EXHIBIT 4

Engineering Design Report

ATTACHMENT J

Thacker Pass Project
Engineering Design Report
Clay Tailings Filter Stack, Waste Rock Storage Facilities, Coarse Gangue Stockpile, Mine Facilities & Process Plant Stormwater Management

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Revision 0

NewFields Project No. 475.0385.000
April 2, 2020

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1 INTRODUCTION

NewFields Mining Design & Technical Services (NewFields) was commissioned by Lithium Nevada Corporation (LNC) to design the Clay Tailings Filter Stack (CTFS), East and West Waste Rock Storage Facilities (WRSF), Coarse Gangue Stockpile (CGS), Process Plant Ponds, and associated infrastructure in support of the application for a Water Pollution Control Permit (WPCP). Information presented in this report was prepared in accordance with the requirements outlined in the State of Nevada Regulations Governing the Design, Construction, Operation and Closure of Mining Operations, Nevada Administrative Code (NAC) 445A.

The Thacker Pass Project is located approximately 20 miles west-northwest of Orovada, 62 miles north-northwest of Winnemucca, between the Kings River Valley to the west, the Quinn River Valley to the east, the Montana Mountains to the north, and the Double H Mountains to the south in an area known as Thacker Pass. The elevation in the Project area ranges from approximately 4,200 to 5,650 feet above mean sea level (amsl). A location map is provided in on the cover of the **Drawings**.

1.1 Scope of Work

The general objectives of the project included the following elements:

- Establish design criteria (Appendix A) for use as a basis to complete the Project design;
- Complete geotechnical field investigations and laboratory testing to assess subsurface conditions and to develop input parameters for geotechnical evaluations of mine waste materials (Appendices B & C);
- Provide geotechnical evaluations for the Plant Site, CTFS, CGS and West and East WRSF (Appendix D);
- Complete a site wide hydrologic analysis;
- Complete hydraulic stormwater analysis and civil designs for the CTFS, Reclaim Pond and West and North Diversion Channels; CGS Sediment Pond; West and East WRSF sediment ponds, Process Plant entrance road culvert design; and review and stamp NA Coal’s hydraulic and civil designs for the Mine Facilities sediment ponds, diversion channels and culverts. (Appendix E);
- Prepare Technical Specifications (**Appendix F**); and
- Generate drawings to support permitting and construction (**Drawings**).

1.2 Project Background

Subsurface exploration of the McDermitt Caldera and Thacker Pass Project area started in 1975. At this time, Chevron began a uranium exploration program in the volcanic rocks located throughout the McDermitt Caldera. The United States Geological Survey (USGS) notified Chevron on the presence of anomalous concentrations of lithium associated with the caldera. Chevron initiated a clay analysis program, which confirmed the presence of high lithium concentrations using airborne gamma ray spectrometry, although their exploration program continued to focus on uranium (Advisian, 2018).

Chevron drilled 234 holes in the 1970s and 1980s that broadly outlined the lithium deposit. Between 1980 and 1987, Chevron conducted a drilling program that focused on lithium targets and conducted extensive metallurgical testing to determine the viability of extracting lithium from the clays.

In 2007, Western Lithium USA Corporation (WLC) began an exploration drilling program focused on the southern portion of the caldera. WLC drilled 232 exploration holes over the course of four years in the Project area, which identified an anomalously high-grade lithium deposit. As part of a merger, WLC officially changed its name to Lithium Americas Corporation (LAC) in March of 2016 and ownership of the Project was placed in LAC's Nevada-based subsidiary, LNC.

LNC continued exploration drilling in 2017 and 2018, drilling an additional 142 holes. The WLC/LNC drilling exploration program drilled a total of 374 HQ (2.5") core holes for a total of 113,951 feet with a range of depths from 20 feet to 760 feet. The average depth of drilling is 302 feet. The HQ core was drilled with either a truck or track mounted core rig capable of 1,500 feet of depth. The drilling proved a viable resource that is available for mining and extraction.

1.3 Project Overview

LNC proposes to construct, operate, reclaim, and close an open pit lithium mining and processing operation, the Thacker Pass Project, located on public lands in northern Humboldt County, NV. Pending the required authorizations and permits, construction for Phase 1 will commence in 2021 and mine production will begin in late 2022. Construction and operation will consist of the open pit mine, West and East WRSF, CGS, CTFS, stockpile areas, roads, ponds, diversion channels, diversion berms, processing facilities, and mine support facilities. **Appendix A** lists the design criteria used to design the facilities.

It is expected that approximately 50 million dry tons of ore will be mined from the open pit. Once the pit is opened and established, as the pit is mined, it will be concurrently backfilled with waste rock. Initially, excavation will start on the western side of the overall pit extents. The West WRSF will be located southwest of the pit and will store 26.4 M CY of excavated mine waste rock material and the East WRSF will be located to the east of the pit and store 5.8 M CY. The CGS, located southeast of the East WRSF, will have a storage capacity of approximately 26.1 M CY. Three growth media stockpiles will store material salvaged from proposed disturbance. Two of these stockpiles will be located southeast of the pit, near the ROM ore stockpile. The third growth media stockpile will be located northeast of the East WRSF.

The Mine Facilities Area located south of the pit and north of SR293, will consist of a truck shop, warehouse, fuel bay, wash station and other ancillary buildings. Stormwater for the area will gravity flow to diversion channels and berms, which will direct flows into sediment ponds. Culverts will be used to convey flows under roads.

Located south of the pit and east of the Mine Facilities Area will be a run-of-mine (ROM) ore stockpile with a storage capacity of 0.5 M CY.

The ROM ore will be dozed into a conveyor trap and fed to an attrition scrubber which will separate the lithium-rich fine clay from the coarse low-grade material. The solids are mixed with water into slurry form and pumped to the Process Plant where the coarse-grained low-grade material (coarse gangue) is separated from the high grade fine-grained material that continues through the process plant. The coarse low-grade material will be stockpiled in the CGS. The Process Plant produces lithium carbonate and lithium hydroxide, which is sold on the market. The clay tailings, neutralization solids and various salts generated as a result of the processing will be sent to the CTFS.

The Sulfuric Acid Plant is located on the south end of the Process Plant and will generate sulfuric acid for use in the leaching process and will also generate steam for energy that will provide power to the project. Maintenance, laboratory, office, and other processing support facilities will be located in this general area as well.

The CTFS will be located east of the Process Plant and is designed to store 70 M CY of structural and non-structural tailings with the capability to expand. The design storage capacity is based on an initial tailings production rate of approximately 2.75 M dry tons per year for up to 25 years.

The base of the CTFS will have an 80-mil high-density polyethylene (HDPE) double-sided textured liner placed above a layer of liner bedding and overlain with collection pipes and a 2-foot thick layer of overliner. A perimeter road will be built around the facility. No solution will be applied to the CTFS; however, seepage that is squeezed from the clay tailings during the consolidation process and any precipitation that falls on the facility will be collected by an underdrain collection system. The underdrain system is designed to provide positive drainage toward a reclaim pond located south of the CTFS. Solution from the reclaim pond will be pumped to the Process Plant as make-up water or left to evaporate.

Upgradient stormwater will be directed around project facilities through diversion channels and into natural drainage ways. Runoff generated from disturbed areas such as the CGS, and East and West WRSF, Mine Facilities Area or Process Plant Area will be routed into sediment basins before release to existing drainage ways. The stormwater plan details and calculations are included in **Appendix E**.

1.4 Use of this Report

This report has been prepared exclusively for LNC. No third party, other than NewFields, shall be entitled to rely on any information, conclusions, opinions or other information contained herein without the express written consent of LNC.

Supporting data upon which our recommendations are based are presented in the following sections of this report. The recommendations presented herein are governed by NewFields' interpretation of the physical properties of the soils encountered in the field investigation, projected groundwater conditions, and the layout and design data generated and discussed in this report. If subsurface conditions other than those described in this report are encountered, or if project details are changed, NewFields should be informed so that our recommendations can be reviewed and amended, as necessary.

2 SITE CHARACTERIZATION

2.1 Climate

Precipitation data from various frequency storm events were obtained using the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 Point Precipitation Frequency Estimates at the mine location from the NOAA website. Average monthly evaporation values for the Rye Patch Dam weather station (approximately 85 miles south-southeast of the project Thacker Pass), were obtained from the Western Regional Climate Center (WRCC) website. Average monthly precipitation data was collected from LNC's site climate monitoring station and compared with the other nearby stations. Reported precipitation, and evaporation values, and storm events are summarized in the Design Criteria in **Appendix A**. **Table 2-1** presents values for the various storm events used in the design.

Table 2-1: Design Storm Events (24-hour duration)

Recurrence Interval (years)	Precipitation Depth (inches)
2	1.13
25	1.96
100	2.48
500	3.12
From NOAA Atlas 14: Latitude: 41.696° N and Longitude: 118.02° W; Elevation = 4,622.8 ft (2018)	

2.2 Local and Regional Geology

The Thacker Pass Project is located in north-central Nevada at the northern end of the Basin and Range tectonic province. Regional geology stretches from southern Oregon to Mexico and is characterized by a series of extension-related normal faults trending roughly north-south resulting in a repetitive series of mountain ranges separated by valleys. The project site is bounded to the north by the Montana Mountains; to the south by the Double H Mountains; to the west by the Kings River Valley; and to the east by the Quinn River Valley.

Local geology of the Thacker Pass Project is controlled by the McDermitt Volcanic Field, a volcanic complex containing four large calderas (or “super volcanoes”) that formed in the middle Miocene. The McDermitt Volcanic Field is located within the southeastern-propagating swarm of volcanism from the Steens Mountain into north-central Nevada. The largest and southeastern most caldera of the McDermitt Volcanic Field, the McDermitt Caldera, hosts the ore body of the Thacker Pass Project. Prior to collapse of the McDermitt Caldera at 16.33 million years ago (Ma), volcanism in the northern portion of the McDermitt Volcanic Field and locally small volumes of lavas erupted near the present-day Oregon-Nevada border. These lavas and the flood basalts are exposed along walls of the McDermitt Caldera and are approximately 16.5 to 16.3 million years old (Advisian, 2018).

A large lake formed in the caldera basin following the eruptions in the McDermitt Volcanic Field. Associated caldera lake sediments that host the Thacker Pass deposit were deposited on top of the horsts and grabens formed during the faulting associated with the Tuff of Thacker Creek. The lake captured sediments that were eroded from the surrounding drainages.

Lacustrine claystone sediments which host lithium ore are found intimately interbedded with thin, repetitive water lain ash sequences. Ash layers are well sorted, medium to coarse sized lapilli grains deposited across wide extents, particularly in the Southwest Basin where thick sequences of basal ash beds were encountered across multiple exploration boreholes. Diagenesis at depth has silicified claystone beds in finely laminated, mudstone sequences. The ratio of ash to claystone in these lacustrine units is a continuum, with thick sequences of ash beds found more abundantly in basal lacustrine deposits in the Southwest Basin Area, and greater components of claystone found in the open pit footprint. The rhyolitic Tuff of Long Ridge is found underlying lacustrine sediments and is present in latite textures of felsic phenocrysts to a fine-grained groundmass. In some instances, the Tuff of Long Ridge was deposited as viscous lava, forming flows and pseudo bedding planes. These deposits are referred to as Rheomorphic Tuffs.

2.3 Subsurface Conditions

A preliminary site investigation was completed by AMEC in 2011. NewFields conducted a site investigation in February 2019 that included 31 boreholes and 29 test pits. Four of the boreholes were extended to depths between 100 and 150 feet below ground surface (bgs). The other twenty-seven were extended to depths of 30 to 50 feet bgs. Another site investigation was completed in December 2019 that included five additional boreholes to 100 feet depth and 21 additional test pits.

Subsurface conditions can generally be classified as a thin veneer of growth media, approximately 12 inches to 24 inches in thickness, overlying alluvium overburden consisting of loose to very dense fine to coarse sands and gravels with varying amounts of clay, silt, sand and gravel overlying residuum composed of slightly weathered to highly weathered basalt. In the open pit area, the alluvium directly overlies claystone with varying amounts of interbedded ash (AMEC, 2011). Throughout the site, thin seams and lenses of low plastic clay and silt were observed in select borings at relatively shallow depths. The thickness of alluvium overburden varies significantly across the site, with recorded thicknesses between 10 feet to over 65 feet.

There is no general trend of overburden thickness or bedrock elevation across the site, primarily due to the degree of weathering and the basalt depositional process.

The site generally slopes to the South-southeast at approximately 4 to 6 percent gradient with isolated slopes up to 15 to 20 percent gradient. Based upon the topography there is significant relief across the entire project; approximately 400 feet of elevation change across the pit area, approximately 160 feet of change across the CTFS, 400 feet of change across the East WRSF and CGS, and approximately 70 feet of elevation change across the Process Plant site. **Appendix D** contains the full geotechnical investigation results.

2.3.1 Groundwater

Prior to 2018, LNC had six active monitoring wells; these wells continue to be monitored and recorded on a quarterly basis. Additional wells were installed at strategic locations in August 2018 by Piteau Associates for groundwater monitoring. The results show the groundwater levels between 70 and 180 feet below ground surface (bgs) in the pit area.

- Groundwater generally flows from north to south-southwest, following the general topographic trend. Groundwater elevations have remained steady over the monitoring period, indicating that the groundwater conditions are at steady state.
- NewFields encountered groundwater in five deep borings during the two site investigations completed in 2019.
    - In BH19-02 groundwater was encountered at a depth of 93 feet bgs,
    - BH19-04 at 93 feet,
    - BH19-05 at 83 feet,
    - BH19-33 at 60 feet,
    - BH-34 at 97 feet,
    - BH19-35 at 90 feet.

The remaining boreholes did not encounter groundwater. Based on the geotechnical investigation, groundwater is not anticipated in the upper 50 feet bgs. In general, groundwater is not expected to influence construction and operation of the process plant, CTFS, East and West WRSF and CGS. Refer to the **Table 2-2** for borehole depth to groundwater findings by NewFields in 2019. All boreholes not included in the table did not encounter groundwater. **Appendix D** includes compete geotechnical investigation results.

Table 2-2: Depth to Water Encountered in the NewFields 2019 Geotechnical Investigations

Piezometer or Borehole	Depth to Groundwater (feet)	Ground Water Elevation (feet amsl)
BH19-02	93.2	4835.1
BH19-04	92.5	4632.9
BH19-05	83.5	4715.4
BH19-33	60.2	4623.8
BH19-34	97.5	4728.5
BH19-35	90.3	4626.7

2.3.2 Surface Water

The topographical arrangement and site terrain straddles the southern end of the Humboldt Range. Surface water drains into two hydrographic basins: Quinn River Basin to the east and Kings River to the west. The CTFS, CGS, East WRSF, Process Plant Facilities and the east half of the Mine Facilities area are located entirely within the Quinn River Basin, as shown on Figure 000 **in Appendix E.2**. The West WRSF and the western edge of the Mine Facilities Area is located within the Kings River Basin. The pit straddles the hydrographic basin boundary. The surface water at the Project Area is associated with outflow from ephemeral creeks and runoff from precipitation as a result of storm events and snowmelt. Most surface drainages at the site are ephemeral and flow seasonally or during storm events or sustained periods of heavy precipitation. A small section of Pole Creek crosses the Plan of Operation (POO) boundary at its northeast corner; it is not located near any planned mine facilities. On the western edge of the project site, a small section of Thacker Creek crosses the POO boundary. No area within 1,300 feet of the creek will be disturbed in the current mine plan. Several existing natural drainages enter the property boundary from the north and traverse the project site. These drainages and runoff from the site discharge to one of the two existing drainage ways located just north of southern plan of operations boundary, roughly parallel to SR 293. The drainage way east of the hydrographic boundary flows east into Crowley Creek. The drainage within the Kings River Basin flows west into Thacker Creek. Surface water delineation and subsequent consultation with the United States Army Corps of Engineers (USACE) has determined there are no Waters of the

United States (WOTUS) within or immediately adjacent to the Project Area (USACE, 2019). The current Jurisdictional Determination was approved on February 8, 2019 and is included in **Attachment I** of the WPCP. A summary of the stormwater design plan and its supporting calculations are located in **Appendix E**.

2.3.3 Stormwater Controls

Stormwater controls have been designed to route upgradient runoff around the proposed project infrastructure and to accommodate and contain on-site runoff from design storm events. The intent of the stormwater controls is to:

- Divert non-contact water (i.e. water that has not come in contact with disturbed ground or process solutions) around the project facilities and discharge to downstream watercourses.
- Convey sediment-laden runoff (i.e. water that comes off stripped surfaces and roadways) as necessary to sediment collection basins prior to discharging to downstream watercourses.
- Contain precipitation from a design storm event that has come in contact with process solution.

For all surface water controls, the hydrological modeling was performed using HEC-HMS, a precipitation-runoff simulation computer program developed by the USACE to calculate the magnitude and timing of the peak flows and volumes resulting from specific storm events. HEC-15 (FHWA, 2005) was then used to estimate channel flow depths and riprap sizing based on the cross-sectional geometry, minimum channel profile slope, and peak flows. The required channel depths and riprap sizing were determined for each channel segment longitudinal slope. In steep sections of the channels, a rock chute calculation was completed based on Natural Resources Conservation Service (NRCS, 1998) design procedures to determine the appropriate channel dimensions and riprap sizing.

2.4 Seismic Hazard

NewFields completed a seismic hazard assessment on July 18, 2019. The results are presented in **Appendix D**. Probabilistic ground motions associated with various risk levels were assessed using the USGS unified hazard tool. The hazard tool application is based on the 2014 USGS national seismic hazard maps and adjusts for the site soil class. The reported peak ground acceleration (PGA) for a 2 percent and 10 percent chance of exceedance in 50 years, which corresponds to a return period of 475 years and 2,475 years, are presented in **Table 2-3**. Deaggregation of the seismic hazard indicates that the mean event is a 6.6 moment magnitude at 14 miles from the site.

Table 2-3: Probabilistic Design Accelerations

Return Period	Reported PGA (g)
475-Year	.09
2,475-Year	.26

2.4.1 Site Classification

The results of the geotechnical subsurface investigation near the process facilities and CTFS (NewFields, 2019) determined that the upper 100 feet consist of 20 to 60 feet of very dense silty sand and gravel fan deposits overlying weathered basalt. The deepest boring near the proposed pit, which is west of the CTFS, was 50 feet and consisted of dense to very densely bedded ash and clay with average Standard Penetration Test (SPT) resistance (N value) of greater than 50 blows per foot. In accordance with the 2015 IBC and ASCE 7-16, the site classifies as very dense soil and soft rock, Site Class C.

The maximum considered earthquake response accelerations at short and long periods, S_S and S_1, respectively, were determined using an online calculator provided from the Structural Engineers Association of California (SEAC) (SEAC, 2019). All relevant seismic design values for structures are listed in **Table 2-4**.

Table 2-4: Code Based Seismic Parameters

Site Soil Class	C
Mapped MCE_R, five (5) percent damped, spectral response acceleration parameter at short periods (Site Class C), S_S	0.50g
Mapped MCE_R, five (5) percent damped, spectral response acceleration parameter at a period of one (1) second (Site Class B), S_1	0.18g
Design, five (5) percent damped, spectral response acceleration parameter at short periods, S_{DS}	0.43g
Design, five (5) percent damped, spectral response acceleration parameter at period of one (1) second, S_{D1}	0.18g

2.4.2 Recommended Design Ground Motions

Ground motions associated with design-level earthquakes were developed for the project site using both site specific code-based procedures and publicly available information from the United States Geological Survey (USGS). Based on all the available information, NewFields recommends the following:

- Earthen structures (such as the CTFS) should be designed considering a MCE PGA equal to 0.44g based on the most conservative results of the Deterministic Seismic Hazard Analysis (DSHA) in

Appendix D.4 and a OBE of 0.09g based on the 475-year return probabilistic event. This is in compliance with the NAC guidelines; and

- Design of structures should be completed using the code based spectral response parameters listed in **Table 2-4**.

2.4.3 Other Seismic Hazards

Potential seismic hazards for any site include ground rupture, slope instability, seismic induced settlement, and liquefaction or strain softening of subsurface deposits. Ground rupture is not expected to be a hazard for the project site or associated facilities since near-surface faulting and active faults are not documented within the project site. Liquefaction, which can occur within loose, saturated granular deposits, is not expected to be a hazard for the project site due to the depth to groundwater and the dense conditions in the near surface overburden. Similarly, potential seismic settlement from liquefaction of saturated, deep deposits is not expected based on our understanding of the subsurface conditions.

3 GEOTECHNICAL INVESTIGATION

As previously discussed, a Prefeasibility Study (PFS) level site investigation was completed for the development of the Thacker Pass Project (AMEC, 2011). The study included a site investigation and subsequent geotechnical recommendations including preliminary geotechnical recommendations for the open pit and foundation and earthwork recommendations for the various facilities associated with the project.

The general location of the process plant and individual structures orientated on the various process plant pads have been altered since the PFS was completed. In February and December 2019, NewFields completed geotechnical investigations to assess the geotechnical conditions in the subsurface near the West and East WRSF, Mine Facilities, CGS, Process Plant and CTFS.

In general, sufficient data is available to suitably characterize the subsurface beneath the majority of the site, but additional data may be necessary to confirm conditions beneath the sulfuric acid plant.

The locations of the NewFields 2019 borings and test pits associated with the recent investigation, as well the previous investigation, are shown on **Drawing A050**.

3.1 2019 Field Investigations

A site investigation was completed by AMEC in 2011 based on an initial project site layout (AMEC, 2011). The project elements subsequently changed and as a result, NewFields completed an additional site investigation between February and April 2019, which included 31 boreholes and 29 test pits. A supplementary site investigation was completed within the footprint of the CTFS in December 2019. This program consisted of five boreholes extended to depths of 100 feet and

21 test pits. The boreholes were advanced using a CME-850 track-mounted drill rig, and each borehole was drilled with 4.25-inch diameter hollow stem auger in soil and diamond bit rock coring methods when in bedrock. Eight boreholes were extended to depths of 100 to 150 feet below ground surface (bgs), with the remaining twenty-seven boreholes extended to depths of 30 to 50 feet bgs. Test pits were excavated with a CAT 320E excavator to depths of 7 to 19 feet bgs. NewFields logged the lithologies and characteristics of subsurface materials based on recovery from the driven samples, soil cuttings brought to the surface on the auger flights and excavator buckets and recovered rock core. All boreholes were abandoned in accordance with the Nevada Administrative Code (NAC) 534 for Underground Water and Wells. The geotechnical borings which did not encounter groundwater were abandoned by backfilling the holes with bentonite from the terminal depth to within 20 feet of the ground surface. Boreholes were then backfilled with neat cement grout to the ground surface. Water was encountered in five boreholes, which were subsequently backfilled from terminal depth to the ground surface with a neat cement grout, in accordance with the NAC 534 regulations.

The borehole and test pit logs summarize the results of material classifications and observations made at each borehole or test pit location. These records include drilling or excavation depth, description of each strata encountered, strata delineation, estimates of strata density, and location of samples retained for laboratory analysis. The logs represent our interpretation of the contents of the field logs and the results of the laboratory tests on select field samples. Borehole and test pit as-installed locations and logs are presented in **Appendices B.1** and **B.2**.

Drawing A050 shows the location of the geotechnical investigation completed at the site. The results of NewFields Geotechnical Investigation were presented in a factual report (October 2019) and presented in **Appendix B.3.**

3.2 Laboratory Testing Program

Soil and rock samples obtained during the field investigation were labeled, packaged and transported to the NewFields laboratory in Elko, Nevada where the majority of the soil testing was completed. Bulk samples tested for corrosivity potential were sent to Sunland Analytical Laboratory. Samples obtained from the field investigation were tested for index properties, natural moisture and unit weight, specific gravity of soil solids, moisture content/unit weight relationships, and corrosivity potential. Individual laboratory data sheets are presented in **Appendix C** and summarized in **Table C-1**. The results of the NewFields Laboratory Testing were presented in a factual report (October, 2019) and presented in **Appendix B.3**

Soil classification involved particle size analyses and Atterberg limits which were used to divide soils into groups such that the engineering properties of the soils within each group are similar. Each sample was categorized according to the Unified Soil Classification System (USCS), which is based on the material gradation and plasticity.

3.2.1 Index Properties

The index properties of soils were evaluated by particle size analyses and Atterberg limits tests. Results indicate that the materials encountered were predominantly composed of fine to coarse grained silty sand with varying amounts of gravel particles.

Atterberg limits results indicate the plasticity index (PI) ranges from non-plastic to high plasticity with the majority of fine-grained materials exhibiting non-plastic behavior. Based on the measured gravimetric water content, the majority of the plastic materials are at or below the plastic limit. The samples yielded an average moisture content of 13.5 percent as measured on a dry weight-basis (i.e. geotechnical definition). The apparent specific gravity of soil solids was measured as 2.54.

3.2.2 Moisture Content – Unit Weight Relationship

The relationships between unit weight (density) and moisture content was established for a bulk sample using Proctor compaction test procedure. The modified Proctor test (ASTM D1557) was performed on a bulk test pit sample to determine the maximum dry unit weight and the corresponding optimum moisture content. The sample yielded a maximum dry unit weight of 78.3 pcf and an optimum moisture content of 34.0 percent.

3.2.3 Corrosivity Potential

Laboratory soil resistivity, pH, and water-soluble sulfates and chlorides tests were conducted on soils obtained from select areas to assess their corrosivity potential, and results are presented in **Table 3-1**.

Table 3-1: Results of Corrosivity Testing Potential

Sample	Depth (ft)	Material Type	pH	Resistivity (ohm–cm)	Sulfates (ppm)	Chlorides (ppm)
BH19-12	2.5-6.5	Silty SAND (SM)	7.65	150	691.9	1246.9
BH19-13	7.5-10.5	Silty SAND (SM)	7.88	780	45.5	103.2
BH19-26	10-11.5	SAND (SW-SM) with gravel and silt	7.85	750	295.2	97.2

The average pH of the native soil was approximately 7.8, which is considered mildly alkaline. The measured resistivity ranged from 150 to 750 ohm-cm, which indicates the soil has a high corrosion potential for steel (American Petroleum Institute, 1991). The average measured chlorides ranged from 97 to 1247 parts per million (ppm), which indicates the soil is mildly corrosive to corrosive to steel. The measured water-soluble sulfates in the soil ranged from 46 to 690ppm, which indicates negligible sulfate exposure for concrete (American Concrete Institute, 1994).

3.3 Clay Tailings Assessment

Samples of leached solids (LFilterCake), neutralization solids (NFilterCake), and sulfate salts (Salt) were provided by LNC and transported to the NewFields AMRL/AASHTO accredited laboratory in Elko, Nevada where the material testing was conducted. Select laboratory tests were performed on individual components (LFilterCake, NFilterCake, and Salt) along with testing performed on composite filtercake samples both with and without salt. The composite filtercake samples are identified as the "tailings" that will be stored in a geomembrane lined facility at the project site. The results of NewFields Tailings Assessment were presented in a Technical Memorandum, TM-07 (December 2019) and are presented in **Appendix C.6.**

The tailings with salt samples were reconstituted at a ratio of 64.1 percent LFilterCake, 17.3 percent NFilterCake, and 18.6 percent Salt, as measured by dry weight. The salts were hydrated with 11.1 percent tap water prior to reconstitution with the tailings. The tailings without salt samples were reconstituted at a ratio of 78.7 percent LFilterCake and 21.3 percent NFilterCake, as measured by dry weight.

It should be noted that all moisture contents presented in this memorandum were completed as per ASTM D2216 and are reported on a dry basis (Weight of water/Weight of dry solids) as this is the common reporting practice for geotechnical reporting.

Index testing included moisture content and Atterberg limits testing, which were used to assess the relationship between as-received moisture and the materials plasticity. Moisture content – unit weight relationships were developed from bulk samples of tailings, both with and without salt. Strength properties of tailings are estimated based upon Unconsolidated Undrained (UU) and Consolidated Undrained (CU) triaxial testing. This laboratory testing program included:

- Atterberg Limits (ASTM D4318)
- Natural Moisture Content (ASTM D2216)
- Modified Proctor Moisture – Unit Weight Relationship (ASTM D1557)
- Unconsolidated Undrained Triaxial Compression (ASTM D2850)
- Consolidated Undrained Triaxial Compression (ASTM D4767)

Individual laboratory testing results for the clay tailings are summarized in **Tables 3-2**, **3-3** and **3-4.** Individual laboratory data sheets are presented in **Appendix C.7.**

3.3.1 Clay Tailings Index Property Testing

The index properties of the materials were evaluated by particle size analysis, moisture content and Atterberg limits testing. The Atterberg limits test was used to measure the moisture content of the upper and lower limits of the range in which the soil is in the plastic state and are only performed on the soil fraction passing the No. 40 sieve (0.42 mm). The moisture content at the upper limit is known as the liquid limit (LL) and the moisture content at the lower limit is designated as the plastic limit (PL). The numerical difference between the LL and the PL, termed the plasticity index (PI), is a measure of the soil plasticity. Generally, soils that exhibit a PI between 5 and 10 are low plasticity, between 10 and 20 correlate to medium plasticity and between 20 and 40 correlate to high plasticity. Particle size analysis and Atterberg limits results indicate that the materials classify as an elastic silt (MH) with varying amounts of fine sand and medium plasticity.

Samples of the individual components were preserved at their as-received moisture content by double sealing bulk samples in airtight plastic bags and storing in sealed buckets. Gravimetric moisture contents for all samples tested ranged between 55 and 75-percent. Most materials had a moisture content above their LL, with the exception of the tailings material without salt.

Table 3-2: RESULTS OF LABORATORY INDEX TESTING

Material	Liquid Limit	Plastic Limit	Plasticity Index	As-Received Moisture Content
LFilterCake	53	40	13	55.7
NFilterCake	64	47	18	68.5
Salt	-	-	-	74.1
Tailings w/Salt	51	40	11	60.9
Tailings w/out Salt	71	59	12	59.3

3.3.2 Clay Tailings Laboratory Compaction Testing

Two moisture-unit weight relationship tests using the modified Proctor method (ASTM D1557) were completed on bulk samples of tailings, one without salt and one with salt. The samples yielded maximum dry unit weights ranging from 70 to 72 pounds per cubic foot (pcf) and optimum moisture contents (OMCs) ranging from 45 to 46 percent. In general, the sample with salt yielded a higher dry unit weight and lower moisture content.

Table 3-3: Results of Laboratory Compaction Testing

Material	Laboratory Compaction	
	Maximum Dry Unit Weight (pcf)	Optimum Moisture Content (%)
Tailings w/out Salt	70.1	46.0

Tailings with Salt	72.4	45.3

3.3.3 Clay Tailings Shear Strength

The shear strength of remolded tailings samples were measured by triaxial compression testing under isotropic Unconsolidated Undrained (UU) and Consolidated Undrained (CU) conditions. A bulk sample of tailings without salt was air dried to the OMC and six individual specimens were selected. Three of the tailings specimens were mixed with the salt and three were kept without salt. A second bulk sample of tailings was air dried to three percent over OMC and two tailings specimens were reconstituted with salt. All eight of these tailings specimens were then remolded at 95 percent of the maximum dry unit weight into 2.8-inch diameter by 5.6-inch tall test specimens.

The UU samples were confined at 25 pounds per square inch (psi) during testing while the CU samples were backpressure saturated and consolidated at 25 and 50 psi, respectively. Mohr-Coulomb strength parameters were developed from the test measurements as shown in **Table 3 - 4**. Consolidated, drained parameters (effective stress) were calculated by subtracting the measured internal pore pressure from the chamber and axial applied stresses.

Table 3-4: Shear Strength Properties

Material	Dry Unit Weight (pcf)	Moisture Content (%)	CU Triaxial Testing				UU Triaxial Testing
			Effective Stress		Total Stress		Undrained Shear Strength (psf)
			Friction Angle (degrees)	Cohesion (psf)	Friction Angle (degrees)	Cohesion (psf)	
Tailings	66.6	45	40	65	19	400	6300
Tailings + Salt	68.8	45	40	180	20	390	700
Tailings+ Salt	66.6	54	42	0	22	0	-

3.4 Coarse Gangue Stockpile Assessment

A sample of Coarse Gangue Stockpile (CGS) material was provided by LNC and transported to the NewFields AMRL/AASHTO accredited laboratory in Elko, Nevada for testing. Select laboratory testing was performed on this sample to obtain engineering parameters for the CGS stability analysis presented in **Appendix D.3**. The laboratory testing program for this sample included:

- Grain Size Distribution (ASTM D422)
- Atterberg Limits (ASTM D4318)
- Direct Shear (ASTM D3080)

Laboratory testing results and individual data sheets for the CGS material are located in **Appendix C.8**.

4 GROWTH MEDIA STRIPPING AND STOCKPILES

Growth media consisting of soils and alluvium will be salvaged from the footprint of proposed disturbances during initial construction and throughput the Project area as mining progresses. Where present, growth media will be stripped and stockpiled for use in future reclamation and closure activities. Growth media will be stockpiled in three major stockpiles.

Growth media stockpiles will be constructed with slopes no steeper than 3H:1V. LNC will implement measures to mitigate erosion, weathering, and leaching of salts and nutrients during storage of growth media. LNC will seed the growth media stockpiles if necessary to create a temporary vegetative cover, which binds the soil and limits loss due to wind and water erosion of the stockpile to avoid increased sediment concentration in surface runoff. All stockpile areas will be constructed with erosion control measures to reduce sediment from leaving the stockpile site.

5 CLAY TAILINGS FILTER STACK (CTFS)

Lithium processing will produce tailings comprised of acid leach filter cake (clay material), neutralization filter cake, magnesium sulfate salt and sodium/potassium sulfate salts, collectively referred to as clay tailings. LNC proposes to place the clay tailings in the CTFS, which will be a permanent lined storage facility, located east of the process plant.

LNC will convey tailings material from the tailings filter press located in the filtration and neutralization building at the process plant to the CTFS. Clay tailings and the collective salt wastes will be transported via two separate conveyors from the process plant and will form two distinct stockpiles within the CTFS footprint. Material from these temporary stockpiles will be placed on the CTFS in conformance with the stacking plan. The conveyor system will be able to transport an average of 500 dry tons per hour during initial production with a potential to increase if required.

Approximately 70 M CY of clay tailings will be placed on the CTFS. The CTFS will be constructed with a structural zone in the exterior of the facility and a non-structural zone in the interior. An interior non-structural zone will be constructed with layers of tailings and salts compacted at 85% of Modified Maximum Dry Density (MMDD) as determined by ASTM D1557. Surrounding this core, a structural zone will be constructed at 95% compaction of MMDD and with 4H:1V sideslopes. The structural zone will be stacked against the nonstructural zone at a slope of 1H:1V with a 3 feet thick chimney drain between them that extends from the overliner layer to the surface. The chimney drain will consist primarily of sands and gravels to provide a hydraulic break between the two zones to dissipate potential pore pressure. The CTFS will be fully lined with an

HDPE geomembrane and underlain with a six-inch liner bedding material. The facility will include an underdrain seepage collection system between the geomembrane and the clay tailings, which will allow seepage water and stormwater to drain to the reclaim pond.

5.1 Mass Grading

The CTFS mass grading will generally follow the native ground that slopes from northwest to southeast at slopes ranging between three and six percent with an average slope of around 3.5 percent. Most of the fill will be placed in the natural drainages that traverse the site and for the perimeter roads around the facility. Most of the cut is in the channels, the Reclaim Pond and along ridgelines across the facility. Drawing A070 shows isopach shading indicating the cut and fill thicknesses of the CTFS and the north and west diversion channels.

The perimeter access road around the CTFS is 32 feet wide with 2.5H:1V slopes. The perimeter haul road is 128 feet wide with 2.5H:1V slopes. The throughway is 80 feet wide with six-foot-high safety berms along fill areas. The road is a minimum five feet high as measured from the inside toe and crest and is sloped inwards towards the pad at two percent as shown on Drawing A107.

Cell divider berms located in the interior of the CTFS are there to separate the facility into stages and maintain containment of stormwater runoff solution in the event of a significant storm event. The cell divider berms are made of common fill approximately 4.5 feet high and rounded for an approximate total width of 34 feet wide. They extend from the north perimeter berm to the south channel with the exception of the divider berm between Cell 1 and Cell 2 which at a natural ridgeline that can be used as a divider berm. Drawings A215 and A216 show the cell divider berm sections.

After the major cut and fills within the facility are completed, the upper 6-inches of the exposed fill or cut surface shall be scarified, moisture conditioned and compacted to provide a liner bedding for the geomembrane. If the existing ground is rocky and does not consist of fine-grained materials smaller than 3/4-inch then material will have to borrowed and placed over the rocky surface.

5.2 Liner System

The CTFS has been designed with a single liner system consisting of 80-mil HDPE double-sided textured geomembrane layer over top of the liner bedding layer.

5.2.1 Liner Bedding

The liner bedding will consist primarily of insitu or borrowed fined grained materials moisture conditioned and compacted to form a smooth firm surface for which to place the geomembrane. Laboratory testing will be performed on liner bedding samples prior to (Control tests) and during construction (Record tests). In-situ moisture/density tests will be completed to assure conformance to the specifications as outlined in **Appendix F**.

The HDPE geomembrane will be textured on both sides to increase the frictional resistance between the liner bedding and overliner materials that will be in contact with the geomembrane. Geomembrane materials will be subjected to testing at the plant site by the manufacturer as well as conformance testing performed by a third-party laboratory to ensure quality. During installation, the liner will be subjected to a QA/QC testing and inspection program as outlined in the Technical Specifications included in **Appendix F**.

A QA/QC program will be implemented during installation to ensure that the geomembrane is installed according to the manufacturer's recommendations, to monitor the integrity of the seams; and to ensure that the minimum thickness of the overlying cover materials (overliner) is maintained.

5.3 Underdrain System

Precipitation that falls upon the CTFS will seep through the tailings and be collected by the underdrain system and directed to the Reclaim Pond. A seepage calculation was completed which showed a maximum seepage rate of up to 74 gpm could flow to the Reclaim Pond at ultimate facility buildout as a result of tailings consolidation. The seepage calculation is presented in **Appendix E**. The underdrain system consists of a network of collection pipes placed on top of the geomembrane and a layer of overliner material placed over the pipes. No solution will be applied to the CTFS other than for periodic surface dust suppression; therefore, the only fluid collected by the underdrain system will be stormwater, natural infiltration or pore water squeezed out of tailings due to long-term consolidation of the tailings material. The facility is divided into six cells of similar size for permanent placement of tailings plus one cell in the southwest corner used for temporary clay tailings and salt stockpiles but the underdrain systems for all the cells are connected.

5.3.1 Solution Collection Piping System

The solution collection piping system will consist of four-inch diameter dual wall smooth interior perforated corrugated polyethylene (CPe) (ADS N-12 equivalent) secondary collection pipes located on the geomembrane and spaced 200 feet apart in a herringbone pattern. The secondary collection pipes drain to a 12-inch diameter dual wall smooth interior perforated (CPe) (ADS N-12 equivalent) collection header pipe situated in the topographic low points of each cell in the CTFS as shown on Drawing A210. The collection header pipes connect into a 12-inch diameter dual wall smooth interior perforated CPe pipe that runs along the channel on the south side of the CTFS. At the CTFS solution outlet channel the 12-inch dual walled perforated CPe pipe connects to a solid 12-inch diameter HDPE DR 17 underdrain outlet pipe which will convey flow into a Parshall Flume for measuring the seepage flow rate and then into the CTFS Reclaim Pond as shown on Drawing A222.

5.3.2 CTFS Stormwater Overflow Pipes

Seven 36-inch diameter HDPE DR 17 stormwater overflow pipes are located at the CTFS Solution Outlet Channel approximately 24 inches above the invert of the 12-inch diameter underdrain outlet pipe. These pipes are designed to convey the CTFS stormwater runoff during a 100-year/24-hour storm event under the haul road and into the CTFS Solution Outlet Channel, which then drains into the Reclaim Pond.

5.3.3 Overliner

The Overliner layer consists of a 24-inch thick drainage medium consisting of minus 1.5-inch sand and gravel mixture that covers the surface of the HLP as shown on Drawings A215 and A216. This single layer will provide protection to the geomembrane during tailings placement and will have a high transmissivity to promote lateral drainage of seepage and stormwater runoff from the CTFS. Overliner will initially be processed from native soils on site and later the coarse gangue stockpile can be used as an overliner source as the material will consist of washed sands.

5.3.4 Chimney Drain

A chimney drain was designed to separate the tailings in the structural zone from the non-structural zone. The non-structural zone will consist primarily of salts and also contain tailings with elevated moisture contents due to weather or upset conditions in the process plant. The chimney drain will consist primarily of sand and serve as a hydraulic break to relieve potential pore pressure built up between the two zones. Piezometers will be installed on either side of the chimney drain to monitor pore pressures in each zone as shown on Drawings A400 and A410.

5.4 Reclaim Pond

Stormwater collected by the underdrain system will be directed to the Reclaim Pond. The pond is a double geomembrane lined pond with an operating capacity of 9.2 million gallons, can store a 100-year, 24-hour storm event runoff volume of 17.8 million gallons and has 3.6 million gallons of storage available in the top 3 feet of freeboard. The total pond volume to the crest is 30.6 million gallons.

The reclaim pond will be double lined with a 60-mil HDPE double-sided textured geomembrane liner on bottom overlain by a 200-mil thick layer of geonet and an 80-mil HDPE double-sided textured geomembrane liner above the geonet. Water collected in the pond will not be discharged as part of the stormwater management. The water will be pumped to the processing plant to be used as make-up water for processing operations or will evaporate. The pond will be equipped with a leak detection and recovery system consisting of a collection sump between the two liners and a riser pipe laid along one of the slopes, providing access for monitoring and recovering any leakage through the primary liner.

5.4.1 Leak Collection and Recovery System

Stormwater collected by the underdrain system will be directed to the Reclaim Pond. The Reclaim Pond has a sump located in the southeast corner. The sump is a total of five feet deep with the lower 2 feet of the sump being the leak collection and recovery sump (LCRS) and the upper 3 feet serving as the pond surface water sump. The LCRS is between the primary and secondary geomembranes and the pond surface water sump is located above the primary geomembrane. The LCRS has bottom dimensions of ten feet by ten feet with 2.5H:1V slopes and has select gravel wrapped in geotextile on top of the secondary geomembrane. A 12-inch diameter HDPE DR 21 pipe with slots cut into the lower ten feet is positioned into the LCRS, which serves as a pump sleeve. A submersible pump will be positioned inside of the pump sleeve and connected to a discharge pipe that will pump leakage from between the layers to the crest of the pond and back onto the primary geomembrane. Drawing A230 shows a section of the LCRS sump.

5.4.2 Pond Pump Back System

The upper three feet of the five-foot-deep CTFS Reclaim Pond sump is a recessed sump above the primary geomembrane that allows the sloping pumpback system to evacuate water out of the pond. The sloping pumpback system is a submersible pump attached to an 8-inch diameter HDPE pipe sleeved inside of an 18-inch diameter HDPE pipe, which serves as a pump sleeve. The pump will pump water out of the pond through the 8-inch pipe back to the Leaching Tanks in the Process Plant if required. The pumpback pipe was designed to pump out 500 gallons per minute. The pump will be designed by the Process Plant designer based on operational preferences. The 18-inch diameter HDPE pipe sleeve will be held down by sheet of 80-mil HDPE liner ballasted with two concrete filled six-inch diameter HDPE pipes. At the crest of the pond the 18-inch diameter HDPE pipe transitions to a flanged stainless-steel pipe that is braced and welded to a steel plate embedded into a six feet wide by six feet long by three feet deep reinforced concrete anchor block. Drawings A235 shows a section of the pond sump and sloping pumpback system.

5.5 Perimeter Haul Road

A perimeter road will be constructed around the CTFS, providing access to and containment of the facility. Along the northern and eastern perimeters of the CTFS, the road will have a crest elevation at least five feet above the top of the geomembrane and a crest width of 32 feet. On the western side of the CTFS, including the area adjacent to the temporary tailings stockpile area, the perimeter road will have a typical crest width of 131 feet (80-ft driving width) and a crest elevation at least eight feet above the top of geomembrane. Along the southern CTFS perimeter, a solution collection channel of varying depth will run along the inside perimeter of the haul road. The CTFS perimeter road in this section will have a crest elevation nine feet above the bottom-of-channel (top of geomembrane) and crest width of 131 feet.

All sections of the CTFS perimeter haul road will be constructed with 2.5H:1V side slopes and safety berms on both sides of the roadway crest. The HDPE double-sided textured geomembrane will be extended from the CTFS base grading, up the inside embankment of the road, and will be anchored into the roadway crest on the embankment-side of the CTFS-side safety berm. Wearing course will consist of an 18-inch thick layer on the haul road surface and a six-inch thick layer on the access road surface.

5.6 CTFS Diversion Channels

Two diversion channels were designed to the north and west of the CTFS to divert stormwater runoff of undisturbed areas around the facility. The stormwater diversions are designed with a maximum 2.5H:1V cut and fill slopes and can convey stormwater runoff from a 500-year/24-hour storm event. The diversion channel varies from 30 feet to 60 feet in width and 2.5H:1V slopes as defined on Drawing A311. There are three culvert crossings designed for the CTFS West Diversion Channel. One is for haul truck traffic entering into the CTFS and the other two are for conveyor crossings from the Process Plant for the clay tailings stockpile and the salt stockpile. A layout of the conveyor crossings is shown on Drawing A305. The channel armoring requirements are shown on Drawing A310.

The CTFS North Diversion Channel is approximately 80 feet wide with 2.5H:1V slopes and diverts water around to the east side of the CTFS. The riprap requirements for the channel are shown on Drawing A313.

The hydrology calculations for each stormwater diversion are provided in **Appendix E**.

6 COARSE GANGUE STOCKPILE (CGS)

Coarse gangue is produced in the classification stage of the mineral processing and is conveyed into the CGS after going through a dewatering process. LNC will convey the coarse gangue material to the CGS located east of the open pit. The gangue material will include lithium content whose economic value cannot be extracted at this time with a rate of return meeting LNC’s criteria, using the proposed technique.

The CGS will be placed above existing ground that has been stripped of one foot of growth media. The stripped growth media will be placed in the growth media stockpile. The coarse gangue material will be placed directly onto prepared subgrade. The stockpile is expected to accommodate approximately 26M CY of material during the first 10 years of operation, and with the ability to expand. The design basis, calculations, design drawings and specifications for the coarse gangue stockpile are included in **Appendix A.**

The CGS is currently conservatively designed per a stacking plan provided by LNC with 50 ft lift heights and 75.5 ft benches graded between each lift to provide an overall stacking slope of 5.5H:1V and intermediate lift slopes of 4H:1V as shown on Drawing C135. Additional stability analysis completed by NewFields show that the coarse gangue sand stockpile can be stacked to 3H:1V slopes and still meet the minimum stability factor of safety if the sands are adequately dewatered during the classification process. Additional strength testing of the coarse gangue material will be conducted during operations and side slope requirements may change in the future. Geochemistry and transport analysis completed by SRK and Piteau shows that the CGS does not require a liner at the foundation.

6.1 CGS Sediment Pond

Stormwater runoff from the CGS will drain to the low point on the south side of the facility and through two 54-inch diameter corrugated metal pipes (CM) into the CGS Sediment Pond as shown on drawing C135.

The CGS Sediment Pond is designed to contain runoff from a 2-year/24-hour storm event and slowly drain over a period of three days through the perforations in the 42-inch diameter HDPE DR 17 riser pipe. Runoff from storm events up to 25-year/24-hour can flow out the top opening of the riser pipe, which has steel mesh over it to keep potential debris from getting lodged inside. The sediment pond is designed to store two feet of sediment and have three feet of freeboard above the spillway invert. Storm events greater than 25-year/24-hour and up to 100-year storm events will drain out of the overflow spillway into the CTFS West Diversion Channel. The peak flow from a 100-year/24-hour storm event can pass through the spillway with one foot of freeboard to the crest of the pond. Drawing C140 shows the layout of the CGS Sediment Pond. Sediment will be removed from the facility once the sediment design capacity has been reached.

Riprap is installed at the inlet and outlets of the sediment pond. The riprap size and thickness is shown on Drawing C140. A layer of non-woven geotextile will be installed beneath all riprap.

7 WASTE ROCK STORAGE FACILITIES (WRSF)

Waste rock material generated from the open pit mining operation will be placed in two proposed WRSFs, located west and east of the pit as shown on Drawing C010. LNC plans to haul waste rock to either WRSF based on operational requirements such as capacity and haul cycle efficiency. The Thacker Pass waste rock and ore have a low potential for acid generation, according to the results of the static testing (NPR greater than 3 for all material types) and confirmed with the kinetic testing program. For this reason, the WRSFs were designed as unlined facilities. The design criteria for the WRSFs is included in **Appendix A** and the stability analysis evaluation is included in Appendix D. Calculations for the sediment ponds are included in **Appendix E**.

7.1 West WRSF

The West WRSF area is 160 acres and is designed with a storage capacity of 26.4M CY at 3.5H:1V slopes. The maximum thickness is 275 feet and the existing topography at the base slopes from north to southwest.

Waste rock will be placed in the West WRSF during of the initial stages of mine operation and will shift later to the East WRSF once it has reached maximum capacity. The WRSF facility will be placed above existing ground that has been stripped of one foot of growth media. The stripped growth media will be placed in the growth media stockpile.

7.1.1 West WRSF Sediment Pond

Stormwater runoff from the West WRSF will drain to the low point in the southwest corner of the facility into the West WRSF Sediment Pond as shown on drawing C105.

The north half of the West WRSF Sediment Pond is in cut and the south half is in fill. The south embankment is 15ft wide with upstream and downstream slopes at 2.5H:1V. The cut slopes on the north side of the pond are at 2.5H:1V. The pond is designed to contain runoff from a 100-year/24-hour storm event to reduce the potential for stormwater runoff in disturbed areas from flowing into Thacker Creek, which is located approximately 2,000 feet to the southwest. The sediment pond is designed to store two feet of sediment and have three feet of freeboard above the spillway invert. Storm events greater than the 100-year/24-hour storm events will drain out of the overflow spillway onto natural ground. The peak flow from a 500-year/24-hour storm event can pass through the spillway with one foot of freeboard to the crest of the pond. Drawing C110 shows the layout of the West WRSF Sediment Pond.

Water draining into the pond will be left to evaporate or infiltrate into the ground. A submersible pump can also be used to pump out water within the pond as well. Sediment will be removed from the facility once the sediment design capacity has been reached.

Riprap is installed at the inlet and outlet of the sediment pond. The riprap size and thickness are shown on Drawing C110. A layer of non-woven geotextile will be installed beneath all riprap.

7.2 East WRSF

The East WRSF area is 137 acres and is designed with a storage capacity of 5.8 M CY at 3.5H:1V slopes with potential to expand. The maximum design thickness is 75 feet and the existing topography at the base slopes from northwest to southeast.

Based on the current mining plan the waste rock from the pit will be placed in the East WRSF during the later stages of mine operation after the West WRSF has reached maximum capacity. The WRSF facility will be placed above existing ground that has been stripped of one foot of topsoil. The stripped topsoil will be placed in the growth media stockpile.

7.2.1 East WRSF Sediment Pond

Stormwater runoff from the East WRSF will drain to the low point in the south corner of the facility into the East WRSF Sediment Pond as shown on drawing C120.

The northern portion of the East WRSF Sediment Pond is in cut and the southern portion is in fill, which ties into the crest of the haul road. The south embankment is a minimum of 15ft wide with upstream and downstream slopes at 2.5H:1V. The cut slopes on the north side of the pond are at 2.5H:1V.

The East WRSF Sediment Pond is designed to contain runoff from a 2-year/24-hour storm event and slowly drain over a period of three days through the perforations in the 36-inch diameter HDPE DR 11 riser pipe. Runoff from storm events up to 25-year/24-hour can flow out the top opening of the riser pipe, which has steel mesh over it to keep potential debris from getting lodged inside. The sediment pond is designed to store two feet of sediment and have three feet of freeboard above the spillway invert. Flows greater than those generated by 25-year/24-hr storm event will drain out of the overflow spillway, across the haul road and into a natural drainage. The peak flow from a 100-year/24-hour storm event can pass through the spillway with one foot of freeboard to the crest of the pond. Drawing C125 shows the layout of the East WRSF Sediment Pond. Sediment will be removed from the facility once the sediment design capacity has been reached.

Riprap is installed at the inlet and outlets of the sediment pond. The riprap size and thickness are shown on Drawing C125. A layer of non-woven geotextile will be installed beneath all riprap.

8 MINE FACILITIES

The mine facilities that are being designed by others will be located southeast of the mine pit as shown in the **Drawings** and will be accessed via the mine facilities access road from SR 293. The main mine facilities area consists of a parking lot, shop/office building, fuel island, wash bay, tire pad and storage area, substation, and ready line.

The ROM stockpile and two of the three growth media stockpiles will be located within the mine facilities area as well, east of the main mine facilities. LNC will haul ore recovered from open pit operation to the ROM stockpile located south of the pit. LNC proposes to construct and operate mineral processing facilities in the attrition scrubbing and classification areas to separate the lithium-rich, fine clay material from the coarse gangue.

8.1 Mining Roads

Mine access and haul roads have been designed to provide access to from the pit to the Mine Facilities Area. The access roads are designed for small equipment traffic and haul roads are designed for large haul truck traffic and other support equipment. Numerous culverts have been designed around the mine facilities area as shown on Drawing 002. The culvert summary shown on Drawing CULV01 provides the drainage area, flow rate, culvert length, elevations, slope, diameter, and number of culverts in the Mine Facilities area. The hydrology calculations for each culvert are provided in Appendix E.

8.2 Mine Stormwater Diversions

Stormwater diversion channels and berms have been designed to direct stormwater runoff from undisturbed areas around the Mine Facilities and to direct stormwater runoff from disturbed areas into the sediment ponds. The stormwater diversions are designed with 3H:1V cut and fill slopes and can convey stormwater runoff from a 100-year/24-hour storm event. A layout of the diversion channels and berms in the Mine Facilities area is shown on Drawing 002. The diversion channel characteristics such as peak flow rate, dimensions, slope, velocity, riprap size and thickness are included in their respective drawings in the Mine Surface Water Control Features drawing set. The hydrology calculations for each stormwater diversion are provided in **Appendix E**.

8.3 Mine Facilities Sediment Ponds

Three sediment ponds were designed for the mine facilities area: Facility Sediment Pond #1, Facility Sediment Pond #2 and Mine Sediment Pond #1. The cut and fill slopes for each facility are 3H:1V for the pond area and the spillway side slopes are at 4H:1V. The southern portion of the facilities are in fill and the northern portions are in cut. The embankment crest widths are 15 feet wide. All of the sediment ponds are designed to contain runoff from a 2-year/24-hour storm event and slowly drain over a period of three days through the perforations in the 36-inch diameter HDPE riser pipe. Runoff from storm events up to 25-year/24-hour can flow out the top opening of the riser pipe, which has steel mesh over it to keep potential debris from getting lodged inside. Flows greater than those generated by a 25-year/24-hr storm event will drain out of the overflow spillway into the natural drainages. The peak flow from a 100-year/24-hour storm event can pass through the spillway with at least one foot of freeboard to the crest of the pond. Drawing 002 shows the location of each of the sediment ponds. Sediment will be removed from the pond basins once the sediment design capacity has been reached.

8.3.1 Facility Sediment Pond #1

Stormwater runoff from the west end of the mine shop/office facility area and the area directly south of the pit will drain into Facility Sediment Pond #1. A diversion channel to the north of the pond and a diversion berm to the east of the pond direct stormwater runoff into the pond. The sediment pond was designed to store three feet of sediment and has three feet of freeboard above the spillway invert. The peak flow from a 100-year/24-hour storm event can pass through the spillway with a minimum of one foot of freeboard to the crest of the pond. Riprap is installed at the inlets and riser pipe outlet of the sediment pond. The pond water elevations, volumes, riprap size and thickness are shown on Drawing FP1-2. A layer of non-woven geotextile will be installed beneath all riprap.

8.3.2 Facility Sediment Pond #2

Stormwater runoff from the eastern portion of the mine shop/ office facility area, ROM Stockpile and Scrubber Pad will drain into Facility Sediment Pond #2. A diversion channel to the west of the pond and a diversion berm to the north of the pond will direct stormwater runoff into the pond. The sediment pond was designed to store three feet of sediment and has 2.5 feet of freeboard above the spillway invert. The peak flow from a 100-year/24-hour storm event can pass through the spillway with a minimum of one foot of freeboard to the crest of the pond. The pond water elevations, volumes, riprap size and thickness are shown on Drawing FP2-2. A layer of non-woven geotextile will be installed beneath all riprap.

8.3.3 Mine Sediment Pond #1

Stormwater runoff from the northeastern portion of the Pit and newly constructed haul roads will drain into the Mine Sediment Pond #1. The sediment pond is located in a natural drainage and was designed to store four feet of sediment and has 3.5 feet of freeboard above the spillway invert. The peak flow from a 100-year/24-hour storm event can pass through the spillway with a minimum of one foot of freeboard to the crest of the pond. Riprap is installed at the inlets and outlets of the sediment pond. The pond water elevations, volumes, riprap size and thickness are shown on Drawing MP1-3. A layer of non-woven geotextile will be installed beneath all riprap.

9 PROCESS PLANT

The Process Plant is designed by others and will be located south of the CGS and west of the CTFS as shown on Drawing A010 and will be accessed via two separate roads from SR 293. One entrance will be for reagent delivery trucks and the other entrance will be for all others. The Process Plant will process lithium rich fine clay and produce clay tailings and sulfate salts, which will be conveyed to the temporary stockpile area at the CTFS. The lithium carbonate and lithium hydroxide will be sold as concentrate.

9.1 Process Plant Entrance Roads

The Process Plant entrance roads are separated to keep reagent truck traffic separated from all other traffic at the process plant. While the roads have separate entrances at SR 293, they come together when crossing the main natural drainage south of the Process Plant as shown on Drawing A010. Culverts were designed along the entrance road to pass the runoff from a 25-year/24-hour storm event. For larger storm events, water will flow over the road.

There are three areas where culverts were designed along the entrance road. The largest is just north of SR293 where the road crosses the main drainage south of the site. Seven 60-inch diameter culverts are required to convey water under the road. The downstream slope of the road has riprap for erosion protection for larger storm events where water will flow over the road. A layout of the drainage crossing is presented on Drawing A324.

Hydrology and Hydraulic calculations for the culverts and the watershed map is provided in **Appendix E.**

9.2 Process Plant Sediment Pond

The Process Plant Sediment Pond is located in a natural drainage southeast of the Process Plant. The sediment pond is designed to contain runoff from a 2-year/24-hour storm event and slowly drain over a period of three days through the perforations in the 24-inch diameter HDPE riser pipe. Runoff from storm events up to 25-year/24-hour can flow out the top opening of the riser pipe, which has steel mesh over it to keep potential debris from getting lodged inside. Storm events greater than 25-year/24-hour frequency will drain out of the overflow spillway into the natural drainages. The peak flow from a 100-year/24-hour storm event can pass through the spillway with a minimum of one foot of freeboard to the crest of the pond. Drawing A300 shows the layout of the sediment pond. Sediment will be removed from the pond basin once the design capacity has been reached.

The sediment pond was designed to store two feet of sediment and has two feet of freeboard above the spillway invert. Riprap is installed at the inlets and riser pipe outlet of the sediment pond. The pond water elevations, volumes, riprap size and thickness are shown on Drawing A300. A layer of non-woven geotextile will be installed beneath all riprap.

10 GEOTECHNICAL EVALUATION

This section summarizes our geotechnical recommendations based on the proposed construction and subsurface conditions encountered beneath the CTFS, CGS, WRSF, and Process Plant. Design parameters and a discussion of geotechnical considerations related to construction of the various components of these facilities are included herein.

At this time, information regarding the Process Plant building types, foundation types and structural loads are not available. All recommendations provided herein are preliminary and will be revised when further information becomes available.

10.1 Plant Foundation Recommendations

The results of NewFields Process Plant Site Soil and Foundation Report were presented in a summary report (November 2019) that is included in **Appendix D.1.**

10.2 CTFS, CGS, and WRSF Stability Assessments

The results of the stability analyses for the CTFS, CGS, and WRSF are presented in the following subsections along with descriptions of the material properties and seismic parameters used in the stability models. The results of NewFields Stability Assessments were presented in a Technical Memorandum, TM-08 (January 2020) and TM-09 (February 2020) and are included in **Appendices D.2 and D.3.**

Stability analyses were performed using the computer program SLIDE v8 by RocScience. SLIDE is a two-dimensional slope stability program for evaluating circular or noncircular failure surfaces in soil or rock slopes using limit equilibrium methods. The Spencer's method, which is appropriate for all slope geometries and soil profiles, was utilized within the stability model and assumes all interslice forces are parallel and have the same inclination. The factor of safety can be defined generally as the resisting forces along a potential failure plane divided by the gravitational and dynamic driving forces. Both static and seismic conditions were analyzed.

In July 2019, NewFields completed a deterministic seismic hazard analysis of the Thacker Pass site, which is presented in **Appendix D.4**. The analysis involved review of regional geology and using the unified hazard tool software program from USGS to determine site classification and peak ground acceleration. The corresponding PGA for the 475-year (OBE) and 2,475-year (MDE) events are 0.09g and 0.26g, respectively. Based on these seismic hazard parameters, and the Hynes-Griffin and Franklin analytical method, a reduced pseudostatic seismic coefficient of 0.13g (one-half of the PGA) is valid and was used to evaluate for post closure pseudostatic conditions.

To assess the stability of slopes during seismic loadings, a pseudostatic approach was used where the potential slide mass is subjected to an additional, destabilizing horizontal force which represents the effect of earthquake motions and is directly related to the PGA. Very simply, the seismic force is the weight of the slide mass multiplied by a horizontal pseudostatic earthquake coefficient (k_H). Since the earthquake motion is not a constant, horizontal destabilizing force, using the full PGA for k_H has been shown to be overly conservative. Hynes-Griffin and Franklin (1984) discussed the concept that using one-half of the PGA for the horizontal pseudostatic earthquake coefficient more closely simulates actual earthquake loading, and with the resulting minimum factor of safety being equal to at least 1.0, slope deformations will be within tolerable limits. Thus, a seismic coefficient equal to one-half the PGA, or 0.13g, was adopted for the pseudostatic stability analyses.

The CTFS, CGS and WRSFs have each been evaluated as an engineered structure and designed as a waste rock storage facility. Minimum acceptable factors of safety for static and pseudostatic conditions were established as 1.3 and 1.05, respectively. The results of the stability analyses are presented in **Appendices D.2** and **D.3.**

10.2.1 Material Properties

Design parameters utilized in the stability evaluations for the CTFS and CGS were conservatively selected based upon laboratory index and strength test data in conjunction with observations from the field investigation and historical experience with similar materials. Design parameters utilized for the stability evaluations for the WRSFs were conservatively selected based upon previous reporting and experience with similar materials. The claystone material is reported by AMEC to have an International Society for Rock Mechanics (ISRM) hardness of S6/R0 and a Rock Quality Designation (RQD) ranging from 0 to 91. This implies that once excavated the material may exhibit engineering behavior similar to a stiff soil rather than a competent or intact rock. The AMEC report also states that the claystone appears to weather and breakdown into a high plastic soil upon exposure to the elements. The engineering parameters for the facility foundations were developed from laboratory index and strength test data in conjunction with observations from the field investigation, previous reporting by others, and historical experience with similar materials.

Material properties used in the stability analysis were based on available laboratory test data and experience with similar materials. Based upon triaxial laboratory testing results, the cohesion within the tailings materials is very sensitive to relatively small changes in moisture contents. For this reason, any effects that cohesion may have on strength have been assumed to be negligible for this stability analysis. It is recommended that long term monitoring and testing be performed to ensure that these assumptions are correct. The material properties used in the stability analyses are summarized in the following paragraphs and in **Table 9-1.**

Table 10-1: Properties Used in the Stability Analyses

Material	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)
Alluvium – Foundation	110	32	0
Drainage Layer	110	35	0
Liner Interface	110	16	0
Non-Structural Tailings	90	16	0
Structural Tailings	100	20	0
Coarse Gangue Material	110	31	0
Waste Rock (Claystone – Clay Soil)	100	18	200

10.2.2 Model Development

Both static and pseudostatic loadings were evaluated for a critical cross section through the ultimate CTFS, CGS and WRSF configurations. This critical location was selected based upon existing topography, proposed grading of the facility foundations (if required) and proposed grading of the facility slopes. The locations of the critical cross sections are presented in **Appendices D.2** and **D.3**. During pseudostatic analysis the tailings material parameters are reduced to account for strain softening during potential deformation.

10.2.3 Stability Analysis Results

Results of the slope stability analyses for the cross sections under consideration are summarized in **Table 10-2** and figures presented in **Appendices D.2** and **D.3**. These figures detail the critical cross section and the failure planes with the lowest factors of safety. Based on this evaluation, the CTFS, CGS and WRSF's will remain stable for static loading conditions. The initial slopes and benches for the East and West WRSF and CGS were provided by North American Mining who is completing the mining plan for LNC. Stability analysis was completed on these facility configurations and it was determined that the slopes used in the design of the East WRSF and CGS may be overly conservative. Since the initial analysis was completed, NewFields completed additional analysis, which shows the East WRSF could be constructed at a steeper slope of 3.5H:1V. Preliminary results also show that 3H:1V slopes are achievable for the coarse gangue stockpile while meeting the minimum factor of safety. Additional samples should be collected during initial operations to determine if steepening the slopes is possible so the facility footprint can be reduced.

Table 10-2: CGS and WRSF Summary of Stability Analysis

Location	Static FoS	Pseudostatic OBE FoS	Pseudostatic MDE FoS
CTFS – Overall Stability	1.3	-	0.7
CGS – Overall Stability (5.5H:1V)	3.6	2.3	2.0
CGS – Inter-Bench Stability (4H:1V)	2.6	1.9	1.7
CGS – Overall Stability (3H:1V)	1.9	1.5	1.3
East WRSF – Overall Stability (5.5H:1V)	2.9	1.7	1.4
East WRSF – Inter-Bench Stability (4H:1V)	2.2	1.5	1.3
West WRSF – Overall Stability (3.5H:1V)	1.3	0.9	0.8

*The current design thickness of the East WRSF is only 75 feet but to allow stable slopes for potential future expansion, the facility will be constructed to the same slope as the West WRSF given the materials will be the same.

Pseudostatic loading conditions indicated that the factor of safety could be less than 1.05 for the CTFS and West WRSF under both the OBE and MDE events and thus a deformation analysis was completed to estimate potential slope movements as presented in **Section 10.2.4**.

10.2.4 Seismic Slope Deformation Analysis

Since the pseudostatic stability evaluation for the CTFS and West WRSF resulted in calculated minimum factors of safety less than 1.05 for the OBE and MDE event, potential seismic deformations of the facility slopes were evaluated using a simplified method. Bray and Travasarou developed a semi-empirical relationship for estimating the magnitude and probability of permanent slope displacements that utilizes a non-linear, fully coupled stick-slip sliding block model to estimate dynamic performance of soil slopes. The response spectrum and moment magnitude of the design earthquake were based on data obtained from the USGS.

Results of the CTFS deformation analysis indicate that for the MDE event, potential slope displacements between 17 to 32 inches could be expected. This estimate is for movement along the entire slope length for the maximum height of 400 feet. It is our professional opinion that these slope movements are acceptable and any potential slope deformation from the MDE seismic event would not result in an excursion of the tailings outside containment.

Results of the WRSF deformation analysis indicate that for the OBE and MDE events potential slope movements between five and 50 inches could be expected. This estimate is for movement along the entire slope length for the maximum thickness of 275 feet. This amount of displacement may cause minor surficial sloughing but will not impact the overall integrity of the facility. Since the West WRSF potential slope movements were acceptable, the same slope was designed for the East WRSF.

11 HAUL AND ACCESS ROADS

LNC will primarily use haul trucks in the Project area for the following activities:

- Movement of ore to the ROM stockpile
- Movement of waste rock material to the WRSFs (during the first years of operation)
- Movement of tailings and salt from the temporary stockpiles to the CTFS.

The haul road maximum gradient will be less than ten percent with an 80-foot road throughway width. Roads will be sloped away from the centerline with the exception of the CTFS perimeter haul roads and have a wearing course thickness of 18 inches. Haul roads in the mine area will be constructed according to MSHA standards. Secondary access roads will be approximately 32 feet in width with a minimum 1.5 percent grade from the centerline and have a wearing course thickness of six inches.

Facility entrance roads off SR293 will be classified as private roads. All site roads will allow for emergency vehicle access minimum requirements. The Process Plant road layout is designed to support the anticipated site traffic for construction, operations and maintenance requirements of the facility. The design considers anticipated vehicle traffic, equipment turning requirements and clearances and ensures access requirements are met.

LNC will construct ditches on the side of roads to capture road runoff as needed. Runoff from haul and secondary roads will be collected and routed to stormwater sediment ponds as needed. Dust control measures used for road grading will include watering before and after grading activities and reduction of equipment speeds during operations, if necessary. Chemical treatment may be used for additional dust suppression.

12 CLOSURE

The Tentative Plan for Permanent Closure (TPPC) is included as **Attachment Q** in the WPCP submittal. The temporary closure plan is included as **Attachment P** of the WPCP submittal; however, no temporary or seasonal closures of the mine are planned during its operation. The following provides a summary of the closure activities described in the TPPC.

Closure and major reclamation activities will occur in the first two years following cessation of mining. Monitoring and maintenance will continue for five years post closure until the final bond release. Post-production reclamation activities will include recontouring, cover placement, placement of growth media, seeding activities, and removal of infrastructure and fluid management.

Throughout the Project's operational phase, concurrent reclamation will occur in areas where final configurations are complete. LNC will begin reclamation activities at the earliest practicable time within areas of the Project that are considered inactive, without potential, or completed. Early initiation of reclamation will stabilize soil, reduce dust, and naturalize runoff.

Earthwork reclamation will ensure that potential visual impacts resulting from development of the proposed Project are minimized. Regraded stockpile slopes will be covered by a layer of growth media. Cover over the clay tailings will include a compacted clay layer overlain with cover soil. This cover soil will consist of coarse gangue or benign pit waste rock with growth media. Growth media will be salvaged from the growth media stockpiles. The proposed reclamation seed mix and application rates are included in **Attachment Q** of the WPCP. The seed mix is designed to provide species that can exist in the environment of northwestern Nevada. The Noxious and Invasive Weed Management Plan, provided in the Plan of Operations, outlines the strategies for proactively preventing noxious and invasive weeds.

In accordance with NAC 445A, the permanent stormwater diversions that will remain during the post-closure period will be designed to handle the 500-year/24-hour design storm event at closure. Regraded slope angles, revegetation (e.g., growth media placement), and BMPs will limit erosion and reduce sediment in runoff. Silt fences, waddles, sediment traps, and other BMPs will help prevent migration of eroded material until reclaimed slopes and exposed surfaces have demonstrated erosional stability.

In general, facility reclamation practices will include decommissioning, demolition, waste removal, backfilling, regrading, placing growth media, and revegetating Project facility areas.

Reclamation efforts will occur on both an interim and, whenever possible, concurrent basis throughout the Project's operational phase. Specific reclamation activities for the main Project infrastructure are further described in **Attachment Q** of the WPCP.

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DRAWINGS

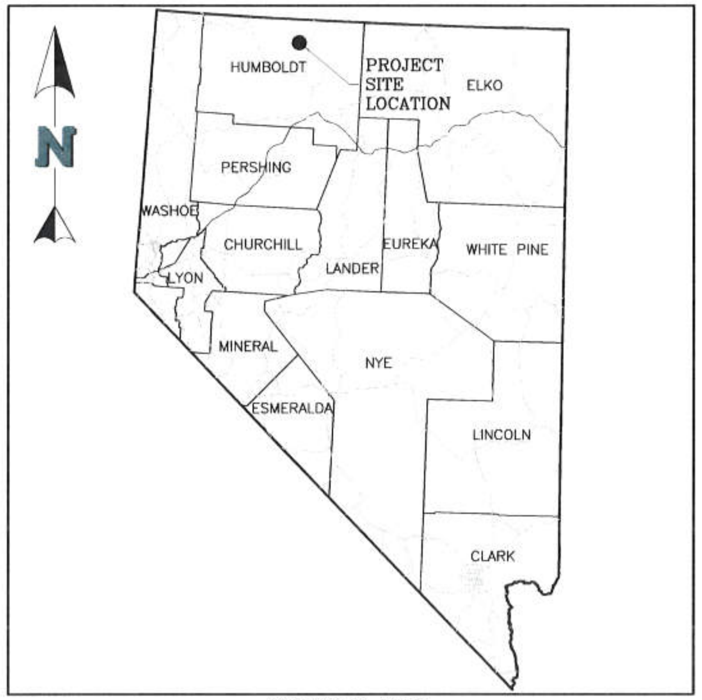
DRAWINGS

NewFields A-Series

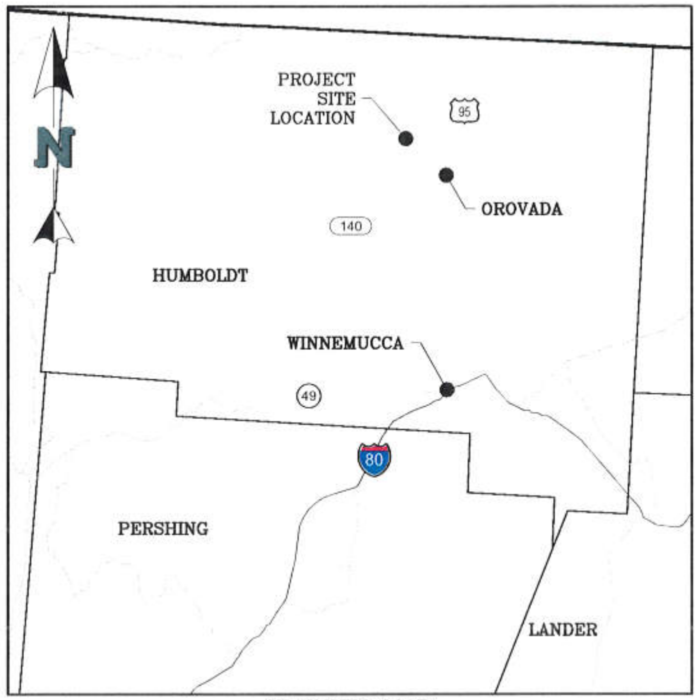
Clay Tailings Filter Stack and Process Plant Stormwater

LITHIUM NEVADA CORP.
THACKER PASS PROJECT
CLAY TAILINGS FILTER STACK AND PROCESS PLANT STORMWATER

ISSUED FOR CONSTRUCTION
APRIL 02, 2020



COUNTY MAP



VICINITY MAP

DWG NO.	DRAWING TITLE	REV
A000	COVER SHEET, INDEX AND VICINITY MAP	0
	PROJECT LAYOUT AND GENERAL EARTHWORKS	
A010	GENERAL PROJECT LAYOUT	0
A050	GEOTECHNICAL INVESTIGATION PLAN	0
A060	CTFS LAYOUT	0
A070	CTFS ISOPACH	0
A100	CTFS STACKED FACILITY LAYOUT	0
A105	TYPICAL STACKING SECTIONS	0
A106	CTFS FACILITY SECTIONS (SHEET 1 OF 2)	0
A107	CTFS FACILITY SECTIONS (SHEET 2 OF 2)	0
A120	PERIMETER ROAD PLAN	0
A125	PERIMETER ROAD PLAN AND PROFILE (SHEET 1 OF 4)	0
A130	PERIMETER ROAD PLAN AND PROFILE (SHEET 2 OF 4)	0
A131	PERIMETER ROAD PLAN AND PROFILE (SHEET 3 OF 4)	0
A132	PERIMETER ROAD PLAN AND PROFILE (SHEET 4 OF 4)	0
A150	TEMPORARY STOCKPILE AREA PLAN	0
A152	CLAY TAILINGS STOCKPILE CONVEYOR CORRIDOR PLAN & PROFILE	0
A154	SALT STOCKPILE CONVEYOR CORRIDOR PLAN & PROFILE	0
	UNDERDRAIN CONVEYANCE AND SOLUTION PONDS	
A210	CTFS UNDERDRAIN PLAN	0
A215	UNDERDRAIN SECTIONS AND DETAILS (1 OF 2)	0
A216	UNDERDRAIN SECTIONS AND DETAILS (2 OF 2)	0
A220	CTFS RECLAIM POND GRADING AND PIPING PLAN	0
A221	CTFS RECLAIM POND SECTIONS AND DETAILS	0
A222	CTFS SOLUTION OUTLET CHANNEL PLAN AND PROFILE	0
A223	CTFS SOLUTION OUTLET CHANNEL SECTIONS AND DETAILS (1 OF 2)	0
A224	CTFS SOLUTION OUTLET CHANNEL SECTIONS AND DETAILS (2 OF 2)	0
A225	CTFS RECLAIM POND ACCESS ROAD PLAN AND PROFILE	0
A226	CTFS SOLUTION CHANNEL DETAILS	0
A227	PARSHALL FLUME SECTIONS AND DETAILS	0
A230	POND SECTIONS AND DETAILS (SHEET 1 OF 2)	0
A235	POND SECTIONS AND DETAILS (SHEET 2 OF 2)	0
	STORMWATER	
A300	PROCESS PLANT SEDIMENT POND PLAN	0
A302	PROCESS PLANT SEDIMENT POND SECTIONS AND DETAILS (SHEET 1 OF 2)	0
A304	PROCESS PLANT SEDIMENT POND SECTIONS AND DETAILS (SHEET 2 OF 2)	0
A305	CTFS STORMWATER PLAN	0
A310	CTFS WEST DIVERSION CHANNEL PLAN & PROFILE (SHEET 1 OF 3)	0
A311	CTFS WEST DIVERSION CHANNEL PLAN & PROFILE (SHEET 2 OF 3)	0
A312	CTFS WEST DIVERSION CHANNEL PLAN & PROFILE (SHEET 3 OF 3)	0
A313	CTFS NORTH DIVERSION CHANNEL PLAN & PROFILE (SHEET 1 OF 3)	0
A314	CTFS NORTH DIVERSION CHANNEL PLAN & PROFILE (SHEET 2 OF 3)	0
A315	CTFS NORTH DIVERSION CHANNEL PLAN & PROFILE (SHEET 3 OF 3)	0
A320	CTFS WEST CHANNEL CULVERT SECTIONS (SHEET 1 OF 2)	0
A322	CTFS WEST CHANNEL CULVERT SECTIONS (SHEET 2 OF 2)	0
A324	PROCESS PLANT ENTRANCE ROAD CULVERT SECTIONS AND DETAILS	0
	INSTRUMENTATION	
A400	CTFS INSTRUMENTATION PLAN	0
A410	CTFS INSTRUMENTATION PLAN SECTIONS & DETAILS	0
	CTFS PHASING	
A500	CTFS STAGE 1 STORMWATER PLAN	0
A510	CTFS STAGE 1 SECTIONS & DETAILS (1 OF 2)	0
A512	CTFS STAGE 1 SECTIONS & DETAILS (2 OF 2)	0
	FENCING	
A600	WILDLIFE FENCING SECTIONS AND DETAILS	0

TEXT ABBREVIATIONS:

CGS – COARSE GANGUE STOCKPILE
℄ – CENTERLINE
CPeP – CORRUGATED POLYETHYLENE PIPE
CS – CARBON STEEL
CTFS – CLAY TAILINGS FILTER STACK
CY – CUBIC YARD
DIA – DIAMETER
DR – DIMENSION RATIO
FT – FOOT
GM – GROWTH MEDIA
HDPE – HIGH DENSITY POLYETHYLENE
LHCSL – LOW HYDRAULIC CONDUCTIVITY SOIL LAYER
MW – MONITORING WELL
PH – EXISTING PRODUCTION WELL
POO – PLAN OF OPERATIONS
PZ – PIEZOMETER
QRPW – QUINN RIVER PRODUCTION WELL
ROW – RIGHT OF WAY
ROM – RUN OF MINE
SR – STATE ROUTE
STD WT – STANDARD WEIGHT
TW – EXISTING TEST PUMPING WELL
TYP – TYPICAL
VFD – VARIABLE FREQUENCY DRIVE
WRSF – WASTE ROCK STORAGE FACILITY
WSH – EXISTING MONITORING WELL
WSE – WATER SURFACE ELEVATION

OWNER:

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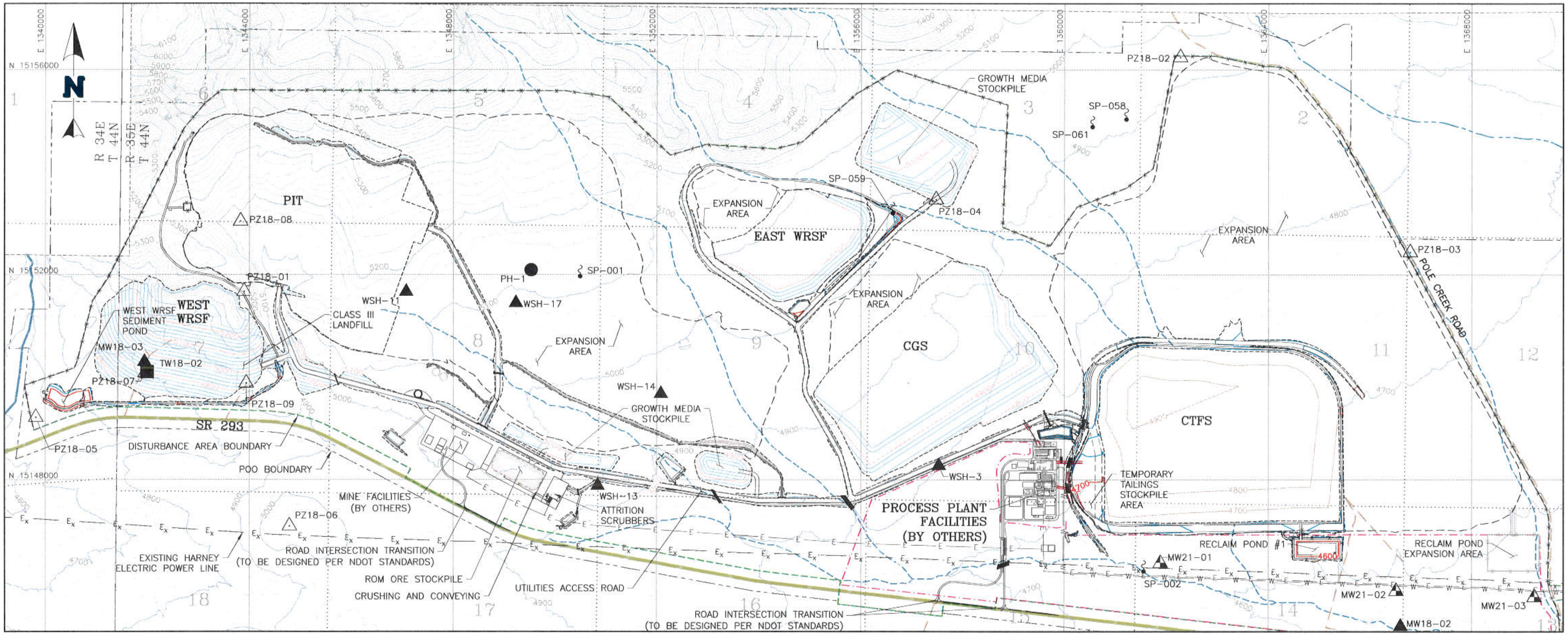

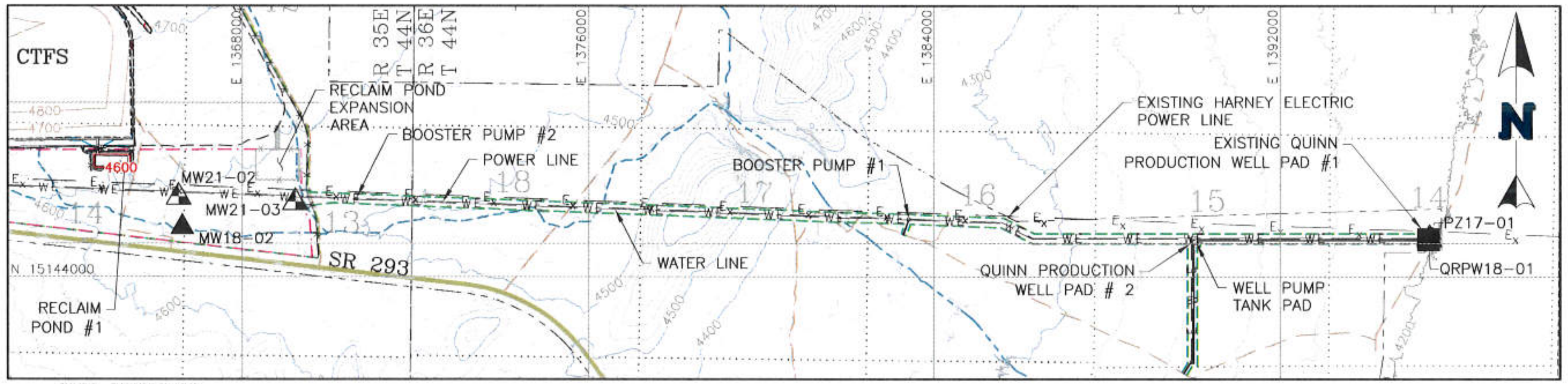

LEGEND:

	EXISTING 20 FT GROUND CONTOURS
4500	EXISTING CONTOUR ELEVATION
	20 FT CTFS CONTOURS
4500	CTFS CONTOUR ELEVATION
	20 FT GROUND CONTOURS
4500	CONTOUR ELEVATION
	20 FT GROUND CONTOURS BY OTHERS
4500	CONTOUR ELEVATION BY OTHERS
	EXISTING ROADS-MAJOR
	EXISTING ROADS
	SURFACE DAYLIGHT
	EXPANSION AREAS
	EXISTING DRAINAGES
	EXISTING EPHEMERAL CREEKS
	EXISTING PERENNIAL STREAMS
	POO BOUNDARY
	DISTURBANCE AREA BOUNDARY
	CULVERT
Ex	EXISTING POWER LINE
:	EXISTING POWER POLES
W	WATER LINE
E	POWER LINE
	FUTURE PLANT EXPANSION
x x	FENCE
▭	STRUCTURE/BUILDING
▣	POND BY OTHERS
	CONVEYOR CORRIDOR
△	EXISTING PIEZOMETER
▲	EXISTING MONITORING WELL
●	EXISTING PRODUCTION WELL
■	EXISTING TEST PUMPING WELL
ʃ	EXISTING SPRING/SEEP
◭	MONITORING WELL
R 34E	RANGE 34 EAST
T 44N	TOWNSHIP 44 NORTH
	RANGE/TOWNSHIP LINE
	SECTION LINES
20	SECTION NUMBER

NOTE:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.

TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

PROFESSIONAL ENGINEER-STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No.21993
4/2/20

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: RL
DRAWN BY: RL

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CLIENT: LITHIUM NEVADA CORP.
PROJECT: THACKER PASS PROJECT
TITLE: GENERAL PROJECT LAYOUT
FILENAME: 0385.000.002M
DRAWING NO.: A010
REVISION: 0

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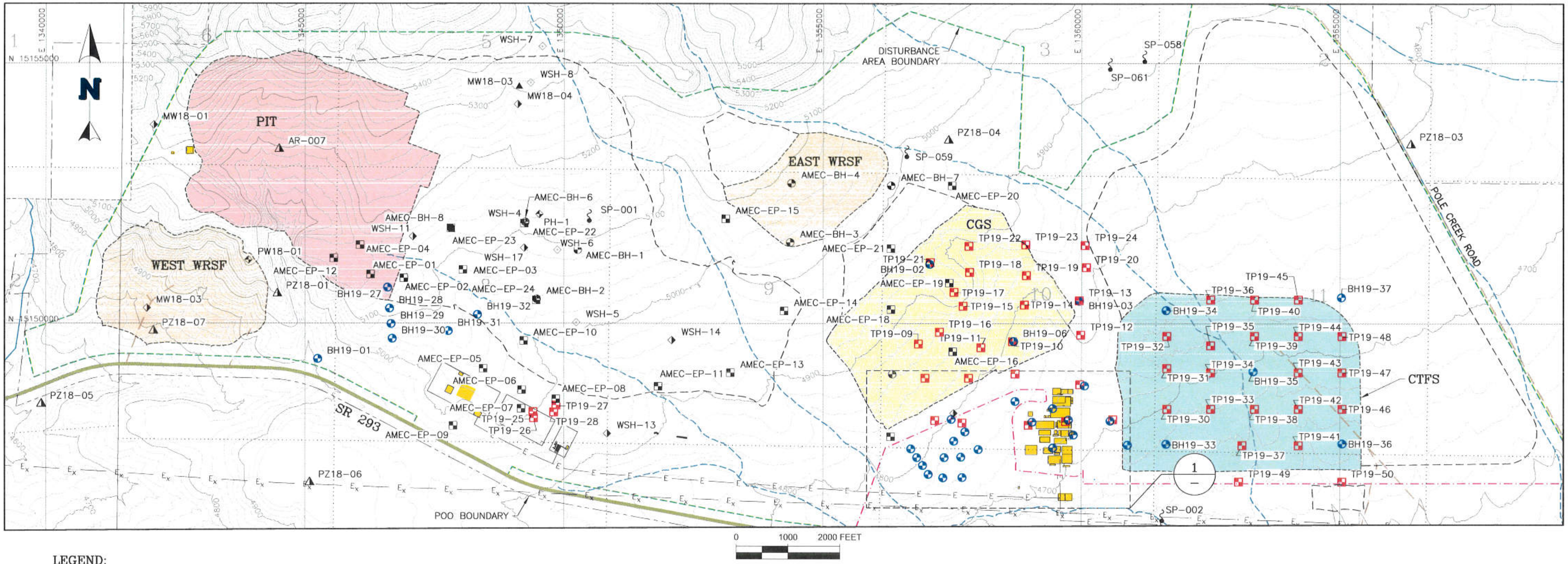

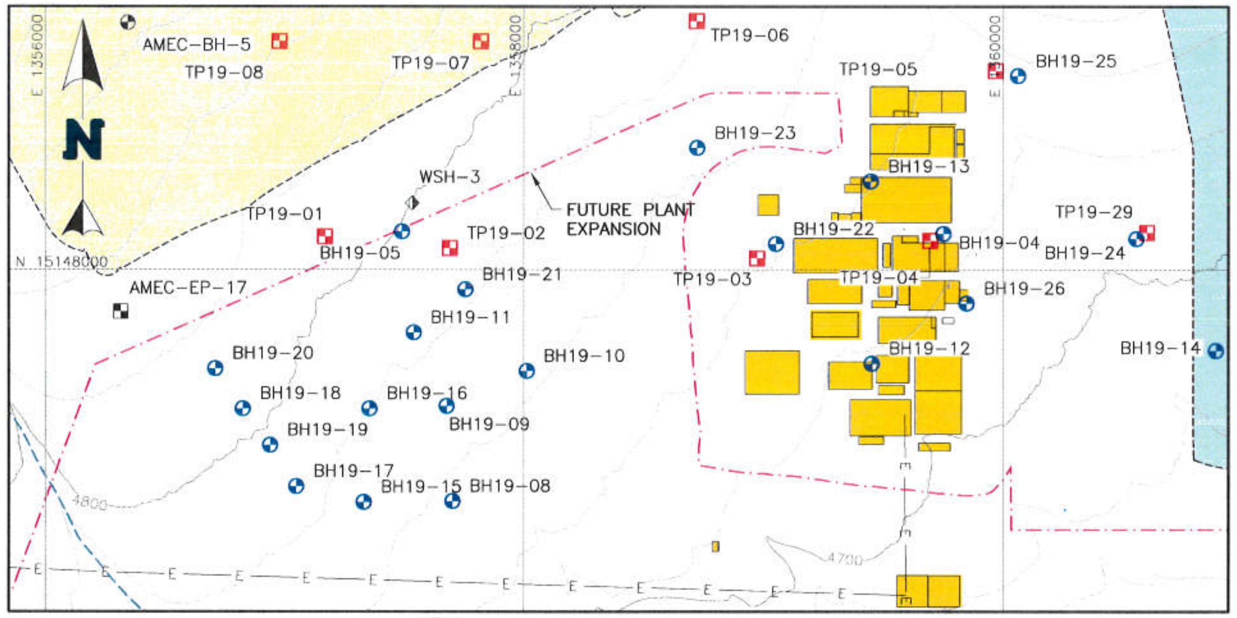

1 — PROCESS FACILITIES AREA

0 400 800 FEET

LEGEND:

- EXISTING 20 FT GROUND CONTOURS
- 4500 EXISTING CONTOUR ELEVATION
- EXISTING ROADS–MAJOR
- EXISTING ROADS
- EXISTING EPHEMERAL CREEKS
- EXISTING MAJOR DRAINAGES
- SURFACE DAYLIGHT
- EXPANSION AREAS
- SECTION LINES
- 20 SECTION NUMBER
- POO BOUNDARY
- DISTURBANCE AREA BOUNDARY
- FUTURE PLANT EXPANSION AREA
- —Ex— EXISTING POWER LINE
- —E— POWER LINE
- : EXISTING POWER POLES
- EXISTING SPRING
- EXISTING BOREHOLE (AMEC 2013)
- EXISTING TEST PIT (AMEC 2013)
- EXISTING MONITORING WELL
- EXISTING MONITORING WELL (ABANDONED)
- EXISTING PIEZOMETER
- EXISTING BOREHOLE (NF 2019)
- EXISTING TEST PIT (NF 2019)
- WASTE ROCK STORAGE FACILITY (WRSF)
- PIT
- COARSE GANGUE STOCKPILE
- CLAY TAILINGS FILTER STACK
- BUILDINGS & INFRASTRUCTURE

NOTES:

1. BH-07 WAS REMOVED FROM DRILLING PLAN.
2. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.

TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

PROFESSIONAL ENGINEER - STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No.21993
4/2/20

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: RL
DRAWN BY: RL

DISCLAIMER

NEWFIELDS PRODUCED THE INFORMATION PRESENTED ON THIS DRAWING THROUGH THE USE OF AVAILABLE TECHNICAL INFORMATION AND EXPERIENCE. RECEIVING THIS DRAWING DOES NOT GUARANTEE ANY RIGHTS TO EITHER SUCH TECHNICAL INFORMATION OR EXPERIENCE. ANY MODIFICATION OR ADAPTATION OF THE DATA OR DRAWING SHALL BE AT USER'S RISK AND WITHOUT ANY LIABILITY OR LEGAL RESPONSIBILITY TO NEWFIELDS.

NewFields

CLIENT: LITHIUM NEVADA CORP.
PROJECT: THACKER PASS PROJECT
TITLE: GEOTECHNICAL INVESTIGATION PLAN
FILENAME: 0385.000.003M
DRAWING NO.: A050
REVISION: 0

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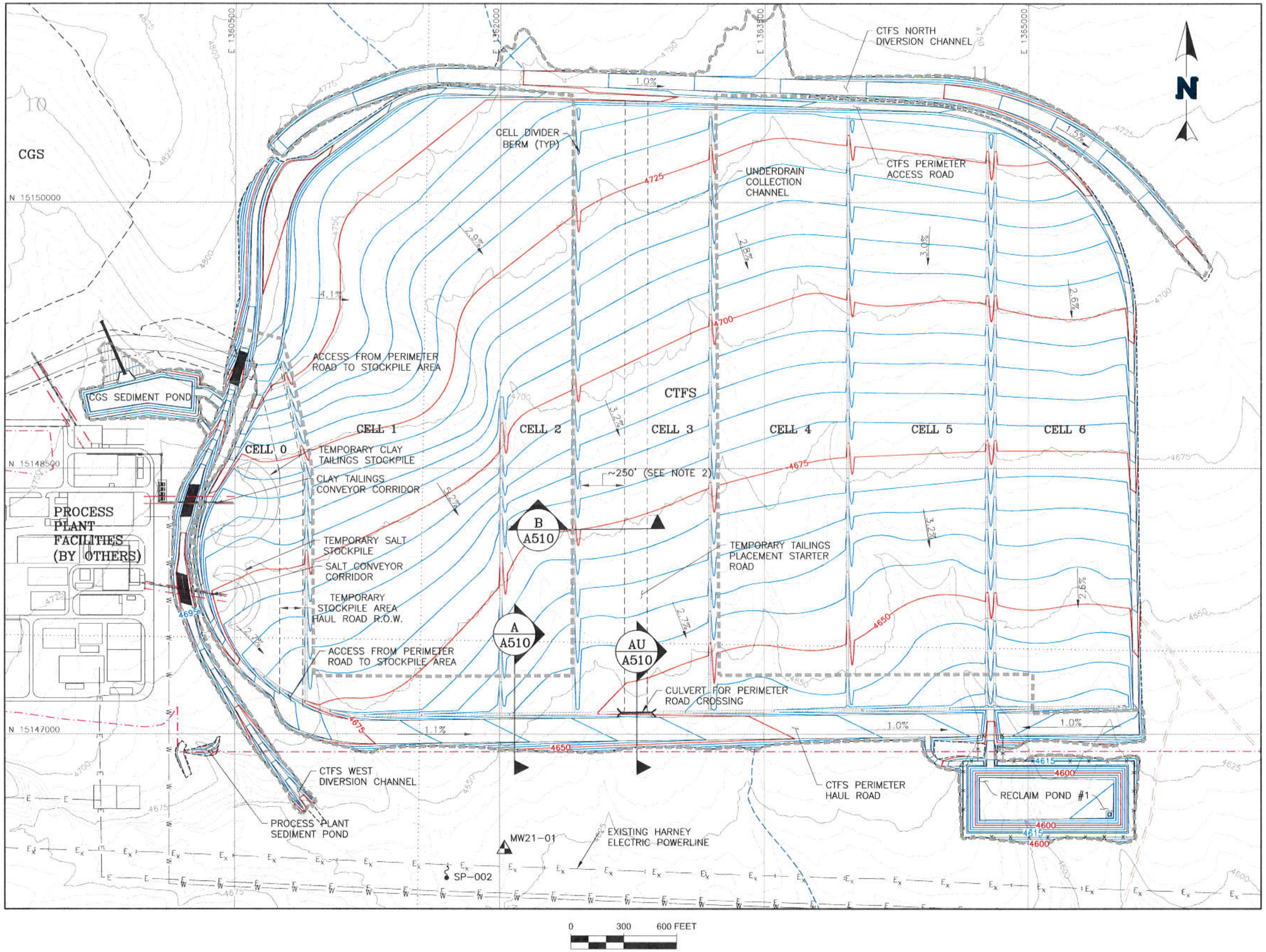

N

LEGEND:

	EXISTING 5 FT GROUND CONTOURS
4500	EXISTING CONTOUR ELEVATION
	5 FT GROUND CONTOURS
4500	CONTOUR ELEVATION
	SECTION LINES
20	SECTION NUMBER
	EXISTING ROADS
	SURFACE DAYLIGHT
	SURFACE DAYLIGHT BY OTHERS
	EXISTING DRAINAGES
	CULVERT
—— Ex ——	EXISTING POWER LINE
:	EXISTING POWER POLES
—— W ——	WATER LINE (BY OTHERS)
—— E ——	POWER LINE (BY OTHERS)
	FUTURE PLANT EXPANSION
—x—x—x—	FENCE
☐	STRUCTURE/BUILDING
	STAGE 1 CONSTRUCTION LIMITS
	CONVEYOR CORRIDOR (BY OTHERS)
	EXISTING SPRING/SEEP
▲	MONITORING WELL

NOTE:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. THE AREA FROM THE CELL DIVIDER BERM TOE TO THE TEMPORARY TAILINGS PLACEMENT ROAD WILL BE FILLED IN WITH OVERLINER MATERIAL CUT FROM THE TEMPORARY ROAD AFTER THE OVERLINER ON THE EAST SIDE OF THE ROAD HAS BEEN PLACED.

MATTHEW T. HALEY
Exp.06/30/21
Matt Haley
CIVIL
4/1/20
No.21993

TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: RL
DRAWN BY: RL

DISCLAIMER

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NewFields

CLIENT: LITHIUM NEVADA CORP.
PROJECT: THACKER PASS PROJECT
TITLE: CTFS LAYOUT
FILENAME: 0385.000.075M
DRAWING NO.: A060
REVISION: 0

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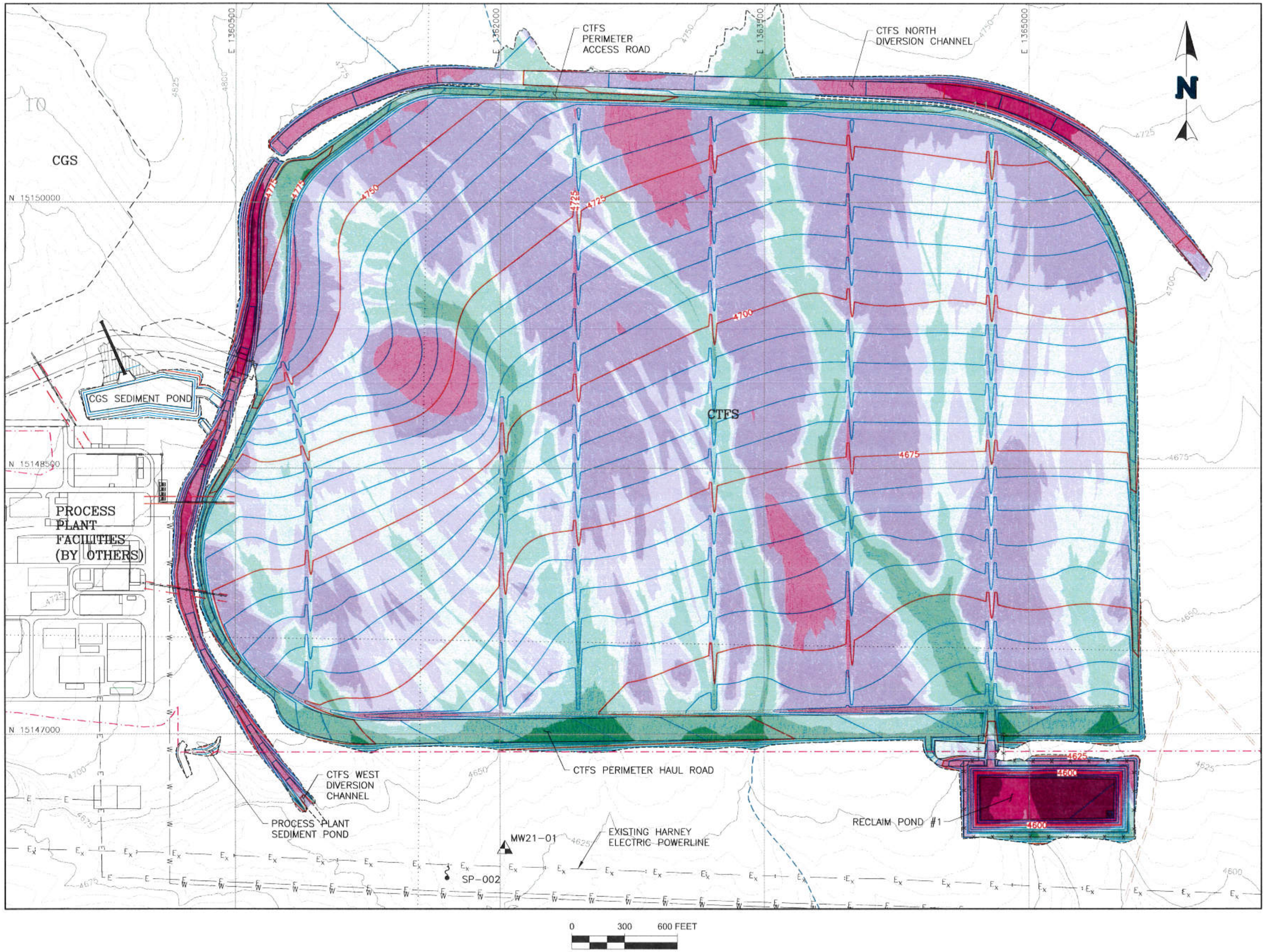

LEGEND:

- EXISTING 5 FT GROUND CONTOURS
- 4500 EXISTING CONTOUR ELEVATION
- 5 FT GROUND CONTOURS
- 4500 CONTOUR ELEVATION
- SECTION LINES
- 20 SECTION NUMBER
- EXISTING ROADS
- SURFACE DAYLIGHT
- SURFACE DAYLIGHT BY OTHERS
- EXISTING DRAINAGES
- CULVERT
- Ex EXISTING POWER LINE
- W WATER LINE (BY OTHERS)
- E POWER LINE
- POWER POLE
- FUTURE PLANT EXPANSION
- FENCE
- STRUCTURE/BUILDING
- CONVEYOR CORRIDOR (BY OTHERS)
- EXISTING SPRING/SEEP
- MONITORING WELL

CUT/FILL ISOPACH CONTOURS

- 25' TO 40' CUT
- 15' TO 25' CUT
- 5' TO 15' CUT
- 1' TO 5' CUT
- 0' TO 1' CUT
- 0' TO 1' FILL
- 1' TO 5' FILL
- 5' TO 15' FILL
- 15' TO 25' FILL
- 25' TO 30' FILL

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. CUT/FILL DEPTHS ARE APPROXIMATE AND ACTUAL VALUES DURING CONSTRUCTION MAY VARY.
3. PROPOSED GROUND CONTOURS REPRESENT TOP OF LINER BEDDING IN LINED AREAS AND TOP OF FINISHED GRADE IN OTHER AREAS.

PROFESSIONAL ENGINEER-STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No.21993
4/2/20

TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

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REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: RL
DRAWN BY: RL

DISCLAIMER

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NewFields

CLIENT: LITHIUM NEVADA CORP.

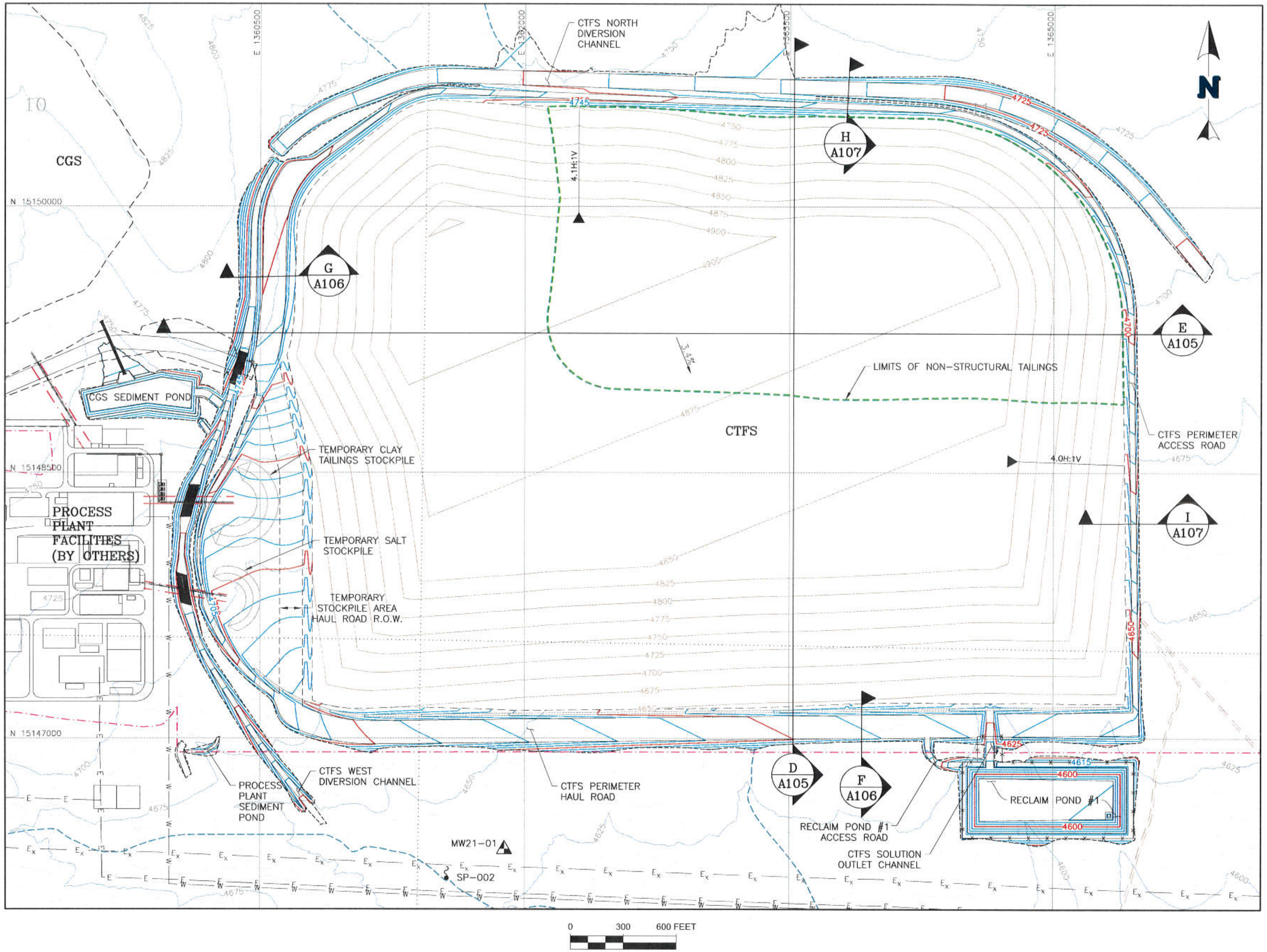
PROJECT: THACKER PASS PROJECT

TITLE: CTFS ISOPACH

FILENAME: 0385.000.006M

DRAWING NO.: A070

REVISION: 0



LEGEND:

	EXISTING 5 FT GROUND CONTOURS
4500	EXISTING CONTOUR ELEVATION
	5 FT CTFS CONTOURS
4500	CTFS CONTOUR ELEVATION
	5 FT GROUND CONTOURS
4500	CONTOUR ELEVATION
	SECTION LINES
20	SECTION NUMBER
	EXISTING ROADS
	SURFACE DAYLIGHT
	SURFACE DAYLIGHT BY OTHERS
	EXISTING DRAINAGES
	CULVERT
Ex	EXISTING POWER LINE
	EXISTING POWER POLES
W	WATER LINE (BY OTHERS)
E	POWER LINE (BY OTHERS)
x x x	FENCE
	FUTURE PLANT EXPANSION
☐	STRUCTURE/BUILDING
	CONVEYOR CORRIDOR (BY OTHERS)
	EXISTING SPRING/SEEP
△	MONITORING WELL

NOTE:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.

MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No.21993
4/2/20

TOPO REFERENCE:

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REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: RL
DRAWN BY: RL

DISCLAIMER

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NewFields

CLIENT: LITHIUM NEVADA CORP.
PROJECT: THACKER PASS PROJECT
TITLE: CTFS STACKED FACILITY LAYOUT
FILENAME: 0385.000.004M
DRAWING NO.: A100
REVISION: 0

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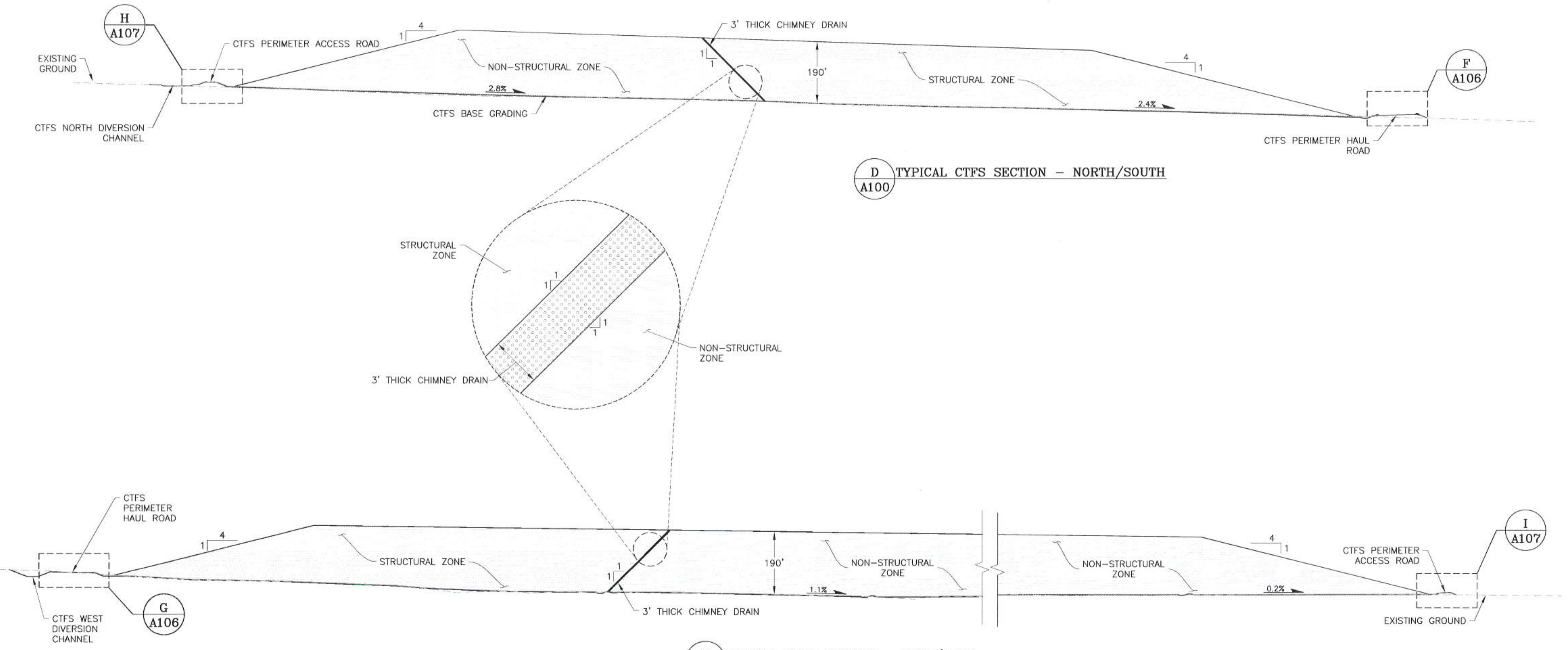

D
A100
TYPICAL CTFS SECTION – NORTH/SOUTH

E
A100
TYPICAL CTFS SECTION – EAST/WEST

MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No. 21993
Matt Haley
4/2/20

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: RL
DRAWN BY: RL

DISCLAIMER

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NewFields

CLIENT: LITHIUM NEVADA CORP.

PROJECT: THACKER PASS PROJECT

TITLE: TYPICAL STACKING SECTIONS

FILENAME: 0385.000.046D

DRAWING NO.: A105

REVISION: 0

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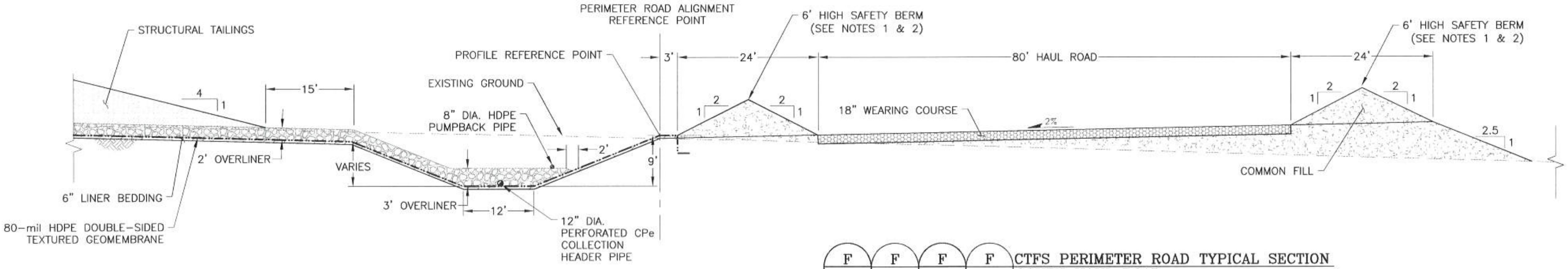
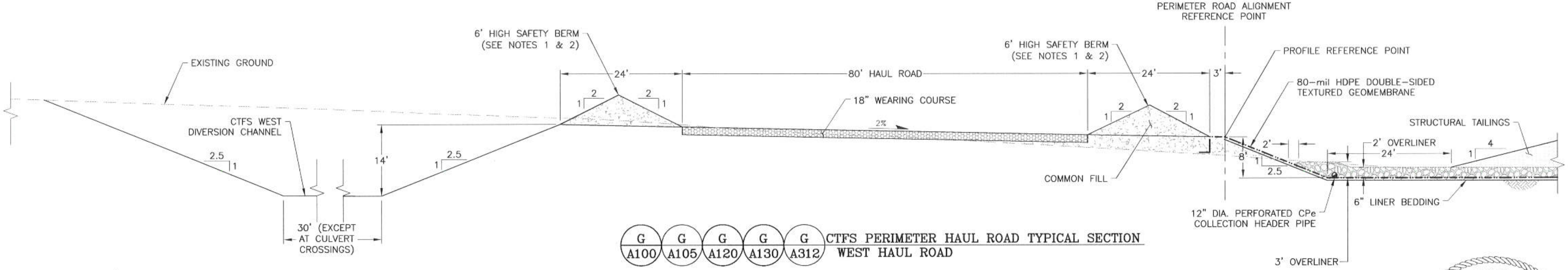


F/A100 F/A105 F/A120 F/A125 CTFS PERIMETER ROAD TYPICAL SECTION
SOUTH HAUL ROAD



G/A100 G/A105 G/A120 G/A130 G/A312 CTFS PERIMETER HAUL ROAD TYPICAL SECTION
WEST HAUL ROAD

NOTES:

1. A SAFETY BERM IS ONLY REQUIRED IN FILL SITUATIONS.
2. A 2 FOOT WIDE BERM BREAK SHALL BE PROVIDED EVERY 50 LINEAR FEET OF BERM FOR STORMWATER RUNOFF ON THE DOWNSLOPE SIDE OF THE ROAD. THE BERM ON THE UPSLOPE SIDE WILL NOT NEED A BERM BREAK.

MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No.21993
Matt Haley 4/2/20

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: RL
DRAWN BY: RL

DISCLAIMER
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NewFields
CLIENT LITHIUM NEVADA CORP.
PROJECT THACKER PASS PROJECT
TITLE CTFS FACILITY SECTIONS (SHEET 1 OF 2)
FILENAME 0385.000.005D
DRAWING NO. A106
REVISION 0

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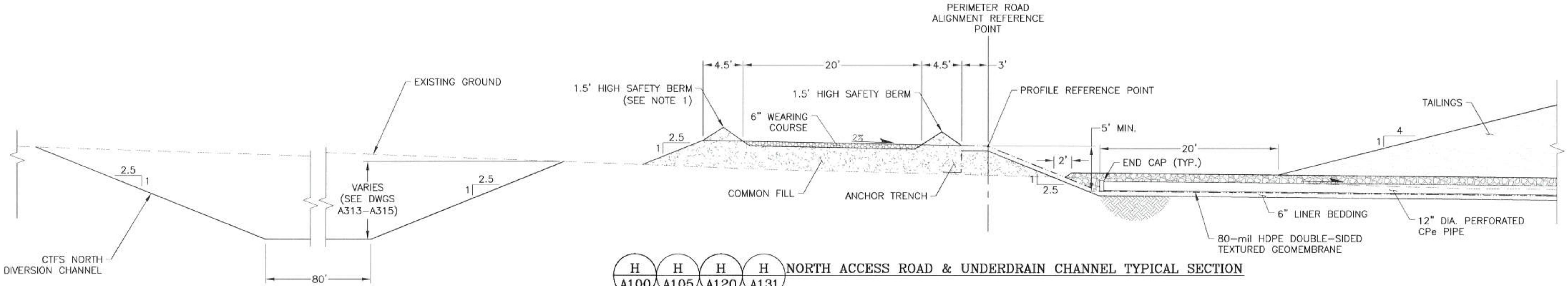
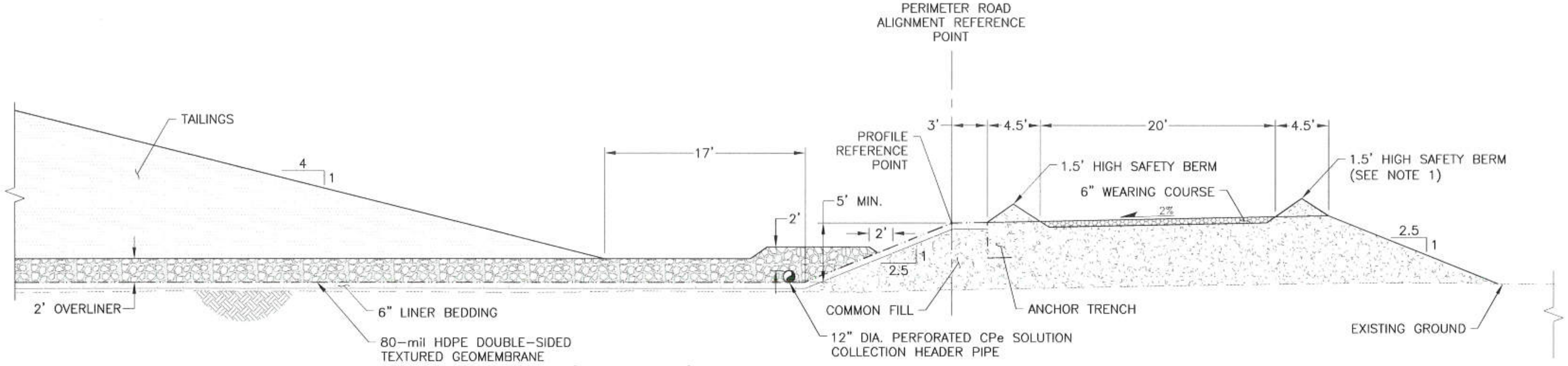


H/A100 H/A105 H/A120 H/A131 NORTH ACCESS ROAD & UNDERDRAIN CHANNEL TYPICAL SECTION



I/A100 I/A105 I/A120 I/A132 EAST ACCESS ROAD TYPICAL SECTION

PROFESSIONAL ENGINEER-STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
Matt Haley
CIVIL
4/2/20
No. 21993

NOTES:

1. A SAFETY BERM IS ONLY REQUIRED IN FILL SITUATIONS.
2. A BERM BREAK SHALL BE PROVIDED EVERY 50 LINEAR FEET OF BERM FOR STORMWATER RUNOFF.
3. THE SURFACE OF PROPOSED FINISHED GRADE SHOULD CONSIST OF FINE GRAINED MATERIAL – EITHER NATIVE OR PROCESSED MATERIALS. THE PURPOSE OF THE LINER BEDDING IS TO PROVIDE A RELATIVELY SMOOTH SURFACE FREE OF ROCK PROTRUSIONS FOR THE OVERLYING GEOMEMBRANE LINER.

0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MH
REV	DATE	DESCRIPTION	TECH	ENG

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: RL
DRAWN BY: RL

DISCLAIMER

NewFields

CLIENT LITHIUM NEVADA CORP.
PROJECT THACKER PASS PROJECT
TITLE CTFS FACILITY SECTIONS (SHEET 2 OF 2)
FILENAME 0385.000.0400
DRAWING NO. A107
REVISION 0

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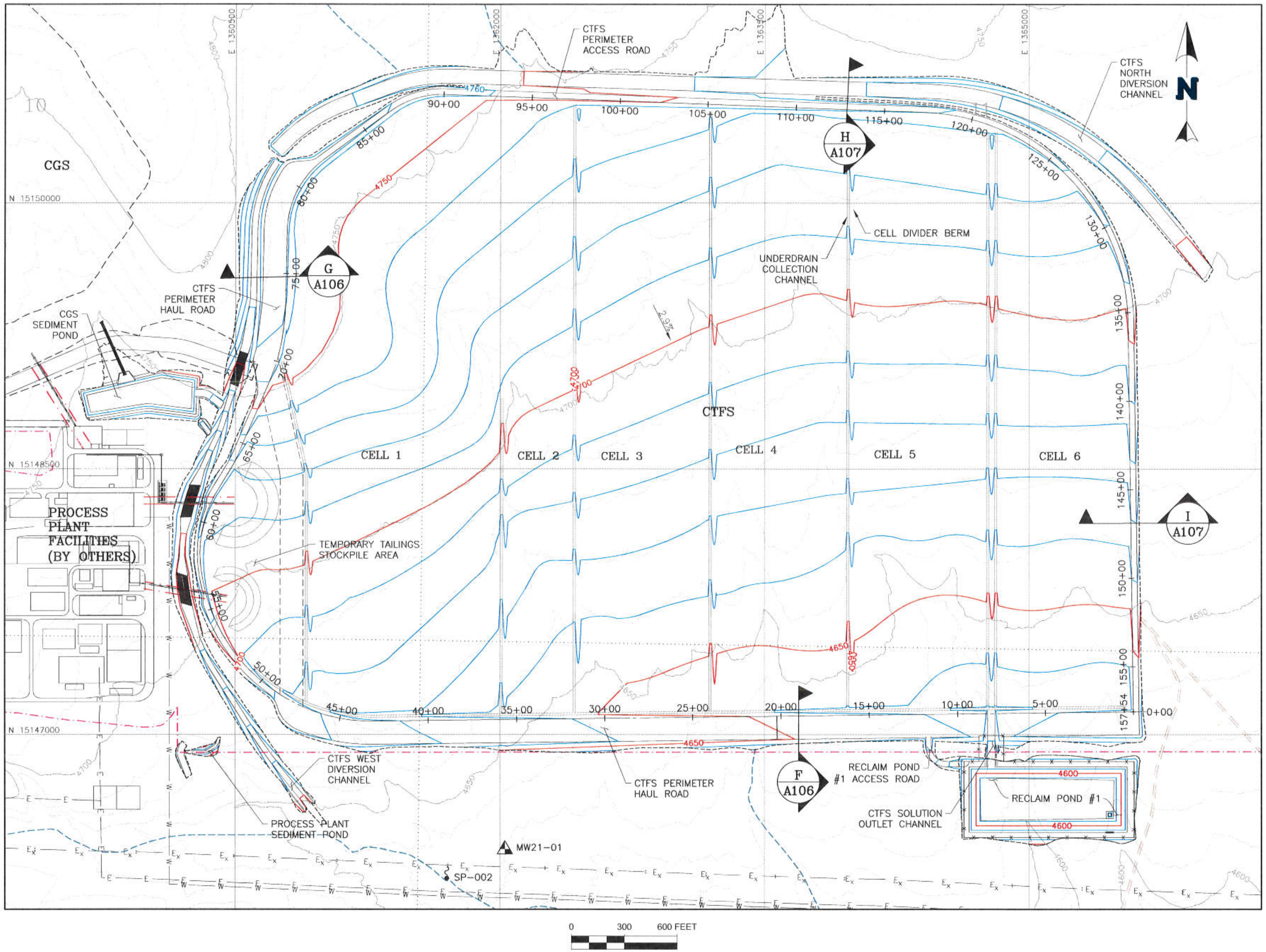

LEGEND:

- EXISTING 10 FT GROUND CONTOURS
- 4500 EXISTING CONTOUR ELEVATION
- 10 FT GROUND CONTOURS
- 4500 CONTOUR ELEVATION
- EXISTING ROADS
- SECTION LINES
- 20 SECTION NUMBER
- SURFACE DAYLIGHT
- SURFACE DAYLIGHT BY OTHERS
- EXISTING DRAINAGES
- CULVERT
- —E_x— EXISTING POWER LINE
- —W— WATER LINE (BY OTHERS)
- —E— POWER LINE (BY OTHERS)
- : EXISTING POWER POLES
- FUTURE PLANT EXPANSION
- —x—x—x— FENCE
- ☐ STRUCTURE/BUILDING
- CONVEYOR CORRIDOR (BY OTHERS)
- EXISTING SPRING/SEEP
- ▲ MONITORING WELL

TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No.21993
Matt Haley
4/2/20

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: SEB
DRAWN BY: RL

DISCLAIMER

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NewFields

CLIENT: LITHIUM NEVADA CORP.

PROJECT: THACKER PASS PROJECT

TITLE: PERIMETER ROAD PLAN

FILENAME: 0385.000.076M

DRAWING NO.: A120

REVISION: 0

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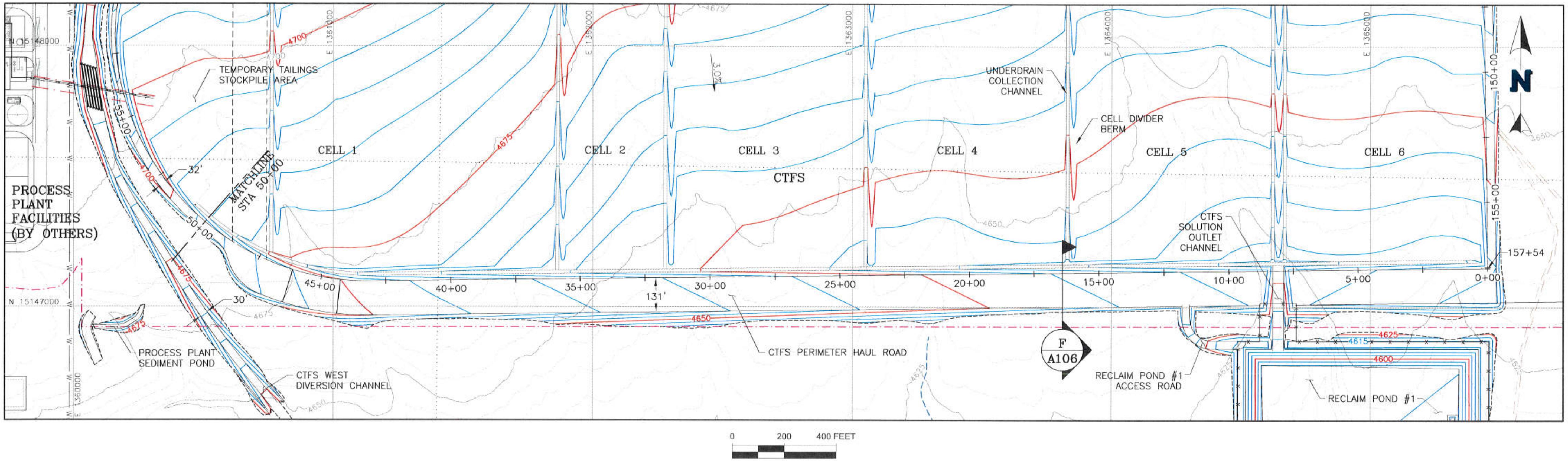

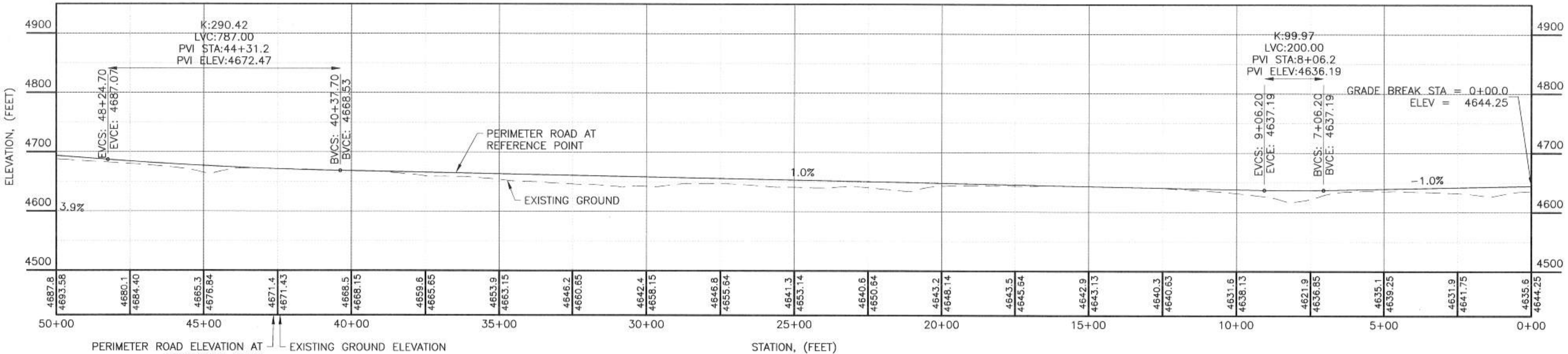

0 200 400 FEET
HORIZONTAL

0 100 200 FEET
VERTICAL

2X EXAGGERATION

LEGEND:

- EXISTING 5 FT GROUND CONTOURS
- 4500 EXISTING CONTOUR ELEVATION
- 5 FT GROUND CONTOURS
- 4500 CONTOUR ELEVATION
- EXISTING ROADS
- SURFACE DAYLIGHT
- EXISTING DRAINAGES
- STRUCTURE/BUILDING
- —W— WATER LINE (BY OTHERS)
- —x—x—x— FENCE
- CONVEYOR CORRIDOR (BY OTHERS)
- FUTURE PLANT EXPANSION
- SECTION LINES

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. THE CTFS WEST DIVERSION CHANNEL IS DESIGNED TO CONVEY STORMWATER FROM A 500YR-24HR STORM EVENT. RIPRAP IS INSTALLED TO 1 FOOT ABOVE THE 100YR-24HR STORM EVENT FLOW DEPTH.

PROFESSIONAL ENGINEER - STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
Matt Haley
CIVIL
4/2/20
No. 21993

TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

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REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: SEB
DRAWN BY: SEB

NewFields

CLIENT: LITHIUM NEVADA CORP.

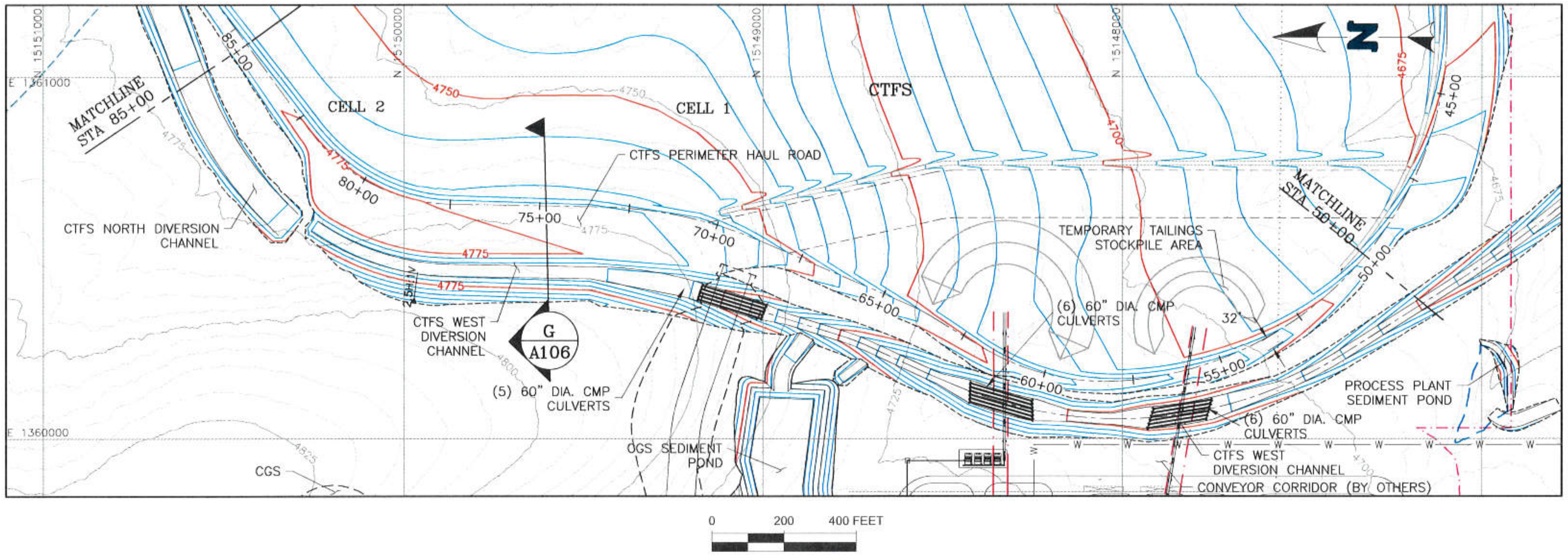
PROJECT: THACKER PASS PROJECT

TITLE: PERIMETER ROAD PLAN AND PROFILE (SHEET 1 OF 4)

FILENAME: 0385.000.070P

DRAWING NO.: A125

REVISION: 0

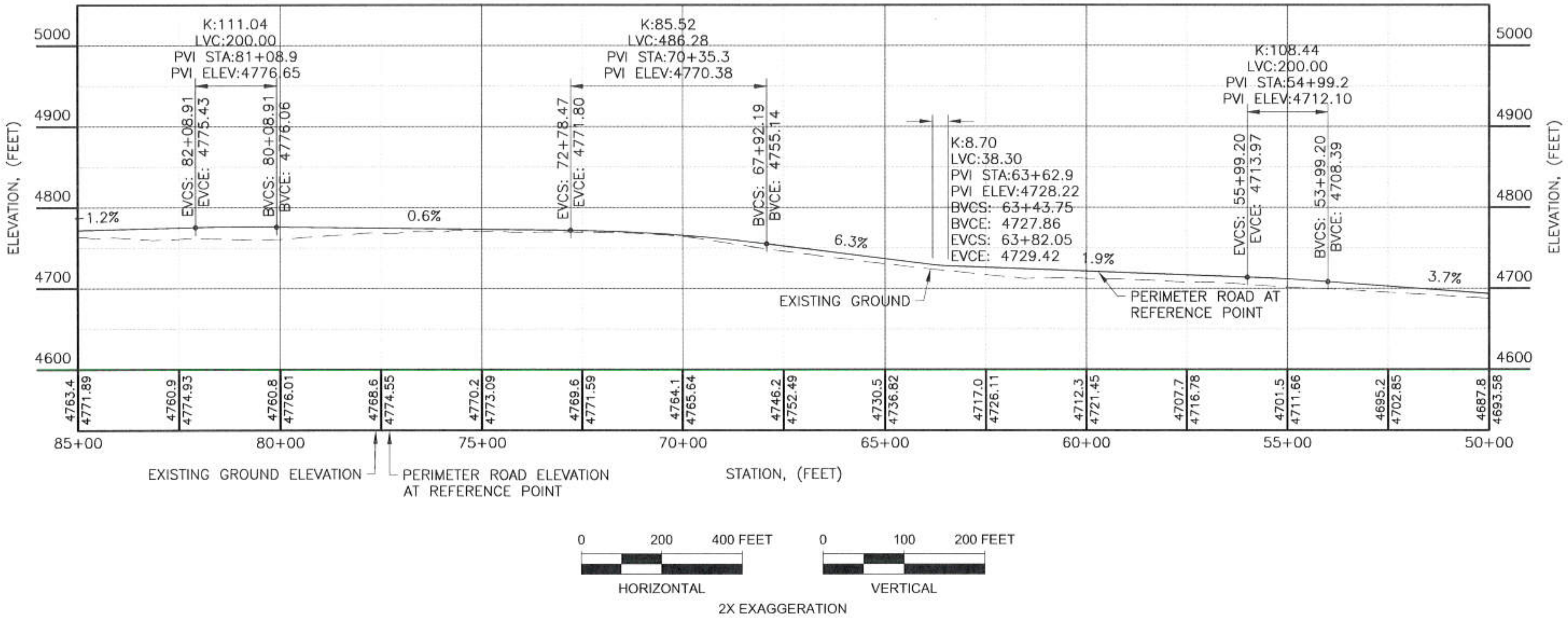


LEGEND:

EXISTING 5 FT GROUND CONTOURS
4500 EXISTING CONTOUR ELEVATION
5 FT GROUND CONTOURS
4500 CONTOUR ELEVATION
EXISTING DRAINAGES
SURFACE DAYLIGHT
SURFACE DAYLIGHT BY OTHERS
SECTION LINES
STRUCTURE/BUILDING
W WATER LINE (BY OTHERS)
x x x FENCE
CONVEYOR CORRIDOR (BY OTHERS)
FUTURE PLANT EXPANSION
CULVERT

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. THE CTFS WEST DIVERSION CHANNEL IS DESIGNED TO CONVEY STORMWATER FROM A 500YR–24HR STORM EVENT. RIPRAP IS INSTALLED TO ONE FOOT ABOVE THE 100YR–24HR STORM EVENT FLOW DEPTH.



CTFS PERIMETER ROAD WIDTH		
STARTING STATION	ENDING STATION	ROAD WIDTH (FT)
0+00	47+01.20	131
47+01.20	49+26.20	TRANSITION
49+26.20	55+39.20	32
55+39.20	55+89.20	TRANSITION
55+89.20	60+81.20	15
60+81.20	61+31.20	TRANSITION
61+31.20	67+56.20	32
67+56.20	69+81.20	TRANSITION
69+81.20	81+10.00	131
81+10.00	86+10.00	TRANSITION
86+10.00	157+54.46	32

PROFESSIONAL ENGINEER – STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No.21993
Matt Haley
4/2/20

TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	NLB	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: SEB
DRAWN BY: SEB

DISCLAIMER

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NewFields

CLIENT LITHIUM NEVADA CORP.

PROJECT THACKER PASS PROJECT

TITLE PERIMETER ROAD PLAN AND PROFILE
(SHEET 2 OF 4)

FILENAME 0385.000.065P
DRAWING NO. A130
REVISION 0

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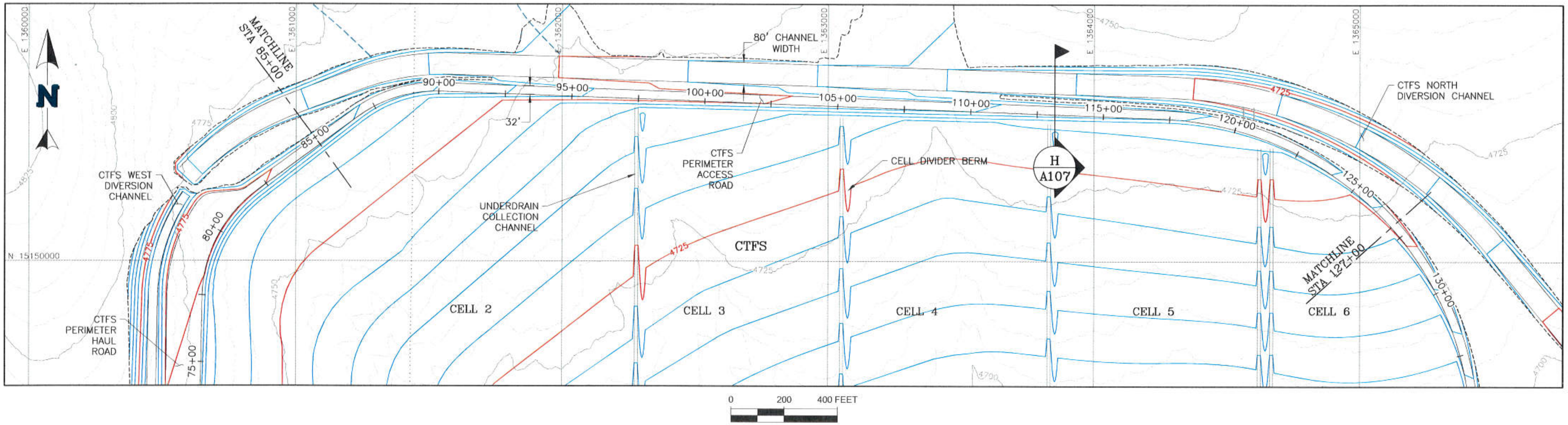
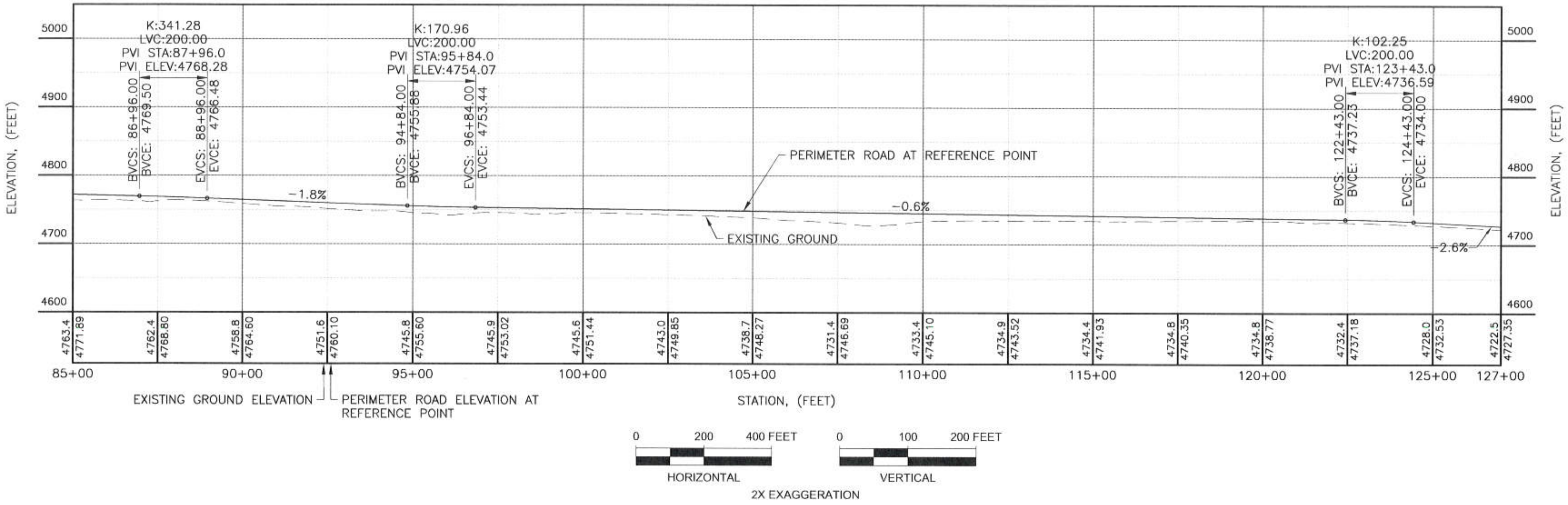




LEGEND:

	EXISTING 5 FT GROUND CONTOURS
4500	EXISTING CONTOUR ELEVATION
	5 FT GROUND CONTOURS
4500	CONTOUR ELEVATION
	EXISTING DRAINAGES
	SURFACE DAYLIGHT
	SURFACE DAYLIGHT BY OTHERS
	SECTION LINES

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. THE CTFS NORTH DIVERSION CHANNEL IS DESIGNED TO CONVEY STORMWATER FROM A 100YR–24HR STORM EVENT.

PROFESSIONAL ENGINEER STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
Matt Haley
CIVIL
4/1/20
No.21993

TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\A-CAD\DWGS\0385.000.072P.dwg–4/1/2020 9:45 AM

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	NLB	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: SEB
DRAWN BY: SEB

DISCLAIMER

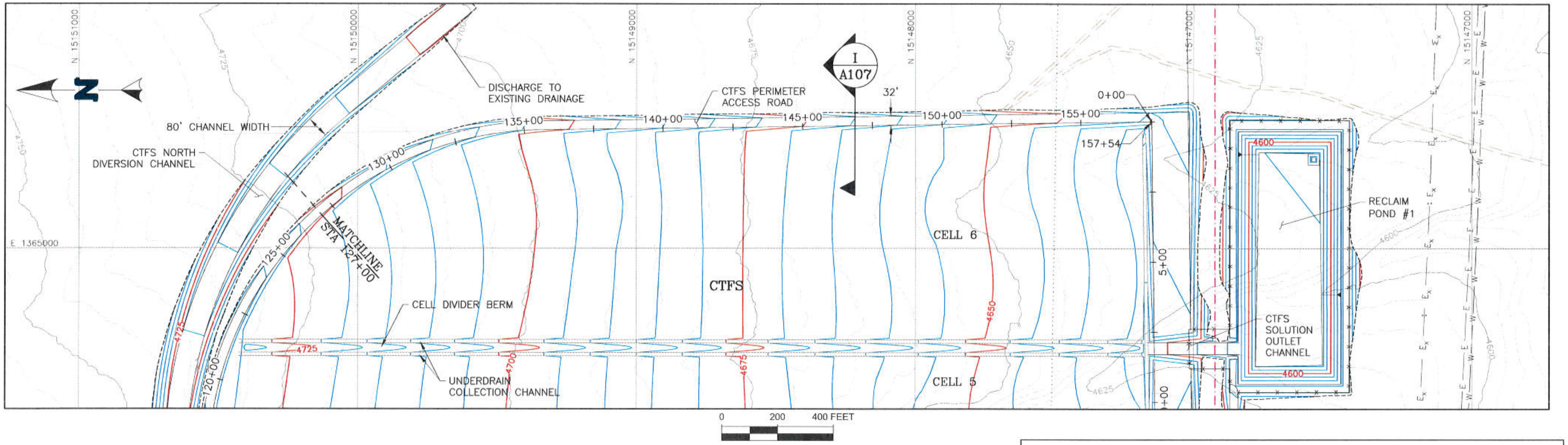
NewFields

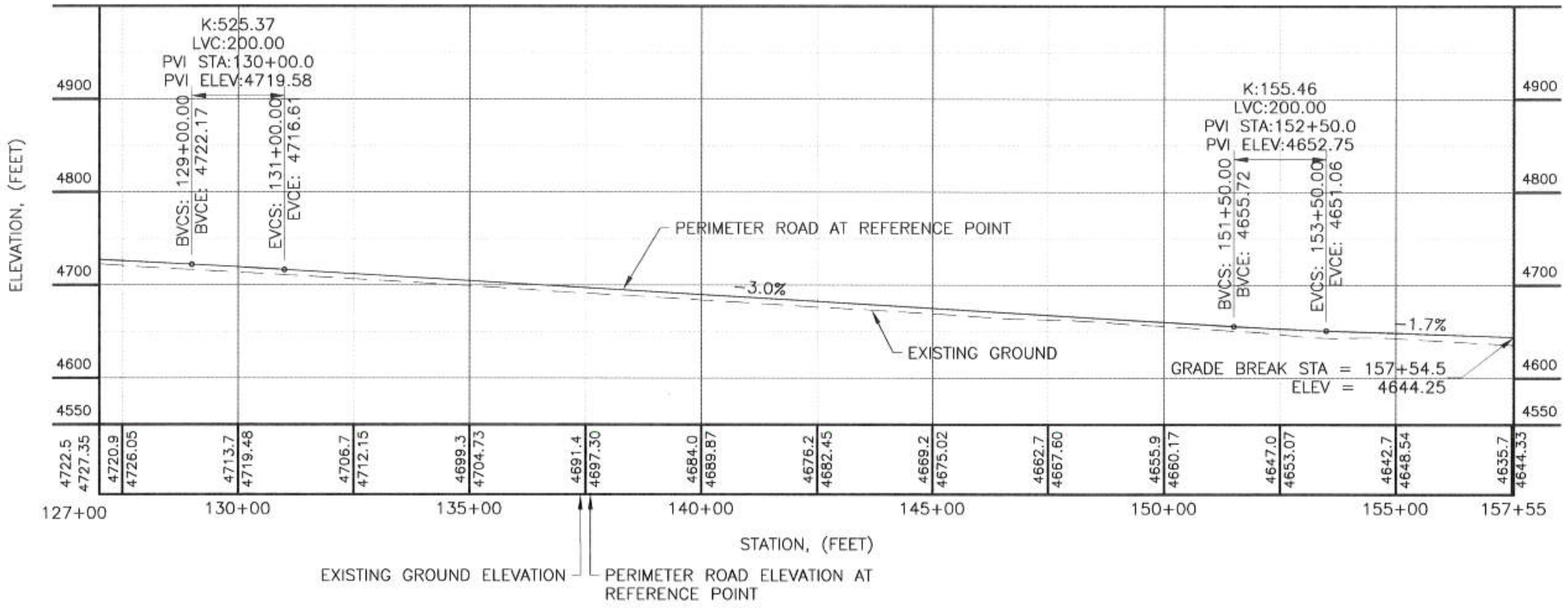
CLIENT: LITHIUM NEVADA CORP.

PROJECT: THACKER PASS PROJECT

TITLE: PERIMETER ROAD PLAN AND PROFILE
(SHEET 3 OF 4)

FILENAME: 0385.000.072P
DRAWING NO.: A131
REVISION: 0





0 200 400 FEET
HORIZONTAL

0 100 200 FEET
VERTICAL

2X EXAGGERATION

PERIMETER ROAD ALIGNMENT TABLE						
	STATION	NORTHING	EASTING	DELTA (D-M-S)	LENGTH (FT)	RADIUS (FT)
PT	0+00.00	15,147,150.24	1,365,451.92			
PC	43+09.68	15,147,097.10	1,361,142.57	085-21-11	1450.15	973.46
PT	57+59.83	15,147,979.66	1,360,161.36			
PC	57+65.02	15,147,984.83	1,360,160.87	036-30-57	430.53	675.54
PT	61+95.56	15,148,397.43	1,360,255.40			
PC	63+61.84	15,148,539.72	1,360,341.45	007-56-24	59.47	429.15
PT	64+21.31	15,148,592.57	1,360,368.60			
PC	68+65.98	15,149,001.22	1,360,543.93	022-12-31	463.16	1194.90
PT	73+29.14	15,149,451.22	1,360,640.55			
PC	77+45.37	15,149,867.39	1,360,647.92	052-59-09	462.39	500.00
PT	82+07.76	15,150,263.05	1,360,853.94			
PC	86+76.04	15,150,538.30	1,361,232.79	038-06-30	332.56	500.00
PT	90+08.60	15,150,633.46	1,361,545.07			
PC	117+27.55	15,150,533.46	1,364,262.18	087-05-36	1829.37	1203.48
PT	135+56.91	15,149,347.57	1,365,421.28			
PT	157+54.45	15,147,150.25	1,365,451.92			

LEGEND:

EXISTING 5 FT GROUND CONTOURS
4500 EXISTING CONTOUR ELEVATION
5 FT GROUND CONTOURS
4500 CONTOUR ELEVATION
EXISTING ROADS
SURFACE DAYLIGHT
SECTION LINES
W WATER LINE (BY OTHERS)
x x FENCE
FUTURE PLANT EXPANSION
E_x EXISTING POWER LINE
E POWERLINE (BY OTHERS)
: EXISTING POWER POLES

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. THE CTFS NORTH DIVERSION CHANNEL IS DESIGNED TO CONVEY STORMWATER FROM THE 100YR-24HR STORM EVENT.

MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No. 21993
Matt Haley
4/2/20

TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

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REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	NLB	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: SEB
DRAWN BY: SEB

DISCLAIMER

NewFields

CLIENT
LITHIUM NEVADA CORP.

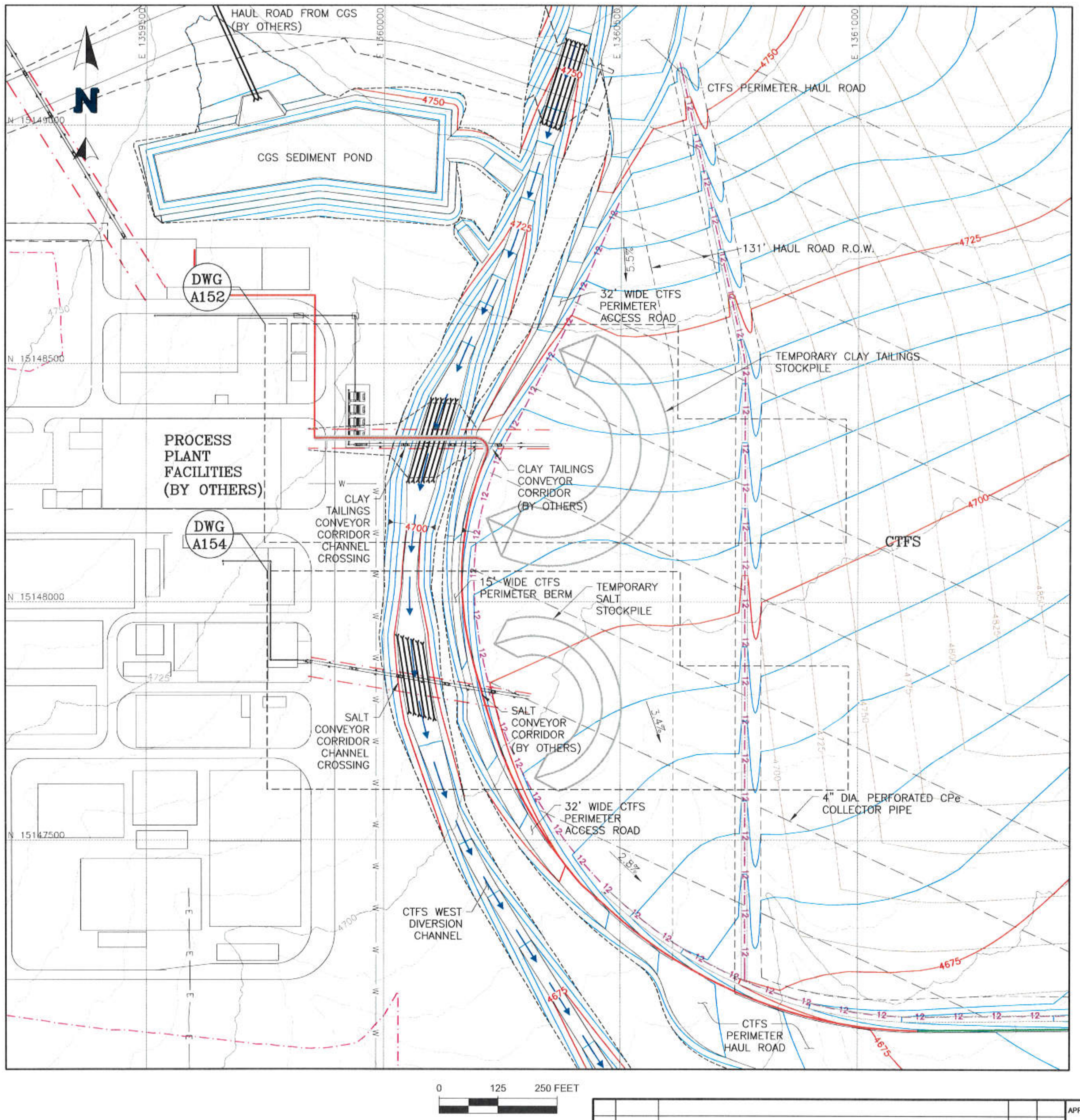
PROJECT
THACKER PASS PROJECT

TITLE
PERIMETER ROAD PLAN AND PROFILE
(SHEET 4 OF 4)

FILENAME
0385.000.073P

DRAWING NO.
A132

REVISION
0



LEGEND:

⁓	EXISTING 5 FT GROUND CONTOURS
4500	EXISTING CONTOUR ELEVATION
⁓	5 FT GROUND CONTOURS
4500	CONTOUR ELEVATION
⁓	5 FT CTFS CONTOURS
4500	CTFS CONTOUR ELEVATION
—W—	WATER LINE (BY OTHERS)
- - -	SURFACE DAYLIGHT
- - -	SURFACE DAYLIGHT BY OTHERS
>—<	CULVERT
— — —	4" DIA. PERFORATED CPe COLLECTION PIPE
—12—·—12—	12" DIA. PERFORATED CPe COLLECTION HEADER PIPE
—	8" DIA. HDPE DR 17 PUMPBACK PIPE
—	8" DIA. HDPE DR 21 PUMPBACK PIPE
▨	8" DIA. HDPE PUMPBACK PIPE SLEEVED IN 12" DIA. HDPE DR 32 CONTAINMENT PIPE
→ →	MAJOR STORMWATER DRAINAGE FLOW PATH

MATTHEW T. HALEY
Exp.06/30/21
No. 21993
Matt Haley
4/2/20

TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: MTH
DRAWN BY: RL

DISCLAIMER

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NewFields
CLIENT: LITHIUM NEVADA CORP.
PROJECT: THACKER PASS PROJECT
TITLE: TEMPORARY STOCKPILE AREA PLAN
FILENAME: 0385.000.094M
DRAWING NO.: A150
REVISION: 0

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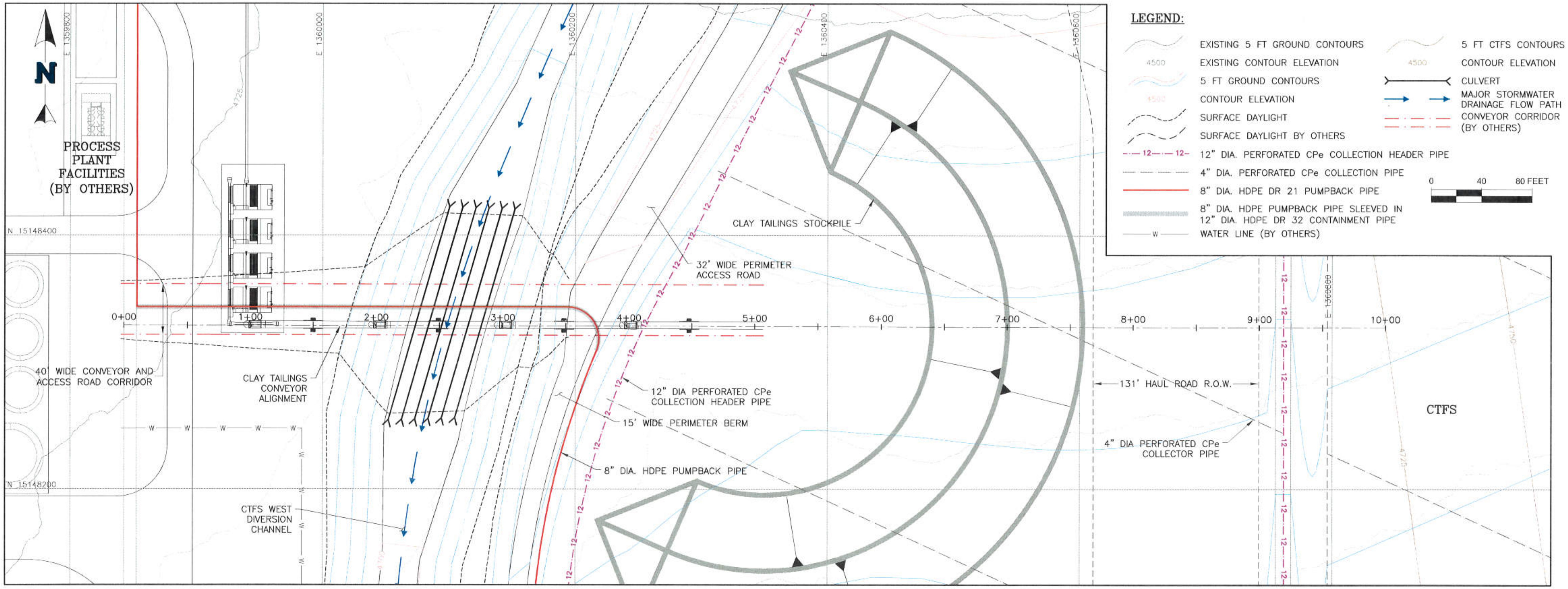
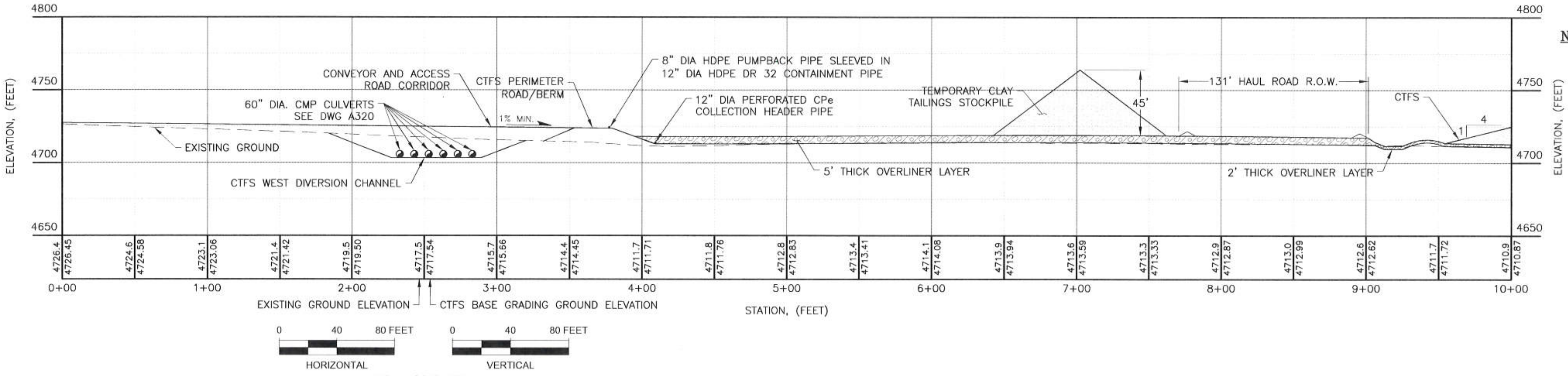


LEGEND:

EXISTING 5 FT GROUND CONTOURS	5 FT CTFS CONTOURS
4500 EXISTING CONTOUR ELEVATION	4500 CONTOUR ELEVATION
5 FT GROUND CONTOURS	CULVERT
4500 CONTOUR ELEVATION	MAJOR STORMWATER DRAINAGE FLOW PATH
SURFACE DAYLIGHT	CONVEYOR CORRIDOR (BY OTHERS)
SURFACE DAYLIGHT BY OTHERS	
-12-12- 12" DIA. PERFORATED CPe COLLECTION HEADER PIPE	
4" DIA. PERFORATED CPe COLLECTION PIPE	
8" DIA. HDPE DR 21 PUMPBACK PIPE	
8" DIA. HDPE PUMPBACK PIPE SLEEVED IN 12" DIA. HDPE DR 32 CONTAINMENT PIPE	
—W— WATER LINE (BY OTHERS)	

0 40 80 FEET



NOTE:

1. TAPER OVERLINER THICKNESS FROM 5' TO 2' THICK OUTSIDE OF STOCKPILE AND HAULAGE AREA.

MATTHEW T. HALEY
Exp. 06/30/21
CIVIL
No. 21993
Matt Haley
4/2/20

TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: MTH
DRAWN BY: RL

DISCLAIMER

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NewFields

CLIENT: LITHIUM NEVADA CORP.
PROJECT: THACKER PASS PROJECT
TITLE: CLAY TAILINGS STOCKPILE CONVEYOR CORRIDOR PLAN & PROFILE
FILENAME: 0385.000.093P
DRAWING NO.: A152
REVISION: 0

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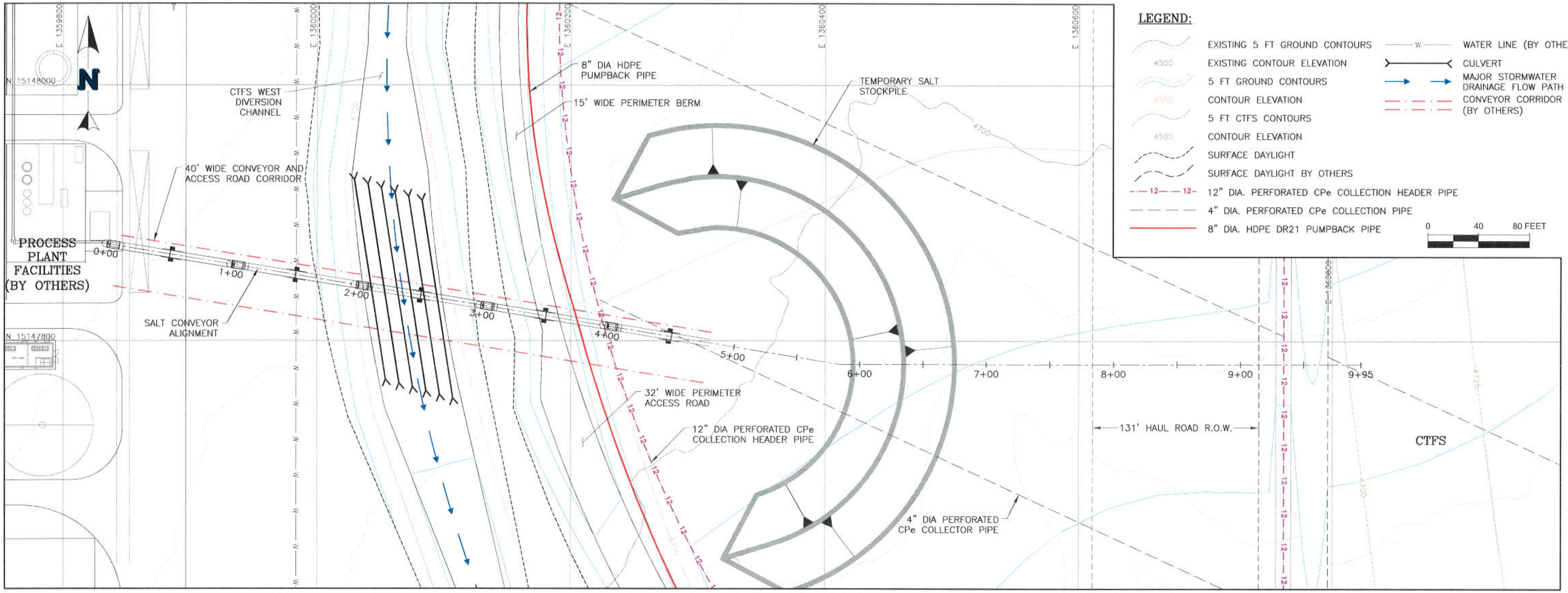

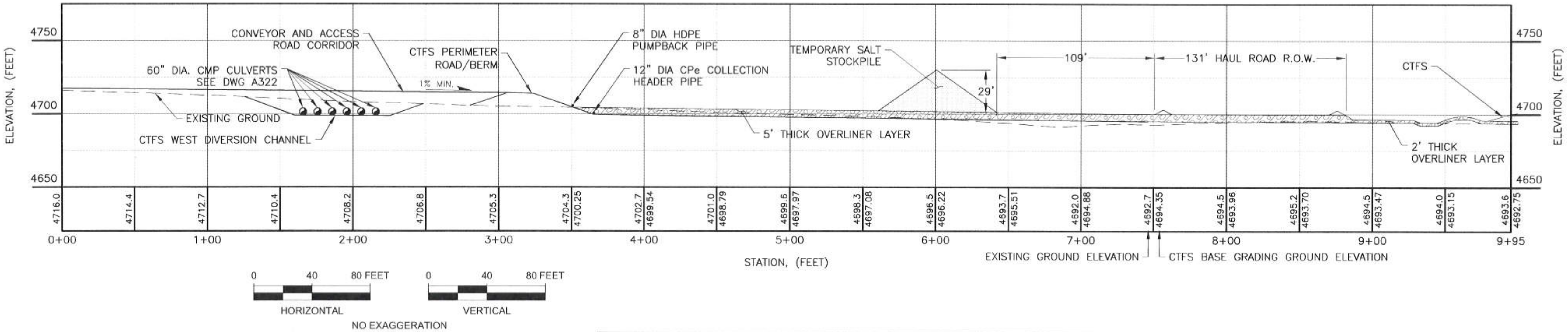

NOTE:

1. TAPER OVERLINER THICKNESS FROM 5' TO 2' THICK OUTSIDE OF STOCKPILE AND HAULAGE AREA.

PROFESSIONAL ENGINEER STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No. 21993
Matt Haley
4/2/20

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: MTH
DRAWN BY: RL

DISCLAIMER

NewFields

CLIENT: LITHIUM NEVADA CORP.
PROJECT: THACKER PASS PROJECT
TITLE: SALT STOCKPILE CONVEYOR CORRIDOR PLAN & PROFILE
FILENAME: 0385.000.093P
DRAWING NO.: A154
REVISION: 0

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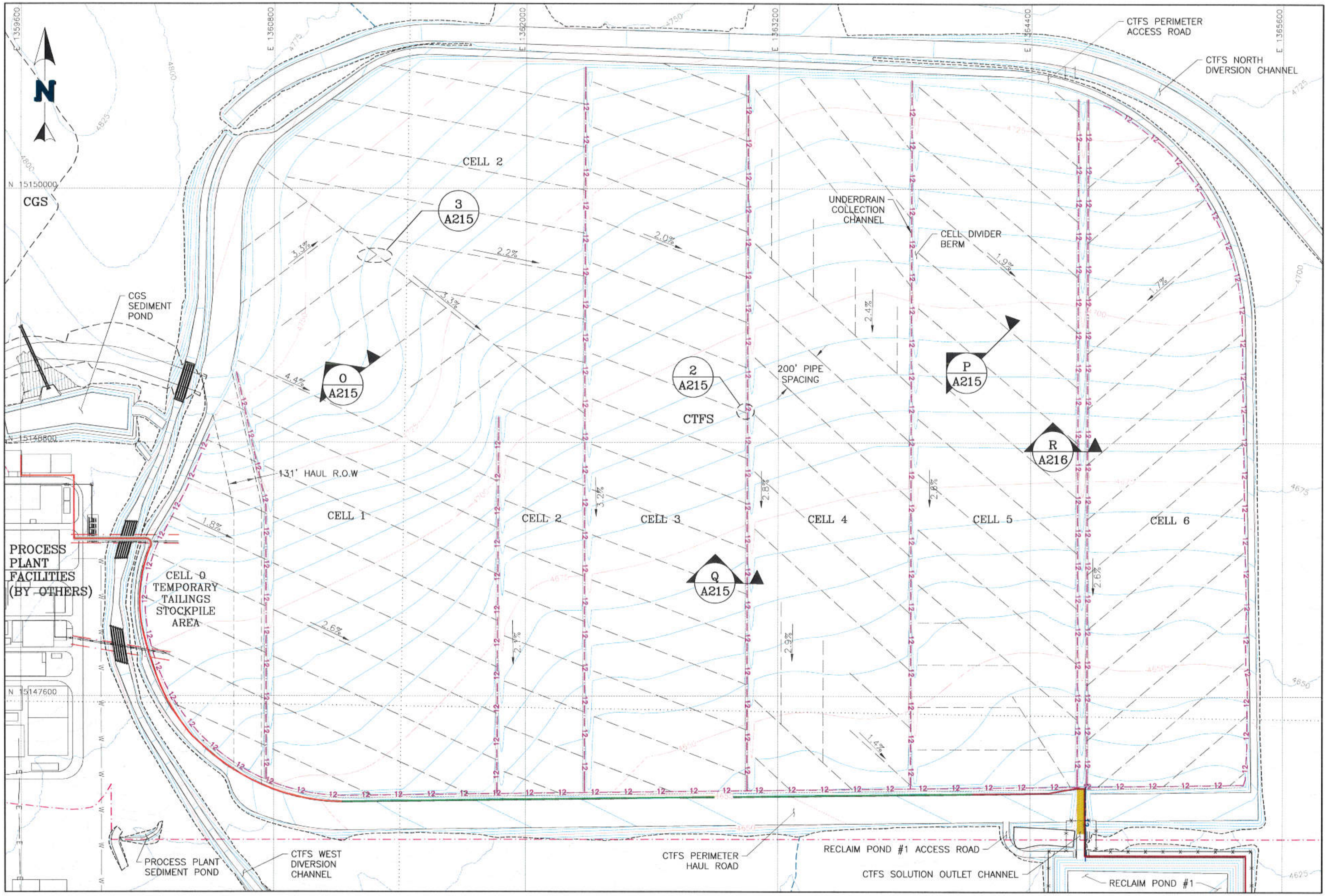

0 240 480 FEET

LEGEND:

- EXISTING 5 FT GROUND CONTOURS
- 4500 EXISTING CONTOUR ELEVATION
- 5 FT GROUND CONTOURS
- 4550 CONTOUR ELEVATION
- SURFACE DAYLIGHT
- SURFACE DAYLIGHT BY OTHERS
- EXISTING DRAINAGES
- FUTURE PLANT EXPANSION
- SECTION LINES
- 20 SECTION NUMBER
- —W— WATER LINE (BY OTHERS)
- —x—x— FENCE
- CONVEYOR CORRIDOR (BY OTHERS)
- CULVERT(S)
- 4" DIA. PERFORATED CPe COLLECTOR PIPE
- —12—12— 12" DIA. PERFORATED CPe COLLECTION HEADER PIPE
- —12—12— 12" DIA. HDPE DR 17 OUTLET PIPE
- 8" DIA. HDPE DR 11 PUMPBACK PIPE
- 8" DIA. HDPE DR 17 PUMPBACK PIPE
- 8" DIA. HDPE DR 21 PUMPBACK PIPE
- 8" DIA. HDPE PUMPBACK PIPE SLEEVED IN 12" DIA HDPE DR 32 CONTAINMENT PIPE
- 36" DIA. HDPE DR 17 OVERFLOW PIPE

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.

PROFESSIONAL ENGINEER STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No.21993
Matt Haley
4/2/20

TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: RL
DRAWN BY: RL

DISCLAIMER

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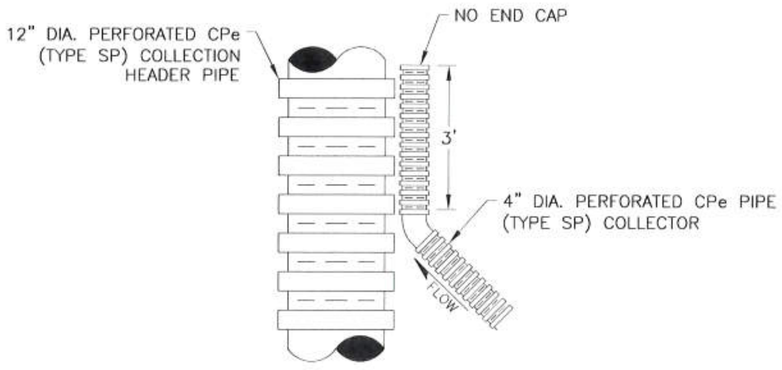
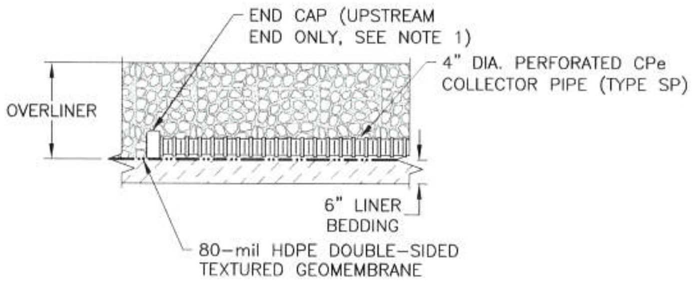
NewFields
CLIENT: LITHIUM NEVADA CORP.
PROJECT: THACKER PASS PROJECT
TITLE: CTFS UNDERDRAIN PLAN
FILENAME: 0385.000.010M
DRAWING NO.: A210
REVISION: 0

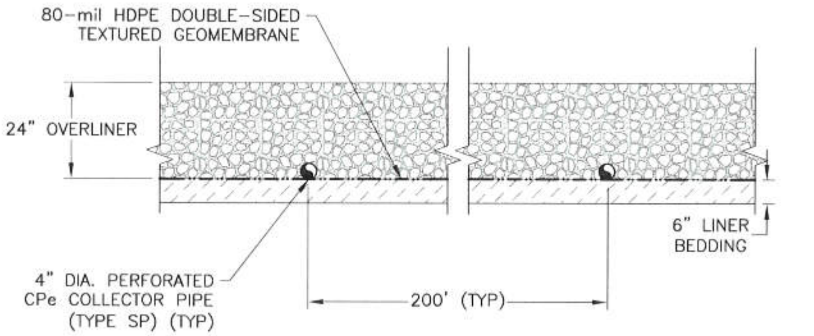
P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\A-CAD\DWGS\0385.000.010M.dwg-4/1/2020 10:05 AM



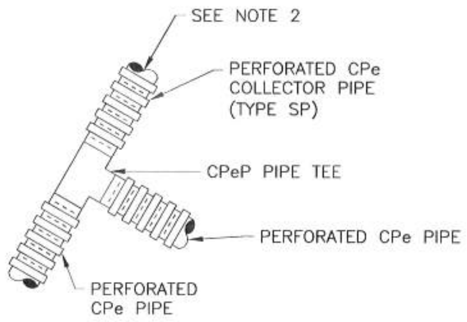
2
A210
PIPE INTERSECTION



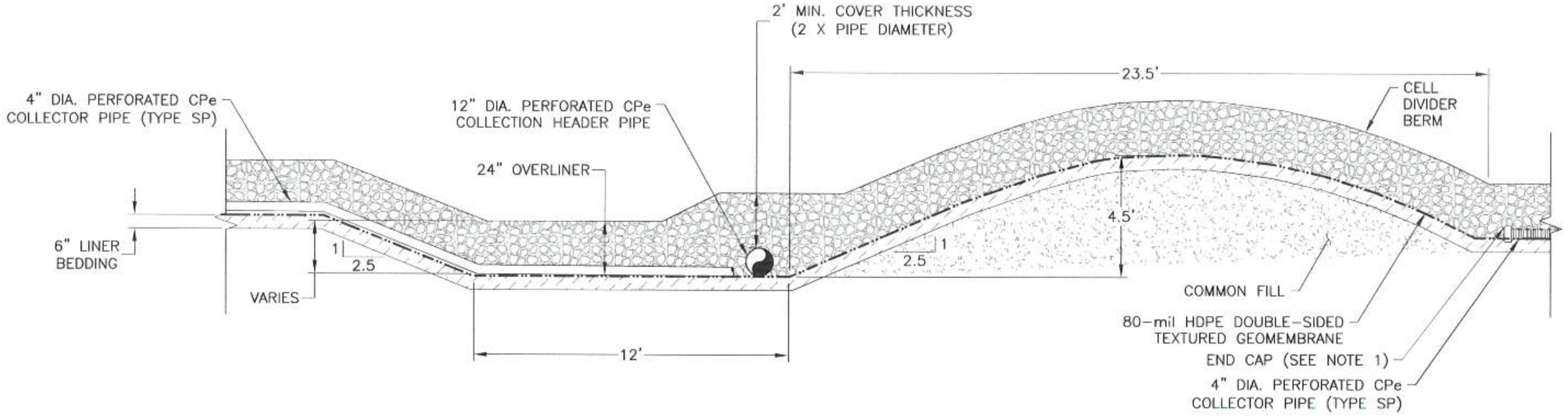
O
A210
TYPICAL CPe PIPE TERMINATION



P
A210
TYPICAL 4" DIA. PERFORATED CPe COLLECTOR PIPE SECTION



3
A210
3
A222
TYPICAL TEE CPE PIPE INTERSECTION



Q
A210
TYPICAL UNDERDRAIN COLLECTION CHANNEL AND CELL DIVIDER BERM

NOTES:

1. ALL UPGRADIENT ENDS OF PIPES SHALL BE CAPPED.
2. PIPE DIAMETER AS SHOWN ON PLAN VIEW.

MATTHEW T.
HALEY
Exp.06/30/21
CIVIL
Matt Haley
4/2/20
No.21993

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\A-CAD\DWGS\0385.000.020M.dwg 4/1/2020 10:05 AM

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: RL
DRAWN BY: RL

DISCLAIMER

NewFields

CLIENT: LITHIUM NEVADA CORP.

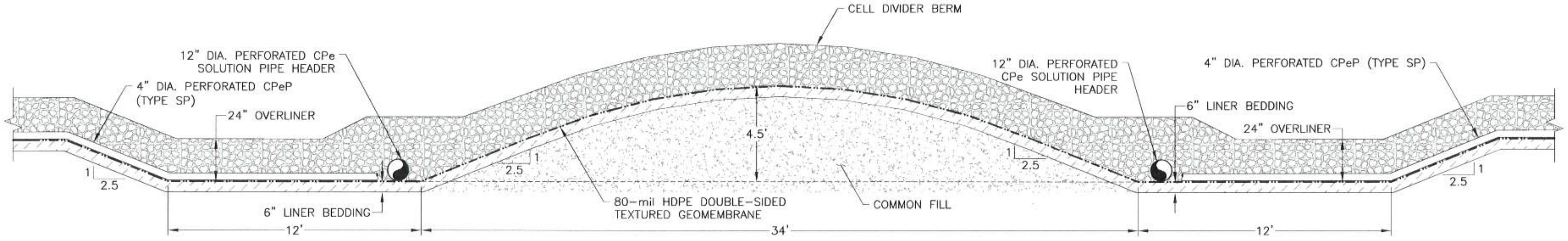
PROJECT: THACKER PASS PROJECT

TITLE: UNDERDRAIN SECTIONS AND DETAILS
(1 OF 2)

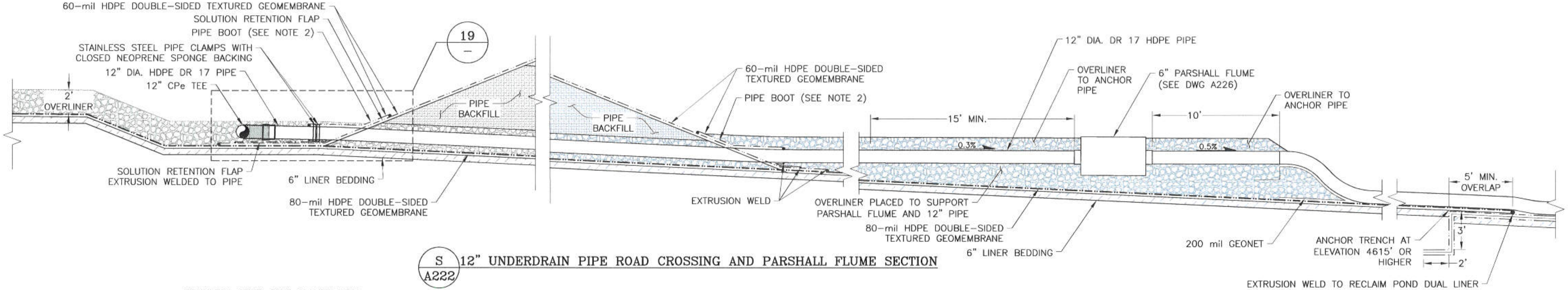
FILENAME: 0385.000.020M

DRAWING NO.: A215

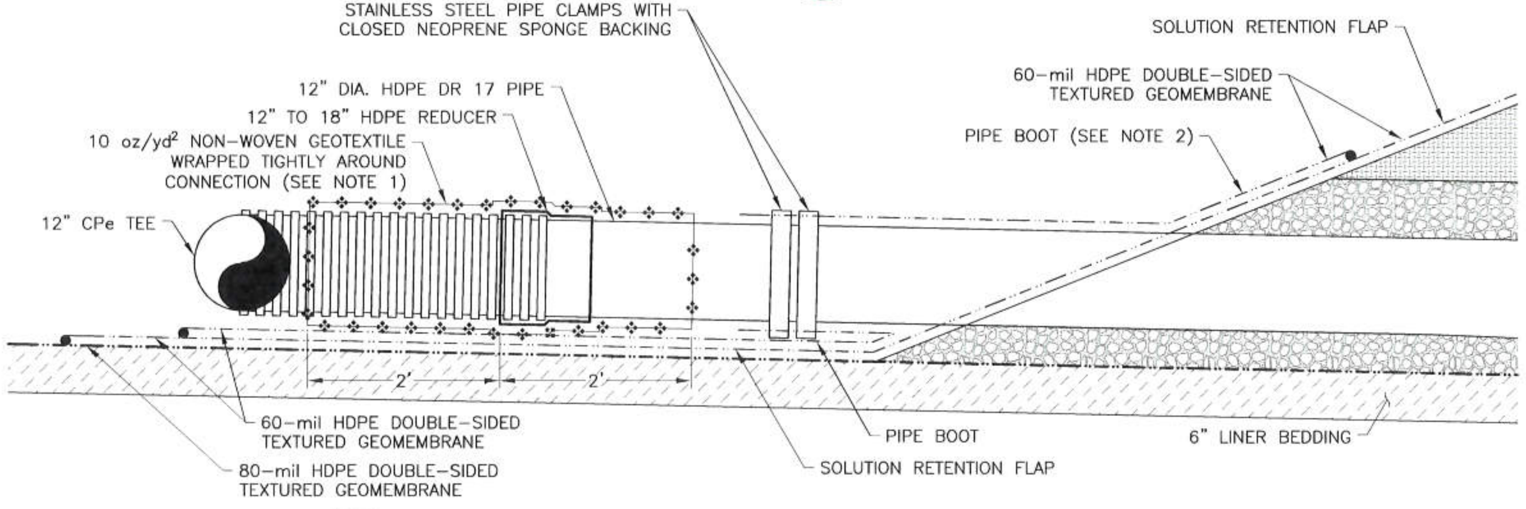
REVISION: 0



R
A210
DUAL SOLUTION HEADER PIPE AND CELL DIVIDER BERM



S
A222
12" UNDERDRAIN PIPE ROAD CROSSING AND PARSHALL FLUME SECTION



19
–
CPE TO HDPE CONNECTION
2' OVERLINER NOT SHOWN

NOTES:

1. THE 12" DIA. CPe PIPE END SHALL BE INSERTED INTO THE 12" X 18" HDPE DR 17 REDUCER AND DOUBLE WRAPPED TIGHTLY WITH 10 oz/yd2 NON-WOVEN GEOTEXTILE EXTENDING 2 FEET MINIMUM ON EACH SIDE OF THE CONNECTION.
2. PRE-MANUFACTURED PIPE BOOTS SHALL BE USED IN PLACE OF FIELD-FITTED PIPE BOOTS WHEREVER POSSIBLE.

PROFESSIONAL ENGINEER-STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No.21993
Matt Haley
4/2/20

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: MTH
DRAWN BY: RL

NewFields
CLIENT: LITHIUM NEVADA CORP.
PROJECT: THACKER PASS PROJECT
TITLE: UNDERDRAIN SECTIONS AND DETAILS
(2 OF 2)
FILENAME: 0385.000.089D
DRAWING NO.: A216
REVISION: 0

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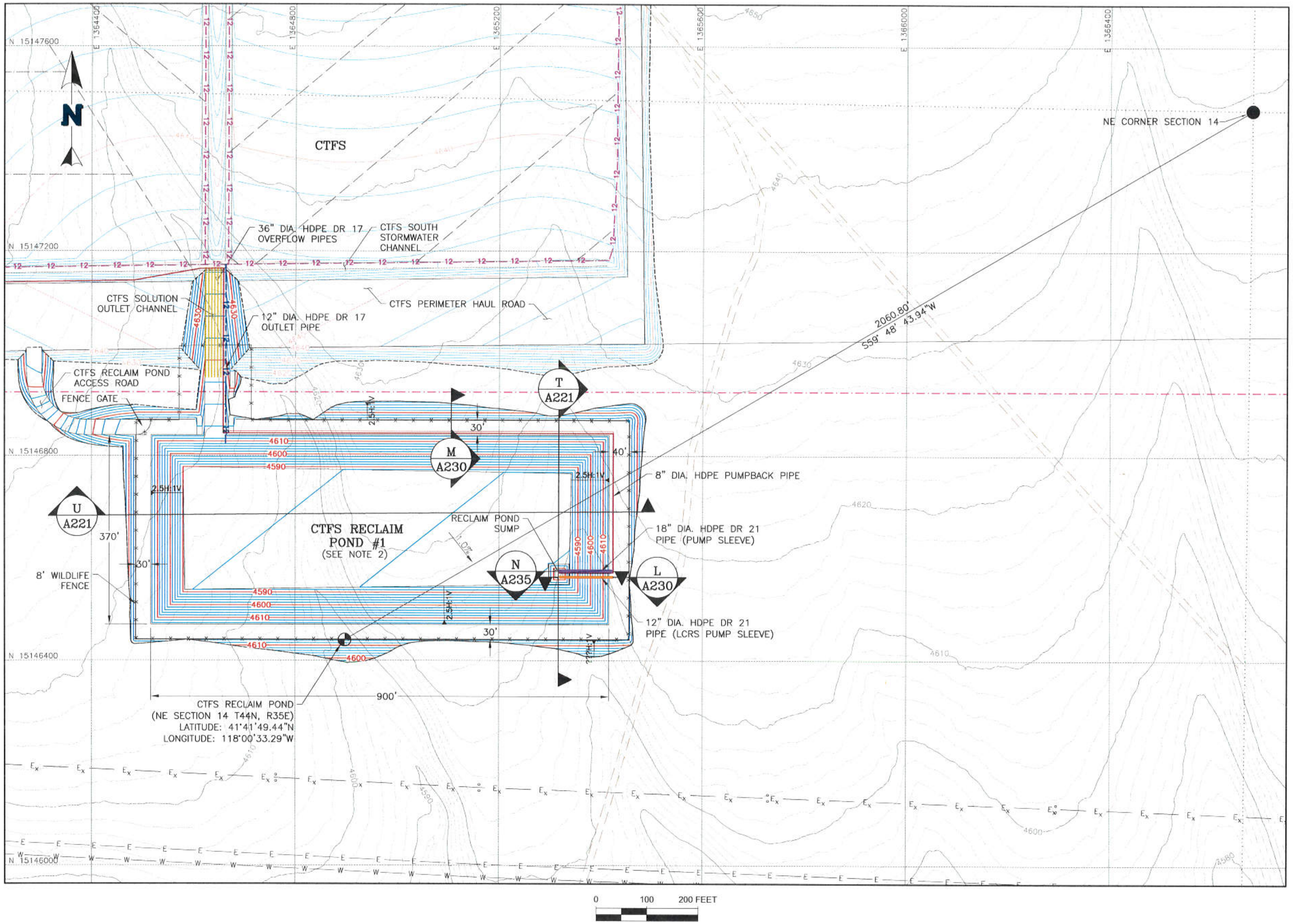

LEGEND:

	EXISTING 2 FT GROUND CONTOURS
4500	EXISTING CONTOUR ELEVATION
	2 FT GROUND CONTOURS
4500	GROUND CONTOUR ELEVATION
	2 FT GROUND CONTOURS
4500	GROUND CONTOUR ELEVATION
	SURFACE DAYLIGHT
	EXISTING ROADS
—x—x—x—	8' WILDLIFE FENCE
	FUTURE PLANT EXPANSION
	SECTION LINES
— Ex —	EXISTING POWER LINE
:	EXISTING POWER POLES
— W —	WATER LINE (BY OTHERS)
— E —	POWER LINE (BY OTHERS)
●	SECTION CORNER
	DEEPEST POINT OF POND GRADING
	4" DIA. PERFORATED CPe COLLECTOR PIPE
—12—— 12—	12" DIA. PERFORATED CPe COLLECTION HEADER PIPE
---12---12-	12" DIA. HDPE DR 17 OUTLET PIPE
	8" DIA. HDPE DR 11 PUMPBACK PIPE
	36" DIA. HDPE DR 17 OVERFLOW PIPE
	18" DIA. HDPE DR 21 PIPE (PUMP SLEEVE)
	12" DIA. HDPE DR 21 PIPE (LCRS PUMP SLEEVE)

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. THE RECLAIM POND IS DESIGNED TO STORE THE 100YR-24HR STORM EVENT VOLUME PLUS 3 FEET OF FREEBOARD.

MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No.21993
Matt Haley
4/2/20

TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\A-CAD\DWGS\0385.000.012M.dwg-4/1/2020 10:07 AM

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: MTH
DRAWN BY: RL

DISCLAIMER

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NewFields

CLIENT
LITHIUM NEVADA CORP.

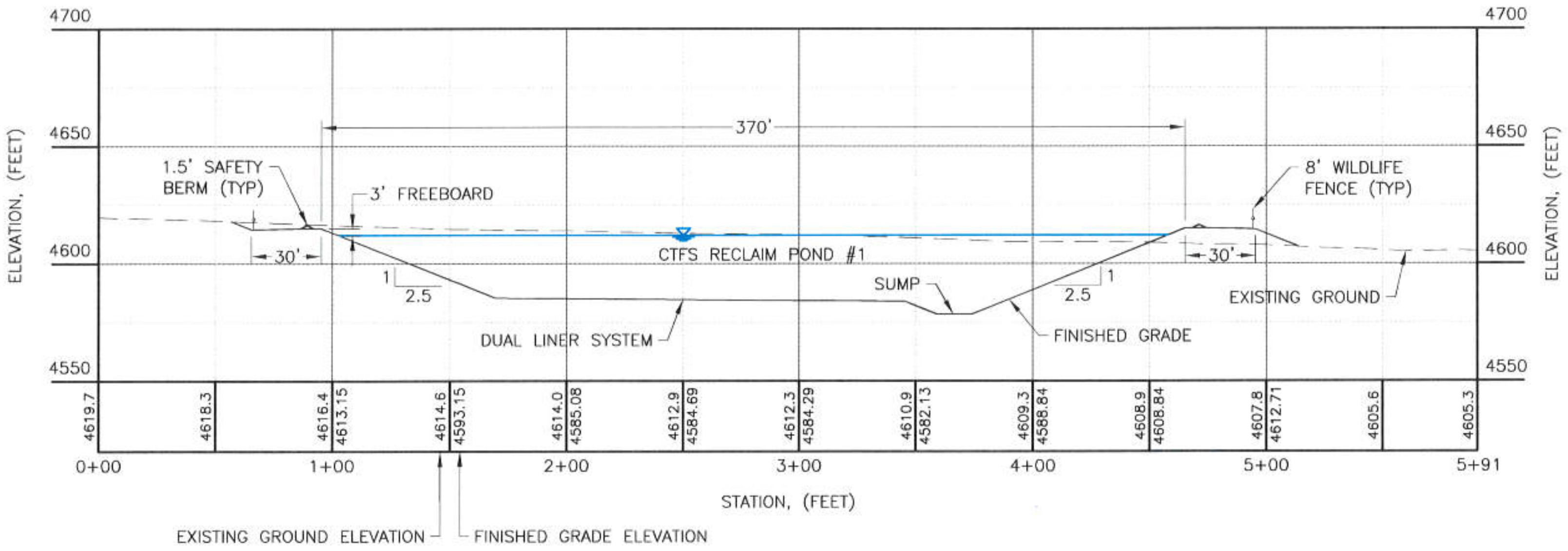
PROJECT
THACKER PASS PROJECT

TITLE
CTFS RECLAIM POND
GRADING AND PIPING PLAN

FILENAME
0385.000.012M

DRAWING NO.
A220

REVISION
0

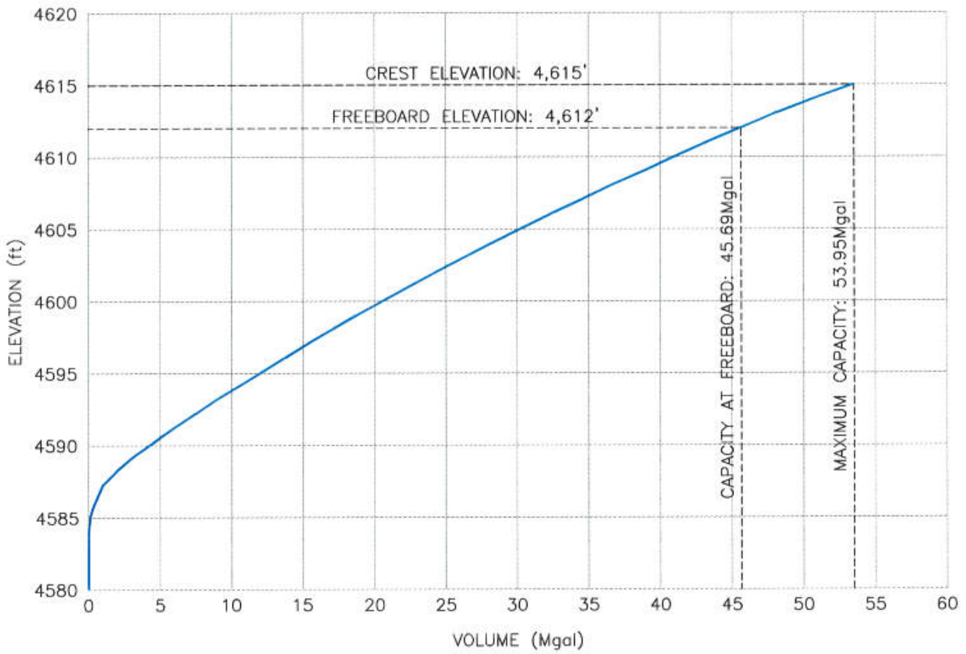


T
A220
CTFS RECLAIM POND CROSS SECTION (N-S)

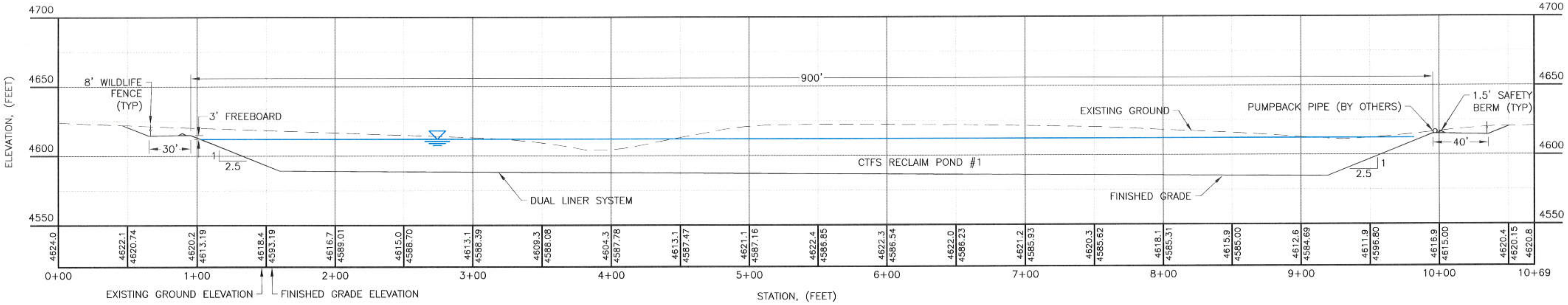
0 40 80 FEET
HORIZONTAL

0 40 80 FEET
VERTICAL

NO EXAGGERATION



CTFS RECLAIM POND FILLING CURVE



U
A220
CTFS RECLAIM POND CROSS SECTION (W-E)

0 40 80 FEET
HORIZONTAL

0 40 80 FEET
VERTICAL

NO EXAGGERATION

MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No.21993
Matt Haley
4/2/20

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: MTH
DRAWN BY: RL

DISCLAIMER

NewFields
CLIENT LITHIUM NEVADA CORP.
PROJECT THACKER PASS PROJECT
TITLE CTFS RECLAIM POND SECTIONS AND DETAILS
FILENAME 0385.000.077D
DRAWING NO. A221
REVISION 0

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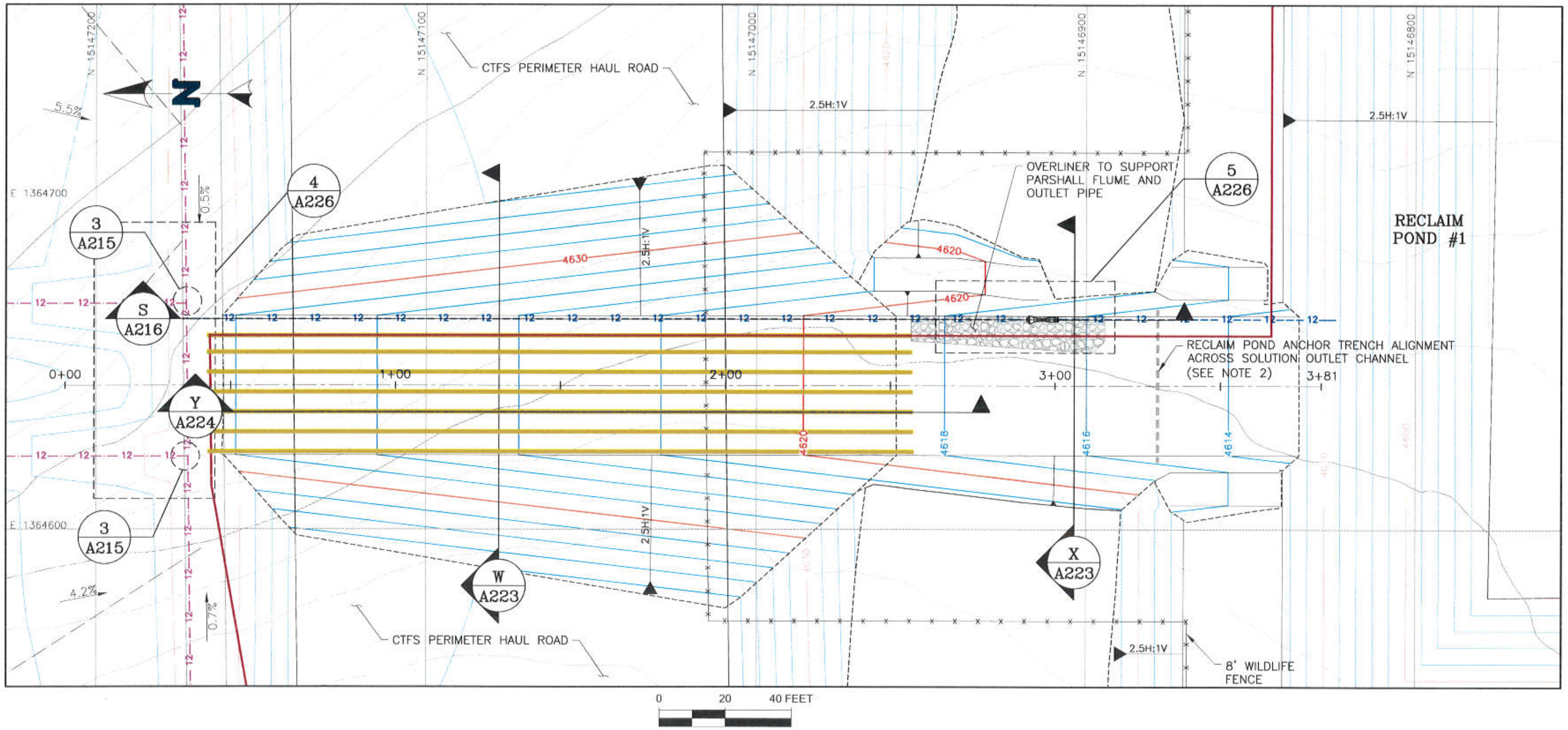

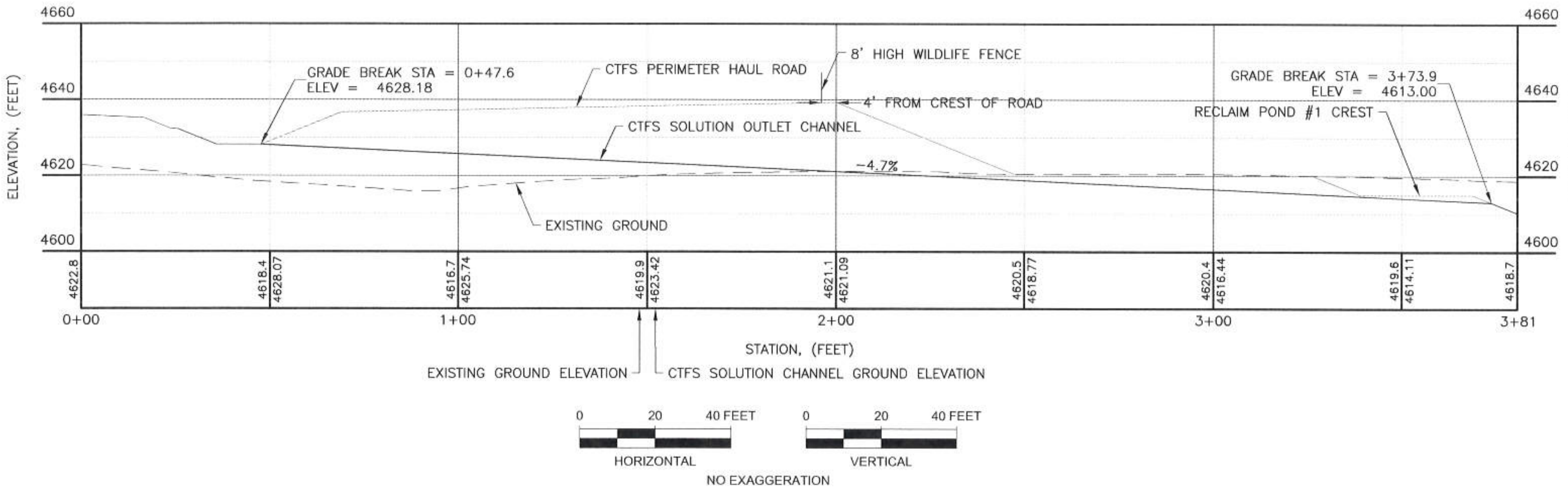

LEGEND:

∿	EXISTING 2 FT GROUND CONTOURS
4500	EXISTING CONTOUR ELEVATION
∿	2 FT GROUND CONTOURS
4500	GROUND CONTOUR ELEVATION
∿	2 FT GROUND CONTOURS
4500	GROUND CONTOUR ELEVATION
- - -	SURFACE DAYLIGHT
—×—×—×—	8' WILDLIFE FENCE
— — — —	4" DIA. PERFORATED CPe COLLECTOR PIPE
-·—12—·—12-	12" DIA. PERFORATED CPe COLLECTION HEADER PIPE
---12---12-	12" DIA. HDPE DR 17 OUTLET PIPE
———	8" DIA. HDPE DR 11 PUMPBACK PIPE
▬	36" DIA. HDPE DR 17 OVERFLOW PIPE
▨	OVERLINER

NOTE:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. ANCHOR TRENCH SHALL BE EXCAVATED AT OR ABOVE THE 4615' ELEVATION ACROSS THE SOLUTION OUTLET CHANNEL. THE SINGLE LAYER FROM THE OUTLET CHANNEL SHALL BE SHINGLED OVER THE TOP AND OVERLAPPING A MINIMUM OF 5FT. SEE SHEET A216 FOR DETAILS.

CTFS SOLUTION OUTLET CHANNEL DEPTH	
STATION (FT)	MIN. CHANNEL DEPTH (FT)
0+62 TO 2+70	3
2+70 TO 2+90	TRANSITION
2+90 TO 3+63	2

PROFESSIONAL ENGINEER-STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
Matt Haley
4/2/20
CIVIL
No.21993

TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

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REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: MTH
DRAWN BY: RL

DISCLAIMER

NewFields

CLIENT
LITHIUM NEVADA CORP.

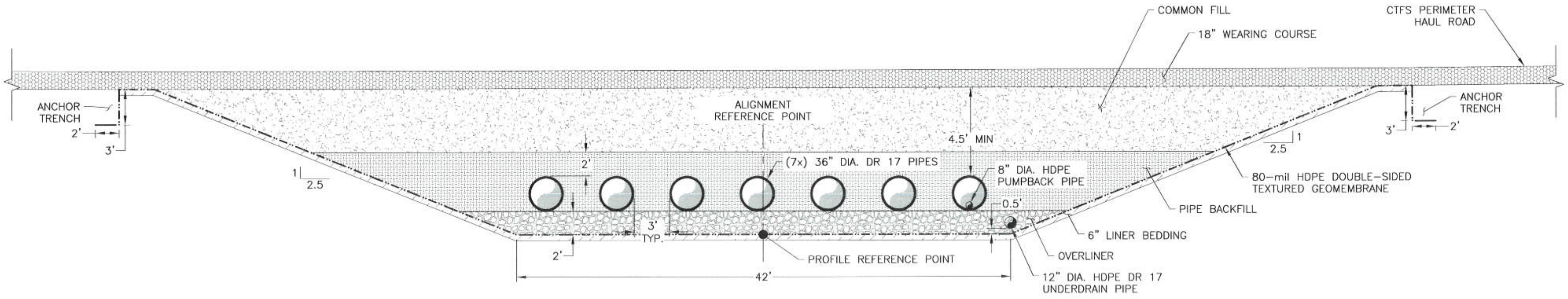
PROJECT
THACKER PASS PROJECT

TITLE
CTFS SOLUTION OUTLET CHANNEL
PLAN AND PROFILE

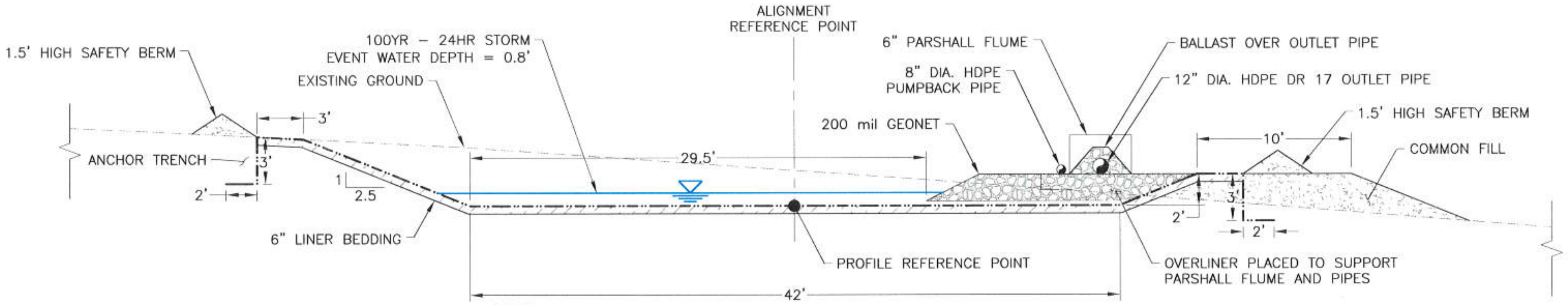
FILENAME
0385.000.085P

DRAWING NO.
A222

REVISION
0



W
A222
CTFS SOLUTION CHANNEL W TO E CROSS SECTION



X
A222
CTFS SOLUTION CHANNEL W TO E CROSS SECTION

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MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No.21993
Matt Haley
4/2/20

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: MTH
DRAWN BY: RL

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CLIENT LITHIUM NEVADA CORP.

PROJECT THACKER PASS PROJECT

TITLE CTFS SOLUTION OUTLET CHANNEL SECTIONS AND DETAILS (1 OF 2)

FILENAME 0385.000.090D
DRAWING NO. A223
REVISION 0

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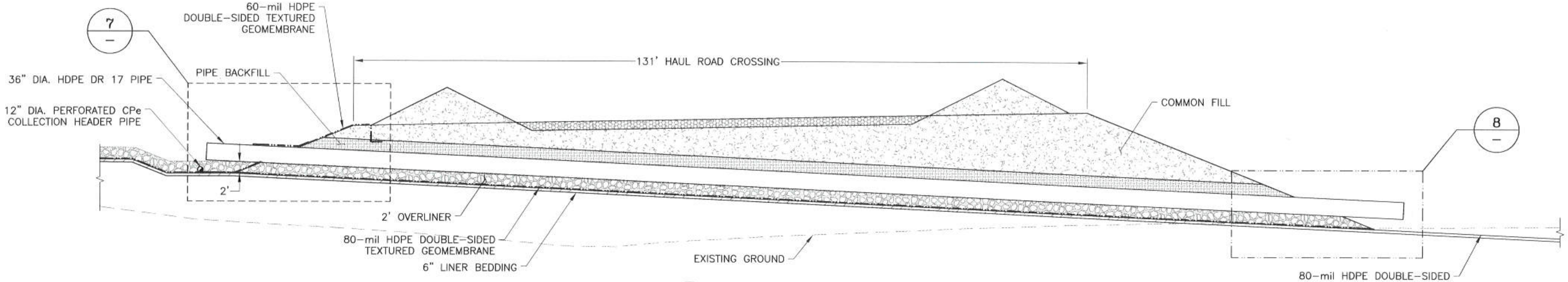

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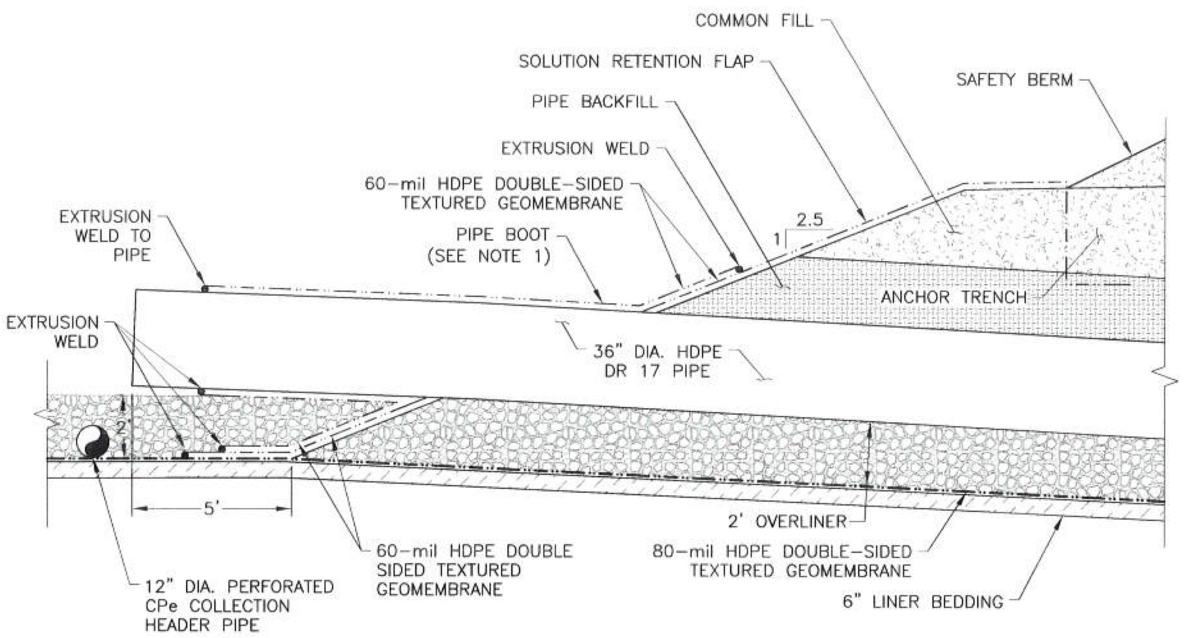
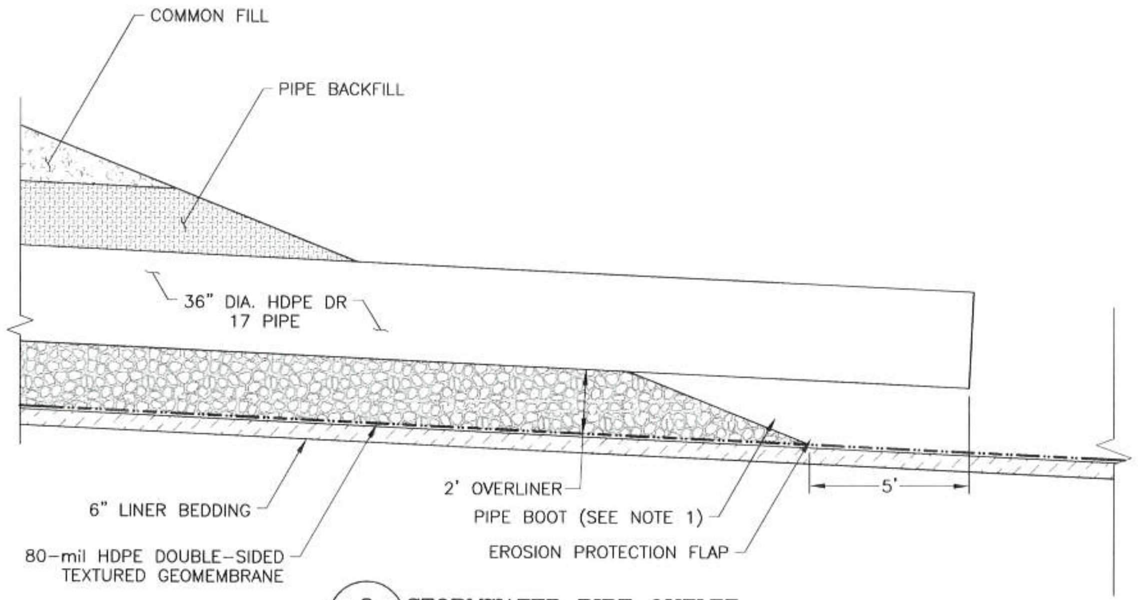
A222
STORMWATER OVERFLOW PIPE TYPICAL SECTION



7
–
UPSTREAM SOLUTION RETENTION FLAP



8
–
STORMWATER PIPE OUTLET

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4/2/20
No. 21993

NOTES:

1. PRE–MANUFACTURED PIPE BOOTS SHALL BE USED IN PLACE OF FIELD–FITTED PIPE BOOTS WHEREVER POSSIBLE.

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

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DESIGNED BY: MTH
DRAWN BY: RL

DISCLAIMER

NewFields
CLIENT: LITHIUM NEVADA CORP.
PROJECT: THACKER PASS PROJECT
TITLE: CTFS SOLUTION OUTLET CHANNEL SECTIONS AND DETAILS (2 OF 2)
FILENAME: 0385.000.095D
DRAWING NO.: A224
REVISION: 0

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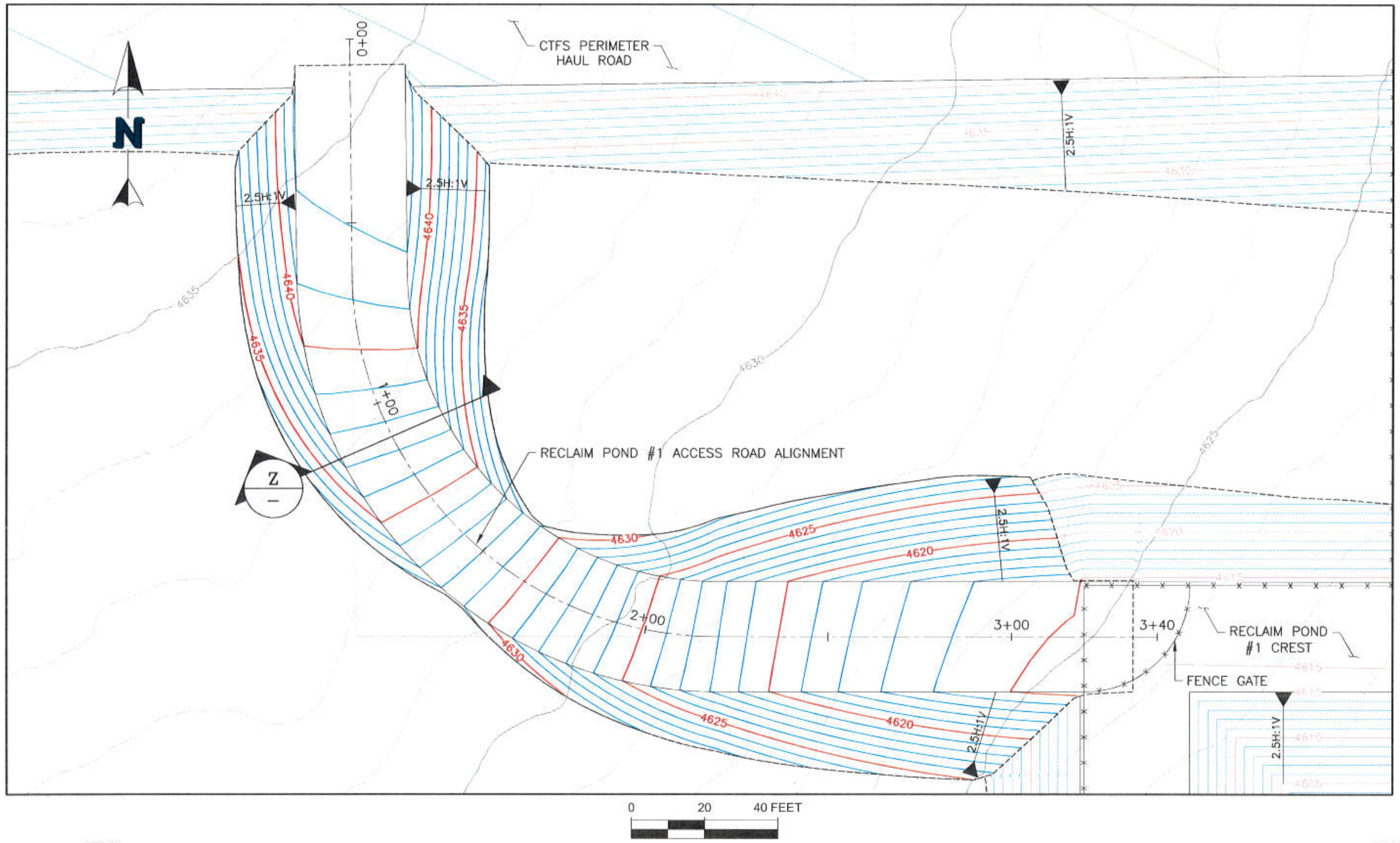
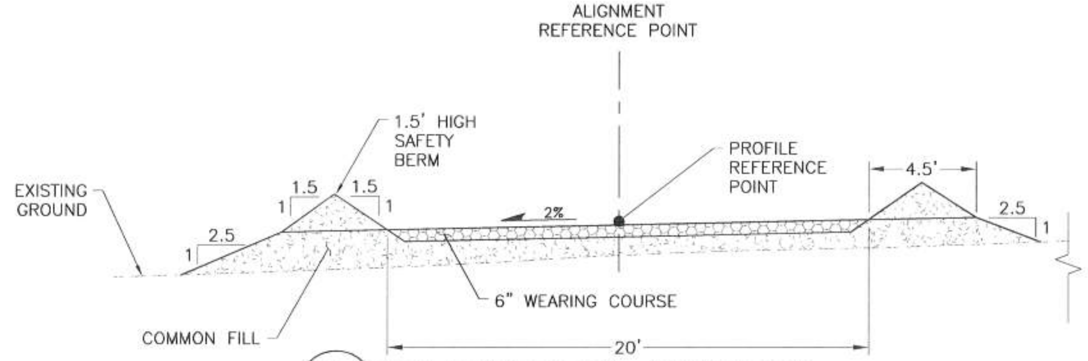


LEGEND:

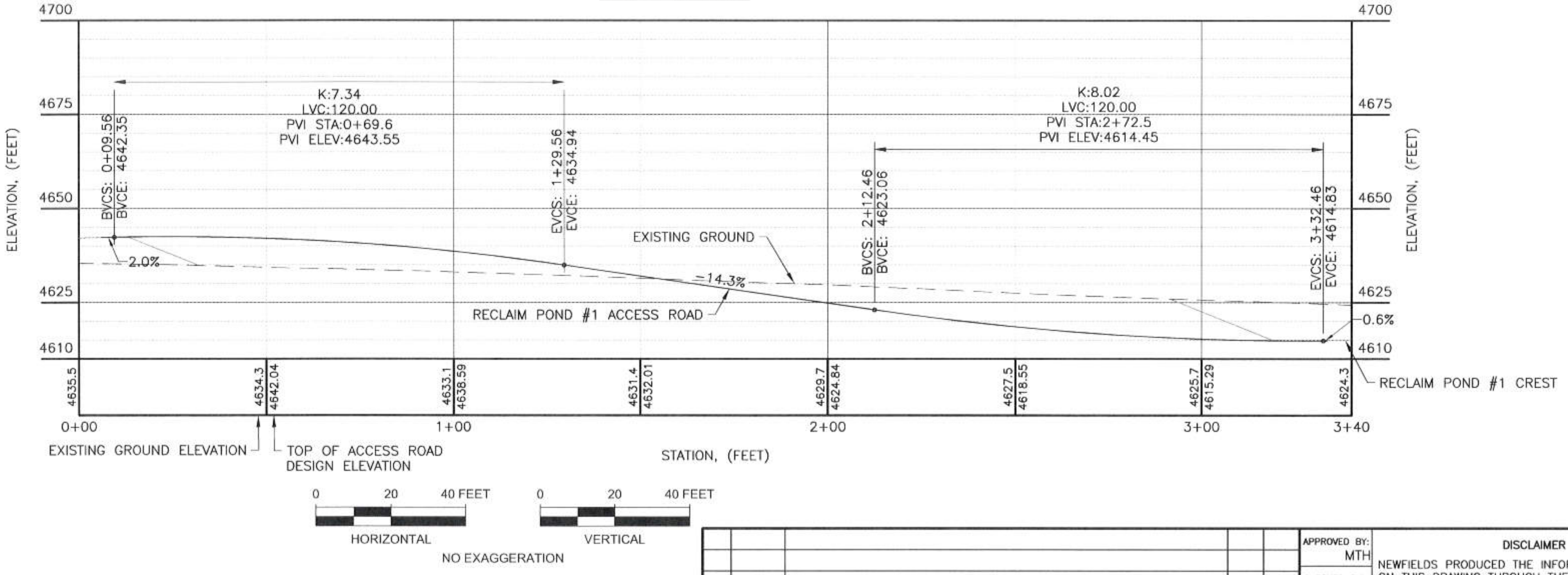
	EXISTING 1 FT GROUND CONTOURS
4500	EXISTING CONTOUR ELEVATION
	1 FT CTFS RECLAIM POND ACCESS ROAD CONTOURS
4500	GROUND CONTOUR ELEVATION
	1 FT GROUND CONTOURS
4500	GROUND CONTOUR ELEVATION
	SURFACE DAYLIGHT
—×—×—×—	8' WILDLIFE FENCE
··········	SECTION LINES

NOTE:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.



Z — CTFS RECLAIM POND ACCESS ROAD TYPICAL SECTION



TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

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No. 21993

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: MTH
DRAWN BY: RL

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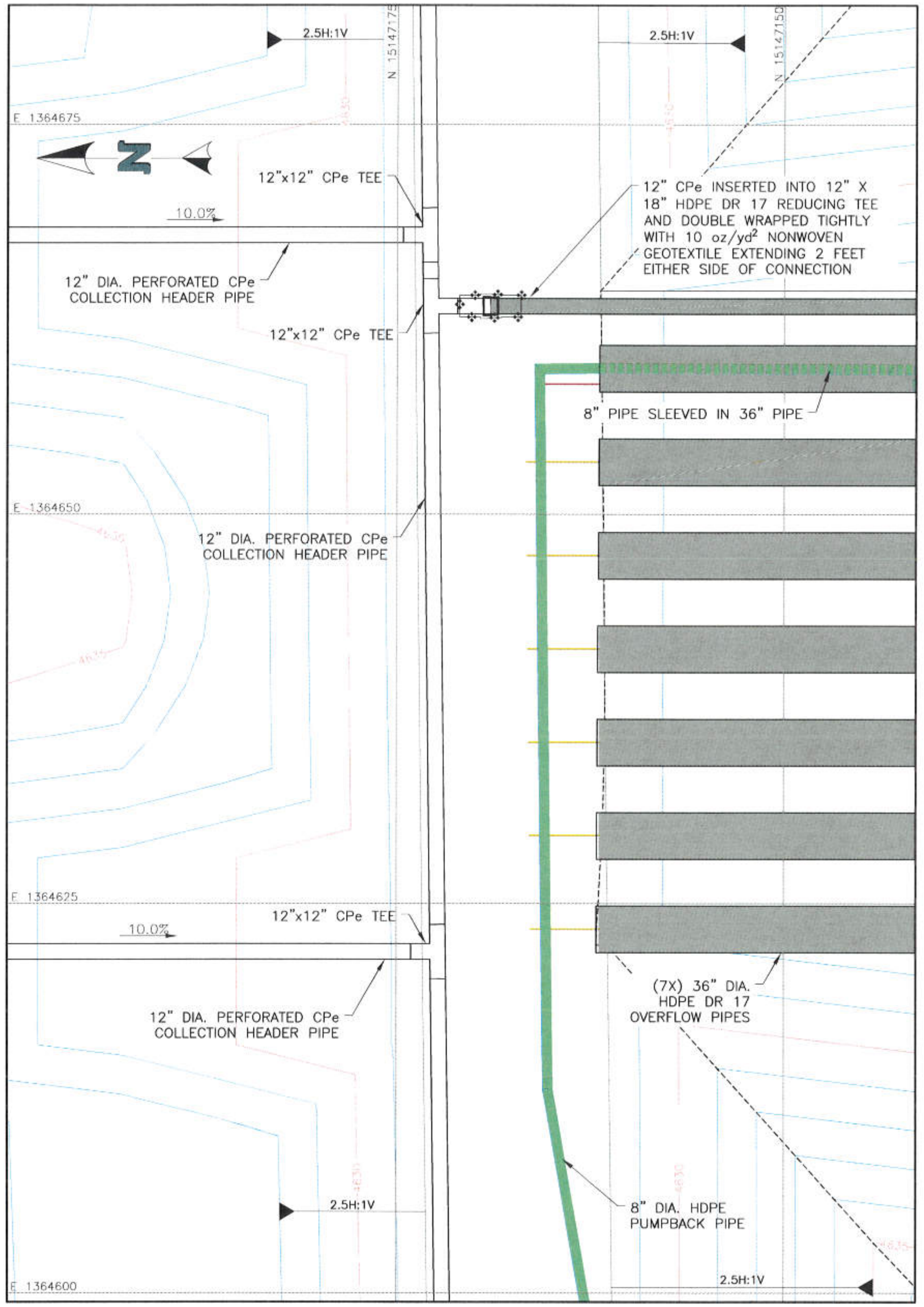
NewFields

CLIENT: LITHIUM NEVADA CORP.

PROJECT: THACKER PASS PROJECT

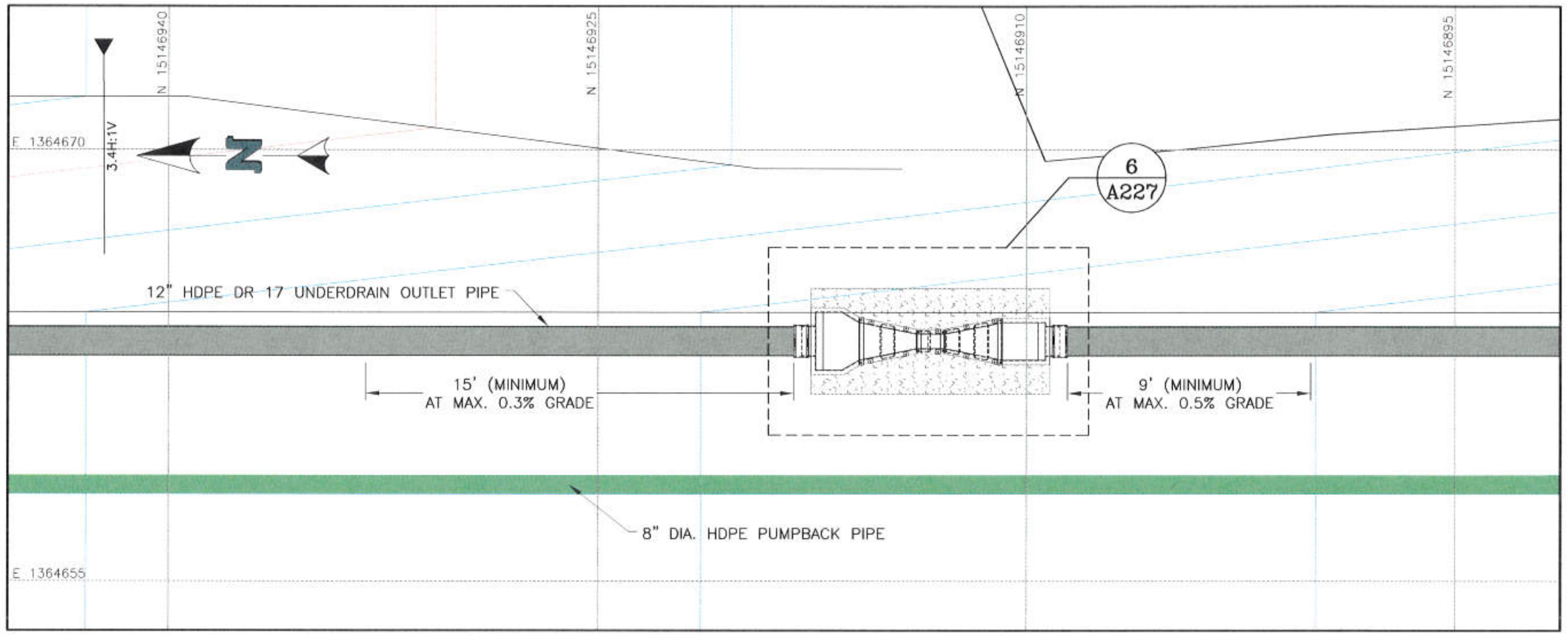
TITLE: CTFS RECLAIM POND ACCESS ROAD PLAN AND PROFILE

FILENAME: 0385.000.086P
DRAWING NO.: A225
REVISION: 0



4 / A222 UNDERDRAIN PIPING OUTLET DETAIL

0 5 10 FEET



5 / A222 PARSHALL FLUME PLAN VIEW

0 3 6 FEET

LEGEND:

1 FT GROUND CONTOURS
4500 GROUND CONTOUR ELEVATION

TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

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No. 21993

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: MTH
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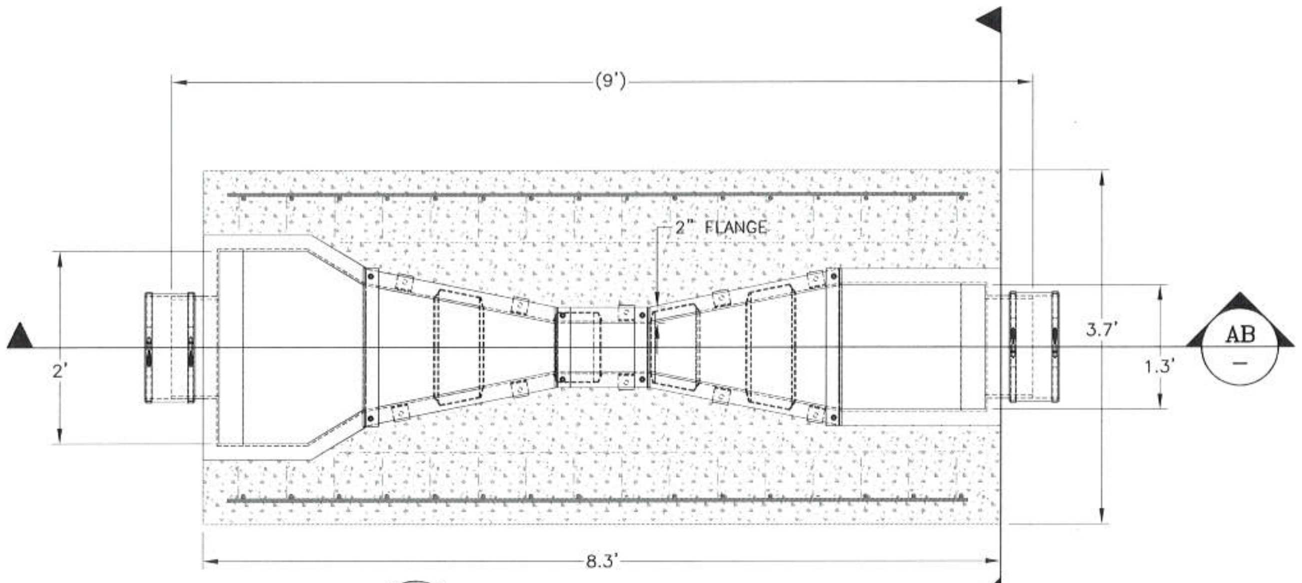
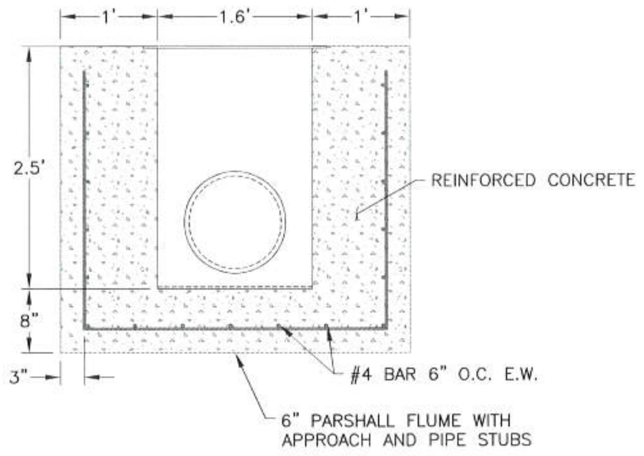
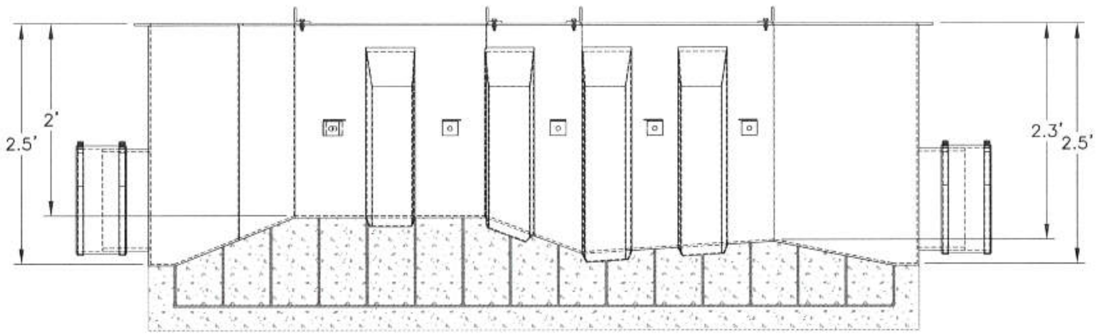
CLIENT: LITHIUM NEVADA CORP.
PROJECT: THACKER PASS PROJECT
TITLE: CTFS SOLUTION OUTLET CHANNEL PLAN
FILENAME: 0385.000.096P
DRAWING NO.: A226
REVISION: 0



6
A226
TYPICAL PARSHALL FLUME PLAN VIEW



AA
–
TYPICAL PARSHALL FLUME CROSS SECTION



AB
–
TYPICAL PARSHALL FLUME LONG SECTION

NOTES:

1. PARSHALL FLUME SHALL HAVE INLET AND OUTLET ADAPTERS AND STUBS, OR APPROVED EQUIVALENT.
2. FLUME SHALL BE INSTALLED LEVEL, BOTH END–TO–END AND SIDE–TO–SIDE, BY USING A BUBBLE LEVEL.
3. PIPES SHALL BE BURIED FOR A MINIMUM OF 20 FEET ON BOTH ENDS OF FLUME ONCE CONSTRUCTION IS COMPLETE.
4. A MINIMUM OF 0.3% AND A MAXIMUM OF 0.5% SLOPE SHALL BE MAINTAINED FOR A MINIMUM DISTANCE OF 15 FEET UPSTREAM AND 10 FEET DOWNSTREAM OF FLUME.
5. CONTRACTOR SHALL PROVIDE THE ENGINEER WITH SHOP DRAWINGS OF THE CONCRETE ENCASEMENT FOR APPROVAL PRIOR TO THE START OF FLUME CONSTRUCTION.
6. INSTALLATION SHALL FOLLOW MANUFACTURER RECOMMENDATIONS.
7. FLUME NEEDS TO BE STRAPPED DOWN OR WEIGHTED DOWN TO PREVENT FLOATING DURING CONCRETE POUR.

PROFESSIONAL ENGINEER STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
Matt Haley
CIVIL
4/2/20
No.21993

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: MTH
DRAWN BY: RL

DISCLAIMER

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NewFields

CLIENT: LITHIUM NEVADA CORP.
PROJECT: THACKER PASS PROJECT
TITLE: PARSHALL FLUME
SECTIONS AND DETAILS
FILENAME: 0385.000.092D
DRAWING NO.: A227
REVISION: 0

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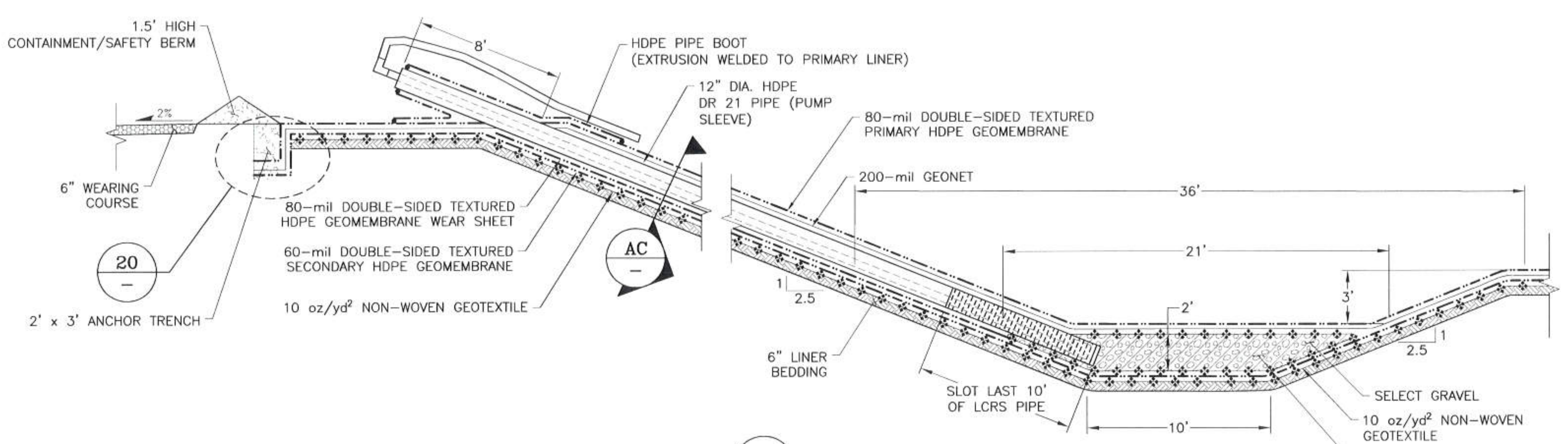
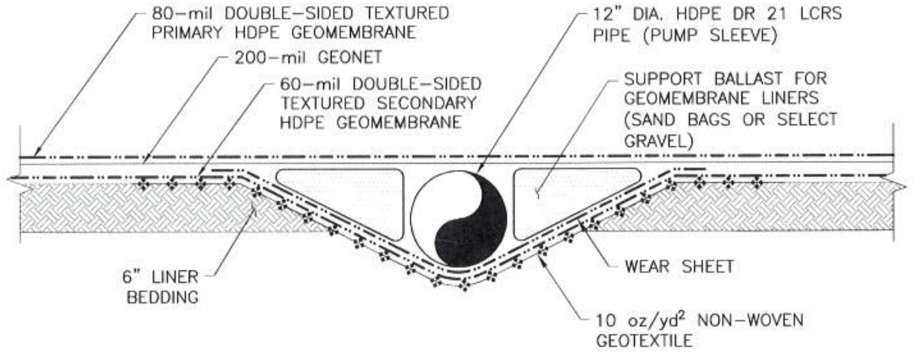
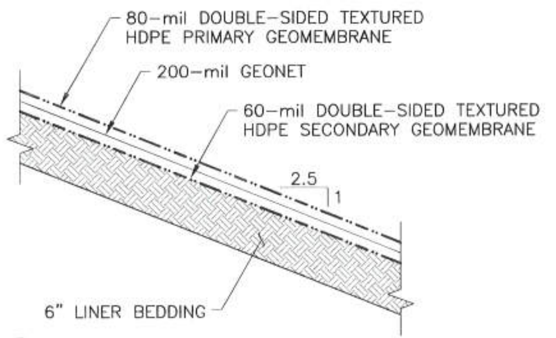


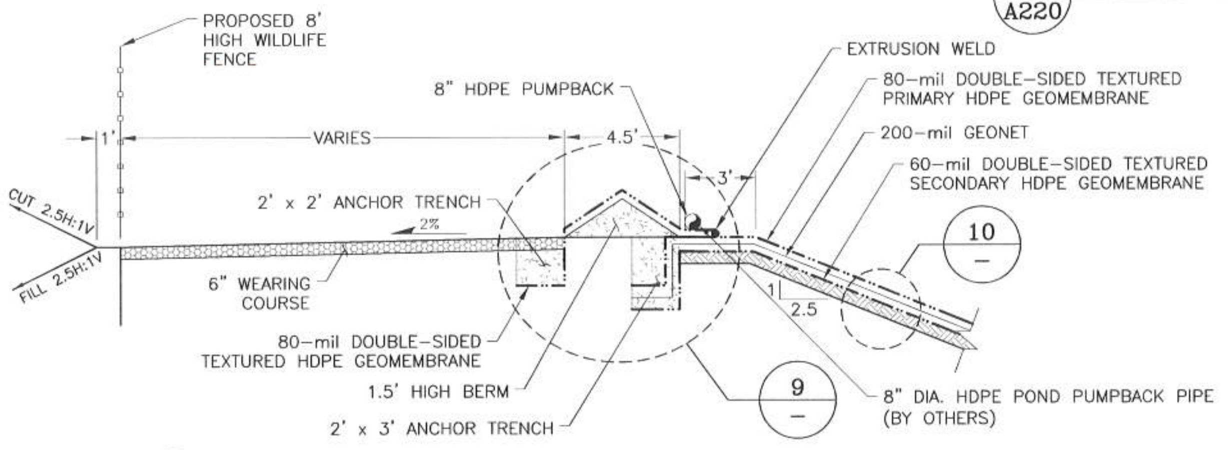
L TYPICAL POND LCRS SUMP
A220



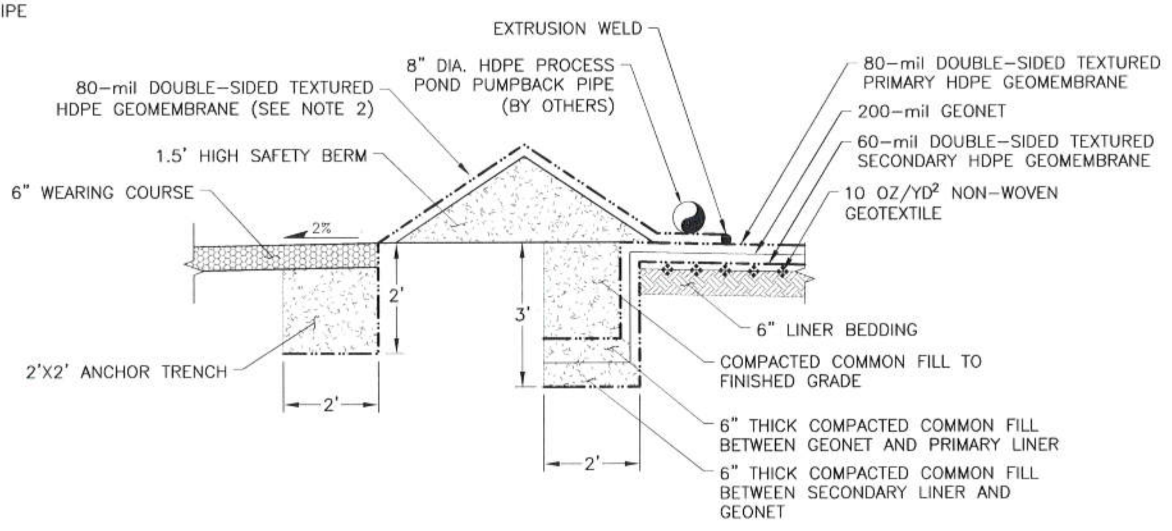
AC LCRS PIPE TYPICAL SECTION
–



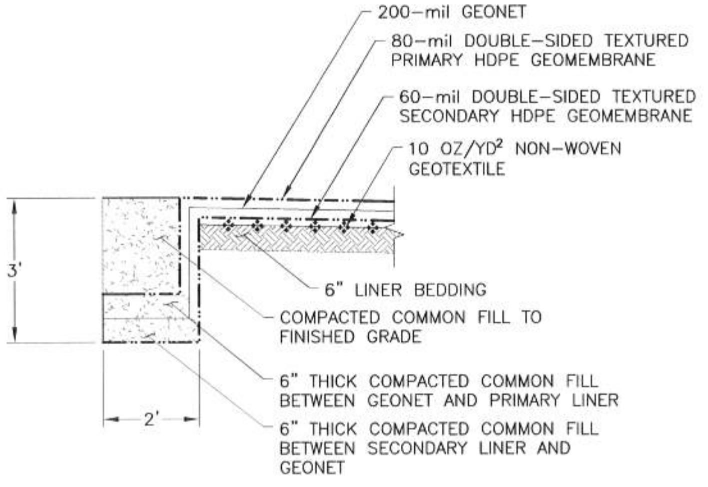
10 POND LINER DETAIL (TYPICAL)
–



M POND CREST AND LINER DETAIL
A220



9 TYPICAL POND ANCHOR TRENCH AND LINED BERM
–



20 TYPICAL POND ANCHOR TRENCH
–

NOTE:

1. LEAK DETECTION SUMP VOLUME IS APPROXIMATELY 529 FT³. ESTIMATED WATER STORAGE VOLUME 1,583 GALLONS BASED ON 40% OF VOID SPACE.
2. THE LINED BERM IS ONLY REQUIRED ALONGSIDE THE POND PUMPBACK PIPE TO PROVIDE SECONDARY CONTAINMENT. EVERYWHERE ELSE ONLY AN EARTHEN BERM IS REQUIRED.

PROFESSIONAL ENGINEER-STATE OF NEVADA
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4/2/20
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REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
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DESIGNED BY: NLB
DRAWN BY: RL

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CLIENT: LITHIUM NEVADA CORP.
PROJECT: THACKER PASS PROJECT
TITLE: POND SECTIONS AND DETAILS (SHEET 1 OF 2)
FILENAME: 0385.000.015D
DRAWING NO.: A230
REVISION: 0

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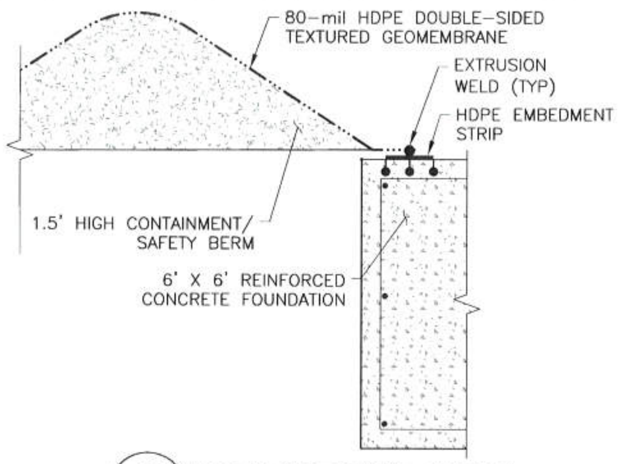
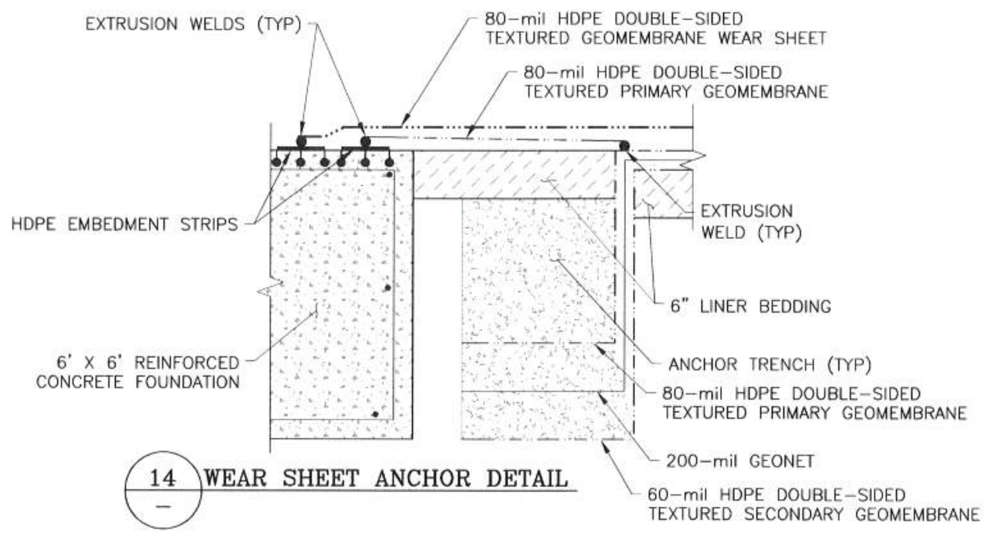
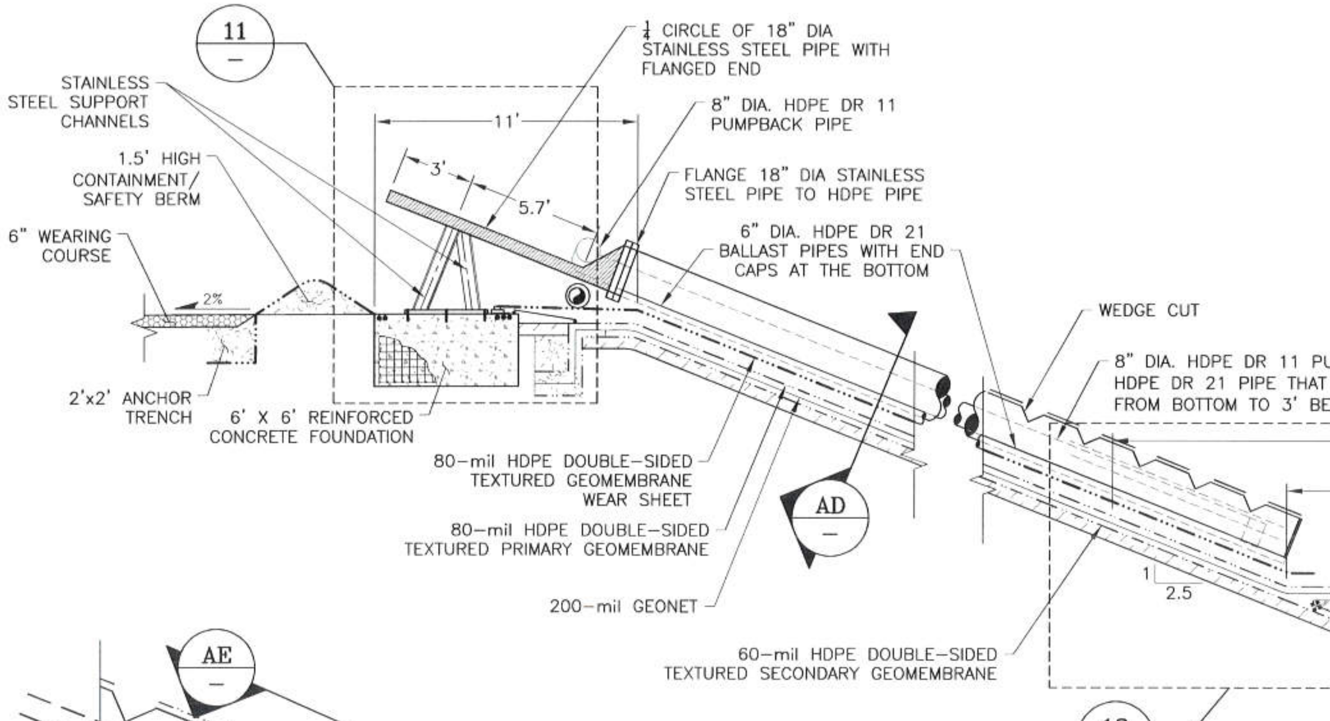


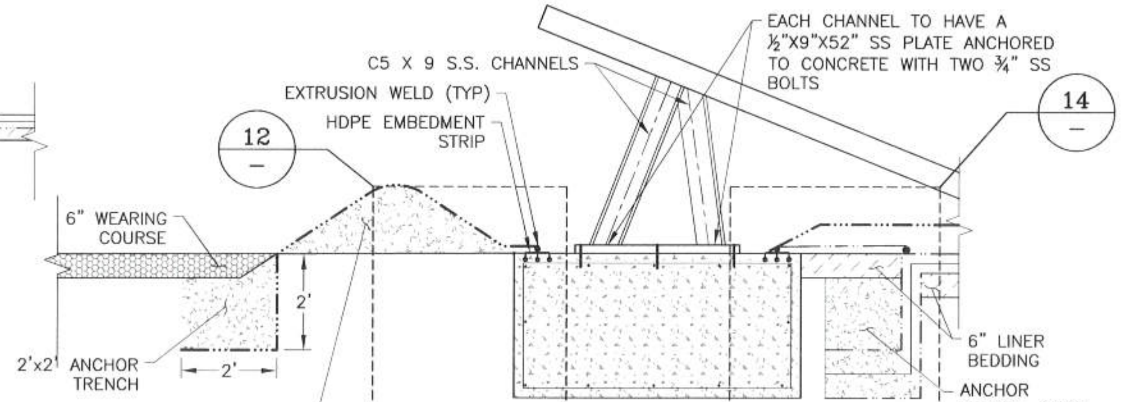
12 HDPE EMBEDMENT STRIPS



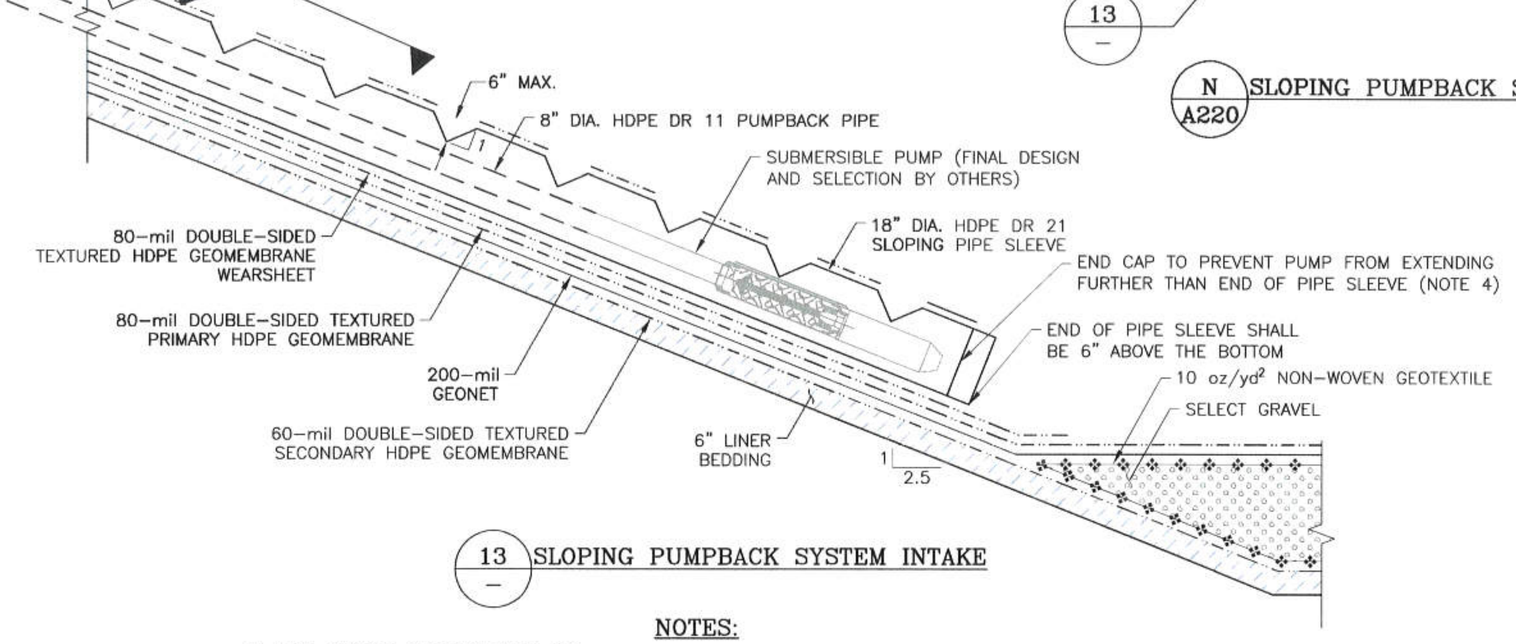
14 WEAR SHEET ANCHOR DETAIL



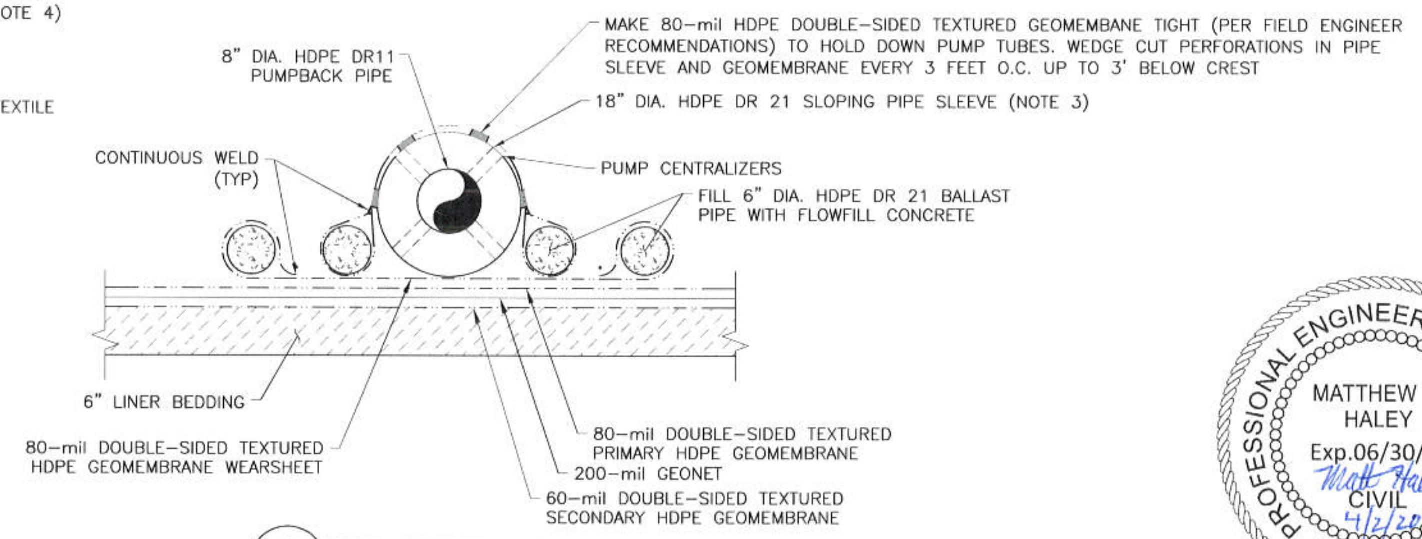
N A220 SLOPING PUMPBACK SYSTEM



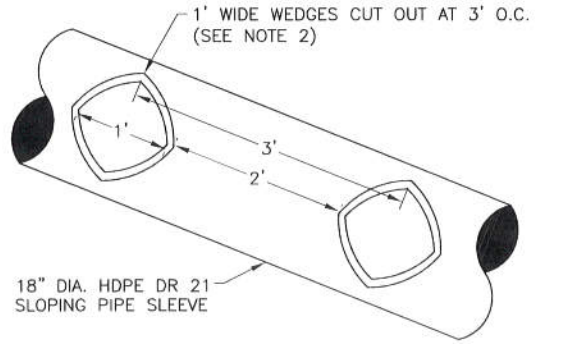
11 PUMPBACK SYSTEM CONCRETE ANCHOR DETAIL



13 SLOPING PUMPBACK SYSTEM INTAKE



AD PIPE SLEEVE SECTION



AE WEDGE CUT PERFORATION DETAIL (PLAN VIEW)

NOTES:

1. THE PUMP BACK SYSTEM SHALL BE INSTALLED SO THAT THE ENTIRE LENGTH OF PUMP SLEEVE AND BALLAST PIPES ARE IN CONTACT WITH THE POND SLOPE.
2. WEDGE CUT PERFORATIONS IN PIPE SLEEVE AND GEOMEMBRANE EVERY 3 FEET O.C. UP TO 3' BELOW CREST.
3. REMOVE WELD BEADS FROM OUTSIDE OF PIPES AND REMOVE ANY SHARP PLASTIC SPURS OR BUMPS ALONG PIPE THAT COULD PUNCTURE THROUGH THE LINER.
4. DRILL TWENTY 1-INCH DIAMETER HOLES IN THE BOTTOM OF 18" HDPE END CAP.

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No. 21993

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
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DESIGNED BY: MTH
DRAWN BY: RL

DISCLAIMER

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CLIENT: LITHIUM NEVADA CORP.

PROJECT: THACKER PASS PROJECT

TITLE: POND SECTIONS AND DETAILS (SHEET 2 OF 2)

FILENAME: 0385.000.011D
DRAWING NO.: A235
REVISION: 0

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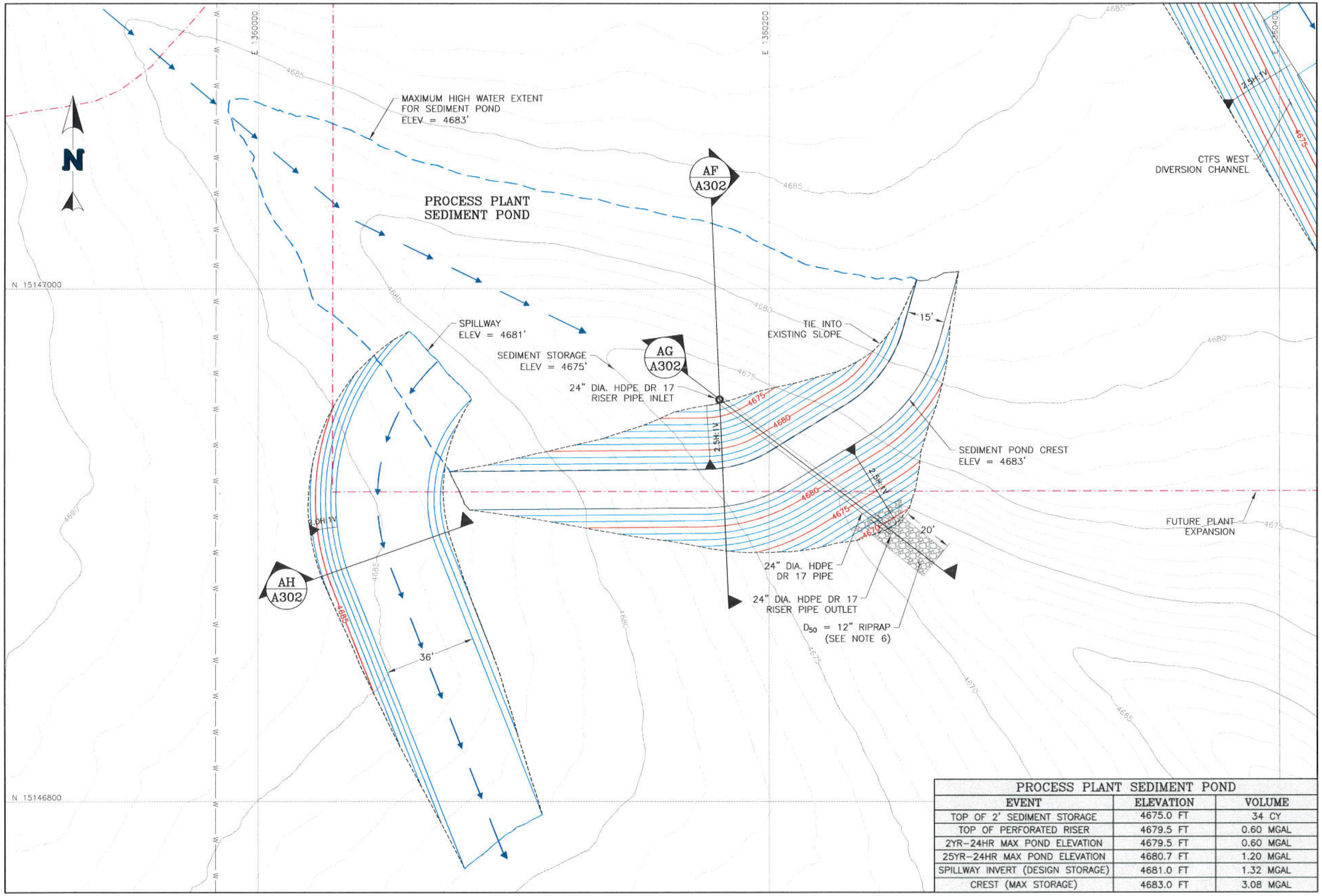

PROCESS PLANT SEDIMENT POND		
EVENT	ELEVATION	VOLUME
TOP OF 2' SEDIMENT STORAGE	4675.0 FT	34 CY
TOP OF PERFORATED RISER	4679.5 FT	0.60 MGAL
2YR-24HR MAX POND ELEVATION	4679.5 FT	0.60 MGAL
25YR-24HR MAX POND ELEVATION	4680.7 FT	1.20 MGAL
SPILLWAY INVERT (DESIGN STORAGE)	4681.0 FT	1.32 MGAL
CREST (MAX STORAGE)	4683.0 FT	3.08 MGAL

0 20 40 FEET

LEGEND:

～	EXISTING 1 FT GROUND CONTOURS
4500	EXISTING CONTOUR ELEVATION
～	1 FT GROUND CONTOURS
4500	CONTOUR ELEVATION
- - -	SURFACE DAYLIGHT
—W—	WATER LINE
→ →	MAJOR STORMWATER DRAINAGE FLOW PATH
— —	MAXIMUM HIGH WATER EXTENT FOR POND
-·-·-	FUTURE PLANT EXPANSION
▨	RIPRAP

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. THE SEDIMENT POND IS SIZED TO FULLY CONTAIN THE 2YR-24HR STORM RUNOFF VOLUME (1.01 MGAL). THE 2YR-24HR VOLUME IN THE TABLE ACCOUNTS FOR DISCHARGE THROUGH PERFORATIONS IN THE RISER PIPE DURING THE STORM.
3. THE RISER PIPE DIAMETER, ELEVATION, AND PERFORATION SPACING ARE DESIGNED TO ALLOW 48 TO 72 HRS OF RETENTION TIME FOR THE 2YR-24HR STORM INFLOW.
4. THE SPILLWAY IS SIZED TO DISCHARGE THE PEAK FLOW OF THE 100YR-24HR STORM PLUS 1 FOOT OF FREEBOARD.
5. MAXIMUM POND ELEVATIONS FOR BOTH THE 2YR-24HR AND 25YR-24HR STORM EVENTS ARE SHOWN IN THE TABLE.
6. 10 OZ/YD² NON-WOVEN GEOTEXTILE TO BE PLACED UNDER ALL RIPRAP.

PROFESSIONAL ENGINEER STATE OF NEVADA
MATTHEW T. HALEY
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No. 21993

TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\A-CAD\DWGS\0385.000.061M.dwg-4/1/2020 11:04 AM

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	SEB	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: SEB
DRAWN BY: SEB

DISCLAIMER

NewFields

CLIENT: LITHIUM NEVADA CORP.

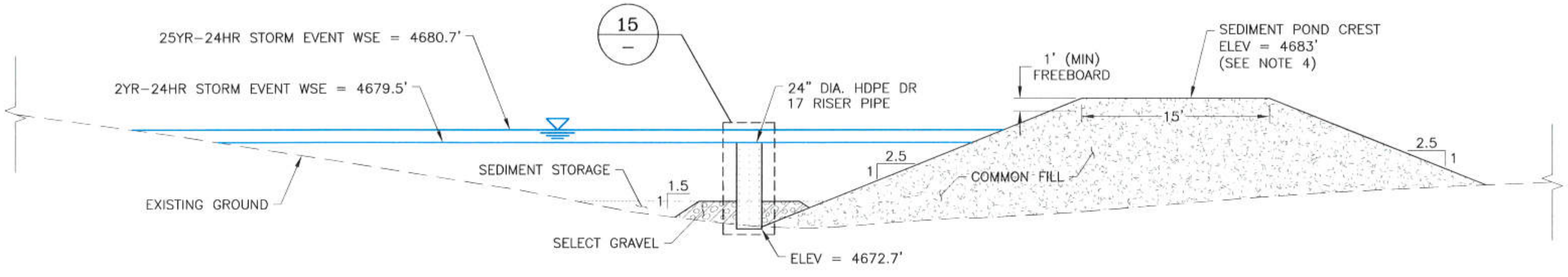
PROJECT: THACKER PASS PROJECT

TITLE: PROCESS PLANT SEDIMENT POND PLAN

FILENAME: 0385.000.061M

DRAWING NO.: A300

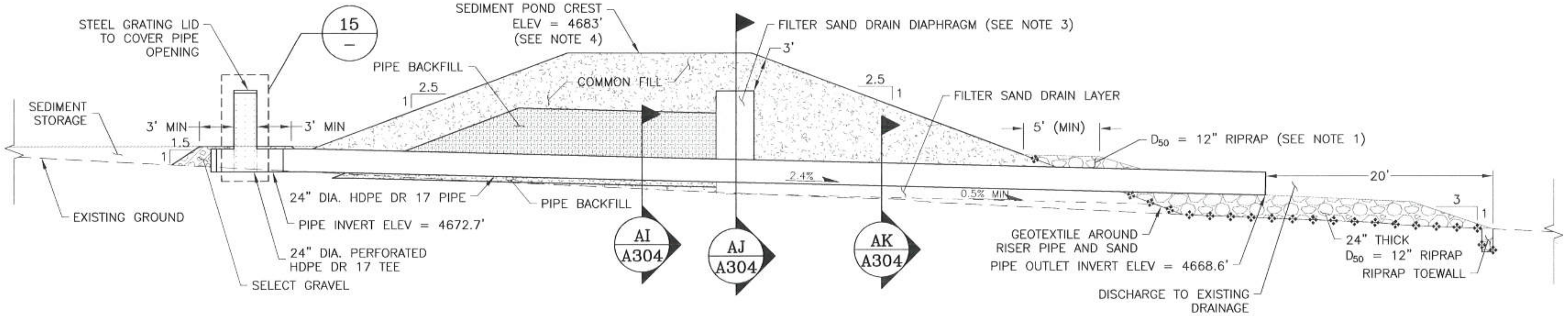
REVISION: 0



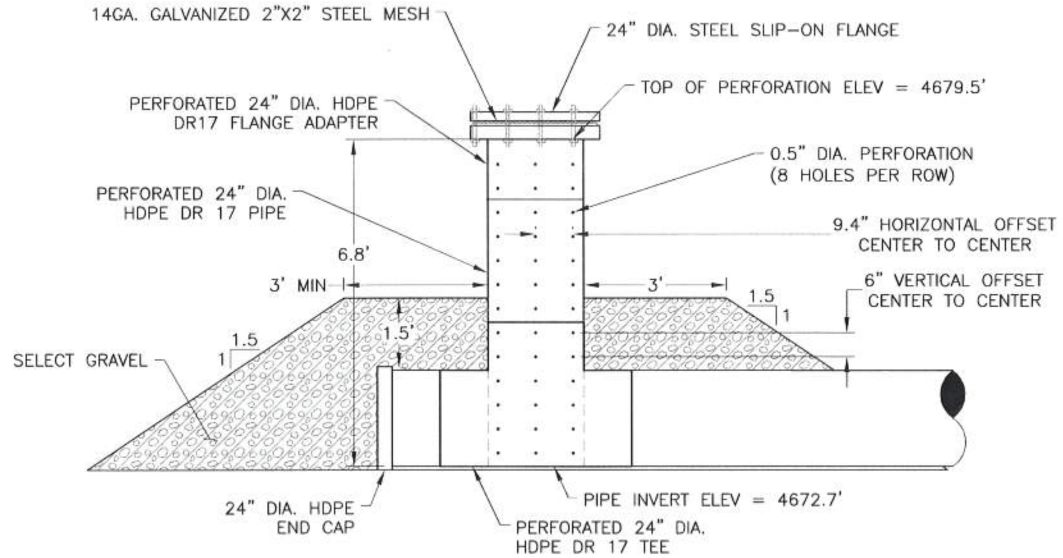
AF A300 PROCESS PLANT SEDIMENT POND TYPICAL SECTION

NOTES:

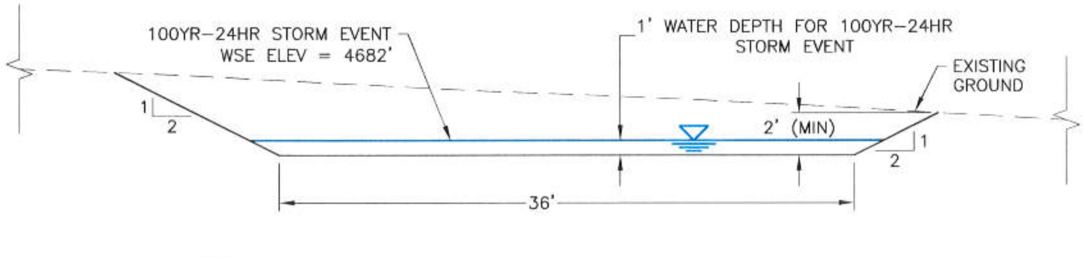
1. PLACE 2 FT THICK LAYER OF RIPRAP ON DOWNSTREAM SLOPE AROUND RISER PIPE AND EXTENDING 20 FT PAST PIPE OUTLET, AND 5 FEET PAST THE FILTER SAND ON THE DOWNSTREAM SLOPE OF THE DAM.
2. PLACE 10 OZ/YD² NON-WOVEN GEOTEXTILE UNDER ALL RIPRAP.
3. A FILTER SAND DRAIN DIAPHRAGM IS REQUIRED IF THE COMMON FILL IS PRIMARILY FINE GRAINED SOILS (SILTS & CLAYS). THE DESIGN ENGINEER WILL DECIDE BASED ON LABORATORY TEST RESULTS FROM PROPOSED COMMON FILL MATERIAL SOURCES.
4. THE EMBANKMENT CREST IS NOT INTENDED TO HAVE VEHICLE ACCESS WHICH IS WHY THERE ARE NO SAFETY BERMS.



AG A300 PROCESS PLANT SEDIMENT POND RISER PIPE SECTION



15 – PERFORATION SCHEDULE ON RISER PIPE



AH A300 PROCESS PLANT SEDIMENT POND SPILLWAY SECTION

MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No.21993
Matt Haley 4/2/20

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: SEB
DRAWN BY: RL

DISCLAIMER

NewFields

CLIENT LITHIUM NEVADA CORP.

PROJECT THACKER PASS PROJECT

TITLE PROCESS PLANT SEDIMENT POND SECTIONS AND DETAILS (SHEET 1 OF 2)

FILENAME 0385.000.062D
DRAWING NO. A302
REVISION 0

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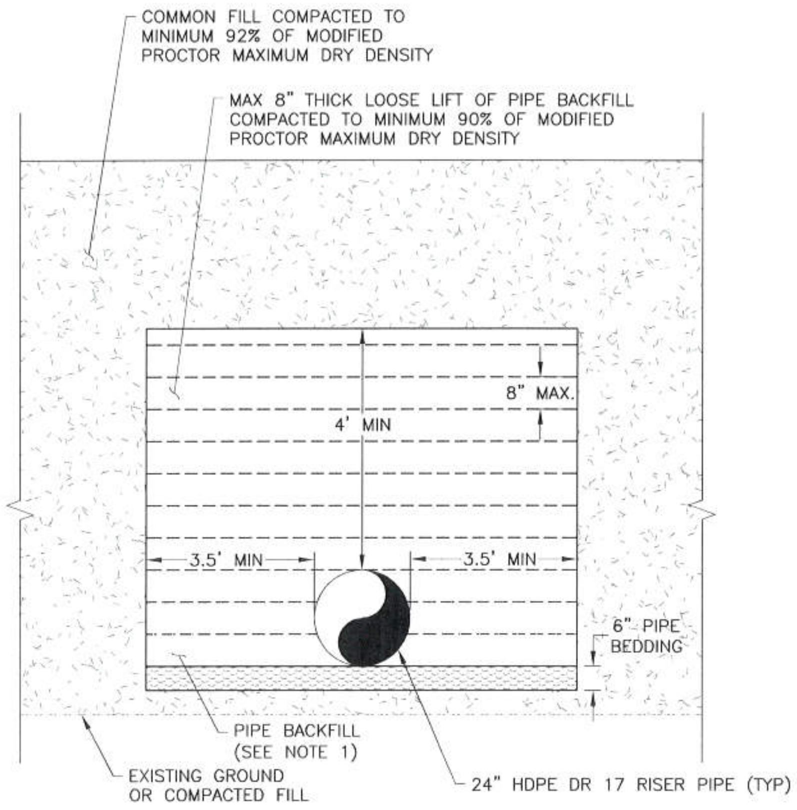
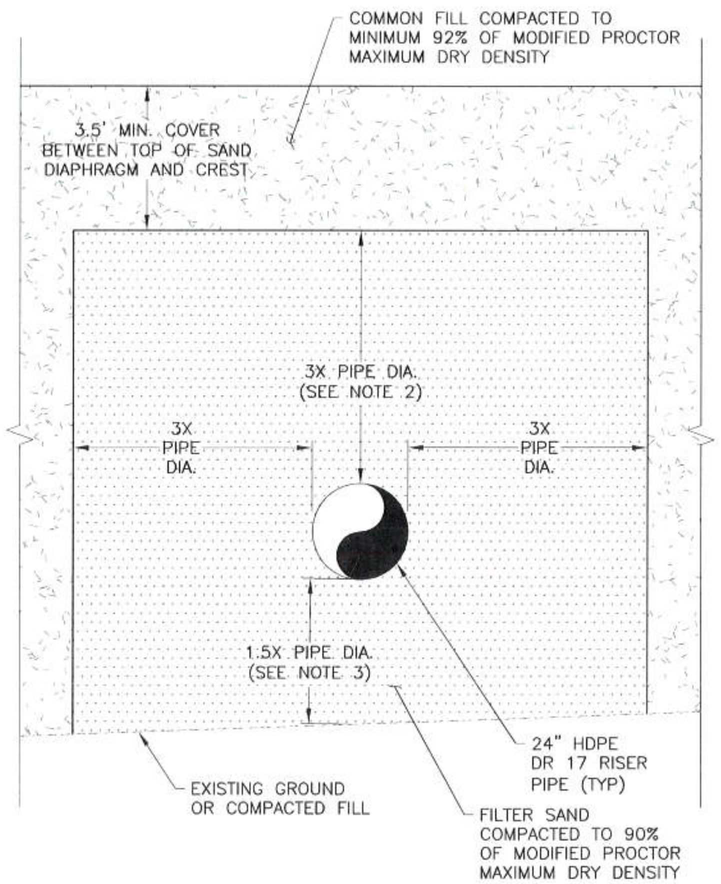


AI
A302
TYPICAL DRAIN PIPE DETAIL



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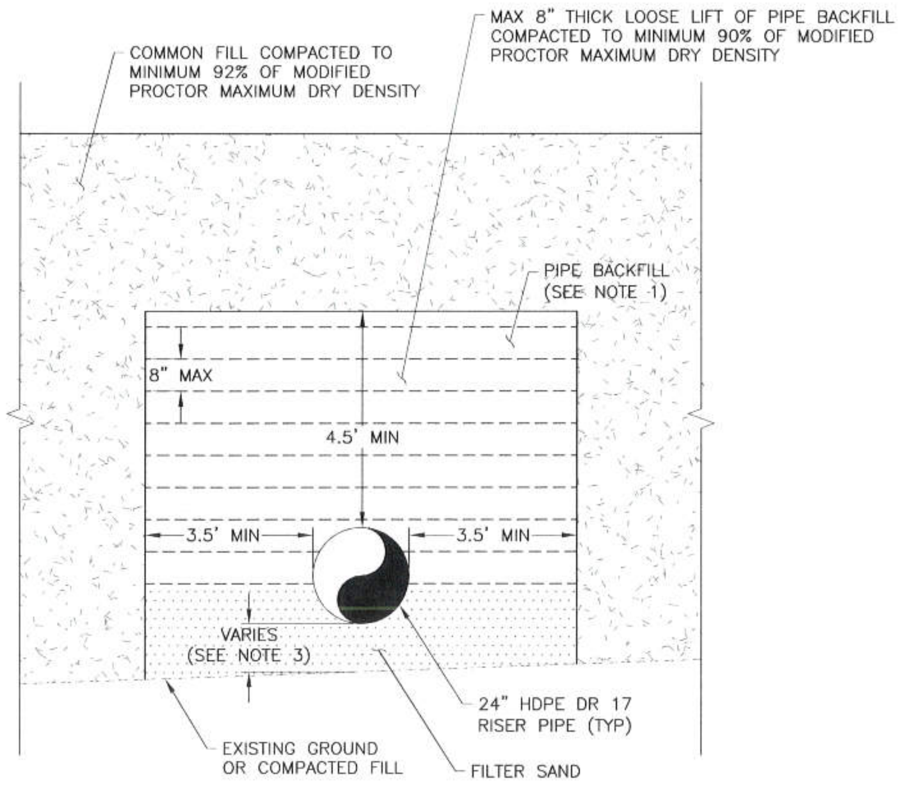
A302
TYPICAL DRAIN DIAPHRAGM DETAIL



AK
A302
TYPICAL DRAIN PIPE DETAIL

NOTES:

1. USE HAND OPERATED COMPACTION EQUIPMENT IN THE PIPE BACKFILL AND FILTER SAND ZONES.
2. TOP OF DIAPHRAGM SHALL BE THE LOWER OF 3X THE PIPE DIAMETER ABOVE THE PIPE OR THE POND SPILLWAY ELEVATION.
3. FILTER SAND BELOW PIPE SHALL BE 1.5X PIPE DIAMETER IF THE PIPE IS IN FULL MATERIAL. IF THE PIPE IS AT OR BELOW THE NATURAL GROUND ELEVATION A MINIMUM OF 1-FOOT OF FILTER SAND SHALL BE PLACED BENEATH THE PIPE.
4. A FILTER SAND DRAIN DIAPHRAGM IS REQUIRED IF THE COMMON FILL IS PRIMARILY FINE GRAINED SOILS (SILTS AND CLAYS). THE DESIGN ENGINEER WILL DECIDE BASED ON LABORATORY TEST RESULTS FROM PROPOSED COMMON FILL MATERIAL SOURCES.

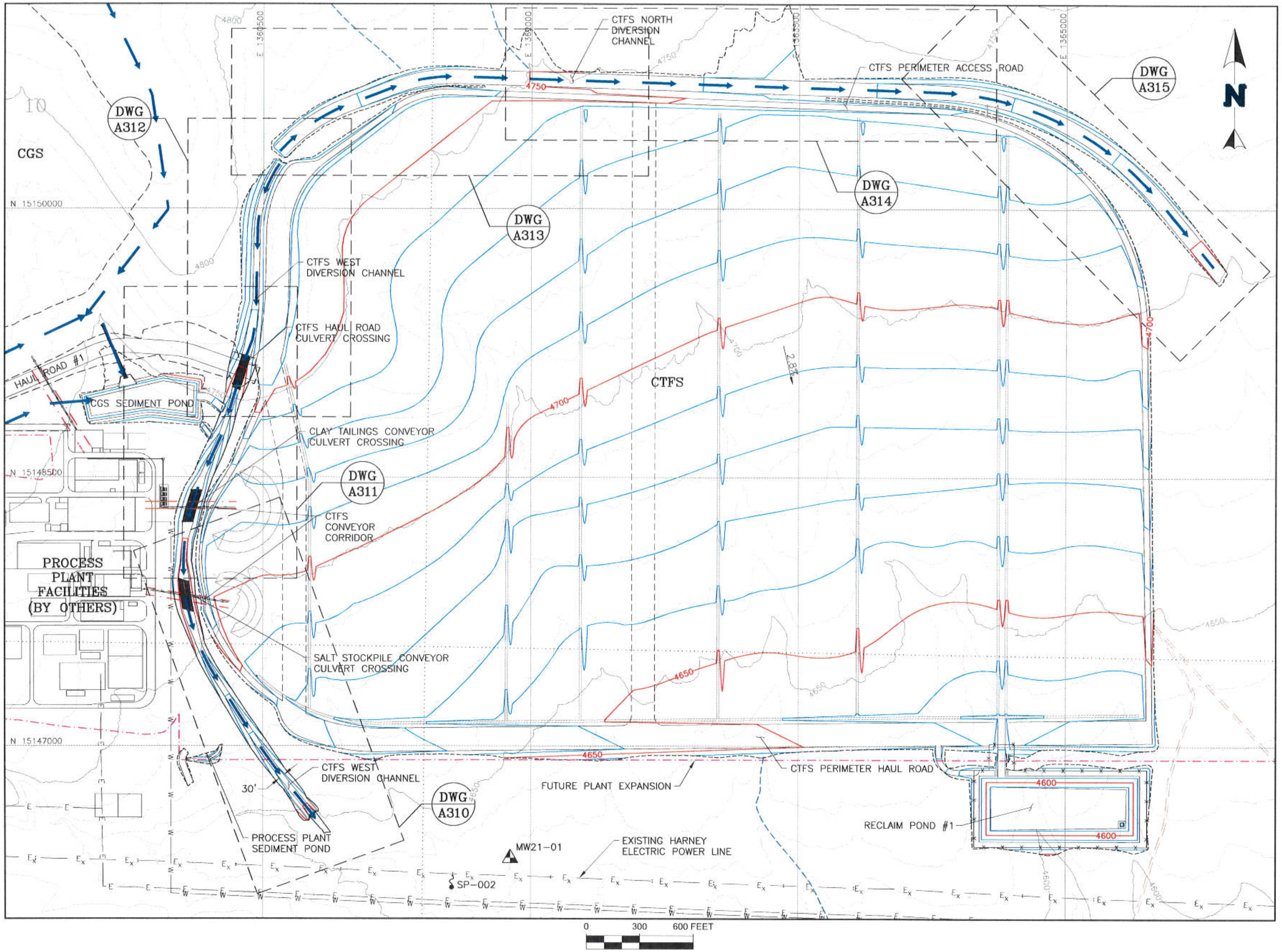
MATTHEW T.
HALEY
Exp.06/30/21
Matt Haley
CIVIL
4/2/20
No.21993

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: SEB
DRAWN BY: RL

NewFields
CLIENT LITHIUM NEVADA CORP.
PROJECT THACKER PASS PROJECT
TITLE PROCESS PLANT SEDIMENT POND SECTIONS AND DETAILS (SHEET 2 OF 2)
FILENAME 0385.000.018D
DRAWING NO. A304
REVISION 0

P:\Projects\0385.000 Lithium Nevada Tracker Pass Project\A-CAD\DWGS\0385.000.018D.dwg-4/1/2020 11:05 AM



LEGEND:

- EXISTING 10 FT GROUND CONTOURS
- 4500 EXISTING CONTOUR ELEVATION
- 10 FT GROUND CONTOURS
- 4500 CONTOUR ELEVATION
- 10 FT GROUND CONTOURS
- 4500 CONTOUR ELEVATION
- EXISTING ROADS
- SURFACE DAYLIGHT
- SURFACE DAYLIGHT BY OTHERS
- STORMWATER DIVERSION CHANNEL
- EXISTING DRAINAGES
- SECTION LINES
- 20 SECTION NUMBER
- STRUCTURE/BUILDING
- W WATER LINE (BY OTHERS)
- E POWER LINE (BY OTHERS)
- FENCE
- CONVEYOR CORRIDOR (BY OTHERS)
- EXISTING POWER POLES
- E_x EXISTING POWER LINE
- CULVERT
- FUTURE PLANT EXPANSION
- MONITORING WELL
- EXISTING SPRING

NOTE:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.

PROFESSIONAL ENGINEER-STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No. 21993
Matt Haley
4/2/20

TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: RL
DRAWN BY: RL

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CLIENT: LITHIUM NEVADA CORP.
PROJECT: THACKER PASS PROJECT
TITLE: CTFS STORMWATER PLAN
FILENAME: 0385.000.064M
DRAWING NO.: A305
REVISION: 0

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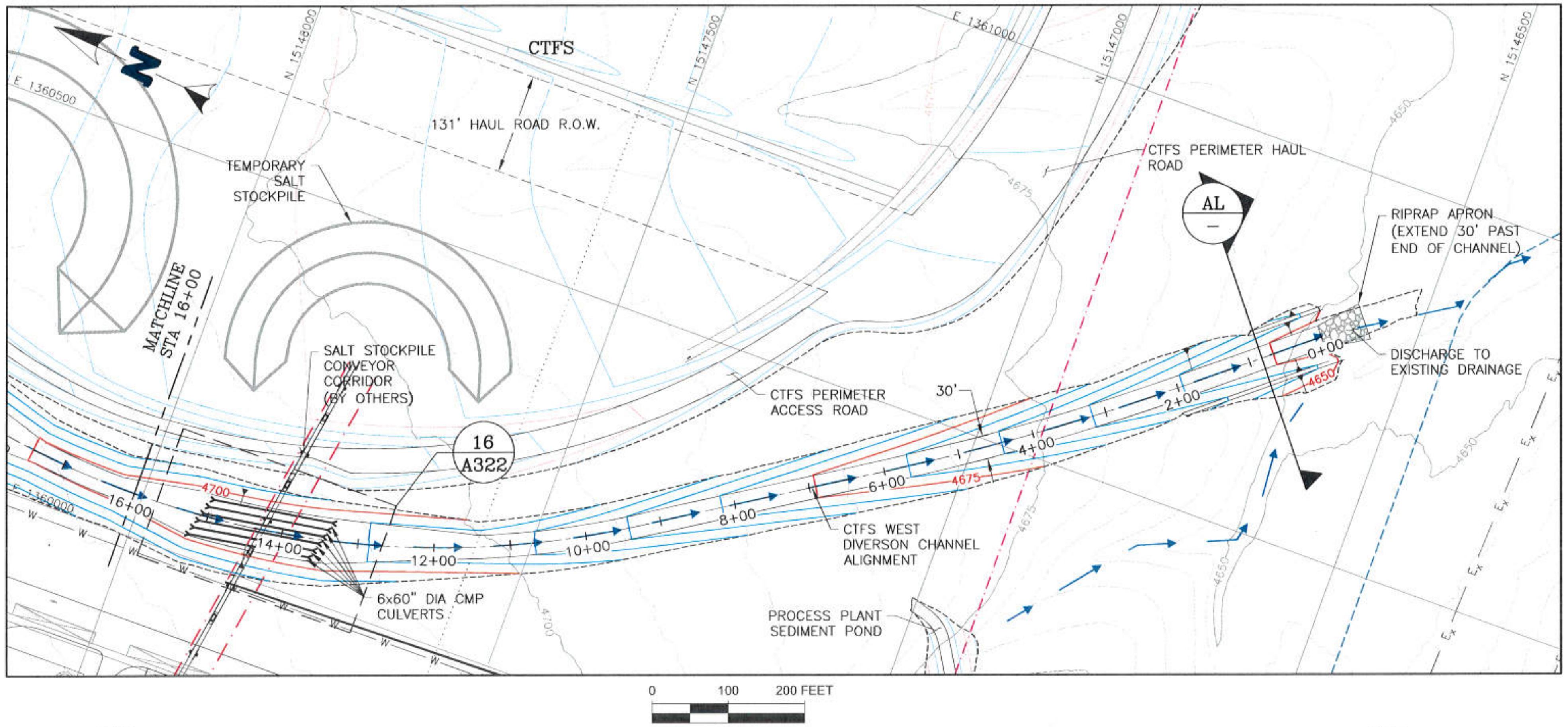


LEGEND:

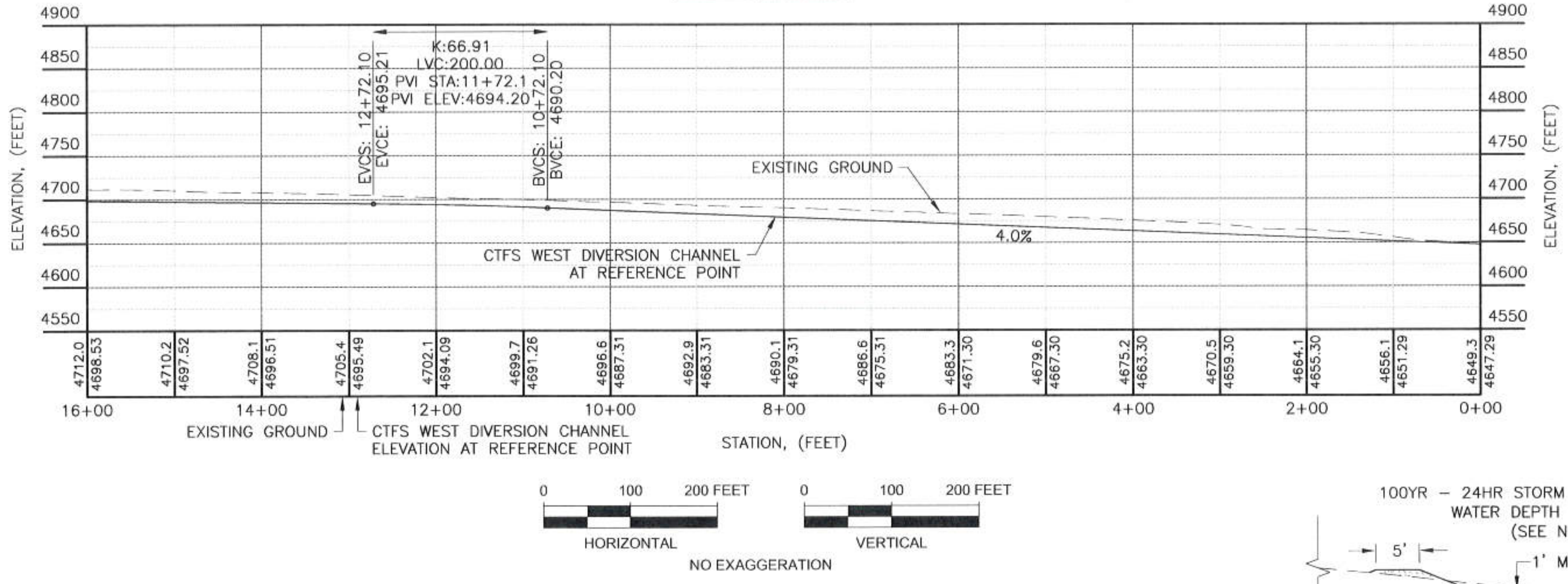
	EXISTING 5 FT GROUND CONTOURS
4500	EXISTING CONTOUR ELEVATION
	5 FT GROUND CONTOURS
4500	CONTOUR ELEVATION
	5 FT GROUND CONTOURS
4500	CONTOUR ELEVATION
— Ex —	EXISTING POWER LINE
∘ ∘	EXISTING POWER POLES
	SURFACE DAYLIGHT
→ →	MAJOR STORMWATER DRAINAGE FLOW PATH
	EXISTING DRAINAGES
······	SECTION LINES
— W —	WATER LINE (BY OTHERS)
	CONVEYOR CORRIDOR (BY OTHERS)
—·—·—	FUTURE PLANT EXPANSION

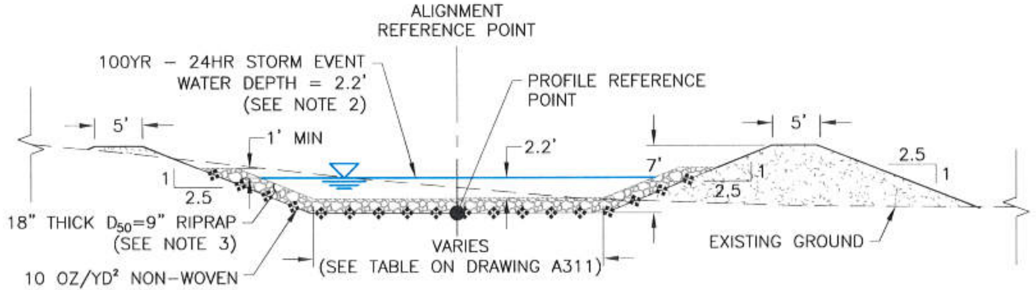
CTFS WEST DIVERSION CHANNEL ALIGNMENT TABLE

	STATION	NORTHING	EASTING	DELTA (D-M-S)	LENGTH (FT)	RADIUS (FT)
PT	0+00.00	15,146,618.45	1,360,776.17			
PC	1+85.38	15,146,761.80	1,360,658.63	006-58-51	410.81	3371.72
PT	5+96.19	15,147,094.52	1,360,418.11			
PC	9+33.77	15,147,379.64	1,360,237.37	055-17-55	1135.84	1176.86
PT	20+69.61	15,148,468.20	1,360,147.46			
PC	21+39.14	15,148,532.23	1,360,174.55	001-47-42	15.67	500.00
PT	21+54.80	15,148,546.56	1,360,180.88			
PC	23+41.22	15,148,715.90	1,360,258.84	007-37-43	66.57	500.00
PT	24+07.79	15,148,778.04	1,360,282.58			
PT	28+25.89	15,149,177.67	1,360,405.48			

CTFS WEST DIVERSION CHANNEL ARMORING (NOTE 3)

STATION (ft)	RIPRAP D_{50} (in)	RIPRAP THICKNESS (in)	CHANNEL DEPTH INCLUDING FREEBOARD (ft)
0+00 TO 13+75	9	18	7
13+75 TO 20+40	4	8	7.5
20+40 TO 25+00	12	24	8.0
25+00 TO 27+00	6	12	7.0
27+00 TO 28+26	4	8	6.0





AL CTFS WEST DIVERSION CHANNEL TYPICAL SECTION

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. STORM EVENT DEPTHS SHOWN INCLUDE THE PEAK FLOWS FROM THE CGS.
3. RIPRAP SHOWN IS THE MINIMUM REQUIRED FOR CURRENT DESIGN AND MAY REQUIRE UPGRADING OR REPLACEMENT IF THE WATERSHED AREA IS INCREASED.

TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

PROFESSIONAL ENGINEER-STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
Matt Haley
CIVIL
4/2/20
No.21993

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	NLB	MH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: SEB
DRAWN BY: SEB

DISCLAIMER

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NewFields

CLIENT LITHIUM NEVADA CORP.

PROJECT THACKER PASS PROJECT

TITLE CTFS WEST DIVERSION CHANNEL
PLAN & PROFILE (SHEET 1 OF 3)

FILENAME 0385.000.068P
DRAWING NO. A310
REVISION 0

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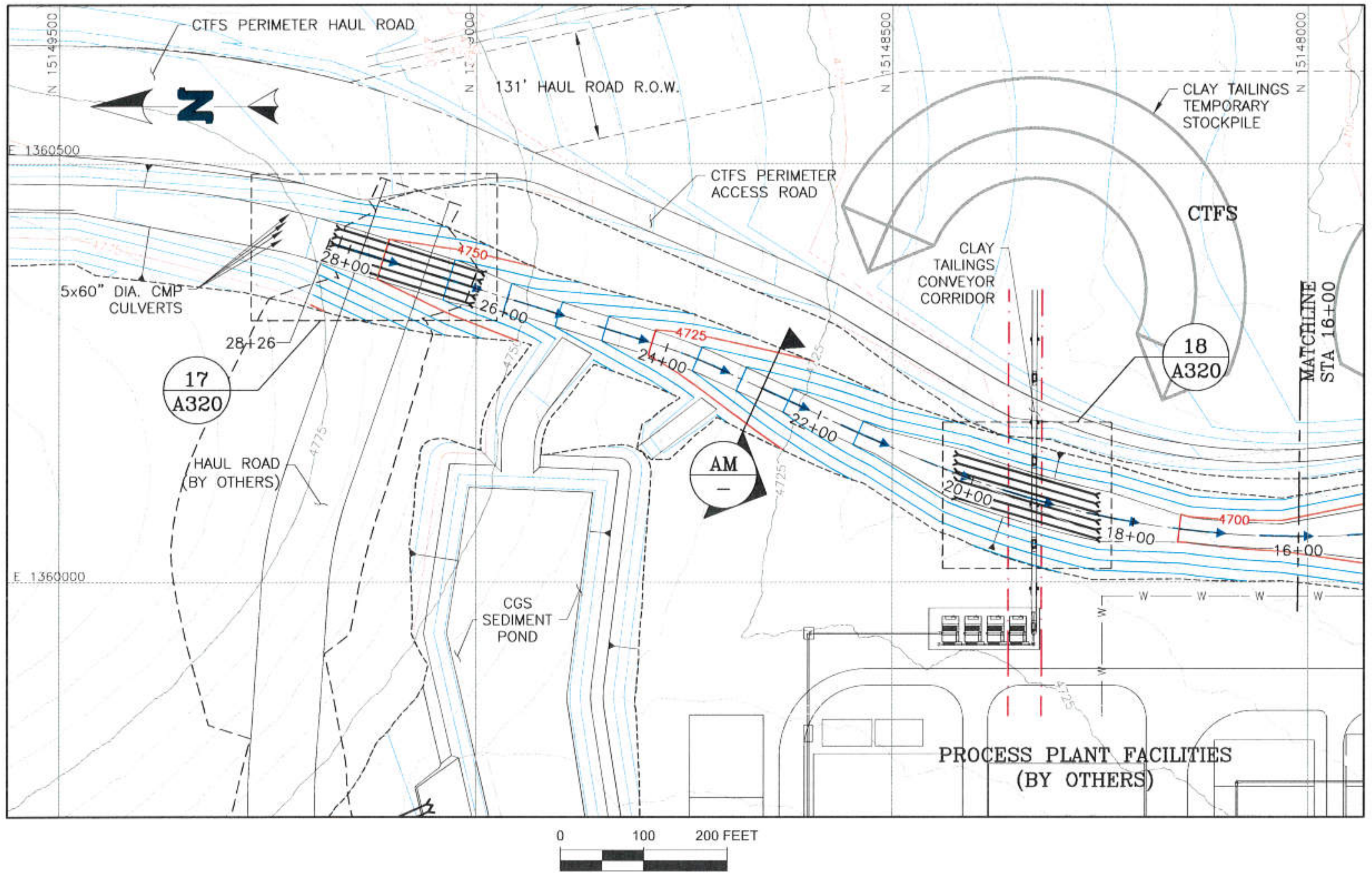
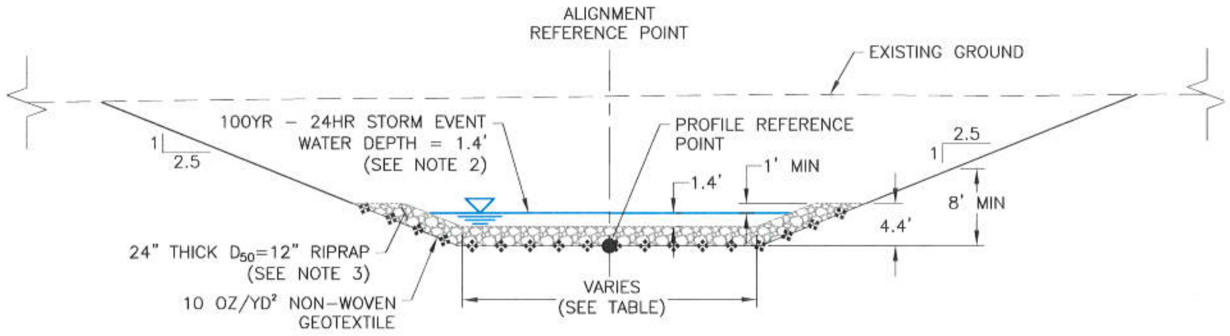


LEGEND:

	EXISTING 5 FT GROUND CONTOURS
4500	EXISTING CONTOUR ELEVATION
	5 FT WEST DIVERSION CHANNEL CONTOURS
4500	CONTOUR ELEVATION
	5 FT GROUND CONTOURS
4500	CONTOUR ELEVATION
	SURFACE DAYLIGHT
	SURFACE DAYLIGHT BY OTHERS
	CULVERT
	MAJOR STORMWATER DRAINAGE FLOW PATH
	SECTION LINES
	STRUCTURE/BUILDING
—W—	WATER LINE (BY OTHERS)
	CONVEYOR CORRIDOR (BY OTHERS)

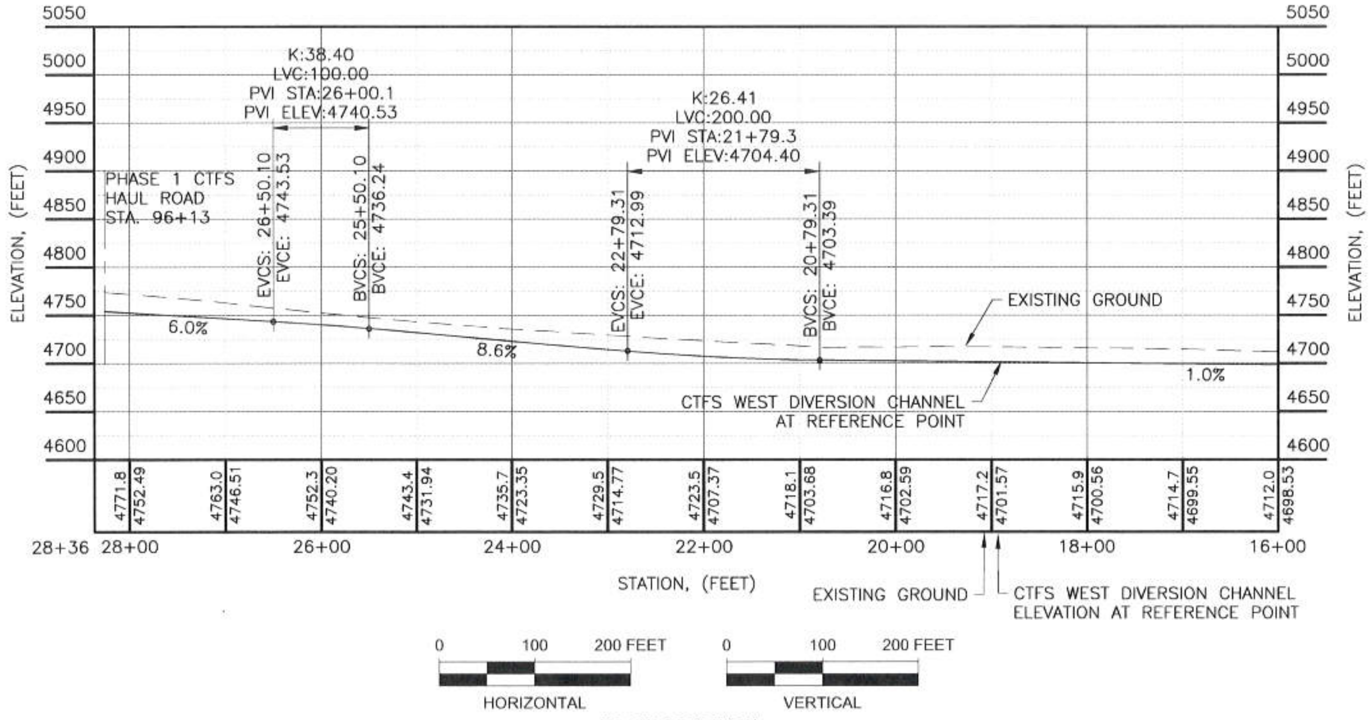
NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. STORM EVENT DEPTHS SHOWN INCLUDE THE PEAK FLOWS FROM THE CGS.
3. RIPRAP SHOWN IS THE MINIMUM REQUIRED FOR CURRENT DESIGN AND REQUIRE UPGRADING OR REPLACEMENT IF THE WATERSHED AREA IS INCREASED.



AM – CTFS WEST DIVERSION CHANNEL TYPICAL SECTION

STA. 20+40 TO 25+00



CTFS WEST DIVERSION CHANNEL WIDTHS*		
START STATION	END STATION	BOTTOM WIDTH (FT)
0+00.0	11+40.0	30
11+40.0	13+40.0	TRANSITION
13+40.0	15+10.0	60
15+10.0	16+10.0	TRANSITION
16+10.0	17+50.0	30
17+50.0	18+50.0	TRANSITION
18+50.0	20+20.0	60
20+20.0	21+20.0	TRANSITION
21+20.0	25+70.0	30
25+70.0	26+63.5	TRANSITION
26+63.5	28+26.0	50

*THE REMAINING WEST DIVERSION CHANNEL PROFILE NORTH OF STATION 28+26 IS INCLUDED WITH THE PERIMETER ROAD PLAN AND PROFILE DRAWING A130. THE WEST DIVERSION CHANNEL WIDTHS CAN BE FOUND ON DRAWING A312.

MATTHEW T. HALEY
Exp.06/30/21
Matt Haley
4/2/20
CIVIL
No.21993

TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	NLH	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: SEB
DRAWN BY: RL

DISCLAIMER

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NewFields

CLIENT: LITHIUM NEVADA CORP.

PROJECT: THACKER PASS PROJECT

TITLE: CTFS WEST DIVERSION CHANNEL
PLAN & PROFILE (SHEET 2 OF 3)

FILENAME: 0385.000.019D
DRAWING NO.: A311
REVISION: 0

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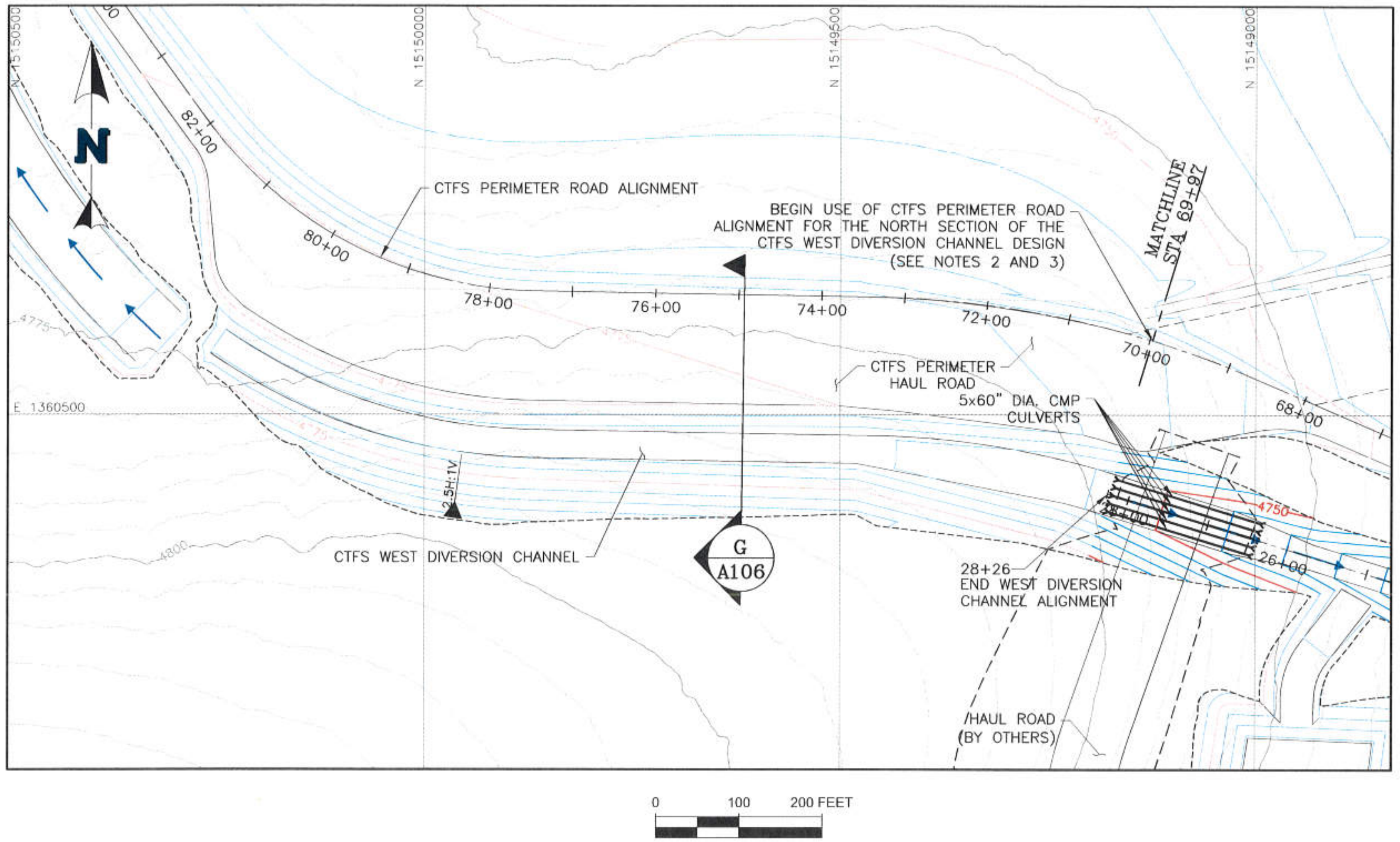

LEGEND:

- EXISTING 5 FT GROUND CONTOURS
- 4500 EXISTING CONTOUR ELEVATION
- 5 FT WEST DIVERSION CHANNEL CONTOURS
- 4500 CONTOUR ELEVATION
- 5 FT GROUND CONTOURS
- 4500 CONTOUR ELEVATION
- SURFACE DAYLIGHT
- SURFACE DAYLIGHT BY OTHERS
- CULVERT
- MAJOR STORMWATER DRAINAGE FLOW PATH
- FENCE

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. STATION 28+26 FOR THE WEST DIVERSION CHANNEL IS LINED UP WITH STATION 69+97 OF THE CTFS PERIMETER ROAD ALIGNMENT.
3. REFER TO THE PROFILE ON DWG A130, STA 69+97 TO 80+40 FOR THE NORTHERN SECTION OF THE CTFS WEST DIVERSION CHANNEL DESIGN.
4. RIPRAP SHOWN IS THE MINIMUM REQUIRED FOR CURRENT DESIGN AND MAY REQUIRE UPGRADING OR REPLACEMENT IF THE WATERSHED AREA IS INCREASED.

CTFS WEST DIVERSION CHANNEL ARMORING

STATION* (ft)	RIPRAP D_{50} (in)	RIPRAP THICKNESS (in)	MIN CHANNEL DEPTH INCLUDING 1' FREEBOARD (ft)
69+97 TO 80+40	NOT REQUIRED	NOT REQUIRED	5

*STATIONS ARE REFERENCING THE CTFS PERIMETER ROAD ALIGNMENT

CTFS WEST DIVERSION CHANNEL WIDTHS

START STATION*	END STATION*	BOTTOM WIDTH (ft)
69+97.0	70+55.0	50
70+55.0	73+55.0	TRANSITION
73+55.0	80+40.0	30

*STATIONS ARE REFERENCING THE CTFS PERIMETER ROAD ALIGNMENT

MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No.21993
Matt Haley
4/2/20

TOPO REFERENCE:

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REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: MTH
DRAWN BY: RL

DISCLAIMER

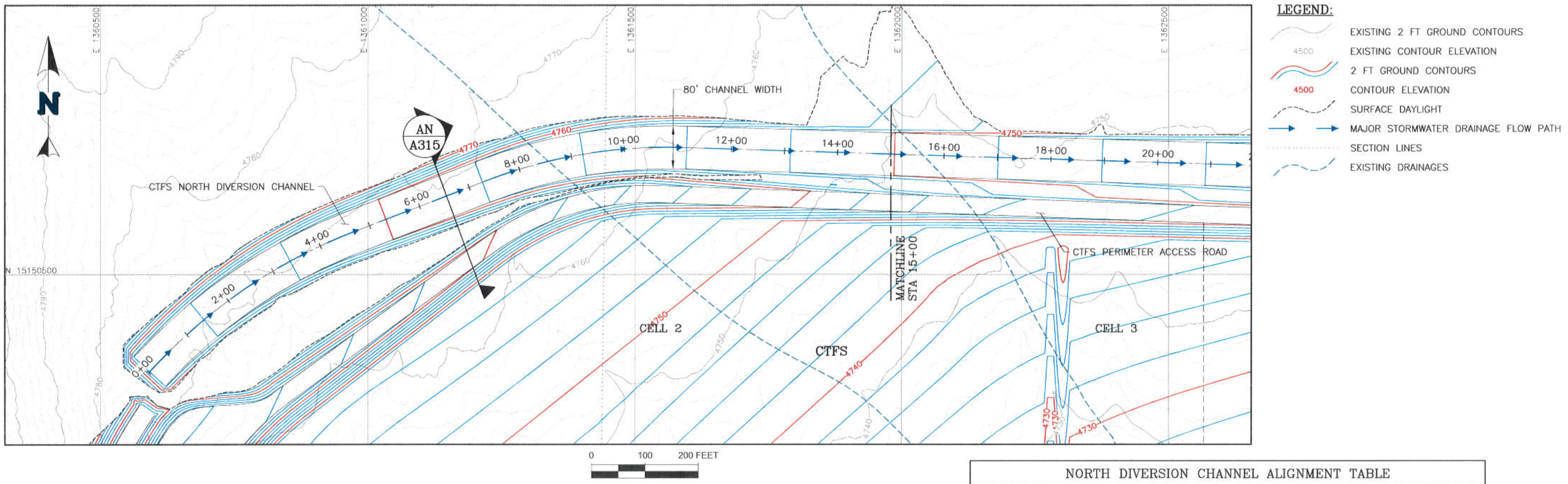
NewFields

CLIENT: LITHIUM NEVADA CORP.

PROJECT: THACKER PASS PROJECT

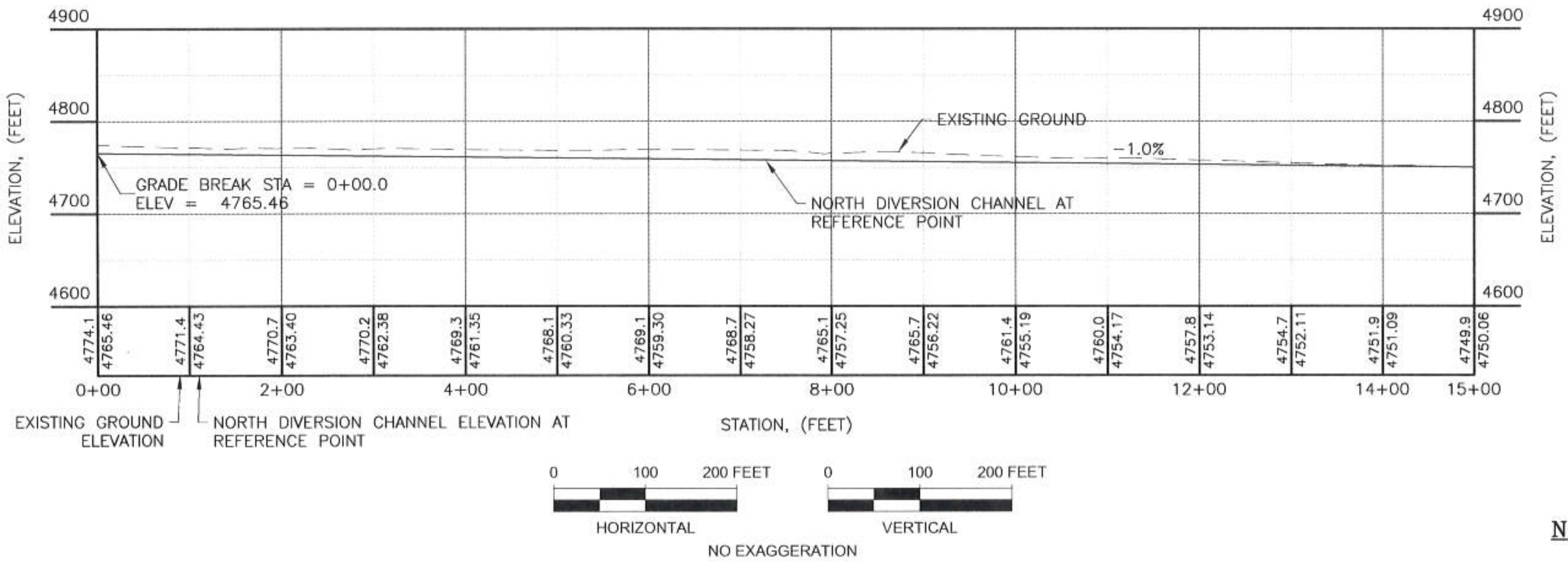
TITLE: CTFS WEST DIVERSION CHANNEL PLAN & PROFILE (SHEET 3 OF 3)

FILENAME: 0385.000.100P
DRAWING NO.: A312
REVISION: 0



	STATION	NORTHING	EASTING	DELTA (D–M–S)	LENGTH (FT)	RADIUS (FT)
PT	0+00.00	15,150,317.89	1,360,590.15			
PC	0+13.44	15,150,327.72	1,360,599.31	026–06–10	454.28	997.15
PT	4+67.72	15,150,579.32	1,360,972.84			
PC	7+35.29	15,150,674.83	1,361,222.79	022–41–20	371.60	938.39
PT	11+06.89	15,150,736.19	1,361,586.83			
PC	38+04.53	15,150,652.54	1,364,283.17	048–35–35	1416.13	1669.75
PT	52+20.65	15,150,048.60	1,365,517.40			
PT	55+91.27	15,149,763.16	1,365,753.79			

NORTH DIVERSION CHANNEL ALIGNMENT TABLE



CTFS NORTH DIVERSION CHANNEL ARMORING

STATION (ft)	RIPRAP D_{50} (in)	RIPRAP THICKNESS (in)	MIN CHANNEL DEPTH INCLUDING 1' FREEBOARD (ft)
0+00 TO 14+00	NOT REQUIRED	NOT REQUIRED	2.5
14+00 TO 44+00	NOT REQUIRED	NOT REQUIRED	3.5
44+00 TO 55+91	6	12	4

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. THE CTFS NORTH DIVERSION CHANNEL IS DESIGNED TO CONVEY STORMWATER FROM THE 100YR – 24HR STORM EVENT.

MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No.21993
Matt Haley
4/2/20

TOPO REFERENCE:

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REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	NLB	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: RL
DRAWN BY: RL

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NewFields

CLIENT
LITHIUM NEVADA CORP.

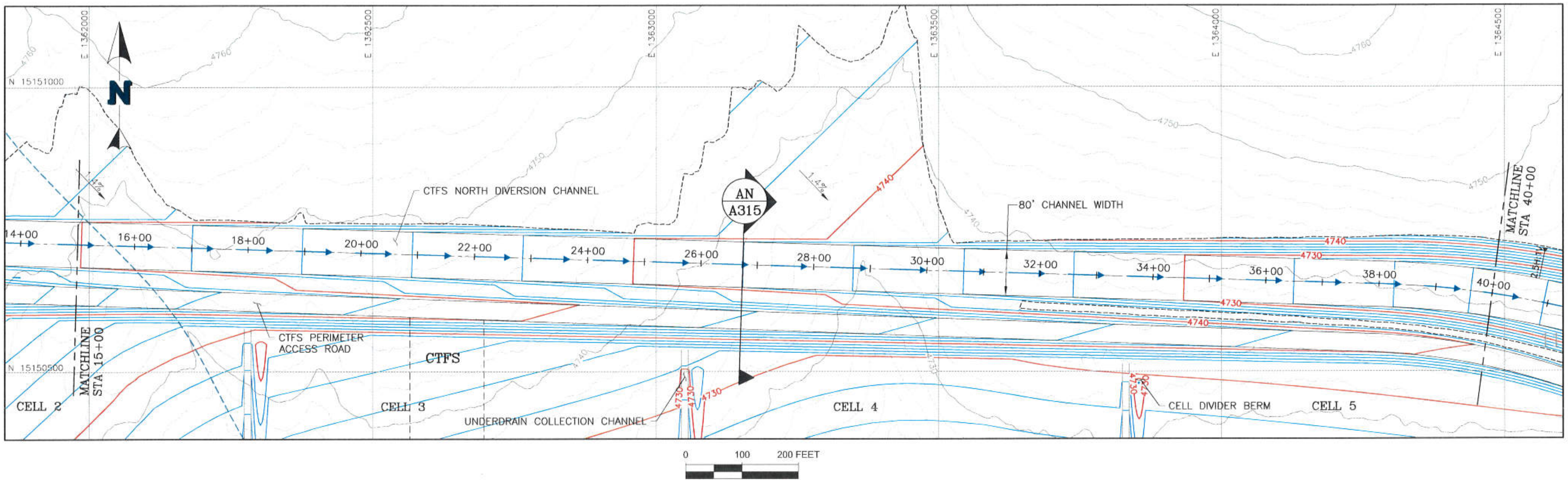
PROJECT
THACKER PASS PROJECT

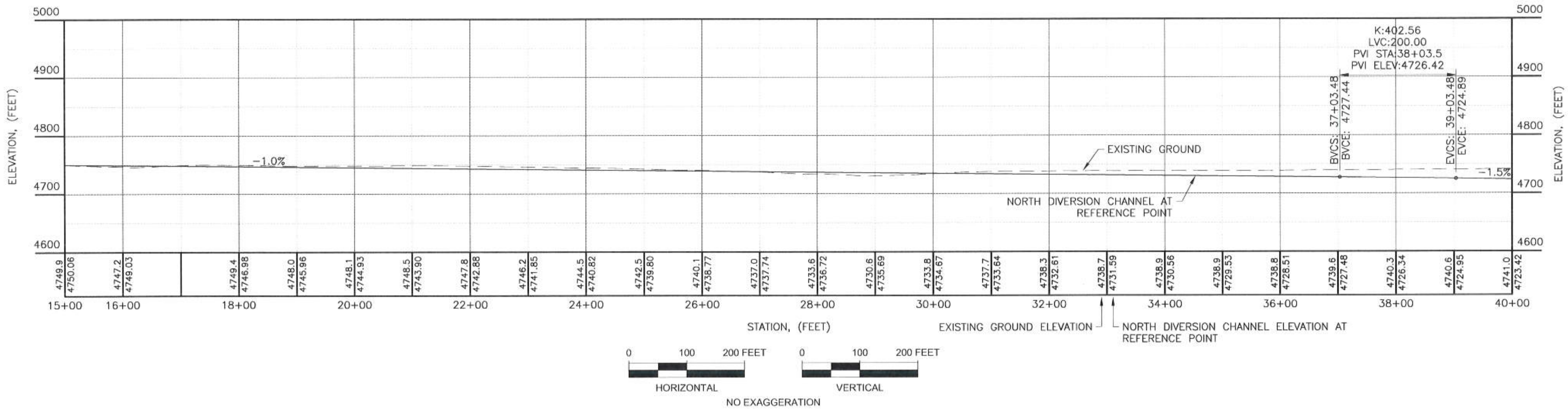
TITLE
CTFS NORTH DIVERSION CHANNEL
PLAN & PROFILE (SHEET 1 OF 3)

FILENAME
0385.000.074P

DRAWING NO.
A313

REVISION
0





LEGEND:

- EXISTING 2 FT GROUND CONTOURS
- 4500 EXISTING CONTOUR ELEVATION
- 2 FT GROUND CONTOURS
- 4500 CONTOUR ELEVATION
- SURFACE DAYLIGHT
- → → MAJOR STORMWATER DRAINAGE FLOW PATH
- EXISTING DRAINAGES

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. THE CTFS NORTH DIVERSION CHANNEL IS DESIGNED TO CONVEY STORMWATER FROM THE 100YR – 24HR STORM EVENT.

PROFESSIONAL ENGINEER STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No.21993
Matt Haley
4/2/20

TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\A-CAD\DWGS\0385.000.081P.dwg-4/1/2020 11:22 AM

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: MTH
DRAWN BY: RL

DISCLAIMER

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NewFields

CLIENT: LITHIUM NEVADA CORP.

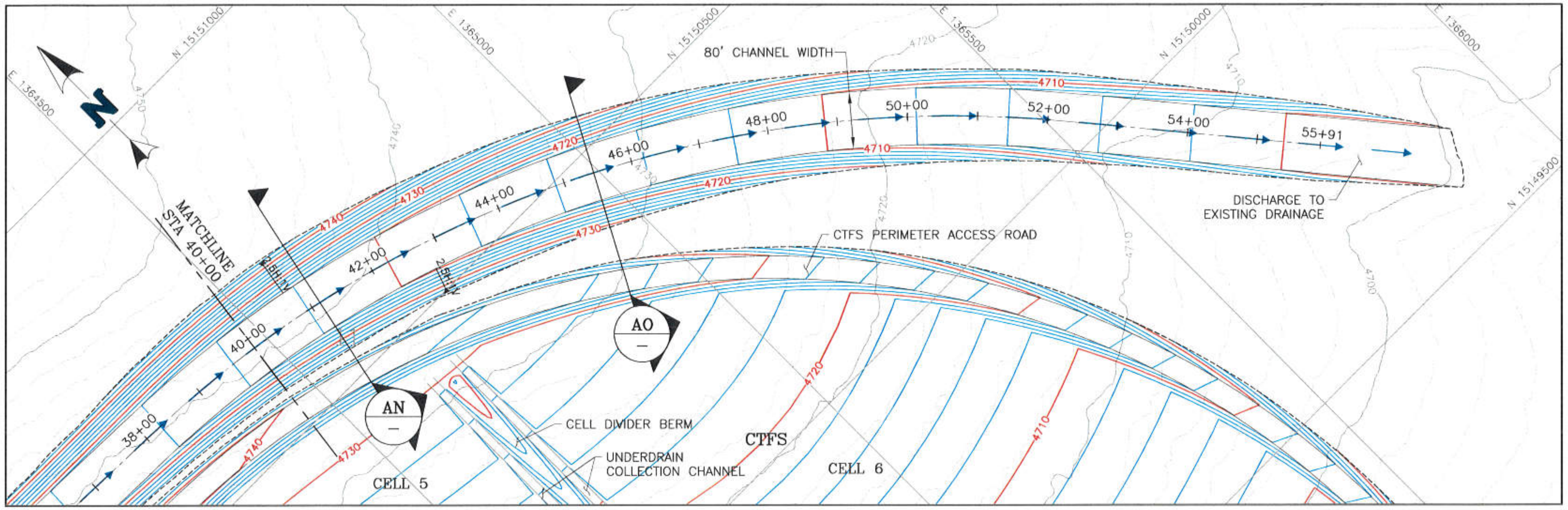
PROJECT: THACKER PASS PROJECT

TITLE: CTFS NORTH DIVERSION CHANNEL PLAN & PROFILE (SHEET 2 OF 3)

FILENAME: 0385.000.081P

DRAWING NO.: A314

REVISION: 0



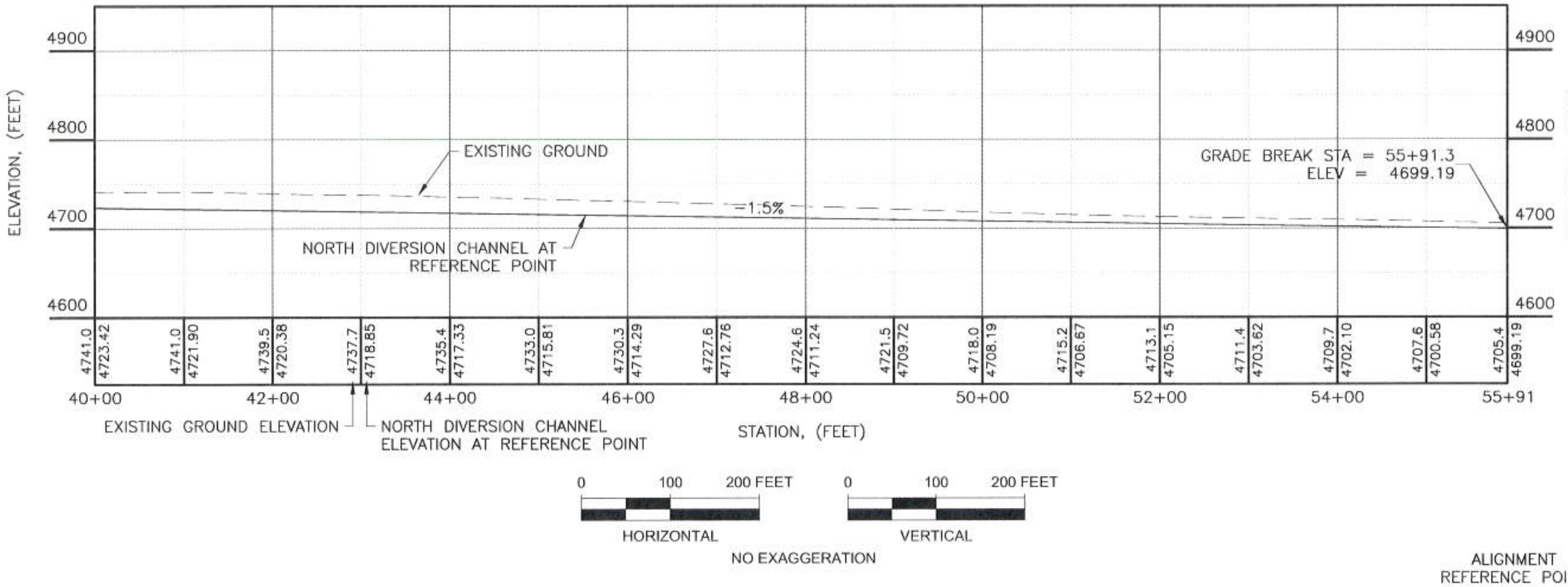
LEGEND:

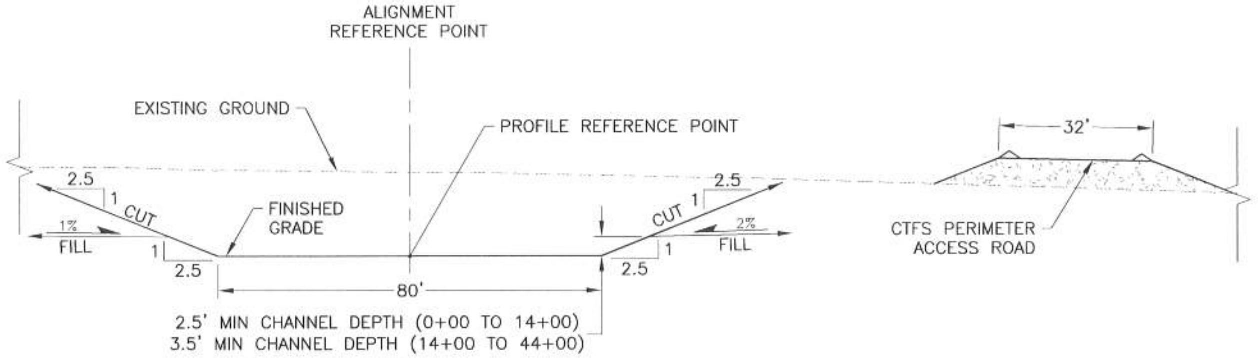
	EXISTING 2 FT GROUND CONTOURS
4500	EXISTING CONTOUR ELEVATION
	2 FT GROUND CONTOURS
4500	CONTOUR ELEVATION
	SURFACE DAYLIGHT
→ →	MAJOR STORMWATER DRAINAGE FLOW PATH

0 100 200 FEET

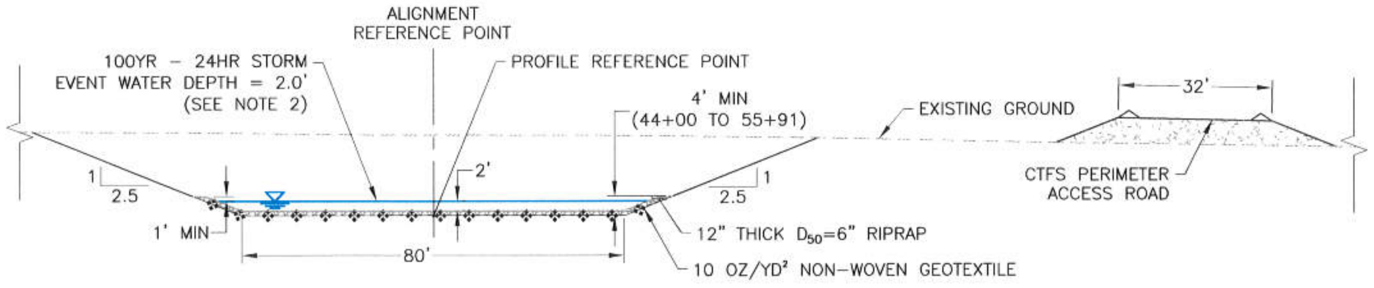
NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. THE CTFS NORTH DIVERSION CHANNEL IS DESIGNED TO CONVEY STORMWATER FROM THE 100YR – 24HR STORM EVENT.





AN A313 AN A314 AN A315 CTFS NORTH DIVERSION CHANNEL CROSS SECTION (NO RIPRAP)



AO – CTFS NORTH DIVERSION CHANNEL CROSS SECTION (WITH RIPRAP)

PROFESSIONAL ENGINEER STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No.21993
Matt Haley
4/2/20

TOPO REFERENCE:

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REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: MTH
DRAWN BY: RL

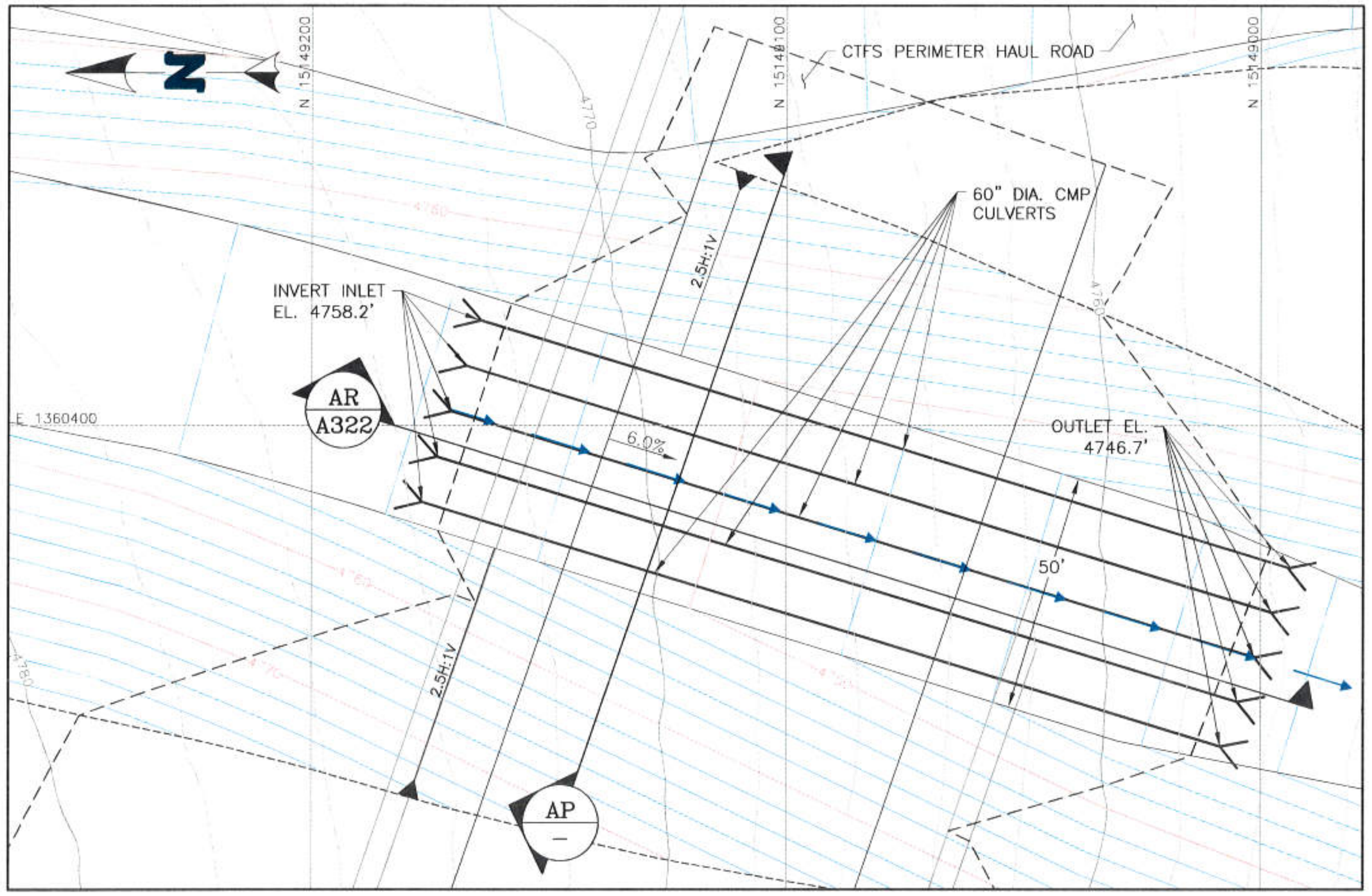
NewFields

CLIENT: LITHIUM NEVADA CORP.

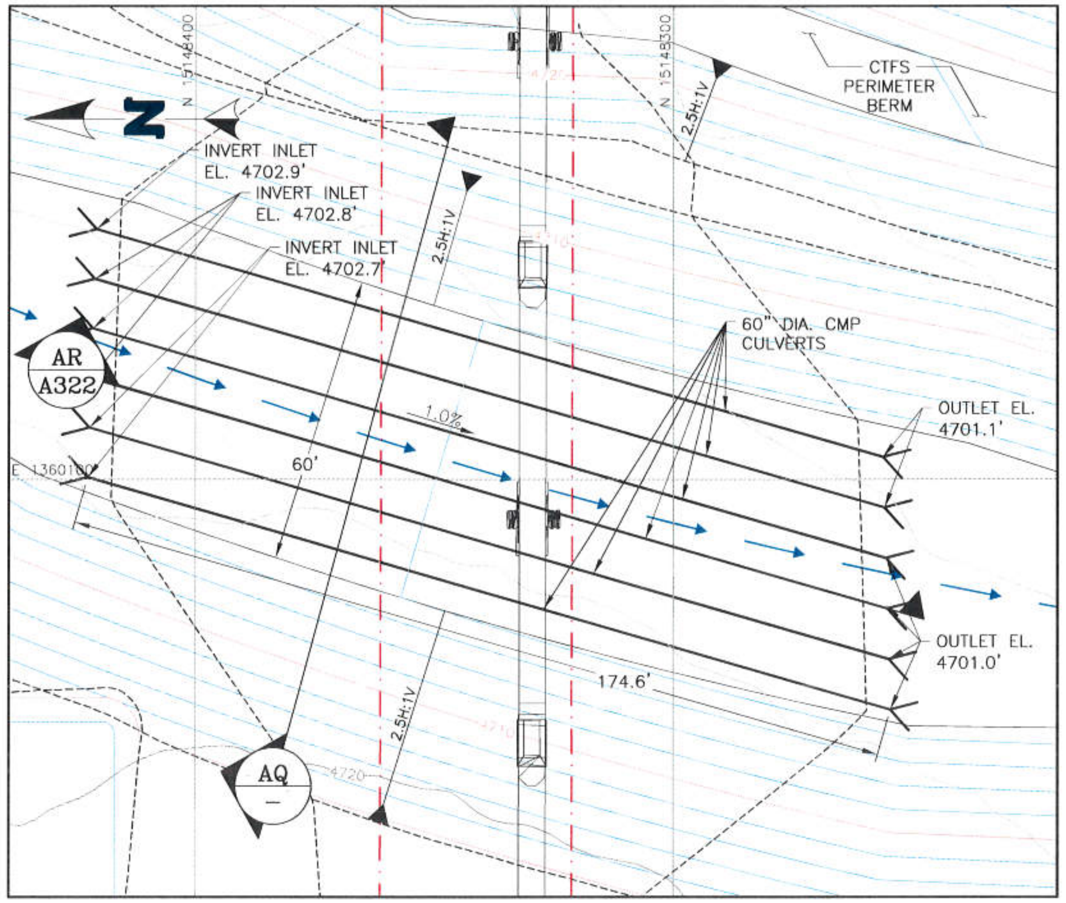
PROJECT: THACKER PASS PROJECT

TITLE: CTFS NORTH DIVERSION CHANNEL PLAN & PROFILE (SHEET 3 OF 3)

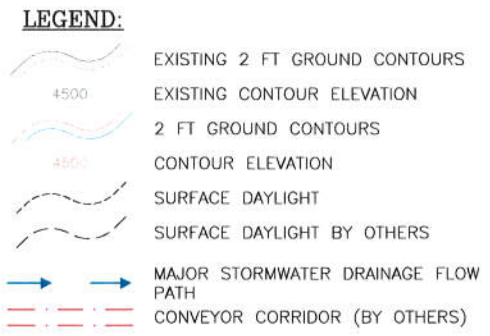
FILENAME: 0385.000.084P
DRAWING NO.: A315
REVISION: 0

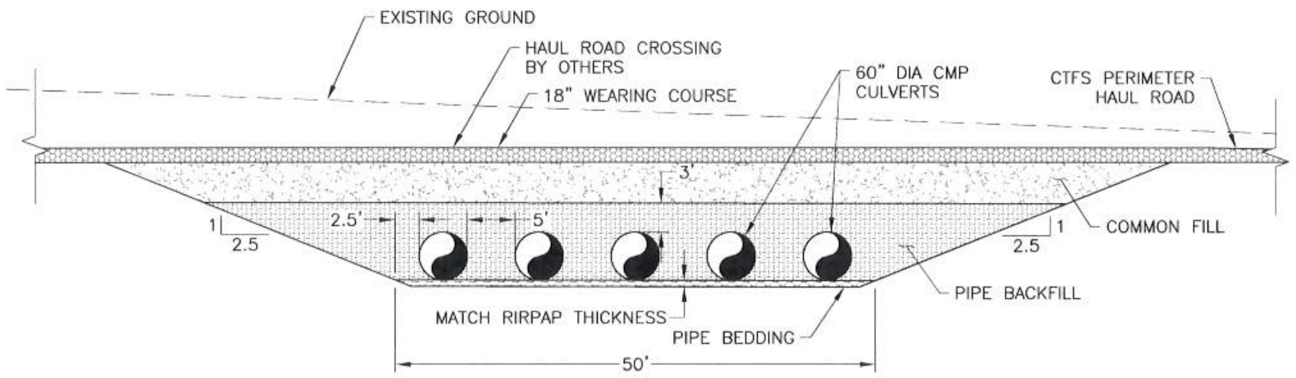


17 / A311 CULVERTS AT CTFS HAUL ROAD CROSSING
WEST DIVERSION CHANNEL

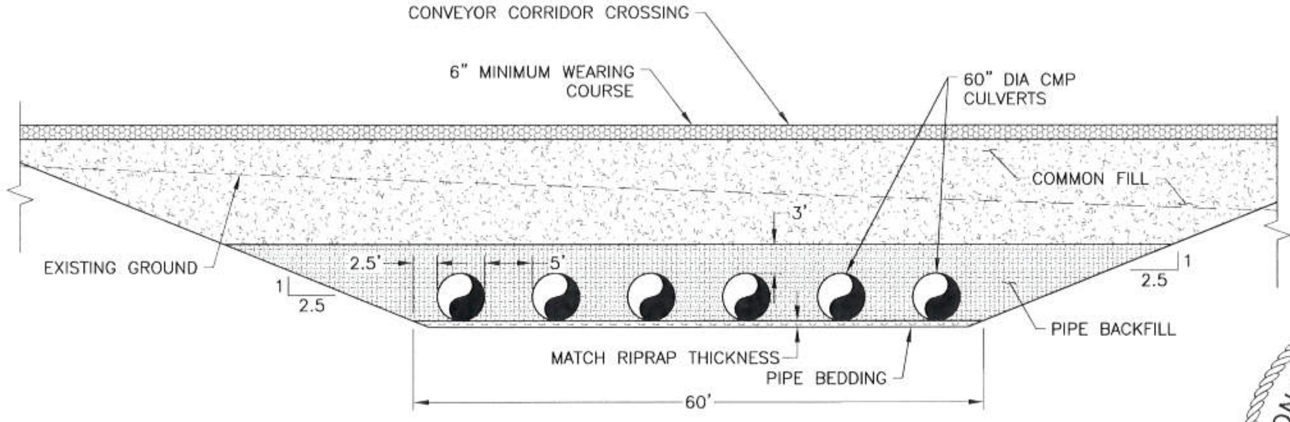


18 / A311 CULVERTS AT CLAY TAILINGS CONVEYOR CORRIDOR
WEST DIVERSION CHANNEL





AP / — CTFS HAUL ROAD CROSSING CULVERT SECTION



AQ / — CTFS CONVEYOR CROSSING CULVERT SECTION

PROFESSIONAL ENGINEER-STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No.21993
Matt Haley
4/2/20

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. THE CULVERTS ARE DESIGNED TO CONVEY STORMWATER FROM THE 100YR – 24HR STORM EVENT.

TOPO REFERENCE:

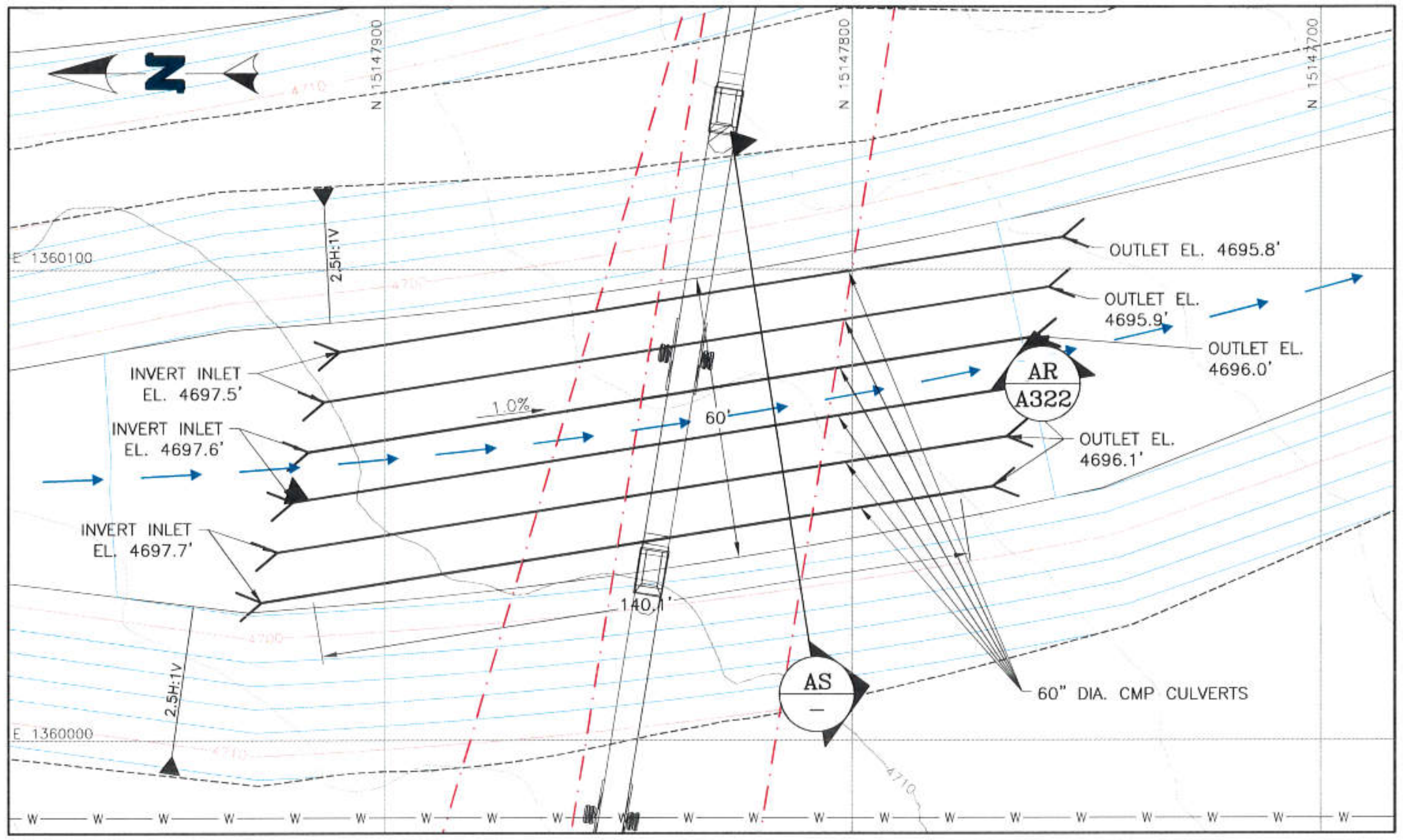
EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\A-CAD\DWGS\0385.000.083D.dwg-4/1/2020 11:28 AM

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: MTH
DRAWN BY: RL

NewFields
CLIENT: LITHIUM NEVADA CORP.
PROJECT: THACKER PASS PROJECT
TITLE: CTFS WEST CHANNEL CULVERT SECTIONS (SHEET 1 OF 2)
FILENAME: 0385.000.083D
DRAWING NO.: A320
REVISION: 0



16
A310
CULVERTS AT SALT STOCKPILE CONVEYOR CROSSING
WEST DIVERSION CHANNEL

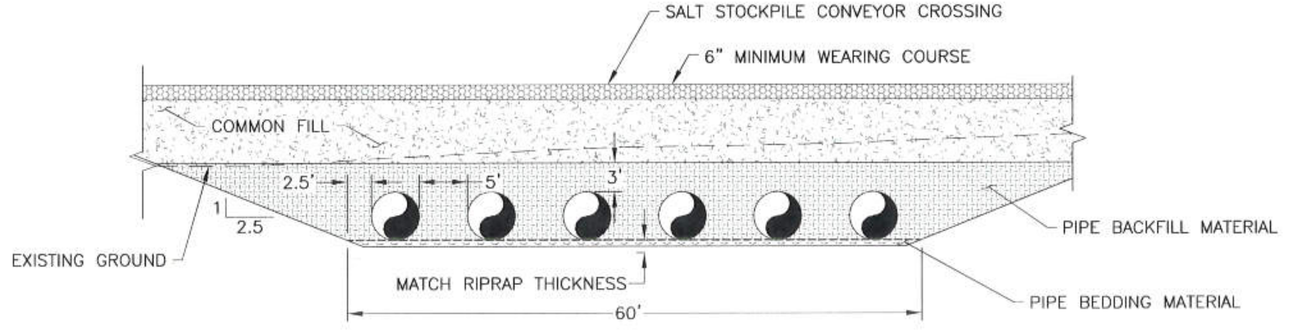
0 20 40 FEET

LEGEND:

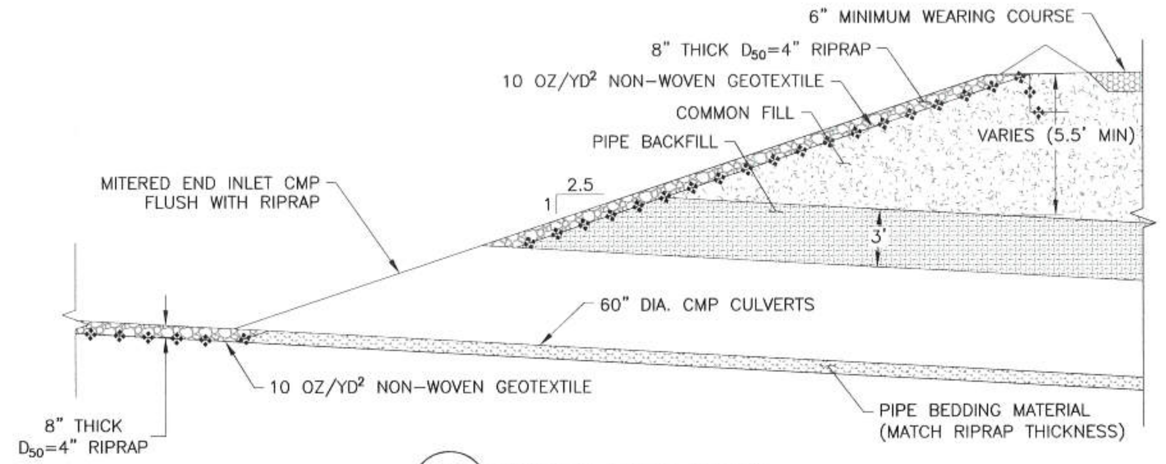
〰	EXISTING 2 FT GROUND CONTOURS
4500	EXISTING CONTOUR ELEVATION
〰	2 FT GROUND CONTOURS
4500	CONTOUR ELEVATION
- - -	SURFACE DAYLIGHT
—W—	WATER LINE (BY OTHERS)
— · —	CONVEYOR CORRIDOR (BY OTHERS)
→ →	MAJOR STORMWATER DRAINAGE FLOW PATH

NOTES:

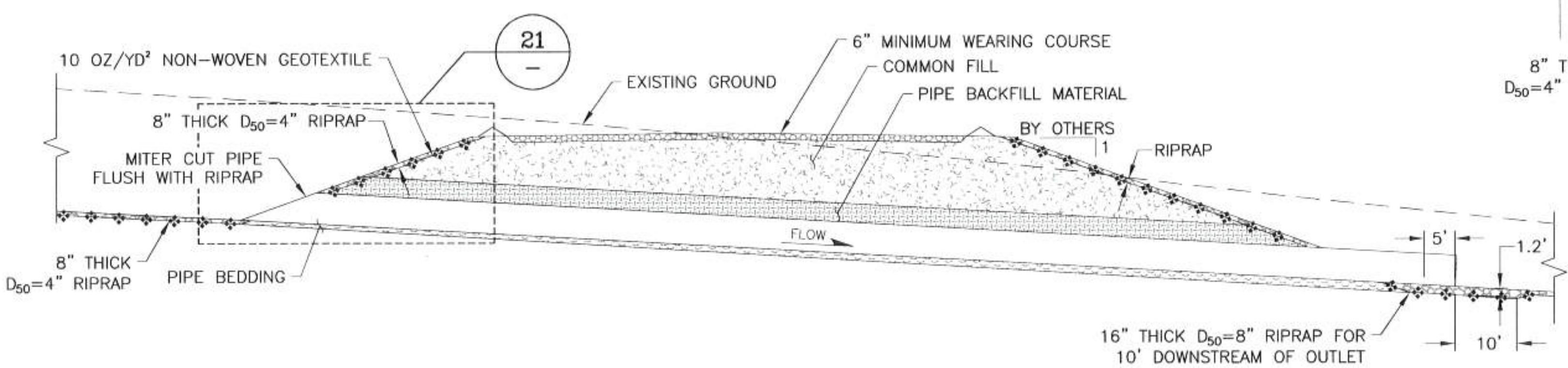
1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. THE CULVERTS ARE DESIGNED TO CONVEY STORMWATER FROM THE 100YR – 24HR STORM EVENT.
3. RIPRAP SHOWN IS THE MINIMUM REQUIRED FOR CURRENT DESIGN AND MAY REQUIRE UPGRADING OR REPLACEMENT IF THE WATERSHED AREA IS INCREASED.



AS
–
CONVEYOR CROSSING CULVERT SECTION



21
–
CULVERT INLET DETAIL



AR
A320
AR
A322
CULVERT CROSSING LONGITUDINAL TYPICAL SECTION

MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No.21993
Matt Haley
4/2/20

TOPO REFERENCE:

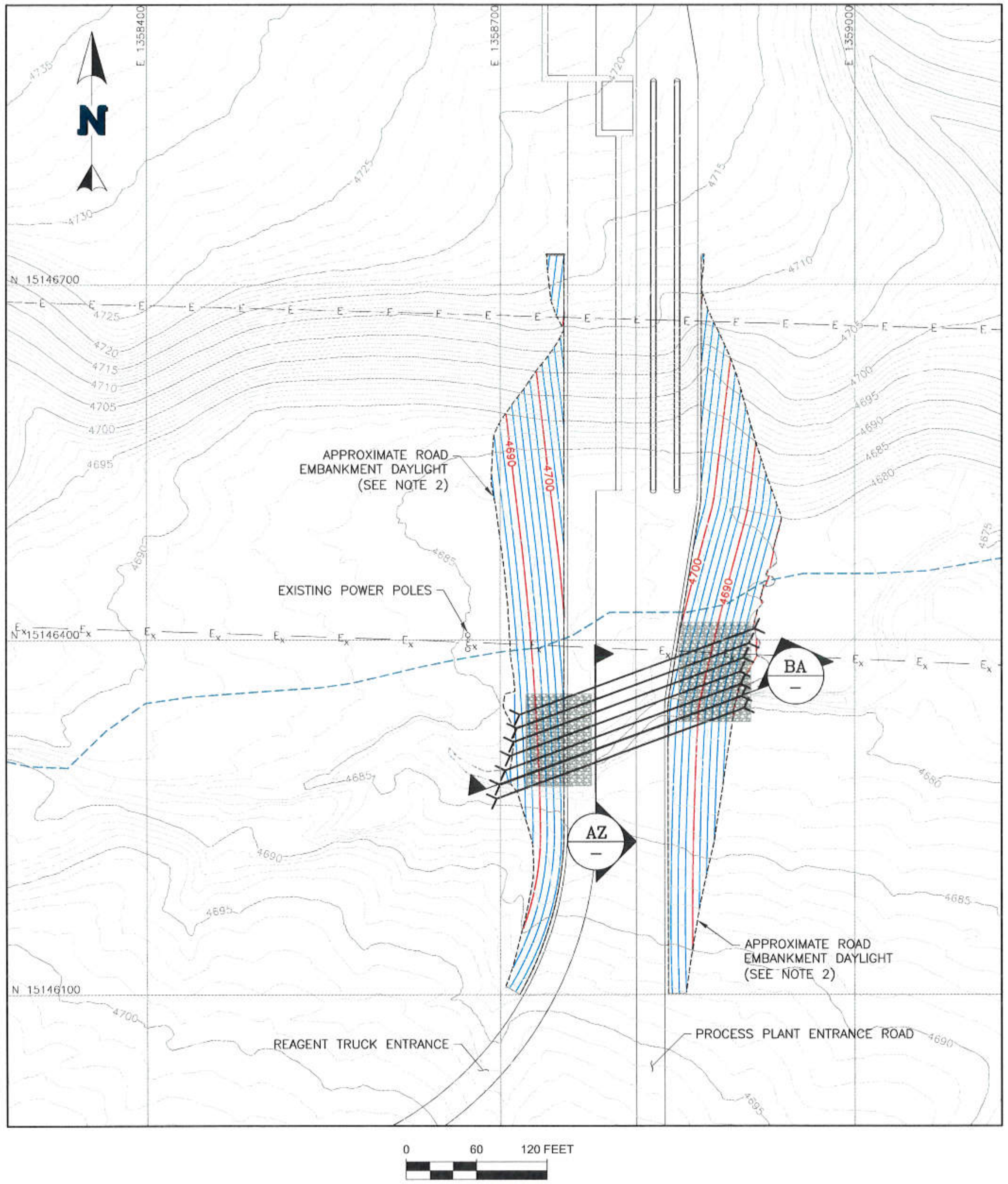
EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\A-CAD\DWGS\0385.000.087P.dwg-4/1/2020 11:29 AM

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: MTH
DRAWN BY: RL

NewFields
CLIENT: LITHIUM NEVADA CORP.
PROJECT: THACKER PASS PROJECT
TITLE: CTFS WEST CHANNEL CULVERT SECTIONS
(SHEET 2 OF 2)
FILENAME: 0385.000.087P
DRAWING NO.: A322
REVISION: 0

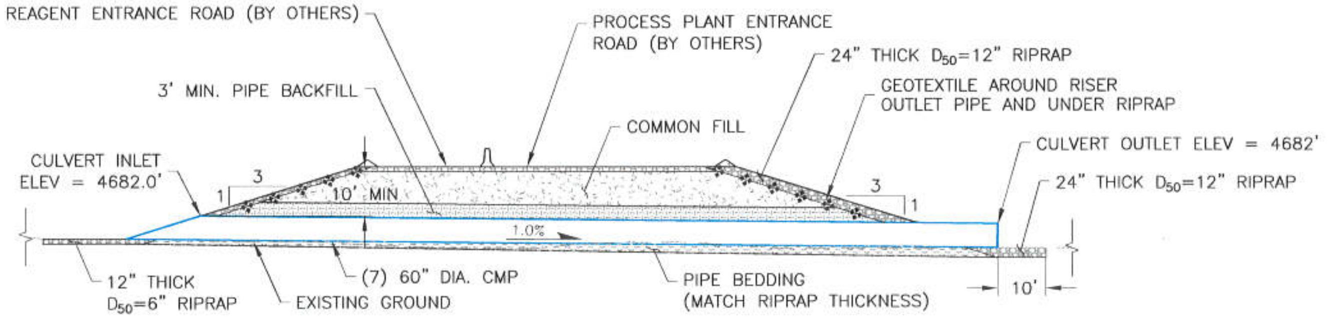


LEGEND:

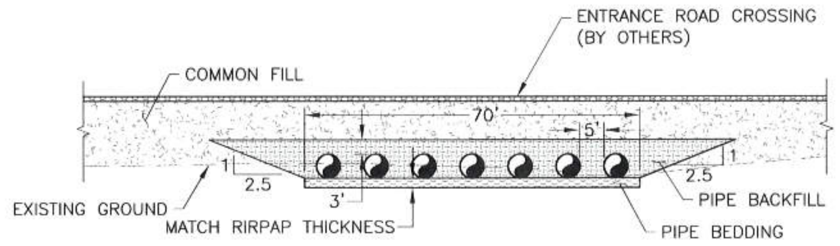
EXISTING 1 FT GROUND CONTOURS
4500 EXISTING CONTOUR ELEVATION
1 FT GROUND CONTOURS
4500 CONTOUR ELEVATION
EXISTING ROADS
SURFACE DAYLIGHT
EXISTING DRAINAGES
CULVERT
E_x EXISTING POWER LINE
W WATER LINE (by others)

NOTE:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. A MINIMUM ROADWAY CREST ELEVATION OF 4697' IS REQUIRED ACROSS THE EXISTING DRAINAGEWAY TO PROVIDE ADEQUATE HEADWATER DEPTH. A CONSTANT ROADWAY ELEVATION, AS SHOWN, IS ASSUMED FOR DESIGN PURPOSES. ACTUAL ROADWAY ELEVATIONS AND GRADING WILL BE DESIGNED BY OTHERS AND MAY IMPACT THE REQUIRED CULVERT LENGTHS.



BA
—
PROCESS PLANT ENTRANCE ROAD CULVERT SECTION



AZ
—
PROCESS PLANT ENTRANCE ROAD CULVERT SECTION

MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No.21993
Matt Haley
4/2/20

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: MTH
DRAWN BY: RL

NewFields
CLIENT LITHIUM NEVADA CORP.
PROJECT THACKER PASS PROJECT
TITLE PROCESS PLANT
ENTRANCE ROAD CULVERT
SECTIONS AND DETAILS
FILENAME 0385.000.104D
DRAWING NO. A324
REVISION 0

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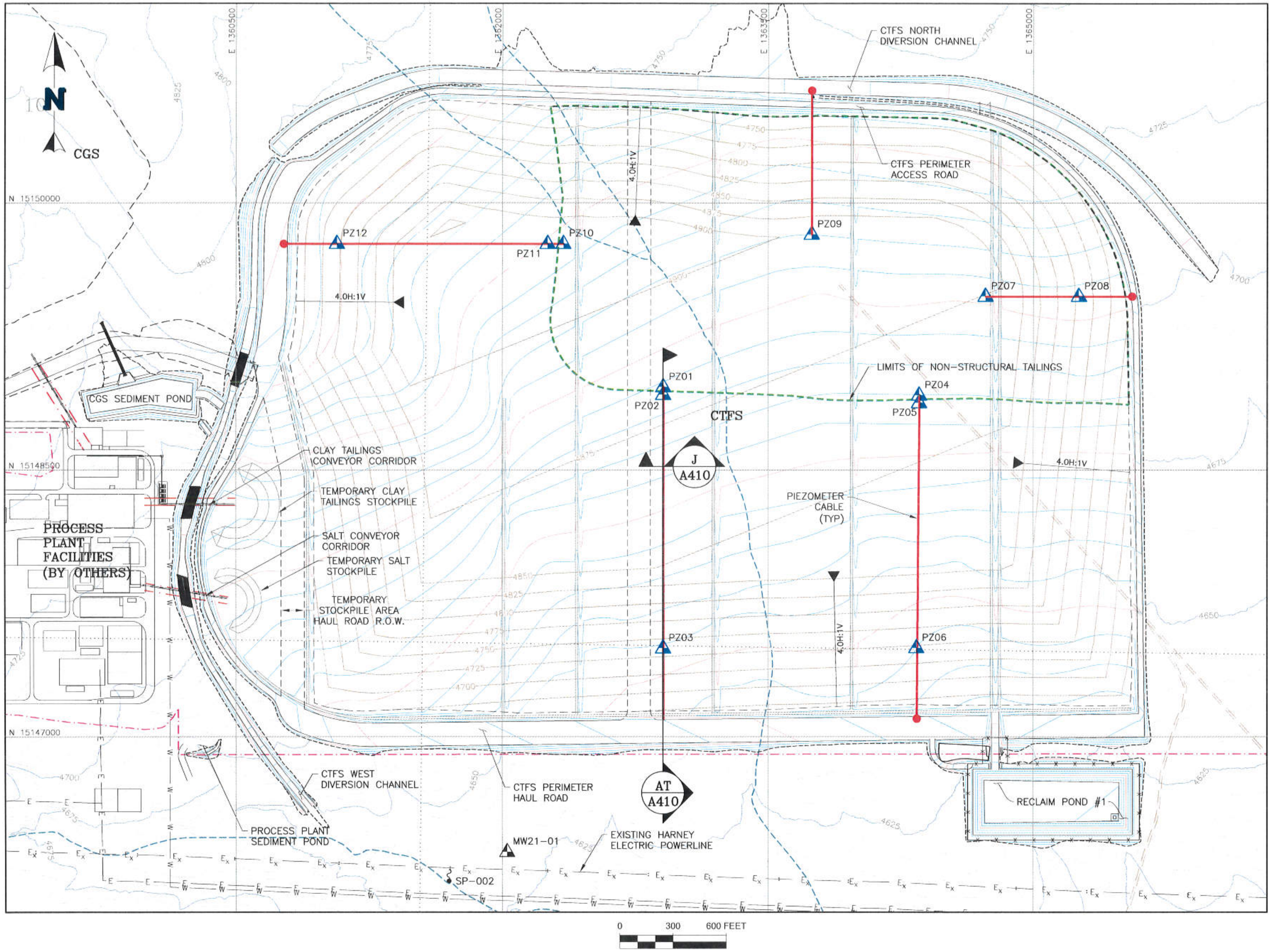

LEGEND:

- EXISTING 5 FT GROUND CONTOURS
- 4500 EXISTING CONTOUR ELEVATION
- 5 FT GROUND CONTOURS
- 4500 CONTOUR ELEVATION
- 5 FT GROUND CONTOURS
- 4500 CONTOUR ELEVATION
- SECTION LINES
- 20 SECTION NUMBER
- EXISTING ROADS
- SURFACE DAYLIGHT
- SURFACE DAYLIGHT (BY OTHERS)
- EXISTING DRAINAGES (BY OTHERS)
- CULVERT
- EX EXISTING POWER LINE
- EXISTING POWER POLES
- W WATER LINE (BY OTHERS)
- E POWER LINE (BY OTHERS)
- × × FENCE
- STRUCTURE/BUILDING
- CONVEYOR CORRIDOR (BY OTHERS)
- EXISTING SPRING/SEEP
- ▲ MONITORING WELL
- ▲ CTFS PIEZOMETER
- CTFS PIEZOMETER CABLE
- ● CTFS PIEZOMETER CABLE

NOTES:

1. ALL LINEWORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. PIEZOMETER READ OUT BOXES TO BE PLACED ON THE INSIDE CREST OF THE PERIMETER ROAD.
3. THE PIEZOMETER CABLE TO BE 1' ABOVE THE OVERLINER.
4. PIEZOMETER READ OUT BOXES SHOULD BE PROTECTED FROM VEHICLE TRAFFIC BY USING CONCRETE BOLLARDS OR BERMS.

MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No.21993
Matt Haley
4/2/20

TOPO REFERENCE:

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REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: MTH
DRAWN BY: RL

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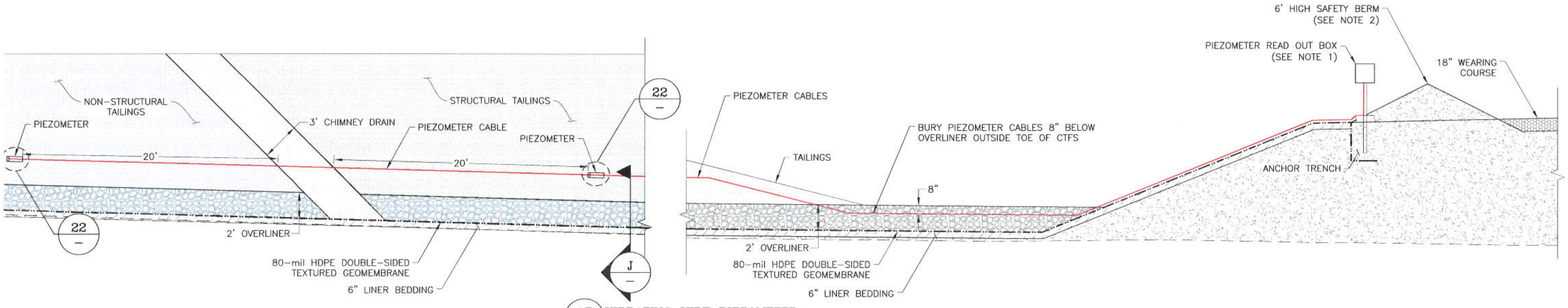
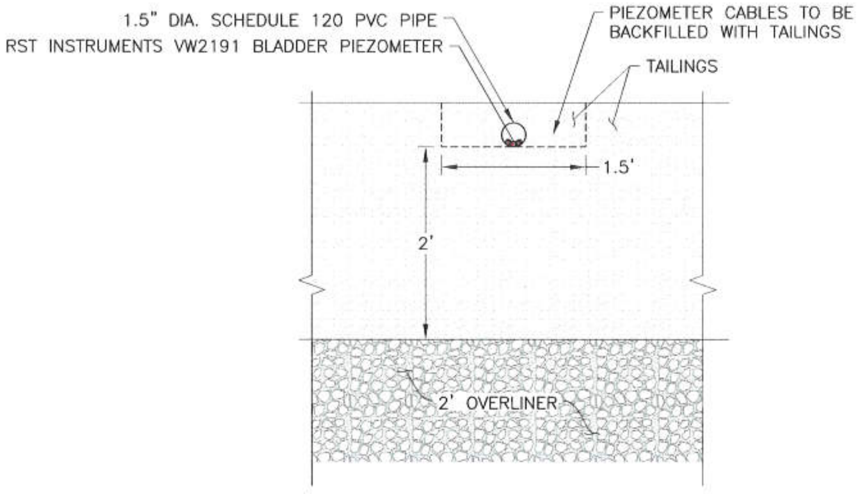
NewFields
CLIENT LITHIUM NEVADA CORP.
PROJECT THACKER PASS PROJECT
TITLE CTFS INSTRUMENTATION PLAN
FILENAME 0385.000.014M
DRAWING NO. A400
REVISION 0

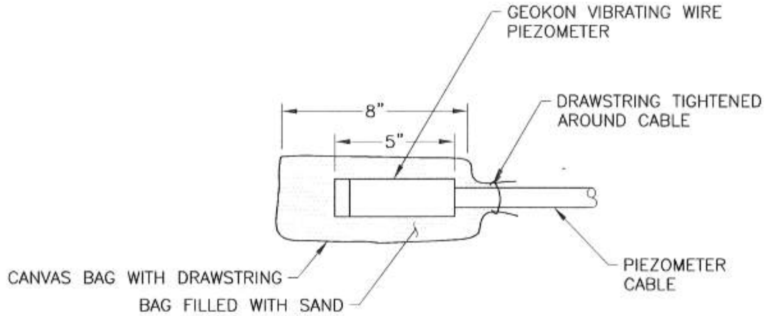
P:\Projects\0385.000 Lithium Nevada Tracker Pass Project\4-CAD\DWGS\0385.000.014M.dwg-4/1/2020 12:42 PM



AT / A400 VIBRATING WIRE PIEZOMETER



J / A400 J / – PIEZOMETER CABLE TRENCH (TYP.)



22 / – VIBRATING WIRE PIEZOMETER

NOTES:

1. CONTRACTOR TO SUBMIT SHOP DRAWING OF FABRICATED STAND.
2. ALLOW A 2' WIDE BREAK IN SAFETY BERM AT PIEZOMETER READ OUT BOX LOCATIONS.

MATTHEW T. HALEY
Exp. 06/30/21
CIVIL
No. 21993
Matt Haley
4/2/20

0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH
REV	DATE	DESCRIPTION	TECH	ENG

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: MTH
DRAWN BY: RL

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NewFields

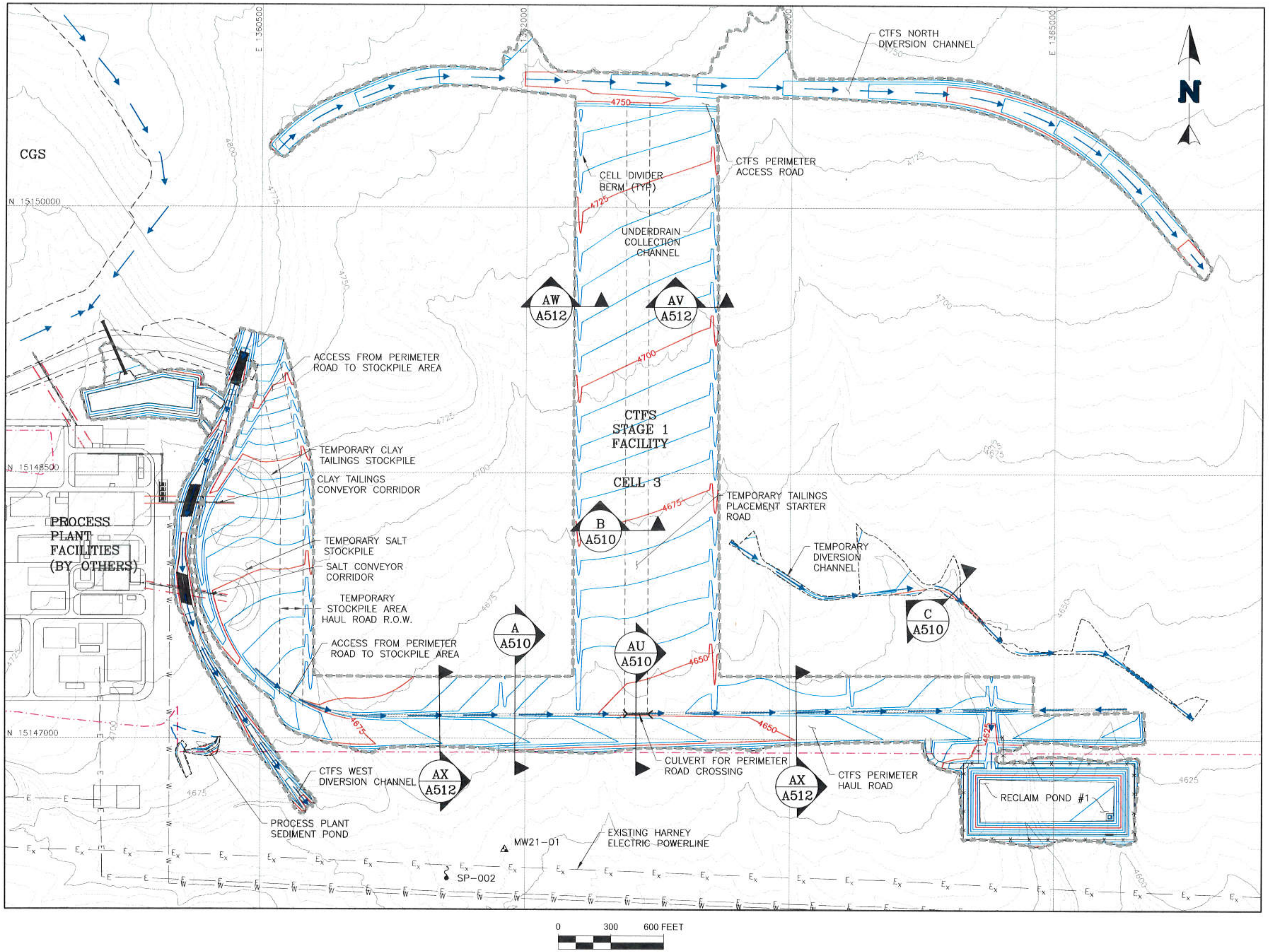
CLIENT
LITHIUM NEVADA CORP.

