9.6 Geotechnical and Paleontological Data

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REVISED GEOTECHNICAL DESIGN REPORT

Ono Lead Track Extension, Milepost 76.54-80.61 Cajon Subdivision, BNSF Railway

SAN BERNARDINO, CALIFORNIA

SHANNON & WILSON

February 26, 2021

Shannon & Wilson No: 51-1-10240-012

Submitted To: TKDA
444 Cedar Street, Suite 1500
St. Paul, MN 55101

Subject: REVISED GEOTECHNICAL DESIGN REPORT, ONO LEAD TRACK EXTENSION, MILEPOST 76.54-80.61
CAJON SUBDIVISION, BNSF RAILWAYSAN BERNARDINO, CALIFORNIA

Shannon & Wilson prepared this report and participated in this project as a subconsultant to Toltz, King, Duvall, Anderson and Associates, Inc. (TKDA). Our scope of services was specified in Agreement Number 0016300.00.001 with TKDA dated December 29, 2016, and Supplemental Subcontract Agreements Numbers 4 and 5, dated February 8, 2019 and April 24, 2019, respectively. This revised report presents our geotechnical design and was prepared by the undersigned and it supersedes our August 26, 2020 report. It presents updated geotechnical recommendations for track design.

We appreciate the opportunity to be of service to you on this project. If you have questions concerning this report, or we may be of further service, please contact us.

Sincerely,

SHANNON & WILSON, INC.

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1 INTRODUCTION

1.1 General

This revised report presents our geotechnical design recommendations for improvements associated with the Ono Lead Track Extension (Project) at the BNSF Railway (BNSF) Cajon Subdivision Milepost (MP) 76.54 to MP 80.61. The Project site is shown in the Vicinity Map, Figure 1. We summarize our subsurface explorations, laboratory testing, and geotechnical engineering analyses, and present conclusions and recommendations for design and construction of the proposed improvements.

Shannon & Wilson previously provided geotechnical recommendations for the alignment in the following reports:

- “Geotechnical Design Report, Trailer Parking Expansion and Ono Lead Track Extension," dated October 26, 2017 for preliminary track design of the Project (Shannon & Wilson, 2017a);
- "Geotechnical Report, Phase 1 Preliminary Infiltration Design, Ono Lead Track Extension Project" dated October 18, 2019 that included preliminary infiltration design for the Project (Shannon & Wilson, 2019b); and
- “Geotechnical Design Report, Ono Lead Track Extension, Milepost 76.54-80.61, Cajon Subdivision" (Design Report) dated August 26, 2020 for proposed sound walls, a crash wall, and municipal improvements (Shannon & Wilson, 2020).

We have revised the Design Report to incorporate the data and recommendations provided in our previous reports listed above at the request of TKDA on February 12, 2021. This design report supersedes are previous design reports listed above in its entirety (specific to this Project).

1.2 Project Description

Our understanding of the proposed Project is based on:

- Our correspondence with TKDA,
- Final plans entitled “BNSF Ono Lead Extension - Property Impacts” prepared by Kimley Horn dated February 1, 2019,
- Plan entitled “BNSF Ono Lead Track Extension Project, Exhibit 1, Potential Locations for Infiltration Basins, County of San Bernardino, State of California,” prepared by JLC Engineering & Consulting, Inc., undated,

- Plans entitled "BNSF Railway Company, Ono Lead Track Extension, Cajon Subdivision (MP 76.54 - MP 80.61)" (Project Plans) prepared by TKDA dated March 6, 2020 (TKDA, 2020a), and
- Plans entitled "City of San Bernardino West 17th Street, North J Street, North Harris Street, and North I Street Relocation, Water Main, Sanity Sewer & Storm Sewer Improvement Plans," prepared by TKDA, dated March 6, 2020 (TKDA, 2020b).

The proposed Project consists of the construction of:

- The new lead track extensions,
- Sound walls,
- A crash wall at the Mt. Vernon Avenue overpass,
- Municipal improvements, and
- Preliminary infiltration design for storm water basins.

1.2.1 New Lead Track

The new lead track and associated improvements described in this section are shown in Figure 2 (7 Sheets), Site and Exploration Plan. Per Sheet G103 of the Project Plans, the track extensions will be designed using 12 inches of ballast over 12 inches of subballast. The track extensions will connect the south end of the existing Ono Lead Tracks to the San Bernardino Intermodal Facility.

1.2.2 Sound Walls

The proposed sound walls (Figure 2, all Sheets) will consist of Caltrans standard sound walls extending 8 feet above the top of rails (TKDA, 2020b). We have assumed the top of rails is no more than 4 feet above the adjacent, existing subgrade (i.e., the sound wall will be 12 feet tall or less). The sound walls will be supported on either shallow and/or deep foundations. There will be an earthen drainage ditch or concrete channel between the sound walls and the tracks. We understand the concrete ditch, where present, may be connected to the sound wall.

1.2.3 Crash Wall

A crash wall is proposed to protect the bridge piers at the Mt. Vernon Avenue overpass (Figure 2, Sheet 2). The proposed crash wall will be approximately 6 feet above top of rail and will be 19.6 feet from the centerline of the proposed lead track to the existing face of bridge pier (TKDA, 2020b). The crash wall will be supported on deep foundations.

1.2.4 Municipal Improvements

The proposed municipal improvements consist of relocating streets including West 17th Street, North J Street, North Harris Street, and North I Street, and reconfiguring ends and elbows of existing streets (Figure 2, Sheets 3, 5, 6, and 7). Flexible pavement is proposed for the relocated streets. We understand this work will also include new and/or relocating existing underground utilities including water, sanitary sewer and storm sewer.

1.2.5 Infiltration Basins

Infiltration basins were originally proposed for the Project, with percolation testing consisting of two phases:

- Phase 1 – Preliminary Infiltration Design; and
- Phase 2 – Final Infiltration Design.

The proposed infiltration basin bottoms were about 7 feet below the existing grade. Originally, nine basin locations were proposed for the Phase 1 design (JLC Engineering, undated). However, only four of the nine basins were accessible for percolation testing to develop the preliminary infiltration design (Figure 2, Sheets 3, 5, and 7). Based on the Phase 1 design results, three of the four basins were selected for the Phase 2 Final Infiltration Design, which would require additional percolation testing.

Prior to the start of the Phase 2 design, the design studies for the infiltration basins were suspended. We understand that stormwater runoff will be treated with a biofiltration system. We have included our data and recommendations from our Phase 1 design in this report as reference.

1.3 Scope of Services

We performed our scope of services in accordance with the following proposals and TKDA agreements:

- Our proposal dated November 17, 2016 and authorized by the "Subcontract Agreement" with TKDA dated December 29, 2016,
- Our proposal dated February 15, 2019 and authorized by the "Subcontract Amendment No. 4" dated March 8, 2019, and
- Our proposal dated April 18, 2019 and authorized by the "Subcontract Amendment No. 5" dated April 24, 2019.

Our services for the Project consisted of the following geotechnical tasks:

- **File Review** – Performed a file review of geologic information contained in our files and readily available online.
- **Site Reconnaissance** – Performed our most recent site reconnaissance on March 18, 2019.
- **Field Preparation** – Included subcontractor coordination, a health and safety plan and utility locates, permits with the City of San Bernardino (City), and traffic control.
- **Subsurface Exploration Program** – Performed soil borings to characterize the subsurface materials.
- **Infiltration Tests** – Performed the Phase 1 infiltration tests at four proposed stormwater infiltration areas.
- **Geotechnical and Chemical Laboratory Testing** – Conducted laboratory tests on selected soil samples.
- **Engineering Analyses** – Performed geotechnical engineering analyses to develop our recommendations.
- **Report** – Prepared previous reports listed above and this report to provide geotechnical design recommendations.

2 SITE DESCRIPTION

2.1 General

The Project site elevations based on Google Earth range from approximately 1,408 to 1,087 feet. Topographically, the site broadly slopes down to the southeast and south.

2.2 BNSF Right-of-Way (ROW)

The Project is adjacent to the existing tracks within the BNSF ROW immediately west of the Interstate 215 Freeway. The existing tracks are generally up to 3 feet above the existing grade on a track embankment. The track alignment generally slopes down toward the south. The alignment includes freeway overpasses and overhead powerlines as shown in Exhibits 2-1 and 2-2 below.

Exhibit 2-1: View of West Highland Avenue overcrossing on BNSF ROW, looking east

Exhibit 2-2: View of Location at Boring B-21 on BNSF ROW, looking northwest

2.3 City Streets

The Project is partially located within the City public streets. Site conditions consist of paved city streets in both residential and commercial neighborhoods. We encountered overhead powerlines and underground utilities below the streets as shown in Exhibits 2-3 and 2-4 below.

Exhibit 2-3: View of N Street and Magnolia Avenue, looking south

Exhibit 2-4: View of West 7th Street Terminus, looking southeast

2.4 Infiltration Basins

Basins 1, 3, and 9 are undeveloped parcels as shown in Exhibits 2-5, 2-6, and 2-8 below. Basin 6 is located at the north end of a paved and developed commercial property as shown in Exhibit 2-7 below.

Exhibit 2-5: View of proposed Basin 1 location, looking northeast.

Exhibit 2-6: View of proposed Basin 3 location, looking northeast.

Exhibit 2-7: View of proposed Basin 6 location, looking southeast

Exhibit 2-8: View of proposed Basin 9 location, looking southeast

3 SUBSURFACE EXPLORATIONS

For our subsurface explorations along the Project alignment, we completed the following:

- Soil borings, designated B-1 to B-23,
- Infiltration borings, designated I-1 to I-4, shown in Figure 3, and
- Test pits, designated TP-09-17, TP-10-17, TP-11-17, TP-13-17 and TP-14-17.

Eight of the soil borings are within BNSF ROW and the remainder are within the City streets. The boring depths range from 16.5 to 26.5 feet below the existing ground surface (bgs). For our infiltration borings, we drilled one soil boring (e.g., Boring I-1) and two adjacent percolation borings (e.g., Borings I-1A and I-1B) at each of the four proposed basin locations to characterize soil properties for infiltration design. The infiltration borings were advanced to a depth of 19 feet bgs. The percolation borings were drilled to a depth of 7 feet bgs. The test pit excavation depths ranged from 5 to 10 feet bgs.

A discussion of the drilling, sampling, and logging procedures used to complete the borings and test pits including the individual exploration logs and an explanation of the symbols and terminology used is included in Appendix A.

4 LABORATORY TESTING

We performed geotechnical and chemical laboratory testing on selected samples retrieved during our subsurface exploration program.

Geotechnical laboratory tests included a visual description, moisture content, grain size analysis, fines content, Atterberg limits, direct shear test, compaction characteristics, R-value, and soil corrosion. Descriptions of laboratory test procedures and results are presented in Appendix B. The moisture content determinations, fines content, and Atterberg limits test results are incorporated into the boring and test pit logs in Appendix A.

Investigation-derived waste (IDW) is waste generated during drilling and sampling activities conducted for the Project. The IDW generated for this Project included soil cuttings and they were placed into nine 55-gallon steel drums. The drums were temporarily stored within Lot 5 of the BNSF Intermodal yard pending the results of analytical testing. Based on the analytical testing results, the drums were transported and disposed off site by Haz Mat Trans Inc.

Following chain-of-custody procedures and to characterize soil from the borings for disposal purposes, we submitted three composite samples (designated S-1, S-2, and S-3) for analytical chemical testing to American Environmental Testing Laboratory Inc. of Burbank, California. Laboratory analytical results and further information can be found in Appendix C, Analytical Results.

5 GEOLOGY AND SUBSURFACE CONDITIONS

5.1 Geologic Setting

The Project lies within the California geomorphic province known as the Transverse Ranges. This province is characterized by east-west-trending valleys and mountains that highly contrast with the tectonic framework of this area, which is dominated by northwest-trending structures.

Locally, the Project is included within a sub structural unit of the Transverse Ranges known as the San Bernardino Basin (Morton and Miller, 2006). The San Bernardino Basin is a depressed region bounded by the San Andreas fault to the northeast, the San Jacinto fault to the southwest, and the Banning fault to the south. The San Jacinto fault forms the boundary between the Perris Block to the southwest and the San Bernardino Basin to the northwest.

The Project lies within the alluvial flood plain of the San Bernardino Valley. Sediments within this area generally originated from the San Bernardino and San Gabriel Mountains via outwash discharge mainly from Lytle Creek Wash, Cajon Wash, Santa Ana Wash, and other smaller tributaries. Locally in the Project area, it is estimated that there is up to 700 +/- feet of alluvial sediments on the northeast side of the San Jacinto fault (Fife and others, 1976).

Accumulated sediments underlying the Project area formed in various kinds of depositional environments. Most of the sediment was deposited by rivers and streams as described above, but some clay and silt formed in lake and marshland environments (Carson and others, 1986).

Morton and Miller (2006) show native surficial sediments at the site to consist of Quaternary-aged very young wash deposits, young axial-channel deposits, and young eolian deposits as shown in the Regional Geologic Map, Figure 4. These deposits are reported as coarser-grained sediments consisting of sands and gravels.

The southern portion of the Project area lies within an artesian groundwater zone that existed into the late 19th century (Fife and others, 1976). Confining layers within the San Bernardino artesian area were not entirely impermeable, creating marshes, bogs, and standing water prior to extensive groundwater withdrawal for agricultural irrigation. We encountered near-surface finer-grained sediments in this area consisting of lean clay, sandy clay, and clayey sand.

5.2 Subsurface Conditions

Under the existing pavement or surficial soil layer, we encountered alluvial deposits to the maximum depth explored. Our interpretation of the subsurface conditions is based on our extrapolation between explorations.

5.2.1 Existing Pavement Section

The existing pavement sections encountered in our subsurface explorations consisted of asphalt concrete (AC), underlain directly on the subgrade soil except for B-11, which was underlain by a layer of aggregate base (AB). We have summarized the existing AC and AB thicknesses observed in our borings within City streets in Exhibit 5-1 below. A 2.5-inch-thick layer of concrete was observed below the AC in boring B-16.

Exhibit 5-1: Existing Pavement Sections

Boring	AC (inches)	AB (inches)
B-7	3.5	-
B-8	3	-
B-9	3	-
B-10	3	-
B-11	5	7
B-12	4	-
B-13	3	-
B-14	3	-
B-15	1.5	-
B-16	4	-
B-17	5	-
B-18	5	-

NOTE:
AB = aggregate base; AC = asphalt concrete

5.2.2 Artificial Fill (af)

Artificial fill directly underlies the ground in 16 borings and 5 test pits. The fill depths range from 2.5 to 6.5 feet bgs. The fill soils consisted of loose to medium dense, silty sand to sandy silt, well-graded sand with silt, and clayey sand. The fill was likely placed during the development of the existing tracks and streets.

5.2.3 Alluvial Fan Deposits (Qa)

We encountered Quaternary-age alluvial fan deposits underlying the artificial fill or subgrade below the City streets. The soils encountered consisted of sand with gravel, sand with silt, silty sand, clayey sand, sandy silt, clay with sand, and sandy clay, occasionally with gravel and cobbles. The relative density of the coarse-grained soils ranged from loose to very dense and the consistency of the fine-grained soils ranged from medium stiff to hard.

5.2.4 Generalized Soil Sections

While varying depending on the boring location, the alignment typically can be characterized in three generalized sections labeled Northern, Middle, and Southern:

- The Northern section extends from approximately Stations 106+00 to 119+00 and Stations 196+00 to 233+00. The Northern section generally consisted of medium dense to dense sand with gravel. In this section, clay was not encountered in our subsurface explorations.
- The Middle section extends from approximately Stations 233+00 to 273+00. The Middle section generally consisted of medium dense, silty sand; stiff, sandy clay; and medium dense sand to the total depths of our subsurface exploration. In this section, clay was generally encountered between 5 and 20 feet bgs.
- The Southern section extends from Stations 273+00 to 329+00. The Southern section generally consisted of stiff, sandy clay; medium dense, silty sand; and dense sand to the total depths of our subsurface exploration. In this section, clay was generally encountered from the ground surface to depths ranging from 10 to 20 feet bgs.

5.2.5 Groundwater

We did not encounter groundwater in our subsurface explorations. Wells located within an approximately 2.5-mile radius of the site indicate groundwater ranges from elevation 805 to 885 feet, resulting in groundwater depths of greater than 200 feet bgs below the site (California Department of Water Resources, 2019). We anticipate groundwater levels will fluctuate in response to rainfall, seasonal variations, and other factors.

6 GEOLOGIC HAZARDS

This section identifies potential geologic hazards at the site, discusses the potential adverse impacts of the geologic hazards, and provides recommended measures to mitigate these impacts, where required. Geologic hazards that could impact the Project include strong ground shaking, seismically induced liquefaction, and subsidence from groundwater withdrawal.

6.1 Seismic Hazards

6.1.1 General

The Project site is located within the seismically active southern California area. Seismic hazards include fault surface rupture, seismic ground motion, and liquefaction, as described below.

6.1.2 Fault Surface Rupture

The Project is not located within an Earthquake Fault Zone, nor is it underlain by known potentially active non-zoned faults. Earthquake Fault Zones are delineated by the California Geological Survey and the State Geologist around active faults. An "active" fault is defined as a fault that has moved within the last 11,700 years.

The closest active fault is the San Jacinto Fault. We performed a Fault Report for the Trailer Parking Expansion portion of the San Bernardino Intermodal Facility Expansion Project (Shannon & Wilson, 2017b). We concluded that the active San Jacinto Fault is likely located within the Earthquake Fault Zone mapped for this fault and is not located near the Ono Siding Extension. Figure 5 shows a portion of the Earthquake Fault Zone west of the Project.

6.1.3 Seismic Ground Motions

We anticipate the site will experience strong ground shaking during an earthquake along faults in the region. The intensity of earthquake motion and seismic hazards that may impact the Project site will depend on the characteristics of the generating fault, distance to the earthquake fault, earthquake magnitude, earthquake duration, and site-specific geologic conditions. Likely sources for strong ground motion are nearby known active faults (e.g., the San Jacinto Fault and San Andreas Fault).

To mitigate the potential for future damages from strong seismic ground shaking, we recommend the sound walls and other structures be analyzed using seismic design criteria in the governing design code, as discussed in Section 7.2 below.

6.1.4 Liquefaction

Soil liquefaction is a phenomenon in which pore pressure in loose, saturated, granular soil increases during ground shaking to a level near the initial effective stress, resulting in a reduction of shear strength of the soil. The loss in shear strength may generate ground settlement, lateral spreading (ground movement on gentle slopes), bearing capacity failure, and/or landslides. Liquefaction potential is greatest where loose granular soil (sand and non-plastic silt) is present below groundwater and is more likely to affect structures when the potentially liquefiable soil is present at depths shallower than 50 feet. Liquefaction potential increases as ground shaking increases and decreases as the fines (clay and silt) content of soil increase.

The groundwater basin that underlies the Project area has experienced significantly lower groundwater elevations from historical highs and the groundwater levels are maintained at these deeper elevations creating a lower potential for liquefaction. The San Bernardino Valley Municipal Water District (SBVMWD, 2011) water management plan and the Upper Santa Ana River Watershed Integrated Regional Water Management Plan (RMC Water and Environment, 2015) propose to continue to monitor groundwater conditions and to maintain a long-term goal of liquefaction hazard reduction and mitigating the threat of liquefaction.

Groundwater was not observed in our subsurface explorations. Publicly available data from existing wells located near the Project indicate that groundwater levels from two locations show groundwater to be more than 200 feet bgs (Department of Water Resources [DWR], 2019). Due to known geologic conditions, shallow perched water tables may also exist at localized areas of the Project (Fife and others, 1976). Although shallow perched water tables may occur within the Project area, they are unlikely to be a cause of liquefaction under existing conditions.

According to the Geologic Hazard Overlays (San Bernardino County [SBC], 2010), the site is mapped within a zone of medium to high liquefaction susceptibility as shown in Figure 5. The liquefaction designations are based on historical high groundwater levels, which as discussed above are presently managed and maintained at deeper elevations. Under existing conditions, we consider the potential for liquefaction to impact the Project to be low.

6.2 Slope Stability

The Project is located in the relatively-level alluvial plain and the nearest slopes approximately ½-mile northeast of the northernmost segment of the project. We consider the potential of permanent slope instability affecting the Project to be negligible.

6.3 Expansive Soil

Expansive soil occurs when clay particles of certain mineralogy (e.g., montmorillonite) interact with water, causing a volume change. Clay soil may swell with increasing moisture content and contract when dried. This phenomenon generally decreases in magnitude with increasing confining pressure at depth. These volume changes may damage spread footings, grade beams, floor slabs, pavement, and other shallow improvements.

The soils encountered within the upper 20 feet bgs were generally granular and not considered expansive. Clays encountered at depth during our explorations were determined to be sandy, lean clays and are considered to have low expansion potential. As such, it is our opinion that the risk of swell/shrink from expansive soil to impact the proposed improvements is negligible.

6.4 Soil Corrosion Potential

We analyzed two samples for pH, resistivity, chloride, and sulfate concentrations to evaluate the potential for corrosive attack on exposed buried metal and reinforced concrete. We collected the samples in the upper 5 feet of the soil profile. The test results and a discussion of the results are provided in Appendix B.

6.5 Erosion

Typically, sandy soil on steep slopes subjected to high velocity water flow or non-vegetated areas are susceptible to erosion. Considering the relatively gentle slope gradient across the site, we consider the potential for significant erosion at the site to be low.

6.6 Flooding and Inundation

According to the U.S. Federal Emergency Management Agency (FEMA, 2019) the Project is located within a Zone X flood zone that is an area of minimal flood hazard and is outside the 0.2% annual chance floodplain. Flooding and inundation are considered to be remote.

6.7 Oil Wells

According to maps prepared by the California Department of Conservation, Division of Oil, Gas and Geothermal Resources (DOGGR), the site is not located within the limits of a known oil field (DOGGR, 2019). The closest well is the active San Bernardino & Colton Oil Company Well #2, which is approximately 8,000 feet southeast of the site. The well was proposed to be drilled to an approximate depth of 1,800 feet (actual depth unknown).

6.8 Subsidence

The Project site is located within an area of known historical subsidence associated with groundwater withdrawal (Lofgren, 1971; Miller and Singer, 1971; Fife and others, 1976) and remains a potential hazard that will continue to be monitored (URS, 2014; RMC Water and Environment, 2015). During the early to middle 20th century, heavy groundwater withdrawal resulted in regional subsidence. Localized ground cracks did appear at some locations in the Upper Santa Ana Valley due to the groundwater withdrawal.

The Project site is located within the Bunker Hill groundwater basin and historical reports showed an average annual subsidence rate 0.015 to 0.030 foot between 1944 to 1956 in the

Project vicinity (Miller and Singer, 1971; Geoscience Support Services, Inc. [Geoscience], 2009). SBVWCD (2018) reports that at present, subsidence is not impacting the groundwater basin.

The regional groundwater management plan recognizes the historical record of subsidence related to groundwater withdrawal (RMC Water and Environment, 2015). The Basin Management Technical Committee of the San Bernardino Basin Area plans to monitor land subsidence in their annual regional Water Management Plan (Geoscience, 2009).

Under the current water management plans, it appears that the potential for regional subsidence would not likely result in significant subsidence of the Bunker Hill basin or result in the appearance of ground deformations, such as ground cracks, from fluid withdrawal. However, if water resource management conditions were to change, subsidence could potentially be a regional impact.

7 ENGINEERING RECOMMENDATIONS

7.1 General

Based on our engineering analyses of the surface and subsurface data, it is our opinion that the proposed Project improvements are feasible provided the recommendations in this report are incorporated into the design as discussed in the following sections. We based our recommendations on analyses that incorporated information from our subsurface exploration program, laboratory testing, and review of existing site information.

7.2 Seismic Design Parameters

7.2.1 General

The ground motion design parameters provided here are in accordance with the American Railway Engineering and Maintenance-of-Way Association (AREMA) manual for railway engineering and the 2016 California Building Code (CBC). These parameters were determined using different web-based tools. The AREMA manual and the CBC utilize different approaches, which can result in different values. The requirements and results for each are provided in the following sections.

7.2.2 Site Class

We characterized the site using Standard Penetration Test (SPT) N-values noted in our exploration logs. We estimated the average SPT N-value for the upper 100 feet of the soil profile and characterized the site as Site Class D.

7.2.3 American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual

The AREMA Manual (AREMA, 2020) recommends the following ground motion design levels:

- Ground Motion Level 1 – Serviceability Performance Criteria State, a seismic event with a 50- to 100-year return period.
- Ground Motion Level 2 – Ultimate Performance Criteria State, a seismic event with a 200- to 475-year return period.
- Ground Motion Level 3 – Survivability Performance Criteria State, a seismic event with a 1,000- to 2,475-year return period.

The AREMA Manual recommends using the U.S. Geological Survey (USGS) web-based interactive tools to determine the seismic design parameters, which are expressed as maximum spectral accelerations for different fundamental periods of the structure. Those parameters are:

- Peak ground acceleration (PGA), for a structural period of 0 second.
- Short-period spectral acceleration (S_S) for a structural period of 0.2 second.
- Long-period spectral acceleration (S_1) for a structural period of 1 second.

Using Site Class D, we obtained the spectral accelerations for each ground motion level using the web-based USGS Unified Hazard tool (USGS, 2014), as summarized in Exhibit 7-1 below. Note that the AREMA Manual does not include a deterministic maximum cap for the 2,475-year return period. Given the proximity of the San Jacinto Fault and the San Andreas Fault, we recommend using the 2016 CBC criteria for the 2,475-year return period which incorporate a deterministic cap for extreme events as discussed in the next section.

Exhibit 7-1: AREMA Seismic Design Values

Return Period (years)	PGA (g)	S_s (g)	S_1 (g)	Mean Earthquake Magnitude
100	0.37	0.86	0.41	7.9
475	0.82	1.79	1.14	
2,475	1.77	3.75	2.33	

NOTE:

AREMA = American Railway Engineering and Maintenance-of-Way Association; g = gravity; PGA = peak ground acceleration; S_1 = long-period spectral acceleration; S_s = short-period spectral acceleration

7.2.4 2016 California Building Code (CBC)

The 2016 CBC design criteria consider a maximum considered earthquake (MCE) hazard with a 2 percent probability of exceedance in 50 years, i.e. a 2,475-year return period, with a deterministic maximum cap in some regions. For seismic design of structures in accordance with the CBC, the design spectral accelerations PGA, S_S, and S_1 are required. We obtained PGA, S_S, and S_1 and site soil response factors (F_{PGA}, F_a, and F_v) using the online design map tool using American Society of Civil Engineers (ASCE) 7 Hazard Tool and following ASCE 7-10 design code. The spectral accelerations PGA, S_S, and S_1 are determined assuming Site Class B (rock) conditions, and then adjusted for Site Class D using site soil response factors to determine the MCE parameters adjusted for site class effects (PGA_M, S_{MS}, and S_{M1}). The design-based values (S_{DS} and S_{D1}) are then determined by multiplying the site adjusted MCE parameters by 2/3. Exhibit 7-2 below summarizes our recommended CBC seismic design parameters.

Exhibit 7-2: 2016 CBC Seismic Design Values

Return Period (years)	Parameters/ Coefficients	Peak Ground Acceleration (PGA) (0-second)	Short Period (0.2-second)	Long Period (1-second)
2,475	Mapped MCE SRA[1] Parameters	PGA = 0.87 g	SS = 2.27 g	S1 = 1.04 g
	Site Class Coefficients[2]	FPGA = 1.0	Fa = 1.0	Fa = 1.5
	Adjusted MCE SRA[1] Parameters	PGAM = 0.87 g	SMS = 2.27 g	SM1 = 1.57 g
	Design SRA Parameters	-	SDS = 1.51 g	SDS = 1.04 g
	Earthquake Magnitude	7.9		

NOTES:

1 SRA = Spectral Response Acceleration

2 Site class coefficients correspond to a Site Class D.

CBC = California Building Code; g = gravity; MCE = maximum considered earthquake

7.3 Deep Foundations

7.3.1 General

The sound walls and crash wall will be founded on cast-in-place drilled hole (CIDH) piles. In accordance with the AREMA Manual, unless site-specific testing is performed, a factor of safety of 2 should be used for estimating foundation capacity in compression. In uplift, a factor of safety of 2 should be used for combinations of primary and secondary forces and a factor of safety of 3 should be used for combinations of secondary forces with dead load alone. Based on the AREMA Manual definitions, dead and live loads are considered primary loads, while wind and seismic loads are considered secondary loads.

In accordance with the 2016 CBC, unless site-specific testing is performed, a factor of safety of 2 should be used for estimating foundation capacity in compression. In uplift, a factor of safety of 3 should be used. Where the uplift is due to wind or seismic loading, a factor of safety of 2 can be used for estimating foundation capacity in uplift.

7.3.2 Axial Capacity

We recommend the axial capacity of the CIDH pile be derived from skin friction. We used the methodology recommended by AASHTO LRFD Bridge Design Specification (American Association of State Highway and Transportation Officials [AASHTO], 2017) to estimate axial capacity, combined with the factor of safeties described above. Figures 5A through 5C present allowable axial capacity for a 12-inch CIDH shaft for the Northern, Middle, and Southern sections of the sound wall alignment, respectively.

7.3.3 Lateral Capacity

7.3.3.1 Sound Walls

We recommend lateral loads from dynamic forces, seismic, wind, and other lateral loadings be resisted by the piles. We evaluated the lateral capacity of the proposed deep foundations using the software LPILE by Ensoft, Inc. (Reese and others, 2015). LPILE calculates elastic stresses and lateral deformations in piles or shafts subjected to lateral loads or deformations. Exhibits 7-3 through 7-5 below summarize the LPILE material models and input parameters we used in our LPILE analysis for the Northern, Middle, and Southern sections, respectively.

Exhibit 7-3: LPILE Parameters – Northern Section

Soil Layer	Depth Below Ground Surface (feet)	Soil Model	Effective Unit Weight, γ' (pcf)	Effective Friction Angle, φ' (degrees)	Undrained Shear Strength, Su (psf)	Horizontal Modulus of Subgrade Reaction, k (pci)	ε_{50}
Medium Dense, Poorly Graded Sand with Gravel	0 - 10	Sand (Reese)	120	32	-	50	-
Dense, Poorly Graded Sand with Gravel	10 - 30	Sand (Reese)	120	36	-	125	-

NOTE:
ε_{50} = strain at 50-percent of the ultimate stress; pcf = pounds per cubic foot; psf = pounds per square foot; pci = pound per cubic inch

Exhibit 7-4: LPILE Parameters – Middle Section

Soil Layer	Depth Below Ground Surface (feet)	Soil Model	Effective Unit Weight, γ' (pcf)	Effective Friction Angle, φ' (degrees)	Undrained Shear Strength, Su (psf)	Horizontal Modulus of Subgrade Reaction, k (pci)	ε_{50}
Medium Dense, Silty Sand	0 - 5	Sand (Reese)	120	30	-	40	-
Stiff, Sandy Lean Clay	5 - 20	Stiff Clay w/o Free Water (Reese)	120	-	1,100		0.0085
Medium Dense, Poorly Graded Sand	20 - 30	Sand (Reese)	120	34	-	90	-

NOTE:
ε_{50} = strain at 50-percent of the ultimate stress; pcf = pounds per cubic foot; psf = pounds per square foot; pci = pound per cubic inch

Exhibit 7-5: LPILE Parameters – Southern Section

Soil Layer	Depth Below Ground Surface (feet)	Soil Model	Effective Unit Weight, γ' (pcf)	Effective Friction Angle, φ' (degrees)	Undrained Shear Strength, Su (psf)	Horizontal Modulus of Subgrade Reaction, k (pci)	ε_{50}
Stiff, Sandy Lean Clay	0 - 15	Stiff Clay w/o Free Water (Reese)	120	-	1750	-	0.0065
Medium Dense, Poorly Graded Sand with Gravel	0 - 10	Sand (Reese)	120	33	-	90	-
Dense, Poorly Graded Sand with Gravel	10 - 30	Sand (Reese)	120	38	-	170	-

NOTE:
ε_{50} = strain at 50-percent of the ultimate stress; pcf = pounds per cubic foot; psf = pounds per square foot; pci = pound per cubic inch

Our analysis assumed a 12-inch-diameter CIDH modeled as an embedded pole with an elastic modulus of 4,030 pounds per square inch. We calculated the allowable pile lateral loads assuming a ½- and 1-inch deflection for a free head loading condition. We assumed a 30-foot pile embedment depth. The soil resistance (p) determined from the lateral capacity analysis should be reduced to account for group effects where the center to center pile spacing is closer than five times the diameter. Figures 6A through 6C present the results of our lateral analysis for the Northern, Middle, and Southern sections of the alignment.

7.3.3.2 Crash Wall

A crash wall is proposed for the protection of the Mt. Vernon Avenue bridge piers in the event of a train derailment. The AREMA Manual for Railway Engineering, Volume 2, Chapter 8, Part 2.1.5 (AREMA, 2020), provides guidelines for the design of reinforced concrete crash walls for the protection of structures or facilities adjacent to the track. For crash walls between 12 and 25 feet clear from center of track, the minimum height is 6 feet above top of rail. For crash walls located less than 12 feet from center of track, the minimum height is 12 feet above top of rail.

Chapter 8, Part C-2.1.5 of AREMA refers to a study performed by Layden (2014) for crash wall design loads from a theoretical train impact. For the design of a crash wall using the simplified method, a minimum point load of 600 kips is applied horizontally and normal to the wall face. The point load is applied at a height of 6 feet above the top of rail for walls up to 25 feet from the centerline of track. This method may be applied where track speeds do not exceed 50 miles per hour (mph) for freight or 70 mph for passenger trains.

Exhibit 7-6: LPILE Parameters – Mt. Vernon Avenue Crash Wall

Soil Layer	Depth Below Ground Surface (feet)	Soil Model	Effective Unit Weight, γ' (pcf)	Effective Friction Angle, φ' (degrees)	Undrained Shear Strength, Su (psf)	Horizontal Modulus of Subgrade Reaction, k (pci)
Medium Dense, Poorly Graded Sand with Gravel	0 - 11	Sand (Reese)	120	32	-	50
Dense, Poorly Graded Sand with Gravel	11 - 30	Sand (Reese)	120	38	-	160

NOTE:
pcf = pounds per cubic foot; psf = pounds per square foot; pci = pound per cubic inch

Our analysis assumed 16-inch and 24-inch diameter piles modeled as an embedded pole with an elastic modulus of 4,030 pounds per square inch. Using a design lateral load of 100 kips for the 16-inch diameter pile and 200 kips for the 24-inch diameter pile, we calculated the pile's lateral deflection, shear force and bending moment for a free-head loading condition. We assumed a 30-foot pile embedment depth. The soil resistance (p) determined from the lateral capacity analysis should be reduced to account for group effects where the center to center pile spacing is closer than five times the diameter. Figures 7 and 8 present the results of our analysis for the crash wall.

7.4 Shallow Foundations

We understand spread footings are being considered as an alternative foundation for the sound wall. We recommend designing spread footings using an allowable bearing pressure of 4,000 pounds per square foot (psf) for square footings and 3,500 psf for continuous footings with a maximum width of 4 feet for the Northern Section. We recommend designing spread footings using an allowable bearing pressure of 2,500 psf for square footings and 2,000 psf for continuous footings with a maximum width of 7 feet for the Middle and Southern sections. These values include a factor of safety of 3. This allowable bearing pressure may be increased by one-third for short-term wind or seismic loads.

The recommended allowable bearing pressure is contingent upon the following considerations:

- The subgrade is prepared and fill is placed in accordance with the recommendations provided below in the Construction Considerations section of this report.
- Column square footings should have a minimum width of 24 inches and continuous wall footings should have a minimum width of 18 inches.
- Footings should be embedded at least 24 inches below the lower adjacent exterior grade and at least 12 inches below the lowest adjacent interior grade.

If adjacent footings are located at different elevations, we recommend that the horizontal distance between them be at least 1.5 times the elevation difference. Where adjoining footings are at different elevations, we recommend that the upper footing step down to the lower footing.

If unanticipated loose or soft soil, or unsuitable bearing material is encountered below the footing level, the subgrade should be overexcavated to undisturbed native alluvium. The overexcavated portion may be backfilled with engineered fill, controlled density fill (CDF), or lean concrete. CDF and lean concrete mixes must have sufficient design strength to support foundation loads.

Spread footing foundations designed and constructed as recommended are estimated to undergo a total elastic settlement of 1 inch or less from static loading. We estimate differential settlement between adjacent column footings or over a 30-foot span of continuous footings will be approximately ½ the total elastic settlement. We anticipate the majority of settlement will occur as the loads are applied during and immediately following construction.

Resistance to lateral forces acting on the spread footings will be provided by frictional resistance along the base of the footing and passive earth pressure acting against the embedded portion of the footing. We recommend an allowable coefficient of friction of 0.4 be used at the interface between cast-in-place concrete and the soil for the Northern Section and an allowable coefficient of fiction of 0.2 for the Middle and Southern Section. These values include a factor of safety of 1.5. The coefficient of sliding friction is not a function of lateral deflection and the full value can be applied over the whole footing geometry.

Additional lateral resistance may be assumed to develop against the vertical face of the foundation due to passive resistance of the foundation soil. Passive resistance for foundations should be ignored in the upper 24 inches below finished grade where not covered by pavement and should be ignored entirely where the soil providing the resistance could be removed in the future. The passive lateral earth pressure resistance can be calculated using an allowable equivalent fluid pressure of 260 pounds per cubic foot (pcf) for the Northern section and 200 pcf for the Middle and Southern sections. These values include a factor of safety of 1.5 and assume lateral movements up to about ½ inch. This value is based on drained conditions.

7.5 Pavement Design

7.5.1 General

Municipal pavement improvements are proposed for the residential streets adjacent and west of the track alignment from approximately 17th Street south to 7th Street. We assumed that pavement sections will consist of a layer of hot-mixed asphalt overlying a layer of Class II aggregate base per section 26-1.02B of the California Department of Transportation (Caltrans) 2018 Standard Specifications placed on prepared subgrade (Caltrans, 2018a).

7.5.2 Flexible Pavement

We evaluated the pavement using flexible pavement following City's Department of Public Works/City Engineer Street Improvement Policy (1987), and design methods provided by Caltrans Highway Design Manual (Caltrans, 2018b). This design method uses the traffic index (TI), R-value, gravel equivalent, and gravel factor to calculate the pavement section. The TI is a measure of the expected wheel loads and traffic volume. The R-value is a measure of the soil resistance to pavement deformation. Gravel equivalent is the calculated thickness of gravel needed to prevent permanent deformation of the underlying layers considering the input TI and R-value. Each material layer of the pavement section is assigned a gravel factor which represents its strength relative to an equivalent thickness of gravel.

We assumed a range of TI values in our calculations. Based on subsurface conditions encountered in borings at the site, we assumed two R-values. For proposed pavement in the Middle section of the Project the subgrade consisted of silty sand and tests provided R-values of 28. In the Southern section, the subgrade consisted of sandy lean clay and the R-value test provided a number of 10. No municipal improvements are planned in the Northern section.

We assumed a TI of 5, 5.5, and 6 for analyses for residential streets where TIs of greater than 6 are not expected. We recommend the flexible pavement sections presented in Exhibit 7-7 and 7-8 for the Middle and Southern sections, respectively.

Exhibit 7-7: Recommended Flexible Pavement Sections (Middle Section)

Traffic Index	Hot-Mix Asphalt Thickness (inches)	Aggregate Base Thickness (inches)
5	3	4
5.5	3	5
6	3.5	6

Exhibit 7-8: Recommended Flexible Pavement Sections (Southern Section)

Traffic Index	Hot-Mix Asphalt Thickness (inches)	Aggregate Base Thickness (inches)
5	3	7
5.5	3	9
6	3.5	9

We recommend a binder type of PG 64-10, as determined by the Caltrans Highway Design Manual for Inland Valley climate.

7.6 Preliminary Infiltration Design

We completed preliminary infiltration design for four proposed storm water infiltration basins. The infiltration basin bottoms were proposed to be about 7 feet below the existing grade.

We measured infiltration rates using the percolation test procedures outlined by the San Bernardino County Stormwater Program (SBCSP, 2011). We performed percolation tests at each percolation boring. The calculated infiltration rates for each percolation test are shown in Exhibit 7-9 below.

Exhibit 7-9: Summary of Infiltration Rates.

Basin No.	Test Location	Infiltration Rate, It
1	I-3A	20.8 in/hr
	I-3B	17.4 in/hr
3	I-4A	5.4 in/hr
	I-4B	7.2 in/hr
6	I-2A	0.2 in/hr
	I-2B	0.2 in/hr
9	I-1A	4.4 in/hr
	I-1B	2.2 in/hr

The SBCSP guidelines require a factor of safety to be applied to the design infiltration rates by the designing engineer.

It is our understanding that the infiltration basins are no longer planned for the Project and that instead, water quality will be treated with a biofiltration system.

7.7 Track Design

We evaluated the proposed lead track section following the design procedure in Chapter 1, Part 2.11.2.2 of American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering (2020) and the methodology developed by Ahlf (2003).

For these analyses, we made the following assumptions:

- Maximum track speed for the track extensions is 79 mph;
- Wheel loads of 37.5 kips and diameter of 36 inches;
- A rail section of 141-pound RE for all new rail;
- Concrete ties spaced 24-inches apart on centers with a depth of 8-3/4 inches supporting the rail; and
- Limiting deflection of 0.25 inch for the rail.

Based on our explorations and laboratory results, we used an average maximum allowable bearing capacity for the soil subgrade or properly prepared granular fill embankments of 2,500 psf and a factor of safety of 3. We recommend the lead track have a minimum ballast section of 12 inches over 8 inches of subballast.

Alternatively, the use of geogrid reinforcement could be considered per AREMA Chapter 1, Section 10.6.1.4, placed at the bottom of the subballast and directly on the existing or prepared subgrade to potentially to reduce the granular layer thickness (GLT). Additional recommendations for this alternative can be provided upon request.

8 CONSTRUCTION CONSIDERATIONS

8.1 General

The applicability of our design recommendations depends on quality construction practices. Poor construction techniques may alter conditions from those upon which our recommendations are based. The following sections present recommendations that should be considered during construction.

8.2 Site Preparation

8.2.1 Clearing and Grubbing

Prior to site grading, construction areas should be cleared of surface and subsurface structures associated with current development of the site including foundations, concrete pavements and AC, utility poles, fence poles, underground utilities, and other deleterious debris. Trees or shrubs designated to be removed should include the entire root ball and all roots larger than ½-inch-diameter. This may require laborers handpicking the roots from the subsurface soils prior to compaction.

Surface vegetation within construction areas should be removed by stripping. Debris from the stripping should not be used in general fill construction in pavement areas. Discing of organics into the surface soils may be a suitable alternate to stripping, depending on the condition and quantity of organics at the time of grading. The decision to utilize discing in lieu of stripping should be made by our representative at the time of earthwork construction.

Difficulty in achieving subgrade compaction or unusual soil instability may be indications of loose fill associated with poor compaction, past subsurface items such as burn pits, dump pits, or utility lines. Should these conditions exist, the unsuitable materials should be excavated to check for subsurface structures and the excavations backfilled with structural fill as described below.

8.2.2 Existing and New Utilities

Underground utilities could cross the Project site. Affected utilities could include several of the following:

- Storm drains
- Sanitary sewers
- Electrical conduits
- Natural gas lines
- Fiber-optic cables
- Telephone/cable lines
- Signal conduits
- Petroleum lines

These utilities could require abandonment, relocation, or replacement prior to construction. Existing utilities that are not relocated may require additional protection against heavy surface loads caused by fills, pavements, or structures. The following sections present our recommendations for design and construction planning of new underground utilities and considerations for existing utilities.

Utility excavations for the Project could consist of: (a) trench excavations for new pipes, (b) excavations for manholes or vaults, or (c) excavations to replace existing utilities. The type of excavation support system selected for construction of proposed utilities would depend on the proposed depth of excavation, the proximity to existing structures, and materials encountered in the excavation.

For planning purposes, we recommend using the excavation criteria in Section 1541.1 of the Cal-OSHA guidelines (Requirements for Protective Systems). For the Project site, near surface soils are best described using the “Granular Soils” definitions. Based on the soil properties and characteristics, the soils should be considered “Type C” in accordance with the soil classification system.

The Contractor should select the best excavation method and must consider worker safety and the potential impacts of ground movements on adjacent facilities. In addition, the excavation must conform to all federal, state, and local safety regulations. The Contractor should be held solely responsible for all damages related to ground movements resulting from trench excavations.

Utility trench bedding and backfill for new or relocated underground utilities should conform to pipe manufacturer's recommendations and local agency requirements. Trench backfill should be composed of structural fill, moisture-conditioned to at least the optimum moisture content and uniformly compacted to at least 90 percent of the maximum dry density (MDD) per ASTM D1557 (ASTM, 2012). The upper 4 feet below pavement sections shall be compacted to at least 95 percent of the MDD at the optimum moisture content.

Existing and proposed utilities located in areas of the proposed improvements could require protection against increased surface loads, depending on the pipe type, load combination, and soil conditions. In these cases, protection using surface slabs for load distribution, casing existing pipes, abandonment, or replacement of the existing pipe sections should be considered.

8.2.3 Subgrade Preparation

Construction areas designated to receive fill or left at-grade should be scarified to a depth of at least 12 inches, thoroughly moisture-conditioned to ±2 percent of the optimum moisture content as determined by ASTM D1557 (Modified Proctor) and uniformly compacted to not less than 95 percent of the MDD determined by ASTM D1557.

In planned pavement areas, following the removal of the existing pavement and excavation to the proposed subgrade level, the exposed subgrade should be proof-rolled with a fully loaded, tandem-axle, 10-yard dump truck or equivalent. We recommend that the proof-rolling be observed by a representative of Shannon & Wilson. If areas are identified as being loose, soft, or yielding during proof-rolling, these areas of the subgrade should be improved by overexcavating to expose a firm and unyielding subgrade. We recommend a maximum overexcavation of 2 feet. If soft or yielding soils are encountered after overexcavating 2 feet, a geotextile (e.g., Mirafi 140N, Tensar biaxial geogrid BX1200, or equivalent) should be installed at the base of the excavation before backfilling with structural fill (described below). Care should be taken during proof-rolling and subgrade preparation to avoid disturbing subgrade and supporting soil that will remain in place, as they can rut and pump under repeated construction traffic.

After proof-rolling, we recommend the exposed soil subgrade be scarified to a depth of 9 inches, moisture conditioned to ±2-percent of the optimum moisture content, and uniformly compacted to at least 95 percent of the MDD, as determined by ASTM D1557 (modified Proctor) and to a firm and unyielding condition.

8.2.4 Structural Fill

Fill soil placed beneath improvements where settlement should be minimized should be structural fill. Structural fill may consist of on-site or imported granular soil that is free of organics, contaminants, debris, and rock fragments larger than 3 inches. The suitability of soil for use as structural fill will depend on its gradation and moisture content. As the amount of fines (portion of soil particles passing a U.S. Standard No. 200 sieve, based on the minus ¾-inch fraction) increases, soil becomes more sensitive to small changes in moisture content, and adequate compaction becomes more difficult to achieve. Structural fill placed during wet weather or on wet subgrade soils should contain no more than 5 percent fines. During dry weather, the fines content may be higher, provided the fill is at suitable moisture content, or could be moisture conditioned and compacted to the specified degree. The fines should have a plasticity index ≤6, and the moisture content of the soil should be within ±2 percent of the optimum moisture content as determined by ASTM D1557 (Modified Proctor).

8.2.5 Placement

Upon completion of the site and subgrade preparation previously described, structural fill should be placed in uniform lifts and compacted to a dense and unyielding condition, to at least 95 percent of the ASTM D1557 MDD. Fills should be placed in uniform, horizontal layers not exceeding 8 inches in loose thickness for heavy, self-propelled compactors, or 4 inches for hand-operated mechanical compactors. The appropriate lift thickness would depend on the Contractor's equipment and the moisture content and quality of the fill material. Recommendations for structural fill compaction are summarized in Exhibit 8-1 below.

Exhibit 8-1: Recommended Fill Compaction

Area	Minimum Relative Compaction (ASTM D1557)
Structural fill beneath the maintenance building and all areas where settlement is to be minimized.	95 percent
Common fill in landscape areas	90 percent

If subgrade or fill soils become loosened or disturbed, additional excavation to expose competent, undisturbed soils and replacement with properly compacted structural fill would be required. We recommend that a representative from our firm be present during structural fill placement to observe the work and perform in-place density tests to evaluate whether the specified compaction is being achieved or not.

8.2.6 Suitability of On-Site Soils

The onsite soils may be moisture sensitive depending on the silt and clay content and susceptible to disturbance by construction equipment. Given the likely variability of the on-site soil, we should observe the on-site soil during removal for suitability as structural fill.

8.2.7 Imported Fill

We recommend that imported structural fill consist of well-graded sand and gravel with a maximum particle size smaller than 3 inches, at least 40 percent retained on the U.S. No. 4 sieve, and less than 5 percent passing the U.S. No. 200 sieve, based on that fraction passing the ¾-inch sieve. We recommend that imported fill be used during wet weather or when placed in wet conditions.

A higher fines content for imported fill could be considered assuming earthwork occurs during periods of dry weather. We recommend that the fines content not exceed 30 percent, and should be non-plastic.

8.2.8 Ballast and Subballast

Ballast and subballast material should meet the specifications outlined in the AREMA Manual. Material requirements include gradation, specific gravity, absorption, degradation, soundness, undesirable particles (clay lumps, friable, flat, elongated) and for some aggregates, chemical analyses. Caltrans Class 2 aggregate base (AB) is a suitable for subballast with the exception that the percent passing No. 200 sieve should be 5 percent or less.

We recommend that base course conform to Caltrans Class 2 AB. The Caltrans Standard Specifications allows up to 12 percent fines content for Class 2 AB. Base course and subballast should be placed in lifts 6 inches thick and compacted to a dense and unyielding condition.

8.3 Drainage

We recommend that subgrade and subballast surfaces be sloped so that water within the track section flows toward the ditches. The drainage should be discharged into a suitable discharge location as approved by the engineer. Grading in all areas should be accomplished to avoid concentration of runoff onto fill, cut slopes, natural slopes steeper than 10 percent, or other erosion-sensitive areas. Long-term track performance is dependent on a drainage system that would permit rapid drainage of water from the ballast and subballast layers and prevent ponding adjacent to the track.

8.4 Paving Materials

The AB should conform to Class 2 Aggregate Base (¾-inch maximum) of Section 26 of the California Department of Transportation Standard Specifications (Caltrans, 2018a). The AB material should be placed in maximum 6-inch-thick lifts, moisture conditioned to ±2 percent of the optimum moisture content, and compacted to at least 95 percent of the maximum dry density as determined by ASTM D1557.

8.5 Foundation Considerations

8.5.1 Footings

The recommended bearing pressures presented in this report require careful preparation of the footing subgrade. Footing excavations should be cleaned of loose soil, leveled, and protected from water. If construction will take place during wet weather or under wet conditions, we recommend that the prepared footing subgrade be protected by placing a thin, lean concrete "rat slab" immediately after excavation is completed. Other methods can be considered upon request.

