MONTGOMERY & ASSOCIATES
Water Resource Consultants

Report

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Prepared for: CAP CENTRAL ARIZONA PROJECT

Results of Exploration Drilling and Piezometer Array Installation Tonopah Desert Recharge Project

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MARICOPA COUNTY, ARIZONA

Contents

Tables

Contents – continued

Illustrations

Appendices

1 EXECUTIVE SUMMARY

Montgomery & Associates (M&A) has prepared this report summarizing results of exploration drilling and piezometer array installation in support of recovery planning for the Tonopah Desert Recharge Project (TDRP). The purpose of exploration drilling was to obtain lithologic and water quality data for the previously unexplored deep part of the aquifer at the TDRP site. The piezometer array was installed for use in monitoring groundwater levels during future aquifer testing. Data from exploration drilling and aquifer testing will provide a basis for refining plans and estimated costs for recovery and treatment of stored water.

The drilling and sampling program included:

- drilling of three exploration boreholes to depths ranging from 1,200 to 1,440 feet
- preparation of drill cuttings descriptions
- monitoring of drilling penetration rates, airlift groundwater production rates, and field water quality parameters
- acquisition of groundwater samples for laboratory chemical analysis
- acquisition of borehole geophysical logs
- completion of one of the boreholes as a grouted-in piezometer array for groundwater level monitoring during subsequent aquifer testing

Hydrogeologic Units. The aquifer at the TDRP site consists of various mixtures of sand and gravel, with relatively small amounts of silt. Analysis of drill cuttings and borehole geophysical logs indicates that these sediments are more lithified in the lower part of the aquifer than in the upper part. Based on degree of lithification, the aquifer is divided into an upper alluvium unit and a lower alluvium unit. The upper alluvium unit extends from land surface to depths in the range of 500 to 600 feet, and consists chiefly of weakly-lithified and weakly- to moderately lithified alluvium. Groundwater level occurs in the upper alluvium unit, at a depth of about 270 feet in the south part of the site and about 310 feet in the north part of the site. The underlying lower alluvium unit consists chiefly of moderately-lithified to well-lithified alluvium, with some interbedded volcanic rocks below 1,180 feet. Due to the

larger degree of lithification, the lower alluvium unit is believed to be substantially less permeable than the upper alluvium unit.

Water Quality. Results of water quality sampling and analyses indicate a general trend of decreasing concentrations of total dissolved solids (TDS) with depth in the aquifer, which is believed to reflect a decreasing influence from recharge of Central Arizona Project (CAP) water.

Results for arsenic indicate a general trend of increasing concentrations with depth. Arsenic concentrations appear to increase most dramatically below depths of about 800 to 900 feet at all three boreholes, possibly reflecting less influence from CAP water below these depths. Although recharge of CAP water appears to have reduced arsenic concentrations, particularly to depths of 800 to 900 feet, concentrations remain above the Maximum Contaminant Level (MCL) below 900 feet in the north part of the site, below 600 feet in the central part of the site, and below 320 feet in the south part.

Results for fluoride also indicate a general trend of increasing concentrations with depth. Concentrations increase most dramatically below a depth of about 600 feet in the north part of the site, and below about 700 feet in the central and south parts of the site. However, concentrations are below the MCL of 4 milligrams per liter (mg/L) to depths of about 900 feet in the north and central parts of the site, and to a depth of about 800 feet in the south part of the site.

Implications for Recovery of Stored Water. Results from the exploration drilling program indicate that, with respect to aquifer permeability and concentrations of arsenic and fluoride, aquifer conditions are more favorable for recovery in the upper part of the aquifer (including upper alluvium unit and upper part of lower alluvium unit), than in the lower part. Planned recovery well depths should be reduced from 1,500 feet to about 900 feet due to small aquifer hydraulic conductivity and poor groundwater quality below 900 feet. Recovery well yields are expected to be smaller than previously assumed for the 2015 recovery plan update. Therefore, more than nine recovery wells would be needed to produce 30,000 acre-feet per year (AF/yr) at full build out. However, capital cost per well would be reduced because the wells would be constructed with smaller diameter casing and would be equipped with smaller pumps.

Recovery wells should be located in the north and central parts of the TDRP site to avoid the higher concentrations of arsenic that appear to occur in the south part of the site.

If recovery wells are located in north and central parts of the site, and are completed to a depth of about 900 feet, initial and final concentrations of arsenic and fluoride may be similar to the concentrations previously assumed for the 2015 recovery plan update.

Recommendations. Results of the exploration drilling program indicate that deeper part of the aquifer at the TDRP site is more lithified and less permeable than the upper part of the aquifer, and that concentrations of arsenic and fluoride increase with depth. The chemical quality of recovered water will depend not only on constituent concentrations, but also on vertical variations in hydraulic conductivity, which will control relative contributions of groundwater from various aquifer intervals to the recovery wells. However, aquifer hydraulic properties have not yet been quantified.

In order to determine vertical variations in hydraulic conductivity and concentrations of arsenic and fluoride in recovered water, it is recommended that a pilot recovery well be installed with three separate perforated intervals that can be isolated and tested individually. An inflatable packer would be used to isolate intervals for testing. The pilot recovery well should be located near exploration borehole EX-B, so that the grouted-in piezometers installed at EX-B can be used to monitor groundwater level response to pumping. It is recommended that the pilot recovery well be constructed to a depth of 900 to 1,000 feet, with 10-inch diameter casing in order to accommodate an 8-inch diameter test pump.

Three pumping tests should be conducted: one for all three perforated intervals open, the second with only the middle and upper intervals open, and the third with only the upper interval open. Data from the three tests would be analyzed to determine aquifer hydraulic properties and chemical quality of recovered for each of the three individual aquifer intervals as well as combinations of intervals. These results, in combination with results from the exploration drilling program will provide a basis for refining plans and estimated costs for recovery and treatment of stored water.

2 INTRODUCTION

In accordance with arrangements with Central Arizona Project (CAP), Montgomery & Associates (M&A) has prepared this report summarizing results of exploration drilling and piezometer array installation in support of recovery planning for the Tonopah Desert Recharge Project (TDRP). The TDRP has been used to store Colorado River water supplies underground on behalf of CAP customers. During times of shortage when deliveries of CAP and Colorado River water are curtailed, the stored water will be recovered, conveyed to the CAP canal, and delivered to CAP customers. TDRP is located in the Lower Hassayampa Basin in western Maricopa County. The facility location is shown on **Figure 1** and a site map is shown on **Figure 2**.

The exploration drilling program was conducted to obtain lithologic and water quality data for the previously unexplored deep part of the aquifer at the TDRP site. The piezometer array installed as part of the drilling program will be used to monitor aquifer response during subsequent aquifer testing. Data from the drilling program and aquifer testing will provide a basis for refining plans and estimated costs for recovery and treatment of stored water.

2.1 Previous Investigations

M&A conducted several investigations that led to the siting, design, and permitting of TDRP (M&A, 2001; 2003a; 2003b, 2006; 2007). In 2005, TDRP was permitted as an Underground Storage Facility (USF) by the Arizona Department of Water Resources to store up to 150,000 acre-feet per year (AF/yr) of CAP water, with a maximum permitted storage volume of 2,000,000 AF over a 20-year period. Since TDRP recharge operations commenced in 2006, approximately 806,000 AF of Arizona's Colorado River water was stored at TDRP by the end of 2014.

A conceptual recovery plan was initially developed in 2009 (M&A, 2009) and was updated in 2015 (M&A, 2015). The recovery plan was updated to reflect changes in schedule and volumes of recovery, and the need to treat recovered water to drinking water standards. The updated conceptual recovery plan included nine recovery wells constructed to a depth of 1,500 feet, and water treatment facilities to reduce concentrations of arsenic and fluoride in recovered water.

2.2 Project Purpose and Scope

The purpose of the exploration drilling program was to obtain additional lithologic and groundwater quality data for the aquifer in the area of the planned recovery wellfield, particularly the deeper unexplored parts of the aquifer. Previously existing data on the aquifer at or adjacent to the TDRP site were limited to data obtained from exploration borehole TD-B and monitor wells MW-1 and MW-2 (**Figure 2**). The exploration borehole TD-B was drilled to a depth of 780 feet below land surface (bls), approximately 290 feet below groundwater level under pre-recharge conditions; however, the two monitor wells were completed to depths of only 518 and 545 feet bls, only about 70 feet below pre-recharge groundwater level. No information on geologic conditions or groundwater chemistry had been obtained below a depth of 780 feet bls.

The drilling and sampling program included:

- drilling of three exploration boreholes to depths ranging from 1,200 to 1,440 feet
- preparation of drill cuttings descriptions
- monitoring of drilling penetration rates, airlift groundwater production rates, and field water quality parameters
- acquisition of groundwater samples for laboratory chemical analysis
- acquisition of borehole geophysical logs
- completion of one of the boreholes as a grouted-in piezometer array for groundwater level monitoring during subsequent aquifer testing

2.3 Hydrogeologic Framework

The TDRP site is located in the northwest part of the Lower Hassayampa Basin in western Maricopa County (**Figure 1**). This groundwater basin is part of the Basin and Range physiographic province of the western United States, which is characterized by fault-bounded basins that are filled with alluvial sediments eroded from surrounding mountains. This basin-fill alluvium consists of interbedded strata of poorly sorted gravel, sand, silt, and clay, and comprises the primary water-bearing units in the region. Detailed descriptions and references for stratigraphy,

hydrogeologic conditions, and groundwater resources for the Lower Hassayampa Basin and the TDRP site are provided in previous reports (M&A, 2001, 2003a, 2003b, 2006, 2007, 2009, 2015).

Information for characterization of aquifer hydraulic parameters in the vicinity of the TDRP site is limited to two short-term pumping tests conducted at monitor wells at the TDRP site (M&A, 2006) and aquifer parameters determined from calibration of the TDRP groundwater flow model. The groundwater flow model was developed to project water level response to recharge and recovery operations and transport of nitrate in the aquifer (M&A, 2003b, 2007, 2009, 2015).

Groundwater quality at or near the TDRP site had previously been characterized based on laboratory analyses of samples obtained from TDRP monitor wells MW-1 and MW-2 from 2005 through 2014, and from exploration borehole TD-B in 2001. Monitor well and borehole locations are shown on **Figure 2**. Monitor wells MW-1 and MW-2 are completed to depths of 518 and 545 feet, respectively, approximately 70 feet below groundwater level at the time of construction. Borehole TD-B was drilled to a depth of 780 feet, about 286 feet below groundwater level at the time of drilling.

Due to the differences in water chemistry between native groundwater and CAP water, concentrations of inorganic constituents in groundwater changed substantially as a result of recharge operations from 2006 through 2014. Concentrations of major cations and anions, and total dissolved solids (TDS) are higher in CAP water than in native groundwater. Concentrations of fluoride, nitrate, and trace metals are higher in native groundwater than in CAP water.

Based on samples obtained from borehole TD-B and monitor wells MW-1 and MW-2 before start of recharge in 2006, measured concentrations of TDS in native groundwater were in the range of 220 to 420 milligrams per liter (mg/L). Concentrations of arsenic in native groundwater were in the range of 0.018 to 0.21 mg/L, approximately 2 to 20 times higher than the primary Maximum Contaminant Level (MCL) of 0.010 mg/L. Concentrations of fluoride were in the range of 5.1 to 6.1 mg/L, slightly above the MCL of 4 mg/L (M&A, 2015).

Based on samples obtained from monitor wells MW-1 and MW-2 in late 2014, post-recharge concentrations of TDS were 620 and 640 mg/L, respectively; concentration of arsenic was 0.016 mg/L, and concentrations of fluoride were 1.7 and 3.0 mg/L, respectively.

3 PROJECT METHODS

3.1 Drilling and Sampling

3.1.1 Drilling Operations

Exploration boreholes EX-A, EX-B, and EX-C were drilled by Yellow Jacket Drilling Services (YJD) of Phoenix, Arizona using a Speedstar 110K drilling rig. The boreholes were drilled to total depths ranging from 1,200 to 1,440 feet bls. Borehole locations are shown on **Figure 2**, and key borehole information is summarized in **Table 1**.

Boreholes were then drilled using the dual-tube reverse-air-circulation method, with both downhole air hammer and tricone rotary drill bits. M&A field personnel monitored drilling operations, described drill cuttings samples, monitored groundwater discharge rates and field water quality parameters, and collected water samples for laboratory chemical analyses. Drilling penetration rate was monitored by both YJD drilling personnel and M&A field staff by recording drill start and stop times for each 20-foot drill rod. Deviation surveys were also regularly conducted by YJD, generally after 100-foot drilled intervals, using an A-1 Sure Shot deviation tool. Daily drilling reports were prepared by both CAP's on-site construction inspector and M&A field personnel.

After completion of drilling, borehole geophysical logs were obtained. Boreholes EX-A and EX-C were abandoned by filling with a high-solids bentonite grout and/or neat cement. Borehole EX-B was completed as a grouted-in piezometer array.

3.1.2 Lithologic Sample Collection and Description

Drill cuttings samples were collected in 10-foot composite intervals and placed in labeled bags. Splits of each sample were placed in labeled plastic chip trays and are stored by M&A. Detailed lithologic descriptions for each well based on drill cuttings samples were prepared in the field by M&A personnel and are given in **Appendix A**. Lithologic descriptions were prepared by evaluating and estimating particle size distribution, degree of lithification, and other relevant physical properties of the sediment and drill cuttings samples, chiefly using manual methods. Lithologic changes were subsequently interpreted using these descriptions in combination with borehole geophysical logs.

3.1.3 Groundwater Production and Water Quality Monitoring and Sampling

Utilizing the dual-tube reverse circulation drilling method to drill EX-A, EX-B, and EX-C made it possible to monitor groundwater production rates and water quality parameters, which included temperature, pH, specific electrical conductance, oxidation-reduction potential, turbidity, and sediment content. These data were recorded after the drilling of each 20-foot drill rod once the water table was encountered. After reaching the end depth of a 20-foot drill rod, air circulation was continued for 10 to 15 minutes to record the observations. The discharge rate was measured using a designated measuring container and stop watch.

Groundwater production rates generally increased with depth below the water table, ranging from less than 30 gallons per minute (gpm) near the water table to maximum rates of 136 gpm at 980 feet in borehole EX-A, 240 gpm at 1,080 feet in borehole EX-B, and 162 gpm at 780 feet in borehole EX-C.

Groundwater samples were collected by M&A personnel for laboratory analyses of common constituents and selected trace constituents. Samples were obtained at 100-foot depth intervals beginning near the depth where groundwater was first encountered. Samples were collected after a purge time of 10 to 30 minutes dependent upon the rate of parameter stabilization. Water quality samples were analyzed by ESC Lab Sciences (ESC) of Mt. Juliet, Tennessee. Samples were picked up daily by a laboratory courier working out of an ESC client support center in Phoenix, Arizona and delivered to their central laboratory for analysis. Chain of custody and traffic reports for all samples were completed and retained by M&A personnel.

A summary of field water quality parameters and concentrations of selected constituents for EX-A, EX-B, and EX-C is included in **Table 1**. Results of laboratory analysis of all groundwater samples collected for EX-A, EX-B, and EX-C are provided in **Tables 2, 3, and 4**, respectively.

3.1.4 Borehole Geophysical Logging

After each borehole was drilled to total depth, borehole geophysical logging was conducted by Southwest Exploration Services (SWE) of Chandler, Arizona. Logs obtained include: 3-arm caliper, fluid temperature, fluid resistivity, 8-, 16-, and 64-inch normal resistivity, single-point resistance, spontaneous potential, natural gamma ray, and sonic logs. SWE provided field and final data in digital format to

M&A and CAP staff. Geophysical logs for EX-A, EX-B, and EX-C are shown on **Figures 4**, **5**, **and 6**, respectively.

3.2 Piezometer Array

A piezometer array consisting of four grouted-in vibrating-wire pressure transducers was installed in exploration borehole EX-B during the period October 13-14, 2016. A schematic diagram of the grouted piezometer array is shown on **Figure 3**. On October 9, prior to installation of the array, a bentonite slurry was pumped into the completed borehole to promote stability for removal of the downhole drilling assembly, geophysical logging, and installation of the permanent grout pipe and transducers. On October 12, 2016 after geophysical logging was completed, a temporary 2-1/4 inch diameter steel tremie pipe was installed to a depth of 700 feet bls as a contingency for grouting operations in the event grouting to land surface could not be completed with the permanent grout pipe.

Beginning on October 13, 2016, the permanent grout pipe was installed from land surface to a depth of 1,170 feet bls. The pipe consisted of 2-3/8-inch outside diameter grade J-55 external upset end (EUE) tubing. During the pipe installation, four vibrating wire pressure transducers (VW's) manufactured by Geokon were attached to the outside of the pipe column to measure pore water pressures at various selected depths in the aquifer. The number and depth setting of the pressure transducers were recommended by M&A and approved by CAP after review of drill cutting samples and geophysical logs. Following installation, the transducers were wired into a Geokon LC-2X4 datalogger by M&A personnel. The piezometer installations in borehole EX-B are summarized in **Table 5** below. Calibration reports prepared by Geokon for each transducer are provided in **Appendix B**.

Table 5. Summary of Vibrating-Wire Pressure Transducers Installed in Borehole EX-B

Identifier	Model Number	Serial Number	Installed Depth (feet bls)	Pressure Rating (megapascals)
VW-1	Geokon 4500SH	1617466	1,050	5
VW-2	Geokon 4500SH	1617467	748	5
VW-3	Geokon 4500S	1618076	570	3
VW-4	Geokon 4500S	1616775	450	2

feet bls = feet below land surface

After the permanent grout pipe and instrumentation were installed in the borehole, pressure grout was installed by YJD using a Reed R40500 grout pump on October 14, 2016. The pressure grout was pre-mixed and delivered by Cemex in three consecutive truck loads, each containing a grout mixture volume of 7 cubic yards. The grout mix consisted of the following ratio by weight: 2.5 parts water; 1 part cement; 0.3 parts bentonite. Samples from each truck load were collected and measured for density using a mud balance prior to being pumped down hole. Each sample measured to specification between 10.5 and 10.6 pounds per gallon. The Cemex grout mixture from each truck load was installed by pumping through the grout pipe and up the borehole annulus. During pumping, the previously installed bentonite slurry was displaced, lifted to land surface, and channeled into the mud pit.

After the third truck load of grout was installed, the grout reached the surface but immediately began to settle down hole. The decision was made for YJD to hand mix additional grout on site to top off the grout level near surface. The tremie line was pulled up to a depth of 100 feet bls. The additional batches of grout were prepared by YJD using a grout mixer and were pumped down the tremie pipe in three lifts to bring the grout level to land surface. Each lift consisted of a mixture of 150 gallons of water, six 47-pound bags of Quikrete Portland Type III cement, and three 50-pound bags of Halliburton Quik-Gel Gold bentonite.

During lifting of the tremie pipe to a depth of 100 feel bls, accurate pressure and temperature readings from the lowermost transducer (VW-1 at 1,050 feet bls) could not be obtained, likely due to a discontinuity in the transducer cable down hole. After troubleshooting by M&A staff, it was determined that the damage was done only to the wiring for temperature readings, and accurate pressure readings could be recovered when connecting only the wires for pressure. Therefore, temperature readings for the lowermost transducer (VW-1) cannot be monitored. The temperature wiring for the VW-1 pressure transducer was permanently disconnected from the datalogger.

4 RESULTS

4.1 Borehole and Lithologic Conditions

4.1.1 Lithologic Descriptions

Lithologic descriptions of drill cutting samples obtained from boreholes EX-A through EX-C were used, in combination with borehole geophysical logs, to characterize physical characteristics of aquifer materials encountered during drilling, and vertical variations in these characteristics. The dual-tube reverse-air-circulation drilling method provides samples from the depth interval being drilled, without mixing with overlying sediments in the borehole. However, particle-size distribution and degree of lithification in the samples are influenced by the following factors:

- Due to grinding of sediments at the bit face during drilling, particle sizes are reduced; therefore, gravel content in the samples is typically smaller, and sand content is typically larger, in the samples than in the aquifer. In addition, some evidence of lithification is lost due to the grinding action.

- Silt and clay content in the samples is smaller than in the aquifer due to entrainment and loss of some of these fines with groundwater being discharged during drilling.

Despite these limitations, the drill cuttings provide a basis for general characterization of the aquifer. Lithologic descriptions indicate various mixtures of sand and gravel with relatively small amounts of silt. Silt content in the samples is typically in the range of 5 to 15 percent, which as stated above is believed to be smaller than in the aquifer. Thin volcanic units were encountered below depths of about 1,180 feet at boreholes EX-A and EX-C. Sediments appear to be generally non- to weakly-lithified above depths of about 500 feet at EX-A, 300 feet at EX-B, and 310 feet at EX-C. Below these depths, degree of lithification ranges from weak-moderate to strong, generally increasing with depth. In general, aquifer permeability would be expected to be largest in the upper part of the aquifer and to generally decrease with depth as degree of lithification increases. Relative degree of lithification based on drill cuttings descriptions is summarized in **Table 6** below.

Table 6. Summary of Relative Degree of Lithification from Drill Cuttings Descriptions

Depth Interval (feet, bls)	Relative Degree of Lithification		
	Borehole EX-A	Borehole EX-B	Borehole EX-C
0 – 100	none	none	none and weak
100 – 200	none	none	weak
200 – 300	none	weak	weak
300 – 400	none	weak – moderate	weak – moderate
400 – 500	None – weak	weak – moderate	weak – moderate
500 – 600	weak – moderate	weak – moderate	moderate
600 – 700	moderate	650 ft: change from weak-moderate to moderate-strong	620 ft: change from moderate to moderate-strong
700 – 800	moderate	moderate- strong	780 ft: change from moderate-strong to strong
800 – 900	moderate	890 ft: change from moderate-strong to moderate and moderate-strong	strong
900 – 1,000	950 ft: change from moderate to moderate-strong	moderate and moderate-strong	strong
1,000 – 1,100	moderate-strong	moderate and moderate-strong	strong
1,100 – 1,200	moderate-strong	moderate and moderate-strong to total depth of 1,200 ft	strong
1,200 – 1.300	moderate-strong		strong
1,300 – 1,400	moderate-strong		strong to total depth of 1,360 ft
1,400 – 1,500	strong to total depth of 1,440 ft		

feet bls = feet below land surface

4.1.2 Geophysical Logs

Geophysical logs are shown on **Figures 4 through 6**. The caliper, resistivity, and sonic logs were very useful, in conjunction with drill cuttings descriptions, for interpreting degree of lithification.

The caliper logs (shown on borehole schematics on **Figures 4 through 6**) indicate relatively large borehole diameters to depths of about 525 to 550 feet at all three boreholes, suggesting sloughing of relatively unconsolidated poorly lithified sediments above these depths. Below 525 to 550 feet, borehole diameters are substantially smaller, indicating increased consolidation and lithification. Borehole diameter is close to the drill bit diameter below about 700 to 725 feet at EX-A and

EX-B **(Figures 4 and 5)**, and below about 850 feet at EX-C **(Figure 6)**, suggesting a further increase in lithification. These results suggest that degree of lithification is smallest above 525 to 550 feet, and largest below 700 to 850 feet.

Resistivity logs indicate relatively low resistivity in the upper part of the boreholes, and much higher resistivity in the lower part. The higher resistivity is believed to reflect smaller porosity (and permeability) of the aquifer and also smaller TDS content of groundwater. At borehole EX-A, resistivity increases slightly at depths of 540 feet and 660 feet, with much larger increases occurring at depths of about 800 feet and 1,160 feet. At borehole EX-B, resistivity increases abruptly at a depth of about 520 feet, and increases gradually between 800 and 900 feet. At borehole EX-C, resistivity increases abruptly at a depth of about 530 feet, and increases gradually between 940 and 1,040 feet. These results suggest that porosity (and permeability) may decrease at depths ranging from 520 to 530 feet in the central and south parts of the TDRP site to about 800 feet in the north part of the site. However, the smaller increases in resistivity at depths of 540 and 660 in borehole EX-A suggest some decrease in porosity at these shallower depths in the north part of the site.

Sonic logs indicate that formation density is relatively low in the uppermost part of the boreholes, increases with depth, and then remains generally high with some small scale variability in the lower part of the boreholes. The higher density at larger depths is believed to reflect increased consolidation and lithification of the sediments. At EX-A, density is relatively low to a depth of about 540 feet, generally increases to a depth of about 800 feet, and then remains relatively high with some variability. At EX-B, density is relatively low to a depth of about 460 feet, generally increases to a depth of about 620 feet, and then remains relatively high with some variability. At EX-C, density is relatively low to a depth of about 520 feet, generally increases to a depth of about 640 feet, and then remains relatively high with some variability. These results suggest that porosity (and permeability) are largest above depths of 460 to 540, and smallest below depths of 620 to 800 feet.

4.1.3 Hydrogeologic Units

Two principal hydrogeologic units have been defined at the TDRP site based on degree of lithification: the upper alluvium unit and the lower alluvium unit. **Figure 7** is a schematic hydrogeologic section showing these two units in relation to groundwater level. The upper alluvium unit extends from land surface to depths in the range of 500 to 600 feet, and consists chiefly of weakly-lithified and weakly- to moderately lithified alluvium. Groundwater level occurs at a depth of approximately

300 feet; saturated thickness of the upper alluvium unit is in the range of 220 to 300 feet. The underlying lower alluvium unit consists chiefly of moderately-lithified to well-lithified alluvium, with some interbedded volcanic rocks below 1,180 feet. Due to the larger degree of lithification, the lower alluvium unit is believed to be substantially less permeable than the upper alluvium unit.

4.2 Groundwater Quality

4.2.1 Total Dissolved Solids and Field Parameters

Results for TDS **(Figure 8)** indicate a general trend of decreasing TDS content with depth, which is believed to reflect a decreasing influence from CAP water with depth. Concentrations of TDS are similar to CAP water (on the order of 600 mg/L) to depths ranging from about 700 feet at borehole EX-C to 900 feet at borehole EX-B. Below these depths, concentrations of TDS decrease with depth, reflecting decreased influence from CAP water, until stabilizing between about 400 and 500 mg/L below depths of 1,000 feet at borehole EX-A, 1,000 feet at borehole EX-B, and 1,100 feet at borehole EX-C. Results for specific electrical conductance (field and laboratory) reflect similar patterns as TDS. Overall, results for TDS and electrical conductance indicate that during recharge operations, CAP water essentially displaced groundwater to depths of 700 to 900 feet, but only partially displaced groundwater below these depths.

Results for field temperature indicate a generally increasing trend with depth, reflecting the natural geothermal gradient.

4.2.2 Arsenic and Fluoride

Results for arsenic **(Figure 9)** indicate a general trend of increasing concentrations with depth, with the magnitude of increase being smallest at borehole EX-A and largest at borehole EX-C. Arsenic concentrations appear to increase most dramatically below depths of about 800 to 900 feet at all three boreholes, possibly reflecting less influence from CAP water below these depths. At borehole EX-A, concentrations are below the MCL of 0.010 mg/L to a depth of about 900 feet, and generally above the MCL below 900 feet, with a maximum concentration of 0.015 mg/L at a depth of 1,000 feet. At borehole EX-B, concentrations are below or near the MCL of 0.010 mg/L to a depth of about 600 feet, increasing to about 0.021 mg/L at 900 feet, and reaching a maximum of about 0.055 mg/L at the total depth of 1,200 feet. At borehole EX-C, concentrations are below the MCL of

0.010 mg/L only for the uppermost sample obtained at a depth of about 320 feet, increasing to about 0.037 at a depth of 800 feet, and reaching a maximum of about 0.076 mg/L at the total depth of 1,360 feet. These results suggest that concentrations of arsenic in native groundwater may be smallest in the north part of the TDRP site and substantially larger in the central and especially in the south part of the site. Although recharge of CAP water appears to have reduced arsenic concentrations, particularly to depths of 800 to 900 feet, concentrations remain above the MCL below 900 feet at EX-A, below 600 feet at EX-B, and below 320 feet at EX-C.

Results for fluoride **(Figure 9)** indicate a general trend of increasing concentrations with depth. Concentrations for fluoride appear to increase most dramatically below a depth of about 600 feet at borehole EX-A, and below about 700 feet at boreholes EX-B and EX-C. However, concentrations are below the MCL of 4 mg/L to depths of about 900 feet at boreholes EX-A and EX-B, and to a depth of about 800 feet at borehole EX-C. Maximum fluoride concentrations are about 4.7 mg/L at EX-A (at 1,000 feet), 5.5 mg/L at EX-B (at 1,200 feet), and 6.2 mg/L at EX-C (1,300 and 1,360 feet).

4.3 Groundwater Levels

After encountering groundwater level in each borehole, measurements of groundwater level were obtained each day prior to start of drilling and after the borehole had been completed to total depth. In addition, after completion of the grouted-in piezometer array in borehole EX-B, pressure measurements were converted to hydraulic head.

4.3.1 Boreholes

Depth to groundwater level measured after completion of boreholes ranges from 270.0 feet bls at borehole EX-C (measured on September 8, 2016) to 310.0 feet bls at borehole EX-A (measured on August 11, 2016). Water level elevations range from 1,048.38 feet above mean sea level (amsl) in borehole EX-A to 1,042.95 feet amsl in borehole EX-C. Water level measurements are summarized below in **Table 7**.

Table 7. Summary of Water Level Measurements in Exploration Boreholes after Completion of Drilling

Borehole	Date	Depth to Water Level (feet bls)	Land Surface Elevation* (feet amsl)	Water Level Elevation (feet amsl)
EX-A	8/11/2016	310.0	1,358.38	1,048.38
EX-B	10/13/2016	288.6	1,332.66	1,044.06
EX-C	9/8/2016	270.0	1,312.95	1,042.95

feet bls = feet below land surface
feet amsl = feet above mean sea level

**Land surface elevation measuring points were surveyed by the CAP Land Survey Division. The reported values are in the NAVD88 vertical control datum. The elevations for EX-A and EX-C were surveyed at the natural ground level following borehole abandonment. The elevation for EX-B was surveyed on the concrete pad at the base of the wellhead vault.*

Groundwater level measurements from monitor wells MW-1 and MW-2, as recorded by CAP's SCADA system, indicate an average declining trend of about 0.03 feet per day from August 11 through October 13. Applying this trend over the 63-day period from August 11 (when water level in EX-A was measured) through October 13 results in a calculated water level elevation of 1,046.5 feet amsl at EX-A on October 13. Applying this trend over the 35-day period from September 8 (when water level in EX-C was measured) through October 13 results in a calculated water level elevation of 1,041.9 at EX-C on October 13. Using these calculated water level elevations for October 13, the water level elevation in EX-A would be 2.4 feet higher than in EX-B, and the water level elevation in EX-C would be 2.2 feet lower than in EX-B.

4.3.2 Piezometer Array

Pressure readings from the four vibrating-wire piezometers installed in borehole EX-B were downloaded on October 28, and converted to hydraulic head. Calculated hydraulic heads range from 1,042.53 feet amsl at the shallowest piezometer VW-4 to 1,037.44 feet amsl at the deepest piezometer VW-4, as summarized below in **Table 8**.

Table 8. Calculated Hydraulic Heads from EX-B Piezometer Array

Location	Installed Depth (feet bls)	Date	Average[a] Logged Gage Reading in digits	Average[a] Calculated Pressure in PSI	Average[a] Calculated[b] Hydraulic Head (feet amsl)
VW-1	1,050	10/28/16	7,143.33	325.35	1,037.44
VW-2	748	10/28/16	7,674.54	196.66	1,041.23
VW-3	570	10/28/16	7,758.14	120.94	1,042.15
VW-4	450	10/28/16	8,281.02	68.88	1,042.53

feet bls = feet below land surface
feet amsl = feet above mean sea level

[a]*Averages are based on 30-second interval measurements logged over a period of 3 hours on the specified day.*
[b]*The calculation for hydraulic head includes a temperature correction that is applied to the sensor pressure reading. Since temperature readings in VW-1 are not available, a projected temperature based on available data was applied in the calculations for VW-1.*

These measurements indicate a downward hydraulic gradient. Average hydraulic gradient over the 600-foot distance between VW-1 and VW-4 is 0.0085 foot/foot.

