Appendix D
Preliminary Geotechnical Investigation

PRELIMINARY GEOTECHNICAL INVESTIGATION

PROPOSED IBC MULTI-USE TRAIL ALONG CREEKWALK (CPI 342301) AND BARRANCA CHANNEL (CIP 342303)
IRVINE, CALIFORNIA

JUNE 2024
PROJECT NO. W1827-88-01

PREPARED FOR:
BKF Engineers
Newport Beach, California

Project No. W1827-88-01
June 2024

BKF Engineers
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Attention: Sheila Amparo

Subject: PRELIMINARY GEOTECHNICAL INVESTIGATION
PROPOSED IBC MULTI-USE TRAILS ALONG
CREEKWALK (CIP 342301) AND BARRANCA CHANNEL (CIP 342303)
IRVINE, CALIFORNIA

Dear Ms. Amparo:

In accordance with your authorization of our proposal dated March 6, 2023, we have performed a preliminary geotechnical investigation for Segment 4 of the proposed IBC multi-use trails along the Creekwalk Channel (CIP 342301) and Barranca Channel (CIP 342303) in the City of Irvine, California. The accompanying report presents the findings of our study and our conclusions and recommendations pertaining to the geotechnical aspects of proposed design and construction. Based on the results of our investigation, it is our opinion that the proposed project can be developed as proposed, provided the recommendations in this report are followed and implemented during design and construction.

If you have any questions regarding this report, or if we may be of further service, please contact the undersigned.

Very truly yours,

GEOCON WEST, INC.

<u>Disclaimer</u>: This DRAFT is intended for the use of the project team to help with the on-going design of the project and provided as a courtesy for review only. This DRAFT should not be relied upon for final design nor produced and submitted to regulatory agencies until a FINAL document is completed with the signature and stamps of the design professionals.

Jose Cejudo	Jelisa Thomas Adams	Gerald A. Kasman
Staff Engineer	GE 3092	CEG 2251

(email) Addressee

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PRELIMINARY GEOTECHNICAL INVESTIGATION

1. PURPOSE AND SCOPE

This report presents the results of a preliminary geotechnical investigation for Segment 4 of the IBC multi-use trails along the Creekwalk Channel (CIP 342301) and Barranca Channel (CIP 342303) in the City of Irvine, California (see Vicinity Map, Figure 1). The purpose of the investigation was to evaluate subsurface soil and geologic conditions underlying the proposed alignment and, based on conditions encountered, to provide conclusions and recommendations pertaining to the geotechnical aspects of design and construction.

The scope of this investigation included a site reconnaissance, site mark out and USA Notification, permitting, field exploration, laboratory testing, engineering analysis, and the preparation of this report. The site was explored from May 8 to May 9, 2024, by excavating sixteen 7-inch diameter borings using a truck-mounted, hollow-stem auger drilling machine. The borings were advanced to depths between approximately 8½ and 20½ feet below the existing ground surface. The approximate locations of the exploratory borings are depicted on the Site Plan (see Figures 2.1 through 2.11). A detailed discussion of the field investigation, including boring logs, is presented in Appendix A.

Laboratory tests were performed on selected soil samples obtained during the investigation to determine pertinent physical and chemical soil properties. Appendix B presents a summary of the laboratory test results.

The recommendations presented herein are based on analysis of the data obtained during the investigation, and our experience with similar soil and geologic conditions. References reviewed to prepare this report are provided in the *List of References* section.

If project details vary significantly from those described herein, Geocon should be contacted to determine the necessity for review and possible revision of this report.

2. SITE AND PROJECT DESCRIPTION

Section 4 of the proposed multi-use trail is located along the Creekwalk and Barranca channels in the City of Irvine, California. Within the project limits, the channels are primarily riprap lined with concrete lining at roadway overcrossings south of Barranca Parkway and concrete lined north of Barranca Parkway. The main trail alignment is occupied by an unpaved maintenance road with undercrossings at Warner Avenue, Barranca Parkway, and Alton Parkway. The alignment terminates at Warner Avenue at the northern boundary and at Coronado Street at the southern boundary. The alignment is generally bounded by multi-story commercial and residential structures to the west, and by the San Diego Creek to the east. Topography includes the channel slopes but is otherwise roughly level with no pronounced highs or lows. Water drainage appears to be sheet flow along the existing ground contours to the adjacent channels. Vegetation is non-existent.

Based on the information provided to us, it is our understanding that the proposed development will consist of approximately 2.25 miles of new paved trail along the Creekwalk channel, as well as an approximately 2,000 foot connector trail between Segments 4 and 6 along the Barranca channel. The new trail will be 11-foot wide and will include safety fencing and lighting, wayfinding signage, and street crossings. The proposed improvements are depicted on the Site Plan (see Figures 2.1 through 2.11).

Any changes in the design, location or elevation of any structure, as outlined in this report, should be reviewed by this office. Geocon should be contacted to determine the necessity for review and possible revision of this report.

3. BACKGROUND REVIEW

As a part of our scope of work, we requested that the project team request pertinent geologic and geotechnical files from the City of Irvine and the Orange County Flood Control District for the proposed alignment area. Although this request was made, no background files were made available to us.

A review of publicly available historic aerials suggest that the current channel alignment was constructed in the 1960’s to 1970’s. We have not reviewed any records pertaining to the grading and construction activities associated with the channel construction.

4. GEOLOGIC SETTING

Segment 4 of the proposed IBC multi-use trail is located at the southeastern edge of the Orange County Coastal Plain, near the base of the western flank of the San Joaquin Hills (Department of Water Resources, 1967). The sediments consist primarily of a sequence of flat-lying basin sediments and Holocene fluvial deposits (California Geological Survey, 2012). This alluviated plain is bounded on the north and east by the Santa Ana Mountains, and on the south-southeast by the San Joaquin Hills. Topography at the site is gently sloping to the south with elevations at the site ranging from approximately 40 to 50 feet above mean sea level (U.S. Geological Survey datum). Regionally, the site is located within the Peninsular Ranges geomorphic province that is characterized by northwest-trending physiographic and geologic structures such as the nearby Newport-Inglewood Fault Zone.

5. SOIL AND GEOLOGIC CONDITIONS

Based on published geologic maps of the area, the site is underlain by artificial fill and Holocene age young alluvial deposits that consist of clay, silt, sand and gravels (CGS, 2012). Detailed stratigraphic profiles of the materials encountered at the site are provided on the boring logs in Appendix A.

5.1 Artificial Fill

Artificial fill was encountered in our explorations to a maximum depth of 12½ feet below existing ground surface. The artificial fill generally consists of brown to dark brown or black clay, sandy clay, clayey sand, to silty sand with a trace of fine to coarse-gravel. The fill can be characterized as dry to wet and loose to dense or very soft to hard. The fill is likely the result of past grading or construction activities at the site. Deeper fill may exist between excavations and in other portions of the site that were not directly explored.

5.2 Younger Alluvium

Holocene age young alluvial valley deposits were encountered beneath the fill in borings B1 and B9. The alluvium generally consists of black to brown clay with various amounts of fine-grained sand. The alluvial soils are characterized as slightly moist to moist and very soft to stiff.

6. GROUNDWATER

The Seismic Hazard Zone Report for the Tustin Quadrangle (CDMG, 2001a) indicates the historically highest groundwater level in the area is approximately 10 feet beneath the existing ground surface. Groundwater information presented in this document is generated from data collected in the early 1900's to the late 1990s. Based on current groundwater basin management practices, it is unlikely that groundwater levels will ever exceed the historic high levels

Groundwater was not encountered in our borings drilled to a maximum depth of approximately 20½ feet below ground surface. Based on the reported historic high groundwater levels in the immediate area (CDMG, 2001a) and the depth of proposed construction, static groundwater is neither expected to be encountered during construction, nor have a detrimental effect on the project. However, it is not uncommon for groundwater levels to vary seasonally or for groundwater seepage conditions to develop where none previously existed (especially in impermeable fine-grained soils which are heavily irrigated or after seasonal rainfall), groundwater seepage levels encountered during construction may be actually higher than those encountered during our investigation. In addition, recent requirements for storm water infiltration could result in shallower seepage conditions in the region. Proper surface drainage of irrigation and precipitation will be critical for future performance of the project. Recommendations for drainage are provided in the *Surface Drainage* section of this report (see Section 8.13).

7. GEOLOGIC HAZARDS

7.1 Surface Fault Rupture

The numerous faults in Southern California include Holocene-active, pre-Holocene, and inactive faults. The criteria for these major groups are based on criteria developed by the California Geological Survey for the Alquist-Priolo Earthquake Fault Zone Program (CGS, 2018). By definition, a Holocene-active fault is one that has had surface displacement within Holocene time (about the last 11,700 years). A pre-Holocene fault has demonstrated surface displacement during Quaternary time (approximately the last 1.6 million years) but has had no known Holocene movement. Faults that have not moved in the last 1.6 million years are considered inactive.

The alignment is not within a state-designated Alquist-Priolo Earthquake Fault Zone (CGS, 2024a; 2024b) for surface fault rupture hazards. No Holocene-active or pre-Holocene faults with the potential for surface fault rupture are known to pass directly beneath the site. Therefore, the potential for surface rupture due to faulting occurring beneath the site during the design life of the proposed development is considered low. However, the site is located in the seismically active southern California region, and could be subjected to moderate to strong ground shaking in the event of an earthquake on one of the many active southern California faults. The faults in the vicinity of the site are shown in Figure 3, Regional Fault Map.

The closest surface trace of a Holocene-active fault to the site is the Newport-Inglewood fault zone (offshore segment) located approximately 8.3 miles to the southwest (USGS, 2006). Other nearby Holocene-active faults include the Whittier fault and the Glen Ivy fault of the Elsinore fault zone located approximately 14½ miles northeast, and 16 miles northeast of the site, respectively (USGS, 2006; Ziony and Jones, 1989). The active San Andreas fault is located approximately 44 miles northeast of the site (USGS, 2006).

Several buried thrust faults, commonly referred to as blind thrusts, underlie the southern California area at depth. These faults are not exposed at the ground surface and are typically identified at depths greater than 3.0 kilometers. The October 1, 1987 M_w 5.9 Whittier Narrows earthquake and the January 17, 1994 M_w 6.7 Northridge earthquake were a result of movement on the Puente Hills Blind Thrust and the Northridge Thrust, respectively. The Puente Hills Blind Thrust underlies the site at depth. These thrust faults and others in the Los Angeles area are not exposed at the surface and do not present a potential surface fault rupture hazard at the site; however, these deep thrust faults are considered active features capable of generating future earthquakes that could result in moderate to significant ground shaking at the site.

7.2 Seismicity

As with all of southern California, the site has experienced historic earthquakes from various regional faults. The seismicity of the region surrounding the site was formulated based on research of an electronic database of earthquake data. The epicenters of recorded earthquakes with magnitudes equal to or greater than 5.0 in the site vicinity are depicted on Figure 4, Regional Seismicity Map. A partial list of moderate to major magnitude earthquakes that have occurred in the southern California area within the last 100 years is included in the table on the following page.

LIST OF HISTORIC EARTHQUAKES

Earthquake (Oldest to Youngest)	Date of Earthquake	Magnitude	Distance to Epicenter (Miles)	Direction to Epicenter
Long Beach	March 10, 1933	6.4	9	WSW
Tehachapi	July 21, 1952	7.5	113	NW
San Fernando	February 9, 1971	6.6	60	NW
Whittier Narrows	October 1, 1987	5.9	29	NW
Sierra Madre	June 28, 1991	5.8	41	NNW
Landers	June 28, 1992	7.3	87	ENE
Big Bear	June 28, 1992	6.4	67	ENE
Northridge	January 17, 1994	6.7	54	NW
Hector Mine	October 16, 1999	7.1	109	NE

The site could be subjected to strong ground shaking in the event of an earthquake. However, this hazard is common in southern California and the effects of ground shaking can be minimized if the proposed structures are designed and constructed in conformance with current building codes and engineering practices.

7.3 Seismic Design Criteria

The following table summarizes the site-specific design criteria obtained from the 2022 California Building Code (CBC; Based on the 2021 International Building Code [IBC] and ASCE 7-16), Chapter 16 Structural Design, Section 1613 Earthquake Loads. The data was calculated using the online application U.S. Seismic Design Maps, provided by the Structural Engineers Association of California (SEAOC). The short spectral response uses a period of 0.2 second. We evaluated the Site Class based on the discussion in Section 1613.2.2 of the 2022 CBC and Table 20.3-1 of ASCE 7-16. The values presented in the table below are for the risk-targeted maximum considered earthquake (MCER).

Given that the project site consists of a 2.25 mile alignment, the values presented in the table on the following page are based on coordinates from roughly the midpoint of the alignment. Furthermore, the values in the table below are with an acceptable range when using coordinates for the northern and southern extents of the alignment.

2022 CBC SEISMIC DESIGN PARAMETERS

Parameter	Value	2022 CBC Reference
Site Class	D	Section 1613.2.2
MCE_R Ground Motion Spectral Response Acceleration – Class B (short), S_S	1.26g	Figure 1613.2.1(1)
MCE_R Ground Motion Spectral Response Acceleration – Class B (1 sec), S_1	0.451g	Figure 1613.2.1(3)
Site Coefficient, F_A	1	Table 1613.2.3(1)
Site Coefficient, F_V	1.849*	Table 1613.2.3(2)
Site Class Modified MCE_R Spectral Response Acceleration (short), S_{MS}	1.26g	Section 1613.2.3 (Eqn 16-20)
Site Class Modified MCE_R Spectral Response Acceleration – (1 sec), S_{M1}	0.834g*	Section 1613.2.3 (Eqn 16-21)
5% Damped Design Spectral Response Acceleration (short), S_{DS}	0.84g	Section 1613.2.4 (Eqn 16-22)
5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.556*	Section 1613.2.4 (Eqn 16-23)

*Per Supplement 3 of ASCE 7-16, a ground motion hazard analysis (GMHA) shall be performed for projects on Site Class "D" sites with 1-second spectral acceleration (S_1) greater than or equal to 0.2g, which is true for this site. However, Supplement 3 of ASCE 7-16 provides an exception stating that that the GMHA may be waived provided that the parameter S_{M1} is increased by 50% for all applications of S_{M1}. The values for parameters S_{M1} and S_{D1} presented above have **not** been increased in accordance with Supplement 3 of ASCE 7-16.

The table below presents the mapped maximum considered geometric mean (MCE_G) seismic design parameters for projects located in Seismic Design Categories of D through F in accordance with ASCE 7-16.

ASCE 7-16 PEAK GROUND ACCELERATION

Parameter	Value	ASCE 7-16 Reference
Mapped MCEG Peak Ground Acceleration, PGA	0.532g	Figure 22-9
Site Coefficient, F_{PGA}	1.1	Table 11.8-1
Site Class Modified MCEG Peak Ground Acceleration, PGA_M	0.585g	Section 11.8.3 (Eqn 11.8-1)

Conformance to the criteria in the above tables for seismic design does not constitute any kind of guarantee or assurance that significant structural damage or ground failure will not occur if a large earthquake occurs. The primary goal of seismic design is to protect life, not to avoid all damage, since such design may be economically prohibitive.

7.4 Liquefaction Potential

Liquefaction is a phenomenon in which loose, saturated, relatively cohesionless soil deposits lose shear strength during strong ground motions. Primary factors controlling liquefaction include intensity and duration of ground motion, gradation characteristics of the subsurface soils, in-situ stress conditions, and the depth to groundwater. Liquefaction is typified by a loss of shear strength in the liquefied layers due to rapid increases in pore water pressure generated by earthquake accelerations.

The current standard of practice, as outlined in the "Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction in California" and "Special Publication 117A, Guidelines for Evaluating and Mitigating Seismic Hazards in California" requires liquefaction analysis to a depth of 50 feet below the lowest portion of the proposed structure. Liquefaction typically occurs in areas where the soils below the water table are composed of poorly consolidated, fine- to medium-grained, primarily sandy soil. In addition to the requisite soil conditions, the ground acceleration and duration of the earthquake must also be of a sufficient level to induce liquefaction.

The State of California Seismic Hazard Zone Map for the Tustin Quadrangle (CDMG, 2001b) and the Safety Element of the Orange County General Plan (2004) indicate that the alignment is located within an area identified as having a potential for liquefaction. However, as indicated in our proposal, given the nature of the proposed improvements, the project is anticipated to be exempt from an evaluation of liquefaction.

7.5 Slope Stability

The topography at the site is relatively level to gently sloping to the southwest. The channel slopes are estimated to be inclined at gradients of approximately 1.5:1 (H:V) or flatter. The site is not located within an area identified as having a potential for slope instability (City of Irvine, 2012a and 2012b). Also, the State of California Seismic Hazard Zones Map for the Tustin Quadrangle (CDMG, 2001b) indicates that the site is not located within an area identified as having a potential for seismic slope instability. There are no known landslides near the site, nor is the site in the path of any known or potential landslides (USGS, 2024a).

Given the relatively surficial nature of the proposed improvements and considering that the project will not alter the geometry or loading of the existing slopes, as indicated in our proposal, analyses of the slope stabilities was not included in the geotechnical scope of work.

7.6 Earthquake-Induced Flooding

Earthquake-induced flooding is inundation caused by failure of dams or other water-retaining structures due to earthquakes. Review of the Orange County Safety Element (2004) indicates that the site is located within the inundation boundary of the Santiago Reservoir. However, this dam, as well as others in California, are continually monitored by various governmental agencies (such as the State of California Division of Safety of Dams and the U.S. Army Corps of Engineers) to guard against the threat of dam failure. Current design, construction practices, and ongoing programs of review, modification, or total reconstruction of existing dams are intended to ensure that all dams are capable of withstanding the maximum considered earthquake (MCE) for the site. Therefore, the potential for inundation at the site as a result of an earthquake-induced dam failure is considered low.

7.7 Tsunamis, Seiches, and Flooding

The site is not located within a coastal area. Therefore, tsunamis are not considered a significant hazard at the site.

Seiches are large waves generated in enclosed bodies of water in response to ground shaking. No major water-retaining structures are located immediately up gradient from the project site. Therefore, flooding resulting from a seismically induced seiche is considered unlikely.

The site is within a 100-year (City of Irvine, 2012b; FEMA, 2024). Therefore, the potential for flooding to impact the proposed development is considered low.

7.8 Oil Fields & Methane Potential

Based on a review of the California Geologic Energy Management Division (CalGEM) Well Finder Website, the site is not located within an oil field and oil or gas wells are not documented within ½-mile of the site (CalGEM, 2024). However, due to the voluntary nature of record reporting by the oil well drilling companies, wells may be improperly located or not shown on the location map and undocumented wells could be encountered during construction. Any wells encountered during construction will need to be properly abandoned in accordance with the current requirements of the CalGEM.

Since the site is not located within the boundaries of a known oil field, the potential for the presence of methane or other volatile gases at the site is considered low. However, should it be determined that a methane study is required for the proposed development it is recommended that a qualified methane consultant be retained to perform the study and provide mitigation measures as necessary.

7.9 Subsidence

Subsidence occurs when a large portion of land is displaced vertically, usually due to the withdrawal of groundwater, oil, or natural gas. Soils that are particularly subject to subsidence include those with high silt or clay content. The site is located within an area of known ground subsidence (USGS, 2024). Subsidence related to groundwater pumping commonly occurs in such small magnitudes and over such large areas that it is generally imperceptible at an individual locality. Accordingly, it affects only regionally extensive structures sensitive to slight elevation changes, such as canals and pipelines. The rate of elevation change is usually uniform over a large enough area that it does not result in differential settlements that would cause damage to individual buildings. Therefore, the potential for subsidence to adversely impact the proposed project is considered low.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 General

8.1.1 It is our opinion that neither soil nor geologic conditions were encountered during the investigation that would preclude the construction of the proposed improvements provided the recommendations presented herein are followed and implemented during design and construction.

8.1.2 Artificial fill was encountered in all borings to depths ranging from 3½ to 12½ feet below existing grade. The existing fill is believed to be the result of past grading and construction activities at the site. Deeper fill may exist in other areas of the site that were not directly explored. Based on the information proved to us, large scale grading is not expected nor considered feasible for construction of the proposed improvements. If needed, the existing fill and site soils are suitable for re-use as engineered fill provided the recommendations in the *Earthwork* section of this report are followed (see Section 8.4).

8.1.3 Based on the depth of existing fill encountered in our site exploration, the relatively surficial nature of the proposed improvements, and the consideration that large-scale grading is not feasible adjacent to the flood control channel, it is anticipated that some artificial fill will be left in place below the improvements. The owner should understand that even though the report recommendations are in full compliance with all applicable requirements, the implementation of the recommendations presented in this report are not intended to completely prevent damage to the structure due to the presence of deep undocumented fill. Repair of the foundation system or of utilities may be required over the lifespan of the structure. If this risk is unacceptable, complete excavation and recompaction of the existing artificial fill should be performed.

8.1.4 Where new paving is to be placed, as a minimum it is recommended that the upper 24 inches of subgrade soil be excavated and properly compacted for paving support. The client should be aware that paving constructed over existing uncertified fill or unsuitable alluvial soil may experience increased settlement and/or cracking and may therefore have a shorter design life and increased maintenance costs. However, as previously discussed, given the depth of existing artificial fill, it is unlikely that complete removal and recompaction of all fill is feasible. Paving recommendations are provided in the *Preliminary Pavement Recommendations* section of this report (see Section 8.10).

8.1.5 It is recommended that flexible utility connections be utilized for all rigid utilities to minimize or prevent damage to utilities from minor differential movements.

8.1.6 All excavations must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon).

8.1.7 The grading contractor should be aware that the existing soils are currently at or above optimum moisture content. If the site soils are oversaturated at the time of grading, they will likely require some spreading and drying activities in order to achieve proper compaction; however, this could change seasonally.

8.1.8 The soils anticipated to be exposed at the excavation bottom will likely be very moist and could be subject to excessive pumping. Stabilization of the bottom of the excavation may likely be required in order to provide a firm working surface upon which heavy equipment can operate. Recommendations for earthwork and bottom stabilization are provided in the *Earthwork* section of this report (see Section 8.4).

8.1.9 It is anticipated that stable excavations for the recommended earthwork can be achieved with sloping measures. However, if excavations in close proximity to an adjacent property line and/or structure are required, special excavation measures may be necessary in order to maintain lateral support of offsite improvements. Excavation recommendations are provided in the *Temporary Excavations* section of this report (Section 8.11).

8.1.10 Any changes in the design, location, or elevation, as outlined in this report, should be reviewed by this office. Geocon should be contacted to determine the necessity for review and possible revision of this report.

8.1.11 The most recent ASTM standards apply to this project and must be utilized, even if older ASTM standards are indicated in this report.

8.2 Soil and Excavation Characteristics

8.2.1 The in-situ soils can be excavated with moderate effort using conventional excavation equipment. Some caving should be anticipated in unshored excavations, especially where granular soils are encountered.

8.2.2 It is the responsibility of the contractor to ensure that all excavations and trenches are properly shored and maintained in accordance with applicable OSHA rules and regulations to maintain safety and maintain the stability of existing adjacent improvements.

8.2.3 Onsite excavations must be conducted in such a manner that potential surcharges from existing structures, construction equipment, and vehicle loads are resisted. The surcharge area may be defined by a 1:1 projection down and away from the bottom of an existing foundation or vehicle load. Penetrations below this 1:1 projection will require special excavation measures such as sloping or shoring. Excavation recommendations are provided in the *Temporary Excavations* and *Trench Shoring* sections of this report (see Section 8.11 and 8.12).

8.2.4 The existing site soils encountered during the investigation are generally considered to have a "medium" to "very high" expansive potential (EI = 47, 57, 77, 80, 102, and 175) and are classified as "expansive" in accordance with the 2022 California Building Code (CBC) Section 1803.5.3. The recommendations presented herein assume that foundations and pavements will derive support in materials with a "high" expansion index.

8.2.5 There is no practical method of totally preventing movement due to expansive soils. Current practice in the Southern California area dictates substantial reinforcement, slab thickening, moisture barriers, and pre-soaking of subgrade soils as methods of reducing the effects of expansive soils. Reasonable reduction of expansive soil effects is considered feasible from a geotechnical viewpoint utilizing such methods, although it is noted that some future distress cannot be precluded when constructing improvements on expansive soils.

8.3 Water-Soluble Sulfate

8.3.1 Laboratory tests were performed on representative samples of the on-site soil to measure the percentage of water-soluble sulfate content. Results from the laboratory water-soluble sulfate tests are presented in Appendix B (Figure B27) and indicate that the on-site soils possess a sulfate exposure class of "S2" to concrete structures as defined by 2022 CBC Section 1904 and ACI 318 Chapter 19. The table below presents a summary of concrete requirements set forth by 2022 CBC Section 1904 and ACI 318. The presence of water-soluble sulfates is not a visually discernible characteristic; therefore, other soil samples from the site could yield different concentrations. Additionally, over time landscaping activities (i.e., addition of fertilizers and other soil nutrients) may affect the concentration.

REQUIREMENTS FOR CONCRETE EXPOSED TO SULFATE-CONTAINING SOLUTIONS

Exposure Class	Water-Soluble Sulfate (SO4) Percent by Weight	Cement Type (ASTM C150)		Maximum Water to Cement Ratio by Weight[1]	Minimum Compressive Strength (psi)
S0	$SO_4<0.10$	No Type Restriction		n/a	2,500
S1	$0.10\leq SO_4<0.20$	II		0.50	4,000
S2	**$0.20\leq SO_4\leq 2.00$**	**V**		**0.45**	**4,500**
S3	$SO_4>2.00$	Option 1	V+Pozzolan or Slag	0.45	4,500
		Option 2	V	0.40	5,000

[1] Maximum water to cement ratio limits do not apply to lightweight concrete

8.3.2 Geocon West, Inc. does not practice in the field of corrosion engineering and mitigation. If corrosion sensitive improvements are planned, it is recommended that a corrosion engineer be retained to evaluate corrosion test results and incorporate the necessary precautions to avoid premature corrosion of buried metal pipes and concrete structures in direct contact with the soils.

8.4 Earthwork

8.4.1 A preconstruction conference should be held at the site prior to the beginning of excavation operations with the owner, contractor, civil engineer, geotechnical engineer, and building official in attendance. Special soil handling requirements can be discussed at that time.

8.4.2 Earthwork should be observed, and compacted fill tested by representatives of Geocon West, Inc. The existing fill and alluvial soil encountered during exploration are suitable for re-use as an engineered fill, provided any encountered oversize material (greater than 6 inches) and any encountered deleterious debris are removed.

8.4.3 Grading should commence with the removal of all existing vegetation and existing improvements from the area to be graded. Deleterious debris such as wood and root structures should be exported from the site and should not be mixed with the fill soils. Asphalt and concrete should not be mixed with the fill soils unless approved by the Geotechnical Engineer. All existing underground improvements planned for removal should be completely excavated and the resulting depressions properly backfilled in accordance with the procedures described herein. Once a clean excavation bottom has been established it must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.).

8.4.4 All excavations must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon).

8.4.5 Due to the potential for high-moisture content soils at the excavation bottom, or if construction is performed during the rainy season and the excavation bottom becomes saturated, stabilization measures may have to be implemented to prevent excessive disturbance the excavation bottom. Should this condition exist, rubber tire equipment should not be allowed in the excavation bottom until it is stabilized or extensive soil disturbance could result. Track mounted equipment should be considered to minimize disturbance to the soils.

8.4.6 Bottom stabilization, if necessary, may be achieved by introducing a thin lift of three to six-inch diameter crushed angular rock into the soft excavation bottom. The use of crushed concrete will also be acceptable. The crushed rock should be spread thinly across the excavation bottom and pressed into the soils by track rolling or wheel rolling with heavy equipment. It is very important that voids between the rock fragments are not created so the rock must be thoroughly pressed or blended into the soils.

8.4.7 An additional method of subgrade stabilization would be to place a minimum 12-inch thick layer of aggregate base over Tensar InterAx NX850 geogrid or equivalent extruded (nonwoven) geotextile. The Tensar geogrids should be installed taught and should overlap in accordance with the manufacturer's recommendations. Prior to placing the geogrid, excessively soft or wet materials should be removed and the resulting excavation bottom should be free of loose material. Non-vibratory compaction methods should be used for compaction of the base material. The aggregate base should be compacted to a dry density of at least 95 percent of the laboratory maximum density near the optimum moisture. If pumping of the subgrade continues, a thicker layer of aggregate base may be placed. It is very important that subgrade stabilization be performed uniformly across the entire excavation bottom.