A representative from our firm should observe each footing excavation for adequate bearing material, prior to placing reinforcing steel. We recommend the footing excavations be observed again immediately prior to the placement of concrete and/or the working surface for the presence of loose and/or wet material.

8.5.2 Pile Foundation Installation

Construction of a CIDH pile foundation requires boring a hole of a specified diameter and depth and then backfilling the hole with reinforced concrete. The selection of equipment and procedures for constructing CIDH piles is a function of equipment access, pile dimensions, subsurface soil conditions, and groundwater characteristics. Consequently, the design and performance of CIDH piles could be significantly influenced by the equipment and construction procedures. In particular, shaft friction would be impacted by the procedures used for construction, and by the concrete properties and method of placement. CIDH pile contractors who participate on this project should be required to demonstrate that they have suitable equipment for this project, and adequate experience in the construction of CIDH piles.

8.5.3 Installation Conditions

The potential of encountering obstructions during CIDH pile installation is low but should be addressed in the Project specifications. Obstructions could be defined in the specifications as any natural or man-made object (including, but not limited to, boulders, logs, and man-made objects) greater than 2 feet in size, and that could not be drilled using earth augers with soil or rock teeth, drill buckets, and/or under-reaming tools, with the drilling equipment operating at maximum power, torque, and down thrust. The Contractor should provide a unit cost to remove obstructions.

To reduce the potential for ground loss, we recommend that the specifications state that where obstructions or caving conditions are encountered in the drilled hole, which in the opinion of the engineer could impact the construction of the CIDH pile or adjacent existing facilities, no further drilling would be allowed until the Contractor implements measures to prevent caving or ground loss.

Casing may be needed in the sandy soils for the installation of CIDH piles for the crash wall. We recommend a clearance of at least 12 inches between the CIDH casing and the existing bridge pier footing.

8.5.4 Installation Observations

Installation of CIDH piles should be observed by our representative. Observation and identification of soil retrieved from auger flights and cleanout buckets should be accomplished by an experienced engineer or their representative who are familiar with subsurface conditions at the project site. These observations should be compared to our characterization of the subsurface conditions used in the engineering analyses.

In addition to a description of the subsurface conditions encountered, the excavation methods, steel reinforcing and concrete placement operations, should be observed and documented.

9 ADDITIONAL GEOTECHNICAL SERVICES

We recommend that Shannon & Wilson be retained to provide additional geotechnical services as the project design moves forward. As a planning tool, we have included additional typical phases of geotechnical services below that may be required as the project progresses:

- Design Development Services – Provide input to the design team, including design revisions, value engineering evaluations, and supplementary recommendations.
- Plan and Specifications Review – Review interim and final plans and specifications provided by others. Plans and specifications may address foundations, grading,

drainage, and/or other project elements that incorporate our geotechnical design recommendations.

- Bid-Support Services – Review contractor work plans, qualifications, or value engineering proposals during the bid phase of the project.
- Preconstruction Support Services – Attend pre-bid construction meetings, review contractor submittals, and review contractor requests for information.
- Construction Observation and Testing Services – Perform construction observation of foundation construction, grading, and/or earthwork. Provide field testing services such as field density testing to verify fill compaction.

Shannon & Wilson, Inc. can provide these services upon request. We would be pleased to discuss or submit a proposal for these services.

10 LIMITATIONS

This report was prepared for the exclusive use of BNSF, TKDA, and other members of the design team for specific application to this project. This report should be provided to prospective contractors for information on factual data only and not as a warranty of subsurface conditions, such as those interpreted from the exploration logs and discussions of subsurface conditions included in this report.

The analyses, conclusions, and recommendations contained in this report are based on site conditions as they presently exist. We assume that the exploratory borings made for this project are representative of the subsurface conditions throughout the project area (i.e., the subsurface conditions everywhere are not significantly different from those disclosed by the explorations). If conditions different from those described in this report are observed or appear to be present during construction, we should be advised at once so that we can review these conditions and reconsider our recommendations, where necessary. If there is a substantial lapse of time between submission of our report and the start of work at the site, or if conditions have changed because of natural forces or construction operations at or near the site, it is recommended that this report be reviewed to determine the applicability of the conclusions and recommendations considering the changed conditions and time lapse.

Within the limitations of the scope, schedule and budget, the analyses, conclusions and recommendations presented in this report were prepared in accordance with generally accepted professional geotechnical engineering principles and practices in this area at the time this report was prepared. We make no other warranty, either express or implied.

These conclusions and recommendations were based on our understanding of the project as described in this report and the site conditions as interpreted from the current explorations.

Unanticipated soil conditions are commonly encountered and cannot be fully determined by merely taking soil samples or completing test borings. Such unexpected conditions frequently require that additional expenditures be made to attain a properly constructed project. Therefore, some contingency fund is recommended to accommodate such potential extra costs.

The scope of our geotechnical services did not include any environmental assessment or evaluation regarding the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater, or air at the subject site. Shannon & Wilson, Inc. can provide these services at your request.

Shannon & Wilson, Inc. has prepared the document, "Important Information About Your Geotechnical/Environmental Report," to assist you and others in understanding the use and limitations of this report.

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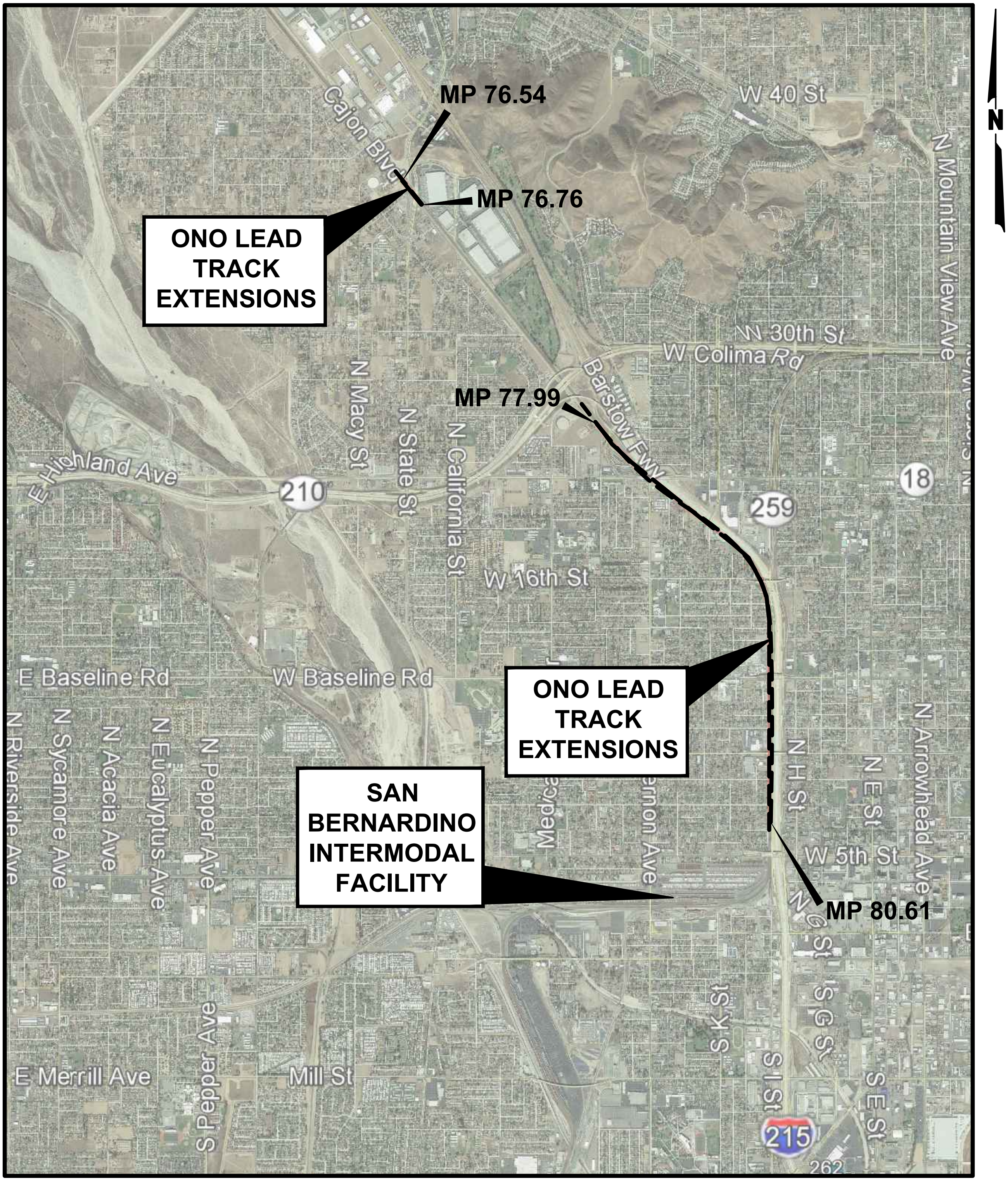

0 2000 4000 8000

SCALE: 1"=4000'

NOTE

Map adapted from aerial imagery provided by Google Earth Pro, reproduced by permission granted by Google Earth ™ Mapping Service.

BNSF property names from http://www.bnsf.com/ship-with-bnsf/support-services/facility-listings.html?loc=san-bernardino

Ono Lead Track Extension
BNSF Railway
San Bernardino, California

VICINITY MAP

February 2021 51-1-10240-012

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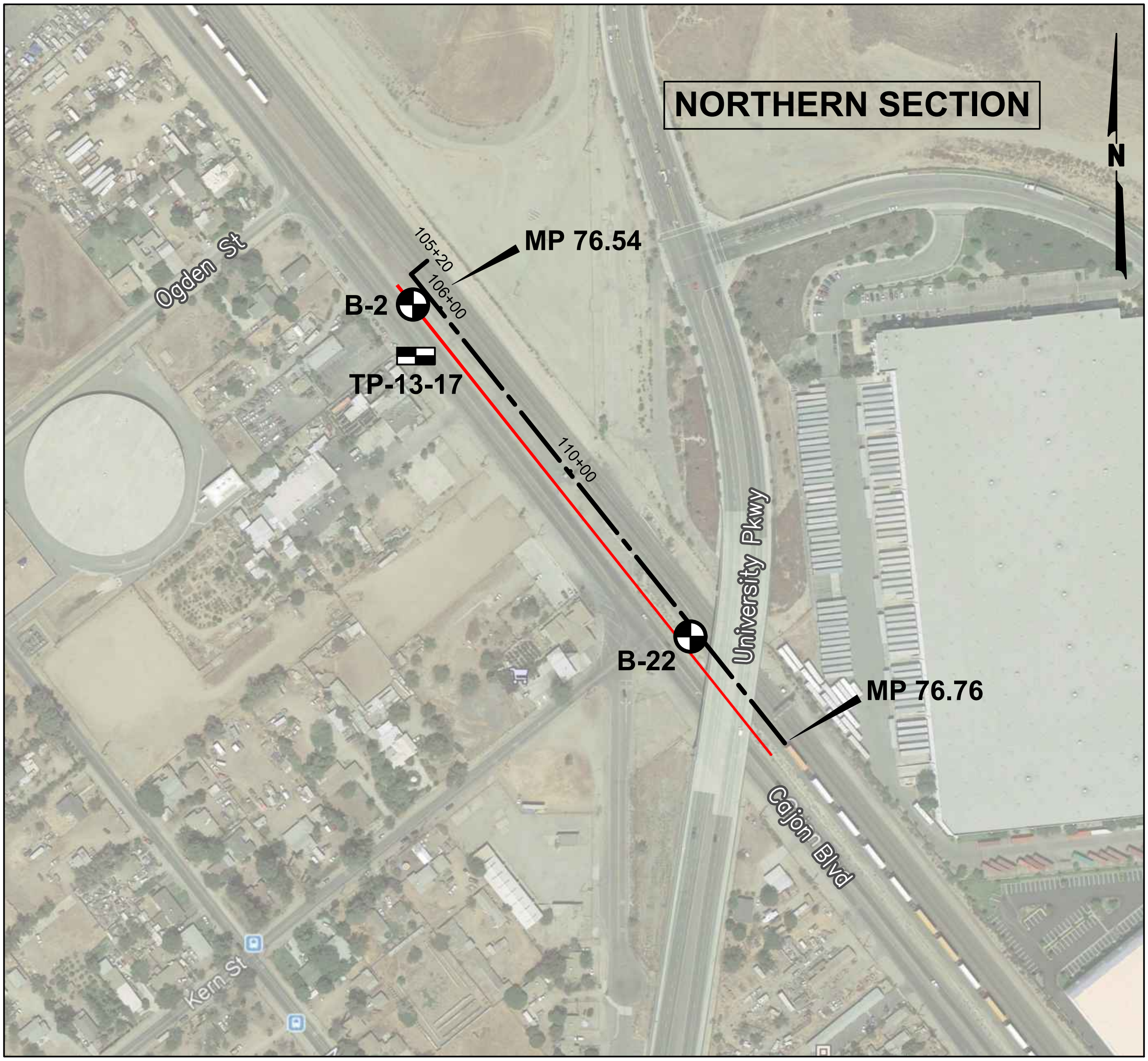
FIG. 1

Filename: I:\EF51-1 LAX\10200s\10240 BNSF San Berdoo\Drafting\012\FIG 1 - VICINITY MAP.dwg Date: 02-26-2021 Login: Louis Larios



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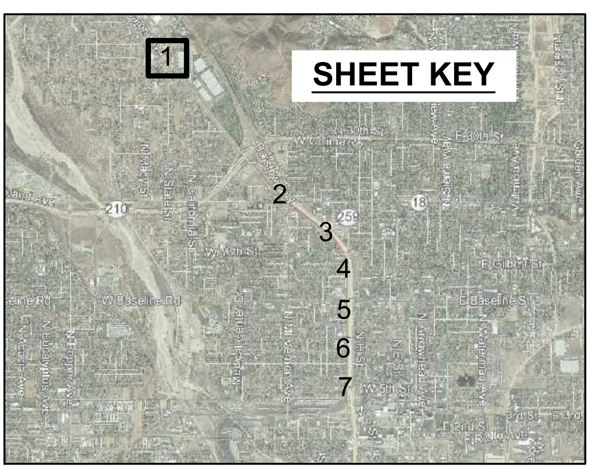

LEGEND

B-1 Boring Designation and Approximate Location

TP-14-17 Test Pit Designation and Approximate Location (Shannon & Wilson, 2017a)

Approximate Location Sound Wall

Proposed Ono Lead Track

Ono Lead Track Extension - Northern Section
BNSF Railway
San Bernardino, California

SITE AND EXPLORATION PLAN

February 2021 51-1-10240-012

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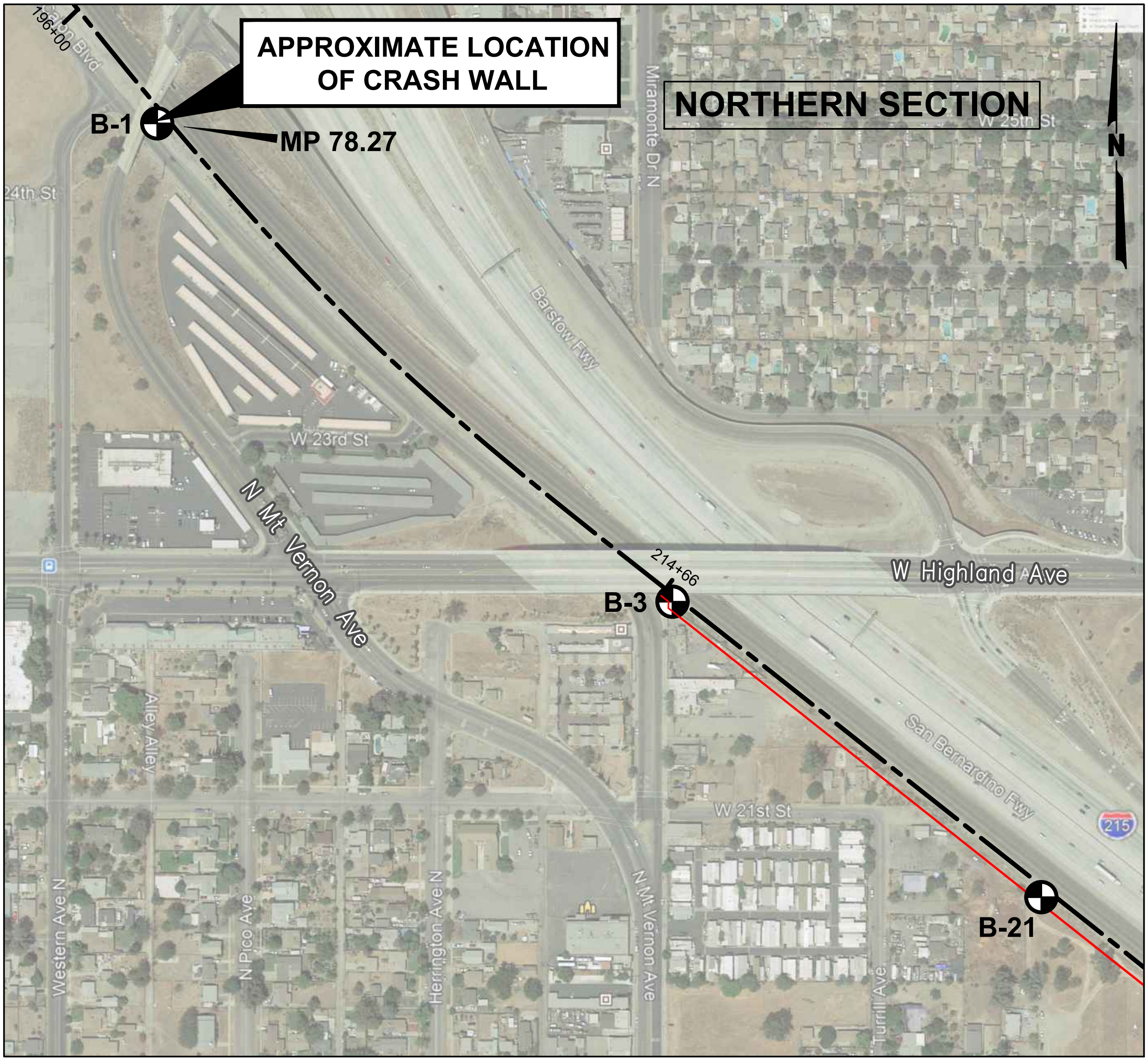
FIG. 2
Sheet 1 of 7

Filename: I:\EF\51-1 LAX\10200s\10240 BNSF San Berdoo\Drafting\012\FIG 2 - SITE AND EXPLORATION PLAN.dwg Date: 02-26-2021 Login: Louis Larios



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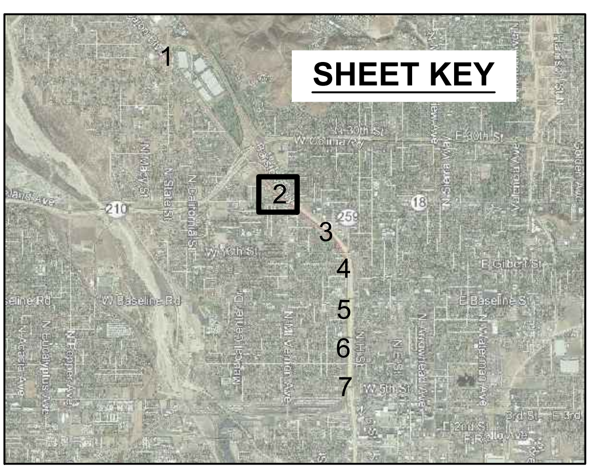

LEGEND

B-1 Boring Designation and Approximate Location

TP-14-17 Test Pit Designation and Approximate Location (Shannon & Wilson, 2017a)

Approximate Location Sound Wall

Proposed Ono Lead Track

Ono Lead Track Extension - Northern Section
BNSF Railway
San Bernardino, California

SITE AND EXPLORATION PLAN

February 2021 51-1-10240-012

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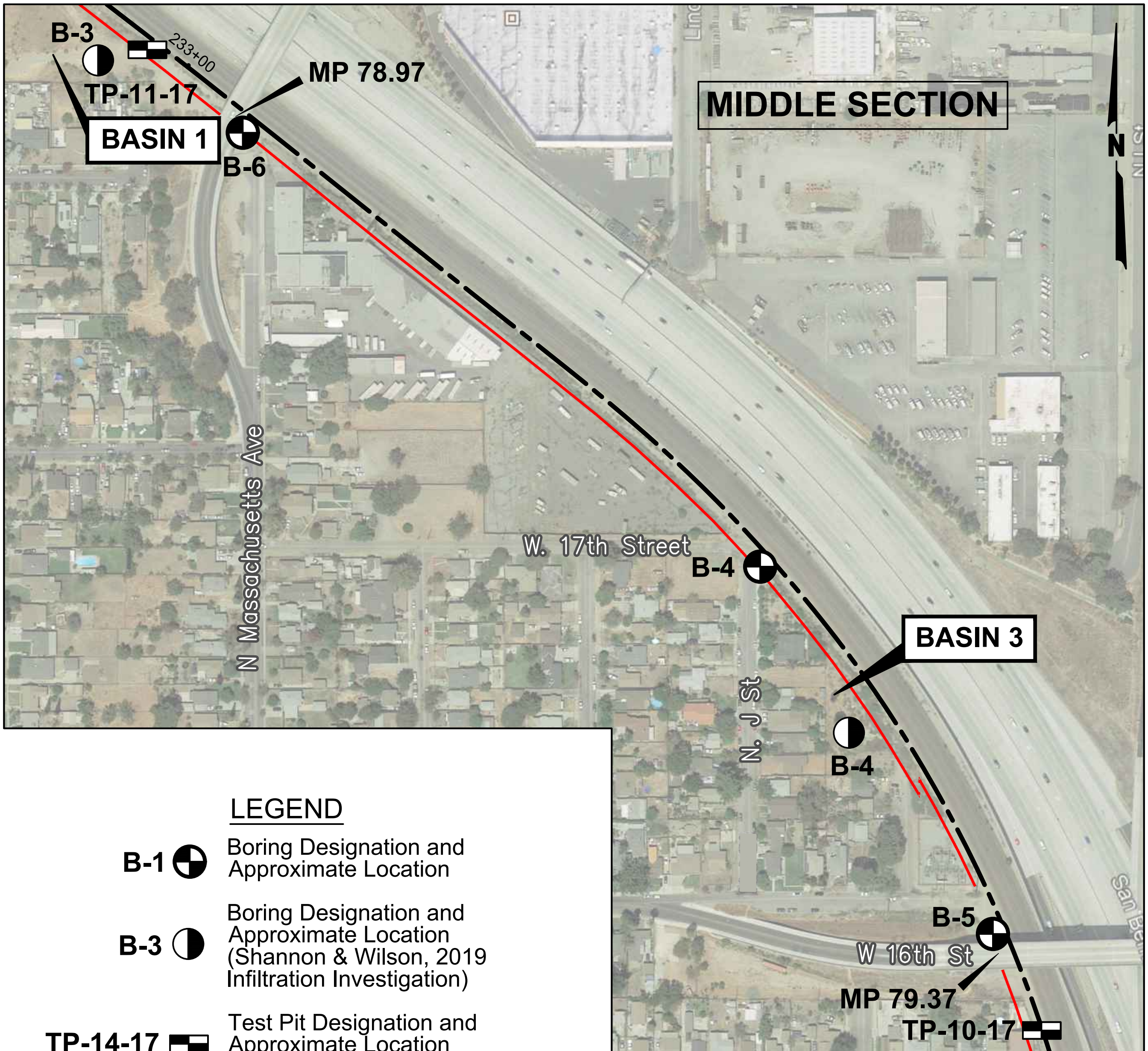
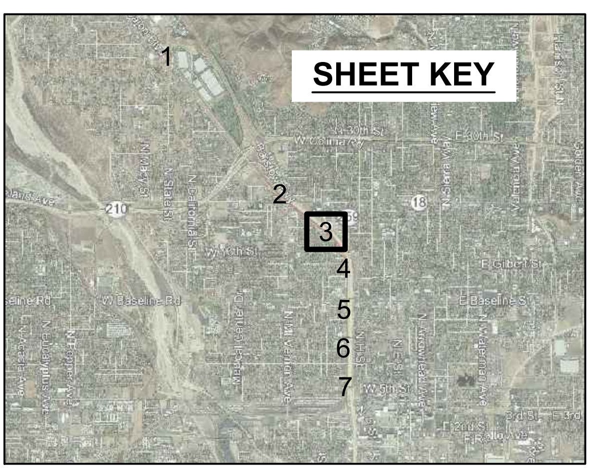
FIG. 2
Sheet 2 of 7

Filename: I:\EF\51-1 LAX\10200s\10240 BNSF San Berdoo\Drafting\012\FIG 2 - SITE AND EXPLORATION PLAN.dwg Date: 02-26-2021 Login: Louis Larios



LEGEND

B-1	Boring Designation and Approximate Location
B-3	Boring Designation and Approximate Location (Shannon & Wilson, 2019 Infiltration Investigation)
TP-14-17	Test Pit Designation and Approximate Location (Shannon & Wilson, 2017a)
	Approximate Location Sound Wall
	Proposed Ono Lead Track



0 150 300 600

SCALE: 1" = 300"

Ono Lead Track Extension - Middle Section
BNSF Railway
San Bernardino, California

SITE AND EXPLORATION PLAN

February 2021 51-1-10240-012

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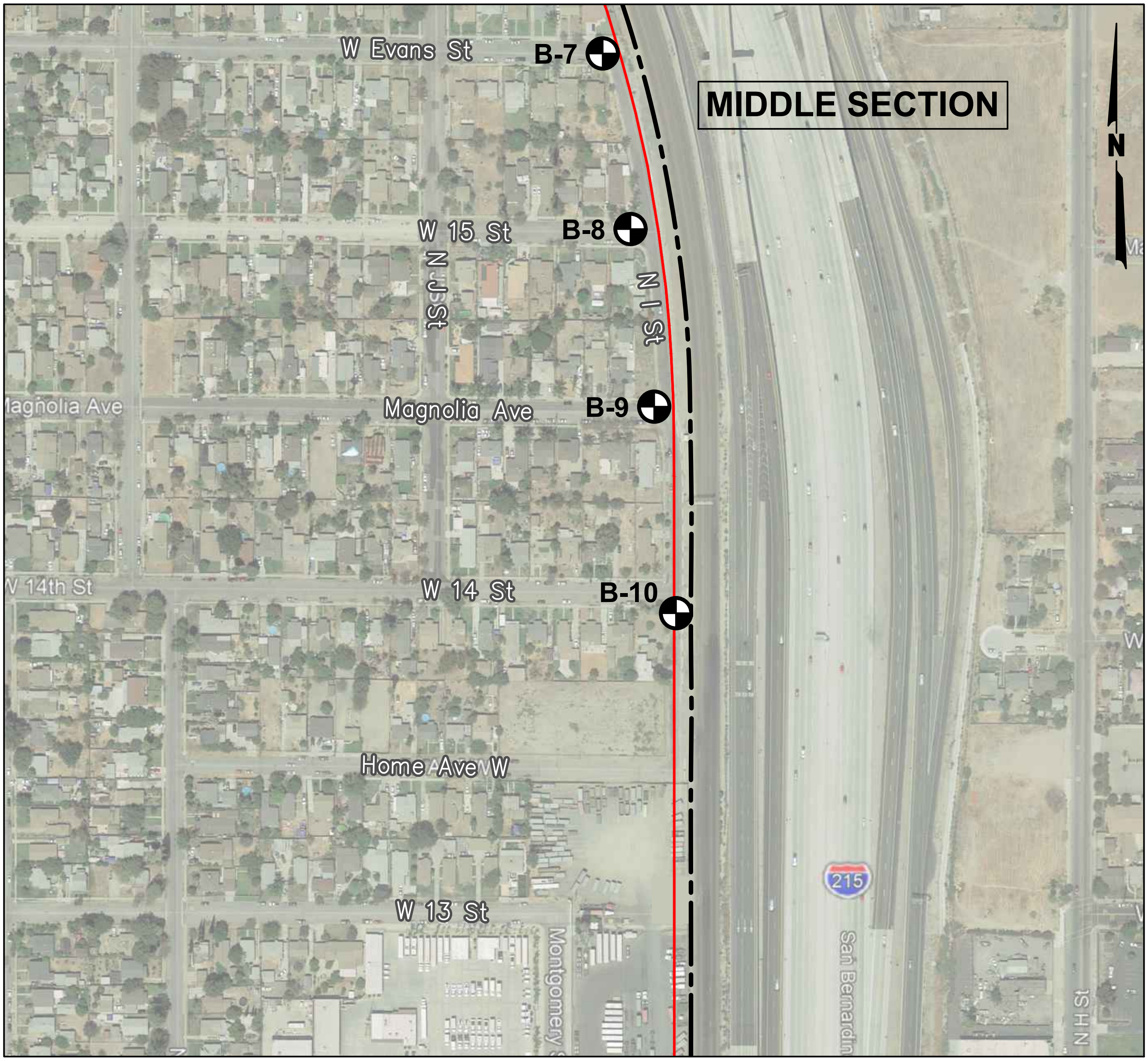
FIG. 2
Sheet 3 of 7

Filename: I:\EF\51-1 LAX\10200s\10240 BNSF San Berdoo\Drafting\012\FIG 2 - SITE AND EXPLORATION PLAN.dwg Date: 02-26-2021 Login: Louis Larios



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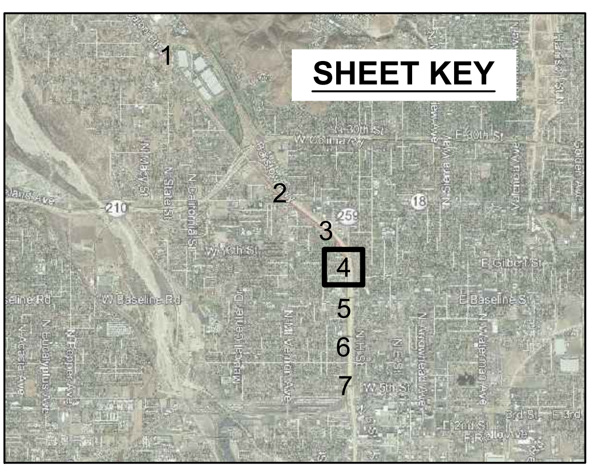

LEGEND

B-1 Boring Designation and Approximate Location

TP-14-17 Test Pit Designation and Approximate Location (Shannon & Wilson, 2017a)

Approximate Location Sound Wall

Proposed Ono Lead Track

Ono Lead Track Extension - Middle Section
BNSF Railway
San Bernardino, California

SITE AND EXPLORATION PLAN

February 2021 51-1-10240-012

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FIG. 2
Sheet 4 of 7

Filename: I:\EF\51-1 LAX\10200s\10240 BNSF San Berdoo\Drafting\012\FIG 2 - SITE AND EXPLORATION PLAN.dwg Date: 02-26-2021 Login: Louis Larios

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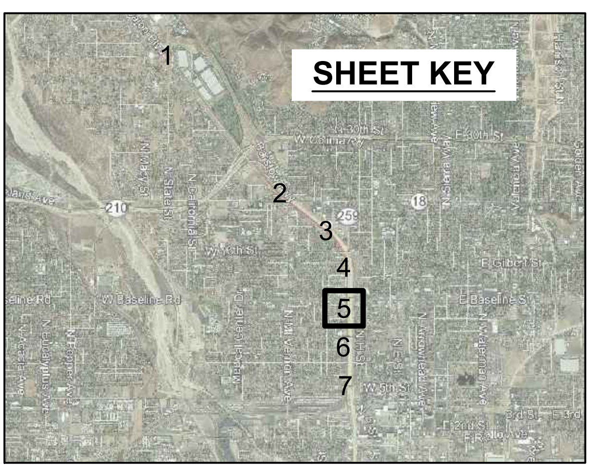
SCALE: 1" = 300"



LEGEND

B-1 Boring Designation and Approximate Location

B-3 Boring Designation and Approximate Location (Shannon & Wilson, 2019 Infiltration Investigation)

TP-14-17 Test Pit Designation and Approximate Location (Shannon & Wilson, 2017a)

Approximate Location Sound Wall

Proposed Ono Lead Track

Ono Lead Track Extension - Southern Section
BNSF Railway
San Bernardino, California

SITE AND EXPLORATION PLAN

February 2021 51-1-10240-012

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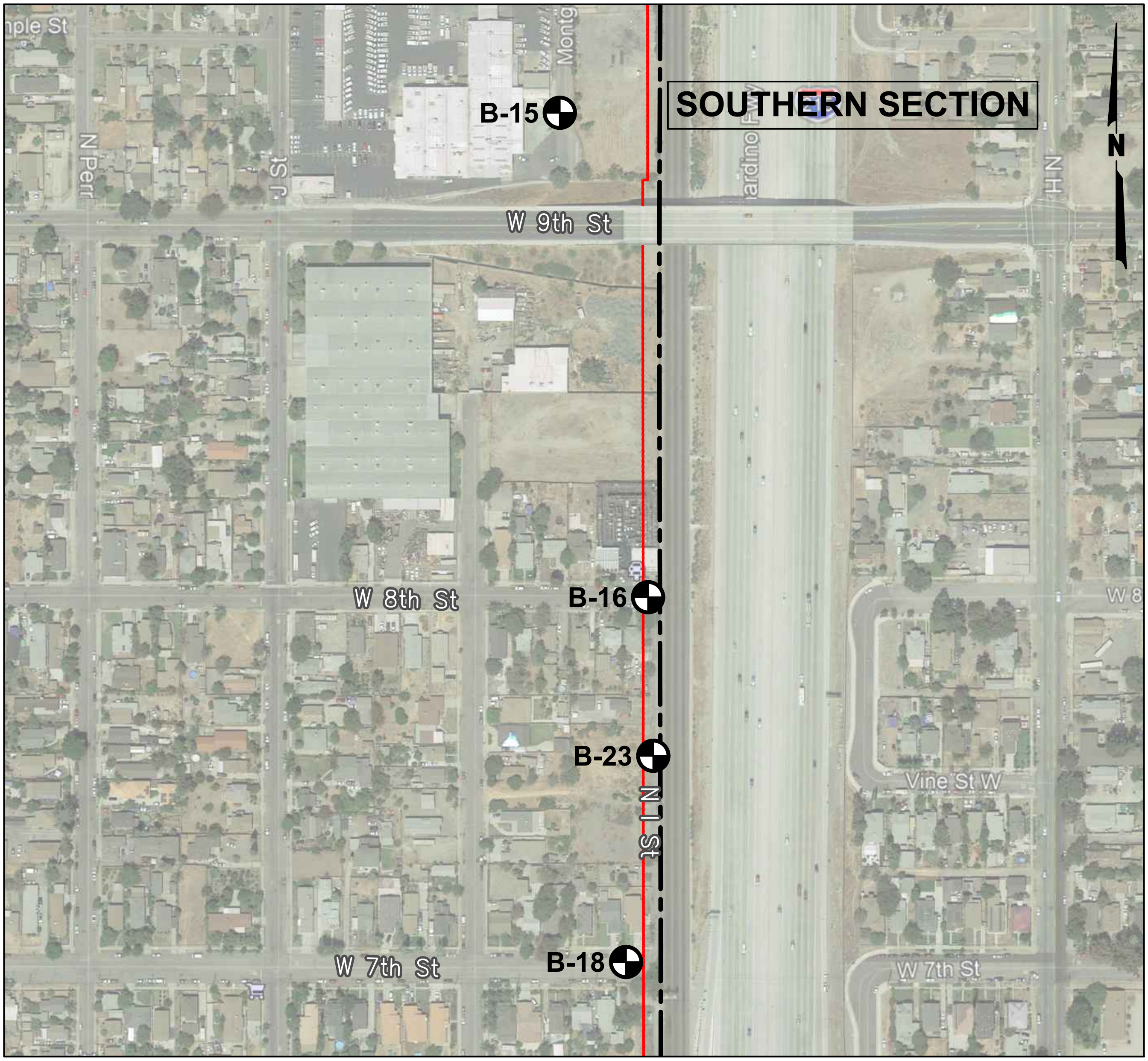
FIG. 2
Sheet 5 of 7

Filename: I:\EF\51-1 LAX10200s\10240 BNSF San Berdoo\Drafting\012\FIG 2 - SITE AND EXPLORATION PLAN.dwg Date: 02-26-2021 Login: Louis Larios



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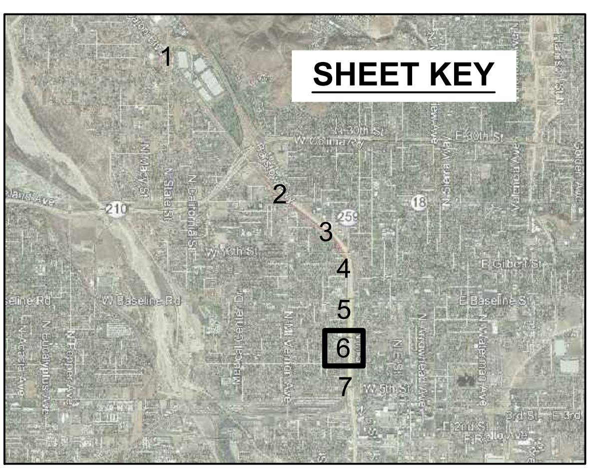

LEGEND

B-1 Boring Designation and Approximate Location

TP-14-17 Test Pit Designation and Approximate Location (Shannon & Wilson, 2017a)

Approximate Location Sound Wall

Proposed Ono Lead Track

Ono Lead Track Extension - Southern Section
BNSF Railway
San Bernardino, California

SITE AND EXPLORATION PLAN

February 2021 51-1-10240-012

SHANNON & WILSON, INC.
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FIG. 2
Sheet 6 of 7

Filename: I:\EF\51-1 LAX10200s\10240 BNSF San Berdoo\Drafting\012\FIG 2 - SITE AND EXPLORATION PLAN.dwg Date: 02-26-2021 Login: Louis Larios

LEGEND

B-1 — Boring Designation and Approximate Location

B-3 — Boring Designation and Approximate Location (Shannon & Wilson, 2019 Infiltration Investigation)

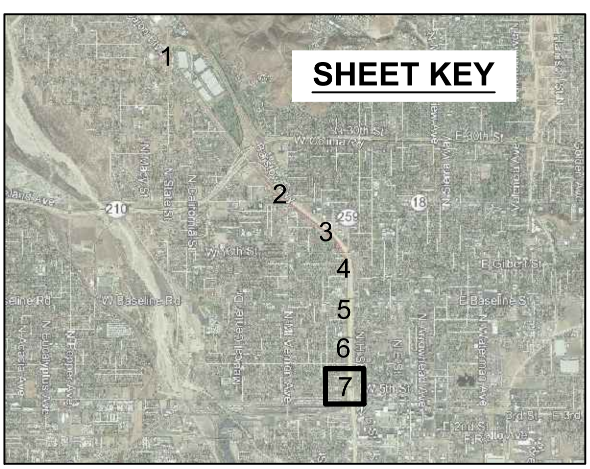
TP-14-17 — Test Pit Designation and Approximate Location (Shannon & Wilson, 2017a)

Approximate Location Sound Wall

Proposed Ono Lead Track

0 150 300 600

SCALE: 1" = 300"



Ono Lead Track Extension - Southern Section
BNSF Railway
San Bernardino, California

SITE AND EXPLORATION PLAN

February 2021 51-1-10240-012

SHANNON & WILSON, INC.
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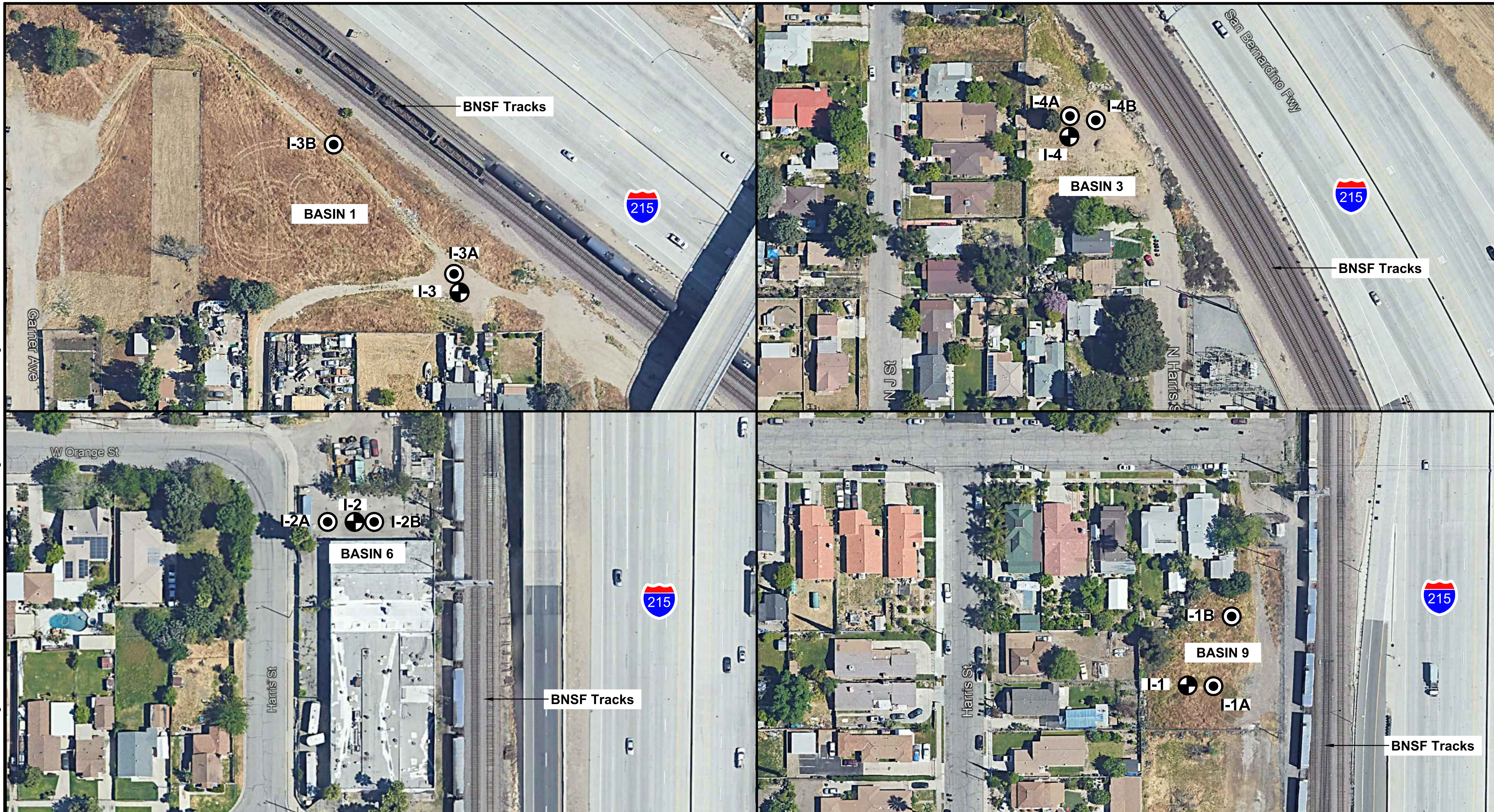
FIG. 2
Sheet 7 of 7



LEGEND

I-1 Soil Boring Designation and Approximate Location

I-1A Percolation Boring Designation and Approximate Location

0 50 100 200

SCALE: 1" =100'

Ono Lead Track Extension
BNSF Railway
San Bernardino, California

SITE AND EXPLORATION PLAN PRELIMINARY INFILTRATION DESIGN

February 2021 51-1-10240-012

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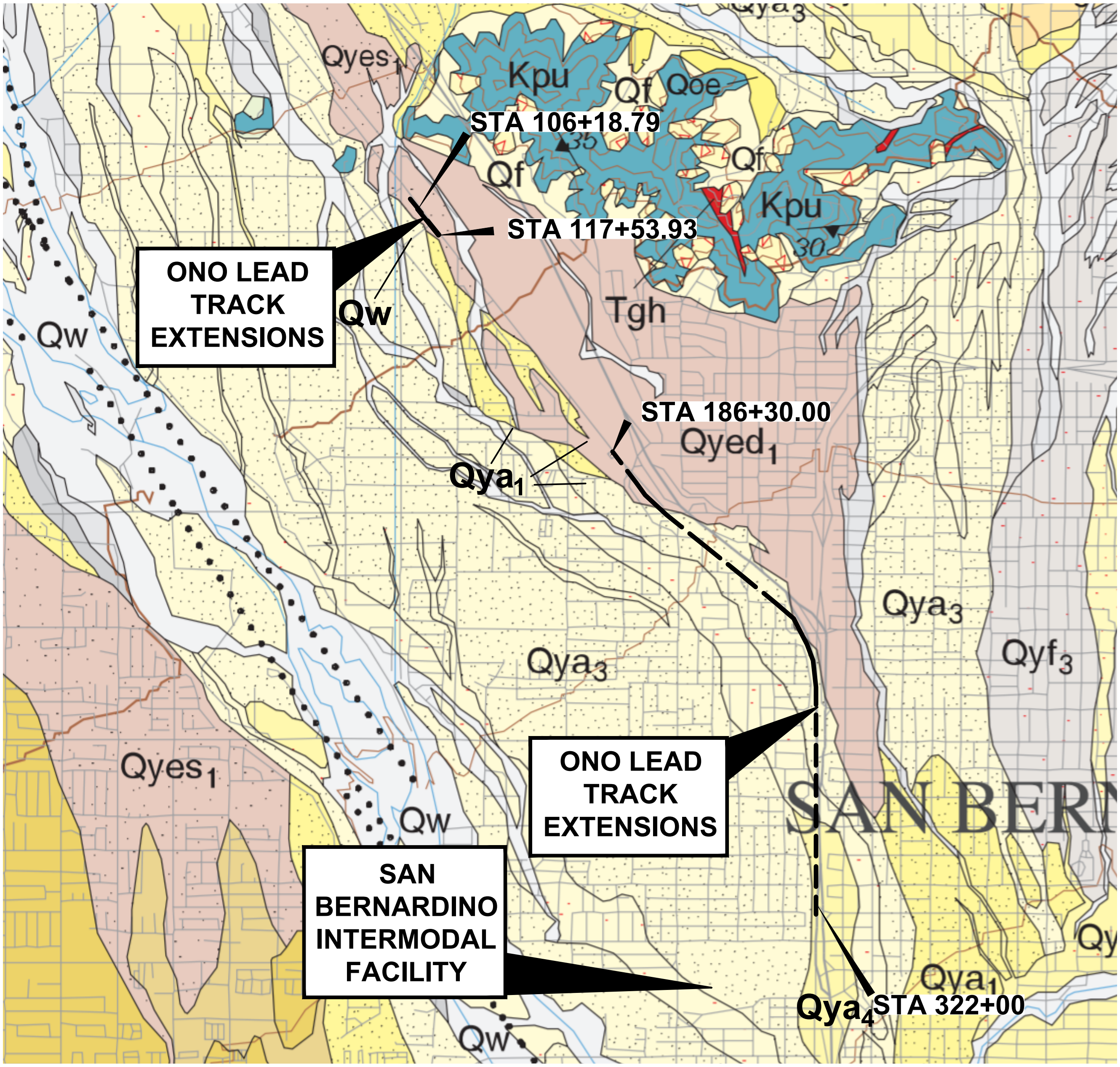
FIG. 3



LEGEND

Qw	Very young wash deposits (late Holocene)
Qf	Very young alluvial-fan deposits (late Holocene)
Qyf3	Young alluvial-fan deposits, Unit 3 (middle Holocene)
Qya4	Young axial-channel deposits, Unit 4 (late Holocene)
Qya3	Young axial-channel deposits, Unit 3 (middle Holocene)
Qya1	Young axial-channel deposits, Unit 1 (early Holocene and late Pleistocene)
Qyed1	Young eolian deposits (dune sand), Unit 1 (early Holocene and late Pleistocene)
Qyes1	Young eolian deposits (sheet sand), Unit 1 (early Holocene and late Pleistocene)
Qoe	Old eolian deposits (late to middle Pleistocene)
Tgh	Hypabyssal granitic rocks (Oligocene)
Kpu	Pelona Schist, undifferentiated (Mesozoic)

0 2000 4000 8000

SCALE: 1" = 4000'

N

NOTE

Map adapted from drawing titled "Geologic Map of the San Bernardino and Santa Ana 30' x 60' Quadrangles, California" USGS, 2006.

Ono Lead Track Extension
BNSF Railway
San Bernardino, California

REGIONAL GEOLOGIC MAP

February 2021 51-1-10240-012

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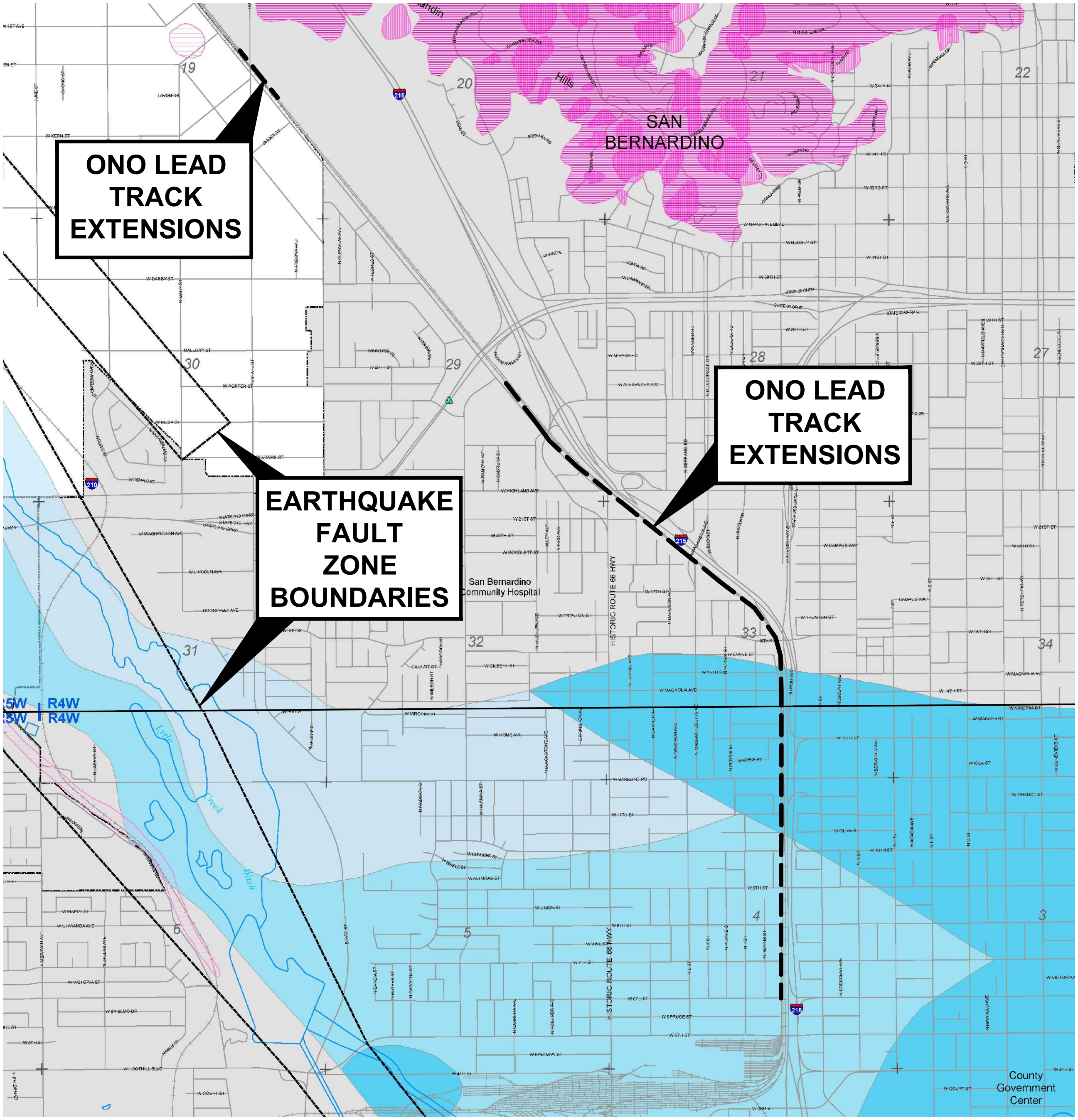
FIG. 4



LEGEND

Generalized Landslide Susceptibility
- Low to moderate
- Moderate to high
- Mapped, Existing Landslide
- Rockfall/Debris-Flow Hazard Area

Zone of Suspected Liquefaction Susceptibility
- Zone of Susceptibility

Generalized Liquefaction Susceptibility
- Low
- Medium
- High

Earthquake Fault Zones
- Earthquake Fault Zone Boundary
- County Designated Fault Zones

0 1500 3000 6000

SCALE: 1" = 3000'

NOTE

Map adapted from drawing titled San Bernardino County Land Use Plan, General Plan, Geologic Hazard Overlays, by County of San Bernardino, 03/09/2010.