5 IMPLICATIONS FOR RECOVERY OF STORED WATER

Results of the exploration drilling program provide important new information for assessing feasibility and estimating costs of direct recovery of stored CAP water. In particular, results provide new information on lithologic and water quality conditions for the previously unexplored deeper part of the aquifer within which recovery wells would be completed.

Previous plans for direct recovery (M&A, 2009 and 2015) were developed based on hydrogeologic and water quality information for the upper part of the aquifer to a depth of approximately 780 feet for one borehole and to less than 550 feet for two monitor wells. Estimates of aquifer hydraulic properties were derived chiefly from calibrating a groundwater flow model to reproduce observed water level response to recharge operations. The 2015 recovery plan update (M&A, 2015) included phased development of a 9-well recovery wellfield, with an ultimate recovery capacity of 30,000 AF/yr at full build out, and water treatment facilities to reduce concentrations of arsenic and fluoride to below the MCLs of 0.010 and 4 mg/L, respectively. Recovery wells were planned to be constructed to a depth of 1,500 feet.

Results from the exploration drilling program indicate that, with respect to aquifer permeability and concentrations of arsenic and fluoride, aquifer conditions are more favorable for recovery in the upper part of the aquifer than in the lower part:

- Hydraulic conductivity of the aquifer is interpreted to be relatively large above a depth of approximately 500 feet, moderate from about 500 to 800 feet, and relatively small below about 800 feet.
    - Caliper logs suggest that degree of lithification is smallest above 500 to 550 feet, and largest below 700 to 850 feet.
    - Resistivity logs suggest that porosity (and permeability) decrease below depths ranging from 520 to 530 feet in the central and south parts of the TDRP site to about 800 feet in the north part of the site.
    - Sonic logs show changes in formation density suggesting that porosity (and permeability) is largest above depths of 460 to 540 feet, and smallest below depths of 620 to 800 feet.

- Groundwater quality conditions may be substantially more favorable in the north part of the site.
    - Arsenic concentration is below the MCL of 0.010 mg/L to depths of about 900 feet at EX-A (north part of site), about 600 feet at EX-B (central part), and less than 400 feet at EX-C (south part).
    - Fluoride is below the MCL of 4 mg/L to depths of about 900 feet at EX-A and EX-B and to a depth of about 800 feet at EX-C.

The following sections address implications of these conditions on planning for direct recovery at the TDRP site.

5.1 Design and Location of Recovery Wells

Planned recovery well depths should be reduced from 1,500 feet to about 900 feet due to small aquifer hydraulic conductivity and poor groundwater quality below 900 feet. With recovery well depths of 900 feet, and pre-recovery depth to groundwater level below 300 feet, initial saturated thickness penetrated by the recovery wells would be less than 600 feet. Although hydraulic conductivity to a depth of about 500 feet may be similar to or larger than assumed for the 2015 recovery plan update (24 feet/day to depth of 1,000 feet), hydraulic conductivity from 500 to 900 feet may be smaller than previously assumed. Due to smaller saturated thickness, and possibly also smaller hydraulic conductivity, recovery well yields are expected to be smaller than previously assumed. Therefore, more than nine recovery wells would be needed to produce 30,000 AF/yr at full build out. However, capital cost per well would be reduced because the wells would be constructed with smaller diameter casing and would be equipped with smaller pumps than the previously assumed.

Recovery wells should be located in the north and central parts of the TDRP site to avoid the higher concentrations of arsenic that appear to occur in the south part of the site.

5.2 Chemical Quality of Recovered Water

For the 2015 recovery plan update (M&A, 2015), it was assumed based on available data that arsenic would increase gradually during recovery operations from 0.016 mg/L initially (post-recharge conditions) to 0.040 mg/L after 26 years of recovery (ambient conditions reflecting native groundwater). It was assumed that fluoride would increase from 2.4 mg/L initially to 5.6 mg/L after 26 years of

recovery. For the 9-well conceptual layout given in the 2015 update, wells were located along the east and southern boundaries of the TDRP site and planned well depths were 1,500 feet. With these well locations and depths, initial and final concentrations of both arsenic and fluoride would likely be larger than previously assumed due to higher concentrations in the south part of the site and in the deeper part of the aquifer throughout the site. If recovery wells are located in north and central parts of the site, and are completed to a depth of about 900 feet, initial and final concentrations of arsenic and fluoride may be similar to the concentrations previously assumed for the 2015 recovery plan update.

6 RECOMMENDATIONS FOR ADDITIONAL INVESTIGATIONS

Results of the exploration drilling program indicate that deeper part of the aquifer at the TDRP site is more lithified and less permeable than the upper part of the aquifer. However, aquifer hydraulic properties have not yet been quantified. Results of the exploration drilling program also indicate that concentrations of arsenic and fluoride increase with depth. The chemical quality of recovered water will depend not only on constituent concentrations, but also on vertical variations in hydraulic conductivity, which will control relative contributions of groundwater from various aquifer intervals to the recovery wells. In order to determine vertical variations in hydraulic conductivity and concentrations of arsenic and fluoride in recovered water, it is recommended that a pilot recovery well be installed with three separate perforated intervals that can be isolated and tested individually. The pilot recovery well should be located near exploration borehole EX-B, so that the grouted-in piezometers installed at EX-B can be used to monitor groundwater level response to pumping at the pilot recovery well. It is recommended that the pilot recovery well be constructed to a depth of approximately 900 to 1,000 feet, with 10-inch diameter casing in order to accommodate an 8-inch diameter test pump.

To complete a 10-inch well, a 16-inch diameter borehole would be drilled to a depth of 900 to 1,000 feet using the flooded-reverse drilling method. During drilling, lithologic logging would be conducted to characterize subsurface materials and identify degree of lithification. Following drilling, geophysical logging would be conducted to further define lithologic changes. Ten-inch diameter low carbon steel casing would then be installed with three screened intervals separated by annular seals. An inflatable packer would be used to isolate intervals for testing.

After developing the well by airlifting, a series of three pumping tests would be conducted:

- Test 1: Entire well, with all three screened intervals open (no inflatable packer installed)
- Test 2: Upper two screened intervals (packer installed between lower and middle intervals)
- Test 3: Uppermost screened interval (packer installed below middle and upper intervals)

For each test, water level drawdown and recovery would be monitored at the pumped well, the EX-B grouted piezometer array, and monitor wells MW-1 and MW-2. Field water quality parameters of pumped groundwater would be monitored and ground-water samples would be obtained for laboratory chemical analyses. Data from the three tests would be analyzed to determine aquifer hydraulic properties and chemical quality of recovered for each of the three individual aquifer intervals as well as combinations of intervals. These results, in combination with results from the exploration drilling program will provide a basis for refining plans and estimated costs for recovery and treatment of stored water.

7 REFERENCES CITED

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TABLE 1. SUMMARY OF KEY INFORMATION FOR EXPLORATION BOREHOLES EX-A, EX-B, AND EX-C TONOPAH DESERT RECHARGE PROJECT

	EX-A	EX-B	EX-C
GENERAL INFORMATION			
Owner Name	Central Arizona Water Conservation District		
Registration Number	55-919728	55-919727	55-919729
Legal Description	NE1/4, SW1/4, NE1/4, Section 33, Township 3 West, Range 7 North	NE1/4, SE1/4, SW1/4, Section 33, Township 3 West, Range 7 North	NE1/4, SE1/4, NW1/4, Section 04, Township 2 West, Range 7 North
Cadastral Location	(B-3-7)33aca	(B-3-7)33cda	(B-2-7)04bda
Latitude / Longitude in NAD83	33° 33' 42.15742" North / 112° 58' 34.06532" West	33° 33' 14.50255" North / 112° 58' 50.07825" West	33° 32' 51.04908" North / 112° 58' 51.67779" West
Land Surface Altitude in NAVD88	1,358.38	1,332.66	1,312.95
CONSTRUCTION SUMMARY			
Dates Drilled	8/4/2016 to 8/18/2016	9/28/2016 to 10/10/2016	8/23/2016 to 9/9/2016
Drilling Contractor	Yellow Jacket Drilling		
Drilling Method	Dual-Tube Reverse Circulation Air Rotary		
Surface Borehole Diameter (inches)	12	12	12
Surface Casing Depth (feet)	21	21	21
Surface Casing Inside Diameter (inches)	8	8	8
Surface Casing Thickness (inches)	0.312	0.312	0.312
Surface Casing Type	Low Carbon Steel	Low Carbon Steel	Low Carbon Steel
Drill Bit Details	Depth Drilled (feet bls) / Diameter + Type (inches)	Depth Drilled (feet bls) / Diameter + Type (inches)	Depth Drilled (feet bls) / Diameter + Type (inches)
	0 to 480 / 6 1/2 Hammer	0 to 1,200 / 7 7/8 Tricone	0 to 560 / 6 1/2 Hammer
	480 to 1,440 / 6 1/4 Tricone		560 to 820 / 6 1/4 Tricone
			820 to 1,360 / 6 1/8 Tricone
Total Borehole Depth (feet bls)	1,440' (surface borehole 21 feet bls)	1,200 (surface borehole 21 feet bls)	1,360' (surface borehole 21 feet bls)
Completion/Abandonment	Abandoned with high solids bentonite grout	Grouted-in Piezometer Array	Abandoned with high solids bentonite grout
Transducers	---	Depth (feet, bls) / Geokon Serial Number	---
	---	448 / 1616775	---
	---	570 / 1618076	---
	---	747 / 1617467	---
	---	1,050 / 1617466	---

WATER QUALITY SUMMARY

Parameter	Unit	Primary MCL	Secondary MCL	Minimum Result [Depth in feet bls]	Maximum Result [Depth in feet bls]	Minimum Result [Depth in feet bls]	Maximum Result [Depth in feet bls]	Minimum Result [Depth in feet bls]	Maximum Result [Depth in feet bls]
Field Temp	degrees Celsius	---	---	20.4 [500]	38.5 [1,300]	21.8 [400]	35.6 [1,200]	20.5 [500]	36.1 [1,300]
Field pH	---	---	6.5 - 8.5	7.91 [600]	8.39 [1,300]	7.87 [500; 800]	8.49 [340]	7.96 [700]	8.47 [1,360]
Field EC	---	---	---	599.9 [1,200]	1,017 [600]	672 [1,200]	1,077 [600]	670.9 [1,300]	1,011 [400]
Lab EC	---	---	---	577 [1,200]	1,020 [600]	676 [1,200]	1,130 [600]	668 [1,300]	1,040 [400]
TDS	mg/L	---	500	352 [1,300]	648 [600]	427 [1,100]	653 [600]	423 [1,300]	641 [400]
Nitrate	mg/L	10	---	1.92 [1,100]	2.95 [800]	0.468 [340]	4.32 [600]	1.01 [1,000]	1.05 [1,200]
Fluoride	mg/L	4	2	1.52 [500]	4.67 [1,000]	1.3 [340]	5.5 [1,200]	0.879 [320]	6.22 [1,300]
Arsenic	mg/L	0.01	---	0.00212 [400]	0.0153 [1,000]	ND [340]	0.0552 [1,200]	0.00188 [320]	0.0841 [1,360]
Chromium	mg/L	---	---	ND [≤600;1,300]	0.0127 [1,000]	ND [≤400; 500]	0.0188 [1,100]	ND [≤700]	0.00938 [1,100]
Cr^{+6}	mg/L	---	---	ND [400; 600] [≥1,400]	0.00986 [1,000]	0.000578 [600]	0.0122 [1,200]	ND [600]	0.00308 [1,360]
Perchlorate	mg/L	0.006*	---	0.000553 [400]	0.00111 [800]	0.00115 [400]	0.00181 [600]	0.000787 [1,000]	0.00128 [600]
Manganese	mg/L	---	0.05	0.0461 [1,000]	0.09 [400]	0.0314 [1,200]	0.0912 [700]	0.028 [1,360]	0.102 [320]
Iron	mg/L	---	0.3	ND [≤700; 900; 1,300]	0.914 [1,440]	ND [340; 600]	6.25 [700]	ND [320; 500]	2.59 [1,000]

ABBREVIATIONS:

NW = Northwest
SW = Southwest
NE = Northeast
SE = Southeast
NAD83 = North American Datum 1983
NAVD88 = North American Vertical Datum 1988
feet bls = feet below land surface
MCL = Maximum Contaminant Level
mg/L = milligrams per liter
Cr^{+6} = Hexavalent Chromium
TDS = Total Dissolved Solids
EC = Specific Conductance
* = California Primary MCL

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TABLE 2. RESULTS OF LABORATORY ANALYSIS OF GROUNDWATER SAMPLES OBTAINED FROM EXPLORATION BOREHOLE EX-A
TONOPAH DESERT RECHARGE PROJECT

TONOPAH DESERT RECHARGE PROJECT BOREHOLE EX-A							SAMPLE IDENTIFICATION											
						Depth, feet below land surface:	400 feet bls	500 feet bls	600 feet bls	700 feet bls	800 feet bls	900 feet bls	1,000 feet bls	1,100 feet bls	1,200 feet bls	1,300 feet bls	1,400 feet bls	1,440 feet bls
						M&A Sampling Personnel:	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
						Date Sampled:	8/5/2016	8/8/2016	8/8/2016	8/9/2016	8/10/2016	8/10/2016	8/11/2016	8/11/2016	8/16/2016	8/17/2016	8/17/2016	8/18/2016
						Time Sampled:	17:00	8:30	16:35	12:30	8:40	14:45	9:55	14:55	15:23	11:30	17:20	13:05
						Sample ID:	8001	8002	8003	8004	8005	8006	8007	8008	8009	8010	8011	8012
						Lab Work Order:	L852272-01	L852264-01	L852272-02	L852597-01	L853012-01	L853012-02	L853341-01	L853341-02	L854231-01	L854546-01	L854546-02	L854879-01
Group	**Constituent / Parameter**	**Units**	**EPA MCL Primary**	**EPA MCL Secondary**	**Filtered / Unfiltered**	**Abbr.**	**SAMPLE RESULTS**											
Field Parameters	Field Temperature	deg C	---	---	---	Temp	23	20.4	23.2	28.3	29.7	30.9	35.4	34.7	37.9	38.5	37.9	37.8
	Field pH	std units	---	---	---	pH	8.06	7.96	7.91	7.99	8.16	8.22	8.29	8.34	8.29	8.39	8.34	8.24
	Field Specific Conductance	µS/cm	---	---	---	S.C.	976	985.4	1,017	940	903.4	787.9	641.1	684.1	599.9	604.9	619.5	675.3
	Field ORP	mV	---	---	---	ORP	-170	-27	-85	-107	-163	23	48	59	38	68	68	41
	Turbidity	FAU	---	---	---	---	135	615	121	71	67	119	48	212	198	471	313	81
Common Anions	Chloride	mg/L	---	250	Unfiltered	Cl	**88.3**	**87.4**	**90.2**	**88.2**	**83.2**	**65.8**	**48.8**	**52.7**	**41**	**42**	**47.9**	**51.8**
	Fluoride	mg/L	4.0	2.0	Unfiltered	F	**1.57**	**1.52**	**1.67**	**2.79**	**3.05**	**3.69**	**4.67**	**4.09**	**4.38**	**4.5**	**4.4**	**4.23**
	Nitrate (as N)	mg/L	10	---	Unfiltered	NO_3	**---**	**---**	**---**	**2.84**	**2.95**	**2.23**	**2.4 - T8**	**1.92**	**2.31**	**2.24**	**2.19**	**---**
	Nitrate-Nitrite	mg/L	(10)	---	Unfiltered	NO_3-NO_2	**0.613**	**0.494**	**1.1**	**---**	**2.82**	**---**	**1.87**	**---**	**---**	**---**	**---**	**2.82**
	Sulfate	mg/L	---	250	Unfiltered	SO_4	**217**	**218**	**237**	**183**	**167**	**133**	**89.6**	**110**	**72**	**74.9**	**80.1**	**95.6**
Dissolved Metals	Arsenic	mg/L	0.010	---	Filtered	As	**0.00212**	**0.0036**	**0.00314**	**0.00505**	**0.00461**	**0.00865**	**0.0153**	**0.0118**	**0.0143**	**0.0118**	**0.0101**	**0.0077**
	Barium	mg/L	2.0	---	Filtered	Ba	**0.00792**	**---**	**0.00711**	**---**	< 0.00500	**---**	**0.00571 - B**	**---**	**---**	**---**	**---**	**---**
	Cadmium	mg/L	0.005	---	Filtered	Cd	< 0.00100	**---**	< 0.00100	**---**	< 0.00100	**---**	< 0.00100	**---**	**---**	**---**	**---**	**---**
	Calcium	mg/L	---	---	Filtered	Ca	**42.4**	**43.6**	**39.4**	**27.6**	**23.2**	**21.9**	**13.4**	**16.2**	**9.61**	**9.89**	**10.6**	**11.5**
	Chromium	mg/L	0.1	---	Filtered	Cr	< 0.00100	< 0.00100	< 0.00100	**0.00264 - B**	**0.00299 - B**	**0.0053**	**0.0127**	**0.009**	**0.00135**	< 0.00100	**0.00156 - B**	**0.00273 - B**
	Chromium VI	mg/L	0.01*	---	Filtered	Cr	< 0.000500	**---**	< 0.000500	**---**	**0.00283**	**---**	**0.00986**	**---**	**0.000721**	**---**	< 0.000500	< 0.000500
	Copper	mg/L	1.3	1.0	Filtered	Cu	< 0.00100	**---**	< 0.00100	**---**	< 0.00100	**---**	**0.00192**	**---**	**---**	**---**	**---**	**---**
	Iron	mg/L	---	0.3	Filtered	Fe	< 0.100	< 0.100	< 0.100	<0.100	**0.134**	< 0.100	**0.607**	**0.107**	**0.118**	< 0.100	**0.141**	**0.914**
	Lead	mg/L	0	---	Filtered	Pb	< 0.00100	**---**	< 0.00100	**---**	< 0.00100	**---**	< 0.00100	**---**	**---**	**---**	**---**	**---**
	Magnesium	mg/L	---	---	Filtered	Mg	**14.6**	**15.4**	**13**	**7.89**	**7.1**	**7.49**	**4.14**	**5.01**	**2.32**	**2.17**	**2.43**	**2.71**
	Manganese	mg/L	---	0.05	Filtered	Mn	**0.09**	**---**	**0.0552**	**---**	**0.0568**	**---**	**0.0461**	**---**	**---**	**---**	**---**	**---**
	Potassium	mg/L	---	---	Filtered	K	**5.19**	**4.97**	**5.24**	**4.59**	**4.46**	**4.18**	**3.78**	**3.51**	**3.25**	**3.06**	**3.16**	**3.57**
	Selenium	mg/L	0.05	---	Filtered	Se	< 0.00200	**---**	< 0.00200	**---**	< 0.00200	**---**	< 0.00200	**---**	**---**	**---**	**---**	**---**
	Sodium	mg/L	---	---	Filtered	Na	**143**	**144**	**158**	**159**	**150**	**132**	**113**	**117**	**118**	**120**	**122**	**122**
	Zinc	mg/L	---	5	Filtered	Zn	< 0.0100	**---**	< 0.0100	**---**	< 0.0100	**---**	< 0.0100	**---**	**---**	**---**	**---**	**---**
Alkalinity / Lab Parameters / Other	Bicarbonate - HCO_3 (as $CaCO_3$)	mg/L	---	---	---	HCO_3	**143**	**136**	**120**	**110**	**145 - J3**	**130**	**138**	**126**	**137**	**141**	**135**	**128**
	Carbonate - CO_3 (as $CaCO_3$)	mg/L	---	---	---	CO_3	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0
	Total Alkalinity (as $CaCO_3$)	mg/L	---	---	---	Alk	**143**	**136 - J6**	**120**	**110**	**145 - J3**	**130**	**138**	**131**	**137**	**141**	**135**	**128**
	pH	std units	---	6.5-8.5	---	pH	**7.89 - T8**	**7.85 - T8**	**7.92 - T8**	**7.43 - T8**	**7.87 - T8**	**7.11 - T8**	**8.27 - T8**	**8.25 - T8**	**8.52 - T8**	**8.48 - T8**	**8.25 - T8**	**8.38 - T8**
	Specific Conductance	µS/cm	---	---	---	E.C.	**986**	**993**	**1,020**	**948**	**888**	**783**	**642**	**683**	**577**	**590**	**605**	**664**
	Total Dissolved Solids	mg/L	---	500	---	TDS	**647 - Q**	**640**	**648**	**564**	**584**	**534**	**425**	**458**	**356 - Q**	**352**	**371**	**388 - Q**
	Perchlorate	mg/L	0.006*	---	---	ClO_4	**0.000553**	**---**	**0.00104**	**---**	**0.00111**	**---**	**0.000804**	**---**	**---**	**---**	**---**	**---**

EXPLANATION:

Abbr. = Abbreviation
deg C = degrees Celsius
std units = standard units
µS/cm = microSiemens per centimeter
mV = millivolts
FAU = Formazin Attenuation Units
mg/L = milligrams per liter
ORP = Oxidation Reduction Potential
* = California Primary MCL
--- = analysis for compound not requested
EPA = United States Environmental Protection Agency
MCL = Maximum Contaminant Level
Result exceeds EPA Primary MCL
Result exceeds EPA Secondary MCL

NOTES:

B = (EPA) - The indicated compound was found in the associated method blank as well as the laboratory sample.
J3 = The associated batch QC was outside the established quality control range for precision.
J6 = The sample matrix interfered with the ability to make any accurate determination; spike value is low.
Q = (ESC) Sample held beyond the accepted holding time.
T8 = (ESC) - Additional method/sample information: Sample(s) received past/too close to holding time expiration.

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TABLE 3. RESULTS OF LABORATORY ANALYSIS OF GROUNDWATER SAMPLES OBTAINED FROM EXPLORATION BOREHOLE EX-B
TONOPAH DESERT RECHARGE PROJECT

TONOPAH DESERT RECHARGE PROJECT BOREHOLE EX-B						SAMPLE IDENTIFICATION										
					Depth, feet below land surface:	340 feet bls	400 feet bls	500 feet bls	600 feet bls	700 feet bls	800 feet bls		900 feet bls	1,000 feet bls	1,100 feet bls	1,200 feet bls
					M&A Sampling Personnel:	ATS	ATS	ATS	JRB/ATS	JRB	JRB	JRB	JRB	JRB	JRB	JRB
					Date Sampled:	9/28/2016	9/28/2016	9/29/2016	10/4/2016	10/6/2016	10/7/2016	10/7/2016	10/7/2016	10/8/2016	10/9/2016	10/10/2016
					Time Sampled:	11:11	13:32	10:01	16:20	13:00	9:05	9:15	15:30	11:45	9:10	12:45
					Sample ID:	8026	8027	8028	8029	8030	8031	8032	8033	8034	8035	8036
					Lab Work Order:	L862836-01	L862836-02	L863166-01	L864176-01	L864833-01	L865038-01	L865038-02	L865038-03	L865030-01	L865026-01	L865318-01
Group	**Constituent / Parameter**	**Units**	**EPA MCL Primary**	**EPA MCL Secondary**	**Filtered / Unfiltered**	**Abbr.**	**SAMPLE RESULTS**									
Field Parameters	Field Temperature	deg C	---	---	---	Temp	26.6	21.8	25.3	26.1	25.6	27.6	27.3	26.9	30.7	33.8	35.6
	Field pH	std units	---	---	---	pH	8.49	8.15	7.87	7.99	7.93	7.88	7.87	7.91	8.01	8.12	8.26
	Field Specific Conductance	µS/cm	---	---	---	S.C.	994	1,005	1,007	1,077	1,063	1,016	1,018	982	871	717	672
	Field ORP	mV	---	---	---	ORP	-105	-147	-134	-95	-93	-87	-78	-41	-40	117	184
	Turbidity	FAU	---	---	---	---	281	98	8	248	91	33	64	21	68	26	122
Common Anions	Chloride	mg/L	---	250	Unfiltered	Cl	**84.5**	**87**	**93.8**	**112**	**104**	**101**	**102**	**94.5**	**81.6**	**60.6**	**63.6**
	Fluoride	mg/L	4.0	2.0	Unfiltered	F	**1.26**	**2.15**	**2.48**	**2.55**	**2.4**	**3.34**	**3.32**	**3.37**	**4.46**	**5.44**	**5.5**
	Nitrate (as N)	mg/L	10	---	Unfiltered	NO_3	**0.468 - Q**	**0.513**	**---**	**4.32**	**---**	**---**	**---**	**---**	**---**	**---**	**3.27**
	Nitrate-Nitrite	mg/L	(10)	---	Unfiltered	NO_3-NO_2	**---**	**---**	**0.63**	**---**	**3.47**	**4.21**	**0.9****	**3.27**	**3.22**	**3.08**	**---**
	Sulfate	mg/L	---	250	Unfiltered	SO_4	**206**	**218**	**246**	**247**	**227**	**206**	**209**	**209**	**162**	**109**	**99.4**
Dissolved Metals	Arsenic	mg/L	0.010	---	Filtered	As	< 0.00100	**0.0043**	**0.0146**	**0.00733**	**0.0172**	**0.0193**	**0.02**	**0.0211**	**0.0375**	**0.0518**	**0.0552**
	Barium	mg/L	2.0	---	Filtered	Ba	---	< 0.00500	**---**	**0.0095**	**---**	< 0.00500	**---**	**---**	< 0.00500	**---**	**---**
	Cadmium	mg/L	0.005	---	Filtered	Cd	---	< 0.00100	**---**	< 0.00100	**---**	< 0.00100	**---**	**---**	< 0.00100	**---**	**---**
	Calcium	mg/L	---	---	Filtered	Ca	**20.6**	**15.3**	**13.4**	**28.1**	**30.2**	**20.3**	**20.2**	**21.3**	**14.1**	**7.27**	**6.35**
	Chromium	mg/L	0.1	---	Filtered	Cr	< 0.00100	< 0.00100	< 0.00100	**0.00198 - B**	**0.00462**	**0.00197**	**0.00236**	**0.00223**	**0.0069**	**0.0188**	**0.0166**
	Chromium VI	mg/L	0.01*	---	Filtered	Cr	---	**0.000739 - T2**	**---**	**0.000578**	**---**	**0.00124**	**---**	**---**	**0.00585**	**---**	**0.0122**
	Copper	mg/L	1.3	1.0	Filtered	Cu	---	< 0.00100	**---**	**0.00125 - B**	**0.00336**	< 0.00100	**---**	**---**	< 0.00100	**---**	**---**
	Iron	mg/L	---	0.3	Filtered	Fe	< 0.100	**0.228**	**0.946**	< 0.100	**6.25**	**0.438**	**0.441**	**0.129**	**0.43**	**1.11**	**0.904**
	Lead	mg/L	0	---	Filtered	Pb	---	< 0.00100	**---**	< 0.00100	**---**	< 0.00100	**---**	**---**	< 0.00100	**---**	**---**
	Magnesium	mg/L	---	---	Filtered	Mg	**3.75**	**1.54**	<1.00	**3.49**	**5.43**	**2.72**	**2.65**	**3.09**	**1.67**	< 1.00	< 1.00
	Manganese	mg/L	---	0.05	Filtered	Mn	**0.0484**	**0.0418**	**0.0341**	**0.0652**	**0.0912**	**0.0411**	**0.0436**	**0.0418**	**0.0378**	**0.0376**	**0.0314**
	Potassium	mg/L	---	---	Filtered	K	**1.68**	< 1.00	< 1.00	**1.88 - B**	**2.63**	**1.65 - B**	**1.66 - B**	**1.57 - B**	**1.2**	< 1.00	< 1.00
	Selenium	mg/L	0.05	---	Filtered	Se	---	< 0.00200	**---**	**0.00213**	**---**	**0.00209**	**---**	**---**	< 0.00200	**---**	**---**
	Sodium	mg/L	---	---	Filtered	Na	**193**	**202**	**208 - V**	**209**	**193**	**187**	**186**	**182**	**167**	**141**	**138**
	Zinc	mg/L	---	5	Filtered	Zn	---	< 0.0100	**---**	< 0.0100	**---**	< 0.0100	**---**	**---**	< 0.0100	**---**	**---**
Alkalinity / Lab Parameters / Other	Bicarbonate - HCO_3 (as $CaCO_3$)	mg/L	---	---	---	HCO_3	**110**	**113**	**74.3**	**82.7**	**108**	**82.5**	**83**	**90.9**	**93.9**	**99.2**	**100**
	Carbonate - CO_3 (as $CaCO_3$)	mg/L	---	---	---	CO_3	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0	**---**	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0
	Total Alkalinity (as $CaCO_3$)	mg/L	---	---	---	Alk	**122**	**113**	**74.3**	**83.9 - B**	**108**	**82.5**	**83**	**91.3**	**93.9**	**99.2**	**102**
	pH	std units	---	6.5-8.5	---	pH	**8.63 - T8**	**8.35 - T8**	**6.98 - T8**	**8.19 - T8**	**8.16 - T8**	**8.13 - T8**	**8.22 - T8**	**8.26 - T8**	**8.11 - T8**	**8.37 - T8**	**8.44**
	Specific Conductance	µS/cm	---	---	---	E.C.	**1,040**	**1,050**	**1,030**	**1,130**	**1,080**	**1,020**	**1,030**	**996**	**872**	**694**	**676**
	Total Dissolved Solids	mg/L	---	500	---	TDS	**637**	**601**	**640**	**653**	**627**	**631**	**407****	**617**	**545**	**427**	**473**
	Perchlorate	mg/L	0.006*	---	---	ClO_4	**---**	**0.00115**	**---**	**0.00181**	**---**	**0.00172**	**---**	**---**	**0.00137**	**---**	**---**

EXPLANATION:

Abbr. = Abbreviation
deg C = degrees Celsius
std units = standard units
µS/cm = microSiemens per centimeter
mV = millivolts
FAU = Formazin Attenuation Units
mg/L = milligrams per liter
ORP = Oxidation Reduction Potential

* = California Primary MCL
** = Data is anomalous.
--- = analysis for compound not requested
EPA = United States Environmental Protection Agency
MCL = Maximum Contaminant Level
Result exceeds EPA Primary MCL
Result exceeds EPA Secondary MCL
Result exceeds California Primary MCL

NOTES:

B = (EPA) - The indicated compound was found in the associated method blank as well as the laboratory sample.
Q = (ESC) - Sample held beyond the accepted holding time.
T2 = (ESC) - Additional method/sample information: The laboratory analysis was performed from an unpreserved, insufficiently or inadequately preserved sample.
T8 = (ESC) - Additional method/sample information: Sample(s) received past/too close to holding time expiration.
V = (ESC) - Additional QC Info: The sample concentration is too high to evaluate accurate spike recoveries.