PROJECT
THACKER PASS PROJECT

TITLE
CTFS INSTRUMENTATION PLAN
SECTIONS & DETAILS

FILENAME
0385.000.017D
DRAWING NO.
A410
REVISION
0

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\A-CAD\DWGS\0385.000.017D.dwg-4/1/2020 12:43 PM



LEGEND:

	EXISTING 5 FT GROUND CONTOURS
4500	EXISTING CONTOUR ELEVATION
	5 FT GROUND CONTOURS
4500	CONTOUR ELEVATION
	SECTION LINES
20	SECTION NUMBER
	EXISTING ROADS
	SURFACE DAYLIGHT
	SURFACE DAYLIGHT BY OTHERS
	EXISTING DRAINAGES
	CULVERT
— Ex —	EXISTING POWER LINE
— W —	WATER LINE (BY OTHERS)
— E —	POWER LINE (BY OTHERS)
	FUTURE PLANT EXPANSION
—x—x—x—	FENCE
▭	STRUCTURE/BUILDING
	STAGE 1 CONSTRUCTION LIMITS
	CONVEYOR CORRIDOR (BY OTHERS)
→ →	MAJOR STORMWATER DRAINAGE FLOW PATH
	EXISTING SPRING/SEEP
△	MONITORING WELL

NOTE:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.

PROFESSIONAL ENGINEER STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No.21993
Matt Haley
4/2/20

TOPO REFERENCE:

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P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\A-CAD\DWGS\0385.000.047D.dwg-4/1/2020 12:45 PM

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: RL
DRAWN BY: RL

DISCLAIMER

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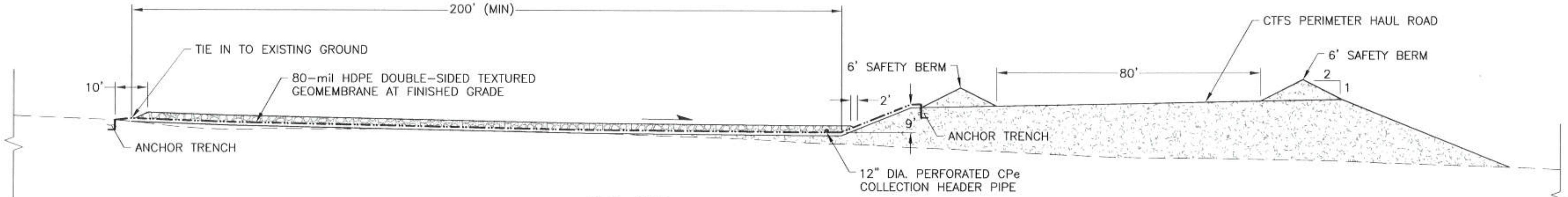
NewFields

CLIENT: LITHIUM NEVADA CORP.

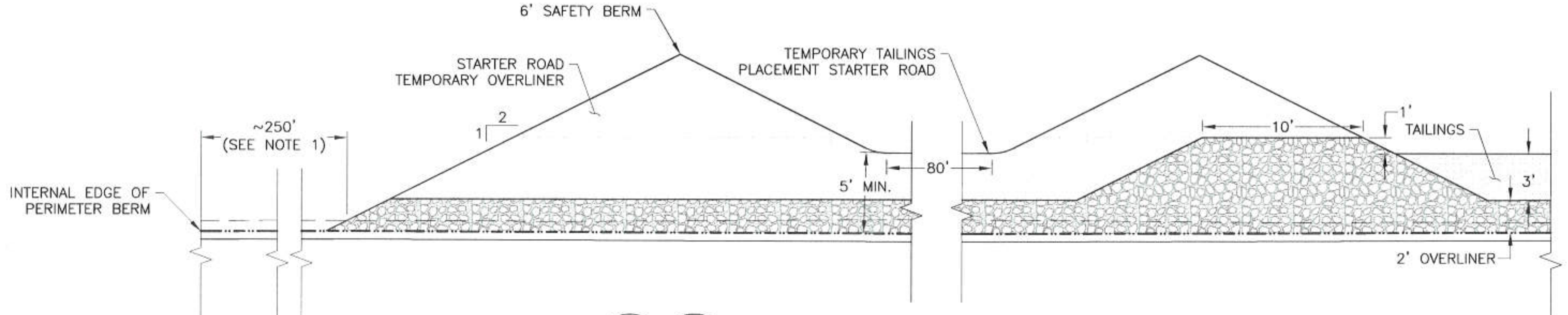
PROJECT: THACKER PASS PROJECT

TITLE: CTFS STAGE 1 STORMWATER PLAN

FILENAME: 0385.000.047D
DRAWING NO.: A500
REVISION: 0



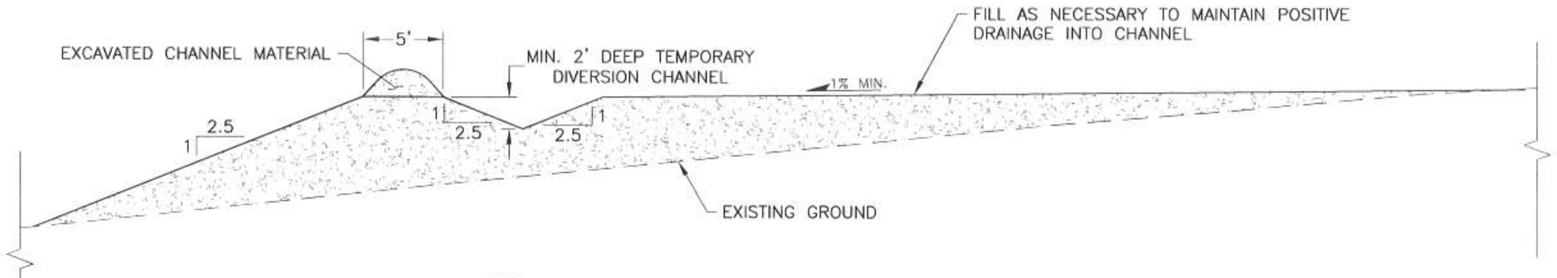
A/A060 A/A500 STAGE 1 FACILITY TYPICAL SECTION



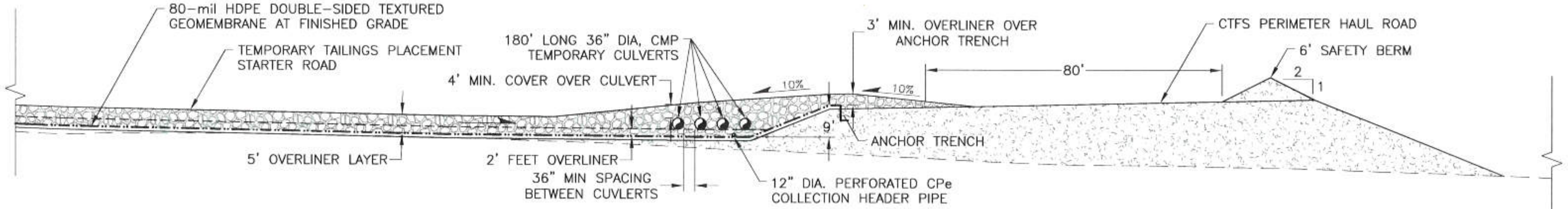
B/A060 B/A500 STAGE 1 CELL DIVIDER BERM TIE-IN TYPICAL SECTION

NOTE:

1. THE AREA FROM THE CELL DIVIDER BERM TOE TO THE TEMPORARY TAILINGS PLACEMENT ROAD WILL BE FILLED IN WITH OVERLINER MATERIAL CUT FROM THE TEMPORARY ROAD AFTER THE TAILINGS ON THE EAST SIDE OF THE ROAD HAS BEEN PLACED.



C/A500 TEMPORARY TAILINGS STARTER ROAD



AU/A060 AU/A500 CTFS PERIMETER CROSSING SECTION

PROFESSIONAL ENGINEER-STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No.21993
Matt Haley
4/2/20

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: RL
DRAWN BY: RL

DISCLAIMER

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NewFields

CLIENT: LITHIUM NEVADA CORP.
PROJECT: THACKER PASS PROJECT
TITLE: CTFS STAGE 1 SECTIONS & DETAILS (1 OF 2)
FILENAME: 0385.000.043D
DRAWING NO.: A510
REVISION: 0

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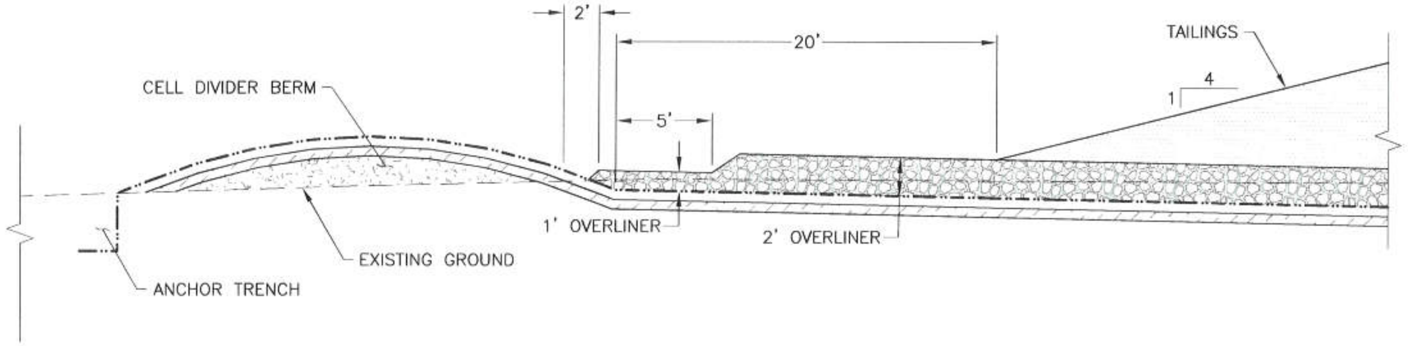
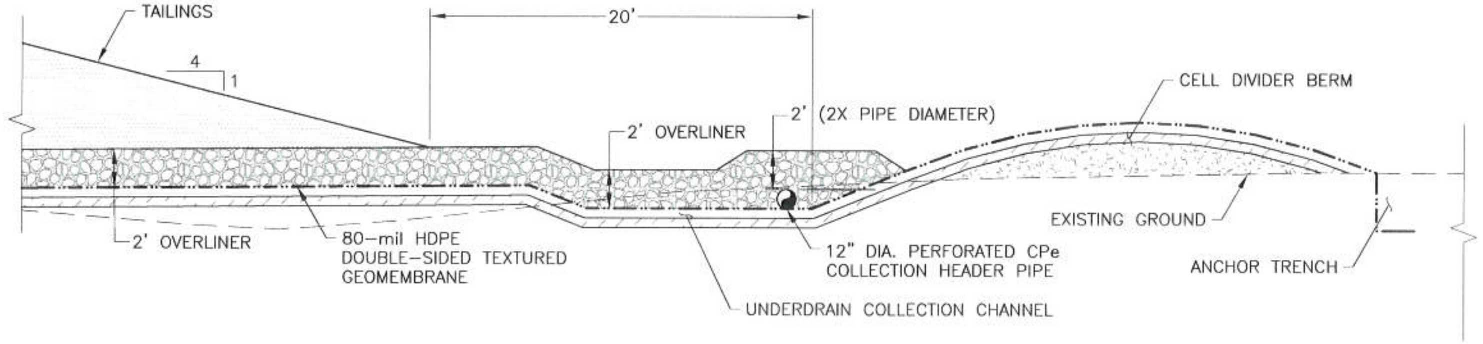


AW / A500 STAGE 1 TYPICAL SECTION



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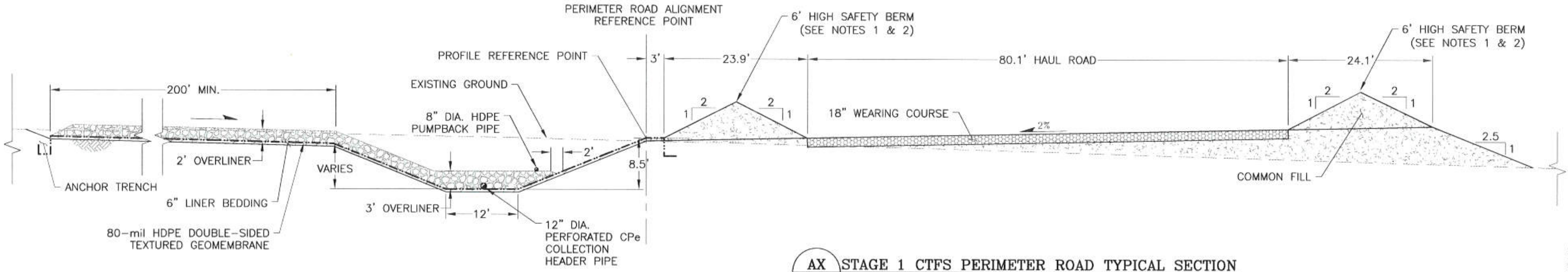

AX / A500 STAGE 1 CTFS PERIMETER ROAD TYPICAL SECTION

PROFESSIONAL ENGINEER-STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No.21993
Matt Haley
4/1/20

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: MTH
DRAWN BY: RL

DISCLAIMER

NewFields

CLIENT: LITHIUM NEVADA CORP.

PROJECT: THACKER PASS PROJECT

TITLE: CTFS STAGE 1 SECTIONS & DETAILS (2 OF 2)

FILENAME: 0385.000.082D

DRAWING NO.: A512

REVISION: 0

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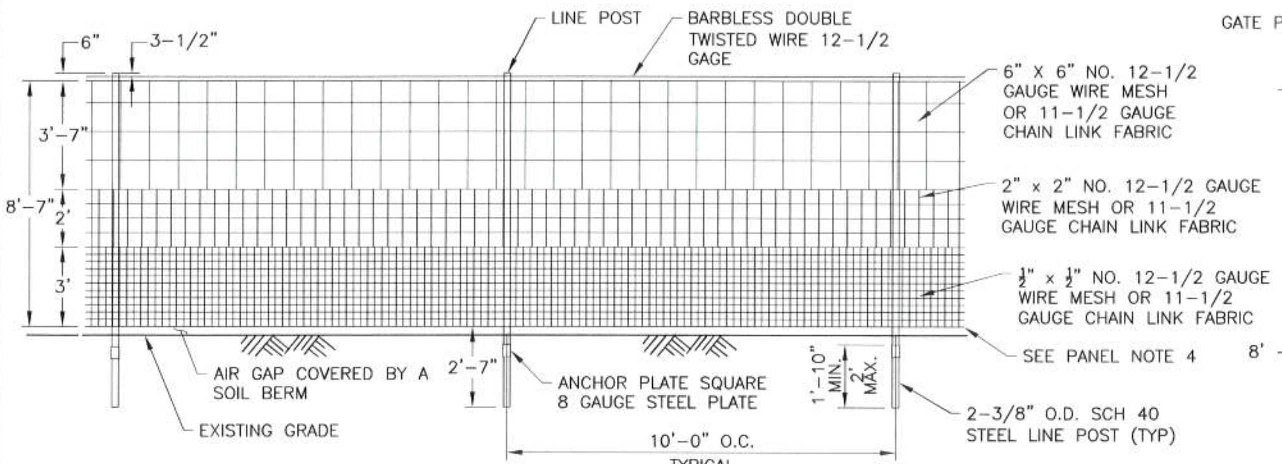
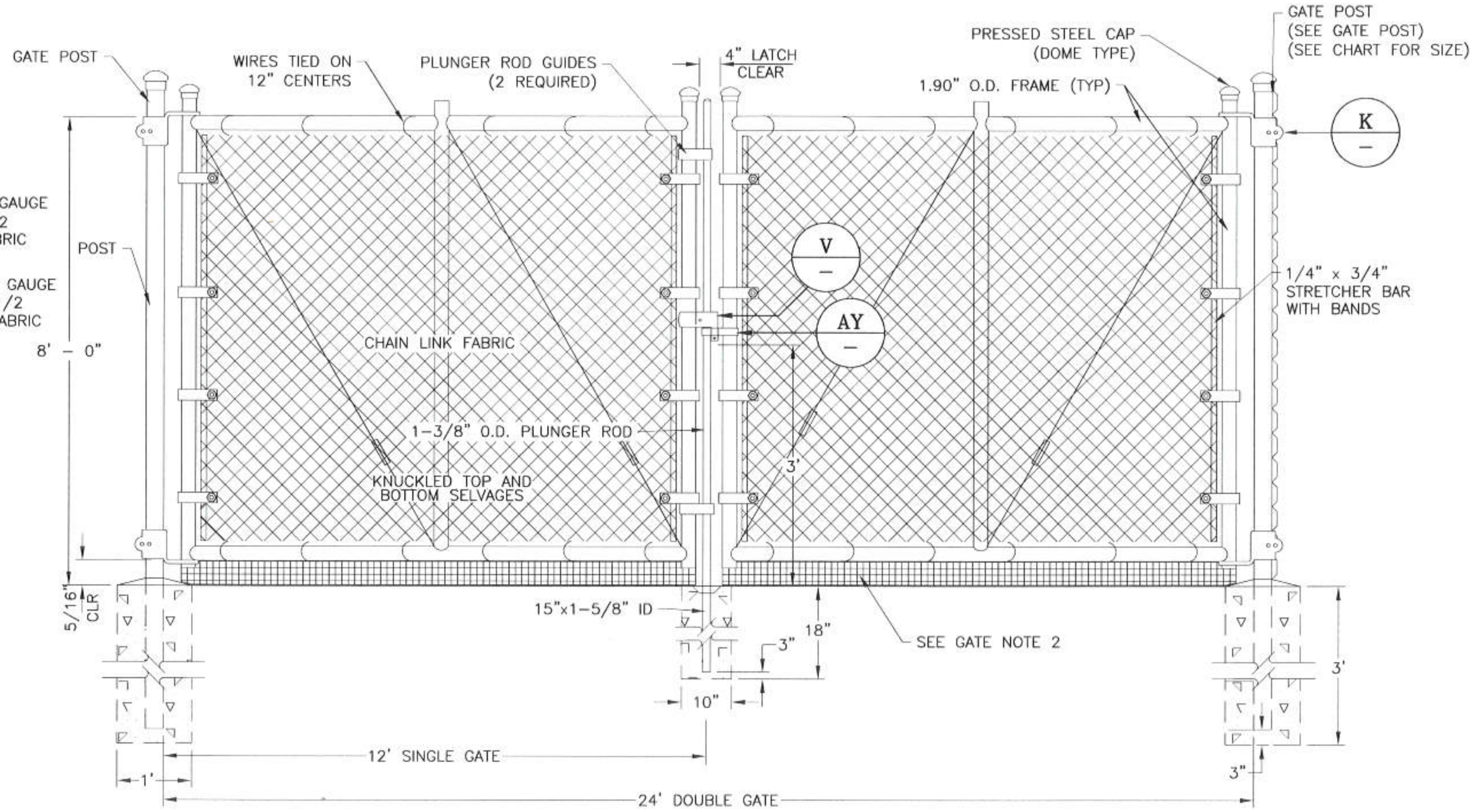
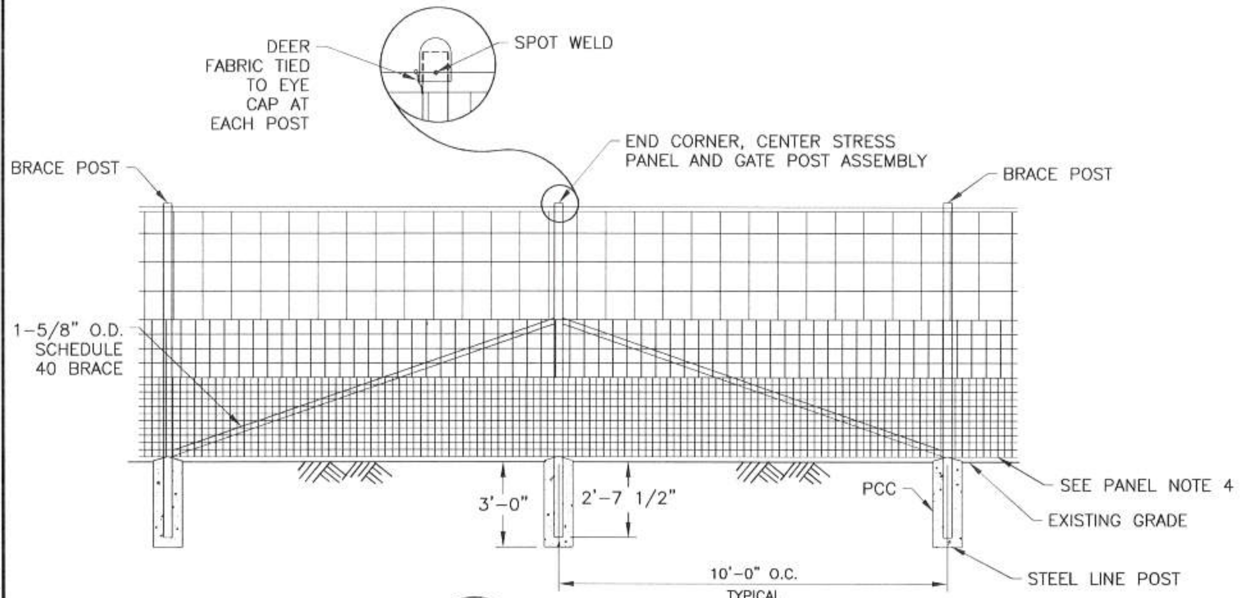


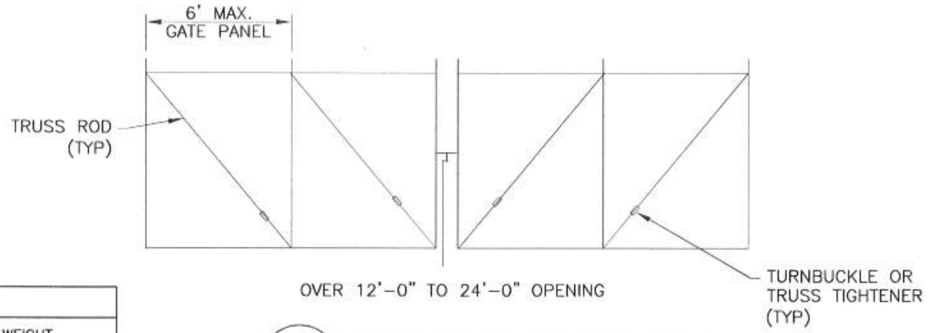
25 LINE PANELS
—



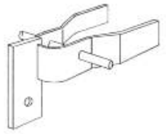
26 DOUBLE SWING GATE
—



23 END PANEL
—

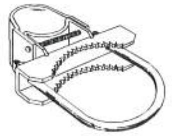


24 FRAME CONSTRUCTION GATES
—



V LOCK KEEPERS
—

AY LOCK KEEPERS GUIDE
—



K HINGE FOR TUBULAR POSTS
—

GATE POST				
GATE OPENING IN FEET		ROUND GATE POLES O.D. (INCHES)	MIN. WEIGHT POUNDS/LIN. FEET	
SINGLE GATE	DOUBLE GATE		CLASS 1	CLASS 2
UP TO 6	UP TO 12	2,875	5.79	4.64
7 THRU 13	13 THRU 26	4.000	9.11	6.56
14 THRU 18	27 THRU 36	6,625	18.97	–

PANEL NOTES:

1. STRESS PANELS SHALL BE PLACED EVERY 1000' ON TANGENTS.
2. STRESS PANELS SHALL BE PLACED EVERY 600' ON CURVES.
3. END PANELS SHALL BE USED WHEREVER A BREAK IN THE FENCE OCCURS, (I.E. GATES, CATTLE GUARDS) AND AT THE BEGINNING AND END OF ALL CURVES
4. WIRES TIED OFF AT STRETCH POINTS. WRAPPED AND SPLICED TO SELF WITH AT LEAST 4 TURNS AT OPPOSITE END OF PANELS.
5. TERMINAL POST AND STRESS PANEL POST ARE BE 2-7/8" O.D.
6. FENCE INSTALLED TIGHT TO THE GROUND. ANY AIR GAP FILLED BY A SOIL BERM

GATE POST NOTES:

1. DIAMETERS AND WEIGHTS LISTED ABOVE ARE MINIMUMS. LARGER SIZES MAY BE USED WITH APPROVAL OF ENGINEER
2. 3-1/2" x 3-1/2" TYPE II POST (4.65 LBS/FT) SHALL BE USED IN PLACE OF 2.875" O.D. ROUND GATE POST.
3. CONCRETE SHALL BE CLASS A OR AA.
4. FENCE FABRIC SHALL BE PLACED FLUSH WITH THE EXISTING GROUND.

GATE NOTES:

1. 3/8" ADJUSTABLE TRUSS RODS INSTALLED ON ALL GATES OVER 6 FEET IN WIDTH.
2. 1/2" X 1/2" NO. 12-1/2 GAUGE WIRE MESH OR 11-1/2 GAUGE CHAIN LINK FABRIC INSTALLED AT THE BOTTOM OF GATES AS REQUIRED TO CLOSE GAP BETWEEN GATE FRAME AND GROUND.

REFERENCE:

THESE DETAILS ARE PROVIDED BY THE NEVADA DEPARTMENT OF TRANSPORTATION IN THE 2010 EDITION OF STANDARD PLANS FOR ROAD AND BRIDGE CONSTRUCTION.

PROFESSIONAL ENGINEER-STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
Matt Haley
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4/1/20
No. 21993

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: MTH
DRAWN BY: RL

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NewFields
CLIENT LITHIUM NEVADA CORP.
PROJECT THACKER PASS PROJECT
TITLE WILDLIFE FENCING SECTIONS AND DETAILS
FILENAME 0385.000.101D
DRAWING NO. A600
REVISION 0

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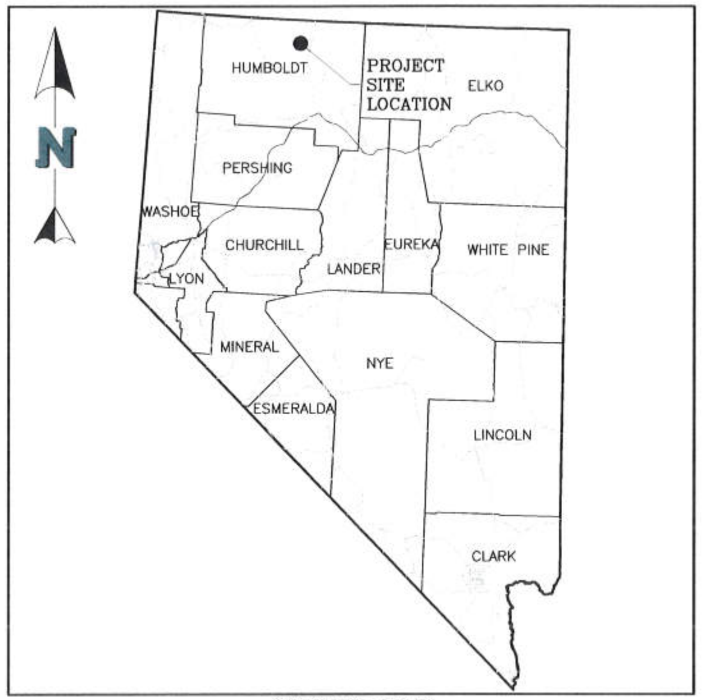
DRAWINGS

NewFields C-Series

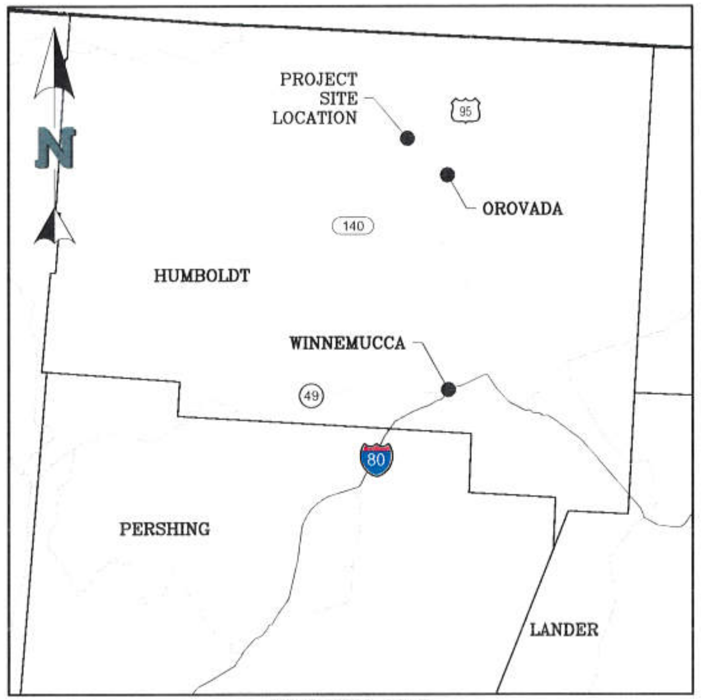
Waste Rock Storage Facilities and Coarse Gangue Stockpile



COUNTY MAP

LITHIUM NEVADA CORP.
THACKER PASS PROJECT
WASTE ROCK STORAGE FACILITIES AND COARSE GANGUE STOCKPILE

ISSUED FOR CONSTRUCTION
APRIL 02, 2020



VICINITY MAP

DRAWING LIST		
DWG NO.	DRAWING TITLE	REV
C000	COVER SHEET, INDEX AND VICINITY MAP	0
C010	OVERALL ULTIMATE PROJECT AND STORMWATER SITE PLAN	0
C050	GEOTECHNICAL INVESTIGATION PLAN	0
C105	WEST WRSF STORMWATER PLAN	0
C110	WEST WRSF SEDIMENT POND PLAN	0
C115	WEST WRSF SEDIMENT POND SECTIONS AND DETAILS (SHEET 1 OF 2)	0
C116	WEST WRSF SEDIMENT POND SECTIONS AND DETAILS (SHEET 2 OF 2)	0
C117	WEST WRSF POND ACCESS ROAD PLAN AND PROFILE	0
C118	WEST WRSF POND ACCESS ROAD SECTIONS AND DETAILS	0
C120	EAST WRSF STORMWATER PLAN	0
C121	EAST WRSF STORMWATER DETAILS	0
C125	EAST WRSF SEDIMENT POND PLAN	0
C130	EAST WRSF SEDIMENT POND SECTIONS AND DETAILS	0
C135	COARSE GANGUE STOCKPILE STORMWATER PLAN	0
C140	COARSE GANGUE STOCKPILE SEDIMENT POND PLAN	0
C143	COARSE GANGUE STOCKPILE SECTIONS AND DETAILS	0
C145	COARSE GANGUE STOCKPILE SEDIMENT POND SECTIONS AND DETAILS	0
C146	COARSE GANGUE STOCKPILE CULVERT SECTIONS	0
C150	FILTER DIAPHRAGM AND RISER PIPE SECTIONS AND DETAILS	0

TEXT ABBREVIATIONS:

CGS – COARSE GANGUE STOCKPILE
℄ – CENTERLINE
CPeP – CORRUGATED POLYETHYLENE PIPE
CS – CARBON STEEL
CTFS – CLAY TAILINGS FILTER STACK
CY – CUBIC YARD
DIA – DIAMETER
DR – DIMENSION RATIO
FT – FOOT
GM – GROWTH MEDIA
HDPE – HIGH DENSITY POLYETHYLENE
LHCSL – LOW HYDRAULIC CONDUCTIVITY SOIL LAYER
MW – MONITORING WELL
PH – EXISTING PRODUCTION WELL
POO – PLAN OF OPERATIONS
PZ – PIEZOMETER
QRPW – QUINN RIVER PRODUCTION WELL
ROM – RUN OF MINE
SR – STATE ROUTE
STD WT – STANDARD WEIGHT
TW – EXISTING TEST PUMPING WELL
TYP – TYPICAL
VFD – VARIABLE FREQUENCY DRIVE
WRSF – WASTE ROCK STORAGE FACILITY
WSH – EXISTING MONITORING WELL
WSE – WATER SURFACE ELEVATION

PROFESSIONAL ENGINEER-STATE OF NEVADA
MATTHEW T.
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Matt Haley
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4/2/20
No.21993

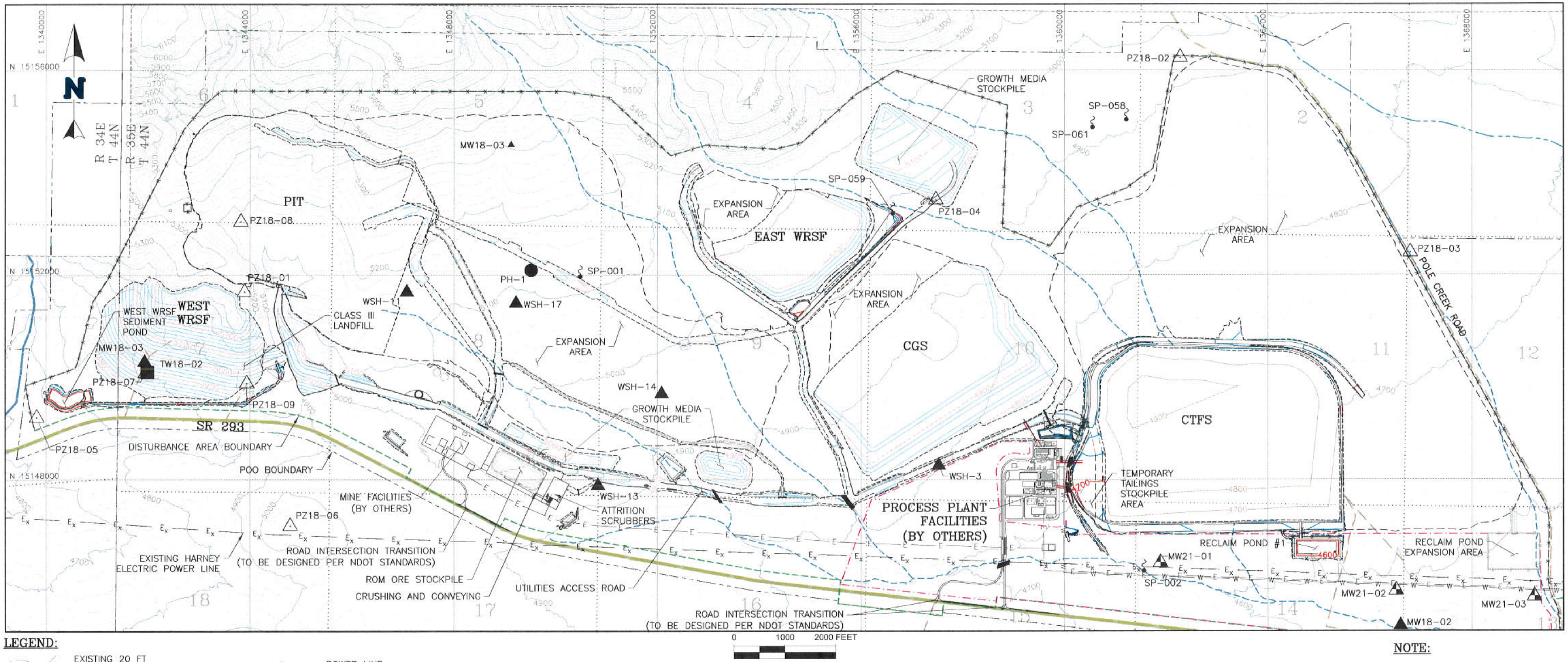
OWNER:

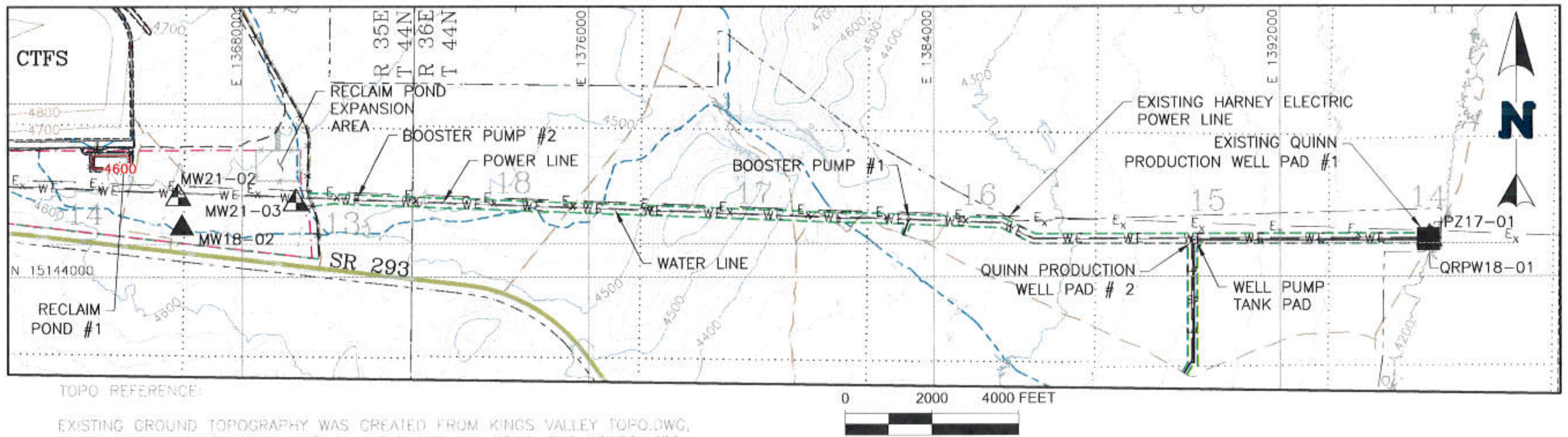
LithiumNevada

LITHIUM NEVADA CORP.
3685 LAKESIDE DRIVE
RENO, NEVADA 89509

NewFields

9400 Station Street, Suite 300, Lone Tree, CO 80124
Phone: (720) 508.3300 www.newfields.com





LEGEND:

	EXISTING 20 FT GROUND CONTOURS
4500	EXISTING CONTOUR ELEVATION
	20 FT CTFS CONTOURS
4500	CTFS CONTOUR ELEVATION
	20 FT GROUND CONTOURS
4500	CONTOUR ELEVATION
	20 FT GROUND CONTOURS BY OTHERS
4500	CONTOUR ELEVATION BY OTHERS
	EXISTING ROADS-MAJOR
	EXISTING ROADS/TRAILS
	SURFACE DAYLIGHT
	EXPANSION AREAS
	EXISTING DRAINAGES
	EXISTING EPHEMERAL CREEKS
	EXISTING PERENNIAL STREAMS
	POO BOUNDARY
	DISTURBANCE AREA BOUNDARY
	CULVERT
Ex	EXISTING POWER LINE
:	EXISTING POWER POLES
W	WATER LINE
E	POWER LINE
	FUTURE PLANT EXPANSION
x x x	FENCE
FO	FIBER OPTIC LINE
▭	STRUCTURE/BUILDING
	CONVEYOR CORRIDOR
△	EXISTING PIEZOMETER
▲	EXISTING MONITORING WELL
●	EXISTING PRODUCTION WELL
■	EXISTING TEST PUMPING WELL
	EXISTING SPRING/SEEP
△	MONITORING WELL
R 34E	RANGE 34 EAST
T 44N	TOWNSHIP 44 NORTH
	RANGE/TOWNSHIP LINE
	SECTION LINES
20	SECTION NUMBER

NOTE:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.

TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

MATTHEW T. HALEY
Exp.06/30/21
Matt Haley
CIVIL
4/2/20
No. 21993

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	JJS	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: RL
DRAWN BY: RL

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NewFields

CLIENT: LITHIUM NEVADA CORP.

PROJECT: THACKER PASS PROJECT

TITLE: OVERALL ULTIMATE PROJECT AND STORMWATER SITE PLAN

FILENAME: 0385.000.002M

DRAWING NO.: C010

REVISION: 0

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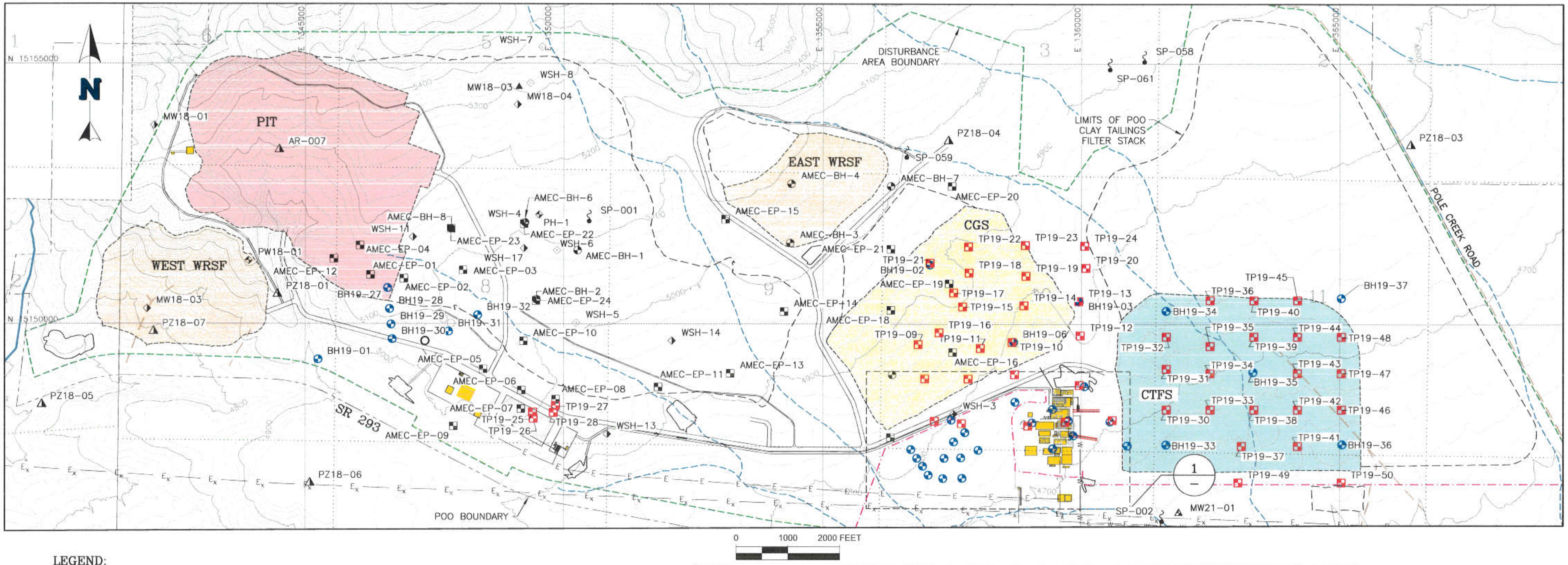

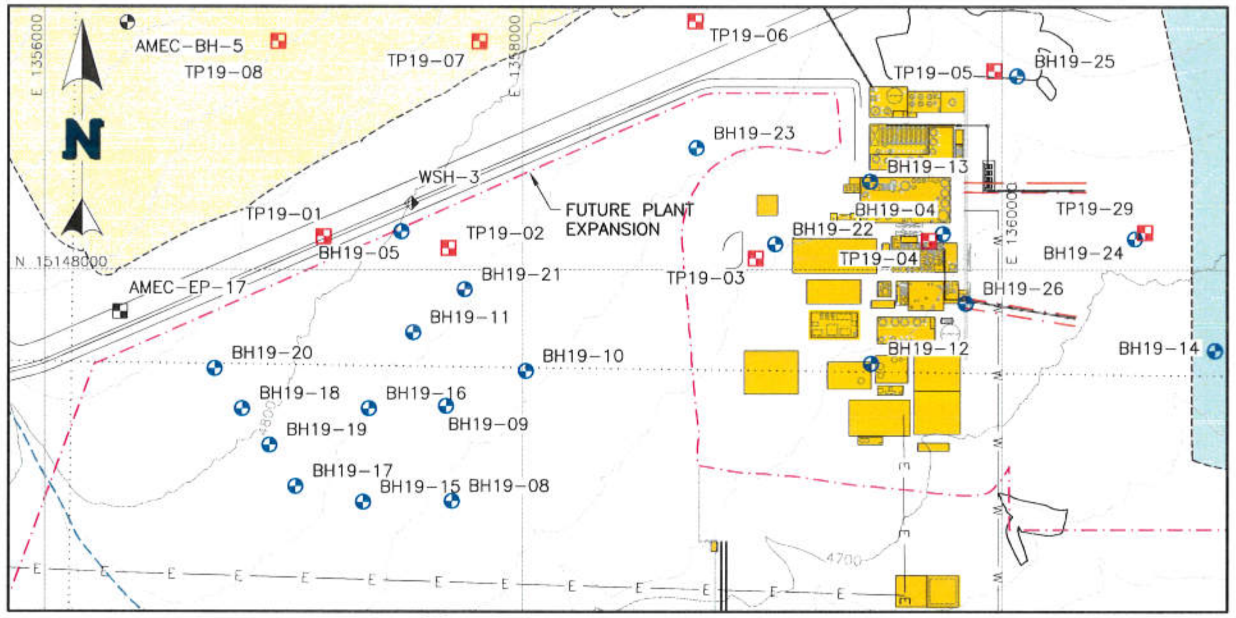

1 PROCESS FACILITIES AREA

0 400 800 FEET

LEGEND:

	EXISTING 20 FT GROUND CONTOURS
4500	EXISTING CONTOUR ELEVATION
	EXISTING ROADS
	EXISTING EPHEMERAL CREEKS
	EXISTING MAJOR DRAINAGES
	SURFACE DAYLIGHT
	EXPANSION AREAS
	SECTION LINES
20	SECTION NUMBER
	POO BOUNDARY
	DISTURBANCE AREA BOUNDARY
	FUTURE PLANT EXPANSION AREA
— Ex —	EXISTING POWER LINE
— E —	POWER LINE
:	EXISTING POWER POLES
≀	EXISTING SPRING
◐	EXISTING BOREHOLE (AMEC 2013)
▚	EXISTING TEST PIT (AMEC 2013)
◆	EXISTING MONITORING WELL
◇	EXISTING MONITORING WELL (ABANDONED)
▲	EXISTING PIEZOMETER
●	EXISTING BOREHOLE (NF 2019)
🟥	EXISTING TEST PIT (NF 2019)
▨	WASTE ROCK STORAGE FACILITY (WRSF)
🟥	PIT (BY OTHERS)
🟨	COARSE GANGUE STOCKPILE
🟦	CLAY TAILINGS FILTER STACK
🟨	BUILDINGS & INFRASTRUCTURE (BY OTHERS)

NOTES:

1. BH-07 WAS REMOVED FROM DRILLING PLAN.
2. ALL LINEWORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
3. EXISTING WELLS AND PIEZOMETERS WITHIN FOOTPRINT OF THE WEST WRSF SHALL BE ABANDONED PER NEVADA ADMINISTRATIVE CODE (NAC) REQUIREMENTS.

TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

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MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No.21993
Matt Haley
4/2/20

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: MTH
DRAWN BY: RL

DISCLAIMER

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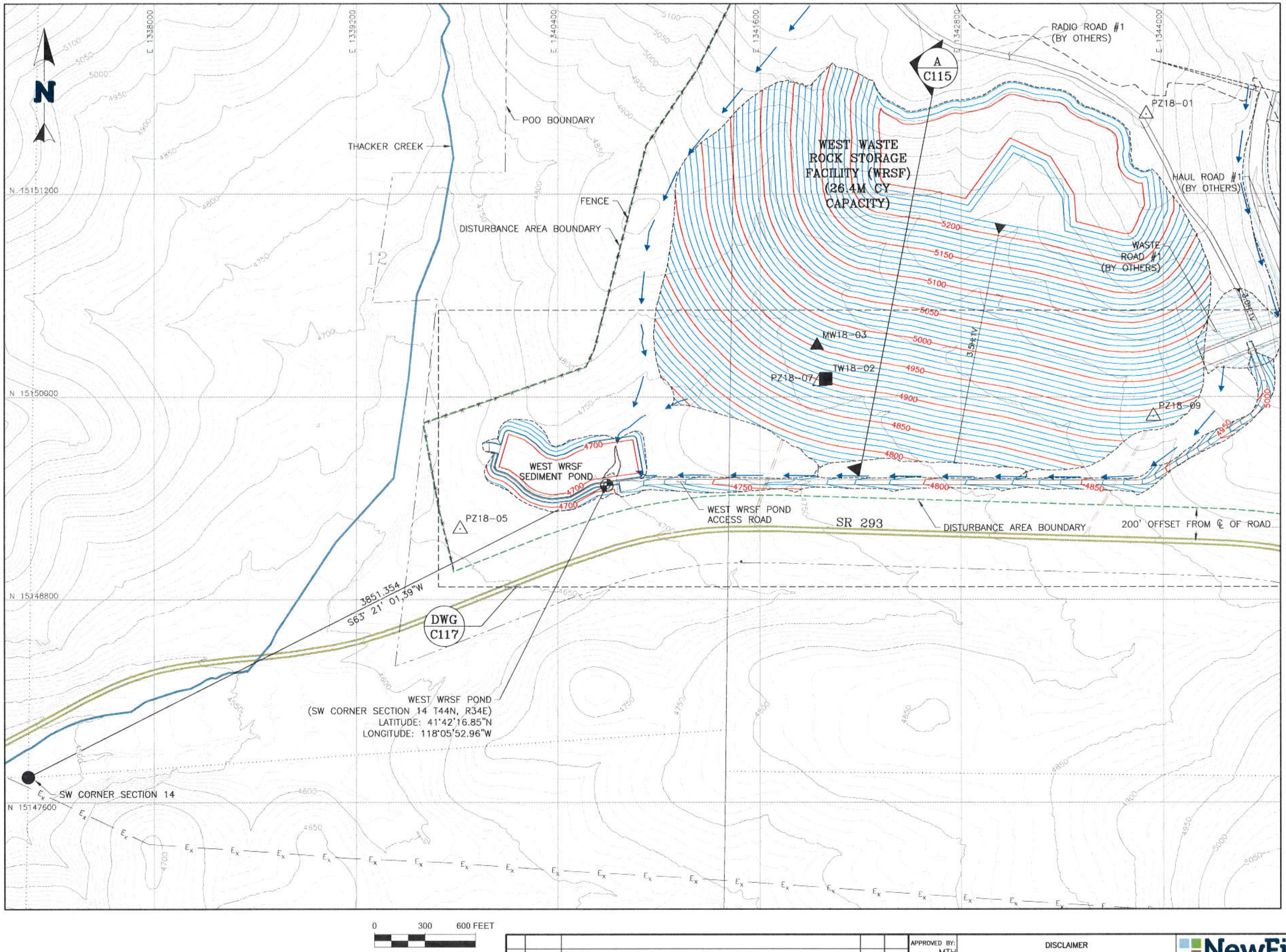
NewFields

CLIENT: LITHIUM NEVADA CORP.

PROJECT: THACKER PASS PROJECT

TITLE: GEOTECHNICAL INVESTIGATION PLAN

FILENAME: 0385.000.078M
DRAWING NO.: C050
REVISION: 0



LEGEND:

- EXISTING 10 FT GROUND CONTOURS
- 4500 EXISTING CONTOUR ELEVATION
- 10 FT GROUND CONTOURS
- 4500 GROUND CONTOUR ELEVATION
- EXISTING ROADS–MAJOR
- EXISTING ROADS
- EXISTING PERENNIAL STREAMS
- SURFACE DAYLIGHT
- 20 SECTION NUMBER
- SECTION LINES
- RANGE/TOWNSHIP LINE
- POO BOUNDARY
- DISTURBANCE AREA BOUNDARY
- —x—x— FENCE
- —Eₓ— EXISTING POWER LINE
- CULVERT (BY OTHERS)
- → MAJOR STORMWATER DRAINAGE FLOW PATH
- △ EXISTING PIEZOMETER
- ▲ EXISTING MONITORING WELL
- ■ EXISTING TEST PUMPING WELL

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. EXISTING WELLS AND PIEZOMETERS WITHIN FOOTPRINT OF THE WEST WRSF SHALL BE ABANDONED PER NEVADA ADMINISTRATIVE CODE (NAC) REQUIREMENTS.

PROFESSIONAL ENGINEER–STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
Matt Haley
CIVIL
4/2/20
No.21993

TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	JJS	MH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: SEB
DRAWN BY: JJS

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NewFields

CLIENT: LITHIUM NEVADA CORP.

PROJECT: THACKER PASS PROJECT

TITLE: WEST WRSF STORMWATER PLAN

FILENAME: 0385.000.021M

DRAWING NO.: C105

REVISION: 0

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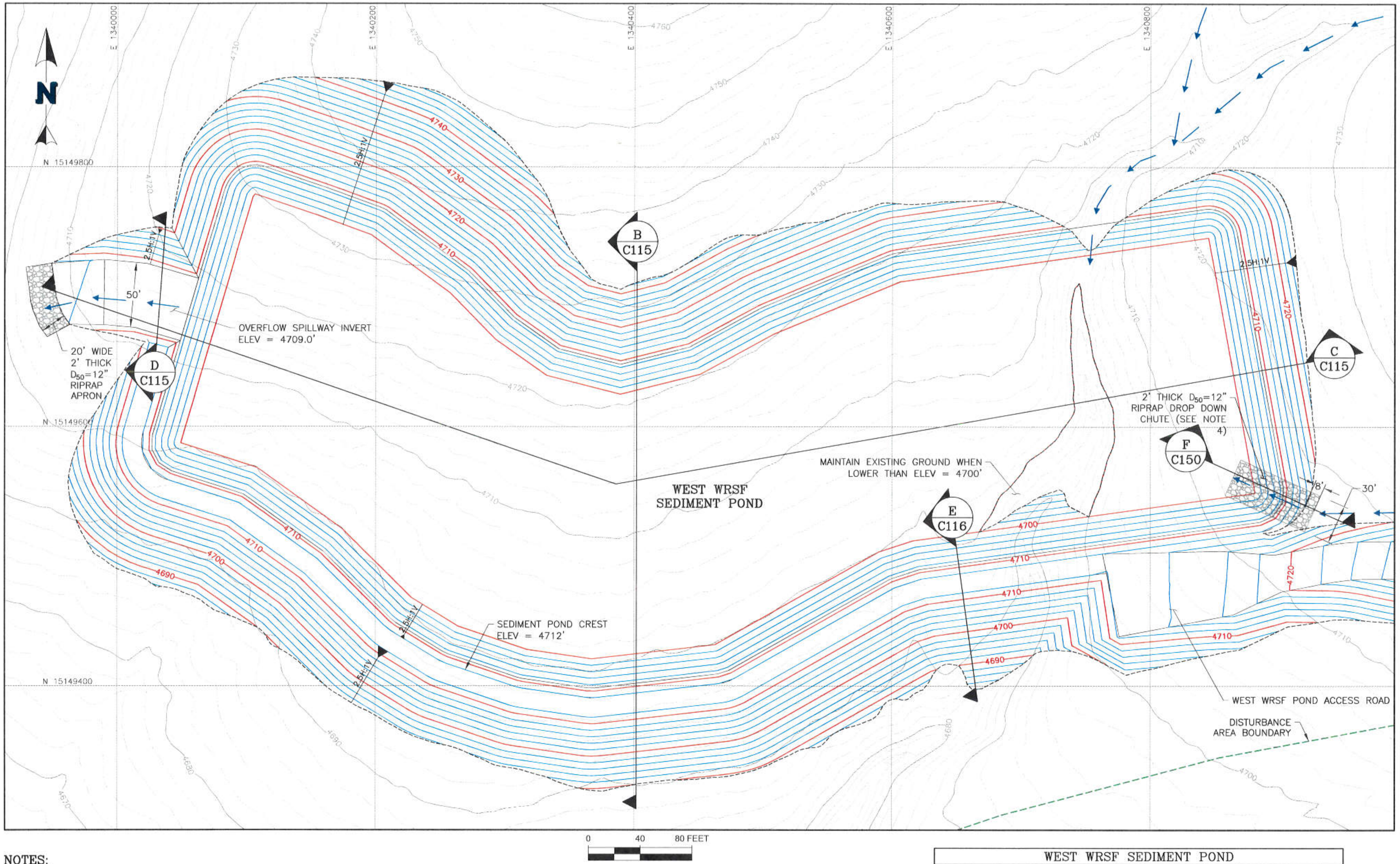

LEGEND:

EXISTING 2 FT GROUND CONTOURS
4500 EXISTING CONTOUR ELEVATION
2 FT GROUND CONTOURS
4500 CONTOUR ELEVATION
SURFACE DAYLIGHT
DISTURBANCE AREA BOUNDARY
→ → MAJOR STORMWATER DRAINAGE FLOW PATH
▨ RIPRAP

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. THE WEST WRSF SEDIMENT POND IS SIZED TO CONTAIN THE 100YR–24HR RUNOFF FROM THE WEST WRSF (9.91 MGAL) IF THE POND IS INITIALLY EMPTY. THE SPILLWAY IS SIZED TO DISCHARGE THE PEAK FLOW FROM THE 500YR–24HR STORM WITH 1 FOOT OF POND FREEBOARD.
3. THE ONLY OUTLET OF THE WEST WRSF SEDIMENT POND IS THE SPILLWAY.
4. PLACE 10 OZ/YD^2 NON–WOVEN GEOTEXTILE UNDER ALL RIPRAP

TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

WEST WRSF SEDIMENT POND

EVENT	ELEVATION	VOLUME
TOP OF 2' SEDIMENT STORAGE	4702.0 FT	6,550 CY
100YR–24HR MAX POND ELEVATION	4708.9 FT	9.91 MGAL
SPILLWAY INVERT	4709.0 FT	10.1 MGAL
FREEBOARD 3'	4709.0 FT – 4712.0 FT	5.1MGAL
CREST	4712.0 FT	15.1 MGAL

MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No. 21993
Matt Haley
4/2/20

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	JJS	MH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: SEB
DRAWN BY: JJS

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NewFields
CLIENT: LITHIUM NEVADA CORP.
PROJECT: THACKER PASS PROJECT
TITLE: WEST WRSF SEDIMENT POND PLAN
FILENAME: 0385.000.051M
DRAWING NO.: C110
REVISION: 0

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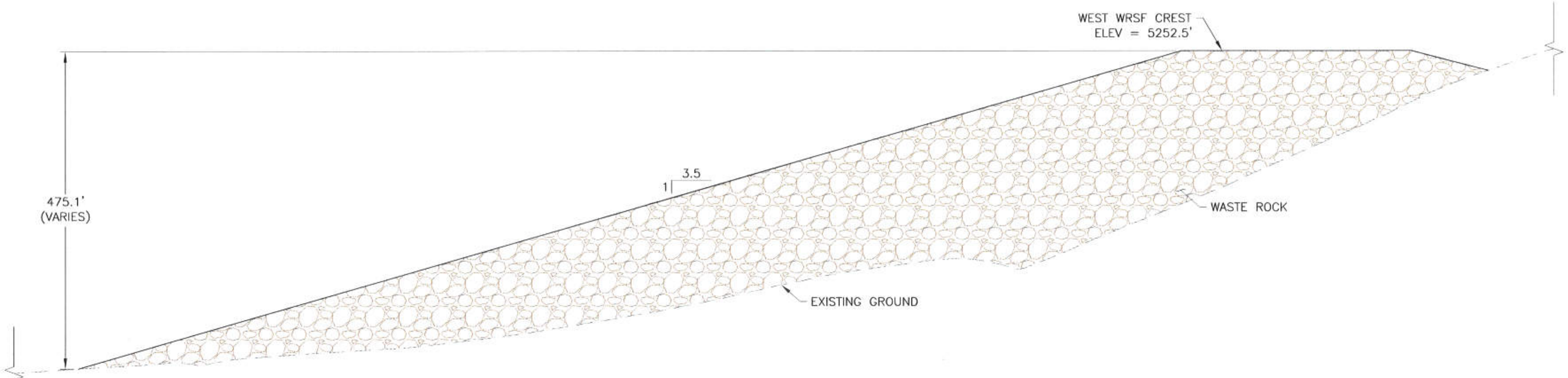
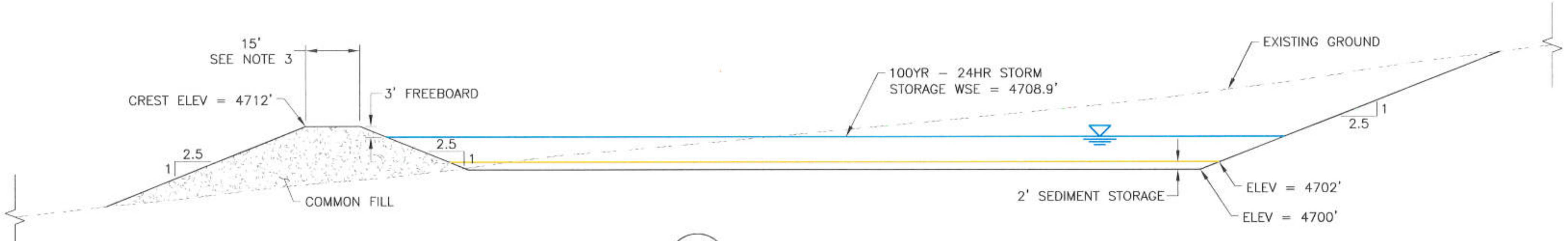
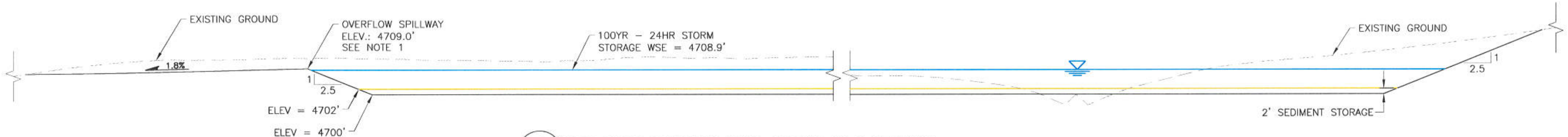


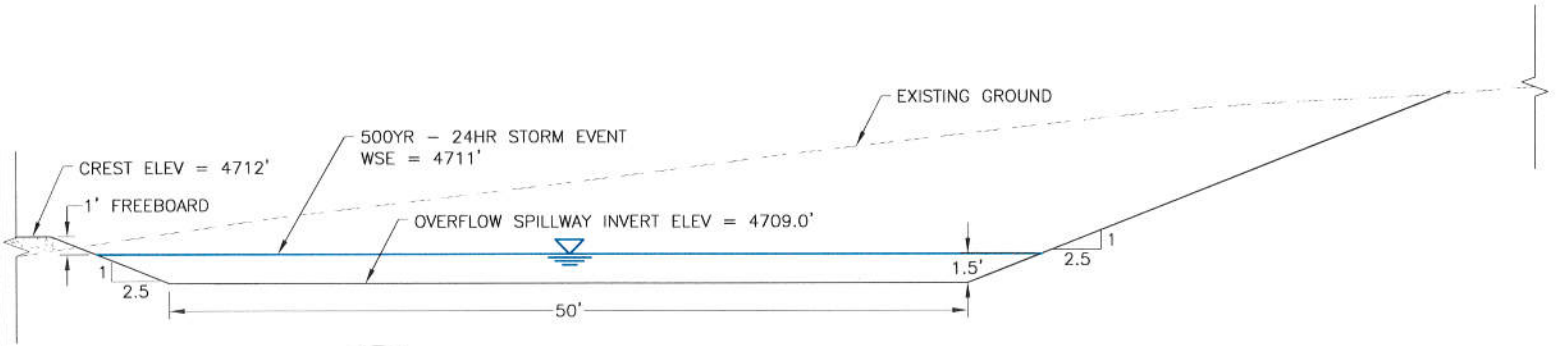
A
C105
WEST WRSF TYPICAL SECTION



B
C110
WEST WRSF SEDIMENT POND TYPICAL N–S SECTION



C
C110
WEST WRSF SEDIMENT POND TYPICAL W–E SECTION



D
C110
WEST WRSF OVERFLOW SPILLWAY SECTION

NOTE:

1. THE WEST WRSF SEDIMENT POND IS DESIGNED TO STORE THE FLOW VOLUME FROM A 100YR–24HR STORM EVENT PLUS 2 FEET OF SEDIMENT.
2. THE WEST WRSF SEDIMENT POND TO HAVE SEDIMENT REMOVAL WHEN THE 2 FEET OF SEDIMENT STORAGE IS REACHED.
3. THE EMBANKMENT CREST IS NOT INTENDED TO HAVE VEHICLE ACCESS WHICH IS WHY THERE ARE NO BERMS.

PROFESSIONAL ENGINEER-STATE OF NEVADA
MATTHEW T.
HALEY
Exp.06/30/21
Matt Haley
CIVIL
4/2/20
No.21993

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	JJS	MH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: SEB
DRAWN BY: JJS

NewFields
CLIENT: LITHIUM NEVADA CORP.
PROJECT: THACKER PASS PROJECT
TITLE: WEST WRSF SEDIMENT POND SECTIONS AND DETAILS (SHEET 1 OF 2)
FILENAME: 0385.000.052D
DRAWING NO.: C115
REVISION: 0

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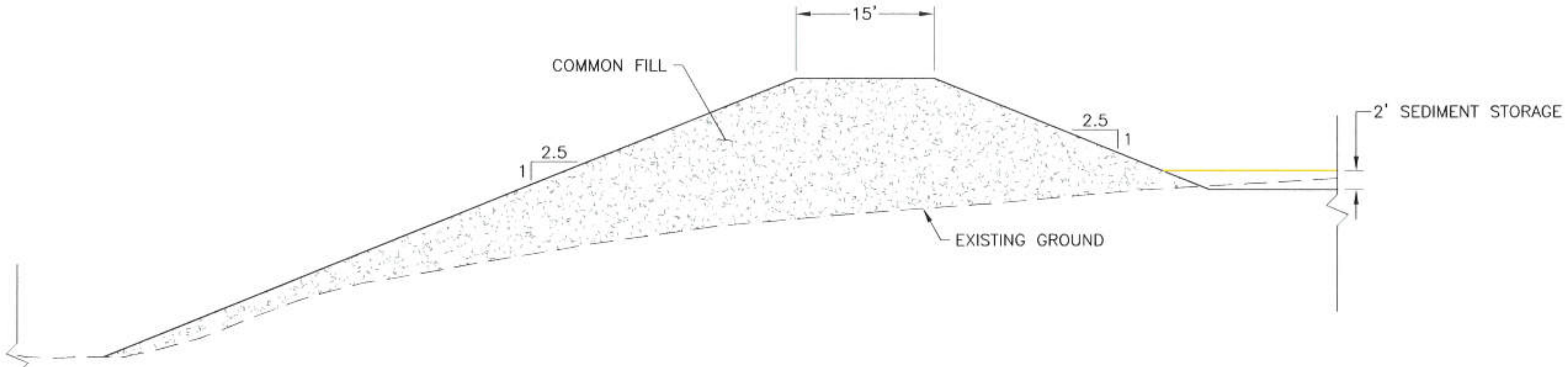

E
C110
WEST WRSF SEDIMENT POND SOUTH EMBANKMENT SECTION

NOTE:

1. THE WEST WRSF SEDIMENT POND IS DESIGNED TO STORE THE FLOW VOLUME FROM A 100YR–24HR STORM EVENT PLUS 2 FEET OF SEDIMENT. SUMPS PUMP TO BE USED TO PUMP OUT WATER IF STORAGE CAPACITY IS NEEDED.
2. THE WEST WRSF SEDIMENT POND TO HAVE SEDIMENT REMOVAL WHEN THE 2 FEET OF SEDIMENT STORAGE IS REACHED.
3. THE EMBANKMENT CREST IS NOT INTENDED TO HAVE VEHICLE ACCESS WHICH IS WHY THERE ARE NO BERMS.

MATTHEW T. HALEY
Exp.06/30/21
Matt Haley
CIVIL
4/2/20
No.21993

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: MTH
DRAWN BY: RL

NewFields
CLIENT: LITHIUM NEVADA CORP.
PROJECT: THACKER PASS PROJECT
TITLE: WEST WRSF SEDIMENT POND SECTIONS AND DETAILS (SHEET 2 OF 2)
FILENAME: 0385.000.097D
DRAWING NO.: C116
REVISION: 0

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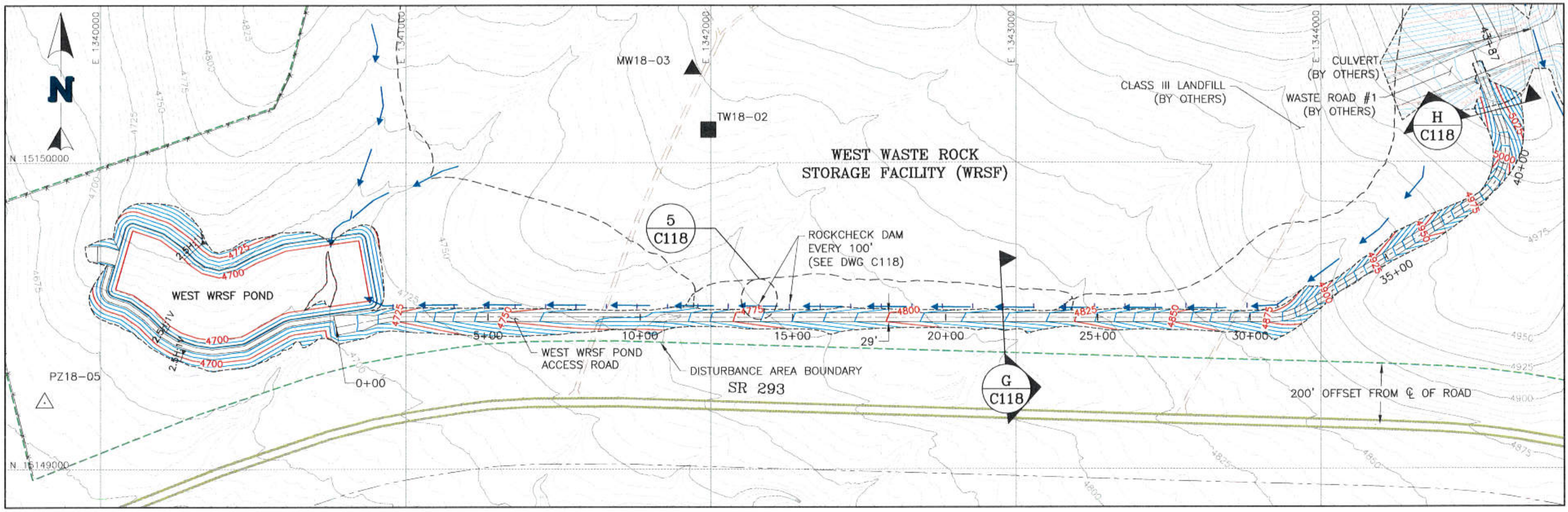
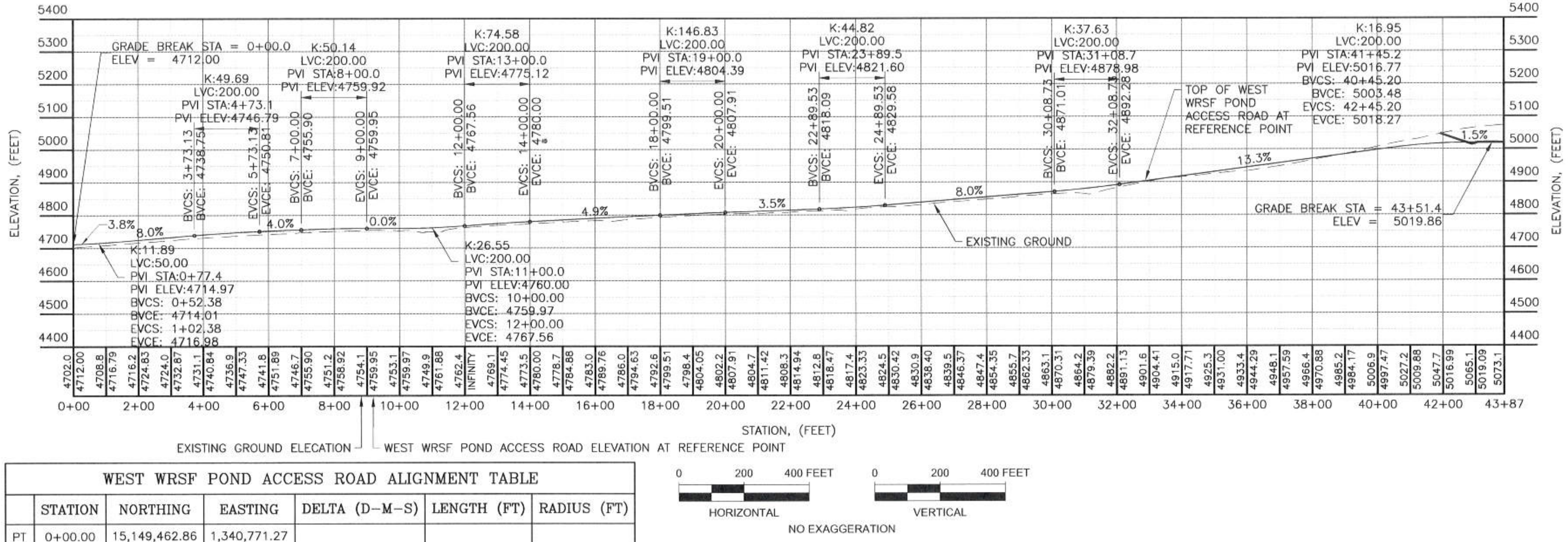


LEGEND:

	EXISTING 5 FT GROUND CONTOURS
4500	EXISTING CONTOUR ELEVATION
	5 FT GROUND CONTOURS
4500	GROUND CONTOUR ELEVATION
	5 FT GROUND CONTOURS BY OTHERS
4500	CONTOUR ELEVATION BY OTHERS
	EXISTING ROADS–MAJOR
	EXISTING ROADS/TRAILS
	SURFACE DAYLIGHT
	POO BOUNDARY
	DISTURBANCE AREA BOUNDARY
–x–x–	FENCE
	CULVERT
→	MAJOR STORMWATER DRAINAGE FLOW PATH
△	EXISTING PIEZOMETER
▲	EXISTING MONITORING WELL
■	EXISTING TEST PUMPING WELL
I	ROCK CHECK DAM



WEST WRSF POND ACCESS ROAD ALIGNMENT TABLE

	STATION	NORTHING	EASTING	DELTA (D–M–S)	LENGTH (FT)	RADIUS (FT)
PT	0+00.00	15,149,462.86	1,340,771.27			
PC	1+65.40	15,149,493.63	1,340,933.79	010–48–53	37.75	200.00
PT	2+03.15	15,149,497.12	1,340,971.32			
PC	30+72.30	15,149,492.39	1,343,840.47	032–07–46	112.15	200.00
PT	31+84.46	15,149,522.84	1,343,946.88			
PC	38+49.98	15,149,875.86	1,344,511.07	079–05–43	276.09	200.00
PT	41+26.08	15,150,117.51	1,344,591.53			
PT	42+56.70	15,150,239.35	1,344,544.44			
PT	43+47.18	15,150,323.57	1,344,511.38			

PROFESSIONAL ENGINEER–STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
Matt Haley
CIVIL
4/2/20
No.21993

TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	NLB	ZR

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: MTH
DRAWN BY: RL

DISCLAIMER

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NewFields
CLIENT: LITHIUM NEVADA CORP.
PROJECT: THACKER PASS PROJECT
TITLE: WEST WRSF POND ACCESS ROAD PLAN AND PROFILE
FILENAME: 0385.000.088P
DRAWING NO.: C117
REVISION: 0

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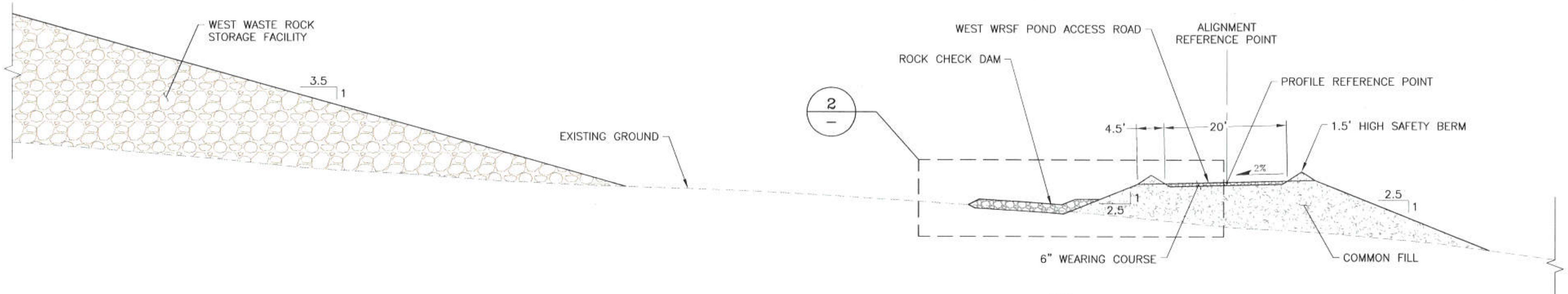
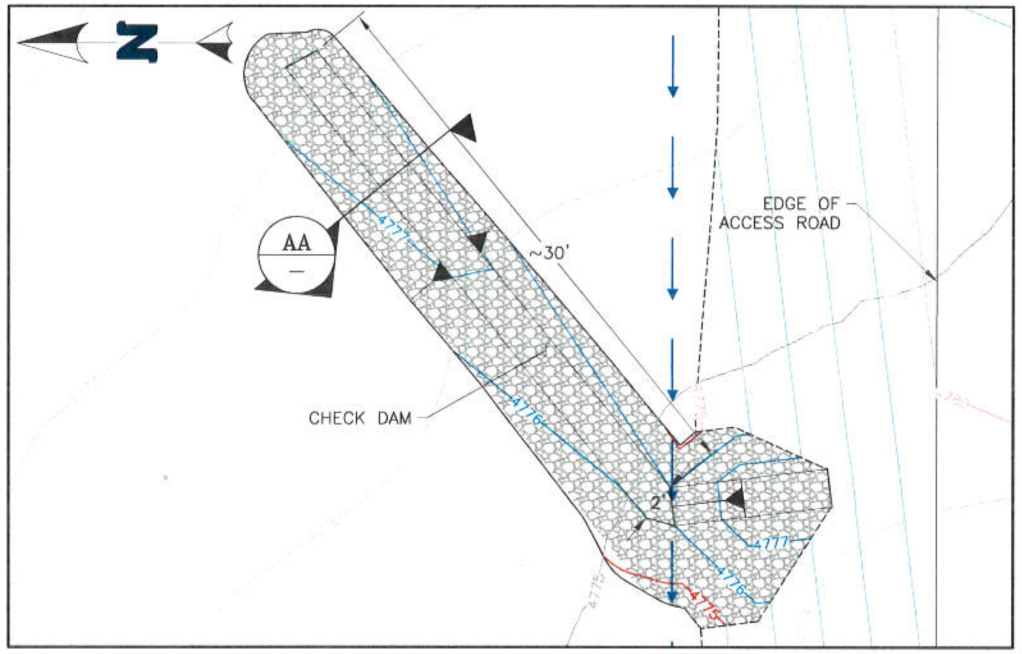
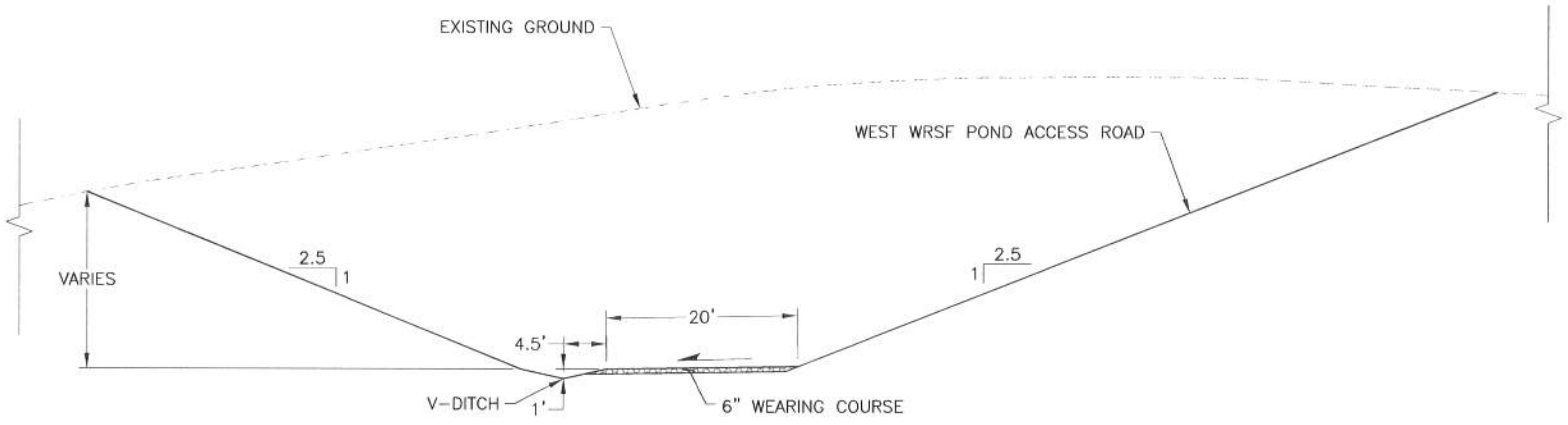


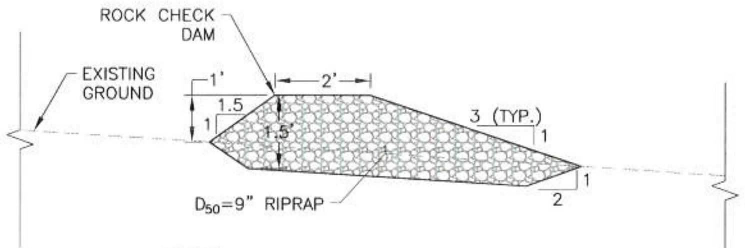
G / C117 WEST WRSF POND ACCESS ROAD SECTION N–S



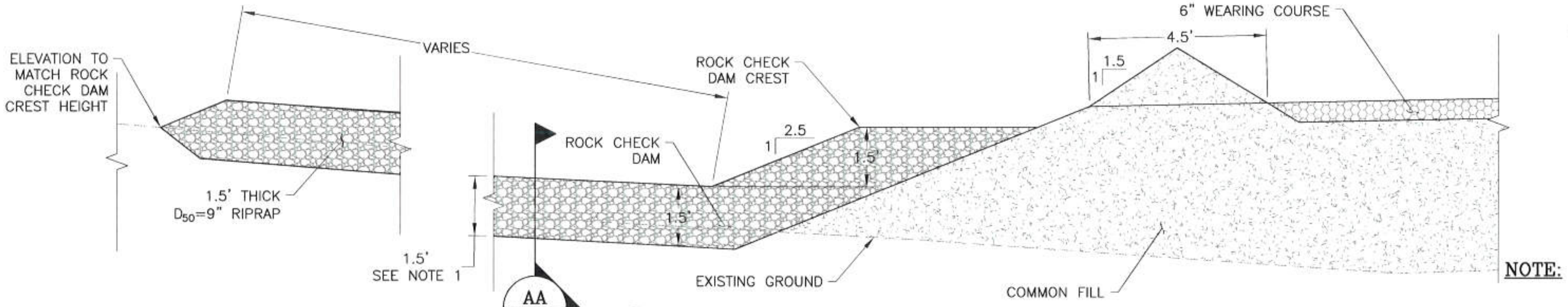
5 / C117 CHECK DAM PLANVIEW



H / C117 WEST WRSF POND ACCESS ROAD SECTION W–E



AA / – TYPICAL ROCK CHECK DAM



2 / – MAJOR STORM WATER DRAINAGE SECTION

NOTE:

1. THE CHECK DAMS SHALL BE 1.5' THICK AND EXTEND HORIZONTALLY UNTIL IT INTERSECTS WITH NATURAL GROUND.

MATTHEW T. HALEY
Exp.06/30/21
Matt Haley
CIVIL
4/2/20
No. 21993

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	NLB	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: ZR
DRAWN BY: NLB

NewFields
CLIENT: LITHIUM NEVADA CORP.
PROJECT: THACKER PASS PROJECT
TITLE: WEST WRSF POND ACCESS ROAD SECTIONS AND DETAILS
FILENAME: 0385.000.091D
DRAWING NO.: C118
REVISION: 0

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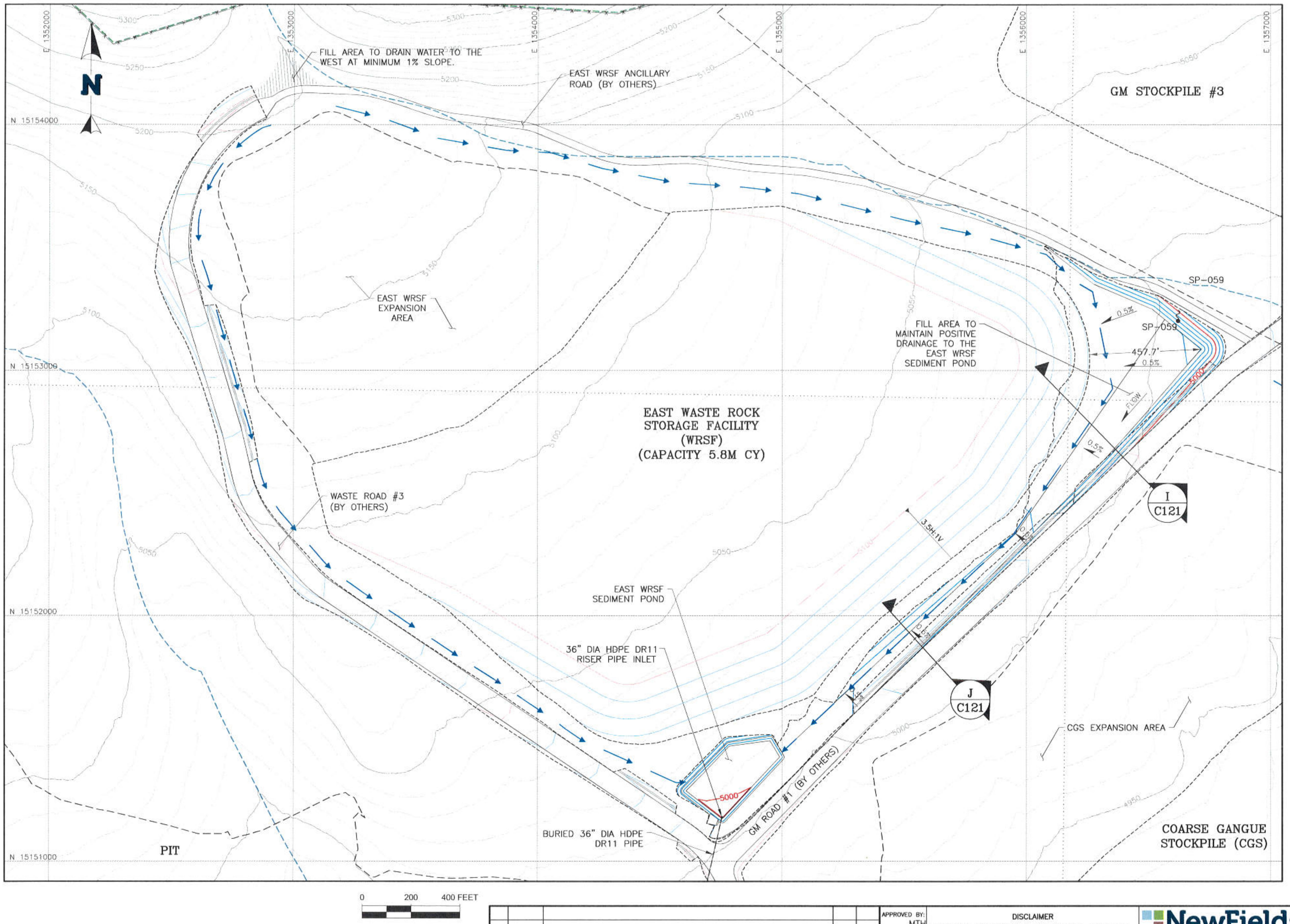

LEGEND:

- EXISTING 10 FT GROUND CONTOURS
- 4500 EXISTING CONTOUR ELEVATION
- 10 FT GROUND CONTOURS
- 4500 CONTOUR ELEVATION
- SURFACE DAYLIGHT
- EXPANSION AREAS
- EXISTING DRAINAGES
- SECTION LINES
- DISTURBANCE AREA BOUNDARY
- FENCE
- MAJOR STORMWATER DRAINAGE FLOW PATH
- CULVERT
- STRUCTURE/BUILDING
- EXISTING SPRING

NOTE:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.

MATTHEW T. HALEY
Exp. 06/30/21
CIVIL
No. 21993
4/2/20

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	JJS	MH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: SEB
DRAWN BY: JJS

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NewFields

CLIENT
LITHIUM NEVADA CORP.

PROJECT
THACKER PASS PROJECT

TITLE
EAST WRSF STORMWATER PLAN

FILENAME
0385.000.053M

DRAWING NO.
C120

REVISION
0

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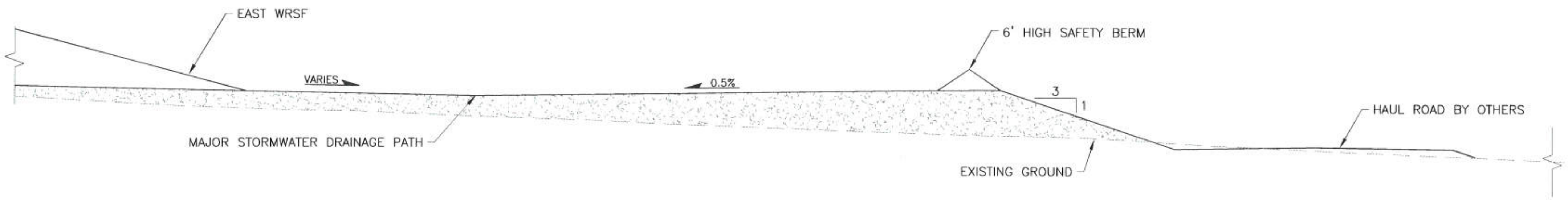
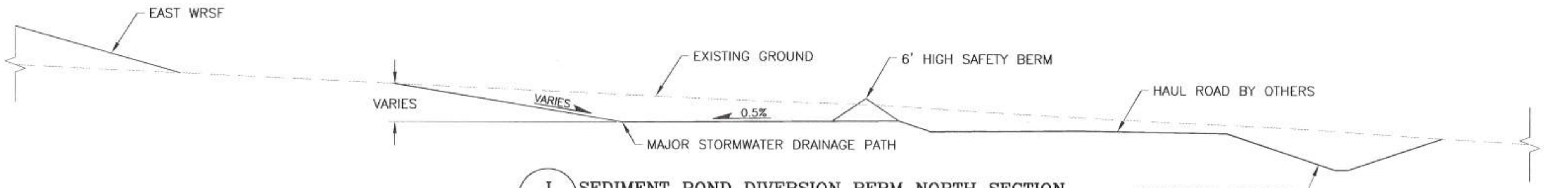


I
C120
SEDIMENT POND DIVERSION BERM SOUTH SECTION



J
C120
SEDIMENT POND DIVERSION BERM NORTH SECTION

MATTHEW T. HALEY
Exp.06/30/21
Matt Haley
CIVIL
4/2/20
No.21993

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: MTH
DRAWN BY: RL

DISCLAIMER

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NewFields

CLIENT: LITHIUM NEVADA CORP.
PROJECT: THACKER PASS PROJECT
TITLE: EAST WRSF STORMWATER DETAILS
FILENAME: 0385.000.099D
DRAWING NO.: C121
REVISION: 0

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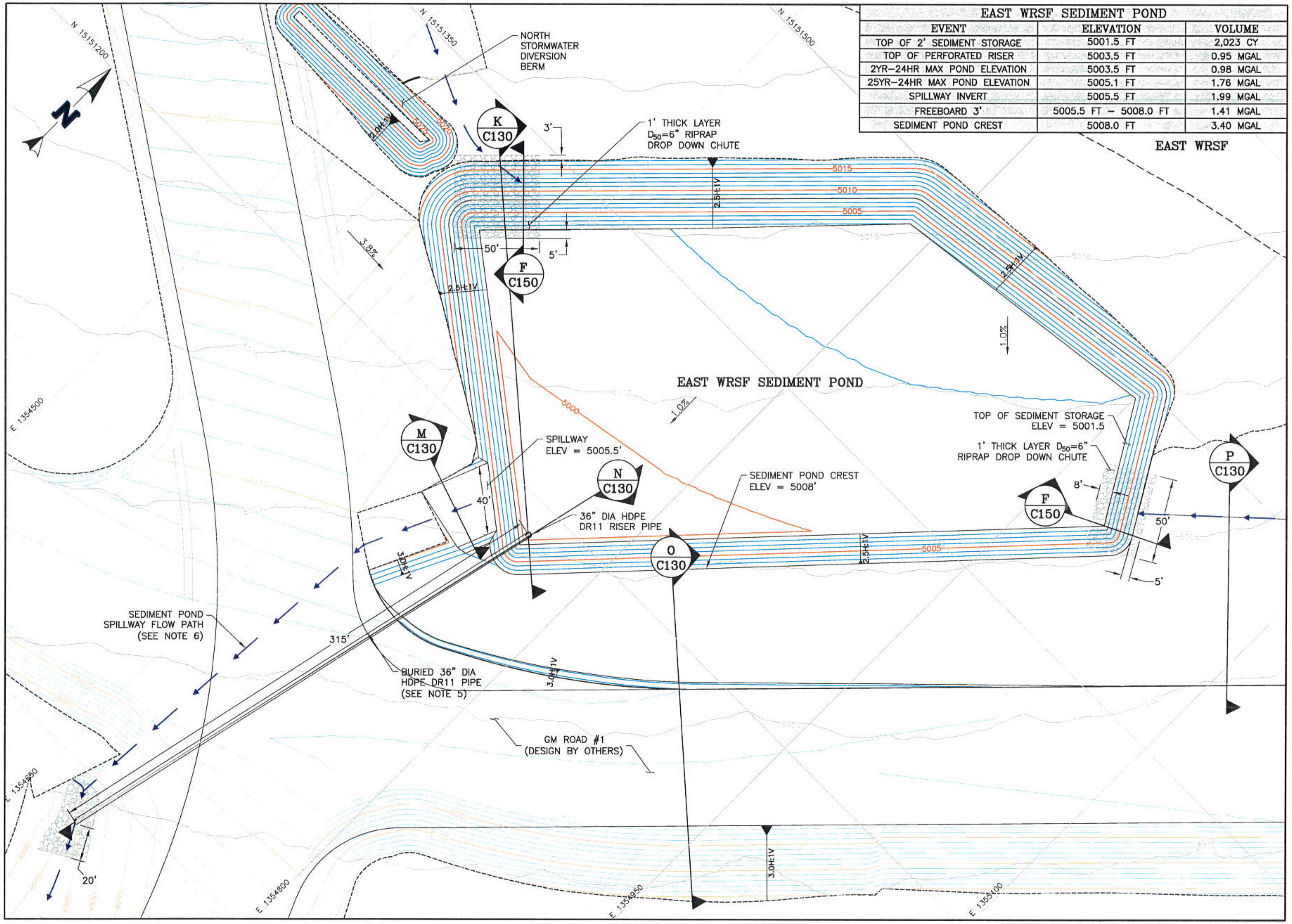

EAST WRSF SEDIMENT POND		
EVENT	ELEVATION	VOLUME
TOP OF 2' SEDIMENT STORAGE	5001.5 FT	2,023 CY
TOP OF PERFORATED RISER	5003.5 FT	0.95 MGAL
2YR–24HR MAX POND ELEVATION	5003.5 FT	0.98 MGAL
25YR–24HR MAX POND ELEVATION	5005.1 FT	1.76 MGAL
SPILLWAY INVERT	5005.5 FT	1.99 MGAL
FREEBOARD 3'	5005.5 FT – 5008.0 FT	1.41 MGAL
SEDIMENT POND CREST	5008.0 FT	3.40 MGAL

LEGEND:

	1 FT EXISTING GROUND CONTOURS
4500	EXISTING CONTOUR ELEVATION
	1 FT GROUND CONTOURS
4500	GROUND CONTOUR ELEVATION
	SURFACE DAYLIGHT
	EXPANSION AREAS
→ →	MAJOR STORMWATER DRAINAGE FLOW PATH
▨	RIPRAP ABOVE 10 OZ/YD² NON-WOVEN GEOTEXTILE

0 30 60 FEET

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. EAST WRSF SEDIMENT POND TO CONTAIN THE 2YR–24HR RUNOFF GENERATED FROM THE EAST WRSF (2.1 MGAL). THE SPILLWAY IS SIZED TO DISCHARGE THE PEAK FLOW OF THE 100YR–24HR STORM WITH 1 FOOT OF FREEBOARD.
3. THE RISER PIPE DIAMETER, ELEVATION, AND PERFORATION SPACING ARE DESIGNED TO GIVE THE STORMWATER IN BASIN 48 TO 72 HRS OF RETENTION TIME FOR THE 2YR–24HR STORM EVENT. FLOWS GREATER THAN 2YR EVENT AND LESS THAN 25YR EVENT WILL DRAIN OUT THE RISER PIPE. FLOWS GREATER THAN 25YR WILL OVERFLOW THROUGH THE SPILLWAY.
4. HAUL ROAD CONTOURS HAVE BEEN APPROXIMATED FROM DAYLIGHT LINES AND TYPICAL CROSS SECTIONS PROVIDED BY NA COAL, AND MAY NOT REFLECT THE FINAL DESIGN SURFACE.
5. A MINIMUM OF 4' COVER OVER THE RISER PIPE IS REQUIRED UNDER THE HAUL ROAD.
6. HAUL ROAD BY OTHERS, DURING CONSTRUCTION OF THE HAUL ROAD INTERSECTION, THE CONTRACTOR WILL BE REQUIRED TO PROVIDE POSITIVE DRAINAGE FROM THE SPILLWAY INVERT TO THE CULVERT OUTLET AS WELL MAINTAIN THE MINIMUM CULVERT COVER REQUIREMENT.

PROFESSIONAL ENGINEER STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No. 21993
Matt Haley
4/2/20

0	4/2/2020	ISSUED FOR CONSTRUCTION	JJS	MH
REV	DATE	DESCRIPTION	TECH	ENG

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: SEB
DRAWN BY: JJS

DISCLAIMER

NEWFIELDS PRODUCED THE INFORMATION PRESENTED ON THIS DRAWING THROUGH THE USE OF AVAILABLE TECHNICAL INFORMATION AND EXPERIENCE. RECEIVING THIS DRAWING DOES NOT GUARANTEE ANY RIGHTS TO EITHER SUCH TECHNICAL INFORMATION OR EXPERIENCE. ANY MODIFICATION OR ADAPTATION OF THE DATA OR DRAWING SHALL BE AT USER'S RISK AND WITHOUT ANY LIABILITY OR LEGAL RESPONSIBILITY TO NEWFIELDS.

NewFields
CLIENT LITHIUM NEVADA CORP.
PROJECT THACKER PASS PROJECT
TITLE EAST WRSF SEDIMENT POND PLAN
FILENAME 0385.000.054M
DRAWING NO. C125
REVISION 0

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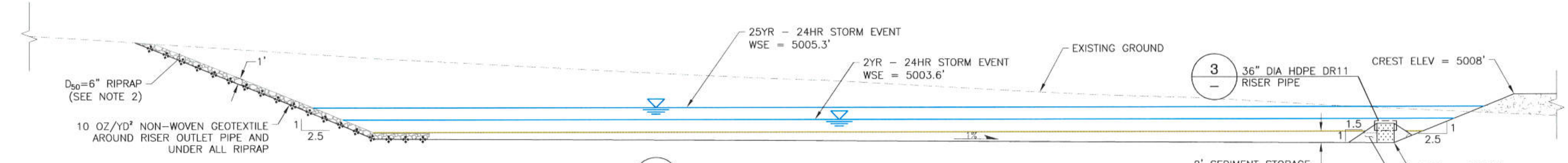
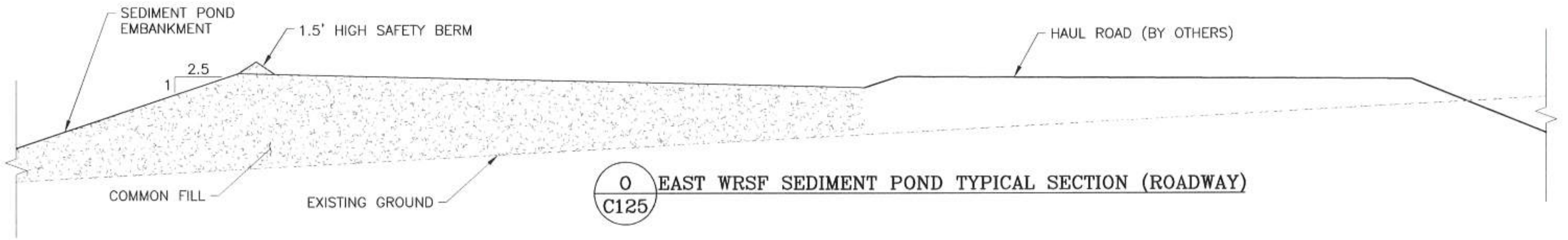
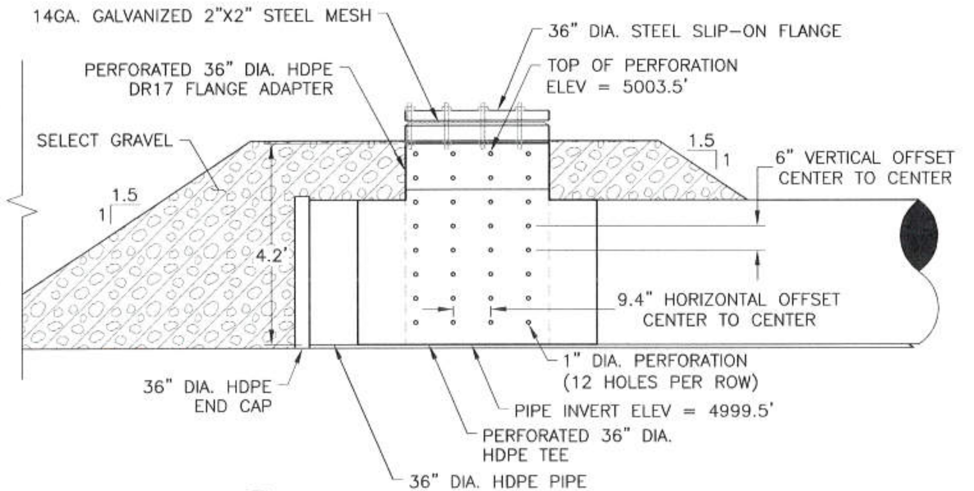


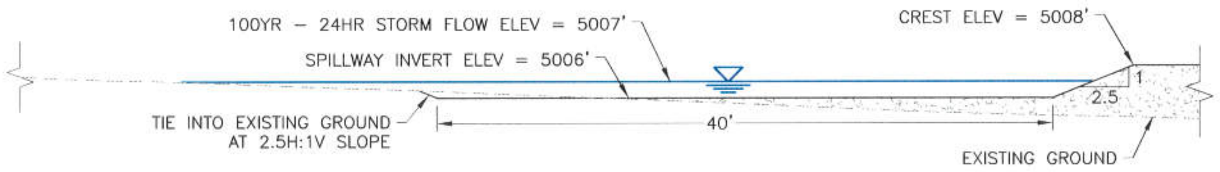
K
C125
EAST WRSF SEDIMENT POND TYPICAL N-S SECTION



O
C125
EAST WRSF SEDIMENT POND TYPICAL SECTION (ROADWAY)



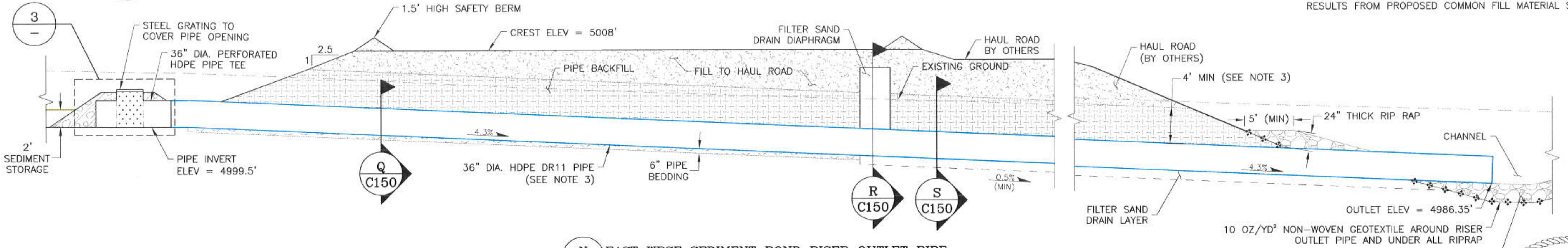
3
–
PERFORATION SCHEDULE ON RISER PIPE
EAST WRSF SEDIMENT POND



M
C125
EAST WRSF SEDIMENT POND SPILLWAY SECTION

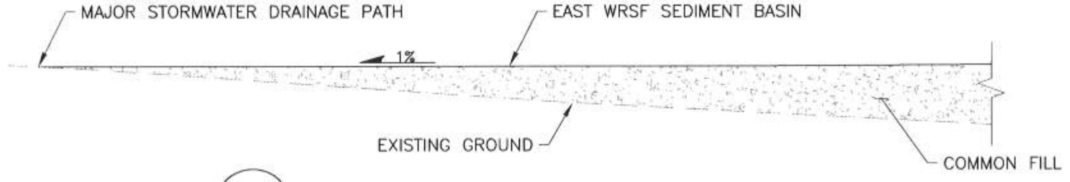
NOTES:

1. PLACE 2 FT THICK LAYER OF RIPRAP ON DOWNSTREAM SLOPE AROUND RISER PIPE AND EXTENDING 20 FT PAST PIPE OUTLET.
2. PLACE 10 OZ/YD² NON-WOVEN GEOTEXTILE UNDER ALL RIPRAP.
3. A MINIMUM OF 4 FT COVER IS REQUIRED OVER THE RISER OUTLET PIPE UNDER THE HAUL ROAD.
4. A FILTER SAND DRAIN DIAPHRAGM IS REQUIRED IF THE COMMON FILL IS PRIMARILY FINE GRAINED SOILS (SILTS & CLAYS). THE DESIGN ENGINEER WILL DECIDE BASED ON LABORATORY TEST RESULTS FROM PROPOSED COMMON FILL MATERIAL SOURCES.



N
C125
EAST WRSF SEDIMENT POND RISER OUTLET PIPE

PROFESSIONAL ENGINEER STATE OF NEVADA
MATTHEW T.
HALEY
Exp.06/30/21
Matt Haley
CIVIL
4/2/20
No.21993



P
C125
TYPICAL SOUTH STORMWATER DIVERSION BERM

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	JJS	MH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: SEB
DRAWN BY: JJS

DISCLAIMER

NewFields
CLIENT LITHIUM NEVADA CORP.
PROJECT THACKER PASS PROJECT
TITLE EAST WRSF SEDIMENT POND SECTIONS AND DETAILS
FILENAME 0385.000.055D
DRAWING NO. C130
REVISION 0

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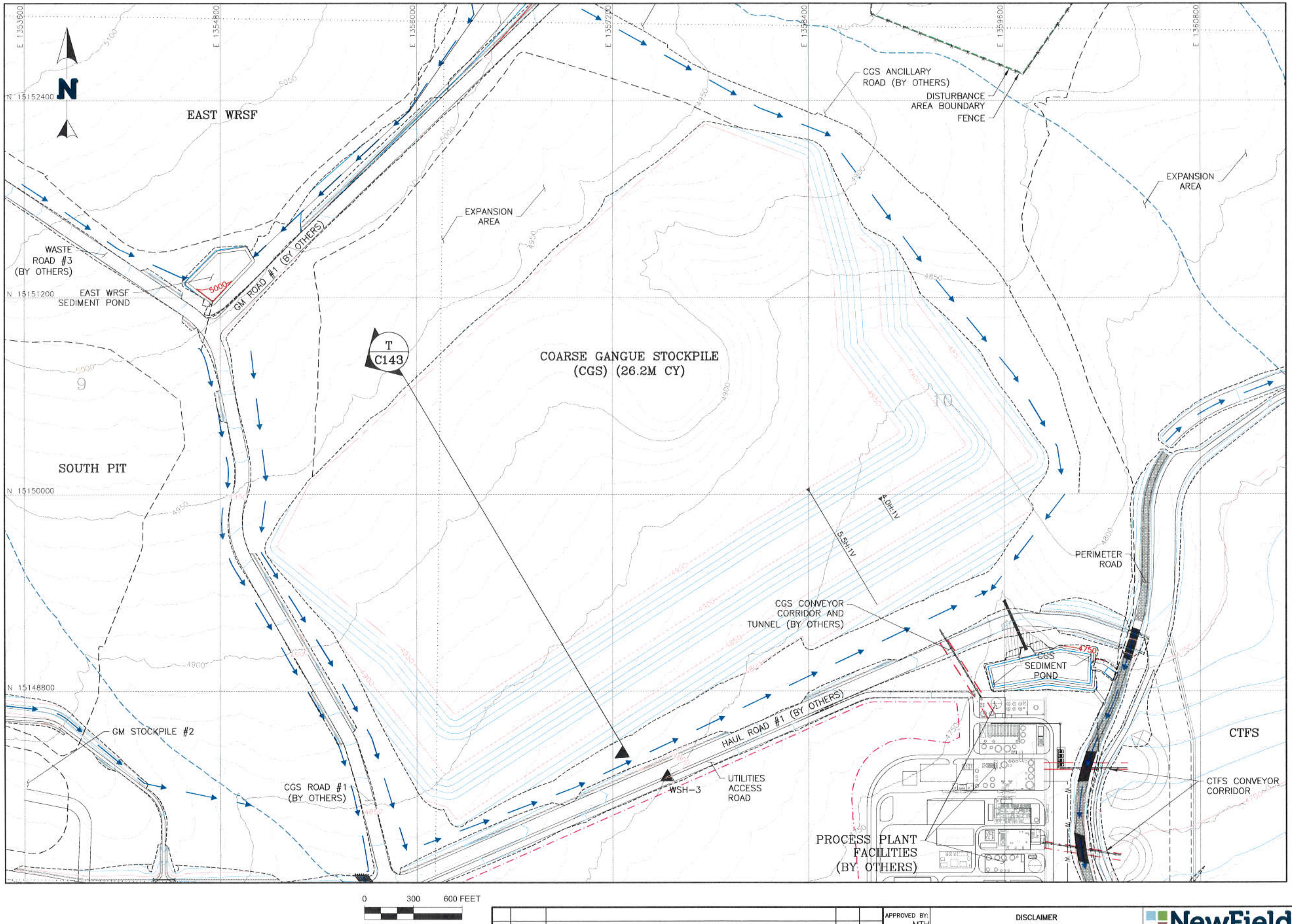

LEGEND:

- EXISTING 10 FT GROUND CONTOURS
- 4500 EXISTING CONTOUR ELEVATION
- 10 FT GROUND CONTOURS
- 4500 CONTOUR ELEVATION
- 10 FT SEDIMENT POND CONTOURS
- 4500 CONTOUR ELEVATION
- EXPANSION AREAS
- SURFACE DAYLIGHT
- EXISTING DRAINAGES
- DISTURBANCE AREA BOUNDARY
- SECTION LINES
- MAJOR STORMWATER DRAINAGE FLOW PATHS
- W WATER LINE
- × × × FENCE
- FUTURE PLANT EXPANSION
- CONVEYOR CORRIDOR
- ▭ STRUCTURE/BUILDING
- CULVERT (BY OTHERS)
- ▲ EXISTING MONITORING WELL
- 10 SECTION NUMBER

NOTE:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.

MATTHEW T. HALEY
Exp. 06/30/21
CIVIL
No. 21993
Matt Haley
4/2/20

TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	JJS	MH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: SEB
DRAWN BY: JJS

DISCLAIMER

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NewFields

CLIENT: LITHIUM NEVADA CORP.

PROJECT: THACKER PASS PROJECT

TITLE: COARSE GANGUE STOCKPILE STORMWATER PLAN

FILENAME: 0385.000.056M
DRAWING NO.: C135
REVISION: 0

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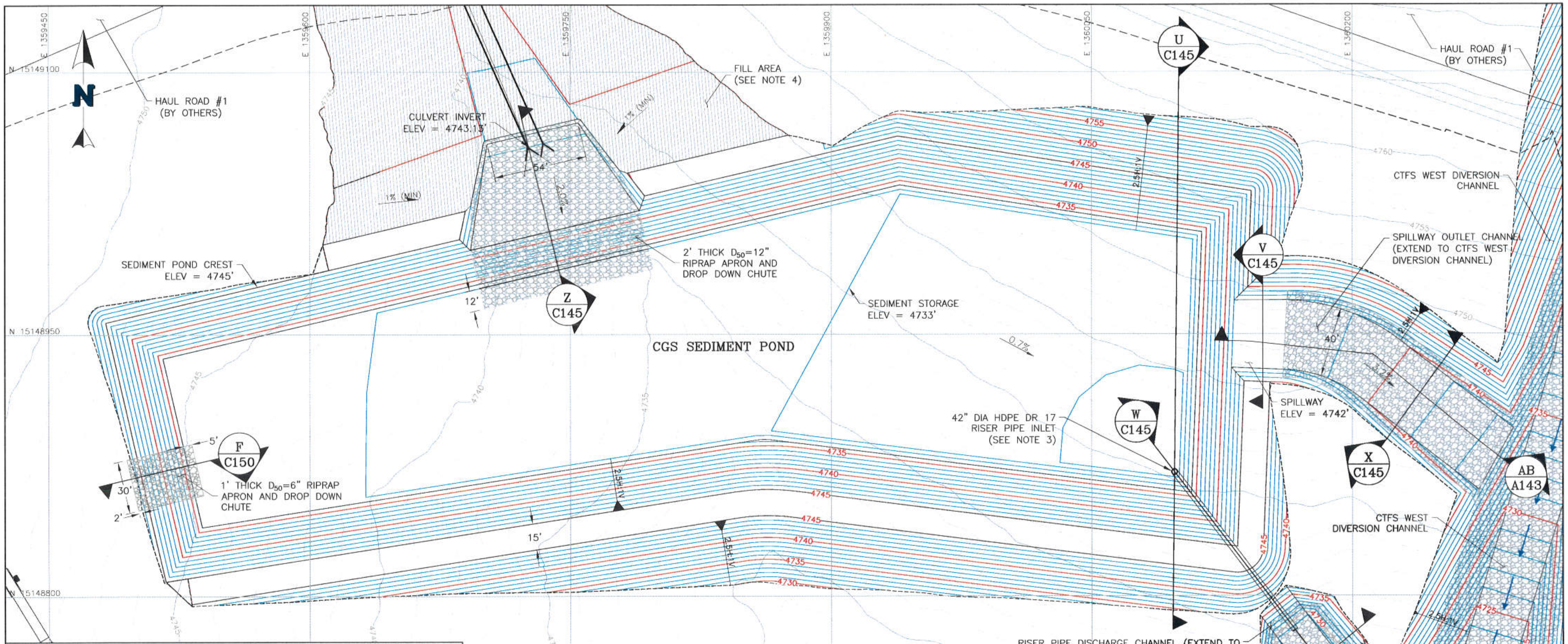


CGS SEDIMENT POND		
EVENT	ELEVATION	VOLUME
TOP OF 2' SEDIMENT STORAGE	4733.0 FT	4,953 CY
TOP OF PERFORATED RISER	4739.0 FT	3.64 MGAL
2YR-24HR MAX POND ELEVATION	4738.1 FT	3.04 MGAL
25YR-24HR MAX FLOW ELEVATION	4741.8 FT	5.65 MGAL
SPILLWAY INVERT (DESIGN STORAGE)	4742.0 FT	5.83 MGAL
FREEBOARD 3'	4742.0 FT – 4745.0 FT	2.46 MGAL
CREST (MAX STORAGE)	4745.0 FT	8.29 MGAL

LEGEND:

EXISTING 1 FT GROUND CONTOURS
4500 EXISTING CONTOUR ELEVATION
1 FT GROUND CONTOURS
4500 CONTOUR ELEVATION
1 FT GROUND CONTOURS BY OTHERS
4500 CONTOUR ELEVATION BY OTHERS
SURFACE DAYLIGHT
→ → MAJOR STORMWATER DRAINAGE FLOW PATH
CULVERT
▨ RIPRAP ABOVE 10 OZ/YD^2 NON-WOVEN GEOTEXTILE

0 30 60 FEET

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. THE CGS SEDIMENT POND IS SIZED TO CONTAIN THE 2YR-24HR RUNOFF GENERATED FROM THE COARSE GANGUE STOCKPILE (5.23 MGAL) WITHOUT DISCHARGE FROM THE POND.
3. THE RISER PIPE DIAMETER, ELEVATION, AND PERFORATION SPACING ARE DESIGNED TO GIVE THE SEDIMENT POND 48 TO 72 HRS OF RETENTION TIME FOR THE 2YR-24HR STORM EVENT. THE SPILLWAY IS SIZED TO DISCHARGE THE PEAK FLOW OF THE 100YR-24HR STORM WITH 1 FOOT OF FREEBOARD. MAXIMUM POND ELEVATIONS FOR BOTH THE 2YR-24HR AND 25YR-24HR STORM EVENTS ARE SHOWN IN THE TABLE ASSUMING FULL FLOW IN RISER PIPE.
4. THE FILL EXTENTS AT THE CGS ROADWAY CULVERT OUTLET SHOWS FILL REQUIRED OVER NATURAL GROUND. MUCH OR ALL OF THE FILL WILL BE INCLUDED IN THE CONSTRUCTION OF HAUL ROAD #1 (BY OTHERS).

PROFESSIONAL ENGINEER STATE OF NEVADA
MATTHEW T. HALEY
Exp. 06/30/21
Matt Haley
CIVIL
4/2/20
No. 21993

TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\A-CAD\DWGS\0385.000.057M.dwg-4/1/2020 9:27 AM

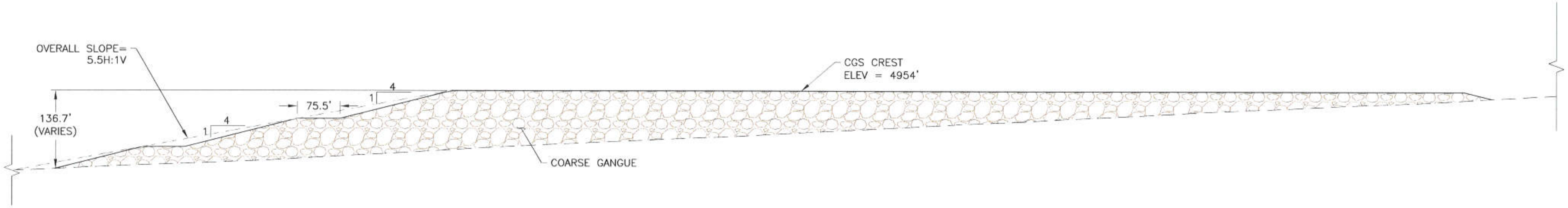
REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	JJS	MH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: SEB
DRAWN BY: JJS

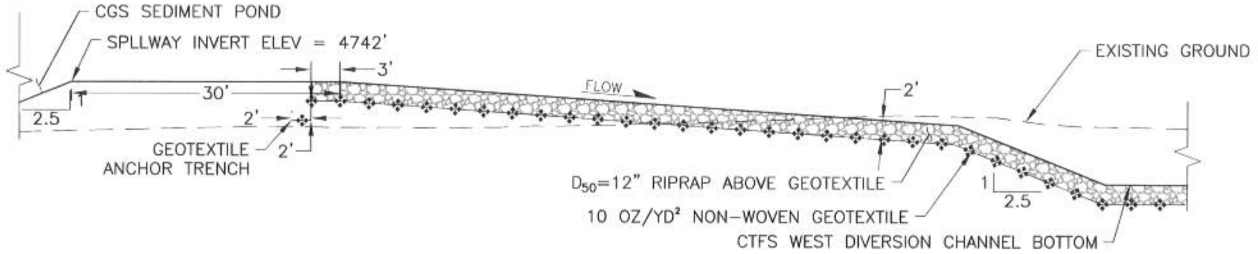
DISCLAIMER

NewFields

CLIENT: LITHIUM NEVADA CORP.
PROJECT: THACKER PASS PROJECT
TITLE: COARSE GANGUE STOCKPILE SEDIMENT POND PLAN
FILENAME: 0385.000.057M
DRAWING NO.: C140
REVISION: 0



T
C135
COARSE GANGUE STOCKPILE TYPICAL SECTION



AB
C140
CGS SEDIMENT POND SPILLWAY SECTION

PROFESSIONAL ENGINEER-STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No.21993
Matt Haley
4/2/20

0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MH
REV	DATE	DESCRIPTION	TECH	ENG

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: MH
DRAWN BY: RL

DISCLAIMER

NEWFIELDS PRODUCED THE INFORMATION PRESENTED ON THIS DRAWING THROUGH THE USE OF AVAILABLE TECHNICAL INFORMATION AND EXPERIENCE. RECEIVING THIS DRAWING DOES NOT GUARANTEE ANY RIGHTS TO EITHER SUCH TECHNICAL INFORMATION OR EXPERIENCE. ANY MODIFICATION OR ADAPTATION OF THE DATA OR DRAWING SHALL BE AT USER'S RISK AND WITHOUT ANY LIABILITY OR LEGAL RESPONSIBILITY TO NEWFIELDS.

NewFields

CLIENT: LITHIUM NEVADA CORP.
PROJECT: THACKER PASS PROJECT
TITLE: COARSE GANGUE STOCKPILE SECTIONS AND DETAILS
FILENAME: 0385.000.071D
DRAWING NO.: C143
REVISION: 0

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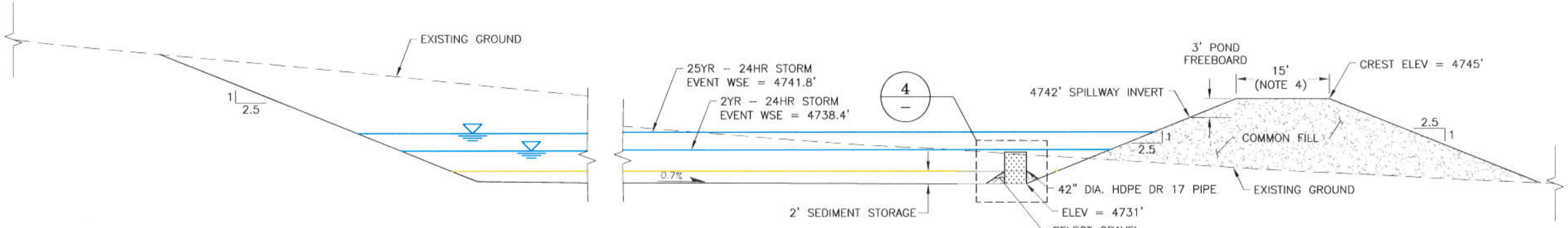
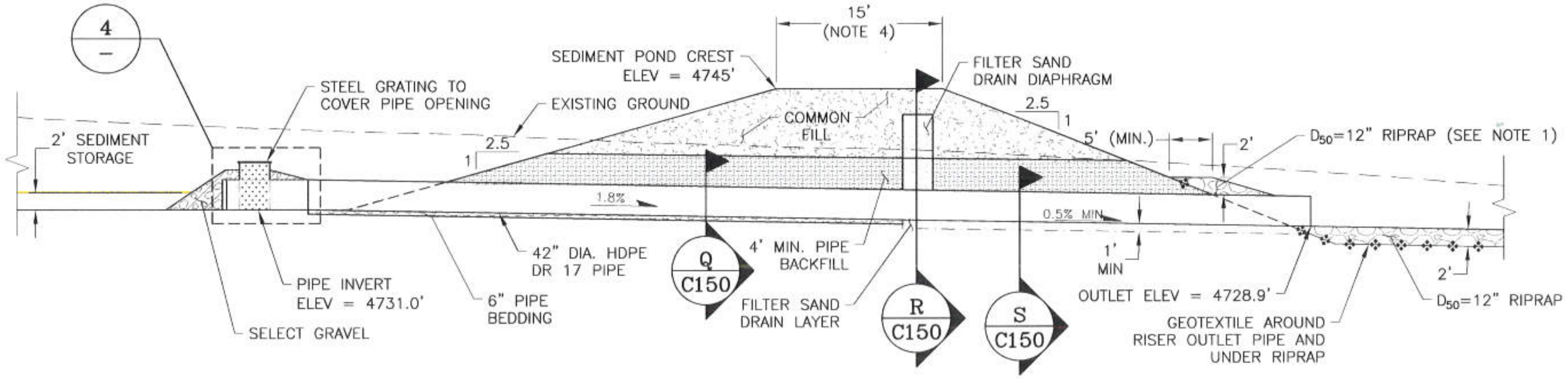
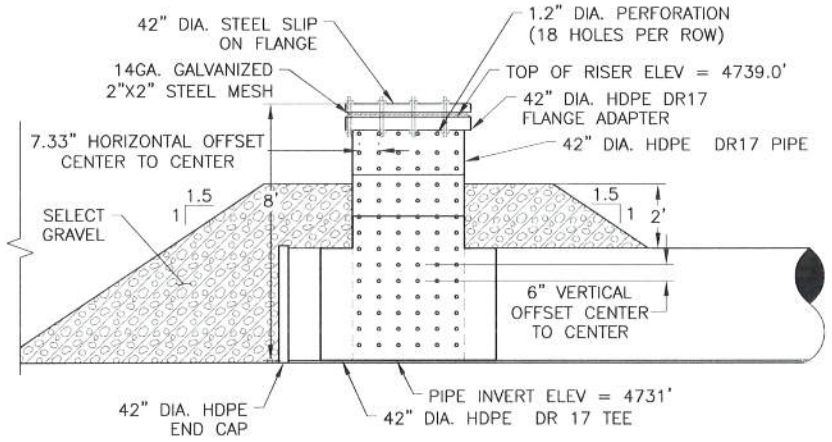


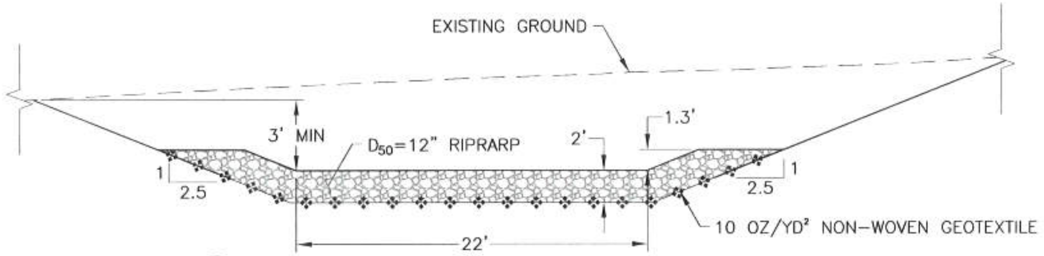
U / C140 CGS SEDIMENT POND TYPICAL SECTION



W / C140 CGS SEDIMENT POND RISER OUTLET PIPE



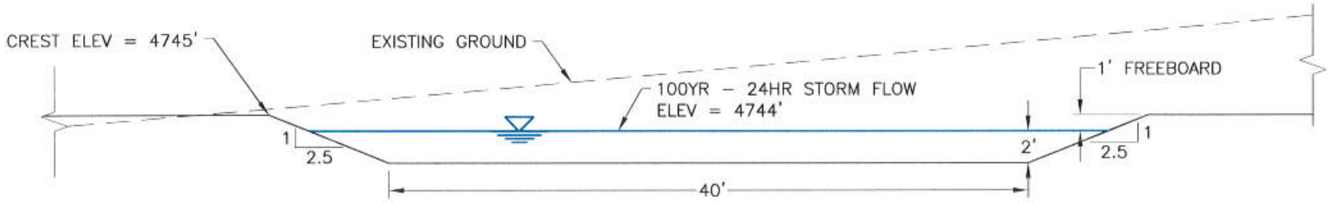
4 / – PERFORATION SCHEDULE ON RISER PIPE FOR CGS POND



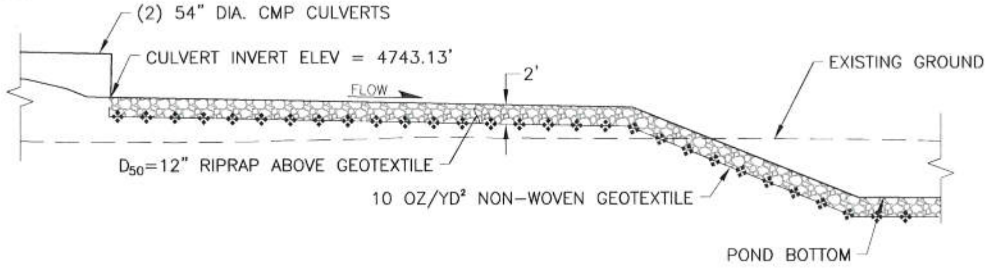
X / C140 CGS SEDIMENT POND RISER DISCHARGE CHANNEL

NOTES:

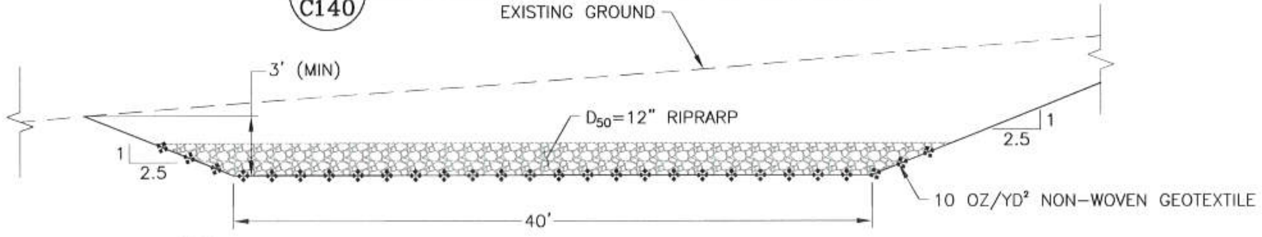
1. PLACE 2 FT THICK LAYER OF RIPRAP ON DOWNSTREAM SLOPE AROUND RISER OUTLET PIPE AND EXTENDING 20 FT PAST PIPE OUTLET.
2. PLACE GEOTEXTILE UNDER ALL RIPRAP.
3. A FILTER SAND DRAIN DIAPHRAGM IS REQUIRED IF THE COMMON FILL IS PRIMARILY FINE GRAINED SOILS (SILTS & CLAYS). THE DESIGN ENGINEER WILL DECIDE BASED ON LABORATORY TEST RESULTS FROM PROPOSED COMMON FILL MATERIAL SOURCES.
4. THE EMBANKMENT CREST IS NOT INTENDED TO HAVE VEHICLE ACCESS WHICH IS WHY THERE ARE NO BERMS.



V / C140 CGS SEDIMENT POND SPILLWAY SECTION



Z / C140 CGS SEDIMENT POND INLET CUT SECTION



Y / C140 CGS SEDIMENT POND SPILLWAY OUTLET CHANNEL

PROFESSIONAL ENGINEER–STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No. 21993
Matt Haley
4/2/20

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	JJS	MH

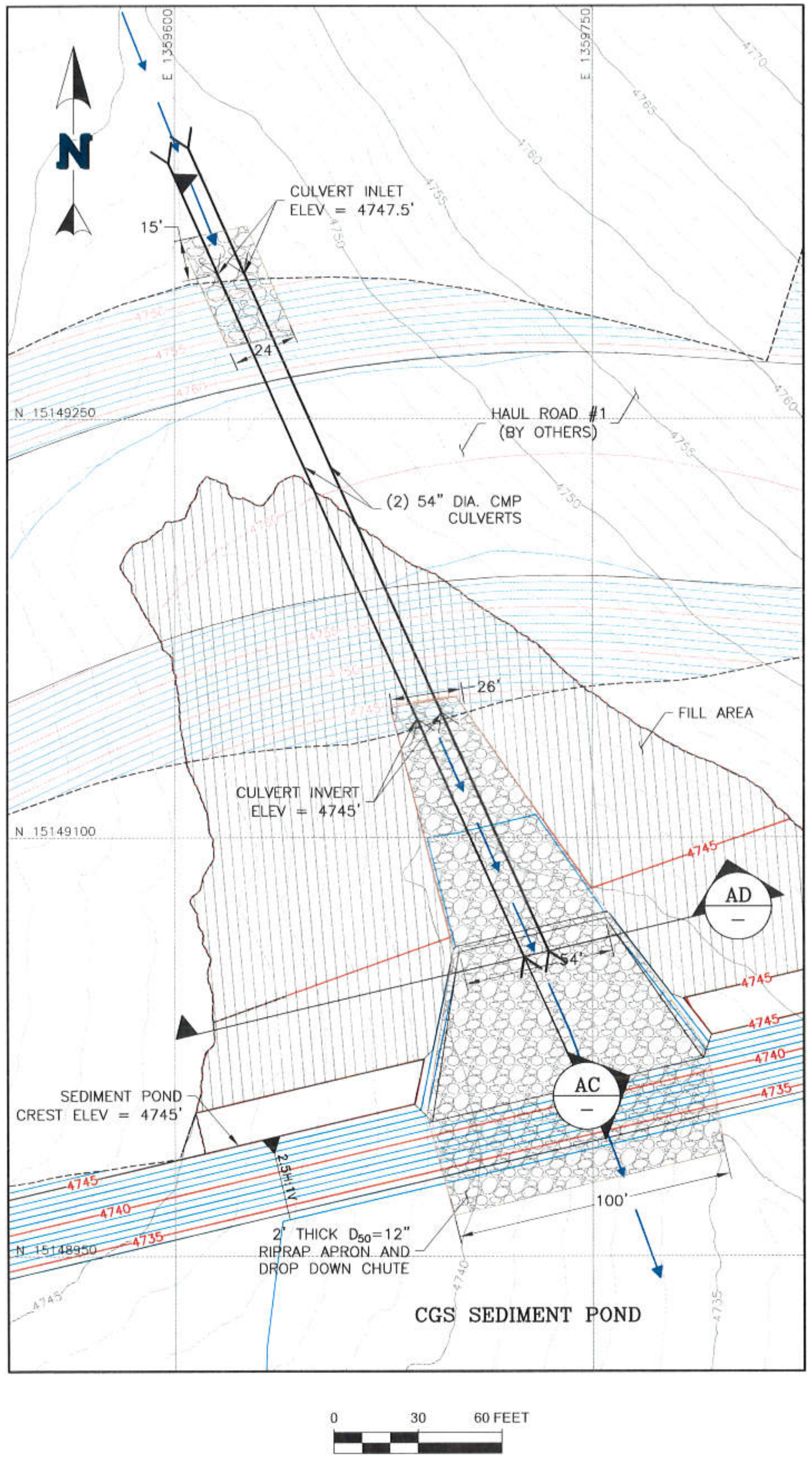
APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: SEB
DRAWN BY: JJS

DISCLAIMER

NEWFIELDS PRODUCED THE INFORMATION PRESENTED ON THIS DRAWING THROUGH THE USE OF AVAILABLE TECHNICAL INFORMATION AND EXPERIENCE. RECEIVING THIS DRAWING DOES NOT GUARANTEE ANY RIGHTS TO EITHER SUCH TECHNICAL INFORMATION OR EXPERIENCE. ANY MODIFICATION OR ADAPTATION OF THE DATA OR DRAWING SHALL BE AT USER'S RISK AND WITHOUT ANY LIABILITY OR LEGAL RESPONSIBILITY TO NEWFIELDS.

NewFields
CLIENT LITHIUM NEVADA CORP.
PROJECT THACKER PASS PROJECT
TITLE COARSE GANGUE STOCKPILE SEDIMENT POND SECTIONS AND DETAILS
FILENAME 0385.000.058D
DRAWING NO. C145
REVISION 0

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\A-CAD\DWGS\0385.000.058D.dwg-4/1/2020 9:30 AM

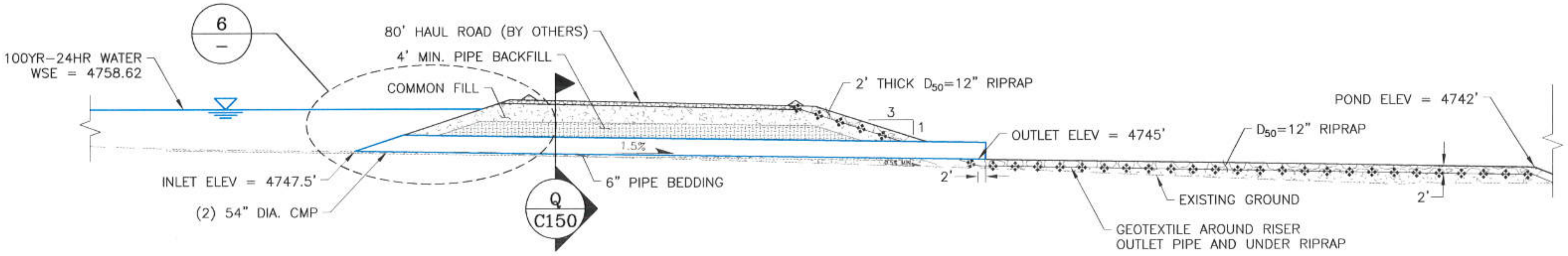


LEGEND:

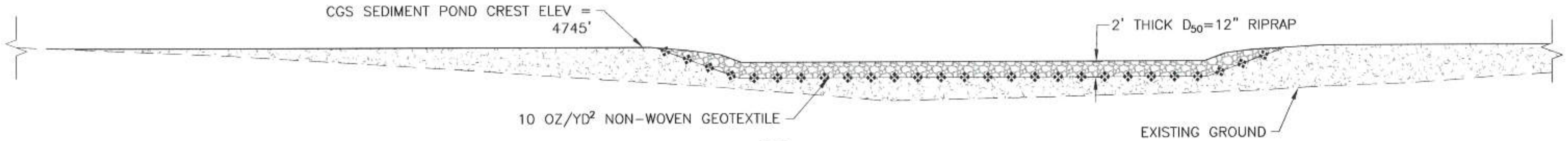
〜	EXISTING 1 FT GROUND CONTOURS
4500	EXISTING CONTOUR ELEVATION
〜	1 FT GROUND CONTOURS
4500	CONTOUR ELEVATION
〜	1 FT GROUND CONTOURS BY OTHERS
4500	CONTOUR ELEVATION BY OTHERS
〜	SURFACE DAYLIGHT
⟩—⟨	CULVERT
▨	RIPRAP ABOVE 10 OZ/YD² NON-WOVEN GEOTEXTILE
→ —	MAJOR STORMWATER DRAINAGE FLOW PATH

NOTES:

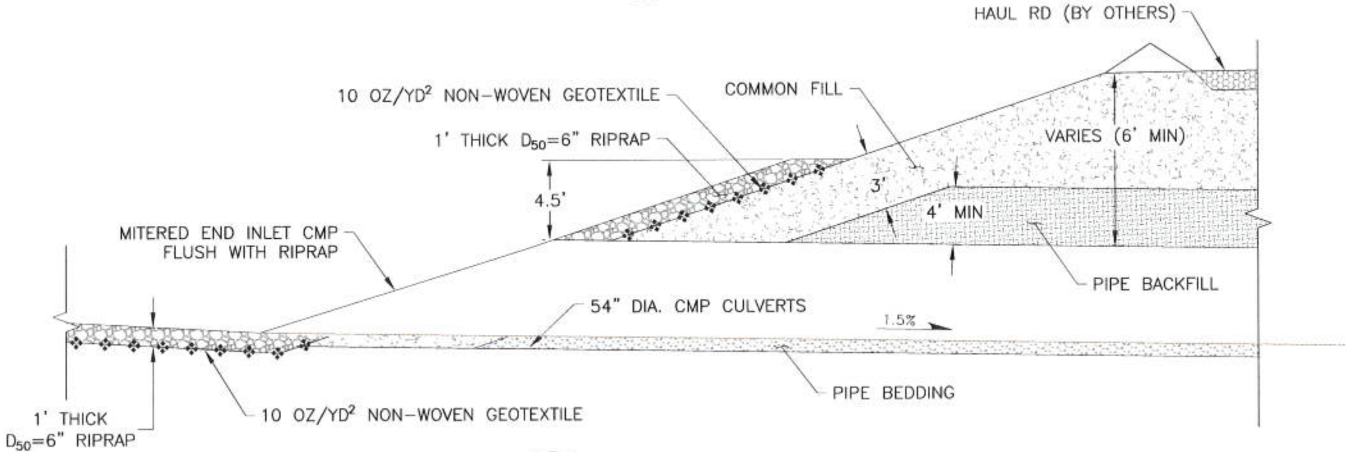
1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. THE CULVERTS ARE DESIGNED TO CONVEY STORMWATER FROM THE 100YR – 24HR STORM EVENT.



AC CGS INLET CULVERT LONGITUDINAL TYPICAL SECTION



AD CGS INLET CULVERT SECTION



6 CULVERT INLET DETAIL

MATTHEW T. HALEY
Exp. 06/30/21
Matt Haley
4/2/20
CIVIL
No. 21993

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: MTH
DRAWN BY: RL

NewFields
CLIENT: LITHIUM NEVADA CORP.
PROJECT: THACKER PASS PROJECT
TITLE: COARSE GANGUE STOCKPILE CULVERT SECTIONS
FILENAME: 0385.000.103D
DRAWING NO.: C146
REVISION: 0

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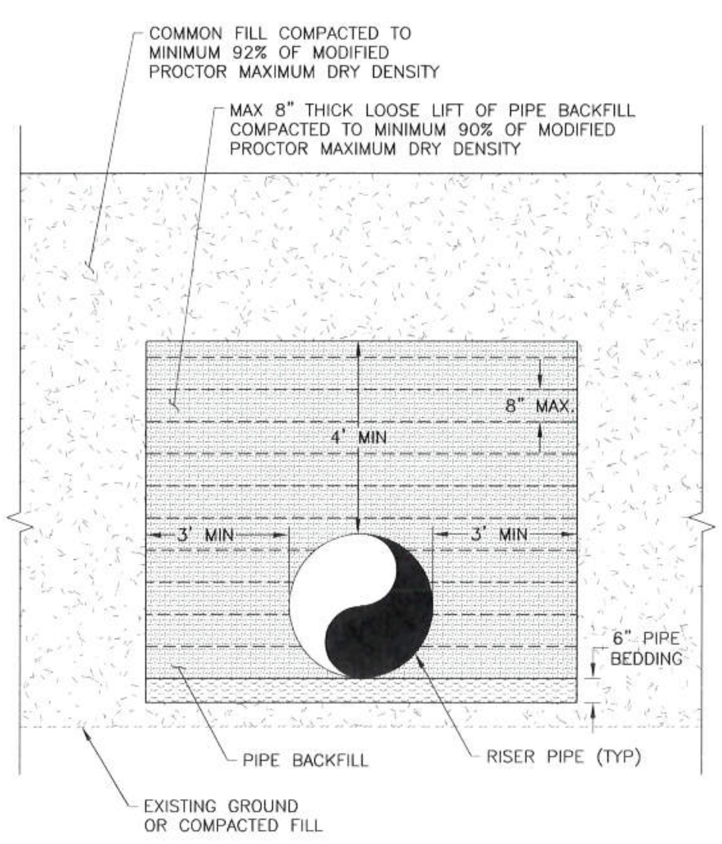
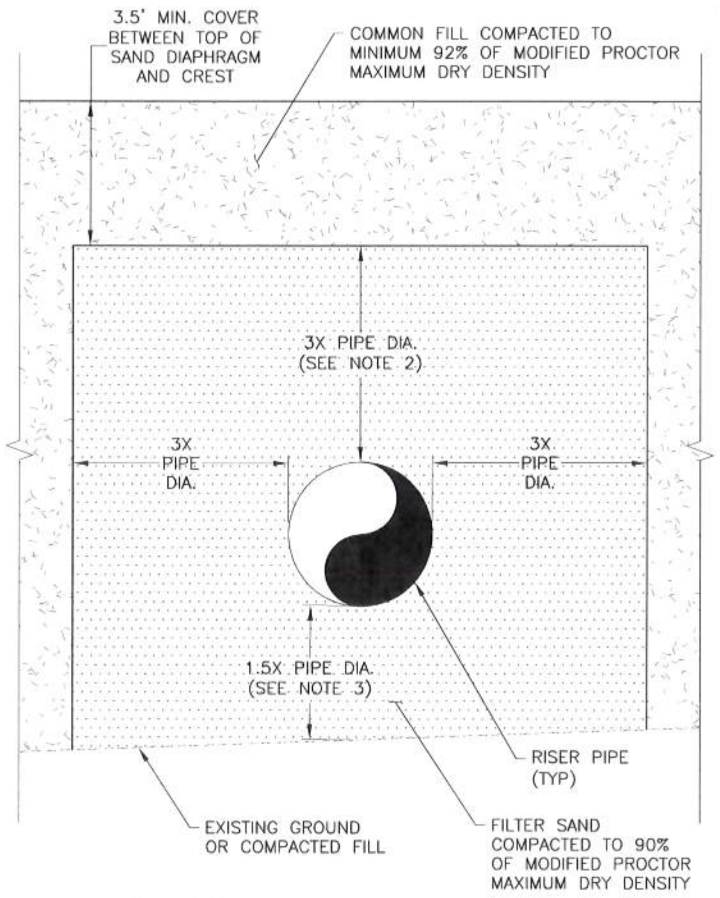
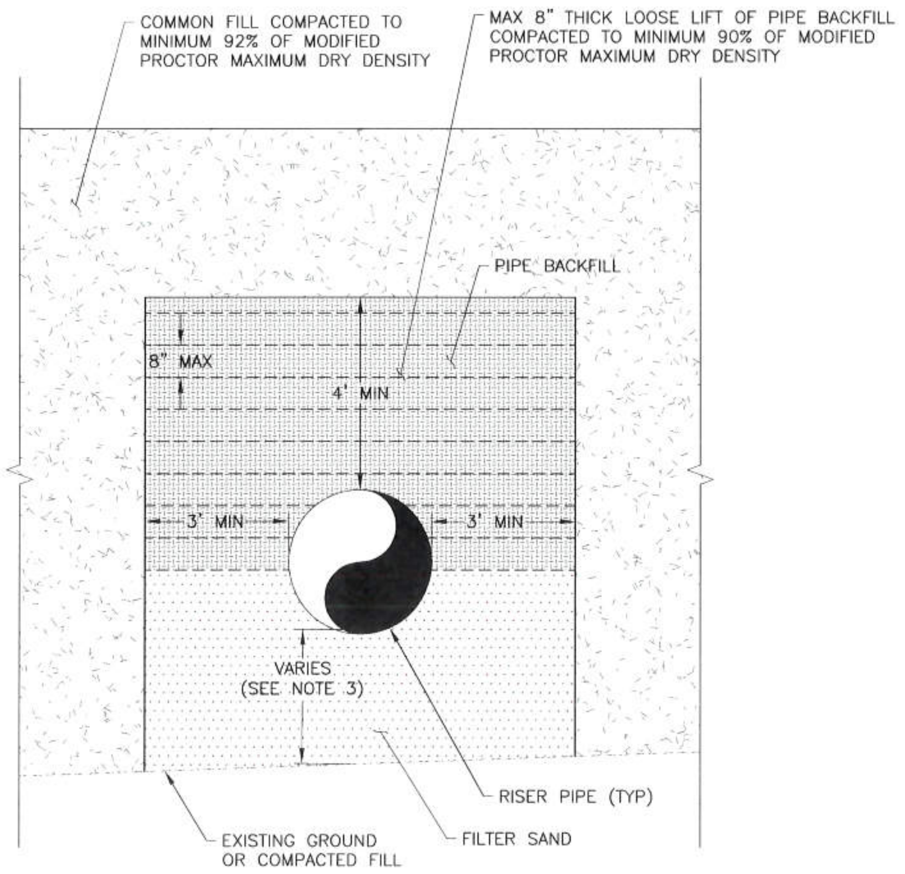


Q/C130 Q/C145 Q/C146 TYPICAL DRAIN PIPE DETAIL



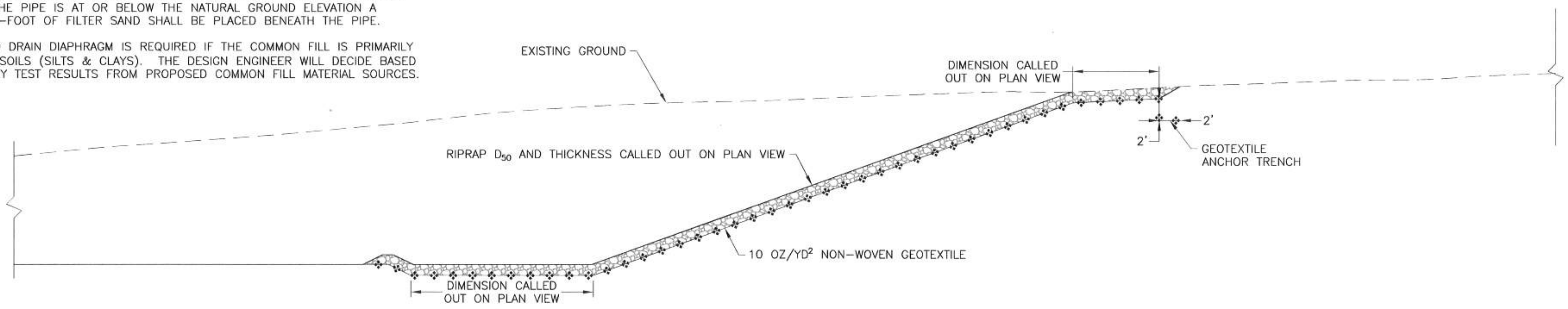
R/C130 R/C145 TYPICAL DRAIN DIAPHRAGM DETAIL



S/C130 S/C145 TYPICAL DRAIN PIPE DETAIL

NOTES:

1. USE HAND OPERATED COMPACTION EQUIPMENT IN THE PIPE BACKFILL AND FILTER SAND ZONES.
2. TOP OF DIAPHRAGM SHALL BE THE LOWER OF 3X PIPE DIAMETER ABOVE THE PIPE OR THE POND SPILLWAY ELEVATION.
3. FILTER SAND BELOW PIPE SHALL BE 1.5X PIPE DIAMETER IF THE PIPE IS IN FILL MATERIAL. IF THE PIPE IS AT OR BELOW THE NATURAL GROUND ELEVATION A MINIMUM OF 1-FOOT OF FILTER SAND SHALL BE PLACED BENEATH THE PIPE.
4. A FILTER SAND DRAIN DIAPHRAGM IS REQUIRED IF THE COMMON FILL IS PRIMARILY FINE GRAINED SOILS (SILTS & CLAYS). THE DESIGN ENGINEER WILL DECIDE BASED ON LABORATORY TEST RESULTS FROM PROPOSED COMMON FILL MATERIAL SOURCES.



F/C110 F/C125 F/C140 RIPRAP DROP DOWN CHUTE TYPICAL SECTION

MATTHEW T. HALEY
Exp.06/30/21
CIVIL
No.21993
Matt Haley
4/2/20

REV	DATE	DESCRIPTION	TECH	ENG
0	4/2/2020	ISSUED FOR CONSTRUCTION	RL	MTH

APPROVED BY: MTH
CHECKED BY: RTB
DESIGNED BY: MTH
DRAWN BY: RL

NewFields
CLIENT: LITHIUM NEVADA CORP.
PROJECT: THACKER PASS PROJECT
TITLE: FILTER DIAPHRAGM AND RISER PIPE SECTIONS AND DETAILS
FILENAME: 0385.000.079D
DRAWING NO.: C150
REVISION: 0

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DRAWINGS

North American Mining
Mine Surface Water Control Features

LITHIUM NEVADA CORP.
THACKER PASS PROJECT
MINE SURFACE WATER CONTROL FEATURES

ISSUED FOR CONSTRUCTION
MARCH 18, 2020

COUNTY MAP

VICINITY MAP

TEXT ABBREVIATIONS:

CGS - COARSE GANGUE STOCKPILE
℄ - CENTERLINE
CPeP - CORRUGATED POLYETHYLENE PIPE
CS - CARBON STEEL
CTFS - CLAY TAILINGS FILTER STACK
CY - CUBIC YARD
DIA - DIAMETER
DR - DIMENSION RATIO
FT - FOOT
GM - GROWTH MEDIA
HDPE - HIGH DENSITY POLYETHYLENE
LHCSL - LOW HYDRAULIC CONDUCTIVITY SOIL LAYER
MW - MONITORING WELL
PH - EXISTING PRODUCTION WELL
POO - PLAN OF OPERATIONS
PZ - PIEZOMETER
QRPW - QUINN RIVER PRODUCTION WELL
ROM - RUN OF MINE
SR - STATE ROUTE
STD WT - STANDARD WEIGHT
TW - EXISTING TEST PUMPING WELL
TYP - TYPICAL
VFD - VARIABLE FREQUENCY DRIVE
WRSF - WASTE ROCK STORAGE FACILITY
WSH - EXISTING MONITORING WELL
WSE - WATER SURFACE ELEVATION

DRAWING LIST

DWG NO.	DRAWING TITLE	REV
000	COVER SHEET, INDEX, AND VICINITY MAP	0
001	OVERALL MINE STORMWATER SITE PLAN	0
002	CULVERT LOCATION AND WATERSHED MAP	0
FP 1-1	FACILITY SEDIMENT POND #1 WATERSHED MAP	0
FP 1-2	FACILITY SEDIMENT POND #1 PLAN VIEW	0
FP 1-3	FACILITY SEDIMENT POND #1 CROSS SECTIONS AND DETAILS	0
FP 2-1	FACILITY SEDIMENT POND #2 WATERSHED MAP	0
FP 2-2	FACILITY SEDIMENT POND #2 PLAN VIEW	0
FP 2-3	FACILITY SEDIMENT POND #2 CROSS SECTIONS AND DETAILS	0
MP 1-1	MINE SEDIMENT POND #1 WATERSHED MAP SHEET 1 OF 2	0
MP 1-2	MINE SEDIMENT POND #1 WATERSHED MAP SHEET 2 OF 2	0
MP 1-3	MINE SEDIMENT POND #1 PLAN VIEW	0
MP 1-4	MINE SEDIMENT POND #1 CROSS SECTIONS AND DETAILS	0
FPD 1-1	FACILITY SEDIMENT POND #1 DIVERSION WATERSHED MAP	0
FPD 1-2	FACILITY SEDIMENT POND #1 DIVERSION PLAN AND PROFILE SHEET 1 OF 2	0
FPD 1-3	FACILITY SEDIMENT POND #1 DIVERSION PLAN AND PROFILE SHEET 2 OF 2	0
FPD 2-1	FACILITY SEDIMENT POND #2 DIVERSION WATERSHED MAP	0
FPD 2-2	FACILITY SEDIMENT POND #2 DIVERSION PLAN AND PROFILE SHEET 1 OF 2	0
FPD 2-3	FACILITY SEDIMENT POND #2 DIVERSION PLAN AND PROFILE SHEET 2 OF 2	0
ARD 1-1	ANCILLARY ROAD #1 DIVERSION WATERSHED MAP	0
ARD 1-2	ANCILLARY ROAD #1 DIVERSION PLAN AND PROFILE SHEET 1 OF 2	0
ARD 1-3	ANCILLARY ROAD #1 DIVERSION PLAN AND PROFILE SHEET 2 OF 2	0
ARD 2-1	ANCILLARY ROAD #2 DIVERSION WATERSHED MAP	0
ARD 2-2	ANCILLARY ROAD #2 DIVERSION PLAN AND PROFILE SHEET 1 OF 3	0
ARD 2-3	ANCILLARY ROAD #2 DIVERSION PLAN AND PROFILE SHEET 2 OF 3	0
ARD 2-4	ANCILLARY ROAD #2 DIVERSION PLAN AND PROFILE SHEET 3 OF 3	0
CULV 01	CULVERT TYPICAL CROSS SECTIONS AND DETAILS	0

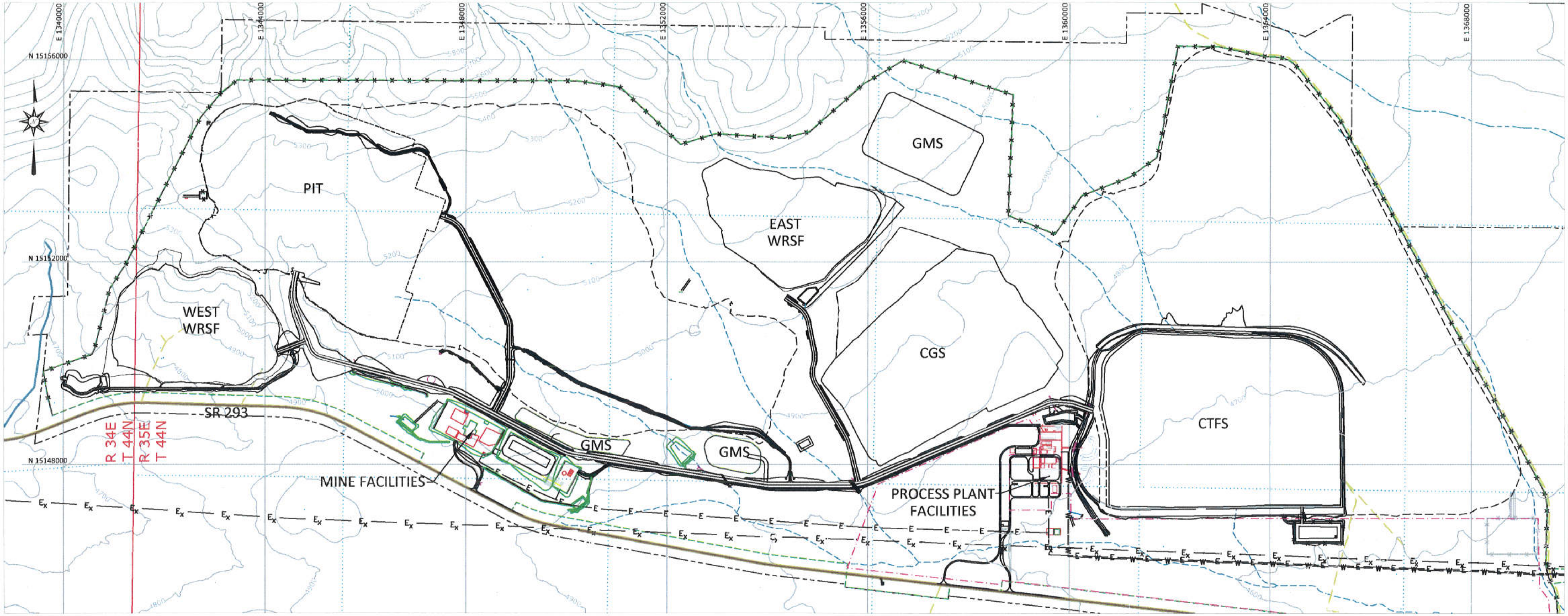
PROFESSIONAL ENGINEER - STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
Matt Haley
CIVIL
3/18/20
No. 21993

NORTH AMERICAN MINING
SAWTOOTH MINING
5340 Legacy Drive, Suite 300, Plano, TX 75238
Phone: (972)448.5400 www.nacoal.com

OWNER

LithiumNevada
LITHIUM NEVADA CORP.
3685 LAKESIDE DRIVE
RENO, NEVADA 89509

NewFields
9400 Station Street, Suite 300, Lone Tree, CO 80124
Phone: (720)508.3300 www.newfields.com



0 2000 4000 FEET

LEGEND

EXISTING 25 FT GROUND CONTOURS
EXISTING ROADS-MAJOR
EXISTING ROADS
SURFACE DAYLIGHT
EXPANSION AREAS
EXISTING DRAINAGES
EXISTING PERENNIAL STREAMS
POO BOUNDARY
DISTURBANCE AREA BOUNDARY
HAULROAD
ANCILLARY ROAD
POND
CONVEYOR CORRIDOR

CULVERT
—Ex— EXISTING POWER LINE
—W— WATER LINE
—E— POWER LINE
—X— FENCE
STRUCTURE/BUILDING

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.

PROFESSIONAL ENGINEER-STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
Matt Haley
CIVIL
3/18/20
No.21993

TOPO REFERENCE

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018 THE COORDINATE SYSTEM IS UTM ZONE 11 NAD 83 SOUTH WITH UNITS IN US SURVEY FEET

REV	DATE	DESCRIPTION
0	3/18/20	Issued for construction

NORTH AMERICAN MINING
SAWTOOTH MINING
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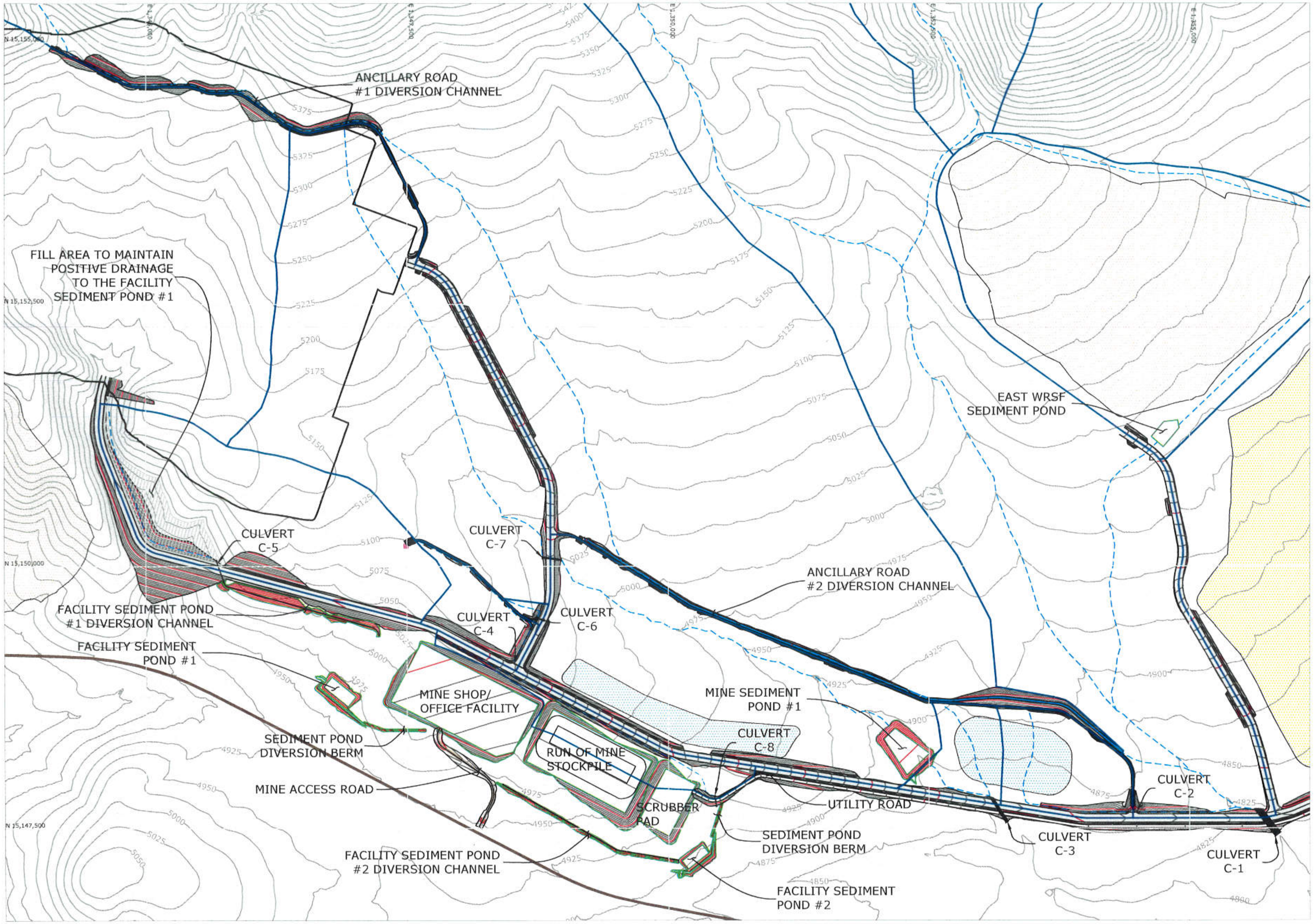
Thacker Pass Project
Overall Mine
Stormwater Site Plan

Drawn By: CJS Date: 03/09/2020
Approved: MTH Date: 03/2020
Scale: 1"=2000' Dwg. No.: 001



0 1000 2000

LEGEND

〰	EXISTING 5 FT GROUND CONTOURS
〰	PROPOSED 5 FT GROUND CONTOURS (PREVIOUSLY DESIGNED STRUCTURES)
〰	PROPOSED 5 FT GROUND CONTOURS
〰	SURFACE DAYLIGHT
〰	WATERSHED BOUNDARY
〰	MAJOR STORMWATER DRAINAGE FLOW PATH
—	HAULROAD
—	ANCILLARY ROAD
▬	EXISTING NEVADA SR 293
▬	DIVERSION CHANNEL
>—<	CULVERT
☐	MINE PIT DISTURBANCE BOUNDARY
▨	FILL AREA
☐	WASTE ROCK STORAGE FACILITY
▨	GROWTH MEDIA STOCKPILE
▨	COARSE GANGUE STOCKPILE
△	RADIO TOWER

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. THE CULVERTS ARE DESIGNED TO CONVEY STORMWATER FROM THE 100-YEAR/24-HOUR STORM EVENT.

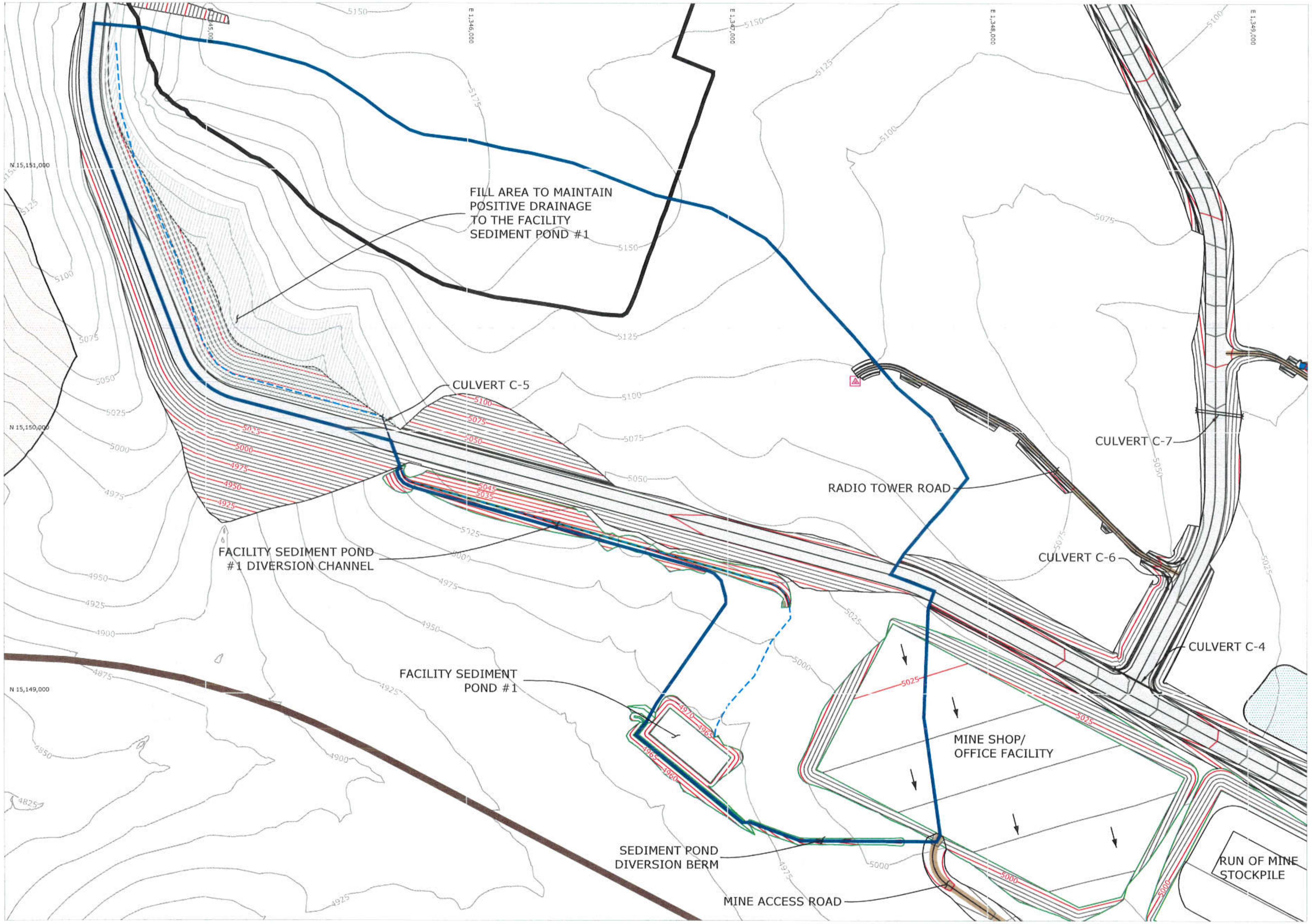
PROFESSIONAL ENGINEER-STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
Matt Haley
CIVIL
3/18/20
No. 21993

REV	DATE	DESCRIPTION
0	3/18/20	Issued for construction

NORTH AMERICAN MINING
SAWTOOTH MINING
NewFields

Thacker Pass Project
Culvert Location and
Watershed Map

Drawn By:	CJS	Date:	2/26/20
Approved:	MTH	Date:	03/20
Scale:	1"=1000'	Dwg. No.:	002



LEGEND

- EXISTING 5 FT GROUND CONTOURS
- PROPOSED 5 FT GROUND CONTOURS (PREVIOUSLY DESIGNED STRUCTURES)
- PROPOSED 5 FT GROUND CONTOURS
- SURFACE DAYLIGHT
- WATERSHED BOUNDARY
- MAJOR STORMWATER DRAINAGE FLOW PATH
- HAULROAD
- ANCILLARY ROAD
- EXISTING NEVADA SR 293
- DIVERSION CHANNEL
- CULVERT
- ▭ MINE PIT DISTURBANCE BOUNDARY
- ▨ FILL AREA
- ▭ WASTE ROCK STORAGE FACILITY
- ▨ GROWTH MEDIA STOCKPILE
- △ RADIO TOWER

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.

PROFESSIONAL ENGINEER - STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
Matt Haley
CIVIL
3/18/20
No. 21993

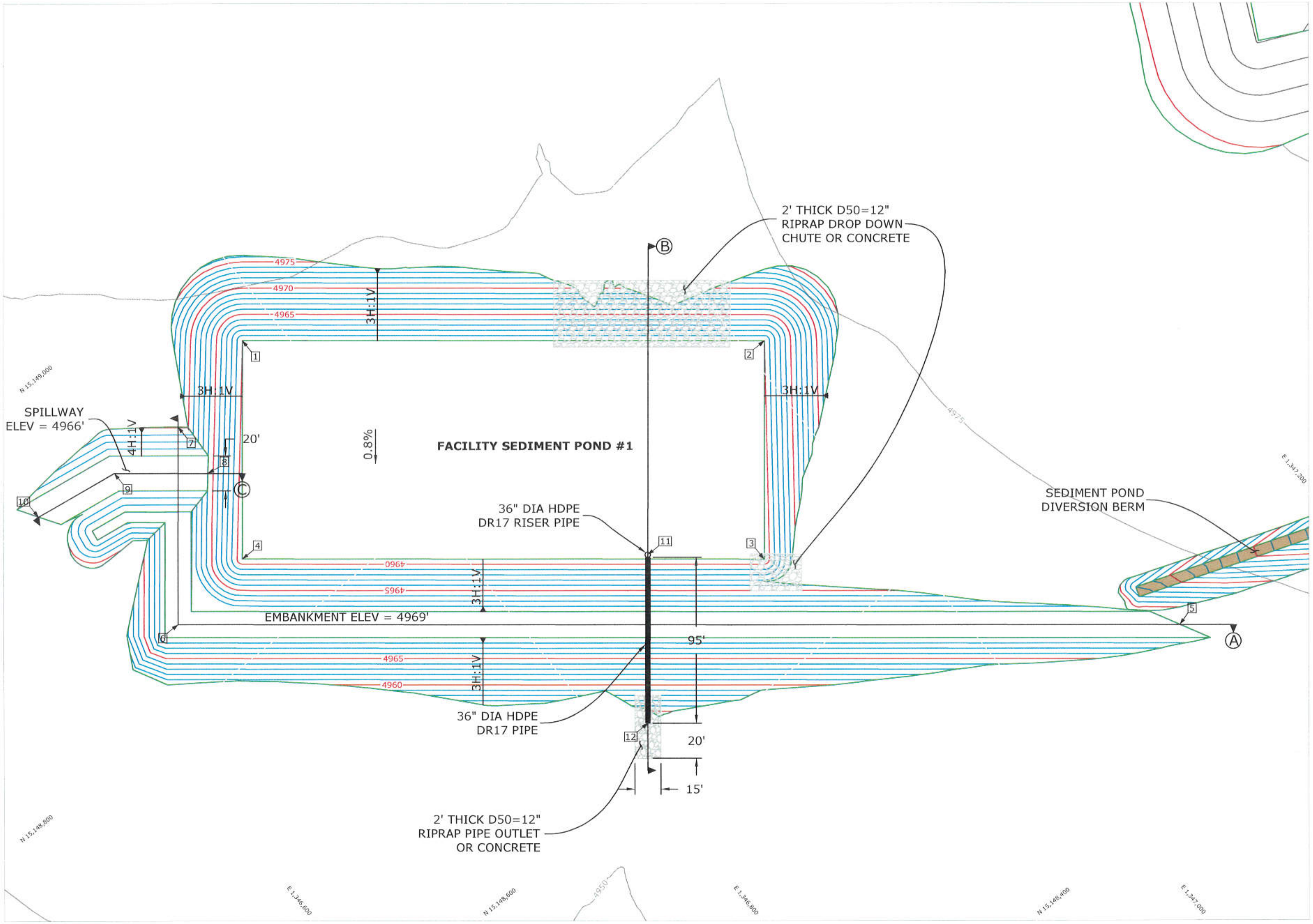
0 400 800

REV	DATE	DESCRIPTION
0	3/18/20	Issued for construction

NORTH AMERICAN MINING
SAWTOOTH MINING
NewFields

Thacker Pass Project
Facility Sediment Pond #1
Watershed Map

Drawn By: CJS Date: 1/31/20
Approved: MTH Date: 03/20
Scale: 1"=400' Dwg. No.: FP 1-1



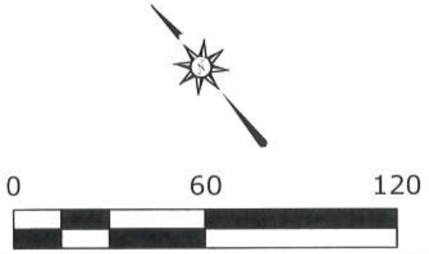
LEGEND

〰	EXISTING 5 FT GROUND CONTOURS
〰	PROPOSED 1 FT GROUND CONTOURS
〰	SURFACE DAYLIGHT
▬	BERM
▨	D50=12" RIPRAP ABOVE 10 oz/yd^2 NON-WOVEN GEOTEXTILE OR CONCRETE

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. FACILITY SEDIMENT POND #1 TO CONTAIN THE 2-YEAR/24-HOUR RUNOFF GENERATED FROM THE DELINEATED WATERSHED. THE SPILLWAY IS SIZED TO DISCHARGE THE PEAK FLOW OF THE 100-YEAR/24-HOUR STORM WITH MINIMUM 1 FOOT OF FREEBOARD.
3. THE RISER PIPE DIAMETER, ELEVATION, AND PERFORATION SPACING ARE DESIGNED TO GIVE THE STORMWATER BASIN 48 TO 72 HOURS OF RETENTION TIME FOR THE 2-YEAR/24-HOUR STORM EVENT. FLOWS GREATER THAN THE 2-YEAR EVENT AND LESS THAN THE 25-YEAR EVENT WILL DRAIN OUT THE RISER PIPE. FLOWS GREATER THAN 25-YEAR EVENT WILL OVERFLOW THROUGH THE SPILLWAY.

PROFESSIONAL ENGINEER-STATE OF NEVADA
MATTHEW T. HALEY
Exp. 06/30/21
Matt Haley
CIVIL
3/18/20
No. 21993

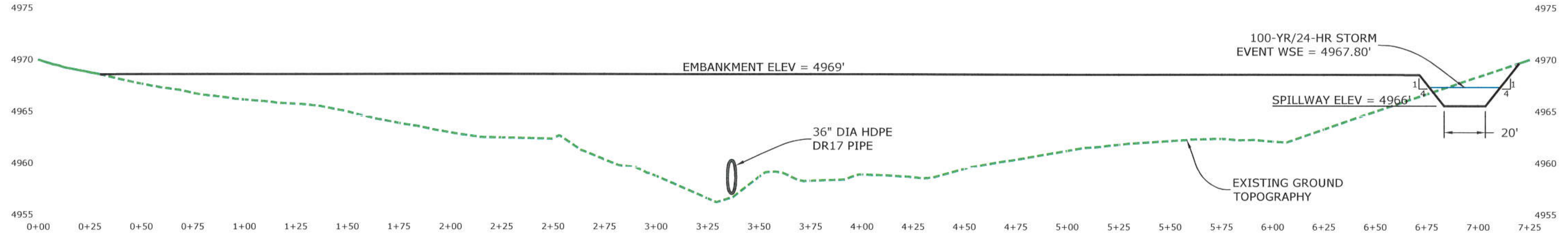


REV	DATE	DESCRIPTION
0	3/18/20	Issued for construction

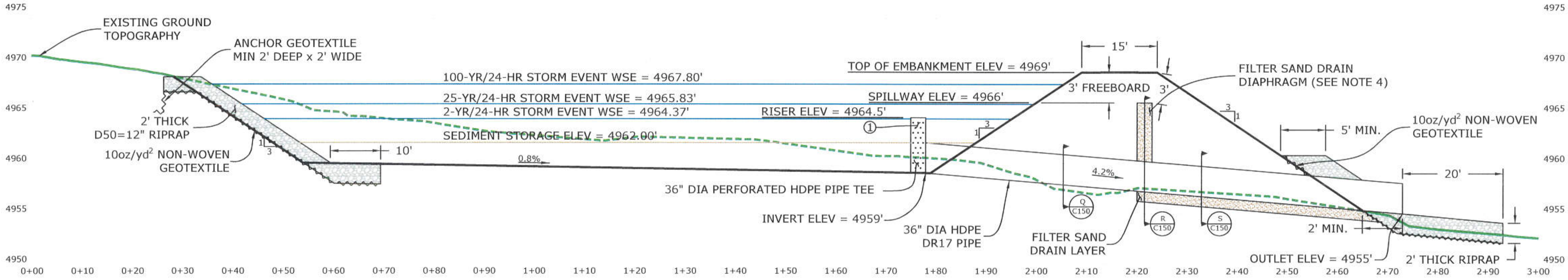
NORTH AMERICAN MINING
SAWTOOTH MINING
NewFields

Thacker Pass Project
Facility Sediment Pond #1
Plan View

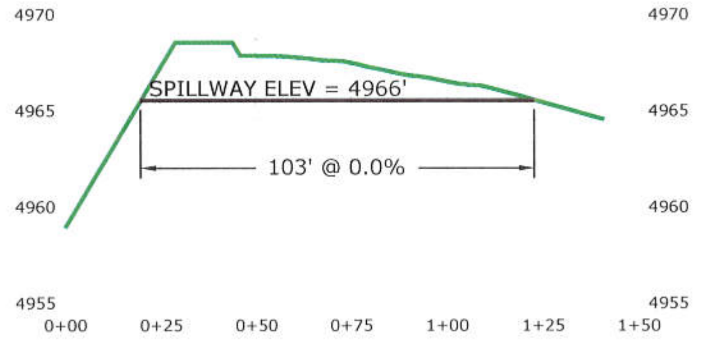
Drawn By: CJS Date: 2/10/20
Approved: MTH Date: 03/20
Scale: 1"=60' Dwg. No.: FP 1-2



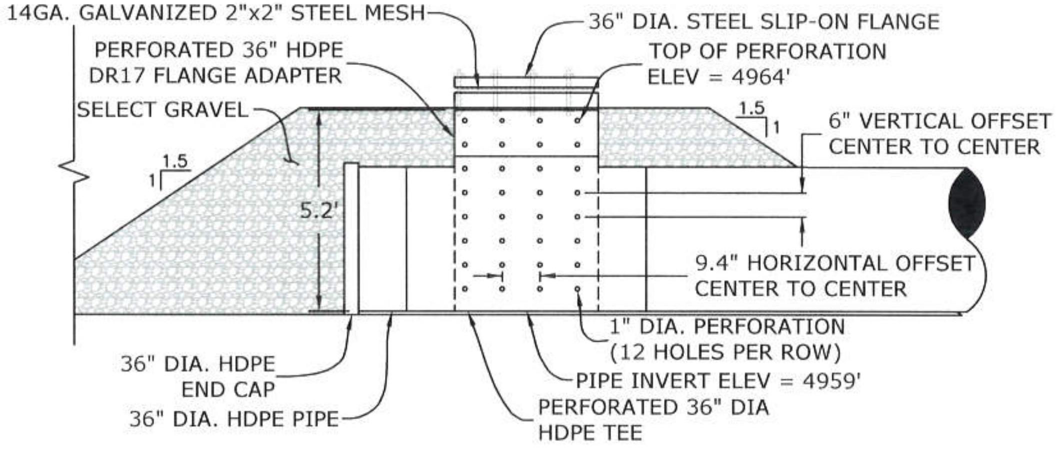
Ⓐ FACILITY SEDIMENT POND #1 EMBANKMENT SECTION
HORZ. SCALE: 1"=50'; VERT. SCALE: 1"=10'



Ⓑ FACILITY SEDIMENT POND #1 TYPICAL SECTION AND RISER OUTLET PIPE
HORZ. SCALE: 1"=20'; VERT. SCALE: 1"=10'



Ⓒ FACILITY SEDIMENT POND #1 SPILLWAY SECTION
HORZ. SCALE: 1"=50'; VERT. SCALE: 1"=10'



① PERFORATION SCHEDULE ON RISER PIPE

NOTES:

1. PLACE 2 FT THICK LAYER OF RIPRAP ON DOWNSTREAM SLOPE AROUND RISER PIPE, EXTENDING 20 FT PAST PIPE OUTLET AND ON POND INLET. CONCRETE CAN BE SUBSTITUTED FOR RIPRAP.
2. PLACE 10oz/yd² NON-WOVEN GEOTEXTILE UNDER ALL RIPRAP. ANCHOR GEOTEXTILE ON UPSTREAM EDGE OF DROP DOWN CHUTES AND SPILLWAYS.
3. SEE NEWFIELDS DRAWING C150 FOR FILTER DIAPHRAGM AND RISER PIPE SECTIONS AND DETAILS.
4. A FILTER SAND DIAPHRAGM IS REQUIRED IF THE COMMON FILL IS PRIMARILY FINE GRAINED SOILS (SILTS AND CLAYS). THE DESIGN ENGINEER WILL DECIDE BASED ON LABORATORY TEST RESULTS FROM PROPOSED COMMON FILL MATERIAL SOURCES PRIOR TO CONSTRUCTION.

PROFESSIONAL ENGINEER - STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
Matt Haley
CIVIL
3/19/20
No. 21993

REV	DATE	DESCRIPTION
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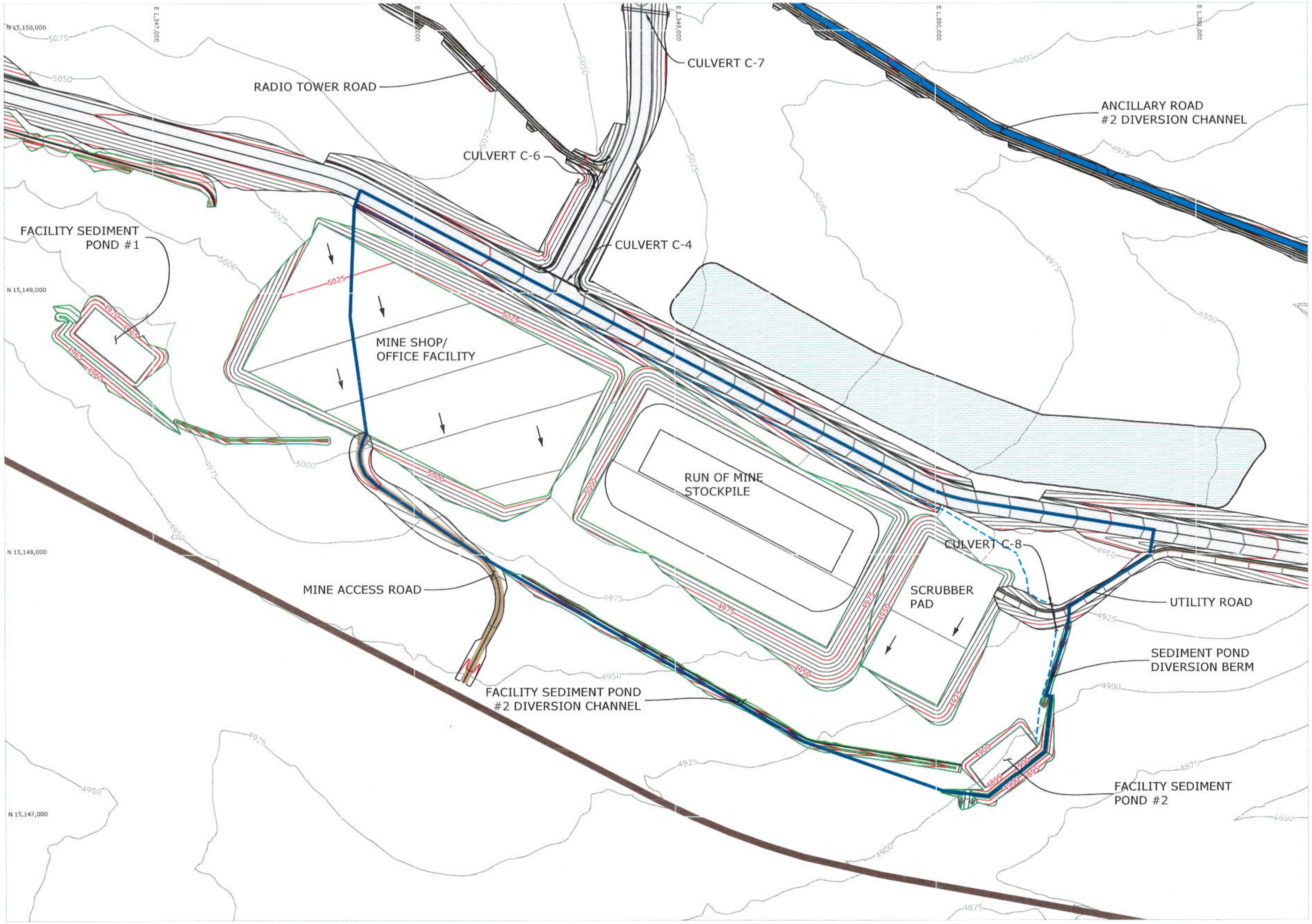
NORTH AMERICAN MINING
SAWTOOTH MINING
NewFields

Thacker Pass Project
Facility Sediment Pond #1
Cross Sections and Details

Drawn By: CJS Date: 2/14/20
Approved: MTH Date: 03/20
Scale: AS SHOWN Dwg. No.: FP 1-3



LEGEND

- EXISTING 5 FT GROUND CONTOURS
- PROPOSED 5 FT GROUND CONTOURS (PREVIOUSLY DESIGNED STRUCTURES)
- PROPOSED 5 FT GROUND CONTOURS
- SURFACE DAYLIGHT
- WATERSHED BOUNDARY
- MAJOR STORMWATER DRAINAGE FLOW PATH
- HAULROAD
- ANCILLARY ROAD
- EXISTING NEVADA SR 293
- DIVERSION CHANNEL
- CULVERT
- ▨ GROWTH MEDIA STOCKPILE

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.

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Exp.06/30/21
Matt Haley
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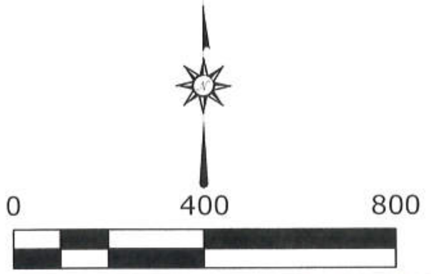
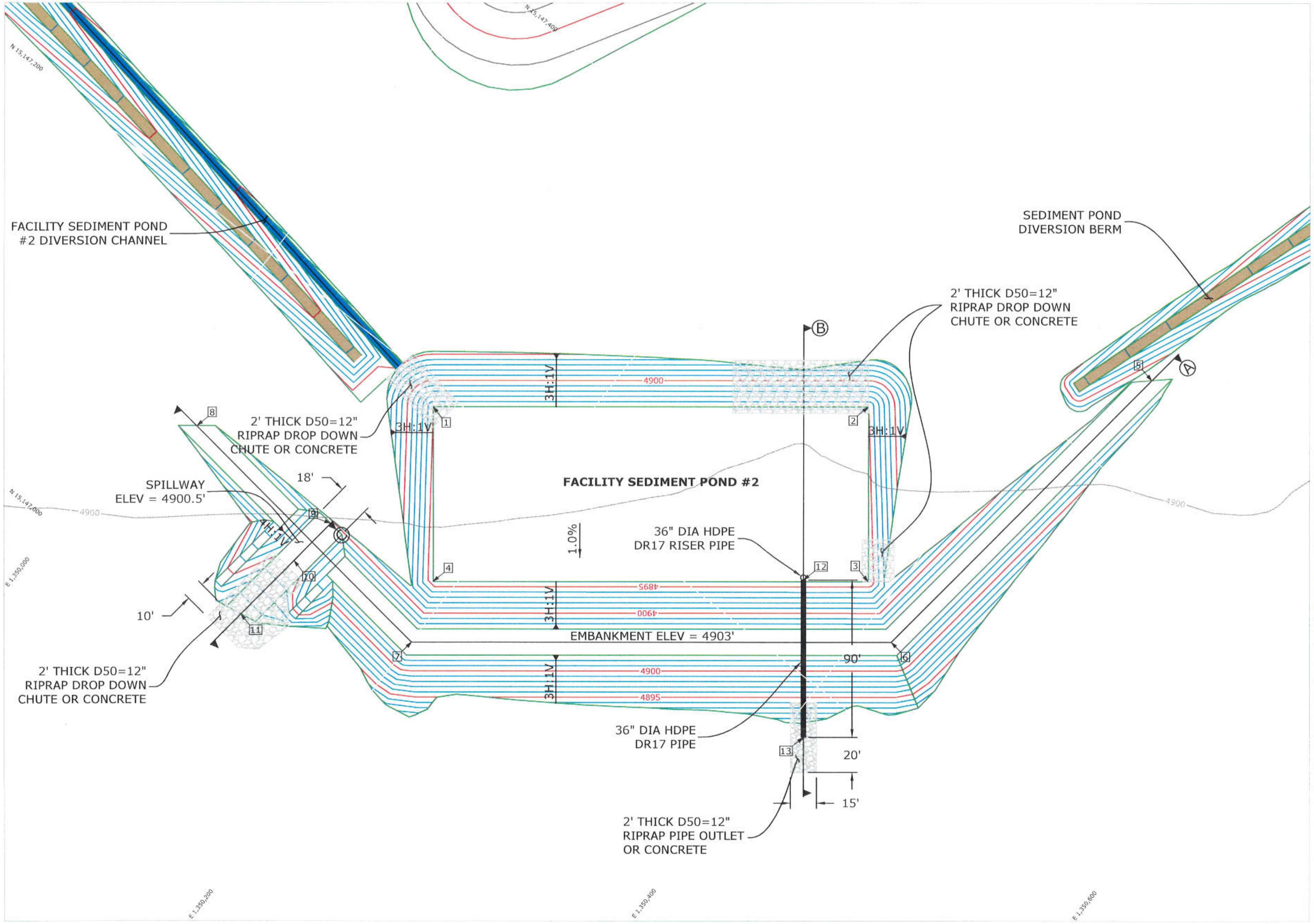


REV	DATE	DESCRIPTION
0	3/18/20	Issued for construction

NORTH AMERICAN MINING
SAWTOOTH MINING
NewFields

Thacker Pass Project
Facility Sediment Pond #2
Watershed Map

Drawn By: CJS Date: 2/19/20
Approved: MTH Date: 03/20
Scale: 1"=400' Dwg. No.: FP 2-1



LEGEND

～	EXISTING 5 FT GROUND CONTOURS
～	PROPOSED 5 FT GROUND CONTOURS (PREVIOUSLY DESIGNED STRUCTURES)
～	PROPOSED 1 FT GROUND CONTOURS
～	SURFACE DAYLIGHT
🟦	DIVERSION CHANNEL
🟫	BERM
▨	D50=12" RIPRAP ABOVE 10 oz/yd^2 NON-WOVEN GEOTEXTILE OR CONCRETE

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. FACILITY SEDIMENT POND #2 TO CONTAIN THE 2-YEAR/24-HOUR RUNOFF GENERATED FROM THE DELINEATED WATERSHED. THE SPILLWAY IS SIZED TO DISCHARGE THE PEAK FLOW OF THE 100-YEAR/24-HOUR STORM WITH MINIMUM 1 FOOT OF FREEBOARD.
3. THE RISER PIPE DIAMETER, ELEVATION, AND PERFORATION SPACING ARE DESIGNED TO GIVE THE STORMWATER BASIN 48 TO 72 HOURS OF RETENTION TIME FOR THE 2-YEAR/24-HOUR STORM EVENT. FLOWS GREATER THAN THE 2-YEAR EVENT AND LESS THAN THE 25-YEAR EVENT WILL DRAIN OUT THE RISER PIPE. FLOWS GREATER THAN 25-YEAR EVENT WILL OVERFLOW THROUGH THE SPILLWAY.

MATTHEW T. HALEY
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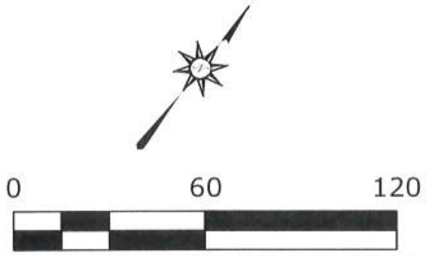
No.21993
Matt Haley
3/18/20

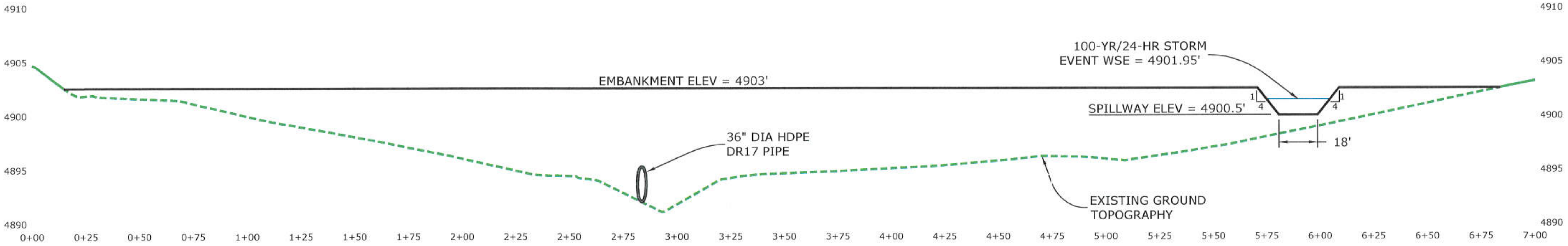


REV	DATE	DESCRIPTION
0	3/18/20	Issued for construction

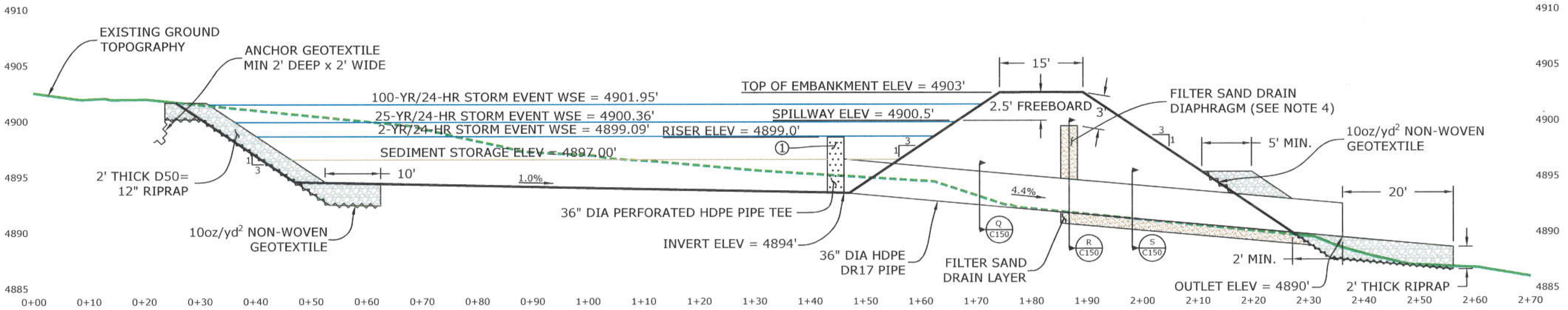
NORTHAMERICAN MINING
SAWTOOTH MINING
NewFields

Thacker Pass Project
Facility Sediment Pond #2
Plan View

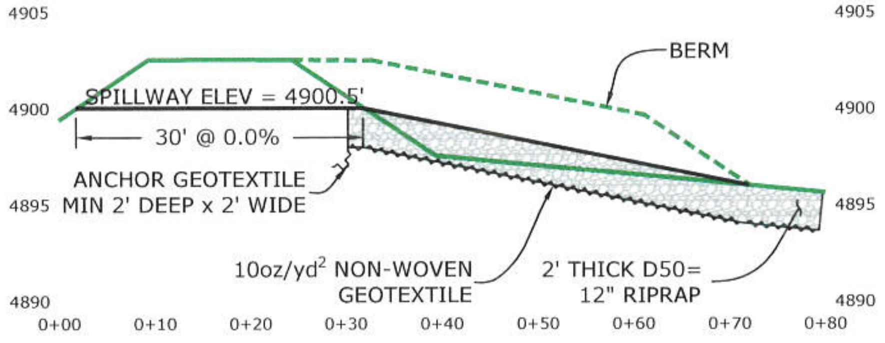
Drawn By: CJS Date: 2/20/20
Approved: MTH Date: 03/20
Scale: 1"=60' Dwg. No.: FP 2-2



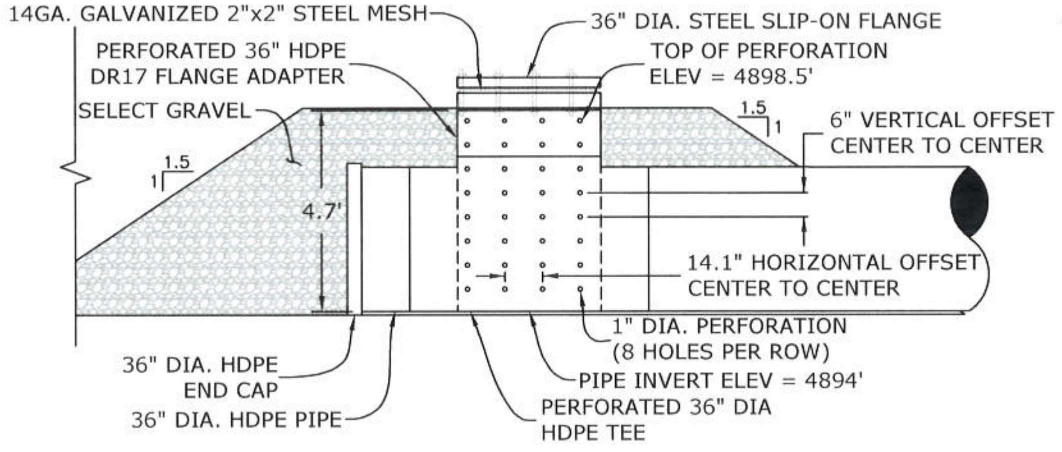
Ⓐ FACILITY SEDIMENT POND #2 EMBANKMENT SECTION
HORZ. SCALE: 1"=50'; VERT. SCALE: 1"=10'



Ⓑ FACILITY SEDIMENT POND #2 TYPICAL SECTION AND RISER OUTLET PIPE
HORZ. SCALE: 1"=20'; VERT. SCALE: 1"=10'



Ⓒ FACILITY SEDIMENT POND #2 SPILLWAY SECTION
HORZ. SCALE: 1"=20'; VERT. SCALE: 1"=10'



① PERFORATION SCHEDULE ON RISER PIPE

NOTES:

1. PLACE 2 FT THICK LAYER OF RIPRAP ON DOWNSTREAM SLOPE AROUND RISER PIPE, EXTENDING 20 FT PAST PIPE OUTLET AND ON POND INLET. CONCRETE CAN BE SUBSTITUTED FOR RIPRAP.
2. PLACE 10oz/yd² NON-WOVEN GEOTEXTILE UNDER ALL RIPRAP. ANCHOR GEOTEXTILE ON UPSTREAM EDGE OF DROP DOWN CHUTES AND SPILLWAYS.
3. SEE NEWFIELDS DRAWING C150 FOR FILTER DIAPHRAGM AND RISER PIPE SECTIONS AND DETAILS.
4. A FILTER SAND DIAPHRAGM IS REQUIRED IF THE COMMON FILL IS PRIMARILY FINE GRAINED SOILS (SILTS AND CLAYS). THE DESIGN ENGINEER WILL DECIDE BASED ON LABORATORY TEST RESULTS FROM PROPOSED COMMON FILL MATERIAL SOURCES PRIOR TO CONSTRUCTION.

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No.21993
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3/18/20

REV	DATE	DESCRIPTION
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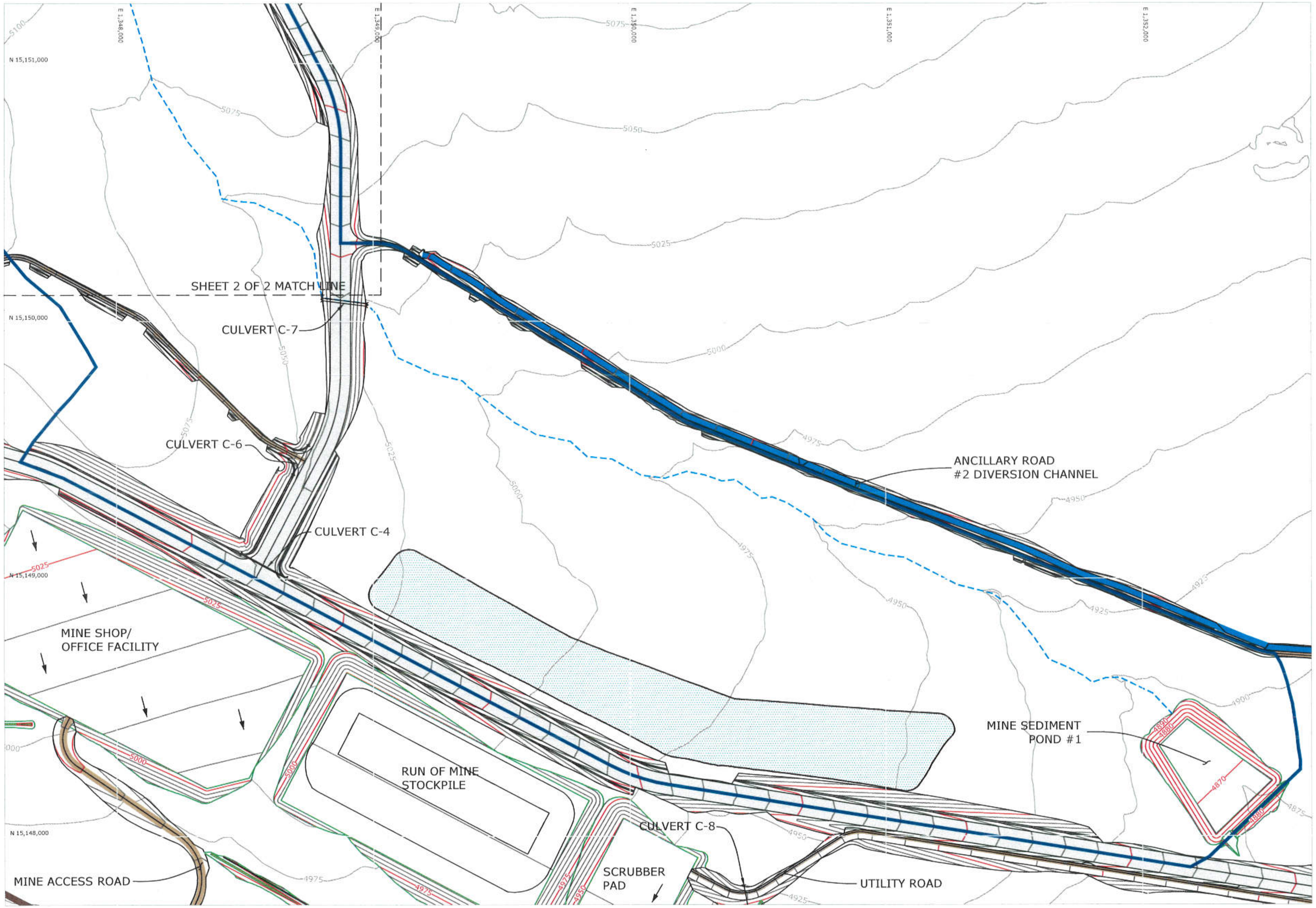
NORTH AMERICAN MINING
SAWTOOTH MINING
NewFields

Thacker Pass Project
Facility Sediment Pond #2
Cross Sections and Details

Drawn By:	CJS	Date:	2/20/20
Approved:	MTH	Date:	03/20
Scale:	AS SHOWN	Dwg. No.:	FP 2-3



LEGEND

〰	EXISTING 5 FT GROUND CONTOURS
〰	PROPOSED 5 FT GROUND CONTOURS (PREVIOUSLY DESIGNED STRUCTURES)
〰	PROPOSED 5 FT GROUND CONTOURS
〰	SURFACE DAYLIGHT
〰	WATERSHED BOUNDARY
〰	MAJOR STORMWATER DRAINAGE FLOW PATH
—	HAULROAD
—	ANCILLARY ROAD
—	DIVERSION CHANNEL
>—<	CULVERT
▨	GROWTH MEDIA STOCKPILE

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.

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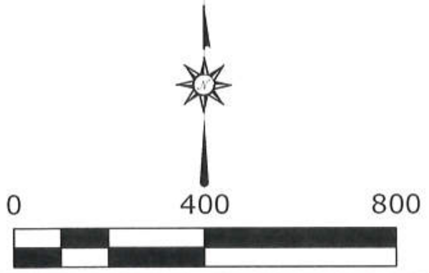
No. 21993



REV	DATE	DESCRIPTION
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NORTH AMERICAN MINING
SAWTOOTH MINING
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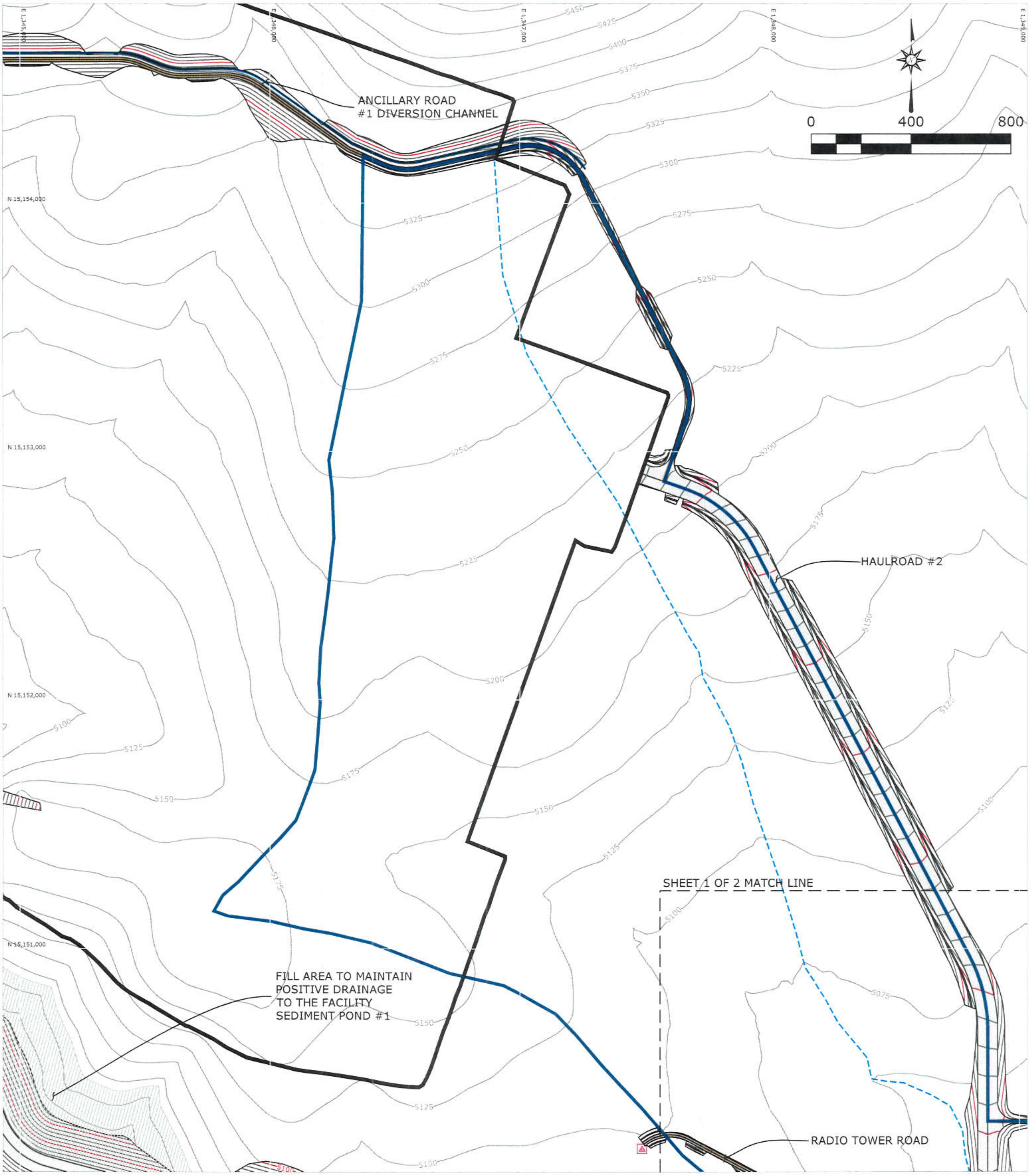
Thacker Pass Project
Mine Sediment Pond #1
Watershed Map Sheet 1 of 2

Drawn By: CJS Date: 2/19/20
Approved: MTH Date: 03/20
Scale: 1"=400' Dwg. No.: MP 1-1



LEGEND

〰	EXISTING 5 FT GROUND CONTOURS	—	HAULROAD
〰	PROPOSED 5 FT GROUND CONTOURS (PREVIOUSLY DESIGNED STRUCTURES)	—	ANCILLARY ROAD
〰	SURFACE DAYLIGHT	▬	DIVERSION CHANNEL
〰	WATERSHED BOUNDARY	☐	MINE PIT DISTURBANCE BOUNDARY
┅	MAJOR STORMWATER DRAINAGE FLOW PATH	▨	FILL AREA
		▨	GROWTH MEDIA STOCKPILE
		△	RADIO TOWER

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.

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CIVIL
3/18/20
No. 21993

REV	DATE	DESCRIPTION
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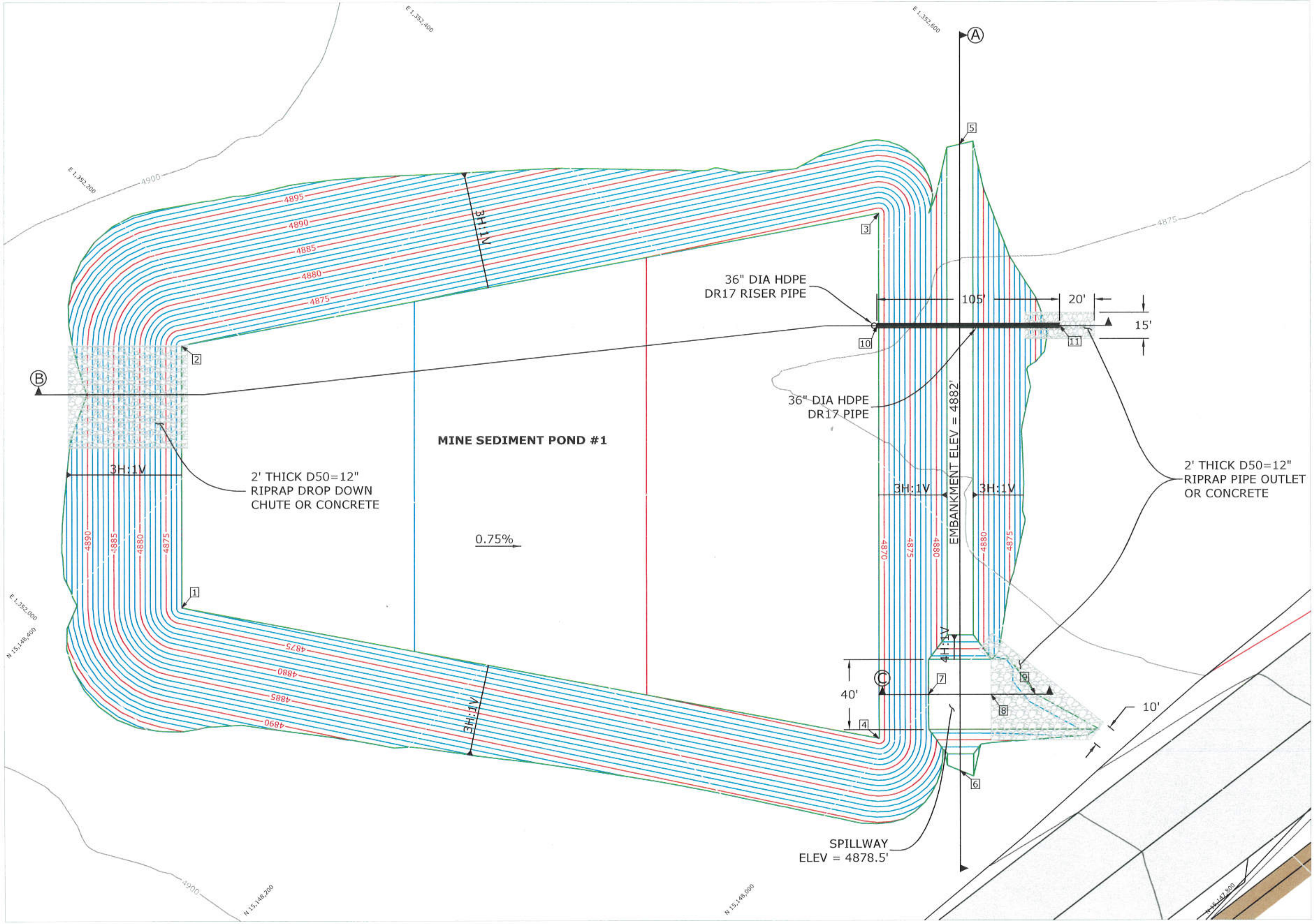
NORTH AMERICAN MINING
SAWTOOTH MINING
NewFields

Thacker Pass Project
Mine Sediment Pond #1
Watershed Map Sheet 2 of 2

Drawn By: CJS Date: 2/19/20
Approved: MTH Date: 03/20
Scale: 1"=400' Dwg. No.: MP 1-2



LEGEND

- EXISTING 5 FT GROUND CONTOURS
- PROPOSED 5 FT GROUND CONTOURS (PREVIOUSLY DESIGNED STRUCTURES)
- PROPOSED 1 FT GROUND CONTOURS
- SURFACE DAYLIGHT
- HAULROAD
- ▨ D50=12" RIPRAP ABOVE 10 oz/yd^2 NON-WOVEN GEOTEXTILE OR CONCRETE

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. MINE SEDIMENT POND #1 TO CONTAIN THE 2-YEAR/24-HOUR RUNOFF GENERATED FROM THE DELINEATED WATERSHED. THE SPILLWAY IS SIZED TO DISCHARGE THE PEAK FLOW OF THE 100-YEAR/24-HOUR STORM WITH MINIMUM 1 FOOT OF FREEBOARD.
3. THE RISER PIPE DIAMETER, ELEVATION, AND PERFORATION SPACING ARE DESIGNED TO GIVE THE STORMWATER BASIN 48 TO 72 HOURS OF RETENTION TIME FOR THE 2-YEAR/24-HOUR STORM EVENT. FLOWS GREATER THAN THE 2-YEAR EVENT AND LESS THAN THE 25-YEAR EVENT WILL DRAIN OUT THE RISER PIPE. FLOWS GREATER THAN 25-YEAR EVENT WILL OVERFLOW THROUGH THE SPILLWAY.

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No.21993

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REV	DATE	DESCRIPTION
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NORTH AMERICAN MINING
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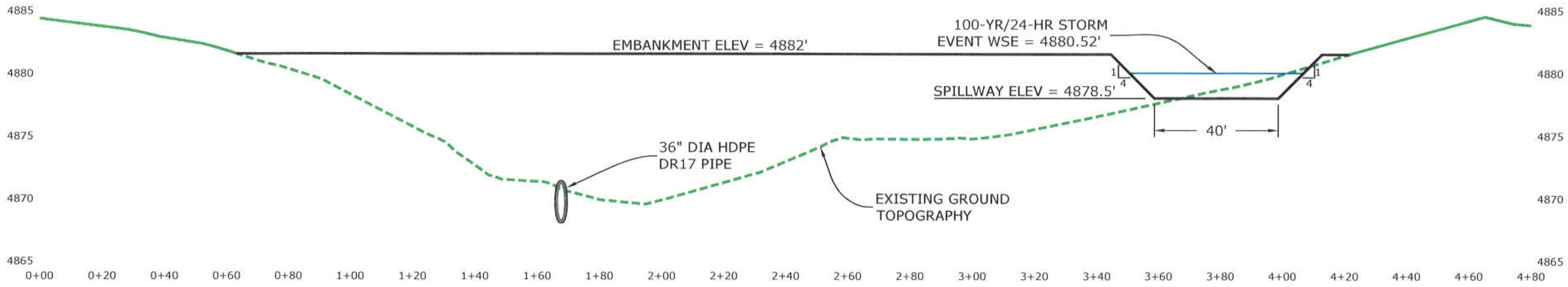
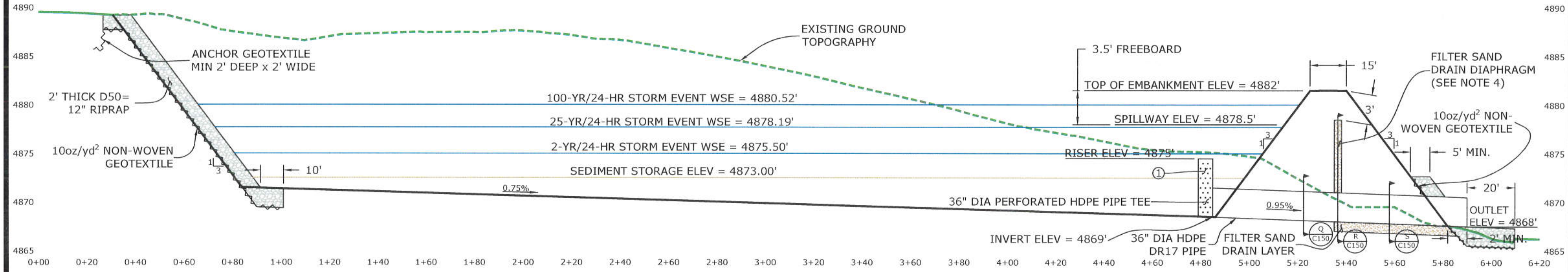
Thacker Pass Project
Mine Sediment Pond #1
Plan View

Drawn By: CJS Date: 2/24/20
Approved: MTH Date: 03/20
Scale: 1"=60' Dwg. No.: MP 1-3



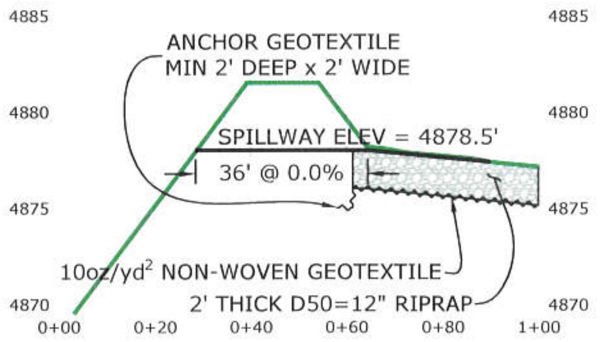
Ⓐ MINE SEDIMENT POND #1 EMBANKMENT SECTION

HORZ. SCALE: 1"=40'; VERT. SCALE: 1"=10'



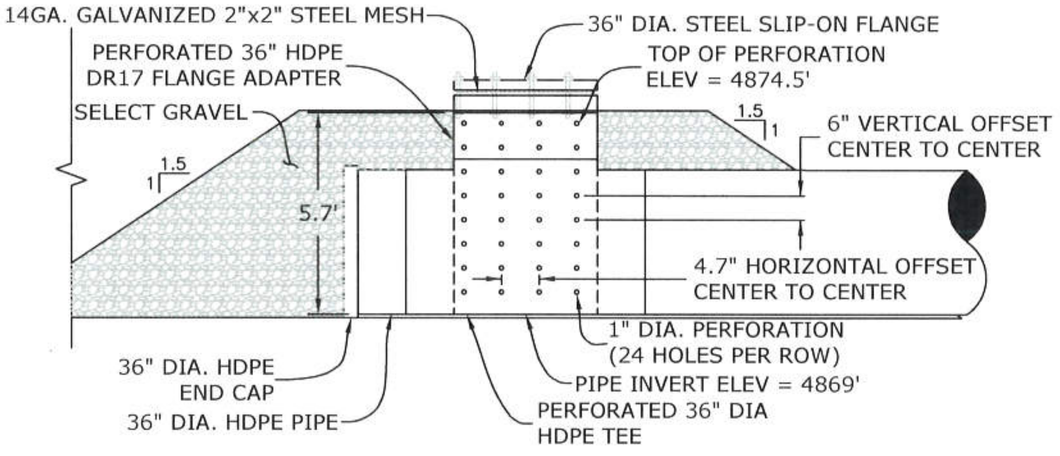
Ⓑ MINE SEDIMENT POND #1 TYPICAL SECTION AND RISER OUTLET PIPE

HORZ. SCALE: 1"=40'; VERT. SCALE: 1"=10'



Ⓒ MINE SEDIMENT POND #1 SPILLWAY SECTION

HORZ. SCALE: 1"=40'; VERT. SCALE: 1"=10'



① PERFORATION SCHEDULE ON RISER PIPE

NOTES:

1. PLACE 2 FT THICK LAYER OF RIPRAP ON DOWNSTREAM SLOPE AROUND RISER PIPE, EXTENDING 20 FT PAST PIPE OUTLET AND ON POND INLET. CONCRETE CAN BE SUBSTITUTED FOR RIPRAP.
2. PLACE 10oz/yd² NON-WOVEN GEOTEXTILE UNDER ALL RIPRAP. ANCHOR GEOTEXTILE ON UPSTREAM EDGE OF DROP DOWN CHUTES AND SPILLWAYS.
3. SEE NEWFIELDS DRAWING C150 FOR FILTER DIAPHRAGM AND RISER PIPE SECTIONS AND DETAILS.
4. A FILTER SAND DIAPHRAGM IS REQUIRED IF THE COMMON FILL IS PRIMARILY FINE GRAINED SOILS (SILTS AND CLAYS). THE DESIGN ENGINEER WILL DECIDE BASED ON LABORATORY TEST RESULTS FROM PROPOSED COMMON FILL MATERIAL SOURCES PRIOR TO CONSTRUCTION.

PROFESSIONAL ENGINEER-STATE OF NEVADA
MATTHEW T. HALEY
Exp.06/30/21
Matt Haley
CIVIL
3/18/20
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REV	DATE	DESCRIPTION
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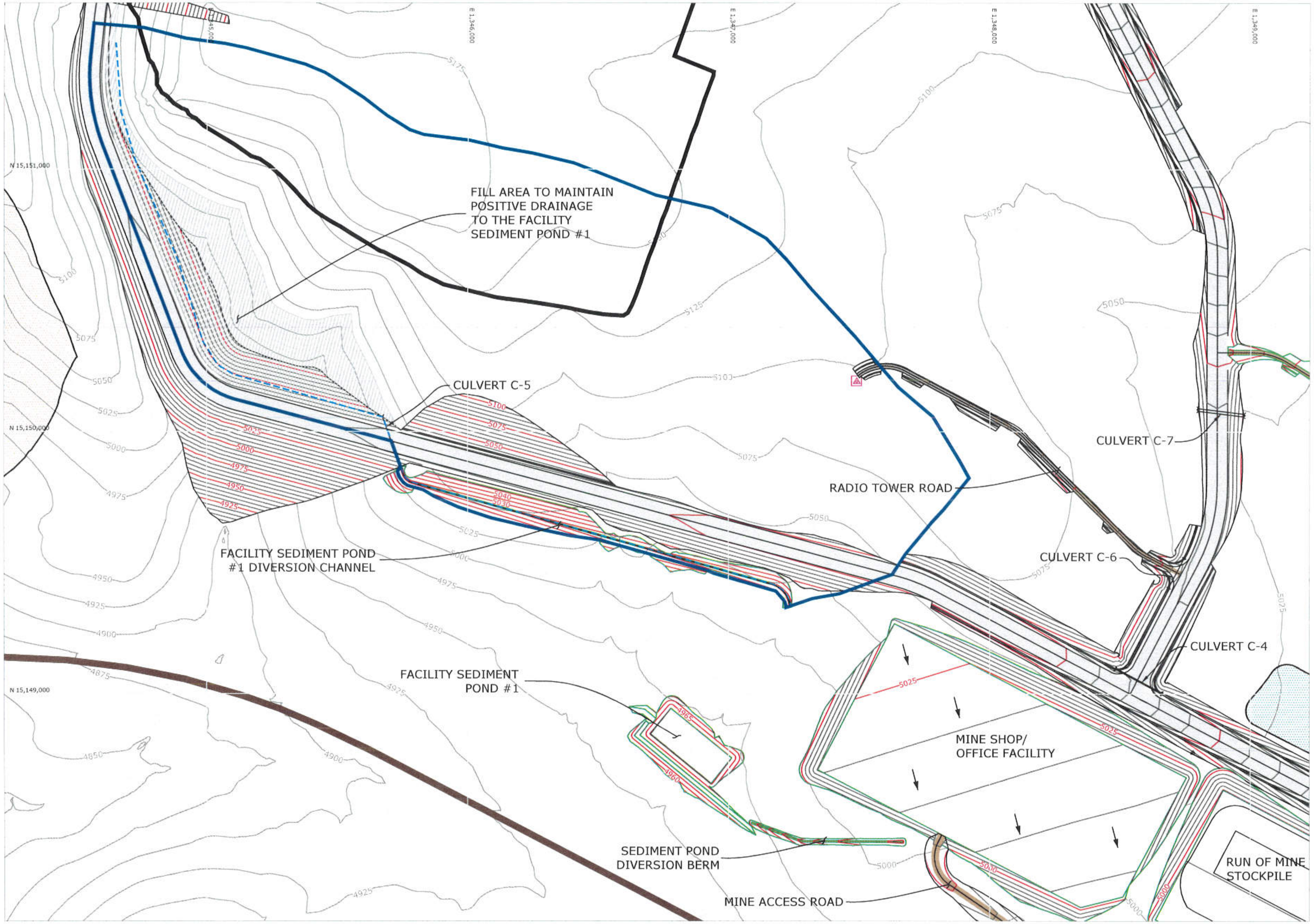
Thacker Pass Project
Mine Sediment Pond #1
Cross Sections and Details

Drawn By: CJS Date: 2/24/20
Approved: MTH Date: 03/20
Scale: AS SHOWN Dwg. No.: MP 1-4



LEGEND

〰	EXISTING 5 FT GROUND CONTOURS
〰	PROPOSED 5 FT GROUND CONTOURS (PREVIOUSLY DESIGNED STRUCTURES)
〰	PROPOSED 5 FT GROUND CONTOURS
〰	SURFACE DAYLIGHT
〰	WATERSHED BOUNDARY
〰	MAJOR STORMWATER DRAINAGE FLOW PATH
—	HAULROAD
—	ANCILLARY ROAD
—	EXISTING NEVADA SR 293
—	DIVERSION CHANNEL
›—‹	CULVERT
—	BERM
▭	MINE PIT DISTURBANCE BOUNDARY
▨	FILL AREA
▭	WASTE ROCK STORAGE FACILITY
▨	GROWTH MEDIA STOCKPILE
△	RADIO TOWER

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. THE FACILITY POND #1 DIVERSION CHANNEL IS DESIGNED TO CONVEY STORMWATER FROM THE 100-YEAR/24-HOUR STORM EVENT.

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Exp.06/30/21
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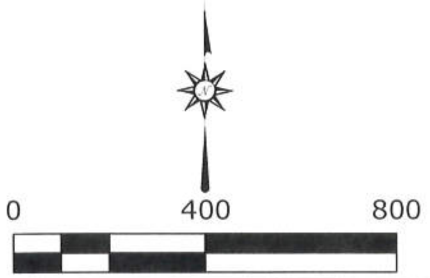
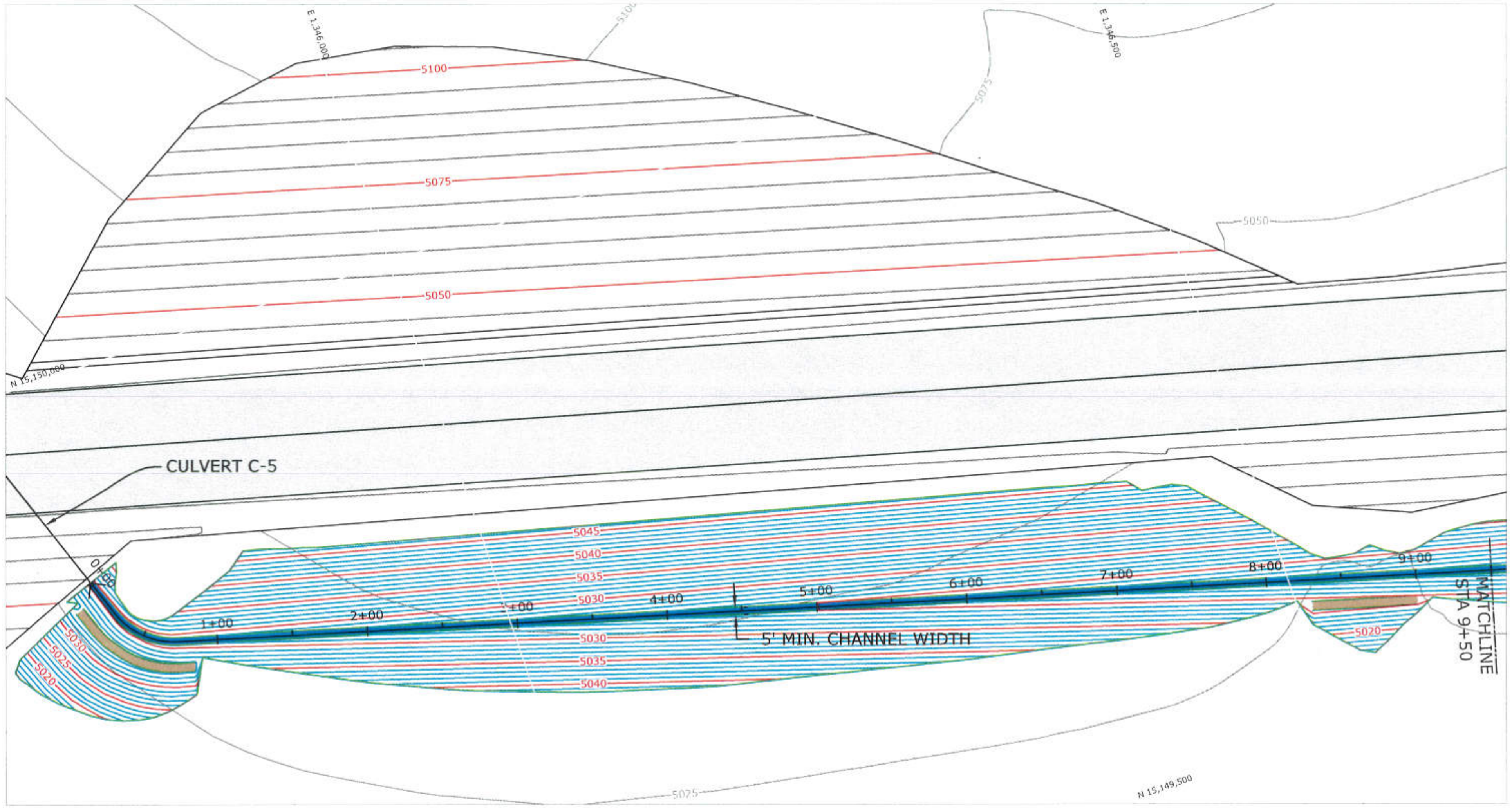


REV	DATE	DESCRIPTION
0	3/18/20	Issued for construction

NORTH AMERICAN MINING
SAWTOOTH MINING
NewFields

Thacker Pass Project
Facility Sediment Pond #1 Diversion
Channel Watershed Map

Drawn By: CJS Date: 2/28/20
Approved: MTH Date: 03/20
Scale: 1"=400' Dwg. No.: FPD 1-1



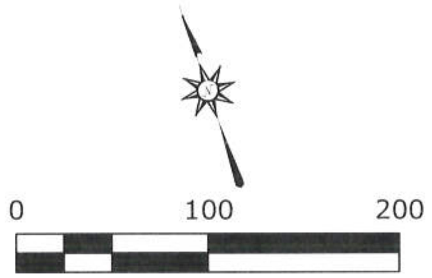
FACILITY SEDIMENT POND #1 DIVERSION CHANNEL PLAN VIEW

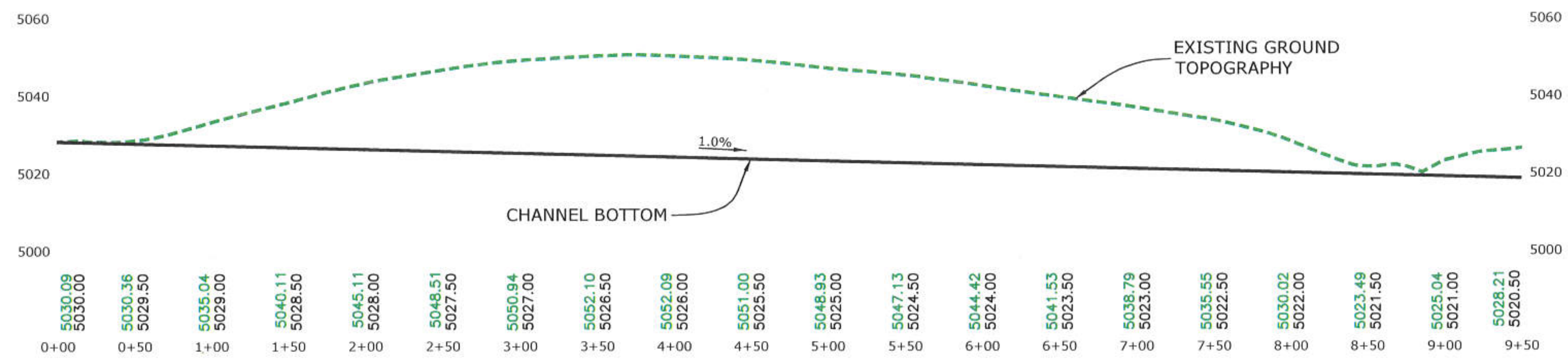
LEGEND

- EXISTING 5 FT GROUND CONTOURS
- PROPOSED 5 FT GROUND CONTOURS (PREVIOUSLY DESIGNED STRUCTURES)
- PROPOSED 1 FT GROUND CONTOURS
- SURFACE DAYLIGHT
- HAULROAD
- DIVERSION CHANNEL
- CULVERT
- BERM

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. THE FACILITY POND #1 DIVERSION CHANNEL IS DESIGNED TO CONVEY STORMWATER FROM THE 100-YEAR/24-HOUR STORM EVENT.





FACILITY SEDIMENT POND #1 DIVERSION CHANNEL PROFILE VIEW

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REV	DATE	DESCRIPTION
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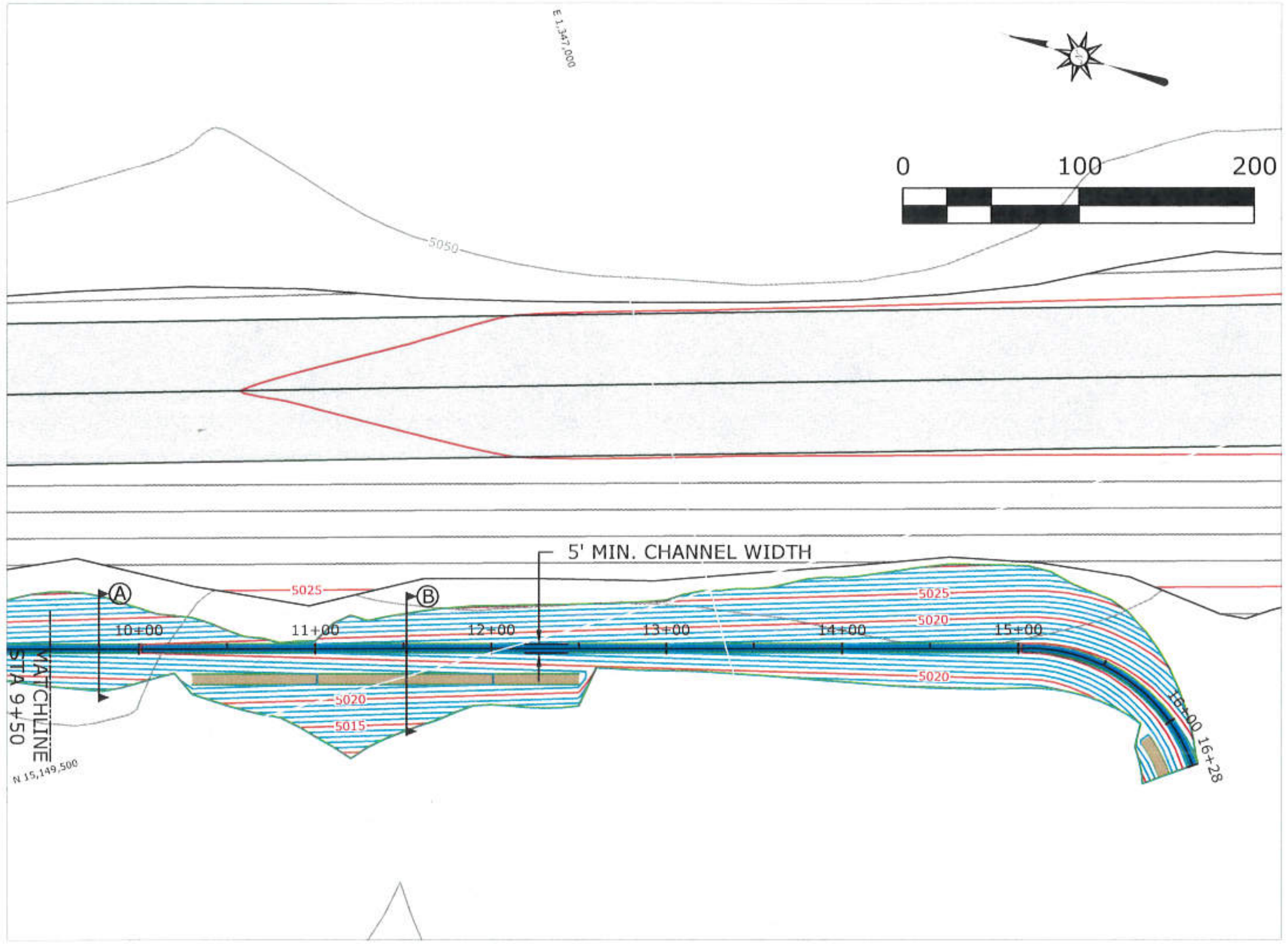
NORTH AMERICAN MINING
SAWTOOTH MINING
NewFields

Thacker Pass Project
Facility Sediment Pond #1 Diversion
Channel Plan and Profile Sheet 1 of 2

Drawn By:	CJS	Date:	2/28/20
Approved:	MTH	Date:	03/20
Scale:	1"=100'	Dwg. No.:	FPD 1-2



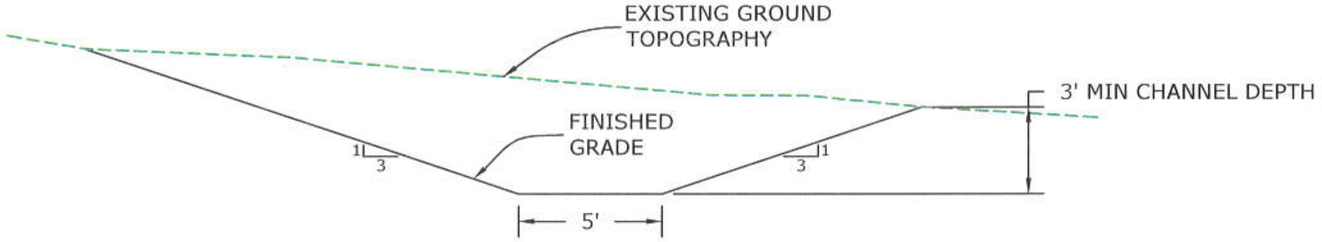
FACILITY SEDIMENT POND #1 DIVERSION CHANNEL PLAN VIEW

LEGEND

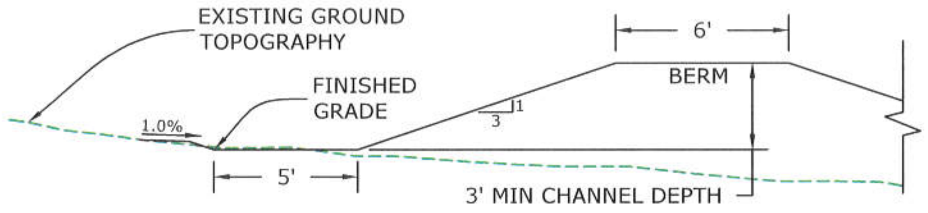
〰	EXISTING 5 FT GROUND CONTOURS
〰	PROPOSED 5 FT GROUND CONTOURS (PREVIOUSLY DESIGNED STRUCTURES)
〰	PROPOSED 1 FT GROUND CONTOURS
〰	SURFACE DAYLIGHT
—	HAULROAD
▬	DIVERSION CHANNEL
>—<	CULVERT
—	BERM

NOTES:

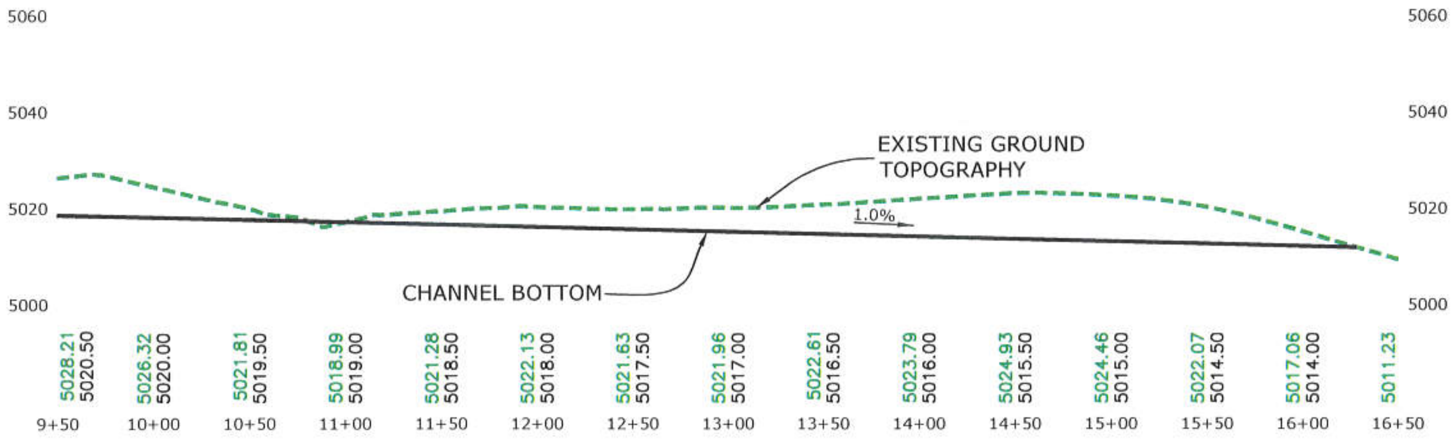
1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. THE FACILITY POND #1 DIVERSION CHANNEL IS DESIGNED TO CONVEY STORMWATER FROM THE 100-YEAR/24-HOUR STORM EVENT.



Ⓐ TYPICAL DIVERSION CHANNEL CROSS SECTION (CUT)



Ⓑ TYPICAL DIVERSION BERM CROSS SECTION (FILL)



FACILITY SEDIMENT POND #1 DIVERSION CHANNEL PROFILE VIEW

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Exp.06/30/21
Matt Haley
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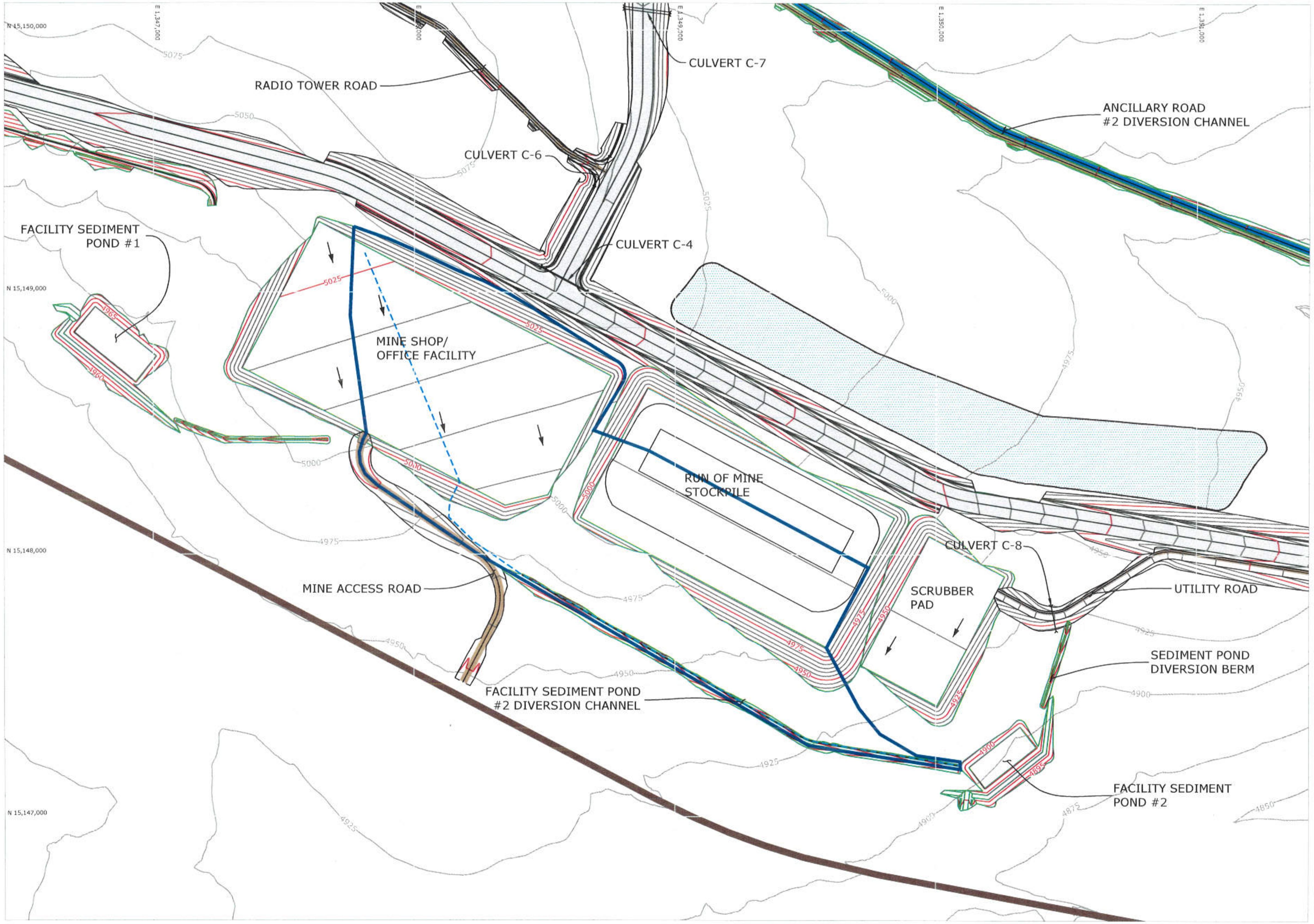
REV	DATE	DESCRIPTION
0	3/18/20	Issued for construction

NORTH AMERICAN MINING
SAWTOOTH MINING
NewFields

Thacker Pass Project
Facility Sediment Pond #1 Diversion
Channel Plan and Profile Sheet 2 of 2

Drawn By:	CJS	Date:	2/28/20
Approved:	MTH	Date:	03/20
Scale:	1"=100'	Dwg. No.:	FPD 1-3



LEGEND

- EXISTING 5 FT GROUND CONTOURS
- PROPOSED 5 FT GROUND CONTOURS (PREVIOUSLY DESIGNED STRUCTURES)
- PROPOSED 5 FT GROUND CONTOURS
- SURFACE DAYLIGHT
- WATERSHED BOUNDARY
- MAJOR STORMWATER DRAINAGE FLOW PATH
- HAULROAD
- ANCILLARY ROAD
- EXISTING NEVADA SR 293
- DIVERSION CHANNEL
- CULVERT
- BERM
- ▨ GROWTH MEDIA STOCKPILE

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. THE FACILITY POND #2 DIVERSION CHANNEL IS DESIGNED TO CONVEY STORMWATER FROM THE 100-YEAR/24-HOUR STORM EVENT.

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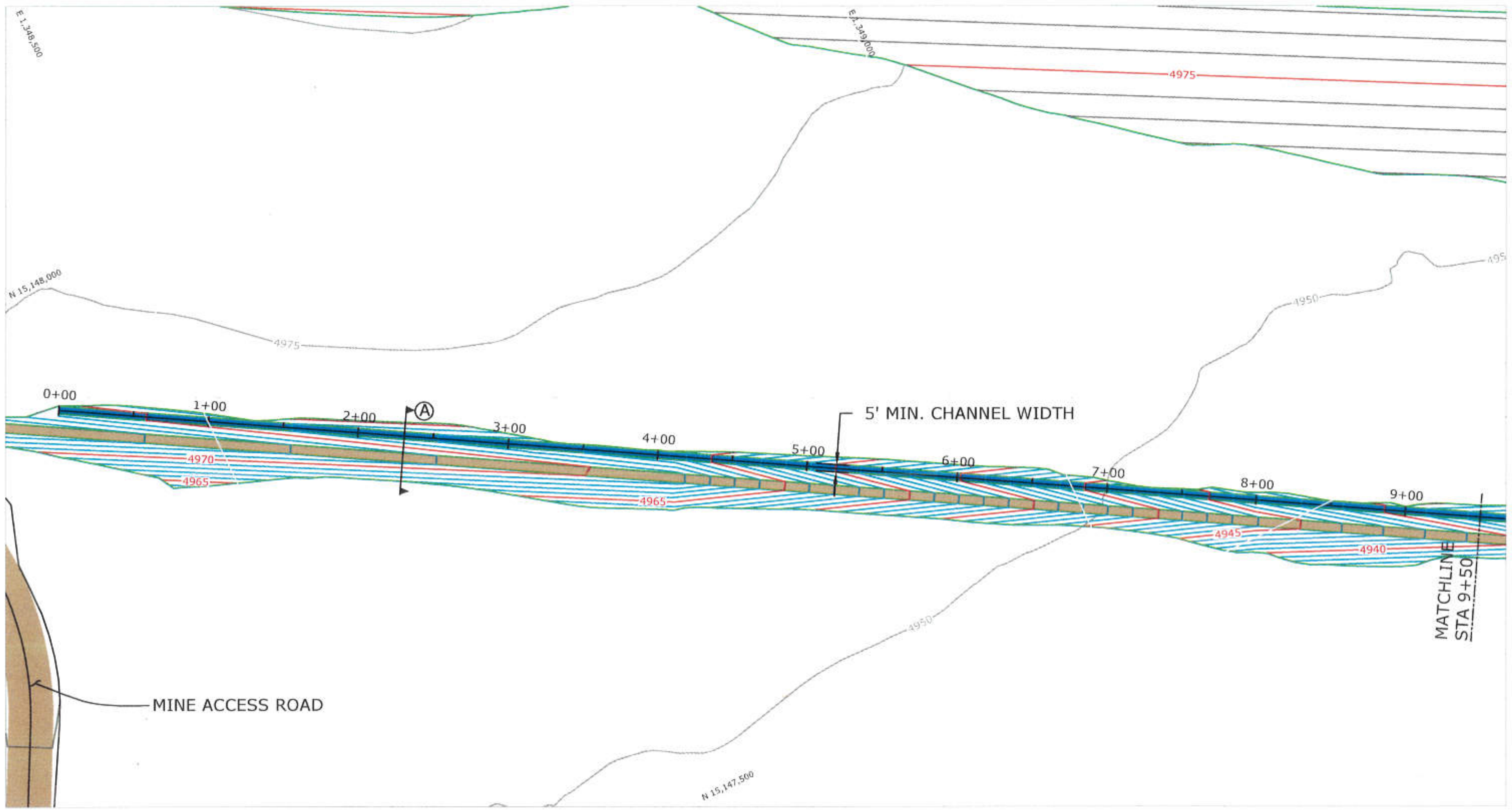
Thacker Pass Project
Facility Sediment Pond #2 Diversion
Channel Watershed Map

Drawn By: CJS Date: 2/28/20
Approved: MTH Date: 03/20
Scale: 1"=400' Dwg. No.: FPD 2-1



FACILITY SEDIMENT POND #2 DIVERSION CHANNEL PLAN VIEW

LEGEND

〰	EXISTING 5 FT GROUND CONTOURS
〰	PROPOSED 5 FT GROUND CONTOURS (PREVIOUSLY DESIGNED STRUCTURES)
〰	PROPOSED 1 FT GROUND CONTOURS
〰	SURFACE DAYLIGHT
▬	ANCILLARY ROAD
▬	DIVERSION CHANNEL
▬	BERM

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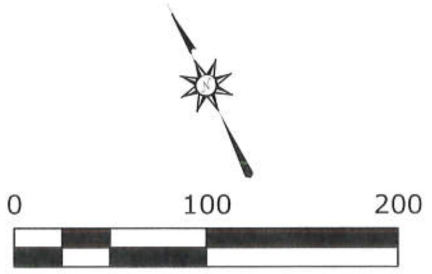

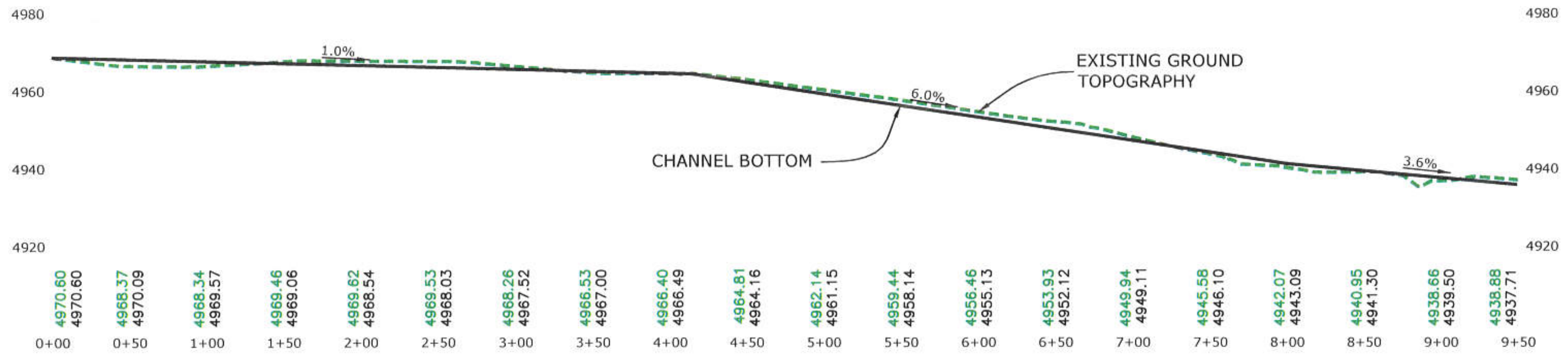

FACILITY SEDIMENT POND #2 DIVERSION CHANNEL PROFILE VIEW

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Thacker Pass Project
Facility Sediment Pond #2 Diversion
Channel Plan and Profile Sheet 1 of 2

Drawn By:	CJS	Date:	2/28/20
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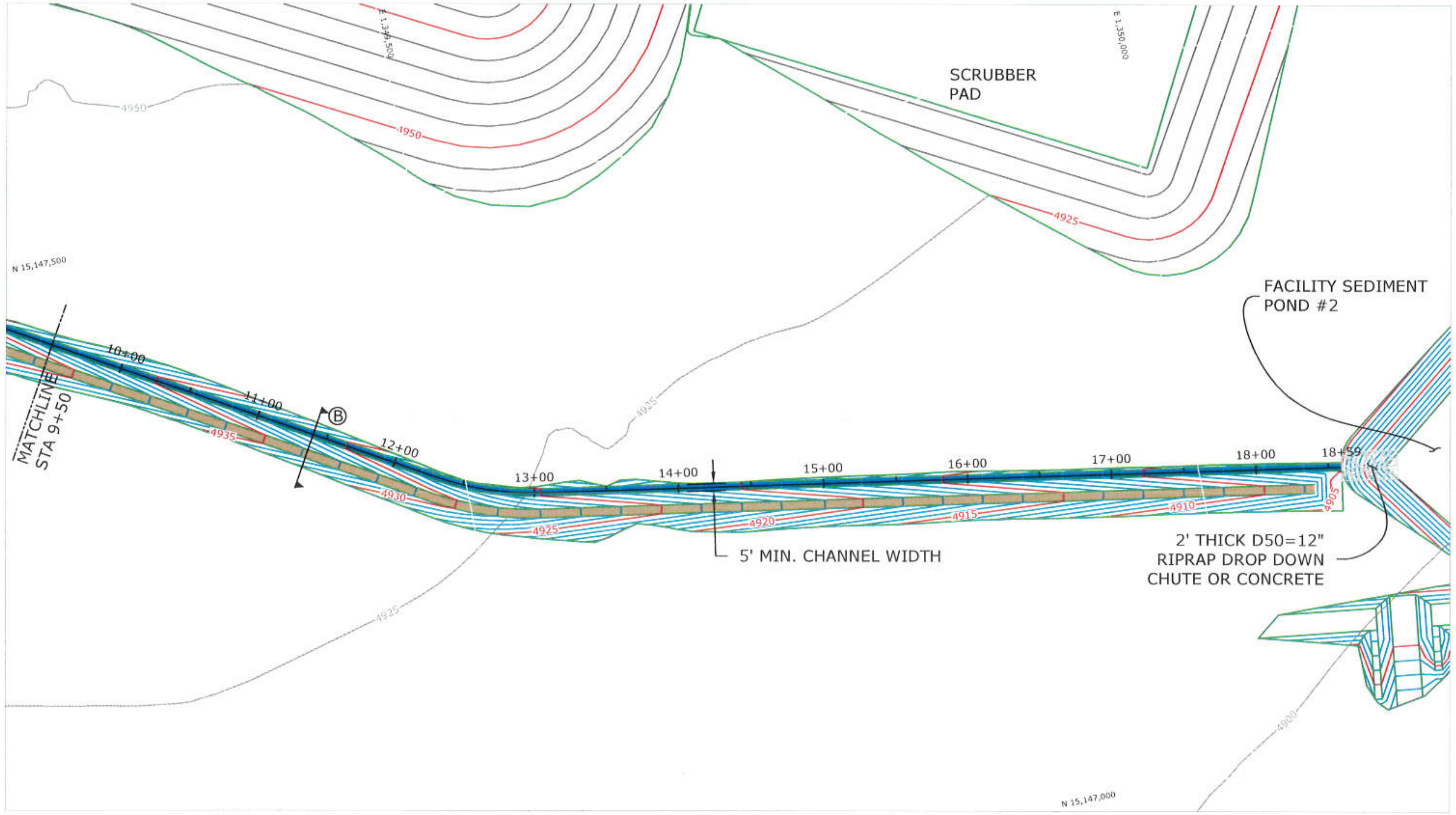
Scale:	1"=100'	Dwg. No.:	FPD 2-2



FACILITY SEDIMENT POND #2 DIVERSION CHANNEL PLAN VIEW

LEGEND

- EXISTING 5 FT GROUND CONTOURS
- PROPOSED 5 FT GROUND CONTOURS (PREVIOUSLY DESIGNED STRUCTURES)
- PROPOSED 1 FT GROUND CONTOURS
- SURFACE DAYLIGHT
- DIVERSION CHANNEL
- BERM

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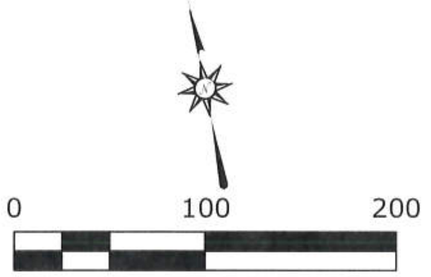
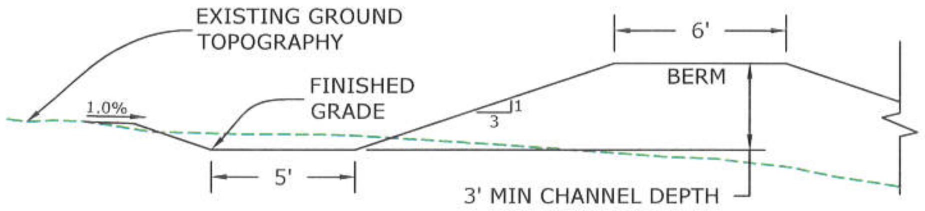
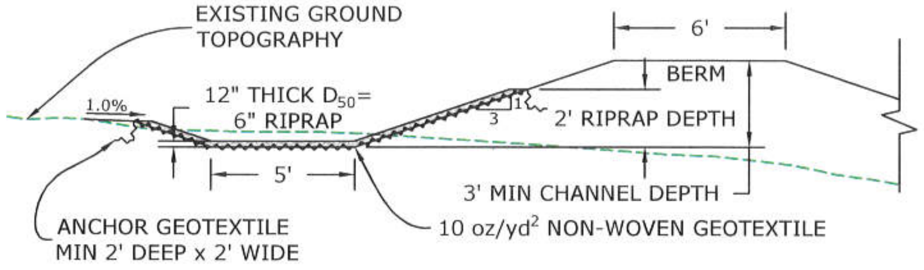
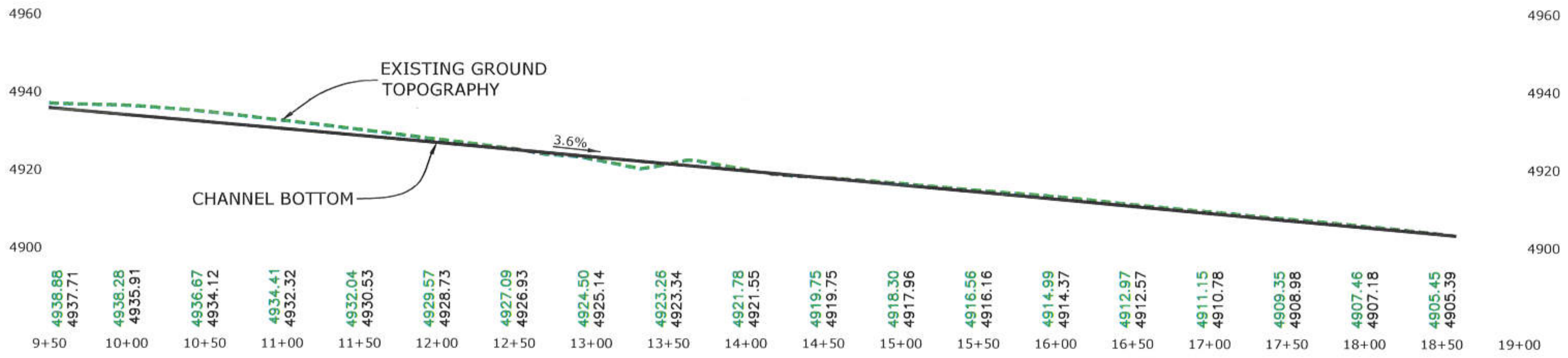




Ⓐ TYPICAL DIVERSION CHANNEL CROSS SECTION (NO RIPRAP)



Ⓑ TYPICAL DIVERSION CHANNEL CROSS SECTION (WITH RIPRAP)



FACILITY SEDIMENT POND #2 DIVERSION CHANNEL PROFILE VIEW

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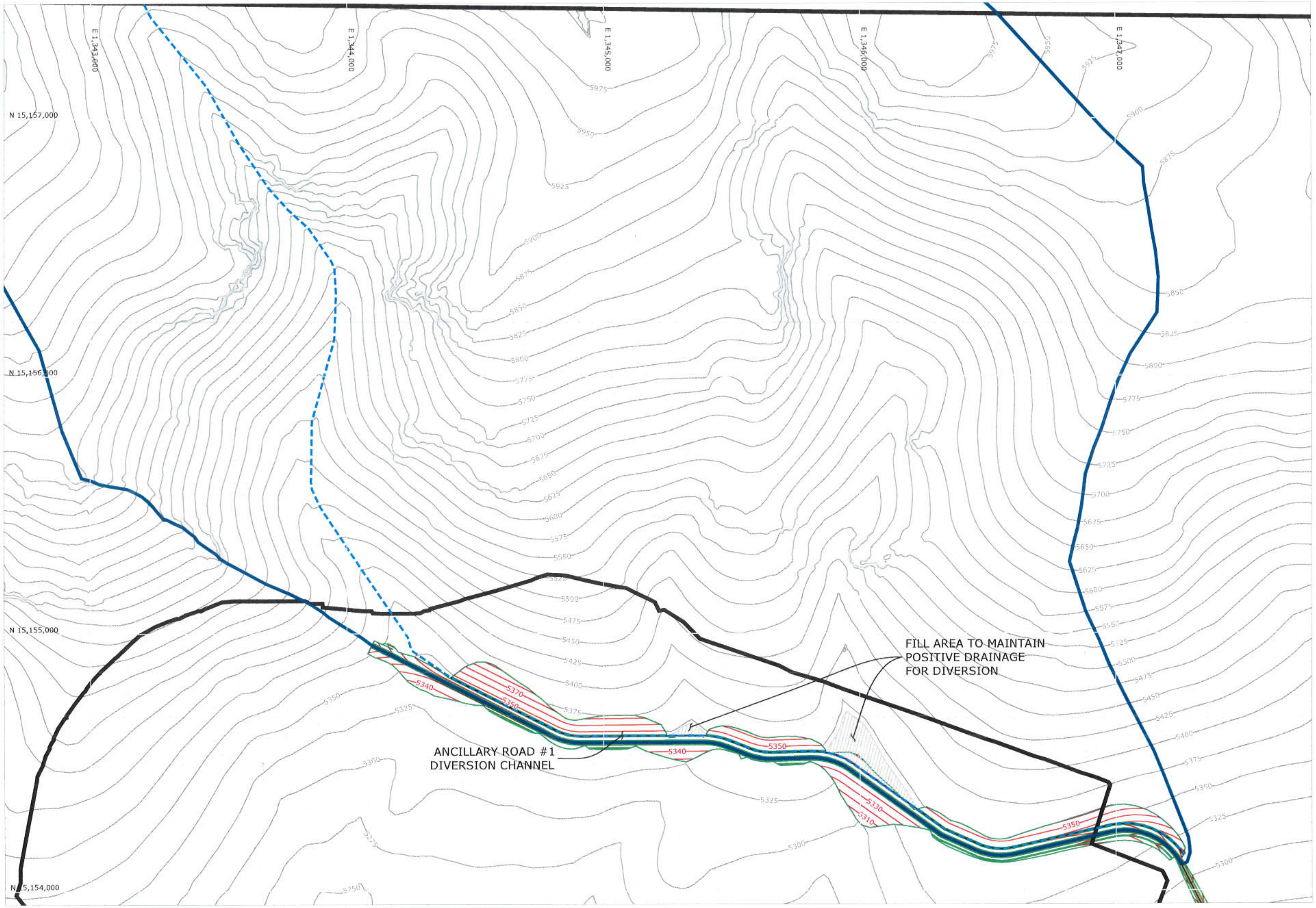
SAWTOOTH MINING
NewFields

Thacker Pass Project
Facility Sediment Pond #2 Diversion
Channel Plan and Profile Sheet 2 of 2

Drawn By: CJS Date: 2/28/20
Approved: MTH Date: 03/20
Scale: 1"=100' Dwg. No.: FPD 2-3



LEGEND

〰	EXISTING 5 FT GROUND CONTOURS
〰	PROPOSED 10 FT GROUND CONTOURS
〰	SURFACE DAYLIGHT
〰	WATERSHED BOUNDARY
⋯	MAJOR STORMWATER DRAINAGE FLOW PATH
━	ANCILLARY ROAD
━	DIVERSION CHANNEL
▭	MINE PIT DISTURBANCE BOUNDARY
▨	FILL AREA

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. THE ANCILLARY ROAD #1 DIVERSION CHANNEL IS DESIGNED TO CONVEY STORMWATER FROM THE 100-YEAR/24-HOUR STORM EVENT.

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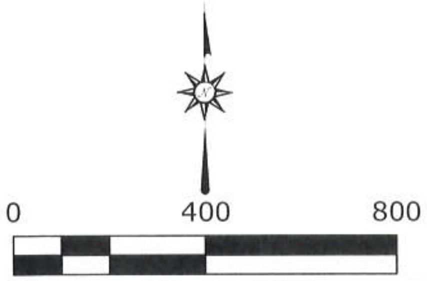

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NORTHAMERICAN MINING
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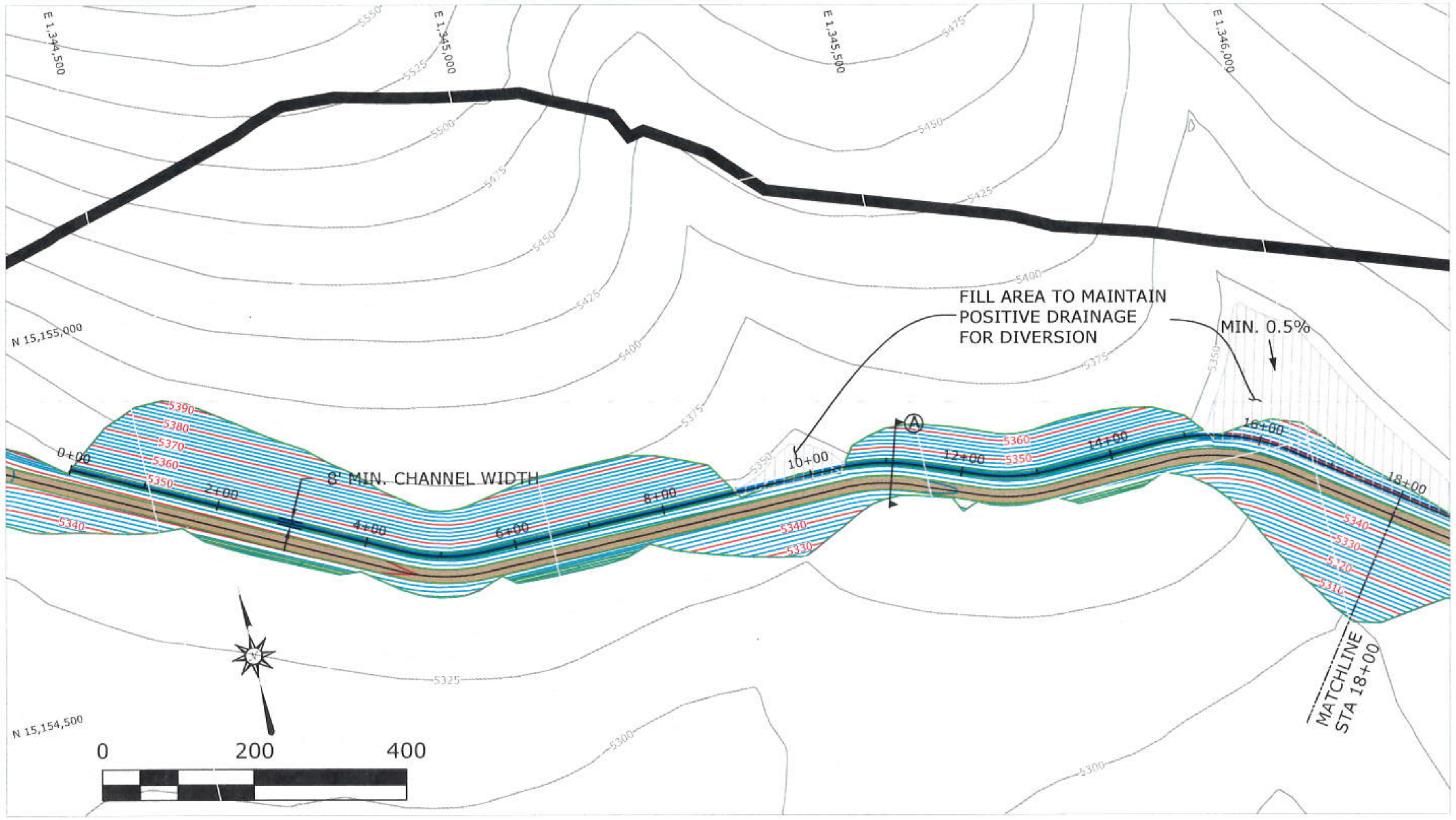
NewFields

Thacker Pass Project
Ancillary Road #1 Diversion
Channel Watershed Map

Drawn By:	CJS	Date:	3/2/20
Approved:	MTH	Date:	03/20
Scale:	1"=400'	Dwg. No.:	ARD 1-1



ANCILLARY ROAD #1 DIVERSION CHANNEL PLAN VIEW

LEGEND

〰	EXISTING 5 FT GROUND CONTOURS
〰	PROPOSED 2 FT GROUND CONTOURS
〰	SURFACE DAYLIGHT
▬	ANCILLARY ROAD
▬	DIVERSION CHANNEL
▭	MINE PIT DISTURBANCE BOUNDARY
▨	FILL AREA

NOTES:

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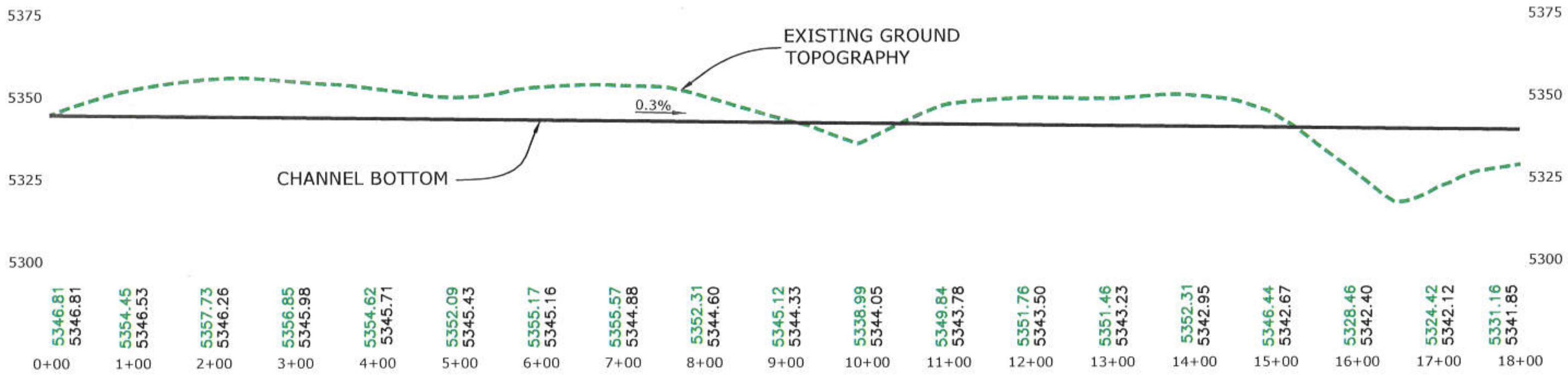

ANCILLARY ROAD #1 DIVERSION CHANNEL PROFILE VIEW

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NORTH AMERICAN MINING
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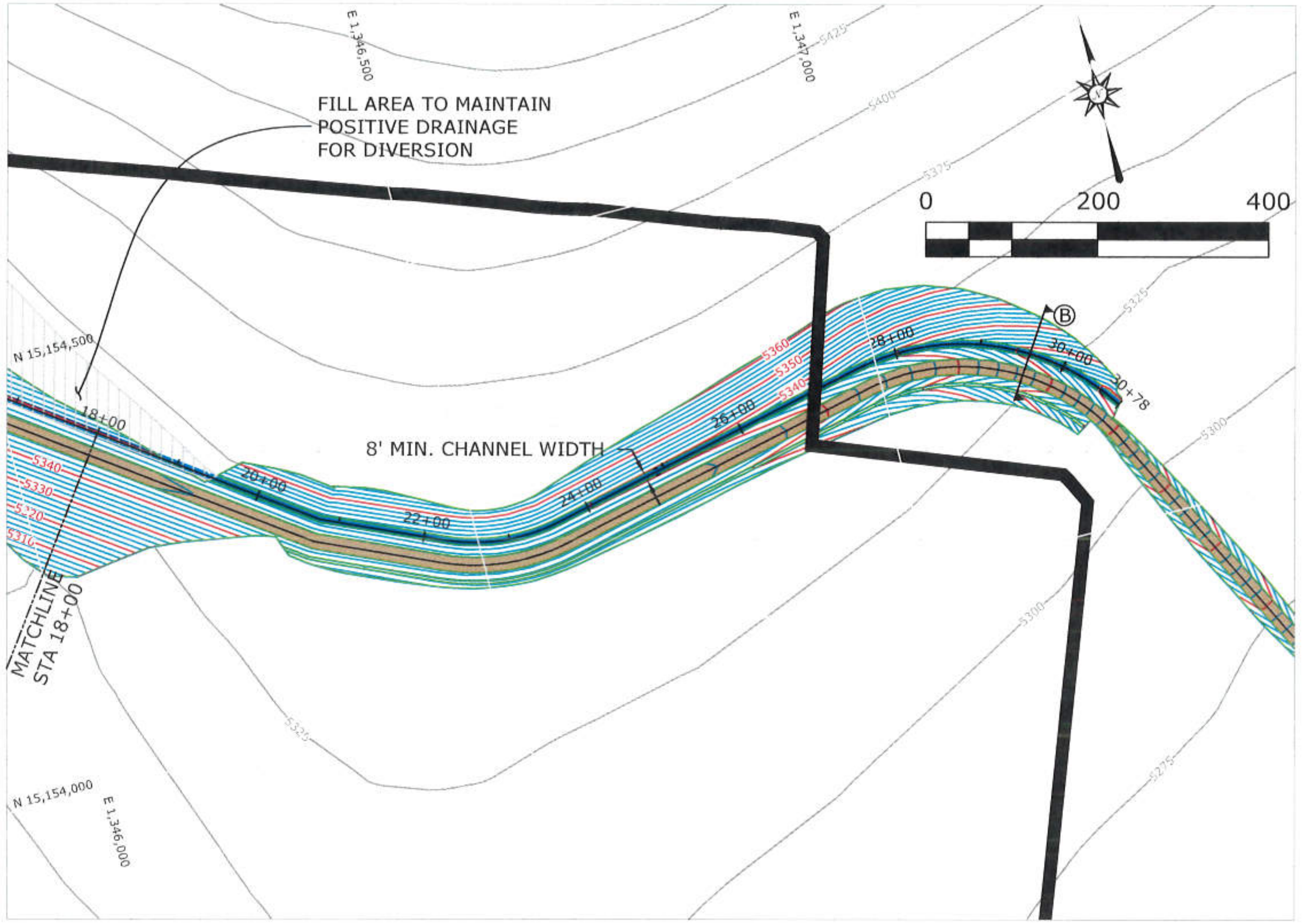
Thacker Pass Project
Ancillary Road #1 Diversion Channel
Plan and Profile Sheet 1 of 2

Drawn By: CJS Date: 3/3/20
Approved: MTH Date: 03/20
Scale: 1"=200' Dwg. No.: ARD 1-2



ANCILLARY ROAD #1 DIVERSION CHANNEL PLAN VIEW

LEGEND

〰	EXISTING 5 FT GROUND CONTOURS
〰	PROPOSED 2 FT GROUND CONTOURS
〰	SURFACE DAYLIGHT
▬	ANCILLARY ROAD
▬	DIVERSION CHANNEL
▭	MINE PIT DISTURBANCE BOUNDARY
▨	FILL AREA

NOTES:

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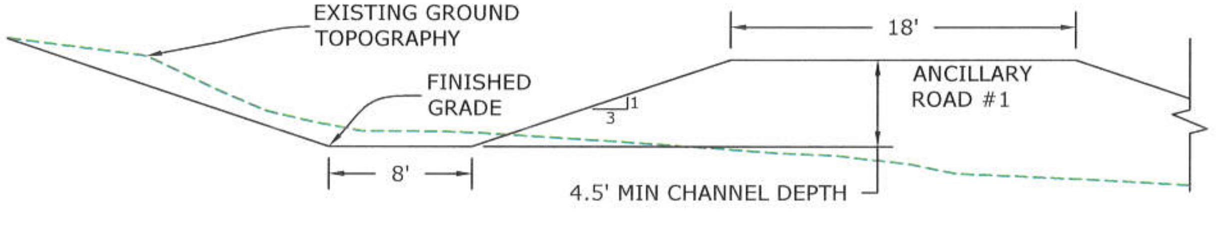
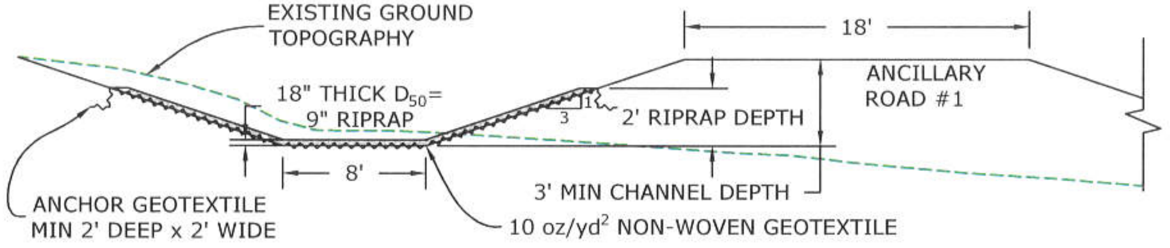
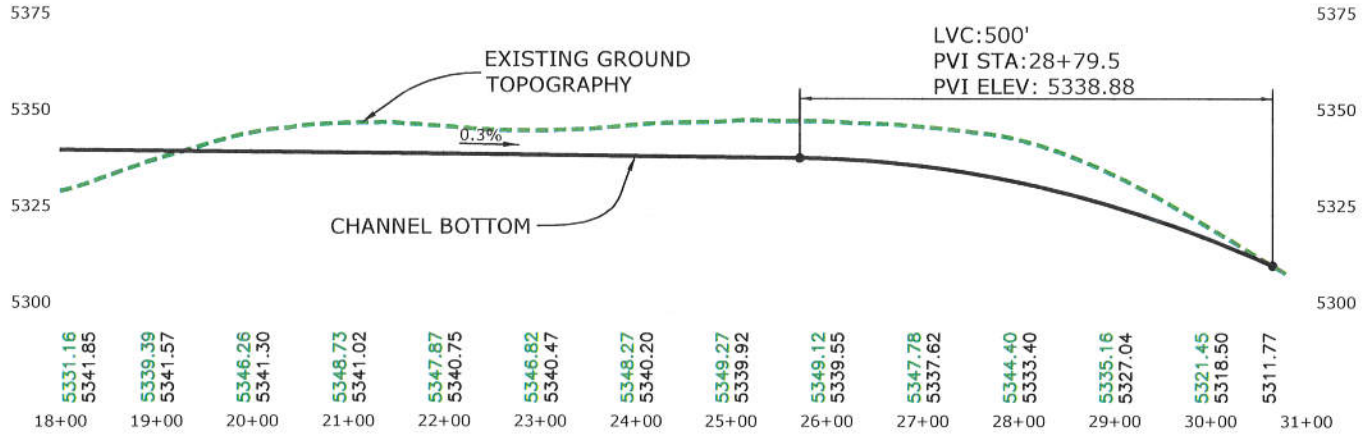


Ⓐ TYPICAL DIVERSION CHANNEL CROSS SECTION (NO RIPRAP)



Ⓑ TYPICAL DIVERSION CHANNEL CROSS SECTION (WITH RIPRAP)



ANCILLARY ROAD #1 DIVERSION CHANNEL PROFILE VIEW

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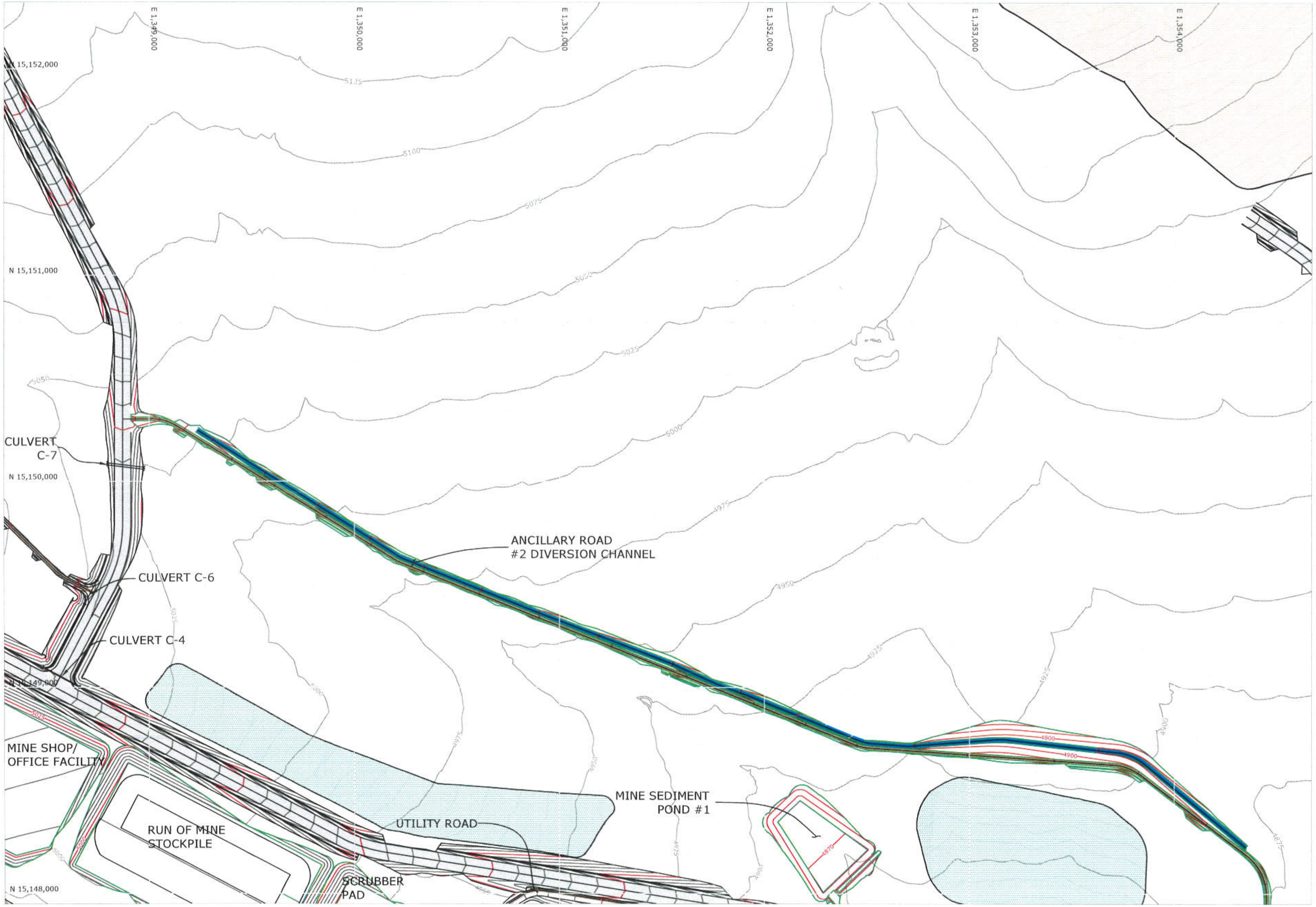
Thacker Pass Project
Ancillary Road #1 Diversion Channel
Plan and Profile Sheet 2 of 2

Drawn By: CJS Date: 3/3/20
Approved: MTH Date: 03/20
Scale: 1"=200' Dwg. No.: ARD 1-3



LEGEND

- EXISTING 5 FT GROUND CONTOURS
- PROPOSED 5 FT GROUND CONTOURS (PREVIOUSLY DESIGNED STRUCTURES)
- PROPOSED 10 FT GROUND CONTOURS
- SURFACE DAYLIGHT
- WATERSHED BOUNDARY
- MAJOR STORMWATER DRAINAGE FLOW PATH
- HAULROAD
- ANCILLARY ROAD
- DIVERSION CHANNEL
- CULVERT
- WASTE ROCK STORAGE FACILITY
- GROWTH MEDIA STOCKPILE

NOTES:

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Thacker Pass Project
Ancillary Road #2 Diversion
Channel Watershed Map

Drawn By: CJS Date: 3/3/20
Approved: MTH Date: 03/20
Scale: 1"=400' Dwg. No.: ARD 2-1

ANCILLARY ROAD #2 DIVERSION CHANNEL PLAN VIEW

LEGEND

〰	EXISTING 5 FT GROUND CONTOURS
〰	PROPOSED 2 FT GROUND CONTOURS
〰	SURFACE DAYLIGHT
▬	ANCILLARY ROAD
▬	DIVERSION CHANNEL

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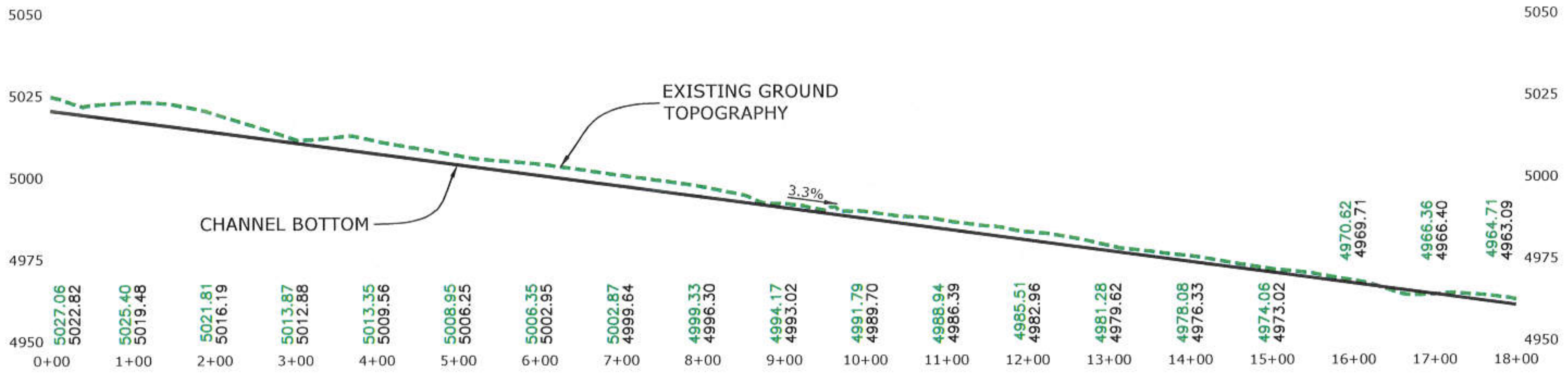

ANCILLARY ROAD #2 DIVERSION CHANNEL PROFILE VIEW

PROFESSIONAL ENGINEER-STATE OF NEVADA
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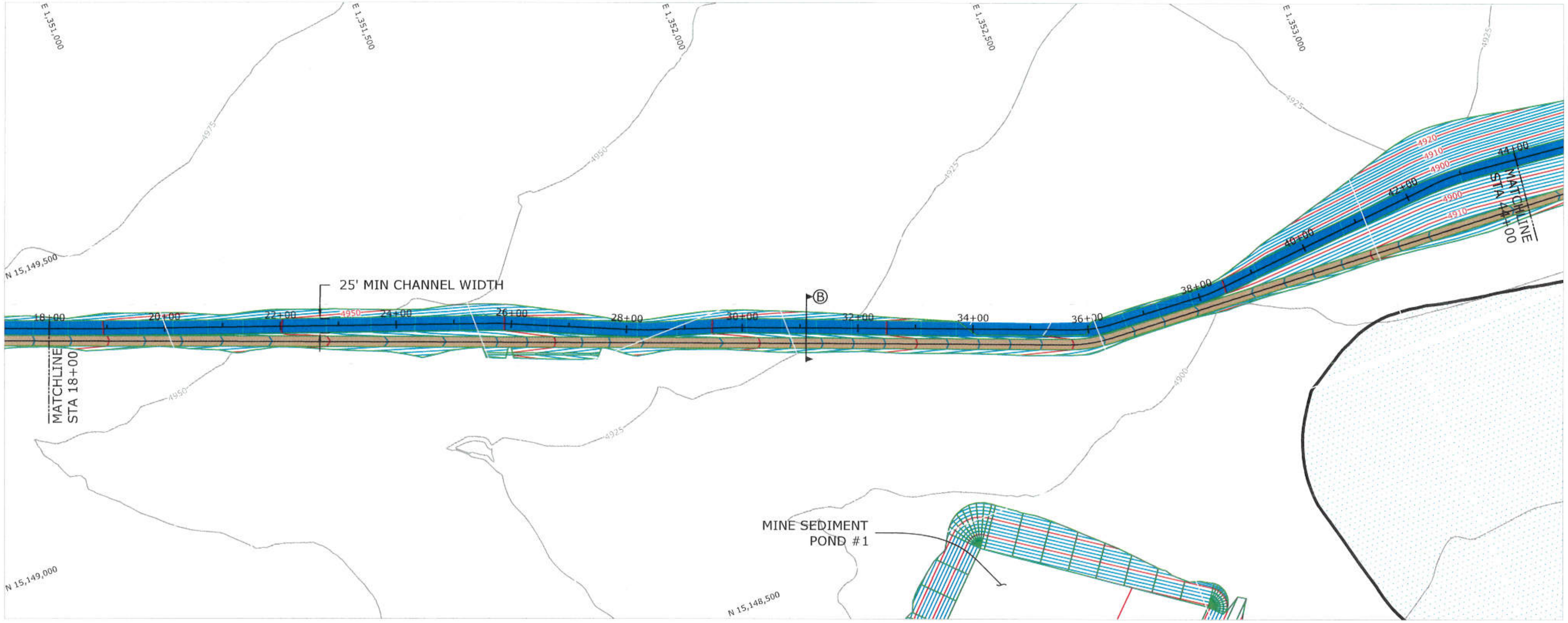
Thacker Pass Project
Ancillary Road #2 Diversion Channel
Plan and Profile Sheet 1 of 3

Drawn By: CJS Date: 3/3/20
Approved: MTH Date: 03/20
Scale: 1"=200' Dwg. No.: ARD 2-2



ANCILLARY ROAD #2 DIVERSION CHANNEL PLAN VIEW

LEGEND

⌒	EXISTING 5 FT GROUND CONTOURS
⌒	PROPOSED 2 FT GROUND CONTOURS
⌒	SURFACE DAYLIGHT
▬	ANCILLARY ROAD
▬	DIVERSION CHANNEL
▨	GROWTH MEDIA STOCKPILE

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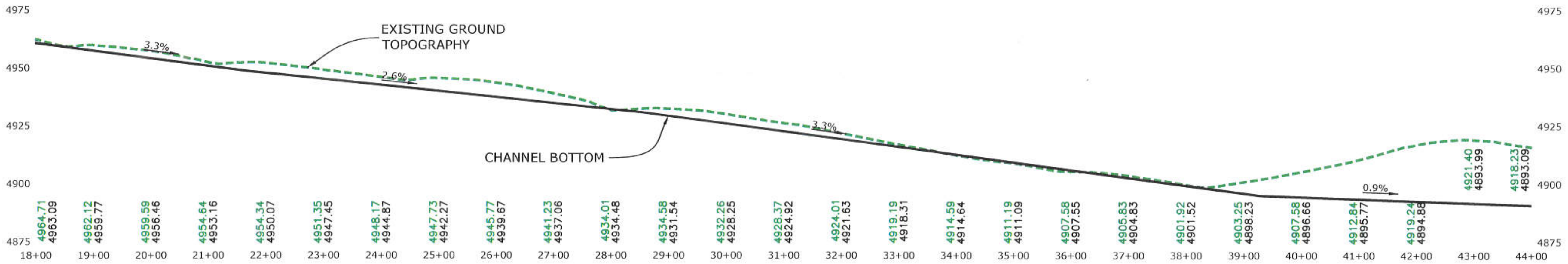

ANCILLARY ROAD #2 DIVERSION CHANNEL PROFILE VIEW

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Sawtooth Mining
NewFields

Thacker Pass Project
Ancillary Road #2 Diversion Channel
Plan and Profile Sheet 2 of 3

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Approved:	MTH	Date:	03/20
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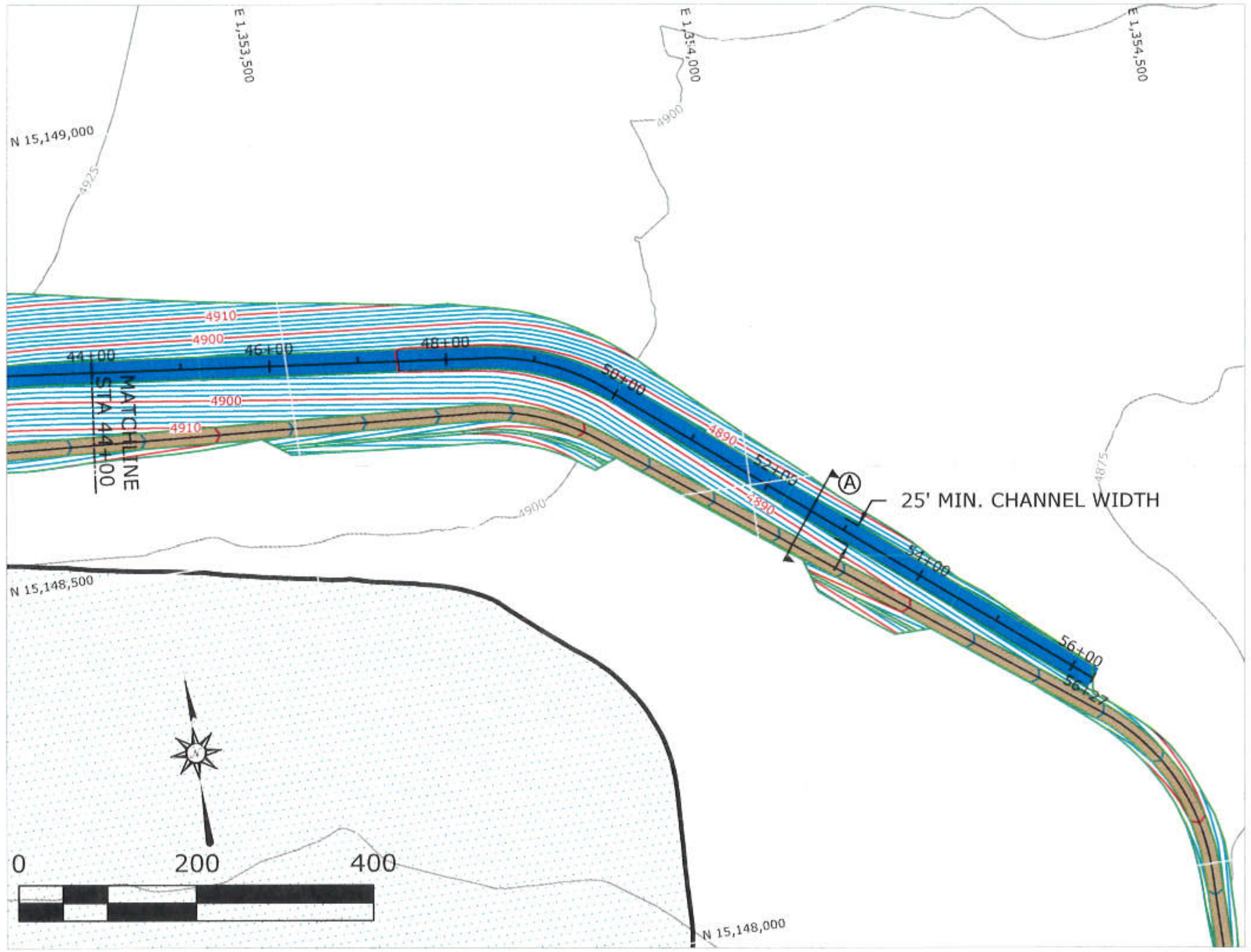

ANCILLARY ROAD #2 DIVERSION CHANNEL PLAN VIEW

LEGEND

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〰	PROPOSED 2 FT GROUND CONTOURS
〰	SURFACE DAYLIGHT
▬	ANCILLARY ROAD
▬	DIVERSION CHANNEL
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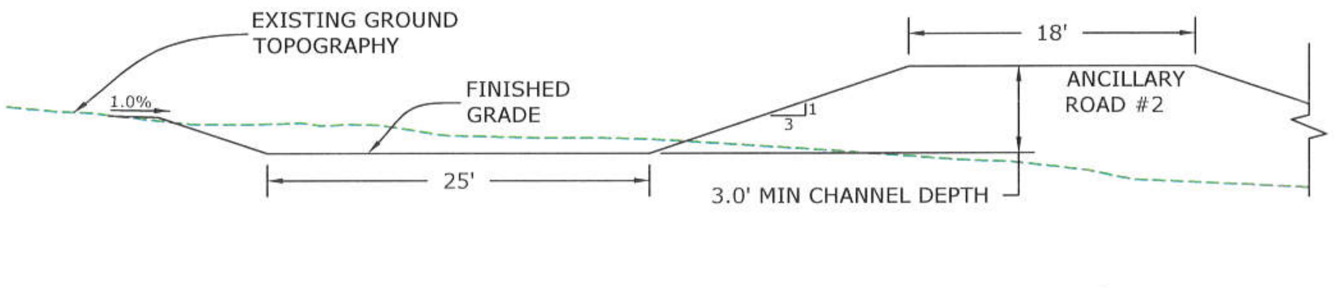
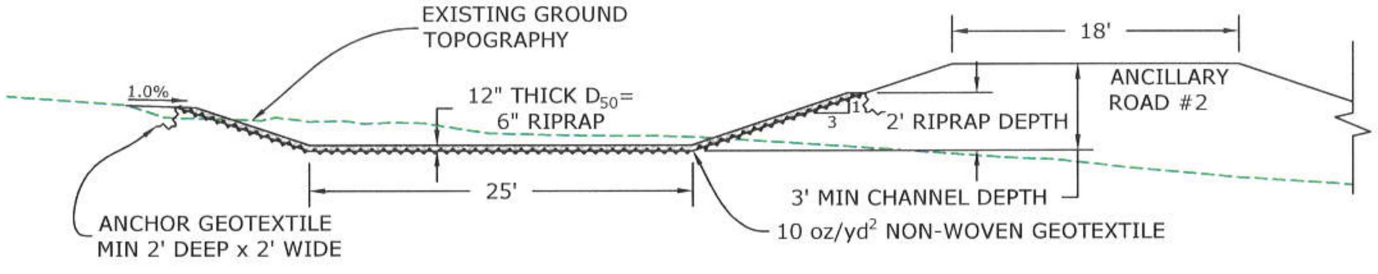
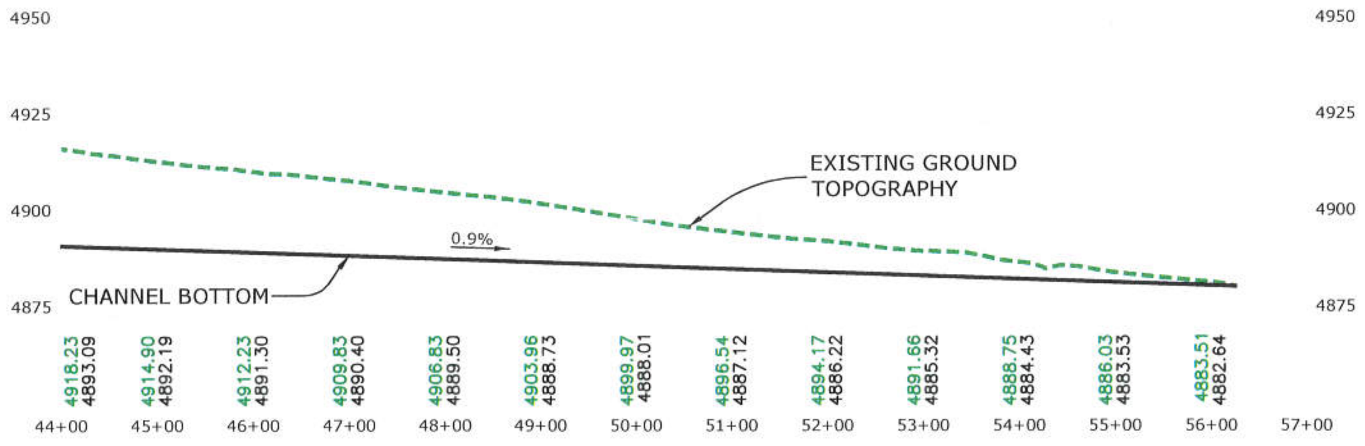


Ⓐ TYPICAL DIVERSION CHANNEL CROSS SECTION (NO RIPRAP)



Ⓑ TYPICAL DIVERSION CHANNEL CROSS SECTION (WITH RIPRAP)



ANCILLARY ROAD #2 DIVERSION CHANNEL PROFILE VIEW

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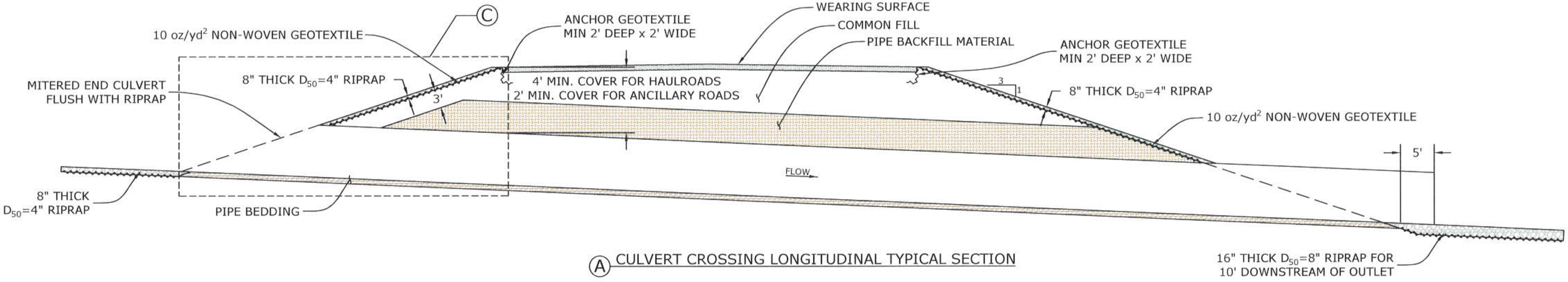
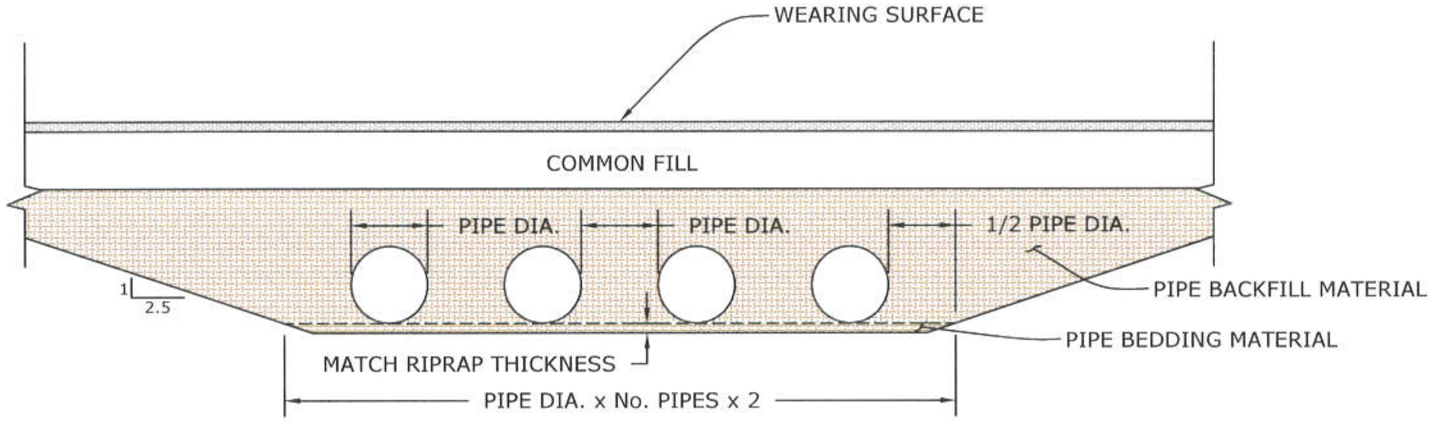
Thacker Pass Project
Ancillary Road #2 Diversion Channel
Plan and Profile Sheet 3 of 3

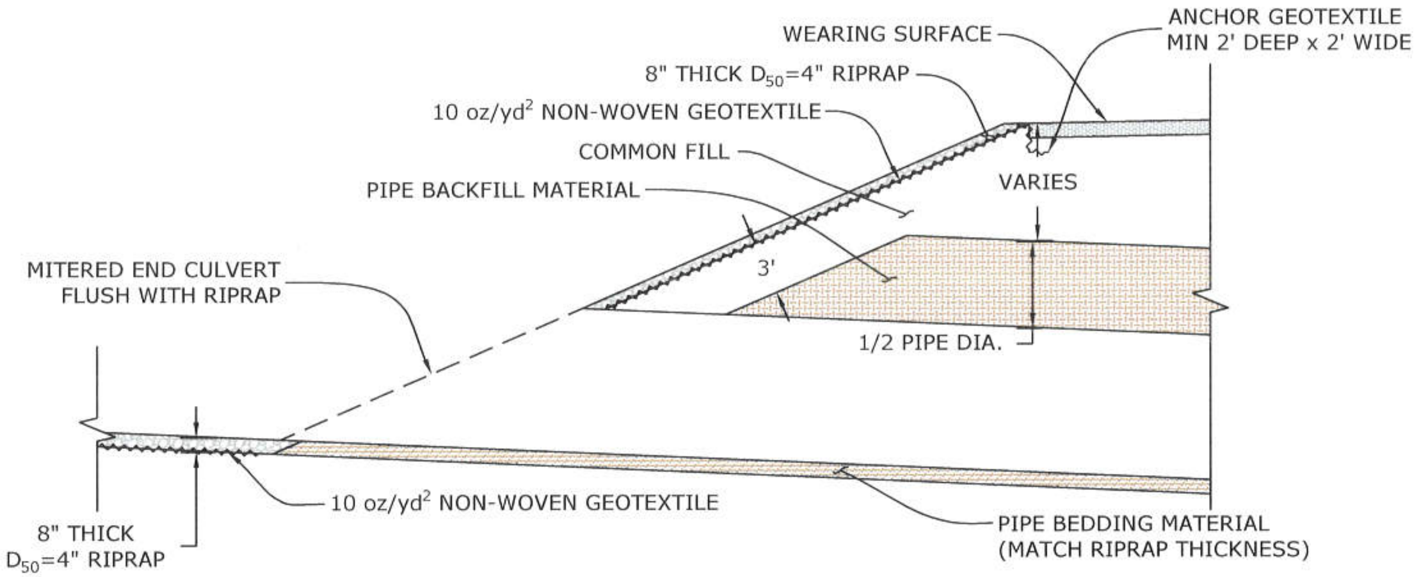
Drawn By:	CJS	Date:	3/3/20
Approved:	MTH	Date:	03/20
Scale:	1"=200'	Dwg. No.:	ARD 2-4



Ⓐ CULVERT CROSSING LONGITUDINAL TYPICAL SECTION



Ⓑ CULVERT TYPICAL CROSS SECTION



Ⓒ CULVERT INLET DETAIL

NOTES:

1. THE CULVERTS ARE DESIGNED TO CONVEY STORMWATER FROM THE 100-YEAR/24-HOUR STORM EVENT.
2. RIPRAP SHOWN IS THE MINIMUM REQUIRED FOR CURRENT DESIGN AND MAY REQUIRE UPGRADING IF WATERSHED AREAS CHANGE IN THE FUTURE.
3. PLACE 10oz/yd^2 NON-WOVEN GEOTEXTILE UNDER ALL RIPRAP.

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Thacker Pass Project
Culvert Typical
Cross Sections and Details

Drawn By: CJS Date: 2/28/20
Approved: MTH Date: 03/20
Scale: AS SHOWN Dwg. No.: CULV 01

APPENDICES

APPENDIX A
Design Criteria

Thacker Pass Project
Design Criteria
General Information

DESCRIPTION	VALUE	COMMENT
TIME FRAME		
Engineering Design	April 2020	
BASE MAPPING		
Projection System	UTM NAD83, Zone 11	
Units	U.S. Imperial	
Existing Ground Topographic File	GeoTerra 2017 Survey	Base topo file for project area provided by LNC

Thacker Pass Project
Design Criteria
Meteorological/Climatological Data

DESCRIPTION	VALUE	COMMENT
CLIMATOLOGICAL FACTORS		
Average annual precipitation	12.29	Climate Analysis Memo (EDR, Appendix E.3.13)
Average annual evaporation	5.92in/year	Climate Analysis Memo (EDR, Appendix E.3.13)
Average daily minimum winter temperature	18.32°F	WRCC Kings River Valley, NV (264236) 1956-2016
Average daily maximum summer temperature	87.84°F	WRCC Kings River Valley, NV (264236) 1956-2016
Frost depth	24 in	Humboldt County Design Criteria
24-HOUR STORM EVENTS		
Recurrence Interval (years)	**Precipitation (in)**	
2	1.13	NOAA PFDS
5	1.41	NOAA PFDS
10	1.64	NOAA PFDS
25	1.96	NOAA PFDS
50	2.21	NOAA PFDS
100	2.48	NOAA PFDS
500	3.12	NOAA PFDS
AVERAGE MONTHLY PRECIPITATION DATA		
Month	**Average Precipitation, 2011-2017 (in)**	
January	1.27	Climate Analysis Memo (EDR, Appendix E.3.13)
February	1.14	Climate Analysis Memo (EDR, Appendix E.3.13)
March	1.17	Climate Analysis Memo (EDR, Appendix E.3.13)
April	1.47	Climate Analysis Memo (EDR, Appendix E.3.13)
May	1.58	Climate Analysis Memo (EDR, Appendix E.3.13)
June	1.16	Climate Analysis Memo (EDR, Appendix E.3.13)
July	0.32	Climate Analysis Memo (EDR, Appendix E.3.13)
August	0.34	Climate Analysis Memo (EDR, Appendix E.3.13)
September	0.58	Climate Analysis Memo (EDR, Appendix E.3.13)
October	0.99	Climate Analysis Memo (EDR, Appendix E.3.13)
November	1.10	Climate Analysis Memo (EDR, Appendix E.3.13)
December	1.18	Climate Analysis Memo (EDR, Appendix E.3.13)
AVERAGE MONTHLY EVAPORATION DATA		
Month	**Average Pan Evaporation (in)**	
January	1.48	Climate Analysis Memo (EDR, Appendix E.3.13)
February	2.13	Climate Analysis Memo (EDR, Appendix E.3.13)
March	3.87	Climate Analysis Memo (EDR, Appendix E.3.13)
April	5.64	Climate Analysis Memo (EDR, Appendix E.3.13)
May	7.41	Climate Analysis Memo (EDR, Appendix E.3.13)
June	10.36	Climate Analysis Memo (EDR, Appendix E.3.13)
July	12.89	Climate Analysis Memo (EDR, Appendix E.3.13)
August	11.40	Climate Analysis Memo (EDR, Appendix E.3.13)
September	7.73	Climate Analysis Memo (EDR, Appendix E.3.13)
October	4.54	Climate Analysis Memo (EDR, Appendix E.3.13)
November	2.30	Climate Analysis Memo (EDR, Appendix E.3.13)
December	1.27	Climate Analysis Memo (EDR, Appendix E.3.13)

Thacker Pass Project
Design Criteria
Clay Tailings Filter Stack

DESCRIPTION	VALUE	COMMENT
GENERAL		
Tailings production rate	2,510,348 dry tonnes/yr for years 1-4 7,531,043 dry tonnes/yr for years 5-10	Design Criteria for Mining and Stockpiles REV5
Starter facility lifespan (Phase 1)	10 years	2019/10/15 Weekly meeting minutes
Phase 1 facility lined pad area	16,820,000 sf	3D Area of lined area within pad berms
Phase 1 facility capacity	67,165,000 cy	Calculated from *Design Criteria for Mining and Stockpiles REV5* & NewFields lab test results
Ultimate facility capacity	351,715,000 cy	Calculated from *Design Criteria for Mining and Stockpiles REV5* & NewFields lab test results
Number of facility phases	2	LNC
TAILINGS PROPERTIES		
Total tailings production for Phase 1	55,227,647 dry tonnes	Design Criteria for Mining and Stockpiles REV5
USCS Description	ML - SILT with sand	NF lab
Atterberg Limits	Tailings w/ salt: LL: 51%, PI: 11%, PL: 40% Tailings w/o salt: LL: 71%, PI: 12%, PL: 59%	NF Lab Test Results
As-Received Tailings moisture content	Tailings w/ salt: 60.9% Tailings w/o salt: 59.3%	Dry basis, NF Lab Test Results
Tailings average max dry density for modified proctor (MMDD)	Tailings w/ salt: 72.4 pcf Tailings w/o salt: 70.1 pcf	NF lab (November 12 - 13, 2019)
Optimum moisture content	Tailings w/ salt: 45.3% (dry basis) Tailings w/o salt: 46% (dry basis)	NF lab (November 12 - 13, 2019)
Tailings specific gravity	2.93	NF Lab as measured using 110F oven temp
FACILITY FEATURES		
Facility Type	Dry stack with concurrent closure	
Closure cover	3 feet of cover material	
Tailings placement method	Conveyors and haul trucks	
Structural/Non-structural zones	**Interior:** Tailings and salts at 85% compaction with 1:1 side slopes **Exterior:** Tailings "buttress" at 95% compaction with 4:1 side slopes. Buttress will have a 400' crest width when facility is 400' high	
Safety berm height (mine construction)	1.5 feet for light vehicle access 6 feet for haul truck access	Mid-axle height of largest equipment Varies based on road width
Containment/lining requirements	Geomembrane over liner bedding	Phase 1
UNDERDRAIN SYSTEM		
Underdrain system	Sand and gravel and perforated pipe over liner system	NF Sizing Calculation in EDR Appendix E

Thacker Pass Project
Design Criteria
Coarse Gangue Stockpile

DESCRIPTION	VALUE	COMMENT
GENERAL		
Number of facility phases	2	LNC
Starter facility lifespan (Phase 1)	10 years	2019/10/15 Weekly meeting minutes
Coarse gangue production rate	825,612 dry tonnes/year, years 1-4 2,476,837 dry tonnes/year, years 5-10	Design Criteria for Mining and Stockpiles Rev5
Coarse Gangue Bulk Density	1300 kg/m3	Design Criteria for Mining and Stockpiles Rev5
Initial/Starter facility capacity (out of pit)	26,106,514cy (19,959,862 m3)	Design Criteria for Mining and Stockpiles Rev5
Ultimate facility capacity (out of pit)	33,226,472cy (25,403,461 m3)	Design Criteria for Mining and Stockpiles Rev5
COARSE GANGUE PROPERTIES		
USCS Description	SP (Poorly graded SAND)	NF lab test results
Atterberg Limits	LL=NP, PI=NP, PL=NP	NF lab test results (MC is per dry basis)
Total coarse gangue production for Phase 1	25,947,821 tonnes	NF Calculation
Coarse Gangue wet basis moisture content	30%	Design Criteria for Mining and Stockpiles Rev5
Coarse Gangue dry basis moisture content	43%	Wet basis to dry basis conversion
Coarse Gangue average max dry density for modified proctor (MMDD)	1,300kg/m3 (81pcf)	Design Criteria for Mining and Stockpiles Rev5
Course Gangue specific gravity	2.81	NF lab test results
FACILITY FEATURES		
Overall stacking slope	Between 3-5.5H:1V	NA Coal /NF
Intermediate lift slope	Angle of Repose (~1.4H:1V)	NA Coal / NF
Bench width	75.5 ft (for 5.5H:1V Overall Slope)	NA Coal
Lift height	49.2 ft	NA Coal
Containment/lining requirements	None	Piteau/LNC

Thacker Pass Project
Design Criteria
Waste Rock Storage Facilities

DESCRIPTION	VALUE	COMMENT
GENERAL		
Time frame for placement in West WRSF	Years 1-9	
Time frame for placement in East WRSF	Year 10	
Volume of out of pit waste mined (10yrs)	32,158,000 cy	Design Criteria for Mining and Stockpiles Rev5
Volume of Waste Placed at West WRSF (Years 1-9)	26,470,000 cy	Design Criteria for Mining and Stockpiles Rev5
Volume of Waste Placed at East WRSF (Year 10)	5,800,000 cy	Design Criteria for Mining and Stockpiles Rev5
Ultimate Designed West WRSF capacity	26,470,000 cy	NewFields Design Feb. 2020
Ultimate Designed East WRSF capacity	11,156,600 yd3	Design Criteria for Mining and Stockpiles Rev5
WASTE ROCK PROPERTIES		
Waste Rock wet basis moisture content	16%	Design Criteria for Mining and Stockpiles Rev5
Waste Rock dry basis moisture content	19%	Wet basis to dry basis conversion
Waste rock bulk density	1593 kg/m3	Design Criteria for Mining and Stockpiles Rev5
WEST WRSF FEATURES		
Overall stacking slope	3.5H:1V	Based on stability modeling
Maximum height	275 ft	Based on stability modeling
Containment/lining requirements	None	LNC
Total volume from CAD	26,469,957 c.y.	NF CAD Surface
EAST WRSF FEATURES		
Overall stacking slope	3.5H:1V	Based on stability modeling
Intermediate lift slope	1.5H:1	
Bench width	100 ft	
Lift height	50 ft	
Containment/lining requirements	None	LNC
Total volume from CAD (Year 10)	6,085,144 c.y.	NF CAD Surface

Thacker Pass
Design Criteria
Process Ponds

DESCRIPTION	VALUE	COMMENT
CTFS RECLAIM POND #1		
Draindown Storage Time	7 days	
Draindown Storage Volume	746,900 gal	Based on seepage rate of 74 gpm
Operational volume	5.6 M gal	Operational = Draindown Volume plus Contingency Capacity
Storm event	17.8 M gal	100-yr/24-hr storm
Freeboard	3 ft	
Freeboard volume	7.2 M gal	
Total Pond volume	30.6 M gal	pond bottom to pond crest
Contingency Capacity	25%	Included in operational volume
Pond side-slopes	2.5:1	
Discharge location/facility	Pump back to process plant facilities	For process reuse or evaporation
Discharge pump rate	500 gpm	From LNC
Pumpback system	Sloping reclaim with submersible pump	HDPE and Stainless Steel Pipe
Lining system	Double geomembrane lined with geonet leak detection system	

Thacker Pass
Design Criteria
Roads

DESCRIPTION	VALUE	COMMENT
ACCESS ROADS		
Maximum road grade	15%	typical
Road width	20 ft	clear distance between berms
Minimum radius	100 ft	measured from centerline
Safety berm height	1.5 ft high with 1.5:1 side slopes	mid-axle height of largest equipment
Wearing course thickness	6 inches	
Design vehicle	Light vehicle	
Traffic pattern	Two way	
CTSF PERIMETER HAUL ROAD		
Maximum road grade	10%	typical
Road width	80 ft	clear distance between berms; NA Coal design
Minimum radius	TBD	measured from centerline
Safety berm height	6 ft high with 2:1 side slopes	mid-axle height of largest equipment
Wearing course thickness	18 inches	NA Coal design
Design vehicle	CAT 777	
Traffic pattern	Two way	

Thacker Pass
Design Criteria
Stormwater Diversion Channels and Culverts

DESCRIPTION	VALUE	COMMENT
Channels		
Storm event for depth sizing	500 year, 24 hour	Closure Criteria
Storm event for erosion control design	100 year, 24 hour	
Freeboard	1 foot minimum	
Erosion protection	For D50 <4", leave channel unlined, otherwise use riprap	See EDR
CTFS and Haul Road Culverts		
Storm event for size requirements	100 year, 24 hour	
Material type	Corrugated Metal Pipe (CMP)	
Maximum headwater	1' below road crossing	
Process Plant Culverts		
Storm event for size requirements	25 year, 24 hour	
Material type	Corrugated Metal Pipe (CMP)	
Maximum headwater	1' below road crest	

Thacker Pass
Design Criteria
Sediment Ponds

DESCRIPTION	VALUE	COMMENT
WEST WRSF SEDIMENT POND		
Pond design storm	100 year, 24 hour	
Pond Freeboard	3 feet	
Emergency Spillway design storm	500 year, 24 hour	
Emergency Spillway freeboard	1 foot	
Discharge location	Natural drainage. Pond will only discharge water in excess of the 100 year, 24 hour storm event	
Pond side-slopes	2.5H:1V	
EAST WRSF, CGS, AND PROCESS PLANT SEDIMENT PONDS		
Pond design storm	2 year, 24 hour	
Pond Freeboard	3 feet	
Sediment Storage	2'	Measured from lowest point in pond
Perforated Riser Design	Discharge the 25 year, 24 hour storm in 48 to 72 hours	
Emergency Spillway design storm	100 year, 24 hour	
Emergency Spillway freeboard	1 foot	
Discharge location	East WRSF - natural drainage or channel CGS - CTFS West Diversion Channel Process Plant - CTFS West Diversion Channel	
Pond side-slopes	2.5H:1V	
MINE FACILITIES SEDIMENT PONDS		
Pond design storm	2 year, 24 hour	
Pond Freeboard	3 feet	
Sediment Storage	2'	Measured from lowest point in pond
Perforated Riser Design	Discharge the 25 year, 24 hour storm in 48 to 72 hours	
Emergency Spillway design storm	100 year, 24 hour	
Emergency Spillway freeboard	1 foot	
Discharge location	Facility Sediment Pond #1 - natural drainage Facility Sediment Pond #2 - natural drainage Mine Sediment Pond #1 - natural drainage	
Pond side-slopes	3H:1V	(Spillway side slopes 4H:1V)

Thacker Pass
Design Criteria
Stability Analysis

DESCRIPTION	VALUE	COMMENT
Seismic Criteria		
Operational Basis Earthquake (OBE)		
Recurrence Interval	475 years	10% PE in 50 years
Moment Magnitude Earthquake	M6.4 at 35mi from site	NF Seismic Hazard, 2019
Peak horizontal ground acceleration	0.09g	NF Seismic Hazard, 2019
Maximum Design Earthquake (MDE)		
Moment Magnitude Earthquake	M6.6 at 14 miles from site	NF Seismic Hazard, 2019
Peak horizontal ground acceleration	0.26g	NF Seismic Hazard, 2019
Stability Analysis		
Static Minimum Factor of Safety	1.3	NDEP Stability Requirements
Pseudo-static Minimum Factor of Safety	>1.05	NDEP Stability Requirements

APPENDIX B

Geotechnical Field Investigation

APPENDIX B.1

Borehole Logs

NewFields

BH19-01

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CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/28/19 **COMPLETED** 3/28/19

GROUND ELEVATION 4914.4 ft **HOLE SIZE** 4.25in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS-84):

DRILLING METHOD HSA

NORTHING 15149319 **EASTING** 1345248

LOGGED BY M. Erdmann **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with cement grout

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
								LIQUID LIMIT	PLASTICITY INDEX				
	0		Snow/Mud										
			Top Soil / Root Zone										
			silty SAND (SM), with gravel, fine to coarse grained, well graded, subangular, high plasticity fines, medium to very dense, brown, dry										
				SS SPT-01	5-11-15 (26)	18							
4910	5												
				MC CAL-01	6-9-6 (15)	18							
				SS SPT-02	7-19-22 (41)	18	32.1	71	27	17.4	44.2	38.4	
4905	10												
				MC CAL-02	25-33-22 (55)	18							Increase in cobbles
4900	15												
				SS SPT-03	11-22-20 (42)	18							
4895	20												
				MC CAL-03	27-40-55 (95)	18							
4890	25												
				SS SPT-04	21-22-28 (50)	18	30	55	25	13.6	66.3	20.1	
4885	30												
				MC CAL-04	24-37-52 (89)	18							
4880	35												
				SS SPT-05	23-20-23 (43)	18							
4875	40												

(Continued Next Page)

NewFields

BH19-01

PAGE 2 OF 2

CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

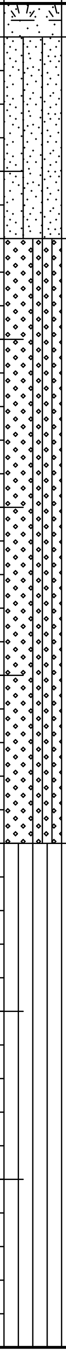
PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	40		silty SAND (SM), with gravel, fine to coarse grained, well graded, subangular, high plasticity fines, medium to very dense, brown, dry *(continued)*	MC CAL-05	16-39-63 (102)	18							
4870	45		SAND (SP), poorly graded, fine grained, sub angular, very dense, brown, moist	SS SPT-06	24-44-48 (92)	18							
4865	50		CLAY (CL), with sand, low plasticity fines, very dense, light brown, moist	MC CAL-06	25-33-70 (103)	18							

Borehole terminated at 51.5'

CLIENT	Lithium Nevada	**PROJECT NAME**	Thacker Pass Geotechnical Investigation
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass, Nevada
DATE STARTED	3/26/19 **COMPLETED** 3/27/19	**GROUND ELEVATION**	4928.3 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR	HazTech	**COORDINATES (WGS-84):**	
DRILLING METHOD	HSA	**NORTHING**	15151138 **EASTING** 1357073
LOGGED BY	C. Coleman **CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)**	93.2
NOTES	Backfilled with benontie chips and cement grout		



ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	Snow/Mud										
		Top Soil / Root Zone										
		silty SAND (SM), with gravel, fine to coarse grained sand and gravel, sub angular, nonplastic fines, dense to very dense, light brown, dry										
4925			SS SPT-01	8-23-26 (49)	18							
	5		MC CAL-01	37-40-63 (103)	18							
4920		SAND (SW-SM), with gravel and silt, fine to coarse sand and gravel, MPS 2.5", sub angular, nonplastic fines, dense to very dense, brown ,dry	SS SPT-02	50/5cm	5							
	10		MC CAL-02	70/6cm	5.5							Increase in cobbles and boulders
4915												
	15		SS SPT-03	13-22-26 (48)	18							
4910												
	20		MC CAL-03	17-30-25 (55)	18							
4905												
	25	SILT (ML), with sand, fine grained, low to high plasticity, very stiff to hard, light brown, dry	SS SPT-04	22-13-12 (25)	18	58.8	105	50	4.2	34.6	61.2	
4900												
	30		MC CAL-04	12-18-27 (45)	18							
4895												
	35		SS SPT-05	9-29-21 (50)	18							
4890												
	40											

(Continued Next Page)

CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	40	SILT (ML), with sand, fine grained, low to high plasticity, very stiff to hard, light brown, dry *(continued)*	MC CAL-05	17-66-58 (124)	18							
4885												
	45	silty SAND (SM), fine grained, high plasticity fines, medium to very dense, dark brown, damp, (highly weathered rock)	SS SPT-06	10-18-29 (47)	18	37.4	80	40	8.1	47.8	44.1	
4880												
	50		MC CAL-06	34-25-31 (56)	18							Switched to open hole mud rotary
4875												
	55		SS SPT-07	9-32-25 (57)	18							
4870												
	60		MC CAL-07	30-49-70/5cm	17							
4865												
	65	Switched to rock core at 65'										

BH19-02

CLIENT Lithium Nevada		**PROJECT NAME** Thcker Pass Geotechnical Investigation	
PROJECT NUMBER 475.0385.000		**PROJECT LOCATION** Thacker Pass, Nevada	
DATE STARTED 3/26/19	**COMPLETED** 3/27/19	**GROUND ELEVATION** 4928.3 ft	**HOLE SIZE** 4.25 in
DRILLING CONTRACTOR HazTech		**COORDINATES (WGS84):**	
DRILLING METHOD HQ Core		**NORTHING** 15151138	**EASTING** 1357073
LOGGED BY C. Coleman	**CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)** 93.2	
NOTES Backfilled with cement grout			

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
4860	65 70	1	5	100	66	SW	R3		[Continuation from soil log at 65 feet] Basalt, black, moderately weathered to slightly weathered, medium strong rock, very close to close joint spacing, slightly rough joint surfaces, some oxidization and clay alteration on joint surfaces				JT		VC to C		SR	OX
4855	75	2	6	100	72	SW	R3						JT		VC to C		SR	OX
4850	80	3	5	100	90	SW	R3						JT		VC to C		SR	OX
4845	85	4	5	100	99	SW	R3						JT		VC to C		SR	OX
4840	90	5	5	100	80	SW	R3						JT		VC to C		SR	CL
4835	95	6	5	100	100	SW	R3					▼	JT		VC to C		SR	CL
4830	100	7	5	100	75	SW	R3						JT		VC to C		SR	CL
4825	105	8	5	100	75	SW	R3						JT		VC to C		SR	CL

(Continued Next Page)

CLIENT Lithium Nevada

PROJECT NAME Thcker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	105	8	5	100	75	SW	R3		[Continuation from soil log at 65 feet] Basalt, black, moderately weathered to slightly weathered, medium strong rock, very close to close joint spacing, slightly rough joint surfaces, some oxidization and clay alteration on joint surfaces *(continued)*				JT		VC to C		SR	CL
4820	110	9	5	100	66	SW	R3						JT		VC to C		SR	CL
4815	115	10	5	100	80	SW	R3						JT		VC to C		SR	CL
4810	120	11	5	100	80	SW	R3						JT		C		SR	CL
4805	125	12	5	100	98	SW	R3						JT		C		SR	CL
4800	130	13	5	100	100	SW	R3						JT		C		SR	CL
4795	135	14	5	100	100	SW	R3						JT		C		SR	CL
4790	140	15	5	100	100	SW	R3						JT		C		SR	CL
4785	145	16	5	100	66	SW	R3		Clay Gouge 145'-150'				JT		C		SR	CL
4780	150	17	4	100	90	SW	R3											

Borehole terminated at 150'

BH19-03

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NewFields

CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/19/19 **COMPLETED** 3/19/19

GROUND ELEVATION 4828 ft **HOLE SIZE** 4.25in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS-84):

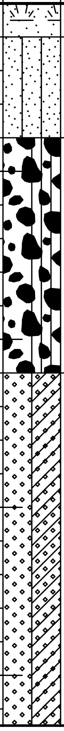
DRILLING METHOD HSA

NORTHING 15150430 **EASTING** 1359957

LOGGED BY C. Coleman **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with cement grout



ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	Snow/Mud										
		Top Soil / Root Zone										
4825		silty SAND (SM), with gravel, fine to coarse sand and gravel, MPS 1.5", sub angular, nonplastic fines, dense, light brown, dry	SS SPT-01	25-19-18 (37)	18							Hard drilling, refusal on auger, hole moved 5-ft north
	5	GRAVEL (GW-GM), with sand and silt, fine to coarse grained, MPS 3", sub angular, nonplastic fines, very dense, brown, dry	MC CAL-01	16-39-59 (98)	18							
4820			SS SPT-02	23-48-33 (81)	18							
	10		MC CAL-02	70/5cm	5							
4815		SAND (SW-SC), with gravel and clay, fine to coarse sand and gravel, MPS 1.0", sub angular, low plasticity fines, very dense, brown, dry										
	15		SS SPT-03	23-36-42 (78)	18							
4810												
	20		MC CAL-04	70/5cm	5							

Switched to rock core at 21.5'

NewFields

BH19-03

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CLIENT Lithium Nevada

PROJECT NAME Thcker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/19/19 **COMPLETED** 3/19/19

GROUND ELEVATION 4828 ft **HOLE SIZE** 4.25 in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS84):

DRILLING METHOD HQ Core

NORTHING 15150430 **EASTING** 1359957

LOGGED BY C. Coleman **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with bentonite chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
4805	20	1	5	100	33	MW	R3		[Continuation from soil log at 20 feet] Blocky volcanic rock, brown to black, moderately weathered, medium strong rock, very close to close joint spacing, slightly rough joint surfaces, clay alteration on joint surfaces				JT		VC to C		SR	CL
4800	25	2	5	100	75	MW	R3						JT		VC to C		SR	CL
4795	30	3	5	100	92	MW	R3						JT		VC to C		SR	CL
4790	35	4	5	99	92	MW	R3						JT		VC to C		SR	CL
4785	40	5	5	100	88	MW	R3						JT		VC to C		SR	CL
4780	45	6	5	100	95	MW	R3						JT		VC to C		SR	CL
	50																	

Borehole terminated at 50'

BH19-04

CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/17/19 **COMPLETED** 3/18/19
GROUND ELEVATION 4725.4 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS-84):
DRILLING METHOD HSA
NORTHING 15145149 **EASTING** 1359752
LOGGED BY M. Erdmann **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) 92.5
NOTES Backfilled with cement grout

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
			Snow/Mud										
4725	0		Top Soil / Root Zone										
			silty SAND (SM), with gravel, fine to corase grained, sub angular, loose to dense, light brown, dry										
				SS SPT-01	5-5-6 (11)	18							
4720	5			MC CAL-01	8-18-27 (45)	18							
				SS SPT-02	7-8-10 (18)	18							
4715	10		silty SAND (SM), with gravel, well graded, fine to coarse grained, sub angular, dense to very dense, light brown, dry	MC CAL-02	16-21-22 (43)	18							
4710	15			SS SPT-03	20-50/6cm	11.5							
4705	20			MC CAL-03	70/5cm	5							

Switched to rock core at 21.5'

BH19-04

CLIENT	Lithium Nevada	**PROJECT NAME**	Thcker Pass Geotechnical Investigation
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass, Nevada
DATE STARTED	3/17/19 **COMPLETED** 3/18/19	**GROUND ELEVATION**	4725.4 ft **HOLE SIZE** 4.25 in
DRILLING CONTRACTOR	HazTech	**COORDINATES (WGS84):**	
DRILLING METHOD	HQ Core	**NORTHING**	15145149 **EASTING** 1359752
LOGGED BY	M. Erdmann **CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)**	92.5
NOTES	Backfilled with cement grout		

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
4705	20								Surface details: Snow/Mud									
		1	3.5	79	0	MW	R1		[Continuation from soil log at 20 feet] Blocky volcanic rock, moderately weathered, very weak rock, very close joint spacing, smooth joint surfaces				JT		VC		S	
4700	25	2	2	88	0	MW	R1						JT		VC		S	
		3	2	90	0	MW	R1						JT		VC		S	
4695	30	4	3	100	55	MW	R1						JT		VC		S	
4690	35	5	5	100	41	MW	R1		Basalt, black to brown, moderately weathered to slightly weathered, very weak to medium strong rock, very close to close joint spacing, slightly rough joint surfaces, clay and calcite alteration on joint surfaces				JT		VC		SR	
4685	40	6	5	100	43	MW	R1						JT		VC		SR	
4680	45	7	5	100	58	MW	R1						JT		VC		SR	
4675	50	8	5	100	49	MW	R1						JT		VC		SR	
4670	55	9	5	100	79	MW	R1						JT		VC		SR	
		10	5	100	65	SW	R3						JT		C		SR	CA
	60																	

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CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
4665	60	11	5	100	87	SW	R3		Basalt, black to brown, moderately weathered to slightly weathered, very weak to medium strong rock, very close to close joint spacing, slightly rough joint surfaces, clay and calcite alteration on joint surfaces *(continued)*				JT		C		SR	CA
4660	65	12	5	100	90	SW	R3						JT		C		SR	CA
4655	70	13	5	100	83	SW	R3						JT		C		SR	CL
4650	75	14	5	100	95	SW	R3						JT		C		SR	CL
4645	80	15	5	100	85	SW	R3						JT		C		SR	CL
4640	85	16	5	100	88	SW	R2						JT		C		SR	CL
4635	90	17	5	100	90	SW	R2					▽	JT		C		SR	CL
4630	95	18	5	100	86	SW	R2						JT		C		SR	CL
4625	100																	

Borehole terminated at 100.5'

NewFields

BH19-05
PAGE 1 OF 1

CLIENT	Lithium Nevada	**PROJECT NAME**	Thacker Pass Geotechnical Investigation
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass, Nevada
DATE STARTED	3/12/19 **COMPLETED** 3/13/19	**GROUND ELEVATION**	4798.9 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR	HazTech	**COORDINATES (WGS-84):**	
DRILLING METHOD	HSA	**NORTHING**	15148159 **EASTING** 1357491
LOGGED BY	C. Coleman **CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)**	83.5

NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Snow/Mud										
			Top Soil / Root Zone										
			silty SAND (SM), with gravel, trace cobbles, fine to corase sand and gravel, MPS 3.0" sub rounded, nonplastic fines, very dense, light brown, dry										
4795				SS SPT-01	46-41-48 (89)	18							
	5			MC CAL-01	31-43-43 (86)	18							
4790				SS SPT-02	29-32-29 (61)	18							
	10		GRAVEL (GW-GM), with sand and silt, fine to coarse grained, MPS 3.0", sub angular, nonplastic fines, very dense, brown, dry	MC CAL-02	21-32-38 (70)	18							
			silty SAND (SM), with clay, fine grained, low plasticty fines, very dense, brown, dry										
4785	15			SS SPT-03	26-28-28 (56)	18							
4780	20			MC CAL-03	34-70/5cm	11							

Switched to rock core at 21.5'

NewFields

BH19-05

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CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/12/19 **COMPLETED** 3/12/19
GROUND ELEVATION 4798.9 ft **HOLE SIZE** 4.25 in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS84):
DRILLING METHOD HQ Core
NORTHING 15148159 **EASTING** 1357491
LOGGED BY C. Coleman **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) 83.5
NOTES Backfilled with bentonite chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	20								Surface details: Snow/Mud									
4775		1	4.5	33	0	HW	R1		[Continuation from soil log at 20 feet] Blocky volcanic rock, highly weathered, weak rock, very close joint spacing, oxidization on joint surface				JT		VC			OX
	25	2	3	100	9	HW	R1						JT		VC			OX
4770	30	3	2.5	100	13	HW	R1						JT		VC			OX
		4	3.5	100	12	HW	R1						JT		VC			OX
4765	35	5	5	100	15	HW	R1						JT		VC			OX
4760 4755	40	6	6.5	100	0	HW	R1						JT		VC			OX
4750	45	7	5	100	13	MW	R2		Basalt, black, moderately weathered to slightly weathered, weak rock to medium strong rock, very close to close joint spacing, oxidization and calcite alteration on joint surface				JT		VC			OX
4745	50	8	5	100	10	HW	R1		Broken zone, clay gouge, highly weathered, very weak, potential fault				JT		VC			CL
4740	55 60	9	5	100	32	MW	R2		Basalt, black, moderately weathered to slightly weathered, weak rock to medium strong rock, very close to close joint spacing, oxidization and calcite alteration on joint surface				JT		VC			OX

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CLIENT Lithium Nevada

PROJECT NAME Thcker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
4735	60	10	5	100	6	MW	R2		Basalt, black, moderately weathered to slightly weathered, weak rock to medium strong rock, very close to close joint spacing, oxidization and calcite alteration on joint surface *(continued)*				JT		VC			OX
4730	65	11	5	100	100	SW	R3						JT		C			OX
4725	70	12	5	100	99	SW	R3						JT		C			OX
4720	75	13	5	100	99	SW	R3						JT		C			OX
4715	80	14	5	100	66	SW	R3					▼	JT		C			OX
4710	85 90	15	7	100	74	SW	R3						JT		C			OX
4705	95	16	4	100	31	SW	R1						JT		VC			CA
4700	100	17	4	100	73	SW	R1						JT		VC			CA

Borehole terminated at 100'

BH19-06

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NewFields

CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/14/19 **COMPLETED** 3/15/19

GROUND ELEVATION 4792.4 ft **HOLE SIZE** 4.25in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS-84):

DRILLING METHOD HSA

NORTHING 15149656 **EASTING** 1358695

LOGGED BY M. Erdmann **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with cement grout

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Snow/Mud										
			Top Soil / Root Zone										
			silty SAND (SM), with gravel, well graded, fine to coarse grained, sub angular, dense to very dense, light brown, dry										
4790													
				SS SPT-01	13-27-50 (77)	18							
	5												
				MC CAL-01	31-31-29 (60)	18							
4785													
				SS SPT-02	20-28-18 (46)	18							
	10												
				MC CAL-02	22-44-27 (71)	18							
4780													
	15												
				SS SPT-03	9-23-50/2cm	14							
4775													
	20												
				MC CAL-03	33-70/4cm	10							

Switched to rock core at 21.5'

BH19-06

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NewFields

CLIENT	Lithium Nevada	**PROJECT NAME**	Thcker Pass Geotechnical Investigation
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass, Nevada
DATE STARTED	3/14/19	**COMPLETED**	3/15/19
GROUND ELEVATION	4792.4 ft	**HOLE SIZE**	4.25 in
DRILLING CONTRACTOR	HazTech	**COORDINATES (WGS84):**	
DRILLING METHOD	HQ Core	**NORTHING**	15149656
EASTING	1358695		
LOGGED BY	M. Erdmann	**CHECKED BY**	K. Magner
DEPTH TO WATER (FT BGS)	No free water encountered		
NOTES	Backfilled with cement grout		

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
4770	25	1	4	80	11	HW	R1		[Continuation from soil log at 21.5 feet] Blocky volcanic rock, brown, highly weathered, extremely weak rock, very close joint spacing, slightly rough joint surfaces, oxidization on joint surface				JT		VC		SR	OX
4765	30	2	5	100	0	HW	R1						JT		VC		SR	OX
4760	35	3	5	100	0	HW	R1		Basalt, black to brown, slightly weathered, weak rock, close joint spacing, slightly rough joint surface, calcite alteration on joint surface				JT		VC		SR	OX
4755	40	4	5	100	15	SW	R2						JT		C		SR	CA
4750	45	5	5	100	63	SW	R2						JT		C		SR	CA
4745	50	6	4.5	100	53	SW	R2						JT		C		SR	CA

Borehole terminated at 50'

NewFields

BH19-08

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CLIENT	Lithium Nevada	**PROJECT NAME**	Thacker Pass Geotechnical Investigation
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass, Nevada
DATE STARTED	3/19/19	**COMPLETED**	3/19/19
GROUND ELEVATION	4756.3 ft	**HOLE SIZE**	4.25in
DRILLING CONTRACTOR	HazTech	**COORDINATES (WGS-84):**	
DRILLING METHOD	HSA	**NORTHING**	15147040
		EASTING	1357703
LOGGED BY	M. Walden	**CHECKED BY**	K. Magner
DEPTH TO WATER (FT BGS)	No free water encountered		
NOTES	Backfilled with benontie chips and cement grout		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
								LIQUID LIMIT	PLASTICITY INDEX				
	0		Snow/Mud										
4755			Top Soil / Root Zone										
			silty SAND (SM), some gravel, fine to coarse grained, well graded, sub angular, medium plasticity fines, medium dense to very dense, light brown, dry	SS SPT-01	4-8-11 (19)	18	19.4	46	18	19.9	44.9	35.2	
4750	5			MC CAL-01	20-38-52 (90)	18							
			silty SAND (SM), fine to coarse grained, well graded, sub angular, very dense, brown, dry	SS SPT-02	19-24-28 (52)	18							
4745	10			MC CAL-02	70/6cm	5.5							

Switched to rock core at 11.5'

BH19-08

CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/3/19 **COMPLETED** 3/3/19
GROUND ELEVATION 4756.3 ft **HOLE SIZE** 4.25 in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS84):
DRILLING METHOD HQ Core
NORTHING 15147040 **EASTING** 1357703
LOGGED BY M. Walden **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with bentonite chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
4745	15	1	4.5	100	13	HW	R1		[Continuation from soil log at 10.5 feet] Blocky volcanic rock, fine grained, reddish brown, highly weathered, very close joint spacing, oxidization on joint surface				JT		VC			OX
4740	20	2	5	100	0	HW	R1		Basalt, grey to black, moderately to slightly weathered, very weak to medium strong rock, very close to close joint spacing, oxidization and calcite alteration on joint surfaces				JT		VC			OX
4735	25	3	6	100	0	HW	R1						JT		VC			OX
4730	30	4	4	100	0	MW	R1						JT		VC			CA
4725	35	5	5	100	0	MW	R1						JT		VC			CA
4720	40	6	5	90	0	MW	R1						JT		VC			CA
4715	45	7	5	94	49	MW	R1						JT		VC			CA
4710	50	8	5	100	54	MW	R3						JT		C			CA
													JT		C			CA

(Continued Next Page)

CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG					
													TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
4705		9	5	100	48	MW	R3		Basalt, grey to black, moderately to slightly weathered, very weak to medium strong rock, very close to close joint spacing, oxidization and calcite alteration on joint surfaces *(continued)*									
		9	5	100	48	MW	R3											
	55												JT		C			CA
4700																		
		10	5	100	37	MW	R3											
	60												JT		C			CA
4695																		
		11	7	100	77	SW	R3											
	65																	
4690																		
													JT		VC			OX
	70																	
4685		12	7.5	100	0	SW	R1											
													JT		C			OX
	75																	
4680																		
		13	5.5	90	52	SW	R1											
	80												JT		VC			OX
4675																		
		14	5	78	0	HW	R1											
	85												JT		C			OX
4670																		
		15	5	100	38	MW	R2											
	90								Clay gouge 90'-100'									CL
4665																		
		16	5	100	53	HW												
	95																	CL
		17	5	100	38	HW												

(Continued Next Page)

CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
4660	100	17	5	100	38	HW		⬡	Clay gouge 90'-100' *(continued)*									

Borehole terminated at 100'

BH19-09

PAGE 1 OF 1

CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/6/19 **COMPLETED** 3/6/19

GROUND ELEVATION 4769.6 ft **HOLE SIZE** 4.25in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS-84):

DRILLING METHOD HSA

NORTHING 15147040 **EASTING** 1357491

LOGGED BY M. Walden **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Snow/Mud										
			Top Soil / Root Zone										
			GRAVEL (GP-GM), with sand and silt, fine to coarse grained, poorly graded, sub angular to angular, nonplastic fines, very dense, light brown, dry	SS SPT-01	15-23-27 (50)	18	10.3	NP	NP	49.1	39.5	11.4	
4765	5												
				MC CAL-01	20-32-70 (102)	16							
				SS SPT-02	20-47-50 (97)	18							
4760	10												
			silty SAND (SM), some gravel, some cobbles, trace clay, fine to coarse grained, well graded, sub angular to angular, very dense, light brown, dry	MC CAL-02	70	5							
4755	15												
				SS SPT-03	32-49-50 (99)	15							
4750	20												
				MC CAL-03	70/5cm	5							
4745	25												
				SS SPT-04	50/3cm	3							

Switched to rock core at 26.5'

BH19-09

CLIENT	Lithium Nevada	**PROJECT NAME**	Thcker Pass Geotechnical Investigation
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass, Nevada
DATE STARTED	3/6/19 **COMPLETED** 3/6/19	**GROUND ELEVATION**	4769.6 ft **HOLE SIZE** 4.25 in
DRILLING CONTRACTOR	HazTech	**COORDINATES (WGS84):**	
DRILLING METHOD	HQ Core	**NORTHING**	15147040 **EASTING** 1357491
LOGGED BY	M. Walden **CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)**	No free water encountered
NOTES	Backfilled with bentonite chips and cement grout		

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	25								Surface details: Snow/Mud									
4740	30	1	5	40	12	HW	R1		[Continuation from soil log at 25.5 feet] Blocky volcanic rock, red to brown, highly weathered, very weak rock, very close joint spacing, oxidization on joint surface				JT		VC			OX
4735	35	2	5	52	13	HW	R1		Basalt, grey to brown, highly weathered, very weak rock, very close joint spacing, oxidization on joint surface				JT		VC			OX

Borehole terminated at 35.5'

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CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/14/19 **COMPLETED** 3/14/19
GROUND ELEVATION 4763.6 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS-84):
DRILLING METHOD HSA
NORTHING 15147580 **EASTING** 1358013
LOGGED BY M. Erdmann **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with cement grout

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
			Snow/Mud										
	0		Top Soil / Rot Zone										
			silty SAND (SM), with gravel, fine to coarse grained, well graded, sub angular, dense, light brown, dry										
4760				SS SPT-01	25-41-47 (88)	18							
	5												
				MC CAL-01	26-60-70/2cm	14							
4755			silty SAND (SM), with gravel, fine to corase grained, well graded, sub angular, very dense, brown, dry	SS SPT-02	13-30-30 (60)	18							
	10												
				MC CAL-02	30-65-66 (131)	18							
4750													
	15												
				SS SPT-03	16-44-50/4cm	16							
4745													
	20			MC CAL-03	70/4cm	4							
4740													
	25												
				SS SPT-04	9-34-23 (57)	18							
4735													
	30			MC CAL-04	16-70/1cm	7							
4730													
	35												

Borehole terminated at 35'

BH19-11

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CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/11/19 **COMPLETED** 3/11/19

GROUND ELEVATION 4784.6 ft **HOLE SIZE** 4.25in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS-84):

DRILLING METHOD HSA

NORTHING 15147740 **EASTING** 1357539

LOGGED BY C. Coleman **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with cement grout

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
		Snow/Mud										
	0	Top Soil/ Root Zone										
		silty SAND (SM), some gravel, fine to corase grained, MPS 1.5", sub angular, nonplastic fines, medium dense to dense, light brown, dry										
			SS SPT-01	3-4-9 (13)	18	23.6	NP	NP	11.3	61.9	26.8	
4780	5											
			MC CAL-01	15-55-70/1cm	13							Hard drilling
			SS SPT-02	50/3cm	3							
4775	10											
			MC CAL-02	70/2cm	2							

Switched to rock core at 11.5'

NewFields

BH19-11

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CLIENT	Lithium Nevada	**PROJECT NAME**	Thcker Pass Geotechnical Investigation
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass, Nevada
DATE STARTED	3/11/19 **COMPLETED** 3/11/19	**GROUND ELEVATION**	4784.6 ft **HOLE SIZE** 4.25 in
DRILLING CONTRACTOR	HazTech	**COORDINATES (WGS84):**	
DRILLING METHOD	HQ Core	**NORTHING**	15147740 **EASTING** 1357539
LOGGED BY	C. Coleman **CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)**	No free water encountered
NOTES	Backfilled with cement grout		

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
		1	3	100	10	HW	R3		[Continuation from soil log at 10.5 feet] Blocky volcanic rock, brown, moderately to highly weathered, medium strong rock, very close to close joint spacing, oxidization on joint surface				JT		VC			OX
													JT		VC			OX
4770	15	2	3	100	0	HW	R3						JT		VC			OX
4765	20	3	4	100	0	HW	R3						JT		VC			OX
4760	25	4	4	88	31	HW	R3						JT		VC			OX
4755	30	5	7	100	0	HW	R3						JT		VC			OX
4750	35	6	5	100	8	HW	R3											

Borehole terminated at 36'

NewFields

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CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/18/19 **COMPLETED** 3/19/19
GROUND ELEVATION 4717.5 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS-84):
DRILLING METHOD HSA
NORTHING 15147611 **EASTING** 1357942
LOGGED BY C. Coleman **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with cuttings and cement grout

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	Snow/Mud										
		Top Soil / Root Zone										
		silty SAND (SM), with gravel, fine to coarse sand and gravel, MPS 1.0", sub angular, nonplastic fines, dense, light brown, dry										
4715												
			SS SPT-01	7-15-31 (46)	18							
	5											
		GRAVEL (GW-GM), with sand and silt, fine to coarse sand and gravel, MPS 3.0", sub angular, nonplastic to high plasticitiy fines, very dense, brown, dry	MC CAL-01	30-45-48 (93)	18							Hard drilling
4710												
			SS SPT-02	21-27-50/4cm	16							
	10											
			MC CAL-02	43-70/5cm	11							
4705												
	15											
			SS SPT-03	22-27-34 (61)	18	10.5	48	27	49.7	35.8	14.5	
4700		CLAY (CL), with sand, trace gravel, fine grained sand, fine to coarse gravel, MPS 1.5", sub angular, medium plasticity fines, hard, brown, damp										
	20											
			MC CAL-03	14-18-24 (42)	18							
4695												
	25											
			SS SPT-04	28-50/4cm	10							Refusal on gravel / rocky material
		SAND (SW-SC), some clay and gravel, fine to coarse sand and gravel, low plasticty fines, very dense, brown, dry										
4690												
	30											
			MC CAL-04	68-70/3cm	9							

Borehole terminated at 31.5'

NF-GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 11/21/19 15:11 - Y:\PROJECTS\0385.000-THACKER PASS LITHIUM NEVADA\L-GEOTECH DATA - ELKO\BOREHOLE LOGS\BOREHOLE SOIL LOGS-CC.19.08.29.GPJ

NewFields

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CLIENT	Lithium Nevada	**PROJECT NAME**	Thacker Pass Geotechnical Investigation
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass, Nevada
DATE STARTED	3/16/19 **COMPLETED** 3/16/19	**GROUND ELEVATION**	4740.2 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR	HazTech	**COORDINATES (WGS-84):**	
DRILLING METHOD	HSA	**NORTHING**	15148367 **EASTING** 1359448
LOGGED BY	M. Erdmann **CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)**	No free water encountered
NOTES	Backfilled with cement grout		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
			Snow/Mud										
4740	0		Top Soil / Root Zone										
			silty SAND (SM), with gravel, well graded, fine to coarse grained, sub angular, very dense, brown, dry										
				SS SPT-01	12-36-50/3cm	15							
4735	5												
				MC CAL-01	62-70/6cm	11.5							
				SS SPT-02	20-41-50/4cm	16							
4730	10												
				MC CAL-02	59-70/5cm	10.5							
4725	15												
				SS SPT-03	20-30-50/3cm	15							
4720	20												
				MC CAL-03	35-41-70/5cm	17							
4715	25												
				SS SPT-04	12-35-50/5cm	17							
4710	30												
				MC CAL-04	28-70/5cm	11							

Switched to rock core at 31.5'

NF-GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 11/21/19 15:11 - Y:\PROJECTS\0385.000-THACKER PASS LITHIUM NEVADA\L-GEOTECH DATA - ELKO\BOREHOLE LOGS\BOREHOLE SOIL LOGS-CC.19.08.29.GPJ

NewFields

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CLIENT Lithium Nevada

PROJECT NAME Thcker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/16/19 **COMPLETED** 3/16/19

GROUND ELEVATION 4740.2 ft **HOLE SIZE** 4.25 in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS84):

DRILLING METHOD HQ Core

NORTHING 15148367 **EASTING** 1357448

LOGGED BY M. Erdmann **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG					
									Surface details: Snow/Mud				TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
4710	30	1	5	100	8	HW	R1		[Continuation from soil log at 30 feet] Basalt, black, highly to moderately weathered, very weak to medium strong rock, very close joint spacing, smooth joint surface, calcite alteration on joint surface				JT		VC		S	
4705	35	2	5	100	24	HW	R1						JT		VC		S	
4700	40	3	5	100	53	MW	R2						JT		VC		S	
4695	45	4	5	100	59	SW	R3						JT		VC		S	CA
	50																	

Borehole terminated at 50'

CLIENT	Lithium Nevada	**PROJECT NAME**	Thacker Pass Geotechnical Investigation
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass, Nevada
DATE STARTED	3/25/19 **COMPLETED** 3/26/19	**GROUND ELEVATION**	4689.8 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR	HazTech	**COORDINATES (WGS-84):**	
DRILLING METHOD	HSA	**NORTHING**	15147664 **EASTING** 1360891
LOGGED BY	C. Coleman **CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)**	No free water encountered
NOTES	Backfilled with benontie chips and cement grout		

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	Snow/Mud										
		Top Soil / Root Zone										
		GRAVEL (GW-GM), with silt and sand, fine to coarse grained, MPS 4.0", sub angular, medium plasticity fines, very dense, dry, brown										
			SS SPT-01	43-50/1cm	7							
4685	5											
			MC CAL-01	56-61-56 (117)	18							
			SS SPT-02	16-50-50/5cm	17							
4680	10											
			MC CAL-02	38-70/4cm	10							Sampler refusal
4675	15											
			SS SPT-03	21-50/4cm	10							
4670	20											
			MC CAL-03	70/4cm	4							
		clayey SAND (SC), fine grained sand, low to medium plasticity fines, very dense, brown, moist										
4665	25											
			SS SPT-04	18-36-44 (80)	18							
4660	30											
			MC CAL-04	23-36-54 (90)	18							

Borehole terminated at 31.5'

NewFields

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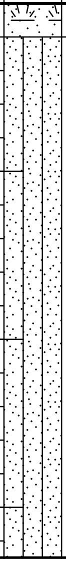
CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/19/19 **COMPLETED** 3/19/19
GROUND ELEVATION 4769.9 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS-84):
DRILLING METHOD HSA
NORTHING 15147036 **EASTING** 1357330
LOGGED BY M. Walden **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with benontie chips and cement grout



ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	Snow/Mud										
		Top Soil / Root Zone										
		silty SAND (SM), some gravel, fine to coarse grained, well grade, sub angular, nonplastic fines, very dense, light brown, dry										
			SS SPT-01	5-32-25 (57)	18							
4765	5											
			MC CAL-01	14-25-36 (61)	18	13.1	NP	NP	7.2	78.0	14.8	DD= 82.6 pcf
			SS SPT-02	25-43-50/3cm	15							
4760	10											
			MC CAL-02	50-70/5cm	11							
4755	15											
			SS SPT-03	43-50/4cm	10							

Switched to rock core at 16.5'

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CLIENT Lithium Nevada

PROJECT NAME Thcker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/3/19 **COMPLETED** 3/3/19

GROUND ELEVATION 4769.9 ft **HOLE SIZE** 4.25 in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS84):

DRILLING METHOD HQ Core

NORTHING 15147036 **EASTING** 1357330

LOGGED BY M. Walden **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with bentonite chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG					
									Surface details: Snow/Mud				TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	15								[Continuation from soil log at 15 feet] Basalt, dark grey, highly to moderately weathered, weak to medium strong rock, very close to close joint spacing, calcite alteration and oxidization on joint surfaces				JT		VC			CA
4750	20	1	9.5	100	16	HW to MW	R1 to R3											
4745	25												JT		VC			CA
		2	6	90	13	HW to MW	R1 to R3											
4740	30																	

Borehole terminated at 30.5'

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CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/5/19 **COMPLETED** 3/5/19
GROUND ELEVATION 4779.9 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS-84):
DRILLING METHOD HSA
NORTHING 15147424 **EASTING** 1357355
LOGGED BY M. Walden **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Snow/Mud										
			Top Soil / Root Zone										
			sandy lean CLAY (CL), fine grained, medium plasticity, stiff to hard, brown, dry	SS SPT-01	4-4-5 (9)	18	18.5	41	17	4.4	32.3	63.3	
4775	5			MC CAL-01	9-26-70/5cm	17							
			silty SAND (SM), with gravel, fine to coarse grained, well graded, sub angular to angular, light brown, dry	SS SPT-02	33-50/2cm	8							
4770	10			MC CAL-02	70/3cm	3							

Switched to rock core at 13.5'

NewFields

BH19-16

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CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/5/19 **COMPLETED** 3/5/19
GROUND ELEVATION 4779.9 ft **HOLE SIZE** 4.25 in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS84):
DRILLING METHOD HQ Core
NORTHING 15147424 **EASTING** 1357355
LOGGED BY M. Walden **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with bentonite chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG					
													TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
									[Continuation from soil log at 13.5 feet] Blocky volcanic rock, reddish brown, highly to moderately weathered, very weak rock, very close joint spacing, oxidization on joint surfaces				JT		VC			OX
4765	15																	
		1	5	100	0	HW	R1											
													JT		VC			OX
		2	1.5	56	0	HW	R1											
4760	20												JT		VC			OX
		3	5	20	0	HW	R1											
4755	25												JT		C			OX
		4	1.5	100	0	MW	R3											
									Basalt, grey, moderately weathered, medium strong rock, close joint spacing, oxidization on joint surface				JT		C			OX
		5	3.5	100	27	MW	R3											
4750	30																	

Borehole terminated at 30'

NewFields

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CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/2/19 **COMPLETED** 3/2/19

GROUND ELEVATION 4788.2 ft **HOLE SIZE** 4.25in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS-84):

DRILLING METHOD HSA

NORTHING 15147036 **EASTING** 1357330

LOGGED BY M. Walden **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Snow/Mud										
			Top Soil / Root Zone										
			silty SAND (SM), some gravel, fine to coarse grained, well graded, sub angular, medium dense to dense, light brown, dry										
4785				SS SPT-01	8-12-12 (24)	18							
	5			MC CAL-01	6-9-13 (22)	18							
4780				SS SPT-02	9-12-17 (29)	18							
	10			MC CAL-02	9-12-13 (25)	18	31.8	50	23	4.8	36.3	58.9	DD= 71.0 pcf
			sandy CLAY (CL), fine grained, high plasticity, very stiff, brown, dry										
4775													
	15		silty SAND (SM), trace gravel and clay, fine to coarse grained, well graded, very dense, brown, dry	SS SPT-03	19-24-36 (60)	18							
4770													
	20		SAND (SP-SM), with silt and gravel, poorly graded, low plasticity fines, very dense, brown, dry	MC CAL-03	39-70/4cm	10	10.0	32	7	35.1	53.7	11.2	
4765													
	25			SS SPT-04	49-50/3cm	9							
4760													
	30			MC CAL-04	70/5cm	5							

Borehole terminated at 31.5'

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NewFields

CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/1/19 **COMPLETED** 3/2/19

GROUND ELEVATION 4804.6 ft **HOLE SIZE** 4.25in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS-84):

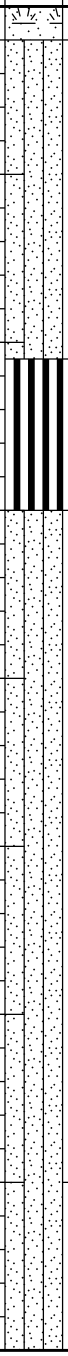
DRILLING METHOD HSA

NORTHING 15147424 **EASTING** 1356823

LOGGED BY M. Walden **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with cement grout



ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	Snow/Mud										
		Top Soil / Root Zone										
		silty SAND (SM), with gravel, trace cobbles, sub angular, MPS 2.0", nonplasitc fines, medium dense, light brown, dry										
			SS SPT-01	13-17-19 (36)	18							
4800	5											
			MC CAL-01	13-19-15 (34)	18							
			SS SPT-02	9-10-11 (21)	18							
4795	10											
		SILT (MH), with sand, fine grained, high plasticty, very stiff, brown,dry	MC CAL-02	6-16-20 (36)	18	37.3	110	55	0	17.5	82.5	DD= 63.4 pcf
4790	15											
		silty SAND (SM), fine to coarse grained, MPS 1.0", sub angular, nonplasitc fines, very dense, brown, dry	SS SPT-03	12-28-50 (78)	18							
4785	20											
			MC CAL-03	18-38-70 (108)	18	35.3	NP	NP	3.3	73.1	23.6	DD= 72.1 pcf
4780	25											
			SS SPT-04	28-43-50 (93)	18							
4775	30											
			MC CAL-04	70/4cm	4							
4770	35											
		silty SAND (SM), with gravel, trace clay, fine to coarse grained, well graded, sub angular, brown, dry	SS SPT-05	30-36-50/3cm	15							
			MC CAL-05	50/2cm	2							
4765	40											

Borehole terminated at 40'

NF-GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 11/21/19 15:11 - Y:\PROJECTS\0385.000-THACKER PASS LITHIUM NEVADA\L-GEOTECH DATA - ELKO\BOREHOLE LOGS\BOREHOLE SOIL LOGS-CC.19.08.29.GPJ

NewFields

BH19-19

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CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/2/19 **COMPLETED** 3/2/19

GROUND ELEVATION 4796.9 ft **HOLE SIZE** 4.25in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS-84):

DRILLING METHOD HSA

NORTHING 15147273 **EASTING** 1356938

LOGGED BY M. Walden **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Snow/Mud										
			Top Soil / Root Zone										
4795			silty SAND (SM), some gravel, fine to coarse grained, well graded, sub angular, medium dense to dense, light brown, dry										
				SS SPT-01	13-18-13 (31)	18							
	5												
				MC CAL-01	18-23-24 (47)	18							
4790													
				SS SPT-02	7-12-13 (25)	18							
	10												
				MC CAL-02	25-42-53 (95)	18							
4785													
	15												
				SS SPT-03	12-28-42 (70)	18							
4780													
	20												
			SAND (SW), with gravel, some silt, fine to coarse grained, well graded, sub angular, very dense, brown, dry	MC CAL-03	70/3cm	2.5							
4775													

Switched to rock core at 24'

BH19-19

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CLIENT Lithium Nevada

PROJECT NAME Thcker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/2/19 **COMPLETED** 3/2/19

GROUND ELEVATION 4796.9 ft **HOLE SIZE** 4.25 in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS84):

DRILLING METHOD HQ Core

NORTHING 15147273 **EASTING** 1356938

LOGGED BY M. Walden **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with bentonite chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	25	1	1.5	50	0	MW	R1	⬡	[Continuation from soil log at 24 feet] Basalt, dark grey, moderately weathered, weak to medium strong rock, very close joint spacing, calcite alteration on joint surfaces				JT		VC			CA
4770	30	2	5	100	14	MW	R1	⬡					JT		VC			CA
4765		3	3	100	0	MW	R3	⬡					JT		VC			CA
	35	4	2	100	37	MW	R3	⬡					JT		VC			CA

Borehole terminated at 35.5'

BH19-20

CLIENT	Lithium Nevada	**PROJECT NAME**	Thacker Pass Geotechnical Investigation
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass, Nevada
DATE STARTED	3/1/19	**COMPLETED**	3/1/19
GROUND ELEVATION	4812.6 ft	**HOLE SIZE**	4.25in
DRILLING CONTRACTOR	HazTech	**COORDINATES (WGS-84):**	
DRILLING METHOD	HSA	**NORTHING**	15147591
EASTING	1356709		
LOGGED BY	M. Walden	**CHECKED BY**	K. Magner
DEPTH TO WATER (FT BGS)	No free water encountered		
NOTES	Backfilled with benontie chips and cement grout		

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	Snow/Mud										
		Top Soil / Root Zone										
		silty SAND (SM), with gravel, trace cobbles, fine to coarse grained, well graded, sub angular, nonplastic to medium plasticity fines, dense to very dense, light brown, dry										
4810												
			SS SPT-01	35-25-20 (45)	18							
	5											
			MC CAL-01	17-26-41 (67)	18	10.9	NP	NP	51.7	34.7	13.6	
4805												
			SS SPT-02	50	6							
	10											
			MC CAL-02	35-41-46 (87)	18							
4800												
	15											
			SS SPT-03	18-20-23 (43)	18							
4795												
	20											
			MC CAL-03	70/5cm	5							
4790												
	25											
			SS SPT-04	14-17-28 (45)	18							
4785												
	30											
			MC CAL-04	41-70/4cm	10	17.3	46	16	29.3	49.1	21.6	
4780												
	35											
			SS SPT-05	18-50/5cm	11							
4775												
	40											

(Continued Next Page)

CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
								LIQUID LIMIT	PLASTICITY INDEX				
	40		silty SAND (SM), with gravel, trace cobbles, fine to coarse grained, well graded, sub angular, nonplastic to medium plasticity fines, dense to very dense, light brown, dry *(continued)*	MC CAL-05	70/2cm	2							
4770													
	45			SS SPT-06	50/3cm	3							
4765													
	50			MC CAL-06	50/1cm	0.5							

Borehole terminated at 51.5'

NewFields

BH19-21

PAGE 1 OF 1

CLIENT Lithium Nevada		**PROJECT NAME** Thacker Pass Geotechnical Investigation	
PROJECT NUMBER 475.0385.000		**PROJECT LOCATION** Thacker Pass, Nevada	
DATE STARTED 3/13/19	**COMPLETED** 3/13/19	**GROUND ELEVATION** 4782.6 ft	**HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech		**COORDINATES (WGS-84):**	
DRILLING METHOD HSA		**NORTHING** 15147919	**EASTING** 1357756
LOGGED BY M. Erdmann	**CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)** No free water encountered	

NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
		Snow/Mud										
	0	Toe Soil / Root Zone										
		silty SAND (SM), with gravel, fine to coarse grained, well graded, subroudned, nonplastic fines, dense to very dense, light brown, dry										
4780			SS SPT-01	4-18-33 (51)	18	23.5	NP	NP	22.4	60.2	17.4	
	5		MC CAL-01	27-37-68 (105)	18							
4775			SS SPT-02	27-50/4cm	10							
	10		MC CAL-02	57-56-70/5cm	17							
4770												
	15		SS SPT-03	39-50/5cm	11							

Switched to rock core at 16.5'

NF-GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 11/21/19 15:11 - Y:\PROJECTS\0385.000-THACKER PASS LITHIUM NEVADA\L-GEOTECH DATA - ELKO\BOREHOLE LOGS\BOREHOLE SOIL LOGS-CC.19.08.29.GPJ

NewFields

BH19-21

PAGE 1 OF 1

CLIENT Lithium Nevada

PROJECT NAME Thcker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/13/19 **COMPLETED** 3/13/19

GROUND ELEVATION 4782.6 ft **HOLE SIZE** 4.25 in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS84):

DRILLING METHOD HQ Core

NORTHING 15147919 **EASTING** 1357756

LOGGED BY M. Erdmann **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with bentonite chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	15								Surface details: Snow/Mud									
4765		1	3.5	17	0	HW	R1		[Continuation from soil log at 15 feet] Blocky volcanic rock, brown, hgihly weathered, extremely weak rock, very close joint spacing, slightly rough joint surface, oxidization on joint surface				JT		VC		SR	OX
	20	2	3	100	0	HW	R1						JT		VC		SR	OX
4760	25	3	3.5	100	0	HW	R1						JT		VC		SR	OX
4755	30	4	5	100	0	HW	R1						JT		VC		SR	OX
4750	35	5	5	67	0	HW	R1						JT		VC		SR	OX
4745	40	6	5	100	0	HW	R1						JT		VC		SR	OX

Borehole terminated at 40'

NF-GEOTECH ROCK CORE LOG - GINT STD US LAB.GDT - 9/23/19 10:30 - Y:\PROJECTS\0385.000-THACKER PASS LITHIUM NEVADA\L-GEOTECH DATA - ELKO\BOREHOLES\ROCK CORE LOGS-CC.GPJ

BH19-22

PAGE 1 OF 1

CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/15/19 **COMPLETED** 3/15/19

GROUND ELEVATION 4741.9 ft **HOLE SIZE** 4.25in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS-84):

DRILLING METHOD HSA

NORTHING 15148106 **EASTING** 1359052

LOGGED BY M. Erdmann **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Snow/Mud										
			Top Soil / Root Zone										
4740			silty SAND (SM), well graded, fine grained, sub angular, medium dense to dense, light brown, dry										
				SS SPT-01	13-12-11 (23)	18							
	5												
				MC CAL-01	19-37-50 (87)	18							
4735													
				SS SPT-02	50/5cm	5							
	10												
				MC CAL-02	70/4cm	4							

Switched to rock core at 11.5'

NewFields

BH19-22

PAGE 1 OF 1

CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/15/19 **COMPLETED** 3/16/19
GROUND ELEVATION 4741.9 ft **HOLE SIZE** 4.25 in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS84):
DRILLING METHOD HQ Core
NORTHING 15148106 **EASTING** 1359051
LOGGED BY M. Erdmann **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with bentonite chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
4730		1	2	63	0	HW	R1		[Continuation from soil log at 11.5 feet] Blocky volcanic rock, brown, highly weathered, very weak to medium strong rock, very close joint spacing, oxidization on joint surface				JT		VC			OX
		2	2	100	25	HW	R1						JT		VC			OX
4725	15	3	5	100	0	HW	R1						JT		VC			OX
	20	4	2.5	40	0	HW	R1						JT		VC			OX
4720	25	5	4	100	0	HW	R1						JT		VC			OX
4715		6	2.5	100	0	HW	R1						JT		VC			OX
		7	1	75	0	HW	R1						JT		VC			OX
	30	8	2	62	0	HW	R1						JT		VC			OX
4710	35	9	4	43	0	HW	R1						JT		VC			OX
4705	40	10	5	81	42	HW	R1											

Borehole terminated at 40'

BH19-23

PAGE 1 OF 1

CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/15/19 **COMPLETED** 3/15/19
GROUND ELEVATION 4766.2 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS-84):
DRILLING METHOD HSA
NORTHING 15148506 **EASTING** 1358723
LOGGED BY M. Erdmann **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	Snow/Mud										
4765		Top Soil / Root Zone										
		silty SAND (SM), with gravel, fine to coarse grained, well graded, sub angular, nonplastic fines, dense, light brown, dry										
			SS SPT-01	9-41-49 (90)	18	14.6	NP	NP	36.9	45.6	17.5	
4760	5		MC CAL-01	33-70/5cm	11							
			SS SPT-02	12-20-30 (50)	18	11.3	NP	NP	40.2	46.6	13.2	
4755	10		MC CAL-02	70/3cm	3							

Switched to rock core at 11.5'

BH19-23

CLIENT Lithium Nevada

PROJECT NAME Thcker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/15/19 **COMPLETED** 3/15/19

GROUND ELEVATION 4766.2 ft **HOLE SIZE** 4.25 in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS84):

DRILLING METHOD HQ Core

NORTHING 15148506 **EASTING** 1358723

LOGGED BY M. Erdmann **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with bentonite chips and cement grout

Surface details: Snow/Mud

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	10							[Continuation from soil log at 10 feet] Blocky volcanic rock, reddish brown, highly weathered, very weak rock, very close joint spacing, smooth joint suface				JT		VC		S	
4755		1	1.5	30	0	HW	R1										
												JT		VC		S	
		2	2	40	0	HW	R1										
												JT		VC		S	
	15	3	2	40	0	HW	R1										
4750												JT		VC		S	
		4	5	100	8	HW	R1										
	20																
4745												JT		VC		S	
		5	5	100	10	HW	R1										
	25																
4740												JT		VC		S	
		6	5	100	0	HW	R1										
	30																
4735												JT		VC		S	
		7	5	100	20	HW	R1										
	35																
4730												JT		VC		S	
		8	5	37	25	HW	R1										
	40																
4725																	
												JT		VC		S	
	45	9	5	50	0	HW	R1										
4720																	
								Basalt, black, moderately weathered, medium strong rock, close joint spacing, smooth joint surface, calcite alteration on joint surface				JT		C		SR	CA
		10	3	100	77	MW	R3										
	50																

(Continued Next Page)

CLIENT Lithium Nevada

PROJECT NAME Thcker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG					
													TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	50								Basalt, black, moderately weathered, medium strong rock, close joint spacing, smooth joint surface, calcite alteration on joint surface									
									Borehole terminated at 50.5'									

BH19-24

PAGE 1 OF 2

CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/25/19 **COMPLETED** 3/25/19

GROUND ELEVATION 4706.3 ft **HOLE SIZE** 4.25in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS-84):

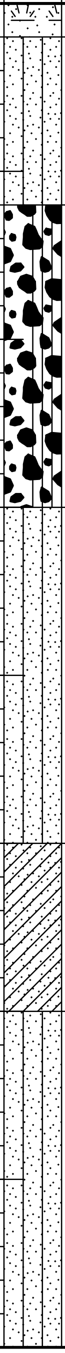
DRILLING METHOD HSA

NORTHING 15148127 **EASTING** 1360558

LOGGED BY C. Coleman **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with cement grout

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
			Snow/Mud										
	0		Top Soil / Root Zone										
4705			silty SAND (SM), with gravel fine to coarse grained sand and gravel, MPS 3.0", sub angular, nonplasitc fines, medium dense to very dense, brown, dry										
				SS SPT-01	16-11-10 (21)	18	15.0	NP	NP	16.6	56.7	26.7	
	5			MC CAL-01	30-34-59 (93)	18							Hard drilling, cobbles and boulders
4700			GRAVEL (GW-GM), with sand and silt, fine to coarse grained, MPS 3.0", sub angular, nonplastic fines, very dense, brown, dry	SS SPT-02	30-50/5cm	11							
	10												
4695				MC CAL-02	19-41-62 (103)	18							
	15												
4690			silty SAND (SM), with gravel, fine to coarse grained, well graded, nonplastic fines, very dense, brown, dry	SS SPT-03	16-33-35 (68)	18	11.6	NP	NP	34.7	52.4	12.9	
	20												
4685				MC CAL-03	70/4cm	4							
	25												
4680			clayey SAND (SC), fine to coarse sand, low to medium plasticity fines, very dense, brown, dry	SS SPT-04	17-49-50/4cm	16							
	30												
4675			silty SAND (SM), fine to coarse grained, poorly graded, medium plasticity fines, very dense, brown, dry, (weathered basalt)	MC CAL-04	45-70	12							
	35												
4670				SS SPT-05	16-31-46 (77)	18	42.5	60	17	1.4	66.1	32.5	
	40												

(Continued Next Page)

CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	40												
4665				MC CAL-05	29-54-70/5cm	17							

Borehole terminated at 41.5'

CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/20/19 **COMPLETED** 3/20/19

GROUND ELEVATION 4734.7 ft **HOLE SIZE** 4.25in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS-84):

DRILLING METHOD HSA

NORTHING 15148804 **EASTING** 1360063

LOGGED BY C. Coleman **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with cement grout

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Snow/Mud										
			Top Soil / Root Zone										
			silty SAND (SM), fine to medium grained, porrly graded, subangular, nonplastic fines, medium dense to very dense, brown, dry										
				SS SPT-01	5-8-8 (16)	18	18.4	NP	NP	5.1	62.2	32.7	
4730	5												
				MC CAL-01	11-17-18 (35)	18							
				SS SPT-02	7-9-9 (18)	18	22.3	NP	NP	1.4	74.1	24.5	
4725	10												
				MC CAL-02	6-16-22 (38)	18							
4720	15												
				SS SPT-03	13-25-25 (50)	18	35.3	NP	NP	0	78.2	21.8	
4715	20												
				MC CAL-03	70/4cm	4							

Switched to rock core at 21.5'

NewFields

BH19-25

PAGE 1 OF 1

CLIENT Lithium Nevada

PROJECT NAME Thcker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/20/19 **COMPLETED** 3/20/19

GROUND ELEVATION 4734.7 ft **HOLE SIZE** 4.25 in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS84):

DRILLING METHOD HQ Core

NORTHING 15148804 **EASTING** 1360063

LOGGED BY C. Coleman **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	20	1	4.5	100	0	HW	R1		[Continuation from soil log at 20 feet] Basalt, black, highly weathered, very weak rock, very close joint spacing, oxidization on joint surface				JT		VC			OX
4710	25	2	4.5	100	0	HW	R1						JT		VC			OX
4705	30	3	5.5	100	0	HW	R1						JT		VC			OX
4700	35	4	5	100	43	HW	R1						JT		VC			OX
4695	40	5	5	95	43	HW	R1						JT		VC			OX
4690 4685	45 50	6	5.5	95	58	HW	R1						JT		VC			OX

Borehole terminated at 50'

NF-GEOTECH ROCK CORE LOG - GINT STD US LAB.GDT - 9/23/19 10:30 - Y:\PROJECTS\0385.000-THACKER PASS LITHIUM NEVADA\L-GEOTECH DATA - ELKO\BOREHOLES\ROCK CORE LOGS-CC.GPJ

BH19-26

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CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/18/19 **COMPLETED** 3/19/19

GROUND ELEVATION 4715.4 ft **HOLE SIZE** 4.25in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS-84):

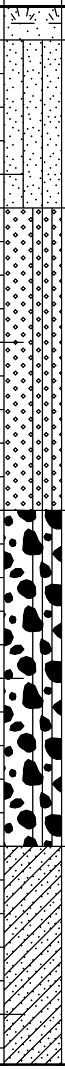
DRILLING METHOD HSA

NORTHING 15147860 **EASTING** 1359848

LOGGED BY C. Coleman **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with cement grout



ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4715	0	Top Soil / Root Zone										
		silty SAND (SM), with gravel, fine to medium sand, fine to coarse gravels, MPS 1.5", sub angular, nonplastic fines, medium dense to dense, lgiht brown, dry										
			SS SPT-01	17-20-21 (41)	18							
4710	5		MC CAL-01	24-18-14 (32)	18	13.5	NP	NP	28.3	54.6	17.1	DD= 80.6 pcf
		SAND (SW-SM), with gravel and silt, fine to corase grained, MPS 1.5", sub angular, nonplastic fines, dense, brown, dry										
			SS SPT-02	16-32-39 (71)	18							
4705	10		MC CAL-02	37-45-70/4cm	16							Increase in gravel size, MPS 2.5"
4700	15	GRAVEL (GW-GM), with sand and silt, fine to corase grained, MPS 2.0", sub angular, nonplastic fines, dense, brown, dry	SS SPT-03	40-50/4cm	10							
4695	20		MC CAL-03	43-70/4cm	10							
4690	25	clayey SAND (SC), trace gravel, fine grained, low plasticity fines, dense, dark brown, dry	SS SPT-04	31-50/4cm	10							
4685	30		MC CAL-04	70-70/3cm	9							

Borehole terminated at 31.5'

NF-GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 11/21/19 15:11 - Y:\PROJECTS\0385.000-THACKER PASS LITHIUM NEVADA\L-GEOTECH DATA - ELKO\BOREHOLE LOGS\BOREHOLE SOIL LOGS-CC.19.08.29.GPJ

NewFields

CLIENT	Lithium Nevada	**PROJECT NAME**	Thacker Pass Geotechnical Investigation
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass, Nevada
DATE STARTED	2/26/19 **COMPLETED** 2/26/19	**GROUND ELEVATION**	5149.1 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR	HazTech	**COORDINATES (WGS-84):**	
DRILLING METHOD	HSA	**NORTHING**	15150690 **EASTING** 1346592
LOGGED BY	M. Walden **CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)**	No free water encountered
NOTES	Backfilled with benontie chips and cement grout		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Snow/Mud										
			Tope Soil / Root Zone										
			SAND (SW-SM), with gravel and silt, fine to coarse grained, well graded, sub angular, very dense, light brown, dry	SS SPT-01									
5145	5			MC CAL-01									
				SS SPT-02	24-28-27 (55)	18							
5140	10												

Switched to rock core at 10'

NewFields

BH19-27

PAGE 1 OF 1

CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 2/26/19 **COMPLETED** 2/26/19
GROUND ELEVATION 5149.1 ft **HOLE SIZE** 4.25 in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS84):
DRILLING METHOD HQ Core
NORTHING 15150690 **EASTING** 1346592
LOGGED BY M. Walden **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with bentonite chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG: TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	10								Surface details: Snow/Mud									
		1	3.5	100	23				(SM) [Continuation from soil log at 10 feet] silty SAND (SM), some clay, trace gravel, well graded, fine to coarse grained, sub angular, very dense, brown to dark grey, some oxidization of clay and ash, moderate cementation of ash layers, planar bedding, (highly weathered blocky volcanic rock)									
5135	15	2	2	90	0													
5130	20	3	5	60	0													
5125	25	4	4.5	78	0													
5120		5	4.5	80	0													

Borehole terminated at 29.5'

NF-GEOTECH ROCK CORE LOG - GINT STD US LAB.GDT - 9/23/19 10:30 - Y:\PROJECTS\0385.000-THACKER PASS LITHIUM NEVADA\L-GEOTECH DATA - ELKO\BOREHOLES\ROCK CORE LOGS-CC.GPJ

NewFields

BH19-28
PAGE 1 OF 1

CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 2/26/19 **COMPLETED** 2/26/19
GROUND ELEVATION 5118.4 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS-84):
DRILLING METHOD HSA
NORTHING 15150289 **EASTING** 1346628
LOGGED BY M. Walden **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	Snow/Mud										
		Top Soil / Root Zone										
		SAND (SW-SM), with silt and gravel, fine to coarse grained, well graded, sub angular, medium dense, light brown, dry										
5115			SS SPT-01	9-16-13 (29)	18							
	5	clayey SAND (SC), with gravel, fine to coarse grained, well graded, sub angular, high plasticity fines, medium dense to very dense, brown, dry	MC CAL-01	14-22-21 (43)	18							
5110			SS SPT-02	16-11-9 (20)	18	15.6	37	21	16.1	43.0	40.9	
	10		MC CAL-02	36-70/3cm	9							
5105												
	15		SS SPT-03	10-29-50/3cm	15							
5100												
	20		MC CAL-03	30-70/3cm	9							
5095												
	25		SS SPT-04	49-50/3cm	9							
5090												
	30		MC CAL-04	36-45-70/4cm	16							

Borehole terminated at 31.5'

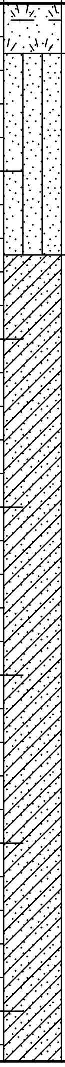
NewFields

BH19-29

PAGE 1 OF 1

CLIENT Lithium Nevada	**PROJECT NAME** Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000	**PROJECT LOCATION** Thacker Pass, Nevada
DATE STARTED 2/28/19 **COMPLETED** 2/28/19	**GROUND ELEVATION** 5077.9 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech	**COORDINATES (WGS-84):**
DRILLING METHOD HSA	**NORTHING** 15149992 **EASTING** 1346657
LOGGED BY M. Walden **CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)** No free water encountered

NOTES Backfilled with benontie chips and cement grout



ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Top Soil / Root Zone										
			silty SAND (SM), with gravel, fine to coarse grained, well graded, angular to sub angular, nonplastic fines, dense to very dense, light brown, moderate cementation, dry										
5075													
				SS SPT-01	29-39-32 (71)	18	12.7	NP	NP	31.5	49.3	19.2	
	5												
				MC CAL-01	14-23-24 (47)	18							
			clayey SAND (SC), fine to coarse grained, well graded, sub angular, low to high plasticity fines, dense to very dense, light brown, dry										
5070													
				SS SPT-02	14-42-24 (66)	18	7.5	31	10	34	44.5	21.5	
	10												
				MC CAL-02	65-70	12							
5065													
	15												
				SS SPT-03	16-16-37 (53)	18	15.3	47	28	18.4	42.8	38.8	
5060													
	20												
				MC CAL-03	70/5cm	5							
5055													
	25												
				SS SPT-04	10-35-26 (61)	18	23.4	62	37	1.1	54.1	44.8	
5050													
	30												
				MC CAL-04	70/5cm	5							

Borehole terminated at 31.5'

BH19-30

PAGE 1 OF 1

CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 2/28/19 **COMPLETED** 2/28/19
GROUND ELEVATION 5038.9 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS-84):
DRILLING METHOD HSA
NORTHING 15149708 **EASTING** 1346680
LOGGED BY M. Walden **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	Snow/Mud										
		Top Soil / Root Zone										
		silty SAND (SM), some gravel, fine to coarse grained, well graded, sub angular, medium dense to very dense, light brown, dry										
5035			SS SPT-01	11-11-8 (19)	18							
	5		MC CAL-01	70/5cm	5							
5030			SS SPT-02	18-26-24 (50)	18							
	10		MC CAL-02	26-31-36 (67)	18							
5025	15		SS SPT-03	20-40-45 (85)	18							
5020	20		MC CAL-03	28-38-61 (99)	18							
5015	25		SS SPT-04	18-20-25 (45)	18							
5010	30		MC CAL-04	15-30-70/5cm	17							

Borehole terminated at 31.5'

BH19-31

PAGE 1 OF 1

CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 2/28/19 **COMPLETED** 2/28/19

GROUND ELEVATION 5089.1 ft **HOLE SIZE** 4.25in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS-84):

DRILLING METHOD HSA

NORTHING 15149855 **EASTING** 1347766

LOGGED BY M. Walden **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free wtaer encountered

NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	Snow/Mud										
		Top Soil / Root Zone										
		clayey SAND (SC), fine to coarse grained, well graded, sub angular, high plasticity fines, medium dense to dense, light brown, dry										
			SS SPT-01	4-6-9 (15)	18							
5085	5											
			MC CAL-01	16-24-60 (84)	18	16.8	61	39	10.1	52.6	37.3	
		silty SAND (SM), fine to coarse grained, well graded, sub rounded, dense, white chalky, dry (ASH)										
			SS SPT-02	18-17-19 (36)	18							
5080	10											
		sandy SILT (ML), trace gravel, fine to coarse grained, well graded, sub rounded, hard, light brown, dry	MC CAL-02	14-28-36/0cm	8							
5075	15											
			SS SPT-03	10-23-27 (50)	18							
5070	20											
			MC CAL-03	16-60-70/5cm	17							
5065	25											
			SS SPT-04	60/4cm	4							
5060			SS SPT-05	49-26-25 (51)	18							
	30											
			MC CAL-04	70/5cm	5							

Borehole terminated at 31.5'

NewFields

BH19-32

PAGE 1 OF 1

CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 2/28/19 **COMPLETED** 2/28/19
GROUND ELEVATION 5062.3 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS-84):
DRILLING METHOD HSA
NORTHING 15150169 **EASTING** 1348329
LOGGED BY M. Walden **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
			Snow/Mud										
	0		Top Soil / Root Zone										
5060			silty SAND (SM), some gravel, trace cobbles, fine to coarse grained, well graded, angular to sub angular, dense to very dense, light brown, dry										
				SS SPT-01	6-15-28 (43)	18							
	5												
				MC CAL-01	32-64-70/5cm	17							
5055													
				SS SPT-02	38-33-37 (70)	18							
	10		calyey SAND (SC), fine grained, poorly graded, high plasticity fines, dense, light brown, dry										
				MC CAL-02	16-32-43 (75)	18							
5050													
	15												
				SS SPT-03	6-16-20 (36)	18	20.3	55	34	7.6	42.9	49.5	
5045													
			silty SAND (SM), fine grained, poorly graded, rounded to sub rounded, very dense, white, dry										
	20												
				MC CAL-03	24-70/3cm	9							
5040													
	25												
				SS SPT-04	29-50/3cm	9							
5035													
	30												
				MC CAL-04	70/5cm	5							

Borehole terminated at 31.5'

NewFields

CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 12/19/19 **COMPLETED** 12/20/19
GROUND ELEVATION 4684 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS-84):
DRILLING METHOD HSA (0-40ft)/Mud Rotary (40-101.5ft)
LATITUDE 15147684 **LONGITUDE** 1361637
LOGGED BY R.Berg **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) 60.2
NOTES Backfilled with bentonite chips to 20ft bgs then grouted with cement to surface

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	Snow/Mud										
		sandy **CLAY (CL)**, fine grained, stiff, low to medium plasticity, brown, slightly moist, with rootlets and interbedded calichi nodules up to 1.5"	SPT	2-3-8 (11)	13							
		well graded **GRAVEL (GW-GM)** with silt and sand, coarse angular mechanically fractured gravel, 2" MPS, very dense, nonplastic, light brown, slightly moist	MC	70/5in	4	10.2	NV	NP	54.4	36.4	9.2	
4680												
	5											
			SPT	27-31-34 (65)	12							fine and coarse gravel
		silty **SAND (SM)** with gravel, fine to coarse sand, fine subangular to angular gravel, 0.5" MPS, dense, nonplastic, light brown, slightly moist	MC	18-20-37 (57)	16	21.1	NV	NP	23	55.1	21.9	
4675												
	10											
			SPT	10-11-9 (20)	15							gravel to 1.5" MPS, medium dense
4670												
	15											
			MC	10-18-22 (40)	17	36.8						decrease in gravel content, red-orange/brown, Dry Density = 68.1pcf
4665												
		clayey **Sand (SC)**, fine sand, very dense, low to medium plasticity, yellow orange to brown, slightly moist, [Highly Weathered Tuff]										
	20											
			SPT	12-38-50 (88)	16							
4660												
	25											
		TUFF light brown to pink and grey, highly to completely weathered, extremely to very weak, fine grained, unfractured, slightly rough	MC	13-27-34 (61)	18	52.4	NV	NP	0	59.8	40.2	
4655												
	30											
			SPT	11-28-28 (56)	18							
4650												
	35											
			MC	15-24-37 (61)	17							
4645												
	40											

(Continued Next Page)

NewFields

CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	40	▨		SPT	11-17-21 (38)	18							
4640		▨											
	45	▨		MC	22-27-34 (61)	18							increased sand content
4635		▨											
	50	▨		SPT	13-17-25 (42)	18							decrease in sand content, high plasticity
4630		▨											
	55	▨		MC	20-34-45 (79)	18							calcite clast inclusion, low to medium plasticity
4625		▨											
	60	▨	▼	SPT	17-38-34 (72)	18							
4620		▨											
	65	▨		MC	43-59-54 (113)	18							large calcite crystals 1/3" dia and gypsum crystalization
4615		▨											
	70	▨		SPT	24-24-43 (67)	18							mm sized black oxide stringers
4610		▨											
	75	▨		MC	45-57-70 (127)	18							black visiculated clasts
4605		▨											
	80	▨		SPT	17-26-35 (61)	18							grey to black, clast size decrease
4600		▨											
	85	▨			40-48-70								large calcite crystallization and calcium carbonate infill (veining).