Ono Lead Track Extension
BNSF Railway
San Bernardino, California

EARTHQUAKE FAULT ZONE BOUNDARIES

February 2021 51-1-10240-012

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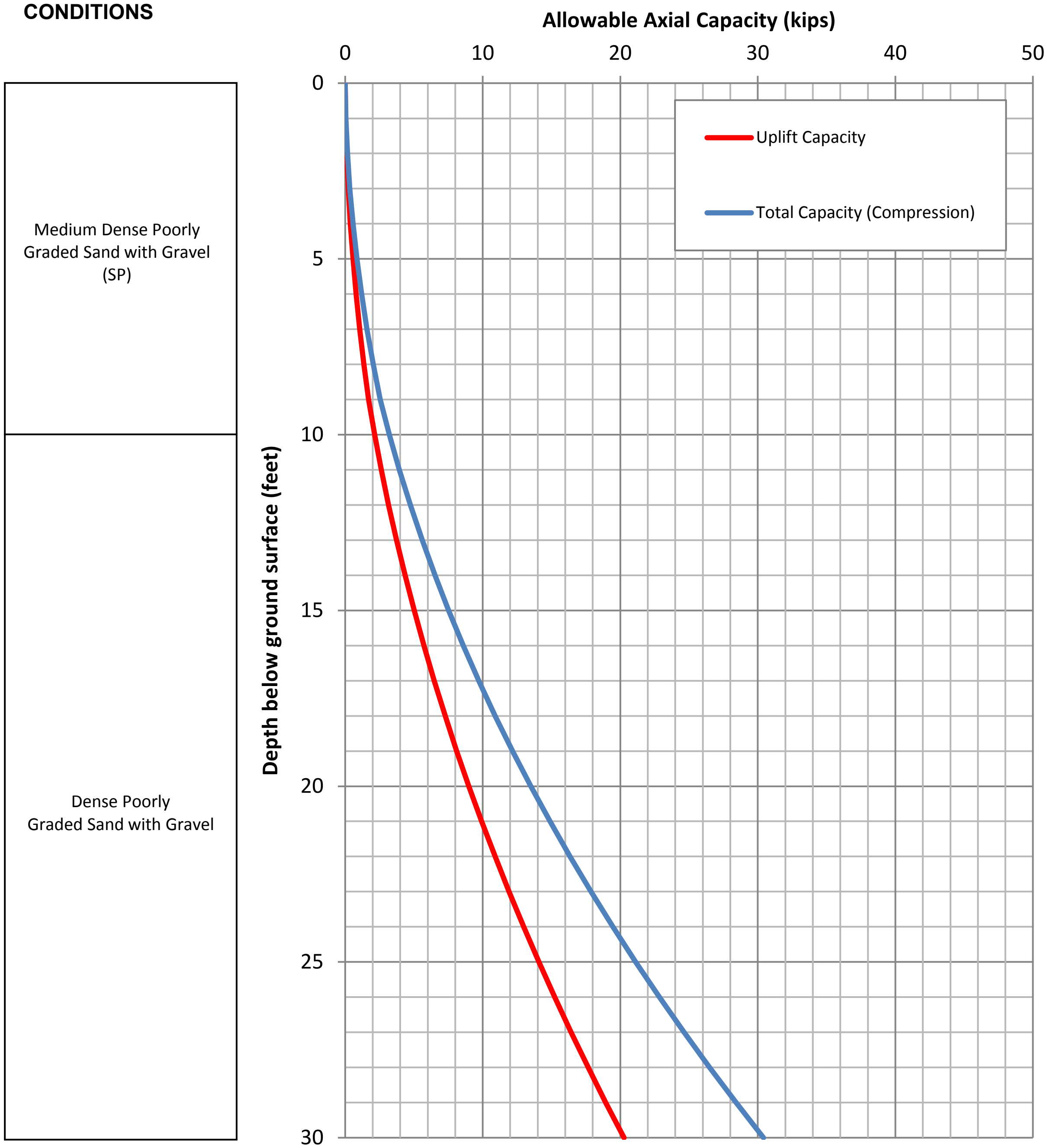
FIG. 5

Filename: I:\EF\51-1 LAX10200s\10240 BNSF San Berdoo\Drafting\012\FIG 4 - COUNTY GEOLOGIC HAZARD OVERLAY.dwg Date: 06-05-2019 Login: Louis Larios

GENERALIZED SUBSURFACE CONDITIONS



NOTES

1. Capacities are based on a single pile and do not consider group effects. Reduction in pile capacity will occur when center-to-center spacing is less than 3D.
2. The analyses do not consider structural capacity of pile section.
3. Factor of Safety (FS) = 2 for Allowable Capacity (Compression), FS = 3 for Uplift.
4. The pile weight may be disregarded when determining net compression load transmitted to the soil.

Ono Lead Track Extension - Northern Section
BNSF Railway
San Bernardino, California

12-INCH CIDH SHAFT
ALLOWABLE AXIAL CAPACITY
SOUND WALL - NORTHERN SECTION

February 2021 51-1-10240-012

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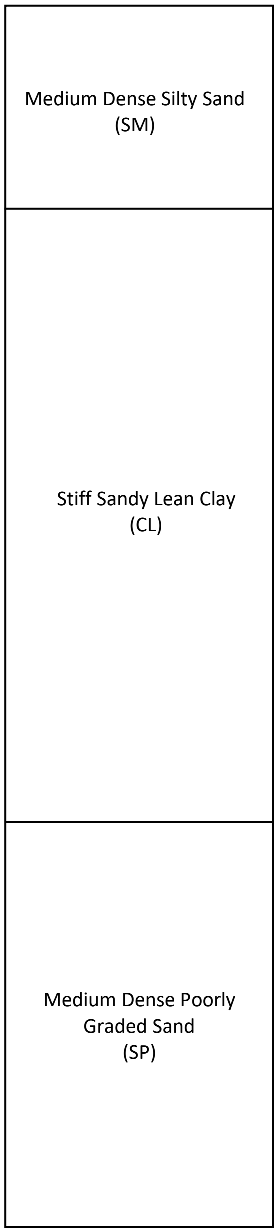
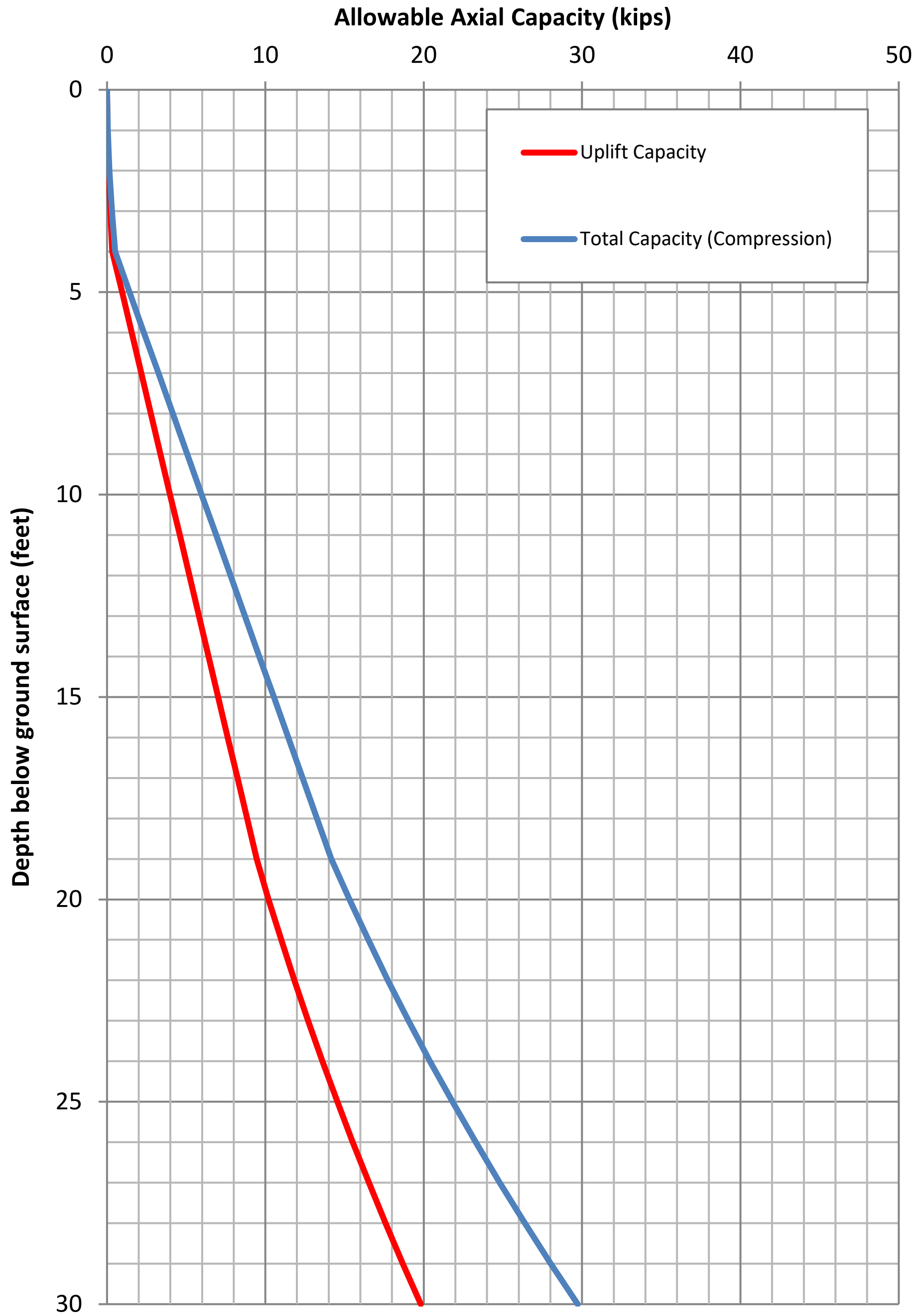
FIG. 6A

GENERALIZED SUBSURFACE CONDITIONS





NOTES

1. Capacities are based on a single pile and do not consider group effects. Reduction in pile capacity will occur when center-to-center spacing is less than 3D.
2. The analyses do not consider structural capacity of pile section.
3. Factor of Safety (FS) = 2 for Allowable Capacity (Compression), FS = 3 for Uplift.
4. The pile weight may be disregarded when determining net compression load transmitted to the soil.

Ono Lead Track Extension - Middle Section
BNSF Railway
San Bernardino, California

12-INCH CIDH SHAFT
ALLOWABLE AXIAL CAPACITY
SOUND WALL - MIDDLE SECTION

February 2021 511-10240-012

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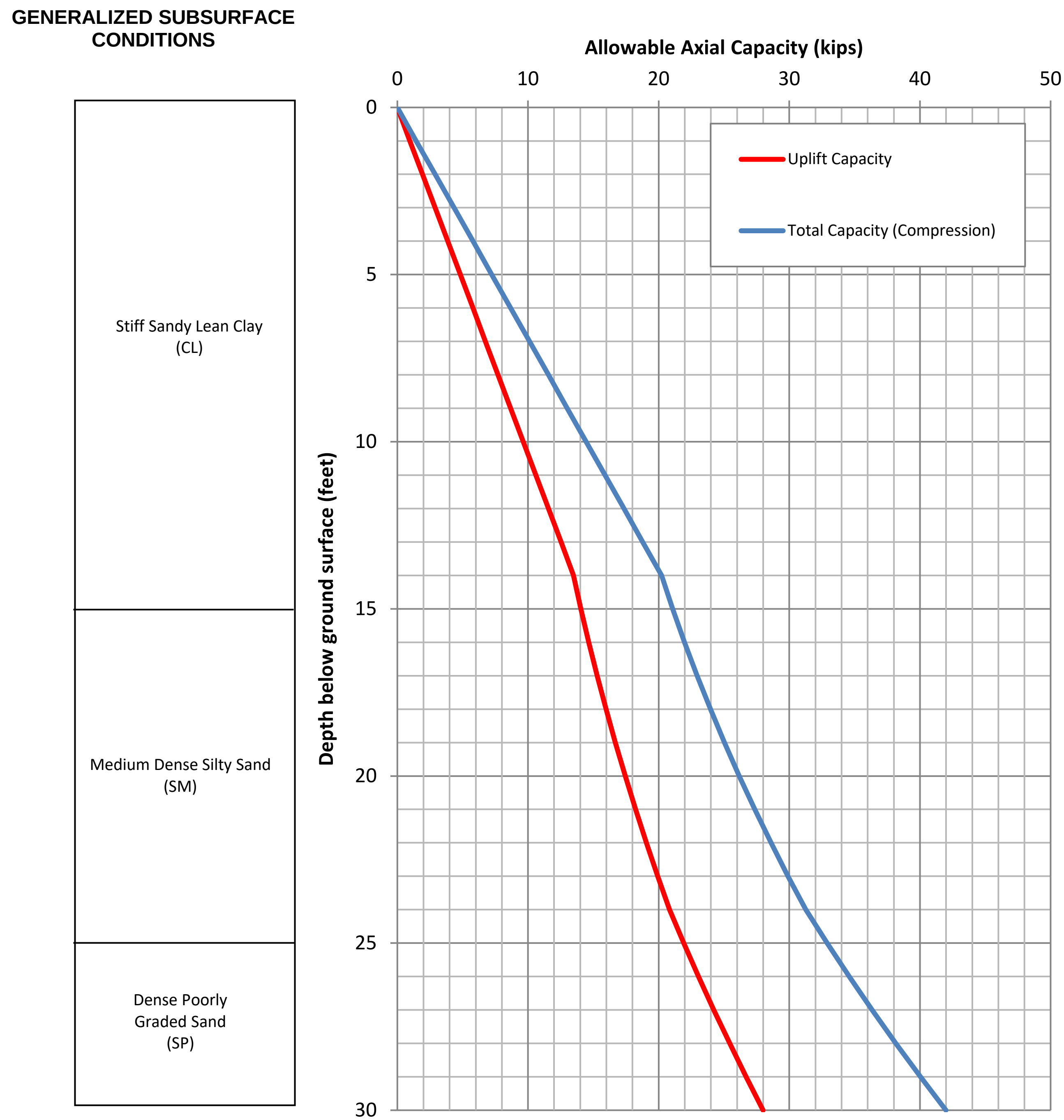
Geotechnical and Environmental Consultants

FIG. 6B



NOTES

1. Capacities are based on a single pile and do not consider group effects. Reduction in pile capacity will occur when center-to-center spacing is less than 3D.
2. The analyses do not consider structural capacity of pile section.
3. Factor of Safety (FS) = 2 for Allowable Capacity (Compression), FS = 3 for Uplift.
4. The pile weight may be disregarded when determining net compression load transmitted to the soil.

Ono Lead Track Extension - Southern Section
BNSF Railway
San Bernardino, California

12-INCH CIDH SHAFT
ALLOWABLE AXIAL CAPACITY
SOUND WALL - SOUTHERN SECTION

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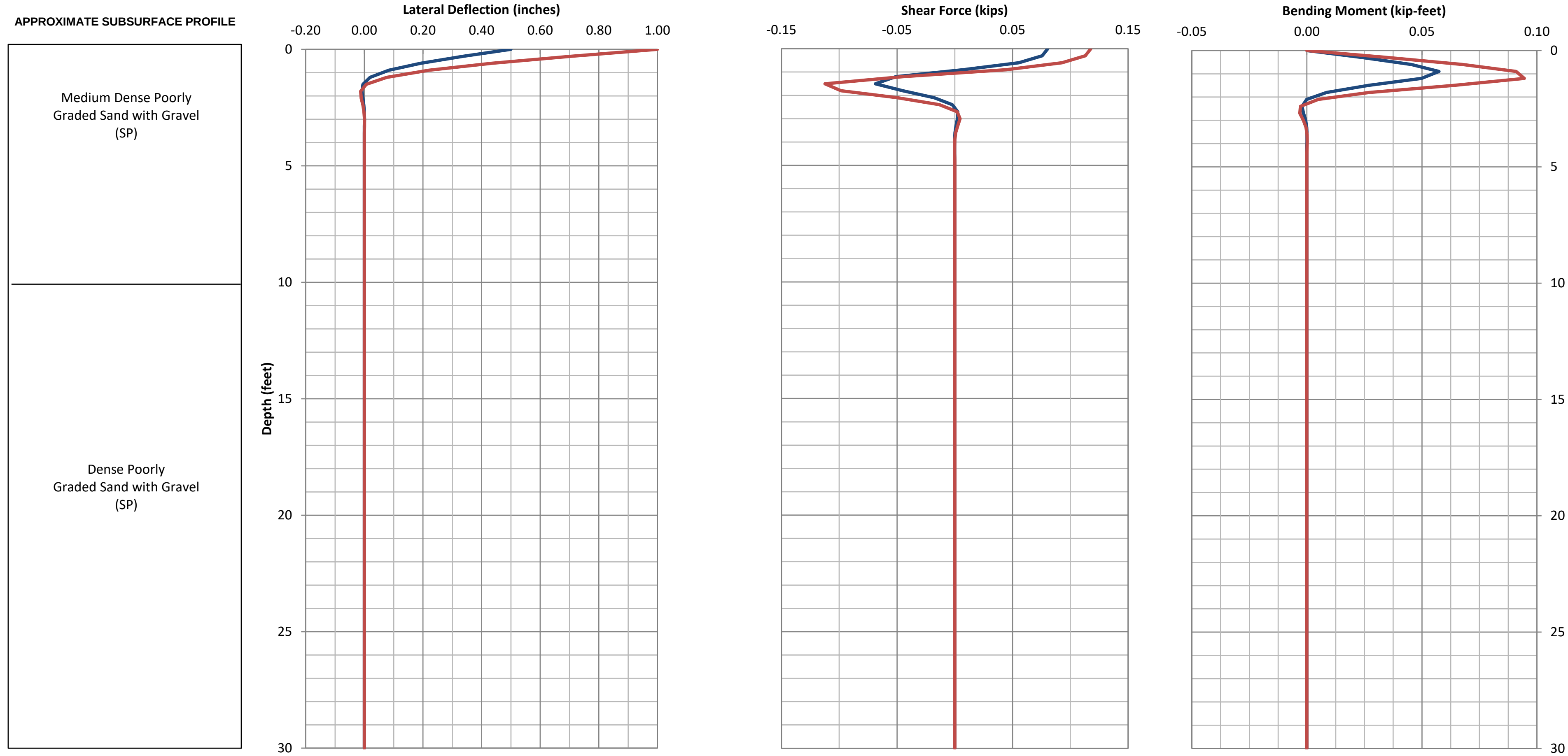
FIG. 6C

EAR



NOTES

1. This elastic analyses is independent of the structural analysis of the pile. The structural engineer shall verify structural capacity.
2. 12-inch diameter CIDH shaft was modeled as an embedded pole with an elastic modulus of 4,030 ksi.
3. The analysis was performed using a 1/2-inch and 1-inch deflection criteria with a free head condition.
4. Analysis assumes a 30 foot pile embedment depth. Shorter pile lengths may results in differing pile behavior.

Ono Lead Track Extension - Northern Section
BNSF Railway
San Bernardino, California

12-INCH CIDH SHAFT
LATERAL PILE RESISTANCE
SOUND WALL - NORTHERN SECTION

February 2021 51-1-10240-012

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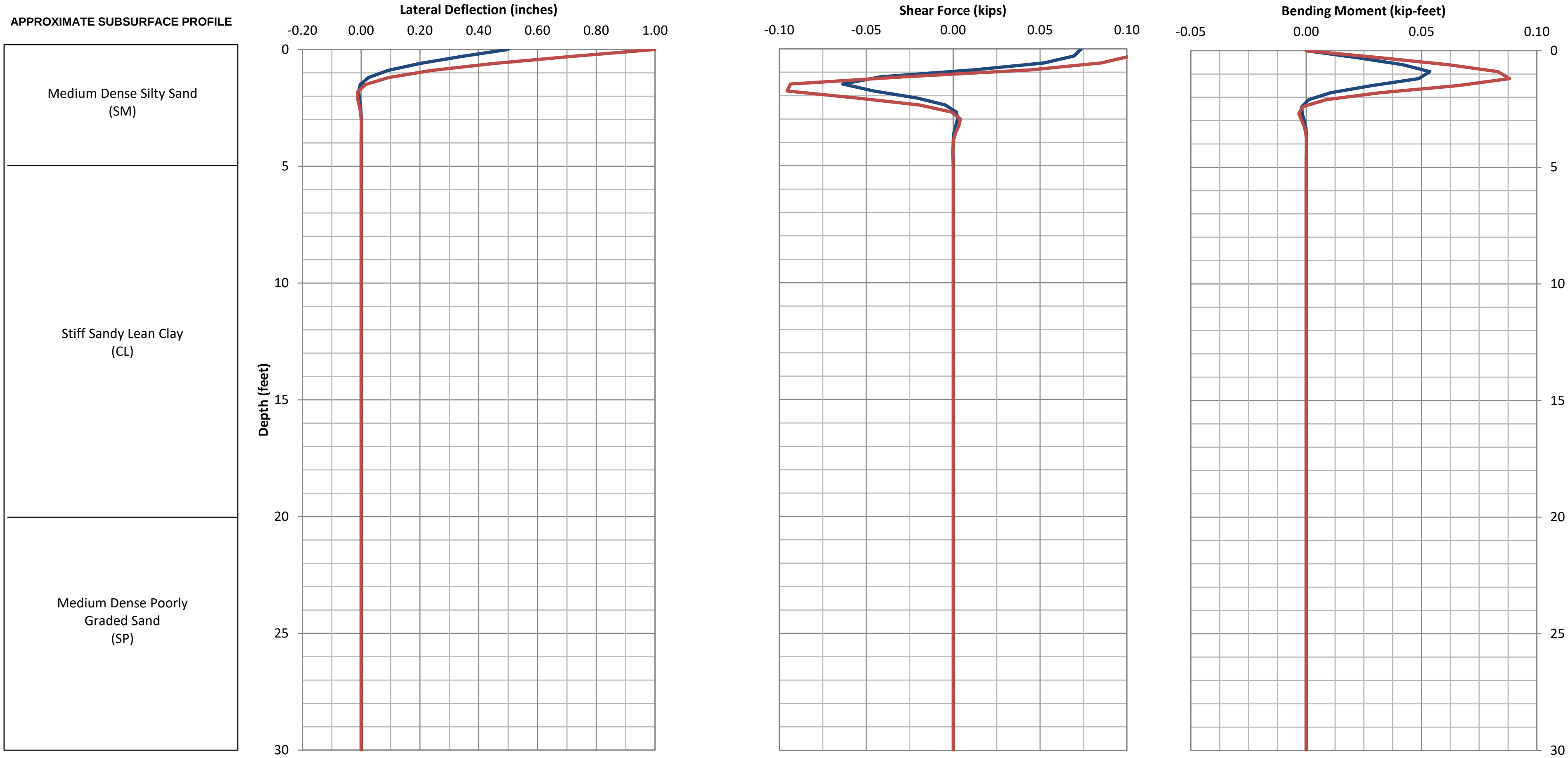
Geotechnical and Environmental Consultants

FIG. 7A

EAR

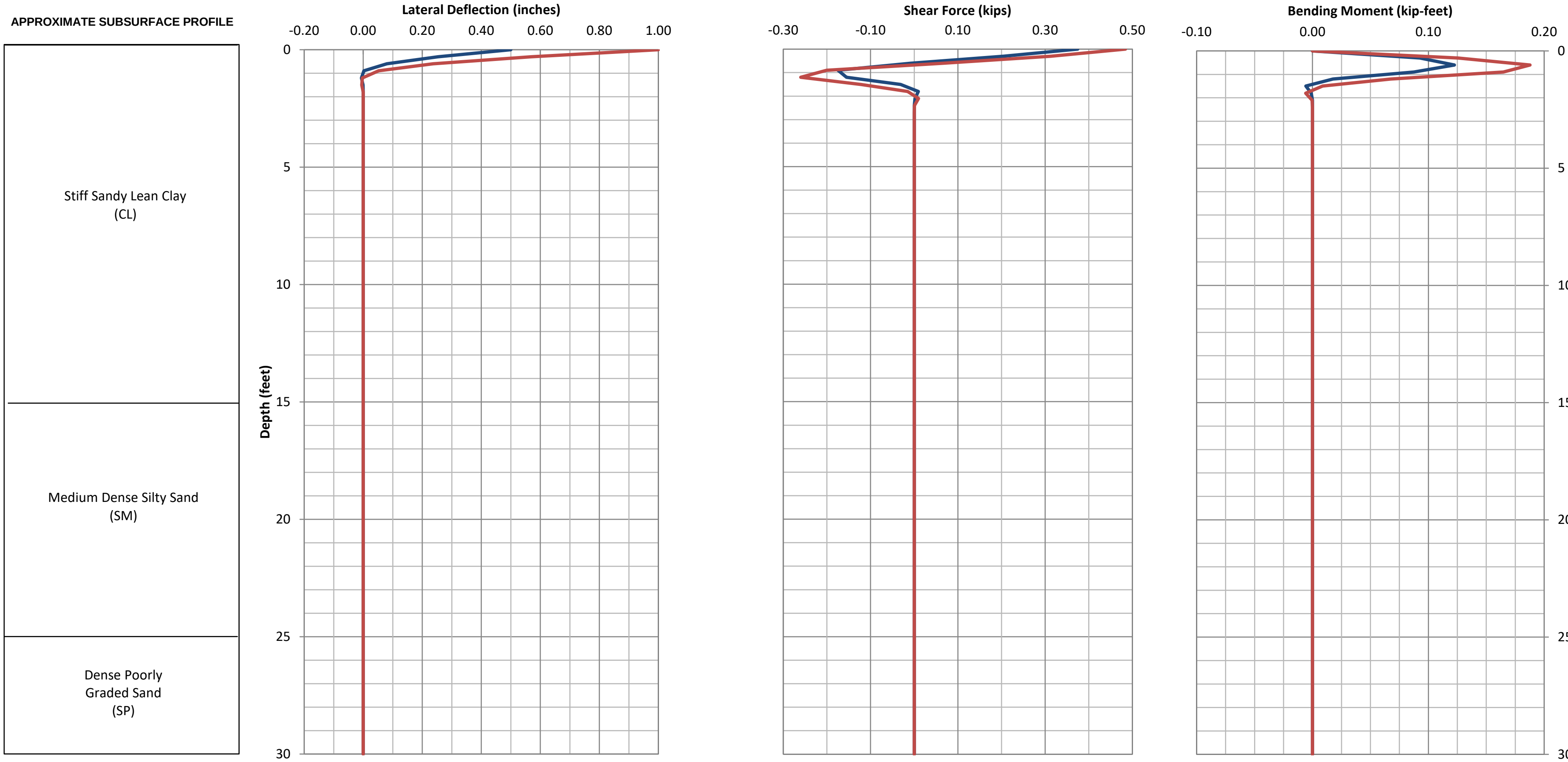


NOTES

1. This elastic analyses is independent of the structural analysis of the pile. The structural engineer shall verify structural capacity.
2. 12-inch diameter CIDH shaft was modeled as an embedded pole with an elastic modulus of 4,030 ksi.
3. The analysis was performed using a 1/2-inch and 1-inch deflection criteria with a free head condition.
4. Analysis assumes a 30 foot pile embedment depth. Shorter pile lengths may results in differing pile behavior.

Ono Lead Track Extension - Middle Section BNSF Railway San Bernardino, California	
12-INCH CIDH SHAFT LATERAL PILE RESISTANCE SOUND WALL - MIDDLE SECTION	
February 2021	51-1-10240-012
SHANNON & WILSON, INC. Geotechnical and Environmental Consultants	**FIG. 7B**

EAR



NOTES

1. This elastic analyses is independent of the structural analysis of the pile. The structural engineer shall verify structural capacity.
2. 12-inch diameter CIDH shaft was modeled as an embedded pole with an elastic modulus of 4,030 ksi.
3. The analysis was performed using a 1/2-inch and 1-inch deflection criteria with a free head condition.
4. Analysis assumes a 30 foot pile embedment depth. Shorter pile lengths may results in differing pile behavior.

Ono Lead Track Extension - Southern Section
BNSF Railway
San Bernardino, California

12-INCH CIDH SHAFT
LATERAL PILE RESISTANCE
SOUND WALL - SOUTHERN SECTION

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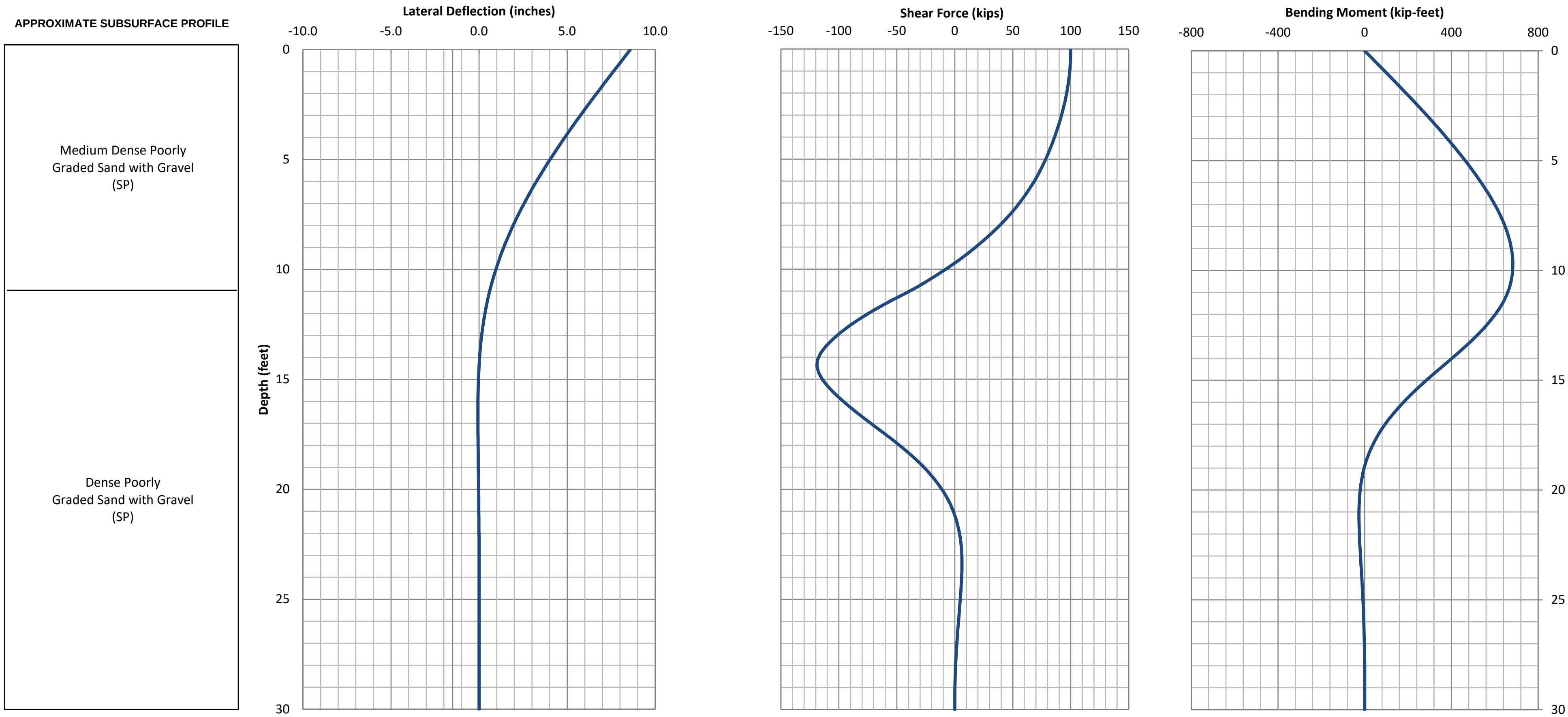
FIG. 7C

JKT



NOTES

1. This elastic analyses is independent of the structural analysis of the pile. The structural engineer shall verify structural capacity.
2. 16-inch diameter CIDH shaft was modeled as an embedded pole with an elastic modulus of 4,030 ksi.
3. The analysis was performed using 100 kips lateral load with a free head condition.
4. Analysis assumes a 30 foot pile embedment depth. Shorter pile lengths may results in differing pile behavior.

Ono Lead Track Extension
BNSF Railway
San Bernardino, California

16-INCH CIDH SHAFT
LATERAL PILE RESISTANCE
CRASH WALL - MT. VERNON AVENUE

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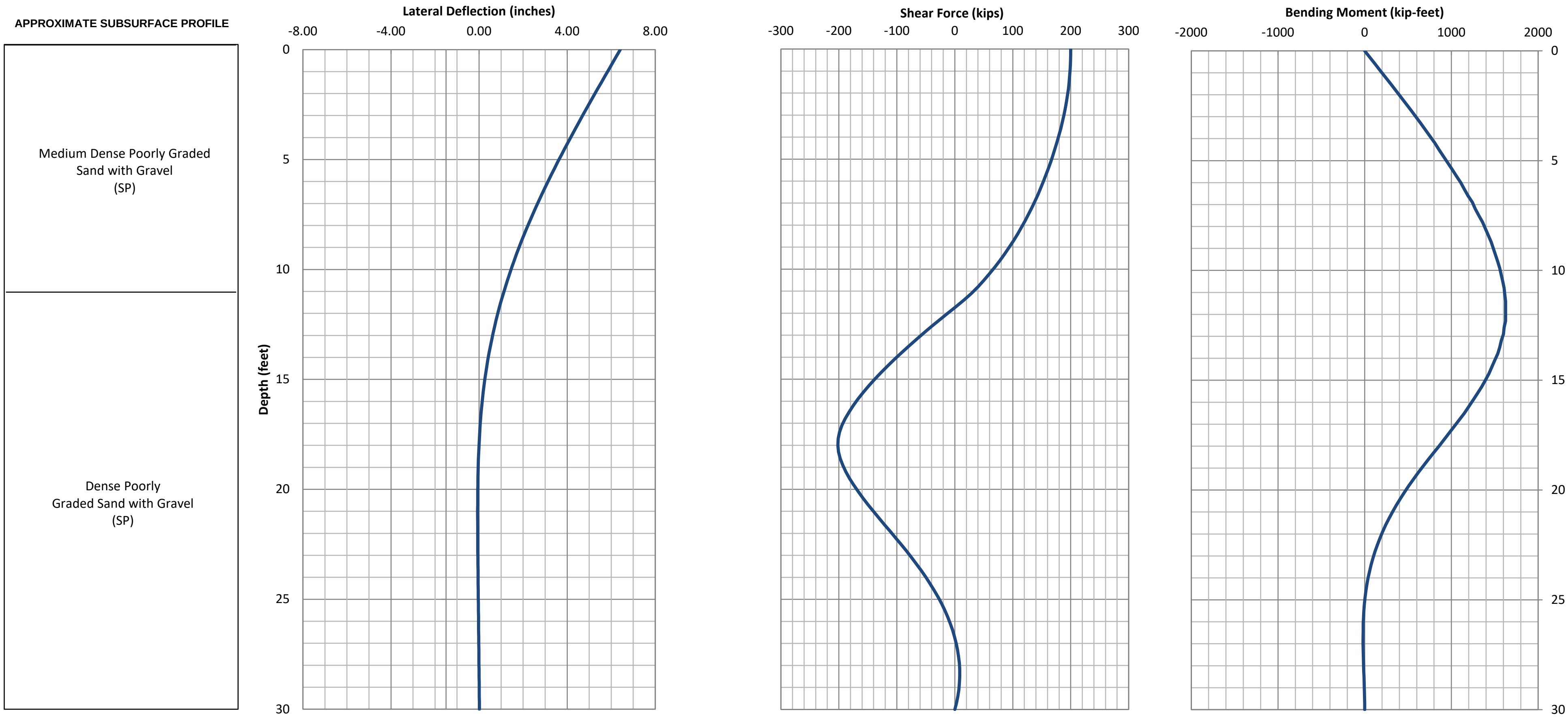
FIG. 8

EAR



NOTES

1. This elastic analyses is independent of the structural analysis of the pile. The structural engineer shall verify structural capacity.
2. 24-inch diameter CIDH shaft was modeled as an embedded pole with an elastic modulus of 4,030 ksi.
3. The analysis was performed using 200 kips lateral load with a free head condition.
4. Analysis assumes a 30 foot pile embedment depth. Shorter pile lengths may results in differing pile behavior.

Ono Lead Track Extension
BNSF Railway
San Bernardino, California

24-INCH CIDH SHAFT
LATERAL PILE RESISTANCE
CRASH WALL - MT VERNON AVENUE

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FIG. 9

APPENDIX A: SUBSURFACE EXPLORATIONS

Appendix A
Subsurface Explorations

CONTENTS

Figures

Shannon & Wilson (S&W) drilled 23 borings, designated as Borings B-1 through B-23, to collect subsurface soil samples. Figure 2, Site and Exploration Plan, shows the approximate boring locations. S&W excavated six test pits designated TP-9-17 through TP-14-17 to collect subsurface soil samples. Bridgewater Equipment of Devore, California excavated the test pits using a Cat ® 450F backhoe. Figure A-31 of this appendix shows the approximate test pit locations. S&W drilled four soil borings during our preliminary infiltration investigation, designated Borings I-1 through I-4, to collect subsurface soil samples. We drilled eight percolation borings, designated Borings I-1 A/B through I-4 A/B, to perform the percolation tests. Figure 3, Site and Exploration Plan Preliminary Infiltration Design, shows the approximate boring locations. A S&W representative observed the field exploration program.

A description of the drilling methods and other field procedures used to perform the subsurface explorations is included in this appendix.

A.1 HEALTH AND SAFETY PLAN

S&W prepared a site-specific health and safety plan before initiation of the field exploration program. The plan identified known hazards at the site and possible hazards related to subsurface structures and utilities. In addition to our health and safety plan, we prepared a "Contractor Safety Action Plan" and uploaded it to BNSFContractor.com in accordance with BNSF's guidelines. The field program was completed with no reportable injuries to S&W personnel or subcontractors.

A.2 SOIL BORINGS

Our subsurface exploration locations of the borings were selected based on the location of the proposed development. We estimated the boring locations by measuring from existing features and estimated the elevations using Google Earth. The boring locations and elevations should be considered accurate to the degree implied by the method used.

The borings were advanced to depths approximately between 16.5 to 26.5 feet below the ground surface (bgs). Borings were completed by by 2R Drilling, Inc. (2R) of Chino, California, under subcontract to S&W. The borings were completed from April 4 through May 1, 2019.

2R drilled borings B-1 to B-20 using an 8-inch-diameter, hollow-stem auger, truck-mounted drill rig. 2R drilled borings B-21 to B-23 using an 8-inch-diameter, hollow-stem auger, limited-access drill rig. After completion of drilling, the drillers backfilled borings located within the BNSF right-of-way with soil cuttings and backfilled borings located within the City of San Bernardino (City) right-of-way with grout. The soil cuttings from borings located within the City right-of-way were placed in drums and staged in BNSF Lot 5, as directed by TKDA and BNSF.

A.3 SAMPLING PROCEDURES

We sampled at 2.5-foot intervals from 2.5 to 10 feet bgs and at 5-foot intervals from 15 to 25 feet bgs. We sampled using a combination of drive samples and grab samples. Drive samples consisted of Standard Penetration Tests (SPTs).

SPTs were performed in general accordance with ASTM D1586 Standard Test Method for SPT and Split-Barrel Sampling of Soils (ASTM, 2018). The SPT consists of driving a 2-inch outside diameter split-spoon sampler a distance of 18 inches into the bottom of the borehole with a 140-pound hammer falling 30 inches. The number of blows required for the last 12 inches of penetration is termed the Standard Penetration Resistance, or N-value. When the resistance exceeded 50 blows for 6 inches or less penetration, the test was terminated and the number of blows and corresponding penetration were recorded. The N-value is an empirical parameter that provides a means for evaluating the relative density, or compactness, of granular soils and the consistency, or stiffness, of cohesive soils. The N-values are plotted on the boring logs.

The split-spoon SPT sampler used during the penetration testing recovered a disturbed sample of the soil. The samples were field classified and recorded on boring logs by our field representative, sealed in jars, and returned to our laboratory for review and testing. Grab soil samples were also obtained by collecting the drill cuttings from the upper 5 feet of select borings and transported to our laboratory for review and testing.

A.4 TEST PITS

Bridgewater equipment excavated six test pits using a Cat ® 450F backhoe, designated TP-9 through TP- 14 along the proposed mainline additions, on April 10, 2017. The test pits excavations ranged between 5 and 7 feet below the existing grade. Our field representative observed the excavation, collected soil samples, and logged the borings. We collected samples as composite grab samples from the excavation cuttings. The excavations were backfilled with soil cuttings and lightly compacted using the excavator bucket.

The logs of the test pits are presented in Figure A-25 to A-30. The log includes specific information regarding our interpretation of soil types or groundwater observed during the exploration. We estimated the test pit elevation using the Project plans. Test pit location map is provided in Figure A-31.

A.5 INFILTRATION SOIL BORINGS

Our subsurface exploration for the Project included drilling and sampling four infiltration soil borings. The four infiltration soil borings were advanced to a depth of approximately 19 feet below the ground surface. Borings were completed by 2R Drilling, Inc. (2R) of Chino, California, under subcontract to Shannon & Wilson. The borings were completed on September 9, 2019.

2R drilled borings I-1 to I-4 using an 8-inch diameter, hollow-stem auger, truck-mounted drill rig. After completion of drilling, the drillers backfilled each boring with soil cuttings.

A.6 PERCOLATION BORINGS

We performed the percolation tests at eight percolation borings. We used 8-inch diameter hollow stem auger to drill two borings at each basin location to a depth of about 7 feet below ground surface (bgs). A 2-inch diameter PVC casing was placed in each hole with the lowest 5-foot section being screened. Wells were removed at all basins except in Basin 9 where the bottom screen was left in place. All borings were backfilled with soil cuttings. Details of the percolation testing are included in Appendix D.

A.7 ENVIRONMENTAL SAMPLING

For contamination potential, we screened the soil samples collected from the borings and drill cuttings generated by the drilling process with a photoionization detector (PID), which measures the presence of volatile organic compounds (VOCs). The intent of PID monitoring is to evaluate the potential presence of contamination of soil and potential exposure to VOC in the breathing zone during drilling operations. Field screening did not indicate potential soil contamination.

For waste characterization purposes, three composite soil samples were collected from the generated cuttings. The samples were submitted to American Environmental Testing Laboratory, Inc. of Burbank, California, for chemical analyses. The chemical testing was completed on April 22, 2019 (see Appendix C). We provided the test results to BNSF for disposal.

A.8 SAMPLE CLASSIFICATION

S&W representatives were onsite throughout the drilling to collect, classify, store, and transport soil samples; to record blow count values; and to perform field screening. In addition, the field representatives also noted drill action; problems during drilling (e.g., heave, hole collapse, etc.); and other issues, if applicable. Soil classification for this project was based on ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) (ASTM, 2017a) and ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedures) (ASTM, 2017b). The system is called the Unified Soil Classification System (USCS) and is summarized in Figure A-1.

We used the data collected during the exploration logging to prepare detailed logs of the borings, which are presented in Figures A-2 through A-24. The Soil Description and Log Key presented as Figure A-1 defines the nomenclature and symbology used to prepare the exploration logs.

A boring log is a written record of the subsurface conditions encountered in the exploration. It shows the soils encountered and the USCS symbol of each layer. Other information shown in the boring logs include groundwater level measurements, types and depths of each sample, PID measurements, horizontal coordinates, and surface elevations. We reviewed the completed boring logs following our Quality Assurance/Quality Control process. This program includes review of the samples by an experienced geologist after initial field observations are made, cross-checks with laboratory test results, and further cross-checks with developed geologic profiles. This detailed procedure is followed to assure consistency of the data presentation and to provide adequate quality control for each exploration.

The geologic units as described in the report are used to maintain consistency when defining geology encountered in the borings throughout the project area. These geologic units are interpretive and are based on our review of existing geologic literature for the project area. The geologic unit designation for each soil layer is shown in the boring log descriptions.

A.9 REFERENCES

ASTM, 2017a, Standard practice for classification of soils for engineering purposes (unified soil classification system), D2487-17: West Conshohocken, Pa., ASTM International, Annual book of standards, 10 p., available: www.astm.org.

ASTM, 2017b, Standard practice for description and identification of soils (visual-manual procedures), D2488-17: West Conshohocken, Pa., ASTM International, Annual book of standards, 13 p., available: www.astm.org.

ASTM, 2018, Standard test method for standard penetration test (SPT) and split-barrel sampling of soils, D1586-18: West Conshohocken, Pa., ASTM International, Annual book of standards, 26 p., available: www.astm.org.

Shannon & Wilson, Inc. (S&W), uses a soil identification system modified from the Unified Soil Classification System (USCS). Elements of the USCS and other definitions are provided on this and the following pages. Soil descriptions are based on visual-manual procedures (ASTM D2488) and laboratory testing procedures (ASTM D2487), if performed.

S&W INORGANIC SOIL CONSTITUENT DEFINITIONS

CONSTITUENT[2]	FINE-GRAINED SOILS (50% or more fines)[1]	COARSE-GRAINED SOILS (less than 50% fines)[1]
Major	***Silt, Lean Clay, Elastic Silt,*** or ***Fat Clay***[3]	***Sand*** or ***Gravel***[4]
Modifying (Secondary) Precedes major constituent	30% or more coarse-grained: ***Sandy*** or ***Gravelly***[4]	More than 12% fine-grained: ***Silty*** or ***Clayey***[3]
Minor Follows major constituent	15% to 30% coarse-grained: ***with Sand*** or ***with Gravel***[4]	5% to 12% fine-grained: ***with Silt*** or ***with Clay***[3]
	30% or more total coarse-grained *and* lesser coarse-grained constituent is 15% or more: ***with Sand*** or ***with Gravel***[5]	15% or more of a second coarse-grained constituent: ***with Sand*** or ***with Gravel***[5]

[1]All percentages are by weight of total specimen passing a 3-inch sieve.
[2]The order of terms is: *Modifying Major with Minor*.
[3]Determined based on behavior.
[4]Determined based on which constituent comprises a larger percentage.
[5]Whichever is the lesser constituent.

MOISTURE CONTENT TERMS

Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, from below water table

STANDARD PENETRATION TEST (SPT) SPECIFICATIONS

Hammer:	140 pounds with a 30-inch free fall. Rope on 6- to 10-inch-diam. cathead 2-1/4 rope turns, > 100 rpm NOTE: If automatic hammers are used, blow counts shown on boring logs should be adjusted to account for efficiency of hammer.
Sampler:	10 to 30 inches long Shoe I.D. = 1.375 inches Barrel I.D. = 1.5 inches Barrel O.D. = 2 inches
N-Value:	Sum blow counts for second and third 6-inch increments. Refusal: 50 blows for 6 inches or less; 10 blows for 0 inches.

NOTE: Penetration resistances (N-values) shown on boring logs are as recorded in the field and have not been corrected for hammer efficiency, overburden, or other factors.

PARTICLE SIZE DEFINITIONS

DESCRIPTION	SIEVE NUMBER AND/OR APPROXIMATE SIZE
FINES	< #200 (0.075 mm = 0.003 in.)
SAND	
Fine	#200 to #40 (0.075 to 0.4 mm; 0.003 to 0.02 in.)
Medium	#40 to #10 (0.4 to 2 mm; 0.02 to 0.08 in.)
Coarse	#10 to #4 (2 to 4.75 mm; 0.08 to 0.187 in.)
GRAVEL	
Fine	#4 to 3/4 in. (4.75 to 19 mm; 0.187 to 0.75 in.)
Coarse	3/4 to 3 in. (19 to 76 mm)
COBBLES	3 to 12 in. (76 to 305 mm)
BOULDERS	> 12 in. (305 mm)

RELATIVE DENSITY / CONSISTENCY

COHESIONLESS SOILS		COHESIVE SOILS	
N, SPT, BLOWS/FT.	RELATIVE DENSITY	N, SPT, BLOWS/FT.	RELATIVE CONSISTENCY
< 4	Very loose	< 2	Very soft
4 - 10	Loose	2 - 4	Soft
10 - 30	Medium dense	4 - 8	Medium stiff
30 - 50	Dense	8 - 15	Stiff
> 50	Very dense	15 - 30	Very stiff
		> 30	Hard

WELL AND BACKFILL SYMBOLS

Bentonite Cement Grout	Surface Cement Seal
Bentonite Grout	Asphalt or Cap
Bentonite Chips	Slough
Silica Sand	Inclinometer or Non-perforated Casing
Perforated or Screened Casing	Vibrating Wire Piezometer

PERCENTAGES TERMS [1, 2]

Trace	< 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

[1]Gravel, sand, and fines estimated by mass. Other constituents, such as organics, cobbles, and boulders, estimated by volume.

[2]Reprinted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.

