BEDELL FLAT HYDROGEOLOGIC INVESTIGATION & GROUNDWATER RECHARGE FEASIBILITY REPORT

Prepared by:

Christian Kropf, Nick White, and Greg Pohll, Ph.D.

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Executive Summary

A Reno, Nevada regional team consisting of seven public agencies is jointly conducting a feasibility study to evaluate whether the State of Nevada's newly adopted "A+" reclaimed water category offers significant water resource management benefits for the Truckee Meadows region, including improving water utilization efficiency, providing operating flexibility during periods of water scarcity, and diversifying the region's water supply portfolio. The regional team includes: City of Reno, City of Sparks, Truckee Meadows Water Authority (TMWA), Northern Nevada Water Planning Commission (NNWPC), Western Regional Water Commission (WRWC), University of Nevada, Reno (UNR), and Washoe County.

State of Nevada Category A+ reclaimed water quality requirements meet all Federal and State of Nevada drinking water standards and is intended for augmenting groundwater aquifers. It is anticipated that A+ water quality will be achieved from a combination of advanced water treatment processes and soil-aquifer treatment.

This report summarizes the hydrogeologic investigation and the feasibility of groundwater recharge in the Bedell Flat hydrographic basin (094). Data has been collected since 2016 to assess the feasibility of the basin to accept 2 million gallons per day (MGD) of A+ recharge water through rapid infiltration basins (RIBs), injection wells, or infiltration through an ephemeral drainage (Bird Springs Drainage). This study included the development of a comprehensive scope of work with tasks including a) historical literature review, b) identifying project "deal breakers", c) identifying all required permits, d) infiltration testing, e) well construction, f) stratigraphic characterization, g) analysis of flooding potential, h) aquifer testing, and i) groundwater modeling.

Previous hydrogeologic investigations in Bedell Flat basin indicate a wide range of groundwater recharge and discharge estimates from 250 – 1,300 AFY. The basin is an elongated, northwest trending structural depression and the maximum thickness of the basin-fill sediments is about 2,500 feet but much shallower to the northwest where most groundwater discharge occurs. Previous drilling and modeling analysis indicate significant clay zones in the north-northwest portions of the basin in the unsaturated and saturated zones, and the aquifer was assumed to be semi-confined to confined. The southern and central regions of the basin were largely unexplored.

An effort was made to identify any "deal breakers" that would prevent the successful recharge, storage, and recovery of banked water from the basin. The largest risks or "deal breakers" were found to be the presence of a thick or extensive low permeability layer that might inhibit infiltration, and low surface or subsurface soil permeability leading to undesirable shallow groundwater conditions.

Permitting, as required by the BLM, was satisfied through a Plan of Development (POD) and Right of Way (ROW) permits that addressed archaeological, biota, and wildlife surveys. Access was granted by the BLM through these ROW permits.

Construction of six boreholes and six new wells in the central and southern portion of the basin were necessary to fully develop the regional hydrogeologic conceptual model. This includes one large diameter test well and five monitoring wells.

Stratigraphic analysis of borehole cores proved to be very important for identifying fine-

grained zones that would inhibit downward fluid migration beneath rapid infiltration basins and significant clay layers within the saturated zone that limit potential groundwater storage.

Analysis of flooding potential showed certain areas with significant erosion and deposition but ultimately storm flows were not considered a deal breaker for future recharge projects.

The aquifer test at TMWA's large-diameter test well yielded a hydraulic conductivity of 30 ft/day and a storativity of 10^{-3}, which represents semi-confined to confined aquifer conditions.

Groundwater modeling results using parameters representative of the Bedell Flat aquifer system were not favorable for a large-scale recharge project. Model results were unfavorable because they indicated the basin cannot adequately transmit and store an additional 2.0 MGD of water without creating undesirable shallow groundwater conditions across large areas in Bedell Flat.

The feasibility investigation concluded that the regional aquifer appears to be semi-confined to confined which is not conducive for artificial recharge and/or injection. Under confined conditions, recharge to the aquifer would create rapid transmission of hydraulic pressure responses throughout large portions of Bedell Flat and would cause undesirable shallow groundwater conditions at the groundwater discharge area located at the north end of the valley. Mitigating the undesirable effects by implementing a groundwater recovery program would be necessary on a short timetable that doesn't allow for banking or storage of recharged water to occur.

The primary conclusion is that further investigation of Bedell Flat as a potential water bank is unattractive given the insufficient storage capacity of the aquifer, significant clay zones within the unsaturated zone, and unfavorable bedrock geometry.

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Introduction

Background

A Reno, Nevada regional team consisting of seven public agencies is jointly conducting a feasibility study to evaluate whether the State of Nevada's newly adopted "A+" reclaimed water category offers significant water resource management benefits for the Truckee Meadows region, including improving water utilization efficiency, providing operating flexibility during periods of water scarcity, and diversifying the region's water supply portfolio. The regional team includes: City of Reno, City of Sparks, Truckee Meadows Water Authority (TMWA), Northern Nevada Water Planning Commission (NNWPC), Western Regional Water Commission (WRWC), University of Nevada, Reno (UNR), and Washoe County.

State of Nevada Category A+ reclaimed water quality requirements meet all Federal and State of Nevada drinking water standards and is intended for augmenting groundwater aquifers. It is anticipated that A+ water quality will be achieved from a combination of advanced water treatment processes and soil-aquifer treatment.

Detailed hydrogeologic investigations and demonstration trials are being conducted at four locations:

- American Flat Road (AFR)
- Bedell Flat (BF)
- Reno-Stead Water Reclamation Facility (RSWRF)
- Cold Springs Water Reclamation Facility (CSWRF)

This report summarizes the hydrogeologic investigation and the feasibility of groundwater recharge in the Bedell Flat hydrographic basin (094). Data has been collected since 2016 to assess the feasibility of the basin to accept 2 million gallons per day (MGD) of A+ recharge water through rapid infiltration basins (RIBs), injection wells, or infiltration through an ephemeral drainage (Bird Springs Drainage).

This report details the hydrogeologic investigation at the Bedell Flat location. This study included the development of a comprehensive scope of work with tasks including

- Literature review
- Deal breaker/Risk analysis
- Permitting
- Infiltration testing
- Well construction
- Stratigraphic characterization
- Analysis of flooding potential
- Aquifer testing
- Groundwater modeling

Study Area

The Bedell Flat hydrographic basin (084 (Figure 1) is located approximately 20 miles north of Reno. The basin is 51 square miles and located north of Lemmon Valley and east of Red Rock Valley, in southern Washoe County, Nevada. Approximately 92 percent of the basin is in public land, managed by the Bureau of Reclamation, and most private lands are in the foothills in the southern portions of the basin. Although information from the whole basin is being analyzed, most of the recent field work to date has been conducted in a 3.5 square mile area in the southern portion of the basin (see Figure 1).

Physiographically, the study site is located on a transition zone between the valley floor and foothill apron. The elevation at the site is approximately 5,100 feet above mean sea level (amsl) and elevations rise to nearly 7,400 feet amsl at the peak of Dogskin Mountain, located in the northeast portion of the basin.

Average annual precipitation on the valley floor averages 12 inches and increases to 18 inches at the crest of Dogskin Mountain (PRISM Climate Group, 2020).

All streams within the basin are intermittent and none of the streams are named (Figure 1).

Results

Literature Review

One of the first hydrogeologic studies in the valley was a reconnaissance level evaluation of 11 basins north of Reno, NV (Rush and Glancy, 1967). The main result was the development of a preliminary groundwater budget which estimated groundwater recharge at 1,100 AFY and outflow of 250 AFY as groundwater evapotranspiration (ET) and subsurface flow to Red Rock Valley. The large imbalance was attributed to the recharge estimate being too large.

A hydrogeologic study was conducted in Bedell Flat to determine the viability of two production wells to provide water to the Red Rock Ranch area (SEA Engineers, 1978). Key findings include

- indications that a lake or playa may have existed in the valley's southeast end at one time
- infiltration of precipitation is the major source of inflow to the groundwater system
- outflow via evapotranspiration at the northwest end of the valley and via groundwater flow to Red Rock Basin
- estimated perennial yield at 450 acre-feet per year (AFY)
- testing at a previously drilled well
- drilling at one of the test holes (TH-1) indicated semi-confined conditions and showed significant clay zones beneath 400 feet below ground surface
- drilling at TH-2 may have encountered bedrock at 400 feet
- aquifer testing of both newly drilled wells yielded transmissivities ranging between 3,000 – 4,000 gallons per day per foot and a storage coefficient of 5×10^{-3}, which is indicative of semi-confined conditions.

Geophysical methods (gravimetric and seismic-refraction) were used to define the thickness of the Cenozoic deposits in the Bedell Flat hydrographic basin (Berger et al., 2001). They determined that Bedell Flat is an elongated, northwest trending structural depression in the pre-Cenozoic basement and the maximum thickness of Cenozoic deposits is about 2,500 feet beneath the southcentral part of the valley. They also noted that shallow groundwater in the northwest corner of Bedell Flat may be a result of decreasing depth to the pre-Cenozoic basement.

A hydrogeologic investigation was conducted in 2003 to summarize what was known about the Bedell Flat system and to propose additional work required to determine the suitability of an additional production well site (Interflow Hydrology, 2003). They used the Maxey-Eakin and Chloride Mass Balance methods to estimate annual recharge of 1,300 AFY. Assuming that 50 percent of this could be salvaged, they determined the perennial yield to be approximately 600 AFY. They also noted that groundwater quality in the basin is excellent with total dissolved solids concentrations typically below 300 milligrams per liter and all constituents meet state and federal drinking water standards.

A groundwater model was developed to simulate a proposed groundwater development in Bedell Flat for use in Lemmon Valley (Interflow Hydrology, 2004). Some of the findings of the study include

- a semi-confined to confined aquifer
- natural groundwater recharge of 1,300 AFY
- groundwater evapotranspiration of 70 AFY
- total interbasin flow of 1,270 AFY toward Red Rock Valley and Antelope Valley
- simulated steady-state drawdown of 117 feet at the pumping well and 25 feet at the northern spring as the result of pumping 500 AFY at an existing well (BF-2) near the center of the valley

A total of 13 soil borings were drilled in Bedell Flat in 2007 to evaluate the near surface geology for potential operation of rapid infiltration basins (Eco:Logic, 2007). The borings were drilled up to 33 feet deep in the Bird Springs drainage, near the BLM stock well, and along the alluvial fan on the east side of the valley. Results indicated that the near surface soils on the southwest side of the valley near the northwest end of Bird Springs Road and at the mouth of the sandy wash to the north may be marginally suitable for construction of infiltration basins. They did note that one sample in the borehole at the end of Bird Springs Road contained significant clay and additional drilling, in-situ infiltration testing, laboratory permeability testing, and deeper borings would be required to thoroughly characterize the area.

Deal Breakers

An effort was made to identify any "deal breakers" or risks that would prevent the successful recharge, storage, and recovery of banked water from the basin. Deal breakers include:

- Environmental and regulatory issues
- Permitting or access issues
- Storm runoff leading to flooding of the potential storage area
- Low-infiltration rates in near-surface soils
- Insufficient storage capacity in the unsaturated zone
- Thick or extensive low permeability layers that inhibit infiltration
- Insufficient storage capacity in the aquifer
- Recharge leading to undesirable shallow groundwater conditions
- Inability to recover recharged water
- Infiltration mobilizes unsaturated zone contaminants to the aquifer
- Incompatible recharged water and native groundwater

Permitting

Environmental and regulatory concerns were resolved through discussions with the Bureau of Land Management (BLM), the Nevada Division of Environmental Protection (NDEP), and the Nevada Division of Water Resources (NDWR). No known environmental and regulatory issues were identified during this feasibility stage.

Permitting, as required by the BLM, was satisfied through a Plan of Development (POD) and Right of Way (ROW) permits that addressed archaeological, biota, and wildlife surveys. Access was granted by the BLM through these ROW permits.

Infiltration Testing

Infiltration capacity was measured via shallow (<9 feet) soil characterization and sampling, small- and large-diameter infiltrometer tests, and heat-trace infiltration observations made inside and outside of the ephemeral drainages. The detailed report describing the infiltration testing is provided in Appendix A. Of the 15 sites investigated, 10 had

unfavorable infiltration rates, but five were found to have favorable soils and high near-surface infiltration rates ranging from 9 ft/day to 54 ft/day. Sites with encouraging infiltration rates became the focus of a drilling and monitoring well investigation conducted as part of this feasibility study.

Well Construction

A total of six boreholes and six wells were constructed for this study as shown in Figure 2. These wells were necessary to fully develop the regional hydrogeologic conceptual model. This includes one large diameter test well and five monitoring wells.

Stratigraphic Characterization

The boreholes and monitoring wells were constructed using sonic drilling technology and soil cores were evaluated in 1-foot intervals. Each interval was hand textured and measured for soil water content and electrical conductivity with a hand-held time-domain reflectometer probe. A bulk soil sample was collected every 5 feet for laboratory analyses. Five split-spoon sample soil cores were collected per well. In all, 369 bulk samples and 46 cores were collected.

Textural analysis proved to be very important for identifying fine-grained zones that would inhibit downward fluid migration beneath rapid infiltration basins. In addition, significant clay layers were identified within the saturated zone that may limit potential storage for groundwater recharge. Figures 3 and 4 show the borehole stratigraphy for the Bird Springs and Sand Hills areas, respectively. It appears that the contrast in bedrock and incision into pediments creates more clay in Bird Springs than in the Sand Hills drainage. Bird Springs is predominantly in granitic bedrock, volcanic tuff, and old pediment deposits which easily weather into coarse sands and clays. Various events that mobilized sediment from both drainages contribute to the interbedded layers of thin clays and thick sands observed in the sediment logs.

Flooding Potential

Flooding potential from Bird Springs drainage was evaluated through aerial photo interpretation, field observations, and flow measurements collected during storm flows. Storms occurring in 2016-2017 and 2017-2018 resulted in significant erosion and deposition in the project area and this information was used to locate investigation areas so they were outside of storm flow impacted areas. Ultimately, the storm flows were not considered a deal breaker. A report by the U.S. Geological Survey (USGS) documents surface water flow and infiltration within the Bird Springs drainage and will be provided upon completion.

Aquifer Test

TMWA conducted a multi-well aquifer test in December 2019 to obtain hydraulic parameters (hydraulic conductivity and storativity) that could later be incorporated into a groundwater model (further discussed below). The Bedell Flat Test Well (see Figure 2) was utilized as the pumping well and the five closest monitoring wells were utilized as observation points. The Test Well was pumped at 415 gallons per minute for approximately 45 hours. Recovery occurred for approximately 24 hours after the pump was shut off.

Water level response was observed within five minutes of starting the test in shallow and deep observation wells (MW-04S and MW-04D) located approximately 440 feet west of the pumping well, and potentially within10 hours in a deep observation well (MW-07D) located approximately 3,700 feet NNW (see Figure 2). Pumping test analyses relied more heavily on the water level response observed in the wells located approximately 440 feet west of the

pumping well given the magnitude of drawdown was larger and easier to identify.

Aquifer test results were interpreted utilizing AQTESOLV 4.5 (Duffield, 2007). Hydraulic conductivity and storativity (dimensionless) values were calculated by a best-fit line matching approach utilizing the Theis equation (Theis, 1935). The resulting parameter values for hydraulic conductivity and storativity were equal to approximately 30 feet per day (ft/day) and 10^{-3}, respectively. Combining the rapid water level response with the resulting storativity value of 10^{-3}, the aquifer in Bedell Flat was designated as semi-confined to confined.

Groundwater Modeling Analysis

A three-dimensional groundwater model was developed for Bedell Flat using MODFLOW-NWT (Niswonger et al., 2011). The model was constructed with 330-foot (100 meter) horizontal grid cell resolution over three layers. The top of the model was defined by land surface which was interpolated from a 33-foot (10 meter) digital elevation model (DEM). Layer one represented unconsolidated Quaternary alluvial sediments which transmit most of the groundwater in the basin. Layer two represented Quaternary alluvial sediments and Tertiary sediments that transmit lesser quantities of groundwater. Lastly, layer three represented the low permeability granitic bedrock.

The hydraulic conductivity field for layer one was established manually by interpolating data from TMWA's 2019 pumping test and a test conducted by SEA in 1978 (SEA, 1978). A value of 30 ft/day was assigned to the area surrounding the TMWA Test Well, whereas a value of 20 ft/day was utilized for the area surrounding two wells tested by SEA located in the northern portion of the basin (Red Rock Ranch, LLC. supply wells).

Hydraulic conductivity for layers two and three were auto-calibrated utilizing parameter estimation software (Doherty, 2010) and pilot point regularization (Doherty, 2003). Hydraulic conductivity values for layers two and three were calibrated to 1 ft/day and 3×10^{-3} ft/day, respectively.

The water budget for the model was structured as follows:

- Groundwater pumping from domestic and stock watering wells was set to 56 AFY;
- Evapotranspiration was set to 166 AFY;
- Subsurface flow through head dependent boundaries (Red Rock and potentially Dry Valley) was set to 377 AFY; and,
- Mountain block recharge was set to 598 AFY.

Due to a lack of significant pumping in Bedell Flat, the groundwater system is likely in a steady-state condition. As such, the groundwater flow model was only calibrated to steady-state conditions given no significant transient trends exist. The steady-state model was calibrated to a two percent relative error.

The steady-state model was converted to a short-duration transient model to simulate the 45-hour aquifer test. The results are shown in Figure 5 which show the simulated and measured depth to water at MW-07D and MW-04D. The model is in excellent agreement with the simulated water level behavior during the 2019 aquifer test.

Three 30-year forward simulations were completed utilizing different specific yield (Sy) values to assess the aquifer's response to recharge activities at two million gallons per day (MGD) under various aquifer confining conditions. The aquifer was modeled as convertible to allow for wetting and drying of

model cells created by water table fluctuations. The three forward simulations were structured as follows:

- Simulation #1 - 2,240 AFY (2.0 MGD) injection with Sy set to 0.1, representing unconfined conditions;
- Simulation #2 - 2,240 AFY (2.0 MGD) injection with Sy set to 0.001, representing semi-confined conditions consistent with the 2019 pumping test results; and,
- Simulation #3 - 2,240 AFY (2.0 MGD) injection with Sy set to 0.001, representing semi-confined conditions consistent with the 2019 pumping test results. This simulation also includes pumping the existing two Red Rock Ranch, LLC. supply wells at a combined rate of approximately 1,600 AFY.

Model results for Simulation #1 were relatively favorable as shown in Figure 6. As expected, ET flux increased from approximately 166 AFY at the beginning of the 30-year simulation to 290 AFY at the end. Similarly, flux across the head dependent boundaries (Red Rock and Dry Valley) increased from approximately 377 AFY to 543 AFY. It is important to note increased flux across each boundary would need to be further characterized to determine how it might translate to an increase in discharge of water at land surface. Groundwater levels beneath at the Red Rock discharge area remained below land surface throughout the entire 30-year simulation (Figure 7).

Model results for Simulation #2 were highly unfavorable because they indicated the basin cannot adequately transmit and store an additional 2.0 MGD of water without creating undesirable shallow groundwater conditions across the entire regional system. Flux across the ET and head dependent boundaries reached unrealistic thresholds (see Figure 8) and undesirable shallow water level conditions were triggered early in the simulation (see Figure 7). These results are significant given the value of Sy utilized for Simulation #2 was calculated utilizing the results of the 2019 pumping test at TMWA's test well and are therefore most representative of the Bedell Flat aquifer system.

Model results for Simulation #3 were also unfavorable. By incorporating groundwater pumping of 1,600 AFY, the unfavorable results that occurred throughout Simulation #2 were only delayed by approximately two years. After two years, flux across the ET and head dependent boundaries again reached unrealistic thresholds (Figure 9) and undesirable shallow water level conditions were triggered (Figure7). Groundwater pumping in excess of 1,600 AFY may provide additional mitigation of these occurrences but it would be necessary very early in the recharge implementation process.

Conclusions

The following conclusions can be drawn from this hydrogeologic investigation:

- Previous hydrogeologic investigations indicate a wide range of groundwater recharge and discharge estimates from 250 – 1,300 AFY; the maximum thickness of the basin-fill sediments is about 2,500 feet but much shallower to the northwest where most groundwater discharge occurs; and previous drilling in the northern part of the basin and modeling analysis indicate significant clay zones in the unsaturated and saturated zones and the aquifer is semi-confined to confined.
- Construction of six boreholes and six new wells were necessary to fully develop the regional hydrogeologic conceptual model.

- Stratigraphic analysis of borehole cores proved to be very important for identifying fine-grained zones that would inhibit downward fluid migration beneath rapid infiltration basins and significant clay layers within the saturated zone that limit potential storage for groundwater recharge.
- Analysis of flooding potential showed certain areas with significant erosion and deposition but ultimately storm flows were not considered a deal breaker for future recharge projects.
- The aquifer test at TMWA's test well yielded a hydraulic conductivity of 30 ft/day and a storativity of 10^{-3}, which represents semi-confined to confined aquifer conditions.
- The feasibility investigation concluded that the regional aquifer appears to be semi-confined to confined which is not conducive for artificial recharge and/or injection. Under confined conditions recharge to the aquifer would create rapid transmission of hydraulic pressure responses throughout large portions of Bedell Flat and would cause undesirable shallow groundwater conditions at the groundwater discharge area located at the north end of the valley. Mitigating the undesirable effects by implementing a groundwater recovery program would be necessary on a timetable that doesn't allow for banking or storage of recharged water to occur.
- The primary conclusion is that further investigation of Bedell Flat as a potential water bank is unattractive given the insufficient storage capacity of the aquifer, significant clay zones within the unsaturated zone, and unfavorable bedrock geometry.

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Figures

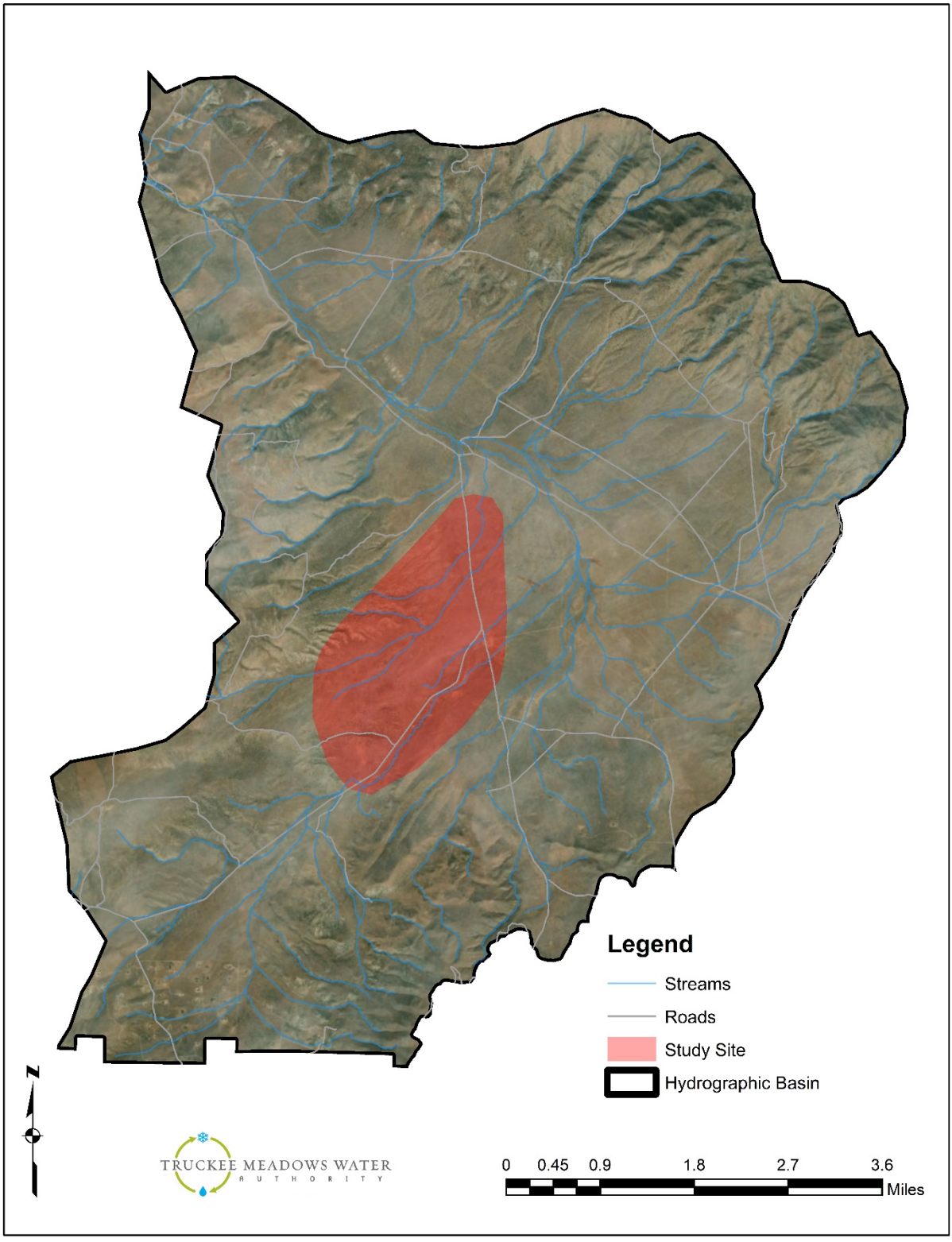

Figure 1. Bedell Flat hydrographic basin and hydrogeologic study area.

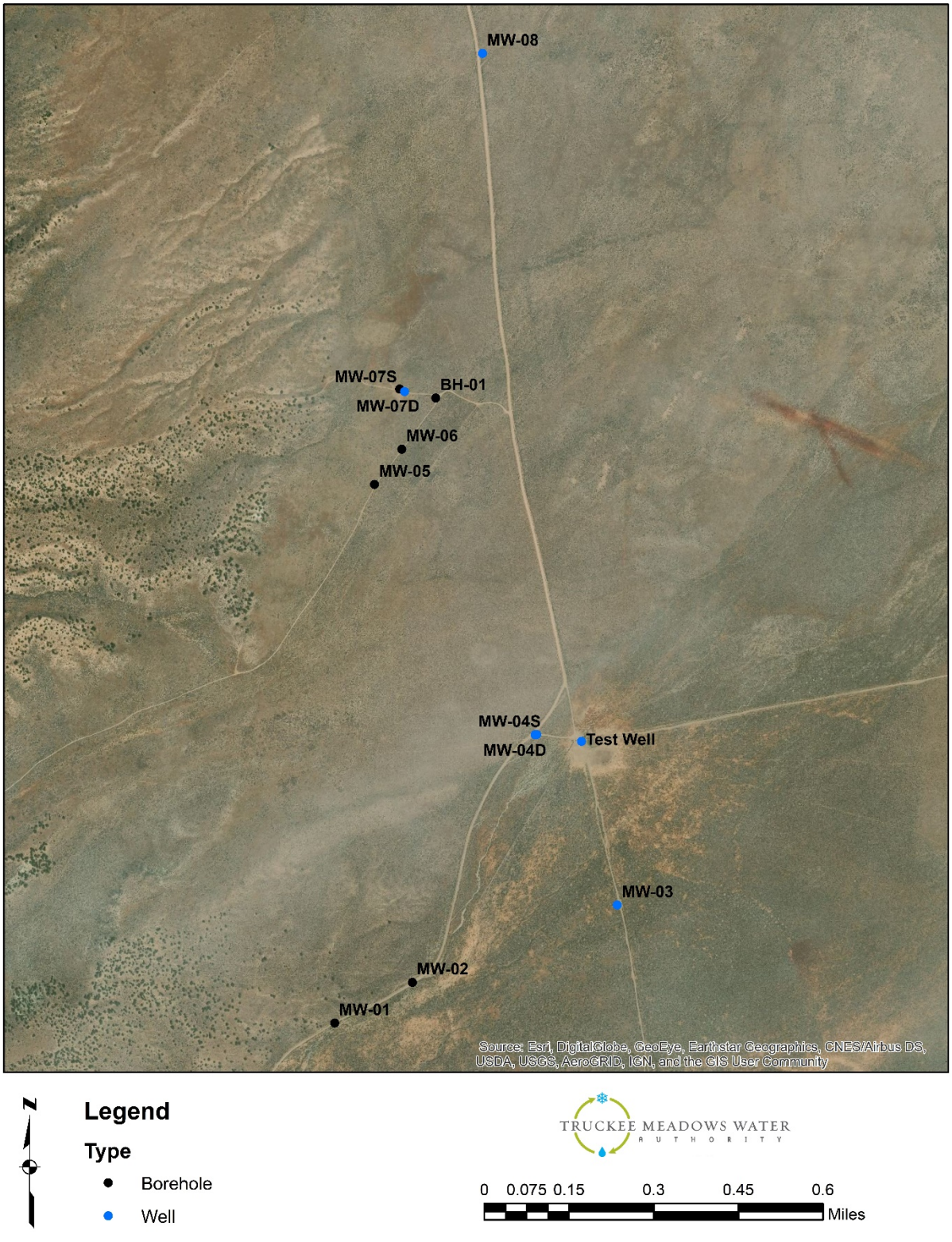

Figure 2. Location of boreholes and wells constructed for this study.

