: 2182
DO%: 67.2
DO mg/L: 6.23
ORP: 169.9

Give GPS to G. Knight for Download

Mobing to Transducer Key 5.3

Location Las Vegas Wash Date 2/10/18
Project / Client NDEP / NERT

0730 reset Transducer setting at Key 5.3

Mobing to next Transducer Location near barometer

0745 Download Transducer @ Key 4.75
Cut lock and replace

0750 Begin YSI post Cal

0805 Park at Three Kids to download Transducer above Weir (Cut and replace lock)

0820 Download Transducer @ Key 3.8

0830 Mobe to Duck creek Weir to pick up GPS for Shipping

Location LAS VEGAS WASH Date 2/10/18

Project / Client NDEP/NERT

Recieve GPS for shipping

0900 Mobe to NERT to drop off Waders and lifejackets

0915 Heading to Fedex to Ship YSI's back to FEI and GPS to Camarillo

0930 Shipping done N. Pryor and C. Murphy-Hogan heading back to Hotel to Checkout for Airport

CMH
2/10/18

Location Date

Project / Client

~~30~~ CMM

NERT Water Quality Sonde Calibration Sheet

Temp: 6.57 Pressure: 762 mmHg

Calibration 2/6/18									Temp: 26.53 Post Calibration Press: 762.25			
YSI	lot number	expiration date	calibration standard	reading initial	reading adjusted	temp	date	time	initials	initial reading	temp	time	initials
556MPS	A7174	7/2018	pH 7.0	7.32	7.00	11.85	2/6/18	0702	CMM	6.74	20.21	11:42	CMM
	A7247	8/2021	pH 4.0	3.91	4.00	11.94		0707	NP	3.80	20.26	11:43	CMM
11J102430	A7234	8/2018	pH 10.0	9.97	10.00	11.59		0709	NP	9.74	20.91	11:46	CMM
	12926	9/2018	Cond. 1413	1.560	1413	10.58		0658	CMM	1340	19.54	11:40	CMM
	NA	NA	DO% 100	101.9	100.2	8.45	2/6/18	0630	CMM	97.9	21.62	11:37	CMM
	12963	10/2018	~~Turbidity 0.0~~ ORP	~~78~~ 78.9	100.0	10.04		0713	CMM	88.4	24.93	11:54	CMM
	NA	NA	DO ~~Turbidity 123.0~~ mg/L	11.93	11.74	8.45	2/6/18	0630	CMM	7.74	21.62	11:37	CMM

~~DO mg/L 11.93 11.74 8.45~~ CMM 2/6/18

~~10/2018 ORP 78.9 100.0 10.04 2/6/18~~ CMM 2/6/18

Temp: 4.42°C 770.64 mmHg

Temp: 20.10°C 769.62 mmHg

Calibration 2/7/18										Post Calibration			
YSI	lot number	expiration date	calibration standard	reading initial	reading adjusted	temp	date	time	initials	initial reading	temp	time	initials
556 MPS	G086-14	3/30/19	pH 7.0	7.27	7.00	10.93	2/7/18	655	CMM	6.95	17.85	13:12	NP
	G053-13	3/14/19	pH 4.0	4.08	4.00	10.63		700	CMM	4.16	18.12	13:16	
600336-4M	G037-27	3/8/18	pH 10.0	10.31	10.04	10.80		705	CMM	9.99	17.79	13.14	
13L39	G006-15	1/10/19	Cond.	2066	1409	9.70		0630	CMM	1370	17.95	13.10	
	NA	NA	DO%	148.0	101.4	5.66		0645	CMM	77.7	20.10	13:07	
	NA	NA	~~Turbidity 0.0~~ DO mg/L	18.58	12.73	5.66		0645	CMM	5.88	20.10	13:07	
			Turbidity 123.0										

2/8/18

NERT Water Quality Sonde Calibration Sheet

Temp: 75°F Pressure 30.1 inHg

Temp: 5.03°C Pressure: 30.2 inHg		Calibration 2/8/18								Temp 13.27 Post Calibration			
YSI	lot number	expiration date	calibration standard	reading initial	reading adjusted	temp	date	time	initials	initial reading	temp	time	initials
	G086-14	3/30/19	pH 7.0	7.01	7.00	12.53	2/8/18	6:54	NP	6.98	17.25	1332	CHA
SN 14G103484	G053-13	3/14/19	pH 4.0	3.90	4.00	12.60	2/8/18	6:51	NP	4.05	17.50	1335	CHA
	G087-27	3/8/18	pH 10.0	10.24	10.01	12.89	2/8/18	6:53	NP	10.00	18.81	1340	CHA
17H110	G00645	1/17/19	Cond.	1398	1409	12.20	2/8/18	6:48	NP	1,319	18.90	1330	CHA
	NA	NA	DO%	102.5	100.4	5.20	2/8/18	6:46	NP	81.1	20 ~~14.94~~	1350	CHA
JD ~~77883~~	NA	NA	DO ~~Turbidity 0.0~~ mg/L	13.05	12.76	5.20	2/8/18	6:46	NP	7.34	20 ~~14.94~~	1350	CHA
86888			~~Turbidity 123.0~~										

CHA 2/8/18

2/9/18

Temp: 14.70°C Pressure: 29.91 inH

Temp: 7.27°C Pressure: 762.25		Calibration 2/9/18								Post Calibration			
YSI	lot number	expiration date	calibration standard	reading initial	reading adjusted	temp	date	time	initials	initial reading	temp	time	initials
	G086-14	3/30/19	pH 7.0	6.95	7.00	15.17	2/9/18	0619	NP	7.01	~~22.87~~	1335	CHA
SN 14G103484	G053-13	3/14/19	pH 4.0	4.16	4.00	14.26		0615	NP	4.03	22.23	1339	CHA
	G087-27	3/8/18	pH 10.0	9.96	10.00	14.81		0617	NP	9.98	21.43	1342	CHA
17H110	G00645	1/17/19	Cond.	1363	1409	13.42		0610	NP	1401	22.40	1332	CHA
	N/A	N/A	DO%	79.6	100.3	10.14		0600	CHA	93.6	20.18	1345	CHA
JD ~~77883~~	N/A	N/A	DO Turbidity ~~0.0~~ mg/L	8.96	11.28	10.14		0600	CHA	8.39	20.18	1345	CHA
86888			~~Turbidity 123.0~~										

CHA 2/9/18

NERT Water Quality Sonde Calibration Sheet

CMH 2/10/18

Temp: 2.09 Pressure: 762.51

YSI	lot number	expiration date	calibration standard	reading: initial	reading: adjusted	temp	date	time	initials	Post Calibration: initial reading	Post Calibration: temp	Post Calibration: time	Post Calibration: initials
			pH 7.0										
			pH 4.0										
			pH 10.0										
		out of range	Cond. 1409	1366	1414	10.11		0645					
			DO%	127.5	100.7	2.91		0640	CMH				
			~~Turbidity 0.0~~										
			Turbidity 123.0										

Abandon Cal for other unit

Temp: 8.18 pressure: 756.5

Temp: 7.66 Pressure: 754.13

Calibration 2/10/18

	YSI	lot number	expiration date	calibration standard	reading: initial	reading: adjusted	temp	date	time	initials	Post Calibration: initial reading	Post Calibration: temp	Post Calibration: time	Post Calibration: initials
		G086-14	3/30/19	pH 7.0	7.03	7.00	14.76	2/10/18	0550	CMH	6.96	13.11	0756	CMH
SN:	14G103484	G053-13	3/14/19	pH 4.0	4.04	4.00	15.13	2/10/18	0554	CMH	3.99	13.28	0758	CMH
		G037-27	3/8/18	pH 10.0	10.05	10.00	15.36	2/10/18	0559	CMH	10.01	13.10	0801	CMH
	17H10	G00645	1/17/19	Cond.	1434	1409	15.37	2/10/18	0548	CMH	1595	13.18	0754	CMH
		NA	NA	DO%	123.7	99.4	8.38	2/10/18	0602	NP	79.8	9.24	0811	CMH
ID	77885	NA	NA	~~Turbidity 0.0~~ 10.0 NTU	14.49	11.66	8.38	2/10/18	0603	NP	9.18	9.24	0811	CMH
	86888			~~Turbidity 123.0~~										

CMH 2/10/18

FIELD ENVIRONMENTAL INSTRUMENTS, INC.

ORDER SHEET

1546 E. Spruce Street

Olathe, KS 66061

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www.fieldenvironmental.com

info@fieldenvironmental.com

QA/QC Check Stamp

Fulfilled ____ Whse Mgmt ____

Sales Rep ____ Boxed ____

Shipped ____

Rental Order

Box Markings:

ORDER NUMBER: 360820

Rep: Gary Yamron
Taken By: gyamron

ORDER DATE: 2/5/18
DELIVERY DATE: 2/5/18

Bill To: Clare Murphy-Hagan
AECOM - Portland, ME
Two City Center, Suite 200
Portland, ME 04101
Phone: 207-775-2800
Cell: 503-318-5970
E-mail: Clare.Murphy-Hagan@aecom.com

Ship To: Clare Murphy-Hagan
Hilton Garden Inn Las Vegas/Henderson
1340 West Warm Springs Road, HOLD FOR GUEST
Henderson, NV 89014
Phone: 503-318-5970

Email Inv: N/A

Payment Type: NET 30

Tax %: 0.000% Tax: Code:

Cust. PO: 60477365, task 2015-150B-01

Outgoing Ship Method: BKC - Fed. Ex. Priority Overnight

Outgoing Ship Acct: 2533 2505 4

RENTAL PERIOD: Tuesday, 2/6/18 through Saturday, 2/10/18

Fed Ex Acct: 253325054 UPS Acct:

FS Option: Return Shipping: CON

ORDER ITEMS:

#	Qty	ID:	Class	Months	Rental Terms Weeks	Days	Sale Price	Item Total	Unit#	Return
1	1	1494	YSI 556 Handheld - Rental	$382.50	$127.50	$50.00		$0.00	65715	
	Item Notes:		*No flow thru cell*							
2	1	8918	YSI 556 Field Cable 4M - Rental	$382.50	$140.25	$55.00		$0.00	74996	
	Item Notes:		*Calibration solutions PH 4,7,10 & Cond included*							
3	1	1494	YSI 556 Handheld - Rental	$382.50	$127.50	$50.00		$0.00	77883	
	Item Notes:		*No flow thru cell*							
4	1	8918	YSI 556 Field Cable 4M - Rental	$382.50	$140.25	$55.00		$0.00	86888	
	Item Notes:		*Calibration solutions PH 4,7,10 & Cond included*							

Printed: 05-Feb-18 15:20

"Rely on FEI!"

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Fax: 913-829-3347

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info@fieldenvironmental.com

ORDER SHEET

Rental Order

QA/QC Check Stamp

Fulfilled ________ Whse Mgmt ________

Sales Rep ________ Boxed ________

Shipped ________

Box Markings:

Sub-Total: $0.00
Tax: Code:
Tax: $0.00
Order Total: $0.00

CUSTOMER SIGNATURE: ______________________ DATE: ____________

Terms and Conditions Available at www.FieldEnvironmental.com

Printed: 05-Feb-18 15:20

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Environmental Equipment & Field Supplies

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Olathe, KS 66061

913-829-3330 866-580-5499

Fax: 913-829-3347

www.fieldenvironmental.com

PACKING SLIP

ORDER NUMBER: 360820

Printed: 05-Feb-18 15:20

Rep: Gary Yamron

Taken By: gyamron

ORDER DATE: 2/5/2018

DELIVERY DATE: 2/5/2018

Clare Murphy-Hagan
Hilton Garden Inn Las Vegas/Henderson

1340 West Warm Springs Road, HOLD FOR GUEST
Henderson, NV, 89014
Phone: 503-318-5970

Ship Method: BKC - Fed. Ex. Priority Overnight
Ship Acct: 2533 2505 4
Insure Value: N/A

Qty	Class	Scan Out	Unit ID	Unit S/N	Scan In	Unit ID	Unit S/N	Notes
1	YSI 556 Handheld - Rental	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
	--> YSI 556 Manual	02/05/2018	974	N/A			N/A	No flow thru cell
	--> YSI 556 Handheld - Rental	02/05/2018	65715	11F100175			11F100175	No flow thru cell
	--> YSI 556 Datalogging Cables	02/05/2018	73544	na			na	No flow thru cell
1	YSI 556 Field Cable 4M - Rental	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
	--> YSI 556 Field Cable 4M - Rent	02/05/2018	74996	13L39-2			13L39-2	Calibration solutions PH 4,7,10 & Cond included
	--> YSI 556 Calibration Cup	02/05/2018	85858	N/A			N/A	Calibration solutions PH 4,7,10 & Cond included
	--> YSI 556 Sensor Guard	02/05/2018	70076	na			na	Calibration solutions PH 4,7,10 & Cond included
1	YSI 556 Handheld - Rental	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
	--> YSI 556 Manual	02/05/2018	58203	na			na	No flow thru cell
	--> YSI 556 Handheld - Rental	02/05/2018	77883	14G103484			14G103484	No flow thru cell
	--> YSI 556 Datalogging Cables	02/05/2018	63028	na			na	No flow thru cell
1	YSI 556 Field Cable 4M - Rental	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
	--> YSI 556 Field Cable 4M - Rent	02/05/2018	86888	17H10			17H10	Calibration solutions PH 4,7,10 & Cond included
	--> YSI 556 Calibration Cup	02/05/2018	1666	N/A			N/A	Calibration solutions PH 4,7,10 & Cond included
	--> YSI 556 Sensor Guard	02/05/2018	86533	na			na	Calibration solutions PH 4,7,10 & Cond included

2/7/18

2/8/18

Rental Period: 2/6/2018 to 2/10/2018

CalibrationData:

Special Instructions:

FIELD ENVIRONMENTAL INSTRUMENTS, INC.
www.fieldenvironmental.com

301 Brushton Avenue
Suite A
Pittsburgh PA 15221
800-393-4009 Toll Free
(412) 436-2600 Local
(412) 436-2616 Fax

YSI 556 MPS Calibration Certificate

Cal Standard	Lot #	Expiration	Pre-Cal Reading	Post-Cal Reading	Acceptable Range
PH 7 @ 25C	7709097	9/30/2019	6.73	7.00	(6.86 to 7.14)
			pH mV value	15.7	(0 mV +/- 50mV)

Cal Standard	Lot #	Expiration	Pre-Cal Reading	Post-Cal Reading	Acceptable Range
PH 4 @ 25C	7710071	10/30/2019	4.10	4.00	(3.92 to 4.08)
			pH mV value	185.8	(180.7mV to 195.7mV)

Cal Standard	Lot #	Expiration	Pre-Cal Reading	Post-Cal Reading	Acceptable Range
PH 10 @ 25C	7708378	8/30/2019	9.91	10.00	(9.80 to 10.20)
			pH mV value	-149.5	(-149.3mV to -164.3mV)

Cal Standard	Lot #	Expiration	Pre-Cal Reading	Post-Cal Reading	Acceptable Range
Conductivity	7710519	11/30/2019	1.282	1.409	(1.338 to 1.479)
			Gain	0.945	(0.9 to 1.10)

Check Standard ORP

Temp ©	Reading	Acceptable Range
23.5	237.5	(+/- 2.0mV)

mV Offset: 16.94 (0 +/- 100)

Dissolved Oxygen

% Saturation	mg/L
100.0	8.54

Gain: 0.79 — Acceptable Range (.7 to 1.4)

New DO Membrane: ○ Yes ◉ No

Model	556-4 MPS
S/N	
Barcode	U77883X
Cable	74996
Order #	360820

DO Cap Color: ○ Black ◉ Blue ○ Yellow

Calibrated By: Steven Bryant

Date of Calibration: 2/5/18 LW

*Solutions provided by LabChem (412-826-5230)

All calibrations performed by FEI conform to manufacturer's specifications. Please report any issues within 24 hours of receiving equipment.
All calibration solutions used are traceable to NIST. Additional documentation is available upon request.

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www.fieldenvironmental.com

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Suite A
Pittsburgh PA 15221
800-393-4009 Toll Free
(412) 436-2600 Local
(412) 436-2616 Fax

YSI 556 MPS Calibration Certificate

Cal Standard	Lot #	Expiration	Pre-Cal Reading	Post-Cal Reading	Acceptable Range
PH 7 @ 25^{C}	7709097	9/30/2019	7.70	7.00	(6.86 to 7.14)
			pH mV value	-11.9	(0 mV +/- 50mV)

Cal Standard	Lot #	Expiration	Pre-Cal Reading	Post-Cal Reading	Acceptable Range
PH 4 @ 25^{C}	7710071	10/30/2019	4.15	4.00	(3.92 to 4.08)
			pH mV value	155.5	(153.1mV to 168.1mV)

Cal Standard	Lot #	Expiration	Pre-Cal Reading	Post-Cal Reading	Acceptable Range
PH 10 @ 25^{C}	7708378	8/30/2019	10.11	10.00	(9.80 to 10.20)
			pH mV value	-185.2	(-176.9mV to -191.9mV)

Cal Standard	Lot #	Expiration	Pre-Cal Reading	Post-Cal Reading	Acceptable Range
Conductivity	7710519	11/30/2019	1.556	1.409	(1.338 to 1.479)
			Gain	0.905	(0.9 to 1.10)

Check Standard	Temp ©	Reading	Acceptable Range
ORP	24.3	237.5	(+/- 2.0mV)

mV Offset 33.07 (0 +/- 100)

Dissolved Oxygen	% Saturation	mg/L
	100.0	8.42

		Acceptable Range
Gain	1.09	(.7 to 1.4)

New DO Membrane: ○ Yes ◉ No

DO Cap Color: ○ Black ◉ Blue ○ Yellow

Model	556-4 MPS
S/N	
Barcode	U65715X
Cable	86888
Order #	360820

Calibrated By: Steven Bryant

Date of Calibration: 2/5/18 LW

*Solutions provided by LabChem (412-826-5230)

All calibrations performed by FEI conform to manufacturer's specifications. Please report any issues within 24 hours of receiving equipment.
All calibration solutions used are traceable to NIST. Additional documentation is available upon request.

SilverState Analytical Laboratories

Sierra Environmental Monitoring

EnviroTech

SALES / RENTAL / REPAIR ORDER

____ Sales Order
X Rental Order
____ Repair Order

Order Date: 2/5/2018

Sales Rep. Stephen West

Customer Name: AECOM (must be official account name)

Set up New Customer Record? Yes: ____ No: ____

Scheduled P/U Date/Time: 2/5/2018 9:30-10 AM

Scheduled Return Date/Time:

X Will Call ____ Local Delivery, Or

____ Ship To Address:

Bill To:

Customer Name: AECOM
Attn: CLARE MURPHY-HAGAN
Address: 1220 Avenida Acaso
City, State, Zip: Camarillo, CA 93012

Ship To:

Name:
Attn:
Address:
City,St, Zip:

Contact Clare Murphy-Hagan Phone: 503-318-5970 Fax: e-mail: clare.murphy-hagan@aecom.com

PO#: 60477365 Job No.: 2015-150B-01 Date Req'd.: Notes:

SHIPPING PREFERENCE:

UPS: □ NEXT DAY □ 2ND DAY □ 3-DAY □ GROUND FEDEX: □ PRIORITY □ STANDARD □ ECONOMY □ GROUND OTHER:

Item	Quantity	Cat. No.	Item Description	Source*	Unit Price	Day	Total Price
1	1	R-YSI-556	YSI 556 Multimeter w. Flow Cell	Rental	$100/300/900	1	$100.00
2	1		Calibration kit (incl. pH, Cond, and ORP stds.)	STK	$30.00		$30.00
			Notes:				
			Shipping - Estimate Only**				
				Total**			$ 130.00

Method of Payment:

X Bill our account (net 30 days) □ C.O.D. □ Visa/MasterCard/Discover/Amex

Card No. ____ Exp. Date: ____

Name on Card: ____ Sec. Code: ____

Billing Zip Code: ____ Signature: ____

*INV=inventory, STK=non-inventory stock, S.O.= special order

**Total does not include shipping and taxes.

Rec'd by: CLARE MURPHY-HAGAN

Printed Name: CLARE MURPHY-HAGAN

Date/Time: 2/5/18 10:57

For Rentals: Date Returned: 2/6/18, Time: 12:15 Sales Rep Initials: [illegible]

Note: All equipment rentals are made per SSAL's Standard Terms and Conditions - copies available upon request.

3626 East Sunset Road, Suite 100, Las Vegas, NV 89120 - Tel: 702-873-4478
1135 Financial Blvd., Reno, NV 89502 - Tel: 775-857-2400
1250 Lamoille Hwy., Suite 629, Elko, NV 89801 - Tel: 775-778-9828
ssalabs.com - sem-analytical.com - envirotechonline.com

Appendix J

Field Modification to the Supplemental Surface Water Investigation Plan

AECOM
1220 Avenida Acaso
Camarillo
CA, 93012
USA
aecom.com

Project name:
NDEP

Project ref:
60477365

To:
NDEP: Carlton Parker, J.D. Dotchin

From:
Kristen Durocher and Harry Van Den Berg
Date:
April 24, 2018

Technical Memorandum

Subject: RI Modification: Supplemental Surface Water Investigation Plan

This technical memorandum presents AECOM's recommended Remedial Investigation (RI) Modification to the approved Supplemental Surface Water Investigation Plan (SSWIP) dated January 30, 2018. This RI Modification was developed based on the findings of initial data collection tasks conducted under the SSWIP including thermal infrared (TIR) imaging and fiber-optic distributed temperature survey (DTS). The approved SSWIP proposed surface water sample transect locations, but indicated that these may change based on the results of the TIR and DTS data. This RI Modification presents those changes, in accordance with a WebEx-based presentation/teleconference meeting held April 17, 2018, and attended by the Nevada Division of Environmental Protection (NDEP), the Nevada Environmental Response Trust (NERT), Ramboll and AECOM.

SSWIP Scope Modification

Surface water sampling from 17 transect locations was proposed in the SSWIP. These proposed transect locations are shown on **Figure 1** and the rationale for their initial selection in the SSWIP is described in **Table 1**.

AECOM reviewed the results of the TIR and DTS and suggested modifications of the transect sampling and grab sampling locations to better capture the potential perchlorate inputs. The modified locations were selected based on thermal anomalies (i.e., locations with warmer or cooler water than surrounding surface water) in combination with perchlorate data from previous sampling events. **Figure 2** presents an overview of the proposed modified sample locations (transects and grab samples). A summary of changes to the transect and grab sample locations in the SSWIP is provided below, with references to attached **Tables 2, 3 and 4**, which provide more detailed rationale for removed transects, new sample locations, and unchanged locations, respectively.

Proposed Transect Locations

- Five transects were removed (**Table 2**):
  - Transect T4.75 was replaced with grab samples near the downstream warm anomalies
  - Transects T4.6 and T4.2 were removed since no changes in perchlorate were noted during previous sampling in this reach and no warm thermal anomalies were encountered during the DTS
  - Two transects were removed due to construction at Sunrise Mountain Weir (T6.35) and Historical Lateral Weir Expansion (T5.3).
- Two transects (T6.45 and T4.0) were moved slightly (**Table 2** and **Table 3**) to T6.5 and T3.9, respectively.

- One transect was added (**Table 3**) at T4.7
- Ten transects were not changed (T6.8, T6.55, T6, T4.85, T4.8, T4.65, T3.8, T3.75, T3.5 and T3.3) (**Table 4**)

Proposed Grab Sample Locations

- The grab sample location at North Shore Road (LW0.9) remains in the plan (**Table 4**)
- The grab sample in the C-1 Channel remains in the plan (sampled if water is present) (**Table 4)**
- Nine new grab sample locations were added (LW4.73S, LW4.73N, LW4.48S, LW4.48N, LW3.68, LW3.55, LW3.2, LW3.15, LW3.11) (**Table 3**)
- Three grab sample locations previously sampled by AECOM will be sampled (LWC3.7, LW3.4, LW3.1) (**Table 3**)

Grab samples will be collected from near-bottom depths to provide data consistent with the transect sampling. In addition, AECOM may collect up to six (6) additional grab samples within the study area of this RI Modification based on field conditions and observations. Those field conditions will largely be evaluated through the use of handheld water-quality probes (i.e., temperature and conductivity) to target areas experiencing the strongest potential influence from suspected nearby ground-water inflow.

The following presents discussions of the reaches of the LVW where several changes to the SSWIP are proposed:

Upper Narrows Weir to Sunrise Mountain Weir **- Figure 3** shows the proposed revised sample locations from Upper Narrows Weir to Sunrise Mountain Weir construction zone.

- The two transects added (T6.55 and T6.5) were placed through the warm anomaly and downstream of the anomalies (upstream of the construction zone).
- Transect T6.35 is removed because its proposed location is within the construction zone.

Calico Ridge Weir to Homestead Weir - **Figure 4** shows the proposed revised sample locations from Calico Ridge Weir to Homestead Weir.

- Transect T4.75, which passed directly through warm anomalies identified during the DTS, was removed and two grab samples at the anomalies were added.
- Transects were added immediately upstream (T4.8) and downstream (T4.7) of the anomalies.
- Previously sampled T4.65 was retained.
- The TIR and DTS data did not indicate warm anomalies in the reach between Lower Narrows Weir and Homestead Weir. Since perchlorate concentrations did not show increases between these weirs and there are no warm anomalies, transect T4.6 and T4.2 were removed. Two grab samples (LW4.48S and LW4.48N) were added to capture the cool anomaly on the south bank and a reference concentration on the north bank, respectively.
- Transect 3.9 was added immediately downstream of Homestead Weir to help determine if perchlorate is better mixed downstream of the weir.

Three Kids Weir to Rainbow Gardens Weir - **Figure 5** shows the proposed revised sample locations from Three Kids Weir to Rainbow Gardens Weir.

- Previously sampled transects T3.8 and T3.75, which are upstream and downstream of Three Kids Weir, respectively, were retained.

- Previously sampled transect T3.5 was retained. Perchlorate concentrations were higher at this transect in 2017 than T3.75, immediately upstream, and the channel has been reworked due to the storm-induced high water. This transect will be sampled for comparison to 2017 data.
- Transect T3.3 was added, which passes through a warm anomaly on the south bank upstream of Rainbow Gardens Weir.
- A grab sample will be collected at LWC3.7, a known seep previously sampled by AECOM.
- Two grab samples will be added: at LW3.68 (through a secondary warm anomaly downstream of LWC3.7 on the south bank) and LW3.55, which is in a side channel on the southern side of the Las Vegas Wash, downstream of the cluster of warm anomalies.