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TABLE 4. RESULTS OF LABORATORY ANALYSIS OF GROUNDWATER SAMPLES OBTAINED FROM EXPLORATION BOREHOLE EX-C
TONOPAH DESERT RECHARGE PROJECT

TONOPAH DESERT RECHARGE PROJECT BOREHOLE EX-C							SAMPLE IDENTIFICATION												
						Depth, feet below land surface:	320 feet bls	400 feet bls	500 feet bls	600 feet bls	700 feet bls	800 feet bls	801 feet bls	900 feet bls	1,000 feet bls	1,100 feet bls		1,200 feet bls	1,300 feet bls	1,360 feet bls
						M&A Sampling Personnel:	MS	MS	MS	MS	MS	ATS	ATS	ATS	ATS	ATS	ATS	ATS	ATS	ATS
						Date Sampled:	8/25/2016	8/25/2016	8/25/2016	8/27/2016	8/28/2016	9/9/2016	8/29/2016	9/6/2016	9/7/2016	9/8/2016	9/8/2016	9/8/2016	9/9/2016	9/9/2016
						Time Sampled:	8:10	10:27	14:50	10:22	11:06	17:21	9:53	17:31	14:47	10:11	10:14	15:39	12:46	15:45
						Sample ID:	8013	8014	8015	8016	8017	8018-B	8018	8019	8020	8021	8022	8023	8024	8025
						Lab Work Order:	L856292-01	L856292-02	L856292-03	L856498-01	L856498-02	L859075-03	L856998-01	L858201-01	L858458-01	L858770-01	L858770-03	L858770-02	L859075-01	L859075-02
Group	**Constituent / Parameter**	**Units**	**EPA MCL Primary**	**EPA MCL Secondary**	**Filtered / Unfiltered**	**Abbr.**	**SAMPLE RESULTS**												
Field Parameters	Field Temperature	deg C	---	---	---	Temp	**21**	**21.5**	**20.5**	**24.2**	**25.6**	**31.3**	**26.1**	**30.5**	**31.4**	**34.7**	**34.6**	**34.2**	**36.1**	**35.7**
	Field pH	std units	---	---	---	pH	**8.11**	**8.26**	**8.07**	**7.98**	**7.96**	**8.36**	**7.98**	**8.38**	**8.23**	**8.2**	**8.2**	**8.23**	**8.36**	**8.47**
	Field Specific Conductance	µS/cm	---	---	---	S.C.	**983.5**	**1,011**	**990.2**	**1,007**	**1,000**	**824.5**	**932**	**885.2**	**816.6**	**715.3**	**719.7**	**696**	**670.9**	**680.2**
	Field ORP	mV	---	---	---	ORP	**-162**	**-163**	**-77**	**-127**	**-75**	**247**	**-51**	**85**	**72**	**135**	**132**	**95**	**246**	**238**
	Turbidity	FAU	---	---	---	---	**492**	**98**	**512**	**69**	**86**	**207**	**46**	**128**	**89**	**25**	**45**	**101**	**210**	**206**
Common Anions	Chloride	mg/L	---	250	Unfiltered	Cl	**86.8**	**82.8**	**86.1**	**88.2**	**87.7**	**68.1**	**80.8**	**75.2**	**70.2**	**57.3**	**---**	**55.2**	**54.3**	**55.2**
	Fluoride	mg/L	4.0	2.0	Unfiltered	F	**0.879**	**1.79**	**1.48**	**2.41**	**2.31**	**4.62**	**3.51**	**4.84**	**4.93**	**5.41**	**---**	**4.69**	**6.22**	**6.17**
	Nitrate (as N)	mg/L	10	---	Unfiltered	NO_3	**---**	**---**	**---**	**---**	**---**	**---**	**---**	**1.03**	**1.01**	**---**	**---**	**1.05**	**---**	**---**
	Nitrate-Nitrite	mg/L	(10)	---	Unfiltered	NO_3-NO_2	**0.247**	**0.322**	**0.506**	**0.242**	**0.495**	**1.02**	**0.907**	**---**	**---**	**1.1**	**---**	**---**	**1.23**	**1.18**
	Sulfate	mg/L	---	250	Unfiltered	SO_4	**243**	**229**	**231**	**230**	**224**	**173**	**207**	**190**	**176**	**132**	**---**	**133**	**122**	**124**
Dissolved Metals	Arsenic	mg/L	0.010	---	Filtered	As	**0.00188**	**0.0189**	**0.00979**	**0.0158**	**0.0252**	**0.0569 - O1**	**0.0365**	**0.0588**	**0.0655**	**0.0809**	**0.0832**	**0.0787**	**0.0757**	**0.0841**
	Barium	mg/L	2.0	---	Filtered	Ba	**---**	< 0.00500	**---**	< 0.00500	**---**	**---**	< 0.00500	**---**	< 0.00500	**---**	**---**	**---**	**---**	**---**
	Cadmium	mg/L	0.005	---	Filtered	Cd	**---**	< 0.00100	**---**	< 0.00100	**---**	**---**	< 0.00100	**---**	< 0.00100	**---**	**---**	**---**	**---**	**---**
	Calcium	mg/L	---	---	Filtered	Ca	**47.9**	**11.4**	**22.1**	**19.7**	**17.7**	**7.11**	**16.3**	**7.67**	**6.97**	**5.28**	**5.45**	**5.56**	**6.26**	**5.4**
	Chromium	mg/L	0.1	---	Filtered	Cr	< 0.00100	< 0.00100	< 0.00100	< 0.00100	< 0.00100	**0.00315 - B**	**0.00174**	**0.00332**	**0.00603**	**0.00902**	**0.00938**	**0.0073**	**0.00249 - B**	**0.00328**
	Chromium VI	mg/L	0.01*	---	Filtered	Cr	**---**	**---**	**---**	< 0.000500	**---**	**---**	**0.0026 - T2**	**---**	**0.0028**	**---**	**---**	**0.00274**	**---**	**0.00308**
	Copper	mg/L	1.3	1.0	Filtered	Cu	**---**	**0.00112**	**---**	< 0.00100	**---**	**---**	< 0.00100	**---**	< 0.00100	**---**	**---**	**---**	**---**	**---**
	Iron	mg/L	---	0.3	Filtered	Fe	< 0.100	**1.14**	< 0.100	**0.122**	**0.382**	**0.302**	**0.134**	**1.84**	**2.59**	**1.68**	**1.67**	**2.02**	**0.386**	**0.248**
	Lead	mg/L	0	---	Filtered	Pb	**---**	< 0.00100	**---**	< 0.00100	**---**	**---**	< 0.00100	**---**	< 0.00100	**---**	**---**	**---**	**---**	**---**
	Magnesium	mg/L	---	---	Filtered	Mg	**12.4**	< 1.00	**4.6**	**3.85**	**---**	< 1.00	**3.04**	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
	Manganese	mg/L	---	0.05	Filtered	Mn	**0.102**	**0.0367**	**0.0613**	**0.0433**	**0.0468**	**0.0326 - O1**	**0.0332**	**0.0538**	**0.0649**	**0.0482**	**0.049**	**0.0507**	**0.0599**	**0.028**
	Potassium	mg/L	---	---	Filtered	K	**2.88**	< 1.00	**1.83**	**1.44**	**1.52**	< 1.00	**1.25**	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
	Selenium	mg/L	0.05	---	Filtered	Se	**---**	< 0.00200	**---**	< 0.00200	**---**	**---**	< 0.00200	**---**	< 0.00200	**---**	**---**	**---**	**---**	**---**
	Sodium	mg/L	---	---	Filtered	Na	**146**	**205**	**184**	**186**	**188**	**173**	**176**	**179**	**171**	**153**	**151**	**148**	**142**	**143**
	Zinc	mg/L	---	5	Filtered	Zn	**---**	< 0.0100	**---**	< 0.0100	**---**	**---**	< 0.0100	**---**	< 0.0100	**---**	**---**	**---**	**---**	**---**
Alkalinity / Lab Parameters / Other	Bicarbonate - HCO_3 (as $CaCO_3$)	mg/L	---	---	---	HCO_3	**128**	**133**	**114**	**128**	**86.9**	**94.8**	**99**	**82.5**	**87.4**	**90.6**	**---**	**93.4**	**87.4**	**85.6**
	Carbonate - CO_3 (as $CaCO_3$)	mg/L	---	---	---	CO_3	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0	**---**	< 20.0	< 20.0	< 20.0
	Total Alkalinity (as $CaCO_3$)	mg/L	---	---	---	Alk	**128**	**133 - J6**	**117**	**128 - J6**	**86.9**	**96.9**	**101**	**85.2**	**87.4**	**98**	**---**	**95.9**	**93.1**	**94.1**
	pH	std units	---	6.5-8.5	---	pH	**7.4 - T8**	**8.15 - T8**	**7.78 - T8**	**7.56 - T8**	**8.06 - T8**	**8.23 - T8**	**7.79 - T8**	**7.16 - T8**	**7.77 - T8**	**8.27 - T8**	**---**	**8.22 - T8**	**8.37 - T8**	**8.45 - T8**
	Specific Conductance	µS/cm	---	---	---	E.C.	**1,010**	**1,040**	**1,030**	**1,010**	**1,030**	**828**	**933**	**865**	**849**	**732**	**---**	**728**	**668**	**697**
	Total Dissolved Solids	mg/L	---	500	---	TDS	**599**	**641**	**572**	**620**	**588**	**543**	**550**	**518**	**537**	**477**	**---**	**478**	**423**	**439**
	Perchlorate	mg/L	0.006*	---	---	ClO_4	**0.000804**	**0.000955**	**---**	**0.00128**	**---**	**---**	**0.000901**	**---**	**0.000787**	**---**	**---**	**---**	**---**	**---**

EXPLANATION:

Abbr. = Abbreviation
deg C = degrees Celsius
std units = standard units
µS/cm = microSiemens per centimeter
mV = millivolts
FAU = Formazin Attenuation Units
mg/L = milligrams per liter
ORP = Oxidation Reduction Potential
* = California Primary MCL
--- = analysis for compound not requested
EPA = United States Environmental Protection Agency
MCL = Maximum Contaminant Level
Result exceeds EPA Primary MCL
Result exceeds EPA Secondary MCL

NOTES:

B = (EPA) - The indicated compound was found in the associated method blank as well as the laboratory sample.
J6 = The sample matrix interfered with the ability to make any accurate determination; spike value is low
O1 = (ESC) The analyte failed the method required serial dilution test and/or subsequent post-spike criteria. These failures indicate matrix interference.
T2 = (ESC) - Additional method/sample information: The laboratory analysis was performed from an unpreserved, insufficiently or inadequately preserved sample.
T8 = (ESC) - Additional method/sample information: Sample(s) received past/too close to holding time expiration.

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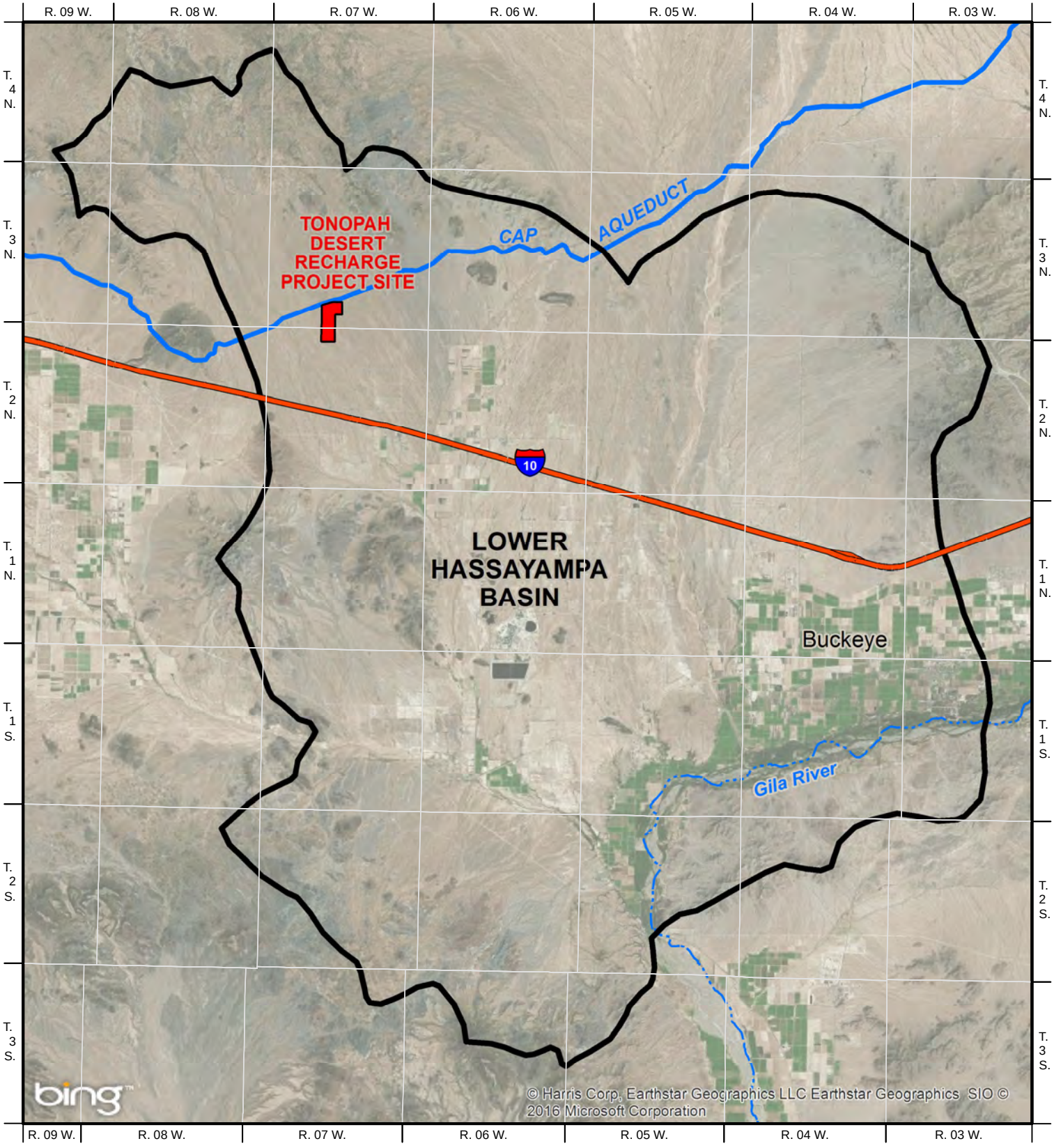

EXPLANATION

Boundary of Groundwater Basin

N

0 1 2 3 4 5
Miles

FIGURE 1. LOCATION OF TONOPAH DESERT RECHARGE PROJECT

GIS-Tuc\1455.03\LocationMap\27Dec2016

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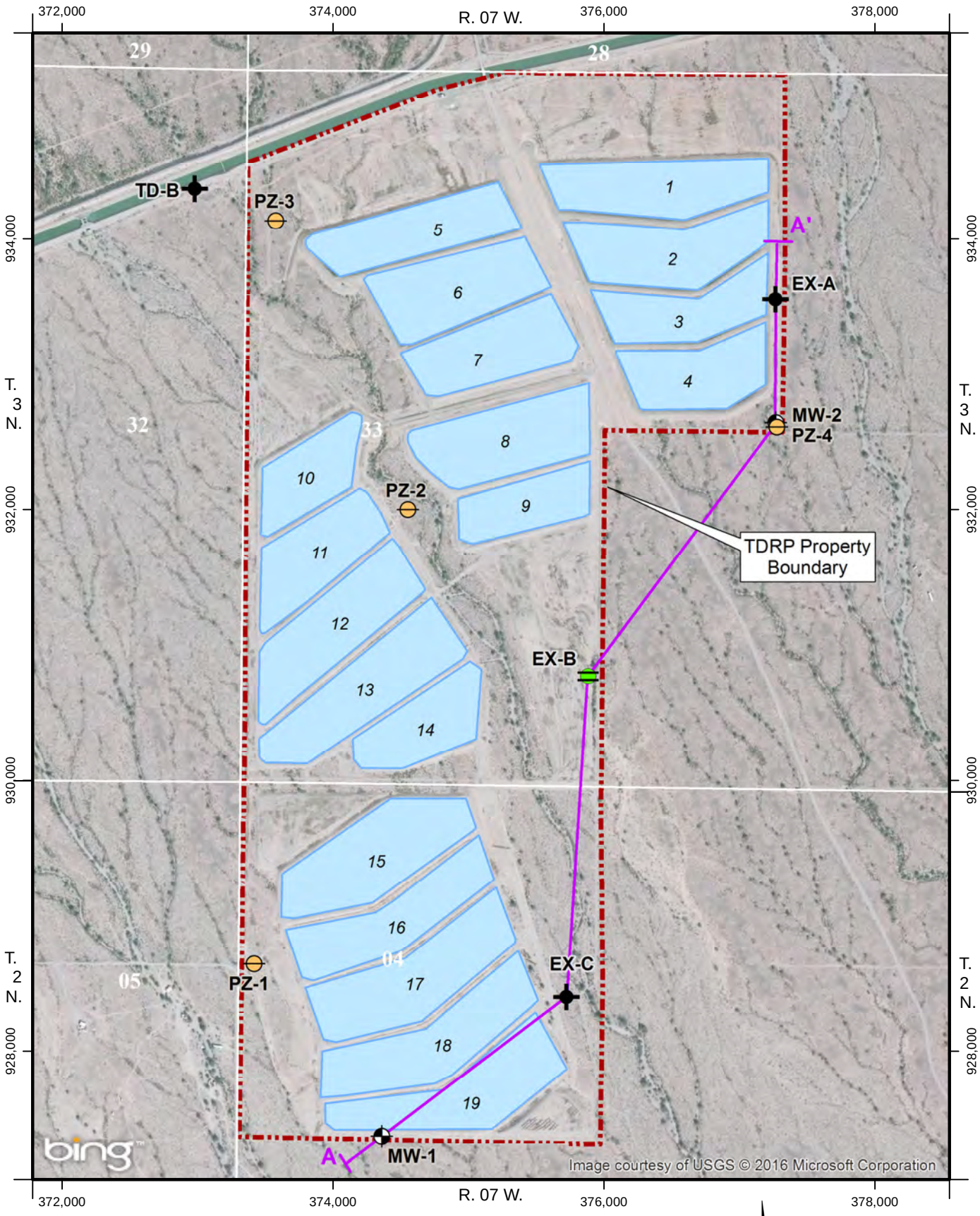

EXPLANATION

- Monitor Well
- Piezometer
- Small-Diameter Exploration Borehole
- Grounted-In Piezometer Array
- A — A' Location of Schematic Hydrogeologic Section

N

0 250 500 750 1,000
Feet

FIGURE 2. SITE MAP OF TONOPAH DESERT RECHARGE PROJECT

GIS-TUC\1455.03\SiteMap\27Dec2016

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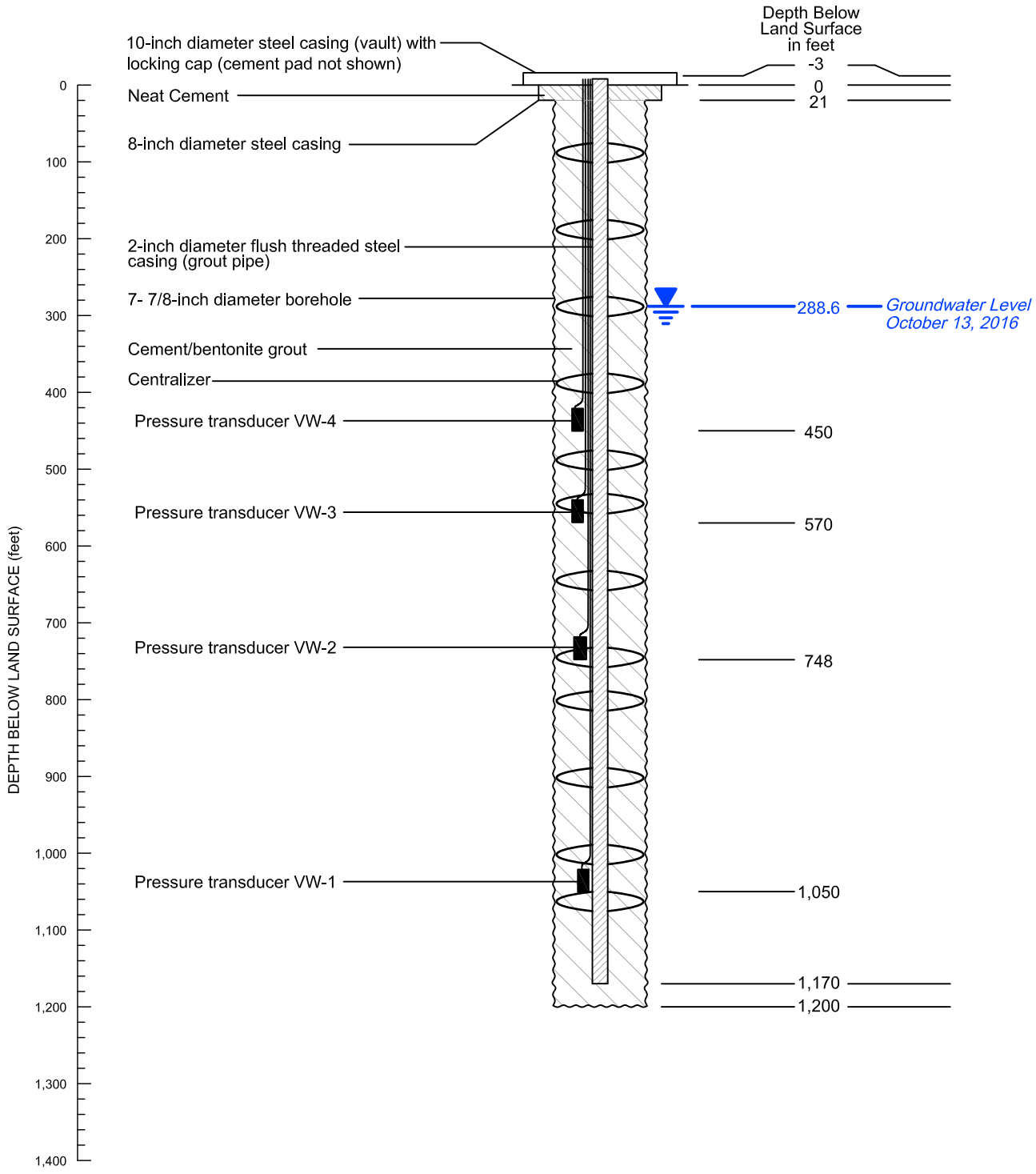

EXPLANATION

Nonpumping Water Level Measured on October 13, 2016, before grouting

WELL: (B-3-7) 33cda	REGISTRATION: 55-919727
STATE: Arizona	COUNTY: Maricopa
LATITUDE: 33° 33' 14.61"	Client: Central Arizona Project
LONGITUDE: 112° 58' 50.13"	CHECKED BY: J. Bell

SCHEMATIC DIAGRAM OF GROUTED PIEZOMETER ARRAY IN BOREHOLE EX-B

2016

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FIGURE 3

Drafting\1455.01\piez_EXB_ws\28Dec2016

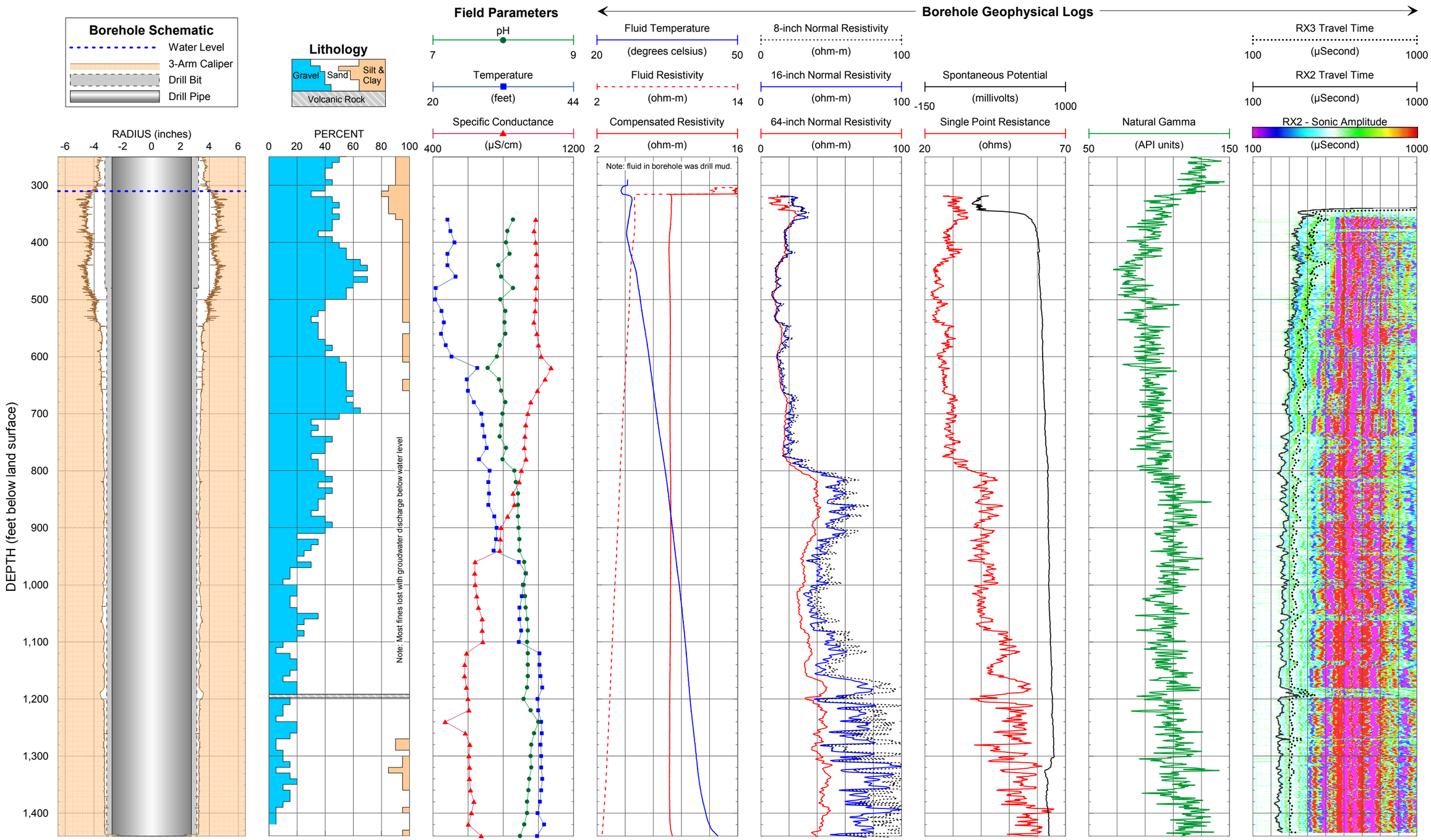

FIGURE 4. SUMMARY OF LITHOLOGY, FIELD WATER QUALITY PARAMETERS, AND GEOPHYSICAL LOGS FOR BOREHOLE EX-A

\1455\03 - Report\Figures\EX-A Summary\EX-A Summary.grf

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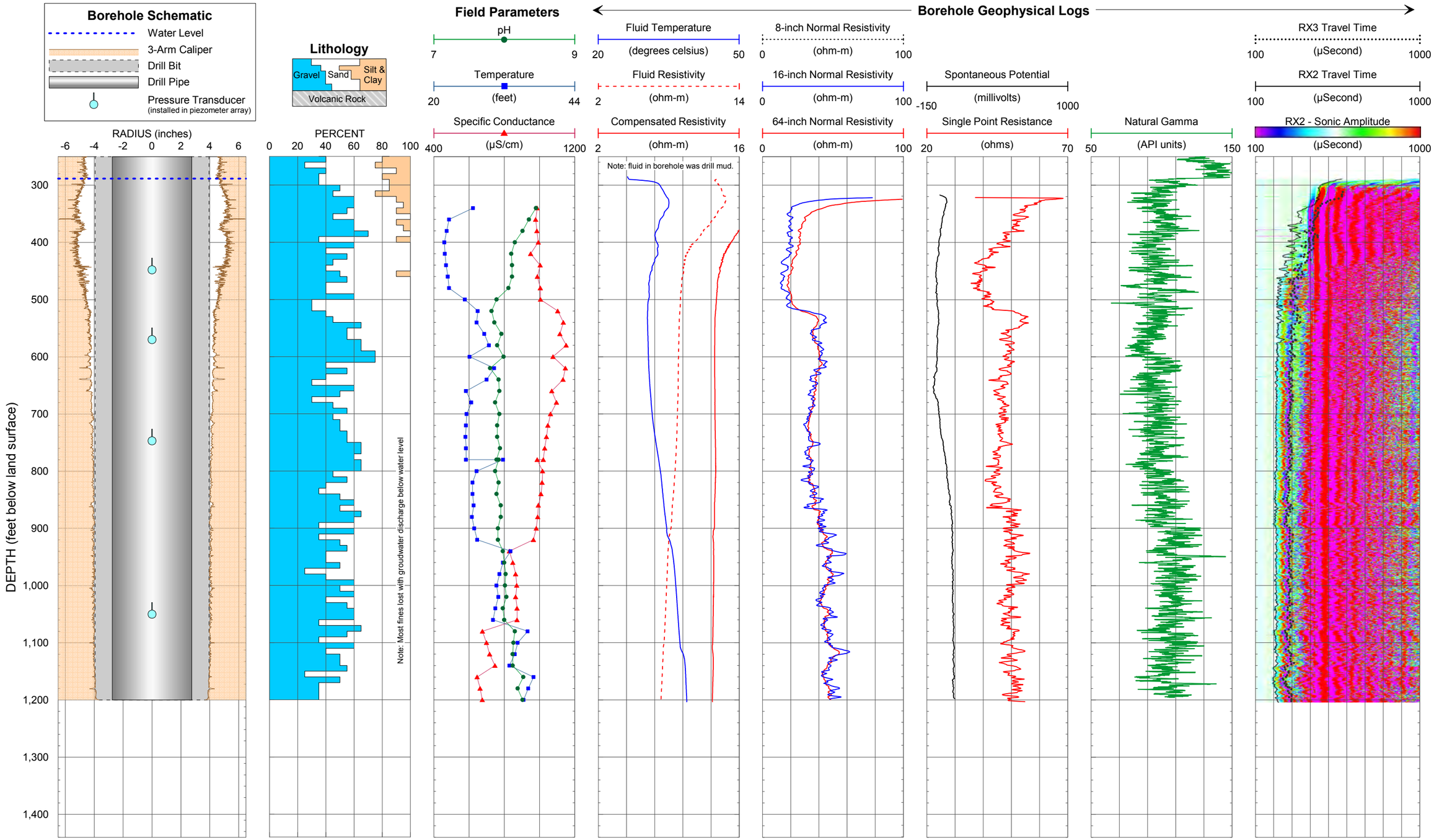

FIGURE 5. SUMMARY OF LITHOLOGY, WATER QUALITY PARAMETERS, AND GEOPHYSICAL LOGS FOR BOREHOLE EX-B

\1455\03 - Report\Figures\EX-B Summary\EX-B Summary.grf

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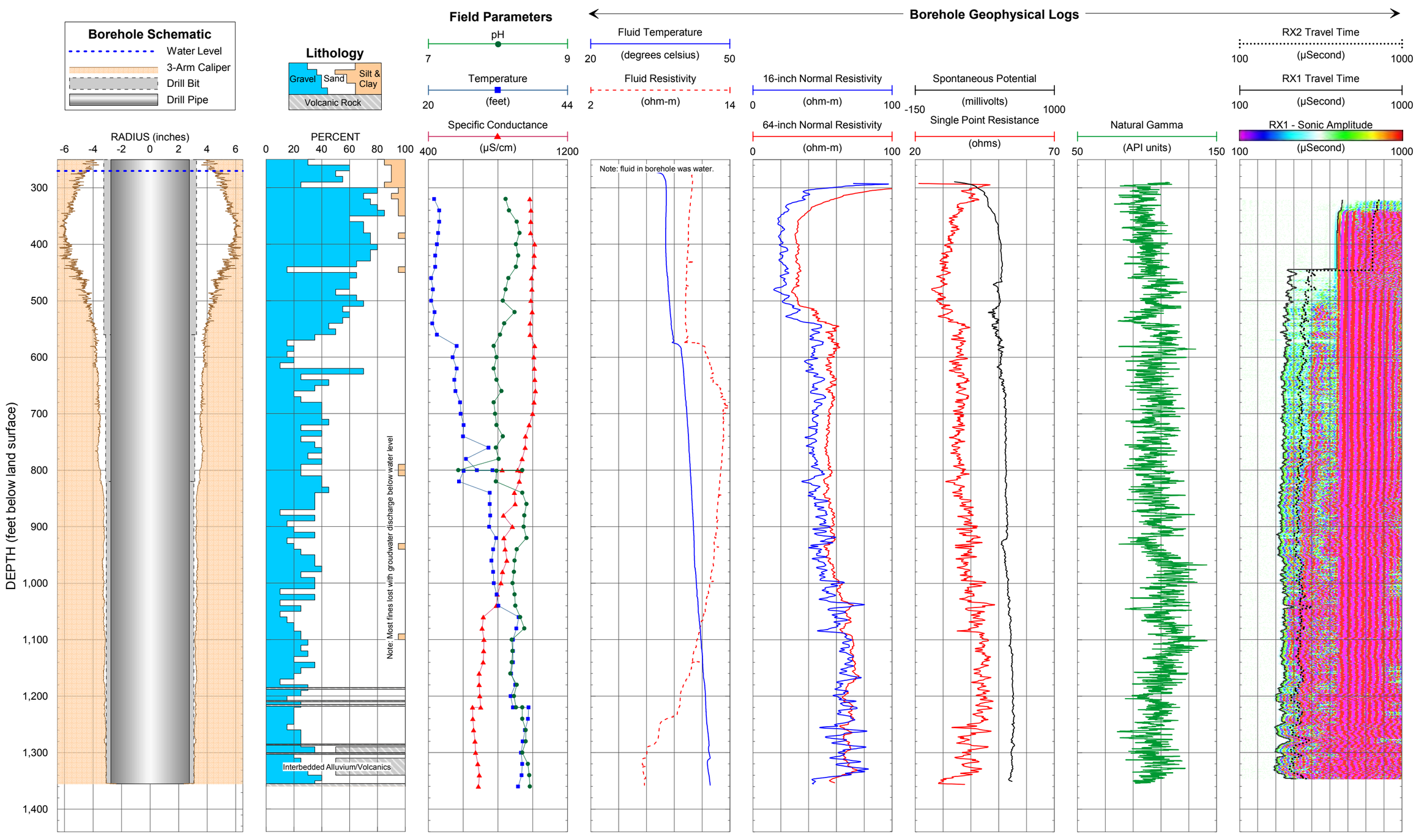

FIGURE 6. SUMMARY OF LITHOLOGY, FIELD WATER QUALITY PARAMETERS, AND GEOPHYSICAL LOGS FOR BOREHOLE EX-C

\1455\03 - Report\Figures\EX-C Summary\EX-C Summary.grf

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SOUTH

NORTH

MW-1

EX-C

EX-B

MW-2

EX-A

Upper Alluvium Unit

Lower Alluvium Unit

Alluvium-Volcanic Unit

Tuff

?