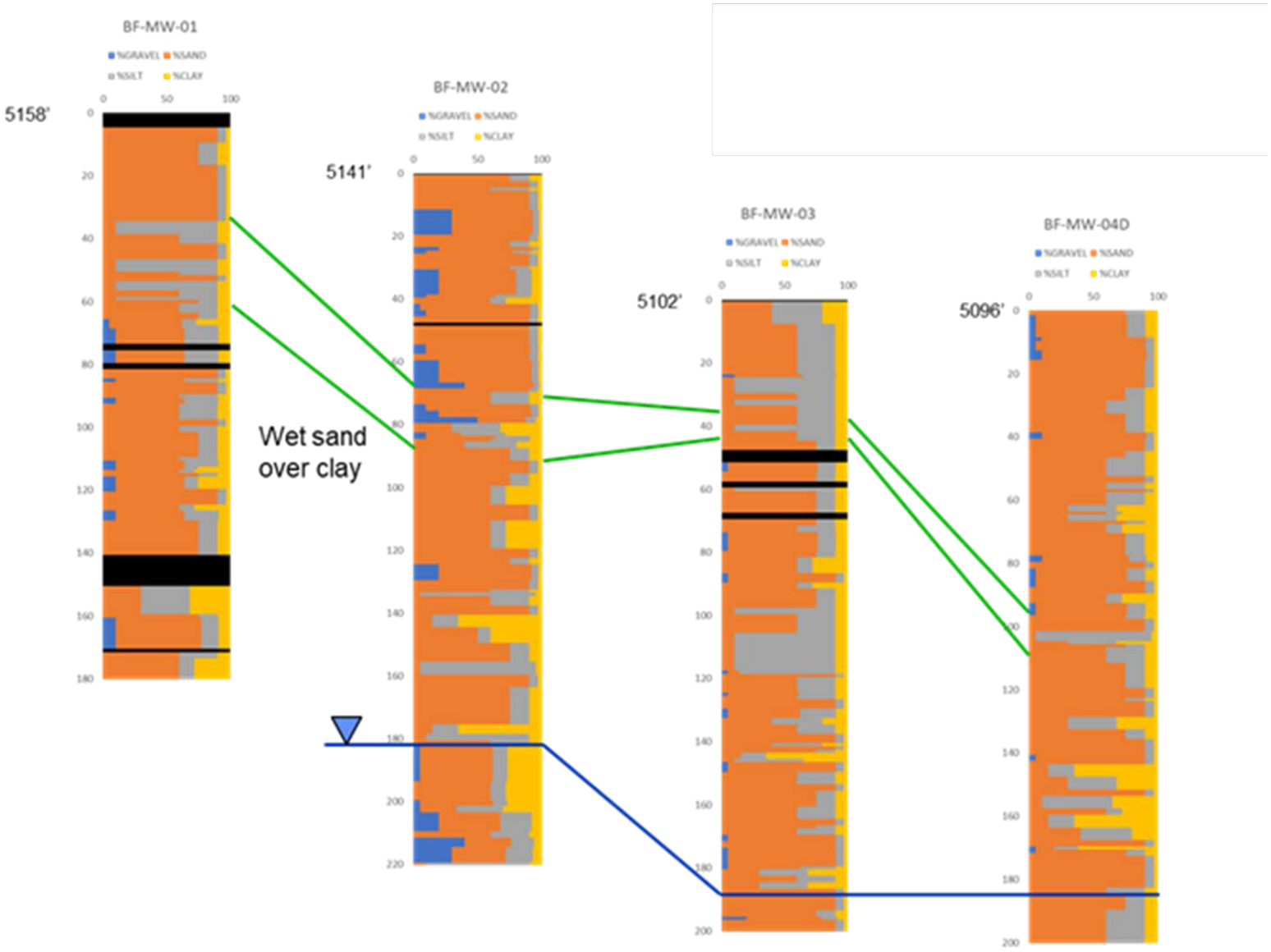

Figure 3. Borehole stratigraphy in the Bird Springs area.

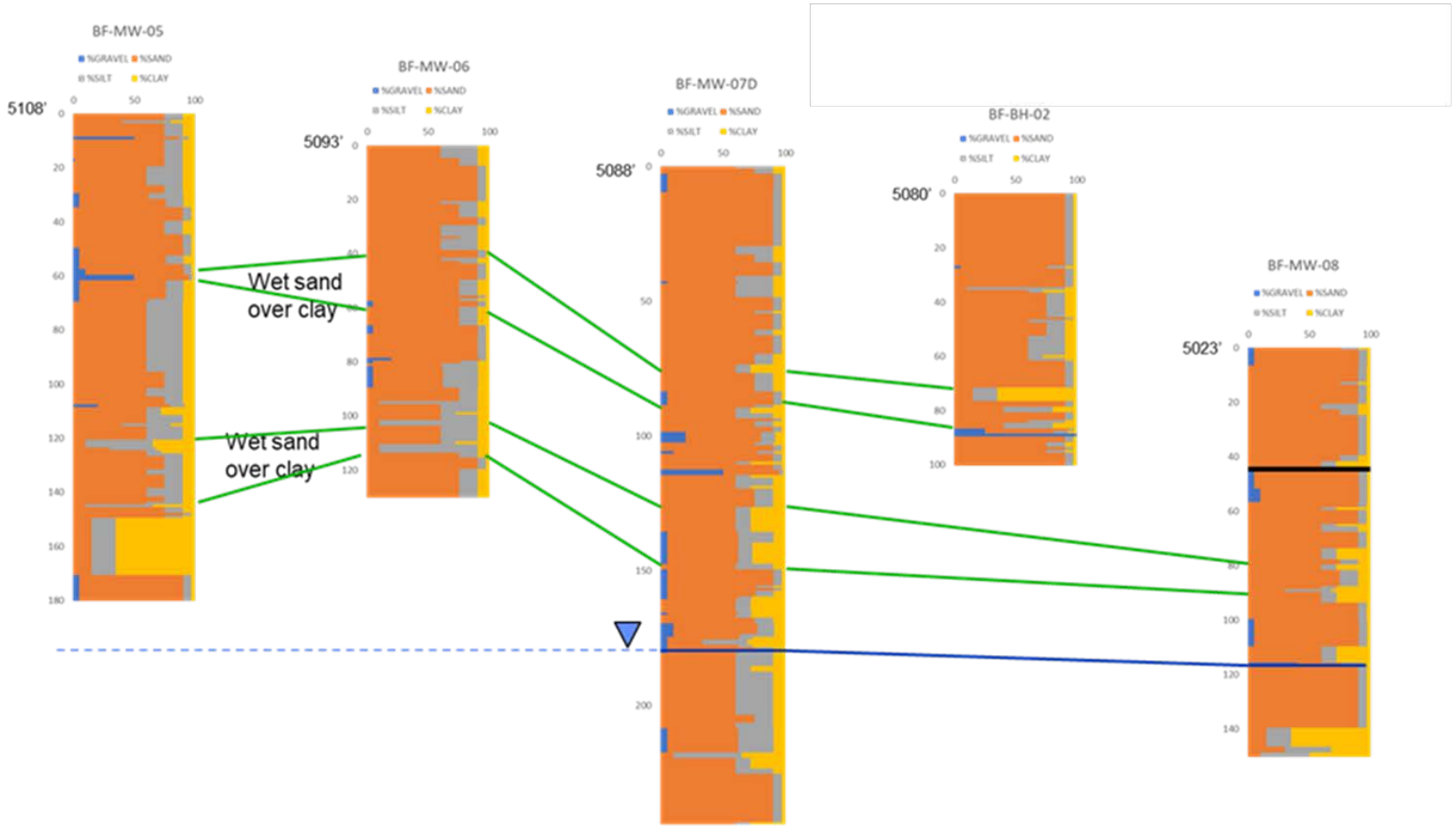

Figure 4. Borehole stratigraphy in the Sand Hills area.

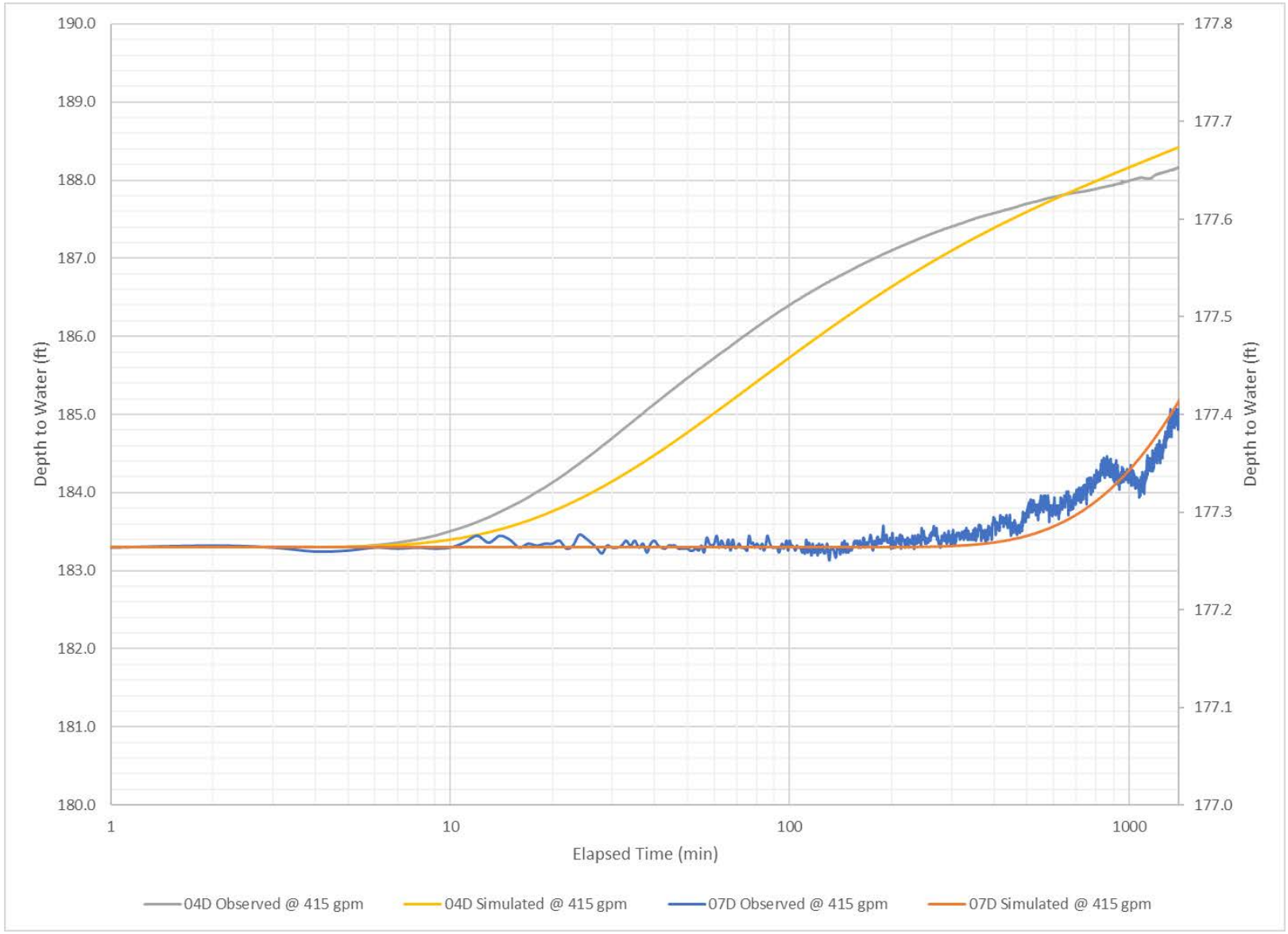

Figure 5. Simulated and measured depth to water for the 45-hour aquifer test at the TMWA Test Well.

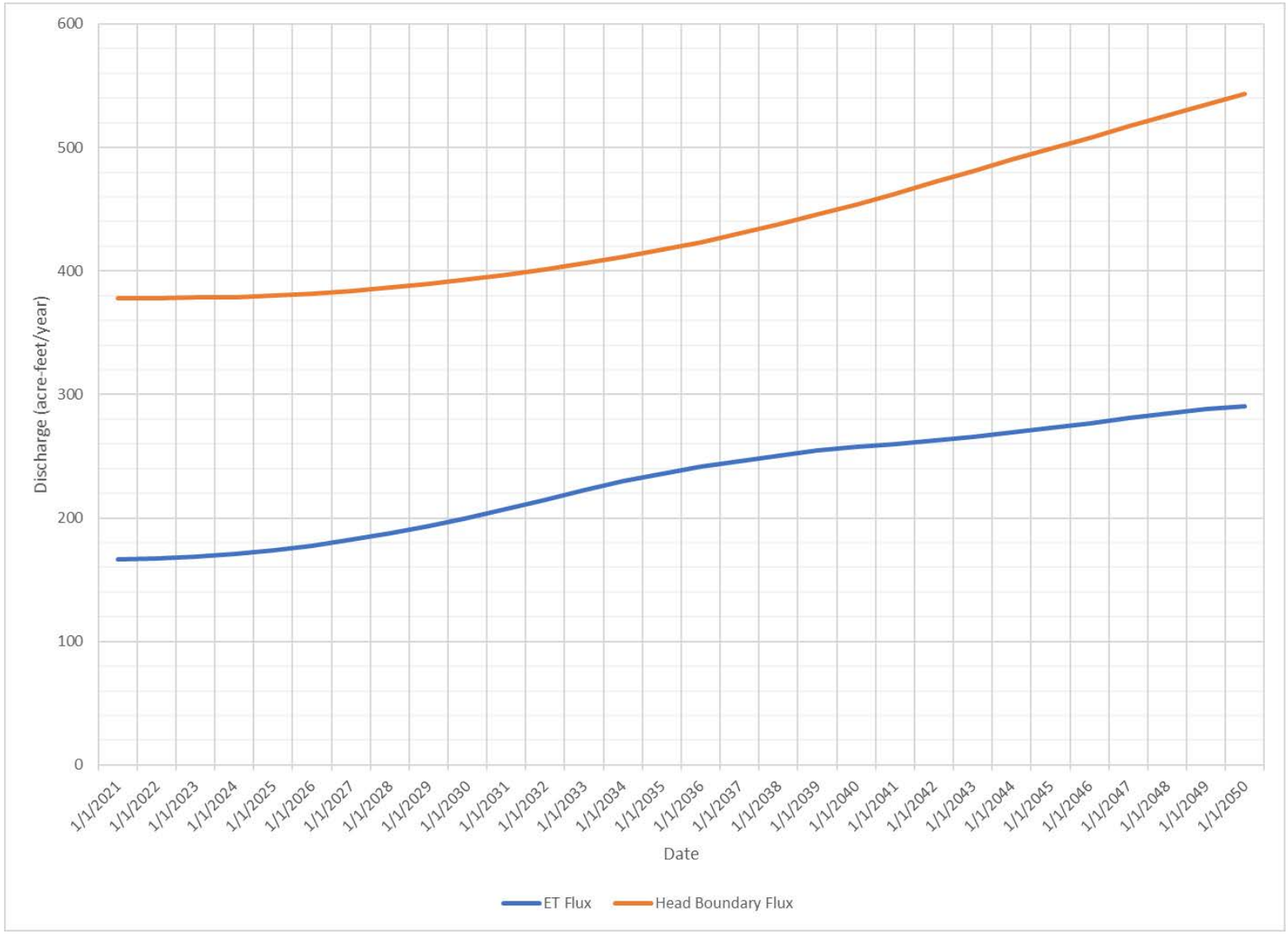

Figure 6. Simulated ET and head boundary flux for Simulation #1 which represents 2.0 MGD injection and Sy = 0.1 (unconfined).

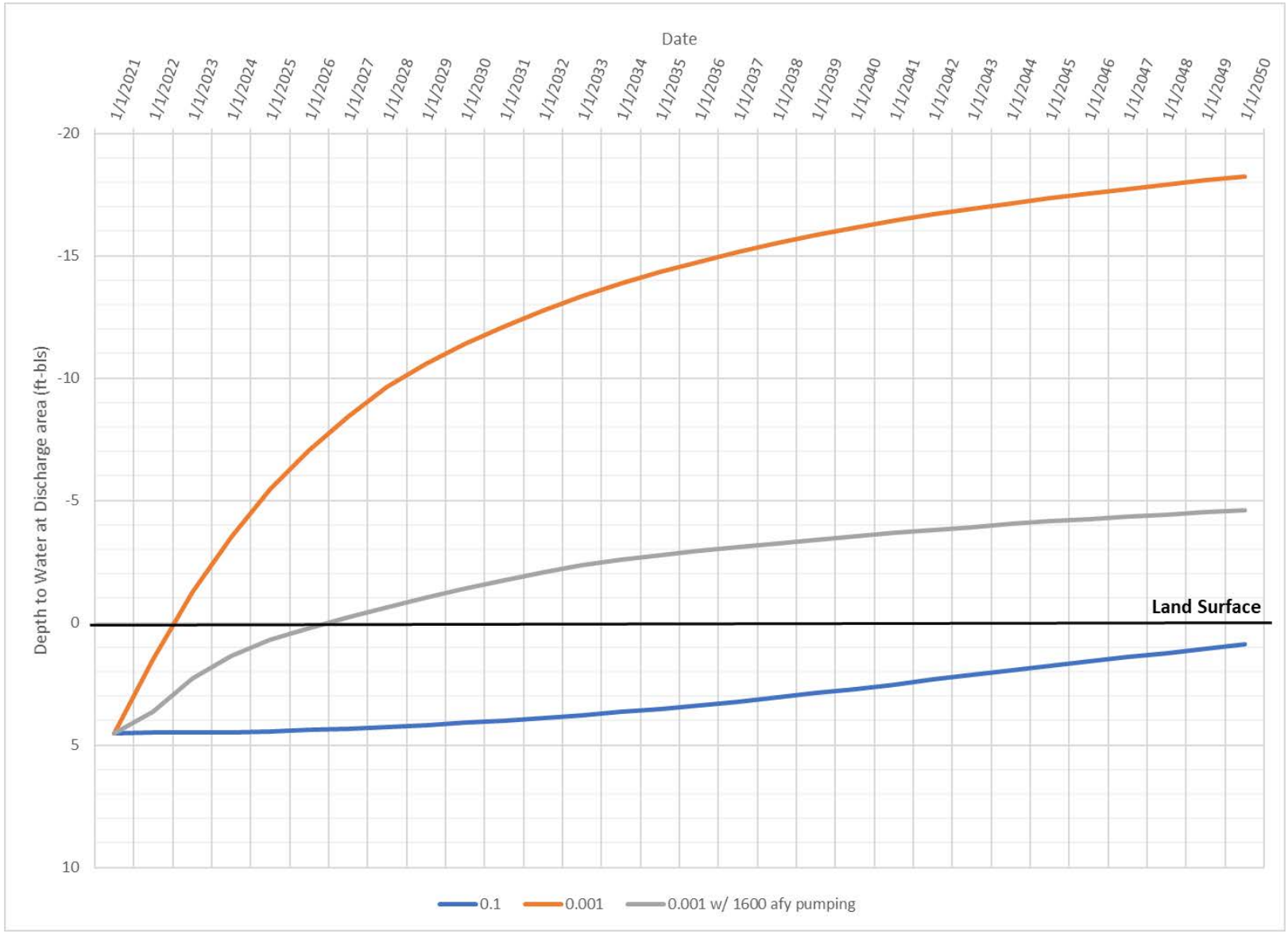

Figure 7. Simulated depth to water at the discharge area located at the northern end of Bedell Flat.

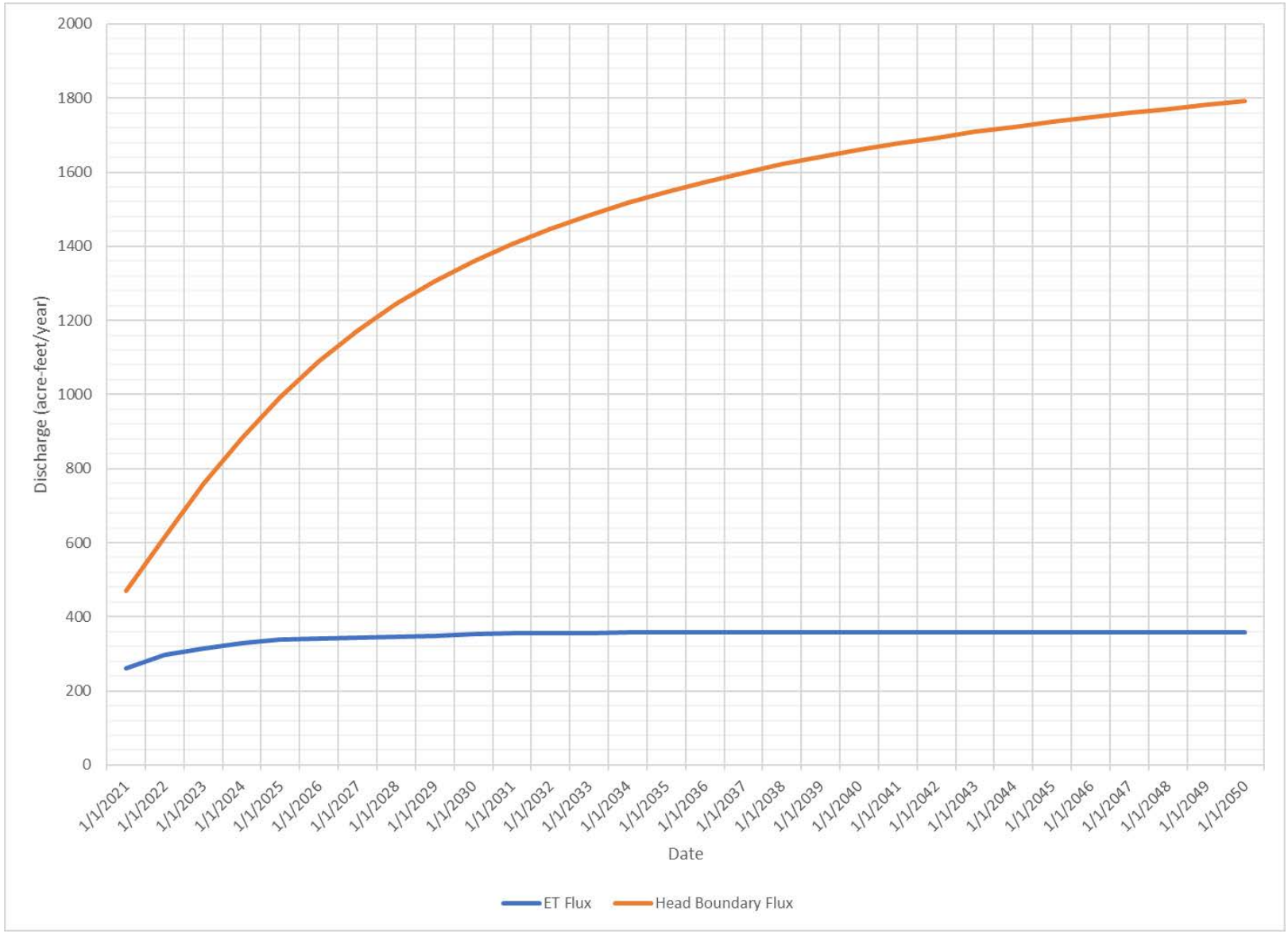

Figure 8. Simulated ET and head boundary flux for Simulation #2 which represents 2.0 MGD injection and Sy = 10^{-3} (semi-confined).

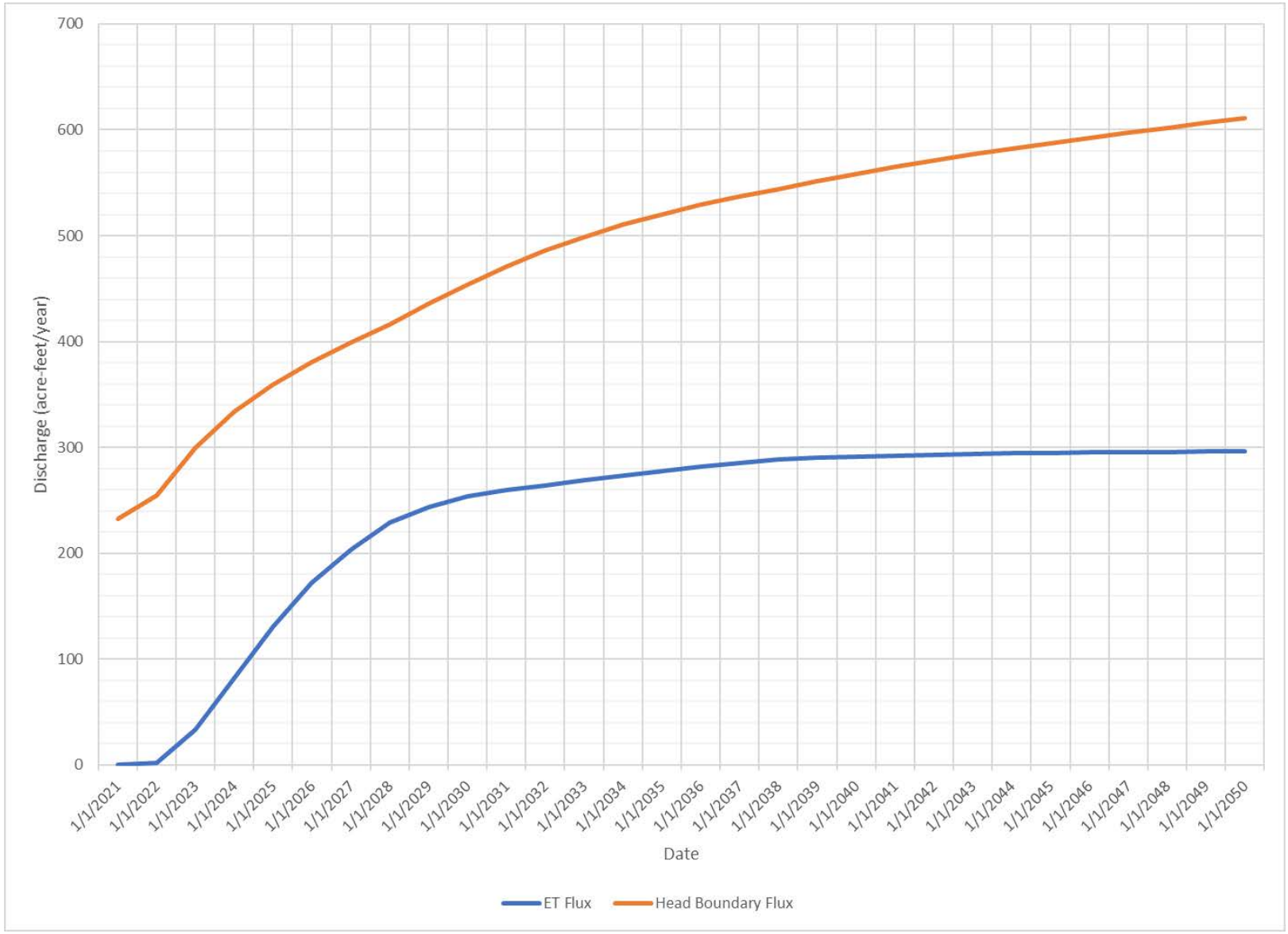

Figure 9. Simulated ET and head boundary flux for Simulation #3 which represents 2.0 MGD injection, Sy = 10^{-3} (semi-confined), and 1,600 AFY of additional pumping.

Appendix A - Bedell Flat Managed Aquifer Recharge Prefeasibility Report

GeoSystems Analysis, Inc.
Innovations in Hydrology

January 22, 2019

Mr. Christian Kropf
Senior Hydrogeologist
Truckee Meadows Water Authority
1355 Capital Blvd.
Reno, NV 89502

RE: Bedell Flat Managed Aquifer Recharge Prefeasibility Report

Dear Christian,

Enclosed please find the final Bedell Flat managed aquifer recharge prefeasibility report, which addresses TMWA review comments and edits. Should you have any questions, please do not hesitate to give us a call.