Rainbow Gardens Weir to Fire Station Weir - **Figure 6** shows detail of the proposed revised sample locations from Rainbow Gardens Weir to Fire Station Weir.

- No transects will be sampled from this reach.
- Previously sampled grab locations at LW3.4 and LW3.1 will be resampled.
- Two grab samples will be collected at new locations LW3.2 and LW3.15, located downstream of cool anomalies on the south bank.
- A grab sample location has been added immediately upstream of Powerline Crossing Weir (LW3.11).

Attachments

Tables

Figures

Table 1
Surface Water Grab Samples and Transect Locations Proposed in the SSWIP
NERT Remedial Investigation, Downgradient Study Area
Henderson, Nevada

Transect Identification or Grab Location	Location	Rationale for Location
LW0.9	Downstream of Lake Lake Vegas at North Shore Road	Long term monitoring location with perchlorate flux estimates. Data from this location will be compared to flux estimates in the Study Area
T3.3	Midway between T3.6 and the Rainbow Gardens Weir	Evaluate for water quality changes downstream of study area
T3.5	Mid-way between Three Kids Weir and Rainbow Gardens Weir	Evaluate water quality downstream of groundwater inputs near Three Kids Weir
T3.75	Immediately downstream of Three Kids Weir	Check for potential groundwater inputs along Three Kids Weir upstream of KM67 (2100 parts per billion of perchlorate)
T3.8	Immediately upstream of Three Kids Weir	Evaluate water quality entering Three Kids Weir
T4.0	Immedialely downstream of the Homestead Weir	Identify the location of the perchlorate inputs in this area
T4.2	Upstream of Homestead Weir	Downgradient of western edge of Henderson Landfill Site near new USGS staff gage/seepage study
T4.6	Downstream of Lower Narrows Weir	Downgradient of middle portions of Henderson Landfill Site in region of observed perchlorate gain
T4.65	Upstream of Lower Narrows Weirs	Downgradient of middle portions of Henderson Landfill Site in region of observed perchlorate gain
T4.75	Downstream of Calico Ridge Weir	Downgradient of western edge of Henderson Landfill Site in region of potential perchlorate gain
T4.8	Immediately upstream of the Calico Ridge Weir	Evaluate water quality above the inputs observed below the Calico Ridge Weir
T4.85	Immediately downstream of Bostick Weir	Evaluate suspected increase in perchlorate concentrations immediately below Bostick Weir
T5.3	Downstream of Historic Lateral Weir Expansion	Mid-point between Pabco Road and Calico Ridge Weir
T6	Upstream of Pabco Road Weir	Downstream of Groundwater inputs from NERT Off-Site Study Area and Henderson wastewater treatment plants
T6.35	Downstream of Proposed Sunrise Mountain Weir	Downgradient of NERT Off-Site Study area near mapped location of KM71 seep (3,400 parts per billion)
T6.45	Upstream of the proposed Sunrise Mountain Weir	Identify the location of the perchlorate inputs observed between Upper Narrows Weir and T6.35
T6.55	Downstream of Upper Narrows Weir	Identify the location of the perchlorate inputs observed between Upper Narrows Weir and T6.35
T6.8	Upstream of Duck Creek Confluence Weir	Upper end of the Downgradient Study at new USGS Gage (09419698)

Note:
Location LW0.9 is a grab location.
Locations prefaced with "T" are transect locations.

Table 2
Surface Water Transect Locations Proposed for Removal or Adjustment
NERT Remedial Investigation, Downgradient Study Area
Henderson, Nevada

Transect Identification	Location	Original Rationale for Location	Rationale for Removal
T6.35	Downstream of Proposed Sunrise Mountain Weir	Downgradient of NERT Off-Site Study area near mapped location of KM71 seep (3,400 parts per billion)	Remove due to construction
T5.3	Downstream of Historic Lateral Weir Expansion	Mid-point between Pabco Road and Calico Ridge Weir	Remove due to construction
T4.75	Downstream of Calico Ridge Weir	Downgradient of western edge of Henderson Landfill Site in region of potential perchlorate gain	Replaced with grab samples at the warm anomalies
T4.6	Downstream of Lower Narrows Weir	Downgradient of middle portions of Henderson Landfill Site in region of observed perchlorate gain	No changes in perchlorate in this reach. No warm anomalies noted.
T4.2	Upstream of Homestead Weir	Downgradient of western edge of Henderson Landfill Site near new USGS staff gage/seepage study	No changes in perchlorate in this reach. No warm anomalies noted.
Transect Identification	**Location**	**Original Rationale for Location**	**Rationale for Moving**
T6.45	Upstream of the proposed Sunrise Mountain Weir	Identify the location of the perchlorate inputs observed between Upper Narrows Weir and T6.35	Relocate due to construction. Moved to T6.5 (see Table 3)
T4.0	Immediately downstream of the Homestead Weir	Identify the location of the perchlorate inputs in this area	Moved downstream to T3.9 to better capture perchlorate/anomaly patterns (See Table 3).

Table 3
Proposed Additional Surface Water Grab Sample and Transect Locations
NERT Remedial Investigation, Downgradient Study Area
Henderson, Nevada

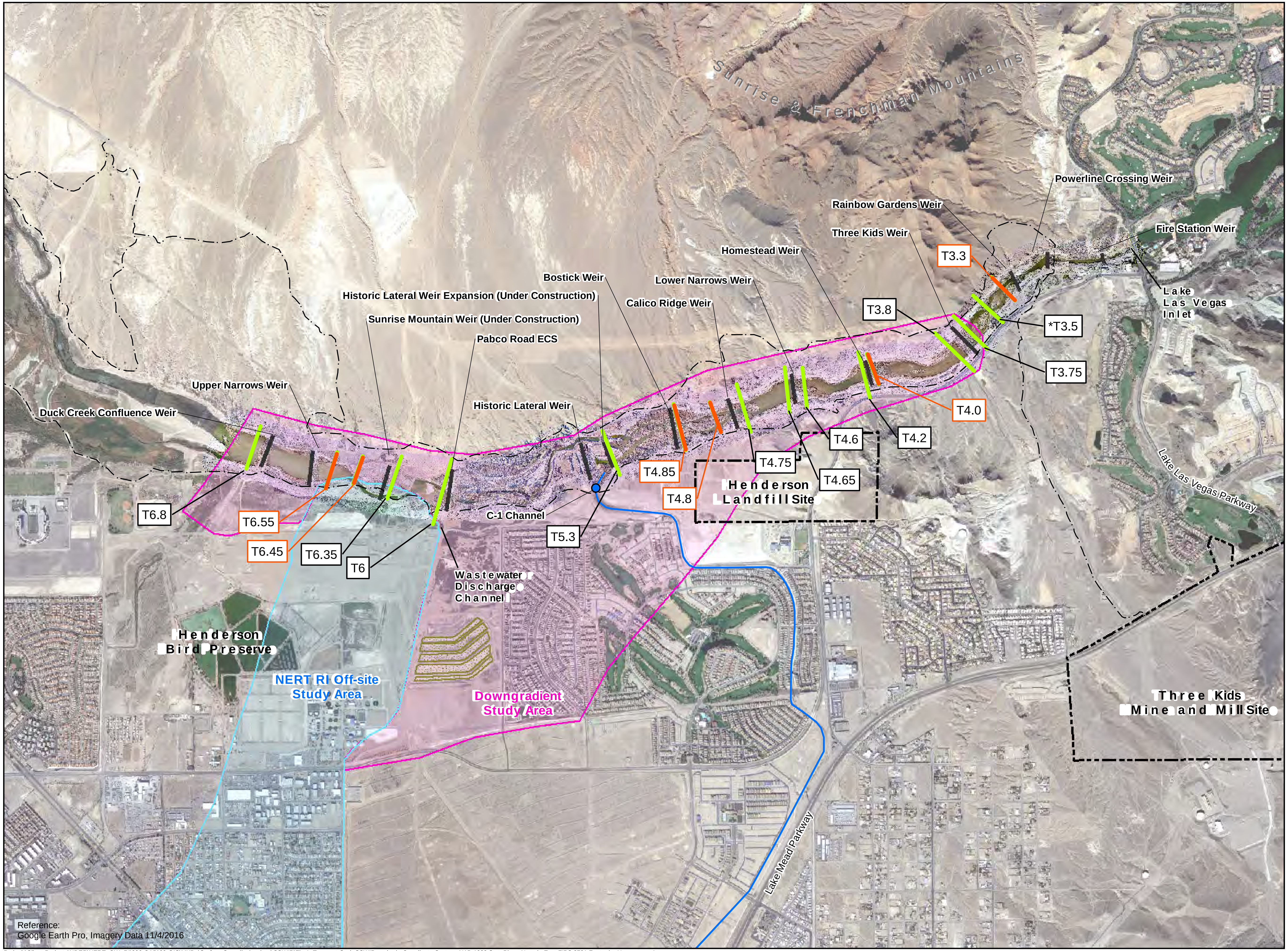
Transect Identification or Grab Sample Location	Location	Rationale for Location
Transects		
T6.5	Upstream of the proposed Sunrise Mountain Weir	Identify the location of the perchlorate inputs observed between Upper Narrows Weir and T6.35. This is previously sampled T6.45 moved upstream outside the Sunrise Mt Weir construction zone
T4.7	Downstream of Calico Ridge Weir	Downgradient of the warm anomalies and the small island in the LVW. Use to determine concentrations in mixed zone
T3.9	Immediately downstream of the Homestead Weir	Identify the location of the perchlorate inputs in this area. This is previoulsy sampled T4.0 moved downstream.
Grab Sample Locations (New)		
LW4.73S	Second anomaly downstream of Calico Ridge Weir	Sample south bank anomaly
LW4.73N	Second anomaly downstream of Calico Ridge Weir	Sample north bank anomaly
LW4.48S	Cool anomaly downstream of Lower Narrows Weir	Sample immediately downstream of south bank cool anomaly
LW4.48N	Across from cool anomaly downstream of Lower Narrows Weir	Provide reference concentration to the cool anomaly on the south bank.
LW3.68	Downstream of Fire Station Weir on south bank near warm anomaly	Warm anomaly on south bank downstream of LWC3.7
LW3.55	Downstream of Fire Station Weir	Downstream of warm anomalies on south bank in side channel
LW3.2	Downstream of Rainbow Gardens Weir	Downstream of cool anomaly on south bank
LW3.15	Downstream of Rainbow Gardens Weir	Downstream of cool anomaly on south bank
LW3.11	Downstream of Rainbow Gardens Weir	Sample immediately prior to Powerline Crossing Weir
Grab Sample Locations (Previously Sampled by AECOM in 2016 and 2017)		
LWC3.7	Downstream of Three Kids Weir at historic seep	Revisit seep location from previous surface water sampling programs (May and December 2016; February 2017)
LW3.4	Downstream of Rainbow Gardens Weir	Revisit surface water sampling location from previous surface water sampling programs (May and December 2016; February 2017)
LW3.1	Downstream of Fire Station Weir	Revisit surface water sampling location from May 2016 surface water sampling program

Notes:
Locations prefaced with "LW" or "LWC" are grab sample locations.
Locations prefaced with "T" are transect locations.

Table 4
Surface Water Grab Sample and Transect Locations Retained from the SSWIP
NERT Remedial Investigation, Downgradient Study Area
Henderson, Nevada

Transect Identification or Grab Sample Location	Location	Rationale for Location
T6.8	Upstream of Duck Creek Confluence Weir	Upper end of the Downgradient Study at new USGS Gage (09419698)
T6.55	Downstream of Upper Narrows Weir	Identify the location of the perchlorate inputs observed between Upper Narrows Weir and T6.35. Ensure this crosses the anomaly on the south bank.
T6	Upstream of Pabco Road Weir	Downstream of Groundwater inputs from NERT Off-Site Study Area and Henderson wastewater treatment plants
T4.85	Immediately downstream of Bostick Weir	Evaluate suspected increase in perchlorate concentrations immediately below Bostick Weir
T4.8	Immediately upstream of the Calico Ridge Weir	Evaluate water quality above the inputs observed below the Calico Ridge Weir
T4.65	Upstream of Lower Narrows Weirs	Downgradient of middle portions of Henderson Landfill Site in region of observed perchlorate gain
T3.8	Immediately upstream of Three Kids Weir	Evaluate water quality entering Three Kids Weir
T3.75	Immediately downstream of Three Kids Weir	Check for potential groundwater inputs along Three Kids Weir upstream of KM67 (2100 parts per billion of perchlorate). This transect includes the approximate area of historic grab sample location LW3.75.
T3.5	Mid-way between Three Kids Weir and Rainbow Gardens Weir	Evaluate water quality downstream of groundwater inputs near Three Kids Weir
T3.3	Midway between T3.6 and the Rainbow Gardens Weir	Evaluate for water quality changes downstream of study area. Sample warm anomaly on south bank.
C-1	C-1 Channel	Capture any inputs from off-site (grab sample if flowing)
LW0.9	Downstream of Lake Lake Vegas at North Shore Road	Long term monitoring location with perchlorate flux estimates. Data from this location will be compared to flux estimates in the Study Area

Notes:
Locations C-1 and LW0.9 are grab sample locations.
Locations prefaced with "T" are transect locations.



OVERVIEW MAP

NV UT CA AZ Map Location Las Vegas

Legend

- Proposed Transects (Previously Sampled in February 2017)
- Proposed Additional Transects
- Approximate C-1 Channel Sample Point; may change based on presence of water
- Weir
- Northern Rapid Infiltration Basins
- Wetlands Trail
- Channels
- NERT RI Downgradient Study Area
- NERT RI Off-site Study Area

Note

* This transect was originally labeled T3.6 but the identification was changed to T3.5 during the field program.

NORTH

0 2,000 Feet

Scale 1:24,000
1 inch = 2,000 feet

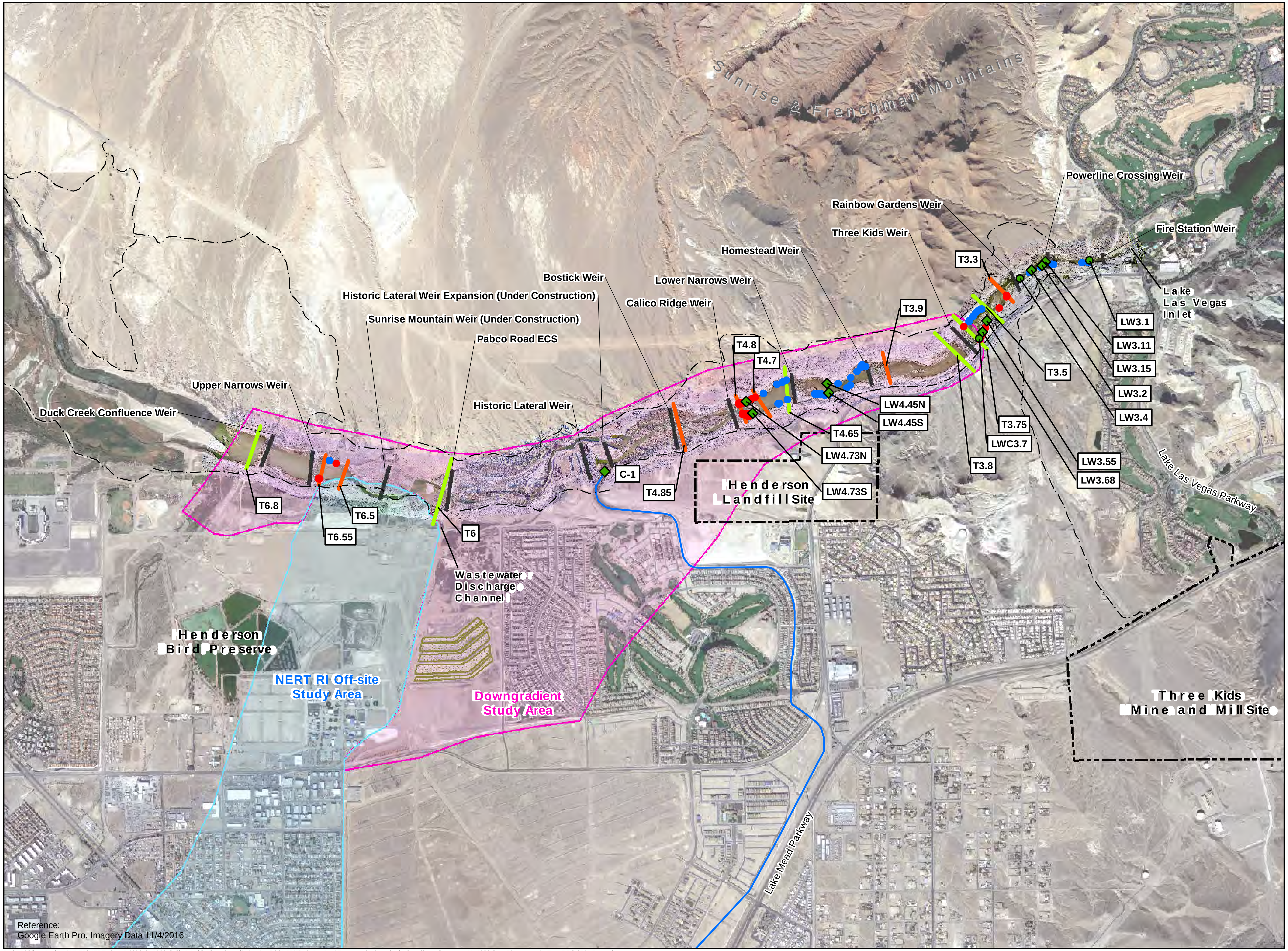
NERT RI
Downgradient Study Area

TRANSECT AND GRAB SAMPLE LOCATIONS AS PROPOSED IN SSWIP

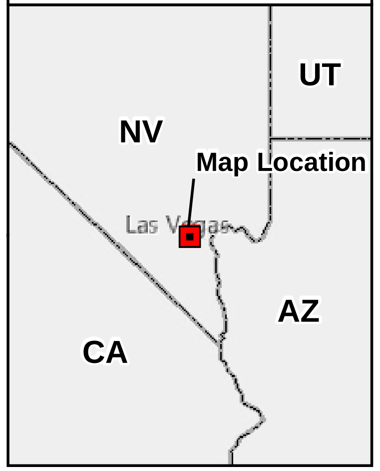
Date: 4/20/2018 Project: 60477365

AECOM **Figure 1**

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\revised SSWIP\Fig 1_Transect-Grab SSWIP.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1



OVERVIEW MAP



Legend

- Warm DTS Anomaly
- Cool DTS Anomaly
- Proposed Transects (Previously Sampled in February 2017)
- Proposed Additional Transects
- Proposed Grab Sample (Previously Sampled in 2016)
- Proposed Additional Grab Sample
- Weir
- Northern Rapid Infiltration Basins
- Wetlands Trail
- Channels
- NERT RI Downgradient Study Area
- NERT RI Off-site Study Area

NORTH

0 2,000

Feet

Scale 1:24,000

1 inch = 2,000 feet

NERT RI
Downgradient Study Area

REVISED TRANSECT AND GRAB SAMPLE LOCATIONS

Date: 4/20/2018 Project: 60477365

AECOM

Figure 2

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\revised SSWIP\Fig 2_Revised-Transect-Grab.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1

Legend

- Warm DTS Anomaly
- Cool DTS Anomaly
- Previously Sampled in February 2017
- Proposed Transects (Previously Sampled in February 2017)
- Proposed Additional Transects

NORTH

0 200

Feet

Scale 1:2,400

1 inch = 200 feet

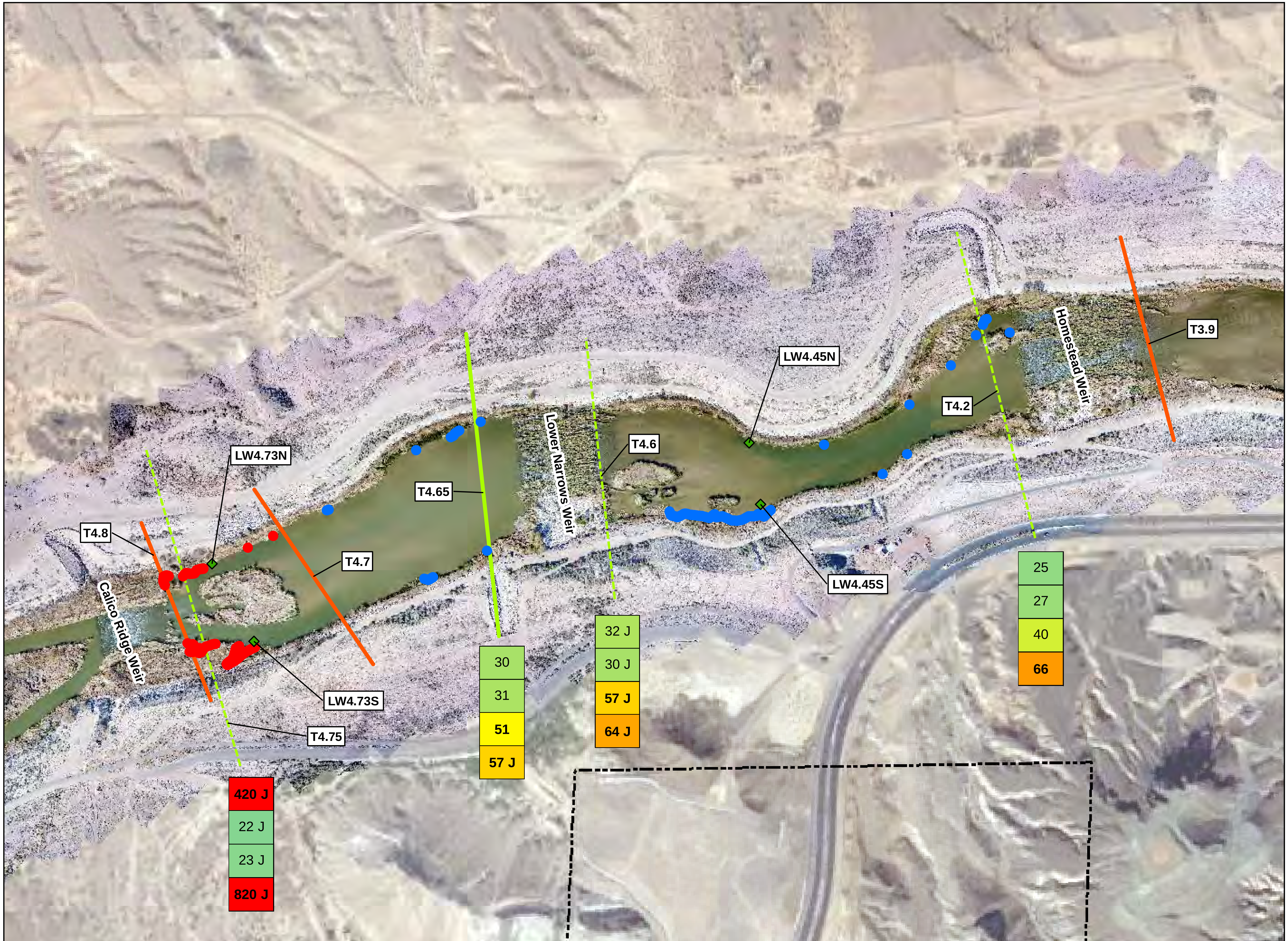
NERT RI
Downgradient Study Area

REVISED TRANSECT LOCATIONS - UPPER NARROWS WEIR TO SUNRISE MOUNTAIN WEIR CONSTRUCTION ZONE

Date: 4/20/2018 Project: 60477365

AECOM

Figure 3



Legend

- Warm DTS Anomaly
- Cool DTS Anomaly
- Previously Sampled in February 2017
- Proposed Transects (Previously Sampled in February 2017)
- Proposed Additional Transects
- Proposed Additional Grab Sample

0 300
Feet

Scale 1:3,600
1 inch = 300 feet

NERT RI
Downgradient Study Area

REVISED TRANSECT AND GRAB SAMPLE LOCATIONS - CALICO RIDGE WEIR TO HOMESTEAD WEIR

Date: 4/20/2018 Project: 60477365

AECOM **Figure 4**

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\revised SSWIP\Fig 4_Calico-Homestead.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1

Legend

- Warm DTS Anomaly
- Cool DTS Anomaly
- Proposed Transects (Previously Sampled in February 2017)
- Proposed Additional Transects
- Proposed Grab Sample (Previously Sampled in 2016)
- Proposed Additional Grab Sample

NORTH

0 200
Feet

Scale 1:2,400
1 inch = 200 feet

NERT RI
Downgradient Study Area

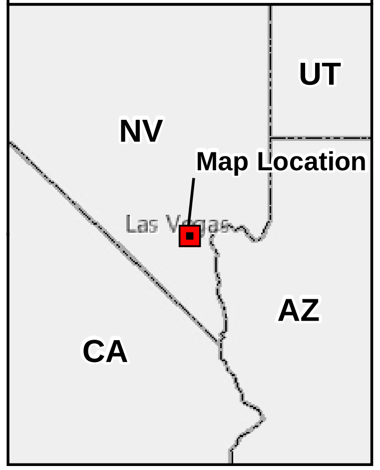
REVISED TRANSECT AND GRAB SAMPLE LOCATIONS - THREE KIDS WEIR TO RAINBOW GARDENS WEIR

Date: 4/20/2018 Project: 60477365

AECOM **Figure 5**

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\revised SSWIP\Fig 5_3Kids-Rainbow.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1

OVERVIEW MAP



Legend

- Cool DTS Anomaly
- Proposed Grab Sample (Previously Sampled in 2016)
- Proposed Additional Grab Sample

NORTH

0 150
Feet

Scale 1:1,800
1 inch = 150 feet

NERT RI
Downgradient Study Area

REVISED GRAB SAMPLE LOCATIONS - RAINBOW GARDENS WEIR TO FIRE STATION WEIR

Date: 4/20/2018 Project: 60477365

AECOM

Figure 6

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\revised SSWIP\Fig 6_Rainbow-Fire.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1

Appendix K

Chain of Custody Record and Analytical Data

TestAmerica Irvine
17461 Derian Ave
Suite 100
Irvine, CA 92614
Phone: 949.261.1022 Fax:

Chain of Custody Record

194859

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
TestAmerica Laboratories, Inc.