8.4.8 All fill and backfill soils should be placed in horizontal loose layers approximately 6 to 8 inches thick, moisture conditioned to approximately two percent above optimum moisture content, and properly compacted to a minimum 90 percent of the maximum dry density in accordance with ASTM D 1557 (latest edition).

8.4.9 Where new paving is to be placed, as a minimum it is recommended that the upper 24 inches of subgrade soil be excavated and properly compacted for paving support. The client should be aware that paving constructed over existing uncertified fill or unsuitable alluvial soil may experience increased settlement and/or cracking and may therefore have a shorter design life and increased maintenance costs. However, as previously discussed, given the depth of existing artificial fill, it is unlikely that complete removal and compaction of all fill is feasible. Paving recommendations are provided in the *Preliminary Pavement Recommendations* section of this report (see Section 8.10).

8.4.10 Foundations for small outlying structures, such as block walls up to 6 feet high, planter walls or trash enclosures, which will not be tied any existing structures, may be supported on conventional foundations deriving support on a minimum of 12 inches of newly placed engineered fill which extends laterally at least 12 inches beyond the foundation area. Where excavation and proper compaction cannot be performed, foundations may derive support directly in undisturbed soils and should be deepened as necessary to maintain a minimum 30-inch embedment into the recommended bearing materials. If the soils exposed in the excavation bottom are soft or loose, compaction of the soils will be required prior to placing steel or concrete.

8.4.11 It is recommended that flexible utility connections be utilized for all rigid utilities to minimize or prevent damage to utilities from minor differential movements. Utility trenches should be properly backfilled in accordance with the following requirements. The pipe should be bedded with clean sands (Sand Equivalent greater than 30) to a depth of at least 1 foot over the pipe, and the bedding material must be inspected and approved in writing by the Geotechnical Engineer (a representative of Geocon). The use of gravel is not acceptable unless used in conjunction with filter fabric to prevent the gravel from having direct contact with soil. The remainder of the trench backfill may be derived from onsite soil or approved import soil, compacted as necessary, until the required compaction is obtained. The use of minimum 2-sack slurry as backfill is also acceptable. Prior to placing any bedding materials or pipes, the excavation bottom must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon).

8.4.12 All imported fill shall be observed, tested, and approved by Geocon West, Inc. prior to bringing soil to the site. Import fill should consist of the characteristics presented in the table below.

SUMMARY OF IMPORT FILL RECOMMENDATIONS

Soil Characteristic	Values
Expansion Potential	"Medium" (Expansion Index of 90 or less)
Particle Size	Maximum Dimension Less Than 6 Inches
	Free of Debris
Corrosivity	Equal to or Less Detrimental Than Existing Onsite Soils

8.4.13 All trench and foundation excavation bottoms must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon), prior to placing bedding materials, fill, steel, gravel, or concrete.

8.5 Shrinkage

8.5.1 Shrinkage results when a volume of material removed at one density is compacted to a higher density. A shrinkage factor of between 10 and 22 percent should be anticipated when excavating and compacting the upper 2 feet of existing earth materials on the site to an average relative compaction of 92 percent.

8.5.2 If import soils will be utilized, the soils must be placed uniformly and at equal thickness below proposed improvement at the direction of the Geotechnical Engineer (a representative of Geocon West, Inc.). Soils can be borrowed from non-improvement areas and later replaced with imported soils.

8.6 Friction Pile Foundations – Light Standards

8.6.1 Typical light standards are between 10 and 15 feet in height and are supported on pile foundations. Cast-in-place friction piles may be utilized for support of the proposed lighting poles provided foundations.

8.6.2 Friction piles should be a minimum of 18 inches in diameter and should be embedded a minimum of 5 feet below the ground surface. Where not protected by pavement, the upper two feet of soil should be ignored when calculating axial and lateral capacity.

8.6.3 Friction piles may be designed based on a skin friction capacity of 160 pounds per square foot and do not require the complete removal of all loose earth materials from the bottom of the excavation since the end-bearing capacity is not being considered for design. However, a cleanout of the excavation bottom will be required. Single pile uplift capacity can be taken as 60 percent of the allowable downward capacity. The allowable downward capacity and allowable uplift capacity may be increased by one-third when considering transient wind or seismic loads.

8.6.4 For design purposes, an allowable passive value may be assumed to be 150 psf per foot with a maximum earth pressure of 1,500 psf. To develop the full lateral value, provisions should be implemented to assure firm contact between the piles and the engineered fill and underlying alluvium. A one-third increase in the passive value may be used for wind or seismic loads. The allowable capacity may be doubled for isolated piles spaced more than three times the diameter on-center.

8.6.5 All drilled pile excavations should be continuously observed by personnel of this firm to verify adequate penetration into the recommended bearing materials. The capacity presented is based on the strength of the soils. The compressive and tensile strength of the pile sections should be checked to verify the structural capacity of the piles.

8.7 Pile Installation

8.7.1 Caving may occur where granular soils are present and the contractor should have casing available prior to commencement of pile excavation. When casing is used, extreme care should be employed so that the pile is not pulled apart as the casing is withdrawn. At no time should the distance between the surface of the concrete and the bottom of the casing be less than 5 feet. Continuous observation of the drilling and pouring of the piles by the Geotechnical Engineer (a representative of Geocon West, Inc.), is required.

8.7.2 Groundwater was not encountered during exploration, and groundwater is not expected to be encountered during construction. However, should groundwater or seepage be encountered during pile installation, the contractor should be prepared. Piles placed below the water level require the use of a tremie to place the concrete into the bottom of the hole. A tremie should consist of a rigid, water-tight tube having a diameter of not less than 6 inches with a hopper at the top. The tube should be equipped with a device that will close the discharge end and prevent water from entering the tube while it is being charged with concrete. The tremie should be supported so as to permit free movement of the discharge end over the entire top surface of the work and to permit rapid lowering when necessary to retard or stop the flow of concrete. The discharge end should be closed at the start of the work to prevent water entering the tube and should be entirely sealed at all times, except when the concrete is being placed. The tremie tube should be kept full of concrete. The flow should be continuous until the work is completed and the resulting concrete seal should be monolithic and homogeneous. The tip of the tremie tube should always be kept about 5 feet below the surface of the concrete and definite steps and safeguards should be taken to insure that the tip of the tremie tube is never raised above the surface of the concrete.

8.7.3 A special concrete mix should be used for concrete to be placed below water. The design should provide for concrete with an unconfined compressive strength psi of 1,000 pounds per square inch (psi) over the initial job specification. An admixture that reduces the problem of segregation of paste/aggregates and dilution of paste should be included. The slump should be commensurate to any research report for the admixture, provided that it should also be the minimum for a reasonable consistency for placing when water is present.

8.7.4 Closely spaced piles should be drilled and filled alternately, with the concrete permitted to set at least eight hours before drilling an adjacent hole. Unless the holes are fully cased from top to bottom, it is not recommended that holes be left open overnight.

8.8 Miscellaneous Foundations

8.8.1 Foundations for small outlying structures, such as block walls up to 6 feet in height, planter walls or trash enclosures, which will not be tied to any existing structure, may be supported on conventional foundations deriving support on a minimum of 12 inches of newly placed engineered fill which extends laterally at least 12 inches beyond the foundation area. Where excavation and compaction cannot be performed, foundations may derive support directly in the competent undisturbed alluvial soils and should be deepened as necessary to maintain a minimum 30-inch embedment into the recommended bearing materials.

8.8.2 Miscellaneous foundations may be designed for a bearing value of 1,000 psf and should be a minimum of 12 inches in width, 30 inches in depth below the lowest adjacent grade and 12 inches into the recommended bearing material. The allowable bearing pressure may be increased by up to one-third for transient loads due to wind or seismic forces. If the soils exposed in the excavation bottom are soft or loose, compaction of the soils will be required prior to placing steel or concrete.

8.8.3 Foundation excavations should be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to the placement of reinforcing steel and concrete to verify that the excavations and exposed soil conditions are consistent with those anticipated.

8.9 Exterior Concrete Slabs-on-Grade

8.9.1 Exterior concrete slabs-on-grade subject to vehicle loading should be designed in accordance with the recommendations in the *Preliminary Pavement Recommendations* section of this report (Section 8.10).

8.9.2 Exterior slabs for walkways or flatwork, not subject to traffic loads, should be at least 4 inches thick and reinforced with No. 4 steel reinforcing bars placed 16 inches on center in both horizontal directions, positioned near the slab midpoint. Prior to construction of slabs, the upper 24 inches of subgrade should be moistened to approximately two percent above optimum moisture content and properly compacted to at least 92 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition). Crack control joints should be spaced at intervals not greater than 10 feet and should be constructed using saw-cuts or other methods as soon as practical following concrete placement. Crack control joints should extend a minimum depth of ¼ the slab thickness. The project structural engineer should design construction joints as necessary.

0.1.6 Due to the expansive potential of the anticipated subgrade soils, the moisture content of the slab subgrade should be maintained and sprinkled as necessary to maintain a moist condition as would be expected in any concrete placement. Furthermore, consideration should be given to doweling slabs into adjacent curbs and foundations to minimize movements and offsets which could lead to a potential tripping hazard. As an alternative, the upper 18 inches of soil could be replaced with granular, non-expansive soils which will reduce the potential for movements and offsets.

8.9.3 The recommendations of this report are intended to reduce the potential for cracking of slabs due to settlement. However, even with the incorporation of the recommendations presented herein, foundations, stucco walls, and slabs-on-grade may exhibit some cracking due to minor soil movement and/or concrete shrinkage. The occurrence of concrete shrinkage cracks is independent of the supporting soil characteristics. Their occurrence may be reduced and/or controlled by limiting the slump of the concrete, proper concrete placement and curing, and by the placement of crack control joints at periodic intervals, in particular, where re-entrant slab corners occur.

8.10 Preliminary Pavement Recommendations

8.10.1 The client should be aware that paving constructed over existing uncertified fill or unsuitable alluvial soil may experience increased settlement and/or cracking and may therefore have a shorter design life and increased maintenance costs. However, as previously discussed, given the depth of existing artificial fill, it is unlikely that complete removal and compaction of all fill is feasible. As a minimum, the upper 24 inches of paving subgrade should be excavated, moisture conditioned to approximately two percent above optimum moisture content, and properly compacted to at least 92 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition).

8.10.2 The laboratory test results indicate R-Values ranging between 4 and 19. The following pavement sections are based on an average R-Value of 10. Once site earthwork activities are complete and prior to placing pavement, additional R-Value can be obtained by laboratory testing to confirm the properties of the soils serving as paving subgrade.

8.10.3 The Traffic Indices listed below are estimates. Geocon does not practice in the field of traffic engineering. The actual Traffic Index for each area should be determined by the project civil engineer. If pavement sections for Traffic Indices other than those listed below are required, Geocon should be contacted to provide additional recommendations. Pavement thicknesses were determined following procedures outlined in the *California Highway Design Manual* (Caltrans). It is anticipated that the majority of traffic will consist of automobile and large truck traffic.

PRELIMINARY PAVEMENT DESIGN SECTIONS

Assumed Vehicle Type	Estimated Traffic Index (TI)	Asphalt Concrete (inches)	Class 2 Aggregate Base (inches)
Pickup Truck or Maintenance / Service Truck	5.0	3.0	9.0

8.10.4 Asphalt concrete should conform to Section 203-6 of the "*Standard Specifications for Public Works Construction"* (Green Book). Class 2 aggregate base materials should conform to Section 26-1.02A of the "*Standard Specifications of the State of California, Department of Transportation"* (Caltrans). The use of Crushed Miscellaneous Base (CMB) in lieu of Class 2 aggregate base is acceptable. Crushed Miscellaneous Base should conform to Section 200-2.4 of the "*Standard Specifications for Public Works Construction"* (Green Book).

8.10.5 Unless specifically designed and evaluated by the project structural engineer, where exterior concrete paving will be utilized for support of vehicles, it is recommended that the concrete be a minimum of 6 inches of concrete reinforced with No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions. Concrete paving supporting vehicular traffic should be underlain by a minimum of 4 inches of aggregate base and a properly compacted subgrade. The subgrade and base material should be compacted to 92 and 95 percent relative compaction, respectively, as determined by ASTM Test Method D 1557 (latest edition).

8.10.6 The performance of pavements is highly dependent upon providing positive surface drainage away from the edge of pavements. Ponding of water on or adjacent to the pavement will likely result in saturation of the subgrade materials and subsequent cracking, subsidence and pavement distress. If planters are planned adjacent to paving, it is recommended that the perimeter curb be extended at least 12 inches below the bottom of the aggregate base to minimize the introduction of water beneath the paving.

8.11 Temporary Excavations

8.11.1 Excavations less than 5 feet in height may be required for earthwork and construction of the proposed improvements. The excavations are expected to expose artificial fill and alluvial soils, which are considered suitable for vertical excavations up to 5 feet in height where loose soils or caving sands are not present, and where excavations are not surcharged by adjacent traffic or structures. Caving of granular alluvial soils should be anticipated.

8.11.2 Vertical excavations greater than 5 feet or where surcharged by existing structures will require sloping or shoring measures in order to provide a stable excavation. It is anticipated that stable excavations for construction of the proposed improvements can be achieved and maintained with sloping measures. Where sufficient space is available, temporary unsurcharged embankments could be sloped back at a uniform 1:1 slope gradient or flatter up to a maximum of 8 feet in height. A uniform slope does not have a vertical portion.

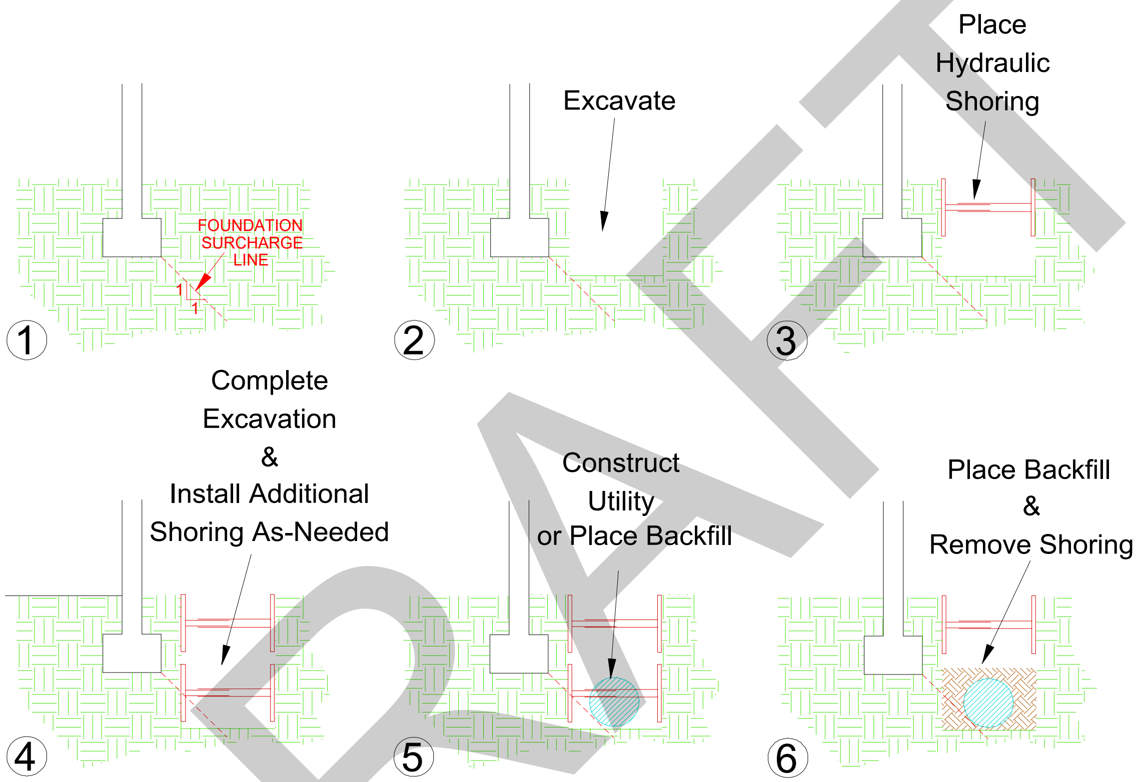
0.1.3 Performing continuous vertical excavations along property lines or adjacent to an existing structure could remove support which is not acceptable. Excavations in close proximity to an adjacent property line or structure may require special excavation measures, such as slot-cutting or shoring. Recommendations for trench shoring are provided in the following sections.

8.11.3 Where temporary construction slopes are utilized, the top of the slope should be barricaded to prevent vehicles and storage loads at the top of the slope within a horizontal distance equal to the height of the slope. If the temporary construction slopes are to be maintained during the rainy season, berms are suggested along the tops of the slopes where necessary to prevent runoff water from entering the excavation and eroding the slope faces. The soils exposed in the cut slopes should be inspected during excavation by our personnel and the contractor's competent person so that modifications of the slopes can be made if variations in the soil conditions occur. All excavations should be stabilized within 30 days of initial excavation.

8.12 Trench Shoring

8.12.1 To protect the existing improvements, hydraulic trench shoring may be implemented where excavations will extend below existing foundations.

8.12.2 Excavation may be conducted adjacent to a foundation but should not extend below the foundation until the shoring is installed. Once shoring is installed the excavation can be completed. Once the concrete is placed to an elevation that is slightly above the bottom of the existing adjacent foundation, the shoring may be removed, and the new foundation constructed. See illustration below.



8.12.3 It is recommended that an equivalent fluid pressure based on the table below be utilized for design of hydraulic shoring.

HEIGHT OF SHORED EXCAVATION (FEET)	EQUIVALENT FLUID PRESSURE (Pounds Per Cubic Foot) (ACTIVE PRESSURE)	EQUIVALENT FLUID PRESSURE (Pounds Per Cubic Foot) (AT-REST PRESSURE)
Up to 5	25	63

8.12.4 It is very important to note that active pressures can only be achieved when movement in the soil (earth wall) occurs. If movement in the soil is not acceptable, such as adjacent to an existing structure, the at-rest pressure should be considered for design purposes.

8.12.5 A qualified engineer should be retained to review and prepare a shoring plan in accordance with the shoring manufacture's specifications.

8.12.6 Additional pressure should be added for a surcharge condition due to sloping ground, vehicular traffic or adjacent structures and should be designed for each condition as the project progresses.

8.12.7 It is recommended that line-load surcharges from adjacent wall footings, use horizontal pressures generated from NAV-FAC DM 7.2. The governing equations are:

$$For\ {}^{x}/_{H} \leq 0.4$$

$$\sigma_H(z) = \frac{0.20 \times \left(\frac{z}{H}\right)}{\left[0.16 + \left(\frac{z}{H}\right)^2\right]^2} \times \frac{Q_L}{H}$$

and

$$For\ {}^{x}/_{H} > 0.4$$

$$\sigma_H(z) = \frac{1.28 \times \left(\frac{x}{H}\right)^2 \times \left(\frac{z}{H}\right)}{\left[\left(\frac{x}{H}\right)^2 + \left(\frac{z}{H}\right)^2\right]^2} \times \frac{Q_L}{H}$$

where x is the distance from the face of the excavation or wall to the vertical line-load, H is the distance from the bottom of the footing to the bottom of excavation or wall, z is the depth at which the horizontal pressure is desired, Q_L is the vertical line-load and $\sigma_H(z)$ is the horizontal pressure at depth z.

8.12.8 It is recommended that vertical point-loads, from construction equipment outriggers or adjacent building columns use horizontal pressures generated from NAV-FAC DM 7.2. The governing equations are:

$$For\ {}^{x}/_{H} \leq 0.4$$

$$\sigma_H(z) = \frac{0.28 \times \left(\frac{z}{H}\right)^2}{\left[0.16 + \left(\frac{z}{H}\right)^2\right]^3} \times \frac{Q_P}{H^2}$$

and

$$For\ {}^{x}/_{H} > 0.4$$

$$\sigma_H(z) = \frac{1.77 \times \left(\frac{x}{H}\right)^2 \times \left(\frac{z}{H}\right)^2}{\left[\left(\frac{x}{H}\right)^2 + \left(\frac{z}{H}\right)^2\right]^3} \times \frac{Q_P}{H^2}$$

then

$$\sigma'_H\,(z) = \sigma_H(z)cos^2(1.1\theta)$$

where *x* is the distance from the face of the excavation/wall to the vertical point-load, *H* is distance from the outrigger/bottom of column footing to the bottom of excavation, *z* is the depth at which the horizontal pressure is desired, *Qp* is the vertical point-load, $\sigma_H(z)$ is the horizontal pressure at depth *z*, *Θ* is the angle between a line perpendicular to the excavation/wall and a line from the point-load to location on the excavation/wall where the surcharge is being evaluated, and $\sigma_H(z)$ is the horizontal pressure at depth *z*.

8.13 Surface Drainage

8.13.1 Proper surface drainage is critical to the future performance of the project. Uncontrolled infiltration of irrigation excess and storm runoff into the soils can adversely affect the performance of the planned improvements. Saturation of a soil can cause it to lose internal shear strength and increase its compressibility, resulting in a change in the original designed engineering properties. Proper drainage should be maintained at all times.

8.13.2 All site drainage should be collected and controlled in non-erosive drainage devices. Drainage should not be allowed to pond anywhere on the site, and especially not against any foundation or retaining wall. The site should be graded and maintained such that surface drainage is directed away from structures in accordance with 2022 CBC 1804.4 or other applicable standards. In addition, drainage should not be allowed to flow uncontrolled over any descending slope.

8.13.3 Positive site drainage should be provided away from pavement and the tops of slopes to swales or other controlled drainage structures. The pavement area should be fine graded such that water is not allowed to pond.

8.14 Future Geotechnical Work

8.14.1 The recommendations provided in this report are considered preliminary and are intended to support the objectives outlined in the project RFP, dated February 16, 2023. Once the project advances to further design stages, the recommendations contained herein should be reviewed and updated as needed. At a minimum, additional future geotechnical work should be anticipated for proposed under- or overcrossings if included in the final project scope.

8.15 Plan Review

8.15.1 Grading, foundation, and, if applicable, shoring plans should be reviewed by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to finalization to verify that the plans have been prepared in substantial conformance with the recommendations of this report and to provide additional analyses or recommendations.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The firm that performed the geotechnical investigation for the project should be retained to provide testing and observation services during construction to provide continuity of geotechnical interpretation and to check that the recommendations presented for geotechnical aspects of site development are incorporated during site grading, construction of improvements, and excavation of foundations. If another geotechnical firm is selected to perform the testing and observation services during construction operations, that firm should prepare a letter indicating their intent to assume the responsibilities of project geotechnical engineer of record. A copy of the letter should be provided to the regulatory agency for their records. In addition, that firm should provide revised recommendations concerning the geotechnical aspects of the proposed development, or a written acknowledgement of their concurrence with the recommendations presented in our report. They should also perform additional analyses deemed necessary to assume the role of Geotechnical Engineer of Record.

2. The recommendations of this report pertain only to the site investigated and are based upon the assumption that the soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon Incorporated should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by Geocon Incorporated.

3. This report is issued with the understanding that it is the responsibility of the owner or their representative to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

4. The findings of this report are valid as of the date of this report. However, changes in the conditions of a property can occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.

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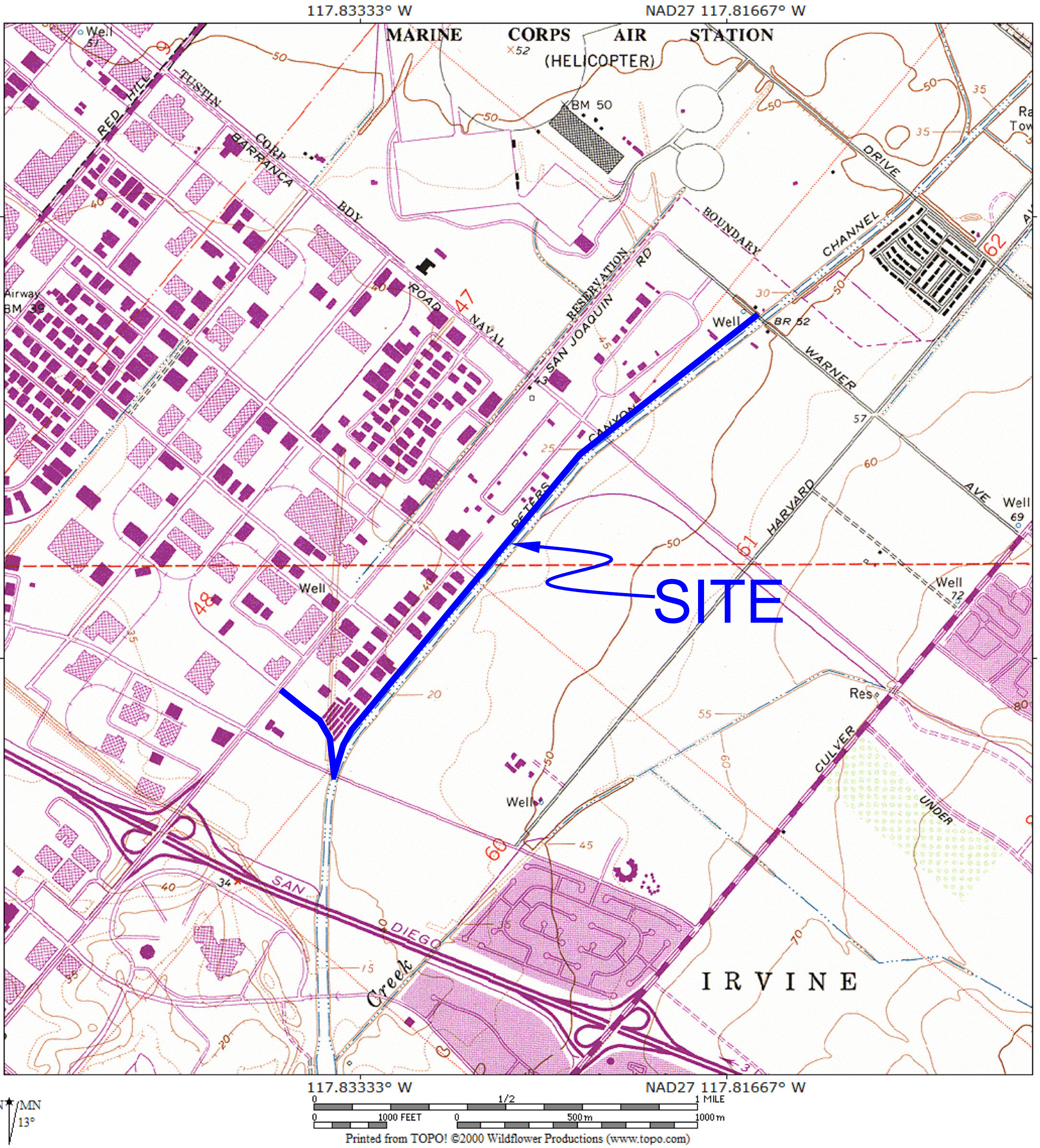

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GEOCON WEST, INC.