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SOIL DESCRIPTION AND LOG KEY

February 2021 51-1-10240-012

SHANNON & WILSON, INC.
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FIG. A-1
Sheet 1 of 3

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)
(Modified From USACE Tech Memo 3-357, ASTM D2487, and ASTM D2488)

MAJOR DIVISIONS			GROUP/GRAPHIC SYMBOL	TYPICAL IDENTIFICATIONS
COARSE-GRAINED SOILS *(more than 50% retained on No. 200 sieve)*	Gravels *(more than 50% of coarse fraction retained on No. 4 sieve)*	Gravel *(less than 5% fines)*	GW	Well-Graded Gravel; Well-Graded Gravel with Sand
			GP	Poorly Graded Gravel; Poorly Graded Gravel with Sand
		Silty or Clayey Gravel *(more than 12% fines)*	GM	Silty Gravel; Silty Gravel with Sand
			GC	Clayey Gravel; Clayey Gravel with Sand
	Sands *(50% or more of coarse fraction passes the No. 4 sieve)*	Sand *(less than 5% fines)*	SW	Well-Graded Sand; Well-Graded Sand with Gravel
			SP	Poorly Graded Sand; Poorly Graded Sand with Gravel
		Silty or Clayey Sand *(more than 12% fines)*	SM	Silty Sand; Silty Sand with Gravel
			SC	Clayey Sand; Clayey Sand with Gravel
FINE-GRAINED SOILS *(50% or more passes the No. 200 sieve)*	Silts and Clays *(liquid limit less than 50)*	Inorganic	ML	Silt; Silt with Sand or Gravel; Sandy or Gravelly Silt
			CL	Lean Clay; Lean Clay with Sand or Gravel; Sandy or Gravelly Lean Clay
		Organic	OL	Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly Organic Silt or Clay
	Silts and Clays *(liquid limit 50 or more)*	Inorganic	MH	Elastic Silt; Elastic Silt with Sand or Gravel; Sandy or Gravelly Elastic Silt
			CH	Fat Clay; Fat Clay with Sand or Gravel; Sandy or Gravelly Fat Clay
		Organic	OH	Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly Organic Silt or Clay
HIGHLY-ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor		PT	Peat or other highly organic soils (see ASTM D4427)

NOTE: No. 4 size = 4.75 mm = 0.187 in.; No. 200 size = 0.075 mm = 0.003 in.

NOTES

1. Dual symbols *(symbols separated by a hyphen, i.e., SP-SM, Sand with Silt)* are used for soils with between 5% and 12% fines or when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart. Graphics shown on the logs for these soil types are a combination of the two graphic symbols (e.g., SP and SM).

2. Borderline symbols *(symbols separated by a slash, i.e., CL/ML, Lean Clay to Silt; SP-SM/SM, Sand with Silt to Silty Sand)* indicate that the soil properties are close to the defining boundary between two groups.

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SOIL DESCRIPTION AND LOG KEY

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FIG. A-1
Sheet 2 of 3

GRADATION TERMS

Poorly Graded	Narrow range of grain sizes present or, within the range of grain sizes present, one or more sizes are missing (Gap Graded). Meets criteria in ASTM D2487, if tested.
Well-Graded	Full range and even distribution of grain sizes present. Meets criteria in ASTM D2487, if tested.

CEMENTATION TERMS[1]

Weak	Crumbles or breaks with handling or slight finger pressure
Moderate	Crumbles or breaks with considerable finger pressure
Strong	Will not crumble or break with finger pressure

PLASTICITY[2]

DESCRIPTION	VISUAL-MANUAL CRITERIA	APPROX. PLASITICTY INDEX RANGE
Nonplastic	A 1/8-in. thread cannot be rolled at any water content.	< 4
Low	A thread can barely be rolled and a lump cannot be formed when drier than the plastic limit.	4 to 10
Medium	A thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. A lump crumbles when drier than the plastic limit.	10 to 20
High	It take considerable time rolling and kneading to reach the plastic limit. A thread can be rerolled several times after reaching the plastic limit. A lump can be formed without crumbling when drier than the plastic limit.	> 20

ADDITIONAL TERMS

Mottled	Irregular patches of different colors.
Bioturbated	Soil disturbance or mixing by plants or animals.
Diamict	Nonsorted sediment; sand and gravel in silt and/or clay matrix.
Cuttings	Material brought to surface by drilling.
Slough	Material that caved from sides of borehole.
Sheared	Disturbed texture, mix of strengths.

PARTICLE ANGULARITY AND SHAPE TERMS[1]

Angular	Sharp edges and unpolished planar surfaces.
Subangular	Similar to angular, but with rounded edges.
Subrounded	Nearly planar sides with well-rounded edges.
Rounded	Smoothly curved sides with no edges.
Flat	Width/thickness ratio > 3.
Elongated	Length/width ratio > 3.

[1]Reprinted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.
[2]Adapted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.

ACRONYMS AND ABBREVIATIONS

ATD	At Time of Drilling
Diam.	Diameter
Elev.	Elevation
ft.	Feet
FeO	Iron Oxide
gal.	Gallons
Horiz.	Horizontal
HSA	Hollow Stem Auger
I.D.	Inside Diameter
in.	Inches
lbs.	Pounds
MgO	Magnesium Oxide
mm	Millimeter
MnO	Manganese Oxide
NA	Not Applicable or Not Available
NP	Nonplastic
O.D.	Outside Diameter
OW	Observation Well
pcf	Pounds per Cubic Foot
PID	Photo-Ionization Detector
PMT	Pressuremeter Test
ppm	Parts per Million
psi	Pounds per Square Inch
PVC	Polyvinyl Chloride
rpm	Rotations per Minute
SPT	Standard Penetration Test
USCS	Unified Soil Classification System
q_u	Unconfined Compressive Strength
VWP	Vibrating Wire Piezometer
Vert.	Vertical
WOH	Weight of Hammer
WOR	Weight of Rods
Wt.	Weight

STRUCTURE TERMS[1]

Interbedded	Alternating layers of varying material or color with layers at least 1/4-inch thick; singular: bed.
Laminated	Alternating layers of varying material or color with layers less than 1/4-inch thick; singular: lamination.
Fissured	Breaks along definite planes or fractures with little resistance.
Slickensided	Fracture planes appear polished or glossy; sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps that resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay.
Homogeneous	Same color and appearance throughout.

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SOIL DESCRIPTION AND LOG KEY

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FIG. A-1
Sheet 3 of 3

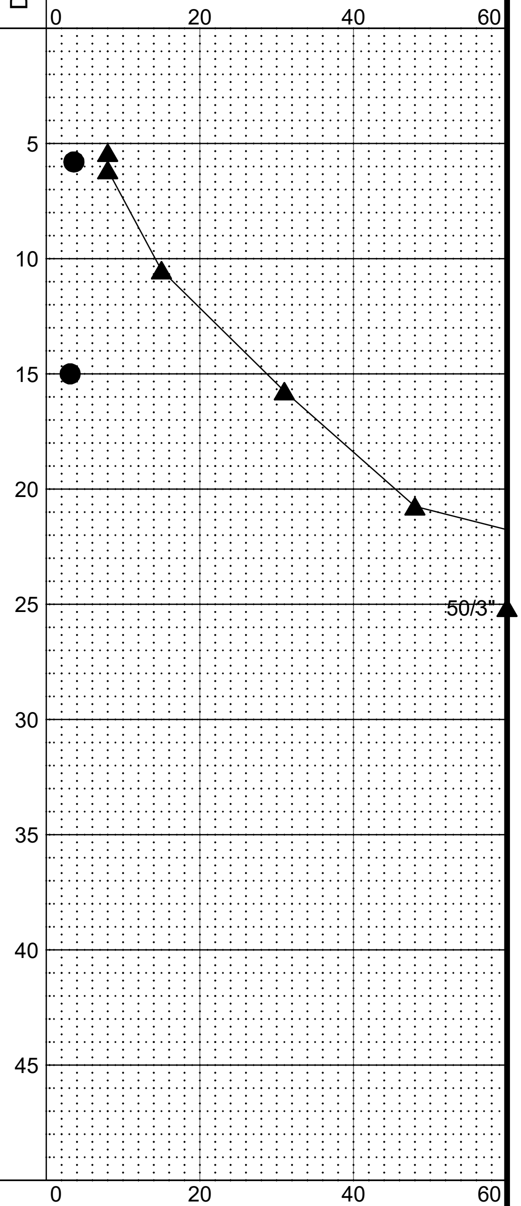
2013_BORING_CLASS3 51-1-10240-012 1.GPJ SWNEW.GDT 8/26/20

Total Depth:	*25.3 ft.*	Latitude:	*34.13887 °*	Drilling Method:	*Hollow Stem Auger*	Hole Diam.:	*8 in.*
Top Elevation:	*~ 1224 ft.*	Longitude:	*-117.3175 °*	Drilling Company:	*2R Drilling*	Rod Diam.:	*-*
Vert. Datum:	*NAVD88*	Station:	*N/A*	Drill Rig Equipment:	*CME 75*	Hammer Type:	*Automatic*
Horiz. Datum:	*WGS84*	Offset:	*N/A*	Other Comments:			

Elevation, ft.	SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.*	Depth, ft.	Symbol	PID, ppm	Samples	Ground Water
1221.5	Red-brown, *Silty Sand (SM)*; moist; fine sand; trace fine gravel. **Artificial Fill (af)**	2.5		0.3	S-1	
1218.2	Loose, brown, *Poorly Graded Sand with Silt (SP-SM)*; moist; fine to medium sand; trace fine gravel. **Alluvium (Qa)**	5.8		3.1 7.1	S-2a S-2b	
1213.0	Loose to medium dense, light brown, *Poorly Graded Sand (SP)*; dry; medium to coarse sand; few fine gravel.	11.0		10.1	S-3	
1198.7	Dense to very dense, gray-brown, *Poorly Graded Sand with Gravel (SP)*; dry; medium to coarse sand; fine gravel.	25.3		37.5 1.1 0.3	S-4 S-5 S-6	
	BOTTOM OF BORING NO GROUNDWATER ENCOUNTERED COMPLETED 4/4/2019					

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



◇ % Fines (<0.075mm)
● % Water Content

LEGEND

* Sample Not Recovered
G Grab Sample
2.0" O.D. Split Spoon Sample

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

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LOG OF BORING B-01

February 2021 51-1-10240-012

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FIG. A-2

REV 3

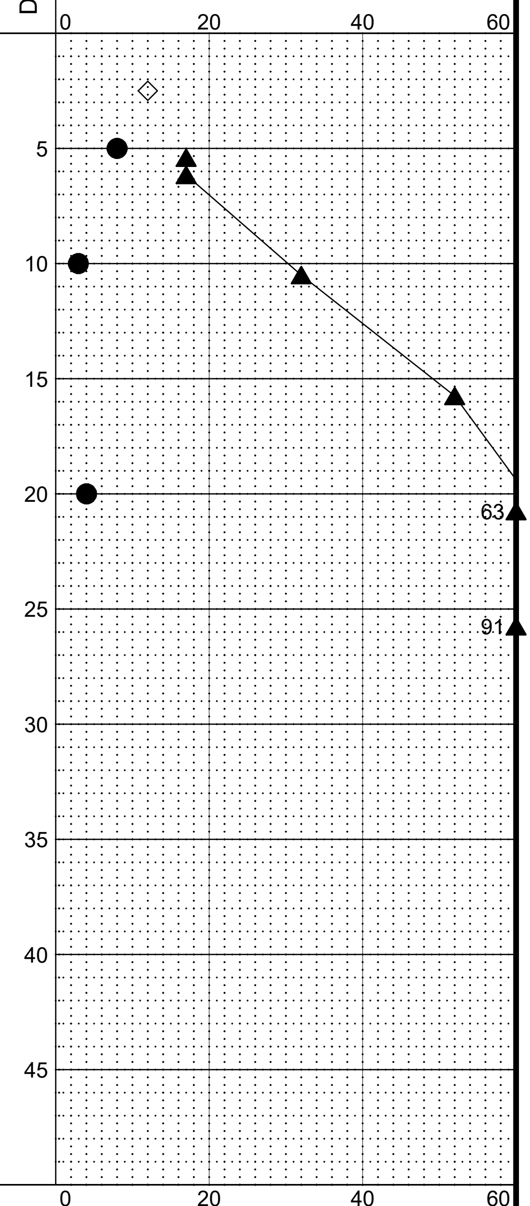
MASTER_LOG_E_MC 51-1-10240-012 1.GPJ SHAN_WIL.GDT 8/26/20 *Log: KXR* *Rev: LAM* *Typ: KXR*

Total Depth:	26.5 ft.	Latitude:	34.15885 °	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation:	~ 1408 ft.	Longitude:	-117.3367 °	Drilling Company:	2R Drilling	Rod Diam.:	-
Vert. Datum:	NAVD88	Station:	N/A	Drill Rig Equipment:	CME 75	Hammer Type:	Automatic
Horiz. Datum:	WGS84	Offset:	N/A	Other Comments:			

Elevation, ft.	SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.*	Depth, ft.	Symbol	PID, ppm	Samples	Ground Water
	Red-brown to brown, *Well Graded Sand with Silt (SW-SM)*; moist; fine to coarse sand. **Artificial Fill (af)**			0.3	S-1 (G)	
				0.9 0.3	S-2a S-2b	
1402.2	Medium dense, light brown, *Poorly Graded Sand with Gravel (SP)*; moist; fine to coarse sand; fine gravel. **Alluvium (Qa)**	5.8				
1398.0	Dense to very dense, light gray-brown, *Poorly Graded Sand (SP)*; dry; fine to coarse sand; fine to coarse gravel.	10.0		3.9	S-3	
				1.3	S-4	
				0.3	S-5	
				1.1	S-6	
1381.5	BOTTOM OF BORING NO GROUNDWATER ENCOUNTERED COMPLETED 4/4/2019	26.5				

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



◇ % Fines (<0.075mm)
● % Water Content

LEGEND

* Sample Not Recovered
G Grab Sample
⌶ 2.0" O.D. Split Spoon Sample

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

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LOG OF BORING B-02

February 2021 51-1-10240-012

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FIG. A-3

REV 3

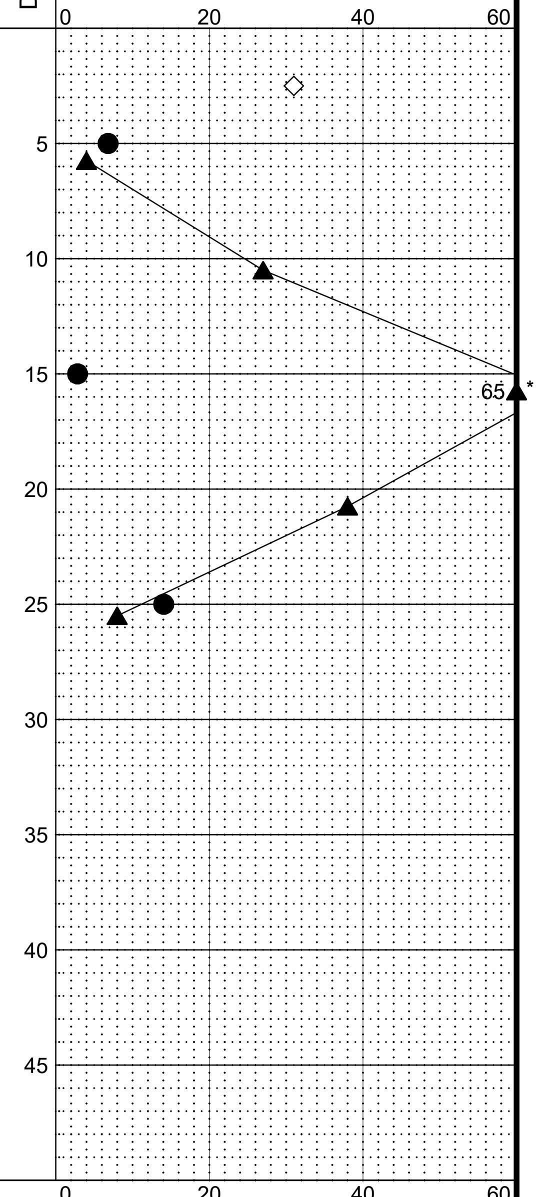
Total Depth:	*26 ft.*	Latitude:	*34.13589 °*	Drilling Method:	*Hollow Stem Auger*
Top Elevation:	*~ 1197 ft.*	Longitude:	*-117.3136 °*	Drilling Company:	*2R Drilling*
Vert. Datum:	*NAVD88*	Station:	*N/A*	Drill Rig Equipment:	*CME 75*
Horiz. Datum:	*WGS84*	Offset:	*N/A*	Other Comments:	

Hole Diam.:	*8 in.*
Rod Diam.:	*-*
Hammer Type:	*Automatic*

Elevation, ft.	SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.*	Depth, ft.	Symbol	PID, ppm	Samples	Ground Water
	Dark brown, *Silty Sand (SM)*; moist; fine sand. **Artificial Fill (af)**			0.7	S-1	
1192.0	Loose, light red-brown, *Silty Sand (SM)*; moist; fine sand. **Alluvium (Qa)**	5.0		3.3	S-2	
1190.5	Medium dense, light gray-brown, *Poorly Graded Sand with Silt and Gravel (SP-SM)*; moist; medium to coarse sand; fine gravel.	6.5		1.1	S-3	
1186.0	Dense to very dense, gray-brown, *Poorly Graded Sand with Gravel (SP)*; moist; medium to coarse sand; fine to coarse gravel.	11.0		3.5 0.8	S-4 S-5	
1175.5	Loose, gray-brown, *Clayey Sand with Gravel (SC)*; dry; medium to coarse sand; fine gravel.	21.5		1.2	S-6	
1171.0	BOTTOM OF BORING NO GROUNDWATER ENCOUNTERED COMPLETED 4/4/2019 *Gravel may be inflating the blow count.	26.0				

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



◇ % Fines (<0.075mm)

● % Water Content

LEGEND

* Sample Not Recovered

G Grab Sample

2.0" O.D. Split Spoon Sample

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

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LOG OF BORING B-03

February 2021 51-1-10240-012

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FIG. A-4

REV 3

Log: KXR Rev: LAM Typ: KXR

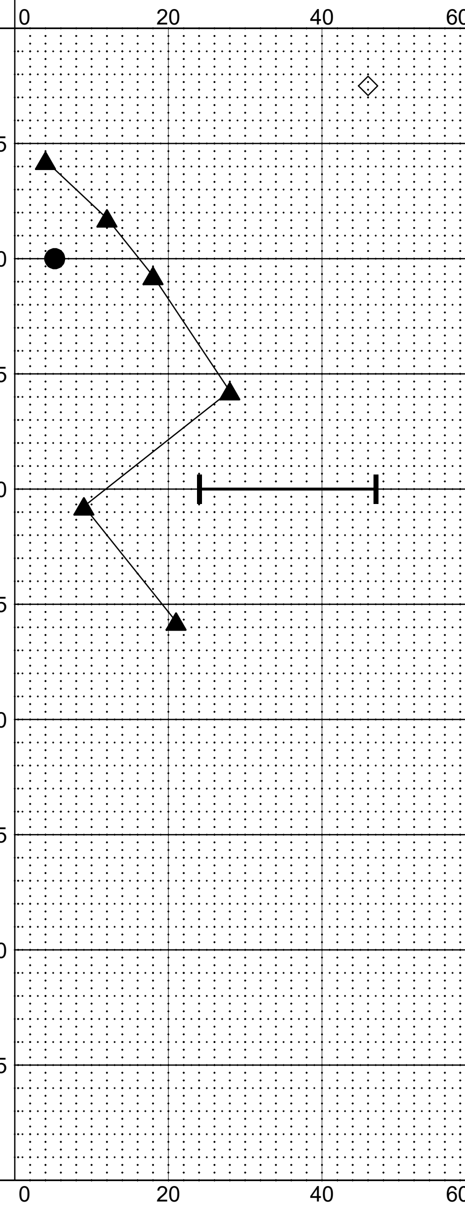
MASTER_LOG_E_MC 51-1-10240-012 1.GPJ SHAN_WIL.GDT 8/26/20

Total Depth:	*26.5 ft.*	Latitude:	*34.13037 °*	Drilling Method:	*Hollow Stem Auger*	Hole Diam.:	*8 in.*
Top Elevation:	*~ 1153 ft.*	Longitude:	*-117.3054 °*	Drilling Company:	*2R Drilling*	Rod Diam.:	*-*
Vert. Datum:	*NAVD88*	Station:	*N/A*	Drill Rig Equipment:	*CME 75*	Hammer Type:	*Automatic*
Horiz. Datum:	*WGS84*	Offset:	*N/A*	Other Comments:			

Elevation, ft.	SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.*	Depth, ft.	Symbol	PID, ppm	Samples	Ground Water
	Dark brown, *Silty Sand (SM)*; moist; fine sand; trace fine gravel. **Artifical Fill (Af)**			8	1	
1148.0	Medium dense, light brown, *Poorly Graded Sand with Silt (SP-SM);* moist; fine to medium sand. **Alluvium (Qa)**	5.0		0 3.7 2.3	2 3 4	
1140.0	Medium dense, gray-brown, *Poorly Graded Sand (SP);* moist; fine to coarse sand; trace fine gravel; contains small pockets of silt/clay.	13.0		0.3	5	
1135.0	Stiff, olive-brown to brown, *Lean Clay (CL);* moist; low to medium plasticity.	18.0		0	6	
1131.0	Medium dense, gray-brown, *Poorly Graded Sand (SP)*; moist.	22.0		0	7	
1126.5	BOTTOM OF BORING NO GROUNDWATER ENCOUNTERED COMPLETED 4/8/2019	26.5				

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



Plastic Limit ⊢●⊣ Liquid Limit
Natural Water Content
◇ % Fines (<0.075mm)
● % Water Content

LEGEND

* Sample Not Recovered

G Grab Sample

I 2.0" O.D. Split Spoon Sample

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

Ono Lead Track Extension
BNSF Railway
San Bernardino, California

LOG OF BORING B-04

February 2021 51-1-10240-012

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-5

REV 3

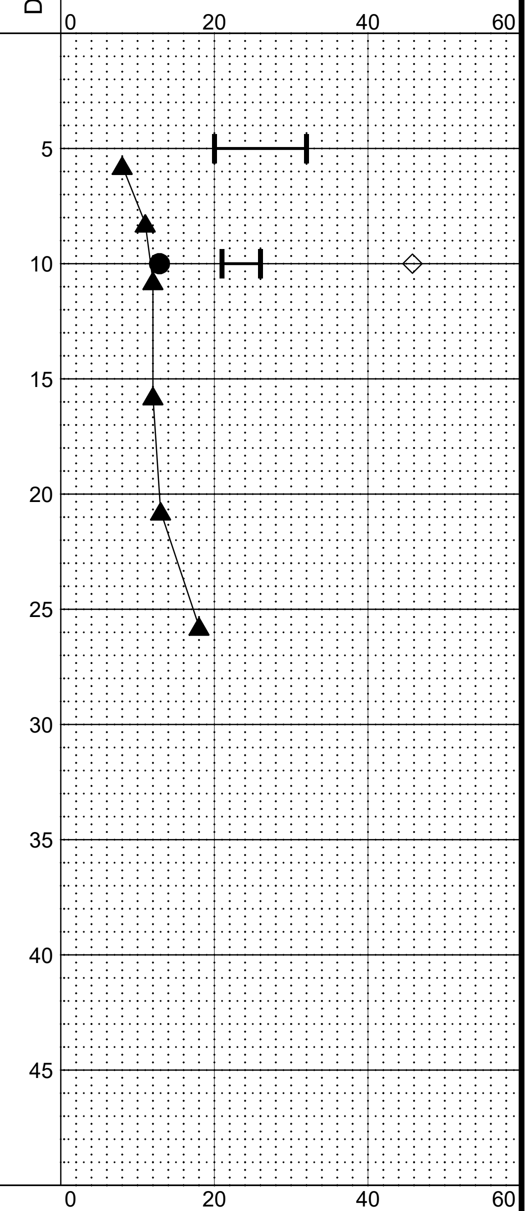
MASTER_LOG_E_MC 51-1-10240-012 1.GPJ SHAN_WIL.GDT 8/26/20

Log: BPT Rev: LAM Typ: KXR

Total Depth:	26.5 ft.	Latitude:	34.12851 °	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation:	~ 1145 ft.	Longitude:	-117.3040 °	Drilling Company:	2R Drilling	Rod Diam.:	-
Vert. Datum:	NAVD88	Station:	N/A	Drill Rig Equipment:	CME 75	Hammer Type:	Automatic
Horiz. Datum:	WGS84	Offset:	N/A	Other Comments:			

Elevation, ft.	SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.*	Depth, ft.	Symbol	PID, ppm	Samples	Ground Water
	Dark brown, *Silty Sand (SM)*; moist; fine sand; trace fine gravel. **Artificial Fill (af)**					
1141.0	Medium stiff to stiff, dark brown, *Sandy Lean Clay (CL);* moist; low to medium plasticity. **Alluvium (Qa)**	4.0		1.3	1	
1138.0	Medium dense, brown, *Silty to Clayey Sand (SC-SM);* moist; fine to medium sand.	7.0		0.2 0	2 3	
1130.0	Stiff, olive-brown to gray-brown, *Sandy Clay (CL);* moist; low to medium plasticity; fine sand.	15.0		0.2	4	
1127.0	Medium dense, gray-brown to brown, *Poorly Graded Sand with Silt (SP-SM);* moist; fine sand.	18.0		0 0	5 6	
1118.5	BOTTOM OF BORING NO GROUNDWATER ENCOUNTERED COMPLETED 4/8/2019	26.5				

PENETRATION RESISTANCE (blows/foot)
▲ Hammer Wt. & Drop: 140 lbs / 30 inches



Plastic Limit ├──●──┤ Liquid Limit
Natural Water Content
◇ % Fines (<0.075mm)
● % Water Content

LEGEND
* Sample Not Recovered
⌶ 2.0" O.D. Split Spoon Sample

NOTES
1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

Ono Lead Track Extension
BNSF Railway
San Bernardino, California

LOG OF BORING B-05

February 2021 | 51-1-10240-012

SHANNON & WILSON, INC.
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FIG. A-6

REV 3

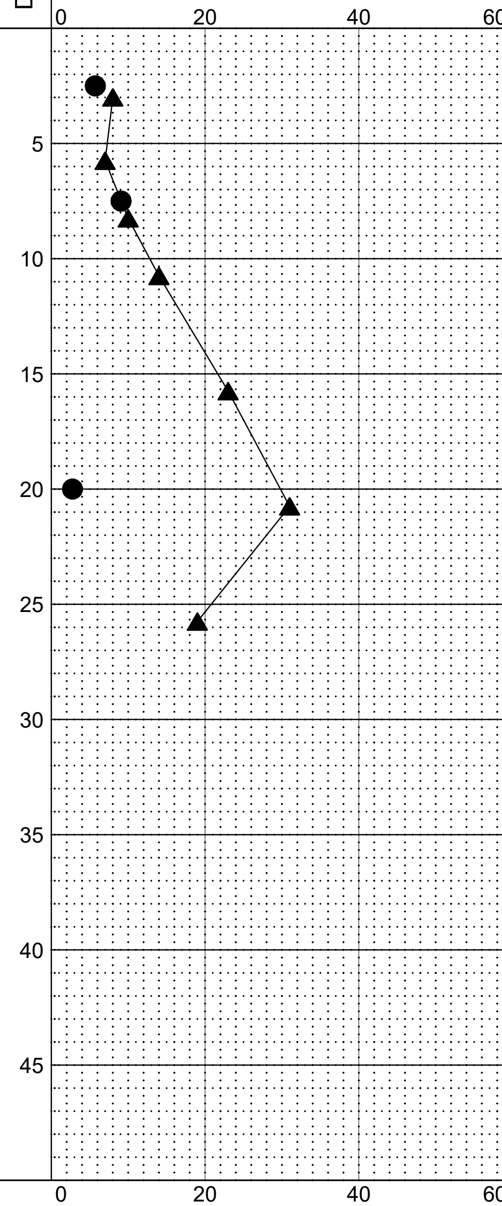
Log: BPT Rev: LAM Typ: KXR
MASTER_LOG_E_MC 51-1-10240-012 1.GPJ SHAN_WIL.GDT 8/26/20

Total Depth: 26.5 ft.	Latitude: 34.13255 °	Drilling Method: Hollow Stem Auger	Hole Diam.: 8 in.
Top Elevation: ~ 1170 ft.	Longitude: -117.3086 °	Drilling Company: 2R Drilling	Rod Diam.: -
Vert. Datum: NAVD88	Station: N/A	Drill Rig Equipment: CME 75	Hammer Type: Automatic
Horiz. Datum: WGS84	Offset: N/A	Other Comments:	

Elevation, ft.	SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.*	Depth, ft.	Symbol	PID, ppm	Samples
	Brown, *Silty Sand (SM)*; moist; fine sand. **Artificial Fill (af)**			0.7	S-1
1166.5	Medium dense, light brown, *Silty Sand (SM)*; moist; medium to coarse sand; trace fine gravel. **Alluvium (Qa)**	3.5		1.8 3 0.3	S-2 S-3 S-4
1158.5	Medium dense, light gray-brown, *Poorly Graded Sand with Silt (SP-SM)*; moist; medium to coarse sand; fine gravel.	11.5		1.1	S-5
1150.0	Medium dense to dense, light gray brown, *Poorly Graded Sand (SP)*; moist; medium to coarse sand; fine gravel.	20.0		1.8 4.2	S-6 S-7
1143.5	BOTTOM OF BORING NO GROUNDWATER ENCOUNTERED COMPLETED 4/9/2019	26.5			

Ground Water

PENETRATION RESISTANCE (blows/foot)
▲ Hammer Wt. & Drop: 140 lbs / 30 inches



LEGEND
* Sample Not Recovered
⌶ 2.0" O.D. Split Spoon Sample

NOTES
1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

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San Bernardino, California

LOG OF BORING B-06

February 2021 51-1-10240-012

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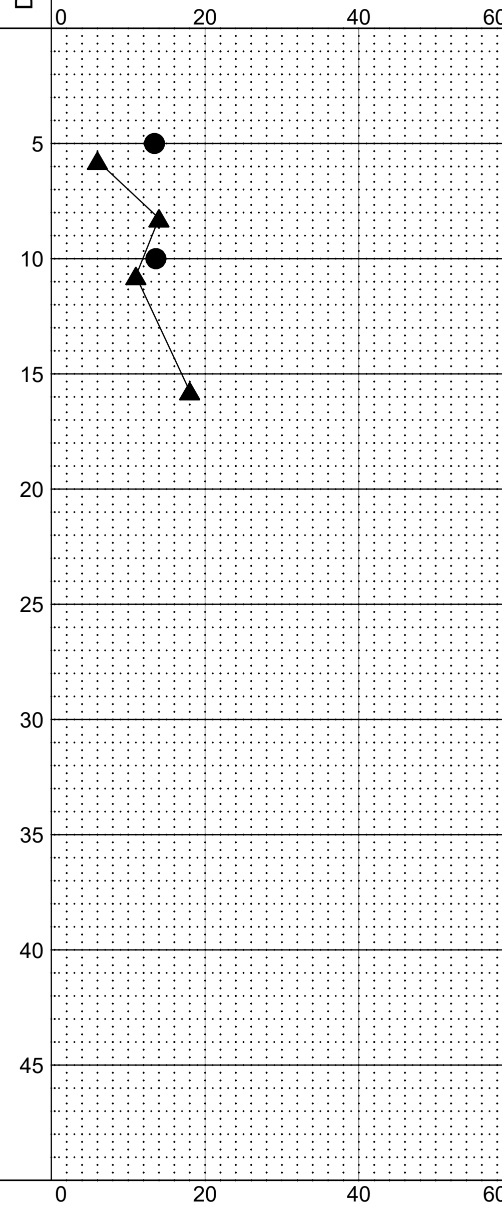
FIG. A-7

REV 3

Total Depth:	16.5 ft.	Latitude:	34.12774 °	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation:	~ 1141 ft.	Longitude:	-117.3038 °	Drilling Company:	2R Drilling	Rod Diam.:	-
Vert. Datum:	NAVD88	Station:	N/A	Drill Rig Equipment:	CME 75	Hammer Type:	Automatic
Horiz. Datum:	WGS84	Offset:	N/A	Other Comments:			

Elevation, ft.	SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.*	Depth, ft.	PID, ppm	Samples
1140.7	Asphalt concrete (3.5 inches)	0.3		
	Brown, *Silty Sand (SM)*; moist; fine sand. **Artificial Fill (af)**		0.1	1 (Grab)
1136.0	Loose, gray-brown, *Silty Sand (SM)*; moist; fine sand. **Alluvium (Qa)**	5.0	0	2
1134.0	Medium dense, brown, *Silty Sand (SM)*; moist; fine to medium sand.	7.0	3.3	3
			7	4
1126.0	Medium dense, light gray-brown, *Poorly Graded Sand (SP)*; moist; medium sand; trace fine gravel.	15.0	5.2	5
1124.5	BOTTOM OF BORING NO GROUNDWATER ENCOUNTERED COMPLETED 4/18/2019	16.5		

PENETRATION RESISTANCE (blows/foot)
▲ Hammer Wt. & Drop: 140 lbs / 30 inches



◇ % Fines (<0.075mm)
● % Water Content

LEGEND

* Sample Not Recovered
G Grab Sample
⌶ 2.0" O.D. Split Spoon Sample

NOTES
1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

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FIG. A-8

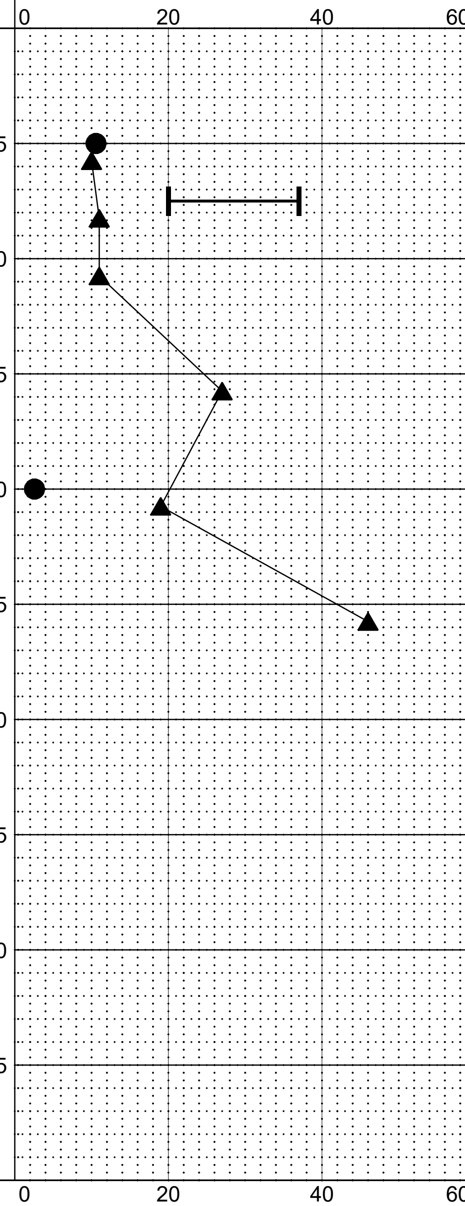
REV 3

Total Depth:	26.5 ft.	Latitude:	34.12685 °	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation:	~ 1139 ft.	Longitude:	-117.3036 °	Drilling Company:	2R Drilling	Rod Diam.:	-
Vert. Datum:	NAVD88	Station:	N/A	Drill Rig Equipment:	CME 75	Hammer Type:	Automatic
Horiz. Datum:	WGS84	Offset:	N/A	Other Comments:			

Elevation, ft.	SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.*	Depth, ft.	PID, ppm	Samples
1138.8	Asphalt concrete (3 inches)	0.3		
	Brown, *Silty Sand (SM)*; moist; fine sand. **Artificial Fill (af)**		0 0.3	1 (G) 2
1132.5	Stiff, dark brown, *Sandy Lean Clay (CL)*; moist; low to medium plasticity; fine to medium sand. **Alluvium (Qa)**	6.5	0.1	3
1129.0	Medium dense, *Silty Sand (SM)*; moist; fine to medium sand.	10.0	4.6 12.2	4 5
1119.0	Medium dense to dense, *Poorly Graded Sand with Gravel (SP)*; moist; fine to coarse sand; fine gravel.	20.0	7.5 1.4	6 7
1112.5	BOTTOM OF BORING NO GROUNDWATER ENCOUNTERED COMPLETED 4/18/2019	26.5		

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: 140 lbs / 30 inches



Plastic Limit ├──●──┤ Liquid Limit
Natural Water Content
◇ % Fines (<0.075mm)
● % Water Content

LEGEND

* Sample Not Recovered

G Grab Sample

2.0" O.D. Split Spoon Sample

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

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BNSF Railway
San Bernardino, California

LOG OF BORING B-08

February 2021 51-1-10240-012

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FIG. A-9

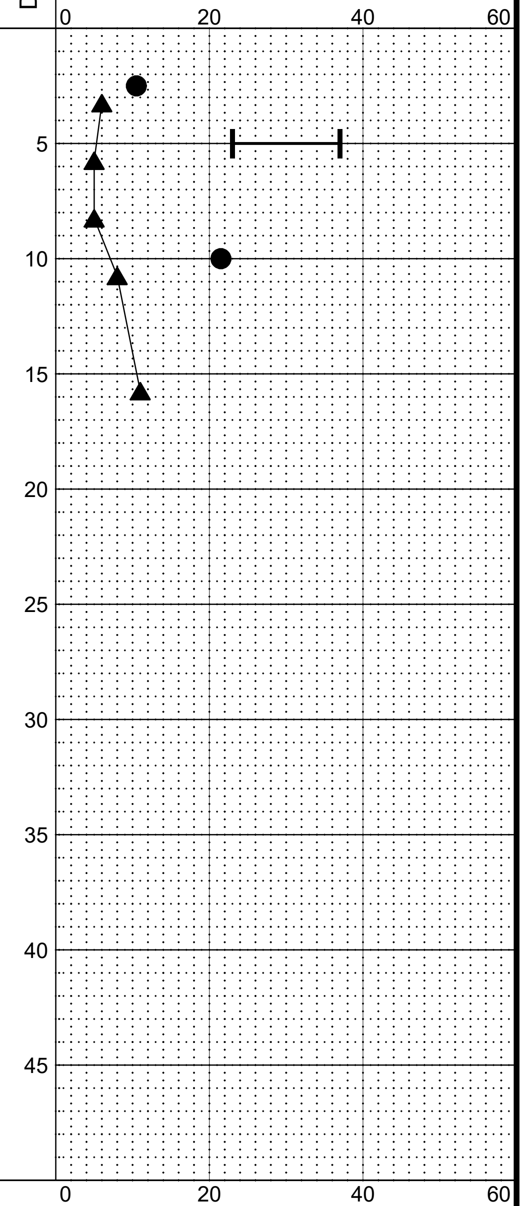
REV 3

Total Depth:	*16.5 ft.*	Latitude:	*34.12596 °*	Drilling Method:	*Hollow Stem Auger*	Hole Diam.:	*8 in.*
Top Elevation:	*~ 1136 ft.*	Longitude:	*-117.3035 °*	Drilling Company:	*2R Drilling*	Rod Diam.:	*-*
Vert. Datum:	*NAVD88*	Station:	*N/A*	Drill Rig Equipment:	*CME 75*	Hammer Type:	*Automatic*
Horiz. Datum:	*WGS84*	Offset:	*N/A*	Other Comments:			

Elevation, ft.	**SOIL DESCRIPTION** *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.*	Depth, ft.	Symbol	PID, ppm	Samples	Ground Water
1135.8	Asphalt concrete (3 inches)	0.3				
	Brown, *Silty Sand (SM)*; moist; fine sand. **Artificial Fill (af)**			1.1	1	
1132.0	Medium stiff, brown to dark brown, *Sandy Lean Clay (CL)*; moist; low to medium plasticity; fine to medium sand. **Alluvium (Qa)**	4.0		2.6	2	
				7.2	3	
				3.1	4	
1121.0	Medium dense, yellow-brown, *Silty Sand (SM)*; moist.	15.0		9.4	5	
1119.5	BOTTOM OF BORING NO GROUNDWATER ENCOUNTERED COMPLETED 4/18/2019	16.5				

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

* Sample Not Recovered

2.0" O.D. Split Spoon Sample

Plastic Limit Liquid Limit

Natural Water Content

◇ % Fines (<0.075mm)

● % Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

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LOG OF BORING B-09

February 2021 51-1-10240-012

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FIG. A-10

REV 3

Log: KXR Rev: LAM Typ: KXR

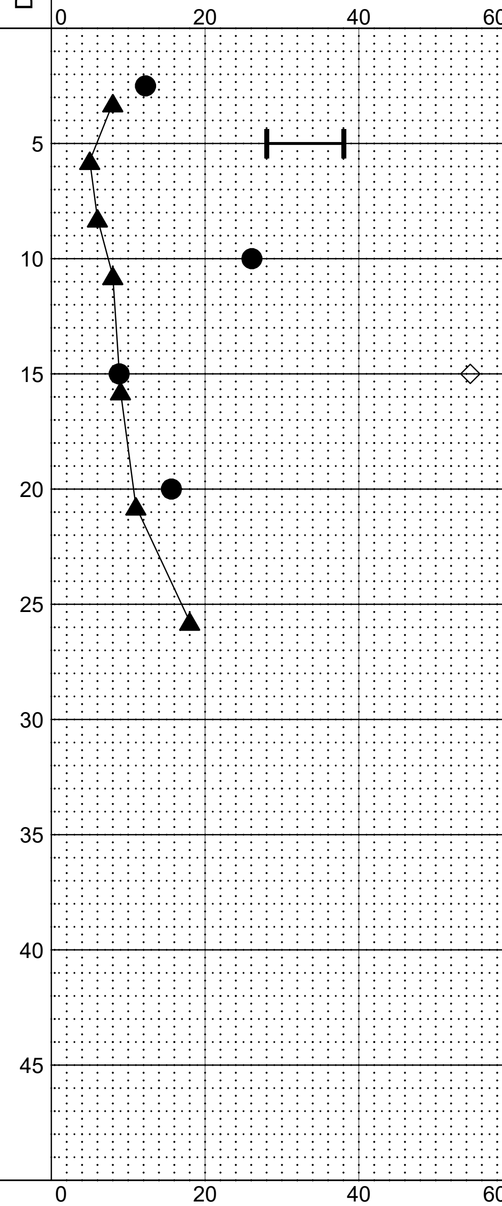
MASTER_LOG_E_MC 51-1-10240-012 1.GPJ SHAN_WIL.GDT 8/26/20

Total Depth: *26.5 ft.*	Latitude: *34.12492 °*	Drilling Method: *Hollow Stem Auger*	Hole Diam.: *8 in.*
Top Elevation: *~ 1135 ft.*	Longitude: *-117.3034 °*	Drilling Company: *2R Drilling*	Rod Diam.: *-*
Vert. Datum: *NAVD88*	Station: *N/A*	Drill Rig Equipment: *CME 75*	Hammer Type: *Automatic*
Horiz. Datum: *WGS84*	Offset: *N/A*	Other Comments:	

Elevation, ft.	SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.*	Depth, ft.	Symbol	PID, ppm	Samples	Ground Water
1134.8	Asphalt concrete (3 inches)	0.3				
	Brown, *Silty Sand (SM)*; moist; fine to coarse sand. **Artificial Fill (af)**			0.3	1	
1131.0	Loose, brown to red-brown, *Sandy Silt (ML)*; moist; fine sand. **Alluvium (Qa)**	4.0		4.2	2	
1127.5	Medium stiff, dark brown, *Sandy Lean Clay (CL)*; moist; low to medium plasticity; fine sand.	7.5		3.1 2.2	3 4	
1120.0	Stiff, dark brown to red-brown, *Sandy Lean Clay (CL)*; moist; low to medium plasticity; fine sand.	15.0		1.7 4.9	5 6	
1110.0	Medium dense, brown, *Poorly Graded Sand (SP)*; moist; fine to medium sand.	25.0		7.2	7	
1108.5	BOTTOM OF BORING NO GROUNDWATER ENCOUNTERED COMPLETED 4/18/2019	26.5				

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

* Sample Not Recovered

2.0" O.D. Split Spoon Sample

Plastic Limit — Liquid Limit

Natural Water Content

◇ % Fines (<0.075mm)

● % Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

Ono Lead Track Extension
BNSF Railway
San Bernardino, California

LOG OF BORING B-10

February 2021 51-1-10240-012

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FIG. A-11

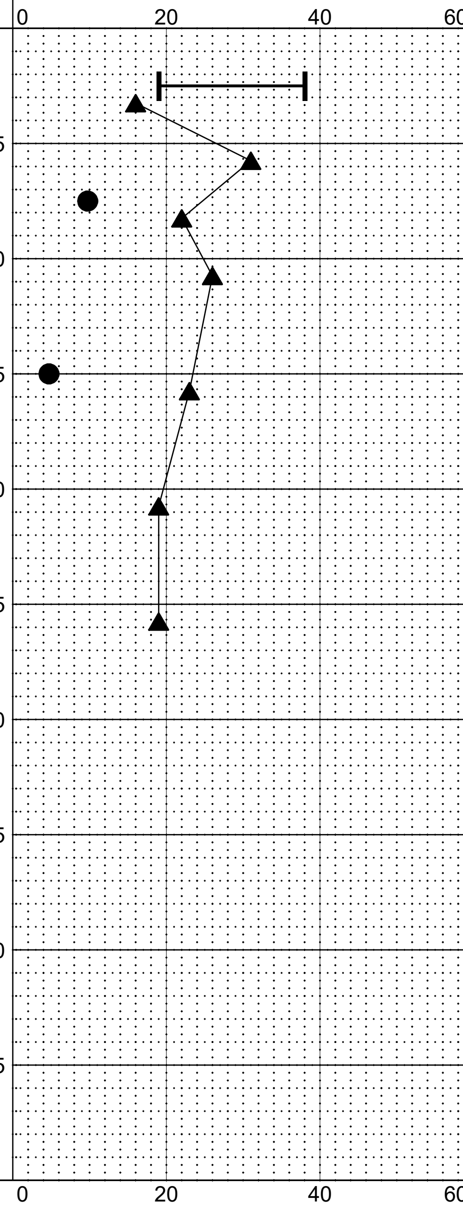
REV 3

Total Depth:	26.5 ft.	Latitude:	34.12126 °	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation:	~ 1122 ft.	Longitude:	-117.3033 °	Drilling Company:	2R Drilling	Rod Diam.:	-
Vert. Datum:	NAVD88	Station:	N/A	Drill Rig Equipment:	CME 75	Hammer Type:	Automatic
Horiz. Datum:	WGS84	Offset:	N/A	Other Comments:			

Elevation, ft.	SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.*	Depth, ft.	Symbol	PID, ppm	Samples	Ground Water
1121.6	Asphalt concrete (5 inches)	0.4				
1121.0	Aggregate base (7 inches)	1.0				
	Very stiff to hard, dark brown to light gray-brown, *Sandy Lean Clay (CL)*; moist to dry; fine to medium sand; trace organics. **Alluvium (Qa)**			0 0.3 2.8	1 2 3	
1112.0	Medium dense, brown to gray-brown, *Poorly Graded Sand with Silt (SP-SM)*; dry to moist; fine sand.	10.0		7.2 5 1.1 1	4 5 6 7	
1095.5	BOTTOM OF BORING NO GROUNDWATER ENCOUNTERED COMPLETED 4/19/2019	26.5				

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: 140 lbs / 30 inches



LEGEND

* Sample Not Recovered

2.0" O.D. Split Spoon Sample

Plastic Limit ├─●─┤ Liquid Limit

Natural Water Content

◇ % Fines (<0.075mm)

● % Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

Ono Lead Track Extension
BNSF Railway
San Bernardino, California

LOG OF BORING B-11

February 2021 51-1-10240-012

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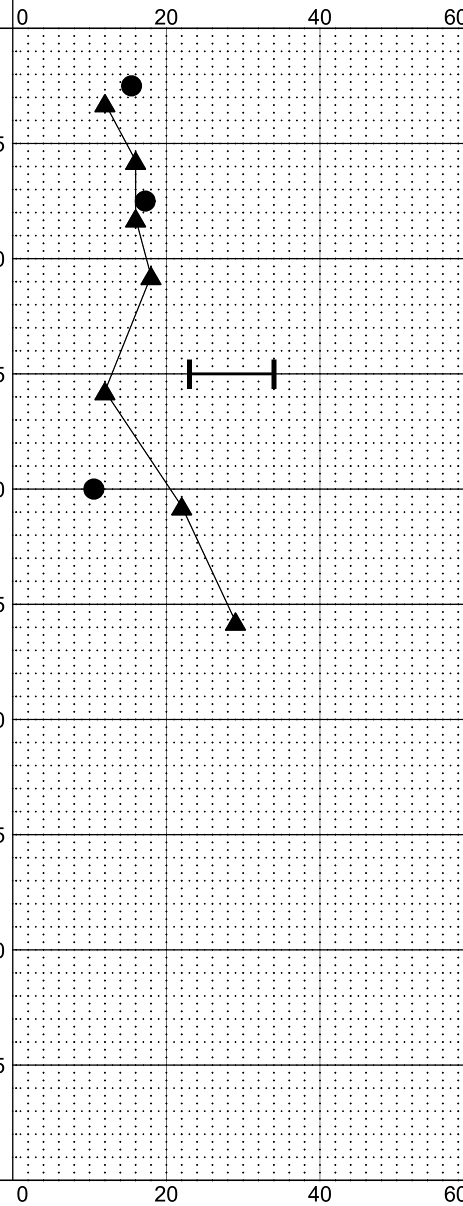
FIG. A-12

REV 3

Total Depth: 26.5 ft.	Latitude: 34.11941 °	Drilling Method: Hollow Stem Auger	Hole Diam.: 8 in.
Top Elevation: ~ 1117 ft.	Longitude: -117.3033 °	Drilling Company: 2R Drilling	Rod Diam.: -
Vert. Datum: NAVD88	Station: N/A	Drill Rig Equipment: CME 75	Hammer Type: Automatic
Horiz. Datum: WGS84	Offset: N/A	Other Comments:	

Elevation, ft.	SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.*	Depth, ft.	Symbol	PID, ppm	Samples	Ground Water
1116.7	Asphalt concrete (4 inches)	0.3				
	Stiff, yellow-brown, *Lean Clay with Sand (CL)*; moist; fine sand; trace silt. **Alluvium (Qa)**			0.1	1	
1112.0	Very stiff, dark brown to brown, *Sandy Lean Clay (CL)*; moist; fine to medium sand.	5.0		0 0.3	2 3	
1107.0	Medium dense, brown, *Silty Sand (SM)*; moist; fine to medium sand.	10.0		1.2	4	
1102.0	Stiff, dark brown, *Sandy Lean Clay (CL)*; moist; fine sand.	15.0		3	5	
1097.0	Medium dense, brown, *Silty Sand (SM)*; moist; fine sand.	20.0		0.2	6	
1092.0	Medium dense, gray-brown, *Poorly Graded Sand with Silt (SP-SM)*; moist; fine to medium sand.	25.0		0.1	7	
1090.5	BOTTOM OF BORING NO GROUNDWATER ENCOUNTERED COMPLETED 4/19/2019	26.5				

PENETRATION RESISTANCE (blows/foot)
▲ Hammer Wt. & Drop: 140 lbs / 30 inches



LEGEND
* Sample Not Recovered
2.0" O.D. Split Spoon Sample

Plastic Limit — Natural Water Content — Liquid Limit
◇ % Fines (<0.075mm)
● % Water Content

NOTES
1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

Ono Lead Track Extension
BNSF Railway
San Bernardino, California

LOG OF BORING B-12

February 2021 51-1-10240-012

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FIG. A-13

REV 3

Total Depth:	16.5 ft.	Latitude:	34.11845 °	Drilling Method:	Hollow Stem Auger
Top Elevation:	~ 1113 ft.	Longitude:	-117.3033 °	Drilling Company:	2R Drilling
Vert. Datum:	NAVD88	Station:	N/A	Drill Rig Equipment:	CME 75
Horiz. Datum:	WGS84	Offset:	N/A	Other Comments:	

Hole Diam.:	8 in.
Rod Diam.:	-
Hammer Type:	Automatic

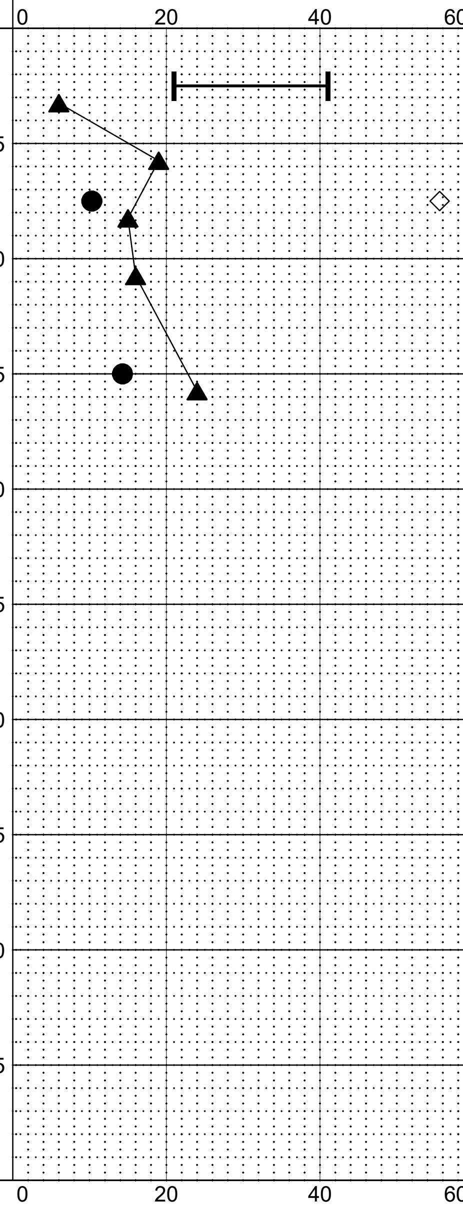
Elevation, ft.	SOIL DESCRIPTION	Depth, ft.	PID, ppm	Samples
1112.8	Asphalt concrete (3 inches)	0.3		
	Medium stiff, dark brown, *Lean Clay with Sand (CL)*; moist; low to medium plasticity; fine sand. **Alluvium (Qa)**		1.2	1
1108.0	Very stiff, yellow-brown to brown, *Sandy Lean Clay (CL)*; moist; low to medium plasticity; fine to medium sand.	5.0	3 0.3	2 3
1103.0	Medium dense, brown, *Silty Sand (SM)*; moist; fine sand.	10.0	0.1	4
1098.0	Very stiff, yellow-brown, *Sandy Lean Clay (CL)*; moist; low to medium plasticity; fine to medium sand.	15.0	1.1	5
1096.5		16.5		

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.