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TAL-8210 (0713)

Client Contact	Project Manager:	Site Contact:	Date:	COC No:
Company Name: AECOM	Tel/Fax:	Lab Contact:	Carrier:	___ of ___ COCs
Address:	Analysis Turnaround Time			Sampler:
City/State/Zip: CAMARILLO CA 90012	☐ CALENDAR DAYS ☐ WORKING DAYS			For Lab Use Only:
Phone: 805 764 4027	TAT if different from Below ___			Walk-in Client:
Fax:	☐ 2 weeks			Lab Sampling:
Project Name: NERF	☑ 1 week			
Site: LVW	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)		CHLORATE	PERCHLORATE / TDS	Sample Specific Notes:
T3-8D-20180503-0.8	5.3.18	1141	G	SW	2				✓	✓	
T3-8E-20180503-0.3	5.3.18	1148	G	SW	2				✓	✓	
LWC3.7-20180503-1.7	5.3.18	1215	G	SW	2				✓	✓	
T6A-20180503-0.4	5.3.18	0930	G	SW	2				✓	✓	
T6B-20180503-0.8	5.3.18	0935	G	SW	2				✓	✓	
T6C-20180503-1.3	5.3.18	0945	G	SW	2				✓	✓	
T6D-20180503-1.5	5.3.18	0955	G	SW	2				✓	✓	
T4.65A-20180503-0.7	5.3.18	1055	G	SW	2				✓	✓	
T4.65B-20180503-1.5	5.3.18	1110	G	SW	2				✓	✓	
T4.65C-20180503-1.1	5.3.18	1120	G	SW	2				✓	✓	
T4.65D-20180503-0.9	5.3.18	1130	G	SW	2				✓	✓	
T4.8A-20180503-0.7	5.3.18	1035	G	SW	2				✓	✓	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ___

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ___ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No | Custody Seal No.: | Cooler Temp. (°C): Obs'd: ___ Corr'd: ___ Therm ID No.: ___

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
[signature]	AECOM	5.3.18 1630	[signature]	TAIW	5/3/18 1630
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

17.6 TAIW

TestAmerica Irvine
17461 Derian Ave
Suite 100
Irvine, CA 92614
Phone: 949.261.1022 Fax:

Chain of Custody Record

194858

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
TestAmerica Laboratories, Inc.
TAL-8210 (0713)

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact		Project Manager:	Site Contact:	Date:	COC No:
Company Name:	AECOM	Tel/Fax:	Lab Contact:	Carrier:	___ of ___ COCs
Address:		**Analysis Turnaround Time**			Sampler:
City/State/Zip:	CAMARILLO CA 90012	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
Phone:	805 764 4027	TAT if different from Below ______			Walk-in Client:
Fax:		☐ 2 weeks			Lab Sampling:
Project Name:	~~LVW~~ NERT	☑ 1 week			
Site:	LVW	☐ 2 days			Job / SDG No.:
P O #		☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	CHLORATE	PERCHLORATE/TDS	Sample Specific Notes:
T4-8B - 20180503 - 1.2	5.3.18	1024	G	SW	2			✓	✓	
T4-8C - 20180503 - 2.2	5.3.18	1045	G	SW	2			✓	✓	
T4-8D - 20180503 - 1.8	5.3.18	1053	G	SW	2			✓	✓	
T4-8E - 20180503 - 2.0	5.3.18	1103	G	SW	2			✓	✓	
T6E - 20180503 - 0.6	5.3.18	1010	G	SW	2			✓	✓	
LW4-48N - 20180503 - 0.6	5.3.18	1415	G	SW	2			✓	✓	
LW4-48S - 20180503 - 0.4	5.3.18	1420	G	SW	2			✓	✓	
LW4-5S - 20180503 - 0.4	5.3.18	1435	G	SW	2			✓	✓	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No | Custody Seal No.: | Cooler Temp. (°C): Obs'd: ______ Corr'd: ______ Therm ID No.: ______

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
[signature]	AECOM	5.3.18 1630	[signature]	TALVS	5/3/18 1630
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

17 ↓ TALV

TestAmerica Irvine
17461 Derian Ave
Suite 100
Irvine, CA 92614
Phone: 949.261.1022 Fax:

Chain of Custody Record

194855

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
TestAmerica Laboratories, Inc.

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TAL-8210 (0713)

Client Contact		Project Manager:	Site Contact:	Date:	COC No:
Company Name:	AECOM	Tel/Fax:	Lab Contact:	Carrier:	____ of ____ COCs
Address:		Analysis Turnaround Time			Sampler:
City/State/Zip:	CAMARILLO CA 90012	☐ CALENDAR DAYS ☐ WORKING DAYS			For Lab Use Only:
Phone:		TAT if different from Below ____			Walk-in Client:
Fax:		☐ 2 weeks			Lab Sampling:
Project Name:	NERT	☑ 1 week			
Site:	LVW	☐ 2 days			Job / SDG No.:
P O #		☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	CHLORATE	PERCHLORATE / TDS	Sample Specific Notes:
LW0.9-20180503-0.8	5/3/18	1625	G	SW	2			✓	✓	
LW0.9-20180503-0.8-FD	5/3/18	1628	G	SW	2			✓	✓	250mL
T3.3A-20180504-0.1	5/4/18	1228	G	SW	2			✓	✓	
T3-3B-20180504-0.8	5.4.18	1220	G	SW	2			✓	✓	
T3-3C-20180504-0.3	5.4.18	1120	G	SW	2			✓	✓	
T3.3D-20180504-0.8	5.4.18	1055	G	SW	2			✓	✓	
T3.3E-20180504-1.2	5.4.18	1108	G	SW	2			✓	✓	
T3.9A-20180504-0.2	5.4.18	0946	G	SW	2			✓	✓	
T3.9B-20180504-0.5	5.4.18	0950	G	SW	2			✓	✓	
T3.9B-20180504.0.5-FD	5.4.18	0955	G	SW	2			✓	✓	
T3.9C-20180504.05	5.4.18	1000	G	SW	2			✓	✓	
T3.9D-20180504.0.1	5.4.18	1010	G	SW	2			✓	✓	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ____

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ____ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No | Custody Seal No.: | Cooler Temp. (°C): Obs'd: ____ Corr'd: ____ Therm ID No.: ____

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
[signature]	AECOM	5.4.18 1630	TTM	TALUS	5-4-18 1630
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TALUS 15.7

TestAmerica Irvine
17461 Derian Ave
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Irvine, CA 92614
Phone: 949.261.1022 Fax:

Chain of Custody Record

194856

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
TestAmerica Laboratories, Inc.

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TAL-8210 (0713)

Client Contact		Project Manager:	Site Contact:	Date:	COC No:
Company Name:	AECOM	Tel/Fax:	Lab Contact:	Carrier:	____ of ____ COCs
Address:		**Analysis Turnaround Time**			Sampler:
City/State/Zip:	CAMARILLO CA 93012	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
Phone:		TAT if different from Below ____			Walk-in Client:
Fax:		☐ 2 weeks			Lab Sampling:
Project Name:	NERF	☑ 1 week			
Site:	LVW	☐ 2 days			Job / SDG No.:
P O #		☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	CHLORIDE	PERCHLORATE / TDS	Sample Specific Notes:
T3-9D-20180504-0.1MSD	5.4.18	1010	G	SW	1			✓		
T3-9D-20180504-0.1-MS	5.4.18	1010	G	SW	2			✓	✓	250mL
LW3.4-20180504-1.1	5.4.18	1220	G	SW	2			✓	✓	
LW3-55-20180504-1-8	5.4.18	1150	G	SW	2			✓	✓	
T3-75A-20180504-0.7	5.4.18	1055	G	SW	2			✓	✓	
T3-75B-20180504-1.0	5.4.18	1005	G	SW	2			✓	✓	
T3-75C-20180504-1.2	5.4.18	1010	G	SW	2			✓	✓	
T3-75D-20180504-1.3	5.4.18	1025	G	SW	2			✓	✓	
T3-75E-20180504-0.2	5.4.18	1035	G	SW	2			✓	✓	
T4-85A-20180504-0.6	5.4.18	0955	G	SW	2			✓	✓	
T4-85B-20180504-2.2	5.4.18	0955	G	SW	2			✓	✓	
T4-85C-20180504-0.9	5.4.18	1045	G	SW	2			✓	✓	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ____________

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ________ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No | Custody Seal No.: | Cooler Temp. (°C): Obs'd:________ Corr'd:________ Therm ID No.:____________

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
[signature]	AECOM	5.4.18 1630	TAM	TALUS	5-4-18 1630
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TALUS 18.7

TestAmerica Irvine
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Chain of Custody Record

194848

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
TestAmerica Laboratories, Inc.
TAL-8210 (0713)

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact		Project Manager:	Site Contact:	Date:	COC No:
Company Name:	AECOM	Tel/Fax:	Lab Contact:	Carrier:	___ of ___ COCs
Address:		Analysis Turnaround Time			Sampler:
City/State/Zip:	CAMARILLO CA 93012	☐ CALENDAR DAYS ☐ WORKING DAYS			For Lab Use Only:
Phone:	805 764 4027	TAT if different from Below ___			Walk-in Client:
Fax:		☐ 2 weeks			Lab Sampling:
Project Name:	NERT	☑ 1 week			
Site:	LVW	☐ 2 days			Job / SDG No.:
P O #		☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y/N)	Perform MS / MSD (Y/N)	CHLORATE	PERCHLORATE / TDS	Sample Specific Notes:
T4.7A - 20180503 - 2.3	5.3.18	1250	G	SW	2			✓	✓	
T4.7B1 - 20180503 - 5.8	5.3.18	1232	G	SW	2			✓	✓	
T4.7B2 - 20180503 - 2.0	5.3.18	1240	G	SW	2			✓	✓	
T4.7C - 20180503 - 2.4	5.3.18	1213	G	SW	2			✓	✓	
T4.7D - 20180503 - 0.8	5.3.18	1202	G	SW	2			✓	✓	
T4.7E - 20180503 - 2.4	5.3.18	1130	G	SW	2			✓	✓	
T4.7F - 20180503 - 0.9	5.3.18	1120	G	SW	2			✓	✓	
T4.7G - 20180503 - 2.2	5.3.18	1111	G	SW	2			✓	✓	
T4.7H - 20180503 - 1.0	5.3.18	1057	G	SW	2			✓	✓	
T3.8A - 20180503 - 1.0	5.3.18	1132	G	SW	2			✓	✓	
T3.8B - 20180503 - 0.7	5.3.18	1136	G	SW	2			✓	✓	
T3.8C - 20180503 - 0.7	5.3.18	1138	G	SW	2			✓	✓	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No | Custody Seal No.: | Cooler Temp. (°C): Obs'd: ______ Corr'd: ______ Therm ID No.: ______

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
[signature]	AECOM	5.3.18 1630	[signature]	TRLW	5/3/18 1630
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

17.6 TRLW

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Chain of Custody Record

194857

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
TestAmerica Laboratories, Inc.

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TAL-8210 (0713)

Client Contact	Project Manager:	Site Contact:	Date:	COC No:
Company Name: AECOM	Tel/Fax:	Lab Contact:	Carrier:	___ of ___ COCs
Address:	Analysis Turnaround Time			Sampler:
City/State/Zip: CAMARILLO CA 93012	☐ CALENDAR DAYS ☐ WORKING DAYS			For Lab Use Only:
Phone:	TAT if different from Below ______			Walk-in Client:
Fax:	☐ 2 weeks			Lab Sampling:
Project Name: NERT	☐ 1 week			
Site: LWW	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	CHLORATE	PERCHLORATE/TDS	Sample Specific Notes:
T4.85D - 20180504 - 0.7	5.4.18	1025	G	SW	2			✓	✓	
T4.85E - 20180504 - 1.0	5.4.18	1034	G	SW	2			✓	✓	
LW0.9 - 20180504 - 0.7	5.4.18	1248	G	SW	2			✓	✓	
T3.3A - 20180504 - 0.1-FB	5.4.18	1415	G	AQ	2			✓	✓	
LW4.73W - ~~2~~0180504 - 2.2	5.4.18	1515	G	SW	2			✓	✓	
LW4.73S - 20180504 - 2.4	5.4.18	1450	G	SW	2			✓	✓	250
C-1 - 20180504 - 0.3	5.4.18	1330	G	SW	2			✓	✓	250

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No | Custody Seal No.: | Cooler Temp. (°C): Obs'd: ______ Corr'd: ______ Therm ID No.: ______

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
[signature]	AECOM	5.4.18 1630	[signature]	TALVS	5-4-18 1630
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TALVS 18.7

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Chain of Custody Record

194847

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
TestAmerica Laboratories, Inc.

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TAL-8210 (0713)

Client Contact		Project Manager:	Site Contact:	Date: 5/1/18	COC No:
Company Name:	AECOM	Tel/Fax:	Lab Contact:	Carrier:	1 of 1 COCs
Address:	1220 Avenida Acaso	Analysis Turnaround Time			Sampler:
City/State/Zip:	Camarillo CA 93012	☐ CALENDAR DAYS ☐ WORKING DAYS			For Lab Use Only:
Phone:	(805) 764-4027	TAT if different from Below ____			Walk-in Client:
Fax:		☐ 2 weeks			Lab Sampling:
Project Name:		☑ 1 week			
Site:		☐ 2 days			Job / SDG No.:
P O #		☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	CHLORATE	PERCHLORATE / TDS	Sample Specific Notes:
T6-55B-20180501-0.6	5.1.18	0933	G	SW	2			✓	✓	
T6-55C-20180501-0.1	5.1.18	0950	G	SW	2			✓	✓	
T6-55D-20180501-0.1	5.1.18	1006	G	SW	2			✓	✓	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ____

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ____ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No | Custody Seal No.: | Cooler Temp. (°C): Obs'd: ____ Corr'd: ____ Therm ID No.: ____

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
[signature]	AECOM	5-1-18 1530	[signature]	TA-IRV	5/1/18 1530
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

9.8 TAW

TestAmerica Irvine
17461 Derian Ave
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Chain of Custody Record

194846

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
TestAmerica Laboratories, Inc.
TAL-8210 (0713)

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact	Project Manager:	Site Contact:	Date: 5/1/18	COC No:
Company Name: AECOM	Tel/Fax:	Lab Contact:	Carrier:	1 of 1 COCs
Address: 1220 Avenida Acaso	Analysis Turnaround Time			Sampler:
City/State/Zip: Camarillo CA 93012	☐ CALENDAR DAYS ☐ WORKING DAYS			For Lab Use Only:
Phone: (805) 764-4027	TAT if different from Below ______			Walk-in Client:
Fax:	☐ 2 weeks			Lab Sampling:
Project Name:	☐ 1 week			
Site:	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	CHLORIDE	PERCHLORATE/TDS	Sample Specific Notes:
T6.5A-20180501-1.2	5/1/18	0910	G	SW	2			✓	✓	
T6.5B-20180501-1.0	5/1/18	0940	G	SW	2			✓	✓	
T6.5C-20180501-1.0	5/1/18	0950	G	SW	2			✓	✓	
T6.5D-20180501-0.5	5/1/18	0955	G	SW	2			✓	✓	
T6.8A-20180501-1.2FB	5.1.18	1300	G	AQ	2			✓	✓	
T6.8A-20180501-1.2	5.1.18	0855	G	SW	2			✓	✓	
T6.8B.20180501-0.9	5.1.18	0905	G	SW	2			✓	✓	
T6-8B.20180501-0.9D	5.1.18	0910	G	SW	2			✓	✓	
T6.8C-20180501-0.4	5.1.18	0910	G	SW	2			✓	✓	
T6-8D-20180501-0.2	5.1.18	0920	G	SW	6		✓	✓	✓	
T6-8E-20180501-0.4	5.1.18	0930	G	SW	2			✓	✓	
T6.55A-20180501-0.4	5.1.18	0916	G	SW	2			✓	✓	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No | Custody Seal No.: | Cooler Temp. (°C): Obs'd: ______ Corr'd: ______ Therm ID No.: ______

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
[signature] AECOM	AECOM	5.1.18 1530	[signature]	[illegible]	5/1/18 1530
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TestAmerica Irvine
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Chain of Custody Record

194849

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
TestAmerica Laboratories, Inc.

TAL-8210 (0713)

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact		Project Manager: Chad Roper		Site Contact:	Date: 5-5-18	COC No:
Company Name: AECOM		Tel/Fax:		Lab Contact:	Carrier:	1 of 3 COCs
Address: 1220 Avenida Acaso		Analysis Turnaround Time				Sampler:
City/State/Zip: Camarillo CA 93012		☐ CALENDAR DAYS	☐ WORKING DAYS			For Lab Use Only:
Phone: (805) 764-4027		TAT if different from Below ____				Walk-in Client:
Fax:		☐ 2 weeks				Lab Sampling:
Project Name: NERT		☒ 1 week				
Site: EV Wash		☐ 2 days				Job / SDG No.:
PO# 60441305		☐ 1 day				

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Chlorate	Perchlorate/TDS	Sample Specific Notes:
T3.5A-20180505-0.45	050518	1140	G	SW	2			X	X	
T3.5B-20180505-0.83		1125	G	SW	2			X	X	
T3.5C-20180505-2.0		1200	G	SW	2			X	X	
T3.5D-20180505-2.4		1213	G	SW	2			X	X	
T3.5E-20180505-2.1		1250	G	SW	2			X	X	
T3.5E-20180505-6.4		1240	G	SW	2			X	X	
T3.5A-20180505-FB		1700	G	AQ	2			X	X	
T3.5B-20180505-0.83-FD		1125	G	SW	2			X	X	
T3.5C-20180505-2.0-MS		1200	G	SW	2			X	X	
T3.5C-20180505-2.0-MSD		1200	G	SW	2			X	X	
~~T3.5E-2018~~										
LW4.735-201805-EB	05/0[illegible]18	1150	G	AQ	2			X	X	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ____

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ____ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No | Custody Seal No.: | Cooler Temp. (°C): Obs'd: ____ Corr'd: ____ Therm ID No.: ____

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
James Mcloy	AECOM	5/7/18 1530	[signature]	TALI	5/7/18 1530
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

5-1 TALI

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Phone: 949.261.1022 Fax:

Chain of Custody Record

194850

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
TestAmerica Laboratories, Inc.
TAL-8210 (0713)

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact			
Company Name: AECOM	Project Manager: Chad Roper	Site Contact:	Date:
Address: 1220 Avenida Acaso	Tel/Fax:	Lab Contact:	Carrier:
City/State/Zip: Camarillo, CA 93012			
Phone: (805) 764-4027			
Fax:			
Project Name: NERT			
Site: LV Wash			
PO# 60477365			

COC No: 2 of 5 COCs
Sampler:
For Lab Use Only:
Walk-in Client:
Lab Sampling:
Job / SDG No.:

Analysis Turnaround Time
☐ CALENDAR DAYS ☐ WORKING DAYS
TAT if different from Below ________
☐ 2 weeks
☒ 1 week
☐ 2 days
☐ 1 day

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Chlorate	Perchlorate/TDS	Sample Specific Notes:
LW3.1-20180505-1.8	5/5/18	1012	G	SW	2			X	X	
LW3.1-20180505-1.8-MS	5/5/18	1012	G	SW	2			X	X	
LW3.1-20180505-1.8-MSD	5/5/18	1012	G	SW	2			X	X	
LW0.9-20180505-0.7	5/5/18	0905	G	SW	2			X	X	
LW0.9-20180505-0.7-FD	5/5/18	0905	G	SW	2			X	X	
LW3.68-20180506-0.83	5/6/18	1030	G	SW	2			X	X	
LW3.68-20180506-0.83-FD	5/6/18	1030	G	SW	2			X	X	
LW3.68-20180506-~~0.83~~-FB	5/7/18	1105	G	AQ	2			X	X	
LW3.2-20180506-1.35	5/6/18	1415	G	SW	2			X	X	
LW3.2-20180506-1.33-FD	5/6/18	1415	G	SW	2			X	X	
LW3.2-20180506-3.9	5/6/18	1400	G	SW	2			X	X	
LW3.15-20180506-2.4	5/6/18	1450	G	SW	2			X	X	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ________

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for________ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No | Custody Seal No.: | Cooler Temp. (°C): Obs'd:________ Corr'd:________ Therm ID No.:________

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
James McCoy	AECOM	5/7/18 1530	[signature]	~~TALV~~	5/7/18 1530
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TestAmerica Phoenix
4625 E. Cotton Center Blvd.
Suite 189
Phoenix, AZ 85040
Phone: 602.437.3340 Fax:

Chain of Custody Record

179598

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
TestAmerica Laboratories, Inc.
TAL-8210 (0713)

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact	Project Manager: Chad Roper	Site Contact:	Date:	COC No:
Company Name: AECOM	Tel/Fax:	Lab Contact:	Carrier:	3 of 3 COCs
Address: 1220 Avenida Acaso	Analysis Turnaround Time			Sampler:
City/State/Zip: Camarillo CA, 93012	☐ CALENDAR DAYS ☐ WORKING DAYS			For Lab Use Only:
Phone: (805) 764-4027	TAT if different from Below			Walk-in Client:
Fax:	☐ 2 weeks			Lab Sampling:
Project Name: NERT	☒ 1 week			
Site: LV Wash	☐ 2 days			Job / SDG No.:
PO# 10477365	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y/N)	Perform MS / MSD (Y/N)	Chlorate	Perchlorate/TDS	Sample Specific Notes:
LW3.15-20180506-2.4-FD	5/6/18	1450	G	SW	2			X	X	
LW3.11-20180506-1.9	5/6/18	1118	G	SW	2			X	X	
LW3.11-20180506-1.9-FD	5/6/18	1118	G	SW	2			X	X	
LW3.11-20180506-1.9-MS	5/6/18	1118	G	SW	2			X	X	
LW3.11-20180506-1.9-MSD	5/6/18	1118	G	SW	2			X	X	
LW3.11-2018050~~[illegible]~~-FB	5/7/18	1100	G	SW	2			X	X	
LW3.15-20180507-EB	5/7/18	1130	G	AQ	2			X	X	
LW0.9-20180507-EB	5/7/18	1115	G	AQ	2			X	X	
LW3.2-20180507-EB	5/7/18	1145	G	AQ	1				X	
~~LW~~ T3.5A-20180507-EB	5/7/18	1120	G	AQ	1				X	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ____

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ____ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No | Custody Seal No.: | Cooler Temp. (°C): Obs'd: ____ Corr'd: ____ Therm ID No.: ____

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
James McCoy	AECOM	5/7/18 1530	[signature]	TA	5/7/18 1530
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Appendix L

Data Validation Summary Reports

AECOM Environment

Prepared for:
Nevada Division of Environmental Protection
Las Vegas, NV

Prepared by:
AECOM
Camarillo, CA
60477365
February 2019 (Rev 0)

Data Validation Summary Report
May 2018 Surface Water Sampling

(Revision 0)

NERT Remedial Investigation – Downgradient Study Area
Nevada Environmental Response Trust Site
Henderson, Nevada

Final Draft

AECOM Environment

Prepared for:
Nevada Division of Environmental Protection
Las Vegas, NV

Prepared by:
AECOM
Camarillo, CA
60477365
February 2019 (Rev 0)

Data Validation Summary Report

May 2018 Surface Water Sampling

(Revision 0)

Final Draft

Lily Bayati

Prepared By Lily Bayati

Chad Roper

Reviewed By Chad Roper, PhD

Contents

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List of Acronyms

DQO	data quality objectives
EB	equipment blank
EPA	U.S. Environmental Protection Agency
FB	field blank
FD	field duplicate
LCS/LCSD	laboratory control sample / laboratory control sample duplicate
MS/MSD	matrix spike / matrix spike duplicate
NDEP	Nevada Department of Environmental Protection
PARCCS	precision, accuracy, representativeness, comparability, completeness, sensitivity
PQL	practical quantitation limit
QA/QC	quality assurance / quality control
QAPP	Quality Assurance Project Plan
RPD	relative percent difference
SDG	sample delivery group
SQL	sample quantitation limit
TDS	Total Dissolved Solids
%R	percent recovery

1.0 Introduction

This Data Validation Summary Report has been prepared by AECOM to assess the validity and usability of laboratory analytical data from the May 2018 Surface Water Sampling conducted in the Downgradient Study Area of the Nevada Environmental Response Trust site in Henderson, Nevada. The assessment was performed by AECOM under the 2017 Quality Assurance Project Plan (QAPP) revision 1 and the Supplemental Surface Water Investigation Plan (AECOM 2018). The project included the collection and analyses of 103 environmental and quality control (QC) samples (AECOM 2017). The analyses were performed by the following methods:

- Chlorate by U.S. Environmental Protection Agency (EPA) Method 300.1B
- Perchlorate by EPA Method 314.0
- Total Dissolved Solids (TDS) by Standard Method 2540C

Laboratory analytical services were provided by TestAmerica, Inc. (Irvine, California). The samples were grouped into sample delivery groups (SDGs). The water samples are associated with quality assurance (QA)/QC samples designed to document the data quality of the entire SDG or a sub-group of samples within an SDG. Table 1 is a cross-reference table listing each sample, analysis, SDG, collection date, laboratory sample number, matrix, and validation level. Table 2 is a reference table that identifies the QC elements reviewed in data validation.

The laboratory analytical data were validated in accordance with procedures described in the Nevada Division of Environmental Protection (NDEP) *Data Verification and Validation Requirements for the BMI Plant Sites and Common Areas Projects*, Henderson, Nevada, dated July 13, 2018. In accordance with NDEP guidance, 100 percent of the analytical data were validated according to Stage 2A data validation procedures.

The analytical data were evaluated for QA/QC based on the following documents: AECOM's QAPP Downgradient Study Area, Henderson, Nevada, Revision, May 2017; NDEP's Revised Guidance on Qualifying Data due to Blank Contamination for the BMI Complex and Common Areas, January 5, 2012; Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, January 2017; and the EPA's SW 846 Third Edition, Test Methods for Evaluating Solid Waste, update I, July 1992; update IIA, August 1993; update II, September 1994; update IIB, January 1995; update III, December 1996; update IV, February 2007.

This report summarizes the QA/QC evaluation of the data according to precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS) relative to the project data quality objectives (DQOs). This report provides a quantitative and qualitative assessment of the data and identifies potential sources of error, uncertainty, and bias that may affect the overall usability.

The PARCCS summary report evaluates and summarizes the results of QA/QC data validation for the entire sampling program. These sections interpret specific QC deviations and their effects on both individual data points and the analyses as a whole. Section 4.0 presents a summary of the PARCCS criteria by comparing quantitative parameters with acceptability criteria defined in the project DQOs. Qualitative PARCCS criteria are also summarized in this section.

1.1 Precision and Accuracy of Environmental Data

Environmental data quality depends on sample collection procedures, analytical methods and instrumentation, documentation, and sample matrix properties. Both sampling procedures and laboratory analyses contain potential sources of uncertainty, error, and/or bias, which affect the overall quality of a measurement. Errors for sample data may result from incomplete equipment decontamination, inappropriate sampling techniques, sample heterogeneity, improper filtering, and improper preservation. The accuracy of analytical results is dependent on selecting appropriate analytical methods, maintaining equipment properly, and complying with QC requirements. The sample matrix also is an important factor in the ability to obtain precise and accurate results within a given media.