ENVIRONMENTAL GEOTECHNICAL MATERIALS

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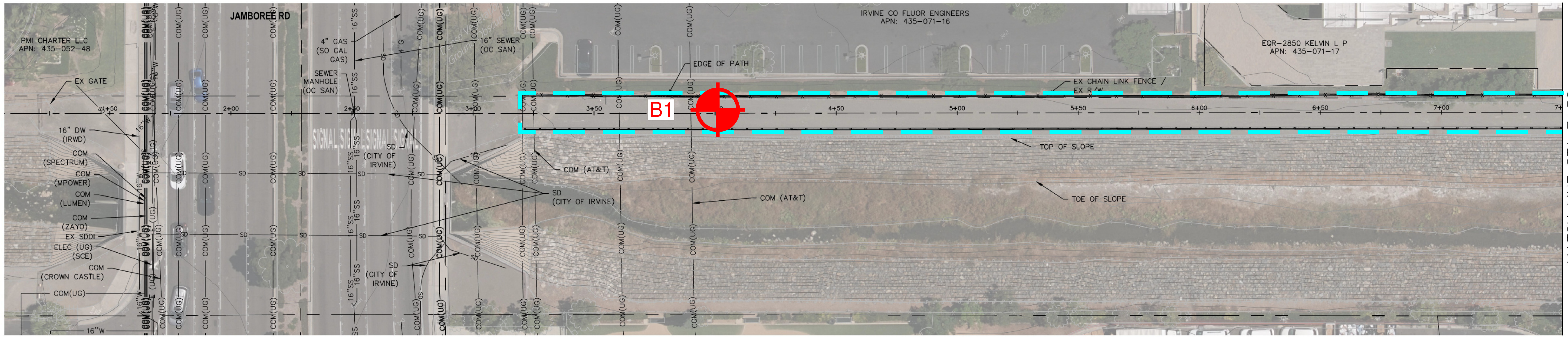
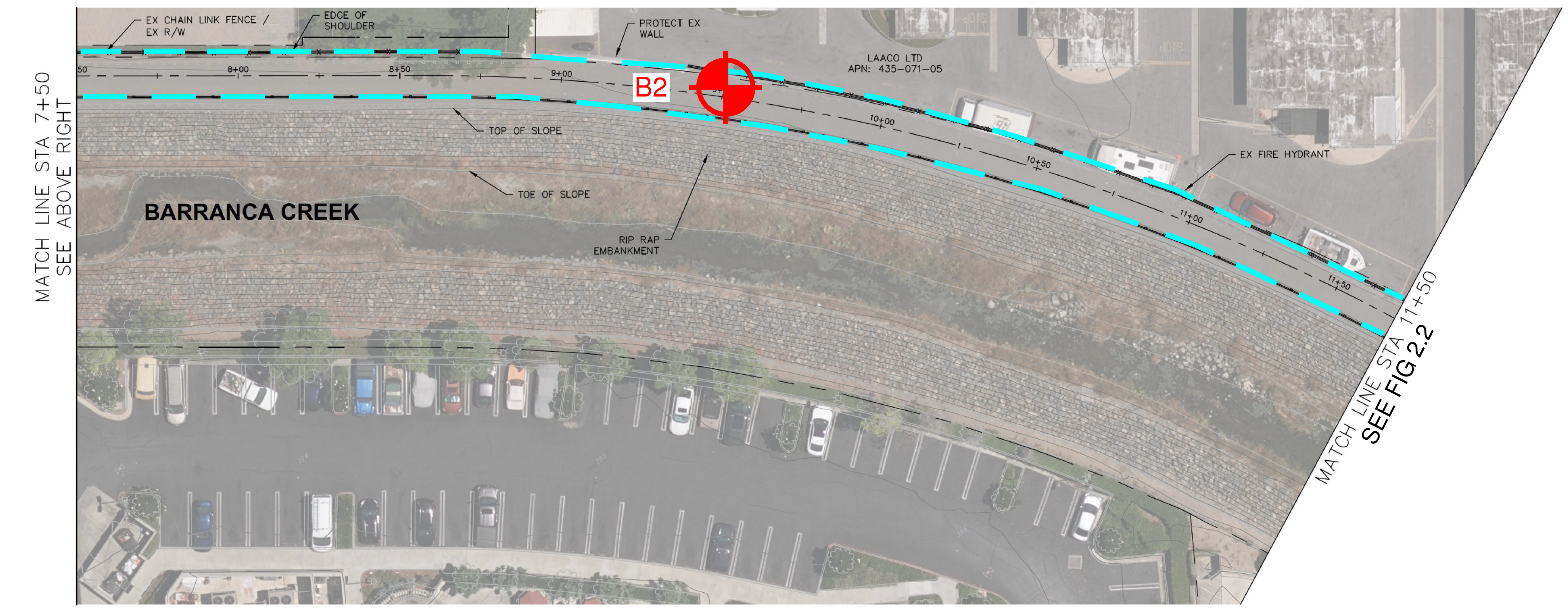
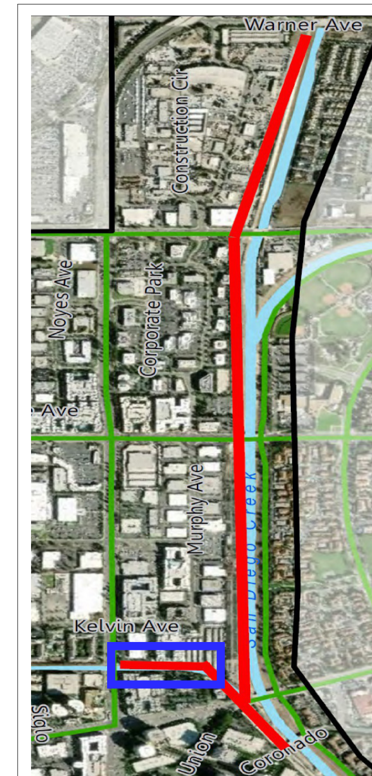
VICINITY MAP

IBC MULTI-USE TRAILS ALONG CREEKWALK (CIP 342301)
AND BARRANCA CHANNEL (CIP 342303)
IRVINE, CALIFORNIA

DRAFTED BY: RA	CHECKED BY: GAK	JUNE 2024	PROJECT NO. W1827-88-01	FIG. 1





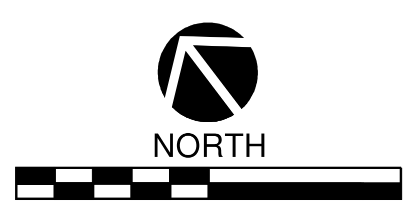


KEY MAP
NOT TO SCALE

LEGEND

B16 — Approximate Location of Boring

Approximate Limits of Proposed Improvments



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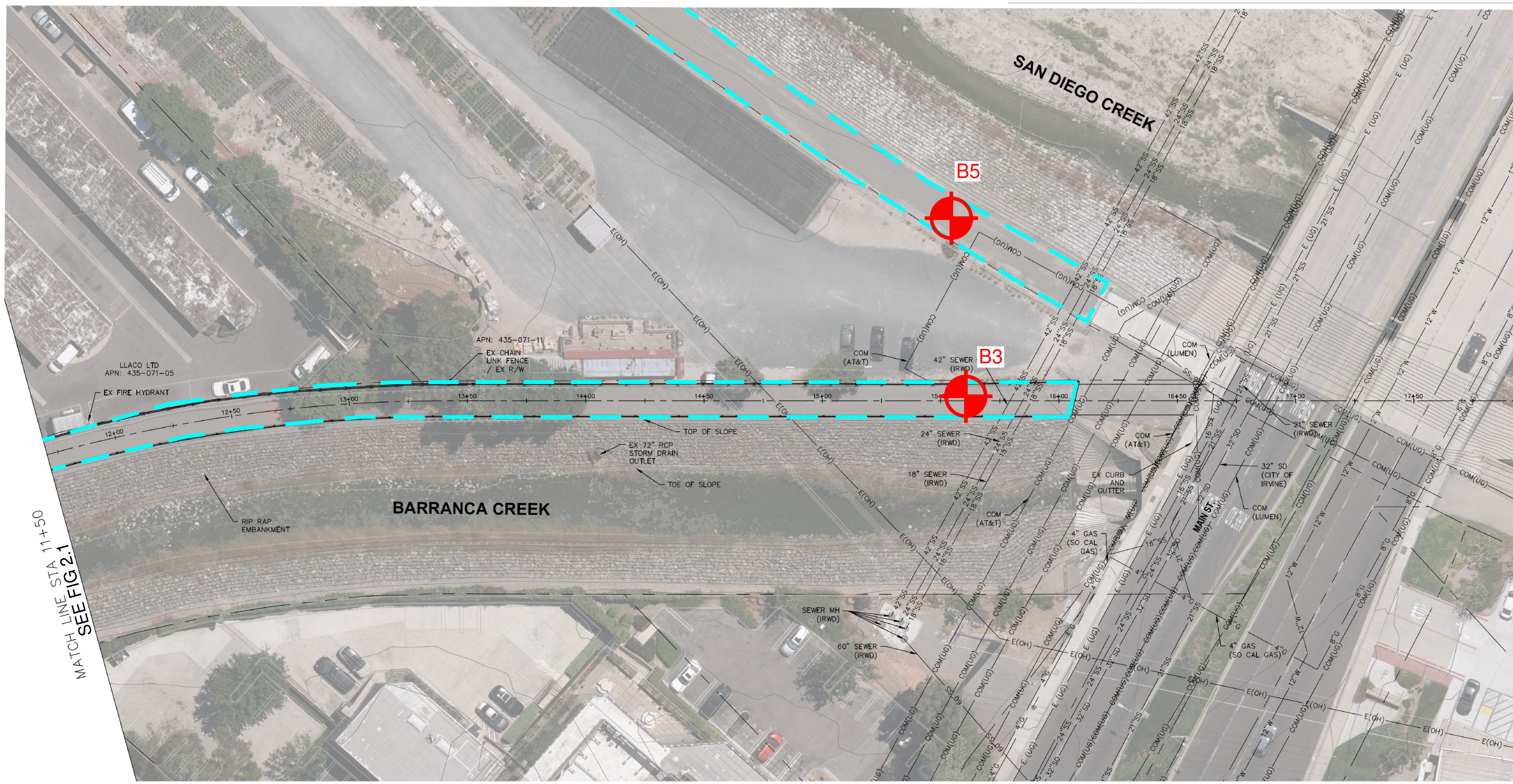
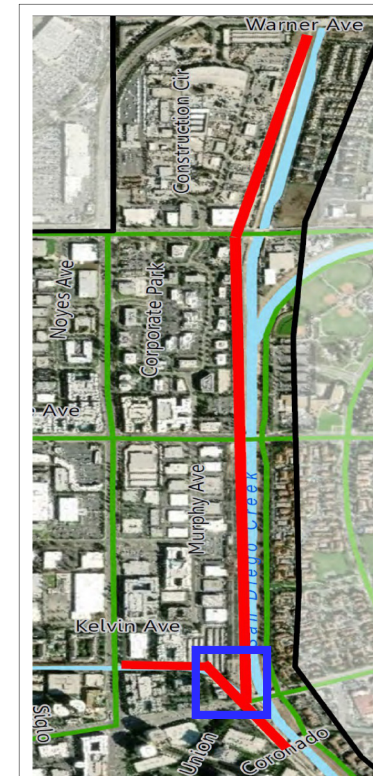
CHECKED BY: JTA | DRAFTED BY: JC

SITE PLAN

IBC Multi-Use Trails
Creekwalk and Barranca Channel
Irvine, California

JUNE 2024	PROJECT NO. W1827-88-01	FIG. 2.1





KEY MAP
NOT TO SCALE

LEGEND

B16 Approximate Location of Boring

Approximate Limits of Proposed Improvments

NORTH

0 50' 100'

GEOCON WEST, INC.

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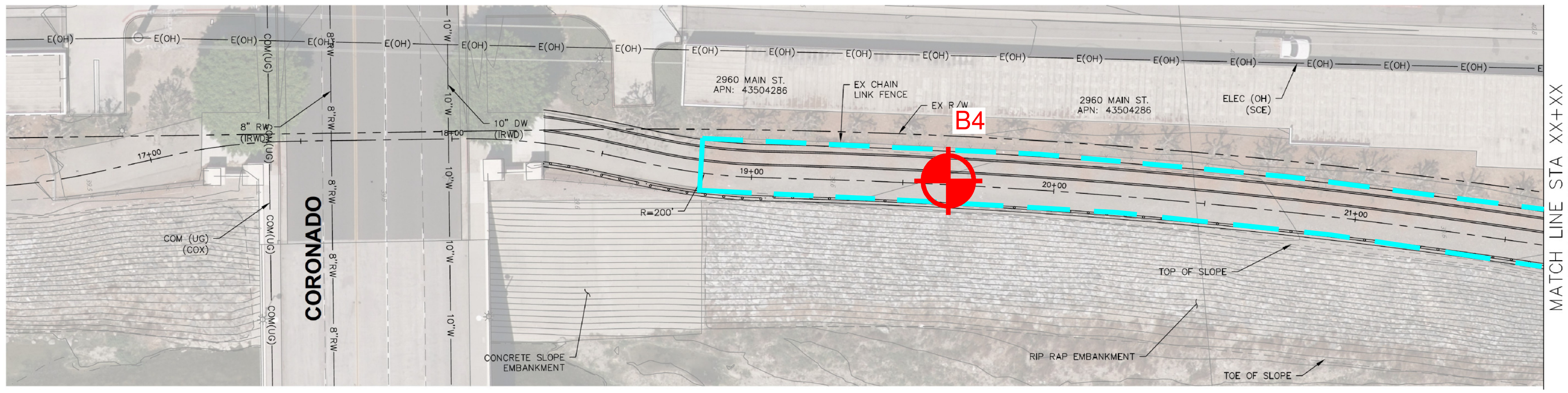
SITE PLAN

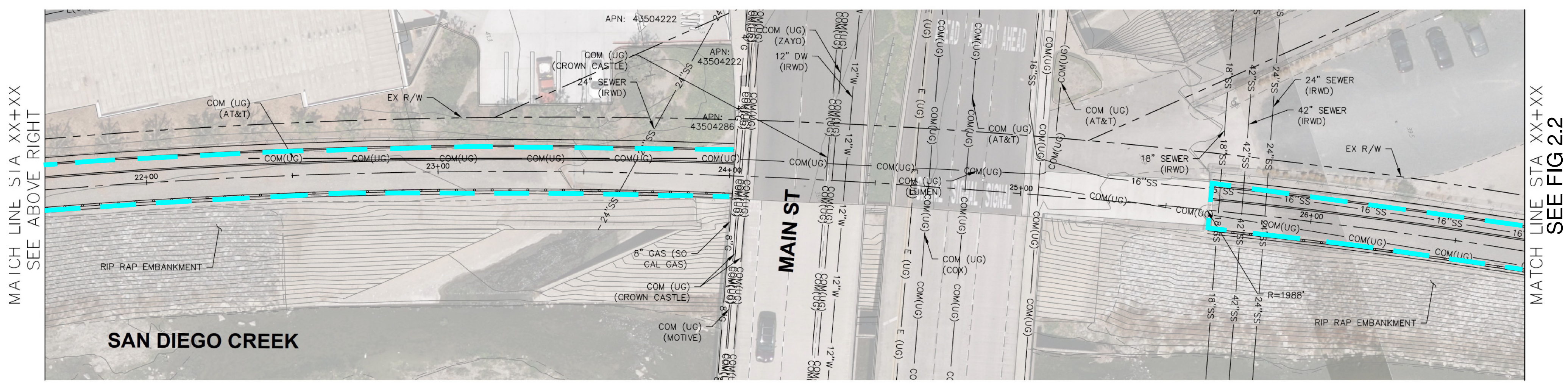
IBC Multi-Use Trails

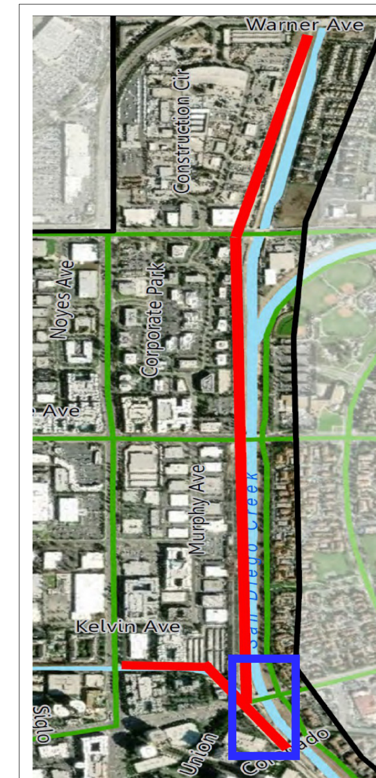
Creekwalk and Barranca Channel

Irvine, California

JUNE 2024 | PROJECT NO. W1827-88-01 | FIG. 2.2







KEY MAP
NOT TO SCALE

LEGEND

B16 Approximate Location of Boring

Approximate Limits of Proposed Improvments

NORTH

0 50' 100'

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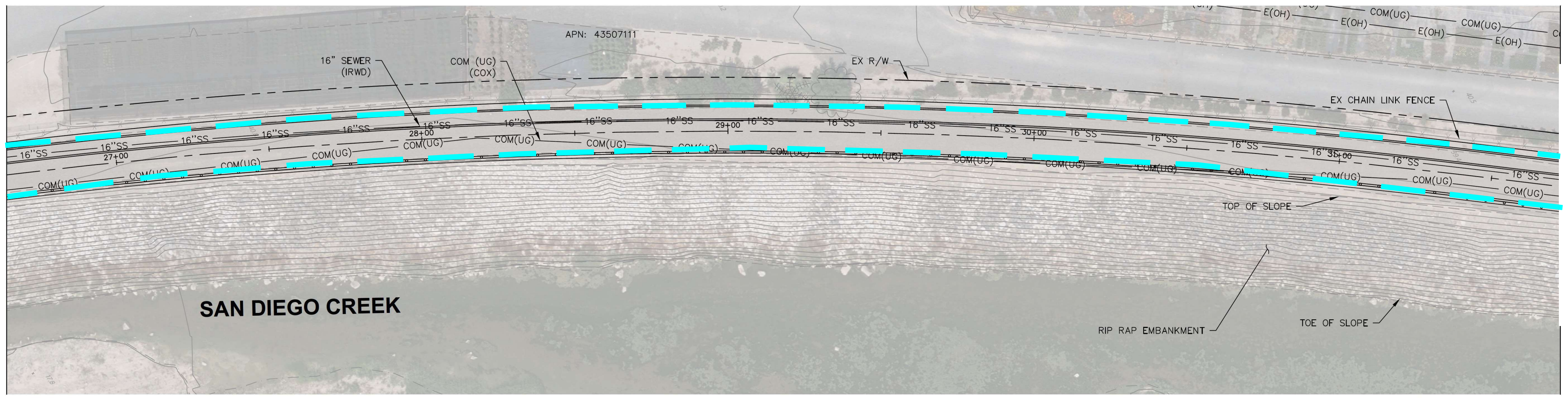
SITE PLAN

IBC Multi-Use Trails
Creekwalk and Barranca Channel
Irvine, California

JUNE 2024 | PROJECT NO. W1827-88-01 | FIG. 2.3

SEE FIG 2.2



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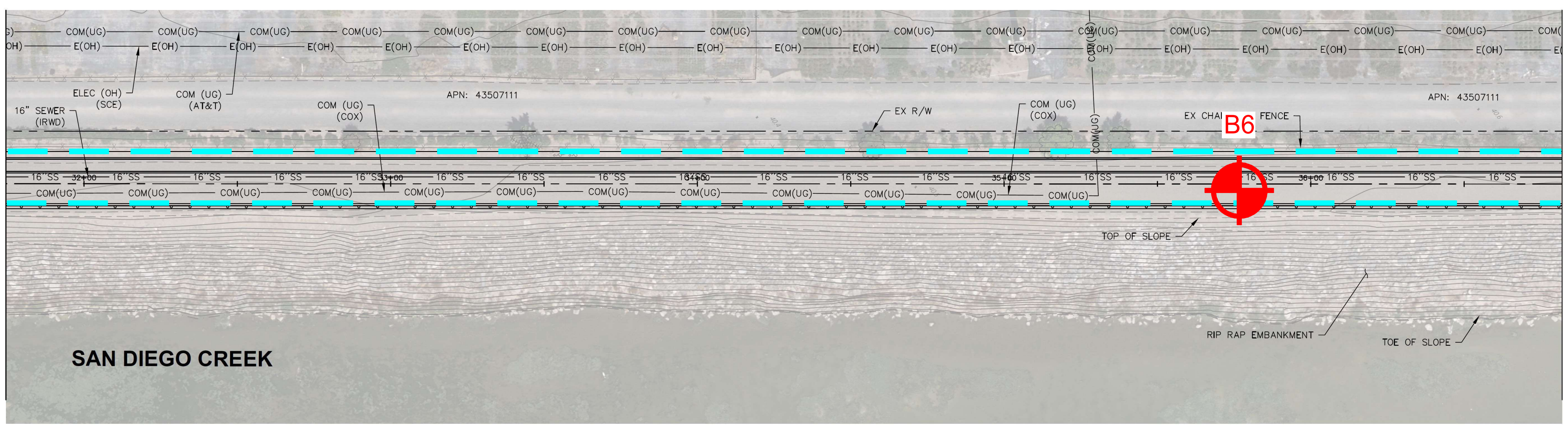
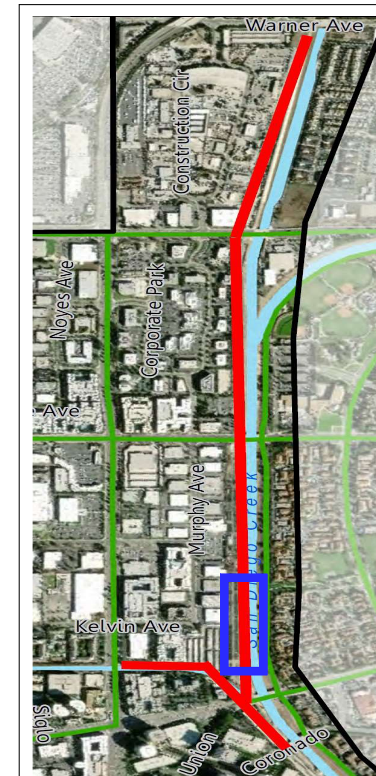
SEE ABOVE RIGHT



SEE FIG 2.5

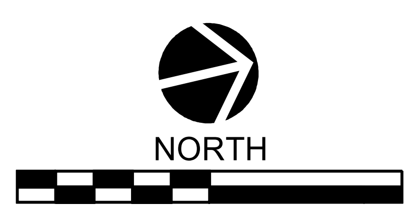


KEY MAP
NOT TO SCALE

LEGEND

B16 — Approximate Location of Boring

— — Approximate Limits of Proposed Improvments



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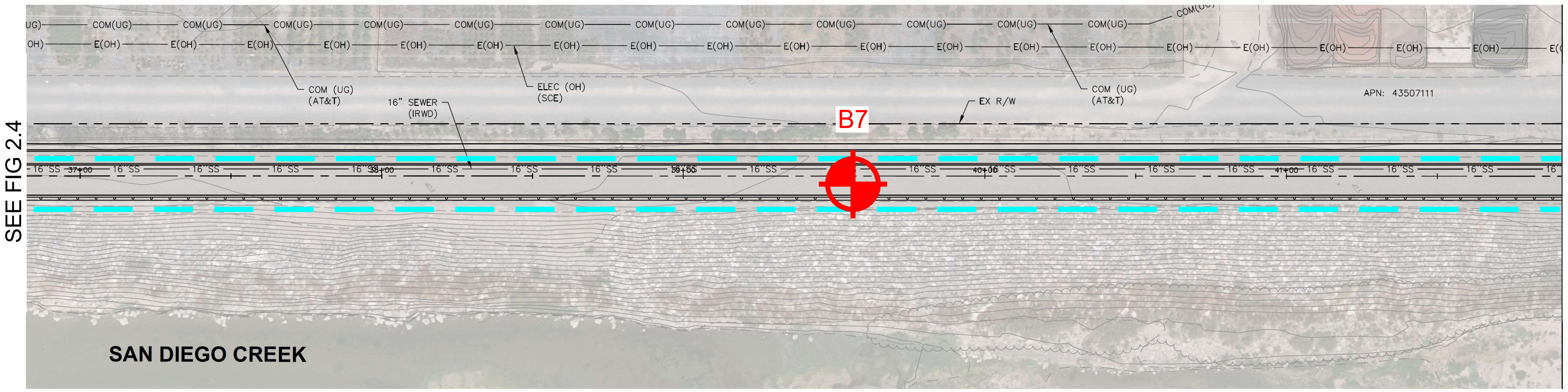
SITE PLAN

IBC Multi-Use Trails
Creekwalk and Barranca Channel
Irvine, California

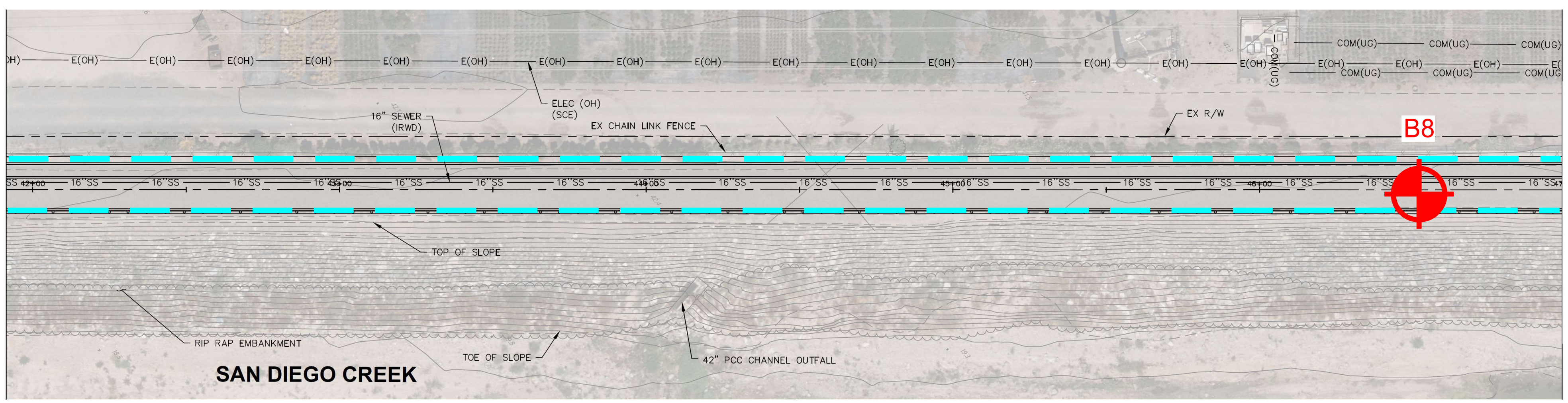
JUNE 2024 | PROJECT NO. W1827-88-01 | FIG. 2.4