(Continued Next Page)

CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
								LIQUID LIMIT	PLASTICITY INDEX				
		▨		MC	(118)	18							possible weathered plagioclase inclusion
4595	90	▨											
		▨		SPT	20-35-49 (84)	18							extreamly weak rock, swelling/ high plasticity
4590	95	▨											
		▨		MC	22-39-51 (90)	18							extremely weak to very weak rock, 25% loss of circulation of drilling mud
4585	100	▨											
		▨		SPT	19-25-49 (74)	18							extreamly weak rock, calcite and calcium carbonate veining

Borehole terminated at 101.5ft

NewFields

BH19-34

PAGE 1 OF 1

CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 12/20/19 **COMPLETED** 12/21/20

GROUND ELEVATION 4826 ft **HOLE SIZE** 4.25in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS-84):

DRILLING METHOD HSA

LATITUDE 15150253 **LONGITUDE** 1361637

LOGGED BY R. Berg **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) 97.5

NOTES Backfilled with bentonite chips to 20ft bgs then grouted with cement to surface

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	Snow/Mud										
4825		sandy **SILT (ML)**, fine sand, firm, low plasticity, dark brown, moist	SPT	1-2-4 (6)	13							
			MC	59-70/5in	11		NV	NP	2.7	43.3	54	2/3 inch thick calichi layer Dry Density = 114.1pcf
	5	poorly graded **GRAVEL (GP)** with sand, fine to coarse sand, fine and coarse angular mechacially fractured gravel, 2" MPS, volcanic gravel, very dense, nonplastic, reddish to light brown, slightly moist										
4820			SPT	35-39-46 (85)	15							
		clayey **GRAVEL (GC)** with sand, fine to coarse sand, fine and coarse angular mechanically fractured gravel, 2" MPS, very dense, low plasticity, red to orange, slightly moist	MC	35-70/4in	8							
4815	10	clayey **SAND (SC)** with gravel, fine to coarse sand, fine and coarse angular mechanically fractured gravel, 2" MPS, very dense, high plasticity, red to orange, slightly moist	SPT	17-49-27 (76)	18	14.2	48	24	30.4	35.9	33.7	clay lense, 1.5" thick, stiff, slightly moist
4810	15		MC	21-35-50/3in	15	14						very dense, Dry Density = 89.7pcf

Switched to rock core at 18.5ft

NewFields

BH19-34

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CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 12/20/19 **COMPLETED** 12/21/19
GROUND ELEVATION 4826 ft **HOLE SIZE** 4.25 in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS84):
DRILLING METHOD HQ Core
NORTHING 15150253 **EASTING** 1361637
LOGGED BY R. Berg **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) 97.5ft bgs
NOTES Backfilled with bentonite chips from 20ft bgs then cement grout to surface

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL
	20	1	2	83	83	SW	R3		**TUFF:** red to brown, slightly weathered, medium to stong, moderately fractured, secondary infill of joints with sandy clay and calcium carbonate			
4805	25	2	5	92	83	SW	R1		**CONGLOMERATE:** dark brown, slightly weathered, extermely weak to very weak, unfractured fractured, secondary infill of joints with sandy clay **TUFF:** red to brown, slightly weathered, medium to strong rock, moderately fractured, secondary infill of joints with sandy clay and calcium carbonate			
4800		3	3	94	88	SW	R1		**CONGLOMERATE:** dark brown, slightly weathered, extermely weak to very weak, moderately fractured, brecciated clasts to 2.5" dia., secondary infill of joints with sandy clay			
	30	4	2	83	33	SW	R4		**TUFF:** red to brown, slightly weathered, medium to strong rock, moderately fractured, secondary infill of joints with sandy clay and calcium carbonate **CONGLOMERATE:** light brown, moderately weathered, extermely weak, moderately fractured, brecciated clasts to 2" dia, secondary infill of joints with sandy clay			
4795		5	0.5	50	0	SW	R0					
	35	6	4.5	18	14	SW	R0		**TUFF**: red to brown, slightly weathered, weak to medium rock, moderately fractured, secondary infill of joints with sandy clay			
4790		7	5	100	46	SW	R1		**SANDY SILTSTONE:** brown, slightly weathered very weak, weakly cemented bedding at 12 deg dip, interbedded with minor sandstone and claystone lenses			

DISCONTINUITY LOG

TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
MF		VT	T	SR	No
JT	12	VT	O	SR	CL
JT	0	VT	T	SR	CL
MF		VT	T	SR	No
MF		VT	T	SR	No
MF		VT	T	SR	No
JT	0	VT	T	SR	CL
MF		VT	T	SR	No
MF		VT	T	SR	No
MF		VT	T	SR	No

NF-GEOTECH ROCK CORE LOG - GINT STD US LAB.GDT - 2/21/20 15:27 - S:\PROJECTS\0385.000 THACKER PASS\ROCK CORE LOGS-CC.GPJ

(Continued Next Page)

CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG					
													TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	40	7	5	100	46	SW	R1		**SANDY SILTSTONE:** brown, slightly weathered very weak, weakly cemented bedding at 12 deg dip, interbedded with minor sandstone and claystone lenses									
4785													MF		VT	T	SR	No
		8	5	81	68	SW	R1											
	45												MF		VT	T	SR	No
4780									**CLAYSTONE:** dark brown, slightly weathered, extremely weak, slightly weathered, minor manganese oxide stringers				JT	~90	VT	O	SR	Mno
		9	3	100	75	SW	R0											
													MF		VT	T	SR	No
	50	10	2	100	58	SW	R0		sand content increases									
													MF		VT	T	SR	No
4775									**SANDY SILTSTONE:** brown, very weak, slightly weathered, weakly cemented bedding at 12 deg dip, interbedded with minor sandstone and claystone lenses									
		11	5	100	65	SW	R1											
	55												MF		VT	T	SR	No
4770																		
		12	5	100	56	SW	R1						BD	12	T	O	S	Qz
													BD	12	T	O	S	Qz
	60												MF		VT	T	SR	No
4765		13	5	100	96	SW	R0		**CLAYSTONE:** white to yellow, slightly weathered,									

(Continued Next Page)

CLIENT Lithium Nevada
PROJECT NUMBER 475.0385.000
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
									extremely weak, slightly weathered, minor manganese oxide stringers									
									SILTY SANDSTONE: grey, slightly weathered, extremely to very weak, interbedded with minor sandstone and claystone lenses									
		13	5	100	96	SW	R0											
	65																	
													MF		VT	T	R	No
4760																		
									sand content increases									
		14	5	100	100	SW	R1											
	70																	
													MF		VT	T	R	No
4755																		
		15	5	100	100	SW	R1											
									minor oxidation present									
	75																	
									soft sediment deformation 75.5-77.5'				MF		VT	T	SR	No
4750																		
		16	5	93	93	SW	R0											
	80																	
									iron concretion 1.5" dia				MF		VT	T	SR	No
4745																		
									clay infill in vertical fracture				V	~90	T	O	S	CL
		17	5	93	93	SW	R1											

(Continued Next Page)

CLIENT Lithium Nevada

PROJECT NAME Thcker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
													V	~90	T	O	S	CL
	85	17	5	93	93	SW	R1		**SILTY SANDSTONE:** grey, slightly weathered, extremely to very weak, interbedded with minor sandstone and claystone lenses clay infill in vertical fracture									
													MF		VT	T	SR	No
4740																		
		18	5	78	30	SW	R1											
									CLAYSTONE: white to yellow, slightly weathered, extremely weak, with green clay infill and minor manganese oxide stringers									
	90																	
													MF		VT	T	SR	No
4735																		
		19	5	93	81	SW	R1											
	95																	
													MF		VT	T	SR	No
4730																		
												▼						
		20	5	60	60	SW	R0											
	100																	
									silicification present, medium strong rock									

Borehole terminated at 100.5'

NewFields

BH19-35

PAGE 1 OF 2

CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 12/22/19 **COMPLETED** 12/23/19
GROUND ELEVATION 4717 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS-84):
DRILLING METHOD HSA
LATITUDE 15149078 **LONGITUDE** 1363320
LOGGED BY R. Berg **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) 90.3
NOTES Backfilled with bentonite chips to 20ft bgs then grouted with cement to surface

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	Snow/Mud										
		sandy **SILT (ML)**, fine sand, stiff, grey brown, slightly moist, with rootlets	SPT	2-3-10 (13)	13							
4715												
			MC	6-12-12 (24)	8							calichi layer approximately 2/3 inch thick
	5											
		silty **GRAVEL (GM)** with sand, fine sand, fine subangular gravel, 0.5" MPS, very dense, medium plasticity, light brown to white, slightly moist	SPT	9-50/4in	5							
4710												
			MC	16-21-46 (67)	16	12.4	47	12	44.3	29.4	26.3	fine and coarse angular to subangular gravel, MPS 1.5", Dry density =87.9pcf mechanically fractured gravel, medium plasticity, slightly moist
	10											
			SPT	46-50/2in	5							
4705												
	15											
		clayey **GRAVEL (GC)** with sand, fine to coarse sand, fine and coarse angular mechancially fractured gravel, MPS 1.5", high plasticity	MC	10-14-20 (34)	15	13.5	59	25	36.9	33.1	30	
4700												
	20											
			SPT	11-15-18 (33)	0							
4695												
	25											increased sand content, low plasticity, reddish brown
			MC	62-70/5in	6							
4690												
	30											
			SPT	37-50/4in	8							decrease in sand content, increase in clay content, low to medium plasticity
4685												
	35											
		CLAYSTONE with interbedded siltstone and ash, light brown to grey, slightly weathered, extremely to very weak, fine grained	MC	20-36-70/5in	17	76.2	NV	NP	22.9	63.1	14.0	
4680												
	40											

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CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
								LIQUID LIMIT	PLASTICITY INDEX				
	40	▨		⧗ SPT	10-40-50/5in	17							calcite inclusion with fine grained sand lenses

Switched to rock core at 40ft

BH19-35

CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 12/22/19 **COMPLETED** 12/23/19
GROUND ELEVATION 4717 ft **HOLE SIZE** 4.25 in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS84):
DRILLING METHOD HQ Core
NORTHING 15149078 **EASTING** 1363320
LOGGED BY R. Berg **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) 90.3ft bgs
NOTES Backfilled with bentonite chips from 20ft bgs then cement grout to surface

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
									CLAYSTONE: yellow to light brown, slightly weathered, extremely to very weak, weakly cemented bedding at 8 deg dip, with manganese oxide stringers and interbedded with minor sandstone and siltstone lenses				MF	0	T	0	SR	No
4675																		
		1	4	100	100	SW	R0											
	45								silicification present				MF	0	T	0	SR	No
4670		2	5	100	83	SW	R1											
									silicification present									
	50								**SILTY SANDSTONE:** grey, slightly weathered, very weak to weak, weakly cemented bedding at 0 deg dip, iron oxide staining, grey, interbedded with minor siltstone and claystone lenses				MF JT	0 0	T VT	0 0	SR S	No Ca
													JT JT	0 0	VT VT	0 0	S SR	Ca Fe
4665		3	5	100	100	SW	R1											
													JT	0	VT	0	SR	Fe
	55												MF	0	T	0	SR	No
									CLAYSTONE: marble grey, slightly weak, extremely to very weak, weakly cemented bedding at 0 deg dip, with mno stringers and interbedded with minor sandstone and siltstone lenses									
									SILTY SANDSTONE: greenish gray, slightly weathered, very weak, interbedded with minor siltstone and claystone lenses									
4660		4	5	86	86	SW	R1											
													JT	0	VT	0	SR	Ca
	60												MF	0	T	0	SR	No
		5	4.8	100	100	SW	R1											

(Continued Next Page)

CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
4655		5	4.8	100	100	SW	R1		**SILTY SANDSTONE:** greenish gray, slightly weathered, very weak, interbedded with minor siltstone and claystone lenses									
	65												MF	0	T	0	SR	No
									CLAYSTONE: grey, slightly weathered, very weak, minor manganese oxide stringers, interbedded with minor sandstone and siltstone lenses									
4650		6	5.2	100	100	SW	R0		**ASH:** white to light grey, slightly weathered, extremely weak, interbedded with minor sandstone and claystone lenses, soft sediment deformation									
									SILTY SANDSTONE: grey, slightly weathered, very weak, manganese oxide stringers, interbedded with minor siltstone and claystone lenses									
	70								**CLAYSTONE:** grey to dark grey, slightly weathered, very weak, minor calcite and soft sediment deformation				MF	0	T	0	SR	No
4645		7	5	100	100	SW	R1		**SILTY SANDSTONE:** grey, slightly weathered, very weak, manganese oxide stringers, interbedded with minor siltstone and claystone lenses									
									SILTY SANDSTONE: grey, very weak, slightly weathered, soft sediment deformation									
									SILTY SANDSTONE: grey, very weak, slightly weathered, manganese oxide stringers, interbedded with minor siltstone and claystone lenses, minor soft sediment deformation									
	75												MF	0	T	0	SR	No
4640		8	5	100	100	SW	R1		oxydiation present									
	80								grades coarser and sandier				MF	0	T	0	SR	No
4635		9	2.5	100	100	SW	R0		**ARKOSIC SANDSTONE**: light grey to greenish grey, slightly weathered, very weak, interbedded with minor siltstone and claystone lenses									
									CLAYSTONE: grey to light grey, slightly weathered, extremely weak, interbedded with minor siltstone and sandstone lenses				MF	0	T	0	SR	No
		10	2.5	100	100	SW	R1		**ARKOSIC SANDSTONE:** grey to green, slightly									

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NewFields

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CLIENT Lithium Nevada

PROJECT NAME Thcker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
		10	2.5	100	100	SW	R1	▨	weathered, very weak, minor soft sediment deformation, interbedded with minor siltstone and claystone lenses									
	85							×	**CLAYSTONE grading to SILTY SANDSTONE:** yellowish white, slightly weathered, very weak, interbedded with minor sandstone and siltstone lenses				MF	0	T	0	SR	No
								×	**SANDY SILTSTONE:** light brown, slightly weathered, extremely to very weak, interbedded with minor sandstone and claystone lenses yellow/ green waxy infill									
4630		11	5	100	100	SW	R1											
								▨	**CLAYSTONE:** light grey to light brown, slightly weathered, extremely to very weak, minor soft sediment deformation and manganese oxide stringers, interbedded with minor sandstone and claystone lenses									
	90											▼	MF	0	T	0	SR	No
								×	**SANDY SILTSTONE:** grey to dark grey, slightly weathered, very weak, oxyidation and calcite nodules, with inclustion of conglomeratic basalts with subangular to subrounded clasts, interbedded with minor sandstone and claystone lenses									
4625		12	5	100	100	SW	R1											
	95												MF	0	T	0	SR	No
4620		13	5	100	100	SW	R1											
								⁘	**SILTY SANDSTONE:** geenish grey, slightly weathered, very weak to weak, interbedded with minor siltstone and claystone lenses									
	100							●	**CONGLOMERATE** dark grey, slightly weathered, weak, with cemented subangular to subrounded basaltic clasts				MF	0	T	0	SR	No
		14	3	100	100	SW	R2											
4615																		

Borehole terminated at 103'

BH19-36

NewFields

CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 12/18/19 **COMPLETED** 12/19/19
GROUND ELEVATION 4650 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS-84):
DRILLING METHOD HSA (0-40ft)/Mud Rotary (40-101.5ft)
LATITUDE 15147690 **LONGITUDE** 1365046
LOGGED BY R. Berg **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No accurate water level
NOTES Backfilled with bentonite chips to 20ft bgs then grouted with cement to surface

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4650	0	Snow/Mud										
		sandy **SILT (ML)**, fine sand, minor fine angular gravel, medium dense, brown, slightly moist	SPT	3-4-10 (14)	9							
		silty **SAND (SM)** with gravel, fine sand, fine angular gravel, loose, nonplastic, light brown, slightly moist	MC	11-4-9 (13)	16	14.9						calichi lense roughly 2/3" thick, veining, Dry Density = 77.8pcf
4645	5	clayey **SAND (SC)**, fine sand, very dense, low plasticity, light brown to yellow, slightly moist	SPT	14-21-50/5in	10	19.4	NV	NP	9.1	65.3	25.6	
		silty **GRAVEL (GM)** with sand, fine sand, fine angular gravel, MPS 0.75", very dense, medium plasticity, light brown to yellow, slightly moist	MC	39-70/5in	9	8.7						Dry Density = 90.9pcf
4640	10		SPT	22-37-50/5in	16	10.4	47	18	42.8	35.1	22.1	mechanically fractured gravel calcium carbonate infill
4635	15		SPT	42-50/5in	10							calcium carbonate cementation in matrix
												fine to coarse sand, fine and coarse angular mechanically fractured gravel, MPS 2", low to medium plasticity, brown to light brown
4630	20		MC	70/5in	4							
4625	25		SPT	50/5in	2							fine gravel, MPS 0.5", medium to high plasticity, moist
4620	30		MC	29-70/5in	8							fine and coarse mechanically fractured gravel, MPS 2"
4615	35	clayey **GRAVEL (GC)** with sand, fine sand, fine angular gravel, MPS 0.75", very dense, medium plasticity, light brown to yellow, slightly moist	SPT	16-32-30 (62)	18	13.1	48	27	42.9	42.1	15	oxiidation present, red to brown coloring
4610	40											

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NewFields

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CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4610	40			MC	70/6in	5							no oxidation
4605	45		clayey **SAND (SC)**, fine sand, very dense, low plasticity, grey, slightly moist	SPT	23-43-50/5in	17							
4600	50		**CLAYSTONE**, light brown to light yellow, slightly weathered, extremely to very weak, interbedded with 1-3cm sand layers, low to medium plasticity, unfractured, with calcite nodules and grey green clay infill	MC	14-22-62 (84)	18							
4595	55		**ARCOSIC SANDSTONE**, grey to light brown, slightly weathered, coarse impure/immature sandstone, very weak, bedded with quartz and plagioclase and grey to green mineral olivine/epidote, unfractured	MC	54-70/5in	4							
4590	60		**SILTY SANDSTONE**, grey, slightly weathered, fine grained, very weak, fresh, grey, unfractured	MC	70/6in	4							
4585	65		**CLAYEY SANDSTONE TO CLAYSTONE**, grey, fresh, extremely to very weak, finer grained, unfractured, low plasticity, waxy	MC	23-38-56 (94)	18							
4580	70			MC	19-34-67 (101)	18							low to medium plasticity, light brown to white
4575	75			MC	8-17-37 (54)	18							claystone becomes more laminar
4570	80			MC	15-17-70/5in	17							very waxy
4565	85				37-63-								

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CLIENT Lithium Nevada

PROJECT NUMBER 475.0385.000

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
				MC	70/2in	14							waxy, grey green
4560	90												
				MC	49-58-63 (121)	18							grey, grades sandier
													grey green, very weak, sample stopped on slightly to moderately weathered oxide layer, roughly 2/3 inch thick, sandier, brittle
4555	95												
				MC	42-70/5in	10							
4550	100												
				MC	16-46-70/3in	18							

Borehole terminated at 101.5ft

NewFields

BH19-37

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CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 12/16/19 **COMPLETED** 12/17/19

GROUND ELEVATION 4734 ft **HOLE SIZE** 4.25in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS-84):

DRILLING METHOD HSA

LATITUDE 15150499 **LONGITUDE** 1365030

LOGGED BY R. Berg **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No accurate water level

NOTES Backfilled with bentonite chips to 20ft bgs then grouted with cement to surface

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
								LIQUID LIMIT	PLASTICITY INDEX				
	0		Snow/Mud										
			sandy **SILT (ML)**, fine sand, stiff, medium to high plasticity, slightly moist to moist, brown, with rootlets	SPT	1-4-7 (11)	8							
4730	5		silty **SAND (SM)**, fine sand, very stiff, low to medium plasticity, light brown to brown, slightly moist	MC	10-22-45 (67)	14	24.5	NV	NP	8.4	74.4	17.2	
			silty **GRAVEL (GM)** with sand, fine to coarse sand, fine angular gravel, MPS .25", very dense, nonplastic, slightly moist	SPT	50/4in	2							
4725	10		sandy **GRAVEL (GP)**, trace silt, fine to coarse sand, fine and coarse angular to subangular mechanically fractured gravel, very dense, light brown to brown, nonplastic	MC	23-33-33 (66)	14	5.4	NV	NP	72.2	23.8	4	sand content increases, angular to subangular mechanically fractured gravel, MPS 2", nonplastic
				SPT	32-50	7							

Switched to rock core at 11.5ft

NewFields

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CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 12/16/19 **COMPLETED** 12/17/19
GROUND ELEVATION 4734 ft **HOLE SIZE** 4.25 in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS84):
DRILLING METHOD HQ Core
NORTHING 15150499 **EASTING** 1365030
LOGGED BY R. Berg **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS)
NOTES Backfilled with bentonite chips from 20ft bgs then cement grout to surface

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
		1	1.5	44	0				poorly graded **GRAVEL (GP)** with sand, fine to coarse sand, fine and coarse subangular to subrounded mechanically fractured gravel, MPS 2", very dense, brown, slightly moist									
		2	0.5	100	0													
4720	15	3	2	88	0													
		4	0.5	66	0				clayey **GRAVEL (GC)** with sand, fine to coarse sand, subangular to subrounded mechanically fractured gravel, very dense, medium to high plasticity, brown, slightly moist									
		5	1.5	78	0													
4715	20	6	3.5	57	0													
									CLAYSTONE: light brown and grey, slightly weathered, extremely to very weak, unfractured, very fine grained				MF		VT	T	SR	No
4710	25	7	5	100	100	SW	R0											
									LAMINATED ASH alternating with CLAYSTONE: light brown and white, slightly weathered, very weak, slightly weathered, waxy, fine grained				MF		VT	T	SR	No
													JT		VC	T	S-SR	Mno
4705	30	8	5	43	43	SW	R1											
													MF		VT	T	SR	No
		9	5	100	100	HW	R1											

(Continued Next Page)

CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG					
													TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
									CLAYSTONE with minor ASH LENSES: light brown to pink very weak to weak, moderately to highly weathered, light brown and white, with minor manganese oxide stringers				JT	80	VT	T	S	Mno
4700		9	5	100	100	HW	R1											
	35																	
									very weak, slightly weathered, unfractured with red/pink hydrothermal alteration									
													MF		VT	T	SR	No
		10	5	100	100	SW	R1											
4695																		
	40																	
									extremely weak, highly weathered, red									
													MF		VT	T	SR	No
									very weak, slightly weathered, light brown to white, with minor green clay infill									
		11	5	80	80	HW	R1											
4690																		
													JT		VC	T	S	CL
	45																	
													MF		VT	T	SR	No
		12	5	46	46	SW	R1											
4685																		
													JT		VC	T	S	CL
	50																	
													MF		VT	T	SR	No
													JT		VC	T	S	CL
		13	5	100	100	MW	R1											
									SANDSTONE: grey, moderately weathered, weak, fine to coarse sand, oxidized				JT		VC	T	SR	Mno
4680																		

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NewFields

CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
									SANDSTONE: grey, moderately weathered, weak, fine to coarse sand, oxidized									
	55	13	5	100	100	MW	R1											
									CLAYSTONE: grey, extremely to very weak, slightly weathered, minor ash lamination				MF		VT	T	SR	No
4675		14	5	80	80	SW	R1											
	60																	
													MF		VT	T	SR	No
4670		15	5	56	56	SW	R1						JT		VC	T		Ca
									minor calcium carbonate cementation, weak to medium strong									
	65																	
													MF		VT	T	SR	No
4665		16	5	100	100	SW	R1											
	70																	
									SANDSTONE: grey to tan, slightly weathered, weak to medium strong, unfractured, grey to tan, fine to coarse sand									
													MF		VT	T	SR	No
4660		17	5	56	56	MW	R3											
									CLAYSTONE with minor ASH LENSES: light brown, slightly weathered, very weak, with minor manganese oxide stringers				JT		VC	T		Mno
	75																	
													MF		VT	T	SR	No
		18	5	86	86	SW	R1											

(Continued Next Page)

CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
								▨	**CLAYSTONE with minor ASH LENSES:** light brown, slightly weathered, very weak, with minor manganese oxide stringers									
4655		18	5	86	86	SW	R1	▨										
	80							▨										
								▨	very weak to weak, minor calcium cementation				MF		VT	T	SR	No
		19	5	86	86	SW	R1	▨										
4650								▨										
	85							▨										
								▨					MF		VT	T	SR	No
		20	5	73	73	SW	R1	▨										
4645								▨										
	90							▨										
								⬡	**BASALT:** grey to black, moderately weathered, hydrothermally altered, weak to medium strong, oxidized, intensely fractured				JT MF		VC VT	VT T	SR SR	Mno No
		21	5	53	53	SW	R3	⬡										
4640								⬡										
								⬡					JT		VC	VT	R	Mno
	95							⬡										
								▨	**CLAYSTONE:** white to light brown, slightly weathered, very weak, unfractured				MF		VT	T	SR	No
		22	5	100	100	SW	R1	▨										
4635								▨										
	100							▨										

(Continued Next Page)

CLIENT Lithium Nevada

PROJECT NAME Thcker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG					
													TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
		22	5	100	100	SW	R1	▨	**CLAYSTONE:** white to light brown, slightly weathered, very weak, unfractured									

Borehole terminated at 101'

APPENDIX B.2

Test Pit Logs

TP19-01

PAGE 1 OF 1

CLIENT Lithium Nevada Corporation
PROJECT NAME Thacker Pass Project
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass
DATE STARTED 2/27/19 **COMPLETED** 2/27/19
GROUND ELEVATION 4809 ft **TOTAL PIT DEPTH** 17 ft
EXCAVATION CONTRACTOR Hunewill Construction
COORDINATES ():
EQUIPMENT CAT 320E
NORTHING 15148138 **EASTING** 1357163
LOGGED BY C.Coleman **CHECKED BY** M. Walden
DEPTH TO WATER (FT BGS) No groundwater encountered
NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
						LIQUID LIMIT	PLASTICITY INDEX				
	0		Surface Conditions: Mud								
			lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown (root zone)								
4805	5		silty SAND (SM) with gravel, fine to coarse grained sand and gravel, subrounded to subangular, low plasticity, dry, light brown	GB S-01-19	12.9	NP	NP	11.5	47.6	36.2	Cobbles and boulders present at 3ft up to 16in diameter % Cobble = 4.7
4800 4795	10 15		GRAVEL (GW-GM) with sand and silt, fine to coarse grained sand and gravel, subrounded to subangular, low plasticity, dry, brown	GB S-01-20							Very hard digging at 10ft, blocky volcanic rock, large cobbles and boulders up to 20in diameter

Test pit terminated at 17ft, refusal on blocky volcanics, large boulders

NewFields

TP19-02

PAGE 1 OF 1

CLIENT	Lithium Nevada Corporation	**PROJECT NAME**	Thacker Pass Project
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass
DATE STARTED	2/27/19	**COMPLETED**	2/27/19
GROUND ELEVATION	4789 ft	**TOTAL PIT DEPTH**	15 ft
EXCAVATION CONTRACTOR	Hunewill Construction	**COORDINATES ():**	
EQUIPMENT	CAT 320E	**NORTHING**	15148089
EASTING	1357687		
LOGGED BY	C.Coleman	**CHECKED BY**	M. Walden
DEPTH TO WATER (FT BGS)	No groundwater encountered		
NOTES	Backfilled with excavated material		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Surface Conditions: Mud								
		▨	lean CLAY (CL) with sand, fine grained, medium plasticity, moist, dark brown, (root zone)	GB S-02-17	29.4	33	12	6.5	22	71.5	
4785	5		GRAVEL (GW-GM) with sand and silt, fine to coarse grained sand and gravel, subrounded, nonplastic, dry, brown								Hard digging Caliche layers from 2-3ft Cobbles and boulders at 4ft up to 16in diameter
4780	10			GB S-02-18							Blocky volcanic rock with phenocrysts, extremely hard digging
4775	15										

Test pit terminated at 15ft refusal on blocky volcanics and large boulders

TP19-03

PAGE 1 OF 1

CLIENT Lithium Nevada Corporation

PROJECT NAME Thacker Pass Project

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass

DATE STARTED 2/27/19 **COMPLETED** 2/27/19

GROUND ELEVATION 4743 ft **TOTAL PIT DEPTH** 14 ft

EXCAVATION CONTRACTOR Hunewill Construction

COORDINATES ():

EQUIPMENT CAT 320E

NORTHING 15148047 **EASTING** 1358970

LOGGED BY C.Coleman **CHECKED BY** M. Walden

DEPTH TO WATER (FT BGS) No groundwater encountered

NOTES Backfilled with excavated material

Surface Conditions: Mud

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown, (root zone)								
4740			silty SAND (SM) with gravel, fine to coarse grained sand and gravel, subrounded, nonplastic, dry, brown	GB S-03-27	15.9	37	8	25.4	41.4	33.2	
	5		silty GRAVEL (GM) with sand, fine to coarse grained sand and gravel, subrounded, nonplastic, dry, brown								
4735				GB S-03-28	10.8	NP	NP	47.8	36.4	13.8	Hard digging at 6ft, cobbles and boulders to 16in diameter, blocky volcanics % Cobble = 2.0
	10										
4730											

Test pit terminated at 14ft, refusal on weathered basalt

NewFields

TP19-04

PAGE 1 OF 1

CLIENT	Lithium Nevada Corporation	**PROJECT NAME**	Thacker Pass Project
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass
DATE STARTED	2/27/19	**COMPLETED**	2/27/19
GROUND ELEVATION	4726 ft	**TOTAL PIT DEPTH**	19 ft
EXCAVATION CONTRACTOR	Hunewill Construction	**COORDINATES ():**	
EQUIPMENT	CAT 320E	**NORTHING**	15148120
EASTING	1359692	**LOGGED BY**	C.Coleman
CHECKED BY	M. Walden	**DEPTH TO WATER (FT BGS)**	No groundwater encountered
NOTES	Backfilled with excavated material		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Surface Conditions: Mud	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4725	0		lean CLAY (CL) with sand, fine grained, low plasticity, moist, brown (root zone)								
			silty SAND (SM) with gravel, fine to coarse grained sand and gravel, subangular, nonplastic, dry, light brown	GB S-04-29	31.2	NP	NP	0.7	56.4	42.9	
4720	5		GRAVEL (GW-GM) with sand and silt, fine to coarse grained sand and gravel, subangular, nonplastic, dry, light brown, (ash bed)	GB S-04-30	20.2	NP	NP	49.1	41.1	9.8	Extremely hard digging at 4ft, dense soil layer, ash
4715 4710	10 15		GRAVEL (GW-GM) with sand and silt, fine to coarse grained sand and gravel, subrounded, nonplastic, dry, brown	GB S-04-31							Cobbles and boulders up to 16in diameter at 8ft, blocky volcanics

Test pit terminated at 19ft, (Excavator limits)

CLIENT Lithium Nevada Corporation	**PROJECT NAME** Thacker Pass Project
PROJECT NUMBER 475.0385.000	**PROJECT LOCATION** Thacker Pass
DATE STARTED 2/28/19 **COMPLETED** 2/28/19	**GROUND ELEVATION** 4734 ft **TOTAL PIT DEPTH** 15 ft
EXCAVATION CONTRACTOR Hunewill Construction	**COORDINATES ():**
EQUIPMENT CAT 320E	**NORTHING** 15148825 **EASTING** 1359965
LOGGED BY C.Coleman **CHECKED BY** M. Walden	**DEPTH TO WATER (FT BGS)** No groundwater encountered
NOTES Backfilled with excavated material	

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
			Surface Conditions: Mud			LIQUID LIMIT	PLASTICITY INDEX				
	0		lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown, (root zone)								
4730	5		GRAVEL (GW-GC) with sand and silt, fine to coarse grained sand and gravel, subrounded, low plasticity, moist, brown	GB s-05-33							Cobbles and boulders up to 12in diameter
4725	10		sandy SILT (ML), fine to coarse grained sand, subrounded, low plasticity, damp, brown	GB s-05-34	23.7	41	10	1.4	31.8	66.8	Weathered basalt starting at 10ft, soft digging
4720	15										

Test pit terminated at 15ft, refusal on weathered basalt

TP19-06

PAGE 1 OF 1

CLIENT Lithium Nevada Corporation

PROJECT NAME Thacker Pass Project

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass

DATE STARTED 2/27/19 **COMPLETED** 2/27/19

GROUND ELEVATION 4782 ft **TOTAL PIT DEPTH** 19 ft

EXCAVATION CONTRACTOR Hunewill Construction

COORDINATES ():

EQUIPMENT CAT 320E

NORTHING 15149032 **EASTING** 1358718

LOGGED BY C.Coleman **CHECKED BY** M. Walden

DEPTH TO WATER (FT BGS) No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Surface Conditions: Mud	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
						LIQUID LIMIT	PLASTICITY INDEX				
	0		lean CLAY (CL) with sand, fine grained, medium plasticity, moist, dark brown, (root zone)								
4780			silty SAND (SM) with gravel , fine to coarse grained sand and gravel, subangular, low plasticity, dry, light brown								
	5			GB s-06-25							Hard digging at 7ft, cobbles and boulders up to 24in diameter
4775											
	10		silty GRAVEL (GM) with sand, fine to coarse grained sand and gravel, subrounded, nonplastic, dry, brown								
4770				GB s-06-26	11.2	NP	NP	42.2	33.5	17	% Cobble = 7.3
	15										
4765											

Test pit terminated at 19ft, (Excavator limits)

TP19-07

NewFields

CLIENT Lithium Nevada Corporation	**PROJECT NAME** Thacker Pass Project
PROJECT NUMBER 475.0385.000	**PROJECT LOCATION** Thacker Pass
DATE STARTED 2/26/19 **COMPLETED** 2/26/19	**GROUND ELEVATION** 4811 ft **TOTAL PIT DEPTH** 10 ft
EXCAVATION CONTRACTOR Hunewill Construction	**COORDINATES ():**
EQUIPMENT CAT 320E	**NORTHING** 15148948 **EASTING** 1357817
LOGGED BY C.Coleman **CHECKED BY** M. Walden	**DEPTH TO WATER (FT BGS)** No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Surface Conditions: Snowy-Mud	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0										
4810		▨	lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown, (root zone)								
	5	▨	fat CLAY (CH) with sand, highly plastic, dry, light brown	GB S-07-13	24	55	33	4.6	18.5	71.5	% Cobbles = 5.4
4805			GRAVEL (GW-GM) with sand and silt, fine to coarse grained sand and gravel, subrounded, nonplastic, dry, light brown	GB S-07-14							Hard digging at 8ft, blocky volcanic rock with phenocrysts, boulders up to 24in diameter
	10		BASALT								

Test pit terminated at 10ft, refusal on basalt

NewFields

TP19-08

PAGE 1 OF 1

CLIENT Lithium Nevada Corporation
PROJECT NAME Thacker Pass Project
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass
DATE STARTED 2/26/19 **COMPLETED** 2/26/19
GROUND ELEVATION 4841 ft **TOTAL PIT DEPTH** 13 ft
EXCAVATION CONTRACTOR Hunewill Construction
COORDINATES ():
EQUIPMENT CAT 320E
NORTHING 15148948 **EASTING** 1356973
LOGGED BY C.Coleman **CHECKED BY** M. Walden
DEPTH TO WATER (FT BGS) No groundwater encountered
NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Surface Conditions: Snowy-Mud	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4840	0	▨	lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown								
			silty GRAVEL (GM), with sand, fine to coarse grained gravel, subangular, low plasticity, dry, light brown	GB s-08-15	14.8	37	9	40.5	40.4	19.1	Extremely hard digging
4835	5		GRAVEL (GP-GM) with sand and silt, fine to coarse grained sand and gravel, subrounded, nonplastic, dry, dark brown	GB s-08-16	9.8	NP	NP	44.2	40	10	Blocky vesicular volcanic rock at 6ft, boulders up to 30in diameter % Cobble = 5.8
4830	10										

Test pit terminated at 13ft, refusal on blocky volcanic rock

TP19-09
PAGE 1 OF 1

CLIENT	Lithium Nevada Corporation	**PROJECT NAME**	Thacker Pass Project
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass
DATE STARTED	2/26/19 **COMPLETED** 2/26/19	**GROUND ELEVATION**	4870 ft **TOTAL PIT DEPTH** 15 ft
EXCAVATION CONTRACTOR	Hunewill Construction	**COORDINATES ():**	
EQUIPMENT	CAT 320E	**NORTHING**	15149606 **EASTING** 1356846
LOGGED BY	C.Coleman **CHECKED BY** M. Walden	**DEPTH TO WATER (FT BGS)**	No groundwater encountered
NOTES	Backfilled with excavated material		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4870	0		Surface Conditions: Snowy-Mud								
			lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown								
			silty SAND (SM) with gravel, well graded, fine to coarse grained sand and gravel, subangular to subrounded, nonplastic, dry, light brown								Very hard digging at 2ft Caliche layer from 2-4ft
4865	5			GB s-09-09							
			silty GRAVEL (GM) with sand, trace silt, poorly graded, fine to coarse grained sand and gravel, subangular, medium plasticity, dry, brown								Cobbles and boulders up to 18in diameter at 7ft, digging through volcanic rock
4860	10			GB s-09-10	12.4	55	24	49.3	27.1	16.5	% Cobble = 7.1
4855	15										Very hard digging near the bottom of the test pit

Test pit terminated at 15ft, refusal on blocky volcanics, boulders up to 36in diameter

TP19-10

PAGE 1 OF 1

CLIENT Lithium Nevada Corporation
PROJECT NAME Thacker Pass Project
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass
DATE STARTED 2/27/19 **COMPLETED** 2/27/19
GROUND ELEVATION 4794 ft **TOTAL PIT DEPTH** 7 ft
EXCAVATION CONTRACTOR Hunewill Construction
COORDINATES ():
EQUIPMENT CAT 320E
NORTHING 15149653 **EASTING** 1358668
LOGGED BY C.Coleman **CHECKED BY** M. Walden
DEPTH TO WATER (FT BGS) No groundwater encountered
NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
			Surface Conditions: Mud								
	0	▨	lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown								
			silty SAND (SM) with gravel, fine to coarse grained sand and gravel, subangular, nonplastic, dry, light brown								
4790	5			GB s-10-24	17.1	NP	NP	35	47.5	17.5	Dense layer from 3-7ft, cobbles up to 10in diameter Extremely hard digging
											Ash layer

Test pit terminated at 7ft, refusal on dense cemented soil

NewFields

TP19-11

PAGE 1 OF 1

CLIENT Lithium Nevada Corporation

PROJECT NAME Thacker Pass Project

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass

DATE STARTED 2/27/19 **COMPLETED** 2/27/19

GROUND ELEVATION 4821 ft **TOTAL PIT DEPTH** 15 ft

EXCAVATION CONTRACTOR Hunewill Construction

COORDINATES ():

EQUIPMENT CAT 320E

NORTHING 15149536 **EASTING** 1358054

LOGGED BY C.Coleman **CHECKED BY** M. Walden

DEPTH TO WATER (FT BGS) No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Surface Conditions: Mud	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4820	0		lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown, (root zone)								
			silty SAND (SM) with gravel, fine to coarse grained sand and gravel, subrounded, low plastic, dry, light brown	GB S-11-21							
4815 4810	5 10		GRAVEL (GP-GM) with sand and silt, fine to coarse grained sand and gravel, subrounded, nonplastic, dry, brown	GB S-11-22	8.1	NP	NP	48.4	38.5	10.3	Extremely hard digging at 5ft, blocky volcanics, cobbles and boulders up to 24in diameter % Cobble = 2.8 Cobbles up to 12in diameter
	15		SAND (SW-SM) with gravel and silt, fine to coarse grained sand and gravel, subrounded, low plasticity, dry, brown	GB S-11-23							Weathered basalt at 13ft

Test pit terminated at 15ft refusal on weathered basalt

TP19-12

CLIENT Lithium Nevada Corporation
PROJECT NAME Thacker Pass Project
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass
DATE STARTED 2/27/19 **COMPLETED** 2/27/19
GROUND ELEVATION 4805 ft **TOTAL PIT DEPTH** 17 ft
EXCAVATION CONTRACTOR Hunewill Construction
COORDINATES ():
EQUIPMENT CAT 320E
NORTHING 15149781 **EASTING** 1359981
LOGGED BY C.Coleman **CHECKED BY** M. Walden
DEPTH TO WATER (FT BGS) No groundwater encountered
NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
						LIQUID LIMIT	PLASTICITY INDEX				
4805	0		Surface Conditions: Mud								
			lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown								
			GRAVEL (GP-GM) with silt and sand, fine to coarse grained sand and gravel, subrounded, nonplastic, dry, light brown								Hard digging
											Cobbles and boulders at 4ft up to 24in diameter
4800	5			GB s-12-32							
											Blocky volcanics at 8ft
4795	10										
4790	15										

Test pit terminated at 17ft, refusal on blocky volcanics

TP19-13

PAGE 1 OF 1

CLIENT Lithium Nevada Corporation

PROJECT NAME Thacker Pass Project

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass

DATE STARTED 2/27/19 **COMPLETED** 2/27/19

GROUND ELEVATION 4830 ft **TOTAL PIT DEPTH** 19 ft

EXCAVATION CONTRACTOR Hunewill Construction

COORDINATES ():

EQUIPMENT CAT 320E

NORTHING 15150438 **EASTING** 1359953

LOGGED BY C.Coleman **CHECKED BY** M. Walden

DEPTH TO WATER (FT BGS) No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4830	0		Surface Conditions: Mud								
			lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown								
			GRAVEL (GP-GM) with sand and silt, fine coarse grained sand and gravel, subrounded, nonplastic, dry, light brown								Blocky volcanic rock at 2ft, extremely hard digging, cobbles and boulders
				GB s-13-31	15.5	52	22	55.6	33.6	10.8	Cobbles up to 12in diameter
4825	5										
			clayey SAND (SC) with gravel, fine to coarse grained sand and gravel, subangular, medium plasticity, dry, light brown								soft digging
4820	10										
				GB s-13-32	30.9	66	34	20.3	32.3	47.4	Cobbles up to 8in diameter
4815	15										

Test pit terminated at 19ft, (Excavator limits)

TP19-14

CLIENT Lithium Nevada Corporation		**PROJECT NAME** Thacker Pass Project	
PROJECT NUMBER 475.0385.000		**PROJECT LOCATION** Thacker Pass	
DATE STARTED 2/28/19	**COMPLETED** 2/28/19	**GROUND ELEVATION** 4795 ft	**TOTAL PIT DEPTH** 19 ft
EXCAVATION CONTRACTOR Hunewill Construction		**COORDINATES ():**	
EQUIPMENT CAT 320E		**NORTHING** 15150356	**EASTING** 1358895
LOGGED BY C.Coleman	**CHECKED BY** M. Walden	**DEPTH TO WATER (FT BGS)** No groundwater encountered	

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4795	0		Surface Conditions: Mud								
		▨	lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown, (root zone)								
			GRAVEL (GW-GM) with silt and sand, fine to coarse grained sand and gravel, subangular, nonplastic, dry, light brown	GB s-14-48							Cobbles up to 8in diameter
4790	5										
			GRAVEL (GW) with sand, fine to coarse grained sand and coarse gravel, subangular, nonplastic, dry, brown								
4785	10			GB s-24-49	25.7	NP	NP	60.9	35.1	4	Weathered basalt at 8ft
4780	15										

Test pit terminated at 19ft, (Excavator limits)

TP19-15

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CLIENT Lithium Nevada Corporation

PROJECT NAME Thacker Pass Project

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass

DATE STARTED 2/28/19 **COMPLETED** 2/28/19

GROUND ELEVATION 4888 ft **TOTAL PIT DEPTH** 14 ft

EXCAVATION CONTRACTOR Hunewill Construction

COORDINATES ():

EQUIPMENT CAT 320E

NORTHING 15150334 **EASTING** 1357707

LOGGED BY C.Coleman **CHECKED BY** M. Walden

DEPTH TO WATER (FT BGS) No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
						LIQUID LIMIT	PLASTICITY INDEX				
	0		Surface Conditions: Mud								
			lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown, (root zone)								
4885			silty GRAVEL (GM) with sand, fine to coarse grained sand and gravel, subangular, nonplastic, dry, light brown	GB s-15-41							Cobbles up to 6in diameter
	5										
			silty SAND (SM) with gravel, fine to coarse grained sand and gravel, nonplastic, dry, brown								Blocky volcanics at 6ft, cobbles up to 8in diameter
4880											
	10			GB s-15-42	22.7	NP	NP	40.3	46.2	13.5	
4875											

Test pit terminated at 14ft, refusal on weathered basalt

TP19-16

CLIENT Lithium Nevada Corporation

PROJECT NAME Thacker Pass Project

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass

DATE STARTED 2/26/19 **COMPLETED** 2/26/19

GROUND ELEVATION 4858 ft **TOTAL PIT DEPTH** 15 ft

EXCAVATION CONTRACTOR Hunewill Construction

COORDINATES ():

EQUIPMENT CAT 320E

NORTHING 15149833 **EASTING** 1357251

LOGGED BY C.Coleman **CHECKED BY** M. Walden

DEPTH TO WATER (FT BGS) No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
						LIQUID LIMIT	PLASTICITY INDEX				
	0		Surface Conditions: Snowy-Mud								
			lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown (root zone)								
4855	5		silty SAND (SM) with gravel, well graded, fine to medium grained sand, fine to coarse gravel, subrounded, nonplastic, dry, light brown	GB s-16-11							Cobbles up to 5in diameter
4850 4845	10 15		silty SAND (SM) with gracel, fine to coarse grained sand and gravel, low plastic, subangular, dry, brown	GB s-16-12	28.9	58	21	25.1	36.3	38.6	Very hard digging at 6ft, cobbles and boulders, blocky volcanic rock Cobbles and boulders up to 18in diameter

Test pit terminated at 15ft on blocky volcanics

TP19-17

PAGE 1 OF 1

CLIENT Lithium Nevada Corporation		**PROJECT NAME** Thacker Pass Project	
PROJECT NUMBER 475.0385.000		**PROJECT LOCATION** Thacker Pass	
DATE STARTED 2/28/19	**COMPLETED** 2/28/19	**GROUND ELEVATION** 4930 ft	**TOTAL PIT DEPTH** 19 ft
EXCAVATION CONTRACTOR Hunewill Construction		**COORDINATES ():**	
EQUIPMENT CAT 320E		**NORTHING** 15150600	**EASTING** 1357532
LOGGED BY C.Coleman	**CHECKED BY** M. Walden	**DEPTH TO WATER (FT BGS)** No groundwater encountered	
NOTES Backfilled with excavated material			

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4930	0		Surface Conditions: Mud								
			lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown (root zone)								
			silty SAND (SM) some gravel, fine to medium grained sand, fine to coarse gravel, subrounded, nonplastic, dry, light brown								
4925	5			GB S-17-39	21.3	NP	NP	8.6	65.7	25.7	Increased gravel content at 6ft
4920	10										
			GRAVEL (GP-GM) with sand and silt, fine to coarse grained sand and gravel, low plastic, subangular, dry, brown								Weathered basalt at 12ft, cobbles up to 10in diameter
4915	15			GB S-17-40							

Test pit terminated at 19ft (Excavator limits)

NewFields

TP19-18

PAGE 1 OF 1

CLIENT Lithium Nevada Corporation
PROJECT NAME Thacker Pass Project
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass
DATE STARTED 2/28/19 **COMPLETED** 2/28/19
GROUND ELEVATION 4899 ft **TOTAL PIT DEPTH** 12 ft
EXCAVATION CONTRACTOR Hunewill Construction
COORDINATES ():
EQUIPMENT CAT 320E
NORTHING 15150981 **EASTING** 1357833
LOGGED BY C.Coleman **CHECKED BY** M. Walden
DEPTH TO WATER (FT BGS) No groundwater encountered
NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Surface Conditions: Mud								
		▨	lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown (root zone)								
		▨	sandy silty CLAY (CL-ML), fine to coarse grained sand, low plasticity, dry, brown								
4895	5										
				✋ GB s-18-43	10.9	28	7	0.2	37.2	62.6	Weathered Basalt starting at 6ft
4890	10										Hard digging at 10ft

Test pit terminated at 12ft, refusal on weathered basalt

NewFields

TP19-19

PAGE 1 OF 1

CLIENT Lithium Nevada Corporation

PROJECT NAME Thacker Pass Project

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass

DATE STARTED 2/28/19 **COMPLETED** 2/28/19

GROUND ELEVATION 4813 ft **TOTAL PIT DEPTH** 9 ft

EXCAVATION CONTRACTOR Hunewill Construction

COORDINATES ():

EQUIPMENT CAT 320E

NORTHING 15150922 **EASTING** 1358932

LOGGED BY C.Coleman **CHECKED BY** M. Walden

DEPTH TO WATER (FT BGS) No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Surface Conditions: Mud								
			lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown (root zone)								
4810			GRAVEL (GW-GM) with sand and silt, fine to coarse grained sand and gravel, subrounded to subangular, low plasticity, dry, brown								
	5			GB s-19-46							Very hard digging at 5ft, cobbles and boulders up to 36in diameter
4805											
			Test pit terminated at 9ft, refusal on cemented blocky volcanic rock								

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NewFields

TP19-20
PAGE 1 OF 1

CLIENT	Lithium Nevada Corporation	**PROJECT NAME**	Thacker Pass Project
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass

DATE STARTED 3/1/19 **COMPLETED** 3/1/19

GROUND ELEVATION 4808 ft **TOTAL PIT DEPTH** 19 ft

EXCAVATION CONTRACTOR Hunewill Construction

COORDINATES ():

EQUIPMENT CAT 320E

NORTHING 15151075 **EASTING** 1360089

LOGGED BY C.Coleman **CHECKED BY** M. Walden

DEPTH TO WATER (FT BGS) No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	Surface Conditions: Frozen Ground								
		lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown (root zone)								
4805		silty SAND (SM) with gravel, fine to coarse grained sand and gravel, subangular, nonplastic, dry, light brown								Cobbles up to 6in diameter
	5									
4800			GB 3-20-50	22.5	NP	NP	11.7	64.5	23.8	
	10									
4795										
	15									
4790		SAND (SW-SC) with clay and gravel, fine to coarse grained sand and gravel, subangular, low plasticity, dry, light brown	GB s-20-51							Cobbles up to 6in diameter

Test pit terminated at 19ft, (Excavator limits)

TP19-21

CLIENT Lithium Nevada Corporation	**PROJECT NAME** Thacker Pass Project
PROJECT NUMBER 475.0385.000	**PROJECT LOCATION** Thacker Pass
DATE STARTED 2/28/19 **COMPLETED** 2/28/19	**GROUND ELEVATION** 4926 ft **TOTAL PIT DEPTH** 13 ft
EXCAVATION CONTRACTOR Hunewill Construction	**COORDINATES ():**
EQUIPMENT CAT 320E	**NORTHING** 15151169 **EASTING** 1357072
LOGGED BY C.Coleman **CHECKED BY** M. Walden	**DEPTH TO WATER (FT BGS)** No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
						LIQUID LIMIT	PLASTICITY INDEX				
	0		Surface Conditions: Mud								
4925			lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown, (root zone)								
			silty SAND (SM) trace gravels, fine to coarse grained sand and gravel, subrounded, nonplastic, damp, light brown								
	5			GB s-21-37	13.1	NP	NP	1.1	55.1	43.8	
4920			GRAVEL (GP-GC) with sand, trace clay, fine to coarse grained sand and gravel, subrounded, low plasticity, dry, brown								Cobbles up to 8in diameter
	10			GB s-21-38							Blocky volcanics starting at 8ft, cobble and boulders, hard digging
4915											

Test pit terminated at 13ft, refusal on basalt

TP19-22

PAGE 1 OF 1

CLIENT	Lithium Nevada Corporation	**PROJECT NAME**	Thacker Pass Project
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass
DATE STARTED	2/28/19	**COMPLETED**	2/28/19
GROUND ELEVATION	4887 ft	**TOTAL PIT DEPTH**	17 ft
EXCAVATION CONTRACTOR	Hunewill Construction	**COORDINATES ():**	
EQUIPMENT	CAT 320E	**NORTHING**	15151484
EASTING	1357823		
LOGGED BY	C.Coleman	**CHECKED BY**	M. Walden
DEPTH TO WATER (FT BGS)	No groundwater encountered		
NOTES	Backfilled with excavated material		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
						LIQUID LIMIT	PLASTICITY INDEX				
	0		Surface Conditions: Mud								
		▨	lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown (root zone)								
4885	5		GRAVEL (GW-GM) with sand and silt, fine to coarse grained sand and gravel, subangular, nonplastic, dry, light brown	GB s-22-44							Cobble and boulders at 4ft up to 12in diameter Lake bed at 6ft
4880			SAND (SW) with gravel, fine to coarse grained gravel, coarse sand, subangular, nonplastic, dry, brown								
	10			GB s-22-45	4.8	NP	NP	47	48.2	4.8	
4875	15										
4870			WEATHERED BASALT								

Test pit terminated at 17ft, refusal on weathered basalt

NewFields

TP19-23

PAGE 1 OF 1

CLIENT Lithium Nevada Corporation
PROJECT NAME Thacker Pass Project
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass
DATE STARTED 2/28/19 **COMPLETED** 2/28/19
GROUND ELEVATION 4869 ft **TOTAL PIT DEPTH** 15 ft
EXCAVATION CONTRACTOR Hunewill Construction
COORDINATES ():
EQUIPMENT CAT 320E
NORTHING 15151512 **EASTING** 1358920
LOGGED BY C.Coleman **CHECKED BY** M. Walden
DEPTH TO WATER (FT BGS) No groundwater encountered
NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
						LIQUID LIMIT	PLASTICITY INDEX				
	0		Surface Conditions: Mud								
		▨	lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown, (root zone)								Very hard digging at 2ft on blocky volcanic rock, boulders up to 36in diameter
		⁙	SAND (SP-SM) with gravel and silt, fine to coarse grained sand and gravel, subangular, nonplastic, dry, brown								
4865											
	5										
				GB s-23-47	8.6	NP	NP	30.7	57.4	11.9	
4860											
	10										
4855											
	15										

Test pit terminated at 15ft, refusal on slightly weathered basalt

TP19-24

PAGE 1 OF 1

CLIENT Lithium Nevada Corporation

PROJECT NAME Thacker Pass Project

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass

DATE STARTED 3/1/19 **COMPLETED** 3/1/19

GROUND ELEVATION 4819 ft **TOTAL PIT DEPTH** 19 ft

EXCAVATION CONTRACTOR Hunewill Construction

COORDINATES ():

EQUIPMENT CAT 320E

NORTHING 15151498 **EASTING** 1360066

LOGGED BY C.Coleman **CHECKED BY** M. Walden

DEPTH TO WATER (FT BGS) No groundwater encountered

NOTES Backfilled with excavated material

Surface Conditions: Frozen Ground

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown, (root zone)								
			GRAVEL (GP-GM) with silt and sand, fine to coarse grained sand and gravel, subrounded, nonplastic, dry, light brown								Hard digging, cobbles up to 8in diameter
4815	5			GB s-24-52							
4810	10		clayey SAND (SC) trace gravel, fine to coarse grained sand and gravel, subangular, medium plasticity, dry, brown								Cobbles up to 5in diameter
4805	15			GB s-24-53	33.9	68	35	5.6	58.7	35.7	
											Weathered basalt at 17ft
4800											

Test pit terminated at 19ft (Excavator limits)

NewFields

TP19-25

CLIENT Lithium Nevada Corporation
PROJECT NAME Thacker Pass Project
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass
DATE STARTED 2/26/19 **COMPLETED** 2/26/19
GROUND ELEVATION 5002 ft **TOTAL PIT DEPTH** 19 ft
EXCAVATION CONTRACTOR Hunewill Construction
COORDINATES ():
EQUIPMENT CAT 320E
NORTHING 15148304 **EASTING** 1349394
LOGGED BY C.Coleman **CHECKED BY** M. Walden
DEPTH TO WATER (FT BGS) No groundwater encountered
NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Surface Conditions: Snowy-Mud	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown, (root zone)								
5000			SAND (SP-SM) with gravel and silt, poorly graded fine to coarse grained sand and gravel, angular, nonplastic, dry, light brown	GB s-25-05							Caliche layers from 1-4ft
4995	5		GRAVEL (GP) with sand, fine to coarse grained sand and gravel, subrounded to subangular, nonplastic, dry, brown								Weathered Basalt starting at 4ft and extending to depth of pit
4990	10			GB s-25-06	8.1	NP	NP	52.9	35.7	2.9	% Cobble = 8.5
4985	15										

Test pit terminated at 19ft (Excavator limits)

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NewFields

TP19-26

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CLIENT Lithium Nevada Corporation
PROJECT NAME Thacker Pass Project
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass
DATE STARTED 2/26/19 **COMPLETED** 2/26/19
GROUND ELEVATION 4989 ft **TOTAL PIT DEPTH** 11 ft
EXCAVATION CONTRACTOR Hunewill Construction
COORDINATES ():
EQUIPMENT CAT 320E
NORTHING 15148181 **EASTING** 1349408
LOGGED BY C.Coleman **CHECKED BY** M. Walden
DEPTH TO WATER (FT BGS) No groundwater encountered
NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Surface Conditions: Snowy-Mud								
			lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown, (root zone)								Test pit located in NDOT gravel borrow
4985	5		silty SAND (SM) with gravel, well graded, fine to coarse grained sand and gravel, subrounded, nonplastic, damp, light brown	GB S-26-07							Potential backfill, gravel up to 2in diameter
			clayey SAND (SC) with gravel, fine to coarse grained sand and gravel, subrounded to subangular, medium plasticity, dry, light brown	GB S-26-08	20.9	53	32	15.9	55.9	28.2	Cobbles up to 6in diameter
4980	10		WEATHERED BASALT								

Test pit terminated at 11ft, refusal on basalt rock

TP19-27
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CLIENT Lithium Nevada Corporation
PROJECT NAME Thacker Pass Project
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass
DATE STARTED 2/26/19 **COMPLETED** 2/26/19
GROUND ELEVATION 4990 ft **TOTAL PIT DEPTH** 16 ft
EXCAVATION CONTRACTOR Hunewill Construction
COORDINATES ():
EQUIPMENT CAT 320E
NORTHING 15148429 **EASTING** 1349841
LOGGED BY C.Coleman **CHECKED BY** M. Walden
DEPTH TO WATER (FT BGS) No groundwater encountered
NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
						LIQUID LIMIT	PLASTICITY INDEX				
4990	0		Surface Conditions: Snowy-Mud								
			lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown, (root zone)								Hard digging, caliche layer from 2-4ft, cobbles up to 12in diameter
			silty SAND (SM) with gravel, fine to coarse grained sand and gravel, subangular, nonplastic, light brown, dry	GB s-27-01	22.5	NP	NP	21.0	60.8	15.8	Caliche layer from 2-4ft
4985	5										
			GRAVEL (GP-GM) with sand and silt, fine to coarse grained sand and gravel, subrounded, low plasticity to nonplastic, dry, light brown	GB s-27-02							Cobbles up to 12in diameter
4980	10										
4975	15										

Test pit terminated at 16ft, refusal on basalt rock

% Cobble = 2.4

NewFields

TP19-28

PAGE 1 OF 1

CLIENT Lithium Nevada Corporation

PROJECT NAME Thacker Pass Project

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass

DATE STARTED 2/26/19 **COMPLETED** 2/26/19

GROUND ELEVATION 4988 ft **TOTAL PIT DEPTH** 19 ft

EXCAVATION CONTRACTOR Hunewill Construction

COORDINATES ():

EQUIPMENT CAT 320E

NORTHING 15148295 **EASTING** 1349799

LOGGED BY C.Coleman **CHECKED BY** M. Walden

DEPTH TO WATER (FT BGS) No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Surface Conditions: Snowy-Mud	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	▨	lean CLAY (CL) with sand, fine grained, poorly graded, low to medium plasticity, moist, brown, (root zone)								
4985		▨	fat CLAY (CH) with sand, fine to coarse grained sand, highly plastic, moist, brown	GB s-28-03	30.7	63	37	4.4	16.1	79.5	Hard digging Caliche layer 3-3.5ft
4980	5	●	GRAVEL (GW-GM) with sand, trace silt, well graded, fine to coarse grained sand and gravel, subrounded to subangular, nonplastic, dry, brown	GB s-28-04	6.6	NP	NP	50.1	43.0	5.5	% Cobble = 1.4 Cobbles and boulders increase 8" up to 30in diameter
4975	10	●									
4970	15	●									

Test pit terminated at 19ft (Excavator limits)

TP19-29
PAGE 1 OF 1

NewFields

CLIENT Lithium Nevada Corporation
PROJECT NAME Thacker Pass Project
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass
DATE STARTED 2/28/19 **COMPLETED** 2/28/19
GROUND ELEVATION 4707 ft **TOTAL PIT DEPTH** 19 ft
EXCAVATION CONTRACTOR Hunewill Construction
COORDINATES ():
EQUIPMENT CAT 320E
NORTHING 15148153 **EASTING** 1360598
LOGGED BY C.Coleman **CHECKED BY** M. Walden
DEPTH TO WATER (FT BGS) No groundwater encountered
NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
						LIQUID LIMIT	PLASTICITY INDEX				
	0		Surface Conditions: Mud								
			lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown, (root zone)								
4705			silty SAND (SM) with gravel, fine to coarse grained sand and gravel, subrounded, nonplastic, dry, light brown								Hard digging at 3ft
	5			GB S-29-35	8.1	NP	NP	37.7	42.9	14.6	% Cobble = 4.8
4700											
	10		GRAVEL (GW-GC) with sand and trace clay, fine to coarse grained sand and gravel, subangular, low plasticity, dry, brown								
4695				GB S-29-36							
	15										
4690											Basalt encountered at bottom of test pit

Test pit terminated at 19ft (Excavator limits)

NewFields

TP19-30

PAGE 1 OF 1

CLIENT Lithium Nevada Corporation
PROJECT NAME Thacker Pass Project
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass
DATE STARTED 12/17/19 **COMPLETED** 12/17/19
GROUND ELEVATION 4696 ft **TOTAL PIT DEPTH** 16 ft
EXCAVATION CONTRACTOR Hunewill Construction
COORDINATES ():
EQUIPMENT CAT 320E
NORTHING 41.7023 **EASTING** 118.02125
LOGGED BY M. Erdmann **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No groundwater encountered
NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Surface Conditions: Frozen Ground	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4695	0		TOPSOIL (CL), loose, wet, dark brown	GB 30-01							
			silty SAND (SM), trace gravel, poorly graded, dense, subrounded, dry, brown, weakly cemented								
	5			GB 30-02	21.5	NP	NP	26.6	58.1	15.3	
4690			some caliche								
			very dense, damp, cemented at 7-9ft								
	10		silty SAND (SM), poorly graded, dense subrounded, damp, grayish brown								
4685											
				GB 30-03							
	15										
4680											

Test pit terminated at 16ft (Excavator limits)

TP19-31

PAGE 1 OF 1

CLIENT Lithium Nevada Corporation
PROJECT NAME Thacker Pass Project
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass
DATE STARTED 12/17/19 **COMPLETED** 12/17/19
GROUND ELEVATION 4722 ft **TOTAL PIT DEPTH** 10 ft
EXCAVATION CONTRACTOR Hunewill Construction
COORDINATES ():
EQUIPMENT CAT 320E
NORTHING 41.40443 **EASTING** 118.02126
LOGGED BY M. Erdmann **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No groundwater encountered
NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
						LIQUID LIMIT	PLASTICITY INDEX				
	0		Surface Conditions: Frozen Ground								
		▨	TOPSOIL (CL), loose, wet, dark brown	GB 31-01							
4720			silty SAND (SM), some gravels, dense to very dense, subrounded, dry grayish brown, moderately cemented caliche								
	5			GB 31-02	11.0	NP	NP	4.1	51.1	44.8	
4715											
	10										

Test pit terminated at 10ft (Practical refusal)

TP19-32

PAGE 1 OF 1

CLIENT	Lithium Nevada Corporation	**PROJECT NAME**	Thacker Pass Project
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass
DATE STARTED	12/17/19	**COMPLETED**	12/17/19
GROUND ELEVATION	4738 ft	**TOTAL PIT DEPTH**	16 ft
EXCAVATION CONTRACTOR	Hunewill Construction	**COORDINATES ():**	
EQUIPMENT	CAT 320E	**NORTHING**	41.70615
EASTING	118.02129		
LOGGED BY	M. Erdmann	**CHECKED BY**	K. Magner
DEPTH TO WATER (FT BGS)	No groundwater encountered		
NOTES	Backfilled with excavated material		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Surface Conditions: Frozen Ground	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		TOPSOIL (CL), loose, wet, dark brown	GB 32-01							
4735	5		SILT (ML), with sand, poorly graded, loose, subrounded, dry, light gray	GB 32-02	12.6	NP	NP	0.8	38.4	60.8	DD: 101.9 pcf, OMC: 21.1%
4730 4725	10 15		GRAVEL with sand and some cobbles (GP), poorly graded, dense, subrounded, damp, reddish brown	GB 32-03							

Test pit terminated at 16ft (Excavator limits)

TP19-33

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CLIENT Lithium Nevada Corporation
PROJECT NAME Thacker Pass Project
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass
DATE STARTED 12/17/19 **COMPLETED** 12/17/19
GROUND ELEVATION 4676 ft **TOTAL PIT DEPTH** 15 ft
EXCAVATION CONTRACTOR Hunewill Construction
COORDINATES ():
EQUIPMENT CAT 320E
NORTHING 41.70235 **EASTING** 118.01813
LOGGED BY M. Erdmann **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No groundwater encountered
NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
						LIQUID LIMIT	PLASTICITY INDEX				
	0		Surface Conditions: Frozen Ground								
4675			TOPSOIL (CL), loose, wet, dark brown	GB 33-01							
			clayey GRAVEL (GC), poorly graded, dense, subrounded, dry, grayish brown, moderately cemented	GB 33-02							
			clayey GRAVEL (GC), with some cobbles and boulders, dense, subrounded, damp, reddish brown								
4670	5										
				GB 33-03	15.2	48	25	47.0	28.8	24.2	
4665	10										
	15										

Test pit terminated at 15ft (Practical refusal)

NF-GEOTECH TEST PIT - GINT STD US LAB.GDT - 2/24/20 08:41 - P:\PROJECTS\0385.000 LITHIUM NEVADA THACKER PASS PROJECT\L-GEOTECH DATA\FIELD INVESTIGATION\TEST PITS\DEC2019_TEST PIT LOGS\THACKER PASS TEST PIT LOGS.GPJ

TP19-34

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CLIENT Lithium Nevada Corporation

PROJECT NAME Thacker Pass Project

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass

DATE STARTED 12/17/19 **COMPLETED** 12/17/19

GROUND ELEVATION 4699 ft **TOTAL PIT DEPTH** 12 ft

EXCAVATION CONTRACTOR Hunewill Construction

COORDINATES ():

EQUIPMENT CAT 320E

NORTHING 41.70426 **EASTING** 118.01816

LOGGED BY M. Erdmann **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Surface Conditions: Frozen Ground	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		TOPSOIL (CL), loose, wet, dark brown	GB 34-01							
			clayey GRAVEL (GC), with sand, some cobbles, poorly graded, dense, subrounded, dry, light brown	GB 34-02							
4695	5										
			some boulders, moist, reddish brown								
4690	10			GB 34-03	6.4	46	27	58.1	23.8	18.1	DD: 124.2 pcf, OMC: 9.0%
			SAND (SP) with gravel, dense, subrounded, damp, brown								

Test pit terminated at 12ft (Practical refusal)

TP19-35

PAGE 1 OF 1

CLIENT Lithium Nevada Corporation

PROJECT NAME Thacker Pass Project

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass

DATE STARTED 12/17/19 **COMPLETED** 12/17/19

GROUND ELEVATION 4717 ft **TOTAL PIT DEPTH** 14 ft

EXCAVATION CONTRACTOR Hunewill Construction

COORDINATES ():

EQUIPMENT CAT 320E

NORTHING 41.7057 **EASTING** 118.01821

LOGGED BY M. Erdmann **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
						LIQUID LIMIT	PLASTICITY INDEX				
	0		Surface Conditions: Frozen Ground								
			TOPSOIL (CL), loose, moist, dark brown	GB 35-01							
4715			clayey GRAVEL (GC), with sand, poorly graded, loose, subrounded, dry, grayish brown								
	5			GB 35-02	6.9	30	10	55.5	21.8	22.7	DD: 134.8 pcf, OMC: 8.0%
4710											
			GRAVEL with sand (GP), poorly graded, dense, subrounded, moist, reddish brown								
	10										
				GB 35-03							
4705											

Test pit terminated at 14ft (Practical Refusal)

NewFields

TP19-36

PAGE 1 OF 1

CLIENT Lithium Nevada Corporation
PROJECT NAME Thacker Pass Project
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass
DATE STARTED 12/17/19 **COMPLETED** 12/17/19
GROUND ELEVATION 4743 ft **TOTAL PIT DEPTH** 13 ft
EXCAVATION CONTRACTOR Hunewill Construction
COORDINATES ():
EQUIPMENT CAT 320E
NORTHING 41.7081 **EASTING** 118.01823
LOGGED BY M. Erdmann **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No groundwater encountered
NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Surface Conditions: Frozen Ground	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		TOPSOIL (CL), loose, moist, dark brown	GB 36-01							
4740	5		silty SAND (SM), poorly graded, loose, subrounded, dry, grayish brown	GB 36-02							
4735			silty SAND (SM), with gravel, some cobbles, poorly graded, dense, subrounded, dry, grayish brown, weakly cemented	GB 36-03	15.6	NP	NP	45.6	24.2	30.2	
4730	10		GRAVEL, with sand some cobbles (GP), poorly graded, dense, subrounded, moist, reddish brown								

Test pit terminated at 13ft (Practical refusal)

TP19-37

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CLIENT Lithium Nevada Corporation	**PROJECT NAME** Thacker Pass Project
PROJECT NUMBER 475.0385.000	**PROJECT LOCATION** Thacker Pass
DATE STARTED 12/17/19 **COMPLETED** 12/17/19	**GROUND ELEVATION** 4639 ft **TOTAL PIT DEPTH** 14 ft
EXCAVATION CONTRACTOR Hunewill Construction	**COORDINATES ():**
EQUIPMENT CAT 320E	**NORTHING** 41.70039 **EASTING** 118.01591
LOGGED BY M. Erdmann **CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)** No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Surface Conditions: Frozen Ground	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		TOPSOIL (CL), loose, moist, dark brown	GB 37-01							
4635	5		silty GRAVEL with some cobbles (GM), dense, subrounded, dry, grayish brown, moderately cemented	GB 37-02							
4630 4625	10		clayey SAND (SC) with gravels, poorly graded, compacted, subrounded, moist, reddish brown	GB 37-03	10.2	56	30	30.6	44.1	25.6	

Test pit terminated at 14ft (Practical refusal)

NewFields

TP19-38

PAGE 1 OF 1

CLIENT	Lithium Nevada Corporation	**PROJECT NAME**	Thacker Pass Project
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass
DATE STARTED	12/17/19	**COMPLETED**	12/17/19
GROUND ELEVATION	4677 ft	**TOTAL PIT DEPTH**	14 ft
EXCAVATION CONTRACTOR	Hunewill Construction	**COORDINATES ():**	
EQUIPMENT	CAT 320E	**NORTHING**	41.70237
		EASTING	115.01507
LOGGED BY	M. Erdmann	**CHECKED BY**	K. Magner
DEPTH TO WATER (FT BGS)	No groundwater encountered		
NOTES	Backfilled with excavated material		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Surface Conditions: Frozen Ground								
		▨	TOPSOIL (CL), loose, moist, dark brown trace gravel	GB 38-01							
4675		⁘	SILT (ML) with sand, some cobble, well graced, loose, dry, light gray	GB 38-02							
	5		clayey GRAVEL (GC), and cobbles, poorly graded, dense, subrounded, dry, light gray, moderately cemented	GB 38-03							
4670 4665	10		GRAVEL (GP) with sand, some cobbles, poorly graded, dense, subrounded, moist, reddish brown	GB 38-04							
		⁘	silty SAND, some gravel (SW), well graded, dense, rounded, moist, brown								

Test pit terminated at 14ft (Practical refusal)

NewFields

TP19-39

PAGE 1 OF 1

CLIENT Lithium Nevada Corporation
PROJECT NAME Thacker Pass Project
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass
DATE STARTED 12/17/19 **COMPLETED** 12/17/19
GROUND ELEVATION 4710 ft **TOTAL PIT DEPTH** 5 ft
EXCAVATION CONTRACTOR Hunewill Construction
COORDINATES ():
EQUIPMENT CAT 320E
NORTHING 41.70625 **EASTING** 118.01509
LOGGED BY M. Erdmann **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No groundwater encountered
NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4710	0		Surface Conditions: Frozen Ground								
		▨	TOPSOIL (CL), loose, moist, dark brown	GB 39-01							
			silty SAND (SM), with gravel, very dense, subrounded, dry, grayish brown, moderately cemented	GB 39-02	15.5	NP	NP	34.5	47.2	18.3	
4705	5										

Test pit terminated at 5ft (Practical refusal)

CLIENT	Lithium Nevada Corporation	**PROJECT NAME**	Thacker Pass Project
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass
DATE STARTED	12/16/19	**COMPLETED**	12/16/19
GROUND ELEVATION	4741 ft	**TOTAL PIT DEPTH**	16 ft
EXCAVATION CONTRACTOR	Hunewill Construction	**COORDINATES ():**	
EQUIPMENT	CAT 320E	**NORTHING**	41.708
		EASTING	118.01494
LOGGED BY	M. Erdmann	**CHECKED BY**	K. Magner
DEPTH TO WATER (FT BGS)	No groundwater encountered		
NOTES	Backfilled with excavated material		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Surface Conditions: Frozen Ground	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0										
4740			TOPSOIL (CL), loose, moist, dark brown	GB 40-01							
			SAND (SP) with gravel and some cobbles, poorly graded, dense, subrounded, moist, light brown	GB 40-02							
			clayey GRAVEL (GC), with sand, poorly graded, very dense, subrounded, moist, light brown								
4735	5										
				GB 40-03	17.7	45	24	47.9	27.0	25.1	
4730	10										
4725	15										

Test pit terminated at 16ft (Excavator limits)

TP19-41
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NewFields

CLIENT Lithium Nevada Corporation		**PROJECT NAME** Thacker Pass Project	
PROJECT NUMBER 475.0385.000		**PROJECT LOCATION** Thacker Pass	
DATE STARTED 12/16/19	**COMPLETED** 12/16/19	**GROUND ELEVATION** 4633 ft	**TOTAL PIT DEPTH** 16 ft
EXCAVATION CONTRACTOR Hunewill Construction		**COORDINATES ():**	
EQUIPMENT CAT 320E		**NORTHING** 41.70044	**EASTING** 118.01191
LOGGED BY M. Erdmann	**CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)** No groundwater encountered	

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
						LIQUID LIMIT	PLASTICITY INDEX				
	0		Surface Conditions: Frozen Ground								
			TOPSOIL (CL), loose, wet, dark brown								
			GRAVEL (GP) with sand, poorly graded, dense, subrounded, dry, grayish brown, weakly cemented	GB 41-01							
4630											
	5			GB 41-02							
4625											
			GRAVEL (GP) with sand, poorly graded, very dense, subrounded, moist, reddish brown								
	10										
4620											
	15										

Test pit terminated at 16ft (Excavator limits)

TP19-42
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NewFields

CLIENT	Lithium Nevada Corporation	**PROJECT NAME**	Thacker Pass Project
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass
DATE STARTED	12/16/19 **COMPLETED** 12/16/19	**GROUND ELEVATION**	4663 ft **TOTAL PIT DEPTH** 15 ft
EXCAVATION CONTRACTOR	Hunewill Construction	**COORDINATES ():**	
EQUIPMENT	CAT 320E	**NORTHING**	41.70243 **EASTING** 118.01197
LOGGED BY	M. Erdmann **CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)**	No groundwater encountered
NOTES	Backfilled with excavated material		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Surface Conditions: Frozen Ground								
			TOPSOIL (CL), loose, moist to wet, dark brown	GB 42-01							
4660	5		silty SAND (SM) with gravel, well graded, dense, subrounded, dry, light grayish brown, moderately cemented	GB 42-01							
4655 4650	10 15		GRAVEL (GP), with sand, poorly graded, dense, subrounded, moist to damp, reddish brown								

Test pit terminated at 15ft (Practical refusal)

NewFields

TP19-43

CLIENT	Lithium Nevada Corporation	**PROJECT NAME**	Thacker Pass Project
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass
DATE STARTED	12/16/19 **COMPLETED** 12/16/19	**GROUND ELEVATION**	4677 ft **TOTAL PIT DEPTH** 5 ft
EXCAVATION CONTRACTOR	Hunewill Construction	**COORDINATES ():**	
EQUIPMENT	CAT 320E	**NORTHING**	41.70447 **EASTING** 118.01186
LOGGED BY	M. Erdmann **CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)**	No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Surface Conditions: Frozen Ground	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	▨	TOPSOIL (CL), loose, wet, dark brown	GB 43-01							
4675	5		GRAVEL (GP) with clay, poorly graded, very dense, subrounded, dry to damp, light brown, moderately cemented	GB 43-02							

Test pit terminated at 5ft (Practical refusal)

TP19-44

CLIENT Lithium Nevada Corporation
PROJECT NAME Thacker Pass Project
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass
DATE STARTED 12/16/19 **COMPLETED** 12/16/19
GROUND ELEVATION 4714 ft **TOTAL PIT DEPTH** 16 ft
EXCAVATION CONTRACTOR Hunewill Construction
COORDINATES ():
EQUIPMENT CAT 320E
NORTHING 41.7062 **EASTING** 118.01184
LOGGED BY M. Erdmann **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No groundwater encountered
NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
						LIQUID LIMIT	PLASTICITY INDEX				
	0		Surface Conditions: Frozen Ground								
			TOPSOIL (CL), loose, moist, brown	GB 44-01							
4710	5		SILT (ML) with sand, trace gravel, well graded, compact, subrounded, damp, light brown								
4705	10		GRAVEL with silt and sand (GW-GM), well graded, dense, subrounded, moist, gray - light brown, moderately cemented	GB 44-02	9.2	NP	NP	52.4	38.9	8.4	DD: 112.6 pcf, OMC: 11.0%
4700	15		GRAVEL (GP) with sand some cobbles, poorly graded, very dense, angular, damp, reddish brown	GB 44-03							

Test pit terminated at 16ft (Excavator limits)

NewFields

TP19-45

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CLIENT Lithium Nevada Corporation

PROJECT NAME Thacker Pass Project

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass

DATE STARTED 12/16/19 **COMPLETED** 12/16/19

GROUND ELEVATION 4735 ft **TOTAL PIT DEPTH** 16 ft

EXCAVATION CONTRACTOR Hunewill Construction

COORDINATES ():

EQUIPMENT CAT 320E

NORTHING 41.70814 **EASTING** 118.01199

LOGGED BY M. Erdmann **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4735	0		Surface Conditions: Frozen Ground								
			TOPSOIL (CL), poorly graded, loose, moist, brown	GB 45-01							
			silty SAND (SM) with trace gravel, well graded, compact, subrounded, moist, light brown								
4730	5			GB 45-02							
4725	10										
			GRAVEL (GP) with sand, well graded, dense, subrounded, dark brown								
4720	15										

Test pit terminated at 16ft (Excavator limits)

TP19-46
PAGE 1 OF 1

CLIENT Lithium Nevada Corporation	**PROJECT NAME** Thacker Pass Project
PROJECT NUMBER 475.0385.000	**PROJECT LOCATION** Thacker Pass
DATE STARTED 12/16/19 **COMPLETED** 12/16/19	**GROUND ELEVATION** 4674 ft **TOTAL PIT DEPTH** 16 ft
EXCAVATION CONTRACTOR Hunewill Construction	**COORDINATES ():**
EQUIPMENT CAT 320E	**NORTHING** 41.70242 **EASTING** 118.00888
LOGGED BY M. Erdmann **CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)** No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Surface Conditions: Frozen Ground	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		TOPSOIL (CL), loose, moist, dark brown	GB 46-01							
4670			SAND with some gravel (SP), poorly graded, compact, subrounded, damp, light brown	GB 46-02							
	5		silty GRAVEL (GM) with sand, poorly graded, dense, subrounded, damp, light gray brown, stratified, moderately cemented	GB 46-03	14.6	38	9	44.5	36.6	18.9	DD: 109.9 pcf, OMC: 14.5%
4665 4660	10 15		GRAVEL (GP) with sand, poorly graded, dense, subrounded, damp, reddish brown	GB 46-04							

Test pit terminated at 16ft (Excavator limits)

TP19-47

PAGE 1 OF 1

CLIENT Lithium Nevada Corporation		**PROJECT NAME** Thacker Pass Project	
PROJECT NUMBER 475.0385.000		**PROJECT LOCATION** Thacker Pass	
DATE STARTED 12/16/19	**COMPLETED** 12/16/19	**GROUND ELEVATION** 4686 ft	**TOTAL PIT DEPTH** 3 ft
EXCAVATION CONTRACTOR Hunewill Construction		**COORDINATES ():**	
EQUIPMENT CAT 320E		**NORTHING** 41.70437	**EASTING** 118.00886
LOGGED BY M. Erdmann	**CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)** No groundwater encountered	

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Surface Conditions: Frozen Ground	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
						LIQUID LIMIT	PLASTICITY INDEX				
	0										
4685			TOPSOIL (CL), loose, moist, dark brown	GB 47-01							
			silty GRAVEL (GM) with sand, well graded, very dense, subangular, dry, light gray brown, moderately cemented	GB 47-02	13.1	NP	NP	54.2	30.9	14.9	

Test pit refusal at 3ft (Practical refusal)

NewFields

TP19-48

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CLIENT Lithium Nevada Corporation	**PROJECT NAME** Thacker Pass Project
PROJECT NUMBER 475.0385.000	**PROJECT LOCATION** Thacker Pass
DATE STARTED 12/16/19 **COMPLETED** 12/16/19	**GROUND ELEVATION** 4713 ft **TOTAL PIT DEPTH** 17 ft
EXCAVATION CONTRACTOR Hunewill Construction	**COORDINATES ():**
EQUIPMENT CAT 320E	**NORTHING** 41.70628 **EASTING** 118.00884
LOGGED BY M. Erdmann **CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)** No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Surface Conditions: Frozen Ground								
		▨	TOPSOIL (CL), loose, moist, brown	GB 48-01							
4710	5	▨	sandy lean CLAY (CL), poorly graded, compact, subrounded, damp, light brown	GB 48-02	20.5	34	13	8.7	34.5	56.8	
4705			GRAVEL (GP) with clay, poorly graded, dense, subrounded, damp, gray brown, moderately cemented	GB 48-03							
4700	10 15		GRAVEL (GP) with sand, poorly graded, dense, subrounded, moist, reddish brown								

Test pit terminated at 17ft (Excavator Limits)

TP19-49

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CLIENT Lithium Nevada Corporation		**PROJECT NAME** Thacker Pass Project	
PROJECT NUMBER 475.0385.000		**PROJECT LOCATION** Thacker Pass	
DATE STARTED 12/17/19	**COMPLETED** 12/17/19	**GROUND ELEVATION** 4642 ft	**TOTAL PIT DEPTH** 15 ft
EXCAVATION CONTRACTOR Hunewill Construction		**COORDINATES ():**	
EQUIPMENT CAT 320E		**NORTHING** 41.69851	**EASTING** 118.01612
LOGGED BY M. Erdmann	**CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)** No groundwater encountered	
NOTES Backfilled with excavated material			

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Surface Conditions: Frozen Ground	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		TOPSOIL (CL), loose, moist, dark brown	GB 49-01							
4640			GRAVEL with silt and sand (GW-GM), well graded, dense, subrounded, dry, grayish brown, moderately cemented	GB 49-02	9.9	NP	NP	65.8	28.0	6.2	
4635 4630	5 10 15		silty GRAVEL, some cobbles (GM), poorly graded, dense, subrounded, moist, reddish brown	GB 49-03							

Test pit terminated at 15ft (Practical refusal)

NewFields

TP19-50

PAGE 1 OF 1

CLIENT	Lithium Nevada Corporation	**PROJECT NAME**	Thacker Pass Project
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass
DATE STARTED	12/16/19	**COMPLETED**	12/16/19
GROUND ELEVATION	4633 ft	**TOTAL PIT DEPTH**	17 ft
EXCAVATION CONTRACTOR	Hunewill Construction	**COORDINATES ():**	
EQUIPMENT	CAT 320E	**NORTHING**	41.69862
		EASTING	118.00877
LOGGED BY	M. Erdmann	**CHECKED BY**	K. Magner
DEPTH TO WATER (FT BGS)	No groundwater encountered		
NOTES	Backfilled with excavated material		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
			Surface Conditions: Frozen Ground								
	0		TOPSOIL (CL), loose, wet, dark brown	GB 50-01							
			GRAVEL (GP) with clay, with cobbles, poorly graded, dense, subangular, dry, light brown, moderately cemented								
4630				GB 50-02							
	5										
			GRAVEL (GP) with sand, poorly graded, dense, subrounded, moist, reddish brown								
4625											
	10										
				GB 50-03							
4620											
	15										

Test pit terminated at 17ft (Excavator limits)

APPENDIX B.3

Geotechnical Investigation Factual Report (2019)

GEOTECHNICAL INVESTIGATION FACTUAL REPORT FOR THE THACKER PASS PROJECT HUMBOLDT COUNTY, NEVADA

Prepared for:
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NewFields Project No.475.0385.000
October 16, 2019

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1. INTRODUCTION

NewFields has completed a field investigation and laboratory testing program in support of Lithium Nevada Corporation's (LNC) Thacker Pass Project. This report presents the findings from that field investigation and provides recommendations for future work. The project site includes a clay tailings filter stack (CTFS), coarse gangue stockpile (CGS), process facilities, open pit and two waste rock storage facilities (WRSF). Geotechnical engineering for the development of the open pit is not included as part of this scope of work.

2. FIELD INVESTIGATION

A preliminary site investigation was completed by AMEC in 2011 for an initial project site layout (AMEC, 2011). The project elements subsequently changed and as a result, NewFields completed an additional site investigation between February and April 2019 which included 31 boreholes and 29 test pits. The boreholes were advanced using a CME-850 track-mounted drill rig, and each borehole was drilled with 4.25-inch diameter hollow stem auger in soil and triple tube wireline rock coring methods when in bedrock. Four boreholes were extended to depths of 100 to 150 feet below ground surface (bgs), with the remaining twenty-seven boreholes extended to depths of 30 to 50 feet bgs. Test pits were excavated with a CAT 320E excavator to depths of 7 to 19 feet bgs. NewFields logged the lithologies and characteristics of subsurface materials based on recovery from the driven samples, soil cuttings brought to the surface on the auger flights and excavator buckets, and recovered rock core.

The borehole and test pit logs summarize the results of material classifications and observations made at each borehole or test pit location. These records include drilling or excavation depth, description of each strata encountered, strata delineation, estimates of strata density, and location of samples retained for laboratory analysis. The logs represent our interpretation of the contents of the field logs and the results of the laboratory tests on select field samples. The as-installed locations of the boreholes and test pits are presented in **Figure 1**. Borehole and test pit logs are presented in **Appendices C** and **D**. It is NewFields' understanding that subsequent drilling has occurred in the vicinity of the mine pit. This work was completed by another company and the collected information is not presented in this report.

It should be noted that the locations for all the project facilities have changed since the NewFields' field investigation was completed, and as such, the completed work does not fully characterize the subsurface beneath each facility. **Figure 2** details the original site layout as presented in the permitted field exploration program.

3. LABORATORY PROGRAM

Soil samples obtained during the field investigation were labeled, packaged and transported to the NewFields AMRL/AASHTO accredited laboratory in Elko, Nevada where the majority of the soil testing was completed. Laboratory testing was completed on select samples collected during the field investigation.

Soil classification involved particle size analyses and Atterberg limits which were used to divide soils into groups such that the engineering properties of the soils within each group are similar. Each sample was categorized according to the Unified Soil Classification System (USCS), which is based on the material gradation and plasticity. Natural moisture content and natural density were recorded from ring-lined samples. Moisture content – unit weight relationships were developed from bulk test pit samples. Strength properties of in-situ soils are estimated based upon standard penetration testing (SPT) and USCS classification. This laboratory testing program included:

- Grain Size Analysis (ASTM D422);
- Atterberg Limits (ASTM D4318);
- Natural Moisture Content (ASTM D2216);
- Natural Density (ASTM 2937); and,
- Modified Proctor Moisture – Density Relationship (ASTM D1557).

Individual laboratory testing results are summarized in **Tables A1** and **B1** and individual lab test results are presented in **Appendices A** and **B.**

It should be noted that all moisture contents presented in this report were completed as per ASTM D2216 are reported as dry basis (Weight of water/Weight of dry solids) as this is the common reporting practice for geotechnical reporting.

4. GENERALIZED SITE CONDITIONS

Subsurface conditions can generally be classified as a thin veneer of growth media, approximately 12 inches to 24 inches in thickness, overlying alluvium overburden consisting of loose to very dense fine to coarse SANDS and GRAVELS with varying amounts of clay, silt, sand and gravel overlying residuum composed of slightly weathered to highly weathered basalt. In the open pit area, the alluvium directly overlies claystone with varying amounts of interbedded ash (AMEC, 2011). Throughout the site, thin seams and lenses of low plastic clay and silt were observed in select borings at relatively shallow depths. The thickness of alluvium overburden varies significantly across the site, with recorded thicknesses between 10 feet to over 65 feet. There is no general trend of overburden thickness or bedrock elevation across the site, primarily due to the degree of weathering and the basalt depositional process.

In three of the four deep boreholes within the CGS and Plant Site areas, groundwater was encountered at depths of approximately 83 to 93 feet below ground surface (bgs). Throughout the remainder of the site, the relatively shallow boreholes did not encounter groundwater in the upper 50 feet bgs.

The site generally slopes to the South-southeast at approximately 4 to 6 percent gradient with isolated slopes up to 15 to 20 percent gradient. Based upon the topography there is significant relief across the entire project; approximately 650 feet of elevation change across the pit area, 350 feet of change across the CTFS, 200 feet of change across the WRSF and CGS, and approximately 150 feet of elevation change across the plant site.

5. GEOTECHNICAL CHARACTERIZATION AND DESIGN STRENGTHS

Recommended geotechnical material parameters are presented in **Table 6-2**. These engineering parameters were chosen based upon the results from laboratory index and strength testing in conjunction with observations from borehole and test pit observations and historical experience with similar materials.

Table 6-1. Material Properties Summary

Material	Wet Unit Weight (pcf)	Moisture Content (%)	Hydraulic Conductivity (cm/sec)	Drained Strength	
				Friction Angle (Degrees)	Cohesion (psf)
Alluvium – In-situ	110	20	1E-04[1]	32[2]	0

Note[1]: Assumed based upon particle size distribution (Freeze and Cherry, 1979)
Note[2]: Assumed based upon particle size distribution and SPT values.

6. OBSERVATIONS AND RECOMMENDATIONS

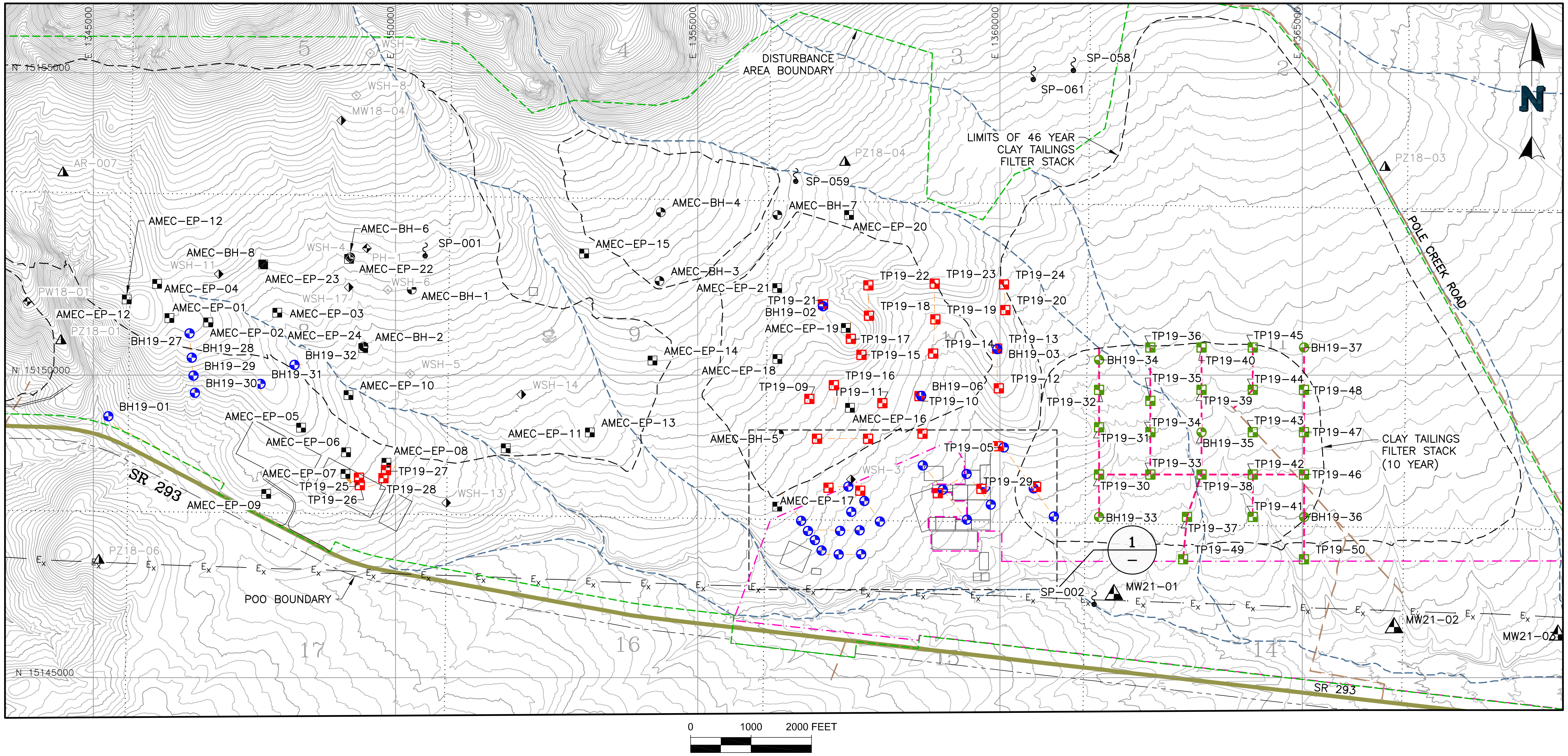
Foundation conditions across the site (where explored) are adequate for the proposed developments. Areas of unsuitable materials, such as low strength or high plasticity materials, that could require removal or replacement were not identified and are not expected to influence construction. Additional borehole and test pit exploration is recommended in the area of the CTFS to further identify soil properties, depth to bedrock, and groundwater conditions. Additional explorations within the plant site areas will also be beneficial as several areas are lacking boreholes as a result of the relocation of plant site facilities.

Alluvial overburden materials may be suitable for use as construction materials. Further strength and deformation testing is recommended to develop well defined material properties. Waste materials from the pit are assumed to consist of clay and ash, further testing should be performed to determine suitability for use as construction materials. Additional testing for interface shear strength of geosynthetic liner applications (underliner and overliner) should be performed.

7. REFERENCES

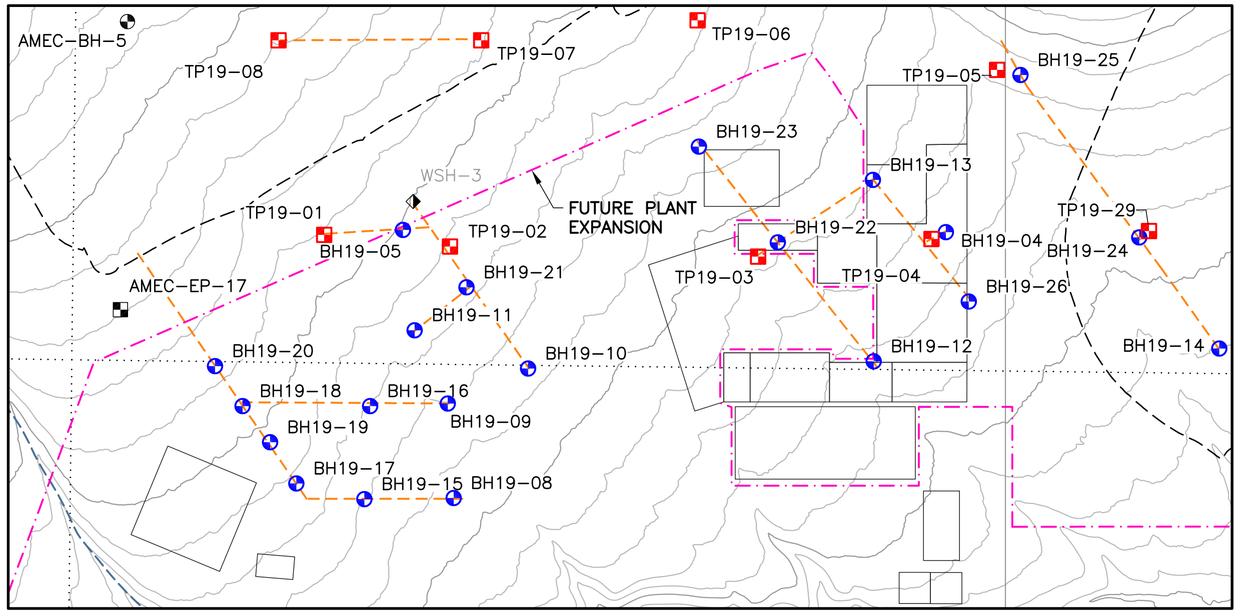
AMEC (2011). "Prefeasibility Level Geotechnical Study Report. Kings Valley Lithium Project. Humboldt County, Nevada." Project No. 10-417-00961. Sparks, Nevada. March, 2011

Freeze, R.A., and Cherry, J.A., (1979), Groundwater: Englewood Cliffs, NJ, Prentice-Hall, 604 p.



LEGEND:

- EXISTING GROUND CONTOURS
- 4500 EXISTING CONTOUR ELEVATION
- EXISTING ROADS–MAJOR
- EXISTING ROADS
- EXISTING DRAINAGES
- EXISTING EPHEMERAL CREEKS
- SECTION LINES
- 20 SECTION NUMBER
- POO BOUNDARY
- DISTURBANCE AREA BOUNDARY
- FUTURE PLANT EXPANSION AREA
- Ex EXISTING POWER LINE
- EXISTING 2019 DISTURBANCE
- PROPOSED DISTURBANCE
- EXISTING SPRING
- EXISTING BOREHOLE (AMEC 2013)
- EXISTING TEST PIT (AMEC 2013)
- EXISTING MONITORING WELL
- ◇ EXISTING MONITORING WELL (ABANDONED)
- ▲ EXISTING PIEZOMETER
- EXISTING BOREHOLE (NF 2019)
- EXISTING TEST PIT (NF 2019)
- PROPOSED BOREHOLE
- PROPOSED TEST PIT
- WASTE ROCK STORAGE FACILITY (WRSF)
- PIT
- COARSE GANGUE STOCKPILE
- CLAY TAILINGS FILTER STACK
- BUILDINGS & INFRASTRUCTURE



1 – PROCESS FACILITIES AREA

0 400 800 FEET

NOTES:

1. BH-07 WAS REMOVED FROM DRILLING PLAN.

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\A-CAD\FIG\0385.000.044F.dwg–12/5/2019 10:22 AM

NewFields	CLIENT LITHIUM NEVADA CORP.
PROJECT	THACKER PASS PROJECT
TITLE GEOTECHNICAL INVESTIGATION PLAN	FILENAME 0385.000.044F FIGURE NO. 1A REVISION 1

TEST PIT LOCATIONS

POINT	NORTHING	EASTING	DEPTH
TP19–01	15,148,138	1,357,163	17.0’
TP19–02	15,148,089	1,357,687	15.0’
TP19–03	15,148,047	1,358,970	14.0’
TP19–04	15,148,120	1,359,692	19.0’
TP19–05	15,148,825	1,359,965	15.0’
TP19–06	15,149,032	1,358,718	19.0’
TP19–07	15,148,948	1,357,817	10.0’
TP19–08	15,148,948	1,356,973	13.0’
TP19–09	15,149,606	1,356,846	15.0’
TP19–10	15,149,653	1,358,668	7.0’
TP19–11	15,149,536	1,358,054	15.0’
TP19–12	15,149,781	1,359,981	17.0’
TP19–13	15,150,438	1,359,953	19.0’
TP19–14	15,150,356	1,358,895	19.0’
TP19–15	15,150,334	1,357,707	14.0’
TP19–16	15,149,833	1,357,251	15.0’
TP19–17	15,150,600	1,357,532	19.0’
TP19–18	15,150,981	1,357,833	12.0’
TP19–19	15,150,922	1,358,932	9.0’
TP19–20	15,151,075	1,360,089	19.0’
TP19–21	15,151,169	1,357,072	13.0’
TP19–22	15,151,484	1,357,823	17.0’
TP19–23	15,151,512	1,358,920	15.0’
TP19–24	15,151,498	1,360,066	19.0’
TP19–25	15,148,304	1,349,394	18.0’
TP19–26	15,148,181	1,349,408	11.0’

TEST PIT LOCATIONS

POINT	NORTHING	EASTING	DEPTH
TP19–27	15,148,429	1,349,841	16.0’
TP19–28	15,148,295	1,349,799	19.0’
TP19–29	15,148,153	1,360,598	19.0’
TP19–30	15,148,357	1,361,640	20.0’
TP19–31	15,149,139	1,361,640	20.0’
TP19–32	15,149,757	1,361,640	20.0’
TP19–33	15,148,357	1,362,487	20.0’
TP19–34	15,149,057	1,362,487	20.0’
TP19–35	15,149,575	1,362,487	20.0’
TP19–36	15,150,457	1,362,487	20.0’
TP19–37	15,147,657	1,363,094	20.0’
TP19–38	15,148,357	1,363,335	20.0’
TP19–39	15,149,757	1,363,335	20.0’
TP19–40	15,150,457	1,363,335	20.0’
TP19–41	15,147,657	1,364,182	20.0’
TP19–42	15,148,357	1,364,182	20.0’
TP19–43	15,149,057	1,364,182	20.0’
TP19–44	15,149,757	1,364,182	20.0’
TP19–45	15,150,457	1,364,182	20.0’
TP19–46	15,148,357	1,365,030	20.0’
TP19–47	15,149,057	1,365,030	20.0’
TP19–48	15,149,757	1,365,030	20.0’
TP19–49	15,146,957	1,363,030	20.0’
TP19–50	15,146,957	1,365,030	20.0’

BOREHOLE LOCATIONS

POINT	NORTHING	EASTING	DEPTH
BH19–01	15,149,319	1,345,248	51.5’
BH19–02	15,151,138	1,357,073	150.0’
BH19–03	15,150,430	1,359,957	50.0’
BH19–04	15,148,149	1,359,752	100.5’
BH19–05	15,148,158	1,357,491	100.0’
BH19–06	15,149,656	1,358,695	50.0’
BH19–08	15,147,040	1,357,703	100.0’
BH19–09	15,147,434	1,357,677	35.3’
BH19–10	15,147,580	1,358,013	35.0’
BH19–11	15,147,740	1,357,539	36.0’
BH19–12	15,147,611	1,359,452	31.5’
BH19–13	15,148,367	1,359,448	50.0’
BH19–14	15,147,664	1,360,891	31.5’
BH19–15	15,147,036	1,357,330	30.5’
BH19–16	15,147,424	1,357,355	30.0’
BH19–17	15,147,101	1,357,047	31.5’
BH19–18	15,147,424	1,356,823	40.0’
BH19–19	15,147,273	1,356,938	35.5’

BOREHOLE LOCATIONS

POINT	NORTHING	EASTING	DEPTH
BH19–20	15,147,591	1,356,709	51.5’
BH19–21	15,147,919	1,357,756	40.0’
BH19–22	15,148,106	1,359,052	40.0’
BH19–23	15,148,506	1,358,723	50.5’
BH19–24	15,148,127	1,360,558	41.5’
BH19–25	15,148,804	1,360,063	50.0’
BH19–26	15,147,860	1,359,848	31.5’
BH19–27	15,150,690	1,346,592	29.5’
BH19–28	15,150,289	1,346,628	31.5’
BH19–29	15,149,992	1,346,657	31.5’
BH19–30	15,149,708	1,346,680	31.5’
BH19–31	15,149,855	1,347,766	31.5’
BH19–32	15,150,169	1,348,329	31.5’
BH19–33	15,147,657	1,361,640	100.0’
BH19–34	15,150,252	1,361,640	100.0’
BH19–35	15,149,057	1,363,335	100.0’
BH19–36	15,147,657	1,365,030	100.0’
BH19–37	15,150,457	1,365,030	100.0’

NewFields
CLIENT
LITHIUM NEVADA CORP.
PROJECT
THACKER PASS PROJECT
TITLE
GEOTECHNICAL INVESTIGATION PLAN
FILENAME
0385.000.044F
FIGURE NO.
1B
REVISION
0

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\A-CAD\FIG\0385.000.044F.dwg-10/21/2019 4:07 PM

FIGURES

Test Pit and Borehole Plan

APPENDIX A

Test Pit Laboratory Data

TABLE A1 - TEST PIT LAB TESTING SUMMARY

SAMPLE LOCATION								GRADATION (%)			ATTERBERG LIMITS			PROCTOR			
Field Sample Number	Laboratory Sample Number	Test Pit ID	Depth (ft)	UNIFIED SOILS CLASSIFICATION (USCS)	USCS ABBREVIATION	Specific Gravity	NATURAL MOISTURE CONTENT (%)	Gravel >#4	Sand	Silt & Clay <#200	Plastic Limit	Liquid Limit	Plasticity Index	Standard Maximum Dry Density (pcf)	SMDD Optimum Moisture Content (%)	Modified Maximum Dry Density (pcf)	MMDD Optimum Moisture Content (%)
S-01-19	19-060-01	TP19-01	4-7 ft	silty SAND	SM		12.9%	16.2	47.6	36.2	NP	NP	NP				
S-01-20		TP19-01	9-12 ft														
S-02-17	19-060-02	TP19-02	0-2 ft	lean CLAY with sand	CL		29.4%	6.5	22	71.5	21	33	12			104.3*	19.4*
S-02-18		TP19-02	6-10 ft														
S-03-27	19-106-02	TP19-03	2-4 ft	silty SAND with gravel	SM		15.9%	25.4	41.4	33.2	29	37	8				
S-03-28	19-060-03	TP19-03	6-9 ft	silty GRAVEL with sand	GM		10.8%	49.8	36.4	13.8	NP	NP	NP				
S-04-29	19-106-03	TP19-04	2-4 ft	silty SAND	SM	2.54	31.2%	0.7	56.4	42.9	46	47	1			78.3	34
S-04-30	19-060-04	TP19-04	5-7 ft	well graded GRAVEL with silt and sand	GW-GM		20.2%	49.1	41.1	9.8	NP	NP	NP				
S-04-31		TP19-04	9-12 ft														
S-05-33		TP19-05	3-6 ft														
S-05-34	19-060-05	TP19-05	8-10 ft	sandy SILT	ML		23.7%	1.4	31.8	66.8	31	41	10				
S-06-25		TP19-06	4-7 ft														
S-06-26	19-060-06	TP19-06	11-13 ft	silty GRAVEL with sand	GM		11.2%	49.5	33.5	17	NP	NP	NP				
S-07-13	19-106-04	TP19-07	2-4 ft	fat CLAY with sand	CH		24.0%	4.6	18.5	71.5	22	55	33				
S-07-14		TP19-07	6-7 ft														
S-08-15	19-106-05	TP19-08	2-4 ft	silty GRAVEL with sand	GM		14.8%	40.5	40.4	19.1	28	37	9				
S-08-16	19-060-07	TP19-08	6-9 ft	GRAVEL with silt and sand	GP-GM		9.8%	50.0	40.0	10.0	NP	NP	NP				
S-09-09		TP19-09	3-6 ft														
S-09-10	19-060-08	TP19-09	8-12 ft	GRAVEL with sand	GM		12.4%	56.4	27.1	16.5	31	55	24				
S-10-24	19-106-06	TP19-10	3-6 ft	silty SAND with gravel	SM		17.1%	35.0	47.5	17.5	NP	NP	NP				
S-11-21		TP19-11	2-4 ft														
S-11-22	19-060-09	TP19-11	7-11 ft	GRAVEL with silt and sand	GP-GM		8.1%	51.2	38.5	10.3	NP	NP	NP				
S-11-23		TP19-11	13-15 ft														
S-12-32		TP19-12	3-6 ft														
S-13-31	19-106-07	TP19-13	3-5 ft	poorly graded GRAVEL with silt and sand	GP-GM		15.4%	55.6	33.6	10.8	30	52	22				
S-13-32	19-060-10	TP19-13	10-13 ft	clayey SAND	SC		30.9%	20.3	32.3	47.4	32	66	34				
S-14-48		TP19-14	3-5 ft														
S-14-49	19-060-11	TP19-14	8-11 ft	well graded GRAVEL with sand	GW		25.7%	60.9	35.1	4.0	NP	NP	NP				
S-15-41		TP19-15	2-4 ft														
S-15-42	19-060-12	TP19-15	8-11 ft	silty SAND with gravel	SM		22.7%	40.3	46.2	13.5	NP	NP	NP				
S-16-11		TP19-16	2-5 ft														
S-16-12	19-060-13	TP19-16	7-10 ft	silty SAND with gravel	SM		28.9%	25.1	36.3	38.6	37	58	21				
S-17-39	19-060-14	TP19-17	4-7 ft	silty SAND	SM		21.3%	8.6	65.7	25.7	NP	NP	NP				
S-17-40		TP19-17	13-15 ft														
S-18-43	19-060-15	TP19-18	5-8 ft	sandy silty CLAY	CL-ML		10.9%	0.2	37.2	62.6	21	28	7				
S-19-46		TP19-19	3-6 ft														
S-20-50	19-060-16	TP19-20	6-10 ft	silty SAND	SM		22.5%	11.7	64.5	23.8	NP	NP	NP				
S-20-51		TP19-20	17-19 ft														
S-21-37	19-060-17	TP19-21	3-5 ft	silty SAND	SM		13.1%	1.1	55.1	43.8	NP	NP	NP				
S-21-38		TP19-21	8-11 ft														

TABLE A1 - TEST PIT LAB TESTING SUMMARY

SAMPLE LOCATION								GRADATION (%)			ATTERBERG LIMITS			PROCTOR			
Field Sample Number	Laboratory Sample Number	Test Pit ID	Depth (ft)	UNIFIED SOILS CLASSIFICATION (USCS)	USCS ABBREVIATION	Specific Gravity	NATURAL MOISTURE CONTENT (%)	Gravel >#4	Sand	Silt & Clay <#200	Plastic Limit	Liquid Limit	Plasticity Index	Standard Maximum Dry Density (pcf)	SMDD Optimum Moisture Content (%)	Modified Maximum Dry Density (pcf)	MMDD Optimum Moisture Content (%)
S-22-44		TP19-22	3-5 ft														
S-22-45	19-060-18	TP19-22	8-11 ft	well graded SAND with gravel	SW		4.8%	47.0	48.2	4.8	NP	NP	NP				
S-23-47	19-060-19	TP19-23	5-9 ft	poorly graded SAND with silt and gravel	SP-SM		8.6%	30.7	57.4	11.9	NP	NP	NP				
S-24-52		TP19-24	4-7 ft														
S-24-53	19-060-20	TP19-24	14-17 ft	clayey SAND	SC		33.9%	5.6	58.7	35.7	33	68	35				
S-25-05		TP19-25	2-4 ft														
S-25-06	19-060-21	TP19-25	7-12 ft	poorly graded GRAVEL with sand	GP		8.1%	61.4	35.7	2.9	NP	NP	NP				
S-26-07		TP19-26	2-4 ft														
S-26-08	19-060-22	TP19-26	6-8 ft	clayey SAND with gravel	SC		20.9%	15.9	55.9	28.2	21	53	32				
S-27-01	19-060-23	TP19-27	3-5 ft	silty SAND with gravel	SM		22.5%	23.4	60.8	15.8	NP	NP	NP				
S-27-02		TP19-27	8-12 ft														
S-28-03	19-106-08	TP19-28	1-3 ft	fat CLAY with sand	CH		30.7%	4.4	16.1	79.5	26	63	37				
S-28-04	19-060-24	TP19-28	5-9 ft	well-graded GRAVEL with silt and sand	GW-GM		6.6%	51.5	43	5.5	NP	NP	NP				
S-29-35	19-060-25	TP19-29	4-7 ft	silty SAND with gravel	SM		8.1%	42.5	42.9	14.6	NP	NP	NP				
S-29-36		TP19-29	11-13 ft														

Notes:

NP Non Plastic

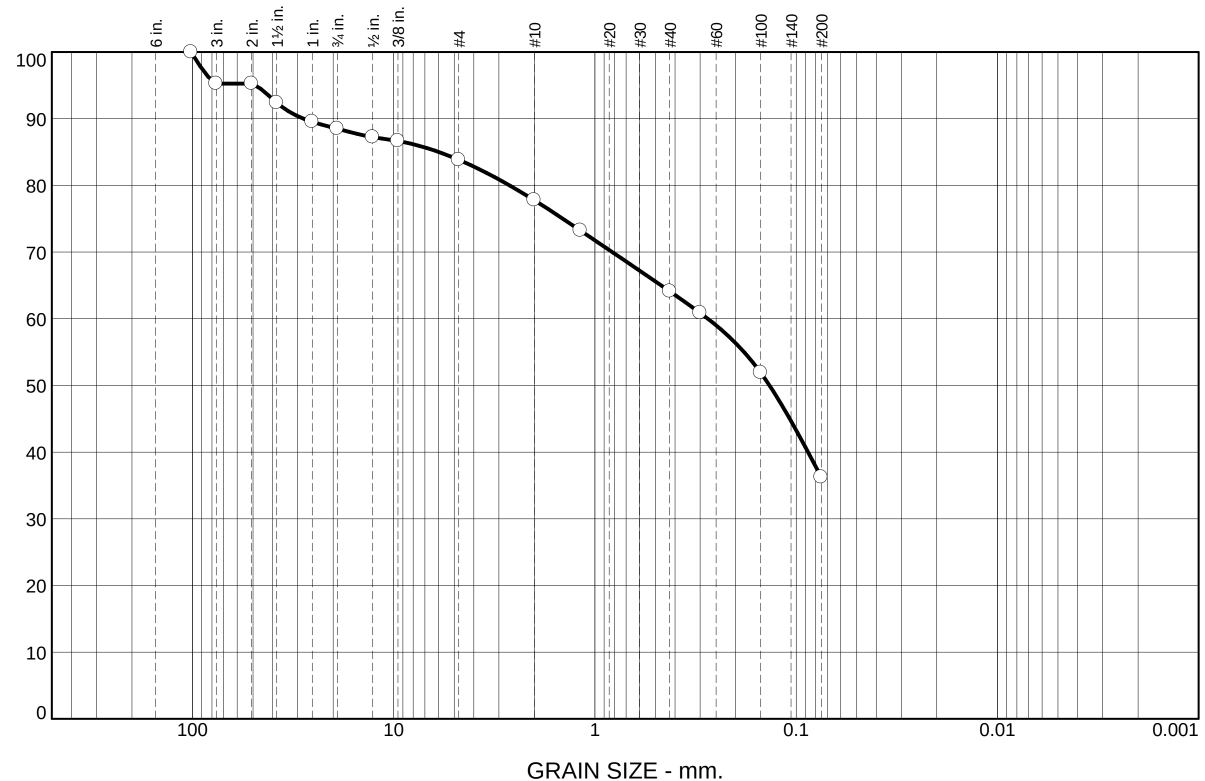
*ASTM D4718-15 Oversized Rock Correction Applied

Moisture contents measured as per ASTM D2216 (weight of water divided by weight of total dry solids)

USCS classifications based on test pit log descriptions in absense of gradation lab test data

Appendix A1 – Particle Size Analysis and Atterberg Limit Results

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
4.7	6.8	4.7	6.0	13.7	27.9	36.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100.0		
3	95.3		
2	95.3		
1.5	92.4		
1	89.5		
.75	88.5		
.5	87.2		
.375	86.7		
#4	83.8		
#10	77.8		
#16	73.2		
#40	64.1		
#50	60.9		
#100	51.9		
#200	36.2		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 28.0127 D_{85}= 5.9592 D_{60}= 0.2747
D_{50}= 0.1357 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-4(0)

Remarks

Natural Moisture Content: 12.9%

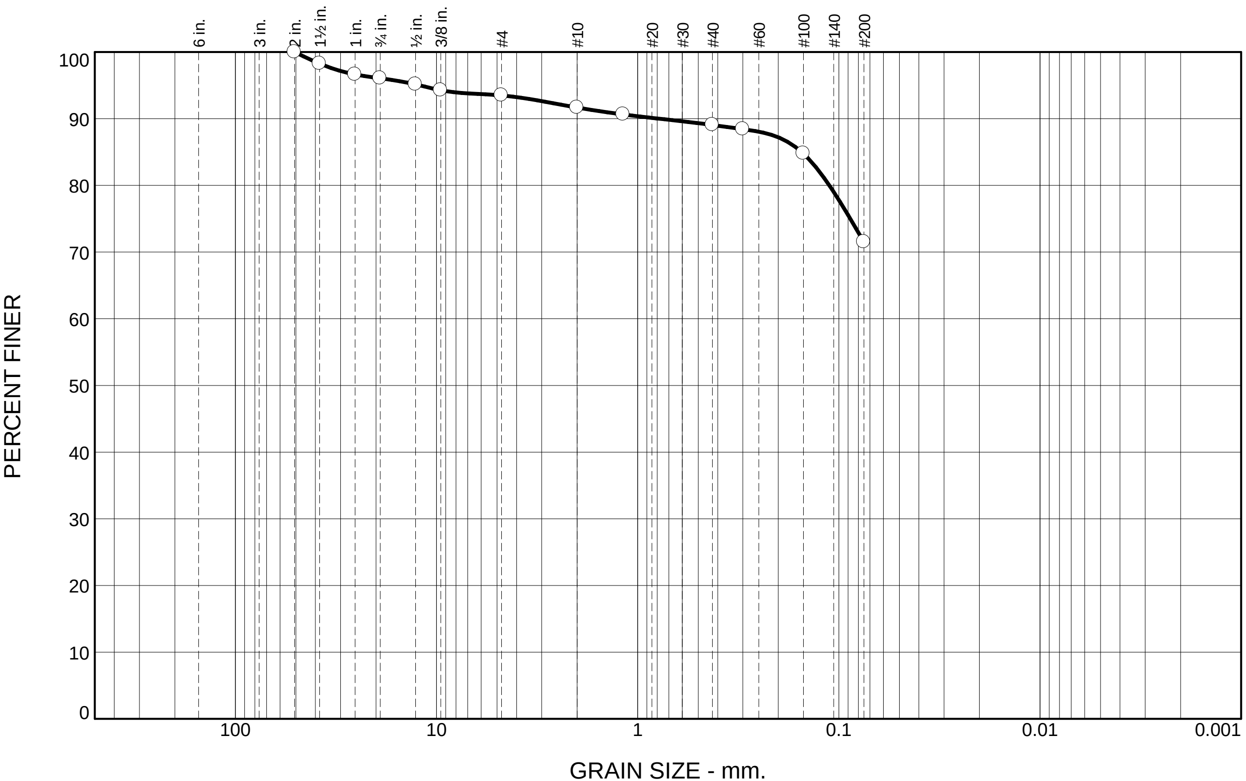
Location: TP19-01
Sample Number: 19-060-01 **Depth:** 4-7' **Date:** 4/1/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-01

Tested By: KS/JB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.9	2.6	1.8	2.6	17.6	71.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2	100.0		
1.5	98.3		
1	96.6		
.75	96.1		
.5	95.1		
.375	94.3		
#4	93.5		
#10	91.7		
#16	90.6		
#40	89.1		
#50	88.4		
#100	84.8		
#200	71.5		

* (no specification provided)

Material Description

Dark Brown lean clay with sand

Atterberg Limits

PL= 21 LL= 33 PI= 12

Coefficients

D_{90}= 0.7771 D_{85}= 0.1529 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(7)

Remarks

Natural Moisture Content: 29.4%

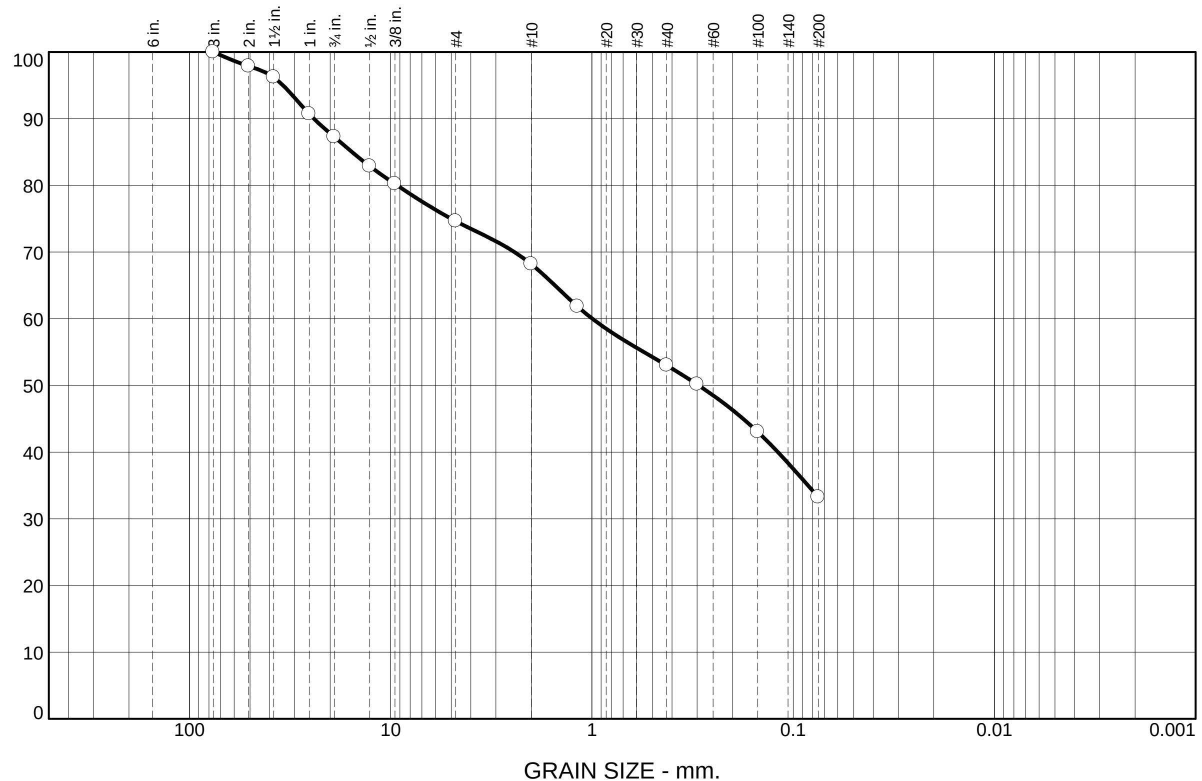
Location: TP19-02
Sample Number: 19-060-02 **Depth:** 0-2' **Date:** 4/1/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-02

Tested By: KS/JB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.7	12.7	6.4	15.2	19.8	33.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	97.9		
1.5	96.2		
1	90.7		
.75	87.3		
.5	82.9		
.375	80.2		
#4	74.6		
#10	68.2		
#16	61.8		
#40	53.0		
#50	50.1		
#100	43.0		
#200	33.2		

* (no specification provided)

Material Description

Light Brown silty sand with gravel

Atterberg Limits

PL= 29 LL= 37 PI= 8

Coefficients

D_{90}= 24.0968 D_{85}= 15.5386 D_{60}= 0.9939
D_{50}= 0.2951 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Natural Moisture Content: 15.9%

Location: TP19-03
Sample Number: 19-106-02 **Depth:** 2-4' **Date:** 4/22/2019

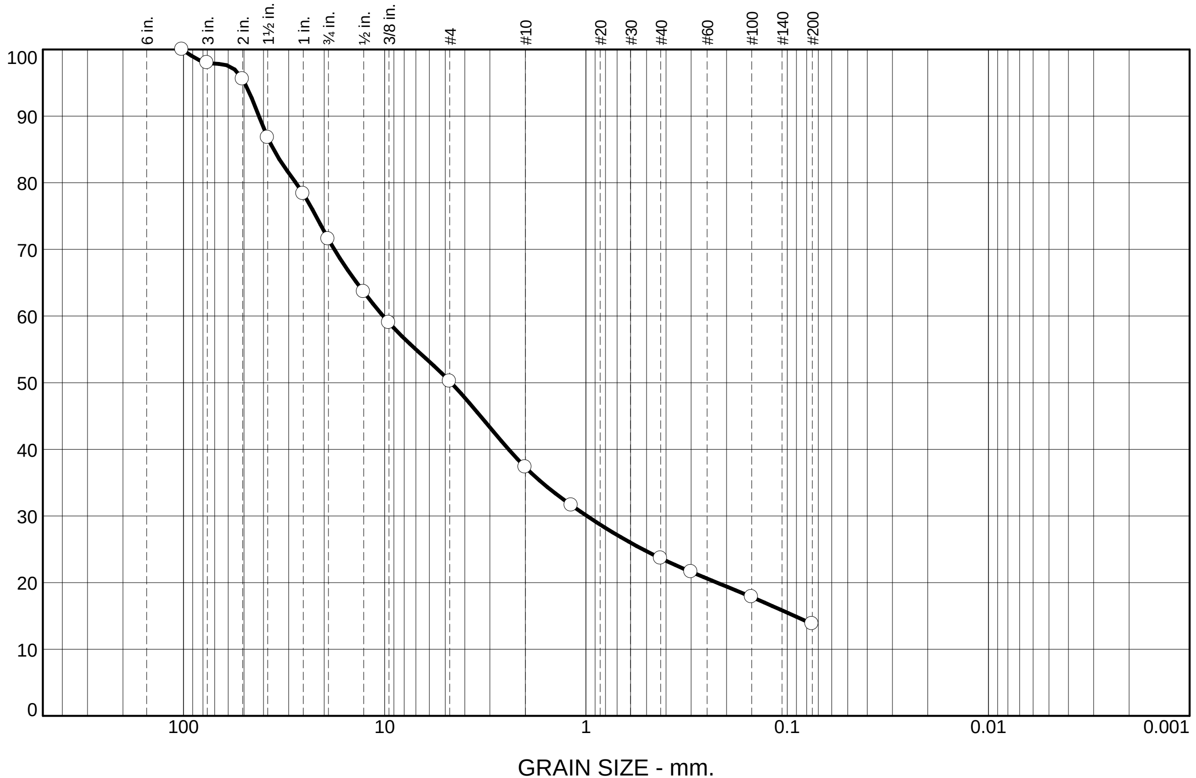
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-106-02

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
2.0	26.5	21.3	12.9	13.6	9.9	13.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100.0		
3	98.0		
2	95.5		
1.5	86.8		
1	78.4		
.75	71.5		
.5	63.6		
.375	59.0		
#4	50.2		
#10	37.3		
#16	31.6		
#40	23.7		
#50	21.6		
#100	17.8		
#200	13.8		

* (no specification provided)

Material Description

Brown silty gravel with sand

Atterberg Limits

PL= NP **LL=** NP **PI=** NP

Coefficients

D_{90}= 42.1555 D_{85}= 35.6517 D_{60}= 10.1835
D_{50}= 4.6790 D_{30}= 0.9884 D_{15}= 0.0920
D_{10}= C_u= C_c=

Classification

USCS= GM **AASHTO=** A-1-a

Remarks

Natural Moisture Content: 10.8%

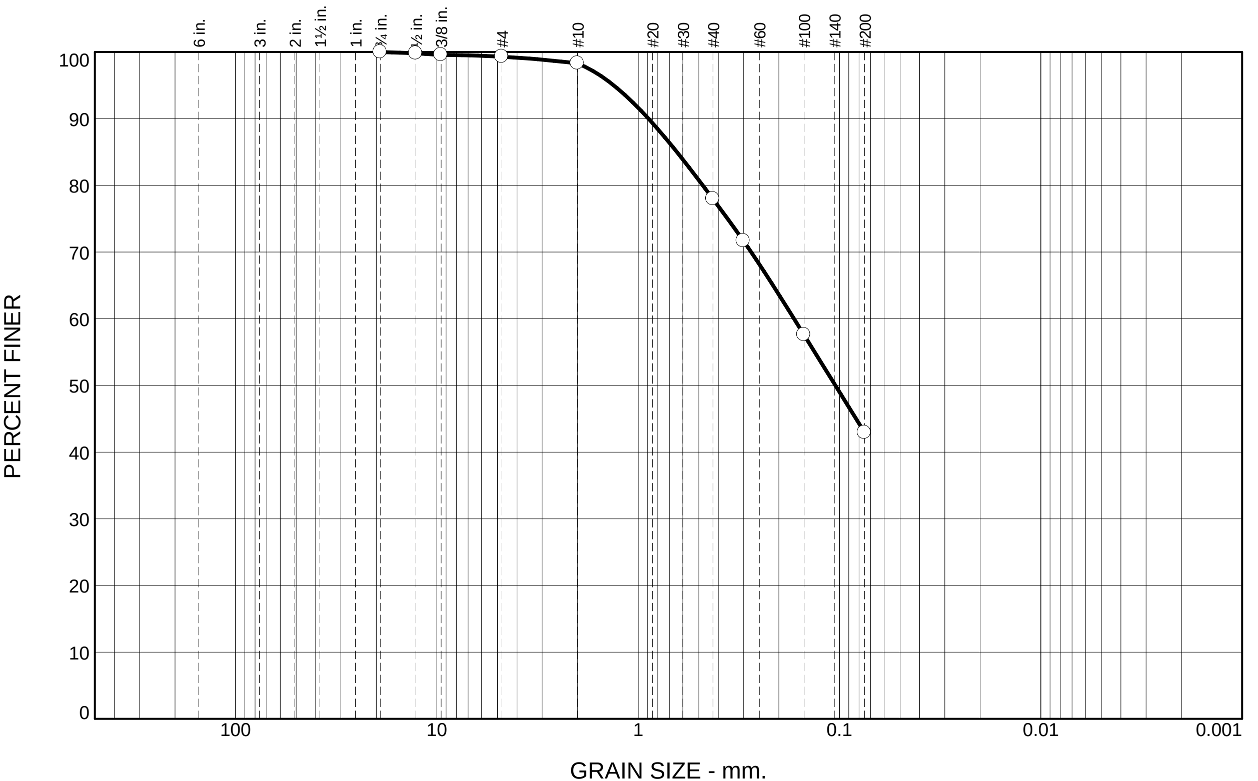
Location: TP19-03
Sample Number: 19-060-03 **Depth:** 6-9' **Date:** 4/1/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-03

Tested By: KS/JB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.7	1.0	20.3	35.1	42.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75"	100.0		
.5"	99.8		
.375"	99.6		
#4	99.3		
#10	98.3		
#40	78.0		
#50	71.7		
#100	57.6		
#200	42.9		

* (no specification provided)

Material Description

Light brown silty sand

Atterberg Limits

PL= 46 LL= 47 PI= 1

Coefficients

D_{90}= 0.8877 D_{85}= 0.6417 D_{60}= 0.1683
D_{50}= 0.1048 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-5(0)

Remarks

Natural Moisture content = 31.2%

Location: TP19-04
Sample Number: 19-106-03 **Depth:** 2-4' **Date:** 5/1/2019

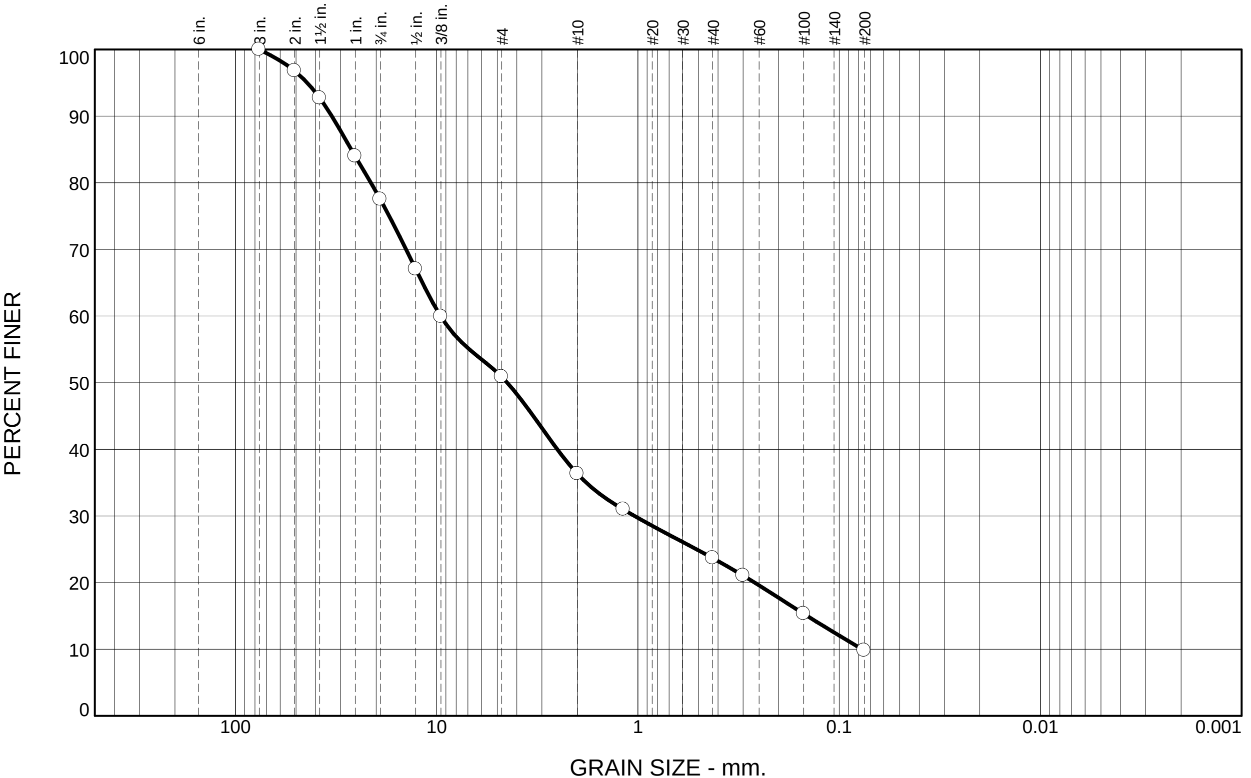
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-106-03

Tested By: JH **Checked By:** KE

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	22.5	26.6	14.6	12.6	13.9	9.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	96.8		
1.5	92.7		
1	84.0		
.75	77.5		
.5	67.0		
.375	59.9		
#4	50.9		
#10	36.3		
#16	31.0		
#40	23.7		
#50	21.0		
#100	15.3		
#200	9.8		

* (no specification provided)

Material Description

Light Brown well-graded gravel with silt and sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 33.2086 D_{85}= 26.5801 D_{60}= 9.5689
D_{50}= 4.4634 D_{30}= 1.0390 D_{15}= 0.1443
D_{10}= 0.0768 C_u= 124.52 C_c= 1.47

Classification

USCS= GW-GM AASHTO= A-1-a

Remarks

Natural Moisture Content: 20.2%

Location: TP19-04
Sample Number: 19-060-04 **Depth:** 5-7' **Date:** 4/1/2019

NewFields

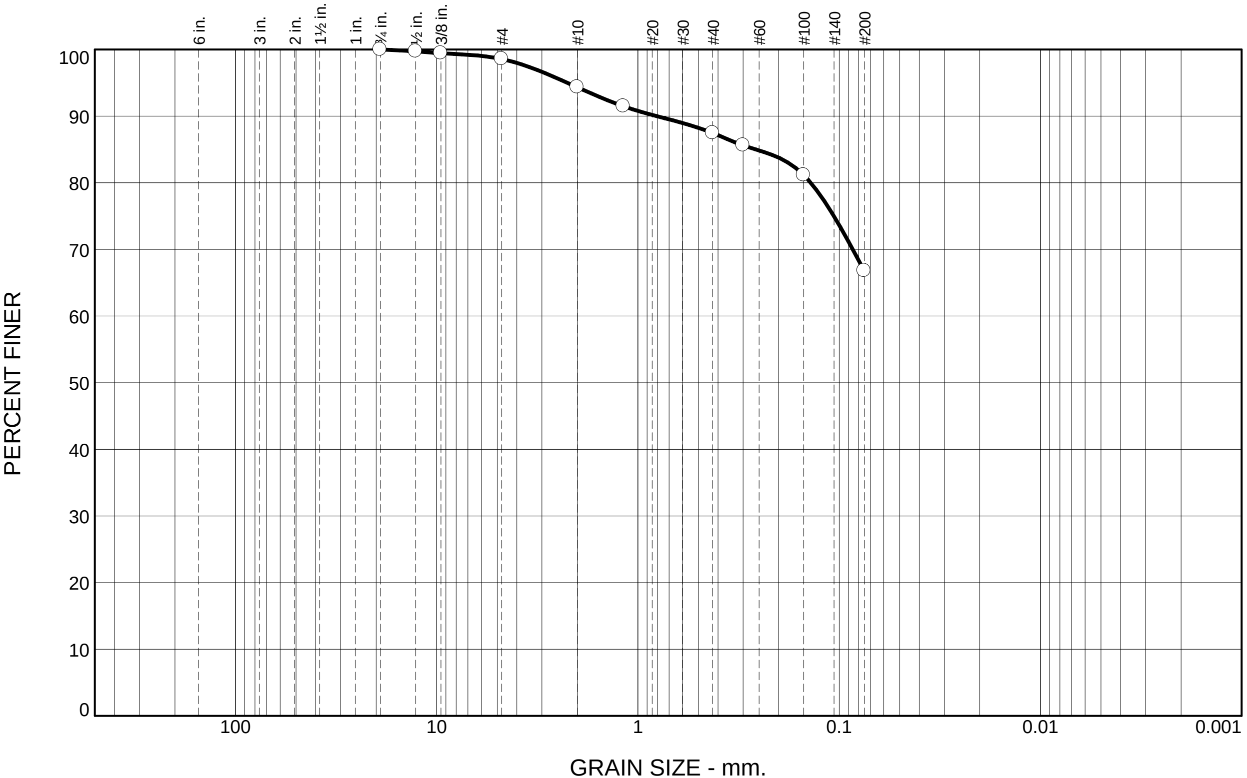
Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-060-04

Tested By: KS/JB **Checked By:** JH

Test results included in this report relate only to the items inspected or tested. This report shall not be reproduced, in full, without prior written approval of NewFields.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.4	4.3	6.8	20.7	66.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	99.7		
.375	99.4		
#4	98.6		
#10	94.3		
#16	91.5		
#40	87.5		
#50	85.6		
#100	81.2		
#200	66.8		

* (no specification provided)

Material Description

Brown sandy silt

Atterberg Limits

PL= 31 LL= 41 PI= 10

Coefficients

D_{90}= 0.8040 D_{85}= 0.2597 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO= A-5(7)

Remarks

Natural Moisture Content: 23.7%

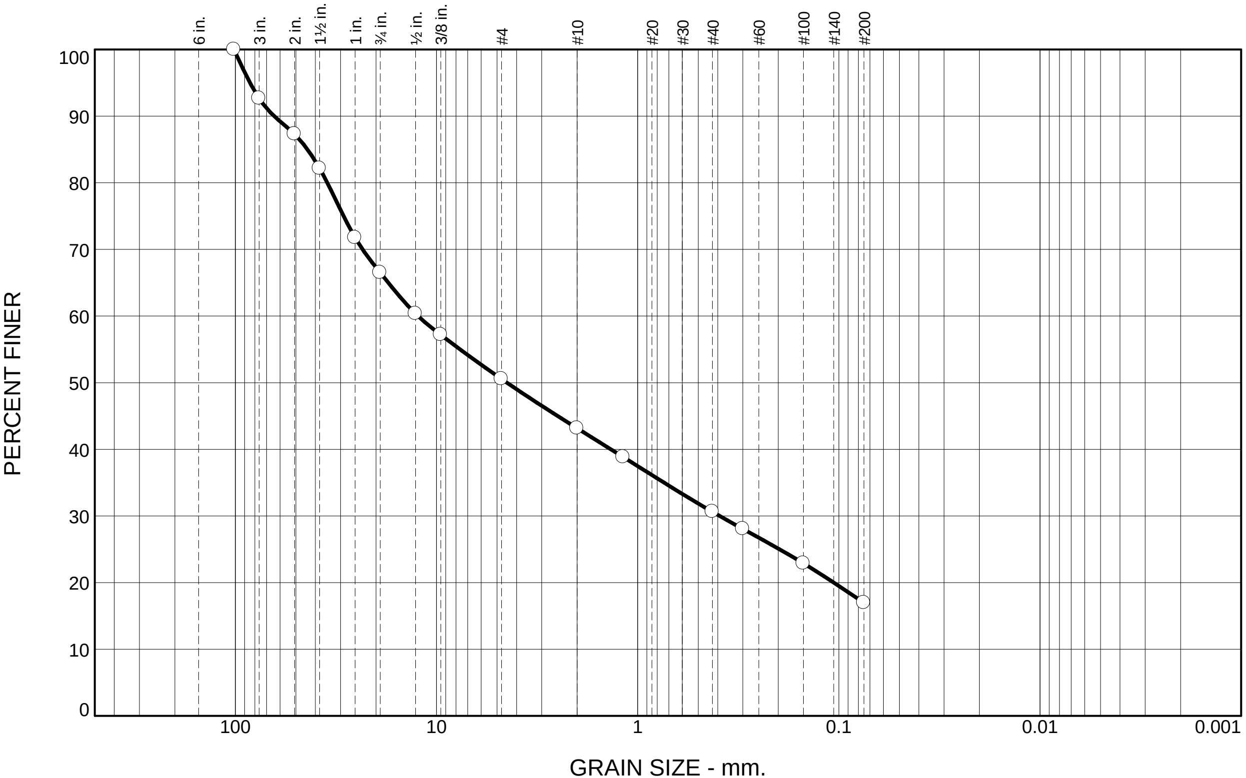
Location: TP19-05
Sample Number: 19-060-05 **Depth:** 8-10' **Date:** 4/1/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-05

Tested By: KS/JB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
7.3	26.2	16.0	7.3	12.6	13.6	17.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100.0		
3	92.7		
2	87.3		
1.5	82.2		
1	71.8		
.75	66.5		
.5	60.3		
.375	57.2		
#4	50.5		
#10	43.2		
#16	38.8		
#40	30.6		
#50	28.1		
#100	22.9		
#200	17.0		

* (no specification provided)

Material Description

Light Brown silty gravel with sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 64.1392 D_{85}= 43.7738 D_{60}= 12.3614
D_{50}= 4.4691 D_{30}= 0.3914 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= GM AASHTO= A-1-b

Remarks

Natural Moisture Content: 11.2%

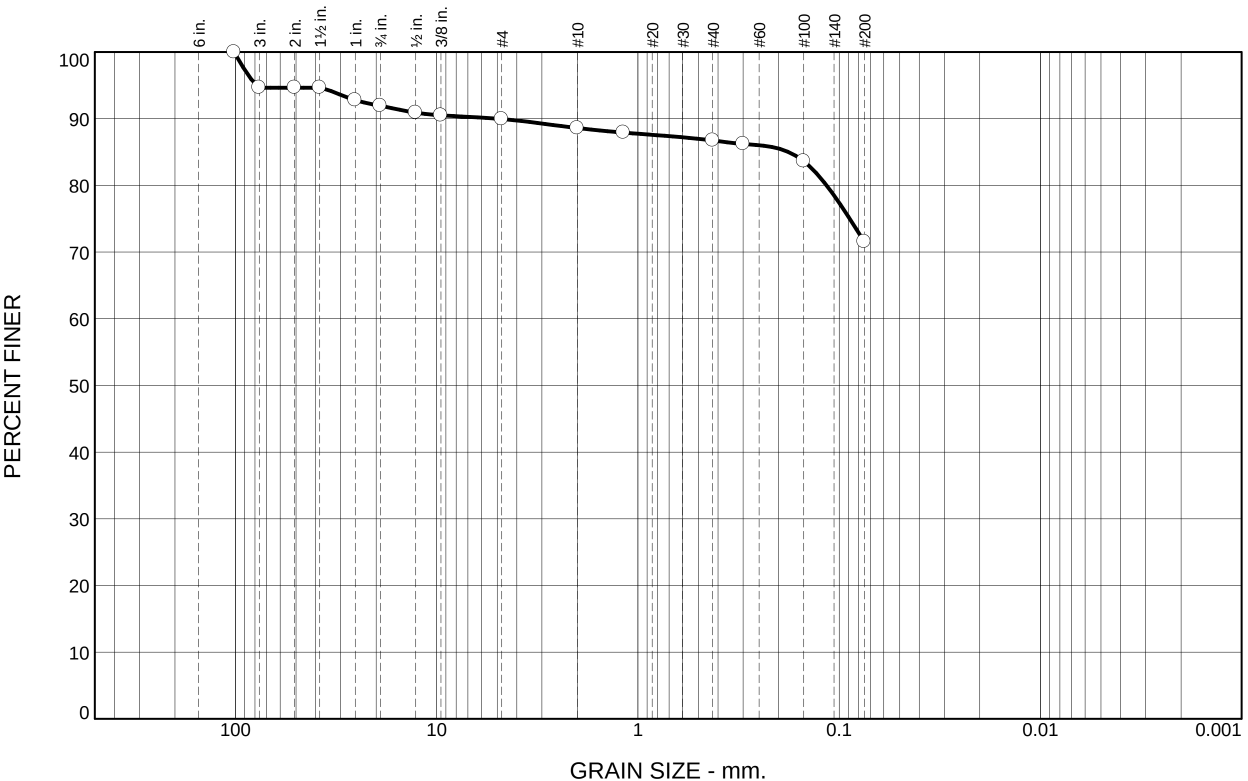
Location: TP19-06
Sample Number: 19-060-06 **Depth:** 11-13' **Date:** 4/1/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-06

Tested By: KS/JB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
5.4	2.7	1.9	1.4	1.9	15.2	71.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100.0		
3	94.6		
2	94.6		
1.5	94.6		
1	92.8		
.75	91.9		
.5	90.9		
.375	90.5		
#4	90.0		
#10	88.6		
#16	87.9		
#40	86.7		
#50	86.2		
#100	83.6		
#200	71.5		

* (no specification provided)

Material Description

Light Brown fat clay with sand

Atterberg Limits

PL= 22 LL= 55 PI= 33

Coefficients

D_{90}= 4.9438 D_{85}= 0.1784 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CH AASHTO= A-7-6(25)

Remarks

Natural Moisture Content: 24.0%

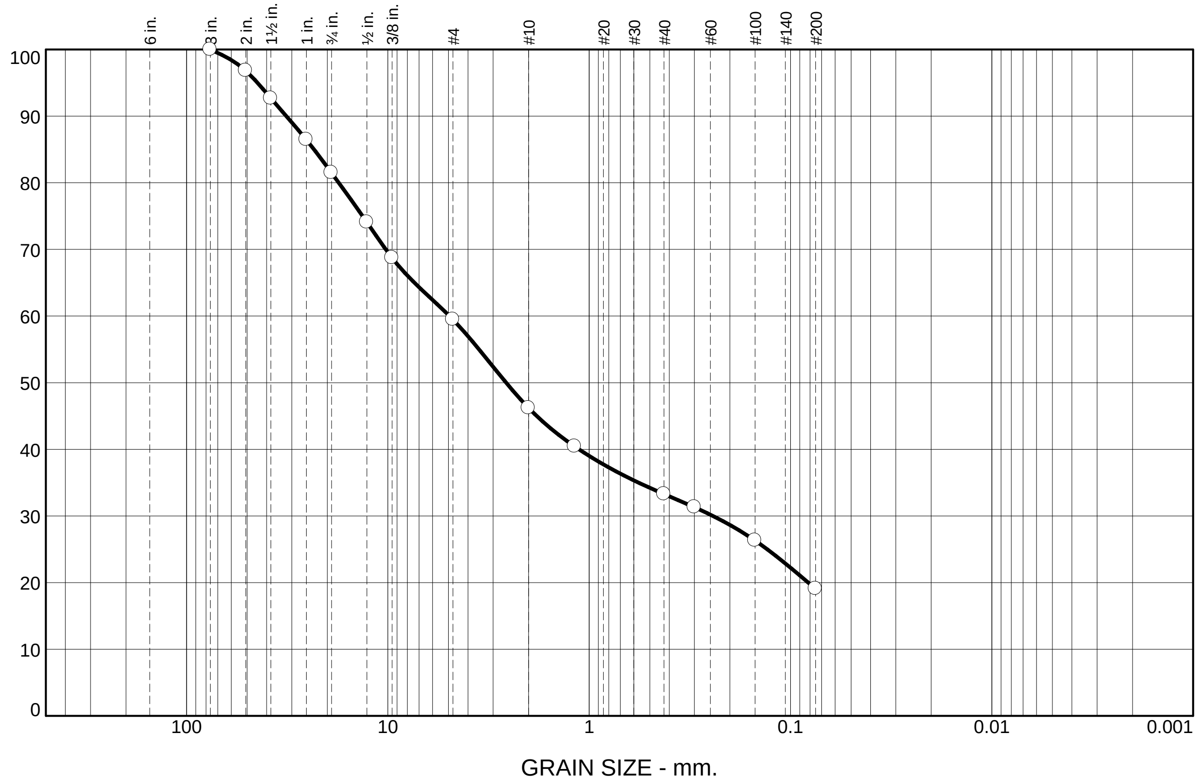
Location: TP19-07
Sample Number: 19-106-04 **Depth:** 2-4' **Date:** 4/22/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-106-04

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	18.5	22.0	13.3	12.9	14.2	19.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	96.8		
1.5	92.7		
1	86.4		
.75	81.5		
.5	74.1		
.375	68.7		
#4	59.5		
#10	46.2		
#16	40.4		
#40	33.3		
#50	31.3		
#100	26.3		
#200	19.1		

* (no specification provided)

Material Description

Light Brown silty gravel with sand

Atterberg Limits

PL= 28 LL= 37 PI= 9

Coefficients

D_{90}= 31.9208 D_{85}= 23.2860 D_{60}= 4.9417
D_{50}= 2.5845 D_{30}= 0.2431 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= GM AASHTO= A-2-4(0)

Remarks

Natural Moisture Content: 14.8%

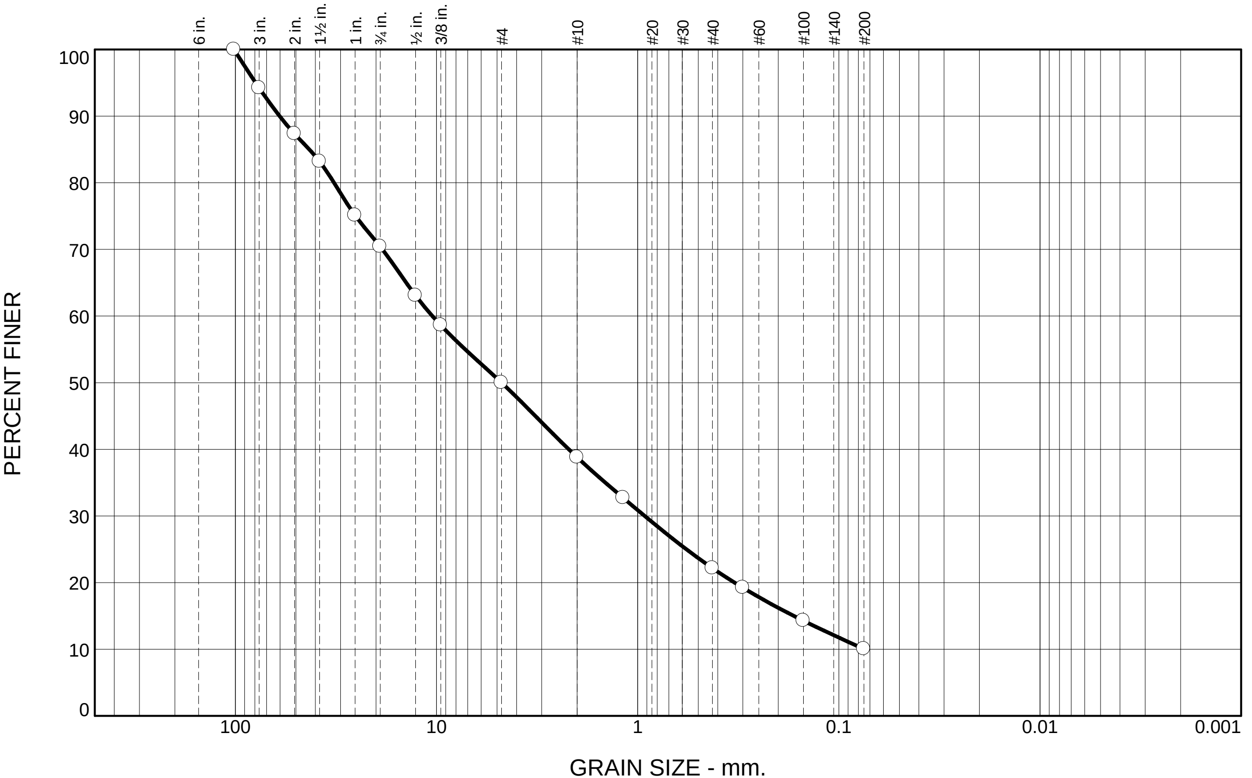
Location: TP19-08
Sample Number: 19-106-05 **Depth:** 2-4' **Date:** 4/22/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-106-05

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
5.8	23.8	20.4	11.2	16.6	12.2	10.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100.0		
3	94.2		
2	87.3		
1.5	83.2		
1	75.1		
.75	70.4		
.5	63.1		
.375	58.6		
#4	50.0		
#10	38.8		
#16	32.7		
#40	22.2		
#50	19.2		
#100	14.3		
#200	10.0		

* (no specification provided)

Material Description

Brown poorly graded gravel with silt and sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 60.2921 D_{85}= 42.8442 D_{60}= 10.4846
D_{50}= 4.7510 D_{30}= 0.9228 D_{15}= 0.1675
D_{10}= C_u= C_c=

Classification

USCS= GP-GM AASHTO= A-1-a

Remarks

Natural Moisture Content: 9.8%

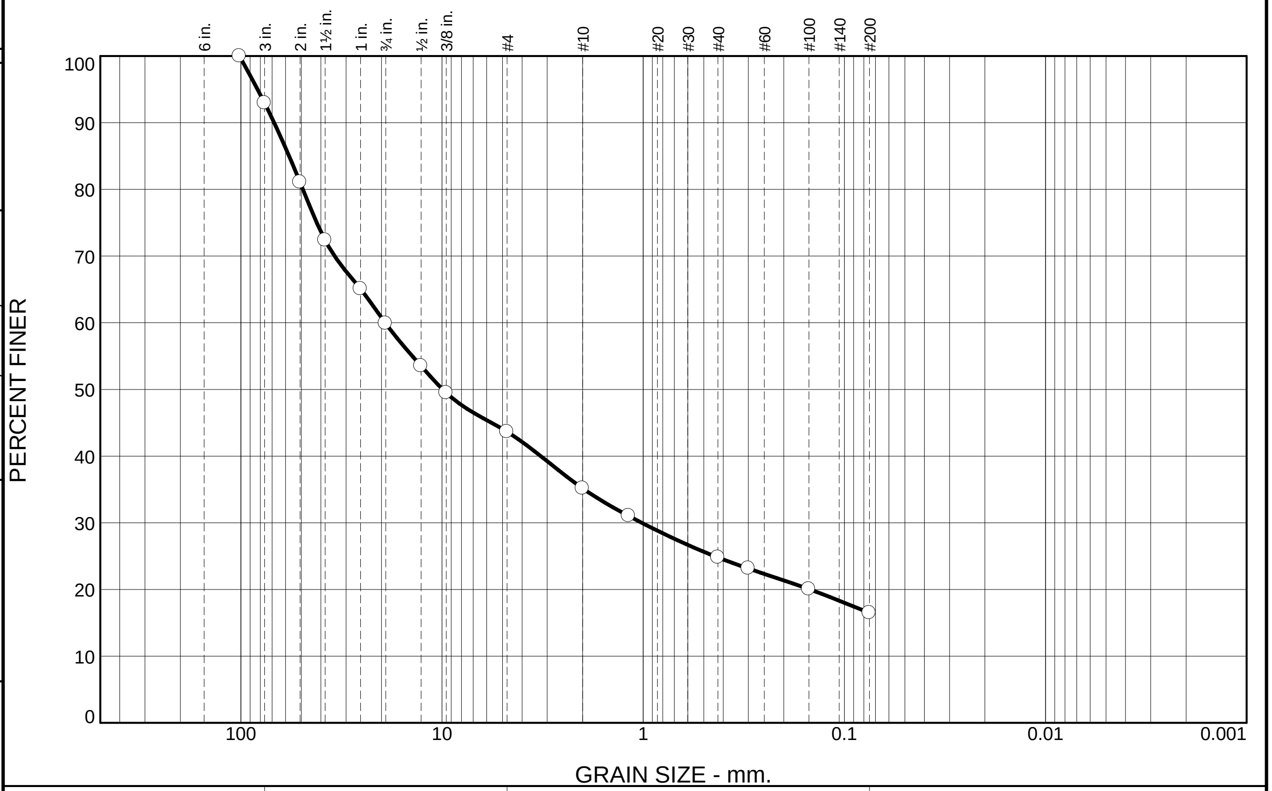
Location: TP19-08
Sample Number: 19-060-07 **Depth:** 6-9' **Date:** 4/1/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-07

Tested By: KS/JB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
7.1	33.0	16.3	8.4	10.4	8.3	16.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100.0		
3	92.9		
2	81.1		
1.5	72.4		
1	65.1		
.75	59.9		
.5	53.5		
.375	49.5		
#4	43.6		
#10	35.2		
#16	31.0		
#40	24.8		
#50	23.1		
#100	20.0		
#200	16.5		

* (no specification provided)

Material Description

Red silty gravel with sand

Atterberg Limits

PL= 31 LL= 55 PI= 24

Coefficients

D_{90}= 68.3561 D_{85}= 57.5969 D_{60}= 19.1693
D_{50}= 9.9271 D_{30}= 1.0157 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= GM AASHTO= A-2-7(0)

Remarks

Natural Moisture Content: 12.4%

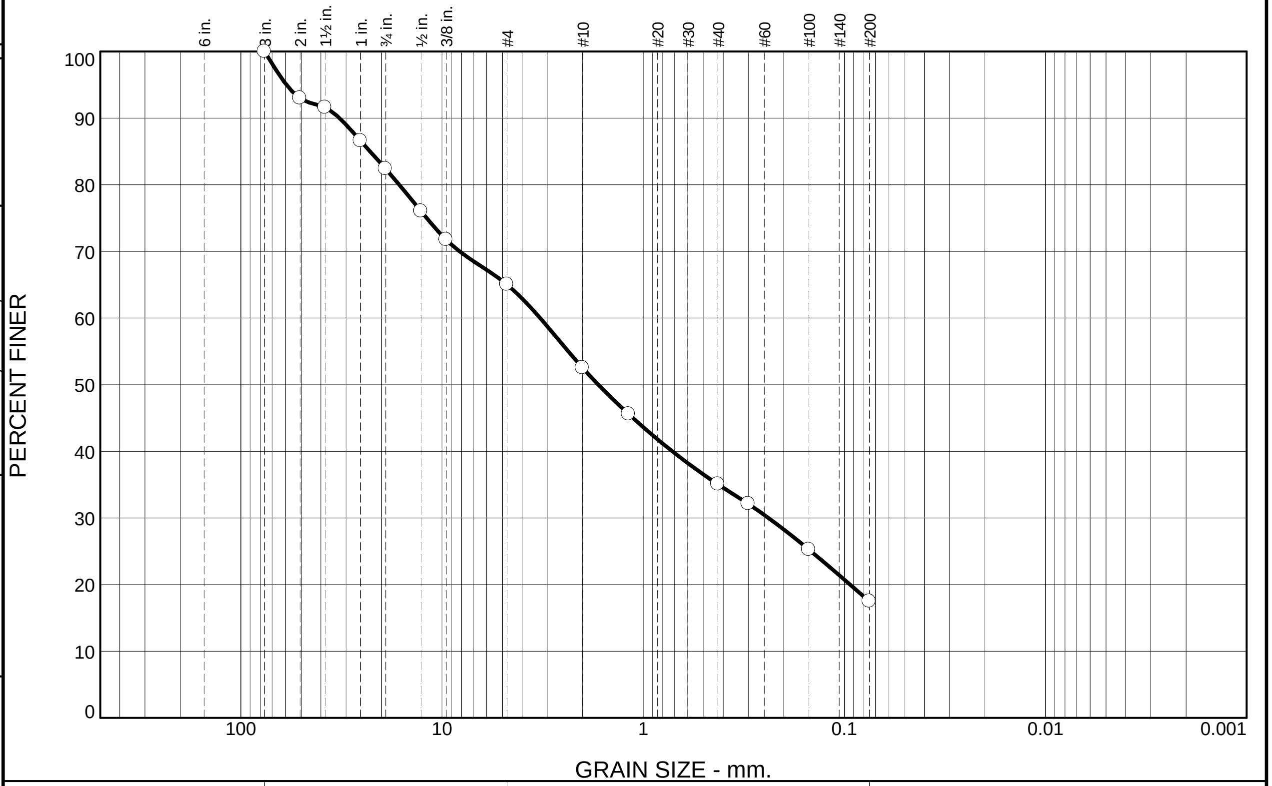
Location: TP19-09
Sample Number: 19-060-08 **Depth:** 8-12' **Date:** 4/1/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-08

Tested By: JH/JB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	17.6	17.4	12.5	17.4	17.6	17.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	93.0		
1.5	91.6		
1	86.6		
.75	82.4		
.5	76.0		
.375	71.7		
#4	65.0		
#10	52.5		
#16	45.6		
#40	35.1		
#50	32.1		
#100	25.3		
#200	17.5		

* (no specification provided)

Material Description

Light Brown silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 32.3094 D_{85}= 22.7954 D_{60}= 3.2545
D_{50}= 1.6732 D_{30}= 0.2385 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Natural Moisture Content: 17.1%

Location: TP19-10
Sample Number: 19-106-06 **Depth:** 3-6' **Date:** 4/22/2019

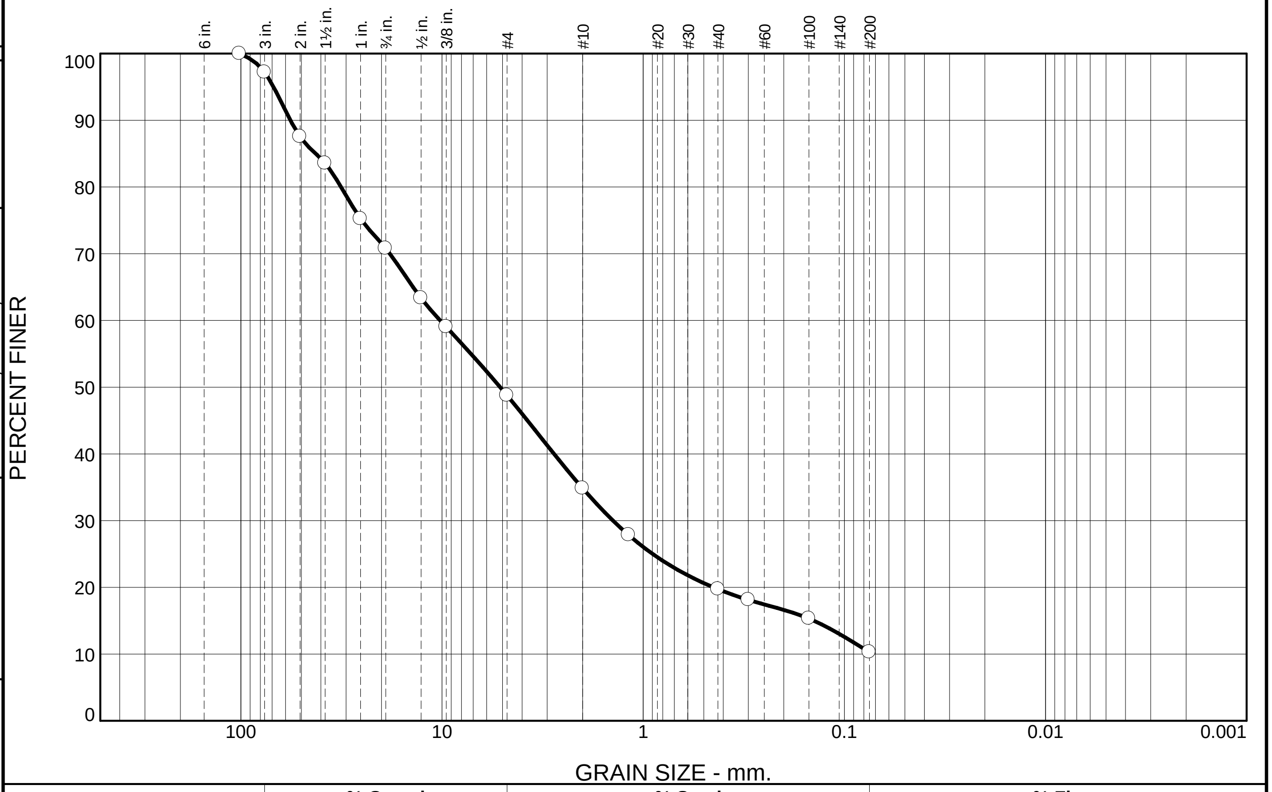
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-106-06

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
2.8	26.4	22.0	14.0	15.1	9.4	10.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100.0		
3	97.2		
2	87.5		
1.5	83.6		
1	75.2		
.75	70.8		
.5	63.3		
.375	59.0		
#4	48.8		
#10	34.8		
#16	27.8		
#40	19.7		
#50	18.1		
#100	15.3		
#200	10.3		

* (no specification provided)

Material Description

Brown poorly graded gravel with silt and sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 56.7320 D_{85}= 42.4246 D_{60}= 10.2159
D_{50}= 5.1396 D_{30}= 1.4127 D_{15}= 0.1421
D_{10}= C_u= C_c=

Classification

USCS= GP-GM AASHTO= A-1-a

Remarks

Natural Moisture Content: 8.1%

Location: TP19-11
Sample Number: 19-060-09 **Depth:** 7-11' **Date:** 4/1/2019

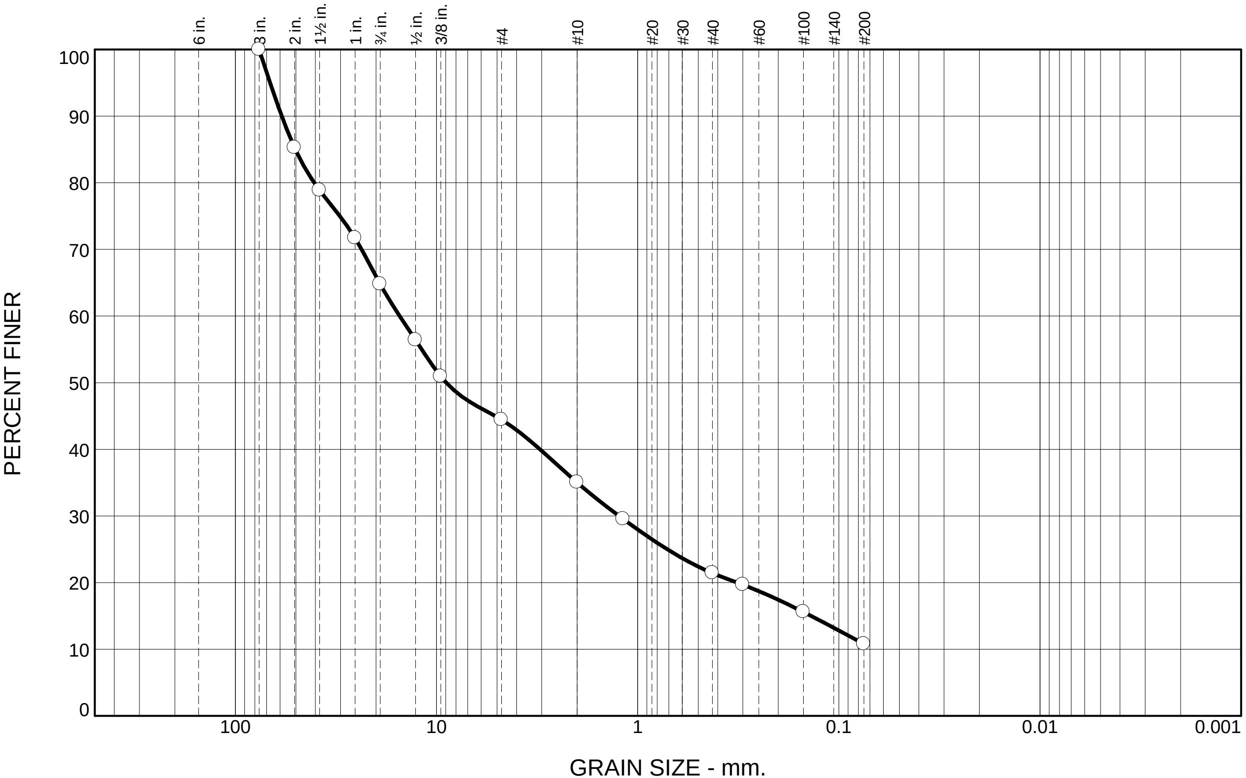
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-060-09

Tested By: JH/JB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	35.2	20.4	9.4	13.6	10.6	10.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	85.3		
1.5	78.9		
1	71.7		
.75	64.8		
.5	56.4		
.375	50.9		
#4	44.4		
#10	35.0		
#16	29.5		
#40	21.4		
#50	19.7		
#100	15.6		
#200	10.8		

* (no specification provided)

Material Description

Light Brown poorly graded gravel with silt and sand

Atterberg Limits

PL= 30 LL= 52 PI= 22

Coefficients

D_{90}= 58.8246 D_{85}= 50.3295 D_{60}= 15.2419
D_{50}= 8.9506 D_{30}= 1.2379 D_{15}= 0.1373
D_{10}= C_u= C_c=

Classification

USCS= GP-GM AASHTO= A-2-7(0)

Remarks

Natural Moisture Content: 15.5%

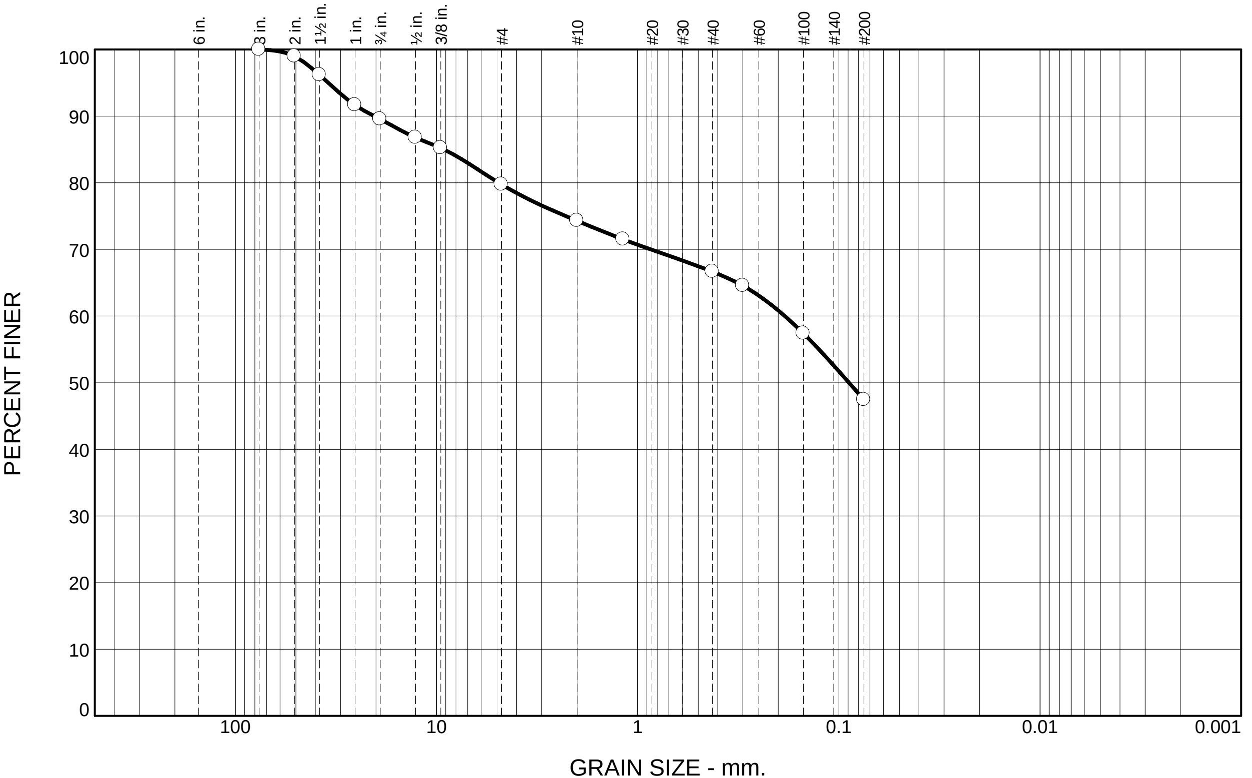
Location: TP19-13
Sample Number: 19-106-07 **Depth:** 3-5' **Date:** 4/22/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-106-07

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	10.5	9.8	5.4	7.6	19.3	47.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	99.0		
1.5	96.2		
1	91.7		
.75	89.5		
.5	86.8		
.375	85.2		
#4	79.7		
#10	74.3		
#16	71.5		
#40	66.7		
#50	64.6		
#100	57.4		
#200	47.4		

* (no specification provided)

Material Description

Light Brown clayey sand with gravel

Atterberg Limits

PL= 32 LL= 66 PI= 34

Coefficients

D_{90}= 20.3770 D_{85}= 9.1917 D_{60}= 0.1857
D_{50}= 0.0890 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-7-5(12)

Remarks

Natural Moisture Content: 30.9%

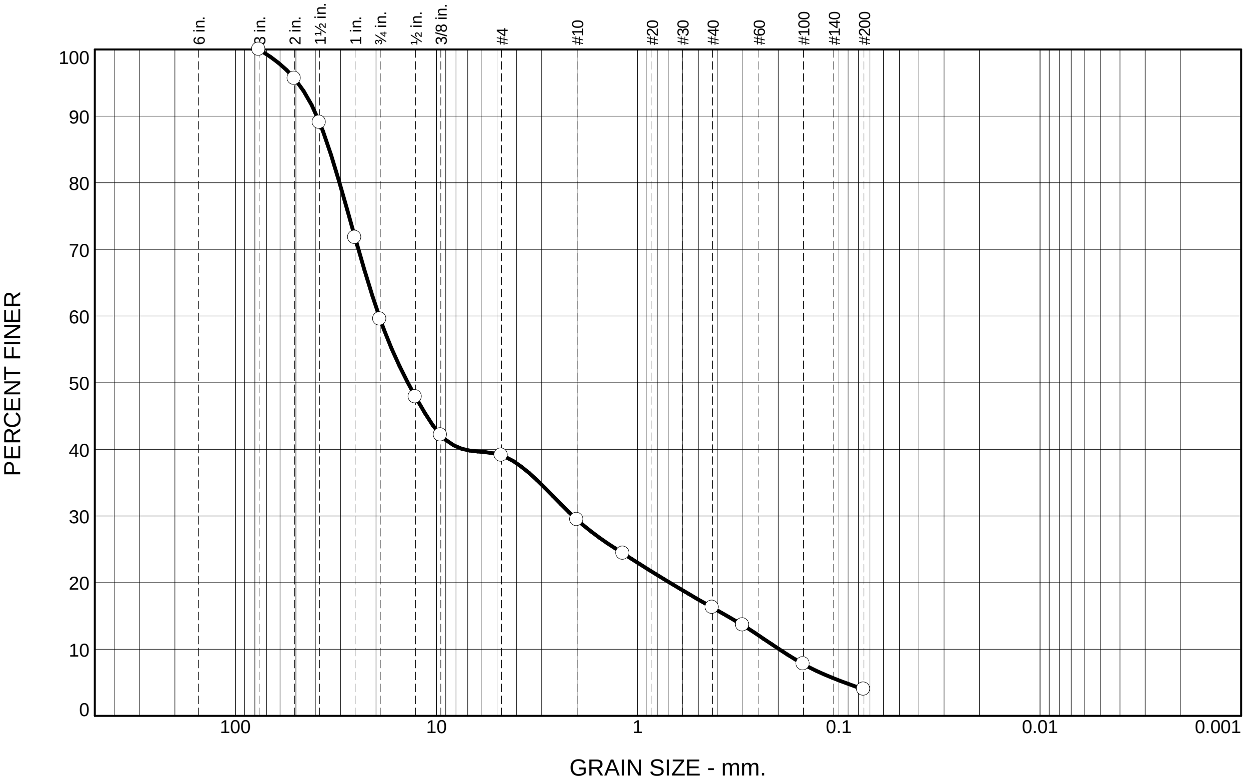
Location: TP19-13
Sample Number: 19-060-10 **Depth:** 10-13' **Date:** 4/1/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-10

Tested By: JH/JB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	40.5	20.4	9.7	13.2	12.2	4.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	95.6		
1.5	89.0		
1	71.8		
.75	59.5		
.5	47.8		
.375	42.1		
#4	39.1		
#10	29.4		
#16	24.4		
#40	16.2		
#50	13.6		
#100	7.8		
#200	4.0		

* (no specification provided)

Material Description

Brown well-graded gravel with sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 39.3129 D_{85}= 34.1247 D_{60}= 19.3064
D_{50}= 13.8796 D_{30}= 2.0991 D_{15}= 0.3593
D_{10}= 0.1980 C_u= 97.48 C_c= 1.15

Classification

USCS= GW AASHTO= A-1-a

Remarks

Natural Moisture Content: 25.7%

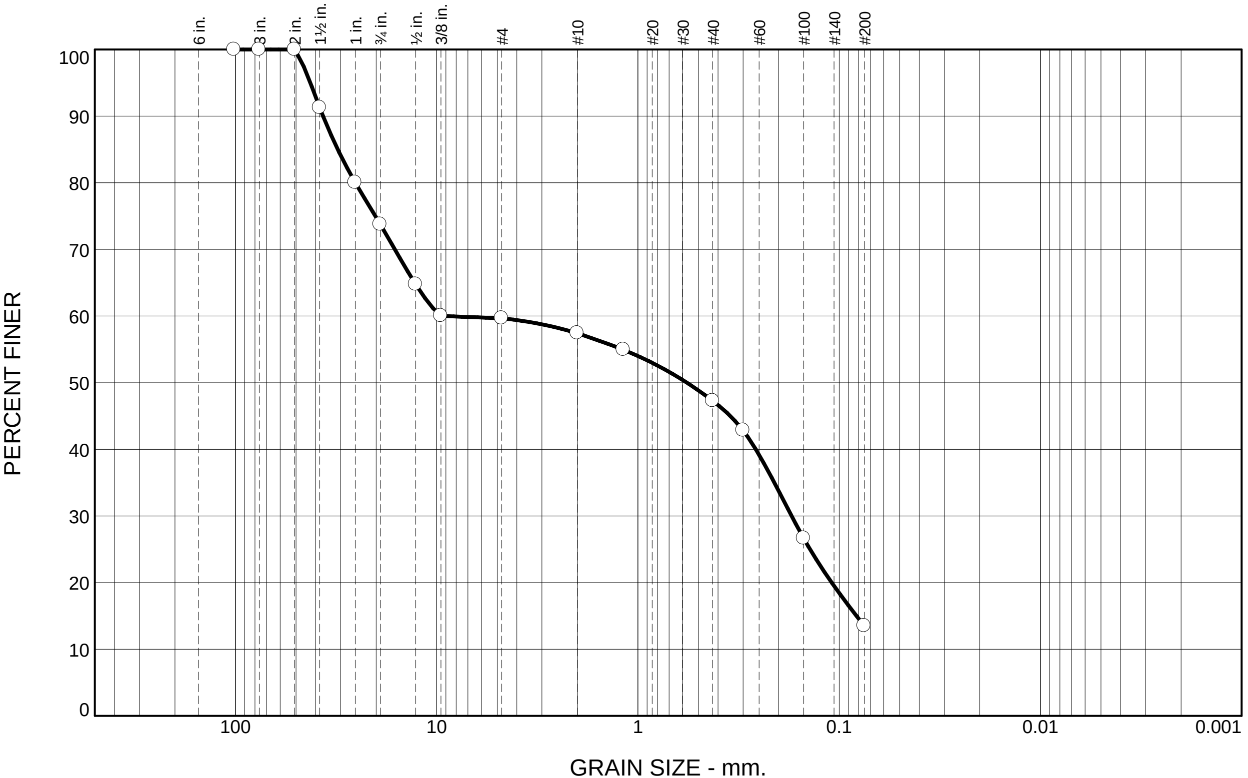
Location: TP19-14
Sample Number: 19-060-11 **Depth:** 8-11' **Date:** 4/1/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-11

Tested By: JH/JB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	26.3	14.0	2.3	10.1	33.8	13.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100.0		
3	100.0		
2	100.0		
1.5	91.3		
1	80.0		
.75	73.7		
.5	64.7		
.375	60.0		
#4	59.7		
#10	57.4		
#16	54.9		
#40	47.3		
#50	42.8		
#100	26.6		
#200	13.5		

* (no specification provided)

Material Description

Light Brown silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 36.6838 D_{85}= 31.0116 D_{60}= 9.1518
D_{50}= 0.5710 D_{30}= 0.1724 D_{15}= 0.0820
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Natural Moisture Content: 22.7%

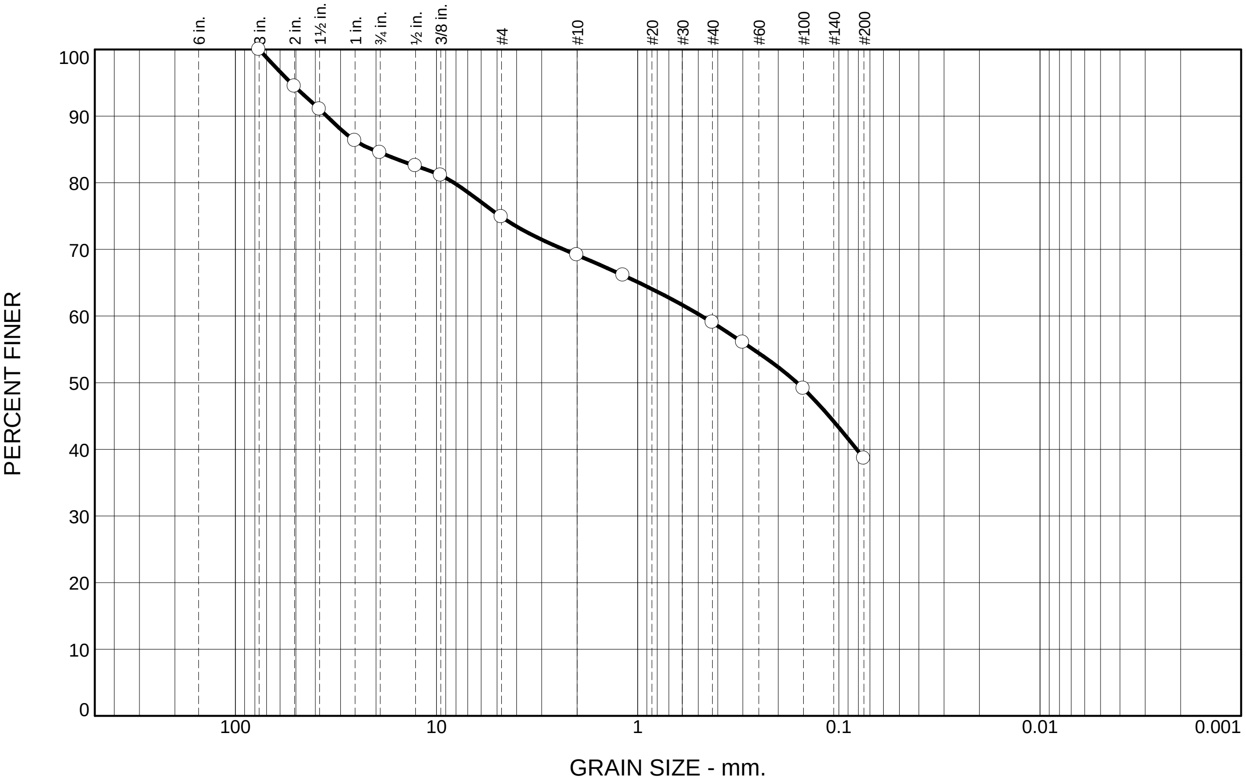
Location: TP19-15
Sample Number: 19-060-12 **Depth:** 8-11' **Date:** 4/1/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-12

Tested By: JH/JB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	15.5	9.6	5.8	10.1	20.4	38.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	94.5		
1.5	91.0		
1	86.3		
.75	84.5		
.5	82.5		
.375	81.1		
#4	74.9		
#10	69.1		
#16	66.1		
#40	59.0		
#50	56.0		
#100	49.1		
#200	38.6		

* (no specification provided)

Material Description

Brown silty sand with gravel

Atterberg Limits

PL= 37 LL= 58 PI= 21

Coefficients

D_{90}= 35.1167 D_{85}= 20.8900 D_{60}= 0.4809
D_{50}= 0.1616 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-7-5(4)

Remarks

Natural Moisture Content: 28.9%

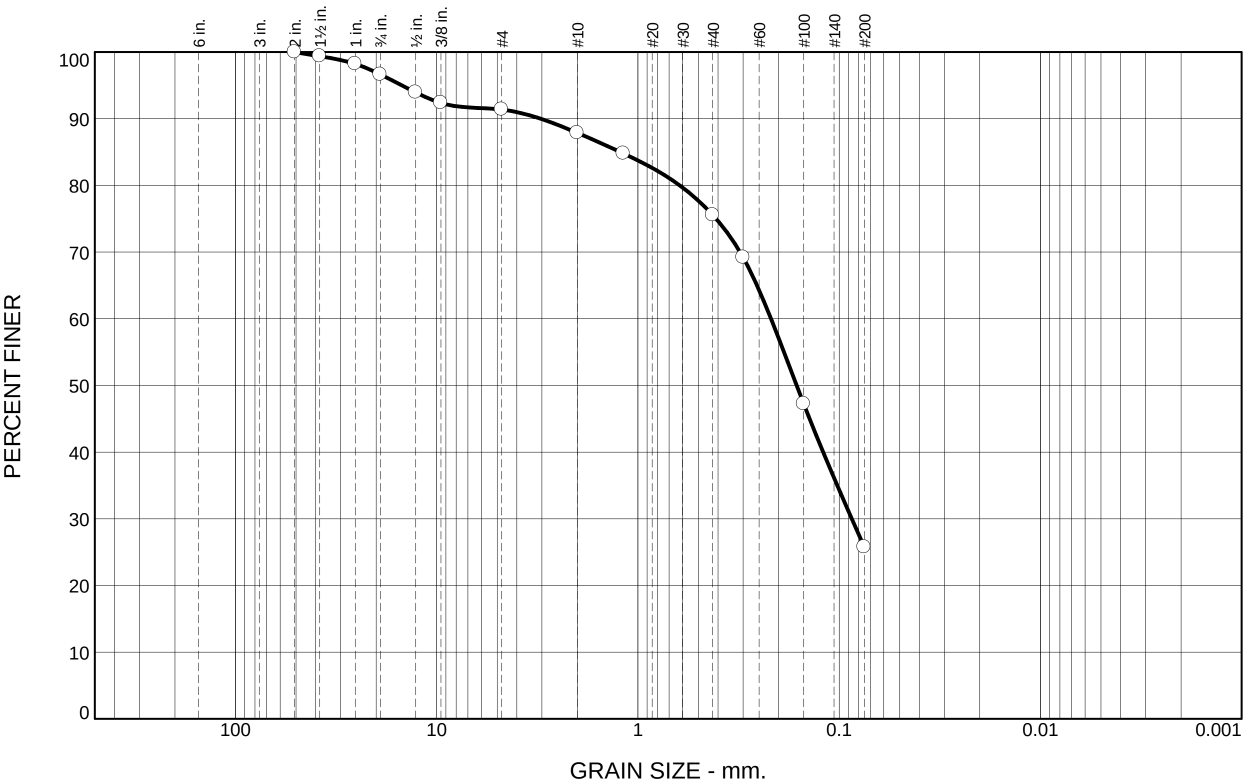
Location: TP19-16
Sample Number: 19-060-13 **Depth:** 7-10' **Date:** 4/1/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-13

Tested By: JH/JB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.4	5.2	3.5	12.3	49.9	25.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2	100.0		
1.5	99.4		
1	98.2		
.75	96.6		
.5	93.9		
.375	92.4		
#4	91.4		
#10	87.9		
#16	84.8		
#40	75.6		
#50	69.2		
#100	47.2		
#200	25.7		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 3.0459 D_{85}= 1.2229 D_{60}= 0.2182
D_{50}= 0.1627 D_{30}= 0.0865 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Natural Moisture Content: 21.3%

Location: TP19-17
Sample Number: 19-060-14 **Depth:** 4-7' **Date:** 4/1/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-14

Tested By: JH/JB **Checked By:** JH

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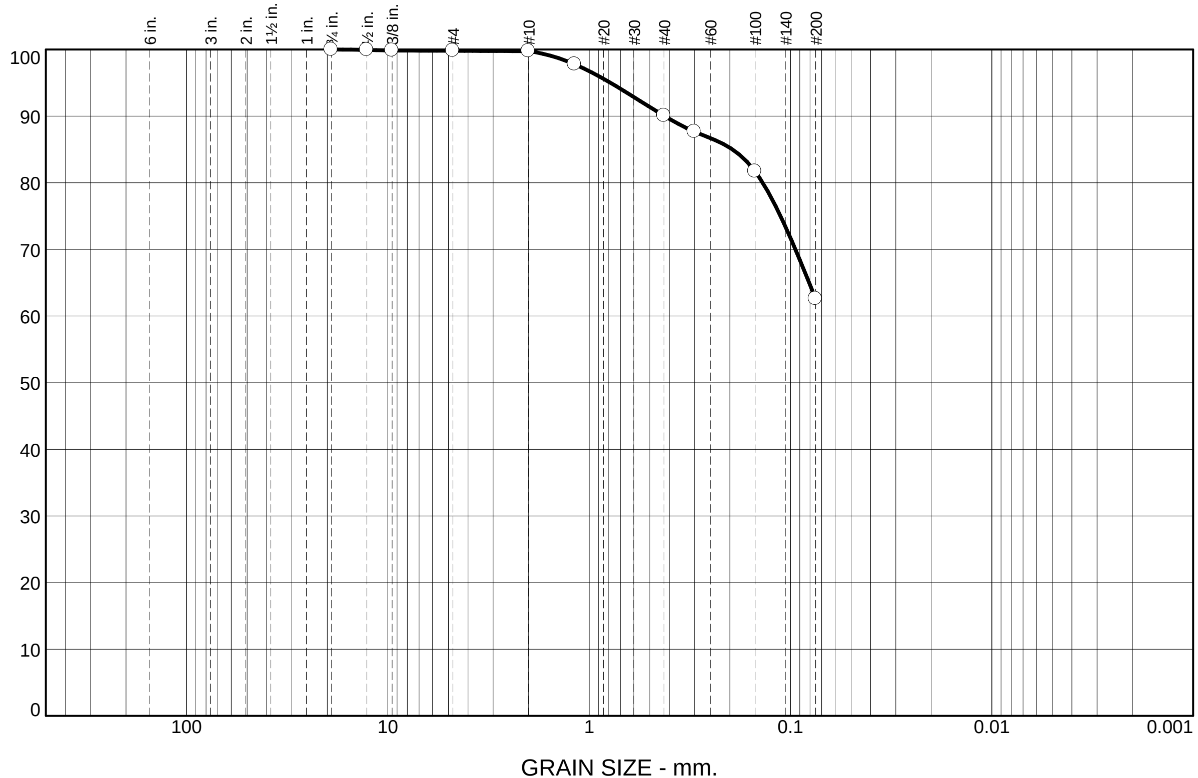
Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.2	0.0	9.7	27.5	62.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	99.9		
.375	99.9		
#4	99.8		
#10	99.8		
#16	97.8		
#40	90.1		
#50	87.7		
#100	81.7		
#200	62.6		

* (no specification provided)

Material Description

Brown sandy silty clay

Atterberg Limits

PL= 21 LL= 28 PI= 7

Coefficients

D_{90}= 0.4206 D_{85}= 0.1940 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL-ML AASHTO= A-4(2)

Remarks

Natural Moisture Content: 10.9%

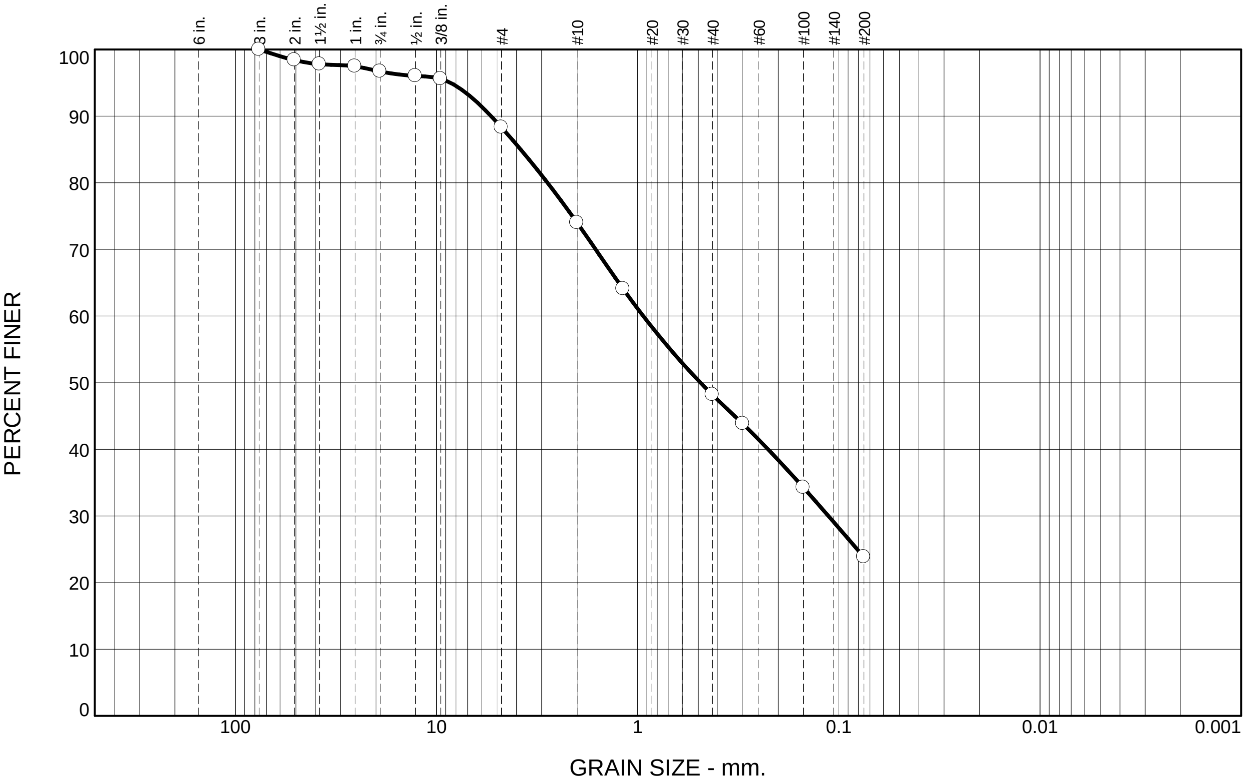
Location: TP19-18
Sample Number: 19-060-15 **Depth:** 5-8' **Date:** 4/1/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-15

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.3	8.4	14.3	25.8	24.4	23.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	98.4		
1.5	97.8		
1	97.5		
.75	96.7		
.5	96.0		
.375	95.6		
#4	88.3		
#10	74.0		
#16	64.1		
#40	48.2		
#50	43.8		
#100	34.3		
#200	23.8		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 5.3563 D_{85}= 3.8174 D_{60}= 0.9376
D_{50}= 0.4869 D_{30}= 0.1127 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Natural Moisture Content: 22.5%

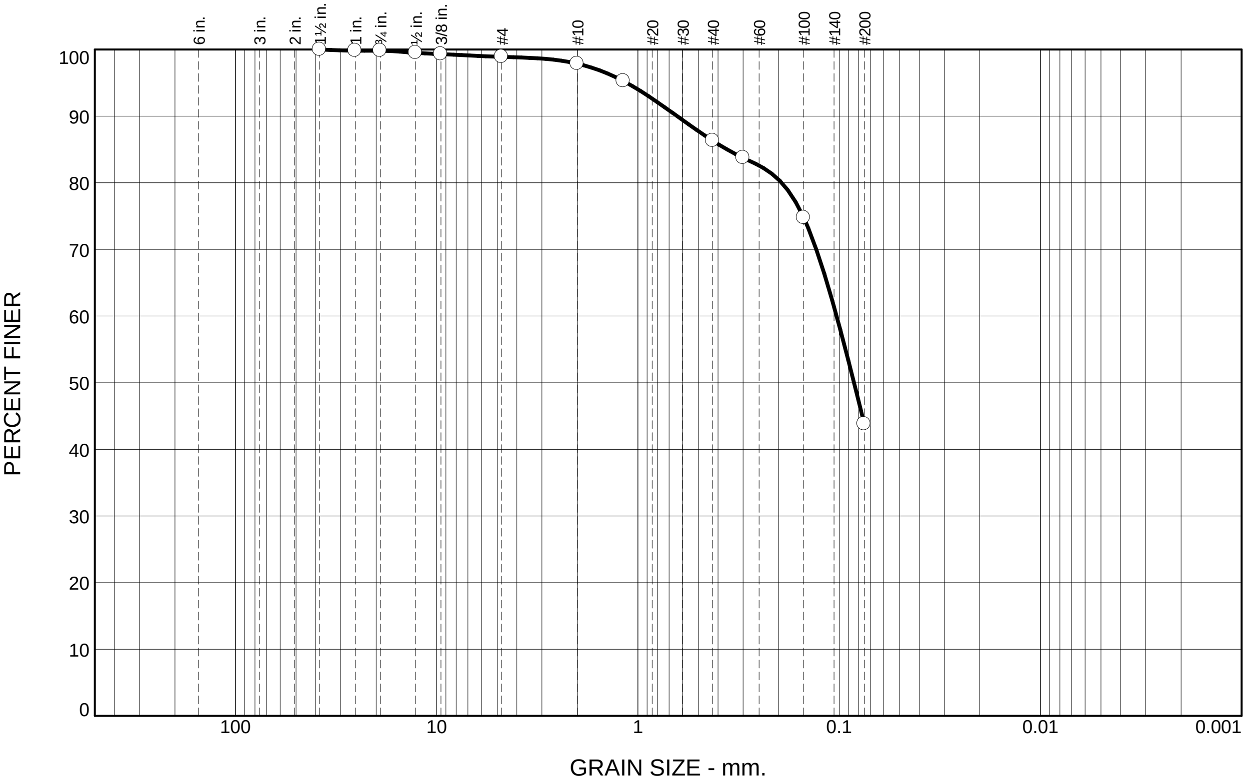
Location: TP19-20
Sample Number: 19-060-16 **Depth:** 6-10' **Date:** 4/1/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-16

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.2	0.9	1.0	11.6	42.5	43.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	99.8		
.75	99.8		
.5	99.5		
.375	99.3		
#4	98.9		
#10	97.9		
#16	95.3		
#40	86.3		
#50	83.7		
#100	74.8		
#200	43.8		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.6382 D_{85}= 0.3600 D_{60}= 0.1030
D_{50}= 0.0844 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-4(0)

Remarks

Natural Moisture Content: 13.1%

Location: TP19-21
Sample Number: 19-060-17 **Depth:** 3-5' **Date:** 4/1/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-17

Tested By: KS **Checked By:** JH

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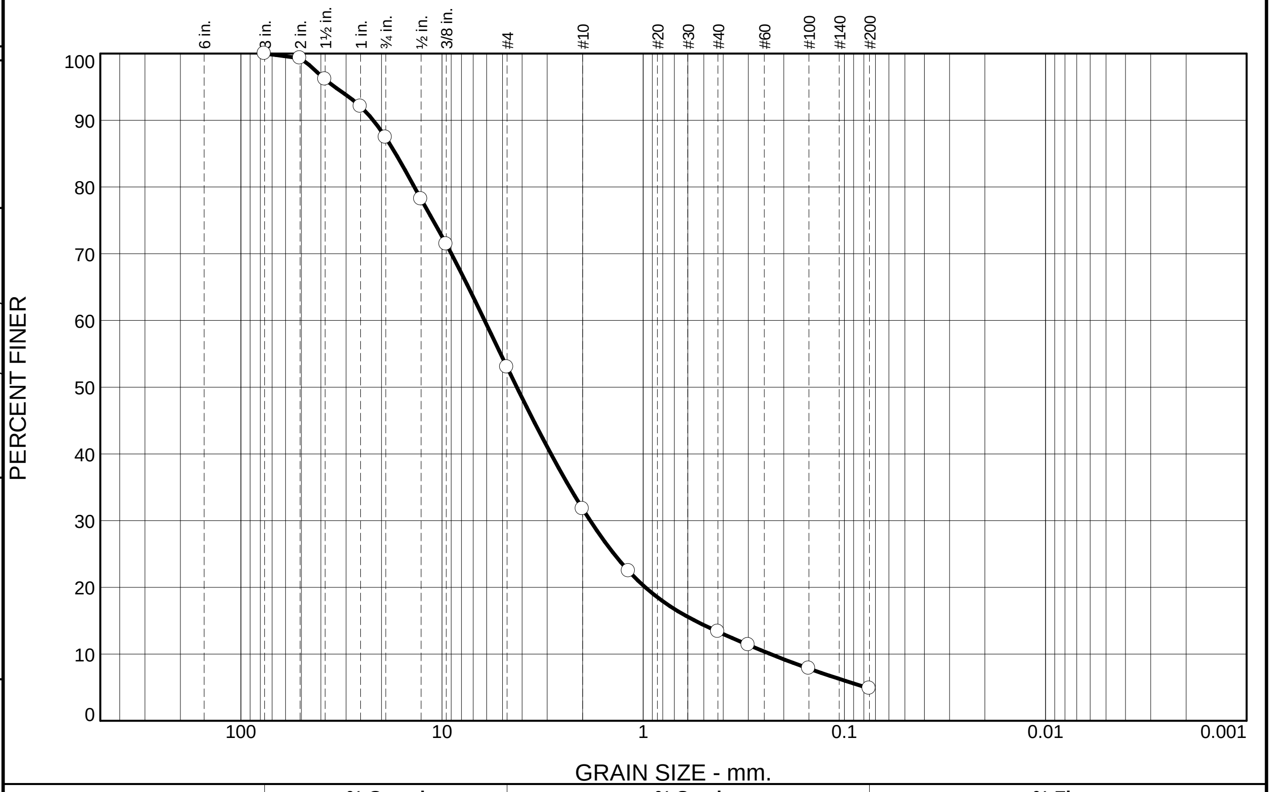
Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.6	34.4	21.2	18.4	8.6	4.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	99.3		
1.5	96.1		
1	92.1		
.75	87.4		
.5	78.2		
.375	71.4		
#4	53.0		
#10	31.8		
#16	22.4		
#40	13.4		
#50	11.4		
#100	7.8		
#200	4.8		

* (no specification provided)

Material Description

Gray well-graded sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 21.9917 D_{85}= 16.9927 D_{60}= 6.1422
D_{50}= 4.2486 D_{30}= 1.8346 D_{15}= 0.5522
D_{10}= 0.2331 C_u= 26.35 C_c= 2.35

Classification

USCS= SW AASHTO= A-1-a

Remarks

Natural Moisture Content: 4.8%

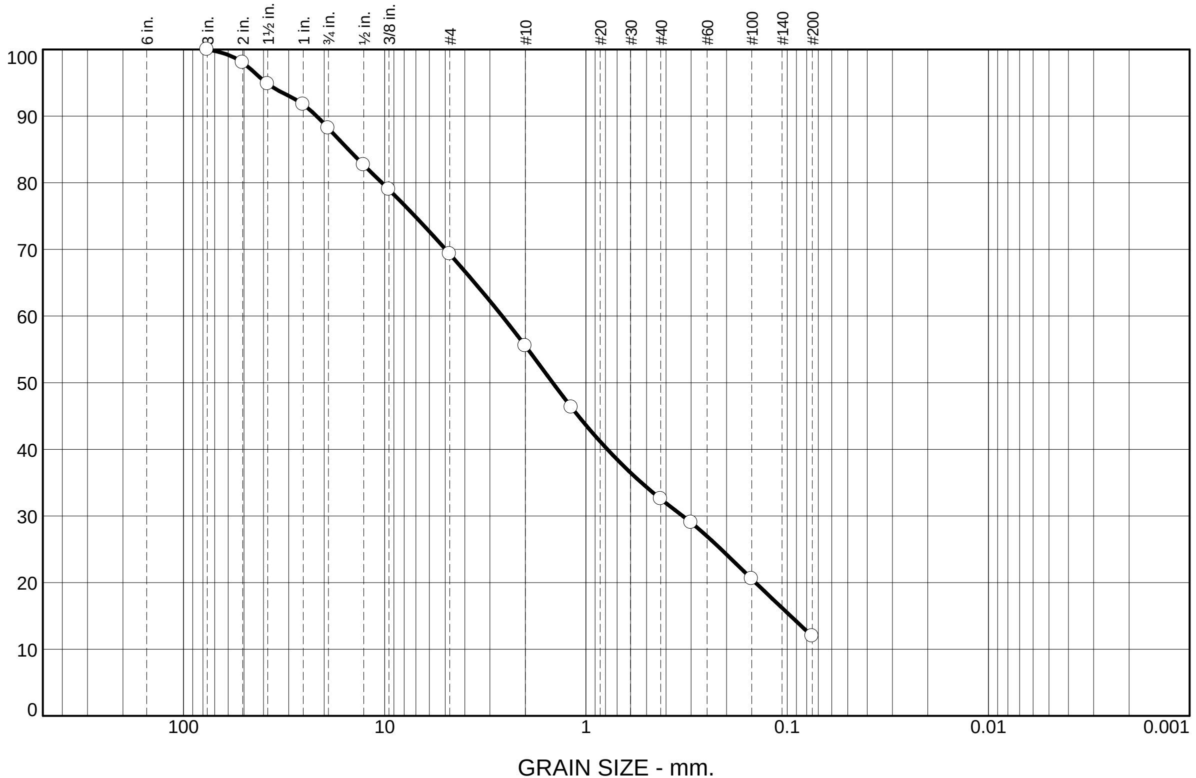
Location: TP19-22
Sample Number: 19-060-18 **Depth:** 8-11' **Date:** 4/1/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-18

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	11.8	18.9	13.8	22.9	20.7	11.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	98.0		
1.5	94.8		
1	91.8		
.75	88.2		
.5	82.7		
.375	79.0		
#4	69.3		
#10	55.5		
#16	46.3		
#40	32.6		
#50	29.0		
#100	20.5		
#200	11.9		

* (no specification provided)

Material Description

Brown poorly graded sand with silt and gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 21.7868 D_{85}= 15.1391 D_{60}= 2.6094
D_{50}= 1.4636 D_{30}= 0.3302 D_{15}= 0.0962
D_{10}= C_u= C_c=

Classification

USCS= SP-SM AASHTO= A-1-b

Remarks

Natural Moisture Content: 8.6%

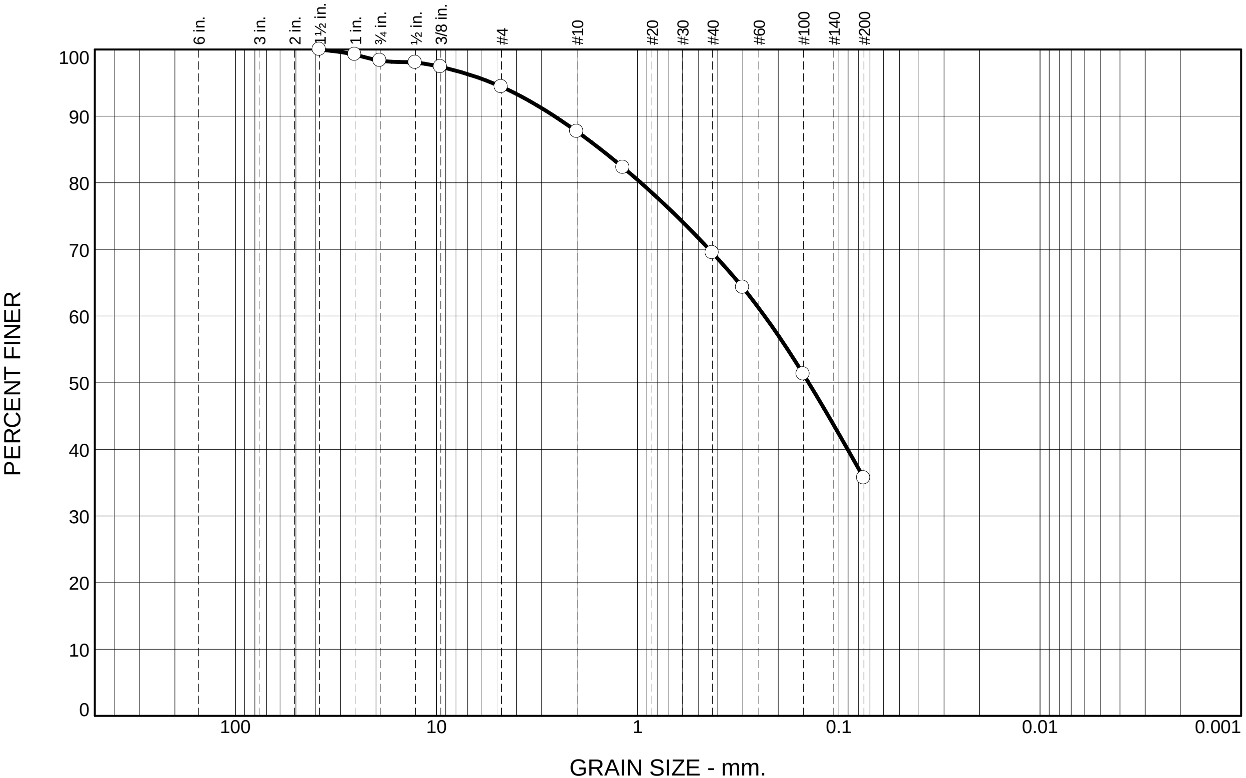
Location: TP19-23
Sample Number: 19-060-19 **Depth:** 5-9' **Date:** 4/1/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-19

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	1.7	3.9	6.7	18.2	33.8	35.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	99.2		
.75	98.3		
.5	98.0		
.375	97.4		
#4	94.4		
#10	87.7		
#16	82.3		
#40	69.5		
#50	64.3		
#100	51.3		
#200	35.7		

* (no specification provided)

Material Description

Light Brown clayey sand

Atterberg Limits

PL= 33 LL= 68 PI= 35

Coefficients

D_{90}= 2.5938 D_{85}= 1.5251 D_{60}= 0.2339
D_{50}= 0.1413 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-7-5(6)

Remarks

Natural Moisture Content: 33.9%

Location: TP19-24
Sample Number: 19-060-20 **Depth:** 14-17' **Date:** 4/1/2019

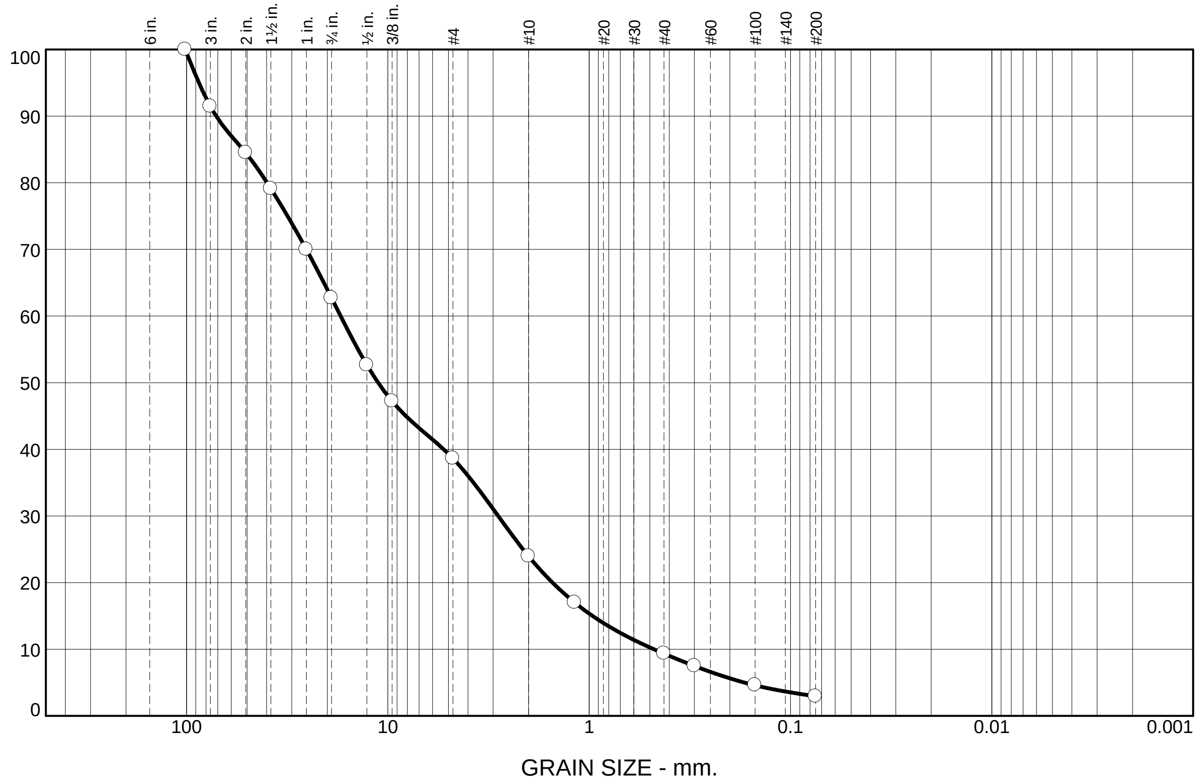
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-060-20

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
8.5	28.8	24.1	14.7	14.6	6.4	2.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100.0		
3	91.5		
2	84.5		
1.5	79.1		
1	70.0		
.75	62.7		
.5	52.6		
.375	47.2		
#4	38.6		
#10	23.9		
#16	17.0		
#40	9.3		
#50	7.5		
#100	4.6		
#200	2.9		

* (no specification provided)

Material Description

Brown poorly graded gravel with sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 71.3287 D_{85}= 52.4236 D_{60}= 17.1564
D_{50}= 11.1788 D_{30}= 2.8311 D_{15}= 0.9624
D_{10}= 0.4767 C_u= 35.99 C_c= 0.98

Classification

USCS= GP AASHTO= A-1-a

Remarks

Natural Moisture Content: 8.1%

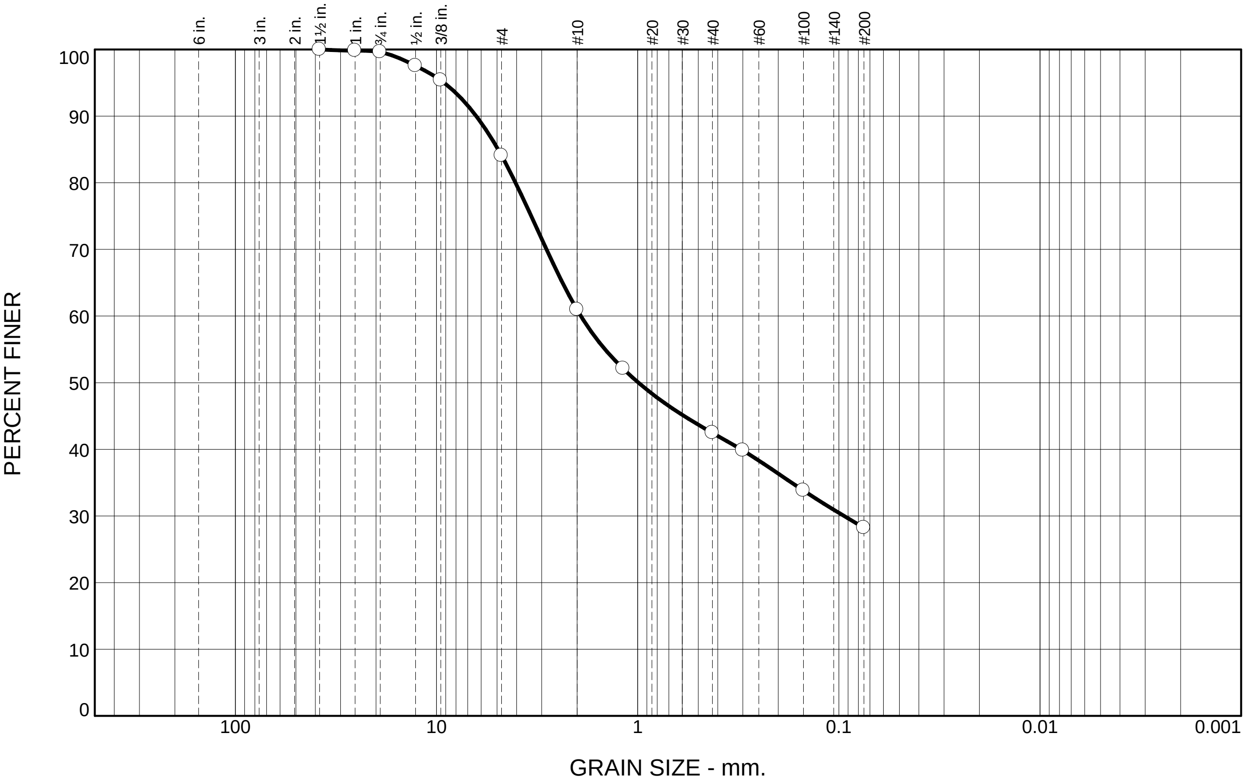
Location: TP19-25
Sample Number: 19-060-21 **Depth:** 7-12' **Date:** 4/1/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-21

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.4	15.5	23.2	18.4	14.3	28.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	99.8		
.75	99.6		
.5	97.6		
.375	95.4		
#4	84.1		
#10	60.9		
#16	52.1		
#40	42.5		
#50	39.8		
#100	33.8		
#200	28.2		

* (no specification provided)

Material Description

Light Brown clayey sand with gravel

Atterberg Limits

PL= 21   LL= 53   PI= 32

Coefficients

D_{90}= 6.3432 D_{85}= 4.9417 D_{60}= 1.9162
D_{50}= 0.9906 D_{30}= 0.0942 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC   AASHTO= A-2-7(3)

Remarks

Natural Moisture Content: 20.9%

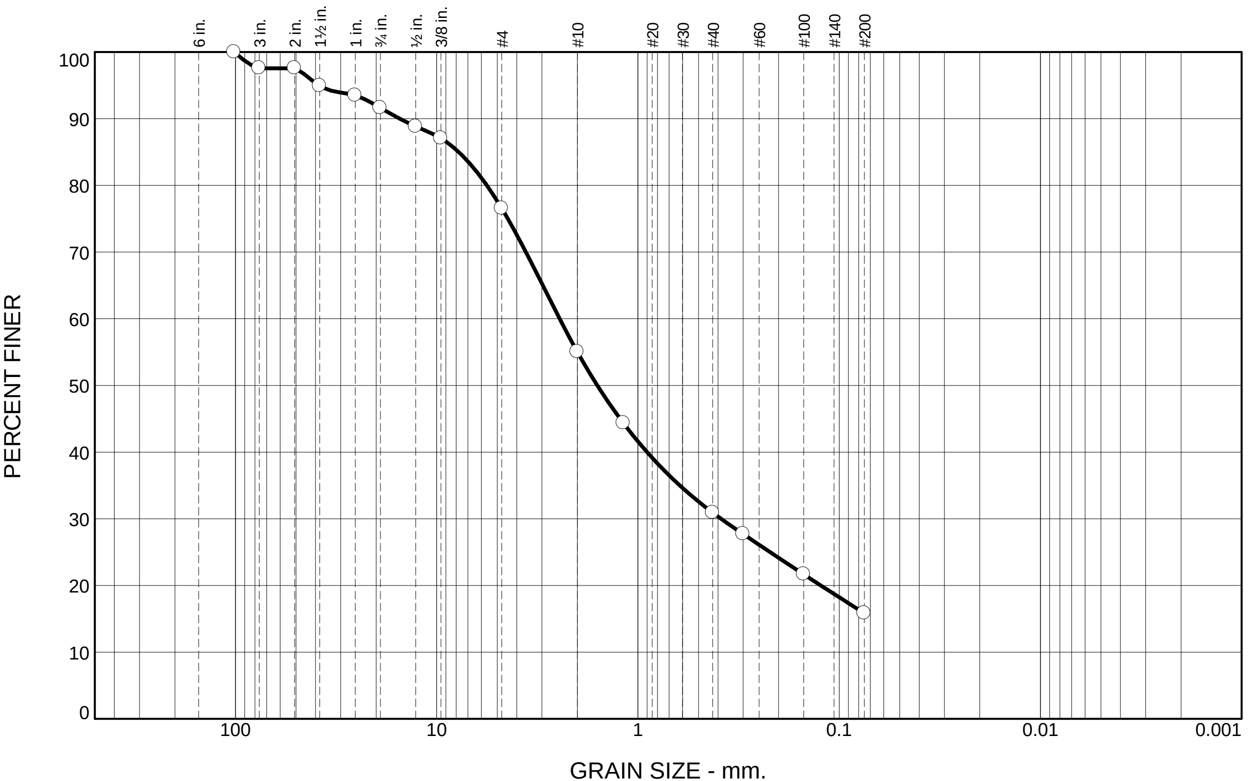
Location: TP19-26
Sample Number: 19-060-22   **Depth:** 6-8'   **Date:** 4/1/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000   **Figure** 19-060-22

Tested By: KS   **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
2.4	6.0	15.0	21.6	24.1	15.1	15.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100.0		
3	97.6		
2	97.6		
1.5	94.9		
1	93.5		
.75	91.6		
.5	88.8		
.375	87.1		
#4	76.6		
#10	55.0		
#16	44.3		
#40	30.9		
#50	27.7		
#100	21.7		
#200	15.8		

* (no specification provided)

Material Description

Light Brown silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 15.2288 D_{85}= 7.7681 D_{60}= 2.4486
D_{50}= 1.5927 D_{30}= 0.3859 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Natural Moisture Content: 22.5%

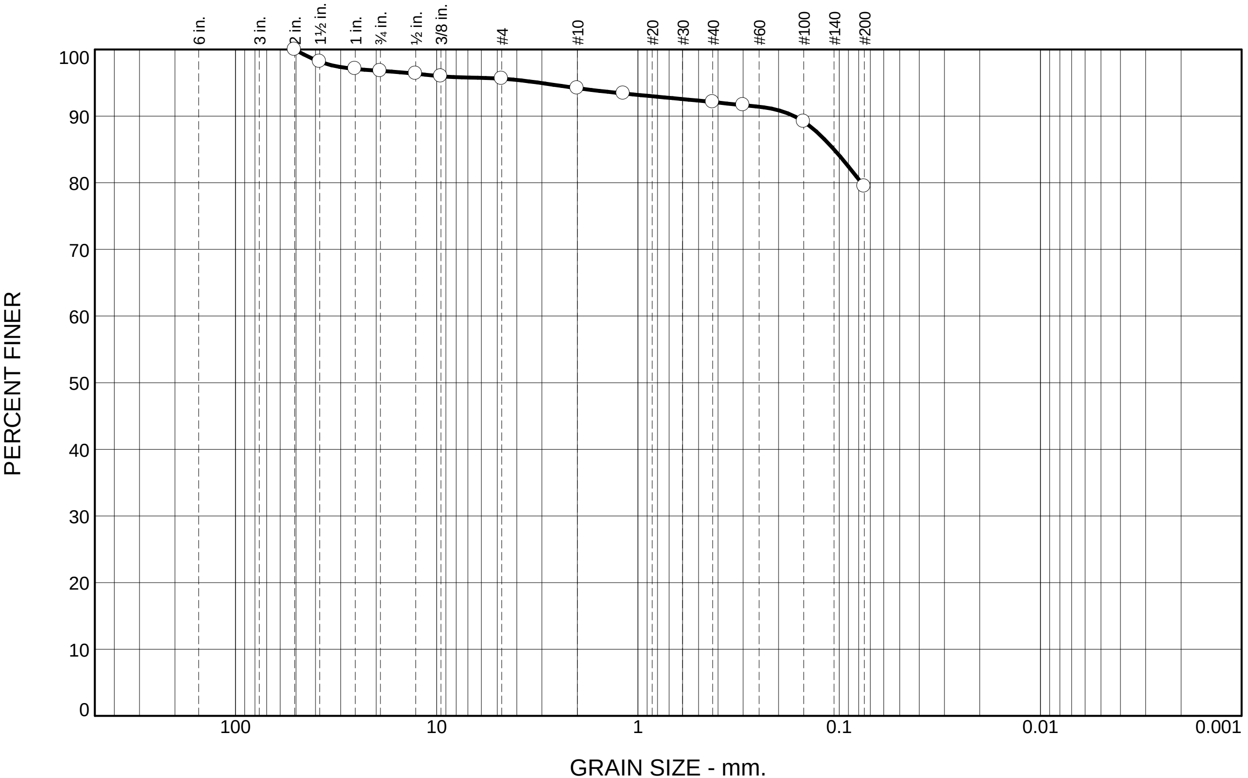
Location: TP19-27
Sample Number: 19-060-23 **Depth:** 3-5' **Date:** 4/1/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-23

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.2	1.2	1.4	2.1	12.6	79.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2	100.0		
1.5	98.2		
1	97.1		
.75	96.8		
.5	96.4		
.375	96.0		
#4	95.6		
#10	94.2		
#16	93.4		
#40	92.1		
#50	91.7		
#100	89.2		
#200	79.5		

* (no specification provided)

Material Description

Light Brown fat clay with sand

Atterberg Limits

PL= 26
LL= 63
PI= 37

Coefficients

D_{90}= 0.1674
D_{85}= 0.1061
D_{60}=
D_{50}=
D_{30}=
D_{15}=
D_{10}=
C_u=
C_c=

Classification

USCS= CH
AASHTO= A-7-6(32)

Remarks

Natural Moisture Content: 30.7%

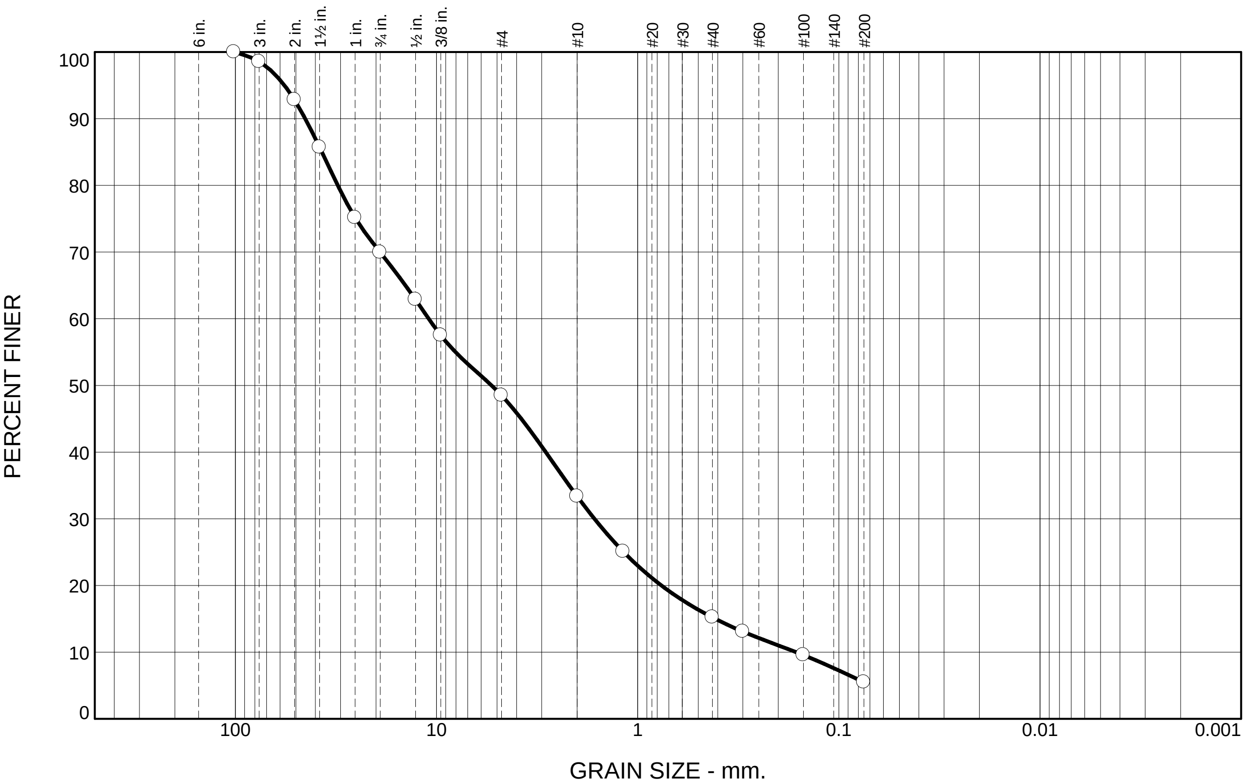
Location: TP19-28
Sample Number: 19-106-08 **Depth:** 1-3' **Date:** 4/22/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-106-08

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
1.4	28.6	21.5	15.1	18.2	9.7	5.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100.0		
3	98.6		
2	92.8		
1.5	85.7		
1	75.2		
.75	70.0		
.5	62.9		
.375	57.5		
#4	48.5		
#10	33.4		
#16	25.1		
#40	15.2		
#50	13.1		
#100	9.6		
#200	5.5		

* (no specification provided)

Material Description

Brown well-graded gravel with silt and sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 44.9128 D_{85}= 37.1412 D_{60}= 10.9377
D_{50}= 5.3294 D_{30}= 1.6411 D_{15}= 0.4116
D_{10}= 0.1634 C_u= 66.94 C_c= 1.51

Classification

USCS= GW-GM AASHTO= A-1-a

Remarks

Natural Moisture Content: 6.6%

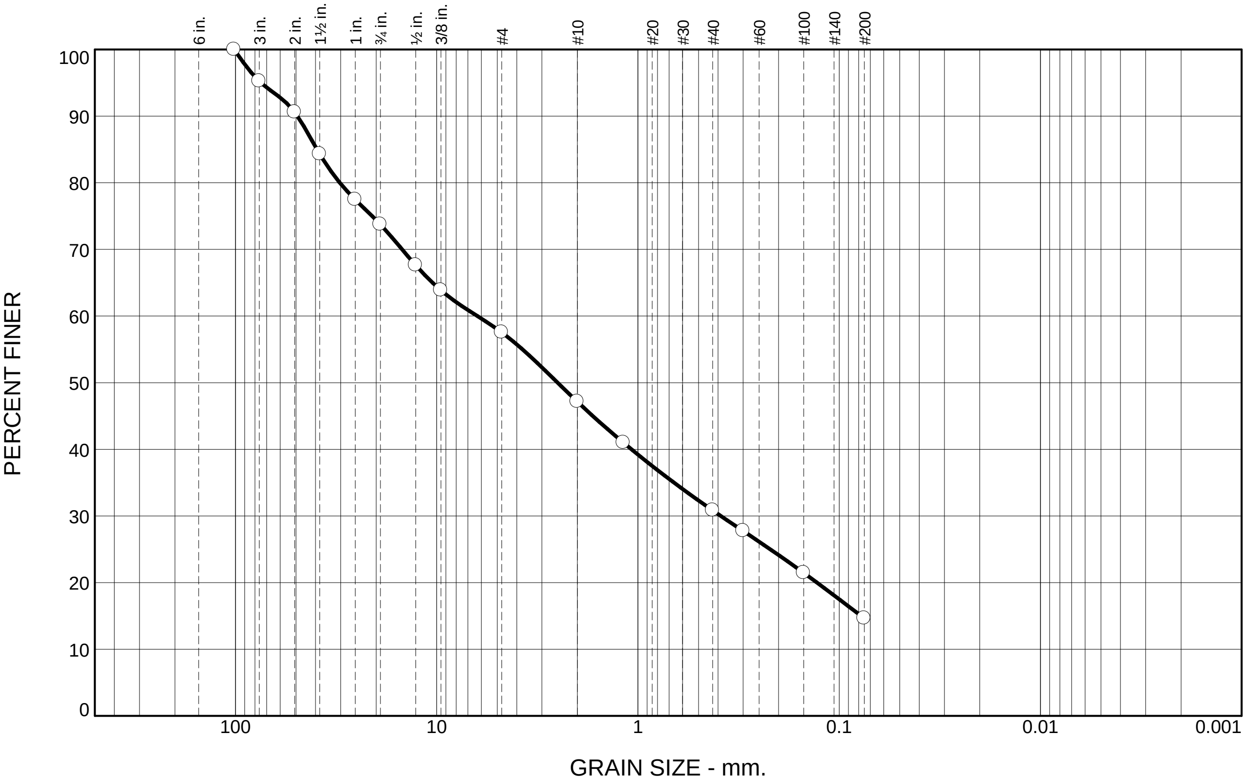
Location: TP19-28
Sample Number: 19-060-24 **Depth:** 5-9' **Date:** 4/1/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-24

Tested By: KS/JB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
4.8	21.5	16.2	10.4	16.3	16.2	14.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100.0		
3	95.2		
2	90.6		
1.5	84.3		
1	77.5		
.75	73.7		
.5	67.6		
.375	63.9		
#4	57.5		
#10	47.1		
#16	41.0		
#40	30.8		
#50	27.7		
#100	21.5		
#200	14.6		

* (no specification provided)

Material Description

Light Brown silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 49.1622 D_{85}= 39.3227 D_{60}= 6.2806
D_{50}= 2.5052 D_{30}= 0.3872 D_{15}= 0.0778
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Natural Moisture Content: 8.1%

Location: TP19-29
Sample Number: 19-060-25 **Depth:** 4-7' **Date:** 4/1/2019

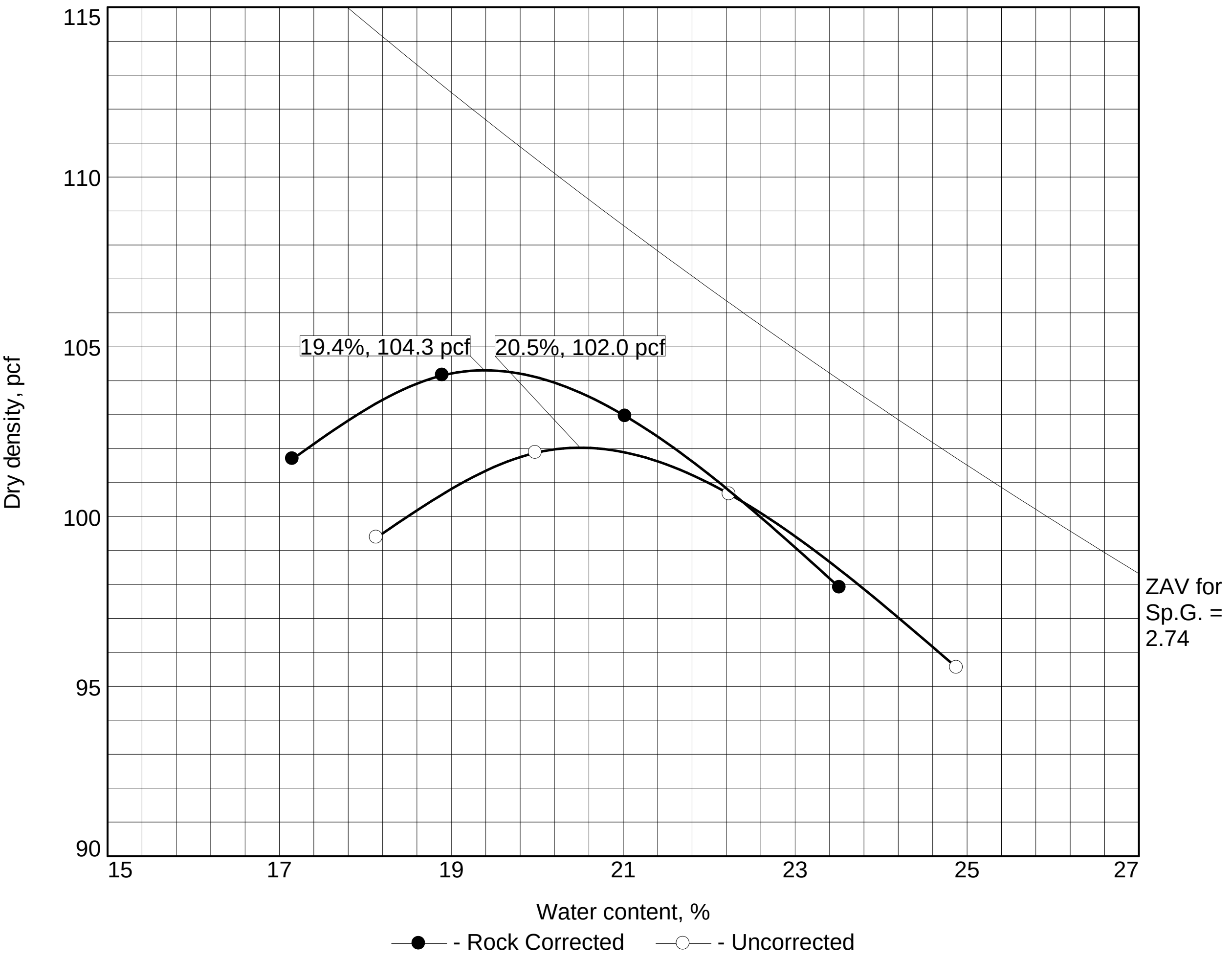
NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-25

Tested By: KS/JB **Checked By:** JH

Appendix A2 – Proctor Results

COMPACTION TEST REPORT



Test specification: ASTM D 1557-12 Method B Modified
ASTM D4718-15 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in.	% < No.200
	USCS	AASHTO						
0-2'	CL	A-6(7)	29.4%	2.74	33	12	5.7	71.5

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 104.3 pcf	102.0 pcf	Dark Brown lean clay with sand
Optimum moisture = 19.4 %	20.5 %	

Project No. 475.0385.000 **Client:** Lithium Nevada
Project: Thacker Pass
Date: 4/26/2019
○ **Location:** TP19-02 **Sample Number:** 19-060-02

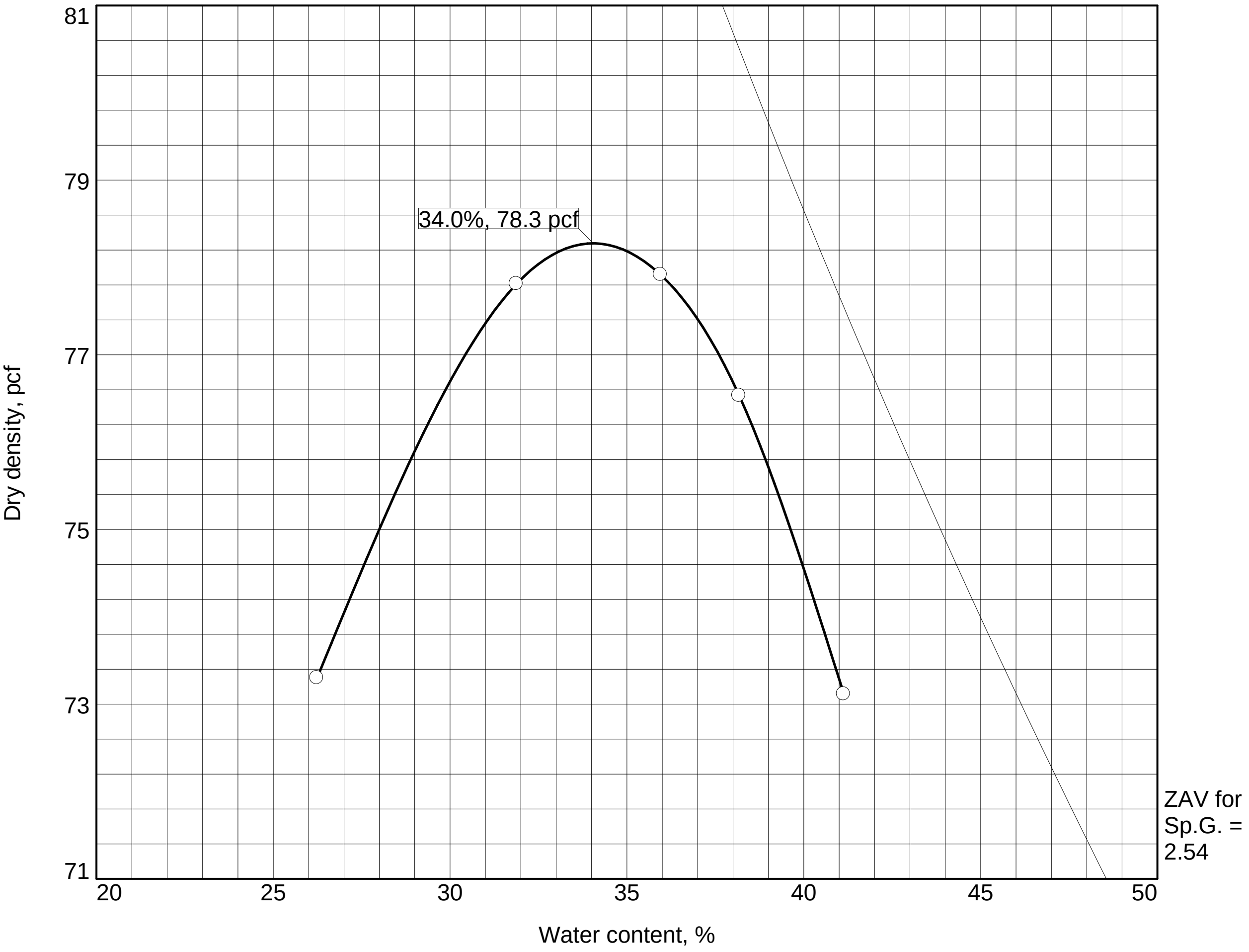
NewFields

Remarks:
*Assumed Specific Gravity

Figure 19-060-02

Tested By: CB **Checked By:** JH

COMPACTION TEST REPORT



Test specification: ASTM D 1557-12 Method A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
2-4'	SM	A-5(0)	31.2%	2.54	47	1	0.7	42.9

TEST RESULTS

Maximum dry density = 78.3 pcf

Optimum moisture = 34.0 %

MATERIAL DESCRIPTION

Light brown silty sand

Project No. 475.0385.000 **Client:** Lithium Nevada
Project: Thacker Pass
Date: 5/1/2019
○ **Location:** TP19-04 **Sample Number:** 19-106-03

NewFields

Remarks:
*Tested Specific Gravity

Figure 19-106-03

Tested By: CB **Checked By:** KE

Appendix A3 – Natural Moisture Content Results

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	Lithium Nevada	**Location:**	TP
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	3/5/2019
Project Engineer:	Eric Niebler	**Tested By:**	KS/JB
Field Sample ID:	TP	**Checked By:**	JH

Drying Conditions: 60 deg C / **110 deg C** Method: **Oven (O)** / Microwave (M) / Hot Plate (H)

Sample No.		19-060-01	19-060-02	19-060-03	19-060-04	19-060-05
Location		TP19-01	TP19-02	TP19-03	TP19-04	TP19-05
Depth		4-7'	0-2'	6-9'	5-7'	8-10'
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	**A**	603.3	580	895	602.1	664.7
Tare + Dry Soil	**B**	539.7	506.7	819.3	521.8	564.4
Tare	**C**	44.9	257.5	120.6	125.1	141.2
Wt. of Water	**D= A-B**	63.6	73.3	75.7	80.3	100.3
Dry Soil, Ws	**E= B-C**	494.8	249.2	698.7	396.7	423.2
Moisture Content, (%)	**(D/E) x100**	**12.9%**	**29.4%**	**10.8%**	**20.2%**	**23.7%**

Sample No.		19-060-06	19-060-07	19-060-08	19-060-09	19-060-10
Location		TP19-06	TP19-08	TP19-09	TP19-11	TP19-13
Depth		11-13'	6-9'	8-12'	7-11'	10-13'
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	**A**	642.9	926.2	789.7	658.1	605.1
Tare + Dry Soil	**B**	597.1	854.8	732.5	618.3	514.9
Tare	**C**	189.5	124.9	270.1	125.3	223.4
Wt. of Water	**D= A-B**	45.8	71.4	57.2	39.8	90.2
Dry Soil, Ws	**E= B-C**	407.6	729.9	462.4	493	291.5
Moisture Content, (%)	**(D/E) x100**	**11.2%**	**9.8%**	**12.4%**	**8.1%**	**30.9%**

Remarks:

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	Lithium Nevada	**Location:**	TP
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	3/5/2019
Project Engineer:	Eric Niebler	**Tested By:**	KS/JB
Field Sample ID:	TP	**Checked By:**	JH

Drying Conditions: 60 deg C / [✓ 110 deg C] Method: [✓ Oven (O)] / Microwave (M) / Hot Plate (H)

Sample No.		19-060-11	19-060-12	19-060-13	19-060-14	19-060-15
Location		TP19-14	TP19-15	TP19-16	TP19-17	TP19-18
Depth		8-11'	8-11'	7-10'	4-7'	5-8'
Soil Description						
(USCS)						
Trial No.		**11**	**12**	**13**	**14**	**15**
Tare No.						
Tare + Wet Soil	**A**	632.6	934.6	859.5	654.3	460.1
Tare + Dry Soil	**B**	527.9	783.8	709.7	572.4	419.2
Tare	**C**	121	120.8	190.6	188.6	45
Wt. of Water	**D= A-B**	104.7	150.8	149.8	81.9	40.9
Dry Soil, Ws	**E= B-C**	406.9	663	519.1	383.8	374.2
Moisture Content, (%)	**(D/E) x100**	**25.7%**	**22.7%**	**28.9%**	**21.3%**	**10.9%**

Sample No.		19-060-16	19-060-17	19-060-18	19-060-19	19-060-20
Location		TP19-20	TP19-21	TP19-22	TP19-23	TP19-24
Depth		6-10'	3-5'	8-11'	5-9'	14-17'
Soil Description						
(USCS)						
Trial No.		**16**	**17**	**18**	**19**	**20**
Tare No.						
Tare + Wet Soil	**A**	352.8	347.2	614.6	837.6	649.7
Tare + Dry Soil	**B**	296.3	312.3	592	786.2	542.3
Tare	**C**	44.9	45.1	121.1	189.3	225.5
Wt. of Water	**D= A-B**	56.5	34.9	22.6	51.4	107.4
Dry Soil, Ws	**E= B-C**	251.4	267.2	470.9	596.9	316.8
Moisture Content, (%)	**(D/E) x100**	**22.5%**	**13.1%**	**4.8%**	**8.6%**	**33.9%**

Remarks:

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	Lithium Nevada	**Location:**	TP
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	3/5/2019
Project Engineer:	Eric Niebler	**Tested By:**	KS/JB
Field Sample ID:	TP	**Checked By:**	JH

Drying Conditions: 60 deg C / [✓ **110 deg C**] Method: [✓ **Oven (O)**] / Microwave (M) / Hot Plate (H)

Sample No.		19-060-21	19-060-22	19-060-23	19-060-24	19-060-25
Location		TP19-25	TP19-26	TP19-27	TP19-28	TP19-29
Depth		7-12'	6-8'	3-5'	5-9'	4-7'
Soil Description						
(USCS)						
Trial No.		**21**	**22**	**23**	**24**	**25**
Tare No.						
Tare + Wet Soil	**A**	746.1	852.9	644	704.4	871.1
Tare + Dry Soil	**B**	699.3	738.3	533.9	668.6	814.8
Tare	**C**	123.9	190.9	45.2	124.6	123.5
Wt. of Water	**D= A-B**	46.8	114.6	110.1	35.8	56.3
Dry Soil, Ws	**E= B-C**	575.4	547.4	488.7	544	691.3
Moisture Content, (%)	**(D/E) x100**	**8.1%**	**20.9%**	**22.5%**	**6.6%**	**8.1%**

Sample No.						
Location						
Depth						
Soil Description						
(USCS)						
Trial No.		**26**	**27**	**28**	**29**	**30**
Tare No.						
Tare + Wet Soil	**A**					
Tare + Dry Soil	**B**					
Tare	**C**					
Wt. of Water	**D= A-B**					
Dry Soil, Ws	**E= B-C**					
Moisture Content, (%)	**(D/E) x100**					

Remarks:

NewFields

NF Form #15

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

Client:	Lithium Nevada	**Location:**	TP
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	4/22/2019
Project Engineer:	Eric Niebler	**Tested By:**	KS
Field Sample ID:	TP	**Checked By:**	JH

Drying Conditions: 60 deg C / [✓ **110 deg C**] Method: [✓ **Oven (O)**] / Microwave (M) / Hot Plate (H)

Sample No.		19-106-02	19-106-03	19-106-04	19-106-05	19-106-06
Location		TP19-03	TP19-04	TP19-07	TP19-08	TP19-10
Depth		2-4'	2-4'	2-4'	2-4'	3-6'
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	**A**	401.7	432.9	650.3	618.1	555.5
Tare + Dry Soil	**B**	363.7	358.6	574.2	563.2	492.6
Tare	**C**	124.7	120.8	257.4	191.2	125.3
Wt. of Water	**D= A-B**	38	74.3	76.1	54.9	62.9
Dry Soil, Ws	**E= B-C**	239	237.8	316.8	372	367.3
Moisture Content, (%)	**(D/E) x100**	**15.9%**	**31.2%**	**24.0%**	**14.8%**	**17.1%**

Sample No.		19-106-07	19-106-08			
Location		TP19-13	TP19-28			
Depth		3-5'	1-3'			
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	**A**	433.6	440			
Tare + Dry Soil	**B**	381.7	347.3			
Tare	**C**	44.9	45			
Wt. of Water	**D= A-B**	51.9	92.7			
Dry Soil, Ws	**E= B-C**	336.8	302.3			
Moisture Content, (%)	**(D/E) x100**	**15.4%**	**30.7%**			

Remarks:

Appendix A4 – Specific Gravity Results

SPECIFIC GRAVITY SOILS (ASTM D854)
LABORATORY WORKSHEET

NF Form #11

Client:	Lithium Nevada	**Field Sample ID:**	TP19-04	**Test Start Date:**	4/30/2019
Project Title:	Thacker Pass	**Laboratory Sample ID:**	19-106-03	**Tested By:**	KE
Project Number:	475.0385.000	**Location:**	TP19-04	**Checked By:**	JH
Project Engineer:	Eric Niebler	**Elevation:**	2-4'	**Sample Description:**	

Sample Number	19-106-03							
Sample Location	TP19-04 (2'-4')							
Prep Dish								
Flask No.	3	15						
1) Wt. of Flask + Soil	115.90	116.63						
2) Wt. of Flask	86.05	86.66						
3) Wt. of Soil = 1-2	29.85	29.97						
4) Calibrated Wt. of Flask + Water	335.19	335.73						
5) (3+4)	365.04	365.70						
6) Wt. of Flask + Water +Soil	353.34	353.98						
7) Volume of Soil = (5-6)	11.70	11.72						
8) Test Temperature, deg.C (Ta)	19.1	19.2						
9) Temperature Correction, k	1.00018	1.00016						
10) Specific Gravity	2.538	2.546						
11) Average Specific Gravity, Gs	2.542							

General Notes:

APPENDIX B

Borehole Laboratory Data

TABLE B1 - BOREHOLE LAB TESTING SUMMARY

SAMPLE LOCATION					UNIFIED SOILS CLASSIFICATION (USCS)	USCS ABBREVIATION	NATURAL DENSITY (wet) (pcf)	NATURAL DENSITY (Dry) (pcf)	NATURAL MOISTURE CONTENT (%)	GRADATION (%)			ATTERBERG LIMITS			CHEMICAL TESTS			
Field Sample Number	Laboratory Sample Number	Borehole ID	Depth From (ft)	Depth To (ft)						Gravel >#4	Sand	Silt & Clay <#200	Plastic Limit	Liquid Limit	Plasticity Index	Soluble Sulfate (ppm)	Soluble Chloride (ppm)	Resistivity (Minimum ohm-cm)	pH
SPT-02	19-110-01	BH19-01	7.5	9	Silty Sand with Gravel	SM			32.1	17.4	44.2	38.4	44	71	27				
SPT-04	19-110-02	BH19-01	25.0	26.5	Silty Sand	SM			30.0	13.6	66.3	20.1	30	55	25				
SPT-04	19-110-03	BH19-02	25.0	26.5	Sandy Elastic Silt	MH			58.8	4.2	34.6	61.2	55	105	50				
SPT-06	19-110-04	BH19-02	45	46.5	Silty Sand	SM			37.4	8.1	47.8	44.1	40	80	40				
SPT-01		BH19-03	3	4															
CAL-01		BH19-03	5	7															
SPT-02		BH19-03	8	9															
CAL-02		BH19-03	10	11															
SPT-03		BH19-03	15	17															
SPT-01		BH19-04	3	4															
CAL-01		BH19-04	5	7															
SPT-02		BH19-04	8	9															
CAL-02		BH19-04	10	12															
SPT-03		BH19-04	15	16															
CAL-03		BH19-04	20	21															
SPT-01		BH19-05	3	4															
CAL-01		BH19-05	5	7															
SPT-02		BH19-05	8	8															
CAL-02A		BH19-05	10	11															
CAL-02B		BH19-05	11	12															
SPT-03		BH19-05	15	17															
CAL-03A		BH19-05	20	21															
CAL-03B		BH19-05	21	21															
SPT-01		BH19-06	3	3'2.5"															
CAL-01		BH19-06	5	7															
SPT-02		BH19-06	8	9															
CAL-02		BH19-06	10	12															
SPT-03		BH19-06	15	16'2"															
CAL-03		BH19-06	20	20'10"															
SPT-01	19-110-05	BH19-08	2.5	4	Silty Sand with Gravel	SM			19.4	19.9	44.9	35.2	28	46	18				
CAL-01		BH19-08	5.0	6.5															
SPT-02		BH19-08	7.5	9															
CAL-02		BH19-08	10	10'5.5"															
SPT-01	19-110-06	BH19-09	2.5	4	Poorly Graded Gravel with Silt and Sand	GP-GM			10.3	49.1	39.5	11.4	NP	NP	NP				
CAL-01		BH19-09	5	6'4"															
SPT-02		BH19-09	7.5	9															
CAL-02		BH19-09	10	10'5"															
SPT-03		BH19-09	15	16'3"															
CAL-03		BH19-09	20	20'5"															
CPT-01		BH19-10	2.5	4															

TABLE B1 - BOREHOLE LAB TESTING SUMMARY

SAMPLE LOCATION					UNIFIED SOILS CLASSIFICATION (USCS)	USCS ABBREVIATION	NATURAL DENSITY (wet) (pcf)	NATURAL DENSITY (Dry) (pcf)	NATURAL MOISTURE CONTENT (%)	GRADATION (%)			ATTERBERG LIMITS			CHEMICAL TESTS			
Field Sample Number	Laboratory Sample Number	Borehole ID	Depth From (ft)	Depth To (ft)						Gravel >#4	Sand	Silt & Clay <#200	Plastic Limit	Liquid Limit	Plasticity Index	Soluble Sulfate (ppm)	Soluble Chloride (ppm)	Resistivity (Minimum ohm-cm)	pH
CAL-01		BH19-10	5	6.5															
SPT-02		BH19-10	7.5	9															
CAL-02		BH19-10	10	11.5															
SPT-03		BH19-10	15	16.5															
CAL-03		BH19-10	20	20.5															
SPT-04		BH19-10	25	26.5															
CAL-04		BH19-10	30	31															
SPT-01	19-110-07	BH19-11	2.5	4	Silty Sand	SM			23.6	11.3	61.9	26.8	NP	NP	NP				
CAL-01		BH19-11	5	6'1"															
SPT-01		BH19-12	2.5	4												691.9	1246.9	150	7.65
CAL-01		BH19-12	5	6.5															
SPT-02		BH19-12	7.5	9															
CAL-02		BH19-12	10.5	11															
SPT-03	19-110-08	BH19-12	15	16.5	Clayey Gravel with Sand	GC			10.5	49.7	35.8	14.5	21	48	27				
CAL-03A		BH19-12	20	21															
CAL-03B		BH19-12	21	21.5															
SPT-04		BH19-12	25	25.5															
CAL-04		BH19-12	30	30'9"															
SPT-01		BH19-13	2.5	3'9"															
CAL-01		BH19-13	5	5'11"															
SPT-02		BH19-13	7.5	9												45.5	103.2	780	7.88
CAL-02		BH19-13	10	10'10.5"															
SPT-03		BH19-13	15	16'3"															
CAL-03		BH19-13	20	21'5.5"															
SPT-04		BH19-13	25	26'5.5"															
CAL-04		BH19-13	30	30'11.5"															
SPT-01		BH19-14	2.5	3															
CAL-01		BH19-14	5	6.5															
SPT-02		BH19-14	7.5	9															
CAL-02		BH19-14	10	11															
SPT-03		BH19-14	15	16															
SPT-04		BH19-14	25	26.5															
CAL-04		BH19-14	31	31.5															
SPT-01		BH19-15	2.5	4															
CAL-01	19-110-09	BH19-15	5.5	6	Silty Sand	SM	93.4	82.6	13.1	7.2	78	14.8	NP	NP	NP				
SPT-02		BH19-15	7.5	8'9"															
CAL-02		BH19-15	10	10'9"															
SPT-01	19-110-10	BH19-16	2.5	4	Sandy Lean Clay	CL			18.5	4.4	32.3	63.3	24	41	17				
CAL-01		BH19-16	5	6'5.5"															
SPT-02		BH19-16	7.5	8'2"															

TABLE B1 - BOREHOLE LAB TESTING SUMMARY

SAMPLE LOCATION					UNIFIED SOILS CLASSIFICATION (USCS)	USCS ABBREVIATION	NATURAL DENSITY (wet) (pcf)	NATURAL DENSITY (Dry) (pcf)	NATURAL MOISTURE CONTENT (%)	GRADATION (%)			ATTERBERG LIMITS			CHEMICAL TESTS			
Field Sample Number	Laboratory Sample Number	Borehole ID	Depth From (ft)	Depth To (ft)						Gravel >#4	Sand	Silt & Clay <#200	Plastic Limit	Liquid Limit	Plasticity Index	Soluble Sulfate (ppm)	Soluble Chloride (ppm)	Resistivity (Minimum ohm-cm)	pH
SPT-01		BH19-17	2.5	4															
CAL-01		BH19-17	5	6.5															
SPT-02		BH19-17	7.5	9															
CAL-02	19-110-11	BH19-17	10.5	11	Sandy Fat Clay	CH	93.6	71	31.8	4.8	36.3	58.9	27	50	23				
SPT-03		BH19-17	15	16.5															
CAL-03	19-110-12	BH19-17	20	20'10"	Poorly Graded Sand with Silt and Gravel	SP-SM			10	35.1	53.7	11.2	25	32	7				
SPT-04		BH19-17	25	25'9"															
CAL-04		BH19-17	30	30'5"															
SPT-01		BH19-18	2.5	4															
CAL-01		BH19-18	5	6.5															
SPT-02		BH19-18	7.5	9															
CAL-02A	19-110-13	BH19-18	10.5	11	Elastic Silt with Sand	MH	87.1	63.4	37.3	0	17.5	82.5	55	110	55				
CAL-02B		BH19-18	11	11.5															
SPT-03		BH19-18	15	16.5															
CAL-03	19-110-14	BH19-18	20.5	21	Silty Sand	SM	97.5	72.1	35.3	3.3	73.1	23.6	NP	NP	NP				
SPT-04		BH19-18	25	26.5															
SPT-05		BH19-18	35	36'3"															
SPT-01		BH19-19	2.5	4															
CAL-01		BH19-19	5.5	6															
SPT-02		BH19-19	7.5	9															
CAL-02		BH19-19	10.5	11															
SPT-03		BH19-19	15.0	16.5															
SPT-01		BH19-20	2.5	4.0															
CAL-01	19-110-15	BH19-20	5.0	6.5	Silty Gravel with Sand	GM			10.9	51.7	34.7	13.6	NP	NP	NP				
CAL-02		BH19-20	10.5	11.0															
SPT-03		BH19-20	15.0	16.5															
CAL-03		BH19-20	20	20'5"															
SPT-04		BH19-20	25.0	26.5															
CAL-04	19-110-16	BH19-20	30	30.5	Silty Sand with Gravel	SM			17.3	29.3	49.1	21.6	30	46	16				
SPT-05		BH19-20	35	35'11"															
SPT-01	19-110-17	BH19-21	2.5	4.0	Silty Sand with Gravel	SM			23.5	22.4	60.2	17.4	NP	NP	NP				
CAL-01		BH19-21	5.0	6.5															
SPT-02		BH19-21	8	8'4"															
CAL-02		BH19-21	10.0	11'5"															
SPT-03		BH19-21	15	15'11"															
SPT-01		BH19-22	3	4															
CAL-01		BH19-22	5	7															
SPT-02		BH19-22	8	7'10.5"															
CAL-02		BH19-22	10	10'4"															
SPT-01	19-110-18	BH19-23	2.5	4.0	Silty Sand with Gravel	SM			14.6	36.9	45.6	17.5	NP	NP	NP				

TABLE B1 - BOREHOLE LAB TESTING SUMMARY

SAMPLE LOCATION					UNIFIED SOILS CLASSIFICATION (USCS)	USCS ABBREVIATION	NATURAL DENSITY (wet) (pcf)	NATURAL DENSITY (Dry) (pcf)	NATURAL MOISTURE CONTENT (%)	GRADATION (%)			ATTERBERG LIMITS			CHEMICAL TESTS			
Field Sample Number	Laboratory Sample Number	Borehole ID	Depth From (ft)	Depth To (ft)						Gravel >#4	Sand	Silt & Clay <#200	Plastic Limit	Liquid Limit	Plasticity Index	Soluble Sulfate (ppm)	Soluble Chloride (ppm)	Resistivity (Minimum ohm-cm)	pH
CAL-01		BH19-23	5.0	5'11.5"															
SPT-02	19-110-19	BH19-23	7.5	9	Silty Sand with Gravel	SM			11.3	40.2	46.6	13.2	NP	NP	NP				
CAL-02		BH19-23	10.0	10'2.5"															
SPT-01	19-110-20	BH19-24	2.5	4.0	Silty Sand with Gravel	SM			15.0	16.6	56.7	26.7	NP	NP	NP				
CAL-01		BH19-24	5.0	6.5															
SPT-02		BH19-24	7.5	8.5															
CAL-02		BH19-24	10.5	11.0															
SPT-03	19-110-21	BH19-24	15	16.5	Silty Sand with Gravel	SM			11.6	34.7	52.4	12.9	NP	NP	NP				
SPT-04		BH19-24	25	26.5															
CAL-04		BH19-24	30	31.0															
SPT-05	19-110-22	BH19-24	35.0	36.5	Silty Sand	SM			42.5	1.4	66.1	32.5	43	60	17				
CAL-05		BH19-24	41.0	41.5															
SPT-01	19-110-23	BH19-25	2.5	4	Silty Sand	SM			18.4	5.1	62.2	32.7	NP	NP	NP				
CAL-01		BH19-25	5	7															
SPT-02	19-110-24	BH19-25	7.5	9.0	Silty Sand	SM			22.3	1.4	74.1	24.5	NP	NP	NP				
CAL-02		BH19-25	10.5	11.0															
SPT-03	19-110-25	BH19-25	15.0	16.5	Silty Sand	SM			35.3	0	78.2	21.8	NP	NP	NP				
SPT-01		BH19-26	2.5	4.0															
CAL-01A	19-110-26	BH19-26	5.0	6.0	Silty Sand with Gravel	SM	91.5	80.6	13.5	28.3	54.6	17.1	NP	NP	NP				
CAL-01B		BH19-26	6	6.5															
SPT-02		BH19-26	7.5	9.0															
CAL-02		BH19-26	10.0	11.5												295.2	97.2	750	7.85
SPT-03		BH19-26	15.0	16.0															
CAL-03		BH19-26	20.0	21.0															
SPT-04		BH19-26	25.0	26.0															
CAL-04		BH19-26	30.0	31.0															
SPT-01		BH19-27	2.5	4.0															
CAL-01		BH19-27	5.0	6.5															
SPT-02		BH19-27	7.5	9.0															
SPT-01		BH19-28	2.5	4.0															
CAL-01A		BH19-28	6	6															
CAL-01B		BH19-28	5	7															
SPT-02	19-110-27	BH19-28	8.5	9	Clayey Sand with Gravel	SC			15.6	16.1	43	40.9	16	37	21				
SPT-03		BH19-28	15	16'3"															
CAL-04A		BH19-28	31	31															
CAL-04B		BH19-28	30	31'4"															
CAL-02		BH19-28	5	6															
CAL-03		BH19-28	20	20'9"															
SPT-02A		BH19-28	9	9															
SPT-02B		BH19-28	8	9															

TABLE B1 - BOREHOLE LAB TESTING SUMMARY

SAMPLE LOCATION					UNIFIED SOILS CLASSIFICATION (USCS)	USCS ABBREVIATION	NATURAL DENSITY (wet) (pcf)	NATURAL DENSITY (Dry) (pcf)	NATURAL MOISTURE CONTENT (%)	GRADATION (%)			ATTERBERG LIMITS			CHEMICAL TESTS			
Field Sample Number	Laboratory Sample Number	Borehole ID	Depth From (ft)	Depth To (ft)						Gravel >#4	Sand	Silt & Clay <#200	Plastic Limit	Liquid Limit	Plasticity Index	Soluble Sulfate (ppm)	Soluble Chloride (ppm)	Resistivity (Minimum ohm-cm)	pH
CAL-02		BH19-28	10	10'9"															
SPT-04		BH19-28	25.0	25'9"															
SPT-01	19-110-28	BH19-29	2.5	4.0	Silty Sand with Gravel	SM			12.7	31.5	49.3	19.2	NP	NP	NP				
CAL-01		BH19-29	6	6															
SPT-02	19-110-29	BH19-29	7.5	9	Clayey Sand with Gravel	SC			7.5	34.0	44.5	21.5	21	31	10				
CAL-02		BH19-29	10	12															
SPT-03	19-110-30	BH19-29	15	16.5	Clayey Sand with Gravel	SC			15.3	18.4	42.8	38.8	19	47	28				
SPT-04A	19-110-31	BH19-29	25.0	26.0	Clayey Sand	SC			23.4	1.1	54.1	44.8	25	62	37				
SPT-04B		BH19-29	26.0	26.5															
CAL-04		BH19-29	30	32															
SPT-01		BH19-30	3	4															
CAL-01		BH19-30	5	5'5"															
SPT-02		BH19-30	8	9															
CAL-02		BH19-30	10	12															
SPT-03		BH19-30	15	17															
CAL-03		BH19-30	20	22															
SPT-04		BH19-30	25.0	26.5															
CAL-04A		BH19-30	30.5	31.0															
CAL-04B		BH19-30	31	31'5"															
SPT-01		BH19-31	2.5	4.0															
CAL-01	19-110-32	BH19-31	5.5	6	Clayey Sand	SC			16.8	10.1	52.6	37.3	22	61	39				
SPT-02		BH19-31	8	9															
CAL-02		BH19-31	10.5	11.0															
SPT-03		BH19-31	15.0	16.5															
CAL-03		BH19-31	20.5	21.0															
SPT-05		BH19-31	28.0	29.5															
CAL-04		BH19-31	30.0	30'5"															
SPT-01		BH19-32	3	4															
CAL-01		BH19-32	5.5	6.0															
SPT-02		BH19-32	8.5	9.0															
CAL-02		BH19-32	10.5	11.0															
SPT-03	19-110-33	BH19-32	15.0	16.5	Clayey Sand	SC			20.3	7.6	42.9	49.5	21	55	34				
CAL-03		BH19-32	20	20'9"															
SPT-04		BH19-32	25	25'9"															
CAL-04		BH19-32	30.0	30'5"															

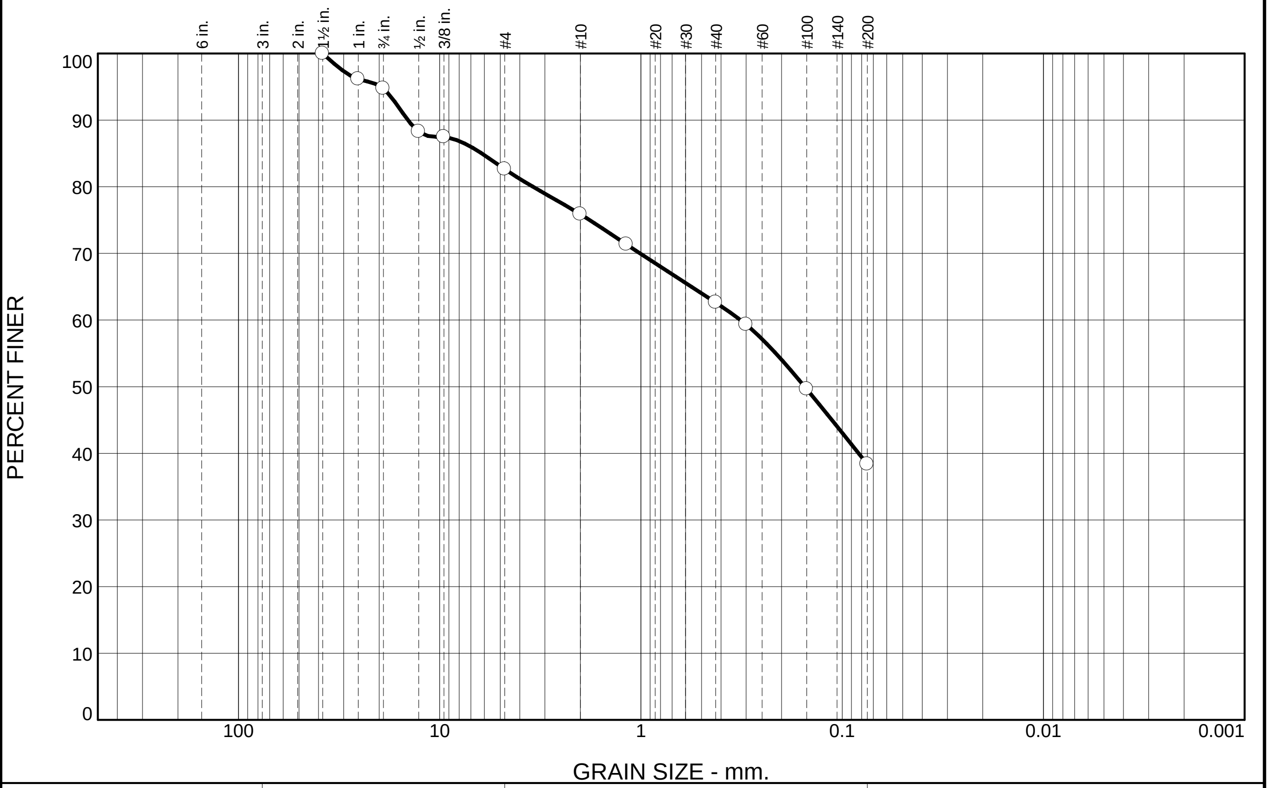
Notes:

NP-Non Plastic

Moisture contents measured as per ASTM D2216 (weight of water divided by weight of total dry solids)

Appendix B1 – Particle Size Analysis and Atterberg Limit Results

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	5.3	12.1	6.7	13.3	24.2	38.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	96.2		
.75	94.7		
.5	88.3		
.375	87.4		
#4	82.6		
#10	75.9		
#16	71.3		
#40	62.6		
#50	59.3		
#100	49.6		
#200	38.4		

* (no specification provided)

Material Description

Light Brown silty sand with gravel

Atterberg Limits

PL= 44 LL= 71 PI= 27

Coefficients

D_{90}= 14.3737 D_{85}= 6.1780 D_{60}= 0.3199
D_{50}= 0.1537 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-7-5(5)

Remarks

Natural Moisture Content: 32.1%

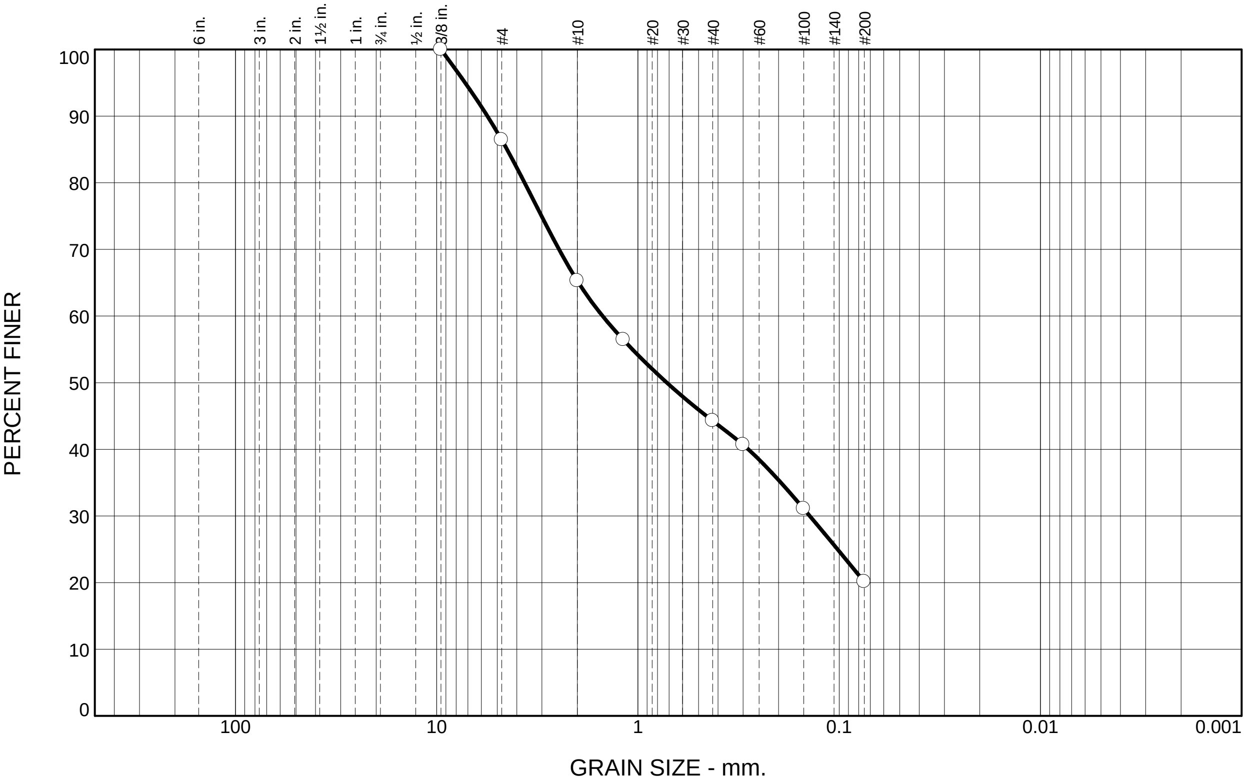
Location: BH19-01
Sample Number: 19-110-01 **Depth:** 7.5-9' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-01

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	13.6	21.1	21.0	24.2	20.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	86.4		
#10	65.3		
#16	56.4		
#40	44.3		
#50	40.7		
#100	31.1		
#200	20.1		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= 30   LL= 55   PI= 25

Coefficients

D_{90}= 5.5955 D_{85}= 4.4720 D_{60}= 1.4988
D_{50}= 0.7183 D_{30}= 0.1401 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM   AASHTO= A-2-7(1)

Remarks

Natural Moisture Content: 30.0%

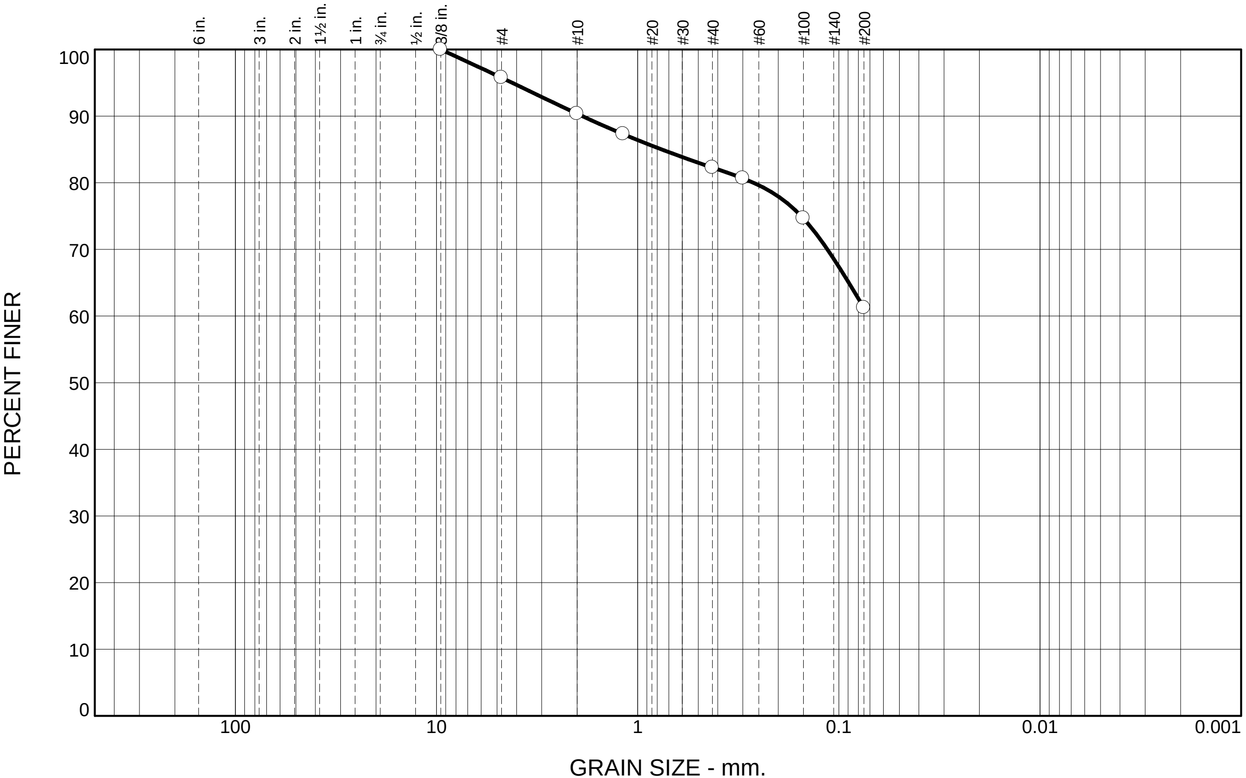
Location: BH19-01
Sample Number: 19-110-02   **Depth:** 25-26.5'   **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000   **Figure** 19-110-02

Tested By: JH   **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.2	5.4	8.1	21.1	61.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	95.8		
#10	90.4		
#16	87.3		
#40	82.3		
#50	80.7		
#100	74.7		
#200	61.2		

* (no specification provided)

Material Description

Light Brown sandy elastic silt

Atterberg Limits

PL= 55 LL= 105 PI= 50

Coefficients

D_{90}= 1.8839 D_{85}= 0.7590 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= MH AASHTO= A-7-5(32)

Remarks

Natural Moisture Content: 58.8%

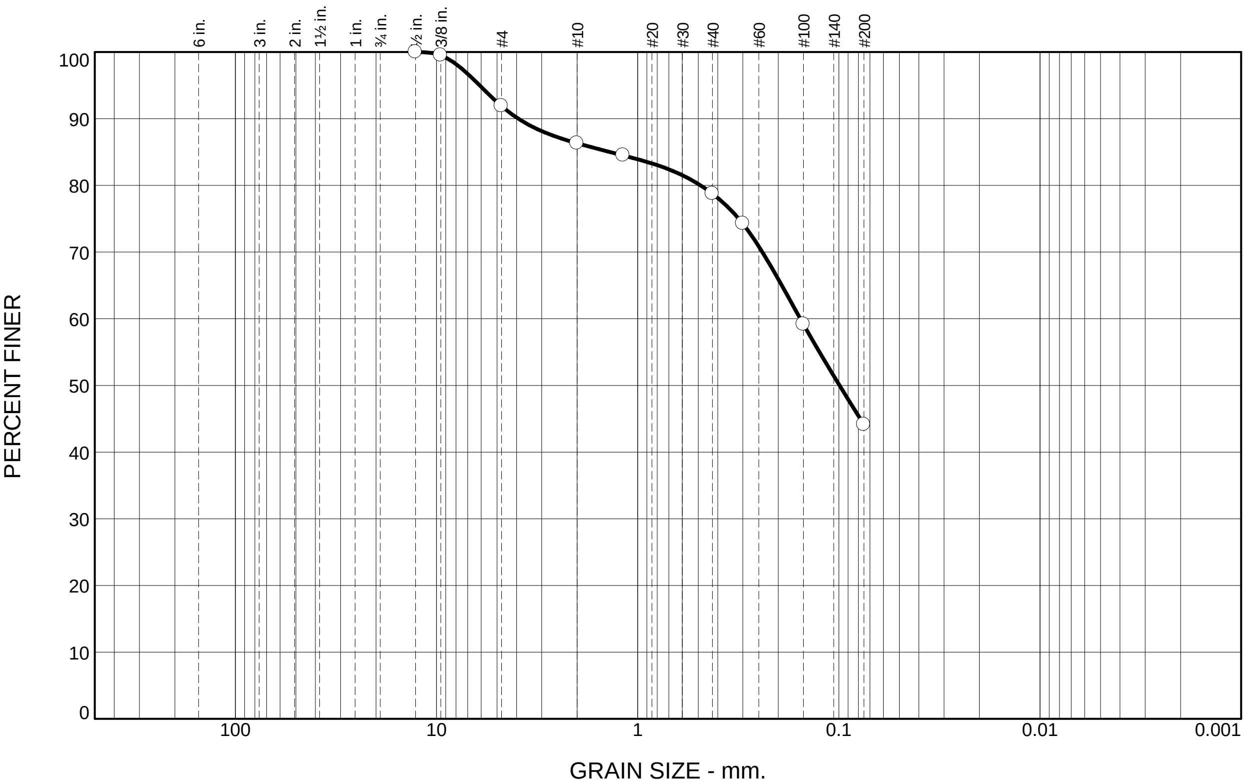
Location: BH19-02
Sample Number: 19-110-03 **Depth:** 25-26.5' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-03

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	8.1	5.6	7.5	34.7	44.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375	99.5		
#4	91.9		
#10	86.3		
#16	84.5		
#40	78.8		
#50	74.3		
#100	59.2		
#200	44.1		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= 40 LL= 80 PI= 40

Coefficients

D_{90}= 3.9167 D_{85}= 1.3730 D_{60}= 0.1554
D_{50}= 0.0992 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-7-5(12)

Remarks

Natural Moisture Content: 37.4%

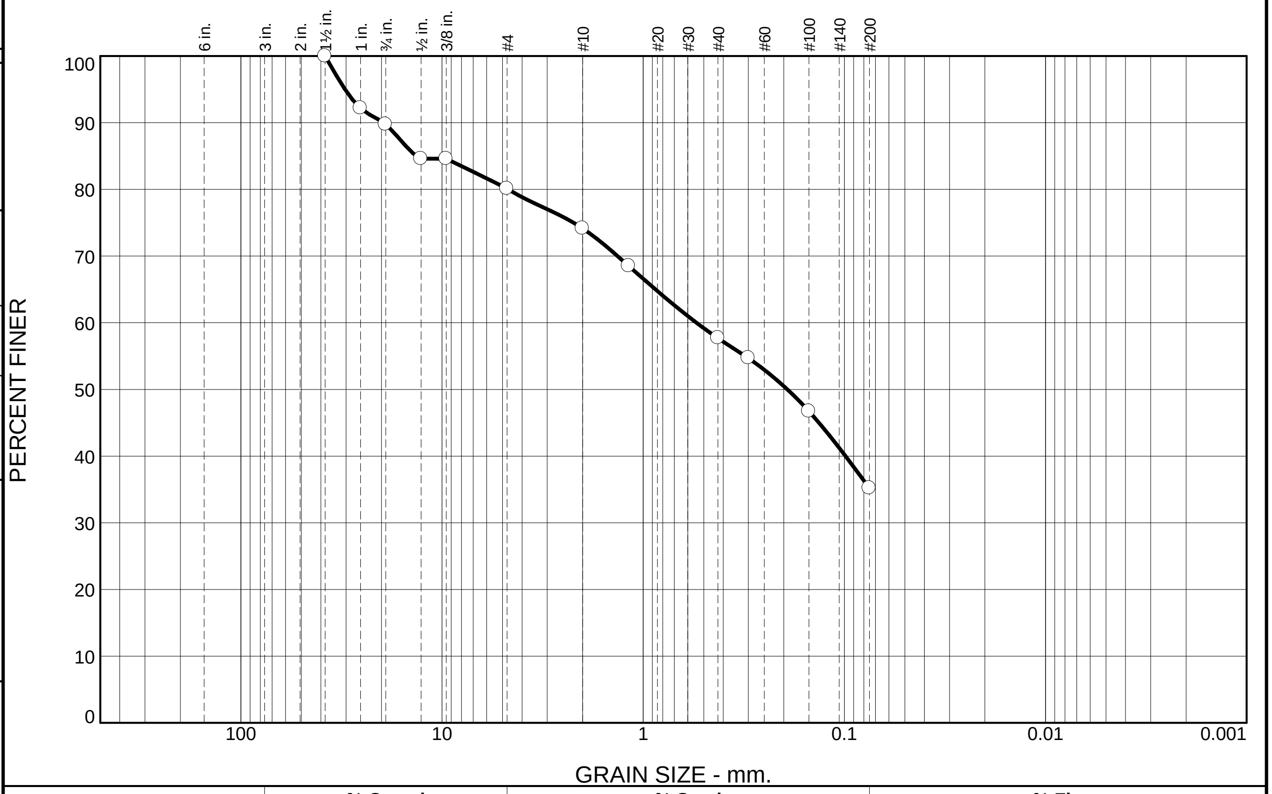
Location: BH19-02
Sample Number: 19-110-04 **Depth:** 45-46.5' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-04

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	10.3	9.6	5.9	16.5	22.5	35.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	92.2		
.75	89.7		
.5	84.6		
.375	84.6		
#4	80.1		
#10	74.2		
#16	68.5		
#40	57.7		
#50	54.7		
#100	46.7		
#200	35.2		

* (no specification provided)

Material Description

Light Brown silty sand with gravel

Atterberg Limits

PL= 28 LL= 46 PI= 18

Coefficients

D_{90}= 19.5627 D_{85}= 13.3874 D_{60}= 0.5429
D_{50}= 0.1919 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-7(2)

Remarks

Natural Moisture Content: 19.4%

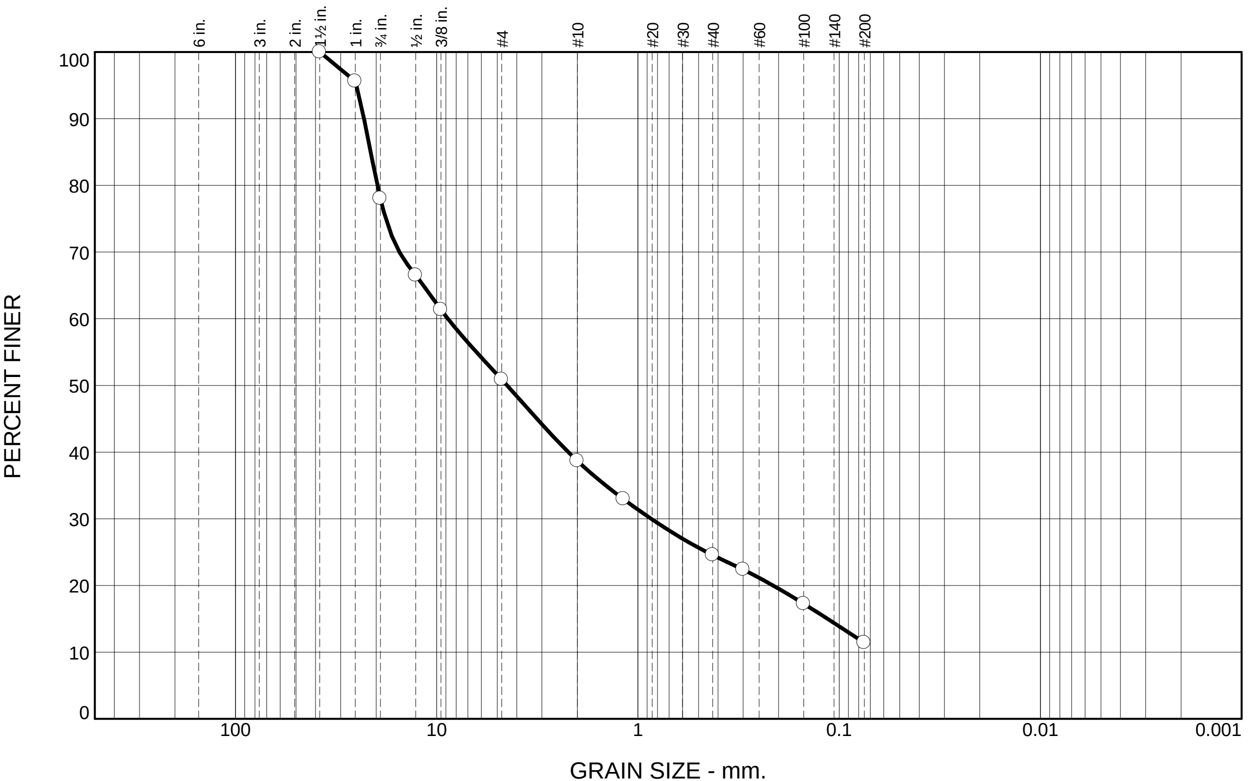
Location: BH19-08
Sample Number: 19-110-05 **Depth:** 2.5-4' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-05

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	22.0	27.1	12.2	14.1	13.2	11.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	95.6		
.75	78.0		
.5	66.5		
.375	61.4		
#4	50.9		
#10	38.7		
#16	33.0		
#40	24.6		
#50	22.4		
#100	17.3		
#200	11.4		

* (no specification provided)

Material Description

Light Brown poorly graded gravel with silt and sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 22.9854 D_{85}= 21.3084 D_{60}= 8.7932
D_{50}= 4.4708 D_{30}= 0.8593 D_{15}= 0.1143
D_{10}= C_u= C_c=

Classification

USCS= GP-GM AASHTO= A-1-a

Remarks

Natural Moisture Content: 10.3%

Location: BH19-09
Sample Number: 19-110-06 **Depth:** 2.5-4' **Date:** 4/25/2019

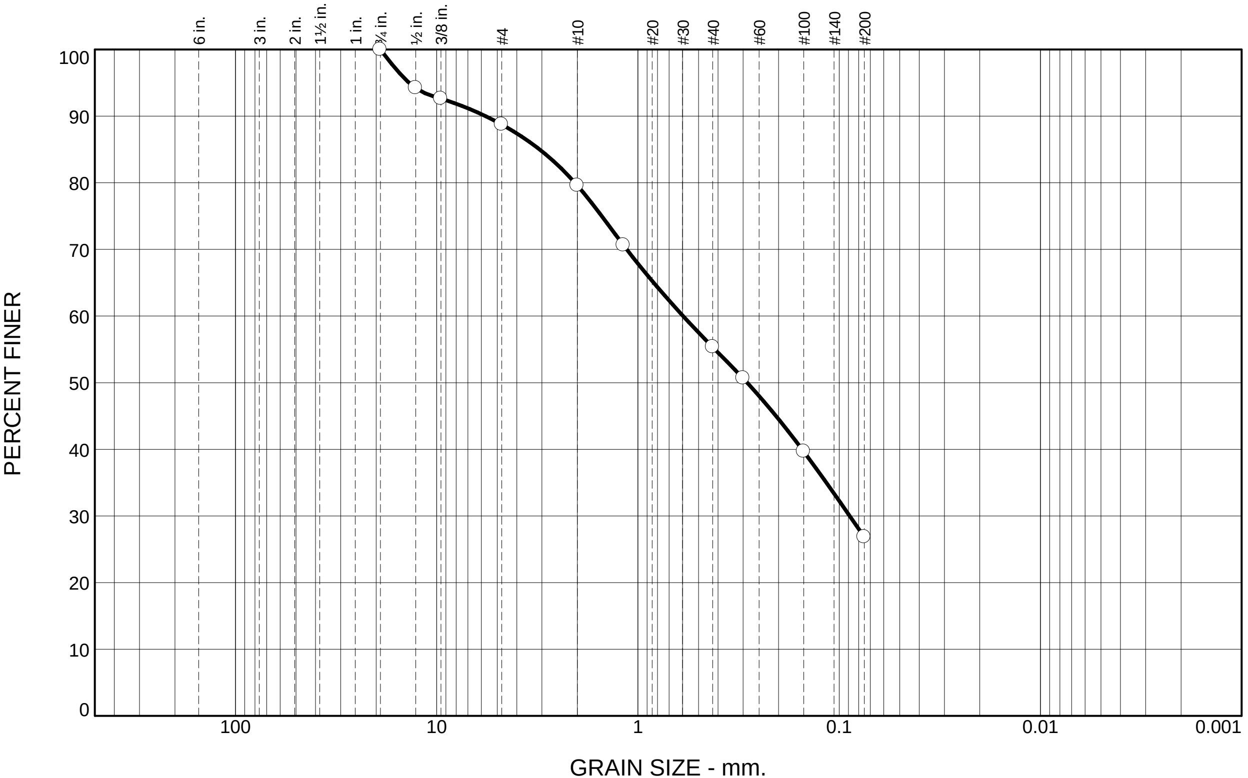
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-110-06

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	11.3	9.1	24.3	28.5	26.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	94.2		
.375	92.6		
#4	88.7		
#10	79.6		
#16	70.6		
#40	55.3		
#50	50.7		
#100	39.7		
#200	26.8		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 5.7198 D_{85}= 3.0786 D_{60}= 0.5962
D_{50}= 0.2864 D_{30}= 0.0886 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Natural Moisture Content: 23.6%

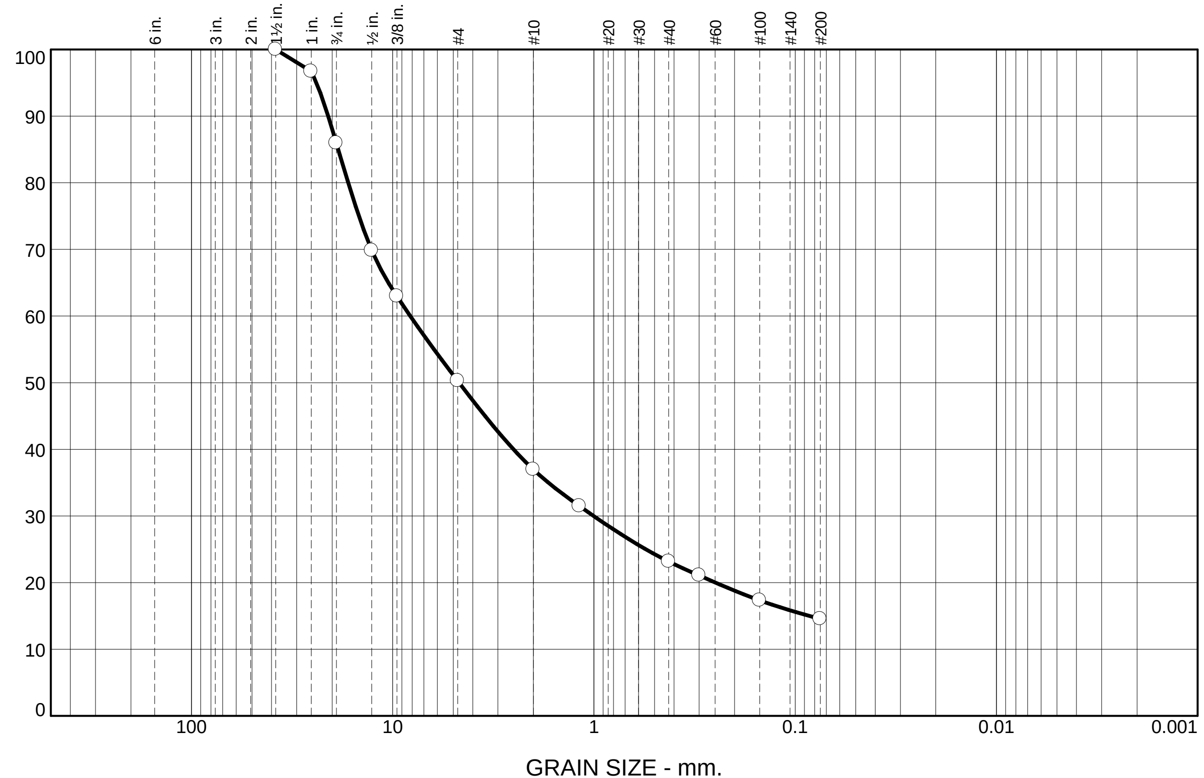
Location: BH19-11
Sample Number: 19-110-07 **Depth:** 2.5-4' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-07

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	14.1	35.6	13.3	13.8	8.7	14.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	96.7		
.75	85.9		
.5	69.8		
.375	63.0		
#4	50.3		
#10	37.0		
#16	31.5		
#40	23.2		
#50	21.1		
#100	17.3		
#200	14.5		

* (no specification provided)

Material Description

Red clayey gravel with sand

Atterberg Limits

PL= 21 LL= 48 PI= 27

Coefficients

D_{90}= 20.9347 D_{85}= 18.6472 D_{60}= 8.1802
D_{50}= 4.6789 D_{30}= 1.0039 D_{15}= 0.0850
D_{10}= C_u= C_c=

Classification

USCS= GC AASHTO= A-2-7(0)

Remarks

Natural Moisture Content: 10.5%

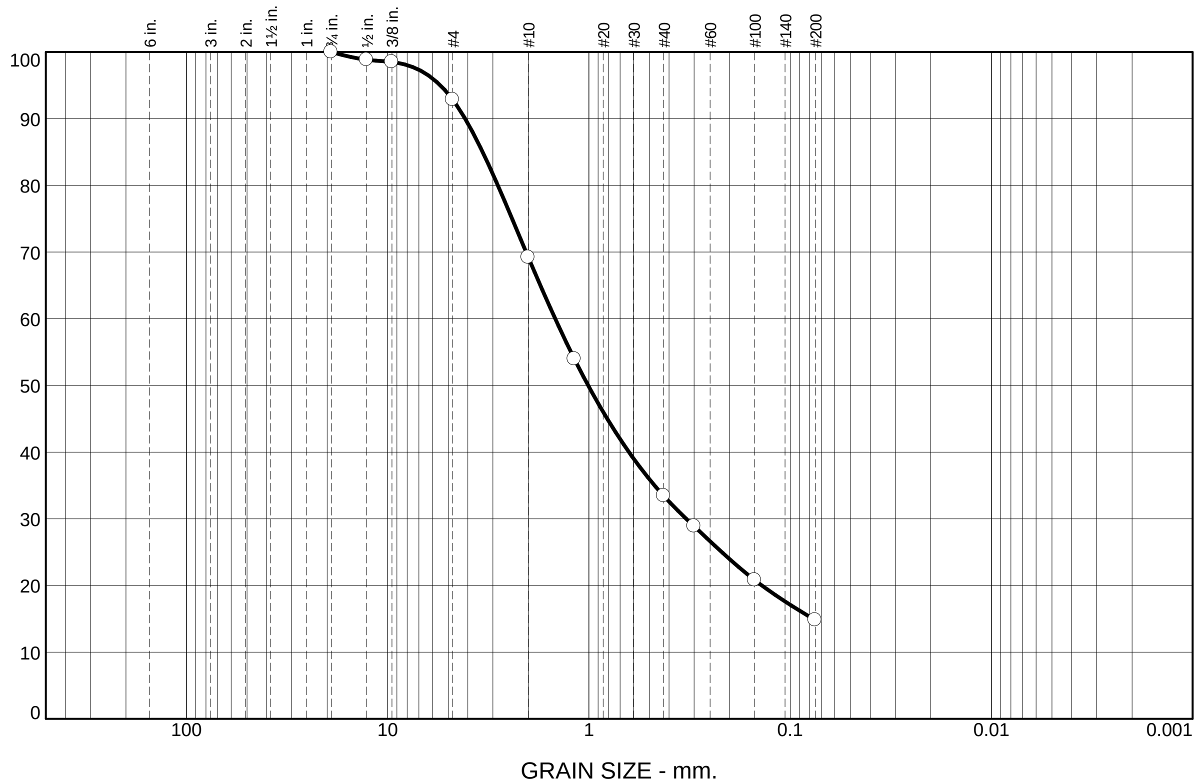
Location: BH19-12
Sample Number: 19-110-08 **Depth:** 15-16.5' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-08

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	7.2	23.6	35.8	18.6	14.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	98.8		
.375	98.5		
#4	92.8		
#10	69.2		
#16	53.9		
#40	33.4		
#50	28.9		
#100	20.8		
#200	14.8		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 4.1224 D_{85}= 3.3740 D_{60}= 1.4708
D_{50}= 1.0089 D_{30}= 0.3282 D_{15}= 0.0771
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Natural Moisture Content: 13.1%

Location: BH19-15
Sample Number: 19-110-09 **Depth:** 5.5-6' **Date:** 4/25/2019

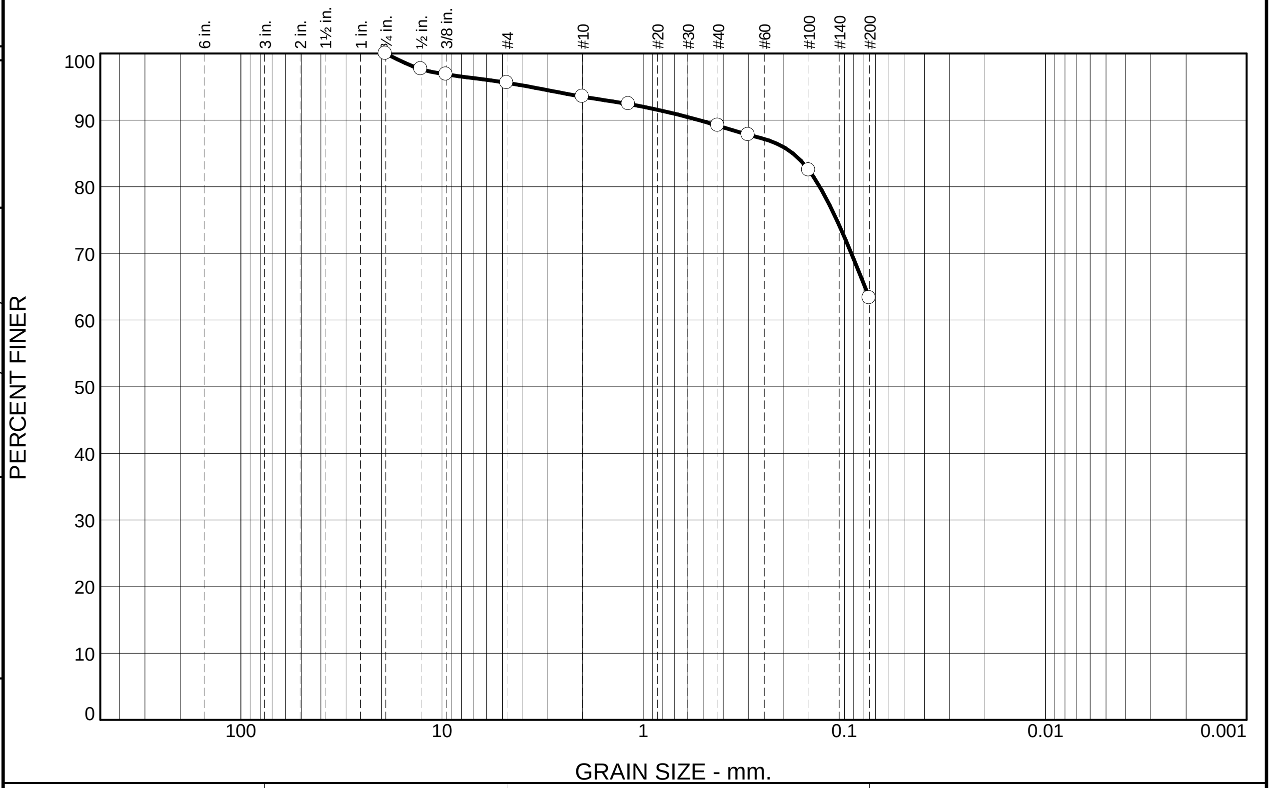
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-110-09

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.4	2.1	4.3	25.9	63.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	97.7		
.375	96.9		
#4	95.6		
#10	93.5		
#16	92.4		
#40	89.2		
#50	87.8		
#100	82.5		
#200	63.3		

* (no specification provided)

Material Description

Light Brown sandy lean clay

Atterberg Limits

PL= 24 LL= 41 PI= 17

Coefficients

D_{90}= 0.5278	D_{85}= 0.1800	D_{60}=
D_{50}=	D_{30}=	D_{15}=
D_{10}=	C_u=	C_c=

Classification

USCS= CL AASHTO= A-7-6(9)

Remarks

Natural Moisture Content: 18.5%

Location: BH19-16
Sample Number: 19-110-10 **Depth:** 2.5-4' **Date:** 4/25/2019

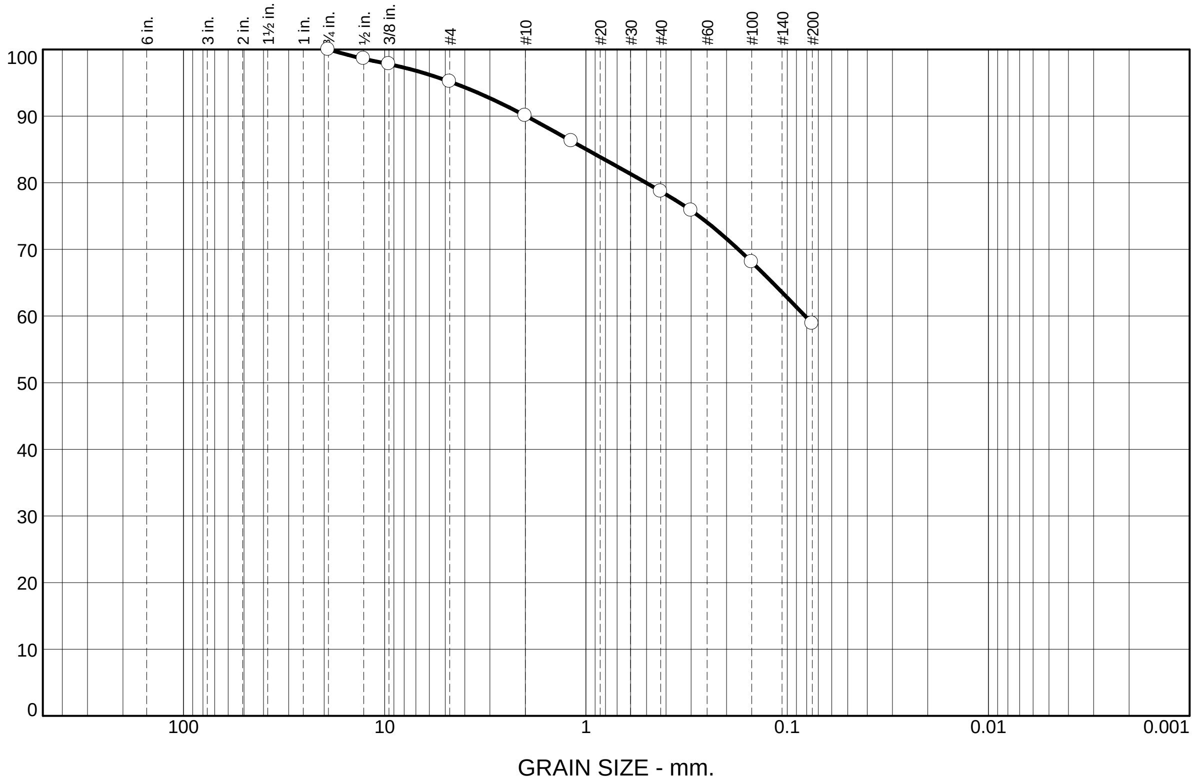
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-110-10

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.8	5.1	11.4	19.8	58.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	98.6		
.375	97.8		
#4	95.2		
#10	90.1		
#16	86.3		
#40	78.7		
#50	75.8		
#100	68.1		
#200	58.9		

* (no specification provided)

Material Description

Light Brown sandy fat clay

Atterberg Limits

PL= 27 LL= 50 PI= 23

Coefficients

D_{90}= 1.9806 D_{85}= 0.9929 D_{60}= 0.0815
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CH AASHTO= A-7-6(12)

Remarks

Natural Moisture Content: 31.8%

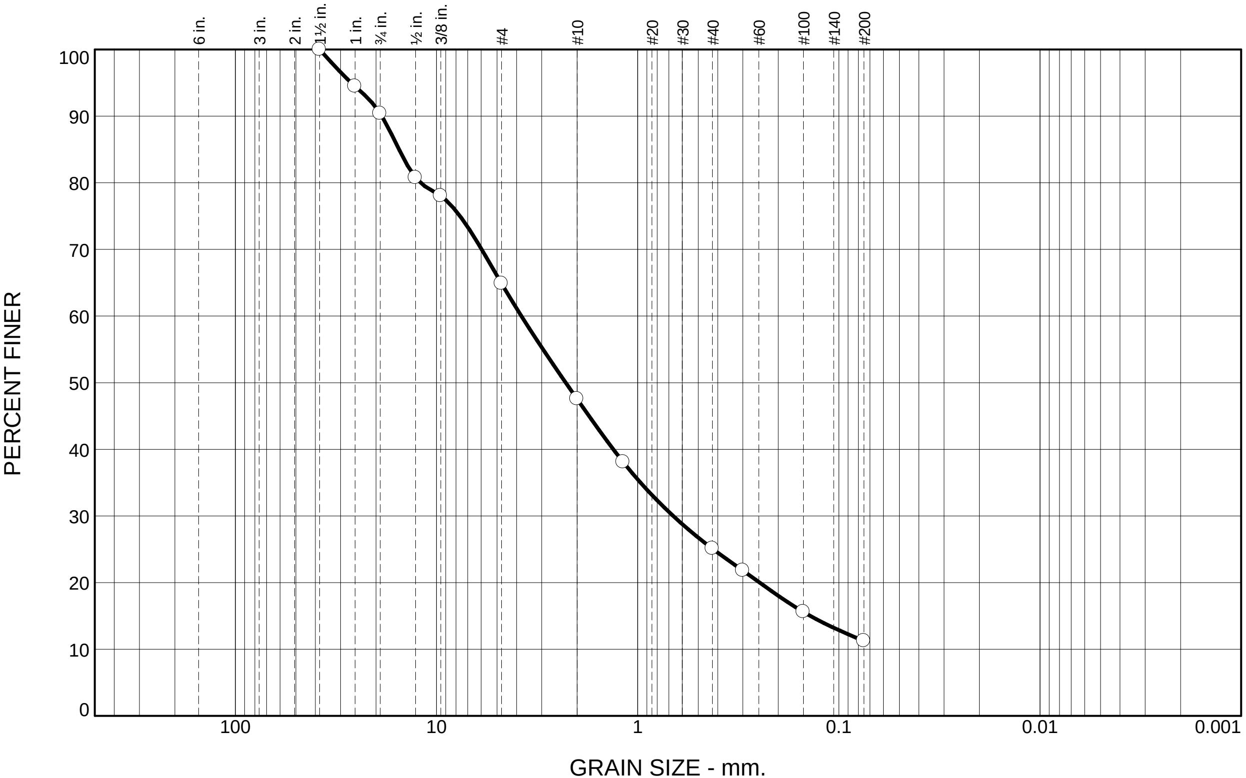
Location: BH19-17
Sample Number: 19-110-11 **Depth:** 10.5-11' **Date:** 4/26/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-11

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	9.6	25.5	17.4	22.4	13.9	11.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	94.5		
.75	90.4		
.5	80.8		
.375	78.0		
#4	64.9		
#10	47.5		
#16	38.1		
#40	25.1		
#50	21.8		
#100	15.6		
#200	11.2		

* (no specification provided)

Material Description

Brown poorly graded sand with silt and gravel

Atterberg Limits

PL= 25 LL= 32 PI= 7

Coefficients

D_{90}= 18.7059 D_{85}= 15.3433 D_{60}= 3.7868
D_{50}= 2.2788 D_{30}= 0.6660 D_{15}= 0.1386
D_{10}= C_u= C_c=

Classification

USCS= SP-SM AASHTO= A-2-4(0)

Remarks

Natural Moisture Content: 10.0%

Location: BH19-17
Sample Number: 19-110-12 **Depth:** 20-21' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-110-12

Tested By: JH/CB **Checked By:** JH

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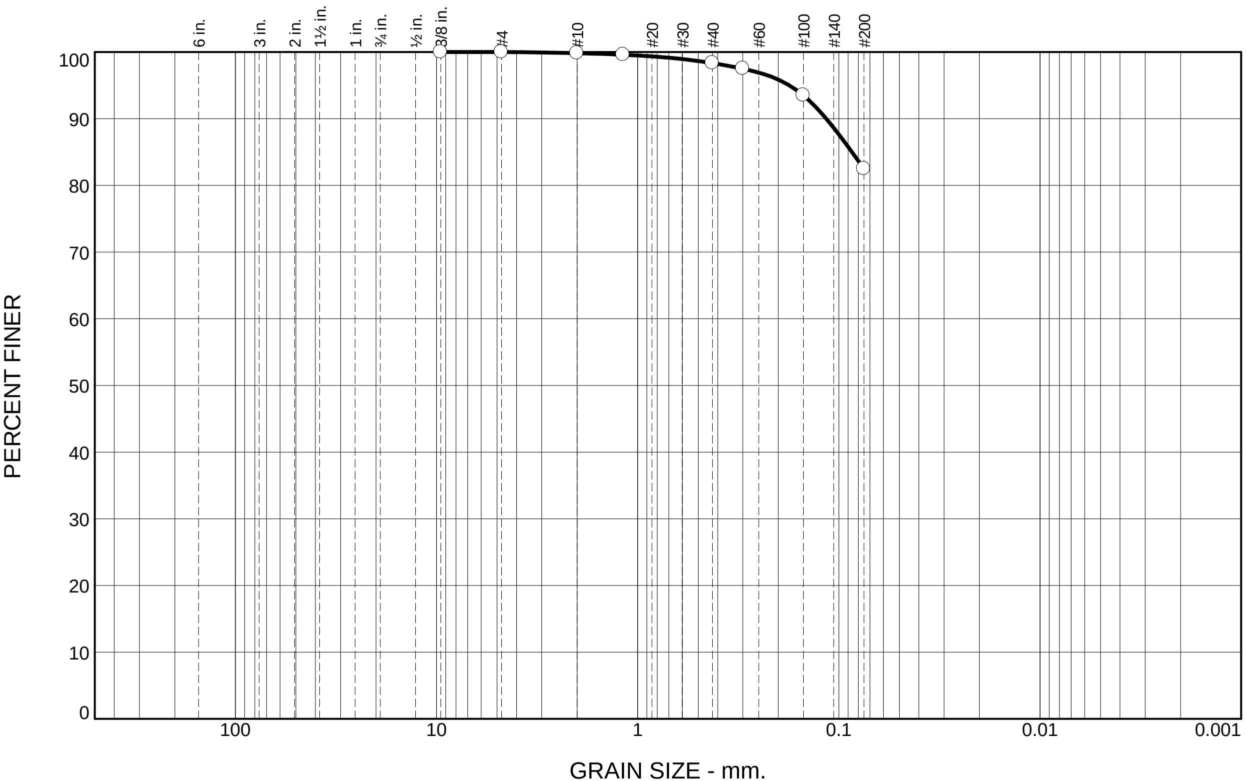
Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	1.5	15.8	82.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	100.0		
#10	99.8		
#16	99.6		
#40	98.3		
#50	97.5		
#100	93.5		
#200	82.5		

* (no specification provided)

Material Description

Light Brown elastic silt with sand

Atterberg Limits

PL= 55 LL= 110 PI= 55

Coefficients

D_{90}= 0.1155 D_{85}= 0.0861 D_{60}=

D_{50}= D_{30}= D_{15}=

D_{10}= C_u= C_c=

Classification

USCS= MH AASHTO= A-7-5(56)

Remarks

Natural Moisture Content: 37.3%

Location: BH19-18

Sample Number: 19-110-13 **Depth:** 10.5-11' **Date:** 4/26/2019

NewFields

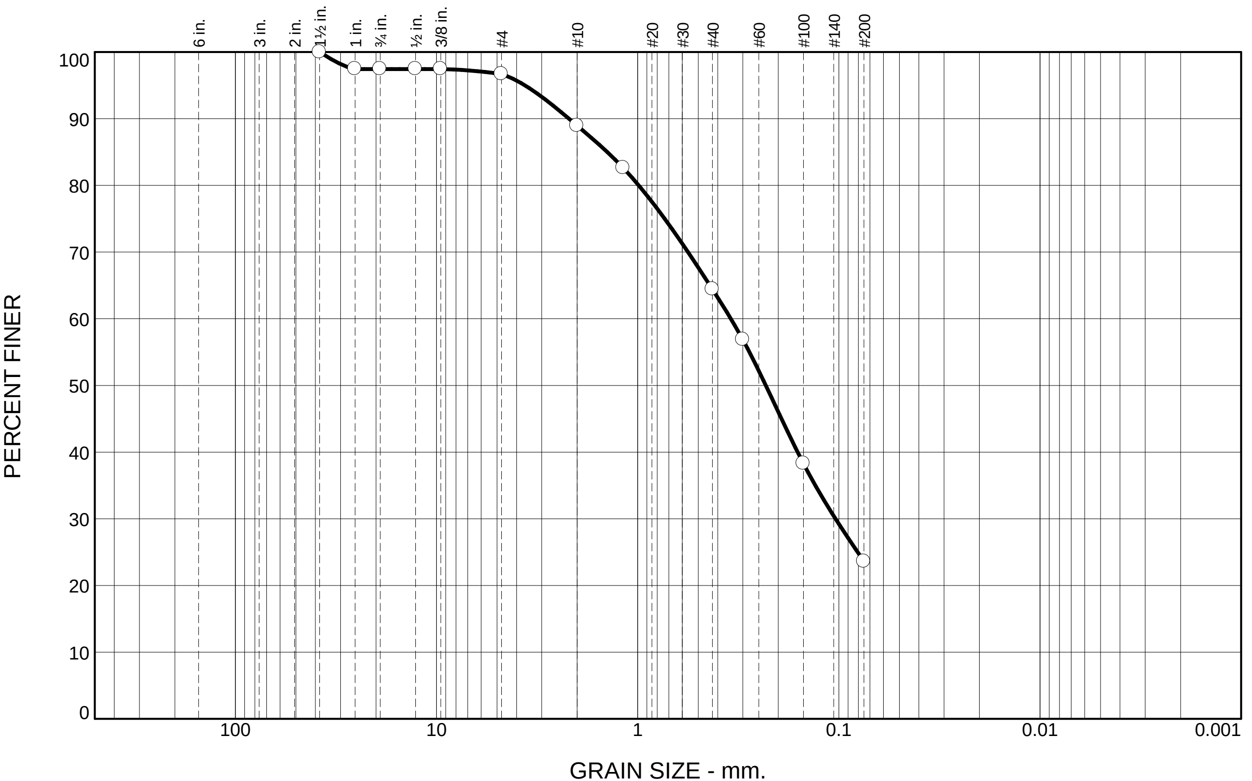
Client: Lithium Nevada

Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-110-13

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.5	0.8	7.7	24.6	40.8	23.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	97.5		
.75	97.5		
.5	97.5		
.375	97.5		
#4	96.7		
#10	89.0		
#16	82.6		
#40	64.4		
#50	56.9		
#100	38.3		
#200	23.6		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 2.1956 D_{85}= 1.4166 D_{60}= 0.3440
D_{50}= 0.2308 D_{30}= 0.1038 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Natural Moisture Content: 35.3%

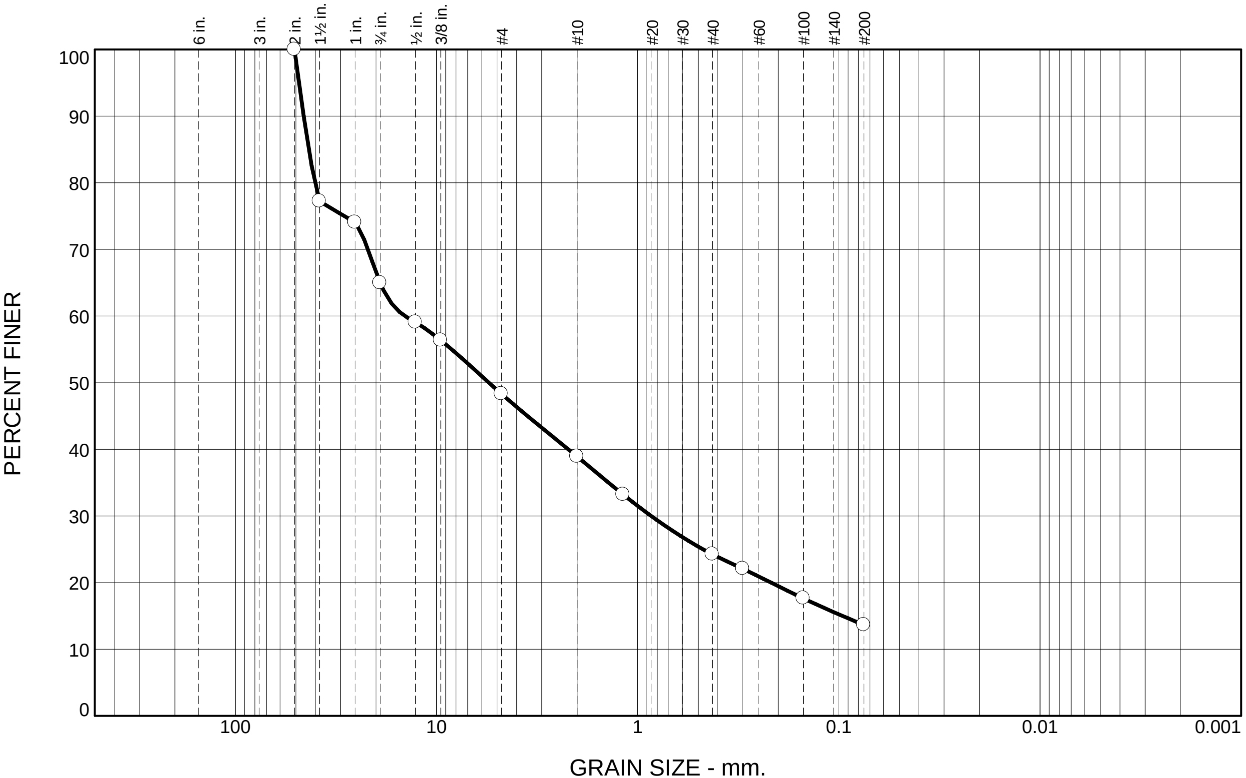
Location: BH19-18
Sample Number: 19-110-14 **Depth:** 20.5-21' **Date:** 4/26/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-14

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	35.0	16.7	9.4	14.7	10.6	13.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2	100.0		
1.5	77.2		
1	74.0		
.75	65.0		
.5	59.1		
.375	56.4		
#4	48.3		
#10	38.9		
#16	33.2		
#40	24.2		
#50	22.1		
#100	17.6		
#200	13.6		

* (no specification provided)

Material Description

Light Brown silty gravel with sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 45.7227 D_{85}= 43.1186 D_{60}= 14.3339
D_{50}= 5.4873 D_{30}= 0.8565 D_{15}= 0.0958
D_{10}= C_u= C_c=

Classification

USCS= GM AASHTO= A-1-a

Remarks

Natural Moisture Content: 10.9%

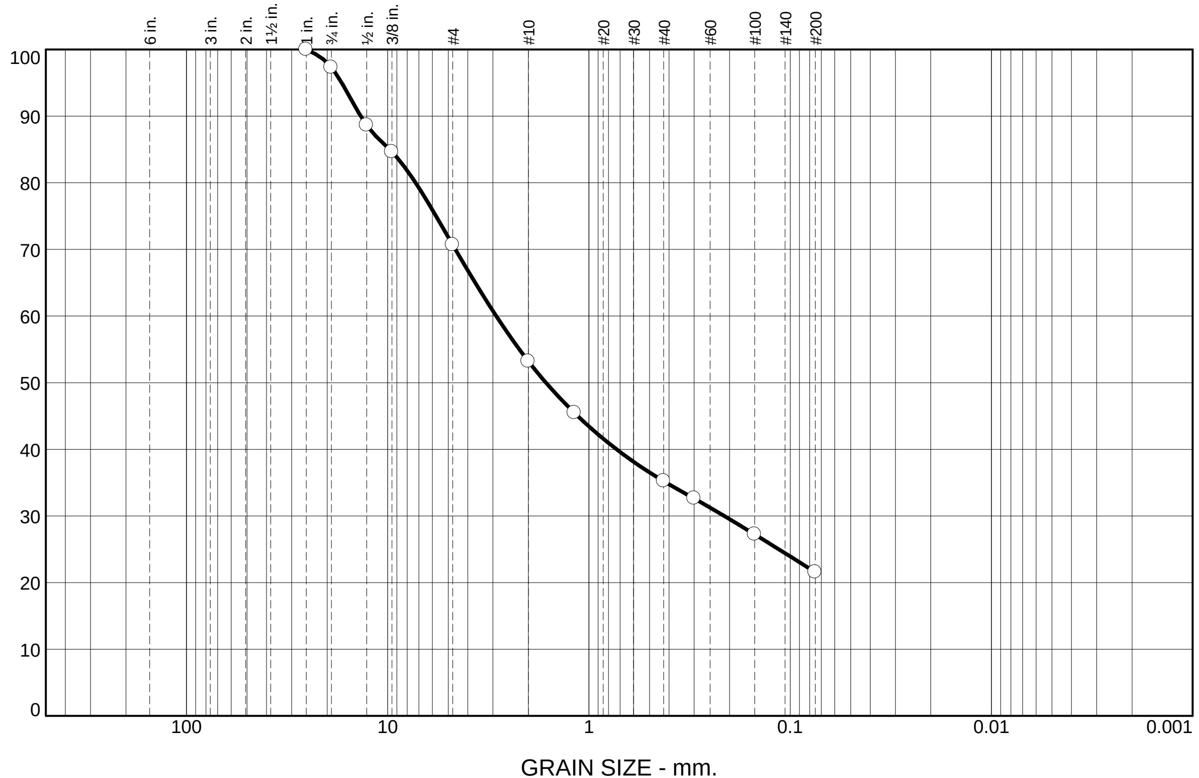
Location: BH19-20
Sample Number: 19-110-15 **Depth:** 5-6.5' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-15

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.7	26.6	17.5	18.0	13.6	21.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	97.3		
.5	88.6		
.375	84.6		
#4	70.7		
#10	53.2		
#16	45.5		
#40	35.2		
#50	32.6		
#100	27.2		
#200	21.6		

* (no specification provided)

Material Description

Gray silty sand with gravel

Atterberg Limits

PL= 30 LL= 46 PI= 16

Coefficients

D_{90}= 13.6076 D_{85}= 9.7854 D_{60}= 2.8874
D_{50}= 1.6363 D_{30}= 0.2127 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-7(0)

Remarks

Natural Moisture Content: 17.3%

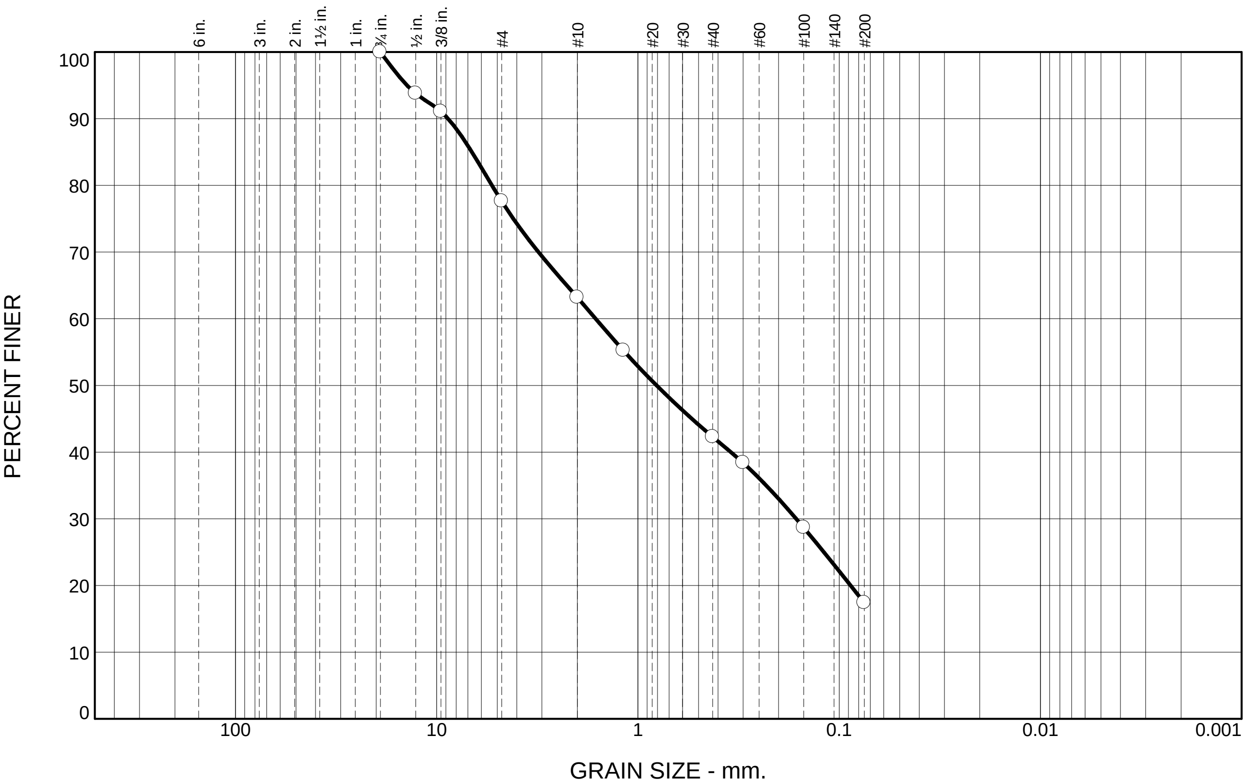
Location: BH19-20
Sample Number: 19-110-16 **Depth:** 30-30.5' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-16

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	22.4	14.4	20.9	24.9	17.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	93.8		
.375	91.1		
#4	77.6		
#10	63.2		
#16	55.2		
#40	42.3		
#50	38.4		
#100	28.7		
#200	17.4		

* (no specification provided)

Material Description

Light Brown silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 8.7776 D_{85}= 6.6845 D_{60}= 1.6225
D_{50}= 0.8076 D_{30}= 0.1636 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Natural Moisture Content: 23.5%

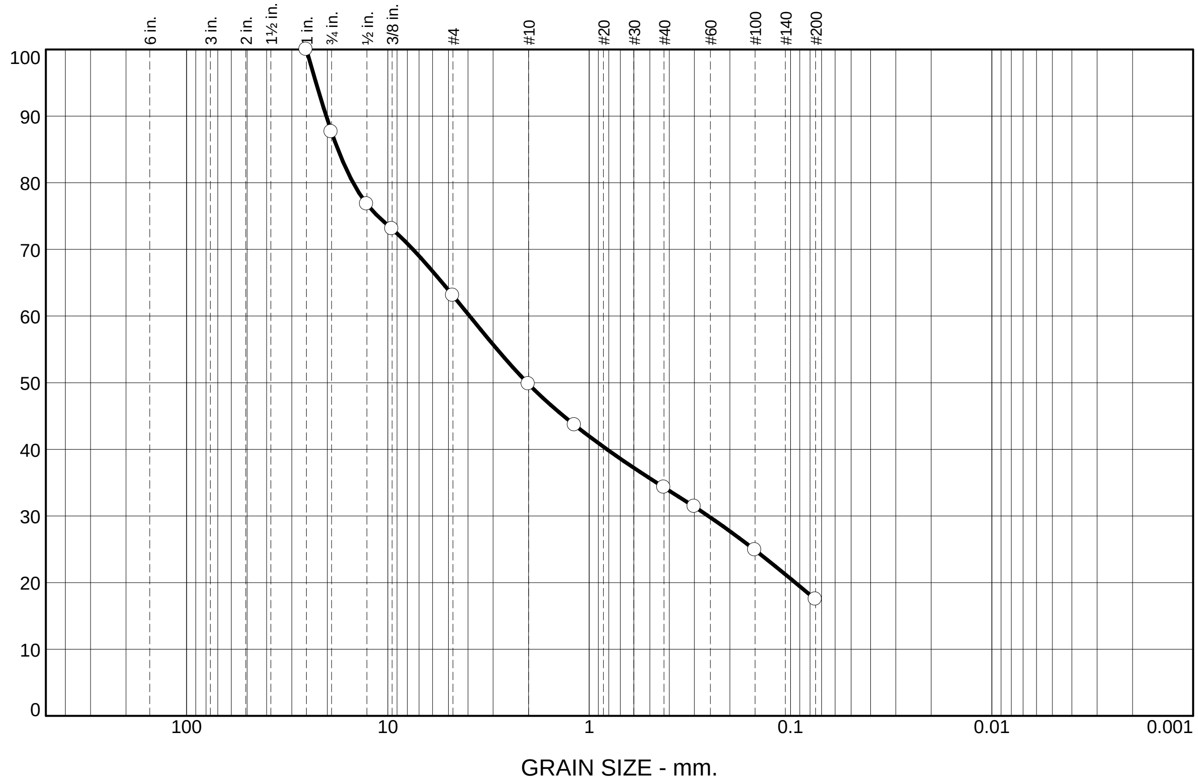
Location: BH19-21
Sample Number: 19-110-17 **Depth:** 2.5-4' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-17

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.4	24.5	13.3	15.5	16.8	17.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	87.6		
.5	76.8		
.375	73.1		
#4	63.1		
#10	49.8		
#16	43.6		
#40	34.3		
#50	31.4		
#100	24.9		
#200	17.5		

* (no specification provided)

Material Description

Light Brown silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 20.2456 D_{85}= 17.6947 D_{60}= 3.9255
D_{50}= 2.0315 D_{30}= 0.2563 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Natural Moisture Content: 14.6%

Location: BH19-23
Sample Number: 19-110-18 **Depth:** 2.5-4' **Date:** 4/25/2019

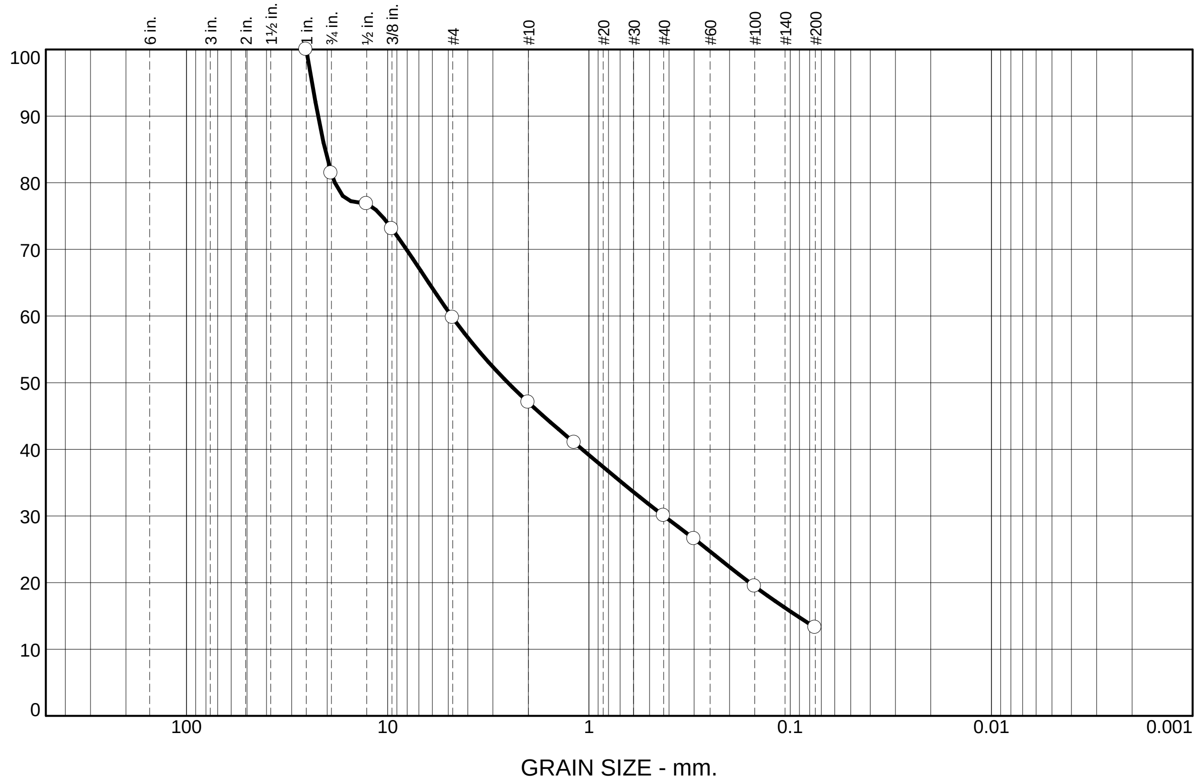
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-110-18

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	18.6	21.6	12.8	17.0	16.8	13.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	81.4		
.5	76.8		
.375	73.1		
#4	59.8		
#10	47.0		
#16	41.0		
#40	30.0		
#50	26.6		
#100	19.4		
#200	13.2		

* (no specification provided)

Material Description

Brown silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 22.1901 D_{85}= 20.4974 D_{60}= 4.8152
D_{50}= 2.5271 D_{30}= 0.4238 D_{15}= 0.0923
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-a

Remarks

Natural Moisture Content: 11.3%

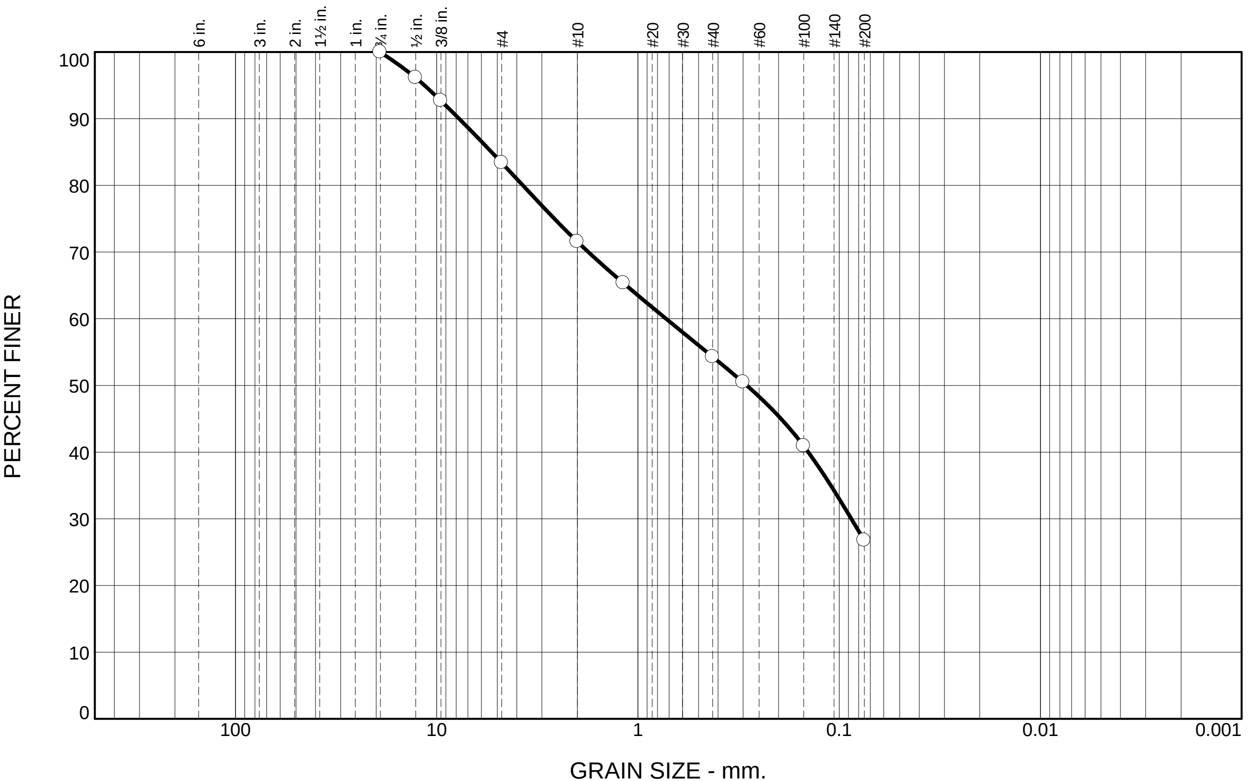
Location: BH19-23
Sample Number: 19-110-19 **Depth:** 7.5-9' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-19

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	16.6	11.8	17.3	27.6	26.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	96.1		
.375	92.7		
#4	83.4		
#10	71.6		
#16	65.3		
#40	54.3		
#50	50.5		
#100	40.9		
#200	26.7		

* (no specification provided)

Material Description

Light Brown silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 7.7348 D_{85}= 5.3379 D_{60}= 0.7245

D_{50}= 0.2880 D_{30}= 0.0870 D_{15}=

D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Natural Moisture Content: 15.0%

Location: BH19-24
Sample Number: 19-110-20 **Depth:** 2.5-4' **Date:** 4/25/2019

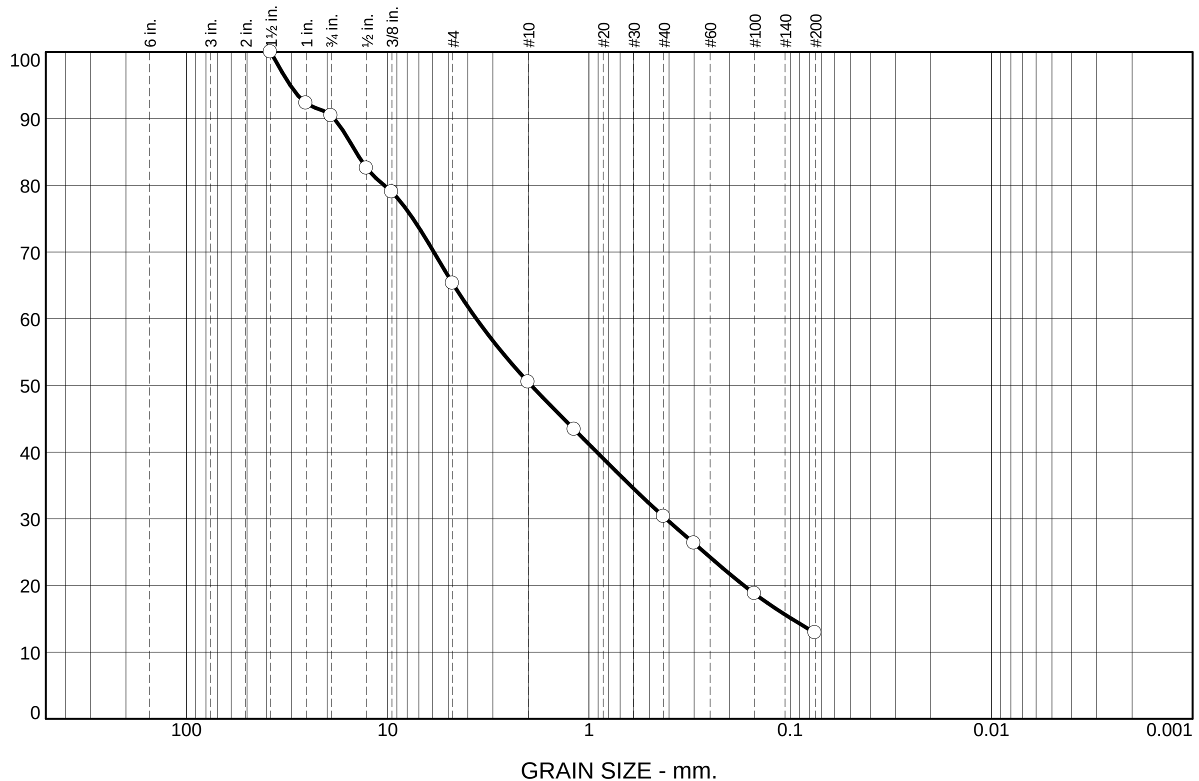
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-110-20

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	9.6	25.1	14.8	20.2	17.4	12.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	92.3		
.75	90.4		
.5	82.6		
.375	79.0		
#4	65.3		
#10	50.5		
#16	43.4		
#40	30.3		
#50	26.3		
#100	18.7		
#200	12.9		

* (no specification provided)

Material Description

Brown silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 18.4347 D_{85}= 14.3621 D_{60}= 3.6280
D_{50}= 1.9333 D_{30}= 0.4138 D_{15}= 0.0982
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-a

Remarks

Natural Moisture Content: 11.6%

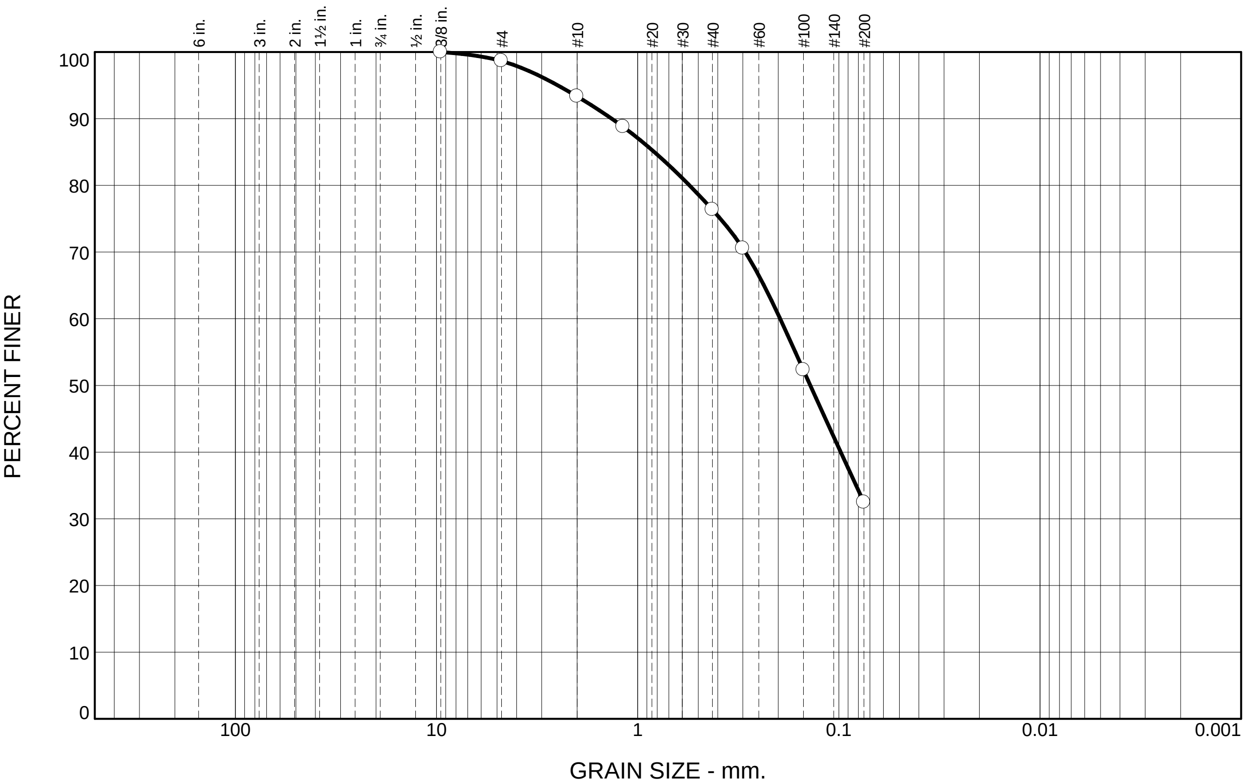
Location: BH19-24
Sample Number: 19-110-21 **Depth:** 15-16.5' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-21

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.4	5.3	16.9	43.9	32.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	98.6		
#10	93.3		
#16	88.8		
#40	76.4		
#50	70.6		
#100	52.3		
#200	32.5		

* (no specification provided)

Material Description

Brown silty sand

Atterberg Limits

PL= 43 LL= 60 PI= 17

Coefficients

D_{90}= 1.3444 D_{85}= 0.8265 D_{60}= 0.1959
D_{50}= 0.1386 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-7(1)

Remarks

Natural Moisture Content: 42.5%

Location: BH19-24
Sample Number: 19-110-22 **Depth:** 35-36.5' **Date:** 4/24/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-110-22

Tested By: JH **Checked By:** JH

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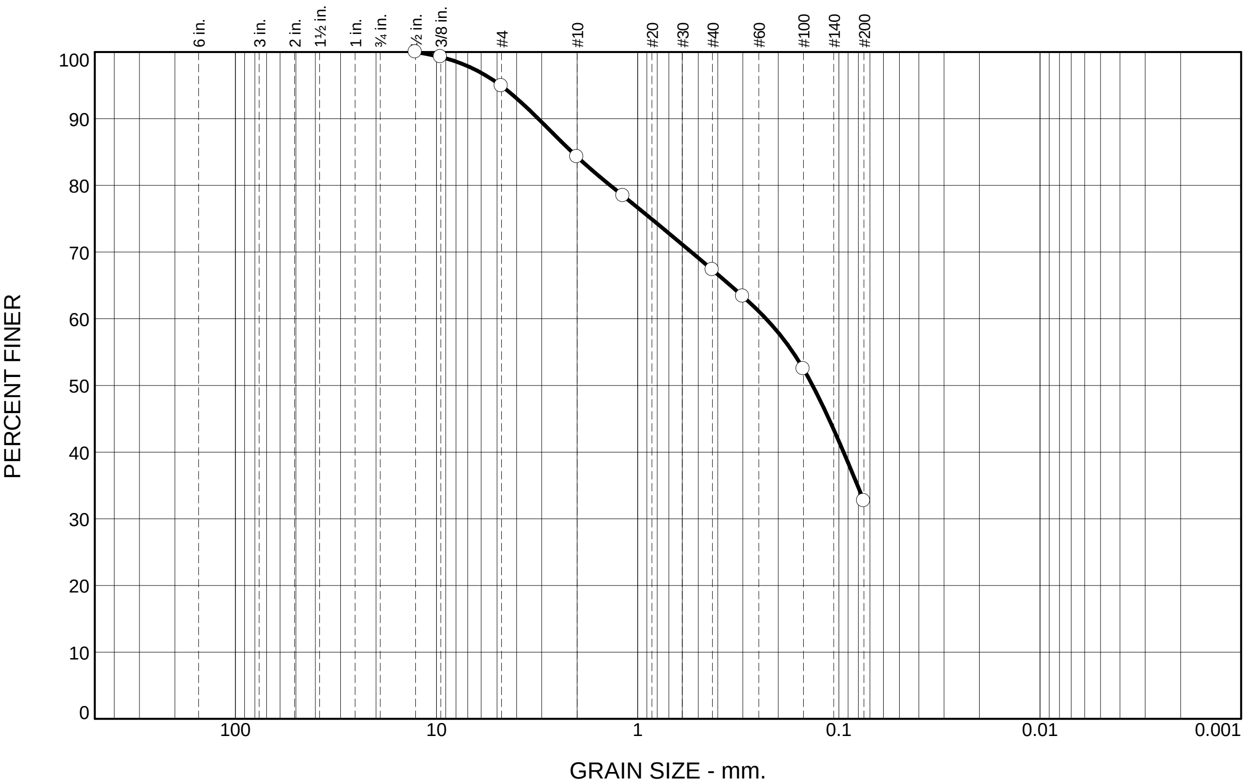
Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	5.1	10.6	17.0	34.6	32.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375	99.3		
#4	94.9		
#10	84.3		
#16	78.4		
#40	67.3		
#50	63.4		
#100	52.5		
#200	32.7		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

$D_{90}=$ 3.1185 $D_{85}=$ 2.1202 $D_{60}=$ 0.2301
$D_{50}=$ 0.1350 $D_{30}=$ $D_{15}=$
$D_{10}=$ $C_u=$ $C_c=$

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Natural Moisture Content: 18.4%

Location: BH19-25
Sample Number: 19-110-23 **Depth:** 2.5-4' **Date:** 4/25/2019

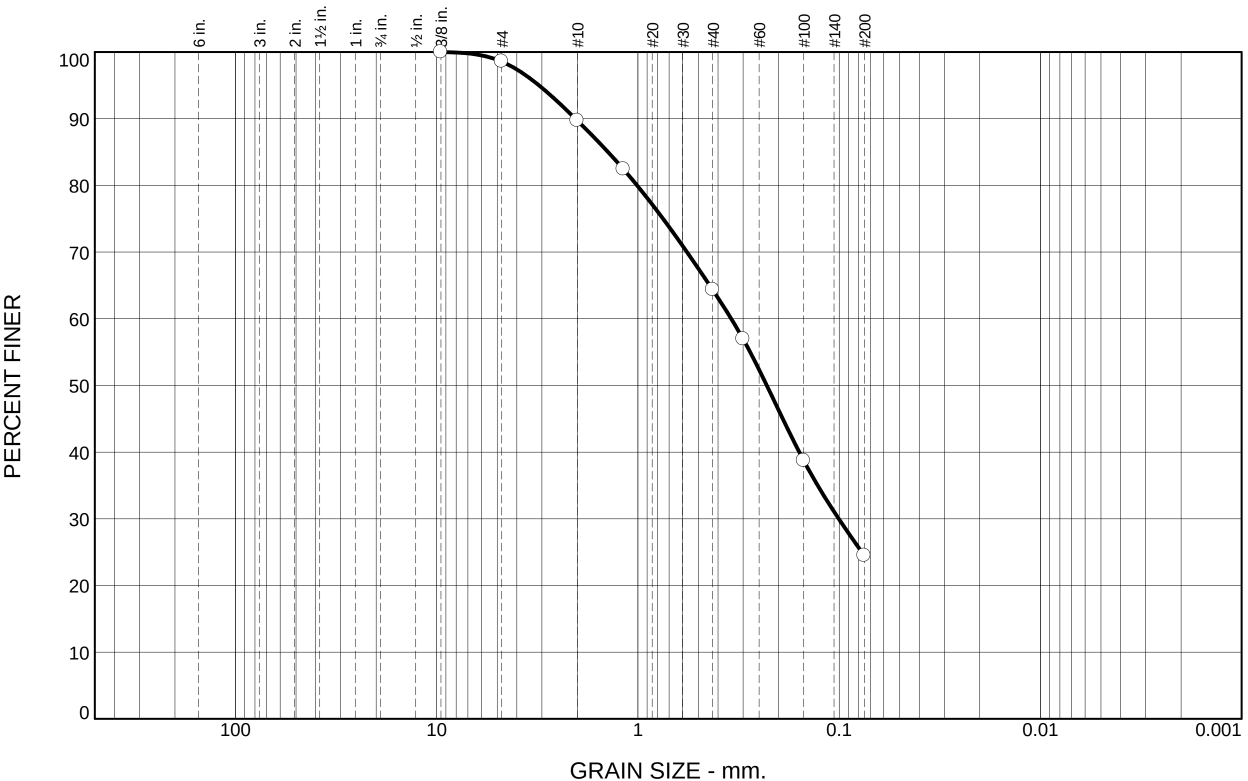
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-110-23

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.4	8.9	25.4	39.8	24.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	98.6		
#10	89.7		
#16	82.4		
#40	64.3		
#50	57.0		
#100	38.7		
#200	24.5		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 2.0447 D_{85}= 1.4078 D_{60}= 0.3436
D_{50}= 0.2290 D_{30}= 0.1005 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Natural Moisture Content: 22.3%

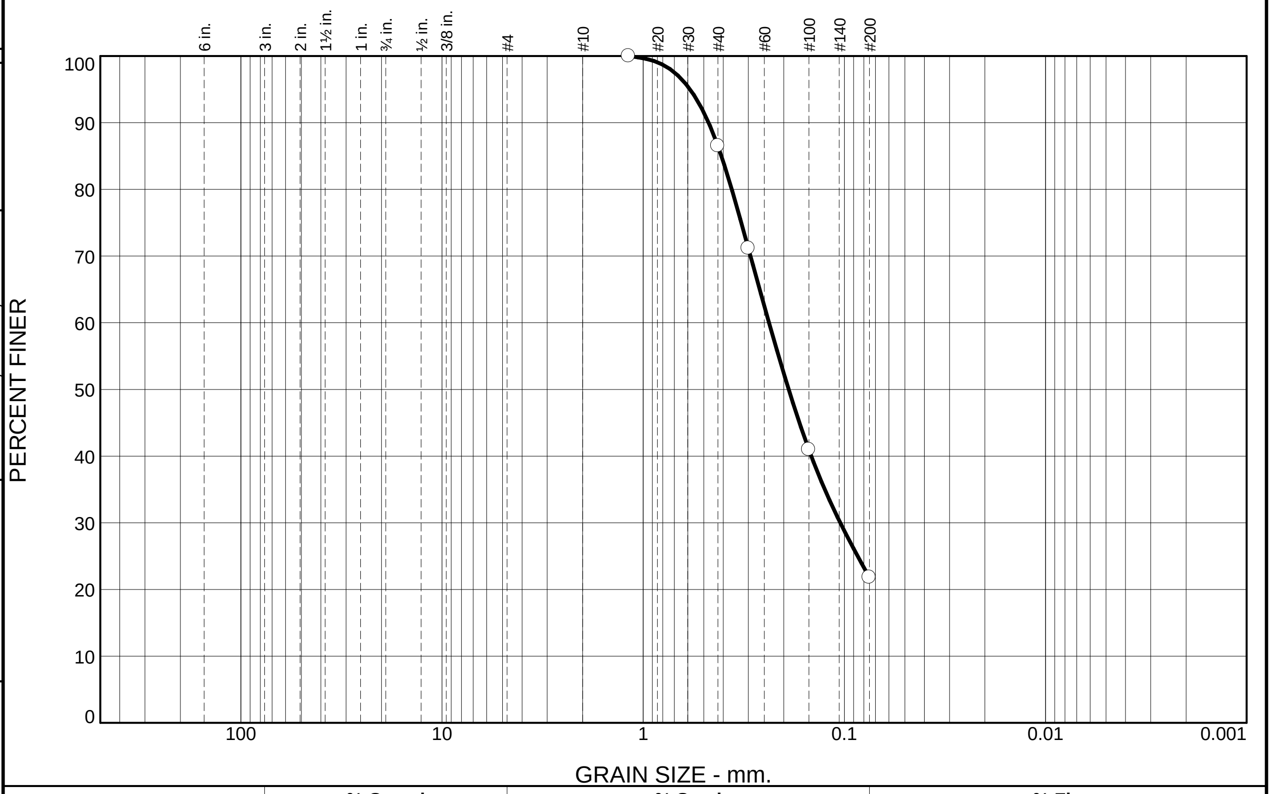
Location: BH19-25
Sample Number: 19-110-24 **Depth:** 7.5-9' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-24

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	13.5	64.7	21.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#16	100.0		
#40	86.5		
#50	71.2		
#100	40.9		
#200	21.8		

* (no specification provided)

Material Description

Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.4725 D_{85}= 0.4082 D_{60}= 0.2369
D_{50}= 0.1891 D_{30}= 0.1047 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Natural Moisture Content: 35.3%

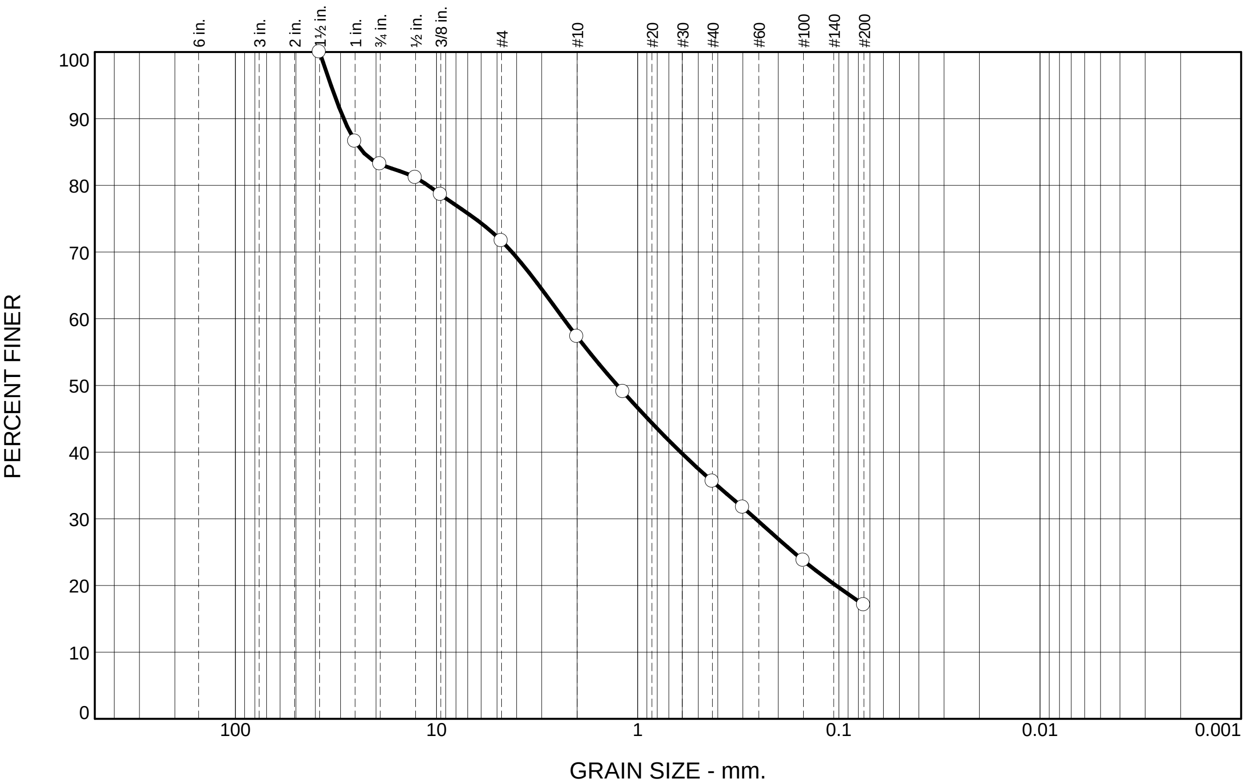
Location: BH19-25
Sample Number: 19-110-25 **Depth:** 15-16.5' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-25

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	16.8	11.5	14.4	21.7	18.5	17.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	86.6		
.75	83.2		
.5	81.2		
.375	78.6		
#4	71.7		
#10	57.3		
#16	49.0		
#40	35.6		
#50	31.7		
#100	23.7		
#200	17.1		

* (no specification provided)

Material Description

Brown silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 28.9248 D_{85}= 23.1909 D_{60}= 2.3361
D_{50}= 1.2606 D_{30}= 0.2590 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Natural Moisture Content: 13.5%

Location: BH19-26
Sample Number: 19-110-26 **Depth:** 5-6' **Date:** 4/26/2019

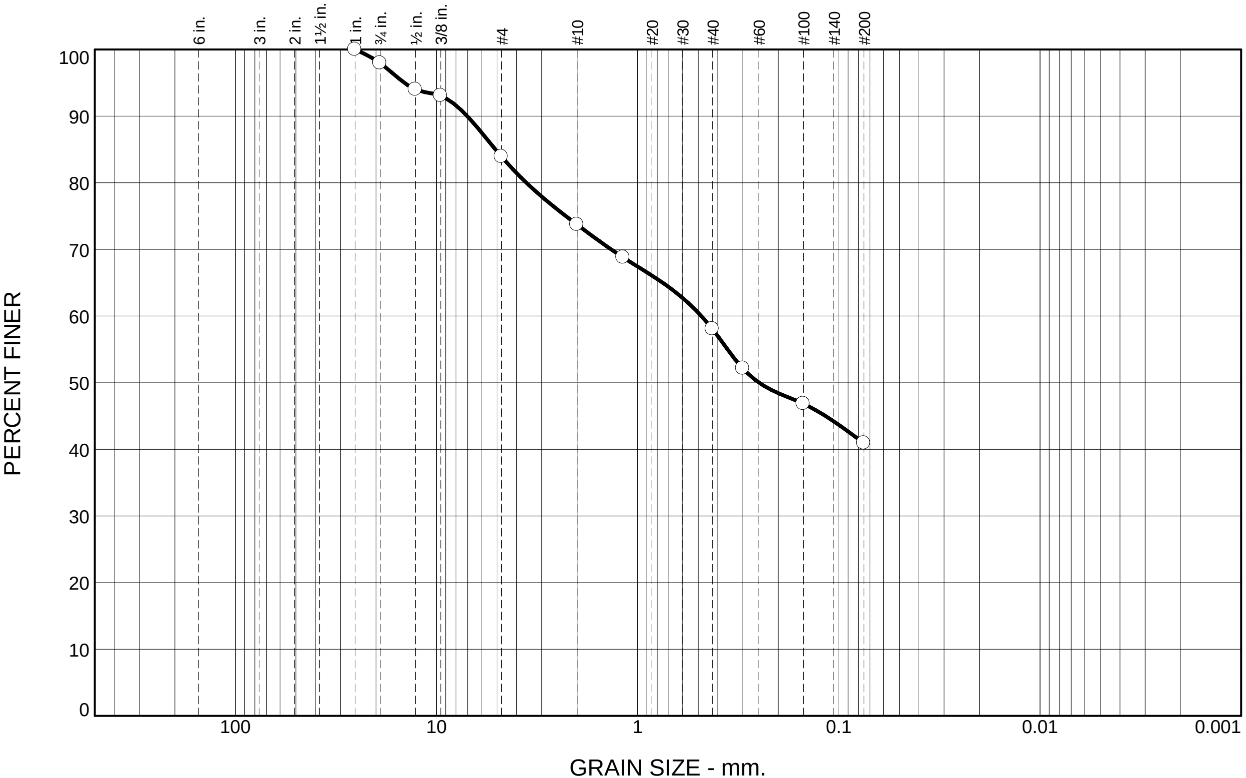
NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-26

Tested By: JH **Checked By:** JH

Test results included in this report relate only to the items inspected or tested. This report shall not be reproduced, in full, without prior written approval of NewFields.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.1	14.0	10.2	15.6	17.2	40.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	97.9		
.5	94.0		
.375	93.0		
#4	83.9		
#10	73.7		
#16	68.8		
#40	58.1		
#50	52.1		
#100	46.8		
#200	40.9		

* (no specification provided)

Material Description

Brown clayey sand with gravel

Atterberg Limits

PL= 16 LL= 37 PI= 21

Coefficients

D_{90}= 7.0344	D_{85}= 5.0939	D_{60}= 0.4822
D_{50}= 0.2492	D_{30}=	D_{15}=
D_{10}=	C_u=	C_c=

Classification

USCS= SC AASHTO= A-6(4)

Remarks

Natural Moisture Content: 15.6%

Location: BH19-28
Sample Number: 19-110-27 **Depth:** 8.5-9' **Date:** 4/25/2019

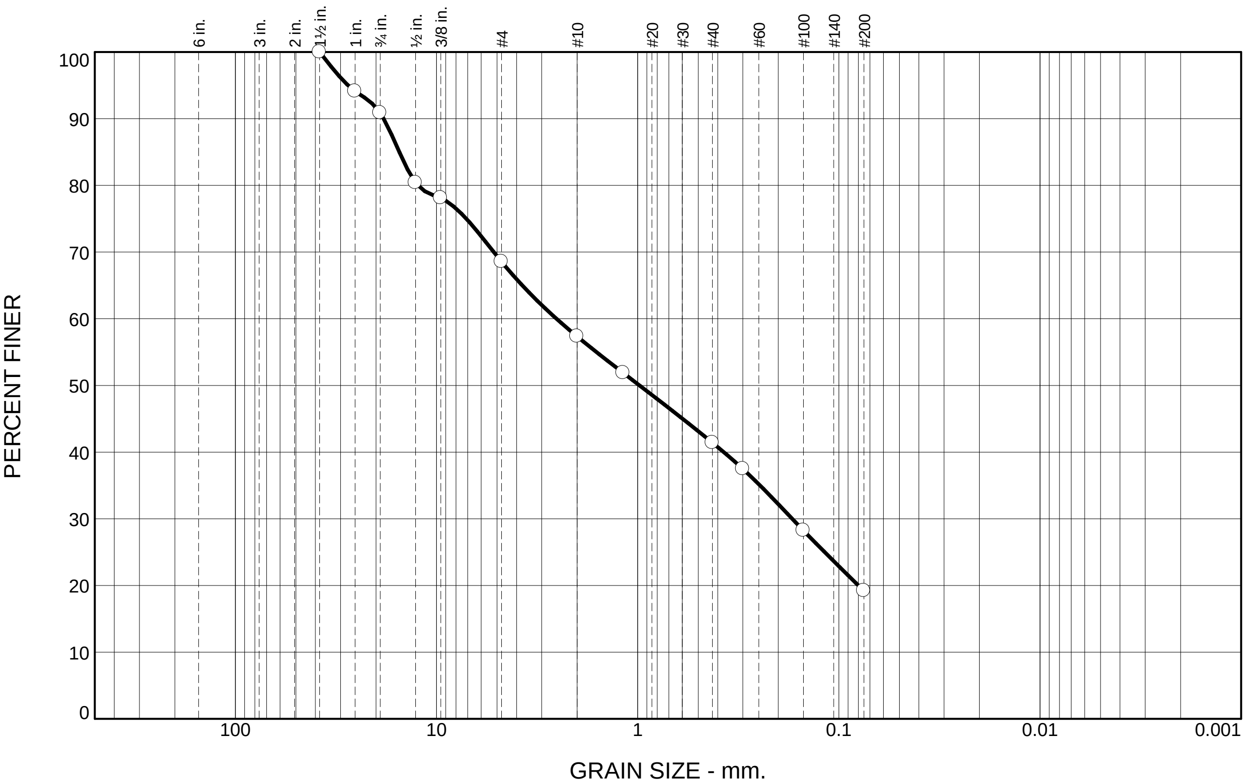
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-110-27

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	9.2	22.3	11.1	16.0	22.2	19.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	94.1		
.75	90.8		
.5	80.4		
.375	78.1		
#4	68.5		
#10	57.4		
#16	51.9		
#40	41.4		
#50	37.5		
#100	28.2		
#200	19.2		

* (no specification provided)

Material Description

Light Brown silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 18.3119 D_{85}= 15.2925 D_{60}= 2.5320
D_{50}= 0.9786 D_{30}= 0.1705 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Natural Moisture Content: 12.7%

Location: BH19-29
Sample Number: 19-110-28 **Depth:** 2.5-4' **Date:** 4/25/2019

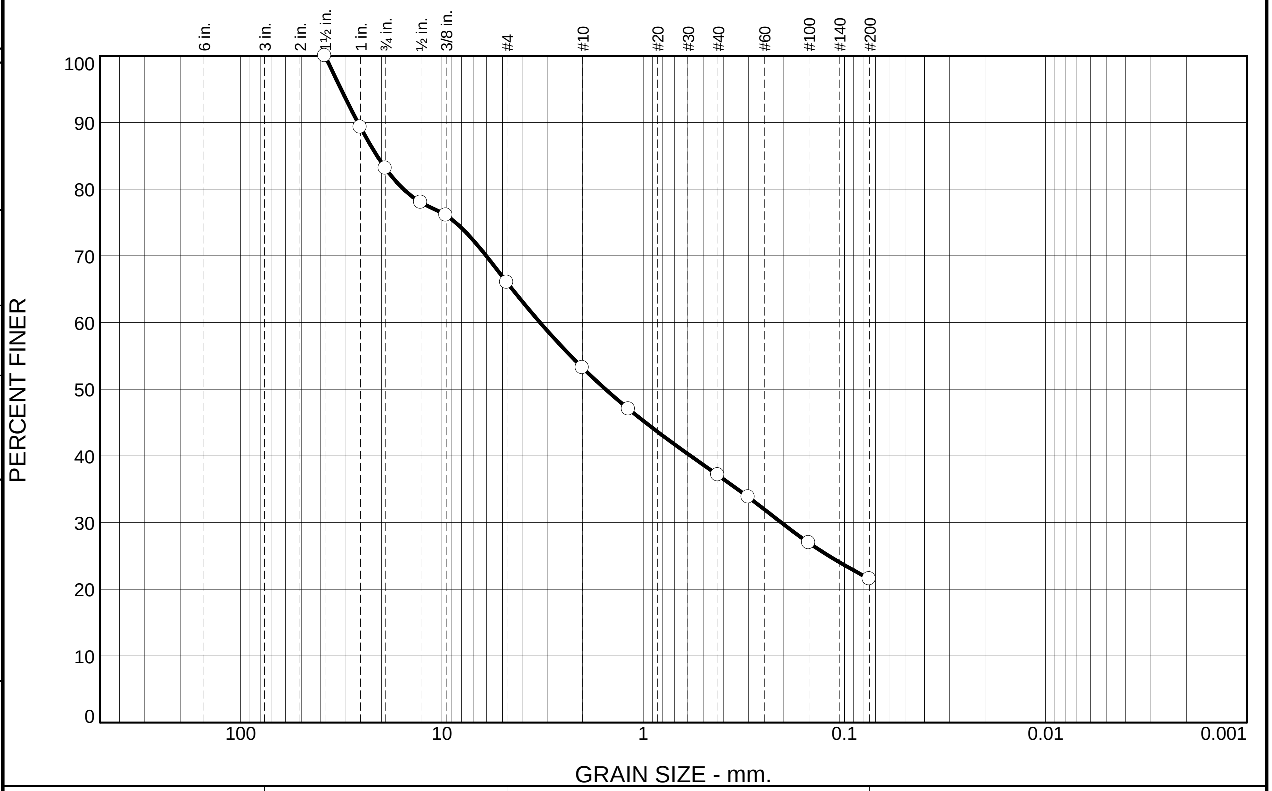
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-110-28

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	16.9	17.1	12.8	16.1	15.6	21.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	89.3		
.75	83.1		
.5	78.0		
.375	76.1		
#4	66.0		
#10	53.2		
#16	47.0		
#40	37.1		
#50	33.8		
#100	26.9		
#200	21.5		

* (no specification provided)

Material Description

Light Brown clayey sand with gravel

Atterberg Limits

PL= 21 LL= 31 PI= 10

Coefficients

D_{90}= 26.1767	D_{85}= 21.0255	D_{60}= 3.2559
D_{50}= 1.5405	D_{30}= 0.2060	D_{15}=
D_{10}=	C_u=	C_c=

Classification

USCS= SC AASHTO= A-2-4(0)