Environmental and laboratory QA/QC samples assess the effects of sampling procedures and evaluate laboratory contamination, laboratory performance, and matrix effects. QA/QC samples include: equipment blanks (EBs), field blanks (FBs), field duplicates (FDs), method blanks, laboratory control samples/laboratory control sample duplicates (LCS/LCSDs), and matrix spike/matrix spike duplicates (MS/MSDs).

Before conducting the PARCCS evaluation, the analytical data were validated according to the QAPP (AECOM 2017), Functional Guidelines (EPA 2017), EPA SW 846 Test Methods, and NDEP guidance (NDEP 2018). Samples not meeting the acceptance criteria were qualified with a flag, an abbreviation indicating a deficiency with the data. The following are flags used in data validation.

J- Estimated - The associated numerical value is an estimated quantity with a negative bias. The analyte was detected but the reported value may not be accurate or precise.

J+ Estimated - The associated numerical value is an estimated quantity with a positive bias. The analyte was detected but the reported value may not be accurate or precise.

J Estimated - The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample. It is not possible to assess the direction of the potential bias. The analyte was detected but the reported value may not be accurate or precise.

R Rejected - The data is unusable (the compound or analyte may or may not be present). Use of the "R" qualifier indicates a significant variance from functional guideline acceptance criteria. Either resampling or reanalysis is necessary to determine the presence or absence of the rejected analyte.

U Nondetected - Analyses were performed for the compound or analyte, but it was not detected.

UJ Estimated/Nondetected - The analyte was analyzed for, but not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.

DNR Do Not Report - A more appropriate result is reported from another analysis or dilution.

A Indicates the finding is based upon technical validation criteria.

P Indicates the finding is related to a protocol/contractual deviation.

The hierarchy of flags is listed below:

R > J The R flag will always take precedence over the J qualifier.

J+ The high bias (J+) flag is applied only to detected results.

J > J+ or J- A non-biased (J) flag will always supersede biased (J+ or J-) flags since it is not possible to assess the direction of the potential bias.

J = J+ plus J- Adding biased (J+, J-) flags with opposite signs will result in a nonbiased flag (J).

UJ = U plus J The UJ flag is used when a non-detected (U) flag is added to J flag.

Table 3 lists the reason codes used. Reason codes explain why flags have been applied and identify possible limitations of data use. Reason codes are cumulative except when one of the flags is R then only the reason code associated to the R flag will be used.

Table 4 presents the overall qualified results after all the flags or validation qualifiers and associated reason codes have been applied.

Once the data are reviewed and qualified according to the QAPP, functional guidelines, EPA Test Methods, and NDEP guidance (NDEP 2018) the data set is then evaluated using PARCCS criteria. PARCCS criteria provide an evaluation of overall data usability. The following is a discussion of PARCCS criteria as related to the project DQOs.

Precision measures the reproducibility of repetitive measurements. It is defined as the degree of mutual agreement among independent measurements as the result of repeated application of the sample analytical process under similar conditions.

Components of precision include analytical precision and total precision. Analytical precision is a measurement of the variability associated with duplicate or replicate analyses of the same sample in the laboratory, and is determined by analysis of laboratory QC samples, such as duplicate control samples, LCSD, MSD, or sample duplicates. If the recoveries of analytes in the specified control samples are comparable within established control limits, then precision is within limits.

Total precision is a measurement of the variability associated with the entire sampling and analytical process. It is determined by analysis of duplicate or replicate field samples, and measures variability introduced by both the laboratory and field operations. Field duplicate samples are analyzed to assess field and analytical precision.

Duplicate results are assessed using the relative percent difference (RPD) between duplicate measurements. If the RPD for laboratory QC samples exceeds the laboratory's statistically determined acceptance ranges, data will be qualified as described in the applicable validation procedure. If the RPD between primary and duplicate field samples exceeds 50 percent for surface water, data will be qualified as described in the applicable validation procedure. The RPD will be calculated as follows:

$$\text{RPD} = \frac{|x_1 - x_2|}{\left(\frac{(x_1 + x_2)}{2}\right)} * 100$$

where:

x_1 = analyte concentration in the primary sample

x_2 = analyte concentration in the duplicate sample

Possible causes of poor precision include improper sample collection or handling, inconsistent sample preparation, and poor instrument stability. In some duplicate pairs, results maybe reported in either the primary or duplicate samples at levels below the practical quantitation limit (PQL) or non-detected. Since these values are considered to be estimates, RPD exceedances from these duplicate pairs do not suggest a significant impact on the data quality.

Accuracy is a measure of the agreement of an experimental determination and the true value of the parameter being measured. It is used to identify bias in a given measurement system. Recoveries outside acceptable QC limits may be caused by factors such as instrumentation, analyst error, or matrix interference. Accuracy is assessed through the analysis of MS, MSD, LCS, and LCSD. In some cases, samples from multiple SDGs were within one QC batch and therefore are associated with the same laboratory QC samples. Accuracy of inorganic analyses is determined using the percent recoveries of MS and LCS analyses.

Percent recovery (%R) is calculated using the following equation:

$$\%R = (A-B)/C \times 100$$

where:

A = measured concentration in the spiked sample
B = measured concentration of the spike compound in the unspiked sample
C = concentration of the spike

The percent recovery of each analyte spiked in MS/MSD samples and LCS/LCSD is evaluated with the acceptance criteria specified by the previously noted documents. Spike recoveries outside the acceptable QC accuracy limits provide an indication of bias, where the reported data may overestimate or underestimate the actual concentration of compounds detected or quantitation limits reported for environmental samples.

Representativeness is a qualitative parameter that expresses the degree to which the sample data are characteristic of a population. It is evaluated by reviewing the QC results of blanks, samples and holding times. Positive detects of compounds in the blank samples identify compounds that may have been introduced into the samples during sample collection, transport, preparation, or analysis. The QA/QC blanks collected and analyzed are method blanks, EBs, and FBs.

A method blank is a laboratory grade water or solid matrix that contains the method reagents and has undergone the same preparation and analysis as the environmental samples. The method blank provides a measure of the combined contamination derived from the laboratory source water, glassware, instruments, reagents, and sample preparation steps. Method blanks are prepared for each sample of a similar matrix extracted by the same method at a similar concentration level.

EBs consist of analyte-free water poured over or through the sample collection equipment. The water is collected in a sample container for laboratory analysis. These blanks are collected after the sampling equipment is decontaminated and measure efficiency of the decontamination procedure. EBs were collected and analyzed for all target analytes.

FBs consist of analyte-free source water stored at the sample collection site. The water is collected from each source used during each sampling event. FBs were collected and analyzed for all target analytes.

For inorganic analyses, contaminants found in both the environmental sample and the blank sample are assumed to be laboratory artifacts if both values are less than the PQL or if a sample result and blank contaminant value were greater than the PQL and the sample result is less than 10 times the blank contaminant value. The blanks and associated samples were evaluated according to the NDEP guidance (NDEP 2018).

Holding times are evaluated to assure that the sample integrity is intact for accurate sample preparation and analysis. Holding times will be specific for each method and matrix analyzed. Holding time exceedance can cause loss of sample constituents due to biodegradation, precipitation, volatilization, and chemical degradation. In accordance with NDEP guidance (NDEP 2018), sample results for analyses that were performed after the method holding time but less than two times the method holding time (if any) would be qualified as estimated (J- or UJ) and nondetect sample results for analyses that were performed after two times the method holding time would be qualified as rejected (R). Detected results are not to be rejected.

Comparability is a qualitative expression of the confidence with which one data set may be compared to another. It provides an assessment of the equivalence of the analytical results to data obtained from other analyses. It is important that data sets be comparable if they are used in conjunction with other data sets. The factors affecting comparability include sample collection and handling techniques, matrix type, and analytical method. If these aspects of sampling and analysis are carried out according to standard analytical procedures, the data are considered comparable. Comparability is also dependent upon other PARCCS criteria, because only when precision, accuracy, and representativeness are known can data sets be compared with confidence.

Completeness is defined as the percentage of acceptable sample results compared to the total number of sample results. Completeness is evaluated to determine if an acceptable amount of usable data were obtained so that a valid scientific site assessment can be completed. Completeness equals the total number of sample results for each fraction minus the total number of rejected sample results divided by the total number of sample results multiplied by 100. As specified in the project DQOs, the goal for completeness for target analytes in each analytical fraction is 90 percent.

Percent completeness is calculated using the following equation:

$$\%C = (T - R)/T \times 100$$

where:

%C = percent completeness
T = total number of sample results
R = total number of rejected sample results

Completeness is also determined by comparing the planned number of samples per method and matrix as specified in the QAPP, with the number determined above.

Sensitivity is the ability of an analytical method or instrument to discriminate between measurement responses representing different concentrations. This capability is established during the planning phase to meet the DQOs. It is important that detection limits and PQLs presented in the QAPP are achieved and that target analytes can be detected at concentrations necessary to support the DQOs. The method detection limits (MDLs) represent the minimum concentration of a substance that can be measured and reported with 99-percent confidence that the analyte concentration is greater than zero. Sample quantitation limits (SQLs) are adjusted values that reflect sample specific actions, such as dilutions or varying aliquot sizes. PQLs are the lowest level at which the entire analytical system gives a recognizable signal and acceptable calibration point for the analyte. The laboratory is required to report detected analytes down to the SQL for this project. The laboratory uses a format that reports estimated values down to the SQL. In addition, sample results are compared to method blank and FB results to identify potential effects of laboratory background and field procedures on sensitivity.

The following sections present a review of QC data chlorate, perchlorate, and TDS analyses.

2.0 Wet Chemistry Analysis

A total of 84 primary water samples and 19 QCs were analyzed for chlorate by EPA Method 300.1B; perchlorate by EPA Method 314.0; and TDS by Standard Method 2540C. All wet chemistry data were assessed to be valid. This section discusses the QA/QC supporting documentation as defined by the PARCCS criteria and evaluated based on the DQOs.

2.1 Precision and Accuracy

2.1.1 Surrogate

Surrogate (dichloroacetic acid) recoveries were evaluated for chlorate analysis by EPA Method 300.1B. All surrogate %Rs met the acceptance criteria as stated in the QAPP.

2.1.2 MS/MSD Samples

Due to MS/MSD %Rs outside of acceptance criteria as stated in the QAPP, the following samples were qualified as estimated ("J-") for chlorate: T3.3A-20180504-0.1, T3.3B-20180504-0.8, T3.3C-20180504-0.3, T3.3D-20180504-0.8, T3.3E-20180504-1.2, T3.9D-20180504-0.1, T3.9A-20180504-0.2, and LW0.9-20180503-0.8-FD The details regarding the qualification of results are presented in Attachment 1, Section 5.

2.1.3 Duplicate Samples

Duplicate samples were evaluated for TDS analysis by SM 2540C. All duplicate RPDs met the acceptance criteria as stated in the QAPP.

2.1.4 LCS Samples

LCS samples were evaluated for all wet chemistry methods. All LCS %Rs met the acceptance criteria as stated in the QAPP.

2.1.5 FD Samples

The FD samples were evaluated for acceptable precision with RPDs. Acceptable field and analytical precision was demonstrated for all field duplicate pairs.

2.1.6 Analyte Quantitation and Target Identification

All analytes reported and the detection limits obtained comply with project specifications. All dilutions were appropriate.

2.2 Representativeness

2.2.1 Sample Preservation and Holding Times

The evaluation of holding times to verify compliance with all wet chemistry methods was conducted. All water samples met the 7-day analysis holding time criteria for TDS and the 28-day analysis holding time criteria for chlorate, and perchlorate.

The details regarding sample preservation and holding times are presented in Attachment 1, Section 1.

2.2.2 Blanks

As previously discussed in Section 1.1, method blanks, EBs, and FBs were analyzed to evaluate representativeness.

2.2.2.1 Method Blanks

No data were qualified due to contaminants detected in the method blanks for this analysis.

2.2.2.2 EBs and FBs

Five EBs (LW0.9-20180507-EB, LW3.15-20180507-EB, LW3.2-20180507-EB, LW4.73S-20180504-EB, and T3.5A-20180507-EB) and five FBs (T6.8A-20180501-FB, T3.3A-20180504-0.1-FB, LW3.11-20180507-FB, LW3.68-20180506-0.83-FB, and T3.5A-20180505-FB) were submitted for analyses. No contaminants were found in EBs and FBs. The details regarding these results are presented in Attachment 1, Section 3.

2.3 Comparability

The laboratory used standard analytical methods for all of the analyses. In all cases, the SQLs attained were at or below the PQLs. Target compounds detected below the PQLs flagged (J) by the laboratory should be considered estimated. The comparability of the data is regarded as acceptable.

2.4 Completeness

The completeness level attained for wet chemistry field samples was 100 percent. This percentage was calculated as the total number of accepted sample results divided by the total number of sample results multiplied by 100.

2.5 Sensitivity

All laboratory PQLs met the specified requirements described in the QAPP.

3.0 Variances in Analytical Performance

The laboratory used standard analytical methods for all of the analyses throughout the project. No systematic variances in analytical performance were noted in the laboratory case narratives.

4.0 Summary of PARCCS Criteria

The validation reports present the PARCCS results for all SDGs. Each PARCCS criterion is discussed in detail in the following sections.

4.1 Precision and Accuracy

Precision and accuracy were evaluated using data quality indicators such as surrogates, MS/MSD, duplicates, LCS/LCSD, and FDs. The precision and accuracy of the data set were considered acceptable after incorporation of validation-qualified results.

All surrogate, MS/MSD, RPDs, duplicates, LCS, and FD %Rs met acceptance criteria with the exceptions noted in Sections 2.1.2.

4.2 Representativeness

All samples for each method and matrix were evaluated for holding time compliance. All samples were associated with a method blank in each individual SDG. The representativeness of the project data is considered acceptable after incorporation of validation-qualified results.

4.3 Comparability

Sampling frequency requirements were met in obtaining necessary EBs, FBs and FDs. The laboratory used standard analytical methods for the analyses. The analytical results were reported in correct standard units. Sample integrity criteria were met. Sample preservation and holding times were within QC criteria. The overall comparability is considered acceptable after incorporation of validation-qualified results.

4.4 Completeness

Of the 252 total analytes reported from primary samples, 0 sample results were rejected. The completeness for the SDGs is as follows:

Parameter	Total Analytes	No. of Rejects	% Completeness
Perchlorate	84	0	100
Chlorate	84	0	100
TDS	84	0	100
Total	**252**	**0**	**100**

The completeness percentage based on rejected data met the 90-percent DQO goal.

4.5 Sensitivity

Sensitivity was achieved by the laboratory to support the DQOs. PQLs met the project requirements and low-level contamination in the method blanks, EBs, and FBs did not affect sensitivity.

5.0 Conclusions and Recommendations

The analytical data quality assessment for the water sample laboratory analytical results generated during the May 2018 Surface water sampling in the Downgradient Study Area of the Nevada Environmental Response Trust (NERT) site in Henderson, Nevada, established that the overall project requirements and completeness levels were met. No results were rejected. Sample results that were found to be estimated ("J-”) are usable for limited purposes only. Based upon the Stage 2A data validation all other results are considered valid and usable for all purposes.

6.0 References

AECOM 2017. Quality Assurance Project Plan (QAPP) NERT Remedial Investigation, Downgradient Study Area, Nevada Environmental Response Trust Site, Henderson, Nevada Revision 1 Final. May

AECOM 2018. Technical Memorandum, RI Modification: Supplemental Surface Water Investigation Plan, April 24.

EPA 2017. Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. January 2017.

NDEP 2018. NDEP Data Validation and Verification Requirements for the BMI Complex and Common Areas. July 13.

Tables

Table 1
Sample Cross Reference
NERT Downgradint Study Area, Henderson Nevada

SDG	Client Sample ID	Lab Sample ID	Matrix	Sample Date	QC Type	Validation Level	Chlorate (E300.1)	Perchlorate (E314.0)	Total Dissolved Solids (SM2540C)
4402102981	T6.55A-20180501-0.4	440-210298-12	W	05/01/18		Stage 2A	X	X	X
4402102981	T6.55B-20180501-0.6	440-210298-13	W	05/01/18		Stage 2A	X	X	X
4402102981	T6.55C-20180501-0.1	440-210298-14	W	05/01/18		Stage 2A	X	X	X
4402102981	T6.55D-20180501-0.1	440-210298-15	W	05/01/18		Stage 2A	X	X	X
4402102981	T6.5A-20180501-1.2	440-210298-1	W	05/01/18		Stage 2A	X	X	X
4402102981	T6.5B-20180501-1.0	440-210298-2	W	05/01/18		Stage 2A	X	X	X
4402102981	T6.5C-20180501-1.0	440-210298-3	W	05/01/18		Stage 2A	X	X	X
4402102981	T6.5D-20180501-0.5	440-210298-4	W	05/01/18		Stage 2A	X	X	X
4402102981	T6.8A-20180501-1.2	440-210298-6	W	05/01/18		Stage 2A	X	X	X
4402102981	T6.8A-20180501-FB	440-210298-5	W	05/01/18	FB	Stage 2A	X	X	X
4402102981	T6.8B-20180501-0.9	440-210298-7	W	05/01/18		Stage 2A	X	X	X
4402102981	T6.8B-20180501-0.9-FD	440-210298-8	W	05/01/18	DUP	Stage 2A	X	X	X
4402102981	T6.8C-20180501-0.4	440-210298-9	W	05/01/18		Stage 2A	X	X	X
4402102981	T6.8D-20180501-0.2	440-210298-10	W	05/01/18		Stage 2A	X	X	X
4402102981	T6.8E-20180501-0.4	440-210298-11	W	05/01/18		Stage 2A	X	X	X
4402106221	T3.8A-20180503-1.0	440-210622-10	W	05/03/18		Stage 2A	X	X	X
4402106221	T3.8B-20180503-0.7	440-210622-11	W	05/03/18		Stage 2A	X	X	X
4402106221	T3.8C-20180503-0.7	440-210622-12	W	05/03/18		Stage 2A	X	X	X
4402106221	T4.7A-20180503-2.3	440-210622-1	W	05/03/18		Stage 2A	X	X	X
4402106221	T4.7B1-20180503-5.8	440-210622-2	W	05/03/18		Stage 2A	X	X	X
4402106221	T4.7B2-20180503-2.0	440-210622-3	W	05/03/18		Stage 2A	X	X	X
4402106221	T4.7C-20180503-2.4	440-210622-4	W	05/03/18		Stage 2A	X	X	X
4402106221	T4.7D-20180503-0.8	440-210622-5	W	05/03/18		Stage 2A	X	X	X
4402106221	T4.7E-20180503-2.4	440-210622-6	W	05/03/18		Stage 2A	X	X	X
4402106221	T4.7F-20180503-0.9	440-210622-7	W	05/03/18		Stage 2A	X	X	X
4402106221	T4.7G-20180503-2.2	440-210622-8	W	05/03/18		Stage 2A	X	X	X
4402106221	T4.7H-20180503-1.0	440-210622-9	W	05/03/18		Stage 2A	X	X	X
4402106231	LWC3.7-20180503-1.7	440-210623-3	W	05/03/18		Stage 2A	X	X	X
4402106231	T3.8D-20180503-0.8	440-210623-1	W	05/03/18		Stage 2A	X	X	X
4402106231	T3.8E-20180503-0.3	440-210623-2	W	05/03/18		Stage 2A	X	X	X
4402106231	T4.65A-20180503-0.7	440-210623-8	W	05/03/18		Stage 2A	X	X	X
4402106231	T4.65B-20180503-1.5	440-210623-9	W	05/03/18		Stage 2A	X	X	X
4402106231	T4.65C-20180503-1.1	440-210623-10	W	05/03/18		Stage 2A	X	X	X
4402106231	T4.65D-20180503-0.9	440-210623-11	W	05/03/18		Stage 2A	X	X	X
4402106231	T4.8A-20180503-0.7	440-210623-12	W	05/03/18		Stage 2A	X	X	X
4402106231	T6A-20180503-0.4	440-210623-4	W	05/03/18		Stage 2A	X	X	X
4402106231	T6B-20180503-0.8	440-210623-5	W	05/03/18		Stage 2A	X	X	X
4402106231	T6C-20180503-1.3	440-210623-6	W	05/03/18		Stage 2A	X	X	X
4402106231	T6D-20180503-1.5	440-210623-7	W	05/03/18		Stage 2A	X	X	X
4402106241	LW4.48N-20180503-0.6	440-210624-6	W	05/03/18		Stage 2A	X	X	X
4402106241	LW4.48S-20180503-0.4	440-210624-7	W	05/03/18		Stage 2A	X	X	X

Table 1
Sample Cross Reference
NERT Downgradint Study Area, Henderson Nevada

SDG	Client Sample ID	Lab Sample ID	Matrix	Sample Date	QC Type	Validation Level	Chlorate (E300.1)	Perchlorate (E314.0)	Total Dissolved Solids (SM2540C)
4402106241	LW4.5S-20180503-0.4	440-210624-8	W	05/03/18		Stage 2A	X	X	X
4402106241	T4.8B-20180503-1.2	440-210624-1	W	05/03/18		Stage 2A	X	X	X
4402106241	T4.8C-20180503-2.2	440-210624-2	W	05/03/18		Stage 2A	X	X	X
4402106241	T4.8D-20180503-1.8	440-210624-3	W	05/03/18		Stage 2A	X	X	X
4402106241	T4.8E-20180503-2.0	440-210624-4	W	05/03/18		Stage 2A	X	X	X
4402106241	T6E-20180503-0.6	440-210624-5	W	05/03/18		Stage 2A	X	X	X
4402106251	C-1-20180504-0.3	440-210625-29	W	05/04/18		Stage 2A	X	X	X
4402106251	LW0.9-20180503-0.8	440-210625-1	W	05/03/18		Stage 2A	X	X	X
4402106251	LW0.9-20180503-0.8-FD	440-210625-2	W	05/03/18	DUP	Stage 2A	X	X	X
4402106251	LW0.9-20180504-0.7	440-210625-25	W	05/04/18		Stage 2A	X	X	X
4402106251	LW3.4-20180504-1.1	440-210625-13	W	05/04/18		Stage 2A	X	X	X
4402106251	LW3.5S-20180504-1.8	440-210625-14	W	05/04/18		Stage 2A	X	X	X
4402106251	LW4.73N-20180504-2.2	440-210625-27	W	05/04/18		Stage 2A	X	X	X
4402106251	LW4.73S-20180504-2.4	440-210625-28	W	05/04/18		Stage 2A	X	X	X
4402106251	T3.3A-20180504-0.1	440-210625-3	W	05/04/18		Stage 2A	X	X	X
4402106251	T3.3A-20180504-0.1-FB	440-210625-26	W	05/04/18	FB	Stage 2A	X	X	X
4402106251	T3.3B-20180504-0.8	440-210625-4	W	05/04/18		Stage 2A	X	X	X
4402106251	T3.3C-20180504-0.3	440-210625-5	W	05/04/18		Stage 2A	X	X	X
4402106251	T3.3D-20180504-0.8	440-210625-6	W	05/04/18		Stage 2A	X	X	X
4402106251	T3.3E-20180504-1.2	440-210625-7	W	05/04/18		Stage 2A	X	X	X
4402106251	T3.75A-20180504-0.7	440-210625-15	W	05/04/18		Stage 2A	X	X	X
4402106251	T3.75B-20180504-1.0	440-210625-16	W	05/04/18		Stage 2A	X	X	X
4402106251	T3.75C-20180504-1.2	440-210625-17	W	05/04/18		Stage 2A	X	X	X
4402106251	T3.75D-20180504-1.3	440-210625-18	W	05/04/18		Stage 2A	X	X	X
4402106251	T3.75E-20180504-0.2	440-210625-19	W	05/04/18		Stage 2A	X	X	X
4402106251	T3.9A-20180504-0.2	440-210625-8	W	05/04/18		Stage 2A	X	X	X
4402106251	T3.9B-20180504-0.5	440-210625-9	W	05/04/18		Stage 2A	X	X	X
4402106251	T3.9B-20180504-0.5-FD	440-210625-10	W	05/04/18	DUP	Stage 2A	X	X	X
4402106251	T3.9C-20180504-0.5	440-210625-11	W	05/04/18		Stage 2A	X	X	X
4402106251	T3.9D-20180504-0.1	440-210625-12	W	05/04/18		Stage 2A	X	X	X
4402106251	T4.85A-20180504-0.6	440-210625-20	W	05/04/18		Stage 2A	X	X	X
4402106251	T4.85B-20180504-2.2	440-210625-21	W	05/04/18		Stage 2A	X	X	X
4402106251	T4.85C-20180504-0.9	440-210625-22	W	05/04/18		Stage 2A	X	X	X
4402106251	T4.85D-20180504-0.7	440-210625-23	W	05/04/18		Stage 2A	X	X	X
4402106251	T4.85E-20180504-1.0	440-210625-24	W	05/04/18		Stage 2A	X	X	X
4402107241	LW0.9-20180505-0.7	440-210724-11	W	05/05/18		Stage 2A	X	X	X
4402107241	LW0.9-20180505-0.7-FD	440-210724-12	W	05/05/18	DUP	Stage 2A	X	X	X
4402107241	LW0.9-20180507-EB	440-210724-25	W	05/07/18	EB	Stage 2A	X	X	X
4402107241	LW3.1-20180505-1.8	440-210724-10	W	05/05/18		Stage 2A	X	X	X
4402107241	LW3.11-20180506-1.9	440-210724-21	W	05/06/18		Stage 2A	X	X	X
4402107241	LW3.11-20180506-1.9-FD	440-210724-22	W	05/06/18	DUP	Stage 2A	X	X	X