SEE FIG 2.4

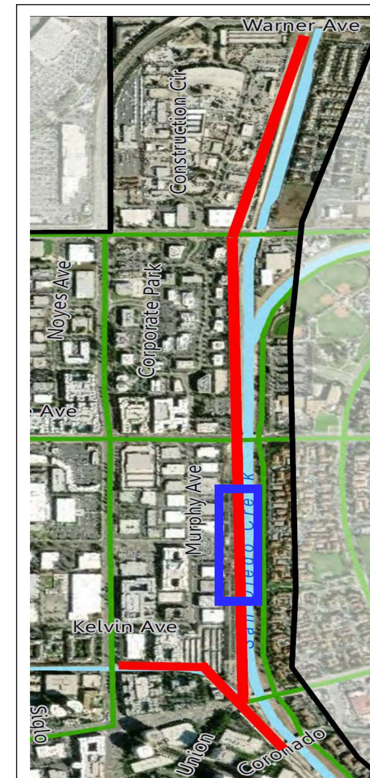


SEE BELOW LEFT

SEE ABOVE RIGHT



SEE FIG 2.6

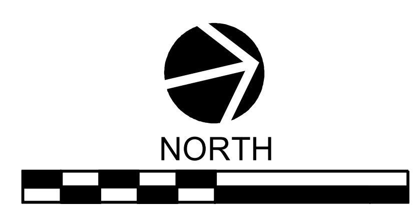


KEY MAP
NOT TO SCALE

LEGEND

B16 Approximate Location of Boring

Approximate Limits of Proposed Improvments



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SITE PLAN

IBC Multi-Use Trails
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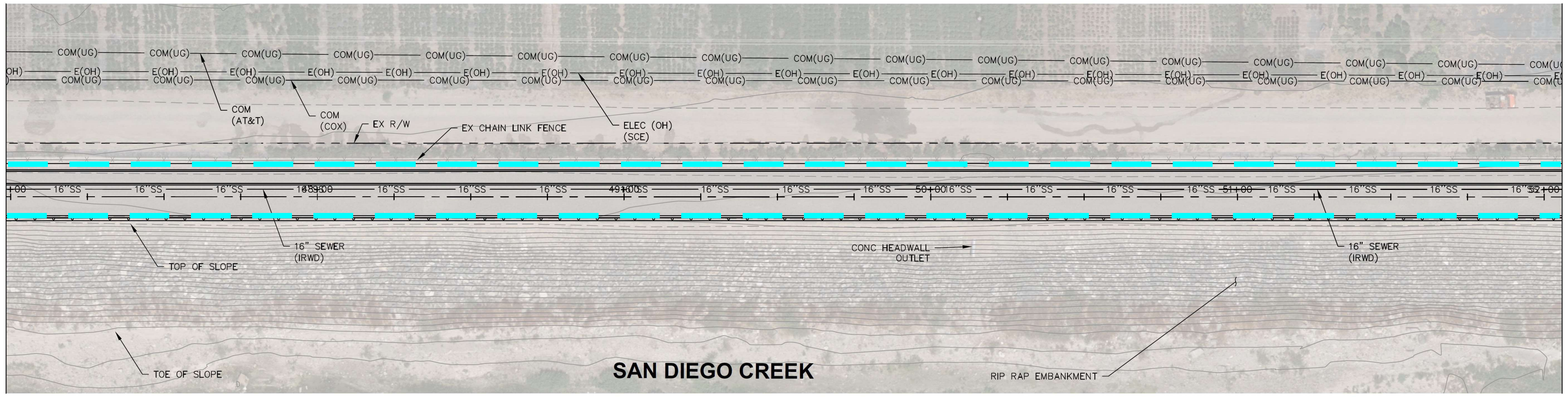
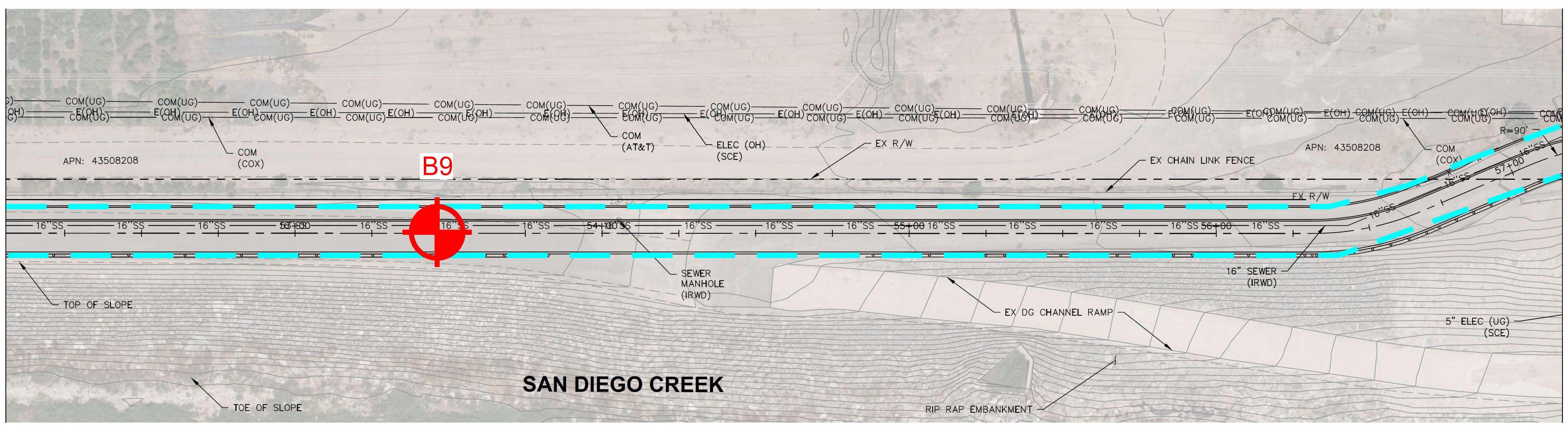
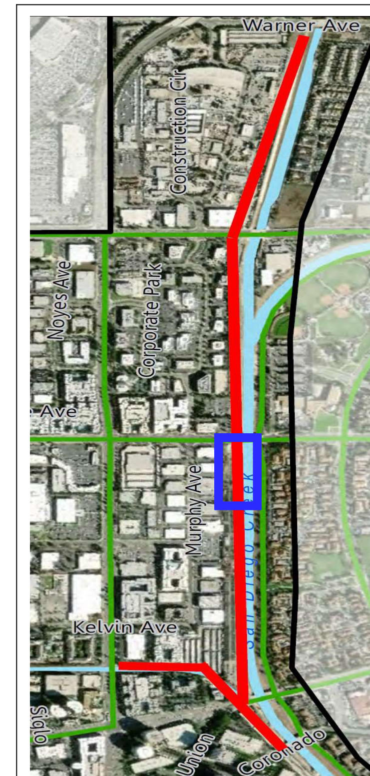
JUNE 2024 | PROJECT NO. W1827-88-01 | FIG. 2.5





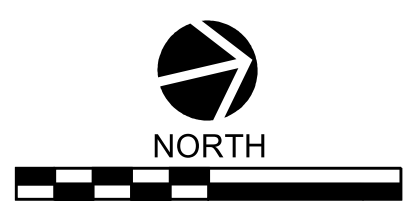


KEY MAP
NOT TO SCALE

LEGEND

B16 — Approximate Location of Boring

Approximate Limits of Proposed Improvments



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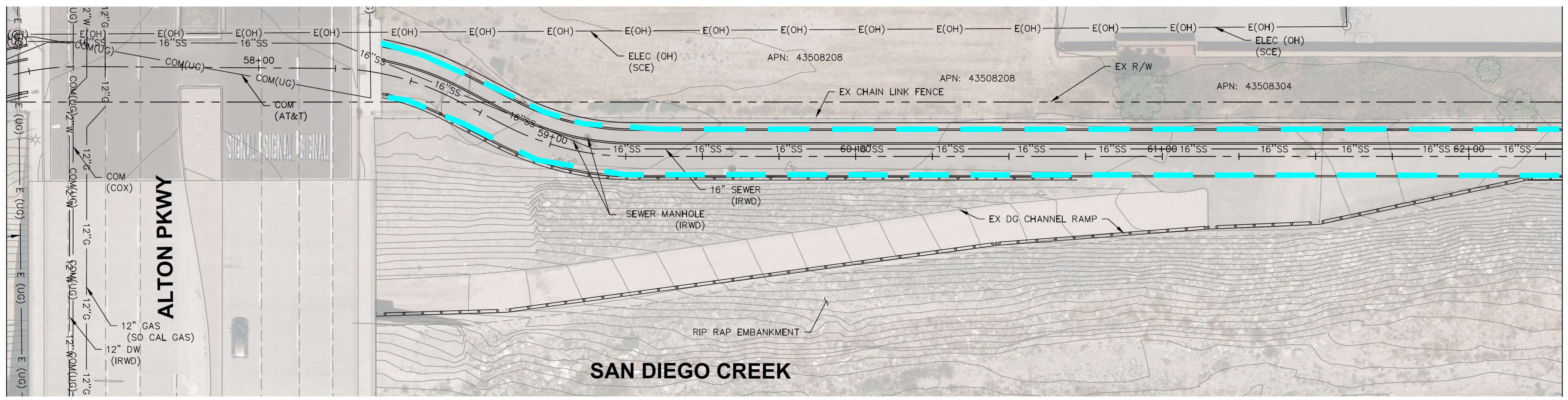
SITE PLAN

IBC Multi-Use Trails
Creekwalk and Barranca Channel
Irvine, California

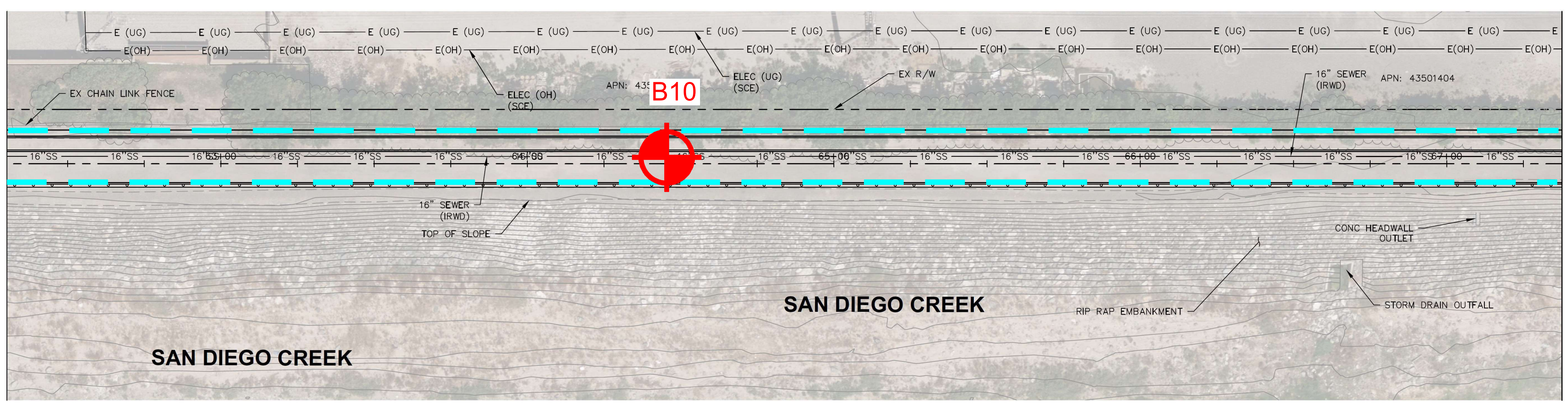
JUNE 2024 | PROJECT NO. W1827-88-01 | FIG. 2.6

SEE FIG 2.6

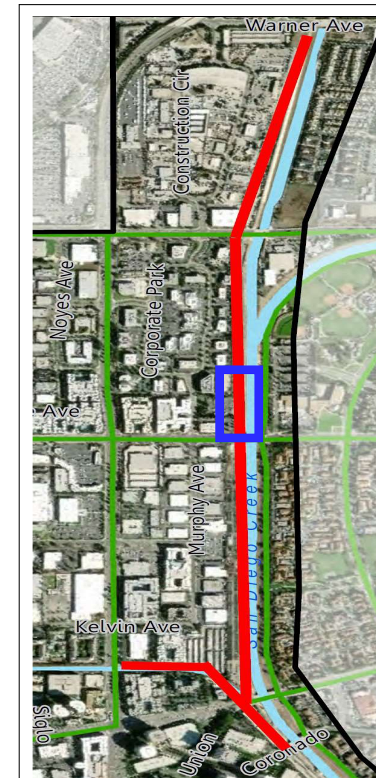


SEE BELOW LEFT

SEE ABOVE RIGHT



SEE FIG 2.8

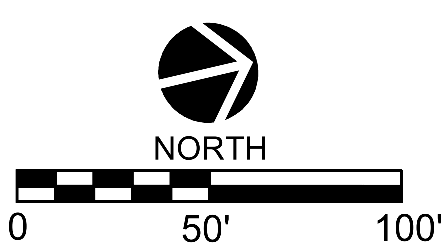


KEY MAP
NOT TO SCALE

LEGEND

B16 Approximate Location of Boring

Approximate Limits of Proposed Improvments



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SITE PLAN

IBC Multi-Use Trails
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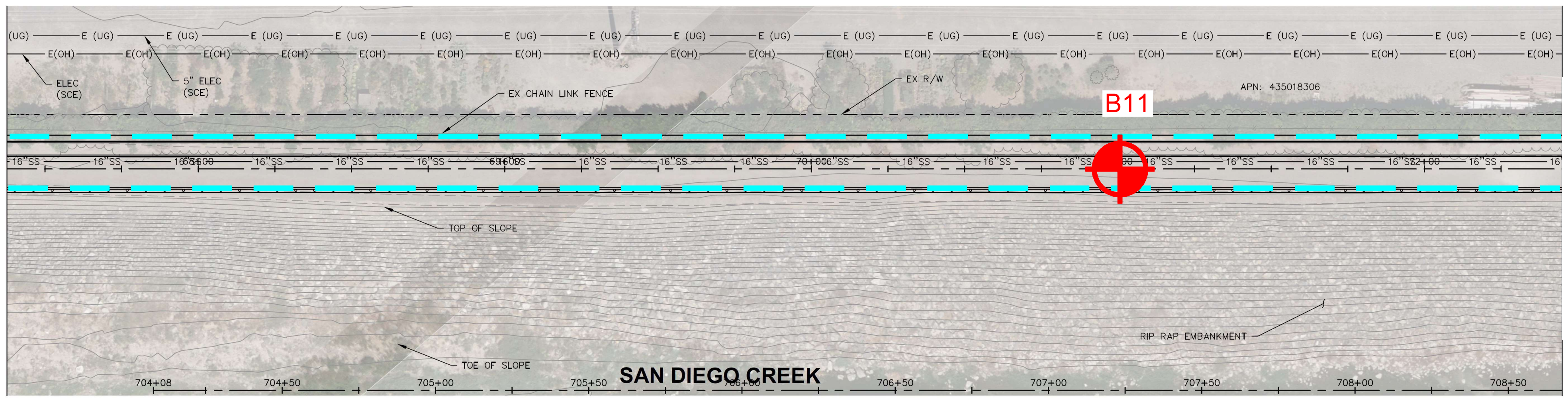
Irvine, California

JUNE 2024 | PROJECT NO. W1827-88-01 | FIG. 2.7

SEE FIG 2.7



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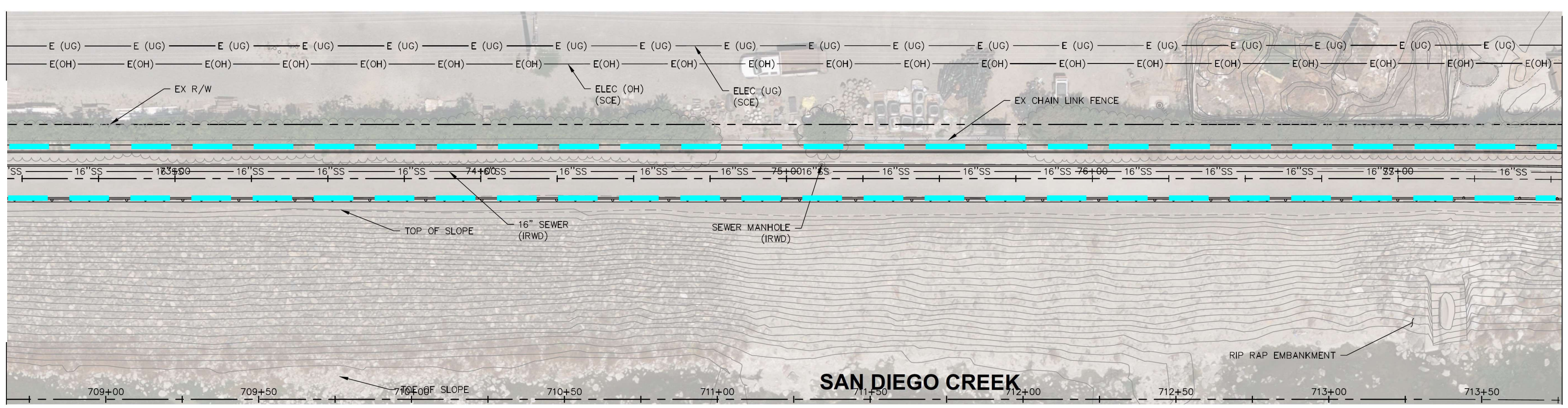
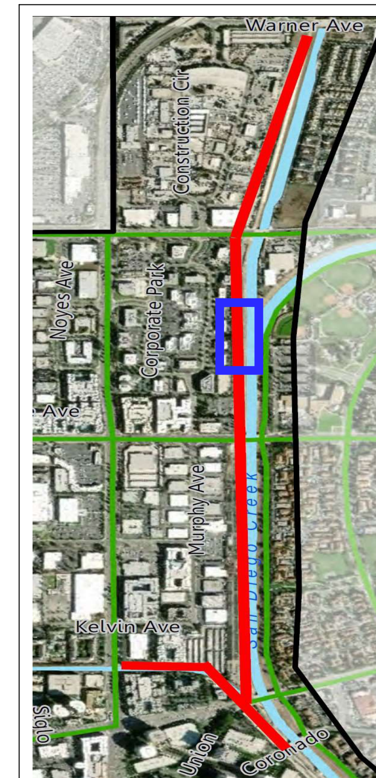
SEE ABOVE RIGHT



SEE FIG 2.9



KEY MAP
NOT TO SCALE

LEGEND

B16 Approximate Location of Boring

Approximate Limits of Proposed Improvments

NORTH

0 50' 100'

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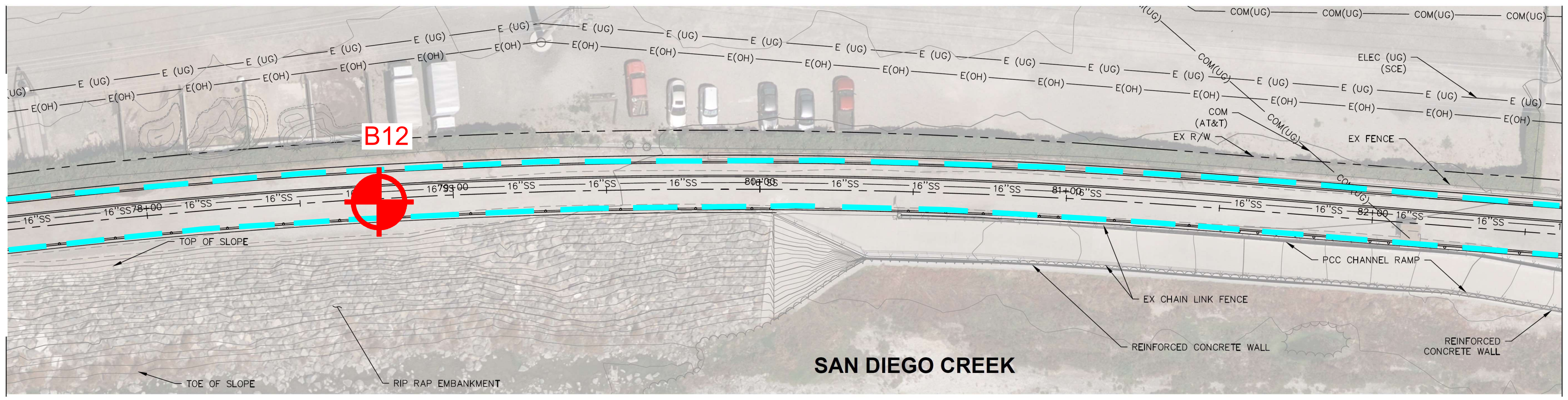
SITE PLAN

IBC Multi-Use Trails
Creekwalk and Barranca Channel
Irvine, California

JUNE 2024	PROJECT NO. W1827-88-01	FIG. 2.8

NORTH

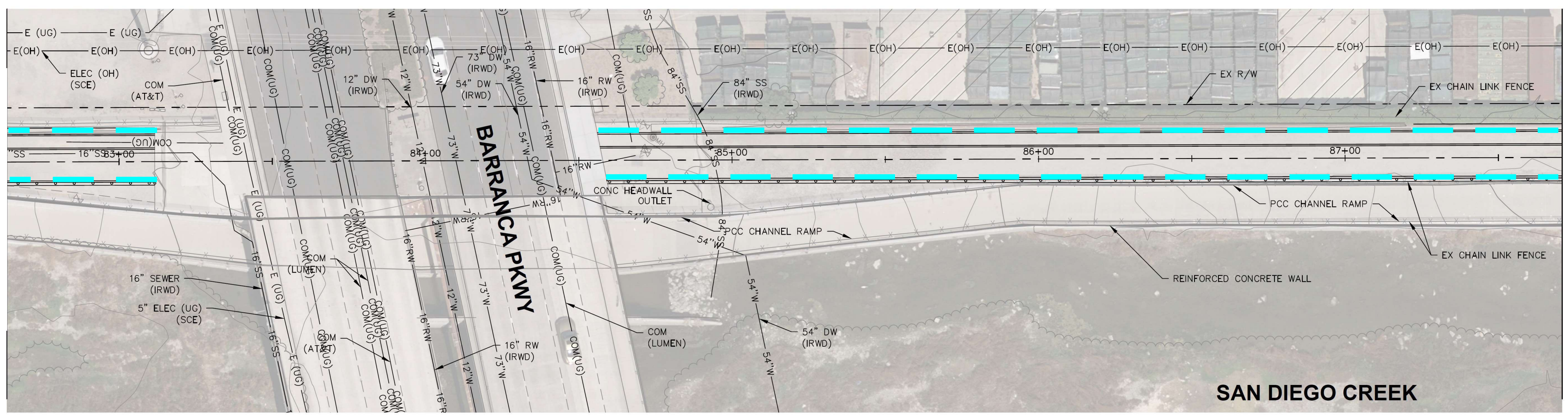
SEE FIG 2.8



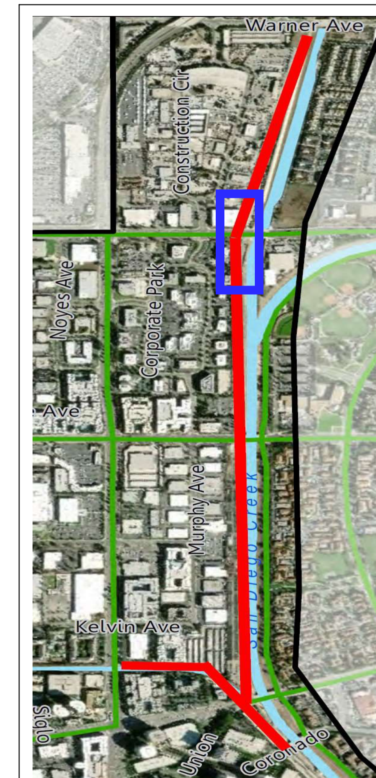
SEE BELOW LEFT

NORTH

SEE ABOVE RIGHT



SEE FIG 2.10



KEY MAP
NOT TO SCALE

LEGEND

B16 Approximate Location of Boring

Approximate Limits of Proposed Improvments

0 50' 100'

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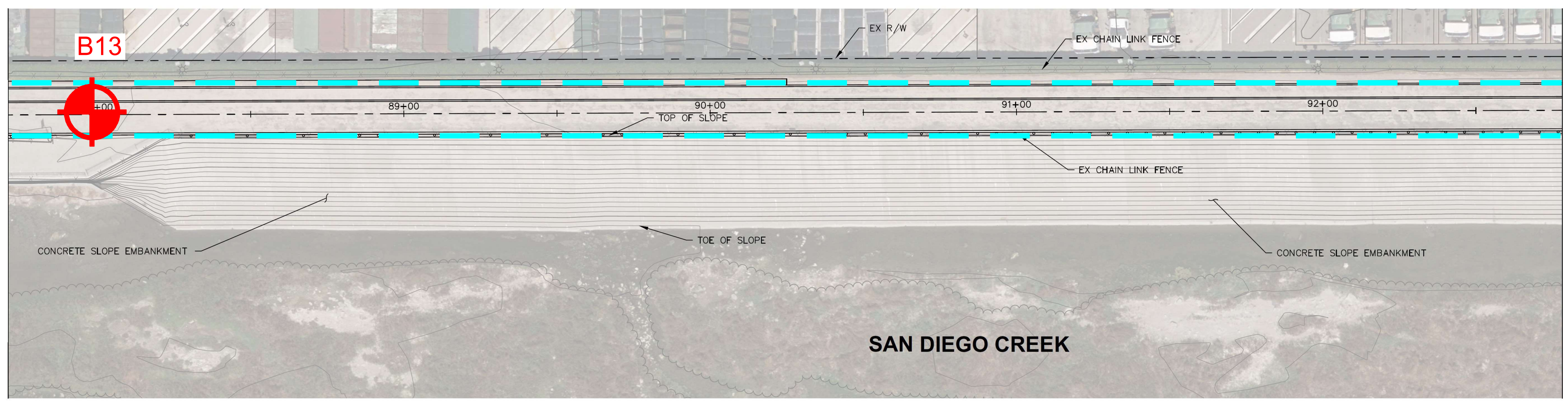
SITE PLAN

IBC Multi-Use Trails
Creekwalk and Barranca Channel
Irvine, California

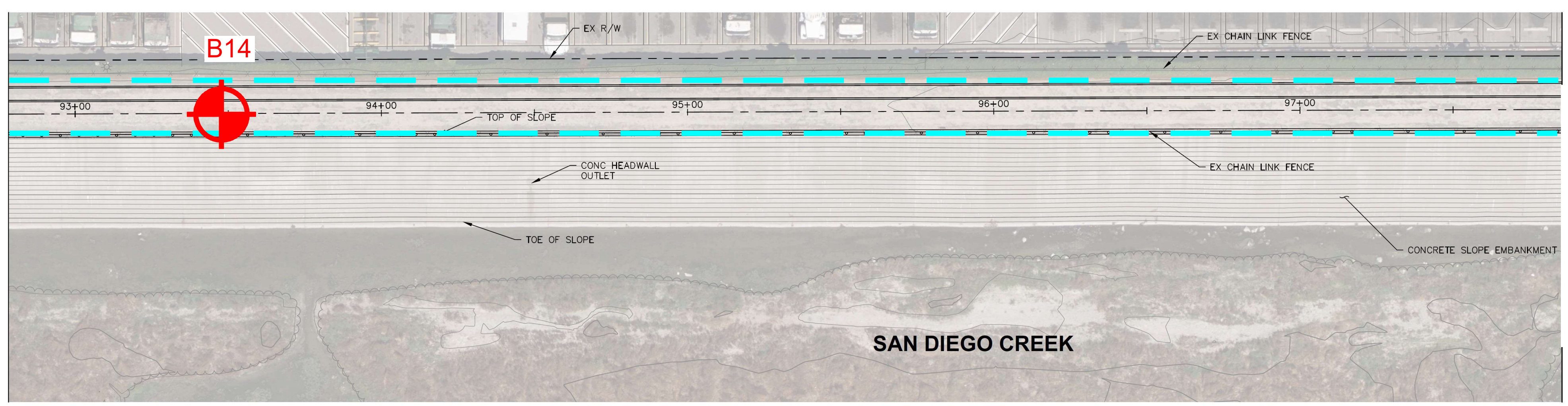
JUNE 2024 | PROJECT NO. W1827-88-01 | FIG. 2.9

SEE FIG 2.9

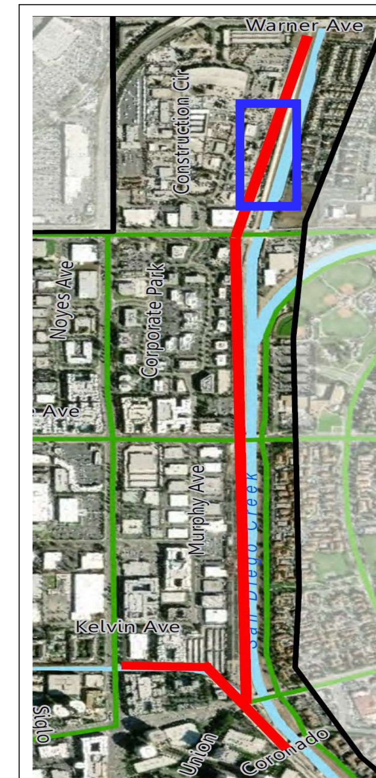


SEE BELOW LEFT

SEE ABOVE RIGHT



SEE FIG 2.11

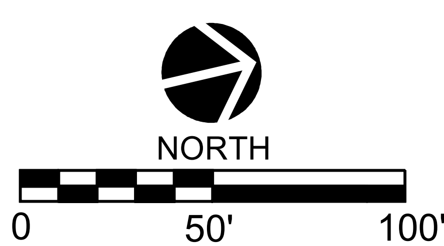


KEY MAP
NOT TO SCALE

LEGEND

B16 Approximate Location of Boring

Approximate Limits of Proposed Improvments



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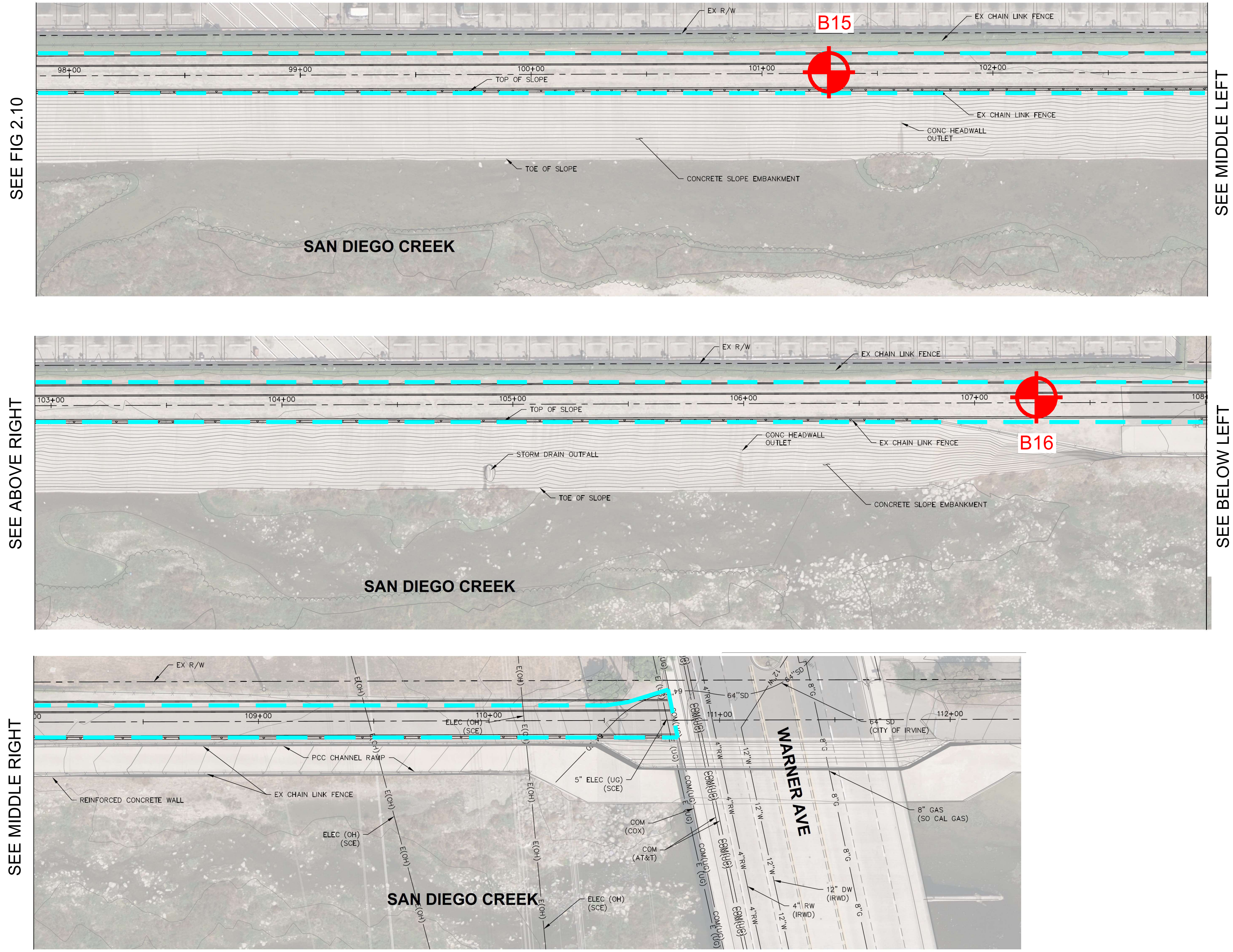
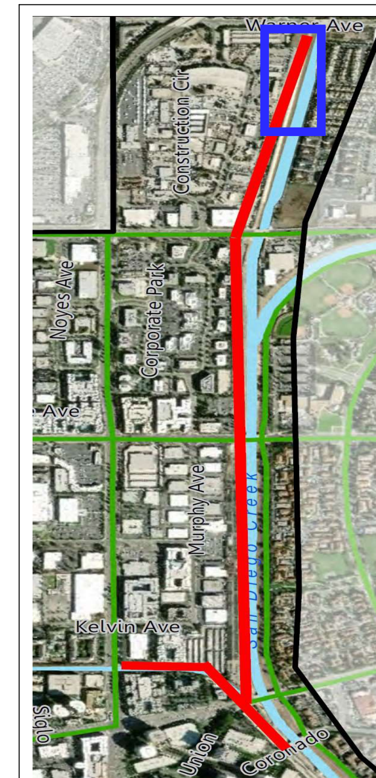
SITE PLAN