Remarks

Natural Moisture Content: 7.5%

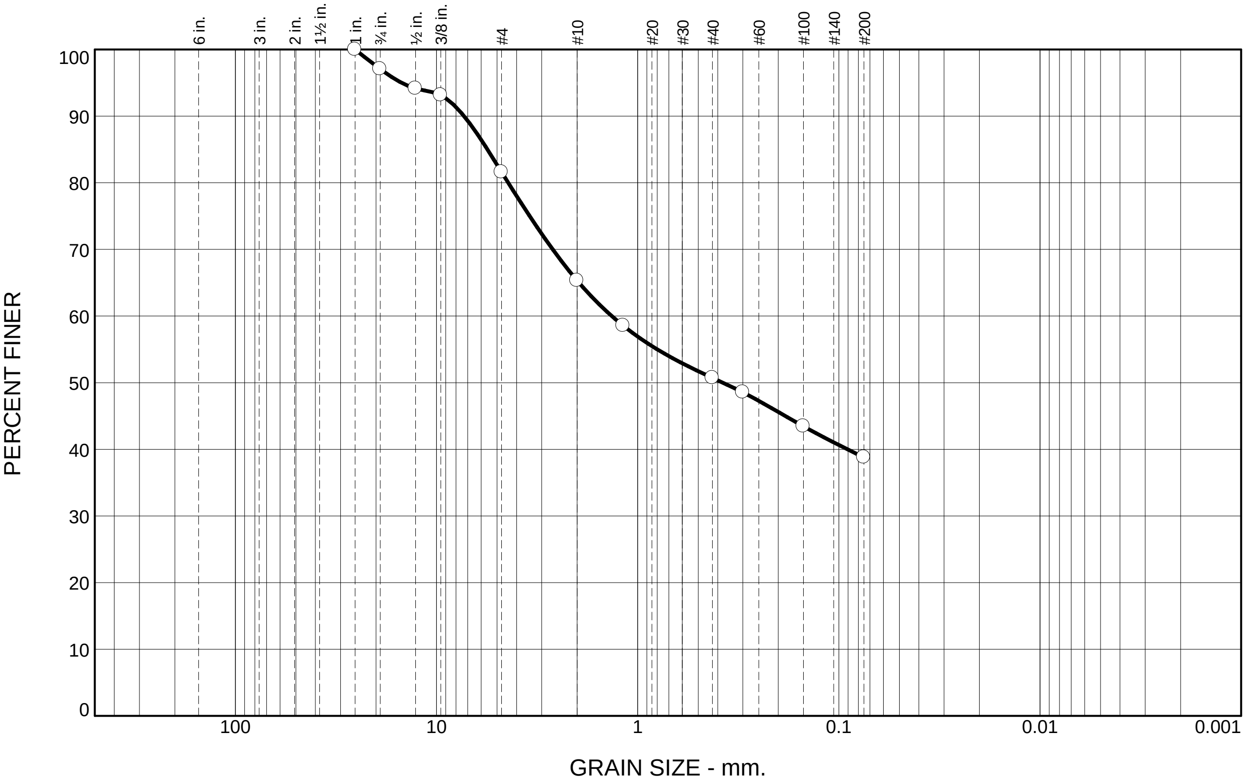
Location: BH19-29
Sample Number: 19-110-29 **Depth:** 7.5-9' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-29

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.9	15.5	16.3	14.6	11.9	38.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	97.1		
.5	94.1		
.375	93.1		
#4	81.6		
#10	65.3		
#16	58.6		
#40	50.7		
#50	48.5		
#100	43.5		
#200	38.8		

* (no specification provided)

Material Description

Light Brown clayey sand with gravel

Atterberg Limits

PL= 19 LL= 47 PI= 28

Coefficients

D_{90}= 7.2941 D_{85}= 5.5841 D_{60}= 1.3456
D_{50}= 0.3772 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-7-6(5)

Remarks

Natural Moisture Content: 15.3%

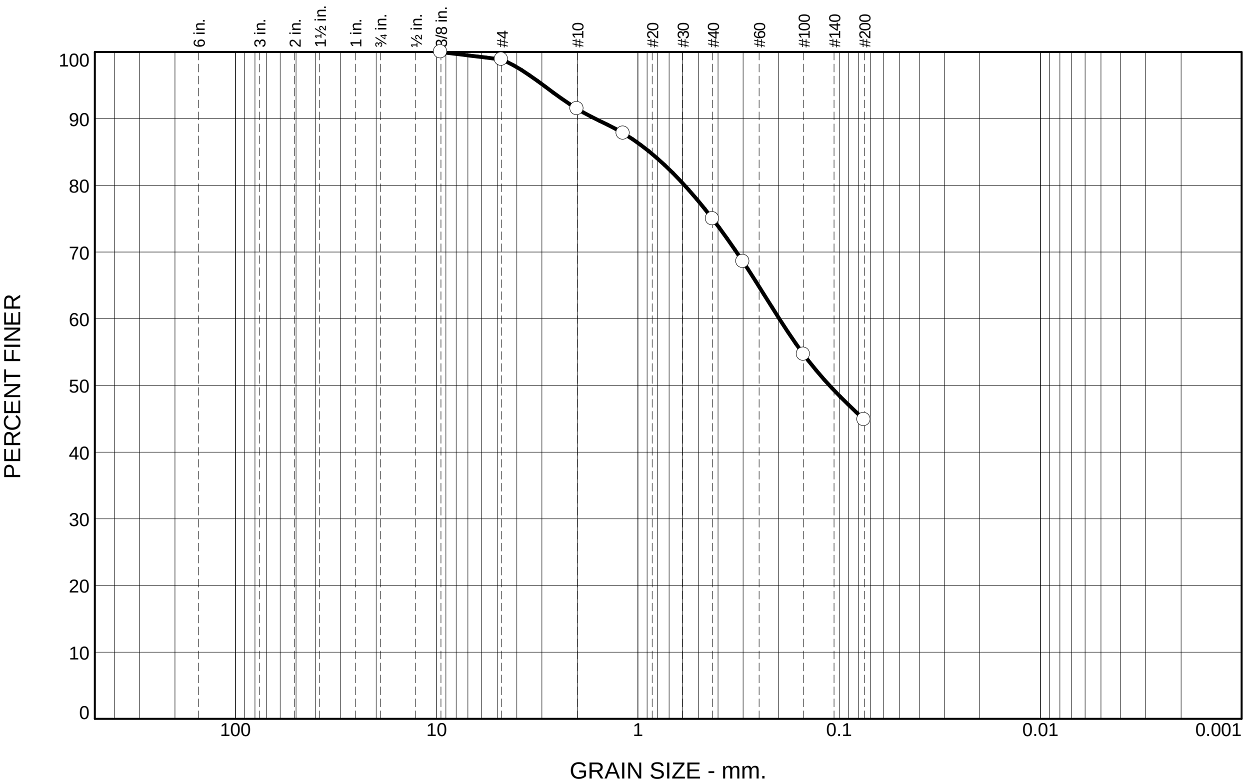
Location: BH19-29
Sample Number: 19-110-30 **Depth:** 15-16.5' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-30

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.1	7.4	16.5	30.2	44.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	98.9		
#10	91.5		
#16	87.8		
#40	75.0		
#50	68.5		
#100	54.6		
#200	44.8		

* (no specification provided)

Material Description

Brown clayey sand

Atterberg Limits

PL= 25 LL= 62 PI= 37

Coefficients

$D_{90}=$ 1.6285 $D_{85}=$ 0.8722 $D_{60}=$ 0.1984
$D_{50}=$ 0.1117 $D_{30}=$ $D_{15}=$
$D_{10}=$ $C_u=$ $C_c=$

Classification

USCS= SC AASHTO= A-7-6(11)

Remarks

Natural Moisture Content: 23.4%

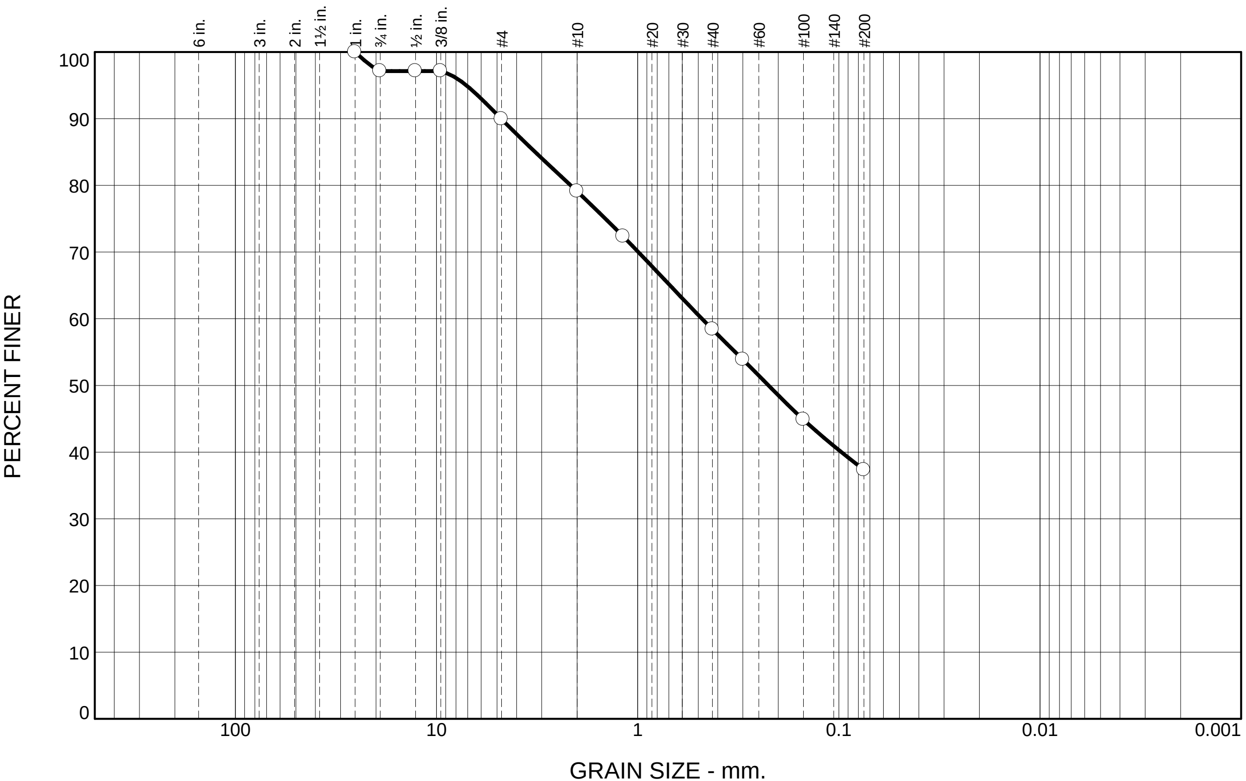
Location: BH19-29
Sample Number: 19-110-31 **Depth:** 25-26' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-31

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.9	7.2	10.8	20.7	21.1	37.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	97.1		
.5	97.1		
.375	97.1		
#4	89.9		
#10	79.1		
#16	72.3		
#40	58.4		
#50	53.9		
#100	44.9		
#200	37.3		

* (no specification provided)

Material Description

Brown clayey sand

Atterberg Limits

PL= 22
LL= 61
PI= 39

Coefficients

D_{90}= 4.7738
D_{85}= 3.2315
D_{60}= 0.4791
D_{50}= 0.2238
D_{30}=
D_{15}=
D_{10}=
C_u=
C_c=

Classification

USCS= SC
AASHTO= A-7-6(7)

Remarks

Natural Moisture Content: 16.8%

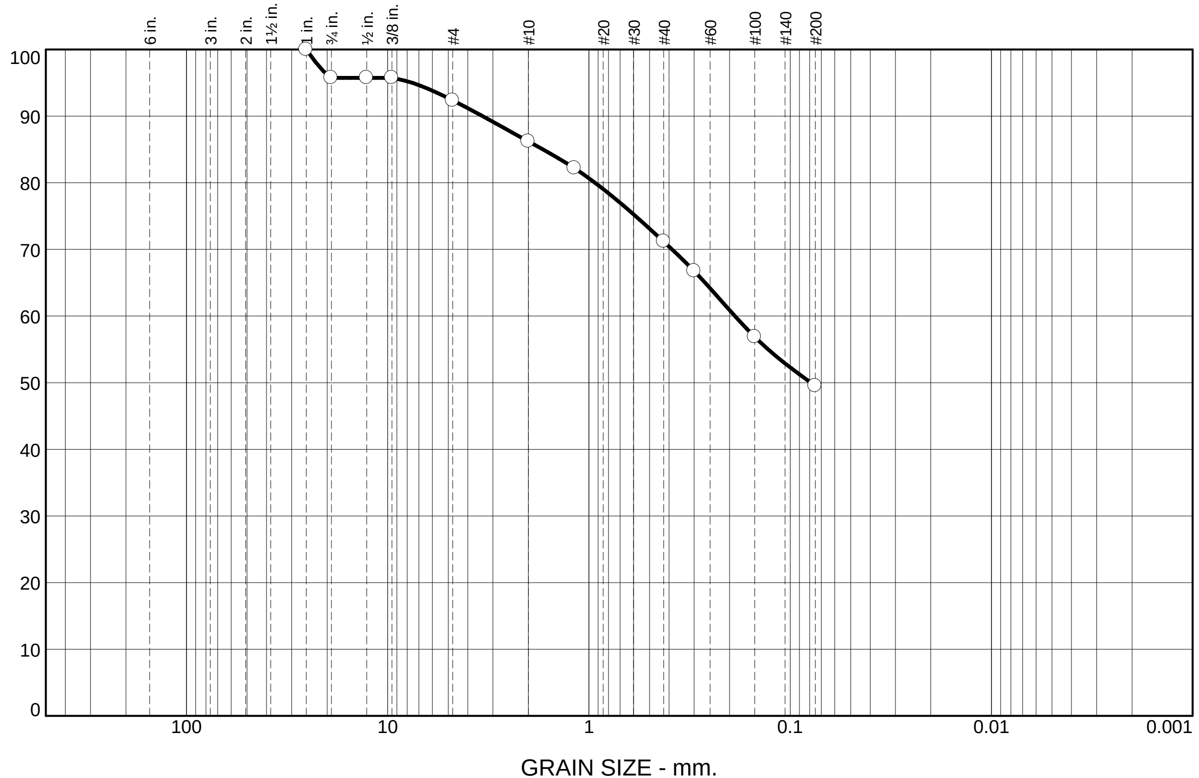
Location: BH19-31
Sample Number: 19-110-32
Depth: 5.5-6'
Date: 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000
Figure 19-110-32

Tested By: JH/CB
Checked By: JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.3	3.3	6.2	15.0	21.7	49.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	95.7		
.5	95.7		
.375	95.7		
#4	92.4		
#10	86.2		
#16	82.2		
#40	71.2		
#50	66.8		
#100	56.9		
#200	49.5		

* (no specification provided)

Material Description

Light Brown clayey sand

Atterberg Limits

PL= 21 LL= 55 PI= 34

Coefficients

D_{90}= 3.3764 D_{85}= 1.6924 D_{60}= 0.1883
D_{50}= 0.0789 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-7-6(13)

Remarks

Natural Moisture Content: 20.3%

Location: BH19-32
Sample Number: 19-110-33 **Depth:** 15-16.5' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-110-33

Tested By: JH/CB **Checked By:** JH

Appendix B2 – Natural Moisture Content Results

NewFields

NF Form #15

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

Client:	Lithium Nevada	**Location:**	See Below
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	4/24/2019
Project Engineer:	Eric Niebler	**Tested By:**	JH
Field Sample ID:	BH	**Checked By:**	JH

Drying Conditions: 60 deg C / [✓ 110 deg C] Method: [✓ Oven (O)] / Microwave (M) / Hot Plate (H)

Sample No.		19-110-01	19-110-02	19-110-03	19-110-04	19-110-05
Location		BH19-01	BH19-01	BH19-02	BH19-02	BH19-08
Depth		7.5-9'	25-26.5'	25-26.5'	45-46.5'	2.5-4'
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	A	674.9	1000.5	599	869.5	509.3
Tare + Dry Soil	B	516.2	774.8	385.5	638.9	430.3
Tare	C	22.3	22.1	22.2	22.1	22.3
Wt. of Water	D= A-B	158.7	225.7	213.5	230.6	79
Dry Soil, Ws	E= B-C	493.9	752.7	363.3	616.8	408
Moisture Content, (%)	**(D/E) x100**	**32.1%**	**30.0%**	**58.8%**	**37.4%**	**19.4%**

Sample No.		19-110-06	19-110-07	19-110-08	19-110-09	19-110-10
Location		BH19-09	BH19-11	BH19-12	BH19-15	BH19-16
Depth		2.5-4'	2.5-4'	15-16.5'	5.5-6'	2.5-4'
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	A	748.6	489.4	760.8	702.2	474.2
Tare + Dry Soil	B	681	400.1	690.5	623.5	403.7
Tare	C	22.2	22.2	22.4	22.3	22.1
Wt. of Water	D= A-B	67.6	89.3	70.3	78.7	70.5
Dry Soil, Ws	E= B-C	658.8	377.9	668.1	601.2	381.6
Moisture Content, (%)	**(D/E) x100**	**10.3%**	**23.6%**	**10.5%**	**13.1%**	**18.5%**

Remarks:

NF Form #15

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

Client:	Lithium Nevada	**Location:**	See Below
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	4/24/2019
Project Engineer:	Eric Niebler	**Tested By:**	JH
Field Sample ID:	BH	**Checked By:**	JH

Drying Conditions: 60 deg C / **110 deg C** Method: **Oven (O)** / Microwave (M) / Hot Plate (H)

Sample No.		19-110-11	19-110-12	19-110-13	19-110-14	19-110-15
Location		BH19-17	BH19-17	BH19-18	BH19-18	BH19-20
Depth		10.5-11'	20-21'	10.5-11'	20.5-21'	5-6.5'
Soil Description						
(USCS)						
Trial No.		**11**	**12**	**13**	**14**	**15**
Tare No.						
Tare + Wet Soil	**A**	685.3	1746.3	645.2	711.7	1912.4
Tare + Dry Soil	**B**	525.4	1590.1	475.8	531.9	1726.9
Tare	**C**	22	21.8	22.1	22.1	21.9
Wt. of Water	**D= A-B**	159.9	156.2	169.4	179.8	185.5
Dry Soil, Ws	**E= B-C**	503.4	1568.3	453.7	509.8	1705
Moisture Content, (%)	**(D/E) x100**	**31.8%**	**10.0%**	**37.3%**	**35.3%**	**10.9%**

Sample No.		19-110-16	19-110-17	19-110-18	19-110-19	19-110-20
Location		BH19-20	BH19-21	BH19-23	BH19-23	BH19-24
Depth		30-30.5'	2.5-4'	2.5-4'	7.5-9	2.5-4'
Soil Description						
(USCS)						
Trial No.		**16**	**17**	**18**	**19**	**20**
Tare No.						
Tare + Wet Soil	**A**	1638.1	614.4	759.7	672.9	554.5
Tare + Dry Soil	**B**	1399.6	501.7	665.5	606.7	485.2
Tare	**C**	22.2	22	22.4	22.3	22.3
Wt. of Water	**D= A-B**	238.5	112.7	94.2	66.2	69.3
Dry Soil, Ws	**E= B-C**	1377.4	479.7	643.1	584.4	462.9
Moisture Content, (%)	**(D/E) x100**	**17.3%**	**23.5%**	**14.6%**	**11.3%**	**15.0%**

Remarks:

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	Lithium Nevada	**Location:**	See Below
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	4/24/2019
Project Engineer:	Eric Niebler	**Tested By:**	JH
Field Sample ID:	BH	**Checked By:**	JH

Drying Conditions: 60 deg C / **110 deg C** Method: **Oven (O)** / Microwave (M) / Hot Plate (H)

Sample No.		19-110-21	19-110-22	19-110-23	19-110-24	19-110-25
Location		BH19-24	BH19-24	BH19-25	BH19-25	BH19-25
Depth		15-16.5'	35-36.5'	2.5-4'	7.5-9'	15-16.5'
Soil Description						
(USCS)						
Trial No.		**21**	**22**	**23**	**24**	**25**
Tare No.						
Tare + Wet Soil	A	671.9	882.8	501.5	523.1	622.6
Tare + Dry Soil	B	604.4	626.1	427	431.8	466
Tare	C	22	22	22.1	22.4	22.4
Wt. of Water	D= A-B	67.5	256.7	74.5	91.3	156.6
Dry Soil, Ws	E= B-C	582.4	604.1	404.9	409.4	443.6
Moisture Content, (%)	**(D/E) x100**	**11.6%**	**42.5%**	**18.4%**	**22.3%**	**35.3%**

Sample No.		19-110-26	19-110-27	19-110-28	19-110-29	19-110-30
Location		BH19-26	BH19-28	BH19-29	BH19-29	BH19-29
Depth		5-6'	8.5-9'	2.5-4'	7.5-9'	15-16.5'
Soil Description						
(USCS)						
Trial No.		**26**	**27**	**28**	**29**	**30**
Tare No.						
Tare + Wet Soil	A	691	751.3	708.9	631.2	924.8
Tare + Dry Soil	B	611.2	652.7	631.5	588.6	805.2
Tare	C	22.1	22.4	22.2	22.2	22
Wt. of Water	D= A-B	79.8	98.6	77.4	42.6	119.6
Dry Soil, Ws	E= B-C	589.1	630.3	609.3	566.4	783.2
Moisture Content, (%)	**(D/E) x100**	**13.5%**	**15.6%**	**12.7%**	**7.5%**	**15.3%**

Remarks:

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	Lithium Nevada	**Location:**	See Below
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	4/24/2019
Project Engineer:	Eric Niebler	**Tested By:**	JH
Field Sample ID:	BH	**Checked By:**	JH

Drying Conditions: 60 deg C / [✓ **110 deg C**] Method: [✓ **Oven (O)**] / Microwave (M) / Hot Plate (H)

Sample No.		19-110-31	19-110-32	19-110-33		
Location		BH19-29	BH19-31	BH19-32		
Depth		25-26'	5.5-6'	15-16.5'		
Soil Description						
(USCS)						
Trial No.		**31**	**32**	**33**	**4**	**5**
Tare No.						
Tare + Wet Soil	**A**	427.1	754.7	892.2		
Tare + Dry Soil	**B**	350.3	649.4	745.6		
Tare	**C**	22	21.8	22.4		
Wt. of Water	**D= A-B**	76.8	105.3	146.6		
Dry Soil, Ws	**E= B-C**	328.3	627.6	723.2		
Moisture Content, (%)	**(D/E) x100**	**23.4%**	**16.8%**	**20.3%**		

Sample No.						
Location						
Depth						
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	**A**					
Tare + Dry Soil	**B**					
Tare	**C**					
Wt. of Water	**D= A-B**					
Dry Soil, Ws	**E= B-C**					
Moisture Content, (%)	**(D/E) x100**					

Remarks:

Appendix B3 – Natural Density Results

NewFields

NATURAL DENSITY (ASTM 2937)

LABORATORY WORKSHEET

NF Form #16

Client:	Lithium Nevada	**Location:**	See Below
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	4/26/2019
Project Engineer:	Eric Niebler	**Tested By:**	JH
Field Sample ID:	BH	**Checked By:**	JH
Laboratory Sample ID:	19-110		

Drying Conditions: 60 deg C / [✓ 110 deg C] Method: [✓ Oven (O)] / Microwave (M)

Trail No.		**1**	**2**	**3**	**4**	**5**
Sample No.		19-110-09	19-110-11	19-110-13	19-110-14	19-110-26
Location		BH19-15	BH19-17	BH19-18	BH19-18	BH19-26
Depth		5.5-6'	10.5-11'	10.5-11'	20.5-21'	5-6'
Soil Description						
(USCS)						
Soil + Liner Wt., g.	**A**	914.8	912.4	855.4	930.1	898.8
Liner Wt., g.	**B**	233.9	240.6	232.0	237.6	230.0
Soil Wt., g.	**C= A-B**	680.9	671.8	623.4	692.5	668.8
Liner Length, in.	**D_1**	5.995	5.959	5.965	5.973	5.942
Sample Length, in.	**D_2**	5.995	5.959	5.965	5.973	5.942
Liner Diameter, in.	**E**	2.429	2.417	2.413	2.402	2.443
Liner Area, in^2	**F= $(D_2^2/4)$*pi**	4.63	4.59	4.57	4.53	4.69
Sample Volume, in^3	**G= D_2*F**	27.78	27.34	27.28	27.07	27.85
Sample Wet Density, pcf	**H= (C/G)*3.81**	93.4	93.6	87.1	97.5	91.5
Sample Dry Density, pcf	**H/(1+(N/100))**	82.6	71.0	63.4	72.1	80.6
Tare No.						
Tare + Wet Soil	**I**	702.2	685.3	645.2	711.7	691
Tare + Dry Soil	**J**	623.5	525.4	475.8	531.9	611.2
Tare	**K**	22.3	22	22.1	22.1	22.1
Wt. of Water	**L= I-J**	78.7	159.9	169.4	179.8	79.8
Dry Soil, Ws	**M=-J-K**	601.2	503.4	453.7	509.8	589.1
Moisture Content, (%)	**N= (L/M) x100**	13.1%	31.8%	37.3%	35.3%	13.5%

Remarks:

APPENDIX C

Borehole Exploration Logs

BH19-01

PAGE 1 OF 2

CLIENT Lithium Nevada	**PROJECT NAME** Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000	**PROJECT LOCATION** Thacker Pass, Nevada
DATE STARTED 3/28/19 **COMPLETED** 3/28/19	**GROUND ELEVATION** 4914.4 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech	**COORDINATES (WGS-84):**
DRILLING METHOD HSA	**NORTHING** 15149319 **EASTING** 1345248
LOGGED BY M. Erdmann **CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)** No free water encountered
NOTES Backfilled with cement grout	

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	0								Top Soil / Root Zone									
									(SM) silty SAND (SM), with gravel, fine to coarse grained, well graded, subangular, high plasticity fines, medium to very dense, brown, dry									
										SS SPT-01	5-11-15 (26)							
4910	5									MC CAL-01	6-9-6 (15)							
										SS SPT-02	7-19-22 (41)							
4905	10									MC CAL-02	25-33-22 (55)							
4900	15									SS SPT-03	11-22-20 (42)							
4895	20									MC CAL-03	27-40-55 (95)							
4890	25									SS SPT-04	21-22-28 (50)							
4885	30									MC CAL-04	24-37-52 (89)							
4880	35									SS SPT-05	23-20-23 (43)							
4875	40																	

(Continued Next Page)

CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	40								(SM) silty SAND (SM), with gravel, fine to coarse grained, well graded, subangular, high plasticity fines, medium to very dense, brown, dry *(continued)*	MC CAL-05	16-39-63 (102)							
4870	45								(SP) SAND (SP), poorly graded, fine grained, sub angular, very dense, brown, moist	SS SPT-06	24-44-48 (92)							
4865	50								(CL) CLAY (CL), with sand, low plasticity fines, very dense, light brown, moist	MC CAL-06	25-33-70 (103)							

Borehole terminated at 51.5'

NewFields

BH19-02

PAGE 1 OF 2

CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/26/19 **COMPLETED** 3/27/19

GROUND ELEVATION 4928.3 ft **HOLE SIZE** 4.25in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS-84):

DRILLING METHOD HSA

NORTHING 15151138 **EASTING** 1357073

LOGGED BY C. Coleman **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) 93.2

NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG					
									Surface details: Snow/Mud				TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	0								Top Soil / Root Zone									
									(SM) silty SAND (SM), with gravel, fine to coarse grained sand and gravel, sub angular, nonplastic fines, dense to very dense, light brown, dry									
4925										SS SPT-01	8-23-26 (49)							
	5									MC CAL-01	37-40-63 (103)							
									(SW-SM) SAND (SW-SM), with gravel and silt, fine to coarse sand and gravel, MPS 2.5", sub angular, nonplastic fines, dense to very dense, brown ,dry	SS SPT-02	50/5cm							
4920																		
	10									MC CAL-02	70/6cm							
4915																		
	15									SS SPT-03	13-22-26 (48)							
4910																		
	20									MC CAL-03	17-30-25 (55)							
4905																		
	25								(ML) SILT (ML), with sand, fine grained, low to high plasticity, very stiff to hard, light brown, dry	SS SPT-04	22-13-12 (25)							
4900																		
	30									MC CAL-04	12-18-27 (45)							
4895																		
	35									SS SPT-05	9-29-21 (50)							
4890																		
	40																	

(Continued Next Page)

NewFields

BH19-02
PAGE 2 OF 2

CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG					
													TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	40								(ML) SILT (ML), with sand, fine grained, low to high plasticity, very stiff to hard, light brown, dry *(continued)*	MC CAL-05	17-66-58 (124)							
4885																		
	45								(SM) silty SAND (SM), fine grained, high plasticity fines, medium to very dense, dark brown, damp, (highly weathered rock)	SS SPT-06	10-18-29 (47)							
4880																		
	50									MC CAL-06	34-25-31 (56)							
4875																		
	55									SS SPT-07	9-32-25 (57)							
4870																		
	60									MC CAL-07	30-49- 70/5cm							
4865																		
	65																	

Switched to rock core at 65'

BH19-02

CLIENT	Lithium Nevada	**PROJECT NAME**	Thcker Pass Geotechnical Investigation
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass, Nevada
DATE STARTED	3/26/19 **COMPLETED** 3/27/19	**GROUND ELEVATION**	4928.3 ft **HOLE SIZE** 4.25 in
DRILLING CONTRACTOR	HazTech	**COORDINATES (WGS84):**	
DRILLING METHOD	HQ Core	**NORTHING**	15151138 **EASTING** 1357073
LOGGED BY	C. Coleman **CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)**	93.2
NOTES	Backfilled with cement grout		

Surface details: Snow/Mud

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
4860	65 70	1	5	100	66	SW	R3		[Continuation from soil log at 65 feet] Basalt, black, moderately weathered to slightly weathered, medium strong rock, very close to close joint spacing, slightly rough joint surfaces, some oxidization and clay alteration on joint surfaces				JT		VC to C		SR	OX
4855	75	2	6	100	72	SW	R3						JT		VC to C		SR	OX
4850	80	3	5	100	90	SW	R3						JT		VC to C		SR	OX
4845	85	4	5	100	99	SW	R3						JT		VC to C		SR	OX
4840	90	5	5	100	80	SW	R3						JT		VC to C		SR	CL
4835	95	6	5	100	100	SW	R3					▼	JT		VC to C		SR	CL
4830	100	7	5	100	75	SW	R3						JT		VC to C		SR	CL
4825	105	8	5	100	75	SW	R3						JT		VC to C		SR	CL

(Continued Next Page)

CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG					
													TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	105	8	5	100	75	SW	R3		[Continuation from soil log at 65 feet] Basalt, black, moderately weathered to slightly weathered, medium strong rock, very close to close joint spacing, slightly rough joint surfaces, some oxidization and clay alteration on joint surfaces *(continued)*									
													JT		VC to C		SR	CL
4820	110	9	5	100	66	SW	R3											
													JT		VC to C		SR	CL
4815	115	10	5	100	80	SW	R3											
													JT		VC to C		SR	CL
4810	120	11	5	100	80	SW	R3											
													JT		C		SR	CL
4805	125	12	5	100	98	SW	R3											
													JT		C		SR	CL
4800	130	13	5	100	100	SW	R3											
													JT		C		SR	CL
4795	135	14	5	100	100	SW	R3											
													JT		C		SR	CL
4790	140	15	5	100	100	SW	R3											
													JT		C		SR	CL
4785	145	16	5	100	66	SW	R3		Clay Gouge 145'-150'									
													JT		C		SR	CL
4780	150	17	4	100	90	SW	R3											

Borehole terminated at 150'

NewFields

BH19-03

PAGE 1 OF 1

CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/19/19 **COMPLETED** 3/19/19
GROUND ELEVATION 4828 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS-84):
DRILLING METHOD HSA
NORTHING 15150430 **EASTING** 1359957
LOGGED BY C. Coleman **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with cement grout

Surface details: Snow/Mud

													DISCONTINUITY LOG					
ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	0							▨	Top Soil / Root Zone									
4825								▨	(SM) silty SAND (SM), with gravel, fine to coarse sand and gravel, MPS 1.5", sub angular, nonplastic fines, dense, light brown, dry	SS SPT-01	25-19-18 (37)							
	5							▨	(GW-GM) GRAVEL (GW-GM), with sand and silt, fine to coarse grained, MPS 3", sub angular, nonplastic fines, very dense, brown, dry	MC CAL-01	16-39-59 (98)							
4820								▨		SS SPT-02	23-48-33 (81)							
	10							▨		MC CAL-02	70/5cm							
4815								▨	(SW-SC) SAND (SW-SC), with gravel and clay, fine to coarse sand and gravel, MPS 1.0", sub angular, low plasticity fines, very dense, brown, dry									
	15							▨		SS SPT-03	23-36-42 (78)							
4810								▨										
	20							▨		MC CAL-04	70/5cm							

Switched to rock core at 21.5'

NewFields

BH19-03

PAGE 1 OF 1

CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/19/19 **COMPLETED** 3/19/19
GROUND ELEVATION 4828 ft **HOLE SIZE** 4.25 in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS84):
DRILLING METHOD HQ Core
NORTHING 15150430 **EASTING** 1359957
LOGGED BY C. Coleman **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with bentonite chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	20								[Continuation from soil log at 20 feet] Blocky volcanic rock, brown to black, moderately weathered, medium strong rock, very close to close joint spacing, slightly rough joint surfaces, clay alteration on joint surfaces				JT		VC to C		SR	CL
4805		1	5	100	33	MW	R3											
	25												JT		VC to C		SR	CL
4800		2	5	100	75	MW	R3											
	30												JT		VC to C		SR	CL
4795		3	5	100	92	MW	R3											
	35												JT		VC to C		SR	CL
4790		4	5	99	92	MW	R3											
	40												JT		VC to C		SR	CL
4785		5	5	100	88	MW	R3											
	45												JT		VC to C		SR	CL
4780		6	5	100	95	MW	R3											
	50																	

Borehole terminated at 50'

BH19-04

NewFields

CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/17/19 **COMPLETED** 3/18/19

GROUND ELEVATION 4725.4 ft **HOLE SIZE** 4.25in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS-84):

DRILLING METHOD HSA

NORTHING 15145149 **EASTING** 1359752

LOGGED BY M. Erdmann **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) 92.5

NOTES Backfilled with cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG					
									Surface details: Snow/Mud				TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
4725	0								Top Soil / Root Zone									
									(SM) silty SAND (SM), with gravel, fine to corase grained, sub angular, loose to dense, light brown, dry	SS SPT-01	5-5-6 (11)							
4720	5									MC CAL-01	8-18-27 (45)							
										SS SPT-02	7-8-10 (18)							
4715	10								(SM) silty SAND (SM), with gravel, well graded, fine to coarse grained, sub angular, dense to very dense, light brown, dry	MC CAL-02	16-21-22 (43)							
4710	15									SS SPT-03	20-50/6cm							
4705	20									MC CAL-03	70/5cm							

Switched to rock core at 21.5'

BH19-04

PAGE 1 OF 2

CLIENT	Lithium Nevada	**PROJECT NAME**	Thcker Pass Geotechnical Investigation
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass, Nevada
DATE STARTED	3/17/19 **COMPLETED** 3/18/19	**GROUND ELEVATION**	4725.4 ft **HOLE SIZE** 4.25 in
DRILLING CONTRACTOR	HazTech	**COORDINATES (WGS84):**	
DRILLING METHOD	HQ Core	**NORTHING**	15145149 **EASTING** 1359752
LOGGED BY	M. Erdmann **CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)**	92.5
NOTES	Backfilled with cement grout		

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
									Surface details: Snow/Mud									
4705	20	1	3.5	79	0	MW	R1		[Continuation from soil log at 20 feet] Blocky volcanic rock, moderately weathered, very weak rock, very close joint spacing, smooth joint surfaces				JT		VC		S	
4700	25	2	2	88	0	MW	R1						JT		VC		S	
		3	2	90	0	MW	R1						JT		VC		S	
4695	30	4	3	100	55	MW	R1						JT		VC		S	
4690	35	5	5	100	41	MW	R1		Basalt, black to brown, moderately weathered to slightly weathered, very weak to medium strong rock, very close to close joint spacing, slightly rough joint surfaces, clay and calcite alteration on joint surfaces				JT		VC		SR	
4685	40	6	5	100	43	MW	R1						JT		VC		SR	
4680	45	7	5	100	58	MW	R1						JT		VC		SR	
4675	50	8	5	100	49	MW	R1						JT		VC		SR	
4670	55	9	5	100	79	MW	R1						JT		VC		SR	
	60	10	5	100	65	SW	R3						JT		C		SR	CA

(Continued Next Page)

CLIENT Lithium Nevada

PROJECT NAME Thcker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
4665	60	11	5	100	87	SW	R3		Basalt, black to brown, moderately weathered to slightly weathered, very weak to medium strong rock, very close to close joint spacing, slightly rough joint surfaces, clay and calcite alteration on joint surfaces *(continued)*				JT		C		SR	CA
4660	65	12	5	100	90	SW	R3						JT		C		SR	CA
4655	70	13	5	100	83	SW	R3						JT		C		SR	CL
4650	75	14	5	100	95	SW	R3						JT		C		SR	CL
4645	80	15	5	100	85	SW	R3						JT		C		SR	CL
4640	85	16	5	100	88	SW	R2						JT		C		SR	CL
4635	90	17	5	100	90	SW	R2					▼	JT		C		SR	CL
4630	95	18	5	100	86	SW	R2						JT		C		SR	CL
4625	100																	

Borehole terminated at 100.5'

NF-GEOTECH ROCK CORE LOG - GINT STD US LAB.GDT - 9/23/19 10:29 - Y:\PROJECTS\0385.000-THACKER PASS LITHIUM NEVADA\L-GEOTECH DATA - ELKO\BOREHOLES\ROCK CORE LOGS-CC.GPJ

NewFields

BH19-05

PAGE 1 OF 1

CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/12/19 **COMPLETED** 3/13/19
GROUND ELEVATION 4798.9 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS-84):
DRILLING METHOD HSA
NORTHING 15148159 **EASTING** 1357491
LOGGED BY C. Coleman **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) 83.5
NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG: TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	0								Top Soil / Root Zone									
									(SM) silty SAND (SM), with gravel, trace cobbles, fine to corase sand and gravel, MPS 3.0" sub rounded, nonplastic fines, very dense, light brown, dry									
4795										SS SPT-01	46-41-48 (89)							
	5									MC CAL-01	31-43-43 (86)							
4790										SS SPT-02	29-32-29 (61)							
	10								(GW-GM) GRAVEL (GW-GM), with sand and silt, fine to coarse grained, MPS 3.0", sub angular, nonplastic fines, very dense, brown, dry	MC CAL-02	21-32-38 (70)							
									(SM) silty SAND (SM), with clay, fine grained, low plasticty fines, very dense, brown, dry									
4785	15									SS SPT-03	26-28-28 (56)							
4780	20									MC CAL-03	34-70/5cm							

Switched to rock core at 21.5'

NF-GEOTECH ROCK CORE LOG - GINT STD US LAB.GDT - 9/23/19 10:31 - Y:\PROJECTS\0385.000-THACKER PASS LITHIUM NEVADA\IL-GEOTECH DATA - ELKO\BOREHOLES\BOREHOLE SOIL LOGS-CC.19.08.29.GPJ

CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/12/19 **COMPLETED** 3/12/19
GROUND ELEVATION 4798.9 ft **HOLE SIZE** 4.25 in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS84):
DRILLING METHOD HQ Core
NORTHING 15148159 **EASTING** 1357491
LOGGED BY C. Coleman **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) 83.5
NOTES Backfilled with bentonite chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	20								Surface details: Snow/Mud									
									[Continuation from soil log at 20 feet] Blocky volcanic rock, highly weathered, weak rock, very close joint spacing, oxidization on joint surface				JT		VC			OX
		1	4.5	33	0	HW	R1											
4775	25												JT		VC			OX
		2	3	100	9	HW	R1											
													JT		VC			OX
4770		3	2.5	100	13	HW	R1											
	30												JT		VC			OX
		4	3.5	100	12	HW	R1											
4765													JT		VC			OX
	35																	
		5	5	100	15	HW	R1											
4760													JT		VC			OX
	40																	
		6	6.5	100	0	HW	R1											
4755																		
	45								Basalt, black, moderately weathered to slightly weathered, weak rock to medium strong rock, very close to close joint spacing, oxidization and calcite alteration on joint surface				JT		VC			OX
		7	5	100	13	MW	R2											
4750																		
	50												JT		VC			CL
		8	5	100	10	HW	R1		Broken zone, clay gouge, highly weathered, very weak, potential fault									
4745																		
	55								Basalt, black, moderately weathered to slightly weathered, weak rock to medium strong rock, very close to close joint spacing, oxidization and calcite alteration on joint surface				JT		VC			OX
		9	5	100	32	MW	R2											
4740	60																	

(Continued Next Page)

CLIENT Lithium Nevada

PROJECT NAME Thcker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
4735	60–65	10	5	100	6	MW	R2		Basalt, black, moderately weathered to slightly weathered, weak rock to medium strong rock, very close to close joint spacing, oxidization and calcite alteration on joint surface *(continued)*				JT		VC			OX
4730	65–70	11	5	100	100	SW	R3						JT		C			OX
4725	70–75	12	5	100	99	SW	R3						JT		C			OX
4720	75–80	13	5	100	99	SW	R3						JT		C			OX
4715	80–85	14	5	100	66	SW	R3					▼	JT		C			OX
4710	85–90	15	7	100	74	SW	R3						JT		C			OX
4705	95	16	4	100	31	SW	R1						JT		VC			CA
4700	100	17	4	100	73	SW	R1						JT		VC			CA

Borehole terminated at 100'

NewFields

BH19-06

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CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/14/19 **COMPLETED** 3/15/19
GROUND ELEVATION 4792.4 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS-84):
DRILLING METHOD HSA
NORTHING 15149656 **EASTING** 1358695
LOGGED BY M. Erdmann **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG					
													TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	0								Top Soil / Root Zone									
									(SM) silty SAND (SM), with gravel, well graded, fine to coarse grained, sub angular, dense to very dense, light brown, dry									
4790										SS SPT-01	13-27-50 (77)							
	5									MC CAL-01	31-31-29 (60)							
4785										SS SPT-02	20-28-18 (46)							
	10									MC CAL-02	22-44-27 (71)							
4780																		
	15									SS SPT-03	9-23- 50/2cm							
4775																		
	20									MC CAL-03	33-70/4cm							

Switched to rock core at 21.5'

NewFields

BH19-06

PAGE 1 OF 1

CLIENT Lithium Nevada

PROJECT NAME Thcker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/14/19 **COMPLETED** 3/15/19

GROUND ELEVATION 4792.4 ft **HOLE SIZE** 4.25 in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS84):

DRILLING METHOD HQ Core

NORTHING 15149656 **EASTING** 1358695

LOGGED BY M. Erdmann **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
4770		1	4	80	11	HW	R1		[Continuation from soil log at 21.5 feet] Blocky volcanic rock, brown, highly weathered, extremely weak rock, very close joint spacing, slightly rough joint surfaces, oxidization on joint surface				JT		VC		SR	OX
	25												JT		VC		SR	OX
4765		2	5	100	0	HW	R1											
	30												JT		VC		SR	OX
4760		3	5	100	0	HW	R1		Basalt, black to brown, slightly weathered, weak rock, close joint spacing, slightly rough joint surface, calcite alteration on joint surface									
	35												JT		C		SR	CA
4755		4	5	100	15	SW	R2											
	40												JT		C		SR	CA
4750		5	5	100	63	SW	R2											
	45												JT		C		SR	CA
4745		6	4.5	100	53	SW	R2											
	50																	

Borehole terminated at 50'

NF-GEOTECH ROCK CORE LOG - GINT STD US LAB.GDT - 9/23/19 10:29 - Y:\PROJECTS\0385.000-THACKER PASS LITHIUM NEVADA\L-GEOTECH DATA - ELKO\BOREHOLES\ROCK CORE LOGS-CC.GPJ

BH19-08

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NewFields

CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/19/19 **COMPLETED** 3/19/19
GROUND ELEVATION 4756.3 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS-84):
DRILLING METHOD HSA
NORTHING 15147040 **EASTING** 1357703
LOGGED BY M. Walden **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG					
													TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	0								Surface details: Snow/Mud									
4755									Top Soil / Root Zone									
									(SM) silty SAND (SM), some gravel, fine to coarse grained, well graded, sub angular, medium plasticity fines, medium dense to very dense, light brown, dry	SS SPT-01	4-8-11 (19)							
4750	5									MC CAL-01	20-38-52 (90)							
									(SM) silty SAND (SM), fine to coarse grained, well graded, sub angular, very dense, brown, dry	SS SPT-02	19-24-28 (52)							
4745	10									MC CAL-02	70/6cm							

Switched to rock core at 11.5'

BH19-08

CLIENT	Lithium Nevada	**PROJECT NAME**	Thcker Pass Geotechnical Investigation
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass, Nevada
DATE STARTED	3/3/19 **COMPLETED** 3/3/19	**GROUND ELEVATION**	4756.3 ft **HOLE SIZE** 4.25 in
DRILLING CONTRACTOR	HazTech	**COORDINATES (WGS84):**	
DRILLING METHOD	HQ Core	**NORTHING**	15147040 **EASTING** 1357703
LOGGED BY	M. Walden **CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)**	No free water encountered
NOTES	Backfilled with bentonite chips and cement grout		

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
4745	15	1	4.5	100	13	HW	R1		[Continuation from soil log at 10.5 feet] Blocky volcanic rock, fine grained, reddish brown, highly weathered, very close joint spacing, oxidization on joint surface				JT		VC			OX
4740	20	2	5	100	0	HW	R1		Basalt, grey to black, moderately to slightly weathered, very weak to medium strong rock, very close to close joint spacing, oxidization and calcite alteration on joint surfaces				JT		VC			OX
4735	25	3	6	100	0	HW	R1						JT		VC			OX
4730	30	4	4	100	0	MW	R1						JT		VC			CA
4725	35	5	5	100	0	MW	R1						JT		VC			CA
4720	40	6	5	90	0	MW	R1						JT		VC			CA
4715	45	7	5	94	49	MW	R1						JT		VC			CA
4710	50	8	5	100	54	MW	R3						JT		C			CA
													JT		C			CA

(Continued Next Page)

CLIENT Lithium Nevada

PROJECT NAME Thcker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
4705		9	5	100	48	MW	R3		Basalt, grey to black, moderately to slightly weathered, very weak to medium strong rock, very close to close joint spacing, oxidization and calcite alteration on joint surfaces *(continued)*									
		9	5	100	48	MW	R3											
	55												JT		C			CA
4700																		
		10	5	100	37	MW	R3											
	60												JT		C			CA
4695																		
		11	7	100	77	SW	R3											
	65																	
4690													JT		VC			OX
	70																	
4685		12	7.5	100	0	SW	R1											
	75												JT		C			OX
4680																		
		13	5.5	90	52	SW	R1											
	80												JT		VC			OX
4675																		
		14	5	78	0	HW	R1											
	85												JT		C			OX
4670																		
		15	5	100	38	MW	R2											
	90								Clay gouge 90'-100'									CL
4665																		
		16	5	100	53	HW												
	95																	CL
		17	5	100	38	HW												

(Continued Next Page)

CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada

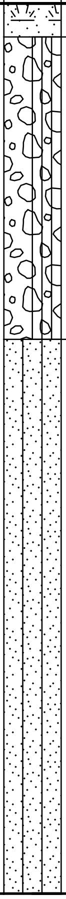
ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DISCONTINUITY LOG DIP	DISCONTINUITY LOG SPACING	DISCONTINUITY LOG APERTURE	DISCONTINUITY LOG ROUGHNESS	DISCONTINUITY LOG INFILL
4660																		
	100	17	5	100	38	HW			Clay gouge 90'-100' *(continued)*									

Borehole terminated at 100'

BH19-09

PAGE 1 OF 1

CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/6/19 **COMPLETED** 3/6/19
GROUND ELEVATION 4769.6 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS-84):
DRILLING METHOD HSA
NORTHING 15147040 **EASTING** 1357491
LOGGED BY M. Walden **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with benontie chips and cement grout



													DISCONTINUITY LOG					
ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	0								Surface details: Snow/Mud									
									Top Soil / Root Zone									
									(GP-GM) GRAVEL (GP-GM), with sand and silt, fine to coarse grained, poorly graded, sub angular to angular, nonplastic fines, very dense, light brown, dry	SS SPT-01	15-23-27 (50)							
4765	5									MC CAL-01	20-32-70 (102)							
										SS SPT-02	20-47-50 (97)							
4760	10								(SM) silty SAND (SM), some gravel, some cobbles, trace clay, fine to coarse grained, well graded, sub angular to angular, very dense, light brown, dry	MC CAL-02	70							
4755	15									SS SPT-03	32-49-50 (99)							
4750	20									MC CAL-03	70/5cm							
4745	25									SS SPT-04	50/3cm							

Switched to rock core at 26.5'

NewFields

BH19-09

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CLIENT	Lithium Nevada	**PROJECT NAME**	Thcker Pass Geotechnical Investigation
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass, Nevada
DATE STARTED	3/6/19	**COMPLETED**	3/6/19
GROUND ELEVATION	4769.6 ft	**HOLE SIZE**	4.25 in
DRILLING CONTRACTOR	HazTech	**COORDINATES (WGS84):**	
DRILLING METHOD	HQ Core	**NORTHING**	15147040
		EASTING	1357491
LOGGED BY	M. Walden	**CHECKED BY**	K. Magner
DEPTH TO WATER (FT BGS)	No free water encountered		
NOTES	Backfilled with bentonite chips and cement grout		

ELEVATION (ft)	DEPTH (ft) 25	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
4740	30	1	5	40	12	HW	R1		[Continuation from soil log at 25.5 feet] Blocky volcanic rock, red to brown, highly weathered, very weak rock, very close joint spacing, oxidization on joint surface				JT		VC			OX
4735	35	2	5	52	13	HW	R1		Basalt, grey to brown, highly weathered, very weak rock, very close joint spacing, oxidization on joint surface				JT		VC			OX

Borehole terminated at 35.5'

NewFields

BH19-10

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CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/14/19 **COMPLETED** 3/14/19

GROUND ELEVATION 4763.6 ft **HOLE SIZE** 4.25in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS-84):

DRILLING METHOD HSA

NORTHING 15147580 **EASTING** 1358013

LOGGED BY M. Erdmann **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	0								Surface details: Snow/Mud									
									Top Soil / Rot Zone									
									(SM) silty SAND (SM), with gravel, fine to coarse grained, well graded, sub angular, dense, light brown, dry									
4760										SS SPT-01	25-41-47 (88)							
	5									MC CAL-01	26-60- 70/2cm							
4755										SS SPT-02	13-30-30 (60)							
									(SM) silty SAND (SM), with gravel, fine to corase grained, well graded, sub angular, very dense, brown, dry									
	10									MC CAL-02	30-65-66 (131)							
4750																		
	15									SS SPT-03	16-44- 50/4cm							
4745																		
	20									MC CAL-03	70/4cm							
4740																		
	25									SS SPT-04	9-34-23 (57)							
4735																		
	30									MC CAL-04	16-70/1cm							
4730																		
	35																	

Borehole terminated at 35'

BH19-11

PAGE 1 OF 1

CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/11/19 **COMPLETED** 3/11/19

GROUND ELEVATION 4784.6 ft **HOLE SIZE** 4.25in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS-84):

DRILLING METHOD HSA

NORTHING 15147740 **EASTING** 1357539

LOGGED BY C. Coleman **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with cement grout

													DISCONTINUITY LOG					
ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	0								Surface details: Snow/Mud									
									Top Soil/ Root Zone									
									(SM) silty SAND (SM), some gravel, fine to corase grained, MPS 1.5", sub angular, nonplastic fines, medium dense to dense, light brown, dry									
										SS SPT-01	3-4-9 (13)							
4780	5									MC CAL-01	15-55- 70/1cm							
										SS SPT-02	50/3cm							
4775	10									MC CAL-02	70/2cm							

Switched to rock core at 11.5'

NewFields

BH19-11
PAGE 1 OF 1

CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/11/19 **COMPLETED** 3/11/19
GROUND ELEVATION 4784.6 ft **HOLE SIZE** 4.25 in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS84):
DRILLING METHOD HQ Core
NORTHING 15147740 **EASTING** 1357539
LOGGED BY C. Coleman **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG					
													TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
		1	3	100	10	HW	R3		[Continuation from soil log at 10.5 feet] Blocky volcanic rock, brown, moderately to highly weathered, medium strong rock, very close to close joint spacing, oxidization on joint surface				JT		VC			OX
													JT		VC			OX
4770	15	2	3	100	0	HW	R3											
													JT		VC			OX
		3	4	100	0	HW	R3											
4765	20																	
													JT		VC			OX
		4	4	88	31	HW	R3											
													JT		VC			OX
4760	25																	
		5	7	100	0	HW	R3											
4755	30																	
													JT		VC			OX
		6	5	100	8	HW	R3											
4750	35																	

Borehole terminated at 36'

BH19-12

PAGE 1 OF 1

CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/18/19 **COMPLETED** 3/19/19

GROUND ELEVATION 4717.5 ft **HOLE SIZE** 4.25in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS-84):

DRILLING METHOD HSA

NORTHING 15147611 **EASTING** 1357942

LOGGED BY C. Coleman **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with cuttings and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG					
													TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	0								Surface details: Snow/Mud									
									Top Soil / Root Zone									
4715									(SM) silty SAND (SM), with gravel, fine to coarse sand and gravel, MPS 1.0", sub angular, nonplastic fines, dense, light brown, dry	SS SPT-01	7-15-31 (46)							
	5								(GW-GM) GRAVEL (GW-GM), with sand and silt, fine to coarse sand and gravel, MPS 3.0", sub angular, nonplastic to high plasticitiy fines, very dense, brown, dry	MC CAL-01	30-45-48 (93)							
4710										SS SPT-02	21-27-50/4cm							
	10									MC CAL-02	43-70/5cm							
4705																		
	15									SS SPT-03	22-27-34 (61)							
4700									(CL) CLAY (CL), with sand, trace gravel, fine grained sand, fine to coarse gravel, MPS 1.5", sub angular, medium plasticity fines, hard, brown, damp									
	20									MC CAL-03	14-18-24 (42)							
4695																		
	25									SS SPT-04	28-50/4cm							
4690									(SW-SC) SAND (SW-SC), some clay and gravel, fine to coarse sand and gravel, low plasticty fines, very dense, brown, dry									
	30									MC CAL-04	68-70/3cm							

Borehole terminated at 31.5'

NewFields

BH19-13

PAGE 1 OF 1

CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/16/19 **COMPLETED** 3/16/19

GROUND ELEVATION 4740.2 ft **HOLE SIZE** 4.25in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS-84):

DRILLING METHOD HSA

NORTHING 15148367 **EASTING** 1359448

LOGGED BY M. Erdmann **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
4740	0								Surface details: Snow/Mud									
									Top Soil / Root Zone									
									(SM) silty SAND (SM), with gravel, well graded, fine to coarse grained, sub angular, very dense, brown, dry									
										SS SPT-01	12-36- 50/3cm							
4735	5									MC CAL-01	62-70/6cm							
										SS SPT-02	20-41- 50/4cm							
4730	10									MC CAL-02	59-70/5cm							
4725	15									SS SPT-03	20-30- 50/3cm							
4720	20									MC CAL-03	35-41- 70/5cm							
4715	25									SS SPT-04	12-35- 50/5cm							
4710	30									MC CAL-04	28-70/5cm							

Switched to rock core at 31.5'

NewFields

BH19-13

PAGE 1 OF 1

CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/16/19 **COMPLETED** 3/16/19
GROUND ELEVATION 4740.2 ft **HOLE SIZE** 4.25 in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS84):
DRILLING METHOD HQ Core
NORTHING 15148367 **EASTING** 1357448
LOGGED BY M. Erdmann **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
									Surface details: Snow/Mud									
4710	30	1	5	100	8	HW	R1		[Continuation from soil log at 30 feet] Basalt, black, highly to moderately weathered, very weak to medium strong rock, very close joint spacing, smooth joint surface, calcite alteration on joint surface				JT		VC		S	
4705	35	2	5	100	24	HW	R1						JT		VC		S	
4700	40	3	5	100	53	MW	R2						JT		VC		S	
4695	45	4	5	100	59	SW	R3						JT		VC		S	CA
	50								Borehole terminated at 50'									

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CLIENT Lithium Nevada		**PROJECT NAME** Thacker Pass Geotechnical Investigation	
PROJECT NUMBER 475.0385.000		**PROJECT LOCATION** Thacker Pass, Nevada	
DATE STARTED 3/25/19	**COMPLETED** 3/26/19	**GROUND ELEVATION** 4689.8 ft	**HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech		**COORDINATES (WGS-84):**	
DRILLING METHOD HSA		**NORTHING** 15147664	**EASTING** 1360891
LOGGED BY C. Coleman	**CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)** No free water encountered	

NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	0								Top Soil / Root Zone									
									(GW-GM) GRAVEL (GW-GM), with silt and sand, fine to coarse grained, MPS 4.0", sub angular, medium plasticity fines, very dense, dry, brown									
										SS SPT-01	43-50/1cm							
4685	5									MC CAL-01	56-61-56 (117)							
										SS SPT-02	16-50- 50/5cm							
4680	10									MC CAL-02	38-70/4cm							
4675	15									SS SPT-03	21-50/4cm							
4670	20									MC CAL-03	70/4cm							
									(SC) clayey SAND (SC), fine grained sand, low to medium plasticity fines, very dense, brown, moist									
4665	25									SS SPT-04	18-36-44 (80)							
4660	30									MC CAL-04	23-36-54 (90)							

Borehole terminated at 31.5'

BH19-15

PAGE 1 OF 1

CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/19/19 **COMPLETED** 3/19/19

GROUND ELEVATION 4769.9 ft **HOLE SIZE** 4.25in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS-84):

DRILLING METHOD HSA

NORTHING 15147036 **EASTING** 1357330

LOGGED BY M. Walden **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG					
													TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	0								Surface details: Snow/Mud									
									Top Soil / Root Zone									
									(SM) silty SAND (SM), some gravel, fine to coarse grained, well grade, sub angular, nonplastic fines, very dense, light brown, dry	SS SPT-01	5-32-25 (57)							
4765	5									MC CAL-01	14-25-36 (61)							
										SS SPT-02	25-43-50/3cm							
4760	10									MC CAL-02	50-70/5cm							
4755	15									SS SPT-03	43-50/4cm							

Switched to rock core at 16.5'

NewFields

BH19-15
PAGE 1 OF 1

CLIENT	Lithium Nevada	**PROJECT NAME**	Thcker Pass Geotechnical Investigation
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass, Nevada
DATE STARTED	3/3/19 **COMPLETED** 3/3/19	**GROUND ELEVATION**	4769.9 ft **HOLE SIZE** 4.25 in
DRILLING CONTRACTOR	HazTech	**COORDINATES (WGS84):**	
DRILLING METHOD	HQ Core	**NORTHING**	15147036 **EASTING** 1357330
LOGGED BY	M. Walden **CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)**	No free water encountered
NOTES	Backfilled with bentonite chips and cement grout		

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	15								Surface details: Snow/Mud									
									[Continuation from soil log at 15 feet] Basalt, dark grey, highly to moderately weathered, weak to medium strong rock, very close to close joint spacing, calcite alteration and oxidization on joint surfaces				JT		VC			CA
4750	20	1	9.5	100	16	HW to MW	R1 to R3											
4745	25												JT		VC			CA
		2	6	90	13	HW to MW	R1 to R3											
4740	30																	

Borehole terminated at 30.5'

NewFields

BH19-16

PAGE 1 OF 1

CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/5/19 **COMPLETED** 3/5/19
GROUND ELEVATION 4779.9 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS-84):
DRILLING METHOD HSA
NORTHING 15147424 **EASTING** 1357355
LOGGED BY M. Walden **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	0								Surface details: Snow/Mud									
									Top Soil / Root Zone									
									(CL) sandy lean CLAY (CL), fine grained, medium plasticity, stiff to hard, brown, dry	SS SPT-01	4-4-5 (9)							
4775	5																	
										MC CAL-01	9-26-70/5cm							
									(SM) silty SAND (SM), with gravel, fine to coarse grained, well graded, sub angular to angular, light brown, dry	SS SPT-02	33-50/2cm							
4770	10																	
										MC CAL-02	70/3cm							

Switched to rock core at 13.5'

NewFields

BH19-16

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CLIENT	Lithium Nevada	**PROJECT NAME**	Thcker Pass Geotechnical Investigation
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass, Nevada
DATE STARTED	3/5/19 **COMPLETED** 3/5/19	**GROUND ELEVATION**	4779.9 ft **HOLE SIZE** 4.25 in
DRILLING CONTRACTOR	HazTech	**COORDINATES (WGS84):**	
DRILLING METHOD	HQ Core	**NORTHING**	15147424 **EASTING** 1357355
LOGGED BY	M. Walden **CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)**	No free water encountered
NOTES	Backfilled with bentonite chips and cement grout		

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
4765	15	1	5	100	0	HW	R1		[Continuation from soil log at 13.5 feet] Blocky volcanic rock, reddish brown, highly to moderately weathered, very weak rock, very close joint spacing, oxidization on joint surfaces				JT		VC			OX
													JT		VC			OX
4760	20	2	1.5	56	0	HW	R1						JT		VC			OX
		3	5	20	0	HW	R1											
4755	25												JT		C			OX
		4	1.5	100	0	MW	R3		Basalt, grey, moderately weathered, medium strong rock, close joint spacing, oxidization on joint surface				JT		C			OX
		5	3.5	100	27	MW	R3											
4750	30																	

Borehole terminated at 30'

NewFields

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CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/2/19 **COMPLETED** 3/2/19
GROUND ELEVATION 4788.2 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS-84):
DRILLING METHOD HSA
NORTHING 15147036 **EASTING** 1357330
LOGGED BY M. Walden **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG					
													TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	0								Surface details: Snow/Mud									
									Top Soil / Root Zone									
									(SM) silty SAND (SM), some gravel, fine to coarse grained, well graded, sub angular, medium dense to dense, light brown, dry									
4785										SS SPT-01	8-12-12 (24)							
	5									MC CAL-01	6-9-13 (22)							
4780										SS SPT-02	9-12-17 (29)							
	10									MC CAL-02	9-12-13 (25)							
									(CL) sandy CLAY (CL), fine grained, high plasticity, very stiff, brown, dry									
4775																		
	15								(SM) silty SAND (SM), trace gravel and clay, fine to coarse grained, well graded, very dense, brown, dry	SS SPT-03	19-24-36 (60)							
4770																		
	20								(SP-SM) SAND (SP-SM), with silt and gravel, poorly graded, low plasticity fines, very dense, brown, dry	MC CAL-03	39-70/4cm							
4765																		
	25									SS SPT-04	49-50/3cm							
4760																		
	30									MC CAL-04	70/5cm							

Borehole terminated at 31.5'

NewFields

BH19-18

PAGE 1 OF 1

CLIENT	Lithium Nevada	**PROJECT NAME**	Thacker Pass Geotechnical Investigation
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass, Nevada
DATE STARTED	3/1/19	**COMPLETED**	3/2/19
GROUND ELEVATION	4804.6 ft	**HOLE SIZE**	4.25in
DRILLING CONTRACTOR	HazTech	**COORDINATES (WGS-84):**	
DRILLING METHOD	HSA	**NORTHING**	15147424
EASTING	1356823		
LOGGED BY	M. Walden	**CHECKED BY**	K. Magner
DEPTH TO WATER (FT BGS)	No free water encountered		
NOTES	Backfilled with cement grout		

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG					
													TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	0								Top Soil / Root Zone									
									(SM) silty SAND (SM), with gravel, trace cobbles, sub angular, MPS 2.0", nonplasitc fines, medium dense, light brown, dry									
										SS SPT-01	13-17-19 (36)							
4800	5																	
										MC CAL-01	13-19-15 (34)							
										SS SPT-02	9-10-11 (21)							
4795	10																	
									(MH) SILT (MH), with sand, fine grained, high plasticty, very stiff, brown,dry	MC CAL-02	6-16-20 (36)							
4790	15																	
									(SM) silty SAND (SM), fine to coarse grained, MPS 1.0", sub angular, nonplasitc fines, very dense, brown, dry	SS SPT-03	12-28-50 (78)							
4785	20																	
										MC CAL-03	18-38-70 (108)							
4780	25																	
										SS SPT-04	28-43-50 (93)							
4775	30																	
										MC CAL-04	70/4cm							
4770	35																	
									(SM) silty SAND (SM), with gravel, trace clay, fine to coarse grained, well graded, sub angular, brown, dry	SS SPT-05	30-36- 50/3cm							
										MC CAL-05	50/2cm							
4765	40																	

Borehole terminated at 40'

NF-GEOTECH ROCK CORE LOG - GINT STD US LAB.GDT - 9/23/19 10:32 - Y:\PROJECTS\0385.000-THACKER PASS LITHIUM NEVADA\L-GEOTECH DATA - ELKO\BOREHOLES\BOREHOLE SOIL LOGS-CC.19.08.29.GPJ

NewFields

BH19-19
PAGE 1 OF 1

CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/2/19 **COMPLETED** 3/2/19
GROUND ELEVATION 4796.9 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS-84):
DRILLING METHOD HSA
NORTHING 15147273 **EASTING** 1356938
LOGGED BY M. Walden **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG					
									Surface details: Snow/Mud				TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	0								Top Soil / Root Zone									
4795									(SM) silty SAND (SM), some gravel, fine to coarse grained, well graded, sub angular, medium dense to dense, light brown, dry	SS SPT-01	13-18-13 (31)							
	5																	
4790										MC CAL-01	18-23-24 (47)							
										SS SPT-02	7-12-13 (25)							
	10									MC CAL-02	25-42-53 (95)							
4785																		
	15									SS SPT-03	12-28-42 (70)							
4780																		
	20								(SW) SAND (SW), with gravel, some silt, fine to coarse grained, well graded, sub angular, very dense, brown, dry	MC CAL-03	70/3cm							
4775																		

Switched to rock core at 24'

NewFields

BH19-19

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CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/2/19 **COMPLETED** 3/2/19
GROUND ELEVATION 4796.9 ft **HOLE SIZE** 4.25 in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS84):
DRILLING METHOD HQ Core
NORTHING 15147273 **EASTING** 1356938
LOGGED BY M. Walden **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with bentonite chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	25	1	1.5	50	0	MW	R1		[Continuation from soil log at 24 feet] Basalt, dark grey, moderately weathered, weak to medium strong rock, very close joint spacing, calcite alteration on joint surfaces				JT		VC			CA
													JT		VC			CA
4770																		
		2	5	100	14	MW	R1											
	30																	
													JT		VC			CA
4765		3	3	100	0	MW	R3											
													JT		VC			CA
	35	4	2	100	37	MW	R3											

Borehole terminated at 35.5'

NF-GEOTECH ROCK CORE LOG - GINT STD US LAB.GDT - 9/23/19 10:29 - Y:\PROJECTS\0385.000-THACKER PASS LITHIUM NEVADA\L-GEOTECH DATA - ELKO\BOREHOLES\ROCK CORE LOGS-CC.GPJ

NewFields

CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/1/19 **COMPLETED** 3/1/19
GROUND ELEVATION 4812.6 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS-84):
DRILLING METHOD HSA
NORTHING 15147591 **EASTING** 1356709
LOGGED BY M. Walden **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	0								Surface details: Snow/Mud Top Soil / Root Zone									
4810									(SM) silty SAND (SM), with gravel, trace cobbles, fine to coarse grained, well graded, sub angular, nonplastic to medium plasticity fines, dense to very dense, light brown, dry	SS SPT-01	35-25-20 (45)							
	5									MC CAL-01	17-26-41 (67)							
4805										SS SPT-02	50							
	10									MC CAL-02	35-41-46 (87)							
4800																		
	15									SS SPT-03	18-20-23 (43)							
4795																		
	20									MC CAL-03	70/5cm							
4790																		
	25									SS SPT-04	14-17-28 (45)							
4785																		
	30									MC CAL-04	41-70/4cm							
4780																		
	35									SS SPT-05	18-50/5cm							
4775																		
	40																	

(Continued Next Page)

CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	40								(SM) silty SAND (SM), with gravel, trace cobbles, fine to coarse grained, well graded, sub angular, nonplastic to medium plasticity fines, dense to very dense, light brown, dry *(continued)*	MC CAL-05	70/2cm							
4770																		
	45									SS SPT-06	50/3cm							
4765																		
	50									MC CAL-06	50/1cm							

Borehole terminated at 51.5'

NewFields

BH19-21

PAGE 1 OF 1

CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/13/19 **COMPLETED** 3/13/19
GROUND ELEVATION 4782.6 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS-84):
DRILLING METHOD HSA
NORTHING 15147919 **EASTING** 1357756
LOGGED BY M. Erdmann **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	0								Surface details: Snow/Mud									
									Toe Soil / Root Zone									
									(SM) silty SAND (SM), with gravel, fine to coarse grained, well graded, subroudned, nonplastic fines, dense to very dense, light brown, dry									
4780										SS SPT-01	4-18-33 (51)							
	5									MC CAL-01	27-37-68 (105)							
4775										SS SPT-02	27-50/4cm							
	10									MC CAL-02	57-56- 70/5cm							
4770																		
	15									SS SPT-03	39-50/5cm							

Switched to rock core at 16.5'

NewFields

BH19-21
PAGE 1 OF 1

CLIENT	Lithium Nevada	**PROJECT NAME**	Thcker Pass Geotechnical Investigation
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass, Nevada
DATE STARTED	3/13/19	**COMPLETED**	3/13/19
GROUND ELEVATION	4782.6 ft	**HOLE SIZE**	4.25 in
DRILLING CONTRACTOR	HazTech	**COORDINATES (WGS84):**	
DRILLING METHOD	HQ Core	**NORTHING**	15147919
EASTING	1357756		
LOGGED BY	M. Erdmann	**CHECKED BY**	K. Magner
DEPTH TO WATER (FT BGS)	No free water encountered		
NOTES	Backfilled with bentonite chips and cement grout		

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	15								Surface details: Snow/Mud									
4765		1	3.5	17	0	HW	R1		[Continuation from soil log at 15 feet] Blocky volcanic rock, brown, hgihly weathered, extremely weak rock, very close joint spacing, slightly rough joint surface, oxidization on joint surface				JT		VC		SR	OX
	20	2	3	100	0	HW	R1						JT		VC		SR	OX
4760	25	3	3.5	100	0	HW	R1						JT		VC		SR	OX
4755	30	4	5	100	0	HW	R1						JT		VC		SR	OX
4750	35	5	5	67	0	HW	R1						JT		VC		SR	OX
4745	40	6	5	100	0	HW	R1						JT		VC		SR	OX

Borehole terminated at 40'

BH19-22

PAGE 1 OF 1

CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/15/19 **COMPLETED** 3/15/19
GROUND ELEVATION 4741.9 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS-84):
DRILLING METHOD HSA
NORTHING 15148106 **EASTING** 1359052
LOGGED BY M. Erdmann **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with benontie chips and cement grout

													DISCONTINUITY LOG					
ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	0								Top Soil / Root Zone									
									(SM) silty SAND (SM), well graded, fine grained, sub angular, medium dense to dense, light brown, dry									
4740																		
										SS SPT-01	13-12-11 (23)							
	5																	
										MC CAL-01	19-37-50 (87)							
4735																		
										SS SPT-02	50/5cm							
	10																	
										MC CAL-02	70/4cm							

Switched to rock core at 11.5'

BH19-22

CLIENT Lithium Nevada

PROJECT NAME Thcker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/15/19 **COMPLETED** 3/16/19

GROUND ELEVATION 4741.9 ft **HOLE SIZE** 4.25 in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS84):

DRILLING METHOD HQ Core

NORTHING 15148106 **EASTING** 1359051

LOGGED BY M. Erdmann **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with bentonite chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
4730		1	2	63	0	HW	R1		[Continuation from soil log at 11.5 feet] Blocky volcanic rock, brown, highly weathered, very weak to medium strong rock, very close joint spacing, oxidization on joint surface				JT		VC			OX
		2	2	100	25	HW	R1						JT		VC			OX
4725	15	3	5	100	0	HW	R1											
	20	4	2.5	40	0	HW	R1						JT		VC			OX
4720	25	5	4	100	0	HW	R1						JT		VC			OX
4715		6	2.5	100	0	HW	R1						JT		VC			OX
		7	1	75	0	HW	R1						JT		VC			OX
	30	8	2	62	0	HW	R1						JT		VC			OX
4710	35	9	4	43	0	HW	R1						JT		VC			OX
4705	40	10	5	81	42	HW	R1						JT		VC			OX

Borehole terminated at 40'

NewFields

BH19-23
PAGE 1 OF 1

CLIENT Lithium Nevada		**PROJECT NAME** Thacker Pass Geotechnical Investigation	
PROJECT NUMBER 475.0385.000		**PROJECT LOCATION** Thacker Pass, Nevada	
DATE STARTED 3/15/19	**COMPLETED** 3/15/19	**GROUND ELEVATION** 4766.2 ft	**HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech		**COORDINATES (WGS-84):**	
DRILLING METHOD HSA		**NORTHING** 15148506	**EASTING** 1358723
LOGGED BY M. Erdmann	**CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)** No free water encountered	

NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	0								Surface details: Snow/Mud									
									Top Soil / Root Zone									
4765									(SM) silty SAND (SM), with gravel, fine to coarse grained, well graded, sub angular, nonplastic fines, dense, light brown, dry									
										SS SPT-01	9-41-49 (90)							
	5									MC CAL-01	33-70/5cm							
4760																		
										SS SPT-02	12-20-30 (50)							
	10									MC CAL-02	70/3cm							
4755																		

Switched to rock core at 11.5'

NewFields

BH19-23

PAGE 1 OF 2

CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/15/19 **COMPLETED** 3/15/19
GROUND ELEVATION 4766.2 ft **HOLE SIZE** 4.25 in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS84):
DRILLING METHOD HQ Core
NORTHING 15148506 **EASTING** 1358723
LOGGED BY M. Erdmann **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with bentonite chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
4755	10	1	1.5	30	0	HW	R1		[Continuation from soil log at 10 feet] Blocky volcanic rock, reddish brown, highly weathered, very weak rock, very close joint spacing, smooth joint suface				JT JT		VC VC		S S	
		2	2	40	0	HW	R1						JT		VC		S	
	15	3	2	40	0	HW	R1						JT		VC		S	
4750	20	4	5	100	8	HW	R1											
4745	25	5	5	100	10	HW	R1						JT		VC		S	
4740	30	6	5	100	0	HW	R1						JT		VC		S	
4735	35	7	5	100	20	HW	R1						JT		VC		S	
4730	40	8	5	37	25	HW	R1						JT		VC		S	
4725																		
4720	45	9	5	50	0	HW	R1						JT		VC		S	
	50	10	3	100	77	MW	R3		Basalt, black, moderately weathered, medium strong rock, close joint spacing, smooth joint surface, calcite alteration on joint surface				JT		C		SR	CA

(Continued Next Page)

CLIENT Lithium Nevada

PROJECT NAME Thcker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG					
													TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	50								Basalt, black, moderately weathered, medium strong rock, close joint spacing, smooth joint surface, calcite alteration on joint surface									

Borehole terminated at 50.5'

NewFields

BH19-24
PAGE 1 OF 2

CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/25/19 **COMPLETED** 3/25/19
GROUND ELEVATION 4706.3 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS-84):
DRILLING METHOD HSA
NORTHING 15148127 **EASTING** 1360558
LOGGED BY C. Coleman **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG					
													TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	0								Surface details: Snow/Mud									
									Top Soil / Root Zone									
4705									(SM) silty SAND (SM), with gravel fine to coarse grained sand and gravel, MPS 3.0", sub angular, nonplasitc fines, medium dense to very dense, brown, dry	SS SPT-01	16-11-10 (21)							
	5									MC CAL-01	30-34-59 (93)							
4700									(GW-GM) GRAVEL (GW-GM), with sand and silt, fine to coarse grained, MPS 3.0", sub angular, nonplastic fines, very dense, brown, dry	SS SPT-02	30-50/5cm							
	10									MC CAL-02	19-41-62 (103)							
4695																		
	15								(SM) silty SAND (SM), with gravel, fine to coarse grained, well graded, nonplastic fines, very dense, brown, dry	SS SPT-03	16-33-35 (68)							
4690																		
	20									MC CAL-03	70/4cm							
4685																		
	25								(SC) clayey SAND (SC), fine to coarse sand, low to medium plasticity fines, very dense, brown, dry	SS SPT-04	17-49-50/4cm							
4680																		
	30								(SM) silty SAND (SM), fine to coarse grained, poorly graded, medium plasticity fines, very dense, brown, dry, (weathered basalt)	MC CAL-04	45-70							
4675																		
	35									SS SPT-05	16-31-46 (77)							
4670																		
	40																	

(Continued Next Page)

NF-GEOTECH ROCK CORE LOG - GINT STD US LAB.GDT - 9/23/19 10:32 - Y:\PROJECTS\0385.000-THACKER PASS LITHIUM NEVADA\IL-GEOTECH DATA - ELKO\BOREHOLES\BOREHOLE SOIL LOGS-CC.19.08.29.GPJ

NewFields

BH19-24
PAGE 2 OF 2

CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG					
													TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
4665	40									MC CAL-05	29-54-70/5cm							

Borehole terminated at 41.5'

NF-GEOTECH ROCK CORE LOG - GINT STD US LAB.GDT - 9/23/19 10:32 - Y:\PROJECTS\0385.000-THACKER PASS LITHIUM NEVADA\L-GEOTECH DATA - ELKO\BOREHOLES\BOREHOLE SOIL LOGS-CC.19.08.29.GPJ

NewFields

BH19-25

PAGE 1 OF 1

CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/20/19 **COMPLETED** 3/20/19

GROUND ELEVATION 4734.7 ft **HOLE SIZE** 4.25in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS-84):

DRILLING METHOD HSA

NORTHING 15148804 **EASTING** 1360063

LOGGED BY C. Coleman **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG					
													TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	0								Surface details: Snow/Mud									
									Top Soil / Root Zone									
									(SM) silty SAND (SM), fine to medium grained, porrly graded, subangular, nonplastic fines, medium dense to very dense, brown, dry									
										SS SPT-01	5-8-8 (16)							
4730	5									MC CAL-01	11-17-18 (35)							
										SS SPT-02	7-9-9 (18)							
4725	10									MC CAL-02	6-16-22 (38)							
4720	15									SS SPT-03	13-25-25 (50)							
4715	20									MC CAL-03	70/4cm							

Switched to rock core at 21.5'

NewFields

BH19-25

PAGE 1 OF 1

CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/20/19 **COMPLETED** 3/20/19
GROUND ELEVATION 4734.7 ft **HOLE SIZE** 4.25 in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS84):
DRILLING METHOD HQ Core
NORTHING 15148804 **EASTING** 1360063
LOGGED BY C. Coleman **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	20								[Continuation from soil log at 20 feet] Basalt, black, highly weathered, very weak rock, very close joint spacing, oxidization on joint surface				JT		VC			OX
		1	4.5	100	0	HW	R1											
4710	25												JT		VC			OX
		2	4.5	100	0	HW	R1											
4705	30												JT		VC			OX
		3	5.5	100	0	HW	R1											
4700	35												JT		VC			OX
		4	5	100	43	HW	R1											
4695	40												JT		VC			OX
		5	5	95	43	HW	R1											
4690	45												JT		VC			OX
		6	5.5	95	58	HW	R1											
4685	50																	

Borehole terminated at 50'

NewFields

BH19-26

PAGE 1 OF 1

CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/18/19 **COMPLETED** 3/19/19
GROUND ELEVATION 4715.4 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS-84):
DRILLING METHOD HSA
NORTHING 15147860 **EASTING** 1359848
LOGGED BY C. Coleman **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DISCONTINUITY LOG DIP	DISCONTINUITY LOG SPACING	DISCONTINUITY LOG APERTURE	DISCONTINUITY LOG ROUGHNESS	DISCONTINUITY LOG INFILL
4715	0								Top Soil / Root Zone									
									(SM) silty SAND (SM), with gravel, fine to medium sand, fine to coarse gravels, MPS 1.5", sub angular, nonplastic fines, medium dense to dense, lgiht brown, dry	SS SPT-01	17-20-21 (41)							
4710	5									MC CAL-01	24-18-14 (32)							
									(SW-SM) SAND (SW-SM), with gravel and silt, fine to corase grained, MPS 1.5", sub angular, nonplastic fines, dense, brown, dry	SS SPT-02	16-32-39 (71)							
4705	10									MC CAL-02	37-45- 70/4cm							
4700	15								(GW-GM) GRAVEL (GW-GM), with sand and silt, fine to corase grained, MPS 2.0", sub angular, nonplastic fines, dense, brown, dry	SS SPT-03	40-50/4cm							
4695	20									MC CAL-03	43-70/4cm							
4690	25								(SC) clayey SAND (SC), trace gravel, fine grained, low plasticity fines, dense, dark brown, dry	SS SPT-04	31-50/4cm							
4685	30									MC CAL-04	70-70/3cm							

Borehole terminated at 31.5'

NF-GEOTECH ROCK CORE LOG - GINT STD US LAB.GDT - 9/23/19 10:32 - Y:\PROJECTS\0385.000-THACKER PASS LITHIUM NEVADA\L-GEOTECH DATA - ELKO\BOREHOLES\BOREHOLE SOIL LOGS-CC.19.08.29.GPJ

BH19-27
PAGE 1 OF 1

NewFields

CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 2/26/19 **COMPLETED** 2/26/19
GROUND ELEVATION 5149.1 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS-84):
DRILLING METHOD HSA
NORTHING 15150690 **EASTING** 1346592
LOGGED BY M. Walden **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG					
													TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	0								Surface details: Snow/Mud									
									Tope Soil / Root Zone									
									(SW-SM) SAND (SW-SM), with gravel and silt, fine to coarse grained, well graded, sub angular, very dense, light brown, dry	SS SPT-01								
5145	5																	
										MC CAL-01								
5140										SS SPT-02	24-28-27 (55)							
	10																	

Switched to rock core at 10'

NewFields

BH19-27

PAGE 1 OF 1

CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 2/26/19 **COMPLETED** 2/26/19
GROUND ELEVATION 5149.1 ft **HOLE SIZE** 4.25 in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS84):
DRILLING METHOD HQ Core
NORTHING 15150690 **EASTING** 1346592
LOGGED BY M. Walden **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with bentonite chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	10								Surface details: Snow/Mud									
		1	3.5	100	23				(SM) [Continuation from soil log at 10 feet] silty SAND (SM), some clay, trace gravel, well graded, fine to coarse grained, sub angular, very dense, brown to dark grey, some oxidization of clay and ash, moderate cementation of ash layers, planar bedding, (highly weathered blocky volcanic rock)									
5135	15	2	2	90	0													
		3	5	60	0													
5130	20																	
		4	4.5	78	0													
5125	25																	
		5	4.5	80	0													
5120																		

Borehole terminated at 29.5'

NewFields

BH19-28

PAGE 1 OF 1

CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 2/26/19 **COMPLETED** 2/26/19

GROUND ELEVATION 5118.4 ft **HOLE SIZE** 4.25in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS-84):

DRILLING METHOD HSA

NORTHING 15150289 **EASTING** 1346628

LOGGED BY M. Walden **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	0								Top Soil / Root Zone									
5115									(SW-SM) SAND (SW-SM), with silt and gravel, fine to coarse grained, well graded, sub angular, medium dense, light brown, dry	SS SPT-01	9-16-13 (29)							
	5								(SC) clayey SAND (SC), with gravel, fine to coarse grained, well graded, sub angular, high plasticity fines, medium dense to very dense, brown, dry	MC CAL-01	14-22-21 (43)							
5110										SS SPT-02	16-11-9 (20)							
	10									MC CAL-02	36-70/3cm							
5105																		
	15									SS SPT-03	10-29-50/3cm							
5100																		
	20									MC CAL-03	30-70/3cm							
5095																		
	25									SS SPT-04	49-50/3cm							
5090																		
	30									MC CAL-04	36-45-70/4cm							

Borehole terminated at 31.5'

BH19-29

NewFields

CLIENT Lithium Nevada		**PROJECT NAME** Thacker Pass Geotechnical Investigation	
PROJECT NUMBER 475.0385.000		**PROJECT LOCATION** Thacker Pass, Nevada	
DATE STARTED 2/28/19	**COMPLETED** 2/28/19	**GROUND ELEVATION** 5077.9 ft	**HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech		**COORDINATES (WGS-84):**	
DRILLING METHOD HSA		**NORTHING** 15149992	**EASTING** 1346657
LOGGED BY M. Walden	**CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)** No free water encountered	

NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG					
													TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	0								Surface details: Snow/Mud									
									Top Soil / Root Zone									
5075									(SM) silty SAND (SM), with gravel, fine to coarse grained, well graded, angular to sub angular, nonplastic fines, dense to very dense, light brown, moderate cementation, dry	SS SPT-01	29-39-32 (71)							
	5									MC CAL-01	14-23-24 (47)							
5070									(SC) clayey SAND (SC), fine to coarse grained, well graded, sub angular, low to high plasticity fines, dense to very dense, light brown, dry	SS SPT-02	14-42-24 (66)							
	10									MC CAL-02	65-70							
5065																		
	15									SS SPT-03	16-16-37 (53)							
5060																		
	20									MC CAL-03	70/5cm							
5055																		
	25									SS SPT-04	10-35-26 (61)							
5050																		
	30									MC CAL-04	70/5cm							

Borehole terminated at 31.5'

NewFields

BH19-30

PAGE 1 OF 1

CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 2/28/19 **COMPLETED** 2/28/19

GROUND ELEVATION 5038.9 ft **HOLE SIZE** 4.25in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS-84):

DRILLING METHOD HSA

NORTHING 15149708 **EASTING** 1346680

LOGGED BY M. Walden **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	0								Surface details: Snow/Mud									
									Top Soil / Root Zone									
									(SM) silty SAND (SM), some gravel, fine to coarse grained, well graded, sub angular, medium dense to very dense, light brown, dry									
5035										SS SPT-01	11-11-8 (19)							
	5									MC CAL-01	70/5cm							
5030										SS SPT-02	18-26-24 (50)							
	10									MC CAL-02	26-31-36 (67)							
5025																		
	15									SS SPT-03	20-40-45 (85)							
5020																		
	20									MC CAL-03	28-38-61 (99)							
5015																		
	25									SS SPT-04	18-20-25 (45)							
5010																		
	30									MC CAL-04	15-30- 70/5cm							

Borehole terminated at 31.5'

BH19-31

CLIENT Lithium Nevada
PROJECT NAME Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 2/28/19 **COMPLETED** 2/28/19
GROUND ELEVATION 5089.1 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS-84):
DRILLING METHOD HSA
NORTHING 15149855 **EASTING** 1347766
LOGGED BY M. Walden **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free wtaer encountered
NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG					
													TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	0								Surface details: Snow/Mud									
									Top Soil / Root Zone									
									(SC) clayey SAND (SC), fine to coarse grained, well graded, sub angular, high plasticity fines, medium dense to dense, light brown, dry	SS SPT-01	4-6-9 (15)							
5085	5									MC CAL-01	16-24-60 (84)							
									(SM) silty SAND (SM), fine to coarse grained, well graded, sub rounded, dense, white chalky, dry (ASH)	SS SPT-02	18-17-19 (36)							
5080	10								(ML) sandy SILT (ML), trace gravel, fine to coarse grained, well graded, sub rounded, hard, light brown, dry	MC CAL-02	14-28-36/0cm							
5075	15									SS SPT-03	10-23-27 (50)							
5070	20									MC CAL-03	16-60-70/5cm							
5065	25									SS SPT-04	60/4cm							
5060										SS SPT-05	49-26-25 (51)							
	30									MC CAL-04	70/5cm							

Borehole terminated at 31.5'

NewFields

BH19-32

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CLIENT	Lithium Nevada	**PROJECT NAME**	Thacker Pass Geotechnical Investigation
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass, Nevada
DATE STARTED	2/28/19 **COMPLETED** 2/28/19	**GROUND ELEVATION**	5062.3 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR	HazTech	**COORDINATES (WGS-84):**	
DRILLING METHOD	HSA	**NORTHING**	15150169 **EASTING** 1348329
LOGGED BY	M. Walden **CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)**	No free water encountered
NOTES	Backfilled with benontie chips and cement grout		

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
									Surface details: Snow/Mud									
	0								Top Soil / Root Zone									
5060									(SM) silty SAND (SM), some gravel, trace cobbles, fine to coarse grained, well graded, angular to sub angular, dense to very dense, light brown, dry	SS SPT-01	6-15-28 (43)							
	5									MC CAL-01	32-64-70/5cm							
5055										SS SPT-02	38-33-37 (70)							
	10								(SC) calyey SAND (SC), fine grained, poorly graded, high plasticity fines, dense, light brown, dry	MC CAL-02	16-32-43 (75)							
5050																		
	15									SS SPT-03	6-16-20 (36)							
5045																		
	20								(SM) silty SAND (SM), fine grained, poorly graded, rounded to sub rounded, very dense, white, dry	MC CAL-03	24-70/3cm							
5040																		
	25									SS SPT-04	29-50/3cm							
5035																		
	30									MC CAL-04	70/5cm							

Borehole terminated at 31.5'

APPENDIX D

Test Pit Exploration Logs

NewFields

TP19-01

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CLIENT Lithium Nevada Corporation

PROJECT NAME Thacker Pass Project

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass

DATE STARTED 2/27/19 **COMPLETED** 2/27/19

GROUND ELEVATION 4809 ft **TOTAL PIT DEPTH** 17 ft

EXCAVATION CONTRACTOR Hunewill Construction

COORDINATES ():

EQUIPMENT CAT 320E

NORTHING 15148138 **EASTING** 1357163

LOGGED BY C.Coleman **CHECKED BY** M. Walden

DEPTH TO WATER (FT BGS) No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Surface Conditions: Mud								
			lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown (root zone)								
			silty SAND (SM) with gravel, fine to coarse grained sand and gravel, subrounded to subangular, low plasticity, dry, light brown								Cobbles and boulders present at 3ft up to 16in diameter
4805	5			GB S-01-19	12.9	NP	NP	11.5	47.6	36.2	% Cobble = 4.7
4800	10		GRAVEL (GW-GM) with sand and silt, fine to coarse grained sand and gravel, subrounded to subangular, low plasticity, dry, brown	GB S-01-20							Very hard digging at 10ft, blocky volcanic rock, large cobbles and boulders up to 20in diameter
4795	15										

Test pit terminated at 17ft, refusal on blocky volcanics, large boulders

TP19-02
PAGE 1 OF 1

CLIENT Lithium Nevada Corporation

PROJECT NAME Thacker Pass Project

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass

DATE STARTED 2/27/19 **COMPLETED** 2/27/19

GROUND ELEVATION 4789 ft **TOTAL PIT DEPTH** 15 ft

EXCAVATION CONTRACTOR Hunewill Construction

COORDINATES ():

EQUIPMENT CAT 320E

NORTHING 15148089 **EASTING** 1357687

LOGGED BY C.Coleman **CHECKED BY** M. Walden

DEPTH TO WATER (FT BGS) No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Surface Conditions: Mud	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
						LIQUID LIMIT	PLASTICITY INDEX				
	0	▨	lean CLAY (CL) with sand, fine grained, medium plasticity, moist, dark brown, (root zone)	GB S-02-17	29.4	33	12	6.5	22	71.5	
4785	5	●	GRAVEL (GW-GM) with sand and silt, fine to coarse grained sand and gravel, subrounded, nonplastic, dry, brown								Hard digging Caliche layers from 2-3ft Cobbles and boulders at 4ft up to 16in diameter
4780	10			GB S-02-18							Blocky volcanic rock with phenocrysts, extremely hard digging
4775	15										

Test pit terminated at 15ft refusal on blocky volcanics and large boulders

NewFields

TP19-03

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CLIENT Lithium Nevada Corporation

PROJECT NAME Thacker Pass Project

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass

DATE STARTED 2/27/19 **COMPLETED** 2/27/19

GROUND ELEVATION 4743 ft **TOTAL PIT DEPTH** 14 ft

EXCAVATION CONTRACTOR Hunewill Construction

COORDINATES ():

EQUIPMENT CAT 320E

NORTHING 15148047 **EASTING** 1358970

LOGGED BY C.Coleman **CHECKED BY** M. Walden

DEPTH TO WATER (FT BGS) No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
						LIQUID LIMIT	PLASTICITY INDEX				
	0		Surface Conditions: Mud								
		▨	lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown, (root zone)								
4740			silty SAND (SM) with gravel, fine to coarse grained sand and gravel, subrounded, nonplastic, dry, brown	GB S-03-27	15.9	37	8	25.4	41.4	33.2	
	5		silty GRAVEL (GM) with sand, fine to coarse grained sand and gravel, subrounded, nonplastic, dry, brown								
4735				GB S-03-28	10.8	NP	NP	47.8	36.4	13.8	Hard digging at 6ft, cobbles and boulders to 16in diameter, blocky volcanics % Cobble = 2.0
	10										
4730											

Test pit terminated at 14ft, refusal on weathered basalt

NewFields

TP19-04
PAGE 1 OF 1

CLIENT	Lithium Nevada Corporation	**PROJECT NAME**	Thacker Pass Project
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass
DATE STARTED	2/27/19	**COMPLETED**	2/27/19
GROUND ELEVATION	4726 ft	**TOTAL PIT DEPTH**	19 ft
EXCAVATION CONTRACTOR	Hunewill Construction	**COORDINATES ():**	
EQUIPMENT	CAT 320E	**NORTHING**	15148120
EASTING	1359692		
LOGGED BY	C.Coleman	**CHECKED BY**	M. Walden
DEPTH TO WATER (FT BGS)	No groundwater encountered		
NOTES	Backfilled with excavated material		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Surface Conditions: Mud	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4725	0		lean CLAY (CL) with sand, fine grained, low plasticity, moist, brown (root zone)								
			silty SAND (SM) with gravel, fine to coarse grained sand and gravel, subangular, nonplastic, dry, light brown	GB S-04-29	31.2	NP	NP	0.7	56.4	42.9	Extremely hard digging at 4ft, dense soil layer, ash
4720	5		GRAVEL (GW-GM) with sand and silt, fine to coarse grained sand and gravel, subangular, nonplastic, dry, light brown, (ash bed)	GB S-04-30	20.2	NP	NP	49.1	41.1	9.8	Cobbles and boulders up to 16in diameter at 8ft, blocky volcanics
4715	10		GRAVEL (GW-GM) with sand and silt, fine to coarse grained sand and gravel, subrounded, nonplastic, dry, brown	GB S-04-31							
4710	15										

Test pit terminated at 19ft, (Excavator limits)

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TP19-05

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CLIENT Lithium Nevada Corporation

PROJECT NAME Thacker Pass Project

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass

DATE STARTED 2/28/19 **COMPLETED** 2/28/19

GROUND ELEVATION 4734 ft **TOTAL PIT DEPTH** 15 ft

EXCAVATION CONTRACTOR Hunewill Construction

COORDINATES ():

EQUIPMENT CAT 320E

NORTHING 15148825 **EASTING** 1359965

LOGGED BY C.Coleman **CHECKED BY** M. Walden

DEPTH TO WATER (FT BGS) No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
						LIQUID LIMIT	PLASTICITY INDEX				
	0		Surface Conditions: Mud								
		▨	lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown, (root zone)								
4730	5		GRAVEL (GW-GC) with sand and silt, fine to coarse grained sand and gravel, subrounded, low plasticity, moist, brown	GB s-05-33							Cobbles and boulders up to 12in diameter
4725	10		sandy SILT (ML), fine to coarse grained sand, subrounded, low plasticity, damp, brown	GB s-05-34	23.7	41	10	1.4	31.8	66.8	Weathered basalt starting at 10ft, soft digging
4720	15										

Test pit terminated at 15ft, refusal on weathered basalt

TP19-06
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NewFields

CLIENT	Lithium Nevada Corporation	**PROJECT NAME**	Thacker Pass Project
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass
DATE STARTED	2/27/19	**COMPLETED**	2/27/19
GROUND ELEVATION	4782 ft	**TOTAL PIT DEPTH**	19 ft
EXCAVATION CONTRACTOR	Hunewill Construction	**COORDINATES ():**	
EQUIPMENT	CAT 320E	**NORTHING**	15149032
EASTING	1358718		
LOGGED BY	C.Coleman	**CHECKED BY**	M. Walden
DEPTH TO WATER (FT BGS)	No groundwater encountered		
NOTES	Backfilled with excavated material		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Surface Conditions: Mud	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
						LIQUID LIMIT	PLASTICITY INDEX				
	0		lean CLAY (CL) with sand, fine grained, medium plasticity, moist, dark brown, (root zone)								
4780			silty SAND (SM) with gravel , fine to coarse grained sand and gravel, subangular, low plasticity, dry, light brown								
	5			GB s-06-25							Hard digging at 7ft, cobbles and boulders up to 24in diameter
4775											
	10		silty GRAVEL (GM) with sand, fine to coarse grained sand and gravel, subrounded, nonplastic, dry, brown								
4770				GB s-06-26	11.2	NP	NP	42.2	33.5	17	% Cobble = 7.3
	15										
4765											

Test pit terminated at 19ft, (Excavator limits)

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NewFields

CLIENT	Lithium Nevada Corporation	**PROJECT NAME**	Thacker Pass Project
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass
DATE STARTED	2/26/19	**COMPLETED**	2/26/19
GROUND ELEVATION	4811 ft	**TOTAL PIT DEPTH**	10 ft
EXCAVATION CONTRACTOR	Hunewill Construction	**COORDINATES ():**	
EQUIPMENT	CAT 320E	**NORTHING**	15148948
		EASTING	1357817
LOGGED BY	C.Coleman	**CHECKED BY**	M. Walden
DEPTH TO WATER (FT BGS)	No groundwater encountered		
NOTES	Backfilled with excavated material		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Surface Conditions: Snowy-Mud								
4810			lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown, (root zone)								
			fat CLAY (CH) with sand, highly plastic, dry, light brown	GB S-07-13	24	55	33	4.6	18.5	71.5	% Cobbles = 5.4
4805	5		GRAVEL (GW-GM) with sand and silt, fine to coarse grained sand and gravel, subrounded, nonplastic, dry, light brown	GB S-07-14							
	10		BASALT								Hard digging at 8ft, blocky volcanic rock with phenocrysts, boulders up to 24in diameter

Test pit terminated at 10ft, refusal on basalt

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NewFields

CLIENT Lithium Nevada Corporation
PROJECT NAME Thacker Pass Project
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass
DATE STARTED 2/26/19 **COMPLETED** 2/26/19
GROUND ELEVATION 4841 ft **TOTAL PIT DEPTH** 13 ft
EXCAVATION CONTRACTOR Hunewill Construction
COORDINATES ():
EQUIPMENT CAT 320E
NORTHING 15148948 **EASTING** 1356973
LOGGED BY C.Coleman **CHECKED BY** M. Walden
DEPTH TO WATER (FT BGS) No groundwater encountered
NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Surface Conditions: Snowy-Mud	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4840	0		lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown								
			silty GRAVEL (GM), with sand, fine to coarse grained gravel, subangular, low plasticity, dry, light brown	GB S-08-15	14.8	37	9	40.5	40.4	19.1	Extremely hard digging
4835	5		GRAVEL (GP-GM) with sand and silt, fine to coarse grained sand and gravel, subrounded, nonplastic, dry, dark brown	GB S-08-16	9.8	NP	NP	44.2	40	10	Blocky vesicular volcanic rock at 6ft, boulders up to 30in diameter % Cobble = 5.8
4830	10										

Test pit terminated at 13ft, refusal on blocky volcanic rock

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CLIENT Lithium Nevada Corporation

PROJECT NAME Thacker Pass Project

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass

DATE STARTED 2/26/19 **COMPLETED** 2/26/19

GROUND ELEVATION 4870 ft **TOTAL PIT DEPTH** 15 ft

EXCAVATION CONTRACTOR Hunewill Construction

COORDINATES ():

EQUIPMENT CAT 320E

NORTHING 15149606 **EASTING** 1356846

LOGGED BY C.Coleman **CHECKED BY** M. Walden

DEPTH TO WATER (FT BGS) No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
						LIQUID LIMIT	PLASTICITY INDEX				
4870	0		Surface Conditions: Snowy-Mud								
			lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown								
			silty SAND (SM) with gravel, well graded, fine to coarse grained sand and gravel, subangular to subrounded, nonplastic, dry, light brown								Very hard digging at 2ft Caliche layer from 2-4ft
4865	5			GB s-09-09							
			silty GRAVEL (GM) with sand, trace silt, poorly graded, fine to coarse grained sand and gravel, subangular, medium plasticity, dry, brown								Cobbles and boulders up to 18in diameter at 7ft, digging through volcanic rock
4860	10			GB s-09-10	12.4	55	24	49.3	27.1	16.5	% Cobble = 7.1
4855	15										Very hard digging near the bottom of the test pit

Test pit terminated at 15ft, refusal on blocky volcanics, boulders up to 36in diameter

NewFields

TP19-10

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CLIENT Lithium Nevada Corporation

PROJECT NAME Thacker Pass Project

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass

DATE STARTED 2/27/19 **COMPLETED** 2/27/19

GROUND ELEVATION 4794 ft **TOTAL PIT DEPTH** 7 ft

EXCAVATION CONTRACTOR Hunewill Construction

COORDINATES ():

EQUIPMENT CAT 320E

NORTHING 15149653 **EASTING** 1358668

LOGGED BY C.Coleman **CHECKED BY** M. Walden

DEPTH TO WATER (FT BGS) No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Surface Conditions: Mud								
		▨	lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown								
			silty SAND (SM) with gravel, fine to coarse grained sand and gravel, subangular, nonplastic, dry, light brown								
4790	5			GB S-10-24	17.1	NP	NP	35	47.5	17.5	Dense layer from 3-7ft, cobbles up to 10in diameter Extremely hard digging
											Ash layer

Test pit terminated at 7ft, refusal on dense cemented soil

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CLIENT	Lithium Nevada Corporation	**PROJECT NAME**	Thacker Pass Project
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass
DATE STARTED	2/27/19	**COMPLETED**	2/27/19
GROUND ELEVATION	4821 ft	**TOTAL PIT DEPTH**	15 ft
EXCAVATION CONTRACTOR	Hunewill Construction	**COORDINATES ():**	
EQUIPMENT	CAT 320E		
NORTHING	15149536	**EASTING**	1358054
LOGGED BY	C.Coleman	**CHECKED BY**	M. Walden
DEPTH TO WATER (FT BGS)	No groundwater encountered		
NOTES	Backfilled with excavated material		

Surface Conditions: Mud

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4820	0		lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown, (root zone)								
			silty SAND (SM) with gravel, fine to coarse grained sand and gravel, subrounded, low plastic, dry, light brown	GB S-11-21							
4815	5		GRAVEL (GP-GM) with sand and silt, fine to coarse grained sand and gravel, subrounded, nonplastic, dry, brown								Extremely hard digging at 5ft, blocky volcanics, cobbles and boulders up to 24in diameter
	10			GB S-11-22	8.1	NP	NP	48.4	38.5	10.3	% Cobble = 2.8
4810											Cobbles up to 12in diameter
	15		SAND (SW-SM) with gravel and silt, fine to coarse grained sand and gravel, subrounded, low plasticity, dry, brown	GB S-11-23							Weathered basalt at 13ft

Test pit terminated at 15ft refusal on weathered basalt

NewFields

TP19-12

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CLIENT Lithium Nevada Corporation		**PROJECT NAME** Thacker Pass Project	
PROJECT NUMBER 475.0385.000		**PROJECT LOCATION** Thacker Pass	
DATE STARTED 2/27/19	**COMPLETED** 2/27/19	**GROUND ELEVATION** 4805 ft	**TOTAL PIT DEPTH** 17 ft
EXCAVATION CONTRACTOR Hunewill Construction		**COORDINATES ():**	
EQUIPMENT CAT 320E		**NORTHING** 15149781	**EASTING** 1359981
LOGGED BY C.Coleman	**CHECKED BY** M. Walden	**DEPTH TO WATER (FT BGS)** No groundwater encountered	
NOTES Backfilled with excavated material			

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4805	0		Surface Conditions: Mud								
			lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown								
			GRAVEL (GP-GM) with silt and sand, fine to coarse grained sand and gravel, subrounded, nonplastic, dry, light brown								Hard digging
				GB s-12-32							Cobbles and boulders at 4ft up to 24in diameter
4800	5										
											Blocky volcanics at 8ft
4795	10										
4790	15										

Test pit terminated at 17ft, refusal on blocky volcanics

TP19-13

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CLIENT	Lithium Nevada Corporation	**PROJECT NAME**	Thacker Pass Project
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass
DATE STARTED	2/27/19 **COMPLETED** 2/27/19	**GROUND ELEVATION**	4830 ft **TOTAL PIT DEPTH** 19 ft
EXCAVATION CONTRACTOR	Hunewill Construction	**COORDINATES ():**	
EQUIPMENT	CAT 320E	**NORTHING**	15150438 **EASTING** 1359953
LOGGED BY	C.Coleman **CHECKED BY** M. Walden	**DEPTH TO WATER (FT BGS)**	No groundwater encountered
NOTES	Backfilled with excavated material		

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION Surface Conditions: Mud	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4830	0	lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown								
		GRAVEL (GP-GM) with sand and silt, fine coarse grained sand and gravel, subrounded, nonplastic, dry, light brown								Blocky volcanic rock at 2ft, extremely hard digging, cobbles and boulders
			GB s-13-31	15.5	52	22	55.6	33.6	10.8	Cobbles up to 12in diameter
4825	5									
		clayey SAND (SC) with gravel, fine to coarse grained sand and gravel, subangular, medium plasticity, dry, light brown								soft digging
4820	10									
			GB s-13-32	30.9	66	34	20.3	32.3	47.4	Cobbles up to 8in diameter
4815	15									

Test pit terminated at 19ft, (Excavator limits)

NewFields

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CLIENT Lithium Nevada Corporation		**PROJECT NAME** Thacker Pass Project	
PROJECT NUMBER 475.0385.000		**PROJECT LOCATION** Thacker Pass	
DATE STARTED 2/28/19	**COMPLETED** 2/28/19	**GROUND ELEVATION** 4795 ft	**TOTAL PIT DEPTH** 19 ft
EXCAVATION CONTRACTOR Hunewill Construction		**COORDINATES ():**	
EQUIPMENT CAT 320E		**NORTHING** 15150356	**EASTING** 1358895
LOGGED BY C.Coleman	**CHECKED BY** M. Walden	**DEPTH TO WATER (FT BGS)** No groundwater encountered	
NOTES Backfilled with excavated material			

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
						LIQUID LIMIT	PLASTICITY INDEX				
4795	0		Surface Conditions: Mud								
			lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown, (root zone)								
			GRAVEL (GW-GM) with silt and sand, fine to coarse grained sand and gravel, subangular, nonplastic, dry, light brown	GB s-14-48							Cobbles up to 8in diameter
4790	5										
			GRAVEL (GW) with sand, fine to coarse grained sand and coarse gravel, subangular, nonplastic, dry, brown								
4785	10			GB s-24-49	25.7	NP	NP	60.9	35.1	4	Weathered basalt at 8ft
4780	15										

Test pit terminated at 19ft, (Excavator limits)

TP19-15

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CLIENT	Lithium Nevada Corporation	**PROJECT NAME**	Thacker Pass Project
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass
DATE STARTED	2/28/19	**COMPLETED**	2/28/19
GROUND ELEVATION	4888 ft	**TOTAL PIT DEPTH**	14 ft
EXCAVATION CONTRACTOR	Hunewill Construction	**COORDINATES ():**	
EQUIPMENT	CAT 320E	**NORTHING**	15150334
EASTING	1357707		
LOGGED BY	C.Coleman	**CHECKED BY**	M. Walden
DEPTH TO WATER (FT BGS)	No groundwater encountered		
NOTES	Backfilled with excavated material		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Surface Conditions: Mud	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown, (root zone)								
4885	5		silty GRAVEL (GM) with sand, fine to coarse grained sand and gravel, subangular, nonplastic, dry, light brown	GB s-15-41							Cobbles up to 6in diameter Blocky volcanics at 6ft, cobbles up to 8in diameter
4880 4875	10		silty SAND (SM) with gravel, fine to coarse grained sand and gravel, nonplastic, dry, brown	GB s-15-42	22.7	NP	NP	40.3	46.2	13.5	

Test pit terminated at 14ft, refusal on weathered basalt

NewFields

TP19-16

PAGE 1 OF 1

CLIENT	Lithium Nevada Corporation	**PROJECT NAME**	Thacker Pass Project
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass
DATE STARTED	2/26/19 **COMPLETED** 2/26/19	**GROUND ELEVATION**	4858 ft **TOTAL PIT DEPTH** 15 ft
EXCAVATION CONTRACTOR	Hunewill Construction	**COORDINATES ():**	
EQUIPMENT	CAT 320E	**NORTHING**	15149833 **EASTING** 1357251
LOGGED BY	C.Coleman **CHECKED BY** M. Walden	**DEPTH TO WATER (FT BGS)**	No groundwater encountered
NOTES	Backfilled with excavated material		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Surface Conditions: Snowy-Mud	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown (root zone)								
4855	5		silty SAND (SM) with gravel, well graded, fine to medium grained sand, fine to coarse gravel, subrounded, nonplastic, dry, light brown	GB s-16-11							Cobbles up to 5in diameter Very hard digging at 6ft, cobbles and boulders, blocky volcanic rock
4850	10		silty SAND (SM) with gracel, fine to coarse grained sand and gravel, low plastic, subangular, dry, brown	GB s-16-12	28.9	58	21	25.1	36.3	38.6	Cobbles and boulders up to 18in diameter
4845	15										

Test pit terminated at 15ft on blocky volcanics

NewFields

TP19-17

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CLIENT Lithium Nevada Corporation

PROJECT NAME Thacker Pass Project

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass

DATE STARTED 2/28/19 **COMPLETED** 2/28/19

GROUND ELEVATION 4930 ft **TOTAL PIT DEPTH** 19 ft

EXCAVATION CONTRACTOR Hunewill Construction

COORDINATES ():

EQUIPMENT CAT 320E

NORTHING 15150600 **EASTING** 1357532

LOGGED BY C.Coleman **CHECKED BY** M. Walden

DEPTH TO WATER (FT BGS) No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4930	0		Surface Conditions: Mud								
			lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown (root zone)								
			silty SAND (SM) some gravel, fine to medium grained sand, fine to coarse gravel, subrounded, nonplastic, dry, light brown								
4925	5			GB s-17-39	21.3	NP	NP	8.6	65.7	25.7	Increased gravel content at 6ft
4920	10										
											Weathered basalt at 12ft, cobbles up to 10in diameter
			GRAVEL (GP-GM) with sand and silt, fine to coarse grained sand and gravel, low plastic, subangular, dry, brown								
				GB s-17-40							
4915	15										

Test pit terminated at 19ft (Excavator limits)

TP19-18

PAGE 1 OF 1

NewFields

CLIENT Lithium Nevada Corporation

PROJECT NAME Thacker Pass Project

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass

DATE STARTED 2/28/19 **COMPLETED** 2/28/19

GROUND ELEVATION 4899 ft **TOTAL PIT DEPTH** 12 ft

EXCAVATION CONTRACTOR Hunewill Construction

COORDINATES ():

EQUIPMENT CAT 320E

NORTHING 15150981 **EASTING** 1357833

LOGGED BY C.Coleman **CHECKED BY** M. Walden

DEPTH TO WATER (FT BGS) No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Surface Conditions: Mud								
		▨	lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown (root zone)								
4895	5	▨	sandy silty CLAY (CL-ML), fine to coarse grained sand, low plasticity, dry, brown								
				GB s-18-43	10.9	28	7	0.2	37.2	62.6	Weathered Basalt starting at 6ft
4890	10										Hard digging at 10ft

Test pit terminated at 12ft, refusal on weathered basalt

NewFields

TP19-19

PAGE 1 OF 1

CLIENT Lithium Nevada Corporation
PROJECT NAME Thacker Pass Project
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass
DATE STARTED 2/28/19 **COMPLETED** 2/28/19
GROUND ELEVATION 4813 ft **TOTAL PIT DEPTH** 9 ft
EXCAVATION CONTRACTOR Hunewill Construction
COORDINATES ():
EQUIPMENT CAT 320E
NORTHING 15150922 **EASTING** 1358932
LOGGED BY C.Coleman **CHECKED BY** M. Walden
DEPTH TO WATER (FT BGS) No groundwater encountered
NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Surface Conditions: Mud								
			lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown (root zone)								
4810			GRAVEL (GW-GM) with sand and silt, fine to coarse grained sand and gravel, subrounded to subangular, low plasticity, dry, brown								
	5			GB s-19-46							Very hard digging at 5ft, cobbles and boulders up to 36in diameter
4805											

Test pit terminated at 9ft, refusal on cemented blocky volcanic rock

NF-GEOTECH TEST PIT - GINT STD US LAB.GDT - 7/3/19 16:13 - S:\PROJECTS\0385.000-THACKER PASS LITHIUM NEVADA\L-GEOTECH DATA\TEST PITS\THACKER PASS LOGS.GPJ

TP19-20
PAGE 1 OF 1

CLIENT	Lithium Nevada Corporation	**PROJECT NAME**	Thacker Pass Project
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass
DATE STARTED	3/1/19	**COMPLETED**	3/1/19
GROUND ELEVATION	4808 ft	**TOTAL PIT DEPTH**	19 ft
EXCAVATION CONTRACTOR	Hunewill Construction	**COORDINATES ():**	
EQUIPMENT	CAT 320E	**NORTHING**	15151075
EASTING	1360089	**DEPTH TO WATER (FT BGS)**	No groundwater encountered
LOGGED BY	C.Coleman	**CHECKED BY**	M. Walden
NOTES	Backfilled with excavated material		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Surface Conditions: Frozen Ground	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown (root zone)								
4805	5		silty SAND (SM) with gravel, fine to coarse grained sand and gravel, subangular, nonplastic, dry, light brown								Cobbles up to 6in diameter
4800	10			GB 3-20-50	22.5	NP	NP	11.7	64.5	23.8	
4795	15										
4790			SAND (SW-SC) with clay and gravel, fine to coarse grained sand and gravel, subangular, low plasticity, dry, light brown	GB s-20-51							Cobbles up to 6in diameter

Test pit terminated at 19ft, (Excavator limits)

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NewFields

TP19-21

PAGE 1 OF 1

CLIENT	Lithium Nevada Corporation	**PROJECT NAME**	Thacker Pass Project
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass
DATE STARTED	2/28/19 **COMPLETED** 2/28/19	**GROUND ELEVATION**	4926 ft **TOTAL PIT DEPTH** 13 ft
EXCAVATION CONTRACTOR	Hunewill Construction	**COORDINATES ():**	
EQUIPMENT	CAT 320E	**NORTHING**	15151169 **EASTING** 1357072
LOGGED BY	C.Coleman **CHECKED BY** M. Walden	**DEPTH TO WATER (FT BGS)**	No groundwater encountered
NOTES	Backfilled with excavated material		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Surface Conditions: Mud								
4925			lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown, (root zone)								
	5		silty SAND (SM) trace gravels, fine to coarse grained sand and gravel, subrounded, nonplastic, damp, light brown	GB s-21-37	13.1	NP	NP	1.1	55.1	43.8	
4920			GRAVEL (GP-GC) with sand, trace clay, fine to coarse grained sand and gravel, subrounded, low plasticity, dry, brown								Cobbles up to 8in diameter
4915	10			GB s-21-38							Blocky volcanics starting at 8ft, cobble and boulders, hard digging

Test pit terminated at 13ft, refusal on basalt

NewFields

TP19-22

PAGE 1 OF 1

CLIENT	Lithium Nevada Corporation	**PROJECT NAME**	Thacker Pass Project
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass
DATE STARTED	2/28/19 **COMPLETED** 2/28/19	**GROUND ELEVATION**	4887 ft **TOTAL PIT DEPTH** 17 ft
EXCAVATION CONTRACTOR	Hunewill Construction	**COORDINATES ():**	
EQUIPMENT	CAT 320E	**NORTHING**	15151484 **EASTING** 1357823
LOGGED BY	C.Coleman **CHECKED BY** M. Walden	**DEPTH TO WATER (FT BGS)**	No groundwater encountered
NOTES	Backfilled with excavated material		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Surface Conditions: Mud								
		▨	lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown (root zone)								
4885			GRAVEL (GW-GM) with sand and silt, fine to coarse grained sand and gravel, subangular, nonplastic, dry, light brown	GB s-22-44							Cobble and boulders at 4ft up to 12in diameter Lake bed at 6ft
	5										
4880			SAND (SW) with gravel, fine to coarse grained gravel, coarse sand, subangular, nonplastic, dry, brown								
	10			GB s-22-45	4.8	NP	NP	47	48.2	4.8	
4875											
	15		WEATHERED BASALT								
4870											

Test pit terminated at 17ft, refusal on weathered basalt

TP19-23

PAGE 1 OF 1

CLIENT Lithium Nevada Corporation

PROJECT NAME Thacker Pass Project

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass

DATE STARTED 2/28/19 **COMPLETED** 2/28/19

GROUND ELEVATION 4869 ft **TOTAL PIT DEPTH** 15 ft

EXCAVATION CONTRACTOR Hunewill Construction

COORDINATES ():

EQUIPMENT CAT 320E

NORTHING 15151512 **EASTING** 1358920

LOGGED BY C.Coleman **CHECKED BY** M. Walden

DEPTH TO WATER (FT BGS) No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Surface Conditions: Mud	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
						LIQUID LIMIT	PLASTICITY INDEX				
	0	▨	lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown, (root zone)								Very hard digging at 2ft on blocky volcanic rock, boulders up to 36in diameter
		⁙	SAND (SP-SM) with gravel and silt, fine to coarse grained sand and gravel, subangular, nonplastic, dry, brown								
4865	5										
				GB s-23-47	8.6	NP	NP	30.7	57.4	11.9	
4860	10										
4855	15										

Test pit terminated at 15ft, refusal on slightly weathered basalt

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TP19-24

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CLIENT Lithium Nevada Corporation

PROJECT NAME Thacker Pass Project

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass

DATE STARTED 3/1/19 **COMPLETED** 3/1/19

GROUND ELEVATION 4819 ft **TOTAL PIT DEPTH** 19 ft

EXCAVATION CONTRACTOR Hunewill Construction

COORDINATES ():

EQUIPMENT CAT 320E

NORTHING 15151498 **EASTING** 1360066

LOGGED BY C.Coleman **CHECKED BY** M. Walden

DEPTH TO WATER (FT BGS) No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
						LIQUID LIMIT	PLASTICITY INDEX				
	0		Surface Conditions: Frozen Ground								
			lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown, (root zone)								
			GRAVEL (GP-GM) with silt and sand, fine to coarse grained sand and gravel, subrounded, nonplastic, dry, light brown								Hard digging, cobbles up to 8in diameter
4815	5			GB s-24-52							
4810	10		clayey SAND (SC) trace gravel, fine to coarse grained sand and gravel, subangular, medium plasticity, dry, brown								Cobbles up to 5in diameter
4805	15			GB s-24-53	33.9	68	35	5.6	58.7	35.7	
											Weathered basalt at 17ft
4800											

Test pit terminated at 19ft (Excavator limits)

NewFields

TP19-25

PAGE 1 OF 1

CLIENT Lithium Nevada Corporation
PROJECT NAME Thacker Pass Project
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass
DATE STARTED 2/26/19 **COMPLETED** 2/26/19
GROUND ELEVATION 5002 ft **TOTAL PIT DEPTH** 19 ft
EXCAVATION CONTRACTOR Hunewill Construction
COORDINATES ():
EQUIPMENT CAT 320E
NORTHING 15148304 **EASTING** 1349394
LOGGED BY C.Coleman **CHECKED BY** M. Walden
DEPTH TO WATER (FT BGS) No groundwater encountered
NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Surface Conditions: Snowy-Mud								
			lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown, (root zone)								
5000			SAND (SP-SM) with gravel and silt, poorly graded fine to coarse grained sand and gravel, angular, nonplastic, dry, light brown	GB s-25-05							Caliche layers from 1-4ft
4995	5		GRAVEL (GP) with sand, fine to coarse grained sand and gravel, subrounded to subangular, nonplastic, dry, brown								Weathered Basalt starting at 4ft and extending to depth of pit
4990	10			GB s-25-06	8.1	NP	NP	52.9	35.7	2.9	% Cobble = 8.5
4985	15										

Test pit terminated at 19ft (Excavator limits)

TP19-26

PAGE 1 OF 1

NewFields

CLIENT Lithium Nevada Corporation	**PROJECT NAME** Thacker Pass Project
PROJECT NUMBER 475.0385.000	**PROJECT LOCATION** Thacker Pass
DATE STARTED 2/26/19 **COMPLETED** 2/26/19	**GROUND ELEVATION** 4989 ft **TOTAL PIT DEPTH** 11 ft
EXCAVATION CONTRACTOR Hunewill Construction	**COORDINATES ():**
EQUIPMENT CAT 320E	**NORTHING** 15148181 **EASTING** 1349408
LOGGED BY C.Coleman **CHECKED BY** M. Walden	**DEPTH TO WATER (FT BGS)** No groundwater encountered
NOTES Backfilled with excavated material	

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Surface Conditions: Snowy-Mud								
			lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown, (root zone)								Test pit located in NDOT gravel borrow
4985	5		silty SAND (SM) with gravel, well graded, fine to coarse grained sand and gravel, subrounded, nonplastic, damp, light brown	GB S-26-07							Potential backfill, gravel up to 2in diameter
			clayey SAND (SC) with gravel, fine to coarse grained sand and gravel, subrounded to subangular, medium plasticity, dry, light brown	GB S-26-08	20.9	53	32	15.9	55.9	28.2	Cobbles up to 6in diameter
4980	10		WEATHERED BASALT								

Test pit terminated at 11ft, refusal on basalt rock

NewFields

TP19-27
PAGE 1 OF 1

CLIENT	Lithium Nevada Corporation	**PROJECT NAME**	Thacker Pass Project
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass
DATE STARTED	2/26/19	**COMPLETED**	2/26/19
GROUND ELEVATION	4990 ft	**TOTAL PIT DEPTH**	16 ft
EXCAVATION CONTRACTOR	Hunewill Construction	**COORDINATES ():**	
EQUIPMENT	CAT 320E	**NORTHING**	15148429
		EASTING	1349841
LOGGED BY	C.Coleman	**CHECKED BY**	M. Walden
DEPTH TO WATER (FT BGS)	No groundwater encountered		
NOTES	Backfilled with excavated material		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
						LIQUID LIMIT	PLASTICITY INDEX				
4990	0		Surface Conditions: Snowy-Mud								
			lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown, (root zone)								Hard digging, caliche layer from 2-4ft, cobbles up to 12in diameter
			silty SAND (SM) with gravel, fine to coarse grained sand and gravel, subangular, nonplastic, light brown, dry	GB s-27-01	22.5	NP	NP	21.0	60.8	15.8	Caliche layer from 2-4ft
4985	5										
			GRAVEL (GP-GM) with sand and silt, fine to coarse grained sand and gravel, subrounded, low plasticity to nonplastic, dry, light brown	GB s-27-02							Cobbles up to 12in diameter
4980	10										
4975	15										

Test pit terminated at 16ft, refusal on basalt rock

% Cobble = 2.4

TP19-28

CLIENT Lithium Nevada Corporation
PROJECT NAME Thacker Pass Project
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass
DATE STARTED 2/26/19 **COMPLETED** 2/26/19
GROUND ELEVATION 4988 ft **TOTAL PIT DEPTH** 19 ft
EXCAVATION CONTRACTOR Hunewill Construction
COORDINATES ():
EQUIPMENT CAT 320E
NORTHING 15148295 **EASTING** 1349799
LOGGED BY C.Coleman **CHECKED BY** M. Walden
DEPTH TO WATER (FT BGS) No groundwater encountered
NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Surface Conditions: Snowy-Mud	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	▨	lean CLAY (CL) with sand, fine grained, poorly graded, low to medium plasticity, moist, brown, (root zone)								
4985		▨	fat CLAY (CH) with sand, fine to coarse grained sand, highly plastic, moist, brown	GB s-28-03	30.7	63	37	4.4	16.1	79.5	Hard digging Caliche layer 3-3.5ft
	5	●	GRAVEL (GW-GM) with sand, trace silt, well graded, fine to coarse grained sand and gravel, subrounded to subangular, nonplastic, dry, brown								
4980				GB s-28-04	6.6	NP	NP	50.1	43.0	5.5	% Cobble = 1.4 Cobbles and boulders increase 8" up to 30in diameter
	10										
4975											
	15										
4970											

Test pit terminated at 19ft (Excavator limits)

NewFields

TP19-29

PAGE 1 OF 1

CLIENT Lithium Nevada Corporation
PROJECT NAME Thacker Pass Project
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass
DATE STARTED 2/28/19 **COMPLETED** 2/28/19
GROUND ELEVATION 4707 ft **TOTAL PIT DEPTH** 19 ft
EXCAVATION CONTRACTOR Hunewill Construction
COORDINATES ():
EQUIPMENT CAT 320E
NORTHING 15148153 **EASTING** 1360598
LOGGED BY C.Coleman **CHECKED BY** M. Walden
DEPTH TO WATER (FT BGS) No groundwater encountered
NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0	Surface Conditions: Mud								
		lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown, (root zone)								
4705		silty SAND (SM) with gravel, fine to coarse grained sand and gravel, subrounded, nonplastic, dry, light brown								Hard digging at 3ft
	5		GB S-29-35	8.1	NP	NP	37.7	42.9	14.6	% Cobble = 4.8
4700										
	10	GRAVEL (GW-GC) with sand and trace clay, fine to coarse grained sand and gravel, subangular, low plasticity, dry, brown								
4695			GB S-29-36							
	15									
4690										Basalt encountered at bottom of test pit

Test pit terminated at 19ft (Excavator limits)

APPENDIX C
Laboratory Test Results

APPENDIX C.1

Laboratory Testing Summary

NewFields

Table C-1
Lithium Nevada Coproration
Geotechnical Investigation
Thacker Pass Project
Laboratory Test Summary

Borehole Number	Sample Depth (ft)	Sample Number	PARTICLE SIZE DISTRUBITION													USCS	MOISTURE CONTENT (%)	NATURAL DRY DENSITY (pcf)	ATTERBERG LIMITS			MOD. PROCTOR^1	
			GRAVEL						SAND						CLAY/SILT				LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX	MAX. DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)
			3.0"	2.0"	1.0"	0.75"	0.5"	0.375"	#4	#10	#16	#40	#50	#100	#200								
BH19-01	7.5-9'	19-110-01	100.0	100.0	96.2	94.7	88.3	87.4	82.6	75.9	71.3	62.6	59.3	49.6	38.4	SM	32.1		71	44	27		
BH19-01	25-26.5'	19-110-02	100.0	100.0	100.0	100.0	100.0	100.0	86.4	65.3	56.4	44.3	40.7	31.1	20.1	SM	30.0		55	30	25		
BH19-02	25-26.5'	19-110-03	100.0	100.0	100.0	100.0	100.0	100.0	95.8	90.4	87.3	82.3	80.7	74.7	61.2	MH	58.8		105	55	50		
BH19-02	45-46.5'	19-110-04	100.0	100.0	100.0	100.0	100.0	99.5	91.9	86.3	84.5	78.8	74.3	59.2	44.1	SM	37.4		80	40	40		
BH19-08	2.5-4'	19-110-05	100.0	100.0	92.2	89.7	84.6	84.6	80.1	74.2	68.5	57.7	54.7	46.7	35.2	SM	19.4		46	28	18		
BH19-09	2.5-4'	19-110-06	100.0	100.0	95.6	78.0	66.5	61.4	50.9	38.7	33.0	24.6	22.4	17.3	11.4	GP-GM	10.3		NP	NP	NP		
BH19-11	2.5-4'	19-110-07	100.0	100.0	100.0	100.0	94.2	92.6	88.7	79.6	70.6	55.3	50.7	39.7	26.8	SM	23.6		NP	NP	NP		
BH19-12	15-16.5'	19-110-08	100.0	100.0	96.7	85.9	69.8	63.0	50.3	37.0	31.5	23.2	21.1	17.3	14.5	GC	10.5		48	21	27		
BH19-15	5.5-6'	19-110-09	100.0	100.0	100.0	100.0	98.8	98.5	92.8	69.2	53.9	33.4	28.9	20.8	14.8	SM	13.1	82.6	NP	NP	NP		
BH19-16	2.5-4'	19-110-10	100.0	100.0	100.0	100.0	97.7	96.9	95.6	93.5	92.4	89.2	87.8	82.5	63.3	CL	18.5		41	24	17		
BH19-17	10.5-11'	19-110-11	100.0	100.0	100.0	100.0	98.6	97.8	95.2	90.1	86.3	78.7	75.8	68.1	58.9	CH	31.8	71.0	50	27	23		
BH19-17	20-21'	19-110-12	100.0	100.0	94.5	90.4	80.8	78.0	64.9	47.5	38.1	25.1	21.8	15.6	11.2	SP-SM	10.0		32	25	7		
BH19-18	10.5-11'	19-110-13	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.8	99.6	98.3	97.5	93.5	82.5	MH	37.3	63.4	110	55	55		
BH19-18	20.5-21'	19-110-14	100.0	100.0	97.5	97.5	97.5	97.5	96.7	89.0	82.6	64.4	56.9	38.3	23.6	SM	35.3	72.1	NP	NP	NP		
BH19-20	5-6.5'	19-110-15	100.0	100.0	74.0	65.0	59.1	56.4	48.3	38.9	33.2	24.2	22.1	17.6	13.6	GM	10.9		NP	NP	NP		
BH19-20	30-30.5'	19-110-16	100.0	100.0	100.0	97.3	88.6	84.6	70.7	53.2	45.5	35.2	32.6	27.2	21.6	SM	17.3		46	30	16		
BH19-21	2.5-4'	19-110-17	100.0	100.0	100.0	100.0	93.8	91.1	77.6	63.2	55.2	42.3	38.4	28.7	17.4	SM	23.5		NP	NP	NP		
BH19-23	2.5-4'	19-110-18	100.0	100.0	100.0	87.6	76.8	73.1	63.1	49.8	43.6	34.3	31.4	24.9	17.5	SM	14.6		NP	NP	NP		
BH19-23	7.5-9'	19-110-19	100.0	100.0	100.0	81.4	76.8	73.1	59.8	47.0	41.0	30.0	26.6	19.4	13.2	SM	11.3		NP	NP	NP		
BH19-24	2.5-4'	19-110-20	100.0	100.0	100.0	100.0	96.1	92.7	83.4	71.6	65.3	54.3	50.5	40.9	26.7	SM	15.0		NP	NP	NP		
BH19-24	15-16.5'	19-110-21	100.0	100.0	92.3	90.4	82.6	79.0	65.3	50.5	43.4	30.3	26.3	18.7	12.9	SM	11.6		NP	NP	NP		
BH19-24	35-36.5'	19-110-22	100.0	100.0	100.0	100.0	100.0	100.0	98.6	93.3	88.8	76.4	70.6	52.3	32.5	SM	42.5		60	43	17		
BH19-25	2.5-4'	19-110-23	100.0	100.0	100.0	100.0	100.0	99.3	94.9	84.3	78.4	67.3	63.4	52.5	32.7	SM	18.4		NP	NP	NP		
BH19-25	7.5-9'	19-110-24	100.0	100.0	100.0	100.0	100.0	100.0	98.6	89.7	82.4	64.3	57.0	38.7	24.5	SM	22.3		NP	NP	NP		
BH19-25	15-16.5'	19-110-25	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	86.5	71.2	40.9	21.8	SM	35.3		NP	NP	NP		

Table C-1
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Borehole Number	Sample Depth (ft)	Sample Number	PARTICLE SIZE DISTRUBUTION													USCS	MOISTURE CONTENT (%)	NATURAL DRY DENSITY (pcf)	ATTERBERG LIMITS			MOD. PROCTOR^1	
			GRAVEL						SAND						CLAY/SILT				LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX	MAX. DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)
			3.0"	2.0"	1.0"	0.75"	0.5"	0.375"	#4	#10	#16	#40	#50	#100	#200								
BH19-26	5-6'	19-110-26	100.0	100.0	86.6	83.2	81.2	78.6	71.7	57.3	49.0	35.6	31.7	23.7	17.1	SM	13.5	80.6	NP	NP	NP		
BH19-28	8.5-9'	19-110-27	100.0	100.0	100.0	97.9	94.0	93.0	83.9	73.7	68.8	58.1	52.1	46.8	40.9	SC	15.6		37	16	21		
BH19-29	2.5-4'	19-110-28	100.0	100.0	94.1	90.8	80.4	78.1	68.5	57.4	51.9	41.4	37.5	28.2	19.2	SM	12.7		NP	NP	NP		
BH19-29	7.5-9'	19-110-29	100.0	100.0	89.3	83.1	78.0	76.1	66.0	53.2	47.0	37.1	33.8	26.9	21.5	SC	7.5		31	21	10		
BH19-29	15-16.5'	19-110-30	100.0	100.0	100.0	97.1	94.1	93.1	81.6	65.3	58.6	50.7	48.5	43.5	38.8	SC	15.3		47	19	28		
BH19-29	25-26'	19-110-31	100.0	100.0	100.0	100.0	100.0	100.0	98.9	91.5	87.8	75.0	68.5	54.6	44.8	SC	23.4		62	25	37		
BH19-31	5.5-6'	19-110-32	100.0	100.0	100.0	97.1	97.1	97.1	89.9	79.1	72.3	58.4	53.9	44.9	37.3	SC	16.8		61	22	39		
BH19-32	15-16.5'	19-110-33	100.0	100.0	100.0	95.7	95.7	95.7	92.4	86.2	82.2	71.2	66.8	56.9	49.5	SC	20.3		55	21	34		
BH19-33	2.5-3'	20-020-01	100.0	100.0	62.8	62.8	56.9	53.1	45.6	34.2	28.5	21.6	19.5	15.0	9.2	GW-GM	10.2		NP	NP	NP		
BH19-33	7.5-8.5'	20-020-02	100.0	100.0	100.0	100.0	93.1	90.0	77.0	64.9	57.5	44.9	40.9	31.5	21.9	SM	21.1		NP	NP	NP		
BH19-33	25-25.5'	20-020-04	100.0	100.0	100.0	100.0	100.0	100.0	100.0	95.7	92.0	86.5	83.9	70.1	40.2	SM	52.4		NP	NP	NP		
BH19-34	2.5-3'	20-020-05	100.0	100.0	100.0	100.0	100.0	98.2	97.3	95.5	91.2	83.2	80.4	71.3	54.0	ML	9.7		NP	NP	NP		
BH19-34	10-11.5'	20-020-07	100.0	100.0	100.0	97.3	87.2	81.3	69.6	57.9	52.8	45.3	43.3	40.0	33.7	SC	14.2		48	24	24		
BH19-35	7.5-8.5'	20-020-09	100.0	100.0	91.9	80.2	73.6	68.6	55.7	46.2	43.0	38.9	37.6	34.0	26.3	GM	12.4		47	35	12		
BH19-35	15-16'	20-020-11	100.0	100.0	84.6	84.6	78.7	75.9	63.1	49.9	44.8	39.0	37.7	34.8	30.0	GM	13.5		59	34	25		
BH19-35	35-35.5'	20-020-12	100.0	100.0	100.0	100.0	99.7	95.5	77.1	64.1	51.6	32.8	28.0	19.8	14.0	SM	76.2		NP	NP	NP		
BH19-36	5-6.5'	20-020-14	100.0	100.0	100.0	100.0	100.0	99.4	90.9	81.5	74.9	57.9	51.3	37.6	25.6	SM	19.5		NP	NP	NP		
BH19-36	10-11.3'	20-020-16	100.0	100.0	100.0	89.8	79.8	72.4	57.2	45.5	40.2	32.0	29.7	25.6	22.1	GM	10.4		47	29	18		
BH19-36	35-36.5'	20-020-17	100.0	100.0	100.0	90.0	80.8	72.3	57.1	42.1	34.6	23.5	21.1	17.5	15.0	GC	13.1		48	21	27		
BH19-37	2.5-3'	20-020-18	100.0	100.0	100.0	100.0	97.3	96.4	91.6	81.8	68.6	44.6	38.4	26.8	17.2	SM	24.5		NP	NP	NP		
BH19-37	7.5-8'	20-020-19	100.0	100.0	62.3	50.7	40.7	36.8	27.8	20.5	17.8	12.6	10.4	6.6	4.0	GP	5.4		NP	NP	NP		
TP19-01	4-7'	19-060-01	95.3	95.3	89.5	88.5	87.2	86.7	83.8	77.8	73.2	64.1	60.9	51.9	36.2	SM	12.9		NP	NP	NP		
TP19-02	0-2'	19-060-02	100.0	100.0	96.6	96.1	95.1	94.3	93.5	91.7	90.6	89.1	88.4	84.8	71.5	CL	29.4		33	21	12	104.3	19.4
TP19-03	2-4'	19-106-02	100.0	97.9	90.7	87.3	82.9	80.2	74.6	68.2	61.8	53.0	50.1	43.0	33.2	SM	15.9		37	29	8		
TP19-03	6-9'	19-060-03	98.0	95.5	78.4	71.5	63.6	59.0	50.2	37.3	31.6	23.7	21.6	17.8	13.8	GM	10.8		NP	NP	NP		

Table C-1
Lithium Nevada Coproration
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Laboratory Test Summary

Borehole Number	Sample Depth (ft)	Sample Number	PARTICLE SIZE DISTRUBUTION													USCS	MOISTURE CONTENT (%)	NATURAL DRY DENSITY (pcf)	ATTERBERG LIMITS			MOD. PROCTOR[1]	
			GRAVEL						SAND						CLAY/SILT				LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX	MAX. DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)
			3.0"	2.0"	1.0"	0.75"	0.5"	0.375"	#4	#10	#16	#40	#50	#100	#200								
TP19-04	2-4'	19-106-03	100.0	100.0	100.0	100.0	99.8	99.6	99.3	98.3	93.9	78.0	71.7	57.6	42.9	SM	31.2		47	46	1	78.4	33.8
TP19-04	5-7'	19-060-04	100.0	96.8	84.0	77.5	67.0	59.9	50.9	36.3	31.0	23.7	21.0	15.3	9.8	GW-GM	20.2		NP	NP	NP		
TP19-05	8-10'	19-060-05	100.0	100.0	100.0	100.0	99.7	99.4	98.6	94.3	91.5	87.5	85.6	81.2	66.8	ML	23.7		41	31	10		
TP19-06	11-13'	19-060-06	92.7	87.3	71.8	66.5	60.3	57.2	50.5	43.2	38.8	30.6	28.1	22.9	17.0	GM	11.2		NP	NP	NP		
TP19-07	2-4'	19-106-04	94.6	94.6	92.8	91.9	90.9	90.5	90.0	88.6	87.9	86.7	86.2	83.6	71.5	CH	24.0		55	22	33		
TP19-08	2-4'	19-106-05	100.0	96.8	86.4	81.5	74.1	68.7	59.5	46.2	40.4	33.3	31.3	26.3	19.1	GM	14.8		37	28	9		
TP19-08	6-9'	19-060-07	94.2	87.3	75.1	70.4	63.1	58.6	50.0	38.8	32.7	22.2	19.2	14.3	10.0	GP-GM	9.8		NP	NP	NP		
TP19-09	8-12'	19-060-08	92.9	81.1	65.1	59.9	53.5	49.5	43.6	35.2	31.0	24.8	23.1	20.0	16.5	GM	12.4		55	31	24		
TP19-10	3-6'	19-106-06	100.0	93.0	86.6	82.4	76.0	71.7	65.0	52.5	45.6	35.1	32.1	25.3	17.5	SM	17.1		NP	NP	NP		
TP19-11	7-11'	19-060-09	97.2	87.5	75.2	70.8	63.3	59.0	48.8	34.8	27.8	19.7	18.1	15.3	10.3	GP-GM	8.1		NP	NP	NP		
TP19-13	3-5'	19-106-07	100.0	85.3	71.7	64.8	56.4	50.9	44.4	35.0	29.5	21.4	19.7	15.6	10.8	GP-GM	15.4		52	30	22		
TP19-13	10-13'	19-060-10	100.0	99.0	91.7	89.5	86.8	85.2	79.7	74.3	71.5	66.7	64.6	57.4	47.4	SC	30.9		66	32	34		
TP19-14	8-11'	19-060-11	100.0	95.6	71.8	59.5	47.8	42.1	39.1	29.4	24.4	16.2	13.6	7.8	4.0	GW	25.7		NP	NP	NP		
TP19-15	8-11'	19-060-12	100.0	100.0	80.0	73.7	64.7	60.0	59.7	57.4	54.9	47.3	42.8	26.6	13.5	SM	22.7		NP	NP	NP		
TP19-16	7-10'	19-060-13	100.0	94.5	86.3	84.5	82.5	81.1	74.9	69.1	66.1	59.0	56.0	49.1	38.6	SM	28.9		58	37	21		
TP19-17	4-7'	19-060-14	100.0	100.0	98.2	96.6	93.9	92.4	91.4	87.9	84.8	75.6	69.2	47.2	25.7	SM	21.3		NP	NP	NP		
TP19-18	5-8'	19-060-15	100.0	100.0	100.0	100.0	99.9	99.9	99.8	99.8	97.8	90.1	87.7	81.7	62.6	CL-ML	10.9		28	21	7		
TP19-20	6-10'	19-060-16	100.0	98.4	97.5	96.7	96.0	95.6	88.3	74.0	64.1	48.2	43.8	34.3	23.8	SM	22.5		NP	NP	NP		
TP19-21	3-5'	19-060-17	100.0	100.0	99.8	99.8	99.5	99.3	98.9	97.9	95.3	86.3	83.7	74.8	43.8	SM	13.1		NP	NP	NP		
TP19-22	8-11'	19-060-18	100.0	99.3	92.1	87.4	78.2	71.4	53.0	31.8	22.4	13.4	11.4	7.8	4.8	SW	4.8		NP	NP	NP		
TP19-23	5-9'	19-060-19	100.0	98.0	91.8	88.2	82.7	79.0	69.3	55.5	46.3	32.6	29.0	20.5	11.9	SP-SM	8.6		NP	NP	NP		
TP19-24	14-17'	19-060-20	100.0	100.0	99.2	98.3	98.0	97.4	94.4	87.7	82.3	69.5	64.3	51.3	35.7	SC	33.9		68	33	35		
TP19-25	7-12'	19-060-21	91.5	84.5	70.0	62.7	52.6	47.2	38.6	23.9	17.0	9.3	7.5	4.6	2.9	GP	8.1		NP	NP	NP		
TP19-26	6-8'	19-060-22	100.0	100.0	99.8	99.6	97.6	95.4	84.1	60.9	52.1	42.5	39.8	33.8	28.2	SC	20.9		53	21	32		
TP19-27	3-5'	19-060-23	97.6	97.6	93.5	91.6	88.8	87.1	76.6	55.0	44.3	30.9	27.7	21.7	15.8	SM	22.5		NP	NP	NP		

NewFields

Table C-1
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Laboratory Test Summary

Borehole Number	Sample Depth (ft)	Sample Number	PARTICLE SIZE DISTRUBITION													USCS	MOISTURE CONTENT (%)	NATURAL DRY DENSITY (pcf)	ATTERBERG LIMITS			MOD. PROCTOR[1]	
			GRAVEL						SAND						CLAY/SILT				LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX	MAX. DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)
			3.0"	2.0"	1.0"	0.75"	0.5"	0.375"	#4	#10	#16	#40	#50	#100	#200								
TP19-28	1-3'	19-106-08	100.0	100.0	97.1	96.8	96.4	96.0	95.6	94.2	93.4	92.1	91.7	89.2	79.5	CH	30.7		63	26	37		
TP19-28	5-9'	19-060-24	98.6	92.8	75.2	70.0	62.9	57.5	48.5	33.4	25.1	15.2	13.1	9.6	5.5	GW-GM	6.6		NP	NP	NP		
TP19-29	4-7'	19-060-25	95.2	90.6	77.5	73.7	67.6	63.9	57.5	47.1	41.0	30.8	27.7	21.5	14.6	SM	8.1		NP	NP	NP		
TP19-30	8"-9'	20-019-01	100.0	100.0	94.9	92.1	86.0	82.4	73.4	56.0	47.2	35.6	32.2	24.3	15.3	SM	21.5		NP	NP	NP		
TP19-31	8"-10'	20-019-02	100.0	100.0	100.0	100.0	99.8	99.7	95.9	89.3	86.6	83.4	82.0	73.8	44.8	SM	11.0		NP	NP	NP		
TP19-32	6"-5'	20-019-03	100.0	100.0	100.0	99.9	99.8	99.8	99.2	96.0	91.1	83.6	81.8	78.4	60.8	ML	12.6		NP	NP	NP	101.9	21.1
TP19-33	3-15'	20-019-04	100.0	89.7	72.0	69.4	63.7	61.3	53.0	44.0	40.5	36.0	35.1	32.5	24.2	GC	15.2		48	23	25		
TP19-34	5-11'	20-019-05	86.3	84.2	66.6	62.7	56.6	47.8	41.9	33.5	30.3	26.2	25.3	23.5	18.1	GC	6.4		46	19	27	124..2	9
TP19-35	8"-8'	20-019-06	100.0	82.7	65.1	60.2	53.9	50.9	44.5	38.2	35.1	30.9	30.1	28.5	22.7	GC	6.9		30	20	10	134.8	8
TP19-36	6-9'	20-019-07	69.2	63.4	63.4	61.7	58.2	57.2	54.4	50.3	48.2	44.4	43.0	38.8	30.2	SM	15.6		NP	NP	NP		
TP19-37	5-14'	20-019-08	96.5	92.6	85.8	83.2	79.9	77.8	69.7	56.1	48.7	36.8	34.2	30.5	25.6	SC	10.2		56	26	30		
TP19-39	8"-5'	20-019-09	100.0	94.8	86.5	83.3	79.2	76.8	65.5	51.2	45.7	37.8	35.0	27.7	18.3	SM	15.5		NP	NP	NP		
TP19-40	1.5-4'	20-019-10	100.0	89.6	71.7	66.0	60.0	56.9	52.1	44.7	40.6	34.4	32.9	29.9	25.1	GC	17.7		45	21	24		
TP19-44	6"-11'	20-019-11	100.0	83.9	70.5	65.4	59.1	55.5	47.6	35.1	28.5	18.9	16.5	12.3	8.4	GW-GM	9.2		NP	NP	NP	112.6	11
TP19-46	4-8'	20-019-12	100.0	95.1	76.7	71.7	65.0	61.8	55.5	48.0	44.5	37.6	34.7	27.6	18.9	GM	14.6		38	29	9	109.9	14.5
TP19-47	8"-3'	20-019-13	100.0	80.3	71.8	68.1	58.7	55.2	45.8	36.7	33.7	29.1	27.1	21.5	14.9	GM	13.1		NP	NP	NP		
TP19-48	6"-5'	20-019-14	100.0	100.0	98.9	96.0	94.9	93.6	91.3	87.7	85.7	81.3	79.2	72.3	56.8	CL	20.5		34	21	13		
TP19-49	8"-4'	20-019-15	76.7	61.2	53.0	49.9	44.2	41.4	34.2	26.2	21.8	15.3	13.6	10.2	6.2	GW-GM	9.9		NP	NP	NP		

[1] Oversize Correction Applied

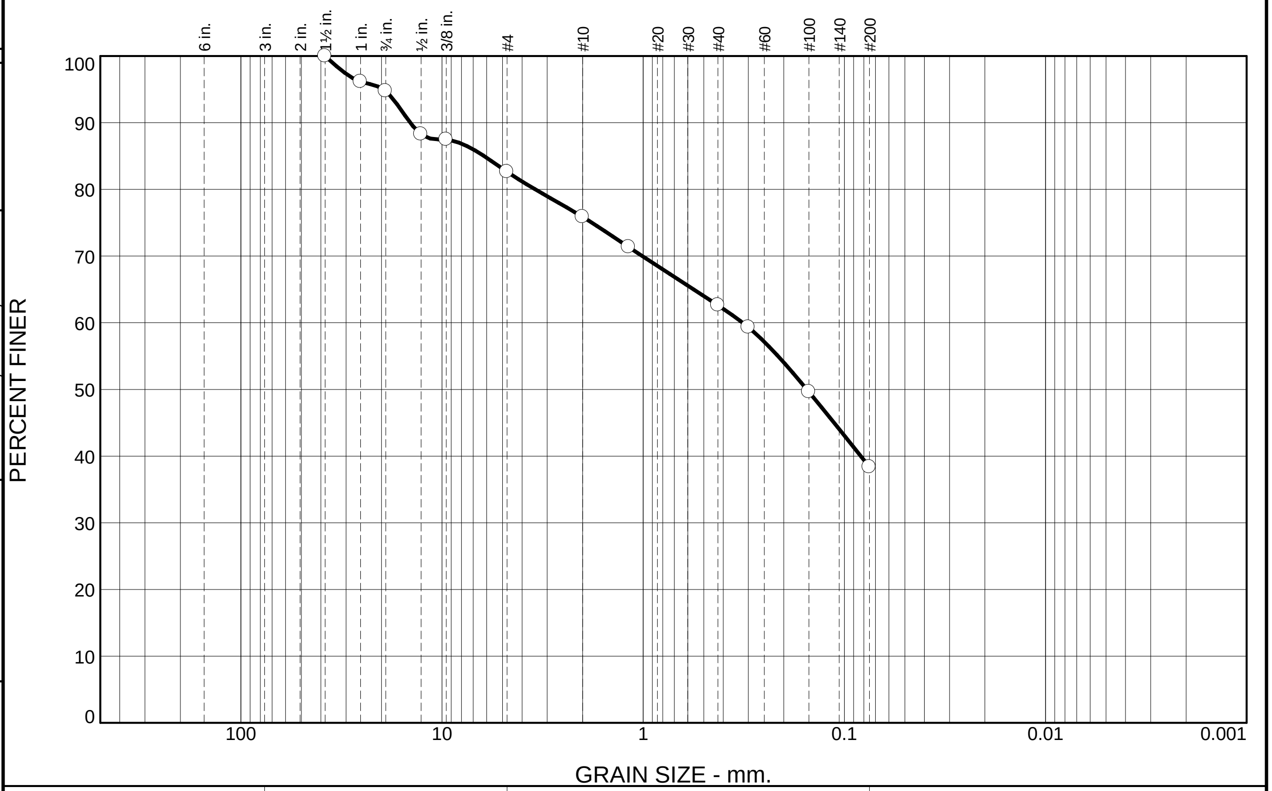
Table C-2
Lithium Nevada Coproration
Geotechnical Investigation
Thacker Pass Project
Laboratory Test Summary

MATERIAL	SAMPLE NUMBER	AS-RECEVIED MOISTURE CONTENT (%)	AS-RECEVIED DRY DENSITY (pcf)	ATTERBERG LIMITS			MOD. PROCTOR		APPARENT SPECIFIC GRAVITY	STRENGTH TESTING REMOLDING PROPERTIES		CU TRIAXIAL TESTING				UU TRIAXIAL TESTING	DIRECT SHEAR TESTING			
												EFFECTIVE STRESS		TOTAL STRESS			TOTAL PEAK STRESS		TOTAL RESIDUAL STRESS	
				LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX	MAX. DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)		MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FRICTION ANGLE (degrees)	COHESION (psf)	FRICTION ANGLE (degrees)	COHESION (psf)	UNDRAINED SHEAR STRENGTH (psf)	FRICTION ANGLE (degrees)	COHESION (psf)	FRICTION ANGLE (degrees)	COHESION (psf)
Pre-Blended Tailings	19-057-01	-	-	-	-	-	-	-	3.12	-	-	-	-	-	-	-	-	-	-	-
Pre-Blended Tailings (w/Salt)	19-263-05	-	-	-	-	-	-	-	3.28	-	-	-	-	-	-	-	-	-	-	-
Pre-Blended Tailings	19-344-02	-	-	71	59	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LFilterCake	19-380-01	55.7	-	53	40	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NFilterCake	19-380-02	68.5	-	65	47	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MagSulf Salt	19-380-03	74.1	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blended Tailings	19-389-01	60.9	-	51	40	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blended Tailings	19-393-01	59.3	-	-	-	-	70.1	46.0	-	-	-	-	-	-	-	-	-	-	-	-
Blended Tailings (w/Salt)	19-393-02	-	-	-	-	-	72.4	45.3	-	-	-	-	-	-	-	-	-	-	-	-
Blended Tailings	19-421-01 and -02	-	-	-	-	-	-	-	-	45.1	66.4	39.5	63.1	19.0	411.4	-	39.5	63.1	-	-
Blended Tailings	19-421-03	-	-	-	-	-	-	-	-	45.1	67.0	-	-	-	-	6330.5	-	-	-	-
Blended Tailings (w/Salt)	19-421-04 and -05	-	-	-	-	-	-	-	-	54.0	66.5	41.9	0.0	22.2	0.0	-	41.9	0.0	-	-
Blended Tailings (w/Salt)	19-421-06	-	-	-	-	-	-	-	-	49.4	68.9	-	-	-	-	699.1	-	-	-	-
Blended Tailings (w/Salt)	19-421-07 and -08	-	-	-	-	-	-	-	-	49.4	69.2	39.5	183.0	20.5	388.0	-	39.5	183.0	-	-
Salt	N/A	74.1	49.4	-	-	-	-	-	-	84.1	42.1	-	-	-	-	-	37.9	0.3	-	-
Coarse Gangue	N/A (19-366-02)	-	-	-	-	-	-	-	-	0.0	88.8	-	-	-	-	-	42.4	0.3	31.3	0.5

APPENDIX C.2

Particle Size Distribution

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	5.3	12.1	6.7	13.3	24.2	38.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	96.2		
.75	94.7		
.5	88.3		
.375	87.4		
#4	82.6		
#10	75.9		
#16	71.3		
#40	62.6		
#50	59.3		
#100	49.6		
#200	38.4		

* (no specification provided)

Material Description

Light Brown silty sand with gravel

Atterberg Limits

PL= 44 LL= 71 PI= 27

Coefficients

D_{90}= 14.3737	D_{85}= 6.1780	D_{60}= 0.3199
D_{50}= 0.1537	D_{30}=	D_{15}=
D_{10}=	C_u=	C_c=

Classification

USCS= SM AASHTO= A-7-5(5)

Remarks

Natural Moisture Content: 32.1%

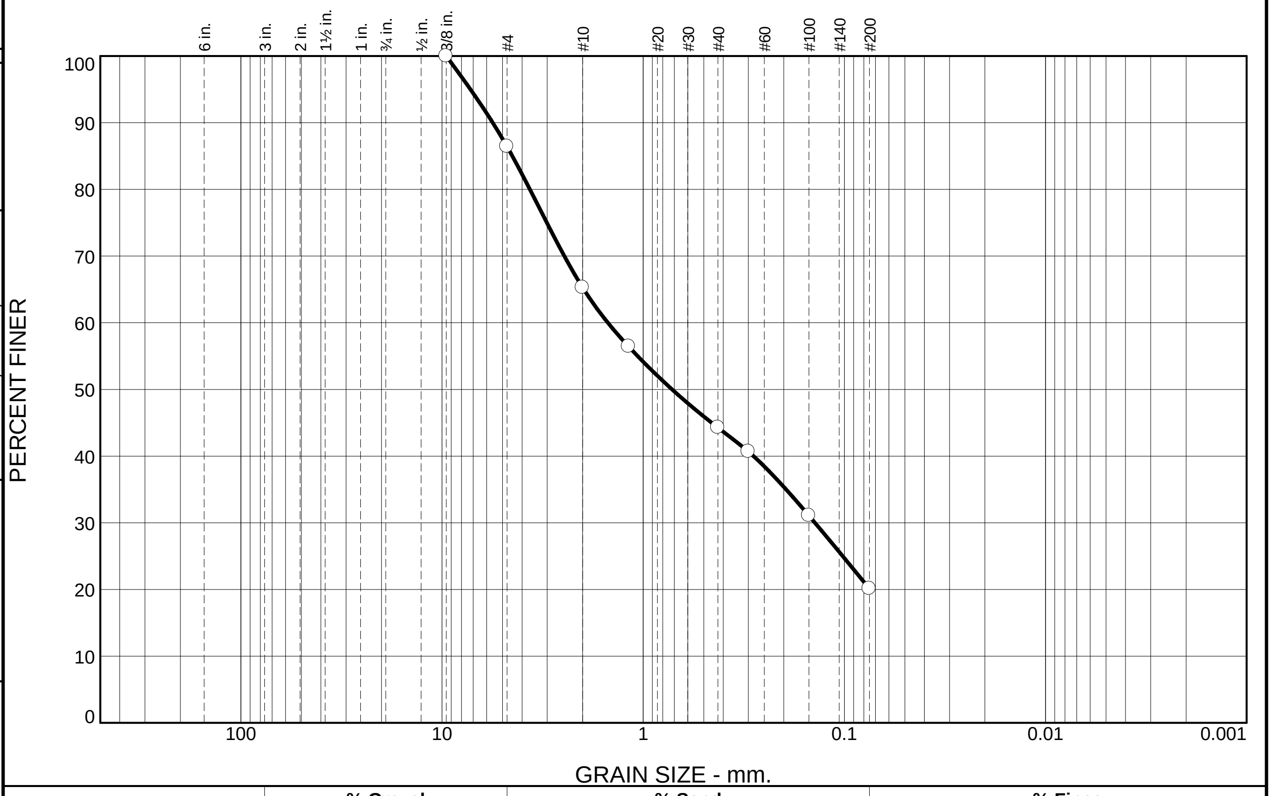
Location: BH19-01
Sample Number: 19-110-01 **Depth:** 7.5-9' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-01

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	13.6	21.1	21.0	24.2	20.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	86.4		
#10	65.3		
#16	56.4		
#40	44.3		
#50	40.7		
#100	31.1		
#200	20.1		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= 30
LL= 55
PI= 25

Coefficients

D_{90}= 5.5955
D_{85}= 4.4720
D_{60}= 1.4988
D_{50}= 0.7183
D_{30}= 0.1401
D_{15}=
D_{10}=
C_u=
C_c=

Classification

USCS= SM
AASHTO= A-2-7(1)

Remarks

Natural Moisture Content: 30.0%

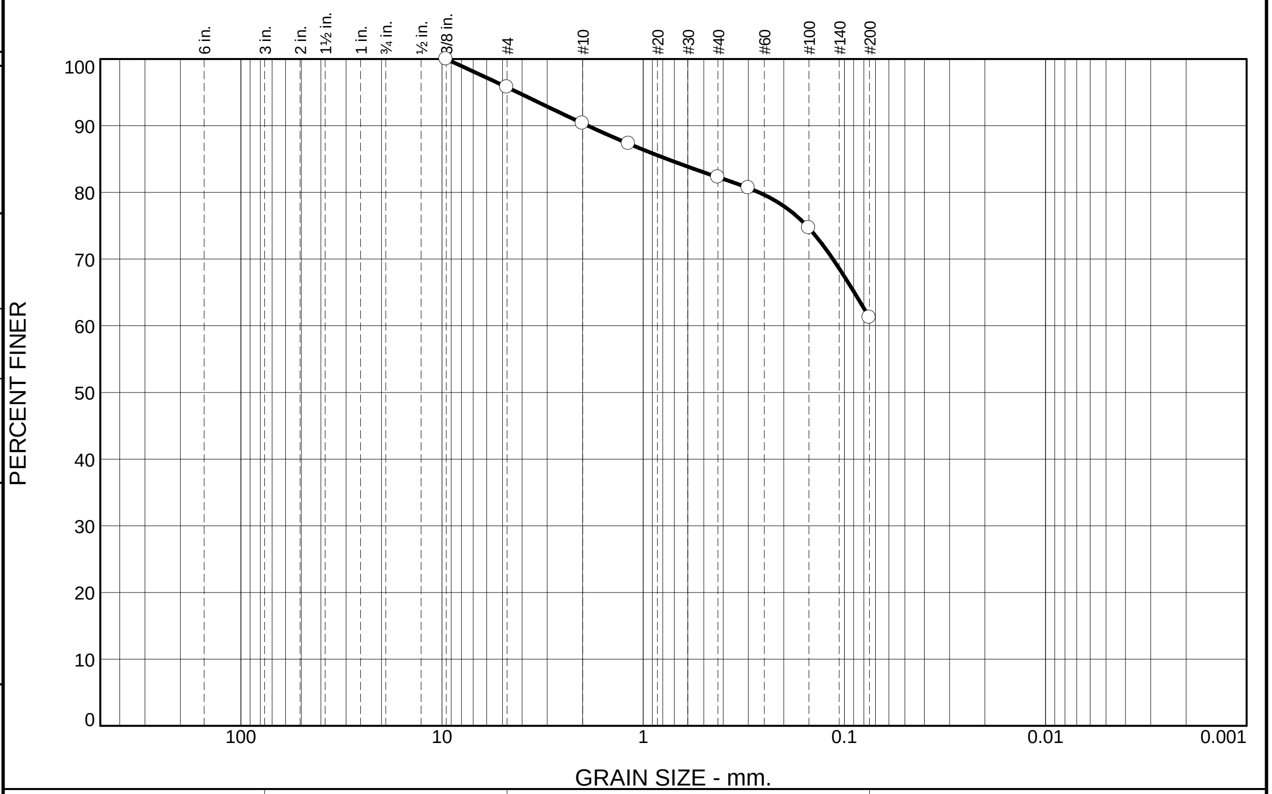
Location: BH19-01
Sample Number: 19-110-02 **Depth:** 25-26.5' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-02

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.2	5.4	8.1	21.1	61.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	95.8		
#10	90.4		
#16	87.3		
#40	82.3		
#50	80.7		
#100	74.7		
#200	61.2		

* (no specification provided)

Material Description

Light Brown sandy elastic silt

Atterberg Limits

PL= 55 LL= 105 PI= 50

Coefficients

D_{90}= 1.8839 D_{85}= 0.7590 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= MH AASHTO= A-7-5(32)

Remarks

Natural Moisture Content: 58.8%

Location: BH19-02
Sample Number: 19-110-03 **Depth:** 25-26.5' **Date:** 4/25/2019

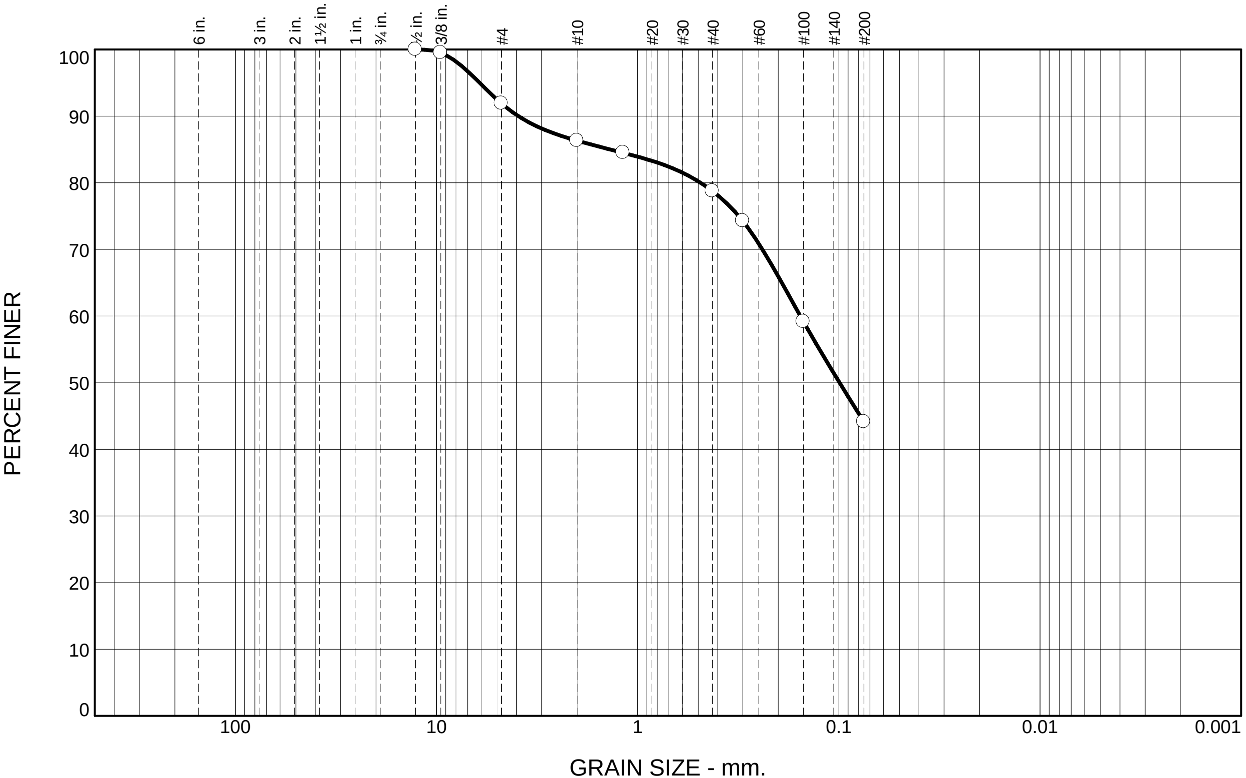
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-110-03

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	8.1	5.6	7.5	34.7	44.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375	99.5		
#4	91.9		
#10	86.3		
#16	84.5		
#40	78.8		
#50	74.3		
#100	59.2		
#200	44.1		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= 40 LL= 80 PI= 40

Coefficients

D_{90}= 3.9167 D_{85}= 1.3730 D_{60}= 0.1554
D_{50}= 0.0992 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-7-5(12)

Remarks

Natural Moisture Content: 37.4%

Location: BH19-02
Sample Number: 19-110-04 **Depth:** 45-46.5' **Date:** 4/25/2019

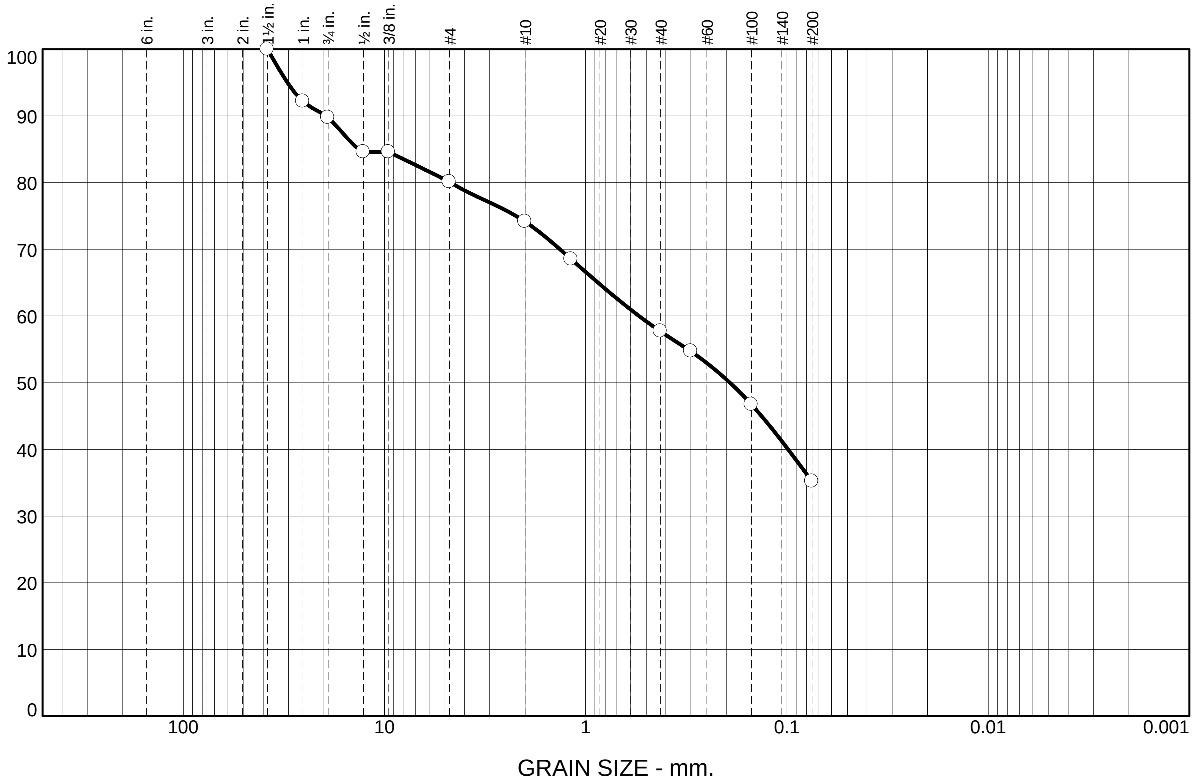
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-110-04

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	10.3	9.6	5.9	16.5	22.5	35.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	92.2		
.75	89.7		
.5	84.6		
.375	84.6		
#4	80.1		
#10	74.2		
#16	68.5		
#40	57.7		
#50	54.7		
#100	46.7		
#200	35.2		

* (no specification provided)

Material Description

Light Brown silty sand with gravel

Atterberg Limits

PL= 28 LL= 46 PI= 18

Coefficients

D_{90}= 19.5627 D_{85}= 13.3874 D_{60}= 0.5429
D_{50}= 0.1919 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-7(2)

Remarks

Natural Moisture Content: 19.4%

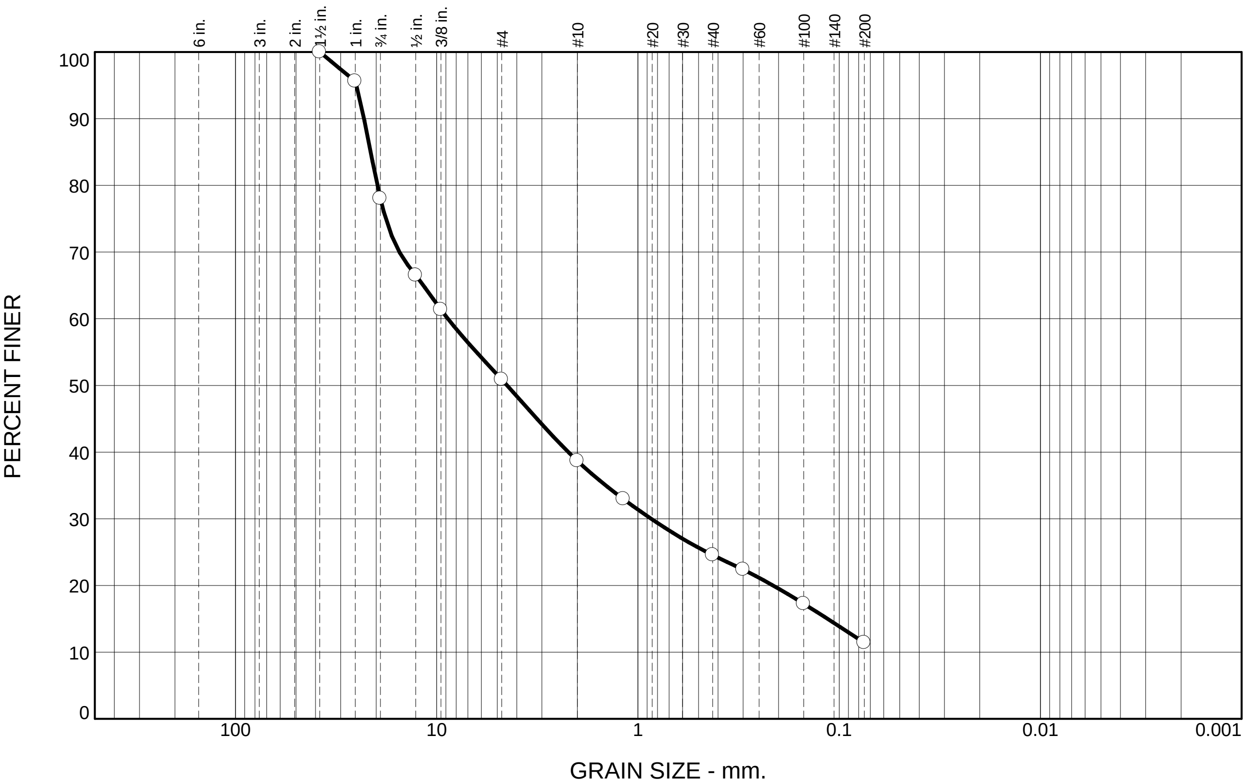
Location: BH19-08
Sample Number: 19-110-05 **Depth:** 2.5-4' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-05

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	22.0	27.1	12.2	14.1	13.2	11.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	95.6		
.75	78.0		
.5	66.5		
.375	61.4		
#4	50.9		
#10	38.7		
#16	33.0		
#40	24.6		
#50	22.4		
#100	17.3		
#200	11.4		

* (no specification provided)

Material Description

Light Brown poorly graded gravel with silt and sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 22.9854 D_{85}= 21.3084 D_{60}= 8.7932
D_{50}= 4.4708 D_{30}= 0.8593 D_{15}= 0.1143
D_{10}= C_u= C_c=

Classification

USCS= GP-GM AASHTO= A-1-a

Remarks

Natural Moisture Content: 10.3%

Location: BH19-09
Sample Number: 19-110-06 **Depth:** 2.5-4' **Date:** 4/25/2019

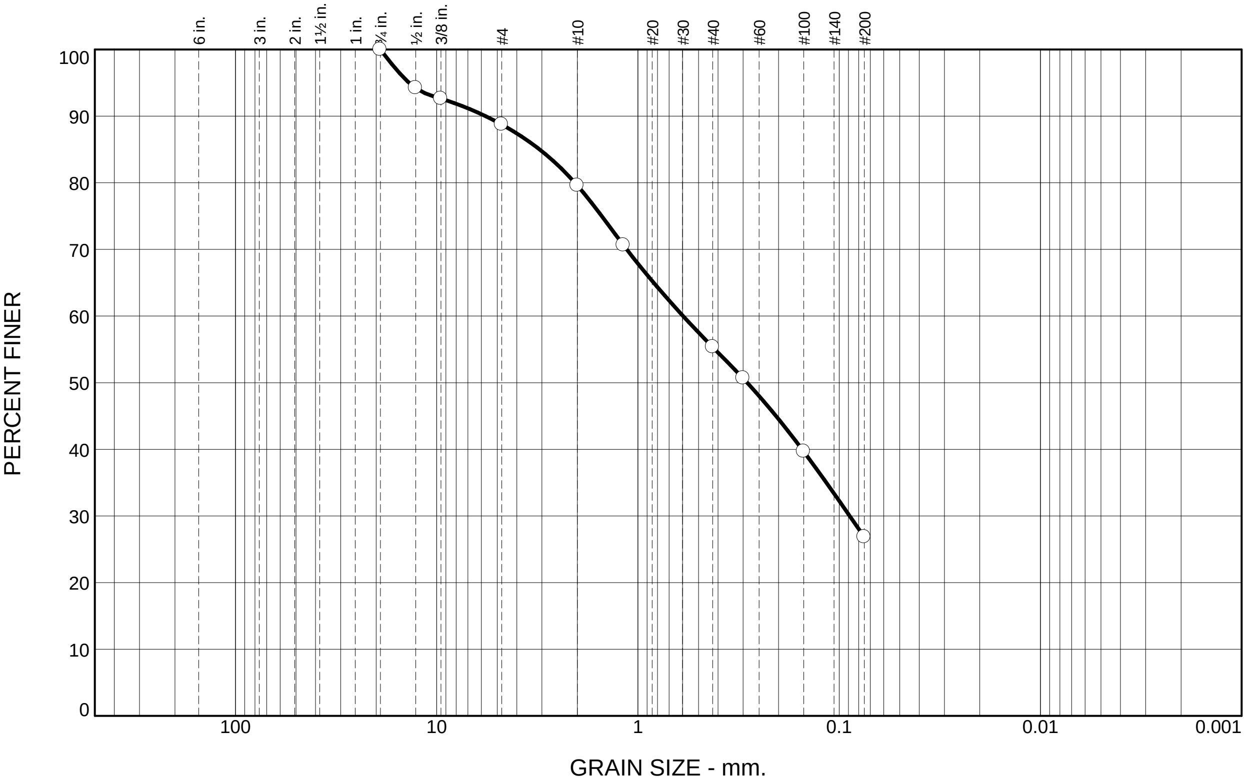
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-110-06

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	11.3	9.1	24.3	28.5	26.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	94.2		
.375	92.6		
#4	88.7		
#10	79.6		
#16	70.6		
#40	55.3		
#50	50.7		
#100	39.7		
#200	26.8		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 5.7198 D_{85}= 3.0786 D_{60}= 0.5962
D_{50}= 0.2864 D_{30}= 0.0886 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Natural Moisture Content: 23.6%

Location: BH19-11
Sample Number: 19-110-07 **Depth:** 2.5-4' **Date:** 4/25/2019

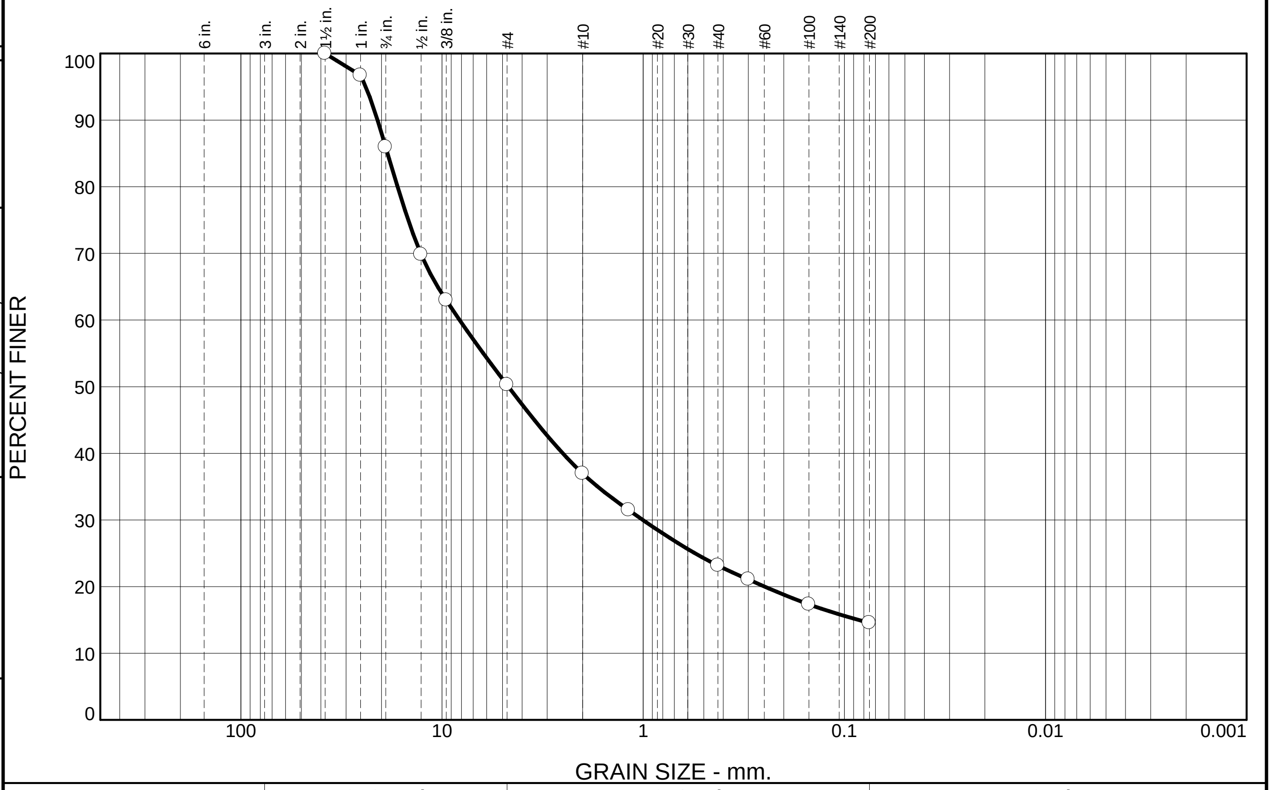
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-110-07

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	14.1	35.6	13.3	13.8	8.7	14.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	96.7		
.75	85.9		
.5	69.8		
.375	63.0		
#4	50.3		
#10	37.0		
#16	31.5		
#40	23.2		
#50	21.1		
#100	17.3		
#200	14.5		

* (no specification provided)

Material Description

Red clayey gravel with sand

Atterberg Limits

PL= 21 LL= 48 PI= 27

Coefficients

D_{90}= 20.9347 D_{85}= 18.6472 D_{60}= 8.1802
D_{50}= 4.6789 D_{30}= 1.0039 D_{15}= 0.0850
D_{10}= C_u= C_c=

Classification

USCS= GC AASHTO= A-2-7(0)

Remarks

Natural Moisture Content: 10.5%

Location: BH19-12
Sample Number: 19-110-08 **Depth:** 15-16.5' **Date:** 4/25/2019

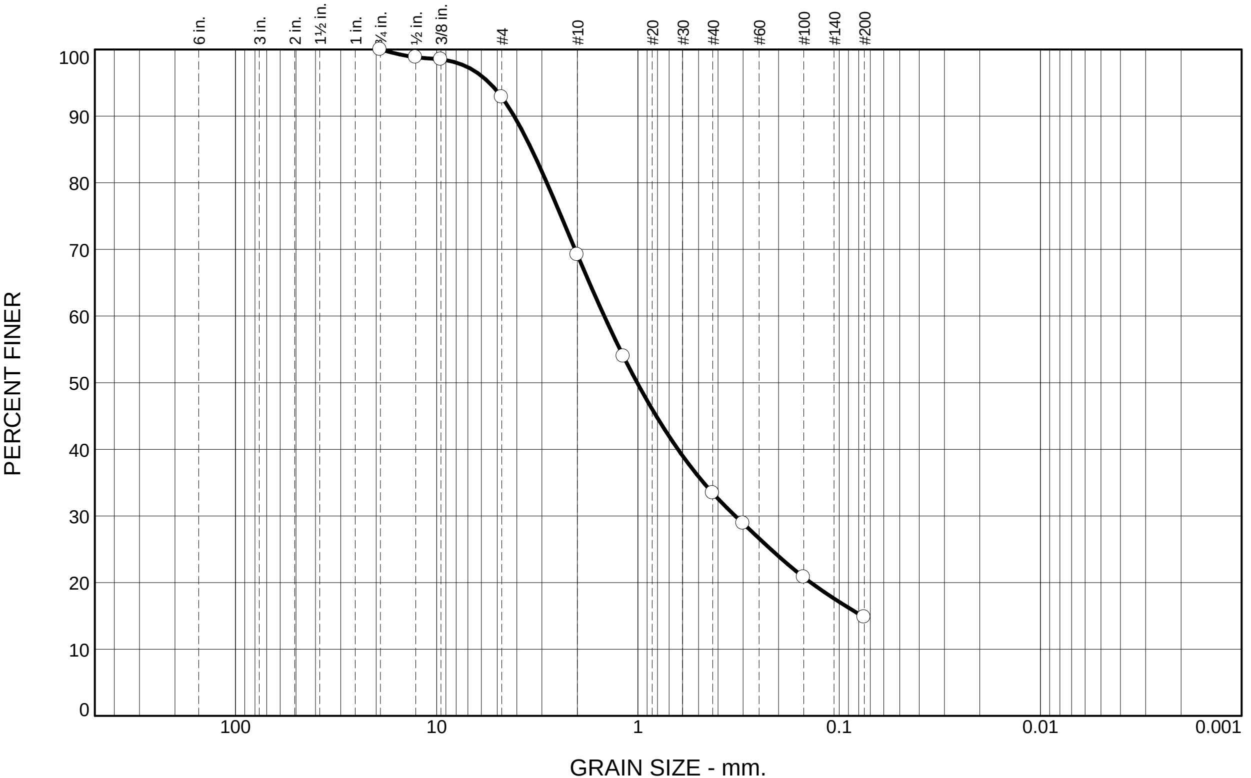
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-110-08

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	7.2	23.6	35.8	18.6	14.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	98.8		
.375	98.5		
#4	92.8		
#10	69.2		
#16	53.9		
#40	33.4		
#50	28.9		
#100	20.8		
#200	14.8		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 4.1224 D_{85}= 3.3740 D_{60}= 1.4708
D_{50}= 1.0089 D_{30}= 0.3282 D_{15}= 0.0771
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Natural Moisture Content: 13.1%

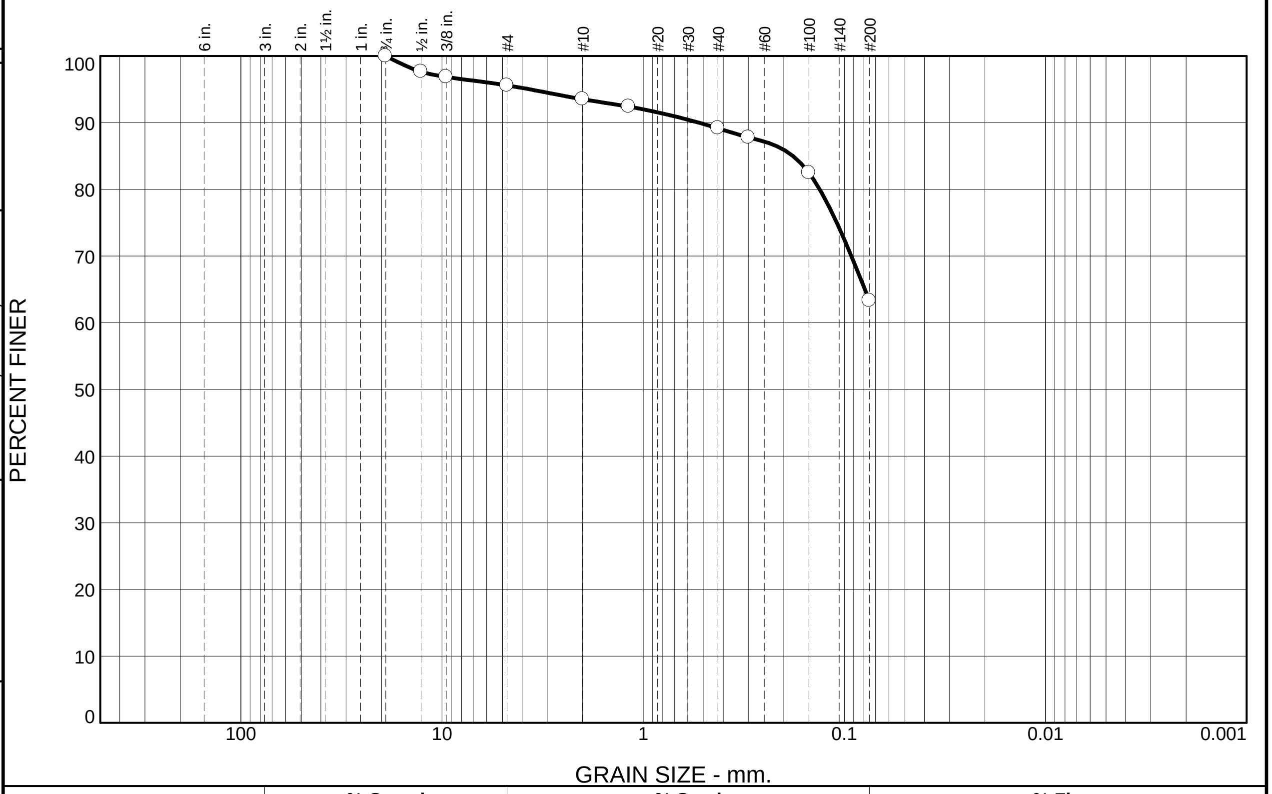
Location: BH19-15
Sample Number: 19-110-09 **Depth:** 5.5-6' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-09

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.4	2.1	4.3	25.9	63.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	97.7		
.375	96.9		
#4	95.6		
#10	93.5		
#16	92.4		
#40	89.2		
#50	87.8		
#100	82.5		
#200	63.3		

* (no specification provided)

Material Description

Light Brown sandy lean clay

Atterberg Limits

PL= 24 LL= 41 PI= 17

Coefficients

D_{90}= 0.5278 D_{85}= 0.1800 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-7-6(9)

Remarks

Natural Moisture Content: 18.5%

Location: BH19-16
Sample Number: 19-110-10 **Depth:** 2.5-4' **Date:** 4/25/2019

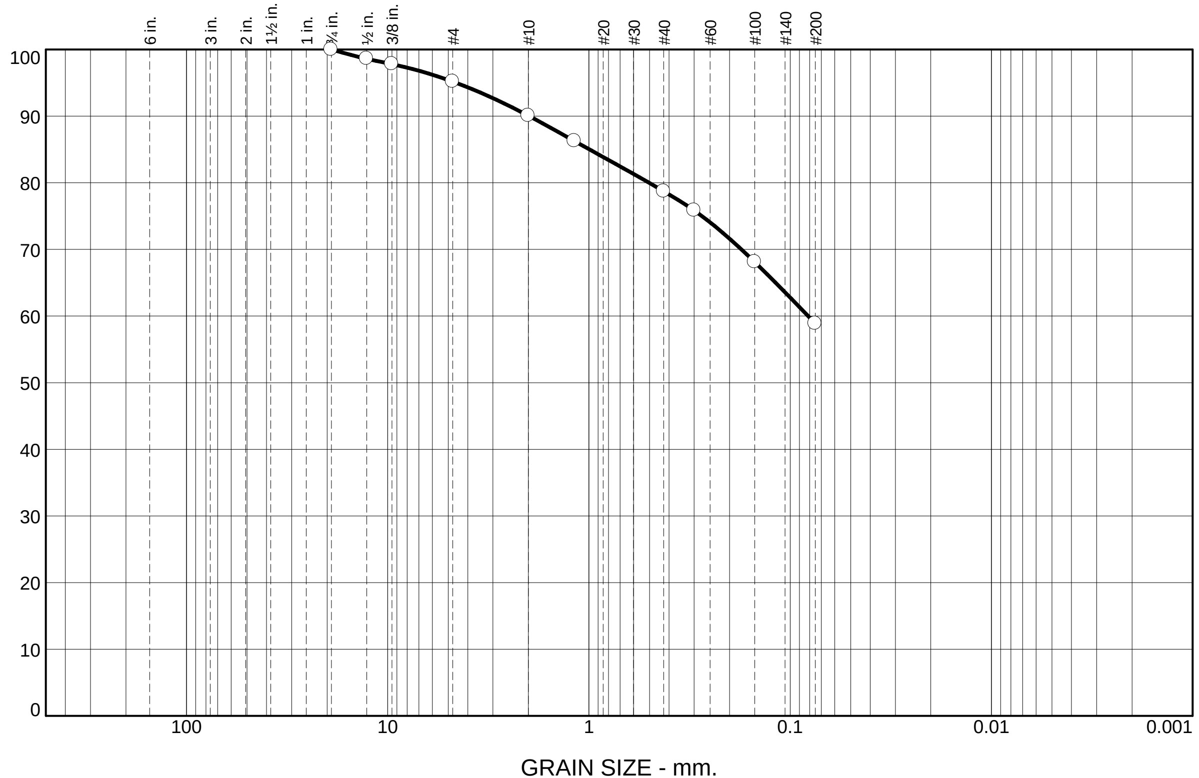
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-110-10

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.8	5.1	11.4	19.8	58.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	98.6		
.375	97.8		
#4	95.2		
#10	90.1		
#16	86.3		
#40	78.7		
#50	75.8		
#100	68.1		
#200	58.9		

* (no specification provided)

Material Description

Light Brown sandy fat clay

Atterberg Limits

PL= 27 LL= 50 PI= 23

Coefficients

D_{90}= 1.9806	D_{85}= 0.9929	D_{60}= 0.0815
D_{50}=	D_{30}=	D_{15}=
D_{10}=	C_u=	C_c=

Classification

USCS= CH AASHTO= A-7-6(12)

Remarks

Natural Moisture Content: 31.8%

Location: BH19-17
Sample Number: 19-110-11 **Depth:** 10.5-11' **Date:** 4/26/2019

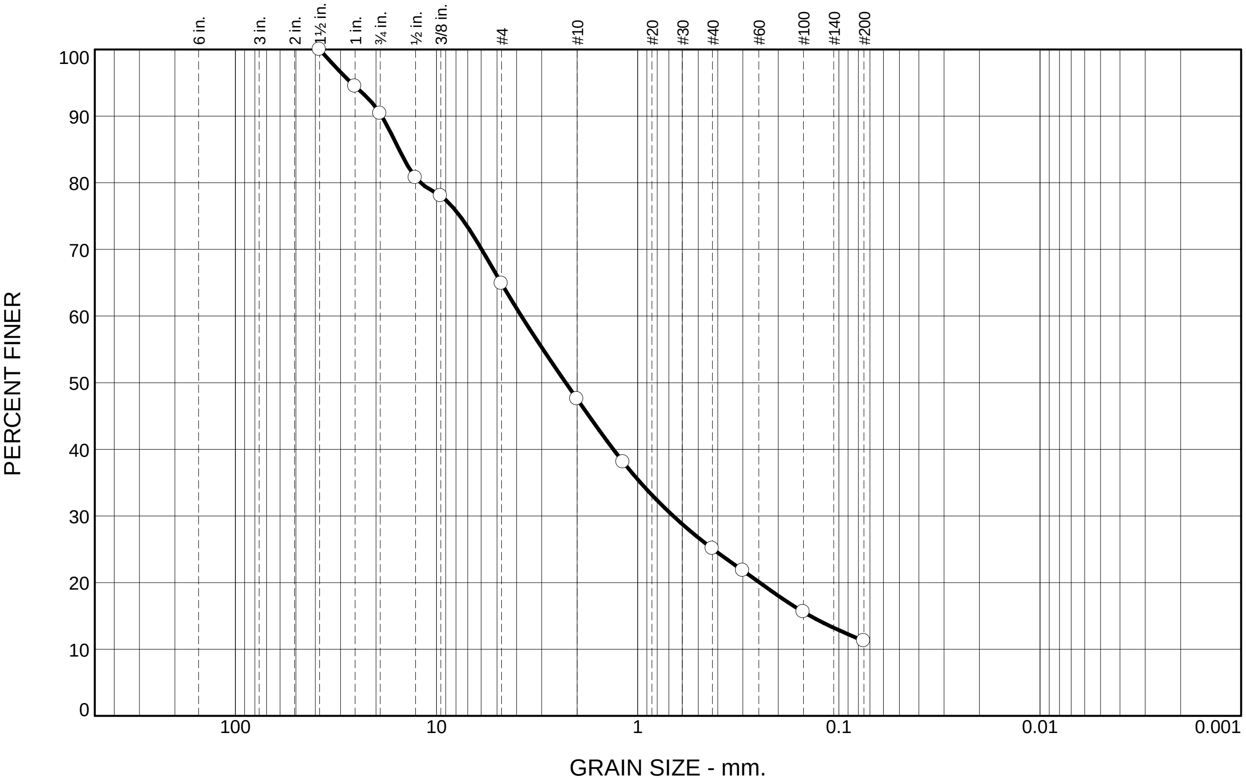
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-110-11

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	9.6	25.5	17.4	22.4	13.9	11.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	94.5		
.75	90.4		
.5	80.8		
.375	78.0		
#4	64.9		
#10	47.5		
#16	38.1		
#40	25.1		
#50	21.8		
#100	15.6		
#200	11.2		

* (no specification provided)

Material Description

Brown poorly graded sand with silt and gravel

Atterberg Limits

PL= 25 LL= 32 PI= 7

Coefficients

D_{90}= 18.7059 D_{85}= 15.3433 D_{60}= 3.7868
D_{50}= 2.2788 D_{30}= 0.6660 D_{15}= 0.1386
D_{10}= C_u= C_c=

Classification

USCS= SP-SM AASHTO= A-2-4(0)

Remarks

Natural Moisture Content: 10.0%

Location: BH19-17
Sample Number: 19-110-12 **Depth:** 20-21' **Date:** 4/25/2019

NewFields

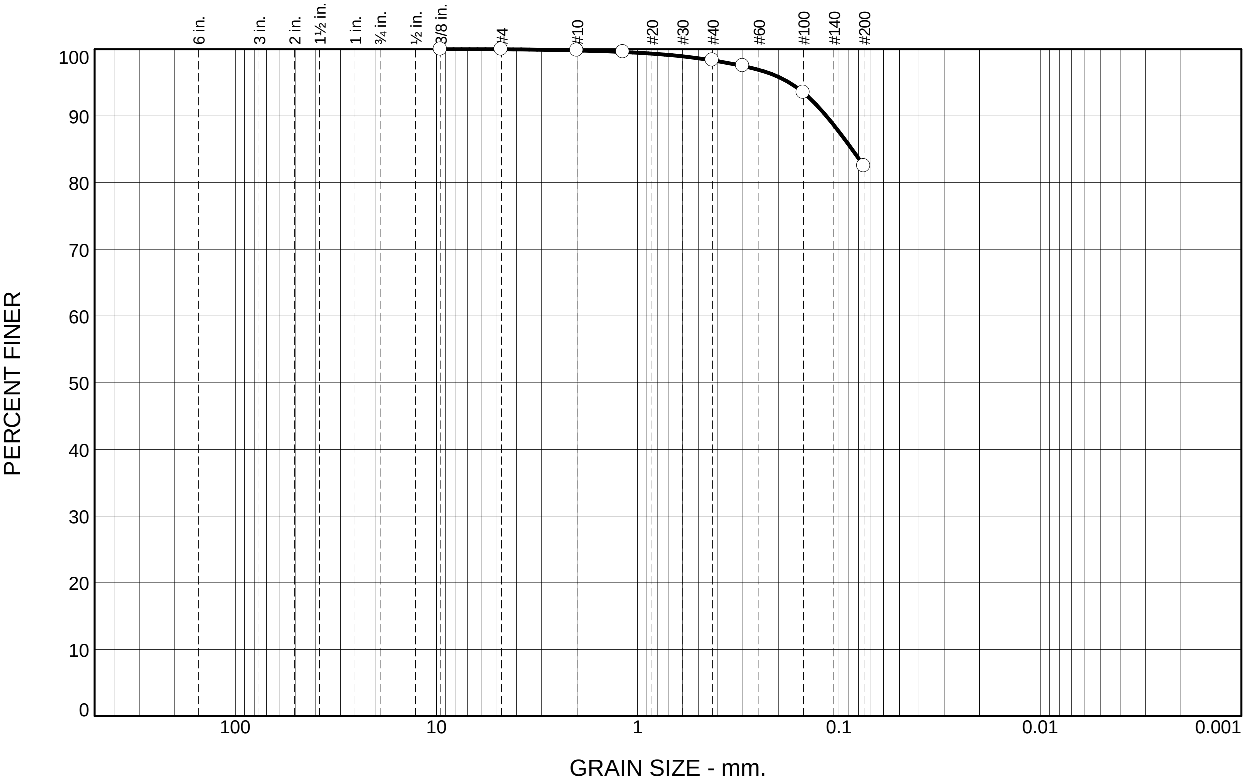
Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-110-12

Tested By: JH/CB **Checked By:** JH

Test results included in this report relate only to the items inspected or tested. This report shall not be reproduced, in full, without prior written approval of NewFields.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	1.5	15.8	82.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	100.0		
#10	99.8		
#16	99.6		
#40	98.3		
#50	97.5		
#100	93.5		
#200	82.5		

* (no specification provided)

Material Description

Light Brown elastic silt with sand

Atterberg Limits

PL= 55 LL= 110 PI= 55

Coefficients

D_{90}= 0.1155 D_{85}= 0.0861 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= MH AASHTO= A-7-5(56)

Remarks

Natural Moisture Content: 37.3%

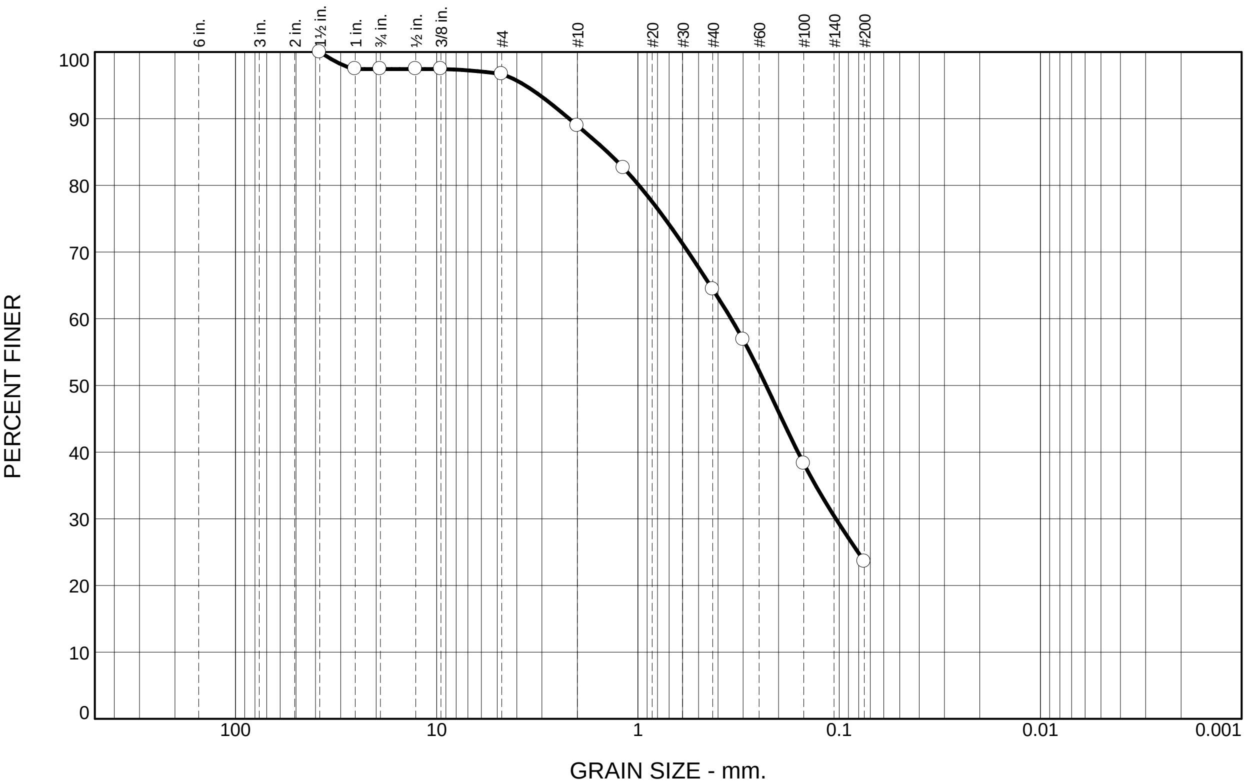
Location: BH19-18
Sample Number: 19-110-13 **Depth:** 10.5-11' **Date:** 4/26/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-13

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.5	0.8	7.7	24.6	40.8	23.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	97.5		
.75	97.5		
.5	97.5		
.375	97.5		
#4	96.7		
#10	89.0		
#16	82.6		
#40	64.4		
#50	56.9		
#100	38.3		
#200	23.6		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= NP   LL= NP   PI= NP

Coefficients

D_{90}= 2.1956 D_{85}= 1.4166 D_{60}= 0.3440
D_{50}= 0.2308 D_{30}= 0.1038 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM   AASHTO= A-2-4(0)

Remarks

Natural Moisture Content: 35.3%

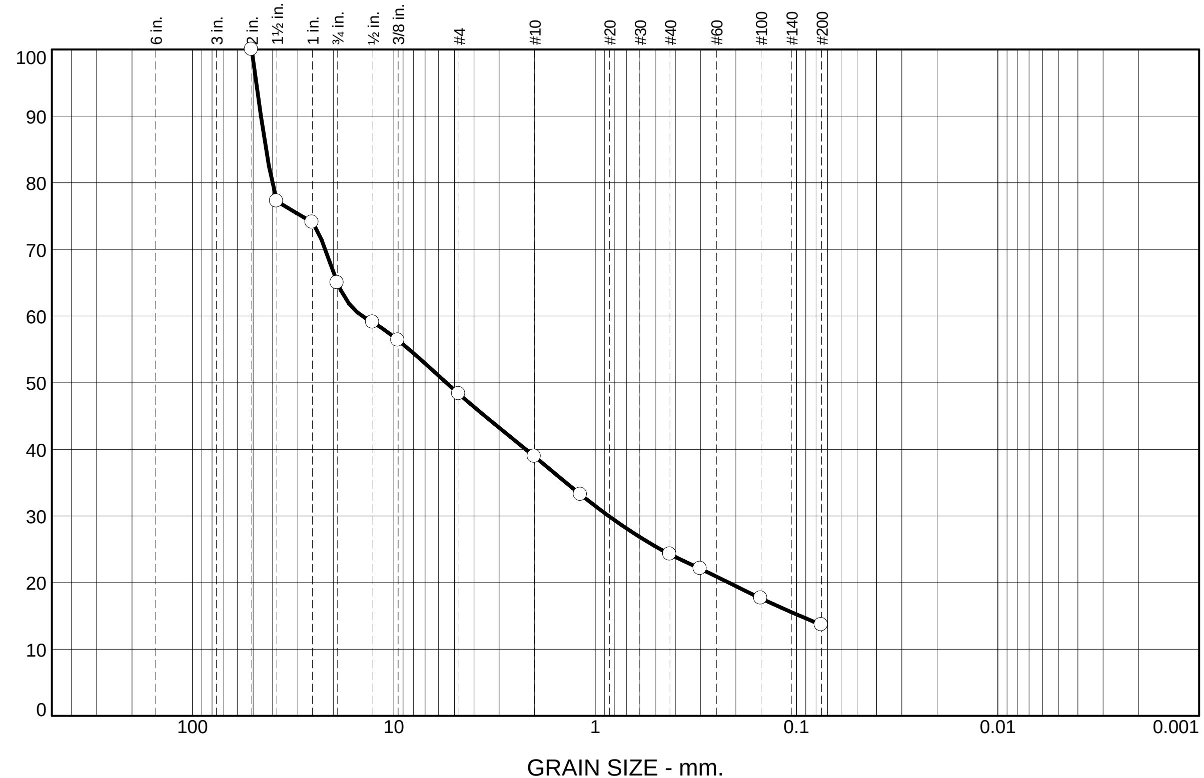
Location: BH19-18
Sample Number: 19-110-14   **Depth:** 20.5-21'   **Date:** 4/26/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000   **Figure** 19-110-14

Tested By: JH   **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	35.0	16.7	9.4	14.7	10.6	13.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2	100.0		
1.5	77.2		
1	74.0		
.75	65.0		
.5	59.1		
.375	56.4		
#4	48.3		
#10	38.9		
#16	33.2		
#40	24.2		
#50	22.1		
#100	17.6		
#200	13.6		

* (no specification provided)

Material Description

Light Brown silty gravel with sand

Atterberg Limits

PL= NP
LL= NP
PI= NP

Coefficients

D_{90}= 45.7227
D_{85}= 43.1186
D_{60}= 14.3339
D_{50}= 5.4873
D_{30}= 0.8565
D_{15}= 0.0958
D_{10}=
C_u=
C_c=

Classification

USCS= GM
AASHTO= A-1-a

Remarks

Natural Moisture Content: 10.9%

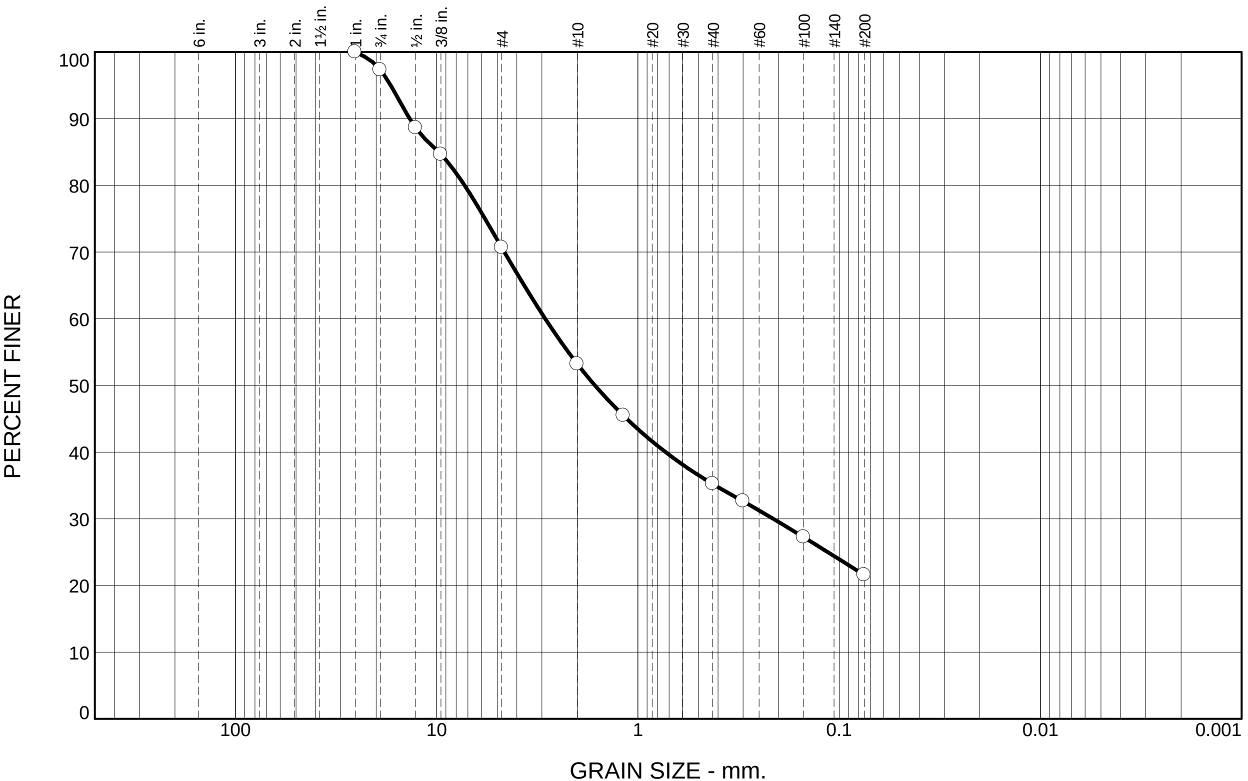
Location: BH19-20
Sample Number: 19-110-15 **Depth:** 5-6.5' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-15

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.7	26.6	17.5	18.0	13.6	21.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	97.3		
.5	88.6		
.375	84.6		
#4	70.7		
#10	53.2		
#16	45.5		
#40	35.2		
#50	32.6		
#100	27.2		
#200	21.6		

* (no specification provided)

Material Description

Gray silty sand with gravel

Atterberg Limits

PL= 30
LL= 46
PI= 16

Coefficients

D_{90}= 13.6076
D_{85}= 9.7854
D_{60}= 2.8874
D_{50}= 1.6363
D_{30}= 0.2127
D_{15}=
D_{10}=
C_u=
C_c=

Classification

USCS= SM
AASHTO= A-2-7(0)

Remarks

Natural Moisture Content: 17.3%

Location: BH19-20
Sample Number: 19-110-16
Depth: 30-30.5'
Date: 4/25/2019

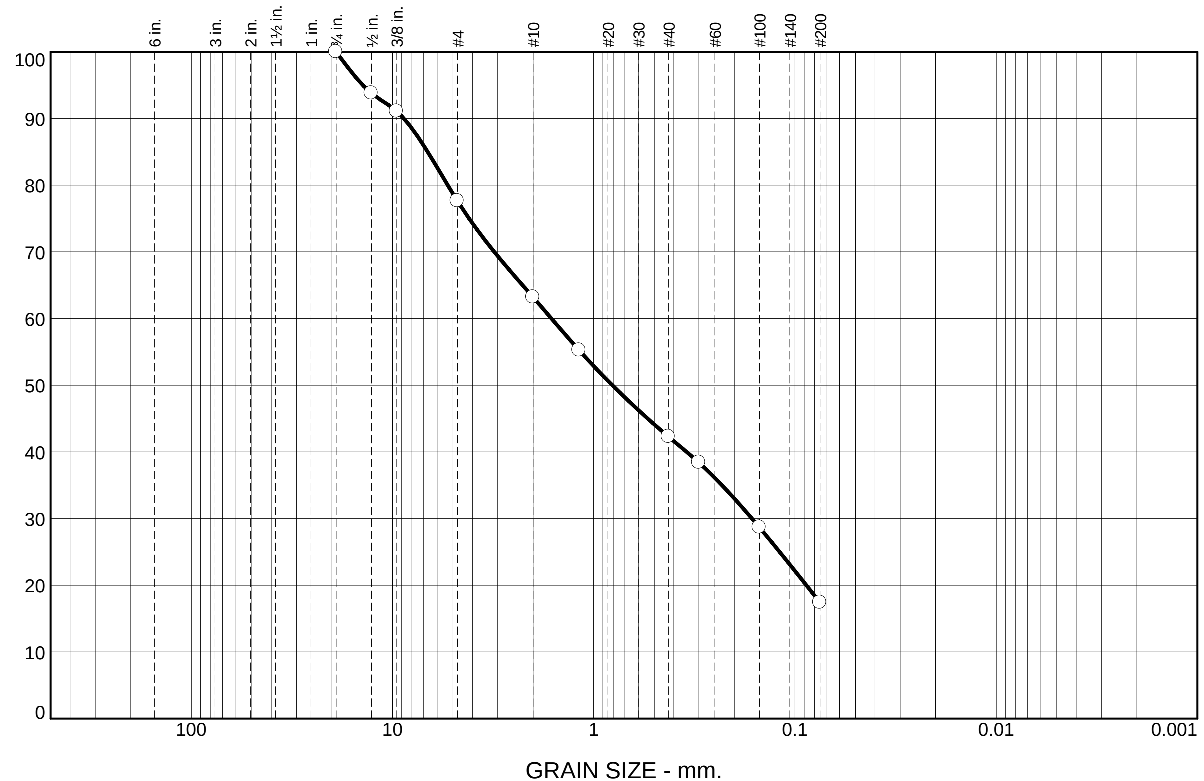
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000
Figure 19-110-16

Tested By: JH/CB
Checked By: JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	22.4	14.4	20.9	24.9	17.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	93.8		
.375	91.1		
#4	77.6		
#10	63.2		
#16	55.2		
#40	42.3		
#50	38.4		
#100	28.7		
#200	17.4		

* (no specification provided)

Material Description

Light Brown silty sand with gravel

Atterberg Limits

PL= NP
LL= NP
PI= NP

Coefficients

D_{90}= 8.7776
D_{85}= 6.6845
D_{60}= 1.6225
D_{50}= 0.8076
D_{30}= 0.1636
D_{15}=
D_{10}=
C_u=
C_c=

Classification

USCS= SM
AASHTO= A-1-b

Remarks

Natural Moisture Content: 23.5%

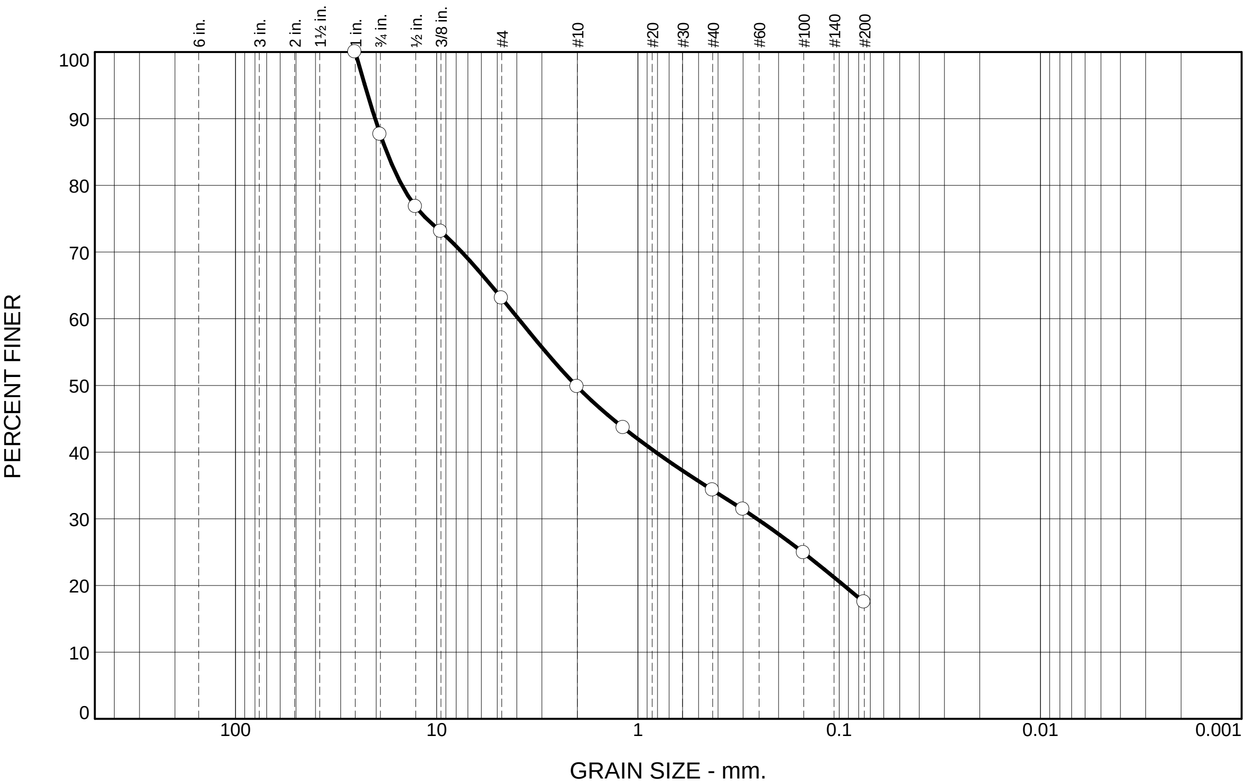
Location: BH19-21
Sample Number: 19-110-17
Depth: 2.5-4'
Date: 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000
Figure 19-110-17

Tested By: JH/CB
Checked By: JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.4	24.5	13.3	15.5	16.8	17.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	87.6		
.5	76.8		
.375	73.1		
#4	63.1		
#10	49.8		
#16	43.6		
#40	34.3		
#50	31.4		
#100	24.9		
#200	17.5		

* (no specification provided)

Material Description

Light Brown silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 20.2456	D_{85}= 17.6947	D_{60}= 3.9255
D_{50}= 2.0315	D_{30}= 0.2563	D_{15}=
D_{10}=	C_u=	C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Natural Moisture Content: 14.6%

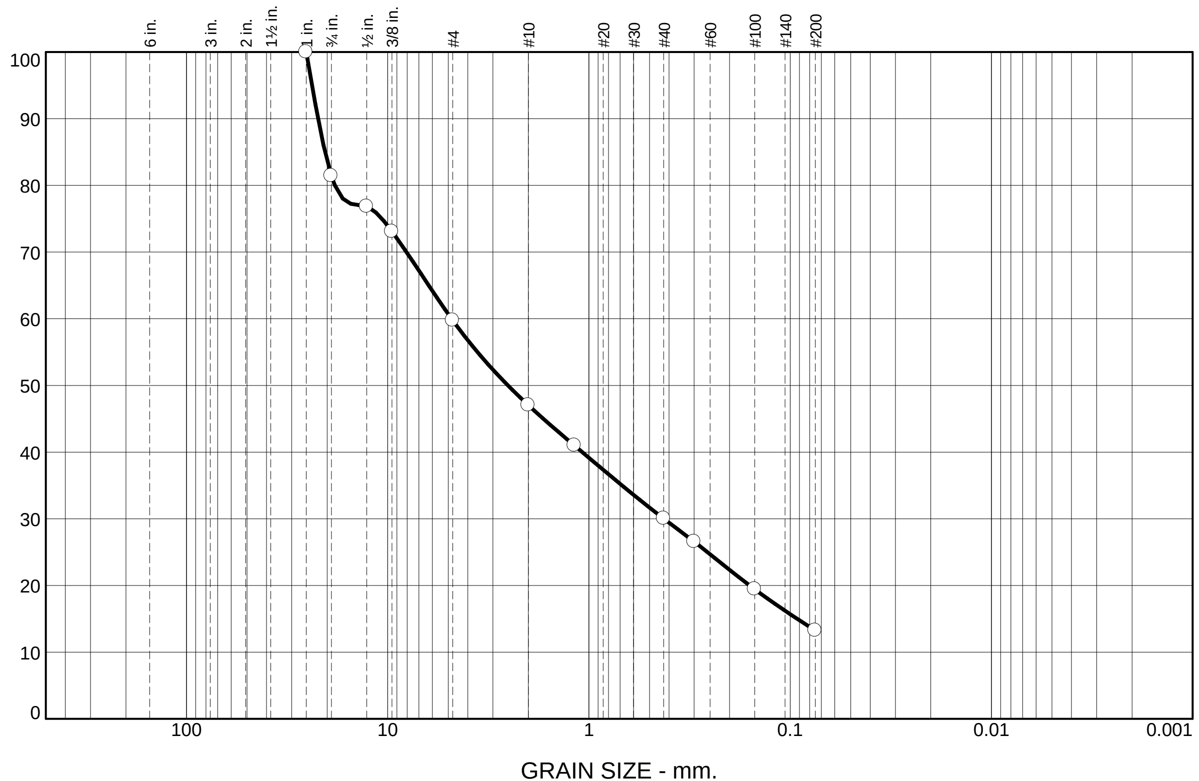
Location: BH19-23
Sample Number: 19-110-18 **Depth:** 2.5-4' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-18

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	18.6	21.6	12.8	17.0	16.8	13.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	81.4		
.5	76.8		
.375	73.1		
#4	59.8		
#10	47.0		
#16	41.0		
#40	30.0		
#50	26.6		
#100	19.4		
#200	13.2		

* (no specification provided)

Material Description

Brown silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 22.1901 D_{85}= 20.4974 D_{60}= 4.8152
D_{50}= 2.5271 D_{30}= 0.4238 D_{15}= 0.0923
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-a

Remarks

Natural Moisture Content: 11.3%

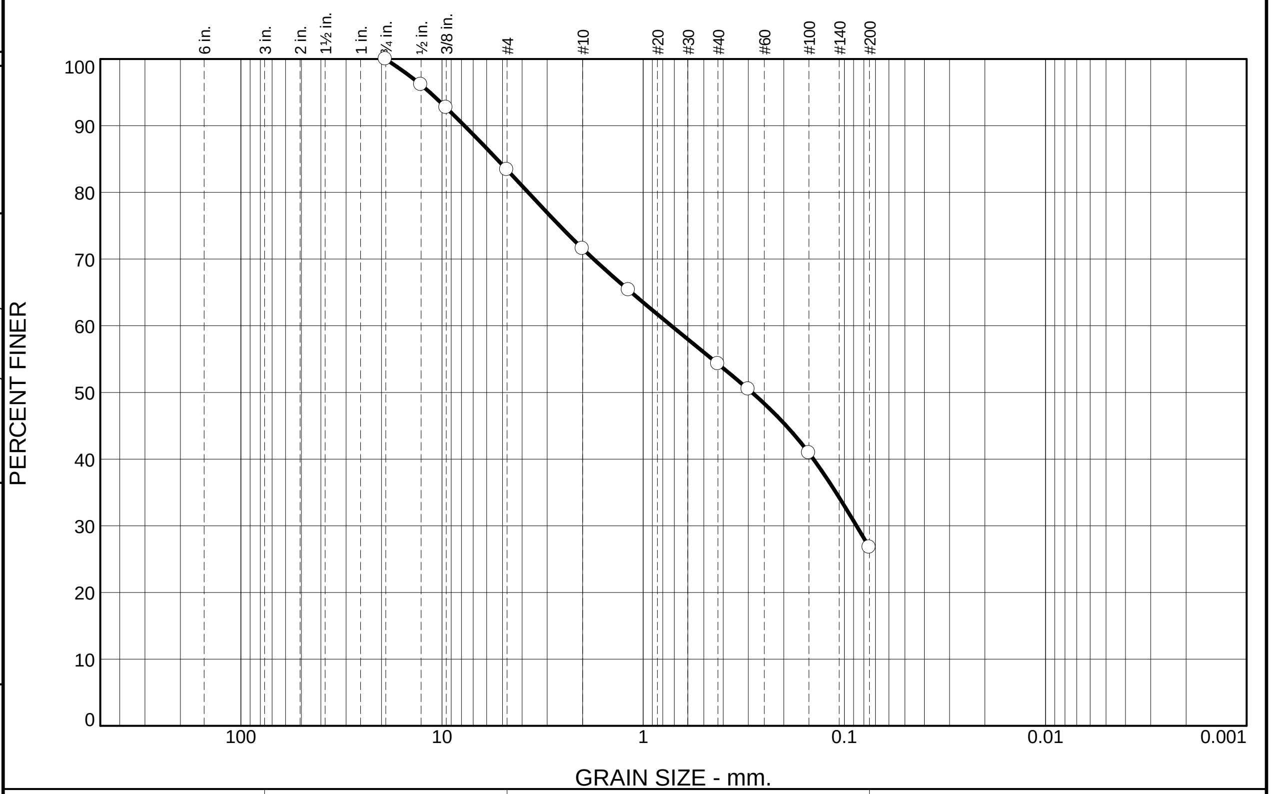
Location: BH19-23
Sample Number: 19-110-19 **Depth:** 7.5-9' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-19

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	16.6	11.8	17.3	27.6	26.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	96.1		
.375	92.7		
#4	83.4		
#10	71.6		
#16	65.3		
#40	54.3		
#50	50.5		
#100	40.9		
#200	26.7		

* (no specification provided)

Material Description

Light Brown silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 7.7348 D_{85}= 5.3379 D_{60}= 0.7245
D_{50}= 0.2880 D_{30}= 0.0870 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Natural Moisture Content: 15.0%

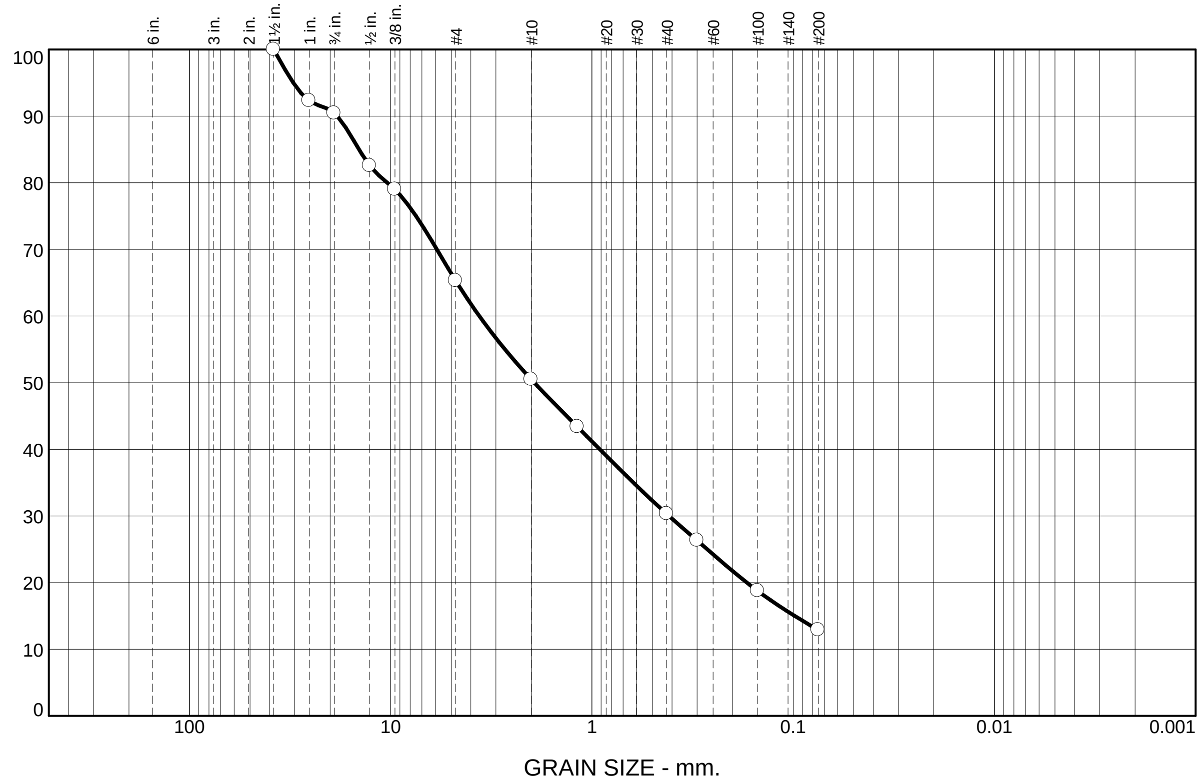
Location: BH19-24
Sample Number: 19-110-20 **Depth:** 2.5-4' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-20

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	9.6	25.1	14.8	20.2	17.4	12.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	92.3		
.75	90.4		
.5	82.6		
.375	79.0		
#4	65.3		
#10	50.5		
#16	43.4		
#40	30.3		
#50	26.3		
#100	18.7		
#200	12.9		

* (no specification provided)

Material Description

Brown silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 18.4347 D_{85}= 14.3621 D_{60}= 3.6280
D_{50}= 1.9333 D_{30}= 0.4138 D_{15}= 0.0982
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-a

Remarks

Natural Moisture Content: 11.6%

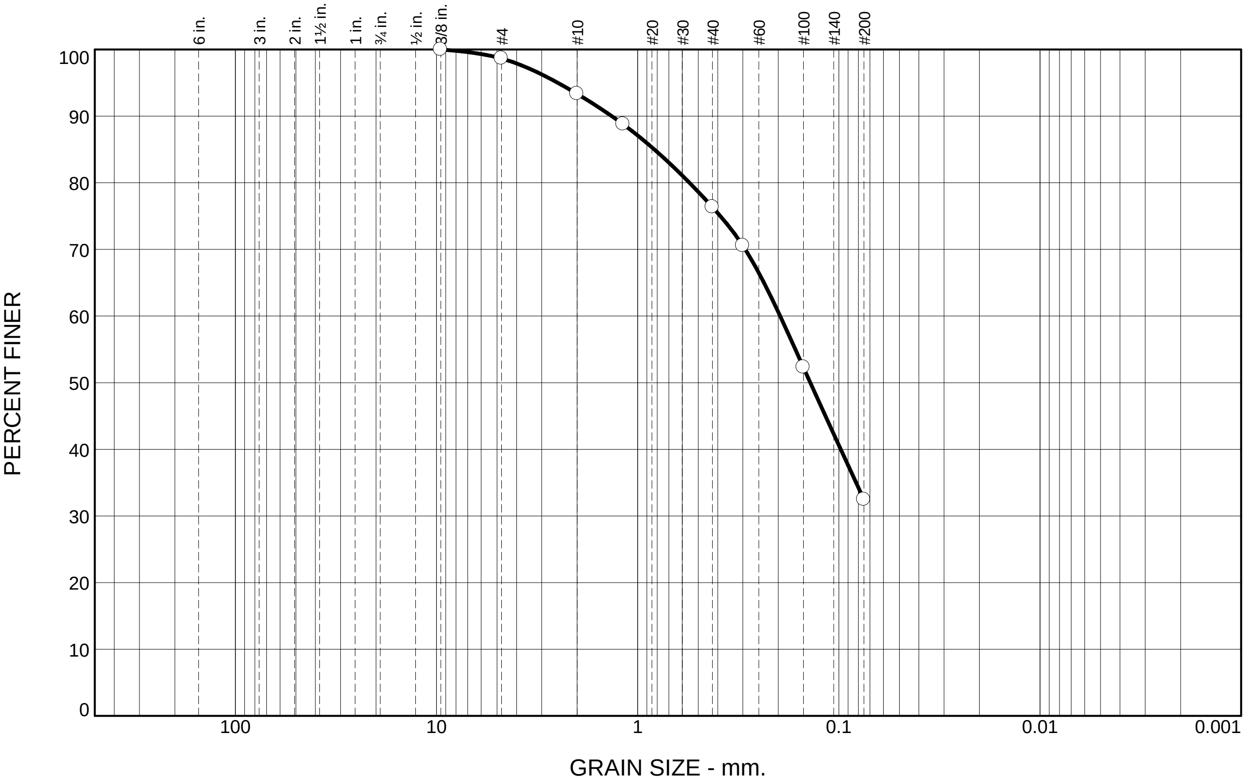
Location: BH19-24
Sample Number: 19-110-21 **Depth:** 15-16.5' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-21

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.4	5.3	16.9	43.9	32.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	98.6		
#10	93.3		
#16	88.8		
#40	76.4		
#50	70.6		
#100	52.3		
#200	32.5		

* (no specification provided)

Material Description

Brown silty sand

Atterberg Limits

PL= 43 LL= 60 PI= 17

Coefficients

D_{90}= 1.3444 D_{85}= 0.8265 D_{60}= 0.1959
D_{50}= 0.1386 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-7(1)

Remarks

Natural Moisture Content: 42.5%

Location: BH19-24
Sample Number: 19-110-22 **Depth:** 35-36.5' **Date:** 4/24/2019

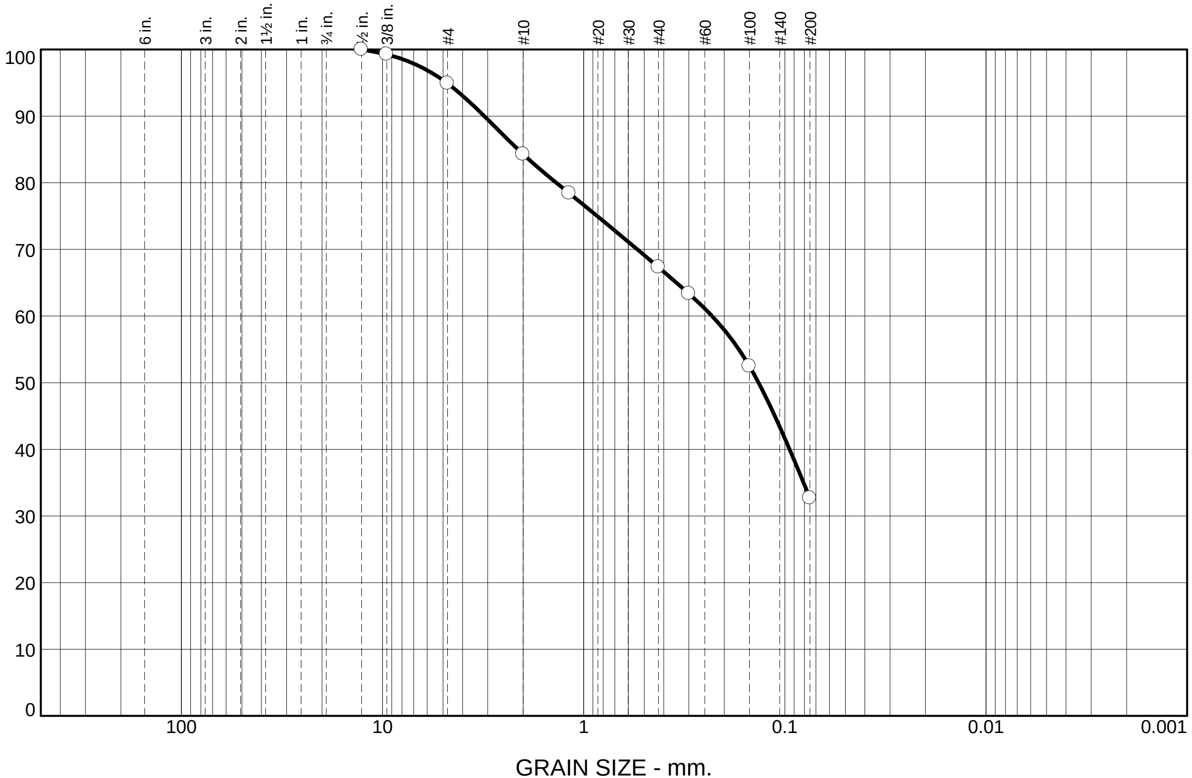
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-110-22

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	5.1	10.6	17.0	34.6	32.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375	99.3		
#4	94.9		
#10	84.3		
#16	78.4		
#40	67.3		
#50	63.4		
#100	52.5		
#200	32.7		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 3.1185 D_{85}= 2.1202 D_{60}= 0.2301
D_{50}= 0.1350 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Natural Moisture Content: 18.4%

Location: BH19-25
Sample Number: 19-110-23 **Depth:** 2.5-4' **Date:** 4/25/2019

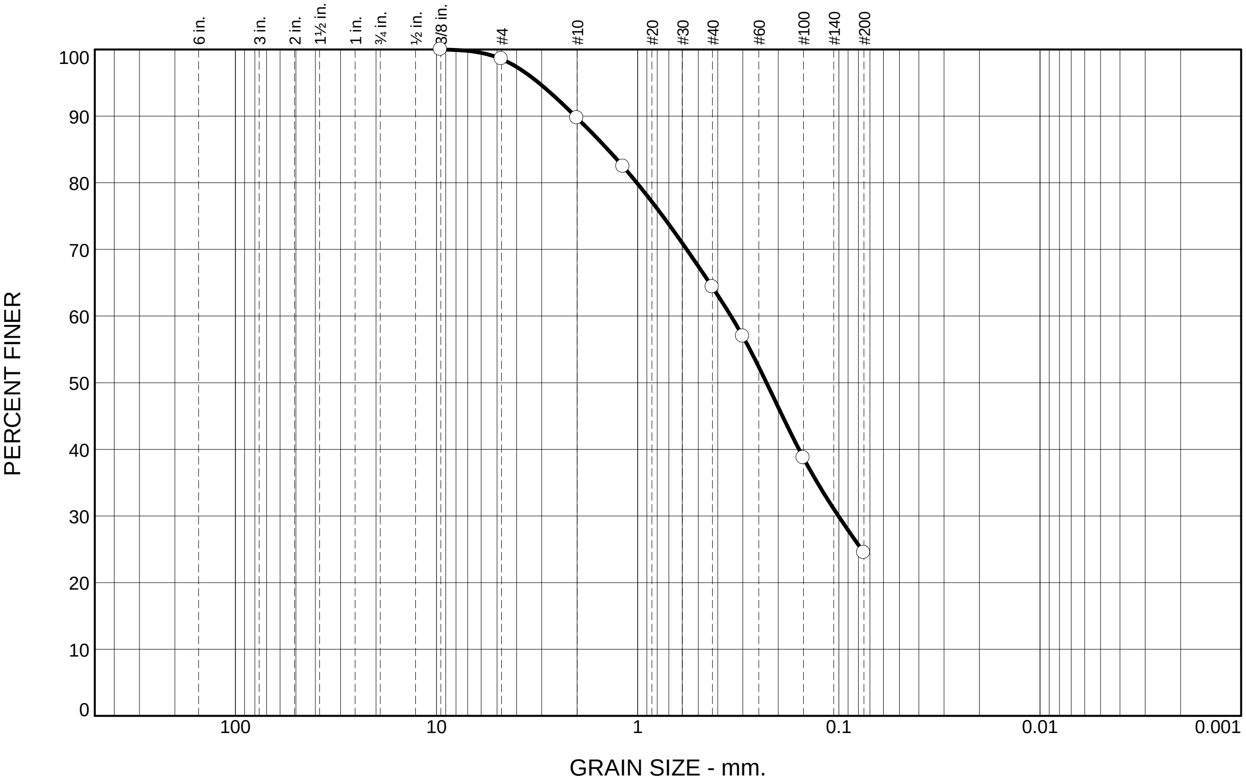
NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-23

Tested By: JH **Checked By:** JH

Test results included in this report relate only to the items inspected or tested. This report shall not be reproduced, in full, without prior written approval of NewFields.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.4	8.9	25.4	39.8	24.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	98.6		
#10	89.7		
#16	82.4		
#40	64.3		
#50	57.0		
#100	38.7		
#200	24.5		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= NP
LL= NP
PI= NP

Coefficients

D_{90}= 2.0447
D_{85}= 1.4078
D_{60}= 0.3436
D_{50}= 0.2290
D_{30}= 0.1005
D_{15}=
D_{10}=
C_u=
C_c=

Classification

USCS= SM
AASHTO= A-2-4(0)

Remarks

Natural Moisture Content: 22.3%

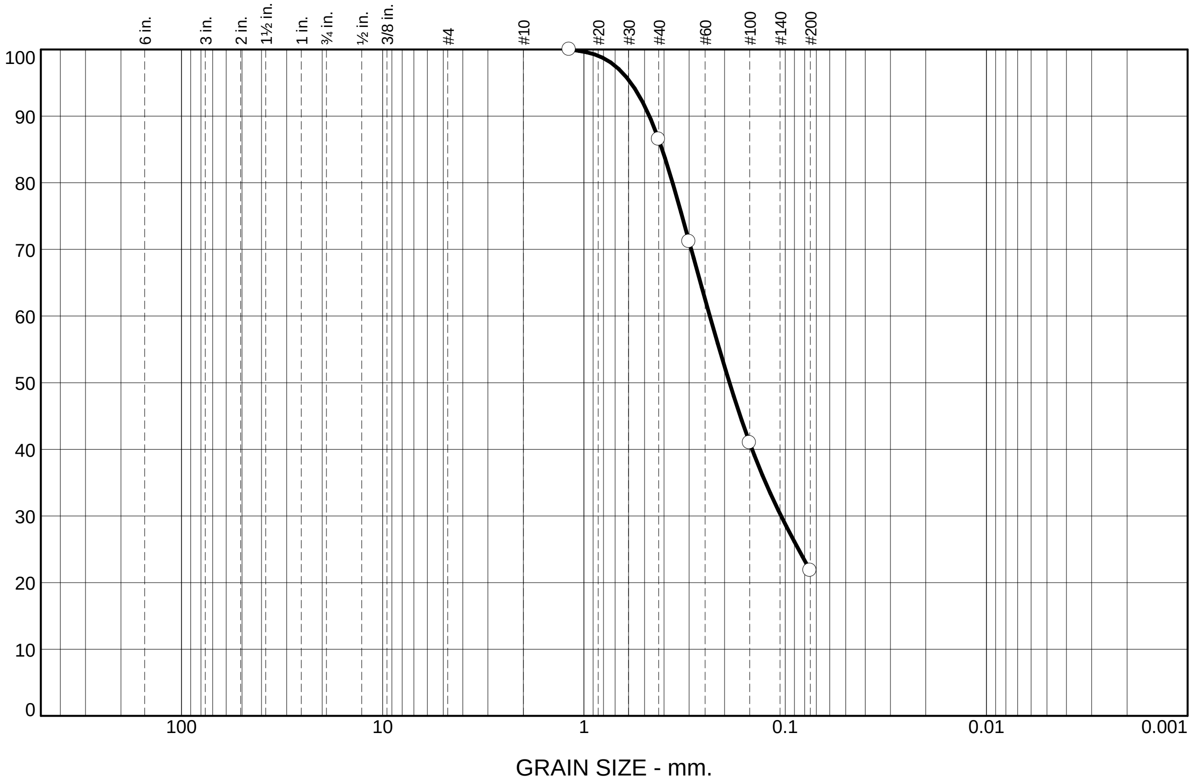
Location: BH19-25
Sample Number: 19-110-24 **Depth:** 7.5-9'
Date: 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-24

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	13.5	64.7	21.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#16	100.0		
#40	86.5		
#50	71.2		
#100	40.9		
#200	21.8		

* (no specification provided)

Material Description

Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.4725 D_{85}= 0.4082 D_{60}= 0.2369
D_{50}= 0.1891 D_{30}= 0.1047 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Natural Moisture Content: 35.3%

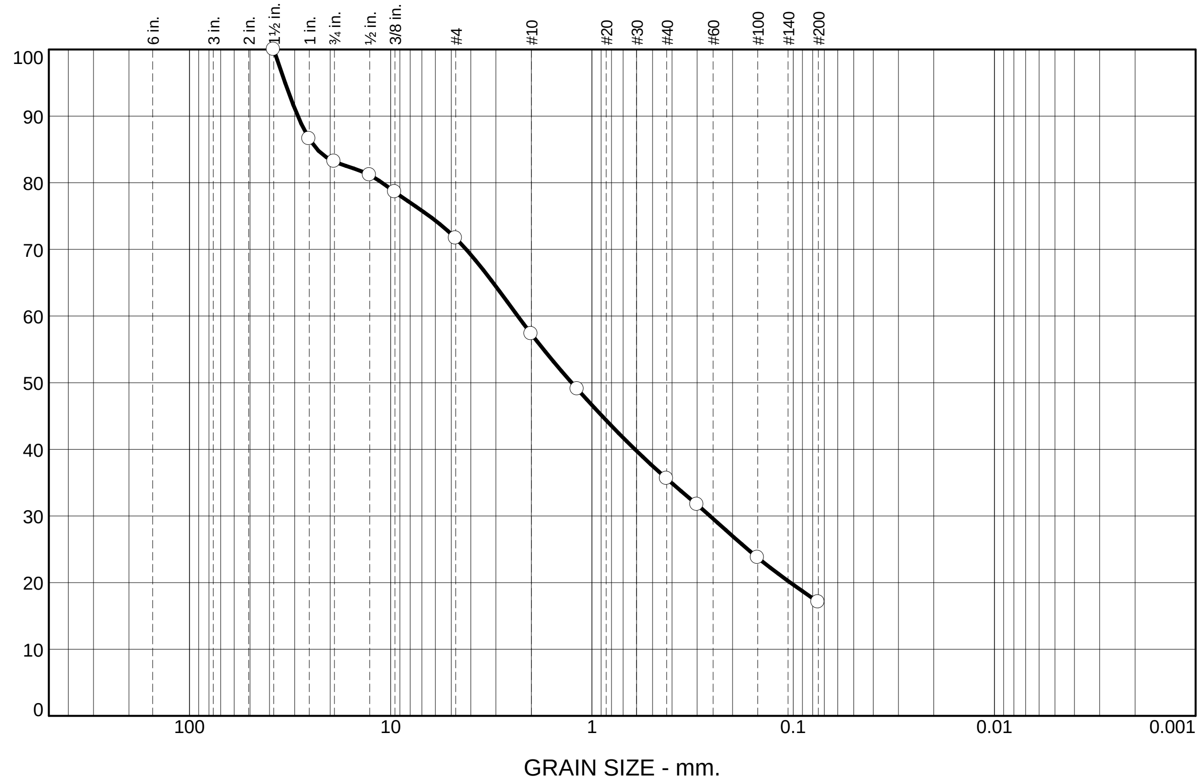
Location: BH19-25
Sample Number: 19-110-25 **Depth:** 15-16.5' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-25

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	16.8	11.5	14.4	21.7	18.5	17.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	86.6		
.75	83.2		
.5	81.2		
.375	78.6		
#4	71.7		
#10	57.3		
#16	49.0		
#40	35.6		
#50	31.7		
#100	23.7		
#200	17.1		

* (no specification provided)

Material Description

Brown silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 28.9248 D_{85}= 23.1909 D_{60}= 2.3361
D_{50}= 1.2606 D_{30}= 0.2590 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Natural Moisture Content: 13.5%

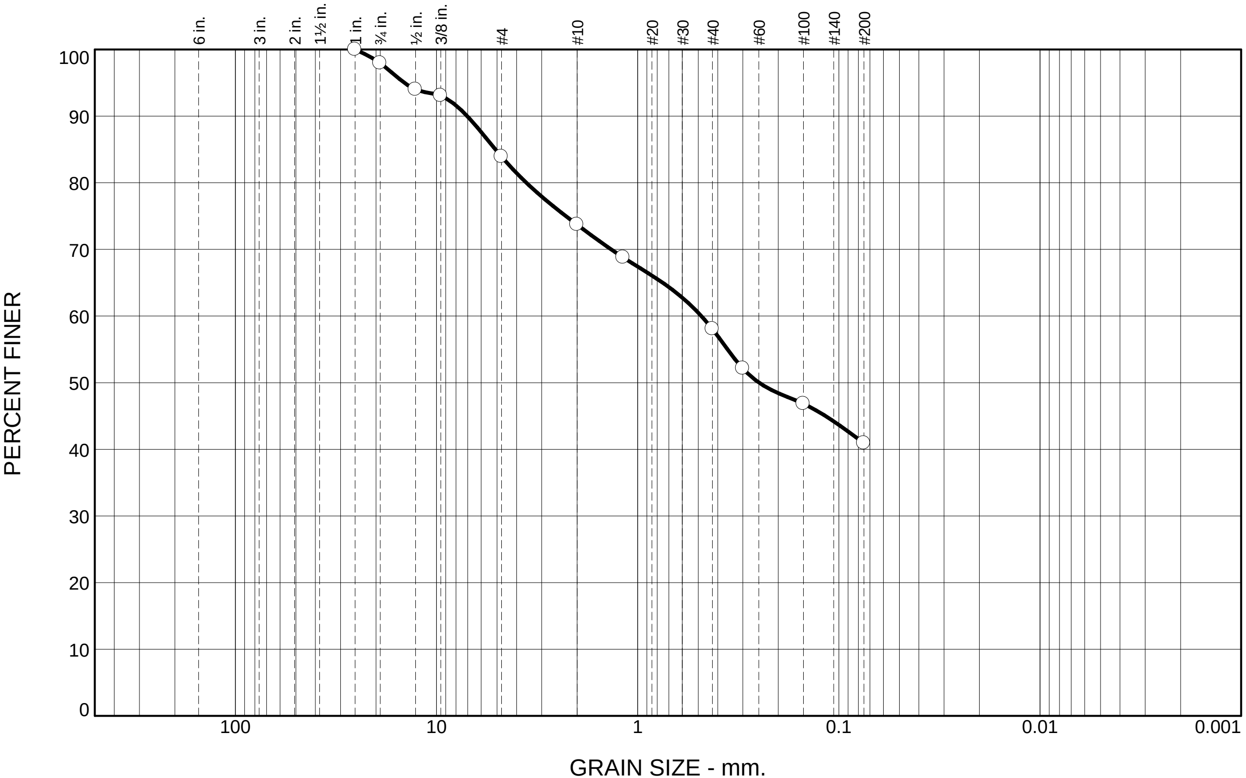
Location: BH19-26
Sample Number: 19-110-26 **Depth:** 5-6' **Date:** 4/26/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-26

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.1	14.0	10.2	15.6	17.2	40.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	97.9		
.5	94.0		
.375	93.0		
#4	83.9		
#10	73.7		
#16	68.8		
#40	58.1		
#50	52.1		
#100	46.8		
#200	40.9		

* (no specification provided)

Material Description

Brown clayey sand with gravel

Atterberg Limits

PL= 16 LL= 37 PI= 21

Coefficients

D_{90}= 7.0344 D_{85}= 5.0939 D_{60}= 0.4822
D_{50}= 0.2492 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-6(4)

Remarks

Natural Moisture Content: 15.6%

Location: BH19-28
Sample Number: 19-110-27 **Depth:** 8.5-9' **Date:** 4/25/2019

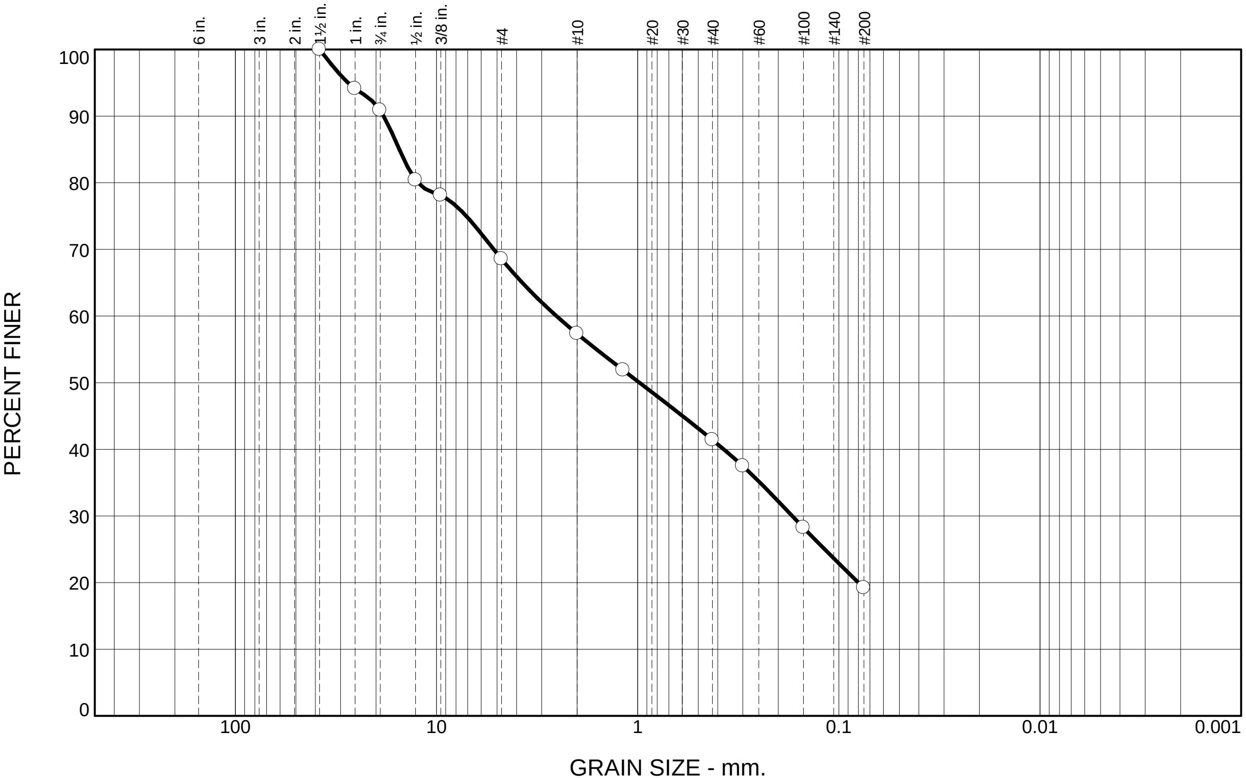
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-110-27

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	9.2	22.3	11.1	16.0	22.2	19.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	94.1		
.75	90.8		
.5	80.4		
.375	78.1		
#4	68.5		
#10	57.4		
#16	51.9		
#40	41.4		
#50	37.5		
#100	28.2		
#200	19.2		

* (no specification provided)

Material Description

Light Brown silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 18.3119 D_{85}= 15.2925 D_{60}= 2.5320
D_{50}= 0.9786 D_{30}= 0.1705 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Natural Moisture Content: 12.7%

Location: BH19-29
Sample Number: 19-110-28 **Depth:** 2.5-4' **Date:** 4/25/2019

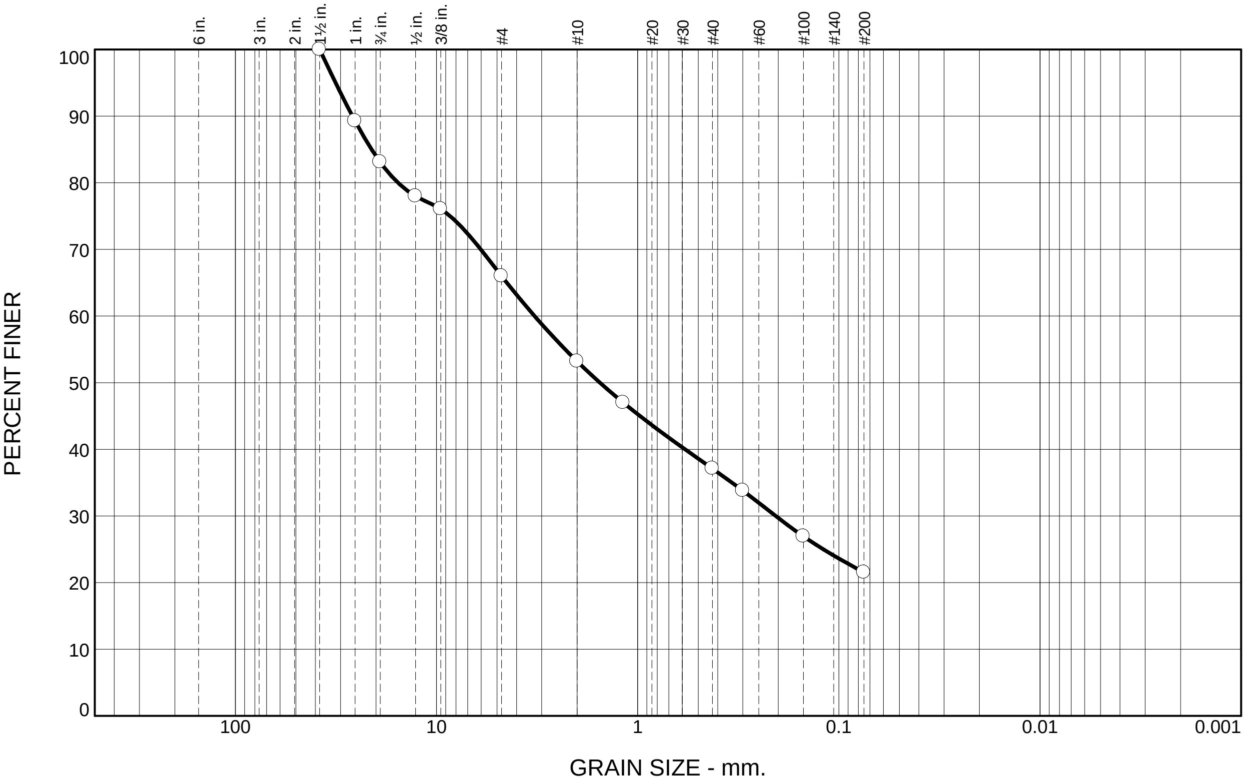
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-110-28

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	16.9	17.1	12.8	16.1	15.6	21.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	89.3		
.75	83.1		
.5	78.0		
.375	76.1		
#4	66.0		
#10	53.2		
#16	47.0		
#40	37.1		
#50	33.8		
#100	26.9		
#200	21.5		

* (no specification provided)

Material Description

Light Brown clayey sand with gravel

Atterberg Limits

PL= 21 LL= 31 PI= 10

Coefficients

D_{90}= 26.1767 D_{85}= 21.0255 D_{60}= 3.2559
D_{50}= 1.5405 D_{30}= 0.2060 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-4(0)

Remarks

Natural Moisture Content: 7.5%

Location: BH19-29
Sample Number: 19-110-29 **Depth:** 7.5-9' **Date:** 4/25/2019

NewFields

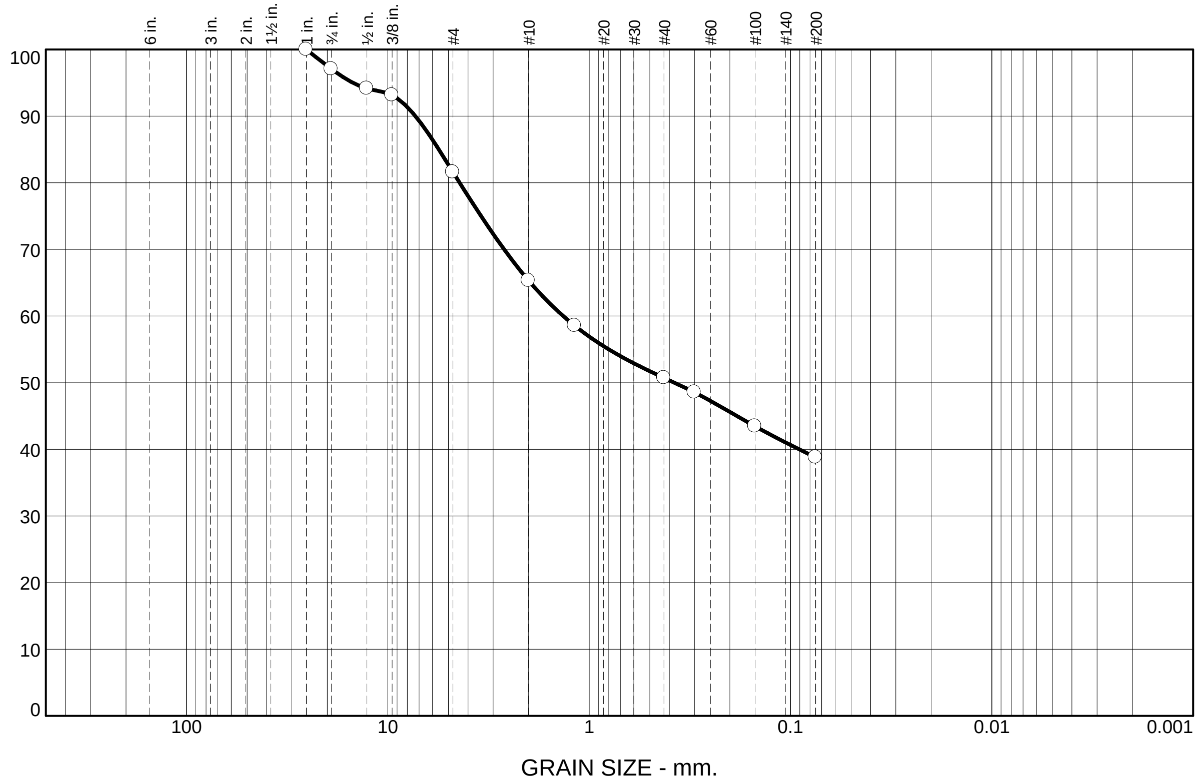
Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-110-29

Tested By: JH/CB **Checked By:** JH

Test results included in this report relate only to the items inspected or tested. This report shall not be reproduced, in full, without prior written approval of NewFields.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.9	15.5	16.3	14.6	11.9	38.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	97.1		
.5	94.1		
.375	93.1		
#4	81.6		
#10	65.3		
#16	58.6		
#40	50.7		
#50	48.5		
#100	43.5		
#200	38.8		

* (no specification provided)

Material Description

Light Brown clayey sand with gravel

Atterberg Limits

PL= 19 LL= 47 PI= 28

Coefficients

D_{90}= 7.2941 D_{85}= 5.5841 D_{60}= 1.3456
D_{50}= 0.3772 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-7-6(5)

Remarks

Natural Moisture Content: 15.3%

Location: BH19-29
Sample Number: 19-110-30 **Depth:** 15-16.5' **Date:** 4/25/2019

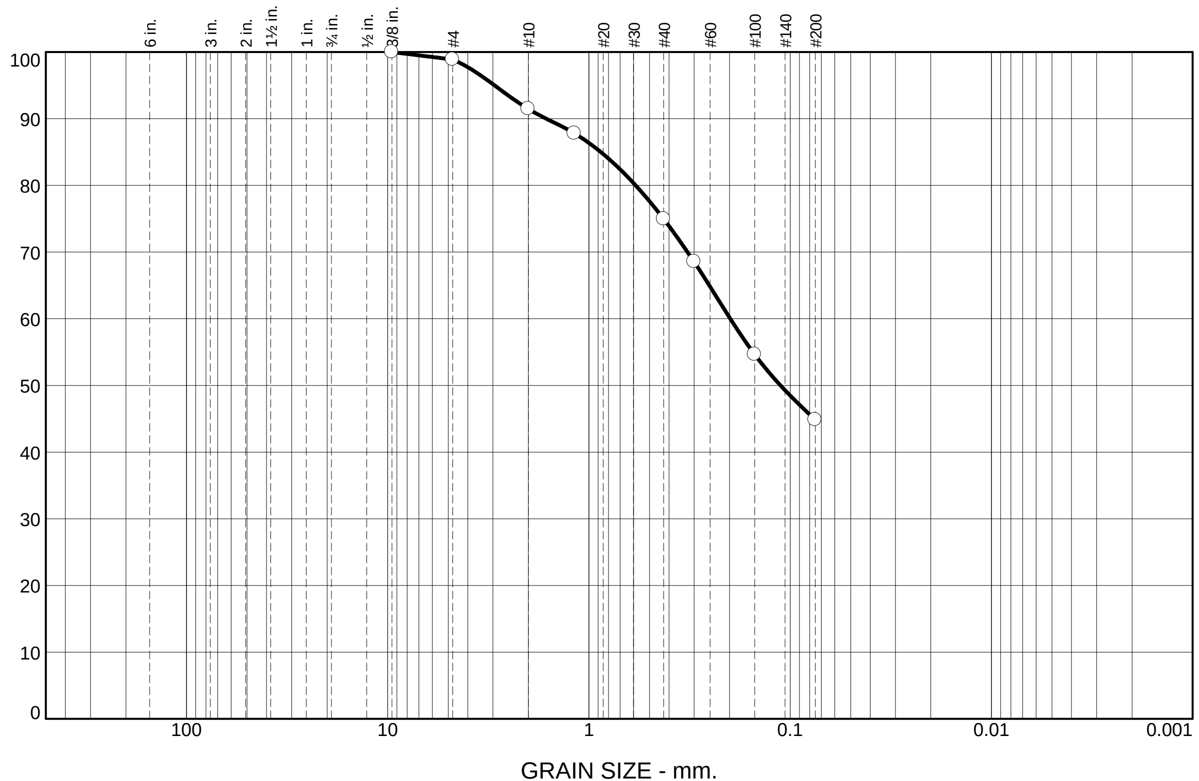
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-110-30

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.1	7.4	16.5	30.2	44.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	98.9		
#10	91.5		
#16	87.8		
#40	75.0		
#50	68.5		
#100	54.6		
#200	44.8		

* (no specification provided)

Material Description

Brown clayey sand

Atterberg Limits

PL= 25 LL= 62 PI= 37

Coefficients

D_{90}= 1.6285 D_{85}= 0.8722 D_{60}= 0.1984
D_{50}= 0.1117 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-7-6(11)

Remarks

Natural Moisture Content: 23.4%

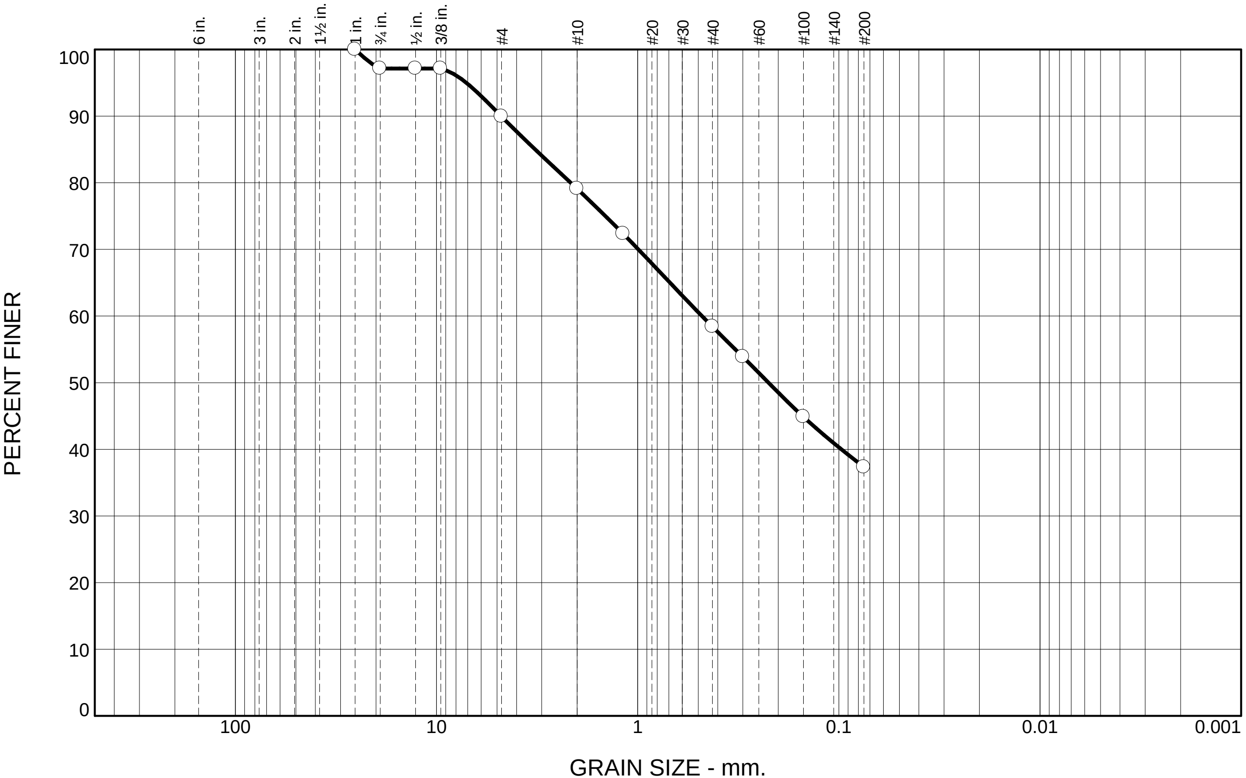
Location: BH19-29
Sample Number: 19-110-31 **Depth:** 25-26' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-31

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.9	7.2	10.8	20.7	21.1	37.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	97.1		
.5	97.1		
.375	97.1		
#4	89.9		
#10	79.1		
#16	72.3		
#40	58.4		
#50	53.9		
#100	44.9		
#200	37.3		

* (no specification provided)

Material Description

Brown clayey sand

Atterberg Limits

PL= 22 LL= 61 PI= 39

Coefficients

D_{90}= 4.7738 D_{85}= 3.2315 D_{60}= 0.4791
D_{50}= 0.2238 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-7-6(7)

Remarks

Natural Moisture Content: 16.8%

Location: BH19-31
Sample Number: 19-110-32 **Depth:** 5.5-6' **Date:** 4/25/2019

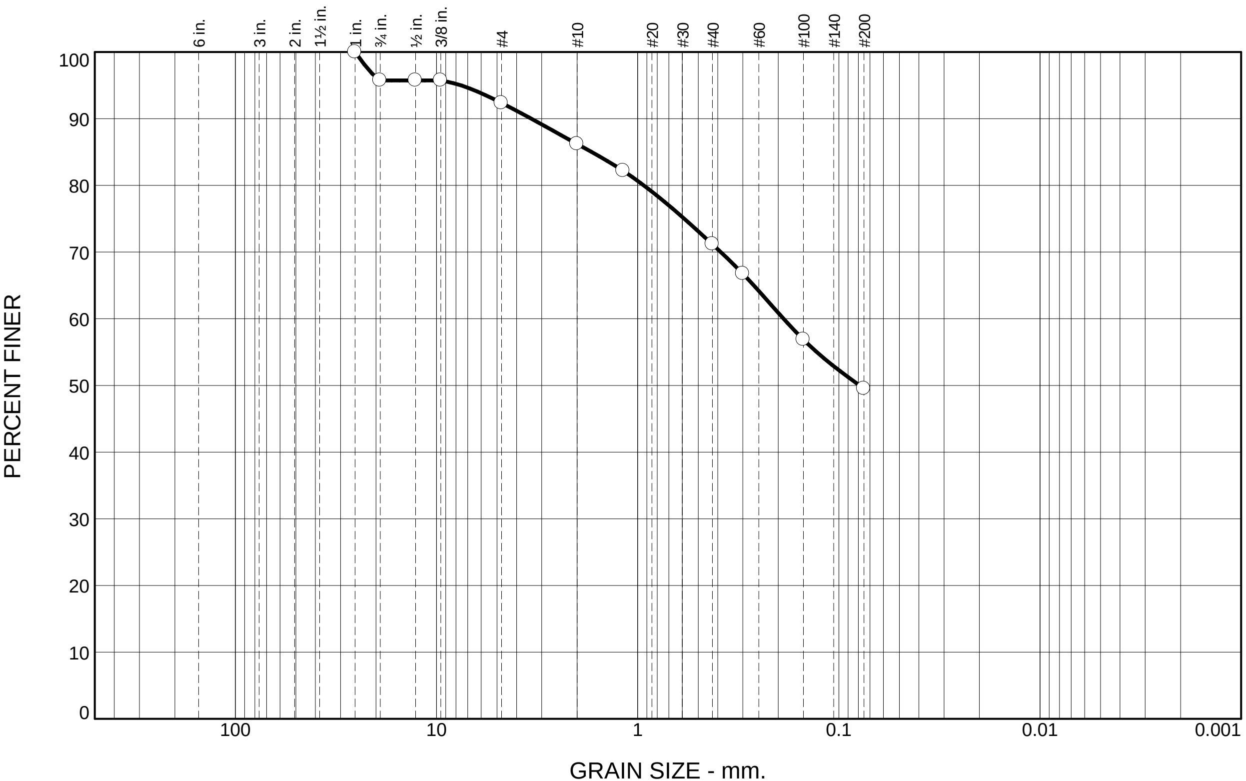
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-110-32

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.3	3.3	6.2	15.0	21.7	49.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	95.7		
.5	95.7		
.375	95.7		
#4	92.4		
#10	86.2		
#16	82.2		
#40	71.2		
#50	66.8		
#100	56.9		
#200	49.5		

* (no specification provided)

Material Description

Light Brown clayey sand

Atterberg Limits

PL= 21 LL= 55 PI= 34

Coefficients

D_{90}= 3.3764 D_{85}= 1.6924 D_{60}= 0.1883
D_{50}= 0.0789 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-7-6(13)

Remarks

Natural Moisture Content: 20.3%

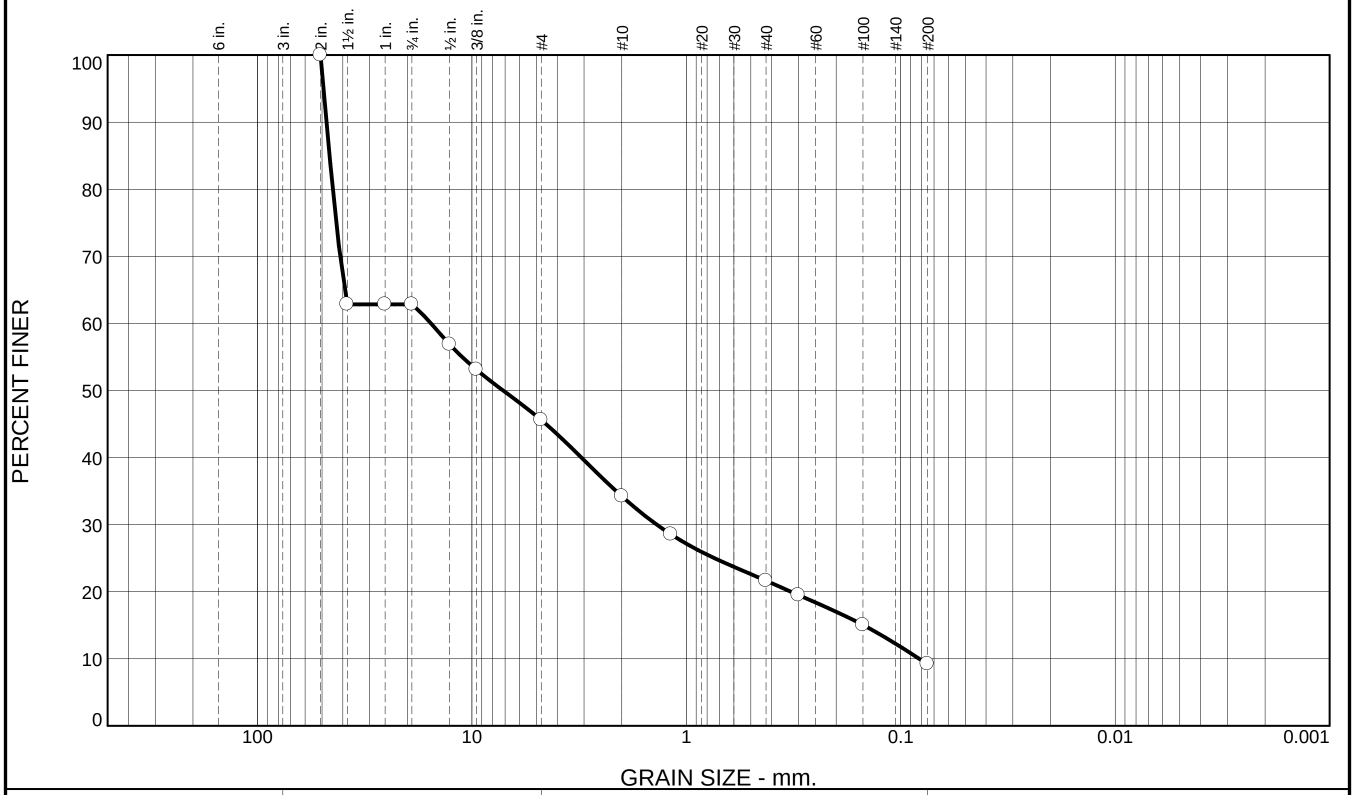
Location: BH19-32
Sample Number: 19-110-33 **Depth:** 15-16.5' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-33

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	37.2	17.2	11.4	12.6	12.4	9.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2"	100.0		
1.5"	62.8		
1"	62.8		
.75"	62.8		
.5"	56.9		
.375"	53.1		
#4	45.6		
#10	34.2		
#16	28.5		
#40	21.6		
#50	19.5		
#100	15.0		
#200	9.2		

* (no specification provided)

Material Description

Light Brown well-graded gravel with silt and sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 47.6644 D_{85}= 46.1168 D_{60}= 15.5221
D_{50}= 7.1564 D_{30}= 1.3749 D_{15}= 0.1492
D_{10}= 0.0819 C_u= 189.43 C_c= 1.49

Classification

USCS= GW-GM AASHTO= A-1-a

Remarks

Location: BH19-33
Sample Number: 20-020-01 **Depth:** 2.5-3' **Date:** 2/6/2020

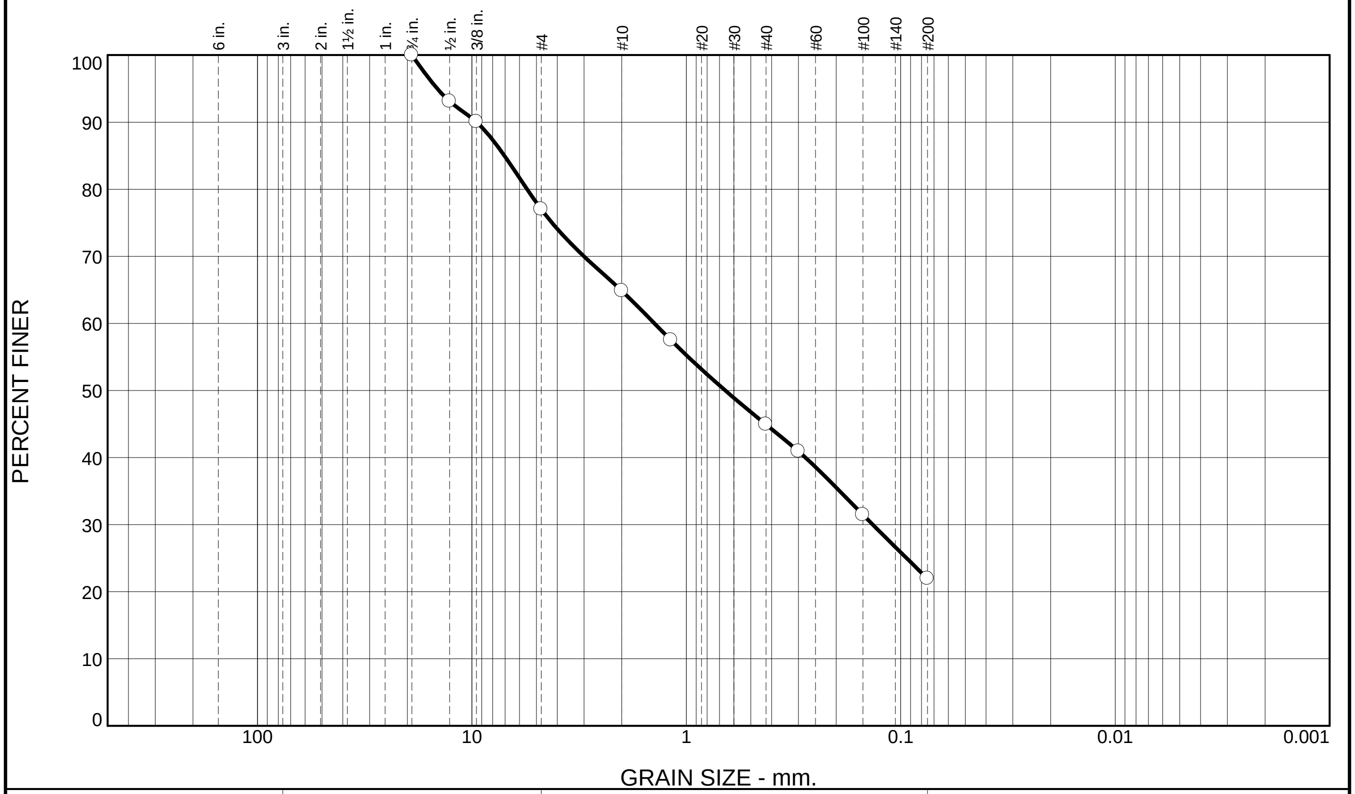
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 20-020-01

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	23.0	12.1	20.0	23.0	21.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75"	100.0		
.5"	93.1		
.375"	90.0		
#4	77.0		
#10	64.9		
#16	57.5		
#40	44.9		
#50	40.9		
#100	31.5		
#200	21.9		

* (no specification provided)

Material Description

Light Brown silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 9.4985 D_{85}= 7.0489 D_{60}= 1.4093
D_{50}= 0.6582 D_{30}= 0.1352 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

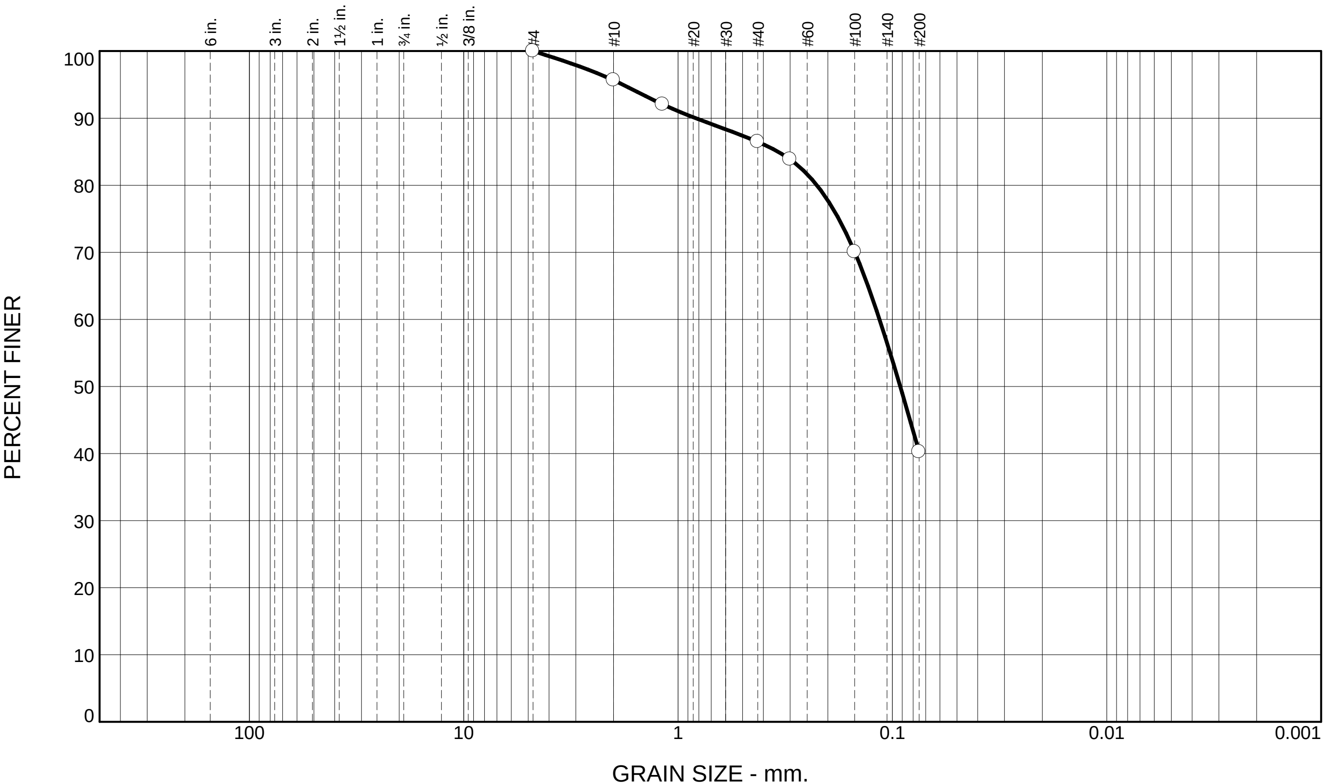
Location: BH19-33
Sample Number: 20-020-02 **Depth:** 7.5-8.5' **Date:** 2/6/2020

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 20-020-02

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	4.3	9.2	46.3	40.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	95.7		
#16	92.0		
#40	86.5		
#50	83.9		
#100	70.1		
#200	40.2		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.8280 D_{85}= 0.3415 D_{60}= 0.1150
D_{50}= 0.0920 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-4(0)

Remarks

Location: BH19-33
Sample Number: 20-020-04 **Depth:** 25-25.5' **Date:** 2/6/2020

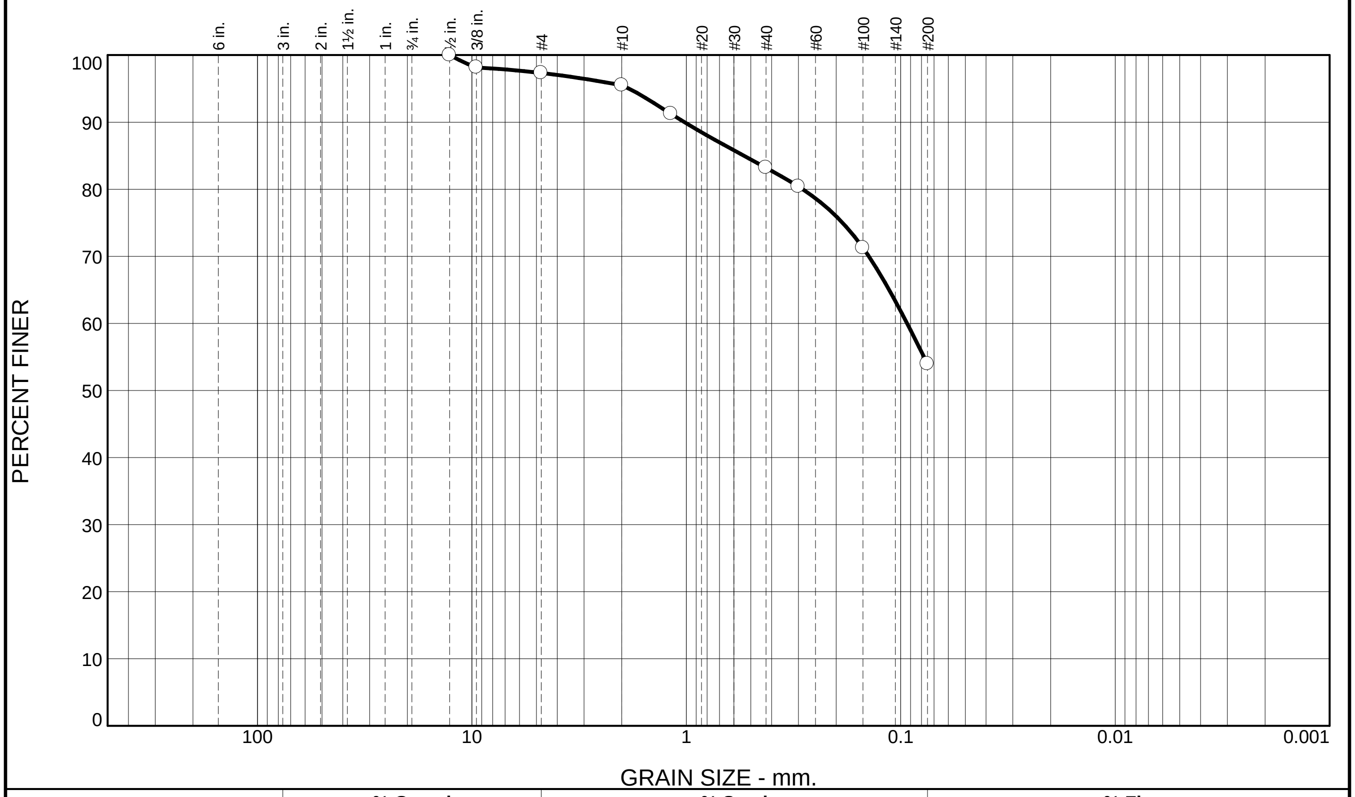
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 20-020-04

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.7	1.8	12.3	29.2	54.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5"	100.0		
.375"	98.2		
#4	97.3		
#10	95.5		
#16	91.2		
#40	83.2		
#50	80.4		
#100	71.3		
#200	54.0		

* (no specification provided)

Material Description

Light Brown sandy silt

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 1.0205 D_{85}= 0.5395 D_{60}= 0.0935
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO= A-4(0)

Remarks

Location: BH19-34
Sample Number: 20-020-05 **Depth:** 2.5-3' **Date:** 2/6/2020

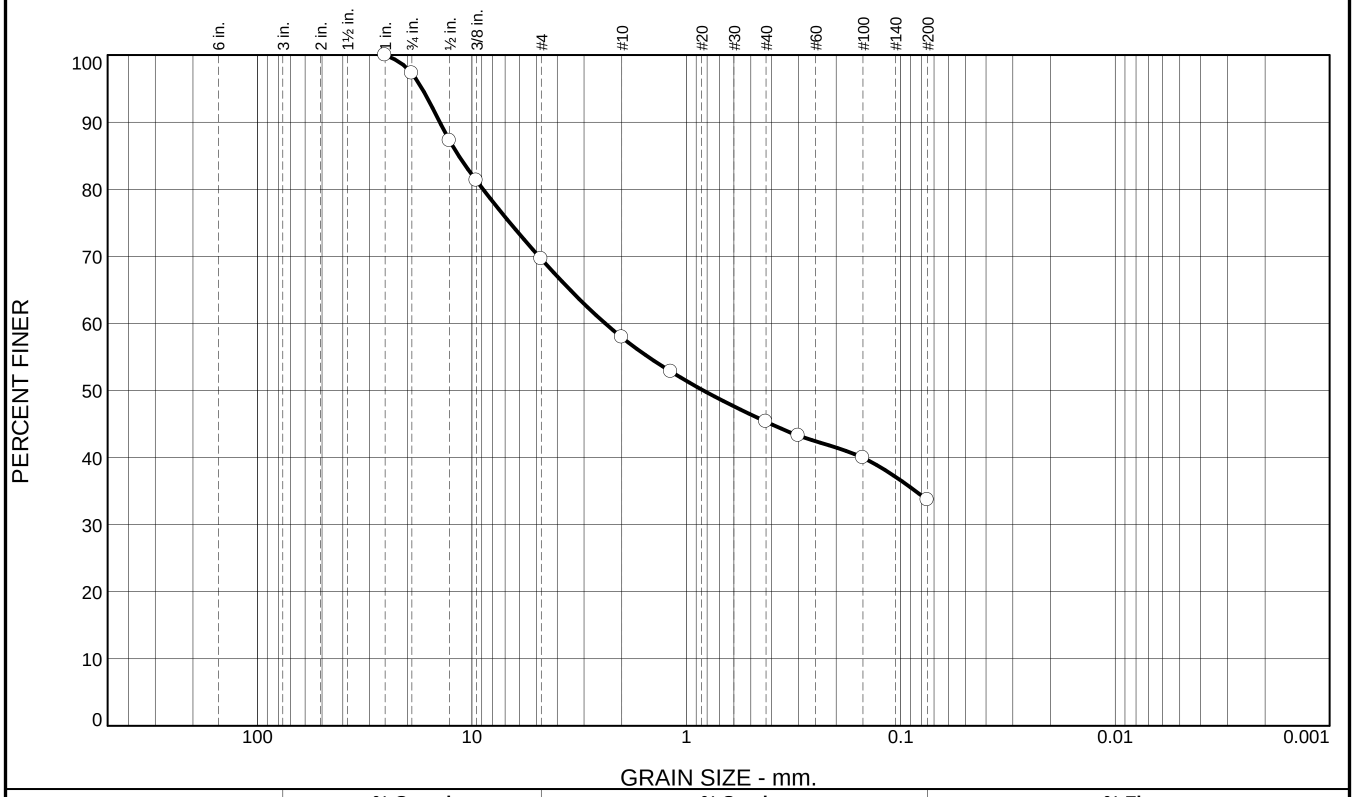
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 20-020-05

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.7	27.7	11.7	12.6	11.6	33.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
.75"	97.3		
.5"	87.2		
.375"	81.3		
#4	69.6		
#10	57.9		
#16	52.8		
#40	45.3		
#50	43.3		
#100	40.0		
#200	33.7		

* (no specification provided)

Material Description

Red clayey sand with gravel

Atterberg Limits

PL= 24 LL= 48 PI= 24

Coefficients

D_{90}= 14.1140 D_{85}= 11.5235 D_{60}= 2.3894
D_{50}= 0.8324 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-7(3)

Remarks

Location: BH19-34
Sample Number: 20-020-07 **Depth:** 10-11.5' **Date:** 2/6/2020

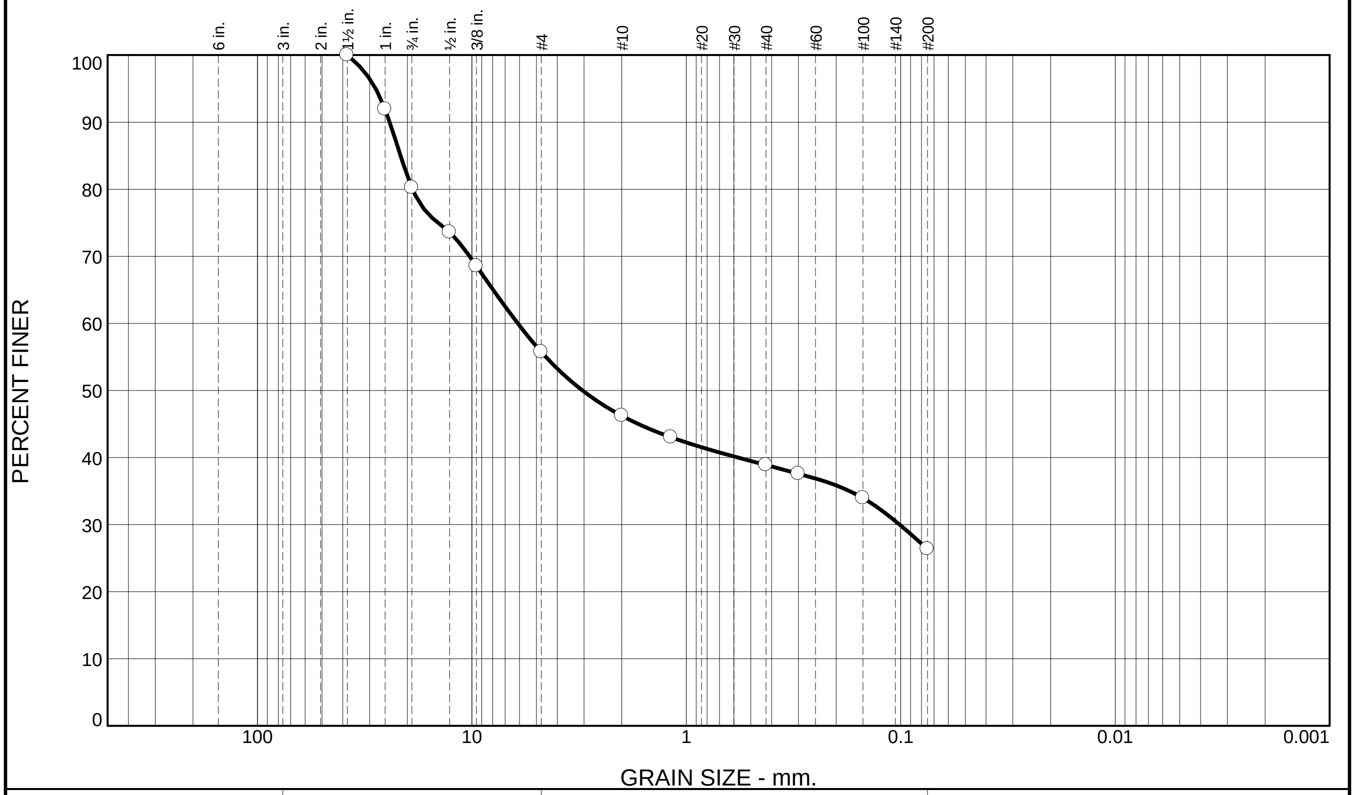
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 20-020-07

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	19.8	24.5	9.5	7.3	12.6	26.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5"	100.0		
1"	91.9		
.75"	80.2		
.5"	73.6		
.375"	68.6		
#4	55.7		
#10	46.2		
#16	43.0		
#40	38.9		
#50	37.6		
#100	34.0		
#200	26.3		

* (no specification provided)

Material Description

Light Brown silty gravel with sand

Atterberg Limits

PL= 35 LL= 47 PI= 12

Coefficients

D_{90}= 24.1706 D_{85}= 21.5216 D_{60}= 6.1084
D_{50}= 3.0512 D_{30}= 0.1013 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= GM AASHTO= A-2-7(0)

Remarks

Location: BH19-35
Sample Number: 20-020-09 **Depth:** 7.5-8.5' **Date:** 2/6/2020

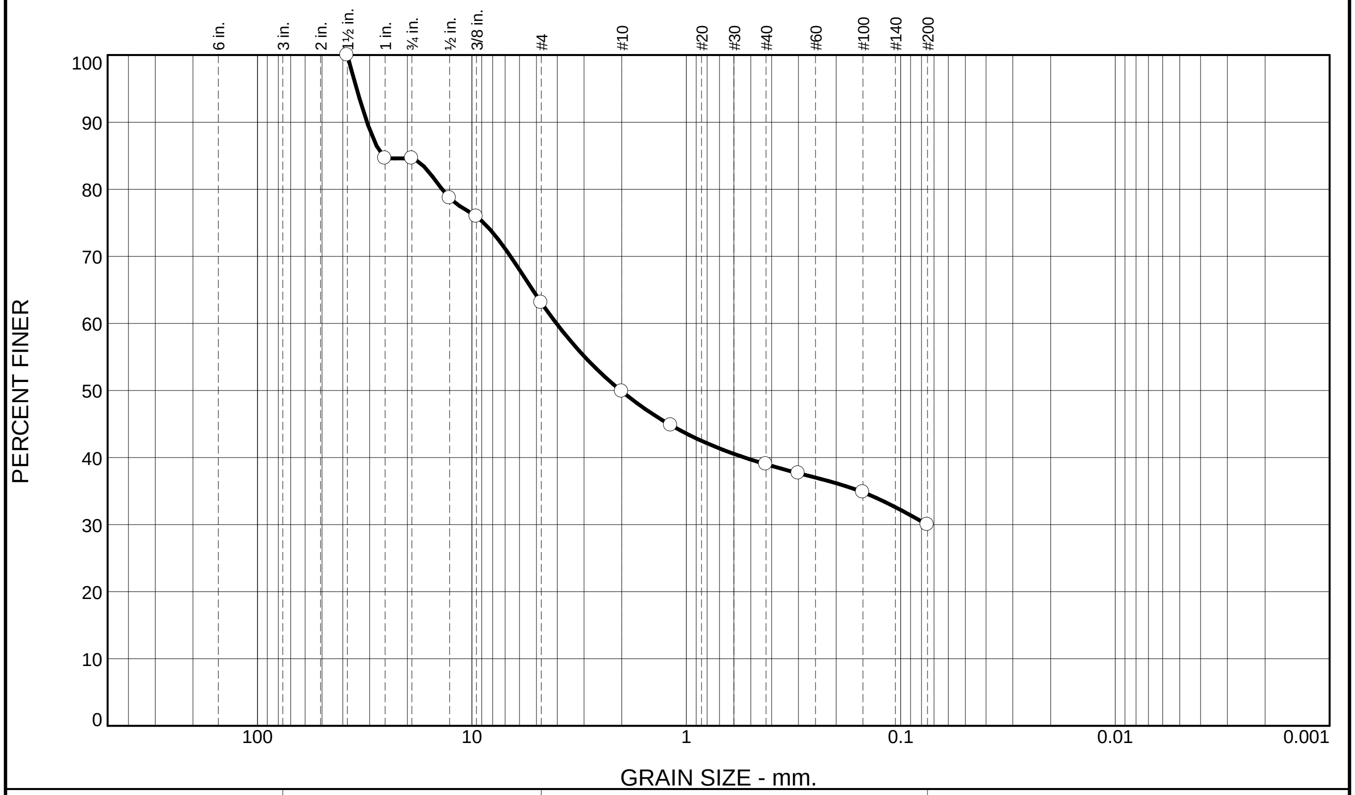
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 20-020-09

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	15.4	21.5	13.2	10.9	9.0	30.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5"	100.0		
1"	84.6		
.75"	84.6		
.5"	78.7		
.375"	75.9		
#4	63.1		
#10	49.9		
#16	44.8		
#40	39.0		
#50	37.7		
#100	34.8		
#200	30.0		

* (no specification provided)

Material Description

Brown silty gravel with sand

Atterberg Limits

PL= 34 LL= 59 PI= 25

Coefficients

D_{90}= 30.8416 D_{85}= 26.0946 D_{60}= 4.0377

D_{50}= 2.0240 D_{30}= 0.0752 D_{15}=

D_{10}= C_u= C_c=

Classification

USCS= GM AASHTO= A-2-7(2)

Remarks

Location: BH19-35

Sample Number: 20-020-11 **Depth:** 15-16' **Date:** 2/6/2020

NewFields

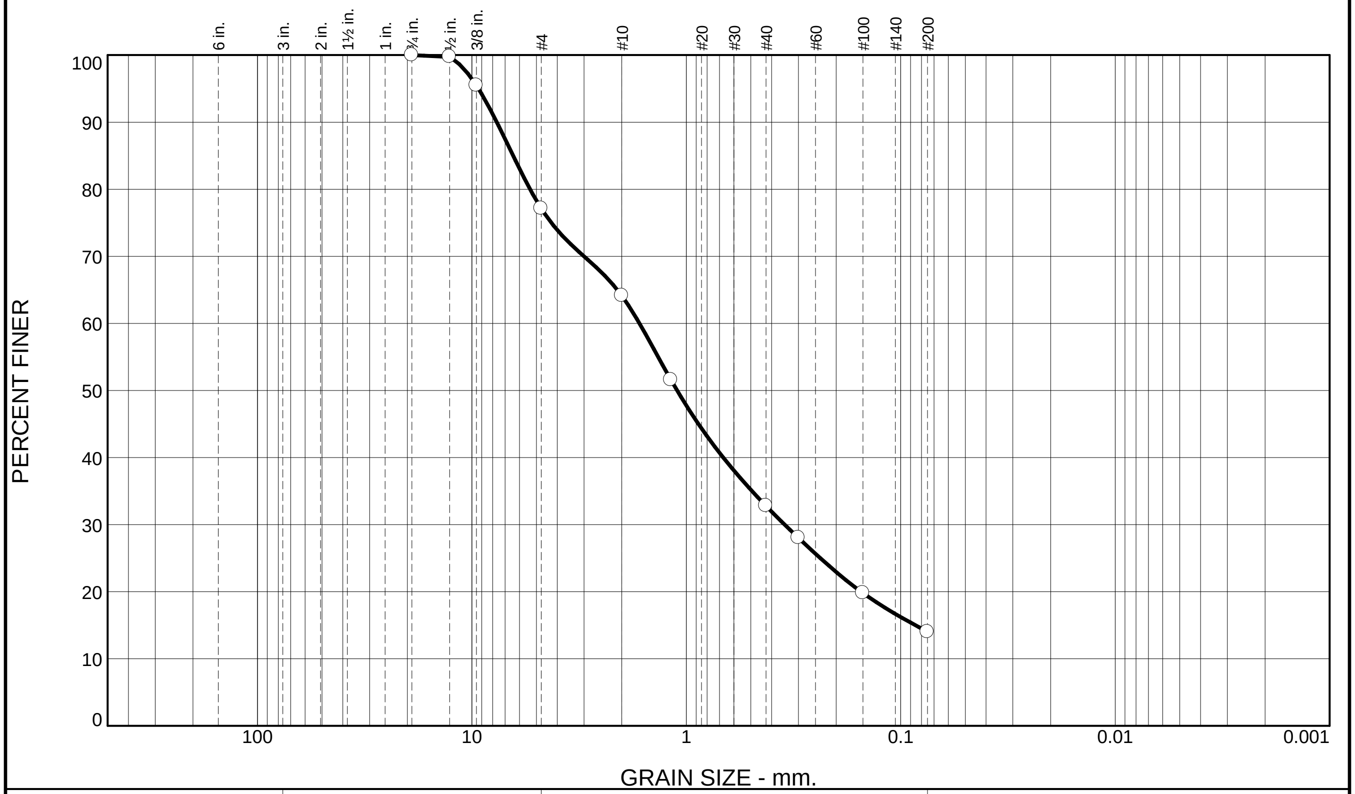
Client: Lithium Nevada

Project: Thacker Pass

Project No: 475.0385.000 **Figure** 20-020-11

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	22.9	13.0	31.3	18.8	14.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75"	100.0		
.5"	99.7		
.375"	95.5		
#4	77.1		
#10	64.1		
#16	51.6		
#40	32.8		
#50	28.0		
#100	19.8		
#200	14.0		

* (no specification provided)

Material Description

Gray silty sand with gravel

Atterberg Limits

PL= NP
LL= NP
PI= NP

Coefficients

D_{90}= 7.6504
D_{85}= 6.4191
D_{60}= 1.6546
D_{50}= 1.1048
D_{30}= 0.3479
D_{15}= 0.0855
D_{10}=
C_u=
C_c=

Classification

USCS= SM
AASHTO= A-1-b

Remarks

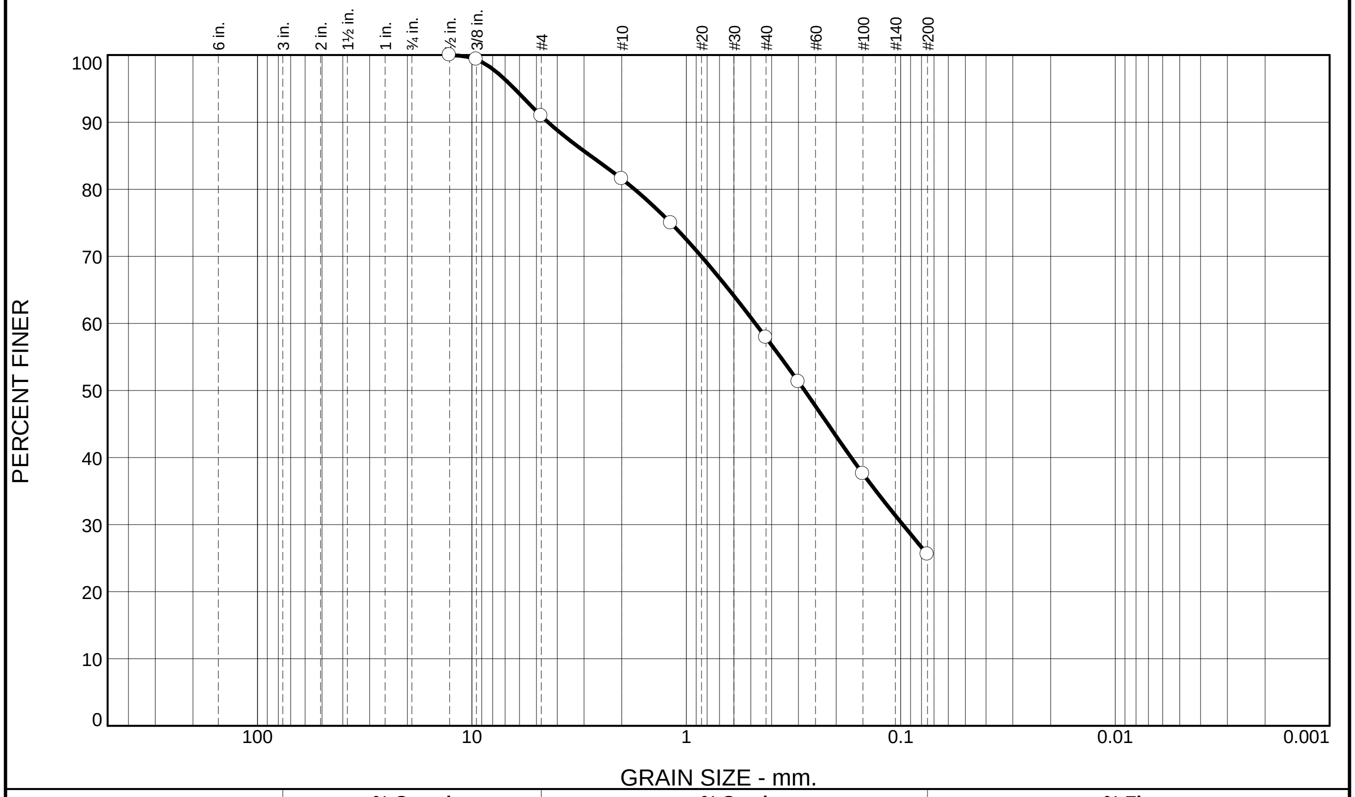
Location: BH19-35
Sample Number: 20-020-12 **Depth:** 35-35.5' **Date:** 2/6/2020

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 20-020-12

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	9.1	9.4	23.6	32.3	25.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5"	100.0		
.375"	99.4		
#4	90.9		
#10	81.5		
#16	74.9		
#40	57.9		
#50	51.3		
#100	37.6		
#200	25.6		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 4.4200 D_{85}= 2.8007 D_{60}= 0.4770
D_{50}= 0.2809 D_{30}= 0.0979 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

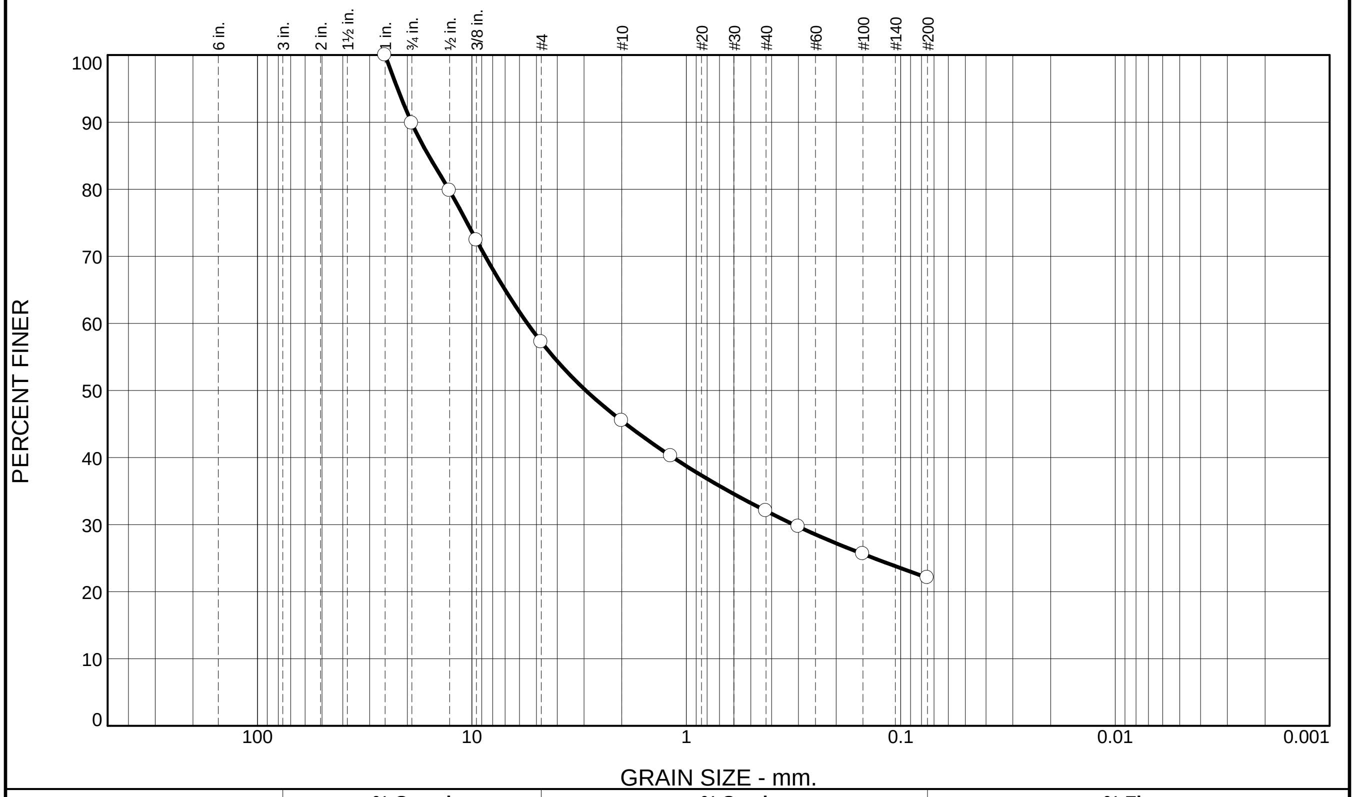
Location: BH19-36
Sample Number: 20-020-14 **Depth:** 5-6.5' **Date:** 2/6/2020

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 20-020-14

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	10.2	32.6	11.7	13.5	9.9	22.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
.75"	89.8		
.5"	79.8		
.375"	72.4		
#4	57.2		
#10	45.5		
#16	40.2		
#40	32.0		
#50	29.7		
#100	25.6		
#200	22.1		

* (no specification provided)

Material Description

Light Brown silty gravel with sand

Atterberg Limits

PL= 29 LL= 47 PI= 18

Coefficients

D_{90}= 19.1567 D_{85}= 15.8955 D_{60}= 5.5135
D_{50}= 2.9428 D_{30}= 0.3151 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= GM AASHTO= A-2-7(1)

Remarks

Location: BH19-36
Sample Number: 20-020-16 **Depth:** 10-11.3' **Date:** 2/6/2020

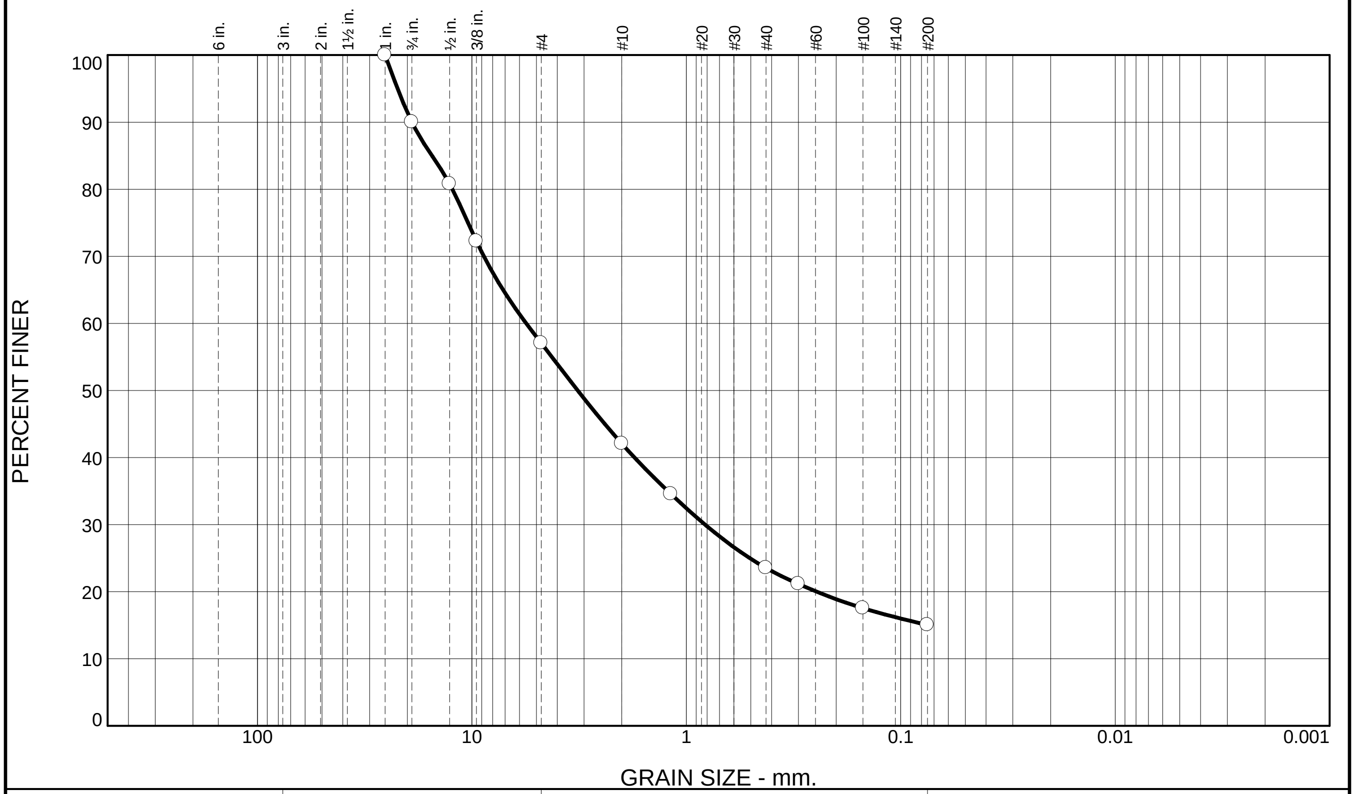
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 20-020-16

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	10.0	32.9	15.0	18.6	8.5	15.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
.75"	90.0		
.5"	80.8		
.375"	72.3		
#4	57.1		
#10	42.1		
#16	34.6		
#40	23.5		
#50	21.1		
#100	17.5		
#200	15.0		

* (no specification provided)

Material Description

Red clayey gravel with sand

Atterberg Limits

PL= 21 LL= 48 PI= 27

Coefficients

D_{90}= 19.0455 D_{85}= 15.3401 D_{60}= 5.5793
D_{50}= 3.2097 D_{30}= 0.8177 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= GC AASHTO= A-2-7(0)

Remarks

Location: BH19-36
Sample Number: 20-020-17 **Depth:** 35-36.5' **Date:** 2/6/2020

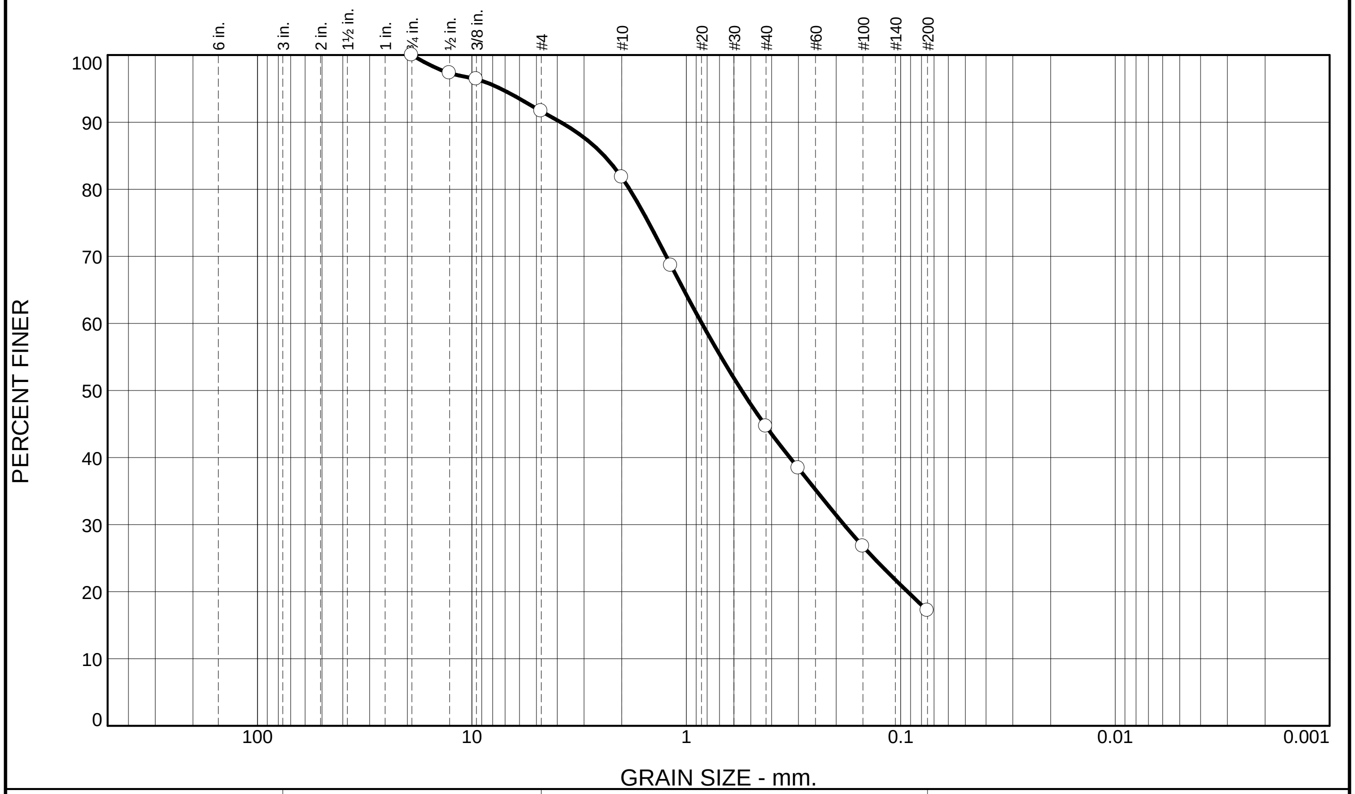
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 20-020-17

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	8.4	9.8	37.2	27.4	17.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75"	100.0		
.5"	97.3		
.375"	96.4		
#4	91.6		
#10	81.8		
#16	68.6		
#40	44.6		
#50	38.4		
#100	26.8		
#200	17.2		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 3.8586 D_{85}= 2.4147 D_{60}= 0.8459

D_{50}= 0.5520 D_{30}= 0.1839 D_{15}=

D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Location: BH19-37

Sample Number: 20-020-18 **Depth:** 2.5-3' **Date:** 2/6/2020

NewFields

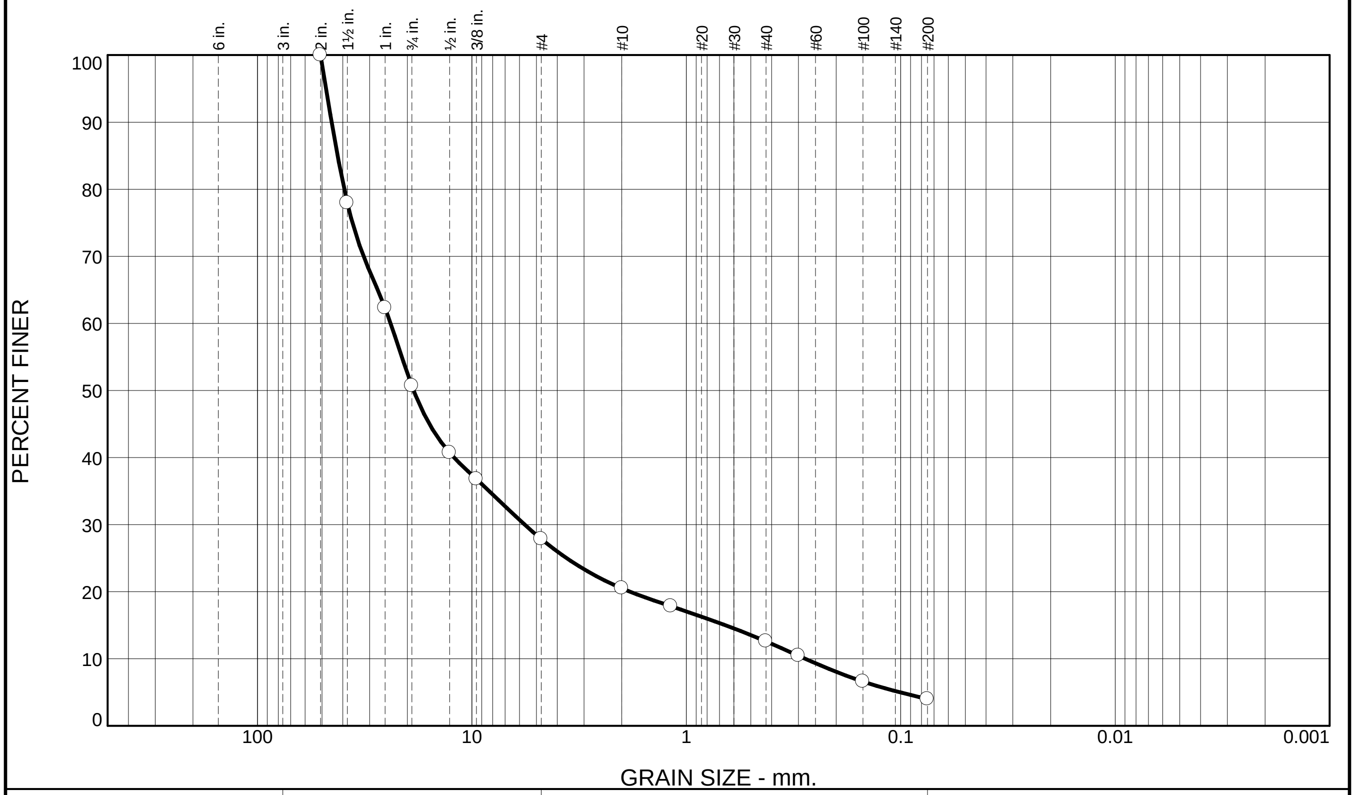
Client: Lithium Nevada

Project: Thacker Pass

Project No: 475.0385.000 **Figure** 20-020-18

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	49.3	22.9	7.3	7.9	8.6	4.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2"	100.0		
1.5"	77.9		
1"	62.3		
.75"	50.7		
.5"	40.7		
.375"	36.8		
#4	27.8		
#10	20.5		
#16	17.8		
#40	12.6		
#50	10.4		
#100	6.6		
#200	4.0		

* (no specification provided)

Material Description

Light Brown poorly graded gravel with sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 45.1070 D_{85}= 42.3108 D_{60}= 23.9302

D_{50}= 18.6919 D_{30}= 5.6749 D_{15}= 0.6582

D_{10}= 0.2789 C_u= 85.79 C_c= 4.82

Classification

USCS= GP AASHTO= A-1-a

Remarks

Location: BH19-37

Sample Number: 20-020-19 **Depth:** 7.5-8' **Date:** 2/6/2020

NewFields

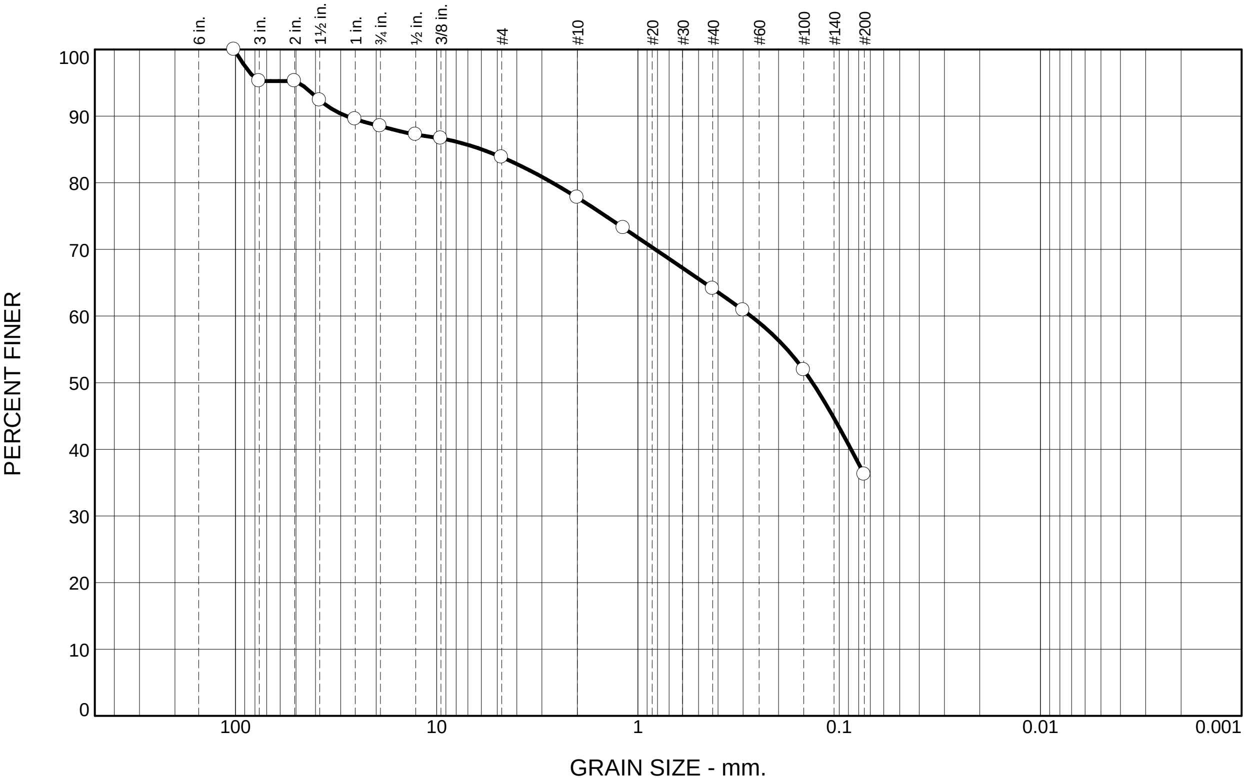
Client: Lithium Nevada

Project: Thacker Pass

Project No: 475.0385.000 **Figure** 20-020-19

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
4.7	6.8	4.7	6.0	13.7	27.9	36.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100.0		
3	95.3		
2	95.3		
1.5	92.4		
1	89.5		
.75	88.5		
.5	87.2		
.375	86.7		
#4	83.8		
#10	77.8		
#16	73.2		
#40	64.1		
#50	60.9		
#100	51.9		
#200	36.2		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 28.0127 D_{85}= 5.9592 D_{60}= 0.2747
D_{50}= 0.1357 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-4(0)

Remarks

Location: TP19-01
Sample Number: 19-060-01 **Depth:** 4-7' **Date:** 3/5/2019

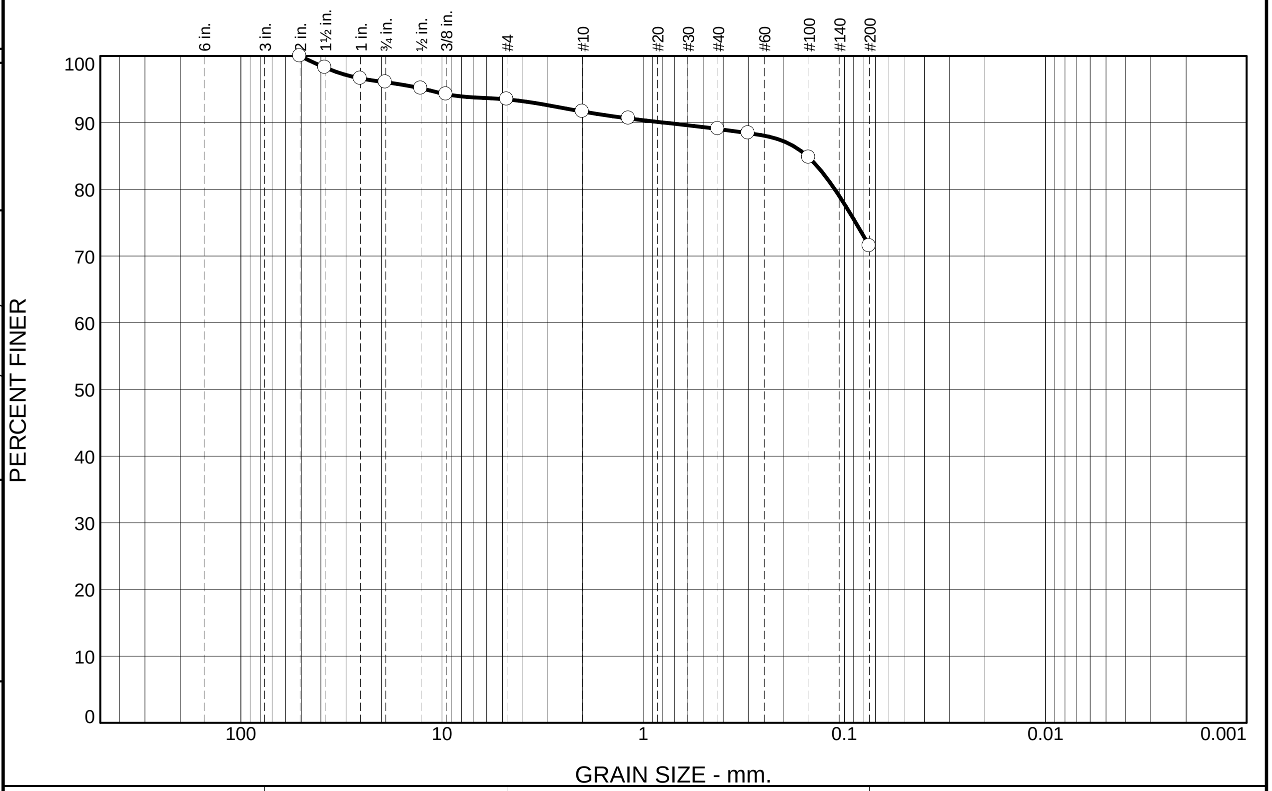
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-060-01

Tested By: KS/JB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.9	2.6	1.8	2.6	17.6	71.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2	100.0		
1.5	98.3		
1	96.6		
.75	96.1		
.5	95.1		
.375	94.3		
#4	93.5		
#10	91.7		
#16	90.6		
#40	89.1		
#50	88.4		
#100	84.8		
#200	71.5		

* (no specification provided)

Material Description

Dark Brown lean clay with sand

Atterberg Limits

PL= 21 LL= 33 PI= 12

Coefficients

D_{90}= 0.7771 D_{85}= 0.1529 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(7)

Remarks

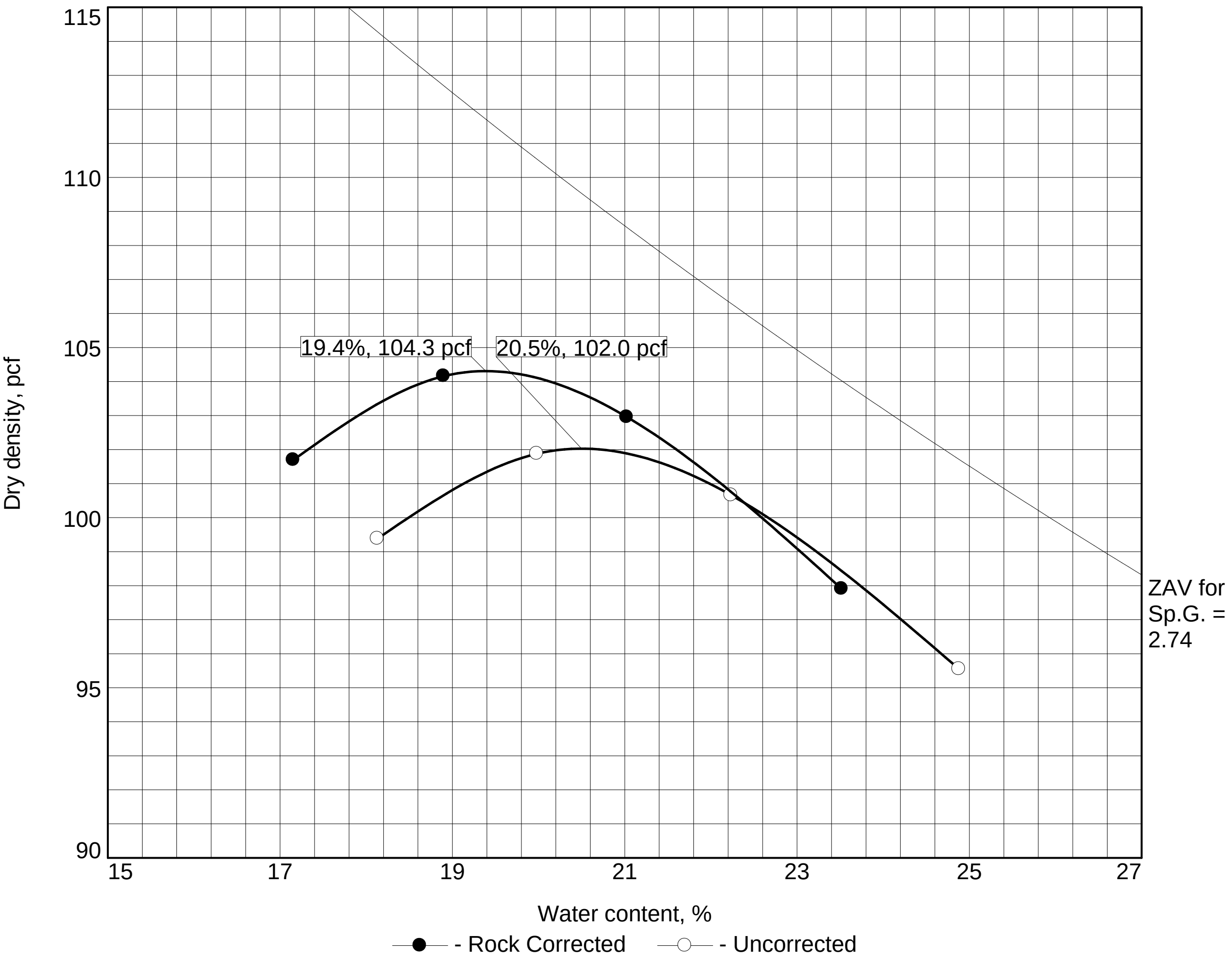
Location: TP19-02
Sample Number: 19-060-02 **Depth:** 0-2' **Date:** 3/5/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-02

Tested By: KS/JB **Checked By:** JH

COMPACTION TEST REPORT



Test specification: ASTM D 1557-12 Method B Modified
ASTM D4718-15 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in.	% < No.200
	USCS	AASHTO						
0-2'	CL	A-6(7)	29.4%	2.74	33	12	5.7	71.5

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 104.3 pcf	102.0 pcf	Dark Brown lean clay with sand
Optimum moisture = 19.4 %	20.5 %	

Project No. 475.0385.000 **Client:** Lithium Nevada
Project: Thacker Pass
Date: 4/26/2019
○ **Location:** TP19-02 **Sample Number:** 19-060-02

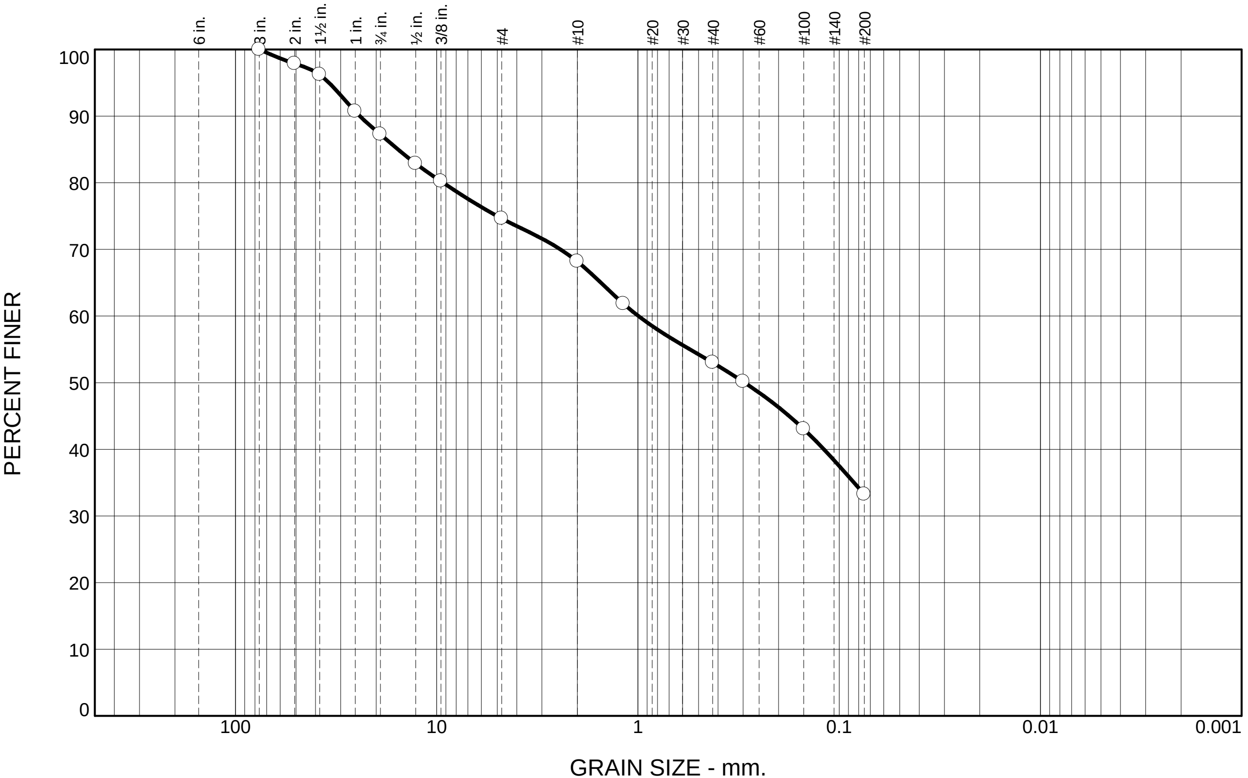
NewFields

Remarks:
*Assumed Specific Gravity

Figure 19-060-02

Tested By: CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.7	12.7	6.4	15.2	19.8	33.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	97.9		
1.5	96.2		
1	90.7		
.75	87.3		
.5	82.9		
.375	80.2		
#4	74.6		
#10	68.2		
#16	61.8		
#40	53.0		
#50	50.1		
#100	43.0		
#200	33.2		

* (no specification provided)

Material Description

Light Brown silty sand with gravel

Atterberg Limits

PL= 29 LL= 37 PI= 8

Coefficients

D_{90}= 24.0968 D_{85}= 15.5386 D_{60}= 0.9939
D_{50}= 0.2951 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Natural Moisture Content: 15.9%

Location: TP19-03
Sample Number: 19-106-02 **Depth:** 2-4' **Date:** 4/22/2019

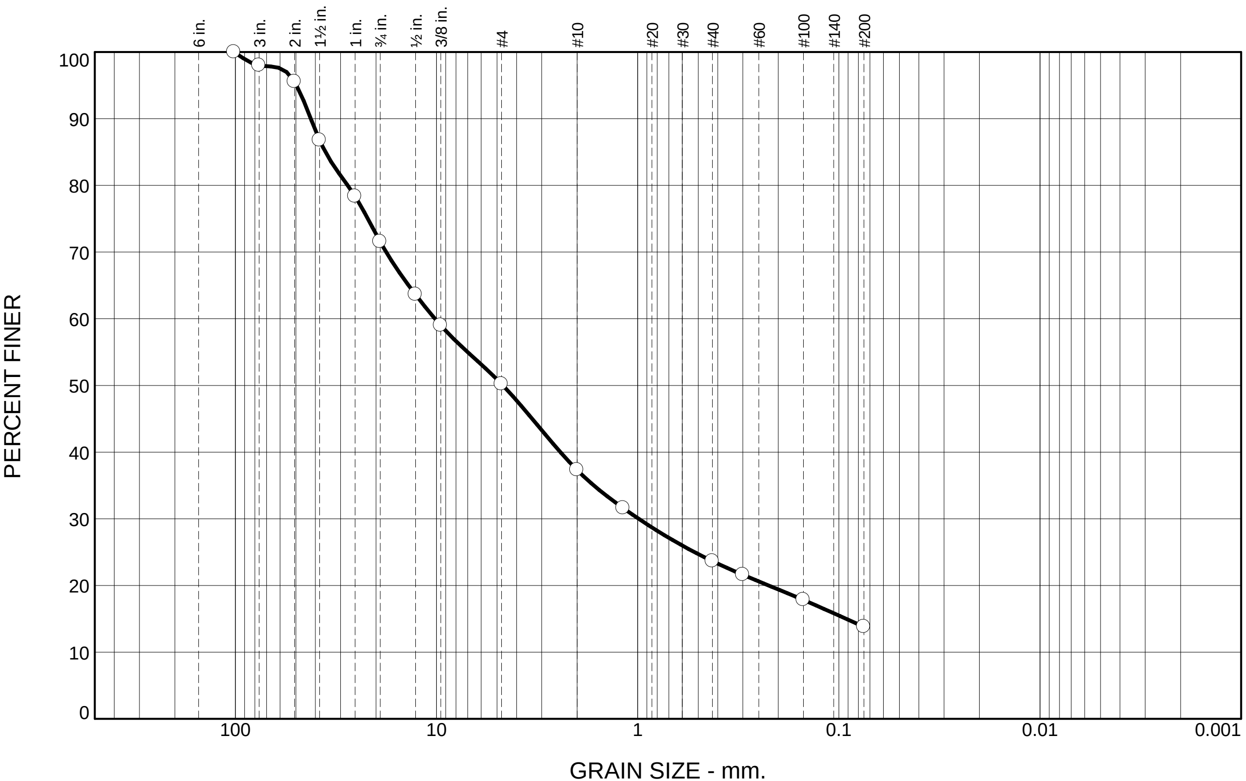
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-106-02

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
2.0	26.5	21.3	12.9	13.6	9.9	13.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100.0		
3	98.0		
2	95.5		
1.5	86.8		
1	78.4		
.75	71.5		
.5	63.6		
.375	59.0		
#4	50.2		
#10	37.3		
#16	31.6		
#40	23.7		
#50	21.6		
#100	17.8		
#200	13.8		

* (no specification provided)

Material Description

Brown silty gravel with sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 42.1555 D_{85}= 35.6517 D_{60}= 10.1835
D_{50}= 4.6790 D_{30}= 0.9884 D_{15}= 0.0920
D_{10}= C_u= C_c=

Classification

USCS= GM AASHTO= A-1-a

Remarks

Location: TP19-03
Sample Number: 19-060-03 **Depth:** 6-9' **Date:** 3/5/2019

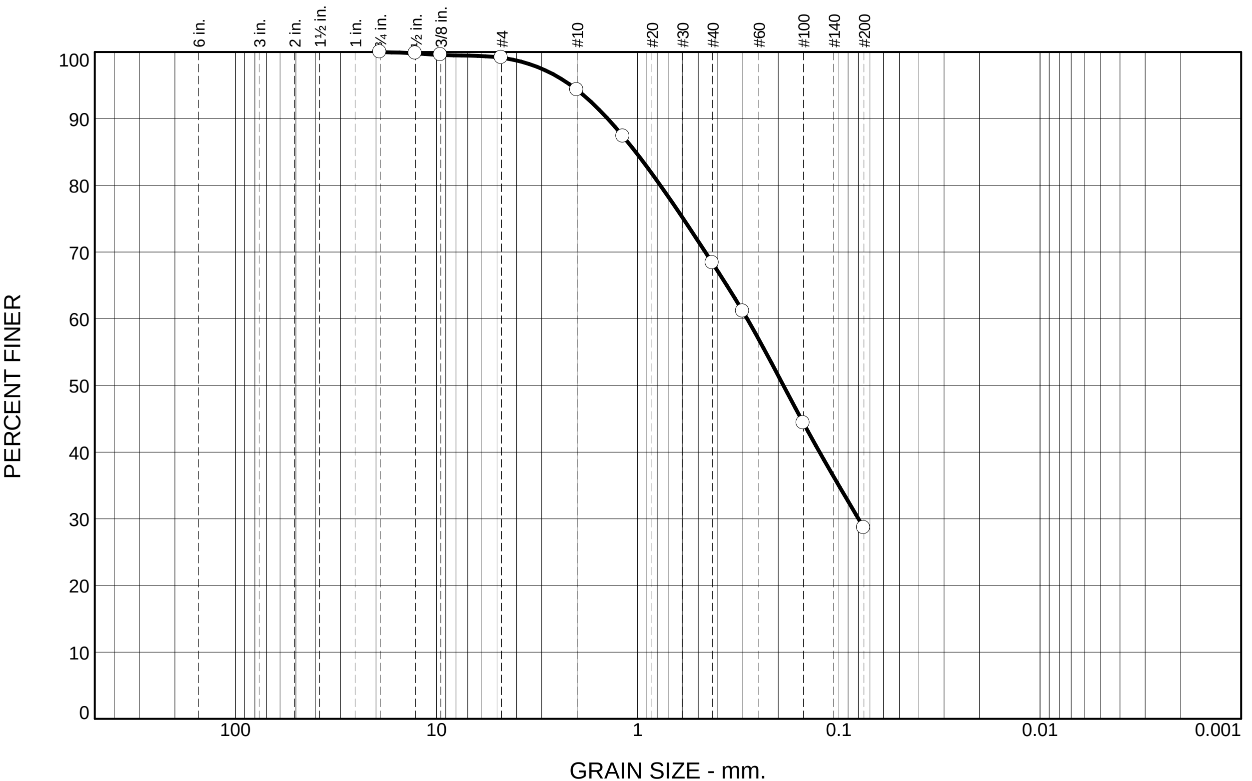
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-060-03

Tested By: KS/JB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.9	4.8	25.9	39.8	28.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	99.8		
.375	99.6		
#4	99.1		
#10	94.3		
#16	87.3		
#40	68.4		
#50	61.1		
#100	44.4		
#200	28.6		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 1.4092 D_{85}= 1.0226 D_{60}= 0.2856

D_{50}= 0.1887 D_{30}= 0.0798 D_{15}=

D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Natural Moisture Content: 31.2%

Location: TP19-04
Sample Number: 19-106-03 **Depth:** 2-4' **Date:** 4/22/2019

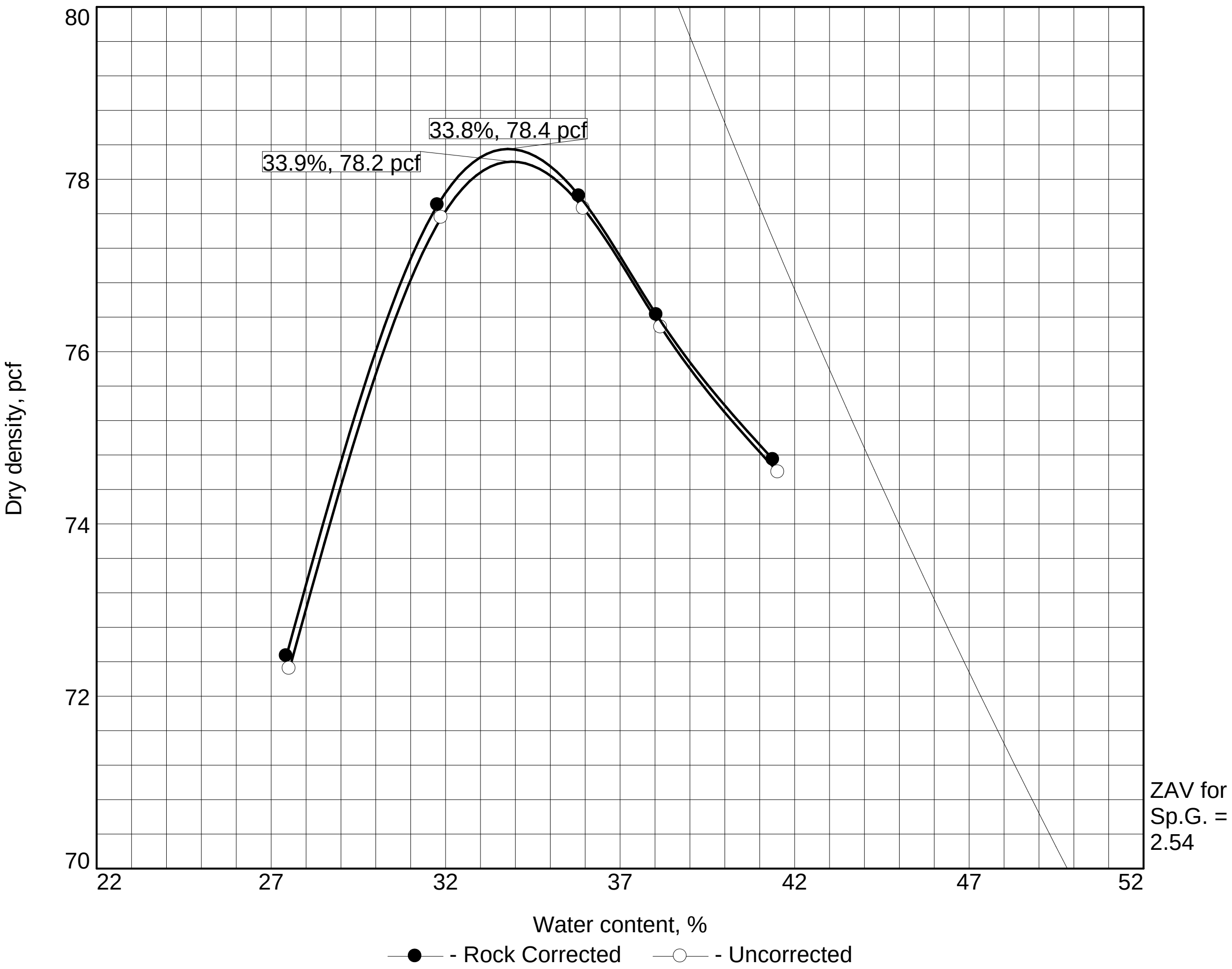
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-106-03

Tested By: KS **Checked By:** JH

COMPACTION TEST REPORT



Test specification: ASTM D 1557-12 Method B Modified
ASTM D4718-15 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in.	% < No.200
	USCS	AASHTO						
2-4'	SM	A-4(0)	24.0%	2.54	NP	NP	0.4	42.9

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 78.4 pcf	78.2 pcf	
Optimum moisture = 33.8 %	33.9 %	

Project No. 475.0385.000 **Client:** Lithium Nevada
Project: Thacker Pass
Date: 4/22/2019
○ **Location:** TP19-04 **Sample Number:** 19-106-03

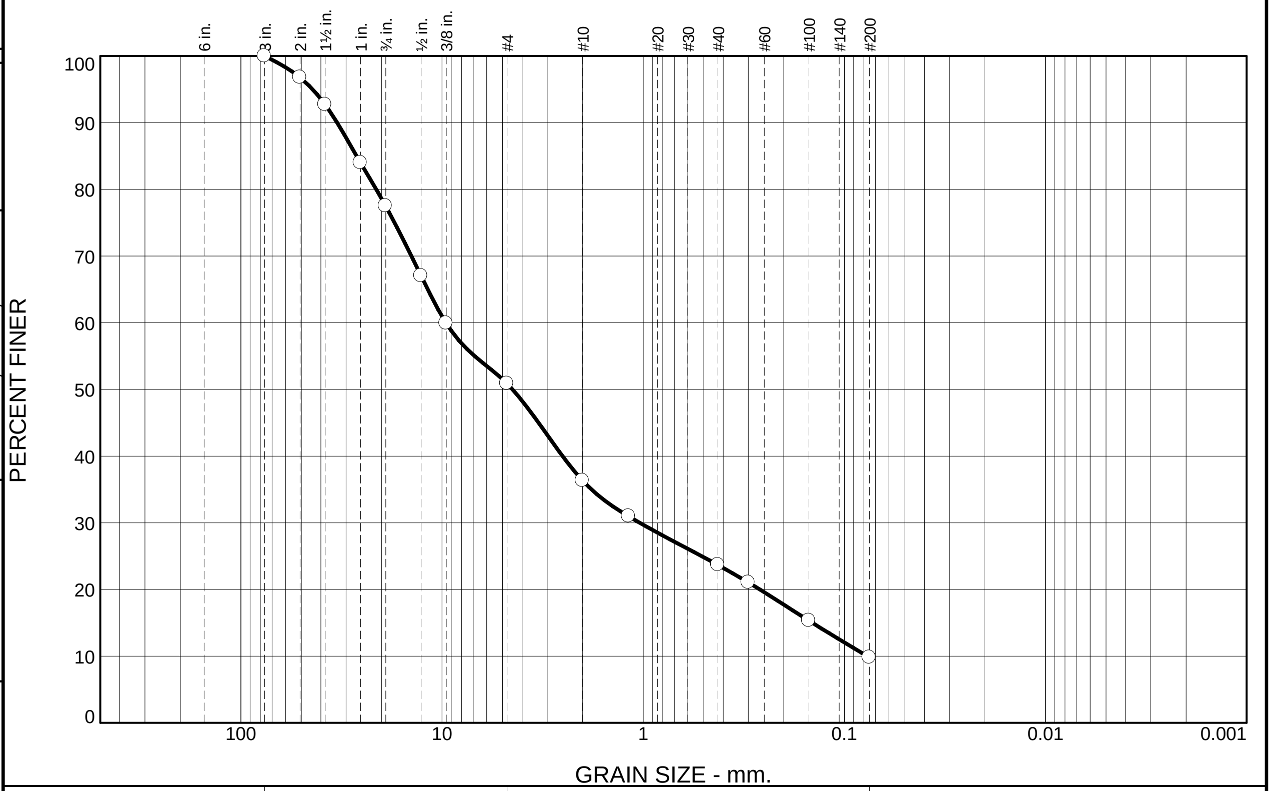
NewFields

Remarks:
*Assuemd Specific Gravity

Figure 19-106-03

Tested By: CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	22.5	26.6	14.6	12.6	13.9	9.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	96.8		
1.5	92.7		
1	84.0		
.75	77.5		
.5	67.0		
.375	59.9		
#4	50.9		
#10	36.3		
#16	31.0		
#40	23.7		
#50	21.0		
#100	15.3		
#200	9.8		

* (no specification provided)

Material Description

Light Brown well-graded gravel with silt and sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 33.2086 D_{85}= 26.5801 D_{60}= 9.5689
D_{50}= 4.4634 D_{30}= 1.0390 D_{15}= 0.1443
D_{10}= 0.0768 C_u= 124.52 C_c= 1.47

Classification

USCS= GW-GM AASHTO= A-1-a

Remarks

Location: TP19-04
Sample Number: 19-060-04 **Depth:** 5-7' **Date:** 3/5/2019

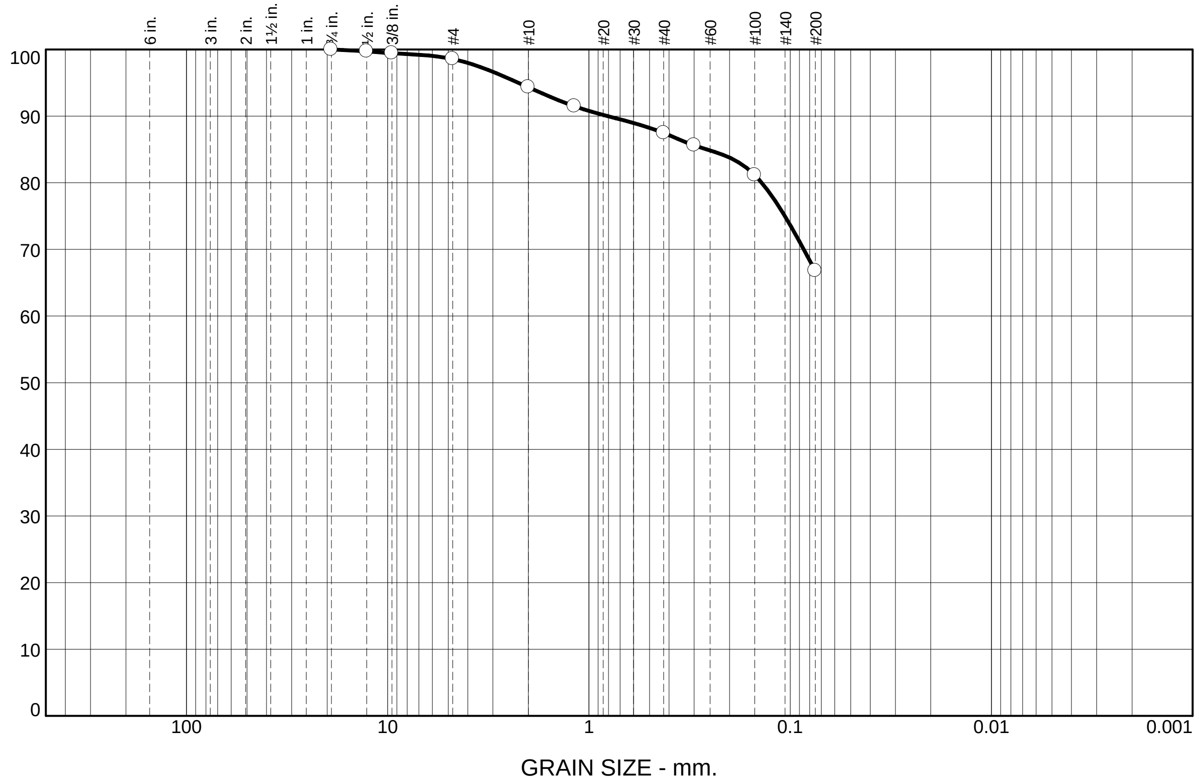
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-060-04

Tested By: KS/JB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.4	4.3	6.8	20.7	66.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	99.7		
.375	99.4		
#4	98.6		
#10	94.3		
#16	91.5		
#40	87.5		
#50	85.6		
#100	81.2		
#200	66.8		

* (no specification provided)

Material Description

Brown sandy silt

Atterberg Limits

PL= 31 LL= 41 PI= 10

Coefficients

D_{90}= 0.8040 D_{85}= 0.2597 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO= A-5(7)

Remarks

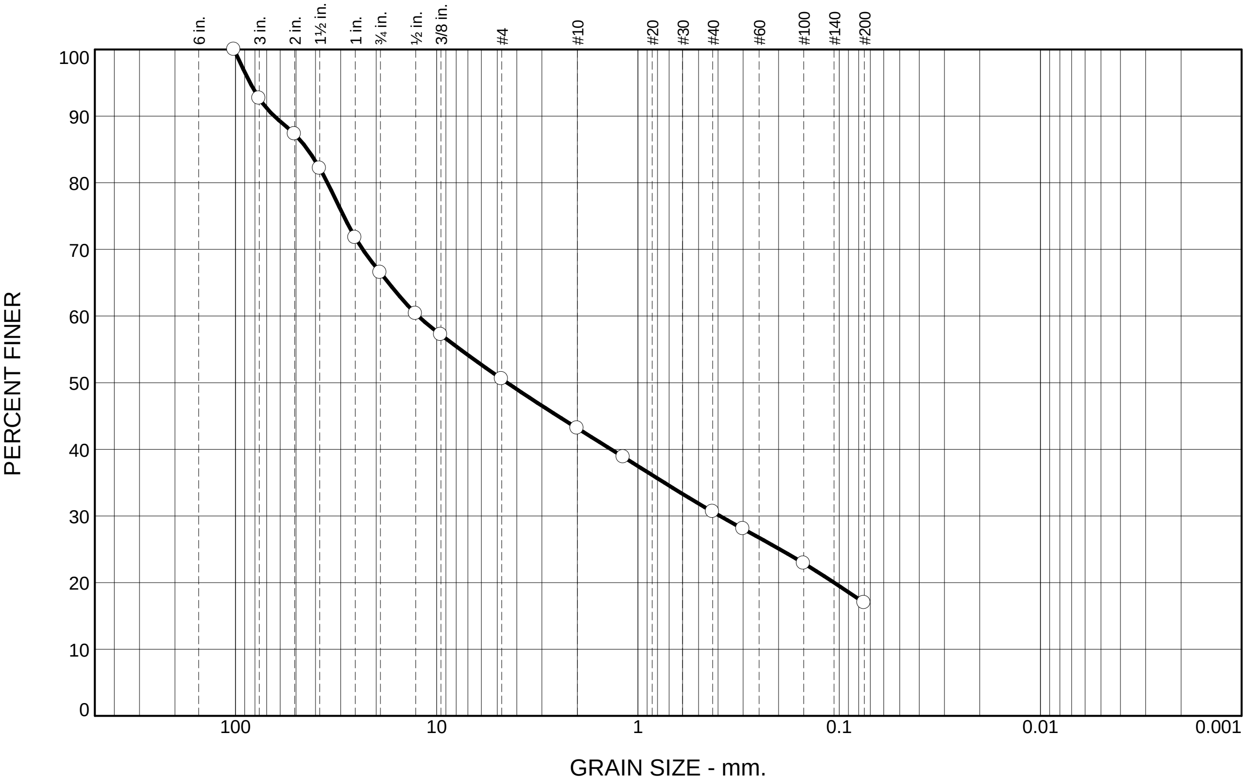
Location: TP19-05
Sample Number: 19-060-05 **Depth:** 8-10' **Date:** 3/5/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-05

Tested By: KS/JB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
7.3	26.2	16.0	7.3	12.6	13.6	17.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100.0		
3	92.7		
2	87.3		
1.5	82.2		
1	71.8		
.75	66.5		
.5	60.3		
.375	57.2		
#4	50.5		
#10	43.2		
#16	38.8		
#40	30.6		
#50	28.1		
#100	22.9		
#200	17.0		

* (no specification provided)

Material Description

Light Brown silty gravel with sand

Atterberg Limits

PL= NP
LL= NP
PI= NP

Coefficients

D_{90}= 64.1392
D_{85}= 43.7738
D_{60}= 12.3614
D_{50}= 4.4691
D_{30}= 0.3914
D_{15}=
D_{10}=
C_u=
C_c=

Classification

USCS= GM
AASHTO= A-1-b

Remarks

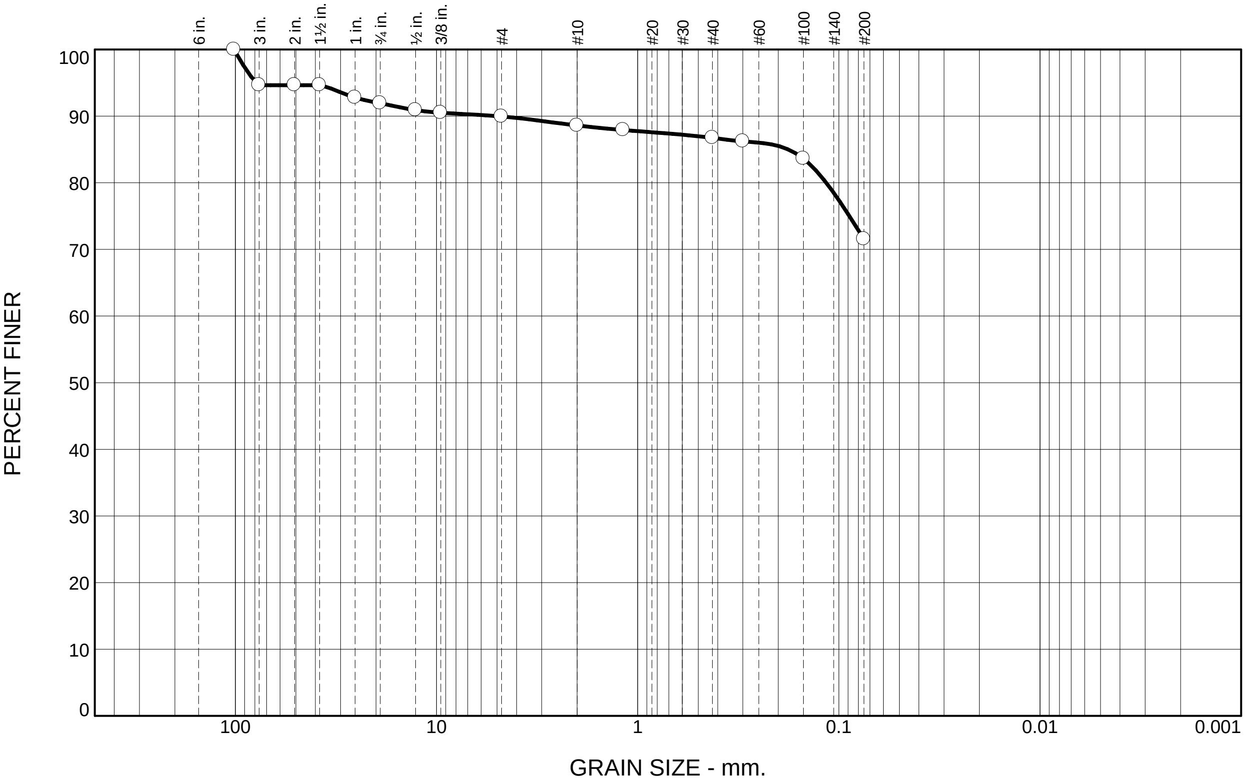
Location: TP19-06
Sample Number: 19-060-06
Depth: 11-13'
Date: 3/5/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000
Figure 19-060-06

Tested By: KS/JB
Checked By: JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
5.4	2.7	1.9	1.4	1.9	15.2	71.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100.0		
3	94.6		
2	94.6		
1.5	94.6		
1	92.8		
.75	91.9		
.5	90.9		
.375	90.5		
#4	90.0		
#10	88.6		
#16	87.9		
#40	86.7		
#50	86.2		
#100	83.6		
#200	71.5		

* (no specification provided)

Material Description

Light Brown fat clay with sand

Atterberg Limits

PL= 22 LL= 55 PI= 33

Coefficients

D_{90}= 4.9438 D_{85}= 0.1784 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CH AASHTO= A-7-6(25)

Remarks

Natural Moisture Content: 24.0%

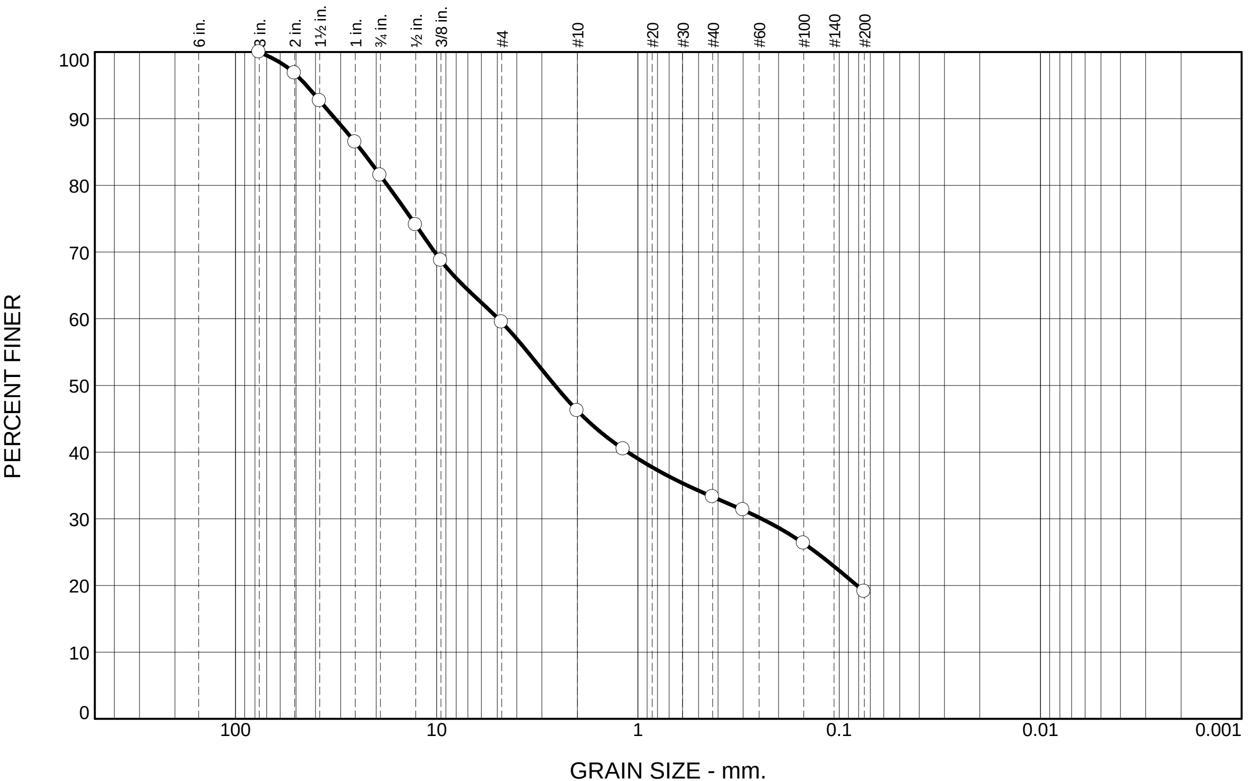
Location: TP19-07
Sample Number: 19-106-04 **Depth:** 2-4' **Date:** 4/22/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-106-04

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	18.5	22.0	13.3	12.9	14.2	19.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	96.8		
1.5	92.7		
1	86.4		
.75	81.5		
.5	74.1		
.375	68.7		
#4	59.5		
#10	46.2		
#16	40.4		
#40	33.3		
#50	31.3		
#100	26.3		
#200	19.1		

* (no specification provided)

Material Description

Light Brown silty gravel with sand

Atterberg Limits

PL= 28 LL= 37 PI= 9

Coefficients

D_{90}= 31.9208 D_{85}= 23.2860 D_{60}= 4.9417
D_{50}= 2.5845 D_{30}= 0.2431 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= GM AASHTO= A-2-4(0)

Remarks

Natural Moisture Content: 14.8%

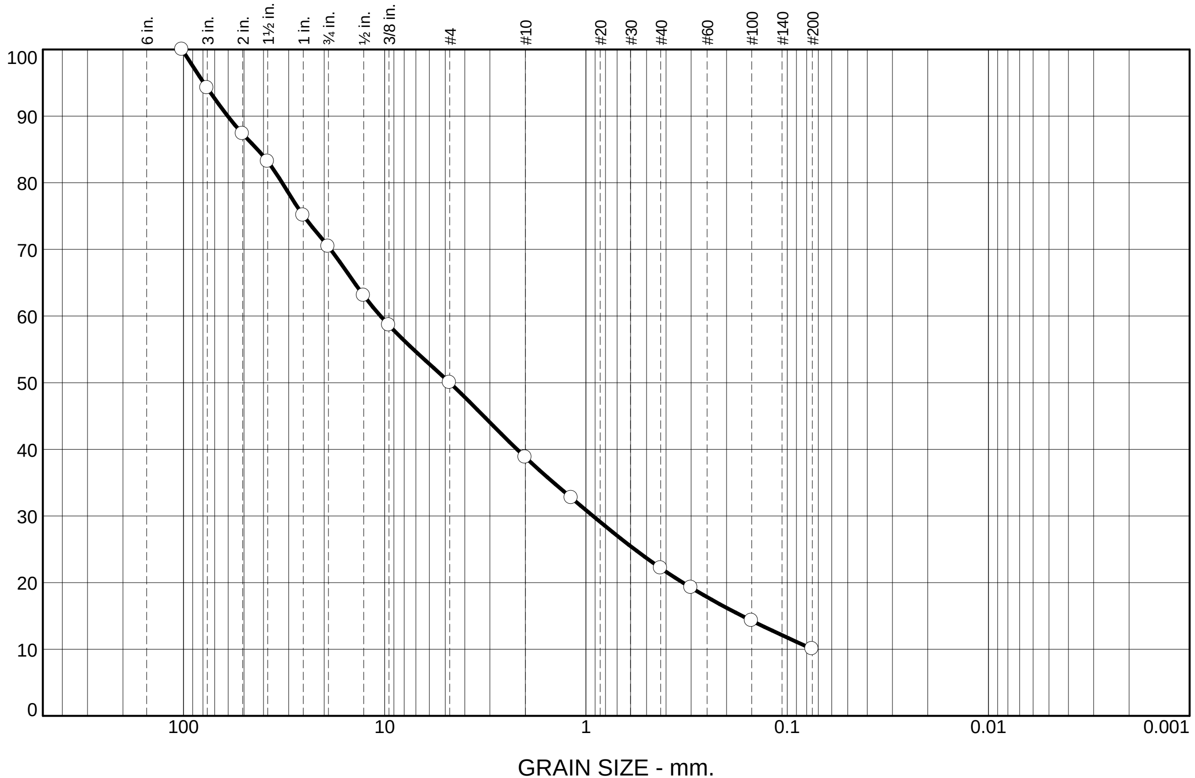
Location: TP19-08
Sample Number: 19-106-05 **Depth:** 2-4' **Date:** 4/22/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-106-05

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
5.8	23.8	20.4	11.2	16.6	12.2	10.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100.0		
3	94.2		
2	87.3		
1.5	83.2		
1	75.1		
.75	70.4		
.5	63.1		
.375	58.6		
#4	50.0		
#10	38.8		
#16	32.7		
#40	22.2		
#50	19.2		
#100	14.3		
#200	10.0		

* (no specification provided)

Material Description

Brown poorly graded gravel with silt and sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 60.2921 D_{85}= 42.8442 D_{60}= 10.4846
D_{50}= 4.7510 D_{30}= 0.9228 D_{15}= 0.1675
D_{10}= C_u= C_c=

Classification

USCS= GP-GM AASHTO= A-1-a

Remarks

Location: TP19-08
Sample Number: 19-060-07 **Depth:** 6-9' **Date:** 3/5/2019

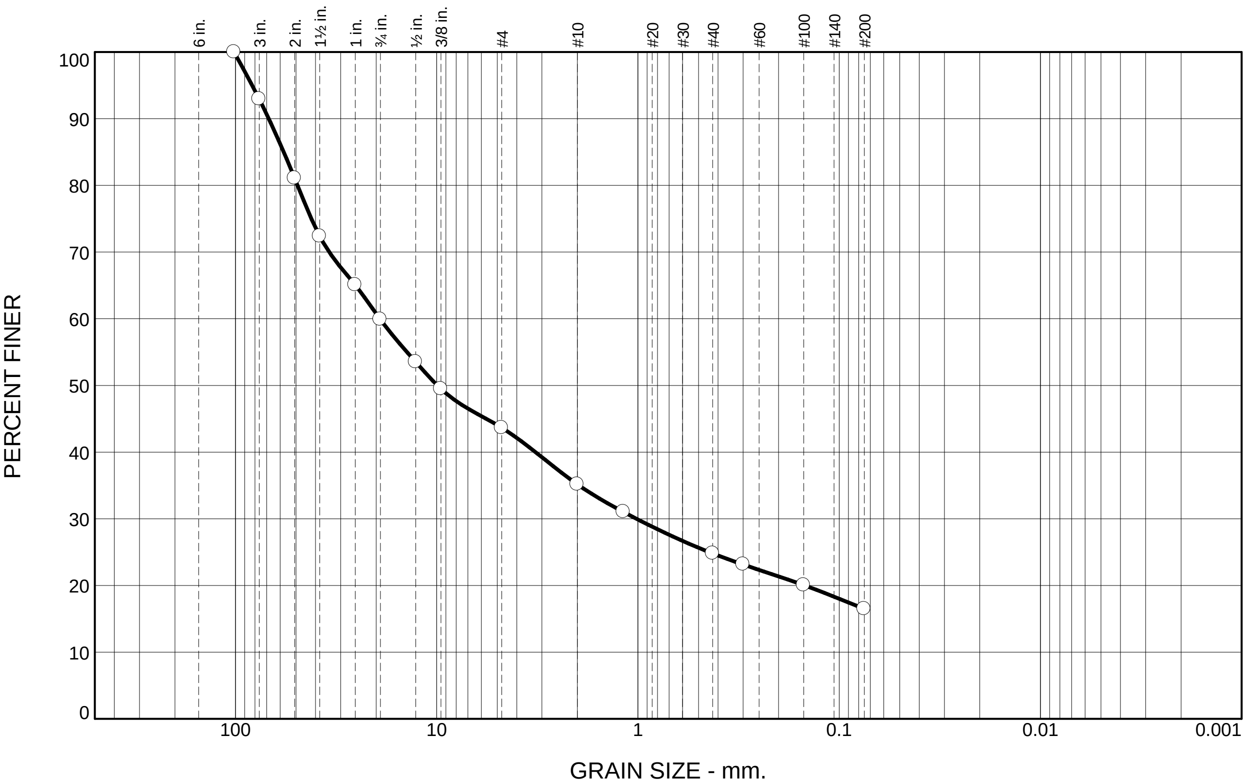
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-060-07

Tested By: KS/JB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
7.1	33.0	16.3	8.4	10.4	8.3	16.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100.0		
3	92.9		
2	81.1		
1.5	72.4		
1	65.1		
.75	59.9		
.5	53.5		
.375	49.5		
#4	43.6		
#10	35.2		
#16	31.0		
#40	24.8		
#50	23.1		
#100	20.0		
#200	16.5		

* (no specification provided)

Material Description

Red silty gravel with sand

Atterberg Limits

PL= 31 LL= 55 PI= 24

Coefficients

D_{90}= 68.3561 D_{85}= 57.5969 D_{60}= 19.1693
D_{50}= 9.9271 D_{30}= 1.0157 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= GM AASHTO= A-2-7(0)

Remarks

Location: TP19-09
Sample Number: 19-060-08 **Depth:** 8-12' **Date:** 3/5/2019

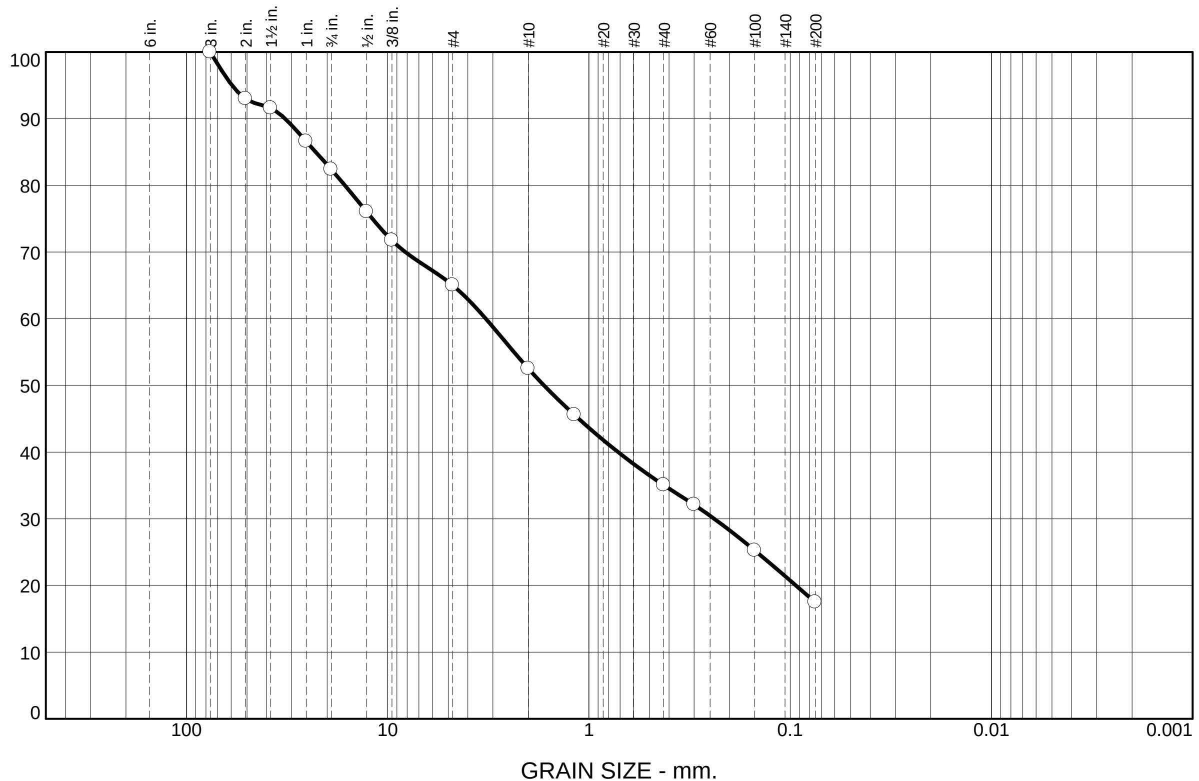
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-060-08

Tested By: JH/JB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	17.6	17.4	12.5	17.4	17.6	17.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	93.0		
1.5	91.6		
1	86.6		
.75	82.4		
.5	76.0		
.375	71.7		
#4	65.0		
#10	52.5		
#16	45.6		
#40	35.1		
#50	32.1		
#100	25.3		
#200	17.5		

* (no specification provided)

Material Description

Light Brown silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 32.3094 D_{85}= 22.7954 D_{60}= 3.2545
D_{50}= 1.6732 D_{30}= 0.2385 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Natural Moisture Content: 17.1%

Location: TP19-10
Sample Number: 19-106-06 **Depth:** 3-6' **Date:** 4/22/2019

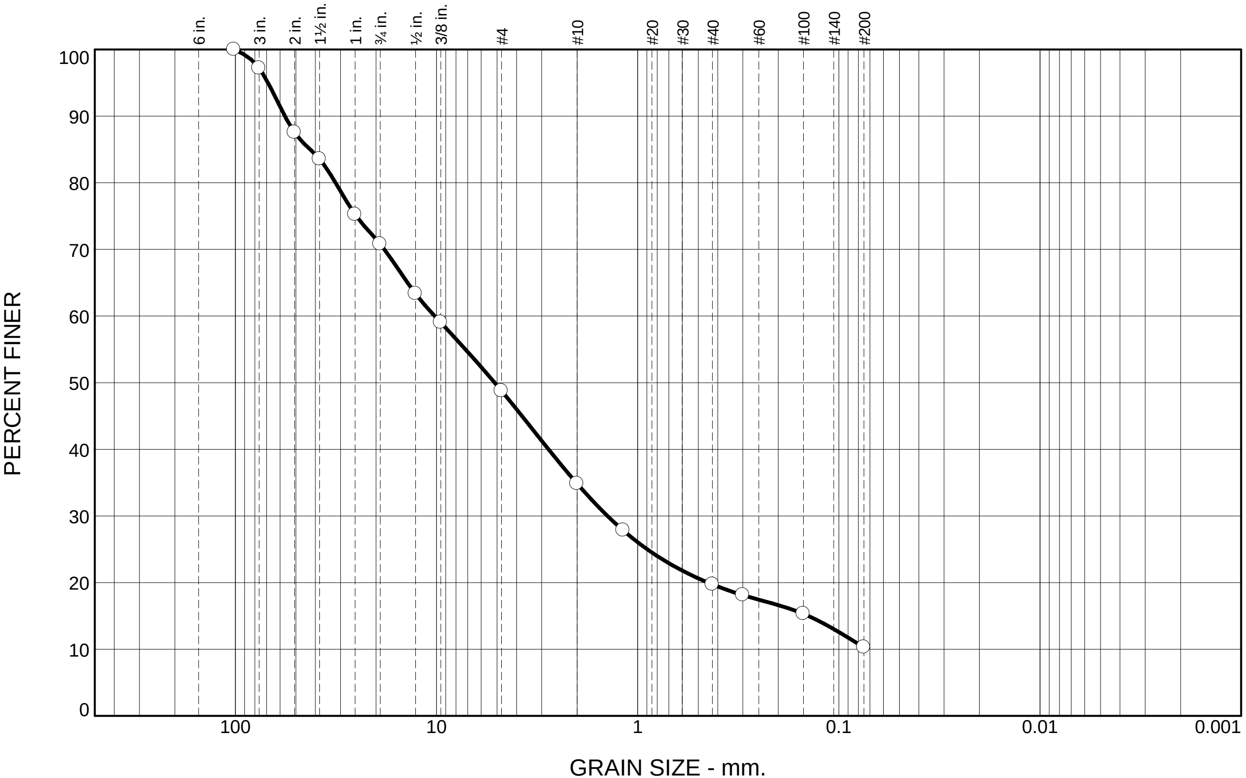
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-106-06

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
2.8	26.4	22.0	14.0	15.1	9.4	10.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100.0		
3	97.2		
2	87.5		
1.5	83.6		
1	75.2		
.75	70.8		
.5	63.3		
.375	59.0		
#4	48.8		
#10	34.8		
#16	27.8		
#40	19.7		
#50	18.1		
#100	15.3		
#200	10.3		

* (no specification provided)

Material Description

Brown poorly graded gravel with silt and sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 56.7320 D_{85}= 42.4246 D_{60}= 10.2159
D_{50}= 5.1396 D_{30}= 1.4127 D_{15}= 0.1421
D_{10}= C_u= C_c=