BOTTOM OF BORING
NO GROUNDWATER ENCOUNTERED
COMPLETED 4/19/2019

Symbol | Ground Water | Depth, ft.

PENETRATION RESISTANCE (blows/foot)
▲ Hammer Wt. & Drop: 140 lbs / 30 inches



LEGEND
* Sample Not Recovered
2.0" O.D. Split Spoon Sample

Plastic Limit —●— Liquid Limit
Natural Water Content
◇ % Fines (<0.075mm)
● % Water Content

NOTES
1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

Ono Lead Track Extension
BNSF Railway
San Bernardino, California

LOG OF BORING B-13

February 2021 51-1-10240-012

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-14

REV 3

Total Depth:	26.5 ft.	Latitude:	34.11772 °	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation:	~ 1111 ft.	Longitude:	-117.3033 °	Drilling Company:	2R Drilling	Rod Diam.:	-
Vert. Datum:	NAVD88	Station:	N/A	Drill Rig Equipment:	CME 75	Hammer Type:	Automatic
Horiz. Datum:	WGS84	Offset:	N/A	Other Comments:			

SOIL DESCRIPTION

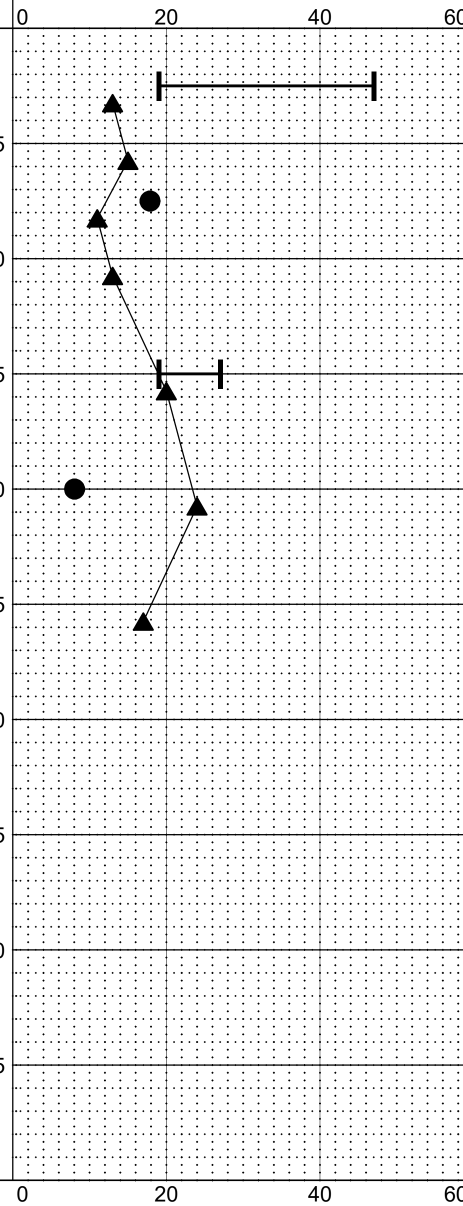
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.

Elevation, ft.	Soil Description	Depth, ft.	PID, ppm	Samples
1110.8	Asphalt concrete (3 inches)	0.3		
1108.5	Loose, yellow-brown, *Poorly Graded Sand (SP)*; moist; fine to coarse sand. **Alluvium (Qa)**	2.5	0.1	1
1106.0	Stiff, dark brown, *Sandy Lean Clay (CL)*; medium plasticity; fine sand.	5.0	0	2
	Stiff to very stiff, yellow-brown to brown, *Sandy Lean Clay (CL)*; moist; low to medium plasticity, fine to medium sand.		0.3	3
			1.2	4
			1	5
1091.0	Medium dense, brown, *Poorly Graded Sand (SP)*; moist; fine to coarse sand.	20.0	0.3	6
			1.1	7
1084.5	BOTTOM OF BORING NO GROUNDWATER ENCOUNTERED COMPLETED 4/22/2019	26.5		

Symbol | Ground Water | Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: 140 lbs / 30 inches



Plastic Limit ├──●──┤ Liquid Limit ◇ % Fines (<0.075mm)
Natural Water Content ● % Water Content

LEGEND

* Sample Not Recovered

⌶ 2.0" O.D. Split Spoon Sample

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

Ono Lead Track Extension
BNSF Railway
San Bernardino, California

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SHANNON & WILSON, INC.
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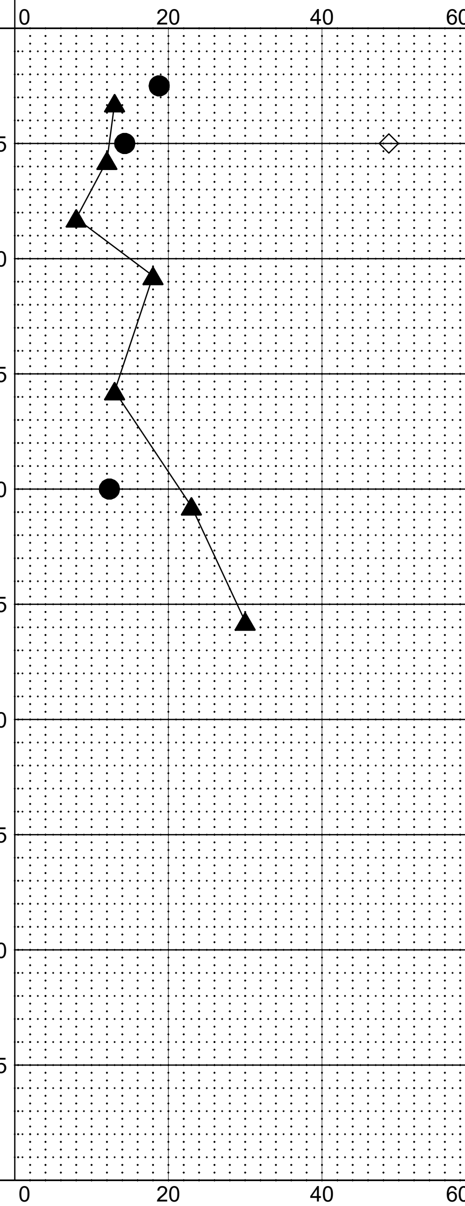
FIG. A-15

REV 3

Total Depth:	26.5 ft.	Latitude:	34.11636 °	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation:	~ 1106 ft.	Longitude:	-117.3039 °	Drilling Company:	2R Drilling	Rod Diam.:	-
Vert. Datum:	NAVD88	Station:	N/A	Drill Rig Equipment:	CME 75	Hammer Type:	Automatic
Horiz. Datum:	WGS84	Offset:	N/A	Other Comments:			

Elevation, ft.	SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.*	Depth, ft.	Symbol	PID, ppm	Samples	Ground Water
1105.9	Asphalt concrete (1.5 inches)	0.1				
	Stiff, dark brown, *Sandy Lean Clay (CL)*; moist; low to medium plasticity; fine sand. **Alluvium (Qa)**			3.2	1	
1101.0	Loose to medium dense, yellow-brown, *Clayey Sand (SC)*; moist; fine to medium sand.	5.0		1.6 2.2	2 3	
1096.0	Medium dense, yellow-brown, *Silty Sand (SM)*; moist; fine to medium sand.	10.0		0.3	4	
1091.0	Medium dense, brown, *Silty Sand (SM)*;; moist; fine sand.	15.0		0 1.1	5 6	
1081.0	Dense, brown, *Well Graded Sand (SW)*; moist; medium sand.	25.0		0.1	7	
1079.5	BOTTOM OF BORING NO GROUNDWATER ENCOUNTERED COMPLETED 4/22/2019	26.5				

PENETRATION RESISTANCE (blows/foot)
▲ Hammer Wt. & Drop: 140 lbs / 30 inches



◇ % Fines (<0.075mm)
● % Water Content

LEGEND

* Sample Not Recovered
⌶ 2.0" O.D. Split Spoon Sample

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

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LOG OF BORING B-15

February 2021 | 51-1-10240-012

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FIG. A-16

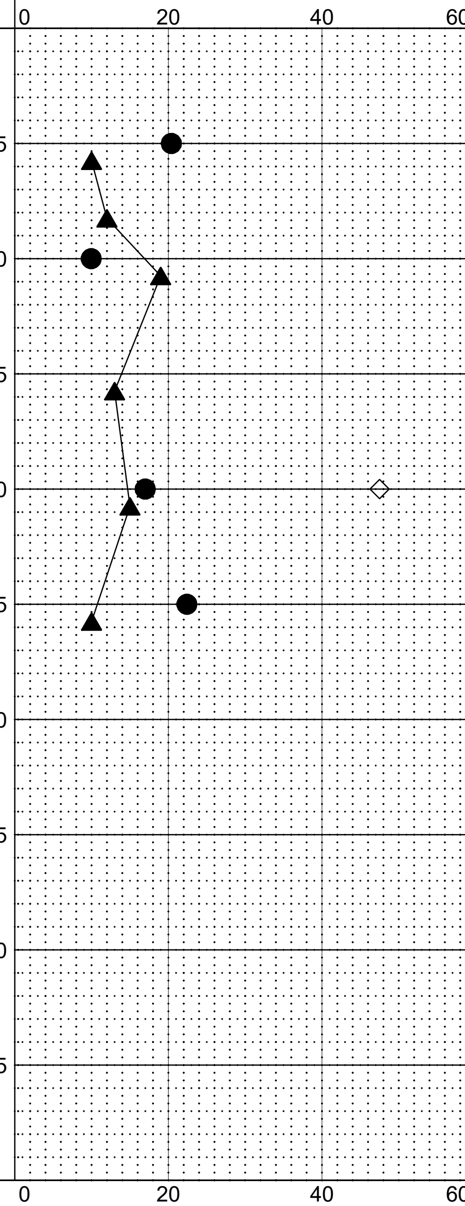
REV 3

Total Depth:	26.5 ft.	Latitude:	34.11393 °	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation:	~ 1101 ft.	Longitude:	-117.3033 °	Drilling Company:	2R Drilling	Rod Diam.:	-
Vert. Datum:	NAVD88	Station:	N/A	Drill Rig Equipment:	CME 75	Hammer Type:	Automatic
Horiz. Datum:	WGS84	Offset:	N/A	Other Comments:			

Elevation, ft.	SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.*	Depth, ft.	PID, ppm	Samples
1100.7	Asphalt concrete (4 inches)	0.3		
1100.5	Concrete block (2.5 inches)	0.5		
	Dark brown, *Sandy Lean Clay (CL)*; moist; fine to medium sand.		2.1	1 (G)
1096.0	**Alluvium (Qa)**	5.0		
	Stiff, dark brown to brown, *Sandy Lean Clay (CL)*; moist; low to medium plasticity; fine to coarse sand; trace fine gravel.		1.3	2
			1.1	3
1091.0	Medium dense, brown, *Silty Sand (SM)*; moist; fine to medium sand.	10.0	0.3	4
1086.0	Stiff, yellow-brown to brown, *Sandy Lean Clay (CL)*; moist; low to medium plasticity; fine sand.	15.0	0	5
1081.0	Medium dense, yellow-brown to brown, *Silty Sand (SM)*; moist; fine sand.	20.0	0.1	6
			0	7
1074.5	BOTTOM OF BORING NO GROUNDWATER ENCOUNTERED COMPLETED 4/22/2019	26.5		

Symbol | Ground Water | Depth, ft.

PENETRATION RESISTANCE (blows/foot)
▲ Hammer Wt. & Drop: 140 lbs / 30 inches



◇ % Fines (<0.075mm)
● % Water Content

LEGEND
* Sample Not Recovered
G Grab Sample
2.0" O.D. Split Spoon Sample

NOTES
1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

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FIG. A-17

REV 3

MASTER_LOG_E_MC 51-1-10240-012 1.GPJ SHAN_WIL.GDT 8/26/20 *Log: KXR* *Rev: LAM* *Typ: KXR*

Total Depth:	26.5 ft.	Latitude:	34.12232 °	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation:	~ 1129 ft.	Longitude:	-117.3045 °	Drilling Company:	2R Drilling	Rod Diam.:	-
Vert. Datum:	NAVD88	Station:	N/A	Drill Rig Equipment:	CME 75	Hammer Type:	Automatic
Horiz. Datum:	WGS84	Offset:	N/A	Other Comments:			

SOIL DESCRIPTION

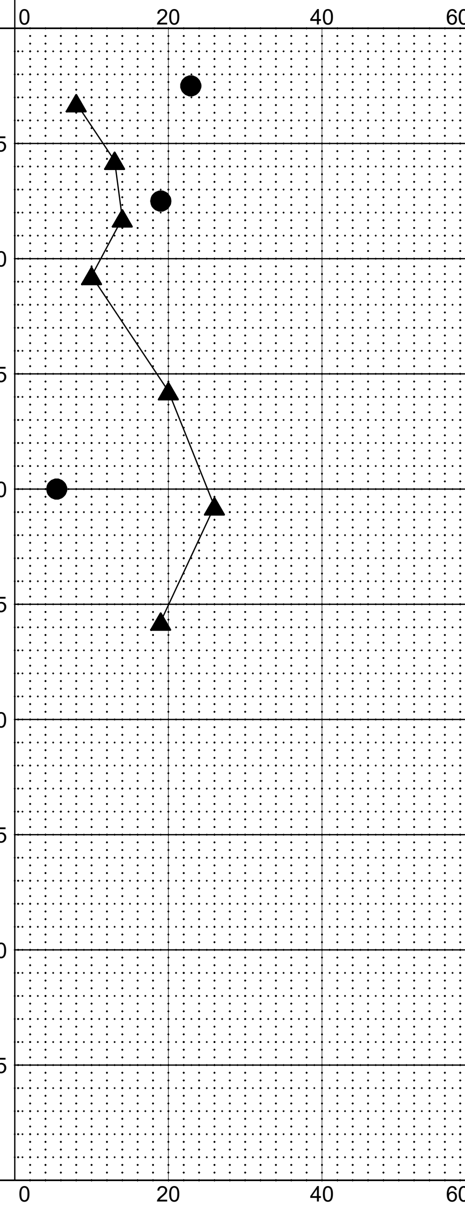
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.

Elevation, ft.	Soil Description	Depth, ft.
1128.6	Asphalt concrete (5 inches)	0.4
1126.5	Loose, dark brown, *Clayey Sand (SC)*; moist; medium sand. **Artificial Fill (af)**	2.5
1119.0	Medium stiff to stiff, dark brown to brown, *Sandy Lean Clay (CL)*; moist; low to medium plasticity; fine to medium sand. **Alluvium (Qa)**	10.0
1109.0	Medium dense, yellow-brown, *Silty Sand (SM)*; moist; fine sand.	20.0
1102.5	Medium dense, yellow-brown to gray-brown, *Poorly Graded Sand with Silt (SP-SM)*; moist; fine sand.	26.5
	BOTTOM OF BORING NO GROUNDWATER ENCOUNTERED COMPLETED 4/23/2019	

Samples	PID, ppm
1	0.6
2	0.1
3	1.1
4	0
5	0.1
6	3.2
7	0

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: 140 lbs / 30 inches



◇ % Fines (<0.075mm)
● % Water Content

LEGEND

* Sample Not Recovered
⌶ 2.0" O.D. Split Spoon Sample

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

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FIG. A-18

REV 3

Total Depth:	*26.5 ft.*	Latitude:	*34.11210 °*	Drilling Method:	*Hollow Stem Auger*	Hole Diam.:	*8 in.*
Top Elevation:	*~ 1092 ft.*	Longitude:	*-117.3035 °*	Drilling Company:	*2R Drilling*	Rod Diam.:	*-*
Vert. Datum:	*NAVD88*	Station:	*N/A*	Drill Rig Equipment:	*CME 75*	Hammer Type:	*Automatic*
Horiz. Datum:	*WGS84*	Offset:	*N/A*	Other Comments:			

SOIL DESCRIPTION

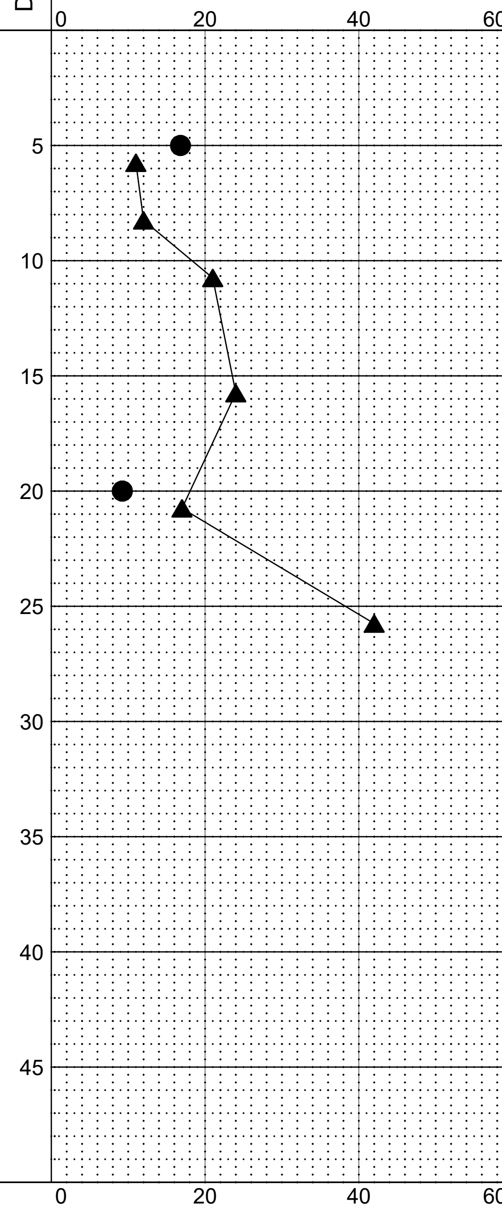
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.

Elevation, ft.	Soil Description	Depth, ft.	PID, ppm	Samples	Ground Water
1091.6	Asphalt concrete (5 inches)	0.4			
	Dark brown to brown, *Sandy Lean Clay (CL)*; moist. **Alluvium (Qa)**		4.2	1 (G)	
1087.0	Stiff, dark brown, *Sandy Lean Clay (CL)*; moist; low to medium plasticity; fine to medium sand.	5.0	7.1	2	
			3	3	
1082.0	Medium dense, yellow-brown to brown, *Silty Sand (SM)*; moist; fine sand.	10.0	0	4	
			0.1	5	
			3.3	6	
1067.0	Dense, light brown, *Poorly Graded Sand with Silt (SP-SM)*; moist; fine to medium sand.	25.0	0.1	7	
1065.5		26.5			

BOTTOM OF BORING
NO GROUNDWATER ENCOUNTERED
COMPLETED 4/23/2019

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

* Sample Not Recovered
G Grab Sample
2.0" O.D. Split Spoon Sample

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

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LOG OF BORING B-18

February 2021 51-1-10240-012

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FIG. A-19

REV 3

Log: KXR Rev: LAM Typ: KXR

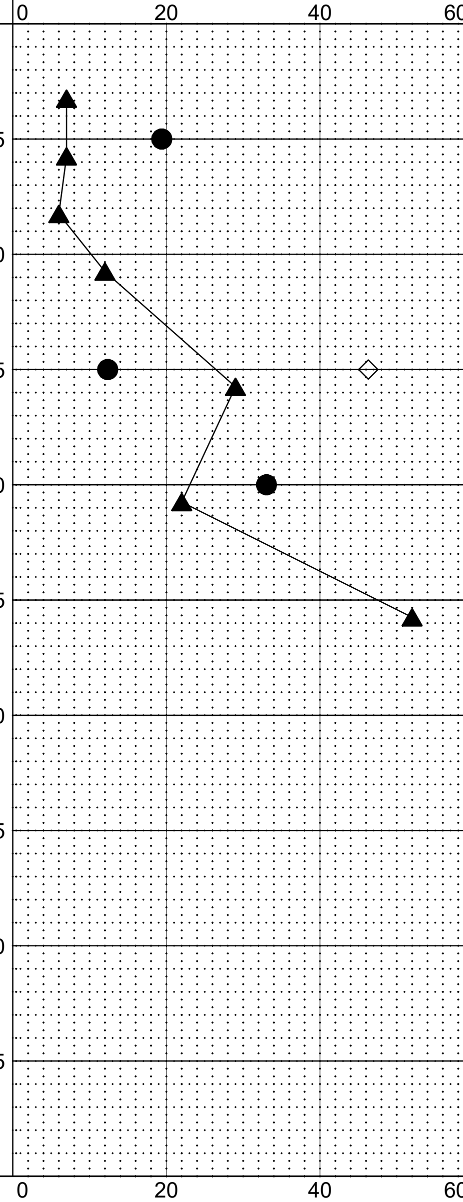
MASTER_LOG_E_MC 51-1-10240-012 1.GPJ SHAN_WIL.GDT 8/26/20

Total Depth: 26.5 ft.	Latitude: 34.11016 °	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation: ~ 1087 ft.	Longitude: -117.3034 °	Drilling Company:	2R Drilling	Rod Diam.:	-
Vert. Datum: NAVD88	Station: N/A	Drill Rig Equipment:	CME 75	Hammer Type:	Automatic
Horiz. Datum: WGS84	Offset: N/A	Other Comments:			

Elevation, ft.	SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.*	Depth, ft.	PID, ppm	Samples
	Medium stiff, brown, *Lean Clay (CL)*; moist; low to medium plasticity. **Alluvium (Qa)**		2.2	1
1083.0	Medium stiff to stiff, yellow-brown to brown, *Sandy Lean Clay (CL)*; moist; low to medium plasticity; fine sand.	4.0	2.9 7.1 4	2 3 4
1072.0	Medium dense, brown, *Silty Sand (SM)*; moist; fine to medium sand.	15.0	0.1	5
1067.0	Very stiff, dark brown, *Sandy Lean Clay (CL)*; moist; low to medium plasticity; fine to medium sand.	20.0	0	6
1062.0	Very dense, gray-brown, *Poorly Graded Sand (SP)*; moist; fine to coarse sand.	25.0	0	7
1060.5	BOTTOM OF BORING NO GROUNDWATER ENCOUNTERED COMPLETED 4/24/2019	26.5		

Symbol | Ground Water | Depth, ft.

PENETRATION RESISTANCE (blows/foot)
▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND
* Sample Not Recovered
⌶ 2.0" O.D. Split Spoon Sample

NOTES
1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

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LOG OF BORING B-19

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FIG. A-20

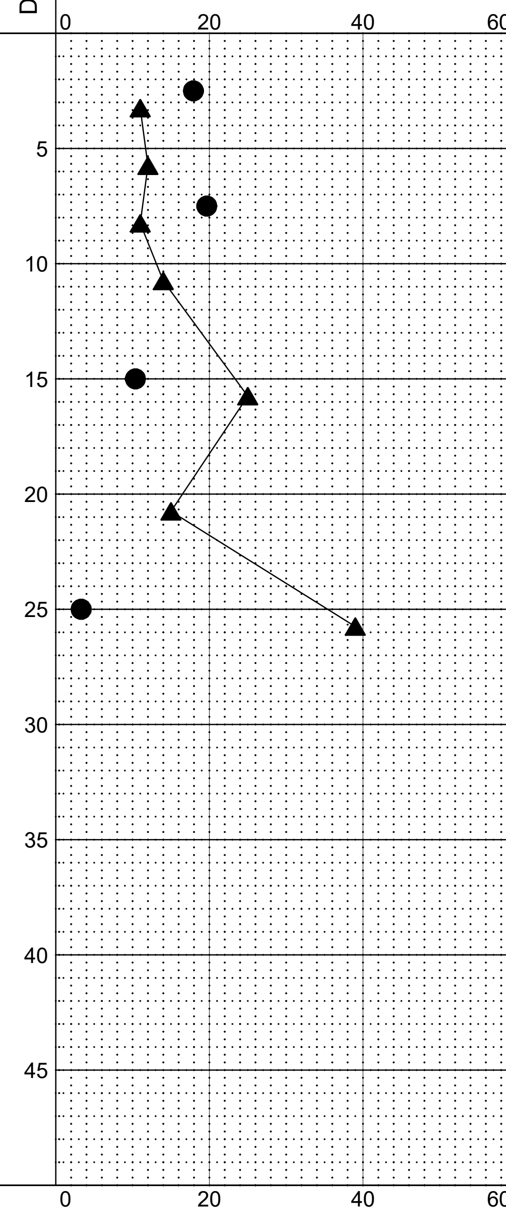
REV 3

Total Depth:	26.5 ft.	Latitude:	34.10888 °	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation:	~ 1111 ft.	Longitude:	-117.3035 °	Drilling Company:	2R Drilling	Rod Diam.:	-
Vert. Datum:	NAVD88	Station:	N/A	Drill Rig Equipment:	CME 75	Hammer Type:	Automatic
Horiz. Datum:	WGS84	Offset:	N/A	Other Comments:			

Elevation, ft.	SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.*	Depth, ft.	PID, ppm	Samples
	Stiff, dark brown to yellow-brown, *Sandy Lean Clay (CL)*; moist; low to medium plasticity; fine to medium sand. **Alluvium (Qa)**		1.4 0.3 2.8 18.1	1 2 3 4
1096.0	Medium dense, brown to gray-brown, *Silty Sand (SM)*; moist; fine sand.	15.0	7.2 0.7	5 6
1086.0	Dense, gray-brown, *Poorly Graded Sand with Silt (SP-SM)*; moist; fine to coarse sand.	25.0	0.1	7
1084.5	BOTTOM OF BORING NO GROUNDWATER ENCOUNTERED COMPLETED 4/24/2019	26.5		

Ground Water

PENETRATION RESISTANCE (blows/foot)
▲ Hammer Wt. & Drop: 140 lbs / 30 inches



LEGEND
* Sample Not Recovered
⌶ 2.0" O.D. Split Spoon Sample

NOTES
1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

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San Bernardino, California

LOG OF BORING B-20

February 2021 51-1-10240-012

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FIG. A-21

REV 3

Log: KXR Rev: LAM Typ: KXR

MASTER_LOG_E_MC 51-1-10240-012 1.GPJ SHAN_WIL.GDT 8/26/20

Total Depth:	26.5 ft.	Latitude:	34.13409 °	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation:	~ 1179 ft.	Longitude:	-117.3109 °	Drilling Company:	2R Drilling	Rod Diam.:	-
Vert. Datum:	NAVD88	Station:	N/A	Drill Rig Equipment:	CME 75 Track	Hammer Type:	Automatic
Horiz. Datum:	WGS84	Offset:	N/A	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

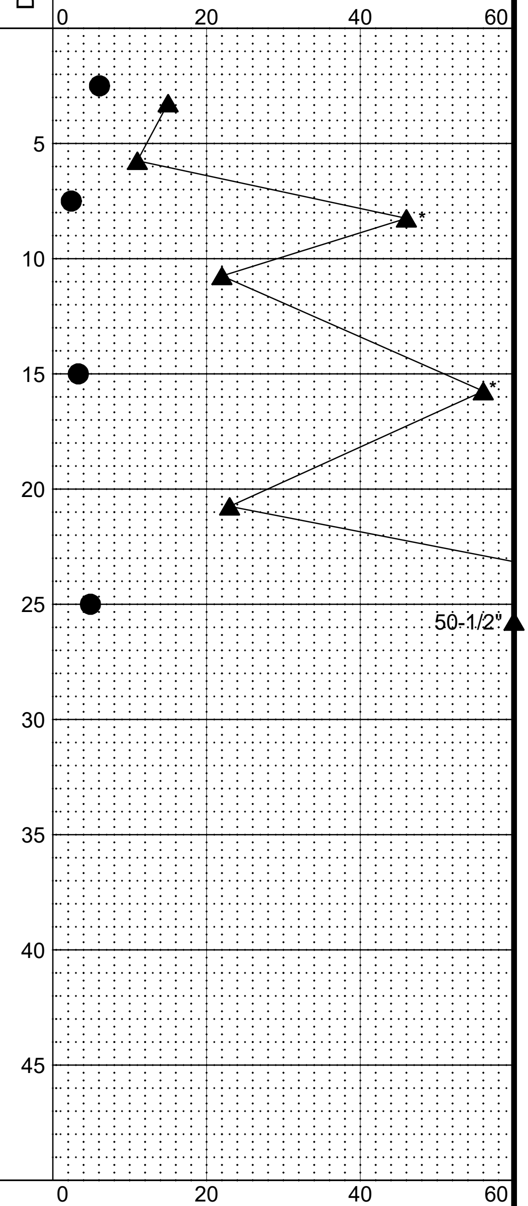
Elevation, ft.	Soil Description	Depth, ft.	Samples
	Loose to medium dense, brown, *Poorly Graded Sand with Gravel (SP)*; moist; fine to coarse sand, fine to coarse gravel. **Alluvium (Qa)**		S-1
1174.0	Medium dense, yellow-brown, *Poorly Graded Sand with Silt (SP-SM)*; moist; fine sand.	5.0	S-2
1171.5	Medium dense to very dense, dark brown to red-brown, *Poorly Graded Sand with Gravel (SP)*; moist; fine to coarse sand, fine gravel.	7.5	S-3, S-4, S-5
1159.0	Medium dense, yellow-brown, *Poorly Graded Sand with Silt (SP-SM)*; moist; fine sand.	20.0	S-6
1154.0	Very dense, brown, *Poorly Graded Sand with Gravel (SP)*; moist; fine to medium sand; fine gravel.	25.0	S-7
1152.5		26.5	

BOTTOM OF BORING
NO GROUNDWATER ENCOUNTERED
COMPLETED 5/1/2019

*Gravel may be inflating the blow count.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: 140 lbs / 30 inches



◇ % Fines (<0.075mm)
● % Water Content

LEGEND

* Sample Not Recovered

2.0" O.D. Split Spoon Sample

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

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FIG. A-22

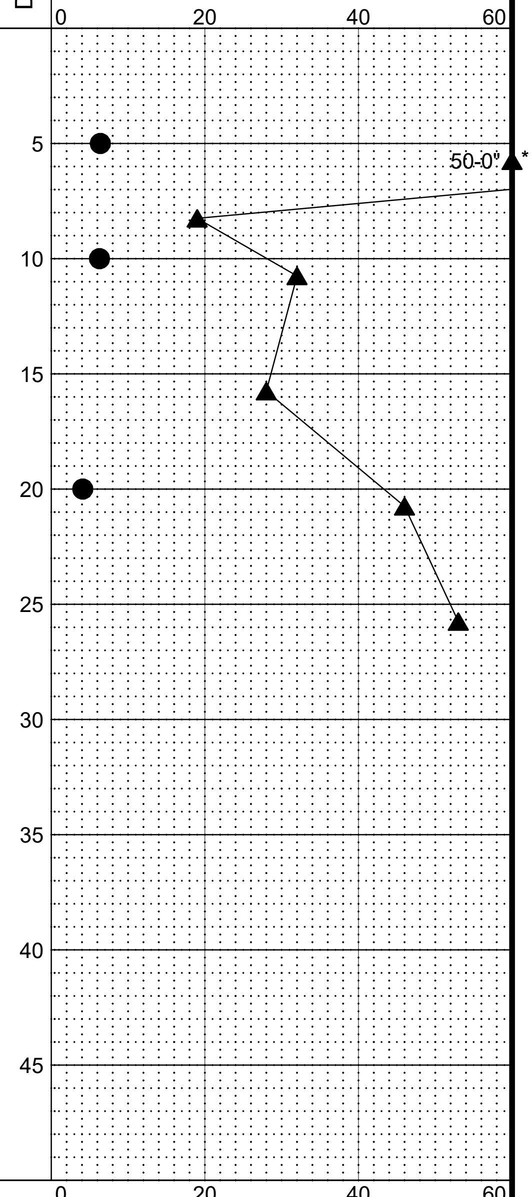
REV 3

Total Depth:	26.5 ft.	Latitude:	34.15678 °	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation:	~ 1393 ft.	Longitude:	-117.3350 °	Drilling Company:	2R Drilling	Rod Diam.:	-
Vert. Datum:	NAVD88	Station:	N/A	Drill Rig Equipment:	CME 75 Track	Hammer Type:	Automatic
Horiz. Datum:	WGS84	Offset:	N/A	Other Comments:			

Elevation, ft.	SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.*	Depth, ft.	Symbol	Samples	Ground Water
	Gray-brown to dark brown, *Poorly Graded Sand with Gravel (SP)*; moist; fine to coarse sand, fine gravel. **Alluvium (Qa)**			S-1 (G)	
1388.0	Medium dense to very dense, dark brown, *Poorly Graded Sand with Gravel (SP)*; moist; fine to coarse sand, fine gravel.	5.0		S-2, S-3, S-4, S-5, S-6, S-7	
1366.5	BOTTOM OF BORING NO GROUNDWATER ENCOUNTERED COMPLETED 5/1/2019 *Gravel may be inflating the blow count.	26.5			

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: 140 lbs / 30 inches



◇ % Fines (<0.075mm)
● % Water Content

LEGEND

- * Sample Not Recovered
- G Grab Sample
- 2.0" O.D. Split Spoon Sample

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

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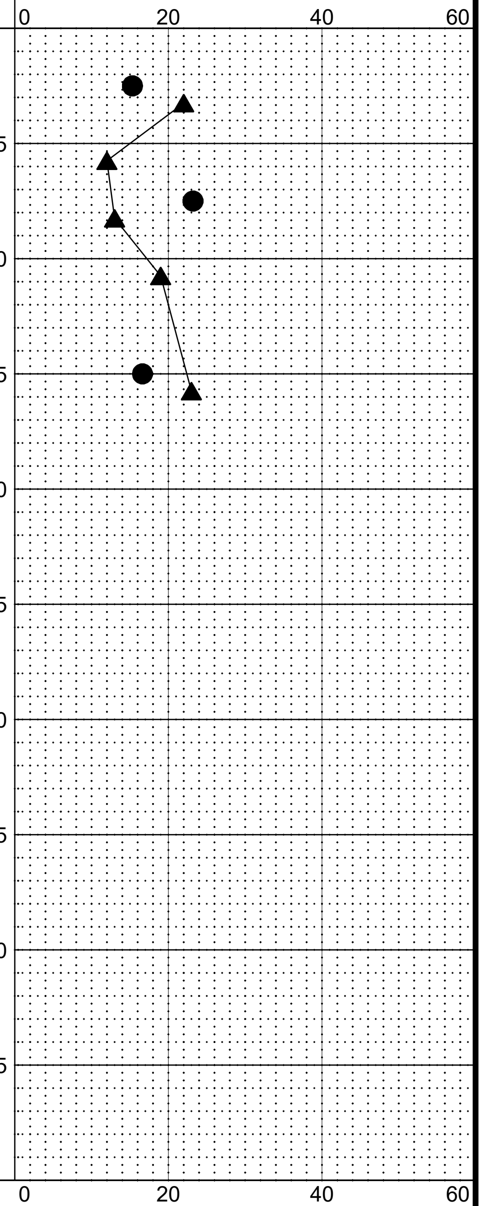
FIG. A-23

REV 3

Total Depth:	16.5 ft.	Latitude:	34.11313 °	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation:	~ 1095 ft.	Longitude:	-117.3033 °	Drilling Company:	2R Drilling	Rod Diam.:	-
Vert. Datum:	NAVD88	Station:	N/A	Drill Rig Equipment:	CME 75 Track	Hammer Type:	Automatic
Horiz. Datum:	WGS84	Offset:	N/A	Other Comments:			

Elevation, ft.	SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.*	Depth, ft.	Symbol	Samples	Ground Water
	Medium dense, brown, *Silty Sand (SM)*; moist; fine sand. **Artificial Fill (af)**			S-1	
1091.0	Medium dense, yellow-brown to brown, *Silty Sand (SM)*; moist; fine sand. **Alluvium (Qa)**	4.0		S-2, S-3, S-4, S-5	
1078.5	BOTTOM OF BORING NO GROUNDWATER ENCOUNTERED COMPLETED 5/1/2019	16.5			

PENETRATION RESISTANCE (blows/foot)
▲ Hammer Wt. & Drop: 140 lbs / 30 inches



◇ % Fines (<0.075mm)
● % Water Content

LEGEND
* Sample Not Recovered
⌶ 2.0" O.D. Split Spoon Sample

NOTES
1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

Ono Lead Track Extension
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San Bernardino, California

LOG OF BORING B-23

February 2021 51-1-10240-012

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-24

REV 3

MASTER_LOG_E_MC 51-1-10240-012 1.GPJ SHAN_WIL.GDT 8/26/20 *Log: KXR Rev: LAM Typ: KXR*

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LOG OF TEST PIT TP-09-17

JOB NO: 51-1-10240-003 DATE: 4-10-17 LOCATION: BNSF Intermodal Facility, San Bernardino, CA

PROJECT: San Bernardino BNSF - Mainline Addition

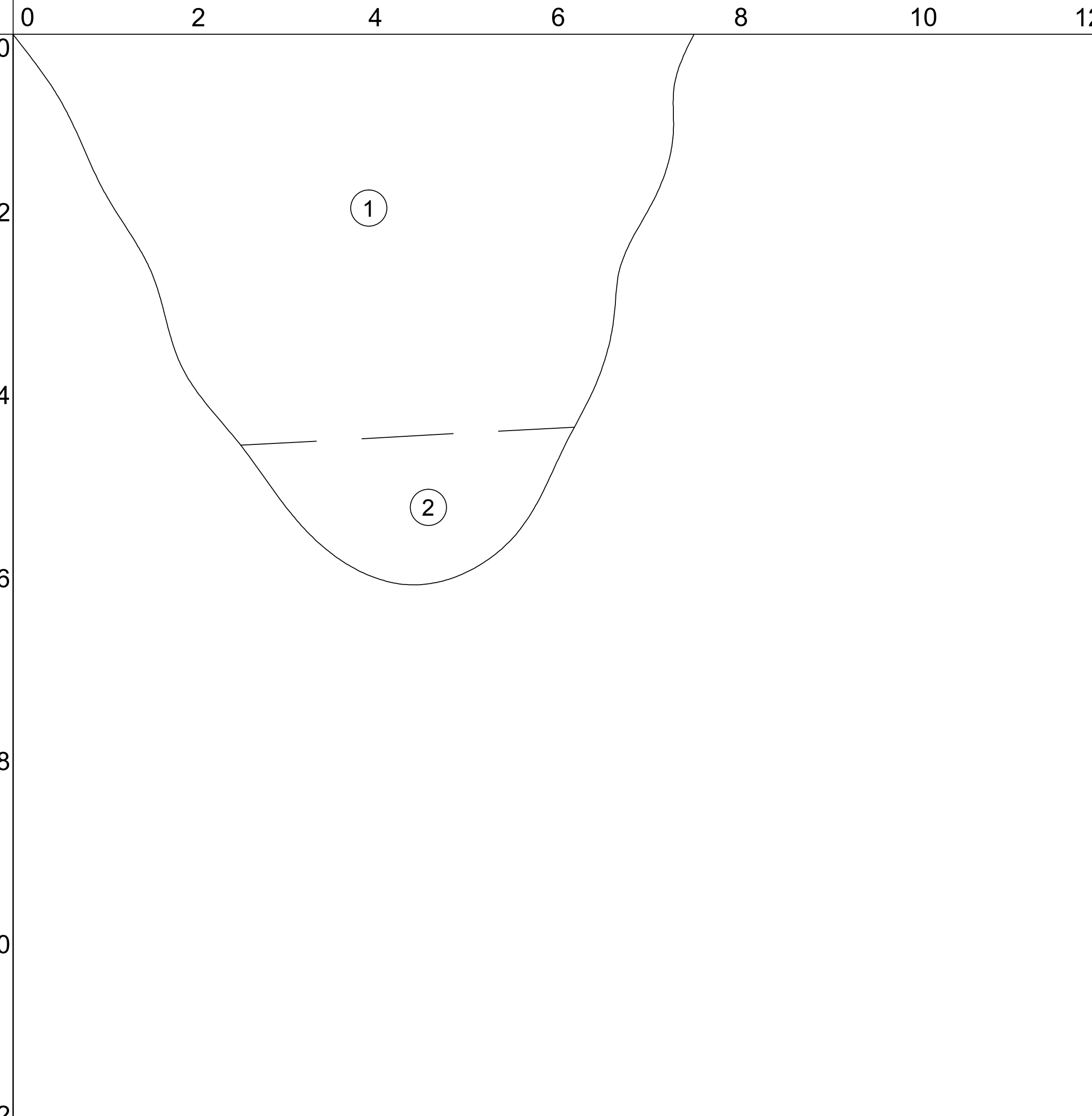
SOIL DESCRIPTION	Ground Water	% Water Content	Samples	Depth, Ft.
(1) Loose to medium dense, olive-brown, Silty Sand (SM) to Sandy Silt (ML); moist; few roots and plastic bags. **Artificial Fill (af)**		19%	S-1	0–2
(2) Stiff, dark brown, Sandy Lean Clay (CL); moist. **Alluvium (Qa)**		20%	S-2	4–6

Sketch of East Pit Side

Surface Elevation: 1115

Due South

Horizontal Distance in Feet



NOTES

FIG. A- 25

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LOG OF TEST PIT TP-10-17

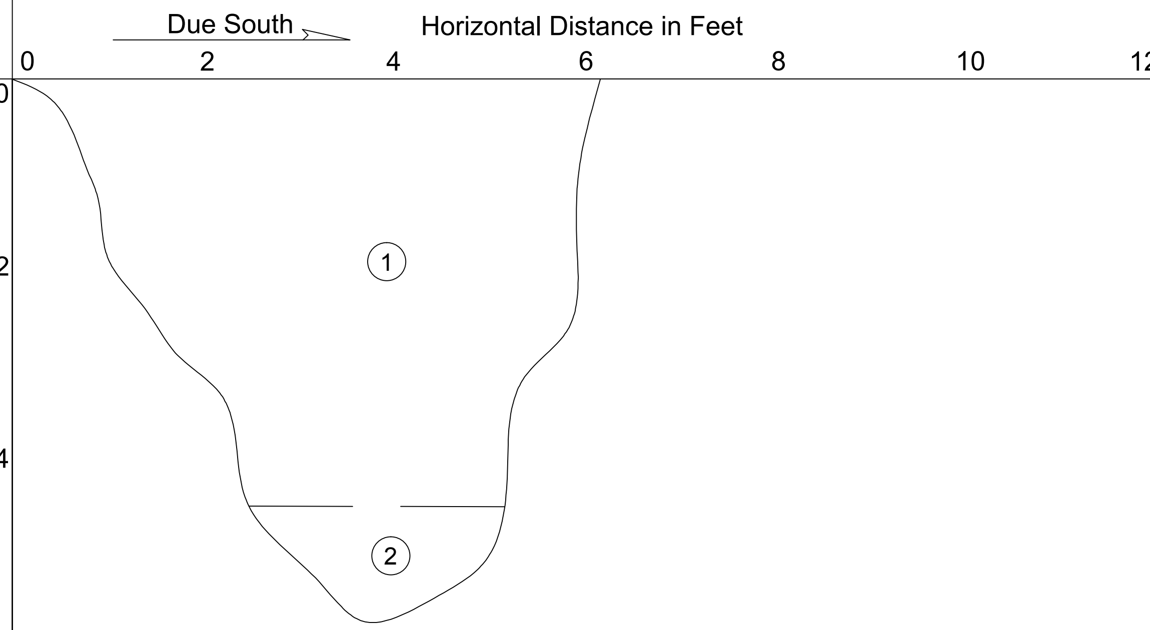
JOB NO: 51-1-10240-003 DATE: 4-10-17 LOCATION: BNSF Intermodal Facility, San Bernardino, CA

PROJECT: San Bernardino BNSF - Mainline Addition

SOIL DESCRIPTION	Ground Water	% Water Content	Samples	Depth, Ft.
(1) Medium dense, red-brown, Sandy Silt (ML) to Silty Sand (SM); moist; fine sand; pieces of ballast are scattered throughout the unit. **Artificial Fill (af)**		8%	S-1	0–2
(2) Medium dense, red-brown, Silty Sand (SM); moist; fine sand. **Alluvium (Qa)**		9%	S-2	4–6

Sketch of East Pit Side

Surface Elevation: 1142



Depth, Ft.: 0, 2, 4, 6, 8, 10, 12

NOTES

______________________.

FIG. A- 26

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LOG OF TEST PIT TP-11-17

JOB NO: 51-1-10240-003 DATE: 4-10-17 LOCATION: BNSF Intermodal Facility, San Bernardino, CA

PROJECT: San Bernardino BNSF - Mainline Addition

SOIL DESCRIPTION	Ground Water	% Water Content	Samples	Depth, Ft.
(1) Ballast.				0
(2) Medium dense, red-brown, Silty Sand (SM); moist; fine sand; plastic bags, bottles and few bolts. **Artificial Fill (af)**		3%	S-1	
(3) Medium dense, red-brown, Clayey Sand (SC); moist; fine sand. **Alluvium (Qa)**				2
				4
		7%	S-2	
				6
				8
				10
				12

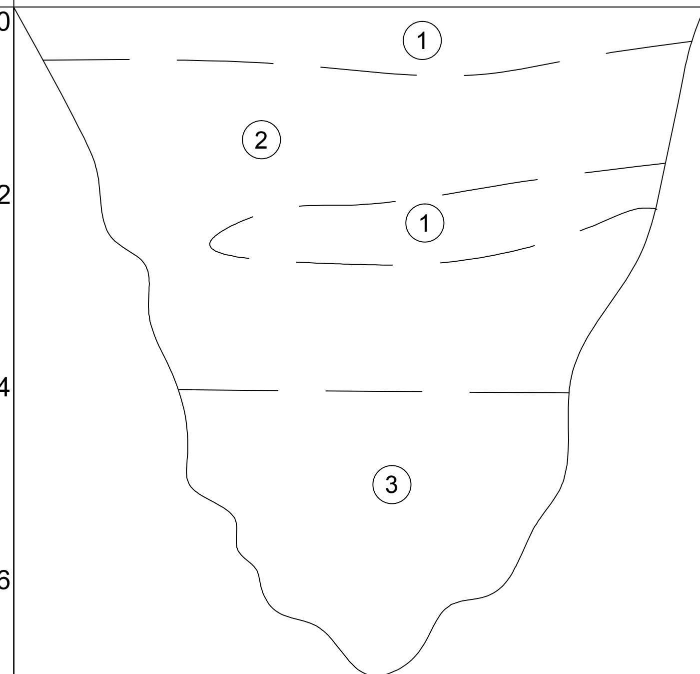
Sketch of East Pit Side

Surface Elevation: 1171

Due South

Horizontal Distance in Feet

0 2 4 6 8 10 12



NOTES

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FIG. A- 27

Filename: \\Lax-fs1\vol1\EF\51-1 LAX\10200s\10240 BNSF San Berdoo\003 Proposed Bridge\graphics\TEST PIT LOGS.dwg Date: 01-17-2013 Login: Louis Larios

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LOG OF TEST PIT TP-12-17

JOB NO: 51-1-10240-003 DATE: 4-10-17 LOCATION: BNSF Intermodal Facility, San Bernardino, CA