Sincerely,

Jason Keller, R.G.
Senior Hydrogeologist

CC: Nick White, TMWA
Mike Milczarek, GSA

3393 N. Dodge Blvd
Tucson, Arizona 85716

phone: 520-628-9330
fax: 520-628-1122

WWW.GEOSYSTEMSANALYSIS.COM

Bedell Flat Managed Aquifer Recharge Prefeasibility Report

Prepared for:
Truckee Meadows Water Authority
1355 Capital Blvd.
Reno, NV 89502

Prepared by:
GeoSystems Analysis
3393 N. Dodge Blvd.
Tucson, AZ 85716
www.gsanalysis.com

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EXECUTIVE SUMMARY

GeoSystems Analysis, Inc. is assisting the Truckee Meadows Water Authority in assessing the feasibility of managed aquifer recharge (MAR) of approximately 3,400 acre-ft/yr of advanced treatment reclaimed water via surface infiltration basins in Bedell Flat, Nevada. In support of this assessment, a near surface investigation test program was completed that consisted of:

1. Test pit geologic logs to a depth of 8 ft below ground surface (bgs);
2. Cylinder infiltrometer (CI) testing;
3. Large trench infiltration testing, and;
4. Laboratory physical property and chemical testing of test pit samples.

Test pit sediments were generally coarse textured, consisting of sandy loam to sandy soils with little to no gravel. In general, the observed sediments were finer textured over the top 1 to 2 feet of the profile and became coarser at depth.

Effective saturated hydraulic conductivity (K_{sat}) values increased with proximity to the Sand Hills wash and Bird Springs drainage and the percentage of sand in the sediments. The geometric mean effective K_{sat} for non-wash/drainage locations were 3.6 ft/day and 2.1 ft/day for trench and CI test methods, respectively. The geometric mean effective K_{sat} values for wash/drainage locations were 14.5 ft/day and 8.7 ft/day for trench and CI test methods, respectively.

The estimated recharge basin area needed to recharge 3,400 ac-ft/yr assuming basin operations 8 out of 12 months of the year (e.g. allowing four months for service interruptions and maintenance) and trench and CI geometric mean effective Ksat values ranges from 3.9 to 6.5 acres for non-wash/drainage basin areas and from 1.0 to 1.6 acres for wash/drainage basin areas. The CI estimated basin area represents a more conservative estimate because the CI measurements were generally performed on the soil surface, whereas the trench estimated basin area represents conditions in which the finer textured soil near the surface is removed. Additionally, the CI measurements account for lateral flow whereas the trench infiltration measurements do not. Test pit and effective K_{sat} results indicate areas within and adjacent to the Sand Hills wash and Bird Springs drainage have near surface soils that are sufficiently permeable for MAR.

Chemical soil tests indicate that MAR is not likely to degrade groundwater quality from flushing of existing arsenic or nitrate nor do salt affected soils exist at the test pit locations.

To refine MAR estimates, we recommend a borehole exploration program be implemented which focuses on defining the shallow subsurface lithology to 100 feet bgs (or groundwater if shallower) to identify the lateral extent of a previously observed compacted layer as well as deeper fine-grained layers that may be encountered. If the compacted layer or other fine-grained layers are extensive, we recommend an integrated vadose zone characterization approach which incorporates borehole exploration and in-situ testing to determine the hydraulic properties and influence of the fine-grained layers. Investigation should be focused at locations that have high near surface effective K_{sat} (e.g. near wash and drainages).

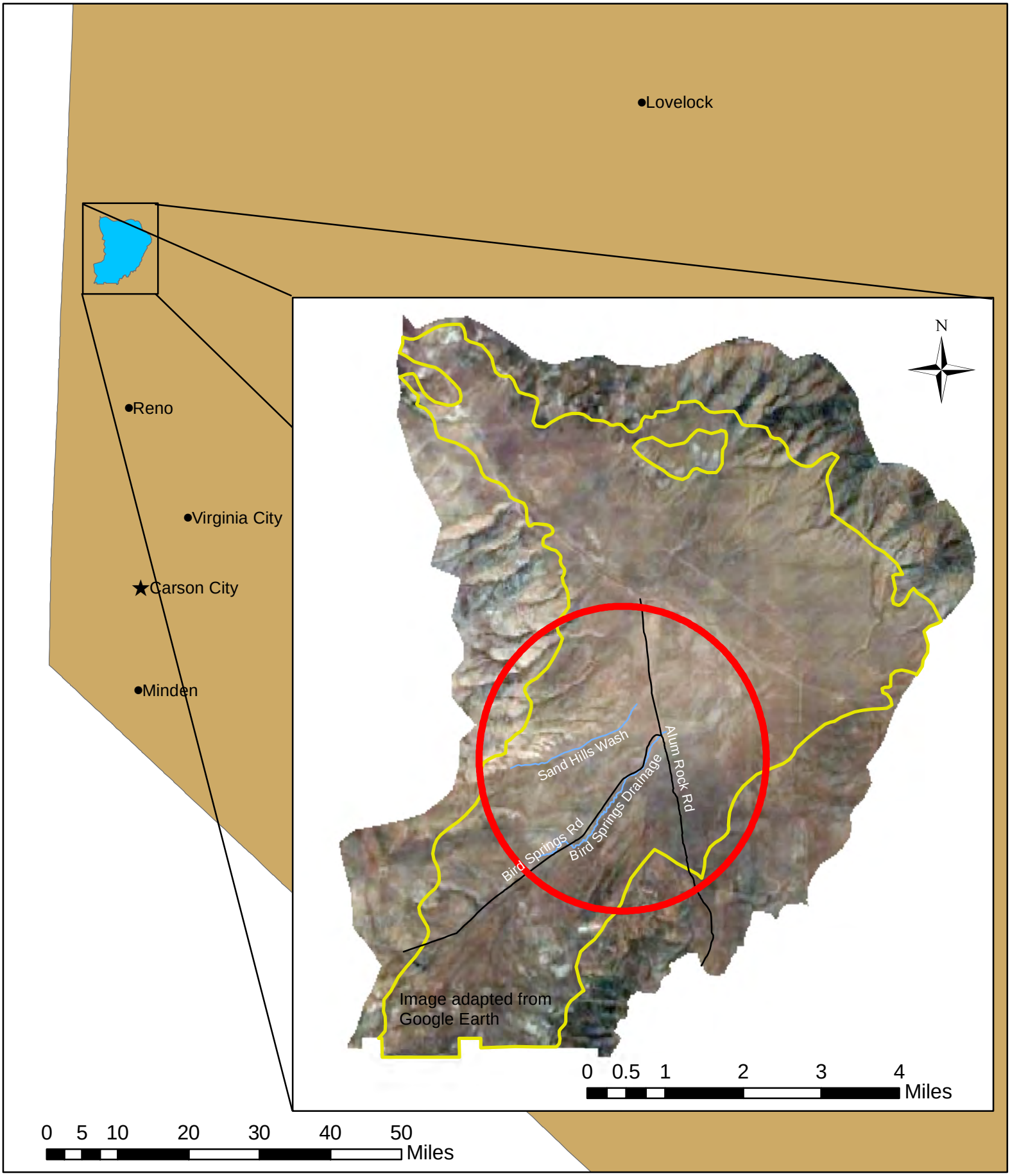
1.0 INTRODUCTION

GeoSystems Analysis, Inc. (GSA) is assisting the Truckee Meadows Water Authority (TMWA) in assessing the feasibility of managed aquifer recharge (MAR) of approximately 3,400 acre-ft/yr of advanced treatment reclaimed water via surface infiltration basins in Bedell Flat, Nevada. This report summarizes results from a test pit and infiltration testing program conducted by TMWA and GSA as well as recommendation for future characterization. Figure 1 shows the location of Bedell Flat and the test program area.

TMWA developed a near surface investigation test program that consisted of:

1. Test pit geologic logs to a depth of 8 ft below ground surface (bgs);
2. Cylinder infiltrometer testing;
3. Large trench infiltration testing, and;
4. Laboratory physical property and chemical testing of test pit samples.

Test locations focused along Bird Springs Road and Sand Hills wash north of Bird Springs Rd. (Figure 2). This area was targeted for investigation due to earlier soil borings indicating the area may be suitable for infiltration basins (ECO:LOGIC Engineering, 2007).



Legend

Bedell Flat Hydrobasin
Unconsolidated deposits
Roads
Drainages
Test Program Area

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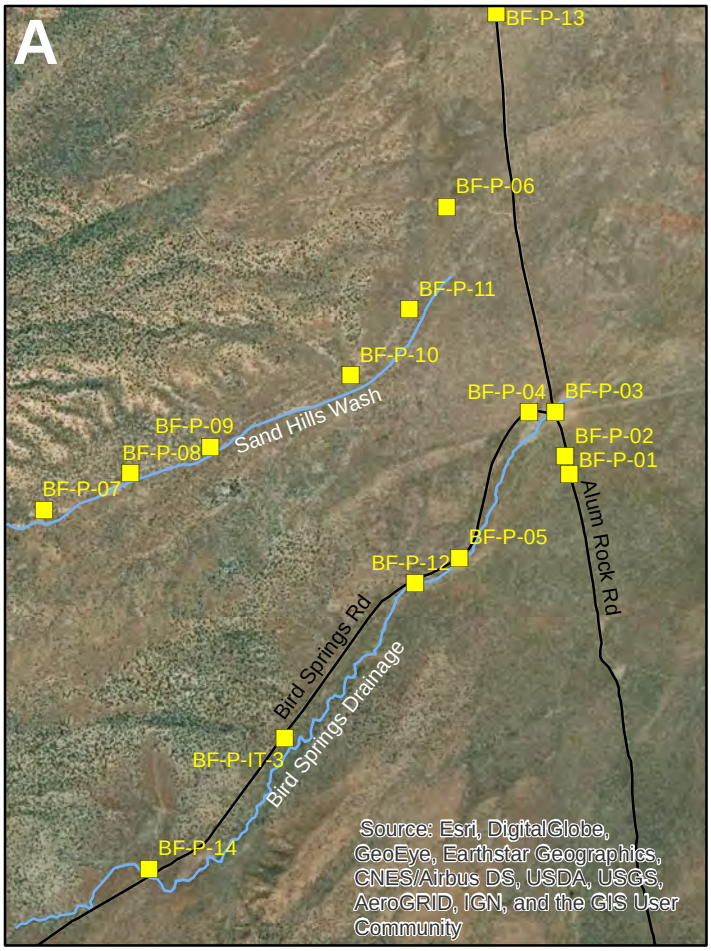
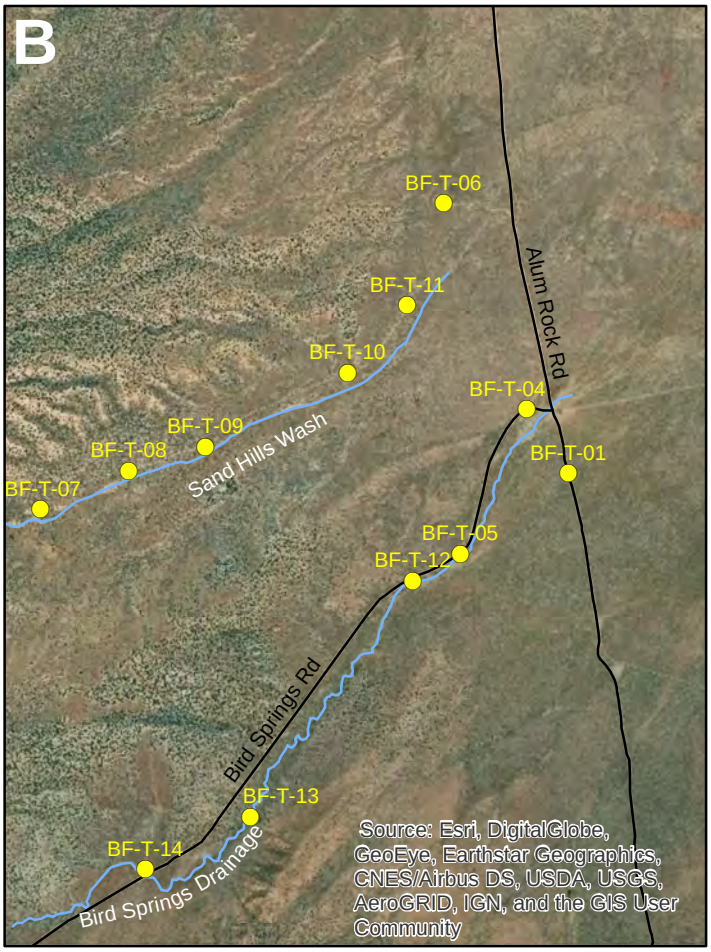
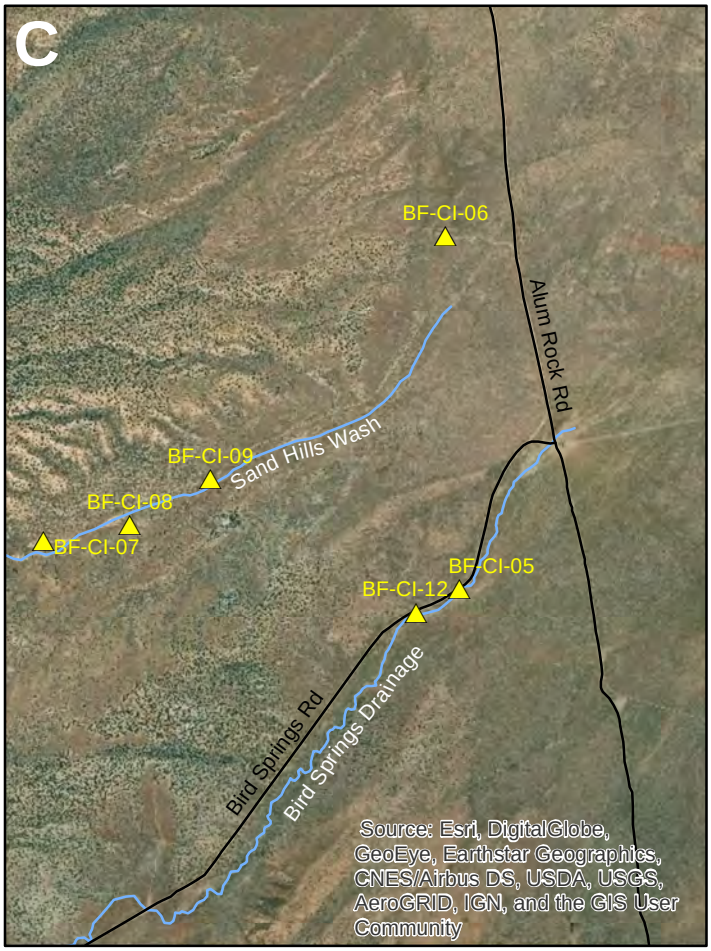
Figure1. Bedell Flat hydrographic unit test program area







Legend

- Soil Log
- Trench Infiltration Test
- Cylinder Infiltration Test
- Roads
- Drainages

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Figure 2. Soil log locations (A) and trench (B) and cylinder (C) infiltrometer test locations

2.0 METHODS

2.1 Test Pit Geologic Logging and Sample Laboratory Testing

Near-surface (0 to 8 ft bgs) soil physical property evaluations were conducted to characterize the near surface lithology. Fifteen test pits were excavated at the locations shown in Figure 2A. Test pit locations were geologically logged by GSA using visual-manual methods (ASTM D 2488) over one-foot depth intervals. Representative grab samples were collected for laboratory physical and chemical analysis.

Laboratory physical property test methods and the number of samples tested are provided in Table 1. Samples tested for particle size distribution (PSD) were selected to represent the range of observed field textures to allow for laboratory calibration of the field texture estimates. Two samples with higher fines (silt and clay) fraction were selected for Atterberg limits testing to evaluate the presence of swelling type clays. Laboratory physical property testing was performed by Black Eagle Consulting, Inc. (Reno, NV).

Table 1. Standard test method for physical property laboratory testing and number of samples

Test	Standard Method[1]	Number Samples Tested
Particle Size Distribution	ASTM C136 / ASTM D6913-17	12
Atterberg Limits	ASTM D4318 - 17	2

[1]American Society for Testing and Materials, Volume 4.08. 2009. West Conshohocken, Pennsylvania

Soil chemical analysis tests, test method and the number of samples tested are provided in Table 2. Two samples per test pit were tested, a shallow sample (2 or 3 ft bgs) and a sample collected at the maximum depth of the test pit (8 ft bgs). Soil chemical testing was performed by Western Environmental Testing Laboratory (Sparks, NV).

Table 2. Standard test method for chemical property laboratory testing and number of samples

Test	Standard Method	Number Samples Tested
pH	SW846 9045D	24
Chloride	EPA 300.0	24
Nitrate Nitrogen	EPA 300.0	24
Sodium Adsorption Ratio	Calculated	24
Electrical Conductivity	SM 2510B	24
Arsenic	EPA 200.7	24
Calcium	EPA 200.7	24
Magnesium	EPA 200.7	24
Sodium	EPA 200.7	24
Total Organic Carbon	EPA 9060A	24

2.2 Trench Infiltration Testing

Trench infiltration tests were conducted to estimate the near surface in-situ saturated hydraulic conductivity (K_{sat}), which represents the rate at which water infiltrates into the soil under field saturated conditions. Trench infiltration tests were performed by TMWA at the locations shown in Figure 2B. Trench test locations were selected based on the presence of coarse soil materials characterized during pit testing. Testing was performed by excavating a trench to a depth of approximately 3 to 4 ft, inserting a 4-foot diameter steel culvert in the trench, adding approximately 2 ft of water inside the culvert, and monitoring the rate of water decline using a Rugged TROLL 100 ® datalogger (In-Situ, Ft. Collins, CO). Effective K_{sat} was calculated from the measured infiltration rates using the Green and Ampt equation with time-varying ponded water depth (Warrick et al., 2005). The calculation did not correct for lateral divergence of subsurface water flow, which can result in an overestimate of K_{sat} (Rice et al., 2014).

2.3 Cylinder Infiltrometer Testing

Single-ring cylinder infiltrometer (CI) tests with lateral divergence correction (Bouwer et al., 1999) were conducted to assess the effective near-surface K_{sat}. The CI testing procedure is provided in Appendix A. CI tests were performed by GSA at the locations shown in Figure 2C. CI testing locations were generally near trench infiltration testing locations, apart from location BF-CI-08 which was in the Sand Hills wash approximately 325 ft south of the nearest trench infiltration test location (BF-T-08).

3.0 RESULTS

3.1 Laboratory Physical Testing and Geologic Logs

Laboratory PSD results are summarized in Table 3. PSD sample gravel fraction was 9% or less. Sand fraction (0.075 mm – 4.75 mm) ranged from 49.7% to 91.1% and percent fines (silt + clay (<0.075 mm)) ranged from 8.9% to 50.3%. Though located in the Bird Springs drainage, sample BF-P-5 at 3 ft bgs was the finest textured sample tested. The occurrence of fines in the otherwise coarse drainage material may be due to fine sediment washing off the dirt road and entering the drainage at this location.

Field geologic logging estimates of percent gravel, sand, silt and clay were adjusted by using the results from the laboratory PSD testing. Regression equations were determined for the laboratory derived percent sand and silt versus manual field texture estimations to obtain lab to field correction parameters (Figure 3). These correction parameters were then applied to all field log estimates of soil texture. Field geologic log sheets for the test pits are provided in Appendix B. Laboratory PSD and Atterberg limits test results are provided in Appendix C.

Table 3. Laboratory sample percent gravel, sand, silt, and clay

Sample	Gravel (>4.75 mm)	Sand (0.075 mm - 4.75 mm)	Silt (0.002 - 0.075 mm)	Clay (<0.002 mm)
	Percent			
BF-P-1 at 3'	1.0	57.7	41.3	
BF-P-2 at 4'	2.0	77.0	21.0	
BF-P-3 at 5'	0.0	49.7	39.6	10.7
BF-P-4 at 3'	0.0	91.1	8.9	
BF-P-5 at 3'	3.0	79.5	16.2	1.3
BF-P-6 at 3'	2.0	84.5	11.7	1.9
BF-P-7 at 3'	2.0	83.3	13.1	1.6
BF-P-8 at 3'	1.0	76.9	19.2	2.9
BF-P-9 at 4'	1.0	79.0	17.3	2.7
BF-P-10' at 2'	0.0	60.4	30.3	9.3
BF-P-11 at 8'	2.0	85.4	12.6	
BF-P-12 at 8'	9.0	75.4	15.6	

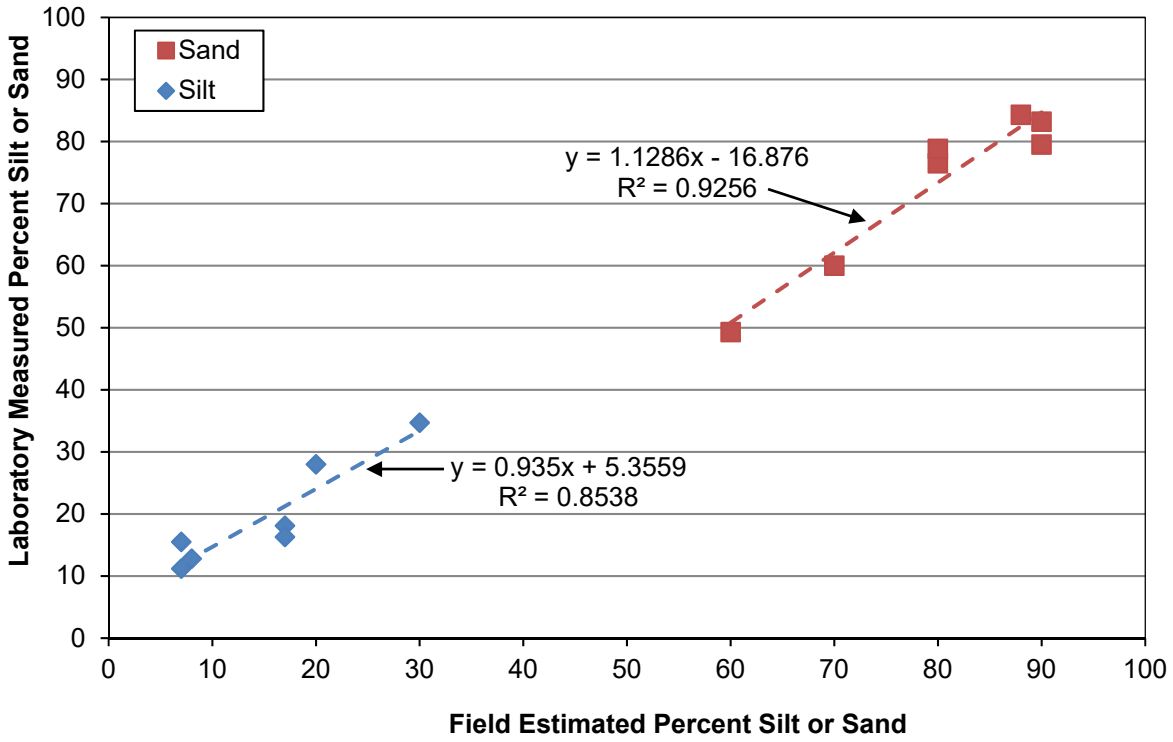


Figure 3. Laboratory calibration to field measured sand and silt size fraction

The estimated percent fines in each test pit as a function of depth are provided in Table 4. Test pit sediments are generally coarse textured, consisting of sandy loam to sandy soils with little to no gravel (10% or less), with greater than 60% sand size fraction and less than 40% fines. In general, the observed sediments were finer textured over the top 1 to 2 feet of the profile and became coarser at depth. Test pit BF-P-3 was finer textured than all other locations, consisting of clay loam and loam soils with greater than 45% fines to a depth of 4 ft bgs. Test pit BF-P-13 was not hand textured, though was noted by TMWA to consist of silty sands with interbedded clay and silt and not ideally suited for a recharge basin.

Atterberg limits test results are summarized in Table 5. The Atterberg limits derived plasticity index (PI) provides an indicator of the clay content and type, where material with a PI between 0 and 3 is non-plastic, between 3 and 15 is slightly plastic, between 15 and 30 is moderately plastic, and greater than 30 is highly plastic. The PIs for samples BF-P-3 at 5 ft bgs and BF-P-10 at 2 ft bgs were 9 and 7, respectively, indicating slight plasticity and low to moderate clay content. These results agree with the PSD measured clay content of 10.7% and 9.3% for samples P-3 at 5 ft bgs and BF-P-10 at 2 ft bgs, respectively (Table 3).

Table 4. Test pit percent fine earth fraction (<0.075 mm)

Depth (ft bgs)	Test Pit											
	BF-P-1	BF-P-2	BF-P-3	BF-P-4	BF-P-5	BF-P-6	BF-P-7	BF-P-8	BF-P-9	BF-P-10	BF-P-11	BF-P-12
	Percent Fines (<0.075 mm)											
0.5	28	39	61	19	19	28	28	28	28	34	56	17
1.5	34	39	61	17	18	39	22	22	22	39	50	12
2.5	34	34	50	11	17	17	17	17	17	34	28	12
3.5	28	22	45	11	17	11	11	28	17	28	28	12
4.5	28	22	39	11	17	11	12	11	28	17	17	17
5.5	28	22	34	11	17	11	23	22	17	22	17	17
6.5	22	22	34	11	34	11	17	17	22	29	17	18
7.5	22	28	34	11	12	11	22	17	22	28	11	18

Table 5. Atterberg limits test results

Sample	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Clay Activity (PI/% Clay)	Clay Type
BF-P-03 at 5'	28	19	9	0.84	Normal
BF-P-10 at 2'	24	17	7	0.75	Normal

Clay activity provides an indication of the dominant clay type present and is calculated as the PI divided by the clay content. Clay activity values between 0.75 and 1.25 indicate normal clays (e.g. illites), clay activity values less than 0.75 indicate inactive clays (e.g. kaolinites), and clay activity values greater than 1.25 indicate active clays (e.g. smectites). Both Atterberg limits samples have a clay activity between 0.75 and 1.25, indicating low shrink-swell tendencies.

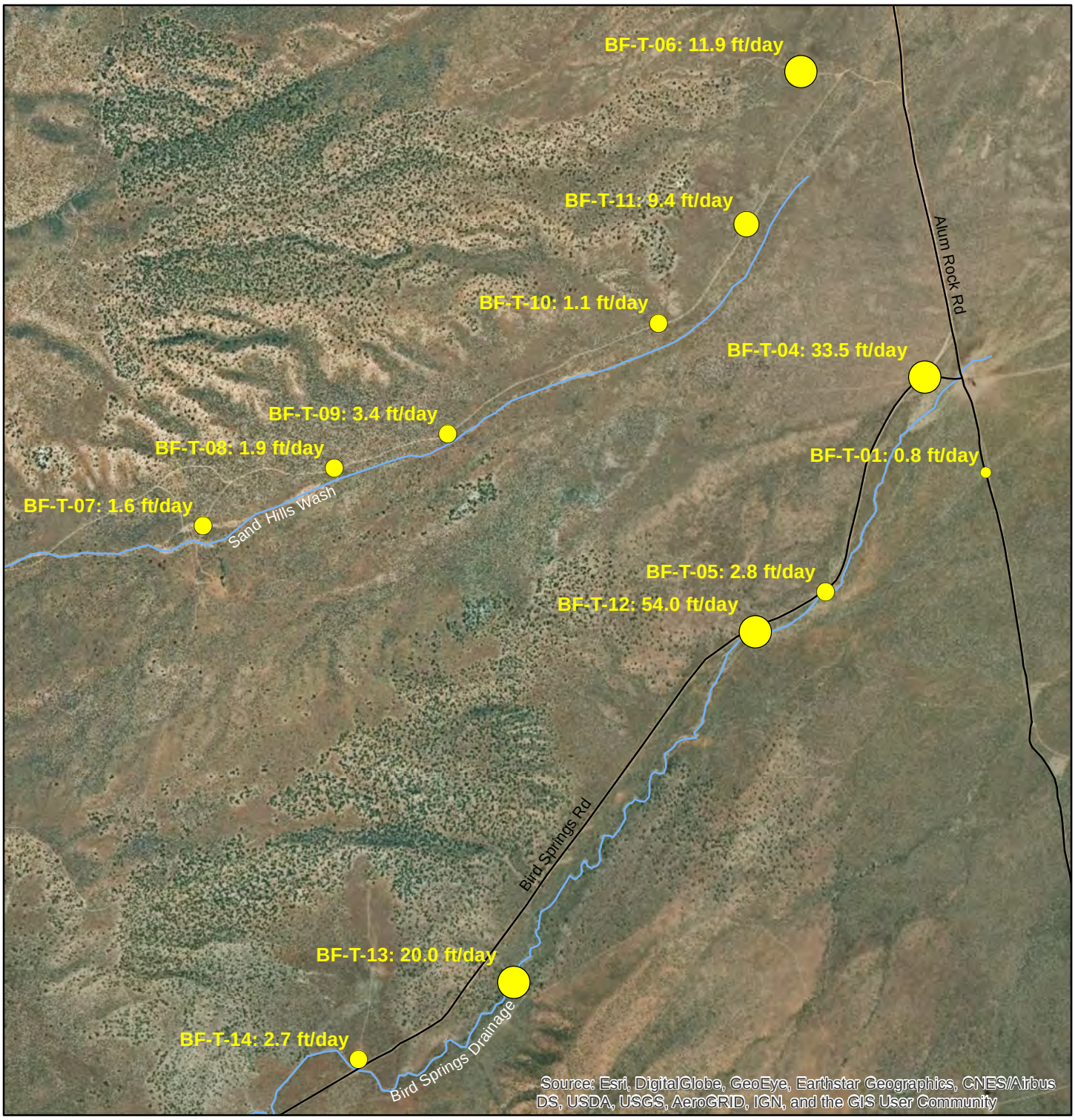
3.2 Trench and Cylinder Infiltrometer Tests

Measured effective K_{sat} values at the trench and cylinder infiltrometer test locations are provided in Table 6 and Table 7, respectively. Effective K_{sat} values are shown spatially in Figure 4 and Figure 5 for the trench and cylinder infiltrometer tests, respectively. Trench effective K_{sat} values were typically greater than CI measured effective K_{sat} values. The difference in effective K_{sat} results may be due to trench testing having occurred at depths ranging from 2.5 ft to 5 ft bgs (Table 6), whereas the CI tests were typically performed at the soil surface (Table 7) where finer textured and less permeable soils are present (Section 3.1). Additionally, the distance of lateral water movement (e.g. at the contact of differing soil textures) was not measured (e.g. via post-test excavation) and the uncorrected lateral divergence in the trench tests may have also

contributed to greater trench effective K_{sat}. Rice et al. (2014) reported up to 6X overestimate of effective K_{sat} when not accounting for lateral divergence.