Classification

USCS= GP-GM AASHTO= A-1-a

Remarks

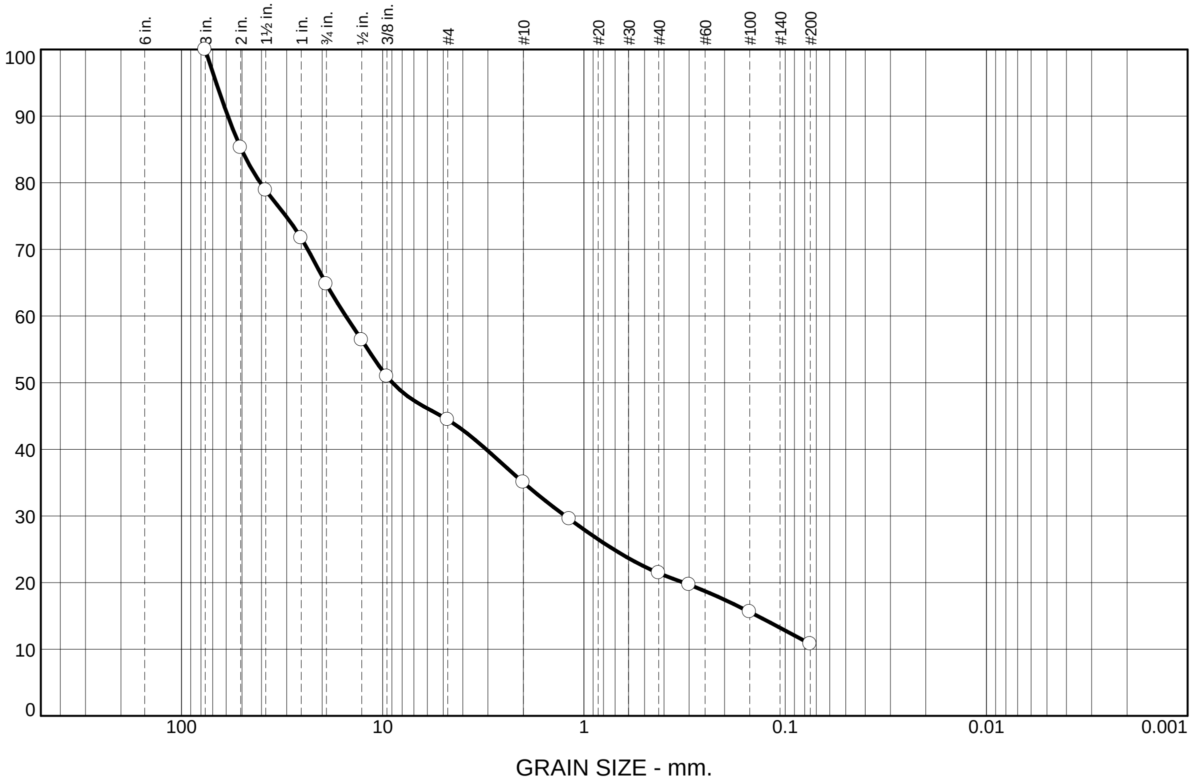
Location: TP19-11
Sample Number: 19-060-09 **Depth:** 7-11' **Date:** 3/5/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-09

Tested By: JH/JB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	35.2	20.4	9.4	13.6	10.6	10.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	85.3		
1.5	78.9		
1	71.7		
.75	64.8		
.5	56.4		
.375	50.9		
#4	44.4		
#10	35.0		
#16	29.5		
#40	21.4		
#50	19.7		
#100	15.6		
#200	10.8		

* (no specification provided)

Material Description

Light Brown poorly graded gravel with silt and sand

Atterberg Limits

PL= 30 LL= 52 PI= 22

Coefficients

D_{90}= 58.8246 D_{85}= 50.3295 D_{60}= 15.2419
D_{50}= 8.9506 D_{30}= 1.2379 D_{15}= 0.1373
D_{10}= C_u= C_c=

Classification

USCS= GP-GM AASHTO= A-2-7(0)

Remarks

Natural Moisture Content: 15.5%

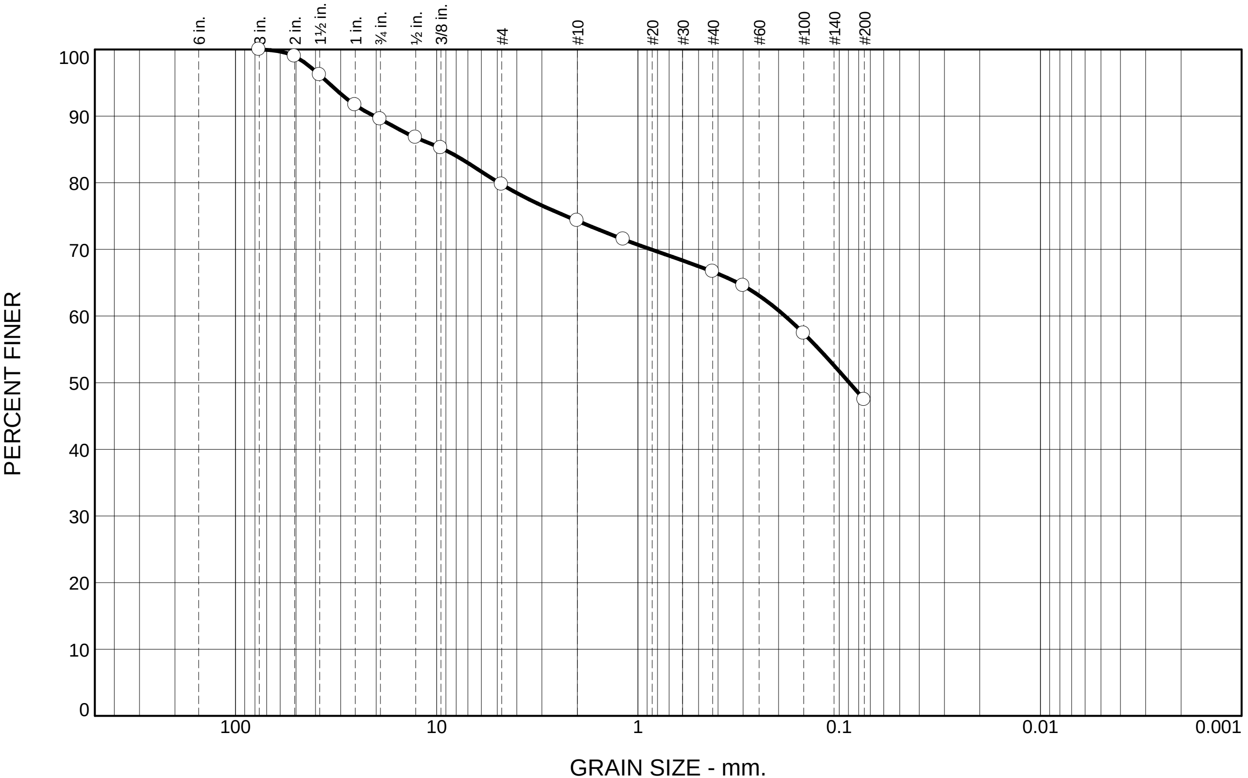
Location: TP19-13
Sample Number: 19-106-07 **Depth:** 3-5' **Date:** 4/22/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-106-07

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	10.5	9.8	5.4	7.6	19.3	47.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	99.0		
1.5	96.2		
1	91.7		
.75	89.5		
.5	86.8		
.375	85.2		
#4	79.7		
#10	74.3		
#16	71.5		
#40	66.7		
#50	64.6		
#100	57.4		
#200	47.4		

* (no specification provided)

Material Description

Light Brown clayey sand with gravel

Atterberg Limits

PL= 32   LL= 66   PI= 34

Coefficients

D_{90}= 20.3770 D_{85}= 9.1917 D_{60}= 0.1857
D_{50}= 0.0890 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC   AASHTO= A-7-5(12)

Remarks

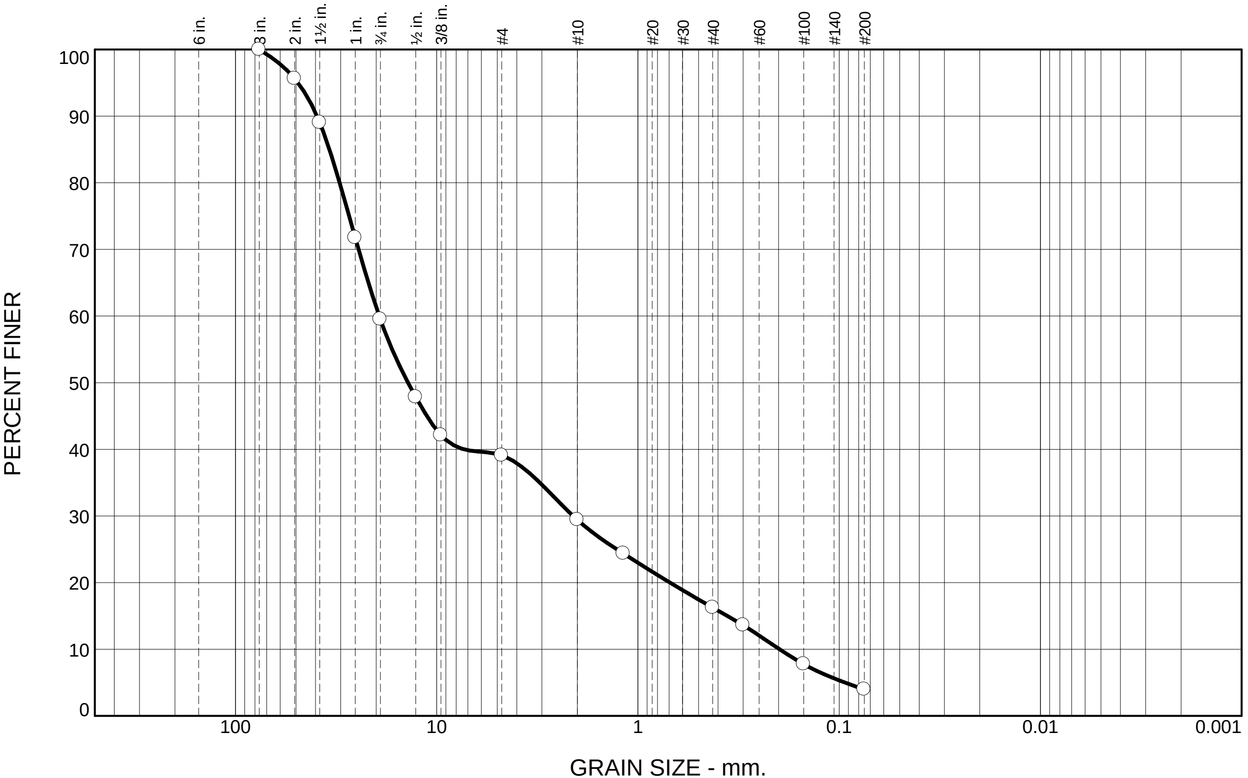
Location: TP19-13
Sample Number: 19-060-10   **Depth:** 10-13'   **Date:** 3/5/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000   **Figure** 19-060-10

Tested By: JH/JB   **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	40.5	20.4	9.7	13.2	12.2	4.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	95.6		
1.5	89.0		
1	71.8		
.75	59.5		
.5	47.8		
.375	42.1		
#4	39.1		
#10	29.4		
#16	24.4		
#40	16.2		
#50	13.6		
#100	7.8		
#200	4.0		

* (no specification provided)

Material Description

Brown well-graded gravel with sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 39.3129 D_{85}= 34.1247 D_{60}= 19.3064
D_{50}= 13.8796 D_{30}= 2.0991 D_{15}= 0.3593
D_{10}= 0.1980 C_u= 97.48 C_c= 1.15

Classification

USCS= GW AASHTO= A-1-a

Remarks

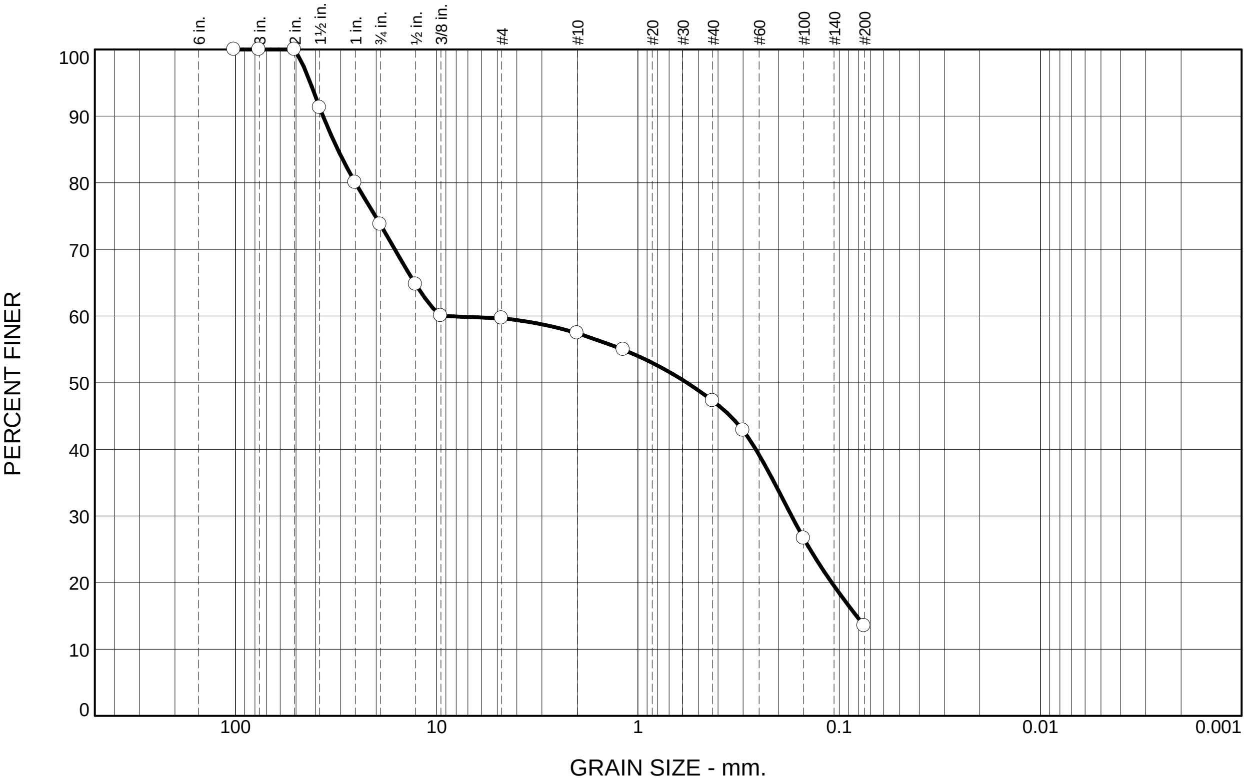
Location: TP19-14
Sample Number: 19-060-11 **Depth:** 8-11' **Date:** 3/5/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-11

Tested By: JH/JB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	26.3	14.0	2.3	10.1	33.8	13.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100.0		
3	100.0		
2	100.0		
1.5	91.3		
1	80.0		
.75	73.7		
.5	64.7		
.375	60.0		
#4	59.7		
#10	57.4		
#16	54.9		
#40	47.3		
#50	42.8		
#100	26.6		
#200	13.5		

* (no specification provided)

Material Description

Light Brown silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 36.6838 D_{85}= 31.0116 D_{60}= 9.1518
D_{50}= 0.5710 D_{30}= 0.1724 D_{15}= 0.0820
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Location: TP19-15
Sample Number: 19-060-12 **Depth:** 8-11' **Date:** 3/5/2019

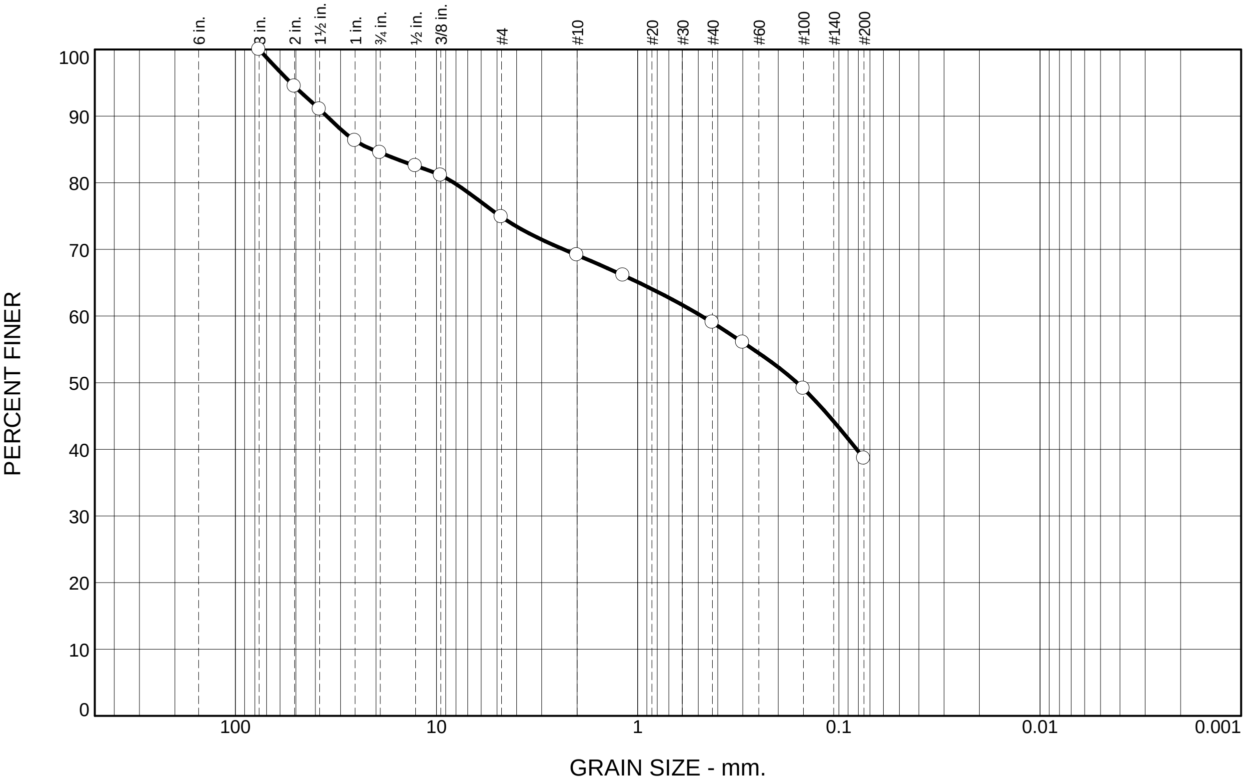
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-060-12

Tested By: JH/JB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	15.5	9.6	5.8	10.1	20.4	38.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	94.5		
1.5	91.0		
1	86.3		
.75	84.5		
.5	82.5		
.375	81.1		
#4	74.9		
#10	69.1		
#16	66.1		
#40	59.0		
#50	56.0		
#100	49.1		
#200	38.6		

* (no specification provided)

Material Description

Brown silty sand with gravel

Atterberg Limits

PL= 37 LL= 58 PI= 21

Coefficients

D_{90}= 35.1167 D_{85}= 20.8900 D_{60}= 0.4809
D_{50}= 0.1616 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-7-5(4)

Remarks

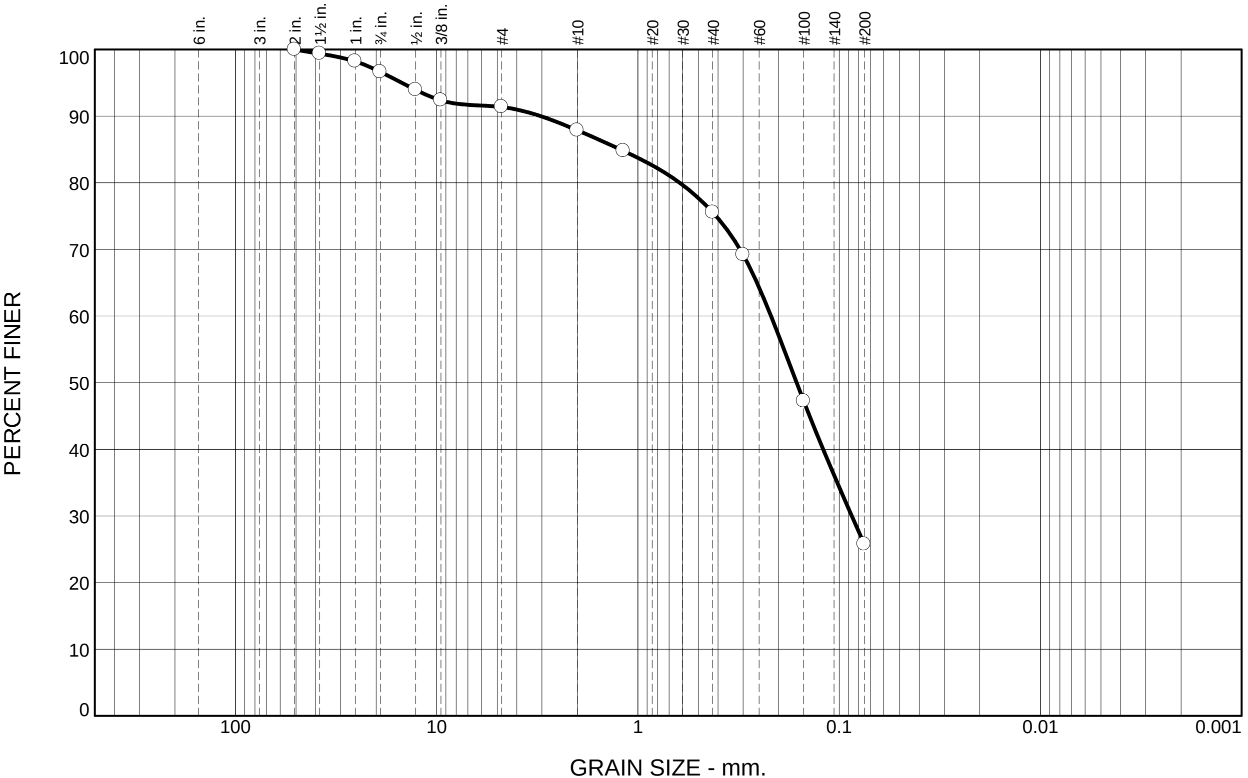
Location: TP19-16
Sample Number: 19-060-13 **Depth:** 7-10' **Date:** 3/5/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-13

Tested By: JH/JB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.4	5.2	3.5	12.3	49.9	25.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2	100.0		
1.5	99.4		
1	98.2		
.75	96.6		
.5	93.9		
.375	92.4		
#4	91.4		
#10	87.9		
#16	84.8		
#40	75.6		
#50	69.2		
#100	47.2		
#200	25.7		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 3.0459 D_{85}= 1.2229 D_{60}= 0.2182
D_{50}= 0.1627 D_{30}= 0.0865 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

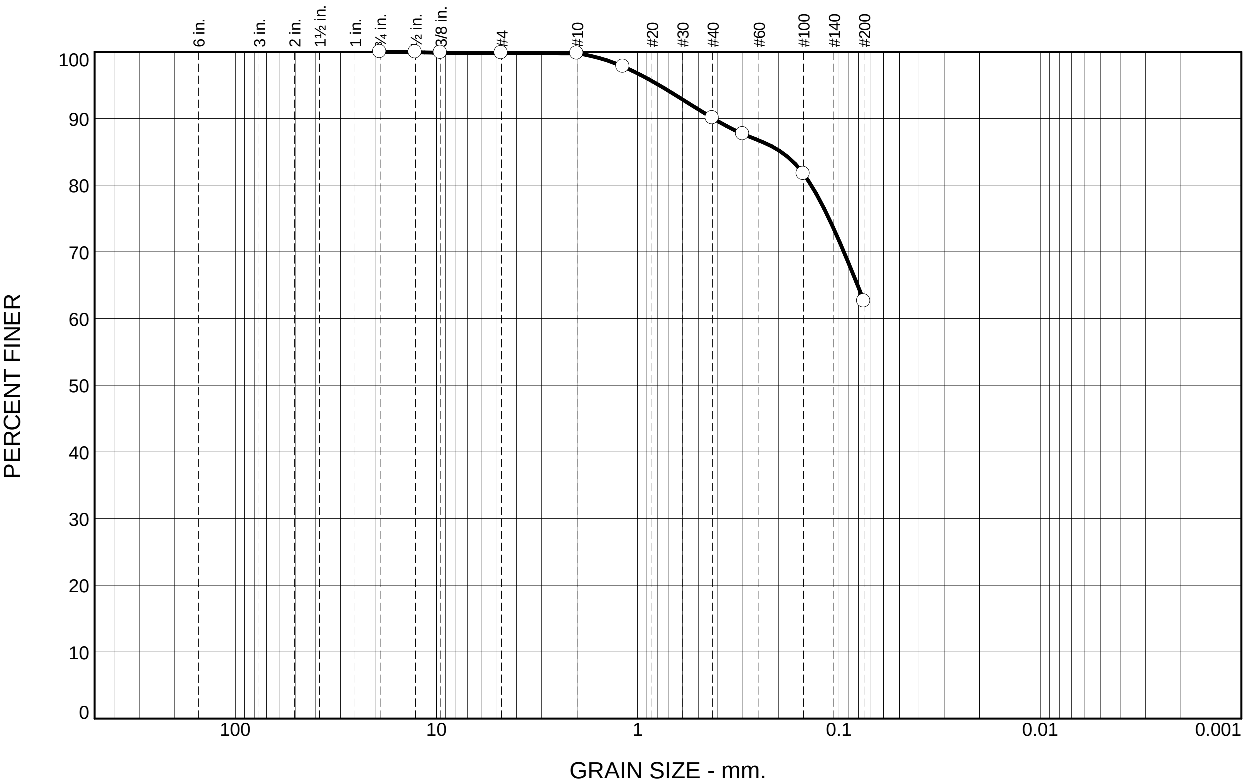
Location: TP19-17
Sample Number: 19-060-14 **Depth:** 4-7' **Date:** 3/5/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-14

Tested By: JH/JB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.2	0.0	9.7	27.5	62.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	99.9		
.375	99.9		
#4	99.8		
#10	99.8		
#16	97.8		
#40	90.1		
#50	87.7		
#100	81.7		
#200	62.6		

* (no specification provided)

Material Description

Brown sandy silty clay

Atterberg Limits

PL= 21 LL= 28 PI= 7

Coefficients

D_{90}= 0.4206 D_{85}= 0.1940 D_{60}=

D_{50}= D_{30}= D_{15}=

D_{10}= C_u= C_c=

Classification

USCS= CL-ML AASHTO= A-4(2)

Remarks

Location: TP19-18

Sample Number: 19-060-15 **Depth:** 5-8' **Date:** 3/6/2019

NewFields

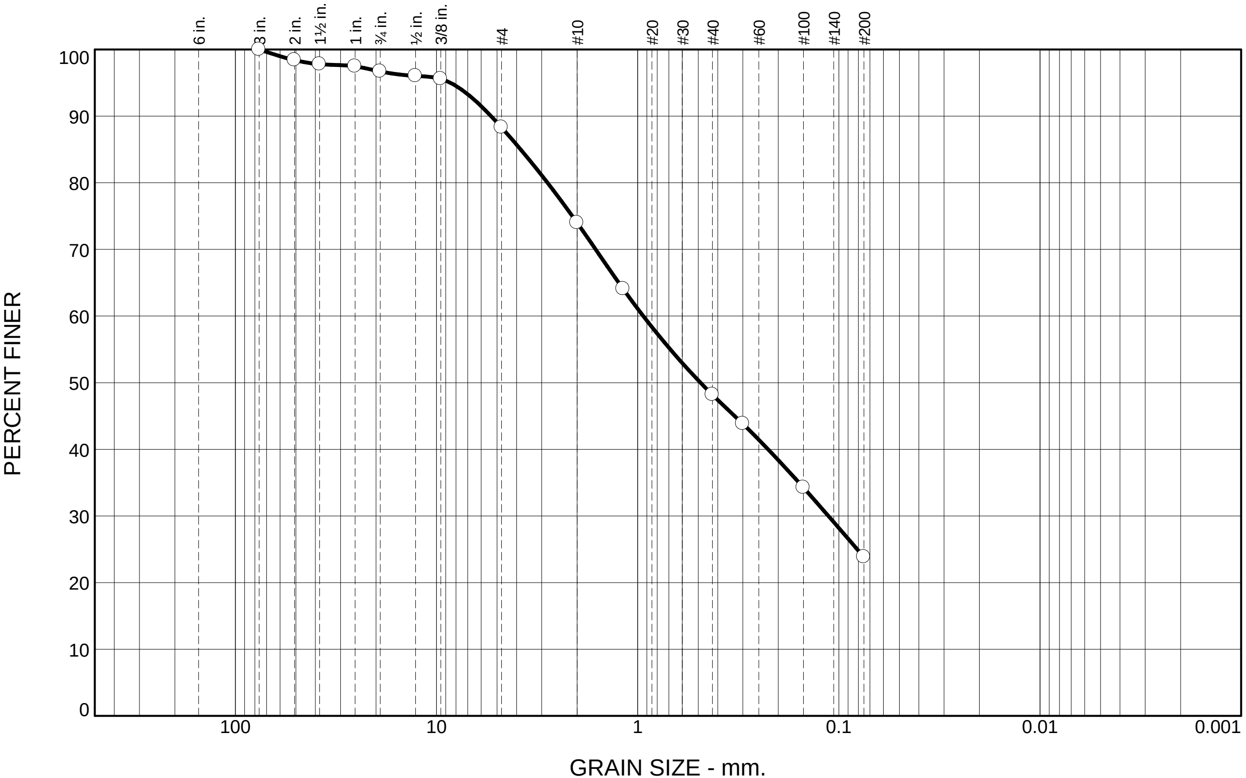
Client: Lithium Nevada

Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-060-15

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.3	8.4	14.3	25.8	24.4	23.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	98.4		
1.5	97.8		
1	97.5		
.75	96.7		
.5	96.0		
.375	95.6		
#4	88.3		
#10	74.0		
#16	64.1		
#40	48.2		
#50	43.8		
#100	34.3		
#200	23.8		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 5.3563 D_{85}= 3.8174 D_{60}= 0.9376
D_{50}= 0.4869 D_{30}= 0.1127 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

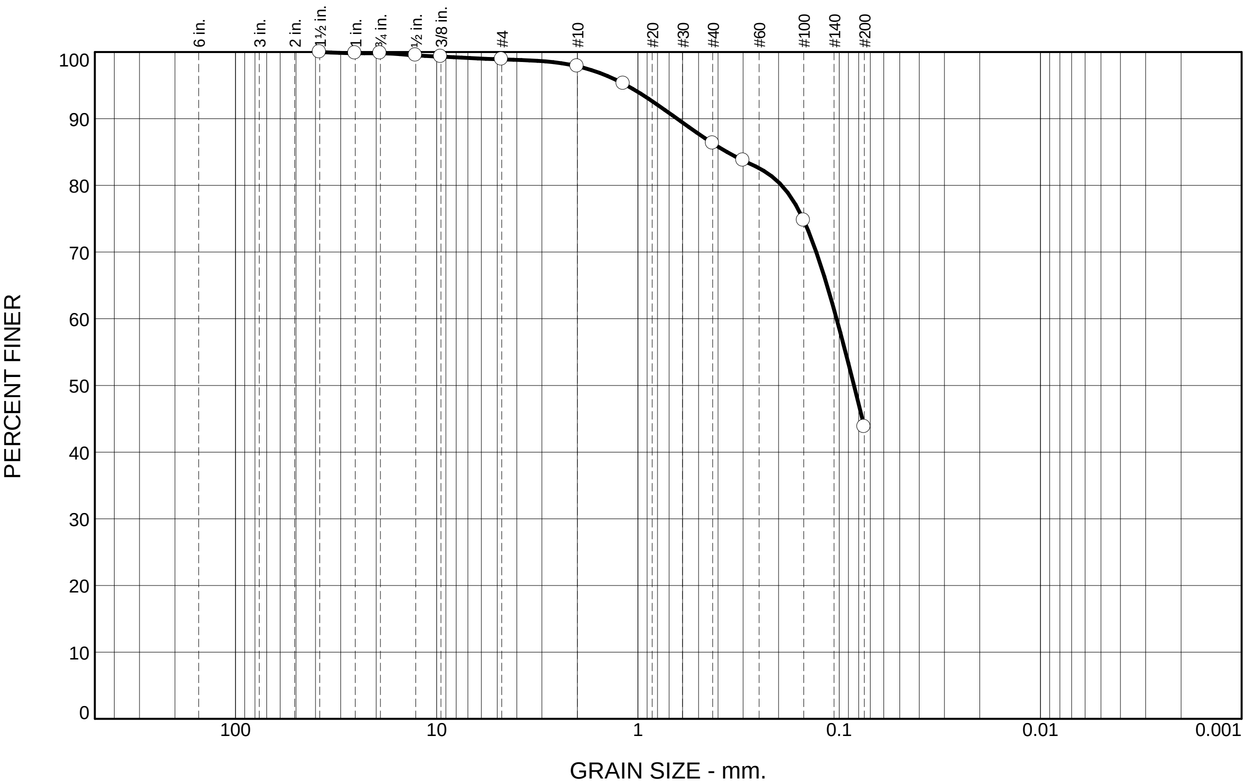
Location: TP19-20
Sample Number: 19-060-16 **Depth:** 6-10' **Date:** 3/6/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-16

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.2	0.9	1.0	11.6	42.5	43.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	99.8		
.75	99.8		
.5	99.5		
.375	99.3		
#4	98.9		
#10	97.9		
#16	95.3		
#40	86.3		
#50	83.7		
#100	74.8		
#200	43.8		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.6382 D_{85}= 0.3600 D_{60}= 0.1030
D_{50}= 0.0844 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-4(0)

Remarks

Location: TP19-21
Sample Number: 19-060-17 **Depth:** 3-5' **Date:** 3/6/2019

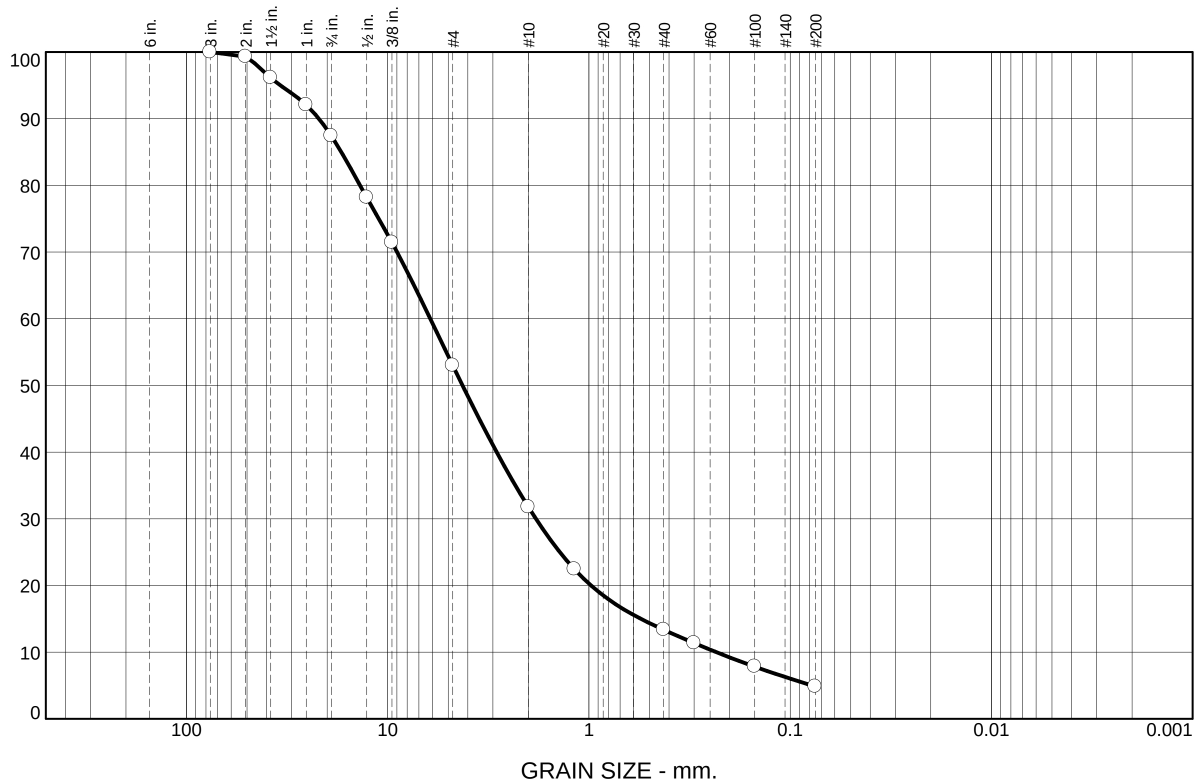
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-060-17

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.6	34.4	21.2	18.4	8.6	4.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	99.3		
1.5	96.1		
1	92.1		
.75	87.4		
.5	78.2		
.375	71.4		
#4	53.0		
#10	31.8		
#16	22.4		
#40	13.4		
#50	11.4		
#100	7.8		
#200	4.8		

* (no specification provided)

Material Description

Gray well-graded sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 21.9917 D_{85}= 16.9927 D_{60}= 6.1422
D_{50}= 4.2486 D_{30}= 1.8346 D_{15}= 0.5522
D_{10}= 0.2331 C_u= 26.35 C_c= 2.35

Classification

USCS= SW AASHTO= A-1-a

Remarks

Location: TP19-22
Sample Number: 19-060-18 **Depth:** 8-11' **Date:** 3/6/2019

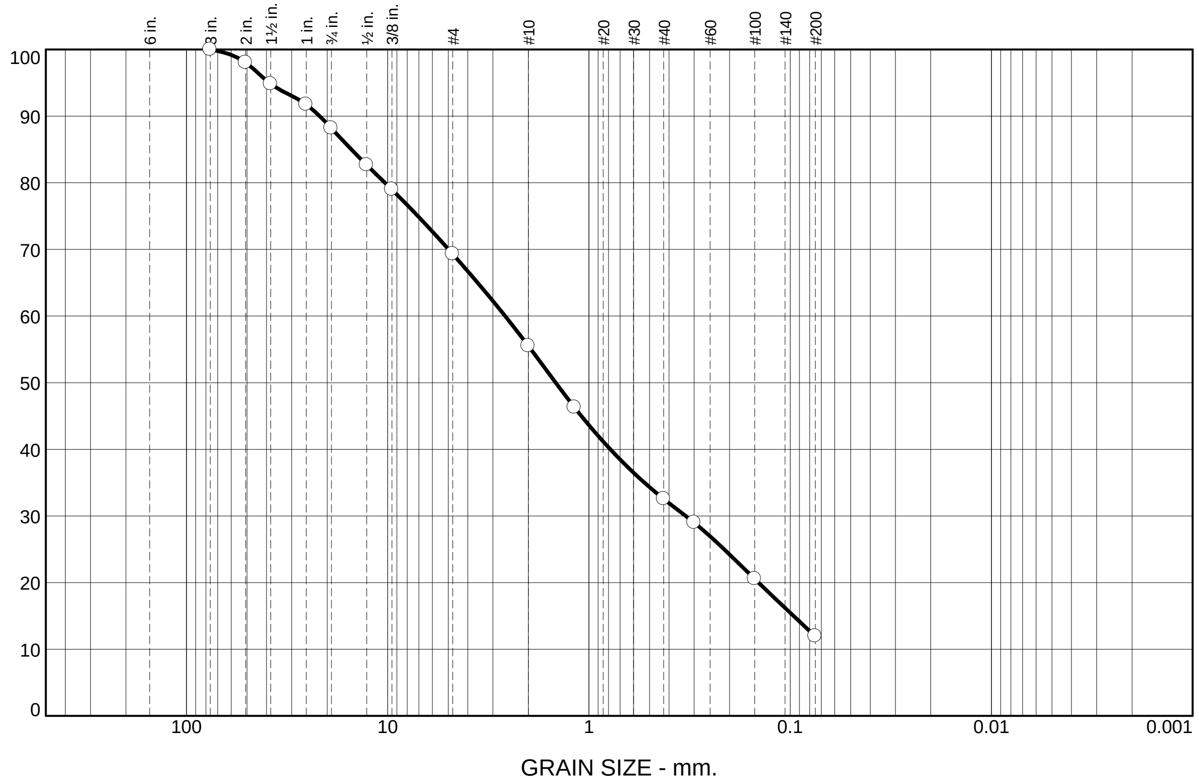
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-060-18

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	11.8	18.9	13.8	22.9	20.7	11.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	98.0		
1.5	94.8		
1	91.8		
.75	88.2		
.5	82.7		
.375	79.0		
#4	69.3		
#10	55.5		
#16	46.3		
#40	32.6		
#50	29.0		
#100	20.5		
#200	11.9		

* (no specification provided)

Material Description

Brown poorly graded sand with silt and gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 21.7868 D_{85}= 15.1391 D_{60}= 2.6094
D_{50}= 1.4636 D_{30}= 0.3302 D_{15}= 0.0962
D_{10}= C_u= C_c=

Classification

USCS= SP-SM AASHTO= A-1-b

Remarks

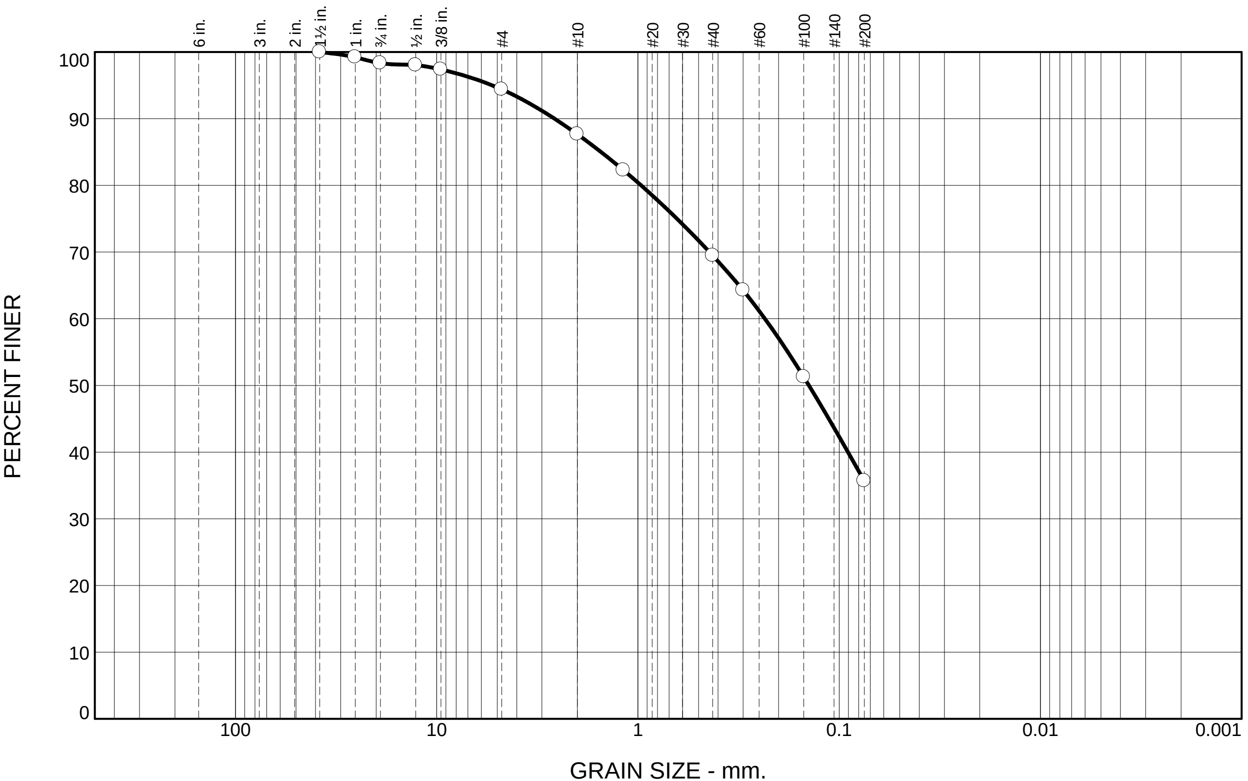
Location: TP19-23
Sample Number: 19-060-19 **Depth:** 5-9' **Date:** 3/6/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-19

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	1.7	3.9	6.7	18.2	33.8	35.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	99.2		
.75	98.3		
.5	98.0		
.375	97.4		
#4	94.4		
#10	87.7		
#16	82.3		
#40	69.5		
#50	64.3		
#100	51.3		
#200	35.7		

* (no specification provided)

Material Description

Light Brown clayey sand

Atterberg Limits

PL= 33 LL= 68 PI= 35

Coefficients

D_{90}= 2.5938 D_{85}= 1.5251 D_{60}= 0.2339
D_{50}= 0.1413 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-7-5(6)

Remarks

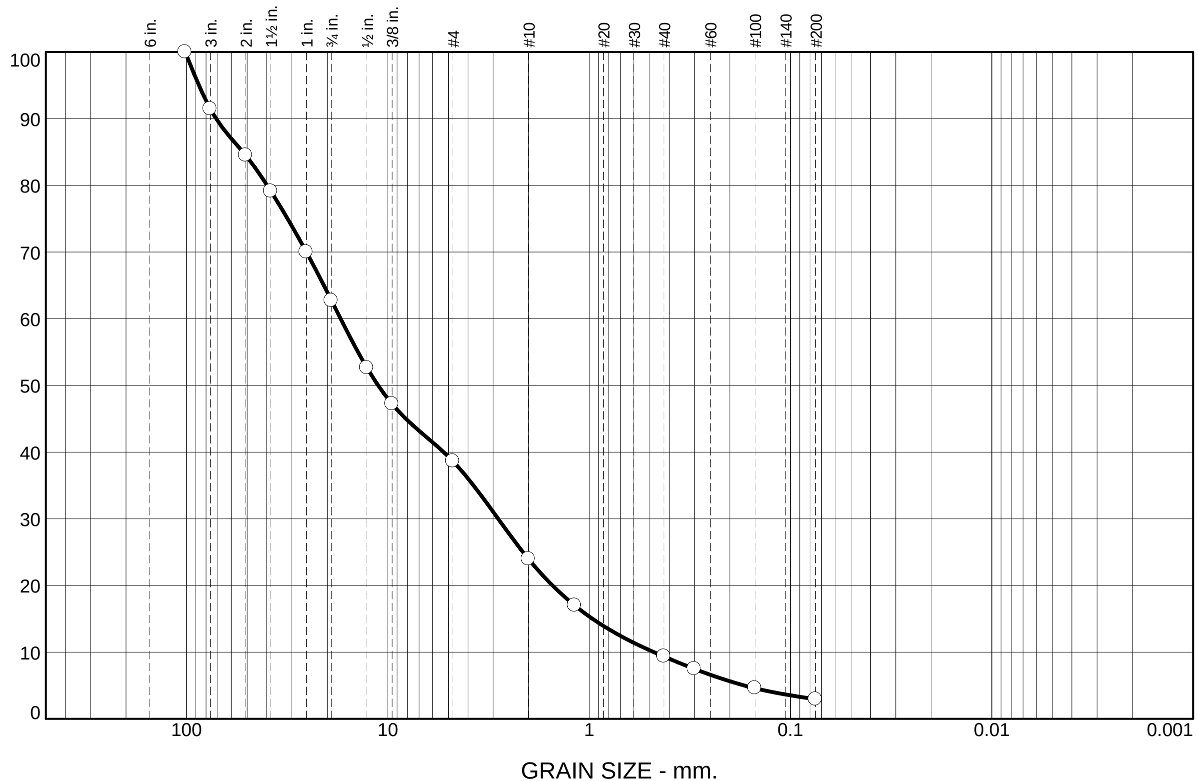
Location: TP19-24
Sample Number: 19-060-20 **Depth:** 14-17' **Date:** 3/6/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-20

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
8.5	28.8	24.1	14.7	14.6	6.4	2.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100.0		
3	91.5		
2	84.5		
1.5	79.1		
1	70.0		
.75	62.7		
.5	52.6		
.375	47.2		
#4	38.6		
#10	23.9		
#16	17.0		
#40	9.3		
#50	7.5		
#100	4.6		
#200	2.9		

* (no specification provided)

Material Description

Brown poorly graded gravel with sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 71.3287 D_{85}= 52.4236 D_{60}= 17.1564
D_{50}= 11.1788 D_{30}= 2.8311 D_{15}= 0.9624
D_{10}= 0.4767 C_u= 35.99 C_c= 0.98

Classification

USCS= GP AASHTO= A-1-a

Remarks

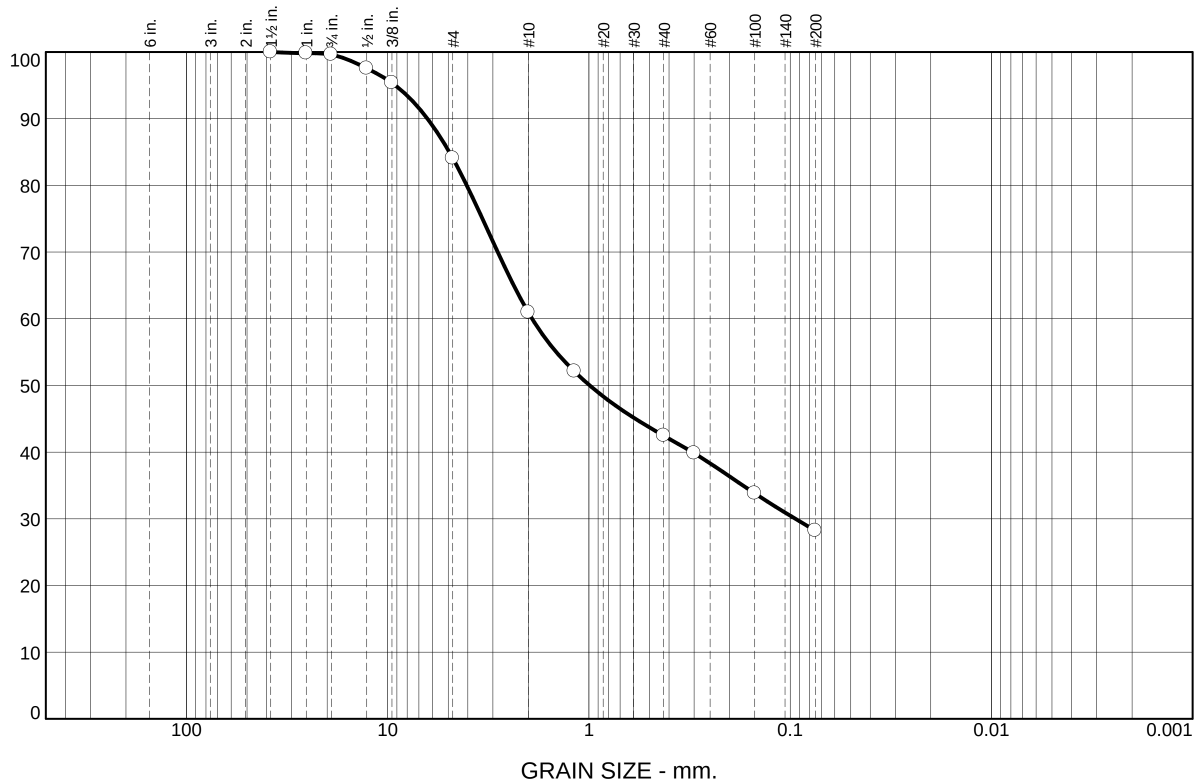
Location: TP19-25
Sample Number: 19-060-21 **Depth:** 7-12' **Date:** 3/6/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-21

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.4	15.5	23.2	18.4	14.3	28.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	99.8		
.75	99.6		
.5	97.6		
.375	95.4		
#4	84.1		
#10	60.9		
#16	52.1		
#40	42.5		
#50	39.8		
#100	33.8		
#200	28.2		

* (no specification provided)

Material Description

Light Brown clayey sand with gravel

Atterberg Limits

PL= 21
LL= 53
PI= 32

Coefficients

D_{90}= 6.3432
D_{85}= 4.9417
D_{60}= 1.9162
D_{50}= 0.9906
D_{30}= 0.0942
D_{15}=
D_{10}=
C_u=
C_c=

Classification

USCS= SC
AASHTO= A-2-7(3)

Remarks

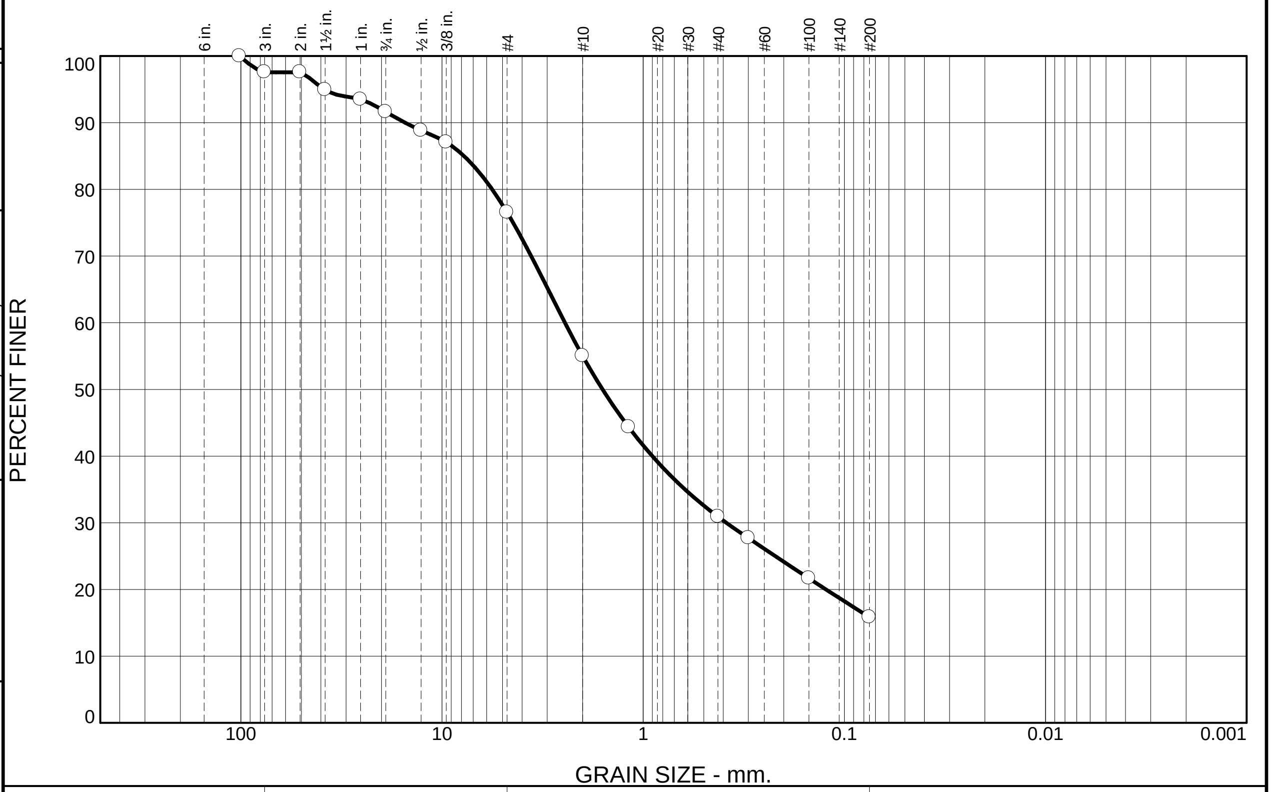
Location: TP19-26
Sample Number: 19-060-22 **Depth:** 6-8'
Date: 3/6/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-22

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
2.4	6.0	15.0	21.6	24.1	15.1	15.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100.0		
3	97.6		
2	97.6		
1.5	94.9		
1	93.5		
.75	91.6		
.5	88.8		
.375	87.1		
#4	76.6		
#10	55.0		
#16	44.3		
#40	30.9		
#50	27.7		
#100	21.7		
#200	15.8		

* (no specification provided)

Material Description

Light Brown silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 15.2288 D_{85}= 7.7681 D_{60}= 2.4486
D_{50}= 1.5927 D_{30}= 0.3859 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Location: TP19-27
Sample Number: 19-060-23 **Depth:** 3-5' **Date:** 3/6/2019

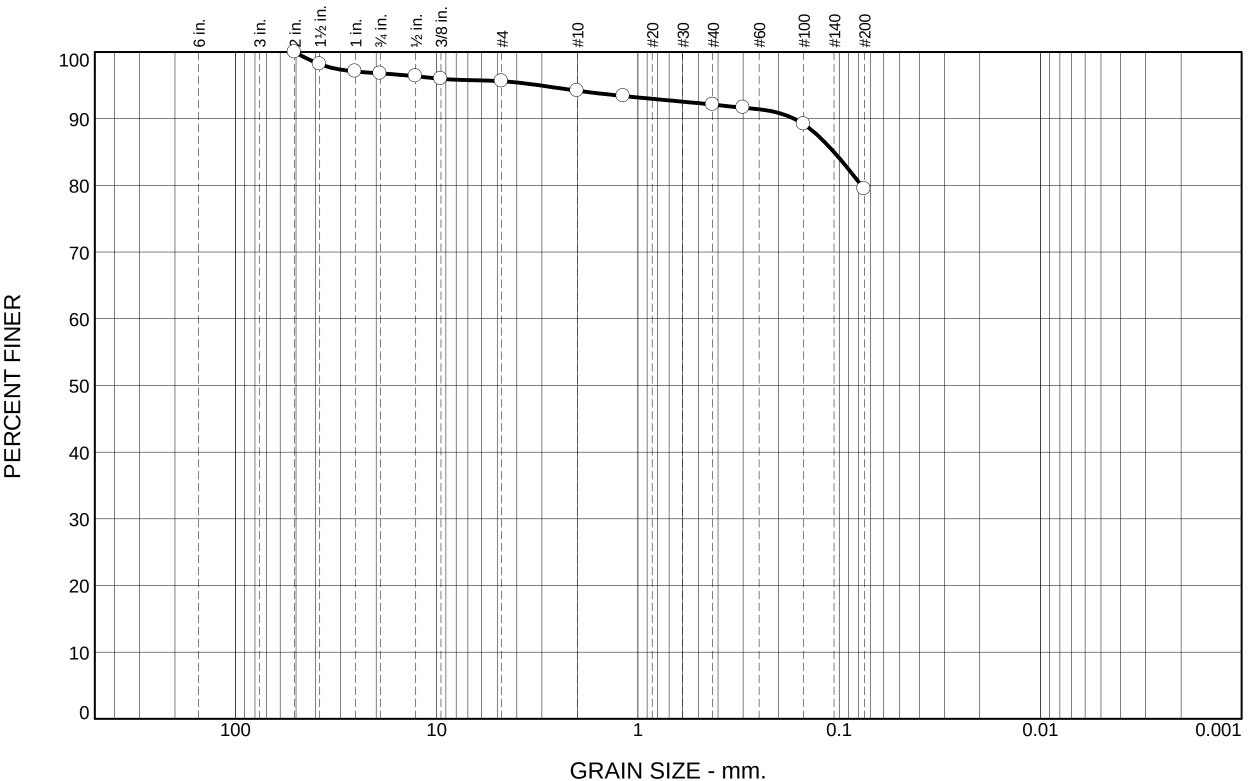
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-060-23

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.2	1.2	1.4	2.1	12.6	79.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2	100.0		
1.5	98.2		
1	97.1		
.75	96.8		
.5	96.4		
.375	96.0		
#4	95.6		
#10	94.2		
#16	93.4		
#40	92.1		
#50	91.7		
#100	89.2		
#200	79.5		

* (no specification provided)

Material Description

Light Brown fat clay with sand

Atterberg Limits

PL= 26 LL= 63 PI= 37

Coefficients

D_{90}= 0.1674 D_{85}= 0.1061 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CH AASHTO= A-7-6(32)

Remarks

Natural Moisture Content: 30.7%

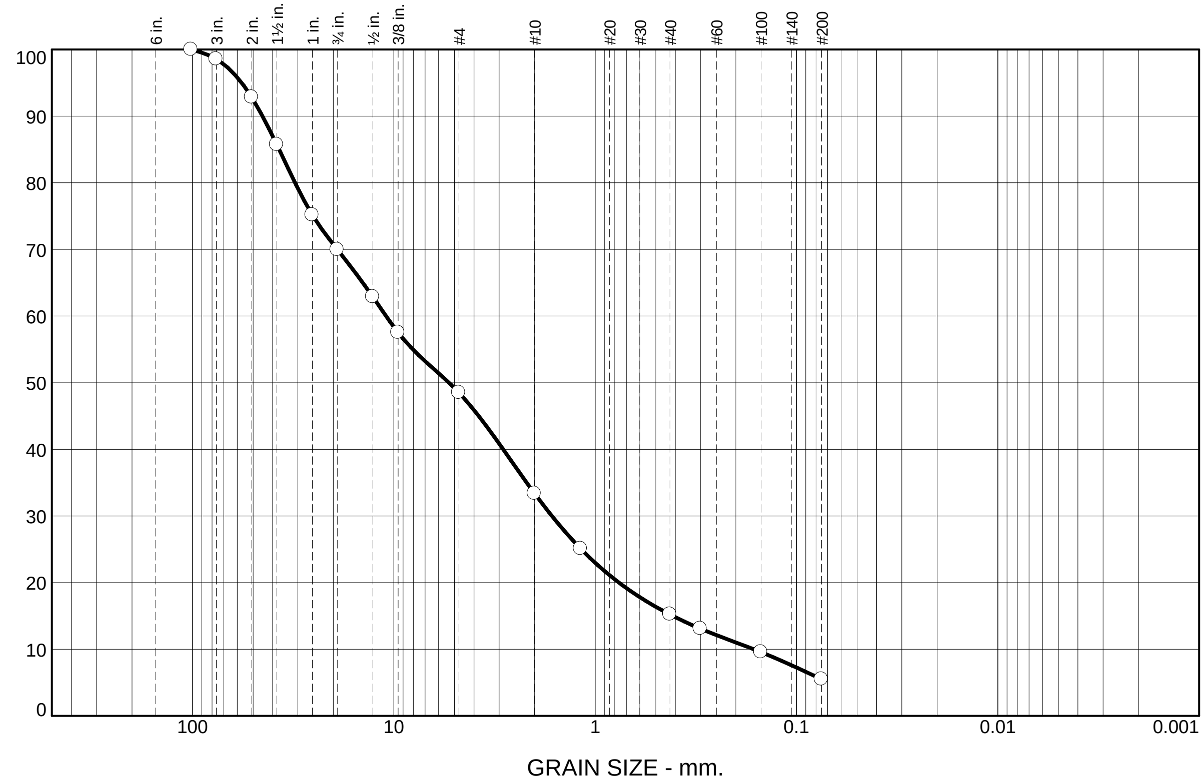
Location: TP19-28
Sample Number: 19-106-08 **Depth:** 1-3' **Date:** 4/22/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-106-08

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
1.4	28.6	21.5	15.1	18.2	9.7	5.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100.0		
3	98.6		
2	92.8		
1.5	85.7		
1	75.2		
.75	70.0		
.5	62.9		
.375	57.5		
#4	48.5		
#10	33.4		
#16	25.1		
#40	15.2		
#50	13.1		
#100	9.6		
#200	5.5		

* (no specification provided)

Material Description

Brown well-graded gravel with silt and sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 44.9128 D_{85}= 37.1412 D_{60}= 10.9377
D_{50}= 5.3294 D_{30}= 1.6411 D_{15}= 0.4116
D_{10}= 0.1634 C_u= 66.94 C_c= 1.51

Classification

USCS= GW-GM AASHTO= A-1-a

Remarks

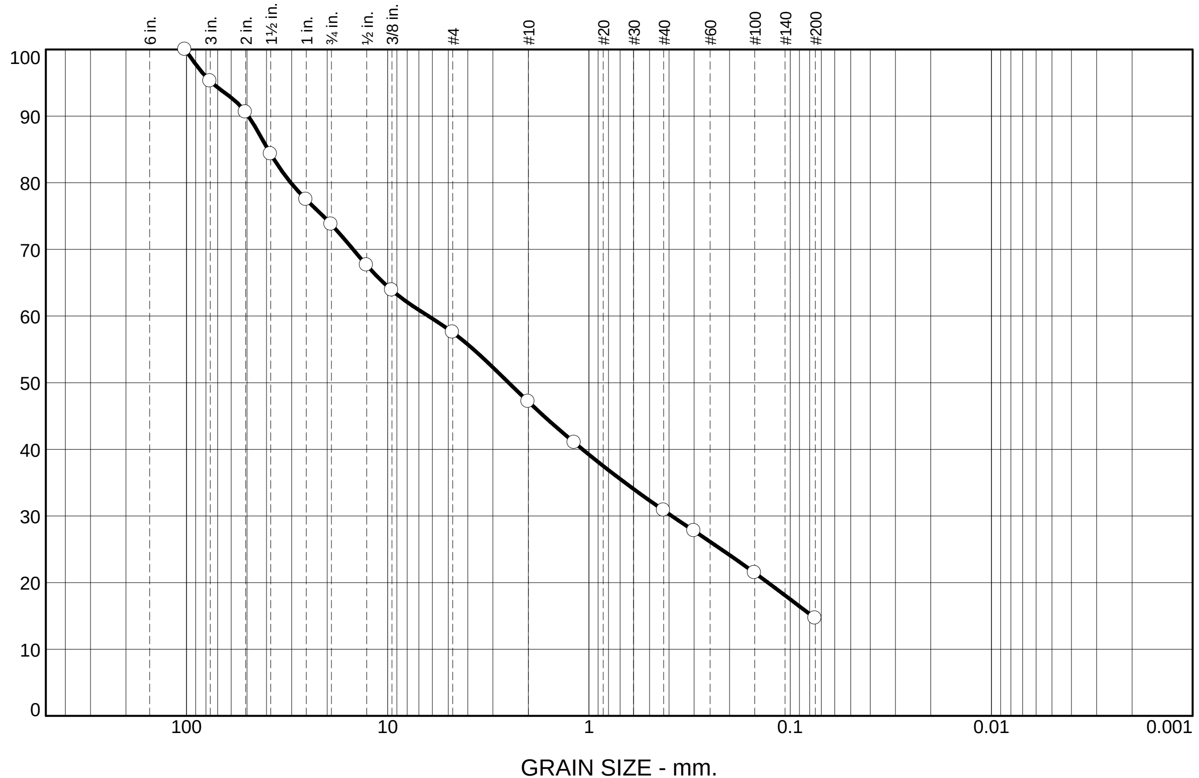
Location: TP19-28
Sample Number: 19-060-24 **Depth:** 5-9' **Date:** 3/6/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-24

Tested By: KS/JB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
4.8	21.5	16.2	10.4	16.3	16.2	14.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100.0		
3	95.2		
2	90.6		
1.5	84.3		
1	77.5		
.75	73.7		
.5	67.6		
.375	63.9		
#4	57.5		
#10	47.1		
#16	41.0		
#40	30.8		
#50	27.7		
#100	21.5		
#200	14.6		

* (no specification provided)

Material Description

Light Brown silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 49.1622 D_{85}= 39.3227 D_{60}= 6.2806

D_{50}= 2.5052 D_{30}= 0.3872 D_{15}= 0.0778

D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Location: TP19-29
Sample Number: 19-060-25 **Depth:** 4-7' **Date:** 3/6/2019

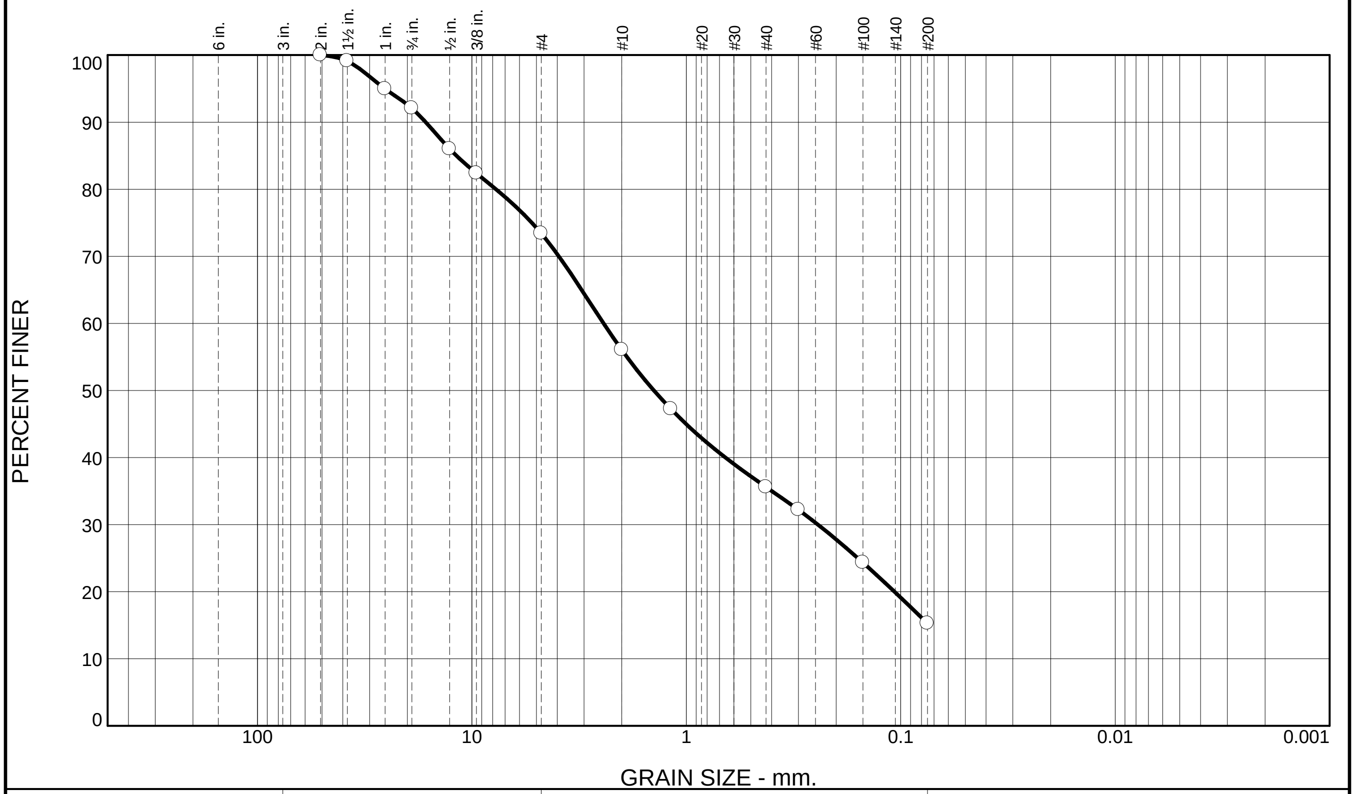
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-060-25

Tested By: KS/JB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	7.9	18.7	17.4	20.4	20.3	15.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2"	100.0		
1.5"	99.1		
1"	94.9		
.75"	92.1		
.5"	86.0		
.375"	82.4		
#4	73.4		
#10	56.0		
#16	47.2		
#40	35.6		
#50	32.2		
#100	24.3		
#200	15.3		

* (no specification provided)

Material Description

Light Brown silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 16.4121 D_{85}= 11.8087 D_{60}= 2.4309
D_{50}= 1.4179 D_{30}= 0.2436 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

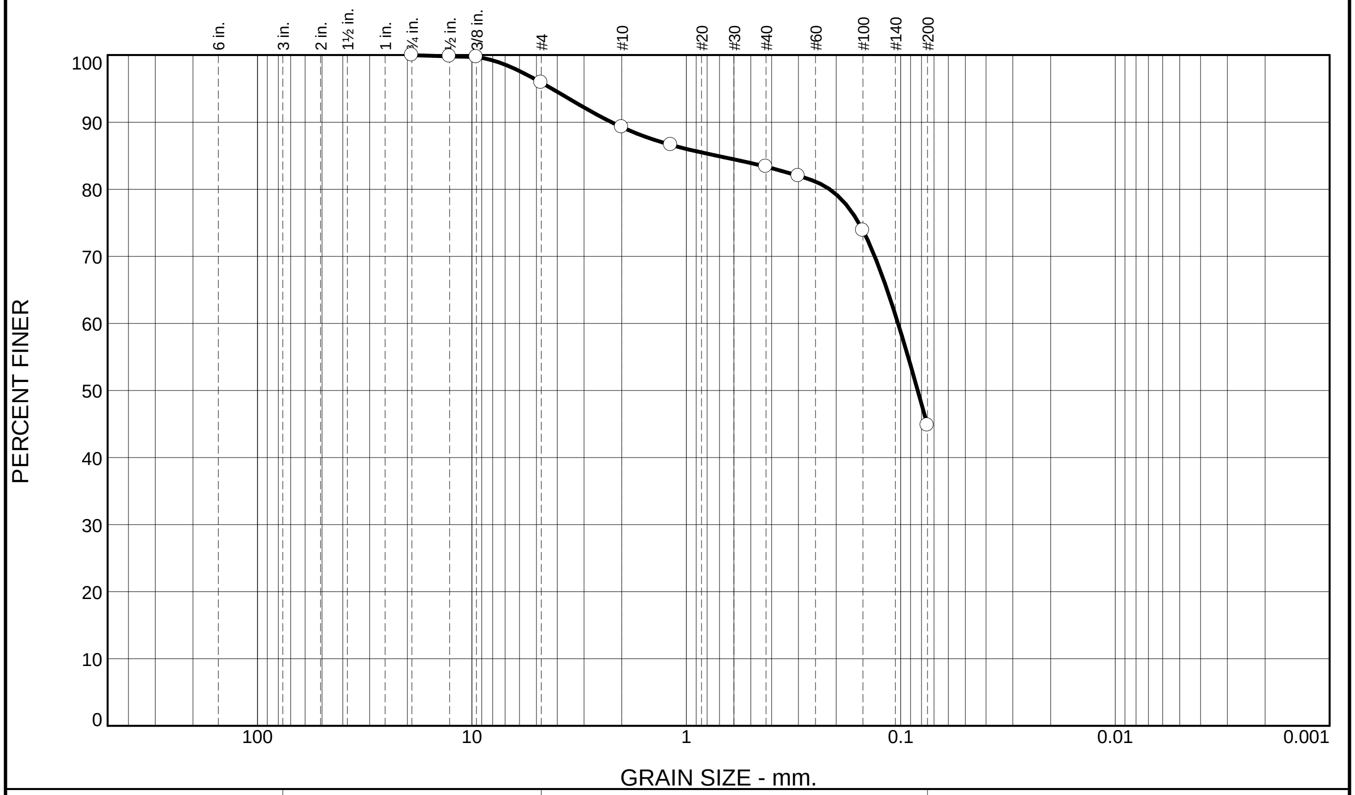
Location: TP19-30
Sample Number: 20-019-01 **Depth:** 8"-9' **Date:** 2/6/2020

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 20-019-01

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.1	6.6	5.9	38.6	44.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75"	100.0		
.5"	99.8		
.375"	99.7		
#4	95.9		
#10	89.3		
#16	86.6		
#40	83.4		
#50	82.0		
#100	73.8		
#200	44.8		

* (no specification provided)

Material Description

Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 2.2353 D_{85}= 0.7216 D_{60}= 0.1030
D_{50}= 0.0833 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-4(0)

Remarks

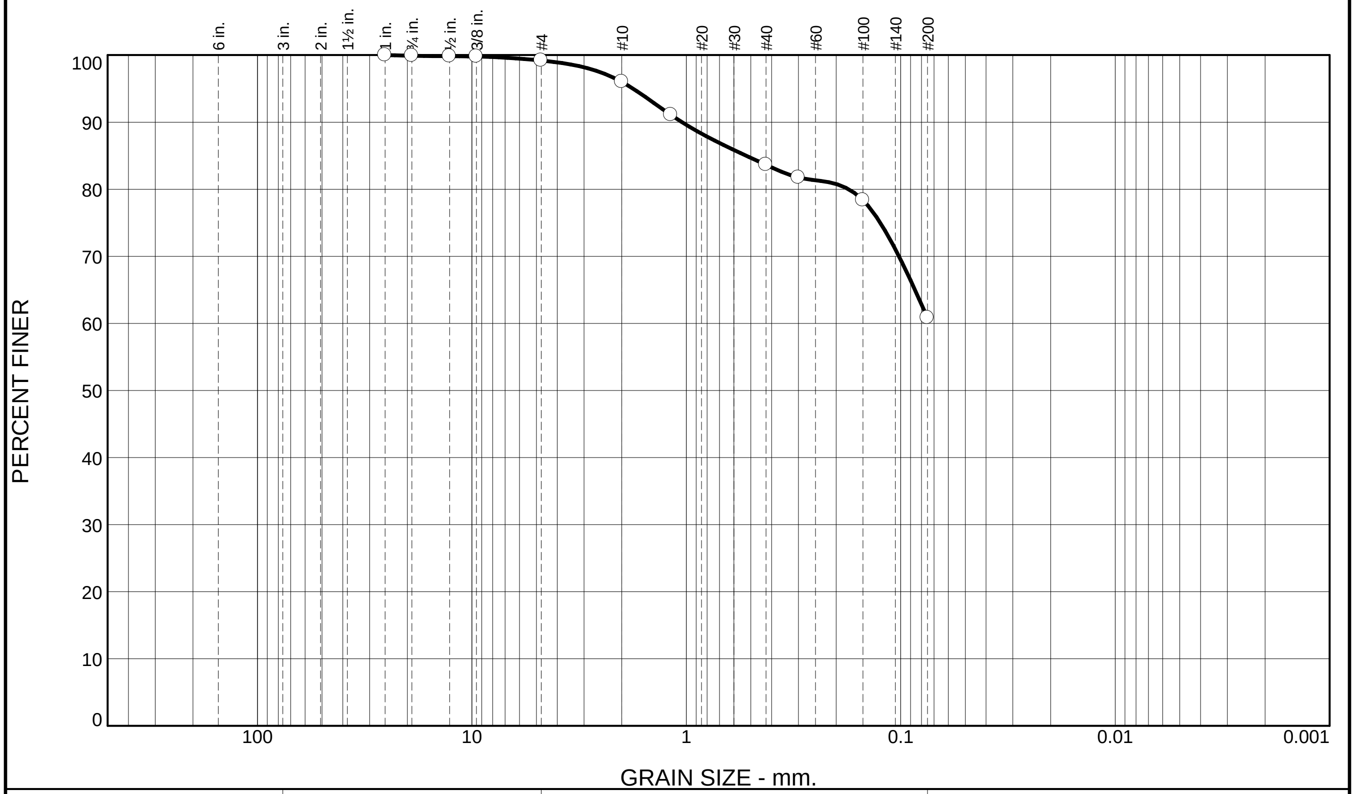
Location: TP19-31
Sample Number: 20-019-02 **Depth:** 8"-10' **Date:** 2/6/2020

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 20-019-02

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.1	0.7	3.2	12.4	22.8	60.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
.75"	99.9		
.5"	99.8		
.375"	99.8		
#4	99.2		
#10	96.0		
#16	91.1		
#40	83.6		
#50	81.8		
#100	78.4		
#200	60.8		

* (no specification provided)

Material Description

Light Brown sandy silt

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 1.0477 D_{85}= 0.5260 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO= A-4(0)

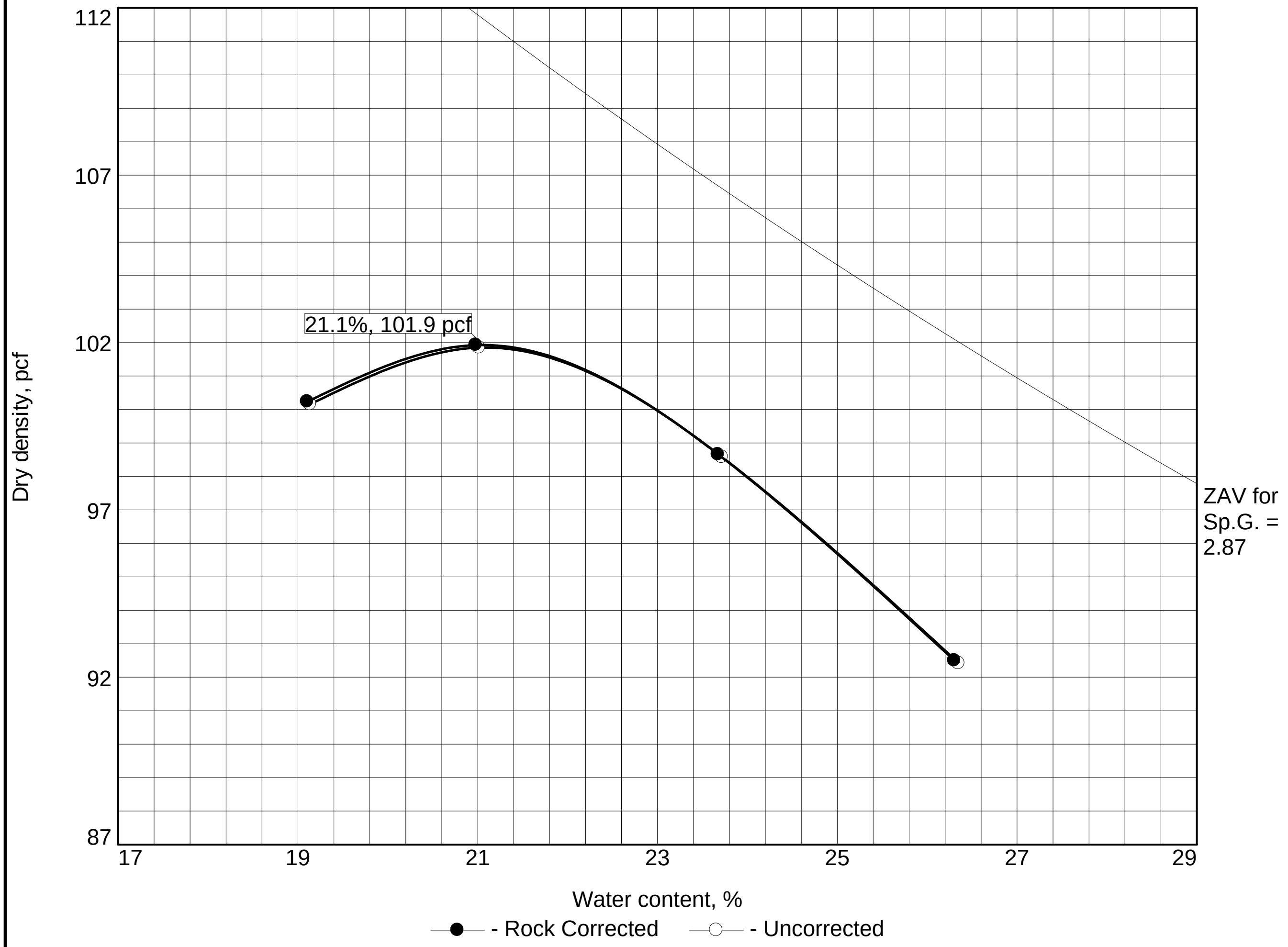
Remarks

Location: TP19-32
Sample Number: 20-019-03 **Depth:** 6"-5' **Date:** 2/6/2020

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 20-019-03

Tested By: JH **Checked By:** JH



Test specification: ASTM D 1557-12 Method B Modified
ASTM D4718-15 Oversize Corr. Applied to Each Test Point

Elev/ Depth	**Classification**		**Nat. Moist.**	**Sp.G.**	**LL**	**PI**	**% > 3/8 in.**	**% < No.200**
	USCS	**AASHTO**						
6"-5'	ML	A-4(0)		2.87	NP	NP	0.2	60.8

ROCK CORRECTED TEST RESULTS	**UNCORRECTED**	**MATERIAL DESCRIPTION**
Maximum dry density = 101.9 pcf	101.9 pcf	Light Brown sandy silt
Optimum moisture = 21.1 %	21.1 %	

Project No. 475.0385.000 **Client:** Lithium Nevada
Project: Thacker Pass
Date: 2/12/2020
○ **Location:** TP19-32 **Sample Number:** 20-019-03

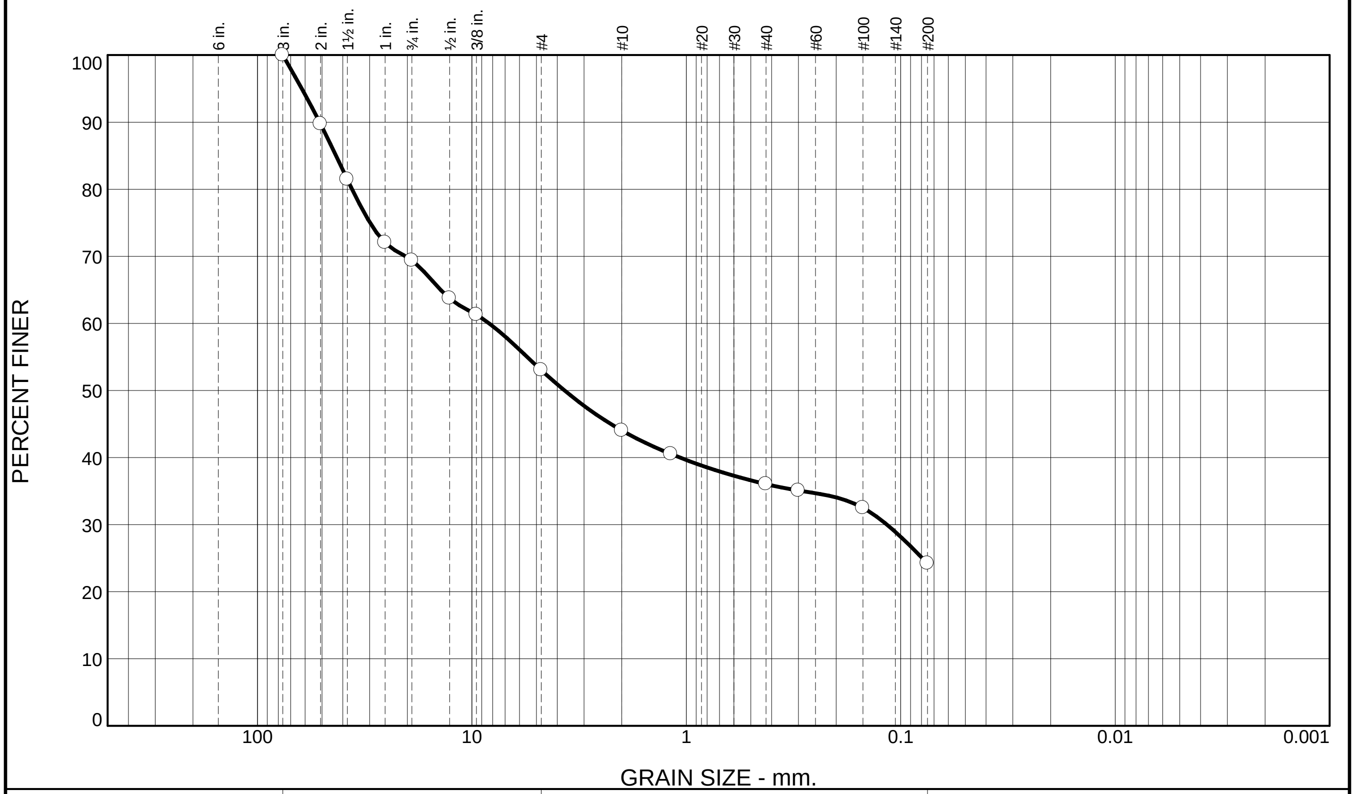
NewFields

Remarks:
*Assumed Specific Gravity

Figure 20-019-03

Tested By: CM/KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	30.6	16.4	9.0	8.0	11.8	24.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100.0		
2"	89.7		
1.5"	81.5		
1"	72.0		
.75"	69.4		
.5"	63.7		
.375"	61.3		
#4	53.0		
#10	44.0		
#16	40.5		
#40	36.0		
#50	35.1		
#100	32.5		
#200	24.2		

* (no specification provided)

Material Description

Brown clayey gravel with sand

Atterberg Limits

PL= 23 LL= 48 PI= 25

Coefficients

D_{90}= 51.3025 D_{85}= 43.0310 D_{60}= 8.3039
D_{50}= 3.7008 D_{30}= 0.1161 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= GC AASHTO= A-2-7(1)

Remarks

Location: TP19-33
Sample Number: 20-019-04 **Depth:** 3-15' **Date:** 2/6/2020

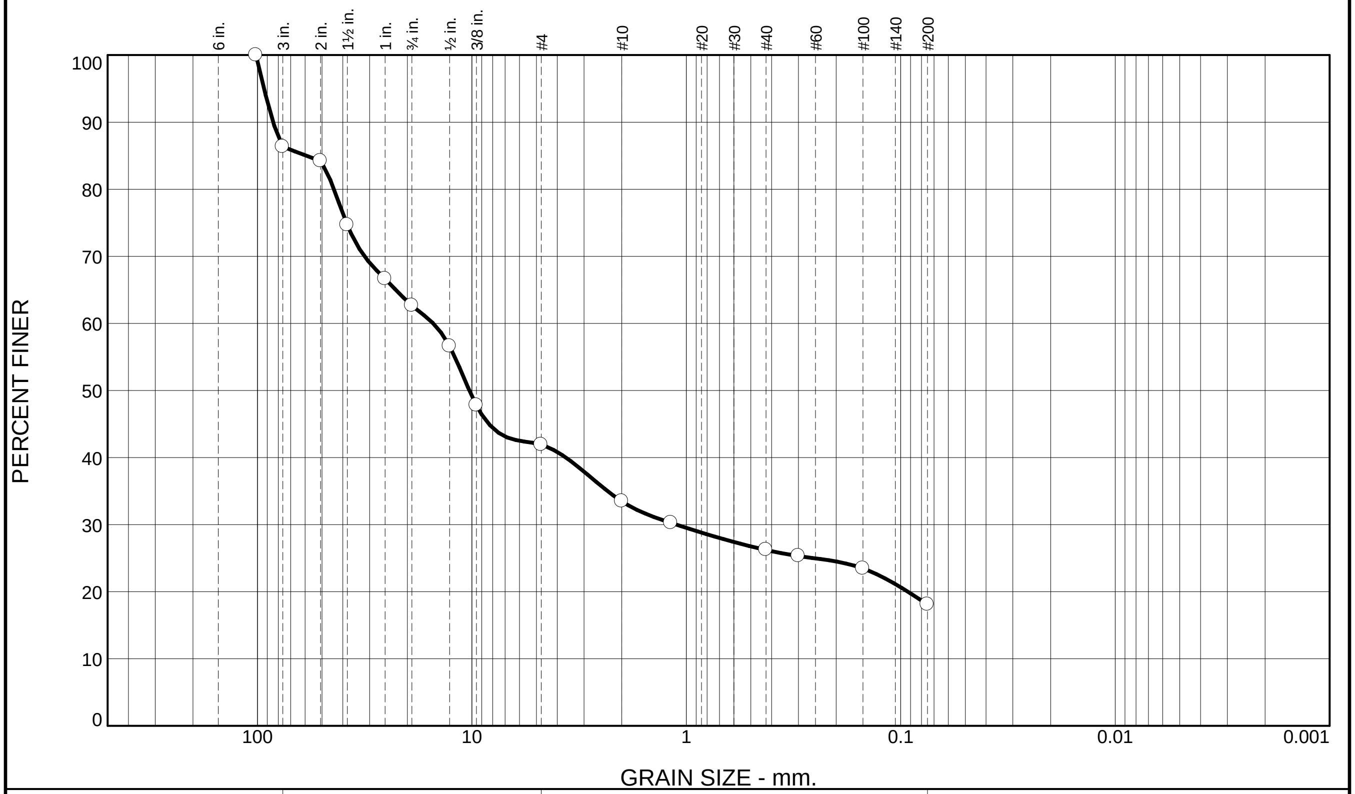
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 20-019-04

Tested By: JH/CM **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
13.7	23.6	20.8	8.4	7.3	8.1	18.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4"	100.0		
3"	86.3		
2"	84.2		
1.5"	74.7		
1"	66.6		
.75"	62.7		
.5"	56.6		
.375"	47.8		
#4	41.9		
#10	33.5		
#16	30.3		
#40	26.2		
#50	25.3		
#100	23.5		
#200	18.1		

* (no specification provided)

Material Description

Brown clayey gravel with sand

Atterberg Limits

PL= 19 LL= 46 PI= 27

Coefficients

D_{90}= 84.5631 D_{85}= 59.1319 D_{60}= 15.1589
D_{50}= 10.2774 D_{30}= 1.1138 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= GC AASHTO= A-2-7(1)

Remarks

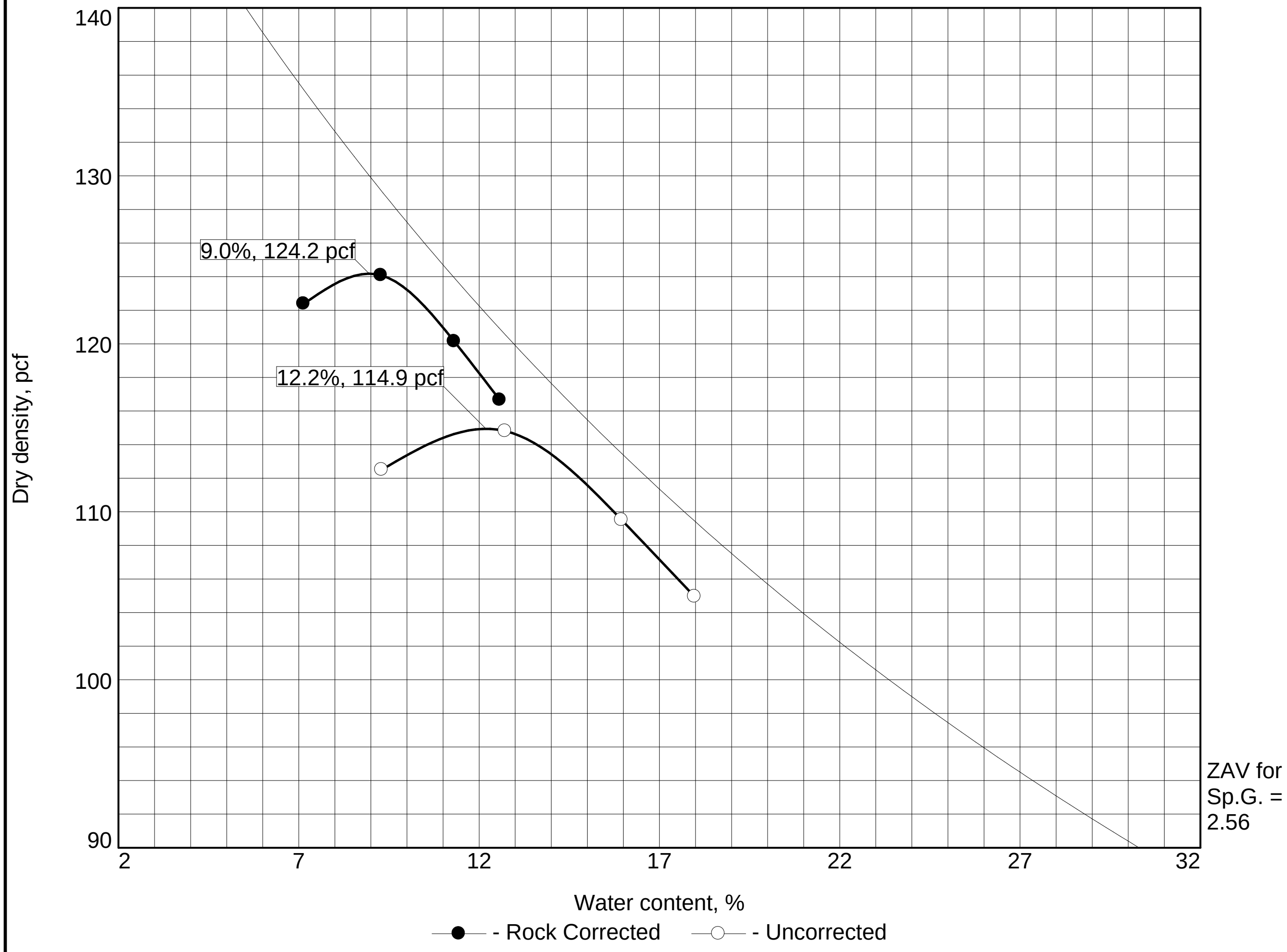
Location: TP19-34
Sample Number: 20-019-05 **Depth:** 5-11' **Date:** 2/6/2020

NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 20-019-05

Tested By: JH/CM **Checked By:** JH



Test specification: ASTM D 1557-12 Method C Modified
ASTM D4718-15 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
5-11'	GC	A-2-7(1)		2.56	46	27	37.3	18.1

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 124.2 pcf	114.9 pcf	Brown clayey gravel with sand
Optimum moisture = 9.0 %	12.2 %	

Project No. 475.0385.000 **Client:** Lithium Nevada
Project: Thacker Pass
Date: 2/12/2020
○ **Location:** TP19-34 **Sample Number:** 20-019-05

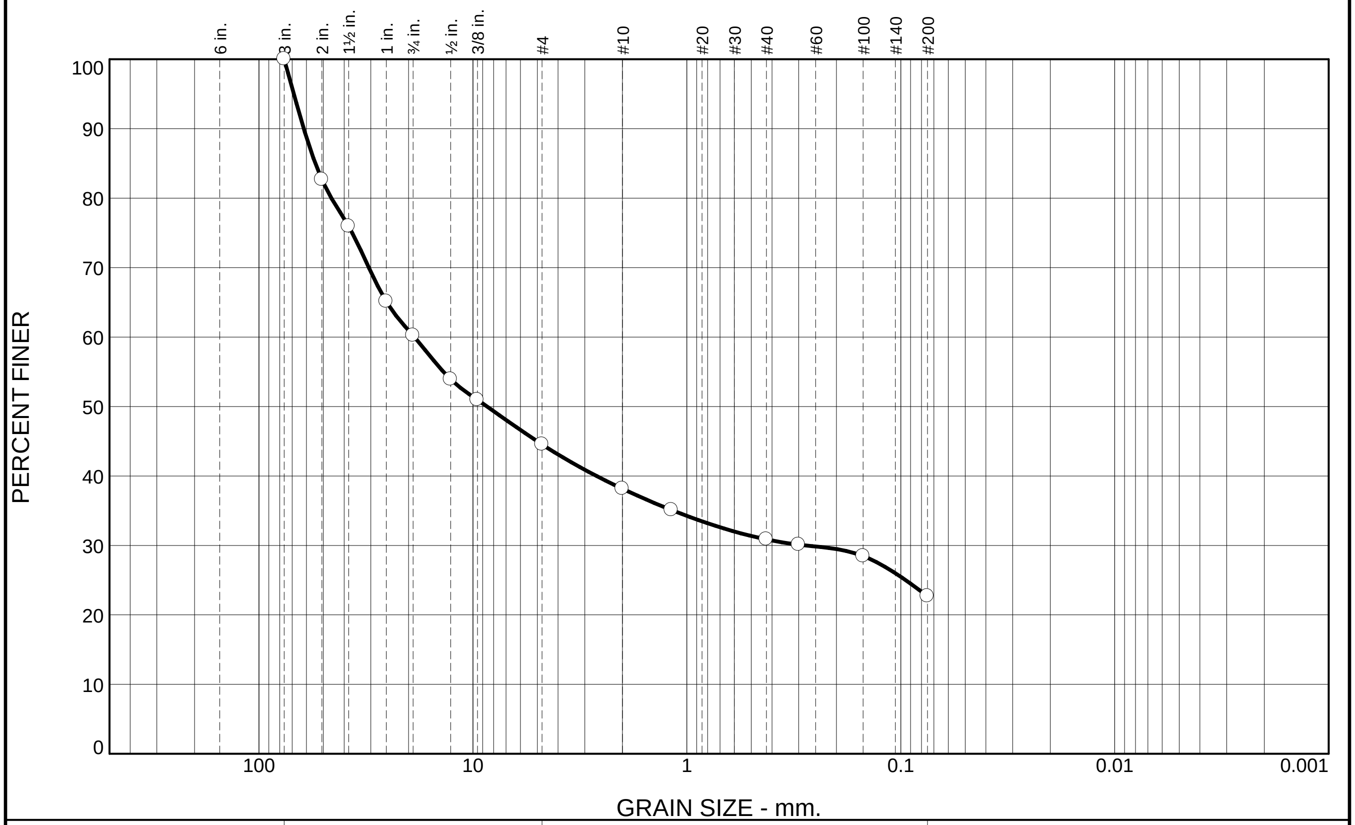
NewFields

Remarks:
*Assumed Specific Gravity

Figure 20-019-05

Tested By: CM/KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	39.8	15.7	6.3	7.3	8.2	22.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100.0		
2"	82.7		
1.5"	75.9		
1"	65.1		
.75"	60.2		
.5"	53.9		
.375"	50.9		
#4	44.5		
#10	38.2		
#16	35.1		
#40	30.9		
#50	30.1		
#100	28.5		
#200	22.7		

* (no specification provided)

Material Description

Brown clayey gravel with sand

Atterberg Limits

PL= 20 LL= 30 PI= 10

Coefficients

D_{90}= 61.7253 D_{85}= 54.5324 D_{60}= 18.7814
D_{50}= 8.5953 D_{30}= 0.2796 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= GC AASHTO= A-2-4(0)

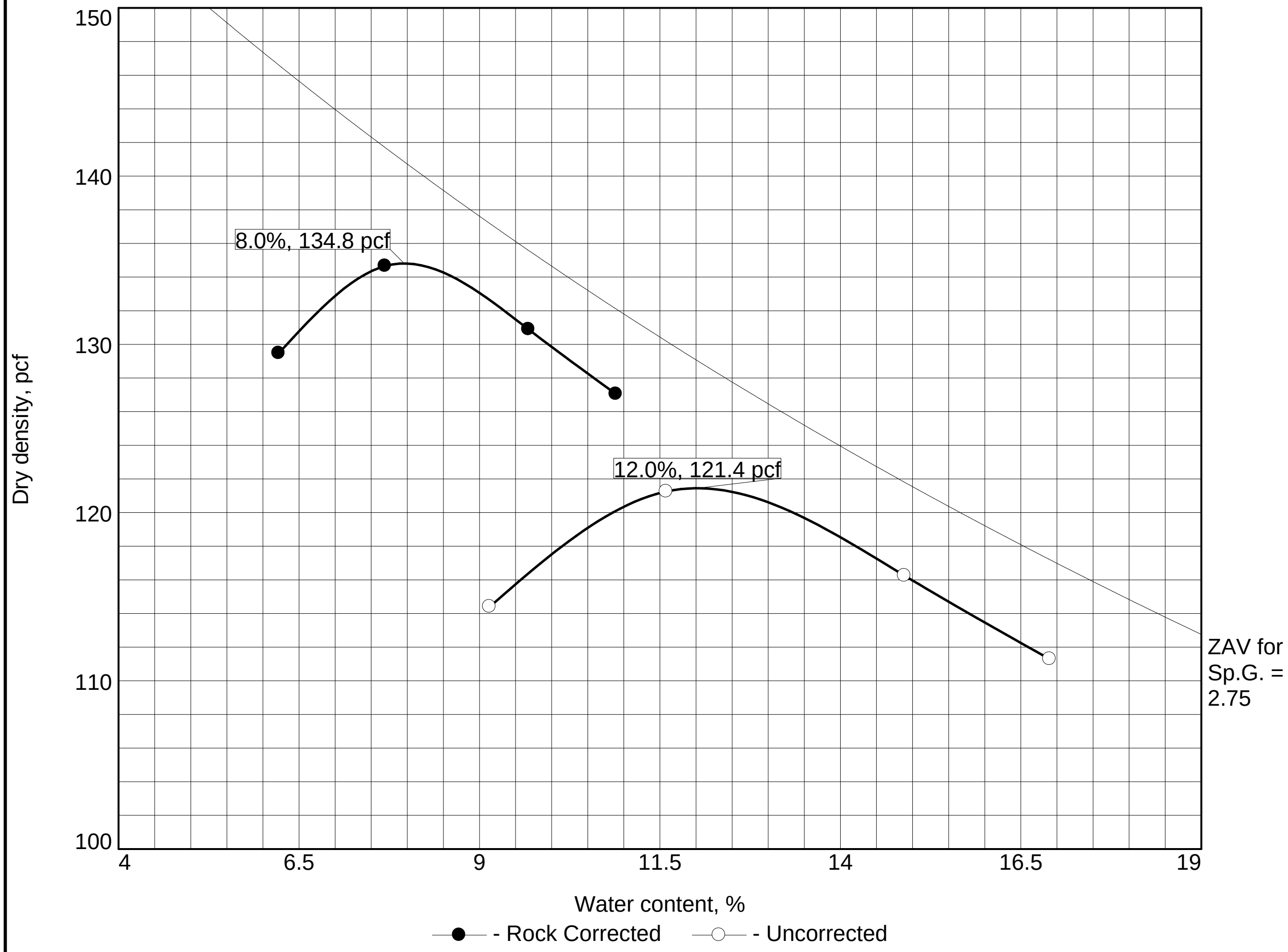
Remarks

Location: TP19-35
Sample Number: 20-019-06 **Depth:** 8"-8' **Date:** 2/6/2020

NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 20-019-06



Test specification: ASTM D 1557-12 Method C Modified
ASTM D4718-15 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification USCS	Classification AASHTO	Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
8"-8'	GC	A-2-4(0)		2.75	30	10	39.8	22.7

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 134.8 pcf	121.4 pcf	Brown clayey gravel with sand
Optimum moisture = 8.0 %	12.0 %	

Project No. 475.0385.000 **Client:** Lithium Nevada
Project: Thacker Pass
Date: 2/13/2020
○ **Location:** TP19-35 **Sample Number:** 20-019-06

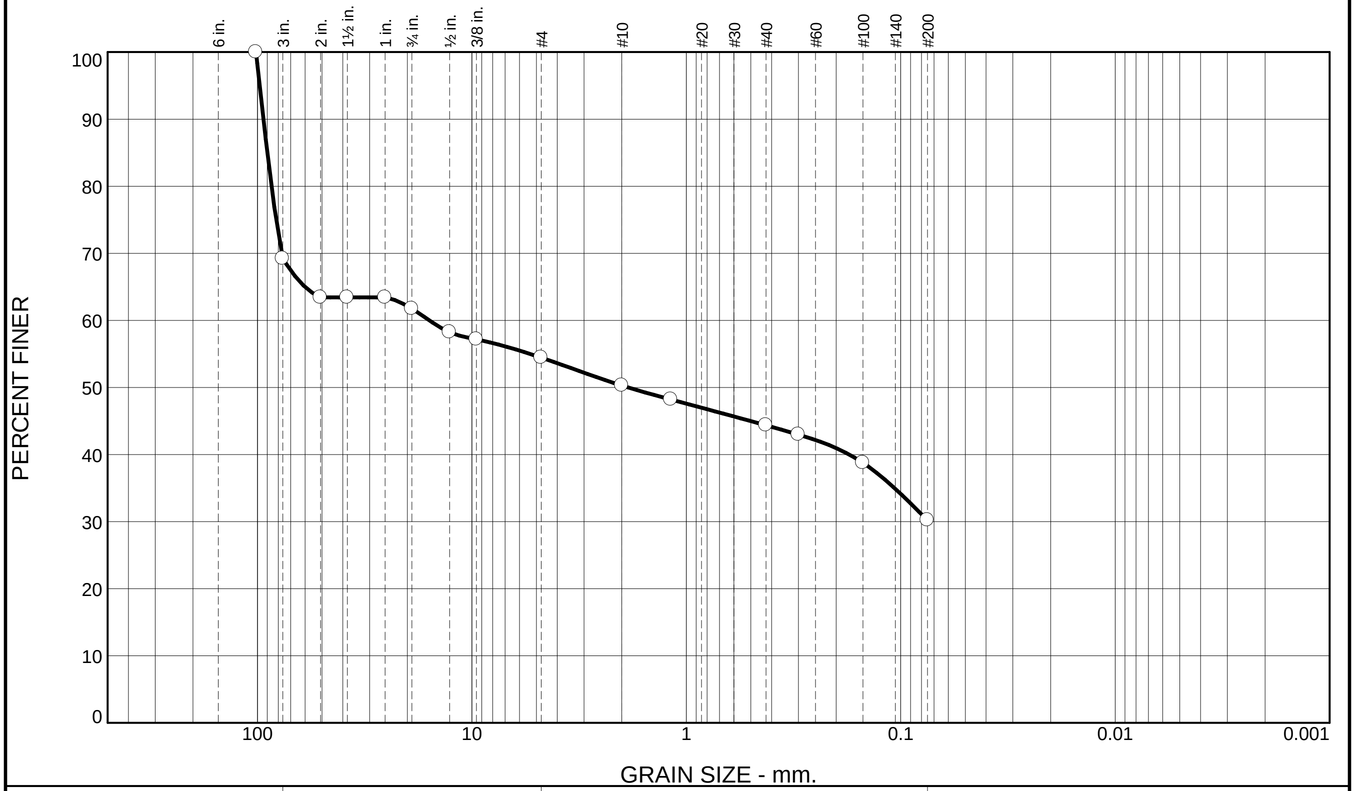
NewFields

Remarks:
*Assumed Specific Gravity

Figure 20-019-06

Tested By: CM **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
30.8	7.5	7.3	4.1	5.9	14.2	30.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4"	100.0		
3"	69.2		
2"	63.4		
1.5"	63.4		
1"	63.4		
.75"	61.7		
.5"	58.2		
.375"	57.2		
#4	54.4		
#10	50.3		
#16	48.2		
#40	44.4		
#50	43.0		
#100	38.8		
#200	30.2		

* (no specification provided)

Material Description

Light Brown silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 93.8211 D_{85}= 89.9797 D_{60}= 15.7817
D_{50}= 1.8694 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-4(0)

Remarks

Location: TP19-36
Sample Number: 20-019-07 **Depth:** 6-9' **Date:** 2/6/2020

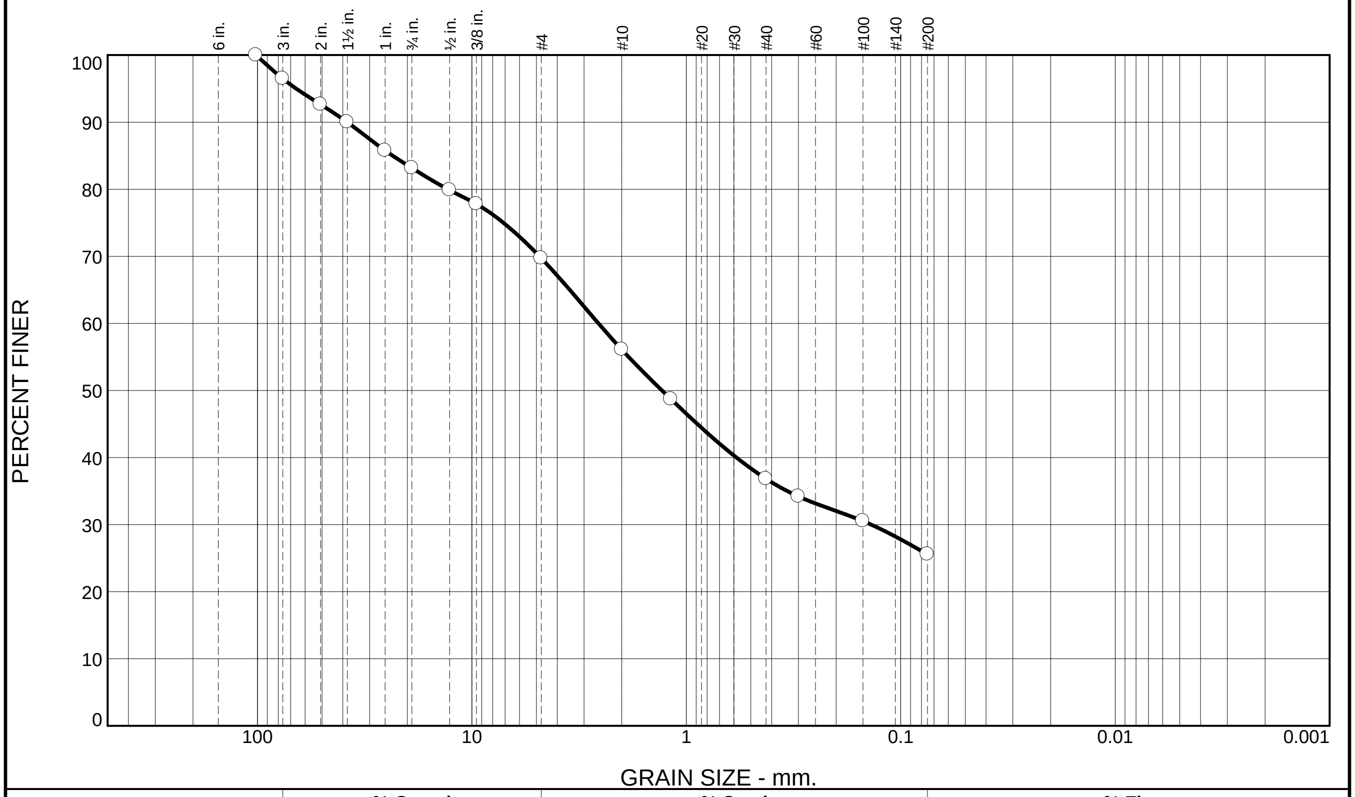
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 20-019-07

Tested By: AR/CM/KS/JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
3.5	13.3	13.5	13.6	19.3	11.2	25.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4"	100.0		
3"	96.5		
2"	92.6		
1.5"	90.0		
1"	85.8		
.75"	83.2		
.5"	79.9		
.375"	77.8		
#4	69.7		
#10	56.1		
#16	48.7		
#40	36.8		
#50	34.2		
#100	30.5		
#200	25.6		

* (no specification provided)

Material Description

Brown clayey sand with gravel

Atterberg Limits

PL= 26 LL= 56 PI= 30

Coefficients

D_{90}= 38.1277 D_{85}= 23.4246 D_{60}= 2.5675

D_{50}= 1.3000 D_{30}= 0.1374 D_{15}=

D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-7(2)

Remarks

Location: TP19-37
Sample Number: 20-019-08 **Depth:** 5-14' **Date:** 2/6/2020

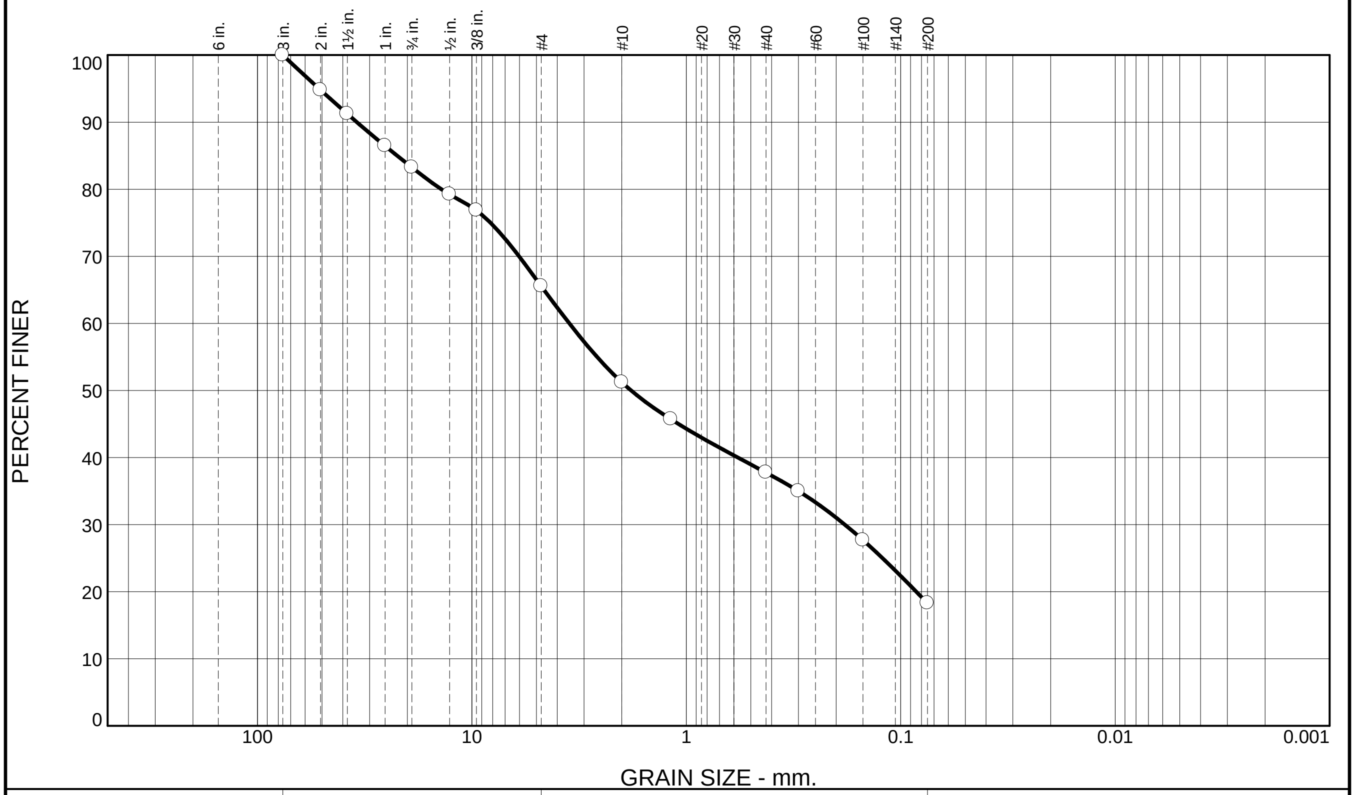
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 20-019-08

Tested By: KS/AR/CM/JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	16.7	17.8	14.3	13.4	19.5	18.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100.0		
2"	94.8		
1.5"	91.2		
1"	86.5		
.75"	83.3		
.5"	79.2		
.375"	76.8		
#4	65.5		
#10	51.2		
#16	45.7		
#40	37.8		
#50	35.0		
#100	27.7		
#200	18.3		

* (no specification provided)

Material Description

Light Brown silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 34.3963 D_{85}= 22.3022 D_{60}= 3.5138

D_{50}= 1.8110 D_{30}= 0.1823 D_{15}=

D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Location: TP19-39

Sample Number: 20-019-09 **Depth:** 8"-5' **Date:** 2/6/2020

NewFields

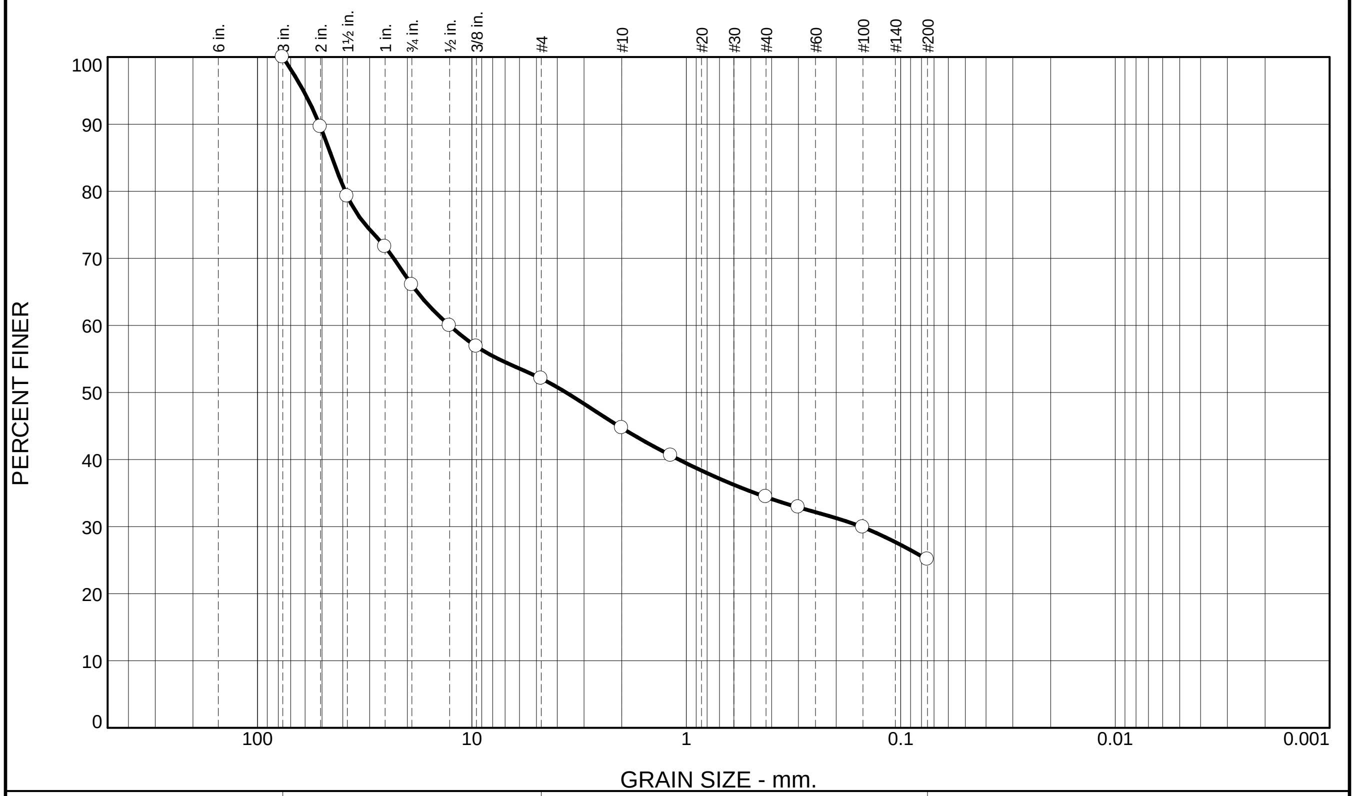
Client: Lithium Nevada

Project: Thacker Pass

Project No: 475.0385.000 **Figure** 20-019-09

Tested By: AR/CM/KS/JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	34.0	13.9	7.4	10.3	9.3	25.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100.0		
2"	89.6		
1.5"	79.3		
1"	71.7		
.75"	66.0		
.5"	60.0		
.375"	56.9		
#4	52.1		
#10	44.7		
#16	40.6		
#40	34.4		
#50	32.9		
#100	29.9		
#200	25.1		

* (no specification provided)

Material Description

Brown clayey gravel with sand

Atterberg Limits

PL= 21 LL= 45 PI= 24

Coefficients

D_{90}= 51.4007 D_{85}= 44.8748 D_{60}= 12.7305
D_{50}= 3.6381 D_{30}= 0.1530 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= GC AASHTO= A-2-7(1)

Remarks

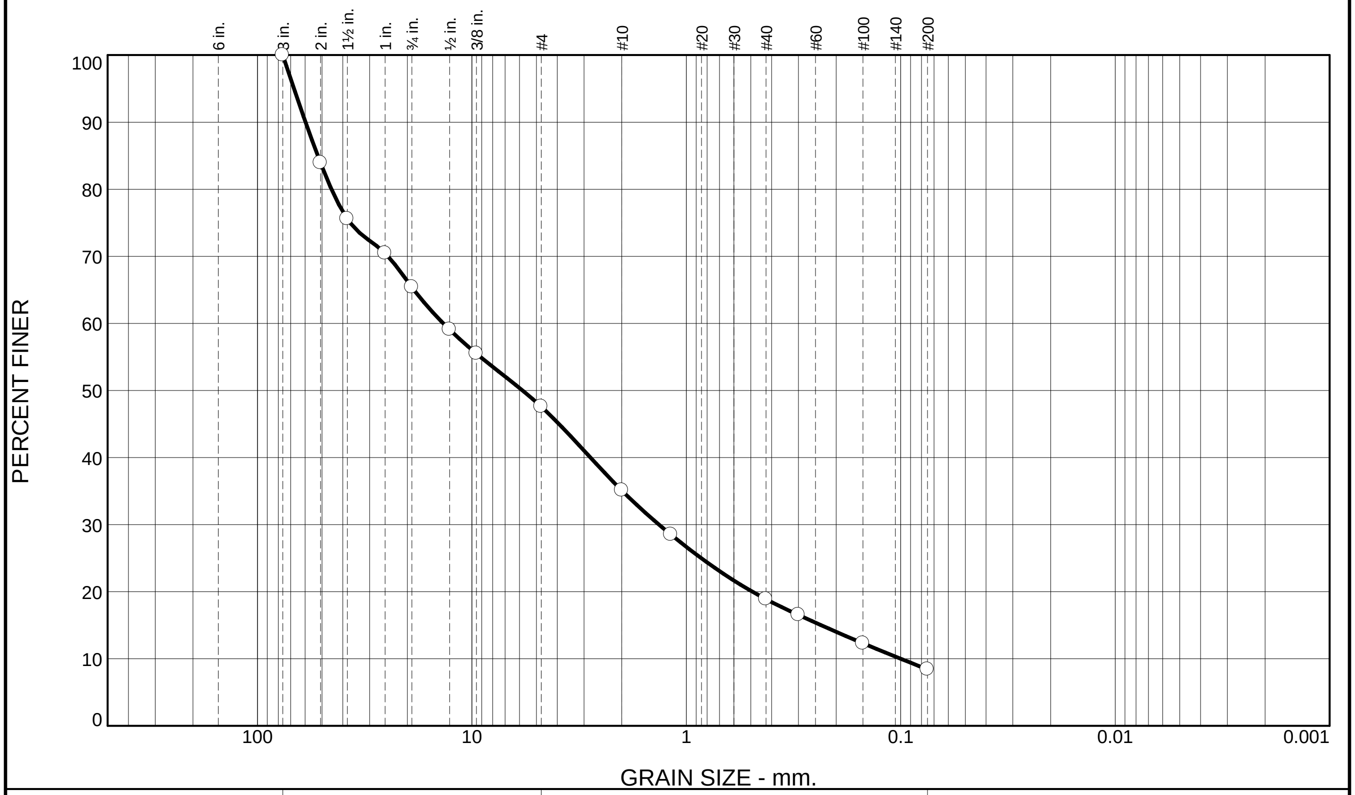
Location: TP19-40
Sample Number: 20-019-10 **Depth:** 1.5-4' **Date:** 2/7/2020

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 20-019-10

Tested By: KS/AR/CM **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	34.6	17.8	12.5	16.2	10.5	8.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100.0		
2"	83.9		
1.5"	75.6		
1"	70.5		
.75"	65.4		
.5"	59.1		
.375"	55.5		
#4	47.6		
#10	35.1		
#16	28.5		
#40	18.9		
#50	16.5		
#100	12.3		
#200	8.4		

* (no specification provided)

Material Description

Brown well-graded gravel with silt and sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 59.6810 D_{85}= 52.3361 D_{60}= 13.5891
D_{50}= 5.8062 D_{30}= 1.3425 D_{15}= 0.2353
D_{10}= 0.1000 C_u= 135.84 C_c= 1.33

Classification

USCS= GW-GM AASHTO= A-1-a

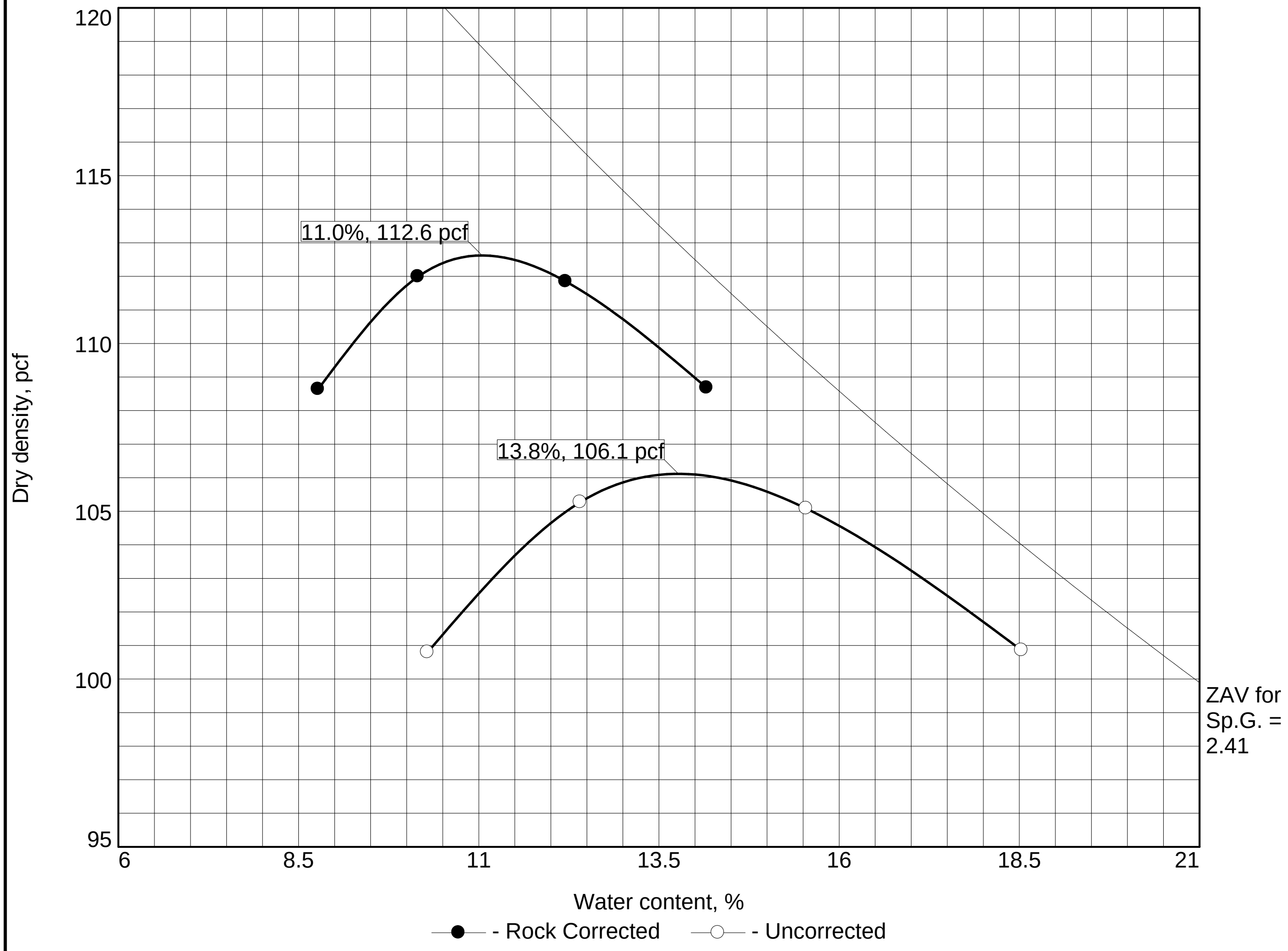
Remarks

Location: TP19-44
Sample Number: 20-019-11 **Depth:** 6"-11' **Date:** 2/7/2020

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 20-019-11

Tested By: KS/CM/AR **Checked By:** JH



Test specification: ASTM D 1557-12 Method C Modified
ASTM D4718-15 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
6"-11'	GW-GM	A-1-a		2.41	NP	NP	34.6	8.4

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 112.6 pcf	106.1 pcf	Brown well-graded gravel with silt and sand
Optimum moisture = 11.0 %	13.8 %	

Project No. 475.0385.000 **Client:** Lithium Nevada
Project: Thacker Pass
Date: 2/13/2020
○ **Location:** TP19-44 **Sample Number:** 20-019-11

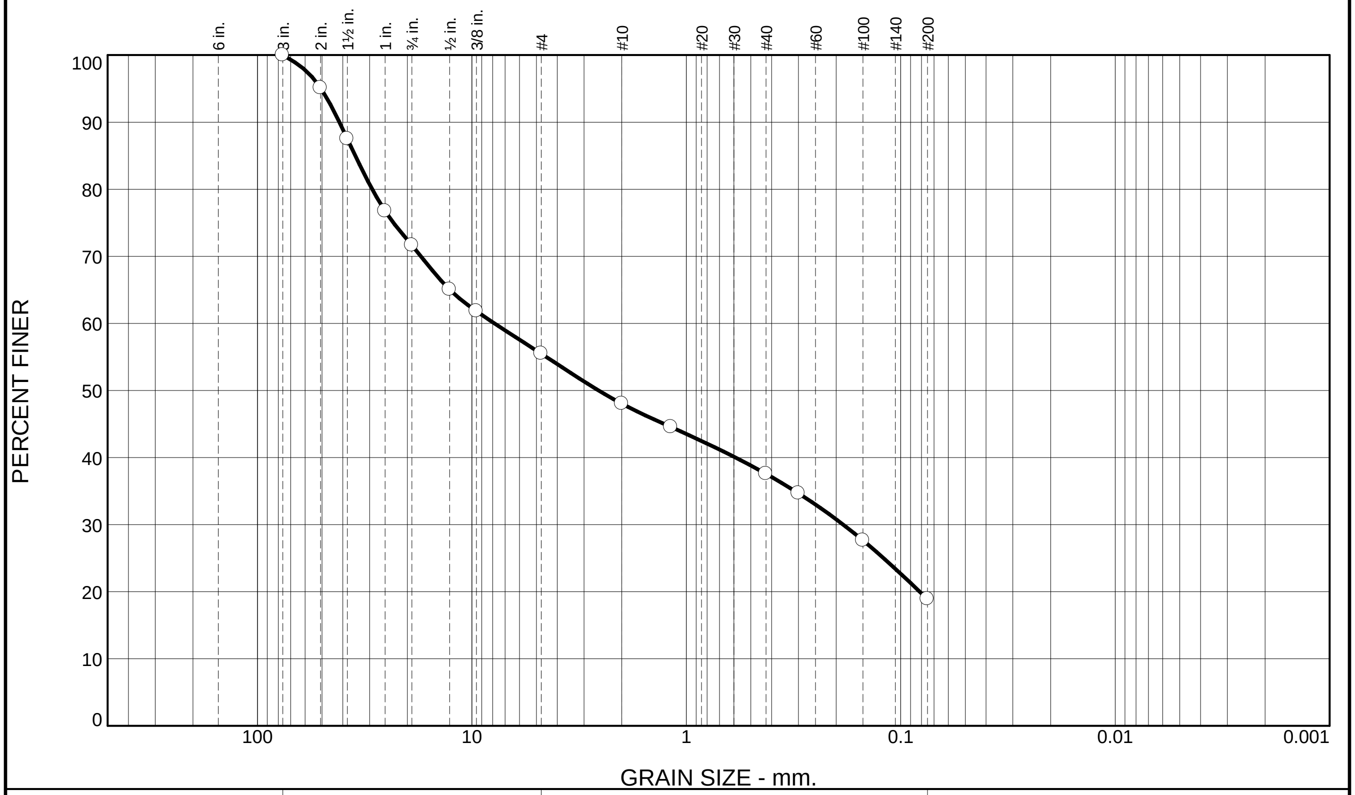
NewFields

Remarks:
*Assumed Specific Gravity

Figure 20-019-11

Tested By: CM **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	28.3	16.2	7.5	10.4	18.7	18.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100.0		
2"	95.1		
1.5"	87.5		
1"	76.7		
.75"	71.7		
.5"	65.0		
.375"	61.8		
#4	55.5		
#10	48.0		
#16	44.5		
#40	37.6		
#50	34.7		
#100	27.6		
#200	18.9		

* (no specification provided)

Material Description

Brown silty gravel with sand

Atterberg Limits

PL= 29 LL= 38 PI= 9

Coefficients

D_{90}= 41.5184 D_{85}= 34.9761 D_{60}= 7.8455
D_{50}= 2.5657 D_{30}= 0.1856 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= GM AASHTO= A-2-4(0)

Remarks

Location: TP19-44
Sample Number: 20-019-12 **Depth:** 4-8' **Date:** 2/7/2020

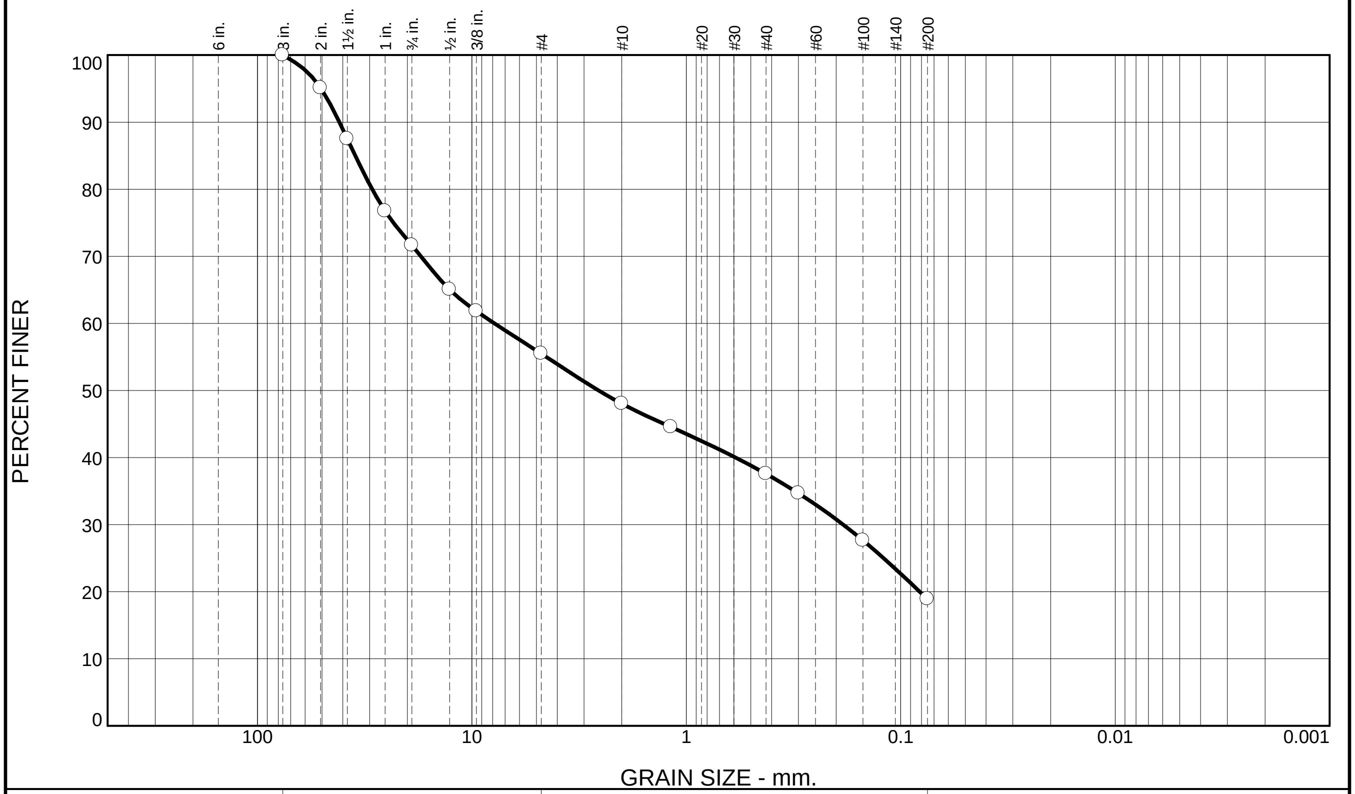
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 20-019-12

Tested By: KS/CM/AR **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	28.3	16.2	7.5	10.4	18.7	18.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100.0		
2"	95.1		
1.5"	87.5		
1"	76.7		
.75"	71.7		
.5"	65.0		
.375"	61.8		
#4	55.5		
#10	48.0		
#16	44.5		
#40	37.6		
#50	34.7		
#100	27.6		
#200	18.9		

* (no specification provided)

Material Description

Brown silty gravel with sand

Atterberg Limits

PL= 29 LL= 38 PI= 9

Coefficients

D_{90}= 41.5184	D_{85}= 34.9761	D_{60}= 7.8455
D_{50}= 2.5657	D_{30}= 0.1856	D_{15}=
D_{10}=	C_u=	C_c=

Classification

USCS= GM AASHTO= A-2-4(0)

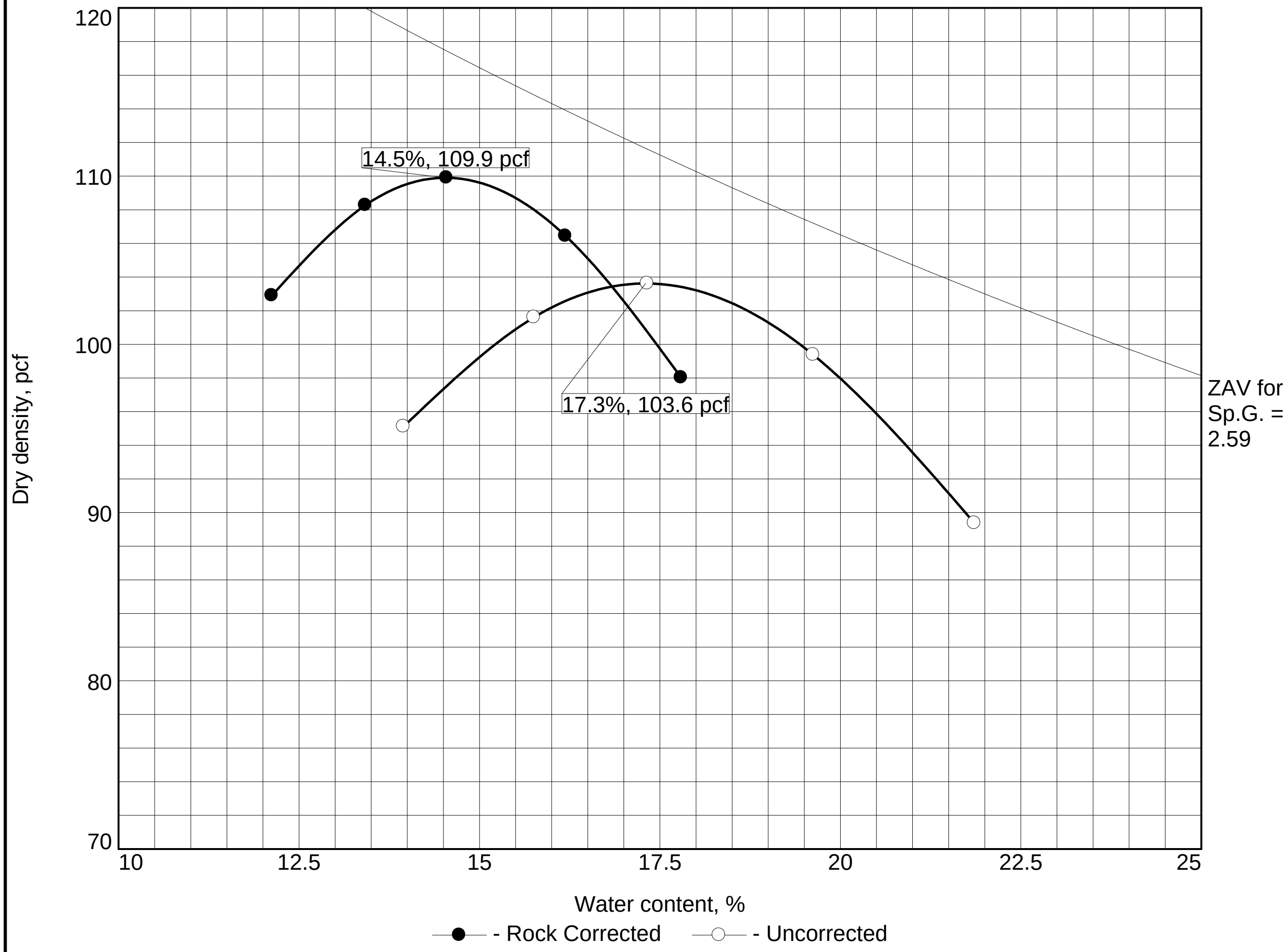
Remarks

Location: TP19-46
Sample Number: 20-019-12 **Depth:** 4-8' **Date:** 2/7/2020

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 20-019-12

Tested By: KS/CM/AR **Checked By:** JH



Test specification: ASTM D 1557-12 Method C Modified
ASTM D4718-15 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
4-8'	GM	A-2-4(0)		2.59	38	9	28.3	18.9

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 109.9 pcf	103.6 pcf	Brown silty gravel with sand
Optimum moisture = 14.5 %	17.3 %	

Project No. 475.0385.000 **Client:** Lithium Nevada
Project: Thacker Pass
Date: 2/13/2020
○ **Location:** TP19-46 **Sample Number:** 20-019-12

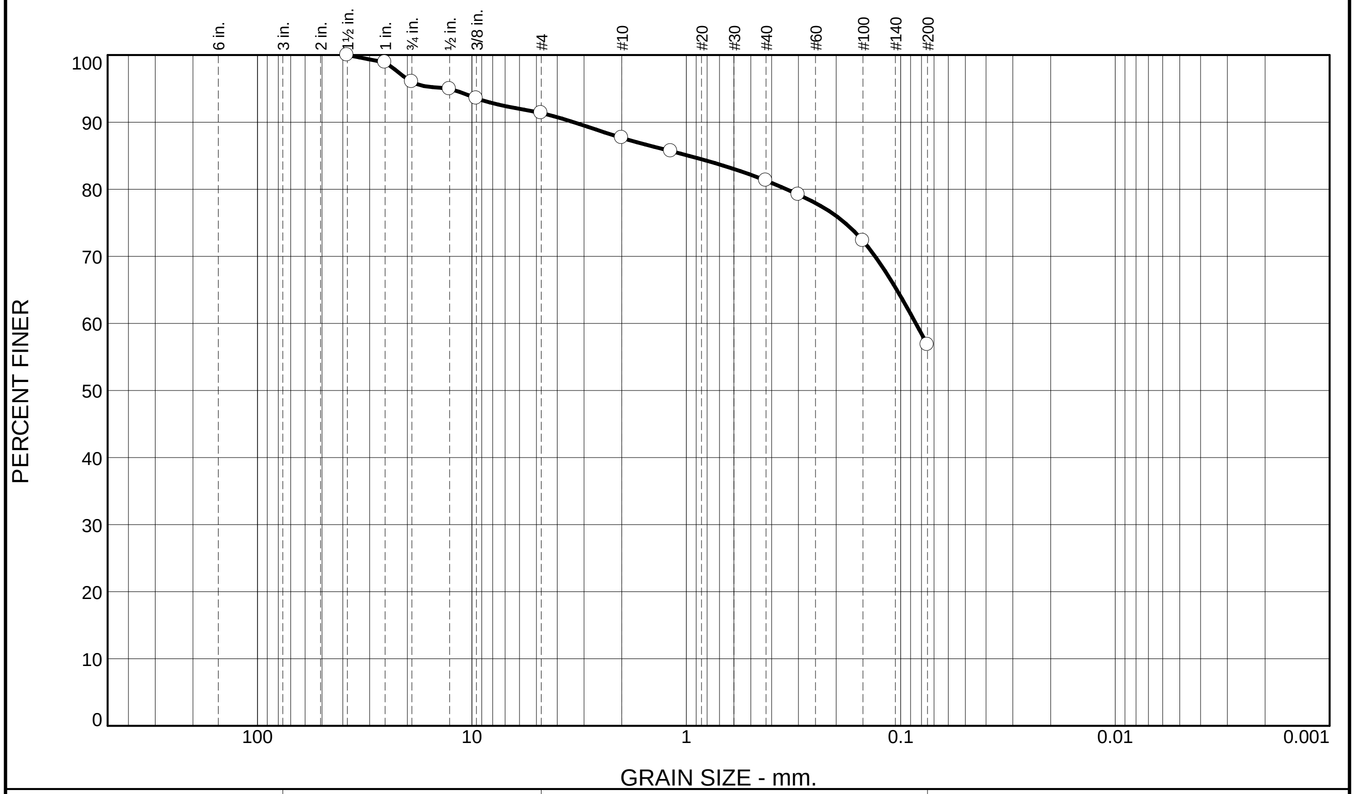
NewFields

Remarks:
*Assumed Specific Gravity

Figure 20-019-12

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.0	4.7	3.6	6.4	24.5	56.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5"	100.0		
1"	98.9		
.75"	96.0		
.5"	94.9		
.375"	93.6		
#4	91.3		
#10	87.7		
#16	85.7		
#40	81.3		
#50	79.2		
#100	72.3		
#200	56.8		

* (no specification provided)

Material Description

Light Brown sandy lean clay

Atterberg Limits

PL= 21 LL= 34 PI= 13

Coefficients

D_{90}= 3.3558 D_{85}= 0.9773 D_{60}= 0.0850
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(5)

Remarks

Location: TP19-48
Sample Number: 20-019-14 **Depth:** 6"-5' **Date:** 2/7/2020

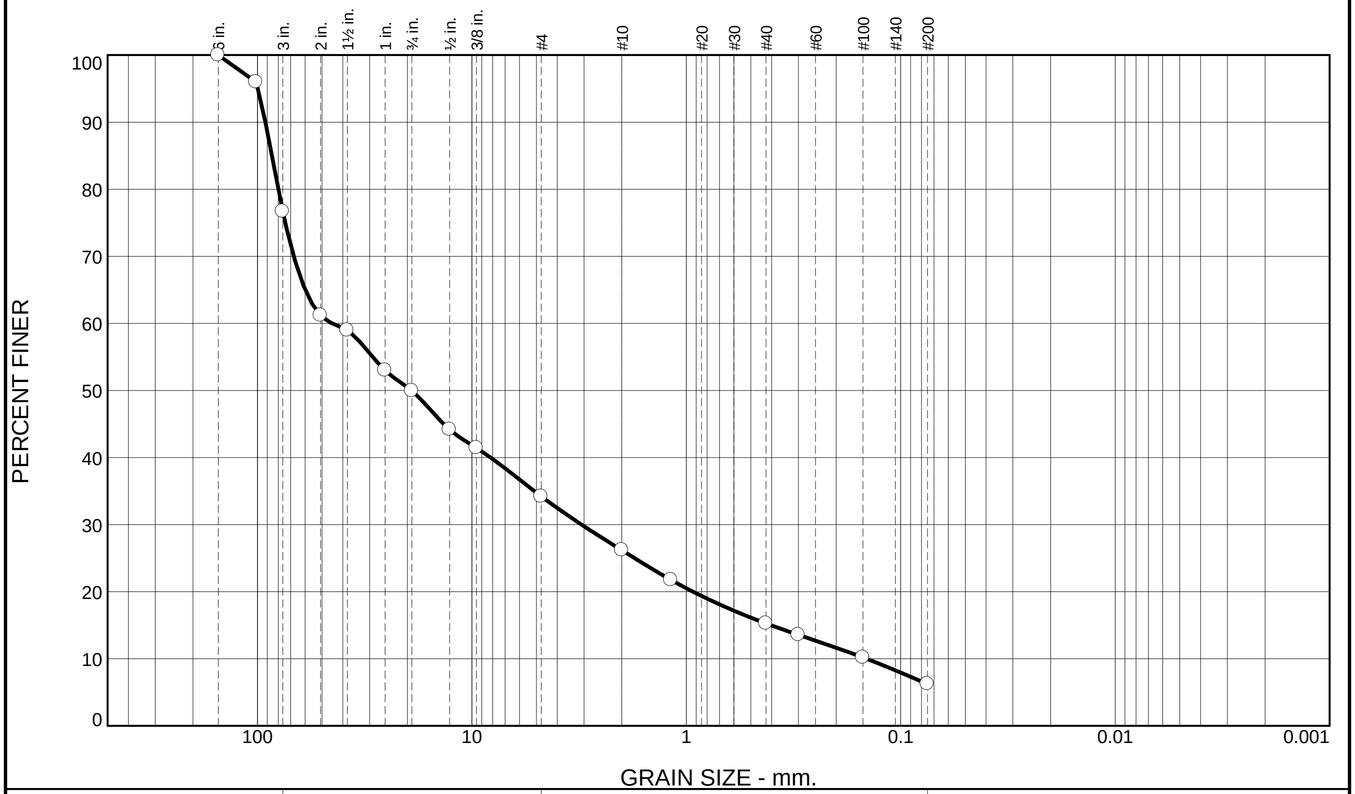
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 20-019-14

Tested By: KS/CM/AR **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
23.3	26.8	15.7	8.0	10.9	9.1	6.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
6"	100.0		
4"	96.0		
3"	76.7		
2"	61.2		
1.5"	58.9		
1"	53.0		
.75"	49.9		
.5"	44.2		
.375"	41.4		
#4	34.2		
#10	26.2		
#16	21.8		
#40	15.3		
#50	13.6		
#100	10.2		
#200	6.2		

* (no specification provided)

Material Description

Brown well-graded gravel with silt and sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 91.8308 D_{85}= 85.6139 D_{60}= 44.8977
D_{50}= 19.1401 D_{30}= 3.0808 D_{15}= 0.4031
D_{10}= 0.1446 C_u= 310.40 C_c= 1.46

Classification

USCS= GW-GM AASHTO= A-1-a

Remarks

Location: TP19-49
Sample Number: 20-019-15 **Depth:** 8"-4' **Date:** 2/7/2020

NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 20-019-15

Tested By: KS/CM/AR **Checked By:** JH

APPENDIX C.3

Moisture Contents

NF Form #15

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

Client:	Lithium Nevada	**Location:**	See Below
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	4/24/2019
Project Engineer:	Eric Niebler	**Tested By:**	JH
Field Sample ID:	BH	**Checked By:**	JH

Drying Conditions: 60 deg C / **110 deg C** Method: **Oven (O)** / Microwave (M) / Hot Plate (H)

Sample No.		19-110-01	19-110-02	19-110-03	19-110-04	19-110-05
Location		BH19-01	BH19-01	BH19-02	BH19-02	BH19-08
Depth		7.5-9'	25-26.5'	25-26.5'	45-46.5'	2.5-4'
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	A	674.9	1000.5	599	869.5	509.3
Tare + Dry Soil	B	516.2	774.8	385.5	638.9	430.3
Tare	C	22.3	22.1	22.2	22.1	22.3
Wt. of Water	D= A-B	158.7	225.7	213.5	230.6	79
Dry Soil, Ws	E= B-C	493.9	752.7	363.3	616.8	408
Moisture Content, (%)	**(D/E) x100**	**32.1%**	**30.0%**	**58.8%**	**37.4%**	**19.4%**

Sample No.		19-110-06	19-110-07	19-110-08	19-110-09	19-110-10
Location		BH19-09	BH19-11	BH19-12	BH19-15	BH19-16
Depth		2.5-4'	2.5-4'	15-16.5'	5.5-6'	2.5-4'
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	A	748.6	489.4	760.8	702.2	474.2
Tare + Dry Soil	B	681	400.1	690.5	623.5	403.7
Tare	C	22.2	22.2	22.4	22.3	22.1
Wt. of Water	D= A-B	67.6	89.3	70.3	78.7	70.5
Dry Soil, Ws	E= B-C	658.8	377.9	668.1	601.2	381.6
Moisture Content, (%)	**(D/E) x100**	**10.3%**	**23.6%**	**10.5%**	**13.1%**	**18.5%**

Remarks:

NewFields

NF Form #15

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

Client:	Lithium Nevada	**Location:**	See Below
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	4/24/2019
Project Engineer:	Eric Niebler	**Tested By:**	JH
Field Sample ID:	BH	**Checked By:**	JH

Drying Conditions: 60 deg C / [✓ 110 deg C] Method: [✓ Oven (O)] / Microwave (M) / Hot Plate (H)

Sample No.		19-110-11	19-110-12	19-110-13	19-110-14	19-110-15
Location		BH19-17	BH19-17	BH19-18	BH19-18	BH19-20
Depth		10.5-11'	20-21'	10.5-11'	20.5-21'	5-6.5'
Soil Description						
(USCS)						
Trial No.		**11**	**12**	**13**	**14**	**15**
Tare No.						
Tare + Wet Soil	A	685.3	1746.3	645.2	711.7	1912.4
Tare + Dry Soil	B	525.4	1590.1	475.8	531.9	1726.9
Tare	C	22	21.8	22.1	22.1	21.9
Wt. of Water	D= A-B	159.9	156.2	169.4	179.8	185.5
Dry Soil, Ws	E= B-C	503.4	1568.3	453.7	509.8	1705
Moisture Content, (%)	(D/E) x100	**31.8%**	**10.0%**	**37.3%**	**35.3%**	**10.9%**

Sample No.		19-110-16	19-110-17	19-110-18	19-110-19	19-110-20
Location		BH19-20	BH19-21	BH19-23	BH19-23	BH19-24
Depth		30-30.5'	2.5-4'	2.5-4'	7.5-9	2.5-4'
Soil Description						
(USCS)						
Trial No.		**16**	**17**	**18**	**19**	**20**
Tare No.						
Tare + Wet Soil	A	1638.1	614.4	759.7	672.9	554.5
Tare + Dry Soil	B	1399.6	501.7	665.5	606.7	485.2
Tare	C	22.2	22	22.4	22.3	22.3
Wt. of Water	D= A-B	238.5	112.7	94.2	66.2	69.3
Dry Soil, Ws	E= B-C	1377.4	479.7	643.1	584.4	462.9
Moisture Content, (%)	(D/E) x100	**17.3%**	**23.5%**	**14.6%**	**11.3%**	**15.0%**

Remarks:

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	Lithium Nevada	**Location:**	See Below
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	4/24/2019
Project Engineer:	Eric Niebler	**Tested By:**	JH
Field Sample ID:	BH	**Checked By:**	JH

Drying Conditions: 60 deg C / **110 deg C** Method: **Oven (O)** / Microwave (M) / Hot Plate (H)

Sample No.		19-110-21	19-110-22	19-110-23	19-110-24	19-110-25
Location		BH19-24	BH19-24	BH19-25	BH19-25	BH19-25
Depth		15-16.5'	35-36.5'	2.5-4'	7.5-9'	15-16.5'
Soil Description						
(USCS)						
Trial No.		**21**	**22**	**23**	**24**	**25**
Tare No.						
Tare + Wet Soil	**A**	671.9	882.8	501.5	523.1	622.6
Tare + Dry Soil	**B**	604.4	626.1	427	431.8	466
Tare	**C**	22	22	22.1	22.4	22.4
Wt. of Water	**D= A-B**	67.5	256.7	74.5	91.3	156.6
Dry Soil, Ws	**E= B-C**	582.4	604.1	404.9	409.4	443.6
Moisture Content, (%)	**(D/E) x100**	**11.6%**	**42.5%**	**18.4%**	**22.3%**	**35.3%**

Sample No.		19-110-26	19-110-27	19-110-28	19-110-29	19-110-30
Location		BH19-26	BH19-28	BH19-29	BH19-29	BH19-29
Depth		5-6'	8.5-9'	2.5-4'	7.5-9'	15-16.5'
Soil Description						
(USCS)						
Trial No.		**26**	**27**	**28**	**29**	**30**
Tare No.						
Tare + Wet Soil	**A**	691	751.3	708.9	631.2	924.8
Tare + Dry Soil	**B**	611.2	652.7	631.5	588.6	805.2
Tare	**C**	22.1	22.4	22.2	22.2	22
Wt. of Water	**D= A-B**	79.8	98.6	77.4	42.6	119.6
Dry Soil, Ws	**E= B-C**	589.1	630.3	609.3	566.4	783.2
Moisture Content, (%)	**(D/E) x100**	**13.5%**	**15.6%**	**12.7%**	**7.5%**	**15.3%**

Remarks:

NF Form #15

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

Client:	Lithium Nevada	**Location:**	See Below
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	4/24/2019
Project Engineer:	Eric Niebler	**Tested By:**	JH
Field Sample ID:	BH	**Checked By:**	JH

Drying Conditions: 60 deg C / [✓ 110 deg C] Method: [✓ Oven (O)] / Microwave (M) / Hot Plate (H)

Sample No.		19-110-31	19-110-32	19-110-33		
Location		BH19-29	BH19-31	BH19-32		
Depth		25-26'	5.5-6'	15-16.5'		
Soil Description						
(USCS)						
Trial No.		**31**	**32**	**33**	**4**	**5**
Tare No.						
Tare + Wet Soil	**A**	427.1	754.7	892.2		
Tare + Dry Soil	**B**	350.3	649.4	745.6		
Tare	**C**	22	21.8	22.4		
Wt. of Water	**D= A-B**	76.8	105.3	146.6		
Dry Soil, Ws	**E= B-C**	328.3	627.6	723.2		
Moisture Content, (%)	**(D/E) x100**	**23.4%**	**16.8%**	**20.3%**		

Sample No.						
Location						
Depth						
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	**A**					
Tare + Dry Soil	**B**					
Tare	**C**					
Wt. of Water	**D= A-B**					
Dry Soil, Ws	**E= B-C**					
Moisture Content, (%)	**(D/E) x100**					

Remarks:

NewFields

NF Form #15

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

Client:	Lithium Nevada	**Location:**	BH19
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	2/5/2020
Project Engineer:	Eric Niebler	**Tested By:**	JH
Field Sample ID:	BH	**Checked By:**	JH

Drying Conditions: 60 deg C / **110 deg C** Method: **Oven (O)** / Microwave (M) / Hot Plate (H)

Sample No.		20-020-01	20-020-02	20-020-04	20-020-05	20-020-07
Location		BH19-33	BH19-33	BH19-33	BH19-34	BH19-34
Depth		2.5-3'	7.5-8.5'	25-25.5'	2.5-3'	10-11.5'
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	A	314.3	1452.1	566.3	324.1	865.7
Tare + Dry Soil	B	289.4	1245.6	414.4	299.4	781.9
Tare	C	44.9	268	124.5	45.2	192.5
Wt. of Water	D= A-B	24.9	206.5	151.9	24.7	83.8
Dry Soil, Ws	E= B-C	244.5	977.6	289.9	254.2	589.4
Moisture Content, (%)	**(D/E) x100**	**10.2%**	**21.1%**	**52.4%**	**9.7%**	**14.2%**

Sample No.		20-020-09	20-020-11	20-020-12	20-020-14	20-020-016
Location		BH19-35	BH19-35	BH19-35	BH19-36	BH19-36
Depth		7.5-8.5'	15-16'	35-35.5'	5-6.5'	10-11.3'
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	A	1628.6	778	722.5	524.6	682.9
Tare + Dry Soil	B	1478.1	708.1	523.5	458.9	629.7
Tare	C	267.7	189.6	262.2	121.6	120.3
Wt. of Water	D= A-B	150.5	69.9	199	65.7	53.2
Dry Soil, Ws	E= B-C	1210.4	518.5	261.3	337.3	509.4
Moisture Content, (%)	**(D/E) x100**	**12.4%**	**13.5%**	**76.2%**	**19.5%**	**10.4%**

Remarks:

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	Lithium Nevada	**Location:**	BH19
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	2/5/2020
Project Engineer:	Eric Niebler	**Tested By:**	JH
Field Sample ID:	BH	**Checked By:**	JH

Drying Conditions: 60 deg C / **110 deg C** Method: **Oven (O)** / Microwave (M) / Hot Plate (H)

Sample No.		20-020-17	20-020-18	20-020-19		
Location		BH19-36	BH19-37	BH19-37		
Depth		35-36.5'	2.5-3'	7.5-8'		
Soil Description						
(USCS)						
Trial No.		**11**	**12**	**13**	**14**	**15**
Tare No.						
Tare + Wet Soil	**A**	808.7	810.3	959.5		
Tare + Dry Soil	**B**	728.9	675.2	919.7		
Tare	**C**	121.4	124.5	188.8		
Wt. of Water	**D= A-B**	79.8	135.1	39.8		
Dry Soil, Ws	**E= B-C**	607.5	550.7	730.9		
Moisture Content, (%)	**(D/E) x100**	**13.1%**	**24.5%**	**5.4%**		

Sample No.						
Location						
Depth						
Soil Description						
(USCS)						
Trial No.		**16**	**17**	**18**	**19**	**20**
Tare No.						
Tare + Wet Soil	**A**					
Tare + Dry Soil	**B**					
Tare	**C**					
Wt. of Water	**D= A-B**					
Dry Soil, Ws	**E= B-C**					
Moisture Content, (%)	**(D/E) x100**					

Remarks:

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	Lithium Nevada	**Location:**	TP
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	3/5/2019
Project Engineer:	Eric Niebler	**Tested By:**	KS/JB
Field Sample ID:	TP	**Checked By:**	JH

Drying Conditions: 60 deg C / **110 deg C** Method: **Oven (O)** / Microwave (M) / Hot Plate (H)

Sample No.		19-060-01	19-060-02	19-060-03	19-060-04	19-060-05
Location		TP19-01	TP19-02	TP19-03	TP19-04	TP19-05
Depth		4-7'	0-2'	6-9'	5-7'	8-10'
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	**A**	603.3	580	895	602.1	664.7
Tare + Dry Soil	**B**	539.7	506.7	819.3	521.8	564.4
Tare	**C**	44.9	257.5	120.6	125.1	141.2
Wt. of Water	**D= A-B**	63.6	73.3	75.7	80.3	100.3
Dry Soil, Ws	**E= B-C**	494.8	249.2	698.7	396.7	423.2
Moisture Content, (%)	**(D/E) x100**	**12.9%**	**29.4%**	**10.8%**	**20.2%**	**23.7%**

Sample No.		19-060-06	19-060-07	19-060-08	19-060-09	19-060-10
Location		TP19-06	TP19-08	TP19-09	TP19-11	TP19-13
Depth		11-13'	6-9'	8-12'	7-11'	10-13'
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	**A**	642.9	926.2	789.7	658.1	605.1
Tare + Dry Soil	**B**	597.1	854.8	732.5	618.3	514.9
Tare	**C**	189.5	124.9	270.1	125.3	223.4
Wt. of Water	**D= A-B**	45.8	71.4	57.2	39.8	90.2
Dry Soil, Ws	**E= B-C**	407.6	729.9	462.4	493	291.5
Moisture Content, (%)	**(D/E) x100**	**11.2%**	**9.8%**	**12.4%**	**8.1%**	**30.9%**

Remarks:

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	Lithium Nevada	**Location:**	TP
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	3/5/2019
Project Engineer:	Eric Niebler	**Tested By:**	KS/JB
Field Sample ID:	TP	**Checked By:**	JH

Drying Conditions: 60 deg C / [✓ 110 deg C] Method: [✓ Oven (O)] / Microwave (M) / Hot Plate (H)

Sample No.		19-060-11	19-060-12	19-060-13	19-060-14	19-060-15
Location		TP19-14	TP19-15	TP19-16	TP19-17	TP19-18
Depth		8-11'	8-11'	7-10'	4-7'	5-8'
Soil Description						
(USCS)						
Trial No.		**11**	**12**	**13**	**14**	**15**
Tare No.						
Tare + Wet Soil	**A**	632.6	934.6	859.5	654.3	460.1
Tare + Dry Soil	**B**	527.9	783.8	709.7	572.4	419.2
Tare	**C**	121	120.8	190.6	188.6	45
Wt. of Water	**D= A-B**	104.7	150.8	149.8	81.9	40.9
Dry Soil, Ws	**E= B-C**	406.9	663	519.1	383.8	374.2
Moisture Content, (%)	**(D/E) x100**	**25.7%**	**22.7%**	**28.9%**	**21.3%**	**10.9%**

Sample No.		19-060-16	19-060-17	19-060-18	19-060-19	19-060-20
Location		TP19-20	TP19-21	TP19-22	TP19-23	TP19-24
Depth		6-10'	3-5'	8-11'	5-9'	14-17'
Soil Description						
(USCS)						
Trial No.		**16**	**17**	**18**	**19**	**20**
Tare No.						
Tare + Wet Soil	**A**	352.8	347.2	614.6	837.6	649.7
Tare + Dry Soil	**B**	296.3	312.3	592	786.2	542.3
Tare	**C**	44.9	45.1	121.1	189.3	225.5
Wt. of Water	**D= A-B**	56.5	34.9	22.6	51.4	107.4
Dry Soil, Ws	**E= B-C**	251.4	267.2	470.9	596.9	316.8
Moisture Content, (%)	**(D/E) x100**	**22.5%**	**13.1%**	**4.8%**	**8.6%**	**33.9%**

Remarks:

NewFields

NF Form #15

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

Client:	Lithium Nevada	**Location:**	TP
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	3/5/2019
Project Engineer:	Eric Niebler	**Tested By:**	KS/JB
Field Sample ID:	TP	**Checked By:**	JH

Drying Conditions: 60 deg C / 110 deg C Method: Oven (O) / Microwave (M) / Hot Plate (H)

Sample No.		19-060-21	19-060-22	19-060-23	19-060-24	19-060-25
Location		TP19-25	TP19-26	TP19-27	TP19-28	TP19-29
Depth		7-12'	6-8'	3-5'	5-9'	4-7'
Soil Description						
(USCS)						
Trial No.		**21**	**22**	**23**	**24**	**25**
Tare No.						
Tare + Wet Soil	**A**	746.1	852.9	644	704.4	871.1
Tare + Dry Soil	**B**	699.3	738.3	533.9	668.6	814.8
Tare	**C**	123.9	190.9	45.2	124.6	123.5
Wt. of Water	**D= A-B**	46.8	114.6	110.1	35.8	56.3
Dry Soil, Ws	**E= B-C**	575.4	547.4	488.7	544	691.3
Moisture Content, (%)	**(D/E) x100**	**8.1%**	**20.9%**	**22.5%**	**6.6%**	**8.1%**

Sample No.						
Location						
Depth						
Soil Description						
(USCS)						
Trial No.		**26**	**27**	**28**	**29**	**30**
Tare No.						
Tare + Wet Soil	**A**					
Tare + Dry Soil	**B**					
Tare	**C**					
Wt. of Water	**D= A-B**					
Dry Soil, Ws	**E= B-C**					
Moisture Content, (%)	**(D/E) x100**					

Remarks:

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	Lithium Nevada	**Location:**	TP
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	4/22/2019
Project Engineer:	Eric Niebler	**Tested By:**	KS
Field Sample ID:	TP	**Checked By:**	JH

Drying Conditions: 60 deg C / **110 deg C** Method: **Oven (O)** / Microwave (M) / Hot Plate (H)

Sample No.		19-106-02	19-106-03	19-106-04	19-106-05	19-106-06
Location		TP19-03	TP19-04	TP19-07	TP19-08	TP19-10
Depth		2-4'	2-4'	2-4'	2-4'	3-6'
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	A	401.7	432.9	650.3	618.1	555.5
Tare + Dry Soil	B	363.7	358.6	574.2	563.2	492.6
Tare	C	124.7	120.8	257.4	191.2	125.3
Wt. of Water	D= A-B	38	74.3	76.1	54.9	62.9
Dry Soil, Ws	E= B-C	239	237.8	316.8	372	367.3
Moisture Content, (%)	**(D/E) x100**	**15.9%**	**31.2%**	**24.0%**	**14.8%**	**17.1%**

Sample No.		19-106-07	19-106-08			
Location		TP19-13	TP19-28			
Depth		3-5'	1-3'			
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	A	433.6	440			
Tare + Dry Soil	B	381.7	347.3			
Tare	C	44.9	45			
Wt. of Water	D= A-B	51.9	92.7			
Dry Soil, Ws	E= B-C	336.8	302.3			
Moisture Content, (%)	**(D/E) x100**	**15.4%**	**30.7%**			

Remarks:

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	Lithium Nevada	**Location:**	TP
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	2/6/2020
Project Engineer:	Eric Niebler	**Tested By:**	KS
Field Sample ID:	TP	**Checked By:**	JH

Drying Conditions: 60 deg C / [✓ 110 deg C] Method: [✓ Oven (O)] / Microwave (M) / Hot Plate (H)

Sample No.	20-019-01	20-019-02	20-019-03	20-019-04	20-019-05
Location	TP19-30	TP19-31	TP19-32	TP19-33	TP19-34
Depth	8"-9'	8"-10'	6"-5'	3-15'	5-11'
Soil Description					
(USCS)					
Trial No.	**1**	**2**	**3**	**4**	**5**
Tare No.					
Tare + Wet Soil **A**	294.2	606.9	456.1	497.5	490.8
Tare + Dry Soil **B**	263.6	572.3	418.6	461.2	463.8
Tare **C**	121.2	258.7	121.1	222.7	44.9
Wt. of Water **D= A-B**	30.6	34.6	37.5	36.3	27
Dry Soil, Ws **E= B-C**	142.4	313.6	297.5	238.5	418.9
Moisture Content, (%) **(D/E) x100**	**21.5%**	**11.0%**	**12.6%**	**15.2%**	**6.4%**

Sample No.	20-019-06	20-019-07	20-019-08	20-019-09	20-019-10
Location	TP19-35	TP19-36	TP19-37	TP19-39	TP19-40
Depth	8"-8'	6-9'	5-14'	8"-5'	1.5-4'
Soil Description					
(USCS)					
Trial No.	**6**	**7**	**8**	**9**	**10**
Tare No.					
Tare + Wet Soil **A**	470.7	569.7	821.1	549.5	529.4
Tare + Dry Soil **B**	448.1	522.7	768.7	491.9	468.5
Tare **C**	120.7	222.2	254.2	120.1	124.2
Wt. of Water **D= A-B**	22.6	47	52.4	57.6	60.9
Dry Soil, Ws **E= B-C**	327.4	300.5	514.5	371.8	344.3
Moisture Content, (%) **(D/E) x100**	**6.9%**	**15.6%**	**10.2%**	**15.5%**	**17.7%**

Remarks:

NewFields

NF Form #15

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

Client:	Lithium Nevada	**Location:**	TP
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	2/6/2020
Project Engineer:	Eric Niebler	**Tested By:**	KS
Field Sample ID:	TP	**Checked By:**	JH

Drying Conditions: 60 deg C / **110 deg C** Method: **Oven (O)** / Microwave (M) / Hot Plate (H)

Sample No.		20-019-11	20-019-12	20-019-13	20-019-14	20-019-15
Location		TP19-44	TP19-46	TP19-47	TP19-48	TP19-49
Depth		6"-11'	4-8'	8"-3'	6"-5'	8"-4'
Soil Description					*	
(USCS)						
Trial No.		**11**	**12**	**13**	**14**	**15**
Tare No.						
Tare + Wet Soil	**A**	790.2	575.2	606.7	486.6	788.1
Tare + Dry Soil	**B**	733.8	517.2	551	435.7	737.3
Tare	**C**	120.3	120.9	124.9	187.7	223
Wt. of Water	**D= A-B**	56.4	58	55.7	50.9	50.8
Dry Soil, Ws	**E= B-C**	613.5	396.3	426.1	248	514.3
Moisture Content, (%)	**(D/E) x100**	**9.2%**	**14.6%**	**13.1%**	**20.5%**	**9.9%**

Sample No.						
Location						
Depth						
Soil Description						
(USCS)						
Trial No.		**16**	**17**	**18**	**19**	**20**
Tare No.						
Tare + Wet Soil	**A**					
Tare + Dry Soil	**B**					
Tare	**C**					
Wt. of Water	**D= A-B**					
Dry Soil, Ws	**E= B-C**					
Moisture Content, (%)	**(D/E) x100**					

Remarks: * Sample 20-019-14: hole in the bag that may have changed moisture content

APPENDIX C.4

Natural Density and Specific Gravity

NewFields **NATURAL DENSITY (ASTM 2937)** NF Form #16

LABORATORY WORKSHEET

Client:	Lithium Nevada	**Location:**	See Below
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	4/26/2019
Project Engineer:	Eric Niebler	**Tested By:**	JH
Field Sample ID:	BH	**Checked By:**	JH
Laboratory Sample ID:	19-110		

Drying Conditions: 60 deg C / 110 deg C Method: Oven (O) / Microwave (M)

Trail No.		**1**	**2**	**3**	**4**	**5**
Sample No.		19-110-09	19-110-11	19-110-13	19-110-14	19-110-26
Location		BH19-15	BH19-17	BH19-18	BH19-18	BH19-26
Depth		5.5-6'	10.5-11'	10.5-11'	20.5-21'	5-6'
Soil Description						
(USCS)						
Soil + Liner Wt., g.	**A**	914.8	912.4	855.4	930.1	898.8
Liner Wt., g.	**B**	233.9	240.6	232.0	237.6	230.0
Soil Wt., g.	**C= A-B**	680.9	671.8	623.4	692.5	668.8
Liner Length, in.	**D_1**	5.995	5.959	5.965	5.973	5.942
Sample Length, in.	**D_2**	5.995	5.959	5.965	5.973	5.942
Liner Diameter, in.	**E**	2.429	2.417	2.413	2.402	2.443
Liner Area, in^2	**$F= (D_2^2/4)*pi$**	4.63	4.59	4.57	4.53	4.69
Sample Volume, in^3	**$G= D_2*F$**	27.78	27.34	27.28	27.07	27.85
Sample Wet Density, pcf	**H= (C/G)*3.81**	93.4	93.6	87.1	97.5	91.5
Sample Dry Density, pcf	**H/(1+(N/100))**	82.6	71.0	63.4	72.1	80.6
Tare No.						
Tare + Wet Soil	**I**	702.2	685.3	645.2	711.7	691
Tare + Dry Soil	**J**	623.5	525.4	475.8	531.9	611.2
Tare	**K**	22.3	22	22.1	22.1	22.1
Wt. of Water	**L= I-J**	78.7	159.9	169.4	179.8	79.8
Dry Soil, Ws	**M=-J-K**	601.2	503.4	453.7	509.8	589.1
Moisture Content, (%)	**N= (L/M) x100**	13.1%	31.8%	37.3%	35.3%	13.5%

Remarks:

NewFields

NATURAL DENSITY (ASTM 2937)

LABORATORY WORKSHEET

NF Form #16

Client:	Lithium Nevada	**Location:**	BH19
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	2/5/2020
Project Engineer:	Eric Niebler	**Tested By:**	JH/KS
Field Sample ID:	BH	**Checked By:**	JH
Laboratory Sample ID:	20-020		

Drying Conditions: 60 deg C / [✓ 110 deg C] Method: [✓ Oven (O)] / Microwave (M)

Trail No.		**1**	**2**	**3**	**4**	**5**
Sample No.		20-020-03	20-020-06	20-020-08	20-020-10	20-020-13
Location		BH19-33	BH19-34	BH19-34	BH19-35	VH19-36
Depth		15.5-16'	2.9-3.4'	15.5-16'	8.5-9'	3.5-4'
Soil Description						
(USCS)						
Soil + Liner Wt., g.	**A**	890.7	931.0	876.7	940.5	719.6
Liner Wt., g.	**B**	231.1	231.9	233.2	231.0	230.3
Soil Wt., g.	**C= A-B**	659.6	699.1	643.5	709.5	489.3
Liner Length, in.	**D_1**	5.956	6	6.005	5.992	5.979
Sample Length, in.	**D_2**	5.956	4.756	5.308	5.649	4.63
Liner Diameter, in.	**E**	2.401	2.429	2.398	2.390	2.394
Liner Area, in^2	**F= (E^2/4)*pi**	4.53	4.63	4.52	4.49	4.50
Sample Volume, in^3	**G= D_2*F**	26.97	22.04	23.97	25.34	20.84
Sample Wet Density, pcf	**H= (C/G)*3.81**	93.2	120.9	102.3	106.7	89.5
Sample Dry Density, pcf	**H/(1+(N/100))**	68.1	114.6	89.7	87.9	77.8
Tare No.						
Tare + Wet Soil	**I**	782.8	889.7	793.5	900.5	711.9
Tare + Dry Soil	**J**	605.5	853.3	714.3	775.4	648.4
Tare	**K**	123.3	191.2	150.4	191.1	223.2
Wt. of Water	**L= I-J**	177.3	36.4	79.2	125.1	63.5
Dry Soil, Ws	**M=-J-K**	482.2	662.1	563.9	584.3	425.2
Moisture Content, (%)	**N= (L/M) x100**	36.8%	5.5%	14.0%	21.4%	14.9%

Remarks:

NewFields **NATURAL DENSITY (ASTM 2937)** NF Form #16

LABORATORY WORKSHEET

Client:	Lithium Nevada	**Location:**	BH19
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	2/5/2020
Project Engineer:	Eric Niebler	**Tested By:**	JH/KS
Field Sample ID:	BH	**Checked By:**	JH
Laboratory Sample ID:	20-020		

Drying Conditions: 60 deg C / 110 deg C Method: Oven (O) / Microwave (M)

Trail No.		**6**	**7**	**8**	**9**	**10**
Sample No.		20-020-15				
Location		BH19-36				
Depth		8-8.5'				
Soil Description						
(USCS)						
Soil + Liner Wt., g.	**A**	789.5				
Liner Wt., g.	**B**	231.2				
Soil Wt., g.	**C= A-B**	558.3				
Liner Length, in.	**D_1**	5.998				
Sample Length, in.	**D_2**	4.544				
Liner Diameter, in.	**E**	2.456				
Liner Area, in^2	**$F= (D_2^2/4)*pi$**	4.74				
Sample Volume, in^3	**$G= D_2*F$**	21.53				
Sample Wet Density, pcf	**H= (C/G)*3.81**	98.8				
Sample Dry Density, pcf	**H/(1+(N/100))**	90.9				
Tare No.						
Tare + Wet Soil	**I**	678.9				
Tare + Dry Soil	**J**	634.2				
Tare	**K**	120.8				
Wt. of Water	**L= I-J**	44.7				
Dry Soil, Ws	**M=-J-K**	513.4				
Moisture Content, (%)	**N= (L/M) x100**	8.7%				

Remarks:

NF Form #11

SPECIFIC GRAVITY SOILS (ASTM D854)
LABORATORY WORKSHEET

Client:	Lithium Nevada	**Field Sample ID:**	TP19-04	**Test Start Date:**	4/30/2019
Project Title:	Thacker Pass	**Laboratory Sample ID:**	19-106-03	**Tested By:**	KE
Project Number:	475.0385.000	**Location:**	TP19-04	**Checked By:**	JH
Project Engineer:	Eric Niebler	**Elevation:**	2-4'	**Sample Description:**	

Sample Number	19-106-03							
Sample Location	TP19-04 (2'-4')							
Prep Dish								
Flask No.	3	15						
1) Wt. of Flask + Soil	115.90	116.63						
2) Wt. of Flask	86.05	86.66						
3) Wt. of Soil = 1-2	29.85	29.97						
4) Calibrated Wt. of Flask + Water	335.19	335.73						
5) (3+4)	365.04	365.70						
6) Wt. of Flask + Water +Soil	353.34	353.98						
7) Volume of Soil = (5-6)	11.70	11.72						
8) Test Temperature, deg.C (Ta)	19.1	19.2						
9) Temperature Correction, k	1.00018	1.00016						
10) Specific Gravity	2.538	2.546						
11) Average Specific Gravity, Gs	2.542							

General Notes:

APPENDIX C.5

Chemical Testing

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 08/23/2019
Date Submitted 08/20/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : BH19-12 Site ID : 2.5-6.5 FT.
Your purchase order number is 4750385.
Thank you for your business.

* For future reference to this analysis please use SUN # 80416-168076.

EVALUATION FOR SOIL CORROSION

Soil pH	7.65	
Minimum Resistivity	0.15 ohm-cm (x1000)	
Chloride	1246.9 ppm	00.12469 %
Sulfate	691.9ppm	00.06919 %
Redox Potential	No Test	
Sulfides	No Test	

METHODS
pH AASHTO T289, Min.Resistivity AASHTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 08/23/2019
Date Submitted 08/20/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : BH19-13 Site ID : 7.5-10.5 FT.
Your purchase order number is 4750385.
Thank you for your business.

* For future reference to this analysis please use SUN # 80416-168077.

EVALUATION FOR SOIL CORROSION

Soil pH	7.88	
Minimum Resistivity	0.78 ohm-cm (x1000)	
Chloride	103.2 ppm	00.01032 %
Sulfate	45.5ppm	00.00455 %
Redox Potential	No Test	
Sulfides	No Test	

METHODS
pH AASHTO T289, Min.Resistivity AASHTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 08/23/2019
Date Submitted 08/20/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : BH19-26 Site ID : 10-11.5 FT.
Your purchase order number is 4750385.
Thank you for your business.

* For future reference to this analysis please use SUN # 80416-168078.

EVALUATION FOR SOIL CORROSION

Soil pH	7.85	
Minimum Resistivity	0.75 ohm-cm (x1000)	
Chloride	97.2 ppm	00.00972 %
Sulfate	295.2ppm	00.02952 %
Redox Potential	No Test	
Sulfides	No Test	

METHODS
pH AASHTO T289, Min.Resistivity AASHTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

SUNLAND ANALYTICAL LAB
11419 Sunrise Gold Cr., Ste.10
Rancho Cordova, CA 95742
(916)852-8557

INVOICE

Inv.No. 100416

Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

Date 08/23/2019
Terms: NET 30, 30+ 15%
Customer P.O.# 4750385
Requestor: Magner

ATTENTION ACCOUNTS PAYABLE

* Please indicate Invo.# on remittance

SUN NOS.	SAMPLE LOCATION		ANALYSIS	PRICE
168076	BH19-12	2.5-6.5 FT	CTP.1-AASHTO	137.00
168077	BH19-13	7.5-10.5 FT	CTP.1-AASHTO	137.00
168078	BH19-26	10-11.5 FT	CTP.1-AASHTO	137.00
	********* Total *********			411.00

APPENDIX C.6
Tailings Assessment Technical Memorandum
(385-TM-07-CTFS)

NewFields
Perspective. Vision. Solutions.
9400 Station Street, Suite 300
Lone Tree, CO 80124
T: 720.508.3300
F: 720.508.3339

TECHNICAL MEMORANDUM (385-TM-07-Tailings Assessment)

To: **Lithium Nevada Corporation**
From: **Kerry Magner, P.E.**
Reviewed By: **Nick Rocco, PhD., P.E.**
Project: **Thacker Pass Project**
Project No: 475.385.000
Subject: **Tailings Assessment**
Date: December 20, 2019

1. INTRODUCTION

NewFields is engaged in a laboratory testing program assessing the geomechanical properties of the waste products (filtercakes and sulfate salts) expected to be generated at Lithium Nevada Corporation's (LNC) proposed Thacker Pass Project. This memo provides a summary of laboratory testing performed on these waste products, our interpretation of the testing results and recommendations for material handling.

2. LABORATORY PROGRAM

Samples of leached solids (LFilterCake), neutralization solids (NFilterCake), and sulfate salts (Salt) were provided by LNC and transported to the NewFields AMRL/AASHTO accredited laboratory in Elko, Nevada where the material testing is being conducted. Select laboratory tests were performed on individual components (LFilterCake, NFilterCake, and Salt) along with testing performed on composite filtercake samples both with and without salt. The composite filtercake samples are identified as the "tailings" that will be stored in a geomembrane lined facility at the project site.

The tailings with salt samples were reconstituted at a ratio of 64.1 percent LFilterCake, 17.3 percent NFilterCake, and 18.6 percent Salt, as measured by dry weight. The salts were hydrated with 11.1 percent tap water prior to reconstitution with the tailings. The tailings without salt samples were reconstituted at a ratio of 78.7 percent LFilterCake and 21.3 percent NFilterCake, as measured by dry weight.

It should be noted that all moisture contents presented in this memorandum were completed as per ASTM D2216 and are reported on a dry basis (Weight of water/Weight of dry solids) as this is the common reporting practice for geotechnical reporting.

Index testing included moisture content and Atterberg limits testing, which were used to assess the relationship between as-received moisture and the materials plasticity. Moisture content – unit weight relationships were developed from bulk samples of tailings, both with and without salt. Strength properties of tailings are estimated based upon Unconsolidated Undrained (UU) and Consolidated Undrained (CU) triaxial testing. This laboratory testing program included:

- Atterberg Limits (ASTM D4318)
- Natural Moisture Content (ASTM D2216)
- Modified Proctor Moisture – Unit Weight Relationship (ASTM D1557)
- Unconsolidated Undrained Triaxial Compression (ASTM D2850)
- Consolidated Undrained Triaxial Compression (ASTM D4767)

Individual laboratory testing results are summarized in **Tables 1, 2** and **3.**

2.1 Index Property Testing

The index properties of the materials were evaluated by particle size analysis, moisture content and Atterberg limits testing. The Atterberg limits test was used to measure the moisture content of the upper and lower limits of the range in which the soil is in the plastic state, and are only performed on the soil fraction passing the No. 40 sieve (0.42 mm). The moisture content at the upper limit is known as the liquid limit (LL) and the moisture content at the lower limit is designated as the plastic limit (PL). The numerical difference between the LL and the PL, termed the plasticity index (PI), is a measure of the soil plasticity. Generally, soils that exhibit a PI between 5 and 10 are low plasticity, between 10 and 20 correlate to medium plasticity and between 20 and 40 correlate to high plasticity. Particle size analysis and Atterberg limits results indicate that the materials classify as an elastic silt (MH) with varying amounts of fine sand and medium plasticity.

Samples of the individual components were preserved at their as-received moisture content by double sealing bulk samples in airtight plastic bags and storing in sealed buckets. Gravimetric moisture contents for all samples tested ranged between 55 and 75-percent. Most materials had a moisture content above their LL, with the exception of the tailings material without salt.

TABLE 1 - RESULTS OF MOISTURE CONTENT AND INDEX TESTING

Material	Liquid Limit	Plastic Limit	Plasticity Index	As-Received Moisture Content
LFilterCake	53	40	13	55.7
NFilterCake	64	47	18	68.5
Salt	-	-	-	74.1
Tailings w/Salt	51	40	11	60.9
Tailings w/out Salt	71	59	12	59.3

2.2 Laboratory Compaction Testing

Two moisture-unit weight relationship tests using the modified Proctor method (ASTM D1557) were completed on bulk samples of tailings, one without salt and one with salt. The samples yielded maximum dry unit weights ranging from 70 to 72 pounds per cubic foot (pcf) and optimum moisture contents (OMCs) ranging from 45 to 46 percent. In general, the sample with salt yielded a higher dry unit weight and lower moisture content.

TABLE 2 - RESULTS OF LABORATORY COMPACTION TESTING

Material	Laboratory Compaction	
	Maximum Dry Unit Weight (pcf)	Optimum Moisture Content (%)
Tailings w/out Salt	70.1	46.0
Tailings with Salt	72.4	45.3

2.3 Shear Strength

The shear strength of remolded tailings samples were measured by the triaxial compression test under isotropic Unconsolidated Undrained (UU) and Consolidated Undrained (CU) conditions. A bulk sample of tailings without salt was air dried to the OMC and six individual specimens were selected. Three of the tailings specimens were mixed with the salt and three were kept without salt. A second bulk sample of tailings was air dried to three percent over OMC and two tailings specimens were reconstituted with salt. All eight of these tailings specimens were then remolded at 95 percent of the maximum dry unit weight into 2.8-inch diameter by 5.6-inch tall test specimens.

The UU samples were confined at 25 pounds per square inch (psi) during testing while the CU samples were backpressure saturated and consolidated at 25 and 50 psi, respectively. Mohr-Coulomb strength parameters were developed from the test measurements as shown in **Table 3**. Consolidated, drained parameters (effective stress) were calculated by subtracting the measured internal pore pressure from the chamber and axial applied stresses.

TABLE 3 - SHEAR STRENGTH PROPERTIES

Material	Dry Unit Weight (pcf)	Moisture Content (%)	CU Triaxial Testing				UU Triaxial Testing
			Effective Stress		Total Stress		Undrained Shear Strength (psf)
			Friction Angle (degrees)	Cohesion (psf)	Friction Angle (degrees)	Cohesion (psf)	
Tailings	66.6	45	40	65	19	400	6300
Tailings + Salt	68.8	45	40	180	20	390	700
Tailings+ Salt	66.6	54	42	0	22	0	-

3. RECOMMENDATIONS

Currently, tailings without salt are produced at a moisture content that is in excess of the liquid limit and approximately 15 percent above optimum moisture content. Materials produced at this moisture content are difficult to handle and result in very low material strengths. The addition of salt to the tailings decreases the LL of the material, further reducing the workability at as produced moisture contents. The testing completed to date indicates that significant shear strength is achieved if the tailings are compacted to 95 percent of the maximum dry unit weight, near OMC and the salts are not mixed with the tailings. Therefore, the recommendation is that the salts be handled separately from the tailings and placed in nonstructural zones within the CTFS facility.

Design parameters utilized in the slope stability evaluation for the Clay Tailings Fitter Stack (CTFS) should be conservatively selected based upon the results of the laboratory testing completed.

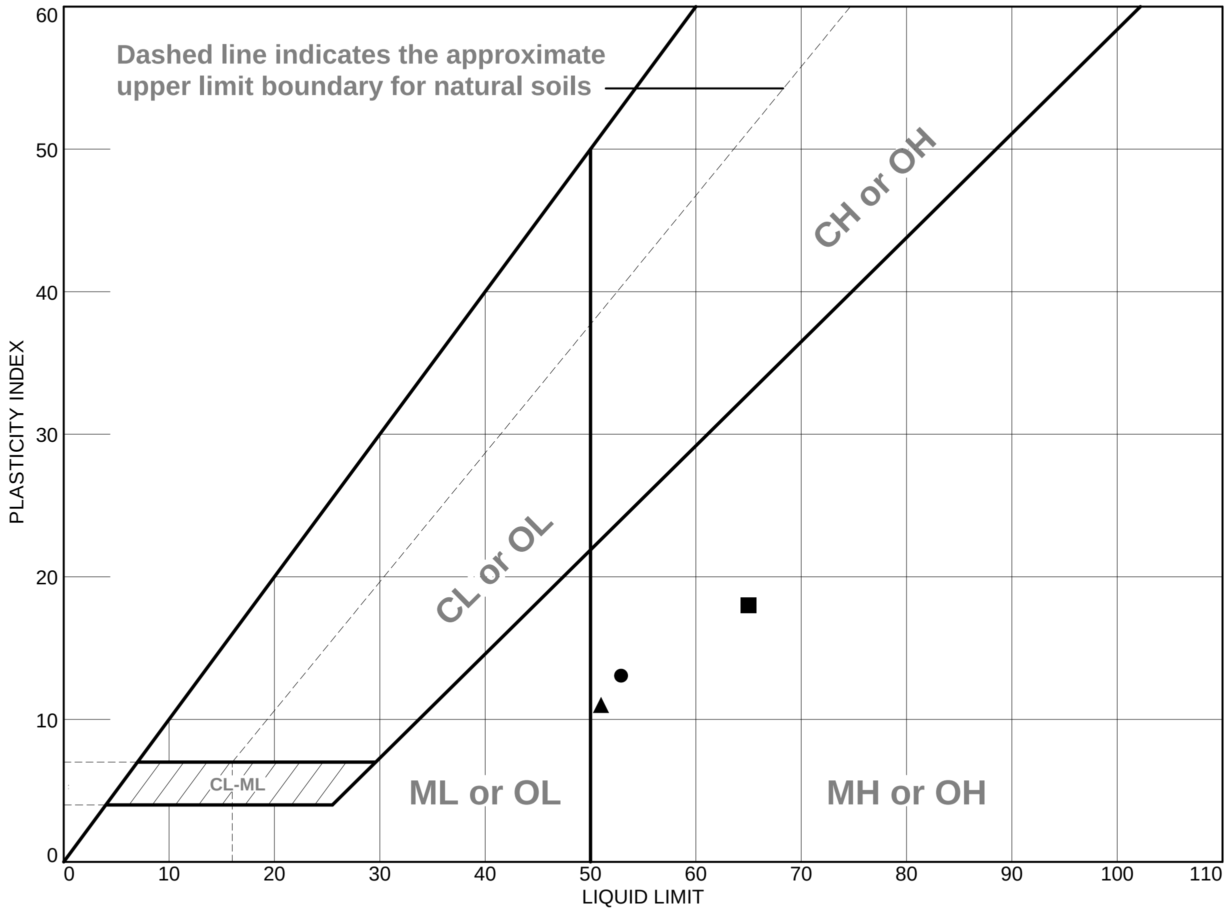
Based upon the laboratory data generated and observations of the materials both pre- and post-testing, it is believed that there will be an increase in material strength over time; although the exact magnitude of this strength increase is unknown. Long-term, there is an opportunity to optimize the facility design if it can be demonstated that the tailings can achieve strength gain after deposition. With that in mind, a robust field investigation program should be completed during early operations to assess assumed improvements.

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\J-REPORTS\Technical Memos\TM-07 Tailings Assessment\TM-07 - Thacker Pass Tailings Assessment.docx

APPENDIX C.7

Tailings Laboratory Testing Results

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	LFILTCAKE Gray	53	40	13			
■	NFILTCAKE RED	65	47	18			
▲	BLEND 11/6/2019	51	40	11			

Project No. 475.0385.000 **Client:** Lithium Nevada

Project: Thacker Pass

●**Location:** LFILTCAKE **Sample Number:** 19-380-01
■**Location:** NFILTCAKE **Sample Number:** 19-380-02
▲**Location:** Blend 11/6/2019 **Sample Number:** 19-389-01

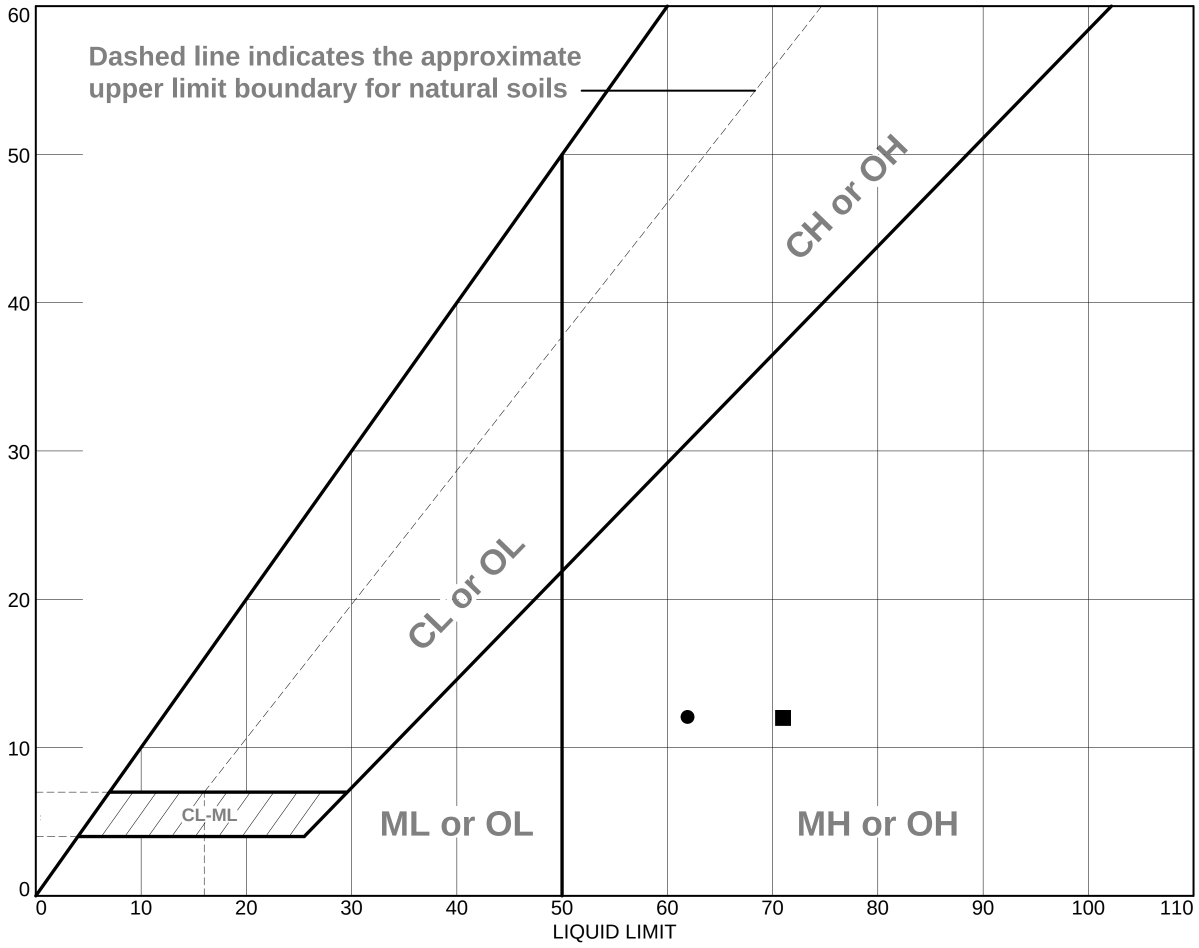
NewFields

Remarks:

Figure 19-380-01

Tested By: JH **Checked By:** JH

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		62	50	12		75	MH
■		71	59	12			

Project No. 475.0385.000 **Client:** Lithium Nevada

Project: Thacker Pass

●**Location:** 60C No Salt Blend **Sample Number:** 19-344-01 60C

■**Location:** 110c No Salt Blend **Sample Number:** 19-344-02 110C

Remarks:

NewFields

Figure 19-344-01

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	Lithium Nevada	**Location:**	See Below
Project Title:	Thacker Pass	**Elevation:**	-
Project Number:	475.0385.000	**Test Date:**	10/31/2019
Project Engineer:	Eric Niebler	**Tested By:**	JH
Field Sample ID:	See Below	**Checked By:**	JH

Drying Conditions: 60 deg C / **110 deg C** Method: **Oven (O)** / Microwave (M) / Hot Plate (H)

Sample No.	19-380-01	19-380-02	19-380-03		
Location	LFILTCAKE	NFILTCAKE	MAGSULF		
Depth					
Soil Description					
(USCS)					
Trial No.	**1**	**2**	**3**	**4**	**5**
Tare No.					
Tare + Wet Soil **A**	229.8	360.7	323.6		
Tare + Dry Soil **B**	163.6	291.1	237.9		
Tare **C**	44.7	189.5	122.3		
Wt. of Water **D= A-B**	66.2	69.6	85.7		
Dry Soil, Ws **E= B-C**	118.9	101.6	115.6		
Moisture Content, (%) **(D/E) x100**	**55.7%**	**68.5%**	**74.1%**		

Sample No.					
Location					
Depth					
Soil Description					
(USCS)					
Trial No.	**6**	**7**	**8**	**9**	**10**
Tare No.					
Tare + Wet Soil **A**					
Tare + Dry Soil **B**					
Tare **C**					
Wt. of Water **D= A-B**					
Dry Soil, Ws **E= B-C**					
Moisture Content, (%) **(D/E) x100**					

Remarks:

NewFields

NF Form #15

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

Client:	Lithium Nevada	**Location:**	See Below
Project Title:	Thacker Pass	**Elevation:**	-
Project Number:	475.0385.000	**Test Date:**	11/7/2019
Project Engineer:	Eric Niebler	**Tested By:**	JH
Field Sample ID:	See Below	**Checked By:**	JH

Drying Conditions: 60 deg C / [✓ **110 deg C**] Method: [✓ **Oven (O)**] / Microwave (M) / Hot Plate (H)

Sample No.	19-389-01				
Location	Blend 11/6/19				
Depth					
Soil Description					
(USCS)					
Trial No.	**1**	**2**	**3**	**4**	**5**
Tare No.					
Tare + Wet Soil **A**	243.1				
Tare + Dry Soil **B**	198.3				
Tare **C**	124.7				
Wt. of Water **D= A-B**	44.8				
Dry Soil, Ws **E= B-C**	73.6				
Moisture Content, (%) **(D/E) x100**	**60.9%**				

Sample No.					
Location					
Depth					
Soil Description					
(USCS)					
Trial No.	**6**	**7**	**8**	**9**	**10**
Tare No.					
Tare + Wet Soil **A**					
Tare + Dry Soil **B**					
Tare **C**					
Wt. of Water **D= A-B**					
Dry Soil, Ws **E= B-C**					
Moisture Content, (%) **(D/E) x100**					

Remarks:

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	Lithium Nevada	**Location:**	Blend w/o Salt
Project Title:	Thacker Pass	**Elevation:**	-
Project Number:	475.0385.000	**Test Date:**	11/12/2019
Project Engineer:	Eric Niebler	**Tested By:**	JH
Field Sample ID:	See Below	**Checked By:**	JH

Drying Conditions: 60 deg C / [✓ **110 deg C**] Method: [✓ **Oven (O)**] / Microwave (M) / Hot Plate (H)

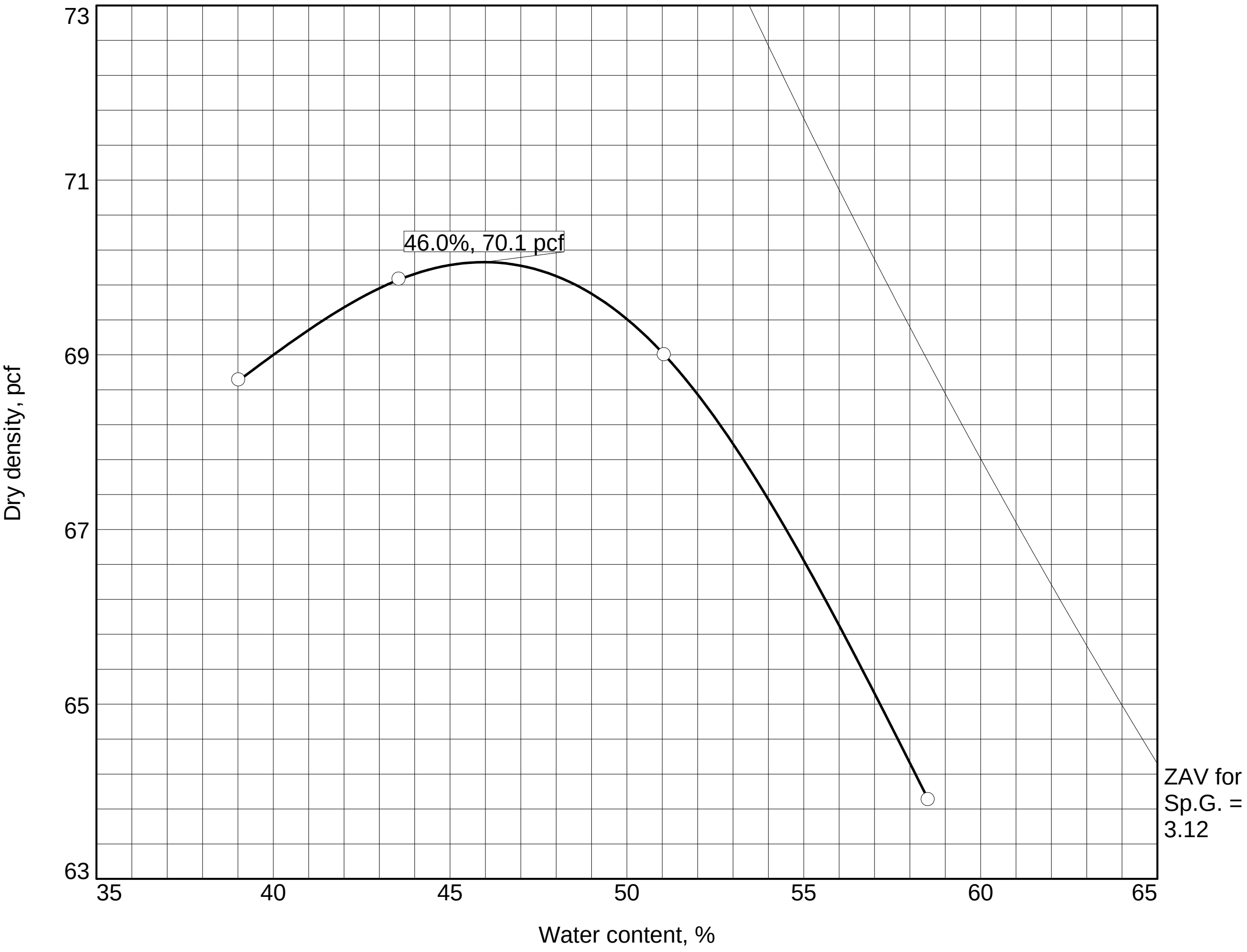
Sample No.		19-393-01				
Location		Blend w/o salt				
Depth						
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	**A**	337.4				
Tare + Dry Soil	**B**	258				
Tare	**C**	124.2				
Wt. of Water	**D= A-B**	79.4				
Dry Soil, Ws	**E= B-C**	133.8				
Moisture Content, (%)	**(D/E) x100**	**59.3%**				

Sample No.						
Location						
Depth						
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	**A**					
Tare + Dry Soil	**B**					
Tare	**C**					
Wt. of Water	**D= A-B**					
Dry Soil, Ws	**E= B-C**					
Moisture Content, (%)	**(D/E) x100**					

Remarks:

Test results included in this report relate only to the items inspected or tested. This report shall not be reproduced, in full, without prior written approval of NewFields.

COMPACTION TEST REPORT



Test specification: ASTM D 1557-12 Method B Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in.	% < No.200
	USCS	AASHTO						
				3.119			0	

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 70.1 pcf Optimum moisture = 46.0 %	Blend without salt

Project No. 475.0385.000 **Client:** Lithium Nevada

Project: Thacker Pass

Date: 11/12/

○ **Location:** Tailings Blend w/o Salt **Sample Number:** 19-393-01

NewFields

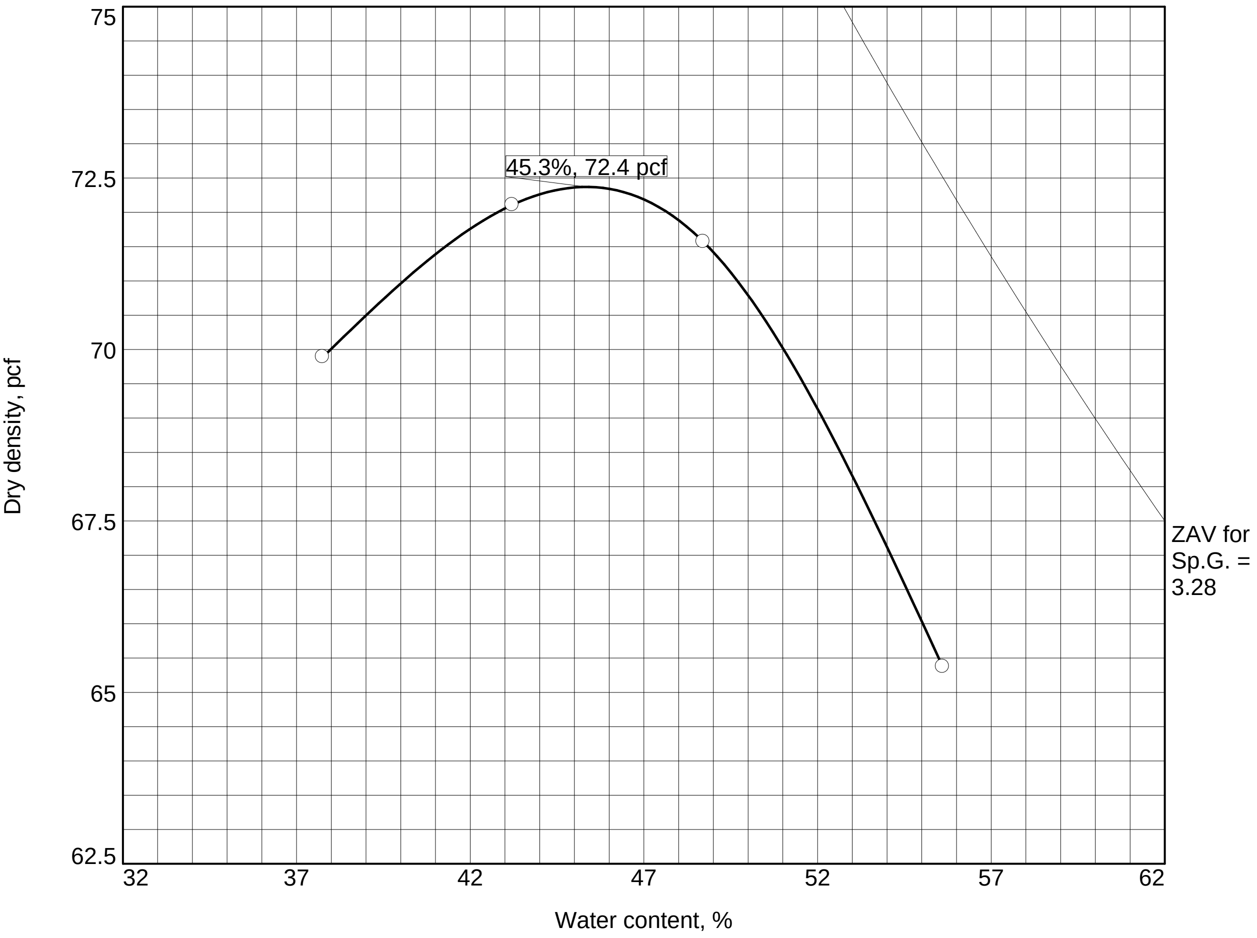
Remarks:

*Measured Specific Gravity (19-057-01)

Figure 19-393-01

Tested By: JH **Checked By:** JH

COMPACTION TEST REPORT



Test specification: ASTM D 1557-12 Method B Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in.	% < No.200
	USCS	AASHTO						
				3.280			0	

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 72.4 pcf Optimum moisture = 45.3 %	

Project No. 475.0385.000 **Client:** Lithium Nevada

Project: Thacker Pass

Date: 11/13/

○ **Location:** Tailings Blend w/ Salt **Sample Number:** 19-393-02

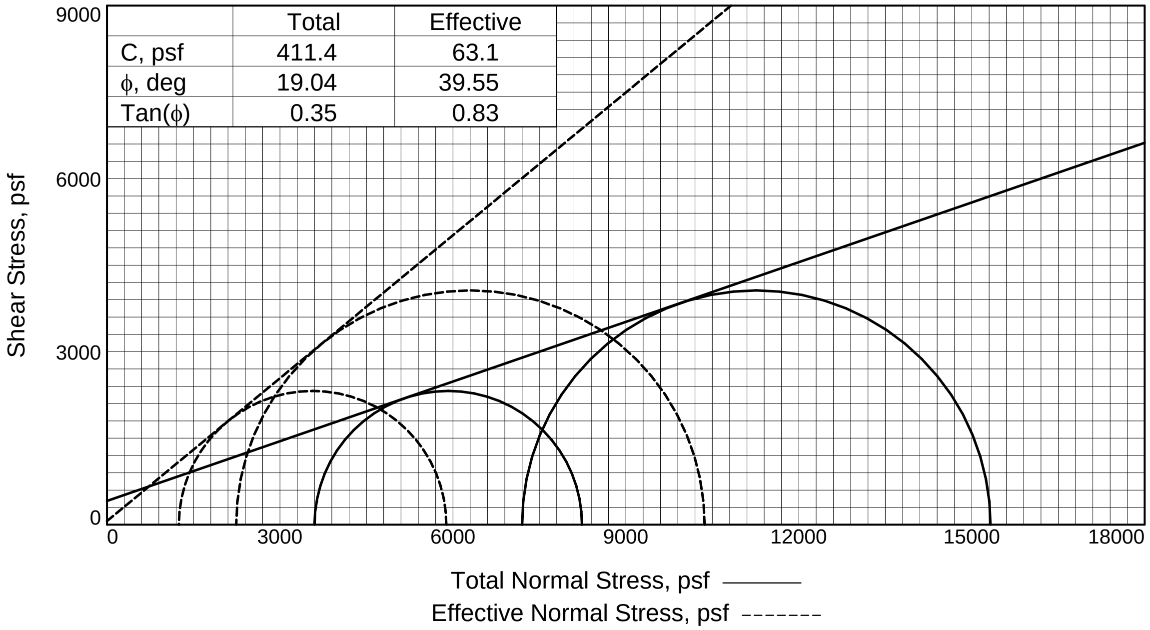
NewFields

Remarks:

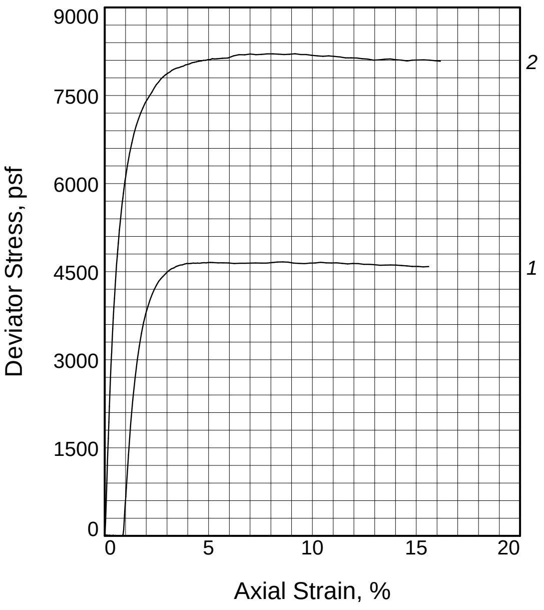
*Measured Specific Gravity (19-263-05)

Figure 19-393-02

Tested By: JH **Checked By:** JH



	Total	Effective
C, psf	411.4	63.1
ϕ, deg	19.04	39.55
Tan(ϕ)	0.35	0.83



Sample No.		1	2
Initial	Water Content, %	45.1	45.1
	Dry Density, pcf	66.4	66.5
	Saturation, %	71.9	71.9
	Void Ratio	2.0077	2.0063
	Diameter, in.	2.801	2.801
	Height, in.	5.629	5.627
At Test	Water Content, %	52.4	43.6
	Dry Density, pcf	74.6	83.4
	Saturation, %	100.0	100.0
	Void Ratio	1.6764	1.3956
	Diameter, in.	2.693	2.594
	Height, in.	5.417	5.227
Strain rate, %/min.		0.02	0.02
Eff. Cell Pressure, psi		25.000	50.000
Fail. Stress, psf		4639.2	8124.2
Total Pore Pr., psf		9599.0	12894.6
Strain, %		6.2	5.4
Ult. Stress, psf			
Total Pore Pr., psf			
Strain, %			
$\bar{\sigma}_1$ Failure, psf		5886.3	10365.4
$\bar{\sigma}_3$ Failure, psf		1247.1	2241.2

Type of Test:
CU with Pore Pressures

Sample Type: Remolded

Description: Filter Cake w/o Salt at OMC - CU Test

LL= 71 **PL=** 12 **PI=** 59

Specific Gravity= 3.2

Remarks: Failure chosen at 5% strain

Figure ______

Client: Lithium Nevada

Project: Thacker Pass

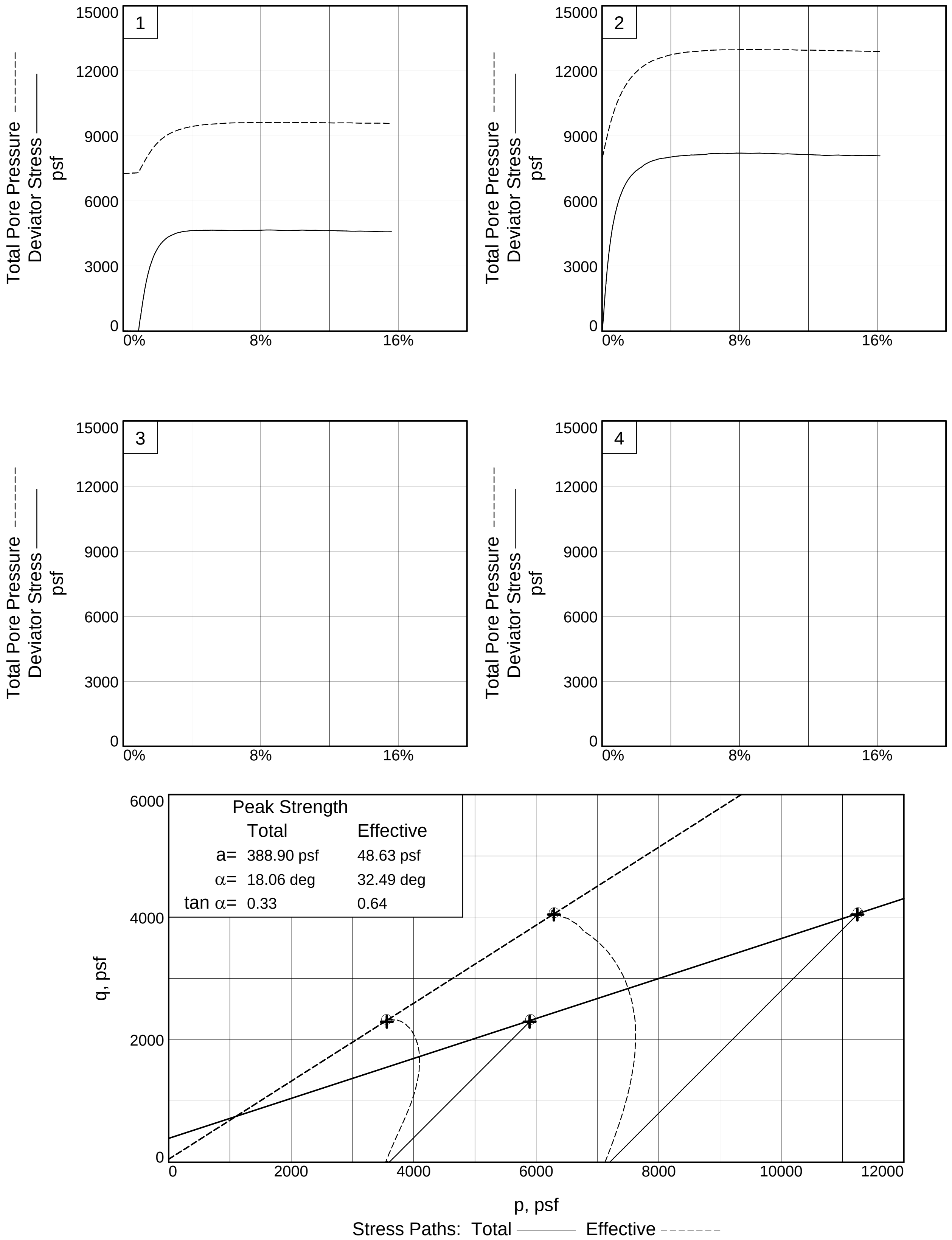
Source of Sample: Reconstituted Tailings

Sample Number: 19-421-01,-02

Proj. No.: 475.0385.000 **Date Sampled:** 12/9/19

NewFields

Tested By: K.Magner



Peak Strength

	Total	Effective
a=	388.90 psf	48.63 psf
α=	18.06 deg	32.49 deg
tan α=	0.33	0.64

Client: Lithium Nevada

Project: Thacker Pass

Source of Sample: Reconstituted Tailings **Sample Number:** 19-421-01,-02

Project No.: 475.0385.000 **Figure** ________

Newfields Mining Design and Technical Services

Tested By: K.Magner

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

12/17/2019
5:01 PM

Date: 12/9/19
Client: Lithium Nevada
Project: Thacker Pass
Project No.: 475.0385.000
Location: Reconstituted Tailings
Sample Number: 19-421-01,-02
Description: Filter Cake w/o Salt at OMC - CU Test
Remarks: Failure chosen at 5% strain
Type of Sample: Remolded
Specific Gravity=3.2 **LL=**71 **PL=**12 **PI=**59
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	417.620			1101.010
Moisture content: Dry soil+tare, gms.	326.920			746.590
Moisture content: Tare, gms.	125.760			150.160
Moisture, %	45.1	62.7	52.4	59.4
Moist specimen weight, gms.	877.40			
Diameter, in.	2.801	2.801	2.693	
Area, in.²	6.162	6.162	5.698	
Height, in.	5.629	5.629	5.417	
Net decrease in height, in.		0.000	0.212	
Wet density, pcf	96.4	108.1	113.7	
Dry density, pcf	66.4	66.4	74.6	
Void ratio	2.0077	2.0077	1.6764	
Saturation, %	71.9	100.0	100.0	

Test Readings for Specimen No. 1

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Consolidation cell pressure = 75.320 psi (10846.1 psf)
Consolidation back pressure = 50.320 psi (7246.1 psf)
Consolidation effective confining stress = 3600.0 psf
Strain rate, %/min. = 0.02
Fail. Stress = 4639.2 psf **at reading no.** 84

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Eff. Stress psf	Major Eff. Stress psf	1:3 Ratio	Pore Press. psi	P psf	Q psf
0	-0.5917	2.954	0.0	0.0	0.0	3570.1	3570.1	1.00	50.527	3570.1	0.0
1	-0.5903	3.474	0.5	0.0	13.2	3570.3	3583.5	1.00	50.526	3576.9	6.6
2	-0.5889	3.504	0.6	0.1	13.9	3569.9	3583.8	1.00	50.529	3576.9	7.0
3	-0.5875	3.472	0.5	0.1	13.1	3570.6	3583.7	1.00	50.524	3577.2	6.5
4	-0.5861	3.430	0.5	0.1	12.0	3570.8	3582.8	1.00	50.523	3576.8	6.0
5	-0.5846	3.406	0.5	0.1	11.4	3570.8	3582.2	1.00	50.523	3576.5	5.7
6	-0.5832	3.361	0.4	0.2	10.3	3570.4	3580.7	1.00	50.525	3575.6	5.1
7	-0.5818	3.291	0.3	0.2	8.0	3570.4	3578.3	1.00	50.526	3574.3	4.0
8	-0.5804	3.390	0.4	0.2	10.4	3570.1	3580.5	1.00	50.527	3575.3	5.2
9	-0.5790	3.380	0.4	0.2	10.0	3569.0	3579.1	1.00	50.535	3574.1	5.0
10	-0.5776	3.346	0.4	0.3	9.1	3567.5	3576.6	1.00	50.545	3572.1	4.5
11	-0.5762	3.288	0.3	0.3	7.6	3567.0	3574.6	1.00	50.549	3570.8	3.8
12	-0.5748	3.309	0.4	0.3	8.0	3566.0	3574.0	1.00	50.556	3570.0	4.0
13	-0.5734	3.303	0.3	0.3	7.8	3564.9	3572.7	1.00	50.563	3568.8	3.9
14	-0.5720	3.331	0.4	0.4	8.4	3563.4	3571.8	1.00	50.574	3567.6	4.2
15	-0.5706	3.387	0.4	0.4	9.7	3562.4	3572.1	1.00	50.581	3567.2	4.9
16	-0.5692	3.405	0.5	0.4	10.1	3560.8	3570.9	1.00	50.592	3565.9	5.1
17	-0.5677	3.331	0.4	0.4	8.1	3559.8	3567.9	1.00	50.599	3563.8	4.1
18	-0.5663	3.307	0.4	0.5	7.5	3559.0	3566.4	1.00	50.605	3562.7	3.7
19	-0.5649	3.312	0.4	0.5	7.5	3558.3	3565.9	1.00	50.609	3562.1	3.8
20	-0.5635	3.316	0.4	0.5	7.5	3556.7	3564.2	1.00	50.621	3560.5	3.8
21	-0.5621	3.315	0.4	0.5	7.4	3555.3	3562.7	1.00	50.631	3559.0	3.7
22	-0.5607	3.270	0.3	0.6	6.2	3554.5	3560.8	1.00	50.636	3557.7	3.1
23	-0.5593	3.246	0.3	0.6	5.5	3554.0	3559.5	1.00	50.640	3556.7	2.8
24	-0.5579	3.174	0.2	0.6	3.6	3552.9	3556.5	1.00	50.647	3554.7	1.8
25	-0.5565	3.203	0.2	0.7	4.3	3551.7	3556.0	1.00	50.656	3553.8	2.2
26	-0.5551	3.228	0.3	0.7	4.8	3550.6	3555.4	1.00	50.663	3553.0	2.4
27	-0.5537	3.273	0.3	0.7	5.9	3549.1	3555.0	1.00	50.673	3552.1	2.9
28	-0.5522	3.243	0.3	0.7	5.0	3547.6	3552.7	1.00	50.684	3550.1	2.5
29	-0.5508	3.239	0.3	0.8	4.9	3547.1	3551.9	1.00	50.687	3549.5	2.4
30	-0.5494	3.212	0.3	0.8	4.1	3546.9	3551.0	1.00	50.689	3549.0	2.1
31	-0.5480	3.183	0.2	0.8	3.3	3545.4	3548.7	1.00	50.699	3547.0	1.7
32	-0.5466	3.291	0.3	0.8	5.9	3544.5	3550.4	1.00	50.706	3547.4	3.0
33	-0.5452	3.361	0.4	0.9	7.6	3542.4	3550.0	1.00	50.720	3546.2	3.8
34	-0.5438	4.160	1.2	0.9	27.5	3534.3	3561.8	1.01	50.776	3548.0	13.8
35	-0.5424	7.191	4.2	0.9	106.1	3509.8	3615.9	1.03	50.946	3562.9	53.1
36	-0.5410	13.222	10.3	0.9	257.1	3464.6	3721.7	1.07	51.260	3593.2	128.5
37	-0.5396	19.852	16.9	1.0	423.0	3417.2	3840.2	1.12	51.589	3628.7	211.5
38	-0.5382	25.420	22.5	1.0	562.2	3378.5	3940.7	1.17	51.858	3659.6	281.1
39	-0.5367	29.681	26.7	1.0	668.6	3349.7	4018.3	1.20	52.058	3684.0	334.3
40	-0.5353	35.727	32.8	1.0	819.7	3307.1	4126.7	1.25	52.354	3716.9	409.8
41	-0.5297	58.211	55.3	1.1	1380.6	3154.2	4534.7	1.44	53.416	3844.5	690.3
42	-0.5241	78.988	76.0	1.2	1897.6	3002.2	4899.9	1.63	54.471	3951.0	948.8
43	-0.5184	95.752	92.8	1.4	2313.6	2863.3	5176.9	1.81	55.436	4020.1	1156.8
44	-0.5128	110.393	107.4	1.5	2675.8	2725.3	5401.1	1.98	56.394	4063.2	1337.9
45	-0.5072	122.768	119.8	1.6	2980.8	2597.1	5578.0	2.15	57.284	4087.6	1490.4
46	-0.5016	132.890	129.9	1.7	3229.2	2479.6	5708.9	2.30	58.100	4094.3	1614.6

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Eff. Stress psf	Major Eff. Stress psf	1:3 Ratio	Pore Press. psi	P psf	Q psf
47	-0.4959	141.857	138.9	1.8	3448.4	2370.6	5819.1	2.45	58.857	4094.9	1724.2
48	-0.4903	149.377	146.4	1.9	3631.3	2270.4	5901.7	2.60	59.553	4086.1	1815.6
49	-0.4847	155.667	152.7	2.0	3783.3	2180.6	5963.9	2.73	60.177	4072.2	1891.6
50	-0.4790	160.966	158.0	2.1	3910.4	2098.1	6008.5	2.86	60.750	4053.3	1955.2
51	-0.4734	165.692	162.7	2.2	4023.1	2023.3	6046.3	2.99	61.270	4034.8	2011.5
52	-0.4678	169.703	166.7	2.3	4117.9	1954.7	6072.6	3.11	61.746	4013.6	2058.9
53	-0.4621	173.218	170.3	2.4	4200.2	1893.3	6093.5	3.22	62.172	3993.4	2100.1
54	-0.4565	176.305	173.4	2.5	4271.8	1837.6	6109.4	3.32	62.559	3973.5	2135.9
55	-0.4509	179.021	176.1	2.6	4334.1	1785.8	6119.9	3.43	62.919	3952.8	2167.0
56	-0.4453	181.200	178.2	2.7	4383.0	1739.8	6122.8	3.52	63.238	3931.3	2191.5
57	-0.4396	182.924	180.0	2.8	4420.7	1698.1	6118.8	3.60	63.528	3908.4	2210.4
58	-0.4340	184.591	181.6	2.9	4456.9	1661.1	6118.0	3.68	63.784	3889.6	2228.4
59	-0.4284	186.379	183.4	3.0	4495.9	1625.9	6121.8	3.77	64.029	3873.8	2248.0
60	-0.4227	187.826	184.9	3.1	4526.5	1593.3	6119.8	3.84	64.256	3856.5	2263.3
61	-0.4171	189.042	186.1	3.2	4551.4	1563.8	6115.3	3.91	64.460	3839.5	2275.7
62	-0.4115	189.795	186.8	3.3	4564.9	1537.0	6101.9	3.97	64.647	3819.4	2282.5
63	-0.4058	190.860	187.9	3.4	4586.0	1512.3	6098.4	4.03	64.818	3805.3	2293.0
64	-0.4002	191.656	188.7	3.5	4600.5	1490.3	6090.8	4.09	64.970	3790.6	2300.3
65	-0.3946	192.301	189.3	3.6	4611.2	1468.8	6080.0	4.14	65.120	3774.4	2305.6
66	-0.3889	192.720	189.8	3.7	4616.5	1449.8	6066.3	4.18	65.252	3758.0	2308.2
67	-0.3833	193.445	190.5	3.8	4629.1	1432.4	6061.5	4.23	65.373	3746.9	2314.6
68	-0.3777	194.025	191.1	4.0	4638.2	1416.8	6055.0	4.27	65.481	3735.9	2319.1
69	-0.3721	194.164	191.2	4.1	4636.5	1402.2	6038.8	4.31	65.582	3720.5	2318.3
70	-0.3664	194.603	191.6	4.2	4642.1	1387.2	6029.3	4.35	65.687	3708.2	2321.1
71	-0.3608	194.941	192.0	4.3	4645.3	1374.4	6019.7	4.38	65.775	3697.1	2322.6
72	-0.3552	195.051	192.1	4.4	4642.9	1362.2	6005.1	4.41	65.860	3683.6	2321.5
73	-0.3495	195.364	192.4	4.5	4645.4	1350.5	5996.0	4.44	65.941	3673.2	2322.7
74	-0.3439	195.549	192.6	4.6	4644.8	1340.4	5985.2	4.47	66.012	3662.8	2322.4
75	-0.3383	195.999	193.0	4.7	4650.6	1331.6	5982.2	4.49	66.073	3656.9	2325.3
76	-0.3326	196.324	193.4	4.8	4653.4	1322.5	5975.9	4.52	66.136	3649.2	2326.7
77	-0.3270	196.431	193.5	4.9	4650.8	1313.8	5964.6	4.54	66.197	3639.2	2325.4
78	-0.3214	196.786	193.8	5.0	4654.3	1306.5	5960.8	4.56	66.247	3633.6	2327.1
79	-0.3158	197.111	194.2	5.1	4657.0	1301.8	5958.8	4.58	66.280	3630.3	2328.5
80	-0.3101	197.225	194.3	5.2	4654.6	1299.4	5954.0	4.58	66.296	3626.7	2327.3
81	-0.2960	197.568	194.6	5.5	4650.1	1284.2	5934.2	4.62	66.402	3609.2	2325.0
82	-0.2820	198.107	195.2	5.7	4650.1	1269.9	5920.0	4.66	66.502	3594.9	2325.1
83	-0.2679	198.534	195.6	6.0	4647.5	1256.7	5904.1	4.70	66.593	3580.4	2323.7
84	-0.2538	198.730	195.8	6.2	4639.2	1247.1	5886.3	4.72	66.660	3566.7	2319.6
85	-0.2397	199.452	196.5	6.5	4643.5	1239.7	5883.2	4.75	66.711	3561.5	2321.7
86	-0.2257	199.984	197.0	6.8	4643.1	1239.0	5882.1	4.75	66.716	3560.6	2321.5
87	-0.2116	200.683	197.7	7.0	4646.6	1236.3	5882.9	4.76	66.734	3559.6	2323.3
88	-0.1975	201.270	198.3	7.3	4647.3	1229.9	5877.2	4.78	66.779	3553.6	2323.7
89	-0.1834	201.769	198.8	7.5	4646.0	1225.6	5871.5	4.79	66.809	3548.5	2323.0
90	-0.1694	202.325	199.4	7.8	4645.9	1221.7	5867.5	4.80	66.836	3544.6	2322.9
91	-0.1553	203.256	200.3	8.1	4654.4	1220.2	5874.6	4.81	66.847	3547.4	2327.2
92	-0.1412	204.260	201.3	8.3	4664.5	1223.6	5888.2	4.81	66.823	3555.9	2332.3
93	-0.1271	204.869	201.9	8.6	4665.4	1227.7	5893.1	4.80	66.794	3560.4	2332.7

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Eff. Stress psf	Major Eff. Stress psf	1:3 Ratio	Pore Press. psi	P psf	Q psf
94	-0.1130	205.266	202.3	8.8	4661.3	1223.5	5884.7	4.81	66.824	3554.1	2330.6
95	-0.0990	205.212	202.3	9.1	4646.7	1220.9	5867.7	4.81	66.841	3544.3	2323.4
96	-0.0849	205.573	202.6	9.4	4641.7	1219.4	5861.1	4.81	66.852	3540.3	2320.9
97	-0.0708	205.934	203.0	9.6	4636.7	1219.5	5856.2	4.80	66.851	3537.8	2318.3
98	-0.0567	206.913	204.0	9.9	4645.6	1224.5	5870.1	4.79	66.817	3547.3	2322.8
99	-0.0427	207.605	204.7	10.1	4647.9	1229.8	5877.7	4.78	66.780	3553.8	2324.0
100	-0.0286	208.718	205.8	10.4	4659.7	1233.3	5893.0	4.78	66.755	3563.2	2329.9
101	-0.0145	208.934	206.0	10.7	4651.1	1231.2	5882.3	4.78	66.770	3556.8	2325.5
102	-0.0004	209.370	206.4	10.9	4647.3	1229.5	5876.9	4.78	66.782	3553.2	2323.7
103	0.0137	210.087	207.1	11.2	4649.9	1229.8	5879.7	4.78	66.779	3554.8	2324.9
104	0.0277	210.337	207.4	11.4	4641.9	1230.5	5872.3	4.77	66.775	3551.4	2320.9
105	0.0418	210.487	207.5	11.7	4631.6	1236.6	5868.2	4.75	66.733	3552.4	2315.8
106	0.0559	211.459	208.5	12.0	4639.6	1243.2	5882.8	4.73	66.687	3563.0	2319.8
107	0.0700	211.956	209.0	12.2	4636.9	1244.9	5881.8	4.72	66.675	3563.4	2318.5
108	0.0841	212.109	209.2	12.5	4626.6	1242.4	5869.0	4.72	66.692	3555.7	2313.3
109	0.0981	212.717	209.8	12.7	4626.3	1242.6	5868.9	4.72	66.691	3555.8	2313.1
110	0.1122	213.034	210.1	13.0	4619.4	1242.0	5861.4	4.72	66.695	3551.7	2309.7
111	0.1263	213.184	210.2	13.3	4608.9	1242.6	5851.5	4.71	66.691	3547.1	2304.5
112	0.1404	213.933	211.0	13.5	4611.5	1249.6	5861.1	4.69	66.642	3555.4	2305.7
113	0.1545	214.698	211.7	13.8	4614.3	1255.1	5869.4	4.68	66.604	3562.2	2307.2
114	0.1685	215.240	212.3	14.0	4612.2	1256.7	5868.9	4.67	66.593	3562.8	2306.1
115	0.1826	215.550	212.6	14.3	4604.9	1254.0	5859.0	4.67	66.612	3556.5	2302.5
116	0.1967	215.907	213.0	14.6	4598.7	1253.2	5851.9	4.67	66.617	3552.5	2299.3
117	0.2108	216.138	213.2	14.8	4589.7	1253.9	5843.6	4.66	66.612	3548.8	2294.8
118	0.2249	216.717	213.8	15.1	4588.1	1254.6	5842.7	4.66	66.607	3548.7	2294.0
119	0.2389	217.063	214.1	15.3	4581.5	1263.0	5844.4	4.63	66.549	3553.7	2290.7
120	0.2530	217.987	215.0	15.6	4587.1	1268.2	5855.4	4.62	66.513	3561.8	2293.6
121	0.2533	217.875	214.9	15.6	4584.5	1268.7	5853.2	4.61	66.510	3560.9	2292.2

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	417.620			1200.790
Moisture content: Dry soil+tare, gms.	326.920			861.440
Moisture content: Tare, gms.	125.760			267.220
Moisture, %	45.1	62.7	43.6	57.1
Moist specimen weight, gms.	877.50			
Diameter, in.	2.801	2.801	2.594	
Area, in.²	6.162	6.162	5.286	
Height, in.	5.627	5.627	5.227	
Net decrease in height, in.		0.000	0.400	
Wet density, pcf	96.4	108.1	119.8	
Dry density, pcf	66.5	66.5	83.4	
Void ratio	2.0063	2.0063	1.3956	
Saturation, %	71.9	100.0	100.0	

Test Readings for Specimen No. 2

Membrane modulus = 0.124105 kN/cm²

Membrane thickness = 0.02 cm

Consolidation cell pressure = 105.110 psi (15135.8 psf)

Consolidation back pressure = 55.110 psi (7935.8 psf)

Consolidation effective confining stress = 7200.0 psf

Strain rate, %/min. = 0.02

Fail. Stress = 8124.2 psf **at reading no.** 80

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Eff. Stress psf	Major Eff. Stress psf	1:3 Ratio	Pore Press. psi	P psf	Q psf
0	-0.5393	4.428	0.0	0.0	0.0	7121.8	7121.8	1.00	55.653	7121.8	0.0
1	-0.5374	12.688	8.3	0.0	224.9	7055.2	7280.1	1.03	56.115	7167.7	112.5
2	-0.5360	22.457	18.0	0.1	490.8	6973.0	7463.8	1.07	56.686	7218.4	245.4
3	-0.5346	33.121	28.7	0.1	780.9	6881.0	7661.9	1.11	57.325	7271.5	390.5
4	-0.5332	43.913	39.5	0.1	1074.4	6785.5	7859.9	1.16	57.988	7322.7	537.2
5	-0.5317	55.078	50.6	0.1	1377.8	6685.7	8063.6	1.21	58.681	7374.7	688.9
6	-0.5303	65.486	61.1	0.2	1660.5	6587.9	8248.5	1.25	59.360	7418.2	830.3
7	-0.5289	75.618	71.2	0.2	1935.6	6490.0	8425.6	1.30	60.040	7457.8	967.8
8	-0.5275	85.456	81.0	0.2	2202.4	6392.0	8594.5	1.34	60.721	7493.2	1101.2
9	-0.5261	94.750	90.3	0.3	2454.4	6295.8	8750.2	1.39	61.389	7523.0	1227.2
10	-0.5247	103.513	99.1	0.3	2691.8	6201.8	8893.6	1.43	62.042	7547.7	1345.9
11	-0.5233	111.721	107.3	0.3	2914.0	6110.5	9024.5	1.48	62.676	7567.5	1457.0
12	-0.5219	119.719	115.3	0.3	3130.4	6020.5	9150.9	1.52	63.301	7585.7	1565.2
13	-0.5205	127.544	123.1	0.4	3341.9	5929.0	9270.9	1.56	63.937	7599.9	1671.0
14	-0.5191	134.621	130.2	0.4	3533.1	5842.8	9375.9	1.60	64.535	7609.4	1766.5
15	-0.5177	141.210	136.8	0.4	3710.9	5759.4	9470.2	1.64	65.114	7614.8	1855.4
16	-0.5162	147.584	143.2	0.4	3882.8	5678.4	9561.2	1.68	65.676	7619.8	1941.4
17	-0.5148	153.609	149.2	0.5	4045.1	5598.6	9643.7	1.72	66.231	7621.1	2022.5
18	-0.5134	159.427	155.0	0.5	4201.7	5520.6	9722.3	1.76	66.773	7621.4	2100.8
19	-0.5120	164.997	160.6	0.5	4351.5	5444.6	9796.1	1.80	67.300	7620.3	2175.7
20	-0.5106	170.345	165.9	0.5	4495.2	5369.9	9865.1	1.84	67.819	7617.5	2247.6
21	-0.5092	175.530	171.1	0.6	4634.4	5295.4	9929.8	1.88	68.337	7612.6	2317.2
22	-0.5078	180.267	175.8	0.6	4761.4	5225.0	9986.4	1.91	68.826	7605.7	2380.7
23	-0.5064	184.679	180.3	0.6	4879.6	5156.0	10035.5	1.95	69.305	7595.7	2439.8
24	-0.5050	188.814	184.4	0.7	4990.2	5089.1	10079.3	1.98	69.769	7584.2	2495.1

Test Readings for Specimen No. 2

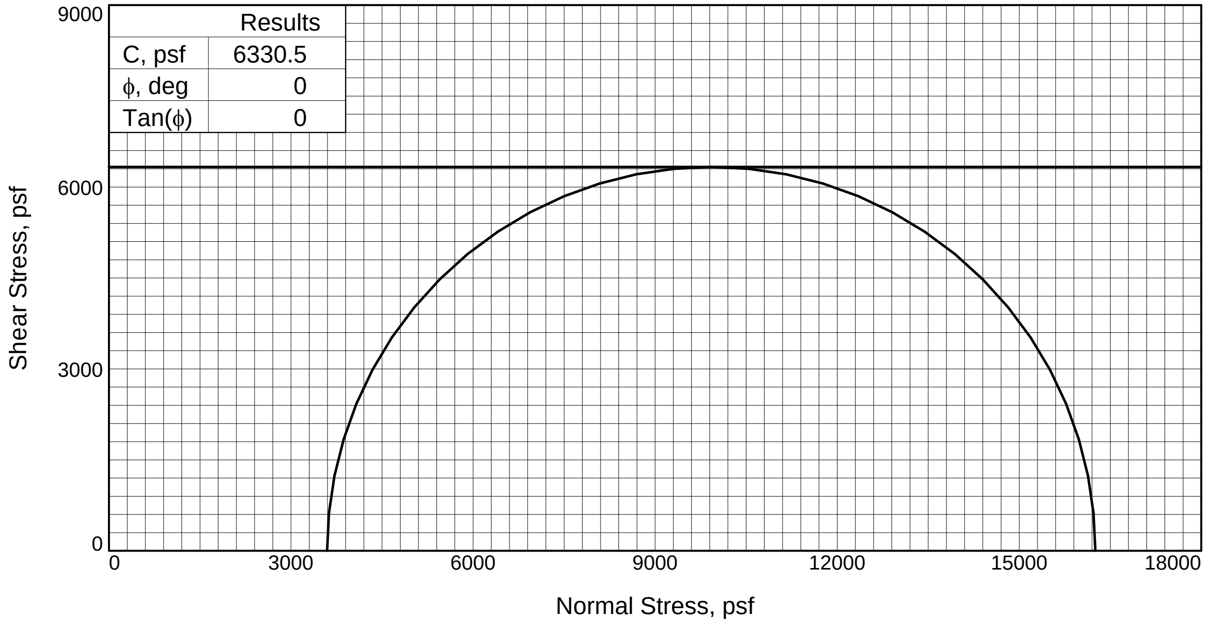
No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Eff. Stress psf	Major Eff. Stress psf	1:3 Ratio	Pore Press. psi	P psf	Q psf
25	-0.5036	192.978	188.5	0.7	5101.5	5023.4	10124.9	2.02	70.225	7574.2	2550.7
26	-0.5022	197.083	192.7	0.7	5211.1	4959.2	10170.3	2.05	70.671	7564.7	2605.6
27	-0.5007	201.011	196.6	0.7	5315.9	4896.4	10212.3	2.09	71.107	7554.3	2658.0
28	-0.4993	204.455	200.0	0.8	5407.6	4835.0	10242.6	2.12	71.533	7538.8	2703.8
29	-0.4979	207.900	203.5	0.8	5499.3	4776.1	10275.4	2.15	71.942	7525.8	2749.6
30	-0.4965	211.250	206.8	0.8	5588.3	4718.4	10306.6	2.18	72.343	7512.5	2794.1
31	-0.4951	214.461	210.0	0.8	5673.5	4662.4	10335.9	2.22	72.732	7499.2	2836.7
32	-0.4937	217.509	213.1	0.9	5754.3	4607.9	10362.2	2.25	73.110	7485.1	2877.1
33	-0.4923	220.548	216.1	0.9	5834.8	4553.9	10388.7	2.28	73.485	7471.3	2917.4
34	-0.4909	223.342	218.9	0.9	5908.6	4501.8	10410.4	2.31	73.847	7456.1	2954.3
35	-0.4895	226.090	221.7	1.0	5981.1	4450.3	10431.4	2.34	74.205	7440.9	2990.5
36	-0.4881	228.840	224.4	1.0	6053.7	4399.8	10453.4	2.38	74.556	7426.6	3026.8
37	-0.4867	231.260	226.8	1.0	6117.3	4351.3	10468.6	2.41	74.892	7410.0	3058.6
38	-0.4853	233.683	229.3	1.0	6180.9	4303.7	10484.6	2.44	75.223	7394.1	3090.5
39	-0.4838	235.831	231.4	1.1	6237.1	4258.5	10495.7	2.46	75.537	7377.1	3118.6
40	-0.4824	238.043	233.6	1.1	6295.0	4213.4	10508.4	2.49	75.850	7360.9	3147.5
41	-0.4768	246.371	241.9	1.2	6512.4	4042.6	10554.9	2.61	77.036	7298.8	3256.2
42	-0.4712	253.283	248.9	1.3	6691.1	3889.8	10581.0	2.72	78.097	7235.4	3345.6
43	-0.4655	259.512	255.1	1.4	6851.1	3750.7	10601.8	2.83	79.064	7176.2	3425.6
44	-0.4599	264.819	260.4	1.5	6986.0	3621.2	10607.2	2.93	79.963	7114.2	3493.0
45	-0.4543	269.398	265.0	1.6	7101.1	3504.7	10605.8	3.03	80.772	7055.3	3550.5
46	-0.4487	273.537	269.1	1.7	7204.1	3399.5	10603.6	3.12	81.503	7001.5	3602.1
47	-0.4430	277.025	272.6	1.8	7289.5	3302.8	10592.3	3.21	82.174	6947.6	3644.7
48	-0.4374	280.536	276.1	1.9	7375.3	3214.6	10589.9	3.29	82.786	6902.2	3687.6
49	-0.4318	283.179	278.8	2.1	7437.7	3134.0	10571.7	3.37	83.346	6852.9	3718.8
50	-0.4261	285.873	281.4	2.2	7501.3	3057.5	10558.8	3.45	83.877	6808.1	3750.7
51	-0.4205	288.216	283.8	2.3	7555.4	2989.3	10544.7	3.53	84.351	6767.0	3777.7
52	-0.4149	291.148	286.7	2.4	7625.1	2927.7	10552.7	3.60	84.779	6740.2	3812.5
53	-0.4092	293.809	289.4	2.5	7687.3	2867.6	10554.9	3.68	85.196	6711.2	3843.7
54	-0.4036	295.740	291.3	2.6	7730.1	2813.6	10543.7	3.75	85.571	6678.6	3865.0
55	-0.3980	298.016	293.6	2.7	7781.9	2763.3	10545.2	3.82	85.920	6654.3	3890.9
56	-0.3923	299.635	295.2	2.8	7816.1	2718.2	10534.3	3.88	86.234	6626.3	3908.1
57	-0.3867	301.218	296.8	2.9	7849.3	2673.2	10522.5	3.94	86.546	6597.8	3924.7
58	-0.3811	302.650	298.2	3.0	7878.4	2639.4	10517.8	3.98	86.781	6578.6	3939.2
59	-0.3755	303.809	299.4	3.1	7900.3	2608.4	10508.7	4.03	86.996	6558.6	3950.1
60	-0.3698	305.245	300.8	3.2	7929.3	2575.7	10505.0	4.08	87.223	6540.3	3964.7
61	-0.3642	306.361	301.9	3.3	7949.9	2546.4	10496.3	4.12	87.427	6521.4	3975.0
62	-0.3586	307.350	302.9	3.5	7967.1	2519.6	10486.6	4.16	87.613	6503.1	3983.5
63	-0.3529	308.002	303.6	3.6	7975.3	2491.2	10466.4	4.20	87.810	6478.8	3987.6
64	-0.3473	308.826	304.4	3.7	7988.0	2465.0	10453.0	4.24	87.992	6459.0	3994.0
65	-0.3417	309.678	305.2	3.8	8001.4	2440.6	10442.0	4.28	88.161	6441.3	4000.7
66	-0.3360	310.763	306.3	3.9	8020.9	2415.9	10436.7	4.32	88.333	6426.3	4010.4
67	-0.3304	311.462	307.0	4.0	8030.1	2396.6	10426.7	4.35	88.467	6411.6	4015.1
68	-0.3248	312.214	307.8	4.1	8040.8	2376.7	10417.4	4.38	88.605	6397.0	4020.4
69	-0.3191	313.255	308.8	4.2	8058.9	2358.7	10417.6	4.42	88.730	6388.1	4029.5
70	-0.3135	313.924	309.5	4.3	8067.3	2343.9	10411.2	4.44	88.833	6377.5	4033.7
71	-0.3079	314.568	310.1	4.4	8075.0	2327.4	10402.4	4.47	88.947	6364.9	4037.5

Test Readings for Specimen No. 2

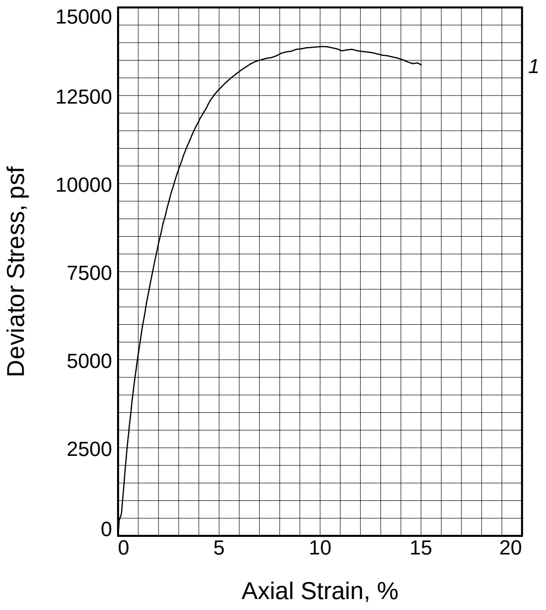
No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Eff. Stress psf	Major Eff. Stress psf	1:3 Ratio	Pore Press. psi	P psf	Q psf
72	-0.3023	315.309	310.9	4.5	8085.1	2312.7	10397.9	4.50	89.049	6355.3	4042.6
73	-0.2966	315.835	311.4	4.6	8089.7	2300.2	10389.9	4.52	89.137	6345.0	4044.8
74	-0.2910	316.479	312.1	4.7	8097.3	2288.5	10385.7	4.54	89.218	6337.1	4048.6
75	-0.2854	316.934	312.5	4.9	8099.9	2277.0	10376.9	4.56	89.298	6326.9	4049.9
76	-0.2797	317.676	313.2	5.0	8109.9	2266.4	10376.3	4.58	89.371	6321.4	4055.0
77	-0.2741	318.067	313.6	5.1	8110.9	2259.9	10370.8	4.59	89.416	6315.4	4055.4
78	-0.2685	319.028	314.6	5.2	8126.5	2253.3	10379.7	4.61	89.462	6316.5	4063.2
79	-0.2628	319.233	314.8	5.3	8122.5	2246.1	10368.6	4.62	89.512	6307.4	4061.3
80	-0.2572	319.657	315.2	5.4	8124.2	2241.2	10365.4	4.62	89.546	6303.3	4062.1
81	-0.2431	320.929	316.5	5.7	8133.8	2223.5	10357.3	4.66	89.669	6290.4	4066.9
82	-0.2291	322.078	317.7	5.9	8140.0	2204.1	10344.1	4.69	89.804	6274.1	4070.0
83	-0.2150	324.378	320.0	6.2	8175.5	2189.7	10365.2	4.73	89.904	6277.4	4087.7
84	-0.2009	326.067	321.6	6.5	8195.0	2176.5	10371.6	4.77	89.995	6274.0	4097.5
85	-0.1868	326.916	322.5	6.7	8193.0	2168.7	10361.7	4.78	90.050	6265.2	4096.5
86	-0.1727	328.385	324.0	7.0	8206.5	2164.5	10371.0	4.79	90.079	6267.8	4103.3
87	-0.1587	328.917	324.5	7.3	8196.2	2165.0	10361.2	4.79	90.075	6263.1	4098.1
88	-0.1446	330.007	325.6	7.6	8199.8	2164.4	10364.2	4.79	90.079	6264.3	4099.9
89	-0.1305	331.294	326.9	7.8	8208.3	2161.3	10369.6	4.80	90.101	6265.5	4104.1
90	-0.1164	332.288	327.9	8.1	8209.2	2155.0	10364.2	4.81	90.145	6259.6	4104.6
91	-0.1023	333.052	328.6	8.4	8204.2	2153.0	10357.2	4.81	90.159	6255.1	4102.1
92	-0.0883	333.808	329.4	8.6	8198.9	2148.2	10347.1	4.82	90.192	6247.7	4099.5
93	-0.0742	334.954	330.5	8.9	8203.2	2148.6	10351.8	4.82	90.189	6250.2	4101.6
94	-0.0601	336.245	331.8	9.2	8210.9	2154.3	10365.1	4.81	90.150	6259.7	4105.4
95	-0.0460	336.678	332.2	9.4	8197.2	2159.5	10356.7	4.80	90.114	6258.1	4098.6
96	-0.0320	337.717	333.3	9.7	8198.4	2163.4	10361.8	4.79	90.086	6262.6	4099.2
97	-0.0179	338.153	333.7	10.0	8184.6	2161.9	10346.6	4.79	90.096	6254.3	4092.3
98	-0.0038	338.761	334.3	10.2	8175.0	2160.3	10335.3	4.78	90.108	6247.8	4087.5
99	0.0103	339.528	335.1	10.5	8169.2	2160.5	10329.7	4.78	90.106	6245.1	4084.6
100	0.0244	340.783	336.4	10.8	8175.1	2160.1	10335.2	4.78	90.109	6247.7	4087.5
101	0.0384	341.428	337.0	11.1	8166.0	2163.0	10329.0	4.78	90.089	6246.0	4083.0
102	0.0525	342.122	337.7	11.3	8158.1	2173.4	10331.5	4.75	90.017	6252.5	4079.0
103	0.0666	342.450	338.0	11.6	8141.2	2178.0	10319.2	4.74	89.985	6248.6	4070.6
104	0.0807	343.444	339.0	11.9	8140.3	2182.4	10322.6	4.73	89.955	6252.5	4070.1
105	0.0948	344.415	340.0	12.1	8138.6	2180.4	10319.0	4.73	89.969	6249.7	4069.3
106	0.1088	344.997	340.6	12.4	8127.6	2182.1	10309.6	4.72	89.957	6245.9	4063.8
107	0.1229	345.806	341.4	12.7	8121.8	2185.9	10307.7	4.72	89.930	6246.8	4060.9
108	0.1370	346.086	341.7	12.9	8103.4	2189.4	10292.8	4.70	89.906	6241.1	4051.7
109	0.1511	347.280	342.9	13.2	8106.6	2195.6	10302.2	4.69	89.862	6248.9	4053.3
110	0.1652	348.858	344.4	13.5	8118.6	2202.5	10321.1	4.69	89.815	6261.8	4059.3
111	0.1792	350.098	345.7	13.7	8122.5	2207.7	10330.1	4.68	89.779	6268.9	4061.2
112	0.1933	350.627	346.2	14.0	8109.5	2208.6	10318.1	4.67	89.773	6263.4	4054.8
113	0.2074	351.398	347.0	14.3	8102.1	2212.1	10314.3	4.66	89.748	6263.2	4051.1
114	0.2215	351.882	347.5	14.6	8087.9	2214.2	10302.2	4.65	89.733	6258.2	4044.0
115	0.2355	353.636	349.2	14.8	8103.1	2221.2	10324.4	4.65	89.685	6272.8	4051.6
116	0.2496	354.832	350.4	15.1	8105.2	2223.7	10328.9	4.64	89.668	6276.3	4052.6
117	0.2637	356.032	351.6	15.4	8107.1	2229.4	10336.5	4.64	89.628	6283.0	4053.6
118	0.2778	356.923	352.5	15.6	8101.8	2233.6	10335.4	4.63	89.599	6284.5	4050.9

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Eff. Stress psf	Major Eff. Stress psf	1:3 Ratio	Pore Press. psi	P psf	Q psf
119	0.2919	357.721	353.3	15.9	8094.2	2239.3	10333.5	4.61	89.559	6286.4	4047.1
120	0.3056	358.409	354.0	16.2	8084.6	2245.8	10330.4	4.60	89.514	6288.1	4042.3



Results	
C, psf	6330.5
ϕ, deg	0
Tan(ϕ)	0



Sample No.		1
Initial	Water Content, %	45.1
	Dry Density, pcf	67.0
	Saturation, %	72.8
	Void Ratio	1.9818
	Diameter, in.	2.801
	Height, in.	5.604
At Test	Water Content, %	46.4
	Dry Density, pcf	67.0
	Saturation, %	74.9
	Void Ratio	1.9818
	Diameter, in.	2.801
	Height, in.	5.604
Strain rate, %/min.		1.00
Back Pressure, psi		0.000
Cell Pressure, psi		24.960
Fail. Stress, psf		12661.0
Strain, %		5.0
Ult. Stress, psf		
Strain, %		
σ_1 Failure, psf		16255.2
σ_3 Failure, psf		3594.2

Type of Test:
Unconsolidated Undrained

Sample Type: Remolded

Description: Filtercake w/o Salt - UU Test

LL= 71 **PL=** 59 **PI=** 12

Specific Gravity= 3.2

Remarks: Failure chosen at 5% strain

Figure ________

Client: Lithium Nevada

Project: Thacker Pass

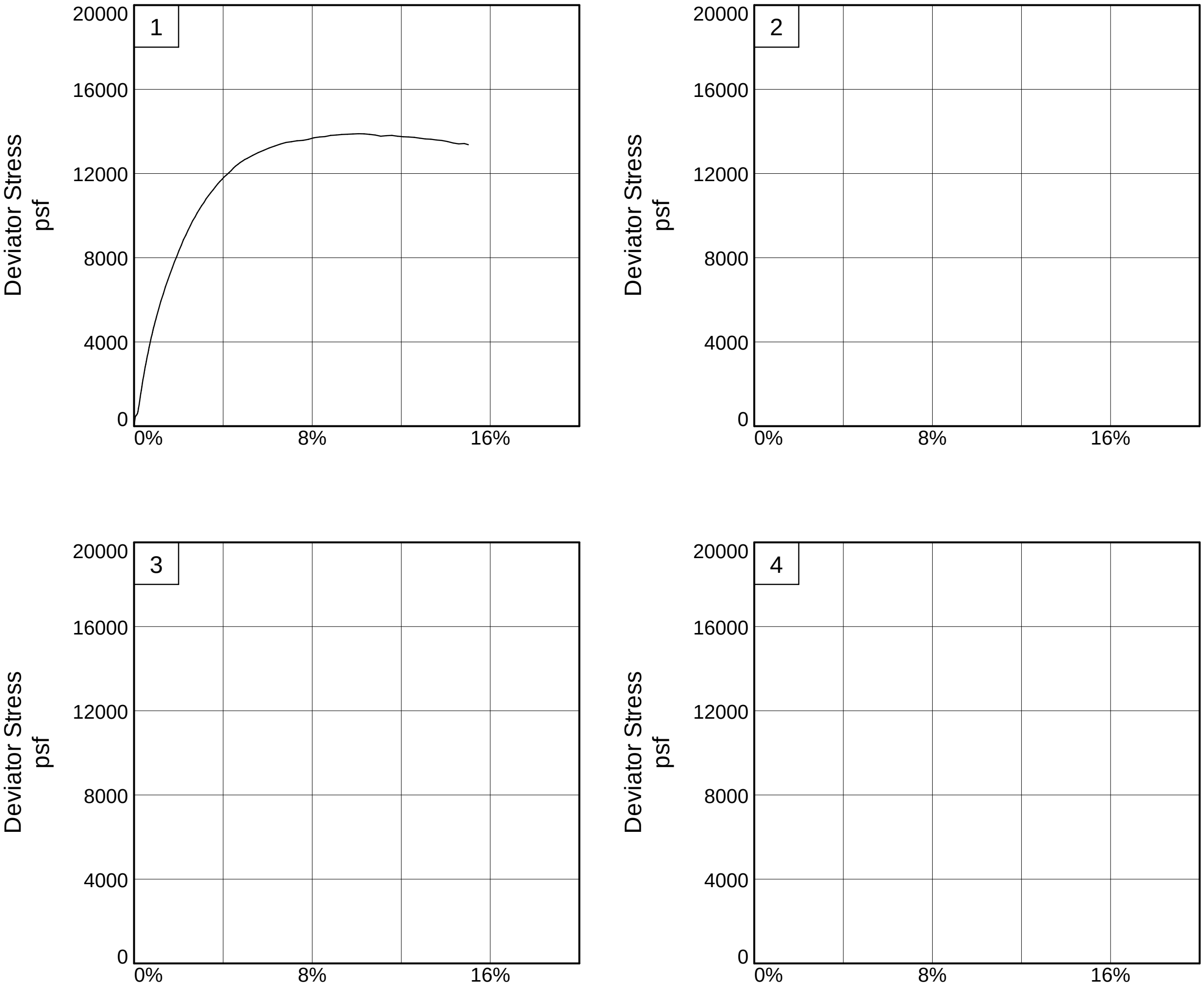
Source of Sample: Reconstituted Tailings

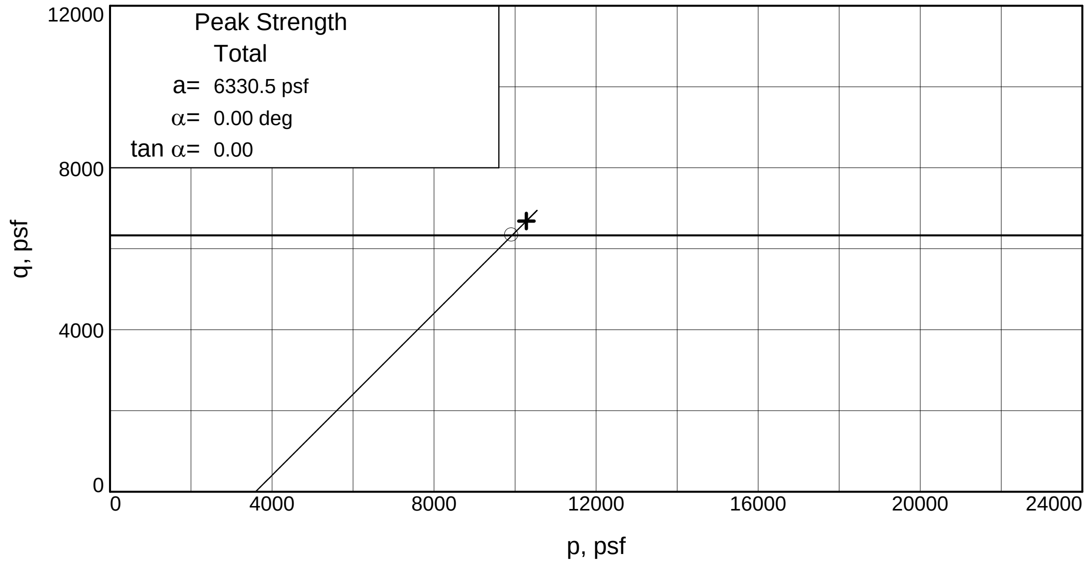
Sample Number: 19-421-03

Proj. No.: 475.0385.000 **Date Sampled:** 12/9/19

NewFields

Tested By: K.Magner **Checked By:** K.Magner





Peak Strength
Total
a= 6330.5 psf
α= 0.00 deg
tan α= 0.00

Stress Paths: o indicates peak + indicates end

Client: Lithium Nevada
Project: Thacker Pass
Source of Sample: Reconstituted Tailings **Sample Number:** 19-421-03
Project No.: 475.0385.000 **Figure** ________

Newfields Mining Design and Technical Services

Tested By: K.Magner **Checked By:** K.Magner

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

12/17/2019
4:33 PM

Date:	12/9/19
Client:	Lithium Nevada
Project:	Thacker Pass
Project No.:	475.0385.000
Location:	Reconstituted Tailings
Sample Number:	19-421-03
Description:	Filtercake w/o Salt - UU Test
Remarks:	Failure chosen at 5% strain
Type of Sample:	Remolded

Specific Gravity=3.2 **LL=**71 **PL=**59 **PI=**12

Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	417.620	1034.400
Moisture content: Dry soil+tare, gms.	326.920	754.140
Moisture content: Tare, gms.	125.760	150.250
Moisture, %	45.1	46.4
Moist specimen weight, gms.	881.10	
Diameter, in.	2.801	
Area, in.²	6.162	
Height, in.	5.604	
Wet density, pcf	97.2	
Dry density, pcf	67.0	
Void ratio	1.9818	
Saturation, %	72.8	

Test Readings for Specimen No. 1

Membrane modulus = 0.124105 kN/cm²

Membrane thickness = 0.02 cm

Cell pressure = 24.960 psi (3594.2 psf)

Back pressure = 0.000 psi (0.0 psf)

Strain rate, %/min. = 1.00

Fail. Stress = 12661.0 psf **at reading no.** 79

Test Readings for Specimen No. 1

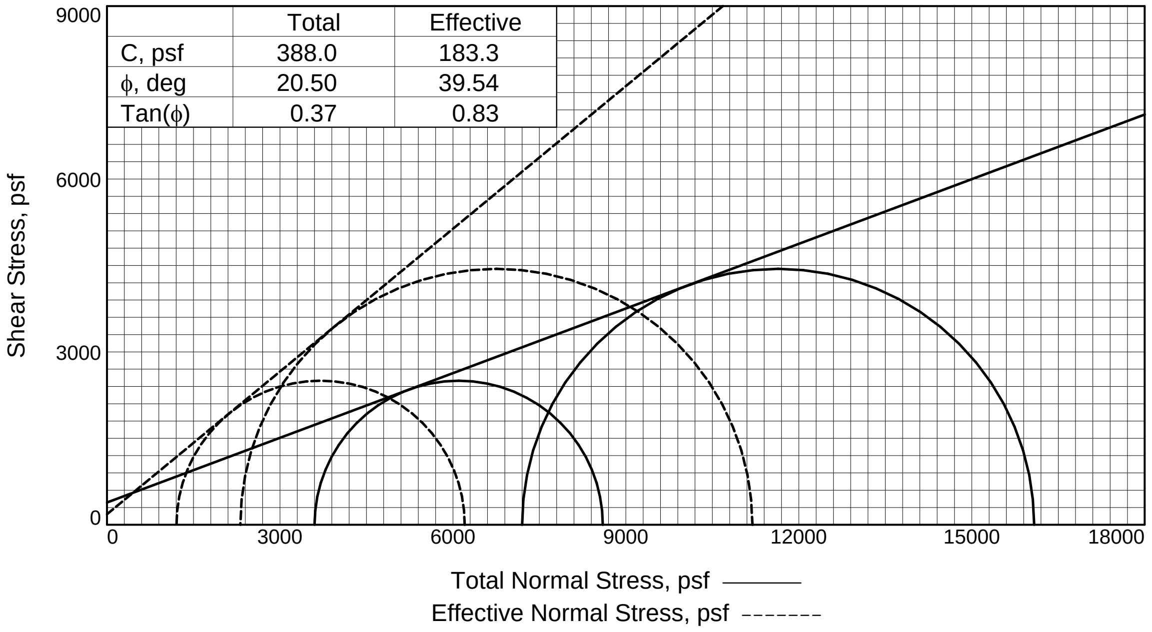
No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Princ. Stress psf	Major Princ. Stress psf	1:3 Ratio	P psf	Q psf
0	0.4272	3.621	0.0	0.0	0.0	3594.2	3594.2	1.00	3594.2	0.0
1	0.4289	13.982	10.4	0.0	242.1	3594.2	3836.3	1.07	3715.3	121.0
2	0.4303	22.352	18.7	0.1	437.5	3594.2	4031.8	1.12	3813.0	218.8
3	0.4316	24.389	20.8	0.1	485.0	3594.2	4079.2	1.13	3836.7	242.5
4	0.4329	25.672	22.1	0.1	514.8	3594.2	4109.0	1.14	3851.6	257.4
5	0.4343	27.182	23.6	0.1	549.9	3594.2	4144.2	1.15	3869.2	275.0
6	0.4357	29.372	25.8	0.2	600.9	3594.2	4195.1	1.17	3894.7	300.4
7	0.4371	33.575	30.0	0.2	698.8	3594.2	4293.0	1.19	3943.6	349.4
8	0.4385	40.381	36.8	0.2	857.3	3594.2	4451.6	1.24	4022.9	428.7
9	0.4399	47.592	44.0	0.2	1025.3	3594.2	4619.5	1.29	4106.9	512.6
10	0.4413	54.981	51.4	0.3	1197.2	3594.2	4791.5	1.33	4192.9	598.6
11	0.4427	62.448	58.8	0.3	1370.9	3594.2	4965.2	1.38	4279.7	685.5
12	0.4441	69.965	66.3	0.3	1545.8	3594.2	5140.0	1.43	4367.1	772.9
13	0.4455	77.181	73.6	0.3	1713.4	3594.2	5307.7	1.48	4451.0	856.7
14	0.4469	84.455	80.8	0.4	1882.4	3594.2	5476.6	1.52	4535.4	941.2
15	0.4483	91.649	88.0	0.4	2049.4	3594.2	5643.7	1.57	4618.9	1024.7
16	0.4497	98.549	94.9	0.4	2209.5	3594.2	5803.8	1.61	4699.0	1104.8
17	0.4511	105.160	101.5	0.4	2362.8	3594.2	5957.0	1.66	4775.6	1181.4
18	0.4525	111.712	108.1	0.5	2514.6	3594.2	6108.9	1.70	4851.5	1257.3
19	0.4539	118.171	114.6	0.5	2664.2	3594.2	6258.5	1.74	4926.3	1332.1
20	0.4553	124.440	120.8	0.5	2809.3	3594.2	6403.5	1.78	4998.9	1404.7
21	0.4567	130.341	126.7	0.5	2945.8	3594.2	6540.0	1.82	5067.1	1472.9
22	0.4581	136.074	132.5	0.6	3078.3	3594.2	6672.5	1.86	5133.4	1539.1
23	0.4595	141.948	138.3	0.6	3214.0	3594.2	6808.2	1.89	5201.2	1607.0
24	0.4609	147.565	143.9	0.6	3343.6	3594.2	6937.9	1.93	5266.1	1671.8
25	0.4623	153.023	149.4	0.6	3469.6	3594.2	7063.8	1.97	5329.0	1734.8
26	0.4637	158.946	155.3	0.7	3606.2	3594.2	7200.4	2.00	5397.3	1803.1
27	0.4651	164.715	161.1	0.7	3739.2	3594.2	7333.4	2.04	5463.8	1869.6
28	0.4665	170.398	166.8	0.7	3870.1	3594.2	7464.4	2.08	5529.3	1935.1
29	0.4679	175.705	172.1	0.7	3992.3	3594.2	7586.5	2.11	5590.4	1996.1
30	0.4693	180.797	177.2	0.8	4109.4	3594.2	7703.6	2.14	5648.9	2054.7
31	0.4707	185.788	182.2	0.8	4224.1	3594.2	7818.3	2.18	5706.3	2112.0
32	0.4721	190.572	187.0	0.8	4333.9	3594.2	7928.1	2.21	5761.2	2167.0
33	0.4735	195.481	191.9	0.8	4446.6	3594.2	8040.8	2.24	5817.5	2223.3
34	0.4749	200.311	196.7	0.9	4557.4	3594.2	8151.6	2.27	5872.9	2278.7
35	0.4764	205.204	201.6	0.9	4669.6	3594.2	8263.8	2.30	5929.0	2334.8
36	0.4778	209.572	206.0	0.9	4769.5	3594.2	8363.7	2.33	5979.0	2384.7
37	0.4792	214.038	210.4	0.9	4871.7	3594.2	8465.9	2.36	6030.1	2435.8
38	0.4806	218.621	215.0	1.0	4976.5	3594.2	8570.8	2.38	6082.5	2488.3
39	0.4820	223.020	219.4	1.0	5077.1	3594.2	8671.3	2.41	6132.8	2538.5
40	0.4835	227.550	223.9	1.0	5180.6	3594.2	8774.8	2.44	6184.5	2590.3
41	0.4894	244.929	241.3	1.1	5576.6	3594.2	9170.9	2.55	6382.6	2788.3
42	0.4947	260.826	257.2	1.2	5938.4	3594.2	9532.6	2.65	6563.4	2969.2
43	0.5009	276.087	272.5	1.3	6283.7	3594.2	9877.9	2.75	6736.1	3141.8
44	0.5061	290.939	287.3	1.4	6619.9	3594.2	10214.2	2.84	6904.2	3310.0
45	0.5123	305.360	301.7	1.5	6944.4	3594.2	10538.6	2.93	7066.4	3472.2
46	0.5176	317.868	314.2	1.6	7225.3	3594.2	10819.5	3.01	7206.9	3612.6

Test Readings for Specimen No. 1

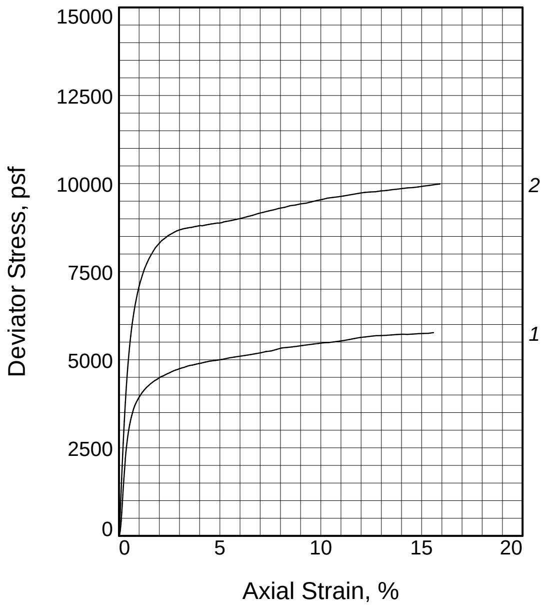
No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Princ. Stress psf	Major Princ. Stress psf	1:3 Ratio	P psf	Q psf
47	0.5236	331.116	327.5	1.7	7521.6	3594.2	11115.9	3.09	7355.1	3760.8
48	0.5289	343.697	340.1	1.8	7803.2	3594.2	11397.4	3.17	7495.8	3901.6
49	0.5350	355.928	352.3	1.9	8074.8	3594.2	11669.1	3.25	7631.7	4037.4
50	0.5403	367.866	364.2	2.0	8340.4	3594.2	11934.7	3.32	7764.5	4170.2
51	0.5464	379.571	376.0	2.1	8598.8	3594.2	12193.1	3.39	7893.7	4299.4
52	0.5517	391.215	387.6	2.2	8856.7	3594.2	12450.9	3.46	8022.6	4428.3
53	0.5579	401.335	397.7	2.3	9077.6	3594.2	12671.9	3.53	8133.1	4538.8
54	0.5631	411.630	408.0	2.4	9303.7	3594.2	12898.0	3.59	8246.1	4651.9
55	0.5693	422.399	418.8	2.5	9538.5	3594.2	13132.7	3.65	8363.5	4769.2
56	0.5745	431.980	428.4	2.6	9747.4	3594.2	13341.6	3.71	8467.9	4873.7
57	0.5807	440.768	437.1	2.7	9936.0	3594.2	13530.3	3.76	8562.3	4968.0
58	0.5860	449.730	446.1	2.8	10129.9	3594.2	13724.1	3.82	8659.2	5064.9
59	0.5921	458.136	454.5	2.9	10309.3	3594.2	13903.5	3.87	8748.9	5154.6
60	0.5973	465.711	462.1	3.0	10470.9	3594.2	14065.2	3.91	8829.7	5235.5
61	0.6035	473.318	469.7	3.1	10631.3	3594.2	14225.5	3.96	8909.9	5315.6
62	0.6087	481.273	477.7	3.2	10800.9	3594.2	14395.1	4.01	8994.7	5400.4
63	0.6149	488.802	485.2	3.3	10958.6	3594.2	14552.8	4.05	9073.5	5479.3
64	0.6202	495.170	491.5	3.4	11091.5	3594.2	14685.8	4.09	9140.0	5545.8
65	0.6263	501.951	498.3	3.6	11231.9	3594.2	14826.1	4.12	9210.2	5615.9
66	0.6316	508.283	504.7	3.6	11363.6	3594.2	14957.8	4.16	9276.0	5681.8
67	0.6377	515.040	511.4	3.8	11502.6	3594.2	15096.8	4.20	9345.5	5751.3
68	0.6431	520.730	517.1	3.9	11619.0	3594.2	15213.3	4.23	9403.8	5809.5
69	0.6492	526.418	522.8	4.0	11733.5	3594.2	15327.7	4.26	9461.0	5866.7
70	0.6545	532.042	528.4	4.1	11848.1	3594.2	15442.4	4.30	9518.3	5924.1
71	0.6606	536.963	533.3	4.2	11944.8	3594.2	15539.0	4.32	9566.6	5972.4
72	0.6659	541.715	538.1	4.3	12039.4	3594.2	15633.7	4.35	9613.9	6019.7
73	0.6720	546.850	543.2	4.4	12140.4	3594.2	15734.7	4.38	9664.5	6070.2
74	0.6772	552.377	548.8	4.5	12251.9	3594.2	15846.2	4.41	9720.2	6126.0
75	0.6828	557.598	554.0	4.6	12355.8	3594.2	15950.0	4.44	9772.1	6177.9
76	0.6890	562.122	558.5	4.7	12442.1	3594.2	16036.4	4.46	9815.3	6221.1
77	0.6943	566.279	562.7	4.8	12522.3	3594.2	16116.5	4.48	9855.4	6261.1
78	0.7004	570.143	566.5	4.9	12593.9	3594.2	16188.2	4.50	9891.2	6297.0
79	0.7057	573.730	570.1	5.0	12661.0	3594.2	16255.2	4.52	9924.7	6330.5
80	0.7118	577.032	573.4	5.1	12719.7	3594.2	16314.0	4.54	9954.1	6359.9
81	0.7256	584.989	581.4	5.3	12862.7	3594.2	16457.0	4.58	10025.6	6431.4
82	0.7396	592.425	588.8	5.6	12993.0	3594.2	16587.2	4.61	10090.7	6496.5
83	0.7536	598.986	595.4	5.8	13103.1	3594.2	16697.3	4.65	10145.8	6551.5
84	0.7676	605.631	602.0	6.1	13214.2	3594.2	16808.4	4.68	10201.3	6607.1
85	0.7817	611.662	608.0	6.3	13310.8	3594.2	16905.0	4.70	10249.6	6655.4
86	0.7956	617.382	613.8	6.6	13400.2	3594.2	16994.5	4.73	10294.4	6700.1
87	0.8096	622.440	618.8	6.8	13474.6	3594.2	17068.9	4.75	10331.6	6737.3
88	0.8236	625.848	622.2	7.1	13512.6	3594.2	17106.8	4.76	10350.5	6756.3
89	0.8376	629.480	625.9	7.3	13554.8	3594.2	17149.0	4.77	10371.6	6777.4
90	0.8523	632.180	628.6	7.6	13574.9	3594.2	17169.1	4.78	10381.7	6787.4
91	0.8661	636.294	632.7	7.8	13627.3	3594.2	17221.5	4.79	10407.9	6813.6
92	0.8799	641.395	637.8	8.1	13700.3	3594.2	17294.6	4.81	10444.4	6850.2
93	0.8940	644.874	641.3	8.3	13737.6	3594.2	17331.8	4.82	10463.0	6868.8

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Princ. Stress psf	Major Princ. Stress psf	1:3 Ratio	P psf	Q psf
94	0.9080	647.539	643.9	8.6	13757.1	3594.2	17351.3	4.83	10472.8	6878.5
95	0.9220	651.786	648.2	8.8	13809.9	3594.2	17404.1	4.84	10499.2	6904.9
96	0.9360	654.390	650.8	9.1	13827.2	3594.2	17421.5	4.85	10507.8	6913.6
97	0.9500	657.538	653.9	9.3	13856.0	3594.2	17450.3	4.86	10522.3	6928.0
98	0.9641	659.780	656.2	9.6	13865.1	3594.2	17459.3	4.86	10526.8	6932.5
99	0.9782	662.374	658.8	9.8	13881.1	3594.2	17475.4	4.86	10534.8	6940.6
100	0.9922	664.734	661.1	10.1	13892.3	3594.2	17486.5	4.87	10540.4	6946.1
101	1.0061	666.251	662.6	10.3	13885.6	3594.2	17479.8	4.86	10537.0	6942.8
102	1.0201	666.765	663.1	10.6	13857.7	3594.2	17451.9	4.86	10523.1	6928.9
103	1.0341	667.198	663.6	10.8	13827.9	3594.2	17422.1	4.85	10508.2	6913.9
104	1.0482	666.338	662.7	11.1	13771.1	3594.2	17365.4	4.83	10479.8	6885.6
105	1.0622	669.472	665.9	11.3	13797.4	3594.2	17391.7	4.84	10492.9	6898.7
106	1.0762	671.986	668.4	11.6	13810.5	3594.2	17404.7	4.84	10499.5	6905.2
107	1.0902	672.034	668.4	11.8	13772.4	3594.2	17366.6	4.83	10480.4	6886.2
108	1.1042	672.877	669.3	12.1	13750.6	3594.2	17344.9	4.83	10469.5	6875.3
109	1.1183	674.096	670.5	12.3	13736.3	3594.2	17330.5	4.82	10462.4	6868.2
110	1.1323	675.005	671.4	12.6	13715.6	3594.2	17309.9	4.82	10452.1	6857.8
111	1.1462	675.285	671.7	12.8	13682.6	3594.2	17276.9	4.81	10435.6	6841.3
112	1.1604	675.432	671.8	13.1	13645.9	3594.2	17240.1	4.80	10417.2	6822.9
113	1.1742	676.545	672.9	13.3	13629.6	3594.2	17223.9	4.79	10409.1	6814.8
114	1.1883	676.841	673.2	13.6	13595.9	3594.2	17190.2	4.78	10392.2	6798.0
115	1.2023	677.310	673.7	13.8	13566.3	3594.2	17160.5	4.77	10377.4	6783.1
116	1.2163	676.803	673.2	14.1	13516.6	3594.2	17110.9	4.76	10352.6	6758.3
117	1.2303	675.622	672.0	14.3	13453.7	3594.2	17048.0	4.74	10321.1	6726.9
118	1.2444	675.239	671.6	14.6	13406.5	3594.2	17000.8	4.73	10297.5	6703.3
119	1.2583	678.120	674.5	14.8	13424.9	3594.2	17019.2	4.74	10306.7	6712.5
120	1.2684	676.681	673.1	15.0	13367.9	3594.2	16962.2	4.72	10278.2	6684.0



	Total	Effective
C, psf	388.0	183.3
ϕ, deg	20.50	39.54
Tan(ϕ)	0.37	0.83



	Sample No.	1	2
Initial	Water Content, %	49.4	49.3
	Dry Density, pcf	69.2	69.4
	Saturation, %	83.7	84.0
	Void Ratio	1.8886	1.8784
	Diameter, in.	2.804	2.803
	Height, in.	5.604	5.605
At Test	Water Content, %	48.9	44.4
	Dry Density, pcf	77.8	82.6
	Saturation, %	100.0	100.0
	Void Ratio	1.5661	1.4198
	Diameter, in.	2.695	2.644
	Height, in.	5.390	5.296
	Strain rate, %/min.	0.02	0.02
	Eff. Cell Pressure, psi	25.000	50.000
	Fail. Stress, psf	5000.0	8881.4
	Total Pore Pr., psf	8880.5	11358.1
	Strain, %	5.0	5.0
	Ult. Stress, psf		
	Total Pore Pr., psf		
	Strain, %		
	$\bar{\sigma}_1$ Failure, psf	6205.3	11194.7
	$\bar{\sigma}_3$ Failure, psf	1205.3	2313.3

Type of Test:
CU with Pore Pressures

Sample Type: Remolded

Description: Filter Cake with Salt at OMC - CU Test

LL= 51 **PL=** 11 **PI=** 40

Assumed Specific Gravity= 3.2

Remarks: Failure chosen at 5% strain

Figure _______

Client: Lithium Nevada

Project: Thacker Pass

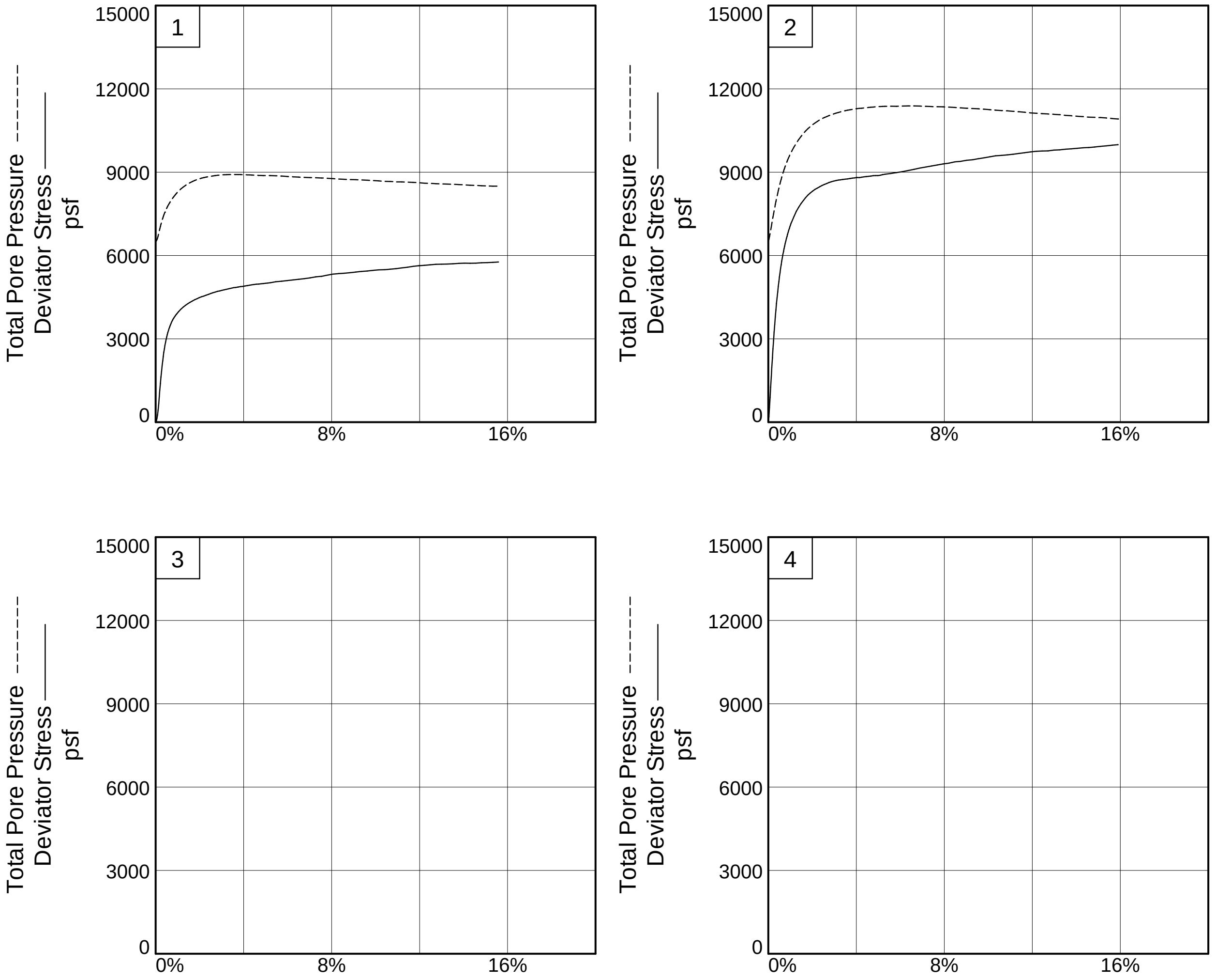
Source of Sample: Reconstituted Tailings

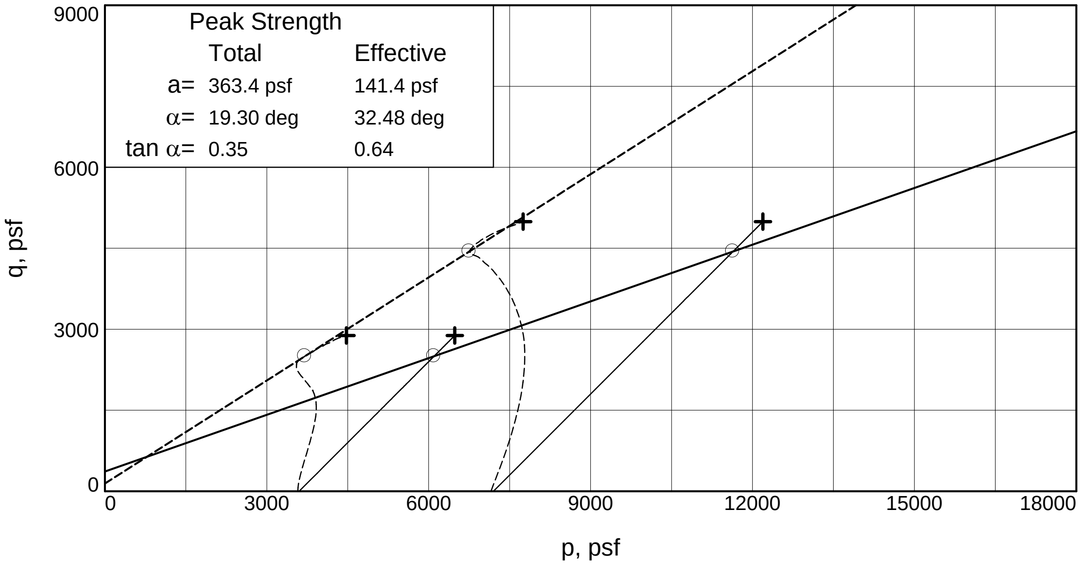
Sample Number: 19-421-07,-08

Proj. No.: 475.0385.000 **Date Sampled:** 12/9/19

NewFields

Tested By: K.Magner





Peak Strength

	Total	Effective
a=	363.4 psf	141.4 psf
α=	19.30 deg	32.48 deg
tan α=	0.35	0.64

Stress Paths: Total ——— Effective - - - - - -

Client: Lithium Nevada

Project: Thacker Pass

Source of Sample: Reconstituted Tailings **Sample Number:** 19-421-07,-08

Project No.: 475.0385.000 **Figure** ________

Newfields Mining Design and Technical Services

Tested By: K.Magner

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

12/17/2019
4:43 PM

Date: 12/9/19
Client: Lithium Nevada
Project: Thacker Pass
Project No.: 475.0385.000
Location: Reconstituted Tailings
Sample Number: 19-421-07,-08
Description: Filter Cake with Salt at OMC - CU Test
Remarks: Failure chosen at 5% strain
Type of Sample: Remolded
Assumed Specific Gravity=3.2 **LL=**51 **PL=**11 **PI=**40
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	567.550			1191.360
Moisture content: Dry soil+tare, gms.	468.830			885.770
Moisture content: Tare, gms.	269.020			267.500
Moisture, %	49.4	59.0	48.9	49.4
Moist specimen weight, gms.	938.60			
Diameter, in.	2.804	2.804	2.695	
Area, in.²	6.175	6.175	5.704	
Height, in.	5.604	5.604	5.390	
Net decrease in height, in.		0.000	0.214	
Wet density, pcf	103.3	110.0	115.9	
Dry density, pcf	69.2	69.2	77.8	
Void ratio	1.8886	1.8886	1.5661	
Saturation, %	83.7	100.0	100.0	

Test Readings for Specimen No. 1

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Consolidation cell pressure = 70.040 psi (10085.8 psf)
Consolidation back pressure = 45.040 psi (6485.8 psf)
Consolidation effective confining stress = 3600.0 psf
Strain rate, %/min. = 0.02
Fail. Stress = 5000.0 psf **at reading no.** 78

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Eff. Stress psf	Major Eff. Stress psf	1:3 Ratio	Pore Press. psi	P psf	Q psf
0	-0.5528	3.292	0.0	0.0	0.0	3575.9	3575.9	1.00	45.207	3575.9	0.0
1	-0.5509	5.215	1.9	0.0	48.5	3552.7	3601.2	1.01	45.369	3576.9	24.3
2	-0.5495	8.643	5.4	0.1	135.0	3511.0	3646.1	1.04	45.658	3578.5	67.5
3	-0.5481	13.831	10.5	0.1	265.9	3454.1	3720.0	1.08	46.053	3587.1	132.9
4	-0.5467	20.458	17.2	0.1	432.9	3386.5	3819.4	1.13	46.523	3602.9	216.5
5	-0.5453	29.725	26.4	0.1	666.4	3298.3	3964.7	1.20	47.135	3631.5	333.2
6	-0.5439	39.442	36.1	0.2	911.2	3208.9	4120.1	1.28	47.756	3664.5	455.6
7	-0.5425	49.300	46.0	0.2	1159.4	3121.7	4281.1	1.37	48.362	3701.4	579.7
8	-0.5411	58.931	55.6	0.2	1401.7	3037.6	4439.3	1.46	48.945	3738.5	700.9
9	-0.5397	67.863	64.6	0.2	1626.3	2958.1	4584.4	1.55	49.498	3771.2	813.2
10	-0.5383	76.044	72.8	0.3	1831.9	2884.5	4716.4	1.64	50.009	3800.4	915.9
11	-0.5369	83.858	80.6	0.3	2028.1	2813.3	4841.4	1.72	50.504	3827.3	1014.1
12	-0.5355	90.994	87.7	0.3	2207.2	2745.8	4952.9	1.80	50.972	3849.4	1103.6
13	-0.5341	97.489	94.2	0.3	2370.0	2684.2	5054.2	1.88	51.400	3869.2	1185.0
14	-0.5327	103.309	100.0	0.4	2515.8	2628.0	5143.8	1.96	51.790	3885.9	1257.9
15	-0.5313	108.359	105.1	0.4	2642.1	2574.9	5217.0	2.03	52.159	3896.0	1321.1
16	-0.5299	113.370	110.1	0.4	2767.4	2523.2	5290.7	2.10	52.517	3907.0	1383.7
17	-0.5285	117.848	114.6	0.5	2879.2	2473.0	5352.2	2.16	52.866	3912.6	1439.6
18	-0.5271	121.860	118.6	0.5	2979.3	2426.7	5406.0	2.23	53.188	3916.4	1489.6
19	-0.5257	125.465	122.2	0.5	3069.1	2383.3	5452.4	2.29	53.489	3917.9	1534.5
20	-0.5243	128.763	125.5	0.5	3151.1	2342.1	5493.2	2.35	53.775	3917.6	1575.6
21	-0.5229	131.706	128.4	0.6	3224.2	2303.2	5527.3	2.40	54.046	3915.2	1612.1
22	-0.5215	134.582	131.3	0.6	3295.5	2264.5	5560.0	2.46	54.314	3912.3	1647.8
23	-0.5201	137.234	133.9	0.6	3361.2	2227.7	5588.9	2.51	54.570	3908.3	1680.6
24	-0.5187	139.549	136.3	0.6	3418.4	2193.6	5612.0	2.56	54.807	3902.8	1709.2
25	-0.5173	141.701	138.4	0.7	3471.5	2160.0	5631.5	2.61	55.040	3895.8	1735.7
26	-0.5159	143.912	140.6	0.7	3526.0	2127.0	5653.0	2.66	55.269	3890.0	1763.0
27	-0.5145	145.887	142.6	0.7	3574.6	2095.8	5670.4	2.71	55.486	3883.1	1787.3
28	-0.5131	147.705	144.4	0.7	3619.2	2065.6	5684.8	2.75	55.696	3875.2	1809.6
29	-0.5117	149.411	146.1	0.8	3661.0	2035.8	5696.9	2.80	55.902	3866.4	1830.5
30	-0.5103	151.054	147.8	0.8	3701.2	2006.9	5708.1	2.84	56.103	3857.5	1850.6
31	-0.5089	152.553	149.3	0.8	3737.8	1978.9	5716.7	2.89	56.298	3847.8	1868.9
32	-0.5075	153.762	150.5	0.8	3767.1	1952.5	5719.6	2.93	56.481	3836.1	1883.5
33	-0.5061	155.093	151.8	0.9	3799.4	1926.5	5725.9	2.97	56.662	3826.2	1899.7
34	-0.5047	156.275	153.0	0.9	3828.0	1900.9	5728.9	3.01	56.839	3814.9	1914.0
35	-0.5033	157.516	154.2	0.9	3858.0	1876.1	5734.1	3.06	57.012	3805.1	1929.0
36	-0.5019	158.554	155.3	0.9	3883.0	1852.3	5735.3	3.10	57.177	3793.8	1941.5
37	-0.5005	159.661	156.4	1.0	3909.6	1828.7	5738.3	3.14	57.341	3783.5	1954.8
38	-0.4991	160.790	157.5	1.0	3936.8	1806.4	5743.3	3.18	57.495	3774.9	1968.4
39	-0.4977	161.780	158.5	1.0	3960.6	1784.2	5744.7	3.22	57.650	3764.5	1980.3
40	-0.4963	162.799	159.5	1.0	3985.0	1763.0	5748.0	3.26	57.797	3755.5	1992.5
41	-0.4907	166.369	163.1	1.2	4069.9	1685.8	5755.7	3.41	58.333	3720.7	2034.9
42	-0.4851	169.577	166.3	1.3	4145.6	1620.0	5765.6	3.56	58.790	3692.8	2072.8
43	-0.4795	172.415	169.1	1.4	4211.9	1558.4	5770.3	3.70	59.218	3664.4	2105.9
44	-0.4739	174.838	171.5	1.5	4267.7	1505.4	5773.1	3.84	59.586	3639.2	2133.9
45	-0.4683	177.065	173.8	1.6	4318.6	1460.0	5778.6	3.96	59.901	3619.3	2159.3
46	-0.4627	179.081	175.8	1.7	4364.1	1419.6	5783.6	4.07	60.182	3601.6	2182.0

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Eff. Stress psf	Major Eff. Stress psf	1:3 Ratio	Pore Press. psi	P psf	Q psf
47	-0.4571	181.065	177.8	1.8	4408.7	1385.3	5793.9	4.18	60.420	3589.6	2204.3
48	-0.4515	182.608	179.3	1.9	4442.2	1353.5	5795.7	4.28	60.641	3574.6	2221.1
49	-0.4459	184.438	181.1	2.0	4482.8	1325.9	5808.7	4.38	60.832	3567.3	2241.4
50	-0.4402	186.060	182.8	2.1	4518.1	1301.8	5819.9	4.47	61.000	3560.8	2259.1
51	-0.4347	187.235	183.9	2.2	4542.3	1282.3	5824.7	4.54	61.135	3553.5	2271.2
52	-0.4290	188.681	185.4	2.3	4573.2	1263.0	5836.2	4.62	61.269	3549.6	2286.6
53	-0.4234	190.054	186.8	2.4	4602.2	1246.9	5849.1	4.69	61.381	3548.0	2301.1
54	-0.4178	191.451	188.2	2.5	4631.7	1232.6	5864.3	4.76	61.480	3548.4	2315.8
55	-0.4122	192.796	189.5	2.6	4659.8	1219.9	5879.7	4.82	61.568	3549.8	2329.9
56	-0.4066	194.084	190.8	2.7	4686.5	1208.5	5894.9	4.88	61.648	3551.7	2343.2
57	-0.4010	195.282	192.0	2.8	4710.9	1197.3	5908.2	4.93	61.725	3552.8	2355.4
58	-0.3954	196.142	192.9	2.9	4726.9	1188.0	5914.9	4.98	61.790	3551.4	2363.4
59	-0.3898	197.288	194.0	3.0	4749.9	1182.1	5932.0	5.02	61.831	3557.0	2374.9
60	-0.3842	198.267	195.0	3.1	4768.8	1177.3	5946.0	5.05	61.864	3561.7	2384.4
61	-0.3786	199.179	195.9	3.2	4785.9	1173.3	5959.2	5.08	61.892	3566.2	2393.0
62	-0.3730	200.230	196.9	3.3	4806.4	1170.0	5976.4	5.11	61.915	3573.2	2403.2
63	-0.3674	201.219	197.9	3.4	4825.4	1168.2	5993.5	5.13	61.928	3580.9	2412.7
64	-0.3618	202.191	198.9	3.5	4843.8	1167.2	6011.1	5.15	61.934	3589.2	2421.9
65	-0.3562	202.691	199.4	3.6	4850.8	1167.3	6018.0	5.16	61.934	3592.6	2425.4
66	-0.3506	203.525	200.2	3.8	4865.8	1167.4	6033.2	5.17	61.933	3600.3	2432.9
67	-0.3450	204.252	201.0	3.9	4878.2	1170.4	6048.6	5.17	61.912	3609.5	2439.1
68	-0.3394	204.933	201.6	4.0	4889.5	1174.2	6063.7	5.16	61.886	3619.0	2444.7
69	-0.3338	205.689	202.4	4.1	4902.5	1178.3	6080.8	5.16	61.857	3629.5	2451.2
70	-0.3282	206.543	203.3	4.2	4917.8	1182.0	6099.8	5.16	61.832	3640.9	2458.9
71	-0.3226	207.319	204.0	4.3	4931.3	1185.1	6116.4	5.16	61.810	3650.7	2465.6
72	-0.3170	208.126	204.8	4.4	4945.4	1189.2	6134.6	5.16	61.782	3661.9	2472.7
73	-0.3114	208.942	205.7	4.5	4959.7	1193.4	6153.1	5.16	61.752	3673.3	2479.9
74	-0.3058	209.499	206.2	4.6	4967.7	1196.7	6164.4	5.15	61.730	3680.5	2483.9
75	-0.3002	210.007	206.7	4.7	4974.5	1199.8	6174.4	5.15	61.708	3687.1	2487.3
76	-0.2946	210.600	207.3	4.8	4983.4	1202.6	6185.9	5.14	61.689	3694.2	2491.7
77	-0.2890	211.147	207.9	4.9	4991.1	1204.4	6195.5	5.14	61.676	3700.0	2495.5
78	-0.2834	211.747	208.5	5.0	5000.0	1205.3	6205.3	5.15	61.670	3705.3	2500.0
79	-0.2778	212.376	209.1	5.1	5009.6	1206.2	6215.8	5.15	61.664	3711.0	2504.8
80	-0.2722	213.106	209.8	5.2	5021.6	1208.1	6229.7	5.16	61.650	3718.9	2510.8
81	-0.2582	215.081	211.8	5.5	5055.0	1214.2	6269.2	5.16	61.608	3741.7	2527.5
82	-0.2442	216.555	213.3	5.7	5076.2	1224.1	6300.3	5.15	61.539	3762.2	2538.1
83	-0.2302	218.142	214.9	6.0	5099.9	1238.6	6338.4	5.12	61.439	3788.5	2549.9
84	-0.2162	219.626	216.3	6.2	5120.9	1251.7	6372.6	5.09	61.348	3812.1	2560.4
85	-0.2022	221.239	217.9	6.5	5144.8	1263.0	6407.7	5.07	61.269	3835.3	2572.4
86	-0.1882	222.917	219.6	6.8	5170.0	1273.1	6443.1	5.06	61.199	3858.1	2585.0
87	-0.1742	224.666	221.4	7.0	5196.6	1279.1	6475.7	5.06	61.157	3877.4	2598.3
88	-0.1602	226.814	223.5	7.3	5232.4	1285.1	6517.5	5.07	61.116	3901.3	2616.2
89	-0.1462	228.211	224.9	7.5	5250.3	1293.0	6543.3	5.06	61.061	3918.2	2625.2
90	-0.1322	230.679	227.4	7.8	5293.0	1303.9	6596.9	5.06	60.985	3950.4	2646.5
91	-0.1182	233.033	229.7	8.1	5332.8	1318.6	6651.4	5.04	60.883	3985.0	2666.4
92	-0.1042	234.462	231.2	8.3	5350.8	1332.2	6683.0	5.02	60.789	4007.6	2675.4
93	-0.0902	235.762	232.5	8.6	5365.6	1342.6	6708.3	5.00	60.716	4025.5	2682.8

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Eff. Stress psf	Major Eff. Stress psf	1:3 Ratio	Pore Press. psi	P psf	Q psf
94	-0.0762	237.225	233.9	8.8	5384.0	1352.9	6736.9	4.98	60.645	4044.9	2692.0
95	-0.0622	238.840	235.5	9.1	5405.8	1357.4	6763.2	4.98	60.614	4060.3	2702.9
96	-0.0482	240.447	237.2	9.4	5427.1	1364.0	6791.1	4.98	60.567	4077.6	2713.5
97	-0.0342	241.866	238.6	9.6	5443.9	1372.3	6816.2	4.97	60.510	4094.3	2722.0
98	-0.0202	243.437	240.1	9.9	5464.0	1387.1	6851.1	4.94	60.407	4119.1	2732.0
99	-0.0062	244.956	241.7	10.1	5482.7	1398.8	6881.5	4.92	60.326	4140.2	2741.4
100	0.0078	245.988	242.7	10.4	5490.2	1412.7	6903.0	4.89	60.229	4157.9	2745.1
101	0.0218	247.569	244.3	10.7	5509.9	1421.5	6931.4	4.88	60.169	4176.5	2755.0
102	0.0358	248.979	245.7	10.9	5525.6	1432.3	6957.9	4.86	60.094	4195.1	2762.8
103	0.0498	250.870	247.6	11.2	5551.9	1435.6	6987.5	4.87	60.070	4211.6	2776.0
104	0.0638	252.778	249.5	11.4	5578.4	1441.7	7020.0	4.87	60.028	4230.9	2789.2
105	0.0778	254.884	251.6	11.7	5608.9	1452.5	7061.4	4.86	59.953	4257.0	2804.5
106	0.0918	256.738	253.4	12.0	5633.7	1466.3	7100.0	4.84	59.857	4283.1	2816.8
107	0.1058	258.149	254.9	12.2	5648.3	1479.0	7127.3	4.82	59.769	4303.2	2824.1
108	0.1198	259.768	256.5	12.5	5667.4	1489.4	7156.8	4.81	59.697	4323.1	2833.7
109	0.1339	261.283	258.0	12.7	5683.9	1499.5	7183.4	4.79	59.627	4341.4	2841.9
110	0.1479	262.254	259.0	13.0	5688.3	1507.7	7196.0	4.77	59.570	4351.8	2844.2
111	0.1619	263.224	259.9	13.3	5692.6	1512.2	7204.7	4.76	59.539	4358.4	2846.3
112	0.1759	264.589	261.3	13.5	5705.3	1519.0	7224.3	4.76	59.491	4371.7	2852.7
113	0.1899	265.905	262.6	13.8	5716.8	1531.0	7247.8	4.73	59.408	4389.4	2858.4
114	0.2039	267.045	263.8	14.0	5724.3	1542.6	7266.9	4.71	59.328	4404.8	2862.2
115	0.2179	267.617	264.3	14.3	5719.4	1553.6	7273.0	4.68	59.251	4413.3	2859.7
116	0.2319	268.767	265.5	14.6	5726.9	1561.4	7288.3	4.67	59.197	4424.9	2863.4
117	0.2459	270.139	266.8	14.8	5739.0	1572.1	7311.1	4.65	59.122	4441.6	2869.5
118	0.2599	271.292	268.0	15.1	5746.2	1578.8	7325.0	4.64	59.076	4451.9	2873.1
119	0.2739	272.382	269.1	15.3	5751.9	1585.9	7337.8	4.63	59.027	4461.8	2876.0
120	0.2872	273.944	270.7	15.6	5768.4	1591.7	7360.1	4.62	58.986	4475.9	2884.2

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	567.350			1006.680
Moisture content: Dry soil+tare, gms.	468.830			715.130
Moisture content: Tare, gms.	269.020			100.880
Moisture, %	49.3	58.7	44.4	47.5
Moist specimen weight, gms.	940.80			
Diameter, in.	2.803	2.803	2.644	
Area, in.²	6.171	6.171	5.490	
Height, in.	5.605	5.605	5.296	
Net decrease in height, in.		0.000	0.309	
Wet density, pcf	103.6	110.1	119.2	
Dry density, pcf	69.4	69.4	82.6	
Void ratio	1.8784	1.8784	1.4198	
Saturation, %	84.0	100.0	100.0	

Test Readings for Specimen No. 2

Membrane modulus = 0.124105 kN/cm²

Membrane thickness = 0.02 cm

Consolidation cell pressure = 94.940 psi (13671.4 psf)

Consolidation back pressure = 44.940 psi (6471.4 psf)

Consolidation effective confining stress = 7200.0 psf

Strain rate, %/min. = 0.02

Fail. Stress = 8881.4 psf **at reading no.** 77

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Eff. Stress psf	Major Eff. Stress psf	1:3 Ratio	Pore Press. psi	P psf	Q psf
0	-0.5834	3.238	0.0	0.0	0.0	7155.8	7155.8	1.00	45.247	7155.8	0.0
1	-0.5820	10.489	7.3	0.0	190.1	7093.9	7284.1	1.03	45.676	7189.0	95.1
2	-0.5806	23.099	19.9	0.1	520.6	6993.0	7513.6	1.07	46.377	7253.3	260.3
3	-0.5792	37.221	34.0	0.1	890.6	6878.6	7769.2	1.13	47.172	7323.9	445.3
4	-0.5778	51.312	48.1	0.1	1259.5	6762.0	8021.5	1.19	47.982	7391.7	629.8
5	-0.5764	65.276	62.0	0.1	1625.0	6642.9	8267.8	1.24	48.809	7455.4	812.5
6	-0.5750	78.668	75.4	0.2	1975.2	6524.8	8500.1	1.30	49.629	7512.5	987.6
7	-0.5736	91.774	88.5	0.2	2317.8	6404.0	8721.8	1.36	50.468	7562.9	1158.9
8	-0.5722	104.178	100.9	0.2	2641.8	6286.1	8927.9	1.42	51.287	7607.0	1320.9
9	-0.5707	116.004	112.8	0.2	2950.6	6170.4	9121.0	1.48	52.090	7645.7	1475.3
10	-0.5693	127.385	124.1	0.3	3247.5	6056.1	9303.6	1.54	52.884	7679.8	1623.7
11	-0.5679	138.079	134.8	0.3	3526.3	5944.3	9470.5	1.59	53.660	7707.4	1763.1
12	-0.5665	148.154	144.9	0.3	3788.8	5835.2	9623.9	1.65	54.418	7729.6	1894.4
13	-0.5651	157.827	154.6	0.3	4040.6	5727.0	9767.6	1.71	55.169	7747.3	2020.3
14	-0.5637	166.749	163.5	0.4	4272.6	5624.4	9897.0	1.76	55.882	7760.7	2136.3
15	-0.5623	174.947	171.7	0.4	4485.6	5527.4	10013.0	1.81	56.555	7770.2	2242.8
16	-0.5609	182.802	179.6	0.4	4689.6	5431.1	10120.7	1.86	57.224	7775.9	2344.8
17	-0.5595	190.250	187.0	0.5	4882.8	5339.1	10221.9	1.91	57.863	7780.5	2441.4
18	-0.5581	197.088	193.9	0.5	5060.0	5250.8	10310.8	1.96	58.476	7780.8	2530.0
19	-0.5567	203.576	200.3	0.5	5228.0	5164.9	10392.9	2.01	59.073	7778.9	2614.0
20	-0.5553	209.773	206.5	0.5	5388.2	5081.3	10469.6	2.06	59.653	7775.4	2694.1
21	-0.5539	215.497	212.3	0.6	5536.1	5002.0	10538.1	2.11	60.204	7770.0	2768.1
22	-0.5525	220.778	217.5	0.6	5672.3	4924.9	10597.2	2.15	60.739	7761.1	2836.2
23	-0.5511	225.868	222.6	0.6	5803.5	4850.6	10654.1	2.20	61.256	7752.3	2901.8
24	-0.5497	230.548	227.3	0.6	5923.9	4779.7	10703.6	2.24	61.748	7741.6	2962.0

Test Readings for Specimen No. 2

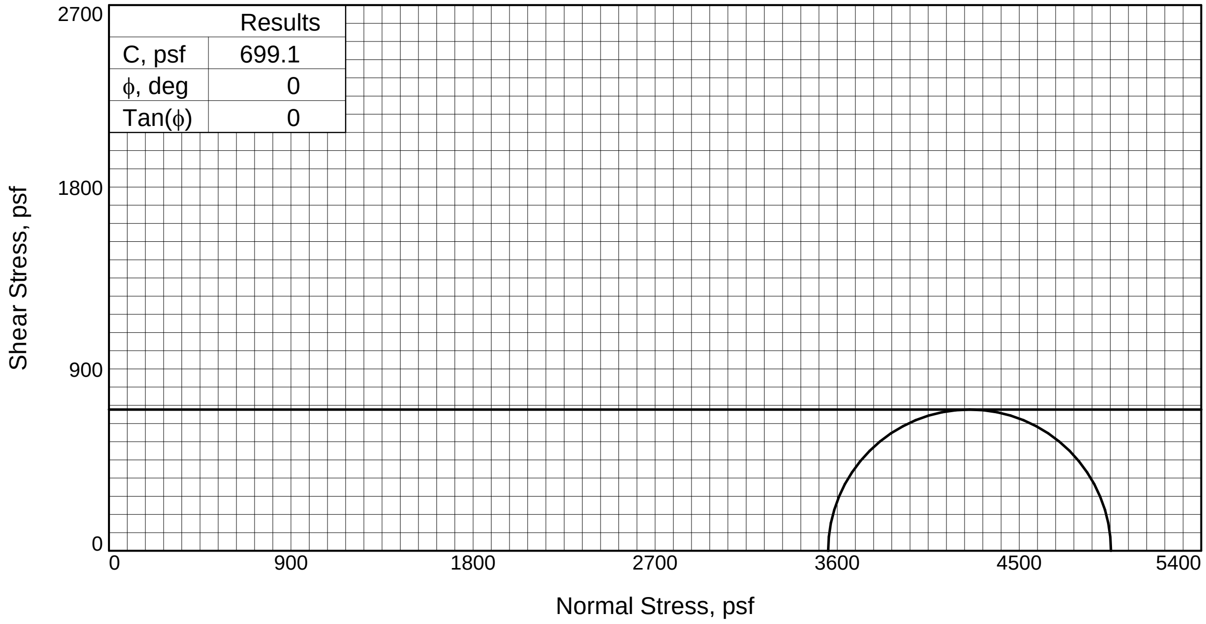
No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Eff. Stress psf	Major Eff. Stress psf	1:3 Ratio	Pore Press. psi	P psf	Q psf
25	-0.5483	235.062	231.8	0.7	6040.0	4710.4	10750.4	2.28	62.229	7730.4	3020.0
26	-0.5469	239.179	235.9	0.7	6145.6	4645.1	10790.7	2.32	62.683	7717.9	3072.8
27	-0.5455	243.096	239.9	0.7	6246.0	4580.4	10826.3	2.36	63.132	7703.3	3123.0
28	-0.5441	247.012	243.8	0.7	6346.2	4518.0	10864.2	2.40	63.565	7691.1	3173.1
29	-0.5427	250.579	247.3	0.8	6437.4	4459.1	10896.4	2.44	63.974	7677.8	3218.7
30	-0.5413	254.109	250.9	0.8	6527.5	4400.5	10928.0	2.48	64.381	7664.2	3263.7
31	-0.5399	257.311	254.1	0.8	6609.0	4344.9	10953.9	2.52	64.767	7649.4	3304.5
32	-0.5385	260.277	257.0	0.8	6684.4	4291.7	10976.1	2.56	65.136	7633.9	3342.2
33	-0.5371	263.366	260.1	0.9	6762.9	4239.3	11002.2	2.60	65.501	7620.7	3381.5
34	-0.5357	266.397	263.2	0.9	6839.9	4188.0	11027.9	2.63	65.857	7607.9	3419.9
35	-0.5342	269.105	265.9	0.9	6908.4	4139.1	11047.5	2.67	66.196	7593.3	3454.2
36	-0.5328	271.623	268.4	1.0	6972.0	4092.3	11064.3	2.70	66.521	7578.3	3486.0
37	-0.5314	274.242	271.0	1.0	7038.1	4046.6	11084.7	2.74	66.839	7565.6	3519.1
38	-0.5300	276.632	273.4	1.0	7098.3	4002.1	11100.4	2.77	67.147	7551.3	3549.2
39	-0.5286	278.987	275.7	1.0	7157.6	3959.7	11117.3	2.81	67.442	7538.5	3578.8
40	-0.5272	281.095	277.9	1.1	7210.3	3919.5	11129.8	2.84	67.721	7524.6	3605.2
41	-0.5216	288.931	285.7	1.2	7405.7	3764.3	11170.0	2.97	68.799	7467.2	3702.9
42	-0.5160	296.336	293.1	1.3	7589.5	3623.1	11212.7	3.09	69.779	7417.9	3794.8
43	-0.5104	302.230	299.0	1.4	7733.8	3499.2	11233.0	3.21	70.640	7366.1	3866.9
44	-0.5048	307.720	304.5	1.5	7867.4	3385.5	11252.9	3.32	71.430	7319.2	3933.7
45	-0.4992	312.351	309.1	1.6	7978.5	3281.2	11259.6	3.43	72.154	7270.4	3989.2
46	-0.4936	316.702	313.5	1.7	8082.1	3187.3	11269.4	3.54	72.806	7228.4	4041.0
47	-0.4880	320.739	317.5	1.8	8177.3	3103.1	11280.4	3.64	73.391	7191.7	4088.7
48	-0.4823	323.893	320.7	1.9	8249.6	3029.2	11278.8	3.72	73.904	7154.0	4124.8
49	-0.4767	326.977	323.7	2.0	8320.0	2959.3	11279.3	3.81	74.389	7119.3	4160.0
50	-0.4711	329.754	326.5	2.1	8382.3	2897.6	11279.9	3.89	74.818	7088.7	4191.1
51	-0.4655	331.893	328.7	2.2	8428.1	2841.4	11269.5	3.97	75.208	7055.4	4214.0
52	-0.4599	334.004	330.8	2.3	8473.0	2791.1	11264.1	4.04	75.557	7027.6	4236.5
53	-0.4543	336.280	333.0	2.4	8522.0	2744.6	11266.7	4.10	75.880	7005.7	4261.0
54	-0.4487	338.085	334.8	2.5	8558.9	2703.9	11262.8	4.17	76.163	6983.4	4279.5
55	-0.4431	339.677	336.4	2.6	8590.3	2671.3	11261.5	4.22	76.390	6966.4	4295.1
56	-0.4375	341.506	338.3	2.8	8627.6	2636.3	11263.9	4.27	76.632	6950.1	4313.8
57	-0.4318	342.955	339.7	2.9	8655.1	2605.5	11260.6	4.32	76.846	6933.0	4327.5
58	-0.4262	344.281	341.0	3.0	8679.4	2575.7	11255.1	4.37	77.053	6915.4	4339.7
59	-0.4206	345.383	342.1	3.1	8697.9	2546.6	11244.5	4.42	77.255	6895.6	4349.0
60	-0.4150	346.461	343.2	3.2	8715.8	2521.0	11236.8	4.46	77.433	6878.9	4357.9
61	-0.4094	347.285	344.0	3.3	8727.2	2497.5	11224.7	4.49	77.596	6861.1	4363.6
62	-0.4038	348.074	344.8	3.4	8737.6	2477.0	11214.6	4.53	77.739	6845.8	4368.8
63	-0.3982	348.985	345.7	3.5	8751.1	2456.4	11207.5	4.56	77.882	6831.9	4375.5
64	-0.3926	349.719	346.5	3.6	8760.0	2438.1	11198.2	4.59	78.009	6818.1	4380.0
65	-0.3870	350.631	347.4	3.7	8773.4	2422.9	11196.3	4.62	78.115	6809.6	4386.7
66	-0.3813	351.456	348.2	3.8	8784.6	2408.2	11192.8	4.65	78.216	6800.5	4392.3
67	-0.3757	352.286	349.0	3.9	8795.8	2394.8	11190.6	4.67	78.310	6792.7	4397.9
68	-0.3701	353.178	349.9	4.0	8808.6	2383.0	11191.5	4.70	78.392	6787.3	4404.3
69	-0.3645	353.355	350.1	4.1	8803.3	2375.7	11179.0	4.71	78.442	6777.3	4401.7
70	-0.3589	354.351	351.1	4.2	8818.6	2368.9	11187.4	4.72	78.490	6778.1	4409.3
71	-0.3533	355.278	352.0	4.3	8832.1	2359.9	11192.0	4.74	78.552	6775.9	4416.0

Test Readings for Specimen No. 2

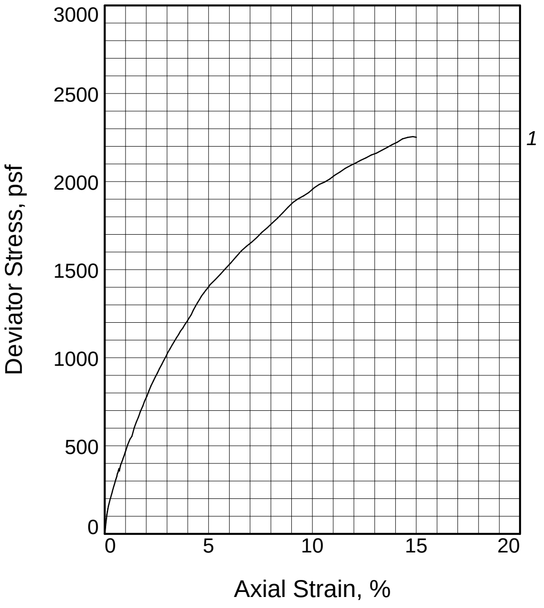
No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Eff. Stress psf	Major Eff. Stress psf	1:3 Ratio	Pore Press. psi	P psf	Q psf
72	-0.3477	356.060	352.8	4.5	8841.9	2350.9	11192.8	4.76	78.614	6771.9	4421.0
73	-0.3421	356.846	353.6	4.6	8851.8	2340.5	11192.3	4.78	78.687	6766.4	4425.9
74	-0.3365	357.665	354.4	4.7	8862.4	2331.7	11194.1	4.80	78.748	6762.9	4431.2
75	-0.3308	358.510	355.3	4.8	8873.7	2325.3	11199.0	4.82	78.792	6762.1	4436.8
76	-0.3252	359.199	356.0	4.9	8881.0	2318.7	11199.8	4.83	78.838	6759.2	4440.5
77	-0.3196	359.612	356.4	5.0	8881.4	2313.3	11194.7	4.84	78.875	6754.0	4440.7
78	-0.3140	360.354	357.1	5.1	8890.0	2308.1	11198.1	4.85	78.911	6753.1	4445.0
79	-0.3084	361.667	358.4	5.2	8912.7	2302.6	11215.3	4.87	78.950	6759.0	4456.4
80	-0.3028	362.504	359.3	5.3	8923.5	2300.5	11224.0	4.88	78.964	6762.3	4461.8
81	-0.2888	364.709	361.5	5.6	8953.2	2295.2	11248.4	4.90	79.001	6771.8	4476.6
82	-0.2747	367.033	363.8	5.8	8985.5	2297.6	11283.0	4.91	78.985	6790.3	4492.7
83	-0.2607	369.477	366.2	6.1	9020.4	2291.9	11312.3	4.94	79.024	6802.1	4510.2
84	-0.2467	372.192	369.0	6.4	9061.6	2287.6	11349.2	4.96	79.054	6818.4	4530.8
85	-0.2326	374.815	371.6	6.6	9100.2	2287.4	11387.7	4.98	79.055	6837.5	4550.1
86	-0.2186	377.919	374.7	6.9	9150.2	2290.4	11440.6	4.99	79.034	6865.5	4575.1
87	-0.2046	380.537	377.3	7.2	9187.9	2299.2	11487.1	5.00	78.974	6893.1	4594.0
88	-0.1905	383.071	379.8	7.4	9223.3	2310.6	11533.8	4.99	78.894	6922.2	4611.6
89	-0.1765	385.647	382.4	7.7	9259.2	2314.2	11573.4	5.00	78.869	6943.8	4629.6
90	-0.1625	388.362	385.1	7.9	9298.2	2318.3	11616.5	5.01	78.840	6967.4	4649.1
91	-0.1485	390.667	387.4	8.2	9326.9	2328.3	11655.2	5.01	78.771	6991.7	4663.5
92	-0.1344	393.621	390.4	8.5	9370.9	2341.5	11712.4	5.00	78.680	7027.0	4685.5
93	-0.1204	395.581	392.3	8.7	9390.7	2356.5	11747.2	4.99	78.575	7051.8	4695.4
94	-0.1064	398.236	395.0	9.0	9426.8	2369.0	11795.8	4.98	78.488	7082.4	4713.4
95	-0.0923	400.164	396.9	9.3	9445.3	2377.4	11822.7	4.97	78.430	7100.0	4722.6
96	-0.0783	402.918	399.7	9.5	9483.0	2388.2	11871.2	4.97	78.355	7129.7	4741.5
97	-0.0643	405.577	402.3	9.8	9518.2	2402.9	11921.1	4.96	78.253	7162.0	4759.1
98	-0.0502	408.193	405.0	10.1	9551.9	2421.9	11973.8	4.94	78.121	7197.8	4775.9
99	-0.0362	410.960	407.7	10.3	9588.8	2439.1	12027.9	4.93	78.002	7233.5	4794.4
100	-0.0222	412.867	409.6	10.6	9605.2	2452.7	12058.0	4.92	77.907	7255.4	4802.6
101	-0.0082	414.928	411.7	10.9	9624.9	2464.3	12089.3	4.91	77.827	7276.8	4812.5
102	0.0059	417.135	413.9	11.1	9647.8	2479.1	12126.9	4.89	77.724	7303.0	4823.9
103	0.0199	419.576	416.3	11.4	9675.8	2496.7	12172.5	4.88	77.602	7334.6	4837.9
104	0.0339	421.904	418.7	11.7	9700.8	2515.5	12216.3	4.86	77.472	7365.9	4850.4
105	0.0480	424.366	421.1	11.9	9728.6	2535.5	12264.1	4.84	77.332	7399.8	4864.3
106	0.0620	426.627	423.4	12.2	9751.4	2549.2	12300.6	4.83	77.237	7424.9	4875.7
107	0.0760	428.451	425.2	12.5	9763.8	2564.9	12328.7	4.81	77.128	7446.8	4881.9
108	0.0901	429.947	426.7	12.7	9768.5	2575.0	12343.6	4.79	77.058	7459.3	4884.3
109	0.1041	432.333	429.1	13.0	9793.4	2586.9	12380.3	4.79	76.975	7483.6	4896.7
110	0.1181	434.036	430.8	13.2	9802.3	2600.9	12403.2	4.77	76.878	7502.0	4901.1
111	0.1321	436.491	433.3	13.5	9828.1	2623.7	12451.8	4.75	76.720	7537.8	4914.0
112	0.1462	438.454	435.2	13.8	9842.3	2640.3	12482.7	4.73	76.604	7561.5	4921.2
113	0.1602	440.623	437.4	14.0	9861.0	2658.2	12519.2	4.71	76.481	7588.7	4930.5
114	0.1742	442.869	439.6	14.3	9881.1	2672.5	12553.6	4.70	76.381	7613.1	4940.5
115	0.1883	444.527	441.3	14.6	9887.7	2688.0	12575.7	4.68	76.273	7631.8	4943.8
116	0.2023	446.679	443.4	14.8	9905.1	2694.3	12599.4	4.68	76.230	7646.8	4952.6
117	0.2163	449.089	445.9	15.1	9928.0	2706.5	12634.4	4.67	76.145	7670.4	4964.0
118	0.2303	451.367	448.1	15.4	9947.6	2719.5	12667.1	4.66	76.055	7693.3	4973.8

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Eff. Stress psf	Major Eff. Stress psf	1:3 Ratio	Pore Press. psi	P psf	Q psf
119	0.2444	453.862	450.6	15.6	9971.6	2740.5	12712.2	4.64	75.909	7726.3	4985.8
120	0.2584	456.120	452.9	15.9	9990.1	2756.4	12746.6	4.62	75.798	7751.5	4995.1
121	0.2586	455.999	452.8	15.9	9987.1	2757.2	12744.3	4.62	75.793	7750.8	4993.5



	Results
C, psf	699.1
ϕ, deg	0
Tan(ϕ)	0



Sample No.		1
Initial	Water Content, %	49.4
	Dry Density, pcf	68.9
	Saturation, %	83.3
	Void Ratio	1.8978
	Diameter, in.	2.807
	Height, in.	5.602
At Test	Water Content, %	50.3
	Dry Density, pcf	68.9
	Saturation, %	84.9
	Void Ratio	1.8978
	Diameter, in.	2.807
	Height, in.	5.602
Strain rate, %/min.		1.00
Back Pressure, psi		0.000
Cell Pressure, psi		24.690
Fail. Stress, psf		1398.2
Strain, %		5.0
Ult. Stress, psf		
Strain, %		
σ_1 Failure, psf		4953.6
σ_3 Failure, psf		3555.4

Type of Test:
Unconsolidated Undrained

Sample Type: Remolded

Description: Filtercake with Salt - UU Test

LL= 51 **PL=** 40 **PI=** 11

Specific Gravity= 3.2

Remarks: Failure chosen at 5% strain

Figure ________

Client: Lithium Nevada

Project: Thacker Pass

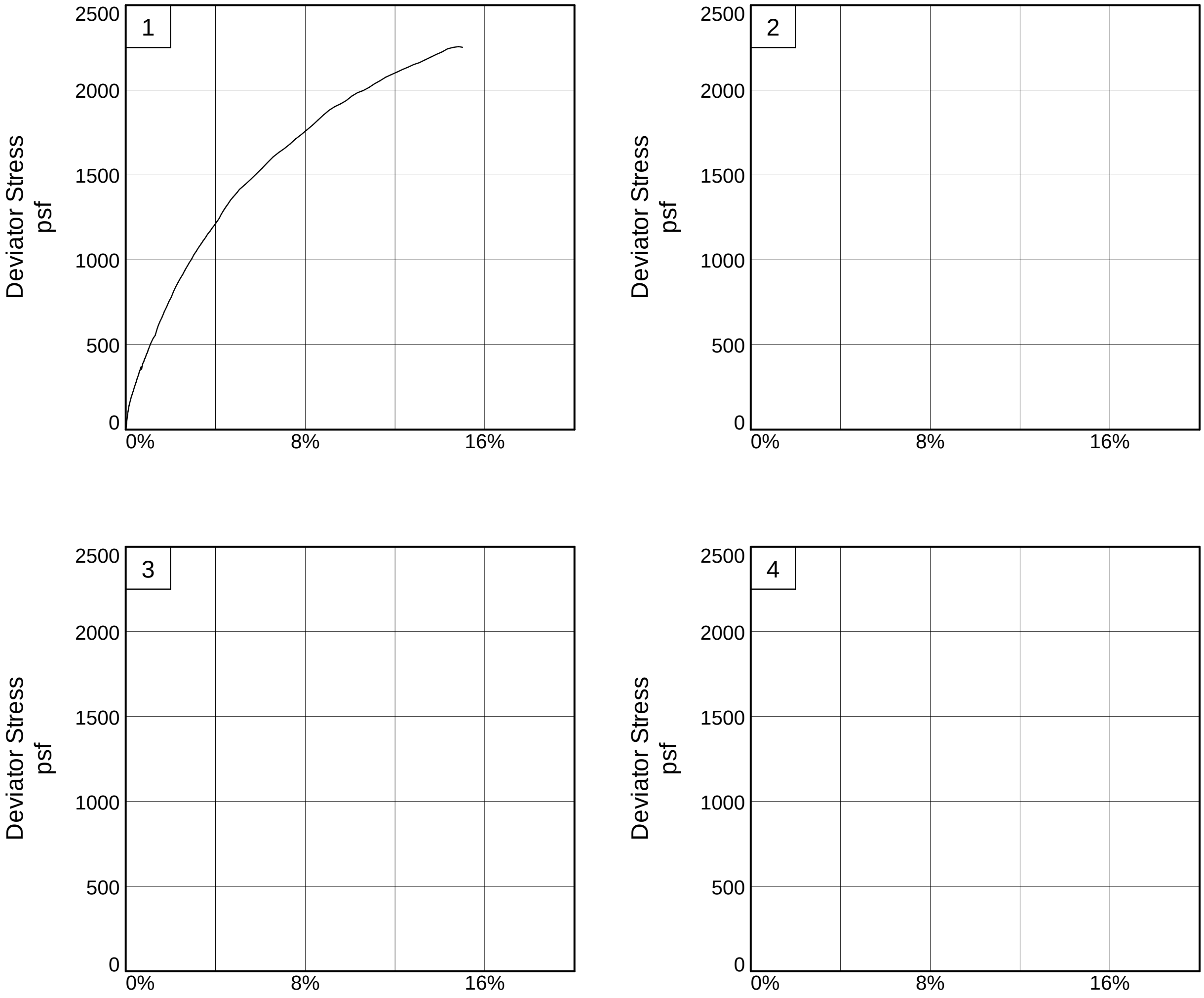
Source of Sample: Reconstituted Tailings

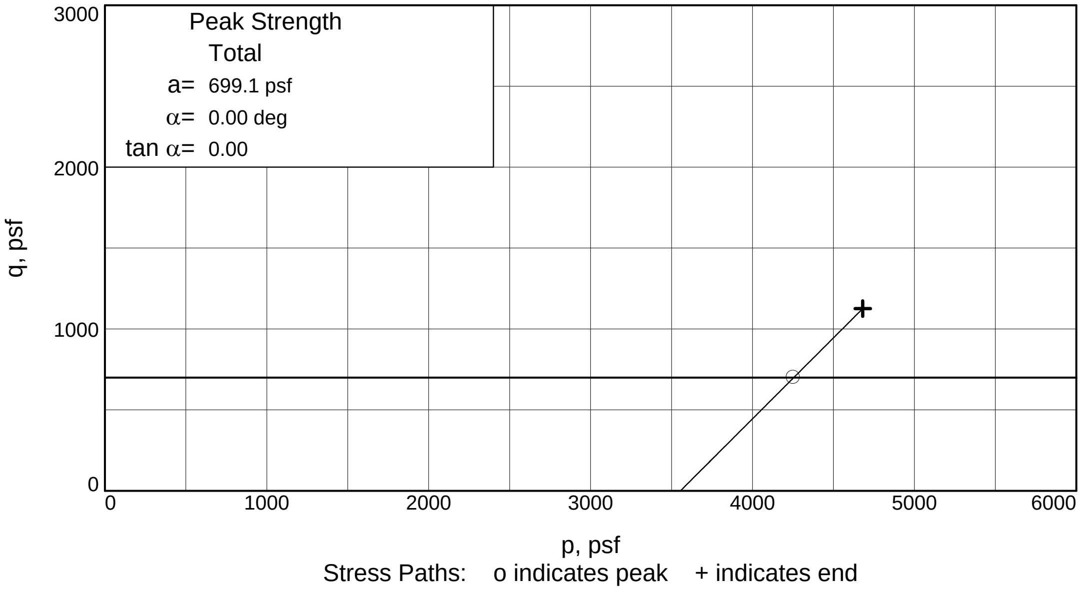
Sample Number: 19-421-06

Proj. No.: 475.0385.000 **Date Sampled:** 12/9/19

NewFields

Tested By: K.Magner **Checked By:** K.Magner





Client: Lithium Nevada

Project: Thacker Pass

Source of Sample: Reconstituted Tailings **Sample Number:** 19-421-06

Project No.: 475.0385.000 **Figure** ________

Newfields Mining Design and Technical Services

Tested By: K.Magner **Checked By:** K.Magner

12/17/2019
4:37 PM

TRIAXIAL COMPRESSION TEST
Unconsolidated Undrained

Date: 12/9/19
Client: Lithium Nevada
Project: Thacker Pass
Project No.: 475.0385.000
Location: Reconstituted Tailings
Sample Number: 19-421-06
Description: Filtercake with Salt - UU Test
Remarks: Failure chosen at 5% strain
Type of Sample: Remolded
Specific Gravity=3.2 **LL=**51 **PL=**40 **PI=**11
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	567.550	1024.550
Moisture content: Dry soil+tare, gms.	468.830	715.250
Moisture content: Tare, gms.	269.020	100.940
Moisture, %	49.4	50.3
Moist specimen weight, gms.	937.30	
Diameter, in.	2.807	
Area, in.^{2}	6.188	
Height, in.	5.602	
Wet density, pcf	103.0	
Dry density, pcf	68.9	
Void ratio	1.8978	
Saturation, %	83.3	

Test Readings for Specimen No. 1

Membrane modulus = 0.124105 kN/cm^2
Membrane thickness = 0.02 cm
Cell pressure = 24.690 psi (3555.4 psf)
Back pressure = 0.000 psi (0.0 psf)
Strain rate, %/min. = 1.00
Fail. Stress = 1398.2 psf **at reading no.** 79

Test Readings for Specimen No. 1

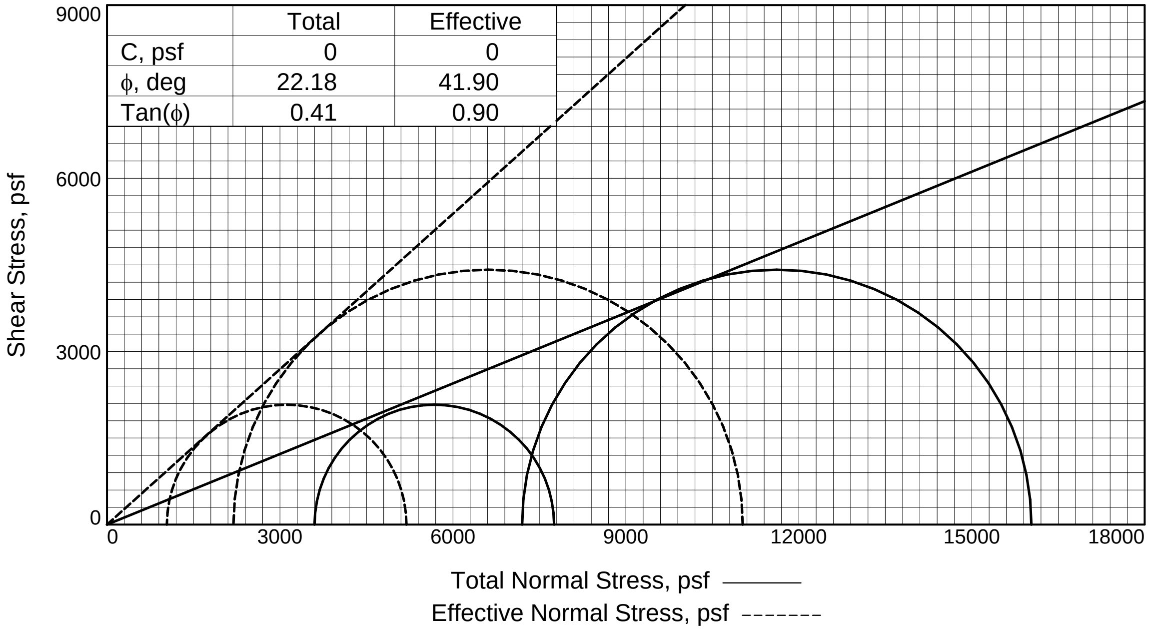
No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Princ. Stress psf	Major Princ. Stress psf	1:3 Ratio	P psf	Q psf
0	0.1364	3.194	0.0	0.0	0.0	3555.4	3555.4	1.00	3555.4	0.0
1	0.1383	4.670	1.5	0.0	34.3	3555.4	3589.7	1.01	3572.5	17.2
2	0.1396	5.926	2.7	0.1	63.5	3555.4	3618.9	1.02	3587.1	31.8
3	0.1409	6.965	3.8	0.1	87.7	3555.4	3643.0	1.02	3599.2	43.8
4	0.1423	7.870	4.7	0.1	108.7	3555.4	3664.1	1.03	3609.7	54.4
5	0.1437	8.631	5.4	0.1	126.4	3555.4	3681.7	1.04	3618.5	63.2
6	0.1451	9.374	6.2	0.2	143.6	3555.4	3699.0	1.04	3627.2	71.8
7	0.1465	10.031	6.8	0.2	158.8	3555.4	3714.2	1.04	3634.8	79.4
8	0.1479	10.537	7.3	0.2	170.5	3555.4	3725.9	1.05	3640.6	85.3
9	0.1493	11.075	7.9	0.2	183.0	3555.4	3738.3	1.05	3646.9	91.5
10	0.1507	11.610	8.4	0.3	195.4	3555.4	3750.7	1.05	3653.0	97.7
11	0.1521	12.014	8.8	0.3	204.7	3555.4	3760.0	1.06	3657.7	102.3
12	0.1535	12.523	9.3	0.3	216.4	3555.4	3771.8	1.06	3663.6	108.2
13	0.1550	12.980	9.8	0.3	227.0	3555.4	3782.3	1.06	3668.8	113.5
14	0.1564	13.432	10.2	0.4	237.4	3555.4	3792.7	1.07	3674.1	118.7
15	0.1578	13.871	10.7	0.4	247.5	3555.4	3802.9	1.07	3679.1	123.8
16	0.1592	14.302	11.1	0.4	257.4	3555.4	3812.8	1.07	3684.1	128.7
17	0.1606	14.788	11.6	0.4	268.6	3555.4	3824.0	1.08	3689.7	134.3
18	0.1620	15.183	12.0	0.5	277.7	3555.4	3833.1	1.08	3694.2	138.9
19	0.1634	15.625	12.4	0.5	287.9	3555.4	3843.2	1.08	3699.3	143.9
20	0.1648	16.095	12.9	0.5	298.7	3555.4	3854.0	1.08	3704.7	149.3
21	0.1662	16.551	13.4	0.5	309.2	3555.4	3864.5	1.09	3709.9	154.6
22	0.1676	16.929	13.7	0.6	317.8	3555.4	3873.2	1.09	3714.3	158.9
23	0.1690	17.337	14.1	0.6	327.2	3555.4	3882.6	1.09	3719.0	163.6
24	0.1704	17.912	14.7	0.6	340.4	3555.4	3895.8	1.10	3725.6	170.2
25	0.1719	18.288	15.1	0.6	349.0	3555.4	3904.4	1.10	3729.9	174.5
26	0.1733	18.714	15.5	0.7	358.8	3555.4	3914.1	1.10	3734.7	179.4
27	0.1747	19.189	16.0	0.7	369.7	3555.4	3925.0	1.10	3740.2	184.8
28	0.1761	18.652	15.5	0.7	357.2	3555.4	3912.5	1.10	3733.9	178.6
29	0.1775	19.418	16.2	0.7	374.8	3555.4	3930.1	1.11	3742.7	187.4
30	0.1789	19.984	16.8	0.8	387.7	3555.4	3943.1	1.11	3749.2	193.9
31	0.1803	20.402	17.2	0.8	397.3	3555.4	3952.6	1.11	3754.0	198.6
32	0.1817	20.666	17.5	0.8	403.3	3555.4	3958.6	1.11	3757.0	201.6
33	0.1831	21.067	17.9	0.8	412.4	3555.4	3967.8	1.12	3761.6	206.2
34	0.1845	21.400	18.2	0.9	420.0	3555.4	3975.4	1.12	3765.4	210.0
35	0.1859	21.743	18.5	0.9	427.8	3555.4	3983.2	1.12	3769.3	213.9
36	0.1874	22.186	19.0	0.9	437.9	3555.4	3993.3	1.12	3774.3	219.0
37	0.1888	22.536	19.3	0.9	445.9	3555.4	4001.2	1.13	3778.3	222.9
38	0.1902	22.839	19.6	1.0	452.7	3555.4	4008.1	1.13	3781.7	226.4
39	0.1916	23.293	20.1	1.0	463.1	3555.4	4018.5	1.13	3786.9	231.5
40	0.1930	23.660	20.5	1.0	471.4	3555.4	4026.8	1.13	3791.1	235.7
41	0.1984	25.186	22.0	1.1	506.1	3555.4	4061.4	1.14	3808.4	253.0
42	0.2046	26.580	23.4	1.2	537.6	3555.4	4092.9	1.15	3824.1	268.8
43	0.2099	27.363	24.2	1.3	555.0	3555.4	4110.4	1.16	3832.9	277.5
44	0.2161	29.457	26.3	1.4	602.4	3555.4	4157.8	1.17	3856.6	301.2
45	0.2213	30.832	27.6	1.5	633.4	3555.4	4188.7	1.18	3872.0	316.7
46	0.2274	32.201	29.0	1.6	664.0	3555.4	4219.4	1.19	3887.4	332.0

Test Readings for Specimen No. 1

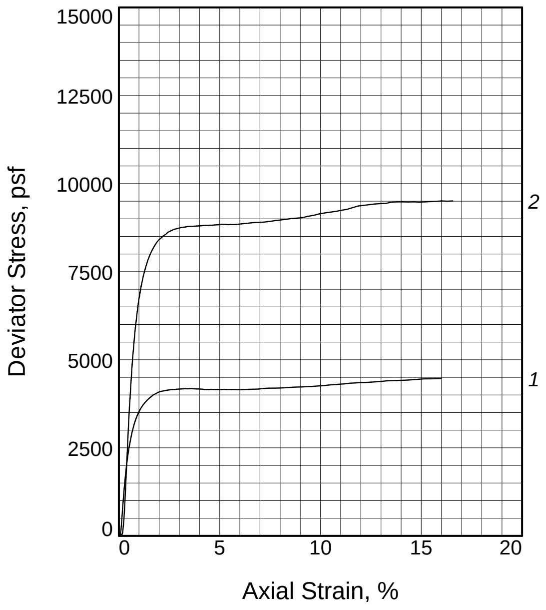
No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Princ. Stress psf	Major Princ. Stress psf	1:3 Ratio	P psf	Q psf
47	0.2326	33.574	30.4	1.7	694.8	3555.4	4250.2	1.20	3902.8	347.4
48	0.2388	34.941	31.7	1.8	725.2	3555.4	4280.6	1.20	3918.0	362.6
49	0.2441	36.257	33.1	1.9	754.6	3555.4	4309.9	1.21	3932.6	377.3
50	0.2503	37.492	34.3	2.0	781.9	3555.4	4337.2	1.22	3946.3	390.9
51	0.2555	38.826	35.6	2.1	811.5	3555.4	4366.9	1.23	3961.1	405.8
52	0.2611	40.113	36.9	2.2	840.0	3555.4	4395.3	1.24	3975.3	420.0
53	0.2673	41.375	38.2	2.3	867.7	3555.4	4423.1	1.24	3989.2	433.8
54	0.2725	42.380	39.2	2.4	889.7	3555.4	4445.0	1.25	4000.2	444.8
55	0.2787	43.484	40.3	2.5	913.7	3555.4	4469.1	1.26	4012.2	456.9
56	0.2839	44.592	41.4	2.6	938.0	3555.4	4493.3	1.26	4024.3	469.0
57	0.2900	45.699	42.5	2.7	961.9	3555.4	4517.3	1.27	4036.3	481.0
58	0.2954	46.737	43.5	2.8	984.5	3555.4	4539.8	1.28	4047.6	492.2
59	0.3014	47.766	44.6	2.9	1006.6	3555.4	4562.0	1.28	4058.7	503.3
60	0.3067	48.862	45.7	3.0	1030.4	3555.4	4585.7	1.29	4070.6	515.2
61	0.3129	49.864	46.7	3.2	1051.8	3555.4	4607.1	1.30	4081.2	525.9
62	0.3182	50.812	47.6	3.2	1072.1	3555.4	4627.5	1.30	4091.4	536.0
63	0.3243	51.817	48.6	3.4	1093.5	3555.4	4648.9	1.31	4102.1	546.7
64	0.3295	52.678	49.5	3.4	1111.8	3555.4	4667.1	1.31	4111.3	555.9
65	0.3356	53.596	50.4	3.6	1131.1	3555.4	4686.5	1.32	4120.9	565.6
66	0.3409	54.556	51.4	3.7	1151.6	3555.4	4706.9	1.32	4131.1	575.8
67	0.3470	55.380	52.2	3.8	1168.7	3555.4	4724.1	1.33	4139.7	584.4
68	0.3522	56.289	53.1	3.9	1187.9	3555.4	4743.3	1.33	4149.3	593.9
69	0.3584	57.181	54.0	4.0	1206.5	3555.4	4761.8	1.34	4158.6	603.2
70	0.3637	58.041	54.8	4.1	1224.5	3555.4	4779.8	1.34	4167.6	612.2
71	0.3698	58.983	55.8	4.2	1244.1	3555.4	4799.5	1.35	4177.4	622.0
72	0.3751	60.157	57.0	4.3	1269.0	3555.4	4824.4	1.36	4189.9	634.5
73	0.3812	61.297	58.1	4.4	1292.9	3555.4	4848.3	1.36	4201.8	646.5
74	0.3865	62.209	59.0	4.5	1311.9	3555.4	4867.3	1.37	4211.3	656.0
75	0.3920	63.106	59.9	4.6	1330.5	3555.4	4885.9	1.37	4220.6	665.3
76	0.3976	64.069	60.9	4.7	1350.5	3555.4	4905.8	1.38	4230.6	675.2
77	0.4037	64.956	61.8	4.8	1368.6	3555.4	4924.0	1.38	4239.7	684.3
78	0.4090	65.643	62.4	4.9	1382.5	3555.4	4937.8	1.39	4246.6	691.2
79	0.4151	66.428	63.2	5.0	1398.2	3555.4	4953.6	1.39	4254.5	699.1
80	0.4204	67.232	64.0	5.1	1414.6	3555.4	4970.0	1.40	4262.7	707.3
81	0.4345	68.719	65.5	5.3	1443.6	3555.4	4999.0	1.41	4277.2	721.8
82	0.4485	70.311	67.1	5.6	1474.8	3555.4	5030.1	1.41	4292.7	737.4
83	0.4626	71.963	68.8	5.8	1507.1	3555.4	5062.4	1.42	4308.9	753.5
84	0.4765	73.597	70.4	6.1	1538.8	3555.4	5094.1	1.43	4324.7	769.4
85	0.4905	75.358	72.2	6.3	1573.1	3555.4	5128.4	1.44	4341.9	786.5
86	0.5046	77.091	73.9	6.6	1606.5	3555.4	5161.9	1.45	4358.6	803.3
87	0.5186	78.485	75.3	6.8	1632.5	3555.4	5187.8	1.46	4371.6	816.2
88	0.5326	79.772	76.6	7.1	1655.9	3555.4	5211.3	1.47	4383.3	828.0
89	0.5466	81.195	78.0	7.3	1682.2	3555.4	5237.5	1.47	4396.4	841.1
90	0.5606	82.812	79.6	7.6	1712.4	3555.4	5267.8	1.48	4411.6	856.2
91	0.5747	84.211	81.0	7.8	1737.7	3555.4	5293.1	1.49	4424.2	868.9
92	0.5886	85.725	82.5	8.1	1765.4	3555.4	5320.8	1.50	4438.1	882.7
93	0.6026	87.236	84.0	8.3	1792.9	3555.4	5348.2	1.50	4451.8	896.4

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Princ. Stress psf	Major Princ. Stress psf	1:3 Ratio	P psf	Q psf
94	0.6168	88.924	85.7	8.6	1823.8	3555.4	5379.2	1.51	4467.3	911.9
95	0.6307	90.591	87.4	8.8	1854.2	3555.4	5409.6	1.52	4482.5	927.1
96	0.6448	92.168	89.0	9.1	1882.5	3555.4	5437.9	1.53	4496.6	941.2
97	0.6587	93.394	90.2	9.3	1903.2	3555.4	5458.6	1.54	4507.0	951.6
98	0.6728	94.389	91.2	9.6	1918.9	3555.4	5474.2	1.54	4514.8	959.4
99	0.6868	95.557	92.4	9.8	1938.1	3555.4	5493.4	1.55	4524.4	969.0
100	0.7014	97.116	93.9	10.1	1965.1	3555.4	5520.4	1.55	4537.9	982.5
101	0.7153	98.289	95.1	10.3	1984.2	3555.4	5539.5	1.56	4547.4	992.1
102	0.7293	99.160	96.0	10.6	1996.8	3555.4	5552.1	1.56	4553.7	998.4
103	0.7432	100.294	97.1	10.8	2014.7	3555.4	5570.1	1.57	4562.7	1007.4
104	0.7572	101.630	98.4	11.1	2036.7	3555.4	5592.1	1.57	4573.7	1018.4
105	0.7712	102.783	99.6	11.3	2054.8	3555.4	5610.2	1.58	4582.8	1027.4
106	0.7852	104.046	100.9	11.6	2075.0	3555.4	5630.3	1.58	4592.8	1037.5
107	0.7992	105.109	101.9	11.8	2090.9	3555.4	5646.3	1.59	4600.8	1045.5
108	0.8132	106.108	102.9	12.1	2105.4	3555.4	5660.8	1.59	4608.1	1052.7
109	0.8272	107.170	104.0	12.3	2121.1	3555.4	5676.5	1.60	4615.9	1060.5
110	0.8412	108.151	105.0	12.6	2135.0	3555.4	5690.4	1.60	4622.9	1067.5
111	0.8554	109.223	106.0	12.8	2150.6	3555.4	5705.9	1.60	4630.7	1075.3
112	0.8693	110.050	106.9	13.1	2161.2	3555.4	5716.5	1.61	4635.9	1080.6
113	0.8834	111.159	108.0	13.3	2177.3	3555.4	5732.6	1.61	4644.0	1088.6
114	0.8979	112.290	109.1	13.6	2193.5	3555.4	5748.9	1.62	4652.1	1096.8
115	0.9119	113.409	110.2	13.8	2209.6	3555.4	5765.0	1.62	4660.2	1104.8
116	0.9256	114.432	111.2	14.1	2223.8	3555.4	5779.1	1.63	4667.3	1111.9
117	0.9396	115.679	112.5	14.3	2242.2	3555.4	5797.5	1.63	4676.5	1121.1
118	0.9536	116.458	113.3	14.6	2251.1	3555.4	5806.5	1.63	4680.9	1125.6
119	0.9676	117.014	113.8	14.8	2255.6	3555.4	5810.9	1.63	4683.1	1127.8
120	0.9770	117.036	113.8	15.0	2251.6	3555.4	5806.9	1.63	4681.1	1125.8



	Total	Effective
C, psf	0	0
ϕ, deg	22.18	41.90
Tan(ϕ)	0.41	0.90



	Sample No.	1	2
Initial	Water Content, %	54.0	54.0
	Dry Density, pcf	66.5	65.4
	Saturation, %	86.3	84.1
	Void Ratio	2.0031	2.0558
	Diameter, in.	2.800	2.803
	Height, in.	5.605	5.652
At Test	Water Content, %	46.5	38.9
	Dry Density, pcf	80.3	89.0
	Saturation, %	100.0	100.0
	Void Ratio	1.4890	1.2457
	Diameter, in.	2.628	2.525
	Height, in.	5.272	5.119
	Strain rate, %/min.	0.02	0.02
	Eff. Cell Pressure, psi	25.000	50.000
	Fail. Stress, psf	4154.6	8833.7
	Total Pore Pr., psf	9742.2	12121.5
	Strain, %	5.0	5.0
	Ult. Stress, psf		
	Total Pore Pr., psf		
	Strain, %		
	$\bar{\sigma}_1$ Failure, psf	5193.7	11027.3
	$\bar{\sigma}_3$ Failure, psf	1039.1	2193.6

Type of Test:
CU with Pore Pressures

Sample Type: Remolded

Description: Filter Cake with Salt at +9% - CU Test

LL= 51 **PL=** 11 **PI=** 40

Specific Gravity= 3.2

Remarks: Failure chosen at 5% strian

Figure ________

Client: Lithium Nevada

Project: Thacker Pass

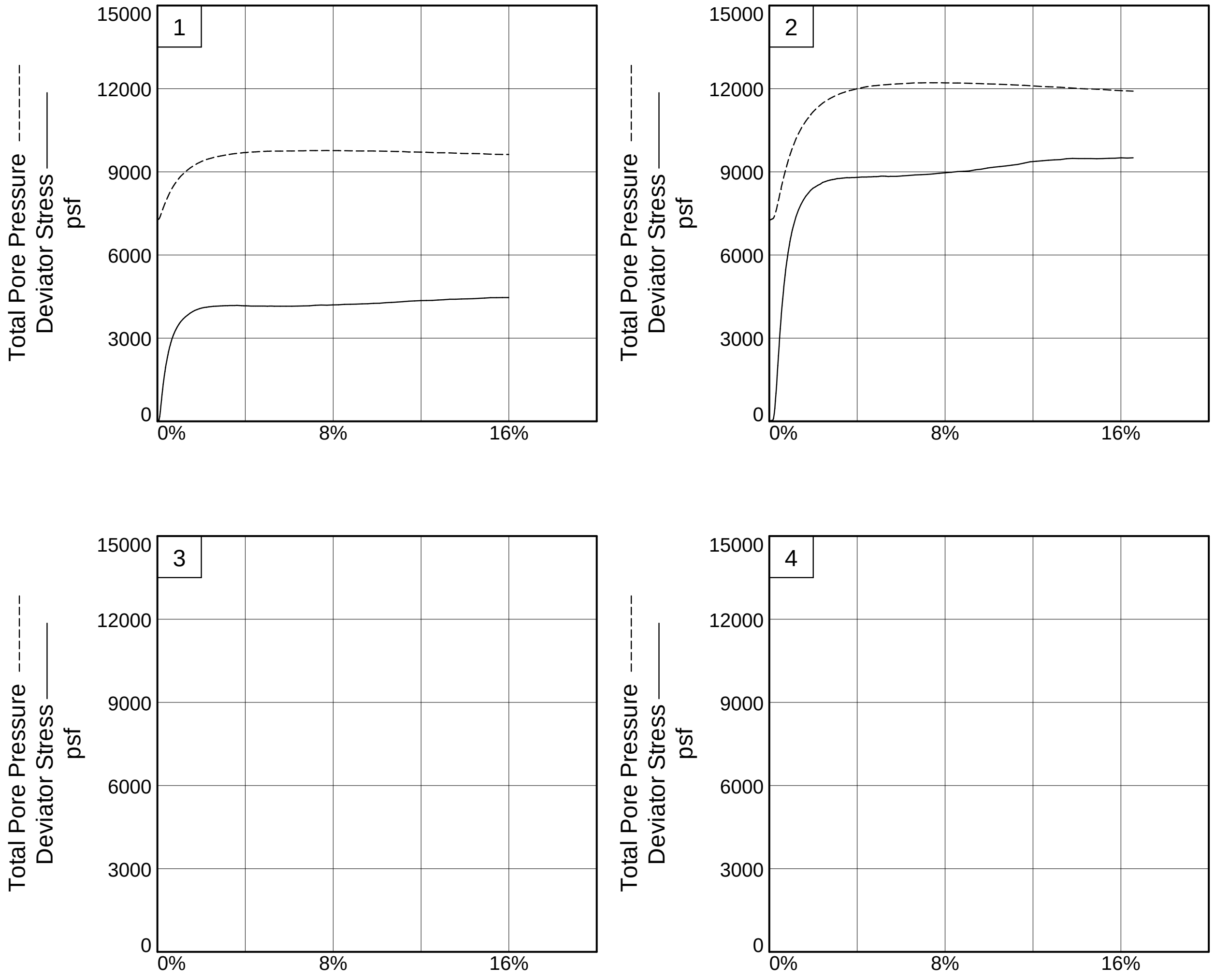
Source of Sample: Reconstituted Tailings

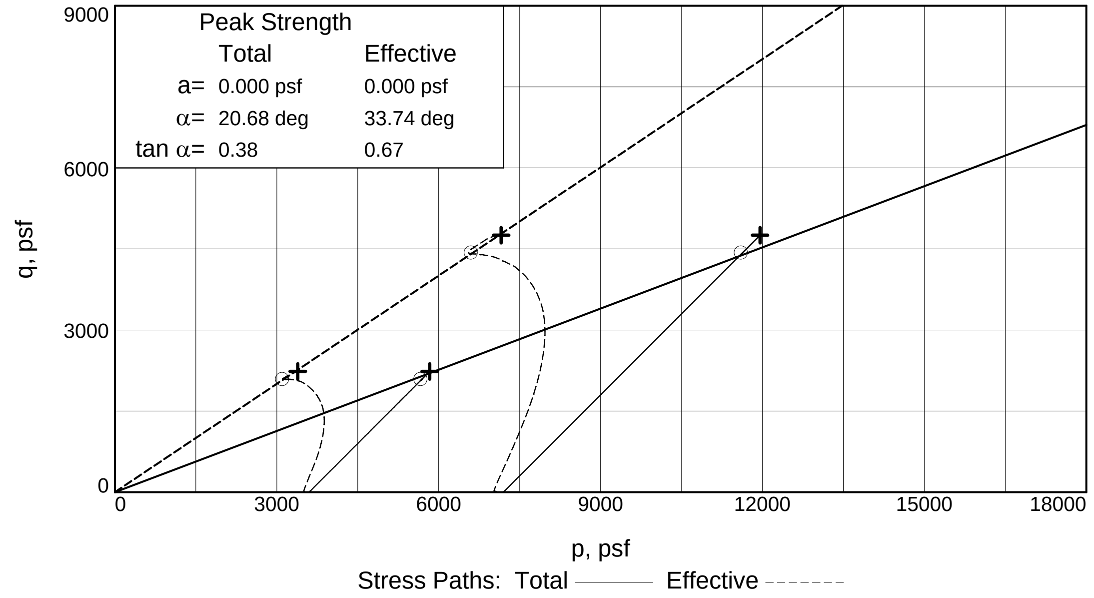
Sample Number: 19-421-04,-05

Proj. No.: 475.0385.000 **Date Sampled:** 12/11/19

NewFields

Tested By: K.Magner **Checked By:** K.Magner





Peak Strength

	Total	Effective
a=	0.000 psf	0.000 psf
α=	20.68 deg	33.74 deg
tan α=	0.38	0.67

Client: Lithium Nevada

Project: Thacker Pass

Source of Sample: Reconstituted Tailings **Sample Number:** 19-421-04,-05

Project No.: 475.0385.000 **Figure** ________

Newfields Mining Design and Technical Services

Tested By: K.Magner **Checked By:** K.Magner

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

12/18/2019
10:26 AM

Date:	12/11/19
Client:	Lithium Nevada
Project:	Thacker Pass
Project No.:	475.0385.000
Location:	Reconstituted Tailings
Sample Number:	19-421-04,-05
Description:	Filter Cake with Salt at +9% - CU Test
Remarks:	Failure chosen at 5% strian
Type of Sample:	Remolded

Specific Gravity=3.2 **LL=**51 **PL=**11 **PI=**40

Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	388.800			1067.840
Moisture content: Dry soil+tare, gms.	294.900			763.500
Moisture content: Tare, gms.	121.020			180.930
Moisture, %	54.0	62.6	46.5	52.2
Moist specimen weight, gms.	928.10			
Diameter, in.	2.800	2.800	2.628	
Area, in.²	6.158	6.158	5.426	
Height, in.	5.605	5.605	5.272	
Net decrease in height, in.		0.000	0.333	
Wet density, pcf	102.4	108.2	117.6	
Dry density, pcf	66.5	66.5	80.3	
Void ratio	2.0031	2.0031	1.4890	
Saturation, %	86.3	100.0	100.0	

Test Readings for Specimen No. 1

Membrane modulus = 0.124105 kN/cm²

Membrane thickness = 0.02 cm

Consolidation cell pressure = 74.870 psi (10781.3 psf)

Consolidation back pressure = 49.870 psi (7181.3 psf)

Consolidation effective confining stress = 3600.0 psf

Strain rate, %/min. = 0.02

Fail. Stress = 4154.6 psf **at reading no.** 77

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Eff. Stress psf	Major Eff. Stress psf	1:3 Ratio	Pore Press. psi	P psf	Q psf
0	-0.5305	2.497	0.0	0.0	0.0	3505.4	3505.4	1.00	50.527	3505.4	0.0
1	-0.5291	3.733	1.2	0.0	32.8	3491.1	3523.9	1.01	50.626	3507.5	16.4
2	-0.5277	3.086	0.6	0.1	15.6	3494.0	3509.6	1.00	50.606	3501.8	7.8
3	-0.5263	4.727	2.2	0.1	59.1	3472.5	3531.6	1.02	50.756	3502.0	29.6
4	-0.5249	9.044	6.5	0.1	173.6	3434.3	3607.9	1.05	51.021	3521.1	86.8
5	-0.5235	16.126	13.6	0.1	361.3	3378.1	3739.4	1.11	51.411	3558.8	180.6
6	-0.5221	23.673	21.2	0.2	561.1	3318.9	3880.0	1.17	51.822	3599.5	280.6
7	-0.5207	31.694	29.2	0.2	773.4	3256.7	4030.1	1.24	52.254	3643.4	386.7
8	-0.5192	39.038	36.5	0.2	967.7	3198.7	4166.4	1.30	52.657	3682.6	483.9
9	-0.5178	46.272	43.8	0.2	1159.0	3139.9	4298.9	1.37	53.065	3719.4	579.5
10	-0.5164	53.242	50.7	0.3	1343.2	3082.1	4425.3	1.44	53.466	3753.7	671.6
11	-0.5150	59.504	57.0	0.3	1508.5	3026.4	4534.9	1.50	53.854	3780.6	754.3
12	-0.5136	65.180	62.7	0.3	1658.3	2973.2	4631.5	1.56	54.223	3802.3	829.1
13	-0.5122	70.660	68.2	0.3	1802.8	2920.2	4723.0	1.62	54.591	3821.6	901.4
14	-0.5108	75.982	73.5	0.4	1943.0	2867.5	4810.5	1.68	54.957	3839.0	971.5
15	-0.5094	80.811	78.3	0.4	2070.1	2817.2	4887.3	1.73	55.306	3852.3	1035.1
16	-0.5080	85.308	82.8	0.4	2188.4	2766.7	4955.1	1.79	55.657	3860.9	1094.2
17	-0.5066	89.485	87.0	0.5	2298.2	2718.3	5016.5	1.85	55.993	3867.4	1149.1
18	-0.5052	93.410	90.9	0.5	2401.2	2672.3	5073.6	1.90	56.312	3872.9	1200.6
19	-0.5038	97.228	94.7	0.5	2501.4	2626.5	5127.9	1.95	56.630	3877.2	1250.7
20	-0.5024	100.858	98.4	0.5	2596.6	2582.4	5179.0	2.01	56.937	3880.7	1298.3
21	-0.5010	104.078	101.6	0.6	2680.9	2540.5	5221.3	2.06	57.228	3880.9	1340.4
22	-0.4996	106.886	104.4	0.6	2754.2	2500.6	5254.8	2.10	57.505	3877.7	1377.1
23	-0.4982	109.847	107.4	0.6	2831.6	2460.0	5291.6	2.15	57.787	3875.8	1415.8
24	-0.4968	112.649	110.2	0.6	2904.7	2419.9	5324.6	2.20	58.065	3872.3	1452.4
25	-0.4954	115.219	112.7	0.7	2971.7	2381.7	5353.4	2.25	58.330	3867.6	1485.9
26	-0.4940	117.563	115.1	0.7	3032.7	2345.1	5377.8	2.29	58.584	3861.5	1516.3
27	-0.4926	119.753	117.3	0.7	3089.6	2309.8	5399.4	2.34	58.830	3854.6	1544.8
28	-0.4912	121.931	119.4	0.7	3146.1	2275.5	5421.6	2.38	59.068	3848.6	1573.0
29	-0.4898	123.799	121.3	0.8	3194.5	2242.5	5436.9	2.42	59.297	3839.7	1597.2
30	-0.4884	125.656	123.2	0.8	3242.5	2210.0	5452.5	2.47	59.523	3831.2	1621.2
31	-0.4870	127.438	124.9	0.8	3288.5	2179.0	5467.5	2.51	59.738	3823.3	1644.3
32	-0.4856	129.009	126.5	0.9	3329.0	2149.7	5478.6	2.55	59.942	3814.2	1664.5
33	-0.4841	130.501	128.0	0.9	3367.3	2120.5	5487.8	2.59	60.144	3804.2	1683.7
34	-0.4827	132.003	129.5	0.9	3405.9	2092.8	5498.7	2.63	60.337	3795.8	1703.0
35	-0.4813	133.408	130.9	0.9	3441.9	2065.3	5507.2	2.67	60.528	3786.2	1721.0
36	-0.4799	134.708	132.2	1.0	3475.2	2038.6	5513.7	2.70	60.713	3776.1	1737.6
37	-0.4785	135.925	133.4	1.0	3506.2	2013.0	5519.2	2.74	60.891	3766.1	1753.1
38	-0.4771	137.240	134.7	1.0	3539.8	1987.7	5527.5	2.78	61.067	3757.6	1769.9
39	-0.4757	138.428	135.9	1.0	3570.1	1963.5	5533.6	2.82	61.235	3748.5	1785.1
40	-0.4743	139.460	137.0	1.1	3596.2	1940.2	5536.4	2.85	61.397	3738.3	1798.1
41	-0.4687	143.406	140.9	1.2	3695.9	1854.1	5550.0	2.99	61.994	3702.0	1847.9
42	-0.4631	146.527	144.0	1.3	3773.7	1775.9	5549.6	3.12	62.537	3662.8	1886.8
43	-0.4575	149.211	146.7	1.4	3839.8	1705.0	5544.9	3.25	63.029	3625.0	1919.9
44	-0.4519	151.730	149.2	1.5	3901.6	1642.2	5543.7	3.38	63.466	3593.0	1950.8
45	-0.4463	153.845	151.3	1.6	3952.6	1586.4	5538.9	3.49	63.854	3562.7	1976.3
46	-0.4407	155.813	153.3	1.7	3999.6	1534.6	5534.2	3.61	64.213	3534.4	1999.8

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Eff. Stress psf	Major Eff. Stress psf	1:3 Ratio	Pore Press. psi	P psf	Q psf
47	-0.4350	157.201	154.7	1.8	4031.5	1485.6	5517.1	3.71	64.553	3501.4	2015.7
48	-0.4294	158.634	156.1	1.9	4064.4	1441.5	5505.9	3.82	64.860	3473.7	2032.2
49	-0.4238	159.834	157.3	2.0	4091.2	1402.1	5493.3	3.92	65.133	3447.7	2045.6
50	-0.4182	160.635	158.1	2.1	4107.6	1367.7	5475.3	4.00	65.372	3421.5	2053.8
51	-0.4126	161.192	158.7	2.2	4117.5	1337.1	5454.6	4.08	65.585	3395.8	2058.8
52	-0.4070	161.869	159.4	2.3	4130.6	1309.2	5439.8	4.16	65.778	3374.5	2065.3
53	-0.4014	162.480	160.0	2.4	4141.9	1286.0	5428.0	4.22	65.939	3357.0	2071.0
54	-0.3958	162.880	160.4	2.6	4147.7	1265.1	5412.9	4.28	66.084	3339.0	2073.9
55	-0.3902	163.373	160.9	2.7	4156.0	1244.0	5400.0	4.34	66.231	3322.0	2078.0
56	-0.3845	163.600	161.1	2.8	4157.3	1225.6	5382.9	4.39	66.359	3304.3	2078.6
57	-0.3789	164.018	161.5	2.9	4163.5	1209.6	5373.1	4.44	66.470	3291.3	2081.7
58	-0.3733	164.298	161.8	3.0	4166.1	1193.5	5359.7	4.49	66.582	3276.6	2083.1
59	-0.3677	164.737	162.2	3.1	4172.9	1176.7	5349.6	4.55	66.698	3263.2	2086.4
60	-0.3621	165.008	162.5	3.2	4175.2	1161.2	5336.4	4.60	66.806	3248.8	2087.6
61	-0.3565	165.279	162.8	3.3	4177.6	1147.7	5325.3	4.64	66.900	3236.5	2088.8
62	-0.3509	165.411	162.9	3.4	4176.4	1135.9	5312.3	4.68	66.982	3224.1	2088.2
63	-0.3453	165.727	163.2	3.5	4179.9	1124.0	5303.8	4.72	67.065	3213.9	2089.9
64	-0.3396	165.944	163.4	3.6	4180.8	1114.0	5294.8	4.75	67.134	3204.4	2090.4
65	-0.3340	165.922	163.4	3.7	4175.6	1104.8	5280.4	4.78	67.198	3192.6	2087.8
66	-0.3284	166.010	163.5	3.8	4173.3	1096.9	5270.1	4.80	67.253	3183.5	2086.6
67	-0.3228	166.089	163.6	3.9	4170.6	1089.6	5260.2	4.83	67.303	3174.9	2085.3
68	-0.3172	166.098	163.6	4.0	4166.3	1082.0	5248.2	4.85	67.356	3165.1	2083.1
69	-0.3116	166.196	163.7	4.2	4164.1	1075.1	5239.3	4.87	67.404	3157.2	2082.1
70	-0.3060	166.137	163.6	4.3	4158.0	1069.1	5227.1	4.89	67.446	3148.1	2079.0
71	-0.3004	166.304	163.8	4.4	4157.6	1063.4	5221.1	4.91	67.485	3142.2	2078.8
72	-0.2948	166.464	164.0	4.5	4157.1	1059.1	5216.1	4.93	67.515	3137.6	2078.5
73	-0.2891	166.720	164.2	4.6	4158.9	1054.0	5212.9	4.95	67.550	3133.5	2079.5
74	-0.2835	166.855	164.4	4.7	4157.7	1049.3	5207.0	4.96	67.583	3128.2	2078.8
75	-0.2779	167.039	164.5	4.8	4157.7	1045.7	5203.3	4.98	67.609	3124.5	2078.8
76	-0.2723	167.208	164.7	4.9	4157.3	1042.0	5199.3	4.99	67.634	3120.6	2078.7
77	-0.2667	167.286	164.8	5.0	4154.6	1039.1	5193.7	5.00	67.654	3116.4	2077.3
78	-0.2611	167.611	165.1	5.1	4158.2	1035.4	5193.5	5.02	67.680	3114.5	2079.1
79	-0.2555	167.836	165.3	5.2	4159.2	1034.5	5193.7	5.02	67.686	3114.1	2079.6
80	-0.2499	167.921	165.4	5.3	4156.6	1034.3	5190.9	5.02	67.687	3112.6	2078.3
81	-0.2358	168.394	165.9	5.6	4156.8	1032.6	5189.4	5.03	67.699	3111.0	2078.4
82	-0.2218	168.748	166.3	5.9	4153.9	1029.2	5183.2	5.04	67.723	3106.2	2077.0
83	-0.2078	169.215	166.7	6.1	4153.8	1027.6	5181.4	5.04	67.734	3104.5	2076.9
84	-0.1938	169.971	167.5	6.4	4160.8	1024.7	5185.5	5.06	67.754	3105.1	2080.4
85	-0.1797	170.531	168.0	6.7	4162.9	1023.0	5185.9	5.07	67.766	3104.4	2081.4
86	-0.1657	171.273	168.8	6.9	4169.3	1015.5	5184.8	5.11	67.818	3100.2	2084.7
87	-0.1517	172.475	170.0	7.2	4187.0	1013.6	5200.6	5.13	67.831	3107.1	2093.5
88	-0.1376	173.328	170.8	7.5	4196.0	1011.8	5207.8	5.15	67.844	3109.8	2098.0
89	-0.1236	173.712	171.2	7.7	4193.3	1011.3	5204.6	5.15	67.847	3108.0	2096.6
90	-0.1096	174.445	171.9	8.0	4199.1	1013.3	5212.5	5.14	67.833	3112.9	2099.6
91	-0.0955	175.135	172.6	8.2	4203.8	1016.1	5219.8	5.14	67.814	3117.9	2101.9
92	-0.0815	176.194	173.7	8.5	4217.3	1016.7	5234.0	5.15	67.810	3125.3	2108.6
93	-0.0675	177.076	174.6	8.8	4226.4	1022.1	5248.5	5.13	67.772	3135.3	2113.2

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Eff. Stress psf	Major Eff. Stress psf	1:3 Ratio	Pore Press. psi	P psf	Q psf
94	-0.0535	177.726	175.2	9.0	4229.7	1026.8	5256.5	5.12	67.740	3141.6	2114.9
95	-0.0394	178.548	176.1	9.3	4237.1	1025.7	5262.8	5.13	67.747	3144.2	2118.6
96	-0.0254	179.396	176.9	9.6	4245.0	1027.5	5272.6	5.13	67.735	3150.0	2122.5
97	-0.0114	180.341	177.8	9.8	4255.2	1029.8	5285.0	5.13	67.719	3157.4	2127.6
98	0.0027	181.216	178.7	10.1	4263.5	1032.5	5296.0	5.13	67.700	3164.3	2131.7
99	0.0167	182.469	180.0	10.4	4280.7	1036.0	5316.7	5.13	67.675	3176.4	2140.3
100	0.0307	183.437	180.9	10.6	4290.9	1041.3	5332.2	5.12	67.639	3186.7	2145.5
101	0.0448	184.572	182.1	10.9	4305.0	1045.8	5350.7	5.12	67.608	3198.3	2152.5
102	0.0588	185.577	183.1	11.2	4315.8	1053.1	5368.9	5.10	67.557	3211.0	2157.9
103	0.0728	186.884	184.4	11.4	4333.6	1063.1	5396.7	5.08	67.487	3229.9	2166.8
104	0.0868	187.840	185.3	11.7	4343.0	1065.2	5408.2	5.08	67.473	3236.7	2171.5
105	0.1009	188.824	186.3	12.0	4352.9	1069.0	5421.9	5.07	67.446	3245.4	2176.4
106	0.1149	189.637	187.1	12.2	4358.6	1073.9	5432.5	5.06	67.412	3253.2	2179.3
107	0.1289	190.408	187.9	12.5	4363.3	1085.3	5448.6	5.02	67.333	3267.0	2181.7
108	0.1430	191.551	189.1	12.8	4376.5	1092.9	5469.4	5.00	67.280	3281.2	2188.2
109	0.1570	192.683	190.2	13.0	4389.3	1094.7	5484.0	5.01	67.268	3289.4	2194.6
110	0.1710	193.896	191.4	13.3	4403.7	1097.4	5501.2	5.01	67.249	3299.3	2201.9
111	0.1851	194.654	192.2	13.6	4407.6	1106.4	5514.1	4.98	67.186	3310.2	2203.8
112	0.1991	195.560	193.1	13.8	4414.8	1114.8	5529.6	4.96	67.128	3322.2	2207.4
113	0.2131	196.285	193.8	14.1	4417.7	1121.4	5539.0	4.94	67.083	3330.2	2208.8
114	0.2271	197.164	194.7	14.4	4424.0	1122.7	5546.6	4.94	67.074	3334.7	2212.0
115	0.2412	198.413	195.9	14.6	4438.5	1124.8	5563.3	4.95	67.059	3344.1	2219.2
116	0.2552	199.373	196.9	14.9	4446.3	1133.8	5580.2	4.92	66.996	3357.0	2223.2
117	0.2692	200.570	198.1	15.2	4459.4	1143.2	5602.6	4.90	66.931	3372.9	2229.7
118	0.2833	201.197	198.7	15.4	4459.5	1150.9	5610.4	4.87	66.878	3380.6	2229.7
119	0.2973	202.015	199.5	15.7	4463.7	1155.6	5619.3	4.86	66.845	3387.5	2231.9
120	0.3113	202.806	200.3	16.0	4467.3	1154.5	5621.7	4.87	66.853	3388.1	2233.6
121	0.3114	202.753	200.3	16.0	4466.0	1155.4	5621.5	4.87	66.846	3388.5	2233.0

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	388.800			1067.840
Moisture content: Dry soil+tare, gms.	294.900			763.500
Moisture content: Tare, gms.	121.020			180.930
Moisture, %	54.0	64.2	38.9	52.2
Moist specimen weight, gms.	921.70			
Diameter, in.	2.803	2.803	2.525	
Area, in.^{2}	6.171	6.171	5.007	
Height, in.	5.652	5.652	5.119	
Net decrease in height, in.		0.000	0.533	
Wet density, pcf	100.7	107.4	123.6	
Dry density, pcf	65.4	65.4	89.0	
Void ratio	2.0558	2.0558	1.2457	
Saturation, %	84.1	100.0	100.0	

Test Readings for Specimen No. 2

Membrane modulus = 0.124105 kN/cm^2

Membrane thickness = 0.02 cm

Consolidation cell pressure = 99.410 psi (14315.0 psf)

Consolidation back pressure = 49.410 psi (7115.0 psf)

Consolidation effective confining stress = 7200.0 psf

Strain rate, %/min. = 0.02

Fail. Stress = 8833.7 psf **at reading no.** 75

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Eff. Stress psf	Major Eff. Stress psf	1:3 Ratio	Pore Press. psi	P psf	Q psf
0	-0.5305	2.455	0.0	0.0	0.0	7080.2	7080.2	1.00	50.242	7080.2	0.0
1	-0.5291	3.295	0.8	0.0	24.1	7054.4	7078.5	1.00	50.421	7066.4	12.1
2	-0.5277	3.358	0.9	0.1	26.0	7041.2	7067.2	1.00	50.513	7054.2	13.0
3	-0.5263	3.469	1.0	0.1	29.1	7030.5	7059.7	1.00	50.587	7045.1	14.6
4	-0.5249	3.527	1.1	0.1	30.8	7021.9	7052.7	1.00	50.647	7037.3	15.4
5	-0.5234	3.663	1.2	0.1	34.7	7013.2	7047.9	1.00	50.707	7030.5	17.3
6	-0.5220	4.177	1.7	0.2	49.4	7002.3	7051.7	1.01	50.783	7027.0	24.7
7	-0.5206	6.377	3.9	0.2	112.6	6978.9	7091.5	1.02	50.945	7035.2	56.3
8	-0.5192	11.730	9.3	0.2	266.2	6932.8	7199.0	1.04	51.266	7065.9	133.1
9	-0.5178	18.839	16.4	0.2	470.0	6875.0	7345.1	1.07	51.667	7110.1	235.0
10	-0.5164	28.060	25.6	0.3	734.4	6802.7	7537.1	1.11	52.169	7169.9	367.2
11	-0.5150	37.943	35.5	0.3	1017.5	6725.3	7742.8	1.15	52.707	7234.0	508.8
12	-0.5135	48.603	46.1	0.3	1322.8	6641.3	7964.1	1.20	53.290	7302.7	661.4
13	-0.5121	60.301	57.8	0.4	1657.7	6547.4	8205.1	1.25	53.942	7376.3	828.8
14	-0.5107	72.660	70.2	0.4	2011.3	6447.4	8458.7	1.31	54.636	7453.1	1005.7
15	-0.5093	84.937	82.5	0.4	2362.4	6345.8	8708.2	1.37	55.342	7527.0	1181.2
16	-0.5079	96.893	94.4	0.4	2704.1	6243.8	8947.9	1.43	56.050	7595.8	1352.0
17	-0.5065	108.331	105.9	0.5	3030.7	6143.1	9173.8	1.49	56.750	7658.5	1515.4
18	-0.5051	119.052	116.6	0.5	3336.7	6043.8	9380.5	1.55	57.439	7712.1	1668.4
19	-0.5036	129.257	126.8	0.5	3627.7	5946.4	9574.1	1.61	58.116	7760.3	1813.9
20	-0.5022	138.981	136.5	0.6	3904.8	5850.2	9755.1	1.67	58.783	7802.6	1952.4
21	-0.5008	148.289	145.8	0.6	4169.9	5754.6	9924.5	1.72	59.447	7839.6	2085.0
22	-0.4994	156.974	154.5	0.6	4417.0	5661.6	10078.6	1.78	60.093	7870.1	2208.5
23	-0.4980	165.138	162.7	0.6	4649.1	5571.1	10220.2	1.83	60.722	7895.6	2324.6
24	-0.4966	172.933	170.5	0.7	4870.5	5482.5	10353.0	1.89	61.337	7917.7	2435.3

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Eff. Stress psf	Major Eff. Stress psf	1:3 Ratio	Pore Press. psi	P psf	Q psf
25	-0.4952	180.358	177.9	0.7	5081.2	5394.6	10475.8	1.94	61.948	7935.2	2540.6
26	-0.4937	187.301	184.8	0.7	5278.1	5309.5	10587.6	1.99	62.538	7948.5	2639.0
27	-0.4923	193.909	191.5	0.7	5465.2	5225.2	10690.4	2.05	63.124	7957.8	2732.6
28	-0.4909	200.040	197.6	0.8	5638.7	5144.8	10783.4	2.10	63.683	7964.1	2819.3
29	-0.4895	205.939	203.5	0.8	5805.4	5065.8	10871.2	2.15	64.231	7968.5	2902.7
30	-0.4881	211.430	209.0	0.8	5960.4	4990.2	10950.6	2.19	64.756	7970.4	2980.2
31	-0.4867	216.366	213.9	0.9	6099.5	4918.6	11018.0	2.24	65.253	7968.3	3049.7
32	-0.4853	221.160	218.7	0.9	6234.5	4846.8	11081.3	2.29	65.752	7964.0	3117.2
33	-0.4838	225.783	223.3	0.9	6364.4	4776.8	11141.2	2.33	66.238	7959.0	3182.2
34	-0.4824	230.044	227.6	0.9	6484.1	4708.6	11192.7	2.38	66.711	7950.6	3242.0
35	-0.4810	234.359	231.9	1.0	6605.2	4641.4	11246.6	2.42	67.178	7944.0	3302.6
36	-0.4796	238.093	235.6	1.0	6709.7	4577.3	11287.0	2.47	67.623	7932.2	3354.8
37	-0.4782	241.675	239.2	1.0	6809.7	4514.7	11324.4	2.51	68.058	7919.6	3404.9
38	-0.4768	245.179	242.7	1.0	6907.6	4453.9	11361.5	2.55	68.480	7907.7	3453.8
39	-0.4754	248.423	246.0	1.1	6997.9	4394.9	11392.8	2.59	68.890	7893.8	3499.0
40	-0.4739	251.456	249.0	1.1	7082.2	4337.4	11419.6	2.63	69.289	7878.5	3541.1
41	-0.4683	262.342	259.9	1.2	7383.6	4124.3	11507.9	2.79	70.769	7816.1	3691.8
42	-0.4626	271.084	268.6	1.3	7623.4	3936.4	11559.9	2.94	72.074	7748.2	3811.7
43	-0.4570	278.307	275.9	1.4	7819.7	3769.1	11588.8	3.07	73.236	7678.9	3909.8
44	-0.4513	284.416	282.0	1.5	7983.9	3620.1	11603.9	3.21	74.271	7612.0	3991.9
45	-0.4457	289.523	287.1	1.7	8119.4	3485.1	11604.4	3.33	75.208	7544.8	4059.7
46	-0.4400	293.653	291.2	1.8	8226.9	3365.1	11592.0	3.44	76.041	7478.6	4113.5
47	-0.4344	297.606	295.2	1.9	8329.3	3254.8	11584.0	3.56	76.807	7419.4	4164.6
48	-0.4287	300.712	298.3	2.0	8407.4	3152.6	11560.1	3.67	77.517	7356.4	4203.7
49	-0.4231	302.952	300.5	2.1	8461.0	3063.8	11524.8	3.76	78.134	7294.3	4230.5
50	-0.4174	305.299	302.8	2.2	8517.5	2979.0	11496.5	3.86	78.723	7237.7	4258.8
51	-0.4118	307.107	304.7	2.3	8558.7	2904.8	11463.5	3.95	79.237	7184.2	4279.3
52	-0.4061	309.513	307.1	2.4	8616.5	2835.8	11452.3	4.04	79.717	7144.0	4308.3
53	-0.4005	310.962	308.5	2.5	8647.4	2776.6	11424.0	4.11	80.128	7100.3	4323.7
54	-0.3948	312.418	310.0	2.7	8678.4	2722.1	11400.5	4.19	80.506	7061.3	4339.2
55	-0.3892	313.684	311.2	2.8	8703.9	2668.6	11372.5	4.26	80.878	7020.5	4352.0
56	-0.3835	314.661	312.2	2.9	8721.3	2621.2	11342.6	4.33	81.207	6981.9	4360.7
57	-0.3779	315.544	313.1	3.0	8736.1	2578.3	11314.4	4.39	81.505	6946.3	4368.0
58	-0.3722	316.624	314.2	3.1	8756.2	2537.7	11293.9	4.45	81.787	6915.8	4378.1
59	-0.3666	317.208	314.8	3.2	8762.5	2503.7	11266.2	4.50	82.023	6885.0	4381.3
60	-0.3609	317.893	315.4	3.3	8771.6	2470.8	11242.4	4.55	82.251	6856.6	4385.8
61	-0.3553	318.588	316.1	3.4	8780.8	2439.5	11220.3	4.60	82.469	6829.9	4390.4
62	-0.3496	319.299	316.8	3.5	8790.5	2411.1	11201.6	4.65	82.666	6806.4	4395.3
63	-0.3440	319.516	317.1	3.6	8786.5	2386.5	11173.0	4.68	82.837	6779.8	4393.2
64	-0.3383	320.147	317.7	3.8	8793.9	2364.4	11158.3	4.72	82.990	6761.4	4396.9
65	-0.3326	320.593	318.1	3.9	8796.1	2343.4	11139.6	4.75	83.136	6741.5	4398.1
66	-0.3270	321.131	318.7	4.0	8800.9	2321.9	11122.8	4.79	83.286	6722.3	4400.4
67	-0.3213	321.652	319.2	4.1	8805.1	2302.2	11107.3	4.82	83.423	6704.7	4402.6
68	-0.3157	322.281	319.8	4.2	8812.3	2282.1	11094.4	4.86	83.562	6688.2	4406.2
69	-0.3100	322.709	320.3	4.3	8814.0	2265.4	11079.3	4.89	83.678	6672.4	4407.0
70	-0.3044	323.094	320.6	4.4	8814.3	2247.5	11061.8	4.92	83.803	6654.6	4407.2
71	-0.2987	323.596	321.1	4.5	8818.0	2233.0	11051.0	4.95	83.903	6642.0	4409.0

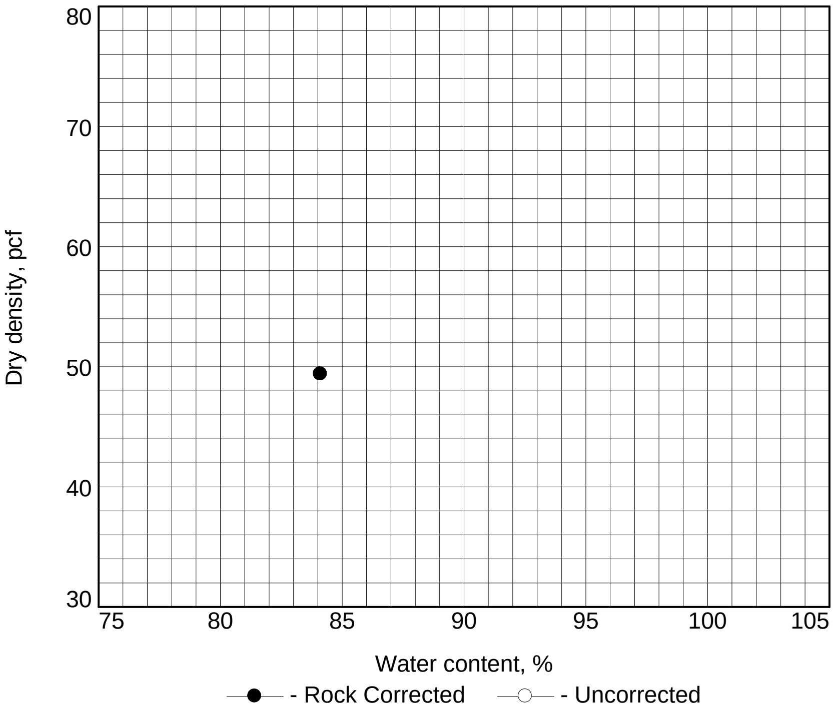
Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Eff. Stress psf	Major Eff. Stress psf	1:3 Ratio	Pore Press. psi	P psf	Q psf
72	-0.2931	323.940	321.5	4.6	8817.2	2219.8	11037.0	4.97	83.995	6628.4	4408.6
73	-0.2874	324.674	322.2	4.7	8827.1	2208.5	11035.6	5.00	84.073	6622.1	4413.6
74	-0.2818	325.126	322.7	4.9	8829.2	2203.1	11032.3	5.01	84.111	6617.7	4414.6
75	-0.2761	325.664	323.2	5.0	8833.7	2193.6	11027.3	5.03	84.177	6610.4	4416.9
76	-0.2705	326.441	324.0	5.1	8844.6	2184.9	11029.6	5.05	84.237	6607.3	4422.3
77	-0.2648	326.807	324.4	5.2	8844.3	2178.1	11022.5	5.06	84.284	6600.3	4422.2
78	-0.2592	327.079	324.6	5.3	8841.4	2171.4	11012.8	5.07	84.331	6592.1	4420.7
79	-0.2535	327.214	324.8	5.4	8834.8	2166.3	11001.1	5.08	84.366	6583.7	4417.4
80	-0.2479	327.684	325.2	5.5	8837.3	2157.2	10994.5	5.10	84.429	6575.9	4418.6
81	-0.2337	328.683	326.2	5.8	8838.5	2143.6	10982.1	5.12	84.524	6562.8	4419.3
82	-0.2196	330.299	327.8	6.1	8856.3	2132.0	10988.3	5.15	84.604	6560.2	4428.1
83	-0.2055	331.837	329.4	6.3	8871.7	2118.0	10989.7	5.19	84.701	6553.9	4435.8
84	-0.1914	333.482	331.0	6.6	8889.7	2105.7	10995.4	5.22	84.787	6550.5	4444.8
85	-0.1772	334.843	332.4	6.9	8899.9	2104.0	11003.9	5.23	84.799	6553.9	4449.9
86	-0.1631	336.136	333.7	7.2	8908.0	2103.7	11011.7	5.23	84.801	6557.7	4454.0
87	-0.1490	337.812	335.4	7.5	8926.1	2102.2	11028.3	5.25	84.812	6565.2	4463.1
88	-0.1348	339.595	337.1	7.7	8946.8	2102.8	11049.6	5.25	84.807	6576.2	4473.4
89	-0.1207	341.358	338.9	8.0	8966.7	2105.6	11072.3	5.26	84.788	6588.9	4483.3
90	-0.1066	343.125	340.7	8.3	8986.4	2108.0	11094.4	5.26	84.771	6601.2	4493.2
91	-0.0924	344.949	342.5	8.6	9007.3	2110.8	11118.2	5.27	84.751	6614.5	4503.7
92	-0.0783	346.428	344.0	8.8	9018.9	2114.8	11133.7	5.26	84.724	6624.3	4509.4
93	-0.0642	348.028	345.6	9.1	9033.4	2120.7	11154.1	5.26	84.683	6637.4	4516.7
94	-0.0500	350.586	348.1	9.4	9072.6	2130.1	11202.7	5.26	84.618	6666.4	4536.3
95	-0.0359	352.696	350.2	9.7	9099.8	2136.2	11236.0	5.26	84.575	6686.1	4549.9
96	-0.0218	355.344	352.9	9.9	9140.6	2142.6	11283.2	5.27	84.531	6712.9	4570.3
97	-0.0076	357.417	355.0	10.2	9166.1	2147.5	11313.7	5.27	84.497	6730.6	4583.1
98	0.0065	359.424	357.0	10.5	9189.6	2156.5	11346.1	5.26	84.434	6751.3	4594.8
99	0.0206	361.488	359.0	10.8	9214.2	2166.0	11380.2	5.25	84.368	6773.1	4607.1
100	0.0347	363.763	361.3	11.0	9243.9	2175.5	11419.5	5.25	84.302	6797.5	4622.0
101	0.0489	365.916	363.5	11.3	9270.2	2185.7	11455.8	5.24	84.232	6820.7	4635.1
102	0.0630	368.898	366.4	11.6	9317.1	2195.4	11512.5	5.24	84.164	6854.0	4658.6
103	0.0771	371.871	369.4	11.9	9363.4	2207.1	11570.4	5.24	84.083	6888.7	4681.7
104	0.0913	373.753	371.3	12.1	9381.6	2222.9	11604.5	5.22	83.973	6913.7	4690.8
105	0.1054	375.691	373.2	12.4	9400.9	2237.9	11638.9	5.20	83.869	6938.4	4700.5
106	0.1195	377.659	375.2	12.7	9420.7	2245.0	11665.8	5.20	83.819	6955.4	4710.4
107	0.1337	379.374	376.9	13.0	9433.9	2254.5	11688.3	5.18	83.754	6971.4	4716.9
108	0.1478	380.840	378.4	13.3	9440.5	2265.0	11705.6	5.17	83.681	6985.3	4720.3
109	0.1619	383.409	381.0	13.5	9474.4	2276.9	11751.3	5.16	83.598	7014.1	4737.2
110	0.1761	384.960	382.5	13.8	9482.6	2294.0	11776.6	5.13	83.479	7035.3	4741.3
111	0.1902	386.089	383.6	14.1	9480.1	2310.1	11790.2	5.10	83.368	7050.1	4740.0
112	0.2043	387.223	384.8	14.4	9477.6	2320.8	11798.3	5.08	83.294	7059.5	4738.8
113	0.2184	388.619	386.2	14.6	9481.3	2324.8	11806.1	5.08	83.265	7065.5	4740.7
114	0.2326	389.580	387.1	14.9	9474.2	2335.2	11809.4	5.06	83.193	7072.3	4737.1
115	0.2467	391.096	388.6	15.2	9480.4	2346.2	11826.6	5.04	83.117	7086.4	4740.2
116	0.2608	392.707	390.3	15.5	9488.7	2362.9	11851.6	5.02	83.001	7107.3	4744.4
117	0.2750	394.250	391.8	15.7	9495.1	2375.9	11871.0	5.00	82.911	7123.4	4747.6
118	0.2891	396.113	393.7	16.0	9509.1	2387.0	11896.0	4.98	82.834	7141.5	4754.5

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Eff. Stress psf	Major Eff. Stress psf	1:3 Ratio	Pore Press. psi	P psf	Q psf
119	0.3032	397.010	394.6	16.3	9499.4	2395.2	11894.6	4.97	82.776	7144.9	4749.7
120	0.3171	398.703	396.2	16.6	9509.2	2403.2	11912.4	4.96	82.721	7157.8	4754.6

COMPACTION TEST REPORT



Curve No.