IBC Multi-Use Trails
Creekwalk and Barranca Channel
Irvine, California

JUNE 2024	PROJECT NO. W1827-88-01	FIG. 2.10



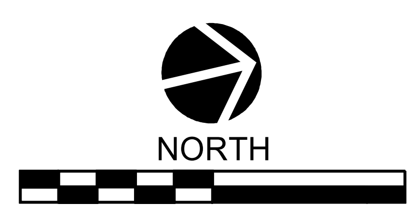


KEY MAP
NOT TO SCALE

LEGEND

B16 — Approximate Location of Boring

Approximate Limits of Proposed Improvments



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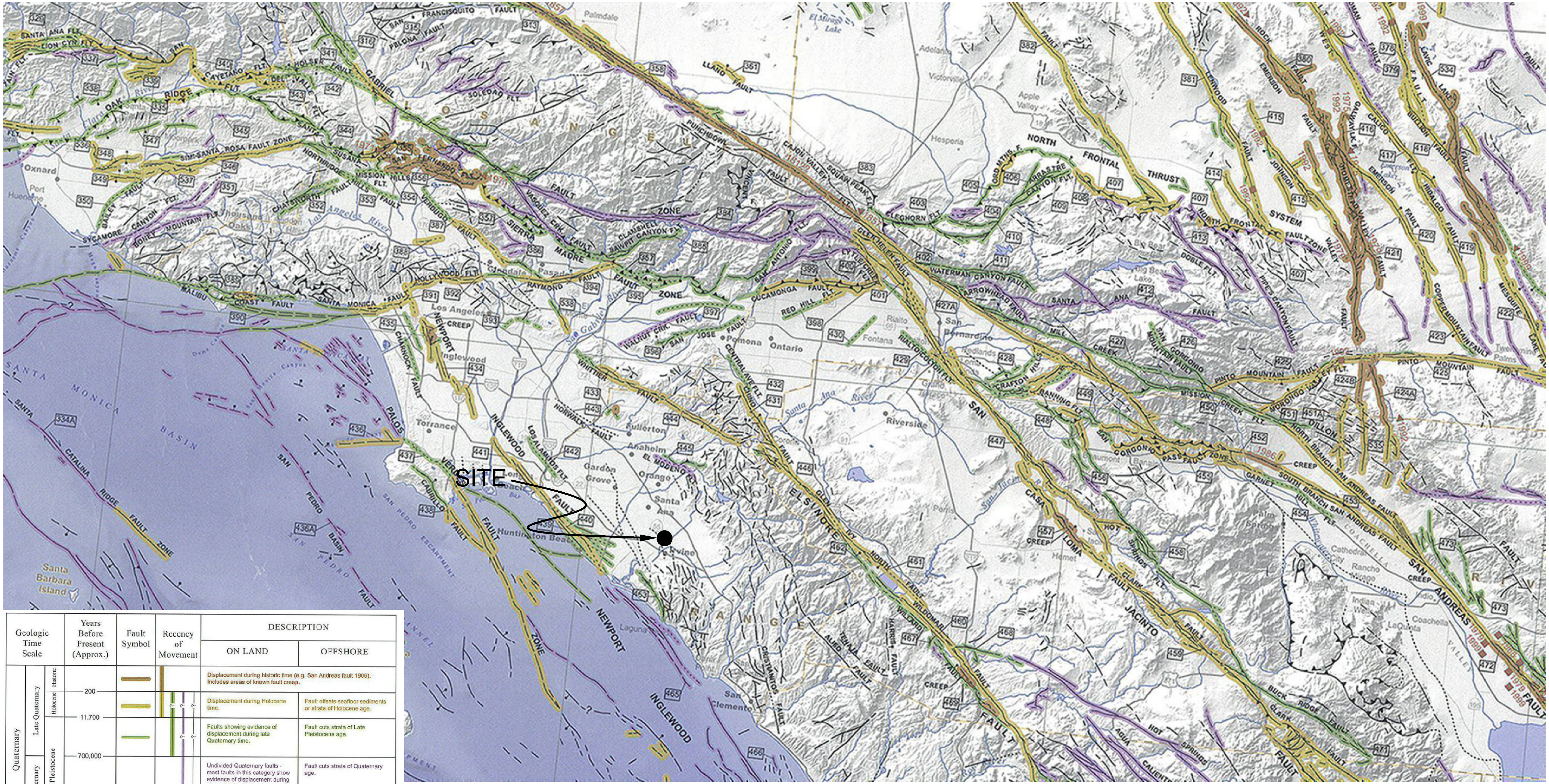
SITE PLAN

IBC Multi-Use Trails
Creekwalk and Barranca Channel
Irvine, California

JUNE 2024 | PROJECT NO. W1827-88-01 | FIG. 2.11

Reference: Jennings, C.W. and Bryant, W. A., 2010, Fault Activity Map of California, California Geological Survey Geologic Data Map No. 6.



Geologic Time Scale			Years Before Present (Approx.)	Fault Symbol	Recency of Movement	DESCRIPTION: ON LAND	DESCRIPTION: OFFSHORE
Quaternary	Late Quaternary	Historic				Displacement during historic time (e.g. San Andreas fault 1906). Includes areas of known fault creep.	
		Holocene	200		? ? ?	Displacement during Holocene time.	Fault offsets seafloor sediments or strata of Holocene age.
		Pleistocene	11,700		? ?	Faults showing evidence of displacement during late Quaternary time.	Fault cuts strata of Late Pleistocene age.
	Early Quaternary		700,000		?	Undivided Quaternary faults - most faults in this category show evidence of displacement during the last 1,600,000 years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age.	Fault cuts strata of Quaternary age.
Pre-Quaternary			1,600,000* – 4.5 billion (Age of Earth)			Faults without recognized Quaternary displacement or showing evidence of no displacement during Quaternary time. Not necessarily inactive.	Fault cuts strata of Pliocene or older age.

* Quaternary now recognized as extending to 2.6 Ma (Walker and Geissman, 2009). Quaternary faults in this map were established using the previous 1.6 Ma criterion.

0 12 24 Miles

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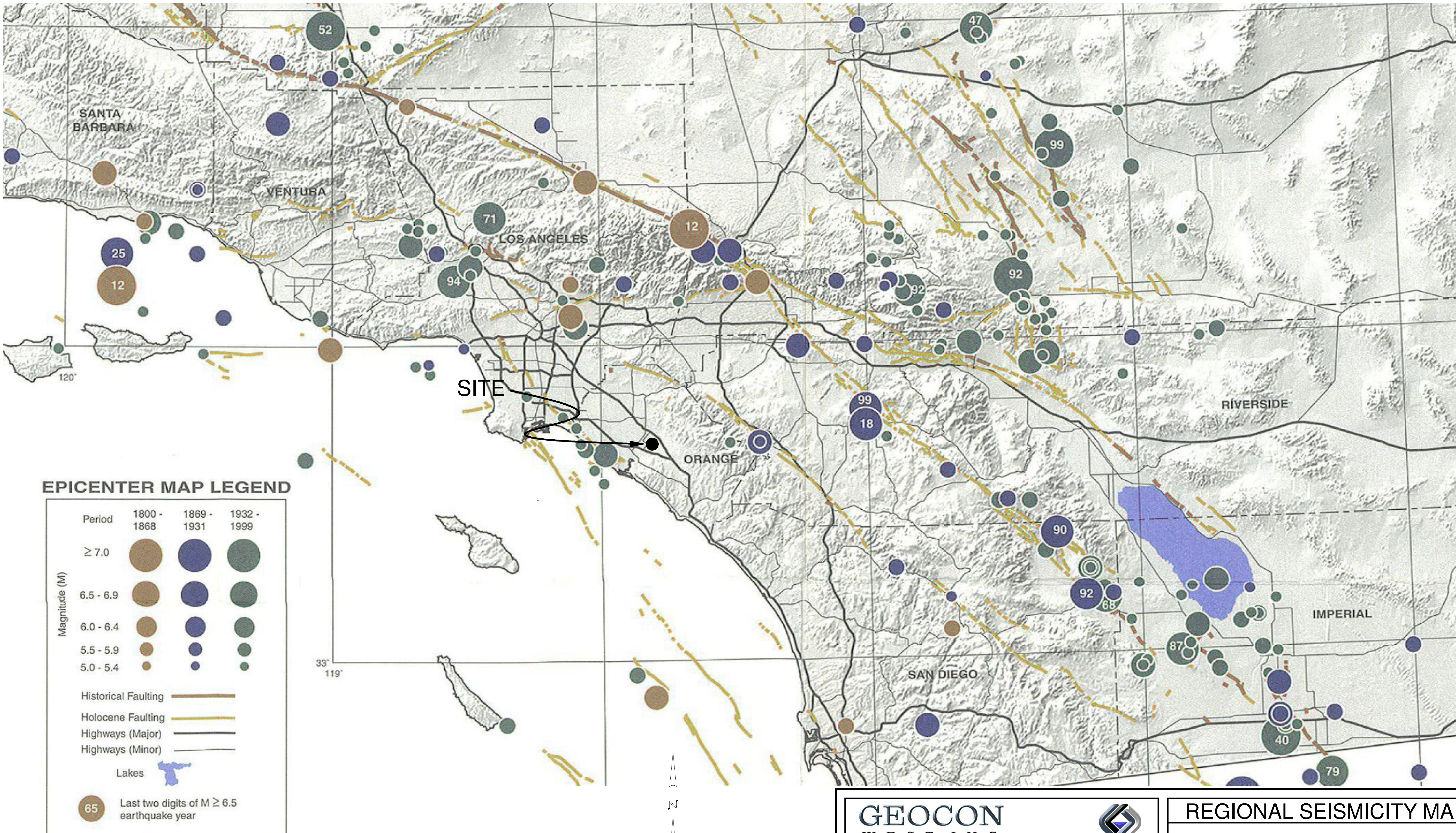
DRAFTED BY: RA | CHECKED BY: GAK

REGIONAL FAULT MAP

IBC MULTI-USE TRAILS
CREEKWALK AND BARRANCA CHANNEL
IRVINE, CALIFORNIA

JUNE 2024 | PROJECT NO. W1827-88-01 | FIG. 3



Reference: Toppozada, T., Branum, D., Petersen, M., Hallstrom, C., Cramer, C., and Reichle, M., 2000, Epicenters and Areas Damaged by M>5 California Earthquakes, 1800 - 1999, California Geological Survey, Map Sheet 49.

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DRAFTED BY: RA | CHECKED BY: GAK

REGIONAL SEISMICITY MAP

IBC MULTI-USE TRAILS
CREEKWALK AND BARRANCA CHANNEL
IRVINE, CALIFORNIA

JUNE 2024 | PROJECT NO. W1827-88-01 | FIG.4

APPENDIX A

APPENDIX A

FIELD INVESTIGATION

The site was explored from May 8 to May 9, 2024, by excavating sixteen 7-inch diameter borings using a truck-mounted, hollow-stem auger drilling machine. The borings were advanced to depths between approximately 8½ and 20½ feet below the existing ground surface. Representative and relatively undisturbed samples were obtained by driving a 3-inch, O. D., California Modified Sampler into the "undisturbed" soil mass with blows from a 140-pound auto-hammer falling 30 inches. The California Modified Sampler was equipped with 1-inch by 2⅜-inch diameter brass sampler rings to facilitate soil removal and testing. Bulk samples were also obtained.

The soil conditions encountered in the borings were visually examined, classified and logged in general accordance with the Unified Soil Classification System (USCS). The logs of the borings are presented on Figures A1 through A16. The logs depict the soil and geologic conditions encountered and the depth at which samples were obtained. The logs also include our interpretation of the conditions between sampling intervals. Therefore, the logs contain both observed and interpreted data. We determined the lines designating the interface between soil materials on the logs using visual observations, penetration rates, excavation characteristics and other factors. The transition between materials may be abrupt or gradual. Where applicable, the logs were revised based on subsequent laboratory testing. The approximate locations of the borings are shown on Figures 2.1 through 2.11.

PROJECT NO. W1827-88-01

BORING 1

ELEV. (MSL.) - - DATE COMPLETED 05/08/2024

EQUIPMENT HOLLOW STEM AUGER BY: ACS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT)*	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK 0-5'				**ARTIFICIAL FILL** Silty Sand, loose, dry, brown, fine- to medium-grained, gravel.			
2					Clayey Sand, loose, slightly moist, brown, fine-grained.			
	B1@2.5'				Sandy Clay, soft, slightly moist, brown, fine-grained.	9	76.3	39.9
4								
6	B1@5'				Clay, soft, slightly moist, brown.	6	76.3	43.9
8	B1@7.5'				Sandy Clay, very soft, moist to wet, brown, fine-grained.	3	91	28.5
10	B1@10'				- soft	4	89.7	35.1
12	B1@12.5'				**ALLUVIUM** Clay, soft, moist, brown.	6	94.8	27.2
14								
16	B1@15'			CL	- very soft	3	88.7	30.8
18	B1@17.5'				- soft	9	102	24.6
20	B1@20'					8	96.4	28.3

Total depth of boring: 20.5 feet
Fill to 12.5 feet.
No groundwater encountered.
Backfilled with cement.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

W1827-88-01 BORING LOGS.GPJ

Figure A1,
Log of Boring 1, Page 1 of 1

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1827-88-01

BORING 2

ELEV. (MSL.) - - DATE COMPLETED 05/08/2024

EQUIPMENT HOLLOW STEM AUGER BY: ACS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT)*	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**ARTIFICIAL FILL** Silty Sand, loose, dry, fine- to medium-grained, gravel.			
2					Clay, soft, slightly moist, brown.			
	B2@2.5'					11	77.9	37.9
4								
	B2@5'				- firm	12	84.9	35.7
6								
8	B2@7.5'					13	79.1	42.4
10	B2@10'				- soft, trace fine-grained sand	10	89.5	30.1

Total depth of boring: 10.5 feet
All fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

Figure A2,
Log of Boring 2, Page 1 of 1

W1827-88-01 BORING LOGS.GPJ

SAMPLE SYMBOLS			
	☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
	⊠ ... DISTURBED OR BAG SAMPLE	◪ ... CHUNK SAMPLE	▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

BORING 3

ELEV. (MSL.) - - DATE COMPLETED 05/08/2024

EQUIPMENT HOLLOW STEM AUGER BY: ACS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT)*	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK 0-5'				**ARTIFICIAL FILL** Silty Sand, loose, dry, brown, fine- to medium-grained, fine to coarse gravel.			
2	B3@2.5'					14	84.4	7.3
4					Sandy Clay, soft to firm, slightly moist, brown, fine-grained.			
6	B3@5'				- firm	16	107.4	19.6
8	B3@7.5'				- trace fine gravel	20	105.1	22.7
10	B3@10'				- dark brown	20	107.4	18.7

Total depth of boring: 10.5 feet
All fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

Figure A3,
Log of Boring 3, Page 1 of 1

W1827-88-01 BORING LOGS.GPJ

SAMPLE SYMBOLS
... SAMPLING UNSUCCESSFUL
... DISTURBED OR BAG SAMPLE
... STANDARD PENETRATION TEST
... CHUNK SAMPLE
... DRIVE SAMPLE (UNDISTURBED)
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1827-88-01

BORING 4

ELEV. (MSL.) - - DATE COMPLETED 05/08/2024

EQUIPMENT HOLLOW STEM AUGER BY: ACS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT)*	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK 0-5'				**ARTIFICIAL FILL** Clayey Sand, loose, slightly moist, brown, fine-grained, gravel.			
2	B4@2.5'				Clayey Sand, loose, slightly moist, brown, fine-grained, trace gravel.	10	105.4	9.6
4								
6	B4@5'				Clay, soft, slightly moist, brown.	10	75.2	45.9
8	B4@7.5'					7	71.1	50.7
10	B4@10'					8	98.9	28

Total depth of boring: 10.5 feet
All fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

Figure A4, Log of Boring 4, Page 1 of 1

W1827-88-01 BORING LOGS.GPJ

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
⊠ ... DISTURBED OR BAG SAMPLE	◪ ... CHUNK SAMPLE	▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1827-88-01

BORING 5

ELEV. (MSL.) - - DATE COMPLETED 05/08/2024

EQUIPMENT HOLLOW STEM AUGER BY: ACS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT)*	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK 0-5'				**ARTIFICIAL FILL** Silty Sand, loose, slightly moist, brown, gravel.			
2	B5@2.5'				Sandy Clay, firm, slightly moist, brown, fine-grained.	19	105	22.9
4								
	B5@5'				Silty Sand, loose, slightly moist, brown, trace clay.	17	93.3	18.2
6								
8	B5@7.5'				Clay, soft, slightly moist, brown.	10	75.5	44.9
10	B5@10'					12	68.9	50.5

Total depth of boring: 10.5 feet
All fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

Figure A5,
Log of Boring 5, Page 1 of 1

W1827-88-01 BORING LOGS.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

BORING 6

ELEV. (MSL.) - -　　DATE COMPLETED 05/08/2024

EQUIPMENT HOLLOW STEM AUGER　　BY: ACS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT)*	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**ARTIFICIAL FILL** Silty Sand, loose, dry, brown, fine- to medium-grained, coarse gravel.			
2								
	B6@2.5'				- medium dense, fine-grained, trace clay	23	97.4	17.3
4								
	B6@5'				Clay, firm, slightly moist, black, trace fine-grained sand.	17	85.1	36.9
6								
8	B6@7.5'					20	74.4	44
10	B6@10'					13	90.4	30.2

Total depth of boring: 10.5 feet
All fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

Figure A6,
Log of Boring 6, Page 1 of 1

W1827-88-01 BORING LOGS.GPJ

SAMPLE SYMBOLS			
	☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
	⊠ ... DISTURBED OR BAG SAMPLE	◪ ... CHUNK SAMPLE	▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1827-88-01

BORING 7

ELEV. (MSL.) - - DATE COMPLETED 05/08/2024

EQUIPMENT HOLLOW STEM AUGER BY: ACS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT)*	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK 0-5'				**ARTIFICIAL FILL** Silty Sand, loose, dry, fine- to medium-grained, coarse gravel.			
2	B7@2.5'				- fine-grained, trace clay	14	99.6	10.9
4								
	B7@5'				Clay, firm, slightly moist, dark brown, trace fine-grained sand.	17	77.7	38.6
6								
8	B7@7.5'				- soft, moist, black, trace fine-grained	9	71.6	51.6
10	B7@10'				- firm, brown	12	92.5	29.9

Total depth of boring: 10.5 feet
All fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

Figure A7,
Log of Boring 7, Page 1 of 1

W1827-88-01 BORING LOGS.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1827-88-01

BORING 8

ELEV. (MSL.) - - DATE COMPLETED 05/08/2024

EQUIPMENT HOLLOW STEM AUGER BY: ACS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT)*	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**ARTIFICIAL FILL** Silty Sand, loose, dry, brown, fine- to medium-grained, coarse gravel.			
2	B8@2.5'				Clay, firm, stiff, slightly moist, brown.	23	92.7	28.3
4					Silty Sand, medium dense, slightly moist, brown, fine-grained, trace clay.			
6	B8@5'				Clay, soft, slightly moist, brown, trace fine-grained.	7	99	18.6
8	B8@7.5'				- stiff, moist, black	26	78	43
10	B8@10'				- firm, brown	14	88.8	33.2

Total depth of boring: 10.5 feet
All fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

Figure A8,
Log of Boring 8, Page 1 of 1

W1827-88-01 BORING LOGS.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1827-88-01

BORING 9

ELEV. (MSL.) - - DATE COMPLETED 05/08/2024

EQUIPMENT HOLLOW STEM AUGER BY: ACS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT)*	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK 0-5'				**ARTIFICIAL FILL** Silty Sand, loose, dry, brown, fine- to medium-grained, coarse gravel.			
2	B9@2.5'				- fine-grained	17	104.3	17.3
4					**ALLUVIUM** Clay, stiff, slightly moist, brown, trace fine-grained sand.			
	B9@5'					13	84.7	31.8
6				CL				
8	B9@7.5'				- soft, moist, black	11	76.1	44.7
10	B9@10'				- stiff, brown	14	92.8	27

Total depth of boring: 10.5 feet
Fill to 3.5 feet.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

Figure A9,
Log of Boring 9, Page 1 of 1

W1827-88-01 BORING LOGS.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1827-88-01

BORING 10

ELEV. (MSL.) - - DATE COMPLETED 05/09/2024

EQUIPMENT HOLLOW STEM AUGER BY: ACS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT)*	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK 0-5'				**ARTIFICIAL FILL** Silty Sand, loose, dry, brown, fine- to medium-grained, fine to coarse gravel.			
2	B10@2.5'				- medium dense, fine-grained, trace clay	23	101.7	15.1
4					Clay, stiff, slightly moist, brown.			
6	B10@5'					20	92.2	28.6
8	B10@7.5'				- trace fine-grained sand	15	89.6	32.8
10	B10@10'					16	94.5	27.5

Total depth of boring: 10.5 feet
All fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

Figure A10,
Log of Boring 10, Page 1 of 1

W1827-88-01 BORING LOGS.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1827-88-01

BORING 11

ELEV. (MSL.) - -   DATE COMPLETED 05/09/2024

EQUIPMENT HOLLOW STEM AUGER   BY: ACS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT)*	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**ARTIFICIAL FILL** Silty Sand, loose, dry, brown, fine- to medium-grained, fine to coarse gravel.			
2					Clay, stiff, slightly moist, brown.			
	B11@2.5'				Silty Sand, medium dense, slightly moist, brown, fine- to medium-grained.	29	101.8	21.2
4								
	B11@5'				Clay, firm, slightly moist, brown.	18	98.9	16.9
6								
8	B11@7.5'				- trace fine-grained	13	87.7	33.5
10	B11@10'					12	98.3	25.7

Total depth of boring: 10.5 feet
All fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

Figure A11, Log of Boring 11, Page 1 of 1

W1827-88-01 BORING LOGS.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. W1827-88-01

BORING 12

ELEV. (MSL.) - - DATE COMPLETED 05/09/2024

EQUIPMENT HOLLOW STEM AUGER BY: ACS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT)*	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK 0-5'				**ARTIFICIAL FILL** Silty Sand, loose, dry, brown, fine- to medium-grained, fine to coarse gravel.			
2	B12@2.5'				Sandy Clay, stiff, slightly moist, brown, fine-grained.	31	106.5	20.6
4								
6	B12@5'				Clay, firm, slightly moist, brown, trace fine-grained sand.	15	87.5	31
8	B12@7.5'					14	91	31.4
10	B12@10'				- soft	7	105.5	21.7

Total depth of boring: 10.5 feet
All fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

Figure A12,
Log of Boring 12, Page 1 of 1

W1827-88-01 BORING LOGS.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1827-88-01

BORING 13

ELEV. (MSL.) - - DATE COMPLETED 05/09/2024

EQUIPMENT HOLLOW STEM AUGER BY: ACS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT)*	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK 0-5'				**ARTIFICIAL FILL** Silty Sand, loose, dry, brown, fine- to medium-grained, fine to coarse gravel.			
2	B13@2.5'				- dense	85	125.6	8.3
4								
6	B13@5'				- medium dense	53	122.3	7.3
8	B13@7.5'				- loose	18	107.8	8.1

Total depth of boring: 8.5 feet
All fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

W1827-88-01 BORING LOGS.GPJ

Figure A13,
Log of Boring 13, Page 1 of 1

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

PROJECT NO. W1827-88-01

BORING 14

ELEV. (MSL.) - - DATE COMPLETED 05/09/2024

EQUIPMENT HOLLOW STEM AUGER BY: ACS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT)*	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**ARTIFICIAL FILL** Silty Sand, loose, dry, brown, fine- to medium-grained, some fine to coarse gravel.			
2	B14@2.5'				Sandy Clay, stiff, slightly moist, brown, fine-grained.	32	100.8	23.2
4								
6	B14@5'				- firm	20	84.6	28.9
8	B14@7.5'				- hard	53	99.6	25
10	B14@10'				Clay, firm, slightly moist, brown.	18	99.2	23.8

Total depth of boring: 10.5 feet
All fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

Figure A14,
Log of Boring 14, Page 1 of 1

W1827-88-01 BORING LOGS.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

BORING 15

ELEV. (MSL.) - - DATE COMPLETED 05/09/2024

EQUIPMENT HOLLOW STEM AUGER BY: ACS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT)*	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK 0-5'				**ARTIFICIAL FILL** Silty Sand, loose, dry, brown, fine- to medium-grained, some fine to coarse gravel.			
2	B15@2.5'				Clay, stiff, slightly moist, brown, trace fine-grained sand.	30	113.8	16.8
4								
6	B15@5'				- black	25	91.5	26.3
8	B15@7.5'				Sandy Clay, stiff, slightly moist, brown, fine-grained.	29	91.7	19.5
10	B15@10'				- firm	13	78	18

Total depth of boring: 10.5 feet
All fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

Figure A15,
Log of Boring 15, Page 1 of 1

W1827-88-01 BORING LOGS.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

BORING 16

ELEV. (MSL.) - - DATE COMPLETED 05/09/2024

EQUIPMENT HOLLOW STEM AUGER BY: ACS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT)*	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**ARTIFICIAL FILL** Silty Sand, loose, dry, brown, fine- to medium-grained, some fine to coarse gravel.			
2	B16@2.5'				Sandy Clay, stiff, slightly moist, brown, fine-grained, some fine to coarse gravel.	22	97.3	6.1
4	B16@5'				Clay, firm, slightly moist, brown, trace fine-grained.	13	110.1	15.4
6								
8	B16@7.5'				Sandy Clay, soft, slightly moist, brown, fine- to medium-grained, some fine to coarse gravel.	26	116.5	14
10	B16@10'					47	122.2	8.9

Total depth of boring: 10.5 feet
All fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

Figure A16,
Log of Boring 16, Page 1 of 1

W1827-88-01 BORING LOGS.GPJ

SAMPLE SYMBOLS
... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

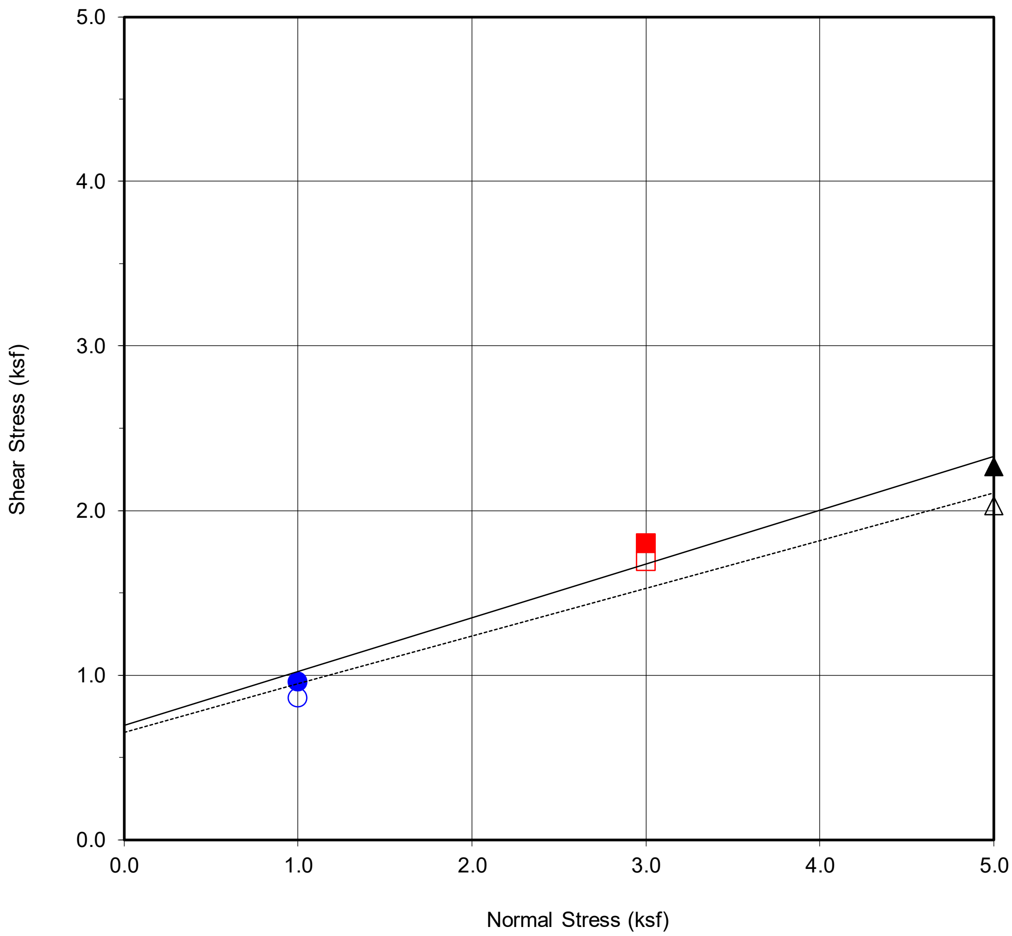
NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

APPENDIX B

APPENDIX B

LABORATORY TESTING

We performed laboratory tests in accordance with generally accepted test methods of the American Society for Testing and Materials (ASTM) or other suggested procedures. We tested selected soil samples for in situ dry density and moisture content, shear strength, consolidation characteristics, maximum dry density and optimum moisture content, resistance value (R-Value), expansion potential, and water-soluble sulfate content. The results of the laboratory tests are summarized in Figures B1 through B27. The in-place dry density and moisture content of the samples tested are presented in the boring logs in Appendix A.