Effective K_{sat} values increased depending on the proximity to a wash or drainage and the percentage of sand in the sediments. For example, test locations BF-T-12 and BF-T-13 were conducted within the Bird Spring drainage in predominately sandy soils with high effective K_{sat} values (54 ft/day and 20 ft/day, respectively). Likewise, CI tests BF-CI-8 and BF-CI-12 were performed within the Bird Spring drainage and Sand Hills wash and showed greater effective K_{sat} values (8.1 ft/day and 9.3 ft/day) than other CI test locations. The geometric mean effective K_{sat} for non-wash/drainage locations were 3.6 ft/day and 2.1 ft/day for trench and CI test methods, respectively. The geometric mean effective K_{sat} values for wash/drainage locations were 14.5 ft/day and 8.7 ft/day for trench and CI test methods, respectively.

Table 8 summarizes the estimated recharge basin area needed to recharge 3,400 ac-ft/yr (3 MGD) assuming basin operations 8 out of 12 months of the year (e.g. allowing four months for service interruptions and maintenance) and the trench and CI measured geometric mean effective K_{sat}. The estimated non-wash/drainage basin area ranges from 3.9 acres to 6.5 acres and the estimated wash/drainage basin area ranges from 1.0 acres to 1.6 acres. The CI estimated basin area represents a more conservative estimate because the CI measurements were generally performed on the soil surface, whereas the trench estimated basin area represents conditions in which the finer textured soil near the surface is removed. Additionally, the CI measurements account for lateral flow whereas the trench infiltration measurements do not.



0 0.175 0.35 0.7 1.05 1.4 Miles

N

Legend

Effective Ksat

- < 1 ft/day
- 1.0 - 5.0 ft/day
- 5.1 - 10.0 ft/day
- > 10 ft/day

Roads

Drainages

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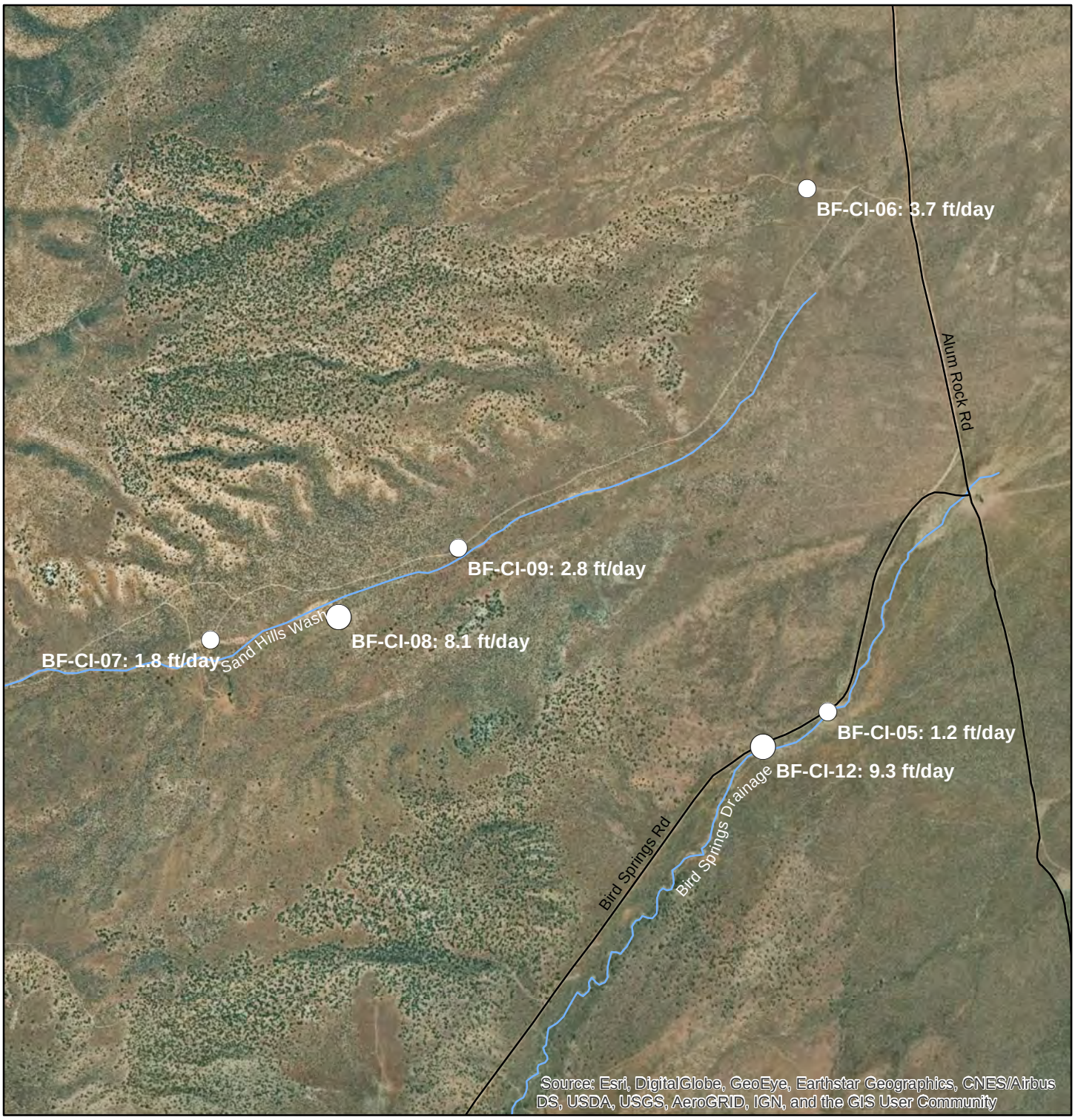
Figure 4. Trench infiltration measured effective saturated hydraulic conductivity



Legend

Effective Ksat

- < 1 ft/day
- 1.0 - 5.0 ft/day
- 5.1 - 10.0 ft/day
- > 10 ft/day

- Roads
- Drainages

Figure 5. Cylinder infiltration measured effective saturated hydraulic conductivity

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Table 6. Trench infiltration measured effective saturated hydraulic conductivity

Location	USDA Soil Texture	Test Depth	Effective Saturated Hydraulic Conductivity	
		(ft bgs)	(cm/s)	(ft/day)
BF-T-01	Sandy loam / Loamy sand	4.0	2.9E-04	0.8
BF-T-04	Sand	4.5	1.2E-02	33.5
BF-T-05*	Loamy sand	2.5	9.8E-04	2.8
BF-T-06	Sand	4.5	4.2E-03	11.9
BF-T-07	Sand / Loamy sand	3.0	5.7E-04	1.6
BF-T-08	Sandy loam / Loamy sand	3.0	6.8E-04	1.9
BF-T-09	Loamy sand	3.0	1.2E-03	3.4
BF-T-10	Sandy loam / Loamy sand	5.0	3.7E-04	1.1
BF-T-11	Sandy loam / Loamy sand	3.4	3.3E-03	9.4
BF-T-12*	Sand / Loamy sand	4.0	1.9E-02	54.0
BF-T-13*	Sand	4.0	7.1E-03	20.0
BF-T-14	Sandy loam / Loamy sand	4.0	9.5E-04	2.7
Non-Wash Area Geometric Mean			1.2E-03	3.6
Wash Area Geometric Mean			1.2E-02	14.5

*wash/drainage location

Table 7. Cylinder infiltrometer measured effective saturated hydraulic conductivity

Location	USDA Soil Texture	Test Depth	Effective Saturated Hydraulic Conductivity	
		(ft bgs)	(cm/s)	(ft/day)
BF-CI-05	Loamy sand	0.0	4.1E-04	1.2
BF-CI-06	Sandy loam	0.2	1.3E-03	3.7
BF-CI-07	Loamy sand	2	6.3E-04	1.8
BF-CI-08*	Sand	0.0	2.8E-03	8.1
BF-CI-09	Sandy loam	0.0	9.8E-04	2.8
BF-CI-12*	Sand	0.0	3.3E-03	9.3
Non-Wash Area Geometric Mean			7.6E-04	2.1
Wash Area Geometric Mean			3.1E-03	8.7

*wash/drainage location

Table 8. Estimated basin area to recharge 3,400 acre-ft/yr

Location	Test Method	Saturated Hydraulic Conductivity (ft/day)	Estimated Basin Area for 3,400 acre-ft/yr Recharge (acres)[1]
Non-Wash	Trench Infiltration	3.6	3.9
	Cylinder Infiltration	2.1	6.5
Wash	Trench Infiltration	14.5	1.0
	Cylinder Infiltration	8.7	1.6

[1]assumes basin operations 8 months of the year

3.3 Chemical Soil Tests

Chemical soil test results are provided in Appendix D and indicate that MAR is not likely to degrade groundwater quality from flushing of existing arsenic or nitrate. Arsenic is below detection limit (<0.46 mg/kg) for all samples tested. Nitrate-nitrogen concentrations are low, ranging from 10.0 mg/kg to below detection limit (<1.0 mg/kg). Chloride concentrations are also low, ranging from 25 mg/kg to below detection limit (<10 mg/kg), indicating minimal evapo-concentration of chloride to a depth of 8 ft bgs.

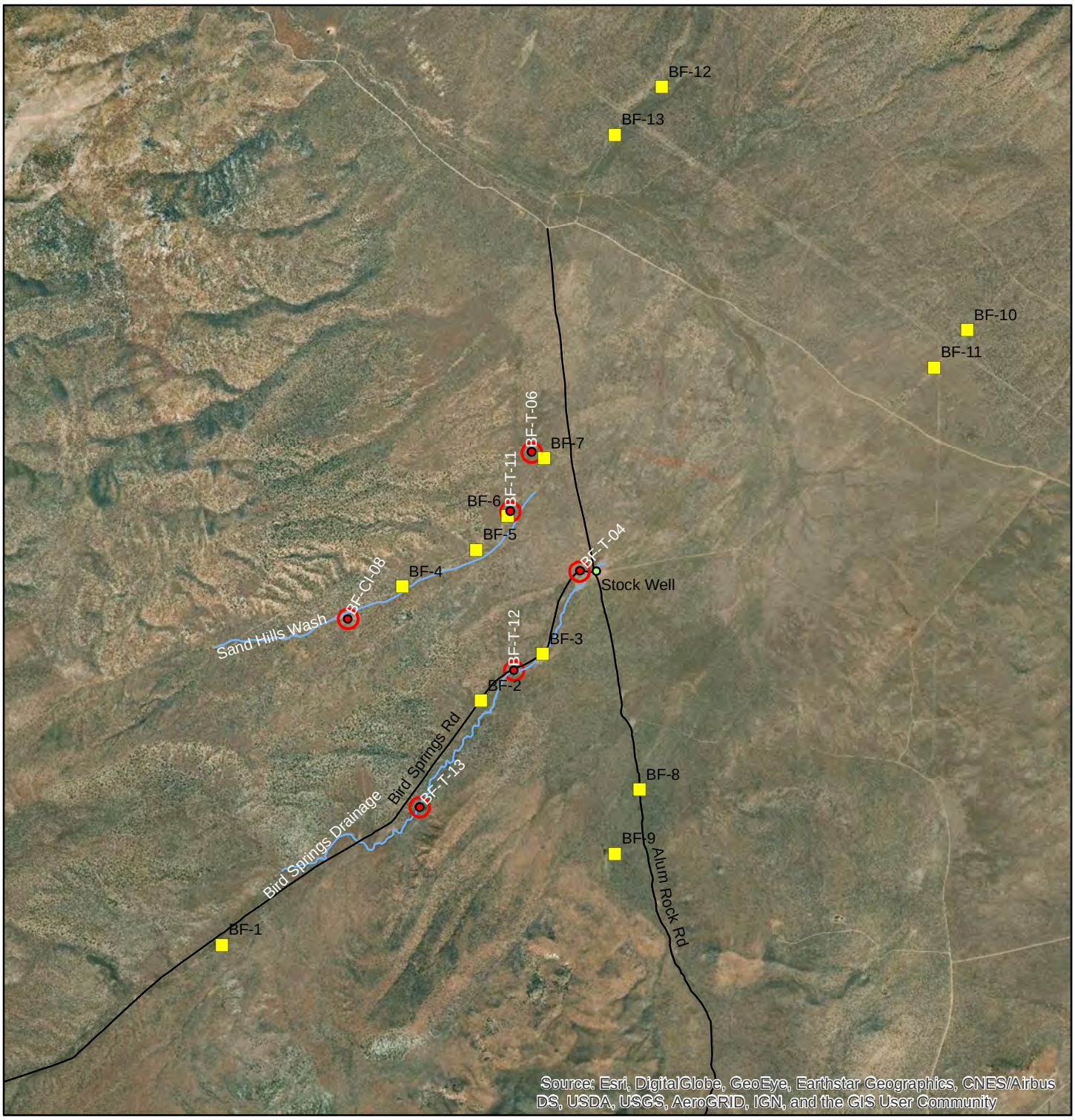
Sodium absorption ratio (SAR) and electrical conductivity results indicate that salt affected soils that may result in reduced soil K_{sat} are not present. The pH ranged from 6.9 to 9.0, indicating soils are circumneutral to moderately alkaline. Total organic carbon was also low, ranging from 1,800 mg/kg to below the detection limit.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Test pit and effective K_{sat} results indicate areas within and adjacent to the Sand Hills wash and Bird Springs drainage have near surface soils that are sufficiently permeable for MAR. CI measured effective K_{sat} provides a more conservative estimate of K_{sat} and yet still indicates good feasibility for MAR. Locations near BF-P-13, BF-P-3, BF-P-2, and BF-P-1 have less permeable near surface soils and should be excluded from further investigation. As a note, preliminary investigations south of BF-P-1 indicate coarse textured soils are present (C. Kropf, personal communication) and this area may be considered for a future test pit and infiltration testing program. Chemical soil tests indicate that MAR is not likely to degrade groundwater quality from flushing of existing arsenic or nitrate nor do salt affected soils exist at the test pit locations.

The driller's log for a stock well installed near the east end of Bird Springs Road (Figure 6) indicates silty sands from 2 ft to 13 ft bgs, alternating medium to coarse sands to approximately 87 ft bgs, and coarse sand with clay and silt layers (87 ft to 103 ft and 126 ft to 181 ft bgs) and

coarse sand layers (103 ft to 126 ft bgs) to the static water level at 181 ft bgs. Exploratory boreholes drilled in 2007 (ECO:LOGIC Engineering, 2007) encountered highly compacted sand and silty sand material at depths ranging from 15 to 20 ft bgs to the maximum drill depth of approximately 30 ft bgs (Figure 6). If present, this highly compacted layer or deeper clay and silt layers could act as a hydraulically controlling layer that creates shallow perched water conditions and decreases basin infiltration rates. To refine MAR estimates, we recommend a borehole exploration program be implemented which focuses on defining the shallow subsurface lithology to 100 feet bgs (or groundwater if shallower) to identify the lateral extent of the previously observed compacted layer as well as deeper fine-grained layers that may be encountered. If the compacted layer or other fine-grained layers are extensive, we recommend an integrated vadose zone characterization approach based on Milczarek et al. (2003) which incorporates borehole exploration and in-situ testing to determine the hydraulic properties and influence of the fine-grained layers. Investigation should be focused at locations that have high near surface effective K_{sat}. These areas should be located near wash and drainages (e.g. BF-T-12, BF-T-13, BF-CI-8) and near the mouth of the wash and drainages (e.g. BF-T-4, BF-T-11, BF-T-6). Recommended investigation areas are identified in Figure 6. Based on the difficulty with hollow-stem auger drilling and sample collection in the compacted material layer (ECO:LOGIC Engineering, 2007), we recommend that sonic drilling be used for the exploratory boreholes.



Legend

- 2007 exploratory boreholes
- 2018 test locations
- Stock Well
- Roads
- Drainages
- Proposed investigation areas

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Figure 6. 2007 exploratory boreholes, stock well, and recommended investigation areas

5.0 REFERENCES

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Appendix A.
Cylinder Infiltrometer Standard Operating Procedures

STANDARD OPERATING PROCEDURE 4.4

Single Ring Infiltrometer with Lateral Divergence Correction

Version 1.0

Prepared by: RR_____ Date: 8/06/2015_____

Reviewed by: _____ Date: _____

Approved by: _____ Date: _____

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TABLES

FIGURES

1.0 General Statement

The single-ring cylinder infiltrometer (CI) method is described by Bouwer et al. (1999). The method is a short-term infiltration test, which provides an in-situ measurement of the effective saturated hydraulic conductivity (K) of soil material.

2.0 Objective

The CI is driven into the material to be tested and then filled with water to the top of the ring. The decline of water in the ring is then monitored (Figure 1a). After the water falls about 5 cm, the time and exact decrease in water level is recorded and the cylinder is refilled. This process is continued until about 40 cm of water have infiltrated or four hours have expired. A shovel is then used to dig outside of the cylinder to determine the distance of lateral divergence (Figure 1b). The depth of the wetting front is also determined by augering in the center of the wetted surface to dryness or the wetting front, if evident. The final infiltration rate, wetting depth and divergence are then used to calculate K..

Figure 1a. Cylinder infiltrometer testing

Figure 1b. Measuring lateral divergence

3.0 Equipment and/or Instrumentation

The following field equipment shall be used to run a CI test:

- Cylinder infiltrometer, minimum diameter of 50 cm, depth of 30 cm.
- 20 to 60 liter water-filled containers to supply water.
- Bubble wrap to place inside the ring while filling with water.
- Stopwatch or watch.
- Thermometer.

- Ruler or tape measure.
- Sledge hammer or equivalent driver and three foot 2x4's for driving the CI into the soil.
- Shovel.
- Pick or breaking bar.
- Hand auger
- Knee pads and/or chair (optional).

4.0 Preparation

The following procedures shall be used to prepare the site and the equipment for running the CI test:

- The measuring surface should be relatively level.
- Large rocks or stones should be removed from the cylinder perimeter.
- The method is not recommended for use on rocky soil that prevents the insertion of the cylinder.
- When measurements are not taken at the ground surface, the site should be leveled after excavation. Care is to be taken to remove loose, disturbed soil.
- The area leveled should be at least one meter larger than the cylinder diameter.

5.0 Procedures

The following procedures shall be used to run the CI test in the field. Data collected shall be recorded in Table 1.

- Drive the CI approximately 4 to 7 cm into the ground using a sledge hammer or driver and 2x4's placed across the CI top.
- In cases where the soil is too compacted to drive the CI to the required depth, the soil may be loosened around the outside perimeter of the cylinder with a pick or breaking bar and then driven in.
- Lightly compact the soil against the inside and outside of the CI ring to minimize preferential flow at the ring-soil contact.
- Place bubble wrap on the soil surface inside the CI ring to prevent soil disturbance during filling with water.
- Fill the CI ring with water to the top, remove bubble wrap and measure water temperature

- Monitor the decline in water level (y). After the water has fallen about 5 cm, record the elapsed time (Δt) and exact decrease in water level (y_n) before the CI is refilled.

- This process is repeated until about 40 cm of water has infiltrated or four hours have expired.

- When the CI has been filled for the last time, water level measurements should be taken more frequently to obtain an accurate infiltration rate.

- At the conclusion of the test, a shovel is used to dig outside of the cylinder to determine the distance (x) of lateral divergence. In moist soils where the lateral wetting cannot be determined by change of color, the lateral wetting can be determined with a portable moisture probe.

- After removing the cylinder, determine the depth of wetting (L) by augering to dryness or the wetting front, when possible.

6.0 Sample Containers, Preservation, and Transmittal

Not applicable.

7.0 Equipment Decontamination and Disposal

Not applicable.

8.0 Documentation

In order to calculate K, the downward flow rate, i_w, must first be corrected for the effect of lateral divergence, based on the radius of the observed wetting front:

1) $$i_w = \frac{i_n \pi r^2}{\pi (r + x)^2}$$

where

i_n = infiltration rate during the last water drop ($y_n/\Delta t_n$),

r = radius of the CI ring,

x = lateral divergence from the ring, and

Δt_n = elapsed time during last water drop

When the depth of the wetting front at the end of the test, L, is difficult to measure, such as in soil that is already moist, it can be calculated from the cumulative infiltration (y_t) as follows:

2) $$L = \frac{y_t \pi r^2}{n\pi(r+x)^2}$$

where *n* is the estimated fillable porosity of the soil, based on the field description of soil texture and initial moisture content. When the depth of the wetting front was directly measured in the field, Equation 2 may be used to estimate fillable porosity.

Applying Darcy's equation to the downward flow i_w (Equation 1) and assuming vertical flow in the wetted zone yields:

3) $$i_w = K\frac{z + L - h_{we}}{L}$$

where:

K = effective saturated hydraulic conductivity of the wetted zone,

z = average depth of water in the cylinder during the last water drop y_n,

h_{we} = water entry value of the soil (estimate of soil suction, from Bouwer et al., 1999).

Soil texture estimates made in the field (Table 1) are used to assign the water entry value for each sample.

Equation 3 is rearranged to solve for *K*:

4) $$K = \frac{i_w L}{(z + L - h_{we})}$$

This calculated *K* is an estimate of the effective field saturated hydraulic conductivity. The effective field saturated hydraulic conductivity, may be less than the true hydraulic conductivity due to air entrapment within the pores. Nonetheless, because of scale effects, cylinder infiltrometers provide a more accurate estimation of saturated hydraulic conductivity than smaller-scale laboratory measurements.

8.1 Spreadsheet

Enter the data into the "Cylinder infiltrometer" spreadsheet to calculate the final K value. The data to be entered is highlighted in yellow. Several tests can be recorded in the same spreadsheet and summarized on the first page.

9.0 Quality Assurance

Quality assurance (QA) for running the CI shall be accomplished by following the procedures contained in this SOP. It is especially important that the sites chosen remain as `undisturbed and are as level as possible. In addition, soils with a large percentage of gravel material, or soils that are loosely compacted increase the probability that the *K* will not be representative of the undisturbed soil matrix.

10.0 References

Bouwer, H., Back, J.T., Oliver, J.M., 1999. Predicting Infiltration and Ground Water Mounds for Artificial Recharge, J Hydro Eng, ASCE, (4) pp. 350-357

Table 1
Sample Single Ring Cylinder Infiltrometer Data Form

Project: _____

Location: _____

Date: _____ Operators: _____

Soil Type: _____

Cover and moisture conditions: _____

Diameter of cylinder: 50.4 cm Height of cylinder: 30 cm

Depth of penetration: _____

Time	Filled level	Water level drop	Infiltration	Accumulated infiltration
_____	_____	Filled	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

Lateral wetting outside cylinder: _____

Wetting depth: _____

Water entry value: _____

Fillable porosity: _____

Final infiltration rate for large area: _____

Appendix B.
Test Pit Geologic Logs

Client:	Truckee Meadows Water Authority	Logged By:	R. Rice	Date:	9/11/2018	
Project No.:	1849	Drilling Company:		Operator:	Ramon	
Test Pit No.	BFP-1			Location:	11S 256887 E 4413691 N	

Depth Interval (ft)		Sample Type (C=core, G=grab)	Moisture Content				Particle Size Distribution, Field				Grading	Particle Size Distribution, Adjusted				Sand Fraction			Plasticity				USDA Group Name	USCS classification	Color	Comments
From	To		Dry	Slightly Moist	Moist	Wet	% Gravel	% Sand	% Silt	% Clay	W= Well, P= Poor	% Gravel	% Sand	% Silt	% Clay	Fine	Medium	Coarse	None	Low	Medium	High				
0	1		x					80	15	5	W	0	72	19	9	x	x		x				sandy loam	SC		Sandy loam
1	3		x					75	18	7	W	0	67	22	11	x				x			sandy loam	SC		
3	4		x					80	15	5	W	0	72	19	9	x			x				sandy loam	SC		
4	5		x					80	15	5	W	0	72	19	9	x			x				sandy loam	SC		
5	6			x				80	15	5	W	0	72	19	9	x			x				sandy loam	SC		
6	7			x				85	12	3	W	0	78	17	6	x	x		x				loamy sand	SC		Loamy sand
7	8			x				85	12	3	W	0	78	17	6	x	x		x				loamy sand	SC		Loamy sand
Test Pit No.			BFP-2																Location:				11S 256870 E	4413774 N		
0	1			x				70	22	8	W	0	61	26	13	x				x			sandy loam	SC		Sandy loam
1	2			x				70	22	8	W	0	61	26	13	x				x			sandy loam	SC		
2	3			x				75	18	7	W	0	67	22	11	x				x			sandy loam	SC		
3	4			x				85	12	3	W	0	78	17	6	x	x		x				loamy sand	SC		loamy sand
4	5			x				85	12	3	W	0	78	17	6	x	x		x				loamy sand	SC		
5	6			x			1	84	12	3	W	1	77	17	6	x	x		x				loamy sand	SC		some gravel, <1%
6	7			x				85	12	3	W	0	78	17	6	x	x		x				loamy sand	SC		
7	8			x				80	15	3	W	0	72	19	9	x	x		x				sandy loam	SC		

Client:		Truckee Meadows Water Authority					Logged By:		R. Rice							Date:	9/11/2018							
Project No.:		1849					Drilling Company:									Operator:	Ramon							
Test Pit No.		BFP-3														Location:	11S	256821 E	4413990 N					
Depth Interval (ft)		Sample Type (C=core, G=grab)	Moisture Content				Particle Size Distribution, Field				Grading	Particle Size Distribution, Adjusted				Sand Fraction			Plasticity				USDA Group Name	USCS classification	Color	Comments
From	To		Dry	Slightly Moist	Moist	Wet	% Gravel	% Sand	% Silt	% Clay	W= Well, P= Poor	% Gravel	% Sand	% Silt	% Clay	Fine	Medium	Coarse	None	Low	Medium	High				
0	1				x			50	30	20	W	0	39	33	28	x						x	clay loam	CL		Loam
1	2				x			50	30	20	W	0	39	33	28	x						x	clay loam	CL		
2	3				x			60	30	10	W	0	50	33	17	x					x		loam	CL		More sand, sandy loam
3	4				x			65	25	10	W	0	55	29	16	x				x			sandy loam	SC		
4	5				x			70	22	8	W	0	61	26	13	x				x			sandy loam	SC		
5	6				x			75	18	7	W	0	67	22	11	x				x			sandy loam	SC		
6	7				x			75	18	7	W	0	67	22	11	x				x			sandy loam	SC		
7	8				x			75	18	7	W	0	67	22	11	x				x			sandy loam	SC		
Test Pit No.		BFP-4														Location:	11S	256694 E	4413984 N					
0	1				x			88	9	3	W	0	81	14	5		x		x				loamy sand	SC		Sandy
1	2				x			90	7	3	W	0	83	12	5		x		x				loamy sand	SC		
2	3				x			95	4	1	W	0	89	9	2		x		x				sand	SW-SC		
3	4				x			95	4	1	W	0	89	9	2		x		x				sand	SW-SC		
4	5				x			95	4	1	W	0	89	9	2		x		x				sand	SW-SC		
5	6				x			95	4	1	W	0	89	9	2		x		x				sand	SW-SC		
6	7				x			95	4	1	W	0	89	9	2		x		x				sand	SW-SC		
7	8				x			95	4	1	W	0	89	9	2		x		x				sand	SW-SC		