Table 1
Sample Cross Reference
NERT Downgradint Study Area, Henderson Nevada

SDG	Client Sample ID	Lab Sample ID	Matrix	Sample Date	QC Type	Validation Level	Chlorate (E300.1)	Perchlorate (E314.0)	Total Dissolved Solids (SM2540C)
4402107241	LW3.11-20180507-FB	440-210724-23	W	05/07/18	FB	Stage 2A	X	X	X
4402107241	LW3.15-20180506-2.4	440-210724-19	W	05/06/18		Stage 2A	X	X	X
4402107241	LW3.15-20180506-2.4-FD	440-210724-20	W	05/06/18	DUP	Stage 2A	X	X	X
4402107241	LW3.15-20180507-EB	440-210724-24	W	05/07/18	EB	Stage 2A	X	X	X
4402107241	LW3.2-20180506-1.33	440-210724-16	W	05/06/18		Stage 2A	X	X	X
4402107241	LW3.2-20180506-1.33-FD	440-210724-17	W	05/06/18	DUP	Stage 2A	X	X	X
4402107241	LW3.2-20180506-3.9	440-210724-18	W	05/06/18		Stage 2A	X	X	X
4402107241	LW3.2-20180507-EB	440-210724-26	W	05/07/18	EB	Stage 2A		X	X
4402107241	LW3.68-20180506-0.83	440-210724-13	W	05/06/18		Stage 2A	X	X	X
4402107241	LW3.68-20180506-0.83-FB	440-210724-15	W	05/06/18	FB	Stage 2A	X	X	X
4402107241	LW3.68-20180506-0.83-FD	440-210724-14	W	05/06/18	DUP	Stage 2A	X	X	X
4402107241	LW4.73S-20180504-EB	440-210724-9	W	05/04/18	EB	Stage 2A	X	X	X
4402107241	T3.5A-20180505-0.45	440-210724-1	W	05/05/18		Stage 2A	X	X	X
4402107241	T3.5A-20180505-FB	440-210724-7	W	05/05/18	FB	Stage 2A	X	X	X
4402107241	T3.5A-20180507-EB	440-210724-27	W	05/07/18	EB	Stage 2A		X	X
4402107241	T3.5B-20180505-0.7	440-210724-2	W	05/05/18		Stage 2A	X	X	X
4402107241	T3.5B-20180505-0.7-FD	440-210724-8	W	05/05/18	DUP	Stage 2A	X	X	X
4402107241	T3.5C-20180505-2.0	440-210724-3	W	05/05/18		Stage 2A	X	X	X
4402107241	T3.5D-20180505-2.4	440-210724-4	W	05/05/18		Stage 2A	X	X	X
4402107241	T3.5E-20180505-2.1	440-210724-5	W	05/05/18		Stage 2A	X	X	X
4402107241	T3.5E-20180505-6.4	440-210724-6	W	05/05/18		Stage 2A	X	X	X

Notes:
SDG - Sample Designation Group
ID - Identifier
QC - Quality control
W - Water
EB - Equipment Blank
FB - Field Blank
DUP - Duplicate

Table 2
Validation Elements
NERT Downgradient Study Area
Henderson, Nevada

Stage 2A	All Analyses
Sample Receipt & Technical Holding Time	√
Laboratory Blanks	√
Field Blanks	√
Surrogate Spikes	√
Matrix Spike (MS), Matrix Spike Duplicate (MSD)	√
Laboratory Duplicate (DUP)	√
Laboratory Control Sample (LCS)/ Laboratory Control Sample Duplicate (LCSD)	√
Field Duplicate	√
Project Quantitation Limits	√
Multiple Results for One Sample	√
Overall Data Usability Assessment	√

Notes:
√ = Reviewed

Table 3
Qualification Codes and Definitions
NERT Downgradient Study Area
Henderson, Nevada

Reason Code	Explanation
a	qualified due to low abundance (radiochemical activity)
be	qualified due to equipment blank contamination
bf	qualified due to field blank contamination
bl	qualified due to laboratory blank contamination
bt	qualified due to trip blank contamination
bp	qualified due to pump blank contamination (wells w/o dedicated pumps, when contamination is detected in the Pump Blk)
br	qualified due to filter blank contamination (aqueous Hexavalent Chromium and Dissolved sample fractions)
c	qualified due to calibration problems
cp	qualified due to insufficient ingrowth (radiochemical only)
dc	dual column confirmation %D exceeded
e	concentration exceeded the calibration range
fd	qualified due to field duplicate imprecision
h	qualified due to holding time exceedance
i	qualified due to internal standard areas
k	qualified as Estimated Maximum Possible Concentrations (dioxins and PCB congeners)
l	qualified due to LCS recoveries
ld	qualified due to laboratory duplicate imprecision (matrix duplicate, MSD, LCSD)
m	qualified due to matrix spike recoveries
nb	qualified due to negative laboratory blank contamination (nondetect results only)
nd	qualified due to non-detected target analyte
o	other
p	qualified as a false positive due to contamination during shipping
pH	sample preservation not within acceptance range
q	qualified due to quantitation problem
s	qualified due to surrogate recoveries
sd	serial dilution did not meet control criteria
sp	detected value reported >SQL <PQL
st	sample receipt temperature exceeded
t	qualified due to elevated helium tracer concentrations
vh	volatile headspace detected in aqueous sample containers submitted for VOC analysis
x	qualified due to low % solids
z	qualified due to ICS results

Table 4
Qualified Results Surface Water Samples
NERT Downgradient Study Area

Henderson, Nevada

SDG	Client Sample ID	Sample Date	Method	Client Analyte ID	Analyte	Lab Result	Lab Qualifier	SQL	PQL	Units	Validator Qualifier	Reason Code	Reason Code Definition	Qualification Finding
4402102981	T6.55A-20180501-0.4	05/01/18	E300.1	14866-68-3	Chlorate	460		5.0	100	µg/L				
4402102981	T6.55A-20180501-0.4	05/01/18	E314.0	14797-73-0	Perchlorate	690		0.95	200	µg/L				
4402102981	T6.55A-20180501-0.4	05/01/18	SM2540C	TDS	Total Dissolved Solids	3800		5.0	50	mg/L				
4402102981	T6.55B-20180501-0.6	05/01/18	E300.1	14866-68-3	Chlorate	94	J	5.0	100	µg/L	J	sp	Detect <PQL	
4402102981	T6.55B-20180501-0.6	05/01/18	E314.0	14797-73-0	Perchlorate	1.3	J	0.95	4.0	µg/L	J	sp	Detect <PQL	
4402102981	T6.55B-20180501-0.6	05/01/18	SM2540C	TDS	Total Dissolved Solids	1500		5.0	20	mg/L				
4402102981	T6.55C-20180501-0.1	05/01/18	E300.1	14866-68-3	Chlorate	85	J	5.0	100	µg/L	J	sp	Detect <PQL	
4402102981	T6.55C-20180501-0.1	05/01/18	E314.0	14797-73-0	Perchlorate	0.95	U	0.95	4.0	µg/L				
4402102981	T6.55C-20180501-0.1	05/01/18	SM2540C	TDS	Total Dissolved Solids	1200		5.0	10	mg/L				
4402102981	T6.55D-20180501-0.1	05/01/18	E300.1	14866-68-3	Chlorate	91	J	5.0	100	µg/L	J	sp	Detect <PQL	
4402102981	T6.55D-20180501-0.1	05/01/18	E314.0	14797-73-0	Perchlorate	0.95	U	0.95	4.0	µg/L				
4402102981	T6.55D-20180501-0.1	05/01/18	SM2540C	TDS	Total Dissolved Solids	1200		5.0	10	mg/L				
4402102981	T6.5A-20180501-1.2	05/01/18	E300.1	14866-68-3	Chlorate	110		5.0	100	µg/L				
4402102981	T6.5A-20180501-1.2	05/01/18	E314.0	14797-73-0	Perchlorate	13		0.95	4.0	µg/L				
4402102981	T6.5A-20180501-1.2	05/01/18	SM2540C	TDS	Total Dissolved Solids	1600		5.0	20	mg/L				
4402102981	T6.5B-20180501-1.0	05/01/18	E300.1	14866-68-3	Chlorate	81	J	5.0	100	µg/L	J	sp	Detect <PQL	
4402102981	T6.5B-20180501-1.0	05/01/18	E314.0	14797-73-0	Perchlorate	0.95	U	0.95	4.0	µg/L				
4402102981	T6.5B-20180501-1.0	05/01/18	SM2540C	TDS	Total Dissolved Solids	1200		5.0	10	mg/L				
4402102981	T6.5C-20180501-1.0	05/01/18	E300.1	14866-68-3	Chlorate	130		5.0	100	µg/L				
4402102981	T6.5C-20180501-1.0	05/01/18	E314.0	14797-73-0	Perchlorate	0.95	U	0.95	4.0	µg/L				
4402102981	T6.5C-20180501-1.0	05/01/18	SM2540C	TDS	Total Dissolved Solids	1100		5.0	10	mg/L				
4402102981	T6.5D-20180501-0.5	05/01/18	E300.1	14866-68-3	Chlorate	94	J	5.0	100	µg/L	J	sp	Detect <PQL	
4402102981	T6.5D-20180501-0.5	05/01/18	E314.0	14797-73-0	Perchlorate	0.95	U	0.95	4.0	µg/L				
4402102981	T6.5D-20180501-0.5	05/01/18	SM2540C	TDS	Total Dissolved Solids	1200		5.0	10	mg/L				
4402102981	T6.8A-20180501-1.2	05/01/18	E300.1	14866-68-3	Chlorate	100		5.0	100	µg/L				
4402102981	T6.8A-20180501-1.2	05/01/18	E314.0	14797-73-0	Perchlorate	0.95	U	0.95	4.0	µg/L				
4402102981	T6.8A-20180501-1.2	05/01/18	SM2540C	TDS	Total Dissolved Solids	1600		5.0	20	mg/L				
4402102981	T6.8A-20180501-FB	05/01/18	E300.1	14866-68-3	Chlorate	5.0	U	5.0	20	µg/L				
4402102981	T6.8A-20180501-FB	05/01/18	E314.0	14797-73-0	Perchlorate	0.95	U	0.95	4.0	µg/L				
4402102981	T6.8A-20180501-FB	05/01/18	SM2540C	TDS	Total Dissolved Solids	5.0	U	5.0	10	mg/L				
4402102981	T6.8B-20180501-0.9	05/01/18	E300.1	14866-68-3	Chlorate	100		5.0	100	µg/L				
4402102981	T6.8B-20180501-0.9	05/01/18	E314.0	14797-73-0	Perchlorate	1.6	J	0.95	4.0	µg/L	J	sp	Detect <PQL	
4402102981	T6.8B-20180501-0.9	05/01/18	SM2540C	TDS	Total Dissolved Solids	1700		5.0	20	mg/L				
4402102981	T6.8B-20180501-0.9-FD	05/01/18	E300.1	14866-68-3	Chlorate	99	J	5.0	100	µg/L	J	sp	Detect <PQL	
4402102981	T6.8B-20180501-0.9-FD	05/01/18	E314.0	14797-73-0	Perchlorate	1.7	J	0.95	4.0	µg/L	J	sp	Detect <PQL	
4402102981	T6.8B-20180501-0.9-FD	05/01/18	SM2540C	TDS	Total Dissolved Solids	1700		5.0	20	mg/L				
4402102981	T6.8C-20180501-0.4	05/01/18	E300.1	14866-68-3	Chlorate	90	J	5.0	100	µg/L	J	sp	Detect <PQL	

Table 4
Qualified Results Surface Water Samples
NERT Downgradient Study Area
Henderson, Nevada

SDG	Client Sample ID	Sample Date	Method	Client Analyte ID	Analyte	Lab Result	Lab Qualifier	SQL	PQL	Units	Validator Qualifier	Reason Code	Reason Code Definition	Qualification Finding
4402102981	T6.8C-20180501-0.4	05/01/18	E314.0	14797-73-0	Perchlorate	1.9	J	0.95	4.0	µg/L	J	sp	Detect <PQL	
4402102981	T6.8C-20180501-0.4	05/01/18	SM2540C	TDS	Total Dissolved Solids	1700		5.0	20	mg/L				
4402102981	T6.8D-20180501-0.2	05/01/18	E300.1	14866-68-3	Chlorate	88	J	5.0	100	µg/L	J	sp	Detect <PQL	
4402102981	T6.8D-20180501-0.2	05/01/18	E314.0	14797-73-0	Perchlorate	0.95	U	0.95	4.0	µg/L				
4402102981	T6.8D-20180501-0.2	05/01/18	SM2540C	TDS	Total Dissolved Solids	1200		5.0	10	mg/L				
4402102981	T6.8E-20180501-0.4	05/01/18	E300.1	14866-68-3	Chlorate	90	J	5.0	100	µg/L	J	sp	Detect <PQL	
4402102981	T6.8E-20180501-0.4	05/01/18	E314.0	14797-73-0	Perchlorate	0.95	U	0.95	4.0	µg/L				
4402102981	T6.8E-20180501-0.4	05/01/18	SM2540C	TDS	Total Dissolved Solids	1100		5.0	10	mg/L				
4402106221	T3.8A-20180503-1.0	05/03/18	E300.1	14866-68-3	Chlorate	190		5.0	100	µg/L				
4402106221	T3.8A-20180503-1.0	05/03/18	E314.0	14797-73-0	Perchlorate	32		0.95	20	µg/L				
4402106221	T3.8A-20180503-1.0	05/03/18	SM2540C	TDS	Total Dissolved Solids	1300		5.0	20	mg/L				
4402106221	T3.8B-20180503-0.7	05/03/18	E300.1	14866-68-3	Chlorate	180		5.0	100	µg/L				
4402106221	T3.8B-20180503-0.7	05/03/18	E314.0	14797-73-0	Perchlorate	36		0.95	8.0	µg/L				
4402106221	T3.8B-20180503-0.7	05/03/18	SM2540C	TDS	Total Dissolved Solids	1300		5.0	20	mg/L				
4402106221	T3.8C-20180503-0.7	05/03/18	E300.1	14866-68-3	Chlorate	140		5.0	100	µg/L				
4402106221	T3.8C-20180503-0.7	05/03/18	E314.0	14797-73-0	Perchlorate	25		0.95	4.0	µg/L				
4402106221	T3.8C-20180503-0.7	05/03/18	SM2540C	TDS	Total Dissolved Solids	1300		5.0	20	mg/L				
4402106221	T4.7A-20180503-2.3	05/03/18	E300.1	14866-68-3	Chlorate	160		5.0	100	µg/L				
4402106221	T4.7A-20180503-2.3	05/03/18	E314.0	14797-73-0	Perchlorate	23		0.95	8.0	µg/L				
4402106221	T4.7A-20180503-2.3	05/03/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402106221	T4.7B1-20180503-5.8	05/03/18	E300.1	14866-68-3	Chlorate	170		5.0	100	µg/L				
4402106221	T4.7B1-20180503-5.8	05/03/18	E314.0	14797-73-0	Perchlorate	22		0.95	8.0	µg/L				
4402106221	T4.7B1-20180503-5.8	05/03/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402106221	T4.7B2-20180503-2.0	05/03/18	E300.1	14866-68-3	Chlorate	160		5.0	100	µg/L				
4402106221	T4.7B2-20180503-2.0	05/03/18	E314.0	14797-73-0	Perchlorate	21		0.95	8.0	µg/L				
4402106221	T4.7B2-20180503-2.0	05/03/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402106221	T4.7C-20180503-2.4	05/03/18	E300.1	14866-68-3	Chlorate	160		5.0	100	µg/L				
4402106221	T4.7C-20180503-2.4	05/03/18	E314.0	14797-73-0	Perchlorate	23		0.95	4.0	µg/L				
4402106221	T4.7C-20180503-2.4	05/03/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402106221	T4.7D-20180503-0.8	05/03/18	E300.1	14866-68-3	Chlorate	140		5.0	100	µg/L				
4402106221	T4.7D-20180503-0.8	05/03/18	E314.0	14797-73-0	Perchlorate	16		0.95	4.0	µg/L				
4402106221	T4.7D-20180503-0.8	05/03/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402106221	T4.7E-20180503-2.4	05/03/18	E300.1	14866-68-3	Chlorate	83	J	5.0	100	µg/L	J	sp	Detect <PQL	
4402106221	T4.7E-20180503-2.4	05/03/18	E314.0	14797-73-0	Perchlorate	12		0.95	4.0	µg/L				
4402106221	T4.7E-20180503-2.4	05/03/18	SM2540C	TDS	Total Dissolved Solids	1300		5.0	20	mg/L				
4402106221	T4.7F-20180503-0.9	05/03/18	E300.1	14866-68-3	Chlorate	76	J	5.0	100	µg/L	J	sp	Detect <PQL	
4402106221	T4.7F-20180503-0.9	05/03/18	E314.0	14797-73-0	Perchlorate	12		0.95	4.0	µg/L				

Table 4

Qualified Results Surface Water Samples

NERT Downgradient Study Area

Henderson, Nevada

SDG	Client Sample ID	Sample Date	Method	Client Analyte ID	Analyte	Lab Result	Lab Qualifier	SQL	PQL	Units	Validator Qualifier	Reason Code	Reason Code Definition	Qualification Finding
4402106221	T4.7F-20180503-0.9	05/03/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402106221	T4.7G-20180503-2.2	05/03/18	E300.1	14866-68-3	Chlorate	80	J	5.0	100	µg/L	J	sp	Detect <PQL	
4402106221	T4.7G-20180503-2.2	05/03/18	E314.0	14797-73-0	Perchlorate	10		0.95	4.0	µg/L				
4402106221	T4.7G-20180503-2.2	05/03/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402106221	T4.7H-20180503-1.0	05/03/18	E300.1	14866-68-3	Chlorate	75	J	5.0	100	µg/L	J	sp	Detect <PQL	
4402106221	T4.7H-20180503-1.0	05/03/18	E314.0	14797-73-0	Perchlorate	15		0.95	4.0	µg/L				
4402106221	T4.7H-20180503-1.0	05/03/18	SM2540C	TDS	Total Dissolved Solids	1300		5.0	20	mg/L				
4402106231	LWC3.7-20180503-1.7	05/03/18	E300.1	14866-68-3	Chlorate	4400		5.0	400	µg/L				
4402106231	LWC3.7-20180503-1.7	05/03/18	E314.0	14797-73-0	Perchlorate	1600		0.95	400	µg/L				
4402106231	LWC3.7-20180503-1.7	05/03/18	SM2540C	TDS	Total Dissolved Solids	3200		5.0	50	mg/L				
4402106231	T3.8D-20180503-0.8	05/03/18	E300.1	14866-68-3	Chlorate	130		5.0	100	µg/L				
4402106231	T3.8D-20180503-0.8	05/03/18	E314.0	14797-73-0	Perchlorate	19		0.95	4.0	µg/L				
4402106231	T3.8D-20180503-0.8	05/03/18	SM2540C	TDS	Total Dissolved Solids	1300		5.0	20	mg/L				
4402106231	T3.8E-20180503-0.3	05/03/18	E300.1	14866-68-3	Chlorate	170		5.0	100	µg/L				
4402106231	T3.8E-20180503-0.3	05/03/18	E314.0	14797-73-0	Perchlorate	41		0.95	20	µg/L				
4402106231	T3.8E-20180503-0.3	05/03/18	SM2540C	TDS	Total Dissolved Solids	1300		5.0	20	mg/L				
4402106231	T4.65A-20180503-0.7	05/03/18	E300.1	14866-68-3	Chlorate	200		5.0	100	µg/L				
4402106231	T4.65A-20180503-0.7	05/03/18	E314.0	14797-73-0	Perchlorate	35		0.95	8.0	µg/L				
4402106231	T4.65A-20180503-0.7	05/03/18	SM2540C	TDS	Total Dissolved Solids	1300		5.0	20	mg/L				
4402106231	T4.65B-20180503-1.5	05/03/18	E300.1	14866-68-3	Chlorate	200		5.0	100	µg/L				
4402106231	T4.65B-20180503-1.5	05/03/18	E314.0	14797-73-0	Perchlorate	35		0.95	8.0	µg/L				
4402106231	T4.65B-20180503-1.5	05/03/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402106231	T4.65C-20180503-1.1	05/03/18	E300.1	14866-68-3	Chlorate	77	J	5.0	100	µg/L	J	sp	Detect <PQL	
4402106231	T4.65C-20180503-1.1	05/03/18	E314.0	14797-73-0	Perchlorate	11		0.95	4.0	µg/L				
4402106231	T4.65C-20180503-1.1	05/03/18	SM2540C	TDS	Total Dissolved Solids	1300		5.0	20	mg/L				
4402106231	T4.65D-20180503-0.9	05/03/18	E300.1	14866-68-3	Chlorate	68	J	5.0	100	µg/L	J	sp	Detect <PQL	
4402106231	T4.65D-20180503-0.9	05/03/18	E314.0	14797-73-0	Perchlorate	14		0.95	4.0	µg/L				
4402106231	T4.65D-20180503-0.9	05/03/18	SM2540C	TDS	Total Dissolved Solids	1300		5.0	20	mg/L				
4402106231	T4.8A-20180503-0.7	05/03/18	E300.1	14866-68-3	Chlorate	13000		5.0	1000	µg/L				
4402106231	T4.8A-20180503-0.7	05/03/18	E314.0	14797-73-0	Perchlorate	3200		0.95	800	µg/L				
4402106231	T4.8A-20180503-0.7	05/03/18	SM2540C	TDS	Total Dissolved Solids	3800		5.0	50	mg/L				
4402106231	T6A-20180503-0.4	05/03/18	E300.1	14866-68-3	Chlorate	150		5.0	100	µg/L				
4402106231	T6A-20180503-0.4	05/03/18	E314.0	14797-73-0	Perchlorate	1.4	J	0.95	4.0	µg/L	J	sp	Detect <PQL	
4402106231	T6A-20180503-0.4	05/03/18	SM2540C	TDS	Total Dissolved Solids	1500		5.0	20	mg/L				
4402106231	T6B-20180503-0.8	05/03/18	E300.1	14866-68-3	Chlorate	200		5.0	100	µg/L				
4402106231	T6B-20180503-0.8	05/03/18	E314.0	14797-73-0	Perchlorate	1.2	J	0.95	4.0	µg/L	J	sp	Detect <PQL	
4402106231	T6B-20180503-0.8	05/03/18	SM2540C	TDS	Total Dissolved Solids	1500		5.0	20	mg/L				

Table 4

Qualified Results Surface Water Samples

NERT Downgradient Study Area

Henderson, Nevada

SDG	Client Sample ID	Sample Date	Method	Client Analyte ID	Analyte	Lab Result	Lab Qualifier	SQL	PQL	Units	Validator Qualifier	Reason Code	Reason Code Definition	Qualification Finding
4402106231	T6C-20180503-1.3	05/03/18	E300.1	14866-68-3	Chlorate	150		5.0	100	µg/L				
4402106231	T6C-20180503-1.3	05/03/18	E314.0	14797-73-0	Perchlorate	1.2	J	0.95	4.0	µg/L	J	sp	Detect <PQL	
4402106231	T6C-20180503-1.3	05/03/18	SM2540C	TDS	Total Dissolved Solids	1500		5.0	20	mg/L				
4402106231	T6D-20180503-1.5	05/03/18	E300.1	14866-68-3	Chlorate	64	J	5.0	100	µg/L	J	sp	Detect <PQL	
4402106231	T6D-20180503-1.5	05/03/18	E314.0	14797-73-0	Perchlorate	3.0	J	0.95	4.0	µg/L	J	sp	Detect <PQL	
4402106231	T6D-20180503-1.5	05/03/18	SM2540C	TDS	Total Dissolved Solids	1300		5.0	20	mg/L				
4402106241	LW4.48N-20180503-0.6	05/03/18	E300.1	14866-68-3	Chlorate	81	J	5.0	100	µg/L	J	sp	Detect <PQL	
4402106241	LW4.48N-20180503-0.6	05/03/18	E314.0	14797-73-0	Perchlorate	8.9		0.95	4.0	µg/L				
4402106241	LW4.48N-20180503-0.6	05/03/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402106241	LW4.48S-20180503-0.4	05/03/18	E300.1	14866-68-3	Chlorate	180		5.0	100	µg/L				
4402106241	LW4.48S-20180503-0.4	05/03/18	E314.0	14797-73-0	Perchlorate	33		0.95	8.0	µg/L				
4402106241	LW4.48S-20180503-0.4	05/03/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402106241	LW4.5S-20180503-0.4	05/03/18	E300.1	14866-68-3	Chlorate	170		5.0	100	µg/L				
4402106241	LW4.5S-20180503-0.4	05/03/18	E314.0	14797-73-0	Perchlorate	29		0.95	8.0	µg/L				
4402106241	LW4.5S-20180503-0.4	05/03/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402106241	T4.8B-20180503-1.2	05/03/18	E300.1	14866-68-3	Chlorate	6500		5.0	1000	µg/L				
4402106241	T4.8B-20180503-1.2	05/03/18	E314.0	14797-73-0	Perchlorate	1800		0.95	400	µg/L				
4402106241	T4.8B-20180503-1.2	05/03/18	SM2540C	TDS	Total Dissolved Solids	2700		5.0	20	mg/L				
4402106241	T4.8C-20180503-2.2	05/03/18	E300.1	14866-68-3	Chlorate	83	J	5.0	100	µg/L	J	sp	Detect <PQL	
4402106241	T4.8C-20180503-2.2	05/03/18	E314.0	14797-73-0	Perchlorate	5.8		0.95	4.0	µg/L				
4402106241	T4.8C-20180503-2.2	05/03/18	SM2540C	TDS	Total Dissolved Solids	1300		5.0	20	mg/L				
4402106241	T4.8D-20180503-1.8	05/03/18	E300.1	14866-68-3	Chlorate	87	J	5.0	100	µg/L	J	sp	Detect <PQL	
4402106241	T4.8D-20180503-1.8	05/03/18	E314.0	14797-73-0	Perchlorate	5.4		0.95	4.0	µg/L				
4402106241	T4.8D-20180503-1.8	05/03/18	SM2540C	TDS	Total Dissolved Solids	1300		5.0	20	mg/L				
4402106241	T4.8E-20180503-2.0	05/03/18	E300.1	14866-68-3	Chlorate	48	J	5.0	100	µg/L	J	sp	Detect <PQL	
4402106241	T4.8E-20180503-2.0	05/03/18	E314.0	14797-73-0	Perchlorate	31		0.95	20	µg/L				
4402106241	T4.8E-20180503-2.0	05/03/18	SM2540C	TDS	Total Dissolved Solids	1500		5.0	20	mg/L				
4402106241	T6E-20180503-0.6	05/03/18	E300.1	14866-68-3	Chlorate	71	J	5.0	100	µg/L	J	sp	Detect <PQL	
4402106241	T6E-20180503-0.6	05/03/18	E314.0	14797-73-0	Perchlorate	2.7	J	0.95	4.0	µg/L	J	sp	Detect <PQL	
4402106241	T6E-20180503-0.6	05/03/18	SM2540C	TDS	Total Dissolved Solids	1300		5.0	20	mg/L				
4402106251	C-1-20180504-0.3	05/04/18	E300.1	14866-68-3	Chlorate	3100		5.0	400	µg/L				
4402106251	C-1-20180504-0.3	05/04/18	E314.0	14797-73-0	Perchlorate	1800		0.95	80	µg/L				
4402106251	C-1-20180504-0.3	05/04/18	SM2540C	TDS	Total Dissolved Solids	3100		5.0	20	mg/L				
4402106251	LW0.9-20180503-0.8	05/03/18	E300.1	14866-68-3	Chlorate	150		5.0	100	µg/L				
4402106251	LW0.9-20180503-0.8	05/03/18	E314.0	14797-73-0	Perchlorate	38		0.95	4.0	µg/L				
4402106251	LW0.9-20180503-0.8	05/03/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402106251	LW0.9-20180503-0.8-FD	05/03/18	E300.1	14866-68-3	Chlorate	140		5.0	100	µg/L	J-	m	MS/MSD<75-125%	MS=67%, MSD=57%