PROJECT: San Bernardino BNSF - Mainline Addition

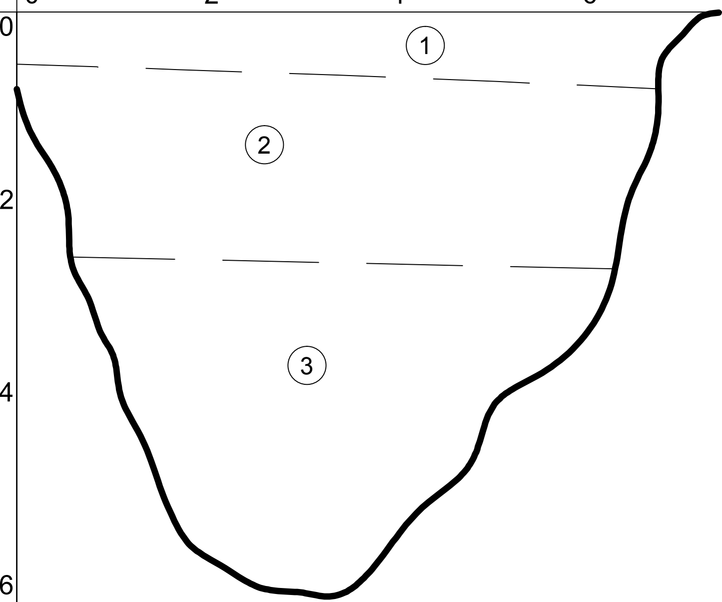
Sketch of East Pit Side

Due South

Surface Elevation: 1234

Horizontal Distance in Feet: 0, 2, 4, 6, 8, 10, 12

SOIL DESCRIPTION	Ground Water	% Water Content	Samples	Depth, Ft.
1 Ballast.				0
2 Medium dense, red-brown, Silty Sand (SM); moist; few gravel; fine sand. **Artificial Fill (af)**		3%	S-1	
				2
3 Medium dense, red, Poorly Graded Sand with Silt (SP-SM); moist; few cobbles; fine to medium sand. **Alluvium (Qa)**		5%	S-2	4
				6
				8
				10
				12



NOTES

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FIG. A- 28

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LOG OF TEST PIT TP-13-17

JOB NO: 51-1-10240-003 DATE: 4-10-17 LOCATION: BNSF Intermodal Facility, San Bernardino, CA

PROJECT: San Bernardino BNSF - Mainline Addition

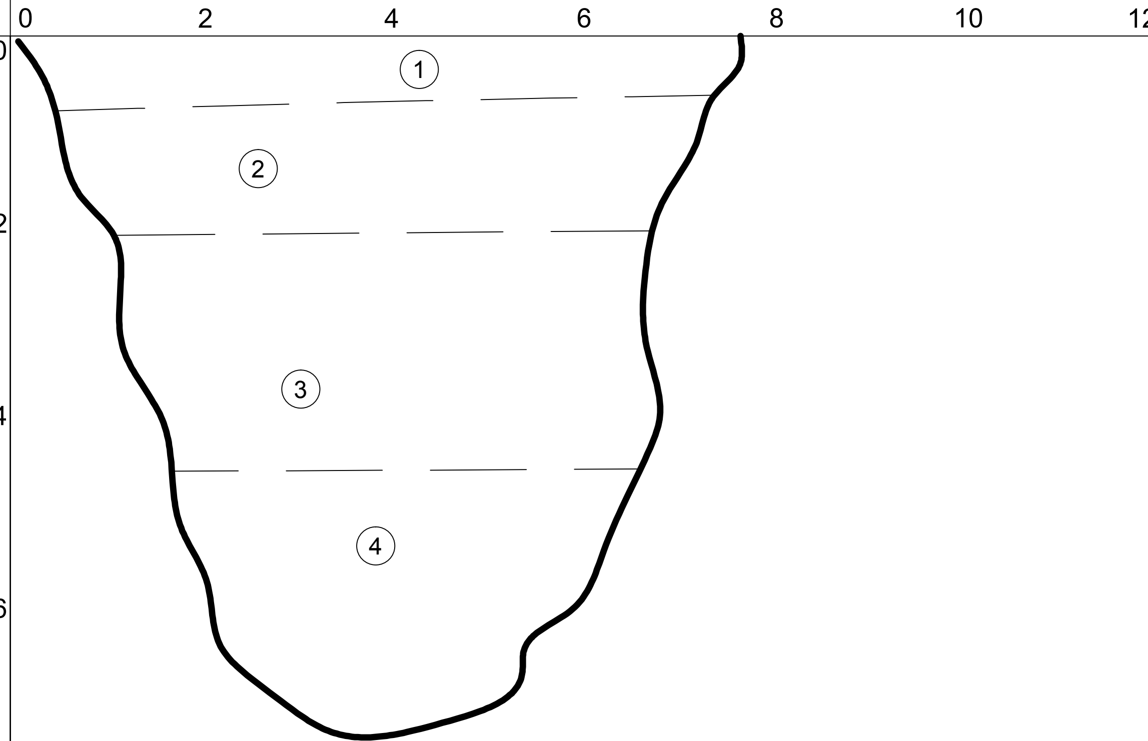
SOIL DESCRIPTION	Ground Water	% Water Content	Samples	Depth, Ft.
(1) Ballast.				0
(2) Medium dense, red-brown, Silty Sand (SM); moist; fine sand. **Artificial Fill (af)**		4%	S-1	
(3) Medium dense, red, Silty Sand (SM); moist; few gravel; fine sand. **Alluvium (Qa)**		9%	S-2	2
(4) Medium dense, red, Silty Sand (SM); moist; few cobbles; fine to medium sand.		5%	S-3	4
				6
				8
				10
				12

Sketch of East Pit Side

Surface Elevation: 1407

Due South

Horizontal Distance in Feet



NOTES

________________________.

FIG. A- 29

Filename: \\Lax-fs1\vol1\EF\51-1 LAX\10200s\10240 BNSF San Berdoo\003 Proposed Bridge\graphics\TEST PIT LOGS.dwg Date: 01-17-2013 Login: Louis Larios

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LOG OF TEST PIT TP-14-17

JOB NO: 51-1-10240-003 DATE: 4-10-17 LOCATION: BNSF Intermodal Facility, San Bernardino, CA

PROJECT: San Bernardino BNSF - Mainline Addition

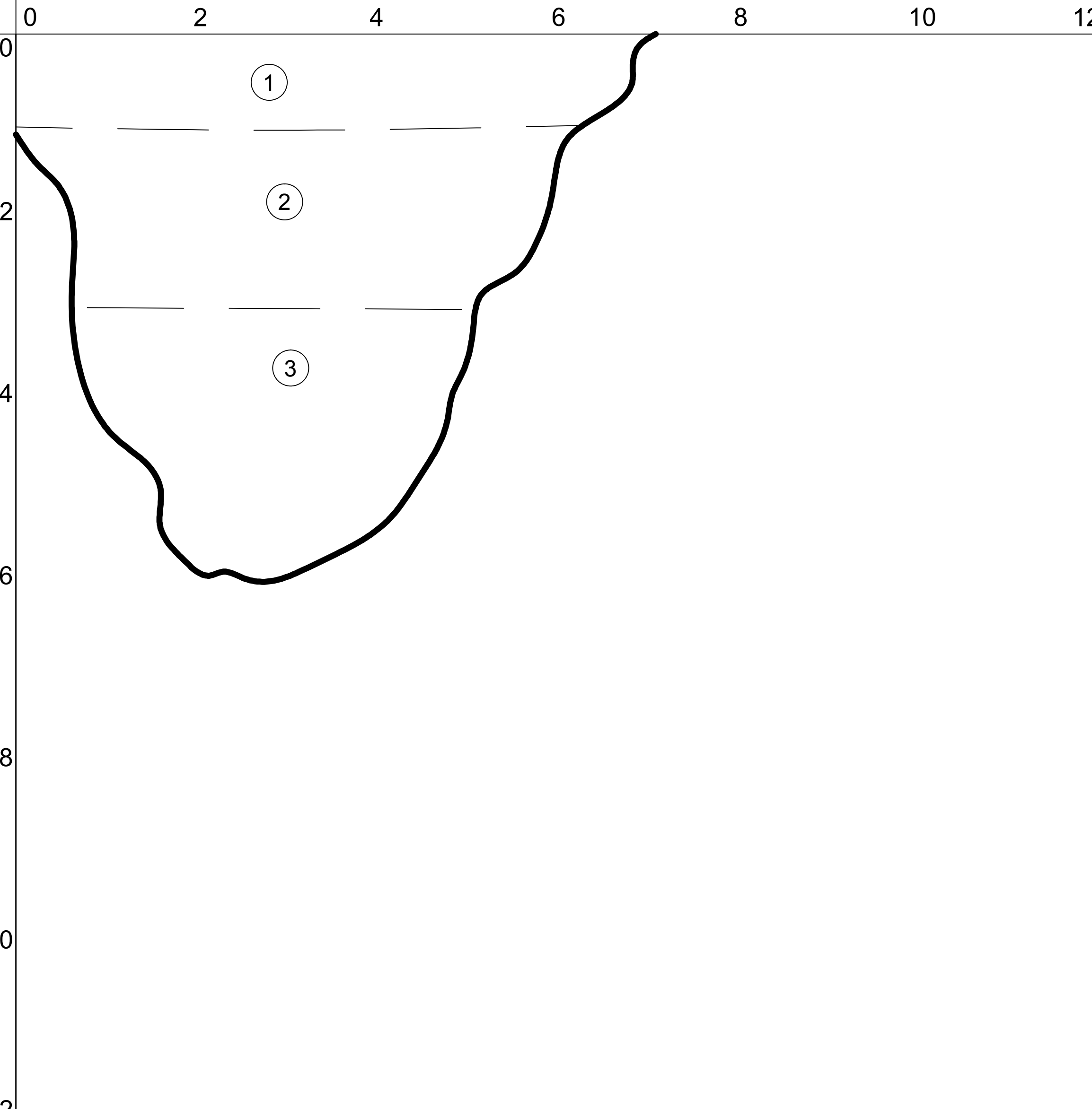
SOIL DESCRIPTION	Ground Water	% Water Content	Samples	Depth, Ft.
(1) Ballast.				0
(2) Stiff, dark brown, Clayey Sand (SC); moist; fine sand; medium plasticity. **Artificial Fill (af)**		17%	S-1	2
(3) Medium dense, red-brown, Clayey Sand (SC); moist; fine sand. **Alluvium (Qa)**		14%	S-2	4

Sketch of East Pit Side

Surface Elevation: 1087

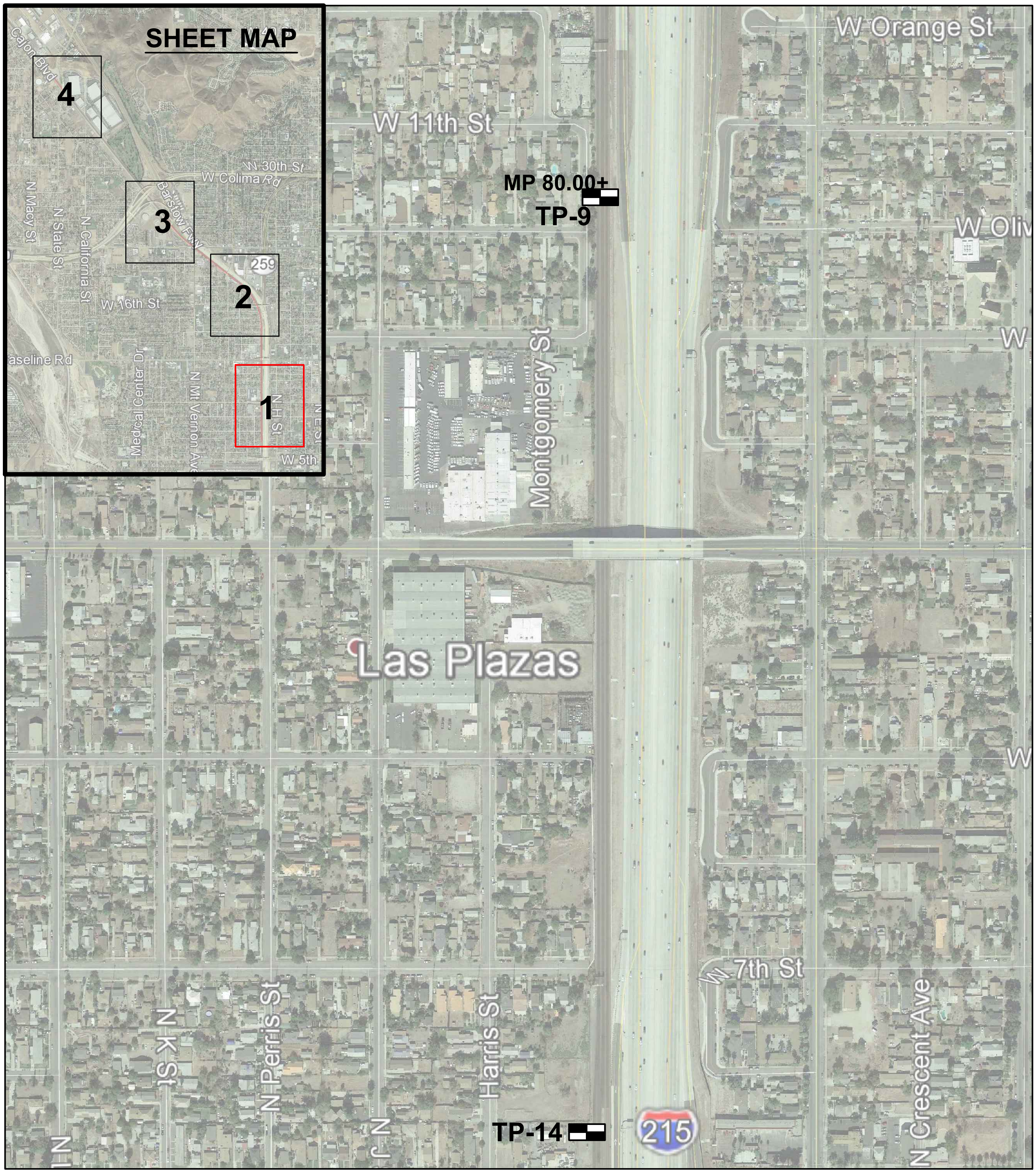
Due South

Horizontal Distance in Feet



NOTES

FIG. A- 30



LEGEND

TP-1 Test Pit Designation and Approximate Location

0 250 500 1000

SCALE: 1"=500'

NOTE

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San Bernardino, California

TEST PIT LOCATION MAP

June 2019 51-1-10240-012

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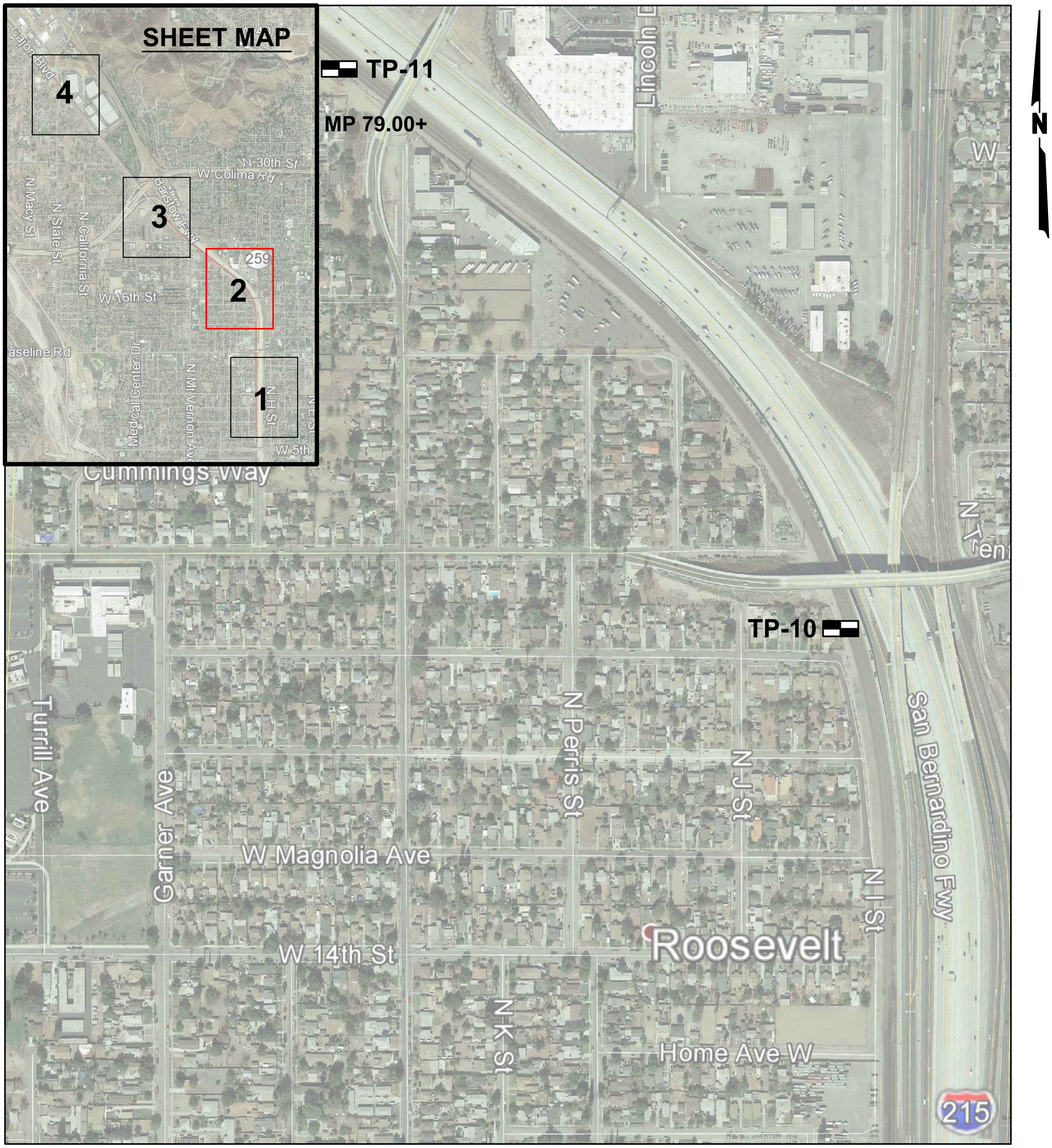
FIG. A-31
Sheet 1 of 4

Filename: \\Lax-fs1\vol1\EF\51-1 LAX\10200s\10240 BNSF San Berdoo\003 Proposed Bridge\graphics\FIG 2 3 - SITE AND EXPLORATION PLAN.dwg Date: 10-06-2017 Login: Louis Larios



LEGEND

TP-1 Test Pit Designation and Approximate Location

0 250 500 1000

SCALE: 1"=500'

NOTE

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TEST PIT LOCATION MAP

June 2019 51-1-10240-012

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FIG. A-31
Sheet 2 of 4

N

LEGEND

TP-1 Test Pit Designation and Approximate Location

0 250 500 1000

SCALE: 1"=500'

NOTE

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TEST PIT LOCATION MAP

June 2019 51-1-10240-012

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FIG. A-31
Sheet 3 of 4

Filename: \\Lax-fs1\vol1\EF\51-1 LAX\10200s\10240 BNSF San Berdoo\003 Proposed Bridge\graphics\FIG 2 3 - SITE AND EXPLORATION PLAN.dwg Date: 10-06-2017 Login: Louis Larios

LEGEND

TP-1 Test Pit Designation and Approximate Location

0 250 500 1000

SCALE: 1"=500'

NOTE

Map adapted from aerial imagery provided by Google Earth Pro, reproduced by permission granted by Google Earth ™ Mapping Service.

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San Bernardino, California

TEST PIT LOCATION MAP

June 2019 51-1-10240-012

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GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. A-31
Sheet 4 of 4

Filename: \\Lax-fs1\vol1\EF\51-1 LAX\10200s\10240 BNSF San Berdoo\003 Proposed Bridge\graphics\FIG 2 3 - SITE AND EXPLORATION PLAN.dwg Date: 10-06-2017 Login: Louis Larios

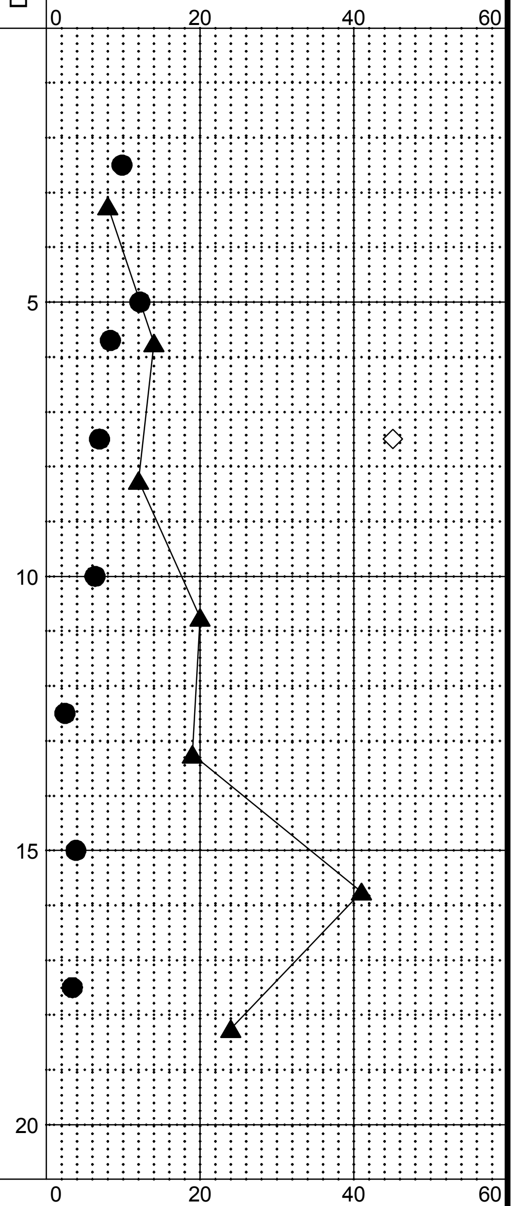
Total Depth:	*17.5 ft.*	Latitude:	*34.11139 °*	Drilling Method:	*Hollow Stem Auger*	Hole Diam.:	*8 in.*
Top Elevation:	*~ 1082 ft.*	Longitude:	*-117.3036 °*	Drilling Company:	*2R*	Rod Diam.:	*AWJ*
Vert. Datum:	*NAVD88*	Station:	*N/A*	Drill Rig Equipment:	*Gtech Drill, GT8*	Hammer Type:	*Automatic*
Horiz. Datum:	*WGS84*	Offset:	*N/A*	Other Comments:			

Elevation, ft.	**SOIL DESCRIPTION** *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.*	Depth, ft.	PID, ppm	Samples
	Loose, brown, *Poorly Graded Sand with Silt (SP-SM)*; dry; fine sand; trace rootlets. **Artificial Fill (af) / Alluvium (Qa)**		8.6	S-1
1077.5	Stiff, brown, *Sandy Lean Clay (CL)*; dry; fine sand; low plasticity fines; trace rootlets. **Alluvium (Qa)**	4.5		S-2a/b
1076.3	Medium dense, brown, *Clayey Sand (SC)*; dry; fine sand.	5.7		
1075.0	Medium dense, dark brown, *Silty Sand (SM)*; dry; fine sand; micaceous.	7.0	0.2	S-3
1072.5	Medium dense, red-yellow to yellow, *Poorly Graded Sand with Silt (SP-SM)*; dry; fine sand.	9.5	0.1	S-4
1070.0	Medium dense to dense, red-yellow to yellow, *Poorly Graded Sand (SP)*; dry; fine to medium sand; trace fines.	12.0	0.1	S-5
			0.2	S-6
			0	S-7
1063.0	Bottom of Boring No groundwater encountered. Boring completed on 09/26/19	19.0		

Ground Water

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

* Sample Not Recovered

⌶ 2.0" O.D. Split Spoon Sample

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

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LOG OF BORING I-1

October 2019 | 51-1-10240-014

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FIG. A-32

REV 3

Total Depth:	17.5 ft.	Latitude:	34.12036 °	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation:	~ 1108 ft.	Longitude:	-117.3035 °	Drilling Company:	2R	Rod Diam.:	AWJ
Vert. Datum:	NAVD88	Station:	N/A	Drill Rig Equipment:	Gtech Drill, GT8	Hammer Type:	Automatic
Horiz. Datum:	WGS84	Offset:	N/A	Other Comments:			

SOIL DESCRIPTION

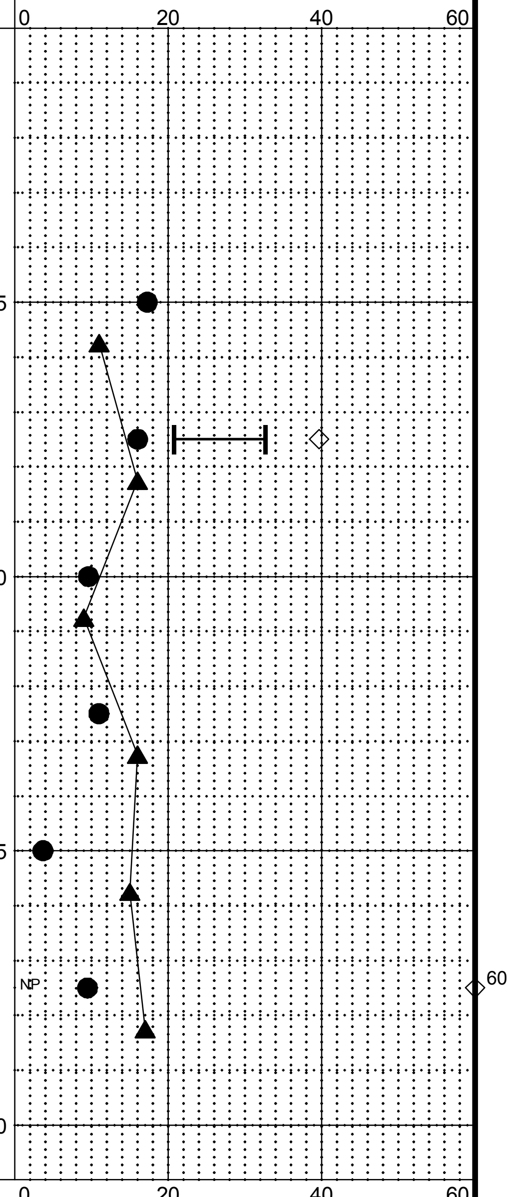
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.

Elevation, ft.	Soil Description	Depth, ft.	PID, ppm	Samples
1107.8	Pavement/Asphalt	0.2		
1107.7	Possibly Base	0.3		
	Medium dense, dark brown to brown, *Clayey Sand (SC)*; dry to moist; fine sand; low plasticity fines. **Artificial Fill (af) / Alluvium (Qa)**			S-1
1103.5	Medium dense, dark brown, *Clayey Sand (SC)*; dry to moist; fine sand; low plasticity fines. **Alluvium (Qa)**	4.5	0	S-2
			0.8	S-3
1098.5	Loose to medium dense, red-yellow to red-brown to brown, *Silty Sand (SM)*; dry; fine sand.	9.5	13.5	S-4
			0.1	S-5
1093.5	Medium dense, red-yellow, *Poorly Graded Sand (SP)*; dry; fine sand; micaceous.	14.5	0.1	S-6
1091.0	Medium dense, dark brown, *Sandy Silt (ML)*; dry; fine sand; micaceous.	17.0	5.6	S-7
1089.0	Bottom of Boring No groundwater encountered. Boring completed on 09/26/19	19.0		

Symbol | Ground Water | Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: 140 lbs / 30 inches



Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content
◇ % Fines (<0.075mm)
● % Water Content

LEGEND

- * Sample Not Recovered
- G Grab Sample
- 2.0" O.D. Split Spoon Sample

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

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LOG OF BORING I-2

October 2019 51-1-10240-014

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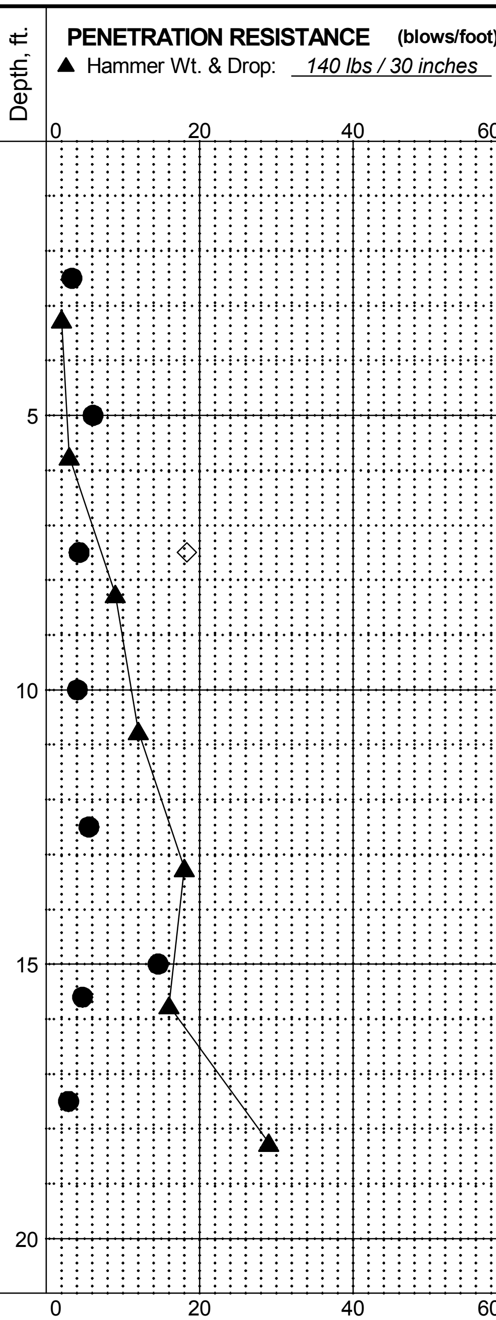
FIG. A-33

REV 3

MASTER_LOG_E_MC 51-1-10240-014.GPJ SHAN_WIL.GDT 10/16/19 Log: CLZ Rev: Typ: CLZ

Total Depth:	*17.5 ft.*	Latitude:	*34.12958 °*	Drilling Method:	*Hollow Stem Auger*	Hole Diam.:	*8 in.*
Top Elevation:	*~ 1141 ft.*	Longitude:	*-117.3049 °*	Drilling Company:	*2R*	Rod Diam.:	*AWJ*
Vert. Datum:	*NAVD88*	Station:	*N/A*	Drill Rig Equipment:	*Gtech Drill, GT8*	Hammer Type:	*Automatic*
Horiz. Datum:	*WGS84*	Offset:	*N/A*	Other Comments:			

Elevation, ft.	SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.*	Depth, ft.	Symbol	PID, ppm	Samples	Ground Water
	Very loose, red-yellow to yellow, *Poorly Graded Sand (SP)*; dry; fine to medium sand. **Artificial Fill (af) / Alluvium (Qa)**				S-1	
1136.5	Very loose, dark brown to brown, *Silty Sand (SM)*; dry to moist; fine to medium sand. **Alluvium (Qa)**	4.5		0	S-2	
1134.0	Loose to medium dense, red-yellow to yellow, *Silty Sand (SM)*; dry to moist; fine to medium sand; micaceous.	7.0		0 1.2	S-3 S-4	
1129.0	Medium dense, red-yellow, *Poorly Graded Sand with Gravel (SP)*; dry to moist; fine to coarse, angular gravel; fine to medium sand, some coarse sand.	12.0		0.5	S-5	
1126.5	Very stiff, olive-brown, *Sandy Lean Clay (CL)*; dry to moist; fine to medium sand.	14.5			S-6a/b	
1125.4	Medium dense, red-yellow, *Poorly Graded Sand (SP)*; dry to moist; fine to medium sand.	15.6				
1124.2	Medium dense, red-yellow, *Poorly Graded Sand with Gravel (SP)*; dry to moist; fine to coarse, subangular to subrounded gravel; fine to medium sand, some coarse sand.	16.9		0	S-7	
1122.0	Bottom of Boring No groundwater encountered. Boring completed on 09/26/19	19.0				



LEGEND

* Sample Not Recovered

⌶ 2.0" O.D. Split Spoon Sample

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

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LOG OF BORING I-3

October 2019 51-1-10240-014

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FIG. A-34

REV 3

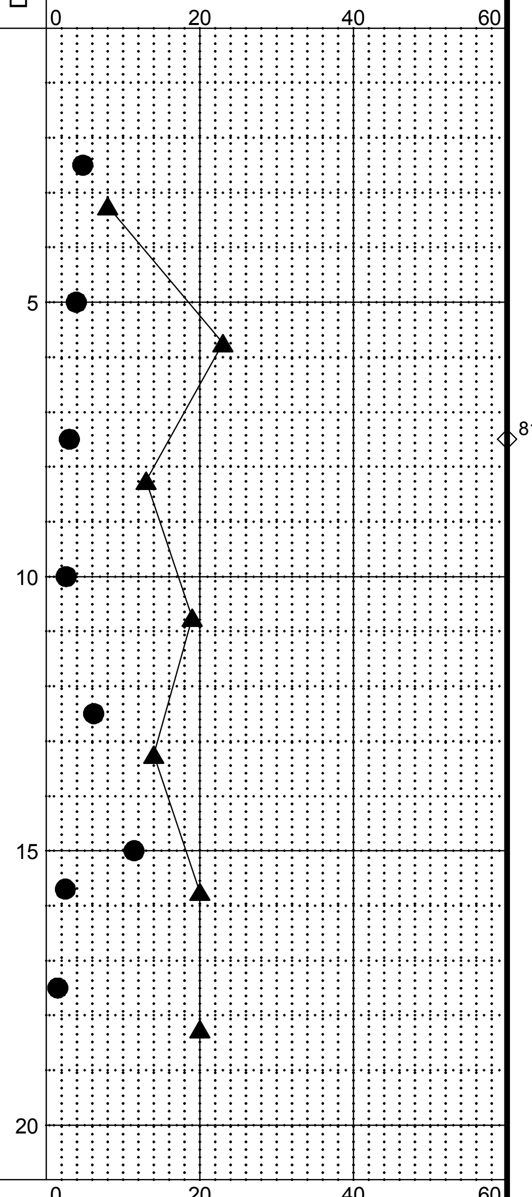
MASTER_LOG_E_MC 51-1-10240-014.GPJ SHAN_WIL.GDT 10/16/19 Log: CLZ Rev: Typ: CLZ

Total Depth:	17.5 ft.	Latitude:	34.13292 °	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation:	~ 1161 ft.	Longitude:	-117.3094 °	Drilling Company:	2R	Rod Diam.:	AWJ
Vert. Datum:	NAVD88	Station:	N/A	Drill Rig Equipment:	CME-45	Hammer Type:	Automatic
Horiz. Datum:	WGS84	Offset:	N/A	Other Comments:			

Elevation, ft.	SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.*	Depth, ft.	Symbol	PID, ppm	Samples	Ground Water
	Loose, red-yellow to yellow, *Poorly Graded Sand (SP)*; dry; fine sand. Sample taken from cuttings; no recovery in spoon. **Artificial Fill (af) / Alluvium (Qa)**				S-1 *	
1156.5	Medium dense, red-yellow to brown, *Poorly Graded Sand (SP)*; dry; trace, fine, angular gravel; fine sand, some medium sand. **Alluvium (Qa)**	4.5			S-2	
1154.0	Medium dense, red-yellow to brown, *Sandy Silt (ML)*; dry; trace gravel; fine to medium sand; micaceous.	7.0		0 0	S-3 S-4	
1149.0	Medium dense, red-yellow, *Poorly Graded Sand (SP)*; dry; fine sand; trace fines.	12.0		0	S-5	
1146.5	Medium dense, red-yellow, *Silty Sand (SM)*; dry; fine sand; micaceous.	14.5			S-6a/b	
1145.3	Medium dense, red-yellow, *Poorly Graded Sand (SP)*; dry; fine sand, some medium sand.	15.7		0	S-7	
1142.0	Bottom of Boring No groundwater encountered. Boring completed on 09/26/19	19.0				

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: 140 lbs / 30 inches



◇ % Fines (<0.075mm)
● % Water Content

LEGEND

* Sample Not Recovered
2.0" O.D. Split Spoon Sample

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

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LOG OF BORING I-4

October 2019 51-1-10240-014

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FIG. A-35

REV 3

MASTER_LOG_E_MC 51-1-10240-014.GPJ SHAN_WIL.GDT 10/16/19 Log: CLZ Rev: Typ: CLZ

Appendix B

Geotechnical Laboratory Testing Procedures and Results

CONTENTS

Exhibits

Figures

B.1 GENERAL

This appendix presents descriptions of the geotechnical laboratory testing procedures and provides the results. Selected samples recovered from the borings were tested to evaluate the basic index and engineering properties of soils. Geotechnical laboratory testing included visual classifications, water content determination, grain size analysis, fines content, Atterberg limits determinations, compaction characteristics, direct shear value, R-value, and corrosion potential. Tests were performed at our laboratory in Glendale, California, and by AP Engineering and Testing of Pomona, California. The laboratory testing was performed in general accordance with ASTM standard test procedures, California Department of Transportation (Caltrans) California Test Method (CTM), and U.S. Environmental Protection Agency (EPA) test methods.

B.2 VISUAL DESCRIPTION AND CLASSIFICATION

Each soil sample was visually described in the field using a system based on ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedures) (ASTM, 2017c). We verified the sample descriptions in our lab. We classified soil samples in the lab when appropriate lab test results were available using ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) (ASTM, 2017b). These ASTM standards generally use the Unified Soil Classification System (USCS). Sample classifications have been incorporated into the soil descriptions on the boring logs presented in Appendix A.

B.3 WATER CONTENT

The natural water content of the soil samples was determined in general accordance with ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass (ASTM, 2019). Comparison of natural water content of a soil with its index properties can be useful in characterizing soil unit weight, consistency, compressibility, and strength. Water contents are presented on the boring logs in Appendix A.

B.4 GRAIN SIZE ANALYSIS

The grain size distribution of selected samples was tested using sieve analyses. The grain size distribution tests were performed in general accordance with the ASTM D6913 Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis (ASTM, 2017e). This test is useful for classifying soils, for providing correlation with soil properties, and for evaluating liquefaction potential.

Grain size analysis results could potentially be affected by sample type and drilling method. The sample type, or more specifically, the inside diameter of the sampler, directly impacts the maximum particle size that can be sampled. For example, the largest diameter particle that can be sampled by a 2-inch Standard Penetration Test sampler (1.375-inch inside diameter) is approximately 1.3 inches, regardless of the maximum particle size of the soil unit being sampled.

Results of these analyses are presented as grain size distribution curves in Figure B-1. The gradation sheet provides the boring number, sample depth, USCS group symbol, and the Atterberg Limits (if performed). The percent passing the No. 200 sieve (0.075 millimeter) is also shown in the boring logs included in Appendix A.

B.5 FINES CONTENT

The fines content of selected samples was determined in general accordance with ASTM D1440 Standard Test Methods for Determining the Amount of Material Finer than 75-µm (No. 200) Sieve in Soils by Washing (ASTM, 2017a). This test is useful for classifying soils, for providing correlation with soil properties, and for evaluating liquefaction potential. The fines content, i.e. the percent passing the No. 200 sieve, is shown on the boring logs included in Appendix A.

B.6 ATTERBERG LIMITS

Soil plasticity was determined by performing Atterberg Limits on selected samples. The tests were performed in general accordance with ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils (ASTM, 2017d). The Atterberg Limits include Liquid Limit (LL), Plastic Limit (PL), and Plasticity Index (PI=LL-PL). These limits are generally used to assist in classification of soil, to indicate soil consistency (when compared to natural water content), to provide correlation to soil properties, to evaluate clogging potential, and to estimate liquefaction potential.

The LL, PL, and PI values determined from the Atterberg Limits tests are shown on the plasticity chart included in Figure B-2. The plasticity chart provides the boring number, the sample depth, and the USCS group symbol. The results of the Atterberg Limits determinations are also shown graphically in the boring logs presented in Appendix A.

B.7 COMPACTION TEST

Compaction testing was performed in general accordance with ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)) (ASTM, 2012). The compaction test is used to estimate the maximum dry density and optimum moisture content of the tested soil. The result of the analysis is shown in Figure B-3.

B.8 DIRECT SHEAR TEST

Direct shear tests were completed on select samples by AP Engineering and Testing, Inc. of Pomona, California. The tests were completed in general accordance with ATSM D3080, Standard test method for direct shear test of soils under consolidated drained conditions. Direct shear test results are presented in Figure B-4.

B.9 R-VALUE TEST

The R-value of a sample in general accordance with ASTM D2844 Standard Test Method for Resistance R-Value and Expansion Pressure of Compacted Soils (ASTM, 2018). The result of the R-value test is shown in Figure B-5.

B.10 CORROSIVITY TESTING

Seven soil samples were submitted for chemical testing, which tested the samples for the corrosion parameters: sulfate and chloride concentrations, resistivity, and pH. The corrosion testing was performed using EPA, ASTM, or Caltrans-approved analytical methods. The following parameters were tested:

- **Sulfate and Chloride Concentration**: Sulfate is an ion that can lead to damage to metallic and concrete structures. Chloride is an ion that converts to hydrochloric acid, which can cause corrosion of metals. Also, its presence tends to decrease the soil resistivity. Chlorides may be found naturally in soils deposited as a result of brackish groundwater and historical geological sea beds, from high organic content, or from the presence of pollutants. The sulfate and chloride concentrations were determined in accordance with CTM 417 and 422, respectively.

Sulfate classification, as defined by ACI-318-14 (American Concrete Institute [ACI], 2014), is presented within Exhibit B-1 below:

Exhibit B-1: Sulfate Exposure

Dissolved Sulfate (SO_4) (ppm)	Sulfate Exposure
< 150	Negligible
150 - < 1,500	Moderate
1,500 – 10,000	Severe
> 10,000	Very Severe

NOTE:
ppm = parts per million

Chloride concentrations ≥ 500 parts per million (ppm) are corrosive to ferrous materials according to California Department of Transportation (Caltrans), 2003.

- **Resistivity**: Soil resistivity is a measure of the tendency for electrical currents produced during the corrosion process to flow freely through the electrolyte. A decrease in resistivity relates to an increase in potential corrosion activity. Roberge (2012) provides corrosivity ratings based on soil resistivity, and is presented in the table shown:

Exhibit B-2: Corrosivity Ratings Based on Soil Resistivity, Roberge (2012)

Soil Resistivity (ohm-cm)	Corrosivity Rating
> 20,000	Essentially non-corrosive
10,000 – 20,000	Mildly corrosive
5,000 – 10,000	Moderately corrosive
3,000 – 5,000	Corrosive
1,000 – 3,000	Highly corrosive
< 1,000	Extremely corrosive

NOTE:
ohm-cm = ohm centimeter

- **pH**: Soil pH is an indication of the acidity or alkalinity of soil and is measured in pH units. Soil pH is defined as the negative logarithm of the hydrogen ion concentration. The pH scale goes from 0 to 14 with a pH of 7 as the neutral point. As the amount of hydrogen ions in the soil increases, the soil pH decreases, thus becoming more acidic. Soils with a pH of 5.5 or less are considered damaging to concrete foundations when tested in accordance with Caltrans, 2003.

The results of the corrosion tests are presented in Figure B-6. The tests resulted with sulfate contents ranging from of 22 to 71 ppm, chloride contents ranging from 32 to 39 ppm, minimum resistivities ranging from 2,300 to 10,049 ohm centimeters, and pH levels ranging from 7.6 to 8.9. The minimum resistivity indicates mildly to highly corrosive potential. A specialist in corrosion-resistance design should review the results for any additional corrosion hazard mitigation actions.

B.11 REFERENCES

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U.S. Environmental Protection Agency (EPA), 1982, EPA Methods for Chemical Analysis for Water and Waste: Washington, D.C., EPA, Report no 300. EPA-600/4-79-020.