Test Specification:
ASTM D 1557-12 Method A Modified

Hammer Wt.: 10 lb.
Hammer Drop: 18 in.
Number of Layers: five
Blows per Layer: 25
Mold Size: 0.03333 cu. ft.
Test Performed on Material Passing #4 **Sieve**

Soil Data

NM	74.1%	**Sp.G.**	
LL		**PI**	
%>#4		**%<#200**	
USCS		**AASHTO**	

TESTING DATA

	1	2	3	4	5	6
WM + WS	12.58					
WM	9.55					
WW + T #1	171.5					
WD + T #1	100.0					
TARE #1	15.0					
WW + T #2						
WD + T #2						
TARE #2						
MOISTURE	84.1					
DRY DENSITY	49.4					

TEST RESULTS

Material Description
Magsulf salt

Project No. 475.0385.000 **Client:** Lithium Nevada
Project: Thacker Pass

○ **Location:** Salts 12/17/2019 +10% moisture

NewFields

Remarks:

Figure

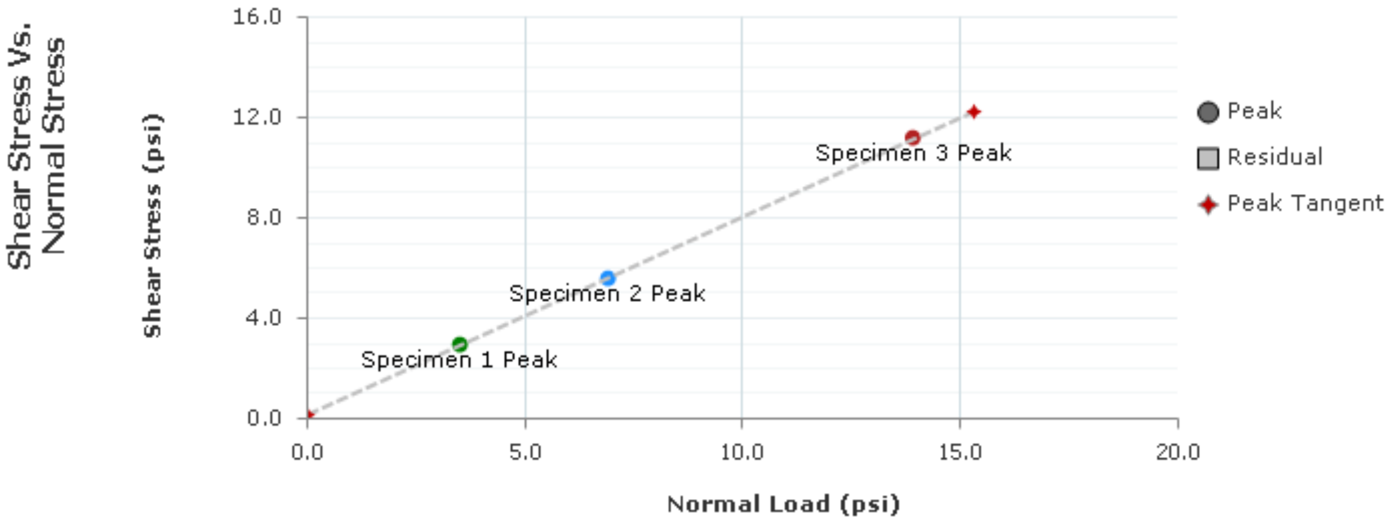
Tested By: KE **Checked By:** KM

NewFields
2227 North 5th Street
Elko, Nevada
775-738-3399

Direct Shear Test

ASTM D3080

Project: Thacker Pass
Project Number: 475.0385.000
Location: Salt
Client Name: Lithium Nevada



C (psi): 0.2
Phi (°): 38.2

Residual C (psi): NA
Residual Phi (°): NA

	Specimen Number							
Initial	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture (%):	84.1	84.1	84.1					
Dry Density (pcf):	42.1	42.1	42.1					
Void Ratio:	3.035	3.035	3.035					
Saturation (%):	75.4	75.4	75.4					
Diameter (in):	2.5000	2.5000	2.5000					
Height (in):	1.2000	1.2000	1.2000					
Final	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture (%):	84.1	84.1	84.1					
Dry Density (pcf):	42.4	42.9	42.4					
Void Ratio:	3.006	2.962	3.005					
Saturation (%):	76.1	77.2	76.1					
Height (in):	1.1914	1.1783	1.1910					
Normal Stress (psi):	3.5	6.9	13.9					
Peak Shear Stress (psi):	3.0	5.6	11.2					
Residual Stress (psi):	NA	NA	NA					
Horizontal Deformation (%):			12.0					
Rate (in/min):	0.006250	0.006250	0.006250					

Checked By: ____________________ Date: _____________

Direct Shear Test

ASTM D3080

Project: Thacker Pass
Project Number: 475.0385.000
Sampling Date: 2/3/2020
Sample Number:
Sample Depth:
Location: Salt
Client Name: Lithium Nevada
Remarks: Salt Testing: As recevied +10% Water

Information Parameters	Specimen Number 1	2	3	4	5	6	7	8
Liquid Limit:	0	0	0					
Plastic Limit:	0	0	0					
Specific Gravity:	2.72	2.72	2.72					
Specific Gravity Method:	ASSUMED	ASSUMED	ASSUMED					
Initial Parameters	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Test Temperature (°C):	0.0	0.0	0.0					
Sample Shape:	ROUND	ROUND	ROUND					
Height (in):	1.2000	1.2000	1.2000					
Diameter (in):	2.5000	2.5000	2.5000					
Area (in²):	4.909	4.909	4.909					
Volume (in³):	5.8905	5.8905	5.8905					
Moisture (%):	84.1	84.1	84.1					
Dry Density (pcf):	42.1	42.1	42.1					
Wet Density (pcf):	77.5	77.5	77.5					
Saturation (%):	75.4	75.4	75.4					
Void Ratio:	3.035	3.035	3.035					
Porosity (%):	75.2	75.2	75.2					
Consolidation Parameters	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Initial Reference Height (in):	1.2000	1.2000	1.2000					
Final Reference Height (in):	1.1914	1.1783	1.1910					
Height (in):	1.1914	1.1783	1.1910					
Final Parameters	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%)	84.1	84.1	84.1					
Dry Density (pcf):	42.4	42.9	42.4					
Wet Density (pcf):	78.0	78.9	78.1					
Saturation (%):	76.1	77.2	76.1					
Void Ratio:	3.006	2.962	3.005					
Porosity (%):	75.0	74.8	75.0					

Checked By: ____________________ Date: _____________

Direct Shear Test

ASTM D3080

Project: Thacker Pass
Project Number: 475.0385.000
Sampling Date: 2/3/2020
Sample Number:
Sample Depth:
Location: Salt
Client Name: Lithium Nevada
Remarks: Salt Testing: As recevied +10% Water

Specific Gravity: 0
Plastic Limit: 0
Liquid Limit: 0
Type: Bulk
Soil Classification: Salt
Specimen Description: White Salt

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch

Checked By: ____________________ Date: _____________

NewFields
2227 North 5th Street
Elko, Nevada
775-738-3399

NewFields

Direct Shear Test

ASTM D3080

Specimen 1

Test Description: ASTM D3080
Other Associated Tests:
Device Details: Humboldt 5760 E-803
Test Specification:
Test Time: 1/31/2020
Technician: K. Magner
Sampling Method: Bulk
Specimen Code:
Specimen Lab #:
Specimen Description: Salt. As received moisture +10% moisture
Specific Gravity: 2.72
Plastic Limit: 0
Liquid Limit: 0
Test Remarks: As received moisture +10% water

Specimen 2

Test Description: ASTM D3080
Other Associated Tests:
Device Details: Humboldt 5760 E-803
Test Specification:
Test Time: 2/2/2020
Technician: K. Magner
Sampling Method:
Specimen Code:
Specimen Lab #:
Specimen Description: Salt. As received moisture +10% moisture
Specific Gravity: 2.72
Plastic Limit: 0
Liquid Limit: 0
Test Remarks: As received moisture +10% moisture

NewFields
2227 North 5th Street
Elko, Nevada
775-738-3399

NewFields

Direct Shear Test

ASTM D3080

Specimen 3

Test Description:	ASTM D3080		
Other Associated Tests:			
Device Details:	Humboldt 5760 E-803		
Test Specification:			
Test Time:	4/2/2020		
Technician:	K. Magner	Sampling Method:	
Specimen Code:		Specimen Lab #:	
Specimen Description:	Salt. As received moisture +10% moisture		
Specific Gravity:	2.72		
Plastic Limit:	0	Liquid Limit:	0
Test Remarks:			

Checked By: ____________________ Date: _____________

NewFields

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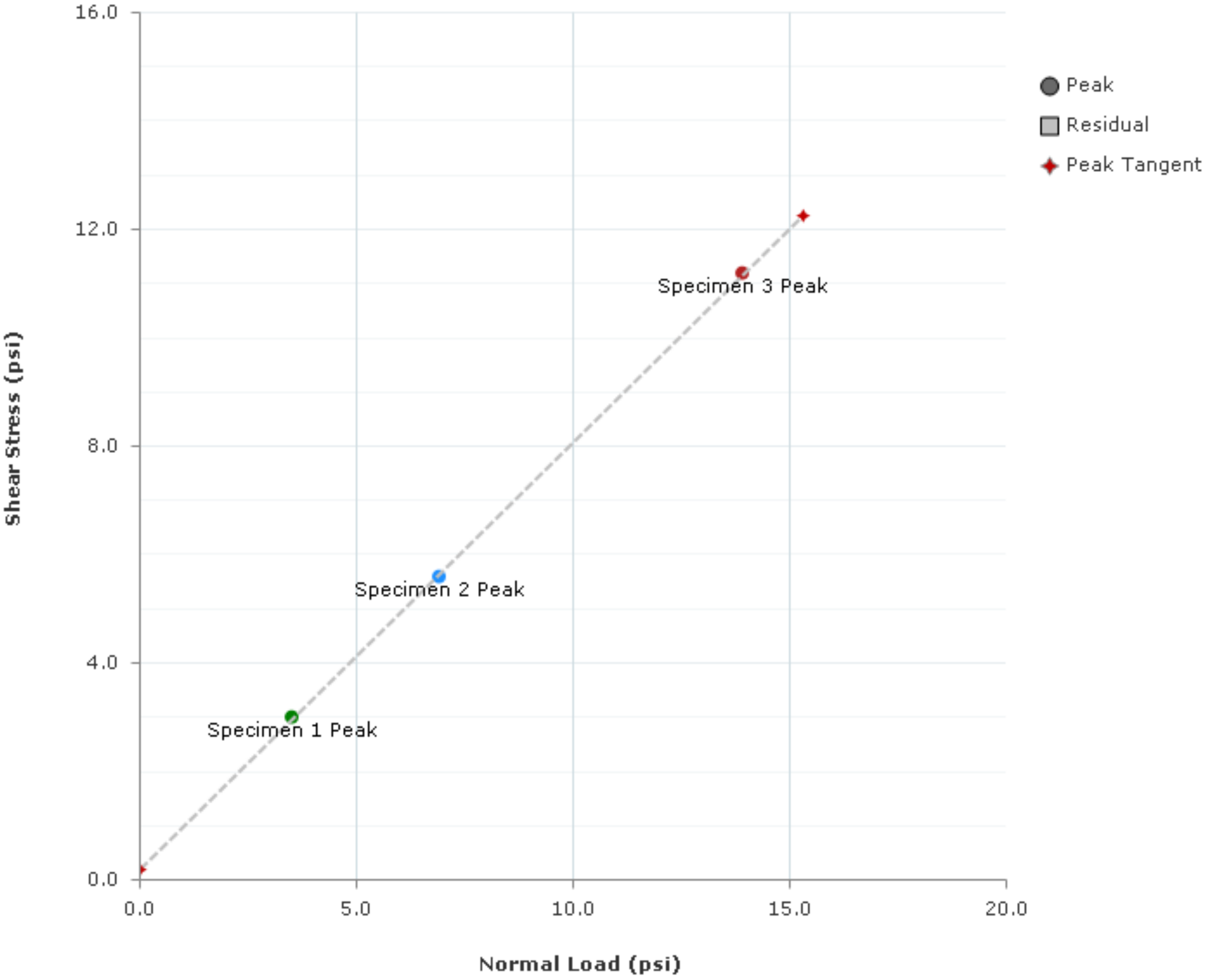
Elko, Nevada
775-738-3399

Direct Shear Test - Shear Stress Vs. Normal Stress

ASTM D3080



Tangent Results	C (psi)	Phi (°)
Peak Tangent:	0.2	38.2
Residual Tangent:	NA	NA

Project Name: Thacker Pass Project Number: 475.0385.000

Checked By: ____________________ Date: ______________

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2227 North 5th Street
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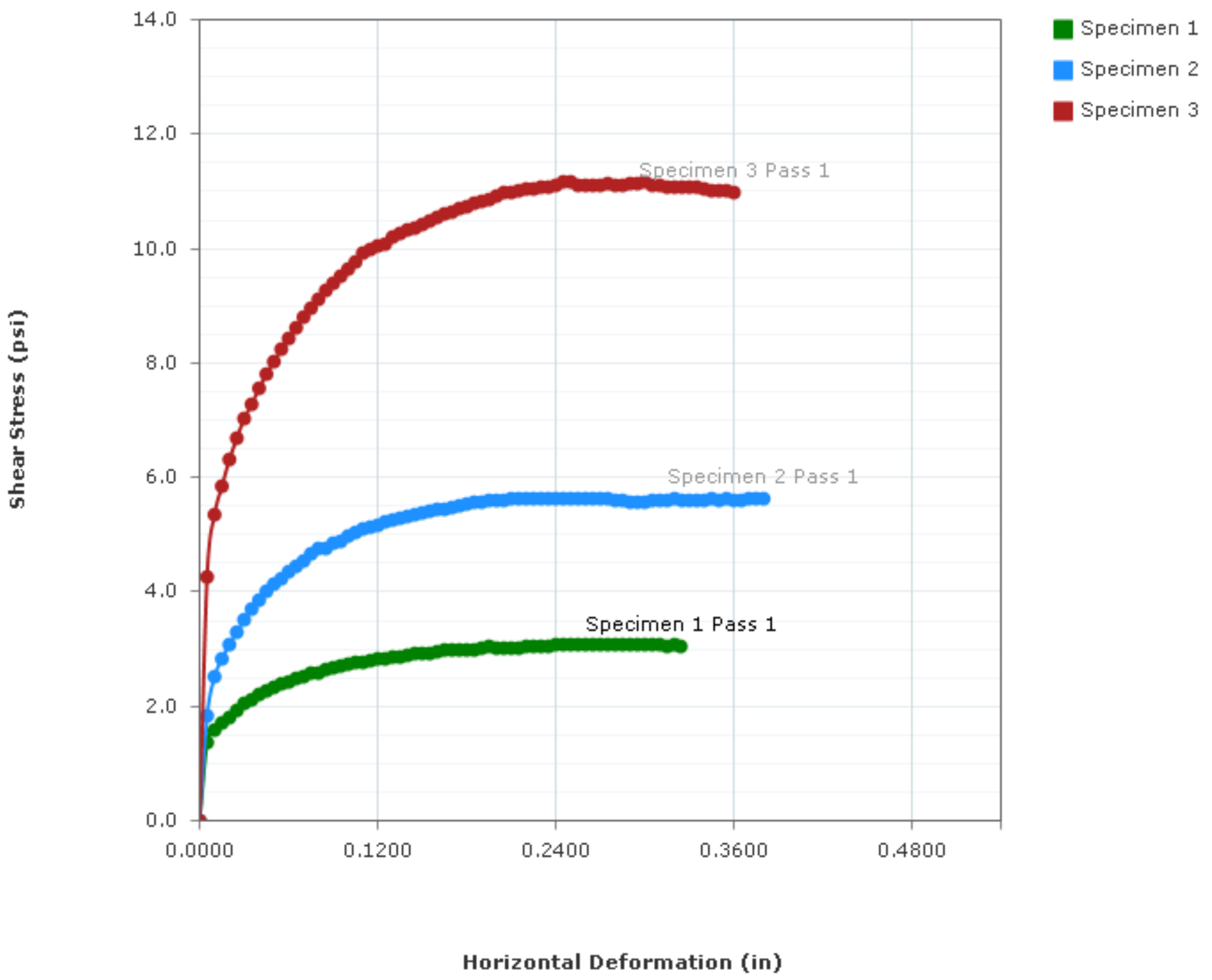
775-738-3399

Graph - Stress Deformation

ASTM D3080



Project Name: Thacker Pass Project Number: 475.0385.000

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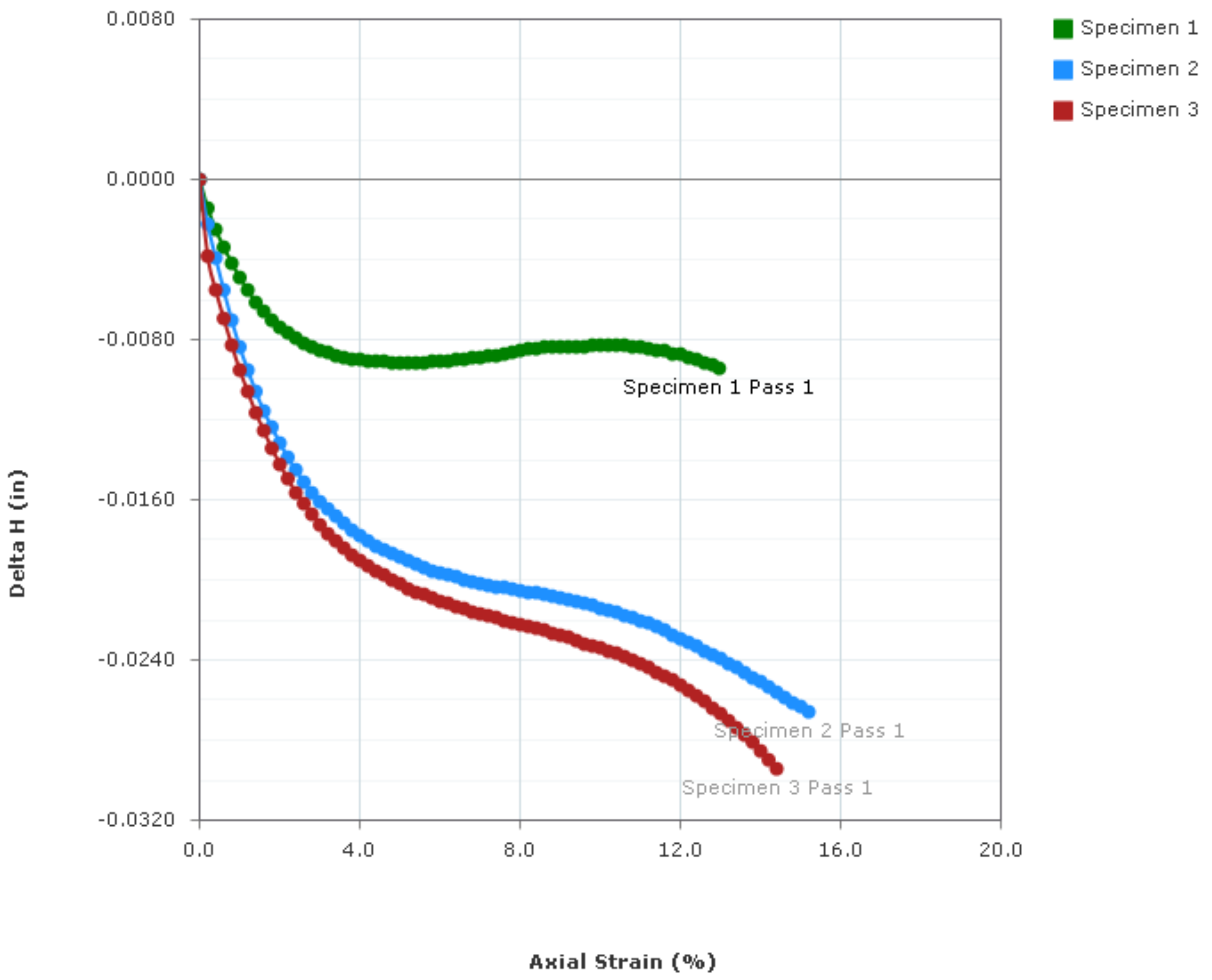
Graph - Delta H

ASTM D3080

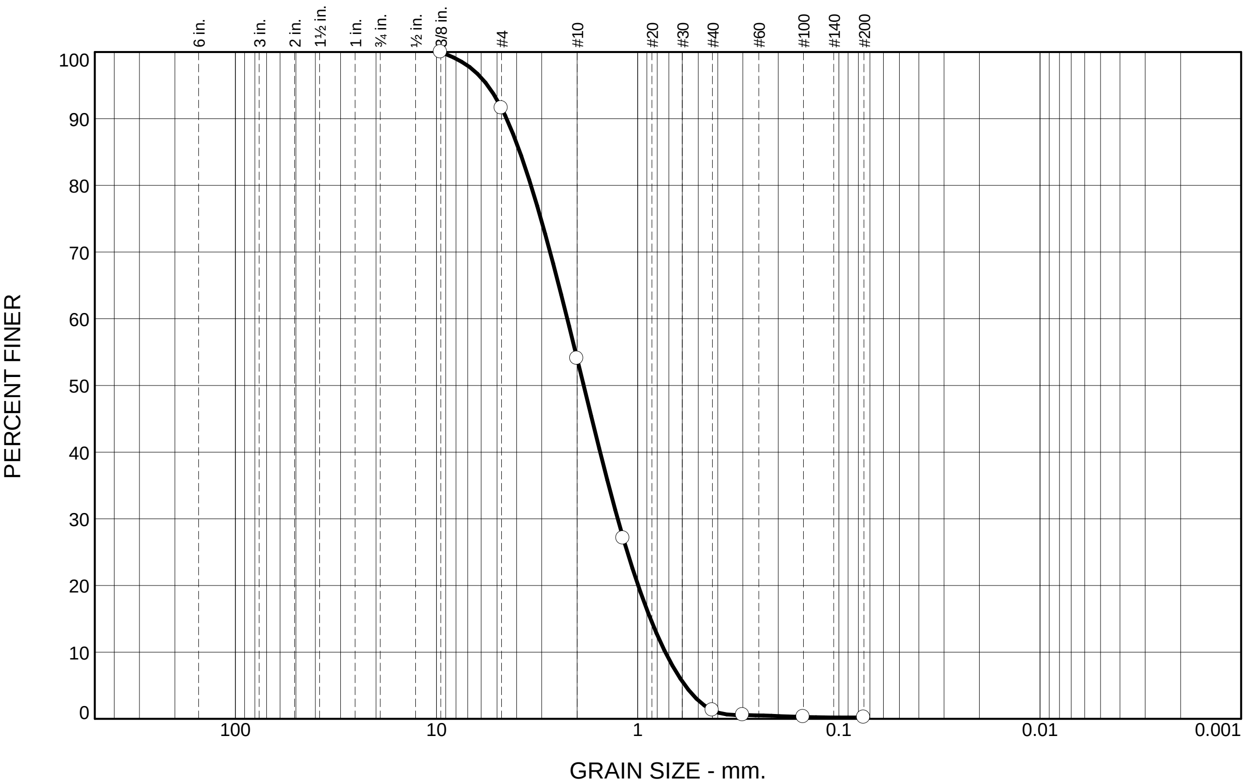


Checked By: ____________________ Date: _____________

APPENDIX C.8

Coarse Gangue Stockpile Laboratory Testing Results

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	8.4	37.6	52.7	1.1	0.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	91.6		
#10	54.0		
#16	27.1		
#40	1.3		
#50	0.6		
#100	0.3		
#200	0.2		

* (no specification provided)

Material Description

Brown poorly graded sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 4.4822 D_{85}= 3.8513 D_{60}= 2.2387
D_{50}= 1.8556 D_{30}= 1.2574 D_{15}= 0.8635
D_{10}= 0.7288 C_u= 3.07 C_c= 0.97

Classification

USCS= SP AASHTO= A-1-b

Remarks

As received moisture: 0%

Location: Coarse Gangue
Sample Number: 19-336-02
Date: 9/25/2019

NewFields

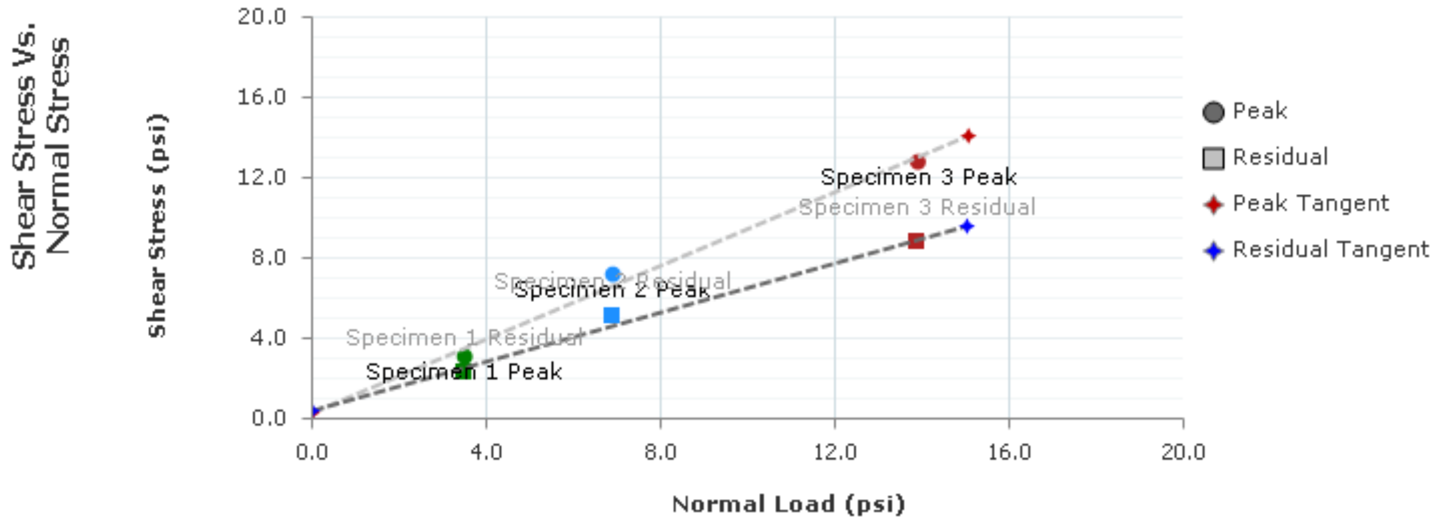
Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-336-02

Tested By: JH **Checked By:** JH

Direct Shear Test

ASTM D3080

Project: Thacker Pass
Project Number: 475.0385
Location: Coarse Gangue Stockpile
Client Name: Lithium Nevada



C (psi): 0.3
Phi (°): 42.4

Residual C (psi): 0.5
Residual Phi (°): 31.3

				Specimen Number				
Initial	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture (%):	0.0	0.0	0.0					
Dry Density (pcf):	88.8	88.8	88.8					
Void Ratio:	0.912	0.912	0.912					
Saturation (%):	0.0	0.0	0.0					
Diameter (in):	4.0000	4.0000	4.0000					
Height (in):	1.2600	1.2600	1.2600					
Final	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture (%):	0.0	0.0	0.0					
Dry Density (pcf):	88.9	88.8	88.8					
Void Ratio:	0.911	0.912	0.912					
Saturation (%):	0.0	0.0	0.0					
Height (in):	1.2596	1.2600	1.2600					
Normal Stress (psi):	3.5	6.9	13.9					
Peak Shear Stress (psi):	3.1	7.2	12.8					
Residual Stress (psi):	2.3	5.1	8.8					
Horizontal Deformation (%):								
Rate (in/min):	0.040000	0.040000	0.040000					

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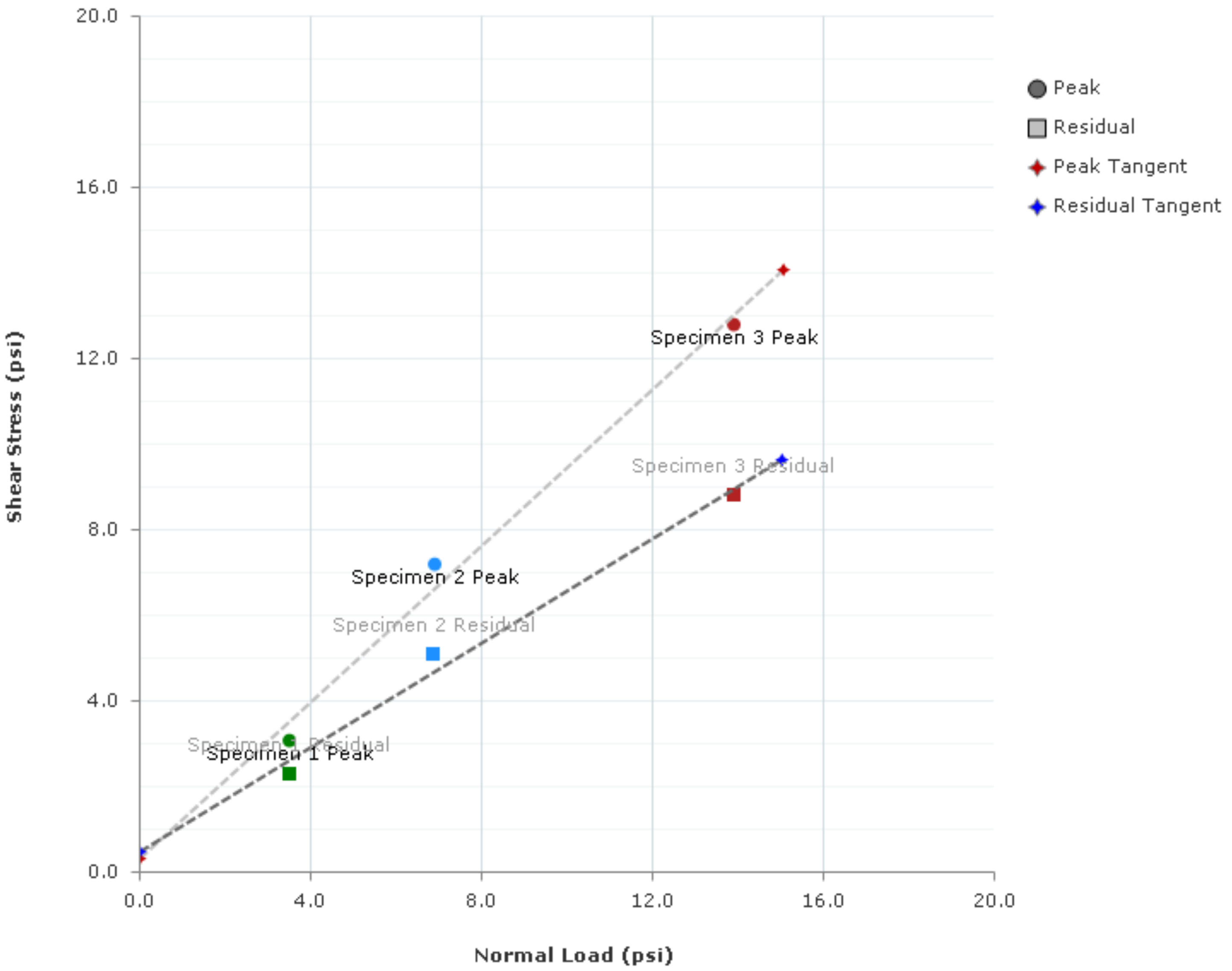
Direct Shear Test - Shear Stress Vs. Normal Stress

ASTM D3080



Tangent Results	C (psi)	Phi (°)
Peak Tangent:	0.3	42.4
Residual Tangent:	0.5	31.3

Project Name: Thacker Pass Project Number: 475.0385

Checked By: ____________________ Date: _____________

NewFields

NewFields
2227 North 5th Street
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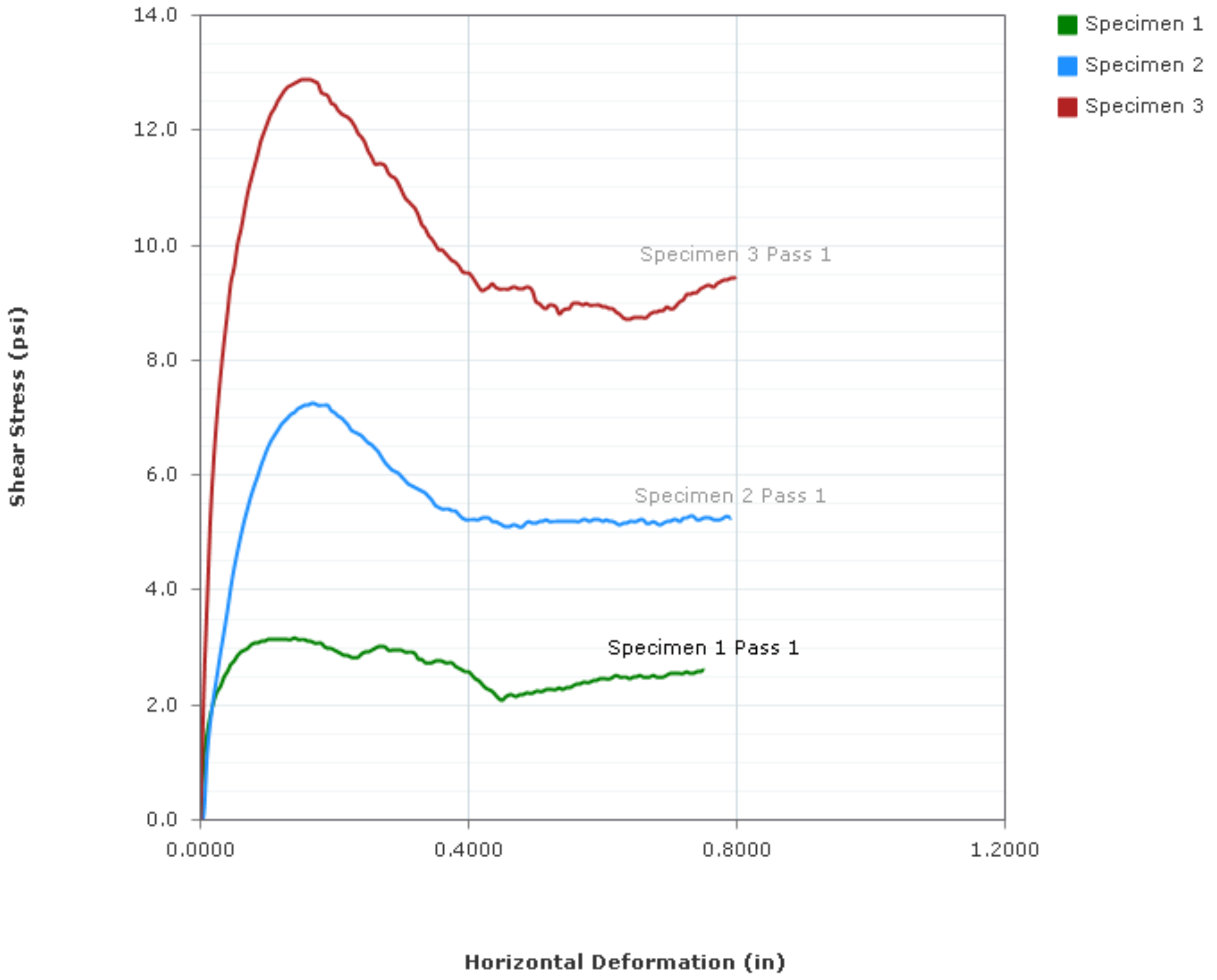
775-738-3399

Graph - Stress Deformation

ASTM D3080



Project Name: Thacker Pass Project Number: 475.0385

Checked By: ____________________ Date: _____________

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2227 North 5th Street
Elko, Nevada
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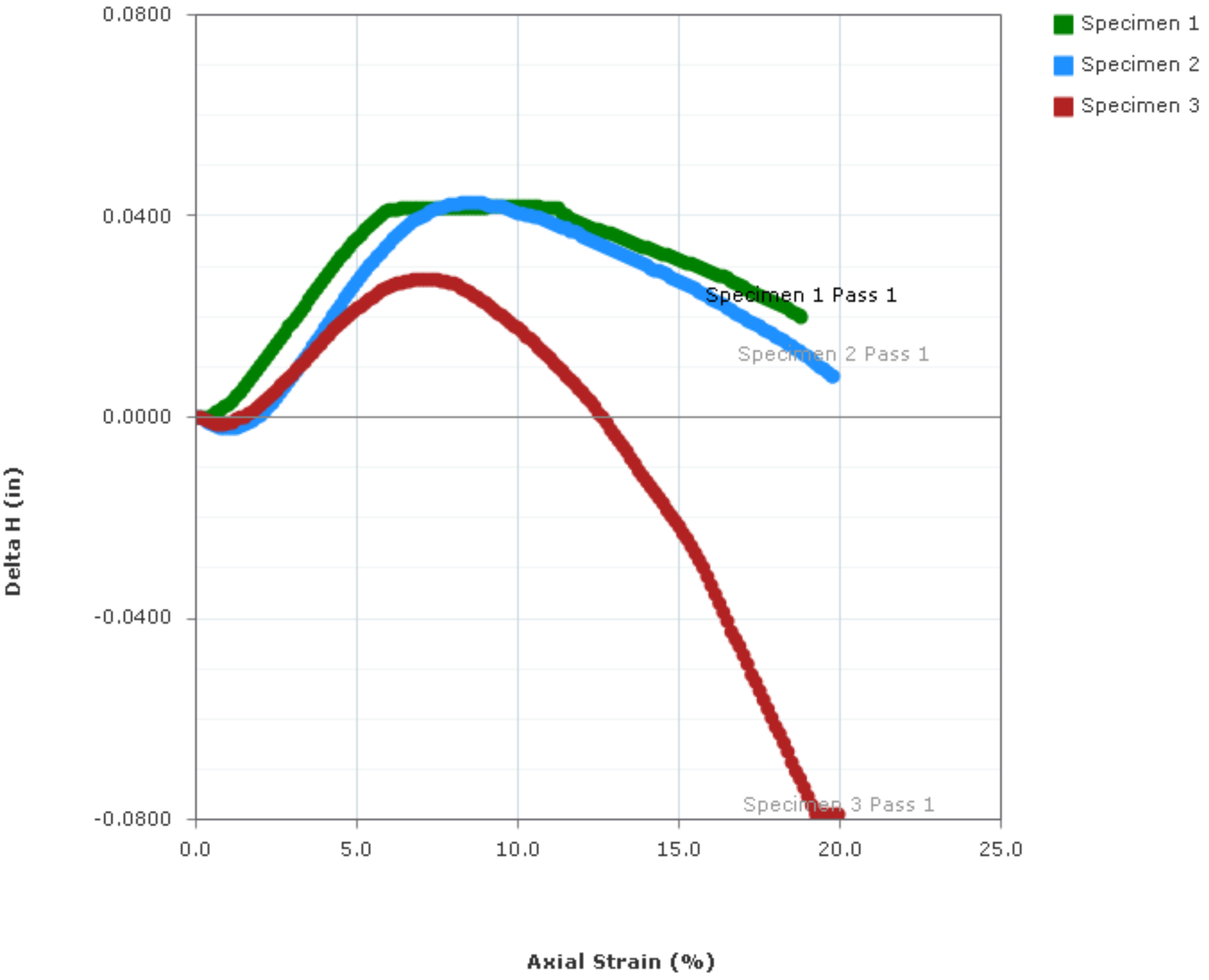
NewFields

Graph - Delta H

ASTM D3080



Project Name: Thacker Pass Project Number: 475.0385

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APPENDIX D

Geotechnical Evaluation

APPENDIX D.1

Plant Site Soils and Foundation Report (2019)

PLANT SITE
SOILS AND FOUNDATION REPORT
THACKER PASS PROJECT

Prepared for:
Lithium Nevada Corporation
3685 Lakeside Drive
Reno, Nevada 89509

Prepared by:
NewFields
9400 Station Street, Suite 300
Lone Tree, CO 80124

NewFields Project No. 475.0385.000
November 29, 2019

NewFields
Perspective. Vision. Solutions.

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November 29, 2019
NewFields Project No. 475.0385.000

Lithium Nevada Corporation
3685 Lakeside Drive
Reno, Nevada 89509

Attn: **Mr. Brett Rabe**
Vice President of Engineering

Subject: **Process Plant Site Soil and Foundation Report**
Thacker Pass Project
Humboldt County, Nevada

Mr. Rabe,

We are pleased to submit the soil and foundation report for the Thacker Pass Process Plant Site Project.

Reporting was completed in general conformance with the proposal to prepare Engineering Design (NewFields Proposal No. 18PD.133). Bearing capacity and design recommendations for spread, strip and mat footings are presented, and general soil recommendations in support of the earthworks associated with the process plant site development are provided. Recommendations presented in the report are based on results of a recent geotechnical investigation and laboratory testing program completed to facilitate design of the mine process plant site area and associated infrastructure.

We appreciate the opportunity to work with Lithium Nevada Corporation on this project. If you have any questions or require additional information, please contact the undersigned.

Sincerely,

NewFields Mining Design & Technical Services

Kerry A. Magner

Kerry A. Magner, P.E.
Senior Geotechnical Engineer II

KERRY A. MAGNER
Exp: 12/31/21
CIVIL
No. 026820
11/29/19

Reviewed by:

Paul Kaplan

Paul Kaplan, P.E.
Principal Engineer

Addressee: (via e-mail)

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Appendix B	Laboratory Testing Data Sheets

1. INTRODUCTION

This report presents the findings from the geotechnical investigation of the Thacker Pass Project for Lithium Nevada Corporation (LNC), and subsequent soil and foundation recommendations for the Process Plant site infrastructure. The work was completed in general conformance with the Proposal to Prepare Water Pollution Control Permit and Engineering Design presented to LNC (October, 2018)

The Thacker Pass Project comprises the development of an open pit lithium mine and associated infrastructure including mine waste facilities (Clay Tailings Filter Stack (CTFS), Waste Rock Dump (WRD), Coarse Gangue Stockpile); Process Plant; and storm water management infrastructure.

1.1. Project Background and Scope

A prefeasibility level geotechnical study (PFS) for an alternate process plant site was completed (AMEC, 2011). The study included a site investigation and subsequent geotechnical recommendations including preliminary geotechnical recommendations for the open pit and foundation and earthwork recommendations for the various facilities associated with the project.

The general location of the process plant and individual structures orientated on the various process plant pads have been altered since the PFS was completed. In spring 2019, NewFields completed a geotechnical investigation to assess the geotechnical conditions in the subsurface beneath the altered Process Plant location. Since the investigation was completed, additional alterations to the plant location and structures has occurred.

In general, sufficient data is available to suitably characterize the subsurface beneath the Process Plant, but additional data is necessary to confirm conditions beneath the sulfuric acid plant. An additional geotechnical program is planned for the future to confirm subsurface conditions beneath the sulfuric acid plant.

NewFields considered information and data from the current and previous investigations, and information from LNC, as the basis to complete our analysis and to evaluate the geotechnical conditions of the proposed Process Plant site. The result of this work was the development of general soil and foundations recommendations that are presented herein.

2. SITE LOCATION AND DESCRIPTION

The Thacker Pass Project is located in Humboldt County Nevada, approximately 60 miles north-northwest of the Winnemucca, Nevada and approximately 50 miles south of the Nevada-Oregon border.

Based on the topographic contours shown on the site plan provided by LNC (Survey by Geoterra, 2017), the Process Plant Site area is characterized by gently sloping topography with existing elevations ranging between 4680 and 4760 feet above mean sea level (amsl). The process plant site is located north of Nevada Route 293 along a southeast facing slope of the Santa Rosa Mountain Range. The area is currently used for ranching with native vegetation in the region consisting primarily of sagebrush and several perennial and ephemeral streams crossing the site

2.1. Regional Geology and Seismicity

The Project is located within the McDermitt caldera near the northern extent of the Great Basin region of the Basin and Range Physiographic Province. In general, the Great Basin is characterized by a series of north trending mountain ranges, and traces of recently active faults are located at the base of many of the linear mountain ranges in the Province. Earthquakes in this region are typically associated with geologically young fault traces and recently active volcanoes.

The McDermitt caldera formed approximately 16.4 million years ago (ma), in an area that had undergone two episodes of Eocene intermittent volcanism at 47 and 39 ma and a major middle Miocene volcanism that led continuously to caldera formation. The caldera is well exposed and has been negligibly affected by later extension.

The McDermitt caldera complex, as wide as 28 miles in diameter, is situated within one of the largest recognized structural depressions. The majority of the collapse occurred along a narrow ring-fault zone of discrete faults with variable downwarp into the caldera between faults (Henry et al., 2016). The region has experienced moderate to low levels of seismicity during recent times.

2.2. Local Geology

The Thacker Pass Project site is located between the Montana Mountains and the Double H Mountains, near the southern edge of the McDermitt Caldera in the Santa Rosa Mountain Range. The stratigraphy and bedrock within the process plant site generally consists of Quaternary alluvial deposits overlying Tertiary basalt and rhyolitic volcanics.

3. PROCESS PLANT SITE GEOTECHNICAL INVESTIGATION

As previously discussed, a PFS site investigation has been completed for the development of the Thacker Pass Project (AMEC, 2011). The locations of the NewFields 2019 borings and test pits associated with the current Process Plant location, as well the previous investigation, are shown on **Figure 1**.

3.1. 2019 Field Investigation

A field exploration campaign for the Project was performed in early 2019 and included a total of thirty-one borings and twenty-nine test pits. Seven borings and three test pits were completed within the general proximity of the currently proposed Process Plant. This investigation was completed to supplement existing site data and acquire more detailed geotechnical information beneath select facilities (Process Plant and CTFS). One boring within the Process Plant footprint was extended to a depth of 100 feet below ground surface (bgs), and the remaining six borings were extended to between 30 to 50 feet bgs. Test pits were excavated to depths of approximately 15 to 20 feet bgs. Test pits completed to less than 20 feet bgs were terminated due to practical refusal on bedrock.

The results from the investigation and laboratory testing have been presented in a Geotechnical Factual Report (NewFields, 2019a). Borehole and test pit logs for exploration performed within the Process Plant are presented in **Appendix A**.

3.2. Laboratory Results

Soil and rock samples obtained during the field investigation were labeled, packaged and transported to the NewFields laboratory in Elko, Nevada where the majority of the soil testing was completed. Bulk samples tested for corrosivity potential were sent to Sunland Analytical Laboratory. Samples obtained from the field investigation were tested for index properties, natural moisture and unit weight, specific gravity of soil solids, moisture content/unit weight relationships, and corrosivity potential. Individual laboratory data sheets are presented in **Appendix B** and summarized in **Table B-1**.

Soil classification involved particle size analyses and Atterberg limits which were used to divide soils into groups such that the engineering properties of the soils within each group are similar. Each sample was categorized according to the Unified Soil Classification System (USCS), which is based on the material gradation and plasticity.

3.2.1. Index Properties

The index properties of soils were evaluated by particle size analyses and Atterberg limits tests. Results indicate that the materials encountered were predominantly composed of fine to coarse grained silty sand with varying amounts of gravel particles.

Atterberg limits results indicate the plasticity index (PI) ranges from nonplastic to high plasticity with the majority of fine-grained materials exhibiting nonplastic behavior. Based on the measured gravimetric water content, the majority of the plastic materials are at or below the plastic limit. The samples yielded an average moisture content of 13.5 percent as measured on a dry weight-basis (i.e. geotechnical definition). The apparent specific gravity of soil solids was measured as 2.54.

3.2.2. Moisture Content – Unit Weight Relationship

The relationships between unit weight (density) and moisture content was established for a bulk sample using Proctor compaction test procedure. The modified Proctor test (ASTM D1557) was performed on a bulk test pit sample to determine the maximum dry unit weight and the corresponding optimum moisture content. The sample yielded a maximum dry unit weight of 78.3 pcf and an optimum moisture content of 34.0 percent.

3.2.3. Corrosivity Potential

Laboratory soil resistivity, pH, and water soluble sulfates and chlorides tests were conducted on soils obtained from select areas to assess their corrosivity potential, and results are presented in **Table 3-1**.

Table 3-1. Results of Corrosivity Potential Testing

Sample	Depth (ft)	Material Type	pH	Resistivity (ohm–cm)	Sulfates (ppm)	Chlorides (ppm)
BH19-12	2.5-6.5	Silty SAND (SM)	7.65	150	691.9	1246.9
BH19-13	7.5-10.5	Silty SAND (SM)	7.88	780	45.5	103.2
BH19-26	10-11.5	SAND (SW-SM) with gravel and silt	7.85	750	295.2	97.2

The average pH of the native soil was approximately 7.8, which is considered mildly alkaline. The measured resistivity ranged from 150 to 750 ohm-cm, which indicates the soil has a high corrosion potential for steel (American Petroleum Institute, 1991). The average measured chlorides ranged from 97 to 1240 parts per million (ppm), which indicates the soil is mildly corrosive to corrosive to steel. The measured water soluble sulfates in the soil ranged from 46 to 690ppm, which indicates negligible sulfate exposure for concrete (American Concrete Institute, 1994).

4. PROCESS PLANT SITE CONDITIONS

As noted previously, the location of the Process Plant has changed since the 2019 site investigation was completed, but in general, sufficient information is available to suitably characterize the subsurface.

4.1. Subsurface Conditions

Subsurface conditions can generally be classified as a thin veneer of growth media, approximately 12 inches in thickness, overlying alluvium overburden consisting of loose to very dense fine to coarse silty sands with varying amounts of gravel overlying residuum composed of slightly weathered to highly weathered basalt. Measured SPT blow counts (N-values) in the alluvium soil ranged between 11 and practical sampler refusal, with the majority of soils exhibiting dense to very dense relative density. Practical refusal is the result of increased gravel fractions. The thickness of alluvium overburden varies significantly across the Process Plant, with recorded thicknesses between 11 feet to over 30 feet.

Exposed surficial bedrock and rock outcrops are present across the entire project site, although outcrop was not observed within the process plant site footprint. Bedrock was encountered at depths of 11 feet near the main parking lot and laydown yard. Under the process plant facilities, bedrock was encountered at depths of 21 feet to over 30 feet bgs. The rock quality designation (RQD) of the bedrock ranges between 0 and 100 percent, and was typically lower near the transition from soil to weathered rock.

There is no general trend of overburden thickness or bedrock elevation across the site, primarily due to the degree of weathering and the basalt depositional process.

4.2. Groundwater Conditions

Groundwater was encountered in the deep borehole at a depth of approximately 93 feet below ground surface (bgs). Throughout the remainder of the Process Plant, the boreholes did not encounter groundwater in the upper 50 feet bgs. In general, groundwater is not expected to influence construction of the Process Plant or future operations.

5. GEOTECHNICAL RECOMMENDATIONS

This section summarizes our geotechnical recommendations based on the proposed construction and subsurface conditions encountered beneath the Process Plant. Design parameters and a discussion of geotechnical considerations related to construction of the various components of the process plant site are included herein.

At this time, information regarding the proposed grading plan, building type, foundation types, foundation elevations, finish floor grades, and structural loads are not available. All recommendations provided herein are preliminary and will be revised when further information becomes available.

As previously noted, there is an approximate 80-foot drop across the Process Plan footprint. Based on this, we have generally assumed that both cut into the existing terrain and fill will be required to create either a large, level pad or series of smaller pads to site the structures.

5.1. Foundation Recommendations

Based on our understanding of the proposed project, anticipated structural loadings, and subsurface conditions, the various mine infrastructure may be supported using a combination of shallow footings (strip and spread footings), mat foundations, and slab-on-grade. Deep foundation elements such as caissons or driven piles are not appropriate. Geotechnical recommendations for design and construction of these foundation types are presented in the following subsections.

The recommendations presented herein assume that mat foundations will include 3 feet of embedment and spread footings include 3 feet of embedment below the proposed ground surface. All foundation elements were assumed to bear upon homogeneous, alluvium with no influence from the underlying rock.

The foundation evaluations considered bearing capacity as a function of shear strength as well as allowable settlement. Because loading information was not available, values of settlement are considered a conservative estimate.

Bearing capacity based on shear strength utilized Mohr-Coulomb strength parameters developed from the current field investigation data and the standard bearing capacity equation with coefficients as defined by Meyerhof (1963). Based upon grainsize distribution and SPT values, all soils at the site were assumed to have an effective friction angle of 36 degrees and a moist unit weight of 100 pounds per cubic foot (pcf). It is assumed that native soils and compacted fills prepared from native soils will have similar strength and deformation properties. The modulus of elasticity (Young's Modulus) was assumed to be 500 kips per square foot (ksf) based on the relationship of SPT blow counts with Young's Modulus presented by Bowles (1996). Drained conditions were considered appropriate for all potential loading scenarios.

The settlement analyses for both shallow footing and mat foundations considered strength and deformation data from the current laboratory testing programs associated with this process plant site location to estimate Young's modulus, which was subsequently related to the subgrade modulus. All compressibility properties applied in the settlement evaluations are summarized in **Table 5-1**.

Table 5-1: Compressibility Parameters for Foundation Design

Material	Unit Weight (pcf)	Young's Modulus (ksf)	Poisson's Ratio
Alluvial Soil	100	500	0.40

5.1.1. Spread and Strip Footings

Allowable (*gross*) bearing capacity estimates were based on shear failure in the foundation utilizing the general Terzaghi bearing capacity equation (1943) that includes factors for foundation shape and embedment depth. The allowable bearing capacity, defined as the maximum foundation pressure against subsurface soils, varies with the footing width. Only vertical loads were considered and the influence from sloping ground conditions around the footings were not evaluated. If these assumptions are not valid, the bearing capacity recommendations should be revised accordingly. Allowable (*net*) bearing pressure was also estimated considering a maximum settlement of 1 inch. Settlement beneath footings was calculated using an elastic theory methodology developed by Schmertmann (1978).

A maximum allowable bearing capacity of 5,000 pounds per square foot (psf) is recommended for spread footings with widths ranging from four to eight feet bearing on either intact cut or compacted fill. For temporary wind or seismic loading, the allowable bearing capacity can be increased by one-third. The recommended allowable bearing pressures are applicable to both cut and fill soils. The recommendations are based on a minimum embedment depth of 36 inches. As noted previously, the proposed site is characterized by zones of both cut and fill.

Strip foundations, if necessary, should be designed with a minimum width of two feet and an allowable bearing capacity of 5,000 psf.

5.1.2. Mat Foundations

Foundation dimensions, anticipated applied pressures, and estimated grading required for mat foundations were not available at the time of this report preparation. All mat foundations should bear on dense intact alluvium or compacted fill, and excavations should be extended as necessary to remove all high plasticity materials beneath the foundation. In general, we do not recommend that mat foundations transition from cut to fill as varying performance of the subgrade can lead to differential settlement across the mat.

For the mat foundations, allowable (*gross*) bearing capacity based on shear failure in the foundation soil utilized the same methodology and strength parameters as that for spread and strip footings.

The modulus of vertical subgrade reaction (k_s) was determined for a range of mat widths and an assumed homogenous subsurface, as shown in **Figure 5-1**.

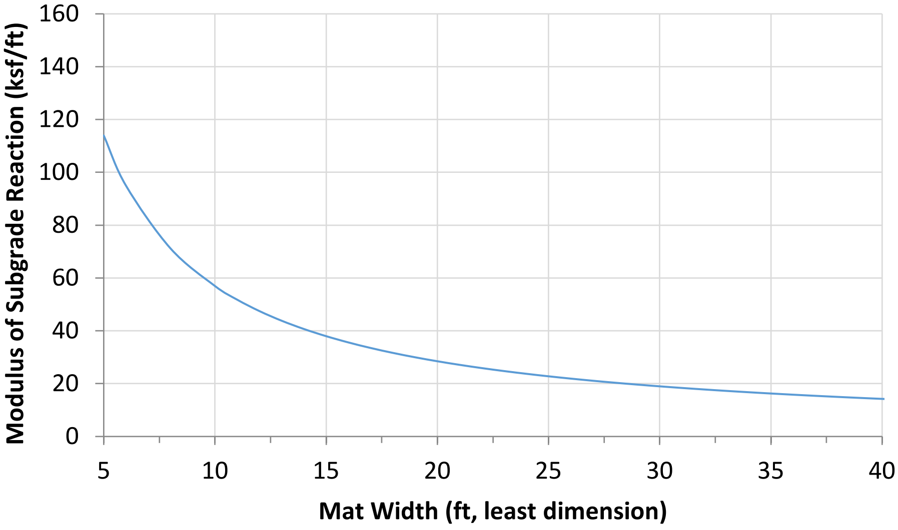

Figure 5-1: Modulus of Subgrade Reaction

5.1.3. Slab-on-Grade

Floor slabs should be supported on a minimum 12-inch layer of *Select Fill* meeting the requirements discussed in **Section 5.4**. Compacted in-place soils or *Common Fill* are all acceptable beneath the *Select Fill* layer. Slab-on-grade floors should be isolated from (e.g. not be structurally connected to) columns and foundation walls to accommodate potential movements between structural elements. The modulus of subgrade reaction can be estimated using the relationship presented in **Figure 5-1**.

We recommend that a vapor barrier be installed between the bottom of the floor slab and the underlying *Select Fill* if any of the following three conditions are met:

- Shallow groundwater is encountered during foundation excavation (unlikely);
- Floor finishes such as linoleum (glue), wood, or moisture-sensitive finishes/coatings are installed over the slab; and/or,
- Drainage pipes are located beneath the slab.

Shallow groundwater is not expected to influence the structures; therefore, installation of sub-slab drains does not appear necessary provided good perimeter drainage is installed around the exterior of the structures. All utility pipes beneath floors should have sealed joints to prevent leaks from degrading the subgrade. Designs should account for downspout connections and ensure that all drainage is away from structures and to engineered surface water runoff collection points. We recommend minimum grade of five percent for at least 10 feet from the base of the structure.

5.1.4. Dynamic Properties

Since shear wave velocity measurements were not obtained during the site investigation, the dynamic, maximum shear moduli (G_{max}) of foundation soils were estimated from correlations with standard penetration resistance (Seed et al., 1986), and recommended design values are as follows:

- G_{max} at the existing ground surface is approximately 1500 ksf
- G_{max} at a depth of 30 feet below the existing ground surface is approximately 4,000 ksf.
- A linear distribution of maximum shear modulus should be considered between these depths and the value should be capped at 4,000 ksf.
- The maximum shear moduli are valid to approximately 0.01 percent dynamic shear strain and should be degraded for larger strains, if applicable.

Estimates of the damping ratio were based on published information (Vucetic and Dobry, 1991) and a nonplastic average plasticity index. Similar to the shear modulus, damping ratio changes with increasing dynamic shear strain, and thus appropriate values should be selected based on the strains induced in the foundation soils. **Table 5-2** presents the recommended damping ratio to be used for design.

Table 5-2: Recommended Damping Ratio

Dynamic Shear Strain (%)	Damping Ratio (%)
0.0001	1.0
0.001	1.5
0.005	3.5
0.01	5.2

5.2. Lateral Earth Pressures

Retaining walls and below-grade foundation walls should be designed to withstand lateral earth pressures caused by adjacent soil and surcharge loads. Lateral loads may be resisted by: (1) friction between the foundation bottoms and the supporting materials, and (2) passive pressures acting against the sides of the footings. For retaining walls bearing on alluvium, we recommend a coefficient of friction of 0.5 times the vertical dead load for sliding resistance.

The recommended lateral earth pressure coefficients and associated equivalent fluid pressures are listed in **Table 5-3**. The transition from the fixed to active condition should be assumed to occur after movements that exceed 0.001H and the transition from the at-rest to passive condition should be assumed to occur after movements that exceed 0.02H, where H is the height of the retained soil.

Table 5-3: Recommended Lateral Earth Pressure Coefficients

Loading Condition	Lateral Earth Coefficient	Equivalent Fluid Pressure (pcf)
Active Case	0.26	26
Fixed (Restrained) Case	0.41	41
Passive Case	3.85	385
Notes: Based on a drained friction angle of 36 degrees for select fill and an average unit weight of 100 pcf.		

If surcharge loads are present, including haul truck traffic, these should also be included in the lateral pressure used for wall design. For uniform surcharge pressures, one-half of the surcharge pressure should be included. The resultant force from surcharge loads would act at H/2 from the base of the wall. Point loads should be considered on a case by case basis.

All foundation walls and soil retention structures should be backfilled with *Select Fill* material meeting the requirements discussed in **Section 5.4**. The backfill should be compacted to 92 percent of the standard Proctor unit weight (ASTM D1557) within 3 percent of optimum moisture content. Backfill should be free draining and an engineered drainage system installed to prevent the build-up of hydrostatic pressures behind structures. Backfill should be placed in uniform lifts and not over-compacted since this can cause excessive lateral pressure on the walls.

It should be noted that these recommendations are applicable to retaining structures that do not exceed 20 feet in height. For structures that exceed 20 feet in height and/or for structures that have traffic loads adjacent to walls that may increase lateral loads, the geotechnical engineer should be retained to review the final wall design. A reinforced soil wall often presents performance and economic advantages compared to conventional cast-in-place concrete for these higher walls.

5.3. Seismic Design

NewFields completed a seismic hazard analysis and these results were previously presented (NewFields, 2019b). In accordance with the 2015 International Building Code (IBC) and ASCE 7-10, the site classifies as very dense soil and soft rock, Site Class C. Based on our understanding of the proposed foundation conditions, there is a possibility that the foundation beneath the process facilities could be reclassified as Site Class B, rock, if the depth to rock is fairly shallow below specific structures. If a re-evaluation of the site class is necessary, the shear wave velocity in the upper 100 feet would need to be directly measured in the field.

5.3.1. Code Based Seismic Parameters for Structures

The maximum considered earthquake response accelerations at short and long periods, S_S and S_1, respectively, were determined using an online calculator from the Structural Engineers Association of California (SEAC) (SEAC, 2019). All relevant seismic design values for structures on site are listed in **Table 5.4.**

Table 5.4: Code Based Seismic Parameters

Site Soil Class	C
Mapped MCE_R, five (5) percent damped, spectral response acceleration parameter at short periods (Site Class C), S_S	0.50g
Mapped MCE_R, five (5) percent damped, spectral response acceleration parameter at a period of one (1) second (Site Class C), S_1	0.18g
Design, five (5) percent damped, spectral response acceleration parameter at short periods, S_{DS}	0.43g
Design, five (5) percent damped, spectral response acceleration parameter at period of one (1) second, S_{D1}	0.18g

5.4. Site Grading Recommendations

The site grading recommendations consider the existing topography at the time of this report, the type of structures anticipated, and the design recommendations for foundations and floor slabs presented in this report. At the time of this report, a grading plan was not available. Cut and fill thickness of up to 10 feet have been assumed. Should conditions change from those discussed in this report, NewFields should be retained to review the changes to determine if the recommendations contained herein are still applicable.

Grading will be required to bring the site to the required grades for some of the structures. Grading should include stripping, clearing and grubbing, preparation of the exposed subgrade, and placement and compaction of fill materials as described in the following subsections. In general, this work includes removal of the existing near surface soil and any shallow bedrock. There is the possibility that local areas of shallow bedrock may be encountered, which may be difficult to excavate by traditional mechanical excavation methods, and light blasting might be required. The existing subsurface data is insufficient to delineate areas, but it is recommended that an earthwork contractor provide a line-item provision for blasting on an as-needed basis, and with LNC approval.

5.4.1. Construction Guidance

Grading will likely be necessary to bring the site to the required grade for the proposed facilities. Grading should include stripping, clearing and grubbing, preparation of the exposed subgrade, the removal/placement of materials, and compaction of fill materials as described in the **Section 5.4.3**. The site grading recommendations consider the existing topography at the time of this report, the type of structures anticipated, and the design recommendations for foundations and floor slabs presented herein. Should conditions change from those discussed in this report, NewFields should be retained to review the changes to determine if the recommendations contained herein are still applicable.

5.4.2. Site Preparation

Topsoil, existing vegetation, and any soft soil should be stripped from areas to receive fill and/or structures. Topsoil should be stockpiled at locations approved by LNC. Positive drainage away from the foundations should be maintained during construction.

In areas to receive fill, the exposed subgrade should be proof-rolled, scarified to a minimum depth of six inches, moisture conditioned and then recompacted to 90 percent of the maximum dry unit weight as determined by a modified Proctor (ASTM D1557) prior to placement of additional fill or construction of overlying structures. If deflections greater than ½-inch are observed during proof-rolling, the soil should be removed and replaced with *Select Fill*, or the materials may be ripped and recompacted until acceptable conditions are observed. Fill and structures should never be placed on soft material.

The surface of natural and compacted subgrade soil can deteriorate and lose strength when exposed to environmental changes and construction activity. In general, after substantial delays in grading, the surface of the soil subgrade should be proof-rolled before placement of additional fill or construction of pavements and slabs, whether due to weather or other factors. Ponded water in excavations at any time during construction is an indication that subgrade materials are likely softened and require attention and recompaction or replacement.

5.4.3. Borrow Material for Fill / Backfill

Fill may be required to bring the subgrade to the specified elevation for some structures and *Select Fill* will be necessary around and beneath structures. The following materials are recommended for earthworks associated with the Process Plant site facilities:

- *Common Fill* should be used to bring building pads to grade, for use in fill slopes, and for localized replacement of soft soils. We recommend *Common Fill* be composed of existing site materials less than four inches in nominal diameter (< 4 inch) and less than 20-percent passing the #200 sieve, provided the fill material is not considered deleterious or expansive (PI less than 15). In general, *Common Fill* should be composed of on-site, near-surface predominantly granular soils.

- *Select Fill* should be used as a base layer underneath foundation elements, slab-on-grade construction, as backfill material behind retaining walls, and as drainage medium for wall and perimeter drains. We recommend that *Select Fill* be composed of nonplastic to low plasticity, two-inch minus material with less than 10-percent materials passing the No. 200 sieve. The PI should be less than 10.

Based on laboratory tests and observations during the field exploration, it is anticipated that a portion of on-site material may be sufficient for use as *Common Fill* with the exception that some material may include high plasticity fines, thereby making it unsuitable for use as *Common Fill*. The site soils likely contain too many fines for *Select Fill*, thus sourcing for an alternative location will be required. Any material brought from off-site borrow areas should be approved before delivery to the site.

5.4.4. Deleterious Material

Material other than satisfactory soil and aggregate, as described above, should be considered unsatisfactory unless a qualified geotechnical engineer states otherwise after visual inspection of the material. Inspection may require confirmatory laboratory testing. Deleterious materials should not be used in site fills and backfills, regardless of whether it is from an on-site source or delivered to the site. Unsatisfactory soils include those included in USCS groups MH, CH, OL, or OH. Soils that are classified as fine-grained (clays and silts) and that exhibit a Plasticity Index greater than 20 are considered high plasticity materials. Deleterious material also includes any organic matter, wood, metal, piping, and may include concrete waste or soil containing cobbles (3 inches to 12 inches) and boulders (greater than 12 inches).

5.4.5. Fill Placement and Compaction

Common Fill should be used to rough grade the building areas in need of fill. A six-inch thick layer of *Select Fill* should extend from the base of the foundation footings past the foundation footprint and at a slope of 2:1 to the ground surface. A six-inch thick layer of *Select Fill* should be placed beneath all floor slabs.

The moisture content of fill materials should be controlled to permit ease in handling and placement and to achieve the specified compaction. **Table 5-5** summarizes the recommended minimum compaction requirements for various areas within the process plant area. Although a large variation in the moisture content is specified, it is generally easier to achieve the specified compaction density if the moisture content of fill is not more three percent above or below the optimum moisture content.

Table 5-5: Minimum Compaction Requirements

Area	Minimum Relative Compaction (%)
Common Fill – Rough Grading	92
Common Fill – Building Areas (Footings beneath *Select Fill*)	95
Common Fill – Building Areas (above footings)	92
Select Fill – Retention Structures, Trenches	92
Select Fill – Directly Beneath Footings and Slab-on-grade flooring	98
Note: Recommended relative compaction given for fill placement are expressed as a percentage of the maximum dry unit weight in accordance with the modified Proctor laboratory test (ASTM D1557 or equivalent). Fill should be moisture-conditioned and placed at no less than 3% below optimum moisture or 3% above the optimum moisture.	

Fill should be placed in lifts no greater than 12 inches thick as measured when the material is loose and heavy equipment is used for compaction. For light compaction equipment (hand-operated equipment), loose lifts should be no thicker than six inches. Hand compaction should be performed for all fills within three feet laterally of existing concrete footings or soil retention structures. Thicker lifts should only be used with the written permission of the geotechnical engineer responsible for testing fill placement.

5.4.6. Earthworks Monitoring

All fill placement and proof rolling of exposed subgrade should be monitored by an experienced geotechnical engineer or soil technician to verify that unsuitable materials are not present and that proper placement and compaction of materials have been accomplished. For mass earthwork, construction specifications should require at least one in-place density test of the compacted fill for every 500 cubic yards with a minimum of one test for each lift. For backfill in trenches or around structures, construction specifications should require at least one in-place density test of the compacted fill for every 150 cubic yards of fill with a minimum of one test for each lift.

Before fill operations begin, representative samples of proposed fill materials should be tested for determination of laboratory compaction characteristics in accordance with the ASTM D1557 standard. Several samples of on-site materials that are suitable for use as *Common Fill* have been tested. Fill soil imported to the site would require testing. The proposed fill materials should be tested for grain size distribution and Atterberg Limits according to ASTM D422 and D4318 standards (or equivalent), respectively.

5.5. Slopes

At the time of this report preparation, a proposed grading plan has not been provided. Based on our understanding of the proposed project, various slopes including benched slopes, continuous slopes and temporary excavation slopes may be necessary for the development of the Process Plant. Geotechnical recommendations for design and construction of these slopes are presented in the following subsections.

For slopes with the potential to support loads (i.e. structures or stockpiles) the desired minimum long term static factor of safety is 2.0; for non-load bearing slopes the desired minimum long term static factor of safety is 1.5. For temporary slopes, a desired end-of-construction factor of safety is 1.3.

5.5.1. Temporary Excavations

All temporary excavations, such as those required for foundation excavations, utility trenches, tanks, and other infrastructure requiring excavation work, should consider slope stability and safety issues, as well as be performed in accordance with Occupational Safety and Health Administration (OSHA) and local regulations; if applicable.

The maximum allowable slope for excavations less than 20 feet in height shall be 1.5H:1V (34 degrees). The excavation can be a continuous slope or vertical excavations no greater than 4 feet deep with benches that have an overall 1.5H:1V slope. Vertical excavations are acceptable if properly shored. Excavations greater than 20 feet are not anticipated; but if required during construction, these slopes should be reviewed by NewFields.

Grading plans should anticipate all temporary excavations will be laid back, or property shored. Excavation spoils should not be stockpiled next to cut slopes. A minimum setback equal to the depth of the excavation should be maintained between the top of the cut slope and the toe of spoil piles. Exposed slopes should be protected from erosion and saturation by rainfall using berms, diversion ditches, and/or plastic sheeting.

Caution should still be exercised as slopes excavated in accordance with these recommendations may still experience localized sloughing, raveling, and sliding. All excavation operations should be performed under the supervision of qualified site personnel.

5.5.2. Permanent Slopes

In general, permanent slopes in alluvium should be constructed no steeper than 2H:1V overall, and flatter slopes should be provided where possible. Slopes should have a minimum of a 3-foot to 5-foot wide bench for each 25 feet of height to intercept runoff and help prevent erosion. Wider benches are recommended to provide operational access and repairs. Permanent, continuous slopes will be susceptible to excessive erosion, surficial sloughing, and raveling, especially until they are revegetated. Revegetation efforts should initiate immediately after construction is complete.

Slopes should be constructed with crest berms and interceptor ditches at the brow of the slope to collect and divert surface runoff away from the slope face. Intermediate benches should be graded at approximately 5 percent (longitudinally) to prevent ponding and divert runoff to controlled downdrain locations. The base of slopes should be designed to drain water to specified collection points to prevent ponding of water.

We do not anticipate groundwater or seepage will be encountered in cut slope excavations. However, if encountered, a stability investigation should be conducted to determine if the seepage will adversely affect the cut. The native soils are susceptible to erosion, and thus drainage control along the slope crest and slope face should be addressed in the grading design. The crest of slopes should be graded at 2 percent to promote drainage away from the slope face.

Structures should be setback a sufficient distance from ascending and descending slopes. Per IBC regulations for ascending slopes, the face of a structure shall be set back from the toe of slope the smaller of half the vertical height of the slope or 15 feet. For descending slopes, the face of the footing shall be set back from the crest of slope the smaller of one-third of the slope height or 35 feet.

5.6. Control of Water

Based on the conditions observed in the borings, natural groundwater is anticipated to have little to no impact on construction activities. We do not anticipate that groundwater will be encountered in significant quantities in any structure or utility excavations; however, if encountered, water should be controllable via ditches and sumps.

Control of surface runoff to prevent erosion of exposed soils, especially on slopes, and the softening of subgrade beneath structures and pavement will be critical if earthwork is performed during the wet season. Surficial drainage of slopes, ditches, trench drains, and pumping from sumps should be used to readily remove any surface water, if needed.

Due to the potential for erosion of the soils prevalent at the site, especially after the ground surface has been disturbed, we recommend a storm water management plan and erosion control plan be developed prior to beginning construction work, implemented, and periodically inspected to reduce storm water runoff, fugitive dust emissions, and erosion. The grades of ditches should be fairly flat to prevent erosion. Sumps should be designed that will minimize siltation and that can be readily cleaned. Additionally, a revegetation plan should be developed and implemented to ensure successful revegetation of slopes and reduce erosion problems.

5.6.1. Drainage near Structures

The following recommendations should be followed to mitigate the potential for detrimental foundation movements due to excessive changes in soil moisture content:

- Positive surface drainage should be provided adjacent to structures such that all surface water is directed away from the foundation and any adjacent ponds, if applicable. Water should be directed into drop inlets and closed pipes that lead to suitable discharge facilities. Rainwater collected on the roof of the buildings should be transported through gutters, downspouts and closed pipes to suitable discharge facilities or drainage swales. In general, drainage conditions should be implemented such that rainwater, including roof water, will not collect or pond adjacent to the building structures.
- One way to alleviate this condition is to grade the ground surface adjacent to the proposed structure such that water flows away from the foundation at a minimum grade of five percent for at least 10 feet from the base of the structure. Concrete walkways should have a minimum slope of two-percent away from the structure to provide positive drainage away from the foundation.
- Landscape vegetation (except grass cover) should not be planted within 5 feet of exterior footings.
- All drain or utility pipes beneath floors should have tight joints to prevent leakage.

6. LIMITATIONS

The analyses, conclusions, and recommendations presented in this report are based on a limited knowledge of site conditions and general assumptions that the geology and geotechnical characteristics of the borings and test pits are representative of the actual subsurface conditions throughout the site (i.e. the actual subsurface conditions at the site are not significantly different from those encountered during the field investigation program). If, during construction, subsurface conditions vary from those encountered in the study described herein, advise NewFields at once so that we can review these conditions and reconsider our recommendations, as necessary. NewFields reserves the opportunity to revise, adjust, or modify the recommendations presented herein.

Unanticipated soil, rock, and groundwater conditions are frequently encountered and cannot be fully determined through limited pre-construction subsurface investigations. Such unexpected conditions commonly require additional expenditures to develop a properly constructed project. Therefore, some contingency in construction budgets is recommended to accommodate potential additional costs.

We strongly recommend NewFields be retained to review the final structural design of the facilities and those portions of the plans and specifications which pertain to earthwork and foundations to determine if they are consistent with our recommendations. In addition, a qualified engineering and testing firm should be retained to observe and document construction, particularly the compaction of engineered fill, general site excavations, and foundation preparation. The construction monitoring and testing services should be performed under separate contract from that of the construction contractor because the purpose of services during construction is to verify contractor compliance with the plans and specifications.

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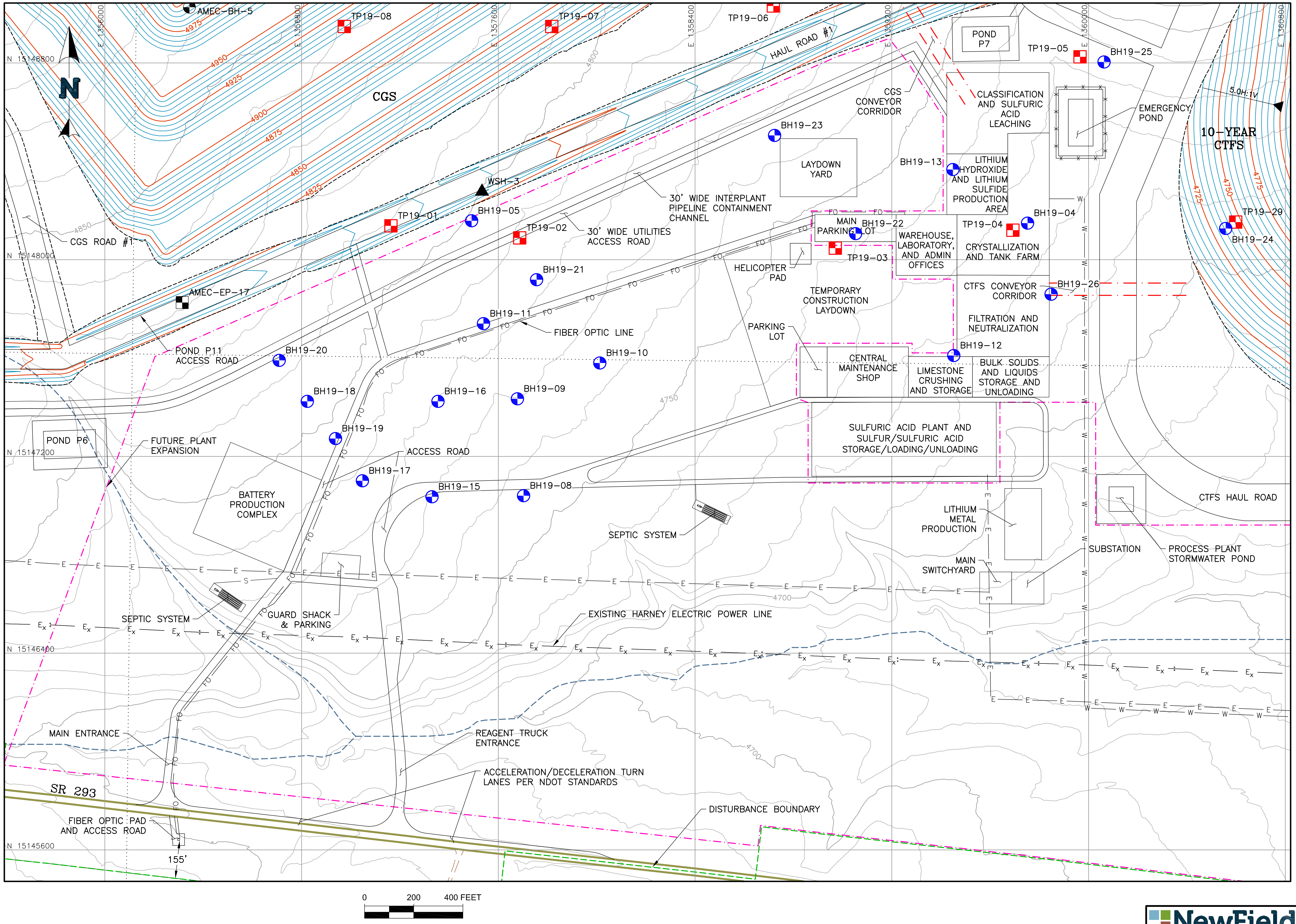
FIGURES

Geotechnical Field Exploration Plan



LEGEND:

	EXISTING 10 FT GROUND CONTOURS
4500	EXISTING CONTOUR ELEVATION
	10 FT GROUND CONTOURS
4500	CONTOUR ELEVATION
	EXISTING ROADS–MAJOR
	SURFACE DAYLIGHT
	EXISTING DRAINAGES
	SECTION LINES
	POO BOUNDARY
	DISTURBANCE BOUNDARY
S	SEPTIC LINE
E_x	EXISTING POWER LINE
:	EXISTING POWER POLES
W	WATER LINE
E	POWER LINE
FO	FIBER OPTIC LINE
x x	FENCE
S	SEPTIC LINE
	FUTURE PLANT EXPANSION
	CONVEYOR CORRIDOR
▭	STRUCTURE/BUILDING
▲	EXISTING MONITORING WELL
●	BOREHOLE
🟥	TEST PIT
▭	POND

NOTE:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. STORMWATER DIVERSION CHANNELS AND CULVERTS NOT SHOWN FOR CLARITY.

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CLIENT
LITHIUM NEVADA CORP.

PROJECT
THACKER PASS PROJECT

TITLE
PROCESS PLANT GEOTECHNICAL
INVESTIGATION PLAN

FILENAME
0385.000.046F

FIGURE NO.
1

REVISION
A

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\A-CAD\FIG\0385.000.046F.dwg-11/14/2019 9:00 AM

APPENDIX A

Borehole and Test Pit Exploration Logs

NewFields

BH19-04

PAGE 1 OF 1

CLIENT Lithium Nevada	**PROJECT NAME** Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000	**PROJECT LOCATION** Thacker Pass, Nevada
DATE STARTED 3/17/19 **COMPLETED** 3/18/19	**GROUND ELEVATION** 4725.4 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech	**COORDINATES (WGS-84):**
DRILLING METHOD HSA	**NORTHING** 15145149 **EASTING** 1359752
LOGGED BY M. Erdmann **CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)** 92.5

NOTES Backfilled with cement grout

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
			Snow/Mud										
4725	0		Top Soil / Root Zone										
			silty SAND (SM), with gravel, fine to corase grained, sub angular, loose to dense, light brown, dry										
				SS SPT-01	5-5-6 (11)	18							
4720	5			MC CAL-01	8-18-27 (45)	18							
				SS SPT-02	7-8-10 (18)	18							
4715	10		silty SAND (SM), with gravel, well graded, fine to coarse grained, sub angular, dense to very dense, light brown, dry	MC CAL-02	16-21-22 (43)	18							
4710	15			SS SPT-03	20-50/6cm	11.5							
4705	20			MC CAL-03	70/5cm	5							

Switched to rock core at 21.5'

BH19-04

PAGE 1 OF 2

CLIENT	Lithium Nevada	**PROJECT NAME**	Thcker Pass Geotechnical Investigation
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass, Nevada
DATE STARTED	3/17/19	**COMPLETED**	3/18/19
GROUND ELEVATION	4725.4 ft	**HOLE SIZE**	4.25 in
DRILLING CONTRACTOR	HazTech	**COORDINATES (WGS84):**	
DRILLING METHOD	HQ Core	**NORTHING**	15145149
EASTING	1359752		
LOGGED BY	M. Erdmann	**CHECKED BY**	K. Magner
DEPTH TO WATER (FT BGS)	92.5		
NOTES	Backfilled with cement grout		

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG: TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
								Surface details: Snow/Mud									
4705	20	1	3.5	79	0	MW	R1	[Continuation from soil log at 20 feet] Blocky volcanic rock, moderately weathered, very weak rock, very close joint spacing, smooth joint surfaces				JT		VC		S	
4700	25	2	2	88	0	MW	R1					JT		VC		S	
		3	2	90	0	MW	R1					JT		VC		S	
4695	30	4	3	100	55	MW	R1					JT		VC		S	
4690	35	5	5	100	41	MW	R1	Basalt, black to brown, moderately weathered to slightly weathered, very weak to medium strong rock, very close to close joint spacing, slightly rough joint surfaces, clay and calcite alteration on joint surfaces				JT		VC		SR	
4685	40	6	5	100	43	MW	R1					JT		VC		SR	
4680	45	7	5	100	58	MW	R1					JT		VC		SR	
4675	50	8	5	100	49	MW	R1					JT		VC		SR	
4670	55	9	5	100	79	MW	R1					JT		VC		SR	
	60	10	5	100	65	SW	R3					JT		C		SR	CA

(Continued Next Page)

CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
4665	60	11	5	100	87	SW	R3		Basalt, black to brown, moderately weathered to slightly weathered, very weak to medium strong rock, very close to close joint spacing, slightly rough joint surfaces, clay and calcite alteration on joint surfaces *(continued)*				JT		C		SR	CA
4660	65	12	5	100	90	SW	R3						JT		C		SR	CA
4655	70	13	5	100	83	SW	R3						JT		C		SR	CL
4650	75	14	5	100	95	SW	R3						JT		C		SR	CL
4645	80	15	5	100	85	SW	R3						JT		C		SR	CL
4640	85	16	5	100	88	SW	R2						JT		C		SR	CL
4635	90	17	5	100	90	SW	R2					▽	JT		C		SR	CL
4630	95	18	5	100	86	SW	R2						JT		C		SR	CL
4625	100																	

Borehole terminated at 100.5'

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BH19-12

PAGE 1 OF 1

CLIENT	Lithium Nevada	**PROJECT NAME**	Thacker Pass Geotechnical Investigation
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass, Nevada
DATE STARTED	3/18/19 **COMPLETED** 3/19/19	**GROUND ELEVATION**	4717.5 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR	HazTech	**COORDINATES (WGS-84):**	
DRILLING METHOD	HSA	**NORTHING**	15147611 **EASTING** 1357942
LOGGED BY	C. Coleman **CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)**	No free water encountered
NOTES	Backfilled with cuttings and cement grout		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Top Soil / Root Zone										
4715			silty SAND (SM), with gravel, fine to coarse sand and gravel, MPS 1.0", sub angular, nonplastic fines, dense, light brown, dry	SS SPT-01	7-15-31 (46)	18							
	5		GRAVEL (GW-GM), with sand and silt, fine to coarse sand and gravel, MPS 3.0", sub angular, nonplastic to high plasticitiy fines, very dense, brown, dry	MC CAL-01	30-45-48 (93)	18							Hard drilling
4710				SS SPT-02	21-27-50/4cm	16							
	10			MC CAL-02	43-70/5cm	11							
4705	15			SS SPT-03	22-27-34 (61)	18	10.5	48	27	49.7	35.8	14.5	
4700			CLAY (CL), with sand, trace gravel, fine grained sand, fine to coarse gravel, MPS 1.5", sub angular, medium plasticity fines, hard, brown, damp										
	20			MC CAL-03	14-18-24 (42)	18							
4695	25			SS SPT-04	28-50/4cm	10							Refusal on gravel / rocky material
4690			SAND (SW-SC), some clay and gravel, fine to coarse sand and gravel, low plastcity fines, very dense, brown, dry										
	30			MC CAL-04	68-70/3cm	9							

Borehole terminated at 31.5'

NewFields

BH19-13

PAGE 1 OF 1

CLIENT Lithium Nevada	**PROJECT NAME** Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000	**PROJECT LOCATION** Thacker Pass, Nevada
DATE STARTED 3/16/19 **COMPLETED** 3/16/19	**GROUND ELEVATION** 4740.2 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech	**COORDINATES (WGS-84):**
DRILLING METHOD HSA	**NORTHING** 15148367 **EASTING** 1359448
LOGGED BY M. Erdmann **CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)** No free water encountered
NOTES Backfilled with cement grout	

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4740	0		Top Soil / Root Zone										
			silty SAND (SM), with gravel, well graded, fine to coarse grained, sub angular, very dense, brown, dry										
				SS SPT-01	12-36- 50/3cm	15							
4735	5			MC CAL-01	62-70/6cm	11.5							
				SS SPT-02	20-41- 50/4cm	16							
4730	10			MC CAL-02	59-70/5cm	10.5							
4725	15			SS SPT-03	20-30- 50/3cm	15							
4720	20			MC CAL-03	35-41- 70/5cm	17							
4715	25			SS SPT-04	12-35- 50/5cm	17							
4710	30			MC CAL-04	28-70/5cm	11							

Switched to rock core at 31.5'

NF-GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 11/21/19 15:11 - Y:\PROJECTS\0385.000-THACKER PASS LITHIUM NEVADA\L-GEOTECH DATA - ELKO\BOREHOLE LOGS\BOREHOLE SOIL LOGS-CC.19.08.29.GPJ

BH19-13
PAGE 1 OF 1

CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/16/19 **COMPLETED** 3/16/19
GROUND ELEVATION 4740.2 ft **HOLE SIZE** 4.25 in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS84):
DRILLING METHOD HQ Core
NORTHING 15148367 **EASTING** 1357448
LOGGED BY M. Erdmann **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
4710	30	1	5	100	8	HW	R1		[Continuation from soil log at 30 feet] Basalt, black, highly to moderately weathered, very weak to medium strong rock, very close joint spacing, smooth joint surface, calcite alteration on joint surface				JT		VC		S	
4705	35	2	5	100	24	HW	R1						JT		VC		S	
4700	40	3	5	100	53	MW	R2						JT		VC		S	
4695	45	4	5	100	59	SW	R3						JT		VC		S	CA
	50																	

Borehole terminated at 50'

NewFields

BH19-22
PAGE 1 OF 1

CLIENT	Lithium Nevada	**PROJECT NAME**	Thacker Pass Geotechnical Investigation
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass, Nevada
DATE STARTED	3/15/19 **COMPLETED** 3/15/19	**GROUND ELEVATION**	4741.9 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR	HazTech	**COORDINATES (WGS-84):**	
DRILLING METHOD	HSA	**NORTHING**	15148106 **EASTING** 1359052
LOGGED BY	M. Erdmann **CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)**	No free water encountered
NOTES	Backfilled with benontie chips and cement grout		

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Snow/Mud										
			Top Soil / Root Zone										
4740			silty SAND (SM), well graded, fine grained, sub angular, medium dense to dense, light brown, dry										
				SS SPT-01	13-12-11 (23)	18							
	5												
				MC CAL-01	19-37-50 (87)	18							
4735													
				SS SPT-02	50/5cm	5							
	10												
				MC CAL-02	70/4cm	4							

Switched to rock core at 11.5'

NewFields

BH19-22

PAGE 1 OF 1

CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/15/19 **COMPLETED** 3/16/19
GROUND ELEVATION 4741.9 ft **HOLE SIZE** 4.25 in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS84):
DRILLING METHOD HQ Core
NORTHING 15148106 **EASTING** 1359051
LOGGED BY M. Erdmann **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with bentonite chips and cement grout

ELEVATION (ft): 4730, 4725, 4720, 4715, 4710, 4705

DEPTH (ft): 15, 20, 25, 30, 35, 40

RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL
						Surface details: Snow/Mud			
1	2	63	0	HW	R1	[Continuation from soil log at 11.5 feet] Blocky volcanic rock, brown, highly weathered, very weak to medium strong rock, very close joint spacing, oxidization on joint surface			
2	2	100	25	HW	R1				
3	5	100	0	HW	R1				
4	2.5	40	0	HW	R1				
5	4	100	0	HW	R1				
6	2.5	100	0	HW	R1				
7	1	75	0	HW	R1				
8	2	62	0	HW	R1				
9	4	43	0	HW	R1				
10	5	81	42	HW	R1				

DISCONTINUITY LOG

TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
JT		VC			OX
JT		VC			OX
JT		VC			OX
JT		VC			OX
JT		VC			OX
JT		VC			OX
JT		VC			OX
JT		VC			OX
JT		VC			OX

Borehole terminated at 40'

NF-GEOTECH ROCK CORE LOG - GINT STD US LAB.GDT - 9/23/19 10:30 - Y:\PROJECTS\0385.000-THACKER PASS LITHIUM NEVADA\L-GEOTECH DATA - ELKO\BOREHOLES\ROCK CORE LOGS-CC.GPJ

NewFields

BH19-23

PAGE 1 OF 1

CLIENT Lithium Nevada	**PROJECT NAME** Thacker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000	**PROJECT LOCATION** Thacker Pass, Nevada
DATE STARTED 3/15/19 **COMPLETED** 3/15/19	**GROUND ELEVATION** 4766.2 ft **HOLE SIZE** 4.25in
DRILLING CONTRACTOR HazTech	**COORDINATES (WGS-84):**
DRILLING METHOD HSA	**NORTHING** 15148506 **EASTING** 1358723
LOGGED BY M. Erdmann **CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)** No free water encountered

NOTES Backfilled with benontie chips and cement grout

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Snow/Mud										
4765			Top Soil / Root Zone										
			silty SAND (SM), with gravel, fine to coarse grained, well graded, sub angular, nonplastic fines, dense, light brown, dry										
				SS SPT-01	9-41-49 (90)	18	14.6	NP	NP	36.9	45.6	17.5	
	5												
4760				MC CAL-01	33-70/5cm	11							
				SS SPT-02	12-20-30 (50)	18	11.3	NP	NP	40.2	46.6	13.2	
	10												
4755				MC CAL-02	70/3cm	3							

Switched to rock core at 11.5'

BH19-23

CLIENT Lithium Nevada
PROJECT NAME Thcker Pass Geotechnical Investigation
PROJECT NUMBER 475.0385.000
PROJECT LOCATION Thacker Pass, Nevada
DATE STARTED 3/15/19 **COMPLETED** 3/15/19
GROUND ELEVATION 4766.2 ft **HOLE SIZE** 4.25 in
DRILLING CONTRACTOR HazTech
COORDINATES (WGS84):
DRILLING METHOD HQ Core
NORTHING 15148506 **EASTING** 1358723
LOGGED BY M. Erdmann **CHECKED BY** K. Magner
DEPTH TO WATER (FT BGS) No free water encountered
NOTES Backfilled with bentonite chips and cement grout

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
									Surface details: Snow/Mud									
4755	10	1	1.5	30	0	HW	R1		[Continuation from soil log at 10 feet] Blocky volcanic rock, reddish brown, highly weathered, very weak rock, very close joint spacing, smooth joint suface				JT		VC		S	
		2	2	40	0	HW	R1						JT		VC		S	
	15	3	2	40	0	HW	R1						JT		VC		S	
4750	20	4	5	100	8	HW	R1						JT		VC		S	
4745	25	5	5	100	10	HW	R1						JT		VC		S	
4740	30	6	5	100	0	HW	R1						JT		VC		S	
4735	35	7	5	100	20	HW	R1						JT		VC		S	
4730	40	8	5	37	25	HW	R1						JT		VC		S	
4725																		
4720	45	9	5	50	0	HW	R1						JT		VC		S	
	50	10	3	100	77	MW	R3		Basalt, black, moderately weathered, medium strong rock, close joint spacing, smooth joint surface, calcite alteration on joint surface				JT		C		SR	CA

(Continued Next Page)

CLIENT Lithium Nevada

PROJECT NAME Thcker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG					
													TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	50								Basalt, black, moderately weathered, medium strong rock, close joint spacing, smooth joint surface, calcite alteration on joint surface									

Borehole terminated at 50.5'

NewFields

BH19-25

PAGE 1 OF 1

CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/20/19 **COMPLETED** 3/20/19

GROUND ELEVATION 4734.7 ft **HOLE SIZE** 4.25in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS-84):

DRILLING METHOD HSA

NORTHING 15148804 **EASTING** 1360063

LOGGED BY C. Coleman **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with cement grout

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		Snow/Mud										
			Top Soil / Root Zone										
			silty SAND (SM), fine to medium grained, porrly graded, subangular, nonplastic fines, medium dense to very dense, brown, dry										
				SS SPT-01	5-8-8 (16)	18	18.4	NP	NP	5.1	62.2	32.7	
4730	5												
				MC CAL-01	11-17-18 (35)	18							
				SS SPT-02	7-9-9 (18)	18	22.3	NP	NP	1.4	74.1	24.5	
4725	10												
				MC CAL-02	6-16-22 (38)	18							
4720	15												
				SS SPT-03	13-25-25 (50)	18	35.3	NP	NP	0	78.2	21.8	
4715	20												
				MC CAL-03	70/4cm	4							

Switched to rock core at 21.5'

NewFields

BH19-25
PAGE 1 OF 1

CLIENT	Lithium Nevada	**PROJECT NAME**	Thcker Pass Geotechnical Investigation
PROJECT NUMBER	475.0385.000	**PROJECT LOCATION**	Thacker Pass, Nevada
DATE STARTED	3/20/19 **COMPLETED** 3/20/19	**GROUND ELEVATION**	4734.7 ft **HOLE SIZE** 4.25 in
DRILLING CONTRACTOR	HazTech	**COORDINATES (WGS84):**	
DRILLING METHOD	HQ Core	**NORTHING**	15148804 **EASTING** 1360063
LOGGED BY	C. Coleman **CHECKED BY** K. Magner	**DEPTH TO WATER (FT BGS)**	No free water encountered
NOTES	Backfilled with cement grout		

ELEVATION (ft)	DEPTH (ft)	RUN NO.	RUN LENGTH	REC (%)	RQD (%)	WEATHERING	HARDNESS	GRAPHIC LOG	MATERIAL DESCRIPTION Surface details: Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	WATER LEVEL	DISCONTINUITY LOG TYPE	DIP	SPACING	APERTURE	ROUGHNESS	INFILL
	20	1	4.5	100	0	HW	R1		[Continuation from soil log at 20 feet] Basalt, black, highly weathered, very weak rock, very close joint spacing, oxidization on joint surface				JT		VC			OX
4710	25	2	4.5	100	0	HW	R1						JT		VC			OX
4705	30	3	5.5	100	0	HW	R1						JT		VC			OX
4700	35	4	5	100	43	HW	R1						JT		VC			OX
4695	40	5	5	95	43	HW	R1						JT		VC			OX
4690	45	6	5.5	95	58	HW	R1						JT		VC			OX
4685	50																	

Borehole terminated at 50'

BH19-26

PAGE 1 OF 1

NewFields

CLIENT Lithium Nevada

PROJECT NAME Thacker Pass Geotechnical Investigation

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass, Nevada

DATE STARTED 3/18/19 **COMPLETED** 3/19/19

GROUND ELEVATION 4715.4 ft **HOLE SIZE** 4.25in

DRILLING CONTRACTOR HazTech

COORDINATES (WGS-84):

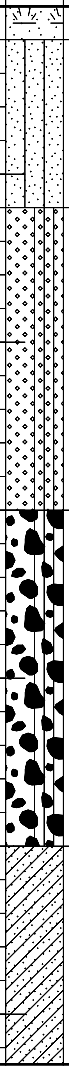
DRILLING METHOD HSA

NORTHING 15147860 **EASTING** 1359848

LOGGED BY C. Coleman **CHECKED BY** K. Magner

DEPTH TO WATER (FT BGS) No free water encountered

NOTES Backfilled with cement grout



ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Snow/Mud	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (INCHES)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
4715	0		Top Soil / Root Zone										
			silty SAND (SM), with gravel, fine to medium sand, fine to coarse gravels, MPS 1.5", sub angular, nonplastic fines, medium dense to dense, lgiht brown, dry	SS SPT-01	17-20-21 (41)	18							
4710	5			MC CAL-01	24-18-14 (32)	18	13.5	NP	NP	28.3	54.6	17.1	DD= 80.6 pcf
			SAND (SW-SM), with gravel and silt, fine to corase grained, MPS 1.5", sub angular, nonplastic fines, dense, brown, dry	SS SPT-02	16-32-39 (71)	18							
4705	10			MC CAL-02	37-45- 70/4cm	16							Increase in gravel size, MPS 2.5"
4700	15		GRAVEL (GW-GM), with sand and silt, fine to corase grained, MPS 2.0", sub angular, nonplastic fines, dense, brown, dry	SS SPT-03	40-50/4cm	10							
4695	20			MC CAL-03	43-70/4cm	10							
4690	25		clayey SAND (SC), trace gravel, fine grained, low plasticity fines, dense, dark brown, dry	SS SPT-04	31-50/4cm	10							
4685	30			MC CAL-04	70-70/3cm	9							

Borehole terminated at 31.5'

TP19-03
PAGE 1 OF 1

CLIENT Lithium Nevada Corporation

PROJECT NAME Thacker Pass Project

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass

DATE STARTED 2/27/19 **COMPLETED** 2/27/19

GROUND ELEVATION 4743 ft **TOTAL PIT DEPTH** 14 ft

EXCAVATION CONTRACTOR Hunewill Construction

COORDINATES ():

EQUIPMENT CAT 320E

NORTHING 15148047 **EASTING** 1358970

LOGGED BY C.Coleman **CHECKED BY** M. Walden

DEPTH TO WATER (FT BGS) No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
						LIQUID LIMIT	PLASTICITY INDEX				
			Surface Conditions: Mud								
	0		lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown, (root zone)								
4740			silty SAND (SM) with gravel, fine to coarse grained sand and gravel, subrounded, nonplastic, dry, brown	GB S-03-27	15.9	37	8	25.4	41.4	33.2	
	5		silty GRAVEL (GM) with sand, fine to coarse grained sand and gravel, subrounded, nonplastic, dry, brown								
4735				GB S-03-28	10.8	NP	NP	47.8	36.4	13.8	Hard digging at 6ft, cobbles and boulders to 16in diameter, blocky volcanics % Cobble = 2.0
	10										
4730											

Test pit terminated at 14ft, refusal on weathered basalt

TP19-04

PAGE 1 OF 1

NewFields

CLIENT Lithium Nevada Corporation

PROJECT NAME Thacker Pass Project

PROJECT NUMBER 475.0385.000

PROJECT LOCATION Thacker Pass

DATE STARTED 2/27/19 **COMPLETED** 2/27/19

GROUND ELEVATION 4726 ft **TOTAL PIT DEPTH** 19 ft

EXCAVATION CONTRACTOR Hunewill Construction

COORDINATES ():

EQUIPMENT CAT 320E

NORTHING 15148120 **EASTING** 1359692

LOGGED BY C.Coleman **CHECKED BY** M. Walden

DEPTH TO WATER (FT BGS) No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS		% GRAVEL	% SAND	% FINES	REMARKS
		Surface Conditions: Mud			LIQUID LIMIT	PLASTICITY INDEX				
	0									
4725		lean CLAY (CL) with sand, fine grained, low plasticity, moist, brown (root zone)								
		silty SAND (SM) with gravel, fine to coarse grained sand and gravel, subangular, nonplastic, dry, light brown	✋ GB s-04-29	31.2	NP	NP	0.7	56.4	42.9	Extremely hard digging at 4ft, dense soil layer, ash
	5	GRAVEL (GW-GM) with sand and silt, fine to coarse grained sand and gravel, subangular, nonplastic, dry, light brown, (ash bed)								
4720			✋ GB s-04-30	20.2	NP	NP	49.1	41.1	9.8	Cobbles and boulders up to 16in diameter at 8ft, blocky volcanics
		GRAVEL (GW-GM) with sand and silt, fine to coarse grained sand and gravel, subrounded, nonplastic, dry, brown								
	10									
4715			✋ GB s-04-31							
	15									
4710										

Test pit terminated at 19ft, (Excavator limits)

NewFields

TP19-05

PAGE 1 OF 1

CLIENT Lithium Nevada Corporation	**PROJECT NAME** Thacker Pass Project
PROJECT NUMBER 475.0385.000	**PROJECT LOCATION** Thacker Pass
DATE STARTED 2/28/19 **COMPLETED** 2/28/19	**GROUND ELEVATION** 4734 ft **TOTAL PIT DEPTH** 15 ft
EXCAVATION CONTRACTOR Hunewill Construction	**COORDINATES ():**
EQUIPMENT CAT 320E	**NORTHING** 15148825 **EASTING** 1359965
LOGGED BY C.Coleman **CHECKED BY** M. Walden	**DEPTH TO WATER (FT BGS)** No groundwater encountered

NOTES Backfilled with excavated material

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION Surface Conditions: Mud	SAMPLE TYPE NUMBER	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	% GRAVEL	% SAND	% FINES	REMARKS
	0		lean CLAY (CL) with sand, fine grained, medium plasticity, moist, brown, (root zone)								
4730	5		GRAVEL (GW-GC) with sand and silt, fine to coarse grained sand and gravel, subrounded, low plasticity, moist, brown	GB s-05-33							Cobbles and boulders up to 12in diameter
4725 4720	10 15		sandy SILT (ML), fine to coarse grained sand, subrounded, low plasticity, damp, brown	GB s-05-34	23.7	41	10	1.4	31.8	66.8	Weathered basalt starting at 10ft, soft digging

Test pit terminated at 15ft, refusal on weathered basalt

APPENDIX B

Laboratory Data Sheets

Table B-1

Lithium Nevada Coproration

Geotechnical Investigation

Thacker Pass Project - Process Plant Facilities

Laboratory Test Summary

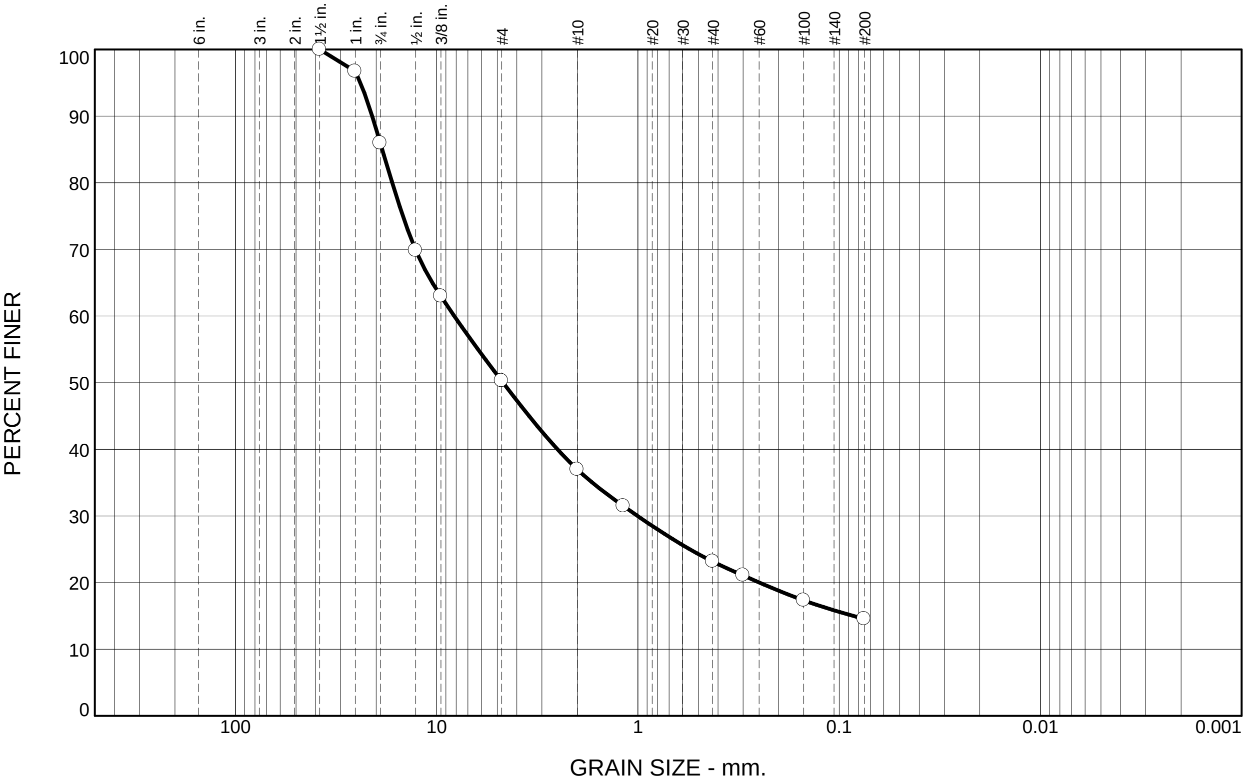
Borehole Number	Sample Depth (ft)	Sample Number	PARTICLE SIZE DISTRUBITION													USCS	MOISTURE CONTENT (%)	NATURAL DRY DENSITY (pcf)	ATTERBERG LIMITS			MOD. PROCTOR[1]	
			GRAVEL						SAND						CLAY/SILT				LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX	MAX. DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)
			3.0"	2.0"	1.0"	0.75"	0.5"	0.375"	#4	#10	#16	#40	#50	#100	#200								
BH19-12	15-16.5'	19-110-08	100.0	100.0	96.7	85.9	69.8	63.0	50.3	37.0	31.5	23.2	21.1	17.3	14.5	GC	10.5		48	21	27		
BH19-23	2.5-4'	19-110-18	100.0	100.0	100.0	87.6	76.8	73.1	63.1	49.8	43.6	34.3	31.4	24.9	17.5	SM	14.6		NP	NP	NP		
BH19-23	7.5-9'	19-110-19	100.0	100.0	100.0	81.4	76.8	73.1	59.8	47.0	41.0	30.0	26.6	19.4	13.2	SM	11.3		NP	NP	NP		
BH19-25	2.5-4'	19-110-23	100.0	100.0	100.0	100.0	100.0	99.3	94.9	84.3	78.4	67.3	63.4	52.5	32.7	SM	18.4		NP	NP	NP		
BH19-25	7.5-9'	19-110-24	100.0	100.0	100.0	100.0	100.0	100.0	98.6	89.7	82.4	64.3	57.0	38.7	24.5	SM	22.3		NP	NP	NP		
BH19-25	15-16.5'	19-110-25	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	86.5	71.2	40.9	21.8	SM	35.3		NP	NP	NP		
BH19-26	5-6'	19-110-26	100.0	100.0	86.6	83.2	81.2	78.6	71.7	57.3	49.0	35.6	31.7	23.7	17.1	SM	13.5	80.6	NP	NP	NP		
TP19-03	2-4'	19-106-02	100.0	97.9	90.7	87.3	82.9	80.2	74.6	68.2	61.8	53.0	50.1	43.0	33.2	SM	15.9		37	29	8		
TP19-03	6-9'	19-060-03	98.0	95.5	78.4	71.5	63.6	59.0	50.2	37.3	31.6	23.7	21.6	17.8	13.8	GM	10.8		NP	NP	NP		
TP19-04	2-4'	19-106-03	100.0	100.0	100.0	100.0	99.8	99.6	99.3	98.3	93.9	78.0	71.7	57.6	42.9	SM	31.2		47	46	1	78.4	33.8
TP19-04	5-7'	19-060-04	100.0	96.8	84.0	77.5	67.0	59.9	50.9	36.3	31.0	23.7	21.0	15.3	9.8	GW-GM	20.2		NP	NP	NP		
TP19-05	8-10'	19-060-05	100.0	100.0	100.0	100.0	99.7	99.4	98.6	94.3	91.5	87.5	85.6	81.2	66.8	ML	23.7		41	31	10		

[1] Oversize Correction Applied

LABORATORY DATA

Borehole Samples: Particle Size Distribution

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	14.1	35.6	13.3	13.8	8.7	14.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	96.7		
.75	85.9		
.5	69.8		
.375	63.0		
#4	50.3		
#10	37.0		
#16	31.5		
#40	23.2		
#50	21.1		
#100	17.3		
#200	14.5		

* (no specification provided)

Material Description

Red clayey gravel with sand

Atterberg Limits

PL= 21 LL= 48 PI= 27

Coefficients

D_{90}= 20.9347 D_{85}= 18.6472 D_{60}= 8.1802
D_{50}= 4.6789 D_{30}= 1.0039 D_{15}= 0.0850
D_{10}= C_u= C_c=

Classification

USCS= GC AASHTO= A-2-7(0)

Remarks

Natural Moisture Content: 10.5%

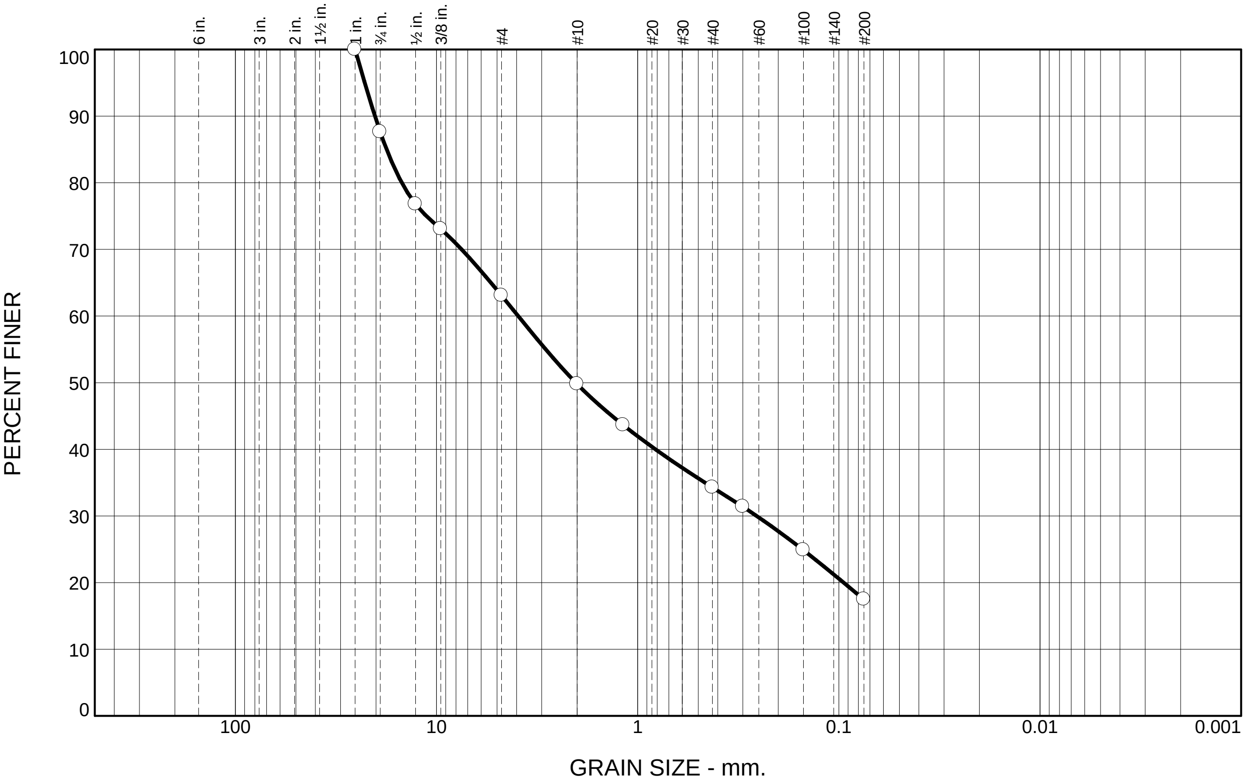
Location: BH19-12
Sample Number: 19-110-08 **Depth:** 15-16.5' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-08

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.4	24.5	13.3	15.5	16.8	17.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	87.6		
.5	76.8		
.375	73.1		
#4	63.1		
#10	49.8		
#16	43.6		
#40	34.3		
#50	31.4		
#100	24.9		
#200	17.5		

* (no specification provided)

Material Description

Light Brown silty sand with gravel

Atterberg Limits

PL= NP　LL= NP　PI= NP

Coefficients

D_{90}= 20.2456　D_{85}= 17.6947　D_{60}= 3.9255
D_{50}= 2.0315　D_{30}= 0.2563　D_{15}=
D_{10}=　C_u=　C_c=

Classification

USCS= SM　AASHTO= A-1-b

Remarks

Natural Moisture Content: 14.6%

Location: BH19-23
Sample Number: 19-110-18　**Depth:** 2.5-4'　**Date:** 4/25/2019

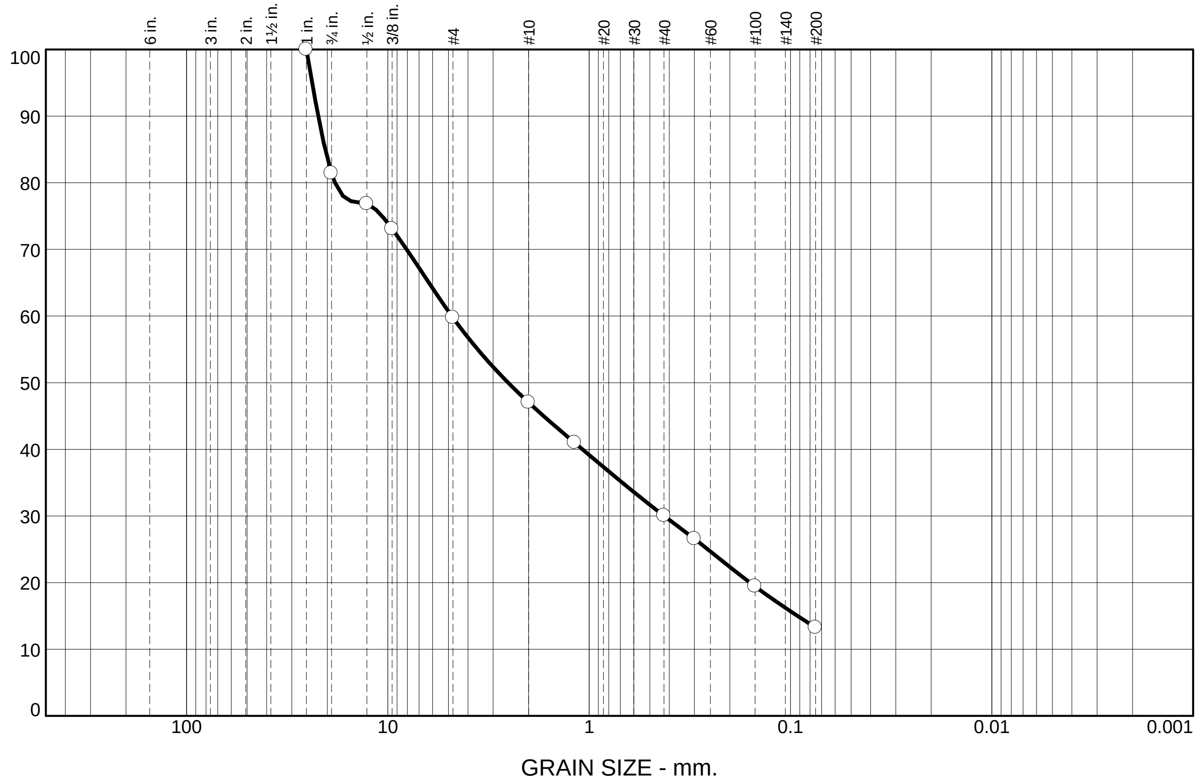
NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000　**Figure** 19-110-18

Tested By: JH/CB　**Checked By:** JH

Test results included in this report relate only to the items inspected or tested. This report shall not be reproduced, in full, without prior written approval of NewFields.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	18.6	21.6	12.8	17.0	16.8	13.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	81.4		
.5	76.8		
.375	73.1		
#4	59.8		
#10	47.0		
#16	41.0		
#40	30.0		
#50	26.6		
#100	19.4		
#200	13.2		

* (no specification provided)

Material Description

Brown silty sand with gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 22.1901 D_{85}= 20.4974 D_{60}= 4.8152
D_{50}= 2.5271 D_{30}= 0.4238 D_{15}= 0.0923
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-a

Remarks

Natural Moisture Content: 11.3%

Location: BH19-23
Sample Number: 19-110-19 **Depth:** 7.5-9' **Date:** 4/25/2019

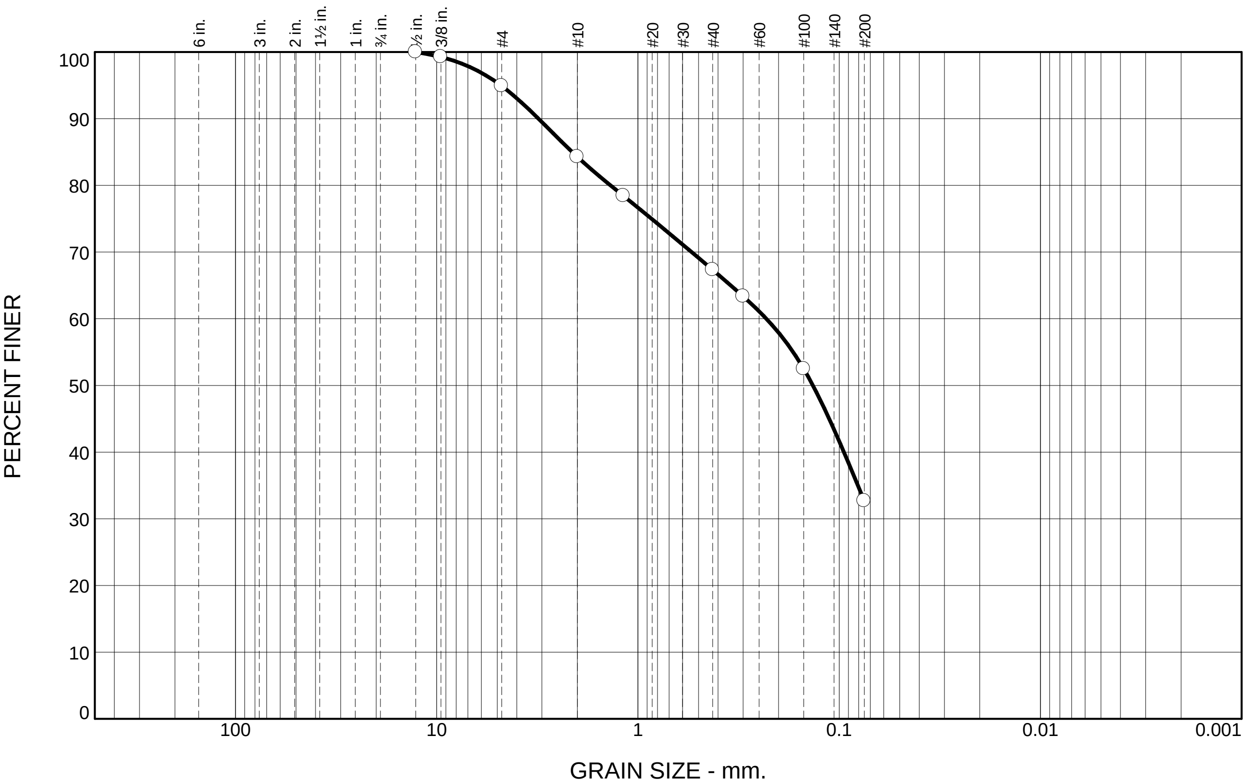
NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-110-19

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	5.1	10.6	17.0	34.6	32.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375	99.3		
#4	94.9		
#10	84.3		
#16	78.4		
#40	67.3		
#50	63.4		
#100	52.5		
#200	32.7		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= NP
LL= NP
PI= NP

Coefficients

D_{90}= 3.1185
D_{85}= 2.1202
D_{60}= 0.2301
D_{50}= 0.1350
D_{30}=
D_{15}=
D_{10}=
C_u=
C_c=

Classification

USCS= SM
AASHTO= A-2-4(0)

Remarks

Natural Moisture Content: 18.4%

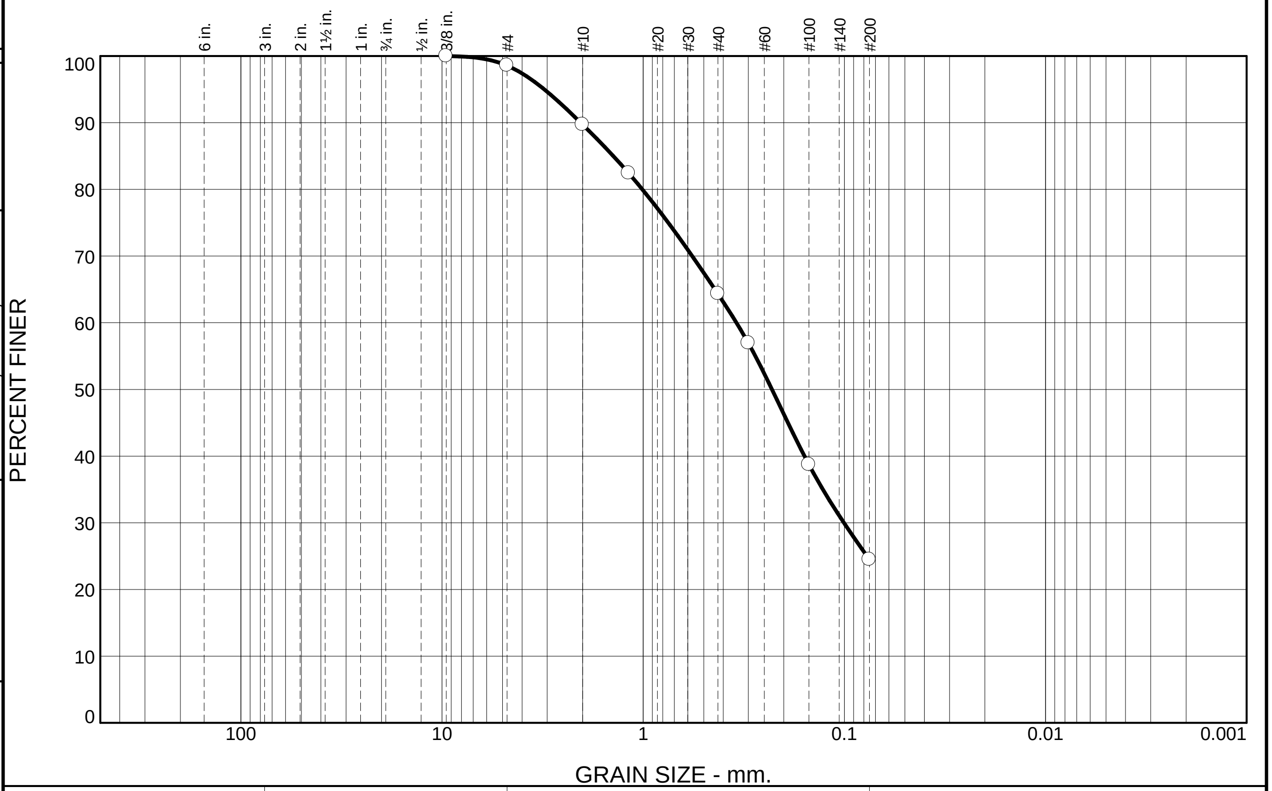
Location: BH19-25
Sample Number: 19-110-23 **Depth:** 2.5-4' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-23

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.4	8.9	25.4	39.8	24.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	98.6		
#10	89.7		
#16	82.4		
#40	64.3		
#50	57.0		
#100	38.7		
#200	24.5		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 2.0447 D_{85}= 1.4078 D_{60}= 0.3436
D_{50}= 0.2290 D_{30}= 0.1005 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Natural Moisture Content: 22.3%

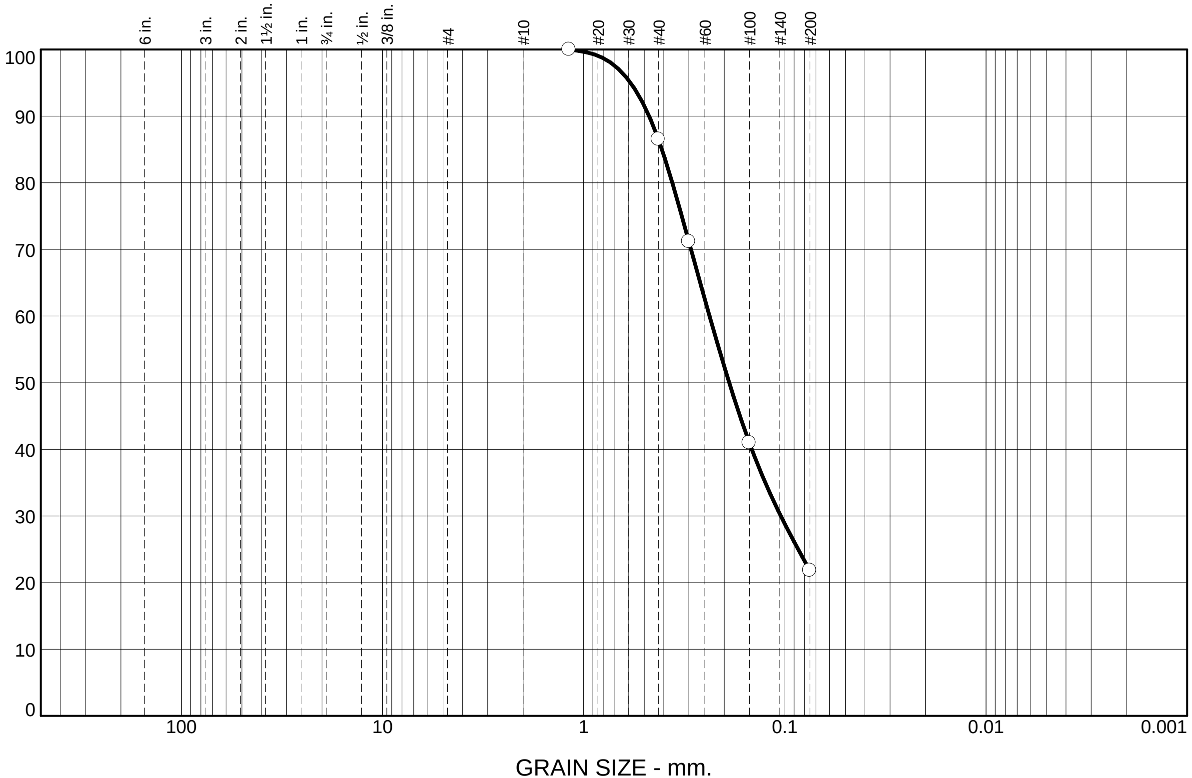
Location: BH19-25
Sample Number: 19-110-24 **Depth:** 7.5-9' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-24

Tested By: JH **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	13.5	64.7	21.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#16	100.0		
#40	86.5		
#50	71.2		
#100	40.9		
#200	21.8		

* (no specification provided)

Material Description

Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.4725 D_{85}= 0.4082 D_{60}= 0.2369
D_{50}= 0.1891 D_{30}= 0.1047 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Natural Moisture Content: 35.3%

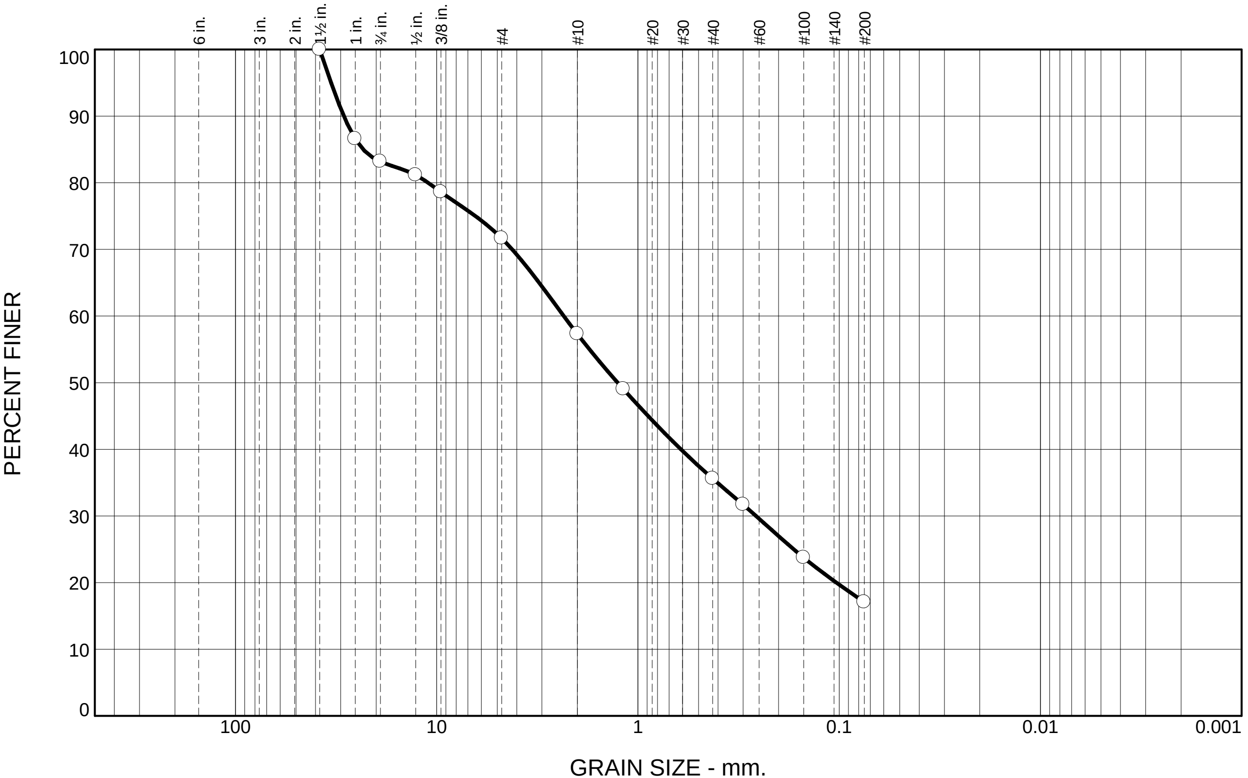
Location: BH19-25
Sample Number: 19-110-25 **Depth:** 15-16.5' **Date:** 4/25/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-110-25

Tested By: JH/CB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	16.8	11.5	14.4	21.7	18.5	17.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	86.6		
.75	83.2		
.5	81.2		
.375	78.6		
#4	71.7		
#10	57.3		
#16	49.0		
#40	35.6		
#50	31.7		
#100	23.7		
#200	17.1		

* (no specification provided)

Material Description

Brown silty sand with gravel

Atterberg Limits

PL= NP	LL= NP	PI= NP

Coefficients

D_{90}= 28.9248	D_{85}= 23.1909	D_{60}= 2.3361
D_{50}= 1.2606	D_{30}= 0.2590	D_{15}=
D_{10}=	C_u=	C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Natural Moisture Content: 13.5%

Location: BH19-26
Sample Number: 19-110-26 **Depth:** 5-6' **Date:** 4/26/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass

Project No: 475.0385.000 **Figure** 19-110-26

Tested By: JH **Checked By:** JH

LABORATORY DATA

Borehole Samples: Natural Unit Weight

NewFields

NATURAL DENSITY (ASTM 2937)

LABORATORY WORKSHEET

NF Form #16

Client:	Lithium Nevada	**Location:**	See Below
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	4/26/2019
Project Engineer:	Eric Niebler	**Tested By:**	JH
Field Sample ID:	BH	**Checked By:**	JH
Laboratory Sample ID:	19-110		

Drying Conditions: 60 deg C / [✓ 110 deg C] Method: [✓ Oven (O)] / Microwave (M)

Trail No.		**1**	**2**	**3**	**4**	**5**
Sample No.		19-110-09	19-110-11	19-110-13	19-110-14	19-110-26
Location		BH19-15	BH19-17	BH19-18	BH19-18	BH19-26
Depth		5.5-6'	10.5-11'	10.5-11'	20.5-21'	5-6'
Soil Description						
(USCS)						
Soil + Liner Wt., g.	**A**	914.8	912.4	855.4	930.1	898.8
Liner Wt., g.	**B**	233.9	240.6	232.0	237.6	230.0
Soil Wt., g.	**C= A-B**	680.9	671.8	623.4	692.5	668.8
Liner Length, in.	**D_1**	5.995	5.959	5.965	5.973	5.942
Sample Length, in.	**D_2**	5.995	5.959	5.965	5.973	5.942
Liner Diameter, in.	**E**	2.429	2.417	2.413	2.402	2.443
Liner Area, in^2	**$F= (D_2^2/4)*pi$**	4.63	4.59	4.57	4.53	4.69
Sample Volume, in^3	**$G= D_2*F$**	27.78	27.34	27.28	27.07	27.85
Sample Wet Density, pcf	**H= (C/G)*3.81**	93.4	93.6	87.1	97.5	91.5
Sample Dry Density, pcf	**H/(1+(N/100))**	82.6	71.0	63.4	72.1	80.6
Tare No.						
Tare + Wet Soil	**I**	702.2	685.3	645.2	711.7	691
Tare + Dry Soil	**J**	623.5	525.4	475.8	531.9	611.2
Tare	**K**	22.3	22	22.1	22.1	22.1
Wt. of Water	**L= I-J**	78.7	159.9	169.4	179.8	79.8
Dry Soil, Ws	**M=-J-K**	601.2	503.4	453.7	509.8	589.1
Moisture Content, (%)	**N= (L/M) x100**	13.1%	31.8%	37.3%	35.3%	13.5%

Remarks:

LABORATORY DATA

Borehole Samples: Chemical Testing Results

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 08/23/2019
Date Submitted 08/20/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : BH19-12 Site ID : 2.5-6.5 FT.
Your purchase order number is 4750385.
Thank you for your business.

* For future reference to this analysis please use SUN # 80416-168076.

EVALUATION FOR SOIL CORROSION

Soil pH	7.65	
Minimum Resistivity	0.15 ohm-cm (x1000)	
Chloride	1246.9 ppm	00.12469 %
Sulfate	691.9ppm	00.06919 %
Redox Potential	No Test	
Sulfides	No Test	

METHODS
pH AASHTO T289, Min.Resistivity AASHTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 08/23/2019
Date Submitted 08/20/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : BH19-13 Site ID : 7.5-10.5 FT.
Your purchase order number is 4750385.
Thank you for your business.

* For future reference to this analysis please use SUN # 80416-168077.

EVALUATION FOR SOIL CORROSION

Soil pH	7.88	
Minimum Resistivity	0.78 ohm-cm (x1000)	
Chloride	103.2 ppm	00.01032 %
Sulfate	45.5ppm	00.00455 %
Redox Potential	No Test	
Sulfides	No Test	

METHODS
pH AASHTO T289, Min.Resistivity AASHTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 08/23/2019
Date Submitted 08/20/2019

To: Kerry Magner
Newfields MDTS
2227 N. 5th St.
Elko, NV 89801

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : BH19-26 Site ID : 10-11.5 FT.
Your purchase order number is 4750385.
Thank you for your business.

* For future reference to this analysis please use SUN # 80416-168078.

EVALUATION FOR SOIL CORROSION

Soil pH	7.85	
Minimum Resistivity	0.75 ohm-cm (x1000)	
Chloride	97.2 ppm	00.00972 %
Sulfate	295.2ppm	00.02952 %
Redox Potential	No Test	
Sulfides	No Test	

METHODS
pH AASHTO T289, Min.Resistivity AASHTO T288 Mod.(Sm.Cell)
Sulfate AASHTO T290, Chloride AASHTO T291
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

LABORATORY DATA

Borehole Samples: Natural Moisture Content

NewFields

NF Form #15

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

Client:	Lithium Nevada	**Location:**	See Below
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	4/24/2019
Project Engineer:	Eric Niebler	**Tested By:**	JH
Field Sample ID:	BH	**Checked By:**	JH

Drying Conditions: 60 deg C / [✓ 110 deg C] Method: [✓ Oven (O)] / Microwave (M) / Hot Plate (H)

Sample No.		19-110-01	19-110-02	19-110-03	19-110-04	19-110-05
Location		BH19-01	BH19-01	BH19-02	BH19-02	BH19-08
Depth		7.5-9'	25-26.5'	25-26.5'	45-46.5'	2.5-4'
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	A	674.9	1000.5	599	869.5	509.3
Tare + Dry Soil	B	516.2	774.8	385.5	638.9	430.3
Tare	C	22.3	22.1	22.2	22.1	22.3
Wt. of Water	D= A-B	158.7	225.7	213.5	230.6	79
Dry Soil, Ws	E= B-C	493.9	752.7	363.3	616.8	408
Moisture Content, (%)	**(D/E) x100**	**32.1%**	**30.0%**	**58.8%**	**37.4%**	**19.4%**

Sample No.		19-110-06	19-110-07	19-110-08	19-110-09	19-110-10
Location		BH19-09	BH19-11	BH19-12	BH19-15	BH19-16
Depth		2.5-4'	2.5-4'	15-16.5'	5.5-6'	2.5-4'
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	A	748.6	489.4	760.8	702.2	474.2
Tare + Dry Soil	B	681	400.1	690.5	623.5	403.7
Tare	C	22.2	22.2	22.4	22.3	22.1
Wt. of Water	D= A-B	67.6	89.3	70.3	78.7	70.5
Dry Soil, Ws	E= B-C	658.8	377.9	668.1	601.2	381.6
Moisture Content, (%)	**(D/E) x100**	**10.3%**	**23.6%**	**10.5%**	**13.1%**	**18.5%**

Remarks:

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	Lithium Nevada	**Location:**	See Below
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	4/24/2019
Project Engineer:	Eric Niebler	**Tested By:**	JH
Field Sample ID:	BH	**Checked By:**	JH

Drying Conditions: 60 deg C / [✓ **110 deg C**] Method: [✓ **Oven (O)**] / Microwave (M) / Hot Plate (H)

Sample No.		19-110-11	19-110-12	19-110-13	19-110-14	19-110-15
Location		BH19-17	BH19-17	BH19-18	BH19-18	BH19-20
Depth		10.5-11'	20-21'	10.5-11'	20.5-21'	5-6.5'
Soil Description						
(USCS)						
Trial No.		**11**	**12**	**13**	**14**	**15**
Tare No.						
Tare + Wet Soil	**A**	685.3	1746.3	645.2	711.7	1912.4
Tare + Dry Soil	**B**	525.4	1590.1	475.8	531.9	1726.9
Tare	**C**	22	21.8	22.1	22.1	21.9
Wt. of Water	**D= A-B**	159.9	156.2	169.4	179.8	185.5
Dry Soil, Ws	**E= B-C**	503.4	1568.3	453.7	509.8	1705
Moisture Content, (%)	**(D/E) x100**	**31.8%**	**10.0%**	**37.3%**	**35.3%**	**10.9%**

Sample No.		19-110-16	19-110-17	19-110-18	19-110-19	19-110-20
Location		BH19-20	BH19-21	BH19-23	BH19-23	BH19-24
Depth		30-30.5'	2.5-4'	2.5-4'	7.5-9	2.5-4'
Soil Description						
(USCS)						
Trial No.		**16**	**17**	**18**	**19**	**20**
Tare No.						
Tare + Wet Soil	**A**	1638.1	614.4	759.7	672.9	554.5
Tare + Dry Soil	**B**	1399.6	501.7	665.5	606.7	485.2
Tare	**C**	22.2	22	22.4	22.3	22.3
Wt. of Water	**D= A-B**	238.5	112.7	94.2	66.2	69.3
Dry Soil, Ws	**E= B-C**	1377.4	479.7	643.1	584.4	462.9
Moisture Content, (%)	**(D/E) x100**	**17.3%**	**23.5%**	**14.6%**	**11.3%**	**15.0%**

Remarks:

NewFields

NF Form #15

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

Client:	Lithium Nevada	**Location:**	See Below
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	4/24/2019
Project Engineer:	Eric Niebler	**Tested By:**	JH
Field Sample ID:	BH	**Checked By:**	JH

Drying Conditions: 60 deg C / [✓ 110 deg C] Method: [✓ Oven (O)] / Microwave (M) / Hot Plate (H)

Sample No.		19-110-21	19-110-22	19-110-23	19-110-24	19-110-25
Location		BH19-24	BH19-24	BH19-25	BH19-25	BH19-25
Depth		15-16.5'	35-36.5'	2.5-4'	7.5-9'	15-16.5'
Soil Description						
(USCS)						
Trial No.		**21**	**22**	**23**	**24**	**25**
Tare No.						
Tare + Wet Soil	A	671.9	882.8	501.5	523.1	622.6
Tare + Dry Soil	B	604.4	626.1	427	431.8	466
Tare	C	22	22	22.1	22.4	22.4
Wt. of Water	D= A-B	67.5	256.7	74.5	91.3	156.6
Dry Soil, Ws	E= B-C	582.4	604.1	404.9	409.4	443.6
Moisture Content, (%)	**(D/E) x100**	**11.6%**	**42.5%**	**18.4%**	**22.3%**	**35.3%**

Sample No.		19-110-26	19-110-27	19-110-28	19-110-29	19-110-30
Location		BH19-26	BH19-28	BH19-29	BH19-29	BH19-29
Depth		5-6'	8.5-9'	2.5-4'	7.5-9'	15-16.5'
Soil Description						
(USCS)						
Trial No.		**26**	**27**	**28**	**29**	**30**
Tare No.						
Tare + Wet Soil	A	691	751.3	708.9	631.2	924.8
Tare + Dry Soil	B	611.2	652.7	631.5	588.6	805.2
Tare	C	22.1	22.4	22.2	22.2	22
Wt. of Water	D= A-B	79.8	98.6	77.4	42.6	119.6
Dry Soil, Ws	E= B-C	589.1	630.3	609.3	566.4	783.2
Moisture Content, (%)	**(D/E) x100**	**13.5%**	**15.6%**	**12.7%**	**7.5%**	**15.3%**

Remarks:

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	Lithium Nevada	**Location:**	See Below
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	4/24/2019
Project Engineer:	Eric Niebler	**Tested By:**	JH
Field Sample ID:	BH	**Checked By:**	JH

Drying Conditions: 60 deg C / **110 deg C** Method: **Oven (O)** / Microwave (M) / Hot Plate (H)

Sample No.		19-110-31	19-110-32	19-110-33		
Location		BH19-29	BH19-31	BH19-32		
Depth		25-26'	5.5-6'	15-16.5'		
Soil Description						
(USCS)						
Trial No.		**31**	**32**	**33**	**4**	**5**
Tare No.						
Tare + Wet Soil	**A**	427.1	754.7	892.2		
Tare + Dry Soil	**B**	350.3	649.4	745.6		
Tare	**C**	22	21.8	22.4		
Wt. of Water	**D= A-B**	76.8	105.3	146.6		
Dry Soil, Ws	**E= B-C**	328.3	627.6	723.2		
Moisture Content, (%)	**(D/E) x100**	**23.4%**	**16.8%**	**20.3%**		

Sample No.						
Location						
Depth						
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	**A**					
Tare + Dry Soil	**B**					
Tare	**C**					
Wt. of Water	**D= A-B**					
Dry Soil, Ws	**E= B-C**					
Moisture Content, (%)	**(D/E) x100**					

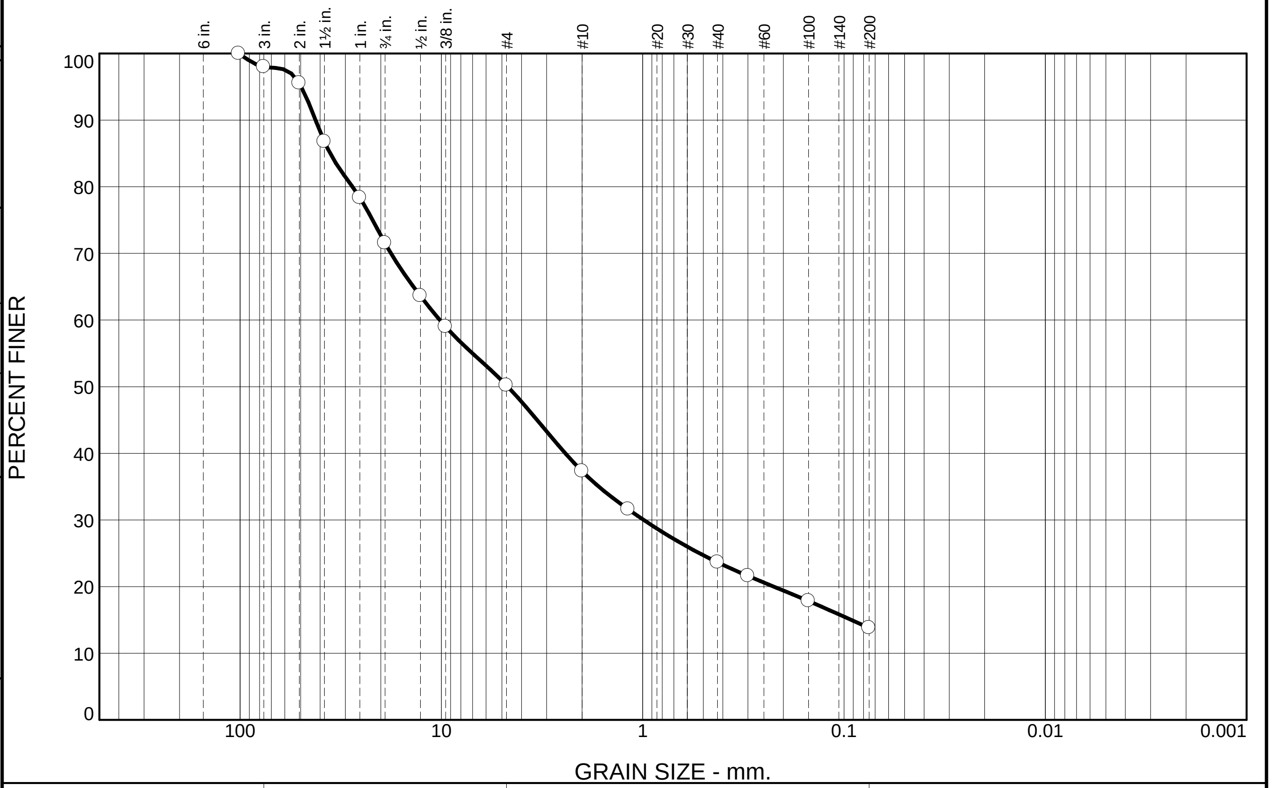
Remarks:

NewFields

LABORATORY DATA

Test Pit Samples: Particle Size Distribution

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
2.0	26.5	21.3	12.9	13.6	9.9	13.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100.0		
3	98.0		
2	95.5		
1.5	86.8		
1	78.4		
.75	71.5		
.5	63.6		
.375	59.0		
#4	50.2		
#10	37.3		
#16	31.6		
#40	23.7		
#50	21.6		
#100	17.8		
#200	13.8		

* (no specification provided)

Material Description

Brown silty gravel with sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 42.1555 D_{85}= 35.6517 D_{60}= 10.1835
D_{50}= 4.6790 D_{30}= 0.9884 D_{15}= 0.0920
D_{10}= C_u= C_c=

Classification

USCS= GM AASHTO= A-1-a

Remarks

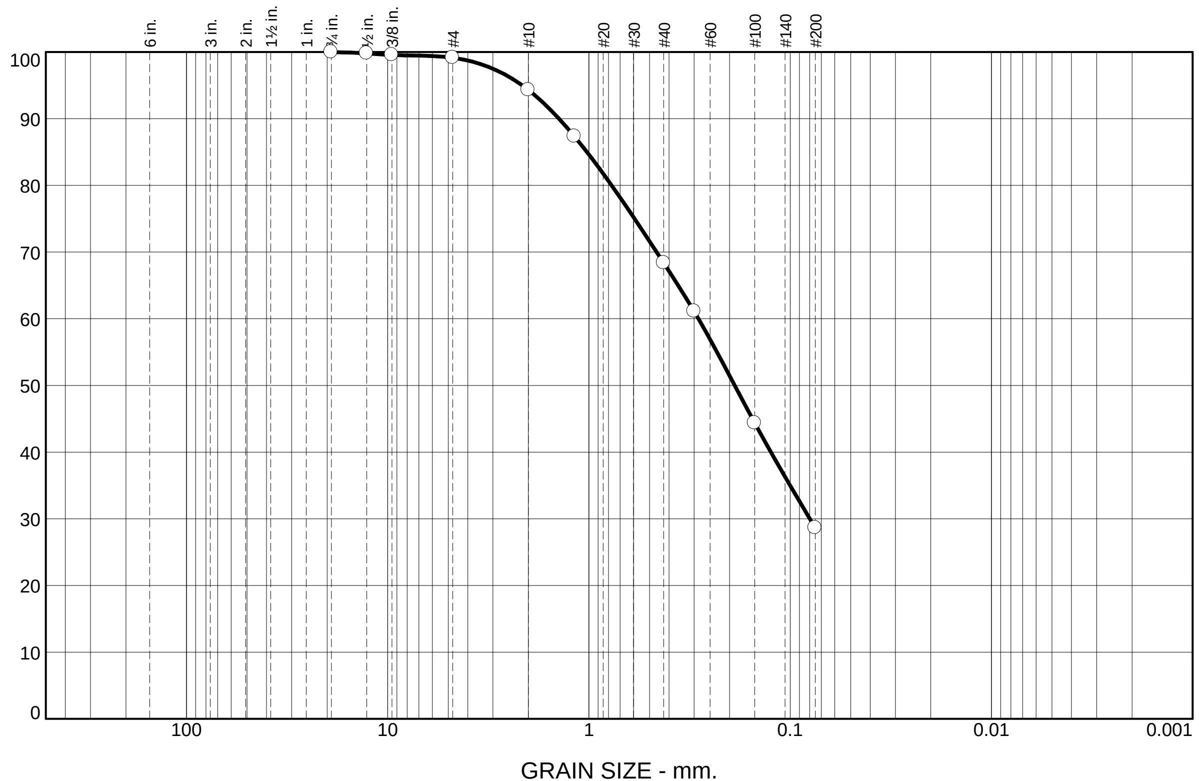
Location: TP19-03
Sample Number: 19-060-03 **Depth:** 6-9' **Date:** 3/5/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-03

Tested By: KS/JB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.9	4.8	25.9	39.8	28.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	99.8		
.375	99.6		
#4	99.1		
#10	94.3		
#16	87.3		
#40	68.4		
#50	61.1		
#100	44.4		
#200	28.6		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 1.4092 D_{85}= 1.0226 D_{60}= 0.2856
D_{50}= 0.1887 D_{30}= 0.0798 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Natural Moisture Content: 31.2%

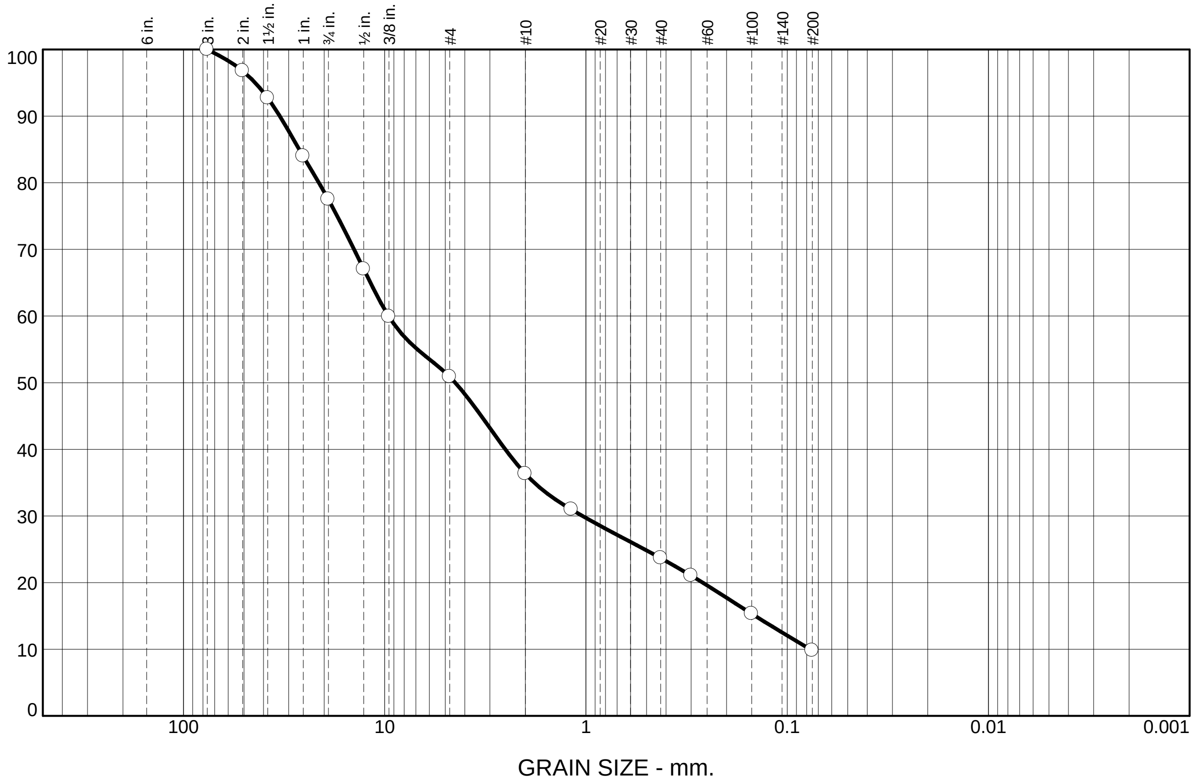
Location: TP19-04
Sample Number: 19-106-03 **Depth:** 2-4' **Date:** 4/22/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-106-03

Tested By: KS **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	22.5	26.6	14.6	12.6	13.9	9.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	96.8		
1.5	92.7		
1	84.0		
.75	77.5		
.5	67.0		
.375	59.9		
#4	50.9		
#10	36.3		
#16	31.0		
#40	23.7		
#50	21.0		
#100	15.3		
#200	9.8		

* (no specification provided)

Material Description

Light Brown well-graded gravel with silt and sand

Atterberg Limits

PL= NP
LL= NP
PI= NP

Coefficients

D_{90}= 33.2086
D_{85}= 26.5801
D_{60}= 9.5689
D_{50}= 4.4634
D_{30}= 1.0390
D_{15}= 0.1443
D_{10}= 0.0768
C_u= 124.52
C_c= 1.47

Classification

USCS= GW-GM
AASHTO= A-1-a

Remarks

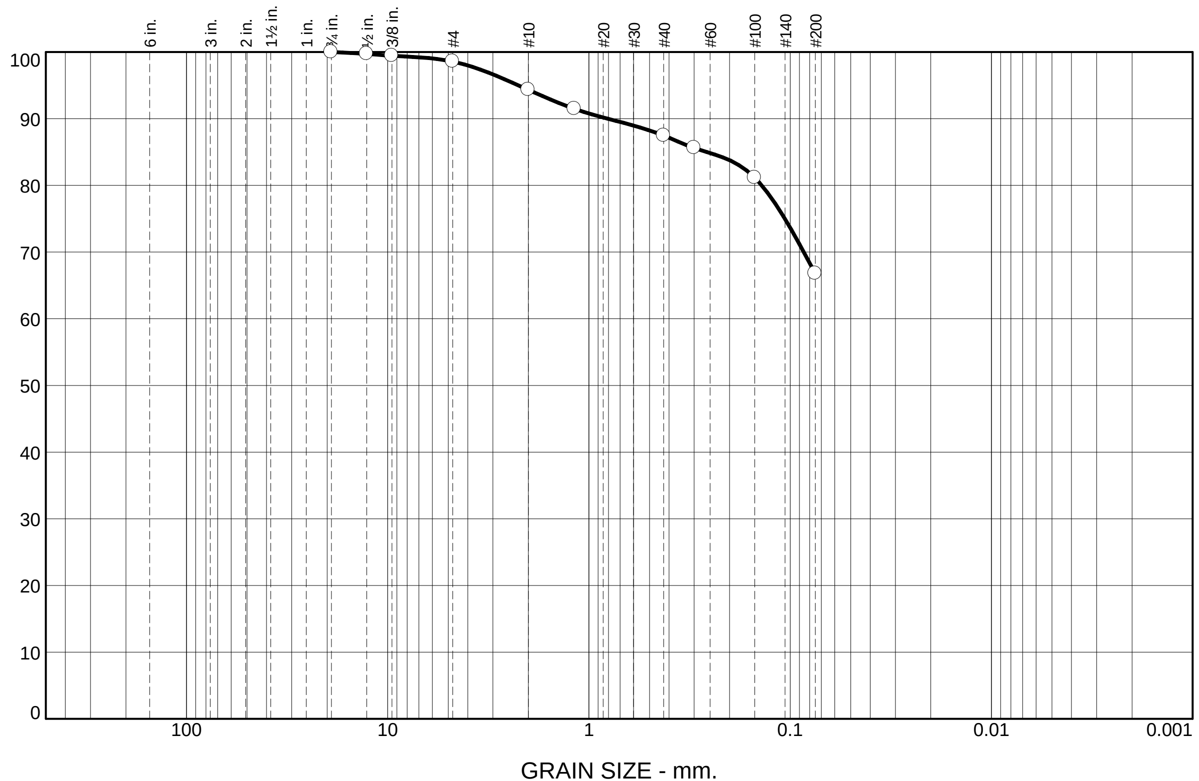
Location: TP19-04
Sample Number: 19-060-04 **Depth:** 5-7'
Date: 3/5/2019

NewFields

Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000
Figure 19-060-04

Tested By: KS/JB **Checked By:** JH

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.4	4.3	6.8	20.7	66.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	99.7		
.375	99.4		
#4	98.6		
#10	94.3		
#16	91.5		
#40	87.5		
#50	85.6		
#100	81.2		
#200	66.8		

* (no specification provided)

Material Description

Brown sandy silt

Atterberg Limits

PL= 31 LL= 41 PI= 10

Coefficients

D_{90}= 0.8040 D_{85}= 0.2597 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO= A-5(7)

Remarks

Location: TP19-05
Sample Number: 19-060-05 **Depth:** 8-10' **Date:** 3/5/2019

NewFields

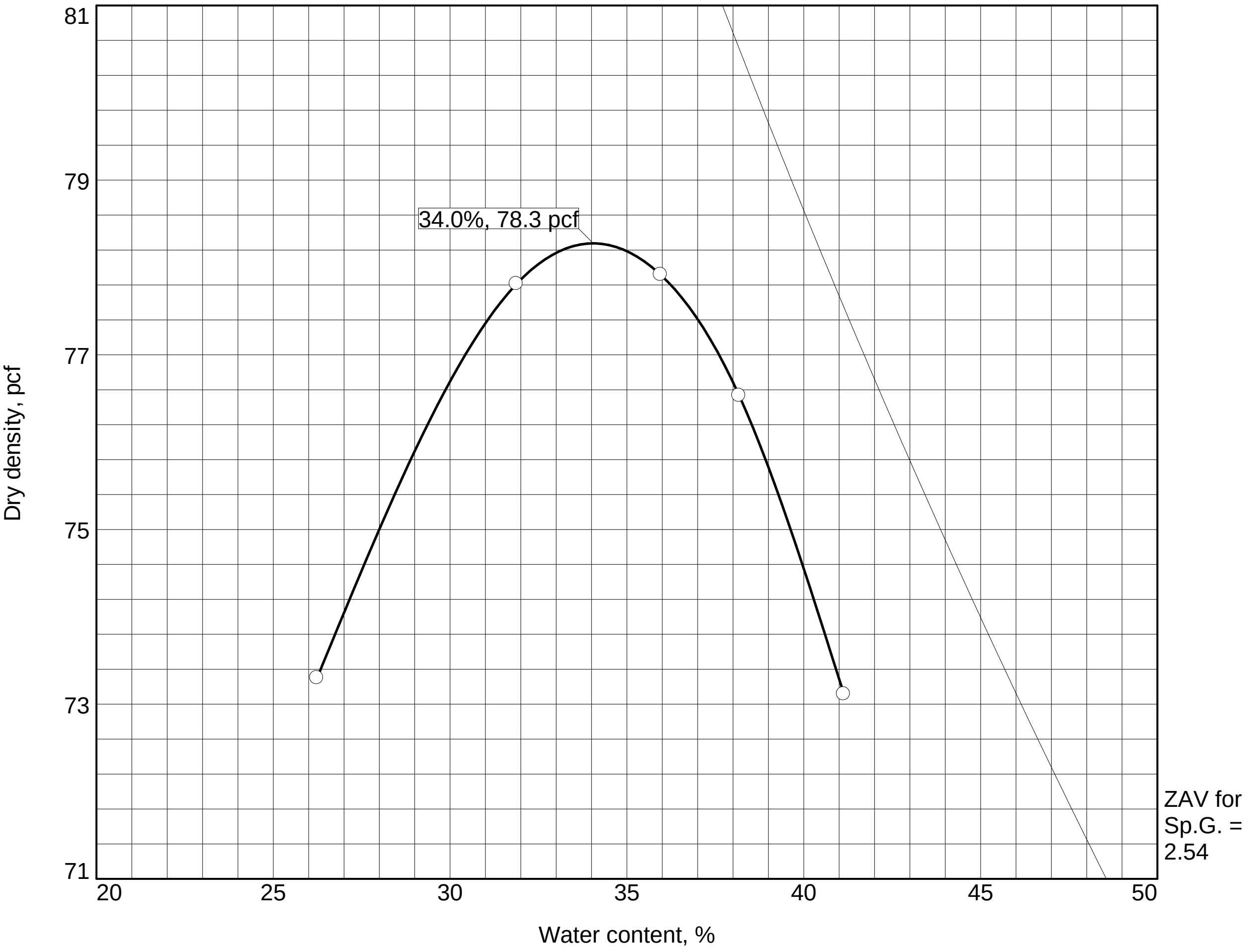
Client: Lithium Nevada
Project: Thacker Pass
Project No: 475.0385.000 **Figure** 19-060-05

Tested By: KS/JB **Checked By:** JH

LABORATORY DATA

Test Pit Samples: Proctor Compaction

COMPACTION TEST REPORT



Test specification: ASTM D 1557-12 Method A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
2-4'	SM	A-5(0)	31.2%	2.54	47	1	0.7	42.9

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 78.3 pcf Optimum moisture = 34.0 %	Light brown silty sand

Project No. 475.0385.000 **Client:** Lithium Nevada

Project: Thacker Pass

Date: 5/1/2019

○ **Location:** TP19-04 **Sample Number:** 19-106-03

NewFields

Remarks:

*Tested Specific Gravity

Figure 19-106-03

Tested By: CB **Checked By:** KE

LABORATORY DATA

Test Pit Samples: Natural Moisture Content

NewFields

NF Form #15

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

Client:	Lithium Nevada	**Location:**	TP
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	3/5/2019
Project Engineer:	Eric Niebler	**Tested By:**	KS/JB
Field Sample ID:	TP	**Checked By:**	JH

Drying Conditions: 60 deg C / [✓ **110 deg C**]   Method: [✓ **Oven (O)**] / Microwave (M) / Hot Plate (H)

Sample No.		19-060-01	19-060-02	19-060-03	19-060-04	19-060-05
Location		TP19-01	TP19-02	TP19-03	TP19-04	TP19-05
Depth		4-7'	0-2'	6-9'	5-7'	8-10'
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	**A**	603.3	580	895	602.1	664.7
Tare + Dry Soil	**B**	539.7	506.7	819.3	521.8	564.4
Tare	**C**	44.9	257.5	120.6	125.1	141.2
Wt. of Water	**D= A-B**	63.6	73.3	75.7	80.3	100.3
Dry Soil, Ws	**E= B-C**	494.8	249.2	698.7	396.7	423.2
Moisture Content, (%)	**(D/E) x100**	**12.9%**	**29.4%**	**10.8%**	**20.2%**	**23.7%**

Sample No.		19-060-06	19-060-07	19-060-08	19-060-09	19-060-10
Location		TP19-06	TP19-08	TP19-09	TP19-11	TP19-13
Depth		11-13'	6-9'	8-12'	7-11'	10-13'
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	**A**	642.9	926.2	789.7	658.1	605.1
Tare + Dry Soil	**B**	597.1	854.8	732.5	618.3	514.9
Tare	**C**	189.5	124.9	270.1	125.3	223.4
Wt. of Water	**D= A-B**	45.8	71.4	57.2	39.8	90.2
Dry Soil, Ws	**E= B-C**	407.6	729.9	462.4	493	291.5
Moisture Content, (%)	**(D/E) x100**	**11.2%**	**9.8%**	**12.4%**	**8.1%**	**30.9%**

Remarks:

NewFields

MOISTURE CONTENT

(ASTM D 2216 / ASTM D 4643)

LABORATORY WORKSHEET

NF Form #15

Client:	Lithium Nevada	**Location:**	TP
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	3/5/2019
Project Engineer:	Eric Niebler	**Tested By:**	KS/JB
Field Sample ID:	TP	**Checked By:**	JH

Drying Conditions: 60 deg C / [✓ **110 deg C**] Method: [✓ **Oven (O)**] / Microwave (M) / Hot Plate (H)

Sample No.		19-060-11	19-060-12	19-060-13	19-060-14	19-060-15
Location		TP19-14	TP19-15	TP19-16	TP19-17	TP19-18
Depth		8-11'	8-11'	7-10'	4-7'	5-8'
Soil Description						
(USCS)						
Trial No.		**11**	**12**	**13**	**14**	**15**
Tare No.						
Tare + Wet Soil	A	632.6	934.6	859.5	654.3	460.1
Tare + Dry Soil	B	527.9	783.8	709.7	572.4	419.2
Tare	C	121	120.8	190.6	188.6	45
Wt. of Water	D= A-B	104.7	150.8	149.8	81.9	40.9
Dry Soil, Ws	E= B-C	406.9	663	519.1	383.8	374.2
Moisture Content, (%)	(D/E) x100	**25.7%**	**22.7%**	**28.9%**	**21.3%**	**10.9%**

Sample No.		19-060-16	19-060-17	19-060-18	19-060-19	19-060-20
Location		TP19-20	TP19-21	TP19-22	TP19-23	TP19-24
Depth		6-10'	3-5'	8-11'	5-9'	14-17'
Soil Description						
(USCS)						
Trial No.		**16**	**17**	**18**	**19**	**20**
Tare No.						
Tare + Wet Soil	A	352.8	347.2	614.6	837.6	649.7
Tare + Dry Soil	B	296.3	312.3	592	786.2	542.3
Tare	C	44.9	45.1	121.1	189.3	225.5
Wt. of Water	D= A-B	56.5	34.9	22.6	51.4	107.4
Dry Soil, Ws	E= B-C	251.4	267.2	470.9	596.9	316.8
Moisture Content, (%)	(D/E) x100	**22.5%**	**13.1%**	**4.8%**	**8.6%**	**33.9%**

Remarks:

NewFields

NF Form #15

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

Client:	Lithium Nevada	**Location:**	TP
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	3/5/2019
Project Engineer:	Eric Niebler	**Tested By:**	KS/JB
Field Sample ID:	TP	**Checked By:**	JH

Drying Conditions: 60 deg C / [✓ **110 deg C**] Method: [✓ **Oven (O)**] / Microwave (M) / Hot Plate (H)

Sample No.		19-060-21	19-060-22	19-060-23	19-060-24	19-060-25
Location		TP19-25	TP19-26	TP19-27	TP19-28	TP19-29
Depth		7-12'	6-8'	3-5'	5-9'	4-7'
Soil Description						
(USCS)						
Trial No.		**21**	**22**	**23**	**24**	**25**
Tare No.						
Tare + Wet Soil	**A**	746.1	852.9	644	704.4	871.1
Tare + Dry Soil	**B**	699.3	738.3	533.9	668.6	814.8
Tare	**C**	123.9	190.9	45.2	124.6	123.5
Wt. of Water	**D= A-B**	46.8	114.6	110.1	35.8	56.3
Dry Soil, Ws	**E= B-C**	575.4	547.4	488.7	544	691.3
Moisture Content, (%)	**(D/E) x100**	**8.1%**	**20.9%**	**22.5%**	**6.6%**	**8.1%**

Sample No.						
Location						
Depth						
Soil Description						
(USCS)						
Trial No.		**26**	**27**	**28**	**29**	**30**
Tare No.						
Tare + Wet Soil	**A**					
Tare + Dry Soil	**B**					
Tare	**C**					
Wt. of Water	**D= A-B**					
Dry Soil, Ws	**E= B-C**					
Moisture Content, (%)	**(D/E) x100**					

Remarks:

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	Lithium Nevada	**Location:**	TP
Project Title:	Thacker Pass	**Elevation:**	See Below
Project Number:	475.0385.000	**Test Date:**	4/22/2019
Project Engineer:	Eric Niebler	**Tested By:**	KS
Field Sample ID:	TP	**Checked By:**	JH

Drying Conditions: 60 deg C / **110 deg C** Method: **Oven (O)** / Microwave (M) / Hot Plate (H)

Sample No.		19-106-02	19-106-03	19-106-04	19-106-05	19-106-06
Location		TP19-03	TP19-04	TP19-07	TP19-08	TP19-10
Depth		2-4'	2-4'	2-4'	2-4'	3-6'
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	A	401.7	432.9	650.3	618.1	555.5
Tare + Dry Soil	B	363.7	358.6	574.2	563.2	492.6
Tare	C	124.7	120.8	257.4	191.2	125.3
Wt. of Water	D= A-B	38	74.3	76.1	54.9	62.9
Dry Soil, Ws	E= B-C	239	237.8	316.8	372	367.3
Moisture Content, (%)	**(D/E) x100**	**15.9%**	**31.2%**	**24.0%**	**14.8%**	**17.1%**

Sample No.		19-106-07	19-106-08			
Location		TP19-13	TP19-28			
Depth		3-5'	1-3'			
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	A	433.6	440			
Tare + Dry Soil	B	381.7	347.3			
Tare	C	44.9	45			
Wt. of Water	D= A-B	51.9	92.7			
Dry Soil, Ws	E= B-C	336.8	302.3			
Moisture Content, (%)	**(D/E) x100**	**15.4%**	**30.7%**			

Remarks:

LABORATORY DATA

Test Pit Samples: Specific Gravity

SPECIFIC GRAVITY SOILS (ASTM D854)

LABORATORY WORKSHEET

NF Form #11

Client:	Lithium Nevada	**Field Sample ID:**	TP19-04	**Test Start Date:**	4/30/2019
Project Title:	Thacker Pass	**Laboratory Sample ID:**	19-106-03	**Tested By:**	KE
Project Number:	475.0385.000	**Location:**	TP19-04	**Checked By:**	JH
Project Engineer:	Eric Niebler	**Elevation:**	2-4'	**Sample Description:**	

Sample Number	19-106-03							
Sample Location	TP19-04 (2'-4')							
Prep Dish								
Flask No.	3	15						
1) Wt. of Flask + Soil	115.90	116.63						
2) Wt. of Flask	86.05	86.66						
3) Wt. of Soil = 1-2	29.85	29.97						
4) Calibrated Wt. of Flask + Water	335.19	335.73						
5) (3+4)	365.04	365.70						
6) Wt. of Flask + Water +Soil	353.34	353.98						
7) Volume of Soil = (5-6)	11.70	11.72						
8) Test Temperature, deg.C (Ta)	19.1	19.2						
9) Temperature Correction, k	1.00018	1.00016						
10) Specific Gravity	2.538	2.546						
11) Average Specific Gravity, Gs	2.542							

General Notes:

APPENDIX D.2

Clay Tailings Filter Stack Stability Technical Memorandum (385-TM-08-STABILITY)

NewFields
Perspective. Vision. Solutions.

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Lone Tree, CO 80124
T: 720.508.3300
F: 720.508.3339

TECHNICAL MEMORANDUM (385-TM-08-STABILITY)

To: **Lithium Nevada Corporation**

From: **NewFields MDTS**

Reviewed By: **Matt Haley, P.E.**

Project: **Thacker Pass Project**

Project No: 475.385.000

Subject: **Clay Tailings Filter Stack Stability**

Date: January 28, 2020

1. INTRODUCTION

NewFields has completed a stability assessment of the Clay Tailings Filter Stack (CTFS) Facility as part of Lithium Nevada Corporation's (LNC) proposed Thacker Pass Project. The CTFS is intended to store the solid waste products (filter cakes and sulfate salts) generated as a result of lithium production. The current stability evaluation was performed to support CTFS design and sizing, and to verify the facility will remain stable for the expected loading conditions. The results of the stability analysis and recommendations are presented herein.

2. GEOTECHNICAL DESIGN

The CTFS facility will consist of a native soils foundation overlain by a geomembrane containment liner, a granular drainage layer, an exterior structural tailings zone, and an interior non-structural tailings zone. The structural zone will be placed at specified relative compaction levels and near optimum moisture content. While the non-structural zone will be placed at a lower density (densified to allow for construction traffic) with potentially higher moisture content. Sulfate salts have been shown to adversely influence the characteristics of composite tailings mixtures in the short-term by reducing the amount of water the filter cake can absorb[1]. The laboratory testing performed on the composite tailings materials mixed with the salts indicate trafficability during placement may be an issue. As a result the sulfate salts will be handled separately from the composite tailings and only placed in the non-structural zone. The higher density tailings in the structural zone, when placed with an exterior slope of 4:1 (horizontal:vertical) will provide the strength needed to achieve geotechnical stability for the facility. The drainage layer will allow for the collection of fluids draining from the base of the tailings mass.

---

[1] NewFields MDTS (2019). "Tailings Assessment." Technical Memo-07. December 20, 2019.

A maximum facility height of 400 feet as measured vertically from the top of the stack to the geomembrane liner was considered for stability evaluation, but the actual facility height will be a function of annual production, mine planning, and life of mine.

3. SEISMIC HAZARD ASSESSMENT

Ground motions associated with design-level earthquakes were previously developed[2] for the Thacker Pass Project and were based on field investigation, site specific analyses, published hazard maps, and building codes.

3.1 Design Ground Motions

The Seismic Hazard Analysis completed for Thacker Pass[2] compared the reported site-specific design accelerations to values reported by USGS[3] . NewFields considers the 475-year and 2,475-year events as reasonable risk levels for operational and closure conditions.

The USGS data was used to determine the operational basis event (OBE) which is considered a ground motion with 10 percent exceedance within a 50-year period (475 year return period). The OBE is based on a moment magnitude of 6.4 at a distance of 35 miles, resulting in a peak ground acceleration (PGA) of 0.09g at the site location. For post-closure design, the maximum design earthquake (MDE) was selected, which is a ground motion with a 2 percent probability of exceedance within a 50-year period (2,475 year return period). The MDE event for the project site is based on a moment magnitude of 6.6 at a distance of 14 miles, resulting in a PGA of 0.26g.

3.2 Material Properties

Design parameters utilized in the stability evaluations for the CTFS were conservatively selected based upon available laboratory test data[1,4]. The material properties are summarized in **Table 1**.

---

[2] NewFields MDTS (2019). "Deterministic Seismic Hazard Analysis." Technical Memo-03. July 18, 2019

[3] United State Geologic Survey (2019). United States Geological Survey – Earthquake Hazards Program, Unified Hazard Tool. https://earthquake.usgs.gov/hazards/interacitve/

[4] NewFields MDTS (2019). "Geotechnical Investigation Factual Report for the Thacker Pass Project." October 16, 2019.

Table 1 – Summary of Material Properties

Material	Unit Weight (lb/ft^3)	Friction Angle (degrees)	Cohesion (lb/ft^2)
Alluvium - Foundation	110	32	0
Drainage Layer	110	35	0
Liner Interface	110	16	0
Non-structural Tailings	90	16	0
Structural Tailings	100	20	0

4. STABILITY EVALUATION

Stability analyses were performed using the computer program SLIDE v8 by RocScience. SLIDE is a two-dimensional slope stability program for evaluating circular or noncircular failure surfaces in soil or rock slopes using limit equilibrium methods. The Spencer's method, which is appropriate for all slope geometries and soil profiles, was utilized within the stability model and assumes all interslice forces are parallel and have the same inclination. The factor of safety can be defined generally as the resisting forces along a potential failure plane divided by the gravitational and dynamic driving forces.

Both static and long-term seismic conditions were analyzed. To assess the stability of slopes during seismic loadings, a pseudostatic approach was considered. This involves the potential slide mass being subjected to an additional destabilizing horizontal force, which represents the effect of earthquake motions and is directly related to the peak ground acceleration (PGA). Described simply, the seismic force is the weight of the slide mass multiplied by a horizontal pseudostatic earthquake coefficient (k_H). Because the earthquake motion is not a constant destabilizing force, using the full PGA for k_H has been shown to be overly conservative. Hynes-Griffin and Franklin[5] discussed using one-half of the PGA for the horizontal pseudostatic earthquake coefficient, with the resulting minimum factor of safety being equal to at least 1.0, will result in slope deformations that will be within tolerable limits. The concept of "tolerable limits" was developed primarily for water retaining structures, such as traditional slurry tailings facilities, and refers to minor seismic induced deformation of the crest elevation and slopes without uncontrolled release of retained solutions.

The corresponding peak ground accelerations (PGA) for these events are 0.09g and 0.26g for the 475-year and 2,475-year events, respectively. Based on the seismic hazard parameters, a

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[5] Hynes-Griffin, M.E. and Franklin, A.G. (1984), Rationalizing the Seismic Coefficient Method, Final Report GL-84-13, U.S. Army Corps of Engineers, Washington, D.C.

reduced pseudostatic seismic coefficient of 0.13g (one-half of the PGA) is valid and was used to evaluate for post closure pseudostatic conditions.

The CTFS is not a water retaining structure, nor is it a dam. The intended use of the facility is the storage of mechanically placed filtered tailings solids. The facility will be constructed in horizontal lifts which will be sloped toward the exterior edges of the stack to shed precipitation runoff to the perimeter of the facility. Between the toe of the slope and the perimeter berm, perforated pipe will be buried in the overliner material to aid in conveying this runoff to the reclaim pond. Additionally, the perimeter of the facility is graded such that runoff can flow around the stacked tailings and down to the reclaim pond. As such, the facility has been evaluated as an engineered structure, similar to a waste rock storage facility or a heap leach pad. Minimum acceptable factors of safety for static and pseudostatic conditions were established as 1.3 and 1.05, respectively.

4.1 Stability Model Development

Both static and pseudostatic loadings were evaluated for a critical cross section through the ultimate CTFS configuration. This critical location was selected based upon existing topography, and proposed grading of the facility foundation. The location of the critical cross section is shown in **Figure 1**. The engineering parameters for the CTFS foundation were developed from laboratory index and strength test data in conjunction with observations from the field investigation and historical experience with similar materials. During pseudostatic analysis the tailings material parameters are reduced to account for strain softening during potential deformation.

Finite element seepage analyses were completed to estimate the maximum phreatic surface allowable to satisfy the minimum static factor of safety. The seepage model assumed the base geomembrane liner was impermeable, and the saturated hydraulic conductivity of tailings within the structural and non-structural zones was 1 x 10^{-7} cm/sec and 1 x 10^{-6} cm/sec, respectively. The hydraulic conductivity of the structural zone was based on laboratory measurements and the non-structural hydraulic conductivity of the combined tailings materials and the sulfate salts was assumed to be one order of magnitude higher due a lower density as a result of less compactive effort applied during placement. The self-weight consolidation of the tailings could lead to saturation in the lower portions of the facility, and the drainage layer is intended to provide base drainage and minimize phreatic surface development. This parametric study determined that the phreatic surface could extend to one-half of the facility height without adversely affecting the overall stability of the facility. The phreatic surface within the fully-lined tailings facility was conservatively assumed to be approximately one-half of the facility height near the center of the non-structural zone tapering to the top of overliner at the toe.

4.2 Results

Results of the slope stability analyses for the cross section under consideration are presented on **Figures 2** and **3**. These figures detail the critical cross section, the modeled phreatic surface, and the failure planes with the lowest factors of safety. Based on this evaluation, the CTFS will remain stable for static loading conditions assuming conservative phreatic head conditions within the non-structural zone.

Pseudostatic loading conditions indicate that the factor of safety could be 0.7, as shown on Figure 3, for the conservative assumptions regarding the elevated phreatic surface conditions and using the MDE event (long term closure condition), and thus a deformation analysis was completed to estimate potential slope movements and determine if they are acceptable.

4.3 Deformation Analysis

Since the pseudostatic stability evaluation resulted in calculated minimum factors of safety less than 1.05 for the MDE event, as shown on Figure 3, potential seismic deformations of facility slopes were evaluated using a simplified method. Bray and Travasarou[6] developed a semi-empirical relationship for estimating the magnitude and probability of permanent slope displacements that utilizes a non-linear, fully coupled stick-slip sliding block model to estimate dynamic performance of soil slopes. The response spectrum and moment magnitude of the design earthquake were based on data obtained from the USGS.

Results of the deformation analysis indicate that for the MDE event, potential slope displacements between 17 to 32 inches could be expected. This estimate is for movement along the entire slope length for the maximum height of 400 feet. It is our professional opinion that these slope movements are acceptable and any potential slope deformation from the MDE seismic event would not result in an excursion of the tailings outside containment.

5. DISCUSSION AND CONCLUSIONS

The results of the stability analyses indicate that the CTFS facility will remain stable during operations and post-closure. The presented design will function as expected as long as monitoring occurs and operational flexibility is considered with regards to material placement.

---

[6] Bray, J.D., and Travasarou, T. (2007). Simplified Procedure for Estimating Earthquake-Induced Deviatoric Slope Displacement, Journal of Geotechnical and Geoenvironmental Engineering, Vol. 133, No. 4.

Systematic monitoring and visual inspection of the facility will be an integral part of the Operations to ensure that the facility is maintained within the design parameters.

Results of the deformation analysis indicate that for an MDE seismic event, potential slope displacements could be as high as 2.5 feet when considering reasonable probability of exceedance and a conservative evaluation of the seismic risk. It is our engineering assessment that this level of slope deformation is within tolerable limits.

Based upon the laboratory data generated and observations of the filtered clay tailings materials both pre- and post-laboratory testing, it is believed that there will be an increase in material strength over time due to curing. At this time, the exact magnitude of this strength increase is unknown. Long-term, there is an opportunity to optimize the facility design if it can be demonstrated that the tailings achieve strength gain after placement. With that in mind, a field investigation program should be completed during early operations to assess in-situ strengths of the placed tailings.

Attachments:

Figure 1: Location Diagram

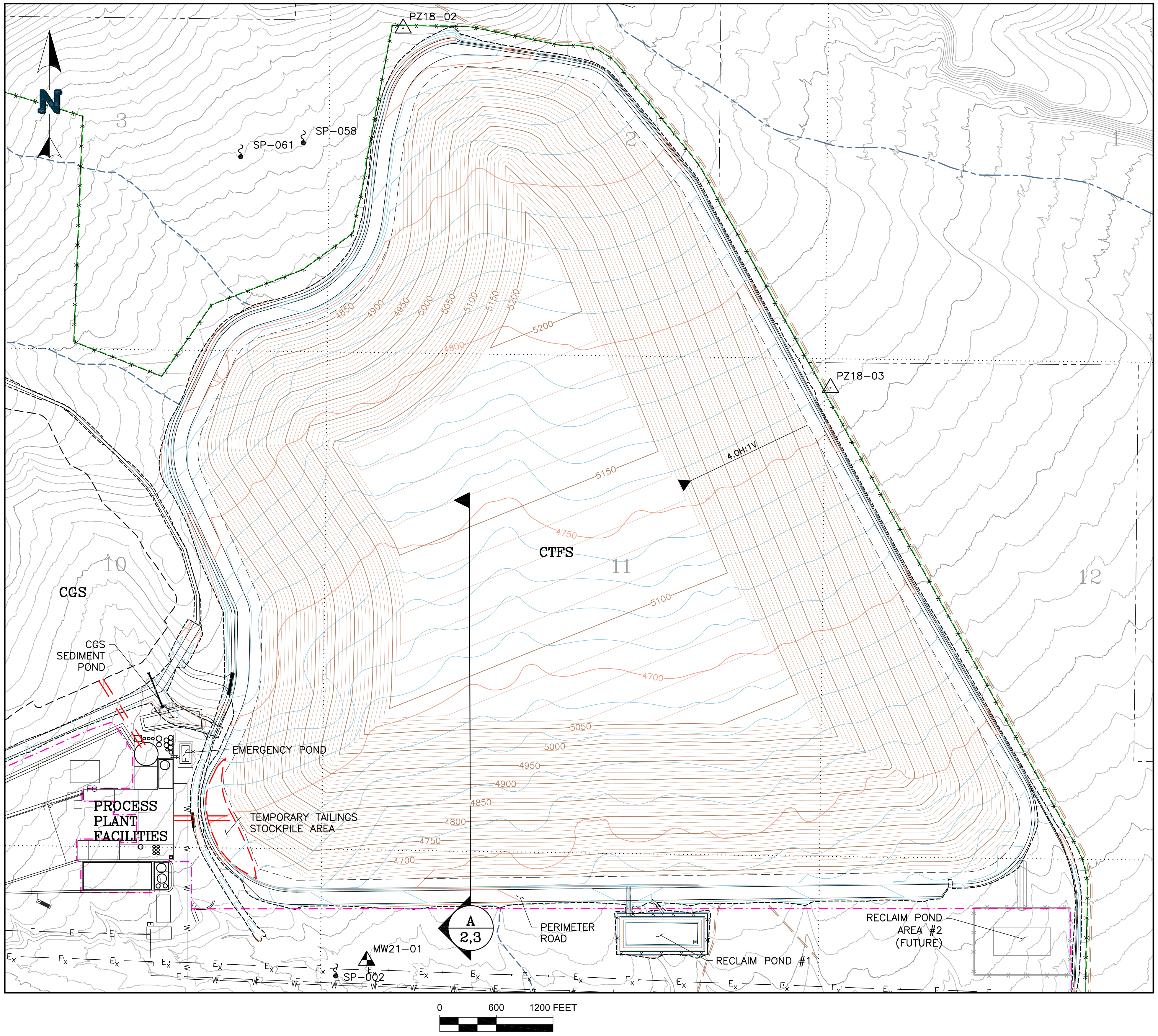
Figure 2: Static Stability Assessment

Figure 3: Pseudostatic Stability Assessment

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\J-REPORTS\Technical Memos\TM-08 CTFS Stability\TM-08 - CTFS Stability-Rev2.docx

FIGURES

Location Diagram and Stability Assessments



LEGEND:

	EXISTING 10 FT GROUND CONTOURS
4500	EXISTING CONTOUR ELEVATION
	10 FT STACK CONTOURS
4500	STACK CONTOUR ELEVATION
	10 FT GROUND CONTOURS
4500	CONTOUR ELEVATION
	SECTION LINES
20	SECTION NUMBER
	EXISTING ROADS
	SURFACE DAYLIGHT
	EXISTING DRAINAGES
	CULVERT(S)
	TEMPORARY TAILINGS STOCKPILE AREA
Ex	EXISTING POWER LINE
:	EXISTING POWER POLES
W	WATER LINE
E	POWER LINE
	FUTURE PLANT EXPANSION
x x x	FENCE
FO	FIBER OPTIC LINE
▭	STRUCTURE/BUILDING
	EXISTING SPRING/SEEP
▲	MONITORING WELL
△	EXISTING PIEZOMETER

NOTE:

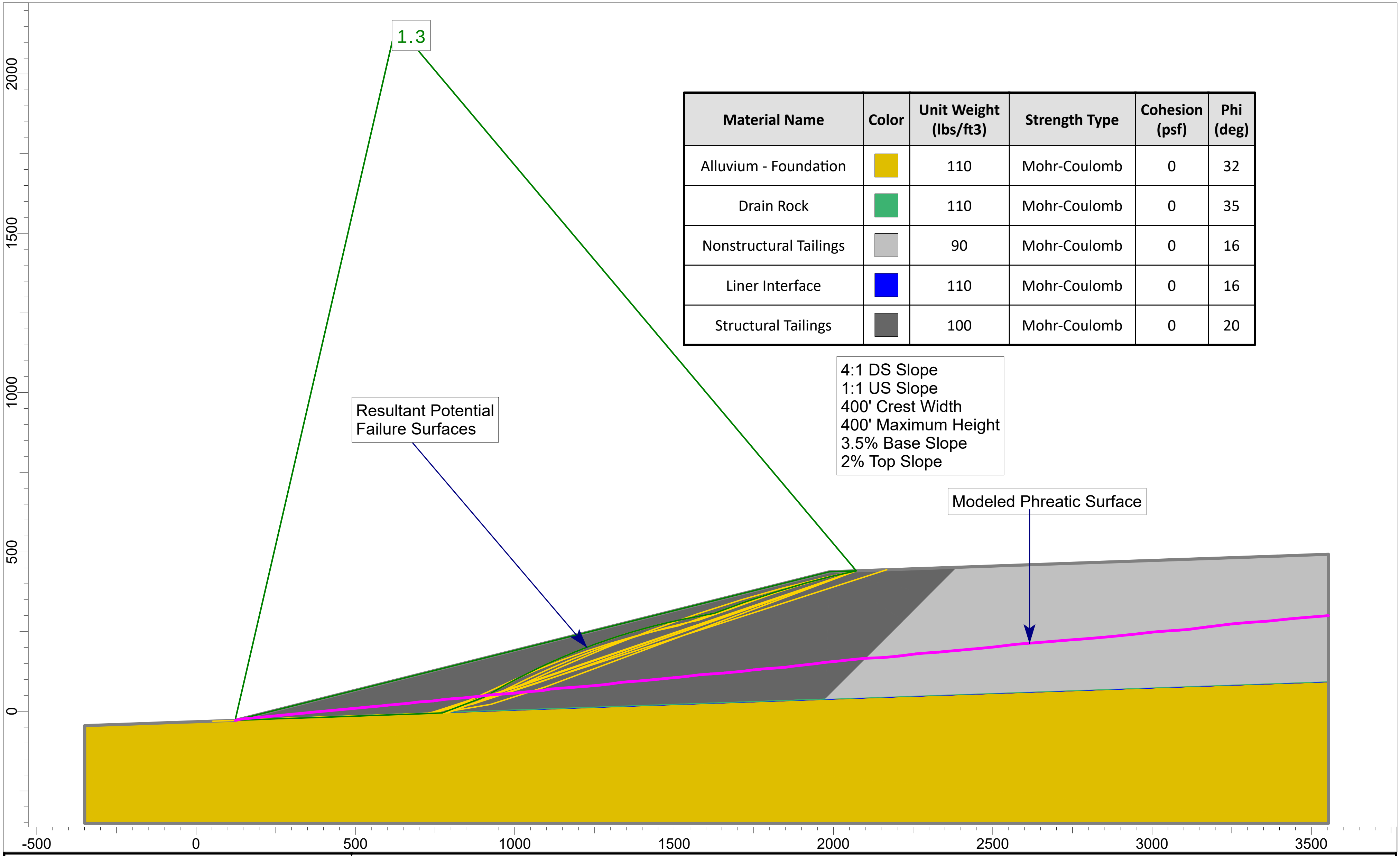
1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.

TOPO REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED FROM KINGS VALLEY TOPO.DWG, WHICH WAS RECEIVED FROM LNC ON NOVEMBER 20, 2018. THE COORDINATE SYSTEM IS UTM ZONE 11 NAD83 SOUTH WITH UNITS IN US SURVEY FEET.

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\A-CAD\FIG\0385.000.075F.dwg–1/17/2020 6:07 PM

NewFields	CLIENT LITHIUM NEVADA CORP.
PROJECT	THACKER PASS PROJECT
TITLE GEOTECH STABILITY SECTIONS LOCATION DIAGRAM	FILENAME 0385.000.075F FIGURE NO. 1 REVISION A



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvium - Foundation	🟨	110	Mohr-Coulomb	0	32
Drain Rock	🟩	110	Mohr-Coulomb	0	35
Nonstructural Tailings	⬜	90	Mohr-Coulomb	0	16
Liner Interface	🟦	110	Mohr-Coulomb	0	16
Structural Tailings	⬛	100	Mohr-Coulomb	0	20

4:1 DS Slope
1:1 US Slope
400' Crest Width
400' Maximum Height
3.5% Base Slope
2% Top Slope

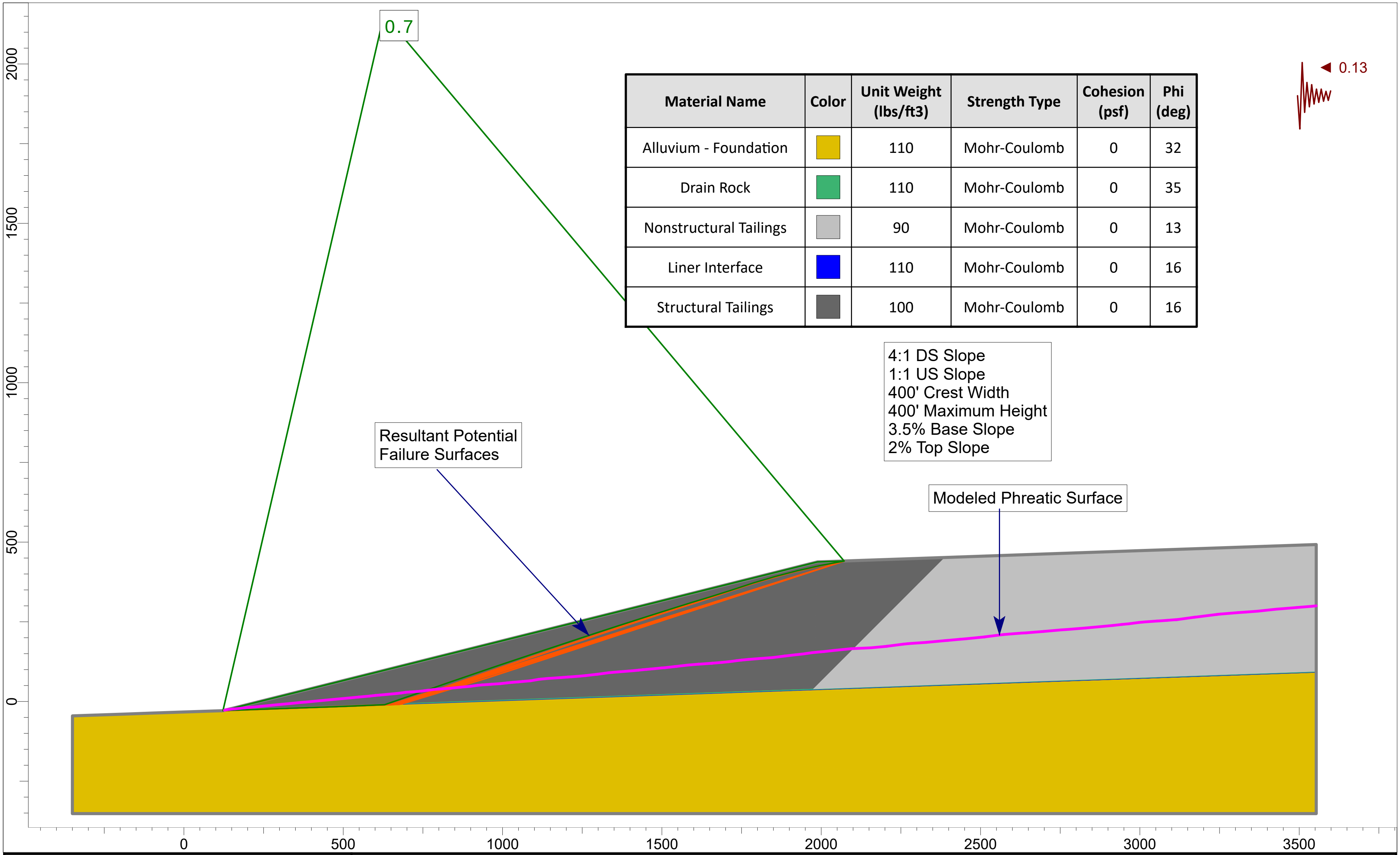
Resultant Potential Failure Surfaces

Modeled Phreatic Surface

NewFields

SLIDEINTERPRET 8.030

Project	Thacker Pass CTFS Analysis
Analysis Description	Figure 2. Static Analysis
Drawn By	K.Magner
Scale	1:5000
Company	NewFields
Date	1/24/2020
File Name	4_1.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvium - Foundation	🟨	110	Mohr-Coulomb	0	32
Drain Rock	🟩	110	Mohr-Coulomb	0	35
Nonstructural Tailings	⬜	90	Mohr-Coulomb	0	13
Liner Interface	🟦	110	Mohr-Coulomb	0	16
Structural Tailings	⬛	100	Mohr-Coulomb	0	16

4:1 DS Slope
1:1 US Slope
400' Crest Width
400' Maximum Height
3.5% Base Slope
2% Top Slope

Resultant Potential Failure Surfaces

Modeled Phreatic Surface

NewFields

Project Thacker Pass CTFS Analysis

Analysis Description Figure 3. Pseudostatic Analysis

Drawn By K.Magner
Scale 1:5000
Company NewFields

Date 1/24/2020
File Name 4_1PS.slmd

SLIDEINTERPRET 8.030

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F: 720.508.3339

TECHNICAL MEMORANDUM
(385-TM-09-R1-CGS/WRSF STABILITY)

To: **Lithium Nevada Corporation**
From: **NewFields MDTS**
Reviewed By: **Matt Haley, P.E.**
Project: **Thacker Pass Project**
Project No: 475.385.000
Subject: **Coarse Gangue Stockpile and Waste Rock Storage Facilities Stability Evaluation**
Date: February 22, 2020

1. INTRODUCTION

NewFields has completed a stability evaluation of the Coarse Gangue Stockpile (CGS) and the Waste Rock Storage Facilities (WRSF) as part of Lithium Nevada Corporation's (LNC) proposed Thacker Pass Project. The CGS and both East and West WRSF's are intended to store non-valuable materials generated from the mining and classification processes. Coarse gangue is a dewatered, fine-to-coarse sand material generated via multiple stages of hydrocylones and final dewatering screens. The hydrocyclones separate the high lithium-bearing, fine clay and silt materials in the feed slurry from the low lithium-bearing, coarse materials. Dewatering screens ensure a consistent low moisture content in the coarse gangue prior to being conveyed to the CGS. The lithium-bearing material reports to the chemical processing plant for lithium extraction and production. The lithium product is not expected to be processed economically at this time from the coarse gangue material.

The waste rock materials are expected to consist primarily of very weak claystone overburden materials excavated during the mining process. Relatively small quantities of alluvium and basalt may also be stored in the WRSF.

The current stability evaluation was performed to support CGS and WRSF design and sizing, and to verify the facility will remain stable for the expected loading conditions. The results of the stability evaluation and recommendations are presented herein.

2. MATERIAL PROPERTIES

Design parameters utilized in the stability evaluations for the CGS were conservatively selected based upon available laboratory test data[1]. Design parameters utilized for the stability evaluations for the WRSFs were conservatively selected based upon previous reporting[4] and experience with similar materials. The claystone material is reported by AMEC[2] to have an International Society for Rock Mechanics (ISRM) hardness of S6/R0 and a Rock Quality Designation (RQD) ranging from 0 to 91. This implies that once excavated the material may exhibit engineering behavior similar to a stiff soil rather than a competent or intact rock. The AMEC report further states that the claystone appears to weather and breakdown into a high plastic soil upon exposure to the elements. The engineering parameters for the facility foundations were developed from laboratory index and strength test data in conjunction with observations from the field investigation, previous reporting by others and historical experience with similar materials.

The material properties utilized in the evaluations for all facilities are summarized in **Table 1**.

TABLE 1 – SUMMARY OF MATERIAL PROPERTIES

Material	Unit Weight (lb/ft^3)	Friction Angle (degrees)	Cohesion (lb/ft^2)
Alluvium - Foundation	110	32	0
Coarse Gangue Material	110	31	0
Waste Rock (Claystone – Clay Soil)	100	18	200

3. GEOTECHNICAL DESIGN

The CGS and WRSFs will each consist of a native soil foundation overlain by placed coarse gangue (sand) or mine pit waste rock (claystone). Materials will be placed in each facility under minimum relative compaction achieved by haulage equipment and at as-produced moisture contents. The design considers that each facility will be constructed as follows:

---

[1] NewFields MDTS (2019). "Geotechnical Investigation Factual Report for the Thacker Pass Project." Technical Report. October, 2019

[2] AMEC Earth and Environmental (2011). "Prefeasibility Level Geotechnical Study Report Kings Valley Lithium Project." Project No. 10-417-0096. March 9, 2011.

- The current CGS design is a maximum of 200 feet thick as measured vertically from the foundation soils to the top of fill. It has an inter-bench slope of 4-Horizontal:1-Vertical (4H:1V), 75-foot wide benches and 50-foot lift thicknesses for an overall slope of 5.5H:1V.
- The current East WRSF design is a maximum of 150 feet thick. It has an inter-bench slope of 4-Horizontal:1-Vertical (4H:1V), 75-foot wide benches and 50-foot lift thicknesses for an overall slope of 5.5H:1V.
- The current West WRSF will be constructed at a 3.5H:1V continuous slope with a maximum thickness of 275 feet.

The actual facility heights will be a function of annual production, mine planning, and life of mine.

4. SEISMIC HAZARD ASSESSMENT

Ground motions associated with design-level earthquakes were previously developed[3] for the Thacker Pass Project and were based on field investigation, site specific analyses, published hazard maps, and building codes.

4.1 Design Ground Motions

The Seismic Hazard Analysis completed for Thacker Pass[1] compared the reported site-specific design accelerations to values reported by USGS[4] . NewFields considers the 475-year and 2,475-year events as reasonable risk levels for operational and closure conditions.

The USGS data was used to determine the operational basis event (OBE) which is considered a ground motion with 10 percent exceedance within a 50-year period (475-year return period). The OBE is based on a moment magnitude of 6.4 at a distance of 35 miles, resulting in a peak ground acceleration (PGA) of 0.09g at the site location. For post-closure design, the maximum design earthquake (MDE) was selected, which is a ground motion with a 2 percent probability of exceedance within a 50-year period (2,475 year return period). The MDE event for the project site is based on a moment magnitude of 6.6 at a distance of 14 miles, resulting in a PGA of 0.26g.

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[3] NewFields MDTS (2019). "Deterministic Seismic Hazard Analysis." Technical Memo-03. July 18, 2019

[4] United State Geologic Survey (2019). United States Geological Survey – Earthquake Hazards Program, Unified Hazard Tool. https://earthquake.usgs.gov/hazards/interacitve/

5. STABILITY EVALUATION

Stability analyses were performed using the computer program SLIDE v8 by RocScience. SLIDE is a two-dimensional slope stability program for evaluating circular or noncircular failure surfaces in soil or rock slopes using limit equilibrium methods. The Spencer's method, which is appropriate for all slope geometries and soil profiles, was utilized within the stability model and assumes all interslice forces are parallel and have the same inclination. The factor of safety can be defined generally as the resisting forces along a potential failure plane divided by the gravitational and dynamic driving forces. For the CGS and East WRSF both the inter-bench slope stability and overall slope stability were analyzed.

Both static and long-term seismic conditions were analyzed. To assess the stability of slopes during seismic loadings, a pseudostatic approach was considered. This involves the potential slide mass being subjected to an additional destabilizing horizontal force, which represents the effect of earthquake motions and is directly related to the peak ground acceleration (PGA). Described simply, the seismic force is the weight of the slide mass multiplied by a horizontal pseudostatic earthquake coefficient (k_H). Because the earthquake motion is not a constant destabilizing force, using the full PGA for k_H has been shown to be overly conservative. To reduce this level of conservativism Hynes-Griffin and Franklin[5] showed that permanent displacements limited to less than 36-inches can be assured when using one-half of the PGA for the horizontal pseudostatic earthquake coefficient and a minimum factor of safety equal to unity.

As identified above, the corresponding PGA for the 475-year (OBE) and 2,475-year (MDE) events are 0.09g and 0.26g, respectively. Based on these seismic hazard parameters, and the Hynes-Griffin and Franklin[5] analytical method, a reduced pseudostatic seismic coefficient of 0.13g (one-half of the PGA) is valid and was used to evaluate for post closure pseudostatic conditions.

The CGS and WRSFs have been evaluated as an engineered structure and designed as a waste rock storage facility. Minimum acceptable factors of safety for static and pseudostatic conditions were established as 1.3 and 1.05, respectively.

5.1 Stability Model Development

Both static and pseudostatic loadings were evaluated for a critical cross section through the ultimate CGS and WRSF configurations. This critical location was selected based upon existing

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[5] Hynes-Griffin, M.E. and Franklin, A.G. (1984), Rationalizing the Seismic Coefficient Method, Final Report GL-84-13, U.S. Army Corps of Engineers, Washington, D.C.

topography and proposed grading of the facility slopes. The location of the critical cross sections are shown in **Figures 1, 2** and **3**.

5.2 Results

Results of the slope stability analyses for the cross sections under consideration are summarized in **Table 2** and presented on **Figures 4** through **18**. These figures detail the critical cross section and the failure planes with the lowest factors of safety. Based on this evaluation, the CGS and WRSF's will remain stable for static loading conditions.

TABLE 2 – SUMMARY OF STABILITY ANALYSIS

Location	Static FoS	Pseudostatic OBE FoS	Pseudostatic MDE FoS
CGS – Overall Stability	3.6	2.3	2.0
CGS – Inter-Bench Stability	2.6	1.9	1.7
East WRSF – Overall Stability	2.9	1.7	1.4
East WRSF – Inter-Bench Stability	2.2	1.5	1.3
West WRSF – Overall Stability	1.3	0.9	0.8

Pseudostatic loading conditions indicate that the factor of safety could be less than 1.05 for the West WRSF under both the OBE and MDE events and thus a deformation analysis was completed to estimate potential slope movements.

5.3 Deformation Analysis

Since the pseudostatic stability evaluation for the West WRSF resulted in calculated minimum factors of safety less than 1.05 for the OBE and MDE event, potential seismic deformations of the facility slopes were evaluated using a simplified method. Bray and Travasarou[6] developed a semi-empirical relationship for estimating the magnitude and probability of permanent slope displacements that utilizes a non-linear, fully coupled stick-slip sliding block model to estimate dynamic performance of soil slopes. The response spectrum and moment magnitude of the design earthquake were based on data obtained from the USGS.

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[6] Bray, J.D., and Travasarou, T. (2007). Simplified Procedure for Estimating Earthquake-Induced Deviatoric Slope Displacement, Journal of Geotechnical and Geoenvironmental Engineering, Vol. 133, No. 4.

Results of the deformation analysis indicate that for the OBE and MDE events potential slope movements between 5 and 50 inches could be expected. This estimate is for movement along the entire slope length for the maximum thickness of 275 feet. This amount of displacement may cause minor surficial sloughing but will not impact the overall integrity of the facility.

6. DISCUSSION AND CONCLUSIONS

The results of the stability analyses indicate that the CGS and the East and West WRSF will remain stable during operations and post-closure. Additional laboratory testing of the remolded claystone waste rock should be performed during initial field operations to verify engineering properties used in this analysis. Systematic monitoring and visual inspection of the facilities will be an integral part of the operations to ensure that the facilities are maintained within the design parameters.

Results of the deformation analysis indicate that for an MDE seismic event, potential slope displacements could be as high as 4 feet when considering reasonable probability of exceedance and a conservative evaluation of the seismic risk. It is our engineering assessment that this level of slope deformation is within tolerable limits.

Attachments:

Figures 1, 2 and 3: Location Diagrams

Figures 4 through 9: CGS Stability Assessment

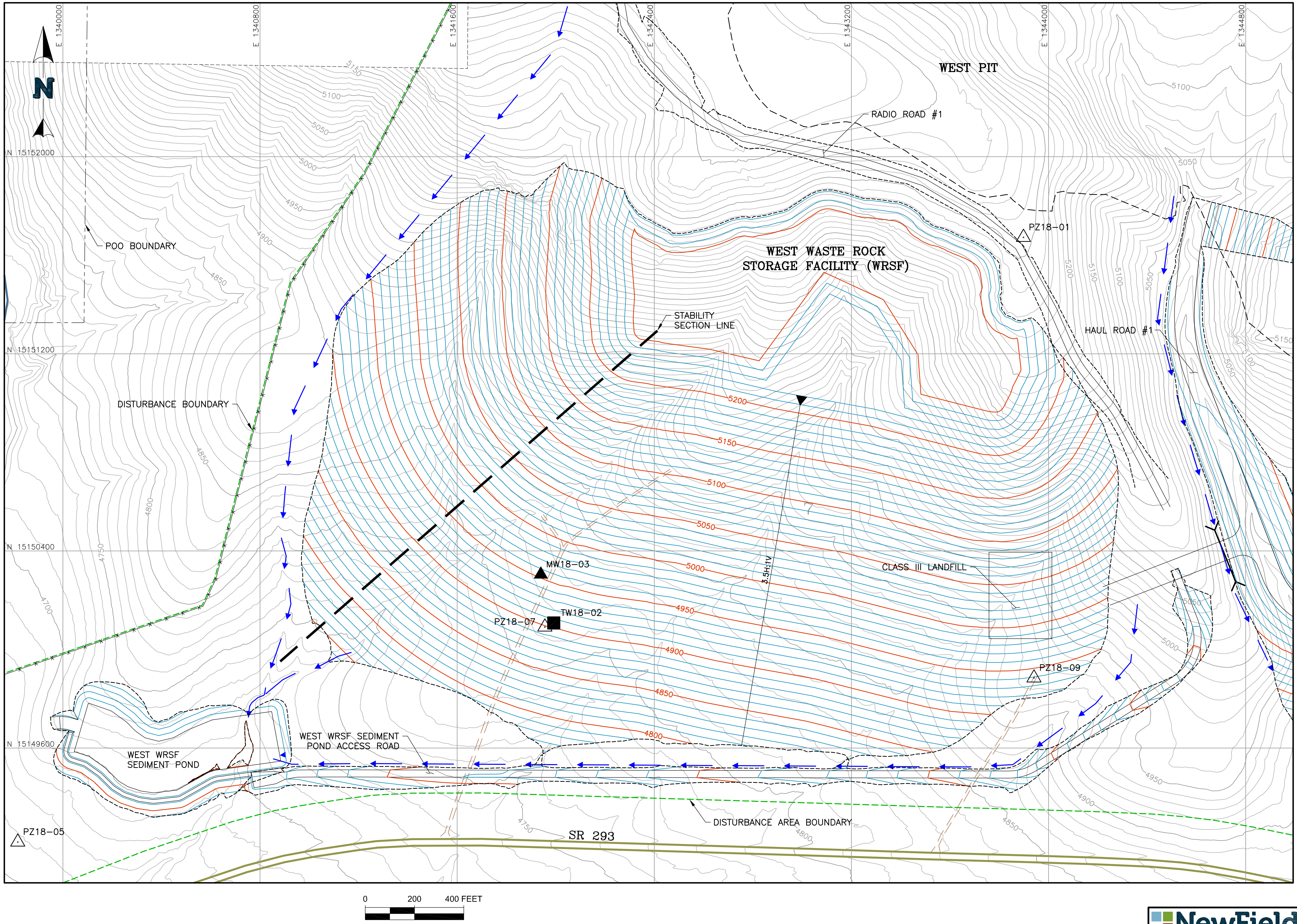
Figures 10 through 15: East WRSF Stability Assessment

Figures 16 through 18: West WRSF Stability Assessment

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\J-REPORTS\Technical Memos\TM-09 CGS and WRSF Stability\Rev 1\TM-09-R1- CGS & WRSF Stability.docx

FIGURES

Location Diagram and Stability Assessments



LEGEND:

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	10 FT GROUND CONTOURS
4500	CONTOUR ELEVATION
	EXISTING ROADS–MAJOR
	EXISTING ROADS/TRAILS
	SURFACE DAYLIGHT
20	SECTION NUMBER
	POO BOUNDARY
	DISTURBANCE AREA BOUNDARY
–x–x–	FENCE
	CULVERT
→ →	STORMWATER DIVERSION CHANNEL
△	EXISTING PIEZOMETER
▲	EXISTING MONITORING WELL
■	EXISTING TEST PUMPING WELL

NOTE:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.

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LITHIUM NEVADA CORP.

PROJECT
THACKER PASS PROJECT

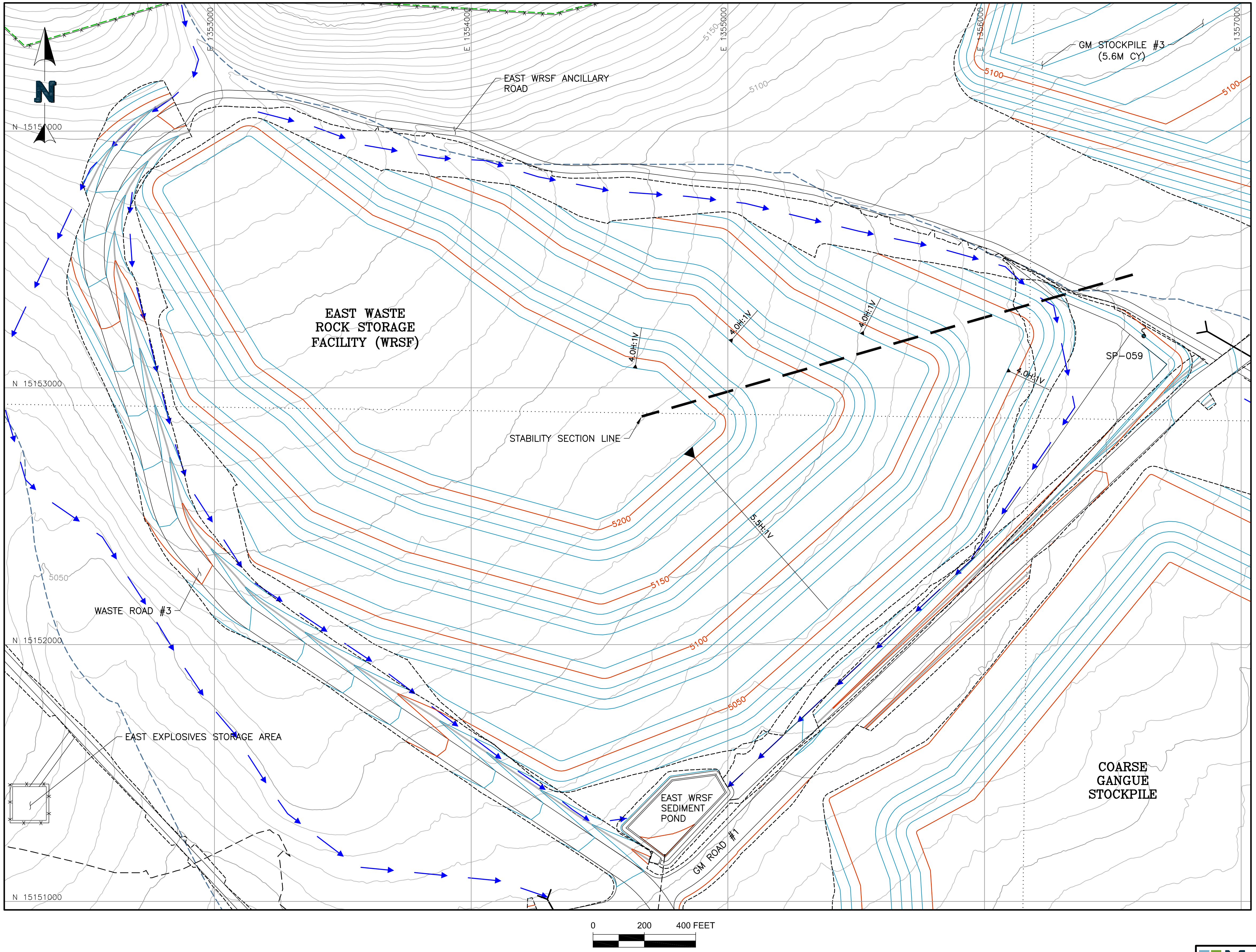
TITLE
WEST WRSF STABILITY SECTION

FILENAME
0385.000.088F

FIGURE NO.
1

REVISION
A

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\A-CAD\FIG\0385.000.088F.dwg–2/5/2020 4:26 PM



LEGEND:

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4500	EXISTING CONTOUR ELEVATION
	10 FT GROUND CONTOURS
4500	CONTOUR ELEVATION
	SURFACE DAYLIGHT
	EXISTING DRAINAGES
	SECTION LINES
20	SECTION NUMBER
	DISTURBANCE AREA BOUNDARY
—x—x—	FENCE
→ →	STORMWATER DIVERSION CHANNEL
	CULVERT
▭	STRUCTURE/BUILDING
△	EXISTING PIEZOMETER
	EXISTING SPRING
▣	POND

NOTE:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.

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CLIENT
LITHIUM NEVADA CORP.

PROJECT
THACKER PASS PROJECT

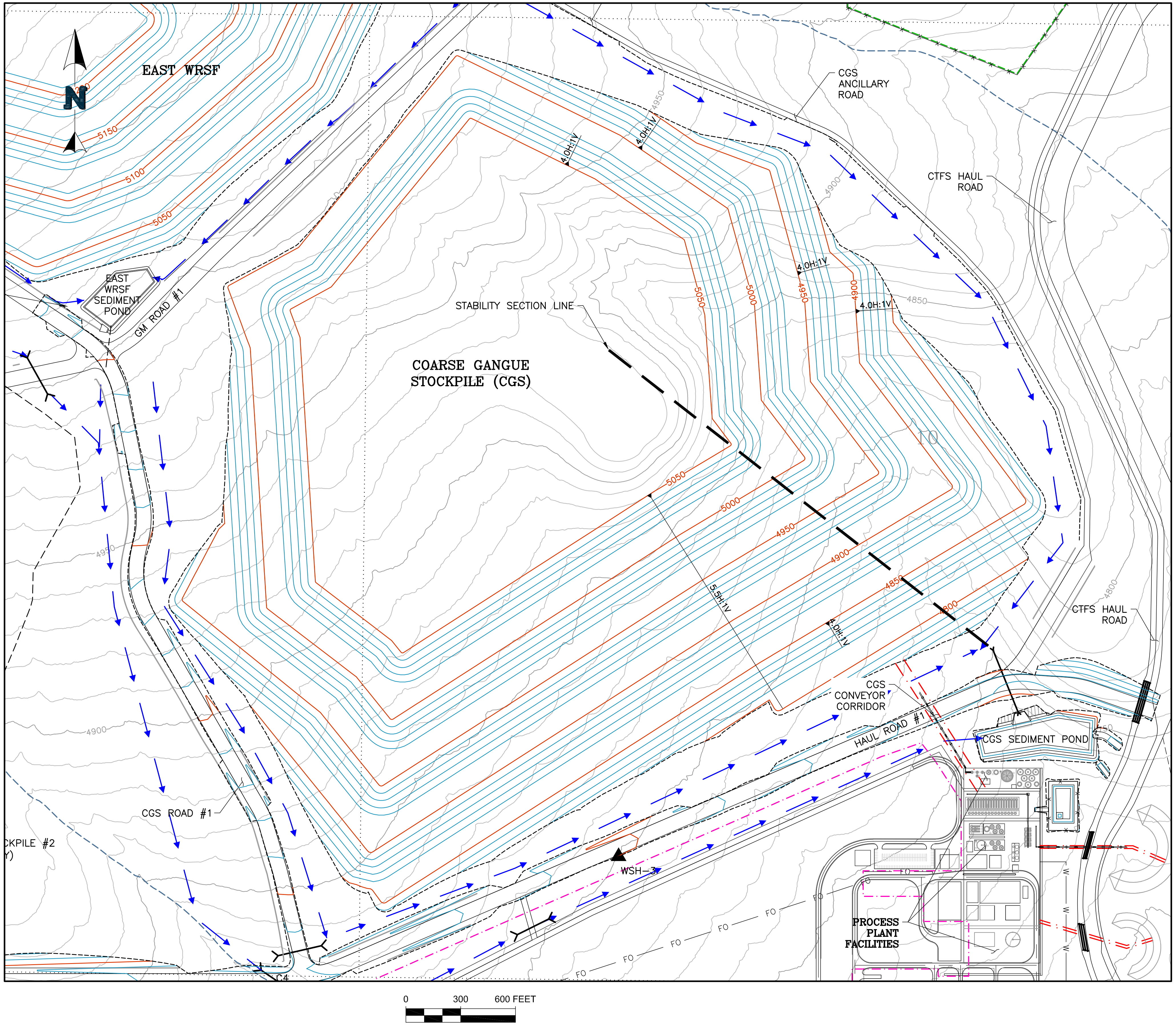
TITLE
EAST WRSF STABILITY SECTION

FILENAME
0385.000.089F

FIGURE NO.
2

REVISION
A

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\A-CAD\FIG\0385.000.089F.dwg-2/6/2020 2:24 PM



LEGEND:

	EXISTING 10 FT GROUND CONTOURS
4500	EXISTING CONTOUR ELEVATION
	10 FT GROUND CONTOURS
4500	CONTOUR ELEVATION
	SURFACE DAYLIGHT
	EXISTING DRAINAGES
	DISTURBANCE AREA BOUNDARY
	SECTION LINES
→ →	STORMWATER DIVERSION CHANNEL
— W —	WATER LINE
— FO —	FIBER OPTIC LINE
—×—×—	FENCE
	FUTURE PLANT EXPANSION
	CONVEYOR CORRIDOR
▭	STRUCTURE/BUILDING
	CULVERT
▲	EXISTING MONITORING WELL

NOTE:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.

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CLIENT
LITHIUM NEVADA CORP.

PROJECT
THACKER PASS PROJECT

TITLE
COARSE GANGUE STOCKPILE
STABILTY SECTION

FILENAME
0385.000.090F

FIGURE NO.
3

REVISION
A

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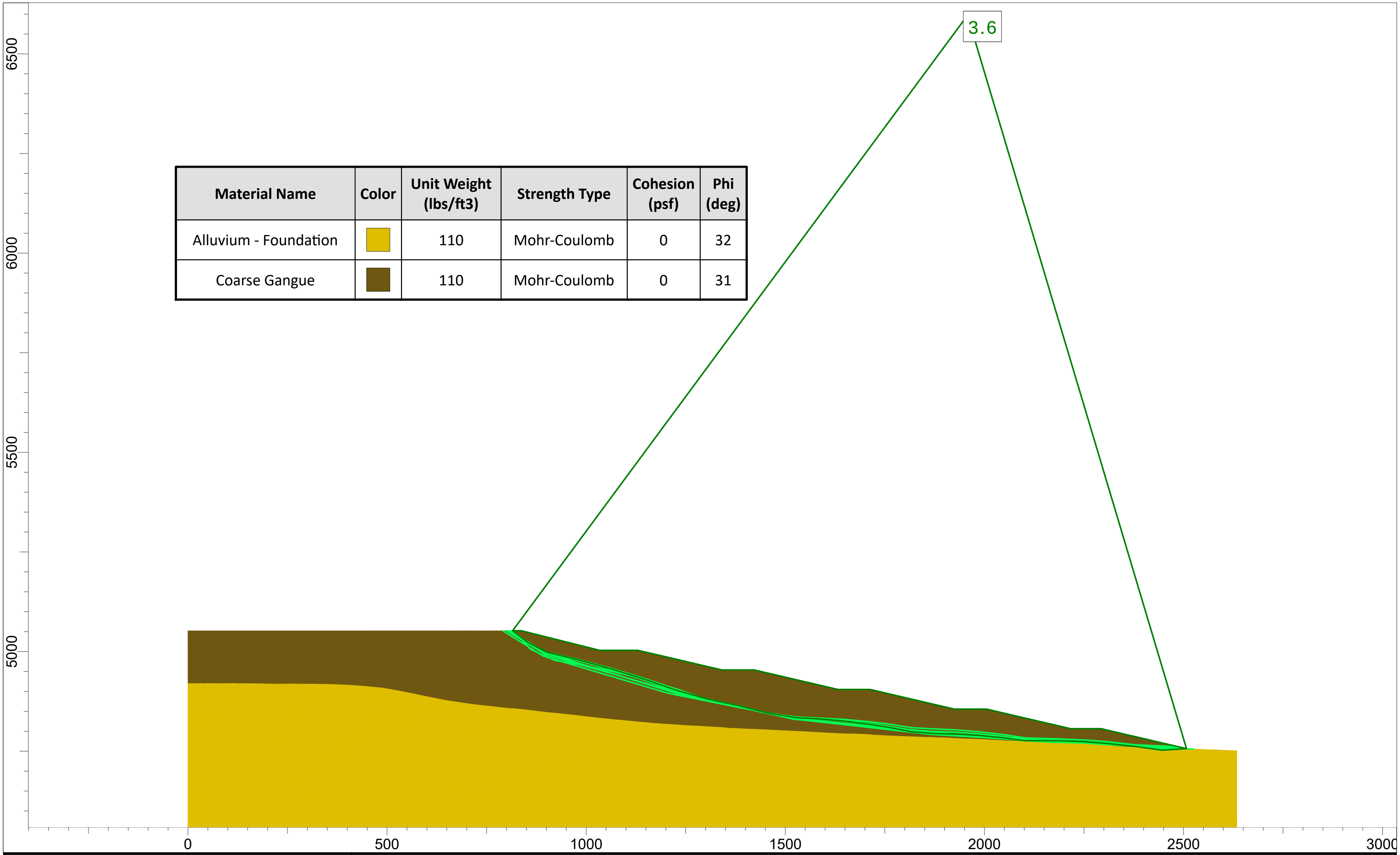


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvium - Foundation	🟨	110	Mohr-Coulomb	0	32
Coarse Gangue	🟫	110	Mohr-Coulomb	0	31

NewFields

Project Thacker Pass CGS Analysis

Analysis Description Figure 4: Coarse Gangue Stockpile - Overall Stability

Drawn By K.Magner

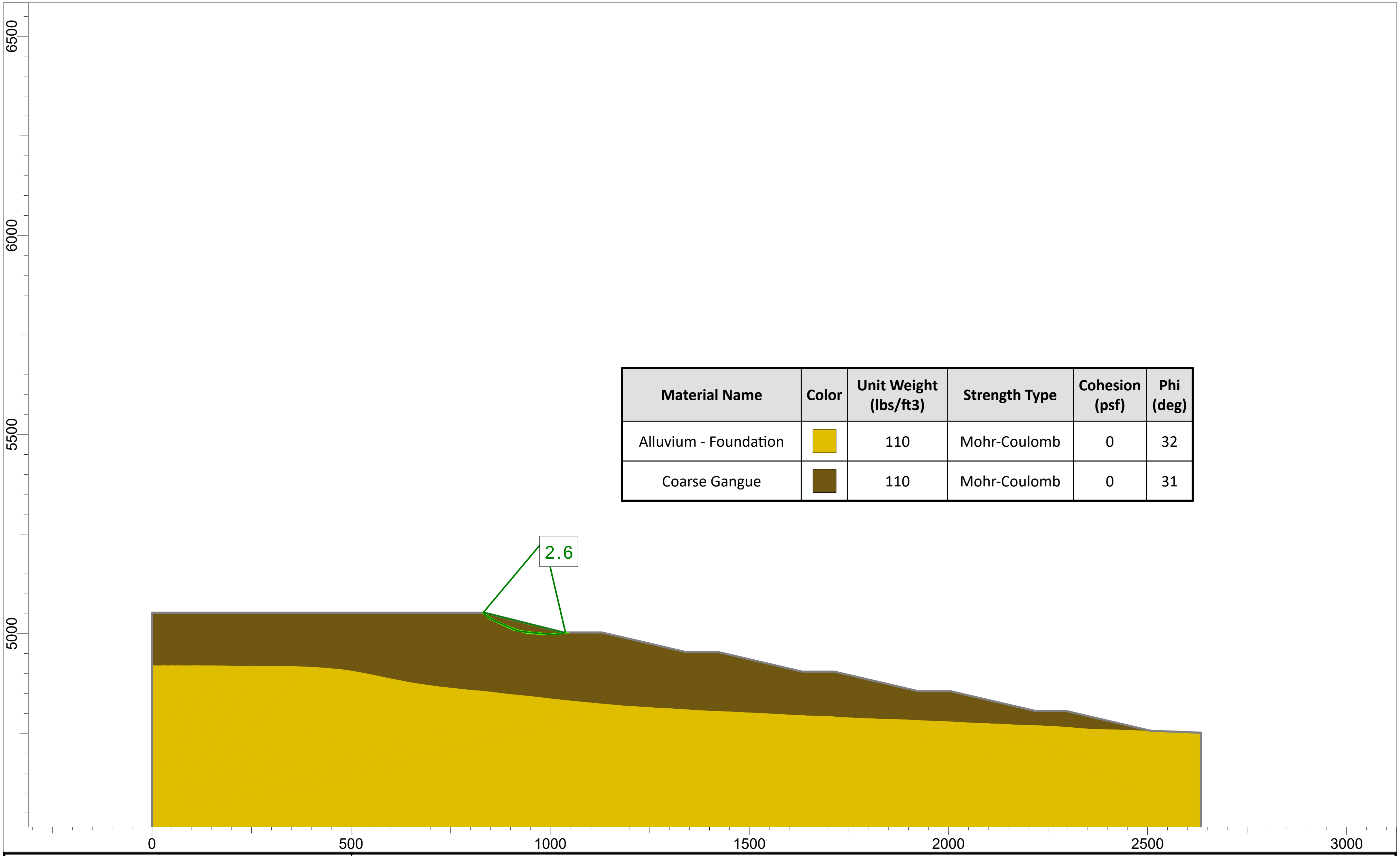
Scale 1:4000

Company NewFields

Date 2/3/20

File Name CGS.slmd

SLIDEINTERPRET 8.031



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvium - Foundation	🟨	110	Mohr-Coulomb	0	32
Coarse Gangue	🟫	110	Mohr-Coulomb	0	31

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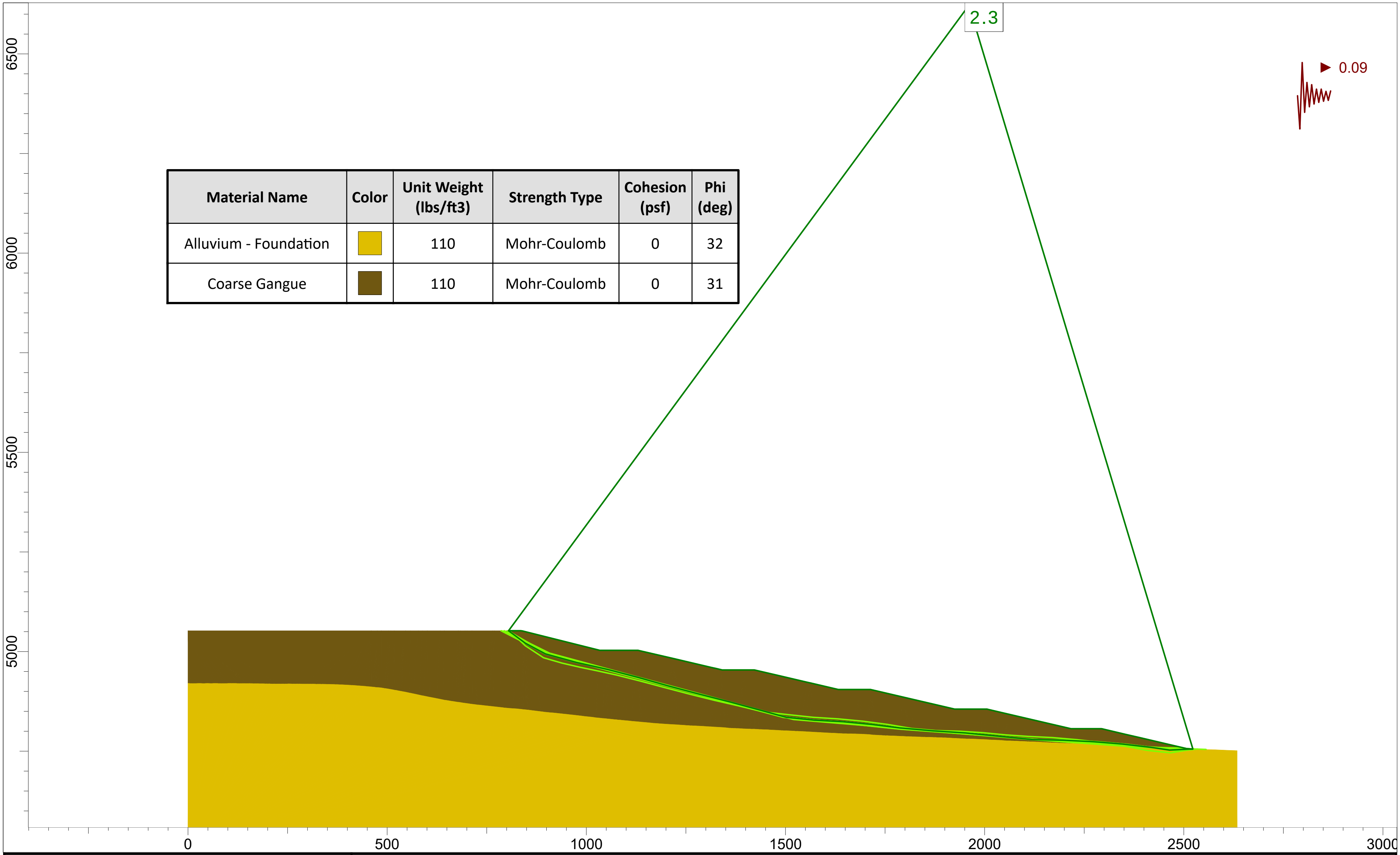
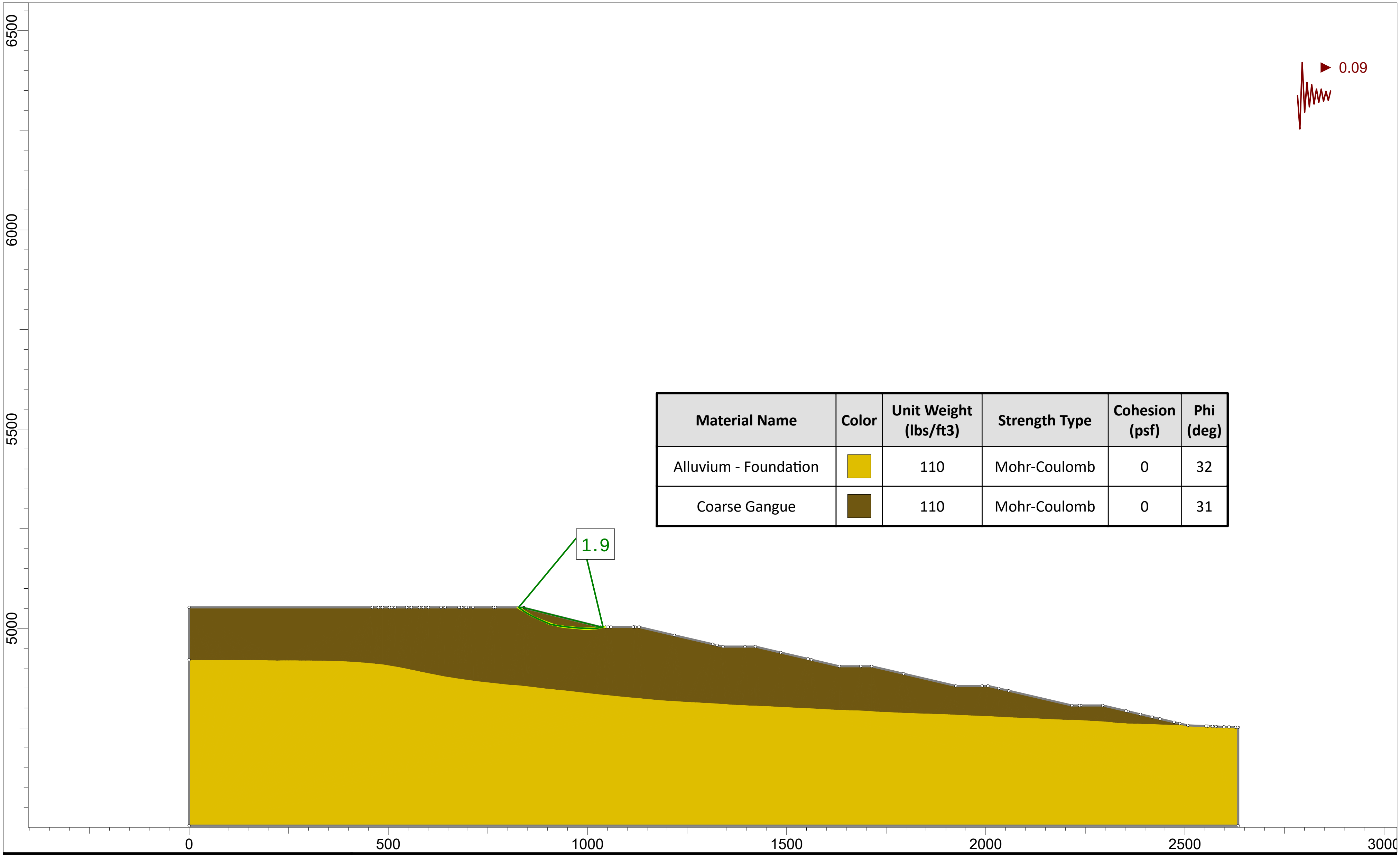
SLIDEINTERPRET 8.031

Project	Thacker Pass CGS Analysis
Analysis Description	Figure 5: Coarse Gangue Stockpile - Inter-bench Slope Stability
Drawn By	K.Magner
Scale	1:4000
Company	NewFields
Date	2/3/20
File Name	CGS.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvium - Foundation	🟨	110	Mohr-Coulomb	0	32
Coarse Gangue	🟫	110	Mohr-Coulomb	0	31

NewFields	*Project* Thacker Pass CGS Analysis		
	Analysis Description Figure 6: Coarse Gangue Stockpile - Overall Stability - Pseudostatic OBE		
	Drawn By K.Magner	*Scale* 1:4000	*Company* NewFields
SLIDEINTERPRET 8.031	*Date* 2/3/20		*File Name* CGS PS OBE.slmd



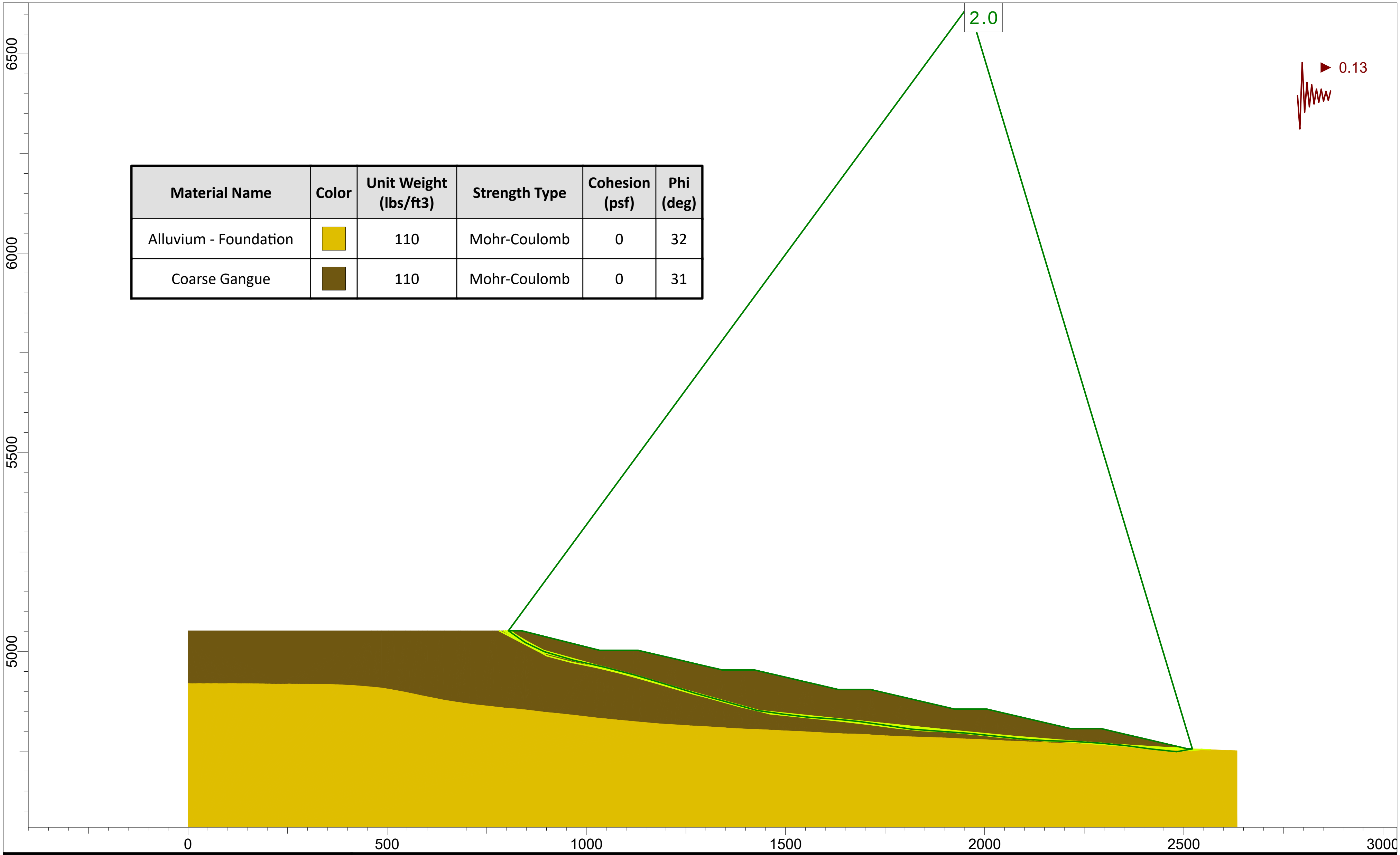
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvium - Foundation	🟨	110	Mohr-Coulomb	0	32
Coarse Gangue	🟫	110	Mohr-Coulomb	0	31

NewFields

SLIDEINTERPRET 8.031

Project	Thacker Pass CGS Analysis
Analysis Description	Figure 7: Coarse Gangue Stockpile - Inter-bench Slope Stability - Pseudostatic OBE

Drawn By	K.Magner	*Scale*	1:4000	*Company*	NewFields
Date	2/3/20			*File Name*	CGS PS OBE.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvium - Foundation	🟨	110	Mohr-Coulomb	0	32
Coarse Gangue	🟫	110	Mohr-Coulomb	0	31

NewFields

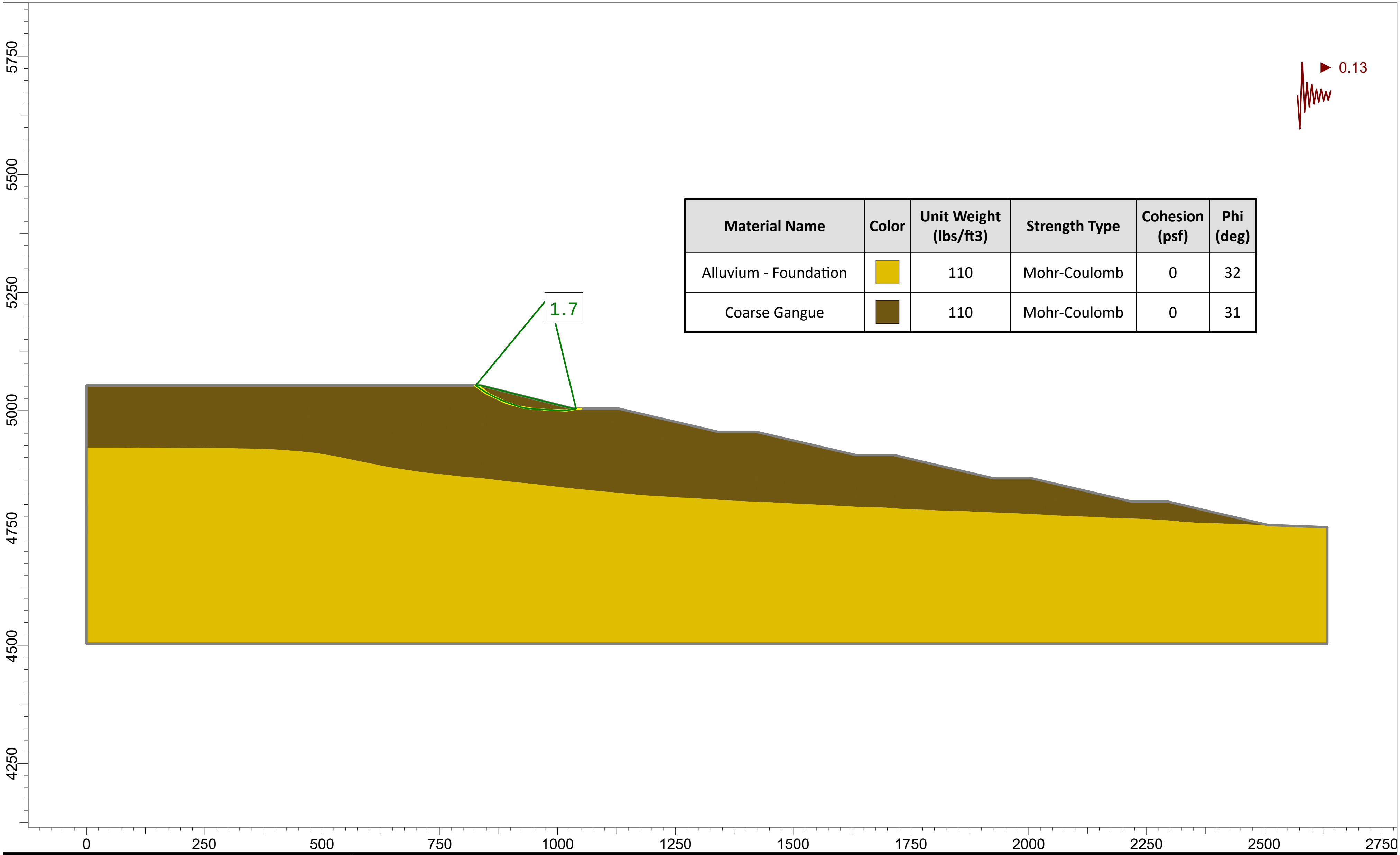
Project Thacker Pass CGS Analysis

Analysis Description Figure 8: Coarse Gangue Stockpile - Overall Stability - Pseudostatic MDE

Drawn By K.Magner *Scale* 1:4000 *Company* NewFields

Date 2/3/20 *File Name* CGS PS MCE.slmd

SLIDEINTERPRET 8.031

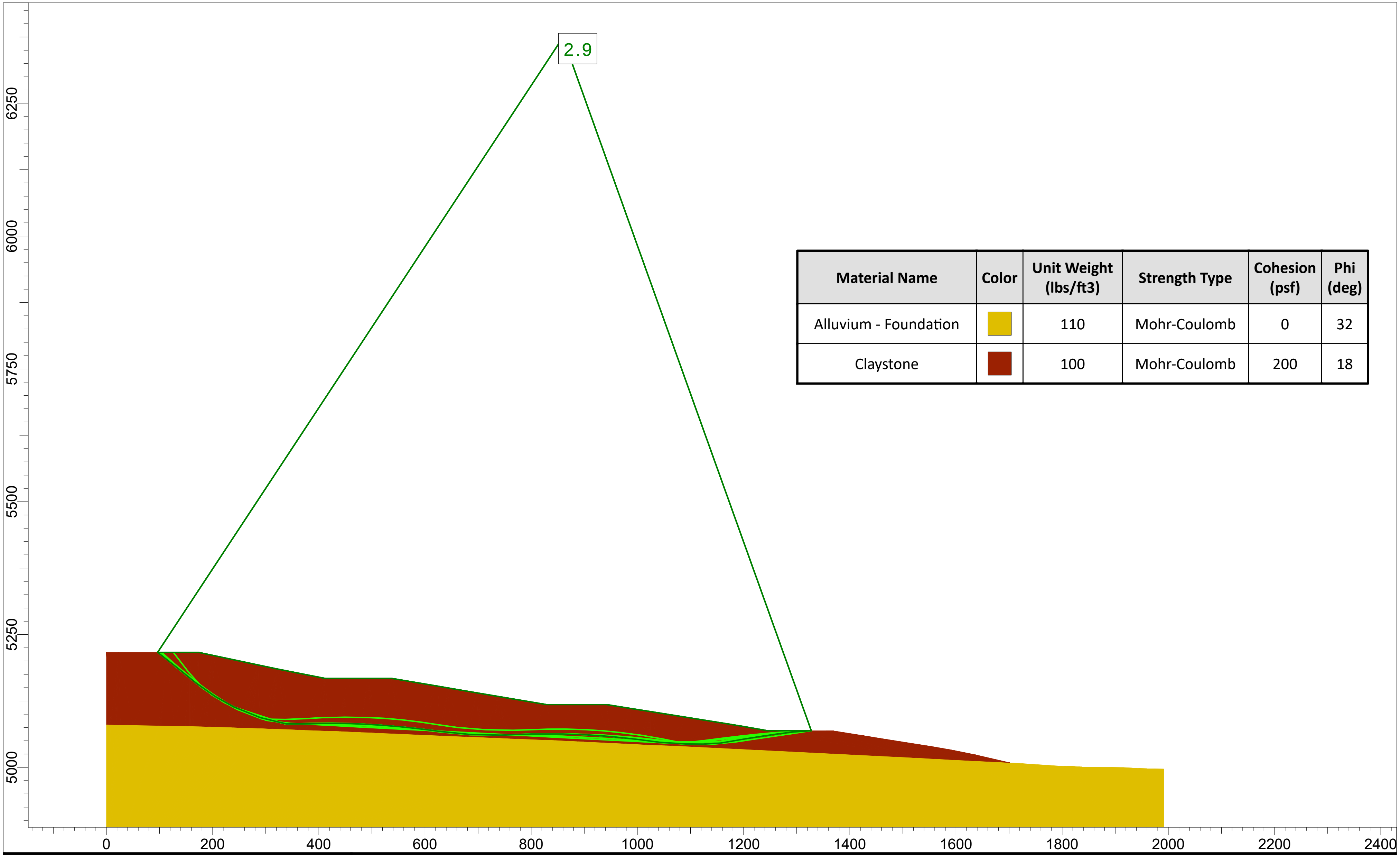


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvium - Foundation	🟨	110	Mohr-Coulomb	0	32
Coarse Gangue	🟫	110	Mohr-Coulomb	0	31

NewFields

Project	Thacker Pass CGS Analysis		
Analysis Description	Figure 9: Coarse Gangue Stockpile - Inter-bench Stability - Pseudostatic MDE		
Drawn By K.Magner	*Scale* 1:3382	*Company*	NewFields
Date	2/3/20	*File Name*	CGS PS MCE.slmd

SLIDEINTERPRET 8.031

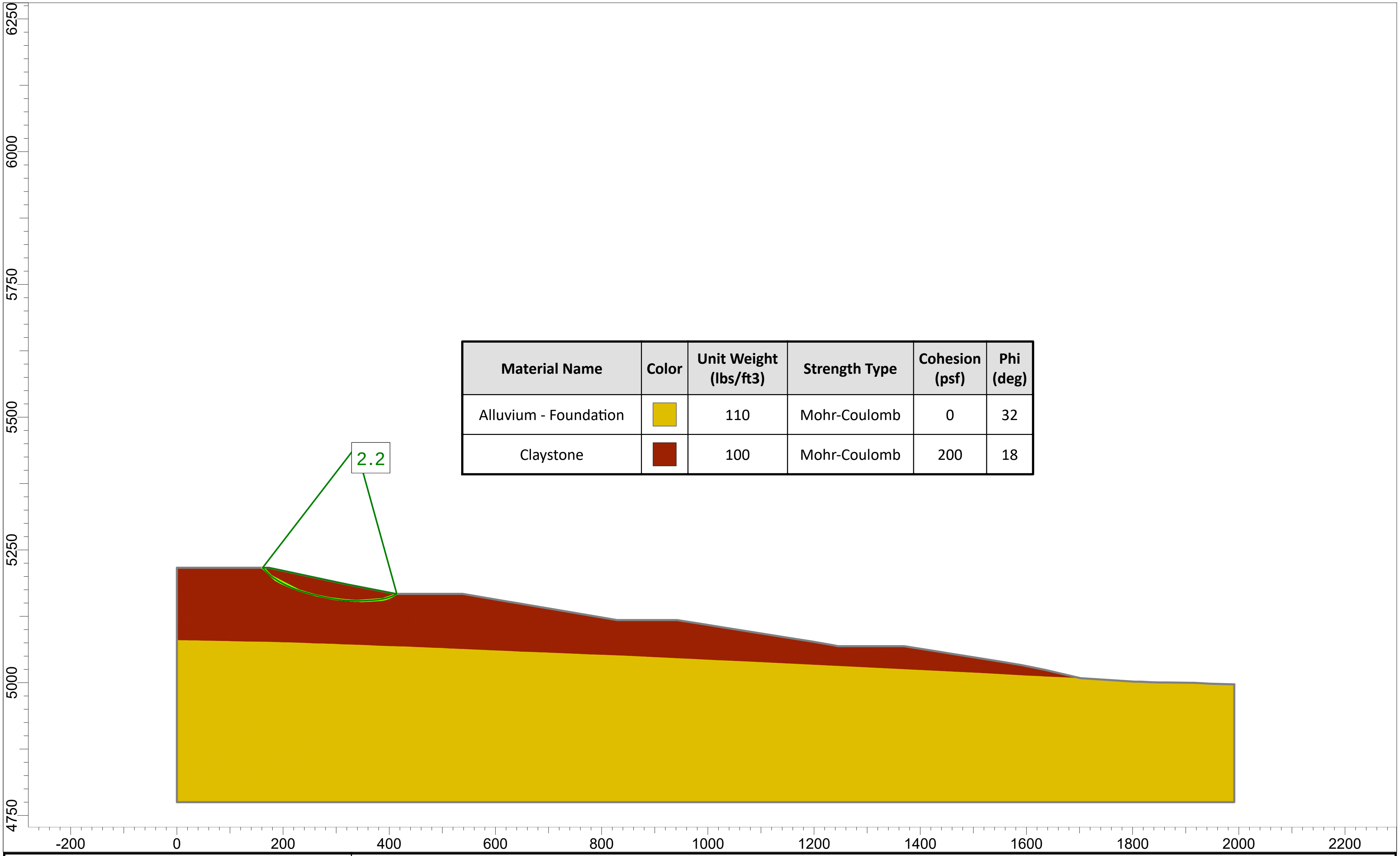


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvium - Foundation	🟨	110	Mohr-Coulomb	0	32
Claystone	🟥	100	Mohr-Coulomb	200	18

NewFields

Project	Thacker Pass East WRSF Analysis
Analysis Description	Figure 10: East Waste Rock Storage Facility - Overall Stability
Drawn By	K.Magner
Scale	1:3000
Company	NewFields
Date	2/3/20
File Name	East WRSF.slmd

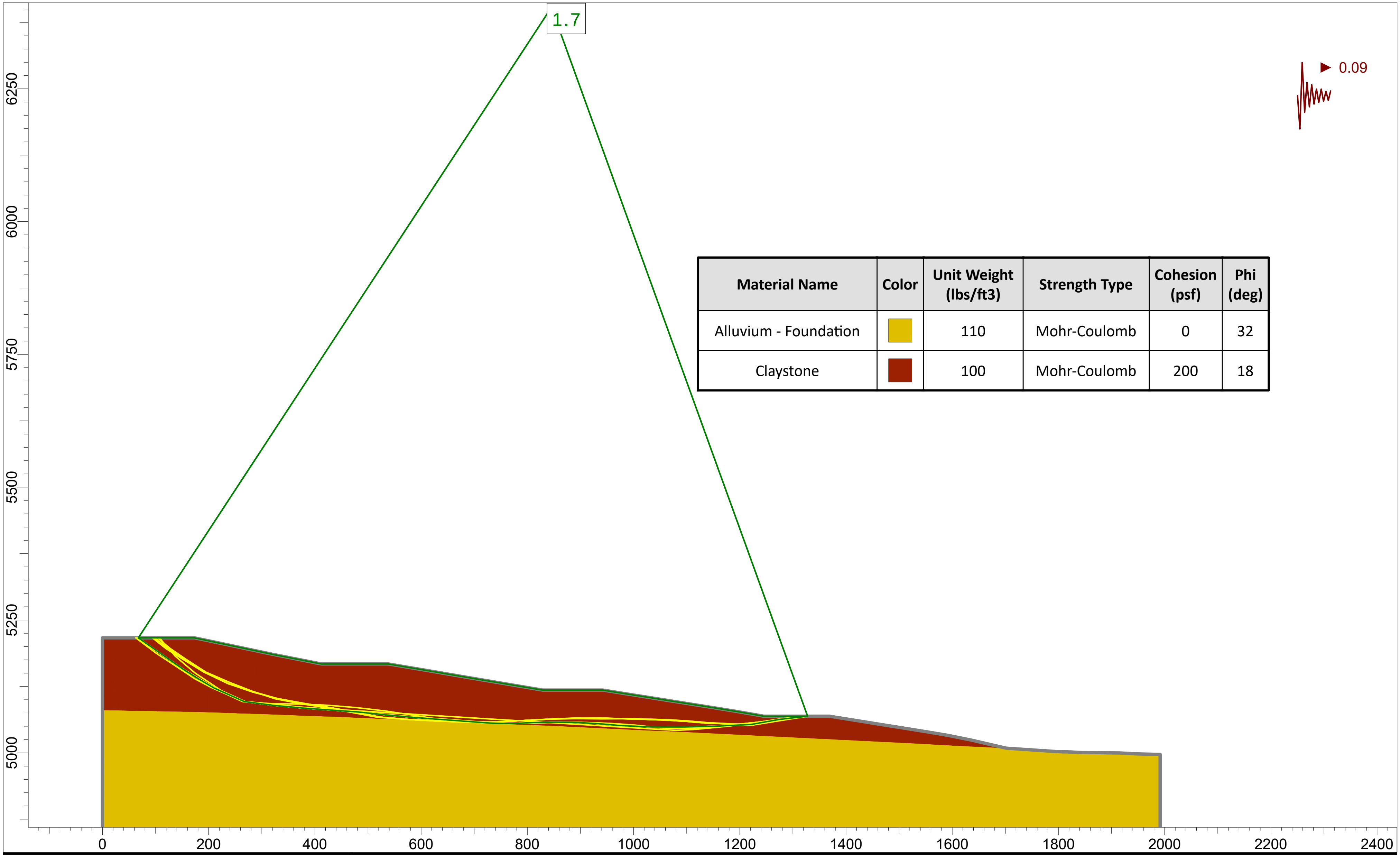
SLIDEINTERPRET 8.031



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvium - Foundation	🟨	110	Mohr-Coulomb	0	32
Claystone	🟥	100	Mohr-Coulomb	200	18

SLIDEINTERPRET 8.031

Project	Thacker Pass East WRSF Analysis
Analysis Description	Figure 11: East Waste Rock Storage Facility - Inter-bench Slope Stability
Drawn By	K.Magner
Scale	1:3000
Company	NewFields
Date	2/3/20
File Name	East WRSF.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvium - Foundation	🟨	110	Mohr-Coulomb	0	32
Claystone	🟥	100	Mohr-Coulomb	200	18

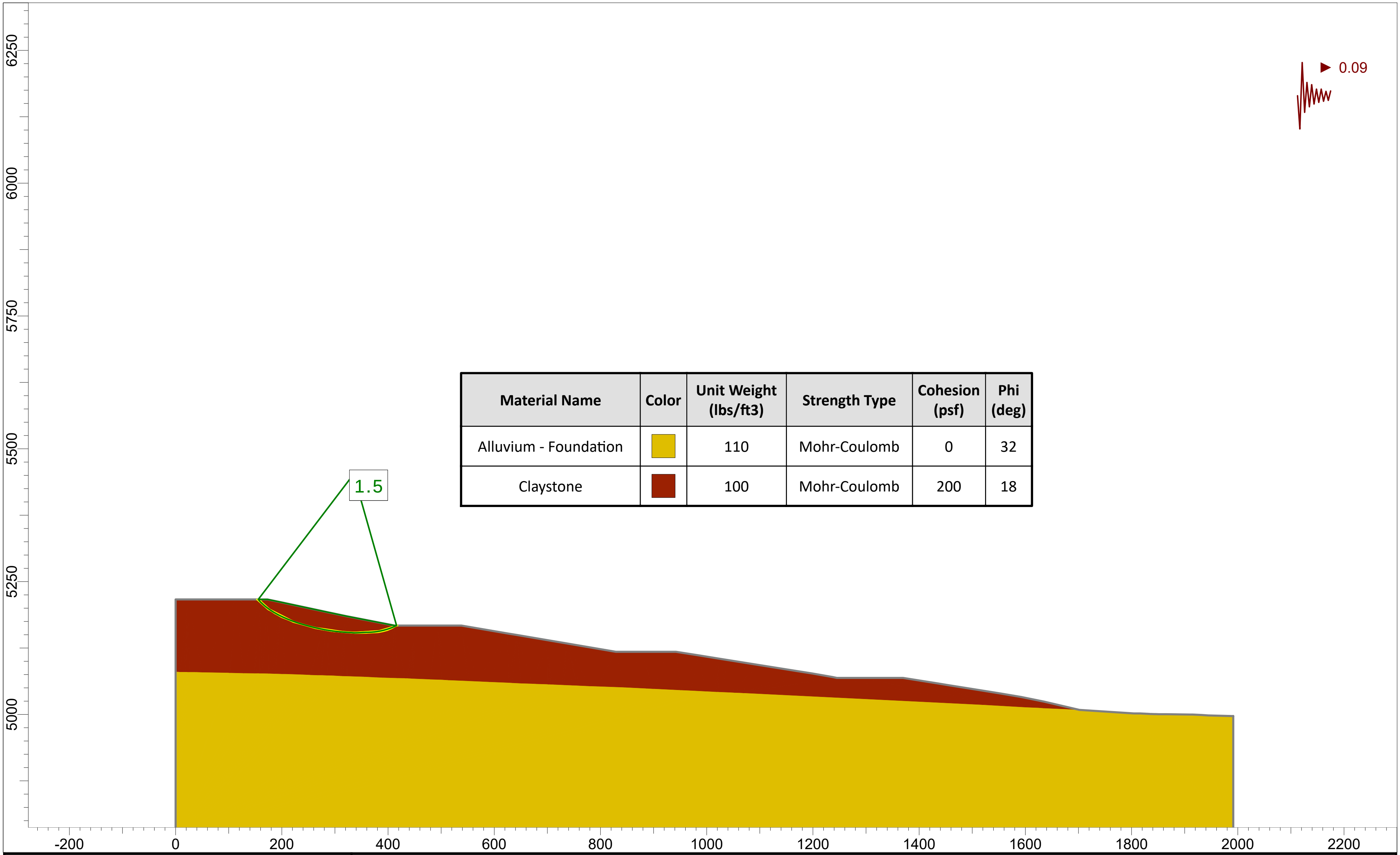
NewFields

Project
Thacker Pass East WRSF Analysis

Analysis Description
Figure 12: East Waste Rock Storage Facility - Overall Stability - Pseudostatic OBE

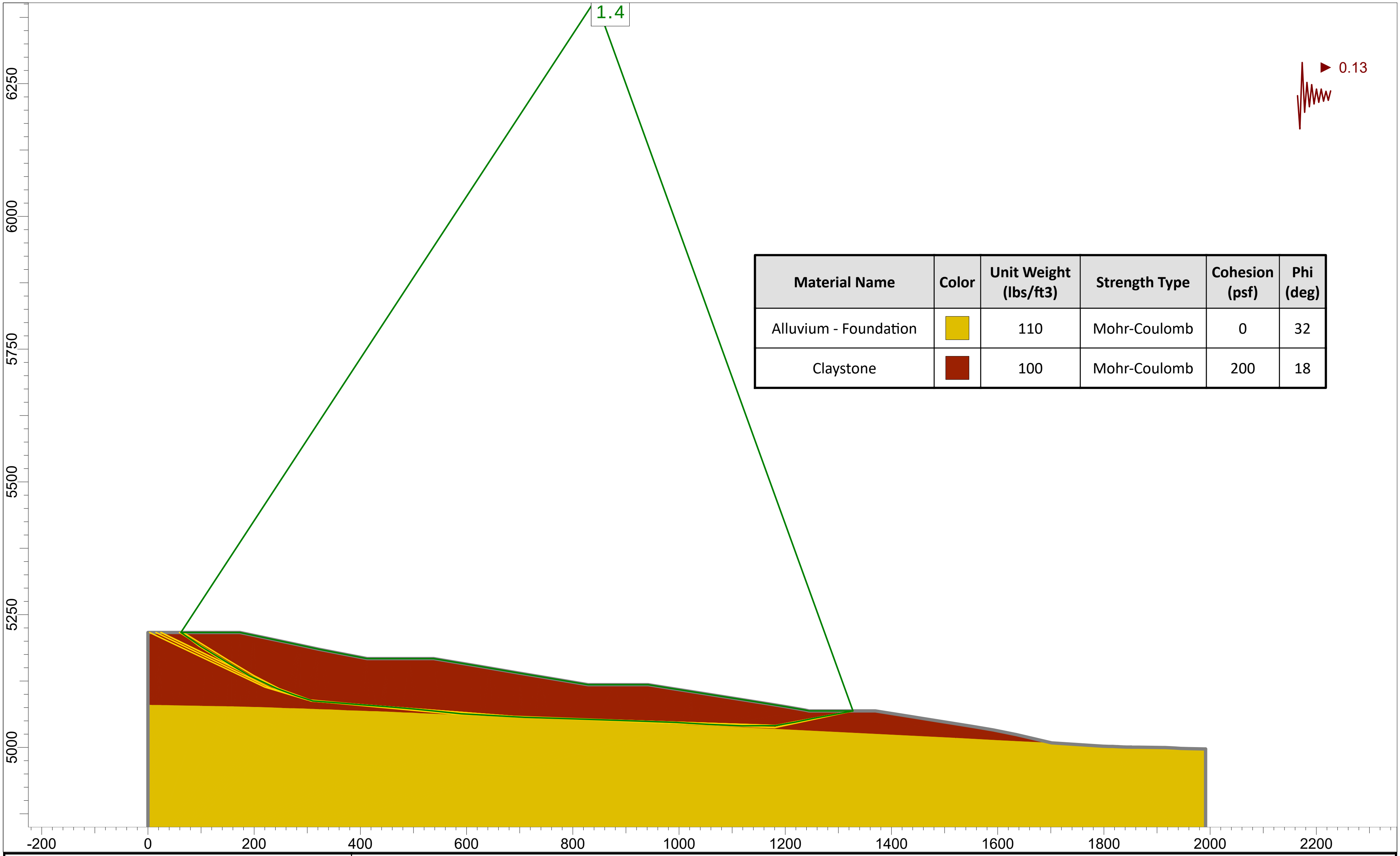
Drawn By K.Magner
Scale 1:3000
Company NewFields
Date 2/3/20
File Name East WRSF PS OBE.slmd

SLIDEINTERPRET 8.031



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvium - Foundation	🟨	110	Mohr-Coulomb	0	32
Claystone	🟥	100	Mohr-Coulomb	200	18

NewFields	*Project* Thacker Pass East WRSF Analysis		
	Analysis Description Figure 13: East Waste Rock Storage Facility - Inter-bench Slope Stability - Psuedostatic OBE		
	Drawn By K.Magner	*Scale* 1:3000	*Company* NewFields
SLIDEINTERPRET 8.031	*Date* 2/3/20		*File Name* East WRSF PS OBE.slmd

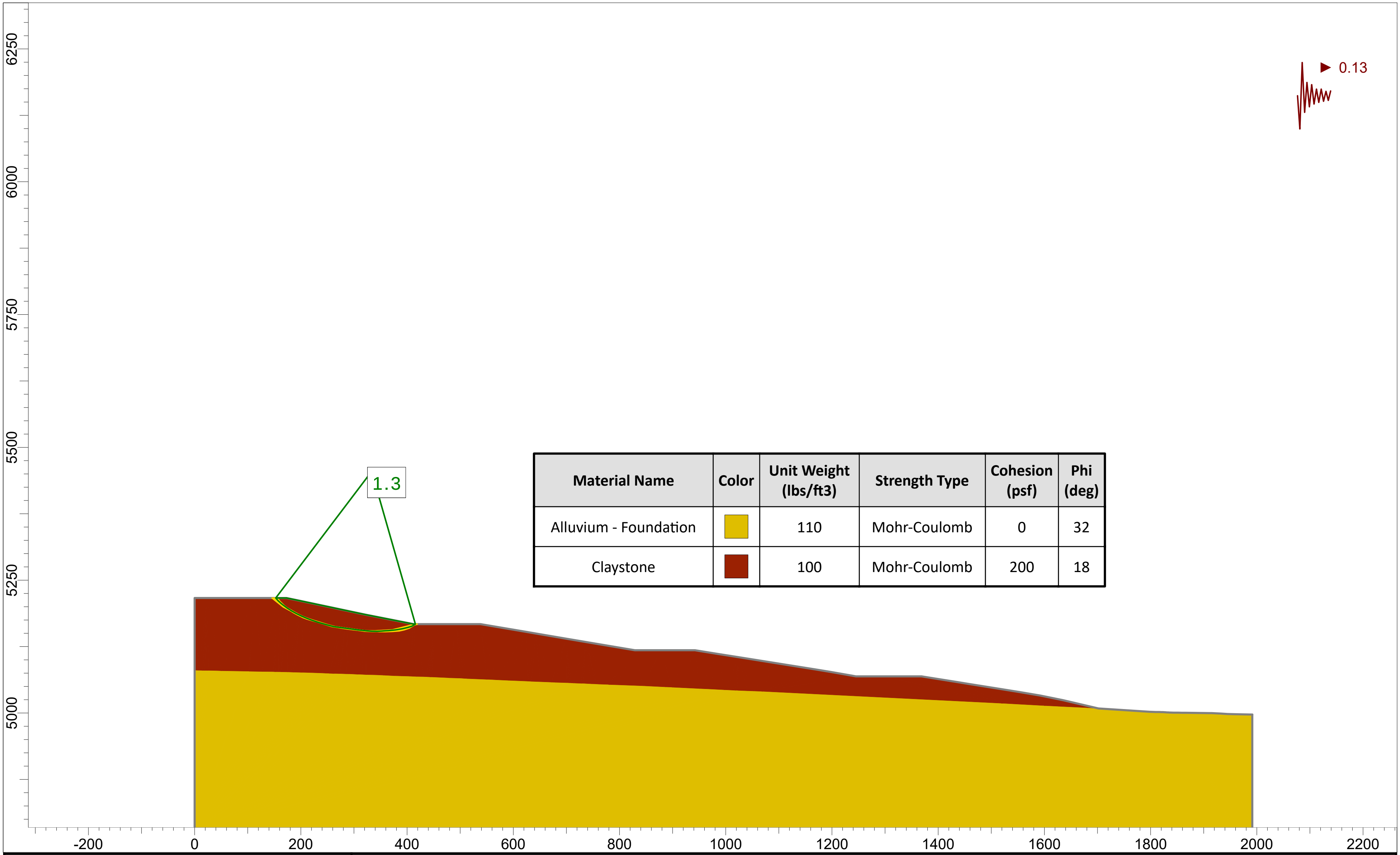


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvium - Foundation	🟨	110	Mohr-Coulomb	0	32
Claystone	🟥	100	Mohr-Coulomb	200	18

NewFields

Project	Thacker Pass East WRSF Analysis		
Analysis Description	Figure 14: East Waste Rock Storage Facility - Overall Stability - Pseudostatic MDE		
Drawn By K.Magner	*Scale* 1:3000	*Company*	NewFields
Date	2/3/20	*File Name*	East WRSF PS MCE.slmd

SLIDEINTERPRET 8.031



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvium - Foundation	🟨	110	Mohr-Coulomb	0	32
Claystone	🟥	100	Mohr-Coulomb	200	18

Project
Thacker Pass East WRSF Analysis

Analysis Description
Figure 15: East Waste Rock Storage Facility - Inter-bench Slope Stability - Pseudostatic MDE

Drawn By K.Magner

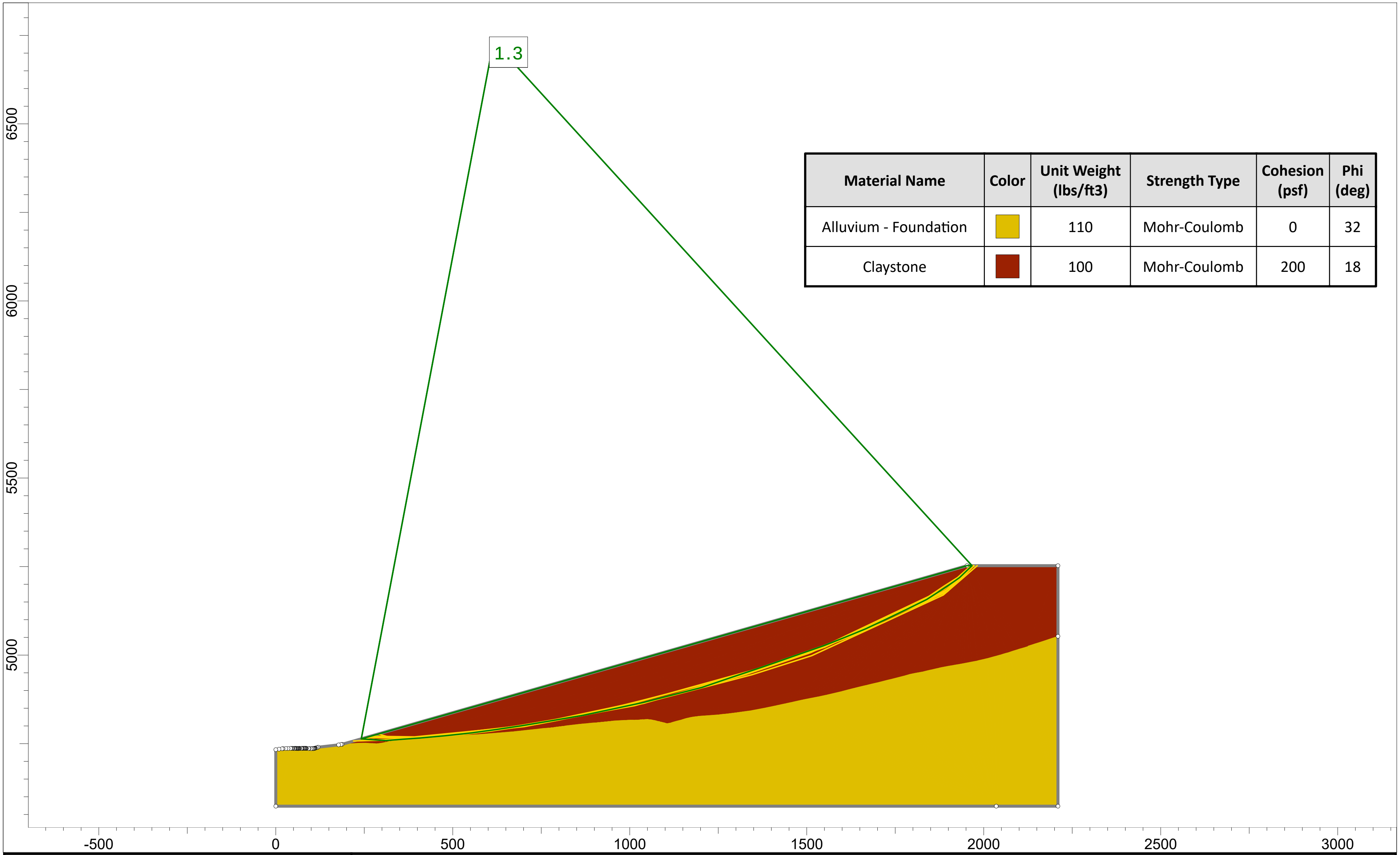
Scale 1:3000

Company NewFields

Date 2/3/20

File Name East WRSF PS MCE.slmd

SLIDEINTERPRET 8.031

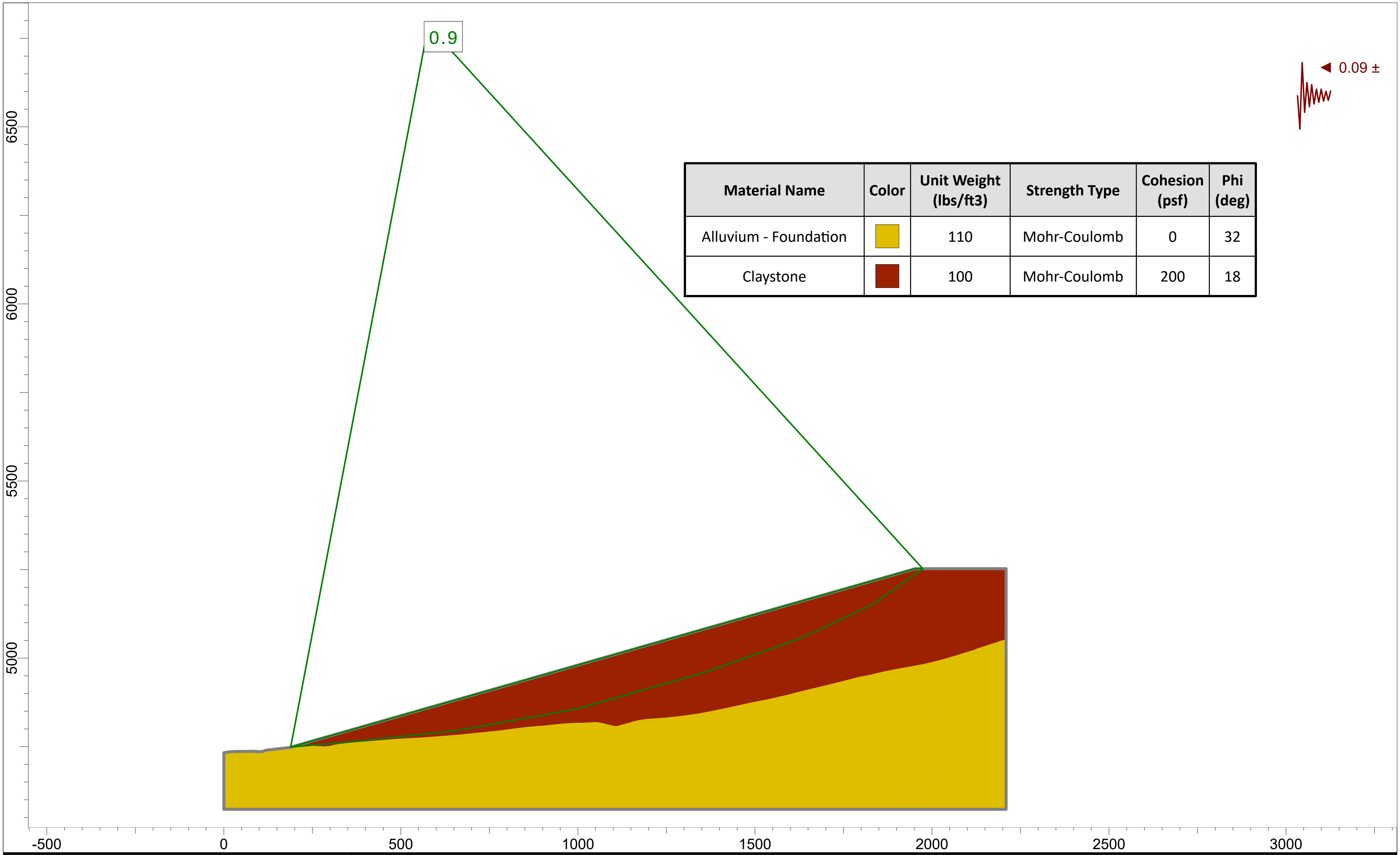


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvium - Foundation	🟨	110	Mohr-Coulomb	0	32
Claystone	🟥	100	Mohr-Coulomb	200	18

Project	Thacker Pass West WRSF Analysis		
Analysis Description	Figure 16: West Waste Rock Storage Facility - Overall Stability		
Drawn By K.Magner	*Scale* 1:4500	*Company*	NewFields
Date	2/4/2020, 4:17:50 PM	*File Name*	West WRSF.slmd

NewFields

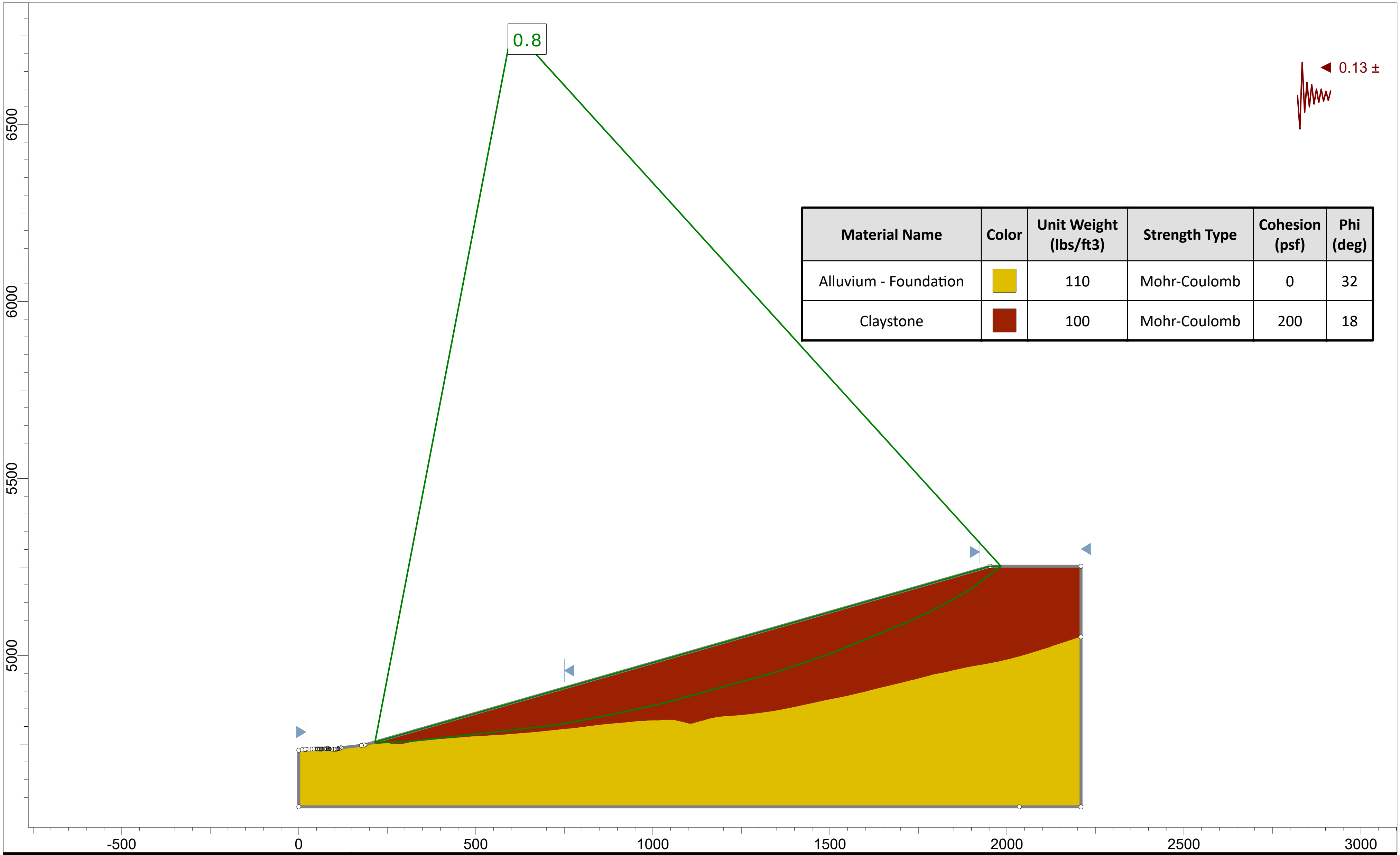
SLIDEINTERPRET 8.031



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvium - Foundation	🟨	110	Mohr-Coulomb	0	32
Claystone	🟥	100	Mohr-Coulomb	200	18

Project	Thacker Pass West WRSF Analysis
Analysis Description	Figure 17: West Waste Rock Storage Facility - Overall Stability - Pseudostatic OBE
Drawn By	K.Magner
Scale	1:4500
Company	NewFields
Date	2/4/2020, 4:17:50 PM
File Name	West WRSF PS OBE.slmd

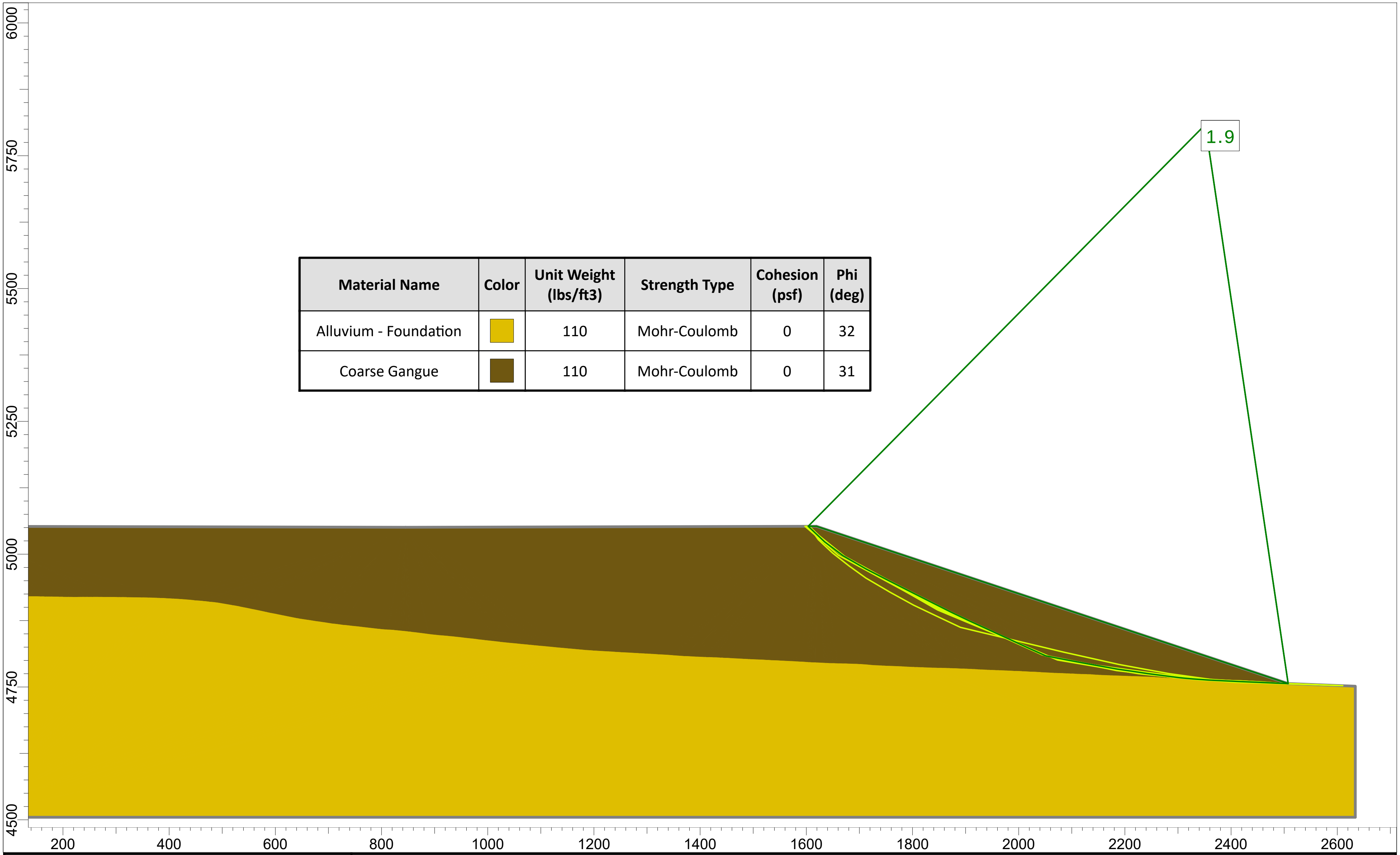
SLIDEINTERPRET 8.031



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvium - Foundation	🟨	110	Mohr-Coulomb	0	32
Claystone	🟥	100	Mohr-Coulomb	200	18

Project	Thacker Pass West WRSF Analysis		
Analysis Description	Figure 18: West Waste Rock Storage Facility - Overall Stability - Pseudostatic MDE		
Drawn By K.Magner	*Scale* 1:4500	*Company*	NewFields
Date	2/4/2020, 4:17:50 PM	*File Name*	West WRSF PS MCE.slmd

SLIDEINTERPRET 8.031

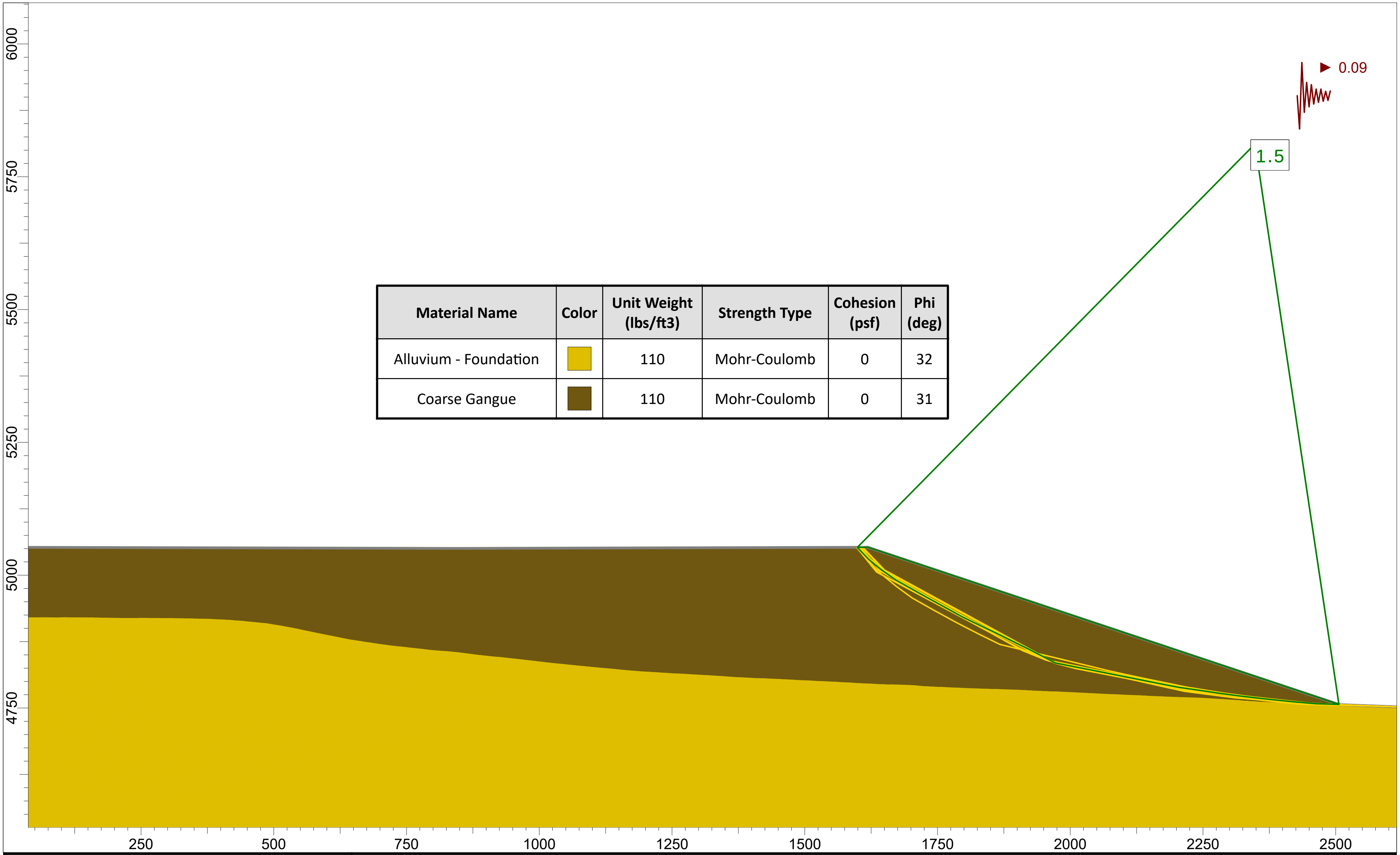


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvium - Foundation	🟨	110	Mohr-Coulomb	0	32
Coarse Gangue	🟫	110	Mohr-Coulomb	0	31

NewFields

SLIDEINTERPRET 8.031

Project	Thacker Pass - CGS Stability Analysis		
Analysis Description	3:1 Slope Analsyis		
Drawn By	K.Magner	*Scale* 1:3000	*Company*
Date	3/5/2020, 11:27:06 AM	*File Name*	CGS.slmd



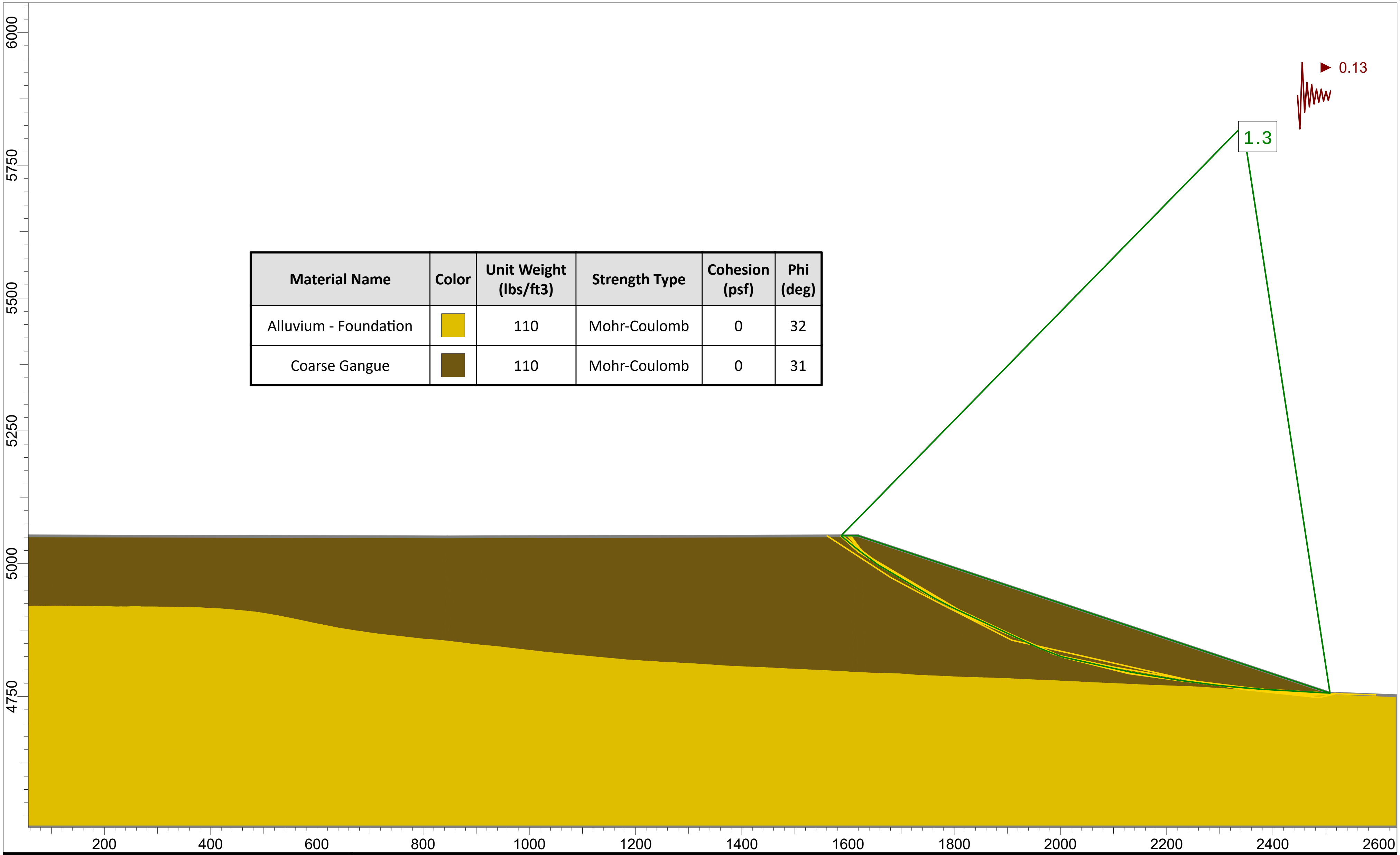
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvium - Foundation	🟨	110	Mohr-Coulomb	0	32
Coarse Gangue	🟫	110	Mohr-Coulomb	0	31

NewFields

SLIDEINTERPRET 8.032

Project	Thacker Pass - CGS Stability Analysis
Analysis Description	Coarse Gangue Stockpile 3:1 Slope - Overall Stability - Pseudostatic OBE

Drawn By	K.Magner	*Scale*	1:3000	*Company*	
Date	3/23/2020, 11:27:06 AM			*File Name*	CGS.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvium - Foundation	🟨	110	Mohr-Coulomb	0	32
Coarse Gangue	🟫	110	Mohr-Coulomb	0	31

NewFields

SLIDEINTERPRET 8.032

Project	Thacker Pass - CGS Stability Analysis		
Analysis Description	Coarse Gangue Stockpile 3:1 Slope - Overall Stability - Psuedostatic MDE		
Drawn By K.Magner	*Scale* 1:3000	*Company*	
Date 3/5/2020, 11:27:06 AM		*File Name* CGS.slmd	

APPENDIX D.4

Deterministic Seismic Hazard Analysis Technical Memorandum

(385-TM-03-RA)

NewFields
Perspective. Vision. Solutions.

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TECHNICAL MEMORANDUM (385-TM-03-RA)

To: **Lithium Nevada Corporation**

From: **Mark Walden, P.Eng.**

Reviewed By: **Nick Rocco, PhD., P.E.**

Project: **Thacker Pass Project**

Project No: 475.385.000

Subject: **Deterministic Seismic Hazard Analysis**

Date: July 18, 2019

1. INTRODUCTION

Lithium Nevada Corporation (LNC) requested that NewFields perform a seismic hazard assessment (SHA) for the Thacker Pass Project. This memo provides our interpretation of regional seismicity and recommendations for the site-wide seismic classification and peak ground accelerations (PGA) for use in design of the clay tailings filter stack (CTFS), coarse gangue stockpile, waste dumps, and material process components.

The scope of services completed for this SHA included the following:

- Review of available literature and project specific reports related to regional geology and tectonics, particularly during the Quaternary Period (last 2.6 million years);
- Review of earthquake catalogues to identify historical earthquake activity within approximately 124 miles from the Project;
- Identify major faults sources within 62 miles of the Project;
- Identify the site classification and code-based seismic ordinates for structural design.
- Utilize existing United States Geological Survey (USGS) seismic hazard tools to perform a probabilistic seismic hazard analysis (PSHA);
- Perform a site-specific deterministic seismic hazard analysis (DSHA) to identify the MCE; and
- Summarize the data and present estimates of seismic hazards in terms of peak horizontal ground acceleration and spectral accelerations for a range of return periods.

Regional seismicity, seismic site classification and recommended seismic design parameters are discussed in the following sections.

2. SEISMIC HISTORY

2.1 Regional Seismicity

The Project is located within the McDermitt caldera near the northern extent of the Great Basin region of the Basin and Range Physiographic Province. In general, the Great Basin is characterized by a series of north trending mountain ranges, and traces of recently active faults are located at the base of many of the linear mountain ranges in the Province. Earthquakes in this region are typically associated with geologically young fault traces and recently active volcanoes.

The McDermitt caldera formed approximately 6.39 ±0.02 million years ago (ma), in an area that had undergone two episodes of Eocene intermittent volcanism at 47 and 39 ma and a major middle Miocene volcanism that led continuously to caldera formation. The caldera is well exposed and has been negligibly affected by later extension. A major caldera fault is well exposed beneath the post-collapse intra-caldera sediment deposits and smaller displacement concentric faults, mostly noted along the northern and western margin, are present outside of the major fault (Henry et al., 2016).

The McDermitt caldera complex, as wide as 28 miles in diameter, is situated within one of the largest recognized structural depressions. The majority of the collapse occurred along a narrow ring-fault zone of discrete faults with variable downwarp into the caldera between faults (Henry et al., 2016). The region has experienced moderate to low levels of seismicity during recent times.

2.2 Historic Earthquake Events

Historical seismicity in the region was reviewed. The following earthquake catalogs were queried to identify earthquake events with a moment magnitude (M_w) of 4.0 or greater within a radius of approximately 124 miles from the Project:

- Advance National Seismic System (ANSS);
- International Seismological Centre (ISC);
- Southern California Earthquake Data Center (SCEDC);
- Northern California Earthquake Data Center (NCEDC); and
- United State Geological Survey (USGS).

All identified historical events were reviewed, and duplicate events, foreshocks and aftershocks were removed. Some historic events were recorded with different magnitude scales than moment magnitude, and the body wave magnitude (M_b) was adjusted to moment magnitude using the recommendations of Scordilis (2006). Local magnitudes (M_l) on the Richter scale, duration magnitudes (M_D) and unknown (not reported) magnitudes were not converted since a universal relationship with moment magnitude does not exist.

The search indicated that few sizeable seismic events have been recorded in the vicinity of the Project. The spatial relationship between the historical earthquakes with M_w greater than 4.0 and the Project is presented in **Figure 1**.

Table 2.1 presents a summary of historical earthquakes with magnitudes of 5.0 and greater recorded within a radius of approximately 124 miles of the Project and the complete historical earthquake catalog is included in **Attachment 1**. The data indicates that large events can, and have occurred in the region. The largest earthquake within the 124-mile radius is the Pleasant Valley earthquake with a magnitude of 7.3 on October 03, 1915, as estimated by dePolo and dePolo, (2012); all other earthquakes within a 124-mile radius of the Project are below magnitude 6.0.

Table 2.1: Record of Historical Earthquakes

Source	Date	Magnitude (M_w)	Distance to Site (mi)
dePolo and dePolo, (2012)	10/3/1915	7.3	102.2
USGS	2/3/1916	5.9	50.5
USGS	8/3/1916	5.8	81.7
ISC	8/29/1941	5.5	81.7
ANSS	7/4/1961	5.4	26.8
USGS	5/30/1968	5.4	60.1
USGS	7/6/1968	5.4	105.3
ISC	6/3/1968	5.3	54.0
USGS	6/18/1937	5.3	98.4
USGS	2/16/1984	5.1	93.3
ISC	11/13/2014	5.1	111.4
USGS	4/11/1917	5.1	117.8
USGS	9/18/1945	5.1	95.8
USGS	1/15/1946	5.1	112.4
USGS	3/3/1973	5.0	120.2
ISC	2/10/1993	5.0	81.7
USGS	10/11/1916	5.0	56.5
USGS	1/11/1923	5.0	117.8
ANSS	12/20/1954	5.0	101.5

2.3 Potentially Active Fault Sources

The Project is close to some regionally active faults. Evaluation of regional faults within a 62-mile radius from site was focused on structures considered capable of generating earthquakes of M_w 5.0 or greater using an empirical relationship between magnitude and rupture area (Wells and Coppersmith, 1994). Faults further from the Project would attenuate and would not generate as significant ground motions at the site.

Table 2.2 presents a summary of active faults identified within 62 miles of the Thacker Pass project site. The data for each fault was based on documented fault length and widths as reported by Pederson, et al. (2008), and the USGS Fault and Fold Database (2006). The distance to site was measured as the closest distance from the fault trace to the project.

Typically, the length of rupture is a portion of the total length of the fault, but there is documentable evidence that shorter faults can rupture along their entire length. For this analysis, the length of rupture was estimated using the following criteria:

- Half the total length for faults longer than 31 miles;
- Two-thirds of the fault length for fault lengths between 15.5 and 13 miles; and
- The total fault length for faults shorter than 15.5 miles.

Traces of the active faults in relation to the project site are presented in **Figure 1**.

Table 2.2 - Parameters for Potentially Active Faults

Fault	Length[1] (mi)	Width[2] (mi)	Sense of slip[2,3]	Distance from site (mi)[1]	Magnitude (M_w)[4]	Slip Rate (mm/yr.)[2]
Montana Mountains - Desert Valley	62.8	12.4	50˚/W/Normal	1.5	7.0	0.10
Hoppin Peaks	56.8	12.4	50˚/E/Normal	5.5	7.0	0.10
Eastern Bilk Creek Mountains FZ	18.0	12.4	50˚/W/Normal	9.6	6.6	0.01
Santa Rosa System	87.6	12.4	50˚/W/Normal	13.6	7.2	0.13
Jackson Mountains FZ	11.8	12.4	50˚/E/Normal	20.7	6.6	0.10
Bloody Run Hills Fault	16.2	12.4	50˚/W/Normal	25.8	6.6	0.01
Eastern Pine Forest Range FZ	37.3	12.4	50˚/E/Normal	26.8	6.8	0.10
Steens FZ	122.4	12.4	50˚/E/Normal	34.7	7.3	0.30
McGee Mountain FZ	21.3	12.4	50˚/Normal	45.6	6.7	0.01
Eastern Osgood Mountains FZ	23.1	12.4	50˚/Normal	55.6	6.7	0.01
Dunn Glen fault	11.3	12.4	50˚/W/Normal	58.0	6.6	0.10
Grass Valley FZ	33.1	12.4	50˚/W/Normal	56.7	6.7	0.10
Tule Springs Rims fault	20.6	12.4	50˚/NW/Normal	50.6	6.6	0.10
Black Rock FZ	43.1	12.4	50˚/W/Normal	61.6	6.9	0.19
Background Source[5]	n/a	n/a	60˚/Normal	9.4	6.5	n/a

NOTES:

1. **Distance and length are as determined by the 2017 USGS quaternary faults interactive map**
2. **Slip rate, and width were determined from Peterson et al. (2008)**
3. **No dip direction reported; assumed to be 60 degrees based on Anderson's Theory of Faulting**
4. **M_w, Moment Magnitude, was calculated using relationship of Wells & Coppersmith (1994)**
5. **The background source accounts for the possibility that an event may be generated in regions that are not associated with previously observed seismic sources (dePolo, 1994)**
6. **FZ = Fault Zone**

3. SEISMIC HAZARD ASSESSMENT

3.1 Site Classification

The results of the recent geotechnical subsurface investigation near the process facilities and CTFS (NewFields, 2019) determined that the upper 100 feet consist of 20 to 60 feet of very dense silty sand and gravel fan deposits overlying weathered basalt. The deepest boring near the proposed pit, which is west of the CTFS, was 50 feet and consisted of dense to very densely bedded ash and clay with average Standard Penetration Test (SPT) resistance of (N value) greater than 50 blows per foot. In accordance with the 2015 IBC and ASCE 7-16, the site classifies as very dense soil and soft rock, Site Class C.

Based on our understanding of the existing foundation conditions, there is a possibility that the foundation beneath the process facilities could be reclassified as Site Class B, rock, but the shear wave velocity in the upper 100 feet would need to be measured.

3.2 Code Based Seismic Parameters for Structures

The maximum considered earthquake response accelerations at short and long periods, S_S and S_1, respectively, were determined using an online calculator from the Structural Engineers Association of California (SEAC) (SEAC, 2019). All relevant seismic design values for structures on site are listed in **Table 3.1** and the direct output from the SEAC Seismic Design Maps are presented in **Attachment 2**.

Table 3.1: Code Based Seismic Parameters

Site Soil Class	C
Mapped MCE_R, five (5) percent damped, spectral response acceleration parameter at short periods (Site Class C), S_S	0.50g
Mapped MCE_R, five (5) percent damped, spectral response acceleration parameter at a period of one (1) second (Site Class C), S_1	0.18g
Design, five (5) percent damped, spectral response acceleration parameter at short periods, S_{DS}	0.43g
Design, five (5) percent damped, spectral response acceleration parameter at period of one (1) second, S_{D1}	0.18g

3.3 Probabilistic Seismic Hazard Analysis

Ground motions associated with design-level earthquakes were developed for the Project and were based on site-specific analyses as defined by the USGS unified hazard tool. The unified hazard tool application is based on the 2014 USGS national seismic hazard maps and adjusts for the site classification.

The Project location and site classification were inputs for the probabilistic assessment. The reported PGA for a 2 percent and 10 percent chance of exceedance in 50 years, which correspond to a return period of 475 years and 2,475 years, are presented in **Table 3.2** and **Attachment 3**.

Deaggregation of the seismic hazard for the 475-year event indicates that the mean event is a 6.4 moment magnitude at 35 miles from the Project. Deaggregation of the seismic hazard for the 2,475-year indicates that the mean event is a 6.6 moment magnitude at 14 miles from the Project.

Table 3.2: Probabilistic Design Accelerations

Return Period	Reported PGA (g)
475-Year	0.09
2,475-Year	0.26

3.4 Deterministic Hazard Analysis

Peak ground accelerations were estimated for historical seismic sources, fault sources, and a background source as part of the deterministic evaluation.

Historical earthquake magnitudes within 62 miles of the Project were all less than 6.0 in all cases, and for the current evaluation the radius was increased to 124 miles in an attempt to incorporate larger historical events. The largest historic event was the magnitude 7.3 Pleasant Valley Earthquake.

Major fault sources within 62 miles of the site were evaluated. The fault sources are limited to potentially active faults within the Quaternary Period (2.6 ma). The largest PGA determined was from the Eastern Bilk Creek Mountains Fault Zone, which is located 15.4 miles from site and has a magnitude of 6.6.

The background source accounts for the possibility that an event may be generated in regions that are not associated with previously observed seismic sources and is based on recommendations by dePolo (1994). The background source for the region is a M_w 6.5 event, which for the current deterministic analysis was assumed to rupture 9 miles from the site.

Attenuation relationships relate PGA or response spectral acceleration to earthquake magnitude, source-to-site distance, and local site conditions. Different attenuation models are required for different types of seismic sources. The five Next Generation (West) attenuation relationships of Abrahamson and Silva (2008), Boore and Atkinson (2008), Campbell and Bozorgnia (2008), Chiou and Youngs (2008), and Idriss (2008) were used to assess the local fault sources and the background event. The specified seismic accelerations are the average acceleration from the ground motion models. The ground motion models are based on the M_w and are generally applicable to M_w equal to 5.0 or greater. When moment magnitude was not available for historic seismic events, alternate available magnitudes were used in the models.

The ground motion models for fault sources rely on estimation of the various site-to-source distance parameters. The Boore and Atkinson attenuation relationship uses the closest horizontal distance to the surface projection of the rupture, often called the Joyner-Boore distance, which was calculated based on fault orientation and dip angle. The remaining four ground motion models use the closest direct distance to the rupture plane, and this distance was estimated following the recommendations of Kaklamanos et al. (2011). The attenuation relationships were used with a conservative shear wave velocity of 1,760 feet per second in the upper one hundred feet of the subsurface materials, based on recent the recent geotechnical site investigation and in accordance with the 2015 IBC. The relationships of Chiou and Youngs and Campbell and Bozorgnia were applied to estimate the depth to a shear wave velocity of 0.6 miles per second (mi/sec) and 1.6 mi/sec, respectively.

The Spudich et al. (1997) and Boore et al. (1993) attenuation relationships were used to estimate the PGA from historic earthquake events. The models were developed based on known earthquake events in western North America. The relationships are based on specific source criteria (i.e. depth of rupture, distance to epicenter, ground type, fault type, etc.), and they were selected based on their applicability to the Project and regional tectonics.

The deterministic PGA calculated for the active faults that are greater than 0.1g are presented in **Table 3.3**, and the PGAs calculated for the historical events of M_w of 5.4 or greater (**Table 2.1**) are presented in **Table 3.4**.

Table 3.3 - Deterministic PGA of Potentially Active Faults

Fault	Calculated PGA from the MCE (g)
Montana Mountains - Desert Valley	0.43
Hoppin Peaks	0.26
Eastern Bilk Creek Mountains Fault Zone	**0.44**
Santa Rosa System	0.29
Jackson Mountains Fault Zone	0.11
Background Source	0.10

Table 3.4 - Deterministic PGA of Historic Seismic Events with M_w 5.0 or Greater

Date	Latitude	Longitude	Magnitude (M_w)	PGA[1]	PGA[2]
10/3/1915	40.258	-117.654	6.80	0.02	0.02
2/3/1916	41.000	-117.800	5.90	0.02	0.02
8/3/1916	41.500	-116.500	5.80	0.02	0.02
8/3/1916	41.500	-116.500	5.60	0.01	0.02
8/29/1941	41.500	-118.500	5.53	0.01	0.01
7/4/1961	40.900	-118.400	5.40	0.04	0.03

Notes:

1. **Determined following Spudich et al. (1997)**
2. **Determined following Boore et al. (1993)**

These values represent the most conservative estimate of the PGA at the site from the MCE event. It should be noted that potential accelerations at the Project significantly decrease for fault sources that are greater than 25 miles and are very small for all of the historical events evaluated.

3.5 Other Seismic Hazards

Potential seismic hazards for any site include ground rupture, slope instability, seismic induced settlement, and liquefaction or strain softening of subsurface deposits. Ground rupture is not a potential hazard for the Project or associated facilities since near-surface faulting and active faults are not documented within the project site. Liquefaction, which can occur within loose, saturated granular deposits, is not expected to be a hazard for the project site due to the depth to groundwater (approximately 90 feet) and the dense conditions in the near surface overburden. Similarly, potential seismic settlement from liquefaction of saturated, deep deposits is not expected based on our understanding of the subsurface conditions.

4. RECOMMENDED DESIGN GROUND MOTIONS

Deterministic and probabilistic SHA were previously completed for the Prefeasibility Geotechnical Study Report (AMEC, 2011), but the current assessments should be used for future design purposes.

The site classification is Site Class C based on the results of the geotechnical site investigation completed in early 2019 and in accordance with the 2015 IBC and ASCE 7-16. Ground motions associated with design-level earthquakes were developed for the Project using both site-specific procedures and publically available information from the USGS. Based on a site-specific deterministic assessment of historic earthquakes and fault sources, the design seismic event would be a M_w 6.6 event on the northern section of the Eastern Bilk Creek Mountains Fault Zone at a distance of approximately 15 miles, which could produce a PGA of 0.44g at the Project. The probabilistic assessment indicated a PGA of approximately 0.09g and 0.26g for the 475-year and 2,475-year return period events, respectively. The deterministic and probabilistic SHA were used to determine an appropriate Operating Basis Earthquake (OBE) and Maximum Design Earthquake (MDE).

The Federal Guidelines for Dam Safety state that “the Operating Basis Earthquake (OBE) is an earthquake that produces ground motions at the site that can reasonably be expected to occur within the service life of the project. The associated performance requirement is that the project function with little or no damage, and without interruption of function. The purpose of the OBE is to protect against economic losses from damage or loss of service. Therefore, the return period for the OBE may be based on economic considerations” (FEMA, 2005). NewFields considers the OBE event consistent with a 2 percent chance of exceedance in 50 years (475 year return period).

Per the Nevada Administrative Code (NAC) for dams and other obstructions, "Maximum Credible Earthquake (MCE) means a hypothetical earthquake of a magnitude determined by the United States Geological Survey as the worst-case scenario that is reasonably possible for the region in which a dam is located". Typically, the MCE is determined through a deterministic seismic hazard analysis. NewFields has completed a deterministic seismic hazard analysis by calculating the peak ground acceleration values for potential seismic sources within 62 miles of the project site.

Based on all the available information, NewFields recommends the following general design criteria for design of the TSF and waste dump(s):

- Earthen structures (such as the CTFS) should be designed considering a MCE PGA equal to 0.44g based on the most conservative results of the DSHA and a OBE of 0.09g based on the 475-year return probabilistic event. This is in compliance with the NAC guidelines; and
- Design of structures should be completed using the code based spectral response parameters listed in Table 3.1.

Attachments:

Figure 1 – Historical Seismic Events and Fault Sources

Attachment 1 – Historic Earthquake Catalogue

Attachment 2 – U.S. Hazard Design Map Results

Attachment 3 – USGS Unified Hazard Tool Results

Addressee: (via e-mail)

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\J-REPORTS\Technical Memos\TM-03 Seismic Classification\TM-03 - Thacker Pass Seismic Hazard Analysis.RevA1.docx

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Figure 1 – Historical Seismic Events and Fault Sources

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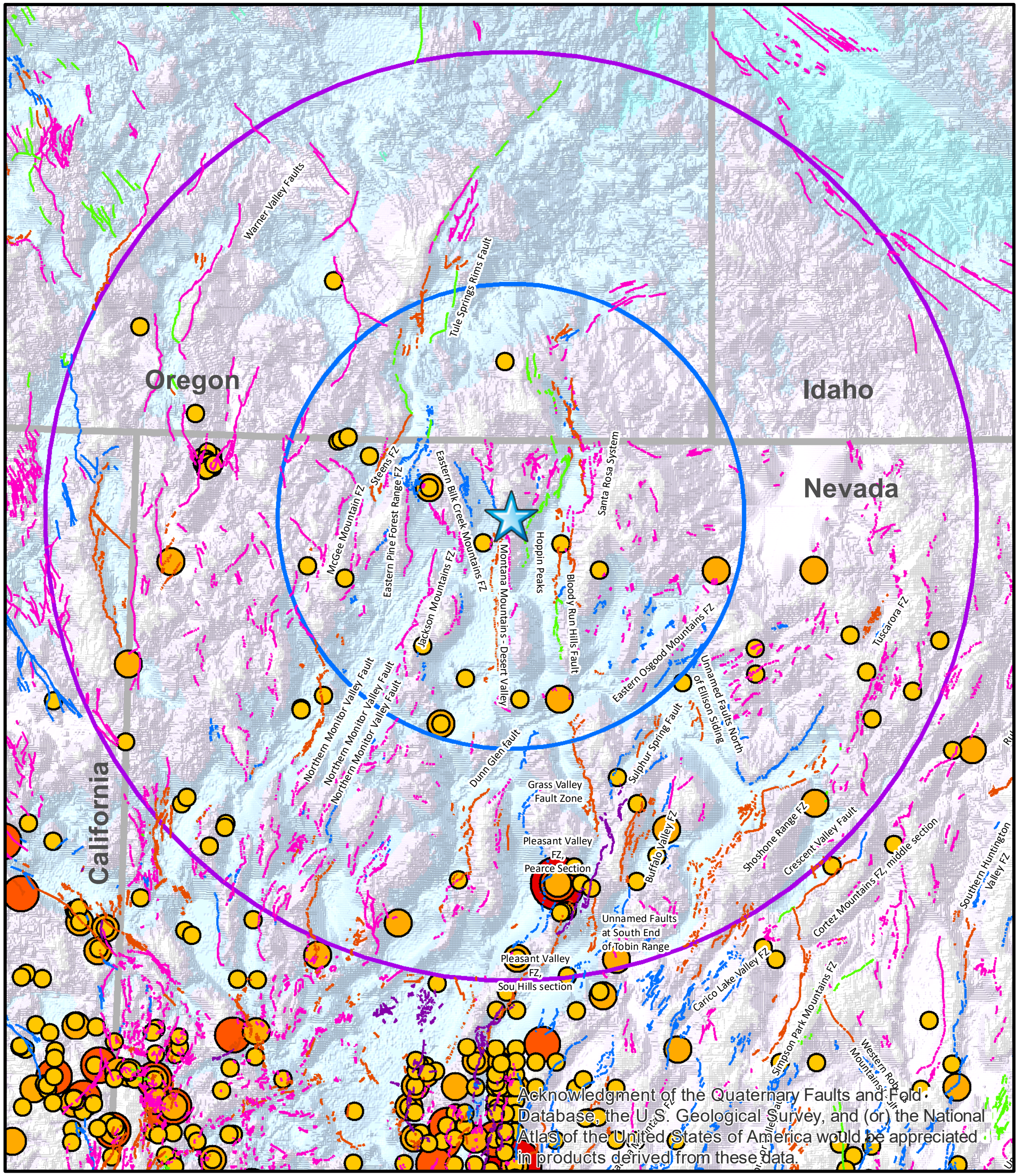

Acknowledgment of the Quaternary Faults and Fold Database, the U.S. Geological Survey, and (or) the National Atlas of the United States of America would be appreciated in products derived from these data.

Legend

★ **Thacker Pass**

— 62 Mile Radius
— 124 Mile Radius

Elevation (feet)

▭ 501 - 1,000
▭ 1,001 - 1,500
▭ 1,501 - 2,000
▭ 2,001 - 6,009

Linear Earthquake Faults

— <1,600,000
— <750,000
— <15,000
— <130,000
— <150
— Class B

Earthquakes: Magnitude

● between 4 and 5
● between 5 and 6
● between 6 and 7
● greater than 7.0

FZ = Fault Zone

1.- Fault database: U.S. Geological Survey, Nevada Bureau of Mines and Geology, and Utah Geological Survey, revised in 2018, Quaternary fault and fold database for the United States, accessed June 14, 2019, from USGS web site: https://earthquake.usgs.gov/hazards/qfaults/.
2.- Historic Earthquakes from Southern California Earthquake Data Center (SCEDC), catalog and Advance National Seismic System (ANSS) catalog accessed through the Northern California Earthquake Data Center (NCEDC) and through USGS
3. Body wave and surface wave events converted to moment magnitude; local magnitude events uncoverted.

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NewFields

CLIENT
LITHIUM NEVADA CORPORATION

PROJECT
THACKER PASS

TITLE
HISTORICAL SEISMIC EVENTS AND FAULT SOURCES

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Attachment 1 – Historic Earthquake Catalogue

Site Lat **41.704821**
Site Long **-118.058406**

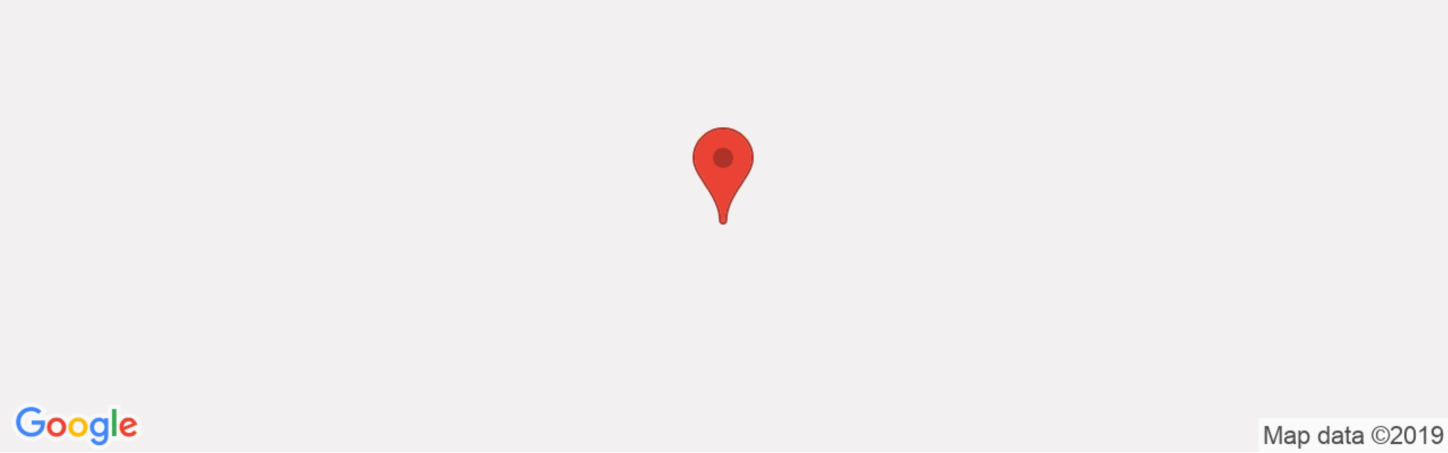
Source	Date	Time	Lat	Lon	Depth	Mag	Magt	DIST to SITE (km)	DIST to SITE (mi)	Mw
dePolo and dePolo, (2012)[1]	10/3/1915	6:53:21 AM	40.26	-117.65	10	7.6	Ms	**164.5**	**102.2**	**7.3**
USGS	2/3/1916	5:03:04 AM	41.00	-117.80		5.9	fa	**81.3**	**50.5**	**5.9**
USGS	8/3/1916	2:22:38 PM	41.50	-116.50		5.8	ML	**131.6**	**81.7**	**5.8**
ISC	8/29/1941	1:09:53 PM	41.50	-118.50	35	5.5	Ms	**43.2**	**26.8**	**5.5**
ANSS	7/4/1961	4:56:00 AM	40.90	-118.40		5.4	ML	**93.9**	**58.4**	**5.4**
USGS	5/30/1968	12:36:00 AM	42.30	-119.80	24	5.1	Mb	**158.4**	**98.4**	**5.4**
USGS	7/6/1968	2:02:40 PM	41.10	-117.40		5.1	Mb	**86.8**	**54.0**	**5.4**
ISC	6/3/1968	1:27:39 PM	42.21	-119.91	8	5.0	Mb	**163.4**	**101.5**	**5.3**
USGS	6/18/1937	9:07:26 AM	41.25	-120.00	35	5.3	Ms	**169.5**	**105.3**	**5.3**
USGS	2/16/1984	11:14:58 AM	39.93	-117.76	8.3	4.8	Mb	**198.6**	**123.4**	**5.1**
ISC	11/13/2014	6:36:08 AM	41.92	-119.67	6.1	4.8	Mb	**136.0**	**84.5**	**5.1**
USGS	4/11/1917	6:59:55 PM	40.00	-118.00		5.1	ML	**189.6**	**117.8**	**5.1**
USGS	9/18/1945	10:39:00 PM	40.60	-116.50		5.1	ML	**179.2**	**111.4**	**5.1**
USGS	1/15/1946	10:31:56 PM	40.50	-117.25		5.1	Unknown	**150.1**	**93.3**	**5.1**
USGS	3/3/1973	3:00:03 AM	41.81	-118.46	5	4.7	Mb	**35.1**	**21.8**	**5.0**
ISC	2/10/1993	9:48:36 PM	40.42	-119.61	10.9	4.7	Mb	**193.2**	**120.1**	**5.0**
USGS	10/11/1916	5:49:09 AM	41.50	-116.50		5.0	ML	**131.6**	**81.7**	**5.0**
USGS	1/11/1923	4:29:00 AM	42.20	-120.30		5.0	ML	**193.4**	**120.2**	**5.0**
ANSS	12/20/1954	5:36:47 PM	40.00	-118.00		5.0	ML	**189.6**	**117.8**	**5.0**
ISC	9/14/2015	1:55:48 PM	41.86	-119.59	7.6	4.6	Mb	**128.0**	**79.5**	**4.9**
ISC	12/24/2015	8:30:39 PM	41.89	-119.60	10	4.6	Mb	**129.5**	**80.5**	**4.9**
USGS	12/15/1962	6:35:00 AM	40.70	-117.50		4.9	ML	**121.1**	**75.3**	**4.9**
ISC	10/22/1966	5:16:24 PM	40.58	-116.25	7	4.5	Mb	**196.7**	**122.2**	**4.9**
USGS	1/30/1968	3:20:06 PM	41.00	-117.40	18	4.5	Mb	**95.7**	**59.5**	**4.9**
USGS	5/3/1980	12:17:38 AM	41.94	-118.84	5	4.5	Mb	**70.0**	**43.5**	**4.9**
ISC	6/30/2004	12:21:44 PM	42.18	-120.21	5	4.5	Mb	**185.6**	**115.3**	**4.9**
USGS	1/28/1966	6:00:11 PM	41.60	-118.20	20	4.4	Mb	**16.6**	**10.3**	**4.8**
ISC	1/29/2015	11:03:20 AM	41.88	-119.65	5.3	4.4	Mb	**133.2**	**82.8**	**4.8**
ISC	7/27/2015	1:05:33 AM	41.82	-119.63	1.8	4.4	Mb	**130.9**	**81.4**	**4.8**
USGS	3/28/1917	11:16:00 AM	41.60	-117.80		4.7	Unknown	**24.4**	**15.2**	**4.7**
USGS	9/22/1936	10:39:07 AM	40.43	-117.28		4.7	ML	**156.1**	**97.0**	**4.7**
USGS	11/16/1956	8:26:10 AM	41.03	-116.45		4.7	ML	**153.8**	**95.5**	**4.7**
ISC	12/7/1966	8:43:59 PM	40.80	-119.98	10	4.3	Mb	**189.5**	**117.7**	**4.7**
ANSS	6/12/1968	1:46:22 AM	42.10	-119.89	33	4.3	Mb	**157.7**	**98.0**	**4.7**
ANSS	6/21/1968	8:33:28 PM	42.21	-119.65	23	4.3	Mb	**143.4**	**89.1**	**4.7**
USGS	4/28/1980	1:55:34 PM	41.87	-118.91	5	4.3	Mb	**72.7**	**45.2**	**4.7**
ISC	9/27/2015	2:44:01 AM	41.87	-119.58	0.4	4.3	Mb	**127.4**	**79.2**	**4.7**
USGS	9/10/1929	8:01:00 PM	41.20	-116.80		4.6	ML	**119.0**	**73.9**	**4.6**
USGS	5/25/1937	5:35:20 AM	41.50	-119.80		4.6	ML	**146.6**	**91.1**	**4.6**
USGS	9/7/1962	11:19:13 PM	41.30	-116.70	33	4.6	ML	**121.7**	**75.7**	**4.6**
ANSS	10/8/2001	5:37:11 AM	41.22	-115.85	0	4.6	ML	**191.8**	**119.1**	**4.6**
ANSS	7/22/2004	8:26:27 PM	42.19	-120.30	5	4.6	Mw	**192.8**	**119.8**	**4.6**
ISC	9/9/2007	1:33:24 AM	40.32	-117.12	10	4.2	Mb	**172.9**	**107.4**	**4.6**
ISC	2/26/2015	7:17:50 PM	41.94	-119.55	10	4.2	Mb	**126.4**	**78.6**	**4.6**
ANSS	3/24/1968	8:45:47 AM	41.10	-117.50	33	4.1	Mb	**81.8**	**50.8**	**4.5**
ISC	5/23/1978	5:47:57 AM	40.83	-117.25	10	4.1	Mb	**118.7**	**73.8**	**4.5**
USGS	2/13/1979	3:52:48 PM	40.93	-116.16	5	4.1	Mb	**180.6**	**112.2**	**4.5**
USGS	2/27/1936	12:40:00 AM	41.00	-119.00		4.5	ML	**111.0**	**69.0**	**4.5**
USGS	3/12/1958	12:09:16 PM	42.40	-120.00		4.5	ML	**178.0**	**110.6**	**4.5**
ANSS	3/19/1971	8:03:46 PM	40.41	-117.09	10	4.0	Mb	**165.2**	**102.6**	**4.4**
ANSS	4/3/1979	12:08:31 PM	40.64	-119.66	5	4.0	Mb	**179.1**	**111.3**	**4.4**
ISC	10/29/2015	4:47:40 PM	41.89	-119.59	1.5	4.0	Mb	**128.3**	**79.7**	**4.4**
ISC	12/6/2015	11:13:28 AM	41.89	-119.62	1.1	4.0	Mb	**130.8**	**81.2**	**4.4**
USGS	2/23/1985	3:36:29 PM	41.17	-118.73	5	4.4	ML	**81.8**	**50.8**	**4.4**
ISC	6/18/1987	4:50:08 AM	41.94	-119.67	5	4.4	ML	**136.0**	**84.5**	**4.4**
ANSS	11/19/2000	12:54:50 PM	40.48	-119.49	12.92	4.4	ML	**181.1**	**112.5**	**4.4**
ISC	12/4/2014	5:24:52 AM	41.85	-119.67	5.5	4.4	ML	**134.5**	**83.6**	**4.4**
ISC	3/13/1955	8:40:23 AM	40.00	-118.00		4.3	M	**189.6**	**117.8**	**4.3**
ISC	12/4/2003	11:13:10 PM	41.36	-119.30	10	4.3	Mb1	**110.4**	**68.6**	**4.3**
ANSS	1/23/2003	9:49:47 PM	39.96	-117.86	6.25	4.2	ML	**194.9**	**121.1**	**4.2**
ISC	4/20/1959	12:33:44 PM	40.00	-118.00		4.2	M	**189.6**	**117.8**	**4.2**
USGS	8/31/1975	11:27:40 AM	40.95	-119.11	33	4.2	ML	**121.7**	**75.6**	**4.2**
ISC	3/25/1987	3:48:39 PM	40.14	-117.68	5	4.2	ML	**177.4**	**110.2**	**4.2**
ISC	6/8/2003	10:14:55 AM	41.17	-116.33	10	4.2	ML	**155.5**	**96.6**	**4.2**
ISC	12/10/2014	1:50:58 PM	41.89	-119.61	2.8	4.2	ML	**130.2**	**80.9**	**4.2**
USGS	8/13/2015	11:31:08 AM	41.89	-119.62	10.3	4.2	ML	**131.2**	**81.5**	**4.2**
USGS	11/19/2015	1:40:03 AM	41.87	-119.62	12.9	4.2	ML	**130.7**	**81.2**	**4.2**
ISC	12/28/2015	3:10:30 PM	41.40	-118.98	10	4.2	ML	**83.7**	**52.0**	**4.2**
ISC	5/14/2016	2:20:31 PM	40.64	-119.47	9	4.2	ML	**167.2**	**103.9**	**4.2**
ANSS	1/10/1956	8:37:24 AM	41.50	-119.10		4.1	ML	**89.6**	**55.6**	**4.1**
USGS	3/5/1987	12:30:21 AM	40.78	-116.25	5	4.1	MD	**182.9**	**113.6**	**4.1**
USGS	10/30/2014	3:16:33 PM	41.91	-119.62	0	4.1	ML	**131.3**	**81.6**	**4.1**
ISC	1/3/2016	3:35:25 PM	41.92	-119.64	7.2	4.1	ML	**133.2**	**82.7**	**4.1**
ANSS	9/28/2011	11:54:04 AM	39.99	-117.88	0	4.1	ML	**191.7**	**119.1**	**4.1**
ANSS	6/6/1956	11:50:07 PM	41.20	-118.50		4.0	ML	**67.1**	**41.7**	**4.0**
ANSS	1/31/1962	4:07:32 AM	40.10	-118.00		4.0	ML	**178.5**	**110.9**	**4.0**
ISC	2/12/1968	8:53:26 AM	41.10	-117.40	13	4.0	M	**86.8**	**54.0**	**4.0**
ANSS	1/26/1985	6:43:24 PM	40.94	-119.11	1.45	4.0	Mc	**122.3**	**76.0**	**4.0**
ISC	8/29/1997	3:48:09 PM	41.87	-119.83	5	4.0	MD	**147.7**	**91.8**	**4.0**
ISC	10/1/2014	12:46:08 PM	41.91	-119.68	2.3	4.0	ML	**136.2**	**84.7**	**4.0**

Note:

1. dePolo, D.M. and dePolo, C.M. (2012). "Earthquakes in Nevada, 1840s to 2010," Nevada Bureau of Mines and Geology, Map 179.

Attachment 2 – U.S. Seismic Design Map Results

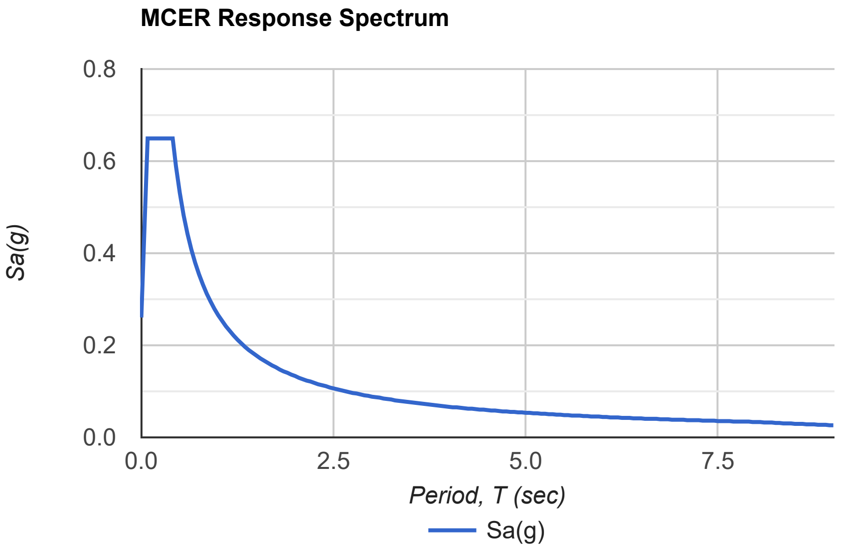
Latitude, Longitude: 41.704821, -118.058406

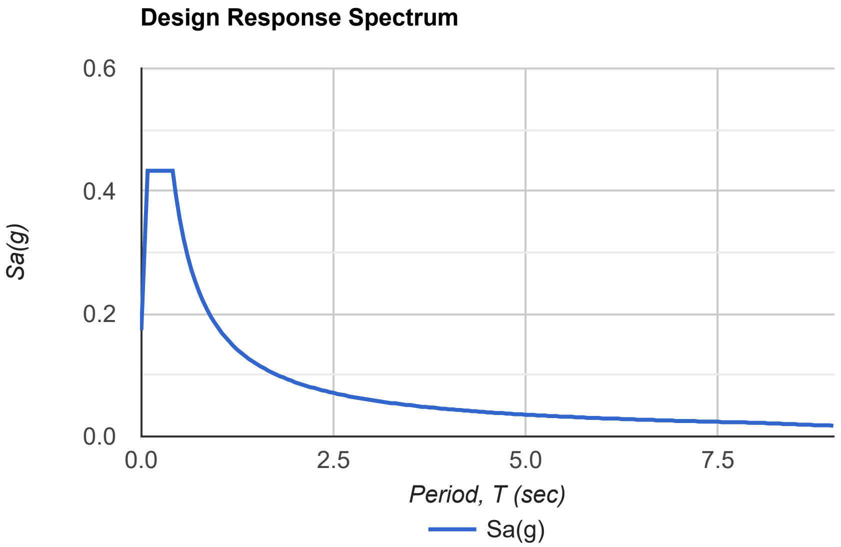


Date	6/20/2019, 1:37:39 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	C - Very Dense Soil and Soft Rock

Type	Value	Description
S_S	0.5	MCE_R ground motion. (for 0.2 second period)
S_1	0.177	MCE_R ground motion. (for 1.0s period)
S_{MS}	0.649	Site-modified spectral acceleration value
S_{M1}	0.265	Site-modified spectral acceleration value
S_{DS}	0.433	Numeric seismic design value at 0.2 second SA
S_{D1}	0.177	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	C	Seismic design category
F_a	1.3	Site amplification factor at 0.2 second
F_v	1.5	Site amplification factor at 1.0 second
PGA	0.223	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.267	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	0.5	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	0.557	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.177	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.194	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.5	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	0.896	Mapped value of the risk coefficient at short periods
C_{R1}	0.912	Mapped value of the risk coefficient at a period of 1 s





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Attachment 3 – USGS Unified Hazard Tool Results

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

^ Input

Edition

Dynamic: Conterminous U.S. 2014 (v4.1

Latitude

Decimal degrees

41.704821

Longitude

Decimal degrees, negative values for western longitudes

-118.058406

Site Class

537 m/s (Site class C)

Spectral Period

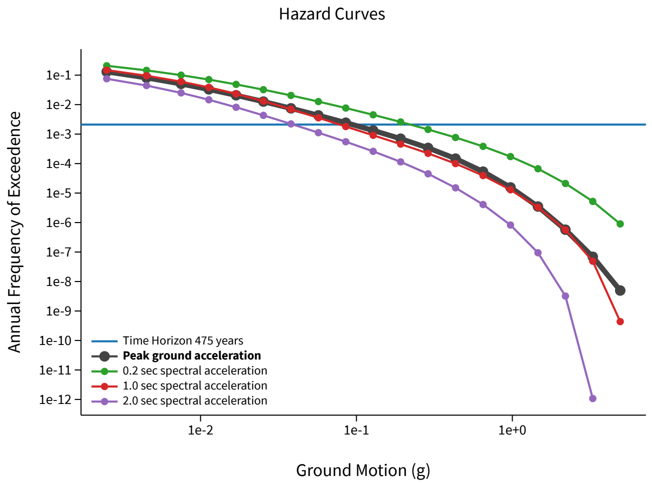
Peak ground acceleration

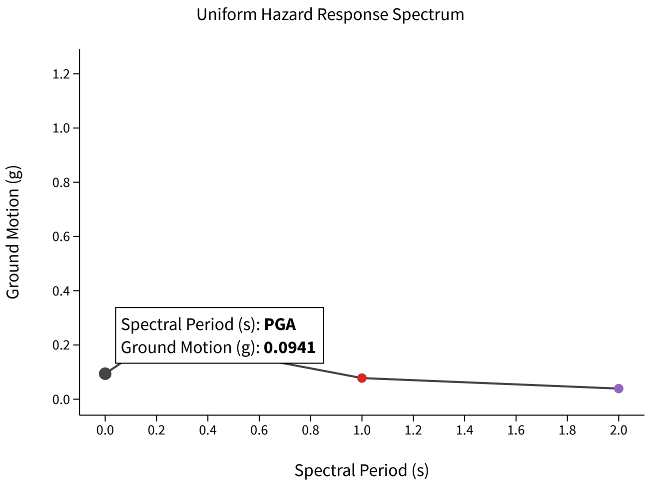
Time Horizon

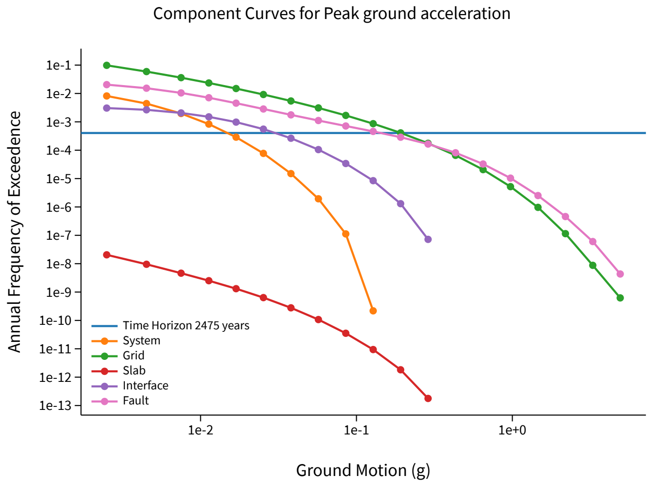
Return period in years

475

Hazard Curve





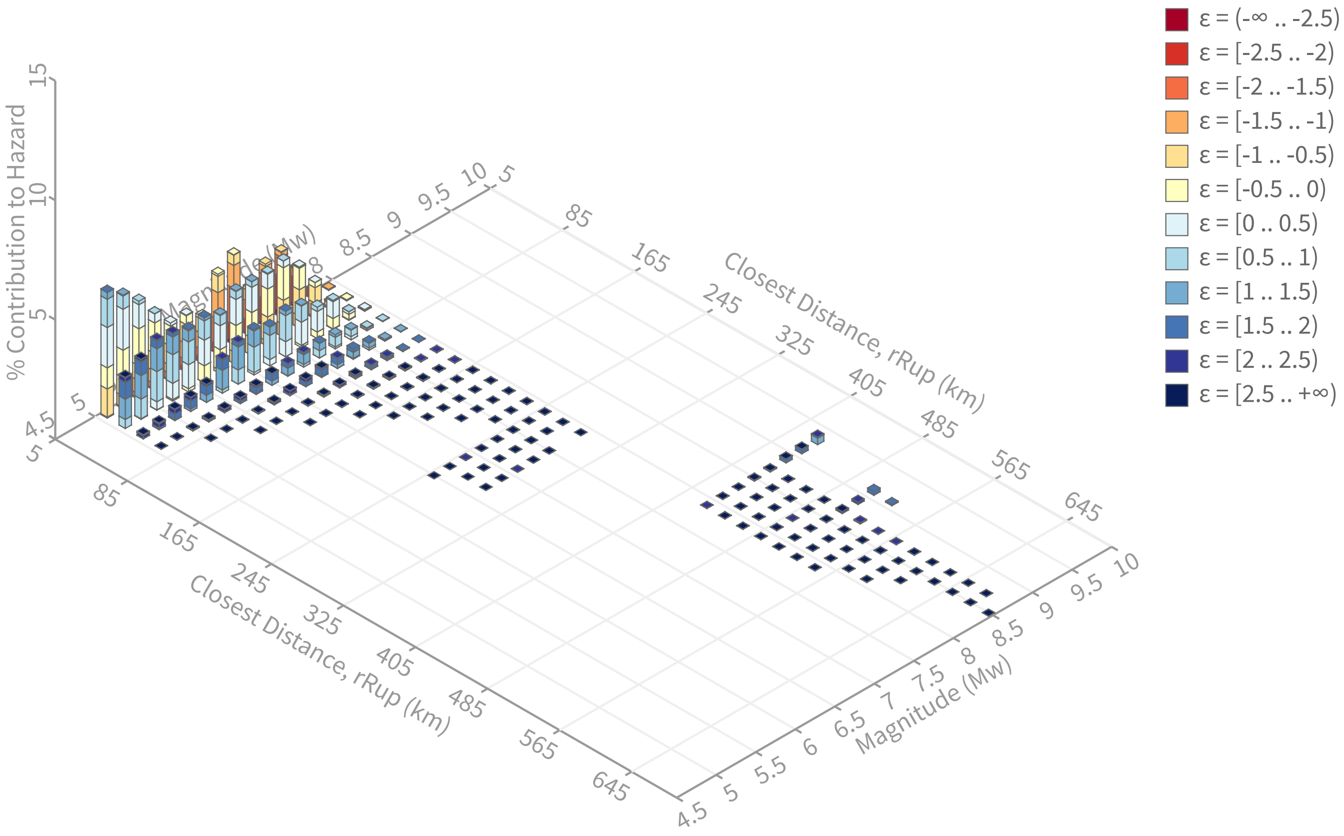


View Raw Data

^ Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 475 yrs
Exceedance rate: 0.0021052632 yr^{-1}
PGA ground motion: 0.094098405 g

Recovered targets

Return period: 482.84091 yrs
Exceedance rate: 0.0020710755 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.38 %

Mean (for all sources)

r: 33.9 km
m: 6.36
ε_0: -0.06 σ

Mode (largest r-m bin)

r: 11.7 km
m: 5.1
ε_0: 0.1 σ
Contribution: 5.26 %

Mode (largest ε_0 bin)

r: 14.62 km
m: 5.3
ε_0: 0.23 σ
Contribution: 1.71 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
EXTmap_2014_fixSm.ch.in (opt)	Grid							25.92
PointSourceFinite: -118.058, 41.808		12.21	5.66	-0.49	118.058°W	41.808°N	0.00	2.59
PointSourceFinite: -118.058, 41.817		12.98	5.70	-0.44	118.058°W	41.817°N	0.00	1.73
PointSourceFinite: -118.058, 41.916		22.13	5.94	0.17	118.058°W	41.916°N	0.00	1.53
PointSourceFinite: -118.058, 41.736		6.34	5.52	-1.24	118.058°W	41.736°N	0.00	1.34
PointSourceFinite: -118.058, 41.853		16.31	5.78	-0.16	118.058°W	41.853°N	0.00	1.22
PointSourceFinite: -118.058, 41.745		6.92	5.58	-1.19	118.058°W	41.745°N	0.00	1.21
EXTmap_2014_adSm.ch.in (opt)	Grid							15.26
PointSourceFinite: -118.058, 41.808		12.21	5.66	-0.49	118.058°W	41.808°N	0.00	1.50
Geologic Model Partial Rupture	Fault							14.02
Santa Rosa system 50		27.25	6.91	-0.53	117.738°W	41.701°N	90.89	2.78
Montana Mountains - Desert Valley 50		10.92	6.85	-1.64	118.129°W	41.714°N	279.68	1.74
Steens 50		56.17	6.99	0.80	118.756°W	41.752°N	275.44	1.48
Hoppin Peaks 50		16.74	6.87	-1.11	117.963°W	41.684°N	106.50	1.43
Santa Rosa system 35		22.65	6.90	-1.16	117.738°W	41.701°N	90.89	1.07
EXTmap_2014_fixSm.gr.in (opt)	Grid							12.05
PointSourceFinite: -118.058, 41.808		12.27	5.64	-0.47	118.058°W	41.808°N	0.00	1.27
Geologic Model Full Rupture	Fault							7.55
EXTmap_2014_adSm.gr.in (opt)	Grid							7.10
EXTmap_2014_fixSm_M8.in (opt)	Grid							4.83
EXTmap_2014_adSm_M8.in (opt)	Grid							2.87
Zeng Model Partial Rupture	Fault							2.24
Bird Model Partial Rupture	Fault							2.13
Bird Model Full Rupture	Fault							2.07
Zeng Model Full Rupture	Fault							1.22
Geologic Model Small Mag	Fault							1.09

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Input

Edition

Dynamic: Conterminous U.S. 2014 (v4.1

Latitude

Decimal degrees

41.704821

Longitude

Decimal degrees, negative values for western longitudes

-118.058406

Site Class

537 m/s (Site class C)

Spectral Period

Peak ground acceleration

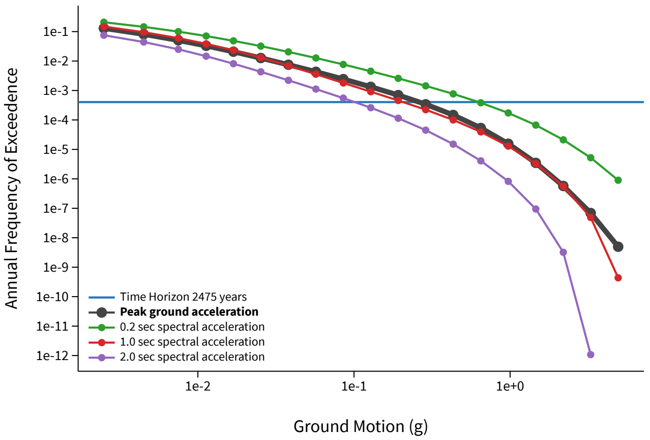
Time Horizon

Return period in years

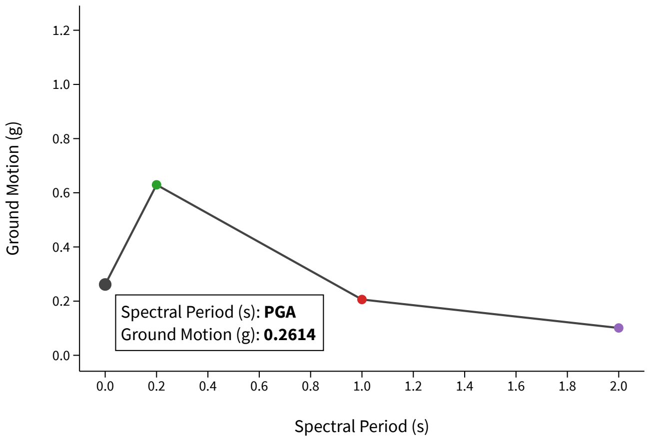
2475

Hazard Curve

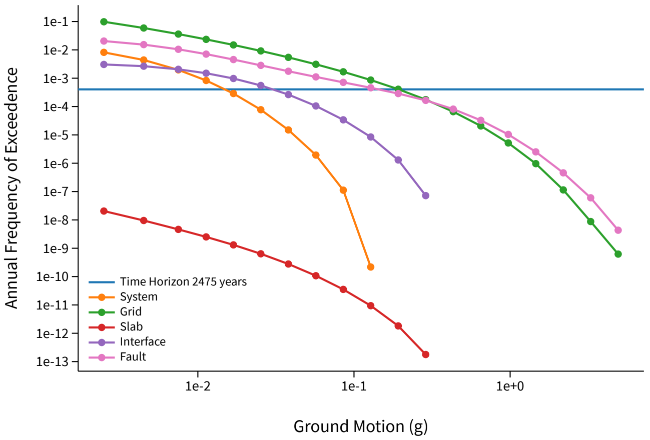
Hazard Curves



Uniform Hazard Response Spectrum



Component Curves for Peak ground acceleration

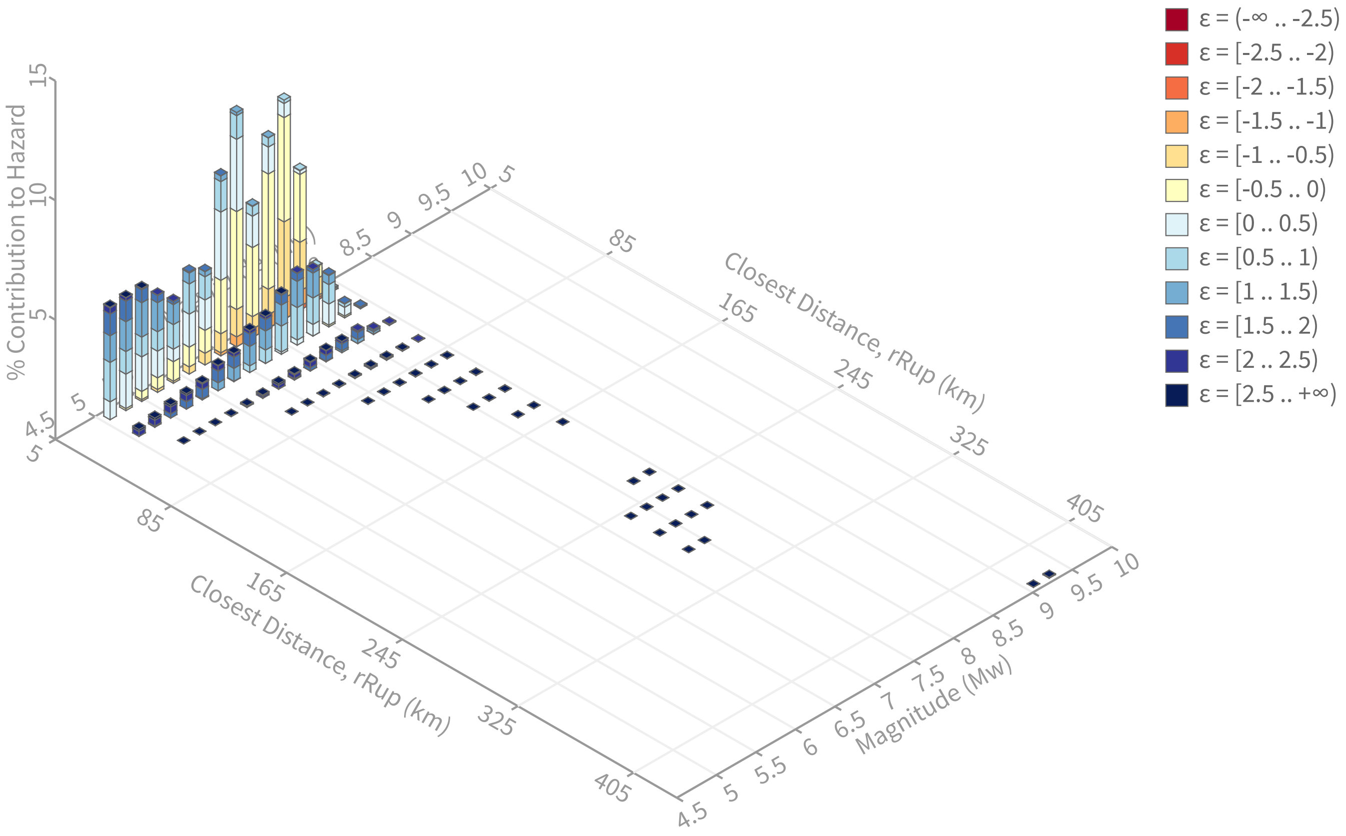


View Raw Data

^ Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
PGA ground motion: 0.26144707 g

Recovered targets

Return period: 2532.8945 yrs
Exceedance rate: 0.00039480524 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.18 %

Mean (for all sources)

r: 14.46 km
m: 6.57
ε_0: 0.39 σ

Mode (largest r-m bin)

r: 10.57 km
m: 6.71
ε_0: -0.08 σ
Contribution: 9.8 %

Mode (largest ε_0 bin)

r: 8.1 km
m: 7.09
ε_0: -0.29 σ
Contribution: 4.82 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
EXTmap_2014_fixSm.ch.in (opt)	Grid							20.30
PointSourceFinite: -118.058, 41.808		11.42	5.95	0.65	118.058°W	41.808°N	0.00	3.29
PointSourceFinite: -118.058, 41.736		6.26	5.64	0.10	118.058°W	41.736°N	0.00	3.09
PointSourceFinite: -118.058, 41.745		6.74	5.75	0.12	118.058°W	41.745°N	0.00	2.67
PointSourceFinite: -118.058, 41.817		12.01	6.04	0.65	118.058°W	41.817°N	0.00	2.11
PointSourceFinite: -118.058, 41.853		14.83	6.17	0.85	118.058°W	41.853°N	0.00	1.14
Geologic Model Partial Rupture	Fault							19.64
Montana Mountains - Desert Valley 50		7.79	6.90	-0.24	118.129°W	41.714°N	279.68	4.70
Santa Rosa system 50		22.88	6.97	0.84	117.738°W	41.701°N	90.89	2.95
Hoppin Peaks 50		11.64	6.93	0.15	117.963°W	41.684°N	106.50	2.73
Santa Rosa system 35		17.27	6.95	0.04	117.738°W	41.701°N	90.89	2.18
Montana Mountains - Desert Valley 65		7.53	6.90	-0.27	118.129°W	41.714°N	279.68	1.61
Montana Mountains - Desert Valley 35		8.10	6.91	-0.21	118.129°W	41.714°N	279.68	1.50
Geologic Model Full Rupture	Fault							14.92
Montana Mountains - Desert Valley 50		5.33	7.36	-0.65	118.129°W	41.714°N	279.68	3.22
Hoppin Peaks 50		8.30	7.36	-0.33	117.963°W	41.684°N	106.50	2.70
Santa Rosa system 50		22.47	7.50	0.44	117.738°W	41.701°N	90.89	1.35
Montana Mountains - Desert Valley 65		5.33	7.36	-0.65	118.129°W	41.714°N	279.68	1.07
Montana Mountains - Desert Valley 35		5.33	7.36	-0.65	118.129°W	41.714°N	279.68	1.07
EXTmap_2014_adSm.ch.in (opt)	Grid							11.67
PointSourceFinite: -118.058, 41.808		11.41	5.95	0.64	118.058°W	41.808°N	0.00	1.91
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PointSourceFinite: -118.058, 41.745		6.74	5.75	0.12	118.058°W	41.745°N	0.00	1.56
PointSourceFinite: -118.058, 41.817		12.01	6.04	0.65	118.058°W	41.817°N	0.00	1.15
EXTmap_2014_fixSm.gr.in (opt)	Grid							9.10
PointSourceFinite: -118.058, 41.808		11.53	5.92	0.68	118.058°W	41.808°N	0.00	1.57
PointSourceFinite: -118.058, 41.736		6.38	5.58	0.17	118.058°W	41.736°N	0.00	1.45
PointSourceFinite: -118.058, 41.745		6.74	5.75	0.12	118.058°W	41.745°N	0.00	1.33
PointSourceFinite: -118.058, 41.817		12.01	6.04	0.65	118.058°W	41.817°N	0.00	1.05
EXTmap_2014_adSm.gr.in (opt)	Grid							5.23
Bird Model Full Rupture	Fault							3.98
Eastern Bilk Creek Mountains 50		13.00	6.76	-0.15	118.262°W	41.706°N	270.59	1.14
EXTmap_2014_fixSm_M8.in (opt)	Grid							3.89
Bird Model Partial Rupture	Fault							3.43
Zeng Model Partial Rupture	Fault							3.04
Zeng Model Full Rupture	Fault							2.34
EXTmap_2014_adSm_M8.in (opt)	Grid							2.24

APPENDIX E

Hydrology and Hydraulic Calculations

NewFields
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9400 Station Street
Suite 300
Lone Tree, CO 80124

T: 720.508.3300
F: 720.508.3339

CALCULATION BRIEF

Project: **Thacker Pass Project**

Project No: **475.0385.000**

Subject: **Stormwater Calculation Package**

Date: **31 March 2020**

1.0 STORMWATER MANAGEMENT PLAN OVERVIEW

The Thacker Pass Stormwater Management Plan for the Plan of Operations (POO) project area includes the facilities for the immediate production plan as well as the future expansion area. Areas of disturbance, including the Coarse Gangue Stockpile (CGS), East and West Waste Rock Storage Facilities (WRFs), and the Clay Tailings Filter Stack (CTFS) were studied specifically as these areas have the most potential to affect the runoff quantity and quality. The goals of the Stormwater Management Plan are to:

- Divert stormwater around the mine facilities and discharge to downstream natural drainageways
- Convey sediment-laden stormwater runoff to stormwater ponds for settling and gradual release.

The Thacker Pass Project is located approximately 20 miles west-northwest of Orovada, 62 miles north-northwest of Winnemucca, between the Kings River Valley to the west, the Quinn River Valley to the east, the Montana Mountains to the north, and the Double H Mountains to the south in an area known as Thacker Pass. The elevation in the Project area ranges from approximately 4,200 to 5,650 feet above mean sea level (amsl).

The project uses existing and natural drainageways in the stormwater management plan wherever practicable (see the figures in Appendix E.2.1). Figure 1 shows the project area straddling the Quinn and King River Valley Hydrographic basins. Site runoff flows north to southeast within the Quinn Basin and north to southwest in the King River Basin. Much of the site runoff drains into an existing natural drainageway running roughly parallel to SR 293 at the southern border of the boundary; this drainageway exists on both sides of the hydrographic boundary and is divided at the high point south of the pit. Flow east of this point discharges into Crowley Creek. Site runoff from within Kings River Basin flows into Thacker Creek.

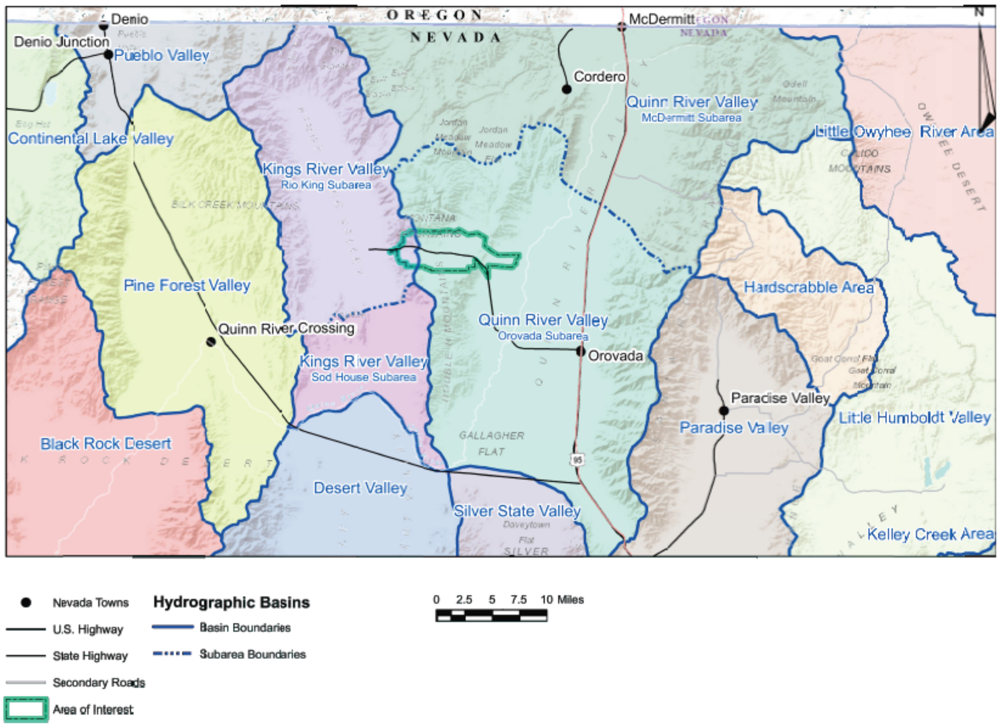
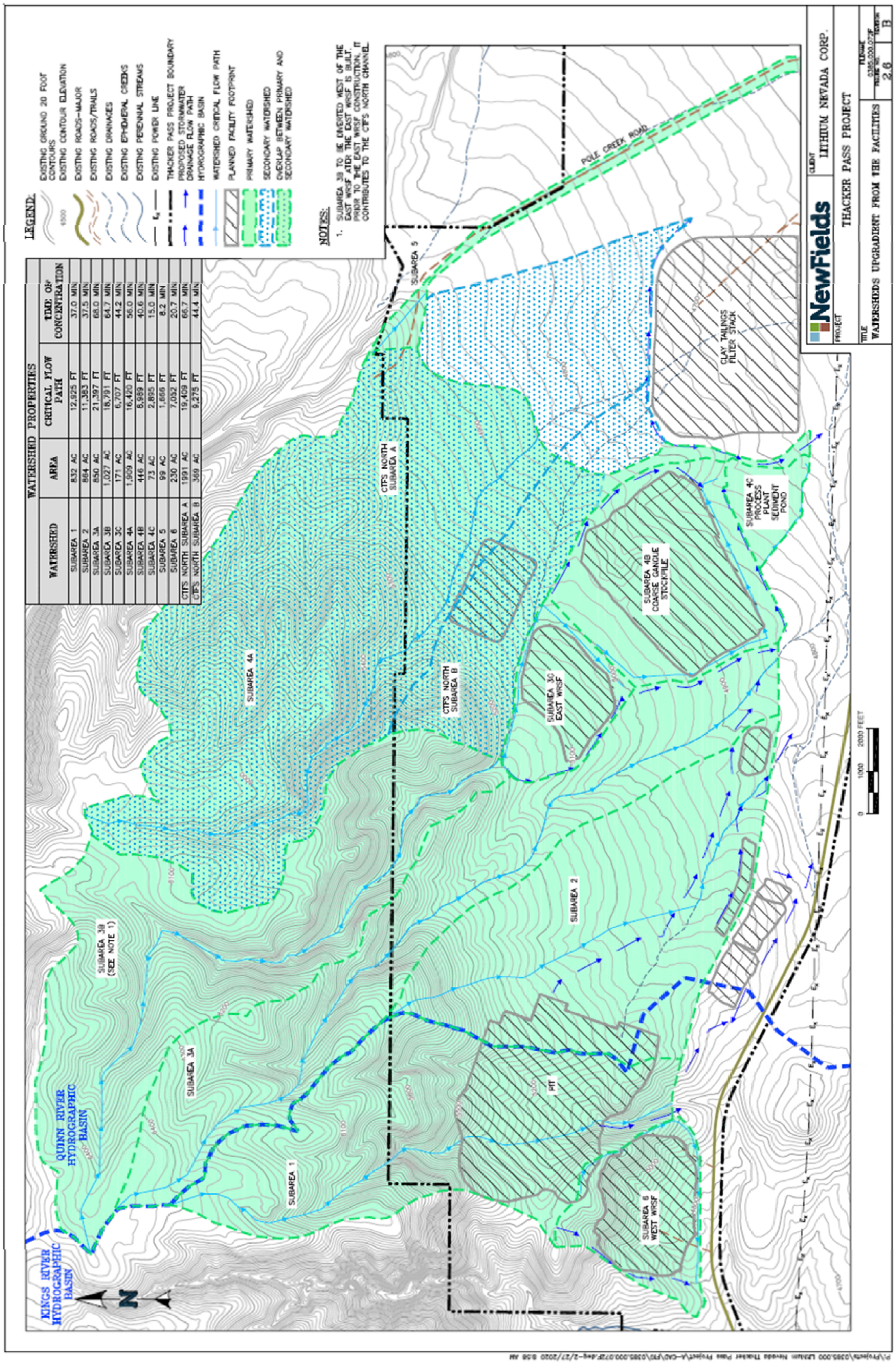


FIGURE 1. HYDROGRAPHIC BASIN MAP

Figure 2 breaks the project area and upstream watersheds into subareas that impact the proposed facilities. Table 1 identifies the watershed subarea(s) associated with the major mine facilities included in this stormwater plan (see Figure 000 in Appendix E.2.1). The area within the CTFS is not included in the watersheds shown; stormwater generated within this area will be captured and treated separately from stormwater external to the CTFS within the Reclaim Pond (see Reclaim Pond filling curve in Appendices attached).

TABLE 1. FACILITY AND SUBAREAS

Facility	Subarea
West WRSF	6
East WRSF	3C
CGS	4B
CTFS West	4, Subcatchment B and C
CTFS North	CTFS North Subareas A and B



WATERSHED PROPERTIES

WATERSHED	AREA	CRITICAL FLOW PATH	TIME OF CONCENTRATION
SUBAREA 1	832 AC	12,925 FT	37.0 MIN
SUBAREA 2	864 AC	11,383 FT	37.5 MIN
SUBAREA 3A	850 AC	21,397 FT	68.0 MIN
SUBAREA 3B	1,027 AC	18,791 FT	64.7 MIN
SUBAREA 3C	171 AC	6,707 FT	44.2 MIN
SUBAREA 4A	1,909 AC	16,420 FT	56.0 MIN
SUBAREA 4B	446 AC	8,989 FT	40.6 MIN
SUBAREA 4C	73 AC	2,885 FT	15.0 MIN
SUBAREA 5	99 AC	1,666 FT	8.2 MIN
SUBAREA 6	230 AC	7,052 FT	20.7 MIN
CTFS NORTH SUBAREA A	1991 AC	19,409 FT	66.7 MIN
CTFS NORTH SUBAREA B	369 AC	9,275 FT	44.4 MIN

NOTES:

1. SUBAREA 3B TO BE DIVERTED WEST OF THE EAST WRSF AFTER THE EAST WRSF IS BUILT. PRIOR TO THE EAST WRSF CONSTRUCTION, IT CONTRIBUTES TO THE CTFS NORTH CHANNEL.

FIGURE 2. HYDROGRAPHIC BASIN MAP

1.1 Subareas 1 and 6

Subareas 1 and 6 (West WRSF) are located within the Kings River Hydrographic Basin and runoff generally flows to the southwest. Subarea 1 has an area of 832 acres, an average watershed slope of 23.9%, and is thinly vegetated with desert flora. There is natural drainageway spanning the basin from the northeast to the south, where it crosses the haul road and SR 293 and discharges into the southern drainageway. After the pit has been constructed, the runoff from the watershed north of the pit will be diverted west into a natural drainage that continues off-site and into Thacker Creek.

A ridge on the southeastern border of Subarea 1 separates its drainage basin from Subarea 6, on which the West WRSF will be constructed. Subarea 6 has an area of 230 acres and an average watershed slope of 21.9%. Runoff from the watershed currently flows southwest, across SR 293, and into Thacker Creek.

1.2 Subarea 2

Subarea 2 is located east of Subarea 1 and south of Subarea 3A. It has an area of 864 acres, and average watershed slope of 9.5%, and is currently sparsely vegetated. There is a natural drainageway that begins at the toe of a ridge at the northern tip of the basin, continues south and currently discharges into the southern drainageway. Eventually the pit will expand across this basin; the ultimate footprint will leave approximately 63 acres north of the pit. This stormwater will need to be captured or diverted east to Subarea 3.

1.3 Subarea 3

Subarea 3 was sub-divided into three watersheds. All will discharge to the proposed culvert southwest of the CGS and east of the growth media stockpiles. Subareas 3A and 3B extend north of the project boundary and discharge into natural drainages traversing the project site; both are primarily covered by desert vegetation and will remain so during mine operation.

Subarea 3A has an area of 850 acres and an average watershed slope of 16.7%. At full expansion of the pit, the Subarea 3A channel will need to be routed around the eastern pit boundary.

Subarea 3B has an area of 1,027 acres and an average watershed slope of 24.8%. There is a ridge at the watersheds outlet of Subarea 3B that has the potential to split the channelized flow; most stormwater continues east, where it merges with the natural drainageway within Subarea 4A. However, when the East WRSF is constructed runoff from Subarea 3B will be diverted to the west, where it will discharge to the natural channel in the lower portion of Subarea 3A.

Subarea 3C includes the area that will be the East WRSF. It has an area of 171 acres and average watershed slope of 6.0%. Prior to mine construction, runoff flows from the northwest to the southeast and does not form or enter into any major channels within the watershed. Runoff starts to channelize within Subarea 4B and eventually discharges into Crowley Creek. However, once the East WRSF is operational the runoff will be directed to the respective sediment basin before releasing over time into Subarea 3A. A mine road and stormwater channel is planned between Subareas 3C and 4B, diverting runoff from Subarea 3C to the west, where it will be discharged into the Subarea 3A drainageway.

1.4 Subareas 4 and 5

Subareas 4 and 5 generate runoff that naturally flows through the CTFS area or along its boundary. Subarea 4 is divided into 3 watersheds. Subarea 4A lies north of the CTFS and has an area of 1,875 acres and average watershed slope of 18.7%. Its runoff flows into a natural drainageway that bisects the CTFS from northwest to south. Subarea 4B is the area that will be the ultimate footprint of the CGS; it has an area of 446 acres and an average watershed slope of 6.1%. Its stormwater naturally channelizes on the eastern side of the basin and discharges into the southern drainageway. During mine operation, the stormwater will follow roughly the same drainage pattern, but will be collected into the CTFS perimeter stormwater channel prior to discharge to the drainageway.

Subarea 4C includes the Process Plant area and upstream of the southwestern-most point of the CTFS. The majority of the subarea is downstream (south) of the CGS; however, there is a sliver of watershed that lies between the eastern CGS boundary and the western CTFS boundary. Subarea 4C has an area of 73 acres and average watershed slope of 4.8%.

Subarea 5 is the area which contributes stormwater to the eastern CTFS boundary. It extends to a ridge just north of the project boundary and includes a long sliver of area east of the CTFS. This section of the Quinn River hydrographic basin upstream of the proposed facilities flows to the southeast; the area east of the CTFS in Subarea 5 does not intersect the CTFS stormwater diversion channel along its boundary until the potential future CTFS limits. Subarea 5 has an area of 99 acres and an average watershed slope of 4.81%.