Client:	Truckee Meadows Water Authority	Logged By:	R. Rice	Date:	9/11/2018	
Project No.:	1849	Drilling Company:		Operator:	Ramon	
Test Pit No.	BFP-5			Location:	11S 256362 E 4413289 N	

Depth Interval (ft)		Sample Type (C=core, G=grab)	Moisture Content				Particle Size Distribution, Field				Grading	Particle Size Distribution, Adjusted				Sand Fraction			Plasticity				USDA Group Name	USCS classification	Color	Comments
From	To		Dry	Slightly Moist	Moist	Wet	% Gravel	% Sand	% Silt	% Clay	W= Well, P= Poor	% Gravel	% Sand	% Silt	% Clay	Fine	Medium	Coarse	None	Low	Medium	High				
0	1			x			15	75	7	3	W	15	67	12	7		x	x	x				loamy sand	SC		Sand with gravel
1	2			x			10	80	7	3	W	10	72	12	6		x	x	x				loamy sand	SC		
2	3			x				90	7	3	W	0	83	12	5			x	x				loamy sand	SC		
3	4			x				90	7	3	W	0	83	12	5	x			x				loamy sand	SC		Lightly cemented
4	5			x				90	7	3	W	0	83	12	5	x			x				loamy sand	SC		
5	6			x				90	7	3	W	0	83	12	5	x	x		x				loamy sand	SC		
6	7			x				75	4	1	W	0	67	9	24		x		x				sandy clay loam	SC		
7	8			x			10	85	4	1	W	10	78	9	3		x		x				loamy sand	SC		
Test Pit No.			BFP-6																Location:				11S 256295 E 4414969 N			
0	1		x					80	15	5	W	0	72	19	9	x	x		x				sandy loam	SC		Sandy loam
1	2		x					70	22	8	W	0	61	26	13	x					x		sandy loam	SC		Loam
2	3			x			2	88	7	3	W	2	81	12	5		x	x	x				loamy sand	SC		Sand
3	4			x				95	4	1	W	0	89	9	2		x	x	x				sand	SW-SC		
4	5			x				95	4	1	W	0	89	9	2		x	x	x				sand	SW-SC		Clean sand
5	6			x				95	4	1	W	0	89	9	2		x	x	x				sand	SW-SC		
6	7			x				95	4	1	W	0	89	9	2		x	x	x				sand	SW-SC		
7	8			x				95	4	1	W	0	89	9	2		x	x	x				sand	SW-SC		

Client:	Truckee Meadows Water Authority	Logged By:	R. Rice	Date:	9/12/2018	
Project No.:	1849	Drilling Company:		Operator:	Ramon	
Test Pit No.	BFP-7			Location:	11S 254379 E 4413520 N	

Depth Interval (ft)		Sample Type (C=core, G=grab)	Moisture Content				Particle Size Distribution, Field				Grading	Particle Size Distribution, Adjusted				Sand Fraction			Plasticity				USDA Group Name	USCS classification	Color	Comments
From	To		Dry	Slightly Moist	Moist	Wet	% Gravel	% Sand	% Silt	% Clay	W= Well, P= Poor	% Gravel	% Sand	% Silt	% Clay	Fine	Medium	Coarse	None	Low	Medium	High				
0	1		x					80	17	3	W	0	72	21	7		x		x				sandy loam	SC		Sandy loam
1	2		x					85	12	3	W	0	78	17	6		x		x				loamy sand	SC		
2	3		x					90	8	2	W	0	83	13	4		x		x				loamy sand	SC		
3	4			x				95	4	1	W	0	89	9	2		x		x				sand	SW-SC		
4	5			x			10	85	4	1	W	10	78	9	3		x		x				loamy sand	SC		
5	6			x			5	80	12	3	W	5	72	17	6	x			x				sandy loam	SC		
6	7			x				90	7	3	W	0	83	12	5	x	x		x				loamy sand	SC		
7	8			x				85	12	3	W	0	78	17	6	x	x		x				loamy sand	SC		
Test Pit No.			BFP-8																Location:				11S	254790 E	4413594 N	
0	1		x					80	17	3	W	0	72	21	7	x	x		x				sandy loam	SC		Sandy loam
1	2		x					85	12	3	W	0	78	17	6	x	x		x				loamy sand	SC		
2	3			x				90	8	2	W	0	83	13	4	x	x		x				loamy sand	SC		Sand
3	4			x				80	17	3	W	0	72	21	7	x	x		x				sandy loam	SC		
4	5			x				95	4	1	W	0	89	9	2		x		x				sand	SW-SC		Sand
5	6			x				85	12	3	W	0	78	17	6		x		x				loamy sand	SC		
6	7			x				90	8	2	W	0	83	13	4		x		x				loamy sand	SC		
7	8			x				90	8	2	W	0	83	13	4		x		x				loamy sand	SC		

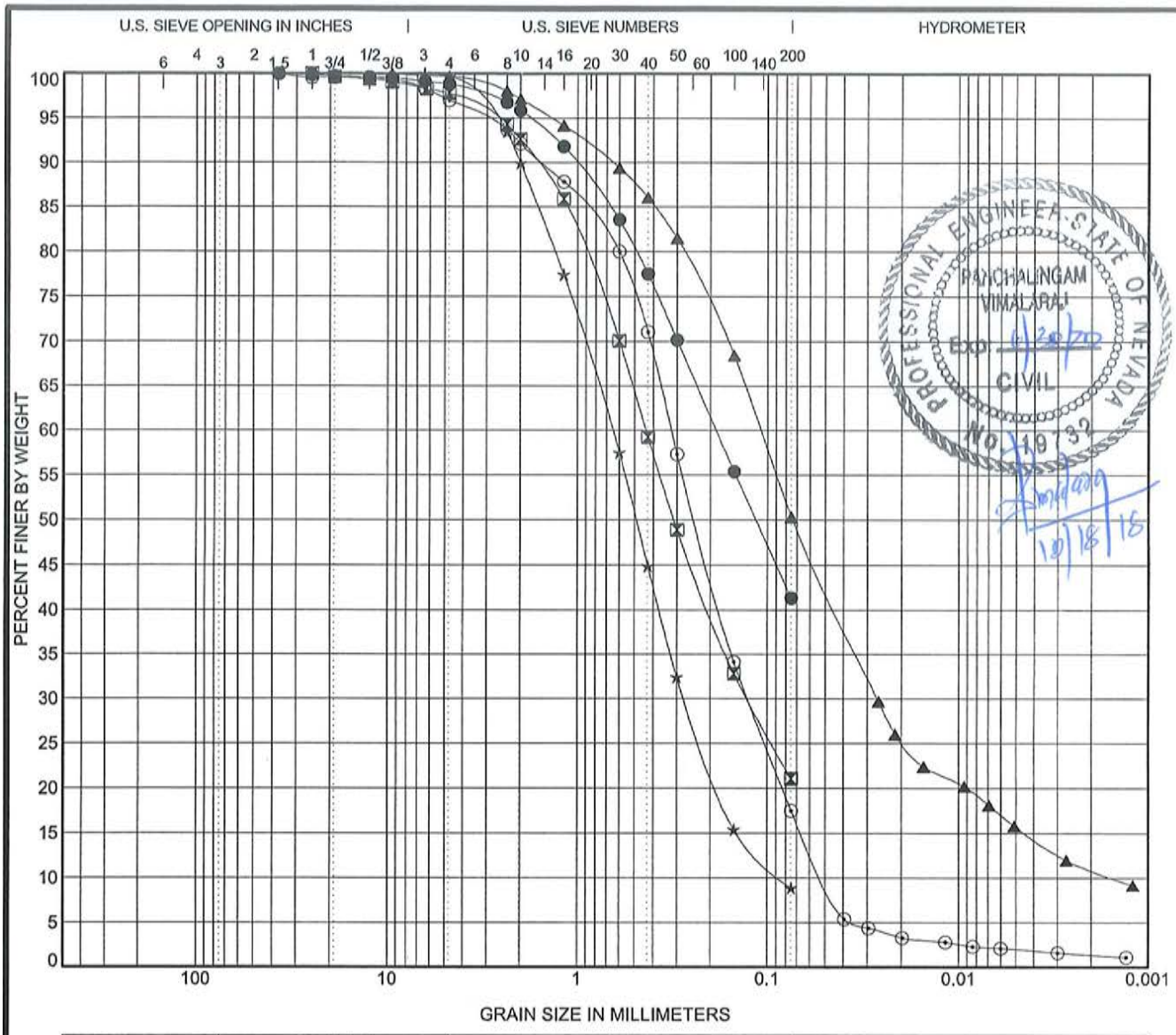
Client:	Truckee Meadows Water Authority	Logged By:	R. Rice	Date:	9/12/2018	
Project No.:	1849	Drilling Company:		Operator:	Ramon	
Test Pit No.	BFP-9			Location:	11S 255175 E 4413815 N	

Depth Interval (ft)		Sample Type (C=core, G=grab)	Moisture Content				Particle Size Distribution, Field				Grading	Particle Size Distribution, Adjusted				Sand Fraction			Plasticity				USDA Group Name	USCS classification	Color	Comments
From	To		Dry	Slightly Moist	Moist	Wet	% Gravel	% Sand	% Silt	% Clay	W= Well, P= Poor	% Gravel	% Sand	% Silt	% Clay	Fine	Medium	Coarse	None	Low	Medium	High				
0	1		x					80	17	3	W	0	72	21	7	x	x		x				sandy loam	SC		Loamy sand
1	2		x					85	12	2	W	0	78	17	6	x	x		x				loamy sand	SC		Sand
2	3		x					90	8	2	W	0	83	13	4	x	x		x				loamy sand	SC		
3	4			x				90	8	2	W	0	83	13	4	x	x		x				loamy sand	SC		
4	5			x				80	17	3	W	0	72	21	7	x	x		x				sandy loam	SC		More fines
5	6			x				90	8	2	W	0	83	13	4	x			x				loamy sand	SC		Sandy
6	7			x				85	13	2	W	0	78	18	5	x	x		x				loamy sand	SC		
7	8			x			1	84	13	2	W	1	77	18	5	x	x		x				loamy sand	SC		
Test Pit No.			BFP-10																Location:				11S	255518 E	4412428 N	
0	1		x					75	18	7	W	0	67	22	11	x				x			sandy loam	SC		Sandy loam
1	2		x					70	20	10	W	0	61	24	15	x					x		sandy loam	SC		more fines
2	3			x				75	18	7	W	0	67	22	11	x				x			sandy loam	SC		
3	4			x				80	17	3	W	0	72	21	7	x	x		x				sandy loam	SC		
4	5			x			5	85	7	3	W	5	78	12	5		x	x	x				loamy sand	SC		
5	6			x				85	13	2	W	0	78	18	5	x	x		x				loamy sand	SC		Sandy
6	7			x			5	75	17	3	W	5	67	21	7	x	x			x			sandy loam	SC		more fines
7	8			x				80	17	3	W	0	72	21	7	x	x		x				sandy loam	SC		

Client:	Truckee Meadows Water Authority	Logged By:	R. Rice	Date:	9/12/2018	
Project No.:	1849	Drilling Company:		Operator:	Ramon	
Test Pit No.	BFP-11			Location:	11S 256125 E 4414476 N	

Depth Interval (ft)		Sample Type (C=core, G=grab)	Moisture Content				Particle Size Distribution, Field				Grading	Particle Size Distribution, Adjusted				Sand Fraction			Plasticity				USDA Group Name	USCS classification	Color	Comments
From	To		Dry	Slightly Moist	Moist	Wet	% Gravel	% Sand	% Silt	% Clay	W= Well, P= Poor	% Gravel	% Sand	% Silt	% Clay	Fine	Medium	Coarse	None	Low	Medium	High				
0	1		x					55	30	15	W	0	44	33	22	x						x	loam	CL		Loam
1	2		x					60	30	10	W	0	50	33	17	x					x		loam	CL		More sand
2	3		x					80	15	5	W	0	72	19	9		x	x		x			sandy loam	SC		Sandy loam with coarse sand
3	4		x					80	15	5	W	0	72	19	9		x			x			sandy loam	SC		
4	5		x					90	7	3	W	0	83	12	5		x		x				loamy sand	SC		
5	6		x					90	7	3	W	0	83	12	5		x	x	x				loamy sand	SC		Coarse sand
6	7		x					90	7	3	W	0	83	12	5		x	x	x				loamy sand	SC		
7	8		x					95	4	1	W	0	89	9	2		x	x	x				sand	SW-SC		
Test Pit No.			BFP-12																Location:				11S	256153 E	4413176 N	
0	1		x					90	7	3	W	0	83	12	5	x			x				loamy sand	SC		In wash, fine sand
1	2			x				94	4	1	W	0	88	9	3		x	x	x				sand	SC		Coarse sand
2	3				x		3	92	4	1	W	3	85	9	2		x		x				sand	SW-SC		
3	4				x		3	92	4	1	W	3	85	9	2		x		x				sand	SW-SC		Medium sand
4	5				x			90	7	3	W	0	83	12	5	x			x				loamy sand	SC		Fine saand
5	6				x			90	7	3	W	0	83	12	5	x			x				loamy sand	SC		
6	7				x		10	80	7	3	W	10	72	12	6	x			x				loamy sand	SC		Fine sand with some gravel
7	8				x		10	80	7	3	W	10	72	12	6	x			x				loamy sand	SC		

Appendix C.
Physical Property Laboratory Report (Black Eagle Consulting, Inc.)



PROFESSIONAL ENGINEER STATE OF NEVADA
PANCHALINGAM VIMALARAJ
EXP: 12/31/20
CIVIL
No. 19732
10/18/18

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		USCS Classification	LL	PL	PI	Cc	Cu
● BF-P-01	2.0'	[Visual]					
⊠ BF-P-02	4.0'	[Visual]					
▲ BF-P-03	5.0'	SANDY LEAN CLAY (CL)	28	19	9	4.31	71.75
★ BF-P-04	3.0'	[Visual]				1.34	7.74
⊙ BF-P-05	3.0'	[Visual]				0.99	6.37

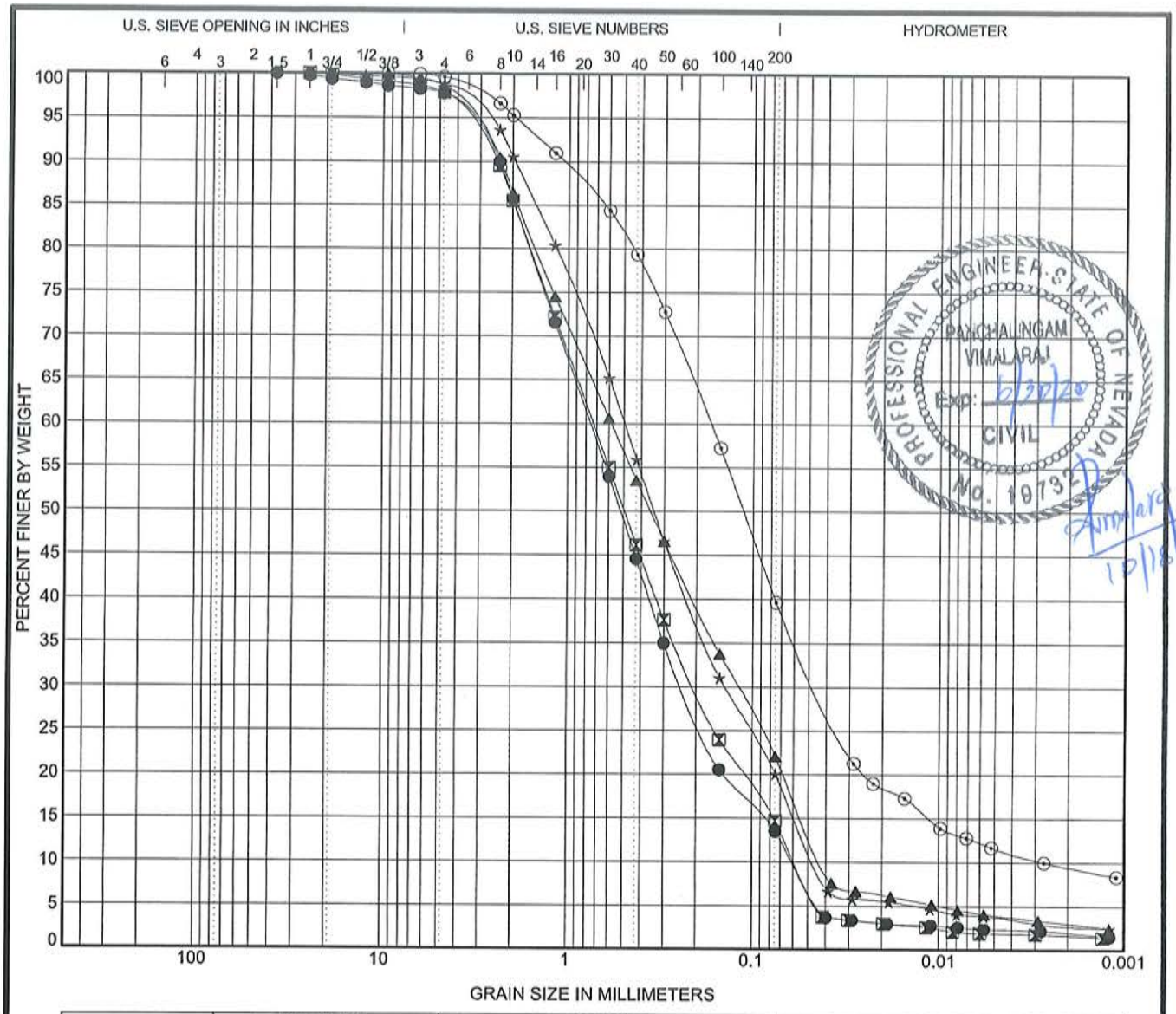
Specimen Identification		D100	D60	D30	D10	MC %	%Gravel	%Sand	%Silt	%Clay
● BF-P-01	2.0'	37	0.186				1.2	57.5	41.3	
⊠ BF-P-02	4.0'	25	0.435	0.127			2.2	76.7	21.1	
▲ BF-P-03	5.0'	9.5	0.109	0.027	0.002		0.3	49.3	34.7	15.7
★ BF-P-04	3.0'	6.4	0.653	0.272	0.084		0.3	90.8	8.9	
⊙ BF-P-05	3.0'	37.5	0.321	0.126	0.05		3.0	79.5	15.5	2.0

Black Eagle Consulting, Inc.
1345 Capital Blvd., Suite A
Reno, Nevada 89502-7140
Telephone: (775) 359-6600
Fax: (775) 359-7766

GRAIN SIZE DISTRIBUTION

Project: Bedell Flat
Location: Washoe County, NV
Project Number: 0398-01-1 Plate: 1a

US GRAIN SIZE2 0398011B.GPJ US LAB.GDT 10/18/2018



PROFESSIONAL ENGINEER, STATE OF NEVADA
PAYCHALINGAM VIMALARAJ
Exp: 6/30/20
CIVIL
No. 19737

10/18/18

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		USCS Classification	LL	PL	PI	Cc	Cu
● BF-P-06	3.0'	[Visual]				1.23	12.65
⊠ BF-P-07	3.0'	[Visual]				0.97	12.58
▲ BF-P-08	3.0'	[Visual]				0.59	13.94
★ BF-P-09	4.0'	[Visual]				0.87	10.85
⊙ BF-P-10	2.0'	SILTY, CLAYEY SAND (SC-SM)	24	17	7	4.44	62.82

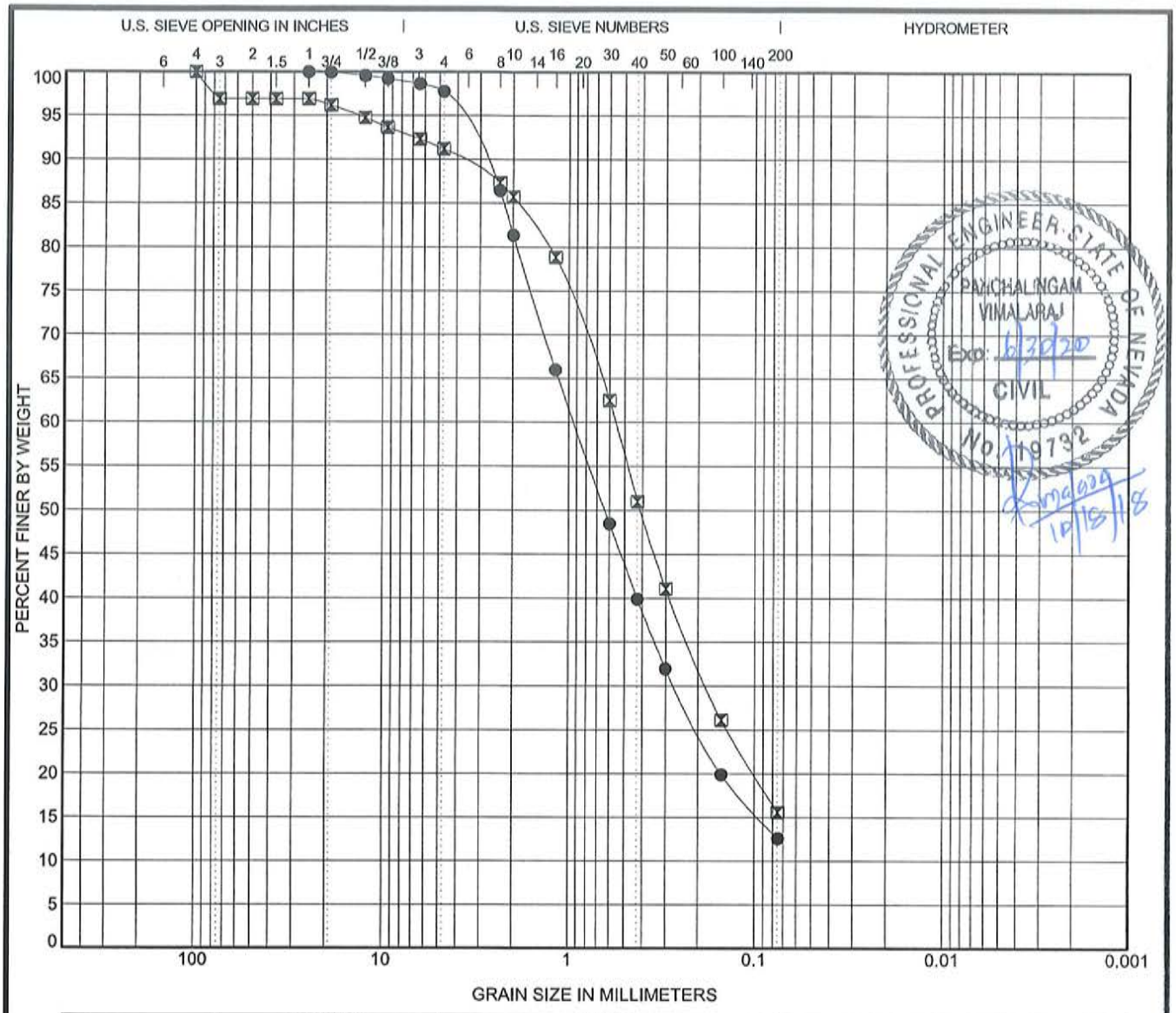
Specimen Identification		D100	D60	D30	D10	MC %	%Gravel	%Sand	%Silt	%Clay
● BF-P-06	3.0'	37.5	0.756	0.236	0.06		2.2	84.3	11.2	2.4
⊠ BF-P-07	3.0'	25	0.731	0.204	0.058		2.1	83.2	12.8	1.9
▲ BF-P-08	3.0'	9.5	0.582	0.12	0.042		1.4	76.5	18.1	4.0
★ BF-P-09	4.0'	25	0.495	0.14	0.046		1.1	78.8	16.3	3.7
⊙ BF-P-10	2.0'	9.5	0.17	0.045	0.003		0.4	60.0	28.0	11.6

Black Eagle Consulting, Inc.
1345 Capital Blvd., Suite A
Reno, Nevada 89502-7140
Telephone: (775) 359-6600
Fax: (775) 359-7766

GRAIN SIZE DISTRIBUTION

Project: Bedell Flat
Location: Washoe County, NV
Project Number: 0398-01-1 Plate: 1b

US GRAIN SIZE2 03980111B.GPJ US LAB.GDT 10/18/2018



PROFESSIONAL ENGINEER STATE OF NEVADA
PANCHALINGAM VIMALARAJ
Exp: 6/30/20
CIVIL
No. 19732
10/18/18

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		USCS Classification	LL	PL	PI	Cc	Cu
● BF-P-11	8.0'	[Visual]					
⊠ BF-P-12	8.0'	[Visual]					

Specimen Identification		D100	D60	D30	D10	MC %	%Gravel	%Sand	%Silt	%Clay
● BF-P-11	8.0'	25	0.937	0.268			2.2	85.2	12.6	
⊠ BF-P-12	8.0'	100	0.557	0.179			5.7	75.6	15.6	

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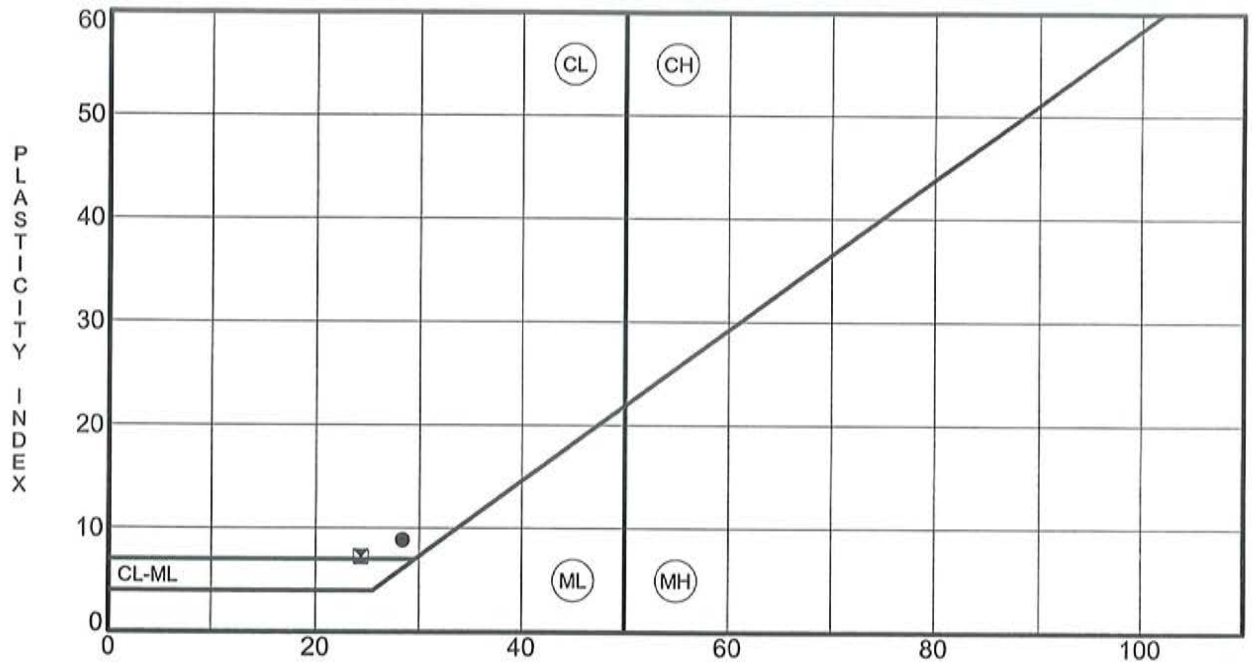
1345 Capital Blvd., Suite A
Reno, Nevada 89502-7140
Telephone: (775) 359-6600
Fax: (775) 359-7766

GRAIN SIZE DISTRIBUTION

Project: Bedell Flat
Location: Washoe County, NV
Project Number: 0398-01-1 Plate: 1c

US_GRAIN_SIZE2_0398011B.GPJ US_LAB.GDT 10/18/2018



Specimen Depth in Feet.

	Specimen Identification		LL	PL	PI	Fines	USCS Classification
●	BF-P-03	5.0'	28	19	9	50	SANDY LEAN CLAY (CL)
⊠	BF-P-10	2.0'	24	17	7	40	SILTY, CLAYEY SAND (SC-SM)

PROFESSIONAL ENGINEER, STATE OF NEVADA
PANCHALINGAM VIMALARAJ
Exp: 6/30/20
CIVIL
No. 19732
10/18/18

Black Eagle Consulting, Inc.
1345 Capital Blvd., Suite A
Reno, Nevada 89502-7140
Telephone: (775) 359-6600
Fax: (775) 359-7766

ATTERBERG LIMITS RESULTS

Project: Bedell Flat
Location: Washoe County, NV
Project Number: 0398-01-1 Plate: 1a

US_ATTERBERG_LIMITS_0398011B.GPJ US_LAB.GDT 10/18/2018

Appendix D.
Chemical Property Laboratory Report (Western Environmental Testing Laboratory)

10/30/2018

Truckee Meadows Water Authority
P.O. Box 30013
Reno, NV 89520-3013
Attn: Christian Kropf

OrderID: *18090719*

Dear: Christian Kropf

This is to transmit the attached analytical report. The analytical data and information contained therein was generated using specified or selected methods contained in references, such as Standard Methods for the Examination of Water and Wastewater, online edition, Methods for Determination of Organic Compounds in Drinking Water, EPA-600/4-79-020, and Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods (SW846) Third Edition.