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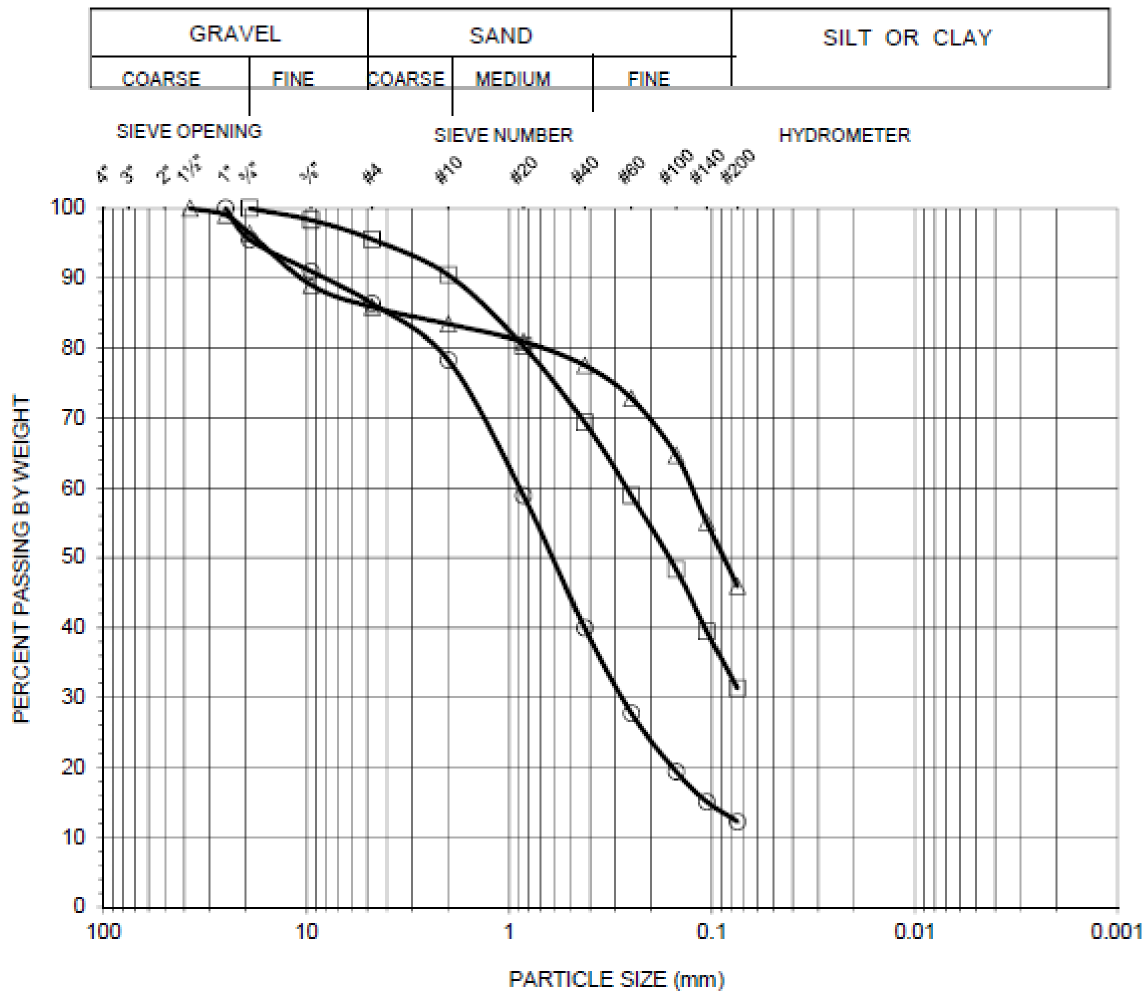
GRAIN SIZE DISTRIBUTION CURVE
ASTM D 6913

Client Name:	Shannon & Wilson, Inc.	Tested by:	DK	Date:	05/07/19
Project Name:	BNSF - Ono Siding	Computed by:	JP	Date:	05/07/19
Project Number:	51-1-10240-012	Checked by:	AP	Date:	05/07/19



Symbol	Boring No.	Sample No.	Sample Depth (feet)	Percent			Atterberg Limits LL:PL:PI	Soil Type U.S.C.S
				Gravel	Sand	Silt & Clay		
○	B-2	S-1	-	14	74	12	N/A	SW-SM
□	B-3	S-1	-	4	65	31	N/A	SM
△	B-4	S-1	-	14	40	46	N/A	SM

GRAIN SIZE DISTRIBUTION

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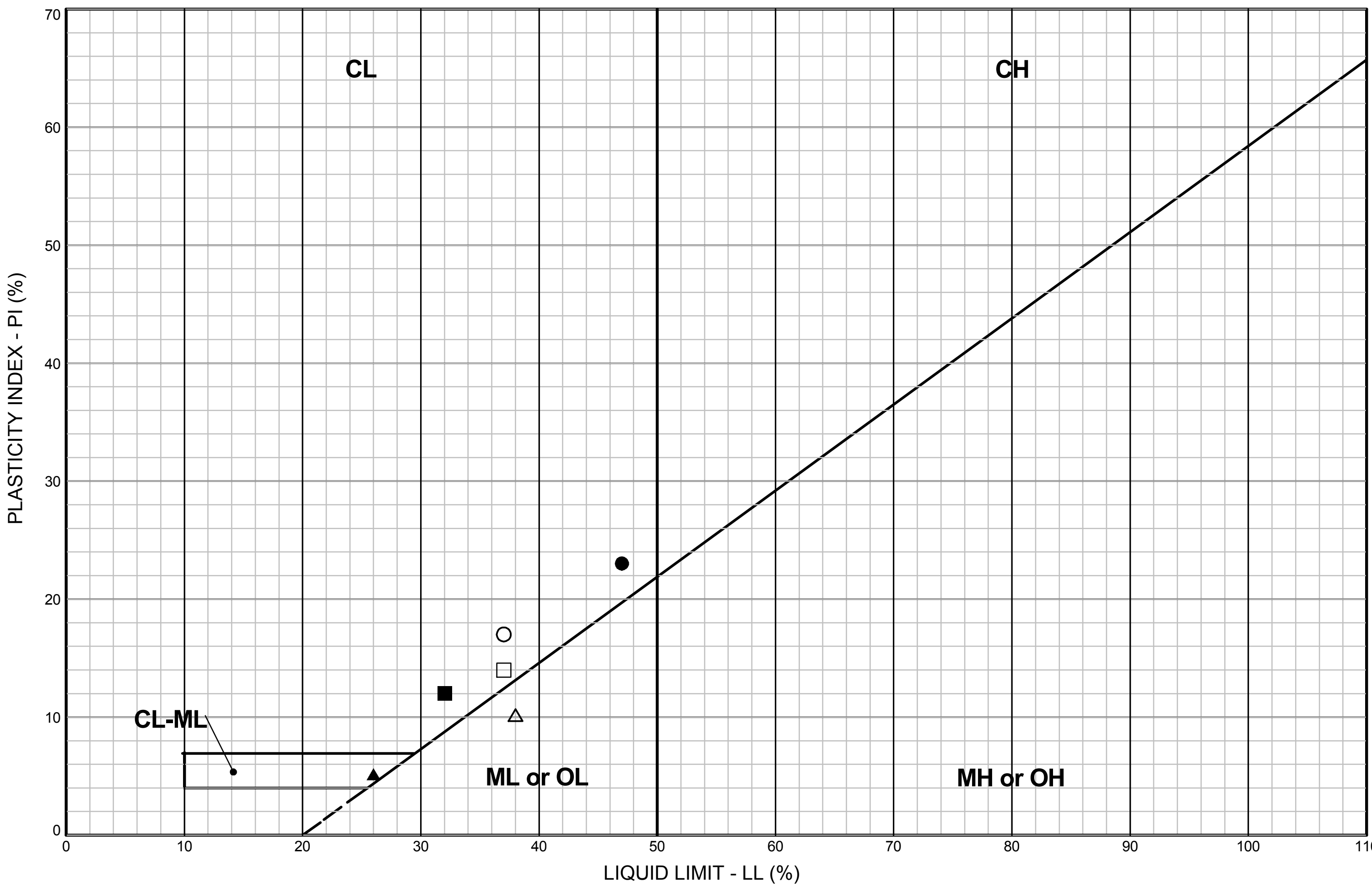
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. B-1



LEGEND

CL: Low plasticity inorganic clays; sandy and silty clays

CH: High plasticity inorganic clays

ML or OL: Inorganic and organic silts and clayey silts of low plasticity

MH or OH: Inorganic and organic silts and clayey silts of high plasticity

CL-ML: Silty clays and clayey silts

NP: Nonplastic

ATT_MAIN 100826-001.GPJ SHAN_WIL.GDT 1/9/19

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● B-4, S-6	20.0	CL	Lean Clay	47	24	23		
■ B-5, S-1	5.0	CL	Lean Clay	32	20	12		
▲ B-5, S-3	10.0	CL-ML	Silty Clay	26	21	5	12.9	
B-5, S-5	20.0	SP-SM	Poorly Graded Sand with Silt	NP	NP	NP		
○ B-8, S-3	7.5	CL	Lean Clay	37	20	17		
□ B-9, S-2	5.0	CL	Lean Clay	37	23	14		
△ B-10, S-2	5.0	ML	Sandy Silt	38	28	10		

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San Bernardino, CA

PLASTICITY CHART

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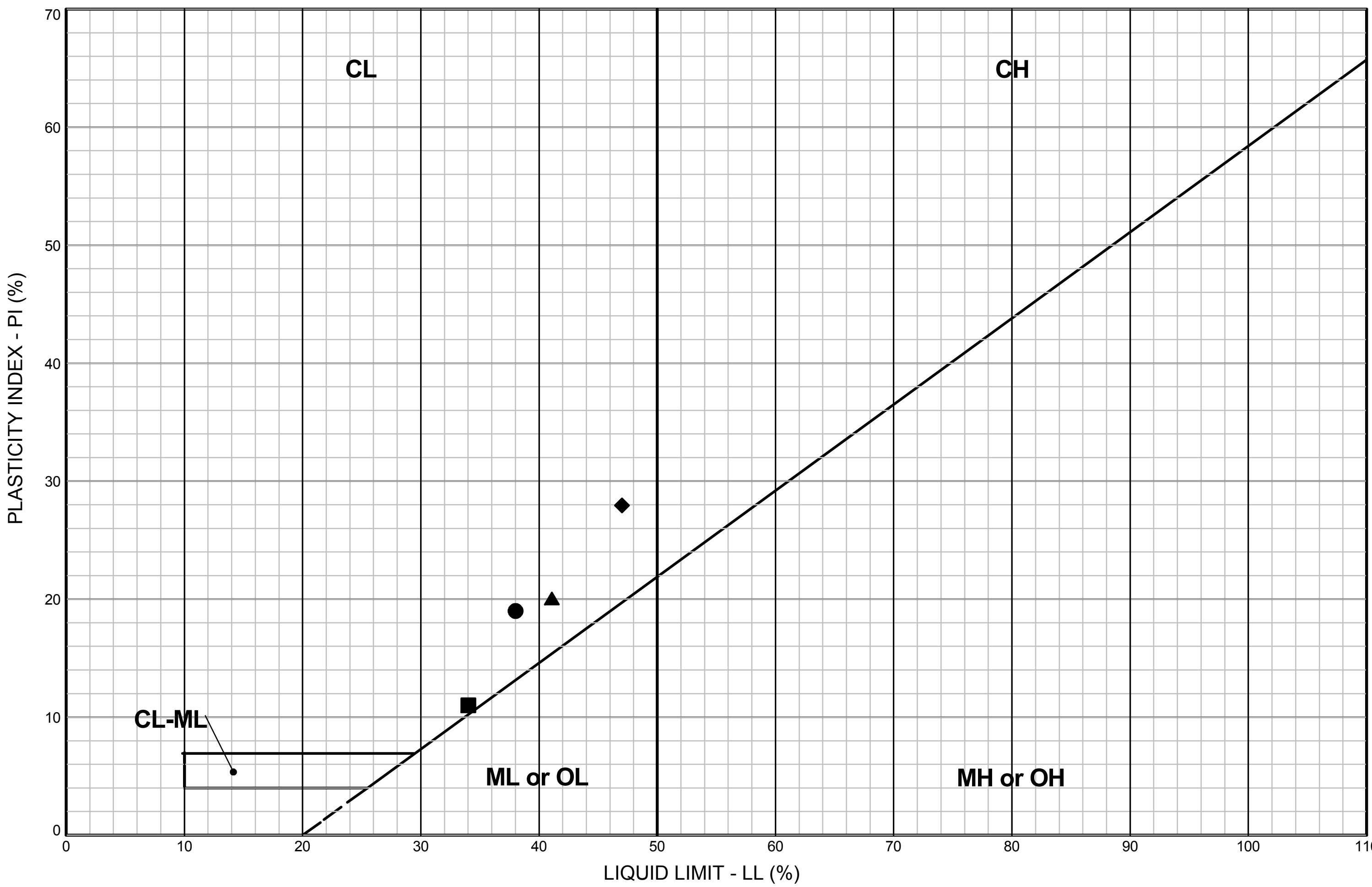
FIG. B-2
Sheet 1 of 3

FIG. B-2



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ML or OL: Inorganic and organic silts and clayey silts of low plasticity

MH or OH: Inorganic and organic silts and clayey silts of high plasticity

CL-ML: Silty clays and clayey silts

NP: Nonplastic

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● B-11, S-1	2.5	CL	Lean Clay	38	19	19		
■ B-12, S-5	15.0	CL	Lean Clay	34	23	11		
▲ B-13, S-1	2.5	CL	Lean Clay	41	21	20		
◆ B-14, S-1	2.5	CL	Lean Clay	47	19	28		

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San Bernardino, California

PLASTICITY CHART

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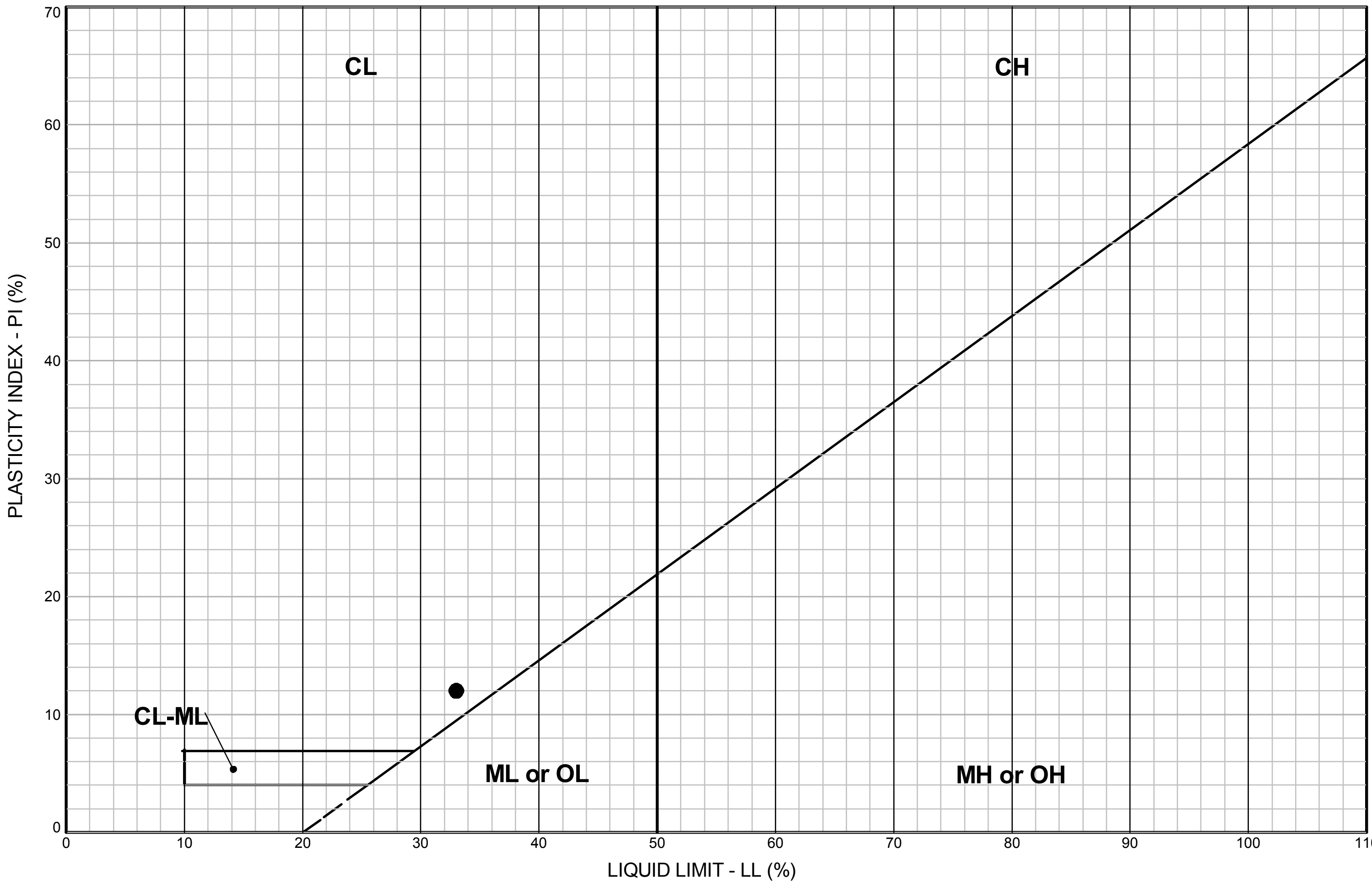
FIG. B-2
Sheet 2 of 3

FIG. B-2



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CL: Low plasticity inorganic clays; sandy and silty clays

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ML or OL: Inorganic and organic silts and clayey silts of low plasticity

MH or OH: Inorganic and organic silts and clayey silts of high plasticity

CL-ML: Silty clays and clayey silts

NP: Nonplastic

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● I-2, S-3	7.5	SC	Clayey Sand	33	21	12	16.0	39.7
I-2, S-7	17.5	ML	Sandy Lean Silt	NP	NP	NP	9.5	60.2

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Ono Lead Design - Infiltration Tests
San Bernardino, California

PLASTICITY CHART

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FIG. B-2
Sheet 3 of 3

FIG. B-2

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COMPACTION TEST

Client:	Shannon & Wilson, Inc.			AP Number:	19-0461
Project Name:	BNSF - Ono Siding	Tested By:	LS	Date:	05/06/19
Project No. :	51-1-10240-012	Calculated By:	JP	Date:	05/07/19
Boring No.:	B-2	Checked By:	AP	Date:	05/07/19
Sample No.:	S-1	Depth(ft.):	-		

Visual Sample Description: Well-Graded Sand w/silt

Compaction Method: [X] ASTM D1557 [ ] ASTM D698

METHOD: C
MOLD VOLUME (CU.FT): 0.0752

Preparation Method: [ ] Moist [X] Dry

Wt. Comp. Soil + Mold (gm.)	7386	7460	7219	7378		
Wt. of Mold (gm.)	2629	2629	2629	2629		
Net Wt. of Soil (gm.)	4757	4831	4590	4749		
Container No.						
Wt. of Container (gm.)	141.24	142.60	151.61	155.52		
Wet Wt. of Soil + Cont. (gm.)	488.87	564.29	602.36	665.33		
Dry Wt. of Soil + Cont. (gm.)	466.89	529.65	582.31	614.70		
Moisture Content (%)	6.75	8.95	4.66	11.03		
Wet Density (pcf)	139.46	141.63	134.56	139.22		
Dry Density (pcf)	130.64	129.99	128.58	125.40		

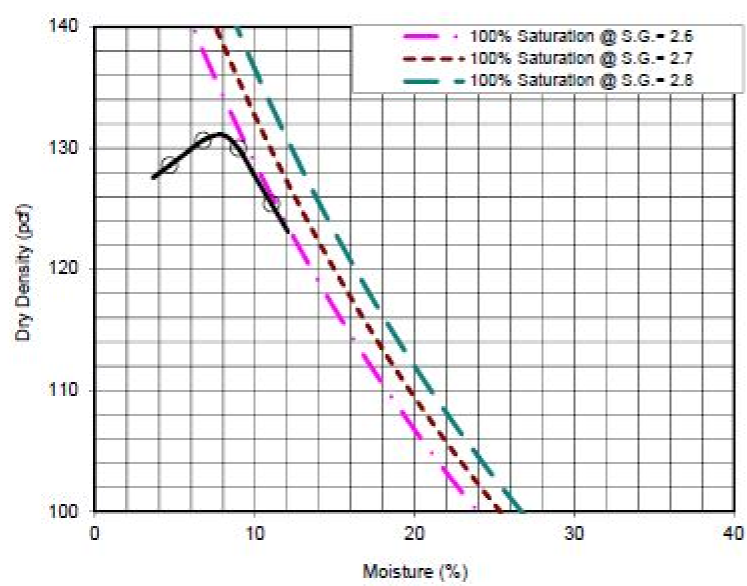
Maximum Dry Density (pcf)	131.1	Optimum Moisture Content (%)	7.9
Maximum Dry Density w/ Rock Correction (pcf)	N/A	Optimum Moisture Content w/ Rock Correction (%)	N/A

PROCEDURE USED

[ ] *METHOD A: Percent of Oversize:* *N/A*
Soil Passing No. 4 (4.75 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)

[ ] *METHOD B: Percent of Oversize:* *N/A*
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)

[X] *METHOD C: Percent of Oversize:* *4.5%*
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)



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COMPACTION TEST

Client:	Shannon & Wilson, Inc.			AP Number:	19-0461
Project Name:	BNSF - Ono Siding	Tested By:	JT	Date:	05/03/19
Project No. :	51-1-10240-012	Calculated By:	JP	Date:	05/07/19
Boring No.:	B-3	Checked By:	AP	Date:	05/07/19
Sample No.:	S-1	Depth(ft.):	-		

Visual Sample Description: Silty Sand

Compaction Method: [X] ASTM D1557 [ ] ASTM D698

METHOD: A

MOLD VOLUME (CU.FT): 0.0333

Preparation Method: [ ] Moist [X] Dry

Wt. Comp. Soil + Mold (gm.)	3889	3997	3917	3726		
Wt. of Mold (gm.)	1836	1836	1836	1836		
Net Wt. of Soil (gm.)	2053	2161	2081	1890		
Container No.						
Wt. of Container (gm.)	150.97	143.52	149.23	146.17		
Wet Wt. of Soil + Cont. (gm.)	437.32	449.73	477.43	494.94		
Dry Wt. of Soil + Cont. (gm.)	418.73	422.72	442.02	479.11		
Moisture Content (%)	6.94	9.67	12.09	4.75		
Wet Density (pcf)	135.78	142.92	137.63	125.00		
Dry Density (pcf)	126.97	130.32	122.78	119.33		

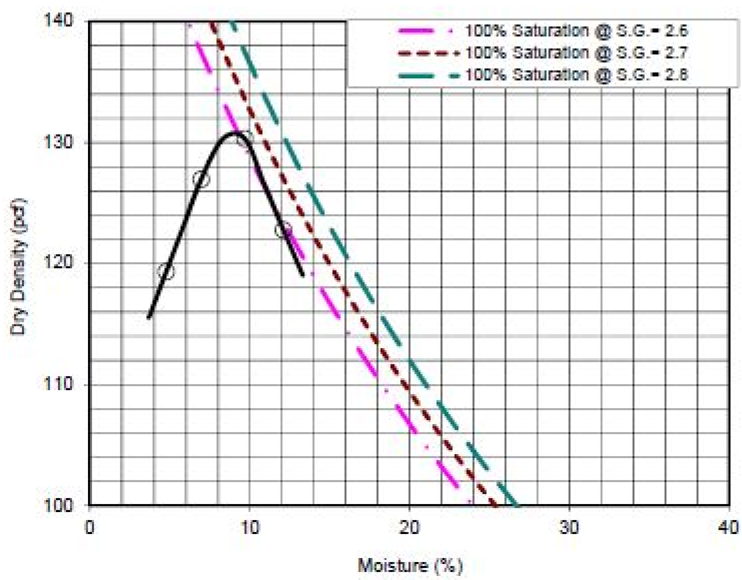
Maximum Dry Density (pcf)	130.5	Optimum Moisture Content (%)	9.0
Maximum Dry Density w/ Rock Correction (pcf)	N/A	Optimum Moisture Content w/ Rock Correction (%)	N/A

PROCEDURE USED

[X] *METHOD A: Percent of Oversize:* *4.6%*
Soil Passing No. 4 (4.75 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)

[ ] *METHOD B: Percent of Oversize:* *N/A*
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)

[ ] *METHOD C: Percent of Oversize:* *N/A*
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)



COMPACTION TEST

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FIG. B-3
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COMPACTION TEST

Client:	Shannon & Wilson, Inc.	AP Number:	19-0461
Project Name:	BNSF - Ono Siding	Tested By: AM	Date: 05/02/19
Project No. :	51-1-10240-012	Calculated By: JP	Date: 05/03/19
Boring No.:	B-4	Checked By: AP	Date: 05/07/19
Sample No.:	S-1	Depth(ft.): -	

Visual Sample Description: Silty Sand, fine-grained

Compaction Method: [X] ASTM D1557 [ ] ASTM D698

Preparation Method: [ ] Moist [X] Dry

METHOD: A
MOLD VOLUME (CU.FT): 0.0333

Wt. Comp. Soil + Mold (gm.)	3849	3872	3767	3837		
Wt. of Mold (gm.)	1836	1836	1836	1836		
Net Wt. of Soil (gm.)	2013	2036	1931	2001		
Container No.						
Wt. of Container (gm.)	137.16	147.81	134.23	136.80		
Wet Wt. of Soil + Cont. (gm.)	359.61	388.11	390.37	410.12		
Dry Wt. of Soil + Cont. (gm.)	338.56	360.65	371.34	374.63		
Moisture Content (%)	10.45	12.90	8.03	14.92		
Wet Density (pcf)	133.13	134.66	127.71	132.34		
Dry Density (pcf)	120.54	119.27	118.22	115.16		

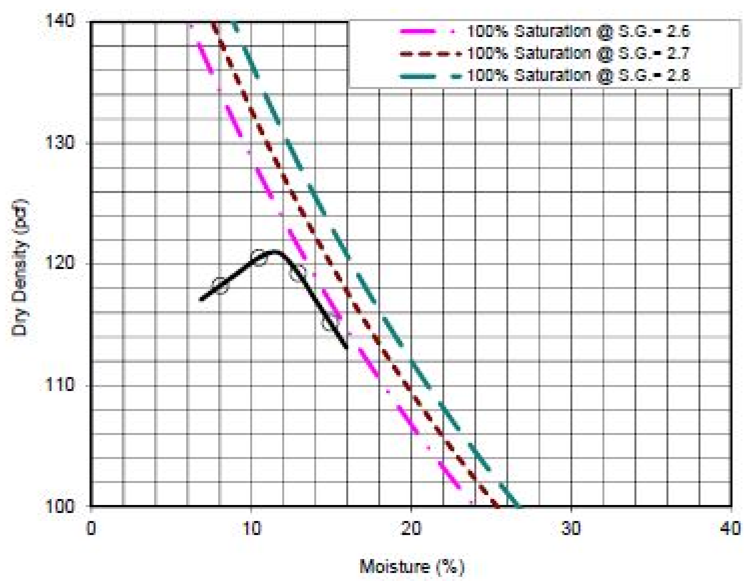
Maximum Dry Density (pcf): 121.0
Maximum Dry Density w/ Rock Correction (pcf): 126.0
Optimum Moisture Content (%): 11.5
Optimum Moisture Content w/ Rock Correction (%): 9.9

PROCEDURE USED

[X] *METHOD A: Percent of Oversize:* *14.2%*
Soil Passing No. 4 (4.75 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)

[ ] *METHOD B: Percent of Oversize:* *N/A*
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)

[ ] *METHOD C: Percent of Oversize:* *N/A*
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)



COMPACTION TEST

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FIG. B-3
Sheet 3 of 3

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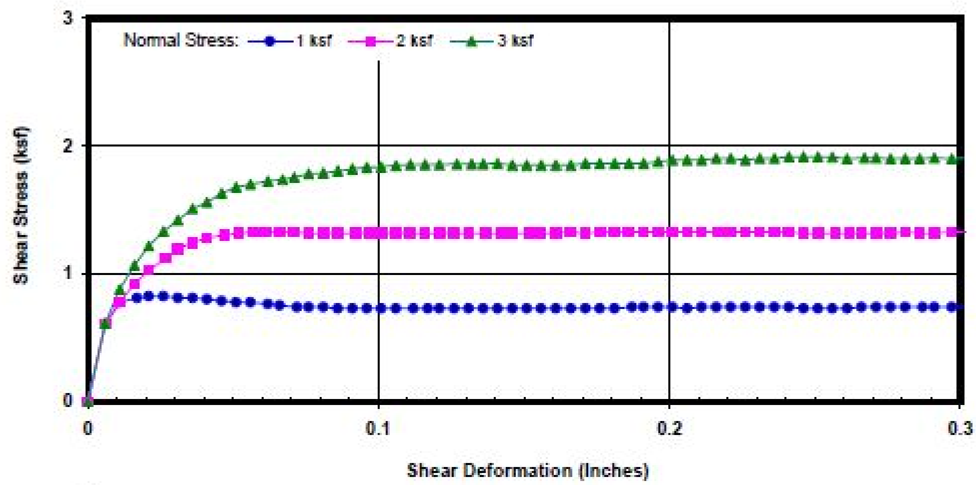
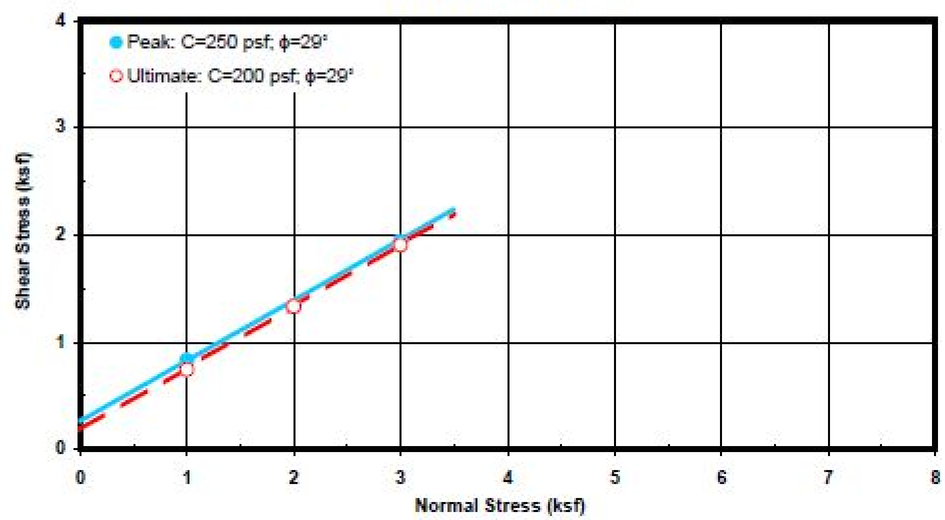
DIRECT SHEAR TEST RESULTS
ASTM D 3080

Project Name:	BNSF - Ono Siding	Tested By:	LS	Date:	05/06/19
Project No.:	51-1-10240-012	Computed By:	JP	Date:	05/07/19
Boring No.:	B-4	Checked by:	AP	Date:	05/07/19
Sample No.:	S-1 Depth (ft): -				
Sample Type:	Remolded to 90% RC at opt. MC				
Soil Description:	Silty Sand				
Test Condition:	Inundated Shear Type: Regular				

Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Initial Moisture Content (%)	Final Moisture Content (%)	Initial Degree Saturation (%)	Final Degree Saturation (%)	Normal Stress (ksf)	Peak Shear Stress (ksf)	Ultimate Shear Stress (ksf)
121.4	108.8	11.6	20.2	57	99	1	0.828	0.744
						2	1.332	1.332
						3	1.940	1.907





DIRECT SHEAR TEST

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FIG. B-4

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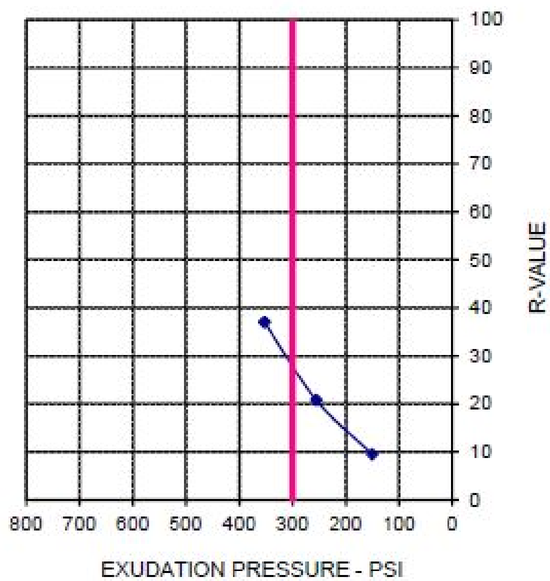
R-VALUE TEST DATA

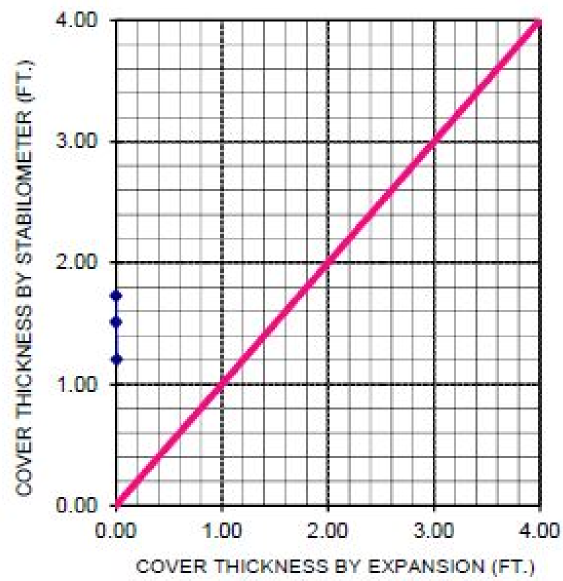
ASTM D2844

Project Name:	BNSF - Ono Siding	Tested By:	ST	Date:	05/01/19
Project Number:	51-1-10240-012	Computed By:	KM	Date:	05/06/19
Boring No.:	B-4	Checked By:	AP	Date:	05/07/19
Sample No.:	S-1	Depth (ft.):	-		
Location:	N/A				
Soil Description:	Silty Sand, fine-grained				

Mold Number	D	E	F	
Water Added, g	0	-18	-28	
Compact Moisture(%)	16.3	14.3	13.2	
Compaction Gage Pressure, psi	100	160	250	
Exudation Pressure, psi	150	256	353	
Sample Height, Inches	2.4	2.4	2.3	
Gross Weight Mold, g	3014	2991	2900	
Tare Weight Mold, g	1964	1955	1968	
Net Sample Weight, g	1049	1037	932	
Expansion, inchesx10^{-4}	0	0	2	
Stability 2,000 (160 psi)	58/132	46/106	34/70	
Turns Displacement	4.76	4.63	4.39	
R-Value Uncorrected	10	22	42	
R-Value Corrected	10	21	37	
Dry Density, pcf	113.9	114.5	108.4	
Traffic Index	8.0	8.0	8.0	
G.E. by Stability	1.73	1.51	1.20	
G.E. by Expansion	0.00	0.00	0.01	

R-VALUE	By Exudation:	28
	By Expansion:	*N/A
	At Equilibrium: (by Exudation)	28
Remarks	Gf = 1.34, and 4.9 % Retained on the ¾" *Not Applicable	





R-VALUE TEST DATA

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. B-5
Sheet 1 of 5

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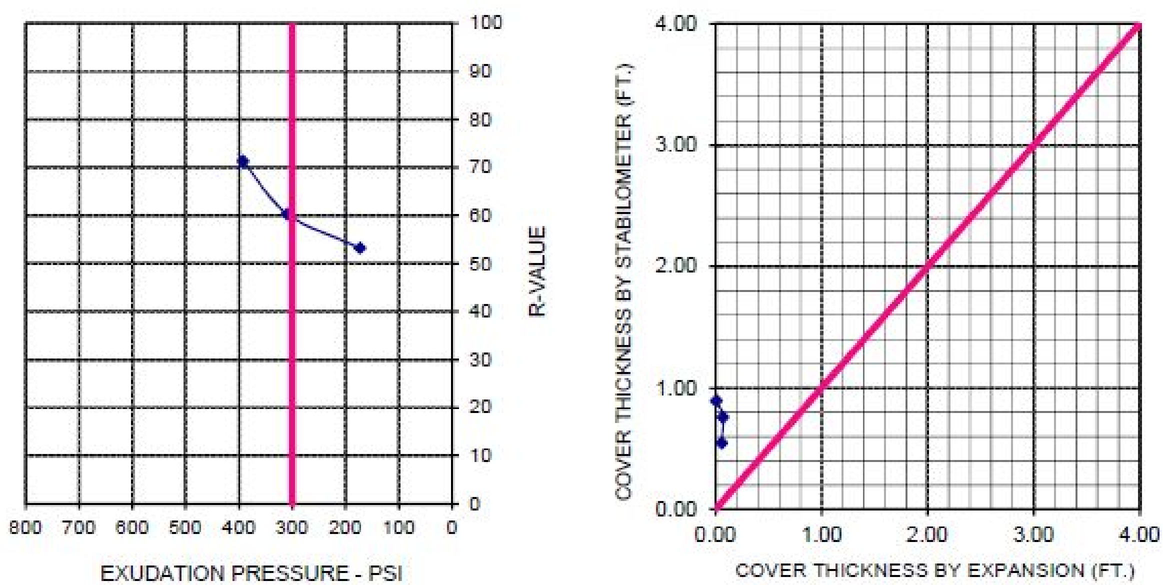
R-VALUE TEST DATA
ASTM D2844

Project Name:	BNSF - Ono Siding	Tested By:	ST	Date:	05/02/19
Project Number:	51-1-10240-012	Computed By:	KM	Date:	05/06/19
Boring No.:	B-7	Checked By:	AP	Date:	05/07/19
Sample No.:	S-1	Depth (ft.):	-		
Location:	N/A				
Soil Description:	Silty Sand				

Mold Number	H	I	I	
Water Added, g	-5	-15	-21	
Compact Moisture(%)	16.3	15.2	14.5	
Compaction Gage Pressure, psi	170	250	240	
Exudation Pressure, psi	173	309	392	
Sample Height, Inches	2.4	2.4	2.4	
Gross Weight Mold, g	2828	2806	2843	
Tare Weight Mold, g	1836	1818	1868	
Net Sample Weight, g	991	988	975	
Expansion, inchesx10^{-4}	2	21	17	
Stability 2,000 (160 psi)	24/44	20/35	12/24	
Turns Displacement	5.10	5.32	5.12	
R-Value Uncorrected	56	63	73	
R-Value Corrected	53	60	71	
Dry Density, pcf	107.6	108.3	107.5	
Traffic Index	8.0	8.0	8.0	
G.E. by Stability	0.89	0.76	0.55	
G.E. by Expansion	0.01	0.07	0.06	

R-VALUE	By Exudation:	60
	By Expansion:	*N/A
	At Equilibrium: (by Exudation)	60
Remarks	Gf = 1.34, and 0.2 % Retained on the ¾" *Not Applicable	



R-VALUE TEST DATA

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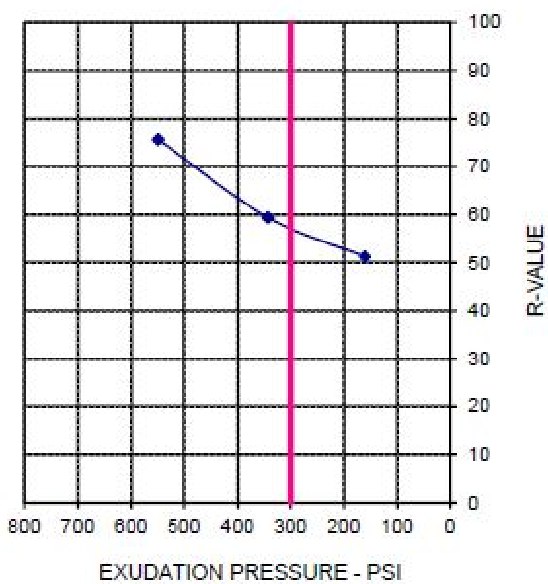
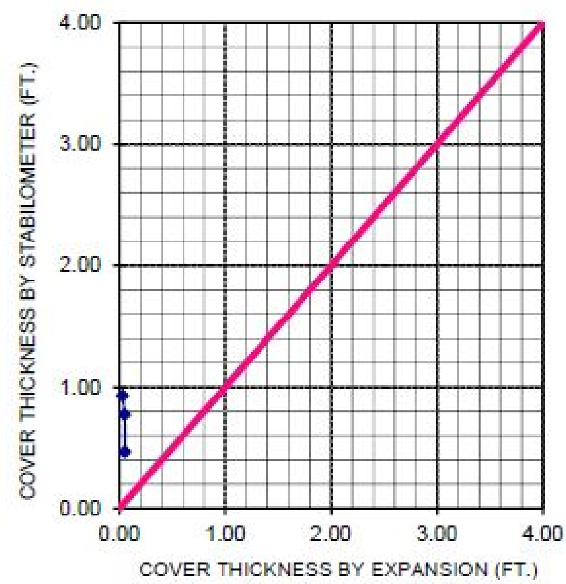
R-VALUE TEST DATA
ASTM D2844

Project Name:	BNSF - Ono Siding	Tested By:	ST	Date:	05/02/19
Project Number:	51-1-10240-012	Computed By:	KM	Date:	05/06/19
Boring No.:	B-8	Checked By:	AP	Date:	05/07/19
Sample No.:	S-1	Depth (ft.): -			
Location:	N/A				
Soil Description:	Silty Sand				

Mold Number	E	G	F	
Water Added, g	0	-15	-20	
Compact Moisture(%)	12.6	10.9	10.3	
Compaction Gage Pressure, psi	200	250	350	
Exudation Pressure, psi	161	343	549	
Sample Height, Inches	2.4	2.3	2.3	
Gross Weight Mold, g	2951	2816	2795	
Tare Weight Mold, g	1954	1827	1818	
Net Sample Weight, g	997	989	977	
Expansion, inchesx10^{-4}	9	15	16	
Stability 2,000 (160 psi)	26/46	19/33	10/18	
Turns Displacement	5.36	5.41	5.43	
R-Value Uncorrected	54	64	78	
R-Value Corrected	51	59	76	
Dry Density, pcf	111.8	117.5	116.7	
Traffic Index	8.0	8.0	8.0	
G.E. by Stability	0.93	0.78	0.47	
G.E. by Expansion	0.03	0.05	0.05	

R-VALUE		
	By Exudation:	57
	By Expansion:	*N/A
	At Equilibrium: (by Exudation)	57
Remarks	Gf = 1.34, and 0.9 % Retained on the ¾" *Not Applicable	





R-VALUE TEST DATA

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GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. B-5

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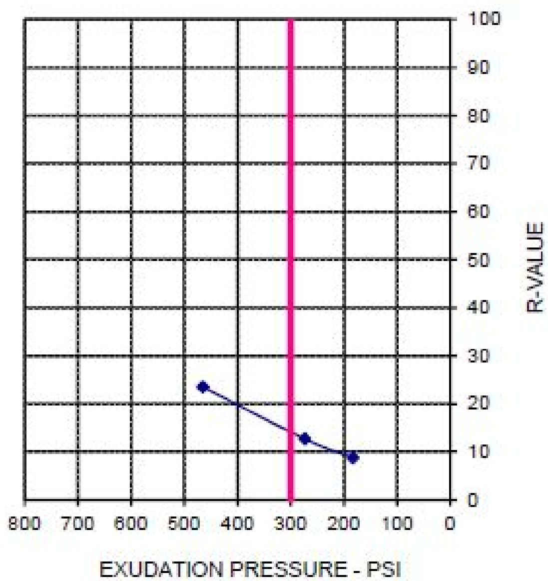
R-VALUE TEST DATA

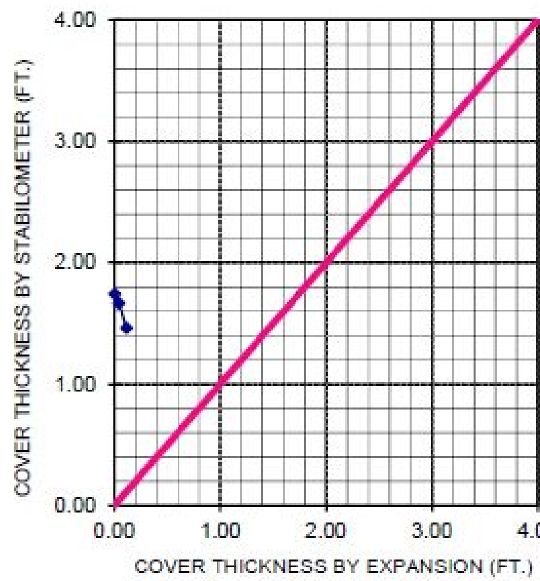
ASTM D2844

Project Name:	BNSF - Ono Siding	Tested By:	ST	Date:	05/02/19
Project Number:	51-1-10240-012	Computed By:	KM	Date:	05/06/19
Boring No.:	B-16	Checked By:	AP	Date:	05/07/19
Sample No.:	S-1	Depth (ft.):	-		
Location:	N/A				
Soil Description:	Sandy Clay				

Mold Number	A	B	C	
Water Added, g	0	-17	-30	
Compact Moisture(%)	18.4	16.5	15.1	
Compaction Gage Pressure, psi	100	200	250	
Exudation Pressure, psi	183	274	466	
Sample Height, Inches	2.5	2.5	2.4	
Gross Weight Mold, g	3002	2996	2980	
Tare Weight Mold, g	1967	1966	1968	
Net Sample Weight, g	1035	1030	1012	
Expansion, inchesx10^{-4}	1	13	34	
Stability 2,000 (160 psi)	62/136	52/124	42/96	
Turns Displacement	4.62	4.99	4.99	
R-Value Uncorrected	9	13	25	
R-Value Corrected	9	13	24	
Dry Density, pcf	105.9	107.1	111.0	
Traffic Index	8.0	8.0	8.0	
G.E. by Stability	1.74	1.67	1.46	
G.E. by Expansion	0.00	0.04	0.11	

R-VALUE	By Exudation:	14
	By Expansion:	*N/A
	At Equilibrium: (by Exudation)	14
Remarks	Gf = 1.34, and 0.5 % Retained on the ¾" *Not Applicable	





R-VALUE TEST DATA

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FIG. B-5

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R-VALUE TEST DATA
ASTM D2844

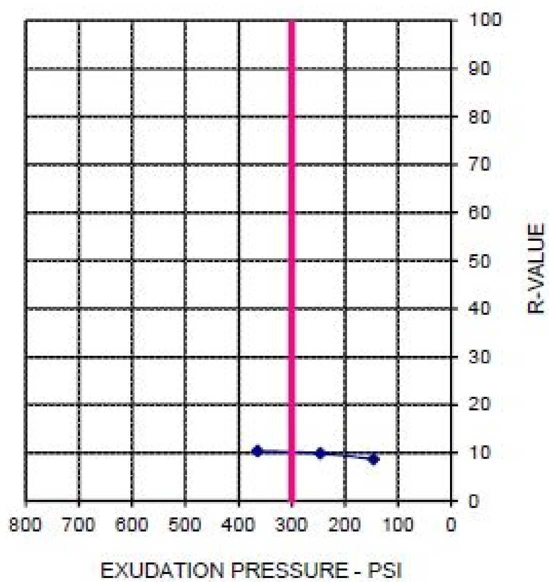
Project Name: BNSF - Ono Siding — Tested By: ST — Date: 05/01/19
Project Number: 51-1-10240-012 — Computed By: KM — Date: 05/06/19
Boring No.: B-18 — Checked By: AP — Date: 05/07/19
Sample No.: S-1 — Depth (ft.): -
Location: N/A
Soil Description: Sandy Clay

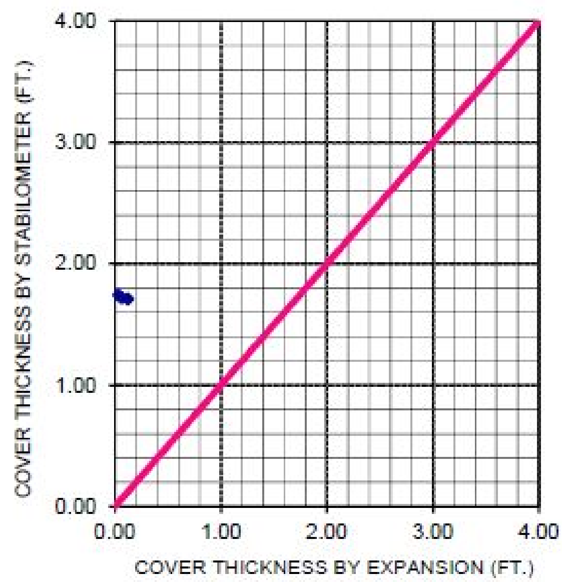
Mold Number	A	B	C	
Water Added, g	6	-6	-20	
Compact Moisture(%)	18.6	17.3	15.7	
Compaction Gage Pressure, psi	50	50	100	
Exudation Pressure, psi	146	246	364	
Sample Height, Inches	2.5	2.5	2.4	
Gross Weight Mold, g	3024	3017	3008	
Tare Weight Mold, g	1967	1966	1968	
Net Sample Weight, g	1057	1051	1040	
Expansion, inchesx10^{-4}	10	19	36	
Stability 2,000 (160 psi)	64/136	63/134	61/132	
Turns Displacement	4.66	4.41	4.34	
R-Value Uncorrected	9	10	11	
R-Value Corrected	9	10	10	
Dry Density, pcf	108.0	108.6	113.5	
Traffic Index	8.0	8.0	8.0	
G.E. by Stability	1.75	1.72	1.71	
G.E. by Expansion	0.03	0.06	0.12	

R-VALUE		
	By Exudation:	10
	By Expansion:	*N/A
	At Equilibrium: (by Exudation)	10

Remarks

Gf = 1.34, and 1.8 % Retained on the ¾"
*Not Applicable





R-VALUE TEST DATA

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CORROSION TEST RESULTS

Client Name: Shannon & Wilson, Inc.
Project Name: BNSF - Ono Siding
Project No.: 51-1-10240-012

AP Job No.: 19-0461
Date: 05/02/19

Boring No.	Sample No.	Depth (feet)	Soil Type	Minimum Resistivity (ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
B-2	S-1	-	SW-SM	7091	7.6	28	36
B-3	S-1	-	SM	4167	8.7	47	35
B-4	S-1	-	SM	4544	8.6	22	34
B-7	S-1	-	SM	10049	8.7	39	33
B-8	S-1	-	SM	8254	8.7	36	32
B-16	S-1	-	CL	2703	8.9	71	39
B-18	S-1	-	CL	2300	8.8	34	35

NOTES:
Resistivity Test and pH: California Test Method 643
Sulfate Content : California Test Method 417
Chloride Content : California Test Method 422
ND = Not Detectable
NA = Not Sufficient Sample
NR = Not Requested

CORROSION TEST

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. B-6

APPENDIX C: ANALYTICAL RESULTS

Appendix C

Analytical Results

CONTENTS

- American Environmental Testing Laboratory, Inc. (AETL), 2019, BNSF San Bernardino Ono Siding analytical results: Report prepared by AETL, Burbank, California, job no. 97573, for Shannon & Wilson, Glendale, California, May 10, 2019, 18 pages.

ANALYTICAL RESULTS

We collected three composite samples from materials generated within the Ono Lead Track Extension Project. Sample S-1 collected materials generated in Borings B-7 through B-10 at Rancho East Lot. Sample S-2 collected materials generated in Borings B-1 through B-6, and Sample S-3 collected materials generated in Borings B-11 through B-17 at the Elliott Block Property. Representative composite samples of the generated investigation-derived waste were collected from the full depths of the borings.

Each sample was analyzed for the following:

- California Title 22 Metals (CAM-17), including Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Copper, Lead, Mercury, Molybdenum, Nickel, Selenium, Silver, Thallium, Vanadium and Zinc using U.S. Environmental Protection Agency (EPA) Method 6010B/6020/7471A;
- Volatile Organic Compounds (VOCs) using EPA Method 8260B;
- Total Petroleum Hydrocarbons as Diesel and Heavy Hydrocarbons using EPA Method 8015D; and
- Total Petroleum Hydrocarbons as Gasoline Light Hydrocarbons using EPA Method 8015G.

The analytical results indicated that:

- No gasoline-range hydrocarbons or VOCs were detected in any of the composite samples;
- No diesel-range hydrocarbons were detected in any of the composite samples; and
- Metals including barium, chromium, cobalt, copper, lead, nickel, vanadium, and zinc where detected in in all three of the composite samples.

Based on the analytical results, the drums were disposed of by Haz Mat Trans Inc.

American Environmental Testing Laboratory Inc.
2834 & 2908 North Naomi Street Burbank, CA 91504 • DOHS NO: 1541, LACSD NO: 10181
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Ordered By

Shannon & Wilson **664 W. Broadway Ave., Ste 201** **Glendale, CA 91204-**	**Number of Pages** 13 **Date Received** 05/02/2019 **Date Reported** 05/10/2019

Telephone: (818)539-8420
Attention: Lorena Manriquez

Job Number	Order Date	Client
97573	05/02/2019	SH&W

Project ID: 51-1-10240-012
Project Name: BNSF San Bernardino
Site: One Siding
San Bernardino, CA

Enclosed please find results of analyses of 3 soil samples which were analyzed as specified on the attached chain of custody. If there are any questions, please do not hesitate to call.

Checked By: ____________ Approved By: C. Razmara

Cyrus Razmara, Ph.D.
Laboratory Director

AMERICAN ENVIRONMENTAL TESTING LABORATORY
2834 NORTH NAOMI ST. BURBANK, CALIFORNIA 91504 DHS # 1541 LACSD# 10181
TEL (888) 288-AETL (818) 845-8200 FAX (818) 845-8840 www.aetlab.com

CHAIN OF CUSTODY RECORD

111535

AETL JOB No. 97573

COMPANY: Shannon & Wilson
PROJECT MANAGER: Lorena Manriquez
COMPANY ADDRESS: 664 W. Broadway, Glendale 91204
PHONE: 818-543-4560
FAX: 206-695-6777
PROJECT NAME: BNSF San Bernardino - Ono Siding
PROJECT #: 51-1-10240-012
SITE NAME AND ADDRESS: Ono Siding, San Bernardino, CA
PO #:

	SAMPLE ID	LAB ID	DATE	TIME	MATRIX	CONTAINER NUMBER/SIZE	PRES.	VOC by GC/MS (8260B)	TPH-Gasoline/Lt. Hydrocarbons (M8015G)	TPH-Diesel/Heavy Hydrocarbons (M8015D)	Title 22 Metals (6010B/7000CAM)						TEST INSTRUCTIONS & COMMENTS
1	S-1	97573.01	5/2/19	0930		1×9oz	ice	/	/	/	/						
2	S-2	97573.02	5/2/19	0940		1×9oz	ice	/	/	/	/						
3	S-3	97573.03	5/2/19	0950		1×9oz	ice	/	/	/	/						
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	

SAMPLE RECEIPT - TO BE FILLED BY LABORATORY

TOTAL NUMBER OF CONTAINERS	3	PROPERLY COOLED Y / N / NA	
CUSTODY SEALS Y / N / NA		SAMPLES INTACT Y / N / NA	
RECEIVED IN GOOD COND. Y / N		SAMPLES ACCEPTED Y / N	

TURN AROUND TIME

☒ NORMAL ☐ RUSH ☐ SAME DAY ☐ NEXT DAY ☐ 2 DAYS ☐ 3 DAYS

DATA DELIVERABLE REQUIRED

☐ HARD COPY
☐ PDF
☐ GEOTRACKER (GLOBAL ID) ______
☐ OTHER (PLEASE SPECIFY) ______

	1.	2.	3.
RELINQUISHED BY (SAMPLER) / RELINQUISHED BY	Signature: K.R. Printed Name: Katelyn Ruiz Date: 5/2/19 Time: 1030	Signature: Printed Name: Date: Time:	Signature: Printed Name: Date: Time:
RECEIVED BY / RECEIVED BY LABORATORY	Signature: Printed Name: Date: Time:	Signature: Printed Name: Date: Time:	AETL Signature: Printed Name: Ant Date: 05/02/19 Time: 1030

DISTRIBUTION: WHITE - Laboratory, CANARY - Laboratory, PINK - Project/Account Manager, YELLOW - Sampler/Originator

AMERICAN ENVIRONMENTAL TESTING LABORATORY
2834 NORTH NAOMI ST. BURBANK, CALIFORNIA 91504 DHS # 1541 LACSD# 10181
TEL (888) 288-AETL (818) 845-8200 FAX (818) 845-8840 www.aetlab.com

COOLER RECEIPT FORM

Client Name: Shannon & Wilson
Project Name:
AETL Job Number: 97573
Date Received: 05/02/19 Received by: Ant
Carrier: ☐ AETL Courier ☒ Client ☐ GSO ☐ FedEx ☐ UPS
☐ Others:

Samples were received in: ☒ Cooler (1) ☐ Other (Specify):
Inside temperature of shipping container No 1: 3.2°C, No 2: , No 3:
Type of sample containers: ☐ VOA, ☐ Glass bottles, ☒ Wide mouth jars, ☐ HDPE bottles, ☐ Metal sleeves, ☐ Others (Specify):
How are samples preserved: ☐ None, ☒ Ice , ☐ Blue Ice, ☐ Dry Ice
☒ None, ☐ HNO_3, ☐ NaOH, ☐ ZnOAc, ☐ HCl, ☐ $Na_2S_2O_3$, ☐ MeOH
☐ Other (Specify):

	Yes	No, explain below	Name, if client was notified.
1. Are the COCs Correct?	X		
2. Are the Sample labels legible?	X		
3. Do samples match the COC?	X		
4. Are the required analyses clear?	X		
5. Is there enough samples for required analysis?	X		
6. Are samples sealed with evidence tape?		X	
7. Are sample containers in good condition?	X		
8. Are samples preserved?	X		
9. Are samples preserved properly for the intended analysis?	X		
10. Are the VOAs free of headspace?	NA		
11. Are the jars free of headspace?	✓		

Explain all "No" answers for above questions:

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Ordered By

Shannon & Wilson 664 W. Broadway Ave., Ste 201 Glendale, CA 91204-	Project ID: 51-1-10240-012 Date Received 05/02/2019 Date Reported 05/10/2019

Telephone: (818)539-8420
Attention: Lorena Manriquez

Job Number	Order Date	Client
97573	05/02/2019	SH&W

CERTIFICATE OF ANALYSIS
CASE NARRATIVE

AETL received 3 samples with the following specification on 05/02/2019.