EXPLANATION

2006 Water Level (pre-recharge)

2010 Water Level (peak recharge)

2016 Water Level

Pressure Transducers

VE = 3.5X

ALTITUDE (feet above mean sea level)

1,400

1,200

1,000

800

600

400

200

0

DISTANCE (miles)

0

0.2

0.4

0.6

0.8

1

1.2

1.4

1.6

FIGURE 7. SCHEMATIC HYDROGEOLOGIC SECTION FOR TONOPAH DESERT RECHARGE PROJECT SITE

\1455\03 - Report\Figures\Section\Schematic Section.grf

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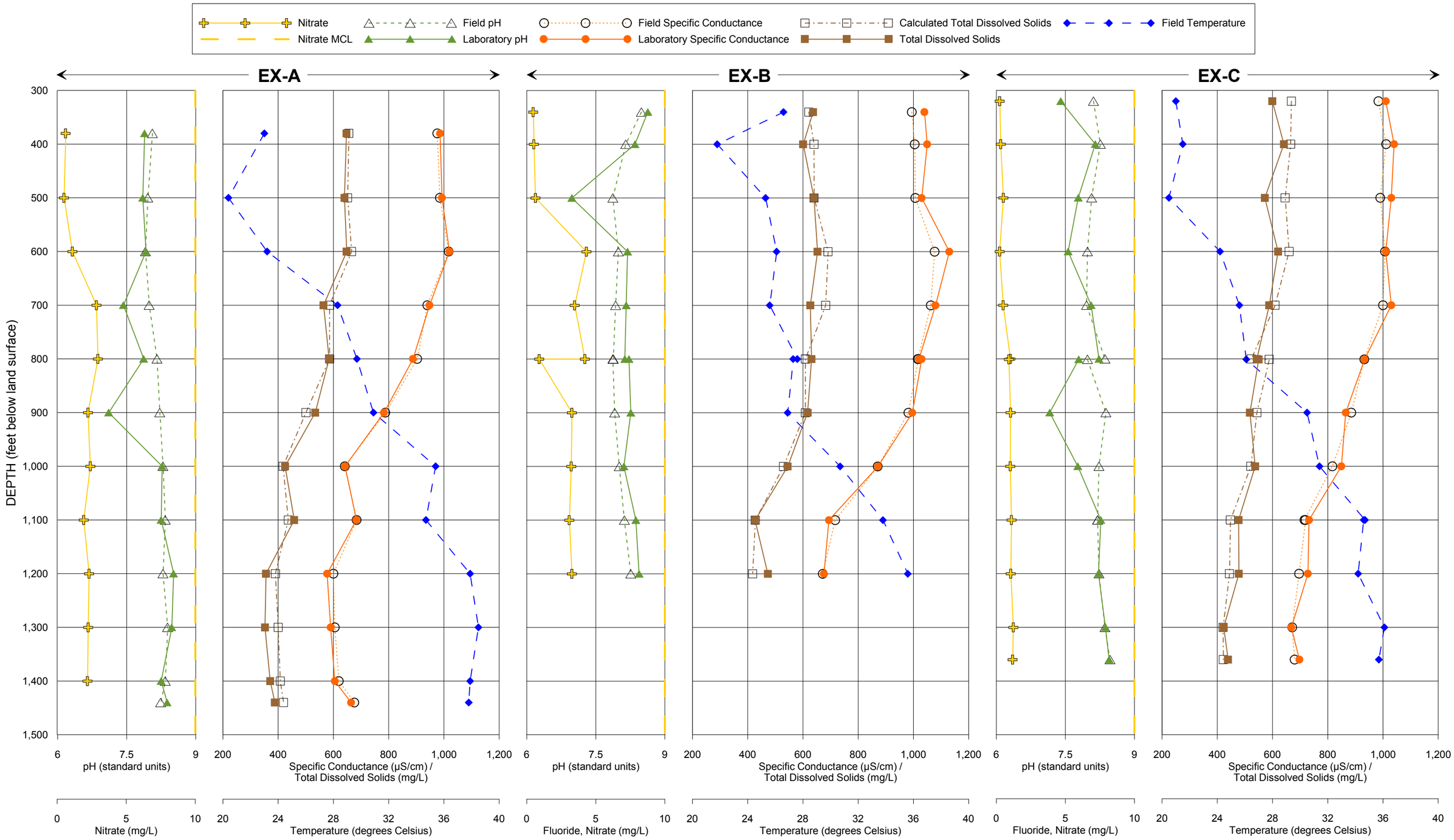

FIGURE 8. SUMMARY OF WATER QUALITY PARAMETERS AND CONCENTRATIONS OF TOTAL DISSOLVED SOLIDS AND NITRATE FOR BOREHOLES EX-A, EX-B, AND EX-C

\1455\03 - Report\WQ_Graphs\Common Constituents.grf

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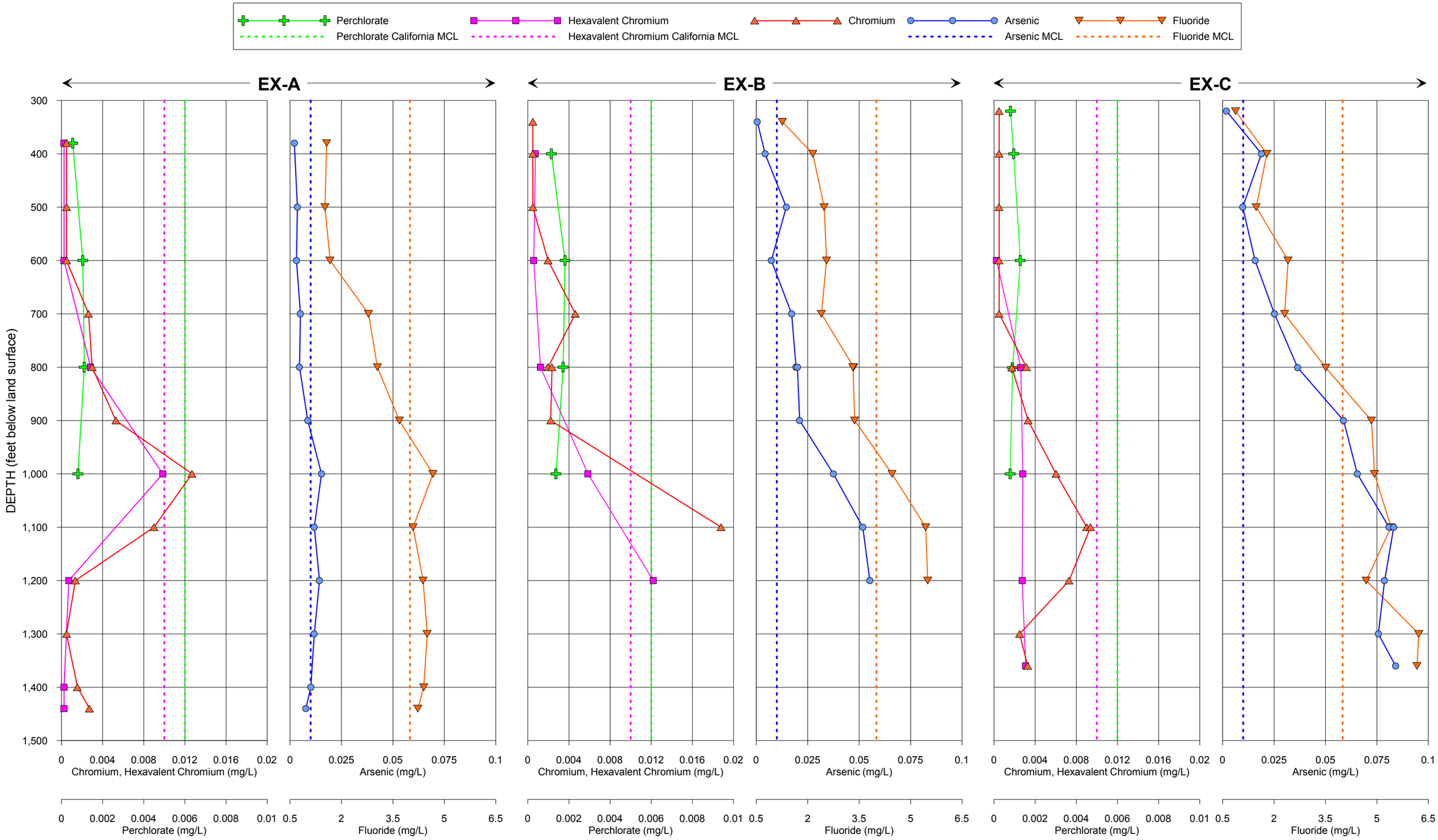

FIGURE 9. SUMMARY OF WATER QUALITY CONSTITUENTS OF CONCERN FOR BOREHOLES EX-A, EX-B, AND EX-C

\1455\03 - Report\WQ_Graphs\COCs.grf

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Appendix A

Lithologic Descriptions of Drill Cutting

Exploration Borehole EX-A
Exploration Borehole EX-B
Exploration Borehole EX-C

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-A [*55-919728*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DRILLING METHOD / COMPANY: Dual-Tube Reverse Circulation Air Rotary / Yellow Jacket Drilling	LOGGED BY: M. Shelley
DEPTH DRILLED / LAND SURFACE ELEVATION: 1440.0 feet / 1358.38 feet msl	DATE DRILLED: Aug. 4 - Aug. 18, 2016
CADASTRAL : (B-3-7)33aca	BOREHOLE DIAMETER: 6.5 inches

DEPTH INTERVAL (feet)	DESCRIPTION
0.0 - 10.0	**SANDY GRAVEL**: Light brown [7.5YR6/3]; gravel 50%, subangular to subrounded, very fine to very coarse sand 45%, silt 5%. Gravel fraction: subangular granules, pebbles, and cobbles to 5 in consisting of Quartzite, tuff, basalt, some quartz vein chips. Non-lithified. Non-plastic. Dry. Reaction to acid: very strong.
10.0 - 20.0	**GRAVELLY SAND**: Light brown [7.5YR6/3]; subangular to subrounded, very fine to very coarse sand 55%, gravel 40%, silt 5%. Gravel fraction: angular to subangular granules, pebbles, and cobbles to 3 in consisting of Quartzite, tuff, basalt, some quartz vein chips. Non-lithified. Non-plastic. Dry. Reaction to acid: very strong.
20.0 - 30.0	**SANDY GRAVEL**: Light brown [7.5YR6/3]; gravel 60%, subangular to subrounded, very fine to very coarse sand 35%, silt 5%. Gravel fraction: subangular to subrounded granules and pebbles to 1 in consisting of Quartzite, tuff, basalt, schist, some quartz vein chips. Non-lithified. Non-plastic. Dry. Reaction to acid: moderate.
30.0 - 40.0	**SANDY GRAVEL**: Brown [7.5YR4/3]; gravel 65%, subangular to subrounded, very fine to very coarse sand 30%, silt 5%. Gravel fraction: subangular to subrounded granules and pebbles to 1 in consisting of Quartzite, tuff, basalt, schist, some quartz vein chips. Non-lithified. Non-plastic. Dry. Reaction to acid: moderate.
40.0 - 50.0	**SILTY GRAVELLY SAND**: Pale brown [10YR6/3]; angular to subrounded, fine to very coarse sand 45%, gravel 30%, silt 25%. Gravel fraction: subangular to rounded granules and pebbles to 0.8 in consisting of Quartzite, tuff, basalt, schist, some quartz vein chips. Non-lithified. Non-plastic. Dry. Reaction to acid: moderate.
50.0 - 60.0	**SILTY GRAVELLY SAND**: Pale brown [10YR6/3]; angular to subrounded, fine to very coarse sand 45%, gravel 35%, silt 20%. Gravel fraction: subangular to rounded granules and pebbles to 0.7 in consisting of Quartzite, tuff, basalt, schist, trace diabase. Non-lithified. Non-plastic. Dry. Reaction to acid: moderate.
60.0 - 70.0	**SILTY SANDY GRAVEL**: Pale brown [10YR6/3]; gravel 50%, subangular to subrounded, fine to very coarse sand 40%, silt 10%. Gravel fraction: subangular to rounded granules and pebbles to 0.5 in consisting of Quartzite, tuff, basalt, schist, trace diabase. Non-lithified. Non-plastic. Dry. Reaction to acid: moderate.
70.0 - 80.0	**SILTY SANDY GRAVEL**: Pale brown [10YR6/3]; gravel 55%, subangular to subrounded, fine to coarse sand 35%, silt 10%. Gravel fraction: subangular to subrounded granules and pebbles to 0.4 in consisting of Quartzite, tuff, basalt, schist, trace diabase. Non-lithified. Non-plastic. Dry. Reaction to acid: moderate to strong.

Gravel/sand division based on Wentworth scale. Grain size fractions estimated using manual field methods.
Grain size fractions rounded to the nearest five percent.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-A [*55-919728*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
80.0 - 90.0	**SILTY GRAVELLY SAND**: Pale brown [10YR6/3]; subangular to subrounded, fine to coarse sand 50%, gravel 40%, silt 10%. Gravel fraction: subangular to subrounded granules and pebbles to 0.5 in consisting of Mostly quartzite; some tuff, basalt, schist, trace diabase. Non-lithified. Non-plastic. Dry. Reaction to acid: moderate.
90.0 - 100.0	**SILTY GRAVELLY SAND**: Pale brown [10YR6/3]; subangular to subrounded, fine to coarse sand 50%, gravel 40%, silt 10%. Gravel fraction: subangular to subrounded granules and pebbles to 0.4 in consisting of Mostly quartzite; some tuff, basalt, schist, trace diabase. Non-lithified. Non-plastic. Dry. Reaction to acid: moderate.
100.0 - 110.0	**SILTY SANDY GRAVEL**: Light brown [7.5YR6/3]; gravel 45%, angular to subrounded, fine to coarse sand 40%, silt 15%. Gravel fraction: angular to subrounded granules and pebbles to 1 in consisting of Mostly quartzite; some tuff, basalt, schist, trace diabase. Non-lithified. Non-plastic. Dry. Reaction to acid: moderate.
110.0 - 120.0	**SILTY SANDY GRAVEL**: Light brown [7.5YR6/3]; gravel 60%, angular to subrounded, fine to very coarse sand 30%, silt 10%. Gravel fraction: angular to subrounded granules and pebbles to 1.5 in consisting of Mostly quartzite; some tuff, basalt, schist, trace diabase. Non-lithified. Non-plastic. Dry. Reaction to acid: strong. Some calcite coatings on chips.
120.0 - 130.0	**SILTY SANDY GRAVEL**: Light brown [7.5YR6/3]; gravel 55%, angular to subrounded, very fine to coarse sand 35%, silt 10%. Gravel fraction: angular to subrounded granules and pebbles to 1.7 in consisting of Mostly quartzite; some tuff, basalt, schist, trace diabase. Non-lithified. Non-plastic. Dry. Reaction to acid: weak to moderate. Some calcite coatings on chips.
130.0 - 140.0	**SILTY SANDY GRAVEL**: Light brown [7.5YR6/3]; gravel 40%, subangular, very fine to coarse sand 30%, silt 30%. Gravel fraction: angular to subrounded granules and pebbles to 0.8 in consisting of Quartzite, schist, basalt, diabase, tuff, some quartz vein. Non-lithified. Non-plastic. Dry. Reaction to acid: weak to moderate.
140.0 - 150.0	**SILTY SANDY GRAVEL**: Light brown [7.5YR6/3]; gravel 60%, subangular, fine to coarse sand 30%, silt 10%. Gravel fraction: angular to subrounded granules and pebbles to 1.5 in consisting of mostly basalt, tuff, diabase; some schist and quartzite. Non-lithified. Non-plastic. Dry. Reaction to acid: weak to moderate.
150.0 - 160.0	**SILTY SANDY GRAVEL**: Light brown [7.5YR6/3]; gravel 60%, subangular to subrounded, fine to coarse sand 25%, silt 15%. Gravel fraction: angular to subrounded granules and pebbles to 0.6 in consisting of mostly basalt, tuff, diabase; some schist and quartzite. Non-lithified. Non-plastic. Dry. Reaction to acid: weak to moderate. Some calcite coatings on chips.
160.0 - 170.0	**SILTY SANDY GRAVEL**: Light brown [7.5YR6/3]; gravel 65%, subangular to subrounded, fine to very coarse sand 30%, silt 5%. Gravel fraction: angular to subrounded granules and pebbles to 1.3 in consisting of mostly basalt, tuff, diabase; some schist and quartzite. Non-lithified. Non-plastic. Dry. Reaction to acid: weak to moderate. Some calcite coatings on chips.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-A [*55-919728*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
170.0 - 180.0	**SILTY SANDY GRAVEL**: Light brown [7.5YR6/3]; gravel 60%, subangular, fine to coarse sand 30%, silt 10%. Gravel fraction: angular to subrounded granules and pebbles to 0.8 in consisting of mostly basalt, tuff, diabase; some schist and quartzite. Non-lithified. Non-plastic. Dry. Reaction to acid: moderate to strong. Some calcite coatings on chips; trace calcite crystals.
180.0 - 190.0	**SILTY SANDY GRAVEL**: Light brown [7.5YR6/3]; gravel 60%, subangular, fine to coarse sand 25%, silt 15%. Gravel fraction: angular to subrounded granules and pebbles to 0.7 in consisting of mostly basalt, tuff, diabase; some schist and quartzite. Non-lithified. Non-plastic. Dry. Reaction to acid: moderate. Some calcite coatings on chips.
190.0 - 200.0	**SILTY SANDY GRAVEL**: Light brown [7.5YR6/3]; gravel 65%, subangular, fine to coarse sand 30%, silt 5%. Gravel fraction: angular to subrounded granules and pebbles to 0.7 in consisting of mostly basalt, tuff, diabase; some schist and quartzite. Non-lithified. Non-plastic. Dry. Reaction to acid: moderate. Some calcite coatings on chips.
200.0 - 210.0	**SILTY SANDY GRAVEL**: Reddish brown [5YR5/3]; gravel 60%, subangular to subrounded, fine to coarse sand 30%, silt 10%. Gravel fraction: angular to subangular granules and pebbles to 1 in consisting of mostly basalt, tuff, diabase; some schist and quartzite. Non-lithified. Non-plastic. Dry. Reaction to acid: moderate. Some calcite coatings on chips.
210.0 - 220.0	**SILTY SANDY GRAVEL**: Reddish brown [5YR5/3]; gravel 60%, subangular to subrounded, fine to coarse sand 30%, silt 10%. Gravel fraction: angular to subangular granules and pebbles to 1.2 in consisting of mostly basalt, tuff, diabase; some schist and quartzite. Non-lithified. Non-plastic. Dry. Reaction to acid: weak. Some calcite coatings on chips.
220.0 - 230.0	**SILTY SANDY GRAVEL**: Reddish gray [5YR5/2]; gravel 60%, subangular, fine to coarse sand 30%, silt 10%. Gravel fraction: angular to subangular granules and pebbles to 1 in consisting of mostly basalt, tuff, diabase; some schist and quartzite. Non-lithified. Non-plastic. Dry. Reaction to acid: weak. Some calcite coatings on chips.
230.0 - 240.0	**SILTY SANDY GRAVEL**: Reddish gray [5YR5/2]; gravel 65%, subangular, fine to coarse sand 25%, silt 10%. Gravel fraction: angular to subangular granules and pebbles to 0.8 in consisting of mostly basalt, tuff, diabase; some schist and quartzite. Non-lithified. Non-plastic. Dry. Reaction to acid: weak. Some calcite coatings on chips.
240.0 - 250.0	**SILTY SANDY GRAVEL**: Light reddish brown [2.5YR6/4]; gravel 55%, subangular to subrounded, very fine to coarse sand 35%, silt 10%. Gravel fraction: angular to subrounded granules and pebbles to 0.7 in consisting of mostly basalt, tuff, diabase; some schist and quartzite. Non-lithified. Non-plastic. Dry. Reaction to acid: weak. Some calcite coatings on chips.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-A [*55-919728*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
250.0 - 260.0	**SILTY SANDY GRAVEL**: Light reddish brown [2.5YR6/4]; gravel 50%, subangular to subrounded, very fine to coarse sand 40%, silt 10%. Gravel fraction: angular to subrounded granules and pebbles to 0.6 in consisting of mostly basalt, tuff, diabase; some schist and quartzite. Non-lithified. Non-plastic. Dry. Reaction to acid: weak.
260.0 - 270.0	**SILTY GRAVELLY SAND**: Light reddish brown [2.5YR6/4]; gravel 45%, subangular, very fine to coarse sand 45%, silt 10%. Gravel fraction: angular to subrounded granules and pebbles to 0.6 in consisting of mostly basalt with some tuff, schist and quartzite. Non-lithified. Non-plastic. Dry. Reaction to acid: weak.
270.0 - 280.0	**SILTY GRAVELLY SAND**: Light reddish brown [2.5YR6/4]; subangular to subrounded, very fine to coarse sand 50%, gravel 40%, silt 10%. Gravel fraction: angular to subrounded granules and pebbles to 0.5 in consisting of mostly basalt with some tuff, schist and quartzite. Non-lithified. Non-plastic. Dry. Reaction to acid: weak.
280.0 - 290.0	**SILTY GRAVELLY SAND**: Light reddish brown [2.5YR6/4]; subangular to subrounded, very fine to coarse sand 50%, gravel 40%, silt 10%. Gravel fraction: angular to subrounded granules and pebbles to 1.2 in consisting of mostly basalt with some tuff, schist and quartzite. Non-lithified. Non-plastic. Dry. Reaction to acid: weak to moderate. Some calcite coatings on chips.
290.0 - 300.0	**SILTY GRAVELLY SAND**: Light reddish brown [2.5YR6/4]; gravel 45%, subangular to subrounded, very fine to coarse sand 45%, silt 10%. Gravel fraction: angular to subrounded granules and pebbles to 0.9 in consisting of mostly basalt with some tuff, schist and quartzite. Non-lithified. Non-plastic. Dry. Reaction to acid: weak to moderate. Some calcite coatings on chips.
300.0 - 310.0	**SILTY GRAVELLY SAND**: Reddish brown [5YR5/4]; subangular to subrounded, very fine to coarse sand 45%, gravel 40%, silt 15%. Gravel fraction: angular to subrounded granules and pebbles to 0.7 in consisting of mostly basalt with some tuff, schist and quartzite. Non-lithified. Non-plastic. Dry. Reaction to acid: weak to moderate. Some calcite coatings on chips.
310.0 - 320.0	**SILTY GRAVELLY SAND**: Reddish brown [5YR5/4]; subangular to subrounded, very fine to coarse sand 50%, gravel 30%, silt 20%. Gravel fraction: subangular to subrounded granules and pebbles to 0.5 in consisting of mostly basalt with some tuff, schist and quartzite. Non-lithified. Non-plastic. Dry. Reaction to acid: weak. Some calcite coatings on chips.
320.0 - 330.0	**SILTY SANDY GRAVEL**: Reddish brown [5YR5/4]; gravel 45%, subangular to subrounded, very fine to coarse sand 40%, silt 15%. Gravel fraction: subangular to subrounded granules and pebbles to 0.8 in consisting of mostly basalt with some tuff, schist and quartzite. Non-lithified. Non-plastic. Dry. Reaction to acid: weak.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-A [*55-919728*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
330.0 - 340.0	**SILTY SANDY GRAVEL**: Reddish brown [5YR5/4]; gravel 50%, subangular, very fine to coarse sand 35%, silt 15%. Gravel fraction: angular to subrounded granules and pebbles to 0.8 in consisting of mostly basalt with some tuff, schist and quartzite. Non-lithified. Non-plastic. Dry. Reaction to acid: weak.
340.0 - 350.0	**SILTY SANDY GRAVEL**: Reddish brown [5YR5/4]; gravel 45%, subangular, very fine to coarse sand 40%, silt 15%. Gravel fraction: angular to subrounded granules and pebbles to 0.6 in consisting of mostly basalt with some tuff, schist and quartzite. Non-lithified. Non-plastic. Dry. Reaction to acid: weak.
350.0 - 360.0	**SILTY SANDY GRAVEL**: Dark reddish brown [2.5YR3/3]; gravel 50%, subangular, very fine to coarse sand 40%, silt 10%. Gravel fraction: subangular to subrounded granules and pebbles to 0.4 in consisting of mostly basalt with some tuff, schist and quartzite. Non-lithified. Non-plastic. Saturated. Reaction to acid: weak. Slightly weathered chips.
360.0 - 370.0	**GRAVELLY SAND**: Dark reddish brown [2.5YR3/3]; subangular, very fine to coarse sand 50%, gravel 45%, silt 5%. Gravel fraction: subangular to subrounded granules and pebbles to 0.4 in consisting of mostly basalt with some tuff, schist and quartzite. Non-lithified. Non-plastic. Saturated. Reaction to acid: very weak. Slightly weathered chips.
370.0 - 380.0	**GRAVELLY SAND**: Dark reddish brown [2.5YR3/3]; subangular, very fine to coarse sand 50%, gravel 45%, silt 5%. Gravel fraction: subangular to subrounded granules and pebbles to 0.5 in consisting of mostly basalt with some tuff, schist and quartzite. Non-lithified. Non-plastic. Saturated. Reaction to acid: none to very weak. Slightly weathered chips.
380.0 - 390.0	**GRAVELLY SAND**: Dark reddish brown [2.5YR3/3]; subangular to subrounded, very fine to coarse sand 60%, gravel 35%, silt 5%. Gravel fraction: subangular to subrounded granules and pebbles to 0.5 in consisting of mostly basalt with some tuff, schist and quartzite. Non-lithified. Non-plastic. Saturated. Reaction to acid: none to very weak. Slightly weathered chips.
390.0 - 400.0	**GRAVELLY SAND**: Dusky red [10R3/3]; subangular, fine to very coarse sand 50%, gravel 45%, silt 5%. Gravel fraction: subangular to subrounded granules and pebbles to 0.6 in consisting of mostly basalt with some schist, quartzite and tuff. Non-lithified. Non-plastic. Saturated. Reaction to acid: none to very weak. Slightly weathered chips.
400.0 - 410.0	**SANDY GRAVEL**: Dusky red [10R3/3]; gravel 50%, subangular, fine to very coarse sand 45%, silt 5%. Gravel fraction: subangular to subrounded granules and pebbles to 0.5 in consisting of mostly basalt with some schist, quartzite and tuff, trace orange chert. Non-lithified. Non-plastic. Saturated. Reaction to acid: none to very weak. Slightly weathered chips.
410.0 - 420.0	**SANDY GRAVEL**: Dusky red [10R3/3]; gravel 55%, subangular, medium to very coarse sand 40%, silt 5%. Gravel fraction: subangular to subrounded granules and pebbles to 0.3 in consisting of mostly basalt with some schist, quartzite and tuff. Non-lithified. Non-plastic. Saturated. Reaction to acid: none to very weak. Slightly weathered chips.