The samples were received by WETLAB-Western Environmental Testing Laboratory in good condition on 9/21/2018. Additional comments are located on page 2 of this report.

If you should have any questions or comments regarding this report, please do not hesitate to call.

Sincerely,

Andy Smith
QA Manager

SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817
EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Western Environmental Testing Laboratory
Report Comments

Truckee Meadows Water Authority - 18090719

Specific Report Comments

The results for SAR, Metals, Chloride, and Nitrate Nitrogen were obtained following a 10:1 DI water to sample extraction.

Subcontracting Comments

The analysis for Total Organic Carbon was performed by Eurofins/Calscience of Garden Grove, CA. Their report is attached.

Report Legend

B	--	Blank contamination; Analyte detected above the method reporting limit in an associated blank
D	--	Due to the sample matrix dilution was required in order to properly detect and report the analyte. The reporting limit has been adjusted accordingly.
HT	--	Sample analyzed beyond the accepted holding time
J	--	The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
M	--	The matrix spike/matrix spike duplicate (MS/MSD) values for the analysis of this parameter were outside acceptance criteria due to probable matrix interference. The reported result should be considered an estimate.
N	--	There was insufficient sample available to perform a spike and/or duplicate on this analytical batch.
NC	--	Not calculated due to matrix interference
QD	--	The sample duplicate or matrix spike duplicate analysis demonstrated sample imprecision. The reported result should be considered an estimate.
QL	--	The result for the laboratory control sample (LCS) was outside WETLAB acceptance criteria and reanalysis was not possible. The reported data should be considered an estimate.
S	--	Surrogate recovery was outside of laboratory acceptance limits due to matrix interference. The associated blank and LCS surrogate recovery was within acceptance limits
SC	--	Spike recovery not calculated. Sample concentration >4X the spike amount; therefore, the spike could not be adequately recovered
U	--	The analyte was analyzed for, but was not detected above the level of the reported sample reporting/quantitation limit

General Lab Comments

Per method recommendation (section 4.4), Samples analyzed by methods EPA 300.0 and EPA 300.1 have been filtered prior to analysis.

The following is an interpretation of the results from EPA method 9223B:
A result of zero (0) indicates absence for both coliform and Escherichia coli meaning the water meets the microbiological requirements of the U.S. EPA Safe Drinking Water Act (SDWA). A result of one (1) for either test indicates presence and the water does not meet the SDWA requirements. Waters with positive tests should be disinfected by a certified water treatment operator and retested.

Per federal regulation the holding time for the following parameters in aqueous/water samples is 15 minutes: Residual Chlorine, pH, Dissolved Oxygen, Sulfite.

SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
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EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Western Environmental Testing Laboratory
Analytical Report

Truckee Meadows Water Authority
P.O. Box 30013
Reno, NV 89520-3013
Attn: Christian Kropf
Phone: (775) 834-8188 **Fax:** (775) 834-8150

Date Printed: 10/30/2018
OrderID: *18090719*
PO\Project: *3783*

Customer Sample ID: BF-P-1 2'
WETLAB Sample ID: 18090719-001
Collect Date/Time: 9/11/2018 10:30
Receive Date: 9/21/2018 10:27

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
General Chemistry							
pH	SW846 9045D	8.38	pH Units	1		10/3/2018	NV00925
Sodium Adsorption Ratio (SAR)	Calc.	1.4	meq/kg	1	0.54	10/26/2018	NV00925
Electrical Conductivity	SM 2510B	68	µmhos/cm	1	1.0	10/3/2018	NV00925
Anions by Ion Chromatography							
Chloride	EPA 300.0	12	mg/kg	10	10	10/10/2018	NV00925
Nitrate Nitrogen	EPA 300.0	1.7	mg/kg	10	1.0	10/10/2018	NV00925
Trace Metals by ICP-OES							
Arsenic	EPA 200.7	ND	Soluble mg/kg	20	0.46	10/25/2018	NV00925
Calcium	EPA 200.7	14	Soluble mg/kg	20	10	10/25/2018	NV00925
Magnesium	EPA 200.7	11	Soluble mg/kg	20	10	10/26/2018	NV00925
Sodium	EPA 200.7	29	Soluble mg/kg	20	10	10/25/2018	NV00925
Sample Preparation							
10:1 DI Water Extraction	WL 10.0	Complete		1		10/3/2018	NV00925
Trace Metals Digestion	EPA 200.2	Complete		1		10/22/2018	NV00925
Subcontracted Analyses							
Total Organic Carbon (TOC)	N/A	See Attached		1			

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817
EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Customer Sample ID: BF-P-1 8' **Collect Date/Time:** 9/11/2018 10:45
WETLAB Sample ID: 18090719-002 **Receive Date:** 9/21/2018 10:27

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
General Chemistry							
pH	SW846 9045D	8.63	pH Units	1		10/3/2018	NV00925
Sodium Adsorption Ratio (SAR)	Calc.	3.7	meq/kg	1	0.54	10/26/2018	NV00925
Electrical Conductivity	SM 2510B	510	µmhos/cm	1	1.0	10/3/2018	NV00925
Anions by Ion Chromatography							
Chloride	EPA 300.0	23	mg/kg	10	10	10/10/2018	NV00925
Nitrate Nitrogen	EPA 300.0	3.4	mg/kg	10	1.0	10/10/2018	NV00925
Trace Metals by ICP-OES							
Arsenic	EPA 200.7	ND	Soluble mg/kg	20	0.46	10/25/2018	NV00925
Calcium	EPA 200.7	48	Soluble mg/kg	20	10	10/25/2018	NV00925
Magnesium	EPA 200.7	14	Soluble mg/kg	20	10	10/26/2018	NV00925
Sodium	EPA 200.7	110	Soluble mg/kg	20	10	10/25/2018	NV00925
Sample Preparation							
10:1 DI Water Extraction	WL 10.0	Complete		1		10/3/2018	NV00925
Trace Metals Digestion	EPA 200.2	Complete		1		10/22/2018	NV00925
Subcontracted Analyses							
Total Organic Carbon (TOC)	N/A	See Attached		1			

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817
EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Customer Sample ID: BF-P-2 2' **Collect Date/Time:** 9/11/2018 11:22
WETLAB Sample ID: 18090719-003 **Receive Date:** 9/21/2018 10:27

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
General Chemistry							
pH	SW846 9045D	8.98	pH Units	1		10/3/2018	NV00925
Sodium Adsorption Ratio (SAR)	Calc.	4.4	meq/kg	1	0.54	10/26/2018	NV00925
Electrical Conductivity	SM 2510B	180	µmhos/cm	1	1.0	10/3/2018	NV00925
Anions by Ion Chromatography							
Chloride	EPA 300.0	12	mg/kg	10	10	10/10/2018	NV00925
Nitrate Nitrogen	EPA 300.0	1.8	mg/kg	10	1.0	10/10/2018	NV00925
Trace Metals by ICP-OES							
Arsenic	EPA 200.7	ND	Soluble mg/kg	20	0.46	10/25/2018	NV00925
Calcium	EPA 200.7	38	Soluble mg/kg	20	10	10/25/2018	NV00925
Magnesium	EPA 200.7	16	Soluble mg/kg	20	10	10/26/2018	NV00925
Sodium	EPA 200.7	130	Soluble mg/kg	20	10	10/25/2018	NV00925
Sample Preparation							
10:1 DI Water Extraction	WL 10.0	Complete		1		10/3/2018	NV00925
Trace Metals Digestion	EPA 200.2	Complete		1		10/22/2018	NV00925
Subcontracted Analyses							
Total Organic Carbon (TOC)	N/A	See Attached		1			

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817
EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Customer Sample ID: BF-P-2 8' **Collect Date/Time:** 9/11/2018 11:25
WETLAB Sample ID: 18090719-004 **Receive Date:** 9/21/2018 10:27

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
General Chemistry							
pH	SW846 9045D	9.03	pH Units	1		10/3/2018	NV00925
Sodium Adsorption Ratio (SAR)	Calc.	3.2	meq/kg	1	0.54	10/26/2018	NV00925
Electrical Conductivity	SM 2510B	190	µmhos/cm	1	1.0	10/3/2018	NV00925
Anions by Ion Chromatography							
Chloride	EPA 300.0	15	mg/kg	10	10	10/10/2018	NV00925
Nitrate Nitrogen	EPA 300.0	2.1	mg/kg	10	1.0	10/10/2018	NV00925
Trace Metals by ICP-OES							
Arsenic	EPA 200.7	ND	Soluble mg/kg	20	0.46	10/25/2018	NV00925
Calcium	EPA 200.7	33	Soluble mg/kg	20	10	10/25/2018	NV00925
Magnesium	EPA 200.7	16	Soluble mg/kg	20	10	10/26/2018	NV00925
Sodium	EPA 200.7	90	Soluble mg/kg	20	10	10/25/2018	NV00925
Sample Preparation							
10:1 DI Water Extraction	WL 10.0	Complete		1		10/3/2018	NV00925
Trace Metals Digestion	EPA 200.2	Complete		1		10/22/2018	NV00925
Subcontracted Analyses							
Total Organic Carbon (TOC)	N/A	See Attached		1			

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817
EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
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EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Customer Sample ID: BF-P-3 2' **Collect Date/Time:** 9/11/2018 12:30
WETLAB Sample ID: 18090719-005 **Receive Date:** 9/21/2018 10:27

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
General Chemistry							
pH	SW846 9045D	7.75	pH Units	1		10/3/2018	NV00925
Sodium Adsorption Ratio (SAR)	Calc.	2.6	meq/kg	1	0.54	10/26/2018	NV00925
Electrical Conductivity	SM 2510B	110	µmhos/cm	1	1.0	10/3/2018	NV00925
Anions by Ion Chromatography							
Chloride	EPA 300.0	25	mg/kg	10	10	10/10/2018	NV00925
Nitrate Nitrogen	EPA 300.0	4.7	mg/kg	10	1.0	10/10/2018	NV00925
Trace Metals by ICP-OES							
Arsenic	EPA 200.7	ND	Soluble mg/kg	20	0.46	10/25/2018	NV00925
Calcium	EPA 200.7	25	Soluble mg/kg	20	10	10/25/2018	NV00925
Magnesium	EPA 200.7	21	Soluble mg/kg	20	10	10/26/2018	NV00925
Sodium	EPA 200.7	72	Soluble mg/kg	20	10	10/25/2018	NV00925
Sample Preparation							
10:1 DI Water Extraction	WL 10.0	Complete		1		10/3/2018	NV00925
Trace Metals Digestion	EPA 200.2	Complete		1		10/22/2018	NV00925
Subcontracted Analyses							
Total Organic Carbon (TOC)	N/A	See Attached		1			

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SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817
EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Customer Sample ID: BF-P-3 8' **Collect Date/Time:** 9/11/2018 12:35
WETLAB Sample ID: 18090719-006 **Receive Date:** 9/21/2018 10:27

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
General Chemistry							
pH	SW846 9045D	8.62	pH Units	1		10/3/2018	NV00925
Sodium Adsorption Ratio (SAR)	Calc.	2.4	meq/kg	1	0.54	10/26/2018	NV00925
Electrical Conductivity	SM 2510B	250	µmhos/cm	1	1.0	10/3/2018	NV00925
Anions by Ion Chromatography							
Chloride	EPA 300.0	12	mg/kg	10	10	10/10/2018	NV00925
Nitrate Nitrogen	EPA 300.0	13	mg/kg	10	1.0	10/10/2018	NV00925
Trace Metals by ICP-OES							
Arsenic	EPA 200.7	ND	Soluble mg/kg	20	0.46	10/25/2018	NV00925
Calcium	EPA 200.7	46	Soluble mg/kg	20	10	10/25/2018	NV00925
Magnesium	EPA 200.7	12	Soluble mg/kg	20	10	10/26/2018	NV00925
Sodium	EPA 200.7	70	Soluble mg/kg	20	10	10/25/2018	NV00925
Sample Preparation							
10:1 DI Water Extraction	WL 10.0	Complete		1		10/3/2018	NV00925
Trace Metals Digestion	EPA 200.2	Complete		1		10/22/2018	NV00925
Subcontracted Analyses							
Total Organic Carbon (TOC)	N/A	See Attached		1			

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SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817
EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Customer Sample ID: BF-P-4 2' **Collect Date/Time:** 9/11/2018 12:55
WETLAB Sample ID: 18090719-007 **Receive Date:** 9/21/2018 10:27

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
General Chemistry							
pH	SW846 9045D	7.47	pH Units	1		10/3/2018	NV00925
Sodium Adsorption Ratio (SAR)	Calc.	1.0	meq/kg	1	0.54	10/26/2018	NV00925
Electrical Conductivity	SM 2510B	43	µmhos/cm	1	1.0	10/3/2018	NV00925
Anions by Ion Chromatography							
Chloride	EPA 300.0	23	mg/kg	10	10	10/10/2018	NV00925
Nitrate Nitrogen	EPA 300.0	2.2	mg/kg	10	1.0	10/10/2018	NV00925
Trace Metals by ICP-OES							
Arsenic	EPA 200.7	ND	Soluble mg/kg	20	0.46	10/26/2018	NV00925
Calcium	EPA 200.7	34	Soluble mg/kg	20	10	10/25/2018	NV00925
Magnesium	EPA 200.7	32	Soluble mg/kg	20	10	10/26/2018	NV00925
Sodium	EPA 200.7	34	Soluble mg/kg	20	10	10/25/2018	NV00925
Sample Preparation							
10:1 DI Water Extraction	WL 10.0	Complete		1		10/3/2018	NV00925
Trace Metals Digestion	EPA 200.2	Complete		1		10/22/2018	NV00925
Subcontracted Analyses							
Total Organic Carbon (TOC)	N/A	See Attached		1			

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817
EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Customer Sample ID: BF-P-4 8' **Collect Date/Time:** 9/11/2018 13:00
WETLAB Sample ID: 18090719-008 **Receive Date:** 9/21/2018 10:27

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
General Chemistry							
pH	SW846 9045D	8.14	pH Units	1		10/3/2018	NV00925
Sodium Adsorption Ratio (SAR)	Calc.	0.89	meq/kg	1	0.54	10/26/2018	NV00925
Electrical Conductivity	SM 2510B	57	µmhos/cm	1	1.0	10/3/2018	NV00925
Anions by Ion Chromatography							
Chloride	EPA 300.0	ND	mg/kg	10	10	10/10/2018	NV00925
Nitrate Nitrogen	EPA 300.0	2.6	mg/kg	10	1.0	10/10/2018	NV00925
Trace Metals by ICP-OES							
Arsenic	EPA 200.7	ND	Soluble mg/kg	20	0.46	10/26/2018	NV00925
Calcium	EPA 200.7	17	Soluble mg/kg	20	10	10/25/2018	NV00925
Magnesium	EPA 200.7	14	Soluble mg/kg	20	10	10/26/2018	NV00925
Sodium	EPA 200.7	20	Soluble mg/kg	20	10	10/25/2018	NV00925
Sample Preparation							
10:1 DI Water Extraction	WL 10.0	Complete		1		10/3/2018	NV00925
Trace Metals Digestion	EPA 200.2	Complete		1		10/22/2018	NV00925
Subcontracted Analyses							
Total Organic Carbon (TOC)	N/A	See Attached		1			

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
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EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Customer Sample ID: BF-P-5 2' **Collect Date/Time:** 9/11/2018 14:00
WETLAB Sample ID: 18090719-009 **Receive Date:** 9/21/2018 10:27

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
General Chemistry							
pH	SW846 9045D	7.99	pH Units	1		10/3/2018	NV00925
Sodium Adsorption Ratio (SAR)	Calc.	9.6	meq/kg	1	0.54	10/26/2018	NV00925
Electrical Conductivity	SM 2510B	80	µmhos/cm	1	1.0	10/3/2018	NV00925
Anions by Ion Chromatography							
Chloride	EPA 300.0	ND	mg/kg	10	10	10/10/2018	NV00925
Nitrate Nitrogen	EPA 300.0	6.3	mg/kg	10	1.0	10/10/2018	NV00925
Trace Metals by ICP-OES							
Arsenic	EPA 200.7	ND	Soluble mg/kg	20	0.46	10/26/2018	NV00925
Calcium	EPA 200.7	12	Soluble mg/kg	20	10	10/25/2018	NV00925
Magnesium	EPA 200.7	ND	Soluble mg/kg	20	10	10/26/2018	NV00925
Sodium	EPA 200.7	170	Soluble mg/kg	20	10	10/25/2018	NV00925
Sample Preparation							
10:1 DI Water Extraction	WL 10.0	Complete		1		10/3/2018	NV00925
Trace Metals Digestion	EPA 200.2	Complete		1		10/22/2018	NV00925
Subcontracted Analyses							
Total Organic Carbon (TOC)	N/A	See Attached		1			

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817
EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Customer Sample ID: BF-P-5 8' **Collect Date/Time:** 9/11/2018 14:05
WETLAB Sample ID: 18090719-010 **Receive Date:** 9/21/2018 10:27

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
General Chemistry							
pH	SW846 9045D	8.84	pH Units	1		10/3/2018	NV00925
Sodium Adsorption Ratio (SAR)	Calc.	10	meq/kg	1	0.54	10/26/2018	NV00925
Electrical Conductivity	SM 2510B	140	µmhos/cm	1	1.0	10/3/2018	NV00925
Anions by Ion Chromatography							
Chloride	EPA 300.0	ND	mg/kg	10	10	10/10/2018	NV00925
Nitrate Nitrogen	EPA 300.0	2.6	mg/kg	10	1.0	10/10/2018	NV00925
Trace Metals by ICP-OES							
Arsenic	EPA 200.7	ND	Soluble mg/kg	20	0.46	10/26/2018	NV00925
Calcium	EPA 200.7	42	Soluble mg/kg	20	10	10/25/2018	NV00925
Magnesium	EPA 200.7	15	Soluble mg/kg	20	10	10/26/2018	NV00925
Sodium	EPA 200.7	300	Soluble mg/kg	20	10	10/25/2018	NV00925
Sample Preparation							
10:1 DI Water Extraction	WL 10.0	Complete		1		10/3/2018	NV00925
Trace Metals Digestion	EPA 200.2	Complete		1		10/22/2018	NV00925
Subcontracted Analyses							
Total Organic Carbon (TOC)	N/A	See Attached		1			

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SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817
EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Customer Sample ID: BF-P-6 3' **Collect Date/Time:** 9/11/2018
WETLAB Sample ID: 18090719-011 **Receive Date:** 9/21/2018 10:27

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
General Chemistry							
pH	SW846 9045D	8.01	pH Units	1		10/3/2018	NV00925
Sodium Adsorption Ratio (SAR)	Calc.	15	meq/kg	1	0.54	10/26/2018	NV00925
Electrical Conductivity	SM 2510B	32	µmhos/cm	1	1.0	10/3/2018	NV00925
Anions by Ion Chromatography							
Chloride	EPA 300.0	11	mg/kg	10	10	10/10/2018	NV00925
Nitrate Nitrogen	EPA 300.0	1.5	mg/kg	10	1.0	10/10/2018	NV00925
Trace Metals by ICP-OES							
Arsenic	EPA 200.7	ND	Soluble mg/kg	20	0.46	10/26/2018	NV00925
Calcium	EPA 200.7	12	Soluble mg/kg	20	10	10/25/2018	NV00925
Magnesium	EPA 200.7	ND	Soluble mg/kg	20	10	10/26/2018	NV00925
Sodium	EPA 200.7	270	Soluble mg/kg	20	10	10/25/2018	NV00925
Sample Preparation							
10:1 DI Water Extraction	WL 10.0	Complete		1		10/3/2018	NV00925
Trace Metals Digestion	EPA 200.2	Complete		1		10/22/2018	NV00925
Subcontracted Analyses							
Total Organic Carbon (TOC)	N/A	See Attached		1			

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SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817
EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Customer Sample ID: BF-P-6 8' **Collect Date/Time:** 9/12/2018
WETLAB Sample ID: 18090719-012 **Receive Date:** 9/21/2018 10:27

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
General Chemistry							
pH	SW846 9045D	8.71	pH Units	1		10/3/2018	NV00925
Sodium Adsorption Ratio (SAR)	Calc.	1.9	meq/kg	1	0.54	10/26/2018	NV00925
Electrical Conductivity	SM 2510B	72	µmhos/cm	1	1.0	10/3/2018	NV00925
Anions by Ion Chromatography							
Chloride	EPA 300.0	ND	mg/kg	10	10	10/10/2018	NV00925
Nitrate Nitrogen	EPA 300.0	1.6	mg/kg	10	1.0	10/10/2018	NV00925
Trace Metals by ICP-OES							
Arsenic	EPA 200.7	ND	Soluble mg/kg	20	0.46	10/26/2018	NV00925
Calcium	EPA 200.7	17	Soluble mg/kg	20	10	10/25/2018	NV00925
Magnesium	EPA 200.7	14	Soluble mg/kg	20	10	10/26/2018	NV00925
Sodium	EPA 200.7	43	Soluble mg/kg	20	10	10/25/2018	NV00925
Sample Preparation							
10:1 DI Water Extraction	WL 10.0	Complete		1		10/3/2018	NV00925
Trace Metals Digestion	EPA 200.2	Complete		1		10/22/2018	NV00925
Subcontracted Analyses							
Total Organic Carbon (TOC)	N/A	See Attached		1			

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SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817
EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Customer Sample ID: BF-P-7 2' **Collect Date/Time:** 9/12/2018 10:10
WETLAB Sample ID: 18090719-013 **Receive Date:** 9/21/2018 10:27

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
General Chemistry							
pH	SW846 9045D	7.38	pH Units	1		10/3/2018	NV00925
Sodium Adsorption Ratio (SAR)	Calc.	1.7	meq/kg	1	0.54	10/26/2018	NV00925
Electrical Conductivity	SM 2510B	22	µmhos/cm	1	1.0	10/3/2018	NV00925
Anions by Ion Chromatography							
Chloride	EPA 300.0	12	mg/kg	10	10	10/10/2018	NV00925
Nitrate Nitrogen	EPA 300.0	1.5	mg/kg	10	1.0	10/10/2018	NV00925
Trace Metals by ICP-OES							
Arsenic	EPA 200.7	ND	Soluble mg/kg	20	0.46	10/26/2018	NV00925
Calcium	EPA 200.7	12	Soluble mg/kg	20	10	10/25/2018	NV00925
Magnesium	EPA 200.7	12	Soluble mg/kg	20	10	10/26/2018	NV00925
Sodium	EPA 200.7	34	Soluble mg/kg	20	10	10/25/2018	NV00925
Sample Preparation							
10:1 DI Water Extraction	WL 10.0	Complete		1		10/4/2018	NV00925
Trace Metals Digestion	EPA 200.2	Complete		1		10/22/2018	NV00925
Subcontracted Analyses							
Total Organic Carbon (TOC)	N/A	See Attached		1			

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SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817
EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Customer Sample ID: BF-P-7 8' **Collect Date/Time:** 9/12/2018 10:15
WETLAB Sample ID: 18090719-014 **Receive Date:** 9/21/2018 10:27

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
General Chemistry							
pH	SW846 9045D	8.67	pH Units	1		10/3/2018	NV00925
Sodium Adsorption Ratio (SAR)	Calc.	1.4	meq/kg	1	0.54	10/26/2018	NV00925
Electrical Conductivity	SM 2510B	140	µmhos/cm	1	1.0	10/3/2018	NV00925
Anions by Ion Chromatography							
Chloride	EPA 300.0	ND	mg/kg	10	10	10/10/2018	NV00925
Nitrate Nitrogen	EPA 300.0	ND	mg/kg	10	1.0	10/10/2018	NV00925
Trace Metals by ICP-OES							
Arsenic	EPA 200.7	ND	Soluble mg/kg	20	0.46	10/26/2018	NV00925
Calcium	EPA 200.7	33	Soluble mg/kg	20	10	10/25/2018	NV00925
Magnesium	EPA 200.7	16	Soluble mg/kg	20	10	10/26/2018	NV00925
Sodium	EPA 200.7	39	Soluble mg/kg	20	10	10/25/2018	NV00925
Sample Preparation							
10:1 DI Water Extraction	WL 10.0	Complete		1		10/4/2018	NV00925
Trace Metals Digestion	EPA 200.2	Complete		1		10/22/2018	NV00925
Subcontracted Analyses							
Total Organic Carbon (TOC)	N/A	See Attached		1			

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SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817
EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Customer Sample ID: BF-P-8 2' **Collect Date/Time:** 9/12/2018 11:00
WETLAB Sample ID: 18090719-015 **Receive Date:** 9/21/2018 10:27

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
General Chemistry							
pH	SW846 9045D	7.31	pH Units	1		10/3/2018	NV00925
Sodium Adsorption Ratio (SAR)	Calc.	1.3	meq/kg	1	0.54	10/26/2018	NV00925
Electrical Conductivity	SM 2510B	44	µmhos/cm	1	1.0	10/3/2018	NV00925
Anions by Ion Chromatography							
Chloride	EPA 300.0	ND	mg/kg	10	10	10/10/2018	NV00925
Nitrate Nitrogen	EPA 300.0	1.0	mg/kg	10	1.0	10/10/2018	NV00925
Trace Metals by ICP-OES							
Arsenic	EPA 200.7	ND	Soluble mg/kg	20	0.46	10/26/2018	NV00925
Calcium	EPA 200.7	19	Soluble mg/kg	20	10	10/25/2018	NV00925
Magnesium	EPA 200.7	19	Soluble mg/kg	20	10	10/26/2018	NV00925
Sodium	EPA 200.7	33	Soluble mg/kg	20	10	10/25/2018	NV00925
Sample Preparation							
10:1 DI Water Extraction	WL 10.0	Complete		1		10/4/2018	NV00925
Trace Metals Digestion	EPA 200.2	Complete		1		10/22/2018	NV00925
Subcontracted Analyses							
Total Organic Carbon (TOC)	N/A	See Attached		1			

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SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817
EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Customer Sample ID: BF-P-8 8' **Collect Date/Time:** 9/12/2018 11:05
WETLAB Sample ID: 18090719-016 **Receive Date:** 9/21/2018 10:27

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
General Chemistry							
pH	SW846 9045D	8.71	pH Units	1		10/3/2018	NV00925
Sodium Adsorption Ratio (SAR)	Calc.	1.5	meq/kg	1	0.54	10/26/2018	NV00925
Electrical Conductivity	SM 2510B	37	µmhos/cm	1	1.0	10/3/2018	NV00925
Anions by Ion Chromatography							
Chloride	EPA 300.0	ND	mg/kg	10	10	10/10/2018	NV00925
Nitrate Nitrogen	EPA 300.0	ND	mg/kg	10	1.0	10/10/2018	NV00925
Trace Metals by ICP-OES							
Arsenic	EPA 200.7	ND	Soluble mg/kg	20	0.46	10/26/2018	NV00925
Calcium	EPA 200.7	15	Soluble mg/kg	20	10	10/25/2018	NV00925
Magnesium	EPA 200.7	15	Soluble mg/kg	20	10	10/26/2018	NV00925
Sodium	EPA 200.7	34	Soluble mg/kg	20	10	10/25/2018	NV00925
Sample Preparation							
10:1 DI Water Extraction	WL 10.0	Complete		1		10/4/2018	NV00925
Trace Metals Digestion	EPA 200.2	Complete		1		10/22/2018	NV00925
Subcontracted Analyses							
Total Organic Carbon (TOC)	N/A	See Attached		1			

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SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817
EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Customer Sample ID: BF-P-9-2' **Collect Date/Time:** 9/12/2018 11:40
WETLAB Sample ID: 18090719-017 **Receive Date:** 9/21/2018 10:27

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
General Chemistry							
pH	SW846 9045D	6.90	pH Units	1		10/3/2018	NV00925
Sodium Adsorption Ratio (SAR)	Calc.	1.5	meq/kg	1	0.54	10/26/2018	NV00925
Electrical Conductivity	SM 2510B	16	µmhos/cm	1	1.0	10/3/2018	NV00925
Anions by Ion Chromatography							
Chloride	EPA 300.0	ND	mg/kg	10	10	10/10/2018	NV00925
Nitrate Nitrogen	EPA 300.0	1.2	mg/kg	10	1.0	10/10/2018	NV00925
Trace Metals by ICP-OES							
Arsenic	EPA 200.7	ND	Soluble mg/kg	20	0.46	10/26/2018	NV00925
Calcium	EPA 200.7	12	Soluble mg/kg	20	10	10/25/2018	NV00925
Magnesium	EPA 200.7	16	Soluble mg/kg	20	10	10/26/2018	NV00925
Sodium	EPA 200.7	33	Soluble mg/kg	20	10	10/25/2018	NV00925
Sample Preparation							
10:1 DI Water Extraction	WL 10.0	Complete		1		10/4/2018	NV00925
Trace Metals Digestion	EPA 200.2	Complete		1		10/22/2018	NV00925
Subcontracted Analyses							
Total Organic Carbon (TOC)	N/A	See Attached		1			