Boring No.	**B1**
Sample No.	**B1@2.5'**
Depth (ft)	**2.5'**
Sample Type:	RING

Soil Identification:		
Sandy Clay (CL)		
Strength Parameters		
	C (psf)	ϕ (^{o})
Peak	695	18
Ultimate	655	16

Normal Stress (kip/ft²)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.96	■ 1.80	▲ 2.27
Shear Stress @ End of Test (ksf)	○ 0.86	□ 1.69	△ 2.03
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	36.8	36.9	38.5
Initial Dry Density (pcf)	80.1	82.8	79.6
Initial Degree of Saturation (%)	90.1	96.2	93.0
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	42.1	38.9	38.6

GEOCON

DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

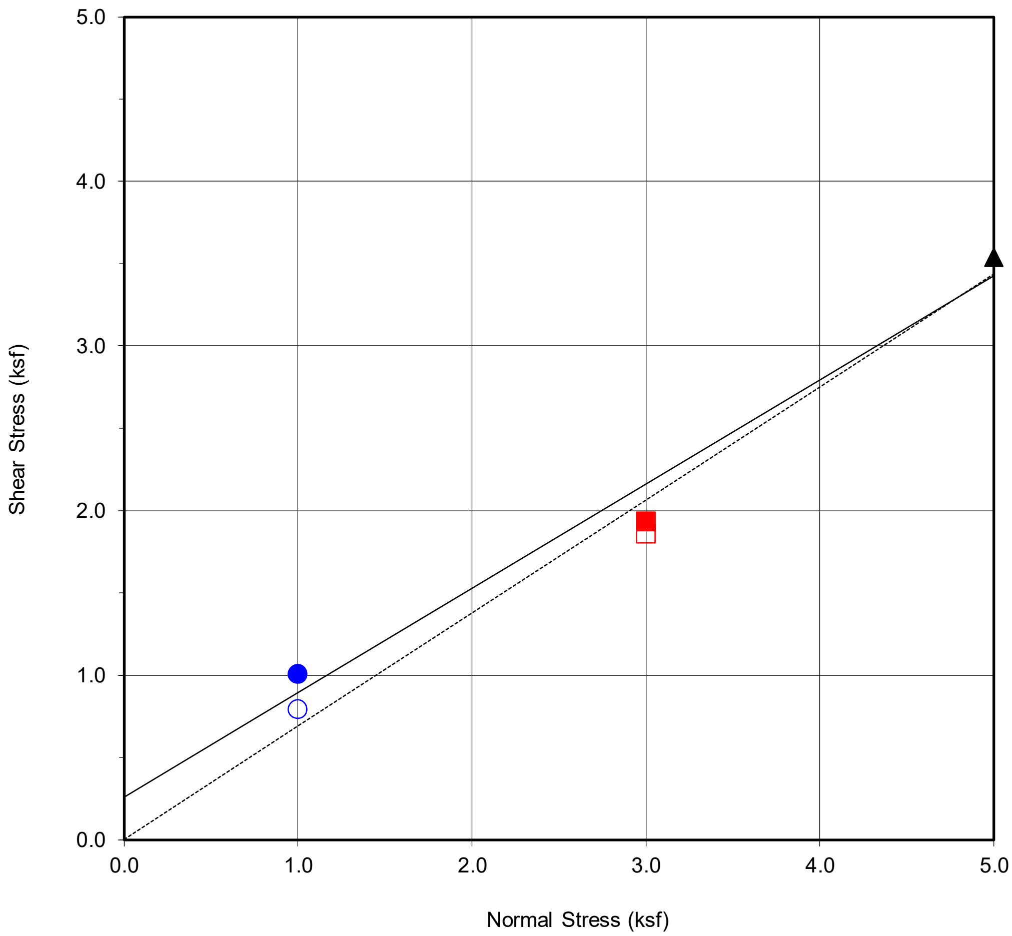
Checked by: JC

Project No.: W1827-88-01

IBC Multi-Use Trails
Creekwalk and Barranca Channel
Irvine, California

June 2024

Figure B1



Boring No.	B4
Sample No.	B4@2.5'
Depth (ft)	2.5'
Sample Type:	RING

Soil Identification:		
Clayey Sand (SC)		
Strength Parameters		
	C (psf)	ϕ (°)
Peak	261	32
Ultimate	3	34

Normal Stress (kip/ft²)	1	3	5
Peak Shear Stress (kip/ft²)	● 1.01	■ 1.93	▲ 3.54
Shear Stress @ End of Test (ksf)	○ 0.79	□ 1.86	△ 3.54
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	27.3	26.6	11.7
Initial Dry Density (pcf)	94.0	92.2	111.5
Initial Degree of Saturation (%)	93.0	86.7	62.0
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	30.8	30.3	16.3

GEOCON

DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

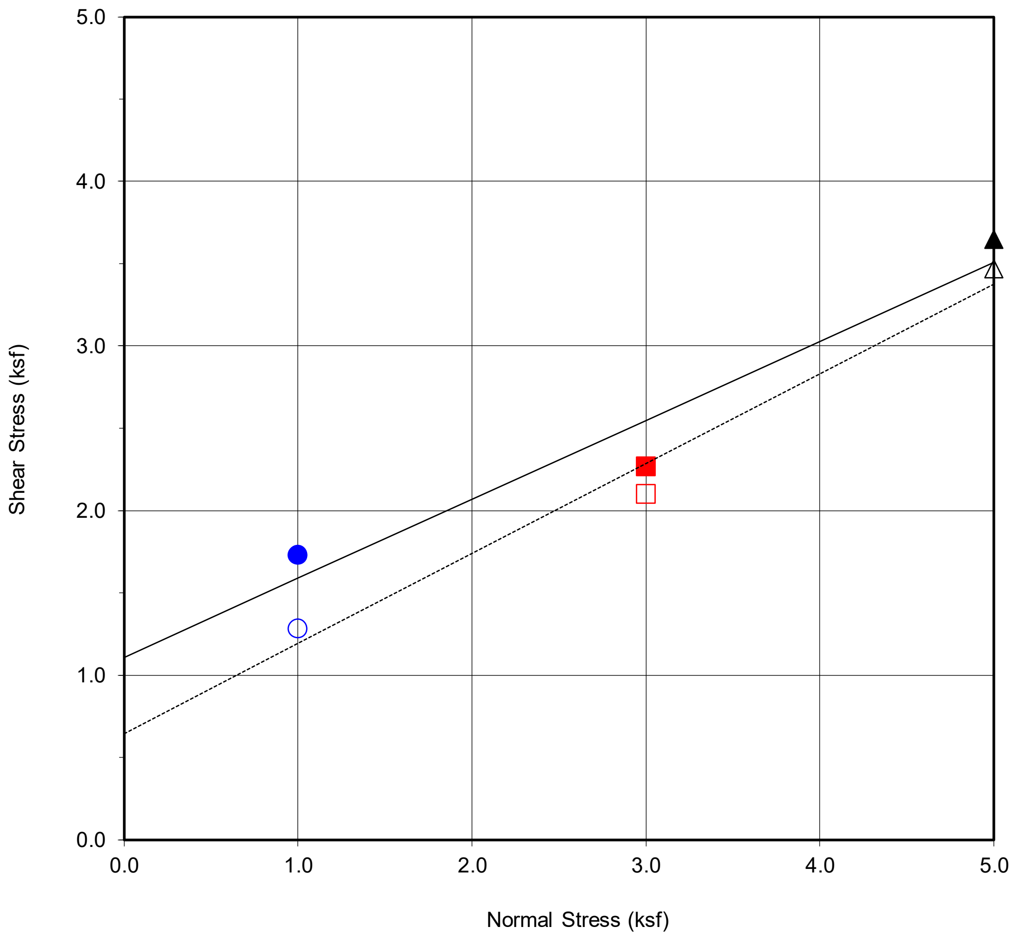
Checked by: JC

Project No.: W1827-88-01

IBC Multi-Use Trails
Creekwalk and Barranca Channel
Irvine, California

June 2024

Figure B2



Boring No.	**B5**
Sample No.	**B5@2.5'**
Depth (ft)	**2.5'**
Sample Type:	RING

Soil Identification:		
Sandy Clay (CL)		
Strength Parameters		
	C (psf)	ϕ (°)
Peak	1108	26
Ultimate	646	29

Normal Stress (kip/ft²)	1	3	5
Peak Shear Stress (kip/ft²)	● 1.73	■ 2.27	▲ 3.65
Shear Stress @ End of Test (ksf)	○ 1.28	□ 2.10	△ 3.47
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	18.9	20.4	17.8
Initial Dry Density (pcf)	109.6	106.3	111.9
Initial Degree of Saturation (%)	94.8	93.8	94.6
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	22.0	22.1	18.4

GEOCON

DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

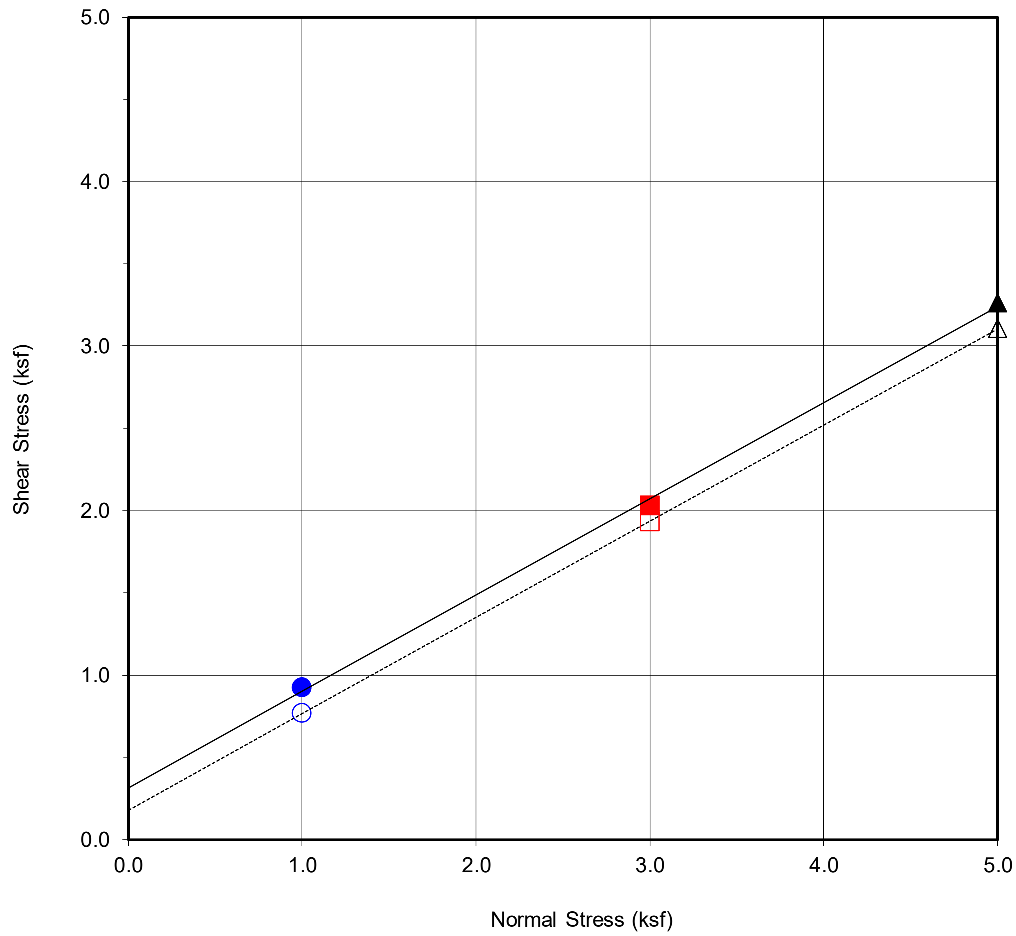
Checked by: JC

Project No.: W1827-88-01

IBC Multi-Use Trails
Creekwalk and Barranca Channel
Irvine, California

June 2024

Figure B3



Boring No.	B7
Sample No.	B7@2.5'
Depth (ft)	2.5'
Sample Type:	RING

Soil Identification:		
Silty Sand (SM)		
Strength Parameters		
	C (psf)	ϕ (°)
Peak	317	30
Ultimate	181	30

Normal Stress (kip/ft²)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.92	■ 2.03	▲ 3.26
Shear Stress @ End of Test (ksf)	○ 0.77	□ 1.93	△ 3.11
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	15.4	15.5	16.3
Initial Dry Density (pcf)	98.5	96.6	97.9
Initial Degree of Saturation (%)	58.3	56.3	61.1
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	25.0	22.8	21.1

GEOCON

DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

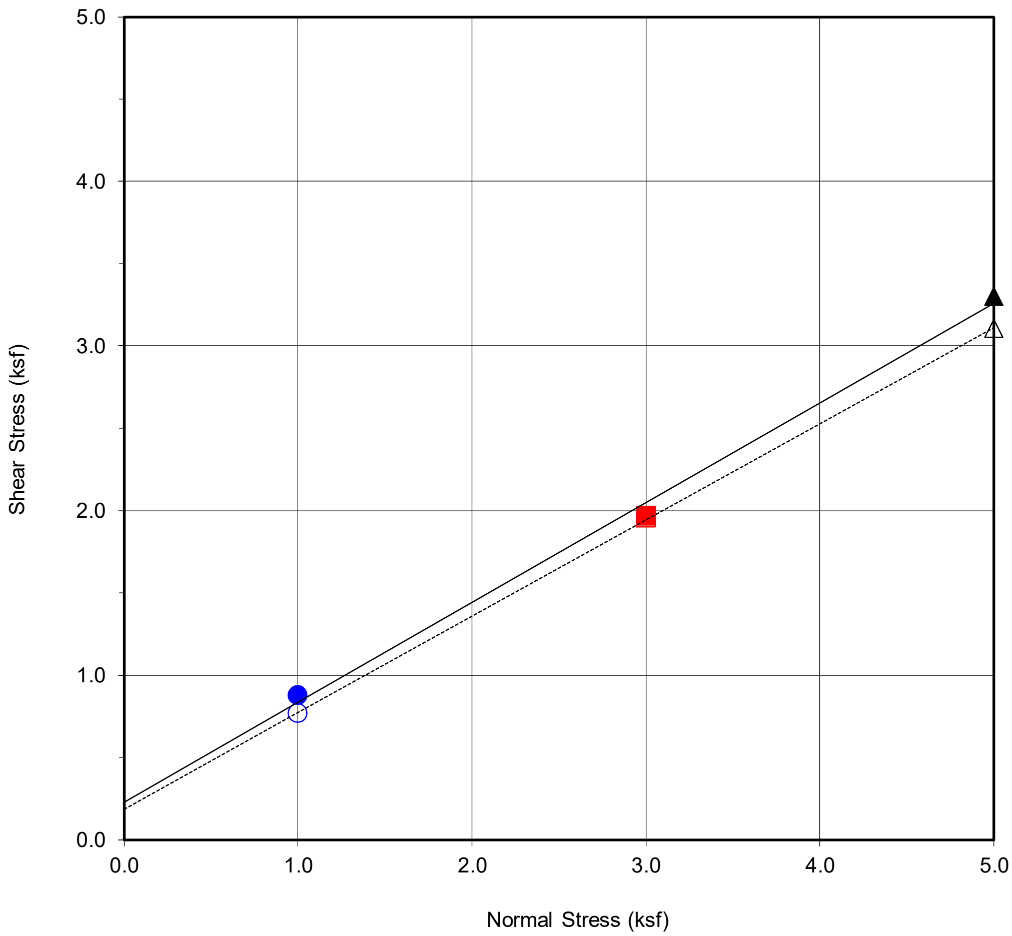
Checked by: JC

Project No.: W1827-88-01

IBC Multi-Use Trails
Creekwalk and Barranca Channel
Irvine, California

June 2024

Figure B4



Boring No.	**B10**
Sample No.	**B10@2.5'**
Depth (ft)	**2.5'**
Sample Type:	RING

Normal Stress (kip/ft²)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.88	■ 1.97	▲ 3.30
Shear Stress @ End of Test (ksf)	○ 0.77	□ 1.96	△ 3.11
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	17.5	15.9	15.5
Initial Dry Density (pcf)	101.8	101.5	103.1
Initial Degree of Saturation (%)	72.1	65.0	66.1
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	25.3	24.4	22.2

Soil Identification:

Silty Sand (SM)

Strength Parameters

	C (psf)	ϕ (°)
Peak	230	31
Ultimate	189	30

GEOCON

DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

Checked by: JC

Project No.: W1827-88-01

IBC Multi-Use Trails
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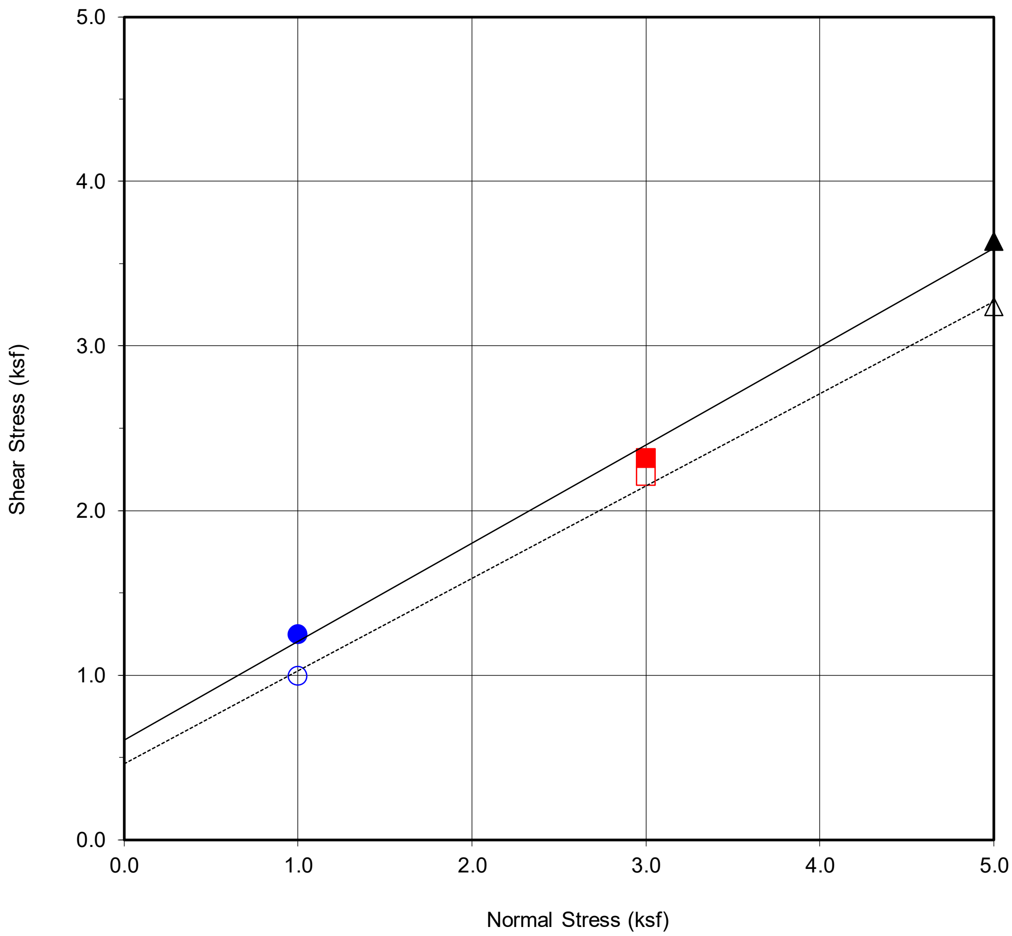
Figure B5



Boring No.	**B15**
Sample No.	**B15@2.5'**
Depth (ft)	**2.5'**
Sample Type:	RING

Soil Identification:		
Clay (CL)		
Strength Parameters		
	C (psf)	ϕ (°)
Peak	609	31
Ultimate	465	29

Normal Stress (kip/ft²)	1	3	5
Peak Shear Stress (kip/ft²)	● 1.25	■ 2.32	▲ 3.64
Shear Stress @ End of Test (ksf)	○ 1.00	□ 2.21	△ 3.24
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	21.5	19.1	15.4
Initial Dry Density (pcf)	106.7	108.3	115.3
Initial Degree of Saturation (%)	100.0	92.4	89.7
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	24.8	22.7	18.0

GEOCON

DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

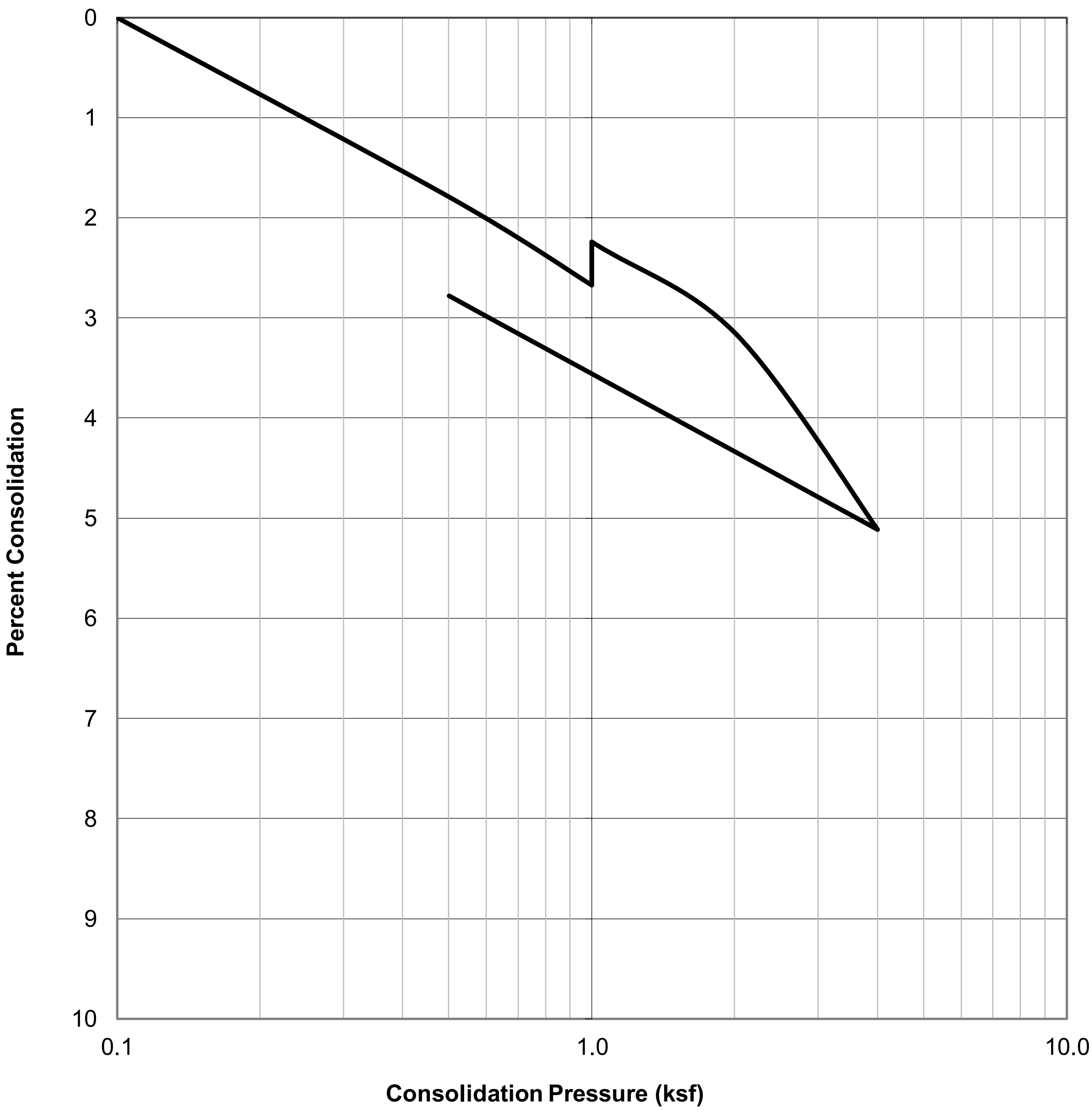
Checked by: JC

Project No.: W1827-88-01

IBC Multi-Use Trails
Creekwalk and Barranca Channel
Irvine, California

June 2024 Figure B6

WATER ADDED AT 1.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B1@5'	Clay (CL)	79.0	42.6	44.1