1.5 Process Plant Facility Culvert Watersheds

A separate HEC-HMS model was created to analyze the flow reporting to the culverts under the mine entrance roads, south of the Process Plant Facilities, and generated within the parking lot, located west of the Plant buildings. Two mine entrance roadways – one for reagent trucks and one for general entry – are currently incorporated in the mine plan. These cross the major natural drainageway to which most of the project area drains. The tributary area includes Subareas 2 and 3, which are discussed in sections 1.2 and 1.3 respectively. Subarea 1 drains west and Subarea 4 discharges to the drainageway east of the roadway crossing. Two additional watersheds extending south of SR293 contribute runoff to the entrance road drainage crossings.

Watershed South Drainage 1 (reference figure 007 in Appendix E.2.1) has an area of 3,997 acres, an average watershed slope of 14.1%, and is covered by sparse desert vegetation. It extends from the south mine road, which is the southern boundary of Subareas 1, 2 and 3A, to the ridge that runs approximately 3 miles south of SR 293. Runoff within the watershed will drain to the northeast and enter the existing channel. Eight CMP culverts, ranging in size between 24” and 30” diameter, cross the highway between mile posts 20.7 and 18.3. Watershed South Drainage 2 is located east of South Drainage 1 and south of SR 294. It has an area of 108 acres, and average watershed slope of 3.9%, and also has sparse desert vegetation. It drains to the northeast to the area between the two entrance roadways. The area between the entrance roads and north of SR 293 is the Guard Shack Watershed, as the guard shack will be located directly north of the watershed. It has an area of 18.7 acres and an average watershed slope of 6.5%.

Roads in the Process Plant Facilities area will be designed by others; however, it was assumed for the watershed delineation that stormwater upstream of the Process Plant Facilities parking lot perimeter road would be diverted along a roadside ditch to the main channel. The Parking Lot watershed comprises of the parking lot area only and has an area of 7.8 acres and an average watershed slope of 5%. Runoff flows to the southeast and currently discharges into the existing main channel.

The existing drainageway in the vicinity of the mine entryway crossing has a wide and shallow geometry. It has a channel bottom width of approximately 290 feet and side slopes of approximately 3.5H:1V on the north bank and 15H:1V on the south bank. During the 100-year 24-hour peak flow, the channel flows approximately 2 feet deep.

2.0 SUMMARY OF METHODOLOGY

This stormwater management plan pertains to the planned facility layout and runoff generated during the initial operation, with the exception of the CTFS East and West stormwater diversion channels, which are designed for the ultimate CTFS configuration.

Hydrologic and hydraulic analyses were conducted to determine the flow rates to each of the stormwater facilities, find the required channel and pond capacities, culvert sizing and calculate the riprap and other channel and pond protection requirements.

2.1 Hydrology

HEC-HMS was used to determine the peak flow rates and total runoff volumes from various design storms. Point precipitation estimates were obtained from NOAA precipitation estimates for the Orovada, NV (41.696° latitude, -118.0206° longitude) and were assumed to have an SCS Type 2 design storm distribution. Table 2 shows the point precipitation depths for the storm events included in this design and the facilities for which they were applied.

TABLE 2: POINT PRECIPITATION ESTIMATES

Design Storm	Precipitation	Facility Design
2 year – 24 hour	1.13 inches	Sediment Ponds
25 year – 24 hour	1.96 inches	Sediment Ponds; Culverts
100 year – 24 hour	2.48 inches	Pond Spillways; Stormwater Channels; CTFS Conveyer Corridor Culverts
500 year – 24 hour	3.12 inches	Stormwater Channels

The project site is nearly entirely composed of type D soils and it is assumed for the hydrologic analysis that all natural ground areas are characterized by type D soil with a poor covering of sagebrush and grass (CN=85). All disturbed areas are assumed to have runoff properties of gravel roads in type D soil. A HEC-HMS model was run for both the ultimate facility layout and the intermediate (phase 1) facility layout. Hydrologic assumptions, inputs, and model results for each are located in section Appendix E.2.

2.2 Channel Sizing

FlowMaster was used to determine the required channel depths for the CTFS stormwater diversion channels and the minimum spillway depths of the sediment ponds. These structures were sized to convey the 100 year-24 hour peak flow with one foot of freeboard. The stormwater diversion channels were also sized to convey the 500 year-24 hour peak runoff within the full channel depth for stormwater diversions that will operate into closure (100-year peak flow depth and freeboard).

Riprap was sized according to the procedure established by Hydraulic Engineering Circular No. 15: Design of Roadside Channels with Flexible Linings (USDOT 2005). As riprap requirements were determined, Flowmaster was updated with the HEC-15 manning's roughness coefficient estimate. Channel and riprap sizing calculations are arranged by channel in Appendix E.3. A summary of the channel requirements is included in Appendix E.1.

2.3 Pond Sizing

Sediment ponds were sized to fully contain the runoff volume generated by the 2-year 24-hr storm event and to fully discharge both the 2-year and 25-year events within 48-72 hours through a riser pipe. The vertical riser pipe outlet has perforations along its circumference to allow for a gradual release from the pond until the water surface rises above the top of pipe elevation. Water above this elevation flows through the open end of the pipe (protected by a steel grate). As the ponded water depth increases, the head on the perforations and the orifice increase, yielding greater flow rates through the outlet.

CAD-generated sediment pond filling curves are included in Appendix E.3.8. Appendix E.3.9 contains the riser pipe sizing calculations and results. Each pond was sizing by inputting the HEC-HMS inflow hydrograph, the pond filling curve, and the riser pipe elevation-discharge curve into an iterative pond balance that calculated the resulting maximum water surface elevation and drain time. The riser pipe height and perforation schedule, or the pond dimensions were modified as necessary to fulfill the design requirements.

2.4 Culvert Sizing

Culverts, including those at road and conveyor crossings across the CTFS West channel and the sediment pond riser pipe outlets, were sized using CulvertMaster. Pipe end elevations, lengths, slopes, and available headwater depths were obtained from CAD-generated cross sections. The CTFS stormwater culverts were sized to convey the 100 year-24 hour peak runoff, as the conveyor corridors and lithium process area are critical areas. Sediment pond pipe outlets were verified to have a minimum capacity of the riser pipe peak inflow.

The entrance road (guard shack) culverts are sized to convey the 25 year – 24 hour peak runoff. Runoff from larger storms may overtop roadways but will flow away from the process facilities. The culverts were also sized using CulvertMaster. These were assumed to have invert elevations matching the existing ground and a minimum roadway cover of 4 feet above the tops of the pipe. It was assumed that stormwater generated south the SR 293 will be conveyed along the roadway and will not contribute to the process plant stormwater.

2.5 Stormwater Controls By Others

The Mine Shop, ROM stockpile, growth media stockpile, haul road diversions, associated culverts and sediment basins were performed by North American Coal. The supporting calculations reviewed and approved by NewFields are included within this Appendix. The associated drawings to support the design elements may be found in the Issued for Construction Drawings included with the Engineering Design Report. These documents follow the same approach, standards, and design criteria for sizing as NewFields performed for the other stormwater controls discussed within this calculation brief.

3.0 STORMWATER FACILITIES

3.1 Clay Tailings Filter Stack (CTFS) Stormwater Diversion Channel

The analysis and design of the CTFS diversion channel was broken out by project phase (initial and ultimate), and by diversion path along the facility (west and east/north). The downstream portion of the West CTFS diversion channel will be built to the ultimate facility requirement. It will be extended to the north along the facility boundary when the CTFS is expanded to its ultimate footprint. The North CTFS channel follows the north initial facility boundary and will be covered during construction of the ultimate facility. The East CTFS stormwater channel will be built when the facility is expanded to its ultimate layout.

3.1.1 West CTFS Channel

The West CTFS channel is designed for the 100yr-24hr peak flow rate from the ultimate facility tributary watershed (2320 ac). The West channel is adjacent to and follows the stationing of the CTFS perimeter haul road between sta. 96+00 and sta. 179+35. Downstream of 96+00, the channel continues south and discharges into the Quinn River. This section of channel is referred to as the CTFS West Outlet channel in the design. During the initial construction, the CTFS west diversion channel upstream of the CTFS West Outlet channel will only be built from station 96+00 to 105+00 (sta. 69+85 to 80+40 of the initial perimeter haul road alignment) and will have a tributary area of 107 ac. The 100-year 24-hour peak flow rate to the downstream channel, including discharge from the CGS sediment pond, is 468 cfs during the initial project phase and 1,348 cfs during at its ultimate construction.

The minimum channel depth is 6 feet from the top of riprap to the top of channel and includes a foot of freeboard above the 100yr-24hr peak flow rate. The freeboard provides additional channel capacity for the 500yr-24hr peak flow rate. The CTFS West Outlet channel is intersected by the haul road intersection at sta.27+50, the tailings conveyor crossing at sta. 19+35, and the salt conveyor corridor at sta. 14+30. CMP culverts will be installed under the crossings at these locations. To convey the 100-year peak flow, five (5) 60-inch culverts are required under the haul road crossing and six (6) 60-inch culverts are required under each of the conveyor corridors. Reference Appendix E.3.3 for the channel and riprap sizing supporting calculations.

3.1.2 North CTFS Channel

The North CTFS channel is temporary and will be covered by the ultimate CTFS facility. It flows adjacent to the initial CTFS northern boundary and discharges on the facility's east side into a natural drainageway. Although the West CTFS channel will be built with the capacity to convey the ultimate facility peak stormwater flows, the majority of the CTFS west tributary area (2213 ac) will contribute to the North CTFS channel during the initial project phase. The North CTFS channel will also receive the runoff from watershed Subarea 3B (1027 ac) until the East WRSF is constructed to its ultimate arrangement.

At its discharge point, the peak discharge is 13,339 cfs during the 100yr-24hr storm event. This peak flow takes into account upstream channel losses from the natural drainageway adjacent to the northern East WRSF boundary and from the initial 1400 feet of the North CTFS channel.

Because it traverses CTFS roughly perpendicular to the natural drainage path, the longitudinal slope is mild in comparison with the West CTFS channel. Nevertheless, due to the high flow rate, an 80 foot bottom width is required to avoid the use of riprap in the majority of the channel. At station 44+00 the channel steepens and riprap is required from this point to the outlet. Reference Appendix E.3.1 for the channel and riprap sizing supporting calculations.

3.1.3 East CTFS Channel

The East CTFS channel will be constructed during the ultimate phase of the CTFS facility. It receives stormwater from Subarea 5, which generates a peak flow rate of 137 cfs during the 100yr-24hr storm event. The channel has a bottom width of 12 feet and minimum required depth of 3.3 feet, including a foot of freeboard. Reference Appendix E.3.2 for the channel and riprap sizing supporting calculations.

3.2 Process Plant Sediment Pond

The Process Plant Sediment Pond is located east of the Lithium process plant facilities and west of the CTFS. It straddles a natural drainageway and utilizes the natural slope for detention. The pond design consists of an earthen embankment across the gully, excavation of the spillway channel, and the installment of the riser pipe outlet and protection. The pond has a small tributary area (approximately 73 acres), and has a 25-year 24-hr peak inflow rate of 76 cfs and 2-year 24-hr total runoff volume of 2.7 ac-ft.

Table 3 summarizes the critical pond volumes and elevations. A 24-inch diameter riser pipe with a perforation height of 4.5 feet is required. The downstream outlet will be protected by D50 =

12” riprap. At maximum pond capacity, the riser pipe as a peak discharge of 30 cfs. Provided optimum operating conditions, the 2-year storm will be fully discharged from the pond in approximately 55 hours and the 25-year storm will be fully discharged in 58.5 hours.

3.3 Coarse Gangue Stockpile (CGS) Sediment Pond

The CGS Sediment Pond is located southeast of the CGS facility, south of the haul road. Stormwater from the CGS will be diverted around the stockpile and though a culvert under the road and into the sediment pond. Stormwater from between the process plant area and the CGS facility will be collected in a diversion ditch and will enter the pond from the northwest. The pond embankment will be protected by riprap at both of these main inflow areas. The riser pipe is located at the southeast corner of the pond and the spillway is placed along the eastern pond embankment. Rip-rap protected channels will convey outflow from the riser pipe outlet and the spillway into the CTFS West Outlet channel, at approximately station 25+00. The 25-year peak inflow rate to the pond is 255.4 cfs and the 2-year 24-hr total runoff volume is 16.8 ac-ft.

See Table 3 for critical pond volumes and elevations. A 42-inch diameter pipe is required for the riser pipe, with a perforation height of 6 feet. At the maximum pond capacity, the riser pipe will have a peak discharge of 136.9 cfs. Given optimum operating conditions, the 2-year and 25-year storms will be fully discharged from the pond in approximately 58.3 hours and 64.8 hours, respectively.

3.4 East Waste Rock Storage Facility (East WRSF) Sediment Pond

The East WRSF Sediment Pond is located at the southwestern corner of the East WRSF facility, north of the haul road intersection. As the natural drainage tends to go uniformly southeast, fill will be placed as necessary to divert runoff from the facility into the pond. Stormwater from the north will be diverted along a constructed berm and into the pond. Riprap will be used to protect the pond embankment at the two main inflow locations, at the northwest and southeast corners of the pond. The riser pipe is located in the southwest corner of the sediment pond. The outlet pipe from the riser will be extended under the haul road intersection and will discharge to the Subarea 3A drainageway. The 25-year 24-hr storm will generative a peak flow of 92 cfs to the pond, and the 2-year 24-hr storm will have a total volume of 6.4 ac-ft reporting to the pond.

Table 3 summarizes the critical pond volumes and elevations. A 36-inch diameter riser pipe with a perforation height of 2 feet is required. At the maximum pond capacity, the riser pipe will have a peak discharge of approximately 77 cfs. Given optimum operating conditions, the 2-year 24-hr storm will have a drain time of approximately 60.3 hours. The 25-year 24-hr storm will have a drain time of approximately 63.3 hours.

3.5 West Waste Rock Storage Facility (West WRSF) Sediment Pond

Runoff generated within the West WRSF by storms equivalent to or smaller than the 100yr-24hr event (30.4 ac-ft) will be contained within the West WRSF sediment basin retention pond. This pond does not have an outlet and will thus need to be pumped after each storm event to ensure adequate capacity during subsequent storms. The pond spillway is designed to convey the 500-year 24-hour peak runoff rate with 1 foot of freeboard. Discharge from the spillway will flow into a natural drainageway to the west of the facility.

TABLE 3: SUMMARY OF SEDIMENT POND CRITICAL ELEVATIONS AND VOLUMES

	Process Plant Sediment Pond	CGS Sediment Pond	East WRSF Sediment Pond	West WRSF Sediment Pond
Sediment Storage	4675.0 ft (34 CY)	4733.0 ft (4,953 CY)	5001.5 ft (2,023 CY)	4702.0 ft (6,550 CY)
Top of Riser Pipe	4679.5 ft (0.6 Mgal)	4739.0 ft (3.64 Mgal)	5003.5 ft (0.95 Mgal)	not applicable
Spillway	4681.0 ft (1.32 Mgal)	4742 ft (5.83 Mgal)	5005.5 ft (1.99 Mgal)	4709.0 ft (10.1 Mgal)
Pond Crest	4683.0 ft (3.08 Mgal)	4745.0 ft (8.29 Mgal)	5008.0 ft (3.40 Mgal)	4712.0 ft (15.1 Mgal)

3.6 Process Plant Facility Culverts

The stormwater design plan includes four culvert sites within the Process Plant Facility and entry way areas. Stormwater generated within the parking lot will have a 25-year 24-hr peak flow of 10 cfs. AN 18-inch diameter CMP culvert will convey stormwater from the northern half of the parking lot to a constructed channel along the southern boundary of the process plant facilities and into the Process Plant Sediment Pond for sediment settling and slow release. The southern half of the parking lot will drain to the southeast corner of the lot, where a 12-inch CMP culvert will allow the stormwater to exit the lot and discharge into the existing drainageway.

In the 25-year 24-hour storm, a peak flow of 1,882 cfs will report the reagent truck entrance road at the channel crossing. A peak flow of 1,914 cfs will report to the eastern entry road where it crosses the drainageway. Six (6) 60” diameter CMP culverts are required at each crossing and both culvert crossings are outlet-controlled and require and a roadway embankment height of approximately 18 feet. Because the existing drainageway is very wide in this area, adequate spacing of the culverts will be available without additional fill or cut into the drainageway.

4.0 REFERENCES

Bentley Systems (2009). Bentley FlowMaster (V8i-SLELECTseries 1) [Software]. Available from http://www.bentley.com

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APPENDIX E.1

Channel and Culvert Design Summary

Lithium Nevada Corporation
Thacker Pass Project
Project Site Stormwater Facilities
Flow Summary and Channel Design

Design Element			Percent of Watershed Area Contributing	Slope (ft/ft)	Riprap Design Flow 100yr, 24h (cfs)	500yr, 24hr Flow at Closure (cfs)	Erosion Protection (D_{50}, in)	Roughness Coefficient	Channel Width (ft)	Channel Side Slopes (X:1)	Velocity (ft/s)	Froude Number	100yr Flow Depth (ft)	500yr Flow Depth (ft)	Design Depth Including Freeboard (ft)	Notes
Phase 1																
Subarea 6	**Description**				**295**	**403.2**										
West WRSF East Diversion	Typical		20.8%	0.22	61.40	83.92		0.035	2	3.5-21.7	9.91	2.94	0.54	0.64	2	
West WRSF South Diversion	Typical		65.8%	0.045	194.1	265.27	9	0.035	1	2.5 -19	3.90	0.72	1.48	2.24	3	
West WRSF West Natural Diversion	Typical		34.2%	0.11	100.9	137.93		0.035	1	3.5-7	12.05	2.66	1.02	1.19	3	
Subarea 3C					**130**	**178.1**										
East WRSF East Natural Diversion	Minimum		29.4%	0.055	38.16	52.28		0.035	2	2.5-6	10.54	3.33	0.48	0.55	2	
East WRSF South Diversion	Typical		67.9%	0.005	88.2	120.90		0.035	1	200-1000	1.08	0.41	0.38	0.43	2	
East WRSF West Natural Diversion	Minimum		32.1%	0.04	41.8	57.20		0.035	1	2.5-40	4.49	1.27	0.66	0.75	2	
Subarea 4B					**361**	**493.3**										
CGS East Natural Diversion	Minimum		39.4%	0.033	142.16	194.26		0.035	1	3.5-40	5.64	1.25	1.1	1.24	3	
CGS South Natural Diversion	Minimum		60.3%	0.015	217.8	297.63		0.035	1	2.5-25	5.23	0.91	1.77	2	3	
CGS West Natural Diversion	Minimum		26.4%	0.042	95.2	130.06		0.035	2	2.5-1000	2.56	1.13	0.28	0.32	2	
Subarea 3B & CTFS North Subareas A & B	**Stationing**				**1344.3**											
Phase 1 CTFS North Channel	0+00	14+00	41%	0.01	540.7			0.035	80	2.5	4.93	0.77	1.31	NA	2.5	Accounts for channel loss in Reach-1 and CTFS North Channel A
Phase 1 CTFS North Channel	14+00	44+00	100%	0.01	1344.3			0.035	80	2.5	6.95	0.84	2.25	NA	3.5	
Phase 1 CTFS North Channel	44+00	55+91	100%	0.015	1344.3		6	0.052	80	2.5	7.89	1.01	2.0	NA	3	
Subareas 4B and 4C	**Stationing**															
Phase 1 CTFS West Channel Outlet	0+00	13+75	100.0%	0.04	468.1		9	0.067	30	2.5	6.69	0.86	2.18	NA	4	
Phase 1 CTFS West Channel Outlet	13+75	20+40	94.7%	0.01	407.1		4	0.046	30	2.5	5.09	0.63	2.35	NA	4	
Phase 1 CTFS West Channel Outlet	20+40	25+00	91.9%	0.084	392.1		12	0.057	30	2.5	8.73	1.37	1.4	NA	3	
Phase 1 CTFS West Channel Outlet	25+00	27+00	42.6%	0.084	45.6		6	0.065	30	2.5	3.57	1	0.41	NA	2	
Phase 1 CTFS West Channel Outlet	27+00	28+00	27.9%	0.053	29.9		4	0.082	30	2.5	2.29	0.63	0.42	NA	2	
Phase 1 CTFS West Channel	71+35	80+40	27.9%	0.006	29.9			0.032	30	2.5	2.08	0.55	0.5	NA	2	

Lithium Nevada Corporation
Thacker Pass Project
Project Site Stormwater Facilities
Flow Summary and Channel Design

Design Element			Percent of Watershed Area Contributing	Slope (ft/ft)	Riprap Design Flow 100yr, 24h (cfs)	500yr, 24hr Flow at Closure (cfs)	Erosion Protection (D_{50}, in)	Roughness Coefficient	Channel Width (ft)	Channel Side Slopes (X:1)	Velocity (ft/s)	Froude Number	100yr Flow Depth (ft)	500yr Flow Depth (ft)	Design Depth Including Freeboard (ft)	Notes
Ultimate																
Subareas 4A, 4B and 4C	**Stationing**															
Phase 1 CTFS West Channel Outlet	0+00	13+75	100.0%	0.04	1348.0	1937.7	12	0.066	30	2.5	9.28	0.94	3.78	4.61	5	
Phase 1 CTFS West Channel Outlet	13+75	20+40	42.3%	0.01	1286.2	1853.7	9	0.055	30	2.5	6.37	0.58	4.82	5.87	6	
Phase 1 CTFS West Channel Outlet	20+40	25+00	27.8%	0.084	1270.7	1832.6	24	0.068	30	2.5	11.41	1.28	2.97	3.65	4	
Phase 1 CTFS West Channel Outlet	25+00	27+00	27.8%	0.084	909.7	1339.3	EX	0.091	30	2.5	8.41	0.95	2.90	3.60	4	
Phase 1 CTFS West Channel Outlet	27+00	28+00	20.8%	0.053	902.2	1329.0	12	0.072	30	2.5	8.40	0.95	2.87	3.57	4	
Phase 1 CTFS West Channel	96+00	106+00	18.7%	0.006	900.0	1326.0	4	0.043	30	2.5	5.66	0.56	3.96	4.89	5	
Phase 1 CTFS West Channel	106+00	112+73	14.1%	0.042	895.0	1319.3	12	0.070	30	2.5	7.88	0.88	3.00	3.73	4	
Phase 1 CTFS West Channel	112+73	116+00	9.2%	0.022	889.7	1312.1	9	0.060	30	2.5	7.00	0.75	3.28	4.08	5	
Phase 1 CTFS West Channel	116+00	123+50	7.5%	0.042	887.9	1309.6	12	0.070	30	2.5	7.85	0.88	2.98	3.71	4	
Phase 1 CTFS West Channel	123+50	126+00	0.0%	0.042	879.9	1298.7	12	0.070	30	2.5	7.82	0.88	3.34	3.68	5	
Phase 1 CTFS West Channel	126+00	132+65	99.7%	0.02	877.2	1294.8	9	0.060	30	2.5	6.74	0.72	3.34	4.15	5.00	
Phase 1 CTFS West Channel	132+65	167+50	82.6%	0.011	727.2	1073.3	6	0.051	30	2.5	5.82	0.62	3.27	4.07	5	
Phase 1 CTFS West Channel	167+50	179+35	3.9%	0.014	34.2	50.5		0.041	30	2.5	2.45	0.66	0.45	0.57	2	
Subarea 5																
CTFS East Diversion	Min Slope		100%	0.027	136.8	200.6	9	0.073	12	2.5	4.26	0.62	1.91	2.35	3	
CTFS East Diversion	Max Slope		100%	0.040	136.8	200.6	9	0.076	12	2.5	4.75	0.71	1.76	2.16	3	

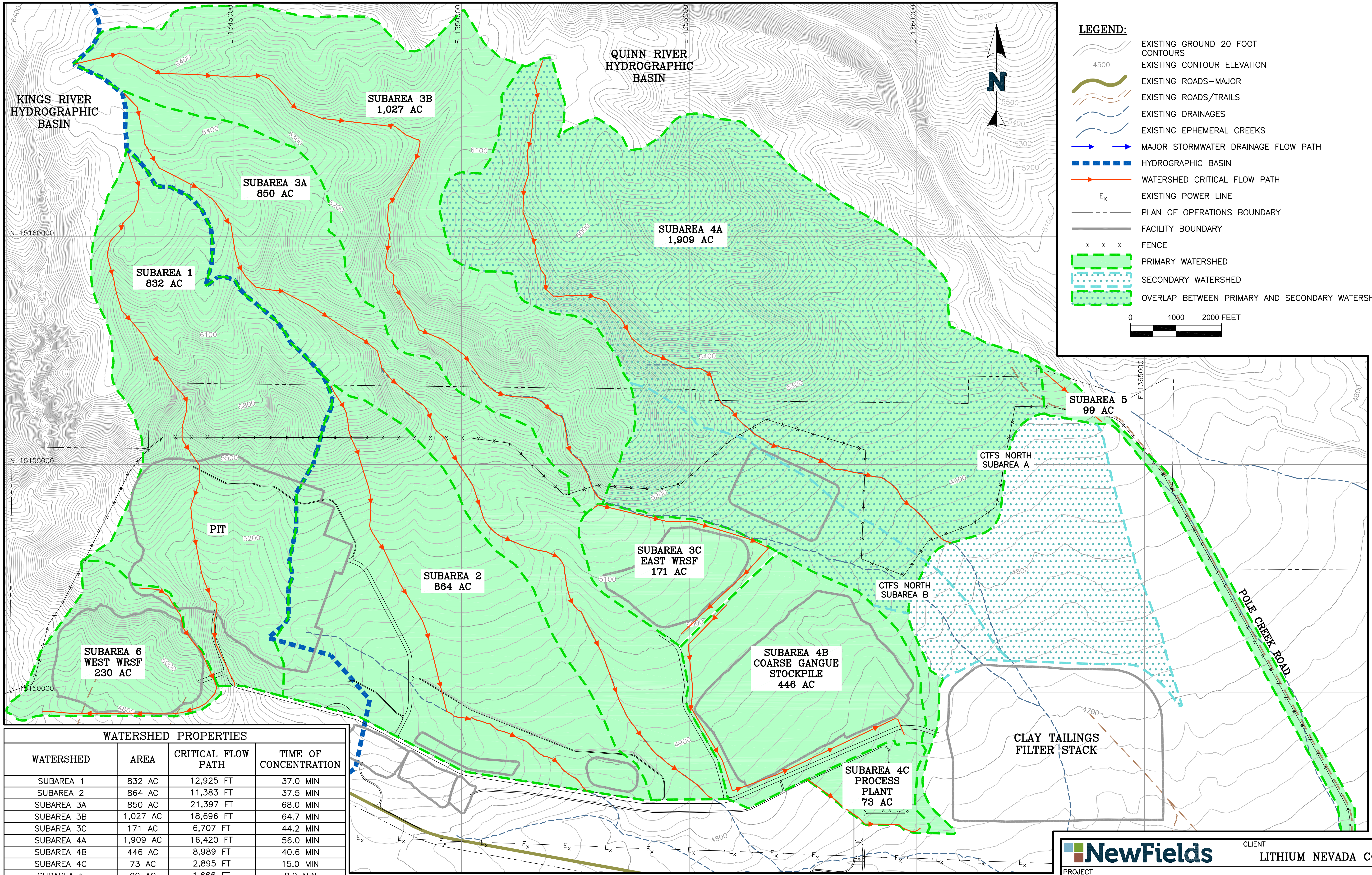
Lithium Nevada Corporation
Thacker Pass Project
Phase 1 and Ultimate Project Site Stormwater Facilities
CMP Flow Summary and Culvert Design

CULVERTS	Slope (ft/ft)	Design Flow 100yr, 24h (cfs)	Number of Culverts	Pipe Inner Dia. (in)	Roughness Coefficient	Velocity (ft/s)	100yr Flow Depth (ft)	Design Depth Including Freeboard (ft)	Headwater Depth (ft)
CTFS Culverts - Ultimate Facility (Built in Phase									
HAUL ROAD FROM CGS									
	0.055	1,194	5	60	0.024	18.27	3.12	4.1	10.6
SALT CONVEYOR CORRIDOR									
	0.011	1,194	6	60	0.024	11.65	4.00	5.0	8.4
TAILINGS CONVEYOR CORRIDOR									
	0.010	1,194	6	60	0.024	11.65	4.00	5.0	8.4
CGS Inlet Culverts - Phase 1 Facilit									
HAUL ROAD FROM CGS									
	0.015	346	2	54	0.024	12.35	3.89	4.9	9.1
Process Plant Facility Culverts (25yr-24hr Design Storn									
PARKING LOT CULVERT									
Total Flow	0.059	10	1	18	0.024	8.56	0.94	1.9	2.5
North	0.010	6.9	1	18	0.024	5.41	1.02	2.0	1.9
South	0.073	3.1	1	12	0.024	6.93	0.55	1.6	1.5
ENTRANCE ROAD CULVERTS									
**25-YR 24-HR FLOW RATE*	0.010	1,914	7	60	0.024	14.56	4.55	5.6	13.3

APPENDIX E.2

Hydrology

E.2.1 WATERSHED FIGURES



WATERSHED PROPERTIES

WATERSHED	AREA	CRITICAL FLOW PATH	TIME OF CONCENTRATION
SUBAREA 1	832 AC	12,925 FT	37.0 MIN
SUBAREA 2	864 AC	11,383 FT	37.5 MIN
SUBAREA 3A	850 AC	21,397 FT	68.0 MIN
SUBAREA 3B	1,027 AC	18,696 FT	64.7 MIN
SUBAREA 3C	171 AC	6,707 FT	44.2 MIN
SUBAREA 4A	1,909 AC	16,420 FT	56.0 MIN
SUBAREA 4B	446 AC	8,989 FT	40.6 MIN
SUBAREA 4C	73 AC	2,895 FT	15.0 MIN
SUBAREA 5	99 AC	1,666 FT	8.2 MIN
SUBAREA 6	230 AC	7,052 FT	20.7 MIN
CTFS NORTH SUBAREA A	1991 AC	19,409 FT	66.7 MIN
CTFS NORTH SUBAREA B	369 AC	9,275 AC	44.4 MIN

NewFields

CLIENT
LITHIUM NEVADA CORP.

PROJECT
THACKER PASS PROJECT

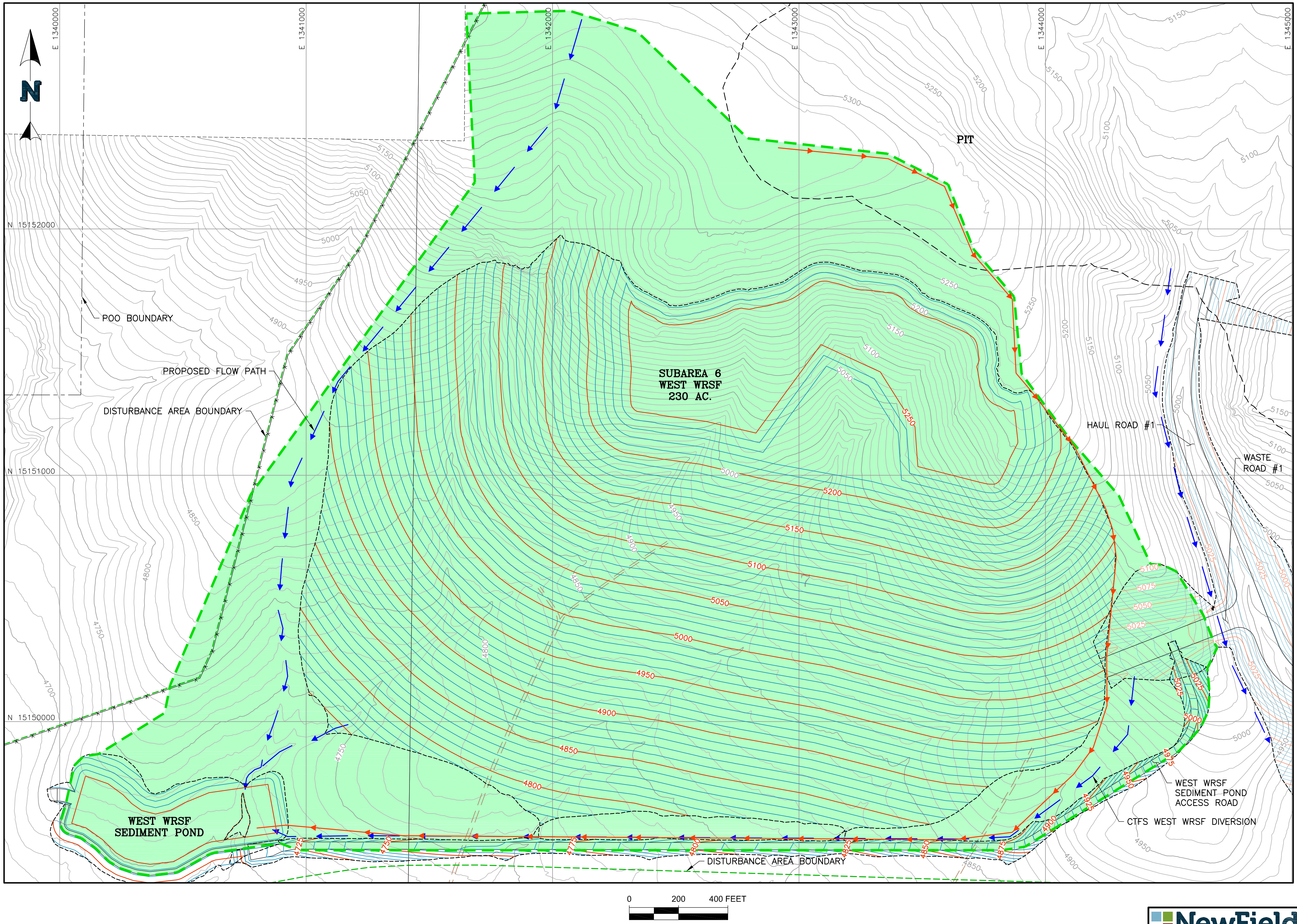
TITLE
WATERSHEDS UPGRADIENT FROM THE FACILITIES

FILENAME
0385.000.073F

FIGURE NO.
000

REVISION
B

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\A-CAD\FIG\0385.000.073F.dwg-2/26/2020 11:50 AM



LEGEND:

- EXISTING 10 FT GROUND CONTOURS
- 4500 EXISTING CONTOUR ELEVATION
- 10 FT GROUND CONTOURS
- 4500 CONTOUR ELEVATION
- SURFACE DAYLIGHT
- EXISTING ROADS
- DISTURBANCE AREA BOUNDARY
- POO BOUNDARY
- RANGE/TOWNSHIP LINE
- FENCE
- CULVERT (BY OTHERS)
- MAJOR STORMWATER DRAINAGE FLOW PATH
- 🟩 WATERSHED
- WATERSHED CRITICAL FLOW PATH

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.

NewFields

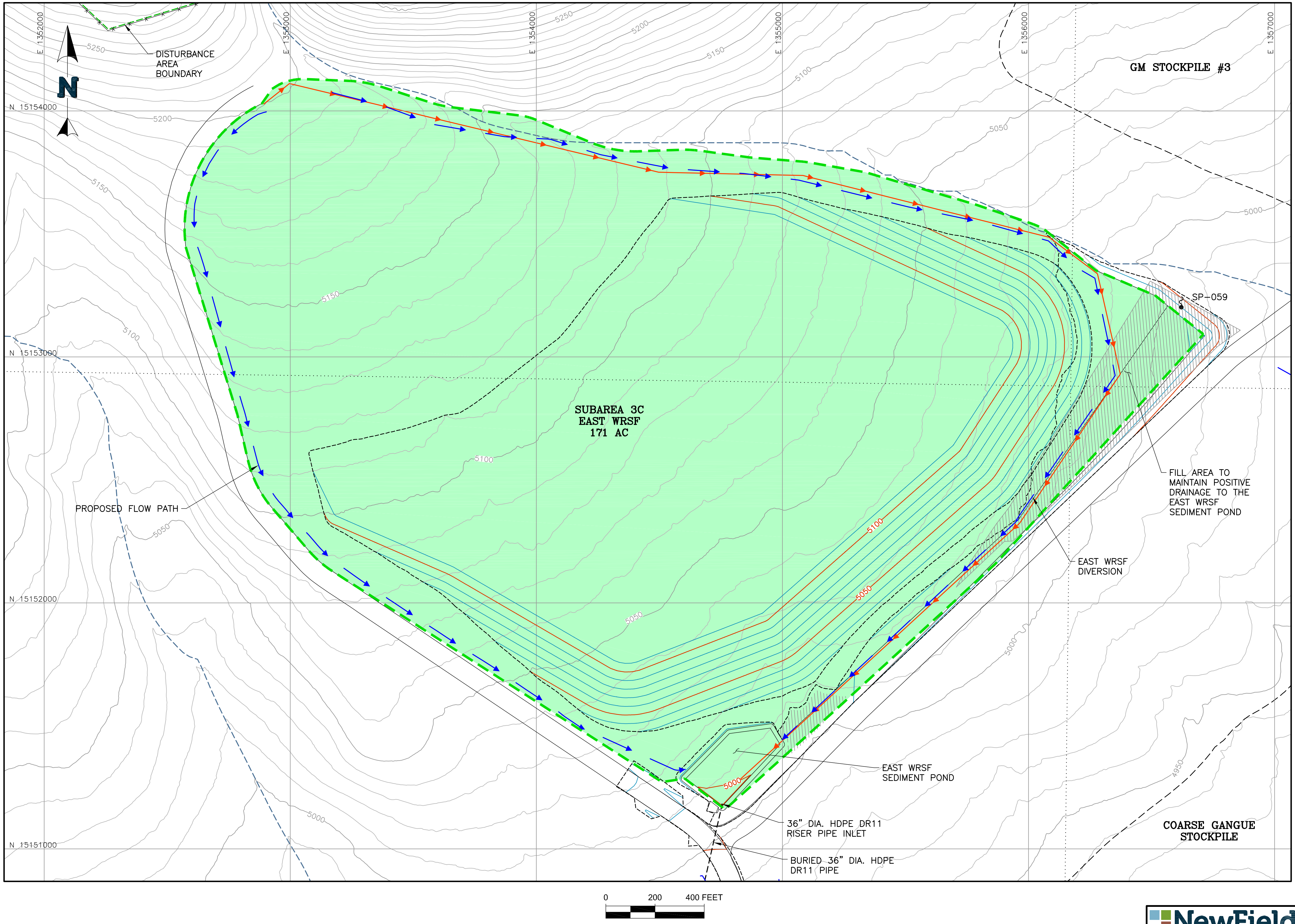
CLIENT
LITHIUM NEVADA CORP.

PROJECT
THACKER PASS PROJECT

TITLE
WEST WRSF SEDIMENT POND WATERSHED

FILENAME	
0385.000.065F	
FIGURE NO.	REVISION
001	B

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\A-CAD\FIG\0385.000.065F.dwg-2/27/2020 4:10 PM



LEGEND:

〰	EXISTING 10 FT GROUND CONTOURS
4500	EXISTING CONTOUR ELEVATION
〰	EXISTING DRAINAGES
〰	10 FT GROUND CONTOURS
4500	CONTOUR ELEVATION
〰	SURFACE DAYLIGHT
- - -	DISTURBANCE AREA BOUNDARY
······	SECTION LINES
—×—×—	FENCE
≻——≺	CULVERT (BY OTHERS)
⌇	EXISTING SPRING/SEEP
→ →	MAJOR STORMWATER DRAINAGE FLOW PATH
🟩	WATERSHED
→	WATERSHED CRITICAL FLOW PATH

NOTE:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\A-CAD\FIG\0385.000.066F.dwg-2/26/2020 9:08 AM

NewFields	CLIENT LITHIUM NEVADA CORP.		
PROJECT THACKER PASS PROJECT			
TITLE EAST WRSF SEDIMENT POND WATERSHED	FILENAME 0385.000.066F	FIGURE NO. 002	REVISION B

LEGEND:

EXISTING 10 FT GROUND CONTOURS
4500 EXISTING CONTOUR ELEVATION
10 FT GROUND CONTOURS
4500 CONTOUR ELEVATION
SURFACE DAYLIGHT
EXISTING DRAINAGES
DISTURBANCE AREA BOUNDARY
FENCE
SECTION LINES
20 SECTION NUMBER
MAJOR STORMWATER DRAINAGE FLOW PATH
CULVERT
🟩 WATERSHED
WATERSHED CRITICAL FLOW PATH

NOTE:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\A-CAD\FIG\0385.000.067F.dwg-2/25/2020 3:04 PM

NewFields

CLIENT
LITHIUM NEVADA CORP.

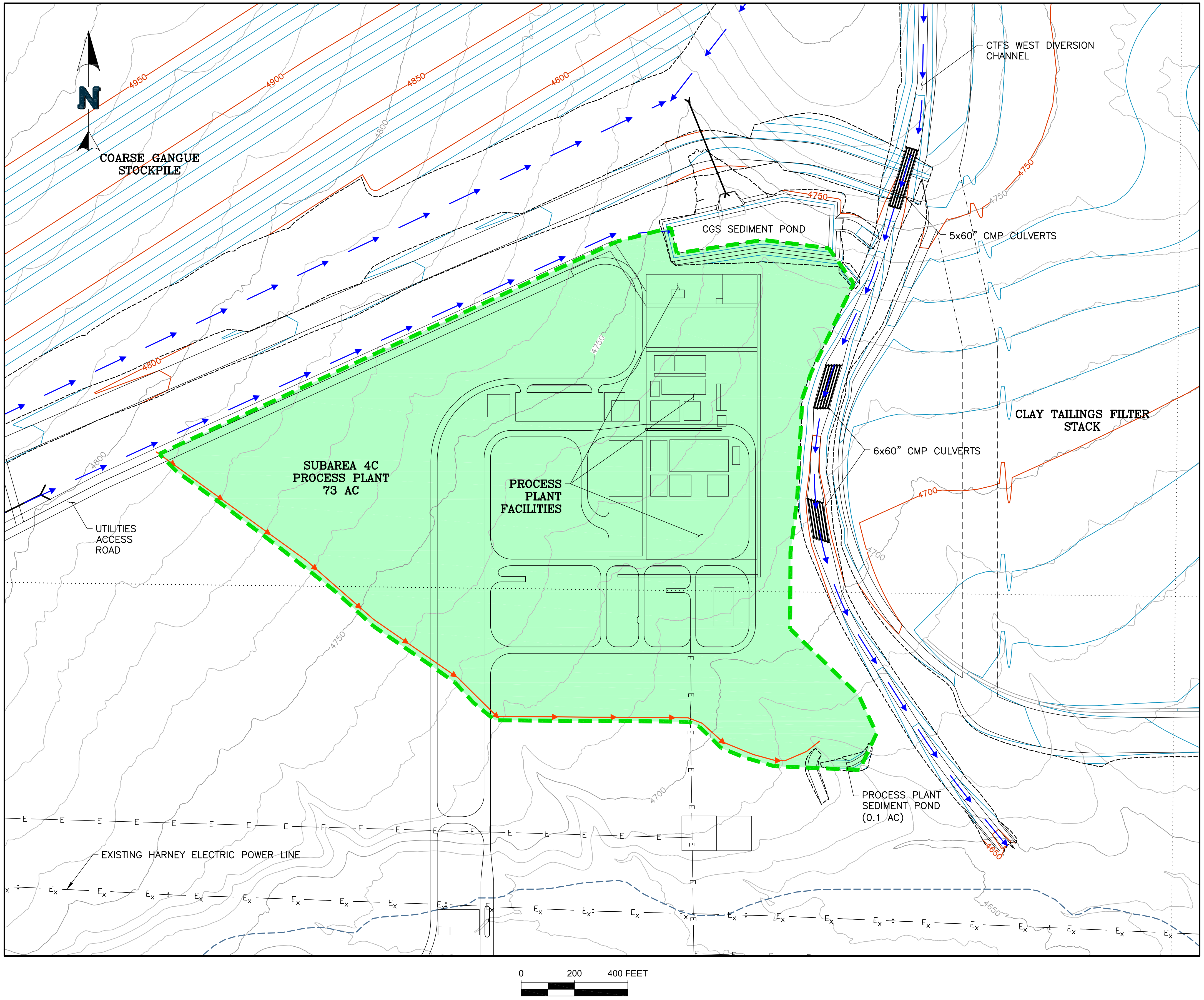
PROJECT
THACKER PASS PROJECT

TITLE
CGS SEDIMENT POND WATERSHED

FILENAME
0385.000.067F

FIGURE NO.
003

REVISION
B



LEGEND:

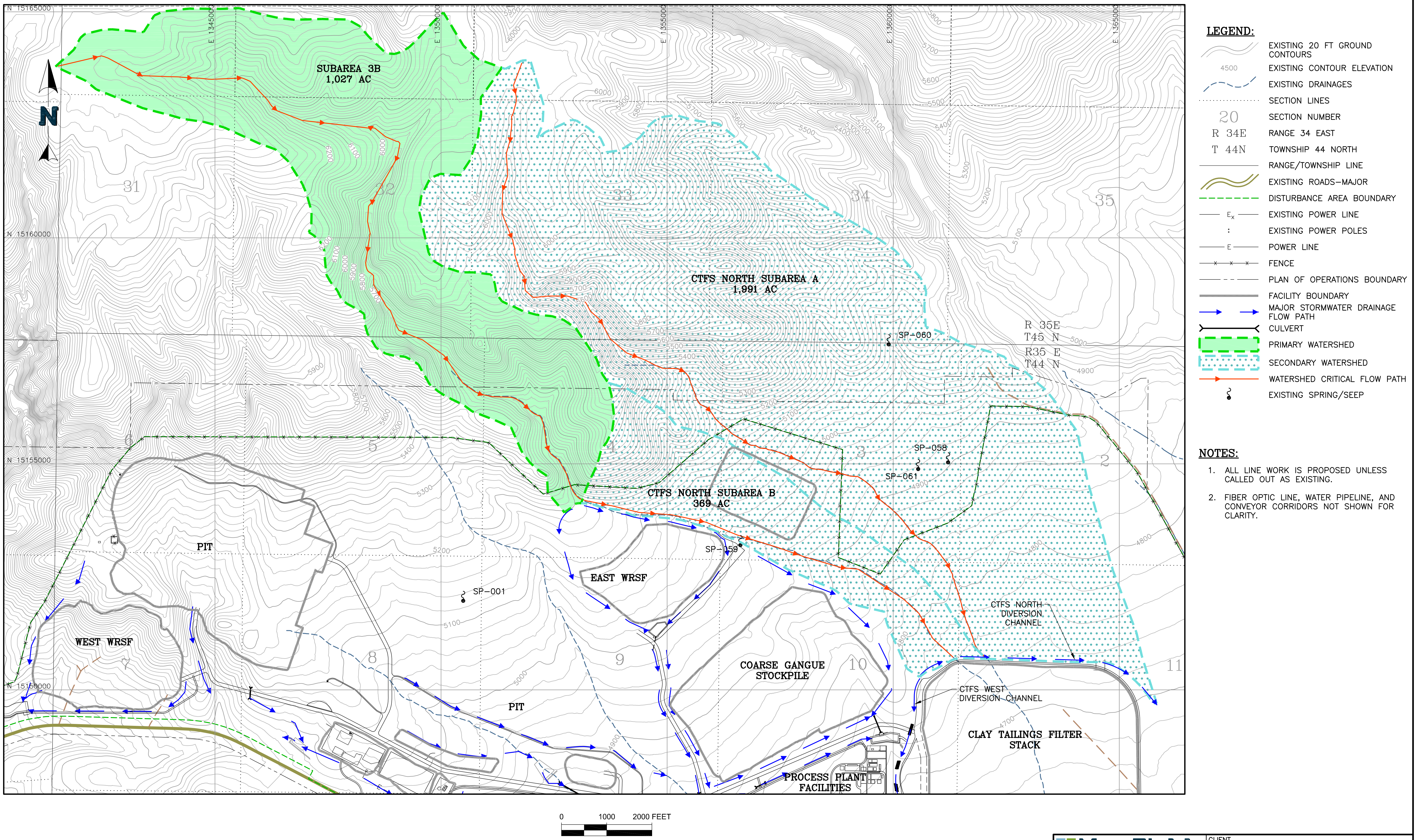
- EXISTING 10 FT GROUND CONTOURS
- 4500 EXISTING CONTOUR ELEVATION
- 10 FT GROUND CONTOURS
- 4500 CONTOUR ELEVATION
- SURFACE DAYLIGHT
- SECTION LINES
- EXISTING DRAINAGES
- —E— POWER LINE
- —x—x—x— FENCE
- → → MAJOR STORMWATER DRAINAGE FLOW PATH
- CULVERT
- 🟩 WATERSHED
- → WATERSHED CRITICAL FLOW PATH

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. FIBER OPTIC LINE, WATER PIPELINE, AND CONVEYOR CORRIDORS NOT SHOWN FOR CLARITY.
3. ACTUAL WATERSHED AREA MAY VARY DEPENDING ON FINAL PLANT SITE GRADING.

NewFields
CLIENT
LITHIUM NEVADA CORP.
PROJECT
THACKER PASS PROJECT
TITLE
PROCESS PLANT SEDIMENT POND WATERSHED
FILENAME
0385.000.068F
FIGURE NO.
004
REVISION
A

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\A-CAD\FIG\0385.000.068F.dwg-2/26/2020 11:29 AM



NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. FIBER OPTIC LINE, WATER PIPELINE, AND CONVEYOR CORRIDORS NOT SHOWN FOR CLARITY.

NewFields

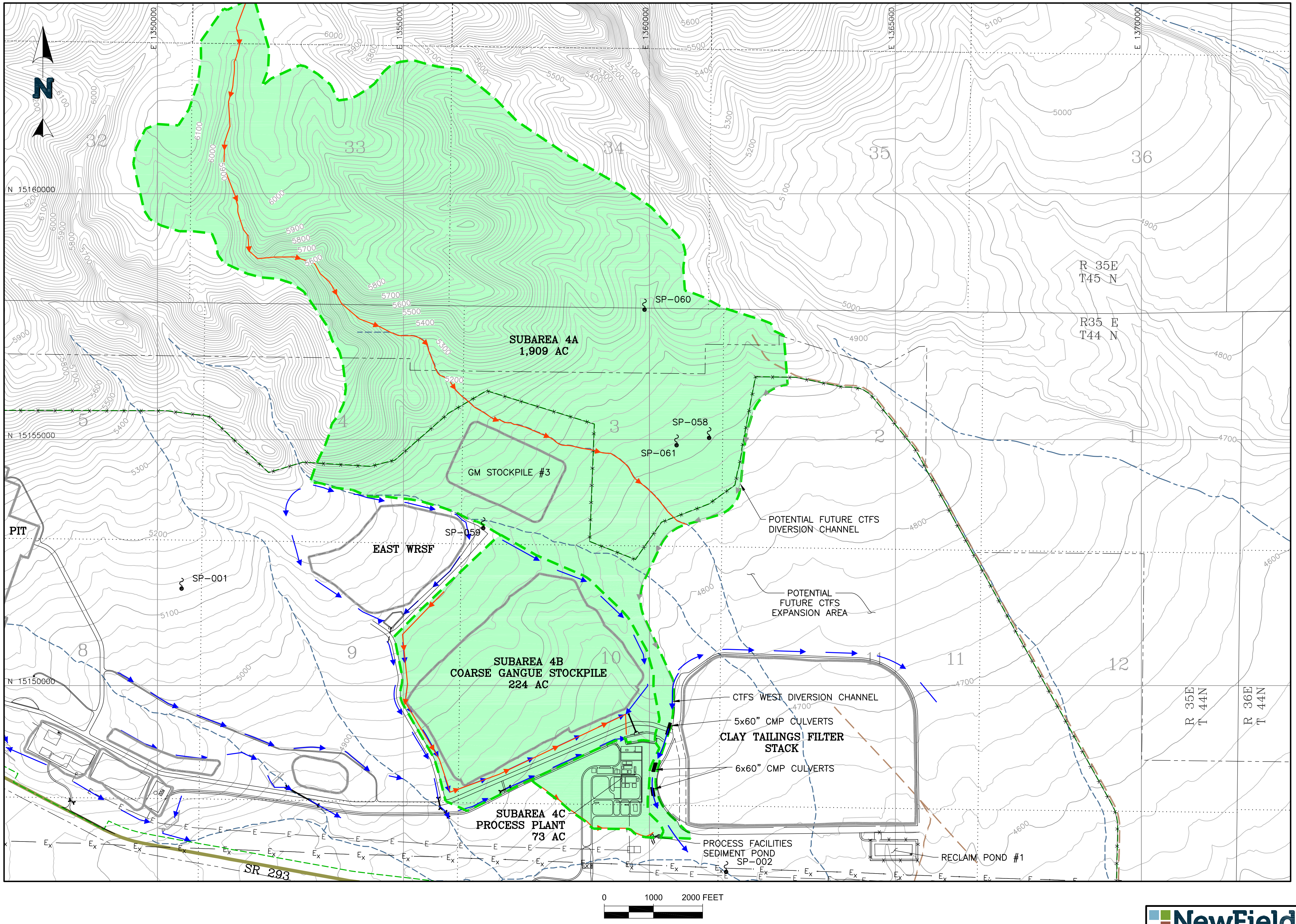
CLIENT
LITHIUM NEVADA CORP.

PROJECT
THACKER PASS PROJECT

TITLE
CTFS NORTH STORMWATER DIVERSION
CHANNEL WATERSHED

FILENAME	
0385.000.070F	
FIGURE NO.	REVISION
005	B

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\A-CAD\FIG\0385.000.070F.dwg-2/26/2020 9:02 AM



LEGEND:

	EXISTING 10 FT GROUND CONTOURS
4500	EXISTING CONTOUR ELEVATION
	SURFACE DAYLIGHT
	EXISTING DRAINAGES
	SECTION LINES
20	SECTION NUMBER
R 34E	RANGE 34 EAST
T 44N	TOWNSHIP 44 NORTH
	EXISTING ROADS–MAJOR
	DISTURBANCE AREA BOUNDARY
E_x	EXISTING POWER LINE
:	EXISTING POWER POLES
E	POWER LINE
× × ×	FENCE
	PLAN OF OPERATIONS BOUNDARY
	FACILITY BOUNDARY
→ →	MAJOR STORMWATER DRAINAGE FLOW PATH
→ →	FUTURE STORMWATER DRAINAGE FLOW PATH
	CULVERT
🟩	WATERSHED
→	WATERSHED CRITICAL FLOW PATH
	EXISTING SPRING/SEEP

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. FIBER OPTIC LINE, WATER PIPELINE, AND CONVEYOR CORRIDORS NOT SHOWN FOR CLARITY.

NewFields

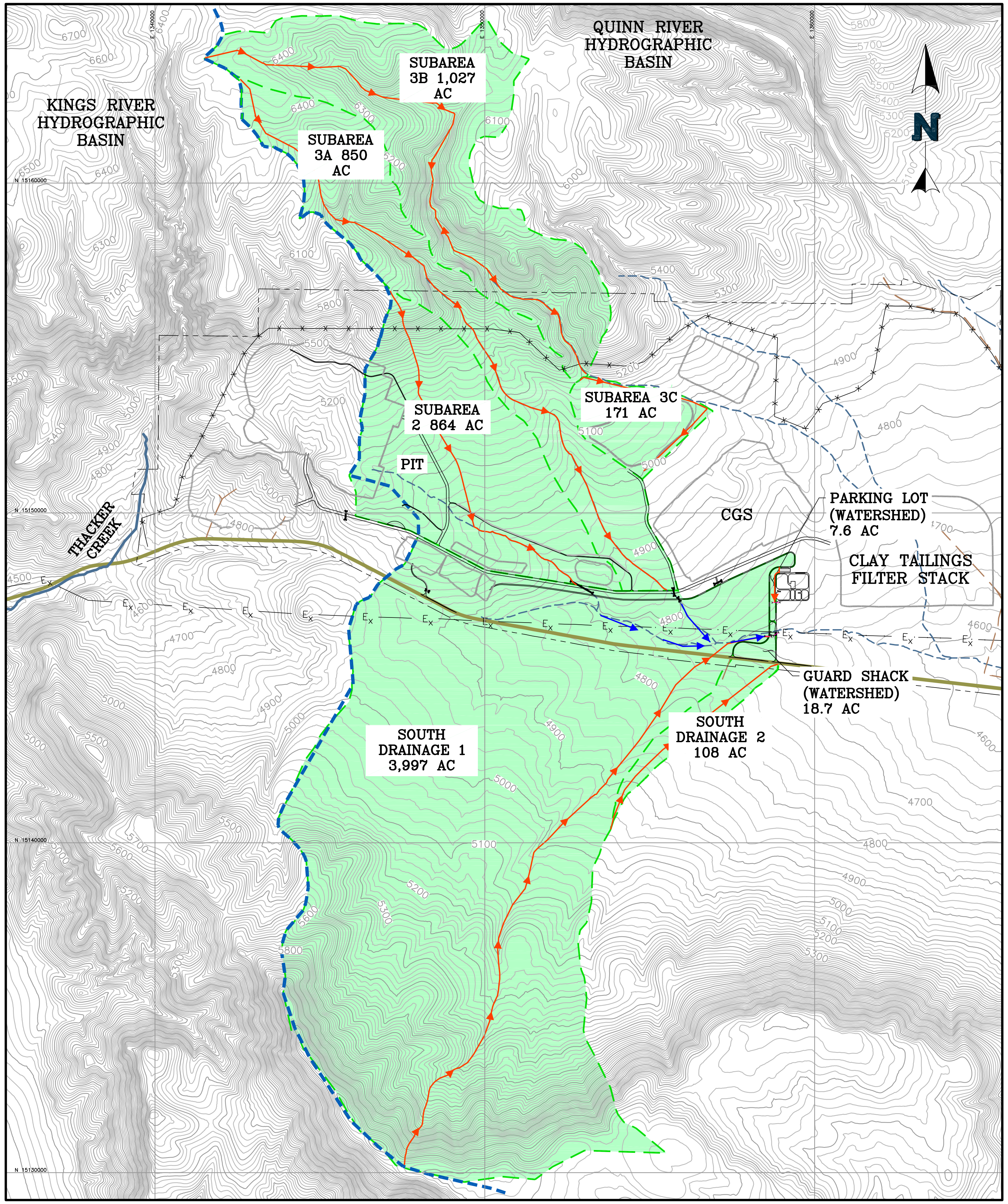
CLIENT
LITHIUM NEVADA CORP.

PROJECT
THACKER PASS PROJECT

TITLE
CTFS WEST STORMWATER DIVERSION CHANNEL WATERSHED

FILENAME	
0385.000.071F	
FIGURE NO.	REVISION
006	B

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\A-CAD\FIG\0385.000.071F.dwg-2/26/2020 11:44 AM



LEGEND:

〰	EXISTING GROUND 20 FOOT CONTOURS
4500	EXISTING CONTOUR ELEVATION
〰	EXISTING ROADS–MAJOR
〰	EXISTING ROADS/TRAILS
〰	EXISTING DRAINAGES
〰	EXISTING EPHEMERAL CREEKS
→ →	MAJOR STORMWATER DRAINAGE FLOW PATH
■■■■■	HYDROGRAPHIC BASIN
— Ex —	EXISTING POWER LINE
— - —	PLAN OF OPERATIONS BOUNDARY
—	FACILITY BOUNDARY
—x—x—	FENCE
🟩	PRIMARY WATERSHED
—▸—	WATERSHED CRITICAL FLOW PATH
>—<	CULVERT UPSTREAM OF PROCESS PLANT FACILITIES
>—<	PROCESS PLANT FACILITY CULVERT

0 1000 2000 FEET

NOTES:

1. ALL LINE WORK IS PROPOSED UNLESS CALLED OUT AS EXISTING.
2. FIBER OPTIC LINE, WATER PIPELINE, AND CONVEYOR CORRIDORS NOT SHOWN FOR CLARITY.
3. ACTUAL WATERSHED AREA MAY VARY DEPENDING ON FINAL PLANT SITE GRADING.

WATERSHED PROPERTIES

WATERSHED	AREA	CRITICAL FLOW PATH	TIME OF CONCENTRATION
PARKING LOT	7.6 AC	1,106 FT	8.7 MIN
SUBAREA 2	864 AC	11,383 FT	37.5 MIN
SUBAREA 3A	850 AC	21,397 FT	68.0 MIN
SUBAREA 3B	1,027 AC	18,696 FT	64.7 MIN
SUBAREA 3C	171 AC	6,707 FT	44.2 MIN
SOUTH DRAINAGE 1	3,998 AC	20,780 FT	64.4 MIN
SOUTH DRAINAGE 2	108.2 AC	7,287 FT	72.9 MIN
GUARD SHACK	18.7 AC	1,362 FT	10.8 MIN

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CLIENT
LITHIUM NEVADA CORP.

PROJECT
THACKER PASS PROJECT

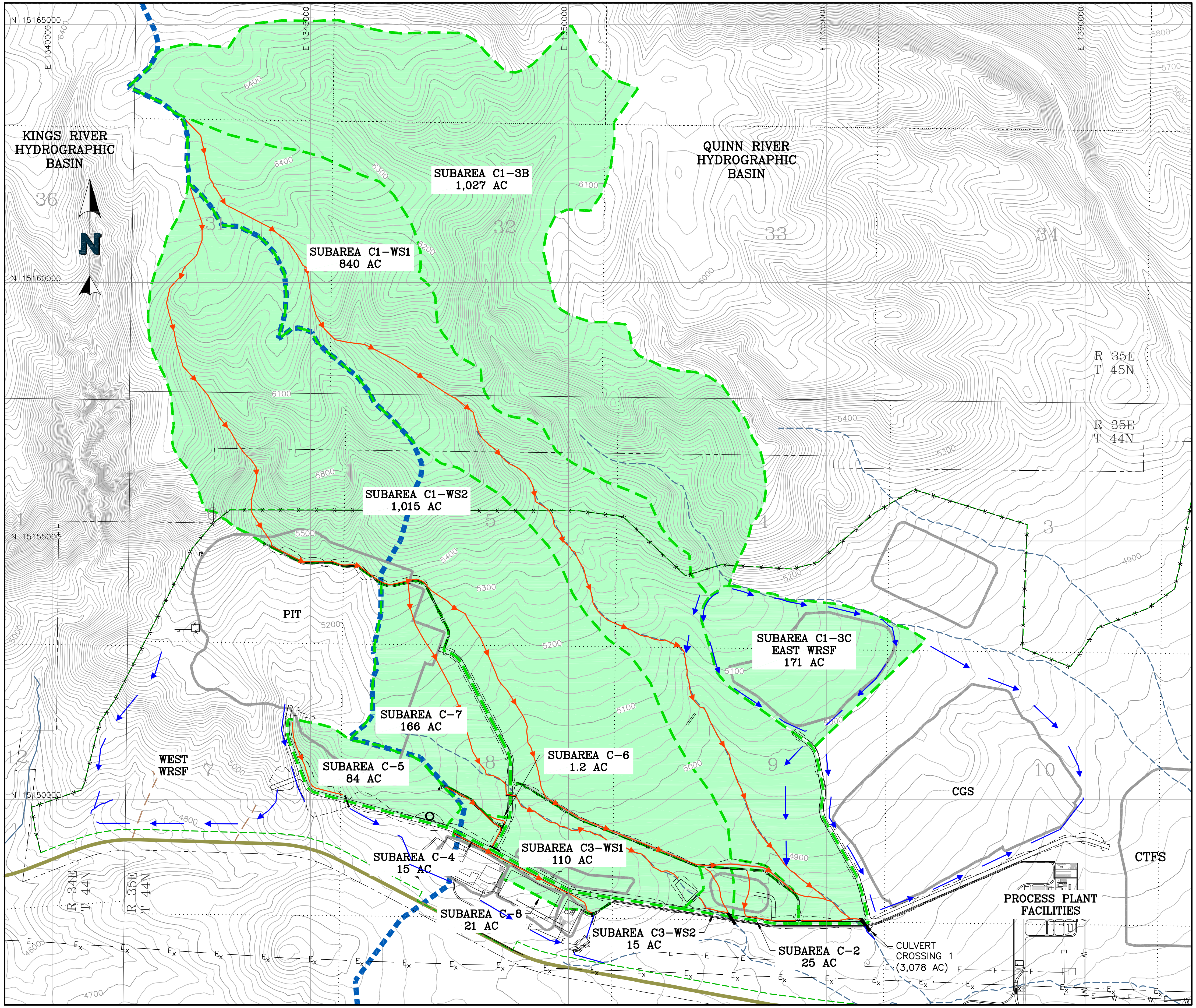
TITLE
PROCESS PLANT FACILITY CULVERTS
CONTRIBUTING WATERSHEDS

FILENAME
0385.000.100F

FIGURE NO.
007

REVISION
A

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\A-CAD\FIG\0385.000.100F.dwg-3/2/2020 12:11 PM



LEGEND:

4500	EXISTING GROUND 20 FOOT CONTOURS EXISTING CONTOUR ELEVATION
	EXISTING ROADS–MAJOR
	EXISTING ROADS/TRAILS
	EXISTING DRAINAGES
	EXISTING EPHEMERAL CREEKS
→ →	MAJOR STORMWATER DRAINAGE FLOW PATH
	HYDROGRAPHIC BASIN
	WATERSHED CRITICAL FLOW PATH
— E_x —	EXISTING POWER LINE
	PLAN OF OPERATIONS BOUNDARY
	FACILITY BOUNDARY
—x—x—	FENCE
	WATERSHED

0 1000 2000 FEET

WATERSHED PROPERTIES			
WATERSHED	AREA	CRITICAL FLOW PATH	TIME OF CONCENTRATION
SUBAREA C1–3B	1,027 AC	18,696 FT	64.7 MIN
SUBAREA C1–3C	171 AC	6,707 FT	44.2 MIN
SUBAREA C1–WS1	840 AC	21,725 FT	71.8 MIN
SUBAREA C1–WS2	1,015 AC	21,185 FT	81.4 MIN
SUBAREA C–2	25 AC	1,825 FT	10.4 MIN
SUBAREA C3–WS1	110 AC	4,145 FT	16.8 MIN
SUBAREA C3–WS2	15 AC	975 FT	3.7 MIN
SUBAREA C–4	15 AC	1,750 FT	5.2 MIN
SUBAREA C–5	84 AC	2,050 FT	23.0 MIN
SUBAREA C–6	1.2 AC	375 FT	0.2 MIN
SUBAREA C–7	166 AC	4,475 FT	14.3 MIN
SUBAREA C–8	21 AC	3,120 FT	8.6 MIN

DRAFT

NewFields
CLIENT
LITHIUM NEVADA
PROJECT
THACKER PASS PROJECT
TITLE
MINE ROAD CULVERTS AND WATERSHEDS
FILENAME
0385.000.101F
FIGURE NO.
008
REVISION
A

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\A-CAD\FIG\0385.000.101F.dwg-3/13/2020 11:09 AM

E.2.2 HEC-HMS DESIGN CALCULATIONS

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CALCULATION COVER SHEET

Client	Lithium Nevada Corporation	Preparer:	S. Breidt	02/10/20
Project	Thacker Pass Project	Checked:	M. Haley	
Title	Stormwater Management Calculations	Revision	C	

CALCULATION OBJECTIVE

1. Estimate the peak runoff from upstream watersheds to design the stormwater diversion channels and sediment ponds.

2. Determine the required size of the diversion channels and erosion protection (if necessary)

ASSUMPTIONS

1. Intial flow rates were calculated using a Manning's n of 0.05 for all riprap-lined channels, and 0.03 for all unlined channels. Actual Manning's n values were then estimated using the Hec-15-Riprap Design Calcs as applicable.

3. Composite SCS Curve numbers are calculated based on ground type.

4. Storm events will be sized according to previous meteorological studies

2-Year	1.13	inches
10-Year	1.64	inches
25-Year	1.96	inches
100-Year	2.48	inches
500-Year	3.12	inches

METHODOLOGY

1. Area and length measurements were determined using AutoCAD Civil 3D.
2. SCS Type II Storm event was modeled.
3. HEC-HMS was used to model the storm events
4. Bentley Flow Master was used to calculate the flow depths for unlined channels
5. HEC-15 Riprap Design calcs were used to calculate flow depths for lined channels

REFERENCES

1. AutoCAD Civil 3D version 2018.

2. United States Department of Agriculture Natural Resources Conservation Service (NRCS). (1986). “Urban Hydrology for Small Watersheds, Technical Release 55 Second Edition,” June

3. U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS). “Part 630 Hydrology National Engineering Handbook.” 210-vi, NEH, May 2010.

4. United Stated Department of Commerce, National Oceanic and Atmospheric Administration. (reprinted 1984). “Hydrometeorological Report No. 49, Probably Maximum Precipitation Estimates, Colorado River and Great Basin Drainages,” (HRM 49)

5. United States Army Corps of Engineers. Hydrologic Modeling System (HEC-HMS) Version 4.2, Computer Program (August 2016)

CONCLUSIONS

1. See attached tables for channel sizing.

Filename:

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\H-CALCULATIONS\Hydrology\[Hydrology - 2020.02.26.xlsx]Hec Calc Cover

Thacker Pass Project
Tailings Storage Facility Stormwater Diversion Channels
Watershed Characteristics

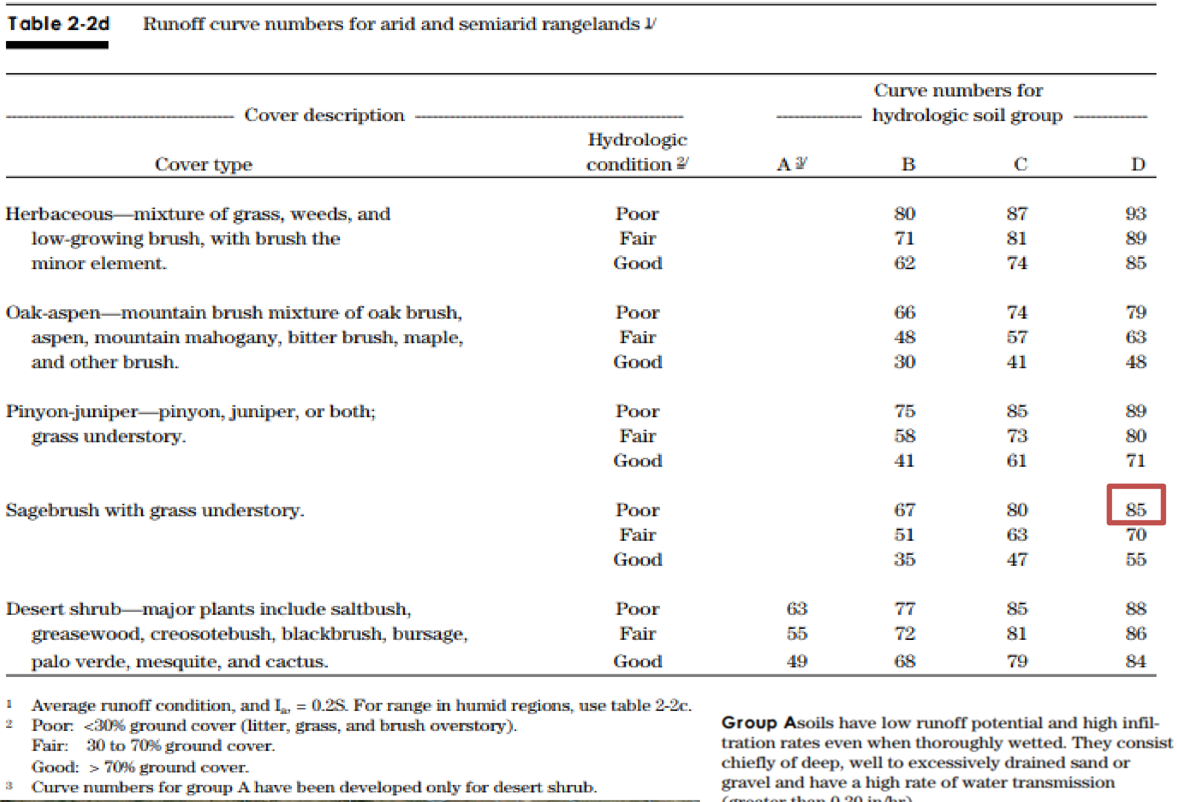


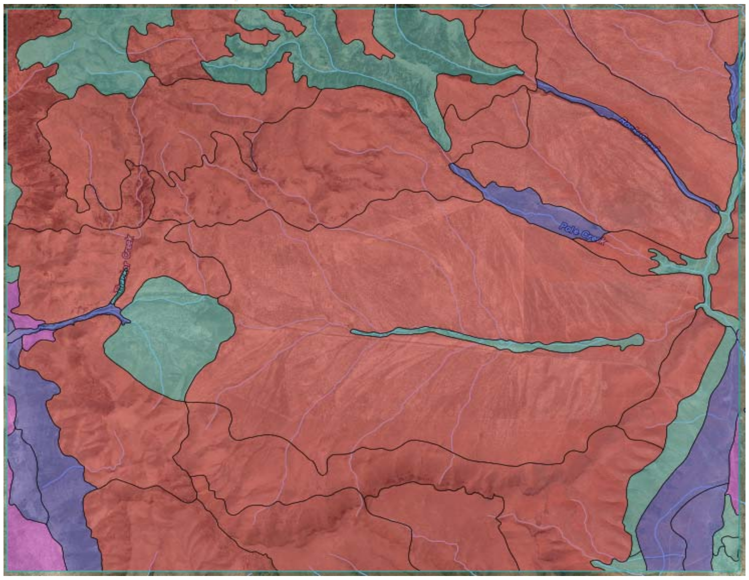
Table 2-2d Runoff curve numbers for arid and semiarid rangelands [1]

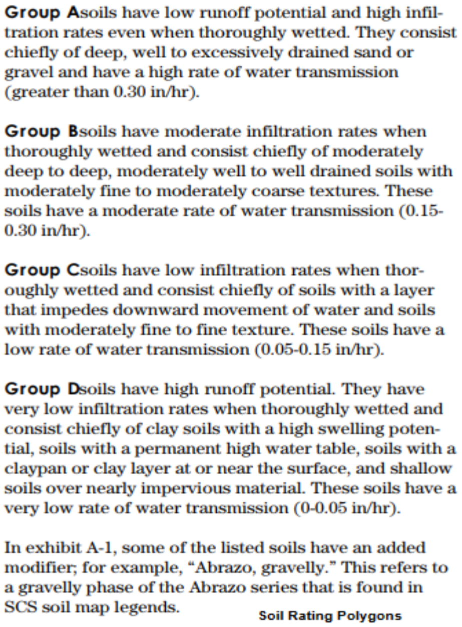
Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition [2]	A [3]	B	C	D
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element.	Poor		80	87	93
	Fair		71	81	89
	Good		62	74	85
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush.	Poor		66	74	79
	Fair		48	57	63
	Good		30	41	48
Pinyon-juniper—pinyon, juniper, or both; grass understory.	Poor		75	85	89
	Fair		58	73	80
	Good		41	61	71
Sagebrush with grass understory.	Poor		67	80	85
	Fair		51	63	70
	Good		35	47	55
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus.	Poor	63	77	85	88
	Fair	55	72	81	86
	Good	49	68	79	84

[1] Average runoff condition, and I_a, = 0.2S. For range in humid regions, use table 2-2c.

[2] Poor: <30% ground cover (litter, grass, and brush overstory).
Fair: 30 to 70% ground cover.
Good: > 70% ground cover.

[3] Curve numbers for group A have been developed only for desert shrub.





Group A soils have low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sand or gravel and have a high rate of water transmission (greater than 0.30 in/hr).

Group B soils have moderate infiltration rates when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.15-0.30 in/hr).

Group C soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission (0.05-0.15 in/hr).

Group D soils have high runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission (0-0.05 in/hr).

In exhibit A-1, some of the listed soils have an added modifier; for example, "Abrazo, gravelly." This refers to a gravelly phase of the Abrazo series that is found in SCS soil map legends.

Soil Rating Polygons

🟪	A
🟩	A/D
🟦	B
🟫	B/D
🟦	C
🟩	C/D
🟥	D
⬜	Not rated or not available

For runoff from roads:

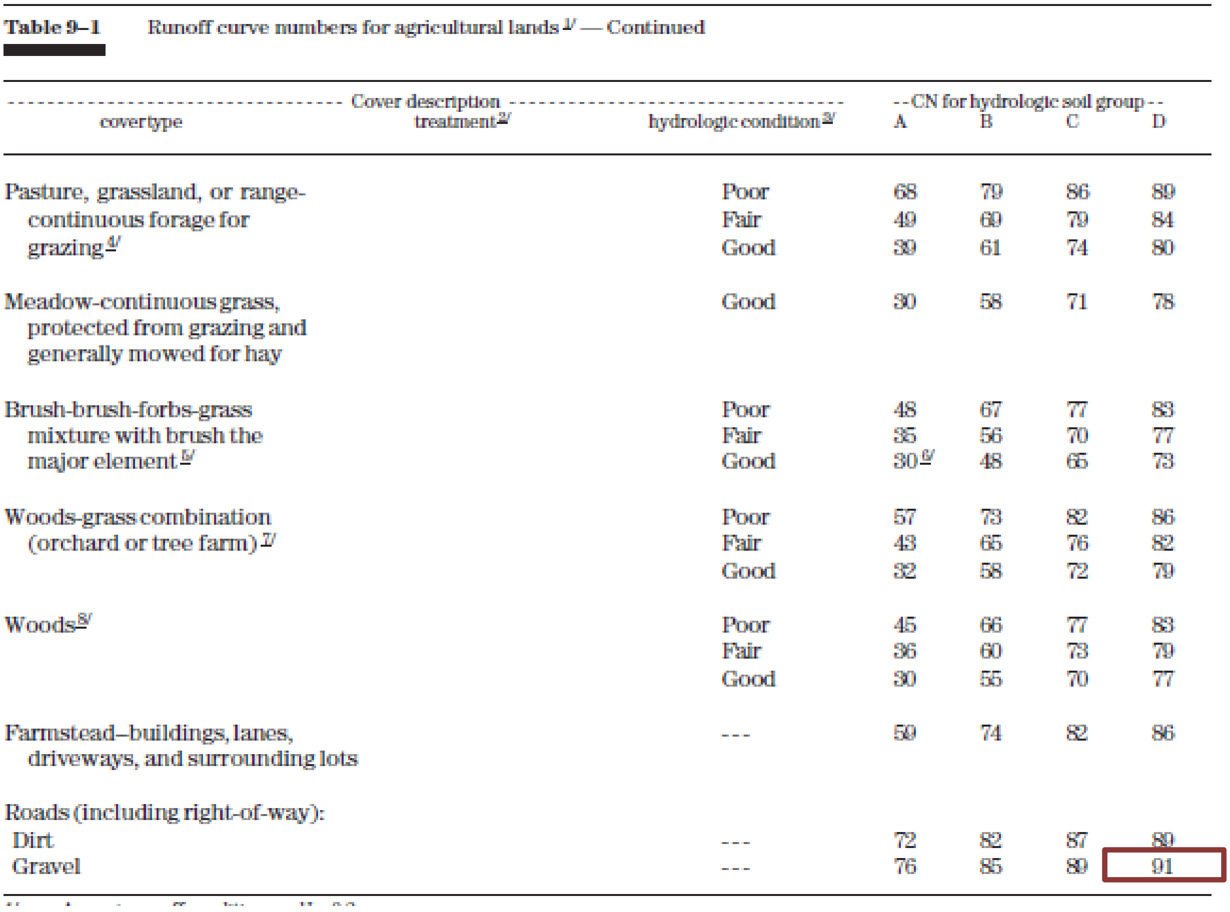
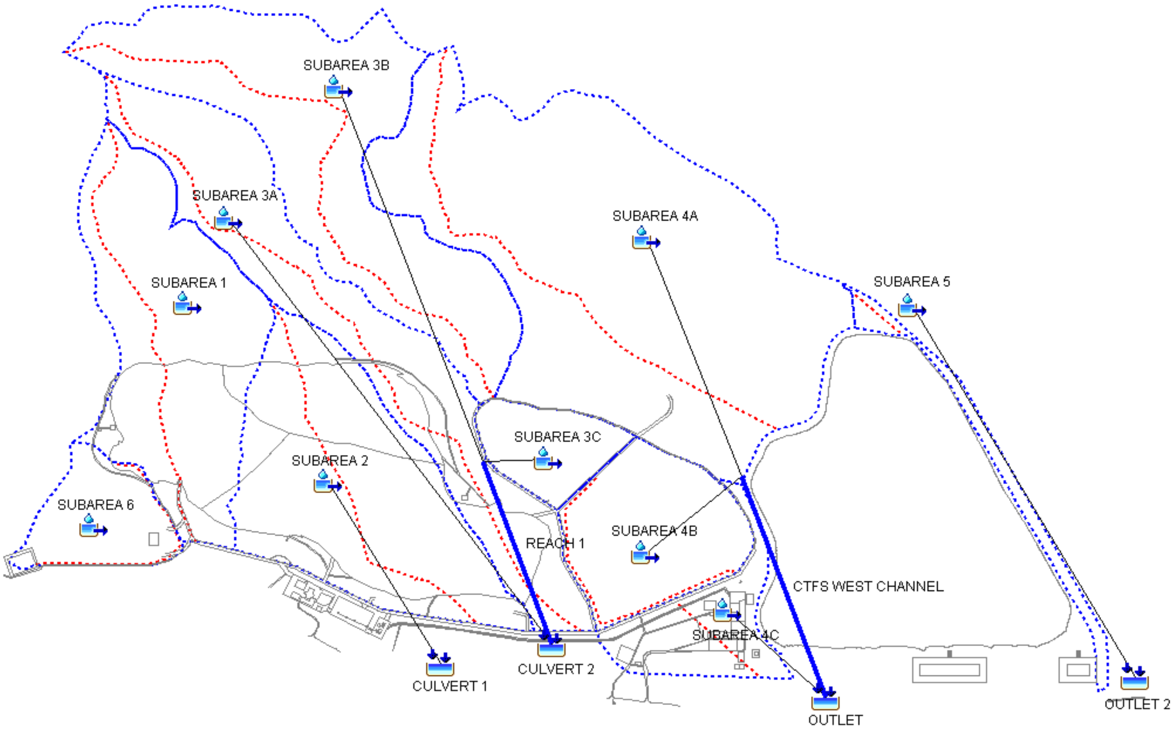


Table 9–1 Runoff curve numbers for agricultural lands [1] — Continued

Cover description: cover type	treatment [2]	hydrologic condition [3]	CN for hydrologic soil group: A	B	C	D
Pasture, grassland, or range-continuous forage for grazing [4]		Poor	68	79	86	89
		Fair	49	69	79	84
		Good	39	61	74	80
Meadow-continuous grass, protected from grazing and generally mowed for hay		Good	30	58	71	78
Brush-brush-forbs-grass mixture with brush the major element [5]		Poor	48	67	77	83
		Fair	35	56	70	77
		Good	30 [6]	48	65	73
Woods-grass combination (orchard or tree farm) [7]		Poor	57	73	82	86
		Fair	43	65	76	82
		Good	32	58	72	79
Woods [8]		Poor	45	66	77	83
		Fair	36	60	73	79
		Good	30	55	70	77
Farmstead–buildings, lanes, driveways, and surrounding lots		---	59	74	82	86
Roads (including right-of-way):						
Dirt		---	72	82	87	89
Gravel		---	76	85	89	91

Lithium Nevada Corporation
Thacker Pass Project
Ultimate Project Site Stormwater Facilities
Hec-HMS Overall View



Lithium Nevada Corporation
Thacker Pass Project
Ultimate Project Site Stormwater Facilities
Lag Time Calculation

$$t_p = \frac{l^{0.8}(S+1)^{0.7}}{1900y^{0.5}}$$

t_p	Lag Time (hr.)
l	Length to Divide (ft)
y	Avg. Watershed Slope (%)
CN	Composite Curve Number
S	1000/CN-10 (in.)
Ia	Initial Abstraction (0.2*S)

▨ Input Values

Lag Time and Watershed Characteristics

Watershed	Area (mi^2)	l (ft)	CN	y	S	t_p (hr)	t_p (min)	Ia
SUBAREA 1	1.2992	12,925	85	11.4%	1.76	0.62	37.0	0.35
SUBAREA 2	1.3505	11,383	85	9.1%	1.76	0.62	37.5	0.35
SUBAREA 3A	1.3284	21,397	85	7.6%	1.76	1.13	68.0	0.35
SUBAREA 3B	1.6053	18,696	85	6.8%	1.76	1.08	64.7	0.35
SUBAREA 3C (EAST WRSF)	0.2671	6,707	91	1.8%	0.99	0.74	44.2	0.20
SUBAREA 4A	2.9822	16,420	85	7.3%	1.76	0.93	56.0	0.35
SUBAREA 4B (CGS)	0.6975	8,989	91	3.4%	0.99	0.68	40.6	0.20
SUBAREA 4C	0.1145	2,895	91	4.0%	0.99	0.25	15.0	0.20
SUBAREA 5	0.1552	1,666	85	8.9%	1.76	0.14	8.2	0.35
SUBAREA 6 (WEST WRSF)	0.3587	6,739	91	9.2%	0.99	0.32	19.5	0.20

Reach Characteristics

Reach	L (ft)	BW	Side Slope	Long. S	Depth (ft)	n
Reach 1	7230	35	27.4	4.43%	14.70	0.035
CTFS West Channel	2834	30	27.4	3.35%	6.00	0.070

Lithium Nevada Corporation
Thacker Pass Project
Ultimate Project Site Stormwater Facilities

2 Year-24 Hour Hec-HMS Results

Hydraulic Element	**Drainage Area (Mi^2)**	**Peak Discharge (ft^3/s)**	**Volume (acre-ft)**
SUBAREA 3C	0.2671	35.3	6.4
SUBAREA 4B	0.6975	97.8	16.8
SUBAREA 6	0.3587	80.8	8.62

25 Year-24 Hour Hec-HMS Results

Hydraulic Element	**Drainage Area (Mi^2)**	**Peak Discharge (ft^3/s)**	**Volume (acre-ft)**
SUBAREA 3C	0.2671	92	16.1
SUBAREA 4B	0.6975	255.4	41.9
SUBAREA 6	0.3587	208.6	21.56

100 Year-24 Hour Hec-HMS Results

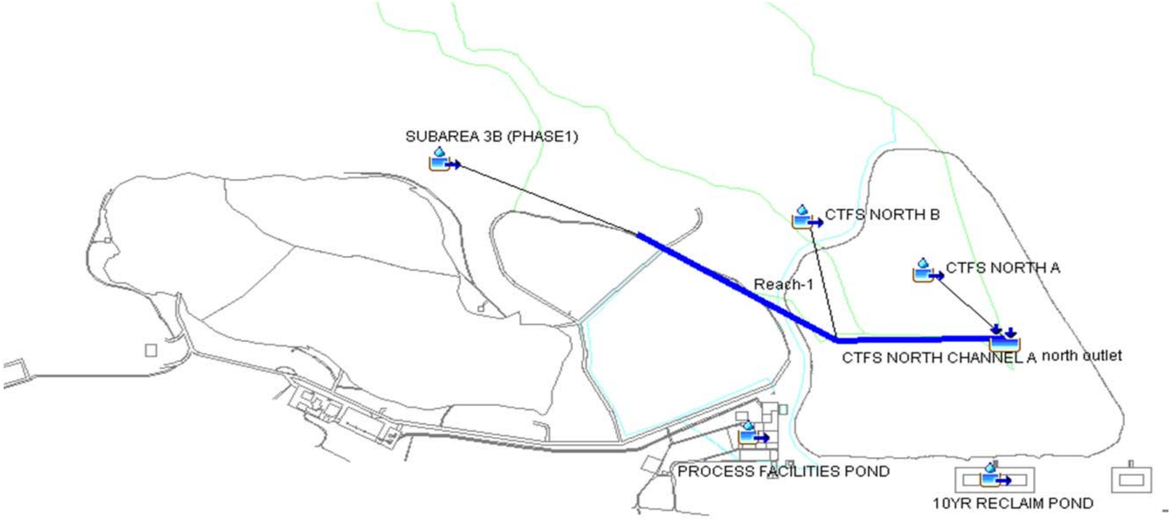
Hydraulic Element	**Drainage Area (Mi^2)**	**Peak Discharge (ft^3/s)**	**Volume (acre-ft)**
CTFS WEST CHANNEL	3.6797	1193.9	244.4
CULVERT 1	1.3505	529.6	83.9
CULVERT 2	3.2008	870.2	204.6
OUTLET	3.7942	1211.8	254.1
OUTLET 2	0.1552	136.8	9.6
REACH 1	1.8724	529.8	122.1
SUBAREA 1	1.2992	514.8	80.7
SUBAREA 2	1.3505	529.6	83.9
SUBAREA 3A	1.3284	340.4	82.5
SUBAREA 3B	1.6053	426.4	99.7
SUBAREA 3C	0.2671	130	22.7
SUBAREA 4A	2.9822	879.9	185.3
SUBAREA 4B	0.6975	361.0	59.2
SUBAREA 4C	0.1145	107.1	9.7
SUBAREA 5	0.1552	136.8	9.6
SUBAREA 6	0.3587	295	30.4

Lithium Nevada Corporation
Thacker Pass Project
Ultimate Project Site Stormwater Facilities

500 Year-24 Hour Hec-HMS Results

Hydraulic Element	Drainage Area (Mi^2)	Peak Discharge (ft^3/s)	Volume (acre-ft)
CTFS WEST CHANNEL	3.6797	1726.5	350.2
CULVERT 1	1.3505	781.1	121.9
CULVERT 2	3.2008	1274	295.5
OUTLET	3.7942	1750.3	363.5
OUTLET 2	0.1552	200.6	14.0
REACH 1	1.8724	772	175.6
SUBAREA 1	1.2992	758.9	117.2
SUBAREA 2	1.3505	781.1	121.9
SUBAREA 3A	1.3284	502	119.9
SUBAREA 3B	1.6053	629.3	144.9
SUBAREA 3C	0.2671	178.1	31.1
SUBAREA 4A	2.9822	1298.7	269.1
SUBAREA 4B	0.6975	493.3	81.1
SUBAREA 4C	0.1145	145.7	13.3
SUBAREA 5	0.1552	200.6	14.0
SUBAREA 6	0.3587	403.2	41.7

Lithium Nevada Corporation
Thacker Pass Project
Phase 1 CTFS Facilities
Hec-HMS Overall View



Lithium Nevada Corporation
Thacker Pass Project
Phase 1 CTFS Facilities
Lag Time Calculation

$$t_p = \frac{l^{0.8}(S+1)^{0.7}}{1900y^{0.5}}$$

t_p	Lag Time (hr.)
l	Length to Divide (ft)
y	Avg. Watershed Slope (%)
CN	Composite Curve Number
S	1000/CN-10 (in.)
Ia	Initial Abstraction (0.2*S)

▨ Input Values

Lag Time and Watershed Characteristics

Watershed	Area (mi^2)	l (ft)	CN	y	S	t_p (hr)	t_p (min)	Ia
CTFS NORTH A	3.1110	19,409	85	6.8%	1.76	1.11	66.7	0.35
CTFS NORTH B	0.5770	9,275	85	4.7%	1.76	0.74	44.4	0.35
SUBAREA 3B	1.6053	18,696	85	6.8%	1.76	1.08	64.7	0.35
RECLAIM POND	0.6429	7,029	91	2.2%	0.99	0.69	41.1	0.20
SUBAREA 4C	0.1145	2,895	91	4.0%	0.99	0.25	15.0	0.20

Reach Characteristics

Reach	L (ft)	BW	Side Slope	Long. S	Depth (ft)	n
Reach 1	9275	30	34.5	4.65%	14.70	0.035
CTFS North Channel A	600	80	2.5	1%	3	0.035

Lithium Nevada Corporation
Thacker Pass Project
Phase 1 CTFS Facilities

2 Year-24 Hour Hec-HMS Results

Hydraulic Element	Drainage Area (Mi^2)	Peak Discharge (ft^3/s)	Volume (acre-ft)
CTFS NORTH A	3.1110	135.2	39.7
SUBAREA 3B (PHASE1)	1.6053	70.9	20.5
Reach-1	1.6053	70.7	20.4
CTFS NORTH B	0.5770	33.4	7.4
CTFS NORTH CHANNEL A	2.1823	87.9	27.7
north outlet	5.2933	216.0	67.4
10YR RECLAIM POND	0.6429	89.3	15.5
SUBAREA 4C	0.1145	30	2.8

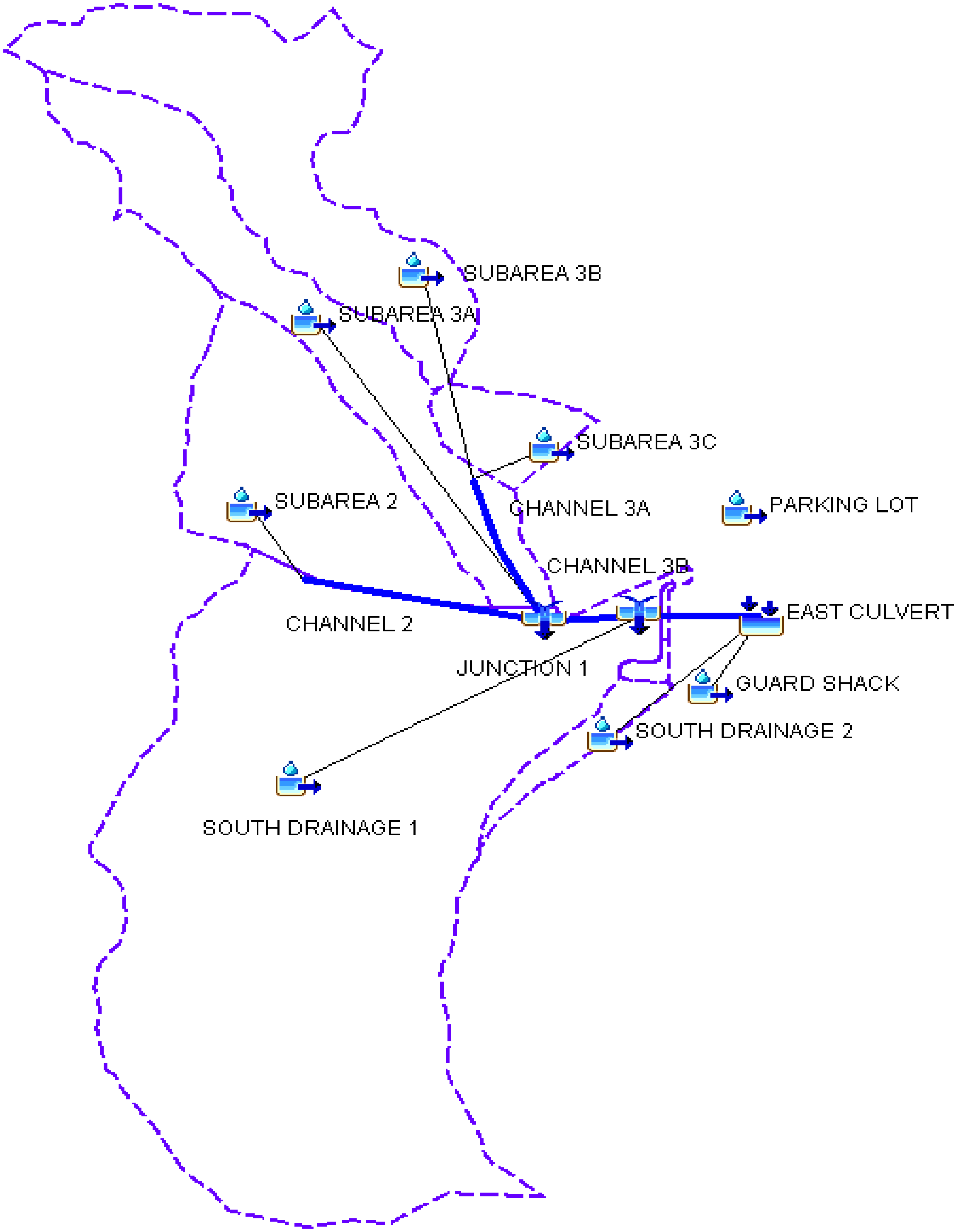
25 Year-24 Hour Hec-HMS Results

Hydraulic Element	Drainage Area (Mi^2)	Peak Discharge (ft^3/s)	Volume (acre-ft)
CTFS NORTH A	3.1110	518	127.4
SUBAREA 3B (PHASE1)	1.6053	271.8	65.8
Reach-1	1.6053	271.3	65.5
CTFS NORTH B	0.5770	129.2	23.6
CTFS NORTH CHANNEL A	2.1823	343.6	89.2
north outlet	5.2933	856.5	216.6
10YR RECLAIM POND	0.6429	233.5	38.6
SUBAREA 4C	0.1145	76.4	6.9

100 Year-24 Hour Hec-HMS Results

Hydraulic Element	Drainage Area (Mi^2)	Peak Discharge (ft^3/s)	Volume (acre-ft)
CTFS NORTH A	3.1110	808.5	193.3
SUBAREA 3B (PHASE1)	1.6053	423.7	99.7
Reach-1	1.6053	423.3	99.3
CTFS NORTH B	0.5770	201.4	35.8
CTFS NORTH CHANNEL A	2.1823	540.7	135.2
north outlet	5.2933	1344.3	328.4
10YR RECLAIM POND	0.6429	330.2	54.5
SUBAREA 4C	0.1145	107.1	9.7

Lithium Nevada Corporation
Thacker Pass Project
Process Plant Facility Culverts
Hec-HMS Overall View



Lithium Nevada Corporation
Thacker Pass Project
Process Plant Facility Culverts
Lag Time Calculation

$$t_p = \frac{l^{0.8}(S+1)^{0.7}}{1900y^{0.5}}$$

t_p	Lag Time (hr.)
l	Length to Divide (ft)
y	Avg. Watershed Slope (%)
CN	Composite Curve Number
S	1000/CN-10 (in.)
Ia	Initial Abstraction (0.2*S)

Input Values

Lag Time and Watershed Characteristics

Watershed	Area (mi^2)	l (ft)	CN	y	S	t_p (hr)	t_p (min)	Ia
Parking Lot	0.0119	1,106	91	2.5%	0.99	0.15	8.7	0.20
Guard Shack	0.0293	1,362	85	3.7%	1.76	0.18	10.8	0.35
South Drainage 1	6.2460	20,780	85	8.1%	1.76	1.07	64.4	0.35
South Drainage 2	0.1691	7,287	85	3.4%	1.76	0.72	42.9	0.35
SUBAREA 2	1.3505	11,383	85	9.1%	1.76	0.62	37.5	0.35
SUBAREA 3A	1.3284	21,397	85	7.6%	1.76	1.13	68.0	0.35
SUBAREA 3B	1.6053	18,696	85	6.8%	1.76	1.08	64.7	0.35
SUBAREA 3C (EAST WRSF)	0.2671	6,707	91	1.8%	0.99	0.74	44.2	0.20

Reach Characteristics

Reach	L (ft)	BW	Side Slope	Long. S	Depth (ft)	n
Channel 2	3,989	3.5	3.7	2.8%	15.00	0.035
Channel 3A	4,142	8.3	11.6	4.2%	9.70	0.035
Channel 3B	1,675	16.3	3.2	3.3%	14.3	0.035
Channel 3C	1,588	12.4	11.5	1.9%	11.2	0.035
Between Culverts	165	19	8.6	2.0%	3	0.035

Lithium Nevada Corporation
Thacker Pass Project
Process Plant Facility Culverts

10 Year-24 Hour Hec-HMS Results

Hydraulic Element	Drainage Area (Mi^2)	Peak Discharge (ft^3/s)	Volume (acre-ft)
PARKING LOT	0.0119	7.4	0.54
SOUTH DRAINAGE 1	6.2460	720.3	179.26
SUBAREA 3B	1.6053	184.5	46.07
SUBAREA 3C	0.2671	68.6	12.04
CHANNEL 3A	1.8724	237.9	58.07
CHANNEL 3B	1.8724	237.7	58.05
SUBAREA 2	1.3505	229.3	38.76
CHANNEL 2	1.3505	228.7	38.72
SUBAREA 3A	1.3284	147.1	38.12
JUNCTION 1	4.5513	563.1	134.89
CHANNEL 3C	4.5513	561.5	134.85
WEST CULVERT	10.7973	1275.6	314.11
BETWEEN CULVERTS	10.7973	1275	314.13
SOUTH DRAINAGE 2	0.1691	26.2	4.85
GUARD SHACK	0.0293	10.6	0.84
EAST CULVERT	10.9957	1297.3	319.82

25 Year-24 Hour Hec-HMS Results

Hydraulic Element	Drainage Area (Mi^2)	Peak Discharge (ft^3/s)	Volume (acre-ft)
PARKING LOT	0.0119	10	0.72
SOUTH DRAINAGE 1	6.2460	1066	255.87
SUBAREA 3B	1.6053	273.2	65.76
SUBAREA 3C	0.2671	92	16.05
CHANNEL 3A	1.8724	345.9	81.77
CHANNEL 3B	1.8724	345.4	81.76
SUBAREA 2	1.3505	338.8	55.32
CHANNEL 2	1.3505	338	55.3
SUBAREA 3A	1.3284	217.8	54.42
JUNCTION 1	4.5513	827.6	191.48
CHANNEL 3C	4.5513	826.6	191.43
WEST CULVERT	10.7973	1882.2	447.3
BETWEEN CULVERTS	10.7973	1881.8	447.33
SOUTH DRAINAGE 2	0.1691	38.7	6.93
GUARD SHACK	0.0293	15.5	1.2
EAST CULVERT	10.9957	1914	455.45

Lithium Nevada Corporation
Thacker Pass Project
Process Plant Facility Culverts

100 Year-24 Hour Hec-HMS Results

Hydraulic Element	**Drainage Area (Mi^2)**	**Peak Discharge (ft^3/s)**	**Volume (acre-ft)**
PARKING LOT	0.0119	14	1.01
SOUTH DRAINAGE 1	6.2460	1665.2	388.05
SUBAREA 3B	1.6053	426.4	99.73
SUBAREA 3C	0.2671	130	22.65
CHANNEL 3A	1.8724	531.2	122.36
CHANNEL 3B	1.8724	529.5	122.36
SUBAREA 2	1.3505	529.6	83.9
CHANNEL 2	1.3505	528.5	83.89
SUBAREA 3A	1.3284	340.4	82.53
JUNCTION 1	4.5513	1284.9	288.78
CHANNEL 3C	4.5513	1278.6	288.77
WEST CULVERT	10.7973	2924.2	676.81
BETWEEN CULVERTS	10.7973	2922.6	676.85
SOUTH DRAINAGE 2	0.1691	60.3	10.51
GUARD SHACK	0.0293	23.8	1.82
EAST CULVERT	10.9957	2976.5	689.2

APPENDIX E.3

Hydraulics

E.3.1 CTFS NORTH CHANNEL

CTFS North PH1 100YR STA 0+00 - 14+00

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.01000	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	80.00	ft
Discharge	535.60	ft³/s

Results

Normal Depth	1.31	ft
Flow Area	108.73	ft²
Wetted Perimeter	87.03	ft
Hydraulic Radius	1.25	ft
Top Width	86.53	ft
Critical Depth	1.10	ft
Critical Slope	0.01758	ft/ft
Velocity	4.93	ft/s
Velocity Head	0.38	ft
Specific Energy	1.68	ft
Froude Number	0.77	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.31	ft
Critical Depth	1.10	ft
Channel Slope	0.01000	ft/ft

CTFS North PH1 100YR STA 14+00 - 44+00

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.01000	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	80.00	ft
Discharge	1338.50	ft³/s

Results

Normal Depth	2.25	ft
Flow Area	192.71	ft²
Wetted Perimeter	92.12	ft
Hydraulic Radius	2.09	ft
Top Width	91.25	ft
Critical Depth	2.01	ft
Critical Slope	0.01458	ft/ft
Velocity	6.95	ft/s
Velocity Head	0.75	ft
Specific Energy	3.00	ft
Froude Number	0.84	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.25	ft
Critical Depth	2.01	ft
Channel Slope	0.01000	ft/ft

CTFS North PH1 100YR STA 44+00 - 55+91

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.01500	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	80.00	ft
Discharge	1338.50	ft³/s

Results

Normal Depth	2.00	ft
Flow Area	169.66	ft²
Wetted Perimeter	90.75	ft
Hydraulic Radius	1.87	ft
Top Width	89.98	ft
Critical Depth	2.01	ft
Critical Slope	0.01458	ft/ft
Velocity	7.89	ft/s
Velocity Head	0.97	ft
Specific Energy	2.96	ft
Froude Number	1.01	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.00	ft
Critical Depth	2.01	ft
Channel Slope	0.01500	ft/ft

HEC-15 RIPRAP DESIGN

NewFields

Lithium Nevada Corporation **Thacker Pass Project** **CTFS North Ph 1 100yr, 24hr storm**	NOTE: Gray boxes require input, Orange boxes require specific values, Red boxes are calculated

Step 1: Channel Design Parameters					
Bottom Width	B	80	ft	135	80
Side Slope	Z	2.5	x:1		
Longitudinal Slope	S	0.015	ft/ft	0.02	0.0135
Flow	Q	1338.5	ft^3/s		

Step 2: Initial Riprap sizing					
Median Stone Size	D_{50}	**0.5**	ft	0.3	0.5
Stone Unit Weight	Ys	165	pcf		
Riprap Calculation Gradation	D_{100}	10.00	inch		
	D_{75}	7.50	inch		
	D_{50}	6.00	inch		
	D_{30}	4.00	inch		
	D_{15}	3.00	inch		
	D_{10}	2.00	inch		

Step 3: Estimate the Flow Depth					
Initial Flow Depth Estimate	D_i	**2.5**	ft	1.14	1.68
Area of Channel	A	215.63	ft^2		
Wetted Perimeter	P	93.46	ft		
Hydraulic Radius	R	2.31	ft		
Wetted Top Width	T	92.50	ft		
Calculated Average Flow Depth	D_a	2.33	ft		

Step 4: Estimate Manning's n and the Implied Discharge			
D_a/D_{50}		4.662	
For $1.5 < D_a/D_{50} < 185$	n	0.052	
Q from mannings	Qi	1308.67	ft^3/s
% Difference from Design Discharge		-2.23%	
For $0.3 < D_a/D_{50} < 1.5$	n	0.053	
function(Froude number)	f(Fr)	0.827	
Froude number	Fr	0.716	
Velocity of flow	V	**6.208**	
effective roughness concrentration	b	0.375	
Roughness element geometry	f(REG)	27.252	
Channel geometry	f(CG)	0.251	
Q from mannings	Qi	1287.39	ft^3/s
% Difference from Design Discharge		-3.82%	

Step 5:		
If % difference is > 5%, estimate a new depth in Step 3	FALSE	Proceed to Step 6
For $0.3 < D_a/D_{50} < 1.5$	FALSE	
If false, proceed to step 6		

Step 6: Calculate Reynolds and Determine Appropriate Shields Parameter & Safety Factor				
Shear Velocity	V_*	1.099		
Reynolds number	R_e	4.51E+04		
Gravity	g	32.2	ft/s^2	
Kinematic Viscosity	v	1.22E-05	ft^2/s	(1.217e-5 for 60 °F)
From Table 6.1	F_*	0.050		
From Table 6.1	SF	1.016		
Specific Gravity of Stone	SG	2.64		
For S < 5%	D_{50}	0.46	ft	

Table 6.1. Selection of Shields' Parameter and Safety Factor			
Reynolds number	F_*	SF	
$\leq 4x10^4$	0.047	1	
$4x10^4<Re<2x10^5$	0.050	1.016	(Linear Interpolation)
$\geq 2x10^5$	0.15	1.5	

Step 7: Iterate Solution till Calculated D50 is Acceptably Smaller then Chosen D50				
Difference to Chosen Riprap	92.12%	<	100%	TRUE
IF FALSE GOTO STEP 2, ADJUST RIPRAP SIZE				

Step 8. Side Slope Assessment					
Stone Angle of Repose	ϕ	42	°		
For 1.5 < Z < 5	K1	0.835			
	ϴ	21.80	°		
	K2	0.83			
Stable D_{50}	$D_{50,s}$	0.46			
Difference to Chosen Riprap		92.47%	<	100%	TRUE

E.3.2 CTFS EAST CHANNEL

Worksheet for CTFS-East Ult 100 YR Max Slope

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.076	
Channel Slope	0.04000	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	12.00	ft
Discharge	136.80	ft³/s

Results

Normal Depth	1.76	ft
Flow Area	28.77	ft²
Wetted Perimeter	21.45	ft
Hydraulic Radius	1.34	ft
Top Width	20.78	ft
Critical Depth	1.43	ft
Critical Slope	0.08306	ft/ft
Velocity	4.75	ft/s
Velocity Head	0.35	ft
Specific Energy	2.11	ft
Froude Number	0.71	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.76	ft
Critical Depth	1.43	ft
Channel Slope	0.04000	ft/ft

Worksheet for CTFS-East Ult 100 YR Max Slope

GVF Output Data

Critical Slope	0.08306	ft/ft

Messages

Notes

PHASE 1 ONLY WEST CHANNEL (BOTTOM RAISED FOR REDUCED FLOW)

REMAINING CTFS WS FLOW = 100 CFS + 100YR CGS POND FLOW = 300 CFS + 100YR PPF POND FLOW = 240 = 640 CFS TOTAL

35' BOTTOM WIDTH = 2' ABOVE ULTIMATE CHANNEL THALWEG

HEC-15 RIPRAP DESIGN

Lithium Nevada Corporation **Thacker Pass Project** **CTFS East Max Slope 100yr, 24hr storm**	NOTE: Gray boxes require input, Orange boxes require specific values, Red boxes are calculated

Step 1: Channel Design Parameters			
Bottom Width	B	12	ft
Side Slope	Z	2.5	x:1
Longitudinal Slope	S	0.04	ft/ft
Flow	Q	136.8	ft^3/s

Step 2: Initial Riprap sizing			
Median Stone Size	D_{50}	**0.75**	ft
Stone Unit Weight	Ys	165	pcf
Riprap Calculation Gradation	D_{100}	15.00	inch
	D_{75}	11.25	inch
	D_{50}	9.00	inch
	D_{30}	6.00	inch
	D_{15}	4.50	inch
	D_{10}	3.00	inch

Step 3: Estimate the Flow Depth			
Initial Flow Depth Estimate	D_i	**1.75**	ft
Area of Channel	A	28.66	ft^2
Wetted Perimeter	P	21.42	ft
Hydraulic Radius	R	1.34	ft
Wetted Top Width	T	20.75	ft
Calculated Average Flow Depth	D_a	1.38	ft

Step 4: Estimate Manning's n and the Implied Discharge			
D_a/D_{50}		1.841	
For $1.5 < D_a/D_{50} < 185$	n	0.076	
Q from mannings	Qi	136.36	ft^3/s
% Difference from Design Discharge		-0.32%	
For $0.3 < D_a/D_{50} < 1.5$	n	0.057	
function(Froude number)	f(Fr)	0.828	
Froude number	Fr	0.716	
Velocity of flow	V	**4.774**	
effective roughness concrentration	b	0.416	
Roughness element geometry	f(REG)	18.223	
Channel geometry	f(CG)	0.324	
Q from mannings	Qi	182.62	ft^3/s
% Difference from Design Discharge		33.49%	

Step 5:			
If % difference is > 5%, estimate a new depth in Step 3		FALSE	Proceed to Step 6
For 0.3 < D_a/D_{50} < 1.5		TRUE	
If false, proceed to step 6			

Step 6: Calculate Reynolds and Determine Appropriate Shields Parameter & Safety Factor				
Shear Velocity	V_*	1.501		
Reynolds number	R_e	9.25E+04		
Gravity	g	32.2	ft/s^2	
Kinematic Viscosity	v	1.22E-05	ft^2/s	(1.217e-5 for 60 °F)
From Table 6.1	F_*	0.081		
From Table 6.1	SF	1.164		
Specific Gravity of Stone	SG	2.64		
For S < 5%	D_{50}	0.61	ft	

Table 6.1. Selection of Shields' Parameter and Safety Factor			
Reynolds number	F_*	SF	
$\leq 4x10^4$	0.047	1	
$4x10^4<Re<2x10^5$	0.081	1.164	(Linear Interpolation)
$\geq 2x10^5$	0.15	1.5	

Step 7: Iterate Solution till Calculated D50 is Acceptably Smaller then Chosen D50				
Difference to Chosen Riprap	81.77%	<	100%	TRUE
IF FALSE GOTO STEP 2, ADJUST RIPRAP SIZE				

Step 8. Side Slope Assessment					
Stone Angle of Repose	ϕ	42	°		
For 1.5 < Z < 5	K1	0.835			
	Θ	21.80	°		
	K2	0.83			
Stable D_{50}	$D_{50,s}$	0.62			
Difference to Chosen Riprap		82.08%	<	100%	TRUE

Worksheet for CTFS-East Ult 100 YR Min Slope

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.073	
Channel Slope	0.02700	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	12.00	ft
Discharge	136.80	ft³/s

Results

Normal Depth	1.91	ft
Flow Area	32.09	ft²
Wetted Perimeter	22.30	ft
Hydraulic Radius	1.44	ft
Top Width	21.56	ft
Critical Depth	1.43	ft
Critical Slope	0.07664	ft/ft
Velocity	4.26	ft/s
Velocity Head	0.28	ft
Specific Energy	2.19	ft
Froude Number	0.62	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.91	ft
Critical Depth	1.43	ft
Channel Slope	0.02700	ft/ft

Worksheet for CTFS-East Ult 100 YR Min Slope

GVF Output Data

Critical Slope	0.07664	ft/ft

Messages

Notes

PHASE 1 ONLY WEST CHANNEL (BOTTOM RAISED FOR REDUCED FLOW)

REMAINING CTFS WS FLOW = 100 CFS + 100YR CGS POND FLOW = 300 CFS + 100YR PPF POND FLOW = 240 = 640 CFS TOTAL

35' BOTTOM WIDTH = 2' ABOVE ULTIMATE CHANNEL THALWEG

HEC-15 RIPRAP DESIGN

Lithium Nevada Corporation **Thacker Pass Project** **CTFS East Min Slope 100yr, 24hr storm**	NOTE: Gray boxes require input, Orange boxes require specific values, Red boxes are calculated

Step 1: Channel Design Parameters

Bottom Width	B	12	ft
Side Slope	Z	2.5	x:1
Longitudinal Slope	S	0.027	ft/ft
Flow	Q	136.8	ft^3/s

Step 2: Initial Riprap sizing

Median Stone Size	D_{50}	**0.75**	ft
Stone Unit Weight	Ys	165	pcf
Riprap Calculation Gradation	D_{100}	15.00	inch
	D_{75}	11.25	inch
	D_{50}	9.00	inch
	D_{30}	6.00	inch
	D_{15}	4.50	inch
	D_{10}	3.00	inch

Step 3: Estimate the Flow Depth

Initial Flow Depth Estimate	D_i	**1.92**	ft
Area of Channel	A	32.26	ft^2
Wetted Perimeter	P	22.34	ft
Hydraulic Radius	R	1.44	ft
Wetted Top Width	T	21.60	ft
Calculated Average Flow Depth	D_a	1.49	ft

Step 4: Estimate Manning's n and the Implied Discharge

D_a/D_{50}		1.991	
For $1.5 < D_a/D_{50} < 185$	n	0.073	
Q from mannings	Qi	137.38	ft^3/s
% Difference from Design Discharge		0.42%	
For $0.3 < D_a/D_{50} < 1.5$	n	0.057	
function(Froude number)	f(Fr)	0.800	
Froude number	Fr	0.612	
Velocity of flow	V	**4.241**	
effective roughness concrentration	b	0.436	
Roughness element geometry	f(REG)	19.794	
Channel geometry	f(CG)	0.312	
Q from mannings	Qi	177.68	ft^3/s
% Difference from Design Discharge		29.88%	

Step 5:

If % difference is > 5%, estimate a new depth in Step 3	FALSE	Proceed to Step 6
For $0.3 < D_a/D_{50} < 1.5$	TRUE	
If false, proceed to step 6		

Step 6: Calculate Reynolds and Determine Appropriate Shields Parameter & Safety Factor

Shear Velocity	V_*	1.292		
Reynolds number	R_e	7.96E+04		
Gravity	g	32.2	ft/s^2	
Kinematic Viscosity	v	1.22E-05	ft^2/s	(1.217e-5 for 60 °F)
From Table 6.1	F_*	0.073		
From Table 6.1	SF	1.124		
Specific Gravity of Stone	SG	2.64		
For S < 5%	D_{50}	0.49	ft	

Table 6.1. Selection of Shields' Parameter and Safety Factor

Reynolds number	F_*	SF	
$\leq 4x10^4$	0.047	1	
$4x10^4<Re<2x10^5$	0.073	1.124	(Linear Interpolation)
$\geq 2x10^5$	0.15	1.5	

Step 7: Iterate Solution till Calculated D50 is Acceptably Smaller then Chosen D50

Difference to Chosen Riprap	65.16%	<	100%	TRUE
IF FALSE GOTO STEP 2, ADJUST RIPRAP SIZE				

Step 8. Side Slope Assessment

Stone Angle of Repose	ϕ	42	°			
For 1.5 < Z < 5	K1	0.835				
	Ɵ	21.80	°			
	K2	0.83				
Stable D_{50}	$D_{50,s}$	0.49				
Difference to Chosen Riprap		65.41%		<	100%	TRUE

Worksheet for CTFS East Ult 500 YR Max Slope

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.076	
Channel Slope	0.04000	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	12.00	ft
Discharge	200.60	ft³/s

Results

Normal Depth	2.16	ft
Flow Area	37.64	ft²
Wetted Perimeter	23.64	ft
Hydraulic Radius	1.59	ft
Top Width	22.81	ft
Critical Depth	1.80	ft
Critical Slope	0.07829	ft/ft
Velocity	5.33	ft/s
Velocity Head	0.44	ft
Specific Energy	2.60	ft
Froude Number	0.73	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.16	ft
Critical Depth	1.80	ft
Channel Slope	0.04000	ft/ft

Worksheet for CTFS East Ult 500 YR Max Slope

GVF Output Data

Critical Slope	0.07829	ft/ft

Messages

Notes

PHASE 1 ONLY WEST CHANNEL (BOTTOM RAISED FOR REDUCED FLOW)

REMAINING CTFS WS FLOW = 100 CFS + 100YR CGS POND FLOW = 300 CFS + 100YR PPF POND FLOW = 240
= 640 CFS TOTAL

35' BOTTOM WIDTH = 2' ABOVE ULTIMATE CHANNEL THALWEG

Worksheet for CTFS East Ult 500 YR Min Slope

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.073	
Channel Slope	0.02700	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	12.00	ft
Discharge	200.60	ft³/s

Results

Normal Depth	2.35	ft
Flow Area	42.03	ft²
Wetted Perimeter	24.66	ft
Hydraulic Radius	1.70	ft
Top Width	23.75	ft
Critical Depth	1.80	ft
Critical Slope	0.07223	ft/ft
Velocity	4.77	ft/s
Velocity Head	0.35	ft
Specific Energy	2.71	ft
Froude Number	0.63	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.35	ft
Critical Depth	1.80	ft
Channel Slope	0.02700	ft/ft

Worksheet for CTFS East Ult 500 YR Min Slope

GVF Output Data

Critical Slope	0.07223	ft/ft

Messages

Notes

PHASE 1 ONLY WEST CHANNEL (BOTTOM RAISED FOR REDUCED FLOW)

REMAINING CTFS WS FLOW = 100 CFS + 100YR CGS POND FLOW = 300 CFS + 100YR PPF POND FLOW = 240
= 640 CFS TOTAL

35' BOTTOM WIDTH = 2' ABOVE ULTIMATE CHANNEL THALWEG

E.3.3 CTFS WEST CHANNEL

Worksheet for CTFS West PH1 STA 0+00 - 13+75

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.067	
Channel Slope	0.04000	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	518.00	ft³/s

Results

Normal Depth	2.18	ft
Flow Area	77.39	ft²
Wetted Perimeter	41.75	ft
Hydraulic Radius	1.85	ft
Top Width	40.91	ft
Critical Depth	1.98	ft
Critical Slope	0.05582	ft/ft
Velocity	6.69	ft/s
Velocity Head	0.70	ft
Specific Energy	2.88	ft
Froude Number	0.86	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.18	ft
Critical Depth	1.98	ft
Channel Slope	0.04000	ft/ft

HEC-15 RIPRAP DESIGN

NewFields

Lithium Nevada Corporation **Thacker Pass Project** **CTFS West Ph 1 0+00-13+75 100yr, 24hr storm**	NOTE: Gray boxes require input, Orange boxes require specific values, Red boxes are calculated

Step 1: Channel Design Parameters			
Bottom Width	B	30	ft
Side Slope	Z	2.5	x:1
Longitudinal Slope	S	0.04	ft/ft
Flow	Q	518	ft^3/s

Step 2: Initial Riprap sizing			
Median Stone Size	D_{50}	**0.75**	ft
Stone Unit Weight	Ys	165	pcf
Riprap Calculation Gradation	D_{100}	15.00	inch
	D_{75}	11.25	inch
	D_{50}	9.00	inch
	D_{30}	6.00	inch
	D_{15}	4.50	inch
	D_{10}	3.00	inch

Step 3: Estimate the Flow Depth			
Initial Flow Depth Estimate	D_i	**2.2**	ft
Area of Channel	A	78.10	ft^2
Wetted Perimeter	P	41.85	ft
Hydraulic Radius	R	1.87	ft
Wetted Top Width	T	41.00	ft
Calculated Average Flow Depth	D_a	1.90	ft

Step 4: Estimate Manning's n and the Implied Discharge			
D_a/D_{50}		2.540	
For $1.5 < D_a/D_{50} < 185$	n	0.067	
Q from mannings	Qi	528.17	ft^3/s
% Difference from Design Discharge		1.96%	
For $0.3 < D_a/D_{50} < 1.5$	n	0.054	
function(Froude number)	f(Fr)	0.866	
Froude number	Fr	0.847	
Velocity of flow	V	**6.633**	
effective roughness concrentration	b	0.397	
Roughness element geometry	f(REG)	21.110	
Channel geometry	f(CG)	0.295	
Q from mannings	Qi	651.48	ft^3/s
% Difference from Design Discharge		25.77%	

Step 5:		
If % difference is > 5%, estimate a new depth in Step 3	FALSE	Proceed to Step 6
For 0.3 < D_a/D_{50} < 1.5	TRUE	
If false, proceed to step 6		

Step 6: Calculate Reynolds and Determine Appropriate Shields Parameter & Safety Factor				
Shear Velocity	V_*	1.683		
Reynolds number	R_e	1.04E+05		
Gravity	g	32.2	ft/s^2	
Kinematic Viscosity	v	1.22E-05	ft^2/s	(1.217e-5 for 60 °F)
From Table 6.1	F_*	0.088		
From Table 6.1	SF	1.199		
Specific Gravity of Stone	SG	2.64		
For S < 5%	D_{50}	0.73	ft	

Table 6.1. Selection of Shields' Parameter and Safety Factor			
Reynolds number	F_*	SF	
≤ $4x10^4$	0.047	1	
$4x10^4$<Re<$2x10^5$	0.088	1.199	(Linear Interpolation)
≥ $2x10^5$	0.15	1.5	

Step 7: Iterate Solution till Calculated D50 is Acceptably Smaller then Chosen D50				
Difference to Chosen Riprap	97.21%	<	100%	TRUE
IF FALSE GOTO STEP 2, ADJUST RIPRAP SIZE				

Step 8. Side Slope Assessment					
Stone Angle of Repose	ϕ	42 °			
For 1.5 < Z < 5	K1	0.835			
	θ	21.80 °			
	K2	0.83			
Stable D_{50}	$D_{50,s}$	0.73			
Difference to Chosen Riprap		97.58%	<	100%	TRUE

Worksheet for CTFS West PH1 STA 13+75 - 20+40

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.046	
Channel Slope	0.01000	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	428.20	ft³/s

Results

Normal Depth	2.35	ft
Flow Area	84.21	ft²
Wetted Perimeter	42.64	ft
Hydraulic Radius	1.97	ft
Top Width	41.74	ft
Critical Depth	1.76	ft
Critical Slope	0.02721	ft/ft
Velocity	5.09	ft/s
Velocity Head	0.40	ft
Specific Energy	2.75	ft
Froude Number	0.63	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.35	ft
Critical Depth	1.76	ft
Channel Slope	0.01000	ft/ft

HEC-15 RIPRAP DESIGN

Lithium Nevada Corporation **Thacker Pass Project** **CTFS West Ph 1 13+75-20+40 100yr, 24hr storm**	NOTE: Gray boxes require input, Orange boxes require specific values, Red boxes are calculated

Step 1: Channel Design Parameters

Bottom Width	B	30	ft
Side Slope	Z	2.5	x:1
Longitudinal Slope	S	0.01	ft/ft
Flow	Q	428.2	ft^3/s

Step 2: Initial Riprap sizing

Median Stone Size	D_{50}	**0.33**	ft
Stone Unit Weight	Ys	165	pcf
Riprap Calculation Gradation	D_{100}	6.60	inch
	D_{75}	4.95	inch
	D_{50}	3.96	inch
	D_{30}	2.64	inch
	D_{15}	1.98	inch
	D_{10}	1.32	inch

Step 3: Estimate the Flow Depth

Initial Flow Depth Estimate	D_i	**2.3**	ft
Area of Channel	A	82.23	ft^2
Wetted Perimeter	P	42.39	ft
Hydraulic Radius	R	1.94	ft
Wetted Top Width	T	41.50	ft
Calculated Average Flow Depth	D_a	1.98	ft

Step 4: Estimate Manning's n and the Implied Discharge

D_a/D_{50}		6.004	
For $1.5 < D_a/D_{50} < 185$	n	0.046	
Q from mannings	Qi	410.26	ft^3/s
% Difference from Design Discharge		-4.19%	
For $0.3 < D_a/D_{50} < 1.5$	n	0.037	
function(Froude number)	f(Fr)	0.859	
Froude number	Fr	0.652	
Velocity of flow	V	**5.208**	
effective roughness concrentration	b	0.549	
Roughness element geometry	f(REG)	48.838	
Channel geometry	f(CG)	0.188	
Q from mannings	Qi	511.38	ft^3/s
% Difference from Design Discharge		19.42%	

Step 5:		
If % difference is > 5%, estimate a new depth in Step 3	FALSE	Proceed to Step 6
For 0.3 < D_a/D_{50} < 1.5	TRUE	
If false, proceed to step 6		

Step 6: Calculate Reynolds and Determine Appropriate Shields Parameter & Safety Factor				
Shear Velocity	V_*	0.861		
Reynolds number	R_e	2.33E+04		
Gravity	g	32.2	ft/s^2	
Kinematic Viscosity	v	1.22E-05	ft^2/s	(1.217e-5 for 60 °F)
From Table 6.1	F_*	0.047		
From Table 6.1	SF	1.000		
Specific Gravity of Stone	SG	2.64		
For S < 5%	D_{50}	0.30	ft	

Table 6.1. Selection of Shields' Parameter and Safety Factor			
Reynolds number	F_*	SF	
$\leq 4x10^4$	0.047	1	
$4x10^4<Re<2x10^5$	0.036	0.948	(Linear Interpolation)
$\geq 2x10^5$	0.15	1.5	

Step 7: Iterate Solution till Calculated D50 is Acceptably Smaller then Chosen D50				
Difference to Chosen Riprap	90.19%	<	100%	TRUE
IF FALSE GOTO STEP 2, ADJUST RIPRAP SIZE				

Step 8. Side Slope Assessment					
Stone Angle of Repose	ϕ	42	°		
For 1.5 < Z < 5	K1	0.835			
	ϴ	21.80	°		
	K2	0.83			
Stable D_{50}	$D_{50,s}$	0.30			
Difference to Chosen Riprap		90.53%	<	100%	TRUE

Worksheet for CTFS West PH1 STA 20+40 - 25+00

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.057	
Channel Slope	0.08400	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	406.30	ft³/s

Results

Normal Depth	1.39	ft
Flow Area	46.54	ft²
Wetted Perimeter	37.49	ft
Hydraulic Radius	1.24	ft
Top Width	36.95	ft
Critical Depth	1.70	ft
Critical Slope	0.04218	ft/ft
Velocity	8.73	ft/s
Velocity Head	1.18	ft
Specific Energy	2.57	ft
Froude Number	1.37	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.39	ft
Critical Depth	1.70	ft
Channel Slope	0.08400	ft/ft

HEC-15 RIPRAP DESIGN

NewFields

Lithium Nevada Corporation **Thacker Pass Project** **CTFS West Ph 1 20+40-25+00 100yr, 24hr storm**	NOTE: Gray boxes require input, Orange boxes require specific values, Red boxes are calculated

Step 1: Channel Design Parameters

Bottom Width	B	30	ft
Side Slope	Z	2.5	x:1
Longitudinal Slope	S	0.084	ft/ft
Flow	Q	406.3	ft^3/s

Step 2: Initial Riprap sizing

Median Stone Size	D_{50}	**1**	ft
Stone Unit Weight	Ys	165	pcf
Riprap Calculation Gradation	D_{100}	20.00	inch
	D_{75}	15.00	inch
	D_{50}	12.00	inch
	D_{30}	8.00	inch
	D_{15}	6.00	inch
	D_{10}	4.00	inch

Step 3: Estimate the Flow Depth

Initial Flow Depth Estimate	D_i	**1.4**	ft
Area of Channel	A	46.90	ft^2
Wetted Perimeter	P	37.54	ft
Hydraulic Radius	R	1.25	ft
Wetted Top Width	T	37.00	ft
Calculated Average Flow Depth	D_a	1.27	ft

Step 4: Estimate Manning's n and the Implied Discharge

D_a/D_{50}		1.268	
For $1.5 < D_a/D_{50} < 185$	n	0.098	
Q from mannings	Qi	240.36	ft^3/s
% Difference from Design Discharge		-40.84%	
For $0.3 < D_a/D_{50} < 1.5$	n	0.057	
function(Froude number)	f(Fr)	1.166	
Froude number	Fr	1.356	
Velocity of flow	V	**8.663**	
effective roughness concrentration	b	0.269	
Roughness element geometry	f(REG)	10.131	
Channel geometry	f(CG)	0.403	
Q from mannings	Qi	409.49	ft^3/s
% Difference from Design Discharge		0.78%	

Step 5:		
If % difference is > 5%, estimate a new depth in Step 3	TRUE	
For $0.3 < D_a/D_{50} < 1.5$	FALSE	Proceed to Step 6
If false, proceed to step 6		

Step 6: Calculate Reynolds and Determine Appropriate Shields Parameter & Safety Factor				
Shear Velocity	V_*	1.946		
Reynolds number	R_e	1.60E+05		
Gravity	g	32.2	ft/s^2	
Kinematic Viscosity	v	1.22E-05	ft^2/s	(1.217e-5 for 60 °F)
From Table 6.1	F_*	0.124		
From Table 6.1	SF	1.375		
Specific Gravity of Stone	SG	2.64		
For S < 5%	D_{50}	0.79	ft	

Table 6.1. Selection of Shields' Parameter and Safety Factor			
Reynolds number	F_*	SF	
$\leq 4x10^4$	0.047	1	
$4x10^4<Re<2x10^5$	0.124	1.375	(Linear Interpolation)
$\geq 2x10^5$	0.15	1.5	

Step 7: Iterate Solution till Calculated D50 is Acceptably Smaller then Chosen D50				
Difference to Chosen Riprap	79.17%	<	100%	TRUE
IF FALSE GOTO STEP 2, ADJUST RIPRAP SIZE				

Step 8. Side Slope Assessment					
Stone Angle of Repose	ɸ	42	°		
For 1.5 < Z < 5	K1	0.835			
	ϴ	21.80	°		
	K2	0.83			
Stable D_{50}	$D_{50,s}$	0.79			
Difference to Chosen Riprap		79.48%	<	100%	TRUE

Worksheet for CTFS West PH1 STA 25+00 - 27+00

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.065	
Channel Slope	0.08400	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	45.60	ft³/s

Results

Normal Depth	0.41	ft
Flow Area	12.77	ft²
Wetted Perimeter	32.22	ft
Hydraulic Radius	0.40	ft
Top Width	32.06	ft
Critical Depth	0.41	ft
Critical Slope	0.08427	ft/ft
Velocity	3.57	ft/s
Velocity Head	0.20	ft
Specific Energy	0.61	ft
Froude Number	1.00	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.41	ft
Critical Depth	0.41	ft
Channel Slope	0.08400	ft/ft

HEC-15 RIPRAP DESIGN

NewFields

Lithium Nevada Corporation **Thacker Pass Project** **CTFS West Ph 1 25+00-27+00 100yr, 24hr storm**	NOTE: Gray boxes require input, Orange boxes require specific values, Red boxes are calculated

Step 1: Channel Design Parameters			
Bottom Width	B	30	ft
Side Slope	Z	2.5	x:1
Longitudinal Slope	S	0.084	ft/ft
Flow	Q	45.6	ft^3/s

Step 2: Initial Riprap sizing			
Median Stone Size	D_{50}	**0.5**	ft
Stone Unit Weight	Ys	165	pcf
Riprap Calculation Gradation	D_{100}	10.00	inch
	D_{75}	7.50	inch
	D_{50}	6.00	inch
	D_{30}	4.00	inch
	D_{15}	3.00	inch
	D_{10}	2.00	inch

Step 3: Estimate the Flow Depth			
Initial Flow Depth Estimate	D_i	**0.41**	ft
Area of Channel	A	12.72	ft^2
Wetted Perimeter	P	32.21	ft
Hydraulic Radius	R	0.39	ft
Wetted Top Width	T	32.05	ft
Calculated Average Flow Depth	D_a	0.40	ft

Step 4: Estimate Manning's n and the Implied Discharge			
D_a/D_{50}		0.794	
For $1.5 < D_a/D_{50} < 185$	n	0.130	
Q from mannings	Qi	22.72	ft^3/s
% Difference from Design Discharge		-50.18%	
For $0.3 < D_a/D_{50} < 1.5$	n	0.065	
function(Froude number)	f(Fr)	1.623	
Froude number	Fr	1.003	
Velocity of flow	V	**3.585**	
effective roughness concrentration	b	0.143	
Roughness element geometry	f(REG)	4.027	
Channel geometry	f(CG)	0.533	
Q from mannings	Qi	45.73	ft^3/s
% Difference from Design Discharge		0.28%	

Step 5:		
If % difference is > 5%, estimate a new depth in Step 3	TRUE	
For 0.3 < D_a/D_{50} < 1.5	FALSE	Proceed to Step 6
If false, proceed to step 6		

Step 6: Calculate Reynolds and Determine Appropriate Shields Parameter & Safety Factor				
Shear Velocity	V_*	1.053		
Reynolds number	R_e	4.33E+04		
Gravity	g	32.2	ft/s^2	
Kinematic Viscosity	v	1.22E-05	ft^2/s	(1.217e-5 for 60 °F)
From Table 6.1	F_*	0.049		
From Table 6.1	SF	1.010		
Specific Gravity of Stone	SG	2.64		
For S < 5%	D_{50}	0.43	ft	

Table 6.1. Selection of Shields' Parameter and Safety Factor			
Reynolds number	F_*	SF	
$\leq 4x10^4$	0.047	1	
$4x10^4$<Re<$2x10^5$	0.049	1.010	(Linear Interpolation)
$\geq 2x10^5$	0.15	1.5	

Step 7: Iterate Solution till Calculated D50 is Acceptably Smaller then Chosen D50				
Difference to Chosen Riprap	86.19%	<	100%	TRUE
IF FALSE GOTO STEP 2, ADJUST RIPRAP SIZE				

Step 8. Side Slope Assessment						
Stone Angle of Repose	ϕ	42	°			
For 1.5 < Z < 5	K1	0.835				
	ϴ	21.80	°			
	K2	0.83				
Stable D_{50}	$D_{50,s}$	0.43				
Difference to Chosen Riprap		86.52%		<	100%	TRUE

Worksheet for CTFS West PH1 STA 27+00 - 29+64

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.082	
Channel Slope	0.05300	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	29.90	ft³/s

Results

Normal Depth	0.42	ft
Flow Area	13.08	ft²
Wetted Perimeter	32.27	ft
Hydraulic Radius	0.41	ft
Top Width	32.11	ft
Critical Depth	0.31	ft
Critical Slope	0.14657	ft/ft
Velocity	2.29	ft/s
Velocity Head	0.08	ft
Specific Energy	0.50	ft
Froude Number	0.63	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.42	ft
Critical Depth	0.31	ft
Channel Slope	0.05300	ft/ft

HEC-15 RIPRAP DESIGN

NewFields

Lithium Nevada Corporation **Thacker Pass Project** **CTFS West Ph 1 27+00-29+64 100yr, 24hr storm**	NOTE: Gray boxes require input, Orange boxes require specific values, Red boxes are calculated

Step 1: Channel Design Parameters			
Bottom Width	B	30	ft
Side Slope	Z	2.5	x:1
Longitudinal Slope	S	0.053	ft/ft
Flow	Q	29.9	ft^3/s

Step 2: Initial Riprap sizing			
Median Stone Size	D_{50}	**0.33**	ft
Stone Unit Weight	Ys	165	pcf
Riprap Calculation Gradation	D_{100}	6.60	inch
	D_{75}	4.95	inch
	D_{50}	3.96	inch
	D_{30}	2.64	inch
	D_{15}	1.98	inch
	D_{10}	1.32	inch

Step 3: Estimate the Flow Depth			
Initial Flow Depth Estimate	D_i	**0.42**	ft
Area of Channel	A	13.04	ft^2
Wetted Perimeter	P	32.26	ft
Hydraulic Radius	R	0.40	ft
Wetted Top Width	T	32.10	ft
Calculated Average Flow Depth	D_a	0.41	ft

Step 4: Estimate Manning's n and the Implied Discharge			
D_a/D_{50}		1.231	
For $1.5 < D_a/D_{50} < 185$	n	0.083	
Q from mannings	Qi	29.53	ft^3/s
% Difference from Design Discharge		-1.25%	
For $0.3 < D_a/D_{50} < 1.5$	n	0.082	
function(Froude number)	f(Fr)	1.029	
Froude number	Fr	0.634	
Velocity of flow	V	**2.293**	
effective roughness concrentration	b	0.170	
Roughness element geometry	f(REG)	5.642	
Channel geometry	f(CG)	0.476	
Q from mannings	Qi	29.93	ft^3/s
% Difference from Design Discharge		0.11%	

Step 5:

If % difference is > 5%, estimate a new depth in Step 3	FALSE	
For 0.3 < D_a/D_{50} < 1.5	FALSE	Proceed to Step 6
If false, proceed to step 6		

Step 6: Calculate Reynolds and Determine Appropriate Shields Parameter & Safety Factor

Shear Velocity	V_*	0.847		
Reynolds number	R_e	2.30E+04		
Gravity	g	32.2	ft/s^2	
Kinematic Viscosity	v	1.22E-05	ft^2/s	(1.217e-5 for 60 °F)
From Table 6.1	F_*	0.047		
From Table 6.1	SF	1.000		
Specific Gravity of Stone	SG	2.64		
For S < 5%	D_{50}	0.29	ft	

Table 6.1. Selection of Shields' Parameter and Safety Factor

Reynolds number	F_*	SF	
≤ $4x10^4$	0.047	1	
$4x10^4$<Re<$2x10^5$	0.036	0.947	(Linear Interpolation)
≥ $2x10^5$	0.15	1.5	

Step 7: Iterate Solution till Calculated D50 is Acceptably Smaller then Chosen D50

Difference to Chosen Riprap	87.29%	<	100%	TRUE
IF FALSE GOTO STEP 2, ADJUST RIPRAP SIZE				

Step 8. Side Slope Assessment

Stone Angle of Repose	ϕ	42	°		
For 1.5 < Z < 5	K1	0.835			
	ϴ	21.80	°		
	K2	0.83			
Stable D_{50}	$D_{50,s}$	0.29			
Difference to Chosen Riprap		87.62%	<	100%	TRUE

Worksheet for CTFS West PH1 STA 29+64 - 38+69

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.032	
Channel Slope	0.00600	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	29.90	ft³/s

Results

Normal Depth	0.46	ft
Flow Area	14.34	ft²
Wetted Perimeter	32.48	ft
Hydraulic Radius	0.44	ft
Top Width	32.30	ft
Critical Depth	0.31	ft
Critical Slope	0.02232	ft/ft
Velocity	2.08	ft/s
Velocity Head	0.07	ft
Specific Energy	0.53	ft
Froude Number	0.55	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.46	ft
Critical Depth	0.31	ft
Channel Slope	0.00600	ft/ft

HEC-15 RIPRAP DESIGN

Lithium Nevada Corporation **Thacker Pass Project** **CTFS West Ph 1 29+64-38+69 100yr, 24hr storm**	NOTE: Gray boxes require input, Orange boxes require specific values, Red boxes are calculated

Step 1: Channel Design Parameters			
Bottom Width	B	30	ft
Side Slope	Z	2.5	x:1
Longitudinal Slope	S	0.006	ft/ft
Flow	Q	29.9	ft^3/s

Step 2: Initial Riprap sizing			
Median Stone Size	D_{50}	**0.05**	ft
Stone Unit Weight	Ys	165	pcf
Riprap Calculation Gradation	D_{100}	1.00	inch
	D_{75}	0.75	inch
	D_{50}	0.60	inch
	D_{30}	0.40	inch
	D_{15}	0.30	inch
	D_{10}	0.20	inch

Step 3: Estimate the Flow Depth			
Initial Flow Depth Estimate	D_i	**0.46**	ft
Area of Channel	A	14.33	ft^2
Wetted Perimeter	P	32.48	ft
Hydraulic Radius	R	0.44	ft
Wetted Top Width	T	32.30	ft
Calculated Average Flow Depth	D_a	0.44	ft

Step 4: Estimate Manning's n and the Implied Discharge			
D_a/D_{50}		8.872	
For $1.5 < D_a/D_{50} < 185$	n	0.032	
Q from mannings	Qi	30.19	ft^3/s
% Difference from Design Discharge		0.99%	
For $0.3 < D_a/D_{50} < 1.5$	n	0.041	
function(Froude number)	f(Fr)	0.762	
Froude number	Fr	0.552	
Velocity of flow	V	**2.087**	
effective roughness concrentration	b	0.359	
Roughness element geometry	f(REG)	34.144	
Channel geometry	f(CG)	0.214	
Q from mannings	Qi	23.28	ft^3/s
% Difference from Design Discharge		-22.12%	

Step 5:		
If % difference is > 5%, estimate a new depth in Step 3	FALSE	Proceed to Step 6
For 0.3 < D_a/D_{50} < 1.5	TRUE	
If false, proceed to step 6		

Step 6: Calculate Reynolds and Determine Appropriate Shields Parameter & Safety Factor				
Shear Velocity	V_*	0.298		
Reynolds number	R_e	1.22E+03		
Gravity	g	32.2	ft/s^2	
Kinematic Viscosity	v	1.22E-05	ft^2/s	(1.217e-5 for 60 °F)
From Table 6.1	F_*	0.047		
From Table 6.1	SF	1.000		
Specific Gravity of Stone	SG	2.64		
For S < 5%	D_{50}	0.04	ft	

Table 6.1. Selection of Shields' Parameter and Safety Factor			
Reynolds number	F_*	SF	
$\leq 4 \times 10^4$	0.047	1	
$4 \times 10^4 < Re < 2 \times 10^5$	0.022	0.879	(Linear Interpolation)
$\geq 2 \times 10^5$	0.15	1.5	

Step 7: Iterate Solution till Calculated D50 is Acceptably Smaller then Chosen D50				
Difference to Chosen Riprap	71.43%	<	100%	TRUE
IF FALSE GOTO STEP 2, ADJUST RIPRAP SIZE				

Step 8. Side Slope Assessment					
Stone Angle of Repose	ϕ	42	°		
For 1.5 < Z < 5	K1	0.835			
	ϴ	21.80	°		
	K2	0.83			
Stable D_{50}	$D_{50,s}$	0.04			
Difference to Chosen Riprap		71.70%	<	100%	TRUE

Worksheet for CTFS West Outlet 0+00 - 13+75

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.066	
Channel Slope	0.04000	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	1381.70	ft³/s

Results

Normal Depth	3.78	ft
Flow Area	148.90	ft²
Wetted Perimeter	50.33	ft
Hydraulic Radius	2.96	ft
Top Width	48.88	ft
Critical Depth	3.63	ft
Critical Slope	0.04600	ft/ft
Velocity	9.28	ft/s
Velocity Head	1.34	ft
Specific Energy	5.11	ft
Froude Number	0.94	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.78	ft
Critical Depth	3.63	ft
Channel Slope	0.04000	ft/ft

HEC-15 RIPRAP DESIGN

Lithium Nevada Corporation **Thacker Pass Project** **CTFS West Ult 0+00-13+75 100yr, 24hr storm**	NOTE: Gray boxes require input, Orange boxes require specific values, Red boxes are calculated

Step 1: Channel Design Parameters			
Bottom Width	B	30	ft
Side Slope	Z	2.5	x:1
Longitudinal Slope	S	0.04	ft/ft
Flow	Q	1382	ft^3/s

Step 2: Initial Riprap sizing			
Median Stone Size	D_{50}	**1**	ft
Stone Unit Weight	Ys	165	pcf
Riprap Calculation Gradation	D_{100}	20.00	inch
	D_{75}	15.00	inch
	D_{50}	12.00	inch
	D_{30}	8.00	inch
	D_{15}	6.00	inch
	D_{10}	4.00	inch

Step 3: Estimate the Flow Depth			
Initial Flow Depth Estimate	D_i	**3.8**	ft
Area of Channel	A	150.10	ft^2
Wetted Perimeter	P	50.46	ft
Hydraulic Radius	R	2.97	ft
Wetted Top Width	T	49.00	ft
Calculated Average Flow Depth	D_a	3.06	ft

Step 4: Estimate Manning's n and the Implied Discharge			
D_a/D_{50}		3.063	
For $1.5 < D_a/D_{50} < 185$	n	0.066	
Q from mannings	Qi	1404.27	ft^3/s
% Difference from Design Discharge		1.61%	
For $0.3 < D_a/D_{50} < 1.5$	n	0.049	
function(Froude number)	f(Fr)	0.887	
Froude number	Fr	0.927	
Velocity of flow	V	**9.207**	
effective roughness concrentration	b	0.486	
Roughness element geometry	f(REG)	28.311	
Channel geometry	f(CG)	0.260	
Q from mannings	Qi	1906.13	ft^3/s
% Difference from Design Discharge		37.93%	

Step 5:		
If % difference is > 5%, estimate a new depth in Step 3	FALSE	Proceed to Step 6
For 0.3 < D_a/D_{50} < 1.5	TRUE	
If false, proceed to step 6		

Step 6: Calculate Reynolds and Determine Appropriate Shields Parameter & Safety Factor				
Shear Velocity	V_*	2.212		
Reynolds number	R_e	1.82E+05		
Gravity	g	32.2	ft/s^2	
Kinematic Viscosity	v	1.22E-05	ft^2/s	(1.217e-5 for 60 °F)
From Table 6.1	F_*	0.138		
From Table 6.1	SF	1.443		
Specific Gravity of Stone	SG	2.64		
For S < 5%	D_{50}	0.96	ft	

Table 6.1. Selection of Shields' Parameter and Safety Factor			
Reynolds number	F_*	SF	
$\leq 4x10^4$	0.047	1	
$4x10^4<Re<2x10^5$	0.138	1.443	(Linear Interpolation)
$\geq 2x10^5$	0.15	1.5	

Step 7: Iterate Solution till Calculated D50 is Acceptably Smaller then Chosen D50				
Difference to Chosen Riprap	96.48%	<	100%	TRUE
IF FALSE GOTO STEP 2, ADJUST RIPRAP SIZE				

Step 8. Side Slope Assessment					
Stone Angle of Repose	ϕ	42	°		
For 1.5 < Z < 5	K1	0.835			
	ϴ	21.80	°		
	K2	0.83			
Stable D_{50}	$D_{50,s}$	0.97			
Difference to Chosen Riprap		96.85%	<	100%	TRUE

Worksheet for CTFS West 106+00 - 112+73

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.070	
Channel Slope	0.04200	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	886.50	ft³/s

Results

Normal Depth	3.00	ft
Flow Area	112.51	ft²
Wetted Perimeter	46.16	ft
Hydraulic Radius	2.44	ft
Top Width	45.00	ft
Critical Depth	2.77	ft
Critical Slope	0.05559	ft/ft
Velocity	7.88	ft/s
Velocity Head	0.96	ft
Specific Energy	3.97	ft
Froude Number	0.88	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.00	ft
Critical Depth	2.77	ft
Channel Slope	0.04200	ft/ft

HEC-15 RIPRAP DESIGN

NewFields

Lithium Nevada Corporation **Thacker Pass Project** **CTFS West Ult 106+00-112+73, 100yr 24hr storm**	NOTE: Gray boxes require input, Orange boxes require specific values, Red boxes are calculated

Step 1: Channel Design Parameters			
Bottom Width	B	30	ft
Side Slope	Z	2.5	x:1
Longitudinal Slope	S	0.042	ft/ft
Flow	Q	886.5	ft^3/s

Step 2: Initial Riprap sizing			
Median Stone Size	D_{50}	**1**	ft
Stone Unit Weight	Ys	165	pcf
Riprap Calculation Gradation	D_{100}	20.00	inch
	D_{75}	15.00	inch
	D_{50}	12.00	inch
	D_{30}	8.00	inch
	D_{15}	6.00	inch
	D_{10}	4.00	inch

Step 3: Estimate the Flow Depth			
Initial Flow Depth Estimate	D_i	**3**	ft
Area of Channel	A	112.50	ft^2
Wetted Perimeter	P	46.16	ft
Hydraulic Radius	R	2.44	ft
Wetted Top Width	T	45.00	ft
Calculated Average Flow Depth	D_a	2.50	ft

Step 4: Estimate Manning's n and the Implied Discharge			
D_a/D_{50}		2.500	
For $1.5 < D_a/D_{50} < 185$	n	0.070	
Q from mannings	Qi	882.88	ft^3/s
% Difference from Design Discharge		-0.41%	
For $0.3 < D_a/D_{50} < 1.5$	n	0.054	
function(Froude number)	f(Fr)	0.872	
Froude number	Fr	0.878	
Velocity of flow	V	**7.880**	
effective roughness concrentration	b	0.428	
Roughness element geometry	f(REG)	22.407	
Channel geometry	f(CG)	0.290	
Q from mannings	Qi	1152.22	ft^3/s
% Difference from Design Discharge		29.97%	

Step 5:		
If % difference is > 5%, estimate a new depth in Step 3	FALSE	Proceed to Step 6
For 0.3 < D_a/D_{50} < 1.5	TRUE	
If false, proceed to step 6		

Step 6: Calculate Reynolds and Determine Appropriate Shields Parameter & Safety Factor				
Shear Velocity	V_*	2.014		
Reynolds number	R_e	1.66E+05		
Gravity	g	32.2	ft/s^2	
Kinematic Viscosity	v	1.22E-05	ft^2/s	(1.217e-5 for 60 °F)
From Table 6.1	F_*	0.128		
From Table 6.1	SF	1.392		
Specific Gravity of Stone	SG	2.64		
For S < 5%	D_{50}	0.83	ft	

Table 6.1. Selection of Shields' Parameter and Safety Factor			
Reynolds number	F_*	SF	
$\leq 4x10^4$	0.047	1	
$4x10^4<Re<2x10^5$	0.128	1.392	(Linear Interpolation)
$\geq 2x10^5$	0.15	1.5	

Step 7: Iterate Solution till Calculated D50 is Acceptably Smaller then Chosen D50				
Difference to Chosen Riprap	83.48%	<	100%	TRUE
IF FALSE GOTO STEP 2, ADJUST RIPRAP SIZE				

Step 8. Side Slope Assessment						
Stone Angle of Repose	ϕ	42	°			
For 1.5 < Z < 5	K1	0.835				
	ϴ	21.80	°			
	K2	0.83				
Stable D_{50}	$D_{50,s}$	0.84				
Difference to Chosen Riprap		83.80%		<	100%	TRUE

Worksheet for CTFS West 112+73 - 116+00

Project Description

Friction Method	Manning Formula	
Solve For	Normal Depth	

Input Data

Roughness Coefficient	0.060	
Channel Slope	0.02200	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	878.70	ft³/s

Results

Normal Depth	3.28	ft
Flow Area	125.50	ft²
Wetted Perimeter	47.69	ft
Hydraulic Radius	2.63	ft
Top Width	46.42	ft
Critical Depth	2.76	ft
Critical Slope	0.04090	ft/ft
Velocity	7.00	ft/s
Velocity Head	0.76	ft
Specific Energy	4.05	ft
Froude Number	0.75	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.28	ft
Critical Depth	2.76	ft
Channel Slope	0.02200	ft/ft

HEC-15 RIPRAP DESIGN

Lithium Nevada Corporation **Thacker Pass Project** **CTFS West Ult 112+73-116+00, 100yr 24hr storm**	NOTE: Gray boxes require input, Orange boxes require specific values, Red boxes are calculated

Step 1: Channel Design Parameters			
Bottom Width	B	30	ft
Side Slope	Z	2.5	x:1
Longitudinal Slope	S	0.022	ft/ft
Flow	Q	878.7	ft^3/s

Step 2: Initial Riprap sizing			
Median Stone Size	D_{50}	**0.75**	ft
Stone Unit Weight	Ys	165	pcf
Riprap Calculation Gradation	D_{100}	15.00	inch
	D_{75}	11.25	inch
	D_{50}	9.00	inch
	D_{30}	6.00	inch
	D_{15}	4.50	inch
	D_{10}	3.00	inch

Step 3: Estimate the Flow Depth			
Initial Flow Depth Estimate	D_i	**3.3**	ft
Area of Channel	A	126.23	ft^2
Wetted Perimeter	P	47.77	ft
Hydraulic Radius	R	2.64	ft
Wetted Top Width	T	46.50	ft
Calculated Average Flow Depth	D_a	2.71	ft

Step 4: Estimate Manning's n and the Implied Discharge			
D_a/D_{50}		3.619	
For $1.5 < D_a/D_{50} < 185$	n	0.060	
Q from mannings	Qi	891.06	ft^3/s
% Difference from Design Discharge		1.41%	
For $0.3 < D_a/D_{50} < 1.5$	n	0.047	
function(Froude number)	f(Fr)	0.855	
Froude number	Fr	0.745	
Velocity of flow	V	**6.961**	
effective roughness concrentration	b	0.501	
Roughness element geometry	f(REG)	32.292	
Channel geometry	f(CG)	0.241	
Q from mannings	Qi	1144.66	ft^3/s
% Difference from Design Discharge		30.27%	

Step 5:

If % difference is > 5%, estimate a new depth in Step 3	FALSE	Proceed to Step 6
For 0.3 < D_a/D_{50} < 1.5	TRUE	
If false, proceed to step 6		

Step 6: Calculate Reynolds and Determine Appropriate Shields Parameter & Safety Factor

Shear Velocity	V_*	1.529		
Reynolds number	R_e	9.42E+04		
Gravity	g	32.2	ft/s^2	
Kinematic Viscosity	v	1.22E-05	ft^2/s	(1.217e-5 for 60 °F)
From Table 6.1	F_*	0.082		
From Table 6.1	SF	1.169		
Specific Gravity of Stone	SG	2.64		
For S < 5%	D_{50}	0.63	ft	

Table 6.1. Selection of Shields' Parameter and Safety Factor

Reynolds number	F_*	SF	
$\leq 4\text{x}10^4$	0.047	1	
$4\text{x}10^4<Re<2\text{x}10^5$	0.082	1.169	(Linear Interpolation)
$\geq 2\text{x}10^5$	0.15	1.5	

Step 7: Iterate Solution till Calculated D50 is Acceptably Smaller then Chosen D50

Difference to Chosen Riprap	84.06%	<	100%	TRUE
IF FALSE GOTO STEP 2, ADJUST RIPRAP SIZE				

Step 8. Side Slope Assessment

Stone Angle of Repose	ϕ	42	°		
For 1.5 < Z < 5	K1	0.835			
	ϴ	21.80	°		
	K2	0.83			
Stable D_{50}	$D_{50,s}$	0.63			
Difference to Chosen Riprap		84.38%	<	100%	TRUE

Worksheet for CTFS West 116+00 - 123+50

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.070	
Channel Slope	0.04200	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	876.10	ft³/s

Results

Normal Depth	2.98	ft
Flow Area	111.61	ft²
Wetted Perimeter	46.05	ft
Hydraulic Radius	2.42	ft
Top Width	44.90	ft
Critical Depth	2.75	ft
Critical Slope	0.05570	ft/ft
Velocity	7.85	ft/s
Velocity Head	0.96	ft
Specific Energy	3.94	ft
Froude Number	0.88	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.98	ft
Critical Depth	2.75	ft
Channel Slope	0.04200	ft/ft

HEC-15 RIPRAP DESIGN

Lithium Nevada Corporation **Thacker Pass Project** **CTFS West Ult 116+00-123+50, 100yr 24hr storm**	NOTE: Gray boxes require input, Orange boxes require specific values, Red boxes are calculated

Step 1: Channel Design Parameters			
Bottom Width	B	30	ft
Side Slope	Z	2.5	x:1
Longitudinal Slope	S	0.042	ft/ft
Flow	Q	876.1	ft^3/s

Step 2: Initial Riprap sizing			
Median Stone Size	D_{50}	**1**	ft
Stone Unit Weight	Ys	165	pcf
Riprap Calculation Gradation	D_{100}	20.00	inch
	D_{75}	15.00	inch
	D_{50}	12.00	inch
	D_{30}	8.00	inch
	D_{15}	6.00	inch
	D_{10}	4.00	inch

Step 3: Estimate the Flow Depth			
Initial Flow Depth Estimate	D_i	**3**	ft
Area of Channel	A	112.50	ft^2
Wetted Perimeter	P	46.16	ft
Hydraulic Radius	R	2.44	ft
Wetted Top Width	T	45.00	ft
Calculated Average Flow Depth	D_a	2.50	ft

Step 4: Estimate Manning's n and the Implied Discharge			
D_a/D_{50}		2.500	
For $1.5 < D_a/D_{50} < 185$	n	0.070	
Q from mannings	Qi	882.88	ft^3/s
% Difference from Design Discharge		0.77%	
For $0.3 < D_a/D_{50} < 1.5$	n	0.054	
function(Froude number)	f(Fr)	0.870	
Froude number	Fr	0.868	
Velocity of flow	V	**7.788**	
effective roughness concrentration	b	0.428	
Roughness element geometry	f(REG)	22.407	
Channel geometry	f(CG)	0.290	
Q from mannings	Qi	1148.88	ft^3/s
% Difference from Design Discharge		31.14%	

Step 5:		
If % difference is > 5%, estimate a new depth in Step 3	FALSE	Proceed to Step 6
For $0.3 < D_a/D_{50} < 1.5$	TRUE	
If false, proceed to step 6		

Step 6: Calculate Reynolds and Determine Appropriate Shields Parameter & Safety Factor				
Shear Velocity	V_*	2.014		
Reynolds number	R_e	1.66E+05		
Gravity	g	32.2	ft/s^2	
Kinematic Viscosity	v	1.22E-05	ft^2/s	(1.217e-5 for 60 °F)
From Table 6.1	F_*	0.128		
From Table 6.1	SF	1.392		
Specific Gravity of Stone	SG	2.64		
For S < 5%	D_{50}	0.83	ft	

Table 6.1. Selection of Shields' Parameter and Safety Factor			
Reynolds number	F_*	SF	
$\leq 4x10^4$	0.047	1	
$4x10^4<Re<2x10^5$	0.128	1.392	(Linear Interpolation)
$\geq 2x10^5$	0.15	1.5	

Step 7: Iterate Solution till Calculated D50 is Acceptably Smaller then Chosen D50				
Difference to Chosen Riprap	83.48%	<	100%	TRUE
IF FALSE GOTO STEP 2, ADJUST RIPRAP SIZE				

Step 8. Side Slope Assessment						
Stone Angle of Repose	ϕ	42	°			
For 1.5 < Z < 5	K1	0.835				
	ϴ	21.80	°			
	K2	0.83				
Stable D_{50}	$D_{50,s}$	0.84				
Difference to Chosen Riprap		83.80%		<	100%	TRUE

Worksheet for CTFS West 132+65 - 167+50

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.051	
Channel Slope	0.01100	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	727.20	ft³/s

Results

Normal Depth	3.27	ft
Flow Area	125.05	ft²
Wetted Perimeter	47.63	ft
Hydraulic Radius	2.63	ft
Top Width	46.37	ft
Critical Depth	2.45	ft
Critical Slope	0.03050	ft/ft
Velocity	5.82	ft/s
Velocity Head	0.53	ft
Specific Energy	3.80	ft
Froude Number	0.62	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.27	ft
Critical Depth	2.45	ft
Channel Slope	0.01100	ft/ft

HEC-15 RIPRAP DESIGN

NewFields

Lithium Nevada Corporation **Thacker Pass Project** **CTFS West Ult 123+50-126+00, 100yr 24hr storm**	NOTE: Gray boxes require input, Orange boxes require specific values, Red boxes are calculated

Step 1: Channel Design Parameters			
Bottom Width	B	30	ft
Side Slope	Z	2.5	x:1
Longitudinal Slope	S	0.042	ft/ft
Flow	Q	864.1	ft^3/s

Step 2: Initial Riprap sizing			
Median Stone Size	D_{50}	**1**	ft
Stone Unit Weight	Ys	165	pcf
Riprap Calculation Gradation	D_{100}	20.00	inch
	D_{75}	15.00	inch
	D_{50}	12.00	inch
	D_{30}	8.00	inch
	D_{15}	6.00	inch
	D_{10}	4.00	inch

Step 3: Estimate the Flow Depth			
Initial Flow Depth Estimate	D_i	**3**	ft
Area of Channel	A	112.50	ft^2
Wetted Perimeter	P	46.16	ft
Hydraulic Radius	R	2.44	ft
Wetted Top Width	T	45.00	ft
Calculated Average Flow Depth	D_a	2.50	ft

Step 4: Estimate Manning's n and the Implied Discharge			
D_a/D_{50}		2.500	
For $1.5 < D_a/D_{50} < 185$	n	0.070	
Q from mannings	Qi	882.88	ft^3/s
% Difference from Design Discharge		2.17%	
For $0.3 < D_a/D_{50} < 1.5$	n	0.054	
function(Froude number)	f(Fr)	0.867	
Froude number	Fr	0.856	
Velocity of flow	V	**7.681**	
effective roughness concrentration	b	0.428	
Roughness element geometry	f(REG)	22.407	
Channel geometry	f(CG)	0.290	
Q from mannings	Qi	1144.99	ft^3/s
% Difference from Design Discharge		32.51%	

Step 5:

If % difference is > 5%, estimate a new depth in Step 3	FALSE	Proceed to Step 6
For 0.3 < D_a/D_{50} < 1.5	TRUE	
If false, proceed to step 6		

Step 6: Calculate Reynolds and Determine Appropriate Shields Parameter & Safety Factor

Shear Velocity	V_*	2.014		
Reynolds number	R_e	1.66E+05		
Gravity	g	32.2	ft/s^2	
Kinematic Viscosity	v	1.22E-05	ft^2/s	(1.217e-5 for 60 °F)
From Table 6.1	F_*	0.128		
From Table 6.1	SF	1.392		
Specific Gravity of Stone	SG	2.64		
For S < 5%	D_{50}	0.83	ft	

Table 6.1. Selection of Shields' Parameter and Safety Factor

Reynolds number	F_*	SF	
$\leq 4\times10^4$	0.047	1	
$4\times10^4<Re<2\times10^5$	0.128	1.392	(Linear Interpolation)
$\geq 2\times10^5$	0.15	1.5	

Step 7: Iterate Solution till Calculated D50 is Acceptably Smaller then Chosen D50

Difference to Chosen Riprap	83.48%	<	100%	TRUE
IF FALSE GOTO STEP 2, ADJUST RIPRAP SIZE				

Step 8. Side Slope Assessment

Stone Angle of Repose	ϕ	42	°		
For 1.5 < Z < 5	K1	0.835			
	ϴ	21.80	°		
	K2	0.83			
Stable D_{50}	$D_{50,s}$	0.84			
Difference to Chosen Riprap		83.80%	<	100%	TRUE

Worksheet for CTFS West 126+00 - 132+65

Project Description

Friction Method	Manning Formula	
Solve For	Normal Depth	

Input Data

Roughness Coefficient	0.060	
Channel Slope	0.02000	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	861.70	ft³/s

Results

Normal Depth	3.34	ft
Flow Area	127.93	ft²
Wetted Perimeter	47.97	ft
Hydraulic Radius	2.67	ft
Top Width	46.68	ft
Critical Depth	2.72	ft
Critical Slope	0.04103	ft/ft
Velocity	6.74	ft/s
Velocity Head	0.71	ft
Specific Energy	4.04	ft
Froude Number	0.72	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.34	ft
Critical Depth	2.72	ft
Channel Slope	0.02000	ft/ft

HEC-15 RIPRAP DESIGN

Lithium Nevada Corporation **Thacker Pass Project** **CTFS West Ult 126+00-132+65, 100yr 24hr storm**	NOTE: Gray boxes require input, Orange boxes require specific values, Red boxes are calculated

Step 1: Channel Design Parameters			
Bottom Width	B	30	ft
Side Slope	Z	2.5	x:1
Longitudinal Slope	S	0.02	ft/ft
Flow	Q	861.7	ft^3/s

Step 2: Initial Riprap sizing			
Median Stone Size	D_{50}	**0.75**	ft
Stone Unit Weight	Ys	165	pcf
Riprap Calculation Gradation	D_{100}	15.00	inch
	D_{75}	11.25	inch
	D_{50}	9.00	inch
	D_{30}	6.00	inch
	D_{15}	4.50	inch
	D_{10}	3.00	inch

Step 3: Estimate the Flow Depth			
Initial Flow Depth Estimate	D_i	**3.35**	ft
Area of Channel	A	128.56	ft^2
Wetted Perimeter	P	48.04	ft
Hydraulic Radius	R	2.68	ft
Wetted Top Width	T	46.75	ft
Calculated Average Flow Depth	D_a	2.75	ft

Step 4: Estimate Manning's n and the Implied Discharge			
D_a/D_{50}		3.666	
For $1.5 < D_a/D_{50} < 185$	n	0.060	
Q from mannings	Qi	875.70	ft^3/s
% Difference from Design Discharge		1.62%	
For $0.3 < D_a/D_{50} < 1.5$	n	0.047	
function(Froude number)	f(Fr)	0.850	
Froude number	Fr	0.712	
Velocity of flow	V	**6.703**	
effective roughness concrentration	b	0.505	
Roughness element geometry	f(REG)	32.794	
Channel geometry	f(CG)	0.239	
Q from mannings	Qi	1120.37	ft^3/s
% Difference from Design Discharge		30.02%	

Step 5:

If % difference is > 5%, estimate a new depth in Step 3	FALSE	Proceed to Step 6
For 0.3 < D_a/D_{50} < 1.5	TRUE	
If false, proceed to step 6		

Step 6: Calculate Reynolds and Determine Appropriate Shields Parameter & Safety Factor

Shear Velocity	V_*	1.469		
Reynolds number	R_e	9.05E+04		
Gravity	g	32.2	ft/s^2	
Kinematic Viscosity	v	1.22E-05	ft^2/s	(1.217e-5 for 60 °F)
From Table 6.1	F_*	0.080		
From Table 6.1	SF	1.158		
Specific Gravity of Stone	SG	2.64		
For S < 5%	D_{50}	0.59	ft	

Table 6.1. Selection of Shields' Parameter and Safety Factor

Reynolds number	F_*	SF	
$\leq 4x10^4$	0.047	1	
$4x10^4 < Re < 2x10^5$	0.080	1.158	(Linear Interpolation)
$\geq 2x10^5$	0.15	1.5	

Step 7: Iterate Solution till Calculated D50 is Acceptably Smaller then Chosen D50

Difference to Chosen Riprap	79.11%	<	100%	TRUE
IF FALSE GOTO STEP 2, ADJUST RIPRAP SIZE				

Step 8. Side Slope Assessment

Stone Angle of Repose	ϕ	42	°		
For 1.5 < Z < 5	K1	0.835			
	ϴ	21.80	°		
	K2	0.83			
Stable D_{50}	$D_{50,s}$	0.60			
Difference to Chosen Riprap		79.41%	<	100%	TRUE

Worksheet for CTFS West Outlet 13+75 - 20+40

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.055	
Channel Slope	0.01000	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	1291.50	ft³/s

Results

Normal Depth	4.82	ft
Flow Area	202.68	ft²
Wetted Perimeter	55.96	ft
Hydraulic Radius	3.62	ft
Top Width	54.10	ft
Critical Depth	3.49	ft
Critical Slope	0.03229	ft/ft
Velocity	6.37	ft/s
Velocity Head	0.63	ft
Specific Energy	5.45	ft
Froude Number	0.58	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	4.82	ft
Critical Depth	3.49	ft
Channel Slope	0.01000	ft/ft

HEC-15 RIPRAP DESIGN

Lithium Nevada Corporation
Thacker Pass Project
CTFS West Ult 13+75-20+40 100yr, 24hr storm

NOTE: Gray boxes require input, Orange boxes require specific values, Red boxes are calculated

Step 1: Channel Design Parameters

Bottom Width	B	30	ft
Side Slope	Z	2.5	x:1
Longitudinal Slope	S	0.01	ft/ft
Flow	Q	1291.5	ft^3/s

Step 2: Initial Riprap sizing

Median Stone Size	D_{50}	**0.75**	ft
Stone Unit Weight	Ys	165	pcf
Riprap Calculation Gradation	D_{100}	15.00	inch
	D_{75}	11.25	inch
	D_{50}	9.00	inch
	D_{30}	6.00	inch
	D_{15}	4.50	inch
	D_{10}	3.00	inch

Step 3: Estimate the Flow Depth

Initial Flow Depth Estimate	D_i	**4.8**	ft
Area of Channel	A	201.60	ft^2
Wetted Perimeter	P	55.85	ft
Hydraulic Radius	R	3.61	ft
Wetted Top Width	T	54.00	ft
Calculated Average Flow Depth	D_a	3.73	ft

Step 4: Estimate Manning's n and the Implied Discharge

D_a/D_{50}		4.978	
For $1.5 < D_a/D_{50} < 185$	n	0.055	
Q from mannings	Qi	1277.02	ft^3/s
% Difference from Design Discharge		-1.12%	
For $0.3 < D_a/D_{50} < 1.5$	n	0.040	
function(Froude number)	f(Fr)	0.883	
Froude number	Fr	0.584	
Velocity of flow	V	**6.406**	
effective roughness concrentration	b	0.607	
Roughness element geometry	f(REG)	47.147	
Channel geometry	f(CG)	0.198	
Q from mannings	Qi	1779.20	ft^3/s
% Difference from Design Discharge		37.76%	

Step 5:

If % difference is > 5%, estimate a new depth in Step 3	FALSE	Proceed to Step 6
For $0.3 < D_a/D_{50} < 1.5$	TRUE	
If false, proceed to step 6		

Step 6: Calculate Reynolds and Determine Appropriate Shields Parameter & Safety Factor

Shear Velocity	V_*	1.243		
Reynolds number	R_e	7.66E+04		
Gravity	g	32.2	ft/s^2	
Kinematic Viscosity	v	1.22E-05	ft^2/s	(1.217e-5 for 60 °F)
From Table 6.1	F_*	0.071		
From Table 6.1	SF	1.114		
Specific Gravity of Stone	SG	2.64		
For S < 5%	D_{50}	0.46	ft	

Table 6.1. Selection of Shields' Parameter and Safety Factor

Reynolds number	F_*	SF	
$\leq 4x10^4$	0.047	1	
$4x10^4<Re<2x10^5$	0.071	1.114	(Linear Interpolation)
$\geq 2x10^5$	0.15	1.5	

Step 7: Iterate Solution till Calculated D50 is Acceptably Smaller then Chosen D50

Difference to Chosen Riprap	61.47%	<	100%	TRUE
IF FALSE GOTO STEP 2, ADJUST RIPRAP SIZE				

Step 8. Side Slope Assessment

Stone Angle of Repose	ϕ	42	°		
For 1.5 < Z < 5	K1	0.835			
	ϴ	21.80	°		
	K2	0.83			
Stable D_{50}	$D_{50,s}$	0.46			
Difference to Chosen Riprap		61.70%	<	100%	TRUE

Worksheet for CTFS West 132+65 - 167+50

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.051	
Channel Slope	0.01100	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	727.20	ft³/s

Results

Normal Depth	3.27	ft
Flow Area	125.05	ft²
Wetted Perimeter	47.63	ft
Hydraulic Radius	2.63	ft
Top Width	46.37	ft
Critical Depth	2.45	ft
Critical Slope	0.03050	ft/ft
Velocity	5.82	ft/s
Velocity Head	0.53	ft
Specific Energy	3.80	ft
Froude Number	0.62	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.27	ft
Critical Depth	2.45	ft
Channel Slope	0.01100	ft/ft

HEC-15 RIPRAP DESIGN

Lithium Nevada Corporation **Thacker Pass Project** **CTFS West Ult 132+65-167+50, 100yr 24hr storm**	NOTE: Gray boxes require input, Orange boxes require specific values, Red boxes are calculated

Step 1: Channel Design Parameters			
Bottom Width	B	30	ft
Side Slope	Z	2.5	x:1
Longitudinal Slope	S	0.011	ft/ft
Flow	Q	727.2	ft^3/s

Step 2: Initial Riprap sizing			
Median Stone Size	D_{50}	**0.5**	ft
Stone Unit Weight	Ys	165	pcf
Riprap Calculation Gradation	D_{100}	10.00	inch
	D_{75}	7.50	inch
	D_{50}	6.00	inch
	D_{30}	4.00	inch
	D_{15}	3.00	inch
	D_{10}	2.00	inch

Step 3: Estimate the Flow Depth			
Initial Flow Depth Estimate	D_i	**3.25**	ft
Area of Channel	A	123.91	ft^2
Wetted Perimeter	P	47.50	ft
Hydraulic Radius	R	2.61	ft
Wetted Top Width	T	46.25	ft
Calculated Average Flow Depth	D_a	2.68	ft

Step 4: Estimate Manning's n and the Implied Discharge			
D_a/D_{50}		5.358	
For $1.5 < D_a/D_{50} < 185$	n	0.051	
Q from mannings	Qi	720.45	ft^3/s
% Difference from Design Discharge		-0.93%	
For $0.3 < D_a/D_{50} < 1.5$	n	0.039	
function(Froude number)	f(Fr)	0.870	
Froude number	Fr	0.632	
Velocity of flow	V	**5.869**	
effective roughness concrentration	b	0.575	
Roughness element geometry	f(REG)	47.342	
Channel geometry	f(CG)	0.194	
Q from mannings	Qi	949.17	ft^3/s
% Difference from Design Discharge		30.52%	

Step 5:

If % difference is > 5%, estimate a new depth in Step 3	FALSE	Proceed to Step 6
For $0.3 < D_a/D_{50} < 1.5$	TRUE	
If false, proceed to step 6		

Step 6: Calculate Reynolds and Determine Appropriate Shields Parameter & Safety Factor

Shear Velocity	V_*	1.073		
Reynolds number	R_e	4.41E+04		
Gravity	g	32.2	ft/s^2	
Kinematic Viscosity	v	1.22E-05	ft^2/s	(1.217e-5 for 60 °F)
From Table 6.1	F_*	0.050		
From Table 6.1	SF	1.013		
Specific Gravity of Stone	SG	2.64		
For S < 5%	D_{50}	0.44	ft	

Table 6.1. Selection of Shields' Parameter and Safety Factor

Reynolds number	F_*	SF	
$\leq 4x10^4$	0.047	1	
$4x10^4<Re<2x10^5$	0.050	1.013	(Linear Interpolation)
$\geq 2x10^5$	0.15	1.5	

Step 7: Iterate Solution till Calculated D50 is Acceptably Smaller then Chosen D50

Difference to Chosen Riprap	88.74%	<	100%	TRUE
IF FALSE GOTO STEP 2, ADJUST RIPRAP SIZE				

Step 8. Side Slope Assessment

Stone Angle of Repose	ϕ	42	°			
For 1.5 < Z < 5	K1	0.835				
	Ɵ	21.80	°			
	K2	0.83				
Stable D_{50}	$D_{50,s}$	0.45				
Difference to Chosen Riprap		89.08%		<	100%	TRUE

Worksheet for CTFS West 167+50 - 179+35

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.041	
Channel Slope	0.01400	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	34.20	ft³/s

Results

Normal Depth	0.45	ft
Flow Area	13.97	ft²
Wetted Perimeter	32.42	ft
Hydraulic Radius	0.43	ft
Top Width	32.25	ft
Critical Depth	0.34	ft
Critical Slope	0.03561	ft/ft
Velocity	2.45	ft/s
Velocity Head	0.09	ft
Specific Energy	0.54	ft
Froude Number	0.66	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.45	ft
Critical Depth	0.34	ft
Channel Slope	0.01400	ft/ft

HEC-15 RIPRAP DESIGN

Lithium Nevada Corporation **Thacker Pass Project** **CTFS West Ult 167+50-179+35, 100yr 24hr storm**	NOTE: Gray boxes require input, Orange boxes require specific values, Red boxes are calculated

Step 1: Channel Design Parameters			
Bottom Width	B	30	ft
Side Slope	Z	2.5	x:1
Longitudinal Slope	S	0.014	ft/ft
Flow	Q	34.2	ft^3/s

Step 2: Initial Riprap sizing			
Median Stone Size	D_{50}	**0.1**	ft
Stone Unit Weight	Ys	165	pcf
Riprap Calculation Gradation	D_{100}	2.00	inch
	D_{75}	1.50	inch
	D_{50}	1.20	inch
	D_{30}	0.80	inch
	D_{15}	0.60	inch
	D_{10}	0.40	inch

Step 3: Estimate the Flow Depth			
Initial Flow Depth Estimate	D_i	**0.45**	ft
Area of Channel	A	14.01	ft^2
Wetted Perimeter	P	32.42	ft
Hydraulic Radius	R	0.43	ft
Wetted Top Width	T	32.25	ft
Calculated Average Flow Depth	D_a	0.43	ft

Step 4: Estimate Manning's n and the Implied Discharge			
D_a/D_{50}		4.343	
For $1.5 < D_a/D_{50} < 185$	n	0.041	
Q from mannings	Qi	34.57	ft^3/s
% Difference from Design Discharge		1.08%	
For $0.3 < D_a/D_{50} < 1.5$	n	0.053	
function(Froude number)	f(Fr)	0.836	
Froude number	Fr	0.653	
Velocity of flow	V	**2.442**	
effective roughness concrentration	b	0.275	
Roughness element geometry	f(REG)	16.866	
Channel geometry	f(CG)	0.306	
Q from mannings	Qi	26.60	ft^3/s
% Difference from Design Discharge		-22.22%	

Step 5:

If % difference is > 5%, estimate a new depth in Step 3	FALSE	Proceed to Step 6
For 0.3 < D_a/D_{50} < 1.5	TRUE	
If false, proceed to step 6		

Step 6: Calculate Reynolds and Determine Appropriate Shields Parameter & Safety Factor

Shear Velocity	V_*	0.450		
Reynolds number	R_e	3.70E+03		
Gravity	g	32.2	ft/s^2	
Kinematic Viscosity	v	1.22E-05	ft^2/s	(1.217e-5 for 60 °F)
From Table 6.1	F_*	0.047		
From Table 6.1	SF	1.000		
Specific Gravity of Stone	SG	2.64		
For S < 5%	D_{50}	0.08	ft	

Table 6.1. Selection of Shields' Parameter and Safety Factor

Reynolds number	F_*	SF	
$\leq 4x10^4$	0.047	1	
$4x10^4<Re<2x10^5$	0.024	0.887	(Linear Interpolation)
$\geq 2x10^5$	0.15	1.5	

Step 7: Iterate Solution till Calculated D50 is Acceptably Smaller then Chosen D50

Difference to Chosen Riprap	81.52%	<	100%	TRUE
IF FALSE GOTO STEP 2, ADJUST RIPRAP SIZE				

Step 8. Side Slope Assessment

Stone Angle of Repose	ϕ	42	°
For 1.5 < Z < 5	K1	0.835	
	ϴ	21.80	°
	K2	0.83	
Stable D_{50}	$D_{50,s}$	0.08	
Difference to Chosen Riprap		81.83%	< 100% TRUE

Worksheet for CTFS West Outlet 20+40 - 25+00

Project Description

Friction Method	Manning Formula	
Solve For	Normal Depth	

Input Data

Roughness Coefficient	0.068	
Channel Slope	0.08400	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	1268.90	ft³/s

Results

Normal Depth	2.97	ft
Flow Area	111.22	ft²
Wetted Perimeter	46.00	ft
Hydraulic Radius	2.42	ft
Top Width	44.86	ft
Critical Depth	3.45	ft
Critical Slope	0.04949	ft/ft
Velocity	11.41	ft/s
Velocity Head	2.02	ft
Specific Energy	4.99	ft
Froude Number	1.28	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.97	ft
Critical Depth	3.45	ft
Channel Slope	0.08400	ft/ft

HEC-15 RIPRAP DESIGN

Lithium Nevada Corporation
Thacker Pass Project
CTFS West Ult 20+40-25+00 100yr, 24hr storm

NOTE: Gray boxes require input, Orange boxes require specific values, Red boxes are calculated

Step 1: Channel Design Parameters

Bottom Width	B	30	ft
Side Slope	Z	2.5	x:1
Longitudinal Slope	S	0.084	ft/ft
Flow	Q	1268.9	ft^3/s

Step 2: Initial Riprap sizing

Median Stone Size	D_{50}	**2**	ft
Stone Unit Weight	Ys	165	pcf
Riprap Calculation Gradation	D_{100}	40.00	inch
	D_{75}	30.00	inch
	D_{50}	24.00	inch
	D_{30}	16.00	inch
	D_{15}	12.00	inch
	D_{10}	8.00	inch

Step 3: Estimate the Flow Depth

Initial Flow Depth Estimate	D_i	**3.7**	ft
Area of Channel	A	145.23	ft^2
Wetted Perimeter	P	49.93	ft
Hydraulic Radius	R	2.91	ft
Wetted Top Width	T	48.50	ft
Calculated Average Flow Depth	D_a	2.99	ft

Step 4: Estimate Manning's n and the Implied Discharge

D_a/D_{50}		1.497	
For $1.5 < D_a/D_{50} < 185$	n	0.099	
Q from mannings	Qi	1286.57	ft^3/s
% Difference from Design Discharge		1.39%	
For $0.3 < D_a/D_{50} < 1.5$	n	0.068	
function(Froude number)	f(Fr)	0.884	
Froude number	Fr	0.890	
Velocity of flow	V	**8.737**	
effective roughness concrentration	b	0.374	
Roughness element geometry	f(REG)	14.820	
Channel geometry	f(CG)	0.353	
Q from mannings	Qi	1876.00	ft^3/s
% Difference from Design Discharge		47.84%	

Step 5:		
If % difference is > 5%, estimate a new depth in Step 3	FALSE	No Good
For 0.3 < D_a/D_{50} < 1.5	TRUE	
If false, proceed to step 6		

Step 6: Calculate Reynolds and Determine Appropriate Shields Parameter & Safety Factor				
Shear Velocity	V_*	3.164		
Reynolds number	R_e	5.20E+05		
Gravity	g	32.2	ft/s^2	
Kinematic Viscosity	v	1.22E-05	ft^2/s	(1.217e-5 for 60 °F)
From Table 6.1	F_*	0.150		
From Table 6.1	SF	1.500		
Specific Gravity of Stone	SG	2.64		
For S < 5%	D_{50}	1.89	ft	

Table 6.1. Selection of Shields' Parameter and Safety Factor			
Reynolds number	F_*	SF	
$\leq 4x10^4$	0.047	1	
$4x10^4<Re<2x10^5$	0.356	2.500	(Linear Interpolation)
$\geq 2x10^5$	0.15	1.5	

Step 7: Iterate Solution till Calculated D50 is Acceptably Smaller then Chosen D50				
Difference to Chosen Riprap	94.51%	<	100%	TRUE
IF FALSE GOTO STEP 2, ADJUST RIPRAP SIZE				

Step 8. Side Slope Assessment						
Stone Angle of Repose	ϕ	42	°			
For 1.5 < Z < 5	K1	0.835				
	ϴ	21.80	°			
	K2	0.83				
Stable D_{50}	$D_{50,s}$	1.90				
Difference to Chosen Riprap		94.87%		<	100%	TRUE

Worksheet for CTFS West Outlet 25+00 - 27+00

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.091	
Channel Slope	0.08400	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	907.90	ft³/s

Results

Normal Depth		2.90	ft
Flow Area		108.00	ft²
Wetted Perimeter		45.61	ft
Hydraulic Radius		2.37	ft
Top Width		44.50	ft
Critical Depth		2.81	ft
Critical Slope		0.09358	ft/ft
Velocity		8.41	ft/s
Velocity Head		1.10	ft
Specific Energy		4.00	ft
Froude Number		0.95	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.90	ft
Critical Depth	2.81	ft
Channel Slope	0.08400	ft/ft

HEC-15 RIPRAP DESIGN

NewFields

Lithium Nevada Corporation **Thacker Pass Project** **CTFS West Ult 25+00-27+00 100yr, 24hr storm**	NOTE: Gray boxes require input, Orange boxes require specific values, Red boxes are calculated

Step 1: Channel Design Parameters			
Bottom Width	B	30	ft
Side Slope	Z	2.5	x:1
Longitudinal Slope	S	0.084	ft/ft
Flow	Q	907.9	ft^3/s

Step 2: Initial Riprap sizing			
Median Stone Size	D_{50}	**1.5**	ft
Stone Unit Weight	Ys	165	pcf
Riprap Calculation Gradation	D_{100}	30.00	inch
	D_{75}	22.50	inch
	D_{50}	18.00	inch
	D_{30}	12.00	inch
	D_{15}	9.00	inch
	D_{10}	6.00	inch

Step 3: Estimate the Flow Depth			
Initial Flow Depth Estimate	D_i	**2.9**	ft
Area of Channel	A	108.03	ft^2
Wetted Perimeter	P	45.62	ft
Hydraulic Radius	R	2.37	ft
Wetted Top Width	T	44.50	ft
Calculated Average Flow Depth	D_a	2.43	ft

Step 4: Estimate Manning's n and the Implied Discharge			
D_a/D_{50}		1.618	
For $1.5 < D_a/D_{50} < 185$	n	0.091	
Q from mannings	Qi	912.32	ft^3/s
% Difference from Design Discharge		0.49%	
For $0.3 < D_a/D_{50} < 1.5$	n	0.064	
function(Froude number)	f(Fr)	0.906	
Froude number	Fr	0.951	
Velocity of flow	V	**8.405**	
effective roughness concrentration	b	0.363	
Roughness element geometry	f(REG)	15.134	
Channel geometry	f(CG)	0.348	
Q from mannings	Qi	1297.97	ft^3/s
% Difference from Design Discharge		42.96%	

Step 5:

If % difference is > 5%, estimate a new depth in Step 3	FALSE	Proceed to Step 6
For 0.3 < D_a/D_{50} < 1.5	TRUE	
If false, proceed to step 6		

Step 6: Calculate Reynolds and Determine Appropriate Shields Parameter & Safety Factor

Shear Velocity	V_*	2.801		
Reynolds number	R_e	3.45E+05		
Gravity	g	32.2	ft/s^2	
Kinematic Viscosity	v	1.22E-05	ft^2/s	(1.217e-5 for 60 °F)
From Table 6.1	F_*	0.150		
From Table 6.1	SF	1.500		
Specific Gravity of Stone	SG	2.64		
For S < 5%	D_{50}	1.48	ft	

Table 6.1. Selection of Shields' Parameter and Safety Factor

Reynolds number	F_*	SF	
$\leq 4x10^4$	0.047	1	
$4x10^4<Re<2x10^5$	0.243	1.954	(Linear Interpolation)
$\geq 2x10^5$	0.15	1.5	

Step 7: Iterate Solution till Calculated D50 is Acceptably Smaller then Chosen D50

Difference to Chosen Riprap	98.77%	<	100%	TRUE
IF FALSE GOTO STEP 2, ADJUST RIPRAP SIZE				

Step 8. Side Slope Assessment

Stone Angle of Repose	ɸ	42	°		
For 1.5 < Z < 5	K1	0.835			
	Ɵ	21.80	°		
	K2	0.83			
Stable D_{50}	$D_{50,s}$	1.49			
Difference to Chosen Riprap		99.15%	<	100%	TRUE

Worksheet for CTFS West Outlet 27+00 - 28+00

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.072	
Channel Slope	0.05300	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	896.90	ft³/s

Results

Normal Depth	2.87	ft
Flow Area	106.82	ft²
Wetted Perimeter	45.47	ft
Hydraulic Radius	2.35	ft
Top Width	44.36	ft
Critical Depth	2.79	ft
Critical Slope	0.05870	ft/ft
Velocity	8.40	ft/s
Velocity Head	1.10	ft
Specific Energy	3.97	ft
Froude Number	0.95	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.87	ft
Critical Depth	2.79	ft
Channel Slope	0.05300	ft/ft

HEC-15 RIPRAP DESIGN

Lithium Nevada Corporation **Thacker Pass Project** **CTFS West Ult 27+00-28+00 100yr, 24hr storm**	NOTE: Gray boxes require input, Orange boxes require specific values, Red boxes are calculated

Step 1: Channel Design Parameters			
Bottom Width	B	30	ft
Side Slope	Z	2.5	x:1
Longitudinal Slope	S	0.053	ft/ft
Flow	Q	896.9	ft^3/s

Step 2: Initial Riprap sizing			
Median Stone Size	D_{50}	**1**	ft
Stone Unit Weight	Ys	165	pcf
Riprap Calculation Gradation	D_{100}	20.00	inch
	D_{75}	15.00	inch
	D_{50}	12.00	inch
	D_{30}	8.00	inch
	D_{15}	6.00	inch
	D_{10}	4.00	inch

Step 3: Estimate the Flow Depth			
Initial Flow Depth Estimate	D_i	**2.85**	ft
Area of Channel	A	105.81	ft^2
Wetted Perimeter	P	45.35	ft
Hydraulic Radius	R	2.33	ft
Wetted Top Width	T	44.25	ft
Calculated Average Flow Depth	D_a	2.39	ft

Step 4: Estimate Manning's n and the Implied Discharge			
D_a/D_{50}		2.391	
For $1.5 < D_a/D_{50} < 185$	n	0.072	
Q from mannings	Qi	891.43	ft^3/s
% Difference from Design Discharge		-0.61%	
For $0.3 < D_a/D_{50} < 1.5$	n	0.054	
function(Froude number)	f(Fr)	0.895	
Froude number	Fr	0.966	
Velocity of flow	V	**8.477**	
effective roughness concrentration	b	0.416	
Roughness element geometry	f(REG)	21.282	
Channel geometry	f(CG)	0.297	
Q from mannings	Qi	1187.70	ft^3/s
% Difference from Design Discharge		32.42%	

Step 5:

If % difference is > 5%, estimate a new depth in Step 3	FALSE	Proceed to Step 6
For $0.3 < D_a/D_{50} < 1.5$	TRUE	
If false, proceed to step 6		

Step 6: Calculate Reynolds and Determine Appropriate Shields Parameter & Safety Factor

Shear Velocity	V_*	2.205		
Reynolds number	R_e	1.81E+05		
Gravity	g	32.2	ft/s^2	
Kinematic Viscosity	v	1.22E-05	ft^2/s	(1.217e-5 for 60 °F)
From Table 6.1	F_*	0.138		
From Table 6.1	SF	1.441		
Specific Gravity of Stone	SG	2.64		
For S < 5%	D_{50}	0.96	ft	

Table 6.1. Selection of Shields' Parameter and Safety Factor

Reynolds number	F_*	SF	
$\le 4\text{x}10^4$	0.047	1	
$4\text{x}10^4 < Re < 2\text{x}10^5$	0.138	1.441	(Linear Interpolation)
$\ge 2\text{x}10^5$	0.15	1.5	

Step 7: Iterate Solution till Calculated D50 is Acceptably Smaller then Chosen D50

Difference to Chosen Riprap	96.01%	<	100%	TRUE
IF FALSE GOTO STEP 2, ADJUST RIPRAP SIZE				

Step 8. Side Slope Assessment

Stone Angle of Repose	ϕ	42	°			
For 1.5 < Z < 5	K1	0.835				
	Θ	21.80	°			
	K2	0.83				
Stable D_{50}	$D_{50,s}$	0.96				
Difference to Chosen Riprap		96.38%		<	100%	TRUE

Worksheet for CTFS West 96+00 - 106+00

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.043	
Channel Slope	0.00600	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	893.70	ft³/s

Results

Normal Depth	3.96	ft
Flow Area	157.84	ft²
Wetted Perimeter	51.31	ft
Hydraulic Radius	3.08	ft
Top Width	49.78	ft
Critical Depth	2.78	ft
Critical Slope	0.02095	ft/ft
Velocity	5.66	ft/s
Velocity Head	0.50	ft
Specific Energy	4.45	ft
Froude Number	0.56	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.96	ft
Critical Depth	2.78	ft
Channel Slope	0.00600	ft/ft

HEC-15 RIPRAP DESIGN

Lithium Nevada Corporation **Thacker Pass Project** **CTFS West Ult 96+00-106+00 100yr, 24hr storm**	NOTE: Gray boxes require input, Orange boxes require specific values, Red boxes are calculated

Step 1: Channel Design Parameters			
Bottom Width	B	30	ft
Side Slope	Z	2.5	x:1
Longitudinal Slope	S	0.006	ft/ft
Flow	Q	893.7	ft^3/s

Step 2: Initial Riprap sizing			
Median Stone Size	D_{50}	**0.33**	ft
Stone Unit Weight	Ys	165	pcf
Riprap Calculation Gradation	D_{100}	6.60	inch
	D_{75}	4.95	inch
	D_{50}	3.96	inch
	D_{30}	2.64	inch
	D_{15}	1.98	inch
	D_{10}	1.32	inch

Step 3: Estimate the Flow Depth			
Initial Flow Depth Estimate	D_i	**3.95**	ft
Area of Channel	A	157.51	ft^2
Wetted Perimeter	P	51.27	ft
Hydraulic Radius	R	3.07	ft
Wetted Top Width	T	49.75	ft
Calculated Average Flow Depth	D_a	3.17	ft

Step 4: Estimate Manning's n and the Implied Discharge			
D_a/D_{50}		9.594	
For $1.5 < D_a/D_{50} < 185$	n	0.043	
Q from mannings	Qi	893.69	ft^3/s
% Difference from Design Discharge		0.00%	
For $0.3 < D_a/D_{50} < 1.5$	n	0.027	
function(Froude number)	f(Fr)	0.987	
Froude number	Fr	0.562	
Velocity of flow	V	**5.674**	
effective roughness concrentration	b	0.740	
Roughness element geometry	f(REG)	90.811	
Channel geometry	f(CG)	0.130	
Q from mannings	Qi	1407.70	ft^3/s
% Difference from Design Discharge		57.51%	

Step 5:

If % difference is > 5%, estimate a new depth in Step 3	FALSE	Proceed to Step 6
For 0.3 < D_a/D_{50} < 1.5	TRUE	
If false, proceed to step 6		

Step 6: Calculate Reynolds and Determine Appropriate Shields Parameter & Safety Factor

Shear Velocity	V_*	0.874		
Reynolds number	R_e	2.37E+04		
Gravity	g	32.2	ft/s^2	
Kinematic Viscosity	v	1.22E-05	ft^2/s	(1.217e-5 for 60 °F)
From Table 6.1	F_*	0.047		
From Table 6.1	SF	1.000		
Specific Gravity of Stone	SG	2.64		
For S < 5%	D_{50}	0.31	ft	

Table 6.1. Selection of Shields' Parameter and Safety Factor

Reynolds number	F_*	SF	
$\leq 4x10^4$	0.047	1	
$4x10^4<Re<2x10^5$	0.036	0.949	(Linear Interpolation)
$\geq 2x10^5$	0.15	1.5	

Step 7: Iterate Solution till Calculated D50 is Acceptably Smaller then Chosen D50

Difference to Chosen Riprap	92.93%	<	100%	TRUE
IF FALSE GOTO STEP 2, ADJUST RIPRAP SIZE				

Step 8. Side Slope Assessment

Stone Angle of Repose	ϕ	42	°			
For 1.5 < Z < 5	K1	0.835				
	θ	21.80	°			
	K2	0.83				
Stable D_{50}	$D_{50,s}$	0.31				
Difference to Chosen Riprap		93.29%		<	100%	TRUE

Worksheet for CTFS West Outlet 500yr 0+00 - 13+75

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.066	
Channel Slope	0.04000	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	1981.70	ft³/s

Results

Normal Depth	4.61	ft
Flow Area	191.28	ft²
Wetted Perimeter	54.81	ft
Hydraulic Radius	3.49	ft
Top Width	53.04	ft
Critical Depth	4.50	ft
Critical Slope	0.04350	ft/ft
Velocity	10.36	ft/s
Velocity Head	1.67	ft
Specific Energy	6.28	ft
Froude Number	0.96	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	4.61	ft
Critical Depth	4.50	ft
Channel Slope	0.04000	ft/ft

Worksheet for CTFS West 500yr 106+00 - 112+73

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.070	
Channel Slope	0.04200	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	1305.90	ft³/s

Results

Normal Depth	3.73	ft
Flow Area	146.66	ft²
Wetted Perimeter	50.08	ft
Hydraulic Radius	2.93	ft
Top Width	48.65	ft
Critical Depth	3.51	ft
Critical Slope	0.05221	ft/ft
Velocity	8.90	ft/s
Velocity Head	1.23	ft
Specific Energy	4.96	ft
Froude Number	0.90	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.73	ft
Critical Depth	3.51	ft
Channel Slope	0.04200	ft/ft

Worksheet for CTFS West 500yr 112+73 - 116+00

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.060	
Channel Slope	0.02200	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	1295.30	ft³/s

Results

Normal Depth	4.08	ft
Flow Area	163.94	ft²
Wetted Perimeter	51.96	ft
Hydraulic Radius	3.15	ft
Top Width	50.39	ft
Critical Depth	3.49	ft
Critical Slope	0.03840	ft/ft
Velocity	7.90	ft/s
Velocity Head	0.97	ft
Specific Energy	5.05	ft
Froude Number	0.77	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	4.08	ft
Critical Depth	3.49	ft
Channel Slope	0.02200	ft/ft

Worksheet for CTFS West 500yr 116+00 - 123+50

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.070	
Channel Slope	0.04200	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	1291.70	ft³/s

Results

Normal Depth	3.71	ft
Flow Area	145.56	ft²
Wetted Perimeter	49.96	ft
Hydraulic Radius	2.91	ft
Top Width	48.53	ft
Critical Depth	3.49	ft
Critical Slope	0.05230	ft/ft
Velocity	8.87	ft/s
Velocity Head	1.22	ft
Specific Energy	4.93	ft
Froude Number	0.90	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.71	ft
Critical Depth	3.49	ft
Channel Slope	0.04200	ft/ft

Worksheet for CTFS West 500yr 123+50 - 126+00

Project Description

Friction Method	Manning Formula	
Solve For	Normal Depth	

Input Data

Roughness Coefficient	0.070	
Channel Slope	0.04200	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	1275.80	ft³/s

Results

Normal Depth	3.68	ft
Flow Area	144.32	ft²
Wetted Perimeter	49.82	ft
Hydraulic Radius	2.90	ft
Top Width	48.41	ft
Critical Depth	3.46	ft
Critical Slope	0.05240	ft/ft
Velocity	8.84	ft/s
Velocity Head	1.21	ft
Specific Energy	4.90	ft
Froude Number	0.90	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.68	ft
Critical Depth	3.46	ft
Channel Slope	0.04200	ft/ft

Worksheet for CTFS West 500yr 126+00 - 132+65

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.060	
Channel Slope	0.02000	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	1271.90	ft³/s

Results

Normal Depth	4.15	ft
Flow Area	167.31	ft²
Wetted Perimeter	52.32	ft
Hydraulic Radius	3.20	ft
Top Width	50.73	ft
Critical Depth	3.45	ft
Critical Slope	0.03852	ft/ft
Velocity	7.60	ft/s
Velocity Head	0.90	ft
Specific Energy	5.04	ft
Froude Number	0.74	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	4.15	ft
Critical Depth	3.45	ft
Channel Slope	0.02000	ft/ft

Worksheet for CTFS West Outlet 500yr 13+75 - 20+40

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.055	
Channel Slope	0.01000	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	1859.10	ft³/s

Results

Normal Depth	5.87	ft
Flow Area	262.07	ft²
Wetted Perimeter	61.60	ft
Hydraulic Radius	4.25	ft
Top Width	59.34	ft
Critical Depth	4.34	ft
Critical Slope	0.03051	ft/ft
Velocity	7.09	ft/s
Velocity Head	0.78	ft
Specific Energy	6.65	ft
Froude Number	0.60	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	5.87	ft
Critical Depth	4.34	ft
Channel Slope	0.01000	ft/ft

Worksheet for CTFS West 500yr 132+65 - 167+50

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.051	
Channel Slope	0.01100	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	1073.30	ft³/s

Results

Normal Depth	4.07	ft
Flow Area	163.50	ft²
Wetted Perimeter	51.92	ft
Hydraulic Radius	3.15	ft
Top Width	50.35	ft
Critical Depth	3.12	ft
Critical Slope	0.02860	ft/ft
Velocity	6.56	ft/s
Velocity Head	0.67	ft
Specific Energy	4.74	ft
Froude Number	0.64	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	4.07	ft
Critical Depth	3.12	ft
Channel Slope	0.01100	ft/ft

Worksheet for CTFS West 500yr 167+50 - 179+35

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.041	
Channel Slope	0.01400	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	50.50	ft³/s

Results

Normal Depth	0.57	ft
Flow Area	17.80	ft²
Wetted Perimeter	33.05	ft
Hydraulic Radius	0.54	ft
Top Width	32.83	ft
Critical Depth	0.44	ft
Critical Slope	0.03282	ft/ft
Velocity	2.84	ft/s
Velocity Head	0.13	ft
Specific Energy	0.69	ft
Froude Number	0.68	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.57	ft
Critical Depth	0.44	ft
Channel Slope	0.01400	ft/ft

Worksheet for CTFS West Outlet 500yr 20+40 - 25+00

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.068	
Channel Slope	0.08400	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	1828.30	ft³/s

Results

Normal Depth	3.65	ft
Flow Area	142.76	ft²
Wetted Perimeter	49.65	ft
Hydraulic Radius	2.88	ft
Top Width	48.24	ft
Critical Depth	4.29	ft
Critical Slope	0.04675	ft/ft
Velocity	12.81	ft/s
Velocity Head	2.55	ft
Specific Energy	6.20	ft
Froude Number	1.31	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.65	ft
Critical Depth	4.29	ft
Channel Slope	0.08400	ft/ft

Worksheet for CTFS West Outlet 500yr 25+00 - 27+00

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.091	
Channel Slope	0.08400	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	1335.00	ft³/s

Results

Normal Depth	3.60	ft
Flow Area	140.51	ft²
Wetted Perimeter	49.40	ft
Hydraulic Radius	2.84	ft
Top Width	48.01	ft
Critical Depth	3.56	ft
Critical Slope	0.08792	ft/ft
Velocity	9.50	ft/s
Velocity Head	1.40	ft
Specific Energy	5.01	ft
Froude Number	0.98	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.60	ft
Critical Depth	3.56	ft
Channel Slope	0.08400	ft/ft

Worksheet for CTFS West Outlet 500yr 27+00 - 28+00

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.072	
Channel Slope	0.05300	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	1320.00	ft³/s

Results

Normal Depth	3.57	ft
Flow Area	139.05	ft²
Wetted Perimeter	49.23	ft
Hydraulic Radius	2.82	ft
Top Width	47.86	ft
Critical Depth	3.53	ft
Critical Slope	0.05514	ft/ft
Velocity	9.49	ft/s
Velocity Head	1.40	ft
Specific Energy	4.97	ft
Froude Number	0.98	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.57	ft
Critical Depth	3.53	ft
Channel Slope	0.05300	ft/ft

Worksheet for CTFS West 500yr 96+00 - 106+00

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.043	
Channel Slope	0.00600	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	30.00	ft
Discharge	1315.60	ft³/s

Results

Normal Depth	4.89	ft
Flow Area	206.66	ft²
Wetted Perimeter	56.35	ft
Hydraulic Radius	3.67	ft
Top Width	54.47	ft
Critical Depth	3.53	ft
Critical Slope	0.01968	ft/ft
Velocity	6.37	ft/s
Velocity Head	0.63	ft
Specific Energy	5.52	ft
Froude Number	0.58	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	4.89	ft
Critical Depth	3.53	ft
Channel Slope	0.00600	ft/ft

E.3.4 CGS

Worksheet for CGS RISER CHANNEL

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.077	
Channel Slope	0.01900	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	32.00	ft
Discharge	136.00	ft³/s

Results

Normal Depth	1.30	ft
Flow Area	45.89	ft²
Wetted Perimeter	39.01	ft
Hydraulic Radius	1.18	ft
Top Width	38.51	ft
Critical Depth	0.81	ft
Critical Slope	0.09567	ft/ft
Velocity	2.96	ft/s
Velocity Head	0.14	ft
Specific Energy	1.44	ft
Froude Number	0.48	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.30	ft
Critical Depth	0.81	ft
Channel Slope	0.01900	ft/ft

Worksheet for CGS SPILLWAY CHANNEL

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.077	
Channel Slope	0.03200	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	32.00	ft
Discharge	361.00	ft³/s

Results

Normal Depth	1.98	ft
Flow Area	73.04	ft²
Wetted Perimeter	42.65	ft
Hydraulic Radius	1.71	ft
Top Width	41.89	ft
Critical Depth	1.52	ft
Critical Slope	0.07928	ft/ft
Velocity	4.94	ft/s
Velocity Head	0.38	ft
Specific Energy	2.36	ft
Froude Number	0.66	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.98	ft
Critical Depth	1.52	ft
Channel Slope	0.03200	ft/ft

CGS East Diversion 100 YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.03300	ft/ft
Left Side Slope	3.50	ft/ft (H:V)
Right Side Slope	40.00	ft/ft (H:V)
Bottom Width	1.00	ft
Discharge	142.17	ft³/s

Results

Normal Depth	1.10	ft
Flow Area	27.22	ft²
Wetted Perimeter	48.84	ft
Hydraulic Radius	0.56	ft
Top Width	48.67	ft
Critical Depth	1.19	ft
Critical Slope	0.02117	ft/ft
Velocity	5.22	ft/s
Velocity Head	0.42	ft
Specific Energy	1.52	ft
Froude Number	1.23	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.10	ft
Critical Depth	1.19	ft
Channel Slope	0.03300	ft/ft

CGS East Diversion 500 YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.03300	ft/ft
Left Side Slope	3.50	ft/ft (H:V)
Right Side Slope	40.00	ft/ft (H:V)
Bottom Width	1.00	ft
Discharge	194.26	ft³/s

Results

Normal Depth	1.24	ft
Flow Area	34.41	ft²
Wetted Perimeter	54.91	ft
Hydraulic Radius	0.63	ft
Top Width	54.73	ft
Critical Depth	1.35	ft
Critical Slope	0.02031	ft/ft
Velocity	5.64	ft/s
Velocity Head	0.50	ft
Specific Energy	1.73	ft
Froude Number	1.25	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.24	ft
Critical Depth	1.35	ft
Channel Slope	0.03300	ft/ft

CGS South Diversion 100 YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.01500	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	25.00	ft/ft (H:V)
Bottom Width	1.00	ft
Discharge	217.80	ft³/s

Results

Normal Depth	1.77	ft
Flow Area	45.01	ft²
Wetted Perimeter	50.14	ft
Hydraulic Radius	0.90	ft
Top Width	49.77	ft
Critical Depth	1.70	ft
Critical Slope	0.01892	ft/ft
Velocity	4.84	ft/s
Velocity Head	0.36	ft
Specific Energy	2.14	ft
Froude Number	0.90	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.77	ft
Critical Depth	1.70	ft
Channel Slope	0.01500	ft/ft

CGS South Diversion 500 YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.01500	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	25.00	ft/ft (H:V)
Bottom Width	1.00	ft
Discharge	297.64	ft³/s

Results

Normal Depth	2.00	ft
Flow Area	56.89	ft²
Wetted Perimeter	56.37	ft
Hydraulic Radius	1.01	ft
Top Width	55.95	ft
Critical Depth	1.93	ft
Critical Slope	0.01814	ft/ft
Velocity	5.23	ft/s
Velocity Head	0.43	ft
Specific Energy	2.42	ft
Froude Number	0.91	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.00	ft
Critical Depth	1.93	ft
Channel Slope	0.01500	ft/ft

CGS West Diversion 100 YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.04200	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	1000.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	95.20	ft³/s

Results

Normal Depth	0.28	ft
Flow Area	40.24	ft²
Wetted Perimeter	284.09	ft
Hydraulic Radius	0.14	ft
Top Width	284.03	ft
Critical Depth	0.29	ft
Critical Slope	0.03379	ft/ft
Velocity	2.37	ft/s
Velocity Head	0.09	ft
Specific Energy	0.37	ft
Froude Number	1.11	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.28	ft
Critical Depth	0.29	ft
Channel Slope	0.04200	ft/ft

CGS West Diversion 500 YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.04200	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	1000.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	130.07	ft³/s

Results

Normal Depth	0.32	ft
Flow Area	50.88	ft²
Wetted Perimeter	319.47	ft
Hydraulic Radius	0.16	ft
Top Width	319.41	ft
Critical Depth	0.33	ft
Critical Slope	0.03241	ft/ft
Velocity	2.56	ft/s
Velocity Head	0.10	ft
Specific Energy	0.42	ft
Froude Number	1.13	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.32	ft
Critical Depth	0.33	ft
Channel Slope	0.04200	ft/ft

E.3.5 EAST WRSF

East WRSF East Diversion 100 YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.29400	ft/ft
Left Side Slope	21.70	ft/ft (H:V)
Right Side Slope	3.50	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	38.16	ft³/s

Results

Normal Depth	0.48	ft
Flow Area	3.92	ft²
Wetted Perimeter	14.28	ft
Hydraulic Radius	0.27	ft
Top Width	14.20	ft
Critical Depth	0.82	ft
Critical Slope	0.02356	ft/ft
Velocity	9.73	ft/s
Velocity Head	1.47	ft
Specific Energy	1.95	ft
Froude Number	3.26	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.48	ft
Critical Depth	0.82	ft
Channel Slope	0.29400	ft/ft

East WRSF East Diversion 500 YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.29400	ft/ft
Left Side Slope	21.70	ft/ft (H:V)
Right Side Slope	3.50	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	52.28	ft³/s

Results

Normal Depth	0.55	ft
Flow Area	4.96	ft²
Wetted Perimeter	16.03	ft
Hydraulic Radius	0.31	ft
Top Width	15.94	ft
Critical Depth	0.94	ft
Critical Slope	0.02259	ft/ft
Velocity	10.54	ft/s
Velocity Head	1.73	ft
Specific Energy	2.28	ft
Froude Number	3.33	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.55	ft
Critical Depth	0.94	ft
Channel Slope	0.29400	ft/ft

East WRSF South Diversion 100 YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.00500	ft/ft
Left Side Slope	1000.00	ft/ft (H:V)
Right Side Slope	200.00	ft/ft (H:V)
Bottom Width	1.00	ft
Discharge	88.20	ft³/s

Results

Normal Depth	0.38	ft
Flow Area	88.31	ft²
Wetted Perimeter	460.37	ft
Hydraulic Radius	0.19	ft
Top Width	460.37	ft
Critical Depth	0.27	ft
Critical Slope	0.03495	ft/ft
Velocity	1.00	ft/s
Velocity Head	0.02	ft
Specific Energy	0.40	ft
Froude Number	0.40	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.38	ft
Critical Depth	0.27	ft
Channel Slope	0.00500	ft/ft

East WRSF South Diversion 500 YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.00500	ft/ft
Left Side Slope	1000.00	ft/ft (H:V)
Right Side Slope	200.00	ft/ft (H:V)
Bottom Width	1.00	ft
Discharge	120.90	ft³/s

Results

Normal Depth	0.43	ft
Flow Area	111.87	ft²
Wetted Perimeter	518.17	ft
Hydraulic Radius	0.22	ft
Top Width	518.17	ft
Critical Depth	0.30	ft
Critical Slope	0.03351	ft/ft
Velocity	1.08	ft/s
Velocity Head	0.02	ft
Specific Energy	0.45	ft
Froude Number	0.41	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.43	ft
Critical Depth	0.30	ft
Channel Slope	0.00500	ft/ft

East WRSF West Diversion 100 YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.04000	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	40.00	ft/ft (H:V)
Bottom Width	1.00	ft
Discharge	41.80	ft³/s

Results

Normal Depth	0.66	ft
Flow Area	10.06	ft²
Wetted Perimeter	29.40	ft
Hydraulic Radius	0.34	ft
Top Width	29.26	ft
Critical Depth	0.73	ft
Critical Slope	0.02489	ft/ft
Velocity	4.15	ft/s
Velocity Head	0.27	ft
Specific Energy	0.93	ft
Froude Number	1.25	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.66	ft
Critical Depth	0.73	ft
Channel Slope	0.04000	ft/ft

East WRSF West Diversion 500 YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.04000	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	40.00	ft/ft (H:V)
Bottom Width	1.00	ft
Discharge	57.20	ft³/s

Results

Normal Depth	0.75	ft
Flow Area	12.73	ft²
Wetted Perimeter	33.06	ft
Hydraulic Radius	0.38	ft
Top Width	32.91	ft
Critical Depth	0.83	ft
Critical Slope	0.02387	ft/ft
Velocity	4.49	ft/s
Velocity Head	0.31	ft
Specific Energy	1.06	ft
Froude Number	1.27	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.75	ft
Critical Depth	0.83	ft
Channel Slope	0.04000	ft/ft

E.3.6 WEST WRSF

West WRSF East Diversion 100 YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.22000	ft/ft
Left Side Slope	21.70	ft/ft (H:V)
Right Side Slope	3.50	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	43.10	ft³/s

Results

Normal Depth	0.54	ft
Flow Area	4.79	ft²
Wetted Perimeter	15.75	ft
Hydraulic Radius	0.30	ft
Top Width	15.66	ft
Critical Depth	0.86	ft
Critical Slope	0.02318	ft/ft
Velocity	9.00	ft/s
Velocity Head	1.26	ft
Specific Energy	1.80	ft
Froude Number	2.87	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.54	ft
Critical Depth	0.86	ft
Channel Slope	0.22000	ft/ft

West WRSF East Diversion 500 YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.22000	ft/ft
Left Side Slope	21.70	ft/ft (H:V)
Right Side Slope	3.50	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	83.90	ft³/s

Results

Normal Depth	0.72	ft
Flow Area	7.88	ft²
Wetted Perimeter	20.14	ft
Hydraulic Radius	0.39	ft
Top Width	20.03	ft
Critical Depth	1.15	ft
Critical Slope	0.02120	ft/ft
Velocity	10.65	ft/s
Velocity Head	1.76	ft
Specific Energy	2.48	ft
Froude Number	2.99	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.72	ft
Critical Depth	1.15	ft
Channel Slope	0.22000	ft/ft

West WRSF South Diversion 100 YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.04500	ft/ft
Left Side Slope	19.00	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	1.00	ft
Discharge	194.10	ft³/s

Results

Normal Depth	1.50	ft
Flow Area	25.75	ft²
Wetted Perimeter	33.62	ft
Hydraulic Radius	0.77	ft
Top Width	33.29	ft
Critical Depth	1.78	ft
Critical Slope	0.01865	ft/ft
Velocity	7.54	ft/s
Velocity Head	0.88	ft
Specific Energy	2.39	ft
Froude Number	1.51	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.50	ft
Critical Depth	1.78	ft
Channel Slope	0.04500	ft/ft

West WRSF South Diversion 500 YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.075	
Channel Slope	0.04500	ft/ft
Left Side Slope	19.00	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	1.00	ft
Discharge	265.30	ft³/s

Results

Normal Depth	2.27	ft
Flow Area	57.65	ft²
Wetted Perimeter	50.30	ft
Hydraulic Radius	1.15	ft
Top Width	49.80	ft
Critical Depth	2.02	ft
Critical Slope	0.08214	ft/ft
Velocity	4.60	ft/s
Velocity Head	0.33	ft
Specific Energy	2.60	ft
Froude Number	0.75	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.27	ft
Critical Depth	2.02	ft
Channel Slope	0.04500	ft/ft

West WRSF West Diversion 100 YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.15000	ft/ft
Left Side Slope	7.00	ft/ft (H:V)
Right Side Slope	3.50	ft/ft (H:V)
Bottom Width	1.00	ft
Discharge	100.90	ft³/s

Results

Normal Depth	1.18	ft
Flow Area	8.44	ft²
Wetted Perimeter	13.60	ft
Hydraulic Radius	0.62	ft
Top Width	13.35	ft
Critical Depth	1.78	ft
Critical Slope	0.01872	ft/ft
Velocity	11.96	ft/s
Velocity Head	2.22	ft
Specific Energy	3.40	ft
Froude Number	2.65	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.18	ft
Critical Depth	1.78	ft
Channel Slope	0.15000	ft/ft

West WRSF West Diversion 500 YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.15000	ft/ft
Left Side Slope	7.00	ft/ft (H:V)
Right Side Slope	3.50	ft/ft (H:V)
Bottom Width	1.00	ft
Discharge	137.90	ft³/s

Results

Normal Depth	1.33	ft
Flow Area	10.66	ft²
Wetted Perimeter	15.28	ft
Hydraulic Radius	0.70	ft
Top Width	15.00	ft
Critical Depth	2.03	ft
Critical Slope	0.01796	ft/ft
Velocity	12.94	ft/s
Velocity Head	2.60	ft
Specific Energy	3.93	ft
Froude Number	2.70	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.33	ft
Critical Depth	2.03	ft
Channel Slope	0.15000	ft/ft

HEC-15 RIPRAP DESIGN

Lithium Nevada Corporation **Thacker Pass Project** **West WRSF South 100yr, 24hr storm**	NOTE: Gray boxes require input, Orange boxes require specific values, Red boxes are calculated

Step 1: Channel Design Parameters			
Bottom Width	B	1	ft
Side Slope	Z	2.5	x:1
Longitudinal Slope	S	0.045	ft/ft
Flow	Q	194.1	ft^3/s

Step 2: Initial Riprap sizing			
Median Stone Size	D_{50}	**1**	ft
Stone Unit Weight	Ys	165	pcf
Riprap Calculation Gradation	D_{100}	20.00	inch
	D_{75}	15.00	inch
	D_{50}	12.00	inch
	D_{30}	8.00	inch
	D_{15}	6.00	inch
	D_{10}	4.00	inch

Step 3: Estimate the Flow Depth			
Initial Flow Depth Estimate	D_i	**3.5**	ft
Area of Channel	A	34.13	ft^2
Wetted Perimeter	P	19.85	ft
Hydraulic Radius	R	1.72	ft
Wetted Top Width	T	18.50	ft
Calculated Average Flow Depth	D_a	1.84	ft

Step 4: Estimate Manning's n and the Implied Discharge			
D_a/D_{50}		1.845	
For $1.5 < D_a/D_{50} < 185$	n	0.080	
Q from mannings	Qi	194.24	ft^3/s
% Difference from Design Discharge		0.07%	
For $0.3 < D_a/D_{50} < 1.5$	n	0.052	
function(Froude number)	f(Fr)	0.854	
Froude number	Fr	0.738	
Velocity of flow	V	**5.688**	
effective roughness concrentration	b	0.500	
Roughness element geometry	f(REG)	20.739	
Channel geometry	f(CG)	0.315	
Q from mannings	Qi	297.40	ft^3/s
% Difference from Design Discharge		53.22%	

Step 5:		
If % difference is > 5%, estimate a new depth in Step 3	FALSE	Proceed to Step 6
For 0.3 < D_a/D_{50} < 1.5	TRUE	
If false, proceed to step 6		

Step 6: Calculate Reynolds and Determine Appropriate Shields Parameter & Safety Factor				
Shear Velocity	V_*	2.252		
Reynolds number	R_e	1.85E+05		
Gravity	g	32.2	ft/s^2	
Kinematic Viscosity	v	1.22E-05	ft^2/s	(1.217e-5 for 60 °F)
From Table 6.1	F_*	0.140		
From Table 6.1	SF	1.453		
Specific Gravity of Stone	SG	2.64		
For S < 5%	D_{50}	0.99	ft	

Table 6.1. Selection of Shields' Parameter and Safety Factor			
Reynolds number	F_*	SF	
$\leq 4x10^4$	0.047	1	
$4x10^4<Re<2x10^5$	0.140	1.453	(Linear Interpolation)
$\geq 2x10^5$	0.15	1.5	

Step 7: Iterate Solution till Calculated D50 is Acceptably Smaller then Chosen D50				
Difference to Chosen Riprap	99.17%	<	100%	TRUE
IF FALSE GOTO STEP 2, ADJUST RIPRAP SIZE				

Step 8. Side Slope Assessment						
Stone Angle of Repose	ϕ	42	°			
For 1.5 < Z < 5	K1	0.835				
	ϴ	21.80	°			
	K2	0.83				
Stable D_{50}	$D_{50,s}$	1.00				
Difference to Chosen Riprap		99.55%		<	100%	TRUE

E.3.7 MINE FACILITIES DIVERSIONS, CULVERTS, AND PONDS

Facility Pond #1 2-Year/24-Hour Storm Event Routing

Corey Sadowsky

North American Coal Corporation
5340 Legacy Drive
Building 1, Suite 300
Plano, TX 75024

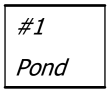
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	2 yr - 24 hr
Rainfall Depth:	1.130 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Facility Pond #1



Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	In	111.000	111.000	37.37	3.94
	Out			1.74	3.22

Structure Detail:

Structure #1 (Pond)

Facility Pond #1

Pond Inputs:

Initial Pool Elev:	4,962.00 ft
Initial Pool:	2.20 ac-ft

Perforated Riser

Riser Diameter (in)	Riser Height (ft)	Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Number of Holes per Elev
31.50	3.00	31.50	95.00	4.20	0.0120	4,964.50	12

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
4,966.00	103.00	4.00:1	4.00:1	20.00

Pond Results:

Peak Elevation:	4,964.37 ft
Dewater Time:	2.64 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4,959.00	0.000	0.000	0.000		
4,959.50	0.222	0.037	0.000		
4,960.00	0.890	0.297	0.000		
4,960.50	0.920	0.749	0.000		
4,961.00	0.950	1.217	0.000		
4,961.50	0.980	1.699	0.000		
4,962.00	1.011	2.197	0.000		Low hole SPW #1
4,962.50	1.042	2.710	0.223	27.87*	
4,963.00	1.074	3.239	0.538	11.90*	
4,963.50	1.108	3.785	0.924	9.25	
4,964.00	1.143	4.348	1.370	6.00	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4,964.37	1.179	4.776	1.736	8.40	Peak Stage
4,964.50	1.190	4.931	1.868		Spillway #1
4,965.00	1.238	5.538	9.038		
4,965.50	1.284	6.168	25.565		
4,966.00	1.331	6.822	31.915		Spillway #2
4,966.50	1.381	7.500	53.019		
4,967.00	1.432	8.203	73.535		
4,967.50	1.490	8.934	120.384		
4,968.00	1.549	9.693	184.620		
4,968.50	1.613	10.484	263.784		
4,969.00	1.679	11.307	359.850		

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Perf. Riser (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
4,959.00	0.000	0.000	0.000
4,959.50	0.000	0.000	0.000
4,960.00	0.000	0.000	0.000
4,960.50	0.000	0.000	0.000
4,961.00	0.000	0.000	0.000
4,961.50	0.000	0.000	0.000
4,962.00	1.00>0.000	0.000	0.000
4,962.50	1.00>0.223	0.000	0.223
4,963.00	1.00>0.538	0.000	0.538
4,963.50	1.00>0.924	0.000	0.924
4,964.00	1.00>1.370	0.000	1.370
4,964.50	1.868	0.000	1.868
4,965.00	9.038	0.000	9.038
4,965.50	25.565	0.000	25.565
4,966.00	31.915	0.000	31.915
4,966.50	36.852	16.167	53.019
4,967.00	41.201	32.334	73.535
4,967.50	45.134	75.250	120.384
4,968.00	48.750	135.869	184.620
4,968.50	52.116	211.667	263.784
4,969.00	55.278	304.572	359.850

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	111.000	0.363	0.000	0.000	91.000	F	37.37	3.942
	Σ	**111.000**						**37.37**	**3.942**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.40	65.00	4,640.00	3.550	0.363
#1	**1**	**Time of Concentration:**					**0.363**

Facility Pond #1 25-Year/24-Hour Storm Event Routing

Corey Sadowsky

North American Coal Corporation
5340 Legacy Drive
Building 1, Suite 300
Plano, TX 75024

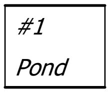
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	25 yr - 24 hr
Rainfall Depth:	1.960 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Facility Pond #1



Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	In	111.000	111.000	94.94	9.84
	Out			29.80	9.02

Structure Detail:

Structure #1 (Pond)

Facility Pond #1

Pond Inputs:

Initial Pool Elev:	4,962.00 ft
Initial Pool:	2.20 ac-ft

Perforated Riser

Riser Diameter (in)	Riser Height (ft)	Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Number of Holes per Elev
31.50	3.00	31.50	95.00	4.20	0.0120	4,964.50	12

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
4,966.00	103.00	4.00:1	4.00:1	20.00

Pond Results:

Peak Elevation:	4,965.83 ft
Dewater Time:	2.97 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4,959.00	0.000	0.000	0.000		
4,959.50	0.222	0.037	0.000		
4,960.00	0.890	0.297	0.000		
4,960.50	0.920	0.749	0.000		
4,961.00	0.950	1.217	0.000		
4,961.50	0.980	1.699	0.000		
4,962.00	1.011	2.197	0.000		Low hole SPW #1
4,962.50	1.042	2.710	0.223	27.87*	
4,963.00	1.074	3.239	0.538	11.90*	
4,963.50	1.108	3.785	0.924	9.25	
4,964.00	1.143	4.348	1.370	6.00	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4,964.50	1.190	4.931	1.868	4.45	Spillway #1
4,965.00	1.238	5.538	9.038	10.10	
4,965.50	1.284	6.168	25.565	1.20	
4,965.83	1.316	6.604	29.801	0.50	Peak Stage
4,966.00	1.331	6.822	31.915		Spillway #2
4,966.50	1.381	7.500	53.019		
4,967.00	1.432	8.203	73.535		
4,967.50	1.490	8.934	120.384		
4,968.00	1.549	9.693	184.620		
4,968.50	1.613	10.484	263.784		
4,969.00	1.679	11.307	359.850		

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Perf. Riser (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
4,959.00	0.000	0.000	0.000
4,959.50	0.000	0.000	0.000
4,960.00	0.000	0.000	0.000
4,960.50	0.000	0.000	0.000
4,961.00	0.000	0.000	0.000
4,961.50	0.000	0.000	0.000
4,962.00	1.00>0.000	0.000	0.000
4,962.50	1.00>0.223	0.000	0.223
4,963.00	1.00>0.538	0.000	0.538
4,963.50	1.00>0.924	0.000	0.924
4,964.00	1.00>1.370	0.000	1.370
4,964.50	1.868	0.000	1.868
4,965.00	9.038	0.000	9.038
4,965.50	25.565	0.000	25.565
4,966.00	31.915	0.000	31.915
4,966.50	36.852	16.167	53.019
4,967.00	41.201	32.334	73.535
4,967.50	45.134	75.250	120.384
4,968.00	48.750	135.869	184.620
4,968.50	52.116	211.667	263.784
4,969.00	55.278	304.572	359.850

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	111.000	0.363	0.000	0.000	91.000	F	94.94	9.836
	Σ	**111.000**						**94.94**	**9.836**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.40	65.00	4,640.00	3.550	0.363
#1	**1**	**Time of Concentration:**					**0.363**

Facility Pond #1 100-Year/24-Hour Storm Event Routing

Corey Sadowsky

North American Coal Corporation
5340 Legacy Drive
Building 1, Suite 300
Plano, TX 75024

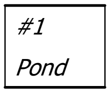
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 24 hr
Rainfall Depth:	2.480 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Facility Pond #1



Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	In	111.000	111.000	133.31	13.87
	Out			111.05	13.87

Structure Detail:

Structure #1 (Pond)

Facility Pond #1

Pond Inputs:

Initial Pool Elev:	4,966.00 ft
Initial Pool:	6.82 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
4,966.00	103.00	4.00:1	4.00:1	20.00

Pond Results:

Peak Elevation:	4,967.80 ft
Dewater Time:	0.64 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4,959.00	0.000	0.000	0.000		
4,959.50	0.222	0.037	0.000		
4,960.00	0.890	0.297	0.000		
4,960.50	0.920	0.749	0.000		
4,961.00	0.950	1.217	0.000		
4,961.50	0.980	1.699	0.000		
4,962.00	1.011	2.197	0.000		
4,962.50	1.042	2.710	0.000		
4,963.00	1.074	3.239	0.000		
4,963.50	1.108	3.785	0.000		
4,964.00	1.143	4.348	0.000		
4,964.50	1.190	4.931	0.000		
4,965.00	1.238	5.538	0.000		
4,965.50	1.284	6.168	0.000		
4,966.00	1.331	6.822	0.000		Spillway #1
4,966.50	1.381	7.500	16.167	13.70	
4,967.00	1.432	8.203	32.334	0.95	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4,967.50	1.490	8.934	75.250	0.50	
4,967.80	1.525	9.382	111.048	0.20	Peak Stage
4,968.00	1.549	9.693	135.869		
4,968.50	1.613	10.484	211.667		
4,969.00	1.679	11.307	304.572		

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
4,959.00	0.000	0.000
4,959.50	0.000	0.000
4,960.00	0.000	0.000
4,960.50	0.000	0.000
4,961.00	0.000	0.000
4,961.50	0.000	0.000
4,962.00	0.000	0.000
4,962.50	0.000	0.000
4,963.00	0.000	0.000
4,963.50	0.000	0.000
4,964.00	0.000	0.000
4,964.50	0.000	0.000
4,965.00	0.000	0.000
4,965.50	0.000	0.000
4,966.00	0.000	0.000
4,966.50	16.167	16.167
4,967.00	32.334	32.334
4,967.50	75.250	75.250
4,968.00	135.869	135.869
4,968.50	211.667	211.667
4,969.00	304.572	304.572

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	111.000	0.363	0.000	0.000	91.000	F	133.31	13.875
	Σ	**111.000**						**133.31**	**13.875**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.40	65.00	4,640.00	3.550	0.363
#1	**1**	**Time of Concentration:**					**0.363**

Facility Pond #2 2-Year/24-Hour Storm Event Routing

Corey Sadowsky

North American Coal Corporation
5340 Legacy Drive
Building 1, Suite 300
Plano, TX 75024

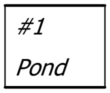
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	2 yr - 24 hr
Rainfall Depth:	1.130 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Facility Pond #2



Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	In	73.000	73.000	30.02	2.64
	Out			2.16	1.86

Structure Detail:

Structure #1 (Pond)

Facility Pond #2

Pond Inputs:

Initial Pool Elev:	4,897.00 ft
Initial Pool:	1.49 ac-ft

Perforated Riser

Riser Diameter (in)	Riser Height (ft)	Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Number of Holes per Elev
31.50	2.00	31.50	90.00	4.40	0.0120	4,899.00	8

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
4,900.50	30.00	4.00:1	4.00:1	18.00

Pond Results:

Peak Elevation:	4,899.09 ft
Dewater Time:	2.65 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4,894.00	0.000	0.000	0.000		
4,894.50	0.150	0.025	0.000		
4,895.00	0.598	0.199	0.000		
4,895.50	0.623	0.505	0.000		
4,896.00	0.647	0.822	0.000		
4,896.50	0.673	1.152	0.000		
4,897.00	0.699	1.495	0.000		
4,897.50	0.727	1.851	0.000		Low hole SPW #1
4,898.00	0.756	2.222	0.149	30.21*	
4,898.50	0.792	2.609	0.359	13.06*	
4,899.00	0.828	3.014	0.616	10.35	Spillway #1

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4,899.09	0.840	3.092	2.163	10.10	Peak Stage
4,899.50	0.874	3.440	9.038		
4,900.00	0.920	3.888	25.565		
4,900.50	0.972	4.361	31.915		Spillway #2
4,901.00	1.025	4.860	57.813		
4,901.50	1.084	5.387	83.124		
4,902.00	1.145	5.945	140.054		
4,902.50	1.216	6.535	207.133		
4,903.00	1.289	7.161	294.893		

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Perf. Riser (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
4,894.00	0.000	0.000	0.000
4,894.50	0.000	0.000	0.000
4,895.00	0.000	0.000	0.000
4,895.50	0.000	0.000	0.000
4,896.00	0.000	0.000	0.000
4,896.50	0.000	0.000	0.000
4,897.00	0.000	0.000	0.000
4,897.50	1.00>0.000	0.000	0.000
4,898.00	1.00>0.149	0.000	0.149
4,898.50	1.00>0.359	0.000	0.359
4,899.00	0.616	0.000	0.616
4,899.50	9.038	0.000	9.038
4,900.00	25.565	0.000	25.565
4,900.50	31.915	0.000	31.915
4,901.00	36.852	20.961	57.813
4,901.50	41.201	41.922	83.124
4,902.00	45.134	94.920	140.054
4,902.50	48.750	158.383	207.133
4,903.00	52.116	242.777	294.893

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	73.000	0.179	0.000	0.000	91.000	F	30.02	2.643
	Σ	**73.000**						**30.02**	**2.643**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	4.01	155.00	3,870.16	6.000	0.179
#1	**1**	**Time of Concentration:**					**0.179**

Facility Pond #2 25-Year/24-Hour Storm Event Routing

Corey Sadowsky

North American Coal Corporation
5340 Legacy Drive
Building 1, Suite 300
Plano, TX 75024

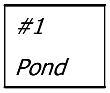
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	25 yr - 24 hr
Rainfall Depth:	1.960 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Facility Pond #2



Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	In	73.000	73.000	74.25	6.60
	Out			30.20	5.80

Structure Detail:

Structure #1 (Pond)

Facility Pond #2

Pond Inputs:

Initial Pool Elev:	4,897.00 ft
Initial Pool:	1.49 ac-ft

Perforated Riser

Riser Diameter (in)	Riser Height (ft)	Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Number of Holes per Elev
31.50	2.00	31.50	90.00	4.40	0.0120	4,899.00	8

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
4,900.50	30.00	4.00:1	4.00:1	18.00

Pond Results:

Peak Elevation:	4,900.36 ft
Dewater Time:	2.75 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4,894.00	0.000	0.000	0.000		
4,894.50	0.150	0.025	0.000		
4,895.00	0.598	0.199	0.000		
4,895.50	0.623	0.505	0.000		
4,896.00	0.647	0.822	0.000		
4,896.50	0.673	1.152	0.000		
4,897.00	0.699	1.495	0.000		
4,897.50	0.727	1.851	0.000		Low hole SPW #1
4,898.00	0.756	2.222	0.149	30.21*	
4,898.50	0.792	2.609	0.359	13.06*	
4,899.00	0.828	3.014	0.616	10.30	Spillway #1

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4,899.50	0.874	3.440	9.038	11.25	
4,900.00	0.920	3.888	25.565	0.80	
4,900.36	0.958	4.233	30.199	0.40	Peak Stage
4,900.50	0.972	4.361	31.915		Spillway #2
4,901.00	1.025	4.860	57.813		
4,901.50	1.084	5.387	83.124		
4,902.00	1.145	5.945	140.054		
4,902.50	1.216	6.535	207.133		
4,903.00	1.289	7.161	294.893		

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Perf. Riser (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
4,894.00	0.000	0.000	0.000
4,894.50	0.000	0.000	0.000
4,895.00	0.000	0.000	0.000
4,895.50	0.000	0.000	0.000
4,896.00	0.000	0.000	0.000
4,896.50	0.000	0.000	0.000
4,897.00	0.000	0.000	0.000
4,897.50	1.00>0.000	0.000	0.000
4,898.00	1.00>0.149	0.000	0.149
4,898.50	1.00>0.359	0.000	0.359
4,899.00	0.616	0.000	0.616
4,899.50	9.038	0.000	9.038
4,900.00	25.565	0.000	25.565
4,900.50	31.915	0.000	31.915
4,901.00	36.852	20.961	57.813
4,901.50	41.201	41.922	83.124
4,902.00	45.134	94.920	140.054
4,902.50	48.750	158.383	207.133
4,903.00	52.116	242.777	294.893

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	73.000	0.179	0.000	0.000	91.000	F	74.25	6.596
	Σ	**73.000**						**74.25**	**6.596**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	4.01	155.00	3,870.16	6.000	0.179
#1	**1**	**Time of Concentration:**					**0.179**

Facility Pond #2 100-Year/24-Hour Storm Event Routing

Corey Sadowsky

North American Coal Corporation
5340 Legacy Drive
Building 1, Suite 300
Plano, TX 75024

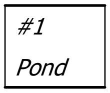
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 24 hr
Rainfall Depth:	2.480 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Facility Pond #2



Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	In	73.000	73.000	103.33	9.31
	Out			90.08	9.31

Structure Detail:

Structure #1 (Pond)

Facility Pond #2

Pond Inputs:

Initial Pool Elev:	4,900.50 ft
Initial Pool:	4.36 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
4,900.50	30.00	4.00:1	4.00:1	18.00

Pond Results:

Peak Elevation:	4,901.95 ft
Dewater Time:	0.57 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4,894.00	0.000	0.000	0.000		
4,894.50	0.150	0.025	0.000		
4,895.00	0.598	0.199	0.000		
4,895.50	0.623	0.505	0.000		
4,896.00	0.647	0.822	0.000		
4,896.50	0.673	1.152	0.000		
4,897.00	0.699	1.495	0.000		
4,897.50	0.727	1.851	0.000		
4,898.00	0.756	2.222	0.000		
4,898.50	0.792	2.609	0.000		
4,899.00	0.828	3.014	0.000		
4,899.50	0.874	3.440	0.000		
4,900.00	0.920	3.888	0.000		
4,900.50	0.972	4.361	0.000		Spillway #1
4,901.00	1.025	4.860	20.961	13.00	
4,901.50	1.084	5.387	41.922	0.50	
4,901.95	1.140	5.894	90.075	0.25	Peak Stage

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
4,902.00	1.145	5.945	94.920	
4,902.50	1.216	6.535	158.383	
4,903.00	1.289	7.161	242.777	

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
4,894.00	0.000	0.000
4,894.50	0.000	0.000
4,895.00	0.000	0.000
4,895.50	0.000	0.000
4,896.00	0.000	0.000
4,896.50	0.000	0.000
4,897.00	0.000	0.000
4,897.50	0.000	0.000
4,898.00	0.000	0.000
4,898.50	0.000	0.000
4,899.00	0.000	0.000
4,899.50	0.000	0.000
4,900.00	0.000	0.000
4,900.50	0.000	0.000
4,901.00	20.961	20.961
4,901.50	41.922	41.922
4,902.00	94.920	94.920
4,902.50	158.383	158.383
4,903.00	242.777	242.777

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	73.000	0.179	0.000	0.000	91.000	F	103.33	9.305
	Σ	**73.000**						**103.33**	**9.305**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	4.01	155.00	3,870.16	6.000	0.179
#1	**1**	**Time of Concentration:**					**0.179**

Mine Pond #1 2-Year/24-Hour Storm Event Routing

Corey Sadowsky

North American Coal Corporation
5340 Legacy Drive
Building 1, Suite 300
Plano, TX 75024

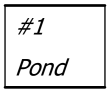
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	2 yr - 24 hr
Rainfall Depth:	1.130 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Mine Pond #1



Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	In	297.000	297.000	101.82	10.59
	Out			8.98	7.96

Structure Detail:

Structure #1 (Pond)

Mine Pond #1

Pond Inputs:

Initial Pool Elev:	4,873.00 ft
Initial Pool:	5.68 ac-ft

Perforated Riser

Riser Diameter (in)	Riser Height (ft)	Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Number of Holes per Elev
31.50	2.00	31.50	105.00	0.95	0.0120	4,875.00	24

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
4,878.50	36.00	4.00:1	4.00:1	40.00

Pond Results:

Peak Elevation:	4,875.50 ft
Dewater Time:	2.81 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4,869.00	0.000	0.000	0.000		
4,869.50	0.218	0.036	0.000		
4,870.00	0.872	0.291	0.000		
4,870.50	1.213	0.810	0.000		
4,871.00	1.611	1.513	0.000		
4,871.50	1.901	2.390	0.000		
4,872.00	2.215	3.418	0.000		
4,872.50	2.260	4.537	0.000		
4,873.00	2.305	5.678	0.000		
4,873.50	2.351	6.842	0.000		Low hole SPW #1
4,874.00	2.397	8.029	0.446	32.22*	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4,874.50	2.443	9.239	1.076	13.61*	
4,875.00	2.489	10.472	1.848	10.45	Spillway #1
4,875.50	2.535	11.719	8.984	11.20	Peak Stage
4,875.50	2.536	11.728	9.038		
4,876.00	2.583	13.008	25.565		
4,876.50	2.630	14.311	31.915		
4,877.00	2.678	15.638	36.852		
4,877.50	2.726	16.989	41.201		
4,878.00	2.775	18.365	45.134		
4,878.50	2.824	19.764	48.750		Spillway #2
4,879.00	2.873	21.188	94.437		
4,879.50	2.922	22.637	139.919		
4,880.00	2.972	24.111	244.561		
4,880.50	3.023	25.610	368.825		
4,881.00	3.075	27.134	517.068		
4,881.50	3.133	28.686	703.717		
4,882.00	3.191	30.267	917.682		

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Perf. Riser (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
4,869.00	0.000	0.000	0.000
4,869.50	0.000	0.000	0.000
4,870.00	0.000	0.000	0.000
4,870.50	0.000	0.000	0.000
4,871.00	0.000	0.000	0.000
4,871.50	0.000	0.000	0.000
4,872.00	0.000	0.000	0.000
4,872.50	0.000	0.000	0.000
4,873.00	0.000	0.000	0.000
4,873.50	1.00>0.000	0.000	0.000
4,874.00	1.00>0.446	0.000	0.446
4,874.50	1.00>1.076	0.000	1.076
4,875.00	1.848	0.000	1.848
4,875.50	9.038	0.000	9.038
4,876.00	25.565	0.000	25.565
4,876.50	31.915	0.000	31.915

Elevation (ft)	Perf. Riser (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
4,877.00	36.852	0.000	36.852
4,877.50	41.201	0.000	41.201
4,878.00	45.134	0.000	45.134
4,878.50	48.750	0.000	48.750
4,879.00	52.116	42.321	94.437
4,879.50	55.278	84.641	139.919
4,880.00	58.268	186.293	244.561
4,880.50	61.112	307.714	368.825
4,881.00	63.829	453.239	517.068
4,881.50	66.435	637.281	703.717
4,882.00	68.943	848.738	917.682

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	297.000	0.347	0.000	0.000	91.000	F	101.82	10.586
	Σ	**297.000**						**101.82**	**10.586**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	5.28	455.00	8,620.00	6.890	0.347
#1	**1**	**Time of Concentration:**					**0.347**

Mine Pond #1 25-Year/24-Hour Storm Event Routing

Corey Sadowsky

North American Coal Corporation
5340 Legacy Drive
Building 1, Suite 300
Plano, TX 75024

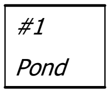
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	25 yr - 24 hr
Rainfall Depth:	1.960 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Mine Pond #1



Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	In	297.000	297.000	257.73	26.42
	Out			46.52	23.72

Structure Detail:

Structure #1 (Pond)

Mine Pond #1

Pond Inputs:

Initial Pool Elev:	4,873.00 ft
Initial Pool:	5.68 ac-ft

Perforated Riser

Riser Diameter (in)	Riser Height (ft)	Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Number of Holes per Elev
31.50	2.00	31.50	105.00	0.95	0.0120	4,875.00	24

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
4,878.50	36.00	4.00:1	4.00:1	40.00

Pond Results:

Peak Elevation:	4,878.19 ft
Dewater Time:	2.93 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4,869.00	0.000	0.000	0.000		
4,869.50	0.218	0.036	0.000		
4,870.00	0.872	0.291	0.000		
4,870.50	1.213	0.810	0.000		
4,871.00	1.611	1.513	0.000		
4,871.50	1.901	2.390	0.000		
4,872.00	2.215	3.418	0.000		
4,872.50	2.260	4.537	0.000		
4,873.00	2.305	5.678	0.000		
4,873.50	2.351	6.842	0.000		Low hole SPW #1
4,874.00	2.397	8.029	0.446	32.22*	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4,874.50	2.443	9.239	1.076	13.61*	
4,875.00	2.489	10.472	1.848	10.45	Spillway #1
4,875.50	2.536	11.728	9.038	7.50	
4,876.00	2.583	13.008	25.565	2.70	
4,876.50	2.630	14.311	31.915	0.90	
4,877.00	2.678	15.638	36.852	0.80	
4,877.50	2.726	16.989	41.201	0.75	
4,878.00	2.775	18.365	45.134	0.80	
4,878.19	2.794	18.902	46.522	0.50	Peak Stage
4,878.50	2.824	19.764	48.750		Spillway #2
4,879.00	2.873	21.188	94.437		
4,879.50	2.922	22.637	139.919		
4,880.00	2.972	24.111	244.561		
4,880.50	3.023	25.610	368.825		
4,881.00	3.075	27.134	517.068		
4,881.50	3.133	28.686	703.717		
4,882.00	3.191	30.267	917.682		

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Perf. Riser (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
4,869.00	0.000	0.000	0.000
4,869.50	0.000	0.000	0.000
4,870.00	0.000	0.000	0.000
4,870.50	0.000	0.000	0.000
4,871.00	0.000	0.000	0.000
4,871.50	0.000	0.000	0.000
4,872.00	0.000	0.000	0.000
4,872.50	0.000	0.000	0.000
4,873.00	0.000	0.000	0.000
4,873.50	1.00>0.000	0.000	0.000
4,874.00	1.00>0.446	0.000	0.446
4,874.50	1.00>1.076	0.000	1.076
4,875.00	1.848	0.000	1.848
4,875.50	9.038	0.000	9.038
4,876.00	25.565	0.000	25.565
4,876.50	31.915	0.000	31.915

Elevation (ft)	Perf. Riser (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
4,877.00	36.852	0.000	36.852
4,877.50	41.201	0.000	41.201
4,878.00	45.134	0.000	45.134
4,878.50	48.750	0.000	48.750
4,879.00	52.116	42.321	94.437
4,879.50	55.278	84.641	139.919
4,880.00	58.268	186.293	244.561
4,880.50	61.112	307.714	368.825
4,881.00	63.829	453.239	517.068
4,881.50	66.435	637.281	703.717
4,882.00	68.943	848.738	917.682

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	297.000	0.347	0.000	0.000	91.000	F	257.73	26.415
	Σ	**297.000**						**257.73**	**26.415**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	5.28	455.00	8,620.00	6.890	0.347
#1	**1**	**Time of Concentration:**					**0.347**

Mine Pond #1 100-Year/24-Hour Storm Event Routing

Corey Sadowsky

North American Coal Corporation
5340 Legacy Drive
Building 1, Suite 300
Plano, TX 75024

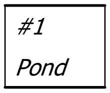
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 24 hr
Rainfall Depth:	2.480 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Mine Pond #1



Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	In	297.000	297.000	361.85	37.26
	Out			312.11	37.26

Structure Detail:

Structure #1 (Pond)

Mine Pond #1

Pond Inputs:

Initial Pool Elev:	4,878.50 ft
Initial Pool:	19.76 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
4,878.50	36.00	4.00:1	4.00:1	40.00

Pond Results:

Peak Elevation:	4,880.52 ft
Dewater Time:	0.63 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
4,869.00	0.000	0.000	0.000	
4,869.50	0.218	0.036	0.000	
4,870.00	0.872	0.291	0.000	
4,870.50	1.213	0.810	0.000	
4,871.00	1.611	1.513	0.000	
4,871.50	1.901	2.390	0.000	
4,872.00	2.215	3.418	0.000	
4,872.50	2.260	4.537	0.000	
4,873.00	2.305	5.678	0.000	
4,873.50	2.351	6.842	0.000	
4,874.00	2.397	8.029	0.000	
4,874.50	2.443	9.239	0.000	
4,875.00	2.489	10.472	0.000	
4,875.50	2.536	11.728	0.000	
4,876.00	2.583	13.008	0.000	
4,876.50	2.630	14.311	0.000	
4,877.00	2.678	15.638	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4,877.50	2.726	16.989	0.000		
4,878.00	2.775	18.365	0.000		
4,878.50	2.824	19.764	0.000		Spillway #1
4,879.00	2.873	21.188	42.321	13.55	
4,879.50	2.922	22.637	84.641	0.85	
4,880.00	2.972	24.111	186.293	0.45	
4,880.50	3.023	25.610	307.714		
4,880.52	3.025	25.656	312.111	0.25	Peak Stage
4,881.00	3.075	27.134	453.239		
4,881.50	3.133	28.686	637.281		
4,882.00	3.191	30.267	848.738		

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
4,869.00	0.000	0.000
4,869.50	0.000	0.000
4,870.00	0.000	0.000
4,870.50	0.000	0.000
4,871.00	0.000	0.000
4,871.50	0.000	0.000
4,872.00	0.000	0.000
4,872.50	0.000	0.000
4,873.00	0.000	0.000
4,873.50	0.000	0.000
4,874.00	0.000	0.000
4,874.50	0.000	0.000
4,875.00	0.000	0.000
4,875.50	0.000	0.000
4,876.00	0.000	0.000
4,876.50	0.000	0.000
4,877.00	0.000	0.000
4,877.50	0.000	0.000
4,878.00	0.000	0.000
4,878.50	0.000	0.000
4,879.00	42.321	42.321
4,879.50	84.641	84.641
4,880.00	186.293	186.293

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
4,880.50	307.714	307.714
4,881.00	453.239	453.239
4,881.50	637.281	637.281
4,882.00	848.738	848.738

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	297.000	0.347	0.000	0.000	91.000	F	361.85	37.262
	Σ	**297.000**						**361.85**	**37.262**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	5.28	455.00	8,620.00	6.890	0.347
#1	**1**	**Time of Concentration:**					**0.347**

Facility Pond #1 Diversion 100-Year/24-Hour Storm Event Routing

Corey Sadowsky

North American Coal Corporation
5340 Legacy Drive
Building 1, Suite 300
Plano, TX 75024

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 24 hr
Rainfall Depth:	2.480 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	Facility Pond #1 Diversion

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	91.000	91.000	95.66	11.33

Structure Detail:

Structure #1 (Null)

Facility Pond #1 Diversion

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	91.000	0.541	0.000	0.000	91.000	F	95.66	11.333
	Σ	**91.000**						**95.66**	**11.333**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	0.24	5.00	2,050.02	1.480	0.384
		8. Large gullies, diversions, and low flowing streams	0.92	15.00	1,630.00	2.870	0.157
#1	**1**	**Time of Concentration:**					**0.541**

Facility Pond #1 Diversion Sta. 0+00 to 16+28

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.01000	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	5.00	ft
Discharge	95.66	ft³/s

Results

Normal Depth	1.89	ft
Flow Area	20.09	ft²
Wetted Perimeter	16.93	ft
Hydraulic Radius	1.19	ft
Top Width	16.31	ft
Critical Depth	1.63	ft
Critical Slope	0.01817	ft/ft
Velocity	4.76	ft/s
Velocity Head	0.35	ft
Specific Energy	2.24	ft
Froude Number	0.76	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.89	ft
Critical Depth	1.63	ft
Channel Slope	0.01000	ft/ft

Facility Pond #1 Diversion Sta. 0+00 to 16+28

GVF Output Data

Critical Slope	0.01817	ft/ft

Facility Pond #2 Diversion 100-Year/24-Hour Storm Event Routing

Corey Sadowsky

North American Coal Corporation
5340 Legacy Drive
Building 1, Suite 300
Plano, TX 75024

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 24 hr
Rainfall Depth:	2.480 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	Facility Pond #2 Diversion

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	40.000	40.000	54.40	5.01

Structure Detail:

Structure #1 (Null)

Facility Pond #2 Diversion

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	40.000	0.217	0.000	0.000	91.000	F	54.40	5.009
	Σ	**40.000**						**54.40**	**5.009**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	7. Paved area and small upland gullies	2.00	26.00	1,300.00	2.840	0.127
		8. Large gullies, diversions, and low flowing streams	3.71	70.00	1,885.00	5.780	0.090
#1	**1**	**Time of Concentration:**					**0.217**

Facility Pond #2 Diversion Sta. 0+00 to 4+14

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.01000	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	5.00	ft
Discharge	54.40	ft³/s

Results

Normal Depth	1.43	ft
Flow Area	13.29	ft²
Wetted Perimeter	14.05	ft
Hydraulic Radius	0.95	ft
Top Width	13.58	ft
Critical Depth	1.21	ft
Critical Slope	0.01965	ft/ft
Velocity	4.09	ft/s
Velocity Head	0.26	ft
Specific Energy	1.69	ft
Froude Number	0.73	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.43	ft
Critical Depth	1.21	ft
Channel Slope	0.01000	ft/ft

Facility Pond #2 Diversion Sta. 0+00 to 4+14

GVF Output Data

Critical Slope	0.01965	ft/ft

Facility Pond #2 Diversion Sta. 4+14 to 8+00

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.045	
Channel Slope	0.06000	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	5.00	ft
Discharge	54.40	ft³/s

Results

Normal Depth	1.03	ft
Flow Area	8.34	ft²
Wetted Perimeter	11.52	ft
Hydraulic Radius	0.72	ft
Top Width	11.18	ft
Critical Depth	1.21	ft
Critical Slope	0.03249	ft/ft
Velocity	6.52	ft/s
Velocity Head	0.66	ft
Specific Energy	1.69	ft
Froude Number	1.33	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.03	ft
Critical Depth	1.21	ft
Channel Slope	0.06000	ft/ft

Facility Pond #2 Diversion Sta. 4+14 to 8+00

GVF Output Data

Critical Slope	0.03249	ft/ft

Facility Pond #2 Diversion Sta. 8+00 to 18+59

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.045	
Channel Slope	0.03600	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	5.00	ft
Discharge	54.40	ft³/s

Results

Normal Depth	1.18	ft
Flow Area	10.03	ft²
Wetted Perimeter	12.44	ft
Hydraulic Radius	0.81	ft
Top Width	12.05	ft
Critical Depth	1.21	ft
Critical Slope	0.03249	ft/ft
Velocity	5.43	ft/s
Velocity Head	0.46	ft
Specific Energy	1.63	ft
Froude Number	1.05	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.18	ft
Critical Depth	1.21	ft
Channel Slope	0.03600	ft/ft

Facility Pond #2 Diversion Sta. 8+00 to 18+59

GVF Output Data

Critical Slope	0.03249	ft/ft

Facility Pond #2 Diversion Sta. 4+14 to 18+59 Riprap

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
5.00	3.0:1	3.0:1	6.0			

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	54.40 cfs	
Depth:	1.03 ft	
Top Width:	11.18 ft	
Velocity:	6.53 fps	
X-Section Area:	8.32 sq ft	
Hydraulic Radius:	0.723 ft	
Froude Number:	1.33	
Manning's n:	0.0450	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

Ancillary Road #1 Diverion 100-Year/24-Hour Storm Event Routing

Corey Sadowsky

North American Coal Corporation
5340 Legacy Drive
Building 1, Suite 300
Plano, TX 75024

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 24 hr
Rainfall Depth:	2.480 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	Ancillary Road #1 Diversion

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	522.000	522.000	237.61	40.28

Structure Detail:

Structure #1 (Null)

Ancillary Road #1 Diversion

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	522.000	0.816	0.000	0.000	85.000	M	237.61	40.276
	Σ	**522.000**						**237.61**	**40.276**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	7. Paved area and small upland gullies	24.98	1,555.00	6,225.00	10.060	0.171
		7. Paved area and small upland gullies	14.97	244.00	1,630.00	7.780	0.058
		8. Large gullies, diversions, and low flowing streams	0.27	8.85	3,280.20	1.550	0.587
#1	**1**	**Time of Concentration:**					**0.816**

Ancillary Road #1 Diversion Sta. 0+00 to 25+78

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.00300	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	8.00	ft
Discharge	237.61	ft³/s

Results

Normal Depth	3.41	ft
Flow Area	62.24	ft²
Wetted Perimeter	29.58	ft
Hydraulic Radius	2.10	ft
Top Width	28.48	ft
Critical Depth	2.27	ft
Critical Slope	0.01611	ft/ft
Velocity	3.82	ft/s
Velocity Head	0.23	ft
Specific Energy	3.64	ft
Froude Number	0.46	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.41	ft
Critical Depth	2.27	ft
Channel Slope	0.00300	ft/ft

Ancillary Road #1 Diversion Sta. 0+00 to 25+78

GVF Output Data

Critical Slope	0.01611	ft/ft

Ancillary Road #1 Diversion Sta. 25+78 to 30+78

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.046	
Channel Slope	0.05500	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	8.00	ft
Discharge	237.61	ft³/s

Results

Normal Depth	1.91	ft
Flow Area	26.25	ft²
Wetted Perimeter	20.09	ft
Hydraulic Radius	1.31	ft
Top Width	19.47	ft
Critical Depth	2.27	ft
Critical Slope	0.02783	ft/ft
Velocity	9.05	ft/s
Velocity Head	1.27	ft
Specific Energy	3.18	ft
Froude Number	1.37	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.91	ft
Critical Depth	2.27	ft
Channel Slope	0.05500	ft/ft

Ancillary Road #1 Diversion Sta. 25+78 to 30+78

GVF Output Data

Critical Slope	0.02783	ft/ft

Ancillary Road #1 Diversion Sta. 25+78 to 30+78 Riprap

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
8.00	3.0:1	3.0:1	5.5			

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	237.61 cfs	
Depth:	1.91 ft	
Top Width:	19.45 ft	
Velocity:	9.07 fps	
X-Section Area:	26.19 sq ft	
Hydraulic Radius:	1.305 ft	
Froude Number:	1.38	
Manning's n:	0.0460	
Dmin:	5.00 in	
D50:	9.00 in	
Dmax:	12.00 in	

Ancillary Road #2 Diversion 100-Year/24-Hour Storm Event Routing

Corey Sadowsky

North American Coal Corporation
5340 Legacy Drive
Building 1, Suite 300
Plano, TX 75024

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 24 hr
Rainfall Depth:	2.480 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	Ancillary Road #2 Diversion

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	1,015.000	1,015.000	334.49	78.27

Structure Detail:

Structure #1 (Null)

Ancillary Road #2 Diversion

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	1,015.000	1.356	0.000	0.000	85.000	M	334.49	78.270
	Σ	**1,015.000**						**334.49**	**78.270**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	7. Paved area and small upland gullies	24.98	1,555.00	6,225.00	10.060	0.171
		7. Paved area and small upland gullies	14.97	244.00	1,630.00	7.780	0.058
		8. Large gullies, diversions, and low flowing streams	0.27	8.85	3,280.20	1.550	0.587
		7. Paved area and small upland gullies	6.00	289.00	4,815.06	4.930	0.271
		8. Large gullies, diversions, and low flowing streams	3.25	170.00	5,235.11	5.400	0.269
#1	**1**	**Time of Concentration:**					**1.356**

Ancillary Road #2 Diversion Sta. 0+00 to 21+68

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.045	
Channel Slope	0.03300	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	25.00	ft
Discharge	334.49	ft³/s

Results

Normal Depth	1.56	ft
Flow Area	46.20	ft²
Wetted Perimeter	34.85	ft
Hydraulic Radius	1.33	ft
Top Width	34.34	ft
Critical Depth	1.65	ft
Critical Slope	0.02680	ft/ft
Velocity	7.24	ft/s
Velocity Head	0.81	ft
Specific Energy	2.37	ft
Froude Number	1.10	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.56	ft
Critical Depth	1.65	ft
Channel Slope	0.03300	ft/ft

Ancillary Road #2 Diversion Sta. 0+00 to 21+68

GVF Output Data

Critical Slope	0.02680	ft/ft

Ancillary Road #2 Diversion Sta. 21+68 to 28+56

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.044	
Channel Slope	0.02600	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	25.00	ft
Discharge	334.49	ft³/s

Results

Normal Depth	1.65	ft
Flow Area	49.28	ft²
Wetted Perimeter	35.41	ft
Hydraulic Radius	1.39	ft
Top Width	34.88	ft
Critical Depth	1.65	ft
Critical Slope	0.02563	ft/ft
Velocity	6.79	ft/s
Velocity Head	0.72	ft
Specific Energy	2.36	ft
Froude Number	1.01	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.65	ft
Critical Depth	1.65	ft
Channel Slope	0.02600	ft/ft

Ancillary Road #2 Diversion Sta. 21+68 to 28+56

GVF Output Data

Critical Slope	0.02563	ft/ft

Ancillary Road #2 Diversion Sta. 28+56 to 39+29

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.045	
Channel Slope	0.03300	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	25.00	ft
Discharge	334.49	ft³/s

Results

Normal Depth	1.56	ft
Flow Area	46.20	ft²
Wetted Perimeter	34.85	ft
Hydraulic Radius	1.33	ft
Top Width	34.34	ft
Critical Depth	1.65	ft
Critical Slope	0.02680	ft/ft
Velocity	7.24	ft/s
Velocity Head	0.81	ft
Specific Energy	2.37	ft
Froude Number	1.10	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.56	ft
Critical Depth	1.65	ft
Channel Slope	0.03300	ft/ft

Ancillary Road #2 Diversion Sta. 28+56 to 39+29

GVF Output Data

Critical Slope	0.02680	ft/ft

Ancillary Road #2 Diversion Sta. 39+29 to 56+27

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.00900	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	25.00	ft
Discharge	334.49	ft³/s

Results

Normal Depth	1.95	ft
Flow Area	60.33	ft²
Wetted Perimeter	37.36	ft
Hydraulic Radius	1.61	ft
Top Width	36.73	ft
Critical Depth	1.65	ft
Critical Slope	0.01621	ft/ft
Velocity	5.54	ft/s
Velocity Head	0.48	ft
Specific Energy	2.43	ft
Froude Number	0.76	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.95	ft
Critical Depth	1.65	ft
Channel Slope	0.00900	ft/ft

Ancillary Road #2 Diversion Sta. 39+29 to 56+27

GVF Output Data

Critical Slope	0.01621	ft/ft

Ancillary Road #2 Diversion Sta. 0+00 to 21+68 Riprap

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
25.00	3.0:1	3.0:1	3.3			

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	334.49 cfs	
Depth:	1.55 ft	
Top Width:	34.33 ft	
Velocity:	7.25 fps	
X-Section Area:	46.12 sq ft	
Hydraulic Radius:	1.324 ft	
Froude Number:	1.10	
Manning's n:	0.0450	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

Ancillary Road #2 Diversion Sta. 21+68 to 28+56 Riprap

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
25.00	3.0:1	3.0:1	2.6			

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	334.49 cfs	
Depth:	1.64 ft	
Top Width:	34.86 ft	
Velocity:	6.80 fps	
X-Section Area:	49.19 sq ft	
Hydraulic Radius:	1.390 ft	
Froude Number:	1.01	
Manning's n:	0.0440	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

Ancillary Road #2 Diversion Sta. 28+56 to 39+29 Riprap

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
25.00	3.0:1	3.0:1	3.3			

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	334.49 cfs	
Depth:	1.55 ft	
Top Width:	34.33 ft	
Velocity:	7.25 fps	
X-Section Area:	46.12 sq ft	
Hydraulic Radius:	1.324 ft	
Froude Number:	1.10	
Manning's n:	0.0450	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

Culvert C-1 100-Year/24-Hour Storm Event Routing

Corey Sadowsky

North American Coal Corporation
5340 Legacy Drive
Building 1, Suite 300
Plano, TX 75024

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 24 hr
Rainfall Depth:	2.480 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	Culvert C-1

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	3,078.000	3,078.000	1,049.13	246.77

Structure Detail:

Structure #1 (Null)

Culvert C-1

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	840.000	1.197	0.000	0.000	85.000	M	300.73	64.785
	2	1,015.000	1.356	0.098	0.353	85.000	M	334.49	78.270
	3	25.000	0.173	0.073	0.353	91.000	F	35.57	3.197
	4	1,027.000	1.019	0.569	0.346	85.000	M	407.86	79.231
	5	171.000	0.542	0.313	0.351	91.000	F	179.61	21.288
	Σ	**3,078.000**						**1,049.13**	**246.772**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	7. Paved area and small upland gullies	6.28	1,365.00	21,725.00	5.040	1.197
#1	**1**	**Time of Concentration:**					**1.197**
#1	2	7. Paved area and small upland gullies	25.00	1,556.00	6,225.04	10.060	0.171
		7. Paved area and small upland gullies	14.97	244.00	1,630.00	7.780	0.058
		8. Large gullies, diversions, and low flowing streams	0.27	8.85	3,280.20	1.550	0.587
		7. Paved area and small upland gullies	6.00	289.00	4,815.06	4.930	0.271
		8. Large gullies, diversions, and low flowing streams	3.25	170.00	5,235.11	5.400	0.269
#1	**2**	**Time of Concentration:**					**1.356**
#1	3	5. Nearly bare and untilled, and alluvial valley fans	5.56	50.00	900.00	2.350	0.106
		8. Large gullies, diversions, and low flowing streams	1.62	15.00	925.01	3.820	0.067
#1	**3**	**Time of Concentration:**					**0.173**
#1	4	7. Paved area and small upland gullies	6.49	1,220.00	18,790.04	5.120	1.019
#1	**4**	**Time of Concentration:**					**1.019**
#1	5	7. Paved area and small upland gullies	2.91	195.00	6,700.11	3.430	0.542
#1	**5**	**Time of Concentration:**					**0.542**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	2	7. Paved area and small upland gullies	4.14	60.00	1,450.00	4.090	0.098
#1	**2**	**Muskingum K:**					**0.098**
#1	3	8. Large gullies, diversions, and low flowing streams	1.86	20.00	1,075.00	4.090	0.073
#1	**3**	**Muskingum K:**					**0.073**
#1	4	5. Nearly bare and untilled, and alluvial valley fans	10.00	125.00	1,250.00	3.160	0.109
		7. Paved area and small upland gullies	3.83	250.00	6,525.03	3.940	0.460
#1	**4**	**Muskingum K:**					**0.569**
#1	5	7. Paved area and small upland gullies	3.97	180.00	4,530.01	4.010	0.313
#1	**5**	**Muskingum K:**					**0.313**

Culvert C-2 100-Year/24-Hour Storm Event Routing

Corey Sadowsky

North American Coal Corporation
5340 Legacy Drive
Building 1, Suite 300
Plano, TX 75024

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 24 hr
Rainfall Depth:	2.480 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	Culvert C-2

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	25.000	25.000	35.57	3.20

Structure Detail:

Structure #1 (Null)

Culvert C-2

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	25.000	0.173	0.000	0.000	91.000	F	35.57	3.197
	Σ	**25.000**						**35.57**	**3.197**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	5.56	50.00	900.00	2.350	0.106
		8. Large gullies, diversions, and low flowing streams	1.62	15.00	925.00	3.820	0.067
#1	**1**	**Time of Concentration:**					**0.173**

Culvert C-3 100-Year/24-Hour Storm Event Routing

Corey Sadowsky

North American Coal Corporation
5340 Legacy Drive
Building 1, Suite 300
Plano, TX 75024

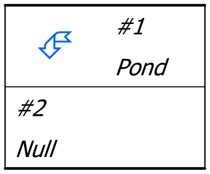
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 24 hr
Rainfall Depth:	2.480 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	#2	0.039	0.364	Mine Pond #1
Null	#2	==>	End	0.000	0.000	Culvert C-3



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	2.31	15.00	650.00	4.55	0.039
#1	**Muskingum K:**					**0.039**

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	In	292.000	292.000	312.37	36.48
	Out			271.37	36.48
#2		15.000	307.000	275.96	38.47

Structure Detail:

Structure #1 (Pond)

Mine Pond #1

Pond Inputs:

Initial Pool Elev:	4,878.50 ft
Initial Pool:	19.76 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
4,878.50	36.00	4.00:1	4.00:1	40.00

Pond Results:

Peak Elevation:	4,880.35 ft
Dewater Time:	0.63 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
4,869.00	0.000	0.000	0.000	
4,869.50	0.218	0.036	0.000	
4,870.00	0.872	0.291	0.000	
4,870.50	1.213	0.810	0.000	
4,871.00	1.611	1.513	0.000	
4,871.50	1.901	2.390	0.000	
4,872.00	2.215	3.418	0.000	
4,872.50	2.260	4.537	0.000	
4,873.00	2.305	5.678	0.000	
4,873.50	2.351	6.842	0.000	
4,874.00	2.397	8.029	0.000	
4,874.50	2.443	9.239	0.000	
4,875.00	2.489	10.472	0.000	
4,875.50	2.536	11.728	0.000	
4,876.00	2.583	13.008	0.000	
4,876.50	2.630	14.311	0.000	
4,877.00	2.678	15.638	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4,877.50	2.726	16.989	0.000		
4,878.00	2.775	18.365	0.000		
4,878.50	2.824	19.764	0.000		Spillway #1
4,879.00	2.873	21.188	42.321	13.60	
4,879.50	2.922	22.637	84.641	0.85	
4,880.00	2.972	24.111	186.293	0.50	
4,880.35	3.008	25.161	271.367	0.25	Peak Stage
4,880.50	3.023	25.610	307.714		
4,881.00	3.075	27.134	453.239		
4,881.50	3.133	28.686	637.281		
4,882.00	3.191	30.267	848.738		

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
4,869.00	0.000	0.000
4,869.50	0.000	0.000
4,870.00	0.000	0.000
4,870.50	0.000	0.000
4,871.00	0.000	0.000
4,871.50	0.000	0.000
4,872.00	0.000	0.000
4,872.50	0.000	0.000
4,873.00	0.000	0.000
4,873.50	0.000	0.000
4,874.00	0.000	0.000
4,874.50	0.000	0.000
4,875.00	0.000	0.000
4,875.50	0.000	0.000
4,876.00	0.000	0.000
4,876.50	0.000	0.000
4,877.00	0.000	0.000
4,877.50	0.000	0.000
4,878.00	0.000	0.000
4,878.50	0.000	0.000
4,879.00	42.321	42.321
4,879.50	84.641	84.641
4,880.00	186.293	186.293

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
4,880.50	307.714	307.714
4,881.00	453.239	453.239
4,881.50	637.281	637.281
4,882.00	848.738	848.738

Structure #2 (Null)

Culvert C-3

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	292.000	0.518	0.000	0.000	91.000	F	312.37	36.480
	Σ	**292.000**						**312.37**	**36.480**
#2	1	15.000	0.062	0.000	0.000	91.000	F	23.61	1.988
	Σ	**307.000**						**275.96**	**38.469**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	7. Paved area and small upland gullies	5.28	455.00	8,620.03	4.620	0.518
#1	**1**	**Time of Concentration:**					**0.518**
#2	1	7. Paved area and small upland gullies	4.62	45.00	975.00	4.320	0.062
#2	**1**	**Time of Concentration:**					**0.062**

Culvert C-4 100-Year/24-Hour Storm Event Routing

Corey Sadowsky

North American Coal Corporation
5340 Legacy Drive
Building 1, Suite 300
Plano, TX 75024

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 24 hr
Rainfall Depth:	2.480 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	Culvert C-4

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	15.000	15.000	23.61	1.99

Structure Detail:

Structure #1 (Null)

Culvert C-4

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	15.000	0.087	0.000	0.000	91.000	F	23.61	1.988
	Σ	**15.000**						**23.61**	**1.988**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	3.43	60.00	1,750.00	5.550	0.087
#1	**1**	**Time of Concentration:**					**0.087**

Culvert C-5 100-Year/24-Hour Storm Event Routing

Corey Sadowsky

North American Coal Corporation
5340 Legacy Drive
Building 1, Suite 300
Plano, TX 75024

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 24 hr
Rainfall Depth:	2.480 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	Culvert C-5

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	84.000	84.000	99.19	10.49

Structure Detail:

Structure #1 (Null)

Culvert C-5

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	84.000	0.384	0.000	0.000	91.000	F	99.19	10.486
	Σ	**84.000**						**99.19**	**10.486**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	0.24	5.00	2,050.00	1.480	0.384
#1	**1**	**Time of Concentration:**					**0.384**

Culvert C-6 100-Year/24-Hour Storm Event Routing

Corey Sadowsky

North American Coal Corporation
5340 Legacy Drive
Building 1, Suite 300
Plano, TX 75024

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 24 hr
Rainfall Depth:	2.480 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	Culvert C-6

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	1.200	1.200	1.89	0.16

Structure Detail:

Structure #1 (Null)

Culvert C-6

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	1.200	0.004	0.000	0.000	91.000	F	1.89	0.158
	Σ	**1.200**						**1.89**	**0.158**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	9. Small streams flowing bankfull	8.00	30.00	375.00	25.450	0.004
#1	**1**	**Time of Concentration:**					**0.004**

Culvert C-7 100-Year/24-Hour Storm Event Routing

Corey Sadowsky

North American Coal Corporation
5340 Legacy Drive
Building 1, Suite 300
Plano, TX 75024

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 24 hr
Rainfall Depth:	2.480 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	Culvert C-7

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	166.000	166.000	222.15	20.96

Structure Detail:

Structure #1 (Null)

Culvert C-7

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	166.000	0.238	0.000	0.000	91.000	F	222.15	20.959
	Σ	**166.000**						**222.15**	**20.959**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	7. Paved area and small upland gullies	6.70	300.00	4,475.00	5.210	0.238
#1	**1**	**Time of Concentration:**					**0.238**

Culvert C-8 100-Year/24-Hour Storm Event Routing

Corey Sadowsky

North American Coal Corporation
5340 Legacy Drive
Building 1, Suite 300
Plano, TX 75024

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 24 hr
Rainfall Depth:	2.480 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	Culvert C-1

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	21.000	21.000	30.00	2.68

Structure Detail:

Structure #1 (Null)

Culvert C-1

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	21.000	0.144	0.000	0.000	91.000	F	30.00	2.684
	Σ	**21.000**						**30.00**	**2.684**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	4.01	125.00	3,120.00	6.000	0.144
#1	**1**	**Time of Concentration:**					**0.144**

Culvert Designer/Analyzer Report
Culvert C-1

Peak Discharge Method: User-Specified			
Design Discharge	1,049.13 cfs	Check Discharge	1,049.13 cfs

Grades Model: Inverts			
Invert Upstream	4,817.20 ft	Invert Downstream	4,802.60 ft
Length	295.00 ft	Slope	0.049492 ft/ft
Drop	14.60 ft		

Headwater Model: Maximum Allowable HW	
Headwater Elevation	4,830.00 ft

Tailwater properties: Irregular Channel

Tailwater conditions for Design Storm.			
Discharge	1,049.13 cfs	Actual Depth	0.00 ft
Velocity	0.00 ft/s		

Tailwater conditions for Check Storm.			
Discharge	1,049.13 cfs	Actual Depth	0.00 ft
Velocity	0.00 ft/s		

	Name	Description	Discharge	HW Elev.	Velocity
x	Trial-1	7-60 inch Circular	1,049.13 cfs	4,823.45 ft	15.80 ft/s

Culvert Designer/Analyzer Report
Culvert C-1

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	4,830.00	ft	Storm Event	Design	
Computed Headwater Eleva	4,823.45	ft	Discharge	1,049.13	cfs
Headwater Depth/Height	1.25		Tailwater Elevation	0.00	ft
Inlet Control HW Elev.	4,823.03	ft	Control Type	Entrance Control	
Outlet Control HW Elev.	4,823.45	ft			

Grades

Upstream Invert	4,817.20	ft	Downstream Invert	4,802.60	ft
Length	295.00	ft	Constructed Slope	0.049492	ft/ft

Hydraulic Profile

Profile	S2		Depth, Downstream	2.43	ft
Slope Type	Steep		Normal Depth	2.43	ft
Flow Regime	Supercritical		Critical Depth	3.51	ft
Velocity Downstream	15.80	ft/s	Critical Slope	0.015985	ft/ft

Section

Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	5.00	ft
Section Size	60 inch		Rise	5.00	ft
Number Sections	7				

Outlet Control Properties

Outlet Control HW Elev.	4,823.45	ft	Upstream Velocity Head	1.61	ft
Ke	0.70		Entrance Loss	1.13	ft

Inlet Control Properties

Inlet Control HW Elev.	4,823.03	ft	Flow Control	Unsubmerged	
Inlet Type	Mitered to slope		Area Full	137.4	ft²
K	0.02100		HDS 5 Chart	2	
M	1.33000		HDS 5 Scale	2	
C	0.04630		Equation Form	1	
Y	0.75000				

Culvert Designer/Analyzer Report
Culvert C-2

Peak Discharge Method: User-Specified					
Design Discharge	35.57	cfs	Check Discharge	35.57	cfs

Grades Model: Inverts					
Invert Upstream	4,839.60	ft	Invert Downstream	4,838.50	ft
Length	120.00	ft	Slope	0.009167	ft/ft
Drop	1.10	ft			

Headwater Model: Maximum Allowable HW		
Headwater Elevation	4,845.00	ft

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.					
Discharge	35.57	cfs	Bottom Elevation	4,838.50	ft
Depth	1.15	ft	Velocity	3.64	ft/s

Tailwater conditions for Check Storm.					
Discharge	35.57	cfs	Bottom Elevation	4,838.50	ft
Depth	1.15	ft	Velocity	3.64	ft/s

Name	Description	Discharge	HW Elev.	Velocity
x Trial-1	1-36 inch Circular	35.57 cfs	4,842.93 ft	7.36 ft/s

Culvert Designer/Analyzer Report
Culvert C-2

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	4,845.00	ft	Storm Event	Design	
Computed Headwater Eleva	4,842.93	ft	Discharge	35.57	cfs
Headwater Depth/Height	1.11		Tailwater Elevation	4,839.65	ft
Inlet Control HW Elev.	4,842.66	ft	Control Type	Outlet Control	
Outlet Control HW Elev.	4,842.93	ft			

Grades

Upstream Invert	4,839.60	ft	Downstream Invert	4,838.50	ft
Length	120.00	ft	Constructed Slope	0.009167	ft/ft

Hydraulic Profile

Profile	M2		Depth, Downstream	1.94	ft
Slope Type	Mild		Normal Depth	2.54	ft
Flow Regime	Subcritical		Critical Depth	1.94	ft
Velocity Downstream	7.36	ft/s	Critical Slope	0.017221	ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.024	
Section Material	CMP	Span	3.00	ft
Section Size	36 inch	Rise	3.00	ft
Number Sections	1			

Outlet Control Properties

Outlet Control HW Elev.	4,842.93	ft	Upstream Velocity Head	0.51	ft
Ke	0.70		Entrance Loss	0.36	ft

Inlet Control Properties

Inlet Control HW Elev.	4,842.66	ft	Flow Control	N/A	
Inlet Type	Mitered to slope		Area Full	7.1	ft²
K	0.02100		HDS 5 Chart	2	
M	1.33000		HDS 5 Scale	2	
C	0.04630		Equation Form	1	
Y	0.75000				

Culvert Designer/Analyzer Report
Culvert C-3

Peak Discharge Method: User-Specified					
Design Discharge	275.96	cfs	Check Discharge	275.96	cfs

Grades Model: Inverts					
Invert Upstream	4,850.00	ft	Invert Downstream	4,833.20	ft
Length	280.00	ft	Slope	0.060000	ft/ft
Drop	16.80	ft			

Headwater Model: Maximum Allowable HW		
Headwater Elevation	4,858.00	ft

Tailwater properties: Irregular Channel

Tailwater conditions for Design Storm.					
Discharge	275.96	cfs	Actual Depth	0.00	ft
Velocity	0.00	ft/s			

Tailwater conditions for Check Storm.					
Discharge	275.96	cfs	Actual Depth	0.00	ft
Velocity	0.00	ft/s			

	Name	Description	Discharge	HW Elev.	Velocity
x	Trial-1	4-48 inch Circular	275.96 cfs	4,854.33 ft	13.95 ft/s

Culvert Designer/Analyzer Report
Culvert C-3

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	4,858.00	ft	Storm Event	Design	
Computed Headwater Eleva	4,854.33	ft	Discharge	275.96	cfs
Headwater Depth/Height	1.08		Tailwater Elevation	0.00	ft
Inlet Control HW Elev.	4,854.07	ft	Control Type	Entrance Control	
Outlet Control HW Elev.	4,854.33	ft			

Grades

Upstream Invert	4,850.00	ft	Downstream Invert	4,833.20	ft
Length	280.00	ft	Constructed Slope	0.060000	ft/ft

Hydraulic Profile

Profile	S2		Depth, Downstream	1.66	ft
Slope Type	Steep		Normal Depth	1.66	ft
Flow Regime	Supercritical		Critical Depth	2.51	ft
Velocity Downstream	13.95	ft/s	Critical Slope	0.015219	ft/ft

Section

Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	4.00	ft
Section Size	48 inch		Rise	4.00	ft
Number Sections	4				

Outlet Control Properties

Outlet Control HW Elev.	4,854.33	ft	Upstream Velocity Head	1.07	ft
Ke	0.70		Entrance Loss	0.75	ft

Inlet Control Properties

Inlet Control HW Elev.	4,854.07	ft	Flow Control	Unsubmerged	
Inlet Type	Mitered to slope		Area Full	50.3	ft²
K	0.02100		HDS 5 Chart	2	
M	1.33000		HDS 5 Scale	2	
C	0.04630		Equation Form	1	
Y	0.75000				

Culvert Designer/Analyzer Report
Culvert C-4

Peak Discharge Method: User-Specified

Design Discharge	23.61	cfs	Check Discharge	23.61	cfs

Grades Model: Inverts

Invert Upstream	5,037.40	ft	Invert Downstream	5,030.80	ft
Length	190.00	ft	Slope	0.034737	ft/ft
Drop	6.60	ft			

Headwater Model: Maximum Allowable HW

Headwater Elevation	5,041.00	ft

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.

Discharge	23.61	cfs	Bottom Elevation	5,030.80	ft
Depth	0.67	ft	Velocity	5.05	ft/s

Tailwater conditions for Check Storm.

Discharge	23.61	cfs	Bottom Elevation	5,030.80	ft
Depth	0.67	ft	Velocity	5.05	ft/s

	Name	Description	Discharge	HW Elev.	Velocity
x	Trial-1	2-24 inch Circular	23.61 cfs	5,039.52 ft	7.33 ft/s

Culvert Designer/Analyzer Report
Culvert C-4

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	5,041.00	ft	Storm Event	Design	
Computed Headwater Eleva	5,039.52	ft	Discharge	23.61	cfs
Headwater Depth/Height	1.06		Tailwater Elevation	5,031.47	ft
Inlet Control HW Elev.	5,039.36	ft	Control Type	Entrance Control	
Outlet Control HW Elev.	5,039.52	ft			

Grades

Upstream Invert	5,037.40	ft	Downstream Invert	5,030.80	ft
Length	190.00	ft	Constructed Slope	0.034737	ft/ft

Hydraulic Profile

Profile	S2		Depth, Downstream	1.02	ft
Slope Type	Steep		Normal Depth	1.02	ft
Flow Regime	Supercritical		Critical Depth	1.23	ft
Velocity Downstream	7.33	ft/s	Critical Slope	0.018889	ft/ft

Section

Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	2				

Outlet Control Properties

Outlet Control HW Elev.	5,039.52	ft	Upstream Velocity Head	0.52	ft
Ke	0.70		Entrance Loss	0.37	ft

Inlet Control Properties

Inlet Control HW Elev.	5,039.36	ft	Flow Control	N/A	
Inlet Type	Mitered to slope		Area Full	6.3	ft²
K	0.02100		HDS 5 Chart	2	
M	1.33000		HDS 5 Scale	2	
C	0.04630		Equation Form	1	
Y	0.75000				

Culvert Designer/Analyzer Report
Culvert C-5

Peak Discharge Method: User-Specified					
Design Discharge	99.19	cfs	Check Discharge	99.19	cfs

Grades Model: Inverts					
Invert Upstream	5,032.50	ft	Invert Downstream	5,030.00	ft
Length	205.00	ft	Slope	0.012195	ft/ft
Drop	2.50	ft			

Headwater Model: Maximum Allowable HW		
Headwater Elevation	5,045.00	ft

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.					
Discharge	99.19	cfs	Bottom Elevation	5,030.00	ft
Depth	1.97	ft	Velocity	4.62	ft/s

Tailwater conditions for Check Storm.					
Discharge	99.19	cfs	Bottom Elevation	5,030.00	ft
Depth	1.97	ft	Velocity	4.62	ft/s

	Name	Description	Discharge	HW Elev.	Velocity
x	Trial-1	1-60 inch Circular	99.19 cfs	5,037.27 ft	8.64 ft/s

Culvert Designer/Analyzer Report
Culvert C-5

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	5,045.00	ft	Storm Event	Design	
Computed Headwater Eleva	5,037.27	ft	Discharge	99.19	cfs
Headwater Depth/Height	0.95		Tailwater Elevation	5,031.97	ft
Inlet Control HW Elev.	5,036.85	ft	Control Type	Outlet Control	
Outlet Control HW Elev.	5,037.27	ft			

Grades

Upstream Invert	5,032.50	ft	Downstream Invert	5,030.00	ft
Length	205.00	ft	Constructed Slope	0.012195	ft/ft

Hydraulic Profile

Profile	M2		Depth, Downstream	2.83	ft
Slope Type	Mild		Normal Depth	2.90	ft
Flow Regime	Subcritical		Critical Depth	2.83	ft
Velocity Downstream	8.64	ft/s	Critical Slope	0.013073	ft/ft

Section

Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	5.00	ft
Section Size	60 inch		Rise	5.00	ft
Number Sections	1				

Outlet Control Properties

Outlet Control HW Elev.	5,037.27	ft	Upstream Velocity Head	1.10	ft
Ke	0.70		Entrance Loss	0.77	ft

Inlet Control Properties

Inlet Control HW Elev.	5,036.85	ft	Flow Control	Unsubmerged	
Inlet Type	Mitered to slope		Area Full	19.6	ft^2
K	0.02100		HDS 5 Chart	2	
M	1.33000		HDS 5 Scale	2	
C	0.04630		Equation Form	1	
Y	0.75000				

Culvert Designer/Analyzer Report
Culvert C-6

Peak Discharge Method: User-Specified

Design Discharge	1.89	cfs	Check Discharge	1.89	cfs

Grades Model: Inverts

Invert Upstream	5,035.60	ft	Invert Downstream	5,035.40	ft
Length	115.00	ft	Slope	0.001739	ft/ft
Drop	0.20	ft			

Headwater Model: Maximum Allowable HW

Headwater Elevation	5,041.00	ft

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.

Discharge	1.89	cfs	Bottom Elevation	5,035.40	ft
Depth	0.37	ft	Velocity	0.83	ft/s

Tailwater conditions for Check Storm.

Discharge	1.89	cfs	Bottom Elevation	5,035.40	ft
Depth	0.37	ft	Velocity	0.83	ft/s

	Name	Description	Discharge	HW Elev.	Velocity
x	Trial-1	1-12 inch Circular	1.89 cfs	5,037.41 ft	3.95 ft/s

Culvert Designer/Analyzer Report
Culvert C-6

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	5,041.00	ft	Storm Event	Design	
Computed Headwater Eleva	5,037.41	ft	Discharge	1.89	cfs
Headwater Depth/Height	1.81		Tailwater Elevation	5,035.77	ft
Inlet Control HW Elev.	5,036.50	ft	Control Type	Outlet Control	
Outlet Control HW Elev.	5,037.41	ft			

Grades

Upstream Invert	5,035.60	ft	Downstream Invert	5,035.40	ft
Length	115.00	ft	Constructed Slope	0.001739	ft/ft

Hydraulic Profile

Profile	CompositeM2PressureProfile		Depth, Downstream	0.59	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	0.59	ft
Velocity Downstream	3.95	ft/s	Critical Slope	0.022876	ft/ft

Section

Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	1.00	ft
Section Size	12 inch		Rise	1.00	ft
Number Sections	1				

Outlet Control Properties

Outlet Control HW Elev.	5,037.41	ft	Upstream Velocity Head	0.09	ft
Ke	0.70		Entrance Loss	0.06	ft

Inlet Control Properties

Inlet Control HW Elev.	5,036.50	ft	Flow Control	N/A	
Inlet Type	Mitered to slope		Area Full	0.8	ft²
K	0.02100		HDS 5 Chart	2	
M	1.33000		HDS 5 Scale	2	
C	0.04630		Equation Form	1	
Y	0.75000				

Culvert Designer/Analyzer Report
Culvert C-7

Peak Discharge Method: User-Specified					
Design Discharge	222.15	cfs	Check Discharge	222.15	cfs

Grades Model: Inverts					
Invert Upstream	5,033.70	ft	Invert Downstream	5,023.50	ft
Length	175.00	ft	Slope	0.058286	ft/ft
Drop	10.20	ft			

Headwater Model: Maximum Allowable HW		
Headwater Elevation	5,045.00	ft

Tailwater properties: Irregular Channel

Tailwater conditions for Design Storm.					
Discharge	222.15	cfs	Actual Depth	0.00	ft
Velocity	0.00	ft/s			

Tailwater conditions for Check Storm.					
Discharge	222.15	cfs	Actual Depth	0.00	ft
Velocity	0.00	ft/s			

	Name	Description	Discharge	HW Elev.	Velocity
x	Trial-1	2-60 inch Circular	222.15 cfs	5,038.85 ft	15.51 ft/s

Culvert Designer/Analyzer Report
Culvert C-7

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	5,045.00	ft	Storm Event	Design	
Computed Headwater Eleva	5,038.85	ft	Discharge	222.15	cfs
Headwater Depth/Height	1.03		Tailwater Elevation	0.00	ft
Inlet Control HW Elev.	5,038.53	ft	Control Type	Entrance Control	
Outlet Control HW Elev.	5,038.85	ft			

Grades

Upstream Invert	5,033.70	ft	Downstream Invert	5,023.50	ft
Length	175.00	ft	Constructed Slope	0.058286	ft/ft

Hydraulic Profile

Profile	S2		Depth, Downstream	1.96	ft
Slope Type	Steep		Normal Depth	1.96	ft
Flow Regime	Supercritical		Critical Depth	3.01	ft
Velocity Downstream	15.51	ft/s	Critical Slope	0.013635	ft/ft

Section

Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	5.00	ft
Section Size	60 inch		Rise	5.00	ft
Number Sections	2				

Outlet Control Properties

Outlet Control HW Elev.	5,038.85	ft	Upstream Velocity Head	1.26	ft
Ke	0.70		Entrance Loss	0.88	ft

Inlet Control Properties

Inlet Control HW Elev.	5,038.53	ft	Flow Control	N/A	
Inlet Type	Mitered to slope		Area Full	39.3	ft²
K	0.02100		HDS 5 Chart	2	
M	1.33000		HDS 5 Scale	2	
C	0.04630		Equation Form	1	
Y	0.75000				

Culvert Designer/Analyzer Report
Culvert C-8

Peak Discharge Method: User-Specified

Design Discharge	30.00	cfs	Check Discharge	30.00	cfs

Grades Model: Inverts

Invert Upstream	4,924.50	ft	Invert Downstream	4,919.10	ft
Length	95.00	ft	Slope	0.056842	ft/ft
Drop	5.40	ft			

Headwater Model: Maximum Allowable HW

Headwater Elevation	4,930.50	ft

Tailwater properties: Irregular Channel

Tailwater conditions for Design Storm.

Discharge	30.00	cfs	Actual Depth	0.00	ft
Velocity	0.00	ft/s			

Tailwater conditions for Check Storm.

Discharge	30.00	cfs	Actual Depth	0.00	ft
Velocity	0.00	ft/s			

	Name	Description	Discharge	HW Elev.	Velocity
x	Trial-1	1-36 inch Circular	30.00 cfs	4,927.53 ft	11.09 ft/s

Culvert Designer/Analyzer Report
Culvert C-8

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	4,930.50	ft	Storm Event	Design	
Computed Headwater Eleva	4,927.53	ft	Discharge	30.00	cfs
Headwater Depth/Height	1.01		Tailwater Elevation	0.00	ft
Inlet Control HW Elev.	4,927.34	ft	Control Type	Entrance Control	
Outlet Control HW Elev.	4,927.53	ft			

Grades

Upstream Invert	4,924.50	ft	Downstream Invert	4,919.10	ft
Length	95.00	ft	Constructed Slope	0.056842	ft/ft

Hydraulic Profile

Profile	S2		Depth, Downstream	1.22	ft
Slope Type	Steep		Normal Depth	1.22	ft
Flow Regime	Supercritical		Critical Depth	1.77	ft
Velocity Downstream	11.09	ft/s	Critical Slope	0.015957	ft/ft

Section

Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	3.00	ft
Section Size	36 inch		Rise	3.00	ft
Number Sections	1				

Outlet Control Properties

Outlet Control HW Elev.	4,927.53	ft	Upstream Velocity Head	0.74	ft
Ke	0.70		Entrance Loss	0.52	ft

Inlet Control Properties

Inlet Control HW Elev.	4,927.34	ft	Flow Control	Unsubmerged	
Inlet Type	Mitered to slope		Area Full	7.1	ft²
K	0.02100		HDS 5 Chart	2	
M	1.33000		HDS 5 Scale	2	
C	0.04630		Equation Form	1	
Y	0.75000				

E.3.8 POND VOLUME CALCULATIONS AND FILLING CURVES

Thacker Pass
Pond Volume Estimate Calculator
RECLAIM POND

Completed by Sarah Breidt December 2019

Length (Top)	900.00
Width (Top)	350.00
Total Depth	9.00
Side Slopes	2.5
Liquid Depth (ft)	10.00
Freeboard (ft)	3.00

SPILLWAY SZING

$$Q = \frac{2}{3} C b \sqrt{2g} H^{3/2}$$

Q	125.7	**b**	37.90
C	0.62	**H**	1

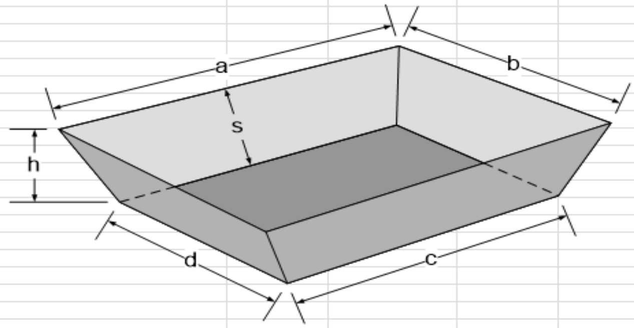
	Length	Width
Pond Dims. @ Liquid Level	885.00	335.00
Pond Dims. @ Bottom	835.00	285.00

	Cubic Feet	*Gallons*
Pond Liquid Volume	**2,668,083.33**	**19,957,263**

Required Volume 2,374,020 **GOOD**

Process Ponds - Calculations

Pond Volume Calculation

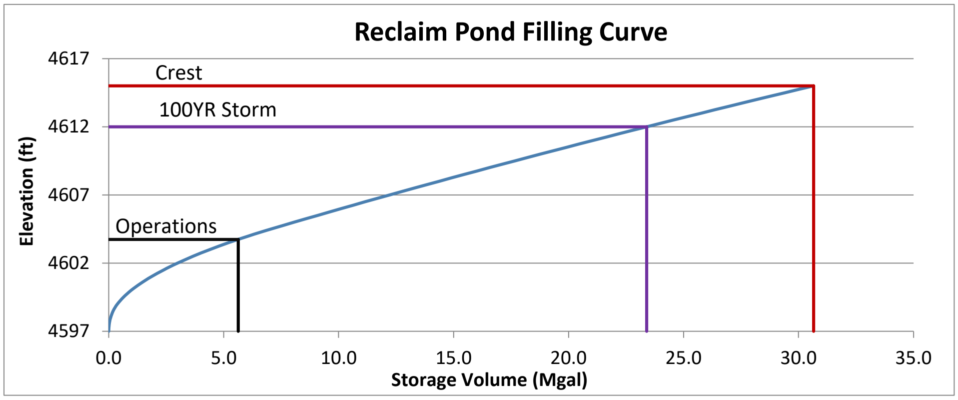


Area and Volume of the Frustrum of a Pyramid

$$\text{Surface Area} = ab + cd + (a+b+c+d) \times \frac{s}{2}$$

$$\text{Volume} = \frac{h\,(ab + cd + \sqrt{abcd}\,)}{3}$$

CAD GENERATED FILLING CURVE



Operational Volume:
5,635,600 gallons
100 YR Strom Volume:
17,757,700 gallons

Thacker Pass
Sediment Pond Spillway Calculator

Broad Crested Weir Equation:

$$Q = \frac{2}{3} C b \sqrt{2g} H^{3/2}$$

🟦 input value

EAST WRSF SEDIMENT POND (sub-area 3C)

Peak Q_{100}	130	cfs	**Flow Depth**	1	ft
Weir Coef.	0.62		**Weir Width**	39.19	ft

CGS SEDIMENT POND (sub-area 4B)

Peak Q_{100}	361	cfs	**Flow Depth**	2	ft
Weir Coef.	0.62		**Weir Width**	38.48	ft

PROCESS PLANT SEDIMENT POND (sub-area 4C)

Peak Q_{100}	106.6	cfs	**Flow Depth**	1	ft
Weir Coef.	0.62		**Weir Width**	32.14	ft

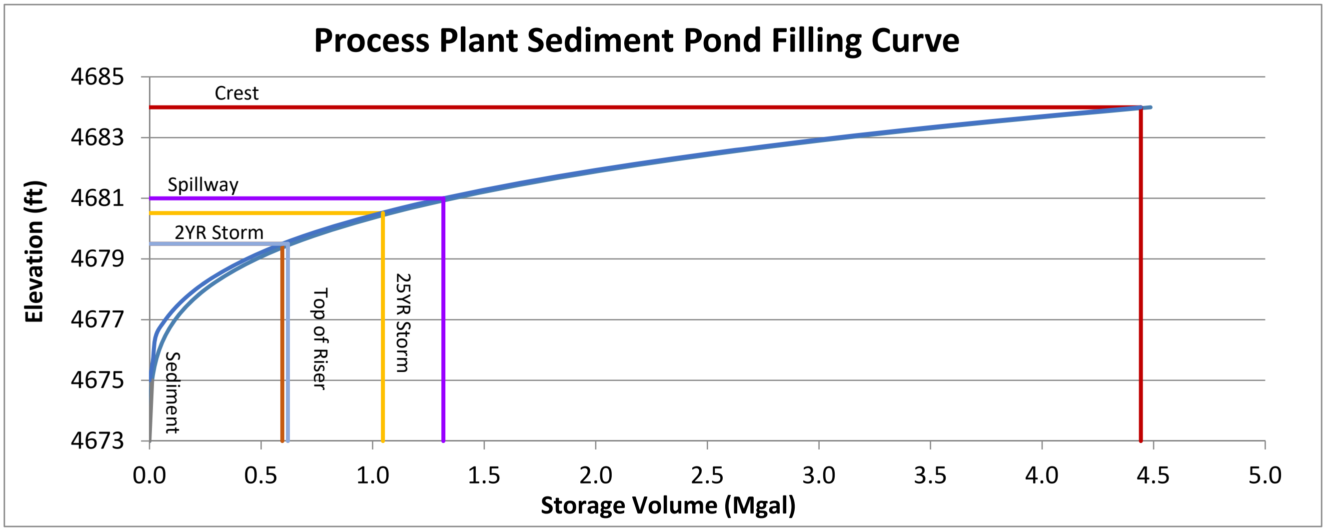
WEST WRSF SEDIMENT POND (sub-area 6)

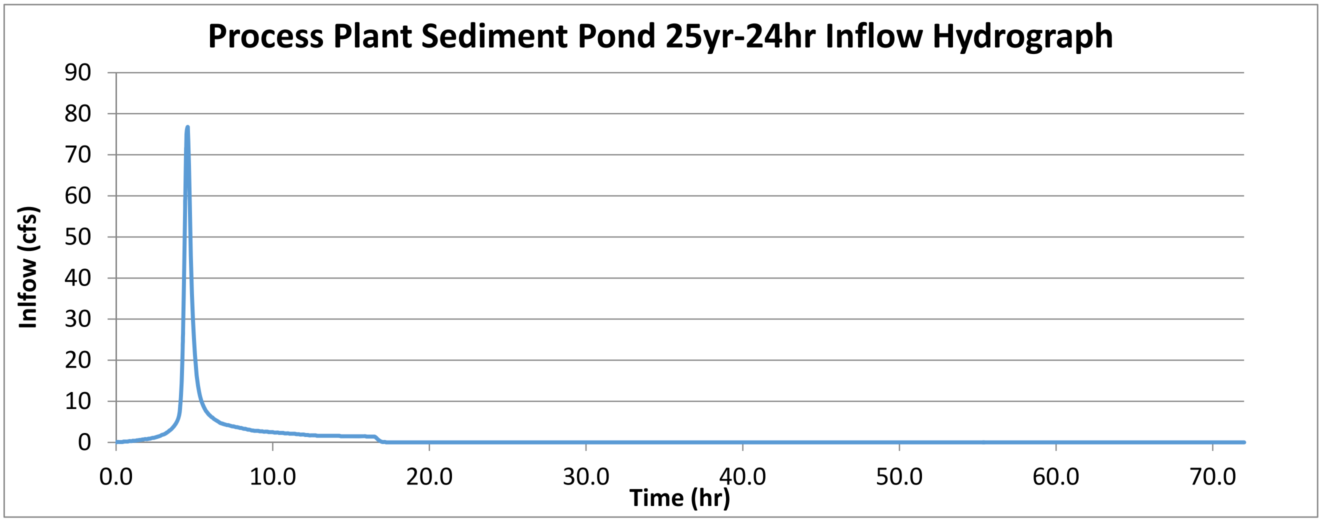
Peak Q_{500}	403.2	cfs	**Flow Depth**	2	ft
Weir Coef.	0.62		**Weir Width**	42.98	ft

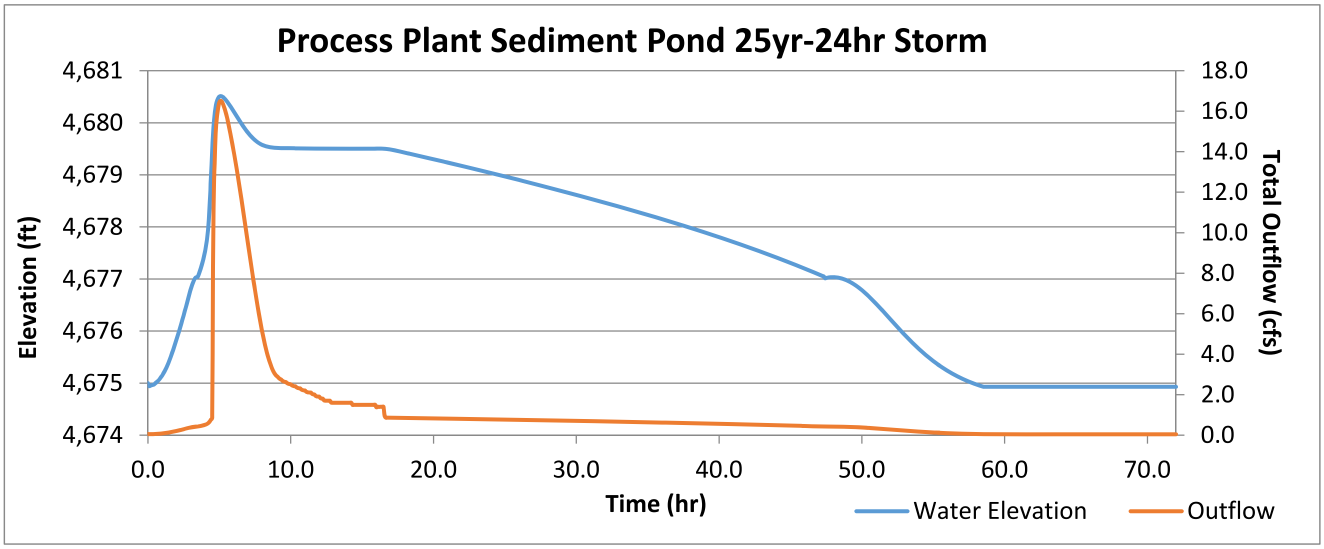
Thacker Pass

CAD GENERATED FILLING CURVE

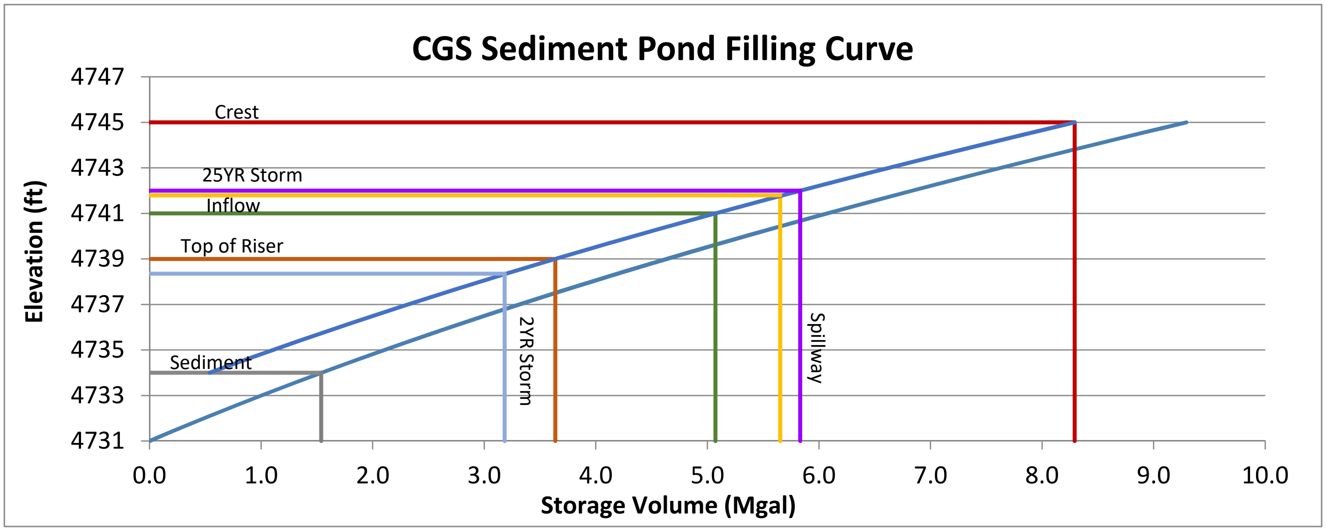
PROCESS PLANT SEDIMENT POND



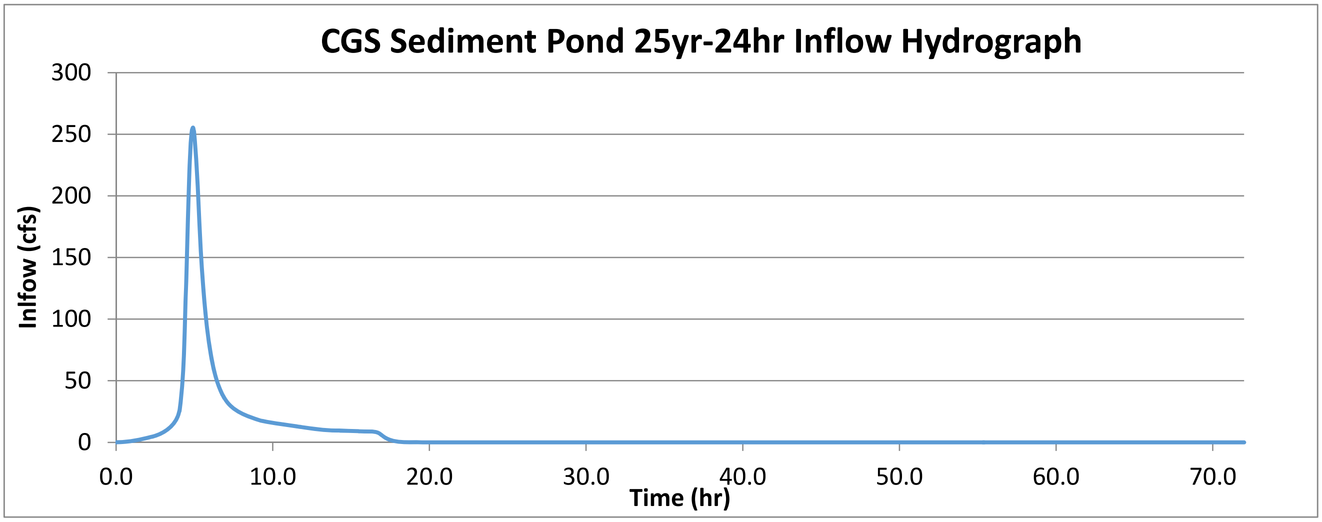




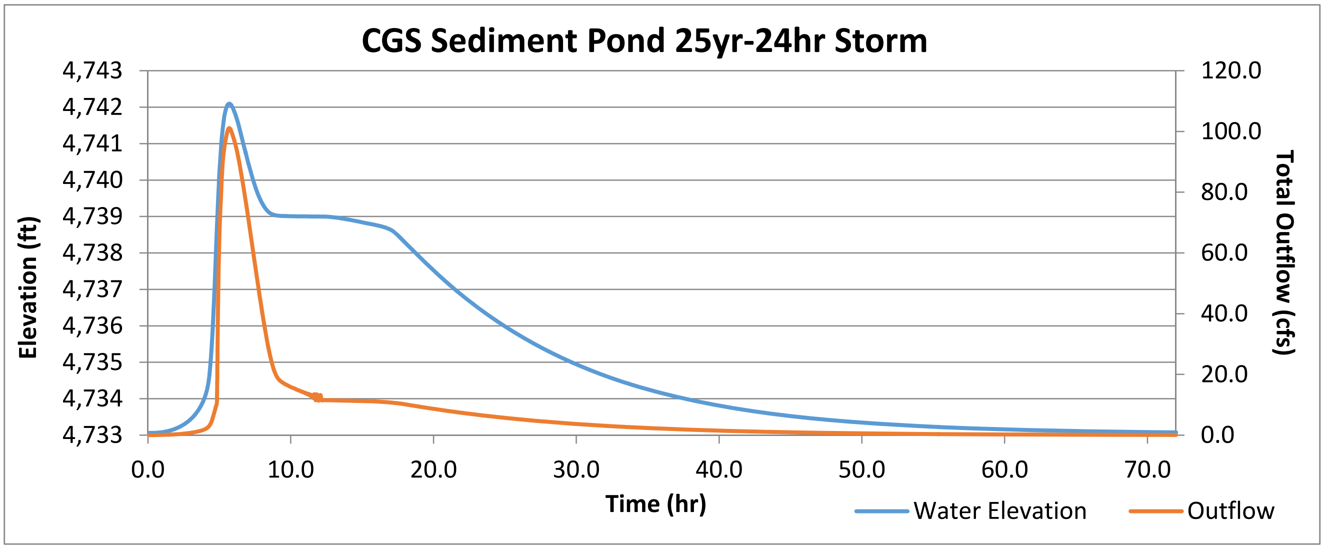
Thacker Pass
CAD GENERATED FILLING CURVE
CGS SEDIMENT POND



CGS Sediment Pond Filling Curve

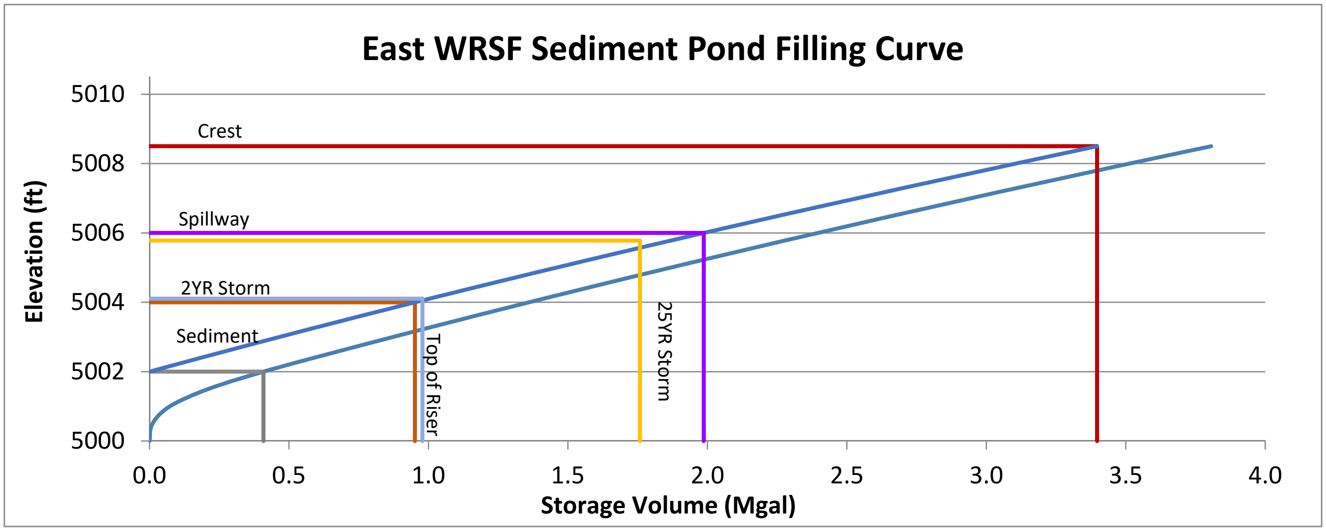


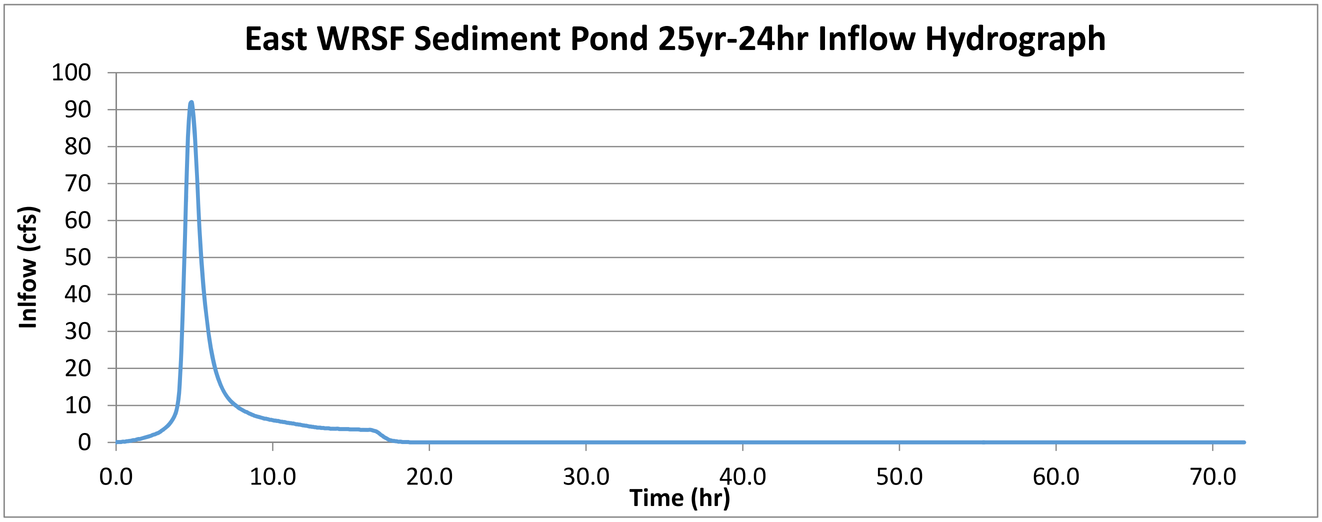
CGS Sediment Pond 25yr-24hr Inflow Hydrograph

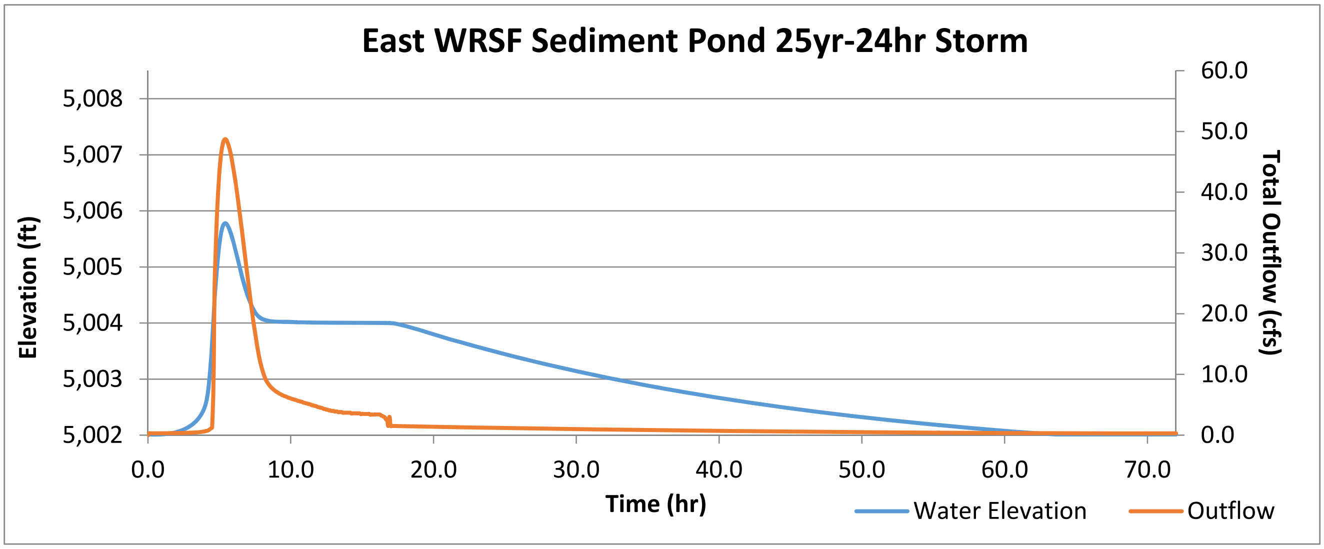


CGS Sediment Pond 25yr-24hr Storm

Thacker Pass
CAD GENERATED FILLING CURVE
East WRSF



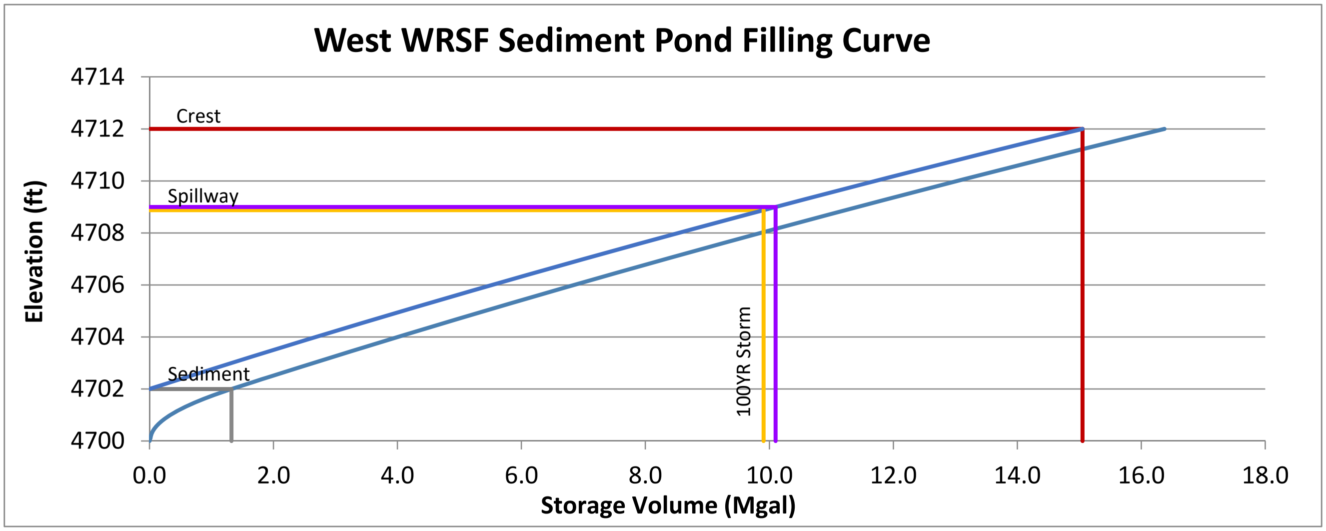


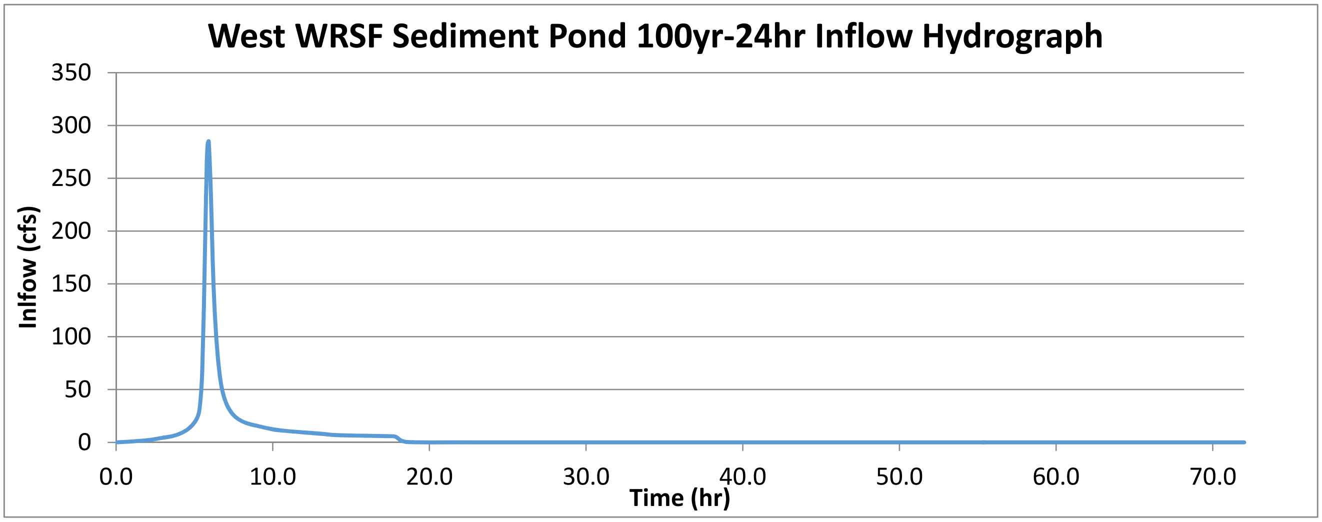


Thacker Pass

CAD GENERATED FILLING CURVE

WEST WRSF SEDIMENT POND





E.3.9 RISER PIPE SIZING

NewFields

Freshwater Basin Perforated Riser Calculations

Client	Lithium Nevada Corp.	**Preparer:**	S. Breidt	
Project	Thacker Pass Project	**Checked:**	R. Li	1/13/2020
Title	Perforated Riser - Process Plant Sediment Pond	**Revision:**	2	

Assumptions/Methodology

1. Vertical riser has a diameter of 2ft, with perforations from elevation 4675ft to 4679.5ft
2. Perforations are 0.5in diameter, with 8 holes per row and 6in between rows, for 10 total rows
3. Flow through an orifice = CdA(2gh)1/2, where Cd = 0.61, A = 0.005454ft2, g = 32.17ft/s2, h= head (ft)
4. "Total Out Flow" row includes a porosity of 0.43 for the rock piled around the riser

OUTFLOW SIMPLIFICATIONS

ORIF	15.37
SPILL	85.475

Inputs

Min. Perforation Elevation	4,675.0 ft	Height of Perforations	4.5 ft	Hole Diameter	**0.5** in =	0.0417 ft	Vertical spacing	**6** in =	0.5 ft
Basin Max. Elevation	4,683.0 ft	Riser Pipe Diameter	2 ft	Area of ind. hole, A	0.0014 ft^2		Total Rows	10	
Max. Perforation Elevation	4,679.5 ft	Pipe End Area	3.14 ft^2	Holes per row	8		Orifice Coefficient, Cd	0.61	
Max Riser Elevation	4,680.0 ft	No. of pipes	1 ft				Gravitational const., g	32.17 ft/s^2	
Max head over riser	3.0 ft								

Spillway elev	4,681.0 ft
Spillway width, b	32.5 ft
Weir coeficient	2.63

Perf Elev. (ft)	**Water Level (ft)**																	
	4675.0	**4675.5**	**4676.0**	**4676.5**	**4677.0**	**4677.5**	**4678.0**	**4678.5**	**4679.0**	**4679.5**	**4680.0**	**4680.5**	**4681.0**	**4681.5**	**4682.0**	**4682.5**	**4683.0**	**END**
4,675.0	0.00	0.04	0.05	0.07	0.08	0.08	0.09	0.10	0.11	0.11	0.12	0.13	0.13	0.14	0.14	0.15	0.15	
4,675.5	0.00	0.00	0.04	0.05	0.07	0.08	0.08	0.09	0.10	0.11	0.11	0.12	0.13	0.13	0.14	0.14	0.15	
4,676.0	0.00	0.00	0.00	0.04	0.05	0.07	0.08	0.08	0.09	0.10	0.11	0.11	0.12	0.13	0.13	0.14	0.14	
4,676.5	0.00	0.00	0.00	0.00	0.04	0.05	0.07	0.08	0.08	0.09	0.10	0.11	0.11	0.12	0.13	0.13	0.14	
4,677.0	0.00	0.00	0.00	0.00	0.00	0.04	0.05	0.07	0.08	0.08	0.09	0.10	0.11	0.11	0.12	0.13	0.13	
4,677.5	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.05	0.07	0.08	0.08	0.09	0.10	0.11	0.11	0.12	0.13	
4,678.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.05	0.07	0.08	0.08	0.09	0.10	0.11	0.11	0.12	
4,678.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.05	0.07	0.08	0.08	0.09	0.10	0.11	0.11	
4,679.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.05	0.07	0.08	0.08	0.09	0.10	0.11	
4,679.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.05	0.07	0.08	0.08	0.09	0.10	
END	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
#REF!	0.00																	
Q_{PERF} (cfs)	0.00	0.04	0.09	0.16	0.23	0.32	0.41	0.51	0.62	0.73	0.85	0.94	1.01	1.08	1.15	1.21	1.27	
OVERTOPPING PERFORATED RISER @4680' elev.						0	0	0	0	0	10.8694	15.3716	18.8263	21.7388	24.3047	26.6245	28.7577	
32.5' LONG, 2' DEEP SPILLWAY						0	0	0	0	0	0	0	0	30	85	157	242	
Total Q_{out} (ft^3/s)		**0.02**	**0.04**	**0.07**	**0.10**	**0.14**	**0.18**	**0.22**	**0.26**	**0.31**	**11.23**	**15.77**	**19.26**	**52.42**	**110.27**	**184.17**	**271.06**	

Freshwater Basin Perforated Riser Calculations

Client	Lithium Nevada Corp.	**Preparer:**	S. Breidt	
Project	Thacker Pass Project	**Checked:**	R. Li	1/14/2020
Title	Perforated Riser - CGS Sediment Pond	**Revision:**	2	

Assumptions/Methodology

1. Vertical riser has a diameter of 3.5ft, with perforations from elevation 4734ft to 4739ft
2. Perforations are 1.2in diameter, with 18 holes per row and 6in between rows, for 11 total rows
3. Flow through an orifice = CdA(2gh)1/2, where Cd = 0.61, A = 0.005454ft2, g = 32.17ft/s2, h= head (ft)
4. "Total Out Flow" row includes a porosity of 0.43 for the rock piled around the riser

OUTFLOW SIMPLIFICATIONS

ORIF	47.08
SPILL	26.3

Inputs

Min. Perforation Elevation	4,733.0 ft	Height of Perforations	6.0 ft	Hole Diameter	1.2 in = 0.1000 ft	Vertical spacing	6 in = 0.5 ft	Spillway elev	4,742.0 ft
Basin Max. Elevation	4,745.0 ft	Riser Pipe Diameter	3.5 ft	Area of ind. hole, A	0.0079 ft^2	Total Rows	13	Spillway width, b	10 ft
Max. Perforation Elevation	4,739.0 ft	Pipe End Area	9.62 ft^2	Holes per row	18	Orifice Coefficient, Cd	0.61	Weir coeficient	2.63
Max Riser Elevation	4,739.5 ft	No. of pipes	1 ft			Gravitational const., g	32.17 ft/s^2		
Max head over riser	5.5 ft								

Perf Elev. (ft)	Water Level (ft)																									
	4733.0	4733.5	4734.0	4734.5	4735.0	4735.5	4736.0	4736.5	4737.0	4737.5	4738.0	4738.5	4739.0	4739.5	4740.0	4740.5	4741.0	4741.5	4742.0	4742.5	4743.0	4743.5	4744.0	4744.5	4745.0	END
4,733.0	0.00	0.49	0.69	0.85	0.98	1.09	1.20	1.29	1.38	1.47	1.55	1.62	1.69	1.76	1.83	1.89	1.96	2.02	2.08	2.13	2.19	2.24	2.29	2.35	2.40	
4,733.5	0.00	0.00	0.49	0.69	0.85	0.98	1.09	1.20	1.29	1.38	1.47	1.55	1.62	1.69	1.76	1.83	1.89	1.96	2.02	2.08	2.13	2.19	2.24	2.29	2.35	
4,734.0	0.00	0.00	0.00	0.49	0.69	0.85	0.98	1.09	1.20	1.29	1.38	1.47	1.55	1.62	1.69	1.76	1.83	1.89	1.96	2.02	2.08	2.13	2.19	2.24	2.29	
4,734.5	0.00	0.00	0.00	0.00	0.49	0.69	0.85	0.98	1.09	1.20	1.29	1.38	1.47	1.55	1.62	1.69	1.76	1.83	1.89	1.96	2.02	2.08	2.13	2.19	2.24	
4,735.0	0.00	0.00	0.00	0.00	0.00	0.49	0.69	0.85	0.98	1.09	1.20	1.29	1.38	1.47	1.55	1.62	1.69	1.76	1.83	1.89	1.96	2.02	2.08	2.13	2.19	
4,735.5	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.69	0.85	0.98	1.09	1.20	1.29	1.38	1.47	1.55	1.62	1.69	1.76	1.83	1.89	1.96	2.02	2.08	2.13	
4,736.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.69	0.85	0.98	1.09	1.20	1.29	1.38	1.47	1.55	1.62	1.69	1.76	1.83	1.89	1.96	2.02	2.08	
4,736.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.69	0.85	0.98	1.09	1.20	1.29	1.38	1.47	1.55	1.62	1.69	1.76	1.83	1.89	1.96	2.02	
4,737.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.69	0.85	0.98	1.09	1.20	1.29	1.38	1.47	1.55	1.62	1.69	1.76	1.83	1.89	1.96	
4,737.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.69	0.85	0.98	1.09	1.20	1.29	1.38	1.47	1.55	1.62	1.69	1.76	1.83	1.89	
4,738.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.69	0.85	0.98	1.09	1.20	1.29	1.38	1.47	1.55	1.62	1.69	1.76	1.83	
Q_{PERF} (cfs)	0.00	0.49	1.18	2.03	3.01	4.10	5.30	6.59	7.98	9.44	10.99	12.12	13.13	14.04	14.89	15.69	16.45	17.18	17.87	18.53	19.17	19.79	20.39	20.97	21.54	
OVERTOPPING PERFORATED RISER @4739.5' elev.						0	0	0	0	0.0	0.0	0.0	0.0	33.3	47.1	57.7	66.6	74.4	81.5	88.1	94.2	99.9	105.3	110.4	115.3	
10' LONG, 3' DEEP SPILLWAY						0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	26	48	74	104	137	
Total Q_{out} (ft^3/s)		**0.21**	**0.51**	**0.87**	**1.29**	**1.76**	**2.28**	**2.83**	**3.43**	**4.06**	**4.73**	**5.21**	**5.64**	**39.33**	**53.48**	**64.40**	**73.65**	**81.82**	**89.22**	**105.34**	**128.70**	**156.69**	**188.42**	**223.38**	**261.23**	

NewFields

Freshwater Basin Perforated Riser Calculations

Client	Lithium Nevada Corp.	**Preparer:**	S. Breidt	
Project	Thacker Pass Project	**Checked:**	R. Li	1/10/2020
Title	Perforated Riser - East WRSF Sediment Pond	**Revision:**	1	

Assumptions/Methodology

1. Vertical riser has a diameter of 3ft, with perforations from elevation 5001.5ft to 5003.5ft
2. Perforations are 1in diameter, with 12 holes per row and 6in between rows, for 5 total rows
3. Flow through an orifice = CdA(2gh)1/2, where Cd = 0.61, A = 0.005454ft2, g = 32.17ft/s2, h= head (ft)
4. "Total Out Flow" row includes a porosity of 0.43 for the rock piled around the riser

OUTFLOW SIMPLIFICATIONS

ORIF	34.59
SPILL	26.3

Inputs

Perforations Min. Elevation	5,001.5 ft	Height of perforations	2.0 ft	Hole Diameter	**1** in = 0.0833 ft	Vertical spacing	**6** in = 0.5 ft	Spillway elev	5,006.0 ft
Basin Max. Elevation	5,008.0 ft	Riser Pipe Diameter	3 ft	Area of ind. hole, A	0.0055 ft^2	Total Rows	5	Spillway width, b	10 ft
Perforations Max. Elevation	5,003.5 ft	Pipe End Area	7.07 ft^2	Holes per row	12	Orifice Coefficient, Cd	0.61	Weir coeficient	2.63
Max riser elevation	5,004.0 ft	No. of pipes	1 ft			Gravitational const., g	32.17 ft/s^2		
Max head over riser	4.0 ft								

Perf Elev. (ft)	**Water Level (ft)**													
	5001.5	5002.0	5002.5	5003.0	5003.5	5004.0	5004.5	5005.0	5005.5	5006.0	5006.5	5007.0	5007.5	5008.0	END
5,001.5	0.00	0.23	0.32	0.39	0.45	0.51	0.55	0.60	0.64	0.68	0.72	0.75	0.78	0.82	
5,002.0	0.00	0.00	0.23	0.32	0.39	0.45	0.51	0.55	0.60	0.64	0.68	0.72	0.75	0.78	
5,002.5	0.00	0.00	0.00	0.23	0.32	0.39	0.45	0.51	0.55	0.60	0.64	0.68	0.72	0.75	
5,003.0	0.00	0.00	0.00	0.00	0.23	0.32	0.39	0.45	0.51	0.55	0.60	0.64	0.68	0.72	
5,003.5	0.00	0.00	0.00	0.00	0.00	0.23	0.32	0.39	0.45	0.51	0.55	0.60	0.64	0.68	
END	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
#VALUE!	0.00														
#VALUE!	0.00														
Q_{PERF} (cfs)	0.00	0.23	0.55	0.94	1.39	1.90	2.23	2.51	2.75	2.98	3.19	3.39	3.57	3.75	
OVERTOPPING PERFORATED RISER @5004' elev.						24.4561	34.5862	42.35926	48.9123	54.6856	59.905	64.7048	69.1724	73.3684	
10' LONG, 2' DEEP SPILLWAY						0	0	0	0	0	9	26	48	74	
Total Q_{out} (ft^3/s)		**0.10**	**0.24**	**0.40**	**0.60**	**25.27**	**35.54**	**43.44**	**50.10**	**55.97**	**70.58**	**92.46**	**119.02**	**149.37**	

E.3.10 CULVERT SIZING

Culvert Calculator Report
Haul Road from CGS

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	4,771.33	ft	Headwater Depth/Height	2.10	
Computed Headwater Elevation	4,768.85	ft	Discharge	1,177.40	cfs
Inlet Control HW Elev.	4,768.85	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	4,767.68	ft	Control Type	Inlet Control	

Grades

Upstream Invert	4,758.33	ft	Downstream Invert	4,746.63	ft
Length	214.00	ft	Constructed Slope	0.054673	ft/ft

Hydraulic Profile

Profile	S2		Depth, Downstream	3.12	ft
Slope Type	Steep		Normal Depth	3.12	ft
Flow Regime	Supercritical		Critical Depth	4.33	ft
Velocity Downstream	18.25	ft/s	Critical Slope	0.025596	ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.024	
Section Material	CMP	Span	5.00	ft
Section Size	60 inch	Rise	5.00	ft
Number Sections	5			

Outlet Control Properties

Outlet Control HW Elev.	4,767.68	ft	Upstream Velocity Head	2.64	ft
Ke	0.90		Entrance Loss	2.38	ft

Inlet Control Properties

Inlet Control HW Elev.	4,768.85	ft	Flow Control	N/A	
Inlet Type	Projecting		Area Full	98.2	ft²
K	0.03400		HDS 5 Chart	2	
M	1.50000		HDS 5 Scale	3	
C	0.05530		Equation Form	1	
Y	0.54000				

Culvert Calculator Report
Salt Conveyor Corridor Crossing

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	4,708.10	ft	Headwater Depth/Height	1.70	
Computed Headwater Elevation	4,707.61	ft	Discharge	1,177.40	cfs
Inlet Control HW Elev.	4,707.30	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	4,707.61	ft	Control Type	Outlet Control	

Grades

Upstream Invert	4,699.10	ft	Downstream Invert	4,697.58	ft
Length	137.00	ft	Constructed Slope	0.011095	ft/ft

Hydraulic Profile

Profile	CompositeM2PressureProfile		Depth, Downstream	4.00	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	4.00	ft
Velocity Downstream	11.65	ft/s	Critical Slope	0.020230	ft/ft

Section

Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	5.00	ft
Section Size	60 inch		Rise	5.00	ft
Number Sections	6				

Outlet Control Properties

Outlet Control HW Elev.	4,707.61	ft	Upstream Velocity Head	1.55	ft
Ke	0.90		Entrance Loss	1.40	ft

Inlet Control Properties

Inlet Control HW Elev.	4,707.30	ft	Flow Control	N/A	
Inlet Type	Projecting		Area Full	117.8	ft²
K	0.03400		HDS 5 Chart	2	
M	1.50000		HDS 5 Scale	3	
C	0.05530		Equation Form	1	
Y	0.54000				

Culvert Calculator Report
Tailings Conveyor Corridor Crossing

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	4,713.21	ft	Headwater Depth/Height	1.75	
Computed Headwater Elevation	4,712.94	ft	Discharge	1,177.40	cfs
Inlet Control HW Elev.	4,712.41	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	4,712.94	ft	Control Type	Outlet Control	

Grades

Upstream Invert	4,704.21	ft	Downstream Invert	4,702.85	ft
Length	139.00	ft	Constructed Slope	0.009784	ft/ft

Hydraulic Profile

Profile	CompositeM2PressureProfile		Depth, Downstream	4.00	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	4.00	ft
Velocity Downstream	11.65	ft/s	Critical Slope	0.020230	ft/ft

Section

Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	5.00	ft
Section Size	60 inch		Rise	5.00	ft
Number Sections	6				

Outlet Control Properties

Outlet Control HW Elev.	4,712.94	ft	Upstream Velocity Head	1.55	ft
Ke	0.90		Entrance Loss	1.40	ft

Inlet Control Properties

Inlet Control HW Elev.	4,712.41	ft	Flow Control	N/A	
Inlet Type	Projecting		Area Full	117.8	ft²
K	0.03400		HDS 5 Chart	2	
M	1.50000		HDS 5 Scale	3	
C	0.05530		Equation Form	1	
Y	0.54000				

Culvert Calculator Report
CGS SEDIMENT POND INLET - 100YR

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	4,761.00	ft	Headwater Depth/Height	1.98	
Computed Headwater Elevation	4,756.40	ft	Discharge	361.00	cfs
Inlet Control HW Elev.	4,754.33	ft	Tailwater Elevation	4,743.00	ft
Outlet Control HW Elev.	4,756.40	ft	Control Type	Outlet Control	

Grades

Upstream Invert	4,747.50	ft	Downstream Invert	4,745.00	ft
Length	167.22	ft	Constructed Slope	0.014950	ft/ft

Hydraulic Profile

Profile	CompositeM2PressureProfile		Depth, Downstream	3.89	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	3.89	ft
Velocity Downstream	12.35	ft/s	Critical Slope	0.026413	ft/ft

Section

Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	4.50	ft
Section Size	54 inch		Rise	4.50	ft
Number Sections	2				

Outlet Control Properties

Outlet Control HW Elev.	4,756.40	ft	Upstream Velocity Head	2.00	ft
Ke	0.20		Entrance Loss	0.40	ft

Inlet Control Properties

Inlet Control HW Elev.	4,754.33	ft	Flow Control	Submerged	
Inlet Type	Beveled ring, 33.7° (1.5:1) bevels		Area Full	31.8	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	B	
C	0.02430		Equation Form	1	
Y	0.83000				

Culvert Calculator Report
MINE ENTRANCE (GUARD SHACK)
CULVERT WEST 25YR

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	0.00	ft	Headwater Depth/Height	2.41	
Computed Headwater Elevation	4,696.04	ft	Discharge	1,882.20	cfs
Inlet Control HW Elev.	4,694.30	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	4,696.04	ft	Control Type	Outlet Control	

Grades

Upstream Invert	4,684.00	ft	Downstream Invert	4,682.00	ft
Length	89.00	ft	Constructed Slope	0.022472	ft/ft

Hydraulic Profile

Profile	CompositeM2PressureProfile		Depth, Downstream	4.72	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	4.72	ft
Velocity Downstream	16.34	ft/s	Critical Slope	0.042754	ft/ft

Section

Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	5.00	ft
Section Size	60 inch		Rise	5.00	ft
Number Sections	6				

Outlet Control Properties

Outlet Control HW Elev.	4,696.04	ft	Upstream Velocity Head	3.97	ft
Ke	0.20		Entrance Loss	0.79	ft

Inlet Control Properties

Inlet Control HW Elev.	4,694.30	ft	Flow Control	Submerged	
Inlet Type	Beveled ring, 33.7° (1.5:1) bevels		Area Full	117.8	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	B	
C	0.02430		Equation Form	1	
Y	0.83000				

Culvert Calculator Report
GUARD SHACK CULVERT EAST 25YR

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	0.00	ft	Headwater Depth/Height	3.08	
Computed Headwater Elevation	4,695.65	ft	Discharge	1,914.00	cfs
Inlet Control HW Elev.	4,690.78	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	4,695.65	ft	Control Type	Outlet Control	

Grades

Upstream Invert	4,680.24	ft	Downstream Invert	4,678.77	ft
Length	138.00	ft	Constructed Slope	0.010652	ft/ft

Hydraulic Profile

Profile	CompositeM2PressureProfile		Depth, Downstream	4.73	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	4.73	ft
Velocity Downstream	16.59	ft/s	Critical Slope	0.044241	ft/ft

Section

Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	5.00	ft
Section Size	60 inch		Rise	5.00	ft
Number Sections	6				

Outlet Control Properties

Outlet Control HW Elev.	4,695.65	ft	Upstream Velocity Head	4.10	ft
Ke	0.20		Entrance Loss	0.82	ft

Inlet Control Properties

Inlet Control HW Elev.	4,690.78	ft	Flow Control	Submerged	
Inlet Type	Beveled ring, 33.7° (1.5:1) bevels		Area Full	117.8	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	B	
C	0.02430		Equation Form	1	
Y	0.83000				

Culvert Calculator Report
GUARD SHACK CULVERT COMBINED ROAD 25YR

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	4,702.00	ft	Headwater Depth/Height	3.29	
Computed Headwater Elevation	4,701.44	ft	Discharge	1,914.00	cfs
Inlet Control HW Elev.	4,696.57	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	4,701.44	ft	Control Type	Outlet Control	

Grades

Upstream Invert	4,685.00	ft	Downstream Invert	4,681.37	ft
Length	200.52	ft	Constructed Slope	0.018103	ft/ft

Hydraulic Profile

Profile	CompositeM2PressureProfile		Depth, Downstream	4.73	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	4.73	ft
Velocity Downstream	16.59	ft/s	Critical Slope	0.044241	ft/ft

Section

Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	5.00	ft
Section Size	60 inch		Rise	5.00	ft
Number Sections	6				

Outlet Control Properties

Outlet Control HW Elev.	4,701.44	ft	Upstream Velocity Head	4.10	ft
Ke	0.20		Entrance Loss	0.82	ft

Inlet Control Properties

Inlet Control HW Elev.	4,696.57	ft	Flow Control	N/A	
Inlet Type	Beveled ring, 45° (1:1) bevels		Area Full	117.8	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	A	
C	0.03000		Equation Form	1	
Y	0.74000				

HEC-15 RIPRAP DESIGN

Lithium Nevada Corporation **Thacker Pass Project** **Mine Entrance Road Culvert Entrance 25yr, 24hr storm**	NOTE: Gray boxes require input, Orange boxes require specific values, Red boxes are calculated

Step 1: Channel Design Parameters			
Bottom Width	B	70	ft
Side Slope	Z	3	x:1
Longitudinal Slope	S	0.01	ft/ft
Flow	Q	1914	ft^3/s

Step 2: Initial Riprap sizing			
Median Stone Size	D_{50}	**0.5**	ft
Stone Unit Weight	Ys	165	pcf
Riprap Calculation Gradation	D_{100}	10.00	inch
	D_{75}	7.50	inch
	D_{50}	6.00	inch
	D_{30}	4.00	inch
	D_{15}	3.00	inch
	D_{10}	2.00	inch

Step 3: Estimate the Flow Depth			
Initial Flow Depth Estimate	D_i	**3.65**	ft
Area of Channel	A	295.47	ft^2
Wetted Perimeter	P	93.08	ft
Hydraulic Radius	R	3.17	ft
Wetted Top Width	T	91.90	ft
Calculated Average Flow Depth	D_a	3.22	ft

Step 4: Estimate Manning's n and the Implied Discharge			
D_a/D_{50}		6.430	
For $1.5 < D_a/D_{50} < 185$	n	0.049	
Q from mannings	Qi	1934.90	ft^3/s
% Difference from Design Discharge		1.09%	
For $0.3 < D_a/D_{50} < 1.5$	n	0.044	
function(Froude number)	f(Fr)	0.827	
Froude number	Fr	0.637	
Velocity of flow	V	**6.478**	
effective roughness concrentration	b	0.489	
Roughness element geometry	f(REG)	44.936	
Channel geometry	f(CG)	0.194	
Q from mannings	Qi	2150.65	ft^3/s
% Difference from Design Discharge		12.36%	

Step 5:		
If % difference is > 5%, estimate a new depth in Step 3	FALSE	Proceed to Step 6
For $0.3 < D_a/D_{50} < 1.5$	TRUE	
If false, proceed to step 6		

Step 6: Calculate Reynolds and Determine Appropriate Shields Parameter & Safety Factor				
Shear Velocity	V_*	1.084		
Reynolds number	R_e	4.45E+04		
Gravity	g	32.2	ft/s^2	
Kinematic Viscosity	v	1.22E-05	ft^2/s	(1.217e-5 for 60 °F)
From Table 6.1	F_*	0.050		
From Table 6.1	SF	1.014		
Specific Gravity of Stone	SG	2.64		
For S < 5%	D_{50}	0.45	ft	

Table 6.1. Selection of Shields' Parameter and Safety Factor			
Reynolds number	F_*	SF	
$\leq 4\times10^4$	0.047	1	
$4\times10^4<Re<2\times10^5$	0.050	1.014	(Linear Interpolation)
$\geq 2\times10^5$	0.15	1.5	

Step 7: Iterate Solution till Calculated D50 is Acceptably Smaller then Chosen D50				
Difference to Chosen Riprap	90.19%	<	100%	TRUE
IF FALSE GOTO STEP 2, ADJUST RIPRAP SIZE				

Step 8. Side Slope Assessment					
Stone Angle of Repose	ϕ	42	°		
For 1.5 < Z < 5	K1	0.868			
	ϴ	18.43	°		
	K2	0.88			
Stable D_{50}	$D_{50,s}$	0.44			
Difference to Chosen Riprap		88.84%	<	100%	TRUE

E.3.11 PIPE CRUSHING CALCULATIONS

NewFields		CALCULATION SHEET		
Client	Lithium Nevada Corp.	Preparer:	SEB	3/10/2020
Project	Thacker Pass Project	Checked:		
Title	12" CMP Temporary Culverts	Revision	A	Page 1

STEEL BURIED PIPE LOAD CAPACITY AND COVER DESIGN

Handbook of Steel Drainage & Highway Construction Products , Corrugated Steel Pipe Institute,

1 Backfill compaction

	85%	

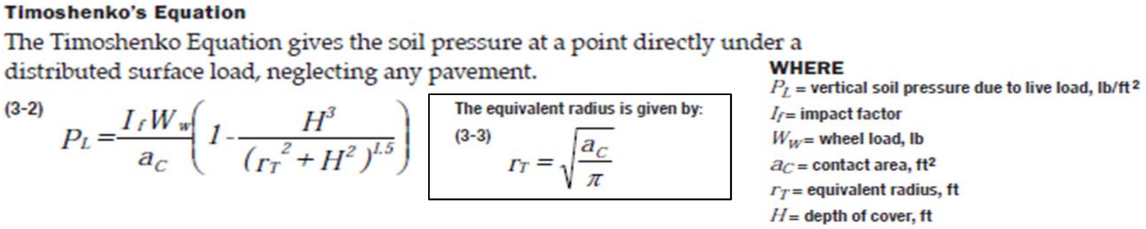
2 Design Pressure

Cover height must be equal to or greater than diameter of pipe

Soil bury depth:	2	ft
Soil Unit Weight	120	pcf
P_E - Vertical Earth Soil Pressure	240	psf
Design Vehicle	777	
Overall Width	11.5	ft
Recommended Maximum Load	85	tons
Additional Payload Weight (Above Recommended)	0	tons
Total Payload Weight		
Loaded Front Axle Weight Distribution	33.33%	
Loaded Rear Axle Weight Distrution	66.67%	
Total Weight (Truck + Payload)	294,405	
Front Axle Weight	98,135	lbs
Rear Axle Weight	196,270	lbs
Tire Size		
Tire width	26.20	in
Pressure	94.00	psi
Load	98,135	lbs
Contact Area	7.25	sf

2.1 Determine Largest Live Load from Truck By Comparing Timoshenko and Boussinesq Eq.

2.1.1: Timoshenko:



Timoshenko's Equation

The Timoshenko Equation gives the soil pressure at a point directly under a distributed surface load, neglecting any pavement.

(3-2)

$$P_L = \frac{I_f W_w}{a_C}\left(1 - \frac{H^3}{(r_T{}^2 + H^2)^{1.5}}\right)$$

The equivalent radius is given by:

(3-3)

$$r_T = \sqrt{\frac{a_C}{\pi}}$$

WHERE

P_L = vertical soil pressure due to live load, lb/ft²

I_f = impact factor

W_W = wheel load, lb

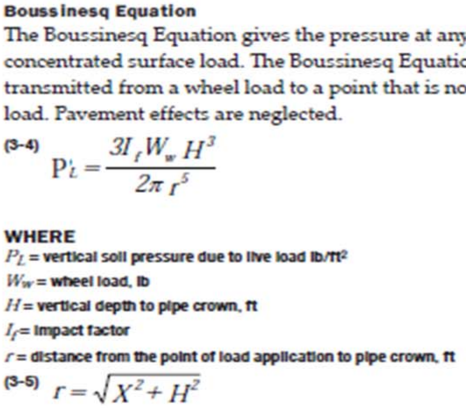
a_C = contact area, ft²

r_T = equivalent radius, ft

H = depth of cover, ft

Impact Factor (If)	Between 2-3 for Haul Truck	3	
Wheel Load (Ww)	Half of rear load	98,135	lbs
Contact Area (Ac)	Tire contact (dual rear tire)	7.25	sf
rT	Equivalent Radius	1.52	
Depth		2.00	ft
P_L - Vertical Live Soil Pressure		20,101	psf
P_T - Total Vertical Soil Pressure, Timoshenko		**20,341**	**psf**

2.1.2: Boussinesq:



Boussinesq Equation

The Boussinesq Equation gives the pressure at any point in a soil mass under a concentrated surface load. The Boussinesq Equation may be used to find the pressure transmitted from a wheel load to a point that is not along the line of action of the load. Pavement effects are neglected.

(3-4)

$$P_L = \frac{3 I_f W_w H^3}{2\pi r^5}$$

WHERE

P_L = vertical soil pressure due to live load lb/ft²

W_w = wheel load, lb

H = vertical depth to pipe crown, ft

I_f = impact factor

r = distance from the point of load application to pipe crown, ft

(3-5)

$$r = \sqrt{X^2 + H^2}$$

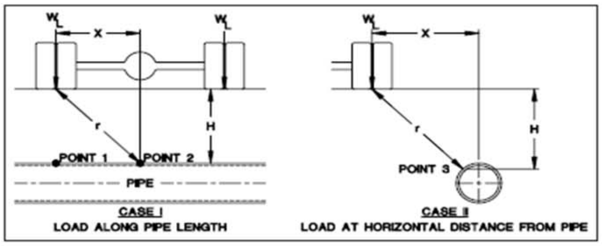


Figure 3-4 Illustration of Boussinesq Point Loading

Loaded weight on center + rear axle

Wl	Per side	98,135	lbs
	x	42.80	in
	r	4	ft
Per side		983.59	psf
P_L - Vertical Live Soil Pressure		1,967.18	psf
P_T - Total Vertical Soil Pressure, Boussinesq		**2,207**	**psf**

2.2 Determine Load Pressure

Use Figure 6.5 to obtain the load factor, K

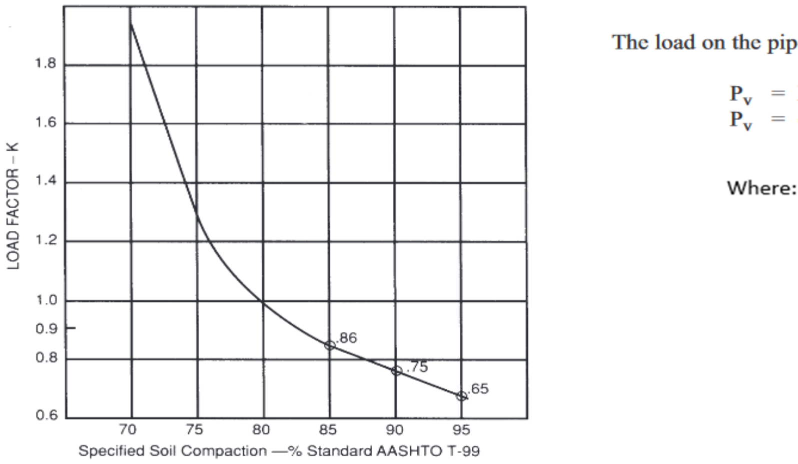


Figure 6.5 Load factors for CSP in backfill compacted to indicated density.

The load on the pipe becomes:

$P_v = K\ (DL + LL)$, when $H \geq S$
$P_v = (DL + LL)$, when $H < S$

Where: P_v=Design Pressure
K = Load Factor
DL = Dead Load (psf)
LL = Live Load (psf)
H= Height of cover (ft)
S = Span (ft)

K =	0.86	
Total load on pipe, Pv:	**17,734**	psf

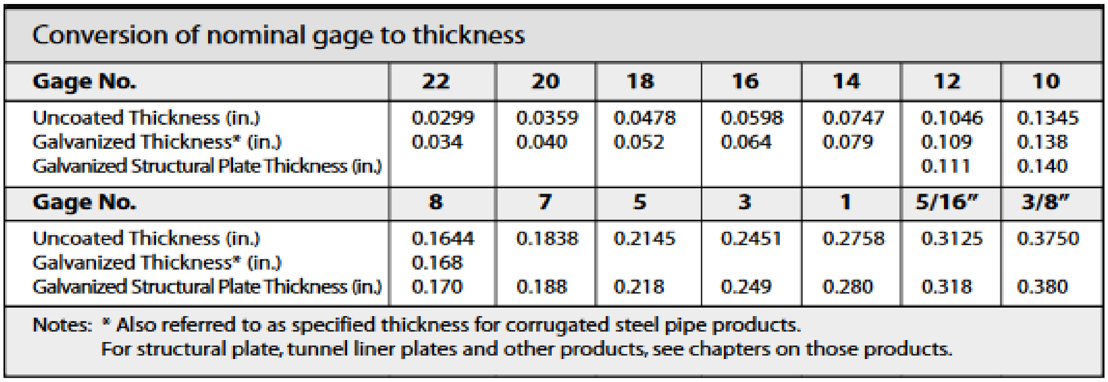
3 Ring Compression

$$C = P_v \bullet \frac{S}{2}$$

C = ring compression, lb/ft
Pv = design pressure, psf
S = span or diameter

Pv	17,734	psf
CMP pipe diameter, S	12	inch
Ring compression, C	**8,867**	psf

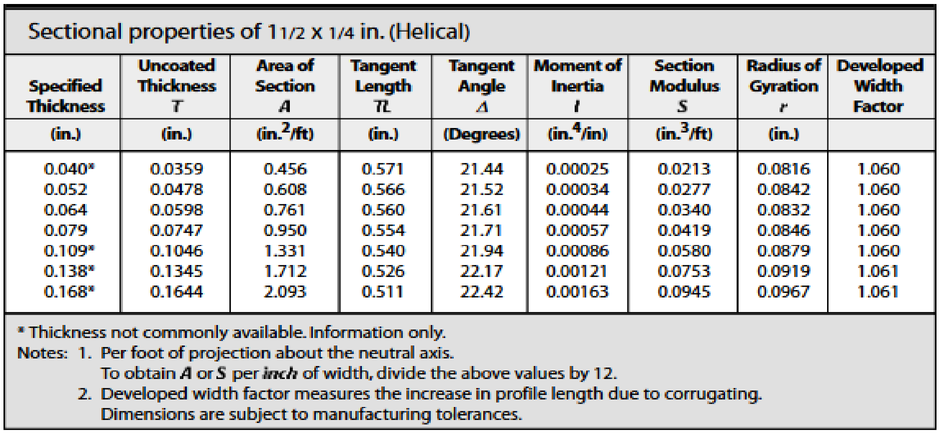
4 Allowable Wall Stress



Conversion of nominal gage to thickness

Gage No.	**22**	**20**	**18**	**16**	**14**	**12**	**10**
Uncoated Thickness (in.)	0.0299	0.0359	0.0478	0.0598	0.0747	0.1046	0.1345
Galvanized Thickness* (in.)	0.034	0.040	0.052	0.064	0.079	0.109	0.138
Galvanized Structural Plate Thickness (in.)						0.111	0.140
Gage No.	**8**	**7**	**5**	**3**	**1**	**5/16″**	**3/8″**
Uncoated Thickness (in.)	0.1644	0.1838	0.2145	0.2451	0.2758	0.3125	0.3750
Galvanized Thickness* (in.)	0.168						
Galvanized Structural Plate Thickness (in.)	0.170	0.188	0.218	0.249	0.280	0.318	0.380

Notes: * Also referred to as specified thickness for corrugated steel pipe products.
For structural plate, tunnel liner plates and other products, see chapters on those products.

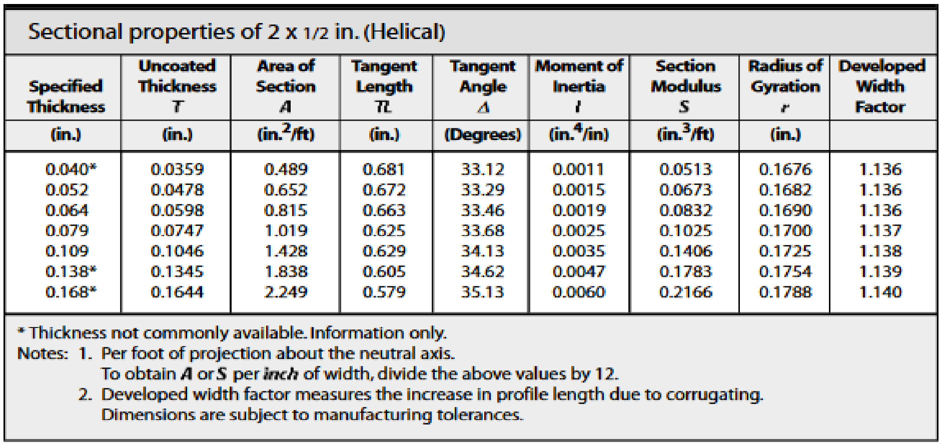


Sectional properties of 11/2 x 1/4 in. (Helical)

Specified Thickness (in.)	Uncoated Thickness *T* (in.)	Area of Section *A* ($in.^2/ft$)	Tangent Length *TL* (in.)	Tangent Angle *Δ* (Degrees)	Moment of Inertia *I* ($in.^4/in$)	Section Modulus *S* ($in.^3/ft$)	Radius of Gyration *r* (in.)	Developed Width Factor
0.040*	0.0359	0.456	0.571	21.44	0.00025	0.0213	0.0816	1.060
0.052	0.0478	0.608	0.566	21.52	0.00034	0.0277	0.0842	1.060
0.064	0.0598	0.761	0.560	21.61	0.00044	0.0340	0.0832	1.060
0.079	0.0747	0.950	0.554	21.71	0.00057	0.0419	0.0846	1.060
0.109*	0.1046	1.331	0.540	21.94	0.00086	0.0580	0.0879	1.060
0.138*	0.1345	1.712	0.526	22.17	0.00121	0.0753	0.0919	1.061
0.168*	0.1644	2.093	0.511	22.42	0.00163	0.0945	0.0967	1.061

* Thickness not commonly available. Information only.

Notes: 1. Per foot of projection about the neutral axis.
To obtain *A* or *S* per *inch* of width, divide the above values by 12.
2. Developed width factor measures the increase in profile length due to corrugating.
Dimensions are subject to manufacturing tolerances.



Sectional properties of 2 x 1/2 in. (Helical)

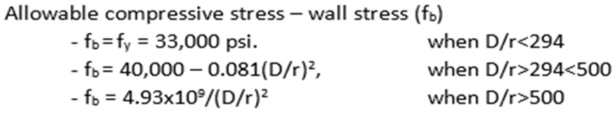
Specified Thickness (in.)	Uncoated Thickness *T* (in.)	Area of Section *A* ($in.^2/ft$)	Tangent Length *TL* (in.)	Tangent Angle *Δ* (Degrees)	Moment of Inertia *I* ($in.^4/in$)	Section Modulus *S* ($in.^3/ft$)	Radius of Gyration *r* (in.)	Developed Width Factor
0.040*	0.0359	0.489	0.681	33.12	0.0011	0.0513	0.1676	1.136
0.052	0.0478	0.652	0.672	33.29	0.0015	0.0673	0.1682	1.136
0.064	0.0598	0.815	0.663	33.46	0.0019	0.0832	0.1690	1.136
0.079	0.0747	1.019	0.625	33.68	0.0025	0.1025	0.1700	1.137
0.109	0.1046	1.428	0.629	34.13	0.0035	0.1406	0.1725	1.138
0.138*	0.1345	1.838	0.605	34.62	0.0047	0.1783	0.1754	1.139
0.168*	0.1644	2.249	0.579	35.13	0.0060	0.2166	0.1788	1.140

* Thickness not commonly available. Information only.

Notes: 1. Per foot of projection about the neutral axis.
To obtain *A* or *S* per *inch* of width, divide the above values by 12.
2. Developed width factor measures the increase in profile length due to corrugating.
Dimensions are subject to manufacturing tolerances.

From Tables:

Selected gage:	12	(Use 2x1/2 in)
Specified thickness:	0.109	in
Radius of Gyration, r:	0.1725	in
Pipe diameter, D	12	in
D/r	70	



Allowable compressive stress – wall stress (f_b)

- $f_b = f_y$ = 33,000 psi. when D/r<294
- f_b = 40,000 – 0.081$(D/r)^2$, when D/r>294<500
- f_b = 4.93x$10^9/(D/r)^2$ when D/r>500

Ultimate compressive stress, fb	33,000	psi
Factor of Safety	2	
Allowable wall stress, fc	16,500	psi

5 Wall Thickness

$$A = \frac{C}{f_c}$$

Required Wall Area, A 0.5374 in^2/foot

Confirm that the selected wall thickness provides the required area

Specified Wall thickness 0.109 in

Wall area from table 1.428 in^2/foot

Check wall areas:

1.428 > 0.5374 GOOD

6 Handling Thickness

$$FF = \frac{D^2}{EI}$$

E = modulus of elasticity

D = diameter or span,

I = moment of inertia of the pipe wall (

Modulus of Elasticity, E 30000000 psi

Moment of Inertia, I (from table) 0.0035 in^4/in

Flexibility Factor, F 0.0014

Flexibility Factor acceptable maximum values:

0.0433 factory made seams

0.02 Field assembled

Factory made:	0.0014	<	0.0433	GOOD
Field assembled:	0.0014	<	0.02	GOOD

7 Seam Strength

From Table 6.4a	Ultimate Seam Strength	769 (kN/m)	
Allowable	FOS = 2	52,705 psf	
Total load on pipe, Pv:		26,352 psf	
		17,734 psf	GOOD

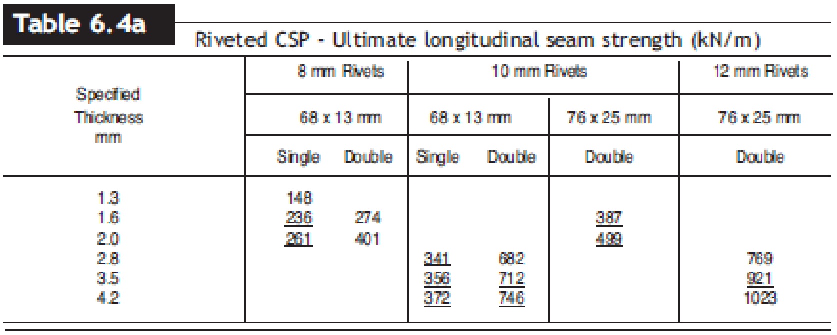


Table 6.4a Riveted CSP - Ultimate longitudinal seam strength (kN/m)

Specified Thickness mm	8 mm Rivets		10 mm Rivets			12 mm Rivets
	68 x 13 mm		68 x 13 mm		76 x 25 mm	76 x 25 mm
	Single	Double	Single	Double	Double	Double
1.3	148					
1.6	236	274			387	
2.0	261	401			499	
2.8			341	682		769
3.5			356	712		921
4.2			372	746		1023

8 Pipe arches

n/a

NewFields	**CALCULATION SHEET**			
Client	Lithium Nevada Corp.	Preparer:	SEB	3/10/2020
Project	Thacker Pass Project	Checked:		
Title	18" CMP Temporary Culverts	Revision	A	Page 1

STEEL BURIED PIPE LOAD CAPACITY AND COVER DESIGN

Handbook of Steel Drainage & Highway Construction Products , Corrugated Steel Pipe Institute,

1 Backfill compaction

	85%	

2 Design Pressure

Cover height must be equal to or greater than diameter of pipe

Soil bury depth:	2	ft
Soil Unit Weight	120	pcf
P_E - Vertical Earth Soil Pressure	240	psf
Design Vehicle	777	
Overall Width	11.5	ft
Recommended Maximum Load	85	tons
Additional Payload Weight (Above Recommended)	0	tons
Total Payload Weight		
Loaded Front Axle Weight Distribution	33.33%	
Loaded Rear Axle Weight Distrution	66.67%	
Total Weight (Truck + Payload)	294,405	
Front Axle Weight	98,135	lbs
Rear Axle Weight	196,270	lbs
Tire Size		
Tire width	26.20	in
Pressure	94.00	psi
Load	98,135	lbs
Contact Area	7.25	sf

2.1 Determine Largest Live Load from Truck By Comparing Timoshenko and Boussinesq Eq.

2.1.1: Timoshenko:

Timoshenko's Equation

The Timoshenko Equation gives the soil pressure at a point directly under a distributed surface load, neglecting any pavement.

(3-2)
$$P_L = \frac{I_f W_w}{a_C}\left(1 - \frac{H^3}{(r_T{}^2 + H^2)^{1.5}}\right)$$

The equivalent radius is given by:

(3-3)
$$r_T = \sqrt{\frac{a_C}{\pi}}$$

WHERE

P_L = vertical soil pressure due to live load, lb/ft²

I_f = impact factor

W_W = wheel load, lb

a_C = contact area, ft²

r_T = equivalent radius, ft

H = depth of cover, ft

Impact Factor (If)	Between 2-3 for Haul Truck	3	
Wheel Load (Ww)	Half of rear load	98,135	lbs
Contact Area (Ac)	Tire contact (dual rear tire)	7.25	sf
rT	Equivalent Radius	1.52	
Depth		2.00	ft
P_L - Vertical Live Soil Pressure		20,101	psf
P_T - Total Vertical Soil Pressure, Timoshenko		**20,341**	**psf**

2.1.2: Boussinesq:

Boussinesq Equation

The Boussinesq Equation gives the pressure at any point in a soil mass under a concentrated surface load. The Boussinesq Equation may be used to find the pressure transmitted from a wheel load to a point that is not along the line of action of the load. Pavement effects are neglected.

(3-4)
$$P_L = \frac{3 I_f W_w H^3}{2\pi r^5}$$

WHERE

P_L = vertical soil pressure due to live load lb/ft²

W_w = wheel load, lb

H = vertical depth to pipe crown, ft

I_f = impact factor

r = distance from the point of load application to pipe crown, ft

(3-5)
$$r = \sqrt{X^2 + H^2}$$

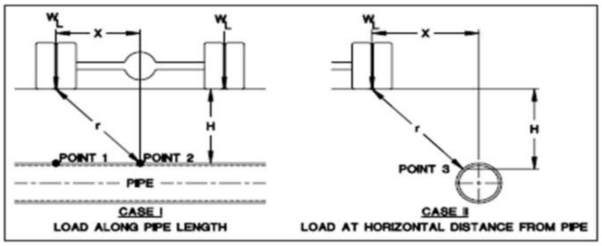


Figure 3-4 Illustration of Boussinesq Point Loading

Loaded weight on center + rear axle

Wl	Per side	98,135	lbs
	x	42.80	in
	r	4	ft
Per side		983.59	psf
P_L - Vertical Live Soil Pressure		1,967.18	psf
P_T - Total Vertical Soil Pressure, Boussinesq		**2,207**	**psf**

2.2 Determine Load Pressure

Use Figure 6.5 to obtain the load factor, K

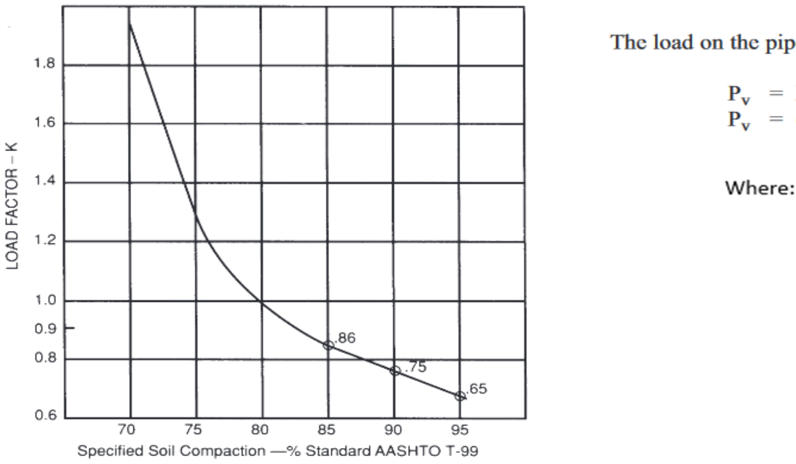


Figure 6.5 Load factors for CSP in backfill compacted to indicated density.

The load on the pipe becomes:

$P_v = K\,(DL + LL)$, when $H \geq S$
$P_v = (DL + LL)$, when $H < S$

Where: P_v=Design Pressure
K = Load Factor
DL = Dead Load (psf)
LL = Live Load (psf)
H= Height of cover (ft)
S = Span (ft)

K =	0.86
Total load on pipe, Pv:	**17,734** psf

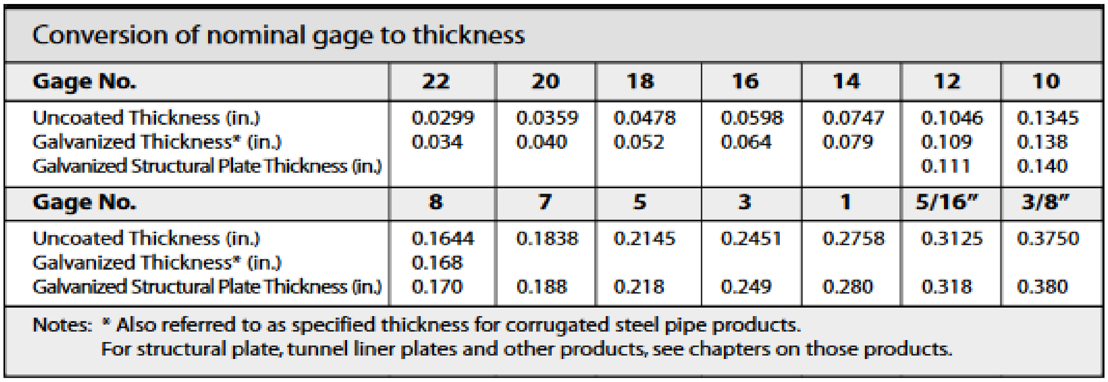
3 Ring Compression

$$C = P_v \cdot \frac{S}{2}$$

C = ring compression, lb/ft
Pv = design pressure, psf
S = span or diameter

Pv	17,734 psf
CMP pipe diameter, S	18 inch
Ring compression, C	**13,300** psf

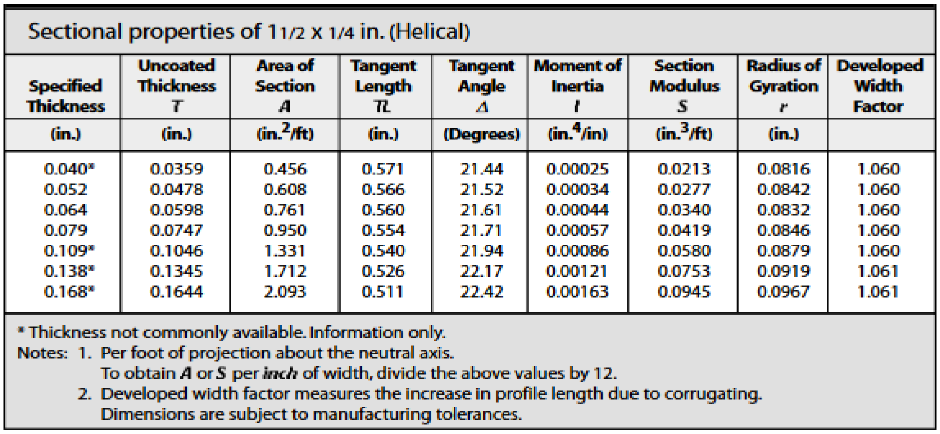
4 Allowable Wall Stress



Conversion of nominal gage to thickness

Gage No.	**22**	**20**	**18**	**16**	**14**	**12**	**10**
Uncoated Thickness (in.)	0.0299	0.0359	0.0478	0.0598	0.0747	0.1046	0.1345
Galvanized Thickness* (in.)	0.034	0.040	0.052	0.064	0.079	0.109	0.138
Galvanized Structural Plate Thickness (in.)						0.111	0.140
Gage No.	**8**	**7**	**5**	**3**	**1**	**5/16”**	**3/8”**
Uncoated Thickness (in.)	0.1644	0.1838	0.2145	0.2451	0.2758	0.3125	0.3750
Galvanized Thickness* (in.)	0.168						
Galvanized Structural Plate Thickness (in.)	0.170	0.188	0.218	0.249	0.280	0.318	0.380

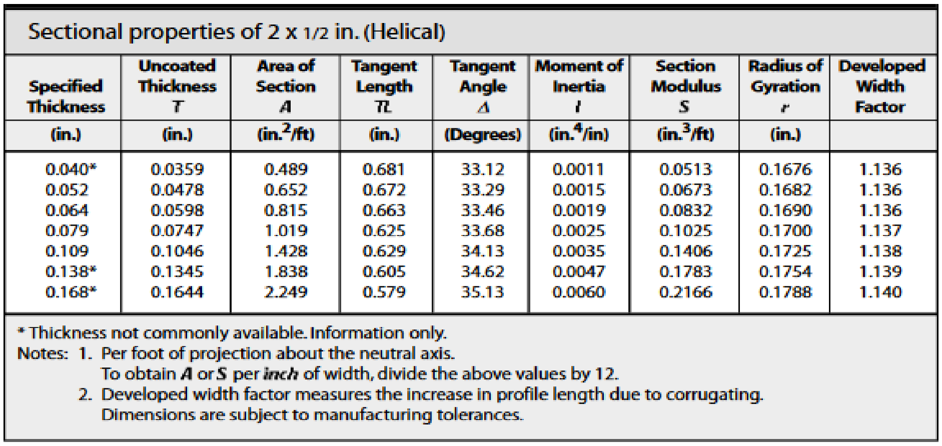
Notes: * Also referred to as specified thickness for corrugated steel pipe products.
For structural plate, tunnel liner plates and other products, see chapters on those products.



Sectional properties of 1 1/2 x 1/4 in. (Helical)

Specified Thickness	Uncoated Thickness *T*	Area of Section *A*	Tangent Length *TL*	Tangent Angle *Δ*	Moment of Inertia *I*	Section Modulus *S*	Radius of Gyration *r*	Developed Width Factor
(in.)	(in.)	(in.^{2}/ft)	(in.)	(Degrees)	(in.^{4}/in)	(in.^{3}/ft)	(in.)	
0.040*	0.0359	0.456	0.571	21.44	0.00025	0.0213	0.0816	1.060
0.052	0.0478	0.608	0.566	21.52	0.00034	0.0277	0.0842	1.060
0.064	0.0598	0.761	0.560	21.61	0.00044	0.0340	0.0832	1.060
0.079	0.0747	0.950	0.554	21.71	0.00057	0.0419	0.0846	1.060
0.109*	0.1046	1.331	0.540	21.94	0.00086	0.0580	0.0879	1.060
0.138*	0.1345	1.712	0.526	22.17	0.00121	0.0753	0.0919	1.061
0.168*	0.1644	2.093	0.511	22.42	0.00163	0.0945	0.0967	1.061

* Thickness not commonly available. Information only.
Notes: 1. Per foot of projection about the neutral axis.
To obtain *A* or *S* per *inch* of width, divide the above values by 12.
2. Developed width factor measures the increase in profile length due to corrugating.
Dimensions are subject to manufacturing tolerances.

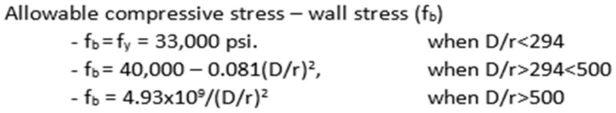


Sectional properties of 2 x 1/2 in. (Helical)

Specified Thickness	Uncoated Thickness *T*	Area of Section *A*	Tangent Length *TL*	Tangent Angle *Δ*	Moment of Inertia *I*	Section Modulus *S*	Radius of Gyration *r*	Developed Width Factor
(in.)	(in.)	(in.^{2}/ft)	(in.)	(Degrees)	(in.^{4}/in)	(in.^{3}/ft)	(in.)	
0.040*	0.0359	0.489	0.681	33.12	0.0011	0.0513	0.1676	1.136
0.052	0.0478	0.652	0.672	33.29	0.0015	0.0673	0.1682	1.136
0.064	0.0598	0.815	0.663	33.46	0.0019	0.0832	0.1690	1.136
0.079	0.0747	1.019	0.625	33.68	0.0025	0.1025	0.1700	1.137
0.109	0.1046	1.428	0.629	34.13	0.0035	0.1406	0.1725	1.138
0.138*	0.1345	1.838	0.605	34.62	0.0047	0.1783	0.1754	1.139
0.168*	0.1644	2.249	0.579	35.13	0.0060	0.2166	0.1788	1.140

* Thickness not commonly available. Information only.
Notes: 1. Per foot of projection about the neutral axis.
To obtain *A* or *S* per *inch* of width, divide the above values by 12.
2. Developed width factor measures the increase in profile length due to corrugating.
Dimensions are subject to manufacturing tolerances.

From Tables:		
Selected gage:	12	(Use 2x1/2 in)
Specified thickness:	0.109	in
Radius of Gyration, r:	0.1725	in
Pipe diameter, D	18	in
D/r	104	



Allowable compressive stress – wall stress (f_b)
- $f_b = f_y$ = 33,000 psi. when D/r<294
- f_b = 40,000 – 0.081(D/r)^2, when D/r>294<500
- f_b = 4.93x10^9/(D/r)^2 when D/r>500

Ultimate compressive stress, fb	33,000	psi
Factor of Safety	2	
Allowable wall stress, fc	16,500	psi

5 Wall Thickness

$$A = \frac{C}{f_c}$$

Required Wall Area, A	0.8061	in^2/foot

Confirm that the selected wall thickness provides the required area

Specified Wall thickness	0.109	in
Wall area from table	1.428	in^2/foot

Check wall areas:

1.428 > 0.8061 GOOD

6 Handling Thickness

$$FF = \frac{D^2}{EI}$$

E = modulus of elasticity
D = diameter or span,
I = moment of inertia of the pipe wall (

Modulus of Elasticity, E	30000000	psi
Moment of Inertia, I (from table)	0.0035	in^4/in
Flexibility Factor, F	0.0031	

Flexibility Factor acceptable maximum values:
0.0433 factory made seams
0.02 Field assembled

Factory made:	0.0031	<	0.0433	GOOD
Field assembled:	0.0031	<	0.02	GOOD

7 Seam Strength

From Table 6.4a	Ultimate Seam Strength	769	(kN/m)	
Allowable	FOS = 2	52,705	psf	
Total load on pipe, Pv:		26,352	psf	
		17,734	psf	GOOD

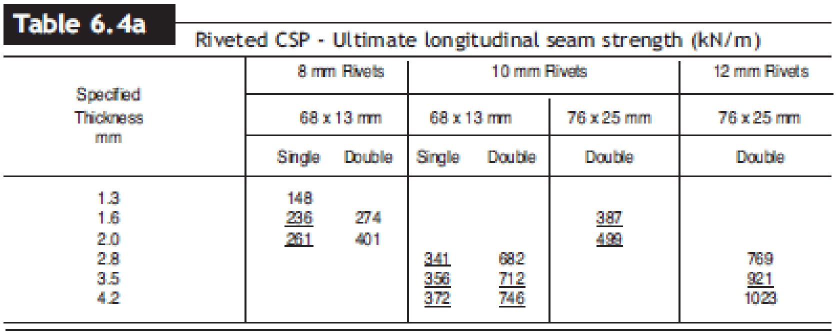


Table 6.4a Riveted CSP - Ultimate longitudinal seam strength (kN/m)

Specified Thickness mm	8 mm Rivets		10 mm Rivets			12 mm Rivets
	68 x 13 mm		68 x 13 mm		76 x 25 mm	76 x 25 mm
	Single	Double	Single	Double	Double	Double
1.3	148					
1.6	236	274			387	
2.0	261	401			499	
2.8			341	682		769
3.5			356	712		921
4.2			372	746		1023

8 Pipe arches

n/a

NewFields	CALCULATION SHEET			
Client	Lithium Nevada Corp.	Preparer:	RL	2/18/2020
Project	Thacker Pass Project	Checked:	ZR	2/19/2020
Title	36" CMP Temporary Culverts	Revision	A	Page 1

STEEL BURIED PIPE LOAD CAPACITY AND COVER DESIGN

Handbook of Steel Drainage & Highway Construction Products , Corrugated Steel Pipe Institute, 2007

1 Backfill compaction

	85%	

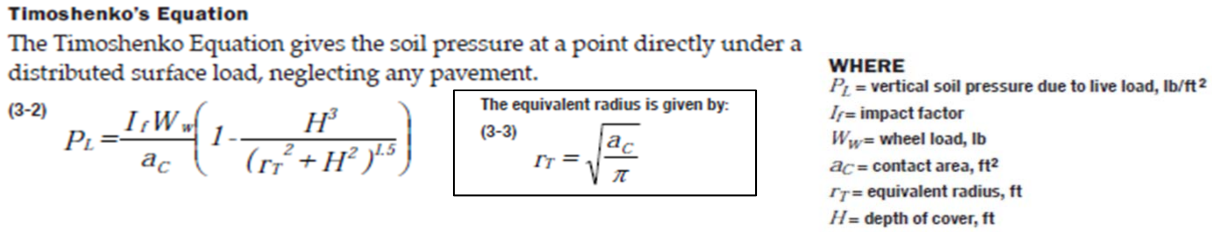
2 Design Pressure

Cover height must be equal to or greater than diameter of pipe

Soil bury depth:	4	ft
Soil Unit Weight	120	pcf
P_E - Vertical Earth Soil Pressure	480	psf
<u>Design Vehicle</u>	777	
Overall Width	11.5	ft
Recommended Maximum Load	85	tons
Additional Payload Weight (Above Recommended)	0	tons
<u>Total Payload Weight</u>		
Loaded Front Axle Weight Distribution	33.33%	
Loaded Rear Axle Weight Distrution	66.67%	
Total Weight (Truck + Payload)	294,405	
Front Axle Weight	98,135	lbs
Rear Axle Weight	196,270	lbs
<u>Tire Size</u>		
Tire width	26.20	in
Pressure	94.00	psi
Load	98,135	lbs
Contact Area	7.25	sf

2.1 Determine Largest Live Load from Truck By Comparing Timoshenko and Boussinesq Eq.

2.1.1: Timoshenko:



Timoshenko's Equation

The Timoshenko Equation gives the soil pressure at a point directly under a distributed surface load, neglecting any pavement.

(3-2)
$$P_L = \frac{I_f W_w}{a_C}\left(1 - \frac{H^3}{(r_T^{\,2} + H^2)^{1.5}}\right)$$

The equivalent radius is given by:

(3-3)
$$r_T = \sqrt{\frac{a_C}{\pi}}$$

WHERE

P_L = vertical soil pressure due to live load, lb/ft²

I_f = impact factor

W_W = wheel load, lb

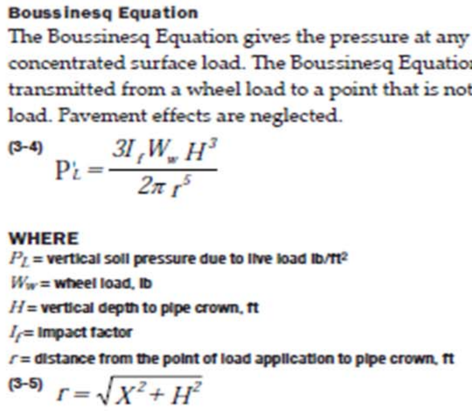
a_C = contact area, ft²

r_T = equivalent radius, ft

H = depth of cover, ft

Impact Factor (If)	Between 2-3 for Haul Truck	3	
Wheel Load (Ww)	Half of rear load	98,135	lbs
Contact Area (Ac)	Tire contact (dual rear tire)	7.25	sf
rT	Equivalent Radius	1.52	
Depth		4.00	ft
P_L - Vertical Live Soil Pressure		7,431	psf
P_T - Total Vertical Soil Pressure, Timoshenko		**7,911**	**psf**

2.1.2: Boussinesq:



Boussinesq Equation

The Boussinesq Equation gives the pressure at any point in a soil mass under a concentrated surface load. The Boussinesq Equation may be used to find the pressure transmitted from a wheel load to a point that is not along the line of action of the load. Pavement effects are neglected.