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SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817
EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Customer Sample ID: BF-P-9-8' **Collect Date/Time:** 9/12/2018 11:45
WETLAB Sample ID: 18090719-018 **Receive Date:** 9/21/2018 10:27

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
General Chemistry							
pH	SW846 9045D	7.79	pH Units	1		10/3/2018	NV00925
Sodium Adsorption Ratio (SAR)	Calc.	1.7	meq/kg	1	0.54	10/26/2018	NV00925
Electrical Conductivity	SM 2510B	72	µmhos/cm	1	1.0	10/3/2018	NV00925
Anions by Ion Chromatography							
Chloride	EPA 300.0	ND	mg/kg	10	10	10/10/2018	NV00925
Nitrate Nitrogen	EPA 300.0	1.2	mg/kg	10	1.0	10/10/2018	NV00925
Trace Metals by ICP-OES							
Arsenic	EPA 200.7	ND	Soluble mg/kg	20	0.46	10/26/2018	NV00925
Calcium	EPA 200.7	18	Soluble mg/kg	20	10	10/25/2018	NV00925
Magnesium	EPA 200.7	22	Soluble mg/kg	20	10	10/26/2018	NV00925
Sodium	EPA 200.7	46	Soluble mg/kg	20	10	10/25/2018	NV00925
Sample Preparation							
10:1 DI Water Extraction	WL 10.0	Complete		1		10/4/2018	NV00925
Trace Metals Digestion	EPA 200.2	Complete		1		10/22/2018	NV00925
Subcontracted Analyses							
Total Organic Carbon (TOC)	N/A	See Attached		1			

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SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817
EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Customer Sample ID: BF-P-10 2' **Collect Date/Time:** 9/12/2018 13:10
WETLAB Sample ID: 18090719-019 **Receive Date:** 9/21/2018 10:27

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
General Chemistry							
pH	SW846 9045D	7.56	pH Units	1		10/3/2018	NV00925
Sodium Adsorption Ratio (SAR)	Calc.	2.3	meq/kg	1	0.54	10/23/2018	NV00925
Electrical Conductivity	SM 2510B	30	µmhos/cm	1	1.0	10/3/2018	NV00925
Anions by Ion Chromatography							
Chloride	EPA 300.0	ND	mg/kg	10	10	10/10/2018	NV00925
Nitrate Nitrogen	EPA 300.0	1.3	mg/kg	10	1.0	10/10/2018	NV00925
Trace Metals by ICP-OES							
Arsenic	EPA 200.7	ND	Soluble mg/kg	20	0.46	10/23/2018	NV00925
Calcium	EPA 200.7	22	Soluble mg/kg	20	10	10/23/2018	NV00925
Magnesium	EPA 200.7	29	Soluble mg/kg	20	10	10/23/2018	NV00925
Sodium	EPA 200.7	69	Soluble mg/kg	20	10	10/23/2018	NV00925
Sample Preparation							
10:1 DI Water Extraction	WL 10.0	Complete		1		10/4/2018	NV00925
Trace Metals Digestion	EPA 200.2	Complete		1		10/22/2018	NV00925
Subcontracted Analyses							
Total Organic Carbon (TOC)	N/A	See Attached		1			

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SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817
EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Customer Sample ID: BF-P-10 8' **Collect Date/Time:** 9/12/2018 13:15
WETLAB Sample ID: 18090719-020 **Receive Date:** 9/21/2018 10:27

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
General Chemistry							
pH	SW846 9045D	7.79	pH Units	1		10/3/2018	NV00925
Sodium Adsorption Ratio (SAR)	Calc.	1.6	meq/kg	1	0.54	10/23/2018	NV00925
Electrical Conductivity	SM 2510B	33	µmhos/cm	1	1.0	10/3/2018	NV00925
Anions by Ion Chromatography							
Chloride	EPA 300.0	ND	mg/kg	10	10	10/10/2018	NV00925
Nitrate Nitrogen	EPA 300.0	1.2	mg/kg	10	1.0	10/10/2018	NV00925
Trace Metals by ICP-OES							
Arsenic	EPA 200.7	ND	Soluble mg/kg	20	0.46	10/23/2018	NV00925
Calcium	EPA 200.7	23	Soluble mg/kg	20	10	10/23/2018	NV00925
Magnesium	EPA 200.7	25	Soluble mg/kg	20	10	10/23/2018	NV00925
Sodium	EPA 200.7	47	Soluble mg/kg	20	10	10/23/2018	NV00925
Sample Preparation							
10:1 DI Water Extraction	WL 10.0	Complete		1		10/4/2018	NV00925
Trace Metals Digestion	EPA 200.2	Complete		1		10/22/2018	NV00925
Subcontracted Analyses							
Total Organic Carbon (TOC)	N/A	See Attached		1			

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SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817
EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Customer Sample ID: BF-P-11 2' **Collect Date/Time:** 9/12/2018 14:05
WETLAB Sample ID: 18090719-021 **Receive Date:** 9/21/2018 10:27

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
General Chemistry							
pH	SW846 9045D	8.02	pH Units	1		10/3/2018	NV00925
Sodium Adsorption Ratio (SAR)	Calc.	2.2	meq/kg	1	0.54	10/23/2018	NV00925
Electrical Conductivity	SM 2510B	34	µmhos/cm	1	1.0	10/3/2018	NV00925
Anions by Ion Chromatography							
Chloride	EPA 300.0	ND	mg/kg	10	10	10/10/2018	NV00925
Nitrate Nitrogen	EPA 300.0	ND	mg/kg	10	1.0	10/10/2018	NV00925
Trace Metals by ICP-OES							
Arsenic	EPA 200.7	ND	Soluble mg/kg	20	0.46	10/23/2018	NV00925
Calcium	EPA 200.7	14	Soluble mg/kg	20	10	10/23/2018	NV00925
Magnesium	EPA 200.7	13	Soluble mg/kg	20	10	10/23/2018	NV00925
Sodium	EPA 200.7	48	Soluble mg/kg	20	10	10/23/2018	NV00925
Sample Preparation							
10:1 DI Water Extraction	WL 10.0	Complete		1		10/4/2018	NV00925
Trace Metals Digestion	EPA 200.2	Complete		1		10/22/2018	NV00925
Subcontracted Analyses							
Total Organic Carbon (TOC)	N/A	See Attached		1			

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817
EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Customer Sample ID: BF-P-11 8' **Collect Date/Time:** 9/12/2018 14:10
WETLAB Sample ID: 18090719-022 **Receive Date:** 9/21/2018 10:27

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
General Chemistry							
pH	SW846 9045D	8.91	pH Units	1		10/3/2018	NV00925
Sodium Adsorption Ratio (SAR)	Calc.	2.7	meq/kg	1	0.54	10/23/2018	NV00925
Electrical Conductivity	SM 2510B	210	µmhos/cm	1	1.0	10/3/2018	NV00925
Anions by Ion Chromatography							
Chloride	EPA 300.0	ND	mg/kg	10	10	10/10/2018	NV00925
Nitrate Nitrogen	EPA 300.0	ND	mg/kg	10	1.0	10/10/2018	NV00925
Trace Metals by ICP-OES							
Arsenic	EPA 200.7	ND	Soluble mg/kg	20	0.46	10/23/2018	NV00925
Calcium	EPA 200.7	36	Soluble mg/kg	20	10	10/23/2018	NV00925
Magnesium	EPA 200.7	17	Soluble mg/kg	20	10	10/23/2018	NV00925
Sodium	EPA 200.7	79	Soluble mg/kg	20	10	10/23/2018	NV00925
Sample Preparation							
10:1 DI Water Extraction	WL 10.0	Complete		1		10/4/2018	NV00925
Trace Metals Digestion	EPA 200.2	Complete		1		10/11/2018	NV00925
Subcontracted Analyses							
Total Organic Carbon (TOC)	N/A	See Attached		1			

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

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1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
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EPA LAB ID: NV00926

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3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Customer Sample ID: BF-P-12 2' **Collect Date/Time:** 9/12/2018 16:00
WETLAB Sample ID: 18090719-023 **Receive Date:** 9/21/2018 10:27

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
General Chemistry							
pH	SW846 9045D	7.89	pH Units	1		10/3/2018	NV00925
Sodium Adsorption Ratio (SAR)	Calc.	1.4	meq/kg	1	0.54	10/23/2018	NV00925
Electrical Conductivity	SM 2510B	33	µmhos/cm	1	1.0	10/3/2018	NV00925
Anions by Ion Chromatography							
Chloride	EPA 300.0	ND	mg/kg	10	10	10/10/2018	NV00925
Nitrate Nitrogen	EPA 300.0	1.6	mg/kg	10	1.0	10/10/2018	NV00925
Trace Metals by ICP-OES							
Arsenic	EPA 200.7	ND	Soluble mg/kg	20	0.46	10/23/2018	NV00925
Calcium	EPA 200.7	26	Soluble mg/kg	20	10	10/23/2018	NV00925
Magnesium	EPA 200.7	25	Soluble mg/kg	20	10	10/23/2018	NV00925
Sodium	EPA 200.7	41	Soluble mg/kg	20	10	10/23/2018	NV00925
Sample Preparation							
10:1 DI Water Extraction	WL 10.0	Complete		1		10/4/2018	NV00925
Trace Metals Digestion	EPA 200.2	Complete		1		10/22/2018	NV00925
Subcontracted Analyses							
Total Organic Carbon (TOC)	N/A	See Attached		1			

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

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3230 Polaris Ave. Suite 4
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tel (702) 475-8899
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EPA LAB ID: NV00932

Customer Sample ID: BF-P-12 8' **Collect Date/Time:** 9/12/2018 16:05
WETLAB Sample ID: 18090719-024 **Receive Date:** 9/21/2018 10:27

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
General Chemistry							
pH	SW846 9045D	8.03	pH Units	1		10/3/2018	NV00925
Sodium Adsorption Ratio (SAR)	Calc.	1.8	meq/kg	1	0.54	10/23/2018	NV00925
Electrical Conductivity	SM 2510B	31	µmhos/cm	1	1.0	10/3/2018	NV00925
Anions by Ion Chromatography							
Chloride	EPA 300.0	ND	mg/kg	10	10	10/10/2018	NV00925
Nitrate Nitrogen	EPA 300.0	ND	mg/kg	10	1.0	10/10/2018	NV00925
Trace Metals by ICP-OES							
Arsenic	EPA 200.7	ND	Soluble mg/kg	20	0.46	10/23/2018	NV00925
Calcium	EPA 200.7	27	Soluble mg/kg	20	10	10/23/2018	NV00925
Magnesium	EPA 200.7	28	Soluble mg/kg	20	10	10/23/2018	NV00925
Sodium	EPA 200.7	56	Soluble mg/kg	20	10	10/23/2018	NV00925
Sample Preparation							
10:1 DI Water Extraction	WL 10.0	Complete		1		10/4/2018	NV00925
Trace Metals Digestion	EPA 200.2	Complete		1		10/22/2018	NV00925
Subcontracted Analyses							
Total Organic Carbon (TOC)	N/A	See Attached		1			

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Sparks, Nevada 89431
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ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
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EPA LAB ID: NV00932

Western Environmental Testing Laboratory
QC Report

QCBatchID	QCType	Parameter	Method	Result	Actual	% Rec	Units
QC18100160	Blank 1	Electrical Conductivity	SM 2510B	ND			µmhos/cm
QC18100161	Blank 1	Electrical Conductivity	SM 2510B	ND			µmhos/cm
QC18100430	Blank 1	Chloride	EPA 300.0	ND			mg/L
		Nitrate Nitrogen	EPA 300.0	ND			mg/L
QC18100431	Blank 1	Chloride	EPA 300.0	ND			mg/L
		Nitrate Nitrogen	EPA 300.0	ND			mg/L
QC18100433	Blank 1	Chloride	EPA 300.0	ND			mg/L
		Nitrate Nitrogen	EPA 300.0	ND			mg/L
QC18100882	Blank 1	Arsenic, Dissolved	EPA 200.7	ND			mg/L
		Calcium, Dissolved	EPA 200.7	ND			mg/L
		Magnesium, Dissolved	EPA 200.7	ND			mg/L
		Sodium, Dissolved	EPA 200.7	ND			mg/L
QC18100970	Blank 1	Arsenic	EPA 200.7	ND			mg/L
		Calcium	EPA 200.7	ND			mg/L
		Magnesium	EPA 200.7	ND			mg/L
		Sodium	EPA 200.7	ND			mg/L
QC18100971	Blank 1	Arsenic	EPA 200.7	ND			mg/L
		Calcium	EPA 200.7	ND			mg/L
		Magnesium	EPA 200.7	ND			mg/L
		Sodium	EPA 200.7	ND			mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Rec	Units
QC18100120	LCS 1	pH	SW846 9045D	7.07	7.00	101	ph Units
QC18100120	LCS 2	pH	SW846 9045D	7.07	7.00	101	ph Units
QC18100160	LCS 1	Electrical Conductivity	SM 2510B	1404	1412	99	µmhos/cm
QC18100161	LCS 1	Electrical Conductivity	SM 2510B	1397	1412	99	µmhos/cm
QC18100430	LCS 1	Chloride	EPA 300.0	10.2	10.0	102	mg/L
		Nitrate Nitrogen	EPA 300.0	2.00	2.00	100	mg/L
QC18100431	LCS 1	Chloride	EPA 300.0	10.2	10.0	102	mg/L
		Nitrate Nitrogen	EPA 300.0	2.00	2.00	100	mg/L
QC18100433	LCS 1	Chloride	EPA 300.0	10.4	10.0	104	mg/L
		Nitrate Nitrogen	EPA 300.0	2.07	2.00	104	mg/L
QC18100882	LCS 1	Arsenic, Dissolved	EPA 200.7	1.01	1.00	102	mg/L
		Calcium, Dissolved	EPA 200.7	10.0	10.0	100	mg/L
		Magnesium, Dissolved	EPA 200.7	10.1	10.0	101	mg/L
		Sodium, Dissolved	EPA 200.7	10.1	10.0	101	mg/L
QC18100970	LCS 1	Arsenic	EPA 200.7	1.02	1.00	102	mg/L
		Calcium	EPA 200.7	9.93	10.0	99	mg/L
		Magnesium	EPA 200.7	9.55	10.0	96	mg/L
		Sodium	EPA 200.7	9.68	10.0	97	mg/L
QC18100971	LCS 1	Arsenic	EPA 200.7	1.02	1.00	102	mg/L
		Calcium	EPA 200.7	9.93	10.0	99	mg/L
		Magnesium	EPA 200.7	9.55	10.0	96	mg/L
		Sodium	EPA 200.7	9.68	10.0	97	mg/L

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result	Units	RPD
QC18100120	Duplicate 1	pH	SW846 9045D	18090719-00	8.38	8.41	pH Units	<1%

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SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
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EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
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EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
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QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result	Units	RPD
QC18100120	Duplicate 2	pH	SW846 9045D	18090719-01	8.01	8.03	pH Units	<1%
QC18100120	Duplicate 3	pH	SW846 9045D	18090719-02	8.02	8.03	pH Units	<1%
QC18100160	Duplicate 1	Electrical Conductivity	SM 2510B	18100144-00	105	97.2	µmhos/cm	8 %
QC18100160	Duplicate 2	Electrical Conductivity	SM 2510B	18090719-00	68.2	68.1	µmhos/cm	<1%
QC18100161	Duplicate 1	Electrical Conductivity	SM 2510B	18090719-01	32.4	32.0	µmhos/cm	1 %

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result		MS Result	MSD Result	Spike Value	Units	MS %Rec	MSD %Rec	RPD %
QC18100430	MS 1	Chloride	EPA 300.0	18100369-001	ND		5.66	5.73	5	mg/L	108	110	1
		Nitrate Nitrogen	EPA 300.0	18100369-001	ND		2.17	2.19	2	mg/L	107	107	<1
QC18100430	MS 2	Chloride	EPA 300.0	18100369-001	ND		5.67	5.68	5	mg/L	109	109	<1
		Nitrate Nitrogen	EPA 300.0	18100369-001	ND		2.17	2.19	2	mg/L	109	109	<1
QC18100431	MS 1	Chloride	EPA 300.0	18100366-002	5.37		10.9	11.0	5	mg/L	110	112	<1
		Nitrate Nitrogen	EPA 300.0	18100366-002	ND		2.18	2.21	2	mg/L	107	108	1
QC18100431	MS 2	Chloride	EPA 300.0	18100328-001	13.6		18.9	19.0	5	mg/L	108	109	<1
		Nitrate Nitrogen	EPA 300.0	18100328-001	2.05		4.25	4.26	2	mg/L	110	110	<1
QC18100433	MS 1	Chloride	EPA 300.0	18100384-001	48.5		74.4	75.0	5	mg/L	104	106	<1
		Nitrate Nitrogen	EPA 300.0	18100384-001	9.32		20.0	20.1	2	mg/L	106	108	<1
QC18100433	MS 2	Chloride	EPA 300.0	18100327-002	59.4		63.6	63.6	5	mg/L	85	85	<1
		Nitrate Nitrogen	EPA 300.0	18100327-002	1.28		3.64	3.71	2	mg/L	118	122	2
QC18100882	MS 1	Arsenic, Dissolved	EPA 200.7	18100682-001	ND		0.997	0.987	1	mg/L	98	96	1
		Calcium, Dissolved	EPA 200.7	18100682-001	45.0		54.4	54.8	10	mg/L	94	99	<1
		Magnesium, Dissolved	EPA 200.7	18100682-001	20.8		30.2	30.4	10	mg/L	94	96	<1
		Sodium, Dissolved	EPA 200.7	18100682-001	87.3		97.9	98.8	10	mg/L	106	115	<1
QC18100970	MS 1	Arsenic	EPA 200.7	18100668-001	31.2	SC	31.8	31.0	1	mg/L	NC	NC	NC
		Calcium	EPA 200.7	18100668-001	103	SC	119	119	10	mg/L	NC	NC	NC
		Magnesium	EPA 200.7	18100668-001	ND		42.4	41.1	10	mg/L	100	86	3
		Sodium	EPA 200.7	18100668-001	38.5	M	51.7	51.9	10	mg/L	NC	NC	NC
QC18100971	MS 1	Arsenic	EPA 200.7	18100668-002	1.85	M	3.17	3.38	1	mg/L	NC	NC	NC
		Calcium	EPA 200.7	18100668-002	58.7		70.9	73.0	10	mg/L	123	143	3
		Magnesium	EPA 200.7	18100668-002	33.5		45.1	53.9	10	mg/L	115	203	18
		Sodium	EPA 200.7	18100668-002	33.3		44.8	45.0	10	mg/L	115	117	<1

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SPARKS
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Sparks, Nevada 89431
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WETLAB
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1084 Lamoille Highway | Elko, Nevada 89801
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tel (702) 475-8899 | fax (702) 776-6152

WETLAB Order ID. 1502074C
Sparks Control #
Elko Control #
LV Control #
Report Due Date
Page 1 of 3

Client Truckee Meadows Water Authority
Address 1355 Capital Blvd.
City, State & Zip Reno, NV 89502
Contact ~~Lauren Roaldson~~ C. Kropf
Phone 775-721-9657 | Collector's Name Lauren Roaldson
Fax n/a | PWS/Project Name n/a
P.O. Number 3783 | PWS/Project Number n/a
Email lroaldson@tmwa.com ~~C kropf@tmwa.com~~

Billing Address (if different than Client Address)
Company SAA
Address
City, State & Zip
Contact
Phone | Fax
Email lroaldson@tmwa.com

Turnaround Time Requirements
Standard ✓
5 Day* (25%) | 72 Hour* (50%)
48 Hour* (100%) | 24 Hour* (200%)
*Surcharges Will Apply

Samples Collected From Which State? NV ✓ CA Other
Compliance Monitoring? Yes | No ✓
Report to Regulatory Agency? Yes | No ✓
Report Results Via PDF ✓ EDD ✓ Other
Standard QC Required? Yes ✓ No

SAMPLE ID/LOCATION	DATE	TIME	PRES TYPE *	SAMPLE TYPE **	NO. OF CONTAINERS	Sodium	Nitrate	Chloride	Arsenic	Organic Carbon	Electrical Cond.	ESP	Spl. No.
BF-P-1 2'	9/11	1030			1	X	X	X	X	X	X	X	
BF-P-1 8'	"	1045			1								
BF-P-2 2'	"	1122			1								
" " 8'	"	1125			1								
BF-P-3 2'	"	1230			1								
" " 8'	"	1235			1								
BF-P-4 2'	"	1255			1								
" " 8'	"	1300			1								
BF-P-5 2'	"	1400			1								

Instructions/Comments/Special Requirements: ESP (Exchangeable Sodium %)

Sample Matrix Key** DW = Drinking Water WW = Wastewater SW = Surface Water MW = Monitoring Well SD = Solid/Sludge SO = Soil HW = Hazardous Waste OTHER:

***SAMPLE PRESERVATIVES:** 1=Unpreserved 2=H2SO4 3=NaOH 4=HCl 5=HNO3 6=Na2S2O3 7=ZnOAc+NaOH 8=HCl/VOA Vial

Temp	Custody Seal	# of Containers	DATE	TIME	Samples Relinquished By	Samples Received By
24.1 °C	Y N None	~~3~~ 24	9/11	1027		
°C	Y N None					
°C	Y N None					
°C	Y N None					

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

Client/Collector attests to the validity and authenticity of this (these) sample(s) and, is (are) aware that tampering with or intentionally mislabeling the sample(s) location, date or time of collection may be considered fraud and subject to legal action (NAC445.0636). ____ initial

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compensation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted. ____ initial

WETLAB will dispose of samples 90 days from sample receipt. Client may request a longer sample storage time for an additional fee. Please contact your Project Manager for details. ____ initial

301.2E

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WETLAB Order ID. 1302571 9
Sparks Control #
Elko Control #
LV Control #
Report Due Date
Page 2 of 3

Client Truckee Meadows Water Authority
Address 1355 Capital Blvd.
City, State & Zip Reno, NV 89502
Contact Lauren Roaldson
Phone 775-721-9657 | Collector's Name Lauren Roaldson
Fax n/a | PWS/Project Name n/a
P.O. Number 2960 | PWS/Project Number n/a
Email lroaldson@tmwa.com

Billing Address (if different than Client Address)
Company SAA
Address
City, State & Zip
Contact
Phone | Fax
Email lroaldson@tmwa.com

Turnaround Time Requirements
Standard ✓
5 Day* (25%) | 72 Hour* (50%)
48 Hour* (100%) | 24 Hour* (200%)
*Surcharges Will Apply

Samples Collected From Which State? NV ✓ CA Other
Compliance Monitoring? Yes | No ✓
Report to Regulatory Agency? Yes | No ✓
Report Results Via PDF ✓ EDD ✓ Other
Standard QC Required? Yes ✓ No

SAMPLE ID/LOCATION	DATE	TIME	PRES TYPE *	SAMPLE TYPE **	NO. OF CONTAINERS	Analyses Requested	Spl. No.
BF-P-5 8'	9/11	1105			1	SAA	
BFP-6 3'	9/11	?			1		
BFP-6 8'	9/12	?			1		
BFP-7 2'		1010			1		
BFP-8 8'		1015			1		
BFP-8 2'		1106			1		
" 8'		1105			1		
BFP-9 2'		1140			1		
" 8'	↓	1145			1		

Instructions/Comments/Special Requirements: ? contact CK for times if needed

Sample Matrix Key** DW = Drinking Water WW = Wastewater SW = Surface Water MW = Monitoring Well SD = Solid/Sludge SO = Soil HW = Hazardous Waste OTHER:

***SAMPLE PRESERVATIVES:** 1=Unpreserved 2=H2SO4 3=NaOH 4=HCl 5=HNO3 6=Na2S2O3 7=ZnOAc+NaOH 8=HCl/VOA Vial

Temp	Custody Seal	# of Containers	DATE	TIME	Samples Relinquished By	Samples Received By
29.1 °C	Y N None	24	9/21			
°C	Y N None					
°C	Y N None					
°C	Y N None					

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Client/Collector attests to the validity and authenticity of this (these) sample(s) and, is (are) aware that tampering with or intentionally mislabeling the sample(s) location, date or time of collection may be considered fraud and subject to legal action (NAC445.0636). ___ initial

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compensation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted. ___ initial

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301.2E

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3230 Polaris Ave., Suite 4 | Las Vegas, Nevada 89102
tel (702) 475-8899 | fax (702) 776-6152

WETLAB Order ID. L8090719
Sparks Control # _____
Elko Control # _____
LV Control # _____
Report Due Date

Page 3 of 3

Client SAA
Address
City, State & Zip
Contact
Phone | Collector's Name
Fax | PWS/Project Name
P.O. Number | PWS/Project Number
Email

Turnaround Time Requirements
Standard _____
5 Day* (25%) SAA | 72 Hour* (50%) _____
48 Hour* (100%) _____ | 24 Hour* (200%) _____
*Surcharges Will Apply

Samples Collected From Which State?
NV SAA CA _____ Other _____

Report Results Via
SAA PDF EDD
Other _____

Compliance Monitoring?
Yes SAA No

Report to Regulatory Agency?
Yes SAA No

Standard QC Required?
Yes SAA No

Billing Address (if different than Client Address)
Company SAA
Address
City, State & Zip
Contact
Phone _____ Fax _____
Email

Analyses Requested

SAMPLE ID/LOCATION	DATE	TIME	PRES TYPE *	SAMPLE TYPE **	NO. OF CONTAINERS	Spl. No.
[illegible] 2'	9/12				1	
[illegible] 8'					1	
BF-P-D 2'		1310			1	
" " 8'		1315			1	
BF-P-11 2'		1405			1	
" " 8"		1410			1	
BFP-12 2'		1600			1	
" " 8'		1605			1	

Instructions/Comments/Special Requirements:

Sample Matrix Key** DW = Drinking Water WW = Wastewater SW = Surface Water MW = Monitoring Well SD = Solid/Sludge SO = Soil HW = Hazardous Waste OTHER:_____

***SAMPLE PRESERVATIVES:** 1=Unpreserved 2=H2SO4 3=NaOH 4=HCl 5=HNO3 6=Na2S2O3 7=ZnOAc+NaOH 8=HCl/VOA Vial

Temp	Custody Seal	# of Containers	DATE	TIME	Samples Relinquished By	Samples Received By
29.4 °C	Y N None	24	9/21	0.27		
°C	Y N None					
°C	Y N None					
°C	Y N None					

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30.

Client/Collector attests to the validity and authenticity of this (these) sample(s) and, is (are) aware that tampering with or intentionally mislabeling the sample(s) location, date or time of collection may be considered fraud and subject to legal action (NAC445.0636). _____ initial

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compensation received, unless other agreements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted. _____ initial

WETLAB will dispose of samples 90 days from sample receipt. Client may request a longer sample storage time for an additional fee. Please contact your Project Manager for details. _____ initial

301.2E

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Supplemental Report 1

The original report has been revised/corrected.

WORK ORDER NUMBER: 18-10-0415

The difference is service

AIR | SOIL | WATER | MARINE CHEMISTRY

Analytical Report For

Client: Western Environmental Testing Laboratory

Client Project Name: 18090719

Attention: Logan Greenwood
475 E Greg Street #119
Sparks, NV 89431-6548

Approved for release on 10/15/2018 by:
Julie Lam
Project Manager

ResultLink

Email your PM

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Contents

Client Project Name: 18090719
Work Order Number: 18-10-0415

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Work Order Narrative

Work Order: 18-10-0415 Page 1 of 1

Condition Upon Receipt:

Samples were received under Chain-of-Custody (COC) on 10/05/18. They were assigned to Work Order 18-10-0415.

Unless otherwise noted on the Sample Receiving forms all samples were received in good condition and within the recommended EPA temperature criteria for the methods noted on the COC. The COC and Sample Receiving Documents are integral elements of the analytical report and are presented at the back of the report.

Holding Times:

All samples were analyzed within prescribed holding times (HT) and/or in accordance with the Calscience Sample Acceptance Policy unless otherwise noted in the analytical report and/or comprehensive case narrative, if required.

Any parameter identified in 40CFR Part 136.3 Table II that is designated as "analyze immediately" with a holding time of <= 15 minutes (40CFR-136.3 Table II, footnote 4), is considered a "field" test and the reported results will be qualified as being received outside of the stated holding time unless received at the laboratory within 15 minutes of the collection time.