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

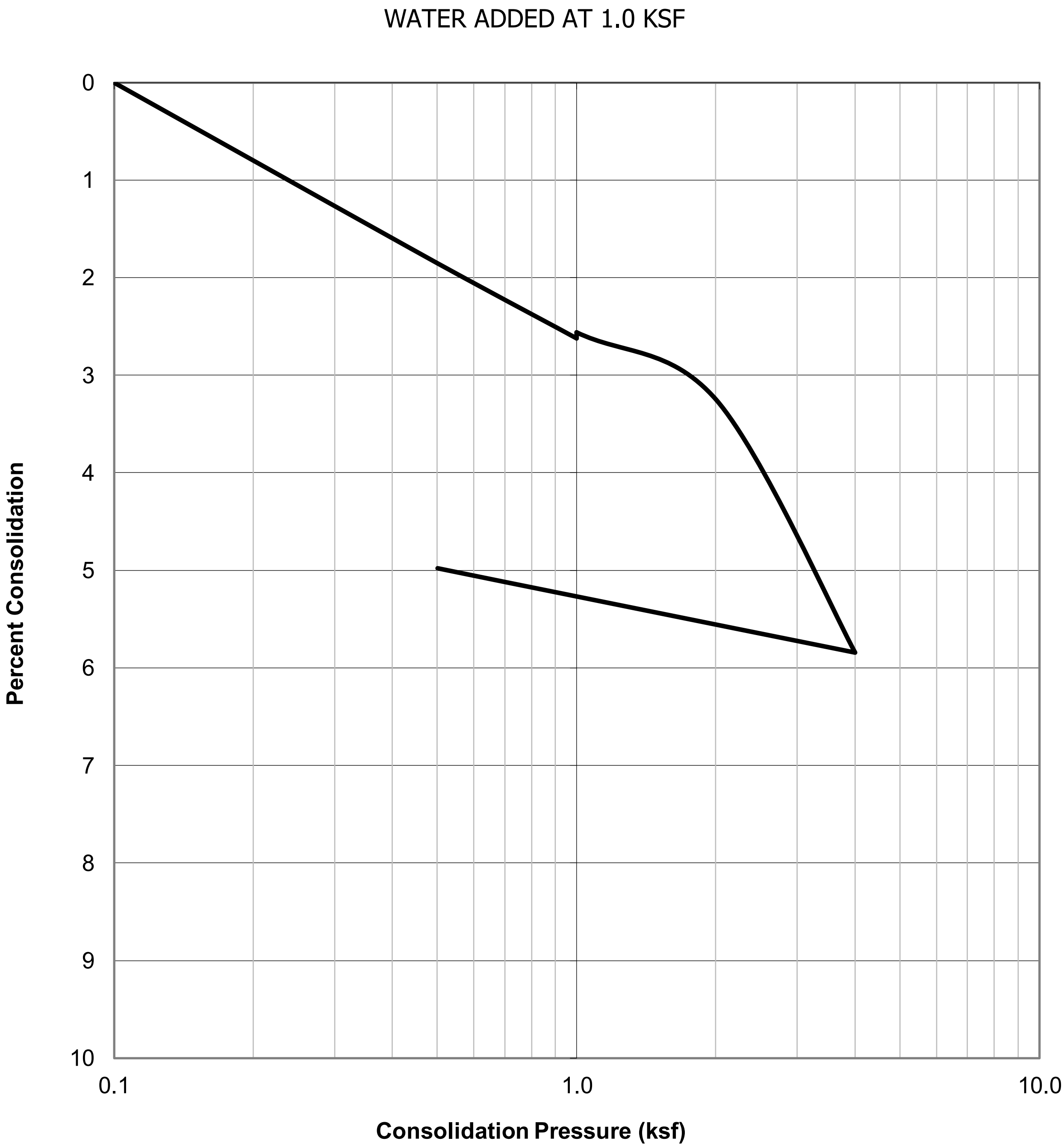
Checked by: JC

Project No.: W1827-88-01

IBC Multi-Use Trails
Creekwalk and Barranca Channel
Irvine, California

June 2024

Figure B7



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B1@10'	Sandy Clay (CL)	90.7	32.5	30.3

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

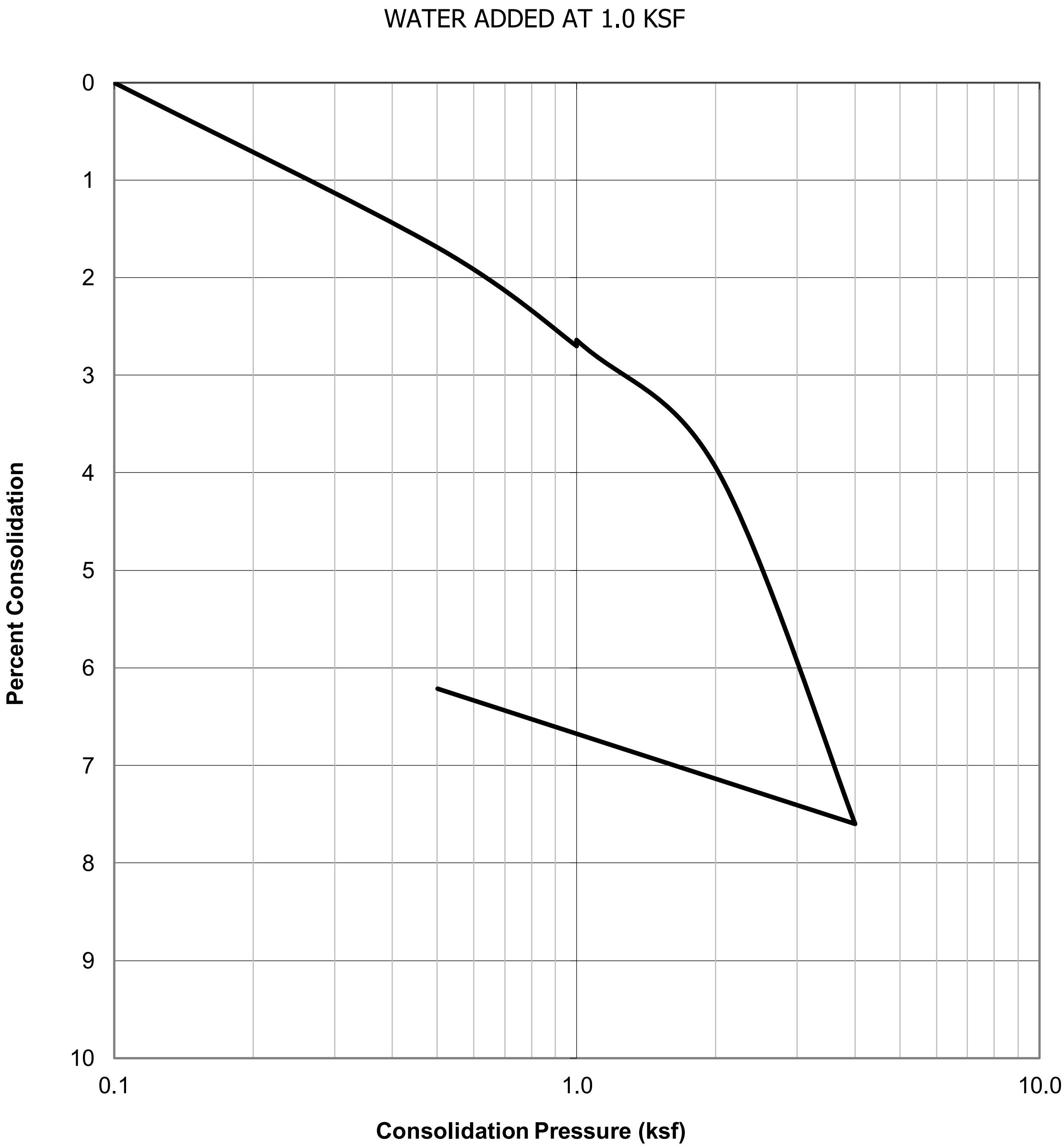
Checked by: JC

Project No.: W1827-88-01

IBC Multi-Use Trails
Creekwalk and Barranca Channel
Irvine, California

June 2024

Figure B8



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B1@15'	Clay (CL)	83.6	38.4	35.3

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

Checked by: JC

Project No.: W1827-88-01

IBC Multi-Use Trails
Creekwalk and Barranca Channel
Irvine, California

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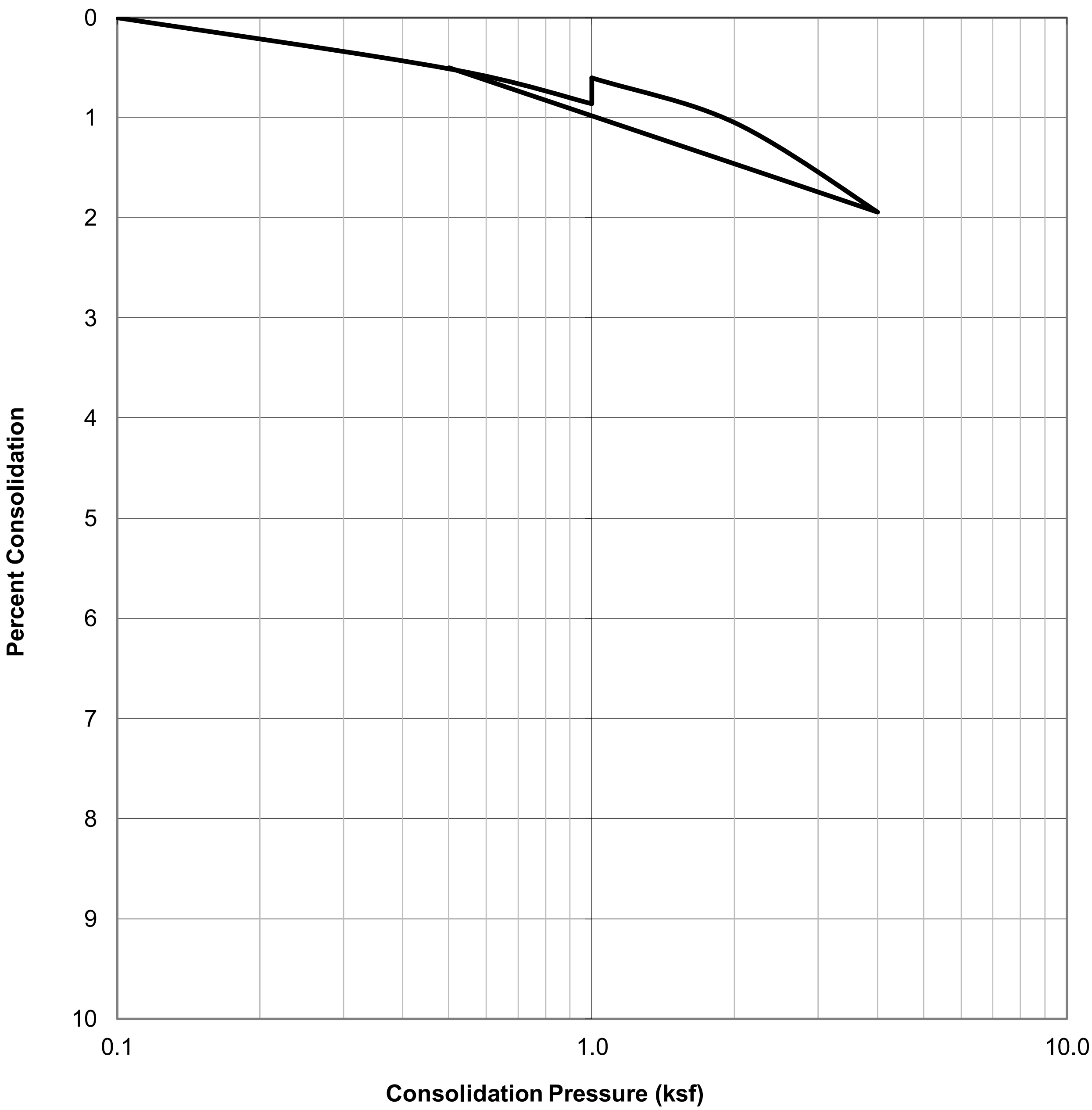
Figure B9

WATER ADDED AT 1.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B4@2.5'	Clayey Sand (SC)	95.7	25.2	28.4

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

Checked by: JC

Project No.: W1827-88-01

IBC Multi-Use Trails
Creekwalk and Barranca Channel
Irvine, California

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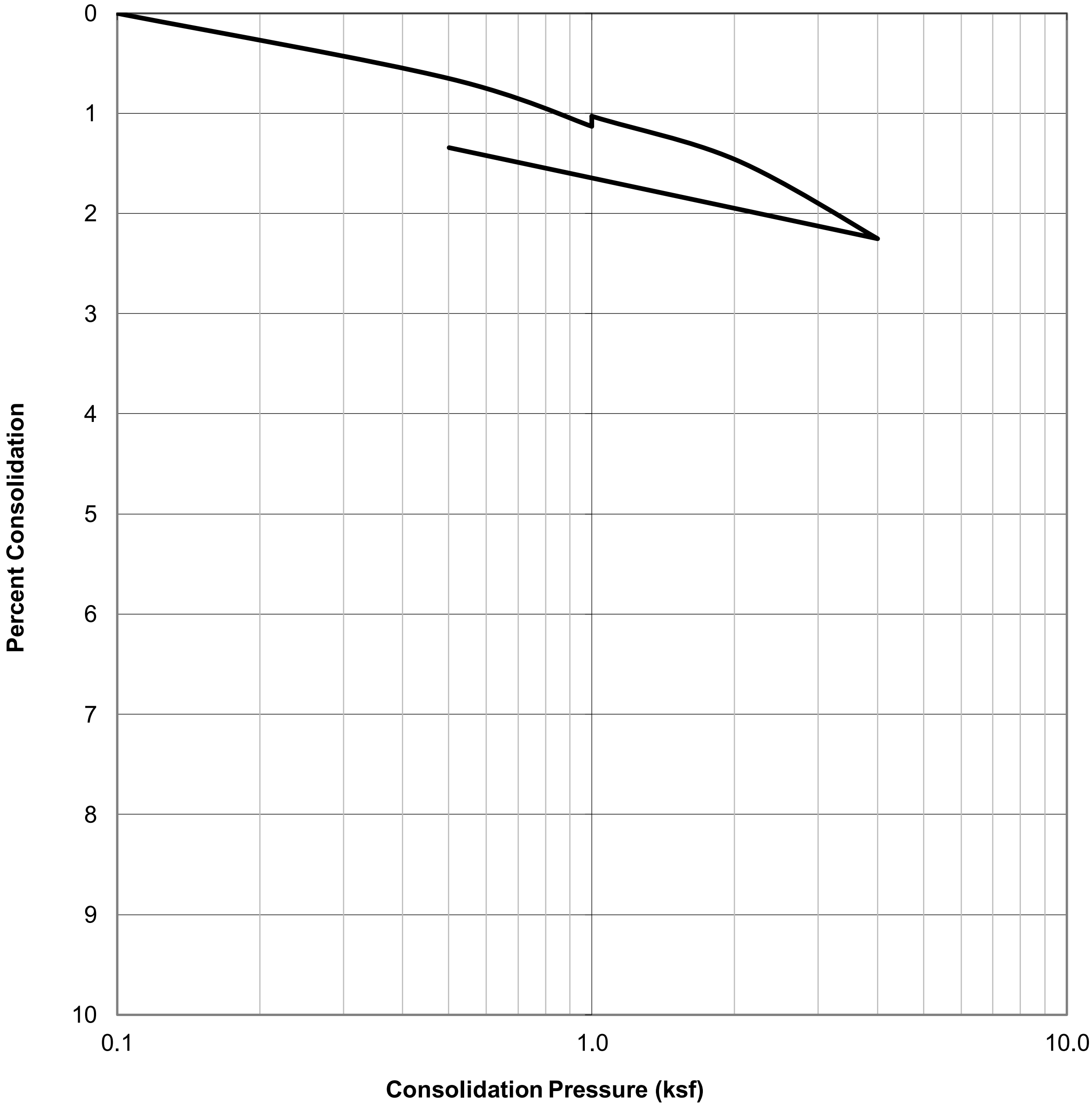
Figure B10

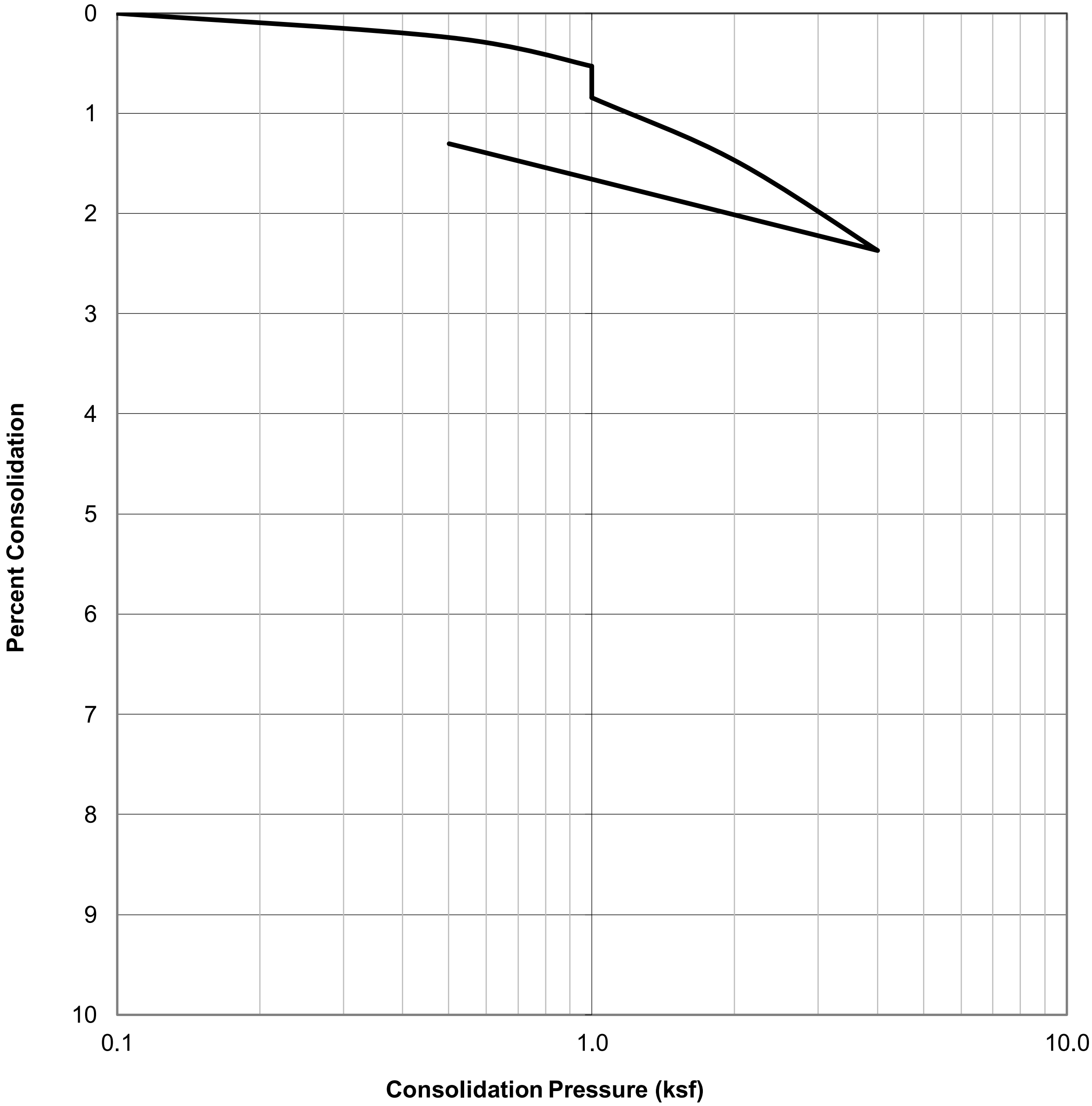
WATER ADDED AT 1.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B5@2.5'	Sandy Clay (CL)	111.5	17.9	19.2

GEOCON	**CONSOLIDATION TEST RESULTS** ASTM D-2435	Project No.: W1827-88-01 IBC Multi-Use Trails Creekwalk and Barranca Channel Irvine, California
	Checked by: JC	June 2024 Figure B11

WATER ADDED AT 1.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B7@2.5'	Silty Sand (SM)	97.9	12.7	22.3

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

Checked by: JC

Project No.: W1827-88-01

IBC Multi-Use Trails
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Irvine, California

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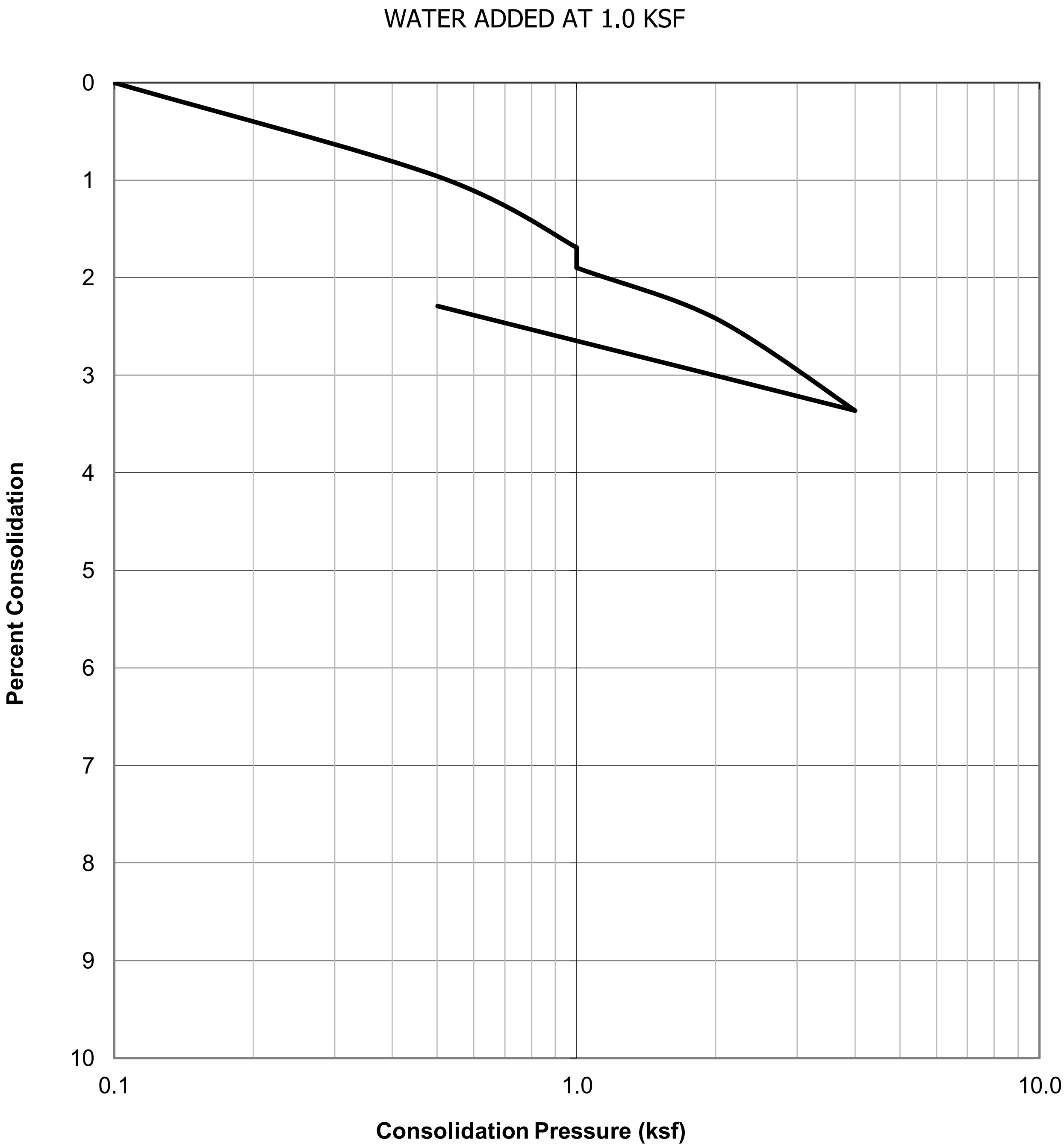


SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B10@2.5'	Silty Sand (SM)	103.7	17.1	23.1

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

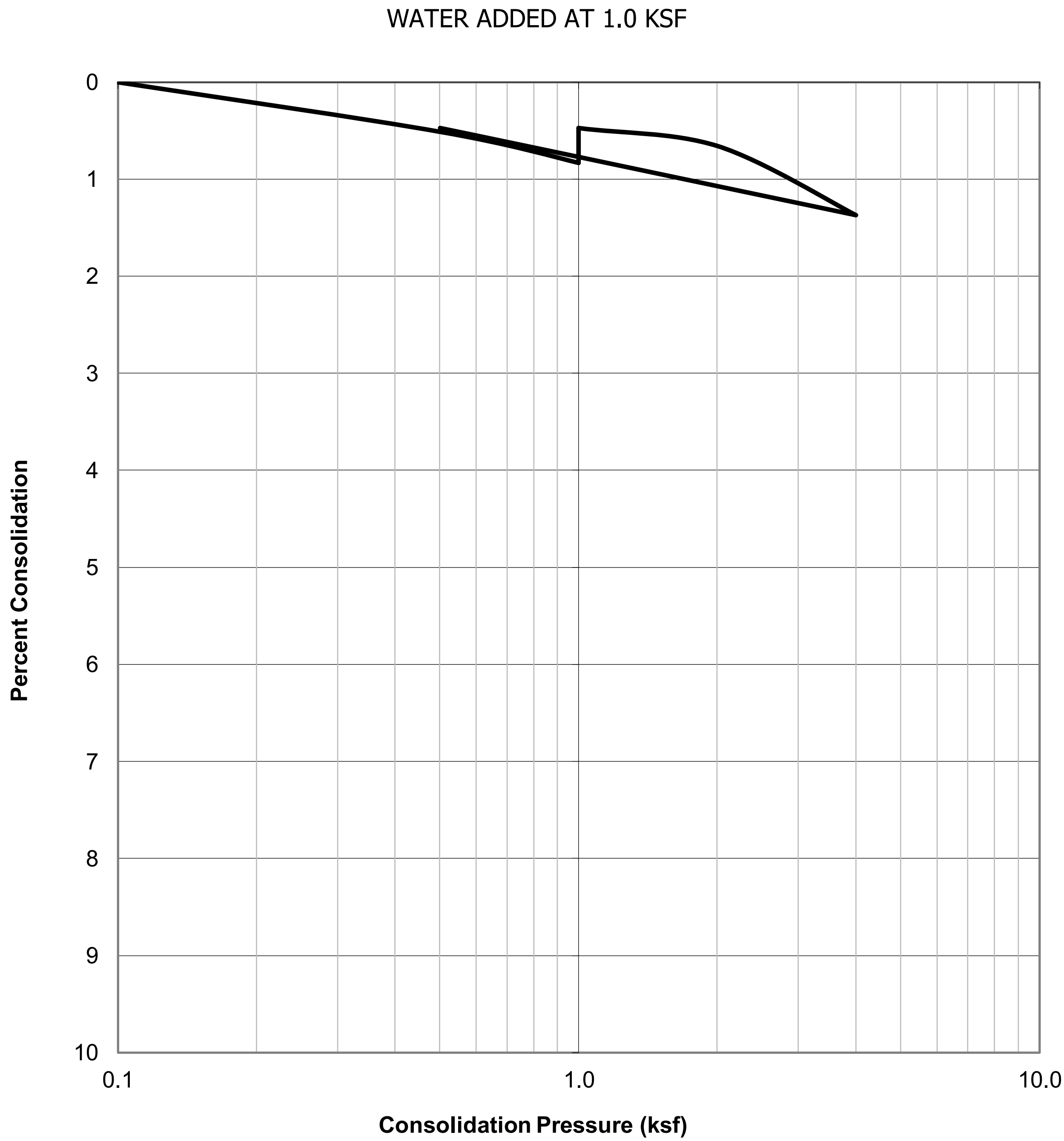
Checked by: JC

Project No.: W1827-88-01

IBC Multi-Use Trails
Creekwalk and Barranca Channel
Irvine, California

June 2024

Figure B13



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B15@2.5'	Clay (CL)	115.6	14.7	17.6