Table 4

Qualified Results Surface Water Samples

NERT Downgradient Study Area

Henderson, Nevada

SDG	Client Sample ID	Sample Date	Method	Client Analyte ID	Analyte	Lab Result	Lab Qualifier	SQL	PQL	Units	Validator Qualifier	Reason Code	Reason Code Definition	Qualification Finding
4402106251	LW0.9-20180503-0.8-FD	05/03/18	E314.0	14797-73-0	Perchlorate	35		0.95	4.0	µg/L				
4402106251	LW0.9-20180503-0.8-FD	05/03/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402106251	LW0.9-20180504-0.7	05/04/18	E300.1	14866-68-3	Chlorate	510		5.0	100	µg/L				
4402106251	LW0.9-20180504-0.7	05/04/18	E314.0	14797-73-0	Perchlorate	49		0.95	4.0	µg/L				
4402106251	LW0.9-20180504-0.7	05/04/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402106251	LW3.4-20180504-1.1	05/04/18	E300.1	14866-68-3	Chlorate	630		5.0	100	µg/L				
4402106251	LW3.4-20180504-1.1	05/04/18	E314.0	14797-73-0	Perchlorate	52		0.95	4.0	µg/L				
4402106251	LW3.4-20180504-1.1	05/04/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402106251	LW3.5S-20180504-1.8	05/04/18	E300.1	14866-68-3	Chlorate	740		5.0	100	µg/L				
4402106251	LW3.5S-20180504-1.8	05/04/18	E314.0	14797-73-0	Perchlorate	96		0.95	4.0	µg/L				
4402106251	LW3.5S-20180504-1.8	05/04/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402106251	LW4.73N-20180504-2.2	05/04/18	E300.1	14866-68-3	Chlorate	440		5.0	100	µg/L				
4402106251	LW4.73N-20180504-2.2	05/04/18	E314.0	14797-73-0	Perchlorate	93		0.95	4.0	µg/L				
4402106251	LW4.73N-20180504-2.2	05/04/18	SM2540C	TDS	Total Dissolved Solids	1500		5.0	20	mg/L				
4402106251	LW4.73S-20180504-2.4	05/04/18	E300.1	14866-68-3	Chlorate	6700		5.0	1000	µg/L				
4402106251	LW4.73S-20180504-2.4	05/04/18	E314.0	14797-73-0	Perchlorate	1500		0.95	80	µg/L				
4402106251	LW4.73S-20180504-2.4	05/04/18	SM2540C	TDS	Total Dissolved Solids	2700		5.0	20	mg/L				
4402106251	T3.3A-20180504-0.1	05/04/18	E300.1	14866-68-3	Chlorate	620		5.0	100	µg/L	J-	m	MS/MSD<75-125%	MS=67%, MSD=57%
4402106251	T3.3A-20180504-0.1	05/04/18	E314.0	14797-73-0	Perchlorate	96		0.95	4.0	µg/L				
4402106251	T3.3A-20180504-0.1	05/04/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402106251	T3.3A-20180504-0.1-FB	05/04/18	E300.1	14866-68-3	Chlorate	5.0	U	5.0	20	µg/L				
4402106251	T3.3A-20180504-0.1-FB	05/04/18	E314.0	14797-73-0	Perchlorate	0.95	U	0.95	4.0	µg/L				
4402106251	T3.3A-20180504-0.1-FB	05/04/18	SM2540C	TDS	Total Dissolved Solids	5.0	U	5.0	10	mg/L				
4402106251	T3.3B-20180504-0.8	05/04/18	E300.1	14866-68-3	Chlorate	500		5.0	100	µg/L	J-	m	MS/MSD<75-125%	MS=67%, MSD=57%
4402106251	T3.3B-20180504-0.8	05/04/18	E314.0	14797-73-0	Perchlorate	89		0.95	4.0	µg/L				
4402106251	T3.3B-20180504-0.8	05/04/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402106251	T3.3C-20180504-0.3	05/04/18	E300.1	14866-68-3	Chlorate	560		5.0	100	µg/L	J-	m	MS/MSD<75-125%	MS=67%, MSD=57%
4402106251	T3.3C-20180504-0.3	05/04/18	E314.0	14797-73-0	Perchlorate	81		0.95	4.0	µg/L				
4402106251	T3.3C-20180504-0.3	05/04/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402106251	T3.3D-20180504-0.8	05/04/18	E300.1	14866-68-3	Chlorate	520		5.0	100	µg/L	J-	m	MS/MSD<75-125%	MS=67%, MSD=57%
4402106251	T3.3D-20180504-0.8	05/04/18	E314.0	14797-73-0	Perchlorate	72		0.95	4.0	µg/L				
4402106251	T3.3D-20180504-0.8	05/04/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402106251	T3.3E-20180504-1.2	05/04/18	E300.1	14866-68-3	Chlorate	450		5.0	100	µg/L	J-	m	MS/MSD<75-125%	MS=67%, MSD=57%
4402106251	T3.3E-20180504-1.2	05/04/18	E314.0	14797-73-0	Perchlorate	33		0.95	4.0	µg/L				
4402106251	T3.3E-20180504-1.2	05/04/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402106251	T3.75A-20180504-0.7	05/04/18	E300.1	14866-68-3	Chlorate	510		5.0	100	µg/L				
4402106251	T3.75A-20180504-0.7	05/04/18	E314.0	14797-73-0	Perchlorate	53		0.95	4.0	µg/L				

Table 4

Qualified Results Surface Water Samples

NERT Downgradient Study Area

Henderson, Nevada

SDG	Client Sample ID	Sample Date	Method	Client Analyte ID	Analyte	Lab Result	Lab Qualifier	SQL	PQL	Units	Validator Qualifier	Reason Code	Reason Code Definition	Qualification Finding
4402106251	T3.75A-20180504-0.7	05/04/18	SM2540C	TDS	Total Dissolved Solids	1300		5.0	20	mg/L				
4402106251	T3.75B-20180504-1.0	05/04/18	E300.1	14866-68-3	Chlorate	460		5.0	100	µg/L				
4402106251	T3.75B-20180504-1.0	05/04/18	E314.0	14797-73-0	Perchlorate	40		0.95	4.0	µg/L				
4402106251	T3.75B-20180504-1.0	05/04/18	SM2540C	TDS	Total Dissolved Solids	1300		5.0	20	mg/L				
4402106251	T3.75C-20180504-1.2	05/04/18	E300.1	14866-68-3	Chlorate	490		5.0	100	µg/L				
4402106251	T3.75C-20180504-1.2	05/04/18	E314.0	14797-73-0	Perchlorate	26		0.95	4.0	µg/L				
4402106251	T3.75C-20180504-1.2	05/04/18	SM2540C	TDS	Total Dissolved Solids	1300		5.0	20	mg/L				
4402106251	T3.75D-20180504-1.3	05/04/18	E300.1	14866-68-3	Chlorate	440		5.0	100	µg/L				
4402106251	T3.75D-20180504-1.3	05/04/18	E314.0	14797-73-0	Perchlorate	19		0.95	4.0	µg/L				
4402106251	T3.75D-20180504-1.3	05/04/18	SM2540C	TDS	Total Dissolved Solids	1300		5.0	20	mg/L				
4402106251	T3.75E-20180504-0.2	05/04/18	E300.1	14866-68-3	Chlorate	690		5.0	100	µg/L				
4402106251	T3.75E-20180504-0.2	05/04/18	E314.0	14797-73-0	Perchlorate	200		0.95	40	µg/L				
4402106251	T3.75E-20180504-0.2	05/04/18	SM2540C	TDS	Total Dissolved Solids	1600		5.0	20	mg/L				
4402106251	T3.9A-20180504-0.2	05/04/18	E300.1	14866-68-3	Chlorate	390		5.0	100	µg/L	J-	m	MS/MSD<75-125%	MS=67%, MSD=57%
4402106251	T3.9A-20180504-0.2	05/04/18	E314.0	14797-73-0	Perchlorate	44		0.95	4.0	µg/L				
4402106251	T3.9A-20180504-0.2	05/04/18	SM2540C	TDS	Total Dissolved Solids	1300		5.0	20	mg/L				
4402106251	T3.9B-20180504-0.5	05/04/18	E300.1	14866-68-3	Chlorate	590		5.0	100	µg/L				
4402106251	T3.9B-20180504-0.5	05/04/18	E314.0	14797-73-0	Perchlorate	39		0.95	4.0	µg/L				
4402106251	T3.9B-20180504-0.5	05/04/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402106251	T3.9B-20180504-0.5-FD	05/04/18	E300.1	14866-68-3	Chlorate	540		5.0	100	µg/L				
4402106251	T3.9B-20180504-0.5-FD	05/04/18	E314.0	14797-73-0	Perchlorate	41		0.95	4.0	µg/L				
4402106251	T3.9B-20180504-0.5-FD	05/04/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402106251	T3.9C-20180504-0.5	05/04/18	E300.1	14866-68-3	Chlorate	580		5.0	100	µg/L				
4402106251	T3.9C-20180504-0.5	05/04/18	E314.0	14797-73-0	Perchlorate	29		0.95	4.0	µg/L				
4402106251	T3.9C-20180504-0.5	05/04/18	SM2540C	TDS	Total Dissolved Solids	1300		5.0	20	mg/L				
4402106251	T3.9D-20180504-0.1	05/04/18	E300.1	14866-68-3	Chlorate	450	F1	5.0	100	µg/L	J-	m	MS/MSD<75-125%	MS=67%, MSD=57%
4402106251	T3.9D-20180504-0.1	05/04/18	E314.0	14797-73-0	Perchlorate	23		0.95	4.0	µg/L				
4402106251	T3.9D-20180504-0.1	05/04/18	SM2540C	TDS	Total Dissolved Solids	1300		5.0	20	mg/L				
4402106251	T4.85A-20180504-0.6	05/04/18	E300.1	14866-68-3	Chlorate	400		5.0	100	µg/L				
4402106251	T4.85A-20180504-0.6	05/04/18	E314.0	14797-73-0	Perchlorate	7.3		0.95	4.0	µg/L				
4402106251	T4.85A-20180504-0.6	05/04/18	SM2540C	TDS	Total Dissolved Solids	1300		5.0	20	mg/L				
4402106251	T4.85B-20180504-2.2	05/04/18	E300.1	14866-68-3	Chlorate	570		5.0	100	µg/L				
4402106251	T4.85B-20180504-2.2	05/04/18	E314.0	14797-73-0	Perchlorate	5.0		0.95	4.0	µg/L				
4402106251	T4.85B-20180504-2.2	05/04/18	SM2540C	TDS	Total Dissolved Solids	1300		5.0	20	mg/L				
4402106251	T4.85C-20180504-0.9	05/04/18	E300.1	14866-68-3	Chlorate	590		5.0	100	µg/L				
4402106251	T4.85C-20180504-0.9	05/04/18	E314.0	14797-73-0	Perchlorate	5.1		0.95	4.0	µg/L				
4402106251	T4.85C-20180504-0.9	05/04/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				

Table 4

Qualified Results Surface Water Samples

NERT Downgradient Study Area

Henderson, Nevada

SDG	Client Sample ID	Sample Date	Method	Client Analyte ID	Analyte	Lab Result	Lab Qualifier	SQL	PQL	Units	Validator Qualifier	Reason Code	Reason Code Definition	Qualification Finding
4402106251	T4.85D-20180504-0.7	05/04/18	E300.1	14866-68-3	Chlorate	580		5.0	100	µg/L				
4402106251	T4.85D-20180504-0.7	05/04/18	E314.0	14797-73-0	Perchlorate	5.3		0.95	4.0	µg/L				
4402106251	T4.85D-20180504-0.7	05/04/18	SM2540C	TDS	Total Dissolved Solids	1300		5.0	20	mg/L				
4402106251	T4.85E-20180504-1.0	05/04/18	E300.1	14866-68-3	Chlorate	560		5.0	100	µg/L				
4402106251	T4.85E-20180504-1.0	05/04/18	E314.0	14797-73-0	Perchlorate	4.7		0.95	4.0	µg/L				
4402106251	T4.85E-20180504-1.0	05/04/18	SM2540C	TDS	Total Dissolved Solids	1300		5.0	20	mg/L				
4402107241	LW0.9-20180505-0.7	05/05/18	E300.1	14866-68-3	Chlorate	270		5.0	100	µg/L				
4402107241	LW0.9-20180505-0.7	05/05/18	E314.0	14797-73-0	Perchlorate	40		0.28	1.0	µg/L				
4402107241	LW0.9-20180505-0.7	05/05/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402107241	LW0.9-20180505-0.7-FD	05/05/18	E300.1	14866-68-3	Chlorate	280		5.0	100	µg/L				
4402107241	LW0.9-20180505-0.7-FD	05/05/18	E314.0	14797-73-0	Perchlorate	40		0.28	1.0	µg/L				
4402107241	LW0.9-20180505-0.7-FD	05/05/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402107241	LW0.9-20180507-EB	05/07/18	E300.1	14866-68-3	Chlorate	5.0	U	5.0	20	µg/L				
4402107241	LW0.9-20180507-EB	05/07/18	E314.0	14797-73-0	Perchlorate	0.28	U	0.28	1.0	µg/L				
4402107241	LW0.9-20180507-EB	05/07/18	SM2540C	TDS	Total Dissolved Solids	5.0	U	5.0	10	mg/L				
4402107241	LW3.1-20180505-1.8	05/05/18	E300.1	14866-68-3	Chlorate	240		5.0	100	µg/L				
4402107241	LW3.1-20180505-1.8	05/05/18	E314.0	14797-73-0	Perchlorate	45		0.28	10	µg/L				
4402107241	LW3.1-20180505-1.8	05/05/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402107241	LW3.11-20180506-1.9	05/06/18	E300.1	14866-68-3	Chlorate	230		5.0	100	µg/L				
4402107241	LW3.11-20180506-1.9	05/06/18	E314.0	14797-73-0	Perchlorate	47		0.28	10	µg/L				
4402107241	LW3.11-20180506-1.9	05/06/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402107241	LW3.11-20180506-1.9-FD	05/06/18	E300.1	14866-68-3	Chlorate	230		5.0	100	µg/L				
4402107241	LW3.11-20180506-1.9-FD	05/06/18	E314.0	14797-73-0	Perchlorate	48		0.28	5.0	µg/L				
4402107241	LW3.11-20180506-1.9-FD	05/06/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402107241	LW3.11-20180507-FB	05/07/18	E300.1	14866-68-3	Chlorate	5.0	U	5.0	20	µg/L				
4402107241	LW3.11-20180507-FB	05/07/18	E314.0	14797-73-0	Perchlorate	0.28	U	0.28	1.0	µg/L				
4402107241	LW3.11-20180507-FB	05/07/18	SM2540C	TDS	Total Dissolved Solids	5.0	U	5.0	10	mg/L				
4402107241	LW3.15-20180506-2.4	05/06/18	E300.1	14866-68-3	Chlorate	220		5.0	100	µg/L				
4402107241	LW3.15-20180506-2.4	05/06/18	E314.0	14797-73-0	Perchlorate	50		0.28	5.0	µg/L				
4402107241	LW3.15-20180506-2.4	05/06/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402107241	LW3.15-20180506-2.4-FD	05/06/18	E300.1	14866-68-3	Chlorate	220		5.0	100	µg/L				
4402107241	LW3.15-20180506-2.4-FD	05/06/18	E314.0	14797-73-0	Perchlorate	54		0.28	5.0	µg/L				
4402107241	LW3.15-20180506-2.4-FD	05/06/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402107241	LW3.15-20180507-EB	05/07/18	E300.1	14866-68-3	Chlorate	5.0	U	5.0	20	µg/L				
4402107241	LW3.15-20180507-EB	05/07/18	E314.0	14797-73-0	Perchlorate	0.28	U	0.28	1.0	µg/L				
4402107241	LW3.15-20180507-EB	05/07/18	SM2540C	TDS	Total Dissolved Solids	5.0	U	5.0	10	mg/L				
4402107241	LW3.2-20180506-1.33	05/06/18	E300.1	14866-68-3	Chlorate	240		5.0	100	µg/L				

Table 4
Qualified Results Surface Water Samples
NERT Downgradient Study Area

Henderson, Nevada

SDG	Client Sample ID	Sample Date	Method	Client Analyte ID	Analyte	Lab Result	Lab Qualifier	SQL	PQL	Units	Validator Qualifier	Reason Code	Reason Code Definition	Qualification Finding
4402107241	LW3.2-20180506-1.33	05/06/18	E314.0	14797-73-0	Perchlorate	50		0.28	5.0	µg/L				
4402107241	LW3.2-20180506-1.33	05/06/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402107241	LW3.2-20180506-1.33-FD	05/06/18	E300.1	14866-68-3	Chlorate	230		5.0	100	µg/L				
4402107241	LW3.2-20180506-1.33-FD	05/06/18	E314.0	14797-73-0	Perchlorate	48		0.28	5.0	µg/L				
4402107241	LW3.2-20180506-1.33-FD	05/06/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402107241	LW3.2-20180506-3.9	05/06/18	E300.1	14866-68-3	Chlorate	220		5.0	100	µg/L				
4402107241	LW3.2-20180506-3.9	05/06/18	E314.0	14797-73-0	Perchlorate	49		0.28	5.0	µg/L				
4402107241	LW3.2-20180506-3.9	05/06/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				
4402107241	LW3.2-20180507-EB	05/07/18	E314.0	14797-73-0	Perchlorate	0.28	U	0.28	1.0	µg/L				
4402107241	LW3.2-20180507-EB	05/07/18	SM2540C	TDS	Total Dissolved Solids	5.0	U	5.0	10	mg/L				
4402107241	LW3.68-20180506-0.83	05/06/18	E300.1	14866-68-3	Chlorate	3100		5.0	400	µg/L				
4402107241	LW3.68-20180506-0.83	05/06/18	E314.0	14797-73-0	Perchlorate	980		0.28	100	µg/L				
4402107241	LW3.68-20180506-0.83	05/06/18	SM2540C	TDS	Total Dissolved Solids	2500		5.0	20	mg/L				
4402107241	LW3.68-20180506-0.83-FB	05/06/18	E300.1	14866-68-3	Chlorate	5.0	U	5.0	20	µg/L				
4402107241	LW3.68-20180506-0.83-FB	05/06/18	E314.0	14797-73-0	Perchlorate	0.28	U	0.28	1.0	µg/L				
4402107241	LW3.68-20180506-0.83-FB	05/06/18	SM2540C	TDS	Total Dissolved Solids	5.0	U	5.0	10	mg/L				
4402107241	LW3.68-20180506-0.83-FD	05/06/18	E300.1	14866-68-3	Chlorate	3000		5.0	400	µg/L				
4402107241	LW3.68-20180506-0.83-FD	05/06/18	E314.0	14797-73-0	Perchlorate	920		0.28	100	µg/L				
4402107241	LW3.68-20180506-0.83-FD	05/06/18	SM2540C	TDS	Total Dissolved Solids	2500		5.0	20	mg/L				
4402107241	LW4.73S-20180504-EB	05/04/18	E300.1	14866-68-3	Chlorate	5.0	U	5.0	20	µg/L				
4402107241	LW4.73S-20180504-EB	05/04/18	E314.0	14797-73-0	Perchlorate	0.28	U	0.28	1.0	µg/L				
4402107241	LW4.73S-20180504-EB	05/04/18	SM2540C	TDS	Total Dissolved Solids	5.0	U	5.0	10	mg/L				
4402107241	T3.5A-20180505-0.45	05/05/18	E300.1	14866-68-3	Chlorate	370		5.0	100	µg/L				
4402107241	T3.5A-20180505-0.45	05/05/18	E314.0	14797-73-0	Perchlorate	90		0.28	10	µg/L				
4402107241	T3.5A-20180505-0.45	05/05/18	SM2540C	TDS	Total Dissolved Solids	1500		5.0	20	mg/L				
4402107241	T3.5A-20180505-FB	05/05/18	E300.1	14866-68-3	Chlorate	5.0	U	5.0	20	µg/L				
4402107241	T3.5A-20180505-FB	05/05/18	E314.0	14797-73-0	Perchlorate	0.28	U	0.28	1.0	µg/L				
4402107241	T3.5A-20180505-FB	05/05/18	SM2540C	TDS	Total Dissolved Solids	5.0	U	5.0	10	mg/L				
4402107241	T3.5A-20180507-EB	05/07/18	E314.0	14797-73-0	Perchlorate	0.28	U	0.28	1.0	µg/L				
4402107241	T3.5A-20180507-EB	05/07/18	SM2540C	TDS	Total Dissolved Solids	5.0	U	5.0	10	mg/L				
4402107241	T3.5B-20180505-0.7	05/05/18	E300.1	14866-68-3	Chlorate	450		5.0	100	µg/L				
4402107241	T3.5B-20180505-0.7	05/05/18	E314.0	14797-73-0	Perchlorate	91		0.28	10	µg/L				
4402107241	T3.5B-20180505-0.7	05/05/18	SM2540C	TDS	Total Dissolved Solids	1500		5.0	20	mg/L				
4402107241	T3.5B-20180505-0.7-FD	05/05/18	E300.1	14866-68-3	Chlorate	490		5.0	100	µg/L				
4402107241	T3.5B-20180505-0.7-FD	05/05/18	E314.0	14797-73-0	Perchlorate	86		0.28	10	µg/L				
4402107241	T3.5B-20180505-0.7-FD	05/05/18	SM2540C	TDS	Total Dissolved Solids	1500		5.0	20	mg/L				
4402107241	T3.5C-20180505-2.0	05/05/18	E300.1	14866-68-3	Chlorate	520		5.0	100	µg/L				

Table 4
Qualified Results Surface Water Samples
NERT Downgradient Study Area
Henderson, Nevada

SDG	Client Sample ID	Sample Date	Method	Client Analyte ID	Analyte	Lab Result	Lab Qualifier	SQL	PQL	Units	Validator Qualifier	Reason Code	Reason Code Definition	Qualification Finding
4402107241	T3.5C-20180505-2.0	05/05/18	E314.0	14797-73-0	Perchlorate	85		0.28	10	µg/L				
4402107241	T3.5C-20180505-2.0	05/05/18	SM2540C	TDS	Total Dissolved Solids	1500		5.0	20	mg/L				
4402107241	T3.5D-20180505-2.4	05/05/18	E300.1	14866-68-3	Chlorate	390		5.0	100	µg/L				
4402107241	T3.5D-20180505-2.4	05/05/18	E314.0	14797-73-0	Perchlorate	33		0.28	1.0	µg/L				
4402107241	T3.5D-20180505-2.4	05/05/18	SM2540C	TDS	Total Dissolved Solids	1500		5.0	20	mg/L				
4402107241	T3.5E-20180505-2.1	05/05/18	E300.1	14866-68-3	Chlorate	450		5.0	100	µg/L				
4402107241	T3.5E-20180505-2.1	05/05/18	E314.0	14797-73-0	Perchlorate	37		0.28	1.0	µg/L				
4402107241	T3.5E-20180505-2.1	05/05/18	SM2540C	TDS	Total Dissolved Solids	1500		5.0	20	mg/L				
4402107241	T3.5E-20180505-6.4	05/05/18	E300.1	14866-68-3	Chlorate	410		5.0	100	µg/L				
4402107241	T3.5E-20180505-6.4	05/05/18	E314.0	14797-73-0	Perchlorate	38		0.28	1.0	µg/L				
4402107241	T3.5E-20180505-6.4	05/05/18	SM2540C	TDS	Total Dissolved Solids	1400		5.0	20	mg/L				

Notes:
SDG Sample Designation Group
ID Identifier
J Estimated. The associated numerical value is the approximate concentration of the analyte in the sample.
It is not possible to assess the direction of the potential bias. The analyte was detected but the reported value may not be accurate or precise.
J- Estimated. The associated numerical value is the approximate concentration of the analyte in the sample.
The associated numerical value is potentially biased low
U Nondetected - Analyses were performed for the compound or analyte, but it was not detected.
SQL sample quantitation limits
PQL practical quantitation limit
µg/l micrograms per liter
mg/l milligrams per liter
MS/MSD matrix spike/ matrix spike duplicate

Attachment 1

Wet Chemistry Data Validation

Chlorate by EPA Method 300.1B
Perchlorate by EPA Method 314.0
Total Dissolved Solids by Standard Method 2540C

1. Sample Receipt and Technical Holding Times

All samples were collected and preserved appropriately, and all analyses were performed within the method-specified holding times. All analyses were performed as requested on the chain of custodies. The laboratory reported all requested analyses and the deliverable data reports were complete.

2. Laboratory Blanks

Laboratory method blanks were analyzed at the proper frequency as required by each analytical method. No contaminants were found in the laboratory method blanks.

3. Field Blanks

Samples LW0.9-20180507-EB, LW3.15-20180507-EB, LW3.2-20180507-EB, LW4.73S-20180504-EB, and T3.5A-20180507-EB were identified as equipment blanks. No contaminants were found in the equipment blanks.

Samples T6.8A-20180501-FB, T3.3A-20180504-0.1-FB, LW3.11-20180507-FB, LW3.68-20180506-0.83-FB, and T3.5A-20180505-FB were identified as field blanks. No contaminants were found in the field blanks.

4. Surrogate

Surrogate (dichloroacetic acid) recoveries were evaluated for chlorate analysis by EPA Method 300.1B. All surrogate percent recoveries met the acceptance criteria.

5. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicate (MSD) sample analysis was performed on associated project samples. Percent recoveries (%R) and relative percent differences (RPD) were within QC limits with the following exception.