Gravel/sand division based on Wentworth scale. Grain size fractions estimated using manual field methods.
Grain size fractions rounded to the nearest five percent.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-A [*55-919728*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
420.0 - 430.0	**SANDY GRAVEL**: Dusky red [10R3/3]; gravel 55%, subangular, medium to very coarse sand 40%, silt 5%. Gravel fraction: subangular granules and pebbles to 0.4 in consisting of mostly basalt with some schist, quartzite and tuff. Non-lithified. Non-plastic. Saturated. Reaction to acid: none to very weak. Slightly weathered chips.
430.0 - 440.0	**SANDY GRAVEL**: Dusky red [10R3/3]; gravel 65%, subangular, medium to very coarse sand 30%, silt 5%. Gravel fraction: subangular granules and pebbles to 0.3 in consisting of mostly basalt with some schist, quartzite and tuff. Non-lithified. Non-plastic. Saturated. Reaction to acid: none to very weak. Slightly weathered chips.
440.0 - 450.0	**SANDY GRAVEL**: Dusky red [10R3/3]; gravel 70%, subangular, medium to very coarse sand 25%, silt 5%. Gravel fraction: subangular granules and pebbles to 0.4 in consisting of mostly basalt with some schist, quartzite and tuff. Non-lithified. Non-plastic. Saturated. Reaction to acid: none to very weak. Slightly weathered chips.
450.0 - 460.0	**SANDY GRAVEL**: Dusky red [10R3/3]; gravel 60%, subangular, medium to very coarse sand 35%, silt 5%. Gravel fraction: subangular granules and pebbles to 0.5 in consisting of mostly basalt with some schist, quartzite and tuff. Weakly lithified. Non-plastic. Saturated. Reaction to acid: none to very weak. Slightly weathered chips; cementation coating chips.
460.0 - 470.0	**SANDY GRAVEL**: Dusky red [10R3/3]; gravel 70%, subangular, medium to very coarse sand 25%, silt 5%. Gravel fraction: subangular granules and pebbles to 0.6 in consisting of mostly basalt with some schist, quartzite and tuff. Weakly lithified. Non-plastic. Saturated. Reaction to acid: weak. Weathered chips; cementation coating chips.
470.0 - 480.0	**SANDY GRAVEL**: Dusky red [10R3/3]; gravel 60%, subangular, medium to very coarse sand 35%, silt 5%. Gravel fraction: subangular to subrounded granules and pebbles to 0.6 in consisting of mostly basalt with some schist, quartzite and tuff. Weakly lithified. Non-plastic. Saturated. Reaction to acid: weak. Weathered chips; cementation coating chips.
480.0 - 490.0	**SANDY GRAVEL**: Dusky red [10R3/3]; gravel 55%, subangular, fine to coarse sand 40%, silt 5%. Gravel fraction: subangular granules and pebbles to 0.8 in consisting of weathered basalt and quartzite; some tuff and schist. Weakly lithified. Non-plastic. Saturated. Reaction to acid: weak. Cementation coating chips.
490.0 - 500.0	**SANDY GRAVEL**: Dusky red [10R3/3]; gravel 55%, subangular, fine to coarse sand 40%, silt 5%. Gravel fraction: subangular granules and pebbles to 0.6 in consisting of weathered basalt and quartzite; some tuff and schist. Weakly lithified. Non-plastic. Saturated. Reaction to acid: weak. Some cementation coating chips.
500.0 - 510.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular, very fine to coarse sand 55%, gravel 40%, silt 5%. Gravel fraction: subangular granules and pebbles to 0.3 in consisting of weathered basalt and quartzite; some tuff and schist. Weakly to moderately lithified. Non-plastic. Saturated. Reaction to acid: none to very weak. Some cementation coating chips.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-A [*55-919728*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
510.0 - 520.0	**GRAVELLY SAND**: Weak red [10R4/3]; angular to subangular, very fine to coarse sand 55%, gravel 40%, silt 5%. Gravel fraction: subangular granules and pebbles to 0.4 in consisting of weathered basalt and quartzite; some tuff and schist. Moderately lithified. Non-plastic. Saturated. Reaction to acid: none to very weak. Some cementation coating chips.
520.0 - 530.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular, very fine to coarse sand 60%, gravel 35%, silt 5%. Gravel fraction: angular to subrounded granules and pebbles to 0.3 in consisting of weathered basalt and quartzite; some tuff and schist. Moderately lithified. Non-plastic. Saturated. Reaction to acid: moderate. Some cementation coating chips.
530.0 - 540.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular, very fine to coarse sand 65%, gravel 30%, silt 5%. Gravel fraction: angular to subrounded granules and pebbles to 0.2 in consisting of weathered basalt and quartzite; some tuff and schist. Moderately lithified. Non-plastic. Saturated. Reaction to acid: weak to moderate. Some cementation coating chips.
540.0 - 550.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular, very fine to coarse sand 65%, gravel 35%. Gravel fraction: angular to subrounded granules and pebbles to 0.3 in consisting of weathered basalt and quartzite; some tuff and schist. Moderately lithified. Non-plastic. Saturated. Reaction to acid: weak to moderate. Some cementation coating chips.
550.0 - 560.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular, very fine to coarse sand 65%, gravel 35%. Gravel fraction: angular to subrounded granules and pebbles to 0.2 in consisting of weathered basalt and quartzite; some tuff and schist. Moderately lithified. Non-plastic. Saturated. Reaction to acid: weak to moderate. Some cementation coating chips.
560.0 - 570.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular, very fine to coarse sand 60%, gravel 35%, silt 5%. Gravel fraction: angular to subrounded granules and pebbles to 0.4 in consisting of weathered basalt and quartzite; some tuff and schist. Moderately lithified. Non-plastic. Saturated. Reaction to acid: weak to moderate. Some cementation coating chips; iron oxidation on chips.
570.0 - 580.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular, very fine to coarse sand 55%, gravel 40%, silt 5%. Gravel fraction: angular to subrounded granules and pebbles to 0.6 in consisting of weathered basalt and quartzite; some tuff and schist. Moderately lithified. Non-plastic. Saturated. Reaction to acid: weak to moderate. Some cementation coating chips; iron oxidation on chips.
580.0 - 590.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular, very fine to coarse sand 50%, gravel 45%, silt 5%. Gravel fraction: angular to subrounded granules and pebbles to 0.6 in consisting of weathered basalt and quartzite; some tuff and schist; trace quartz vein. Moderately lithified. Non-plastic. Saturated. Reaction to acid: weak to moderate. Some cementation coating chips; iron oxidation on chips.

Gravel/sand division based on Wentworth scale. Grain size fractions estimated using manual field methods.
Grain size fractions rounded to the nearest five percent.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-A [*55-919728*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
590.0 - 600.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular, very fine to coarse sand 55%, gravel 40%, silt 5%. Gravel fraction: angular to subrounded granules and pebbles to 0.5 in consisting of weathered basalt and quartzite; some tuff and schist. Moderately lithified. Non-plastic. Saturated. Reaction to acid: weak. Some cementation coating chips; iron oxidation on chips.
600.0 - 610.0	**SANDY GRAVEL**: Weak red [10R4/3]; gravel 50%, subangular, very fine to coarse sand 45%, silt 5%. Gravel fraction: angular to subrounded granules and pebbles to 0.4 in consisting of weathered basalt and quartzite; some tuff and schist. Moderately lithified. Non-plastic. Saturated. Reaction to acid: very weak. Some cementation coating chips; iron oxidation on chips.
610.0 - 620.0	**SANDY GRAVEL**: Weak red [10R4/3]; gravel 55%, subangular, very fine to coarse sand 45%. Gravel fraction: angular to subrounded granules and pebbles to 0.7 in consisting of weathered basalt and quartzite; some tuff and schist. Moderately lithified. Non-plastic. Saturated. Reaction to acid: very weak. Some cementation coating chips; iron oxidation on chips.
620.0 - 630.0	**SANDY GRAVEL**: Weak red [10R4/3]; gravel 55%, subangular, very fine to coarse sand 45%. Gravel fraction: angular to subrounded granules and pebbles to 0.8 in consisting of weathered basalt and quartzite; some tuff and schist. Moderately lithified. Non-plastic. Saturated. Reaction to acid: none to very weak. Some cementation coating chips; iron oxidation on chips.
630.0 - 640.0	**SANDY GRAVEL**: Weak red [10R4/3]; gravel 55%, subangular, very fine to coarse sand 45%. Gravel fraction: angular to subrounded granules and pebbles to 0.6 in consisting of weathered basalt and quartzite; some tuff and schist. Moderately lithified. Non-plastic. Saturated. Reaction to acid: none to very weak. Some cementation coating chips; iron oxidation on chips.
640.0 - 650.0	**SANDY GRAVEL**: Weak red [10R4/3]; gravel 55%, subangular, very fine to coarse sand 40%, silt and clay 5%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of weathered basalt and quartzite; some tuff and schist. Moderately lithified. Medium plasticity. Saturated. Reaction to acid: none to very weak. Some cementation coating chips; iron oxidation on chips.
650.0 - 660.0	**SANDY GRAVEL**: Weak red [10R4/3]; gravel 55%, subangular to subrounded, fine to coarse sand 40%, silt 5%. Gravel fraction: angular to subangular granules and pebbles to 0.6 in consisting of weathered basalt and quartzite; some granite/tuff; trace schist. Moderately lithified. Non-plastic. Saturated. Reaction to acid: none. Some cementation coating chips; iron oxidation on chips.
660.0 - 670.0	**SANDY GRAVEL**: Weak red [10R4/3]; gravel 60%, subangular to subrounded, fine to very coarse sand 40%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of weathered basalt and quartzite; some granite/tuff and conglomerate chips; trace schist. Moderately lithified. Non-plastic. Saturated. Reaction to acid: none. Trace cementation coating chips; iron oxidation on chips.

Gravel/sand division based on Wentworth scale. Grain size fractions estimated using manual field methods.
Grain size fractions rounded to the nearest five percent.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-A [*55-919728*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
670.0 - 680.0	**SANDY GRAVEL**: Weak red [10R4/3]; gravel 55%, subangular to subrounded, fine to very coarse sand 45%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of weathered basalt and quartzite; some granite/tuff and conglomerate chips; trace schist. Moderately lithified. Non-plastic. Saturated. Reaction to acid: none. Trace cementation coating chips; iron oxidation on chips.
680.0 - 690.0	**SANDY GRAVEL**: Weak red [10R4/3]; gravel 60%, subangular to subrounded, fine to very coarse sand 40%. Gravel fraction: angular to subangular granules and pebbles to 0.7 in consisting of weathered basalt and quartzite; some granite/tuff and conglomerate chips; trace schist. Moderately lithified. Non-plastic. Saturated. Reaction to acid: none. Trace cementation coating chips; iron oxidation on chips.
690.0 - 700.0	**SANDY GRAVEL**: Weak red [10R4/3]; gravel 65%, subangular to subrounded, fine to very coarse sand 35%. Gravel fraction: angular to subangular granules and pebbles to 0.4 in consisting of weathered basalt, quartzite and granite/tuff; some conglomerate chips. Moderately lithified. Non-plastic. Saturated. Reaction to acid: none. Some cementation coating chips; iron oxidation on chips.
700.0 - 710.0	**GRAVELLY SAND**: Weak red [10R4/3]; gravel 50%, subangular to subrounded, medium to very coarse sand 50%. Gravel fraction: angular to subangular granules and pebbles to 0.3 in consisting of weathered basalt, quartzite and granite/tuff; some conglomerate chips. Moderately lithified. Non-plastic. Saturated. Reaction to acid: none. Some cementation coating chips; iron oxidation on chips.
710.0 - 720.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular to subrounded, fine to very coarse sand 70%, gravel 30%. Gravel fraction: angular to subangular granules and pebbles to 0.4 in consisting of weathered basalt, quartzite and granite/tuff; some conglomerate chips. Moderately lithified. Non-plastic. Saturated. Reaction to acid: none. Some cementation coating chips; iron oxidation on chips.
720.0 - 730.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular to subrounded, fine to very coarse sand 65%, gravel 35%. Gravel fraction: angular to subangular granules and pebbles to 0.3 in consisting of weathered basalt, quartzite and granite/tuff; some conglomerate chips. Moderately lithified. Non-plastic. Saturated. Reaction to acid: none. Some cementation coating chips; iron oxidation on chips.
730.0 - 740.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular to subrounded, fine to very coarse sand 70%, gravel 30%. Gravel fraction: angular to subangular granules and pebbles to 0.3 in consisting of weathered basalt, quartzite and granite/tuff; some conglomerate chips. Moderately lithified. Non-plastic. Saturated. Reaction to acid: none. Some cementation coating chips; iron oxidation on chips.
740.0 - 750.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular to subrounded, fine to very coarse sand 55%, gravel 45%. Gravel fraction: angular to subangular granules and pebbles to 0.2 in consisting of weathered basalt, quartzite and granite/tuff; some conglomerate chips. Moderately lithified. Non-plastic. Saturated. Reaction to acid: none. Some cementation coating chips; iron oxidation on chips.

Gravel/sand division based on Wentworth scale. Grain size fractions estimated using manual field methods.
Grain size fractions rounded to the nearest five percent.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-A [*55-919728*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
750.0 - 760.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular to subrounded, fine to very coarse sand 60%, gravel 40%. Gravel fraction: angular to subangular granules and pebbles to 0.4 in consisting of weathered basalt, quartzite and granite/tuff; some conglomerate chips. Moderately lithified. Non-plastic. Saturated. Reaction to acid: none. Some cementation coating chips; iron oxidation on chips.
760.0 - 770.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular to subrounded, fine to very coarse sand 60%, gravel 40%. Gravel fraction: subangular granules and pebbles to 0.4 in consisting of weathered basalt, quartzite and granite/tuff; some conglomerate chips. Moderately lithified. Non-plastic. Saturated. Reaction to acid: none. Some cementation coating chips; iron oxidation on chips.
770.0 - 780.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular to subrounded, medium to very coarse sand 70%, gravel 30%. Gravel fraction: subangular granules and pebbles to 0.2 in consisting of weathered basalt, quartzite and granite/tuff; some conglomerate chips. Moderately lithified. Non-plastic. Saturated. Reaction to acid: none. Some cementation coating chips; iron oxidation on chips.
780.0 - 790.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular, medium to very coarse sand 65%, gravel 35%. Gravel fraction: subangular granules and pebbles to 0.3 in consisting of weathered basalt and quartzite; some tuff; trace diabase and conglomerate chips. Moderately lithified. Non-plastic. Saturated. Reaction to acid: none. Some cementation coating chips.
790.0 - 800.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular, medium to very coarse sand 65%, gravel 35%. Gravel fraction: subangular granules and pebbles to 0.3 in consisting of weathered basalt and quartzite; some tuff; trace diabase and conglomerate chips. Moderately lithified. Non-plastic. Saturated. Reaction to acid: none. Some cementation coating chips.
800.0 - 810.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular, medium to very coarse sand 60%, gravel 40%. Gravel fraction: subangular to subrounded granules and pebbles to 0.5 in consisting of weathered basalt and quartzite; some tuff; trace diabase and conglomerate chips. Moderately lithified. Non-plastic. Saturated. Reaction to acid: none. Some cementation coating chips.
810.0 - 820.0	**GRAVELLY SAND**: Reddish brown [2.5YR4/3]; subangular, medium to very coarse sand 55%, gravel 45%. Gravel fraction: subangular to subrounded granules and pebbles to 0.4 in consisting of weathered tuff and quartzite; some basalt; trace diabase and conglomerate chips. Moderately lithified. Non-plastic. Saturated. Reaction to acid: none. Some cementation coating chips.
820.0 - 830.0	**GRAVELLY SAND**: Reddish brown [2.5YR4/3]; subangular, medium to very coarse sand 65%, gravel 35%. Gravel fraction: subangular to subrounded granules and pebbles to 0.3 in consisting of weathered tuff and quartzite; some basalt; trace diabase and conglomerate chips. Moderately lithified. Non-plastic. Saturated. Reaction to acid: none. Some cementation coating chips.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-A [*55-919728*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
830.0 - 840.0	**GRAVELLY SAND**: Reddish brown [2.5YR4/3]; subangular, medium to very coarse sand 55%, gravel 45%. Gravel fraction: subangular to subrounded granules and pebbles to 0.6 in consisting of weathered tuff and quartzite; some basalt; trace diabase and conglomerate chips. Moderately lithified. Non-plastic. Saturated. Reaction to acid: weak to moderate. Some cementation coating chips.
840.0 - 850.0	**GRAVELLY SAND**: Reddish brown [2.5YR4/3]; subangular, medium to very coarse sand 60%, gravel 40%. Gravel fraction: subangular to subrounded granules and pebbles to 0.3 in consisting of weathered tuff and quartzite; some basalt; trace diabase and conglomerate chips. Moderately lithified. Non-plastic. Saturated. Reaction to acid: weak to moderate. Some cementation coating chips.
850.0 - 860.0	**GRAVELLY SAND**: Reddish brown [2.5YR4/3]; subangular, medium to very coarse sand 65%, gravel 35%. Gravel fraction: subangular to subrounded granules and pebbles to 0.2 in consisting of weathered tuff and quartzite; some basalt; trace diabase and conglomerate chips. Moderately lithified. Non-plastic. Saturated. Reaction to acid: weak to moderate. Some cementation coating chips.
860.0 - 870.0	**GRAVELLY SAND**: Reddish brown [2.5YR4/3]; subangular, medium to very coarse sand 65%, gravel 35%. Gravel fraction: subangular to subrounded granules and pebbles to 0.3 in consisting of weathered tuff and quartzite; some basalt; trace diabase and conglomerate chips. Moderately lithified. Non-plastic. Saturated. Reaction to acid: weak to moderate. Some cementation coating chips.
870.0 - 880.0	**GRAVELLY SAND**: Reddish brown [2.5YR4/3]; subangular, medium to very coarse sand 70%, gravel 30%. Gravel fraction: subangular to subrounded granules and pebbles to 0.5 in consisting of weathered tuff and quartzite; some basalt; trace diabase and conglomerate chips. Moderately lithified. Non-plastic. Saturated. Reaction to acid: weak to moderate. Some cementation coating chips.
880.0 - 890.0	**GRAVELLY SAND**: Reddish brown [2.5YR4/3]; subangular, medium to very coarse sand 60%, gravel 40%. Gravel fraction: subangular granules and pebbles to 0.7 in consisting of weathered tuff and quartzite; some basalt; trace diabase and conglomerate chips. Moderately lithified. Non-plastic. Saturated. Reaction to acid: weak to moderate. Some cementation coating chips.
890.0 - 900.0	**GRAVELLY SAND**: Reddish brown [2.5YR4/3]; subangular, medium to very coarse sand 55%, gravel 45%. Gravel fraction: subangular granules and pebbles to 0.8 in consisting of weathered tuff and quartzite; some basalt; trace diabase and conglomerate chips. Moderately lithified. Non-plastic. Saturated. Reaction to acid: weak to moderate. Some cementation coating chips.
900.0 - 910.0	**GRAVELLY SAND**: Reddish brown [2.5YR4/3]; subangular, medium to very coarse sand 60%, gravel 40%. Gravel fraction: subangular granules and pebbles to 0.7 in consisting of weathered tuff and quartzite; some basalt; trace diabase and conglomerate chips. Moderately lithified. Non-plastic. Saturated. Reaction to acid: weak. Some cementation coating chips.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-A [*55-919728*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
910.0 - 920.0	**GRAVELLY SAND**: Weak red [10R4/2]; subangular, medium to very coarse sand 80%, gravel 20%. Gravel fraction: subangular granules and pebbles to 0.2 in consisting of weathered tuff, basalt, and quartzite; trace chert. Weakly to moderately lithified. Non-plastic. Saturated. Reaction to acid: weak. Some cementation coating chips.
920.0 - 930.0	**GRAVELLY SAND**: Weak red [10R4/2]; subangular, medium to very coarse sand 65%, gravel 35%. Gravel fraction: subangular granules and pebbles to 0.6 in consisting of weathered tuff, basalt, and quartzite; trace chert. Moderately lithified. Non-plastic. Saturated. Reaction to acid: very weak. Some cementation coating chips.
930.0 - 940.0	**GRAVELLY SAND**: Weak red [10R4/2]; subangular, fine to very coarse sand 70%, gravel 30%. Gravel fraction: subangular granules and pebbles to 0.2 in consisting of weathered tuff, basalt, and quartzite; trace chert. Moderately lithified. Non-plastic. Saturated. Reaction to acid: very weak. Some cementation coating chips.
940.0 - 950.0	**GRAVELLY SAND**: Weak red [10R4/2]; subangular, fine to very coarse sand 75%, gravel 25%. Gravel fraction: subangular granules and pebbles to 0.7 in consisting of weathered tuff, basalt, and quartzite; trace chert. Moderately lithified. Non-plastic. Saturated. Reaction to acid: very weak. Some cementation coating chips.
950.0 - 960.0	**GRAVELLY SAND**: Weak red [10R4/2]; subangular to subrounded, fine to very coarse sand 80%, gravel 20%. Gravel fraction: subangular granules and pebbles to 0.4 in consisting of weathered tuff, basalt, and quartzite; trace chert. Moderately lithified. Non-plastic. Saturated. Reaction to acid: weak. Some cementation coating chips.
960.0 - 970.0	**GRAVELLY SAND**: Weak red [10R4/2]; subangular to subrounded, fine to very coarse sand 70%, gravel 30%. Gravel fraction: subangular granules and pebbles to 0.6 in consisting of weathered tuff, basalt, and quartzite; trace chert. Moderately lithified. Non-plastic. Saturated. Reaction to acid: weak. Some cementation coating chips.
970.0 - 980.0	**GRAVELLY SAND**: Weak red [10R4/2]; subangular, fine to very coarse sand 85%, gravel 15%. Gravel fraction: subangular granules and pebbles to 0.3 in consisting of weathered tuff, basalt, and quartzite; trace chert. Moderately lithified. Non-plastic. Saturated. Reaction to acid: very weak. Some cementation coating chips.
980.0 - 990.0	**GRAVELLY SAND**: Weak red [10R4/2]; subangular, fine to very coarse sand 85%, gravel 15%. Gravel fraction: subangular to subrounded granules and pebbles to 0.2 in consisting of weathered tuff, basalt, and quartzite; trace chert. Moderately lithified. Non-plastic. Saturated. Reaction to acid: weak. Some cementation coating chips.
990.0 - 1,000.0	**GRAVELLY SAND**: Weak red [10R4/2]; subangular, fine to very coarse sand 90%, gravel 10%. Gravel fraction: subangular to subrounded granules and pebbles to 0.2 in consisting of weathered tuff, basalt, and quartzite; trace chert. Moderately lithified. Non-plastic. Saturated. Reaction to acid: very weak. Some cementation coating chips.

Gravel/sand division based on Wentworth scale. Grain size fractions estimated using manual field methods.
Grain size fractions rounded to the nearest five percent.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-A [*55-919728*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
1,000.0 - 1,010.0	**GRAVELLY SAND**: Weak red [10R4/2]; subangular, fine to very coarse sand 80%, gravel 20%. Gravel fraction: subangular to subrounded granules and pebbles to 0.4 in consisting of weathered tuff, basalt, and quartzite; trace chert. Moderately lithified. Non-plastic. Saturated. Reaction to acid: very weak. Some cementation coating chips.
1,010.0 - 1,020.0	**GRAVELLY SAND**: Weak red [10R4/2]; subangular, fine to very coarse sand 80%, gravel 20%. Gravel fraction: subangular to subrounded granules and pebbles to 0.5 in consisting of weathered tuff, basalt, and quartzite; trace chert. Moderately lithified. Non-plastic. Saturated. Reaction to acid: weak. Some cementation coating chips; iron oxidation on clasts.
1,020.0 - 1,030.0	**GRAVELLY SAND**: Weak red [10R4/2]; subangular, fine to very coarse sand 85%, gravel 15%. Gravel fraction: subangular to subrounded granules and pebbles to 0.3 in consisting of weathered tuff, basalt, and quartzite; trace chert. Moderately lithified. Non-plastic. Saturated. Reaction to acid: very weak. Some cementation coating chips; iron oxidation on clasts.
1,030.0 - 1,040.0	**GRAVELLY SAND**: Weak red [10R4/2]; subangular, fine to very coarse sand 85%, gravel 15%. Gravel fraction: subangular to subrounded granules and pebbles to 0.2 in consisting of weathered tuff, basalt, and quartzite; trace chert. Moderately lithified. Non-plastic. Saturated. Reaction to acid: weak to moderate. Some cementation coating chips; iron oxidation on clasts.
1,040.0 - 1,050.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular to subrounded, very fine to coarse sand 80%, gravel 20%. Gravel fraction: subangular to subrounded granules and pebbles to 0.4 in consisting of weathered tuff, basalt, and quartzite; trace yellow sandstone. Moderately lithified. Non-plastic. Saturated. Reaction to acid: very weak. Some cementation coating chips; iron oxidation on clasts.
1,050.0 - 1,060.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular to subrounded, fine to coarse sand 65%, gravel 35%. Gravel fraction: subangular to subrounded granules and pebbles to 0.3 in consisting of weathered tuff, basalt, and quartzite; trace yellow sandstone. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: very weak. Some cementation coating chips; iron oxidation on clasts.
1,060.0 - 1,070.0	**GRAVELLY SAND**: Reddish brown [5YR5/3]; subangular to subrounded, fine to coarse sand 75%, gravel 25%. Gravel fraction: subangular to subrounded granules and pebbles to 0.2 in consisting of weathered tuff, basalt, and quartzite; trace yellow sandstone. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: very weak. Some cementation coating chips; iron oxidation on clasts.
1,070.0 - 1,080.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular to subrounded, fine to coarse sand 80%, gravel 20%. Gravel fraction: subangular to subrounded granules and pebbles to 0.3 in consisting of weathered tuff, basalt, and quartzite; trace yellow sandstone. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: weak to moderate. Some cementation coating chips; iron oxidation on clasts.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-A [*55-919728*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
1,080.0 - 1,090.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular to subrounded, fine to coarse sand 75%, gravel 25%. Gravel fraction: subangular to subrounded granules and pebbles to 0.2 in consisting of weathered tuff, basalt, and quartzite; trace yellow sandstone. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: weak to moderate. Some cementation coating chips; iron oxidation on clasts.
1,090.0 - 1,100.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular to subrounded, fine to coarse sand 80%, gravel 20%. Gravel fraction: subangular to subrounded granules and pebbles to 0.2 in consisting of weathered tuff, basalt, and quartzite; trace yellow sandstone. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: very weak. Some cementation coating chips; iron oxidation on clasts.
1,100.0 - 1,110.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular to subrounded, fine to coarse sand 90%, gravel 10%. Gravel fraction: subangular granules and pebbles to 0.4 in consisting of weathered tuff, basalt, and quartzite; trace yellow sandstone. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: weak to moderate. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.
1,110.0 - 1,120.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular to subrounded, fine to coarse sand 95%, gravel 5%. Gravel fraction: subangular granules and pebbles to 0.1 in consisting of weathered tuff, basalt, and quartzite; trace yellow sandstone. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: weak. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.
1,120.0 - 1,130.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular to subrounded, fine to coarse sand 85%, gravel 15%. Gravel fraction: subangular granules and pebbles to 0.3 in consisting of weathered tuff, basalt, and quartzite; trace yellow sandstone. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: weak. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.
1,130.0 - 1,140.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular to subrounded, fine to coarse sand 80%, gravel 20%. Gravel fraction: subangular granules and pebbles to 0.3 in consisting of weathered tuff, basalt, and quartzite; trace yellow sandstone. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: very weak. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.
1,140.0 - 1,150.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular to subrounded, fine to coarse sand 80%, gravel 20%. Gravel fraction: subangular granules and pebbles to 0.2 in consisting of weathered tuff, basalt, and quartzite; trace yellow sandstone. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: very weak. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.
1,150.0 - 1,160.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular to subrounded, fine to coarse sand 85%, gravel 15%. Gravel fraction: subangular granules and pebbles to 0.1 in consisting of weathered tuff, basalt, and quartzite; trace yellow sandstone. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: weak to moderate. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.

Gravel/sand division based on Wentworth scale. Grain size fractions estimated using manual field methods.
Grain size fractions rounded to the nearest five percent.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-A [*55-919728*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
1,160.0 - 1,170.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular to subrounded, fine to coarse sand 90%, gravel 10%. Gravel fraction: subangular granules and pebbles to 0.1 in consisting of weathered tuff, basalt, and quartzite; trace yellow sandstone. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: weak to moderate. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.
1,170.0 - 1,180.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular, very fine to very coarse sand 80%, gravel 20%. Gravel fraction: subangular granules and pebbles to 0.5 in consisting of weathered tuff, basalt, and quartzite. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: very weak. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.
1,180.0 - 1,192.0	**GRAVELLY SAND**: Weak red [10R4/3]; subangular, very fine to very coarse sand 80%, gravel 20%. Gravel fraction: subangular granules and pebbles to 0.4 in consisting of weathered tuff, basalt, and quartzite. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: very weak. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.
1,192.0 - 1,198.0	**FELSIC TUFF**: Pinkish gray [7.5YR7/2]; Gravel fraction: to 0.3 in consisting of tan-white felsic tuff; quartz, plagioclase and biotite phenocrysts in a cystalline matrix. Weakly to moderately lithified. Non to high plasticity. Saturated. Reaction to acid: very weak. White clay at the base of tuff unit.
1,198.0 - 1,210.0	**GRAVELLY SAND**: Weak red [2.5YR4/2]; subangular, fine to very coarse sand 85%, gravel 15%. Gravel fraction: subangular granules and pebbles to 0.2 in consisting of weathered tuff, basalt, quartzite and brown siltstone. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: very weak. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.
1,210.0 - 1,220.0	**GRAVELLY SAND**: Weak red [2.5YR4/2]; subangular, very fine to very coarse sand 90%, gravel 10%. Gravel fraction: subangular granules and pebbles to 0.2 in consisting of weathered tuff, basalt, quartzite and brown siltstone. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: very weak. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.
1,220.0 - 1,230.0	**GRAVELLY SAND**: Weak red [2.5YR4/2]; subangular, very fine to very coarse sand 90%, gravel 10%. Gravel fraction: subangular granules and pebbles to 0.2 in consisting of weathered tuff, basalt, quartzite and brown siltstone. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: weak. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.
1,230.0 - 1,240.0	**SAND**: Weak red [2.5YR4/2]; subangular, very fine to very coarse sand 95%, gravel 5%. Gravel fraction: subangular granules and pebbles to 0.1 in consisting of weathered tuff, basalt, quartzite and brown siltstone. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: very weak. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.

Gravel/sand division based on Wentworth scale. Grain size fractions estimated using manual field methods.
Grain size fractions rounded to the nearest five percent.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-A [*55-919728*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
1,240.0 - 1,250.0	**GRAVELLY SAND**: Weak red [2.5YR4/2]; subangular, very fine to very coarse sand 80%, gravel 20%. Gravel fraction: subangular granules and pebbles to 0.3 in consisting of weathered tuff, basalt, quartzite and brown siltstone. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: very weak. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.
1,250.0 - 1,260.0	**GRAVELLY SAND**: Weak red [2.5YR4/2]; subangular, very fine to very coarse sand 80%, gravel 20%. Gravel fraction: subangular granules and pebbles to 0.4 in consisting of weathered tuff, basalt, quartzite and brown siltstone. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: very weak. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.
1,260.0 - 1,270.0	**GRAVELLY SAND**: Weak red [2.5YR4/2]; subangular, very fine to very coarse sand 85%, gravel 15%. Gravel fraction: subangular granules and pebbles to 0.2 in consisting of weathered tuff, basalt, quartzite and brown siltstone. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: very weak. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.
1,270.0 - 1,280.0	**SILTEY-CLAYEY SAND**: Weak red [2.5YR4/2]; subangular, very fine to very coarse sand 85%, silt and clay 10%, gravel 5%. Gravel fraction: subangular granules and pebbles to 0.1 in consisting of weathered tuff, basalt, quartzite and brown siltstone. Moderately to well lithified. Non to medium plasticity. Saturated. Reaction to acid: very weak. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.
1,280.0 - 1,290.0	**SILTY SAND**: Weak red [2.5YR4/2]; subangular, very fine to very coarse sand 85%, silt 10%, gravel 5%. Gravel fraction: subangular granules and pebbles to 0.1 in consisting of weathered tuff, basalt, quartzite and brown siltstone. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: weak to moderate. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.
1,290.0 - 1,300.0	**GRAVELLY SAND**: Weak red [2.5YR4/2]; subangular, very fine to very coarse sand 90%, gravel 10%. Gravel fraction: subangular granules and pebbles to 0.2 in consisting of weathered tuff, basalt, quartzite and brown siltstone. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: weak. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.
1,300.0 - 1,310.0	**GRAVELLY SAND**: Weak red [2.5YR4/2]; subangular to subrounded, very fine to very coarse sand 85%, gravel 10%, silt 5%. Gravel fraction: subangular to subrounded granules and pebbles to 0.3 in consisting of weathered basalt with some quartzite and tuff. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: very weak. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.
1,310.0 - 1,320.0	**SILTY GRAVELLY SAND**: Weak red [2.5YR4/2]; subangular to subrounded, very fine to very coarse sand 80%, gravel 15%, silt 5%. Gravel fraction: subangular to subrounded granules and pebbles to 0.3 in consisting of weathered basalt with some quartzite and tuff. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: weak to moderate. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-A [*55-919728*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
1,320.0 - 1,330.0	**SILTY SAND**: Weak red [2.5YR4/2]; subangular to subrounded, very fine to very coarse sand 80%, silt 15%, gravel 5%. Gravel fraction: subangular to subrounded granules and pebbles to 0.2 in consisting of weathered basalt with some quartzite and tuff. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: weak. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.
1,330.0 - 1,340.0	**GRAVELLY SAND**: Weak red [2.5YR4/2]; subangular to subrounded, very fine to very coarse sand 80%, gravel 15%, silt 5%. Gravel fraction: subangular to subrounded granules and pebbles to 0.3 in consisting of weathered basalt with some quartzite and tuff. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: very weak. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.
1,340.0 - 1,350.0	**GRAVELLY SAND**: Weak red [2.5YR4/2]; subangular to subrounded, very fine to very coarse sand 75%, gravel 20%, silt 5%. Gravel fraction: subangular granules and pebbles to 0.4 in consisting of weathered basalt with some quartzite and tuff. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: very weak. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.
1,350.0 - 1,360.0	**GRAVELLY SAND**: Weak red [2.5YR4/2]; subangular to subrounded, very fine to very coarse sand 85%, gravel 10%, silt 5%. Gravel fraction: subangular granules and pebbles to 0.2 in consisting of weathered basalt with some quartzite and tuff. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: moderate. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.
1,360.0 - 1,370.0	**GRAVELLY SAND**: Weak red [2.5YR4/2]; subangular to subrounded, very fine to very coarse sand 85%, gravel 15%. Gravel fraction: subangular granules and pebbles to 0.3 in consisting of weathered basalt with some quartzite and tuff. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: very weak. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.
1,370.0 - 1,380.0	**GRAVELLY SAND**: Weak red [2.5YR4/2]; subangular to subrounded, very fine to very coarse sand 85%, gravel 15%. Gravel fraction: subangular granules and pebbles to 0.2 in consisting of weathered basalt with some quartzite and tuff. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: very weak. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.
1,380.0 - 1,390.0	**GRAVELLY SAND**: Weak red [2.5YR4/2]; subangular to subrounded, very fine to very coarse sand 90%, gravel 10%. Gravel fraction: subangular to subrounded granules and pebbles to 0.2 in consisting of weathered basalt with some quartzite and tuff. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: very weak. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.
1,390.0 - 1,400.0	**SAND**: Weak red [2.5YR4/2]; subangular to subrounded, very fine to very coarse sand 90%, gravel 5%, silt 5%. Gravel fraction: subangular to subrounded granules and pebbles to 0.1 in consisting of weathered basalt with some quartzite and tuff. Moderately to well lithified. Non-plastic. Saturated. Reaction to acid: very weak. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.