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

Checked by: JC

Project No.: W1827-88-01

IBC Multi-Use Trails
Creekwalk and Barranca Channel
Irvine, California

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Figure B14

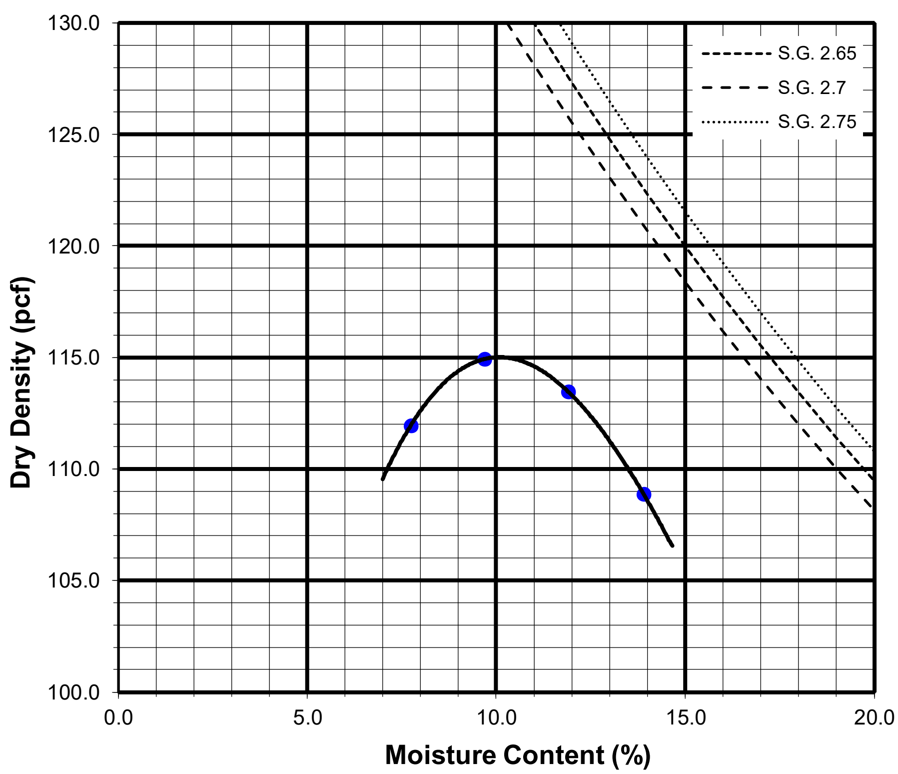
Sample No:

B3@0-5'	Sandy Clay (CL)

TEST NO.		1	2	3	4	5	6
Wt. Compacted Soil + Mold	(g)	6104	6186	6200	6155		
Weight of Mold	(g)	4282	4282	4282	4282		
Net Weight of Soil	(g)	1822	1904	1918	1873		
Wet Weight of Soil + Cont.	(g)	2205.9	2288.1	2331.9	2398.6		
Dry Weight of Soil + Cont.	(g)	2074.6	2119.5	2127.3	2154.2		
Weight of Container	(g)	378.7	377.7	407.7	395.8		
Moisture Content	(%)	7.7	9.7	11.9	13.9		
Wet Density	(pcf)	120.6	126.1	127.0	124.0		
Dry Density	(pcf)	112.0	114.9	113.5	108.9		

Maximum Dry Density (pcf)	**115.5**
Bulk Specific Gravity (dry)	**2.68**
Corrected Maximum Dry Density (pcf)	**118.1**

Optimum Moisture Content (%)	**10.8**
Oversized Fraction (%)	**7.1**
Corrected Moisture Content (%)	**10.0**



Preparation Method: B

GEOCON	**COMPACTION CHARACTERISTICS USING MODIFIED EFFORT TEST RESULTS** ASTM D-1557	Project No.: W1827-88-01 IBC Multi-Use Trails Creekwalk and Barranca Channel Irvine, California
	Checked by: JC	June 2024 Figure B15

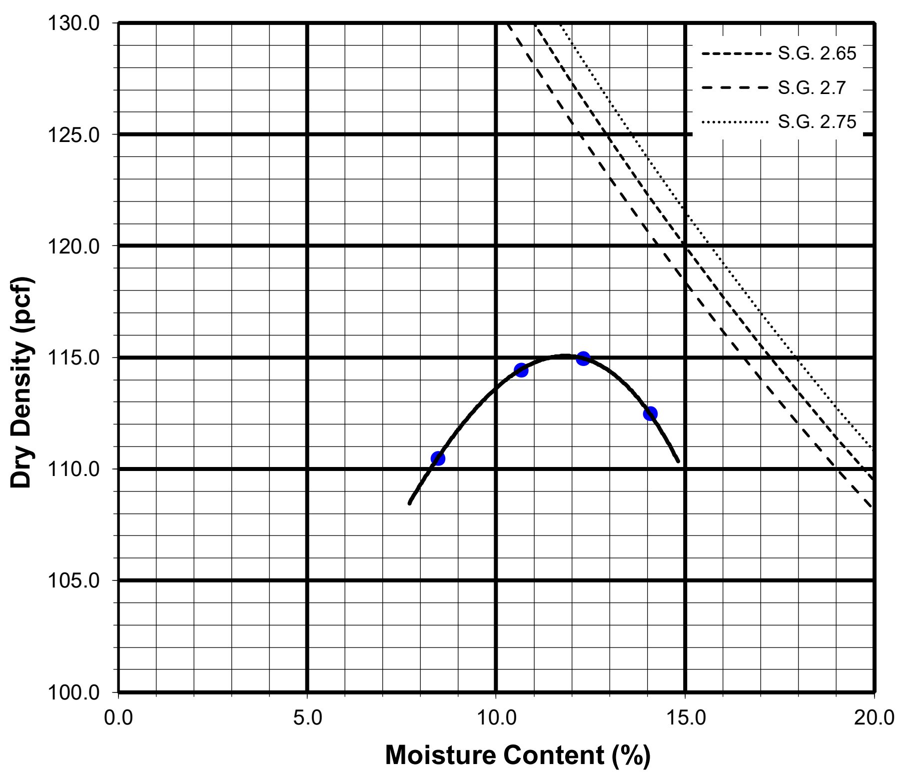
Sample No:

B4@0-5'	Clayey Sand (SC)

TEST NO.		1	2	3	4	5	6
Wt. Compacted Soil + Mold	(g)	6092	6195	6232	6220		
Weight of Mold	(g)	4282	4282	4282	4282		
Net Weight of Soil	(g)	1810	1913	1950	1938		
Wet Weight of Soil + Cont.	(g)	2193.7	2246.1	2335.3	2328.7		
Dry Weight of Soil + Cont.	(g)	2052.2	2066.3	2120.9	2088.0		
Weight of Container	(g)	378.2	378.2	377.3	376.4		
Moisture Content	(%)	8.5	10.7	12.3	14.1		
Wet Density	(pcf)	119.8	126.6	129.1	128.3		
Dry Density	(pcf)	110.5	114.5	115.0	112.5		

Maximum Dry Density (pcf)	**115.5**
Bulk Specific Gravity (dry)	**2.37**
Corrected Maximum Dry Density (pcf)	**119.0**

Optimum Moisture Content (%)	**11.5**
Oversized Fraction (%)	**13.5**
Corrected Moisture Content (%)	**9.9**



Preparation Method: B

COMPACTION CHARACTERISTICS USING MODIFIED EFFORT TEST RESULTS

ASTM D-1557

GEOCON

Checked by: JC

Project No.: W1827-88-01

IBC Multi-Use Trails
Creekwalk and Barranca Channel
Irvine, California

June 2024

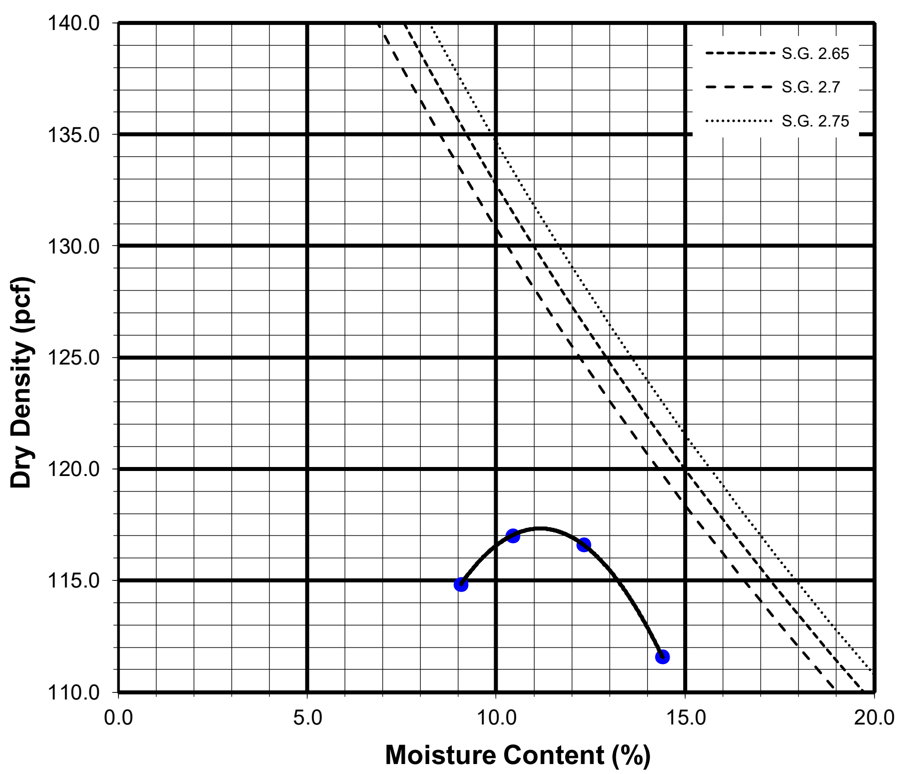
Figure B16

Sample No:

B7@0-5'	Silty Sand (SM)

TEST NO.		1	2	3	4	5	6
Wt. Compacted Soil + Mold	(g)	6174	6234	6260	6210		
Weight of Mold	(g)	4282	4282	4282	4282		
Net Weight of Soil	(g)	1892	1952	1978	1928		
Wet Weight of Soil + Cont.	(g)	2312.6	2371.8	2413.2	2444.0		
Dry Weight of Soil + Cont.	(g)	2154.5	2186.5	2193.7	2184.1		
Weight of Container	(g)	411.2	409.6	409.7	378.5		
Moisture Content	(%)	9.1	10.4	12.3	14.4		
Wet Density	(pcf)	125.3	129.2	131.0	127.6		
Dry Density	(pcf)	114.8	117.0	116.6	111.6		

Maximum Dry Density (pcf)	**118.0**	**Optimum Moisture Content (%)**	**11.4**



Preparation Method: A

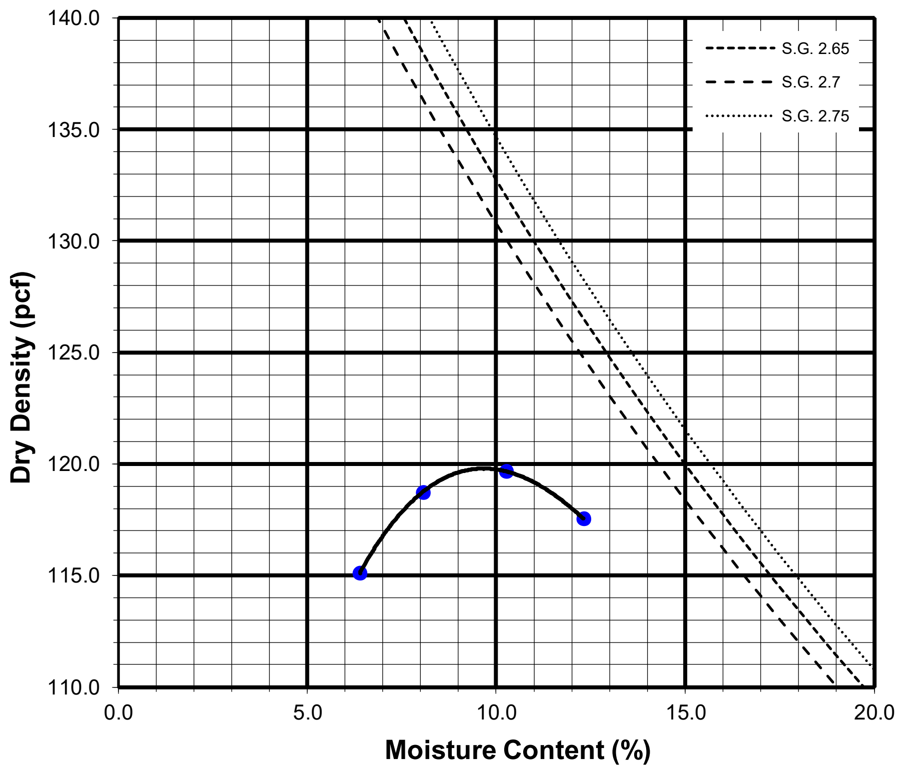
GEOCON	**COMPACTION CHARACTERISTICS USING MODIFIED EFFORT TEST RESULTS** ASTM D-1557	Project No.: W1827-88-01 IBC Multi-Use Trails Creekwalk and Barranca Channel Irvine, California
	Checked by: JC	June 2024 Figure B17

Sample No:

B10@0-5'	Clayey Sand (SC)

TEST NO.		1	2	3	4	5	6
Wt. Compacted Soil + Mold	(g)	6220	6275	6276	6132		
Weight of Mold	(g)	4282	4282	4282	4282		
Net Weight of Soil	(g)	1938	1993	1994	1850		
Wet Weight of Soil + Cont.	(g)	2323.4	2379.9	2379.1	2235.9		
Dry Weight of Soil + Cont.	(g)	2178.4	2193.7	2159.8	2124.2		
Weight of Container	(g)	378.2	378.7	378.0	377.4		
Moisture Content	(%)	8.1	10.3	12.3	6.4		
Wet Density	(pcf)	128.3	131.9	132.0	122.5		
Dry Density	(pcf)	118.7	119.7	117.5	115.1		

Maximum Dry Density (pcf)	120.5	Optimum Moisture Content (%)	9.0



Preparation Method: B

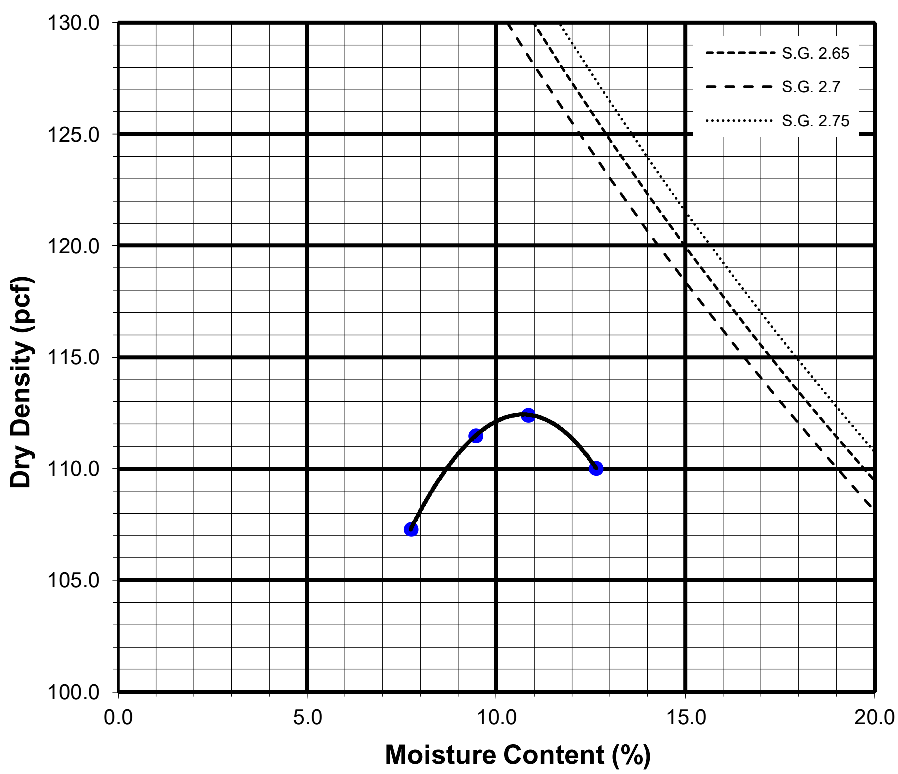
GEOCON	**COMPACTION CHARACTERISTICS USING MODIFIED EFFORT TEST RESULTS** ASTM D-1557	Project No.: W1827-88-01
		IBC Multi-Use Trails Creekwalk and Barranca Channel Irvine, California
	Checked by: JC	June 2024 Figure B18

Sample No:

B15@0-5'	Sandy Clay (CL)

TEST NO.		1	2	3	4	5	6
Wt. Compacted Soil + Mold	(g)	6028	6125	6164	6154		
Weight of Mold	(g)	4282	4282	4282	4282		
Net Weight of Soil	(g)	1746	1843	1882	1872		
Wet Weight of Soil + Cont.	(g)	2131.0	2198.3	2270.5	2260.9		
Dry Weight of Soil + Cont.	(g)	2005.1	2041.1	2085.5	2049.8		
Weight of Container	(g)	378.3	378.0	377.4	378.8		
Moisture Content	(%)	7.7	9.5	10.8	12.6		
Wet Density	(pcf)	115.6	122.0	124.6	123.9		
Dry Density	(pcf)	107.3	111.5	112.4	110.0		

Maximum Dry Density (pcf)	112.5	Optimum Moisture Content (%)	10.1



Preparation Method: A

COMPACTION CHARACTERISTICS USING MODIFIED EFFORT TEST RESULTS

ASTM D-1557

Checked by: JC

GEOCON

Project No.: W1827-88-01

IBC Multi-Use Trails
Creekwalk and Barranca Channel
Irvine, California

June 2024

Figure B19

SUMMARY OF LABORATORY R-VALUE TEST RESULTS

Sample No.	Soil Description	R-Value
B3 @ 0-5'	Sandy Clay (CL)	4
B4 @ 0-5'	Clayey Sand (SC)	12
B7 @ 0-5'	Silty Sand (SM)	19
B10 @ 0-5'	Clayey Sand (SC)	10
B15 @ 0-5'	Sandy Clay (CL)	6

B1@0-5'

MOLDED SPECIMEN		BEFORE TEST	AFTER TEST
Specimen Diameter	(in.)	4.0	4.0
Specimen Height	(in.)	1.0	1.2
Wt. Comp. Soil + Mold	(gm)	547.5	623.6
Wt. of Mold	(gm)	198.5	198.5
Specific Gravity	(Assumed)	2.7	2.7
Wet Wt. of Soil + Cont.	(gm)	1191.2	623.6
Dry Wt. of Soil + Cont.	(gm)	1148.7	299.6
Wt. of Container	(gm)	891.2	198.5
Moisture Content	(%)	16.5	41.9
Wet Density	(pcf)	105.3	128.1
Dry Density	(pcf)	90.4	90.2
Void Ratio		0.9	1.2
Total Porosity		0.5	0.5
Pore Volume	(cc)	96.0	132.3
Degree of Saturation	(%) [S_{meas}]	51.9	94.8

Date	Time	Pressure (psi)	Elapsed Time (min)	Dial Readings (in.)
5/17/2024	10:00	1.0	0	0.3995
5/17/2024	10:10	1.0	10	0.3998
Add Distilled Water to the Specimen				
5/18/2024	10:00	1.0	1430	0.5752
5/18/2024	11:00	1.0	1490	0.5752

Expansion Index (EI meas) =	175.4
Expansion Index (Report) =	**175**

Expansion Index, EI_{50}	CBC CLASSIFICATION *	UBC CLASSIFICATION **
0-20	Non-Expansive	Very Low
21-50	Expansive	Low
51-90	Expansive	Medium
91-130	Expansive	High
>130	Expansive	Very High

* Reference: 2022 California Building Code, Section 1803.5.3

** Reference: 1997 Uniform Building Code, Table 18-I-B.

GEOCON

EXPANSION INDEX TEST RESULTS

ASTM D-4829

Checked by: JC

Project No.: W1827-88-01

IBC Multi-Use Trails
Creekwalk and Barranca Channel
Irvine, California

June 2024

Figure B21

B3@0-5'

MOLDED SPECIMEN		BEFORE TEST	AFTER TEST
Specimen Diameter	(in.)	4.0	4.0
Specimen Height	(in.)	1.0	1.1
Wt. Comp. Soil + Mold	(gm)	595.9	647.0
Wt. of Mold	(gm)	198.6	198.6
Specific Gravity	(Assumed)	2.7	2.7
Wet Wt. of Soil + Cont.	(gm)	308.4	647.0
Dry Wt. of Soil + Cont.	(gm)	281.2	361.2
Wt. of Container	(gm)	8.4	198.6
Moisture Content	(%)	10.0	24.1
Wet Density	(pcf)	119.8	135.1
Dry Density	(pcf)	109.0	108.8
Void Ratio		0.5	0.7
Total Porosity		0.4	0.4
Pore Volume	(cc)	73.2	89.7
Degree of Saturation	(%) [S_{meas}]	49.7	97.2

Date	Time	Pressure (psi)	Elapsed Time (min)	Dial Readings (in.)
5/18/2024	10:00	1.0	0	0.2992
5/18/2024	10:10	1.0	10	0.2992
Add Distilled Water to the Specimen				
5/19/2024	10:00	1.0	1430	0.3789
5/19/2024	11:00	1.0	1490	0.3789

Expansion Index (EI meas) =	79.7
Expansion Index (Report) =	**80**

Expansion Index, EI_{50}	CBC CLASSIFICATION *	UBC CLASSIFICATION **
0-20	Non-Expansive	Very Low
21-50	Expansive	Low
51-90	Expansive	Medium
91-130	Expansive	High
>130	Expansive	Very High

* Reference: 2022 California Building Code, Section 1803.5.3

** Reference: 1997 Uniform Building Code, Table 18-I-B.

GEOCON

EXPANSION INDEX TEST RESULTS

ASTM D-4829

Checked by: JC

Project No.: W1827-88-01

IBC Multi-Use Trails
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Irvine, California

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Figure B22

B4@0-5'

MOLDED SPECIMEN		BEFORE TEST	AFTER TEST
Specimen Diameter	(in.)	4.0	4.0
Specimen Height	(in.)	1.0	1.1
Wt. Comp. Soil + Mold	(gm)	595.1	640.4
Wt. of Mold	(gm)	200.8	200.8
Specific Gravity	(Assumed)	2.7	2.7
Wet Wt. of Soil + Cont.	(gm)	308.6	640.4
Dry Wt. of Soil + Cont.	(gm)	278.8	355.2
Wt. of Container	(gm)	8.6	200.8
Moisture Content	(%)	11.0	23.8
Wet Density	(pcf)	118.9	132.4
Dry Density	(pcf)	107.2	107.0
Void Ratio		0.6	0.7
Total Porosity		0.4	0.4
Pore Volume	(cc)	75.4	91.4
Degree of Saturation	(%) [S_{meas}]	52.2	92.3

Date	Time	Pressure (psi)	Elapsed Time (min)	Dial Readings (in.)
5/17/2024	10:00	1.0	0	0.2562
5/17/2024	10:10	1.0	10	0.2563
Add Distilled Water to the Specimen				
5/18/2024	10:00	1.0	1430	0.3334
5/18/2024	11:00	1.0	1490	0.3334

Expansion Index (EI meas) =	77.1
Expansion Index (Report) =	**77**

Expansion Index, EI_{50}	CBC CLASSIFICATION *	UBC CLASSIFICATION **
0-20	Non-Expansive	Very Low
21-50	Expansive	Low
51-90	Expansive	Medium
91-130	Expansive	High
>130	Expansive	Very High

* Reference: 2022 California Building Code, Section 1803.5.3

** Reference: 1997 Uniform Building Code, Table 18-I-B.

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Figure B23

B7@0-5'

MOLDED SPECIMEN		BEFORE TEST	AFTER TEST
Specimen Diameter	(in.)	4.0	4.0
Specimen Height	(in.)	1.0	1.1
Wt. Comp. Soil + Mold	(gm)	603.4	639.0
Wt. of Mold	(gm)	203.2	203.2
Specific Gravity	(Assumed)	2.7	2.7
Wet Wt. of Soil + Cont.	(gm)	308.7	639.0
Dry Wt. of Soil + Cont.	(gm)	281.4	363.8
Wt. of Container	(gm)	8.7	203.2
Moisture Content	(%)	10.0	19.8
Wet Density	(pcf)	120.7	131.3
Dry Density	(pcf)	109.7	109.6
Void Ratio		0.5	0.6
Total Porosity		0.3	0.4
Pore Volume	(cc)	72.2	84.0
Degree of Saturation	(%) [S_{meas}]	50.8	85.7

Date	Time	Pressure (psi)	Elapsed Time (min)	Dial Readings (in.)
5/17/2024	10:00	1.0	0	0.4458
5/17/2024	10:10	1.0	10	0.4462
Add Distilled Water to the Specimen				
5/18/2024	10:00	1.0	1430	0.5028
5/18/2024	11:00	1.0	1490	0.5028

Expansion Index (EI meas) =	56.6
Expansion Index (Report) =	**57**

Expansion Index, EI_{50}	CBC CLASSIFICATION *	UBC CLASSIFICATION **
0-20	Non-Expansive	Very Low
21-50	Expansive	Low
51-90	Expansive	Medium
91-130	Expansive	High
>130	Expansive	Very High

* Reference: 2022 California Building Code, Section 1803.5.3

** Reference: 1997 Uniform Building Code, Table 18-I-B.

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Figure B24

B10@0-5'

MOLDED SPECIMEN		BEFORE TEST	AFTER TEST
Specimen Diameter	(in.)	4.0	4.0
Specimen Height	(in.)	1.0	1.0
Wt. Comp. Soil + Mold	(gm)	596.3	630.9
Wt. of Mold	(gm)	195.3	195.3
Specific Gravity	(Assumed)	2.7	2.7
Wet Wt. of Soil + Cont.	(gm)	308.7	630.9
Dry Wt. of Soil + Cont.	(gm)	281.7	364.9
Wt. of Container	(gm)	8.7	195.3
Moisture Content	(%)	9.9	19.4
Wet Density	(pcf)	121.0	131.2
Dry Density	(pcf)	110.1	109.9
Void Ratio		0.5	0.6
Total Porosity		0.3	0.4
Pore Volume	(cc)	71.9	81.6
Degree of Saturation	(%) [S_{meas}]	50.7	86.7

Date	Time	Pressure (psi)	Elapsed Time (min)	Dial Readings (in.)
5/17/2024	10:00	1.0	0	0.4254
5/17/2024	10:10	1.0	10	0.4251
Add Distilled Water to the Specimen				
5/18/2024	10:00	1.0	1430	0.4721
5/18/2024	11:00	1.0	1490	0.4721

Expansion Index (EI meas) =	47
Expansion Index (Report) =	**47**

Expansion Index, EI_{50}	CBC CLASSIFICATION *	UBC CLASSIFICATION **
0-20	Non-Expansive	Very Low
21-50	Expansive	Low
51-90	Expansive	Medium
91-130	Expansive	High
>130	Expansive	Very High

* Reference: 2022 California Building Code, Section 1803.5.3
** Reference: 1997 Uniform Building Code, Table 18-I-B.

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Figure B25

B15@0-5'

MOLDED SPECIMEN		BEFORE TEST	AFTER TEST
Specimen Diameter	(in.)	4.0	4.0
Specimen Height	(in.)	1.0	1.1
Wt. Comp. Soil + Mold	(gm)	584.5	642.9
Wt. of Mold	(gm)	201.8	201.8
Specific Gravity	(Assumed)	2.7	2.7
Wet Wt. of Soil + Cont.	(gm)	308.6	642.9
Dry Wt. of Soil + Cont.	(gm)	277.0	342.3
Wt. of Container	(gm)	8.6	201.8
Moisture Content	(%)	11.8	28.9
Wet Density	(pcf)	115.4	132.9
Dry Density	(pcf)	103.3	103.1
Void Ratio		0.6	0.8
Total Porosity		0.4	0.4
Pore Volume	(cc)	80.2	101.4
Degree of Saturation	(%) [S_{meas}]	50.8	97.5

Date	Time	Pressure (psi)	Elapsed Time (min)	Dial Readings (in.)
5/17/2024	10:00	1.0	0	0.4594
5/17/2024	10:10	1.0	10	0.4602
Add Distilled Water to the Specimen				
5/18/2024	10:00	1.0	1430	0.5624
5/18/2024	11:00	1.0	1490	0.5624

Expansion Index (EI meas) =	102.2
Expansion Index (Report) =	**102**

Expansion Index, EI_{50}	CBC CLASSIFICATION *	UBC CLASSIFICATION **
0-20	Non-Expansive	Very Low
21-50	Expansive	Low
51-90	Expansive	Medium
91-130	Expansive	High
>130	Expansive	Very High

* Reference: 2022 California Building Code, Section 1803.5.3
** Reference: 1997 Uniform Building Code, Table 18-I-B.

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Irvine, California

June 2024 Figure B26

SUMMARY OF LABORATORY WATER SOLUBLE SULFATE TEST RESULTS
AASHTO T290 ASTM C1580

Sample No.	Water Soluble Sulfate (% SO_4)	Sulfate Exposure
B1@0-5'	1.699	S2
B3@0-5'	1.210	S2
B4@0-5'	0.424	S2
B7@0-5'	0.308	S2
B10@0-5'	0.408	S2
B15@0-5'	1.228	S2