(3-4)
$$P_L = \frac{3 I_f W_w H^3}{2\pi r^5}$$

WHERE

P_L = vertical soil pressure due to live load lb/ft²

W_w = wheel load, lb

H = vertical depth to pipe crown, ft

I_f = impact factor

r = distance from the point of load application to pipe crown, ft

(3-5)
$$r = \sqrt{X^2 + H^2}$$

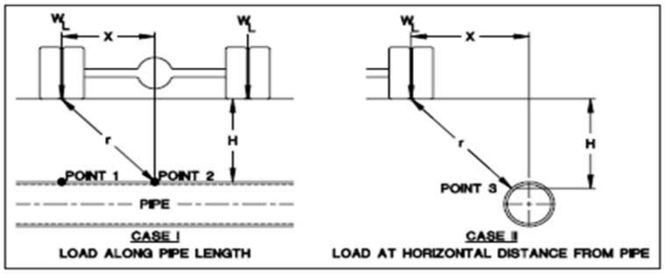


Figure 3-4 Illustration of Boussinesq Point Loading

Loaded weight on center + rear axle

Wl	Per side	98,135	lbs
	x	42.80	in
	r	5	ft
Per side		2,035.00	psf
P_L - Vertical Live Soil Pressure		4,070.00	psf
P_T - Total Vertical Soil Pressure, Boussinesq		**4,550**	**psf**

2.2 Determine Load Pressure

Use Figure 6.5 to obtain the load factor, K

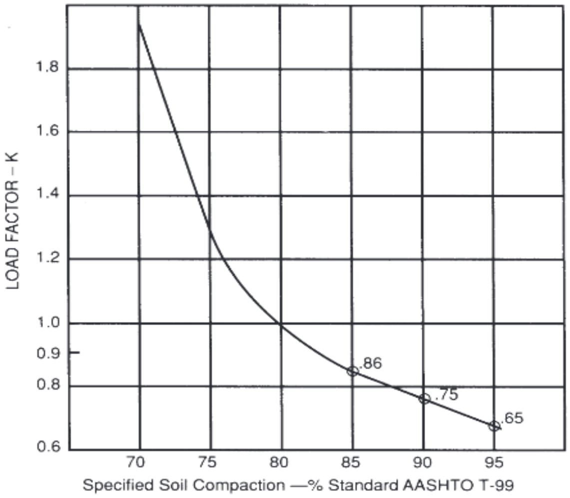


Figure 6.5 Load factors for CSP in backfill compacted to indicated density.

The load on the pipe becomes:

$$P_v = K\,(DL + LL), \text{ when } H \geq S$$
$$P_v = (DL + LL), \text{ when } H < S$$

Where: P_v=Design Pressure
K = Load Factor
DL = Dead Load (psf)
LL = Live Load (psf)
H= Height of cover (ft)
S = Span (ft)

K =	0.86
Total load on pipe, Pv:	**7,283** psf

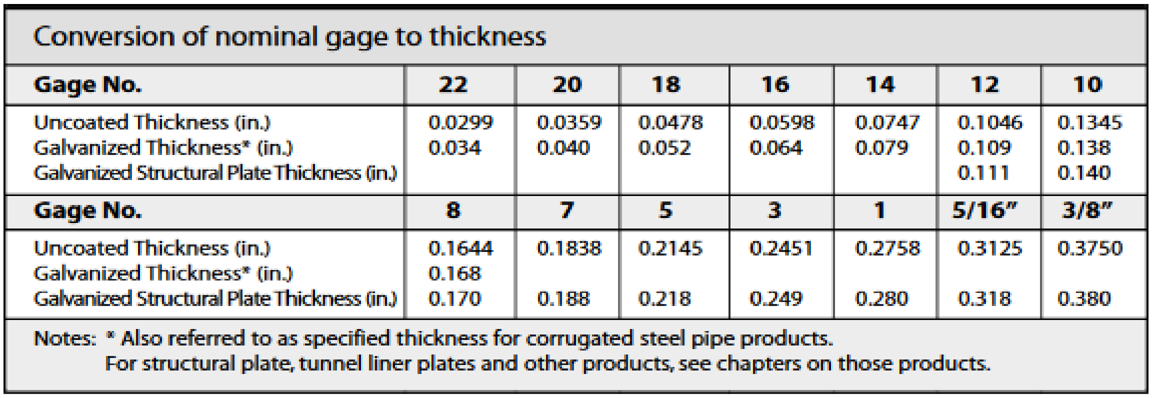
3 Ring Compression

$$C = P_v \bullet \frac{S}{2}$$

C = ring compression, lb/ft
Pv = design pressure, psf
S = span or diameter

Pv	7,283	psf
CMP pipe diameter, S	36	inch
Ring compression, C	**10,925**	psf

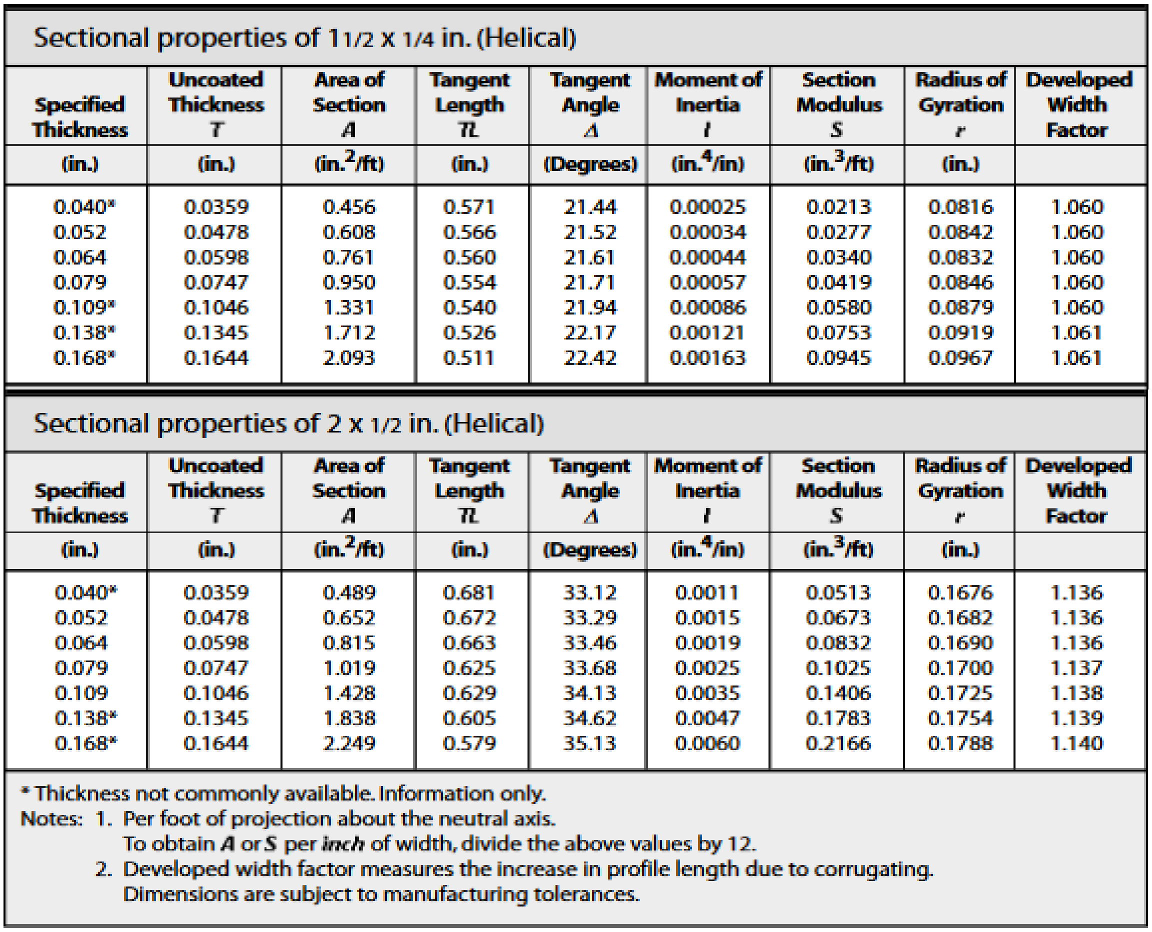
4 Allowable Wall Stress



Conversion of nominal gage to thickness

Gage No.	**22**	**20**	**18**	**16**	**14**	**12**	**10**
Uncoated Thickness (in.)	0.0299	0.0359	0.0478	0.0598	0.0747	0.1046	0.1345
Galvanized Thickness* (in.)	0.034	0.040	0.052	0.064	0.079	0.109	0.138
Galvanized Structural Plate Thickness (in.)						0.111	0.140
Gage No.	**8**	**7**	**5**	**3**	**1**	**5/16"**	**3/8"**
Uncoated Thickness (in.)	0.1644	0.1838	0.2145	0.2451	0.2758	0.3125	0.3750
Galvanized Thickness* (in.)	0.168						
Galvanized Structural Plate Thickness (in.)	0.170	0.188	0.218	0.249	0.280	0.318	0.380

Notes: * Also referred to as specified thickness for corrugated steel pipe products.
For structural plate, tunnel liner plates and other products, see chapters on those products.



Sectional properties of 11/2 x 1/4 in. (Helical)

Specified Thickness	Uncoated Thickness *T*	Area of Section *A*	Tangent Length *TL*	Tangent Angle *Δ*	Moment of Inertia *I*	Section Modulus *S*	Radius of Gyration *r*	Developed Width Factor
(in.)	(in.)	(in.^{2}/ft)	(in.)	(Degrees)	(in.^{4}/in)	(in.^{3}/ft)	(in.)	
0.040*	0.0359	0.456	0.571	21.44	0.00025	0.0213	0.0816	1.060
0.052	0.0478	0.608	0.566	21.52	0.00034	0.0277	0.0842	1.060
0.064	0.0598	0.761	0.560	21.61	0.00044	0.0340	0.0832	1.060
0.079	0.0747	0.950	0.554	21.71	0.00057	0.0419	0.0846	1.060
0.109*	0.1046	1.331	0.540	21.94	0.00086	0.0580	0.0879	1.060
0.138*	0.1345	1.712	0.526	22.17	0.00121	0.0753	0.0919	1.061
0.168*	0.1644	2.093	0.511	22.42	0.00163	0.0945	0.0967	1.061

Sectional properties of 2 x 1/2 in. (Helical)

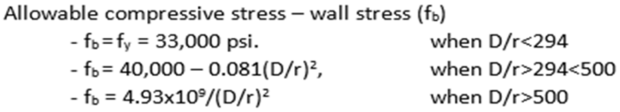
Specified Thickness	Uncoated Thickness *T*	Area of Section *A*	Tangent Length *TL*	Tangent Angle *Δ*	Moment of Inertia *I*	Section Modulus *S*	Radius of Gyration *r*	Developed Width Factor
(in.)	(in.)	(in.^{2}/ft)	(in.)	(Degrees)	(in.^{4}/in)	(in.^{3}/ft)	(in.)	
0.040*	0.0359	0.489	0.681	33.12	0.0011	0.0513	0.1676	1.136
0.052	0.0478	0.652	0.672	33.29	0.0015	0.0673	0.1682	1.136
0.064	0.0598	0.815	0.663	33.46	0.0019	0.0832	0.1690	1.136
0.079	0.0747	1.019	0.625	33.68	0.0025	0.1025	0.1700	1.137
0.109	0.1046	1.428	0.629	34.13	0.0035	0.1406	0.1725	1.138
0.138*	0.1345	1.838	0.605	34.62	0.0047	0.1783	0.1754	1.139
0.168*	0.1644	2.249	0.579	35.13	0.0060	0.2166	0.1788	1.140

* Thickness not commonly available. Information only.

Notes: 1. Per foot of projection about the neutral axis.
To obtain *A* or *S* per *inch* of width, divide the above values by 12.
2. Developed width factor measures the increase in profile length due to corrugating.
Dimensions are subject to manufacturing tolerances.

From Tables:

Selected gage:	12	(Use 2x1/2 in)
Specified thickness:	0.109	in
Radius of Gyration, r:	0.1725	in
Pipe diameter, D	36	in
D/r	209	



Allowable compressive stress – wall stress (f_b)

- $f_b = f_y$ = 33,000 psi. when D/r<294
- f_b = 40,000 – 0.081$(D/r)^2$, when D/r>294<500
- f_b = 4.93x$10^9/(D/r)^2$ when D/r>500

Ultimate compressive stress, fb	33,000	psi
Factor of Safety	2	
Allowable wall stress, fc	16,500	psi

5 Wall Thickness

$$A = \frac{C}{f_c}$$

Required Wall Area, A	0.6621	in^2/foot

Confirm that the selected wall thickness provides the required area

Specified Wall thickness	0.109	in
Wall area from table	1.428	in^2/foot

Check wall areas:

1.428	>	0.6621	GOOD

6 Handling Thickness

$$FF = \frac{D^2}{EI}$$

E = modulus of elasticity
D = diameter or span,
I = moment of inertia of the pipe wall (

Modulus of Elasticity, E	30000000	psi
Moment of Inertia, I (from table)	0.0035	in^4/in
Flexibility Factor, F	0.0123	

Flexibility Factor acceptable maximum values:

0.0433 factory made seams

0.02 Field assembled

Factory made:	0.0123	<	0.0433	GOOD
Field assembled:	0.0123	<	0.02	GOOD

7 Seam Strength

From Table 6.4a	Ultimate Seam Strength	769	(kN/m)	
Allowable	FOS = 2	52,705	psf	
Total load on pipe, Pv:		26,352	psf	
		7,283	psf	GOOD

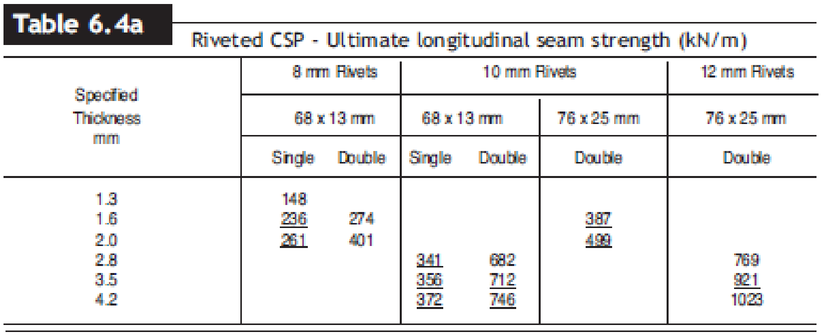


Table 6.4a Riveted CSP - Ultimate longitudinal seam strength (kN/m)

Specified Thickness mm	8 mm Rivets		10 mm Rivets			12 mm Rivets
	68 x 13 mm		68 x 13 mm		76 x 25 mm	76 x 25 mm
	Single	Double	Single	Double	Double	Double
1.3	148					
1.6	236	274			387	
2.0	261	401			499	
2.8			341	682		769
3.5			356	712		921
4.2			372	746		1023

8 Pipe arches

n/a

NewFields	CALCULATION SHEET		
Client	Lithium Nevada Corp.	Preparer:	SEB	2/28/2020
Project	Thacker Pass Project	Checked:		
Title	54" CMP CGS Inlet Culverts	Revision	A	Page 1

STEEL BURIED PIPE LOAD CAPACITY AND COVER DESIGN

Handbook of Steel Drainage & Highway Construction Products , Corrugated Steel Pipe Institute, 2007

1 Backfill compaction

	85%	

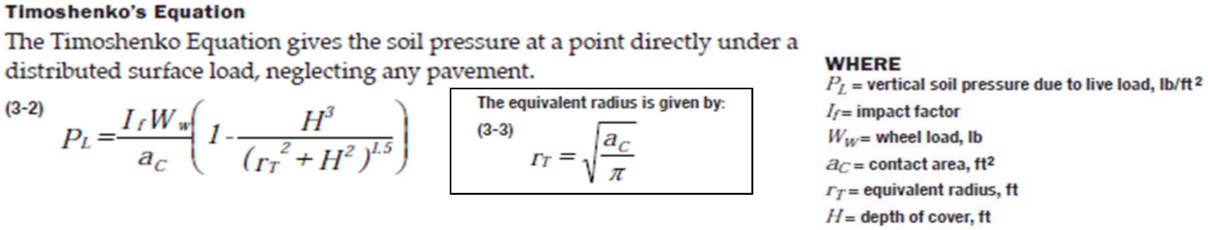
2 Design Pressure

Cover height must be equal to or greater than diameter of pipe

Soil bury depth:	3	ft
Soil Unit Weight	120	pcf
P_E - Vertical Earth Soil Pressure	360	psf
Design Vehicle	777	
Overall Width	11.5	ft
Recommended Maximum Load	85	tons
Additional Payload Weight (Above Recommended)	0	tons
Total Payload Weight		
Loaded Front Axle Weight Distribution	33.33%	
Loaded Rear Axle Weight Distrution	66.67%	
Total Weight (Truck + Payload)	294,405	
Front Axle Weight	98,135	lbs
Rear Axle Weight	196,270	lbs
Tire Size		
Tire width	26.20	in
Pressure	94.00	psi
Load	98,135	lbs
Contact Area	7.25	sf

2.1 Determine Largest Live Load from Truck By Comparing Timoshenko and Boussinesq Eq.

2.1.1: Timoshenko:



Timoshenko's Equation

The Timoshenko Equation gives the soil pressure at a point directly under a distributed surface load, neglecting any pavement.

(3-2) $$P_L = \frac{I_f W_w}{a_C}\left(1 - \frac{H^3}{(r_T^{\,2} + H^2)^{1.5}}\right)$$

The equivalent radius is given by:

(3-3) $$r_T = \sqrt{\frac{a_C}{\pi}}$$

WHERE

P_L = vertical soil pressure due to live load, lb/ft²

I_f = impact factor

W_W = wheel load, lb

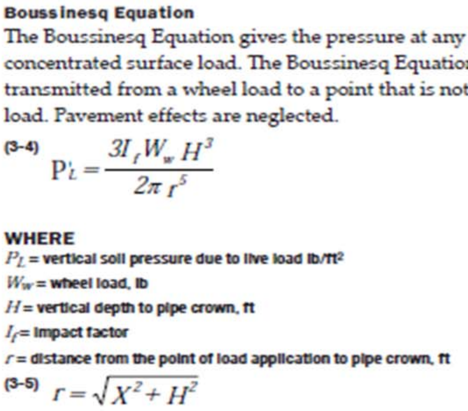
a_C = contact area, ft²

r_T = equivalent radius, ft

H = depth of cover, ft

Impact Factor (If)	Between 2-3 for Haul Truck	3	
Wheel Load (Ww)	Half of rear load	98,135	lbs
Contact Area (Ac)	Tire contact (dual rear tire)	7.25	sf
rT	Equivalent Radius	1.52	
Depth		3.00	ft
P_L - Vertical Live Soil Pressure		11,773	psf
P_T - Total Vertical Soil Pressure, Timoshenko		**12,133**	**psf**

2.1.2: Boussinesq:



Boussinesq Equation

The Boussinesq Equation gives the pressure at any point in a soil mass under a concentrated surface load. The Boussinesq Equation may be used to find the pressure transmitted from a wheel load to a point that is not along the line of action of the load. Pavement effects are neglected.

(3-4) $$P_L = \frac{3 I_f W_w H^3}{2\pi r^5}$$

WHERE

P_L = vertical soil pressure due to live load lb/ft²

W_W = wheel load, lb

H = vertical depth to pipe crown, ft

I_f = impact factor

r = distance from the point of load application to pipe crown, ft

(3-5) $$r = \sqrt{X^2 + H^2}$$

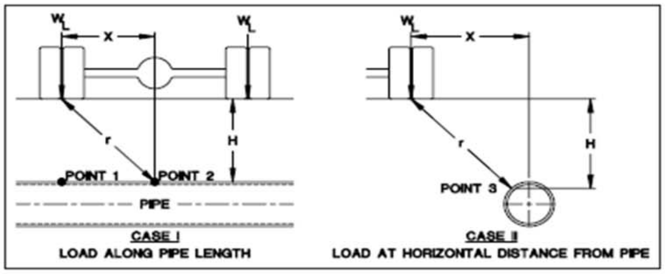


Figure 3-4 Illustration of Boussinesq Point Loading

Loaded weight on center + rear axle

Wl	Per side	98,135	lbs
	x	42.80	in
	r	5	ft
Per side		1,726.02	psf
P_L - Vertical Live Soil Pressure		3,452.04	psf
P_T - Total Vertical Soil Pressure, Boussinesq		**3,812**	**psf**

2.2 Determine Load Pressure

Use Figure 6.5 to obtain the load factor, K

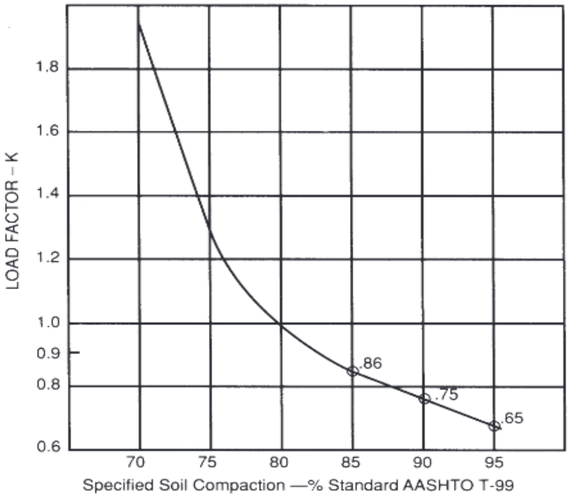


Figure 6.5 Load factors for CSP in backfill compacted to indicated density.

The load on the pipe becomes:

$P_v = K\,(DL + LL)$, when $H \geq S$
$P_v = (DL + LL)$, when $H < S$

Where: P_v=Design Pressure
K = Load Factor
DL = Dead Load (psf)
LL = Live Load (psf)
H= Height of cover (ft)
S = Span (ft)

K = 0.86

Total load on pipe, Pv: **10,795** psf

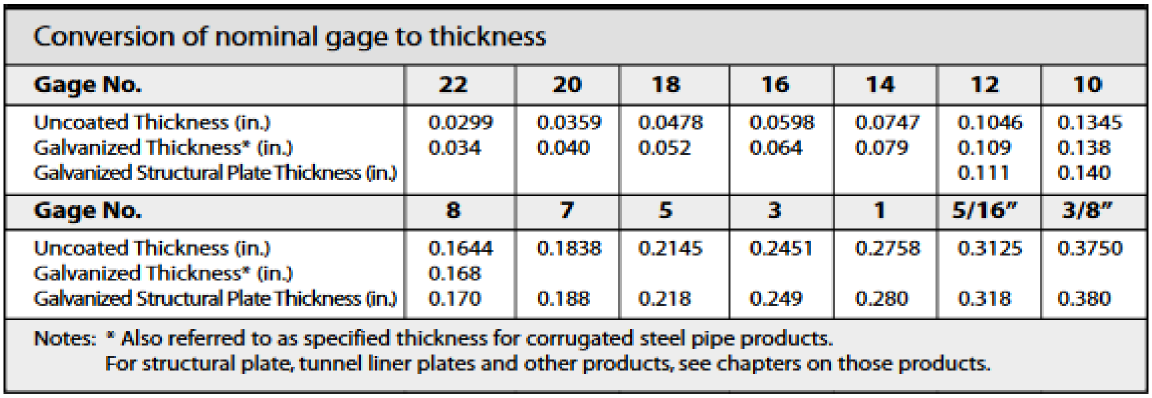
3 Ring Compression

$$C = P_v \bullet \frac{S}{2}$$

C = ring compression, lb/ft
Pv = design pressure, psf
S = span or diameter

Pv	10,795	psf
CMP pipe diameter, S	54	inch
Ring compression, C	**24,288**	psf

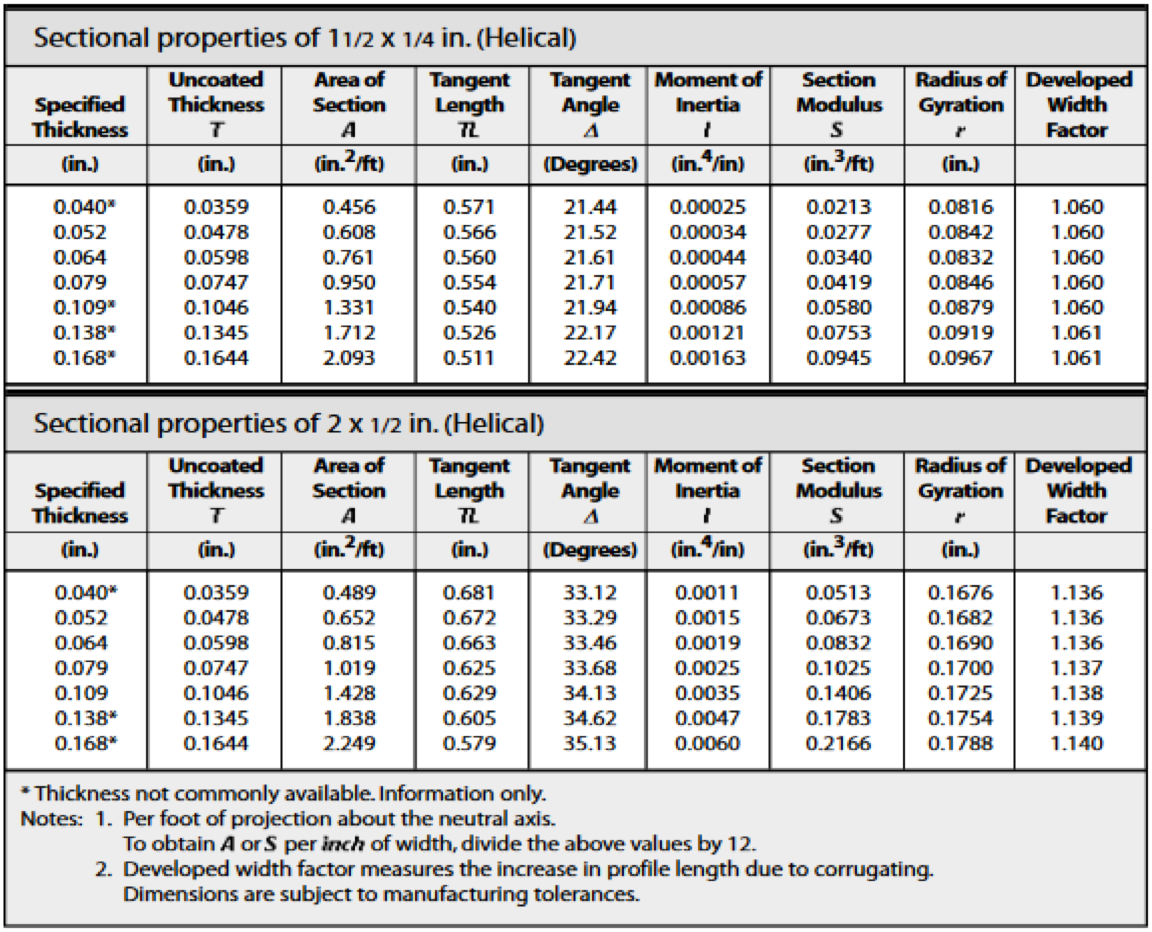
4 Allowable Wall Stress



Conversion of nominal gage to thickness

Gage No.	**22**	**20**	**18**	**16**	**14**	**12**	**10**
Uncoated Thickness (in.)	0.0299	0.0359	0.0478	0.0598	0.0747	0.1046	0.1345
Galvanized Thickness* (in.)	0.034	0.040	0.052	0.064	0.079	0.109	0.138
Galvanized Structural Plate Thickness (in.)						0.111	0.140
Gage No.	**8**	**7**	**5**	**3**	**1**	**5/16″**	**3/8″**
Uncoated Thickness (in.)	0.1644	0.1838	0.2145	0.2451	0.2758	0.3125	0.3750
Galvanized Thickness* (in.)	0.168						
Galvanized Structural Plate Thickness (in.)	0.170	0.188	0.218	0.249	0.280	0.318	0.380

Notes: * Also referred to as specified thickness for corrugated steel pipe products.
For structural plate, tunnel liner plates and other products, see chapters on those products.



Sectional properties of 1 1/2 x 1/4 in. (Helical)

Specified Thickness	Uncoated Thickness *T*	Area of Section *A*	Tangent Length *TL*	Tangent Angle *Δ*	Moment of Inertia *I*	Section Modulus *S*	Radius of Gyration *r*	Developed Width Factor
(in.)	(in.)	(in.^{2}/ft)	(in.)	(Degrees)	(in.^{4}/in)	(in.^{3}/ft)	(in.)	
0.040*	0.0359	0.456	0.571	21.44	0.00025	0.0213	0.0816	1.060
0.052	0.0478	0.608	0.566	21.52	0.00034	0.0277	0.0842	1.060
0.064	0.0598	0.761	0.560	21.61	0.00044	0.0340	0.0832	1.060
0.079	0.0747	0.950	0.554	21.71	0.00057	0.0419	0.0846	1.060
0.109*	0.1046	1.331	0.540	21.94	0.00086	0.0580	0.0879	1.060
0.138*	0.1345	1.712	0.526	22.17	0.00121	0.0753	0.0919	1.061
0.168*	0.1644	2.093	0.511	22.42	0.00163	0.0945	0.0967	1.061

Sectional properties of 2 x 1/2 in. (Helical)

Specified Thickness	Uncoated Thickness *T*	Area of Section *A*	Tangent Length *TL*	Tangent Angle *Δ*	Moment of Inertia *I*	Section Modulus *S*	Radius of Gyration *r*	Developed Width Factor
(in.)	(in.)	(in.^{2}/ft)	(in.)	(Degrees)	(in.^{4}/in)	(in.^{3}/ft)	(in.)	
0.040*	0.0359	0.489	0.681	33.12	0.0011	0.0513	0.1676	1.136
0.052	0.0478	0.652	0.672	33.29	0.0015	0.0673	0.1682	1.136
0.064	0.0598	0.815	0.663	33.46	0.0019	0.0832	0.1690	1.136
0.079	0.0747	1.019	0.625	33.68	0.0025	0.1025	0.1700	1.137
0.109	0.1046	1.428	0.629	34.13	0.0035	0.1406	0.1725	1.138
0.138*	0.1345	1.838	0.605	34.62	0.0047	0.1783	0.1754	1.139
0.168*	0.1644	2.249	0.579	35.13	0.0060	0.2166	0.1788	1.140

* Thickness not commonly available. Information only.

Notes: 1. Per foot of projection about the neutral axis.
To obtain ***A*** or ***S*** per ***inch*** of width, divide the above values by 12.
2. Developed width factor measures the increase in profile length due to corrugating.
Dimensions are subject to manufacturing tolerances.

From Tables:

Selected gage:	8	(Use 2x1/2 in)
Specified thickness:	0.168	in
Radius of Gyration, r:	0.1788	in

Pipe diameter, D	54	in
D/r	302	

Allowable compressive stress – wall stress (f_b)

- $f_b = f_y$ = 33,000 psi.	when D/r<294
- f_b = 40,000 – 0.081$(D/r)^2$,	when D/r>294<500
- f_b = 4.93x$10^9/(D/r)^2$	when D/r>500

Ultimate compressive stress, fb	32,612	psi
Factor of Safety	2	
Allowable wall stress, fc	16,306	psi

5 Wall Thickness

$$A = \frac{C}{f_c}$$

Required Wall Area, A	1.4895	in^2/foot

Confirm that the selected wall thickness provides the required area

Specified Wall thickness	0.168	in
Wall area from table	2.249	in^2/foot

Check wall areas:

2.249	>	1.4895	GOOD

6 Handling Thickness

$$FF = \frac{D^2}{EI}$$

E = modulus of elasticity

D = diameter or span,

I = moment of inertia of the pipe wall

Modulus of Elasticity, E	30000000	psi
Moment of Inertia, I (from table)	0.006	in^4/in
Flexibility Factor, F	0.0162	

Flexibility Factor acceptable maximum values:

0.0433 factory made seams

0.02 Field assembled

Factory made:	0.0162	<	0.0433	GOOD
Field assembled:	0.0162	<	0.02	GOOD

7 Seam Strength

From Table 6.4a	Ultimate Seam Strength	341	kN/m	
		23,371	psf	
Allowable	FOS = 2	11,685	psf	
Total load on pipe, Pv:		10,795	psf	GOOD

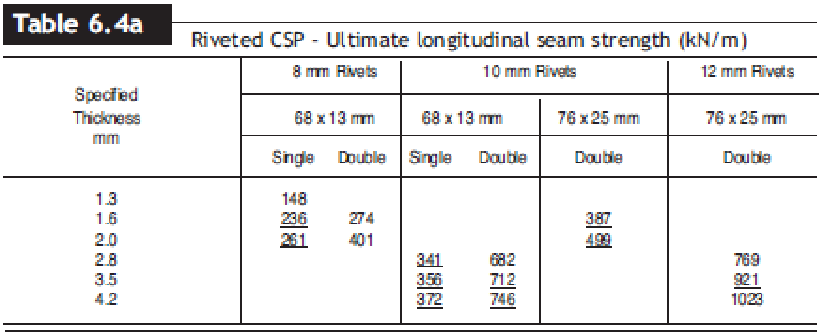


Table 6.4a

Riveted CSP - Ultimate longitudinal seam strength (kN/m)

Specified Thickness mm	8 mm Rivets		10 mm Rivets			12 mm Rivets
	68 x 13 mm		68 x 13 mm		76 x 25 mm	76 x 25 mm
	Single	Double	Single	Double	Double	Double
1.3	148					
1.6	236	274			387	
2.0	261	401			499	
2.8			341	682		769
3.5			356	712		921
4.2			372	746		1023

8 Pipe arches

n/a

NewFields		**CALCULATION SHEET**		
Client	Lithium Nevada Corp.	Preparer:	RL	2/20/2020
Project	Thacker Pass Project	Checked:	ZR	
Title	60" CMP Culverts - CTFS West Diversion	Revision	A	Page 1

STEEL BURIED PIPE LOAD CAPACITY AND COVER DESIGN

Handbook of Steel Drainage & Highway Construction Products , Corrugated Steel Pipe Institute, 2007

1 Backfill compaction

90%

2 Design Pressure

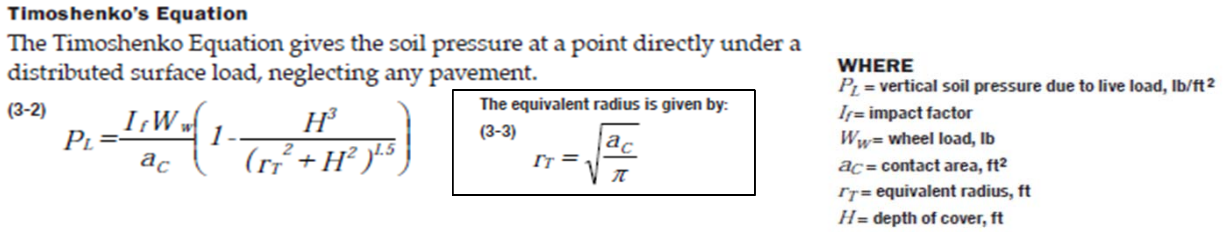
Cover height must be equal to or greater than diameter of pipe

Soil bury depth:	3	ft
Soil Unit Weight	120	pcf
P_E - Vertical Earth Soil Pressure	360	psf

Design Vehicle	777	
Overall Width	11.5	ft
Recommended Maximum Load	85	tons
Additional Payload Weight (Above Recommended)	0	tons
Total Payload Weight		
Loaded Front Axle Weight Distribution	33.33%	
Loaded Rear Axle Weight Distrution	66.67%	
Total Weight (Truck + Payload)	294,405	
Front Axle Weight	98,135	lbs
Rear Axle Weight	196,270	lbs
Tire Size		
Tire width	26.20	in
Pressure	94.00	psi
Load	98,135	lbs
Contact Area	7.25	sf

2.1 Determine Largest Live Load from Truck By Comparing Timoshenko and Boussinesq Eq.

2.1.1: Timoshenko:



Timoshenko's Equation

The Timoshenko Equation gives the soil pressure at a point directly under a distributed surface load, neglecting any pavement.

(3-2)
$$P_L = \frac{I_f W_w}{a_C}\left(1 - \frac{H^3}{(r_T^2 + H^2)^{1.5}}\right)$$

The equivalent radius is given by:

(3-3)
$$r_T = \sqrt{\frac{a_C}{\pi}}$$

WHERE

P_L = vertical soil pressure due to live load, lb/ft²

I_f = impact factor

W_W = wheel load, lb

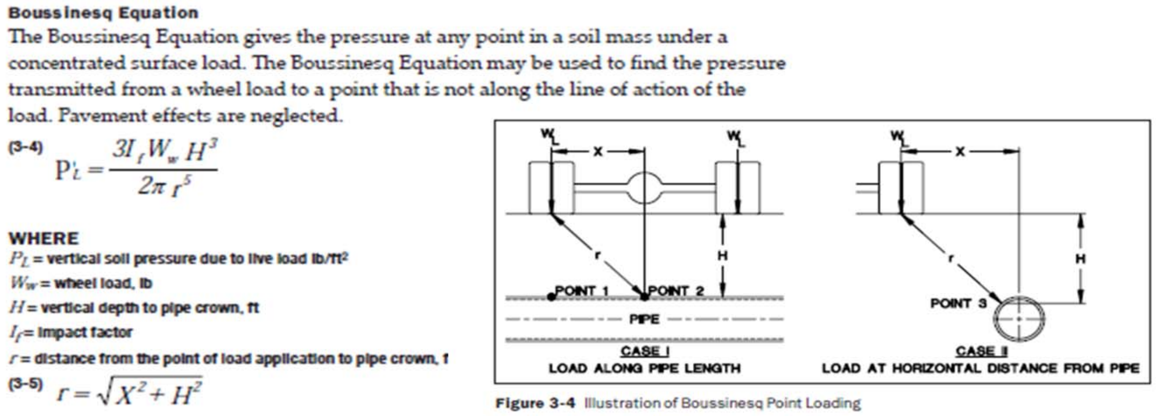
a_C = contact area, ft²

r_T = equivalent radius, ft

H = depth of cover, ft

Impact Factor (If)	Between 2-3 for Haul Truck	3	
Wheel Load (Ww)	Half of rear load	98,135	lbs
Contact Area (Ac)	Tire contact (dual rear tire)	7.25	sf
rT	Equivalent Radius	1.52	
Depth		3.00	ft
P_L - Vertical Live Soil Pressure		11,773	psf
P_T - Total Vertical Soil Pressure, Timoshenko		**12,133**	**psf**

2.1.2: Boussinesq:



Boussinesq Equation

The Boussinesq Equation gives the pressure at any point in a soil mass under a concentrated surface load. The Boussinesq Equation may be used to find the pressure transmitted from a wheel load to a point that is not along the line of action of the load. Pavement effects are neglected.

(3-4)
$$P_L = \frac{3 I_f W_w H^3}{2\pi r^5}$$

WHERE

P_L = vertical soil pressure due to live load lb/ft²

W_W = wheel load, lb

H = vertical depth to pipe crown, ft

I_f = impact factor

r = distance from the point of load application to pipe crown, f

(3-5)
$$r = \sqrt{X^2 + H^2}$$

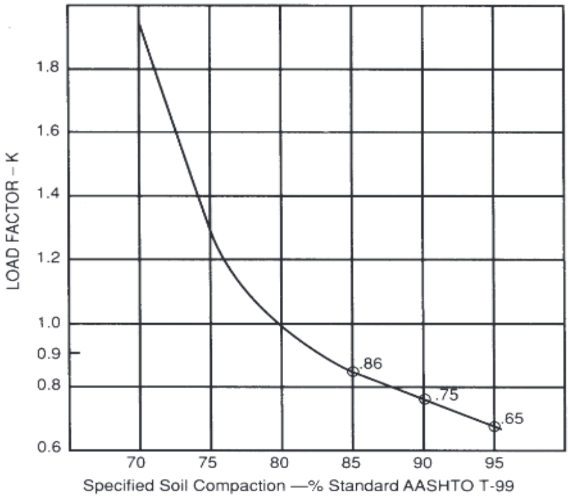
Figure 3-4 Illustration of Boussinesq Point Loading

Loaded weight on center + rear axle

Wl	Per side	98,135	lbs
	x	42.80	in
	r	5	ft
Per side		1,726.02	psf
P_L - Vertical Live Soil Pressure		3,452.04	psf
P_T - Total Vertical Soil Pressure, Boussinesq		**3,812**	**psf**

2.2 Determine Load Pressure

Use Figure 6.5 to obtain the load factor, K



The load on the pipe becomes:

$P_v = K\,(DL + LL)$, when $H \geq S$
$P_v = (DL + LL)$, when $H < S$

Where:
P_v=Design Pressure
K = Load Factor
DL = Dead Load (psf)
LL = Live Load (psf)
H= Height of cover (ft)
S = Span (ft)

Figure 6.5 Load factors for CSP in backfill compacted to indicated density.

K =	0.75
Total load on pipe, Pv:	**9,460** psf

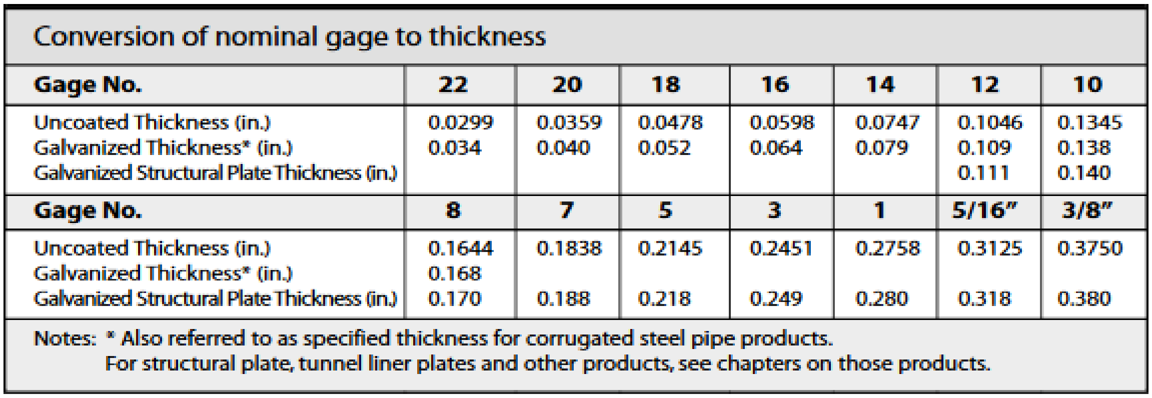
3 Ring Compression

$$C = P_v \cdot \frac{S}{2}$$

C = ring compression, lb/ft
Pv = design pressure, psf
S = span or diameter

Pv	9,460	psf
CMP pipe diameter, S	60	inch
Ring compression, C	**23,650**	psf

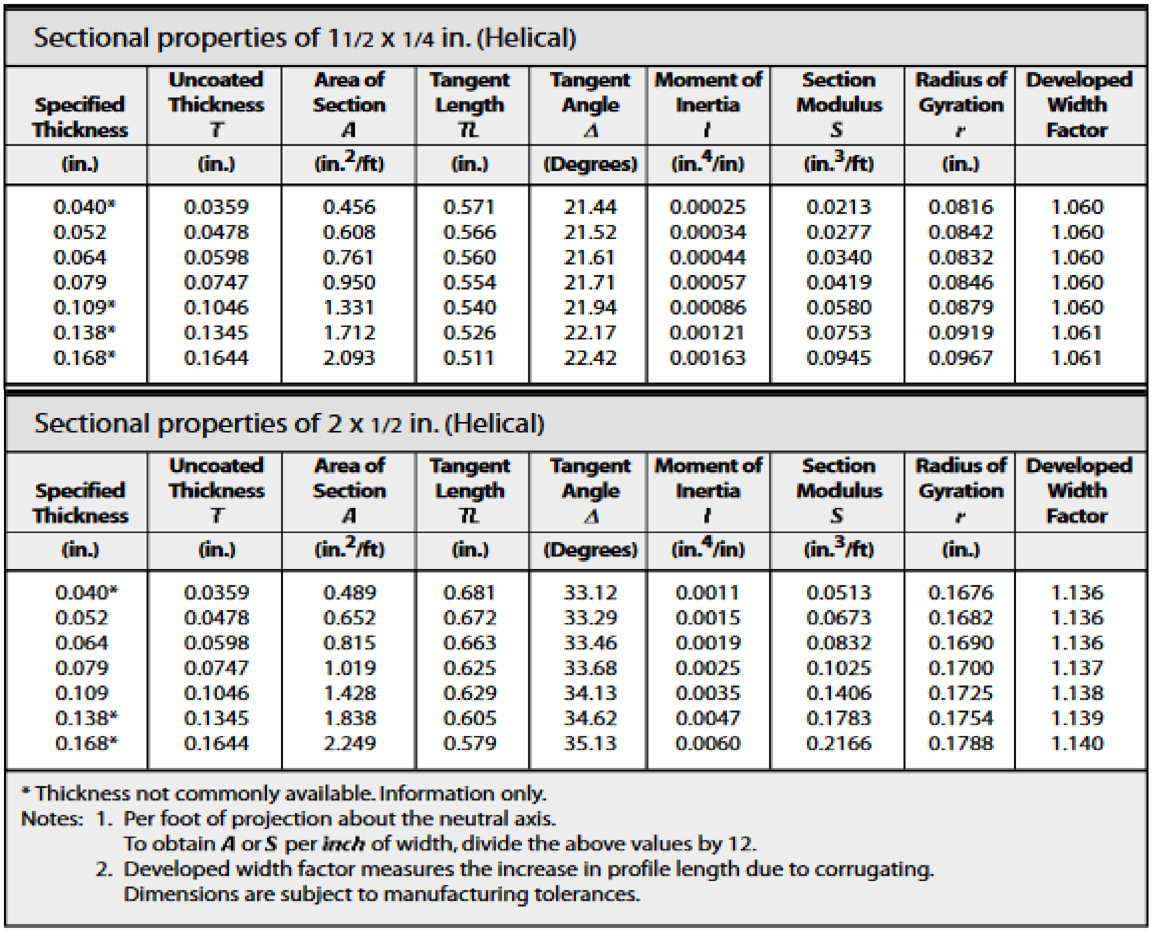
4 Allowable Wall Stress



Conversion of nominal gage to thickness

Gage No.	**22**	**20**	**18**	**16**	**14**	**12**	**10**
Uncoated Thickness (in.)	0.0299	0.0359	0.0478	0.0598	0.0747	0.1046	0.1345
Galvanized Thickness* (in.)	0.034	0.040	0.052	0.064	0.079	0.109	0.138
Galvanized Structural Plate Thickness (in.)						0.111	0.140
Gage No.	**8**	**7**	**5**	**3**	**1**	**5/16"**	**3/8"**
Uncoated Thickness (in.)	0.1644	0.1838	0.2145	0.2451	0.2758	0.3125	0.3750
Galvanized Thickness* (in.)	0.168						
Galvanized Structural Plate Thickness (in.)	0.170	0.188	0.218	0.249	0.280	0.318	0.380

Notes: * Also referred to as specified thickness for corrugated steel pipe products.
For structural plate, tunnel liner plates and other products, see chapters on those products.



Sectional properties of 1 1/2 x 1/4 in. (Helical)

Specified Thickness	Uncoated Thickness *T*	Area of Section *A*	Tangent Length *TL*	Tangent Angle *Δ*	Moment of Inertia *I*	Section Modulus *S*	Radius of Gyration *r*	Developed Width Factor
(in.)	(in.)	$(in.^2/ft)$	(in.)	(Degrees)	$(in.^4/in)$	$(in.^3/ft)$	(in.)	
0.040*	0.0359	0.456	0.571	21.44	0.00025	0.0213	0.0816	1.060
0.052	0.0478	0.608	0.566	21.52	0.00034	0.0277	0.0842	1.060
0.064	0.0598	0.761	0.560	21.61	0.00044	0.0340	0.0832	1.060
0.079	0.0747	0.950	0.554	21.71	0.00057	0.0419	0.0846	1.060
0.109*	0.1046	1.331	0.540	21.94	0.00086	0.0580	0.0879	1.060
0.138*	0.1345	1.712	0.526	22.17	0.00121	0.0753	0.0919	1.061
0.168*	0.1644	2.093	0.511	22.42	0.00163	0.0945	0.0967	1.061

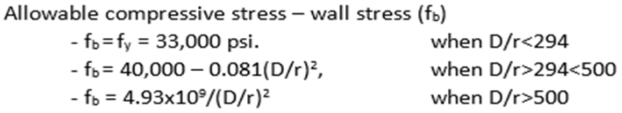
Sectional properties of 2 x 1/2 in. (Helical)

Specified Thickness	Uncoated Thickness *T*	Area of Section *A*	Tangent Length *TL*	Tangent Angle *Δ*	Moment of Inertia *I*	Section Modulus *S*	Radius of Gyration *r*	Developed Width Factor
(in.)	(in.)	$(in.^2/ft)$	(in.)	(Degrees)	$(in.^4/in)$	$(in.^3/ft)$	(in.)	
0.040*	0.0359	0.489	0.681	33.12	0.0011	0.0513	0.1676	1.136
0.052	0.0478	0.652	0.672	33.29	0.0015	0.0673	0.1682	1.136
0.064	0.0598	0.815	0.663	33.46	0.0019	0.0832	0.1690	1.136
0.079	0.0747	1.019	0.625	33.68	0.0025	0.1025	0.1700	1.137
0.109	0.1046	1.428	0.629	34.13	0.0035	0.1406	0.1725	1.138
0.138*	0.1345	1.838	0.605	34.62	0.0047	0.1783	0.1754	1.139
0.168*	0.1644	2.249	0.579	35.13	0.0060	0.2166	0.1788	1.140

* Thickness not commonly available. Information only.

Notes: 1. Per foot of projection about the neutral axis.
To obtain *A* or *S* per *inch* of width, divide the above values by 12.
2. Developed width factor measures the increase in profile length due to corrugating.
Dimensions are subject to manufacturing tolerances.

From Tables:		
Selected gage:	8	(Use 2x1/2 in)
Uncoated thickness:	0.1644	in
Radius of Gyration, r:	0.1788	in
Pipe diameter, D	60	in
D/r	336	



Allowable compressive stress – wall stress (f_b)
- $f_b = f_y$ = 33,000 psi. when $D/r<294$
- f_b = 40,000 – $0.081(D/r)^2$, when $D/r>294<500$
- $f_b = 4.93x10^9/(D/r)^2$ when $D/r>500$

Ultimate compressive stress, fb	30,879	psi
Factor of Safety	2	
Allowable wall stress, fc	**15,439**	psi

5 Wall Thickness

$$A = \frac{C}{f_c}$$

Required Wall Area, A	1.5318	in^2/foot

Select the wall thickness that provides the required area

Specified Wall thickness	0.168	in
Wall area from table	2.249	in^2/foot

Check wall areas:

2.249	>	1.5318	GOOD

6 Handling Stiffness

$$FF = \frac{D^2}{EI}$$

E = modulus of elasticity
D = diameter or span,
I = moment of inertia of the pipe wall (

Modulus of Elasticity, E	30000000	psi
Moment of Inertia, I (from table)	0.006	in^4/in
Flexibility Factor, F	0.0200	

Flexibility Factor acceptable maximum values:

0.0433 factory made seams

0.02 Field assembled

Factory made:	0.0200	<	0.0433	GOOD
Field assembled:	0.0200	=	0.02	GOOD

7 Seam Strength

From Table 6.4a

Ultimate Seam Strength		372	kN/m	
		25,496	lb/ft	
Allowable	FOS = 2	12,748	psf	
Total load on pipe, Pv:		9,460	psf	GOOD

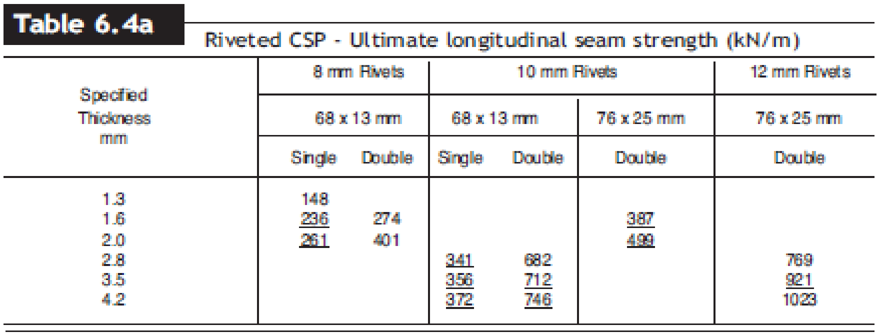


Table 6.4a Riveted CSP - Ultimate longitudinal seam strength (kN/m)

Specified Thickness mm	8 mm Rivets		10 mm Rivets			12 mm Rivets
	68 x 13 mm		68 x 13 mm		76 x 25 mm	76 x 25 mm
	Single	Double	Single	Double	Double	Double
1.3	148					
1.6	236	274			387	
2.0	261	401			499	
2.8			341	682		769
3.5			356	712		921
4.2			372	746		1023

8 Pipe arches

n/a

NewFields	CALCULATION SHEET		
Client	Lithium Nevada Corp	Preparer:	MTH	2/7/2020
Project	Thacker Pass Project	Checked:	RL	2/7/2020
Title	24" Dia HDPE (DR17) Pipeline	Revision	A	Page 1

HDPE BURIED PIPE LOAD CAPACITY AND COVER DESIGN

Design Methodology Per Design of PE Piping Systems, Plastic Pipe Institute

Determine Vertical Soil Pressure

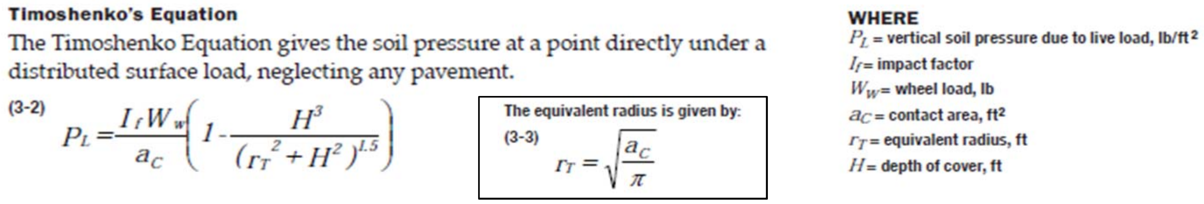
Soil Bury Depth	3.00	Feet
Soil Unit Weight	120.00	pcf
P_E - Vertical Earth Soil Pressure	360.00	psf

Determine Largest Live Load from Truck By Comparing Timoshenko and Boussinesq Eq. Below

Truck		740	
	Empty Truck Weight	72,400	lbs
	Overall Width	12	ft
	Recommended Maximum Load	42	tons
	Additional Payload Weight (Above Recommened Load)	0	tons
Total Payload Weight		42	tons
	Total Payload Weight	84,000	lbs
	Loaded Front Axle Weight Distribution	51.10%	%
	Loaded Rear Axle Weight Distrution	48.90%	%
	Total Weight (Truck + Payload)	156,400	
	Front Axle Weight	79,920.40	lbs
	Rear Axle Weight	76,479.60	lbs
Tire Size		29.5R25	
	Tire width	29.50	in
	Pressure	76.00	psi
	Load	39960.20	lbs
	Contact Area	3.65	sf

Determine Live Load from Truck

Use Timoshenko's Equation



Timoshenko's Equation

The Timoshenko Equation gives the soil pressure at a point directly under a distributed surface load, neglecting any pavement.

(3-2)
$$P_L = \frac{I_f W_w}{a_C}\left(1 - \frac{H^3}{(r_T^2 + H^2)^{1.5}}\right)$$

The equivalent radius is given by:

(3-3)
$$r_T = \sqrt{\frac{a_C}{\pi}}$$

WHERE

P_L = vertical soil pressure due to live load, lb/ft²

I_f = impact factor

W_W = wheel load, lb

a_C = contact area, ft²

r_T = equivalent radius, ft

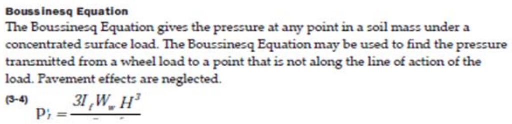
H = depth of cover, ft

Impact Factor (If)	Between 2-3 for Haul Truck	3	
Wheel Load (Ww)	793D Haul Truck (half of rear load)	39,960	lbs
Contact Area (Ac)	Tire contact (dual rear tire)	3.65	sf
rT	Equivalent Radius	1.08	
Depth		3.00	ft
P_L - Vertical Live Soil Pressure		5,468	psf

P_T - Total Vertical Soil Pressure **5,828 psf**

Determine Live Load from Truck

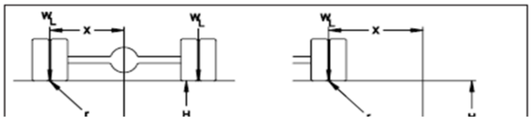
Use Boussinesq's Equation

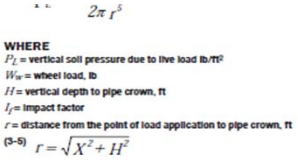


Boussinesq Equation

The Boussinesq Equation gives the pressure at any point in a soil mass under a concentrated surface load. The Boussinesq Equation may be used to find the pressure transmitted from a wheel load to a point that is not along the line of action of the load. Pavement effects are neglected.

(3-4)
$$P_L = \frac{3 I_f W_w H^3}{}$$




$2\pi r^5$

WHERE

P_L = vertical soil pressure due to live load lb/ft²

W_W = wheel load, lb

H = vertical depth to pipe crown, ft

I_f = impact factor

r = distance from the point of load application to pipe crown, ft

(3-5) $r = \sqrt{X^2 + H^2}$

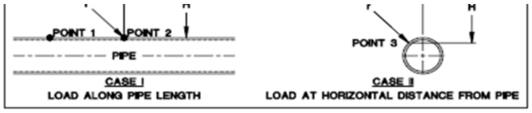


Figure 3-4 Illustration of Boussinesq Point Loading

Loaded weight on center + rear axle			lbs
Wl	Per side	39,960	lbs
	x	42.50	in
	r	5	ft
Per side		717.41	psf
P_L - Vertical Live Soil Pressure		1,434.82	psf
P_T - Total Vertical Soil Pressure		**1,795**	**psf**

Client	Lithium Nevada Corp	Preparer:	MTH	2/7/2020
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Title	24" Dia HDPE (DR17) Pipeline	Revision	A	Page 2

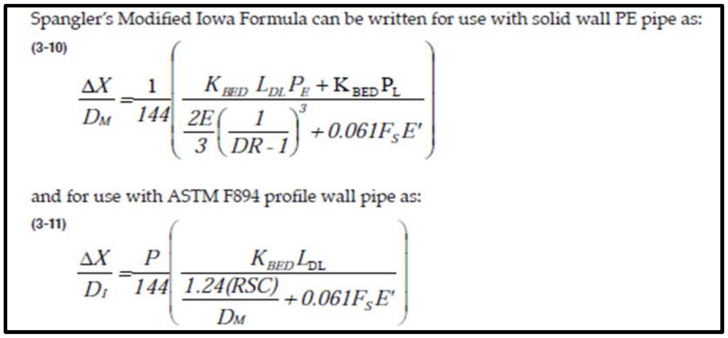
HDPE BURIED PIPE LOAD CAPACITY AND COVER DESIGN

Pipe Selected

Pipe size	24	Inches
Pipe DR	DR17	
Pipe Outside Diameter (D_O)	24	inches
Pipe Inside Diameter (D_I)	21.007	inches

Determine Pipe Deflection Modified Iowa Equation

Use when bury depth is 18"
or at least 1 pipe diameter


Spangler's Modified Iowa Formula can be written for use with solid wall PE pipe as:

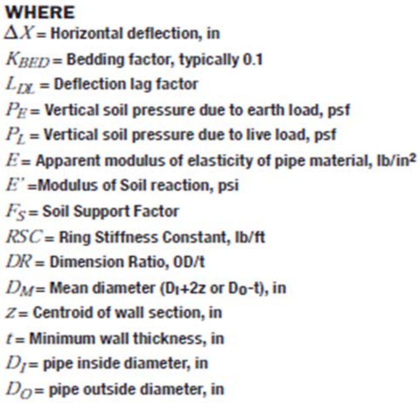
(3-10)

$$\frac{\Delta X}{D_M} = \frac{1}{144}\left(\frac{K_{BED}\,L_{DL}\,P_E + K_{BED}\,P_L}{\frac{2E}{3}\left(\frac{1}{DR-1}\right)^3 + 0.061F_S E'}\right)$$

and for use with ASTM F894 profile wall pipe as:

(3-11)

$$\frac{\Delta X}{D_I} = \frac{P}{144}\left(\frac{K_{BED}L_{DL}}{\frac{1.24(RSC)}{D_M} + 0.061F_S E'}\right)$$


WHERE

ΔX = Horizontal deflection, in

K_{BED} = Bedding factor, typically 0.1

L_{DL} = Deflection lag factor

P_E = Vertical soil pressure due to earth load, psf

P_L = Vertical soil pressure due to live load, psf

E = Apparent modulus of elasticity of pipe material, lb/in²

E' =Modulus of Soil reaction, psi

F_S = Soil Support Factor

RSC = Ring Stiffness Constant, lb/ft

DR = Dimension Ratio, OD/t

D_M = Mean diameter (D_I+2z or D_O-t), in

z = Centroid of wall section, in

t = Minimum wall thickness, in

D_I = pipe inside diameter, in

D_O = pipe outside diameter, in

K_{BED}	0.1		Typical
L_{DL}	1		Deflection Lag Factor
E	28,000	psi	See Table B.1.1 Below for Vehicle Loading
E'	2000	psi	See Table 3-7 below
E'_N	2000	psi	See Table 3-9 below
Bd	108		Trench Width (inches)
Do	24		Pipe Outside Diameter (inches)
DR	17		
Bd/D_O	4.5		
E'_N/E'	1		
Fs	1		See Table 3-10 below

Use Timoshenko's Equation

$\Delta X/D_I$ = 0.031981 = 3.2% **< 5% Therefore Design is Adequate,**

Tabe 3-11 for Deflection Limit Check

Use Boussinesq's Equation

0.009849 **1%**

Client	Lithium Nevada Corp	Preparer:	MTH	2/7/2020
Project	Thacker Pass Project	Checked:	RL	2/7/2020
Title	24" Dia HDPE (DR17) Pipeline	Revision	A	Page 3

HDPE BURIED PIPE LOAD CAPACITY AND COVER DESIGN

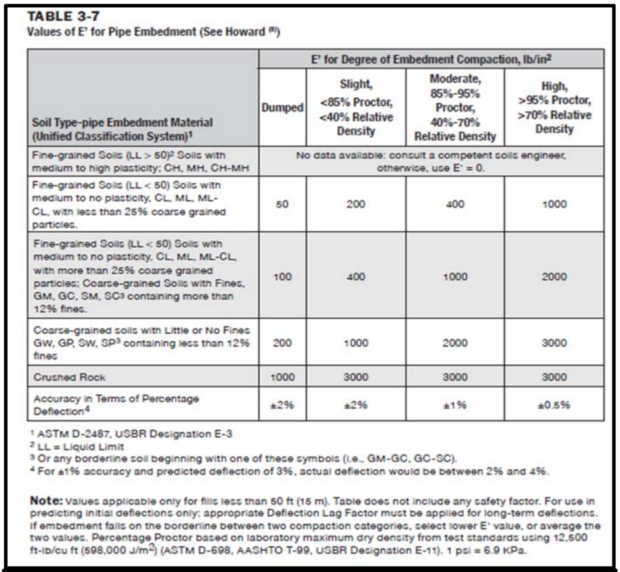


TABLE 3-7
Values of E' for Pipe Embedment (See Howard (8))

Soil Type-pipe Embedment Material (Unified Classification System)[1]	E' for Degree of Embedment Compaction, lb/in²: Dumped	Slight, <85% Proctor, <40% Relative Density	Moderate, 85%-95% Proctor, 40%-70% Relative Density	High, >95% Proctor, >70% Relative Density
Fine-grained Soils (LL > 50)[2] Soils with medium to high plasticity; CH, MH, CH-MH	No data available: consult a competent soils engineer, otherwise, use E' = 0.			
Fine-grained Soils (LL < 50) Soils with medium to no plasticity, CL, ML, ML-CL, with less than 25% coarse grained particles.	50	200	400	1000
Fine-grained Soils (LL < 50) Soils with medium to no plasticity, CL, ML, ML-CL, with more than 25% coarse grained particles; Coarse-grained Soils with Fines, GM, GC, SM, SC[3] containing more than 12% fines.	100	400	1000	2000
Coarse-grained soils with Little or No Fines GW, GP, SW, SP[3] containing less than 12% fines	200	1000	2000	3000
Crushed Rock	1000	3000	3000	3000
Accuracy in Terms of Percentage Deflection[4]	±2%	±2%	±1%	±0.5%

[1] ASTM D-2487, USBR Designation E-3
[2] LL = Liquid Limit
[3] Or any borderline soil beginning with one of these symbols (i.e., GM-GC, GC-SC).
[4] For ±1% accuracy and predicted deflection of 3%, actual deflection would be between 2% and 4%.

Note: Values applicable only for fills less than 50 ft (15 m). Table does not include any safety factor. For use in predicting initial deflections only; appropriate Deflection Lag Factor must be applied for long-term deflections. If embedment falls on the borderline between two compaction categories, select lower E' value, or average the two values. Percentage Proctor based on laboratory maximum dry density from test standards using 12,500 ft-lb/cu ft (598,000 J/m²) (ASTM D-698, AASHTO T-99, USBR Designation E-11). 1 psi = 6.9 KPa.

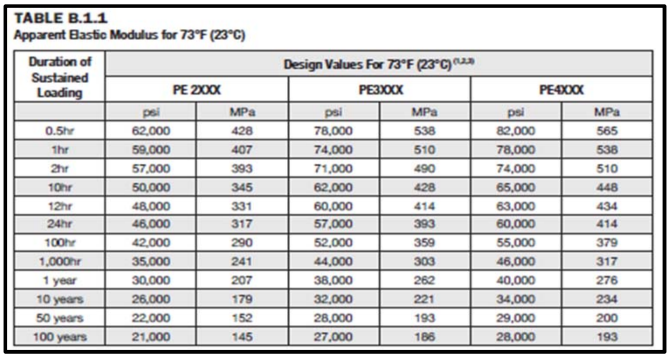


TABLE B.1.1
Apparent Elastic Modulus for 73°F (23°C)

Duration of Sustained Loading	Design Values For 73°F (23°C) (1,2,3): PE 2XXX psi	PE 2XXX MPa	PE3XXX psi	PE3XXX MPa	PE4XXX psi	PE4XXX MPa
0.5hr	62,000	428	78,000	538	82,000	565
1hr	59,000	407	74,000	510	78,000	538
2hr	57,000	393	71,000	490	74,000	510
10hr	50,000	345	62,000	428	65,000	448
12hr	48,000	331	60,000	414	63,000	434
24hr	46,000	317	57,000	393	60,000	414
100hr	42,000	290	52,000	359	55,000	379
1,000hr	35,000	241	44,000	303	46,000	317
1 year	30,000	207	38,000	262	40,000	276
10 years	26,000	179	32,000	221	34,000	234
50 years	22,000	152	28,000	193	29,000	200
100 years	21,000	145	27,000	186	28,000	193

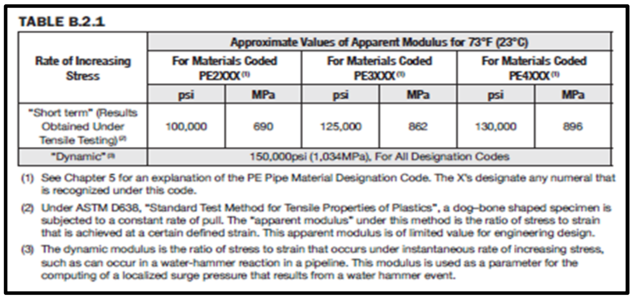


TABLE B.2.1

Rate of Increasing Stress	Approximate Values of Apparent Modulus for 73°F (23°C): For Materials Coded PE2XXX (1) psi	PE2XXX (1) MPa	For Materials Coded PE3XXX (1) psi	PE3XXX (1) MPa	For Materials Coded PE4XXX (1) psi	PE4XXX (1) MPa
"Short term" (Results Obtained Under Tensile Testing) (2)	100,000	690	125,000	862	130,000	896
"Dynamic" (3)	150,000psi (1,034MPa), For All Designation Codes					

(1) See Chapter 5 for an explanation of the PE Pipe Material Designation Code. The X's designate any numeral that is recognized under this code.
(2) Under ASTM D638, "Standard Test Method for Tensile Properties of Plastics", a dog–bone shaped specimen is subjected to a constant rate of pull. The "apparent modulus" under this method is the ratio of stress to strain that is achieved at a certain defined strain. This apparent modulus is of limited value for engineering design.
(3) The dynamic modulus is the ratio of stress to strain that occurs under instantaneous rate of increasing stress, such as can occur in a water-hammer reaction in a pipeline. This modulus is used as a parameter for the computing of a localized surge pressure that results from a water hammer event.

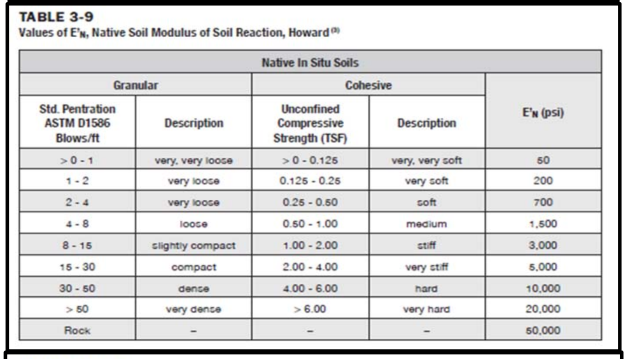


TABLE 3-9
Values of E'$_N$, Native Soil Modulus of Soil Reaction, Howard (3)

Native In Situ Soils: Granular: Std. Pentration ASTM D1586 Blows/ft	Granular: Description	Cohesive: Unconfined Compressive Strength (TSF)	Cohesive: Description	E'$_N$ (psi)
> 0 - 1	very, very loose	> 0 - 0.125	very, very soft	50
1 - 2	very loose	0.125 - 0.25	very soft	200
2 - 4	very loose	0.25 - 0.50	soft	700
4 - 8	loose	0.50 - 1.00	medium	1,500
8 - 15	slightly compact	1.00 - 2.00	stiff	3,000
15 - 30	compact	2.00 - 4.00	very stiff	5,000
30 - 50	dense	4.00 - 6.00	hard	10,000
> 50	very dense	> 6.00	very hard	20,000
Rock	–	–	–	50,000

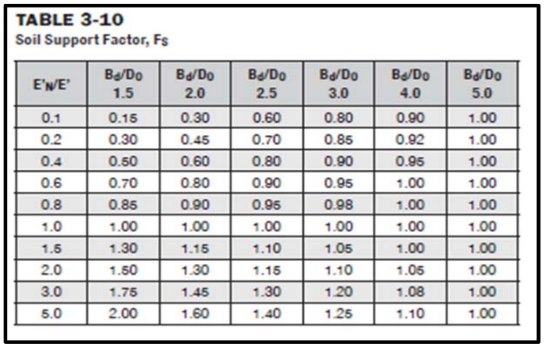


TABLE 3-10
Soil Support Factor, F_S

E'$_N$/E'	B_d/D_O 1.5	B_d/D_O 2.0	B_d/D_O 2.5	B_d/D_O 3.0	B_d/D_O 4.0	B_d/D_O 5.0
0.1	0.15	0.30	0.60	0.80	0.90	1.00
0.2	0.30	0.45	0.70	0.85	0.92	1.00
0.4	0.50	0.60	0.80	0.90	0.95	1.00
0.6	0.70	0.80	0.90	0.95	1.00	1.00
0.8	0.85	0.90	0.95	0.98	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00
1.5	1.30	1.15	1.10	1.05	1.00	1.00
2.0	1.50	1.30	1.15	1.10	1.05	1.00
3.0	1.75	1.45	1.30	1.20	1.08	1.00
5.0	2.00	1.60	1.40	1.25	1.10	1.00

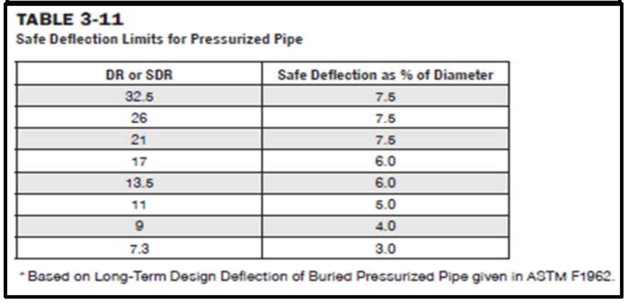


TABLE 3-11
Safe Deflection Limits for Pressurized Pipe

DR or SDR	Safe Deflection as % of Diameter
32.5	7.5
26	7.5
21	7.5
17	6.0
13.5	6.0
11	5.0
9	4.0
7.3	3.0

* Based on Long-Term Design Deflection of Buried Pressurized Pipe given in ASTM F1962.

Client	Lithium Nevada Corp	Preparer:	MTH	
Project	Thacker Pass Project	Checked:	RL	
Title	24" Dia HDPE (DR17) Pipeline	Revision	A	Page 4

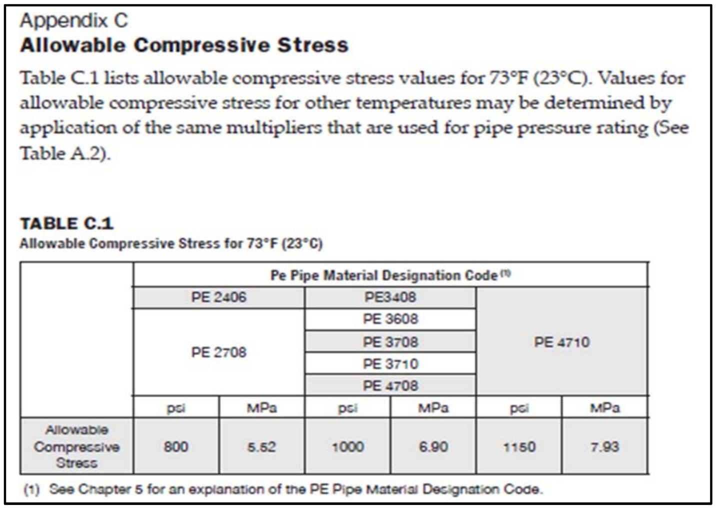
HDPE BURIED PIPE LOAD CAPACITY AND COVER DESIGN

Check Compressive Ring Thrust

(3-13)
$$S = \frac{(P_E + P_L)\,DR}{288}$$

S= **344 psi** **<** **1150 psi for PE 4710 HDPE**

Therefore, design is adequate



Appendix C

Allowable Compressive Stress

Table C.1 lists allowable compressive stress values for 73°F (23°C). Values for allowable compressive stress for other temperatures may be determined by application of the same multipliers that are used for pipe pressure rating (See Table A.2).

TABLE C.1

Allowable Compressive Stress for 73°F (23°C)

	Pe Pipe Material Designation Code (1)					
	PE 2406 PE 2708		PE3408 PE 3608 PE 3708 PE 3710 PE 4708		PE 4710	
	psi	MPa	psi	MPa	psi	MPa
Allowable Compressive Stress	800	5.52	1000	6.90	1150	7.93

(1) See Chapter 5 for an explanation of the PE Pipe Material Designation Code.

Check for Constrained Buckling

(3-15)
$$P_{WC} = \frac{5.65}{N}\sqrt{RB'E'\frac{E}{12(DR-1)^3}}$$

Pwc Allowable buckling pressure

Safety Factor (N)	2	For Plastic Pipe

(3-17)
$$R = 1 - 0.33\frac{H_{GW}}{H}$$

Buoyancy Reduction Factor (R)	1.00	
Depth of Cover (H)	3.00	ft
Height of Ground Water Above Pipe (H_{GW})	0	ft

(3-18)
$$B' = \frac{1}{1 + 4e^{(-0.065H)}}$$

Soil Support Factor (B')	0.23	
Use Long Term E for Buckling (E)	28,000	Per Table B.1.1

P_{WC}= **6,628 psf** **>** **P_E** **=** **5,828** **psf**

Therefore, design is adequate

NewFields

CALCULATION SHEET

Client	Lithium Nevada Corp	Preparer:	MTH	12/19/2019
Project	Thacker Pass Project	Checked:	KDJ	
Title	36" Dia HDPE (DR11) Pipeline	Revision	A	Page 1

HDPE BURIED PIPE LOAD CAPACITY AND COVER DESIGN

Design Methodology Per Design of PE Piping Systems, Plastic Pipe Institute

Determine Vertical Soil Pressure

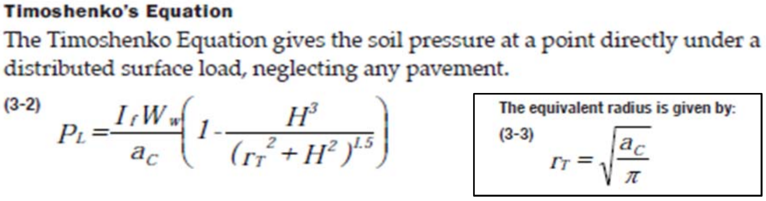
Soil Bury Depth	4.00	Feet
Soil Unit Weight	120.00	pcf
P_E - Vertical Earth Soil Pressure	480.00	psf

Determine Largest Live Load from Truck By Comparing Timoshenko and Boussinesq Eq. Below

Truck		785D	
	Empty Truck Weight	259,257	lbs
	Overall Width	22	ft
	Recommended Maximum Load	150	tons
	Additional Payload Weight (Above Recommened Load)	0	tons
Total Payload Weight		150	tons
	Total Payload Weight	300,000	lbs
	Loaded Front Axle Weight Distribution	33.33%	%
	Loaded Rear Axle Weight Distrution	66.67%	%
	Total Weight (Truck + Payload)	559,257	
	Front Axle Weight	186,419.00	lbs
	Rear Axle Weight	372,838.00	lbs
Tire Size		33.00-51	
	Tire width	36.70	in
	Pressure	116.00	psi
	Load	186419.00	lbs
	Contact Area	11.16	sf

Determine Live Load from Truck

Use Timoshenko's Equation



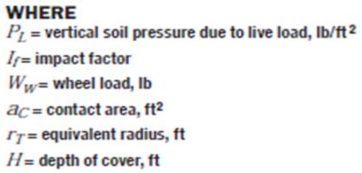
Timoshenko's Equation

The Timoshenko Equation gives the soil pressure at a point directly under a distributed surface load, neglecting any pavement.

(3-2)
$$P_L = \frac{I_f W_w}{a_C}\left(1 - \frac{H^3}{(r_T^{\,2} + H^2)^{1.5}}\right)$$

The equivalent radius is given by:

(3-3)
$$r_T = \sqrt{\frac{a_C}{\pi}}$$



WHERE

P_L = vertical soil pressure due to live load, lb/ft²

I_f = impact factor

W_W = wheel load, lb

a_C = contact area, ft²

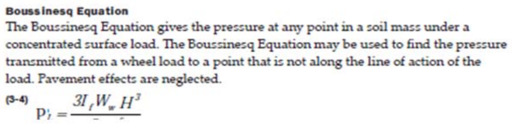
r_T = equivalent radius, ft

H = depth of cover, ft

Impact Factor (If)	Between 2-3 for Haul Truck	3	
Wheel Load (Ww)	793D Haul Truck (half of rear load)	186,419	lbs
Contact Area (Ac)	Tire contact (dual rear tire)	11.16	sf
rT	Equivalent Radius	1.88	
Depth		4.00	ft
P_L - Vertical Live Soil Pressure		13,016	psf
P_T - Total Vertical Soil Pressure		**13,496**	**psf**

Determine Live Load from Truck

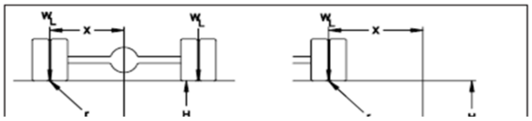
Use Boussinesq's Equation

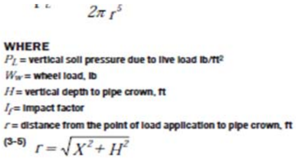


Boussinesq Equation

The Boussinesq Equation gives the pressure at any point in a soil mass under a concentrated surface load. The Boussinesq Equation may be used to find the pressure transmitted from a wheel load to a point that is not along the line of action of the load. Pavement effects are neglected.

(3-4)
$$P_L = \frac{3 I_f W_w H^3}{}$$





$2\pi r^5$

WHERE

P_L = vertical soil pressure due to live load lb/ft²

W_W = wheel load, lb

H = vertical depth to pipe crown, ft

I_f = impact factor

r = distance from the point of load application to pipe crown, ft

(3-5) $r = \sqrt{X^2 + H^2}$

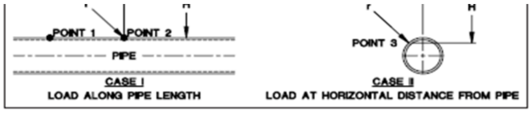


Figure 3-4 Illustration of Boussinesq Point Loading

Loaded weight on center + rear axle			lbs
Wl	Per side	186,419	lbs
	x	94.10	in
	r	9	ft
Per side		323.29	psf
P_L - Vertical Live Soil Pressure		646.58	psf
P_T - Total Vertical Soil Pressure		**1,127**	**psf**

Client	Lithium Nevada Corp	Preparer:	MTH	12/19/2019
Project	Thacker Pass Project	Checked:	KDJ	
Title	36" Dia HDPE (DR11) Pipeline	Revision	A	Page 2

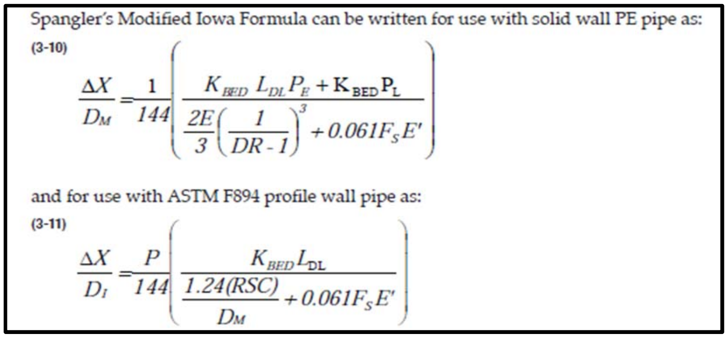
HDPE BURIED PIPE LOAD CAPACITY AND COVER DESIGN

Pipe Selected

Pipe size	36	Inches
Pipe DR	DR11	
Pipe Outside Diameter (D_O)	36	inches
Pipe Inside Diameter (D_I)	29.062	inches

Determine Pipe Deflection Modified Iowa Equation

Use when bury depth is 18"
or at least 1 pipe diameter



Spangler's Modified Iowa Formula can be written for use with solid wall PE pipe as:

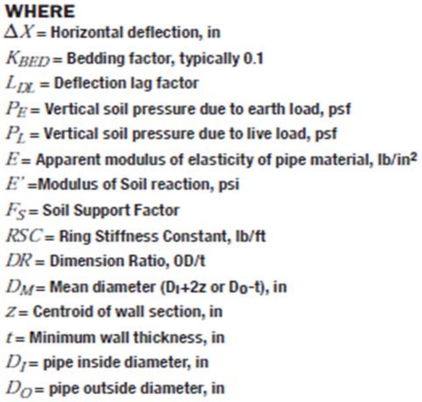
(3-10)

$$\frac{\Delta X}{D_M} = \frac{1}{144}\left(\frac{K_{BED}\,L_{DL}\,P_E + K_{BED}\,P_L}{\frac{2E}{3}\left(\frac{1}{DR-1}\right)^3 + 0.061F_S E'}\right)$$

and for use with ASTM F894 profile wall pipe as:

(3-11)

$$\frac{\Delta X}{D_I} = \frac{P}{144}\left(\frac{K_{BED}L_{DL}}{\frac{1.24(RSC)}{D_M} + 0.061F_S E'}\right)$$



WHERE

ΔX = Horizontal deflection, in
K_{BED} = Bedding factor, typically 0.1
L_{DL} = Deflection lag factor
P_E = Vertical soil pressure due to earth load, psf
P_L = Vertical soil pressure due to live load, psf
E = Apparent modulus of elasticity of pipe material, lb/in²
E' =Modulus of Soil reaction, psi
F_S = Soil Support Factor
RSC = Ring Stiffness Constant, lb/ft
DR = Dimension Ratio, OD/t
D_M = Mean diameter (D_I+2z or D_O-t), in
z = Centroid of wall section, in
t = Minimum wall thickness, in
D_I = pipe inside diameter, in
D_O = pipe outside diameter, in

K_{BED}	0.1		Typical
L_{DL}	1		Deflection Lag Factor
E	28,000	psi	See Table B.1.1 Below for Vehicle Loading
E'	3000	psi	See Table 3-7 below
E'_N	2000	psi	See Table 3-9 below
Bd	108		Trench Width (inches)
Do	36		Pipe Outside Diameter (inches)
DR	11		
Bd/D_O	3		
E'_N/E'	0.666667		
Fs	1		See Table 3-10 below

Use Timoshenko's Equation

$\Delta X/D_I$ = 0.046475 = 4.6% **< 5% Therefore Design is Adequate,**
Tabe 3-11 for Deflection Limit Check

Use Boussinesq's Equation

0.003879 **0%**

Client	Lithium Nevada Corp	Preparer:	MTH	12/19/2019
Project	Thacker Pass Project	Checked:	KDJ	
Title	36" Dia HDPE (DR11) Pipeline	Revision	A	Page 3

HDPE BURIED PIPE LOAD CAPACITY AND COVER DESIGN

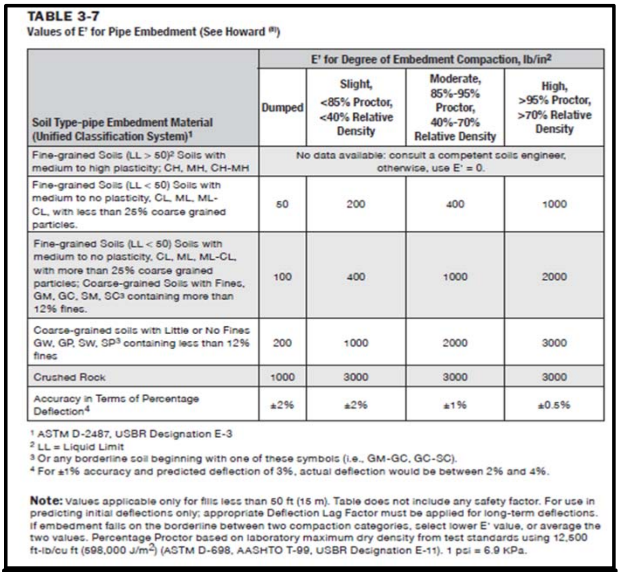


TABLE 3-7
Values of E' for Pipe Embedment (See Howard (8))

Soil Type-pipe Embedment Material (Unified Classification System)[1]	E' for Degree of Embedment Compaction, lb/in^2			
	Dumped	Slight, <85% Proctor, <40% Relative Density	Moderate, 85%-95% Proctor, 40%-70% Relative Density	High, >95% Proctor, >70% Relative Density
Fine-grained Soils (LL > 50)[2] Soils with medium to high plasticity; CH, MH, CH-MH	No data available: consult a competent soils engineer, otherwise, use E' = 0.			
Fine-grained Soils (LL < 50) Soils with medium to no plasticity, CL, ML, ML-CL, with less than 25% coarse grained particles.	50	200	400	1000
Fine-grained Soils (LL < 50) Soils with medium to no plasticity, CL, ML, ML-CL, with more than 25% coarse grained particles; Coarse-grained Soils with Fines, GM, GC, SM, SC[3] containing more than 12% fines.	100	400	1000	2000
Coarse-grained soils with Little or No Fines GW, GP, SW, SP[3] containing less than 12% fines	200	1000	2000	3000
Crushed Rock	1000	3000	3000	3000
Accuracy in Terms of Percentage Deflection[4]	±2%	±2%	±1%	±0.5%

[1] ASTM D-2487, USBR Designation E-3
[2] LL = Liquid Limit
[3] Or any borderline soil beginning with one of these symbols (i.e., GM-GC, GC-SC).
[4] For ±1% accuracy and predicted deflection of 3%, actual deflection would be between 2% and 4%.

Note: Values applicable only for fills less than 50 ft (15 m). Table does not include any safety factor. For use in predicting initial deflections only; appropriate Deflection Lag Factor must be applied for long-term deflections. If embedment falls on the borderline between two compaction categories, select lower E' value, or average the two values. Percentage Proctor based on laboratory maximum dry density from test standards using 12,500 ft-lb/cu ft (598,000 J/m^2) (ASTM D-698, AASHTO T-99, USBR Designation E-11). 1 psi = 6.9 KPa.

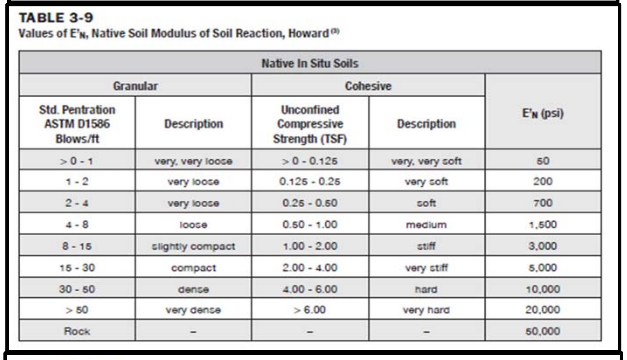


TABLE 3-9
Values of E'_N, Native Soil Modulus of Soil Reaction, Howard (3)

Native In Situ Soils				
Granular		Cohesive		E'_N (psi)
Std. Pentration ASTM D1586 Blows/ft	Description	Unconfined Compressive Strength (TSF)	Description	
> 0 - 1	very, very loose	> 0 - 0.125	very, very soft	50
1 - 2	very loose	0.125 - 0.25	very soft	200
2 - 4	very loose	0.25 - 0.50	soft	700
4 - 8	loose	0.50 - 1.00	medium	1,500
8 - 15	slightly compact	1.00 - 2.00	stiff	3,000
15 - 30	compact	2.00 - 4.00	very stiff	5,000
30 - 50	dense	4.00 - 6.00	hard	10,000
> 50	very dense	> 6.00	very hard	20,000
Rock	–	–	–	50,000

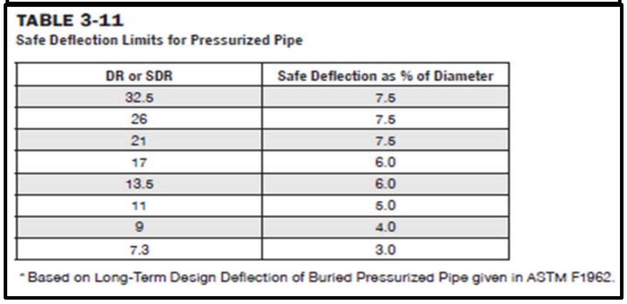


TABLE 3-11
Safe Deflection Limits for Pressurized Pipe

DR or SDR	Safe Deflection as % of Diameter
32.5	7.5
26	7.5
21	7.5
17	6.0
13.5	6.0
11	5.0
9	4.0
7.3	3.0

* Based on Long-Term Design Deflection of Buried Pressurized Pipe given in ASTM F1962.

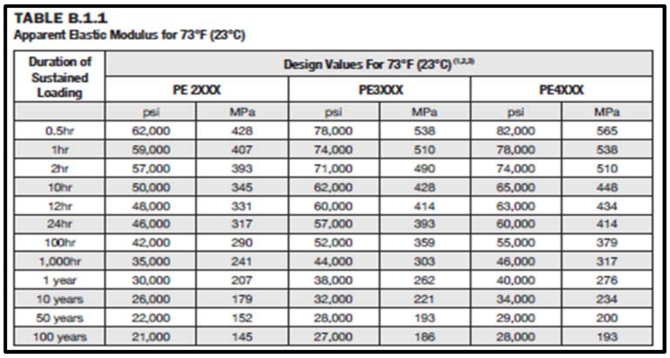


TABLE B.1.1
Apparent Elastic Modulus for 73°F (23°C)

Duration of Sustained Loading	Design Values For 73°F (23°C) (1,2,3)					
	PE 2XXX		PE3XXX		PE4XXX	
	psi	MPa	psi	MPa	psi	MPa
0.5hr	62,000	428	78,000	538	82,000	565
1hr	59,000	407	74,000	510	78,000	538
2hr	57,000	393	71,000	490	74,000	510
10hr	50,000	345	62,000	428	65,000	448
12hr	48,000	331	60,000	414	63,000	434
24hr	46,000	317	57,000	393	60,000	414
100hr	42,000	290	52,000	359	55,000	379
1,000hr	35,000	241	44,000	303	46,000	317
1 year	30,000	207	38,000	262	40,000	276
10 years	26,000	179	32,000	221	34,000	234
50 years	22,000	152	28,000	193	29,000	200
100 years	21,000	145	27,000	186	28,000	193

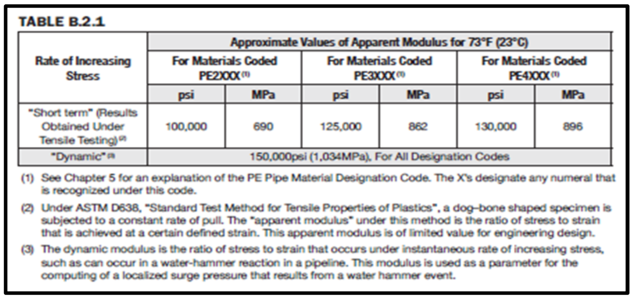


TABLE B.2.1

Rate of Increasing Stress	Approximate Values of Apparent Modulus for 73°F (23°C)					
	For Materials Coded PE2XXX (1)		For Materials Coded PE3XXX (1)		For Materials Coded PE4XXX (1)	
	psi	MPa	psi	MPa	psi	MPa
"Short term" (Results Obtained Under Tensile Testing) (2)	100,000	690	125,000	862	130,000	896
"Dynamic" (3)	150,000psi (1,034MPa), For All Designation Codes					

(1) See Chapter 5 for an explanation of the PE Pipe Material Designation Code. The X's designate any numeral that is recognized under this code.

(2) Under ASTM D638, "Standard Test Method for Tensile Properties of Plastics", a dog–bone shaped specimen is subjected to a constant rate of pull. The "apparent modulus" under this method is the ratio of stress to strain that is achieved at a certain defined strain. This apparent modulus is of limited value for engineering design.

(3) The dynamic modulus is the ratio of stress to strain that occurs under instantaneous rate of increasing stress, such as can occur in a water-hammer reaction in a pipeline. This modulus is used as a parameter for the computing of a localized surge pressure that results from a water hammer event.

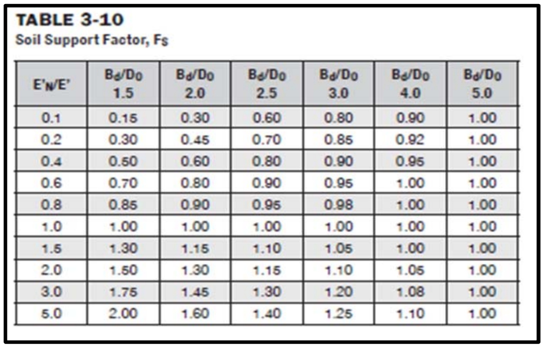


TABLE 3-10
Soil Support Factor, F_S

E'_N/E'	B_d/D_O 1.5	B_d/D_O 2.0	B_d/D_O 2.5	B_d/D_O 3.0	B_d/D_O 4.0	B_d/D_O 5.0
0.1	0.15	0.30	0.60	0.80	0.90	1.00
0.2	0.30	0.45	0.70	0.85	0.92	1.00
0.4	0.50	0.60	0.80	0.90	0.95	1.00
0.6	0.70	0.80	0.90	0.95	1.00	1.00
0.8	0.85	0.90	0.95	0.98	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00
1.5	1.30	1.15	1.10	1.05	1.00	1.00
2.0	1.50	1.30	1.15	1.10	1.05	1.00
3.0	1.75	1.45	1.30	1.20	1.08	1.00
5.0	2.00	1.60	1.40	1.25	1.10	1.00

Client	Lithium Nevada Corp	Preparer:	MTH	
Project	Thacker Pass Project	Checked:	KDJ	
Title	36" Dia HDPE (DR11) Pipeline	Revision	A	Page 4

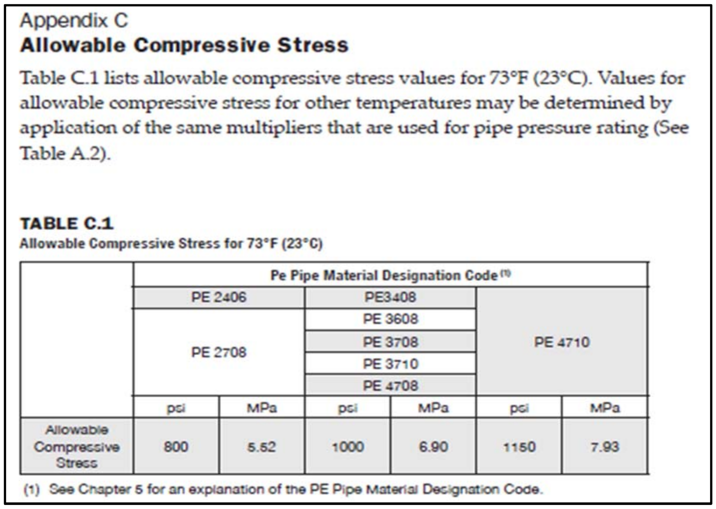
HDPE BURIED PIPE LOAD CAPACITY AND COVER DESIGN

Check Compressive Ring Thrust

(3-13) $$S = \frac{(P_E + P_L)\,DR}{288}$$

S= **515 psi** **<** **1150 psi for PE 4710 HDPE**

Therefore, design is adequate



Appendix C

Allowable Compressive Stress

Table C.1 lists allowable compressive stress values for 73°F (23°C). Values for allowable compressive stress for other temperatures may be determined by application of the same multipliers that are used for pipe pressure rating (See Table A.2).

TABLE C.1

Allowable Compressive Stress for 73°F (23°C)

	Pe Pipe Material Designation Code (1)					
	PE 2406 PE 2708		PE3408 PE 3608 PE 3708 PE 3710 PE 4708		PE 4710	
	psi	MPa	psi	MPa	psi	MPa
Allowable Compressive Stress	800	5.52	1000	6.90	1150	7.93

(1) See Chapter 5 for an explanation of the PE Pipe Material Designation Code.

Check for Constrained Buckling

(3-15) $$P_{WC} = \frac{5.65}{N}\sqrt{RB'E'\frac{E}{12(DR-1)^3}}$$

Pwc Allowable buckling pressure

Safety Factor (N)	2	For Plastic Pipe

(3-17) $$R = 1 - 0.33\frac{H_{GW}}{H}$$

Buoyancy Reduction Factor (R)	1.00	
Depth of Cover (H)	4.00	ft
Height of Ground Water Above Pipe (H_{GW})	0	ft

(3-18) $$B' = \frac{1}{1 + 4e^{(-0.065H)}}$$

Soil Support Factor (B')	0.24	
Use Long Term E for Buckling (E)	28,000	Per Table B.1.1

P_{WC}= 16,841 psf > P_E = 13,496 psf

Therefore, design is adequate

NewFields	CALCULATION SHEET		
Client	Lithium Nevada Corp	Preparer:	RLL	1/31/2020
Project	Thacker Pass Project	Checked:	MH	2/5/2020
Title	36" Dia HDPE (DR17) Pipeline	Revision	A	Page 1

HDPE BURIED PIPE LOAD CAPACITY AND COVER DESIGN

Design Methodology Per Design of PE Piping Systems, Plastic Pipe Institute

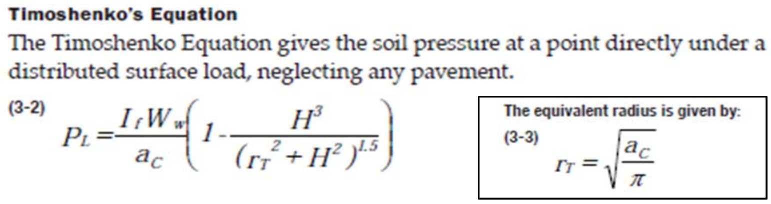
Determine Vertical Soil Pressure

Soil Bury Depth (Top of pipe to top of fill)	5.00	Feet
Soil Unit Weight	120.00	pcf
P_E - Vertical Earth Soil Pressure	600.00	psf

Determine Largest Live Load from Truck By Comparing Timoshenko and Boussinesq Eq. Below

Truck	777	
Empty Truck Weight	124,403	lbs
Overall Width	12	ft
Recommended Maximum Load	85	tons
Additional Payload Weight (Above Recommended Load)	0	tons
Total Payload Weight	85	tons
Total Payload Weight	170,000	lbs
Loaded Front Axle Weight Distribution	33.33%	%
Loaded Rear Axle Weight Distrution	66.67%	%
Total Weight (Truck + Payload)	294,403	
Front Axle Weight	98,134.17	lbs
Rear Axle Weight	196,268.33	lbs
Tire Size	24x49 42pr	
Tire width	26.20	in
Pressure	94.00	psi
Load	98134.17	lbs
Contact Area	7.25	sf

Determine Live Load from Truck — Use Timoshenko's Equation



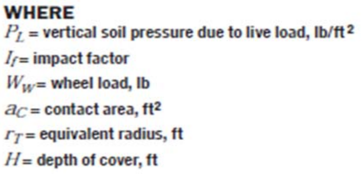
Timoshenko's Equation

The Timoshenko Equation gives the soil pressure at a point directly under a distributed surface load, neglecting any pavement.

(3-2)
$$P_L = \frac{I_f W_w}{a_C}\left(1 - \frac{H^3}{(r_T^2 + H^2)^{1.5}}\right)$$

The equivalent radius is given by:

(3-3)
$$r_T = \sqrt{\frac{a_C}{\pi}}$$



WHERE

P_L = vertical soil pressure due to live load, lb/ft²

I_f = impact factor

W_W = wheel load, lb

a_C = contact area, ft²

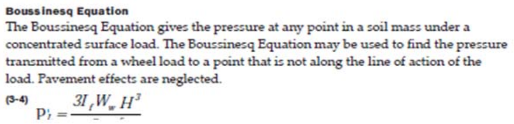
r_T = equivalent radius, ft

H = depth of cover, ft

Impact Factor (If)	Between 2-3 for Haul Truck	3	
Wheel Load (Ww)	793D Haul Truck (half of rear load)	98,134	lbs
Contact Area (Ac)	Tire contact (dual rear tire)	7.25	sf
rT	Equivalent Radius	1.52	
Depth		5.00	ft
P_L - Vertical Live Soil Pressure		5,037	psf

P_T - Total Vertical Soil Pressure 5,637 psf

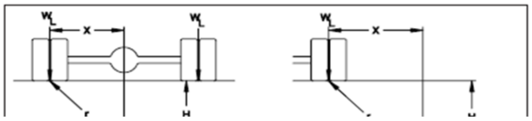
Determine Live Load from Truck — Use Boussinesq's Equation

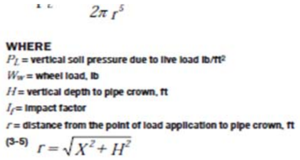


Boussinesq Equation

The Boussinesq Equation gives the pressure at any point in a soil mass under a concentrated surface load. The Boussinesq Equation may be used to find the pressure transmitted from a wheel load to a point that is not along the line of action of the load. Pavement effects are neglected.

(3-4)
$$P_L = \frac{3I_f W_w H^3}{}$$





$2\pi r^5$

WHERE

P_L = vertical soil pressure due to live load lb/ft²

W_W = wheel load, lb

H = vertical depth to pipe crown, ft

I_f = impact factor

r = distance from the point of load application to pipe crown, ft

(3-5) $r = \sqrt{X^2 + H^2}$

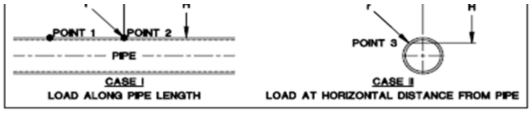


Figure 3-4 Illustration of Boussinesq Point Loading

Loaded weight on center + rear axle			lbs
Wl	Per side	98,134	lbs
	x	42.80	in
	r	6	ft
Per side		2,010.63	psf
P_L - Vertical Live Soil Pressure		4,021.26	psf
P_T - Total Vertical Soil Pressure		**4,621**	**psf**

Client	Lithium Nevada Corp	Preparer:	RLL	12/19/2019
Project	Thacker Pass Project	Checked:	MH	
Title	36" Dia HDPE (DR17) Pipeline	Revision	A	Page 2

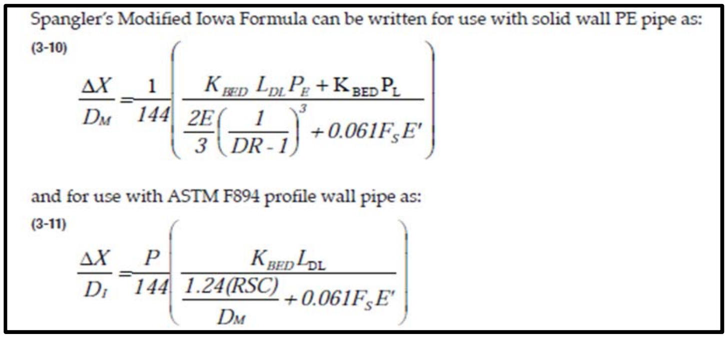
HDPE BURIED PIPE LOAD CAPACITY AND COVER DESIGN

Pipe Selected

Pipe size	36	Inches
Pipe DR	DR17	
Pipe Outside Diameter (D_O)	36	inches
Pipe Inside Diameter (D_I)	31.511	inches

Determine Pipe Deflection Modified Iowa Equation

Use when bury depth is 18"
or at least 1 pipe diameter



Spangler's Modified Iowa Formula can be written for use with solid wall PE pipe as:

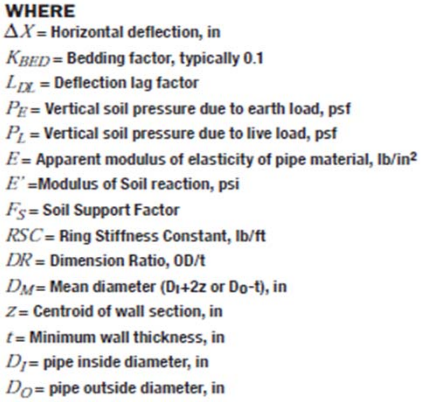
(3-10)

$$\frac{\Delta X}{D_M} = \frac{1}{144}\left(\frac{K_{BED} L_{DL} P_E + K_{BED} P_L}{\frac{2E}{3}\left(\frac{1}{DR-1}\right)^3 + 0.061 F_S E'}\right)$$

and for use with ASTM F894 profile wall pipe as:

(3-11)

$$\frac{\Delta X}{D_I} = \frac{P}{144}\left(\frac{K_{BED} L_{DL}}{\frac{1.24(RSC)}{D_M} + 0.061 F_S E'}\right)$$



WHERE

ΔX = Horizontal deflection, in
K_{BED} = Bedding factor, typically 0.1
L_{DL} = Deflection lag factor
P_E = Vertical soil pressure due to earth load, psf
P_L = Vertical soil pressure due to live load, psf
E = Apparent modulus of elasticity of pipe material, lb/in²
E' =Modulus of Soil reaction, psi
F_S = Soil Support Factor
RSC = Ring Stiffness Constant, lb/ft
DR = Dimension Ratio, OD/t
D_M = Mean diameter (D_I+2z or D_O-t), in
z = Centroid of wall section, in
t = Minimum wall thickness, in
D_I = pipe inside diameter, in
D_O = pipe outside diameter, in

K_{BED}	0.1		Typical
L_{DL}	1		Deflection Lag Factor
E	28,000	psi	See Table B.1.1 Below for Vehicle Loading
E'	2000	psi	See Table 3-7 below
E'_N	3000	psi	See Table 3-9 below
Bd	108		Trench Width (inches)
Do	36		Pipe Outside Diameter (inches)
DR	17		
Bd/D_O	3		
E'_N/E'	1.5		
Fs	1.05		See Table 3-10 below

Use Timoshenko's Equation

$\Delta X/D_I$ = 0.02951 = 3.0% **< 6% Therefore Design is Adequate,**
Tabe 3-11 for Deflection Limit Check

Use Boussinesq's Equation

0.024192 **2%**

Client	Lithium Nevada Corp	Preparer:	RLL	12/19/2019
Project	Thacker Pass Project	Checked:	MH	
Title	36" Dia HDPE (DR17) Pipeline	Revision	A	Page 3

HDPE BURIED PIPE LOAD CAPACITY AND COVER DESIGN

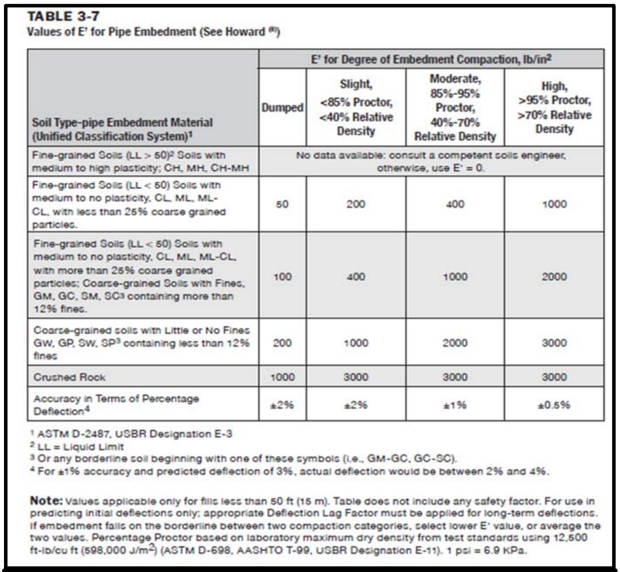


TABLE 3-7
Values of E' for Pipe Embedment (See Howard (8))

Soil Type-pipe Embedment Material (Unified Classification System)[1]	E' for Degree of Embedment Compaction, lb/in^2			
	Dumped	Slight, <85% Proctor, <40% Relative Density	Moderate, 85%-95% Proctor, 40%-70% Relative Density	High, >95% Proctor, >70% Relative Density
Fine-grained Soils (LL > 50)[2] Soils with medium to high plasticity; CH, MH, CH-MH	No data available: consult a competent soils engineer, otherwise, use E' = 0.			
Fine-grained Soils (LL < 50) Soils with medium to no plasticity, CL, ML, ML-CL, with less than 25% coarse grained particles.	50	200	400	1000
Fine-grained Soils (LL < 50) Soils with medium to no plasticity, CL, ML, ML-CL, with more than 25% coarse grained particles; Coarse-grained Soils with Fines, GM, GC, SM, SC[3] containing more than 12% fines.	100	400	1000	2000
Coarse-grained soils with Little or No Fines GW, GP, SW, SP[3] containing less than 12% fines	200	1000	2000	3000
Crushed Rock	1000	3000	3000	3000
Accuracy in Terms of Percentage Deflection[4]	±2%	±2%	±1%	±0.5%

[1] ASTM D-2487, USBR Designation E-3
[2] LL = Liquid Limit
[3] Or any borderline soil beginning with one of these symbols (i.e., GM-GC, GC-SC).
[4] For ±1% accuracy and predicted deflection of 3%, actual deflection would be between 2% and 4%.

Note: Values applicable only for fills less than 50 ft (15 m). Table does not include any safety factor. For use in predicting initial deflections only; appropriate Deflection Lag Factor must be applied for long-term deflections. If embedment falls on the borderline between two compaction categories, select lower E' value, or average the two values. Percentage Proctor based on laboratory maximum dry density from test standards using 12,500 ft-lb/cu ft (598,000 J/m^2) (ASTM D-698, AASHTO T-99, USBR Designation E-11). 1 psi = 6.9 KPa.

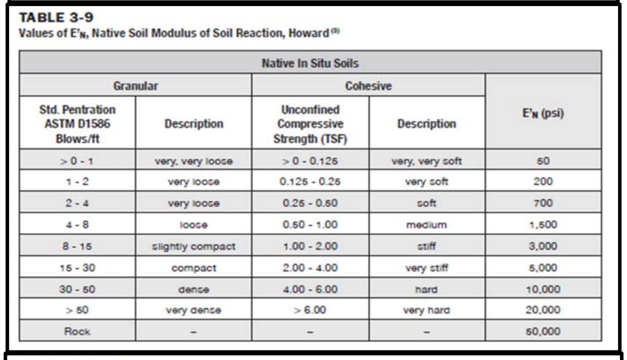


TABLE 3-9
Values of E'_N, Native Soil Modulus of Soil Reaction, Howard (3)

Native In Situ Soils				
Granular		Cohesive		E'_N (psi)
Std. Pentration ASTM D1586 Blows/ft	Description	Unconfined Compressive Strength (TSF)	Description	
> 0 - 1	very, very loose	> 0 - 0.125	very, very soft	50
1 - 2	very loose	0.125 - 0.25	very soft	200
2 - 4	very loose	0.25 - 0.50	soft	700
4 - 8	loose	0.50 - 1.00	medium	1,500
8 - 15	slightly compact	1.00 - 2.00	stiff	3,000
15 - 30	compact	2.00 - 4.00	very stiff	5,000
30 - 50	dense	4.00 - 6.00	hard	10,000
> 50	very dense	> 6.00	very hard	20,000
Rock	–	–	–	50,000

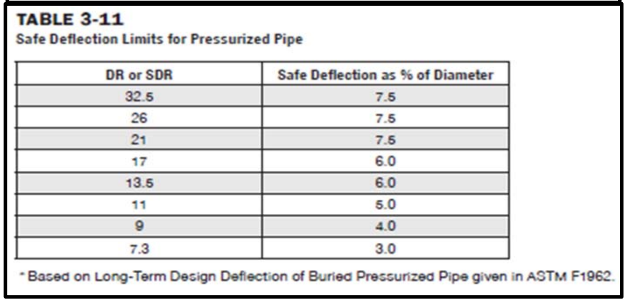


TABLE 3-11
Safe Deflection Limits for Pressurized Pipe

DR or SDR	Safe Deflection as % of Diameter
32.5	7.5
26	7.5
21	7.5
17	6.0
13.5	6.0
11	5.0
9	4.0
7.3	3.0

* Based on Long-Term Design Deflection of Buried Pressurized Pipe given in ASTM F1962.

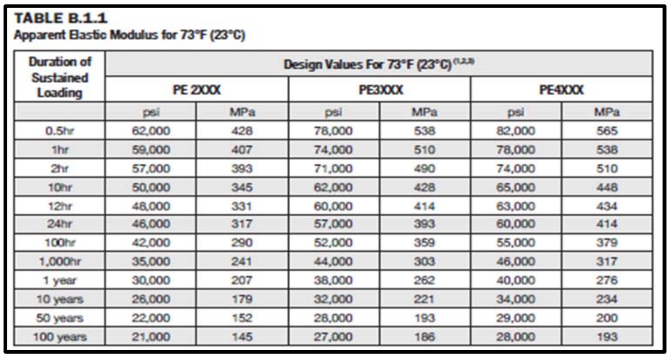


TABLE B.1.1
Apparent Elastic Modulus for 73°F (23°C)

Duration of Sustained Loading	Design Values For 73°F (23°C) (1,2,3)					
	PE 2XXX		PE3XXX		PE4XXX	
	psi	MPa	psi	MPa	psi	MPa
0.5hr	62,000	428	78,000	538	82,000	565
1hr	59,000	407	74,000	510	78,000	538
2hr	57,000	393	71,000	490	74,000	510
10hr	50,000	345	62,000	428	65,000	448
12hr	48,000	331	60,000	414	63,000	434
24hr	46,000	317	57,000	393	60,000	414
100hr	42,000	290	52,000	359	55,000	379
1,000hr	35,000	241	44,000	303	46,000	317
1 year	30,000	207	38,000	262	40,000	276
10 years	26,000	179	32,000	221	34,000	234
50 years	22,000	152	28,000	193	29,000	200
100 years	21,000	145	27,000	186	28,000	193

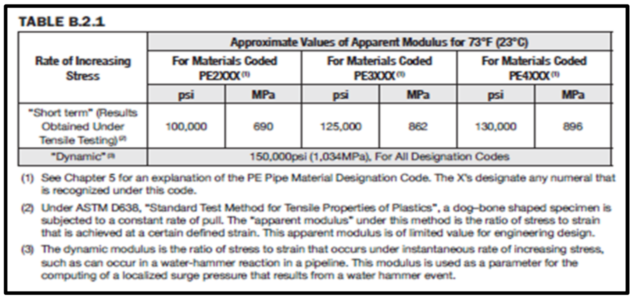


TABLE B.2.1

Rate of Increasing Stress	Approximate Values of Apparent Modulus for 73°F (23°C)					
	For Materials Coded PE2XXX (1)		For Materials Coded PE3XXX (1)		For Materials Coded PE4XXX (1)	
	psi	MPa	psi	MPa	psi	MPa
"Short term" (Results Obtained Under Tensile Testing) (2)	100,000	690	125,000	862	130,000	896
"Dynamic" (3)	150,000psi (1,034MPa), For All Designation Codes					

(1) See Chapter 5 for an explanation of the PE Pipe Material Designation Code. The X's designate any numeral that is recognized under this code.

(2) Under ASTM D638, "Standard Test Method for Tensile Properties of Plastics", a dog–bone shaped specimen is subjected to a constant rate of pull. The "apparent modulus" under this method is the ratio of stress to strain that is achieved at a certain defined strain. This apparent modulus is of limited value for engineering design.

(3) The dynamic modulus is the ratio of stress to strain that occurs under instantaneous rate of increasing stress, such as can occur in a water-hammer reaction in a pipeline. This modulus is used as a parameter for the computing of a localized surge pressure that results from a water hammer event.

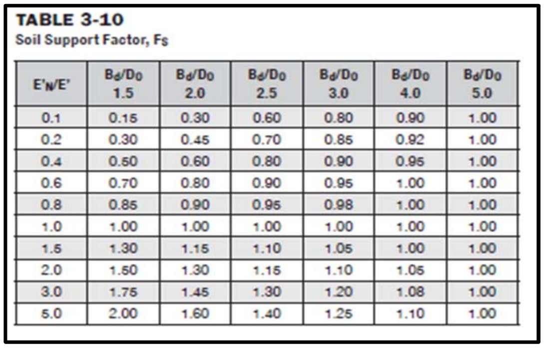


TABLE 3-10
Soil Support Factor, F_S

E'_N/E'	B_d/D_O 1.5	B_d/D_O 2.0	B_d/D_O 2.5	B_d/D_O 3.0	B_d/D_O 4.0	B_d/D_O 5.0
0.1	0.15	0.30	0.60	0.80	0.90	1.00
0.2	0.30	0.45	0.70	0.85	0.92	1.00
0.4	0.50	0.60	0.80	0.90	0.95	1.00
0.6	0.70	0.80	0.90	0.95	1.00	1.00
0.8	0.85	0.90	0.95	0.98	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00
1.5	1.30	1.15	1.10	1.05	1.00	1.00
2.0	1.50	1.30	1.15	1.10	1.05	1.00
3.0	1.75	1.45	1.30	1.20	1.08	1.00
5.0	2.00	1.60	1.40	1.25	1.10	1.00

Client	Lithium Nevada Corp	Preparer:	RLL	
Project	Thacker Pass Project	Checked:	MH	
Title	36" Dia HDPE (DR17) Pipeline	Revision	A	Page 4

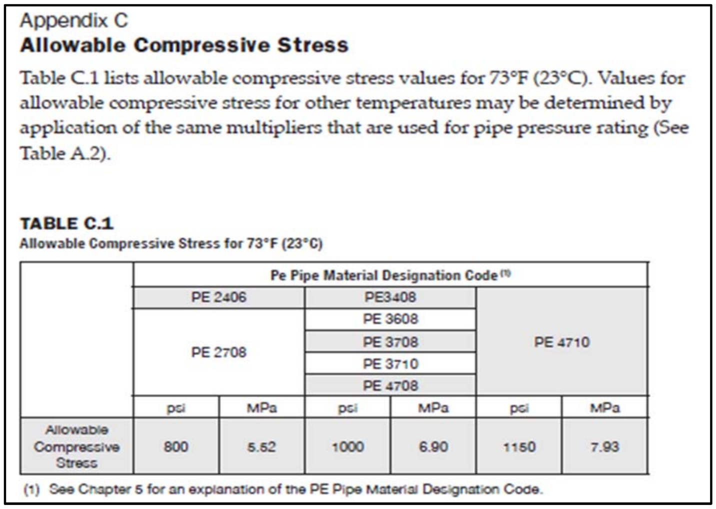
HDPE BURIED PIPE LOAD CAPACITY AND COVER DESIGN

Check Compressive Ring Thrust

(3-13) $$S = \frac{(P_E + P_L)\,DR}{288}$$

S= **333** **psi** **<** **1150 psi for PE 4710 HDPE**

Therefore, design is adequate



Appendix C

Allowable Compressive Stress

Table C.1 lists allowable compressive stress values for 73°F (23°C). Values for allowable compressive stress for other temperatures may be determined by application of the same multipliers that are used for pipe pressure rating (See Table A.2).

TABLE C.1

Allowable Compressive Stress for 73°F (23°C)

	Pe Pipe Material Designation Code[1]					
	PE 2406 PE 2708		PE3408 PE 3608 PE 3708 PE 3710 PE 4708		PE 4710	
	psi	MPa	psi	MPa	psi	MPa
Allowable Compressive Stress	800	5.52	1000	6.90	1150	7.93

(1) See Chapter 5 for an explanation of the PE Pipe Material Designation Code.

Check for Constrained Buckling

Pwc Allowable buckling pressure

(3-15) $$P_{WC} = \frac{5.65}{N}\sqrt{RB'E'\frac{E}{12(DR-1)^3}}$$

(3-17) $$R = 1 - 0.33\frac{H_{GW}}{H}$$

(3-18) $$B' = \frac{1}{1+4e^{(-0.065H)}}$$

Safety Factor (N)	2	For Plastic Pipe
Buoyancy Reduction Factor (R)	1.00	
Depth of Cover (H)	5.00	ft
Height of Ground Water Above Pipe (H_{GW})	0	ft
Soil Support Factor (B')	0.26	
Use Long Term E for Buckling (E)	28,000	Per Table B.1.1

P_{WC}= **6,962** **psf** **>** **P_E** **=** **5,637** **psf**

Therefore, design is adequate

E.3.12 ROCK CHUTE CALCULATIONS

Rock Chute Design Data

(Version 4.01 - 04/23/03, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: *CGS Pond Inlet* **County:** *Thacker Pass, NV*
Designer: *Zach Recine* **Checked by:**
Date: 2/10/2020 **Date:**

Input Channel Geometry

→ ***Inlet Channel***	→ ***Chute***	→ ***Outlet Channel***
Bw = *54.0* ft.	Bw = *100.0* ft.	Bw = *100.0* ft.
Side slopes = *2.5* (m:1)	Factor of safety = *1.20* (F_s)	Side slopes = *2.5* (m:1)
n-value = *0.080*	Side slopes = *2.5* (m:1) → ***2.0:1 max.***	n-value = *0.035*
Bed slope = *0.0200* ft./ft.	Bed slope (2.5:1) = *0.400* ft./ft. → ***2.5:1 max.***	Bed slope = *0.0050* ft./ft.
Freeboard = *1.0* ft.	Outlet apron depth, d = *1.0* ft.	Base flow = *0.0* cfs

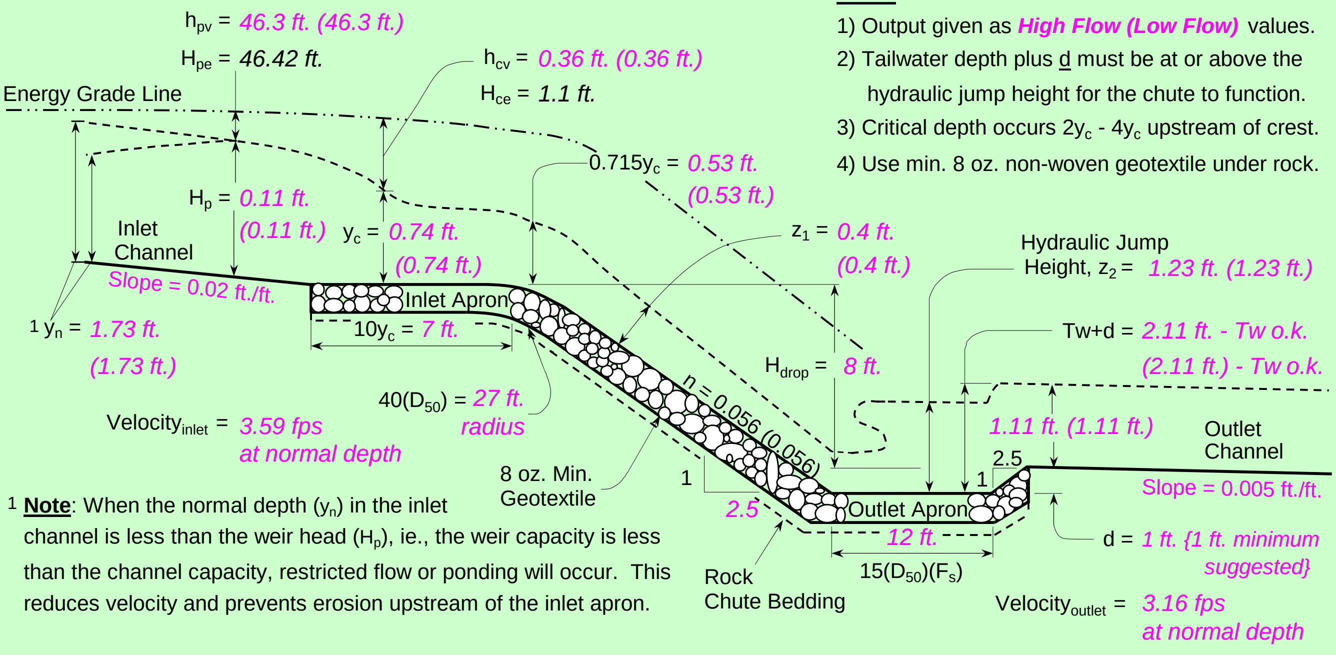
Design Storm Data (Table 2, NHCP, NRCS Grade Stabilization Structure No. 410)

Drainage area = *446.0* acres Rainfall = ● 0 - 3 in. ○ 3 - 5 in. ○ 5+ in.
Apron elev. --- Inlet = *4742.0* ft. --- Outlet = *4733.0* ft. --- *(H_{drop} = 8 ft.)*
Chute capacity = Q10-year *Minimum capacity (based on a 5-year,*
Total capacity = Q25-year *24-hour storm with a 0 - 3 inch rainfall)*
Q_{high} = *361.0* cfs High flow storm through chute → Tw (ft.) = *Program* 0.40
Q_{low} = *361.0* cfs Low flow storm through chute → Tw (ft.) = *Program*

***Note**: The total required capacity is routed through the chute (principal spillway) or in combination with an auxiliary spillway.*
***Input tailwater (Tw)**:*

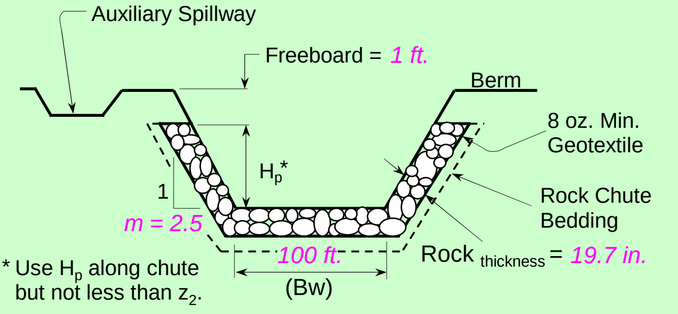
Profile and Cross Section (Output)

Notes:
1) Output given as ***High Flow (Low Flow)*** values.
2) Tailwater depth plus d must be at or above the hydraulic jump height for the chute to function.
3) Critical depth occurs $2y_c$ - $4y_c$ upstream of crest.
4) Use min. 8 oz. non-woven geotextile under rock.



1 **Note**: When the normal depth (y_n) in the inlet channel is less than the weir head (H_p), ie., the weir capacity is less than the channel capacity, restricted flow or ponding will occur. This reduces velocity and prevents erosion upstream of the inlet apron.

Profile Along Centerline of Chute



* Use H_p along chute but not less than z_2.

q_t =	*3.58 cfs/ft.*	Equivalent unit discharge
F_S =	*1.20*	Factor of safety (multiplier)
z_1 =	*0.4 ft.*	Normal depth in chute
n-value =	*0.056*	Manning's roughness coefficient
$D_{50}(F_S)$ =	*9.9 in. (70 lbs. - 50% round / 50% angular)*	
$2(D_{50})(F_S)$ =	*19.7 in.*	Rock chute thickness
Tw + d =	*2.11 ft.*	Tailwater above outlet apron
z_2 =	*1.23 ft.*	Hydraulic jump height
****** The outlet***	***will***	***function adequately***

Typical Cross Section **High Flow Storm Information**

Rock Chute Design Data

(Version 4.01 - 04/23/03, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: CGS Pond West Inlet
Designer: Zach Recine
Date: 2/11/2020

County: Thacker Pass, NV
Checked by:
Date:

Input Channel Geometry

Inlet Channel	Chute	Outlet Channel
Bw = 30.0 ft.	Bw = 30.0 ft.	Bw = 50.0 ft.
Side slopes = 2.5 (m:1)	Factor of safety = 1.20 (F_s)	Side slopes = 2.5 (m:1)
n-value = 0.070	Side slopes = 2.5 (m:1) → **2.0:1 max.**	n-value = 0.035
Bed slope = 0.0200 ft./ft.	Bed slope (2.5:1) = 0.400 ft./ft. → **2.5:1 max.**	Bed slope = 0.0050 ft./ft.
Freeboard = 1.0 ft.	Outlet apron depth, d = 1.0 ft.	Base flow = 0.0 cfs

Design Storm Data (Table 2, NHCP, NRCS Grade Stabilization Structure No. 410)

Drainage area = 446.0 acres Rainfall = ● 0 - 3 in. ○ 3 - 5 in. ○ 5+ in.

Apron elev. --- Inlet = 4746.0 ft. --- Outlet = 4734.0 ft. --- (H_{drop} = 11 ft.)

Chute capacity = Q25-year

Total capacity = Q100-year

Minimum capacity (based on a 5-year, 24-hour storm with a 0 - 3 inch rainfall)

Q_{high} = 18.0 cfs High flow storm through chute → Tw (ft.) = *Program*

Q_{low} = 18.0 cfs Low flow storm through chute → Tw (ft.) = *Program*

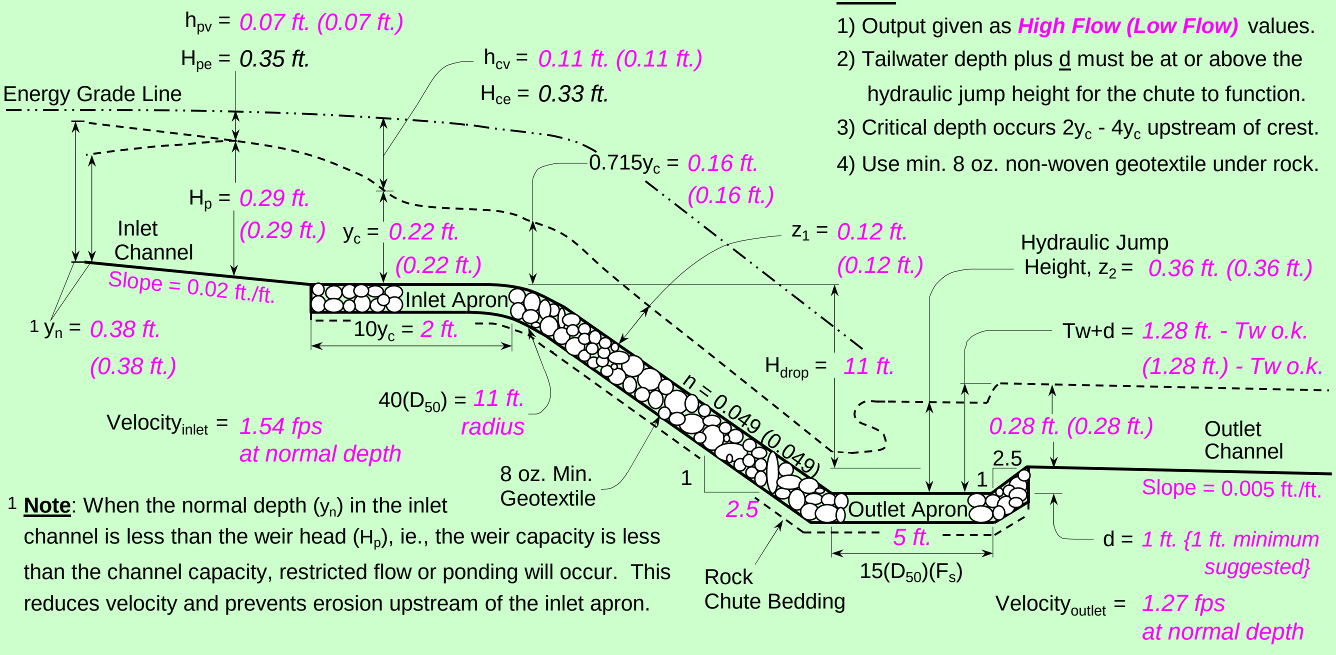
***Note**: The total required capacity is routed through the chute (principal spillway) or in combination with an auxiliary spillway.*

***Input tailwater (Tw)**:*

Profile and Cross Section (Output)

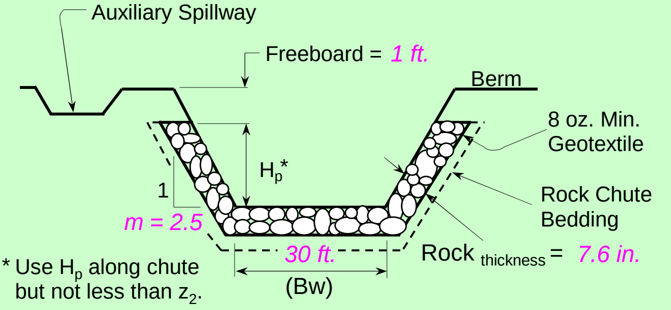
Notes:

1) Output given as ***High Flow (Low Flow)*** values.
2) Tailwater depth plus d must be at or above the hydraulic jump height for the chute to function.
3) Critical depth occurs $2y_c$ - $4y_c$ upstream of crest.
4) Use min. 8 oz. non-woven geotextile under rock.



[1] **Note**: When the normal depth (y_n) in the inlet channel is less than the weir head (H_p), ie., the weir capacity is less than the channel capacity, restricted flow or ponding will occur. This reduces velocity and prevents erosion upstream of the inlet apron.

Profile Along Centerline of Chute



* Use H_p along chute but not less than z_2.

Typical Cross Section

q_t =	0.59 cfs/ft.	Equivalent unit discharge
F_S =	1.20	Factor of safety (multiplier)
z_1 =	0.12 ft.	Normal depth in chute
n-value =	0.049	Manning's roughness coefficient
$D_{50}(F_s)$ =	3.8 in. (4 lbs. - 50% round / 50% angular)	
$2(D_{50})(F_s)$ =	7.6 in.	Rock chute thickness
Tw + d =	1.28 ft.	Tailwater above outlet apron
z_2 =	0.36 ft.	Hydraulic jump height
****** The outlet***	***will***	***function adequately***

High Flow Storm Information

Rock Chute Design Data

(Version 4.01 - 04/23/03, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: *East WRSF East Pond Inlet* **County:** *Thacker Pass, NV*
Designer: *Zach Recine* **Checked by:**
Date: 2/10/2020 **Date:**

Input Channel Geometry

→ ***Inlet Channel***		→ ***Chute***		→ ***Outlet Channel***	
Bw =	*50.0* ft.	Bw =	*50.0* ft.	Bw =	*100.0* ft.
Side slopes =	*2.5* (m:1)	Factor of safety =	*1.20* (F_s)	Side slopes =	*2.5* (m:1)
n-value =	*0.035*	Side slopes =	*2.5* (m:1) → ***2.0:1 max.***	n-value =	*0.035*
Bed slope =	*0.0370* ft./ft.	Bed slope (2.5:1) =	*0.400* ft./ft. → ***2.5:1 max.***	Bed slope =	*0.0050* ft./ft.
Freeboard =	*1.0* ft.	Outlet apron depth, d =	*1.0* ft.	Base flow =	*0.0* cfs

Design Storm Data (Table 2, NHCP, NRCS Grade Stabilization Structure No. 410)

Drainage area = *50.0* acres Rainfall = ● 0 - 3 in. ○ 3 - 5 in. ○ 5+ in.

Apron elev. --- Inlet = *5017.0* ft. --- Outlet = *5002.0* ft. --- (H_{drop} = 14 ft.)

Chute capacity = Q25-year *Minimum capacity (based on a 5-year,*

Total capacity = Q100-year *24-hour storm with a 0 - 3 inch rainfall)*

Q_{high} = *38.2* cfs High flow storm through chute → Tw (ft.) = *Program* 0.40

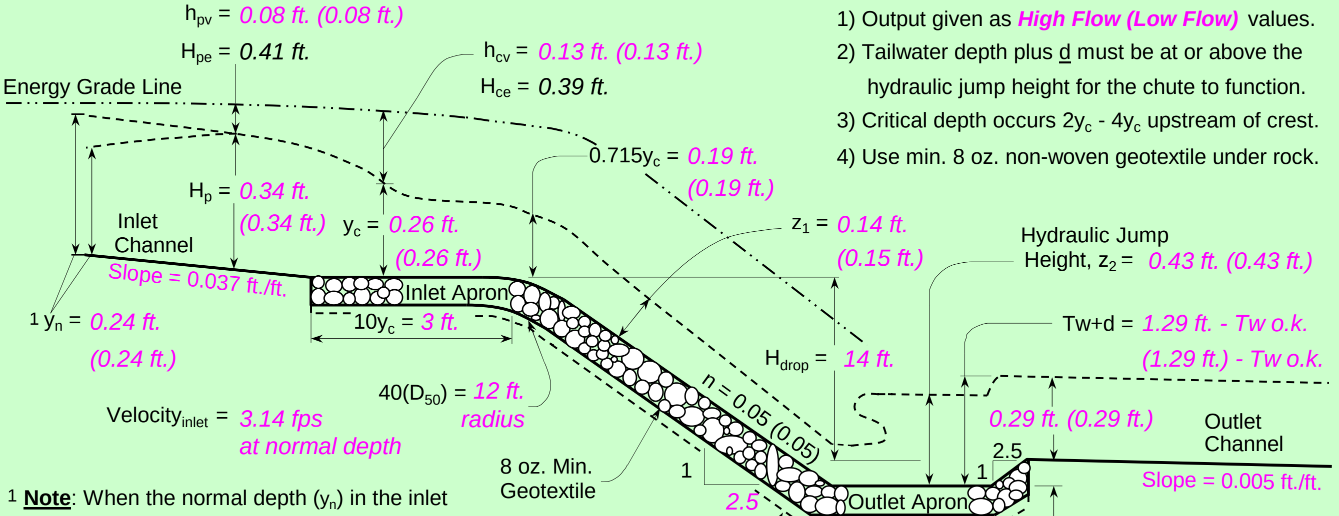
Q_{low} = *38.2* cfs Low flow storm through chute → Tw (ft.) = *Program*

***Note**: The total required capacity is routed through the chute (principal spillway) or in combination with an auxiliary spillway.*

***Input tailwater (Tw)**:*

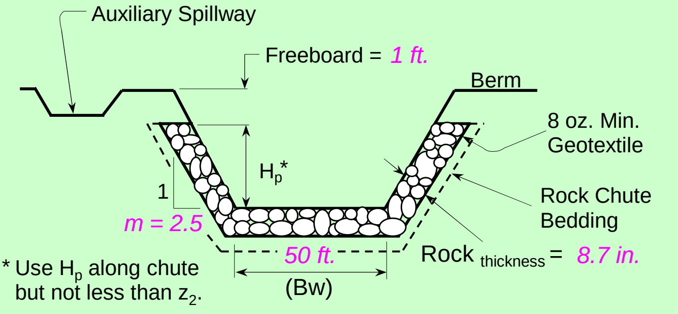
Profile and Cross Section (Output)

Notes:
1) Output given as ***High Flow (Low Flow)*** values.
2) Tailwater depth plus d must be at or above the hydraulic jump height for the chute to function.
3) Critical depth occurs $2y_c$ - $4y_c$ upstream of crest.
4) Use min. 8 oz. non-woven geotextile under rock.



1 **Note**: When the normal depth (y_n) in the inlet channel is less than the weir head (H_p), ie., the weir capacity is less than the channel capacity, restricted flow or ponding will occur. This reduces velocity and prevents erosion upstream of the inlet apron.

Profile Along Centerline of Chute



* Use H_p along chute but not less than z_2.

q_t =	0.76 cfs/ft.	Equivalent unit discharge
F_S =	1.20	Factor of safety (multiplier)
z_1 =	0.14 ft.	Normal depth in chute
n-value =	0.05	Manning's roughness coefficient
$D_{50}(F_s)$ =	4.3 in. (6 lbs. - 50% round / 50% angular)	
$2(D_{50})(F_s)$ =	8.7 in.	Rock chute thickness
Tw + d =	1.29 ft.	Tailwater above outlet apron
z_2 =	0.43 ft.	Hydraulic jump height
****** The outlet***	***will***	***function adequately***

Typical Cross Section

High Flow Storm Information

Rock Chute Design Data

(Version 4.01 - 04/23/03, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: East WRSF South Pond Inlet
County: Thacker Pass, NV
Designer: Zach Recine
Checked by:
Date: 2/10/2020
Date:

Input Channel Geometry

→ Inlet Channel	→ Chute	→ Outlet Channel
Bw = 50.0 ft.	Bw = 50.0 ft.	Bw = 100.0 ft.
Side slopes = 2.5 (m:1)	Factor of safety = 1.20 (F_s)	Side slopes = 2.5 (m:1)
n-value = 0.035	Side slopes = 2.5 (m:1) → **2.0:1 max.**	n-value = 0.035
Bed slope = 0.0050 ft./ft.	Bed slope (2.5:1) = 0.400 ft./ft. → **2.5:1 max.**	Bed slope = 0.0050 ft./ft.
Freeboard = 1.0 ft.	Outlet apron depth, d = 1.0 ft.	Base flow = 0.0 cfs

Design Storm Data (Table 2, NHCP, NRCS Grade Stabilization Structure No. 410)

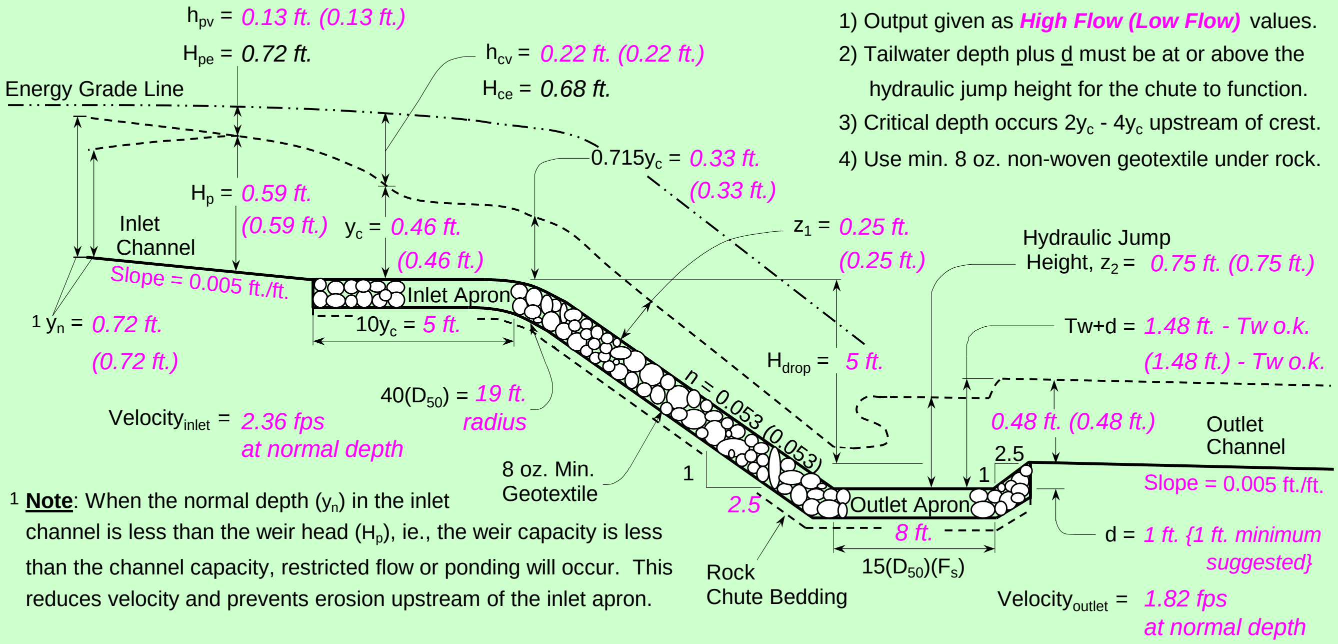
Drainage area = 270.0 acres
Rainfall = ● 0 - 3 in. ○ 3 - 5 in. ○ 5+ in.
Apron elev. --- Inlet = 5008.0 ft. --- Outlet = 5002.0 ft. --- (H_{drop} = 5 ft.)
Chute capacity = Q5-year
Total capacity = Q10-year
Minimum capacity (based on a 5-year, 24-hour storm with a 0 - 3 inch rainfall)
Q_{high} = 88.2 cfs High flow storm through chute → Tw (ft.) = Program 0.40
Q_{low} = 88.2 cfs Low flow storm through chute → Tw (ft.) = Program

***Note**: The total required capacity is routed through the chute (principal spillway) or in combination with an auxiliary spillway.*

***Input tailwater (Tw)**:*

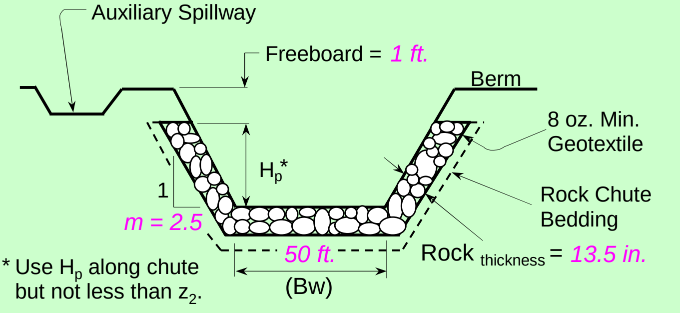
Profile and Cross Section (Output)

Notes:
1) Output given as ***High Flow (Low Flow)*** values.
2) Tailwater depth plus d must be at or above the hydraulic jump height for the chute to function.
3) Critical depth occurs $2y_c$ - $4y_c$ upstream of crest.
4) Use min. 8 oz. non-woven geotextile under rock.



1 **Note**: When the normal depth (y_n) in the inlet channel is less than the weir head (H_p), ie., the weir capacity is less than the channel capacity, restricted flow or ponding will occur. This reduces velocity and prevents erosion upstream of the inlet apron.

Profile Along Centerline of Chute



* Use H_p along chute but not less than z_2.

Typical Cross Section

q_t =	1.74 cfs/ft.	Equivalent unit discharge
F_S =	1.20	Factor of safety (multiplier)
z_1 =	0.25 ft.	Normal depth in chute
n-value =	0.053	Manning's roughness coefficient
$D_{50}(F_s)$ =	6.7 in. (22 lbs. - 50% round / 50% angular)	
$2(D_{50})(F_s)$ =	13.5 in.	Rock chute thickness
Tw + d =	1.48 ft.	Tailwater above outlet apron
z_2 =	0.75 ft.	Hydraulic jump height
****** The outlet***	***will***	***function adequately***

High Flow Storm Information

Rock Chute Design Data

(Version 4.01 - 04/23/03, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project:	West WRSF Pond Inlet	**County:**	Thacker Pass, NV
Designer:	Zach Recine	**Checked by:**	
Date:	2/10/2020	**Date:**	

Input Channel Geometry

Inlet Channel	**Chute**	**Outlet Channel**
Bw = 30.0 ft.	Bw = 30.0 ft.	Bw = 50.0 ft.
Side slopes = 2.5 (m:1)	Factor of safety = 1.20 (F_s)	Side slopes = 2.5 (m:1)
n-value = 0.080	Side slopes = 2.5 (m:1) → **2.0:1 max.**	n-value = 0.035
Bed slope = 0.0700 ft./ft.	Bed slope (2.5:1) = 0.400 ft./ft. → **2.5:1 max.**	Bed slope = 0.0050 ft./ft.
Freeboard = 1.0 ft.	Outlet apron depth, d = 1.0 ft.	Base flow = 0.0 cfs

Design Storm Data (Table 2, NHCP, NRCS Grade Stabilization Structure No. 410)

Drainage area = 150.0 acres Rainfall = ● 0 - 3 in. ○ 3 - 5 in. ○ 5+ in.

Apron elev. --- Inlet = 4720.0 ft. --- Outlet = 4700.0 ft. --- (H_{drop} = 19 ft.)

Chute capacity = Q25-year

Total capacity = Q100-year

Minimum capacity (based on a 5-year, 24-hour storm with a 0 - 3 inch rainfall)

Q_{high} = 136.3 cfs High flow storm through chute → Tw (ft.) = *Program* 0.40

Q_{low} = 136.3 cfs Low flow storm through chute → Tw (ft.) = *Program*

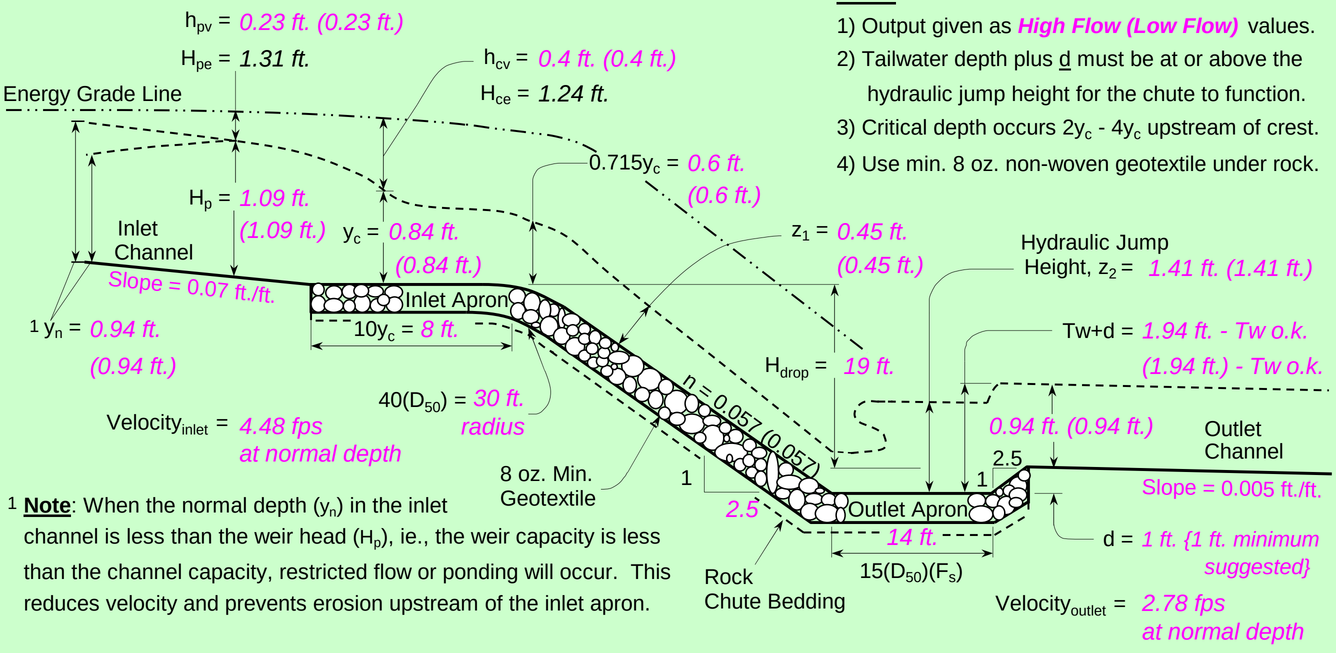
***Note**: The total required capacity is routed through the chute (principal spillway) or in combination with an auxiliary spillway.*

***Input tailwater (Tw)**:*

Profile and Cross Section (Output)

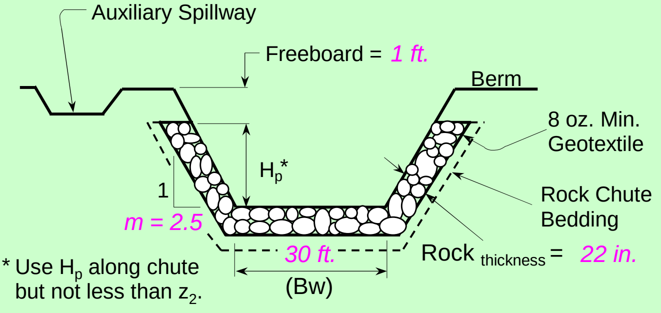
Notes:

1) Output given as ***High Flow (Low Flow)*** values.
2) Tailwater depth plus d must be at or above the hydraulic jump height for the chute to function.
3) Critical depth occurs $2y_c$ - $4y_c$ upstream of crest.
4) Use min. 8 oz. non-woven geotextile under rock.



^{1} **Note**: When the normal depth (y_n) in the inlet channel is less than the weir head (H_p), ie., the weir capacity is less than the channel capacity, restricted flow or ponding will occur. This reduces velocity and prevents erosion upstream of the inlet apron.

Profile Along Centerline of Chute



* Use H_p along chute but not less than z_2.

q_t =	4.38 cfs/ft.	Equivalent unit discharge
F_S =	1.20	Factor of safety (multiplier)
z_1 =	0.45 ft.	Normal depth in chute
n-value =	0.057	Manning's roughness coefficient
$D_{50}(F_s)$ =	11 in. (96 lbs. - 50% round / 50% angular)	
$2(D_{50})(F_s)$ =	22 in.	Rock chute thickness
Tw + d =	1.94 ft.	Tailwater above outlet apron
z_2 =	1.41 ft.	Hydraulic jump height
****** The outlet***	***will***	***function adequately***

Typical Cross Section

High Flow Storm Information

E.3.13 CLIMATE ANALYSIS MEMO

Ecological Resource Consultants, Inc.
35715 US Hwy. 40, Suite D204 ~ Evergreen, CO ~ 80439 ~ (303) 679-4820

Technical Memorandum

Date: **December 10, 2019**

To: **Matt Haley, NewFields**

From: **Troy Thompson**

Re: **Thacker Pass Climate Analysis**

1.0 Introduction

Ecological Resource Consultants Inc. (ERC) has evaluated available climate data for Lithium Nevada Corporation's (LNC's) Thacker Pass Project. This site is located in Humboldt County, Nevada and is located at roughly latitude 41.696° N, longitude 118.0206° W at an elevation of approximately 4600 feet above mean sea level (amsl). The evaluation was conducted to refine precipitation and evaporation values that should be used to define climate-related design criteria for mine planning and design.

2.0 Climatological Stations

Site and regional data were gathered for this analysis. LNC started recording detailed climatological data at the project site in October of 2011. Site data is collected hourly. Regionally precipitation data is available from the Western Regional Climate Center (WRCC) for the McDermitt Station (COOP No. 264935-1), Orovada 3W Station (COOP No. 262818-1) and the Kings River Valley Station (COOP No. 264236-1). Monthly data was available from the regional sites. The location of each station relative to the site is given in **Figure 1**. McDermitt started collecting data in 1892, Orovada 3W started in 1911 and Kings River Valley started in 1956. Each of the three stations has data gaps and the years of data judged by ERC to be sufficient for inclusion are given in **Table 1**. The table also lists pertinent information about each station.

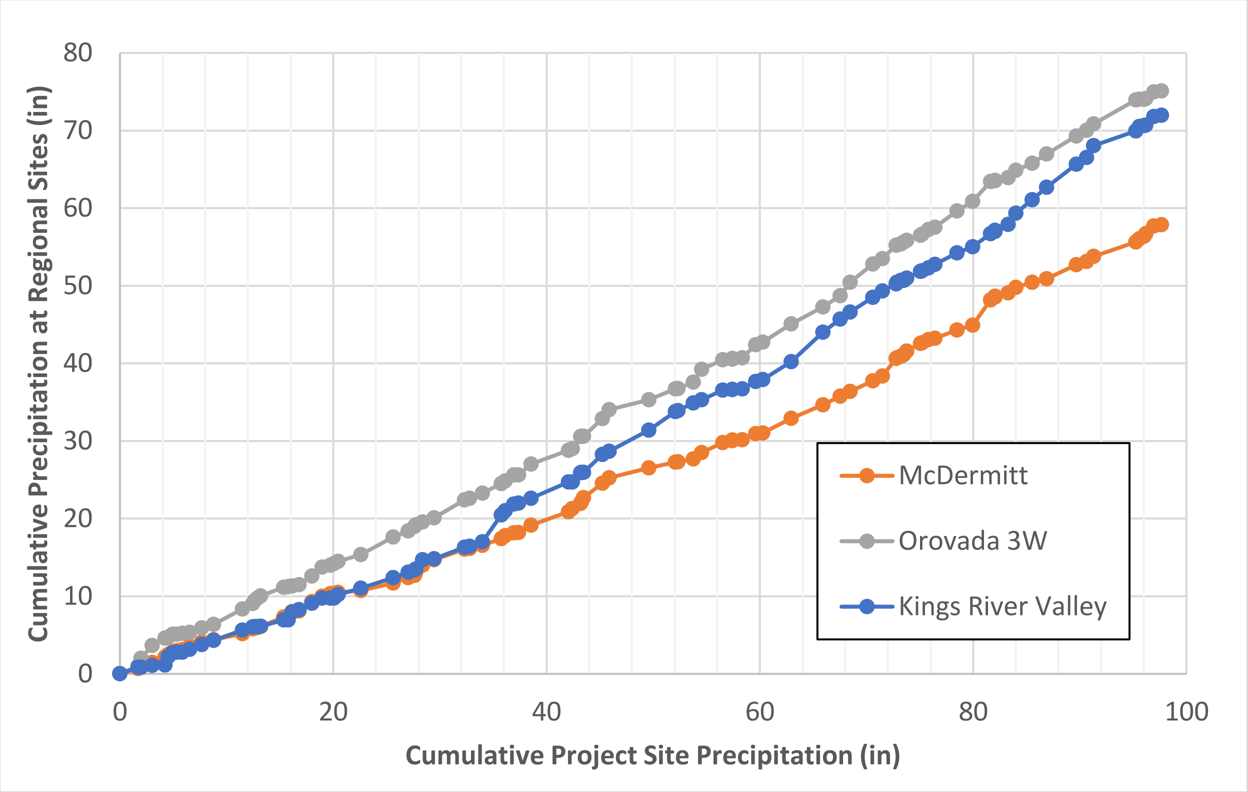
Figure 1. Station Locations (from Google Earth)

Table 1. Meteorological Station Data

Site	Distance from Project & Direction	Elevation (ft)	Years Precipitation Data Available	Mean Annual Precipitation over Record (in)	Mean Annual Precip 2012-2018 (in)	Evaporation Data Available
Site	NA	4,600	2012-2019	12.55	12.22	Yes
McDermitt	25 miles NE	4,500	1980-1996, 1998-2019	8.19	7.20	No
Orovada 3W	14 miles SE	4,300	1912, 1914-1917, 1926-1945, 1947, 1951-1964, 1967-2003, 2006-2019	10.62	9.28	No
Kings River Valley	12 miles NW	4,240	1957, 1959-1961, 1969-1971, 1981, 1983, 1985-2001, 2012-2019	8.88	8.73	No

Data suggests that precipitation at the site is greater than that observed at regional stations. In order to evaluate how data from the different stations correlate to site precipitation, the overlapping periods of record were compared. Data was first evaluated using double mass curves and monthly precipitation data. Double mass curves plot the cumulative precipitation at sites with the idea that sites with good correlation plot along a line with a consistent slope. For our assessment we plotted the cumulative precipitation at each of the three regional sites versus cumulative precipitation at the project site for the period of January 2012 through October 2019. Results are presented in **Figure 2**.

Figure 2. Monthly Precipitation Double Mass Curves Comparing Regional Stations to the Site (1/2012 – 10/2019)

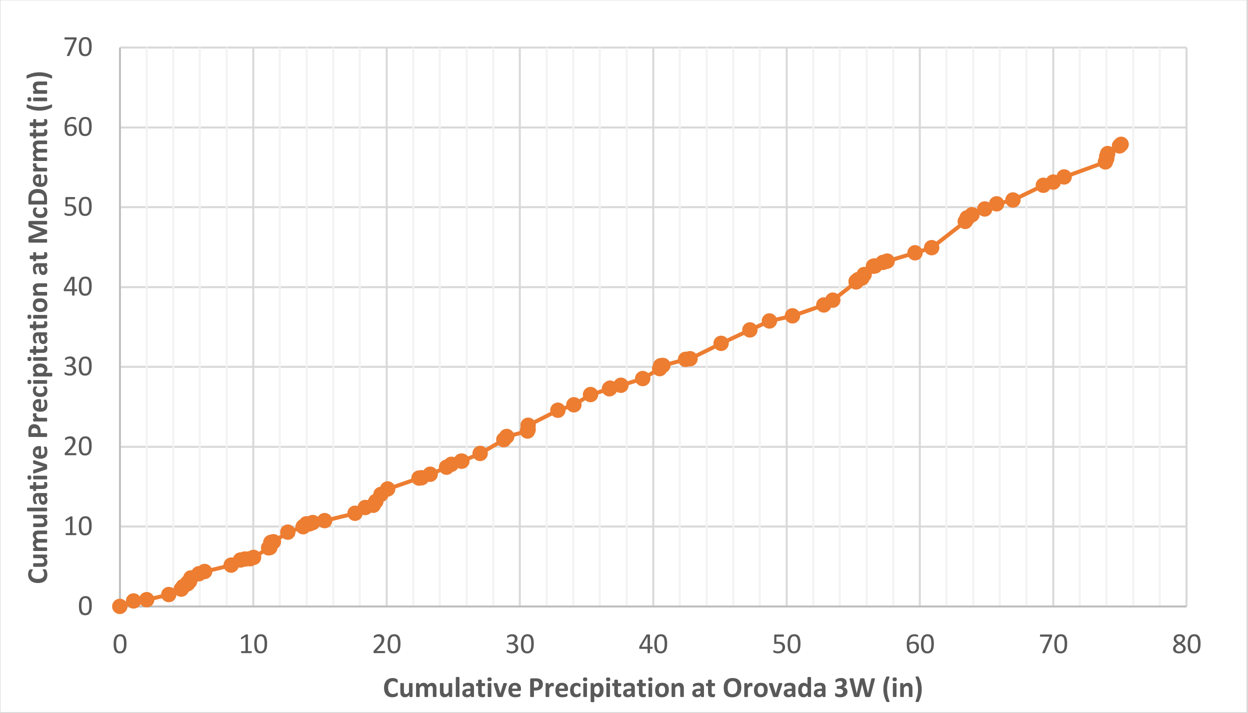


Some observations can be made when considering the double mass curve data

- Until roughly 35 inches on the X axis, which shows project site data, all three lines plotted relatively straight. The cumulative precipitation at the project site reached 35 inches in December of 2014. This suggests that site data from 2012 – 2014 correlated very well with regional data.
- Starting at roughly 35 inches on the X axis the slope of the Kings River Valley line increases. Starting at roughly 42 inches on the X axis the slopes of the McDermitt and the Orovada 3W lines increase. Increases in slopes on this plot indicate a point where the ratio of precipitation at the regional station increases as compared to the project site.
- Data from the McDermitt and Kings River Valley stations are nearly identical from 2012-2014. After this point they diverge suggesting that one or more of these stations does not have consistent data

Given the non-linearity in the graph and the breaks discussed above there is reason to believe that one or more of the data sets could be in question. The similar trends between data from the McDermitt and Orovada 3W in **Figure 2** suggests that there may be consistency between data recorded at these sites. A double mass curve comparing cumulative precipitation at these sites from 2012 through October 2019 was completed with results shown in **Figure 3**.

Figure 3. Monthly Precipitation Double Mass Curves for McDermitt and Orovada 3W Stations (1/2012 – 10/2019)



The consistent slope of the line comparing precipitation at McDermitt and Orovada 3W suggests consistency at both sites with Orovada 3W receiving roughly 24% more precipitation than McDermitt. As these two sites were found to produce consistent data and **Figure 2** shows that data from Kings River Valley are not consistent, Kings River Valley data was dropped from our assessment.

ERC then compared the correlation between monthly site data and monthly data at McDermitt and Orovada 3W in order to evaluate which station's data can be more closely related to site data. **Figure 4** shows the correlation between the site and McDermitt and **Figure 5** presents this data for the site and Orovada 3W.

Figure 4. Correlation of Monthly Precipitation Data for the Site and McDermitt Station (1/2012 – 10/2019)

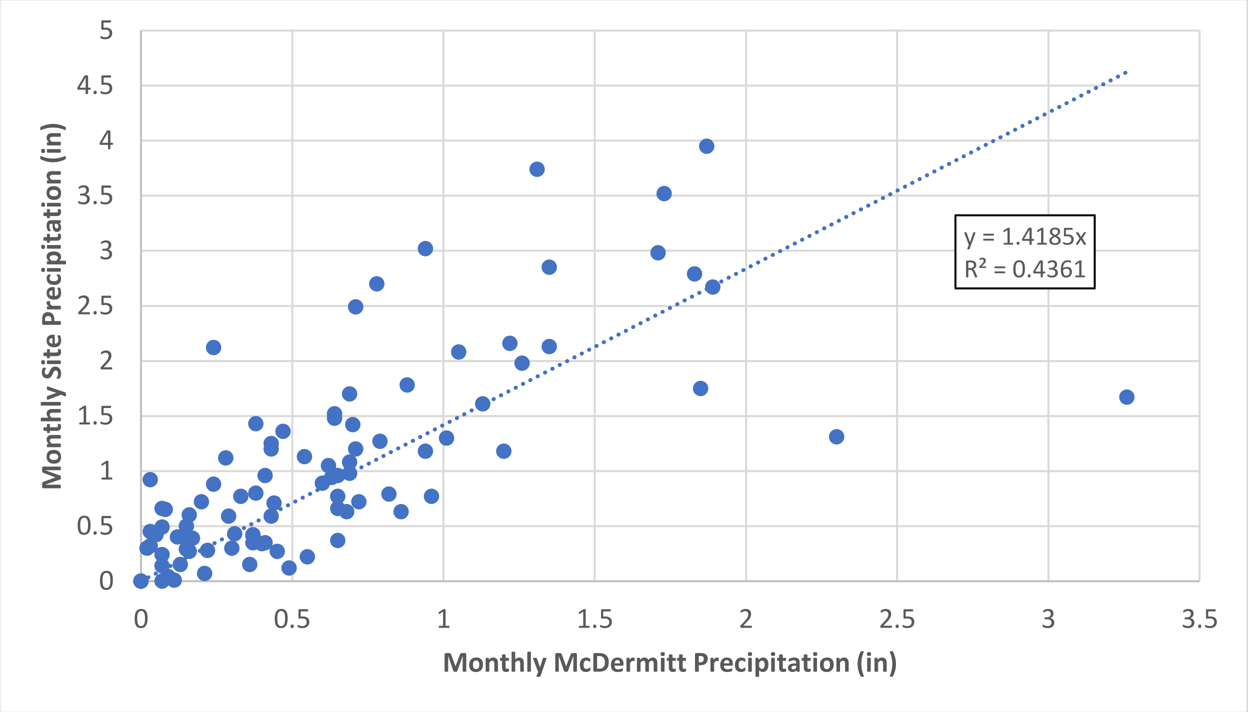
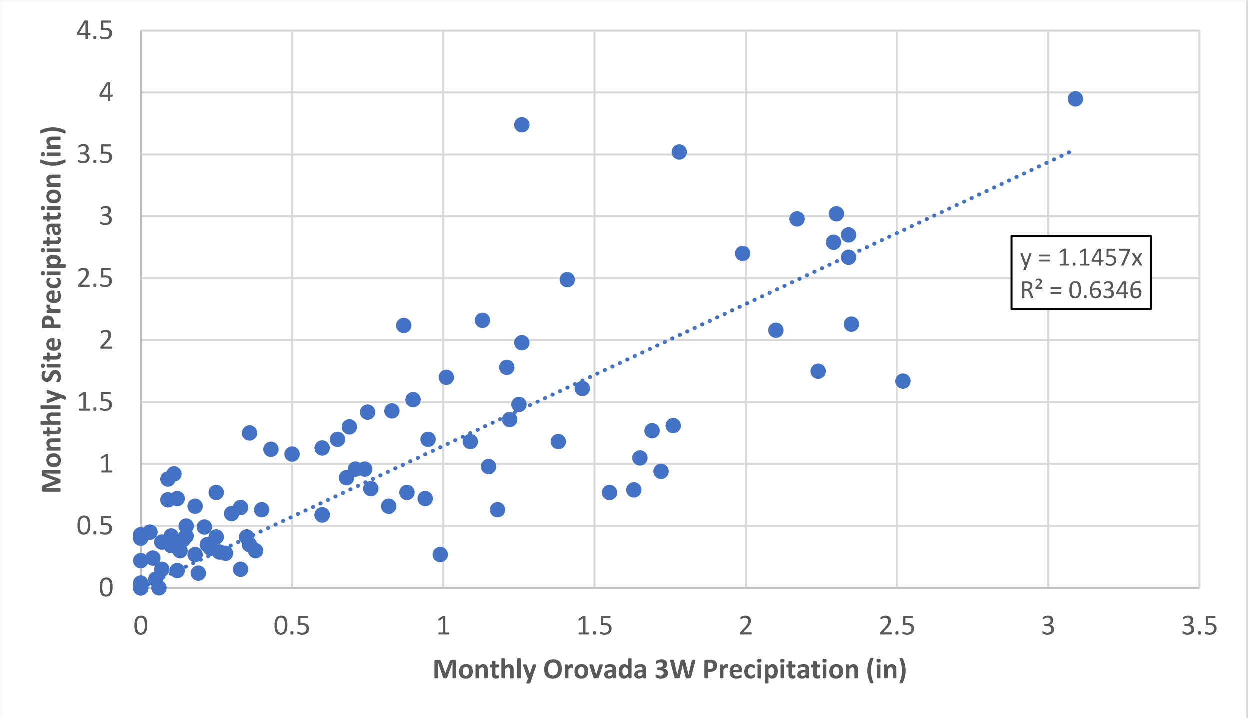


Figure 5. Correlation of Monthly Precipitation Data for the Site and Orovada 3W Station (1/2012 – 10/2019)



Given that site data correlates better with Orovada 3W than McDermitt (correlation coefficients of 0.63 vs. 0.44) and average annual precipitation at the site from 2012-2018 (12.22 inches) is more similar to Orovada 3W (9.28 inches) than McDermitt (7.20 inches), Orovada was carried forward in the analysis.

3.0 Monthly Site Precipitation Estimates

Monthly estimates of site data were then developed for the full period of record where data is available at the Orovada 3W site. For October 2011 – October 2019 monthly site estimates were taken as actual data recorded at the site. For earlier times, monthly site data was estimated by multiplying the calculated site to Orovada 3W correlation coefficient by the monthly value recorded at Orovada 3W for the years of available data presented in **Table 1**. This produced a synthetic a 91-year precipitation data set for the site. This full data set is provided in **Appendix A**. Monthly statistics for the 91 years of data is provided in **Table 2**.

Table 2. Statistics for Estimated Site Monthly Precipitation Based on Synthetic 91-Year Record (in)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	1.27	1.14	1.17	1.47	1.58	1.16	0.32	0.34	0.58	0.99	1.10	1.18	12.29
StdDev	0.77	0.80	0.79	0.94	1.16	1.08	0.37	0.70	0.71	0.89	0.78	0.97	3.39
Min	0.07	0.06	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.80
Max	3.52	3.77	3.02	5.69	6.34	4.69	1.82	4.33	2.97	3.68	3.07	4.64	21.76

The long-term mean annual precipitation at the site is estimated to be 12.29 inches, which is very similar to the average of 12.55 obtained from use of site data alone. The range of annual totals at the site is estimated to be 5.80 to 21.76 with an annual standard deviation of 3.39 inches. It is recommended that this data be used for current design calculations. As additional site data is collected, estimates should be updated.

4.0 Monthly Runoff Coefficients

For storage and water balance calculations, the portion of precipitation that results in runoff is needed. Runoff as a percentage of monthly precipitation was estimated using the National Resource Conservation Service (NRCS) Curve Number method combined with daily precipitation recorded at the site station. For a given curve number, runoff was estimated by determining the potential maximum retention after runoff ($S_{0.20}$) as provided by the NRCS in the TR-55 report, **Equation 1**. The potential maximum retention was then converted to the 5% retention value ($S_{0.05}$), as detailed by Lim, Engel, Muthukirshnan, and Harbor in the *Effects of Initial Abstraction and Urbanization of Estimated Runoff Using CN Technology*, **Equation 2**. Using this value, the depth of runoff could be obtained by **Equation 3**. These estimated runoff percentages represent the average annual amount of runoff out of the total average annual precipitation for a range of selected curve numbers, as provided in **Table 3.** Note that if estimating runoff from a specific storm event, runoff should be calculated for that event as percentages will be higher for a single event than they are for annual averages.

Equation 1

$$S = \frac{1000}{CN} - 10$$

Equation 2

$$S_{0.05} = 1.33 S_{0.20}{}^{1.15}$$

Equation 3

$$Q = \begin{cases} 0 & \text{for } P \leq 0.05S \\ \frac{(P - 0.05S_{0.05})^2}{P + 0.95S_{0.05}} & \text{for } P > 0.05S \end{cases}$$

Where: $S = S_{0.20}$ = Potential maximum retention after runoff

CN = Curve number

$S_{0.05}$ = Converted maximum retention with an assumed 5% storage

P = Precipitation (in)

Q = Runoff depth (in)

This analysis was completed using the 94 months of daily precipitation data from the site. Total daily runoff was compared to total daily precipitation over the full period of record. Runoff as a percentage of precipitation was determined for the full period. Resulting runoff percentages for a range of Curve Numbers from 60 to 95 were calculated and are presented in **Table 3**. The low values in the table are a function of the relatively low daily precipitation accumulations.

Table 3. Estimated Runoff as a Percentage of Annual Precipitation

Curve Number	65	70	75	80	85	90	95	99
Average Annual Runoff Percentage	0.4%	0.9%	1.9%	3.6%	6.9%	13.5%	29.2%	70.6%

5.0 24-Hour Storm Depths and Distribution

Precipitation frequency estimates for the site were obtained from NOAA Atlas 14 Vol 1 based on the site coordinates for a range of 24-hour storm events. The storm depths were developed from NOAA's point precipitation estimator and resulted in the storm depths presented in **Table 4**.

Table 4. NOAA Atlas 14 Vol 1 24-Hour Storm Depths for Project Site

Recurrence Interval (years)	2-year	5-year	10-year	25-year	50-year	100-year	200-year	500-year	1,000-year
Precipitation Depth (in)	1.13	1.41	1.64	1.96	2.21	2.48	2.75	3.12	3.41

The distribution of 24-hour storms were evaluated for use in design. To develop a distribution, ERC utilized the intensity, duration and frequency (IDF) data from the NOAA point precipitation website. Examples of the IDF data for the 100-year, 24-hour storm is given in **Table 5**. General point precipitation frequency data recommended for use at the site for other durations and frequencies are provided in **Appendix B**.

Table 5. NOAA Atlas 14 Vol 1 Precipitation Depths for the 100-year, 24-hour Storm

Duration	5 min	10 min	15 min	30 min	60 min	2 hr	3 hr	6 hr	12 hr	24 hr
Precipitation Depth (in)	0.38	0.58	0.72	0.97	1.20	1.35	1.44	1.53	2.17	2.48

6.0 Evaporation Data

The project site weather station collects the following data on an hourly basis:

- Precipitation
- Temperature at 2 meters
- Temperature at 10 meters
- Wind speed
- Relative humidity
- Atmospheric pressure
- Solar radiation

This extensive climatological data set allowed ERC to estimate site specific evaporation. Evaporation was calculated following the Penman-Monteith procedure using FAO-56 Method (Zotarelli, 2010). Hourly data was compiled to generate daily data with minimum and maximum temperature and relative humidity defined as the high and low values for each day. Pan evaporation at the site was estimated by taking evapotranspiration (ET) rates determined from the Penman-Monteith method using a short-grass reference crop and multiplying values by 1.2 to convert them to pan evaporation. A summary of site evaporation data calculated from site data using the Penman-Monteith method is provided in **Table 6**. Data suggests that the mean annual site pan evaporation is approximately 71 inches.

Table 6. Calculated Monthly Site Pan Evaporation

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2011										4.34	2.10	1.86	
2012	2.10	2.15	4.10	5.87	9.00	11.11	13.14	11.81	8.49	5.22	2.43	1.31	76.75
2013	0.94	1.97	4.46	6.13	8.13	10.91	13.82	11.47	7.38	4.15	2.62	1.27	73.24
2014	2.14	2.37	3.89	5.85	8.85	10.78	12.84	9.70	8.19	4.84	2.15	1.25	72.85
2015	1.57	2.75	4.89	6.15	7.14	11.92	11.01	11.42	7.63	4.73	1.87	1.38	72.48
2016	1.04	2.30	3.50	5.98	5.10	7.95	13.25	12.21	7.81	4.19	2.31	1.07	66.70
2017	0.93	1.90	3.74	4.58	7.70	10.22	13.61	11.65	7.36	4.60	2.41	1.56	70.26
2018	1.81	2.24	3.32	5.43	7.32	10.60	13.40	11.70	8.43	4.30	2.34	1.04	71.92
2019	1.26	1.35	3.05	5.15	6.00	9.40	12.03	11.27	6.55	4.28			
Minimum	0.93	1.35	3.05	4.58	5.10	7.95	11.01	9.70	6.55	4.15	1.87	1.04	66.70
Mean	1.48	2.13	3.87	5.64	7.41	10.36	12.89	11.40	7.73	4.54	2.30	1.27	71.01
Median	1.42	2.20	3.82	5.86	7.51	10.69	13.20	11.56	7.72	4.34	2.32	1.29	71.92
Maximum	2.14	2.75	4.89	6.15	9.00	11.92	13.82	12.21	8.49	5.22	2.62	1.86	76.75

Monthly pan evaporation estimates at the site were then compared with pan evaporation measurements taken from the Rye Patch Dam site for verification. Pan evaporation data is available at Rye Patch for the months of March through November. Comparisons of the data sets are provided in **Table 7**. The table shows that values calculated from site data compare well with data measured at Rye Patch. It is recommended that values calculated from site data be used for further evaluations.

Table 7. Monthly Pan Evaporation Comparison

Month	Calculated from Site Data Using P-M (in)	Rye Patch Station (in)	Difference (in)
January	1.48	NA	NA
February	2.13	NA	NA
March	3.87	NA	NA
April	5.64	NA	NA
May	7.41	8.55	1.14
June	10.36	9.95	-0.41
July	12.89	12.80	-0.09
August	11.40	11.30	-0.10
September	7.73	8.12	0.39
October	4.54	4.90	0.36
November	2.30	NA	NA
December	1.27	NA	NA
Annual	71.01	NA	NA
May - Oct	54.33	55.62	1.29

7.0 Summary and Conclusions

Ecological Resource Consultants Inc. completed an evaluation of precipitation and evaporation for design purposes at the Thacker Pass site. Estimates were derived using approximately eight years of daily site precipitation data supplemented with regional climatological data. Long-term annual average precipitation at the site is predicted to be approximately 12.29 inches, which is only slightly less than the average of 12.22 inches recorded over the short period of record at the site station. The range of annual precipitation at the site over a 91-year period of record that is based on data from the Orovada 3W station is estimated to be 5.80 inches to 21.76 inches.

Short-term (24-hour) storms from the 1-year to the 500-year event were defined for the site using NOAA's point precipitation estimator. The 100-year, 24-hour storm was determined to be 2.48 inches. Annual pan evaporation for the site is estimated to be 71.01 inches based on hourly data collected on site.

References

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Appendix A

Synthetic Monthly Project Site Precipitation

Estimated Site Precipitation Based on Correlation to Orovada 3W

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
1912	0.69	0.86	1.67	1.89	1.6	0.96	0.62	0.44	0.8	1.48	1.04	0.15	12.2
1914	2.68	0.73	0.11	2.03	0.78	4.48	0.46	0	1.32	0.47	0	1.17	14.23
1915	0.68	2.61	1.04	2.9	2.5	0.64	0.65	0	0.49	0	0.62	0.84	12.97
1916	1.32	1.21	0.81	0.78	1.09	0.16	0.32	0.07	0.09	2.72	0.53	0.63	9.73
1917	1.03	0.66	0.45	1.08	3.73	0.5	0.08	0.34	0.38	0	0.54	0.11	8.9
1926	1.52	1.2	0.09	2.31	1.88	0	0.1	0.02	0	0.61	1.98	0.47	10.18
1927	1.03	2.33	1.27	1.44	1.54	1.56	0.02	0.02	0.07	1.68	2.14	0.47	13.57
1928	0.74	0.65	1.89	1.16	0.06	0.45	0.03	0.05	0.13	0.48	1.34	0.93	7.91
1929	1.11	1.44	1.41	1.57	0.16	0.95	0	0	0	0.21	0	0.78	7.63
1930	2.49	0.94	1.01	1.02	2.84	0.92	0.09	0.19	0.58	0.76	1.63	0	12.47
1931	0.84	1.25	0.73	0.21	0.32	1.78	0	0.05	0.21	0.31	0.95	1.84	8.49
1932	1.15	0.6	1.88	0.85	2.91	1.98	0.48	0.01	0.03	0.26	0.42	0.6	11.17
1933	1.4	0.16	0.5	0.8	1.16	0.02	0.08	0.1	0.49	1.82	0.03	0.93	7.49
1934	0.96	3.77	0.86	1.62	0.85	1.6	0.01	0	0.09	1.6	1.72	1.13	14.21
1935	1.28	1.27	1.29	5.69	2.78	0	0.05	0.01	0.01	0.96	0.85	1.81	16
1936	1.97	1.88	0.41	0.8	1.12	1.56	0.65	0.19	0.38	0.01	0	1.17	10.14
1937	0.99	2.25	1.41	1.08	1.83	0.38	0.66	0	0.09	0.53	1.52	1.01	11.75
1938	1.55	2.96	1.82	3.68	2.46	3.41	0.32	0.21	0.44	3.48	1.17	0.26	21.76
1939	1.16	1.27	0.57	0.47	0.97	0.6	0.49	0.06	0.71	2.72	0.41	1.33	10.76
1940	2.73	1.47	1.58	0.94	0	0.36	0.23	0.06	2.97	3.52	1.63	2.11	17.6
1941	1.49	2	1.05	2.91	2.33	2.14	1.34	1.17	0.33	1.66	1.41	1.29	19.12
1942	1.87	1.04	0.38	1.79	3.07	1.49	0.02	0	0.16	0.33	2.27	2.76	15.18
1943	1.84	0.73	0.52	1.19	1.09	1.52	0.03	0	0	0.88	0.14	0.09	8.03
1944	1.54	2.53	0.54	2.33	1.01	4.26	0.4	0	0.52	0.45	3.07	0.84	17.49
1945	1.58	1.79	2.38	0.4	2.86	1.13	0.32	0.02	0.27	1.47	1.64	2.38	16.24
1947	0.09	0.46	0.79	1.51	2.29	1.1	0	0.13	0.03	1.49	1.02	0.6	9.51
1951	1.34	1.81	0.36	1.76	1.49	0.15	0	0.18	0	1.56	0.53	2.34	11.52
1952	2.21	1.43	1.23	0.88	1.32	4.42	0.57	0	2.42	0	0.99	1.07	16.54
1953	1.2	0.73	0.02	0.88	4.43	1.5	0	0.3	0	0.22	0.58	1.04	10.9
1954	0.47	0.58	2.23	0.54	0.1	0.46	0	0.01	0	0	1.02	1.08	6.49
1955	1.28	0.42	0.53	1.4	1.65	0.73	0.18	0	0	0.18	1.07	3.52	10.96
1956	3.52	1.13	0	2.13	3.35	0.33	1.18	0	0.64	2.42	0.02	0.91	15.63
1957	1.26	1.49	2.7	2.13	6.34	0.34	0	0.02	0.34	2.36	2.15	1.6	20.73
1958	1.18	2.51	1.66	2.42	0.44	3.32	0	0.5	0	0.31	0.48	0.48	13.3

Estimated Site Precipitation Based on Correlation to Orovada 3W

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
1959	1.36	1.37	0.53	0.08	1.8	1.05	0	0.39	1.27	0.46	0	0.52	8.83
1960	0.97	1.6	1.62	0.72	1.27	0.08	1.82	0.16	0	0.54	2.8	1.44	13.02
1961	0.29	1	2.96	0.11	0.62	0.7	1	0.44	1.44	0.62	0.65	1.15	10.98
1962	1.25	3	1.74	0.31	1.78	0.52	0	0.16	0.11	0.81	1.47	0.1	11.25
1963	1.23	1.24	0.55	1.57	2.59	2.06	0	0	0.42	1.01	1.66	0.39	12.72
1964	1.65	0.06	0.55	1.67	1.5	3.07	0.37	0.53	0	1.44	1.96	4.28	17.08
1967	2.45	0.19	1.23	2.33	2.33	1.16	0.32	0.17	0.39	0.56	0.84	0.01	11.98
1968	0.66	1.59	0.46	1.19	0.8	0.62	0	2.2	0	0.61	2.77	1.6	12.5
1969	3.06	1.23	0.32	1.76	0	1.32	0.02	0	0	1.75	0.34	1.7	11.5
1970	3.07	0.06	0.13	1.41	1.42	4.69	0.26	0.58	0.02	0.38	2.39	1.62	16.03
1971	0.55	0.32	1.82	1.33	2.59	2.53	0	0	1.74	0.81	1.46	1.7	14.85
1972	0.93	0.7	0.95	0.4	0.11	1.5	0	0	0.63	1.2	2.22	0.79	9.43
1973	2.26	0.72	1.67	2.33	1.11	0.37	0.05	0.46	0.81	0.4	1.82	1.59	13.59
1974	0.82	0.34	1.64	1.88	0	0	0.87	0.36	0	2.2	0.3	1.39	9.8
1975	1.02	1.62	2.62	0.93	0.42	1.66	0.33	1.05	0.25	3.1	0.56	0.32	13.88
1976	0.6	1.64	0.38	1.49	0.34	1.7	1.5	4.33	2.38	0.32	0.24	0.06	14.98
1977	0.53	0.36	0.49	0.14	3.07	2.85	0.79	1.17	0.45	0	1.46	1.11	12.42
1978	1.75	1.32	2.06	3.01	0.69	1.23	0.15	0	2.04	0.01	0.55	0.14	12.95
1979	1.32	1.17	2.31	1.29	0.42	0.73	0.55	1.64	0	1.65	1.05	0.73	12.86
1980	2.2	1.2	0.95	0.52	2.39	0.55	0.18	0.17	0.94	0.49	1.11	0.39	11.09
1981	0.97	0.64	1.49	0.7	2.41	0.22	0.37	0.11	0.26	1.87	2.18	1.63	12.85
1982	0.49	0.44	1.68	0.57	0.24	1.96	0.64	0	1.76	1.13	0.93	0.92	10.76
1983	1.21	1.55	2.54	3.82	1.16	1.72	0.06	0.91	0.94	0.92	1.87	4.64	21.34
1984	0.23	0.6	2.04	1.95	1.27	1.39	0.24	0.68	0.23	2.52	2.73	0.26	14.14
1985	0.24	0.47	0.72	0.45	1.49	0.02	0.69	0.15	1.51	0.8	2.92	0.34	9.8
1986	0.09	3.01	0.63	1.76	1.56	1.16	0.66	0.09	1.73	0.11	0.37	0.17	11.34
1987	1.15	0.52	1.82	1.21	1.6	0.57	0.4	0.74	0	1.15	1.03	1.83	12.02
1988	1.47	0.11	0.11	1.6	0.86	1.2	0	0	0.34	0	2.26	1.15	9.1
1989	0.07	0.27	2.78	1.49	1.56	0.03	0	0.19	1.09	0.76	0.92	0.27	9.43
1990	0.82	0.73	0.87	1.41	1.88	0.1	0.74	0.71	0.19	0.05	0.26	0.81	8.57
1991	0.16	0.17	2.35	2.69	2.82	1.7	0.05	0.09	0.61	1.29	0.53	0.73	13.19
1992	0.11	1.05	0.87	0.3	0.03	1.46	0.25	0	0	0.52	0.34	0.87	5.8
1993	1.25	0.57	1.37	0.52	0.57	1.31	0.69	4.01	0	0.99	0.23	1.15	12.66
1994	0.14	0.42	0	2.52	1.09	1.16	0	0	1.32	0.53	2.64	1.28	11.1

Estimated Site Precipitation Based on Correlation to Orovada 3W

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
1995	2.76	0.24	2.41	2.33	2.91	1.13	0.77	0	0.15	0.05	0.18	1.94	14.87
1996	1.64	1.13	1.4	1.17	1.28	0.89	0.1	0.18	0.47	0.86	0.74	2.03	11.89
1997	1.97	0.36	0.45	1.59	0.47	1.52	0.57	0.09	0.17	0.4	0.84	1.04	9.47
1998	1.63	2.22	2.76	2.9	3.84	1.16	0.32	0	2.8	1.9	1.11	0.11	20.75
1999	1.8	1.16	0.42	0.56	0.86	0.87	0	0.19	0.72	0.44	0.55	0.13	7.7
2000	1.91	2.68	1.34	1.9	0.93	0.07	0	0.38	0.97	2.38	0.15	0.86	13.57
2001	0.92	0.99	0.5	1.32	0.26	0.13	0.86	0	0.41	0.06	2.02	1.56	9.03
2002	1.26	0.81	0.5	0.82	1.15	0.54	0.16	0.03	0.68	0.19	1.27	0.57	7.98
2003	0.94	0.49	0.63	1.66	2.62	0	0.29	0.79	0.38	0	1.68	2.43	11.91
2006	1.31	0.97	0.86	3.47	1.67	0.63	0	0	0.06	0.17	1.13	0.82	11.09
2007	0.09	1.79	0.21	1.02	0.19	0.73	0	0	1.04	2.07	0.55	0.95	8.64
2008	0.91	0.89	0.52	0.27	1.68	0.34	0.05	0.11	0.16	0.54	1.16	1.37	8
2009	1.73	0.55	0.73	1.48	1.02	3.98	0.33	0.47	0.18	0.77	0.31	1.24	12.79
2010	1.47	0.6	1.46	2.28	2.19	0.88	0.62	0.18	0.36	3.68	0.95	3.68	18.35
2011	0.25	0.74	2.35	1.7	1.72	1.16	0.27	0.02	0.02	1.16	0.61	0.04	10.04
2012	1.7	0.27	1.05	1.2	0.3	0.41	0.4	0.5	0.71	1.13	1.12	2.7	11.49
2013	0.96	0.15	0.3	0.29	2.16	0.42	0.37	0.66	1.18	0.98	0.77	0.32	8.56
2014	0.41	2.12	3.02	1.42	0.59	0.12	0.63	1.08	2.85	0.49	1.2	1.78	15.71
2015	0.35	0.8	0.45	1.18	3.52	0.35	0.77	0.07	0.22	1.75	0.63	3.74	13.83
2016	2.49	0.24	1.43	0.79	1.98	0.88	0.01	0	0.92	1.27	0.65	2.67	13.33
2017	2.98	1.61	0.94	2.13	0.89	1.31	0.04	0.39	0.28	0.27	1.3	0.14	12.28
2018	0.59	0.6	2.08	1.48	1.67	0.42	0	0	0	1.25	0.72	1.52	10.33
2019	1.36	2.79	0.96	0.66	3.95	0.34	0.43	0.15	0.77	0.72			
Period of Record Statistics													
MEAN	1.27	1.14	1.17	1.47	1.58	1.16	0.32	0.34	0.58	0.99	1.10	1.18	12.29
S.D.	0.77	0.80	0.79	0.94	1.16	1.08	0.37	0.70	0.71	0.89	0.78	0.97	3.39
SKEW	0.65	0.99	0.56	1.35	1.09	1.59	1.54	4.13	1.74	1.14	0.67	1.41	0.74
MAX	3.52	3.77	3.02	5.69	6.34	4.69	1.82	4.33	2.97	3.68	3.07	4.64	21.76
MIN	0.07	0.06	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.80
YRS	91	91	91	91	91	91	91	91	91	91	90	90	90

Appendix B

Point Precipitation Frequency Data for Project Site

NOAA Atlas 14, Volume 1, Version 5
Location name: Orovada, Nevada, USA*
Latitude: 41.696°, Longitude: -118.0206°
Elevation: 4622.8 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.092 (0.081-0.108)	0.117 (0.102-0.138)	0.161 (0.139-0.188)	0.200 (0.171-0.233)	0.260 (0.218-0.306)	0.316 (0.258-0.376)	0.381 (0.302-0.459)	0.456 (0.350-0.557)	0.578 (0.421-0.723)	0.690 (0.483-0.882)
10-min	0.139 (0.123-0.164)	0.179 (0.156-0.210)	0.245 (0.212-0.287)	0.304 (0.260-0.356)	0.396 (0.332-0.466)	0.481 (0.393-0.572)	0.581 (0.461-0.699)	0.695 (0.534-0.848)	0.879 (0.641-1.10)	1.05 (0.736-1.34)
15-min	0.173 (0.153-0.204)	0.222 (0.193-0.261)	0.304 (0.263-0.355)	0.377 (0.323-0.441)	0.491 (0.411-0.578)	0.596 (0.487-0.709)	0.720 (0.571-0.867)	0.861 (0.662-1.05)	1.09 (0.795-1.36)	1.30 (0.912-1.67)
30-min	0.233 (0.206-0.274)	0.298 (0.260-0.351)	0.409 (0.354-0.479)	0.508 (0.435-0.594)	0.661 (0.554-0.778)	0.803 (0.656-0.955)	0.970 (0.769-1.17)	1.16 (0.891-1.42)	1.47 (1.07-1.84)	1.75 (1.23-2.24)
60-min	0.289 (0.255-0.339)	0.369 (0.322-0.434)	0.507 (0.438-0.593)	0.629 (0.538-0.735)	0.819 (0.686-0.963)	0.994 (0.812-1.18)	1.20 (0.952-1.45)	1.44 (1.10-1.75)	1.82 (1.33-2.27)	2.17 (1.52-2.78)
2-hr	0.377 (0.337-0.428)	0.475 (0.426-0.540)	0.628 (0.560-0.711)	0.760 (0.672-0.859)	0.964 (0.837-1.10)	1.14 (0.969-1.31)	1.35 (1.12-1.56)	1.59 (1.29-1.87)	1.98 (1.54-2.38)	2.33 (1.75-2.87)
3-hr	0.448 (0.406-0.501)	0.560 (0.506-0.625)	0.722 (0.651-0.807)	0.860 (0.770-0.962)	1.07 (0.939-1.20)	1.24 (1.07-1.40)	1.44 (1.23-1.65)	1.69 (1.40-1.95)	2.07 (1.66-2.44)	2.41 (1.88-2.90)
6-hr	0.599 (0.545-0.664)	0.748 (0.678-0.833)	0.945 (0.857-1.05)	1.11 (0.999-1.23)	1.34 (1.19-1.50)	1.53 (1.35-1.72)	1.73 (1.50-1.97)	1.97 (1.68-2.26)	2.35 (1.95-2.75)	2.69 (2.18-3.20)
12-hr	0.760 (0.689-0.843)	0.956 (0.868-1.06)	1.21 (1.09-1.34)	1.42 (1.28-1.57)	1.70 (1.52-1.89)	1.93 (1.70-2.16)	2.17 (1.89-2.44)	2.42 (2.07-2.75)	2.77 (2.32-3.21)	3.09 (2.54-3.63)
24-hr	0.903 (0.815-1.01)	1.13 (1.02-1.26)	1.41 (1.28-1.57)	1.64 (1.48-1.83)	1.96 (1.76-2.18)	2.21 (1.98-2.46)	2.48 (2.20-2.75)	2.75 (2.42-3.06)	3.12 (2.72-3.48)	3.41 (2.95-3.82)
2-day	1.10 (0.989-1.22)	1.37 (1.23-1.52)	1.69 (1.53-1.88)	1.96 (1.76-2.17)	2.32 (2.08-2.57)	2.59 (2.31-2.87)	2.88 (2.56-3.18)	3.17 (2.80-3.51)	3.56 (3.11-3.95)	3.87 (3.35-4.31)
3-day	1.21 (1.09-1.35)	1.51 (1.36-1.69)	1.87 (1.69-2.08)	2.15 (1.94-2.40)	2.54 (2.28-2.82)	2.84 (2.54-3.15)	3.15 (2.80-3.49)	3.46 (3.06-3.85)	3.88 (3.39-4.32)	4.20 (3.64-4.69)
4-day	1.33 (1.20-1.49)	1.65 (1.49-1.85)	2.04 (1.84-2.28)	2.35 (2.12-2.63)	2.77 (2.48-3.08)	3.09 (2.76-3.44)	3.41 (3.04-3.80)	3.75 (3.32-4.18)	4.19 (3.67-4.68)	4.53 (3.94-5.08)
7-day	1.59 (1.43-1.77)	1.98 (1.79-2.21)	2.45 (2.21-2.73)	2.81 (2.53-3.13)	3.30 (2.95-3.66)	3.66 (3.27-4.07)	4.04 (3.59-4.49)	4.41 (3.89-4.92)	4.90 (4.29-5.49)	5.28 (4.59-5.93)
10-day	1.81 (1.62-2.01)	2.25 (2.03-2.50)	2.78 (2.50-3.09)	3.20 (2.86-3.55)	3.75 (3.35-4.16)	4.16 (3.71-4.62)	4.58 (4.06-5.09)	5.00 (4.41-5.57)	5.56 (4.86-6.21)	5.98 (5.19-6.70)
20-day	2.33 (2.11-2.57)	2.91 (2.65-3.22)	3.61 (3.27-3.98)	4.14 (3.74-4.56)	4.84 (4.37-5.33)	5.36 (4.82-5.91)	5.88 (5.26-6.49)	6.39 (5.70-7.07)	7.07 (6.25-7.84)	7.57 (6.65-8.43)
30-day	2.83 (2.56-3.13)	3.54 (3.20-3.91)	4.39 (3.97-4.85)	5.05 (4.56-5.58)	5.93 (5.34-6.56)	6.60 (5.92-7.29)	7.28 (6.49-8.05)	7.96 (7.06-8.82)	8.85 (7.79-9.86)	9.53 (8.33-10.7)
45-day	3.50 (3.16-3.87)	4.38 (3.96-4.84)	5.42 (4.91-5.99)	6.23 (5.62-6.88)	7.29 (6.55-8.05)	8.09 (7.25-8.94)	8.89 (7.93-9.84)	9.69 (8.60-10.8)	10.8 (9.45-12.0)	11.6 (10.1-12.9)
60-day	4.05 (3.66-4.50)	5.08 (4.59-5.64)	6.31 (5.70-7.00)	7.24 (6.54-8.03)	8.46 (7.61-9.38)	9.36 (8.40-10.4)	10.3 (9.17-11.4)	11.2 (9.92-12.4)	12.4 (10.9-13.8)	13.2 (11.6-14.8)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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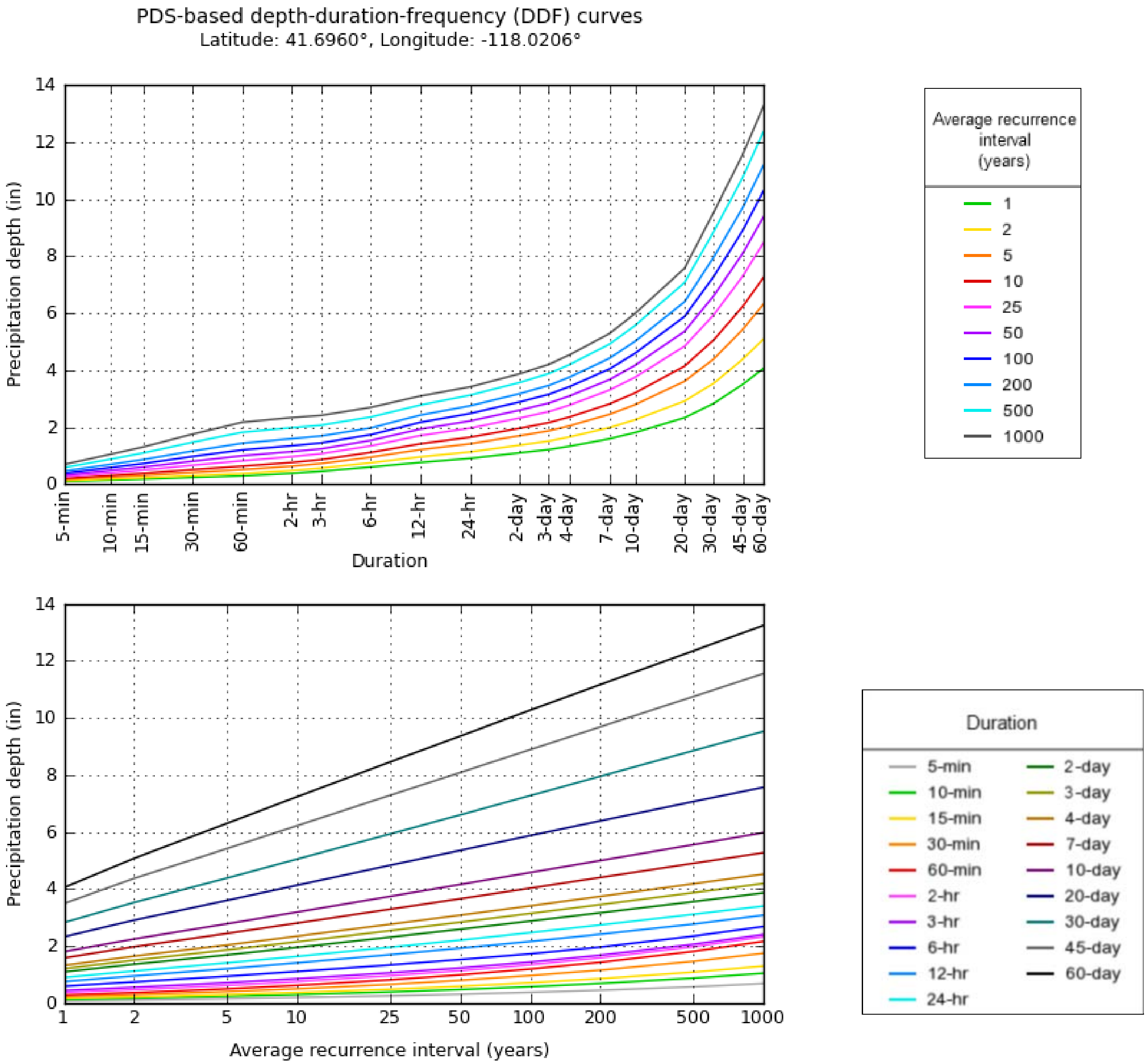
PF graphical



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Created (GMT): Wed Dec 12 21:21:26 2018

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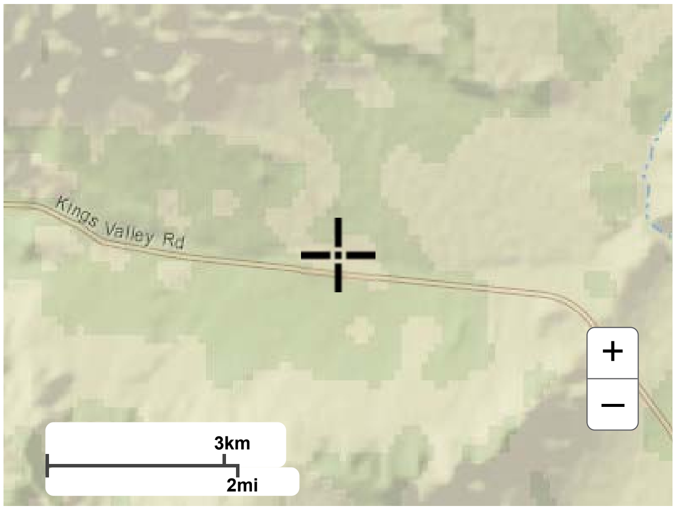
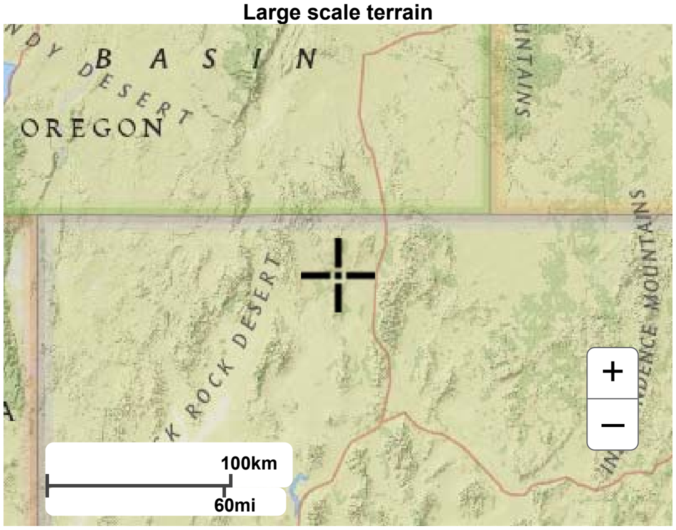
Maps & aerials

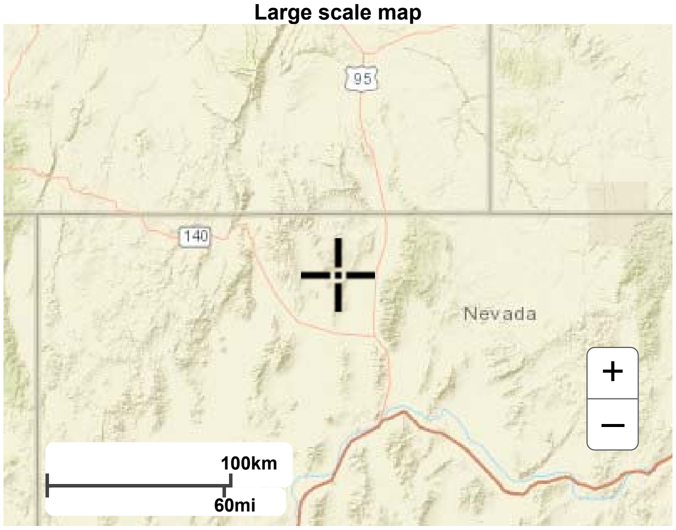
Small scale terrain



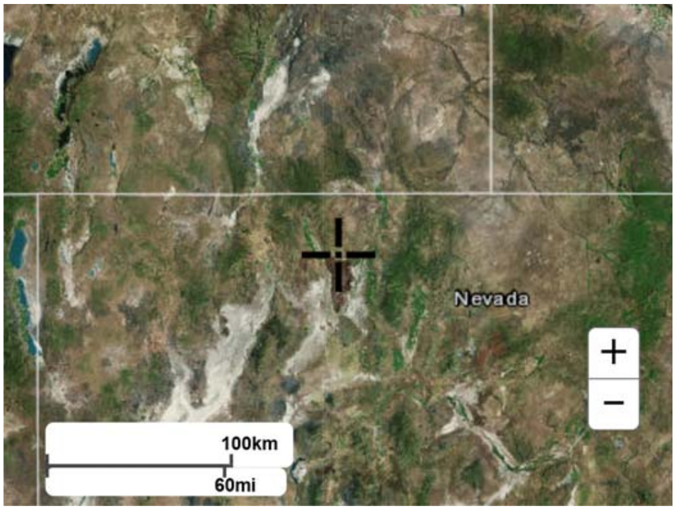
Large scale terrain



Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

APPENDIX F

Technical Specifications

APPENDIX F.1

General

NewFields
Perspective. Vision. Solutions.

April 2, 2020
NewFields Project No. 475.0385.000

Lithium Nevada Corp.
3685 Lakeside Drive
Reno, Nevada 89509

Attention: **Brett Rabe**
VP of Engineering

RE: **TECHNICAL SPECIFICATIONS**
Thacker Pass Project
Humboldt County, Nevada

Transmitted herewith are the Technical Specifications for the Thacker Pass Project and the associated infrastructure. These Technical Specifications cover material quality and placement criteria for earthworks, geosynthetics, piping, and other related elements of the project as shown on the Issued for Construction Drawings. Construction Drawings are submitted under separate cover.

If you have any questions or require additional information, please contact the undersigned.

Sincerely,

NewFields Mining Design & Technical Services

Matt Haley

Matt Haley, P.E.
Project Manager

Reviewed by:

Keith Williams, P.E.
Principal Engineer

MH/KCW/jdh

P:\Projects\0385.000 Lithium Nevada Thacker Pass Project\I-TECH SPECS\0-0385-000-SP-GEN-0.docx

www.NewFields.com 9400 Station Street, Suite 300, Lone Tree, Colorado 80124 T. 720.508.3300

NewFields	**CLIENT** **Lithium Nevada Corporation**				**PROJECT NO** 475.0385.000	
PROJECT: THACKER PASS PROJECT						
TITLE: GENERAL SPECIFICATIONS FOR THE CONSTRUCTION OF THE CTFS, WRSF, CGS, AND MINE FACILITIES & PROCESS PLANT STORMWATER MANAGEMENT					**SPECIFICATION NO.** **0-0385-000-SP-GEN-0**	

REV	**DATE**	**PAGES**	**APPROVALS**			**REMARKS**
			AUTHOR	**REVIEW**	**CLIENT**	
0	04/02/2020	5	MH	KCW	BR	Issued for Construction

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1. INTRODUCTION

These Specifications and the associated Drawings (issued separately) constitute the earthworks, geosynthetics, concrete, and piping package associated with the Lithium Nevada Corporation (LNC), Thacker Pass Project. The Project is located in northern Nevada in Humboldt County, approximately 20 miles west-northwest of Orovada, 62 miles north-northwest of Winnemucca, and approximately 20 miles south of the Oregon border. The area is located approximately 4,920 feet above mean sea level (amsl) at the southern end of the McDermitt Caldera and covers approximately 3,367 ha.

Definition of Terms

- “**Owner**" is defined as LNC. The **Owner's** properly authorized representative will act on behalf of the **Owner**.
- "**Construction Manager**" is defined as a representative appointed and authorized by the **Owner** to act as a liaison between the **Owner**, the **General Contractor**, the **Lining Contractor** and the **Engineer**. Depending on staff availability, the **Owner** may act as the **Construction Manager**.
- "**Engineer**" is defined as NewFields (Engineer of Record), appointed and authorized by the **Owne**r. The **Engineer** shall be a registered Professional Engineer in the State of Nevada. The **Owner** must identify the **Engineer** in writing to the **General Contractor**.
- "**Inspector**" is defined as the party or parties representing the **Owner** under the supervision of the **Engineer**. The **Inspectors** will perform Construction Quality Assurance (**CQA**) observations and testing for the project. A supervisory inspector with a minimum of five (5) years of experience in earthworks and geosynthetics testing shall review all work performed by inspectors on the job site. Resumes of all inspectors shall be submitted to the **Owner** for approval.
- "**General Contractor**" is defined as the party that has executed the contract agreement for the specified **Work** with the **Owner** or its authorized representative(s)/agent(s). It is anticipated that the **General Contractor** shall perform all earthwork related activities and shall subcontract geomembrane lining installation, fencing installation, pipeline installation, and other related construction activities as defined in the Scope of Work.
- "**Lining Contractor**” and “**Lining Quality Control** (**CQC**)” are defined as the party(ies) contracted by the **General Contractor** to install the geomembrane and complete **CQC** activities for the specified **Work**.
- “**Pipeline Contractor**” is defined as the party(ies) contracted by the **General Contractor** to install the HDPE and steel pipelines for the project.
- “**Fencing Contractor**” is defined as the party(ies) contracted by the **General Contractor** to install the fencing for the project.

- "**Construction Quality Control (CQC)"** refers to the systematic inspections and testing completed to control the quality of construction and to ensure conformance with the project specifications.
- "**Construction Quality Assurance (CQA)**" refers to the overview and inspection program consisting of systematic observations, **CQC** document review, and independent testing completed to provide adequate confidence that the construction conforms to the design.
- "**Specifications**" are defined as this document, all supplemental addenda, and any modifications furnished by the **Owner**, the **Engineer**, or others that apply to the **Work**.
- "**Drawings**" are defined as the Construction Drawings for the project furnished by the **Owner**, **Engineer**, or others that apply to the **Work**.
- **"Manufacturer"** is defined as the supplier of any specified materials.
- "**Site**" is defined as the Thacker Pass project being built by the **Owner** and where the **Work** is to be completed as described in these **Specifications** and detailed on the **Drawings**.
- "**Contract**" is defined as the document executed by the **Owner** or its authorized representative(s)/agent(s) with the **General Contractor** to complete specified portions of the **Work**.
- "**Work**" is defined as the entire completed construction or the various separately identifiable parts thereof as shown on the **Drawings** and as described in the **Specifications** and **Contract**.
- "**Modifications**" are defined as changes made to the **Specifications** or the **Drawings** that are approved by the **Owner** and **Engineer** in writing, after the **Specifications** and **Drawings** have been issued for construction. These also refer to changes to design elements in the field to account for unforeseen conditions.
- "**Plant**" is defined as all equipment, supplies, accommodations, temporary offices, etc., required to complete the **Work.**
- "**Units**" - these **Specifications** and the **Drawings** use English units; however, metric units are used when appropriate.

2. LIST OF SPECIFICATIONS

A list of the Specifications for the project is presented in Table 2-1.

Table 2-1: List of Specifications

Document Number	Subject	Rev	Date
0-0378-000-SP-GEN-0	General	0	04/02/2020
1-0378-000-SP-EW-0	Earthworks	0	04/02/2020
2-0378-000-SP-GM-0	Geomembrane Liner	0	04/02/2020
3-0378-000-SP-GT-0	Geotextile	0	04/02/2020
4-0378-000-SP-GN-0	Geonet	0	04/02/2020
5-0378-000-SP-HDP-0	High Density Polyethylene Pipe	0	04/02/2020
6-0378-000-SP-CPeP-0	Corrugated Polyethylene Pipe	0	04/02/2020
7-0378-000-SP-SSP-0	Stainless Steel Pipe	0	04/02/2020
8-0378-000-SP-CMP-0	Corrugated Metal Pipe	0	04/02/2020
9-0378-000-SP-C0-0	Concrete	0	04/02/2020

3. SCOPE OF WORK

The technical specifications are for construction of the Clay Tailings Filter Stack (CTFS), Waste Rock Storage Facilities (WRSF), Coarse Gangue Stockpile, sediment ponds, stormwater diversion channels & berms, roads, and other associated infrastructure as shown on the following Issued for Construction drawing sets:

- Clay Tailings Filter Stack & Process Plant Sediment Pond
- Waste Rock Storage Facilities and Coarse Gangue Stockpile
- Mine Surface Water Control Features

4. RECORD OF CONSTRUCTION REPORT

At the completion of the project, the Engineer shall produce a Record of Construction (ROC) Report for submission to the Nevada Division of Environmental Protection – Bureau of Mining Regulation and Reclamation (NDEP-BMRR). The ROC Report shall be submitted within 30 days of the completion of the Work pursuant to NAC 445A.427. The ROC Report shall include the following:

1. As-built drawings of the process components;
2. A summary of the CQA procedures which were carried out during construction; and
3. A description of significant modifications to the design that were made during constructions.

Details of required elements including survey and testing frequency as defined in these Specifications.

APPENDIX F.2

Earthworks

NewFields	**CLIENT** **Lithium Nevada Corporation**			**PROJECT NO** 475.0385.000

PROJECT: THACKER PASS PROJECT

TITLE: TECHNICAL SPECIFICATIONS FOR EARTHWORKS MATERIALS AND CONSTRUCTION

SPECIFICATION NO. 1-0385-000-SP-EW-0

			APPROVALS			
REV	**DATE**	**PAGES**	**AUTHOR**	**REVIEW**	**CLIENT**	**REMARKS**
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1. GENERAL

This specification defines the requirements for the earthwork construction activities for the Thacker Pass Project owned by Lithium Nevada Corporation. The specifications set forth in this document cover the quality of materials and workmanship for earthworks construction.

Any alternatives or exceptions to this specification shall be submitted in writing to the Owner or its designated representative(s)/agent(s) and shall be approved by the Engineer.

The Definition of Terms is provided in Specification No. 0-0385-000-SP-GEN-0.

2. CODES AND STANDARDS

All tests shall be performed in accordance with the current edition of the testing standards as indicated below.

2.1. American Association of State Highway and Transportation Officials (AASHTO):

- AASHTO T103-08: “Soundness of Aggregates by Freezing and Thawing (Procedure A Total Immersion in Water)”, American Association of State Highway and Transportation Officials, Washington DC, www.transportation.org.
- AASHTO T104-99: “Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate”, American Association of State Highway and Transportation Officials, Washington DC., www.transportation.org.

2.2. American Society for Testing and Materials (ASTM):

- ASTM C88/C88M-18: “Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate”, ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM C117-17: “Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing”, ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM C131/C131M-14: “Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine”, ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM C136/C136M-14: “Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates”, ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM C535-16: “Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine”, ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D 1556/D1556M-15e1: “Standard Test Methods for Density and Unit Weight of Soil in Place by Sand-Cone Method”, ASTM International, West Conshohocken, PA, www.astm.org.

- ASTM D1557-12e1: “Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort”, ASTM International, West Conshohocken, PA, www.astm.org.
- WK63917 Reinstatement of D2434 – 68(2006): “Standard Test Method for Permeability of Granular Soils (Constant Head) (Withdrawn 2015)”, ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D4318-17e1: “Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils”, ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D4644-16: “Standard Test Method for Slake Durability of Shales and Other Similar Weak Rocks”, ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D5030/D5030M-13a: “Standard Test Method for Density of Soil and Rock in Place by the Water Replacement Method in a Test Pit”, ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D6913/D6913M-17: “Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis”, ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D6938-17a: “Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)”, ASTM International, West Conshohocken, PA, www.astm.org.

2.3. United States Bureau of Reclamation (USBR):

- USBR 5605: “Determining Permeability and Settlement of Soils Containing Gravel, Fixed Wall Saturated Hydraulic Conductivity”, U.S. Bureau of Reclamation, Washington, DC., usbr.gov.

2.4. United States Department of Transportation- Federal Highway Administration (USDOT-FHWA):

- USDOT FLH T 521: “Standard Method of Determining Riprap Gradation by Wolman Count”, United States Department of Transportation- Federal Highway Administration, Washington, DC. highways.dot.gov

3. LANDSCAPE PRESERVATION

The Contractor shall exercise care at all times to preserve the natural landscape and shall conduct operations to prevent unnecessary damage, scarring or defacing of the natural surroundings in the vicinity of the Work. Movement of personnel and equipment within the Site disturbance, Site access roads, and easements provided for access to the Work shall be performed in a manner to prevent damage to the property and the environment. In no case shall the Contractor disturb any areas outside the limits of the Work as defined by the Owner.

4. DUST CONTROL

The General Contractor, for the duration of the contract, shall maintain all excavations, mass grading operations, haul roads, access roads, waste disposal areas, borrow areas, and all other work areas free from excessive dust as determined by the Owner. Industry accepted methods of dust control suitable for the area involved, such as sprinkling water from an approved source, will be permitted. Alternative methods for dust control shall be approved by the Owner.

5. WEATHER LIMITATIONS

Unless approved in the field by the Engineer, controlled fill shall not be constructed when the atmospheric temperature is at thirty-five (35) degrees Fahrenheit (F) and falling. When the temperature falls below thirty-five (35) degrees F, it shall be the responsibility of the General Contractor to protect all areas of completed surfaces against any detrimental effects by methods approved by the Engineer. Any areas that are damaged by freezing shall be removed or reconditioned, reshaped and re-compacted by the General Contractor in conformance with the requirements of this Specification. In no case shall frozen fill materials be incorporated into the mass grading operations nor shall fill be placed on frozen ground, snow or materials that have not been approved by the Inspector.

Overliner placement shall be suspended at no cost to the Owner if, in the opinion of the Engineer, the operation creates unsafe conditions due to moisture or ice build-up on the geomembrane, visibility becomes problematic or the quality of Work is being compromised. The General Contractor shall make sure material is not rutting or pumping under the construction traffic due to the excessive moisture. Materials shall not be placed on concentrations of snow or ice, nor shall concentrations of snow or ice be incorporated into the Overliner materials either prior to or during placement. Snow and ice shall be removed from the geomembrane surface prior to Overliner placement. The snow or ice shall be removed a sufficient distance from the geomembrane and Overliner material interface such that Construction Quality Assurance (CQA) personnel can examine the geomembrane conditions prior to Overliner placement. Frozen chunks in the Overliner material that could damage the geomembrane or add excessive moisture to the material once thawed are not allowed.

6. EARTHWORKS

This section presents the technical requirements for the earthworks construction for the Thacker Pass Project.

All equipment used by the General Contractor shall meet satisfactory conditions and comply with the Specifications with the approval of the Engineer. The Engineer reserves the right to request in writing a change in the required equipment or procedure of any work and the General Contractor shall comply.

6.1. Control of Surface Water and Stormwater Runoff

During the construction period, the General Contractor will be responsible for constructing and maintaining any temporary ditches, channels, and/or sediment control features required to protect the Work and control surface water flows and sediment.

The General Contractor shall submit plans for temporary surface water runoff control to the Construction Manager for review and approval. The temporary surface water runoff control, including temporary and permanent berms, channels and any other control measures, shall be built according to the line and grade indicated on the plan submitted by the General Contractor and shall be maintained throughout the Work.

The General Contractor shall construct erosion control measures required to prevent significant transport of sediments from the stockpiles, construction areas, and other areas of the Work that may be subject to the effects of runoff.

The General Contractor shall provide equipment and perform all necessary work to maintain the areas of surface and groundwater collection to remove sediments from the water before it leaves the site. The General Contractor shall provide the temporary erosion control measures and make improvements immediately to these control measures if it is deemed necessary by the Owner or Engineer.

The General Contractor shall prevent all damage to the work areas due to drying, water runoff and sediment control.

The General Contractor shall remove all temporary installations of erosion control measures when they are no longer necessary and restore the areas affected by these measures.

The General Contractor shall be responsible for the damage that results from rainfall runoff and for failed erosion control measures.

6.2. Clear and Grub, and Growth Media Removal

The area within the disturbance limits of the Thacker Pass Project is a combination of native vegetated terrain that requires removal of vegetation and topsoil stripping, previously undisturbed area, storage of organic material, and storage piles of various rock and soil materials. No clearing and stripping shall occur in an area until the area has been approved by the Owner.

Based upon studies of site vegetation and topsoil thickness conditions, the average thickness of stripping of topsoil and grubbing of vegetation is anticipated to be twelve (12)-inches.

Clearing and stripping consists of cutting vegetation at the soil level, removing this material as well as branches and any other vegetation. The vegetation and surface topsoil materials, that are considered the root zone, shall be excavated, loaded, and hauled to a stockpile location adjacent to the work area designated by the Owner. The limits of stripping shall generally extend approximately ten (10) feet outside of the Work activity areas as shown on the Drawings. Any clearing and stripping beyond the limits shown on the Drawings, or as required by the Engineer, shall be subject to the approval of the Owner.

Topsoil stockpiles shall be leveled, trimmed, and shaped to prevent the occurrence of ponding or concentrations of surface runoff and to provide a neat appearance. Finished slopes of the stockpiles shall be graded to 2.5H:1V (horizontal to vertical) for interim reclamation. All surface water runoff shall be directed to available natural drainage courses. The General Contractor shall use proper sediment control measures approved by the Construction Manager. Clearing and stripping will be carried out using whatever method is deemed necessary, providing it is consistent with producing an acceptable end result as determined by the Owner and the Engineer. Care is to be taken to minimize erosion and excessive sediment buildup.

After stripping of the required area, the surface shall be prepared as specified on the Drawings or in the Technical Specifications. Prior to any surface treatment on a stripped area, the Engineer shall be notified to inspect the stripped area and designate the method of treatment required for continuance of Work. A survey shall be taken of the area immediately prior to and immediately after stripping operations to determine quantities and/or for verification of lift/layer thickness to be placed after stripping is complete.

6.3. Over-excavation of Existing Surface Soils

After initial clearing and grubbing operations are completed, over-excavation of any softer soils to the contact of relatively firm soils or rock shall be performed only at the direction of the Engineer. If required, over-excavation shall be performed in embankment foundation areas and facility footprints. Confirmation of adequate sub-excavation and exposure of firm soils or rock shall be made by the Inspector subject to approval by the Engineer.

6.4. Surface Foundation Preparation and Compaction

Once the work area has been cleared and stripped to the satisfaction of the Engineer, the surface shall be prepared before any overlying materials are placed. All work areas shall be graded according to the limits shown on the Drawings. Areas of both cut and fill shall be required to bring the grading of the work area to the elevations specified in the Drawings.

The upper eight (8) inches of native soils (foundation preparation) beneath cut surfaces and areas to receive fill shall be scarified, moisture conditioned, and compacted to ninety (90) percent of the maximum dry density, within three (3) percent of optimum moisture content as determined by the Modified Proctor Density Test, ASTM D1557.

Scarification and compaction can be deleted in areas which intact bedrock is exposed at the surface. The Engineer may waive this requirement if the exposed surface soils without manipulating will provide a firm, non-yielding surface for fill placement, in which case the surface shall be moistened, lightly scarified, and the first layer of fill placed.

All boulders and cobbles that are located at the surface and/or partially exposed in a finish cut or fill area that could be detrimental to the overlying construction shall be removed as directed by the Engineer.

Areas of unsuitable material as determined by the Engineer or areas of pre-existing fill not compacted to the specifications shall be excavated to the limits designated by the Engineer and replaced with compacted Common Fill.

In cut areas where six (6) inches of material suitable for use as Liner Bedding material is encountered and approved by the Engineer, native soils shall be scarified; moisture conditioned and compacted to meet the requirements of Section 6.6.3 and for finished surface preparation as defined in Section 7.

The General Contractor is responsible for maintaining surfaces in a satisfactory condition after approval of the Engineer. The General Contractor shall protect the prepared surface from weather, construction equipment and other factors.

6.5. Excavations and Borrow Areas

6.5.1. General

Excavation methods, techniques, and procedures shall be developed with consideration to the nature of the materials to be excavated and shall include all precautions that are necessary to preserve, in an undisturbed condition, all areas outside the lines and grades shown on the Drawings or as required by the Engineer. Excavation, shaping, etc., shall be carried out by whatever method is considered most suitable, providing it is consistent with producing an acceptable result as determined by the Engineer. Excavations shall be graded to provide drainage and prevent ponding. For excavations that cannot be graded to drain, the General Contractor shall make provisions for the equipment and labor necessary to keep the excavations free of standing water.

No excavation beyond the lines and grades shown on the Drawings or as required by the Engineer shall be completed without the prior approval of the Engineer/Owner. The General Contractor shall protect and maintain all excavations until the adjacent placement or overlying placement of material has been completed. No Work is allowed outside of approved disturbance boundaries.

All earth materials, boulders, or detached pieces of solid rock less than one (1) cubic yard in volume shall be classified as common excavation. No additional allowance above the unit prices bid for rock fill placement shall be permitted for excavation of wet or frozen materials. All excavated material may be used as fill provided it meets the requirements for the class of material in which its use is intended as specified herein.

6.5.2. Rock Excavation

Rock excavation shall be classified as material that cannot be effectively loosened or broken down in a single pass by ripping with a late model tractor-mounted hydraulic ripper, equipped with one digging point of standard Manufacturer's design that is adequately sized for use with and propelled by a crawler-type tractor, rated at a minimum 410-net flywheel horsepower and operating in low gear. All boulders or detached pieces of solid rock in excess of one cubic yard in volume shall be classified as rock excavation. These materials may be used for fill if they meet the requirements for the class of materials in which its use is intended as specified herein.

The rock excavation pricing shall not take effect if the General Contractor can rip an average of 250 cubic yards per hour over a four (4) hour time period with a D10 dozer equipped with a single ripper shank.

The General Contractor shall notify and meet with the Construction Manager at the reported site of the rock excavation prior to starting the four (4) hour time period. No additional allowance above the unit prices bid for rock fill placement shall be permitted without prior written approval by the Construction Manager and the Engineer.

Based on the results of field exploration, bedrock is expected to be encountered within the depth of excavation at some areas of the project site. Areas to receive HDPE liner in which bedrock is encountered within the depth of the excavation shall be over-excavated a minimum depth of six (6)-inches below finished grade such that the Liner Bedding can be placed where shown on the Drawings. The rock surface shall be relatively smooth such that no rock asperities extend more than one (1) inch above the surrounding area. Over-excavation in excess of the six (6)-inches specified herein shall be at the expense of the General Contractor.

6.5.3. Borrow Activities

The General Contractor shall coordinate borrow activities with the Engineer and CQA to allow the sampling and testing of materials prior to their excavation. The General Contractor shall allow the Engineer adequate time to evaluate potential borrow materials. Materials from excavations within the works or borrow areas that meet the specified requirements for other construction materials shall be stockpiled or placed in fill areas as directed by the Engineer/Owner. Unsuitable or excess materials shall be hauled to designated waste or stockpile areas approved by the Owner.

The materials obtained from borrow pits or Owner-stockpiled material shall be selected to ensure that the gradation requirements for the various construction materials are achieved and that the materials are as homogeneous as possible. Care shall be taken to avoid cross-contaminating different types of materials.

On-site borrow areas shall be developed within the limits shown on the Drawings or as required by the Owner. Should the General Contractor wish to develop additional borrow sources, written approval shall be received from the Owner prior to proceeding. Approval by the Owner may require that subsurface investigations be carried out to obtain samples as are required by the Engineer to make an appropriate assessment of the suitability of the borrow materials in the area for the intended use.

Borrow pit operations shall be subject to the approval of the Owner and Engineer and shall avoid waste of any suitable construction material therein. Clearing and stripping of any borrow area is to be completed with all salvageable topsoil stockpiled in areas designated on the Drawings or as directed by the Owner. Each borrow area shall be developed with due consideration for drainage and runoff from the excavated surfaces not to cause erosion of the adjacent terrain. Each borrow area shall be excavated in near-horizontal layers and in such a manner that water will not collect and pond except as approved by the Owner. Before being abandoned, the sides of any borrow areas outside the Work area shall be brought to stable slopes not steeper than 2.5H:1V with slope intersections rounded and contoured to provide a natural, neatly graded appearance.

Care shall be taken to minimize and control the generation of dust as discussed in Section 4.

6.6. Fill Materials

Earthfill shall not be placed until the clearing and stripping; required foundation preparations have been completed; and the foundation has been inspected and approved by the Engineer; and any required surveys completed.

All material used for fill shall be loaded and hauled to the placement site, dumped, spread, and leveled to the specified layer thickness. Fill shall be moisture conditioned and compacted to form a dense integral fill in accordance with the Technical Specifications and as approved by the Engineer. Care shall be taken at all times to avoid segregation of the material being placed and, if required by the Engineer, all pockets of segregated or undesirable material shall be removed and replaced with material that matches the surrounding material. All oversize material shall be removed from the fill material either prior to it being placed or after it is dumped and spread but prior to compaction. No additional payment will be made to remove oversized materials unless the work is specifically identified as a payment item on the Schedule of Quantities.

For most construction conditions, the fill is to be constructed in near horizontal layers with each layer being completed over the full length and breadth of the zone before placement of subsequent layers. Each zone shall be constructed with materials meeting the specified requirements and shall be free from lenses, pockets, and layers of materials that are substantially different in gradation from the surrounding material in the same zone, as determined by the Engineer.

Except in areas approved by the Engineer, where space is limited or as otherwise specified, fill shall be placed by routing the hauling and spreading units approximately parallel to the axis of fill. The hauling equipment shall be routed in such a manner that they do not follow in the same paths but spread their travel routes evenly over the surface of the fill to aid in compaction of the fill placed.

Moisture conditioning is the operation required to increase or decrease the moisture content of material to within the specified limits. If moisture conditioning is necessary, it may be carried out by whatever method the General Contractor deems is suitable, provided it produces the moisture content specified in these Technical Specifications or designated by the Engineer. The General Contractor shall take the necessary measures to ensure that moisture is being distributed uniformly throughout each layer of material being placed immediately prior to compaction. Measures shall be adopted as are necessary to ensure that the designated moisture content is preserved after compaction until the overlying layer is placed.

All particles having dimensions that interfere with compaction in the fill as determined by the Engineer or CQA shall be removed from the zone in which they were placed either prior to or during compaction.

The rolling pattern for compaction of all zone boundaries or construction joints shall be such that the full number of roller passes required in one of the adjacent zones, or on one side of the construction joint, extends completely across the boundary or joint.

Minor deviations from the material properties and gradation limits specified in the following sections may be acceptable, subject to the review and approval of the Engineer.

6.6.1. Rockfill

Any material having more than thirty (30) percent plus three-quarter (¾) inch size rock shall be classified as rockfill. Rockfill may be obtained from excavations in areas of the facilities or borrow areas designated by the Construction Manager and approved by the Engineer. Rockfill can be placed as Common Fill in the base of the deeper fills and shall not be used in the upper two (2) feet of fills in areas that will receive Liner Bedding and concrete.

Material Properties - Rockfill may have a wide range of Unified Soil Classifications (USCS) and may contain significant variations in gradation and compaction properties. Rockfill shall have no particles larger than two-thirds (2/3) of the lift being placed, unless otherwise approved by the Engineer. Oversize materials shall be removed from the fill.

Placement Methods - Rockfill for mass grading operations shall be placed in lifts not to exceed four feet if compacted with mine haul trucks or twelve (12) inches in compacted thickness with standard construction equipment, unless authorized by the Engineer. The type of compaction equipment, and number of passes, shall be approved by the Engineer in writing based on an acceptable field fill compaction performance test.

Construction and monitoring of the field test shall be performed per U.S. Army Corps of Engineers' guidelines for test fill construction. The test fill may be located so that it is incorporated within the limits of the compacted fill areas. The moisture content of the minus three-quarter (¾) inch material shall be within three (3) percent of optimum moisture prior to placement.

The data to be collected during construction of the test fill and submitted to the Engineer for approval shall include:

- Amount of settlement after every two (2) passes of ten (10) ton minimum (static drum weight) vibratory, smooth-drum roller compactor, or a loaded haul truck to a maximum of fifteen (15) passes
- Gradation and moisture content of in-place material.
- In-place fill density at completion of the test by bulk density or nuclear gauge methods (if applicable). If needed, a water replacement method test may be required to assess compaction for rockfill.

A curve showing change in settlement versus number of passes shall be produced from the data. This curve will be used to determine the required minimum number of passes for acceptable compaction. In general, the minimum number of passes will be that number to achieve eighty (80) percent of the total settlement obtained after ten (10) complete passes of the compaction equipment. Final determination by the Engineer of the lift thickness and minimum required passes will be based on review of the test data.

6.6.2. Common Fill

Common Fill will be placed in areas where the material is not required to be of uniform character and engineering properties. Common Fill shall consist of inorganic soil and rock materials from required excavations, mine waste, or borrow material from other sources as designated by the Construction Manager and approved by the Engineer. Common Fill can be used to within six (6)-inches of finished grade in areas of the facilities which receive Liner Bedding.

In areas to be covered with geomembrane and not designated to receive Liner Bedding material, the Common fill may extend to finished grade provided finished surface preparation is performed and matches material specifications in accordance with the Liner Bedding requirements in Section 6.6.3 and for finished surface preparation as defined in Section 7.

Material Properties – Common Fill shall contain less than thirty (30) percent rock (materials above three-quarter (¾) inch size and up to eight (8) inch maximum rock size will have a wide range of Unified Soil Classifications and may contain significant variations in gradation and compaction properties. Common Fill shall be placed in areas where the material is not required to be of uniform character and engineering properties. Common Fill shall be free of roots, grass and other organic material and consist of inorganic soil and rock materials from required excavations, mine waste, or borrow material from other sources, as approved by the Engineer.

Materials shall be considered suitable for use as Common Fill provided they contain no particles larger than eight (8) inches nominal diameter (least dimension). Materials containing rock or cobbles, and gravel from required excavations may be used subject to the Engineer's approval and provided the rock be reasonably graded such that large void spaces do not result. The maximum size rock shall be no larger than two-thirds (2/3) the lift thickness. Furthermore, the anchor trench material shall consist of non-deleterious or consolidating materials that are two (2) inch minus.

Placement Methods - Common Fill shall be placed in twelve (12) inch maximum loose lifts and compacted to ninety-two (92) percent of the maximum dry density (ASTM D1557). The moisture content during compaction shall be maintained within three (3) percent of optimum moisture content (OMC) as determined in accordance with ASTM D1557.

Anchor trench backfill shall be compacted to a minimum of ninety (90) percent of ASTM D1557 maximum dry density, and care shall be taken to prevent any damage to the geomembrane. Except as necessary for construction, ballasting and the safety of the Works, geomembrane anchor trenches shall not be filled until approved by the Engineer.

Slight variations from the specified moisture range may be acceptable subject to the acceptance of the Engineer and provided the required relative compaction specifications are achieved. The Common Fill material shall be compacted with appropriate compaction equipment capable of achieving compaction through the full thickness of the lift layer. If the Common Fill placement and compaction utilizes ninety (90) ton or larger haul trucks, the lift thickness can be increased subject to the approval of the Engineer.

6.6.3. Liner Bedding

Material Properties - Liner Bedding material shall consist primarily of a finer-grained material primarily used to provide suitable bedding for geomembrane deployment and installation.

The material gradation shall be as follows and meet the following grading requirements as determined by ASTM D6913, unless otherwise approved by the Engineer:

Sieve Size (square openings)	Percent Passing (by dry weight)
2-inch	100
No. 4	25-100
No. 200	0-100

No minimum Atterberg limits requirements are specified for Liner Bedding materials.

Placement Methods – If the existing materials do not meet the requirements of this specification, Liner Bedding will be sourced from local borrow areas or stockpiles and placed in a single lift, moisture conditioned to within three (3) percent of OMC and compacted to at least ninety (90) percent of the maximum dry density as determined by ASTM D1557.

Smooth drum finishing rollers shall be used to achieve the specified compaction. The areas that are inaccessible to large compaction equipment shall be compacted using jumping jack, plate compactors or other compaction methods approved by the Engineer. Any particles projected up from the surface greater than ¾” shall be removed by hand or other methods approved by the Engineer that achieve a smooth compacted surface.

The General Contractor shall protect the finished surface of the Liner Bedding from weather damage between placement activity and coverage by the Geomembrane Installation.

If moisture accumulates under the Geomembrane before or after welding the panels and softens the Liner Bedding layer, the geomembrane shall be removed, and the Liner Bedding shall be repaired to comply with the Specifications.

If any area of Liner Bedding does not comply with the requirements of the Specifications and is not approved by the Engineer, it shall be considered in nonconformance and the General Contractor shall be required to rework the area until acceptable. Subgrade requirements for geosynthetic installation are discussed further in Section 7.

6.6.4. Select Gravel

Material Properties - Select gravel shall be a processed or natural clean gravel material containing nonplastic fines. The select gravel shall consist of materials composed of hard, durable stone particles free from organic material and generally free of thin, flat, and elongated pieces.

The select gravel shall generally conform to the following graduation requirements as determined by ASTM C136 and C117.

Sieve Size (square openings)	Percent Passing (by dry weight)
1-inch	100
3/4-inch	50-100
No. 4	0-10
No. 40	0-5
Non-plastic per ASTM D4318	

The select gravel material shall be nonplastic when tested in accordance with ASTM D4318.

The percent of wear when subject to the Los Angeles abrasion test (ASTM C131, 500 revolutions) shall be no greater than forty (40).

Where geotextile is encapsulating the select gravel it shall consist of a nonwoven, needle punched, polypropylene fabric meeting the requirements of latest revision to Specification 3-0378-000-SP-GT-A.

Placement Methods – Select Gravel material shall be placed with minimal compaction by mechanical means in order to maintain transmissivity and porosity of the material and to avoid damage to the geomembrane and geotextile material during placement.

6.6.5. Overliner

Material Properties - The Overliner will be native materials produced from an onsite borrow source or based on availability, Coarse Gangue material, processed and generated through a crushing and screening operation. The Overliner material shall consist of a sandy gravel material. The materials shall be composed of hard, durable stone particles reasonably free from thin, flat, and elongated pieces.

The material shall meet the following gradation limits unless otherwise approved by the Engineer:

Sieve Size (square openings)	Percent Passing (by dry weight)
1.5 - inch	90-100
1/2 - inch	40-80
1/4 - inch	20-60
No. 200	0-10
Non-plastic per ASTM D4318	

The in-place Overliner material shall meet the grading and consistency requirements as determined in accordance with ASTM C117 and ASTM D6913. The Overliner material shall be non-plastic when tested in accordance with ASTM D4318.

The Overliner materials shall have a coefficient of permeability 1 x 10^{-4} cm/s or greater when tested in accordance with USBR 5605 - Amended with an applied stress of 32 ksf. The target permeability for the Overliner is two orders of magnitude faster than the overlying tailings material with a minimum limit of one order of magnitude faster than the overlying tailings. Based on the testing completed to date the target overliner permeability is 1 x 10^{-4} cm/s.

Material used for Overliner may be approved by the Engineer by visual inspection if the rock is determined to be sound and durable. However, if in the Engineer's opinion, the material is marginal or unacceptable, the Engineer may require one or more of the following laboratory tests on representative samples of the material in order to assess the quality of the material.

Overliner Material Laboratory Tests

Test Description	Test Method	Specification Requirement
Los Angeles Abrasion	ASTM C 535	50% Loss Maximum (after 500 revolutions)
Sodium Sulfate or Magnesium Sulfate Soundness	AASHTO T 104 or ASTM C88	10% Maximum Loss (after 5 cycles)
Soundness by Freezing and Thawing	AASHTO T 103	10% Maximum Loss (after 12 cycles)
Slake Durability	ASTM 4644	Classification as Type 1

Placement Methods – Overliner shall be placed to the lines and grade shown on the Drawings. Proposed equipment and placement methods shall be outlined in the General Contractor's proposal to the Owner. Proposed equipment and placement methods to minimize compaction of the Overliner materials shall also be outlined in the General Contractor's proposal to the Owner.

Before placing the Overliner, the General Contractor shall verify by a visual inspection that all geosynthetic material installed in the area is free from perforations, wrinkles, scratches and other damage. The Engineer shall inspect the geosynthetic material to verify that it is ready to receive the Overliner.

Overliner material shall be placed directly on the geomembrane and around piping with extreme care to prevent damage. This is generally done by hauling and placing the material on the geomembrane in a single lift with haulage units that exert less than 80 psi of ground pressure.

The material shall be spread with a low ground pressure crawler-type tractor or equivalent that exerts less than 20 psi of ground pressure. The material shall be placed at a minimum loose thickness such that the compacted lift thickness is not less than the design thickness shown on the drawings (General Contractor to determine allowance for settlement). At no time shall equipment operate directly on the surface of the geomembrane.

Special attention shall be taken when being placed over the Corrugated Polyethylene (CPe) and High Density Polyethylene (HDPE) pipe. All oversized material that may damage the pipework or geomembrane will be removed by whatever means necessary to ensure there is no damage. Because of the thickness of the Overliner and the potential crushing of the collector pipes and damage of the geomembrane, vehicle traffic on the Overliner shall be as minimal as possible and shall be restricted to roadways and other main access ways. Overliner thickness within roadways shall be maintained at least four (4) feet above the geomembrane surface. A minimum cover equal to 2-feet over the top of the CPe pipe shall be maintained at all times.

Placement equipment and procedures shall minimize compaction of the Overliner material and watering shall be limited to thickened access roads. Increased thicknesses of material shall be required in areas with large diameter piping to prevent crushing from haulage vehicle traffic. Haulage equipment may also necessitate increased cover material thickness within haulage

Placement of Overliner at angles of approximately forty five (45) degrees from normal is acceptable, provided the material is placed from the bottom up. Placement of Overliner parallel to the contours and across the slope is not acceptable. Placement of Overliner shall be performed in accordance with the Design Drawings and Technical Specifications in a manner which maintains the integrity of the geomembrane and allows placement of the collection pipe as shown on the drawings. A written placement procedure with proposed methods and equipment to be used shall be developed and provided to the Engineer for review and approval prior to Overliner placement on steep slopes.

The General Contractor shall not place fill materials at such times that, in the opinion of the Engineer, conditions for such operations are unsatisfactory due to precipitation, low temperatures or any other reasons. As ambient air temperature increases, wrinkles in the HDPE geomembrane will develop due to thermal expansion of the geomembrane. Placement of Overliner will cease if the wrinkles become large enough to fold over or it causes a crease to form when covered with Overliner material. Overliner material shall be placed during the cooler times of the day or during the evening when the geomembrane lays relatively flat. To minimize the effect of wrinkles, the Overliner shall be placed in an uphill direction and /or parallel to the contours. At no time, shall conditions result in movement/slippage of the Overliner materials that could potentially cause geomembrane or pipe damage.

The thickness of the Overliner shall be verified by the Engineer and areas with deficient amounts of material shall be reworked to comply with the Specifications. Overliner placement around the perimeter of the facility shall be as shown on the Drawings. Any damage to the geosynthetic material during installation shall be exposed by the General Contractor and repaired by the Geomembrane Lining Contractor. If overliner is placed at night, the General Contractor must develop an approved plan including adequate lighting.

The General Contractor shall supply a full-time laborer (one laborer per one dozer) to visually inspect one-hundred (100) percent of the Overliner placement.

6.6.6. Wearing Course

The roadway-wearing surface is to be constructed using select mine waste material. A source for the material will be provided by the Owner. Some removal of oversized rock will be required. Wearing Course shall generally conform to the following gradation requirements as determined by ASTM D6913 or as approved by the Engineer.

Material Properties - The Wearing Course materials shall consist of approved materials and shall meet the specified grading requirements as determined by ASTM D6913 or as approved by the Engineer.

Sieve Size (square openings)	Percent Passing (by dry weight)
3-inch	100
3/4-inch	50-90
No. 4	35-65
No. 16	15-40
No. 200	2-10

For optimal performance, the plasticity index for road surfacing materials shall be less than nine (9) as determined in accordance with ASTM D4318.

Placement Methods - Road wearing course materials shall be placed in lifts not to exceed six (6) inches in compacted thickness. Compaction of road wearing course material shall be to a minimum of ninety-five (95) percent of ASTM D1557 maximum dry density. The moisture content shall be sufficient to obtain adequate density.

6.6.7. Pipe Bedding and Pipe Backfill

Material Properties - Pipe bedding and backfill material shall consist of materials with the following typical characteristics:

Sieve Size (square openings)	Percent Passing (by dry weight)	
	Pipe Backfill	Pipe Bedding
4 -inch	100	
3 -inch	90-100	
1-½ -inch	--	100
¾ -inch	70-100	90-100
No. 4	--	30-70
No. 40	10-50	--
No. 200	0-35	5-15
Plasticity Index	10 max	10 max

Pipe bedding and pipe backfill shall be free of organic material.

Placement Methods - The pipe embedment materials shall be stable, sufficiently workable for placement under the sides of the pipe to provide satisfactory haunching, and to be able to achieve soil compaction. The particle size of the material in contact with the pipe shall not exceed one (1) inch for pipes six (6) to sixteen (16) inches, and 1 ½ inches for larger pipes.

Backfilling shall be done as soon as possible after pipe or culvert installation. Suitable backfill, free from large lumps, clods, or rocks shall be placed alongside the structure in loose layers not exceeding eight (8) inches thick to provide a berm of compacted earth on each side of the pipe or structure (where applicable). The fill materials shall be a minimum of five (5) feet wide or the width of the pipe diameter/structure but no less than required to operate the appropriate compaction equipment.

Pipe bedding and backfill shall be placed one small layer at the time, and then spread uniformly each layer in such a matter so that no un-filled space or gaps remain in the placed material. Each eight (8) inch layer shall be moisture-conditioned near optimum, as required to facilitate compaction, and compacted to a minimum of ninety (90) percent of the maximum dry density as determined by ASTM D1557 or as directed by the Engineer.

If it is necessary to construct a haul or other vehicle road over the pipe trench, the Engineer shall be consulted prior to the initiation of trench construction for specification modification to achieve structure sufficient for such traffic loading.

Backfill shall be placed symmetrically on each side of the structure. The backfill differential on either side of the pipe shall not exceed eight (8) inches or one quarter (1/4) of the diameter of the structure (whichever is less).

Prior to adding each new layer of loose backfill material until a minimum twelve (12) inches of cover is obtained, an inspection shall be made of the inside of the structure for local or unequal deformation caused by the backfilling operation. Only hand-operated tamping equipment shall be allowed within vertical planes three (3) feet beyond the horizontal projection of the outside surfaces of the structure (or as recommended by the pipe/structure manufacturer/designer). No heavy earthmoving equipment shall be permitted over the structure until a minimum of 150 percent of the largest buried pipe diameter of compacted fill has been placed over the top of the structure (or the minimum cover recommended by the pipe manufacturer/designer). In no case shall the minimum compacted structural cover be less than twelve (12) inches.

Backfill material shall not be placed against any concrete foundation, abutment, wing wall, or culvert until the concrete has been in place at least seven (7) days or the compressive strength of the concrete is seventy five (75) percent of the required twenty eight (28) day strength. On structures that are not permanently supported laterally and that cannot tolerate horizontal movement, internal bracing or support should be placed during backfill operations.

The General Contractor shall place backfill material by methods which have been approved by the Engineer prior to pipe backfill placement. The proposed method provided to the Engineer shall demonstrate that equipment used will not disturb or damage the pipe during placement and compaction of the pipe backfill.

6.6.8. Filter Sand

Material Properties Filter sand shall consist of either native material sourced from an onsite borrow source, imported or a processed using a crushing and/or screening operation. Common Fill material used to construct the embankment near the Filter Diaphragm and Filter Layer will indicate the required physical properties for the Filter Sand material and will be specified by the Engineer at the time of placement. The Filter Sand shall have a maximum plasticity index of 5 as determined by ASTM D4318.

Laboratory testing shall be completed on all Filter Sand sources prior to placement.

Placement Methods – The Filter Sand material shall be placed, moisture conditioned and compacted in accordance with the Pipe Bedding requirements under Section 6.6.7.

6.6.9. Riprap

Material Properties - Riprap shall be hard, angular, durable and reasonably well graded rock and shall be free of overburden, spoil, organic or any other deleterious material. Rounded stone is not acceptable. The riprap shall generally conform to the following gradation requirements as determined by USDOT FLH T521 (Wolman Count). The stone shall have a minimum specific gravity of 2.5. The riprap stone shall be such that its greatest dimension is not greater than three times its least dimension.

Riprap D_{50} = 4 inches

Sieve Size	% Passing	Typical Stone Mass
8 in.	100	
6 in.	70-100	10 lbs.
4 in.	50-70	3 lbs.
2 in.	2-15	0.5 lbs.

Riprap D_{50} = 6 inches

Sieve Size	Percent Passing (%)	Typical Stone Mass
12 in.	100	
9 in.	70-100	35 lbs.
6 in.	50-70	10 lbs.
2 in.	2-10	0.5 lbs.

Riprap D_{50} = 9 inches

Sieve Size	% Passing	Typical Stone Mass
18 in.	100	
15 in.	70-100	165 lbs.
9 in.	50-70	35 lbs.
6 in.	35-55	10 lbs.
3 in.	2-10	1.3 lbs.

Riprap D_{50} = 12 inches

Sieve Size	% Passing	Typical Stone Mass
24 in.	100	
21 in.	70-100	440 lbs.
18 in.	50-70	275 lbs.
12 in.	35-55	88 lbs.
4 in.	2-10	3 lbs.

Riprap D_{50} = 24 inches

Sieve Size	% Passing	Typical Stone Mass
48 in.	100	
36 in.	70-100	2,200 lbs.
30 in.	50-70	1,280 lbs.
24 in.	35-55	650 lbs.
8 in.	2-10	10 lbs.

Minor deviations from the above may be acceptable, subject to the review and approval of the Engineer. Material used for riprap may be approved by the Engineer by visual inspection if the rock is determined to be sound and durable. However, if in the Engineers opinion, the material is marginal or unacceptable, the Engineer may require the General Contractor to have performed one or more of the following laboratory tests on representative samples of the riprap in order to assess the quality of the riprap material.

Riprap Laboratory Tests

Test Description	Test Method	Specification Requirement
Los Angeles Abrasion	ASTM C 535	50% Loss Maximum (after 500 revolutions)
Sodium Sulfate or Magnesium Sulfate Soundness	AASHTO T 104 or ASTM C88	10% Maximum Loss (after 5 cycles)
Soundness by Freezing and Thawing	AASHTO T 103	10% Maximum Loss (after 12 cycles)
Slake Durability	ASTM 4644	Classification as Type 1

Placement Methods - Surfaces and piping to be protected by riprap shall be dressed to a smooth surface. All soft or objectionable material shall be removed as directed by the Engineer and replaced with an approved material. Materials underlying the riprap shall be placed in accordance with each material's specific placement specifications.

The riprap shall be placed as shown on the Drawings or as required by the Engineer in a manner that will produce a reasonably well graded mass of stone with the minimum practicable percentage of voids and good stone interlocking/contact. The entire mass of stone shall be placed in reasonable conformance with the lines, grades, and thicknesses shown on the

Drawings. Riprap shall be placed to its full thickness during a single operation and in such a manner as to avoid damaging or displacing the underlying bedding material or geotextile. The riprap minimum thickness shall be two (2) times the specified D_{50}, unless otherwise specified on the Drawings.

The larger stones shall be well distributed and the materials shall be placed and distributed so that there will be no large accumulations of either the larger or the smaller size stones. Hand placing or rearranging of individual stones by mechanical equipment may be required to achieve the results specified.

6.6.10. Structural Tailings

Material Properties – Structural Tailings will be delivered and stacked in the CTFS from the Process Plant.

Placement Methods - Structural Tailings shall be placed in the areas shown on the Drawings and free of organic and other deleterious material, in twelve (12)-inch loose lifts or as determined to be acceptable by the Engineer after testing trials are completed at the start of operations. This material shall be moisture conditioned if needed to ninety-five (95) percent of the maximum dry density as determined by ASTM D1557. Slight variations from the specified moisture range may be acceptable subject to acceptance by the Engineer and provided the required compacted densities are achieved. If oversize materials are encountered during fill placement, the Engineer should be consulted on oversize placement methodology.

The fill material shall be compacted with a pad foot and/or smooth drum vibratory compactor capable of achieving compaction through the full thickness of the lift layer. Placement shall be performed in such a manner that material placed is not rutting, pumping or exhibiting excessively deflection during compaction under haul traffic loading. If the surface exhibits excessive deflection, the material in the area of question may require stabilization using a combination of moisture reduction through active drying and re-compaction, selective placement of rocky material and re-compaction, or other means of stabilization such as geogrid placement in these areas.

6.6.11. Non-Structural Tailings

Material Properties – Non-Structural Tailings will be delivered and stacked in the CTFS from the Process Plant. The non-structural zone is designated primarily for placement of the salts and also for clay tailings with higher moisture contents than is allowed to achieve 95 percent compaction in the structural zone. The density requirement in the non-structural zone is lower than required for the structural zone.

Placement Methods - Structural Tailings shall be placed in the areas shown on the Drawings and free of organic and other deleterious material, in twelve (12)-inch loose lifts or as determined to be acceptable by the Engineer after testing trials are completed at the start of operations. This material shall be compacted to approximately 85 percent of the maximum dry density as determined by ASTM D1557 unless otherwise approved by the Engineer based on strength testing completed during operations.

The fill material shall be compacted by routing equipment traffic over the area or compacting with a pad foot and/or smooth drum vibratory compactor capable of achieving compaction through the full thickness of the lift layer. Placement shall be performed in such a manner that excessive rutting, pumping or deflection during compaction occurs under haul traffic loading. If the surface exhibits excessive deflection, the material in the area of question may require stabilization using a combination of moisture reduction through active drying and re-compaction, selective placement and blending with drier material and re-compaction, or other means of stabilization as approved by the Engineer.

6.6.12. Chimney Drain

Material Properties – Chimney Drain material will be native sand materials produced from an onsite borrow source or sand material from the Coarse Gangue Stockpile. The Chimney Drain material shall have a coefficient of permeability 1 x 10^{-4} cm/s or greater when tested in accordance with USBR 5605 - Amended with an applied stress of 32 ksf. The target permeability for the Chimney Drain is two orders of magnitude faster than the adjacent tailings material with a minimum limit of one order of magnitude faster than the overlying tailings. Based on the testing completed to date the target overliner permeability is 1 x 10^{-4} cm/s.

Placement Methods – Chimney Drain construction shall be performed concurrent with tailings placement by placing the material between the Structural and Non-Structural Tailings Zones as shown on the Drawings. This material shall be compacted to approximately 85 percent of the maximum dry density as determined by ASTM D1557. Tailings or other contaminates shall be removed from the surface of the Chimney Sand prior to placing the subsequent layer of sand. The sand layer is shall be a minimum of 3 feet thick and shall be routinely surveyed during construction to confirm the thickness and determine the extents of the sand layer.

7. LINER SURFACE PREPARATION OF AREAS TO RECEIVE GEOSYNTHETIC LINING

Areas to receive geomembrane lining shall be free of angular particles protruding over three-quarter (¾) inch and hard objects that may damage the geomembrane. Where excessive coarse material is exposed at the surface, rock removal by appropriate methods or other surface finishing as directed by the Engineer will be required. Rough areas with depressions or loose material shall be covered with a cushion of fine-grained materials or for large depressions, with screened material (passed over one-half (½) inch mesh screen) or equivalent.

After placement of the Common Fill and Liner Bedding materials, some oversize and/or objectionable materials should be anticipated by the General Contractor. Removal of oversize and objectionable materials by blading, rock-raking, hand picking or other methods shall be required to meet the Specifications for finished surface preparation. All areas to receive geomembrane lining shall meet the requirements for finished surface preparation as defined herein. No separate payment shall be made for rock removal; it shall be included as part of surface preparation.

Once the General Contractor believes that the surface preparation is complete, an inspection will be completed by the geomembrane Lining Contractor, Engineer, Inspector, and Owner with the General Contractor present. The General Contractor shall fix any areas found during inspection that need repairing prior to Geomembrane Installation. Following the verification of the surface, the Lining Contractor shall sign an acceptance form and assumes full responsibility for the verified area should conditions be altered by occurrences outside the control of the General Contractor.

8. COMPACTION EQUIPMENT

Sufficient compaction equipment, of the types and sizes required to complete the work, shall be provided for compaction of the various fill materials. The use of alternative equipment will be dependent upon completion of suitable test fills to the satisfaction of the Engineer to confirm that the alternative equipment will compact the fill materials to the specified density.

Compaction equipment shall be maintained in good working condition at all times to ensure that the amount of compaction obtained is a maximum for the equipment. The General Contractor shall provide the Owner and Engineer a list of proposed compaction equipment to be used before commencing Work.

8.1. Smooth Drum Vibratory Roller

Smooth drum vibratory rollers shall be equipped with a suitable cleaning device to prevent the accumulation of material on the drum during rolling. Each roller shall have a total static weight of not less than 20,000 pounds at the drum when the roller is standing on level ground. The drum shall be not less than sixty (60) inches in diameter and seventy eight (78) inches in width. The vibration frequency of the roller drum during operation shall be between 1,100 and 1,500 vibrations per minute, and the centrifugal force developed by the roller, at 1,250 vibrations per minute, shall not be less than 38,000 pounds.

For compaction by the vibratory roller, a single coverage shall be defined as one (1) pass of the roller. A minimum overlap of twelve (12) inches shall be maintained between the surfaces traversed by adjacent passes of the roller drum. During compaction, the roller shall be propelled at two (2) miles per hour (mph) or lesser speed as approved by the Engineer. The power of the motor driving the vibrator shall be sufficient to maintain the specified frequency and centrifugal force under the most adverse conditions that may be encountered during the compaction of the fill. Propulsion equipment for the roller shall be adequate to propel the roller at speeds up to four (4) mph.

8.2. Tamping-Foot Roller

The majority of the fill may be compacted with a tamping-foot roller. The tamping-foot roller shall be self-propelled and fully ballasted with a standard tamping-foot design developing 5,000 pounds in force per linear foot of width at rest on level ground or equivalent as approved by the Engineer.

8.3. Special Compactors

Special compactors shall be used to compact materials that, in the opinion of the Engineer, cannot be compacted properly by the specified larger vibratory roller because of location or accessibility.

Special compaction measures shall be adopted such as hand-held or small walk behind compactors or other methods approved by the Engineer to compact fill in trenches, around structures, and in other confined areas that are not accessible to the larger vibratory roller or tamping-foot roller. Such compaction shall be to the specified density for the particular material.

9. CONSTRUCTION QUALITY ASSURANCE (CQA)

The Engineer CQA team will monitor and perform the QA testing for the project. Any questions with regard to the Drawings or Technical Specifications associated with the proposed construction shall be addressed to the Engineer for clarifications in accordance with the established project protocol. The Engineer shall approve all changes to the Drawings or Specifications prior to implementing the change.

Construction Quality Control (CQC) functions are the responsibility of the General Contractor and the Lining Contractor and entail completing and recording (as detailed herein) field inspection and control for the project. CQA shall be performed under the direction of a Nevada Professional Engineer and shall be performed by a laboratory from a company that holds current accreditations from AASHTO, AMRL and CCRL.

Testing of the work by CQA does not relieve the Contractors of liability for substandard work.

The General Contractor is responsible for setting out the correct lines and grades to ensure that the Work is constructed accordingly. The project Surveyor will check lines and grades and will verify all quantity measurements and calculations.

The Engineer shall be the interpreter of the Technical Specifications, and shall direct observations and tests as considered necessary to assess and accept the quality of the Work. An Inspector under the direction of the Engineer shall make continuous observations and tests of construction operations. The Engineer shall represent the Owner and shall be responsible during construction for the following:

- Construction observations for quality assurance
- CQA materials testing and inspection for compliance with the Specifications
- Reporting

CQA shall be performed in accordance with the latest test methods in accordance with American Society for Testing and Materials (ASTM) and other recognized industry standards. The tests shall include Control and Record Tests.

9.1. Control Tests

CQA shall complete tests for gradation, moisture content, moisture density relationship and other tests as applicable on samples of fill materials taken from borrow areas and on the fill after spreading and prior to compaction at the frequencies listed in Section 11. Testing shall be sufficient to ensure that the fill material is in full compliance with the Technical Specifications. Materials not meeting the specified material properties shall be reworked or rejected until passing results are achieved.

9.2. Record Tests

CQA shall conduct field density, moisture content, and other tests on the compacted in-place fill and shall obtain samples of the compacted fill for related laboratory testing at such frequency as the Engineer considers necessary to determine that the compacted fill is in full compliance with the Technical Specifications. Areas with failing field tests shall be reworked until passing tests are achieved.

The Inspector, under the supervision of the Engineer, shall perform testing to classify each specified construction material type. Tests performed shall consist of grain-size distribution analyses and Atterberg limits testing to classify each material type for its specified use in construction. Additionally, moisture content, moisture-density relationships, in-place density and moisture tests shall be performed to verify that the construction conforms to the Drawings and Technical Specifications. Observations and tests performed by the Inspector shall not relieve the General Contractor of responsibility for providing adequate CQC measures nor of responsibility for damage to or loss of material before acceptance. The General Contractor shall, at his expense, furnish any labor and equipment necessary to assist the Inspector in obtaining samples for testing. The General Contractor shall allow sufficient time for the Inspector to carry out the required testing and observations at no additional cost to the Owner.

9.3. Reporting

The Engineer shall submit daily reports of observations and tests to the Construction Manager. The reports shall be submitted in a timely fashion. Items of non-conformance will be brought to the attention of the Construction Manager as soon as possible, after identification.

A copy of all test results will be maintained at the construction site, and shall include the following:

- Date issued
- Project title and number
- Date of testing and/or sampling
- Designation or use of material tested
- Type of test and specification
- Location of test
- Description of work activities
- Photos
- Discussion of inspection and test results and issues
- Observations regarding compliance or noncompliance with Drawings and Technical Specifications

Upon completion of construction, the Engineer shall submit a Record of Construction (ROC) Report stating that the project was completed in substantial conformance with the approved Drawings and Technical Specifications and presenting test summaries, record drawings, as-built drawings and other supporting data necessary to document the completed construction.

10. CONSTRUCTION TOLERANCES

The General Contractor shall construct the various aspects of the project to the lines and grades shown on the Drawings, or as required by the Engineer, within the following tolerances:

- Finish grades and slopes for the improvements shall be in general conformance with the Drawings. Deviations from finished grades and slopes are subject to approval by the Engineer and shall not result in low spots, pockets, non-uniform slopes or contours, or result in slopes which deviate by more than 0.1 feet from the design. The overall slope shall be the same as shown on the Drawings. When specified, maximum grades shall not be exceeded.

- Unless noted otherwise on the Drawings, maximum permissible combined horizontal deviation from the lines and grades shown on the Drawings or as required by the Engineer shall be 1.0 feet. The intent of the design must be maintained.
- Pond and sump crest elevations shown on the Drawings shall be minimum allowable elevations and shall not be exceeded by more than 0.1 feet.
- All pipes shall be constructed to the following tolerances: alignment and grade shall not deviate from Manufacturer recommendations and more than five (5) percent of the nominal diameter of the pipe from a straight line between control points. All pipelines shall be constructed to the grade percentages shown on the drawings.

11. TESTING FREQUENCIES

CQA shall carry out frequent quality control and quality assurance tests to determine compliance of the Work with the Technical Specifications.

Both Control tests and Record tests count towards the total number of tests required. The latest edition of standard procedures shall be used for all activities, and in general, these will be adopted from recognized organizations such as ASTM. The Table 11-1 outlines the test methods and the minimum testing requirements for the project are presented in Tables 11-2 through 11-13.

Table 11-1: Test Methods

Test	Type of Test	Test Method
C1, R1	Atterberg Limits	ASTM D4318
C2, R2	Moisture Content	ASTM D6938 or D2216
C3, R3	Particle Size Distribution	ASTM D6913*, ASTM C136
C4, R4	Laboratory Compaction - Modified Proctor	ASTM D1557
R5a	Nuclear Density	ASTM D6938
R5b	Sand Cone	ASTM D1556
R5c	Water Replacement	ASTM D5030
C6, R6	Laboratory Permeability	ASTM D5084/ USBR 5605
C7, R7	Rigid Wall Constant Head Permeability	USBR 5605
C8, R8	Los Angeles Abrasion	ASTM C535
R9	Wolman Count	USDOT FLH T521

Notes: C = Control Tests; R = Record Tests
All samples to be washed over a No.200 sieve.
Minimum test Frequencies provided include both Control and Record Tests combined.
[a] Hydrometer tests down to the 2-micron size will be carried out as directed by the Engineer but will generally not be required

Table 11-2: Test Frequency – Surface Preparation/Liner Bedding

Test	Type of Test	Frequency (one per)
R1	Atterberg Limits	Soil Type / 250,000 sf
R2	Moisture Content	Soil Type / 250,000 sf
R3	Particle Size Distribution	Soil Type / 250,000 sf
R4	Laboratory Compaction	Soil Type / 500,000 sf
R5a	Nuclear Density	50,000 ft^2
Note: Required number of tests shall be determined by whichever method of determining the frequency requires the most tests.		

Table 11-3: Test Frequency – Rockfill

Activity	Frequency (one per)
Visual Inspection and Documentation	Continuous during placement activities
US Army Corps of Engineers Test Fill (EM 1110-2-2301)	Test fill for rock type

Table 11-4: Test Frequency – Common Fill

Test	Type of Test	Frequency (one per)
C1, R1	Atterberg Limits	Soil Type / 50,000 cy
C2, R2	Moisture Content	per nuclear density requirements
C3, R3	Particle Size Distribution	Soil Type / 50,000 cy
C4, R4	Laboratory Compaction	Soil Type / 200,000 cy
R5a	Nuclear Density	5,000 cy in CTFS, CGS & WRSF areas, every 1,000 cy pond areas & every 1,000 LF for anchor trenches
R5b/R5c	Sand Cone or Water Replacement Density	As Needed by CQA
Note: Required number of tests shall be determined by whichever method of determining the frequency requires the most tests.		

Table 11-5: Test Frequency – Select Gravel

Test	Type of Test	Frequency (one per)
C1, R1	Atterberg Limits	20 cy
C3, R3	Particle Size Distribution	20 cy
C8, R8	Los Angeles Abrasion	Per Soil Type
Note: Required number of tests shall be determined by whichever method of determining the frequency requires the most tests.		

Table 11-6: Test Frequency – Overliner

Test	Type of Test	Frequency (one per)
C1, R1	Atterberg Limits	Soil Type / 10,000 cy
R2	Moisture Content	Soil Type / 10,000 cy
C3,R3	Particle Size Distribution	Soil Type / 10,000 cy
C7	Rigid Wall Constant Head Permeability	100,000 cy
R8	Los Angeles Abrasion	Soil Type/ 300,000 cy
Note: Required number of tests shall be determined by whichever method of determining the frequency requires the most tests.		

Table 11-7: Test Frequency – Wearing Course

Test	Type of Test	Frequency (one per)
C1,R1	Atterberg Limits	2,000 cy
C3,R3	Particle Size Distribution	2,000 cy
C4,R4	Laboratory Compaction	10,000 cy
R5a	Nuclear Density	2,500 LF
Note: Required number of tests shall be determined by whichever method of determining the frequency requires the most tests.		

Table 11-8: Test Frequency – Pipe Backfill and Pipe Bedding

Test	Type of Test	Minimum Frequency (one per)
C1, R1	Atterberg Limits	Soil type/500 cy or 1 per structure
C2, R2	Moisture Content	per nuclear density requirements
C3, R3	Particle Size Distribution	Soil type/500 cy or 1 per structure
C4, R4	Laboratory Compaction	Soil type/500 cy or 1 per structure
R5a	Nuclear Density	15 cy*
Note: Frequency of testing for backfill for minor foundations shall be determined by the Project Field Engineer. Required number of tests shall be determined by whichever method of determining the frequency requires the most tests. *Minimum 1 per lift for each side of pipe.		

Table 11-9: Test Frequency – Filter Sand

Test	Type of Test	Minimum Frequency (one per)
C1, R1	Atterberg Limits	Soil type/20 cy
C2, R2	Moisture Content	per nuclear density requirements
C3, R3	Particle Size Distribution	20 cy
C4, R4	Laboratory Compaction	Soil type/40 cy
R5a	Nuclear Density	1 per lift per each side of pipe
Note: Required number of tests shall be determined by whichever method of determining the frequency requires the most tests.		

Table 11-10: Test Frequency – Riprap

Test	Type of Test	Frequency (one per)
Visual Inspection and Documentation		Continuous during placement
R9	Wolman Count	One per size and every 750 linear feet of channel

Table 11-11: Test Frequency – Structural Tailings

Test	Type of Test	Frequency (one per)
R1	Atterberg Limits	1 per week/ 60,000 cy
R2	Moisture Content	per nuclear density requirements
R3	Particle Size Distribution	1 per week/ 60,000 cy
R4	Laboratory Compaction	1 per week/ 60,000 cy
R5a	Nuclear Density	1 per lift/ 1 per day of placement/ 5,000 cy
Note: Required number of tests shall be determined by whichever method of determining the frequency requires the most tests.		

Table 11-12: Test Frequency – Non-Structural Tailings

Test	Type of Test	Frequency (one per)
R1	Atterberg Limits	1 per week/ 60,000 cy
R2	Moisture Content	per nuclear density requirements
R3	Particle Size Distribution	1 per week/ 60,000 cy
R4	Laboratory Compaction	1 per week/ 60,000 cy
R5a	Nuclear Density	1 per lift / 1 per day of placement/ 10,000 cy
Note: Required number of tests shall be determined by whichever method of determining the frequency requires the most tests.		

Table 11-13: Test Frequency – Chimney Drain

Test	Type of Test	Frequency (one per)
C1, R1	Atterberg Limits	Soil Type/ 1,000 cy
R2	Moisture Content	Per nuclear density requirements
C3, R3	Particle Size Distribution	Soil Type/ 1,000 cy
C4, R4	Laboratory Compaction	Soil type/ 5,000 cy
R5a	Nuclear Density	500 cy
Note: Required number of tests shall be determined by whichever method of determining the frequency requires the most tests.		

APPENDIX F.3

Geomembrane

NewFields	**CLIENT** **Lithium Nevada Corporation**	**PROJECT NO** 475.0385.000
PROJECT: THACKER PASS PROJECT		
TITLE: TECHNICAL SPECIFICATIONS FOR HIGH DENSITY AND LINEAR LOW DENSITY POLYETHYLENE GEOMEMBRANE LINER MATERIALS AND INSTALLATION		**SPECIFICATION NO.** **2-0385-000-SP-GM-0**

REV	**DATE**	**PAGES**	**APPROVALS**			**REMARKS**
			AUTHOR	**REVIEW**	**CLIENT**	
0	04/02/2020	24	MH	KCW	BR	Issued for Construction

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1. GENERAL

This Specification defines the requirements for geomembrane materials, installation, quality control and quality assurance associated with the Thacker Pass Project owned by Lithium Nevada Corporation.

Any requests for alternatives or exceptions to this Specification shall be submitted in writing to the Construction Manager and shall be approved by the Engineer and the Owner.

The Definition of Terms is provided in Specification No. 0-0385-000-SP-GEN-0.

2. CODES AND STANDARDS

All tests shall be performed in accordance with the current edition of the testing standards as indicated below.

2.1. American Society for Testing and Materials (ASTM) Standards

- ASTM D792-13: “Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement”, ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D1004-13: “Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting”, ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D1238-13: “Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer”, ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D1505-18: “Standard Test Method for Density of Plastics by the Density-Gradient Technique”, ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D1557-12e1: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort, ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D1603-14: “Standard Test Method for Carbon Black Content in Olefin Plastics”, ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D3895-19: “Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry”, ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D4218-15: “Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds By the Muffle-Furnace Technique”, ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D4437/D4437M-16(2018): “Standard Practice for Nondestructive Testing (NDT) for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes”, ASTM International, West Conshohocken, PA, www.astm.org.

- ASTM D4833/D4833M-07(2013)e1: "Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D5199-12(2019): "Standard Test Method for Measuring the Nominal Thickness of Geosynthetics", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D5321/D5321M-19: "Standard Test Method for Determining the Shear Strength of Soil-Geosynthetic and Geosynthetic-Geosynthetic Interfaces by Direct Shear", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D5397-19a: "Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D5596-03(2016): "Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D5641/D5641M-16: "Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D5721-08(2018): "Standard Practice for Air-Oven Aging of Polyolefin Geomembranes", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D5820-95(2018): "Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D5885/D5885M-17: "Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D5994/D5994M-10(2015)e1: "Standard Test Method for Measuring Core Thickness of Textured Geomembrane", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D6365-99(2018): "Standard Practice for the Nondestructive Testing of Geomembrane Seams using the Spark Test", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D6370-99(2019): "Standard Test Method for Rubber-Compositional Analysis of Thermogravimetry (TGA)", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D6392-12(2018): "Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D6693/D6693M-04(2015)e1: "Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes", ASTM International, West Conshohocken, PA, www.astm.org.

- ASTM D6747-15: “Standard Guide for Selection of Techniques for Electrical Detection of Potential Leak Paths in Geomembranes”, ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D7007-16: “Standard Practices for Electrical Methods for Locating Leaks in Geomembranes Covered with Water or Earthen Materials”, ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D7238-06(2017): “Standard Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus”, ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D7240-18: “Standard Practice for Leak Location using Geomembranes with an Insulating Layer in Intimate Contact with a Conductive Layer via Electrical Capacitance Technique (Conductive Geomembrane Spark Test)”, ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D7466/D7466M-10(2015)e1: “Standard Test Method for Measuring Asperity Height of Textured Geomembranes”, ASTM International, West Conshohocken, PA, www.astm.org.

2.2. Geosynthetic Research Institute (GRI) Standards

- GRI GM9 Revision 1, January 10, 2013: “Cold Weather Seaming of Geomembranes”, Geosynthetic Institute, Folsom, PA, www.geosynthetic-institute.org.
- GRI GM10 Revision 4, July 23, 2015: “The Stress Crack Resistance of HDPE Geomembrane Sheet”, Geosynthetic Institute, Folsom, PA, www.geosynthetic-institute.org.
- GRI GM13 Revision 15, September 9, 2019: “Test Properties, Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes”, Geosynthetic Institute, Folsom, PA, www.geosynthetic-institute.org.
- GRI GM14 Revision 1, January 9, 2013: “Selecting Variable Intervals for Taking Geomembrane Destructive Seam Samples Using the Method of Attributes”, Geosynthetic Institute, Folsom, PA, www.geosynthetic-institute.org.
- GRI GM19(a) Revision 9, July 28, 2017: “Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes”, Geosynthetic Institute, Folsom, PA, www.geosynthetic-institute.org.

3. GEOMEMBRANE

There are two geomembranes specified for the Thacker Pass Project. An 80-mil High Density Polyethylene (HDPE) double-sided textured geomembrane shall be installed in the Clay Tailings Filter Stack (CTFS) and solution channel. In the Reclaim Pond an 80-mil double-sided textured HDPE geomembrane will be installed as the primary liner and a 60-mil double-sided textured

HDPE geomembrane will be installed as the secondary liner with geonet separating the two liners.

3.1. Manufacturer's Quality Control

The geomembrane shall be a high quality formulation containing approximately ninety-seven (97) percent polymer and three (3) percent carbon black with antioxidants and heat stabilizers. The material shall be resistant to ultraviolet (UV) rays. All resin shall be hexene-based, consist of all virgin material from the same Manufacturer, shall not be intermixed, and no reclaimed polymer may be added to the resin. The manufacturing process shall not use more than ten (10) percent regrind. If regrind is used, it must be similar to the parent material.

The geomembrane material shall comprise of new, first-quality products designed and manufactured specifically for the purpose of liquid containment in hydraulic structures as applied to the mining industry. The material shall be produced to be free of holes, blisters, undispersed raw materials, or any sign of contamination by foreign matter. The geomembrane shall be supplied in roll form. Each roll shall be identified with labels indicating roll number, thickness, length, width, and Manufacturer's name and date of manufacture.

The Manufacturer's laboratory must be certified by Geosynthetic Accreditation Institute (GAI) Laboratory Accreditation Program (LAP) for the tests being performed and shall have a third-party independent quality assurance program. All test results shall be provided to the Engineer and the rolls of material shall be clearly identified and correlate to the test results.

Extrudate rod or bead material shall be made from the same type of resin as the geomembrane and be from the same resin supplier as the resin used to manufacture the geomembrane.

3.2. Manufacturer's Warranty

The material shall be warranted against Manufacturer's defects as well as degradation due to UV light for exposed areas for a minimum of 20 years from the date of installation or as mutually agreed prior to award of the contract for supply between the Owner and the Geomembrane Manufacturer. The warranty shall cover the cost of material, freight and duties, handling, labor, and equipment to replace the defective or failed material.

3.3. Submittals Post-Award

3.3.1. Manufacturer Submittals

Prior to delivery, the Manufacturer shall submit a Quality Control Certificate for each roll of material. These certificates shall clearly indicate the roll or rolls which the results represent. Roll goods shipped to the project site which do not meet or exceed the Manufacturer's published Specifications and the Specifications stated herein shall be rejected.

Resin data including the following:

- Certification stating that the resin meets the specification requirements and that it is all from the same Manufacturer (see Table 3-1).
- Statement certifying no reclaimed polymer and no more than ten (10) percent rework of the same type of material is added to the resin (product run may be recycled).
- Copy of quality assurance and quality control certificates issued by resin supplier.

Table 3-1: HDPE Raw Material Properties

Property	Test Method	Specification
Density (g/cm^3)	ASTM D1505	$\geq$0.932
Melt Flow Index (g/10 min)	ASTM D1238 (190/2.16)	$\leq$1.0
OIT (minutes)	ASTM D3895 (1 atm/200°C)	$\geq$100

Geomembrane roll, extrudate rod and bead material:

- All rolls shall be delivered with labels affixed to or markings on the selvage edge clearly stating the Manufacturer’s name, product identification, material thickness, roll number, roll type, roll dimensions and roll weight.
- Copy of quality assurance and quality control certificates issued by the Geomembrane Manufacturer.
- Certification that the geomembrane material delivered to the project complies with these Specifications.
- Certification that extrudate rod or bead is from one Manufacturer, it was obtained from the same resin supplier, and comes from the same resin type which was used to manufacture the geomembrane rolls.

It is the Manufacturer’s responsibility to submit timely proposals and submittals allowing a minimum of two (2) weeks for review and approval.

3.3.2. Lining Contractor Submittals

The Lining Contractor shall supply the Construction Manager and Engineer with the following prior to commencement of work:

- Panel layouts of the liner that must be approved by the Engineer prior to commencing the Work. The submittal shall include a proposed field panel “identification” code numbering system.

- Resumes for the Master Welder and other welder’s with a description of their qualifications and experience for approval prior to arrival on site.
- The Lining Contractor shall submit a copy of their Quality Control Manual prior to the start of installation of any geomembrane. If there are discrepancies between this Specification and the Lining Contractor’s Quality Control Manual, the more stringent requirements shall apply, unless determined otherwise by the Engineer. The Engineer shall review and approve the Lining Contractor’s Quality Control Manual including logs, inspection and testing methods and forms prior to the Lining Contractor commencing the Work.

3.4. Third Party Conformance Testing (Manufacturing)

Conformance testing shall be conducted by a third party laboratory to statistically measure conformance of the geomembrane roll goods shipped to the project. Conformance testing is not the responsibility of the Lining Contractor.

3.4.1. Sampling Procedures

Samples shall be taken at a rate of one per lot or one per 1,000,000 square feet of roll goods shipped to the project, whichever results in the greater number of tests. Rolls shall be selected at random for testing and should be from different resin lots if more than one (1) resin lot is used to make the rolls.

Samples shall be removed from the roll at a random location, but shall not include any area within the first three (3) lineal feet of the end and/or edge of the roll. The sample shall be a minimum of one and a half (1.5) feet by three (3) feet in size and shall be marked with an arrow to indicate the machine direction and the Liner Manufacturer’s roll and lot identification number shall be included on the sample.

3.4.2. Test Results

Conformance testing shall include the following tests. The Engineer shall review the test results for project compliance and shall provide a written report to the Construction Manager.

- Thickness (ASTM D5994)
- Density (ASTM D1505/D792 method B)
- Tensile Properties (ASTM D6693)
- Carbon Black Content (ASTM D4218)

3.4.3. Procedures for Conformance Test Failure

Should any test results indicate non-conformance with the Specifications, the non-conforming roll number shall be identified and additional conformance testing shall be performed on rolls with adjacent numbers. All non-conforming rolls shall be identified and set aside.

3.5. HDPE Geomembrane Materials

Tests to be performed and minimum specifications shall include, but not be limited to, the following items presented in Table 3-2:

Table 3-2: HDPE Geomembrane - Textured
(Reference: GRI Test Method GM13 Revision 15, dated 09/09/2019)

Properties	Test Method	Test Value		Testing Frequency (minimum)
		60 mil (1.5 mm)	80 mil (2.0 mm)	
Thickness (min. avg.)	ASTM D5994	Nominal (-5%)	Nominal (-5%)	Per roll
▪ Lowest individual for 8 out of 10 values		-10%	-10%	
▪ Lowest individual for any of the 10 values		-15%	-15%	
Asperity Height mils (min. avg.)	D 7466	16 mil	16 mil	Every 2nd roll[1]
Density mg/L (min. avg.)	ASTM D1505/D792	0.940 g/cc	0.940 g/cc	200,000 lbs
Tensile Properties [2] (min. avg.)	ASTM D6693 Type IV			20,000 lbs
▪ Yield strength		126 lbs/in	168 lbs/in	
▪ Break strength		90 lbs/in	120 lbs/in	
▪ Yield elongation		12%	12%	
▪ Break elongation		100%	100%	
Tear Resistance (min. avg.)	ASTM D1004	42 lbs	56 lbs	45,000 lbs
Puncture Resistance (min. avg.)	ASTM D4833	90 lbs	120 lbs	45,000 lbs
Stress Crack Resistance [3]	ASTM D5397 (App.)	500 hrs	500 hrs	Per GRI-GM10
Carbon Black Content (range)	ASTM D4218 [4]	2.0-3.0%	2.0-3.0%	20,000 lbs
Carbon Black Dispersion	ASTM D5596	Note 5	Note 5	45,000 lbs
Oxidative Induction Time (OIT) (min. avg.) [6]				200,000 lbs
a) Standard OIT	ASTM D3895	100 min.	100 min.	
--OR--				
b) High Pressure OIT	ASTM D5885	400 min.	400 min.	
Oven Aging at 85°C [6, 7]	ASTM D5721			Each formulation
a) Standard OIT (min. avg.) - % retained after 90 days	ASTM D3895	55%	55%	
--OR--				
b) High Pressure OIT (min. avg.) - % retained after 90 days	ASTM D5885	80%	80%	
UV Resistance[8]	ASTM D7238			Each formulation
a) Standard OIT (min. avg.)	ASTM D3895	N.R.[9]	N.R.[9]	
--OR--				
b) High Pressure OIT (min. avg.) - % retained after 1,600 hrs [10]	ASTM D5885	50%	50%	

1. **Alternate the measurement side for double-sided textured sheet.**
2. **Machine direction (MD) and cross-machine direction (XMD) average values should be on the basis of five (5) test specimens each direction. Yield elongation is calculated using a gauge length of 1.3 inches. Break elongation is calculated using a gauge length of 2.0 inches.**
3. **P-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials.**
   The yield stress used to calculate the applied load for the SP-NCTL test should be the Manufacturer's mean value via MQC testing.
4. **Other methods, such as D1603 (tube furnace) or D6370 (TGA) are acceptable if an appropriate correlation to D4218 (muffle furnace) can be established.**
5. **Carbon black dispersion (only near spherical agglomerates) for ten (10) different views: Nine (9) in Categories 1 or 2 and one (1) in Category 3.**
6. **The Manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.**
7. **It is also recommended to evaluate samples at 30 and 60 days to compare with the 90-day response.**
8. **The condition of the test should be 20-hour UV cycle at 75°C followed by 4-hour condensation at 60°C.**
9. **Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV-exposed samples.**
10. **UV resistance is based on percent-retained value regardless of the original HP-OIT value.**

4. GEOMEMBRANE INSTALLATION

4.1. General

The geomembrane shall be installed within the areas shown on the Drawings or as directed by the Engineer.

The geomembrane rolls shall be stored so they are protected from puncture, dust, grease, moisture, mechanical abrasion, and excessive heat or other damage. The rolls shall be stored on a flat smooth surface (minus one (1)-inch well graded gravel rolled with a smooth drum or equivalent) and not stacked more than two rolls high. Care shall be taken to maintain identification and Manufacturer data on the roll.

Prior to deployment of geomembrane, the Lining Contractor shall inspect and accept, with the Engineer, CQA and the Construction Manager, all surfaces on which the geomembrane is to be placed. The surface on which the geomembrane is to be installed shall be free of sharp particles, rocks, or other objectionable material or debris. Sharp and/or objectionable objects shall be removed by raking, sweeping, or hand picking, as necessary.

Installation of the geomembrane shall be performed under the direction of a supervisor who has installed a minimum of 10,000,000 square feet (ft^2) of the specified type of geomembrane or similar. Seaming shall be performed under the direction of a master seamer (who may also be the field installation supervisor or crew foreman) with seaming experience of a minimum of 3,000,000 ft^2 of the geomembrane type specified or similar product, using the same type of seaming apparatus to be used in the current project. During the seaming, the field installation supervisor or master seamer shall be present. Qualified technicians employed by the Lining Contractor shall complete all seaming, patching, testing, and other welding operations.

The geomembrane shall be placed over the prepared surfaces using methods and procedures that ensure a minimum of handling. Adequate temporary and permanent anchoring devices and ballasting shall be provided to prevent uplift and damage due to wind. The Lining Contractor is solely responsible for the safety of his operations including decisions regarding deployment in adverse weather conditions and the amount of temporary anchoring and ballasting required. The Lining Contractor shall take necessary precautions to protect the geomembrane from damage, including prohibiting workers from smoking on or near the geomembrane and wearing foot apparel that would damage the membrane.

To the extent possible, seams shall be oriented parallel to the fall line, slope or grade of the ground. The panels shall be secured temporarily with sandbags or other approved ballasting method to hold them in place until the field seams have been completed and the geomembrane has been permanently anchored. Ballast material shall conform to the specified requirements for overliner material.

The Lining Contractor shall take into account that high winds are prevalent at the project Site and may result in liner damage and delays. The Lining Contractor shall take all necessary measures to ensure that each panel is sufficiently ballasted to prevent damage or movement by wind. Fusion of panels and repairs will only be permitted under weather conditions allowing such work, and within the warranty limits of the Geomembrane Manufacturer, as approved by the Construction Manager and the Engineer.

Horizontal field seams on slopes shall be kept to a minimum and require the approval of the Engineer. Horizontal seams on steep slopes shall be avoided where possible by placing the liner at a 45-degree angle to the slope. Generally, horizontal seams are to be no closer than ten (10)-feet from the toe of the slope. Horizontal seams shall be made by lapping or shingling the uphill material over the downhill material. Panels shall be shingled in a manner that prevents water from running beneath the liner or seam.

The geomembrane shall be installed in a relaxed condition and shall be free of tension or stress upon completion of the installation. The installed geomembrane shall contain sufficient slack material to allow for thermal expansion and contraction during the annual extreme temperatures expected at the Site. Individual wrinkles should take the form of undulations in the liner but should not be large enough for the material to fold over on itself.

During installation, the Lining Contractor shall give each field panel an “identification” code number consistent with the approved layout plan. The CQC, CQA and the Engineer shall agree upon the numbering system before liner installation starts. The Lining Contractor shall update the layout plan as each panel is installed to show the location of each panel. A field panel is defined as the area of geomembrane that is to be seamed in the field (roll or portion of a roll cut in the field).

Individual panels of geomembrane material shall be laid out in a pattern that will produce the least number of seams. The material shall be overlapped prior to welding. Extreme care shall be taken by the Lining Contractor in the preparation of the areas to be welded. The joint interface shall be cleaned and prepared according to industry standard procedures, those specified by the material Manufacturer and those approved by the Engineer. Seaming shall not take place unless the panels are dry and clean. All sheeting shall be welded together by thermal methods. When placing panels together where one panel has been deployed previously, the adjacent panels will need to be allowed to equilibrate in temperature and slack before welding.

Any area showing damage due to excessive scuffing, puncture, or distress from any cause shall be replaced or repaired with an additional piece of geomembrane. Patching of panels to repair defects shall be limited. If excessive physical damage occurs to the geomembrane during or after installation (i.e. wind blowout, rock or equipment damage) the Engineer may require the damaged area to be replaced. What constitutes excessive physical damage shall be determined in the field by the Construction Manager, Owner and the Engineer.

No “fish mouths” will be allowed within the seam area. Where “fish mouths” occur, the material shall be cut, overlapped, and the area shall be patched.

Geomembrane panels must have a finished overlap of four (4) to six (6)-inches for double-wedge welded seams and minimum six (6)-inches for extrusion welded seams. Notwithstanding this provision, sufficient overlap shall be provided to allow shear and peel tests to be performed on any seam.

Handling and storage of the geomembrane material shall be in accordance with the Manufacturer’s printed instructions. Persons walking or working on the geomembrane shall not engage in activities or wear foot apparel that could damage the geomembrane.

An adequate amount of handling equipment, welding apparatuses, and testing equipment shall be maintained on site by the Lining Contractor to avoid delays due to problems with equipment failures.

4.2. Cold Weather Procedures

Cold weather installations should follow the guidelines as outlined in GRI GM9.

Seaming of geomembrane materials shall not be allowed when the sheet temperatures are less than 32° F (0° C) unless the following conditions are met:

- Seaming of the geomembrane at material temperatures below 32° F (0° C) shall be allowed if the Lining Contractor can demonstrate to the Engineer, CQA and the Construction Manager, using prequalification test seams, that field seams comply with the project Specifications, the safety of the crew is ensured, and geomembrane material can be fabricated (i.e. pipe boots, penetrations, repairs. etc.) at sub-freezing temperatures.
- The Lining Contractor shall submit to the Engineer, CQA and the Construction Manager for approval, detailed procedures for seaming at low temperatures, including the following:
  - Preheating of the geomembrane.
  - The provision of a tent or other device as necessary to prevent heat losses during seaming and rapid heat losses subsequent to seaming.
  - Number of test welds required to determine appropriate seaming parameters.

4.3. Hot Weather Seaming

Seaming of geomembrane materials shall not be allowed when the sheet temperature is above 170° F (75° C) as measured by an infrared thermometer or surface thermocouple, unless otherwise approved by the Engineer. Any approval to seam geomembrane above these limits shall be based on recommendations by the Manufacturer and on a field demonstration by the Lining Contractor using prequalification test seams to demonstrate that seams comply with the Technical Specifications.

4.4. Geomembrane Installation Quality Control

4.4.1. General

The Lining Contractor shall be fully responsible for carrying out all quality control inspection and tests on the geomembrane and shall do so to the satisfaction of the Engineer and in accordance with this Technical Specification and the Lining Contractor’s Quality Control Manual. On-site physical nondestructive and destructive testing shall be completed on all joints to ensure that watertight uniform seams are achieved on a continuous basis as installation proceeds. The CQA shall randomly witness destructive tests completed by the Lining Contractor’s CQC.

Fusion of panels and repairs will only be permitted under weather conditions allowing Work that is in conformance to the Specifications and within the warranty limits imposed by the Manufacturer and to the approval of the Engineer and CQA.

The Lining Contractor shall not have more than 500,000 ft^2 of geomembrane deployed at any time without final CQA/CQC and acceptance by the CQA. At the beginning of each day’s Work, the Lining Contractor shall provide the CQA with copies of all the previous days’ reports (electronic format) as well as an update of the quantity and location of geomembrane placed.

4.4.2. Trial Welds

Trial welds shall be completed to verify the performance of the welding equipment and operator prior to performing production welds or if Work stoppages or significant changes in temperature or weather conditions occur. No welding equipment or operator shall perform production welds until equipment and operator have successfully completed a trial weld and are approved by the CQA. The following procedures shall be followed for trial welds:

- Make trial welds under the same surface and environmental conditions as the production welds; i.e., in contact with subgrade and similar ambient temperature.
- Minimum of two trial welds per day per welding apparatus – one made prior to the start of Work and one completed at mid-shift, Work stoppages or for every five (5) hours of seaming operations.

- Cut ten (10) each (five (5) for peel test, five (5) for shear test) one (1)-inch wide by six (6)-inch long test strips from the trial weld.
- Quantitatively test specimens for peel adhesion and for bonded seam strength (shear).
- Trial weld specimens shall pass when the results shown in Table 4-1 are achieved in both peel and shear tests and:
- The break, when peel testing, occurs by Separation in the Plane of the sheet (SIP), not through adhesion failure separation (AD). When the seam separation is equal to or greater than twenty-five (25) percent of the track width, it is a failed test.
- Confirm the break is ductile.
- Repeat the trial weld, in its entirety, when the trial weld samples fail in either peel or shear as defined in Table 4-1 and above.
- The Lining Contractor is responsible for submitting all documentation of CQC testing to the Engineer and the Construction Manager daily.

Table 4-1: Seam Strength and Related Properties of Thermally Bonded Smooth and Textured HDPE Geomembranes (Reference: GRI Test Method GM19a Revision 9 updated 07/28/2017)

Geomembrane Nominal Thickness	60-mil (1.5 mm)	80-mil (2.0 mm)
Hot Wedge Seams [1]		
Shear strength [2] (lbs/in.)	120	160
Shear elongation at break [3] (%)	50	50
Peel strength [2] (lbs/in.)	91	121
Peel separation (%)	≤25	≤25
Extrusion (Fillet) Seams		
Shear strength [2] (lbs/in.)	120	160
Shear elongation at break [3] (%)	50	50
Peel strength [2] (lbs/in.)	78	104
Peel separation (%)	≤25	≤25

[1] Also for hot air and ultrasonic seaming methods.

[2] Elongation measurements should be omitted for field testing.

[3] Value listed for shear and peel strengths are for 5 out of 5 test strip specimens. All 5 out of 5 testing results should meet or exceed the values in the table.

4.4.3. Field Seaming

The Lining Contractor shall have at least one Master Welder who shall provide direct supervision to the other welders. Field seaming procedures and requirements shall include:

- The welding equipment shall be capable of continuously monitoring and controlling the temperature in the zone of contact where the machine is fusing the material to ensure changes in environmental conditions will not affect the integrity of the weld.
- The seam area shall be cleaned of dust, mud, moisture and debris immediately ahead of the welding apparatus.
- The seam overlaps shall be aligned consistent with the requirements of the welding equipment being used. A four (4)-inch to six (6)-inch overlap shall be used for double-wedge welded seams and six (6)-inches for extrusion welded seams unless approved otherwise by the Engineer.
- Seaming shall not proceed when the ambient air temperature or adverse weather conditions jeopardize the integrity of the geomembrane installation.
- Extrusion welding apparatus' shall be purged of heat-degraded extrudate before welding.
- The double-wedge fusion welding process shall be used unless alternate methods are approved by the Engineer. Extrusion welding shall be permitted to weld short seams to repair small areas where double-wedge welding is not feasible, and for caps and patches.

4.4.4. Field Seam and Panel Inspection and Testing

4.4.4.1. Nondestructive Testing and Inspection

The Lining Contractor CQC and CQA shall perform visual inspections of deployed and welded geomembrane panels to identify defects, damage, or protrusion of sharp objects that may affect the integrity of the geomembrane. Defective or damaged areas shall be marked and repaired according to the Specifications and the guidelines in the Lining Contractor's Quality Control Manual.

The CQC performed by the Lining Contractor and CQA shall inspect each seam, marking their initials and date inspected at the end of each panel. Any area showing a defect shall be marked and repaired in accordance with the applicable repair procedures.

4.4.4.2. Continuity Testing

A maximum effort shall be made by the Lining Contractor to install a high quality and leak-free geomembrane liner. This implies that all seams completed in the field, patches, and extrusions shall be tested and recorded. All failures shall be isolated and repaired as directed by the Engineer and CQA. A general testing procedure for the Lining Contractor CQC is as follows:

- Test all field seams, repairs and patches with interseam pressure, vacuum box, spark test, or other approved methods. Non-destructive testing methods are discussed in the following subsections.
- Isolate and repair all areas indicating any defects. Retest the repair.

4.4.4.3. Interseam Pressure Testing

Test procedure shall be in accordance with ASTM D5820 for interseam pressure for seams (for double-wedge welding only):

- Seal both ends of the seam to be tested by applying heat to the end of the seam via a heat gun until flow temperature is achieved. Clamp off the ends and let cool.
- Insert a pressure gauge with needle assembly into the end of the seam and seal.
- Pressurize the air channel between the two seams to between thirty (30) psi and thirty-five (35) psi. Following pressure stabilization, take the initial pressure reading, hold the pressure a minimum of three (3) minutes and take a second reading.
- The allowable leak-down for the seam is three (3) psi maximum.
- If the pressure drop is below the maximum allowable three (3) psi, open the air channel at the end away from the pressure gauge. Air should rush out and the pressure gauge should register an immediate drop in pressure, indicating that the entire length of seam has been tested. If this does not happen, either the air channel is blocked or the equipment is faulty, and the test is not valid.
- Enter the results of the leak test on the appropriate documentation, indicating either a passed or a failed seam. If the seam fails, the repair Work and subsequent testing should be recorded on the same document.
- Repair the area where the pressure gauge/needle assembly was installed and where the air was released.

4.4.4.4. Vacuum Box Testing

Where possible, the Lining Contractor CQC shall test all extrusion seams in accordance with ASTM5641:

- Mix a solution of liquid detergent and clean water and apply an ample amount to the area to be tested. If a seam contains excess overlap or loose edges, it must be trimmed before testing.
- Place a rigid transparent vacuum box over the area and apply a slight amount of downward pressure to the box to seat the seal strip to the liner.
- Apply a vacuum of four (4) psi to eight (8) psi for a minimum of ten (10) seconds to the area. The Lining Contractor CQC shall examine the geomembrane through the viewing window for the presence of soap bubbles indicating a leak. If no bubbles appear after ten (10) seconds, consider the area leak free. Once the area is leak free, depressurize the box and move it over the next adjoining area with an appropriate overlap and repeat the process.

- Enter the results of the leak test on the appropriate documentation, indicating either a passed or a failed seam. If the seam fails, the repair Work and subsequent testing should be recorded on the same document.

4.4.4.5. Spark Testing

Extrusion welded patches, caps, pipe boots, etc., in lieu of vacuum-box testing, shall be spark tested in accordance with ASTM D6365 and the following procedures:

- The seam shall be prepared for extrusion welding in accordance with the Lining Contractor's procedures.
- Just prior to applying the extrusion bead, a small-gauge copper wire (18-gauge bare copper wire or equivalent) shall be placed into the seam. The wire should be grounded at one end and placed at the edge of the top sheet of the overlap seam. Tucking the wire under the edge of the top sheet will help hold the wire in place during welding, but this should be done prior to grinding to avoid the risk of contamination of the weld area. Electrically conductive tape placed along the edge of the overlying patch can also be used instead of copper wire.
- Apply the extrudate bead as normal and allow the weld to cool.
- Complete a calibration test on a trial seam containing a non-welded segment ensuring the identification of such a defect (non-welded segment) under the planned spark tester settings and procedures.
- Energize the spark tester and move the electrode wand near the trial seam to determine the maximum length of spark that can be generated. Adjust the output voltage setting until the spark length exceeds the greatest potential leak path distance. This is typically the diagonal distance from the embedded wire to the edge of the weld bead at a "T" joint.
- Once the output voltage has been set, testing can be started. Testing is performed by passing the electrode over the seams with the electrode in contact with the membrane or the extruded weld bead. The audible and visual indication of a spark provides the determination of a potential leak path.
- If a potential leak is detected the area can be repaired with a patch. Applying additional weld beads adjacent to the leaking weld is not an acceptable repair technique. This will only lengthen the leak path to the extent that the spark tester may not be capable of generating a spark of sufficient length to breach the lengthened gap.
- After patching, the seam must be retested until no defects are indicated.
- Enter the results of the spark test on the appropriate documentation, indicating either a passed or a failed seam. If the seam fails, the repair Work and subsequent testing should be recorded on the same document.
- When flammable gasses are present, use special care and precautions in the area to be tested.

4.4.4.6. Destructive Testing

Peel and shear seam strength testing shall be carried out on samples of seams removed from the installed panels. For these tests, the following procedures shall be followed:

- Coupon sampling of all field seams, including patches and repair areas, shall be taken by cutting perpendicular to the seams a sample approximately thirty-six (36)-inch long by a six (6)-inch wide (minimum) centered over the seam. This sample shall be cut into three twelve (12)-inch long samples and labeled with the sample number, date, time, location and seam number, and individually marked “Owner (Archive) Sample”, “CQA Sample”, and “Lining Contractor CQC Sample”. The frequency and location shall be determined by the CQA, but shall not be less than one sample per five-hundred (500)-feet of field seam. These coupons shall be tested by the Lining Contractor on-site for peel (five (5) coupons) and shear seam strength (five (5) coupons) and thickness in accordance with ASTM D6392. The CQA shall also test the samples for conformance. If there is any discrepancy in the results, the CQA results will override the Lining Contractor’s.
- Heat-welded seams shall be allowed to cool or warm to about 70°F prior to testing. Solvent seams, when used, shall be allowed to cure according to the Manufacturer’s recommendations. Additionally, at the Engineer’s option, approximately ten (10) percent of the coupons (size one (1)-inch by six (6)-inches) shall be sent to an independent laboratory for confirmation testing. Should the lab and field tests conflict, installation shall halt until the conflict is resolved to the satisfaction of the Engineer.

Weld specimens shall pass the requirements for shear and peel presented in Table 4-1 and as follows:

- Both weld interfaces on double-wedge welds shall be tested.
- During testing, the break shall occur by Separation in the Plane of the sheet (SIP) not through adhesion failure separation (AD). When the seam separation is equal to or greater than twenty-five (25) percent of the track width, it is a failed test.
- The break must be ductile.

4.4.4.7. Procedure in the Case of Destructive Test Failure

In the case that a destructive seam test fails in either shear or peel, the entire length of seam represented by this test is in question. At a minimum, the procedure for destructive test failures shall be as follows:

1. The Lining Contractor shall provide the Engineer with two additional destructive test samples spaced a minimum of one hundred and fifty (150) feet on either side of the failed test or at the direction of CQA and the Engineer.
2. The Engineer and the Construction Manager reserve the right to take additional samples as warranted to adequately assess the quality of the work.

3. From each destructive test sample, ten (10) test coupons will be cut. Five (5) of these samples will be tested for seam shear strength and five will be tested for peel strength. Both weld interfaces on double wedge welds shall be tested.
4. If passing tests are achieved from the tracking samples obtained in Item 1, the 300 feet of seam represented by the passing tests is in question. Additional samples at closer intervals can be taken or the 300 feet of seam shall be capped.
5. If a failing test occurs at the new destructive test location, an additional test will be taken at a minimum of 50 feet from the failed test or at the direction of CQA and the Engineer. This procedure is repeated until the extent or length of failed section is fully defined or the edge of the seam that was originally represented by the original test is reached.
6. If passing tests are achieved at the minimum 150-foot distance from the failed destructive test, additional destructive tests may be taken at a closer spacing from the failed test at the discretion of the Lining Contractor. If the tests at the closer interval fail, additional destructive tests at a wider interval shall be taken until the length of failed seam is fully defined.
7. Once the length of the defective seam is identified, the Lining Contractor shall either cut out the defective seam and wedge weld a new piece of liner in the seam area; or install a cap-patch strip over the affected seam area. Cap-patches shall be a minimum of three (3) feet in width and shall be centered over the defective seam. Extrusion welding the exposed flap of liner on wedge welded seams or additional extrusion welding of extrusion-welded seams shall not be allowed.
8. An additional destructive test sample shall be taken within the repaired area and tested in accordance with Item 3. Nondestructive testing by appropriate methods shall also be performed within the repaired area. In the case that the retest of the repaired area fails, the procedure as previously described shall be repeated until passing tests are achieved.

4.4.4.8. Repair Procedures

Damaged or defective geomembrane or seam areas failing a destructive or non-destructive test shall be repaired. Each repair requires a non-destructive test using either a vacuum box or spark testing methods. The Lining Contractor shall be responsible for repair of damaged or defective areas. The repair method shall be decided by the Lining Contractor but must be agreed upon by the Engineer. Procedures available include the following:

- Replacement: Remove damaged geomembrane or unacceptable seam and replace with acceptable geomembrane materials if the damage cannot be satisfactorily repaired.
- Patching: Used to repair large holes, tears, undispersed raw materials, and contamination by foreign matter.
- Capping: Used to repair large lengths of failed seams.

Abrading and rewelding of small seam areas and welding the flap on fusion-welded seams are not acceptable repair procedures and shall not be accepted by CQA.

In addition, the following procedures shall be observed:

- Surfaces of the geomembrane that are to be repaired by extrusion welds shall be lightly abraded to remove oxidation and ensure cleanliness.
- All geomembrane shall be clean and dry at the time of repair.
- Extend patches or caps at least six (6)-inches for extrusion welds and four (4)-inches for wedge welds beyond the edge of the defect, and round the corners of the patch material. The edges of all patches are to be beveled.

Furthermore, repair verification shall be performed as follows:

- Number, date, location, repair technician, CQC and test outcome of each patch.
- Non-destructively test each repair using methods required in this Technical Specification.
- Enter the results of the repair procedures on the appropriate documentation, indicating the repair verification. If the repair fails, the repair Work and subsequent testing should be recorded on the same document.

4.4.5. Lining Contractor’s CQC Reporting and As-Built

Lining Contractor’s CQC will be responsible for recording and reporting the following information on a daily basis:

- Panel Deployment Log
- Seaming Log
- Trial Weld Test Results
- Destructive Testing Results
- Documentation of all seam and major patch repairs

The log formats shall be included in the Lining Contractor’s Quality Control Manual and the format and information to be included on the logs is subject to approval by the Engineer and CQA.

At the completion of the installation, the Lining Contractor shall provide the CQA or Engineer and the Construction Manager the following information no later than five (5) calendar days after the installation Work has been completed:

- Completed as-built Drawings (AutoCAD compatible format) showing the surveyed geomembrane panel layout, seams, location of destructive test samples, and the location of major repairs including repaired seams, major patches and capped areas.
- Completed CQC documents (hard copy and electronic (pdf) format) including the Panel Deployment Log, Seaming Log, Trial Weld Test Results, Destructive Testing Results, and Seam Repair Log.

4.5. Lining Contractor Warranty

The Lining Contractor shall warrant the installation against workmanship defects a minimum of five (5) years from the date of installation or as mutually agreed prior to award of the Contract. This warranty shall cover the cost of material, freight and duties, handling, labor, and equipment to replace or repair defective workmanship.

5. HYDROSTATIC TEST PROCEDURES

The Ponds shall be hydrostatically tested for leakage as described herein. Hydrostatic testing and full-time CQA observations shall be employed before, during and after construction.

- Evacuate all leak detection systems of any residual fluids that may have accumulated during construction.
- Begin filling the pond with cool (not warm or hot) fresh water.
- Monitor the leak detection system and water level at regular time intervals. The time interval will depend upon how fast the water is rising in the pond.
- Record all pertinent levels as monitoring continues.
- If, at any time during the test, leakage is discovered, immediately stop filling the pond.
- Quantify the leak rate by pumping the leak detection port.
- Lower the water level and continue to monitor and quantify the leak rate.
- When the leakage stops, the leak(s) will be bounded by the two recorded water levels.
- Visually inspect, identify suspect areas, repair and retest in accordance with the same procedures outlined above.
- Continue the test until the maximum fluid level is attained with zero leakage. The maximum fluid levels are defined as two feet below crest elevation as determined by as-built survey.

6. CONSTRUCTION QUALITY ASSURANCE (CQA) REQUIREMENTS

6.1. General

The Engineer shall be the interpreter of the site construction Technical Specifications, and shall make observations and tests as considered necessary to assess and accept the quality of the work. Continuous observations and tests of construction operations shall be made by Inspectors under the direction of the Engineer.

The Construction Manager shall be responsible for verification of lines and grades prior to acceptance of the completed work. The Lining Contractor shall be responsible for any surveying required during liner placement. The Lining Contractor shall also be responsible for the preparation of record (as-built) drawings for all lined areas.

The CQA activities shall be performed under the direction of an Inspector who has monitored the installation of a minimum of 5,000,000 square feet (ft^2) of the specified type of geomembrane or similar.

6.2. CQA Inspection and Review Requirements

The CQA shall be responsible for inspecting the geomembrane installation to ensure that the Work is completed in accordance with the Technical Specifications. Inspections and review shall include, but not be limited to the following:

- Random visual verification of trial welding results
- Random visual verification of production seaming operations
- Random visual verification of seam testing (air tests) and results
- Random visual verification of vacuum box and spark testing
- Random verification of the Lining Contractor CQC destructive seam strength testing
- Final inspection and approval of completed geomembrane
- Review of the Lining Contractor CQC documentation

6.3. CQA Testing Requirements

The CQA shall be responsible for the following testing:

- Trial weld verification (ten (10) percent minimum, randomly selected). Frequency to be increased at the discretion of the CQA, if conflicting results occur or poor quality is indicated.
- Destructive Test verification. Additional test samples above minimum frequency may be collected and tested at the discretion of the CQA.

A CQA Sampling & Testing Guide is presented on Table 6-1.

Table 6-1: Geomembrane CQA Sampling & Testing Guide

Material	Tests	Frequency
HDPE Geomembrane Liner	1. Destructive shear and peel tests (minimum).	1. Every 500 linear feet of seam for each welding machine (randomly located).
	2. Air pressurization testing, vacuum testing, or equivalent method. (Performed by **Lining Contractor** and randomly observed by the Inspector.)	2. Entire length of field welded seams.

6.4. CQA Reporting and Review of Lining Contractor CQC Information

CQA and the Engineer shall be responsible for reviewing the information submitted by the Lining Contractor's CQC. This shall include the panel deployment log, seaming log and trial weld and destructive testing results as well as the as-built information.

The CQA shall also produce a daily report (weekly reports may also be required) and a summary for testing completed (Trial Weld and Destructive Test Results) to document activities associated with installation of the geomembrane. A copy of all test results will be maintained at the construction site, and shall include the following:

- Date issued
- Project title and number
- Date of testing and/or sampling
- Designation of material tested
- Type of test and specification
- Location of test
- Observations regarding compliance or noncompliance with Drawings and Technical Specifications

As-built surveyed drawings as defined above (Section 4.4.5) provided by the Lining Contractor. Panel seam locations, destructive sample locations and repairs shall be surveyed. As-built drawings based on the required survey shall be submitted to the Construction Manager and the Engineer within five (5) business days of the completion of the liner installation. The Lining Contractor shall provide draft as-built drawings to the Engineer for review prior to finalization. As-built drawings shall be prepared and submitted in electronic format (AutoCAD v. 2018 or compatible). Copies of each drawing shall be submitted to the Construction Manager and Engineer for inclusion in the ROC Report. Drawings shall be provided in 11"x17" size and the number copies shall be determined by the Owner.

APPENDIX F.4

Geotextile

NewFields	**CLIENT** **Lithium Nevada Corporation**	**PROJECT NO** 475.0385.000
PROJECT: THACKER PASS PROJECT		
TITLE: TECHNICAL SPECIFICATION FOR GEOTEXTILE MATERIALS AND INSTALLATION		**SPECIFICATION NO.** **3-0385-000-SP-GT-0**

			APPROVALS			
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1. GENERAL

This Specification defines the requirements for the geotextile materials and placement activities associated with the Thacker Pass Project owned by Lithium Nevada Corporation.

Any alternatives or exceptions to this Specification shall be submitted in writing to the Construction Manager and shall be approved by the Engineer and the Owner.

Geotextile shall be used beneath any riprap and as cushion for geomembrane as shown on the Drawings.

The Definition of Terms is provided in Specification No. 0-0385-000-SP-GEN-0.

2. CODES AND STANDARDS

All tests shall be performed in accordance with the current edition of the testing standards as indicated below.

2.1. American Association of State Highway and Transportation Officials (AASHTO):

- M288-17 – "Geotextile Specification for Highway Applications", American Association of State Highway and Transportation Officials, Washington DC, www.transportation.org.

2.2. American Society for Testing and Materials (ASTM):

- ASTM D4354-12: "Standard Practice for Sampling of Geosynthetics and Rolled Erosion Control Products (RECPs) for Testing", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D4491/D4491M-17: "Standard Test Method for Water Permeability of Geotextiles by Permittivity" ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D4533/D4533M-15: "Standard Test Method for Trapezoid Tearing Strength of Geotextiles", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D4632/D4632M-15a: "Standard Test Method for Grab Breaking Load and Elongation of Geotextiles", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D4751-20: "Standard Test Method for Determining Apparent Opening Size of a Geotextile" ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D4759-11(2018): "Standard Practice for Determining the Specification Conformance of Geosynthetics", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D4873/D4873M-17: "Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D5035-11(2019):– "Test Method for Breaking Strength and Elongation of Textile Fabrics" (2" Strip Method), ASTM International, West Conshohocken, PA, www.astm.org.

- ASTM D5261-10(2018): “Standard Test Method for Measuring Mass per Unit Area of Geotextiles”, ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D6241-14: “Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe”, ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D7238-06(2017): “Standard Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus”, ASTM International, West Conshohocken, PA, www.astm.org.

2.3. Geosynthetic Research Institute (GRI):

- GRI GT12(a) Revision 2, March 3, 2016: “Test Methods and Properties for Nonwoven Geotextiles Used as Protection (or Cushioning) Materials”, Geosynthetic Institute, Folsom, PA, www.geosynthetic-institute.org.
- GRI GT13(a) Revision 4, June 20, 2017: “Test Methods and Properties for Geotextiles Used as Separation Between Subgrade Soil and Aggregate”, Geosynthetic Institute, Folsom, PA, www.geosynthetic-institute.org.

3. SUBMITTALS

3.1. Post-Award

- Prior to material delivery to the project site, the Contractor shall provide the Engineer with a written certification or Manufacturer’s quality control data indicating that the geotextile meets or exceeds the values specified herein.
- The Contractor shall also submit the Manufacturer’s quality control manual for the geotextile that will be delivered to the site.

3.2. Manufacturing

- Manufacturer quality control certificates stating the name of the Manufacturer, product name, style number, chemical composition of the filaments or yarns, and other pertinent information to fully describe the geotextile shall be provided.
- The Manufacturer is responsible for establishing and maintaining a quality control program to assure compliance with the requirements of the Specification. Documentation describing the quality control program shall be provided.
- The Manufacturer’s certificate shall state that the finished geotextile meets the Minimum Average Roll Value (MARV) requirements of the Specification as evaluated under the Manufacturer’s quality control program. A person having legal authority to bind the Manufacturer shall attest to the certificate.
- Mislabeling or misrepresentation of materials shall be reason to reject those geotextile products.

4. SHIPMENT, STORAGE AND HANDLING

- Geotextile labelling, shipment and storage shall follow ASTM D4873. Product labels shall clearly show the Manufacturer name, style, and roll number. Each shipping document shall include a notation certifying that the material is in accordance with the Manufacturer's certificate.
- Each geotextile roll shall be wrapped with a material that will protect the geotextile, including the ends of the roll, from damage due to shipment, water, sunlight and contaminants. The protective wrapping shall be maintained during periods of shipment and storage.
- During storage, geotextile rolls shall be elevated off the ground and adequately covered to protect them from the following: site construction damage, precipitation, extended ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, flames including welding sparks, temperatures in excess of 160° F (71° C), and any other environmental condition that may damage the property values of the geotextile.

5. MATERIAL

- The nonwoven needle punched geotextile specified herein shall be made from staple fiber.
- The geotextile shall be of new prime quality virgin polymer of 100-percent polypropylene (97-percent polypropylene and three (3)-percent carbon black with antioxidants and heat stabilizers) or polypropylene blend designed and manufactured specifically for the purpose of separation, tensile reinforcement, planar flow, filtration and protection and shall be used as designated on the Drawings.
- The geotextile shall be able to withstand direct exposure to ultraviolet radiation from the sun for up to 30 days without any noticeable effect on index or performance properties.
- Rolls shall be free of holes, contamination and foreign debris.
- Geotextile shall meet or exceed all material properties listed in Table 5-1 based on the specific purpose and expected conditions.

Table 5-1: Geotextile

(Reference: GRI Test Method GT12(a) Revision 2, dated 03/03/2016)

Property	Test Method (ASTM)	Unit	Mass/Unit Area (oz/yd^3)					
Mass per unit area	D5261	oz/yd^2	10	12	16	24	32	60
Grab tensile strength	D4632	lb	230	300	370	450	500	630
Grab tensile elongation	D4632	%	50	50	50	50	50	50
Trap. tear strength	D4533	lb	95	115	145	200	215	290
Puncture (CBR) Strength	D6241	lb	700	800	900	1100	1700	2400
UV resistance[2]	D7238	%	70	70	70	70	70	70

Notes:
1. All values are MARV except UV resistance which is a minimum value.
2. Evaluation to be on 2.0 inch strip tensile specimens per ASTM 5035 after 500 lt. hours exposure.

6. EXECUTION

6.1. Construction Quality Assurance

- The Engineer shall review the material certificates prior to installation of geotextile.
- The Engineer shall examine the geotextile rolls upon delivery to the site and report any deviations from the Specifications to the Contractor.
- The Engineer may decide to arrange for conformance testing of the rolls delivered to the job site. For this purpose, the Engineer shall take a sample three (3) feet (along roll length) by roll width according to ASTM Practice D4354. The sample shall be properly marked, wrapped and sent to an independent laboratory for conformance testing at the discretion of the Engineer.
- The pass or fail of the conformance test results shall be determined according to ASTM D4759.

6.2. Installation

- The geotextile shall be handled in such a manner to ensure that it is not damaged in any way.
- The geotextile shall be installed to the lines and grades as shown on the Drawings and as described herein.
- The geotextile shall be deployed down the slope in such a manner to continuously keep the geotextile in tension by self-weight. The geotextile shall be securely anchored in an anchor trench where applicable, or by other approved or specified methods.
- All geotextiles shall be weighted by sandbags or approved equivalent to prevent damage from the wind. Protection shall be installed during placement and shall remain in place until replaced with cover material.

- The Contractor shall take necessary precautions to prevent damage to adjacent or underlying materials during placement of the geotextile. Should damage to such material occur, the Contractor shall repair the damaged materials at his own cost and to the satisfaction of the Engineer.
- During placement of the geotextile, care shall be taken not to entrap soil, stones or excessive moisture that could hamper subsequent seaming (as applicable) of the geotextile as judged by the Engineer.
- The geotextile shall not be exposed to precipitation prior to being installed and shall not be exposed to direct sunlight for more than 15 days after installation.
- Geotextile placed on flat ground or geotextile which will be ballasted shall be overlapped a minimum of eight (8)-inches.
- Geotextile pieces shall be connected together using overlap, heat bonding or stitching methods as approved by the Engineer. Sewn seams shall be made using polymeric thread with chemical resistance equal to or exceeding that of the geotextile. All sewn seams shall be continuous. Seams shall be oriented down slopes perpendicular to grading contours unless otherwise specified. For heat seaming, fusion welding techniques recommended by the Manufacturer shall be used.
- The Contractor shall not use heavy equipment to traffic above the geotextile without approved protection.
- Material overlying the geotextile shall be carefully placed to avoid wrinkling or damage to the geotextile.
- Holes in the geotextile material shall be repaired using a patch of identical material extending a minimum six (6)-inches on all sides of the hole and heat bonded. If heat bonding is not possible, the patch shall extend a minimum of eighteen (18)-inches on all sides of the hole.
- In areas where the non-woven geotextile is used as separation or filtration, care shall be taken to install the layer without producing holes or gaps where the migration of fines into the drainage system could occur. This is accomplished by ensuring sufficient overlap of seams of eighteen (18)-inches minimum overlap and properly wrapping the edges of the geotextile within the gravel areas being protected or by over running the edges of the geotextile beyond the area requiring separation or filtration.

7. CERTIFICATION

At the completion of the geotextile installation, the Contractor shall provide the Owner with a certification stating that the geotextile was installed in accordance with the Technical Specifications. The certification shall be provided to the Owner prior to the demobilization of the installation personnel from the site unless agreed otherwise by the Owner.

APPENDIX F.5

Geonet

NewFields	CLIENT Lithium Nevada Corporation	PROJECT NO 475.0385.000
PROJECT: THACKER PASS PROJECT		
TITLE: TECHNICAL SPECIFICATIONS FOR GEONET MATERIALS AND INSTALLATION		**SPECIFICATION NO.** **4-0385-000-SP-GN-0**

			APPROVALS			
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1. GENERAL

This Specification defines the requirements for geonet materials, installation, quality control and quality assurance associated with the Thacker Pass Project owned by Lithium Nevada Corporation.

Any alternatives or exceptions to this Specification shall be submitted in writing to the Construction Manager and shall be approved by the Engineer and the Owner.

The Definition of Terms is provided in Specification 0-0385-000-SP-GEN-0.

Geonet will be used as an intermediate drainage layer between the primary and secondary geomembrane liners for the ponds and in the outlet channel to reduce potential erosion.

2. CODES AND STANDARDS

All tests shall be performed in accordance with the current edition of the testing standards as indicated below.

2.1. American Society for Testing and Materials (ASTM)

- ASTM D792-13: “Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement”, ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D1238-13: “Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer,” ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D1505-18: “Standard Test Method for Density of Plastics by the Density-Gradient Technique,” ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D1603-14: “Standard Test Method for Carbon Black in Olefin Plastics,” ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D4218-15: “Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds By the Muffle-Furnace Technique”, ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D4716/D4716M-14: “Standard Test Method for Determining the (In-Plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head,” ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D5035-11(2019): “Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method),” ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D5199-12(2019): “Standard Test Method for Measuring Nominal Thickness of Geosynthetics,” ASTM International, West Conshohocken, PA, www.astm.org.

2.2. Geosynthetic Research Institute (GRI)

- GRI GN2 and GC13 Revision 1, September 25, 2012: "Standard Guide for Joining and Attaching Geonets and Drainage Composites", Geosynthetic Institute, Folsom, PA, www.geosynthetic-institute.org.
- GRI GN4 Revision 3, January 14, 2020: "Standard Specification for Test Methods and Properties for Testing Frequency for Biplanar Geonets and Biplanar Geonet Composites," Geosynthetic Institute, Folsom, PA, www.geosynthetic-institute.org.

3. SUBMITTALS POST-AWARD

- Prior to material delivery to the project Site, the Contractor shall provide the Engineer with written certification and Manufacturer's quality control data, which displays that the geonet meets, or exceeds the values specified herein.

3.1. Submittals during Manufacturing

- Manufacturer quality control certificates stating the name of the Manufacturer, product name, length, width, roll number and any other pertinent information to fully describe the geonet.
- The Manufacturer is responsible for establishing and maintaining a quality control program to assure compliance with the requirements of this Specification. Documentation describing the quality control program shall be made available upon request.
- The Manufacturer's certificate shall state that the finished geonet meets the Minimum Average Roll Value (MARV) requirements of the Specification as evaluated under the Manufacturer's quality control program. A person having legal authority to bind the Manufacturer shall attest to the certificate.
- Mislabeling or misrepresentation of materials shall be reason to reject geonet products.

3.2. Shipment, Storage and Handling

- Product labels shall clearly show the Manufacturer or supplier name, style, and roll number. Each shipping document shall include a notation certifying that the material is in accordance with the Manufacturer's certificate.
- Delivery of rolls of geonet will be prepared to ship by appropriate means to prevent damage to the material and to facilitate off-loading.
- The Contractor shall provide the on-site storage location for the geonet. The Contractor shall protect the geonet from abrasions, excessive dirt and moisture. The area shall be level (no wooden pallets), smooth, protected from vandalism and close to the Work area.
- The Contractor shall handle all geonet in such a manner to ensure it is not damaged in any way.

- The Lining Contractor shall take all necessary precautions to prevent damage to the underlying layers during placement of the geonet.

3.3. Warranty

- The material shall be warranted, on a prorated basis against defects for a period of twenty (20) years from the date of the geonet installation or as mutually agreed prior to award of the Contract for supply between the Owner and the Manufacturer.
- Installation shall be warranted against defects in workmanship for a period of one (1)-year from the date of geonet completion.

4. PRODUCT

4.1. Geonet Properties

The geonet shall be 200-mil (5 mm) in nominal thickness and shall be manufactured by extruding two (2) crossing strands to form a bi-planar drainage net structure.

The geonet shall meet or exceed the material property values listed in Table 4-1.

Table 4-1: Required Properties, Test Methods and Values for Geonet

Property	Test Method	Frequency (minimum)	Units	Values			
Thickness (nominal) (min.ave.)	ASTM D5199	50,000 lb	mils (mm)	200 (5.0)	250 (6.3)	275 (7.0)	300 (7.6)
Density (minimum)	ASTM D1505/ ASTM D792, Method B	50,000 lb	g/cm^3	0.95	0.95	0.95	0.95
Tensile Strength (Machine Direction)	ASTM D7179	50,000 lb	lbs/in	45	60	67.5	75
Carbon Black Content	ASTM D4218 ASTM D1603 [2]	100,000 lb	Percent	1.5-3	1.5-3	1.5-3	1.5-3
Melt Flow Index	ASTM D1238, 190°, 2.16kg	Per Resin Lot	g/10 minutes (max.)	≤1.0	≤1.0	≤1.0	≤1.0
Transmissivity [1]	ASTM D4716	200,000 lb	gal/min-ft	5.0	7.2	8.10	9.0

Notes:
1. **Gradient of 1.0, normal load of 10,000 psf (479 kN/m^2), water at 70°F (21°C), between steel plates for 15 minutes.**
2. **Modified.**

5. EXECUTION

5.1. Construction Quality Assurance (CQA)

The CQA shall examine the geonet rolls upon delivery to the Site and report any deviations from Specifications to the Contractor and the Lining Contractor.

5.2. Installation

- The geonet rolls shall be installed in the direction of the slope and in the intended direction of flow. At no time shall any vehicles (pickup trucks, cars, utility vehicles (or similar), four wheel ATV's (or similar) be driven on the geonet. If the geonet is driven on, CQA shall inspect the area for damage and require replacement or repairs, if necessary.
- If the project contains long, steep slopes, special care should be taken so that only full-length rolls are used at the top of the slope.
- In the presence of wind, all geonet shall be weighted down with sandbags or the equivalent. Sandbags shall be used during placement and remain until the geonet is secured.
- When an anchor trench is at the top of the slope, the geonet shall be properly anchored to resist sliding. Anchor trench compaction equipment shall not come into direct contact with the geonet.
- In applying fill material, no equipment shall drive directly across the geonet. The specified fill material shall be placed and spread utilizing vehicles with a low ground pressure.

5.3. Seams and Overlaps

- Each component of the geonet shall be secured to the like component at overlaps.
- Adjacent edges along the length of the geonet roll shall be overlapped a minimum of four (4)-inches.
- The overlapped edges shall be joined by tying the geonet structure with cable ties. These ties shall be spaced every five (5) feet along the roll length. Ties for connecting the seams shall be resistant to degradation due to ultraviolet light and should be compatible with the process solution used for the project. Ties should be installed such that the clasp of the tie is placed between the grids of the geonet.
- Adjoining rolls across the roll width should be shingled down in the direction of the slope with a minimum of one (1)-foot overlap and joined together with cable ties spaced every one (1)-foot along the roll width.

5.4. Repairs

- Prior to covering the deployed geonet, the material shall be inspected by the Lining Contractor and CQA for proper installation and damage resulting from construction.
- Any rips, tears or damaged areas on the deployed geonet shall be patched. The patch shall extend six (6)-inches beyond the damage and shall be secured to the original geonet by tying every six (6)-inches (or as necessary) with the approved cable ties. If the area to be repaired is more than fifty (50) percent of the width of the panel, the damaged area shall be cut out and the two portions of the geonet shall be joined in accordance with Section 5.3.

6. CERTIFICATION

At the completion of the geonet installation, the Lining Contractor shall provide CQA and the Owner with a certification stating that the geonet was installed in accordance with these Specifications together with a test result report. The certification shall be provided to CQA and the Owner prior to the demobilization of the installation personnel from the Site unless agreed otherwise by the Owner.

APPENDIX F.6

HDPE Pipe

NewFields	**CLIENT** **Lithium Nevada Corporation**	**PROJECT NO** 475.0385.000

PROJECT: THACKER PASS PROJECT

TITLE: TECHNICAL SPECIFICATIONS FOR HIGH DENSITY POLYETHYLENE (HDPE) PIPE MATERIALS AND INSTALLATION

SPECIFICATION NO.
5-0385-000-SP-HDP-0

			APPROVALS			
REV	**DATE**	**PAGES**	**AUTHOR**	**REVIEW**	**CLIENT**	**REMARKS**
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This specification defines the requirements for High-Density Polyethylene (HDPE) PE 4710 pipe materials, installation, and quality control associated with the Thacker Pass Project owned by Lithium Nevada Corporation.

Any alternatives or exceptions to this Specification shall be submitted in writing to the Construction Manager and shall be approved by the Engineer and the Owner.

The Definition of Terms is provided in Specification No. 0-0385-000-SP-GEN-0.

2. CODES AND STANDARDS

All piping shall be of the best quality available complying with the current standards for the following:

- ANSI: American National Standard Institute
- ASTM: American Society of Testing and Materials
- AWWA: American Water Works Association
- AASHTO: American Association of State Highway Officials
- SPI: Society of the Plastics Industry, Inc.
- PPI: Plastics Pipe Institute
- IPS: Iron Pipe Sizing
- ISO: International Organization for Standardization

3. HDPE PIPE MATERIALS

Materials used for the manufacture of HDPE pipe and fittings shall have a standard thermoplastic material designation code of PE 4710 and comply with all requirements for ASTM D3350. The pipe shall contain no recycled compound except that generated in the Manufacturer's own plant from the resin of the same Specification and from the same raw material supplier. The dimensional and performance characteristics shall conform to the requirements of ASTM F714 for sizes four (4)-inches IPS and larger and conform to ASTM D3035 for sizes smaller than four (4)-inches IPS. In addition, materials used for the manufacture of the HDPE pipe and fittings shall meet the physical property requirements listed in Table 3-1.

Table 3-1: Physical Material Properties for HDPE Pipe (PE 4710)

Property	Unit	Standard	Nominal Value
Material Designation	-	ASTM F412	PE 4710
Cell Classification	-	ASTM D3350	445474 C (black)
Density (Natural)	g/cc	ASTM D1505	0.947
Density (Black)	g/cc	ASTM D1505	0.959
Melt Index	g/10 minutes	ASTM D1238	< 0.08
Flexural Modulus	psi	ASTM D790	140,000
Tensile Strength @ Ultimate	psi	ASTM D638	5,000
Tensile Strength @ yield	psi	ASTM D638	>3,600
PENT	hours	ASTM F1473	>500
ESCR	hours	ASTM D1693	>10,000
HDB at 73°F (23°C)	psi	ASTM D2837	1,600
Color; UV Stabilizer	% C	ASTM D1603	Black with minimum 2% carbon black with UV Stabilizer
Modulus of Elasticity (long term)	psi	ASTM D638	30,000

The pipe Manufacturer's quality control system shall be certified by an appropriate independent body to meet the requirements of the ISO 9001 Quality Management Program.

All stub ends/flange adapters, shall be of at least the same wall thickness and pressure rating and the same resin type and Manufacturer as the pipe to be joined, unless otherwise approved by the Engineer. Backing flanges for HDPE pipe shall be the convoluted type of ductile iron material (ASTM A536 grade range from 60/40/18 to 65/45/12, drilled to ANSI bolt circles, and have a pressure rating of 150 psi) unless otherwise approved by the Engineer.

Fabricated fittings intended for use in non-pressure or low pressure services may be manufactured from the same diameter and DR rating as used in the piping system (note: the pressure rating of these fittings will be approximately only 75 percent of the straight pipe of the same DR). Fittings not intended for use in pressure service shall be clearly marked or tagged.

Fabricated fittings intended for use in pressure service shall meet or exceed the design pressure of the piping system and be fabricated from pipe of at least the next numerically smaller dimension ratio unless otherwise shown on the Drawings. Ends shall be machined to match the joining pipe DR.

Where HDPE and corrugated polyethylene (CPEP) pipes are connected, manufactured fittings shall be used unless otherwise shown on the Drawings or approved by the Engineer. All other joints shall be fused or flange-jointed as shown on the Drawings. Flange assembly bolts, when specified as machine bolts, shall conform to the requirements of ASTM A307, Grade A standard, square-head machine bolts conforming to ASME/ANSI B 18.2.1 with heavy hot-pressed hexagonal nuts. Bolt length shall be such that, after joints are made up, bolts shall protrude through the nut by at least one-half (½)-inch.

Stud bolts, when specified, shall be ASTM A193 Grade B7 with two-hex head nuts, ASTM A194 Grade 2H each for above ground service and ASTM A193 Grade B8 with Stainless Steel nuts in accordance with ASTM A194. Alternately, commercial Grade 18-8 Stainless Steel bolts and nuts may be used for buried service.

Gaskets shall be used at all flanged connections and shall be full face, black nitrile rubber gaskets (Garlock style 9122 or equal), and one-eighth ($^1/_8$)-inch thick.

4. CERTIFICATES

The General Contractor shall submit one (1) original and two (2) copies of certificates provided by the Manufacturer indicating that all materials, pipe and fittings comply with the applicable portions of this Technical Specification.

Before incorporating any piping materials into the project, a certification of materials shall be submitted by the Manufacturer or Supplier. The certificate shall include:

- Name of Manufacturer
- Name of Fabricator
- Chemical composition and coating, if any
- Product description and life expectancy, if applicable
- Statement of Specification compliance including the name of this project
- Signature of authorized official attesting to the information presented
- Manufacturer's recommendations for field installation and repairs

All materials shall be subject to the approval of the Engineer.

5. SHOP AND FIELD LEAK TESTING OF PIPING SYSTEMS

Any shop fabricated pipe assemblies shall be pressure checked, at the Engineers discretion, to a fully hydrostatic condition equal to the pressure rating of the pipe prior to shipment to the jobsite. The duration of the test shall be at least twenty-four (24) hours.

All pipe assemblies shall be hydrostatically pressure tested after connection to any auxiliary piping after burial or when installation is completed as described in Section 7.4.

6. PIPE DELIVERY, HANDLING, AND STORAGE

Pipe, fittings, valves and other appurtenances shall be loaded and unloaded by lifting with hoists in such a manner as to avoid damage or hazard. The interior of all pipe and fittings shall be kept free from dirt and foreign material at all times.

7. PIPE INSTALLATION

7.1. General

The pipe shall be installed to the lines and grades and generally in the manner shown on the Drawings. Where specific lines and grades are not indicated on the Drawings, the lines and grades will be determined in the field, by the Engineer, to suit the existing ground conditions. The General Contractor shall use equipment and methods acceptable to the Engineer and in accordance with the pipe Manufacturer's recommendations for handling and placement of the pipe and fittings.

The General Contractor shall provide and install all piping required to complete the piping installation in accordance with industry standard piping practices, regardless of whether such piping is specifically detailed on the Drawings. The general layout as shown on the Drawings shall be maintained. Where interference is encountered during installation or relocation of pipelines is deemed necessary, the Engineer shall be consulted before any changes are made.

All pipelines shall be erected to preserve accurate alignment. Care shall be taken, in the installation of pipeline runs where drainage is required, to ensure that the pipeline has a continuous slope to the point of drainage.

Prior to installation, each segment of pipe and all fittings shall be inspected for defects and/or damage. All pipe, fittings, and other appurtenances shall be carefully lowered into position, piece by piece. Under no circumstances shall such materials be dropped into position. Extreme care shall be taken to prevent foreign material from entering the pipe while it is being installed. Temporary end caps or other approved means shall cover open ends of the pipe when installation is not in progress.

Wherever obstructions not shown on the plans are encountered during the construction and where such obstructions interfere with the Work to the extent that an alteration in the lines or grades of the pipe is required, the Engineer shall approve any deviation or arrange for removal, relocation, or reconstruction of the obstructions.

7.2. Joining

7.2.1. Heat Fusion

Pipe and fittings shall be joined by one of the following types of thermal fusion in accordance with the Manufacturer's recommended procedures: butt fusion, saddle fusion, or socket fusion.

Upon request, the Manufacturer shall provide fusion training by authorized personnel or an authorized representative. The General Contractor shall be responsible for ensuring that personnel have received proper training in accordance with the Manufacturer's recommended procedures. Records of training shall be maintained by the General Contractor and evidence of training shall not exceed 12 months from date of construction.

Butt fusions performed between pipe ends or pipe ends and fittings shall be within the following allowable wall mismatches:

- Two (2) DR difference for pipe and fitting diameters six (6)-inch IPS and smaller
- One (1) DR difference for above six (6) inch through 18-inch
- No difference for diameters above 18-inch.

The difference in DR is determined from the following DR values: 7, 9, 11, 13.5, 17, 21, 26, and 32.5.

7.2.2. Other Methods of Joining

Polyethylene pipe and fittings where heat fusion is not possible may be joined together or to other materials through the use of electrofusion fittings; flange adapters with backup rings; mechanical couplings designed for connecting polyethylene pipe and fittings to itself or to another material; or Mechanical Joint (MJ) adapters. All alternative joining methods and devices shall be approved by the Engineer. The Manufacturer of the joining device shall be consulted for proper installation procedures.

7.3. Marking

Pipe and tubing shall be permanently marked in accordance with all applicable standards in accordance with this Technical Specification. Marking, as follows, shall be continuously (or spaced at intervals not exceeding 5 feet) heat-stamped indent print and shall remain legible under normal handling and installation practices:

1. Name and/or trademark of the pipe Manufacturer
2. Nominal pipe size
3. Dimension Ratio
4. The letters PE followed by the polyethylene grade per ASTM D3350, followed by the Hydrostatic Design basis in 100's of psi, e.g., PE 4710

5. Manufacturing Standard Reference, e.g., ASTM F714
6. A production code from which the date and place of manufacture can be determined

Fittings shall be marked on the body or hub. Marking shall be in accordance with the applicable standard depending on the fitting type. Marking on the fitting shall include the following whenever possible:

1. Nominal size and Outside Diameter (OD) base (such as 12-inch IPS)
2. Standard material code designation (such as PE 4710)
3. Dimension ratio
4. Pressure class if for pressure service

Mechanical fittings shall be marked with size, body material designation code, pressure rating, and the Manufacturer's name or trademark.

7.4. Testing

The General Contractor shall be responsible for field setup and performance of the fusion equipment and the fusion procedure used by the operator. Upon request, the General Contractor shall verify the fusion quality by marking and testing in accordance with the Manufacturer's recommended qualification procedure. The General Contractor shall be responsible for the necessary adjustments to the setup, equipment, operation, and fusion procedure. Fusions that fail the qualification procedure shall be remade.

Hydrostatic testing shall be conducted if required by the Owner to a minimum of 110 percent of the maximum operating pressure or design pressure, whichever is greater. The field leak test shall be at least twenty-four (24) hours in duration.

APPENDIX F.7

CPe Pipe

NewFields	CLIENT Lithium Nevada Corporation			PROJECT NO 475.0385.000		
PROJECT: THACKER PASS PROJECT						
TITLE: TECHNICAL SPECIFICATIONS FOR CORRUGATED POLYETHYLENE PIPE MATERIALS AND INSTALLATION				**SPECIFICATION NO.** **6-0385-000-SP-CPEP-0**		

			APPROVALS			
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1. GENERAL

This Specification defines the requirements for Corrugated Polyethylene Pipe (CPeP) and manifold materials, installation, and quality control associated with the Thacker Pass Project owned by Lithium Nevada Corporation.

Any alternatives or exceptions to this Specification shall be submitted in writing to the Owner or its designated representative(s)/agent(s) and shall be approved by the Engineer.

CPeP and various caps and fittings shall be used for underdrain piping as shown on the Drawings. The underdrain piping shall be placed on top of the geomembrane liner at approximately two-hundred (200) foot centers. The general layout of the underdrain piping shall be according to the Drawings. The pipe for the project is corrugated perforated dual walled smooth interior Advanced Drainage System (ADS) N-12 ST IB “Type SP” or Engineer approved equivalent. Couplings (non-watertight) shall be corrugated to match the pipe corrugations and shall provide sufficient longitudinal strength to preserve pipe alignment and prevent separation at the joints. Couplings, unless watertight connections are specified, shall be split collar or external snap couplers and shall engage at least two full corrugations on each pipe section. Where pipe is joined to other materials or fittings, or joined by other methods, the manufacturer’s recommendations shall be strictly enforced.

The Definition of Terms is provided in Specification No. 0-0385-000-SP-GEN-0.

2. CODES AND STANDARDS

All pipe work shall be of the best quality available complying with the current standards for the following:

- ANSI: American National Standard Institute
- ASTM: American Society of Testing and Materials
- AWWA: American Water Works Association
- AASHTO: American Association of State Highway Officials
- SPI: Society of the Plastics Industry, Inc.
- PPI: Plastics Pipe Institute

3. CORRUGATED POLYETHYLENE PIPE (CPEP) WITH SMOOTH INTERIOR

3.1. Material Properties

Pipe and fittings shall be made of virgin polyethylene compounds that conform with the applicable current edition of the AASHTO Material Specifications for cell classification as defined and described in ASTM D3350. Resins that have higher cell classifications in one or more properties, with the exception of density, are acceptable provided the product requirements are met.

For slow crack growth resistance, acceptance of resins shall be determined by using the notched constant ligament stress (NCLS) test in accordance with ASTM F2136 except that the applied stress for the NCLS test shall be six hundred (600) psi (note: the notched depth of twenty (20) percent of the nominal thickness of the specimen is critical to this procedure). The average failure time of the five (5) test specimens must exceed twenty-four (24) hours with no single test specimen failure time of less than seventeen (17) hours.

Pipe and fittings shall be manufactured and comply with the current edition of AASHTO Standard Specifications M252 and M294. All sizes shall conform to the AASHTO classification “Type S” for smooth wall interior solid pipe and “Type SP” for smooth wall interior perforated pipe.

The minimum parallel plate stiffness values at five (5)-percent deflection when tested in accordance with ASTM D2412 shall be as presented in Table 3-1.

Table 3-1: Smooth Interior, Corrugated Exterior Perforated Pipe

Inside Diameter (nominal)	**Pipe Stiffness (minimum)**	
	(pii)	**(kPa)**
4, 6, 8, 10 and 12 inch (100, 150, 200, 250 and 300 mm)	50	340
15 inch (375 mm)	42	290
18 inch (450 mm)	40	275
24 inch (600 mm)	34	235
30 inch (750 mm)	28	195
36 inch (900 mm)	22	150
42 inch (1050 mm)	20	140
48 inch (1200 mm)	18	125
60 inch (1500 mm)	14	97
Note: pii = pounds per inch per inch of deflection.		

Where perforations are specified, they shall conform to the following requirements.

- AASHTO M252 “Class II” for four (4)-inch to ten (10)-inch diameter CPeP
- AASHTO M294 “Class II” for twelve (12)-inch to thirty-six (36)-inch diameter CPeP

Couplers and fittings shall not reduce or impair the overall integrity or function of the piping. Fittings may be either molded or fabricated. Approved fittings for corrugated pipe include in-line joint fittings, such as couplers and reducers, and branch or complimentary assembly fittings such as tees, wyes, crosses and end caps. These fittings may be installed using dual walled split couplers or external snap couplers. Couplers shall be rated soil-tight. Couplers shall provide sufficient longitudinal strength to preserve pipe alignment and prevent separation at the joints. Only fittings supplied or recommended by the Manufacturer shall be used.

CPeP to HDPE pipe connections, if required, shall be as shown on the Drawings. If specified, shall be made using CPeP-to-HDPE adapters supplied by the CPeP manufacturer. The HDPE pipe end of the adapter shall match the DR (Dimensional Ratio) of the pipe being connected.

Pipe sizes and types shall be as specified on the Drawings, or as required by the Engineer.

3.2. Submittals

The CPeP material supplier shall submit to the Engineer, a Manufacturer's certification that all pipe and fittings they intend to supply comply with the applicable portions of the Technical Specifications.

3.3. Pipe Delivery, Handling, and Storage

Pipe, fittings, valves and other appurtenances shall be loaded and unloaded by lifting with hoists in such a manner as to avoid damage or hazard. Under no circumstances shall pipe or pipe fittings be dropped to the ground or into trenches. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground. The interior of all pipe and pipe fittings shall be kept free from dirt and foreign material at all times.

This shall include the furnishing of all materials and labor required for the replacement of installed material damaged prior to the final acceptance of the Work.

3.4. Pipe Installation

Installation of the CPeP shall be in accordance with either AASHTO Section 30 or ASTM Recommended Practice D2321, as described elsewhere in these Technical Specifications and as recommended by the Manufacturer. CPeP shall be installed to the sizes, lines, and grades shown on the Drawings. Pipes will be joined use bell and spigot pipes. For pipe connections to fittings or pipe connections without a bell and spigot a dual walled split coupler or external snap coupler shall be used. For split coupler connections the open seam of the coupler shall be turned to the side of the pipe. Pipes shall be closely monitored during backfilling activities to ensure no damage is done to the pipe or jointing system and they do not become separated.

Where specific lines and grades are not indicated on the Drawings, the lines and grades will be determined by the Engineer in the field to suit the existing ground conditions. The General Contractor shall use equipment and methods acceptable to the Engineer and in accordance with the pipe Manufacturer's recommendations for handling and placement of the pipe and fittings.

The General Contractor shall provide and install all piping required to complete the piping installation in accordance with standard practices, regardless of whether such piping is specifically detailed on the Drawings. The general layout as shown on the Drawings shall be maintained. Where interference is encountered during installation or relocation of pipelines is deemed necessary, the Engineer shall be consulted before any changes are made.

All pipelines shall be erected to preserve accurate alignment. Care shall be taken in the installation of pipeline runs where drainage is required to ensure that the pipeline has a continuous slope to the point of drainage.

Prior to installation, each segment of pipe and all fittings shall be inspected for defects or damage. All pipe, fittings and other appurtenances shall be carefully lowered into position, piece by piece. Under no circumstances shall such materials be dropped into position. Extreme care shall be taken to prevent foreign material from entering the pipe while it is being installed. Temporary end caps or other approved means shall cover open ends of the pipe when installation is not in progress.

All up gradient ends of underdrain piping shall be securely capped.

Pipe bends to form curves either in the horizontal or vertical plane shall not exceed that recommended by the Manufacturer or approved by the Engineer. The cutting of pipe for inserting fittings or closure pieces shall be done in a neat manner and with good workmanship without damage to the pipe and leaving a smooth end at right angles to the axis of the pipe.

Wherever obstructions not shown on the Drawings are encountered during construction, and where such obstructions interfere with the work to an extent that an alteration in the lines or grades of the pipe is required, the Engineer shall approve any deviation or arrange for removal, relocation, or reconstruction of the obstructions.

APPENDIX F.8

Stainless Steel Pipe

NewFields	CLIENT Lithium Nevada Corporation	PROJECT NO 475.0385.000

PROJECT: THACKER PASS PROJECT

TITLE: TECHNICAL SPECIFICATIONS FOR STAINLESS STEEL PIPING MATERIALS AND INSTALLATION

SPECIFICATION NO. **7-0385-000-SP-SSP-0**

			APPROVALS			
REV	DATE	PAGES	AUTHOR	REVIEW	CLIENT	REMARKS
0	04/02/2020	7	MH	KCW	BR	Issued for Construction

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1. GENERAL

This Specification defines the requirements for stainless steel pipe materials, installation, and quality control associated with the Thacker Pass Project owned by Lithium Nevada Corporation.

Any alternatives or exceptions to this Specification shall be submitted in writing to the Construction Manager and shall be approved by the Engineer and the Owner.

The Definition of Terms is provided in Specification No. 0-0385-000-SP-GEN-0.

2. CODES AND STANDARDS

Piping systems shall generally conform to ANSI/ASME B36.19 (Stainless Steel Pipe) plus any other applicable standards as published by ANSI, ASTM, AWWA or any of the other standards organizations in the following list:

- ANSI: American National Standards Institute
- ASME: American Society of Mechanical Engineers
- ASTM: American Society for Testing and Materials
- AWWA: American Water Works Association
- AWS: American Welding Society
- ISO: International Organization for Standardization
- MSS: Manufacturers Standardization Society of the Valve and Fittings Industry

3. STAINLESS STEEL MATERIALS

3.1. Pipe

The top portion of the eighteen (18) inch diameter Reclaim pond sloping pumpback pipe sleeve shall consist of ASTM A269 Grade TP316LN welded or seamless austenitic stainless steel pipe. The majority of the pipe will be cut in half, except where the flange is welded to the pipe to be connected to the remaining high density polyethylene (HDPE) pumpback tube and will act as a saddle to rest the pump when preparing it for installation.

3.2. Support Structure

The stainless steel potion of the pumpback tube will be supported by two (2), C5x9 ASTM A276 & ASTM A484 316L stainless steel channels, each anchored to the concrete foundation with an one-half (½)-inch by nine (9) inch by fifty-two (52) inch ASTM A480 316L stainless steel anchor plate and two (2) three-quarter (¾) inch ASTM A193, Grade B8M hex head stainless steel anchor bolts. The stainless steel pipe shall comply with the requirements for test methods, dimensions, and markings found in the requirements of and ASME B36.19M as follows:

3.3. Joints

Joints shall conform to the following requirements:

- Flanges:
  - 2-inch to 30-inch: Class 150 slip-on or weld neck standard weight, raised face, stainless steel ASTM A182 F316L/ANSI B16.5 A flange, welded in accordance with AWS D1.6.
- Bolting (All sizes):
  - Anchor bolts: Stainless steel hex head anchor bolts (ASTM A193, Grade B8M)
  - Stud bolt: ASTM A193, Grade B8M with two (2) hex nuts (ASTM A194, Grade 8M)
- Gaskets:
  - All sizes: ANSI (rating as shown on drawings), full face 1/16–inch-thick Gylon style, Garlock 3504, or equivalent

Dimensions of all flanges, gaskets, and bolts shall conform to ANSI B16.5 latest edition.

4. SUBMITTALS

The Contractor shall submit to the Engineer test data for each lot and a Manufacturer’s certification that all pipe and fittings under their supply comply with the applicable portions of the Specifications. The certificate shall include:

- Name of Manufacturer
- Name of Fabricator
- Product description and life expectancy, if applicable
- Statement of Specification compliance including the name of this project
- Signature of authorized official attesting to the information presented
- Manufacturer's recommendations for field installation and repairs

All materials shall be subject to the approval of the Engineer.

5. PIPE DELIVERY, HANDLING, AND STORAGE

5.1. General

Pipe, fittings, structural members, and other appurtenances shall be loaded and unloaded by lifting with hoists in such a manner as to avoid damage or hazard. The interior of all pipe and fittings shall be kept free from dirt and foreign material at all times.

The Contractor shall execute the work in accordance with this Specification, with its references and accompanying documentation, and with industry-accepted practice for the class of work.

The Contractor shall provide all equipment, tools, qualified labor, and supervision necessary to execute the work and shall remove all equipment and excess material upon completion.

Piping shall be installed in prefabricated sections, or by site fabrication/assembly in accordance with the requirements of the Drawings and Specifications.

All consumables such as, but not limited to, welding rod, temporary gaskets, welding and cutting gases, lubricants, etc., shall be supplied by the Contractor.

5.2. Storage, Protection, and Handling

All materials shall be stored in a secured area.

All materials shall be stored and handled with precaution from damage, contamination, misplacement, or disappearance.

All new valves, hoses, gaskets, stud bolts, and other fittings and fasteners shall be warehouse-stored or containerized to prevent damage, deterioration, or misplacement.

Welding electrodes shall be stored at a temperature and by a method to control moisture, or in the case of low hydrogen-type coated electrodes, eliminate moisture contamination. Storage methods shall be in accordance with the Manufacturer's recommendations. Welding and pipeline installation will be completed in proximity to the completed geomembrane installation. The Contractor shall protect the geomembrane from damage from the welding and installation process.

All new piping, valves, fittings, and accessories shall be stored on timber blocking, pallets, or other suitable means; kept above the level of any standing water; and kept free from dirt, grease, paint sprays, and any other contaminants.

All necessary precautions shall be taken to ensure the exclusion of foreign matter and debris from piping, fitting, and structural members.

When handling or lifting piping, components, or piping spools, all necessary precautions shall be taken to prevent damage to the material, including sling damage. Chains shall not be employed for lifts.

5.3. Verification of Conditions

Assemblies, subassemblies, and components shall be checked for conformance to approved detail and arrangement drawings. The accuracy of the layout shall be checked with respect to orientation, elevation, and dimensioning of all piping systems.

Assemblies, subassemblies, and components shall be inspected for foreign matter and debris and cleaned as required prior to fabrication and installation. Bolting shall be checked for damage, have adequate lubrication, and have all necessary nuts and washers.

5.4. Temporary Works

The Contractor shall be responsible for the stability of partially installed pipework and shall ensure that temporary works do not cause adverse stress conditions in fabricated pipe.

6. INSTALLATION

All Work shall be done by qualified craftsman in a neat and workmanlike manner conforming to applicable codes and accepted standards for good workmanship.

All pipe welders and welding procedures for piping shall be qualified as described in Chapter V of the latest edition of the Chemical Plant and Refinery Piping Code ASME B31.3; ASME Boiler and Pressure Vessel Code, Section IX; and ASME B36.19 Stainless Steel Pipe.

All welds shall be full penetration.

All pipe materials shall be inspected prior to installation to ensure cleanliness.

Do not bend or pull pipe to a radius by any procedure that will cause wrinkling, thinning, or flattening of the pipe cross section.

During installation, care shall be taken to ensure that excessive loads and moments are not transmitted to equipment flanges due to poor alignment or unintentional “cold pull.”

All pipelines shall be installed to preserve accurate alignment. Care shall be taken, in the installation of pipeline runs where drainage is required, that the pipeline will slope toward the point of drainage.

Before final assembly, the faces for each pair of flanges and the corresponding gasket shall be examined for cleanliness, damage, and defects. Flanged connections shall be assembled such that gasket contact pressure is uniform throughout the tightening operation. Where necessary, construction gaskets shall be employed before butt-welding sections of pipe to ensure that there is no misalignment. Upon completion of welding, the construction gasket shall be removed and replaced with the specified service gasket.

Flanges shall be oriented on the pipe spools so that bolt holes straddle and are equidistant from horizontal and vertical centerlines unless otherwise shown on the Drawings.

Flanged joints that have been made up and broken shall not be remade with the same gaskets. New gaskets shall be installed in all such instances.

Tack welds may be used to hold pipe edges to be welded in line, but all tack welds shall be removed by grinding before completing the joint.

Bolt threads shall be adequately greased with approved lubricant prior to assembly.

7. PIPE PLACEMENT

The pipe shall be installed to the lines and grades shown on the Drawings. Pipe fittings shall be installed at the required locations. Prior to installation, each section of pipe and each fitting shall be inspected for defects and/or damage.

The Contractor shall use equipment and methods approved by the Engineer for safe, convenient and satisfactory execution of the Work. All pipe, fittings, structural members, and other appurtenances shall be carefully lowered into place. Under no circumstances shall such materials be dropped into place. Extreme care shall be taken to prevent damage to the geomembrane liner system and to prevent foreign material from entering the pipe while it is being installed. During periods when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or other means approved by the Engineer.

The cutting of pipe for inserting fittings or closure pieces shall be done in a neat and workmanship-like manner without damage to the pipe or coating. Cutting of pipe shall leave a smooth end at right angles to the axis of the pipe.

Whenever it is necessary to deflect pipe from a straight line, either in the vertical or horizontal plane, to avoid obstructions or where long radius curves are permitted, the amount of deflection allowed shall not exceed that recommended by the Manufacturer, and as required for satisfactory joining and shall be approved by the Engineer.

Wherever significant site variations not shown on the plans are encountered during the construction, and where such obstructions interfere with the Work to an extent that an alteration in the lines or grades of the pipe is required, the Engineer shall have the authority to order such deviation or to arrange for removal, relocation or reconstruction of the obstructions. If the deviation results in a change in the amount of Work done by the Contractor, an increase in the Work shall be compensated for on the basis of payment as detailed in the Contract, or on a change-order basis. A reduction of Work shall result in a similar credit to the Owner.

7.1. Flange Bolting

Coat all flange bolts with a suitable anti-seize lubricant grease prior to final joint assembly. Remove excess lubricant and leave the joint clean.

- Leave not less than one (1) or more than three (3) full threads exposed beyond the nut after tightening flange bolts.

7.2. Inspection and Testing

The Engineer shall have access to the Work at all times and may inspect the Work at any stage to ensure that both materials and workmanship agree with the Specifications. Inspections and tests will be performed on the welds at the discretion of the Owner designated CQA personnel.

After installation, the Contractor shall test all piping as further described and shall correct any deficiencies indicated by such tests. The Engineer and the Owner shall be notified 24 hours in advance of all tests and shall witness all testing. Systems may be tested simultaneously if of the same test conditions. Tests may be conducted through a previously tested system, if that system has been tested at higher or equal conditions of pressure and temperature.

Due to the open nature of the pumpback tube saddle and supporting structure, hydrostatic testing will not be required.

8. GEOMEMBRANE LINER PROTECTION

8.1. Installation Near Geomembrane

When possible, welding shall be performed away from the geomembrane and assembled pieces bolted into place. If welding is necessary near the geomembrane, care shall be taken to protect the geomembrane from damage by covering the area during installation.

8.2. Repair of Damage

The General Contractor shall be responsible for the repair of any damage to the geomembrane liner that occurs during installation of the stainless steel portion of the pumpback tube.

APPENDIX F.9

Corrugated Metal Pipe

NewFields	CLIENT Lithium Nevada Corporation	PROJECT NO 475.0385.000

PROJECT: THACKER PASS PROJECT

TITLE: TECHNICAL SPECIFICATIONS FOR CORRUGATED METAL PIPE MATERIALS AND INSTALLATION	SPECIFICATION NO. 8-0385-000-SP-CMP-0

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1. GENERAL

This Specification defines the requirements for Corrugated Metal Pipe (CMP) materials, installation, and quality control associated with the Thacker Pass Project owned by Lithium Nevada Corporation.

Any alternatives or exceptions to this Specification shall be submitted in writing to the Construction Manager and shall be approved by the Engineer and the Owner.

The Definition of Terms is provided in Specification No. 0-0385-000-SP-GEN-0.

Earthwork requirements are provided in Specification No. 1-0385-000-SP-EW-0.

2. CODES AND STANDARDS

All pipe Work shall be of the best quality available complying with the current standards for the following:

- AASHTO M36: “Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains”, American Association of State Highway and Transportation Officials, Washington DC., www.transportation.org.
- AASHTO M218: “Standard Specification for Steel Sheet, Zinc-Coated (Galvanized), for Corrugated Steel Pipe”, American Association of State Highway and Transportation Officials, Washington DC., www.transportation.org.

3. SUBMITTALS

The General Contractor shall submit to the Owner and the Engineer a Manufacturer’s certification that all CMP and fittings they intend to supply comply with the applicable portions of the Specifications.

4. MATERIAL PROPERTIES

The galvanized steel shall conform to the applicable requirements of AASHTO M218. Galvanizing shall be in accordance with AASHTO M36. CMP shall consist of the diameter of pipe shown on the Drawings with three (3) inch by one (1) inch corrugations. Pipe gauge shall be Number twelve (12).

5. HANDLING & ASSEMBLY

Handling and assembly shall be in accordance with the Manufacturer’s recommendations.

6. INSTALLATION

CMP shall be installed to the sizes, lines, and grades shown on the Drawings. Pipe sections shall be joined with Manufacturer recommended couplers with the open seam of the coupler turned to the side of the pipe. Pipes shall be closely monitored during backfilling activities to ensure no damage is done to the pipe and the pipe joints are not damaged or separated. All CMP damaged during construction shall be replaced at the General Contractor's expense.

The pipe shall be installed to the lines and grades and generally in the manner shown on the Drawings. Where specific lines and grades are not indicated on the Drawings, the lines and grades will be determined by the Engineer in the field to suit the existing ground conditions. The General Contractor shall use equipment and methods acceptable to the Engineer and in accordance with the pipe Manufacturer's recommendations for handling and placement of the pipe and fittings.

The General Contractor shall provide and install all piping required to complete the piping installation in accordance with good piping practices, regardless of whether such piping is specifically detailed on the Drawings. The general layout as shown on the Drawings shall be maintained.

All pipelines shall be erected to preserve accurate alignment. Care shall be taken in the installation of pipeline runs where drainage is required to ensure that the pipeline has a continuous slope to the point of drainage.

Prior to installation, each segment of pipe and all fittings shall be inspected for defects and/or damage. All pipe, fittings, and other appurtenances shall be carefully lowered into position, piece by piece. Under no circumstances shall such materials be dropped into position.

Pipe bends to form curves either in the horizontal or vertical plane shall not exceed that recommended by the Manufacturer or approved by the Engineer. The cutting of pipe for inserting fittings or closure pieces shall be done in a neat manner and with good workmanship according to manufacturer recommendations without damage to the pipe and leaving a smooth end at right angles to the axis of the pipe.

Wherever obstructions not shown on the plans are encountered during construction, and where such obstructions interfere with the Work to an extent that an alteration in the lines or grades of the pipe is required, the Engineer shall approve any deviation or arrange for removal or relocation of the obstructions.

APPENDIX F.10

Concrete

NewFields	**CLIENT** **Lithium Nevada Corporation**				**PROJECT NO** 475.0385.000
PROJECT: THACKER PASS PROJECT					
TITLE: TECHNICAL SPECIFICATIONS FOR CONCRETE MATERIALS AND CONSTRUCTION					**SPECIFICATION NO.** **9-0385-000-SP-CO-0**

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1. GENERAL

1.1. Scope

This specification defines the requirements for concrete materials and methods of construction for cast-in-place concrete in the field, installation and quality control associate with the Thacker Pass Project owned by Lithium Nevada Corporation.

Any alternatives or exceptions to this specification shall be submitted in writing to Lithium Nevada Corporation or its designated representative with the bid.

The basis of this specification is ACI 301-16, "Specification for Structural Concrete." It is the intent of this specification to conform to the requirements of this document as a minimum standard.

The Definition of Terms is provided in Specification No. 0-0385-000-SP-GEN-0.

1.2. Reviews

The Contractor shall, at the start and during the course of Work where appropriate, meet with the Engineer for the review of the following:

- Proposed equipment and methods for storing constitutive components, mixing, and conveying concrete. The Contractor shall provide documentation that the concrete supplier meets industry certification.
- Contractor's Quality Control Program. The concrete supplier shall implement a Quality Control Plan to ensure that the Owner's and Contractor's performance requirements will be met.
- Inspection and testing of cement, aggregate, water, admixtures, reinforcement and storage of these materials.
- Proposed form material, form ties, and form release materials.
- Concrete mix designs with regard to strength, performance, shrinkage, porosity, durability and suitability for Project requirements. The concrete supplier shall submit documentation to the satisfaction of the Owner demonstrating that the proposed mix design(s) will achieve the required strength, durability, and performance requirements.
- Periodical inspection of the mixing plant.
- Prior to the erection of formwork, or the placement of reinforcement, or concrete, the:
  - Proposed methods of placing concrete.
  - Proposed methods and materials for supporting and securing reinforcement items to be cast-in and formwork including details of the reinforcement chairs and spacers.
  - Proposed details and positions of construction and crack control joints.

- Immediately prior to concrete placement:

  - The inspection by the Engineer of formwork, reinforcement, cast-in items, and preparation of existing concrete. Inspection by the Engineer of formwork shall be for conformance with the project documents, but not for structural strength and stability, which is the sole responsibility of the Contractor.

- Prior to concrete placement:
  - Sampling and testing of concrete and inspection of concrete placement procedures.
  - Preparation of existing concrete for bonding to new concrete.
  - Proposed curing methods, stripping times and hot and cold weather protection and concreting procedures.

1.3. Definition of Terms

- "The Standard" is ACI 301-16 "Specification for Structural Concrete."

1.4. Reference Standards and Publications

Only the major reference publications are listed below. The complete list shall include all the referenced documents included in the referenced publications below. The Contractor shall have a copy of the publications highlighted in bold onsite and provide access to the Engineer to the publications.

- IBC 2018: International Building Code.
- ACI 301-16: Specification for Structural Concrete. Methods of Test and Standard Practices for Concrete.
- ACI 318-14: Building Code Requirements for Structural Concrete.
- ACI SP-4: Formwork for Concrete.
- ASTM A615/A615M-18e1: "Standard Specification For Deformed and Carbon Steel Bars for Concrete Reinforcement", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM C33/C33M-18: "Standard Specification for Concrete Aggregates", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM C150/C150M-19a: "Standard Specification for Portland Cement", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM C260/C260M-10a(2016): "Standard Specification for Air-Entraining Admixtures for Concrete", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM C494/C494M-17: "Standard Specification for Chemical Admixtures for Concrete", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM C1017/C1017M-13e1: "Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete", ASTM International, West Conshohocken, PA, www.astm.org.

- ASTM D1752-18: “Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction”, ASTM International, West Conshohocken, PA, www.astm.org
- ANSI/AWS D1-4: Structural Welding Code – Reinforcing Steel.
- ACI SP66 (2004): ACI Detailing Manual.

1.5. Submittals

All proposals and submissions by the Contractor and all responses by the Engineer shall be in writing. Acceptance of the Contractor's proposals and submissions by the Engineer shall not relieve the Contractor of his responsibility for the work as defined by the contract.

Contractor submissions to the Engineer shall include qualifying documentation for all materials and products including:

- Proposed concrete mix proportions including supporting trial mix results and certification that the mix proportions will produce concrete of the specified quality and yield; anticipated slumps for each proposed mix before and after addition of superplasticizer.
- Documentation that the plant, equipment, and all materials to be used in the concrete comply with the requirements of ACI 301.
- Mill certificates for reinforcing steel.
- Reinforcing bar detail lists and placing drawings shall be submitted to the Engineer for his records.
- Mill certificates for cement and supplementary cementing materials.
- Description of the proposed concrete batching plant and conveying systems, including capacity, admixture provision batching system, cold weather capabilities, hot weather capabilities, quality control procedures.
- Note that submissions to the Engineer and reviews of submissions by the Engineer shall be completed prior to placing any concrete or doing any concrete work. The Contractor shall schedule the submissions to allow for at least two weeks for review by the Engineer.

The Contractor may petition the Engineer for the acceptance of:

Supplementary Cementing Materials (fly ash, silica fume and granulated blast furnace slag). The petition shall include:

- Identification of the source, information on its service record in concrete subjected to similar service, and test data showing conformance with Cementitious Materials Compendium including uniformity requirements.
- Proposed dosage and timing of addition for each class of concrete as applicable.

Water-Reducing Admixture; Water-Reducing High Range Admixture (Superplasticizer); Accelerating Admixtures. The petition shall identify the:

- Manufacturer
- Proposed dosage, and timing of addition for each class of concrete, as applicable
- Type of admixture (retarding, accelerating, normal set)

1.6. Quality Assurance

Records shall be kept for all submissions and for:

- Temperature of the plastic concrete and strength tests in accordance with Sections 4.2.2.8 and 4.2.3 of the “The Standard". (See Section 1.3 of this specification for definition of "The Standard.")
- A certificate of accuracy of the scales at the batch plant
- Temperature at the time of concrete placement
- Delivery tickets: The Contractor shall ensure that the records indicate where the delivered concrete was used so that remedial action can be taken if it is subsequently determined that the concrete is unsuitable for use.
- Temperature records, including methods used for the placement and curing of concrete when low temperature as specified in Section 4.2.2.8, or high temperature as specified in Section 5.3.2.1.C of “The Standard" are exceeded.

2. GENERAL

Table 1. Structural Class of Concrete

CLASS #	STRUCTURAL CLASS OF CONCRETE:	Max. Size Aggregate inch	Total Ent. Air + 1%	28 Day Compressive Strength psi	Admixtures Required	Max. Water: Cement	Min-Max. slump (inches)
1.	Slabs, Beams, Columns and Walls	¾	6	4000	AEA	0.45	3-5
2.	Waterproof, Chest Walls, Aggressive Exposure and Hydraulic Structures	¾	6	4000	AEA & WRA	0.4	3-5

Notes:

1. **Concrete mix designs shall be based on trial mixes prepared by the Contractor and submitted to the Engineer for review. The trials shall use a minimum of three cement factors separated by 50 lbs/yd3 with air content approximating the maximum values in.**
    - **Reduce air to 3% for slabs to be steel troweled, except exterior slabs.**
    - **All cement shall be Type II**
    - **AEA = Air entraining agent. WRA = water reducing agent.**
    - **Water: Cement = Water -to- cementitious materials ratio.**
    - **Fine and coarse aggregate to be Normal -density aggregate UNO on drawings.**
2. **When concrete is to be placed by pump, properties shall be measured at discharge from the hose. The sand content of the pump mix, as a ratio by weight of total aggregate, shall not be increased more than 3% from the conventionally placed concrete.**
3. **Water reducing high range admixtures (superplasticizers) may be used to obtain higher slumps for workability subject to the Engineer's acceptance.**

2.1. Materials

2.1.1. Cements and Supplementary Cementing

Portland cement shall be Type II unless otherwise shown on the drawings.

2.1.2. Aggregates

Normal-Density Fine Aggregate:

The requirements in ASTM C33 shall be modified as per Table 2.

Table 2. Grading Limits for Fine Aggregate (FA)

Total Passing Sieve: Percentage by Mass	US Standard Sieve Size No.
95-100	4
80-100	8
50-80	16
25-60	30
5-30	50
0-10	100

The fineness modulus of the sand shall be not less than 2.5 not more than 2.9.

2.2. Admixtures

Water-reducing admixtures and water-reducing high range admixtures (superplasticizers) shall meet the requirements of ASTM C494, Standard Specification for Chemical Admixtures for Concrete.

Calcium chloride shall not be used. Admixtures containing chlorides may be used providing the total chloride ion content in the concrete does not exceed 0.1% by weight of cement.

2.3. Concrete Properties

Concrete strengths and maximum aggregate size shall be as per Table 2 in clause 2.1.2 above.

Concrete shall be normal density concrete unless noted otherwise on the drawings.

2.4. Construction Quality Assurance/Quality Control

The evaluation of concrete quality shall be the responsibility of the Contractor and shall be carried out as outlined in Section 1.6 of “The Standard".

The Contractor shall provide a full time coordinator who shall be present at all times during concrete work and who shall be thoroughly trained and experienced in placing the types of concrete specified and who shall direct all the work performed under this specification. The coordinator shall have the authority to request that mixing trucks return to the batch plant if delivery times are exceeded or to interrupt work if any other quality issues are not being met.

The Owner may elect to undertake independent testing but this shall not relieve the Contractor's responsibility to perform testing as described below.

Test results shall be submitted to the Engineer for review within 5 working days of the testing.

A strength test shall comprise the testing of four test cylinders. A minimum of four test cylinders shall be taken for each day of placing, and there shall be at least one test for each 100 cubic yards of concrete and for each class of concrete.

One of the cylinders shall be tested at 7 days and two at 28 days and 1 at 56 days. The test results shall be the average of the two 28-day cylinders.

The concrete shall be considered to have met strength requirements if the average of every set of three consecutive strength tests for each class of concrete exceeds the specified strength and no individual strength test is more than 500 psi below the specified strength. If these strength requirements are not met, the Engineer will require adjustments to the mix proportions and additional testing as permitted by Section 1.6 of “The Standard".

Accelerated strength tests shall not be used as an alternative to the standard cylinder test.

3. PRODUCTION AND DELIVERY

When concrete is mixed in truck mixers, a complete mixing cycle of 70 - 100 revolutions at mixing speed shall be completed before the truck leaves the plant.

Requirements of Section 4.3.2.1 of “The Standard" shall control the Contractor's additions of water to concrete (except super-plasticized concrete) including:

The specified water-to-cement ratio shall not be exceeded.

No more than 90 minutes has elapsed from the time of batching to the start of discharge.

Addition of water is only at the start of discharge (i.e., not more than 10% of the concrete has been discharged).

A 30 revolution mixing cycle shall follow water additions.

Water may not be added more than once to a load.

The amount of water added and by whose authority shall be recorded on the delivery ticket.

4. FORMWORK, REINFORCEMENT, EMBEDDED METAL AND PRESTRESSING

4.1. Reinforcement

All reinforcement shall conform to ASTM A615/A615M-18e1.

Reinforcement shall be provided in accordance with the requirements of ACI 318-14.

4.2. Hardware and Miscellaneous Materials

Dissimilar metals shall be electrically separated when embedded in concrete.

Aluminum including aluminum conduits shall not be embedded in concrete.

4.3. Storage of Reinforcement

Reinforcement shall be protected from corrosion. Special precautions shall be taken for winter conditions to ensure that reinforcement can be identified.

4.4. Formwork

The Contractor who places the concrete (the Concrete Contractor) is responsible for the adequacy of all formwork and falsework including metal deck formwork, and satisfying all codes and regulations governing formwork and falsework. The Contractor shall provide calculations for all concrete formwork and shoring, sealed by a Professional Engineer if requested by the Engineer or Owner.

The design, fabrication, erection, and use of concrete formwork shall conform to the requirements of ACI SP-4.

Falsework for suspended concrete elements shall conform to ACI SP-4.

Unless otherwise shown on the drawings, forms shall be constructed to produce the final concrete Surface Class in the following locations:

Surface Class B –

Normal Exposed Concrete – All interior and exterior columns, walls, beams, and underside of slabs.

Form Material: Form ply.

Resulting Surface: Free from honeycombing, large bug-holes or voids greater than 1/2" across and/or depth, fins or misalignments greater than 1/8".

Construction: Maximum deflection 1/270 of span; patching of form panels permitted.

Patching: Refer to Section 5.3.7 of “The Standard".

Surface Class C –

All concrete not exposed to view such as buried foundations and non-exposed faces of retaining walls.

Form Material: Shiplap or form ply.

Resulting Surface: No specific requirements other than freedom from major voids or honeycomb; minimum dimensions and reinforcement cover to be maintained.

Patching: Not normally required except in areas where reinforcement is exposed. Refer to Section 5.3.7 of “The Standard”.

For Surface Class B surfaces, exterior corners and edges exposed to view including horizontal edges of tank pads and curbs shall have 1" x 1" chamfers. Edges of slabs, curbs and pads shall be hand tooled.

All sharp corners for members composed of steel fiber-reinforced concrete shall have 1" x 1" chamfers or be rounded to a radius of 5/8".

4.4.1. Formwork Removal

Unless otherwise shown on the drawings or advised by the Engineer, formwork must not be removed prior to the lapsed time after concrete placement (Minimum Stripping Time) according to the Table 3 below and as otherwise prescribed in the notes following the table.

Minimum stripping times are the lesser of Column A (Minimum Stripping Time) or Column B (Time to Achieve Minimum Percentage of Specified 28 Day Strength).

Table 3. Stripping Time

	A Minimum Stripping Time (days):	B Time to Achieve Specified Strength of (%):
Foundation, pile caps, piers, grade walls, pedestals, columns, equipment bases less than 4 ft high	2	30
Foundation, pile caps, piers, grade walls, pedestals, columns, equipment bases greater than 4 ft high	4	60
Walls for liquid containment vessels	5	70
Edges of elevated slabs	2	30
Soffits of slabs without construction loads	7	70
Soffits of slabs with construction loads	14	85
Sides of beams and girders	7	70
Bottom of beams and girders without construction loads	14	85
Bottom of beams and girders with construction loads	21	90

Notes:

1. **Minimum stripping time is the lesser of columns A or B, or as extended by Notes 2 through 5, below.**
2. **If retention of formwork is chosen as a means of curing, extend the stripping time to the required curing time. See Table 4 - Minimum Cure Times.**
3. **If ambient temperatures are less than 50ºF extend the stripping time to the satisfaction of the Engineer.**
4. **Stripping times "with construction loads" are based on superimposed construction loads equal to the load capacity of the member at the time that the loads are imposed, to a maximum equal to the design gravity temporary live load of the member. If the superimposed construction load is greater than this, extend the stripping time to the satisfaction of the Engineer, and see Section 4.4.1 of this specification.**
5. **If more than 10% of supplementary cementitious material is incorporated in the mix, extend the stripping time to the satisfaction of the Engineer.**

4.5. Fabrication and Placement of Reinforcement

Stirrups and ties of Grade 60 ksi material must meet the bending requirements of Grade 40 ksi steel.

Bar supports and side form spacers shall be non-conductive and shall be the type pre-approved by the Engineer.

Top reinforcement in slabs in process buildings subject to wash down (i.e. all floors with slopes) shall have a minimum cover of 2 3/8", unless otherwise shown on the drawings.

Reinforcement shall be securely tied at intersections with wire not less than 16 ga. or clips. Slab reinforcement shall be carried on approved concrete pads or approved chairs providing support spacing of not more than 48". Top slab steel shall be carried on support bars of #5 minimum size supported not over 38" apart. Where temperature steel is used to support top slab steel and if temperature steel is 3/8" size, then supports shall not be over 35" apart.

Support bars or spacer bars placed directly on metal deck formwork shall be epoxy-coated or fiberglass or other non-metallic material.

Welding procedure for reinforcing bars is to be done in accordance with ANSI/AWS D1.4. Tack welding of reinforcing bars is not permitted. Reinforcing bars shall only be welded as shown on the drawings or as approved by the Engineer in writing.

4.6. Fabrication and Placement of Hardware and Other Embedded Items

Anchor bolts (rods) shall be placed to the tolerances listed in *“The Standard*". Templates should be used for placing anchor bolts for small equipment and tanks.

All other embedded metal such as door sills, beam support plates and trench angles, shall be set true within ± 1/8" of position shown on drawings.

4.7. Post-Tensioning

No addendum.

5. PLACING, FINISHING AND CURING CONCRETE

5.1. Storage of Materials Used For Placing, Finishing, and Curing

Store so that materials are not affected by soil/ground moisture.

5.2. Placing of Concrete

The Contractor shall notify the Engineer before placing any concrete. There shall be adequate notice such that the formwork, reinforcing and embedded metal placement can be reviewed. In no case, shall the notice be less than 24 hours. The Contractor shall verify all anchor bolt and embedded metal locations before placing concrete.

Concrete shall be deposited as closely as practical to its final position in horizontal or wedge-shaped layers not more than 18 inches deep. Lateral movement of the concrete by means of vibrators will not be permitted.

Concrete shall be dropped vertically, without lateral movement, into formwork without interference. Unconfined free fall shall be limited to 5 ft unless otherwise required or approved by the Engineer. If placement methods require free fall of more than 5 ft, the tremie method of placement will be required.

Proposed methods and equipment used for the concrete consolidation shall be in accordance with the report of ACI Committee 609 – “Consolidation of Concrete.”

5.2.1. Bonding Fresh Concrete to Rock or Hardened Concrete

Surfaces of hardened concrete shall be cleaned with high pressure jets or mechanical means to expose the coarse aggregate to a reveal of 1/4" and remove all laitance and loose material. Unless otherwise shown on drawings, bonding shall be accomplished by:

- Vertical Joints –Surface shall be dampened (but not saturated) immediately prior to placing fresh concrete.
- Horizontal Joints – For those horizontal joints in liquid-retaining structures or those specifically designated on the drawings or by the Engineer, a 6" layer of special bonding mix shall be placed and be well vibrated to achieve maximum bond. The concrete to be used for this special bonding mix shall be the normal mix proportions with one-half the coarse aggregate removed and the slump increased to 5".
- For other horizontal joints, treat same as "Vertical Joints".

Where roughening of the rock or hardened concrete surface is specified, the surface shall be roughened to expose the coarse aggregate to full amplitude of at least 1/4".

5.3. Joints

Joints shall be constructed and located as described on the drawings. Whenever PVC waterstop is specified, it shall be wired to the reinforcing steel with all waterstop joints properly fused to provide a continuous seal.

5.4. Joint Filler

The joint filler shall be standard cork joint filler with an insoluble phenolic resin binder, conforming to ASTM Designation D1752, Type 2.

All joints in the filler material shall be made tight so that mortar from fresh concrete will not seep through to the opposite concrete surface.

5.5. Joint Sealant

The Contractor shall supply and apply joint sealant complete with bond breakers and backup materials to expansion joints and elsewhere in concrete structures as shown on the Drawings or otherwise required by the Engineer.

Except as otherwise specified herein, surface bond breakers and backup materials shall be companion products of the joint sealant used for the work as recommended by the sealant manufacturer and approved by the Engineer.

5.6. Curing and Protection

All exposed concrete surfaces shall be cured as given in accordance with the requirements of Section 5.3.6 of “The Standard". Moist curing shall be used. Curing compounds are not permitted for this exposure class of concrete. In addition, surfaces which are to be; water-proofed, painted, coated, will receive a separate topping or grout, or is adjacent to a pour where good bond is required, shall be wet cured only (curing compounds are not permitted).

Curing may consist of formwork retained in place and/or an approved curing method. Approved methods are a, b, or c of Section 5.3.6.4 of "The Standard".

Unless otherwise shown on the drawings or advised by the Engineer, curing must be carried out for the lapsed time (Minimum Cure Times) according to the following table and otherwise prescribed in the notes below the table.

Minimum cure times are the lesser of Column A or Column B in Table 4.

Table 4. Minimum Cure Times

Element	A Cure Time (days):	B Time to Achieve Min. % of Specified Strength of:	C Method of Curing per Section 5.3.6 of “The Standard”
Foundations, pile caps, piers, grade walls, walls, pedestals, columns, equipment bases	7	70	Any
Top surfaces of slabs	7	70	As noted below or (3)

Notes:
1. The Contractor may establish the Minimum % of Specified Strength by testing field cure cylinders or by other non-destructive testing which is acceptable to the Engineer.
2. Cure times shown are based on minimum ambient temperatures of 50ºF. For lower temperatures the Contractor shall extend the cure times to the satisfaction of the Engineer.
3. For accelerated strength concrete mixes cure times shall be the minimum defined in Table 4 above.

5.6.1. Curing of Slab Surfaces

Proper curing of slabs is essential and must be done as follows. Begin curing as soon as the plastic curing membrane can be applied without damage to the newly finished surface.

The concrete surface is to be wetted immediately after final finishing and covered with a 6 mil polyethylene membrane, clear or white, and secured in place with weights so as to prevent exposure of the concrete surface during the curing period. The membrane shall cover all exposed surfaces of the concrete.

Place the membrane flat, without wrinkles, to minimize mottled discoloration.

Edges shall be lapped 1-foot minimum and tape sealed.

Provide traffic protection to protect the concrete surface and the polyethylene curing membrane.

Leave the curing membrane undisturbed for a minimum of 7 days.

Maintain a film of water under the membrane and add water as required.

5.6.2. Hot Weather Protection

The plastic concrete temperature at time of placement shall not exceed temperatures in Section 5.3.6.5 of “The Standard". When the air temperature is expected to be 80°F or higher, suitable protection shall be provided.

5.6.3. Cold Weather Protection

The minimum plastic concrete temperature at placement shall not be less than temperatures in Section 4.2.2.8 of “The Standard". When the air temperature is or is expected to fall lower than 41°F, suitable protection shall be provided.

5.7. Finishing and Treatment of Slab Surfaces

The final floor finish shall be one of the following types:

- STEEL TROWEL: Dense hard surface obtained by multiple steel trowel passes.
- NON-SLIP SWIRL: Multiple steel trowel passes but with final pass of aluminum float.
- BROOM: Multiple steel trowel passes followed by brooming to the required texture.

Unless designated on the drawings, the following floor finishes shall be used in these areas:

- STEEL TROWEL: Control rooms, electrical rooms, dry process floors, warehouses, under FRP tanks.
- NON-SLIP SWIRL: All process floors that are rarely wetted with water.
- BROOM: Exterior concrete slabs with significant vehicular or people traffic, slabs in process areas that are frequently wetted or flooded or are subject to spillage of process materials, and under steel tanks.

5.8. Finishing of Formed Surfaces

Projecting imperfections shall be removed; depressed imperfections shall be patched by chipping to sharp margin and by filling with mortar. Patches exposed to view shall blend with surrounding surfaces. All patchwork shall be carried out immediately following the stripping of forms and while concrete is still green. Patches shall be properly installed and cured.

The required quality of formed surface shall be as designated in Section 4.5 of this specification. The particular patching procedure required for each area shall be reviewed with the Engineer prior to starting.

6. CONSTRUCTION LOADS

The Contractor shall take precautions to ensure concrete is not damaged from construction loads prior to reaching its specified strength. The Contractor shall ensure concrete is not loaded in excess of its design capacity after reaching its specified compressive strength. The Contractor shall review plans for placing construction loads with the Engineer.