Gravel/sand division based on Wentworth scale. Grain size fractions estimated using manual field methods.
Grain size fractions rounded to the nearest five percent.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-A [*55-919728*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
1,400.0 - 1,410.0	**SAND**: Weak red [2.5YR4/2]; subangular to subrounded, very fine to coarse sand 95%, gravel 5%. Gravel fraction: subangular to subrounded granules and pebbles to 0.1 in consisting of weathered basalt with some quartzite and tuff. Well lithified. Non-plastic. Saturated. Reaction to acid: very weak. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.
1,410.0 - 1,420.0	**SAND**: Weak red [2.5YR4/2]; subangular to subrounded, very fine to coarse sand 95%, gravel 5%. Gravel fraction: subangular to subrounded granules and pebbles to 0.2 in consisting of weathered basalt with some quartzite and tuff. Well lithified. Non-plastic. Saturated. Reaction to acid: weak. Pulverized cuttings; some cementation coating chips; iron oxidation on clasts.
1,420.0 - 1,430.0	**SAND**: Weak red [2.5YR4/2]; subangular to subrounded, very fine to coarse sand 100%, trace gravel. Gravel fraction: subangular to subrounded granules and pebbles to 0.1 in consisting of weathered basalt with some quartzite and tuff. Well lithified. Non-plastic. Saturated. Reaction to acid: moderate. Pulverized cuttings to mostly fine sand; some cementation coating chips; iron oxidation on clasts.
1,430.0 - 1,440.0	**SAND**: Weak red [2.5YR4/2]; subangular to subrounded, very fine to medium sand 95%, silt 5%, trace gravel. Gravel fraction: subangular to subrounded granules and pebbles to 0.1 in consisting of weathered basalt with some quartzite and tuff. Well lithified. Non-plastic. Saturated. Reaction to acid: weak. Pulverized cuttings to mostly fine sand; some cementation coating chips; iron oxidation on clasts.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-B [*55-919727*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DRILLING METHOD / COMPANY: Dual-Tube Reverse Circulation Air Rotary / Yellow Jacket Drilling	LOGGED BY: M. Shelley, A. Scott
DEPTH DRILLED / LAND SURFACE ELEVATION: 1200.0 feet / 1332.66 feet msl	DATE DRILLED: Sep. 28 - Oct. 10, 2016
CADASTRAL : (B-3-7)33cda	BOREHOLE DIAMETER: 8 inches

DEPTH INTERVAL (feet)	DESCRIPTION
0.0 - 10.0	**GRAVELLY AND SANDY CLAY**: Reddish gray [5YR5/2]; silt and clay 70%, subangular to rounded, fine to very coarse sand 20%, gravel 10%. Gravel fraction: subangular to subrounded granules and pebbles to 0.75 in consisting of Volcanics, quartz/quartzite, slate. Non-lithified. Medium plasticity. Dry. Poorly sorted. Reaction to acid: strong. Some calcium carbonate coatings.
10.0 - 20.0	**SANDY AND CLAYEY GRAVEL**: Reddish brown [5YR4/4]; gravel 50%, silt and clay 30%, angular to subrounded, medium to very coarse sand 20%. Gravel fraction: subangular to subrounded granules and pebbles to 0.75 in consisting of Volcanics, quartz/quartzite, slate. Non-lithified. Low plasticity. Dry. Poorly sorted. Reaction to acid: weak. Some calcium carbonate coatings.
20.0 - 30.0	**SANDY GRAVEL**: Reddish brown [5YR4/4]; gravel 90%, subangular to subrounded, coarse to very coarse sand 10%. Gravel fraction: angular to subrounded granules and pebbles to 1.25 in consisting of Volcanics, quartz/quartzite, slate. Non-lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: none. Some calcium carbonate coatings.
30.0 - 40.0	**SANDY GRAVEL**: Reddish brown [5YR4/4]; gravel 75%, subangular to subrounded, coarse to very coarse sand 20%, silt and clay 5%. Gravel fraction: angular to rounded granules and pebbles to 1.5 in consisting of Volcanics, quartz/quartzite, slate. Non-lithified. Low plasticity. Dry. Poorly sorted. Reaction to acid: moderate to strong. Some calcium carbonate coatings.
40.0 - 50.0	**SILTY, SANDY GRAVEL**: Reddish brown [5YR4/4]; gravel 55%, subrounded to rounded, fine to very coarse sand 30%, silt 15%. Gravel fraction: angular to subrounded granules and pebbles to 1 in consisting of Volcanics, quartz/quartzite, slate. Non-lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: moderate to strong. Some calcium carbonate coatings.
50.0 - 60.0	**CLAYEY, SANDY GRAVEL**: Reddish gray [5YR5/2]; gravel 65%, subangular to subrounded, coarse to very coarse sand 25%, silt and clay 10%. Gravel fraction: angular to subrounded granules and pebbles to 1 in consisting of Volcanics, quartz/quartzite, slate. Non-lithified. Low plasticity. Dry. Poorly sorted. Reaction to acid: moderate to strong. Some calcium carbonate coatings.
60.0 - 70.0	**CLAYEY, SANDY GRAVEL**: Reddish brown [5YR4/4]; gravel 60%, silt and clay 25%, subangular to subrounded, fine to very coarse sand 15%. Gravel fraction: angular to subrounded granules and pebbles to 0.75 in consisting of Volcanics, quartz/quartzite, slate. Non-lithified. Low to medium plasticity. Dry. Poorly sorted. Reaction to acid: strong. Some calcium carbonate coatings; some large quartz fragments.

Gravel/sand division based on Wentworth scale. Grain size fractions estimated using manual field methods.
Grain size fractions rounded to the nearest five percent.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-B [*55-919727*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
70.0 - 80.0	**SILTY, SANDY GRAVEL**: Reddish brown [5YR4/4]; gravel 55%, angular to subrounded, fine to very coarse sand 30%, silt and clay 15%. Gravel fraction: angular to subrounded granules and pebbles to 1.5 in consisting of Volcanics, quartz/quartzite, slate. Non-lithified. Low plasticity. Dry. Poorly sorted. Reaction to acid: strong. Some calcium carbonate coatings.
80.0 - 90.0	**SILTY, SANDY GRAVEL**: Reddish brown [5YR4/4]; gravel 60%, angular to subrounded, fine to very coarse sand 25%, silt and clay 15%. Gravel fraction: angular to subrounded granules and pebbles to 1 in consisting of Volcanics, quartz/quartzite, slate. Non-lithified. Low plasticity. Dry. Poorly sorted. Reaction to acid: strong. Some calcium carbonate coatings; some meta foliation in rock fragments.
90.0 - 100.0	**SANDY GRAVEL**: Weak red [10R5/4]; gravel 70%, subangular to subrounded, fine to very coarse sand 25%, silt 5%. Gravel fraction: angular to subrounded granules and pebbles to 1.25 in consisting of Volcanics, quartz/quartzite, slate. Non-lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: moderate to strong. Some calcium carbonate coatings; large rhyolite fragments; gravel is coarse.
100.0 - 110.0	**CLAYEY AND SANDY GRAVEL**: Light reddish brown [5YR6/4]; gravel 50%, subangular to subrounded, fine to very coarse sand 30%, silt and clay 20%. Gravel fraction: angular to subangular granules and pebbles to 1 in consisting of Volcanics, quartz/quartzite, slate. Non-lithified. Low plasticity. Dry. Poorly sorted. Reaction to acid: strong. Some calcium carbonate coatings.
110.0 - 120.0	**CLAYEY, SILTY, SAND AND GRAVEL**: Weak red [10R5/4]; gravel 45%, angular to subangular, fine to very coarse sand 35%, silt and clay 20%. Gravel fraction: angular to subrounded granules and pebbles to 1 in consisting of Volcanics, quartz/quartzite, slate. Non-lithified. Low plasticity. Dry. Poorly sorted. Reaction to acid: strong. Some calcium carbonate coatings.
120.0 - 130.0	**CLAYEY, SILTY, SAND AND GRAVEL**: Weak red [10R5/4]; gravel 40%, subangular to subrounded, fine to very coarse sand 40%, silt and clay 20%. Gravel fraction: angular to subrounded granules and pebbles to 0.75 in consisting of Volcanics, quartz/quartzite, slate. Non-lithified. Low plasticity. Dry. Poorly sorted. Reaction to acid: strong. Some calcium carbonate coatings; some schist fragments.
130.0 - 140.0	**CLAYEY AND SANDY GRAVEL**: Weak red [10R5/4]; gravel 60%, angular to subrounded, medium to very coarse sand 25%, silt and clay 15%. Gravel fraction: angular to subrounded granules and pebbles to 1 in consisting of Volcanics, quartz/quartzite, slate. Non-lithified. Low plasticity. Dry. Poorly sorted. Reaction to acid: strong. Some calcium carbonate coatings.
140.0 - 150.0	**SILTY, SANDY GRAVEL**: Weak red [10R5/4]; gravel 60%, angular to subangular, fine to very coarse sand 30%, silt 10%. Gravel fraction: angular to subrounded granules and pebbles to 1 in consisting of Volcanics, quartz/quartzite, slate. Non-lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: strong. Some calcium carbonate coatings.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-B [*55-919727*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
150.0 - 160.0	**SILTY SAND AND GRAVEL**: Weak red [10R5/4]; gravel 50%, angular to subrounded, fine to very coarse sand 40%, silt 10%. Gravel fraction: angular to subrounded granules and pebbles to 0.75 in consisting of Volcanics, quartz/quartzite, slate. Non-lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: strong. Some calcium carbonate coatings.
160.0 - 170.0	**SILTY, SANDY GRAVEL**: Weak red [10R5/4]; gravel 60%, subangular to rounded, fine to very coarse sand 30%, silt 10%. Gravel fraction: angular to subrounded granules and pebbles to 1 in consisting of Volcanics, quartz/quartzite, slate. Non-lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: moderate to strong. Some calcium carbonate coatings; trace cemented fragments.
170.0 - 180.0	**SILTY, SANDY GRAVEL**: Weak red [10R5/4]; gravel 60%, subangular to subrounded, fine to very coarse sand 25%, silt 15%. Gravel fraction: angular to subrounded granules and pebbles to 1 in consisting of Volcanics, quartz/quartzite, slate. Non-lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: strong. Some calcium carbonate coatings.
180.0 - 190.0	**SILTY AND CLAYEY, SANDY GRAVEL**: Weak red [10R5/4]; gravel 50%, angular to subrounded, fine to very coarse sand 30%, silt and clay 20%. Gravel fraction: angular to subrounded granules and pebbles to 1 in consisting of Volcanics, quartz/quartzite, slate. Non-lithified. Low plasticity. Dry. Poorly sorted. Reaction to acid: moderate. Some calcium carbonate coatings.
190.0 - 200.0	**SILTY AND SANDY GRAVEL**: Weak red [10R5/4]; gravel 65%, angular to subrounded, fine to very coarse sand 20%, silt 15%. Gravel fraction: angular to subrounded granules and pebbles to 1 in consisting of Volcanics, quartz/quartzite, slate. Non-lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: weak to moderate. Some calcium carbonate coatings.
200.0 - 210.0	**SANDY GRAVEL**: Weak red [10R5/4]; gravel 80%, subangular to subrounded, fine to very coarse sand 15%, silt 5%. Gravel fraction: angular to subrounded granules and pebbles to 1 in consisting of Volcanics, quartz/quartzite, slate. Weakly lithified. Non-plastic. Dry. Moderately sorted. Reaction to acid: moderate to strong. Some calcium carbonate coatings; some conglomerate fragments.
210.0 - 220.0	**SILTY AND CLAYEY AND SANDY GRAVEL**: Dark reddish brown [5YR3/2]; gravel 55%, subangular to subrounded, fine to very coarse sand 30%, silt and clay 15%. Gravel fraction: angular to subrounded granules and pebbles to 1 in consisting of Volcanics, quartz/quartzite, slate. Weakly lithified. Low plasticity. Dry. Poorly sorted. Reaction to acid: moderate to strong. Some calcium carbonate coatings; some calcite and schist.
220.0 - 230.0	**SANDY GRAVEL**: Dark reddish brown [5YR3/2]; gravel 75%, angular to subrounded, fine to very coarse sand 20%, silt 5%. Gravel fraction: angular to subangular granules and pebbles to 1 in consisting of Volcanics, quartz/quartzite, slate. Weakly lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: strong. Some calcium carbonate coatings; some schist.

Gravel/sand division based on Wentworth scale. Grain size fractions estimated using manual field methods.
Grain size fractions rounded to the nearest five percent.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-B [*55-919727*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
230.0 - 240.0	**SANDY GRAVEL**: Weak red [10R5/4]; gravel 75%, subangular to rounded, fine to very coarse sand 20%, silt 5%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Volcanics, quartz/quartzite, slate. Weakly lithified. Non-plastic. Dry. Moderately sorted. Reaction to acid: strong. Some calcium carbonate coatings; some schist.
240.0 - 250.0	**SILTY, GRAVELLY SAND**: Reddish brown [5YR4/4]; angular to subrounded, fine to very coarse sand 50%, gravel 35%, silt 15%. Gravel fraction: angular to subrounded granules and pebbles to 1 in consisting of Volcanics, quartzite, slate, schist. Weakly lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: strong. Some calcium carbonate coatings.
250.0 - 260.0	**SILTY GRAVEL AND SAND**: Reddish brown [5YR4/4]; gravel 40%, subangular to subrounded, medium to very coarse sand 40%, silt 20%. Gravel fraction: angular to subrounded granules and pebbles to 0.5 in consisting of Volcanics, quartz/quartzite, slate. Weakly lithified. Non-plastic. Dry. Moderately sorted. Reaction to acid: weak to moderate. Some calcium carbonate coatings.
260.0 - 270.0	**SILTY AND CLAYEY AND GRAVELLY SAND**: Reddish brown [5YR4/4]; angular to subrounded, fine to very coarse sand 50%, gravel 25%, silt and clay 25%. Gravel fraction: angular to subrounded granules and pebbles to 0.5 in consisting of Volcanics, quartzite, slate, schist. Weakly lithified. Low plasticity. Dry. Poorly sorted. Reaction to acid: strong. Some calcium carbonate coatings.
270.0 - 280.0	**SILTY GRAVEL AND SAND**: Reddish brown [5YR4/4]; angular to subrounded, fine to very coarse sand 50%, gravel 40%, silt 10%. Gravel fraction: angular to subangular granules and pebbles to 1 in consisting of Volcanics, quartzite, slate, schist. Weakly lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: weak to strong. Some calcium carbonate coatings.
280.0 - 290.0	**SILTY SAND AND GRAVEL**: Dusky red [10R3/2]; angular to subrounded, fine to very coarse sand 45%, gravel 35%, silt 20%. Gravel fraction: angular to subrounded granules and pebbles to 0.5 in consisting of Volcanics, quartzite, slate, schist. Weakly lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: strong. Some calcium carbonate coatings.
290.0 - 300.0	**SILTY, GRAVELLY SAND**: Dusky red [10R3/2]; angular to subrounded, fine to very coarse sand 50%, gravel 35%, silt 15%. Gravel fraction: angular to subrounded granules and pebbles to 0.5 in consisting of Volcanics, quartzite, slate, schist. Weakly lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: moderate. Some calcium carbonate coatings.
300.0 - 310.0	**SILTY, SANDY GRAVEL**: Reddish brown [5YR4/4], dark reddish brown [5YR3/2]; gravel 50%, angular to subrounded, fine to very coarse sand 35%, silt 15%. Gravel fraction: angular to subrounded granules and pebbles to 1 in consisting of Volcanics, quartzite, slate, schist. Weakly lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: weak. Trace calcite.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-B [*55-919727*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
310.0 - 320.0	**SILTY, SANDY GRAVEL**: Reddish brown [5YR4/4]; gravel 45%, angular to subrounded, fine to very coarse sand 30%, silt 25%. Gravel fraction: angular to subrounded granules and pebbles to 0.75 in consisting of Volcanics, quartzite, slate, schist. Weakly lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: weak.
320.0 - 330.0	**SILTY, SANDY GRAVEL**: Dusky red [10R3/2]; gravel 60%, angular to subrounded, fine to very coarse sand 30%, silt 10%. Gravel fraction: angular to subrounded granules and pebbles to 1 in consisting of Volcanics, quartzite, slate, schist. Weakly lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: none. Some cementation on fragments.
330.0 - 340.0	**SANDY GRAVEL**: Dusky red [10R3/2]; gravel 60%, subangular to subrounded, fine to very coarse sand 35%, silt 5%. Gravel fraction: angular to subrounded granules and pebbles to 0.5 in consisting of Volcanics, quartzite, slate, schist. Weakly lithified. Non-plastic. Moist. Poorly sorted. Reaction to acid: none to weak.
340.0 - 350.0	**SILTY, SANDY GRAVEL**: Dusky red [10R3/2]; gravel 55%, angular to subrounded, fine to very coarse sand 35%, silt 10%. Gravel fraction: angular to subrounded granules and pebbles to 0.5 in consisting of Volcanics, quartzite, slate, schist. Weakly lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak to moderate. Some calcite.
350.0 - 360.0	**GRAVELLY SAND**: Dusky red [10R3/2]; angular to subrounded, fine to very coarse sand 55%, gravel 45%. Gravel fraction: angular to subrounded granules and pebbles to 0.5 in consisting of Volcanics, quartzite, slate, schist. Weakly lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak to moderate. Some calcite.
360.0 - 370.0	**SILTY, SANDY GRAVEL**: Dusky red [10R3/2]; gravel 60%, angular to subrounded, fine to very coarse sand 30%, silt 10%. Gravel fraction: angular to subrounded granules and pebbles to 1 in consisting of Volcanics, quartzite, slate, schist. Weakly lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak.
370.0 - 380.0	**SANDY GRAVEL**: Dusky red [10R3/2]; gravel 60%, angular to subrounded, fine to very coarse sand 35%, silt 5%. Gravel fraction: angular to subrounded granules and pebbles to 0.5 in consisting of Volcanics, quartzite, slate, schist. Weakly lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak.
380.0 - 390.0	**SANDY GRAVEL**: Dusky red [10R3/2]; gravel 70%, subangular to subrounded, fine to very coarse sand 30%. Gravel fraction: angular to subrounded granules and pebbles to 1 in consisting of Volcanics, quartzite, slate, schist. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak to moderate. Iron cement.
390.0 - 400.0	**SILTY, GRAVELLY SAND**: Dusky red [10R3/2]; subangular to subrounded, fine to very coarse sand 55%, gravel 35%, silt 10%. Gravel fraction: angular to subrounded granules and pebbles to 1 in consisting of Volcanics, quartzite, slate, schist. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak to moderate. Iron cement.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-B [*55-919727*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
400.0 - 410.0	**SANDY GRAVEL**: Dusky red [10R3/2]; gravel 60%, subangular to subrounded, fine to very coarse sand 40%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Volcanics, quartzite, slate, schist. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak to moderate. Iron cement; some calcite.
410.0 - 420.0	**GRAVELLY SAND**: Dusky red [10R3/2]; subangular to subrounded, fine to very coarse sand 60%, gravel 40%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Volcanics, quartzite, slate, schist. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak to moderate.
420.0 - 430.0	**SAND AND GRAVEL**: Dusky red [10R3/2]; gravel 55%, subangular to subrounded, fine to very coarse sand 45%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Volcanics, quartzite, slate, schist. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak to moderate. Some calcite.
430.0 - 440.0	**GRAVEL AND SAND**: Dark reddish brown [5YR3/2]; subangular to subrounded, fine to very coarse sand 55%, gravel 45%. Gravel fraction: angular to subrounded granules and pebbles to 0.5 in consisting of Volcanics, quartzite, slate, schist. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak.
440.0 - 450.0	**GRAVELLY SAND**: Dusky red [10R3/2]; angular to subrounded, fine to very coarse sand 60%, gravel 40%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Volcanics, quartzite, slate, schist. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak to moderate. Some calcite.
450.0 - 460.0	**SILTY SAND AND GRAVEL**: Dusky red [10R3/2]; gravel 50%, angular to subangular, fine to very coarse sand 40%, silt 10%. Gravel fraction: angular to subrounded granules and pebbles to 1 in consisting of Volcanics, quartzite, slate, schist. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak. Some calcite; some iron oxidation.
460.0 - 470.0	**SAND AND GRAVEL**: Dusky red [10R3/2]; gravel 55%, angular to subrounded, fine to very coarse sand 45%. Gravel fraction: angular to subrounded granules and pebbles to 1 in consisting of Volcanics, quartzite, slate, schist. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak. Some iron oxidation.
470.0 - 480.0	**GRAVELLY SAND**: Dusky red [10R3/2]; subangular to rounded, fine to very coarse sand 60%, gravel 40%. Gravel fraction: angular to subrounded granules and pebbles to 1 in consisting of Volcanics, quartzite, slate, schist. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak to moderate.
480.0 - 490.0	**GRAVELLY SAND**: Dusky red [10R3/2]; subangular to rounded, fine to very coarse sand 60%, gravel 40%. Gravel fraction: angular to subangular granules and pebbles to 0.75 in consisting of Volcanics, quartzite, slate, schist. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: moderate.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-B [*55-919727*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
490.0 - 500.0	**SANDY GRAVELLY**: Dark reddish brown [5YR3/4]; gravel 60%, subangular to rounded, fine to very coarse sand 40%. Gravel fraction: angular to subangular granules and pebbles to 0.75 in consisting of Volcanics, quartzite, slate, schist. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak.
500.0 - 510.0	**GRAVELLY SAND**: Dusky red [10R3/2]; subangular to subrounded, fine to very coarse sand 70%, gravel 30%. Gravel fraction: angular to subrounded granules and pebbles to 0.75 in consisting of Volcanics, quartzite, slate, schist. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak.
510.0 - 520.0	**GRAVELLY SAND**: Dark reddish brown [5YR3/4]; subangular to subrounded, fine to very coarse sand 70%, gravel 30%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Volcanics, quartzite, slate, schist. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak to moderate. Some calcite and iron oxidation.
520.0 - 530.0	**GRAVELLY SAND**: Dark reddish brown [5YR3/2]; subangular to subrounded, fine to very coarse sand 60%, gravel 40%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Volcanics, quartzite, slate, schist. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Some calcite and iron oxidation.
530.0 - 540.0	**GRAVEL AND SAND**: Dark reddish brown [5YR3/2]; subangular to subrounded, fine to very coarse sand 55%, gravel 45%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Volcanics, quartzite, slate, schist. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak. Some calcite and iron oxidation.
540.0 - 550.0	**SANDY GRAVEL**: Dark reddish brown [5YR3/2]; gravel 65%, subangular to subrounded, fine to very coarse sand 35%. Gravel fraction: angular to subangular granules and pebbles to 0.75 in consisting of Volcanics, rhyolite, quartzite, quartz, slate, schist, basalt. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Abundant iron oxidation.
550.0 - 560.0	**SAND AND GRAVEL**: Dark reddish brown [5YR3/2]; gravel 55%, subangular to subrounded, fine to very coarse sand 45%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Volcanics, rhyolite, quartzite, quartz, slate, schist, basalt, and trace siltstone. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Some iron oxidation.
560.0 - 570.0	**SAND AND GRAVEL**: Dark reddish brown [5YR3/2]; gravel 55%, subangular to subrounded, fine to very coarse sand 45%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Volcanics, rhyolite, quartzite, quartz, slate, schist, basalt, and trace siltstone. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Some iron oxidation.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-B [*55-919727*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
570.0 - 580.0	**SANDY GRAVEL**: Dark reddish brown [5YR3/2]; gravel 65%, subangular to subrounded, fine to very coarse sand 35%. Gravel fraction: angular to subangular granules and pebbles to 0.75 in consisting of Volcanics, rhyolite, quartzite, quartz, slate, schist, basalt; and rhyolitic tuff; trace chert. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Some iron oxidation.
580.0 - 590.0	**SANDY GRAVEL**: Dark reddish brown [5YR3/2]; gravel 65%, subangular to subrounded, fine to very coarse sand 35%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Volcanics, rhyolite, quartzite, quartz, slate, schist, basalt. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Some iron oxidation.
590.0 - 600.0	**SANDY GRAVEL**: Dark reddish brown [5YR3/2]; gravel 75%, subangular to subrounded, fine to very coarse sand 25%. Gravel fraction: angular to subangular granules and pebbles to 1.5 in consisting of Volcanics, rhyolite, quartzite, quartz, slate, schist, basalt. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Some iron oxidation.
600.0 - 610.0	**SANDY GRAVEL**: Dark reddish brown [5YR3/2]; gravel 75%, subangular to subrounded, fine to very coarse sand 25%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Volcanics, rhyolite, quartzite, quartz, slate, schist, basalt. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Abundant iron oxidation.
610.0 - 620.0	**GRAVELLY SAND**: Dark reddish brown [5YR3/2]; subangular to subrounded, fine to very coarse sand 60%, gravel 40%. Gravel fraction: angular to subangular granules and pebbles to 0.3 in consisting of Volcanics, rhyolite, quartzite, quartz, slate, schist, basalt. Weakly to moderately lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: none to weak. Trace iron oxidation.
620.0 - 630.0	**SAND AND GRAVEL**: Dark reddish brown [5YR3/2]; gravel 55%, subangular to subrounded, fine to very coarse sand 45%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Volcanics, rhyolite, quartzite, quartz, slate, schist, basalt. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Trace iron oxidation.
630.0 - 640.0	**GRAVELLY SAND**: Dark reddish brown [5YR3/2]; subangular to subrounded, fine to very coarse sand 60%, gravel 40%. Gravel fraction: angular to subangular granules and pebbles to 0.3 in consisting of Volcanics, rhyolite, quartzite, quartz, slate, schist, basalt. Weakly to moderately lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: none to weak. Trace iron oxidation.
640.0 - 650.0	**GRAVELLY SAND**: Dark reddish brown [5YR3/2]; subangular to subrounded, fine to very coarse sand 70%, gravel 30%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Volcanics, rhyolite, basalt, tuff, slate, schist, quartz. Weakly to moderately lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: none to weak. Trace iron oxidation.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-B [*55-919727*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
650.0 - 660.0	**SANDY GRAVEL**: Dark reddish brown [5YR3/2]; gravel 60%, subangular to subrounded, fine to very coarse sand 40%. Gravel fraction: angular to subangular granules and pebbles to 1.2 in consisting of Volcanics, rhyolite, basalt, tuff, slate, schist, quartz. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Trace iron oxidation.
660.0 - 670.0	**SAND AND GRAVEL**: Dark reddish brown [5YR3/2]; gravel 50%, subangular to subrounded, fine to very coarse sand 50%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Volcanics, rhyolite, basalt, tuff, slate, schist, quartz; trace granite. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Trace iron oxidation.
670.0 - 680.0	**GRAVELLY SAND**: Dark reddish brown [5YR3/2]; subangular to subrounded, fine to very coarse sand 70%, gravel 30%. Gravel fraction: angular to subangular granules and pebbles to 0.3 in consisting of Volcanics, rhyolite, basalt, tuff, slate, schist, quartz. Weakly to moderately lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: none to weak. Trace calcite; trace iron oxidation.
680.0 - 690.0	**SAND AND GRAVEL**: Dark reddish brown [5YR3/2]; subangular to subrounded, fine to very coarse sand 55%, gravel 45%. Gravel fraction: angular to subangular granules and pebbles to 0.7 in consisting of Volcanics, rhyolite, basalt, tuff, slate, schist, quartz; trace granite. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Trace conglomerate fragments; cementation.
690.0 - 700.0	**SAND AND GRAVEL**: Dark reddish brown [5YR3/2]; gravel 55%, subangular to subrounded, fine to very coarse sand 45%. Gravel fraction: angular to subangular granules and pebbles to 0.8 in consisting of Volcanics, rhyolite, basalt, tuff, slate, schist, quartz. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Some conglomerate; abundant iron oxidation.
700.0 - 710.0	**SAND AND GRAVEL**: Dark reddish brown [5YR3/2]; subangular to subrounded, fine to very coarse sand 55%, gravel 45%. Gravel fraction: angular to subangular granules and pebbles to 0.8 in consisting of Volcanics, rhyolite, basalt, tuff, slate, schist, quartz. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Some conglomerate fragments; some iron oxidation.
710.0 - 720.0	**SAND AND GRAVEL**: Dark reddish brown [5YR3/2]; gravel 50%, subangular to subrounded, fine to very coarse sand 50%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Volcanics, rhyolite, basalt, tuff, trace slate, quartz. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Some iron oxidation.
720.0 - 730.0	**SAND AND GRAVEL**: Dark reddish brown [5YR3/2]; gravel 50%, subangular to subrounded, fine to very coarse sand 50%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Volcanics, rhyolite, basalt, tuff, slate, schist, quartz. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Some iron oxidation.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-B [*55-919727*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
730.0 - 740.0	**SAND AND GRAVEL**: Dark reddish brown [5YR3/2]; gravel 55%, subangular to subrounded, fine to very coarse sand 45%. Gravel fraction: angular to subangular granules and pebbles to 0.75 in consisting of Volcanics, rhyolite, basalt, tuff, slate, schist, quartz. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Some iron oxidation.
740.0 - 750.0	**SAND AND GRAVEL**: Dark reddish brown [5YR3/2]; gravel 55%, subangular to subrounded, fine to very coarse sand 45%. Gravel fraction: angular to subangular granules and pebbles to 0.8 in consisting of Volcanics, rhyolite, basalt, tuff, slate, schist, quartz. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Some iron oxidation.
750.0 - 760.0	**SANDY GRAVEL**: Dark reddish brown [5YR3/2]; gravel 65%, subangular to subrounded, fine to very coarse sand 35%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Volcanics, rhyolite, basalt, tuff, slate, schist, quartz; granite. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Abundant iron oxidation.
760.0 - 770.0	**SANDY GRAVEL**: Dark reddish brown [5YR3/2]; gravel 60%, subangular to subrounded, fine to very coarse sand 40%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Volcanics, rhyolite, basalt, tuff, slate, schist, quartz; granite. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Abundant iron oxidation.
770.0 - 780.0	**SANDY GRAVEL**: Dark reddish brown [5YR3/2]; gravel 60%, subangular to subrounded, fine to very coarse sand 40%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Volcanics, rhyolite, basalt, tuff, slate, schist, quartz; granite. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Abundant iron oxidation.
780.0 - 800.0	**SANDY GRAVEL**: Dark reddish brown [5YR3/2]; gravel 65%, subangular to subrounded, fine to very coarse sand 35%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Abundant iron oxidation.
800.0 - 810.0	**SAND AND GRAVEL**: Dark reddish brown [5YR3/2]; subangular to subrounded, fine to very coarse sand 55%, gravel 45%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Some iron oxidation.
810.0 - 820.0	**SAND AND GRAVEL**: Dark reddish brown [5YR3/2]; gravel 55%, subangular to subrounded, fine to very coarse sand 45%. Gravel fraction: angular to subangular granules and pebbles to 1.25 in consisting of Cemented conglomerate; volcanics, basalt, tuff, rhyolite, quartz, trace granite, siltstone. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Abundant iron oxidation.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-B [*55-919727*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
820.0 - 830.0	**GRAVELLY SAND**: Dark reddish brown [5YR3/2]; subangular to subrounded, fine to very coarse sand 60%, gravel 40%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Abundant iron oxidation.
830.0 - 840.0	**GRAVELLY SAND**: Dark reddish brown [5YR3/2]; subangular to subrounded, fine to very coarse sand 65%, gravel 35%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Abundant iron oxidation.
840.0 - 850.0	**SAND AND GRAVEL**: Dark reddish brown [5YR3/2]; gravel 50%, subangular to subrounded, fine to very coarse sand 50%. Gravel fraction: angular to subangular granules and pebbles to 0.75 in consisting of Cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Abundant iron oxidation.
850.0 - 860.0	**SANDY GRAVEL**: Dark reddish brown [5YR3/2]; gravel 60%, subangular to subrounded, fine to very coarse sand 40%. Gravel fraction: angular to subangular granules and pebbles to 0.75 in consisting of Cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Abundant iron oxidation.
860.0 - 870.0	**SAND AND GRAVEL**: Dark reddish brown [5YR3/2]; gravel 50%, subangular to subrounded, fine to very coarse sand 50%. Gravel fraction: angular to subangular granules and pebbles to 0.75 in consisting of Cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Abundant iron oxidation.
870.0 - 880.0	**SANDY GRAVEL**: Dark reddish brown [5YR3/2]; gravel 65%, subangular to subrounded, fine to very coarse sand 35%. Gravel fraction: angular to subangular granules and pebbles to 0.75 in consisting of Mostly basalt; cemented conglomerate; volcanics, rhyolite, quartz, trace granite, siltstone. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Abundant iron oxidation.
880.0 - 890.0	**SANDY GRAVEL**: Dark reddish brown [5YR3/2]; gravel 60%, subangular to subrounded, fine to very coarse sand 40%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Cemented conglomerate; volcanics, basalt, rhyolite, quartz, diabase, trace granite, siltstone/slate. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Abundant iron oxidation.
890.0 - 900.0	**GRAVELLY SAND**: Dark reddish brown [5YR3/2]; subangular to subrounded, fine to very coarse sand 65%, gravel 35%. Gravel fraction: angular to subangular granules and pebbles to 0.25 in consisting of Volcanics, basalt, rhyolite, quartz, trace granite, siltstone slate; trace schist. Moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Abundant iron oxidation.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-B [*55-919727*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
900.0 - 910.0	**SANDY GRAVEL**: Dark reddish brown [5YR3/2]; gravel 60%, subangular to subrounded, fine to very coarse sand 40%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Some cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone. Moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Abundant iron oxidation.
910.0 - 920.0	**GRAVELLY SAND**: Dark reddish brown [5YR3/2]; subangular to subrounded, fine to very coarse sand 65%, gravel 35%. Gravel fraction: rounded to subangular granules and pebbles to 0.5 in consisting of Volcanics, basalt, rhyolite, quartz, trace granite, siltstone. Moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Abundant iron oxidation.
920.0 - 930.0	**SAND AND GRAVEL**: Dark reddish brown [5YR3/2]; gravel 50%, subangular to subrounded, fine to very coarse sand 50%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone, trace slate and schist. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Some iron oxidation.
930.0 - 940.0	**SAND AND GRAVEL**: Dark reddish brown [5YR3/2]; gravel 55%, subangular to subrounded, fine to very coarse sand 45%. Gravel fraction: angular to subangular granules and pebbles to 1 in consisting of Volcanics, basalt, rhyolite, quartz, trace granite, siltstone, trace slate and schist. Moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Some iron oxidation.
940.0 - 950.0	**GRAVELLY SAND**: Dark reddish brown [5YR3/2]; subangular to subrounded, fine to very coarse sand 60%, gravel 40%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Some cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone, trace slate and schist. Moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Abundant iron oxidation.
950.0 - 960.0	**GRAVELLY SAND**: Dark reddish brown [5YR3/2]; subangular to subrounded, fine to very coarse sand 60%, gravel 40%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Some cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone, trace slate and schist. Moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Abundant iron oxidation.
960.0 - 970.0	**SAND AND GRAVEL**: Dark reddish brown [5YR3/2]; gravel 50%, subangular to subrounded, fine to very coarse sand 50%. Gravel fraction: angular to subangular granules and pebbles to 0.75 in consisting of Some cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone, trace slate and schist; and tuff. Moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Some iron oxidation.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-B [*55-919727*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
970.0 - 980.0	**GRAVELLY SAND**: Reddish brown [5YR4/4]; subangular to subrounded, fine to very coarse sand 75%, gravel 25%. Gravel fraction: angular to subangular granules and pebbles to 0.25 in consisting of Cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone, trace slate and schist. Moderately lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: none to weak. Cementation. Some iron oxidation.
980.0 - 990.0	**GRAVELLY SAND**: Reddish brown [5YR4/4]; subangular to subrounded, fine to very coarse sand 60%, gravel 40%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Cemented conglomerate fragments; volcanics, basalt, rhyolite, quartz, trace granite, siltstone, trace slate and schist. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Some iron oxidation.
990.0 - 1,000.0	**SANDY GRAVEL**: Dark reddish brown [5YR3/2]; gravel 60%, subangular to subrounded, fine to very coarse sand 40%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone, trace slate and schist; and andesite. Moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Some iron oxidation.
1,000.0 - 1,010.0	**SAND AND GRAVEL**: Dark reddish brown [5YR3/2]; gravel 50%, subangular to subrounded, fine to very coarse sand 50%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Volcanics, basalt, rhyolite, quartz, trace granite, siltstone, trace slate and schist; and andesite. Moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Some iron oxidation.
1,010.0 - 1,020.0	**SANDY GRAVEL**: Dark reddish brown [5YR3/2]; gravel 60%, subangular to subrounded, fine to very coarse sand 40%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Volcanics, basalt, rhyolite, quartz, trace granite, siltstone, trace slate and schist; and andesite. Moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Some iron oxidation.
1,020.0 - 1,030.0	**GRAVELLY SAND**: Dark reddish brown [5YR3/2]; subangular to subrounded, fine to very coarse sand 60%, gravel 40%. Gravel fraction: angular to subangular granules and pebbles to 0.25 in consisting of Volcanics, basalt, rhyolite, quartz, trace granite, siltstone, trace slate and schist; and andesite. Moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Some iron oxidation.
1,030.0 - 1,040.0	**SAND AND GRAVEL**: Reddish brown [5YR4/4]; gravel 55%, subangular to subrounded, fine to very coarse sand 45%. Gravel fraction: angular to subangular granules and pebbles to 0.25 in consisting of Cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone, trace slate and schist; and andesite. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Some iron oxidation.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-B [*55-919727*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
1,040.0 - 1,050.0	**SANDY GRAVEL**: Reddish brown [5YR4/4]; gravel 60%, subangular to subrounded, fine to very coarse sand 40%. Gravel fraction: angular to subangular granules and pebbles to 0.25 in consisting of Cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone, trace slate and schist; and andesite. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Some iron oxidation.
1,050.0 - 1,060.0	**SANDY GRAVEL**: Reddish brown [5YR4/4]; gravel 60%, subangular to subrounded, fine to very coarse sand 40%. Gravel fraction: angular to subangular granules and pebbles to 1.2 in consisting of Cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone, trace slate and schist; and andesite. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Some iron oxidation.
1,060.0 - 1,070.0	**GRAVELLY SAND**: Dark reddish brown [5YR3/2]; subangular to subrounded, fine to very coarse sand 65%, gravel 35%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone, trace slate and schist; and andesite. Moderately to well lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: none to weak. Cementation. Some iron oxidation.
1,070.0 - 1,080.0	**SANDY GRAVEL**: Reddish brown [5YR4/4]; gravel 65%, subangular to subrounded, fine to very coarse sand 35%. Gravel fraction: angular to subangular granules and pebbles to 1.1 in consisting of Cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone, trace slate and schist; and andesite. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Abundant iron oxidation.
1,080.0 - 1,090.0	**SAND AND GRAVEL**: Dark reddish brown [5YR3/2]; gravel 55%, subangular to subrounded, fine to very coarse sand 45%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Volcanics, mostly basalt, rhyolite, quartz, trace granite, siltstone, trace slate and schist. Moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Some iron oxidation.
1,090.0 - 1,100.0	**GRAVELLY SAND**: Dark reddish brown [5YR3/2]; subangular to subrounded, fine to very coarse sand 65%, gravel 35%. Gravel fraction: angular to subangular granules and pebbles to 0.25 in consisting of Cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone, trace slate and schist; and andesite. Moderately lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: none to weak. Cementation. Some iron oxidation.
1,100.0 - 1,110.0	**SANDY GRAVEL**: Dark reddish brown [5YR3/2]; gravel 60%, subangular to subrounded, fine to very coarse sand 40%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone, trace slate and schist; and andesite. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Some iron oxidation.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-B [*55-919727*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
1,110.0 - 1,120.0	**GRAVELLY SAND**: Dark reddish brown [5YR3/2]; subangular to subrounded, fine to very coarse sand 60%, gravel 40%. Gravel fraction: angular to subangular granules and pebbles to 0.25 in consisting of Cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone, trace slate and schist; and andesite. Moderately lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: none to weak. Cementation. Some iron oxidation.
1,120.0 - 1,130.0	**SAND AND GRAVEL**: Dark reddish brown [5YR3/2]; gravel 50%, subangular to subrounded, fine to very coarse sand 50%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone, trace slate and schist; and andesite. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Some iron oxidation.
1,130.0 - 1,140.0	**SAND AND GRAVEL**: Dark reddish brown [5YR3/2]; gravel 50%, subangular to subrounded, fine to very coarse sand 50%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone, trace slate and schist; and andesite. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Some iron oxidation.
1,140.0 - 1,150.0	**SAND AND GRAVEL**: Dark reddish brown [5YR3/2]; gravel 55%, subangular to subrounded, fine to very coarse sand 45%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone, trace slate and schist; and andesite. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Some iron oxidation.
1,150.0 - 1,160.0	**GRAVELLY SAND**: Dark reddish brown [5YR3/2]; subangular to subrounded, fine to very coarse sand 75%, gravel 25%. Gravel fraction: angular to subangular granules and pebbles to 0.25 in consisting of Volcanics, basalt, rhyolite, quartz, trace granite, siltstone, trace slate and schist; and andesite. Weakly to moderately lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: none to weak. Some iron oxidation.
1,160.0 - 1,170.0	**SAND AND GRAVEL**: Dark reddish brown [5YR3/2]; gravel 50%, subangular to subrounded, fine to very coarse sand 50%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone, trace slate and schist; and andesite. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to weak. Cementation. Some iron oxidation.
1,170.0 - 1,180.0	**GRAVELLY SAND**: Dark reddish brown [5YR3/2]; subangular to subrounded, fine to very coarse sand 65%, gravel 35%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone, trace slate and schist; and andesite. Moderately to well lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: none to weak. Cementation. Some iron oxidation.