EPA Method	Sample	Analyte	MS Recovery	MSD Recovery	RPD	Qualified Samples	Qualifier
300.1B	T3.9D-20180504-0.1	Chlorate	67%	57%	4	**T3.3A-20180504-0.1** **T3.3B-20180504-0.8** **T3.3C-20180504-0.3** **T3.3D-20180504-0.8** **T3.3E-20180504-1.2** **T3.9D-20180504-0.1** **T3.9A-20180504-0.2** **LW0.9-20180503-0.8-FD**	**J-**
MS/MSD %Recovery Limits= 75-125%							

MS/MSD recovery limits do not apply when the sample concentration is ≥ 4x the spike added. In such an event, the data was reported unflagged (*USEPA National Functional Guidelines)*. In addition, batch or non-project MS/MSD data were not evaluated.

6. Duplicate Sample Analysis

Duplicate (DUP) analyses were performed for Total Dissolved Solids by Standard Method 2540C. All duplicate analyses met criteria and therefore no samples were qualified based on duplicate analysis results.

7. Laboratory Control Samples

Laboratory control samples (LCS) and laboratory control samples duplicates (LCSD) were analyzed as required by the method. Percent recoveries (%R) were within QC limits. Relative percent differences (RPD) were within QC limits.

8. Field Duplicates

Samples T6.8B-20180501-0.9-FD, LW0.9-20180503-0.8-FD, T3.9B-20180504-0.5-FD, LW0.9-20180505-0.7-FD, LW3.11-20180506-1.9-FD, LW3.15-20180506-2.4-FD, LW3.2-20180506-1.33-FD, LW3.68-20180506-0.83-FD, and T3.5B-20180505-0.7-FD were identified as field duplicates. Acceptable field and analytical precision was demonstrated for all field duplicate pairs. When the sample or field duplicate concentration is <RL, the RL is used for calculation purposes.

9. Sample Result Verification

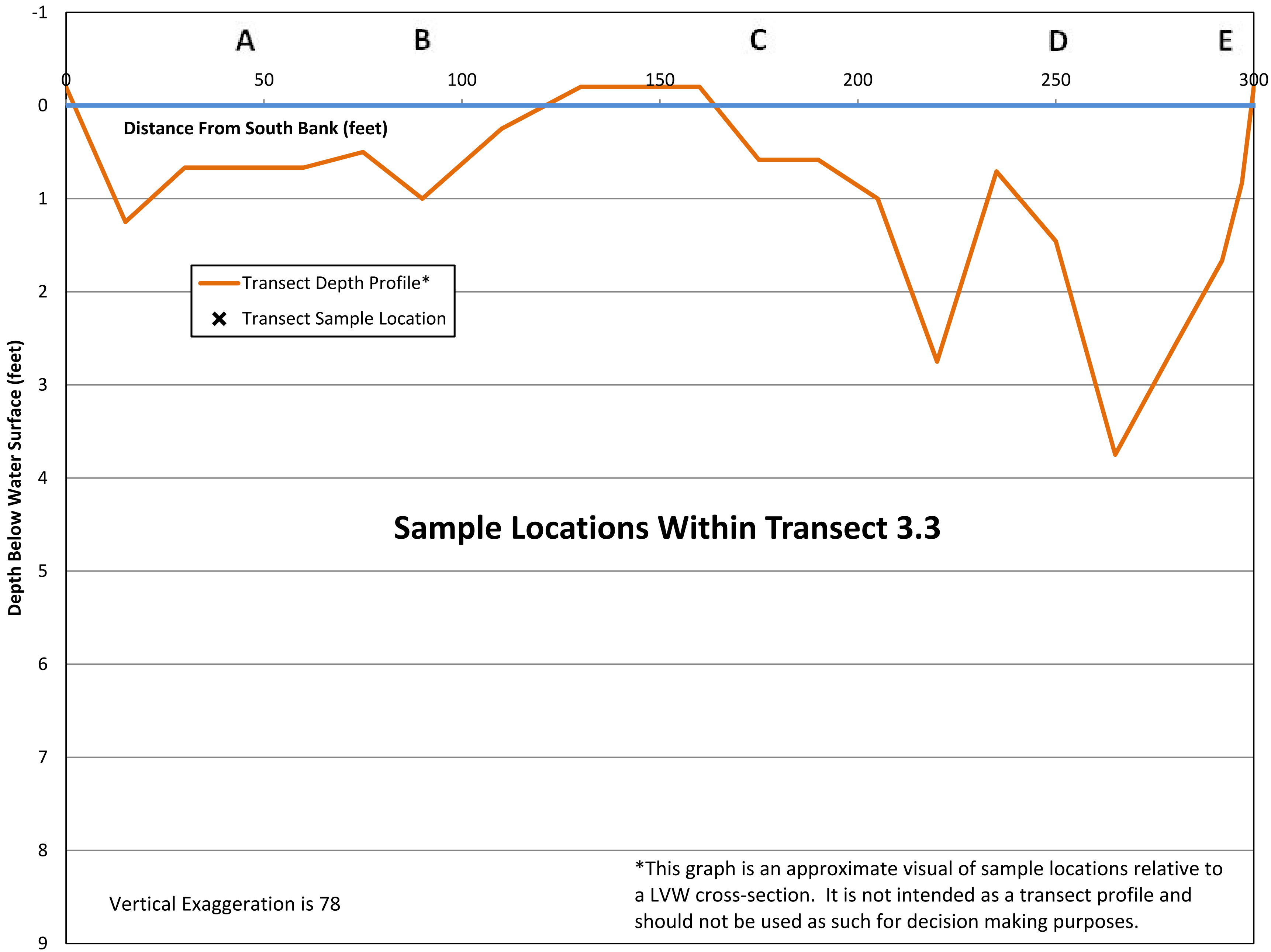
Raw data were not reviewed for Stage 2A validation.

10. Overall Assessment of Data

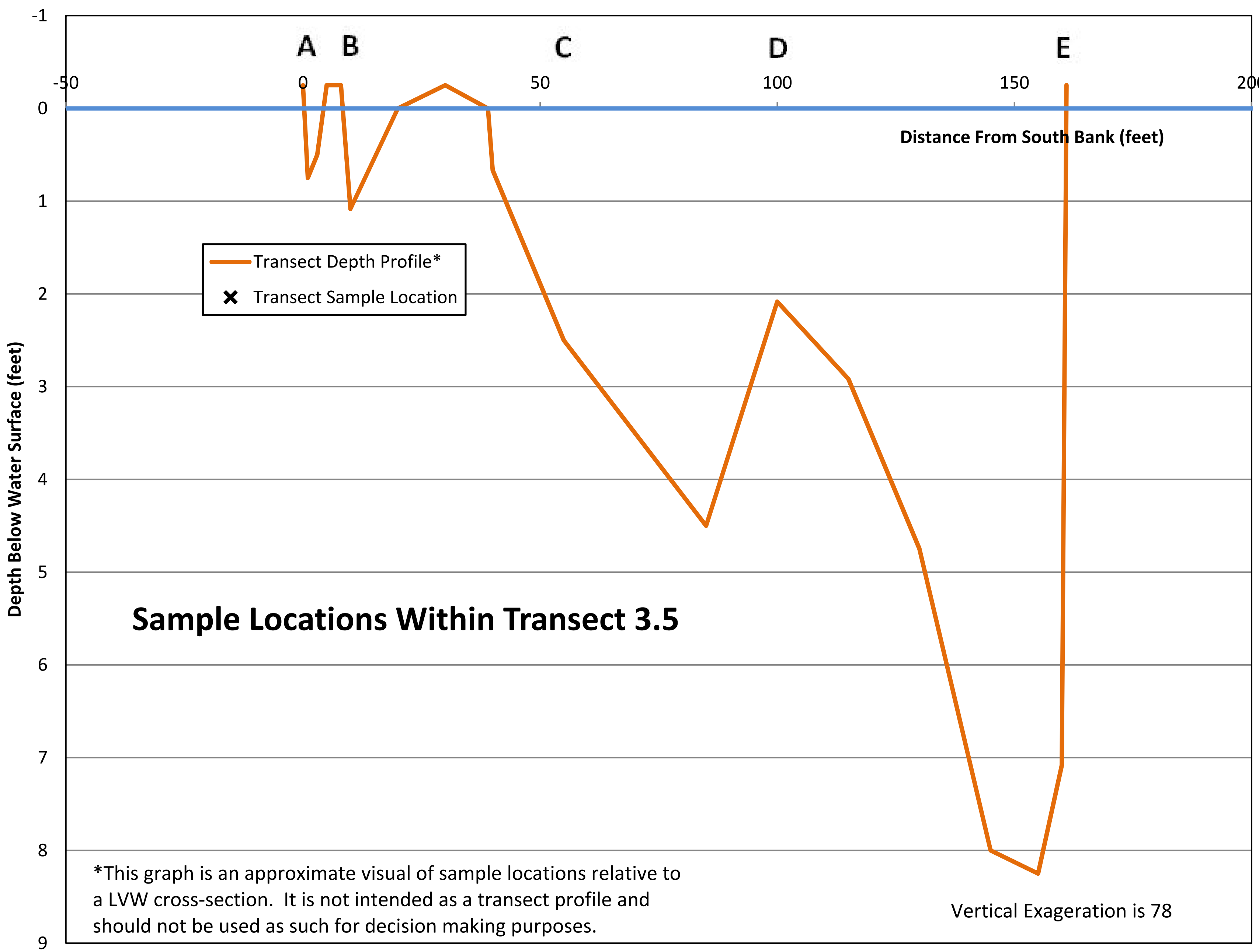
All samples were analyzed as requested and all holding times were met. Due to matrix interference, the results for chlorate for eight samples were qualified as estimated (“J-“). No other data were qualified. Overall, based on this data validation, the data as qualified are useable for meeting project objectives. All results are considered to be valid; the analytical completeness defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for analysis, for the project is 100%. Additionally, because all samples in each data set were collected and analyzed under similar prescribed conditions, the data are considered to be comparable.

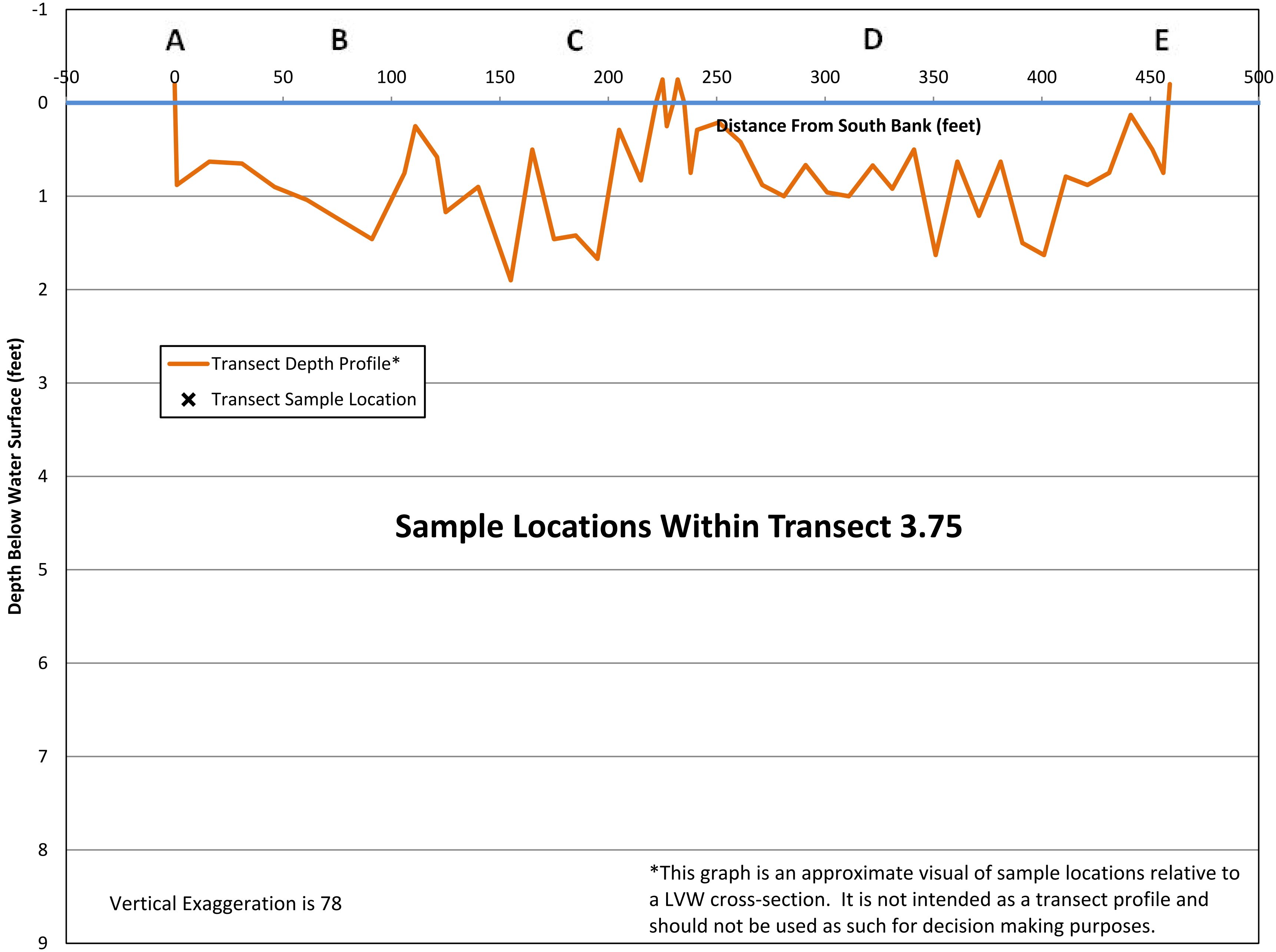
Appendix M

Cross Sections of Transects

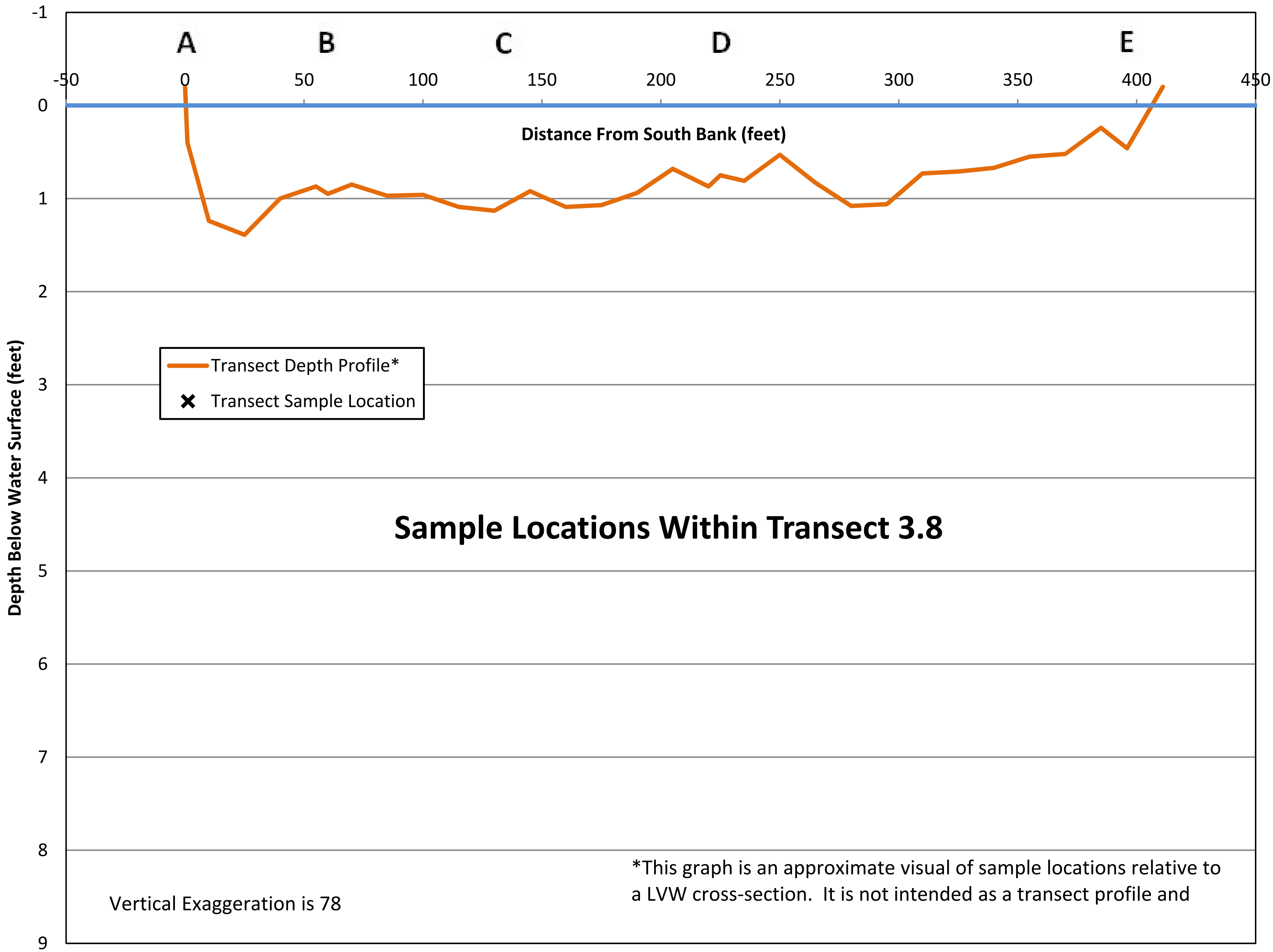


A
B
C
D
E
0
50
100
150
200
250
300
-1
0
1
2
3
4
5
6
7
8
9
Distance From South Bank (feet)
Depth Below Water Surface (feet)
Transect Depth Profile*
Transect Sample Location
Sample Locations Within Transect 3.3
Vertical Exaggeration is 78
*This graph is an approximate visual of sample locations relative to a LVW cross-section. It is not intended as a transect profile and should not be used as such for decision making purposes.

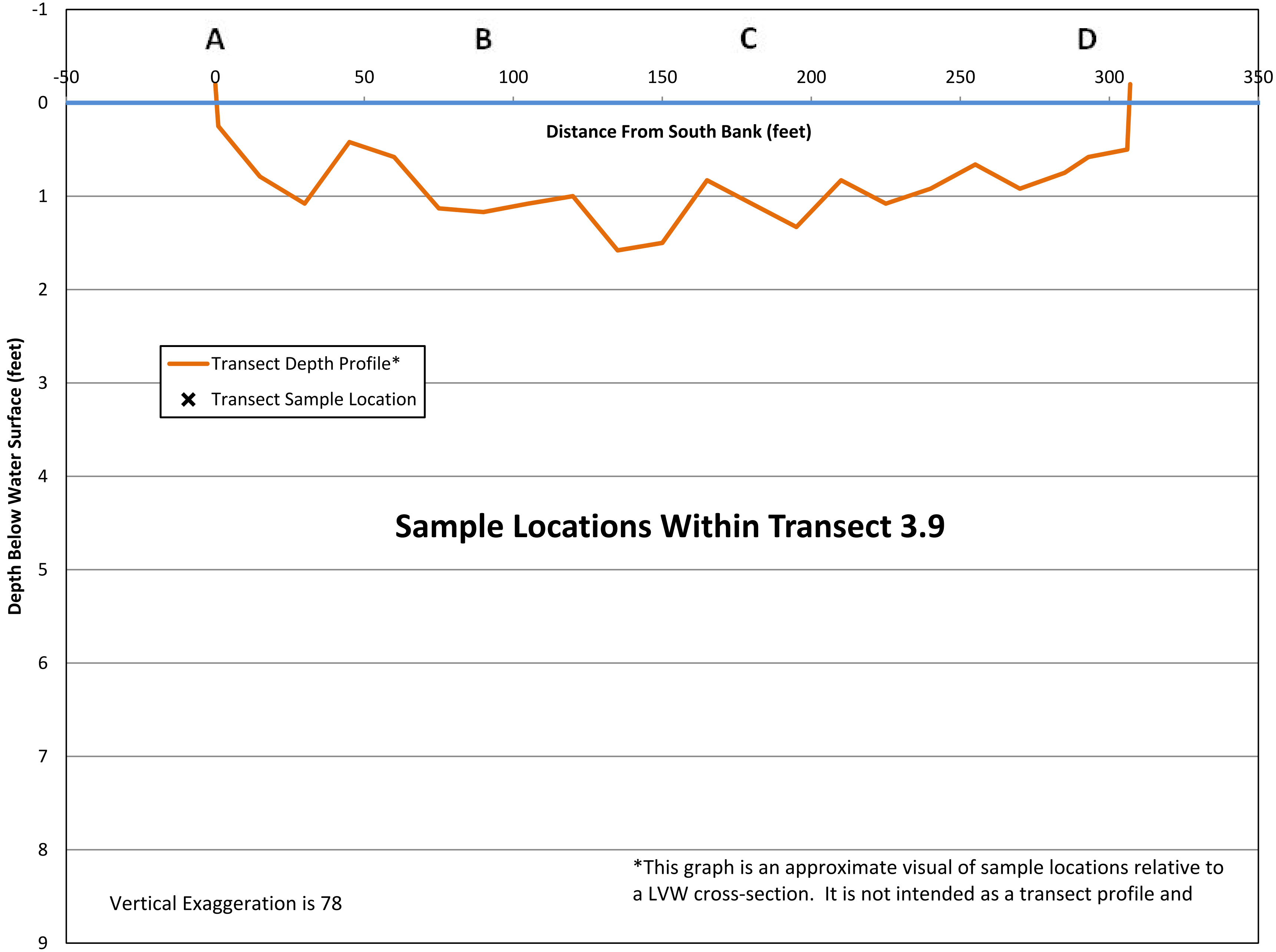

A
B
C
D
E
-50
0
50
100
150
200
Distance From South Bank (feet)
-1
0
1
2
3
4
5
6
7
8
9
Depth Below Water Surface (feet)
Transect Depth Profile*
Transect Sample Location
Sample Locations Within Transect 3.5
*This graph is an approximate visual of sample locations relative to a LVW cross-section. It is not intended as a transect profile and should not be used as such for decision making purposes.
Vertical Exageration is 78



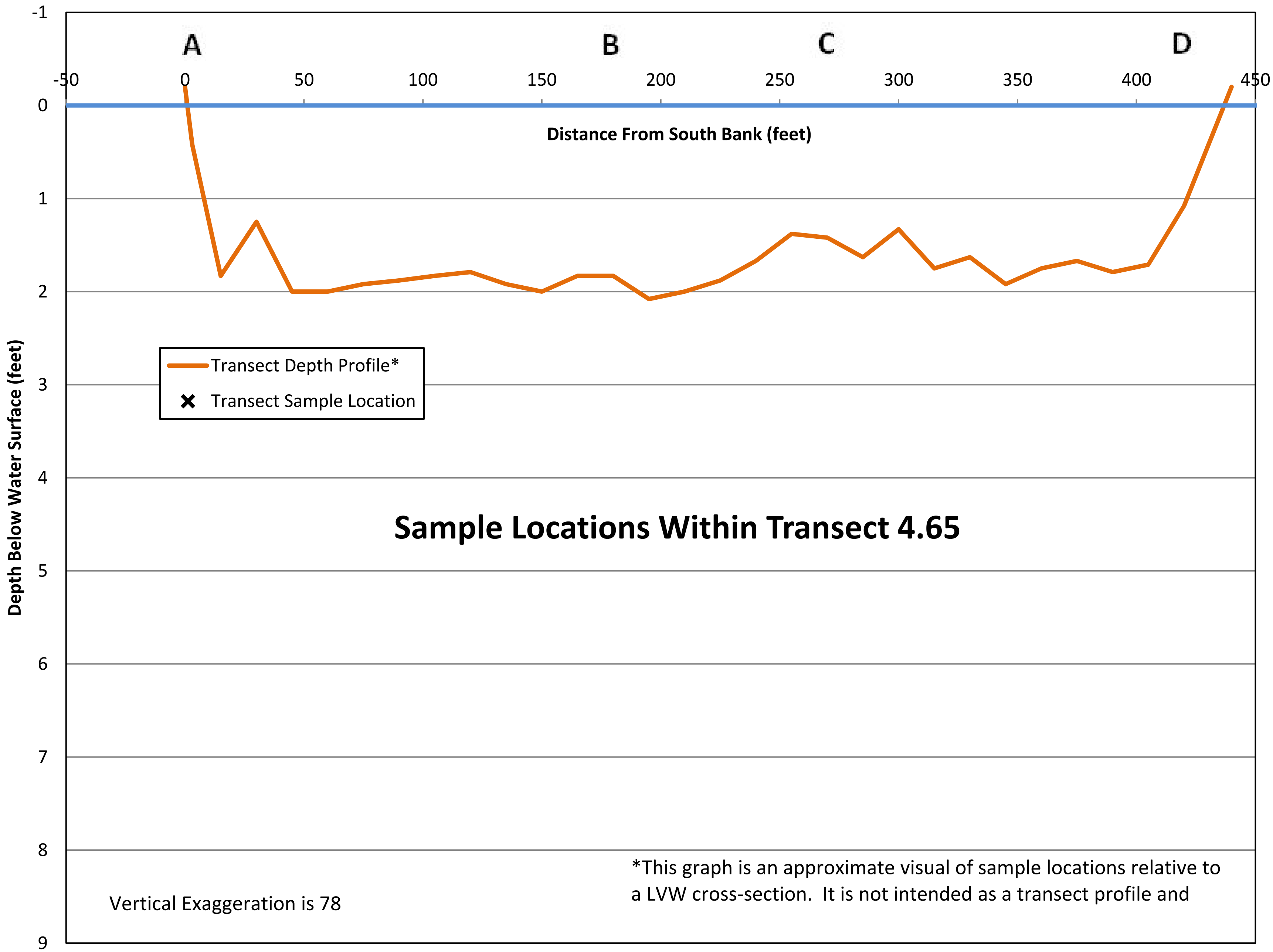
Sample Locations Within Transect 3.75
A
B
C
D
E
-50
0
50
100
150
200
250
300
350
400
450
500
Distance From South Bank (feet)
Depth Below Water Surface (feet)
-1
0
1
2
3
4
5
6
7
8
9
Transect Depth Profile*
Transect Sample Location
Vertical Exaggeration is 78
*This graph is an approximate visual of sample locations relative to a LVW cross-section. It is not intended as a transect profile and should not be used as such for decision making purposes.