Quality Control:

All quality control parameters (QC) were within established control limits except where noted in the QC summary forms or described further within this report.

Subcontractor Information:

Unless otherwise noted below (or on the subcontract form), no samples were subcontracted.

Additional Comments:

Air - Sorbent-extracted air methods (EPA TO-4A, EPA TO-10, EPA TO-13A, EPA TO-17): Analytical results are converted from mass/sample basis to mass/volume basis using client-supplied air volumes.

Solid - Unless otherwise indicated, solid sample data is reported on a wet weight basis, not corrected for % moisture. All QC results are always reported on a wet weight basis.

DoD Projects:

The test results contained in this report are accredited under the laboratory's ISO/IEC 17025:2005 and DoD-ELAP accreditation issued by the ANSI-ASQ National Accreditation Board. Refer to certificate and scope of accreditation ADE-1864.

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Sample Summary

Client:	Western Environmental Testing Laboratory	Work Order:	18-10-0415
	475 E Greg Street #119	Project Name:	18090719
	Sparks, NV 89431-6548	PO Number:	
		Date/Time Received:	10/05/18 08:30
		Number of Containers:	24
Attn:	Logan Greenwood		

Sample Identification	Lab Number	Collection Date and Time	Number of Containers	Matrix
BF-P-1 2	18-10-0415-1	09/11/18 10:30	1	Solid
BF-P-1 8	18-10-0415-2	09/11/18 10:45	1	Solid
BF-P-2 2	18-10-0415-3	09/11/18 11:22	1	Solid
BF-P-2 8	18-10-0415-4	09/11/18 11:25	1	Solid
BF-P-3 2	18-10-0415-5	09/11/18 12:30	1	Solid
BF-P-3 8	18-10-0415-6	09/11/18 12:35	1	Solid
BF-P-4 2	18-10-0415-7	09/11/18 12:55	1	Solid
BF-P-4 8	18-10-0415-8	09/11/18 13:00	1	Solid
BF-P-5 2	18-10-0415-9	09/11/18 14:00	1	Solid
BF-P-5 8	18-10-0415-10	09/11/18 14:05	1	Solid
BF-P-6 3	18-10-0415-11	09/11/18 00:00	1	Solid
BF-P-6 8	18-10-0415-12	09/12/18 00:00	1	Solid
BF-P-7 2	18-10-0415-13	09/12/18 10:10	1	Solid
BF-P-7 8	18-10-0415-14	09/12/18 10:15	1	Solid
BF-P-8 2	18-10-0415-15	09/12/18 11:00	1	Solid
BF-P-8 8	18-10-0415-16	09/12/18 11:05	1	Solid
BF-P-9 2	18-10-0415-17	09/12/18 11:40	1	Solid
BF-P-9 8	18-10-0415-18	09/12/18 11:45	1	Solid
BF-P-10 2	18-10-0415-19	09/12/18 13:10	1	Solid
BF-P-10 8	18-10-0415-20	09/12/18 13:15	1	Solid
BF-P-11 2	18-10-0415-21	09/12/18 14:05	1	Solid
BF-P-11 8	18-10-0415-22	09/12/18 14:10	1	Solid
BF-P-12 2	18-10-0415-23	09/12/18 16:00	1	Solid
BF-P-12 8	18-10-0415-24	09/12/18 16:05	1	Solid

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Analytical Report

Western Environmental Testing Laboratory
475 E Greg Street #119
Sparks, NV 89431-6548

Project: 18090719

Date Received: 10/05/18
Work Order: 18-10-0415
Preparation: N/A
Method: EPA 9060A
Units: mg/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BF-P-1 2	**18-10-0415-1-A**	**09/11/18 10:30**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 15:44**	**I1009TOCL1**

Comment(s): - Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qualifiers
Carbon, Total Organic	1400	550	1.00	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BF-P-1 8	**18-10-0415-2-A**	**09/11/18 10:45**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 15:44**	**I1009TOCL1**

Comment(s): - Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qualifiers
Carbon, Total Organic	ND	540	1.00	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BF-P-2 2	**18-10-0415-3-A**	**09/11/18 11:22**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 15:44**	**I1009TOCL1**

Comment(s): - Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qualifiers
Carbon, Total Organic	1200	580	1.00	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BF-P-2 8	**18-10-0415-4-A**	**09/11/18 11:25**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 15:44**	**I1009TOCL1**

Comment(s): - Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qualifiers
Carbon, Total Organic	ND	530	1.00	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BF-P-3 2	**18-10-0415-5-A**	**09/11/18 12:30**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 15:44**	**I1009TOCL1**

Comment(s): - Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qualifiers
Carbon, Total Organic	1800	590	1.00	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BF-P-3 8	**18-10-0415-6-A**	**09/11/18 12:35**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 15:44**	**I1009TOCL1**

Comment(s): - Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qualifiers
Carbon, Total Organic	ND	610	1.00	

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RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Western Environmental Testing Laboratory		Date Received:	10/05/18
475 E Greg Street #119		Work Order:	18-10-0415
Sparks, NV 89431-6548		Preparation:	N/A
		Method:	EPA 9060A
		Units:	mg/kg
Project: 18090719			Page 2 of 5

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BF-P-4 2	**18-10-0415-7-A**	**09/11/18 12:55**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 15:44**	**I1009TOCL1**

Comment(s): - Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qualifiers
Carbon, Total Organic	ND	520	1.00	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BF-P-4 8	**18-10-0415-8-A**	**09/11/18 13:00**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 15:44**	**I1009TOCL1**

Comment(s): - Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qualifiers
Carbon, Total Organic	ND	520	1.00	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BF-P-5 2	**18-10-0415-9-A**	**09/11/18 14:00**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 15:44**	**I1009TOCL1**

Comment(s): - Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qualifiers
Carbon, Total Organic	ND	520	1.00	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BF-P-5 8	**18-10-0415-10-A**	**09/11/18 14:05**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 15:44**	**I1009TOCL1**

Comment(s): - Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qualifiers
Carbon, Total Organic	ND	530	1.00	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BF-P-6 3	**18-10-0415-11-A**	**09/11/18 00:00**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 15:44**	**I1009TOCL1**

Comment(s): - Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qualifiers
Carbon, Total Organic	ND	620	1.00	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BF-P-6 8	**18-10-0415-12-A**	**09/12/18 00:00**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 15:44**	**I1009TOCL1**

Comment(s): - Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qualifiers
Carbon, Total Organic	ND	520	1.00	

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RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Western Environmental Testing Laboratory		Date Received:	10/05/18
475 E Greg Street #119		Work Order:	18-10-0415
Sparks, NV 89431-6548		Preparation:	N/A
		Method:	EPA 9060A
		Units:	mg/kg
Project: 18090719			Page 3 of 5

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BF-P-7 2	**18-10-0415-13-A**	**09/12/18 10:10**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 15:44**	**I1009TOCL1**

Comment(s): - Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qualifiers
Carbon, Total Organic	ND	550	1.00	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BF-P-7 8	**18-10-0415-14-A**	**09/12/18 10:15**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 15:44**	**I1009TOCL1**

Comment(s): - Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qualifiers
Carbon, Total Organic	ND	530	1.00	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BF-P-8 2	**18-10-0415-15-A**	**09/12/18 11:00**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 15:44**	**I1009TOCL1**

Comment(s): - Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qualifiers
Carbon, Total Organic	ND	520	1.00	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BF-P-8 8	**18-10-0415-16-A**	**09/12/18 11:05**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 15:44**	**I1009TOCL1**

Comment(s): - Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qualifiers
Carbon, Total Organic	ND	510	1.00	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BF-P-9 2	**18-10-0415-17-A**	**09/12/18 11:40**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 15:44**	**I1009TOCL1**

Comment(s): - Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qualifiers
Carbon, Total Organic	ND	580	1.00	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BF-P-9 8	**18-10-0415-18-A**	**09/12/18 11:45**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 15:44**	**I1009TOCL1**

Comment(s): - Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qualifiers
Carbon, Total Organic	ND	520	1.00	

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RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Western Environmental Testing Laboratory
475 E Greg Street #119
Sparks, NV 89431-6548

Project: 18090719

Date Received: 10/05/18
Work Order: 18-10-0415
Preparation: N/A
Method: EPA 9060A
Units: mg/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BF-P-10 2	**18-10-0415-19-A**	**09/12/18 13:10**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 15:44**	**I1009TOCL1**

Comment(s): - Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qualifiers
Carbon, Total Organic	1100	540	1.00	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BF-P-10 8	**18-10-0415-20-A**	**09/12/18 13:15**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 14:11**	**I1009TOCL2**

Comment(s): - Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qualifiers
Carbon, Total Organic	1600	520	1.00	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BF-P-11 2	**18-10-0415-21-A**	**09/12/18 14:05**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 14:11**	**I1009TOCL2**

Comment(s): - Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qualifiers
Carbon, Total Organic	720	570	1.00	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BF-P-11 8	**18-10-0415-22-A**	**09/12/18 14:10**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 14:11**	**I1009TOCL2**

Comment(s): - Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qualifiers
Carbon, Total Organic	ND	620	1.00	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BF-P-12 2	**18-10-0415-23-A**	**09/12/18 16:00**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 14:11**	**I1009TOCL2**

Comment(s): - Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qualifiers
Carbon, Total Organic	ND	520	1.00	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BF-P-12 8	**18-10-0415-24-A**	**09/12/18 16:05**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 14:11**	**I1009TOCL2**

Comment(s): - Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qualifiers
Carbon, Total Organic	ND	600	1.00	

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RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Western Environmental Testing Laboratory
475 E Greg Street #119
Sparks, NV 89431-6548

Project: 18090719

Date Received: 10/05/18
Work Order: 18-10-0415
Preparation: N/A
Method: EPA 9060A
Units: mg/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**099-06-013-1904**	**N/A**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 15:44**	**I1009TOCL1**

Parameter	Result	RL	DF	Qualifiers
Carbon, Total Organic	ND	500	1.00	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**099-06-013-1905**	**N/A**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 14:11**	**I1009TOCL2**

Parameter	Result	RL	DF	Qualifiers
Carbon, Total Organic	ND	500	1.00	

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RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Quality Control - Spike/Spike Duplicate

Western Environmental Testing Laboratory		Date Received:	10/05/18
475 E Greg Street #119		Work Order:	18-10-0415
Sparks, NV 89431-6548		Preparation:	N/A
		Method:	EPA 9060A
Project: 18090719			Page 1 of 2

Quality Control Sample ID	Type	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
BF-P-1 2	**Sample**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 15:44**	**I1009TOCS1**
BF-P-1 2	**Matrix Spike**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 15:44**	**I1009TOCS1**
BF-P-1 2	**Matrix Spike Duplicate**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 15:44**	**I1009TOCS1**

Parameter	Sample Conc.	Spike Added	MS Conc.	MS %Rec.	MSD Conc.	MSD %Rec.	%Rec. CL	RPD	RPD CL	Qualifiers
Carbon, Total Organic	1320	30000	26090	83	26020	82	75-125	0	0-25	

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RPD: Relative Percent Difference. CL: Control Limits

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Quality Control - Spike/Spike Duplicate

Western Environmental Testing Laboratory
475 E Greg Street #119
Sparks, NV 89431-6548

Project: 18090719

Date Received: 10/05/18
Work Order: 18-10-0415
Preparation: N/A
Method: EPA 9060A

Quality Control Sample ID	Type	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
18-10-0086-1	**Sample**	**Sediment**	**TOC 10**	**10/09/18**	**10/11/18 14:11**	**I1009TOCS2**
18-10-0086-1	**Matrix Spike**	**Sediment**	**TOC 10**	**10/09/18**	**10/11/18 14:11**	**I1009TOCS2**
18-10-0086-1	**Matrix Spike Duplicate**	**Sediment**	**TOC 10**	**10/09/18**	**10/11/18 14:11**	**I1009TOCS2**

Parameter	Sample Conc.	Spike Added	MS Conc.	MS %Rec.	MSD Conc.	MSD %Rec.	%Rec. CL	RPD	RPD CL	Qualifiers
Carbon, Total Organic	3460	30000	30080	89	31000	92	75-125	3	0-25	

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RPD: Relative Percent Difference. CL: Control Limits

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Quality Control - LCS/LCSD

Western Environmental Testing Laboratory
475 E Greg Street #119
Sparks, NV 89431-6548

Project: 18090719

Date Received: 10/05/18
Work Order: 18-10-0415
Preparation: N/A
Method: EPA 9060A

Quality Control Sample ID	Type	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
099-06-013-1904	**LCS**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 15:44**	**I1009TOCL1**
099-06-013-1904	**LCSD**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 15:44**	**I1009TOCL1**

Parameter	Spike Added	LCS Conc.	LCS %Rec.	LCSD Conc.	LCSD %Rec.	%Rec. CL	RPD	RPD CL	Qualifiers
Carbon, Total Organic	6000	6209	103	5728	95	80-120	8	0-20	

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RPD: Relative Percent Difference. CL: Control Limits

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Quality Control - LCS/LCSD

Western Environmental Testing Laboratory
475 E Greg Street #119
Sparks, NV 89431-6548

Project: 18090719

Date Received: 10/05/18
Work Order: 18-10-0415
Preparation: N/A
Method: EPA 9060A

Quality Control Sample ID	Type	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
099-06-013-1905	**LCS**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 14:11**	**I1009TOCL2**
099-06-013-1905	**LCSD**	**Solid**	**TOC 10**	**10/09/18**	**10/11/18 14:11**	**I1009TOCL2**

Parameter	Spike Added	LCS Conc.	LCS %Rec.	LCSD Conc.	LCSD %Rec.	%Rec. CL	RPD	RPD CL	Qualifiers
Carbon, Total Organic	6000	6103	102	5958	99	80-120	2	0-20	

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RPD: Relative Percent Difference. CL: Control Limits

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Sample Analysis Summary Report

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Method	Extraction	Chemist ID	Instrument	Analytical Location
EPA 9060A	N/A	834	TOC 10	1
EPA 9060A	N/A	1166	TOC 10	1

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Glossary of Terms and Qualifiers

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Qualifiers	Definition
*	See applicable analysis comment.
<	Less than the indicated value.
>	Greater than the indicated value.
1	Surrogate compound recovery was out of control due to a required sample dilution. Therefore, the sample data was reported without further clarification.
2	Surrogate compound recovery was out of control due to matrix interference. The associated method blank surrogate spike compound was in control and, therefore, the sample data was reported without further clarification.
3	Recovery of the Matrix Spike (MS) or Matrix Spike Duplicate (MSD) compound was out of control due to suspected matrix interference. The associated LCS recovery was in control.
4	The MS/MSD RPD was out of control due to suspected matrix interference.
5	The PDS/PDSD or PES/PESD associated with this batch of samples was out of control due to suspected matrix interference.
6	Surrogate recovery below the acceptance limit.
7	Surrogate recovery above the acceptance limit.
B	Analyte was present in the associated method blank.
BU	Sample analyzed after holding time expired.
BV	Sample received after holding time expired.
CI	See case narrative.
E	Concentration exceeds the calibration range.
ET	Sample was extracted past end of recommended max. holding time.
HD	The chromatographic pattern was inconsistent with the profile of the reference fuel standard.
HDH	The sample chromatographic pattern for TPH matches the chromatographic pattern of the specified standard but heavier hydrocarbons were also present (or detected).
HDL	The sample chromatographic pattern for TPH matches the chromatographic pattern of the specified standard but lighter hydrocarbons were also present (or detected).
J	Analyte was detected at a concentration below the reporting limit and above the laboratory method detection limit. Reported value is estimated.
JA	Analyte positively identified but quantitation is an estimate.
ME	LCS Recovery Percentage is within Marginal Exceedance (ME) Control Limit range (+/- 4 SD from the mean).
ND	Parameter not detected at the indicated reporting limit.
Q	Spike recovery and RPD control limits do not apply resulting from the parameter concentration in the sample exceeding the spike concentration by a factor of four or greater.
SG	The sample extract was subjected to Silica Gel treatment prior to analysis.
X	% Recovery and/or RPD out-of-range.
Z	Analyte presence was not confirmed by second column or GC/MS analysis.
	Solid - Unless otherwise indicated, solid sample data is reported on a wet weight basis, not corrected for % moisture. All QC results are reported on a wet weight basis.
	Any parameter identified in 40CFR Part 136.3 Table II that is designated as "analyze immediately" with a holding time of <= 15 minutes (40CFR-136.3 Table II, footnote 4), is considered a "field" test and the reported results will be qualified as being received outside of the stated holding time unless received at the laboratory within 15 minutes of the collection time.
	A calculated total result (Example: Total Pesticides) is the summation of each component concentration and/or, if "J" flags are reported, estimated concentration. Component concentrations showing not detected (ND) are summed into the calculated total result as zero concentrations.

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WETLAB
WESTERN ENVIRONMENTAL TESTING LABORATORY

CHAIN OF CUSTODY RECORD

18-10-0415

Western Environmental Testing Laboratory
475 E. Greg Street #119
Sparks, NV 89431
Logan Greenwood Ph: (775) 355-0202
LoganG@wetlaboratory.com Fax: (775) 355-0817

Total # of sample containers: 24

3783

Subcontractor: ASEP

All Samples Refrigerated?: Y X N ___
Compliance: Y ___ N X
CA Write ON: Y ___ N X
QC: Y X N ___
Water System #:

Sample Receipt Condition:
Temperature: 2.4°C IR#2

Job ID
18090719

Notes:

Sample Date/Time	Sample ID - Site ID	Matrix	Parameter	SampleNumber
9/11/2018 10:30 AM	BF-P-1 2 - 1	Soil	Total Organic Carbon (TOC)	18090719-001
9/11/2018 10:45 AM	BF-P-1 8 - 2	Soil	Total Organic Carbon (TOC)	18090719-002
9/11/2018 11:22 AM	BF-P-2 2 - 3	Soil	Total Organic Carbon (TOC)	18090719-003
9/11/2018 11:25 AM	BF-P-2 8 - 4	Soil	Total Organic Carbon (TOC)	18090719-004
9/11/2018 12:30 PM	BF-P-3 2 - 5	Soil	Total Organic Carbon (TOC)	18090719-005
9/11/2018 12:35 PM	BF-P-3 8 - 6	Soil	Total Organic Carbon (TOC)	18090719-006
9/11/2018 12:55 PM	BF-P-4 2 - 7	Soil	Total Organic Carbon (TOC)	18090719-007
9/11/2018 1:00 PM	BF-P-4 8 - 8	Soil	Total Organic Carbon (TOC)	18090719-008
9/11/2018 2:00 PM	BF-P-5 2 - 9	Soil	Total Organic Carbon (TOC)	18090719-009

WETLAB
WESTERN ENVIRONMENTAL TESTING LABORATORY

CHAIN OF CUSTODY RECORD

0415

9/11/2018 2:05 PM	BF-P-5 8 - 10	Soil	Total Organic Carbon (TOC)	18090719-010
9/11/2018	BF-P-6 3 - 11	Soil	Total Organic Carbon (TOC)	18090719-011
9/12/2018	BF-P-6 8 - 12	Soil	Total Organic Carbon (TOC)	18090719-012
9/12/2018 10:10 AM	BF-P-7 2 - 13	Soil	Total Organic Carbon (TOC)	18090719-013
9/12/2018 10:15 AM	BF-P-7 8 - 14	Soil	Total Organic Carbon (TOC)	18090719-014
9/12/2018 11:00 AM	BF-P-8 2 - 15	Soil	Total Organic Carbon (TOC)	18090719-015
9/12/2018 11:05 AM	BF-P-8 8 - 16	Soil	Total Organic Carbon (TOC)	18090719-016
9/12/2018 11:40 AM	BF-P-9-2 - 17	Soil	Total Organic Carbon (TOC)	18090719-017
9/12/2018 11:45 AM	BF-P-9-8 - 18	Soil	Total Organic Carbon (TOC)	18090719-018
9/12/2018 1:10 PM	BF-P-10 2 - 19	Soil	Total Organic Carbon (TOC)	18090719-019
9/12/2018 1:15 PM	BF-P-10 8 - 20	Soil	Total Organic Carbon (TOC)	18090719-020
9/12/2018 2:05 PM	BF-P-11 2 - 21	Soil	Total Organic Carbon (TOC)	18090719-021
9/12/2018 2:10 PM	BF-P-11 8 - 22	Soil	Total Organic Carbon (TOC)	18090719-022

WETLAB
WESTERN ENVIRONMENTAL TESTING LABORATORY

CHAIN OF CUSTODY RECORD

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9/12/2018 4:00 PM	BF-P-12 2 - 23	Soil	Total Organic Carbon (TOC)	18090719-023
9/12/2018 4:05 PM	BF-P-12 8 - 24	Soil	Total Organic Carbon (TOC)	18090719-024

Relinquished by: (Signature) Michelle Lee	Date: 10/1/18	Time: 1500	Received by: (Signature) GSO	1745		
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	10/2/18	10:15	
Relinquished by: (Signature)	Date: 10/4/18	Time: 11:15	Received by: (Signature) Jaynthughes	10.4.18	1115	

Jaynthughes 10/4/18 11:36 Enhouse 10.4.18 11:36 @ 18.6°C JH 10.4.18

Enhouse 10/4/18@1530 GSO 10/4/18 @1530

18/5/18 0830

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10/4/2018

GSO a GLS company GLS

800-322-5555
www.gso.com

Ship From
WESTERN ENVIRONMENTAL TESTING LABORATORY
LISA MASON
3230 POLARIS AVE. #3 & 4
LAS VEGAS, NV 89102

Ship To
EUROFINS CALSCIENCE
JULIE LAM
7440 LINCOLN WAY
GARDEN GROVE, CA 92841

COD: $0.00
Weight: 31 lb(s)
Reference:
LAS VEGAS
Delivery Instructions:

Signature Type: NOT REQUIRED

Tracking #: 542299803

EPS

ORC **C**

GARDEN GROVE

S92841A

91672657

Print Date: 10/4/2018 1:53 PM

LABEL INSTRUCTIONS:

Do not copy or reprint this label for additional shipments - each package must have a unique barcode.
Step 1: Use the "Print Label" button on this page to print the shipping label on a laser or inkjet printer.
Step 2: Fold this page in half.
Step 3: Securely attach this label to your package and do not cover the barcode.

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WORK ORDER NUMBER: 18-10-0215

SAMPLE RECEIPT CHECKLIST

COOLER 1 OF 1

CLIENT: WETLAB

DATE: 10/05/2018

TEMPERATURE: (Criteria: 0.0°C – 6.0°C, not frozen except sediment/tissue)

Thermometer ID: SC6 (CF: 0.0°C); Temperature (w/o CF): 2.2 °C (w/ CF): 2.2 °C; ☑ Blank ☐ Sample

☐ Sample(s) outside temperature criteria (PM/APM contacted by: _____)

☐ Sample(s) outside temperature criteria but received on ice/chilled on same day of sampling

☐ Sample(s) received at ambient temperature; placed on ice for transport by courier

Ambient Temperature: ☐ Air ☐ Filter Checked by: VJ6P

CUSTODY SEAL:

Cooler ☑ Present and Intact ☐ Present but Not Intact ☐ Not Present ☐ N/A Checked by: VJ6P

Sample(s) ☐ Present and Intact ☐ Present but Not Intact ☑ Not Present ☐ N/A Checked by: UDZL

SAMPLE CONDITION:	Yes	No	N/A
Chain-of-Custody (COC) document(s) received with samples	☑	☐	☐
COC document(s) received complete	☑	☑	☐
☐ Sampling date ☑ Sampling time ☐ Matrix ☐ Number of containers			
☐ No analysis requested ☐ Not relinquished ☐ No relinquished date ☐ No relinquished time			
Sampler's name indicated on COC	☐	☐	☑
Sample container label(s) consistent with COC	☑	☐	☐
Sample container(s) intact and in good condition	☐	☑	☐
Proper containers for analyses requested	☑	☐	☐
Sufficient volume/mass for analyses requested	☑	☐	☐
Samples received within holding time	☑	☐	☐
Aqueous samples for certain analyses received within 15-minute holding time			
☐ pH ☐ Residual Chlorine ☐ Dissolved Sulfide ☐ Dissolved Oxygen	☐	☐	☑
Proper preservation chemical(s) noted on COC and/or sample container	☐	☐	☑
Unpreserved aqueous sample(s) received for certain analyses			
☐ Volatile Organics ☐ Total Metals ☐ Dissolved Metals			
Acid/base preserved samples - pH within acceptable range	☐	☐	☑
Container(s) for certain analysis free of headspace	☐	☐	☑
☐ Volatile Organics ☐ Dissolved Gases (RSK-175) ☐ Dissolved Oxygen (SM 4500)			
☐ Carbon Dioxide (SM 4500) ☐ Ferrous Iron (SM 3500) ☐ Hydrogen Sulfide (Hach)			
Tedlar™ bag(s) free of condensation	☐	☐	☑

CONTAINER TYPE: (Trip Blank Lot Number: _____)

Aqueous: ☐ VOA ☐ VOA**h** ☐ VOA**na$_2$** ☐ 100PJ ☐ 100PJ**na$_2$** ☐ 125AGB ☐ 125AGB**h** ☐ 125AGB**p** ☐ 125PB ☐ 125PB**znna** (pH__9)

☐ 250AGB ☐ 250CGB ☐ 250CGB**s** (pH__2) ☐ 250PB ☐ 250PB**n** (pH__2) ☐ 500AGB ☐ 500AGJ ☐ 500AGJ**s** (pH__2) ☐ 500PB

☐ 1AGB ☐ 1AGB**na$_2$** ☐ 1AGB**s** (pH__2) ☐ 1AGB**s** (O&G) ☐ 1PB ☐ 1PB**na** (pH__12) ☐ _____ ☐ _____ ☐ _____

Solid: ☑ 4ozCGJ ☐ 8ozCGJ ☐ 16ozCGJ ☐ Sleeve (___) ☐ EnCores® (___) ☐ TerraCores® (___) ☐ _____ ☐ _____ ☐ _____

Air: ☐ Tedlar™ ☐ Canister ☐ Sorbent Tube ☐ PUF ☐ _____ **Other Matrix** (_____): ☐ _____ ☐ _____ ☐ _____

Container: **A** = Amber, **B** = Bottle, **C** = Clear, **E** = Envelope, **G** = Glass, **J** = Jar, **P** = Plastic, and **Z** = Ziploc/Resealable Bag

Preservative: **b** = buffered, **f** = filtered, **h** = HCl, **n** = HNO_3, **na** = NaOH, **na$_2$** = $Na_2S_2O_3$, **p** = H_3PO_4, Labeled/Checked by: UDZL

s = H_2SO_4, **u** = ultra-pure, **x** = Na_2SO_3+$NaHSO_4.H_2O$, **znna** = Zn $(CH_3CO_2)_2$ + NaOH Reviewed by: HMW

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WORK ORDER NUMBER: 18-10- 0415

SAMPLE ANOMALY REPORT

DATE: 10/05/2018

SAMPLES, CONTAINERS, AND LABELS:

- ☐ Sample(s) NOT RECEIVED but listed on COC
- ☐ Sample(s) received but NOT LISTED on COC
- ☐ Holding time expired (list client or ECI sample ID and analysis)
- ☐ Insufficient sample amount for requested analysis (list analysis)
- ☐ Improper container(s) used (list analysis)
- ☐ Improper preservative used (list analysis)
- ☐ pH outside acceptable range (list analysis)
- ☐ No preservative noted on COC or label (list analysis and notify lab)
- ☐ Sample container(s) not labeled
- ☐ Client sample label(s) illegible (list container type and analysis)
- ☑ Client sample label(s) do not match COC (comment)
  - ☐ Project information
  - ☐ Client sample ID
  - ☑ Sampling date and/or time
  - ☐ Number of container(s)
  - ☐ Requested analysis
- ☑ Sample container(s) compromised (comment)
  - ☐ Broken
  - ☑ Water present in sample container
- ☐ Air sample container(s) compromised (comment)
  - ☐ Flat
  - ☐ Very low in volume
  - ☐ Leaking (not transferred; duplicate bag submitted)
  - ☐ Leaking (transferred into ECI Tedlar™ bags*)
  - ☐ Leaking (transferred into client's Tedlar™ bags*)

* Transferred at client's request.

Comments

* (-11), (-17), (-22), (-24) water present in sample container.

(-11) (-12) NO collection time per label.

MISCELLANEOUS: (Describe)

Comments

HEADSPACE:

(Containers with bubble > 6 mm or ¼ inch for volatile organic or dissolved gas analysis)

ECI Sample ID	ECI Container ID	Total Number**	ECI Sample ID	ECI Container ID	Total Number**

(Containers with bubble for other analysis)

ECI Sample ID	ECI Container ID	Total Number**	Requested Analysis

Comments: _____

** Record the total number of containers (i.e., vials or bottles) for the affected sample.

Reported by: UDL

Reviewed by: HMW

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