Gravel/sand division based on Wentworth scale. Grain size fractions estimated using manual field methods.
Grain size fractions rounded to the nearest five percent.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-B [*55-919727*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
1,180.0 - 1,190.0	**GRAVELLY SAND**: Dark reddish brown [5YR3/2]; subangular to subrounded, fine to very coarse sand 65%, gravel 35%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone, trace slate and schist; and andesite. Moderately to well lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: none to weak. Cementation. Some iron oxidation.
1,190.0 - 1,200.0	**GRAVELLY SAND**: Dark reddish brown [5YR3/2]; subangular to subrounded, fine to very coarse sand 65%, gravel 35%. Gravel fraction: angular to subangular granules and pebbles to 0.5 in consisting of Cemented conglomerate; volcanics, basalt, rhyolite, quartz, trace granite, siltstone, trace slate and schist; and andesite. Moderately to well lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: none to weak. Cementation. Some iron oxidation.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-C [*55-919729*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DRILLING METHOD / COMPANY: Dual-Tube Reverse Circulation Air Rotary / Yellow Jacket Drilling	LOGGED BY: A. Scott, J. Bell
DEPTH DRILLED / LAND SURFACE ELEVATION: 1360.0 feet / 1312.95 feet msl	DATE DRILLED: Aug. 23 - Sep. 9, 2016
CADASTRAL : (B-3-7)04bda	BOREHOLE DIAMETER: 6.5 inches

DEPTH INTERVAL (feet)	DESCRIPTION
0.0 - 10.0	**SILTY GRAVELLY SAND**: Pale reddish brown [10R5/4]; subangular to subrounded, very fine to very coarse sand 50%, gravel 35%, silt 15%. Gravel fraction: subangular to rounded to 3 in consisting of Quartzite, basalt, schist, tuff, rholite, and diabase. Non-lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: very strong.
10.0 - 20.0	**SILTY GRAVELLY SAND**: Pale reddish brown [10R5/4]; subangular to subrounded, very fine to very coarse sand 60%, gravel 25%, silt 15%. Gravel fraction: subangular to rounded to 2.5 in consisting of Quartzite, basalt, schist, tuff, rholite, and diabase. Non-lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: very strong.
20.0 - 30.0	**SILTY SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 55%, subangular to subrounded, very fine to very coarse sand 25%, silt 20%. Gravel fraction: subangular to subrounded to 1.6 in consisting of Quartzite, basalt, schist, tuff, rholite, and diabase. Non-lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: moderate.
30.0 - 40.0	**SILTY SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 60%, subangular to subrounded, very fine to very coarse sand 25%, silt 15%. Gravel fraction: subangular to subrounded to 1.2 in consisting of Quartzite, basalt, schist, tuff, rholite, and diabase. Non-lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: moderate.
40.0 - 50.0	**SILTY SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 55%, subangular to subrounded, very fine to very coarse sand 30%, silt 15%. Gravel fraction: angular to subrounded to 1 in consisting of Quartzite, basalt, schist, tuff, rholite, and diabase. Non-lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: very weak.
50.0 - 60.0	**SILTY SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 60%, subangular to subrounded, very fine to very coarse sand 20%, silt 20%. Gravel fraction: angular to subrounded to 0.8 in consisting of Quartzite, basalt, schist, tuff, rholite, and diabase. Non-lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: very weak.
60.0 - 70.0	**SILTY SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 55%, subangular to subrounded, very fine to very coarse sand 25%, silt 20%. Gravel fraction: angular to subrounded to 1 in consisting of Quartzite, basalt, schist, tuff, rholite, and diabase. Non-lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: weak.
70.0 - 80.0	**SILTY SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 45%, subangular to subrounded, very fine to very coarse sand 30%, silt 25%. Gravel fraction: angular to subrounded to 0.8 in consisting of Quartzite, basalt, schist, tuff, rholite, and diabase. Non-lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: weak. Trace iron oxide on chips.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-C [*55-919729*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
80.0 - 90.0	**SILTY SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 65%, subangular to subrounded, very fine to very coarse sand 25%, silt 10%. Gravel fraction: angular to subrounded to 1.1 in consisting of Quartzite, basalt, schist, tuff, rholite, and diabase. Non-lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: weak. Trace iron oxide on chips.
90.0 - 100.0	**SILTY SANDY GRAVEL**: Moderate reddish brown [10R4/6]; gravel 70%, subangular to subrounded, very fine to very coarse sand 20%, silt 10%. Gravel fraction: angular to rounded to 0.9 in consisting of Quartzite, basalt, schist, tuff, rholite, and diabase; trace limstone. Non-lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: weak to moderate.
100.0 - 110.0	**SILTY SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 65%, subangular to subrounded, very fine to very coarse sand 25%, silt 10%. Gravel fraction: angular to subrounded to 0.8 in consisting of Quartzite, basalt, schist, tuff, rholite, and diabase; trace limstone. Non-lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: weak.
110.0 - 120.0	**SILTY SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 60%, subangular to subrounded, very fine to very coarse sand 25%, silt 15%. Gravel fraction: subangular to subrounded to 1.1 in consisting of Quartzite, basalt, schist, tuff, rholite, and diabase; trace limstone. Non-lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: weak.
120.0 - 130.0	**SILTY SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 65%, subangular to subrounded, very fine to very coarse sand 20%, silt 15%. Gravel fraction: subangular to subrounded to 1 in consisting of Quartzite, basalt, schist, tuff, rholite, and diabase; trace limstone. Non-lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: very weak.
130.0 - 140.0	**SILTY SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 40%, subangular to subrounded, very fine to very coarse sand 35%, silt 25%. Gravel fraction: angular to subrounded to 0.8 in consisting of Basalt, quartzite, schist, and tuff; trace diabase. Weakly lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: very weak. Trace iron oxide staining on chips.
140.0 - 150.0	**SILTY SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 45%, subangular to subrounded, very fine to very coarse sand 30%, silt 25%. Gravel fraction: angular to subrounded to 1.2 in consisting of Basalt, quartzite, schist, and tuff; trace diabase. Weakly lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: weak. Trace iron oxide staining on chips.
150.0 - 160.0	**SILTY GRAVELLY SAND**: Very dusky red [10R2/2]; subangular to subrounded, very fine to very coarse sand 50%, gravel 30%, silt 20%. Gravel fraction: angular to subrounded to 0.6 in consisting of Basalt, quartzite, schist, and tuff; trace diabase. Weakly lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: very weak. Trace iron oxide staining on chips; trace low plasticity clay.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-C [*55-919729*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
160.0 - 170.0	**SILTY SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 40%, subangular to subrounded, very fine to very coarse sand 35%, silt 25%. Gravel fraction: angular to subrounded to 0.7 in consisting of Basalt, quartzite, schist, and tuff; trace diabase. Weakly lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: very weak. Trace iron oxide staining on chips.
170.0 - 180.0	**SILTY SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 50%, subangular to subrounded, very fine to very coarse sand 30%, silt 20%. Gravel fraction: angular to subrounded to 0.7 in consisting of Basalt, quartzite, schist, and tuff; trace diabase. Weakly lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: very weak. Trace iron oxide staining on chips.
180.0 - 190.0	**SILTY SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 55%, subangular to subrounded, very fine to very coarse sand 30%, silt 15%. Gravel fraction: angular to subrounded to 1 in consisting of Basalt, quartzite, schist, and tuff; trace diabase. Weakly lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: very weak. Trace iron oxide staining on chips.
190.0 - 200.0	**SILTY GRAVELLY SAND**: Very dusky red [10R2/2]; subangular to subrounded, very fine to very coarse sand 55%, gravel 30%, silt 15%. Gravel fraction: angular to subrounded to 0.6 in consisting of Basalt, quartzite, schist, and tuff; trace diabase. Weakly lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: very weak. Trace iron oxide staining on chips.
200.0 - 210.0	**SILTY SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 55%, subangular to subrounded, very fine to very coarse sand 35%, silt 10%. Gravel fraction: subangular to subrounded to 1.3 in consisting of Mostly basalt and quartzite; trace diabase, schist and tuff. Weakly lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: very weak. Trace iron oxide staining on chips.
210.0 - 220.0	**GRAVELLY SILTY SAND**: Very dusky red [10R2/2]; subangular to subrounded, very fine to very coarse sand 50%, gravel 25%, silt 25%. Gravel fraction: subangular to subrounded to 1.1 in consisting of Mostly basalt and quartzite; trace diabase, schist and tuff. Weakly lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: very weak. Trace iron oxide staining on chips.
220.0 - 230.0	**SILTY SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 55%, subangular to subrounded, very fine to very coarse sand 30%, silt 15%. Gravel fraction: subangular to subrounded to 1 in consisting of Mostly basalt and quartzite; trace diabase, schist and tuff. Weakly lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: very weak. Trace iron oxide staining on chips.
230.0 - 240.0	**SILTY GRAVELLY SAND**: Very dusky red [10R2/2]; subangular to subrounded, very fine to very coarse sand 55%, gravel 25%, silt 20%. Gravel fraction: angular to subrounded to 0.7 in consisting of Mostly basalt and quartzite; trace diabase, schist and tuff. Weakly lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: very weak. Trace iron oxide staining on chips.

Gravel/sand division based on Wentworth scale. Grain size fractions estimated using manual field methods.
Grain size fractions rounded to the nearest five percent.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-C [*55-919729*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
240.0 - 250.0	**SILTY GRAVELLY SAND**: Very dusky red [10R2/2]; subangular to subrounded, very fine to very coarse sand 45%, gravel 35%, silt 20%. Gravel fraction: subangular to rounded to 0.6 in consisting of Mostly basalt and quartzite; trace diabase, schist, limestone and tuff. Weakly lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: weak to moderate. Trace iron oxide staining on chips.
250.0 - 260.0	**SILTY GRAVELLY SAND**: Very dusky red [10R2/2]; subangular to subrounded, very fine to very coarse sand 55%, gravel 30%, silt 15%. Gravel fraction: subangular to rounded to 1.1 in consisting of Mostly basalt and quartzite; trace diabase, schist, limestone and tuff. Weakly lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: weak. Trace iron oxide staining on chips.
260.0 - 270.0	**SILTY SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 60%, subangular to subrounded, very fine to very coarse sand 30%, silt 10%. Gravel fraction: subangular to subrounded to 0.8 in consisting of Mostly basalt and quartzite; trace schist and tuff. Weakly lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: very weak.
270.0 - 280.0	**SILTY SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 50%, subangular to subrounded, very fine to very coarse sand 40%, silt 10%. Gravel fraction: subangular to rounded to 0.6 in consisting of Mostly basalt and quartzite; trace schist and tuff. Weakly lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: weak to moderate.
280.0 - 290.0	**SILTY SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 55%, subangular to subrounded, very fine to very coarse sand 35%, silt 10%. Gravel fraction: angular to rounded to 1.2 in consisting of Mostly basalt and quartzite; trace schist, tuff and rhyolite. Weakly lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: very weak.
290.0 - 300.0	**SILTY SANDY GRAVEL**: Very dusky red [10R2/2]; subangular to subrounded, very fine to very coarse sand 60%, gravel 25%, silt 15%. Gravel fraction: subangular to rounded to 1 in consisting of Mostly basalt and quartzite; trace schist, tuff and rhyolite. Weakly lithified. Non-plastic. Dry. Poorly sorted. Reaction to acid: very weak.
300.0 - 310.0	**SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 80%, subangular, fine to very coarse sand 15%, silt 5%. Gravel fraction: angular to subrounded to 0.9 in consisting of Mostly basalt and quartzite; trace schist, tuff and rhyolite. Weakly lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: very weak. Trace iron oxide staining on chips.
310.0 - 320.0	**SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 70%, subangular, fine to very coarse sand 20%, silt 10%. Gravel fraction: angular to subrounded to 1.4 in consisting of Mostly basalt and quartzite; trace schist, tuff and rhyolite. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: very weak. Trace iron oxide staining on chips.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-C [*55-919729*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
320.0 - 330.0	**SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 75%, subangular, fine to very coarse sand 20%, silt 5%. Gravel fraction: angular to subrounded to 1.5 in consisting of Mostly basalt and quartzite; trace schist, tuff and rhyolite. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak. Trace iron oxide staining on chips.
330.0 - 340.0	**SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 80%, subangular, fine to very coarse sand 15%, silt 5%. Gravel fraction: angular to subrounded to 1.3 in consisting of Mostly basalt and quartzite; trace schist, tuff and rhyolite. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: very weak. Trace iron oxide staining on chips.
340.0 - 350.0	**SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 85%, subangular to subrounded, medium to very coarse sand 10%, silt 5%. Gravel fraction: subangular to subrounded to 1 in consisting of Mostly basalt and quartzite; trace schist, tuff and rhyolite. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak. Trace iron oxide staining on chips.
350.0 - 360.0	**SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 60%, subangular to subrounded, medium to very coarse sand 40%. Gravel fraction: subangular to subrounded to 0.7 in consisting of Mostly basalt and quartzite; trace schist, tuff, rhyolite and calcite vein. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak to moderate. Trace iron oxide staining on chips.
360.0 - 370.0	**SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 70%, subangular to subrounded, medium to very coarse sand 30%. Gravel fraction: subangular to subrounded to 0.6 in consisting of Mostly basalt and quartzite; trace schist, tuff, rhyolite and calcite vein. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak to moderate. Trace iron oxide staining on chips.
370.0 - 380.0	**SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 70%, subangular to subrounded, medium to very coarse sand 30%. Gravel fraction: subangular to subrounded to 0.6 in consisting of Mostly basalt and quartzite; trace schist, tuff, rhyolite and calcite vein. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak to moderate. Trace iron oxide staining on chips.
380.0 - 390.0	**SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 75%, subangular to subrounded, medium to very coarse sand 20%, silt 5%. Gravel fraction: subangular to subrounded to 1.2 in consisting of Mostly basalt and quartzite; trace schist, tuff, rhyolite and calcite vein. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak to moderate. Trace iron oxide staining on chips.
390.0 - 400.0	**SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 75%, subangular to subrounded, fine to very coarse sand 25%. Gravel fraction: angular to subrounded to 0.8 in consisting of Quartzite, basalt, schist and tuff; trace diabase. Weakly to moderately lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: weak. Trace iron oxide staining on chips.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-C [*55-919729*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
400.0 - 410.0	**SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 80%, subangular to subrounded, fine to very coarse sand 20%. Gravel fraction: angular to subrounded to 1.2 in consisting of Quartzite, basalt, schist and tuff; trace diabase. Weakly to moderately lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: weak. Trace iron oxide staining on chips.
410.0 - 420.0	**SANDY GRAVEL**: Moderate brown [5YR3/4]; gravel 75%, subangular to subrounded, fine to very coarse sand 25%. Gravel fraction: angular to subrounded to 1 in consisting of Quartzite, basalt, schist and tuff; trace diabase. Weakly to moderately lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: very weak. Trace iron oxide staining on chips.
420.0 - 430.0	**SANDY GRAVEL**: Moderate brown [5YR3/4]; gravel 75%, subangular to subrounded, fine to very coarse sand 25%. Gravel fraction: angular to subrounded to 0.8 in consisting of Quartzite, basalt, schist and tuff; trace diabase. Weakly to moderately lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: weak. Trace iron oxide staining on chips.
430.0 - 440.0	**SANDY GRAVEL**: Moderate brown [5YR3/4]; gravel 65%, subangular to subrounded, very fine to very coarse sand 35%. Gravel fraction: subangular to rounded to 0.8 in consisting of Quartzite, basalt, schist and tuff; trace diabase. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak. Trace iron oxide staining on chips.
440.0 - 450.0	**GRAVELLY SAND**: Moderate brown [5YR3/4]; subangular to subrounded, very fine to very coarse sand 80%, gravel 15%, silt 5%. Gravel fraction: subangular to subrounded to 0.4 in consisting of Quartzite, basalt, schist and tuff; trace diabase. Weakly to moderately lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: moderate to strong. Trace iron oxide staining on chips.
450.0 - 460.0	**SANDY GRAVEL**: Moderate brown [5YR3/4]; gravel 65%, subangular to subrounded, fine to very coarse sand 35%. Gravel fraction: subangular to subrounded to 0.6 in consisting of Quartzite, basalt, schist and tuff; trace diabase. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: moderate. Trace iron oxide staining on chips.
460.0 - 470.0	**SANDY GRAVEL**: Moderate brown [5YR3/4]; gravel 60%, subangular to subrounded, medium to very coarse sand 40%. Gravel fraction: subangular to subrounded to 0.4 in consisting of Quartzite, basalt, schist and tuff; trace diabase. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak. Trace iron oxide staining on chips.
470.0 - 480.0	**SANDY GRAVEL**: Moderate brown [5YR3/4]; gravel 60%, subangular to subrounded, medium to very coarse sand 40%. Gravel fraction: subangular to subrounded to 0.6 in consisting of Quartzite, basalt, schist and tuff; trace diabase. Weakly to moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak. Trace iron oxide staining on chips.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-C [*55-919729*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
480.0 - 490.0	**GRAVELLY SAND**: Moderate brown [5YR3/4]; gravel 50%, subangular to subrounded, fine to very coarse sand 50%. Gravel fraction: subangular to subrounded to 1.2 in consisting of Quartzite, basalt, schist and tuff; trace diabase. Moderately lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: weak to moderate. Trace iron oxide staining on chips; cementation present on clasts.
490.0 - 500.0	**SANDY GRAVEL**: Pale brown [5YR5/2]; gravel 65%, subangular to subrounded, fine to very coarse sand 35%. Gravel fraction: subangular to subrounded to 0.7 in consisting of Quartzite, basalt, schist and tuff; trace diabase. Moderately lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: weak. Trace iron oxide staining on chips; cementation present on clasts.
500.0 - 510.0	**SANDY GRAVEL**: Pale brown [5YR5/2]; gravel 70%, subangular to subrounded, fine to very coarse sand 30%. Gravel fraction: subangular to 0.8 in consisting of Quartzite, basalt, schist and tuff; trace diabase. Moderately lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: weak. Trace iron oxide staining on chips; cementation present on clasts.
510.0 - 520.0	**SANDY GRAVEL**: Pale brown [5YR5/2]; gravel 55%, subangular to subrounded, fine to very coarse sand 45%. Gravel fraction: subangular to 0.6 in consisting of Quartzite, basalt, schist and tuff; trace diabase. Moderately lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: weak to moderate. Trace iron oxide staining on chips; cementation present on clasts.
520.0 - 530.0	**SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 60%, subangular to subrounded, fine to very coarse sand 40%. Gravel fraction: subangular to subrounded to 1 in consisting of Basalt, quartzite, schist, and tuff. Moderately lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: weak. Trace iron oxide staining on chips; cementation present on clasts.
530.0 - 540.0	**SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 55%, subangular to subrounded, fine to very coarse sand 45%. Gravel fraction: subangular to 0.8 in consisting of Basalt, quartzite, schist, and tuff. Moderately lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: weak. Trace iron oxide staining on chips; cementation present on clasts.
540.0 - 550.0	**GRAVELLY SAND**: Moderate brown [5YR3/4]; subangular to subrounded, fine to very coarse sand 55%, gravel 45%. Gravel fraction: subangular to 0.6 in consisting of Basalt, quartzite, schist, and tuff. Moderately lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: weak. Trace iron oxide staining on chips; cementation present on clasts.
550.0 - 560.0	**GRAVELLY SAND**: Moderate brown [5YR3/4]; gravel 50%, subangular to subrounded, fine to very coarse sand 50%. Gravel fraction: subangular to 0.6 in consisting of Basalt, quartzite, schist, and tuff. Moderately lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: weak to moderate. Trace iron oxide staining on chips; cementation present on clasts.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-C [*55-919729*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
560.0 - 570.0	**GRAVELLY SAND**: Moderate brown [5YR3/4]; subangular to subrounded, fine to very coarse sand 65%, gravel 35%. Gravel fraction: subangular to 0.5 in consisting of Basalt, quartzite, schist, and tuff. Moderately lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: very weak. Trace iron oxide staining on chips; cementation present on clasts.
570.0 - 580.0	**GRAVELLY SAND**: Moderate brown [5YR3/4]; subangular to subrounded, fine to very coarse sand 85%, gravel 15%. Gravel fraction: subangular to 1 in consisting of Basalt, quartzite, schist, and tuff. Moderately lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: weak. Trace iron oxide staining on chips; cementation present on clasts.
580.0 - 590.0	**GRAVELLY SAND**: Moderate brown [5YR3/4]; angular to subrounded, fine to very coarse sand 80%, gravel 20%. Gravel fraction: subangular to subrounded to 1.2 in consisting of Basalt, quartzite, schist, and tuff. Moderately lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: very weak. Trace iron oxide staining on chips; cementation present on clasts.
590.0 - 600.0	**GRAVELLY SAND**: Moderate brown [5YR3/4]; angular to subrounded, fine to very coarse sand 85%, gravel 15%. Gravel fraction: subangular to subrounded to 0.7 in consisting of Basalt, quartzite, schist, and tuff. Moderately lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: very weak. Trace iron oxide staining on chips; cementation present on clasts.
600.0 - 610.0	**GRAVELLY SAND**: Moderate brown [5YR3/4]; angular to subrounded, fine to very coarse sand 80%, gravel 20%. Gravel fraction: subangular to subrounded to 0.6 in consisting of Basalt, quartzite, schist, and tuff. Moderately lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: weak. Trace iron oxide staining on chips; cementation present on clasts.
610.0 - 620.0	**GRAVELLY SAND**: Moderate brown [5YR3/4]; angular to subrounded, fine to very coarse sand 90%, gravel 10%. Gravel fraction: subangular to subrounded to 0.5 in consisting of Basalt, quartzite, schist, and tuff. Moderately lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: weak to moderate. Trace iron oxide staining on chips; cementation present on clasts.
620.0 - 630.0	**SANDY GRAVEL**: Very dusky red [10R2/2]; gravel 70%, angular to subrounded, fine to very coarse sand 30%. Gravel fraction: angular to subrounded to 1.4 in consisting of Mixed lithology conglomerate consisting of basalt, quartzite, schist, tuff, rhyolite; trace chert. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak. Trace iron oxide staining on chips; cementation present on clasts; conglomerate chips.
630.0 - 640.0	**GRAVELLY SAND**: Very dusky red [10R2/2]; angular to subrounded, fine to very coarse sand 75%, gravel 25%. Gravel fraction: angular to subrounded to 0.7 in consisting of Mixed lithology conglomerate consisting of basalt, quartzite, schist, tuff, rhyolite. Moderately to well lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: moderate. Trace iron oxide staining on chips; cementation present on clasts; conglomerate chips.