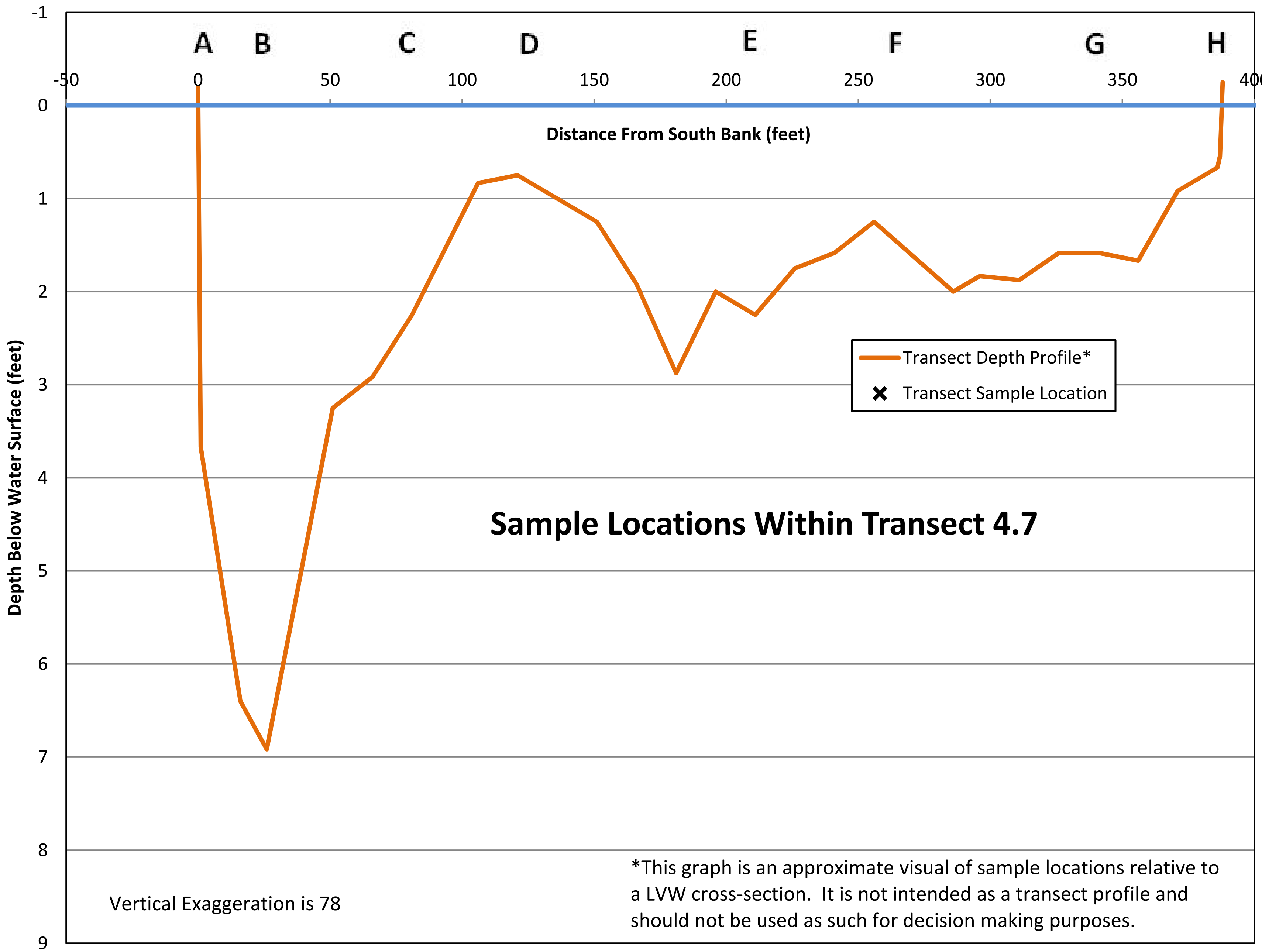
Sample Locations Within Transect 3.8
A
B
C
D
E
-50
0
50
100
150
200
250
300
350
400
450
Distance From South Bank (feet)
Depth Below Water Surface (feet)
-1
0
1
2
3
4
5
6
7
8
9
Transect Depth Profile*
Transect Sample Location
Vertical Exaggeration is 78
*This graph is an approximate visual of sample locations relative to a LVW cross-section. It is not intended as a transect profile and



Sample Locations Within Transect 3.9
A
B
C
D
-50
0
50
100
150
200
250
300
350
-1
0
1
2
3
4
5
6
7
8
9
Distance From South Bank (feet)
Depth Below Water Surface (feet)
Transect Depth Profile*
Transect Sample Location
Vertical Exaggeration is 78
*This graph is an approximate visual of sample locations relative to a LVW cross-section. It is not intended as a transect profile and

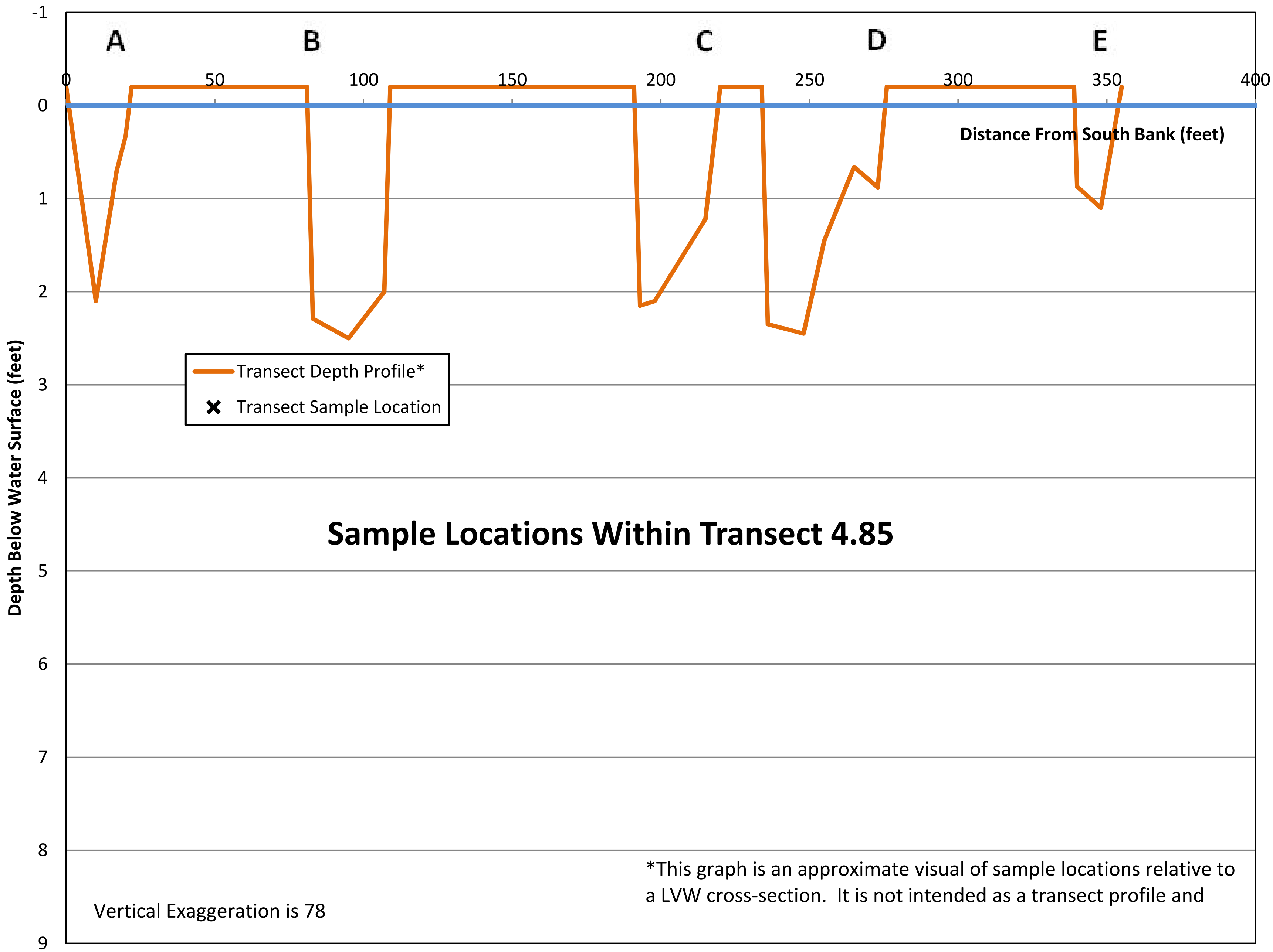


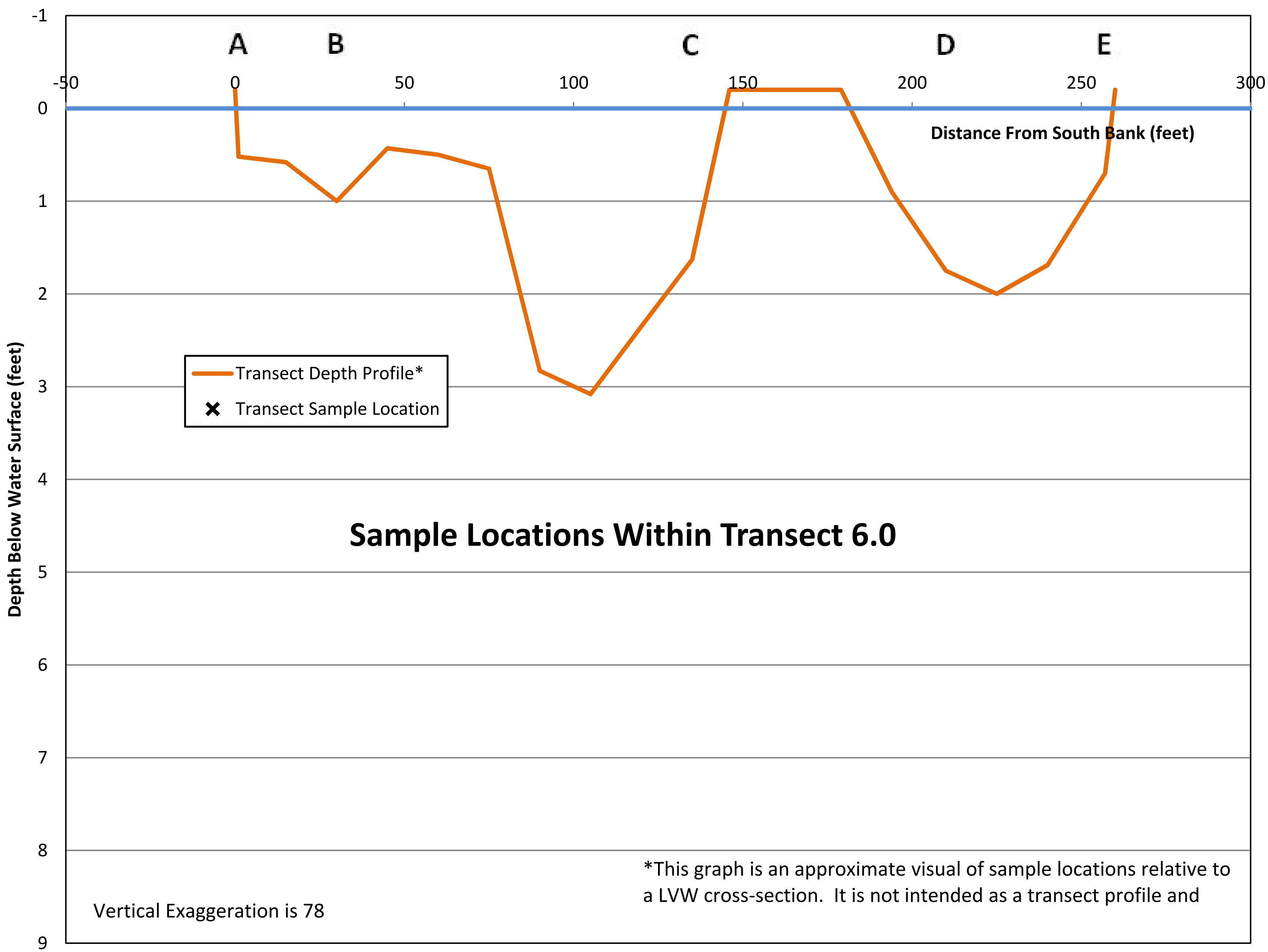
A
B
C
D
-50
0
50
100
150
200
250
300
350
400
450
Distance From South Bank (feet)
-1
0
1
2
3
4
5
6
7
8
9
Depth Below Water Surface (feet)
Transect Depth Profile*
Transect Sample Location
Sample Locations Within Transect 4.65
Vertical Exaggeration is 78
*This graph is an approximate visual of sample locations relative to a LVW cross-section. It is not intended as a transect profile and



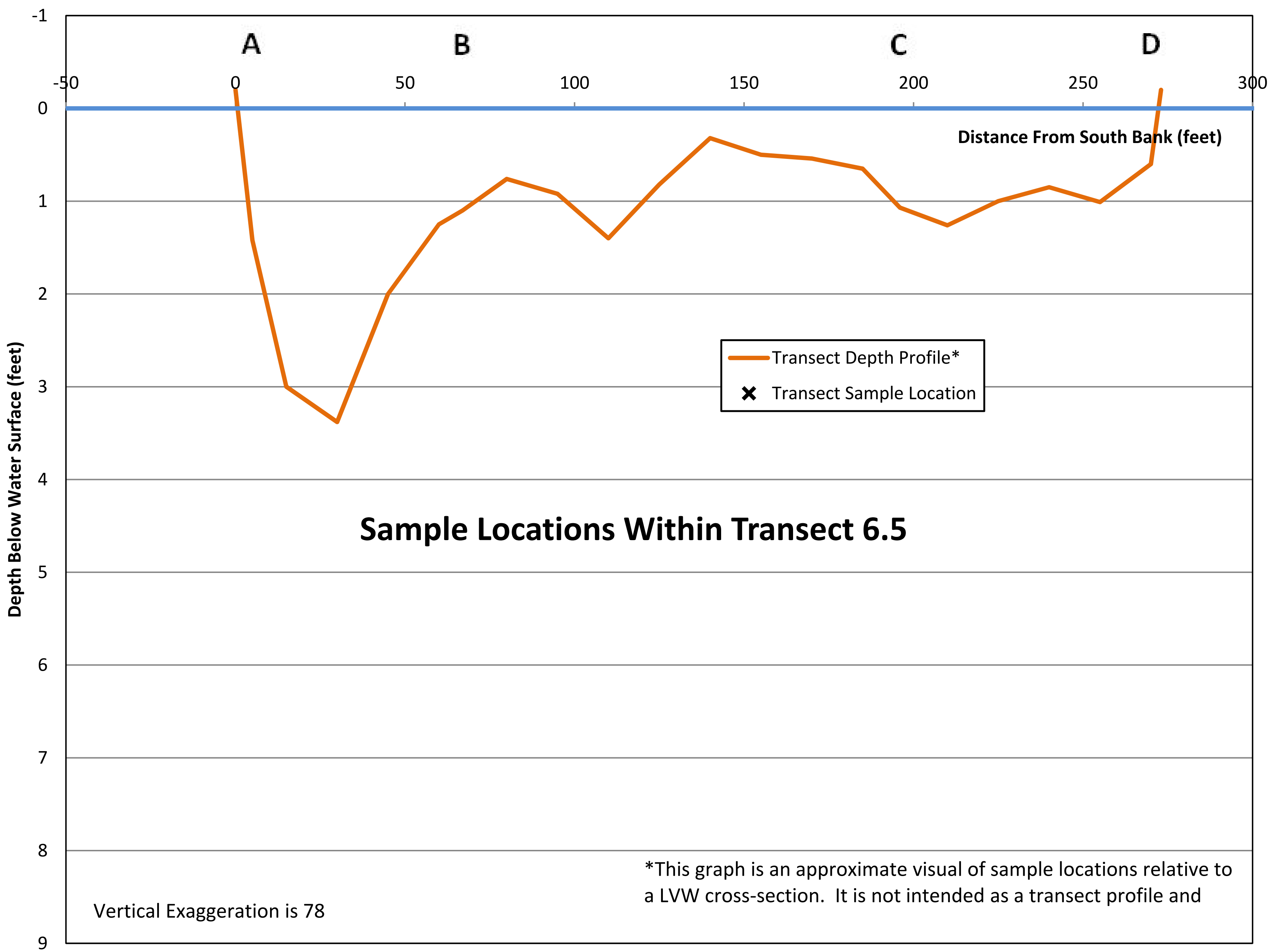
Sample Locations Within Transect 4.7
A
B
C
D
E
F
G
H
-50
0
50
100
150
200
250
300
350
400
Distance From South Bank (feet)
-1
0
1
2
3
4
5
6
7
8
9
Depth Below Water Surface (feet)
Transect Depth Profile*
Transect Sample Location
Vertical Exaggeration is 78
*This graph is an approximate visual of sample locations relative to a LVW cross-section. It is not intended as a transect profile and should not be used as such for decision making purposes.

A
B
C
D
E
-1
0
1
2
3
4
5
6
7
8
9
-50
0
50
100
150
200
250
300
350
Distance From South Bank (feet)
Depth Below Water Surface (feet)
Transect Depth Profile*
Transect Sample Location
Sample Locations Within Transect 4.8
*This graph is an approximate visual of sample locations relative to
a LVW cross-section. It is not intended as a transect profile and
should not be used as such for decision making purposes.
Vertical Exaggeration is 78

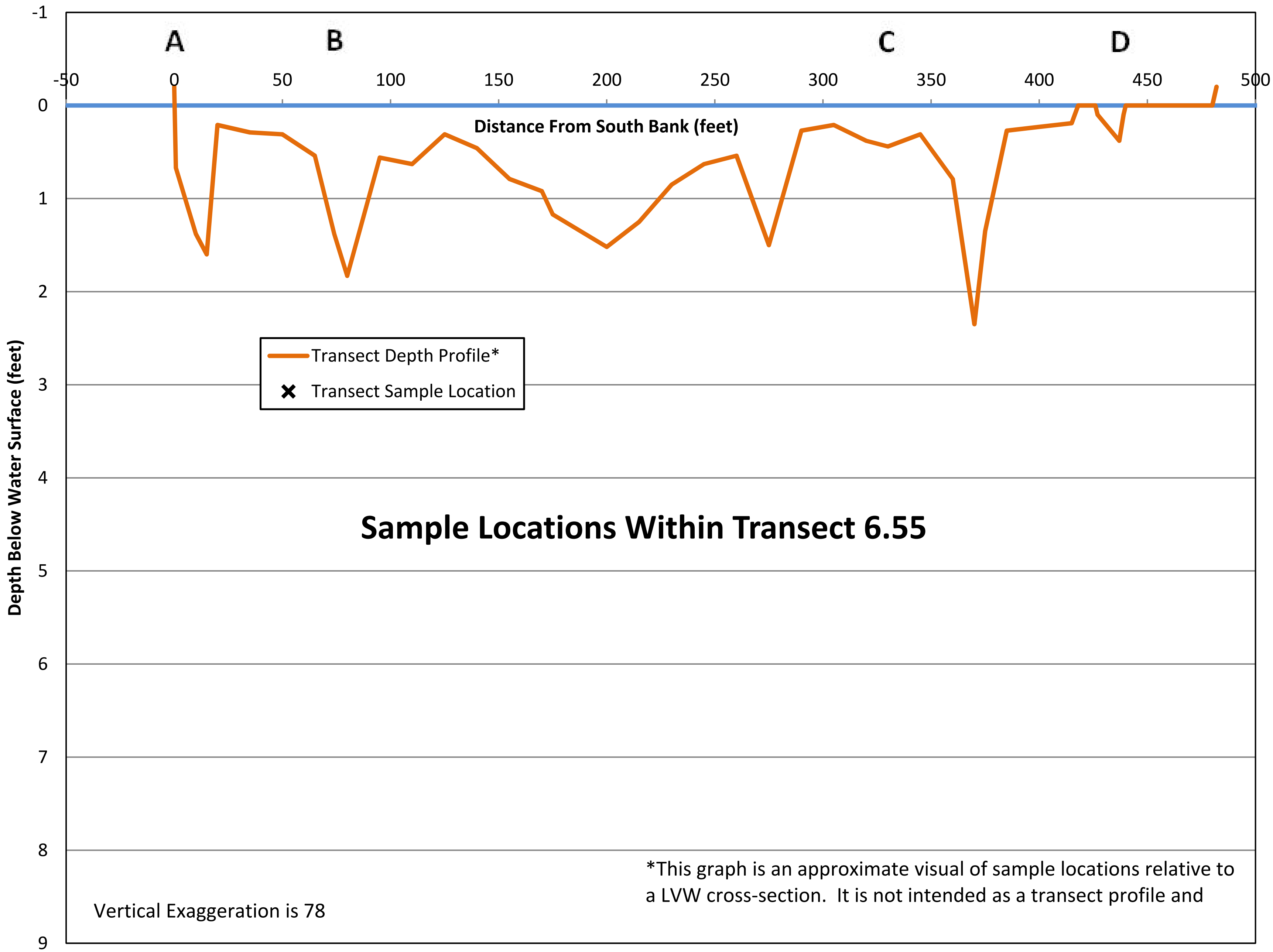

A
B
C
D
E
0
50
100
150
200
250
300
350
400
-1
0
1
2
3
4
5
6
7
8
9
Distance From South Bank (feet)
Depth Below Water Surface (feet)
Transect Depth Profile*
Transect Sample Location
Sample Locations Within Transect 4.85
Vertical Exaggeration is 78
*This graph is an approximate visual of sample locations relative to
a LVW cross-section. It is not intended as a transect profile and



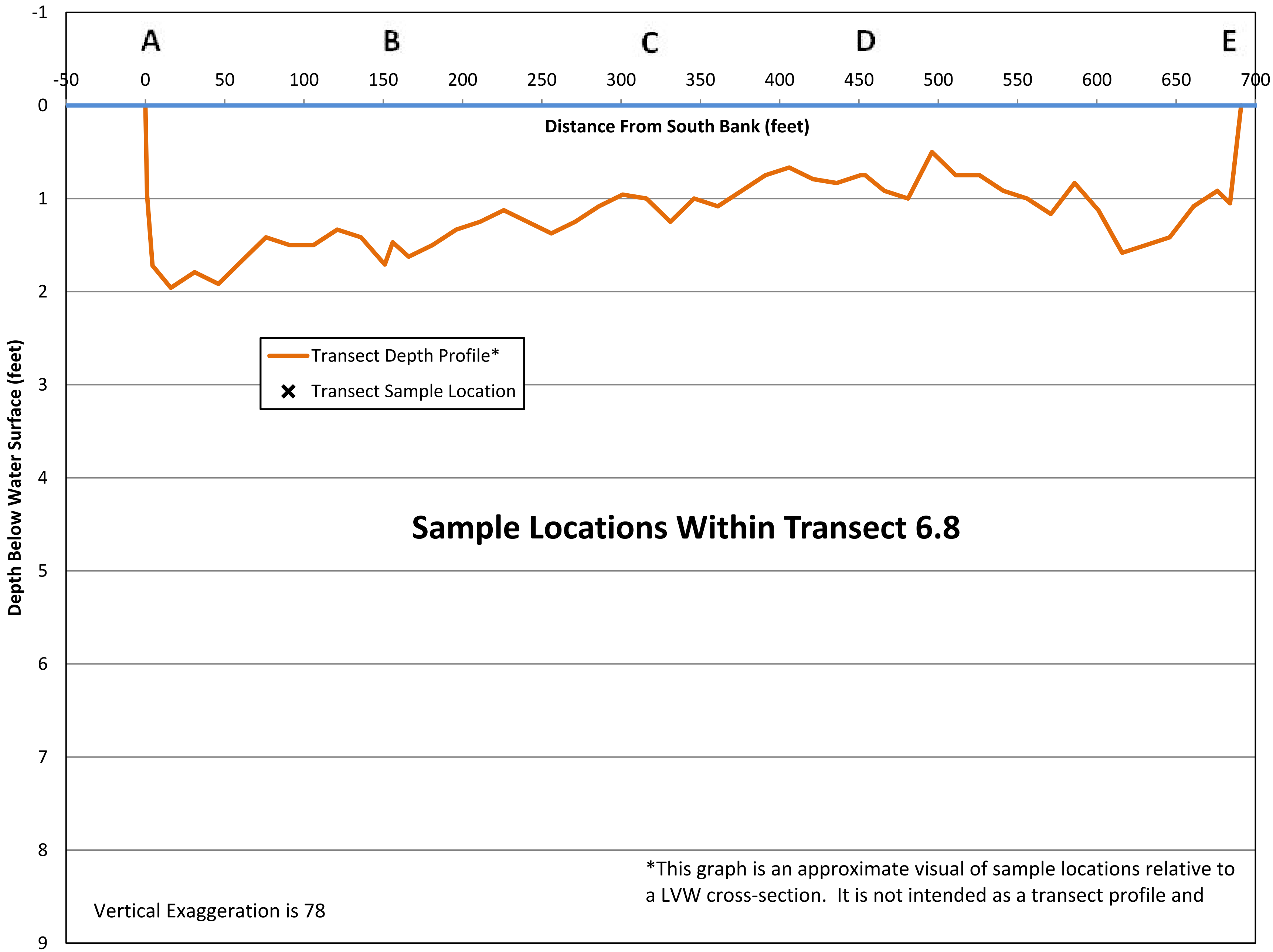
Sample Locations Within Transect 6.0
A
B
C
D
E
-50
0
50
100
150
200
250
300
Distance From South Bank (feet)
-1
0
1
2
3
4
5
6
7
8
9
Depth Below Water Surface (feet)
Transect Depth Profile*
Transect Sample Location
Vertical Exaggeration is 78
*This graph is an approximate visual of sample locations relative to a LVW cross-section. It is not intended as a transect profile and



A
B
C
D
-1
0
1
2
3
4
5
6
7
8
9
-50
0
50
100
150
200
250
300
Distance From South Bank (feet)
Depth Below Water Surface (feet)
Transcect Depth Profile*
Transect Sample Location
Sample Locations Within Transect 6.5
Vertical Exaggeration is 78
*This graph is an approximate visual of sample locations relative to
a LVW cross-section. It is not intended as a transect profile and



Sample Locations Within Transect 6.55
A
B
C
D
Distance From South Bank (feet)
-50
0
50
100
150
200
250
300
350
400
450
500
Depth Below Water Surface (feet)
-1
0
1
2
3
4
5
6
7
8
9
Transect Depth Profile*
Transect Sample Location
Vertical Exaggeration is 78
*This graph is an approximate visual of sample locations relative to a LVW cross-section. It is not intended as a transect profile and



Sample Locations Within Transect 6.8
A
B
C
D
E
-50
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
Distance From South Bank (feet)
-1
0
1
2
3
4
5
6
7
8
9
Depth Below Water Surface (feet)
Transect Depth Profile*
Transect Sample Location
Vertical Exaggeration is 78
*This graph is an approximate visual of sample locations relative to
a LVW cross-section. It is not intended as a transect profile and