Lab ID	Sample ID	Sample Date	Matrix	Quantity Of Containers
97573.01	S-1	05/02/2019	Soil	1
97573.02	S-2	05/02/2019	Soil	1
97573.03	S-3	05/02/2019	Soil	1

Method ^ Submethod	*Req Date*	*Priority*	*TAT*	*Units*
(6010B/7000CAM)	05/09/2019	2	Normal	mg/Kg
(8260B)	05/09/2019	2	Normal	ug/Kg
(M8015D) ^ C13-C40	05/09/2019	2	Normal	mg/Kg
(M8015G)	05/09/2019	2	Normal	mg/Kg

The samples were analyzed as specified on the enclosed chain of custody. Analytical non-conformances have been noted on the report.

Unless otherwise noted, all results of soil and solid samples are based on wet weight.

Checked By: ______________ Approved By: C. Razmara

Cyrus Razmara, Ph.D.
Laboratory Director

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ANALYTICAL RESULTS

Ordered By

Shannon & Wilson
664 W. Broadway Ave., Ste 201
Glendale, CA 91204-

Site

One Siding
San Bernardino, CA

Telephone: (818)539-8420
Attn: Lorena Manriquez
Page: **2**

Project ID: 51-1-10240-012
Project Name: BNSF San Bernardino

AETL Job Number	Submitted	Client
97573	05/02/2019	SH&W

Method: (8260B), Volatile Organic Compounds by GC/MS (SW846)

QC Batch No: 0503192A1

Our Lab I.D.			Method Blank	97573.01	97573.02	97573.03	
Client Sample I.D.				S-1	S-2	S-3	
Date Sampled				05/02/2019	05/02/2019	05/02/2019	
Date Prepared			05/03/2019	05/03/2019	05/03/2019	05/03/2019	
Preparation Method			5030	5030	5030	5030	
Date Analyzed			05/03/2019	05/03/2019	05/03/2019	05/03/2019	
Matrix			Soil	Soil	Soil	Soil	
Units			ug/Kg	ug/Kg	ug/Kg	ug/Kg	
Dilution Factor			1	1	1	1	
Analytes	**MDL**	**PQL**	**Results**	**Results**	**Results**	**Results**	
Acetone	25	50	ND	ND	ND	ND	
Benzene	1.0	10.0	ND	ND	ND	ND	
Bromobenzene (Phenyl bromide)	5.0	10.0	ND	ND	ND	ND	
Bromochloromethane	5.0	10.0	ND	ND	ND	ND	
Bromodichloromethane	5.0	10.0	ND	ND	ND	ND	
Bromoform (Tribromomethane)	25	50	ND	ND	ND	ND	
Bromomethane (Methyl bromide)	15	30	ND	ND	ND	ND	
2-Butanone (MEK)	25	50	ND	ND	ND	ND	
n-Butylbenzene	5.0	10.0	ND	ND	ND	ND	
sec-Butylbenzene	5.0	10.0	ND	ND	ND	ND	
tert-Butylbenzene	5.0	10.0	ND	ND	ND	ND	
Carbon Disulfide	25	50	ND	ND	ND	ND	
Carbon tetrachloride	5.0	10.0	ND	ND	ND	ND	
Chlorobenzene	5.0	10.0	ND	ND	ND	ND	
Chloroethane	15	30	ND	ND	ND	ND	
2-Chloroethyl vinyl ether	50	50	ND	ND	ND	ND	
Chloroform (Trichloromethane)	5.0	10.0	ND	ND	ND	ND	
Chloromethane (Methyl chloride)	15	30	ND	ND	ND	ND	
2-Chlorotoluene	5.0	10.0	ND	ND	ND	ND	
4-Chlorotoluene	5.0	10.0	ND	ND	ND	ND	
1,2-Dibromo-3-chloropropane (DBCP)	5.0	10.0	ND	ND	ND	ND	
Dibromochloromethane	5.0	10.0	ND	ND	ND	ND	
1,2-Dibromoethane (EDB)	5.0	10.0	ND	ND	ND	ND	
Dibromomethane	5.0	10.0	ND	ND	ND	ND	
1,2-Dichlorobenzene	5.0	10.0	ND	ND	ND	ND	
1,3-Dichlorobenzene	5.0	10.0	ND	ND	ND	ND	
1,4-Dichlorobenzene	5.0	10.0	ND	ND	ND	ND	
Dichlorodifluoromethane	15	30	ND	ND	ND	ND	

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ANALYTICAL RESULTS

Project ID: 51-1-10240-012
Project Name: BNSF San Bernardino

AETL Job Number	Submitted	Client
97573	05/02/2019	SH&W

Method: (8260B), Volatile Organic Compounds by GC/MS (SW846)

QC Batch No: 0503192A1

Our Lab I.D.			Method Blank	97573.01	97573.02	97573.03	
Client Sample I.D.				S-1	S-2	S-3	
Date Sampled				05/02/2019	05/02/2019	05/02/2019	
Date Prepared			05/03/2019	05/03/2019	05/03/2019	05/03/2019	
Preparation Method			5030	5030	5030	5030	
Date Analyzed			05/03/2019	05/03/2019	05/03/2019	05/03/2019	
Matrix			Soil	Soil	Soil	Soil	
Units			ug/Kg	ug/Kg	ug/Kg	ug/Kg	
Dilution Factor			1	1	1	1	
Analytes	**MDL**	**PQL**	**Results**	**Results**	**Results**	**Results**	
1,1-Dichloroethane	5.0	10.0	ND	ND	ND	ND	
1,2-Dichloroethane (EDC)	5.0	10.0	ND	ND	ND	ND	
1,1-Dichloroethene	5.0	10.0	ND	ND	ND	ND	
cis-1,2-Dichloroethene	5.0	10.0	ND	ND	ND	ND	
trans-1,2-Dichloroethene	5.0	10.0	ND	ND	ND	ND	
1,2-Dichloropropane	5.0	10.0	ND	ND	ND	ND	
1,3-Dichloropropane	5.0	10.0	ND	ND	ND	ND	
2,2-Dichloropropane	5.0	10.0	ND	ND	ND	ND	
1,1-Dichloropropene	5.0	10.0	ND	ND	ND	ND	
cis-1,3-Dichloropropene	5.0	10.0	ND	ND	ND	ND	
trans-1,3-Dichloropropene	5.0	10.0	ND	ND	ND	ND	
Ethylbenzene	1.0	10.0	ND	ND	ND	ND	
Hexachlorobutadiene	15	30	ND	ND	ND	ND	
2-Hexanone	25	50	ND	ND	ND	ND	
Iodomethane	5.0	10.0	ND	ND	ND	ND	
Isopropylbenzene	5.0	10.0	ND	ND	ND	ND	
p-Isopropyltoluene	5.0	10.0	ND	ND	ND	ND	
4-Methyl-2-pentanone (MIBK)	25	50	ND	ND	ND	ND	
Methyl-tert-butyl ether (MTBE)	2.0	10.0	ND	ND	ND	ND	
Methylene chloride (DCM)	25	50	ND	ND	ND	ND	
Naphthalene	5.0	10.0	ND	ND	ND	ND	
n-Propylbenzene	5.0	10.0	ND	ND	ND	ND	
Styrene	5.0	10.0	ND	ND	ND	ND	
1,1,1,2-Tetrachloroethane	5.0	10.0	ND	ND	ND	ND	
1,1,2,2-Tetrachloroethane	5.0	10.0	ND	ND	ND	ND	
Tetrachloroethene	2.0	10.0	ND	ND	ND	ND	
Toluene (Methyl benzene)	1.0	10.0	ND	ND	ND	ND	
1,2,3-Trichlorobenzene	5.0	10.0	ND	ND	ND	ND	
1,2,4-Trichlorobenzene	5.0	10.0	ND	ND	ND	ND	
1,1,1-Trichloroethane	5.0	10.0	ND	ND	ND	ND	
1,1,2-Trichloroethane	5.0	10.0	ND	ND	ND	ND	
Trichloroethene	1.5	10.0	ND	ND	ND	ND	
Trichlorofluoromethane	5.0	10.0	ND	ND	ND	ND	
1,2,3-Trichloropropane	1.0	5.0	ND	ND	ND	ND	

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ANALYTICAL RESULTS

Project ID: 51-1-10240-012
Project Name: BNSF San Bernardino

AETL Job Number	Submitted	Client
97573	05/02/2019	SH&W

Method: (8260B), Volatile Organic Compounds by GC/MS (SW846)

QC Batch No: 0503192A1

Our Lab I.D.			Method Blank	**97573.01**	**97573.02**	**97573.03**	
Client Sample I.D.				S-1	S-2	S-3	
Date Sampled				05/02/2019	05/02/2019	05/02/2019	
Date Prepared			05/03/2019	05/03/2019	05/03/2019	05/03/2019	
Preparation Method			5030	5030	5030	5030	
Date Analyzed			05/03/2019	05/03/2019	05/03/2019	05/03/2019	
Matrix			Soil	Soil	Soil	Soil	
Units			ug/Kg	ug/Kg	ug/Kg	ug/Kg	
Dilution Factor			1	1	1	1	
Analytes	**MDL**	**PQL**	**Results**	**Results**	**Results**	**Results**	
1,2,4-Trimethylbenzene	5.0	10.0	ND	ND	ND	ND	
1,3,5-Trimethylbenzene	5.0	10.0	ND	ND	ND	ND	
Vinyl Acetate	25	50	ND	ND	ND	ND	
Vinyl chloride (Chloroethene)	5.0	10.0	ND	ND	ND	ND	
o-Xylene	1.0	10.0	ND	ND	ND	ND	
m,p-Xylenes	1.0	20.0	ND	ND	ND	ND	
Our Lab I.D.			Method Blank	**97573.01**	**97573.02**	**97573.03**	
Surrogates	**%Rec.Limit**		**% Rec.**	**% Rec.**	**% Rec.**	**% Rec.**	
Bromofluorobenzene	75-125		99.7	97.5	97.7	102	
Dibromofluoromethane	75-125		102	99.1	98.3	103	
Toluene-d8	75-125		105	105	105	104	

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Project ID: 51-1-10240-012
Project Name: BNSF San Bernardino

AETL Job Number	Submitted	Client
97573	05/02/2019	SH&W

Method: (M8015G), TPH as Gasoline and Light Hydrocarbons Using GC/FID

QC Batch No: 050319OB1

Our Lab I.D.			Method Blank	97573.01	97573.02	97573.03	
Client Sample I.D.				S-1	S-2	S-3	
Date Sampled				05/02/2019	05/02/2019	05/02/2019	
Date Prepared			05/03/2019	05/02/2019	05/02/2019	05/02/2019	
Preparation Method			5030	5030	5030	5030	
Date Analyzed			05/03/2019	05/03/2019	05/03/2019	05/03/2019	
Matrix			Soil	Soil	Soil	Soil	
Units			mg/Kg	mg/Kg	mg/Kg	mg/Kg	
Dilution Factor			1	1	1	1	
Analytes	**MDL**	**PQL**	**Results**	**Results**	**Results**	**Results**	
TPH as Gasoline and Light HC. (C4-C12)	0.100	1.000	ND	ND	ND	ND	
Our Lab I.D.			Method Blank	97573.01	97573.02	97573.03	
Surrogates	**%Rec.Limit**		**% Rec.**	**% Rec.**	**% Rec.**	**% Rec.**	
Bromofluorobenzene	75-125		118	110	112	112	

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Project ID: 51-1-10240-012
Project Name: BNSF San Bernardino

AETL Job Number	Submitted	Client
97573	05/02/2019	SH&W

Method: (M8015D), TPH as Diesel and Heavy Hydrocarbons Using GC/FID

QC Batch No: 050319PB1

Our Lab I.D.			Method Blank	97573.01	97573.02	97573.03	
Client Sample I.D.				S-1	S-2	S-3	
Date Sampled				05/02/2019	05/02/2019	05/02/2019	
Date Prepared			05/03/2019	05/03/2019	05/03/2019	05/03/2019	
Preparation Method			3550B	3550B	3550B	3550B	
Date Analyzed			05/03/2019	05/03/2019	05/03/2019	05/03/2019	
Matrix			Soil	Soil	Soil	Soil	
Units			mg/Kg	mg/Kg	mg/Kg	mg/Kg	
Dilution Factor			1	1	1	1	
Analytes	**MDL**	**PQL**	**Results**	**Results**	**Results**	**Results**	
TPH as Diesel (C13-C22)	1.0	5.0	ND	ND	ND	ND	
TPH as Heavy Hydrocarbons (C23-C40)	1.0	5.0	ND	ND	ND	ND	
TPH Total as Diesel and Heavy HC.C13-C40	1.0	5.0	ND	ND	ND	ND	
Our Lab I.D.			Method Blank	97573.01	97573.02	97573.03	
Surrogates	%Rec.Limit		% Rec.	% Rec.	% Rec.	% Rec.	
Chlorobenzene	75-125		120	116	118	117	

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Project ID: 51-1-10240-012
Project Name: BNSF San Bernardino

AETL Job Number	Submitted	Client
97573	05/02/2019	SH&W

Method: (6010B/7000CAM), Title 22 Metals (SW-846)

QC Batch No: 0506192C1

Our Lab I.D.			Method Blank	97573.01	97573.02	97573.03	
Client Sample I.D.				S-1	S-2	S-3	
Date Sampled				05/02/2019	05/02/2019	05/02/2019	
Date Prepared			05/06/2019	05/06/2019	05/06/2019	05/06/2019	
Preparation Method			3050B	3050B	3050B	3050B	
Date Analyzed			05/06/2019	05/06/2019	05/06/2019	05/06/2019	
Matrix			Soil	Soil	Soil	Soil	
Units			mg/Kg	mg/Kg	mg/Kg	mg/Kg	
Dilution Factor			1	1	1	1	
Analytes	**MDL**	**PQL**	**Results**	**Results**	**Results**	**Results**	
Antimony	1.0	5.0	ND	ND	ND	ND	
Arsenic	1.0	5.0	ND	ND	ND	ND	
Barium	2.5	5.0	ND	85.5	89.9	70.7	
Beryllium	1.0	2.5	ND	ND	ND	ND	
Cadmium	1.0	2.5	ND	ND	ND	ND	
Chromium	2.5	5.0	ND	14.1	16.1	13.9	
Cobalt	2.5	5.0	ND	6.89	7.13	6.17	
Copper	2.5	5.0	ND	14.3	15.2	12.5	
Lead	2.5	5.0	ND	ND	ND	ND	
Mercury (By EPA 7471)	0.1	0.2	ND	ND	ND	ND	
Molybdenum	2.0	5.0	ND	ND	ND	ND	
Nickel	2.5	5.0	ND	13.2	16.9	13.1	
Selenium	1.0	5.0	ND	ND	ND	ND	
Silver	2.0	5.0	ND	ND	ND	ND	
Thallium	0.7	5.0	ND	ND	ND	ND	
Vanadium	2.5	5.0	ND	29.9	30.0	25.6	
Zinc	2.5	5.0	ND	42.8	42.2	37.4	

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Project ID: 51-1-10240-012

Project Name: BNSF San Bernardino

AETL Job Number	Submitted	Client
97573	05/02/2019	SH&W

Method: (6010B/7000CAM), Title 22 Metals (SW-846)

QC Batch No: 0506192C1; Dup or Spiked Sample: 97573.01; LCS: Clean Sand; QC Prepared: 05/06/2019; QC Analyzed: 05/06/2019; Units: mg/Kg

Analytes	Sample Result	MS Concen	MS Recov	MS % REC	MS DUP Concen	MS DUP Recov	MS DUP % REC	RPD %	MS/MSD % Limit	MS RPD % Limit
Antimony	0.00	50.0	49.7	99.4	50.0	50.5	101	1.6	75-125	<15
Arsenic	0.00	50.0	41.6	83.2	50.0	42.3	84.6	1.7	75-125	<15
Barium	85.5	50.0	151 M	131	50.0	149 M	127	3.1	75-125	<15
Beryllium	0.00	50.0	39.6	79.2	50.0	40.1	80.2	1.3	75-125	<15
Cadmium	0.00	50.0	39.5	79.0	50.0	39.6	79.2	<1	75-125	<15
Chromium	14.1	50.0	53.7	79.2	50.0	53.8	79.4	<1	75-125	<15
Cobalt	6.89	50.0	44.9	76.0	50.0	44.9	76.0	<1	75-125	<15
Copper	14.3	50.0	65.3	102	50.0	65.8	103	<1	75-125	<15
Lead	0.00	50.0	35.6 M	71.2	50.0	35.4 M	70.8	<1	75-125	<15
Mercury (By EPA 7471)	0.0140	0.500	0.669M	131	0.500	0.664M	130	<1	75-125	<15
Molybdenum	0.00	50.0	40.5	81.0	50.0	41.1	82.2	1.5	75-125	<15
Nickel	13.2	50.0	64.7	103	50.0	65.2	104	<1	75-125	<15
Selenium	0.00	50.0	33.5	67.0	50.0	35.1	70.2	4.7	75-125	<15
Silver	0.00	50.0	41.2	82.4	50.0	41.6	83.2	<1	75-125	<15
Thallium	0.00	50.0	24.4 M	48.8	50.0	24.1 M	48.2	1.2	75-125	<15
Vanadium	29.9	50.0	74.5	89.2	50.0	75.3	90.8	1.8	75-125	<15
Zinc	42.8	50.0	88.5	91.4	50.0	88.6	91.6	<1	75-125	<15

QC Batch No: 0506192C1; Dup or Spiked Sample: 97573.01; LCS: Clean Sand; QC Prepared: 05/06/2019; QC Analyzed: 05/06/2019; Units: mg/Kg

Analytes	LCS Concen	LCS Recov	LCS % REC	LCS DUP Concen	LCS DUP Recov	LCS DUP % REC	LCS RPD % REC	LCS/LCSD % Limit	LCS RPD % Limit	
Antimony	50.0	53.7	107	50.0	54.5	109	1.9	75-125	<15	
Arsenic	50.0	51.2	102	50.0	51.4	103	<1	75-125	<15	
Barium	50.0	61.5	123	50.0	61.2	122	<1	75-125	<15	
Beryllium	50.0	48.8	97.6	50.0	48.6	97.2	<1	75-125	<15	
Cadmium	50.0	46.5	93.0	50.0	47.0	94.0	1.1	75-125	<15	
Chromium	50.0	47.1	94.2	50.0	47.1	94.2	<1	75-125	<15	
Cobalt	50.0	47.0	94.0	50.0	47.6	95.2	1.3	75-125	<15	
Copper	50.0	51.3	103	50.0	52.9	106	2.9	75-125	<15	
Lead	50.0	44.7	89.4	50.0	44.7	89.4	<1	75-125	<15	

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QUALITY CONTROL RESULTS

Project ID: 51-1-10240-012
Project Name: BNSF San Bernardino

AETL Job Number	Submitted	Client
97573	05/02/2019	SH&W

Method: (6010B/7000CAM), Title 22 Metals (SW-846)

QC Batch No: 0506192C1; Dup or Spiked Sample: 97573.01; LCS: Clean Sand; QC Prepared: 05/06/2019; QC Analyzed: 05/06/2019; Units: mg/Kg

Analytes	LCS Concen	LCS Recov	LCS % REC	LCS DUP Concen	LCS DUP Recov	LCS DUP % REC	LCS RPD % REC	LCS/LCSD % Limit	LCS RPD % Limit	
Mercury (By EPA 7471)	0.500	0.510	102	0.500	0.500	100	2.0	75-125	<15	
Molybdenum	50.0	45.2	90.4	50.0	46.1	92.2	2.0	75-125	<15	
Nickel	50.0	48.6	97.2	50.0	50.0	100	2.8	75-125	<15	
Selenium	50.0	52.3	105	50.0	54.0	108	2.8	75-125	<15	
Silver	50.0	50.9	102	50.0	52.0	104	1.9	75-125	<15	
Thallium	50.0	46.3	92.6	50.0	47.3	94.6	2.1	75-125	<15	
Vanadium	50.0	48.9	97.8	50.0	49.8	99.6	1.8	75-125	<15	
Zinc	50.0	50.6	101	50.0	51.2	102	<1	75-125	<15	

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Project ID: 51-1-10240-012
Project Name: BNSF San Bernardino

AETL Job Number	Submitted	Client
97573	05/02/2019	SH&W

Method: (8260B), Volatile Organic Compounds by GC/MS (SW846)

QC Batch No: 0503192A1; Dup or Spiked Sample: 97573.03; LCS: Clean Sand; QC Prepared: 05/03/2019; QC Analyzed: 05/03/2019; Units: ug/Kg

Analytes	Sample Result	MS Concen	MS Recov	MS % REC	MS DUP Concen	MS DUP Recov	MS DUP % REC	RPD %	MS/MSD % Limit	MS RPD % Limit
Benzene	0.00	50.0	48.4	96.8	50.0	53.0	106	9.1	75-125	<20
Carbon tetrachloride	0.00	50.0	51.0	102	50.0	56.0	112	9.3	75-125	<20
Chlorobenzene	0.00	50.0	51.0	102	50.0	54.5	109	6.6	75-125	<20
Chloroform (Trichloromethane)	0.00	50.0	53.5	107	50.0	51.5	103	3.8	75-125	<20
1,2-Dichlorobenzene	0.00	50.0	49.2	98.4	50.0	53.0	106	7.4	75-125	<20
1,1-Dichloroethane	0.00	50.0	59.0	118	50.0	49.3	98.6	17.9	75-125	<20
1,1-Dichloroethene	0.00	50.0	52.0	104	50.0	53.0	106	1.9	75-125	<20
cis-1,2-Dichloroethene	0.00	50.0	49.7	99.4	50.0	55.5	111	11.0	75-125	<20
Ethylbenzene	0.00	50.0	50.5	101	50.0	55.0	110	8.5	75-125	<20
Methyl-tert-butyl ether (MTBE)	0.00	50.0	45.4	90.8	50.0	53.0	106	15.4	75-125	<20
n-Propylbenzene	0.00	50.0	50.5	101	50.0	56.0	112	10.3	75-125	<20
Toluene (Methyl benzene)	0.00	50.0	50.0	100	50.0	55.0	110	9.5	75-125	<20
1,1,1-Trichloroethane	0.00	50.0	48.7	97.4	50.0	53.5	107	9.4	75-125	<20
1,1,2-Trichloroethane	0.00	50.0	42.2	84.4	50.0	44.7	89.4	5.8	75-125	<20
Trichloroethene	0.00	50.0	49.5	99.0	50.0	55.0	110	10.5	75-125	<20
1,2,4-Trimethylbenzene	0.00	50.0	52.5	105	50.0	55.0	110	4.7	75-125	<20
1,3,5-Trimethylbenzene	0.00	50.0	49.7	99.4	50.0	53.5	107	7.4	75-125	<20
o-Xylene	0.00	50.0	51.0	102	50.0	54.5	109	6.6	75-125	<20
m,p-Xylenes	0.00	100	104	104	100	110	110	5.6	75-125	<20
Surrogates										
Bromofluorobenzene	0.00	50.0	47.3	94.5	50.0	48.4	96.7	2.3	75-125	<20
Dibromofluoromethane	0.00	50.0	45.6	91.1	50.0	50.0	100	9.3	75-125	<20
Toluene-d8	0.00	50.0	49.4	98.7	50.0	50.5	101	2.3	75-125	<20

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QUALITY CONTROL RESULTS

Project ID: 51-1-10240-012
Project Name: BNSF San Bernardino

AETL Job Number	Submitted	Client
97573	05/02/2019	SH&W

Method: (8260B), Volatile Organic Compounds by GC/MS (SW846)

QC Batch No: 0503192A1; Dup or Spiked Sample: 97573.03; LCS: Clean Sand; QC Prepared: 05/03/2019; QC Analyzed: 05/03/2019; Units: ug/Kg

Analytes	LCS Concen	LCS Recov	LCS % REC	LCS DUP Concen	LCS DUP Recov	LCS DUP % REC	LCS RPD % REC	LCS/LCSD % Limit	LCS RPD % Limit	
Benzene	50.0	59.0	118	50.0	55.0	110	7.0	75-125	<20	
Carbon tetrachloride	50.0	62.5	125	50.0	57.0	114	9.2	75-125	<20	
Chlorobenzene	50.0	59.5	119	50.0	58.0	116	2.6	75-125	<20	
Chloroform (Trichloromethane)	50.0	61.5	123	50.0	53.5	107	13.9	75-125	<20	
1,2-Dichlorobenzene	50.0	58.0	116	50.0	55.5	111	4.4	75-125	<20	
1,1-Dichloroethane	50.0	56.5	113	50.0	54.0	108	4.5	75-125	<20	
1,1-Dichloroethene	50.0	58.5	117	50.0	60.0	120	2.5	75-125	<20	
cis-1,2-Dichloroethene	50.0	62.5	125	50.0	62.5	125	<1	75-125	<20	
Ethylbenzene	50.0	60.0	120	50.0	57.5	115	4.3	75-125	<20	
Methyl-tert-butyl ether (MTBE)	50.0	55.0	110	50.0	56.0	112	1.8	75-125	<20	
n-Propylbenzene	50.0	57.5	115	50.0	54.5	109	5.4	75-125	<20	
Toluene (Methyl benzene)	50.0	55.5	111	50.0	57.5	115	3.5	75-125	<20	
1,1,1-Trichloroethane	50.0	62.5	125	50.0	55.5	111	11.9	75-125	<20	
1,1,2-Trichloroethane	50.0	57.0	114	50.0	55.0	110	3.6	75-125	<20	
Trichloroethene	50.0	59.0	118	50.0	56.0	112	5.2	75-125	<20	
1,2,4-Trimethylbenzene	50.0	58.5	117	50.0	56.5	113	3.5	75-125	<20	
1,3,5-Trimethylbenzene	50.0	57.5	115	50.0	54.5	109	5.4	75-125	<20	
o-Xylene	50.0	60.5	121	50.0	57.0	114	6.0	75-125	<20	
m,p-Xylenes	100	121	121	100	116	116	4.2	75-125	<20	
Surrogates										
Bromofluorobenzene	50.0	47.5	94.9	50.0	47.9	95.8	<1	75-125	<20	
Dibromofluoromethane	50.0	52.5	105	50.0	50.5	101	3.9	75-125	<20	
Toluene-d8	50.0	45.8	91.5	50.0	50.5	101	9.9	75-125	<20	

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QUALITY CONTROL RESULTS

Ordered By

Shannon & Wilson
664 W. Broadway Ave., Ste 201
Glendale, CA 91204-

Site

One Siding
San Bernardino, CA

Telephone: (818)539-8420
Attn: Lorena Manriquez
Page: **12**

Project ID: 51-1-10240-012
Project Name: BNSF San Bernardino

AETL Job Number	Submitted	Client
97573	05/02/2019	SH&W

Method: (M8015D), TPH as Diesel and Heavy Hydrocarbons Using GC/FID

QC Batch No: 050319PB1; Dup or Spiked Sample: 97613.12; LCS: Clean Sand; QC Prepared: 05/03/2019; QC Analyzed: 05/03/2019; Units: mg/Kg

Analytes	Sample Result	MS Concen	MS Recov	MS % REC	MS DUP Concen	MS DUP Recov	MS DUP % REC	RPD %	MS/MSD % Limit	MS RPD % Limit
TPH as Diesel (C13-C22)	0.00	500	555	111	500	535	107	3.7	75-125	<20
Surrogates										
Chlorobenzene	0.00	100	115	115	100	114	114	<1	75-125	<20

QC Batch No: 050319PB1; Dup or Spiked Sample: 97613.12; LCS: Clean Sand; QC Prepared: 05/03/2019; QC Analyzed: 05/03/2019; Units: mg/Kg

Analytes	LCS Concen	LCS Recov	LCS % REC	LCS DUP Concen	LCS DUP Recov	LCS DUP % REC	LCS RPD % REC	LCS/LCSD % Limit	LCS RPD % Limit	
TPH as Diesel (C13-C22)	500	550	110	500	555	111	<1	75-125	<20	
Surrogates										
Chlorobenzene	100	121	121	100	120	120	<1	75-125	<20	

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QUALITY CONTROL RESULTS

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Telephone: (818)539-8420
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Page: **13**

Project ID: 51-1-10240-012
Project Name: BNSF San Bernardino

AETL Job Number	Submitted	Client
97573	05/02/2019	SH&W

Method: (M8015G), TPH as Gasoline and Light Hydrocarbons Using GC/FID

QC Batch No: 050319OB1; Dup or Spiked Sample: 97573.03; LCS: Clean Sand; MS AND SD Prepared: 05/02/2019; LCS Prepared: 05/03/2019; QC Analyzed: 05/03/2019;
Units: mg/Kg

Analytes	Sample Result	MS Concen	MS Recov	MS % REC	MS DUP Concen	MS DUP Recov	MS DUP % REC	RPD %	MS/MSD % Limit	MS RPD % Limit
TPH as Gasoline and Light HC. (C4-C12)	0.00	1.00	0.821	82.1	1.00	0.832	83.2	1.3	75-125	<20
Surrogates										
Bromofluorobenzene	0.00	0.0500	0.0595	119	0.0500	0.0555	111	7.0	75-125	<20

QC Batch No: 050319OB1; Dup or Spiked Sample: 97573.03; LCS: Clean Sand; MS AND SD Prepared: 05/02/2019; LCS Prepared: 05/03/2019; QC Analyzed: 05/03/2019;
Units: mg/Kg

Analytes	LCS Concen	LCS Recov	LCS % REC	LCS DUP Concen	LCS DUP Recov	LCS DUP % REC	LCS RPD % REC	LCS/LCSD % Limit	LCS RPD % Limit	
TPH as Gasoline and Light HC. (C4-C12)	1.00	1.01	101	1.00	1.01	101	<1	75-125	<20	
Surrogates										
Bromofluorobenzene	0.0500	0.0565	113	0.0500	0.0570	114	<1	75-125	<20	

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Data Qualifiers and Descriptors

Data Qualifier:

#:	Recovery is not within acceptable control limits.
*:	In the QC section, sample results have been taken directly from the ICP reading. No preparation factor has been applied.
B:	Analyte was present in the Method Blank.
D:	Result is from a diluted analysis.
E:	Result is beyond calibration limits and is estimated.
H:	Analysis was performed over the allowed holding time due to circumstances which were beyond laboratory control.
J:	Analyte was detected . However, the analyte concentration is an estimated value, which is between the Method Detection Limit (MDL) and the Practical Quantitation Limit (PQL).
M:	Matrix spike recovery is outside control limits due to matrix interference. Laboratory Control Sample recovery was acceptable.
MCL:	Maximum Contaminant Level
NS:	No Standard Available
S6:	Surrogate recovery is outside control limits due to matrix interference.
S8:	The analysis of the sample required a dilution such that the surrogate concentration was diluted below the method acceptance criteria.
X:	Results represent LCS and LCSD data.

Definition:

%Limi:	Percent acceptable limits.
%REC:	Percent recovery.
Con.L:	Acceptable Control Limits
Conce:	Added concentration to the sample.
LCS:	Laboratory Control Sample
MDL:	Method Detection Limit is a statistically derived number which is specific for each instrument, each method, and each compound. It indicates a distinctively detectable quantity with 99% probability.

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Data Qualifiers and Descriptors

MS:	Matrix Spike
MS DU:	Matrix Spike Duplicate
ND:	Analyte was not detected in the sample at or above MDL.
PQL:	Practical Quantitation Limit or ML (Minimum Level as per RWQCB) is the minimum concentration that can be quantified with more than 99% confidence. Taking into account all aspects of the entire analytical instrumentation and practice.
Recov:	Recovered concentration in the sample.
RPD:	Relative Percent Difference

APPENDIX D: INFILTRATION TESTING

Appendix D

Infiltration Testing

CONTENTS

Figures

D.1 GENERAL

This appendix presents descriptions of the percolation testing procedures and provides the results. The percolation testing was performed in general accordance with the Technical Guidance Document of Water Quality Management Plan (San Bernardino County Stormwater Program, 2011). We measured the percolation rates using the percolation test procedure described in Section VII.3.8 of this document.

D.2 PERCOLATION TEST PROCEDURES

We performed the percolation tests at the eight percolation borings. The invert of the stormwater infiltration basin is proposed to be approximately 7 feet below the existing ground surface at each basin location.

We used the shallow percolation test (less than 10 feet) procedure for the 8-inch diameter hollow stem auger borings. Each basin location was excavated with two borings to a depth of about 7 feet below ground surface (bgs). After excavation was completed for each hole, 3/8-inch diameter pea gravel was placed in the bottom 2 inches of the hole. A 2-inch diameter PVC casing was placed in each hole with the lowest 5-foot section being screened. The screen and cased PVC sections were then surrounded with #3 Monterey sand to prevent caving of the borings. Water was placed into the PVC pipe for each test hole from a water tank and hose or water bottle.

We presoaked the eight test holes so that water flowing into the hole was held constant at a level at least five times the hole's radius above the gravel at the bottom of the hole. Pre-soak tests in Basins 1, 3, and 9 showed the soils to be generally sandy. In Basin 6, the tests indicated the soils to be generally silty or clayey. The following test procedures for each condition are described below. The holes were refilled after each reading. The measurements were recorded with a Solinst water level sounder and read to the closest 1/100th of a foot from the top of the PVC casing. The percolation test data were recorded on percolation test data sheets and the results are attached.

D.2.1 Tests In Sandy Soils

When two consecutive measurements showed that 6 inches of water drained in less than 25 minutes, the test was run for an additional hour with measurements taken every 10 minutes. The drop that occurred during the final 10 minutes was used to calculate the infiltration rate.

D.2.2 Tests In Silty/Clayey Soils

Testing was initiated at least 15 hours after the pre-soak. The drop in water level was measured over a 30 minute period for at least 6 hours, with refilling after every 30-minute reading for a total of twelve measurements per hole. The drop that occurred during the final reading was used to calculate the infiltration rate.

D.3 INFILTRATION RATE CALCULATIONS

Infiltration rates were calculated using the Porchet method also known as the inverse borehole method. This method converts the percolation rate data from the final percolation interval. This method uses the following data:

- Time interval, Δt
- Initial Depth to Water, D_o
- Final Depth to Water, D_f
- Total Depth of Test Hole, D_T
- Test Hole Radius, r

The conversion equation to calculate the infiltration rate is:

$$I_t = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})}$$

"H_o" is the initial height of water at the selected time interval: $H_o = D_T - D_o$
"H_f" is the final height of water at the selected time interval: $H_f = D_T - D_f$
"ΔH" is the change in height over the time interval: $\Delta H = \Delta D = H_o - H_f$
"H_{avg}" is the average head height over the time interval: H_{avg} $(H_o - H_f)/2$
"I_t" is the tested infiltration rate.

Using the Porchet conversion, the infiltration rates are summarized in Exhibit 7.9 of the report.

D.4 REFERENCES

San Bernardino County Stormwater Program, 2011, Technical guidance document of water quality management plans (WQMP), Appendix D, Section VII-Infiltration rate evaluation protocol and factor of safety recommendations, Orange County technical guidance documents appendices May 19, 2011, document dated July 28, 2011.

PERCOLATION TEST DATA FORM

Project Name: BNSF San Bernardino – Ono Lead Extension

Project Number: 51-1-10240-014

Percolation Test By: Sean Wilson, CEG 2245

Percolation Test Location: Basin #9

Date of Test: September 26, 2019

Test Hole Number: Test B-1A

Depth to bottom of hole: 7.37 feet Diameter of hole: 8 inches

Pre-saturation: Greater than 6 inches of water in less than 25 minutes in two consecutive readings.

Soil Description: Silty Sand (SM)

Reading Number	Start Time (mm:ss)	Stop Time (mm:ss)	Time Interval (mm:ss)	Initial Depth to Water (feet)	Final Depth to Water (feet)	Change in Water Level (feet)	Percolation Rate (mpi)
1	00:00	15:00	15:00	4.92	5.60	0.68	N/A
2	00:00	10:00	10:00	4.30	5.50	1.20	N/A
3	00:00	10:00	10:00	4.30	5.13	0.83	1.00
4	00:00	10:00	10:00	3.90	5.04	1.14	0.73
5	00:00	10:00	10:00	3.93	5.11	1.18	0.71
6	00:00	10:00	10:00	3.70	5.00	1.30	0.64
7	00:00	10:00	10:00	3.60	4.98	1.38	0.60
8	00:00	10:00	10:00	3.49	4.89	1.40	0.60

Notes: The depth to water was measured from a fixed reference point (top-of-pipe) that does not correspond to the depth of the hole. Readings 3 to 8 taken every 10 minutes for one hour minimum.

Measurements were read to the closest 1/100th-foot.

PERCOLATION TEST DATA FORM

Project Name: BNSF San Bernardino – Ono Lead Extension

Project Number: 51-1-10240-014

Percolation Test By: Sean Wilson, CEG 2245

Percolation Test Location: Basin #9

Date of Test: September 26, 2019

Test Hole Number: Test B-1B

Depth to bottom of hole: 7.07 feet Diameter of hole: 8 inches

Pre-saturation: Greater than 6 inches of water in less than 25 minutes in two consecutive readings.

Soil Description: Silty Sand (SM)

Reading Number	Start Time (mm:ss)	Stop Time (mm:ss)	Time Interval (mm:ss)	Initial Depth to Water (feet)	Final Depth to Water (feet)	Change in Water Level (feet)	Percolation Rate (mpi)
1	00:00	25:00	25:00	3.34	5.21	1.87	N/A
2	00:00	07:00	07:00	3.22	3.95	0.73	N/A
3	00:00	10:00	10:00	2.76	4.04	1.28	0.65
4	00:00	10:00	10:00	3.62	4.48	0.86	0.97
5	00:00	10:00	10:00	3.74	4.52	0.78	1.07
6	00:00	10:00	10:00	3.72	4.48	0.76	1.10
7	00:00	10:00	10:00	3.69	4.47	0.78	1.07
8	00:00	10:00	10:00	3.74	4.50	0.76	1.10

Notes: The depth to water was measured from a fixed reference point (top-of-pipe) that does not correspond to the depth of the hole. Readings 3 to 8 taken every 10 minutes for one hour minimum.

Measurements were read to the closest 1/100th-foot.

PERCOLATION TEST DATA FORM

Project Name: BNSF San Bernardino – Ono Lead Extension

Project Number: 51-1-10240-014

Percolation Test By: Sean Wilson, CEG 2245

Percolation Test Location: Basin #6

Date of Test: September 27, 2019

Test Hole Number: Test B-2A

Depth to bottom of hole: 7.52 feet Diameter of hole: 8 inches

Pre-saturation: Presaturated hole for more than 15 hours

Soil Description: Clayey Sand (SC)

Reading Number	Start Time (mm:ss)	Stop Time (mm:ss)	Time Interval (mm:ss)	Initial Depth to Water (feet)	Final Depth to Water (feet)	Change in Water Level (feet)	Percolation Rate (mpi)
1	00:00	30:00	30:00	4.85	5.04	0.19	13.16
2	00:00	30:00	30:00	4.62	4.84	0.22	11.36
3	00:00	30:00	30:00	4.59	4.81	0.22	11.36
4	00:00	30:00	30:00	4.61	4.8	0.19	13.16
5	00:00	30:00	30:00	4.66	4.82	0.16	15.63
6	00:00	30:00	30:00	4.57	4.77	0.20	12.50
7	00:00	30:00	30:00	4.53	4.75	0.22	11.36
8	00:00	30:00	30:00	4.52	4.71	0.19	13.16
9	00:00	30:00	30:00	4.57	4.73	0.16	15.63
10	00:00	30:00	30:00	4.52	4.72	0.20	12.50
11	00:00	30:00	30:00	4.48	4.70	0.22	11.36
12	00:00	30:00	30:00	4.42	4.62	0.20	12.50

Notes: The depth to water was measured from a fixed reference point (top-of-pipe) that does not correspond to the depth of the hole. Readings taken every 30 minutes for 6 hours.

Measurements were read to the closest 1/100th-foot.

PERCOLATION TEST DATA FORM

Project Name: BNSF San Bernardino – Ono Lead Extension

Project Number: 51-1-10240-014

Percolation Test By: Sean Wilson, CEG 2245

Percolation Test Location: Basin #6

Date of Test: September 27, 2019

Test Hole Number: Test B-2B

Depth to bottom of hole: 7.50 feet Diameter of hole: 8 inches

Pre-saturation: Presaturated hole for more than 15 hours

Soil Description: Clayey Sand (SC)

Reading Number	Start Time (mm:ss)	Stop Time (mm:ss)	Time Interval (mm:ss)	Initial Depth to Water (feet)	Final Depth to Water (feet)	Change in Water Level (feet)	Percolation Rate (mpi)
1	00:00	30:00	30:00	4.15	4.16	0.01	250.00
2	00:00	30:00	30:00	4.03	4.06	0.03	83.33
3	00:00	30:00	30:00	3.95	4.08	0.13	19.23
4	00:00	30:00	30:00	4.02	4.13	0.11	22.73
5	00:00	30:00	30:00	3.77	3.96	0.19	13.16
6	00:00	30:00	30:00	3.84	3.97	0.13	19.23
7	00:00	30:00	30:00	3.67	3.94	0.27	9.26
8	00:00	30:00	30:00	3.54	3.79	0.25	10.00
9	00:00	30:00	30:00	3.55	3.83	0.28	8.93
10	00:00	30:00	30:00	3.52	3.78	0.26	9.62
11	00:00	30:00	30:00	3.52	3.84	0.32	7.81
12	00:00	30:00	30:00	3.55	3.80	0.25	10.00

Notes: The depth to water was measured from a fixed reference point (top-of-pipe) that does not correspond to the depth of the hole. Readings taken every 30 minutes for 6 hours.

Measurements were read to the closest 1/100th-foot.

PERCOLATION TEST DATA FORM

Project Name: BNSF San Bernardino – Ono Lead Extension

Project Number: 51-1-10240-014

Percolation Test By: Sean Wilson, CEG 2245

Percolation Test Location: Basin #1

Date of Test: September 30, 2019

Test Hole Number: Test B-3A

Depth to bottom of hole: 7.41 feet Diameter of hole: 8 inches

Pre-saturation: Greater than 6 inches of water in less than 25 minutes in two consecutive readings.

Soil Description: Silty Sand (SM)

Reading Number	Start Time (mm:ss)	Stop Time (mm:ss)	Time Interval (mm:ss)	Initial Depth to Water (feet)	Final Depth to Water (feet)	Change in Water Level (feet)	Percolation Rate (mpi)
1	00:00	02:00	02:00	6.46	7.52	1.06	N/A
2	00:00	03:00	03:00	6.10	7.72	1.62	N/A
3	00:00	10:00	10:00	5.84	8.25	2.41	0.35
4	00:00	10:00	10:00	6.50	8.26	1.76	0.47
5	00:00	10:00	10:00	6.41	8.26	1.85	0.45
6	00:00	10:00	10:00	6.50	8.27	1.77	0.47
7	00:00	10:00	10:00	6.25	8.29	2.04	0.41
8	00:00	10:00	10:00	6.40	8.29	1.89	0.44

Notes: The depth to water was measured from a fixed reference point (top-of-pipe) that does not correspond to the depth of the hole. Readings 3 to 8 taken every 10 minutes for one hour minimum.

Measurements were read to the closest 1/100th-foot.

PERCOLATION TEST DATA FORM

Project Name: BNSF San Bernardino – Ono Lead Extension

Project Number: 51-1-10240-014

Percolation Test By: Sean Wilson, CEG 2245

Percolation Test Location: Basin #1

Date of Test: September 30, 2019

Test Hole Number: Test B-3B

Depth to bottom of hole: 7.60 feet   Diameter of hole: 8 inches

Pre-saturation: Greater than 6 inches of water in less than 25 minutes in two consecutive readings.

Soil Description: Silty Sand (SM)

Reading Number	Start Time (mm:ss)	Stop Time (mm:ss)	Time Interval (mm:ss)	Initial Depth to Water (feet)	Final Depth to Water (feet)	Change in Water Level (feet)	Percolation Rate (mpi)
1	00:00	05:00	05:00	5.75	7.85	2.1	N/A
2	00:00	03:00	03:00	5.10	7.45	2.35	N/A
3	00:00	10:00	10:00	5.80	8.18	2.38	0.35
4	00:00	10:00	10:00	5.10	8.18	3.08	0.27
5	00:00	10:00	10:00	5.10	8.18	3.08	0.27
6	00:00	10:00	10:00	4.95	8.15	3.20	0.26
7	00:00	10:00	10:00	5.25	8.10	2.85	0.29
8	00:00	10:00	10:00	5.30	8.10	2.80	0.30

Notes: The depth to water was measured from a fixed reference point (top-of-pipe) that does not correspond to the depth of the hole. Readings 3 to 8 taken every 10 minutes for one hour minimum.

Measurements were read to the closest 1/100th-foot.

PERCOLATION TEST DATA FORM

Project Name: BNSF San Bernardino – Ono Lead Extension

Project Number: 51-1-10240-014

Percolation Test By: Sean Wilson, CEG 2245

Percolation Test Location: Basin #3

Date of Test: September 30, 2019

Test Hole Number: Test B-4A

Depth to bottom of hole: 6.71 feet Diameter of hole: 8 inches

Pre-saturation: Greater than 6 inches of water in less than 25 minutes in two consecutive readings.

Soil Description: Poorly Graded Sand with Silt (SP-SM)

Reading Number	Start Time (mm:ss)	Stop Time (mm:ss)	Time Interval (mm:ss)	Initial Depth to Water (feet)	Final Depth to Water (feet)	Change in Water Level (feet)	Percolation Rate (mpi)
1	00:00	02:00	02:00	4.62	5.25	0.63	N/A
2	00:00	07:00	07:00	5.15	5.80	0.65	N/A
3	00:00	10:00	10:00	4.12	5.70	1.58	0.53
4	00:00	10:00	10:00	4.20	5.50	1.30	0.64
5	00:00	10:00	10:00	4.17	5.45	1.28	0.65
6	00:00	10:00	10:00	4.20	5.50	1.30	0.64
7	00:00	10:00	10:00	4.20	5.46	1.26	0.66
8	00:00	10:00	10:00	4.10	5.37	1.27	0.66

Notes: The depth to water was measured from a fixed reference point (top-of-pipe) that does not correspond to the depth of the hole. Readings 3 to 8 taken every 10 minutes for one hour minimum.

Measurements were read to the closest 1/100th-foot.

PERCOLATION TEST DATA FORM

Project Name: BNSF San Bernardino – Ono Lead Extension

Project Number: 51-1-10240-014

Percolation Test By: Sean Wilson, CEG 2245

Percolation Test Location: Basin #3

Date of Test: September 30, 2019

Test Hole Number: Test B-4B

Depth to bottom of hole: 5.70 feet   Diameter of hole: 8 inches

Pre-saturation: Greater than 6 inches of water in less than 25 minutes in two consecutive readings.

Soil Description: Poorly Graded Sand with Silt (SP-SM)

Reading Number	Start Time (mm:ss)	Stop Time (mm:ss)	Time Interval (mm:ss)	Initial Depth to Water (feet)	Final Depth to Water (feet)	Change in Water Level (feet)	Percolation Rate (mpi)
1	00:00	04:00	04:00	4.67	5.44	0.77	N/A
2	00:00	03:00	03:00	4.61	5.33	0.72	N/A
3	00:00	10:00	10:00	4.45	5.71	1.26	0.66
4	00:00	10:00	10:00	4.75	5.76	1.01	0.83
5	00:00	10:00	10:00	4.67	5.71	1.04	0.80
6	00:00	10:00	10:00	4.52	5.66	1.14	0.73
7	00:00	10:00	10:00	4.57	5.65	1.08	0.77
8	00:00	10:00	10:00	4.58	5.63	1.05	0.79

Notes: The depth to water was measured from a fixed reference point (top-of-pipe) that does not correspond to the depth of the hole. Readings 3 to 8 taken every 10 minutes for one hour minimum.

Measurements were read to the closest 1/100th-foot.

IMPORTANT INFORMATION

Important Information

About Your Geotechnical/Environmental Report

IMPORTANT INFORMATION

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors that were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent

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such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

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READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports, and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland

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of Los Angeles County
900 Exposition Boulevard
Los Angeles, CA 90007

tel 213.763.DINO
www.nhm.org

NATURAL HISTORY MUSEUM
LOS ANGELES COUNTY

Vertebrate Paleontology Section
Telephone: (213) 763-3325

e-mail: smcleod@nhm.org

5 September 2018

BCR Consulting
505 West 8th Street
Claremont, CA 91711

Attn: David Brunzell, Principal Investigator / Archaeologist

re: Paleontological resources for the Vertebrate Paleontology Records Search for the proposed linear alignment Project, in the City of San Bernardino, San Bernardino County, project area

Dear David:

I have conducted a thorough check of our paleontology collection records for the locality and specimen data for the proposed linear alignment Project, in the City of San Bernardino, San Bernardino County, project area as outlined on the portions of the San Bernardino North and San Bernardino South USGS topographic quadrangle maps that you sent to me via e-mail on 22 August 2018. We do not have any vertebrate fossil localities that lie directly within the proposed project area, but we do have vertebrate fossil localities farther afield from sedimentary deposits similar to those that occur at depth in the proposed project area.

Surface deposits in the entire proposed project area are composed of younger Quaternary Alluvium, derived as alluvial fan deposits from the San Gabriel Mountains to the north, primarily via Cajon Wash and Lytle Creek that currently flow just to the southwest of the proposed project area. These deposits typically do not contain significant vertebrate fossils, at least in the uppermost layers, but they may be underlain at relatively shallow depth by older sedimentary deposits that do contain significant fossil vertebrate remains. Our closest fossil vertebrate locality from similar older Quaternary deposits is LACM 7811, quite some distance to the west-southwest of the proposed project area west of Mira Loma along Sumner Avenue, that produced a fossil specimen of whipsnake, *Masticophis*, at a depth of 9 to 11 feet below the surface. Even further to the southwest between Corona and Norco our vertebrate fossil locality LACM 1207 produced a fossil specimen of deer, *Odocoileus*.

Shallow excavations in the younger Quaternary Alluvium exposed throughout the proposed project area are unlikely to encounter significant vertebrate fossils. Deeper excavations that extend down into older Quaternary deposits, however, may well encounter significant remains of fossil vertebrates. Any substantial excavations in the sedimentary deposits in the proposed project area, therefore, should be monitored closely to quickly and professionally recover any fossil remains while not impeding development. Also, sediment samples should be collected and processed to determine the small fossil potential in the proposed project area. Any fossils collected should be placed in an accredited scientific institution for the benefit of current and future generations.

This records search covers only the vertebrate paleontology records of the Natural History Museum of Los Angeles County. It is not intended to be a thorough paleontological survey of the proposed project area covering other institutional records, a literature survey, or any potential on-site survey.

Sincerely,

Samuel A. McLeod

Samuel A. McLeod, Ph.D.
Vertebrate Paleontology

enclosure: invoice