Gravel/sand division based on Wentworth scale. Grain size fractions estimated using manual field methods.
Grain size fractions rounded to the nearest five percent.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-C [*55-919729*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
640.0 - 650.0	**GRAVELLY SAND**: Very dusky red [10R2/2]; angular to subrounded, fine to very coarse sand 55%, gravel 45%. Gravel fraction: angular to subrounded to 1.1 in consisting of Mixed lithology conglomerate consisting of basalt, quartzite, schist, tuff, rhyolite. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak. Trace iron oxide staining on chips; cementation present on clasts; conglomerate chips.
650.0 - 660.0	**GRAVELLY SAND**: Moderate brown [5YR3/4]; angular to subrounded, fine to very coarse sand 65%, gravel 35%. Gravel fraction: angular to subrounded to 1 in consisting of Mixed lithology conglomerate consisting of basalt, quartzite, schist, tuff, rhyolite; trace chert. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak. Trace iron oxide staining on chips; cementation present on clasts; conglomerate chips.
660.0 - 670.0	**GRAVELLY SAND**: Moderate brown [5YR3/4]; angular to subrounded, fine to very coarse sand 80%, gravel 20%. Gravel fraction: angular to subrounded to 0.7 in consisting of Mixed lithology conglomerate consisting of basalt, quartzite, schist, tuff, rhyolite; trace chert. Moderately to well lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: very weak. Trace iron oxide staining on chips; cementation present on clasts; conglomerate chips.
670.0 - 680.0	**GRAVELLY SAND**: Moderate brown [5YR3/4]; angular to subrounded, fine to very coarse sand 75%, gravel 25%. Gravel fraction: angular to subrounded to 0.9 in consisting of Mixed lithology conglomerate consisting of basalt, quartzite, schist, tuff, rhyolite. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: very weak. Trace iron oxide staining on chips; cementation present on clasts; conglomerate chips.
680.0 - 690.0	**GRAVELLY SAND**: Moderate brown [5YR3/4]; angular to subrounded, fine to very coarse sand 60%, gravel 40%. Gravel fraction: angular to subrounded to 0.7 in consisting of Mixed lithology conglomerate consisting of mostly quartzite, tuff, rhyolite, and basalt; trace schist. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: very weak. Trace iron oxide staining on chips; cementation present on clasts; conglomerate chips.
690.0 - 700.0	**GRAVELLY SAND**: Moderate brown [5YR3/4]; angular to subrounded, fine to very coarse sand 60%, gravel 40%. Gravel fraction: angular to subrounded to 0.6 in consisting of Mixed lithology conglomerate consisting of mostly quartzite, tuff, rhyolite, and basalt; trace schist. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: very weak. Trace iron oxide staining on chips; cementation present on clasts; conglomerate chips.
700.0 - 710.0	**GRAVELLY SAND**: Moderate brown [5YR3/4]; angular to subrounded, fine to very coarse sand 60%, gravel 40%. Gravel fraction: angular to subrounded to 0.8 in consisting of Mixed lithology conglomerate consisting of mostly quartzite, tuff, rhyolite, and basalt; trace schist. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: very weak. Trace iron oxide staining on chips; cementation present on clasts; conglomerate chips.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-C [*55-919729*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
710.0 - 720.0	**GRAVELLY SAND**: Moderate brown [5YR3/4]; angular to subrounded, fine to very coarse sand 55%, gravel 45%. Gravel fraction: angular to subrounded to 1 in consisting of Mixed lithology conglomerate consisting of mostly quartzite, tuff, rhyolite, and basalt; trace schist. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: very weak. Trace iron oxide staining on chips; cementation present on clasts; conglomerate chips.
720.0 - 730.0	**GRAVELLY SAND**: Moderate brown [5YR3/4]; angular to subrounded, fine to very coarse sand 75%, gravel 25%. Gravel fraction: angular to subrounded to 0.6 in consisting of Mixed lithology conglomerate consisting of mostly quartzite, tuff, rhyolite, and basalt; trace schist. Moderately to well lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: weak to moderate. Trace iron oxide staining on chips; cementation present on clasts; conglomerate chips.
730.0 - 740.0	**GRAVELLY SAND**: Moderate brown [5YR3/4]; angular to subrounded, fine to very coarse sand 60%, gravel 40%. Gravel fraction: angular to subrounded to 0.7 in consisting of Mixed lithology conglomerate consisting of mostly quartzite, tuff, rhyolite, and basalt; trace schist. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: very weak. Trace iron oxide staining on chips; cementation present on clasts; conglomerate chips.
740.0 - 750.0	**GRAVELLY SAND**: Moderate brown [5YR3/4]; angular to subrounded, fine to very coarse sand 75%, gravel 25%. Gravel fraction: angular to subrounded to 0.5 in consisting of Mixed lithology conglomerate consisting of mostly quartzite, tuff, rhyolite, and basalt; trace schist. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: very weak.
750.0 - 760.0	**GRAVELLY SAND**: Moderate brown [5YR3/4]; angular to subrounded, fine to very coarse sand 65%, gravel 35%. Gravel fraction: angular to subrounded to 0.6 in consisting of Mixed lithology conglomerate consisting of mostly quartzite, tuff, rhyolite, and basalt; trace schist. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak to moderate. Some cementation present on clasts.
760.0 - 770.0	**GRAVELLY SAND**: Moderate brown [5YR3/4]; angular to subrounded, fine to very coarse sand 60%, gravel 40%. Gravel fraction: angular to subrounded to 0.5 in consisting of Mixed lithology conglomerate consisting of mostly quartzite, tuff, rhyolite, and basalt; trace schist. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: moderate to strong. Iron oxide staining on some grains; cementation present on clasts.
770.0 - 780.0	**GRAVELLY SAND**: Moderate brown [5YR3/4]; angular to subangular, fine to very coarse sand 70%, gravel 30%. Gravel fraction: angular to subrounded to 0.5 in consisting of Mixed lithology conglomerate consisting of mostly quartzite, tuff, rhyolite, and basalt; trace schist. Moderately to well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak to moderate. Sand is mostly finely ground by bit.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-C [*55-919729*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
780.0 - 790.0	**GRAVELLY SAND**: Moderate brown [5YR3/4]; subangular to subrounded, fine to very coarse sand 60%, gravel 40%. Gravel fraction: angular to subrounded to 0.5 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak. Some cementation; cuttings apear to be finely ground by bit action.
790.0 - 800.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 70%, gravel 25%, silt 5%. Gravel fraction: subangular to subrounded to 0.6 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak. Some cementation; some calcite crystals; cuttings apear to be finely ground by bit action.
800.0 - 810.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 70%, gravel 25%, silt 5%. Gravel fraction: angular to subrounded to 0.5 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak. Some cementation; some calcite crystals; cuttings apear to be finely ground by bit action.
810.0 - 820.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 60%, gravel 40%. Gravel fraction: angular to subrounded to 0.5 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak. Some cementation; some calcite crystals; cuttings apear to be finely ground by bit action; some calcite crystals; sparse clay balls.
820.0 - 830.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 60%, gravel 40%. Gravel fraction: angular to subrounded to 0.5 in consisting of Mixed lithology conglomerate consisting of mostly volcanics with some granitic fragments. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak to moderate. Some chips of conglomerate; some calcite cementation; switched to new tri-cone bit.
830.0 - 840.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 55%, gravel 45%. Gravel fraction: angular to subrounded to 1 in consisting of Mixed lithology conglomerate consisting of mostly volcanics with some granitic fragments. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak. Some chips of conglomerate; some calcite cementation.
840.0 - 850.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 65%, gravel 35%. Gravel fraction: angular to subrounded to 0.5 in consisting of Mixed lithology conglomerate consisting of mostly volcanics with some granitic fragments. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: moderate. Some chips of conglomerate.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-C [*55-919729*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
850.0 - 860.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 65%, gravel 35%. Gravel fraction: angular to subangular to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics with some granitic fragments. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak to moderate. Some chips of conglomerate; (rare gravel chips up to 1").
860.0 - 870.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 65%, gravel 35%. Gravel fraction: angular to subrounded to 0.5 in consisting of Mixed lithology conglomerate consisting of mostly volcanics with some granitic fragments. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak. Some chips of conglomerate; (few gravel chips up to 1").
870.0 - 880.0	**SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 90%, gravel 10%. Gravel fraction: angular to subrounded to 0.25 in consisting of Sandstone with sparse volcanic gravel. Well lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: weak. Gravel minearalogy mostly volcanics; sand percentage may be over-represented by bit action.
880.0 - 890.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 65%, gravel 35%. Gravel fraction: angular to subangular to 0.5 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak.
890.0 - 900.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 85%, gravel 15%. Gravel fraction: angular to subrounded to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak to moderate. Some conglomerate chips; sparse gravel 1" particles.
900.0 - 910.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 80%, gravel 20%. Gravel fraction: angular to subangular to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: weak.
910.0 - 920.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 65%, gravel 35%. Gravel fraction: angular to subangular to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: very weak. Some conglomerate chips exhibintg iron oxide cementation; sparse gravel 0.75" particles.
920.0 - 930.0	**SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 85%, gravel 15%. Gravel fraction: angular to subangular to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: weak.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-C [*55-919729*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
930.0 - 940.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 75%, gravel 20%, silt 5%. Gravel fraction: angular to subrounded to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics with some granitic fragments. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak. About 5% fines (mostly silt); sparse clay balls.
940.0 - 950.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 75%, gravel 25%. Gravel fraction: angular to subangular to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics with some granitic fragments. Well lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: weak. Sparse 0.75" gravel particles.
950.0 - 960.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 65%, gravel 35%. Gravel fraction: angular to subangular to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics with some granitic fragments. Well lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: weak.
960.0 - 970.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 65%, gravel 35%. Gravel fraction: angular to subangular to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics with some granitic fragments. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak.
970.0 - 980.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 60%, gravel 40%. Gravel fraction: angular to subangular to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics with some granitic fragments. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak.
980.0 - 990.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 75%, gravel 25%. Gravel fraction: subangular to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics with some granitic fragments. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak to moderate.
990.0 - 1,000.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 65%, gravel 35%. Gravel fraction: angular to subangular to 0.5 in consisting of Mixed lithology conglomerate consisting of mostly volcanics with some granitic fragments. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak. Some iron oxide cemented conglomerate chips.
1,000.0 - 1,010.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 65%, gravel 35%. Gravel fraction: angular to subangular to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics with some granitic fragments. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak. Sparse cemented chips.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-C [*55-919729*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
1,010.0 - 1,020.0	**SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 90%, gravel 10%. Gravel fraction: angular to subangular to 0.25 in consisting of Sandstone with sparse volcanic gravel. Well lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: weak. No clear sign of cementation; mostly medium to coarse sand; rare clay balls.
1,020.0 - 1,030.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 65%, gravel 35%. Gravel fraction: subangular to subrounded to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics with some granitic fragments. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak. Some conglomerate chips.
1,030.0 - 1,040.0	**SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 90%, gravel 10%. Gravel fraction: subangular to subrounded to 0.25 in consisting of Sandstone with sparse volcanic gravel. Well lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: weak. Some granitic gravel; mostly medium to coarse sand.
1,040.0 - 1,050.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 75%, gravel 25%. Gravel fraction: subangular to subrounded to 0.5 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: very weak. Some cemented chips; mostly coarse sand.
1,050.0 - 1,060.0	**SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 90%, gravel 10%. Gravel fraction: angular to subrounded to 0.25 in consisting of Sandstone with sparse volcanic gravel. Well lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: very weak. Mostly medium to coarse sand.
1,060.0 - 1,070.0	**SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 85%, gravel 15%. Gravel fraction: angular to subangular to 0.25 in consisting of Sandstone with sparse volcanic gravel. Well lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: very weak. Mostly coarse sand.
1,070.0 - 1,085.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 80%, gravel 20%. Gravel fraction: angular to subangular to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: very weak. Trace of subrounded gravel.
1,085.0 - 1,090.0	**GRAVELLY SAND**: Gray [N5]; subangular to subrounded, fine to very coarse sand 75%, gravel 25%. Gravel fraction: angular to subrounded to 0.5 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: very weak. Mostly medium to coarse sand; few clay balls.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-C [*55-919729*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
1,090.0 - 1,100.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 70%, gravel 25%, silt 5%. Gravel fraction: angular to subrounded to 0.5 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: weak. Mostly fine to medium sand; 5% silt; sparse congolmerate chips.
1,100.0 - 1,110.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 70%, gravel 30%. Gravel fraction: angular to subangular to 0.75 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: very weak. Mostly medium to coarse sand; some conglomerate chips.
1,110.0 - 1,120.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 75%, gravel 25%. Gravel fraction: angular to subrounded to 0.5 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: very weak. Mostly medium to coarse sand; some conglomerate chips.
1,120.0 - 1,130.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 70%, gravel 30%. Gravel fraction: angular to subrounded to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: very weak. Mostly medium to coarse sand; sparse 0.5" gravel; some conglomerate chips; trace clay balls; some calcite cement and fracture fillings.
1,130.0 - 1,140.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 80%, gravel 20%. Gravel fraction: angular to subrounded to 0.5 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: very weak.
1,140.0 - 1,150.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 65%, gravel 35%. Gravel fraction: angular to subangular to 0.5 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: very weak. Some conglomerate fragrments; trace of subrounded gravel.
1,150.0 - 1,160.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 75%, gravel 25%. Gravel fraction: angular to subrounded to 0.5 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: very weak.
1,160.0 - 1,170.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 80%, gravel 20%. Gravel fraction: angular to subangular to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: very weak.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-C [*55-919729*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
1,170.0 - 1,180.0	**SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 90%, gravel 10%. Gravel fraction: angular to subrounded to 0.25 in consisting of Sandstone with sparse volcanic gravel. Well lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: very weak.
1,180.0 - 1,185.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 70%, gravel 30%. Gravel fraction: angular to subrounded to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: very weak.
1,185.0 - 1,188.0	**TRACHYTE**: Grayish brown [5Y3/2]; silt 100%, trace gravel, trace sand. consisting of Trachyte; light colored aphanetic volcanic rock with occasional small phenocrysts. Well lithified. Non-plastic. Saturated. Reaction to acid: none to strong. Calcite coatings present (likely filled fractures); unit thickness is approximate.
1,188.0 - 1,190.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 70%, gravel 30%. Gravel fraction: angular to subrounded to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: very weak.
1,190.0 - 1,200.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 75%, gravel 25%. Gravel fraction: angular to subrounded to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: very weak. Mostly medium sand; sparse clay balls and conglomerate chips.
1,200.0 - 1,208.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 85%, gravel 15%. Gravel fraction: angular to subrounded to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: very weak. Mostly medium sand; sparse clay balls and conglomerate chips.
1,208.0 - 1,210.0	**DACITE**: Grayish brown [5Y3/2]; silt 100%, trace gravel, trace sand. consisting of Dacite; intermediate colored aphanetic volcanic rock with dark phenocrysts (hornblende). Well lithified. Non-plastic. Saturated. Reaction to acid: none. Unit thickness is approximate.
1,210.0 - 1,215.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 75%, gravel 25%. Gravel fraction: angular to subrounded to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: very weak. Mostly medium sand; sparse conglomerate chips.
1,215.0 - 1,218.0	**DACITE/ANDESITE**: Grayish brown [5Y3/2]; silt 100%, trace gravel, trace sand. consisting of Dacite or Andesite; dark to gray-blue colored aphanetic to porphyritic volcanic rock with carbonate accessory minerals. Well lithified. Non-plastic. Saturated. Reaction to acid: none to strong. Unit thickness is approximate.

Gravel/sand division based on Wentworth scale. Grain size fractions estimated using manual field methods.
Grain size fractions rounded to the nearest five percent.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-C [*55-919729*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
1,218.0 - 1,220.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 75%, gravel 25%. Gravel fraction: angular to subrounded to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: very weak. Mostly medium sand; sparse conglomerate chips.
1,220.0 - 1,230.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 80%, gravel 20%. Gravel fraction: angular to subangular to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to very weak. Trace subrounded gravel; trace gravel up to 0.5".
1,230.0 - 1,240.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 80%, gravel 20%. Gravel fraction: angular to subrounded to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Moderately sorted. Reaction to acid: none to very weak. Some conglomerate chips.
1,240.0 - 1,250.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 80%, gravel 20%. Gravel fraction: angular to subrounded to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Non-plastic. Saturated. Poorly sorted. Reaction to acid: none to very weak.
1,250.0 - 1,260.0	**GRAVELLY SAND**: Grayish brown [5Y3/2]; subangular to subrounded, fine to very coarse sand 85%, gravel 15%. Gravel fraction: angular to subrounded to 0.5 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Saturated. Poorly sorted. Reaction to acid: very weak. Few clay balls.
1,260.0 - 1,270.0	**GRAVELLY SAND**: Dusky brown [5YR2/2]; subangular to subrounded, fine to very coarse sand 75%, gravel 25%. Gravel fraction: angular to subangular to 0.5 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Saturated. Poorly sorted. Reaction to acid: none to very weak. Mostly medium to coarse sand; sparse subrounded gravel.
1,270.0 - 1,280.0	**GRAVELLY SAND**: Dusky brown [5YR2/2]; subangular to subrounded, fine to very coarse sand 75%, gravel 25%. Gravel fraction: angular to subrounded to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Saturated. Poorly sorted. Reaction to acid: very weak. Mostly medium to coarse sand; few clay balls; some conglomerate chips.
1,280.0 - 1,285.0	**GRAVELLY SAND**: Dark yellowish brown [10YR4/2]; subangular to subrounded, fine to very coarse sand 75%, gravel 25%. Gravel fraction: angular to rounded to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Saturated. Moderately sorted. Reaction to acid: none to very weak. Mostly medium to coarse sand; some conglomerate chips.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-C [*55-919729*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
1,285.0 - 1,287.0	**DACITE**: Light brown [5YR6/4]; consisting of Dacite; light colored porphyrtic volcanic rock. Well lithified. Saturated. Reaction to acid: none. Some chips tuffaceous and appear to be weathered; unit thickness is approximate.
1,287.0 - 1,290.0	**GRAVELLY SAND**: Dark yellowish brown [10YR4/2]; subangular to subrounded, fine to very coarse sand 75%, gravel 25%. Gravel fraction: angular to rounded to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Saturated. Moderately sorted. Reaction to acid: none. Mostly medium to coarse sand; some conglomerate chips.
1,290.0 - 1,300.0	**INTERBEDDED GRAVELLY SAND AND VOLCANIC LAYERS**: Grayish brown [5Y3/2]; gravel 70%, subangular to subrounded, fine to very coarse sand 30%. Gravel fraction: angular to subrounded to 0.5 in consisting of Mixed lithology conglomerate consisting of mostly volcanics interbedded with volcanic layers and/or re-worked volcanics. Well lithified. Saturated. Poorly sorted. Reaction to acid: none to moderate. Conglomerate and dense apahanetic volcanic rock chips.
1,300.0 - 1,301.0	**GRAVELLY SAND**: Dusky brown [5YR2/2]; subangular to subrounded, fine to very coarse sand 80%, gravel 20%. Gravel fraction: angular to subangular to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Saturated. Moderately sorted. Reaction to acid: none to very weak. Mostly medium sand.
1,301.0 - 1,303.0	**ANDESITE**: Brownish black [5YR2/1]; consisting of Andesite; dark colored aphanetic to porphyritic volcanic rock with cacite veins. Well lithified. Saturated. Reaction to acid: none to moderate. Unit thickness is approximate.
1,303.0 - 1,310.0	**GRAVELLY SAND**: Dusky brown [5YR2/2]; subangular to subrounded, fine to very coarse sand 80%, gravel 20%. Gravel fraction: angular to subangular to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Saturated. Moderately sorted. Reaction to acid: none to very weak. Mostly medium sand.
1,310.0 - 1,320.0	**INTERBEDDED GRAVELLY SAND AND VOLCANIC LAYERS**: Grayish brown [5Y3/2]; gravel 50%, subangular to subrounded, fine to very coarse sand 50%. Gravel fraction: angular to subrounded to 0.5 in consisting of Mixed lithology conglomerate consisting of mostly volcanics interbedded with volcanic layers and/or re-worked volcanics. Well lithified. Saturated. Poorly sorted. Reaction to acid: none to moderate. Conglomerate and dense volcanic chips; trace red silicified clay.
1,320.0 - 1,330.0	**INTERBEDDED GRAVELLY SAND AND VOLCANIC LAYERS**: Grayish brown [5Y3/2]; gravel 60%, subangular to subrounded, fine to very coarse sand 40%. Gravel fraction: angular to subrounded to 0.75 in consisting of Mixed lithology conglomerate consisting of mostly volcanics interbedded with volcanic layers and/or re-worked volcanics. Well lithified. Saturated. Poorly sorted. Reaction to acid: none to moderate. Conglomerate and dense volcanic chips; trace red silicified clay.

APPENDIX A. LITHOLOGIC DESCRIPTIONS FOR DRILL CUTTINGS FROM EXPLORATION BOREHOLE EX-C [*55-919729*] TONOPAH DESERT RECHARGE PROJECT TONOPAH, ARIZONA

DEPTH INTERVAL (feet)	DESCRIPTION
1,330.0 - 1,340.0	**INTERBEDDED GRAVELLY SAND AND VOLCANIC LAYERS**: Grayish brown [5Y3/2]; gravel 60%, subangular to subrounded, fine to very coarse sand 40%. Gravel fraction: angular to subrounded to 0.75 in consisting of Mixed lithology conglomerate consisting of mostly volcanics interbedded with volcanic layers and/or re-worked volcanics. Well lithified. Saturated. Poorly sorted. Reaction to acid: none to moderate. Conglomerate and dense volcanic chips; trace red silicified clay.
1,340.0 - 1,350.0	**GRAVELLY SAND**: Moderate yellowish brown [10YR5/4]; subangular to subrounded, fine to very coarse sand 60%, gravel 40%. Gravel fraction: subangular to rounded to 0.25 in consisting of Mixed lithology conglomerate consisting of mostly volcanics. Well lithified. Saturated. Poorly sorted. Reaction to acid: moderate to strong. More rounded 1340' to 1345'.
1,350.0 - 1,355.0	**ANDESITE WITH THIN GRAVELLY SAND INTERBEDS**: Moderate brown [5YR3/4]; subangular to subrounded, medium to very coarse sand 65%, gravel 35%. Gravel fraction: subangular to subrounded to 0.25 in consisting of Andesite; dark colored aphanetic to porphyritic volcani rock with mixed lithology conglomerate. Well lithified. Saturated. Poorly sorted. Reaction to acid: moderate to strong. 60% of cuttings are fresh-cut rock chips (sand/gravel % represents only sediment portion of cuttings).
1,355.0 - 1,360.0	**FELSIC TUFF**: Grayish orange [10YR7/4]; consisting of Tuff; light colored tufffaceous volcanic rock. Moderately lithified. Saturated. Reaction to acid: none to weak. Some chips appear to be welded.

MONTGOMERY & ASSOCIATES

Appendix B

Geokon Vibrating-Wire Pressure Transducer Calibration Reports

VW-1
VW-2
VW-3
VW-4

GEOKON 48 Spencer St. Lebanon, NH 03766 USA

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500SH-5 MPa

Serial Number: 1617466

Calibration Instruction: VW Pressure Transducers

Cable Length: 1200 feet

Date of Calibration: May 31, 2016

This calibration has been verified/validated as of 11/03/2016

Temperature: 23.10 °C

Barometric Pressure: 990.5 mbar

Technician: Kelly Rogers

Applied Pressure (MPa)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8899	8900	8900	0.007	0.14	-0.002	-0.03
1.0	8118	8114	8116	1.003	0.06	1.004	0.08
2.0	7339	7338	7339	1.991	-0.17	1.997	-0.05
3.0	6551	6551	6551	2.993	-0.15	2.999	-0.03
4.0	5758	5758	5758	4.001	0.01	4.002	0.04
5.0	4965	4966	4966	5.008	0.16	5.000	-0.01

(MPa) Linear Gage Factor (G): -0.001271 (MPa/ digit)

Polynomial Gage factors: A: -3.923E-09 B: -0.001217 C:

Thermal Factor (K): 0.001321 (MPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gage Factor (G): -0.1844 (psi/ digit)

Polynomial Gage Factors: A: -5.69E-07 B: -0.1765 C:

Thermal Factor (K): 0.1917 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in MPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8894 Temperature: 22.4 °C Barometer: 994.5 mbar

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON 48 Spencer St. Lebanon, NH 03766 USA

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500SH-5 MPa

Serial Number: 1617467

Calibration Instruction: VW Pressure Transducers

Cable Length: 900 feet

Date of Calibration: May 31, 2016

This calibration has been verified/validated as of 11/03/2016

Temperature: 23.10 °C

Barometric Pressure: 990.5 mbar

Technician: Kelly Rogers

Applied Pressure (MPa)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8760	8760	8760	0.009	0.17	-0.001	-0.03
1.0	7954	7950	7952	1.002	0.04	1.004	0.07
2.0	7149	7149	7149	1.989	-0.21	1.997	-0.06
3.0	6333	6333	6333	2.993	-0.14	3.000	0.01
4.0	5515	5515	5515	3.999	-0.03	4.000	0.01
5.0	4691	4694	4693	5.010	0.20	5.000	0.00

(MPa) Linear Gage Factor (G): -0.001230 (MPa/ digit)

Polynomial Gage factors: A: -4.396E-09 B: -0.001170 C:

Thermal Factor (K): 0.001323 (MPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gage Factor (G): -0.1783 (psi/ digit)

Polynomial Gage Factors: A: -6.376E-07 B: -0.1698 C:

Thermal Factor (K): 0.1919 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in MPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8753 Temperature: 22.5 °C Barometer: 994.5 mbar

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON 48 Spencer St. Lebanon, NH 03766 USA

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-3 MPa

Serial Number: 1618076

Calibration Instruction: VW Pressure Transducers

Cable Length: 600 feet

Date of Calibration: June 15, 2016

This calibration has been verified/validated as of 11/03/2016

Temperature: 23.30 °C

Barometric Pressure: 991.6 mbar

Technician: Kelly Rogers

Applied Pressure (MPa)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	8769	8770	8770	0.007	0.23	0.000	-0.01
0.6	8031	8032	8032	0.599	-0.04	0.600	0.02
1.2	7289	7290	7290	1.194	-0.21	1.200	0.00
1.8	6542	6542	6542	1.793	-0.22	1.800	-0.01
2.4	5788	5788	5788	2.398	-0.06	2.400	0.00
3.0	5028	5029	5029	3.007	0.24	3.000	0.00

(MPa) Linear Gage Factor (G): -0.0008020 (MPa/ digit)

Polynomial Gage factors: A: -3.971E-09 B: -0.0007473 C:

Thermal Factor (K): 0.0008028 (MPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gage Factor (G): -0.1163 (psi/ digit)

Polynomial Gage Factors: A: -5.759E-07 B: -0.1084 C:

Thermal Factor (K): 0.1164 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in MPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 8773 Temperature: 23.1 °C Barometer: 988.9 mbar

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

GEOKON 48 Spencer St. Lebanon, NH 03766 USA

Vibrating Wire Pressure Transducer Calibration Report

Model Number: 4500S-2 MPa

Serial Number: 1616775

Calibration Instruction: VW Pressure Transducers

Cable Length: 480 feet

Date of Calibration: May 24, 2016

This calibration has been verified/validated as of 11/03/2016

Temperature: 23.30 °C

Barometric Pressure: 992.7 mbar

Technician:

Applied Pressure (MPa)	Gage Reading 1st Cycle	Gage Reading 2nd Cycle	Average Gage Reading	Calculated Pressure (Linear)	Error Linear (%FS)	Calculated Pressure (Polynomial)	Error Polynomial (%FS)
0.0	9128	9128	9128	0.002	0.11	0.000	0.00
0.4	8407	8407	8407	0.400	0.00	0.400	0.01
0.8	7685	7685	7685	0.798	-0.08	0.800	-0.01
1.2	6960	6960	6960	1.198	-0.09	1.200	-0.01
1.6	6232	6232	6232	1.600	-0.01	1.600	0.01
2.0	5502	5503	5503	2.002	0.11	2.000	0.00

(MPa) Linear Gage Factor (G): -0.0005517 (MPa/ digit)

Polynomial Gage factors: A: -1.216E-09 B: -0.0005339 C:

Thermal Factor (K): 0.0005311 (MPa/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

(psi) Linear Gage Factor (G): -0.08002 (psi/ digit)

Polynomial Gage Factors: A: -1.764E-07 B: -0.07743 C:

Thermal Factor (K): 0.07703 (psi/ °C)

Calculate C by setting P=0 and R_1 = initial field zero reading into the polynomial equation

Calculated Pressures:

Linear, $P = G(R_1 - R_0) + K(T_1 - T_0) - (S_1 - S_0)$*

Polynomial, $P = AR_1^2 + BR_1 + C + K(T_1 - T_0) - (S_1 - S_0)$*

*Barometric pressures expressed in MPa or psi. Barometric compensation is not required with vented transducers.

Factory Zero Reading: 9133 Temperature: 22.8 °C Barometer: 988.9 mbar

The above instrument was found to be in tolerance in all operating ranges.
The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.