REPORT OF PRELIMINARY GEOTECHNICAL INVESTIGATION AND COASTAL BLUFF EDGE EVALUATION

Princess Street Coastal Trail
7957 Princess Street
La Jolla, California

JOB NO. 22-13797
28 September 2023

Prepared for:

Environmental Center of San Diego

Geotechnical Exploration, Inc.
SOIL AND FOUNDATION ENGINEERING • GROUNDWATER • ENGINEERING GEOLOGY

28 September 2023

Ms. Pamela Heatherington, Board of Directors
Environmental Center of San Diego
Via Email: contactecosd@gmail.com

Job No. 22-13797

Subject: **Report of Preliminary Geotechnical Investigation and Coastal Bluff Edge Evaluation**
Princess Street Coastal Trail
7957 Princess Street
La Jolla, California

Dear Ms. Heatherington:

In accordance with your request, ***Geotechnical Exploration, Inc.*** has performed a preliminary geotechnical investigation, evaluation of the general geologic conditions and coastal bluff edge location and recession evaluation at the property located at 7957 Princess Street per the requirements of the City of San Diego. It is our understanding that a public accessway is being developed through an easement to a pocket beach below. The field work was performed on July 11, 2023.

In our opinion, if the conclusions and recommendations presented in this report are implemented during site preparation, the easement area will be suited for the proposed stairway and associated improvements.

This opportunity to be of service is sincerely appreciated. Should you have any questions concerning the following report, please do not hesitate to contact us. Reference to our **Job No. 22-13797** will expedite a response to your inquiries.

Respectfully submitted,

GEOTECHNICAL EXPLORATION, INC.

Jaime A. Cerros, P.E.
R.C.E. 34422/G.E. 2007
Senior Geotechnical Engineer

Leslie D. Reed, President
C.E.G. 999/P.G. 3391

7420 TRADE STREET • SAN DIEGO, CA. 92121 • (858) 549-7222 • FAX: (858) 549-1604 • EMAIL: geotech@gei-sd.com

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The following report presents the findings and recommendations of ***Geotechnical Exploration, Inc.*** for the subject project.

I. PROJECT SUMMARY

It is our understanding, based on discussion with Ms. Pam Heatherington of the Environmental Center of San Diego, that the easement along the south property line of the existing residential lot is being developed to receive a public accessway to a pocket beach below. The proposed 5-foot-wide stair structure, made primarily of wood components, begins at a high point elevation of approximately 46 feet and leads down to a viewing platform at approximately 23 feet, where the structure terminates. The proposed new construction will utilize standard-type building materials and conventional foundations.

II. SCOPE OF WORK

Final construction plans have not been provided to us during the preparation of this report, however, we reviewed conceptual master plans prepared by Rana Creek Living Architecture, dated February 10, 2020. The scope of work we performed is briefly outlined as follows:

1. Identified, classified, and evaluated the surface and subsurface soils in accessible areas within the easement in conformance with the Unified Soil Classification System, with regard to the feasibility of the proposed project.

2. Evaluated representative samples of the fill in the upper portion of the easement and the underlying Old Paralic Deposits and Point Loma Formation underlying the entire lot for their geotechnical engineering properties.

3. Provided conclusions and recommendations pertinent to the project development.

4. Recommended preliminary foundation design information and design criteria - suitable to the proposed stairway structure and construction of associated improvements.

5. Evaluated the strength and erosion characteristics of the Cretaceous Point Loma Formation which comprises the lower bluff face below the upper old paralic/terrace deposits and overlying fill soils.

6. Performed slope stability and bluff recession analysis as it relates to the proposed construction.

Our subsurface investigation revealed that the majority of the lot is underlain at shallow depth, i.e., less than 2 to 3 feet, by native soils consisting of dense/hard, silty sand and sandy clay identified as the Cretaceous-age Point Loma Formation (Kp). Fill soils ranging in maximum thickness of 3 feet overlie the Point Loma Formation on the lower bluff. The fill soils consist of variable density (loose to medium dense), dark brown, silty/clayey sand with gravel. As encountered in the exploratory handpits, the fill soils are underlain by moderately to well cemented Point Loma (Kp) formational materials. Although not encountered in the exploratory handpits, the Old Paralic Deposits are mapped above the Point Loma Formation in the upper bluff.

It is recommended that new foundations be founded into the underlying dense/hard Point Loma Formation. Existing shallow fill soils will require complete removal and/or recompaction prior to placement of new fill or improvements.

III. <u>SITE DESCRIPTION</u>

The subject property is known as Assessor's Parcel No. 350-151-01-00, Lot 11 in Block 3, according to Recorded Map 000959, in the La Jolla area of the City and County of San Diego, State of California. The easement area covers approximately .002-acre and is located along the southern property line of the property located at 7957 Princess Street in the La Jolla area of the City of San Diego (for site location, refer to the Vicinity Map, Figure No. I).

The property is oriented in a slightly northwesterly to southeasterly direction and is bounded to the south by a similar residence about 5 feet higher in elevation; to the west and northwest by a westerly and northerly descending ocean bluff (sea cliff) and the Pacific Ocean and to the east by northern terminus of Princess Street (for site plan, refer to the Plot Plan and Site-Specific Geologic Map, Figure No. IIa).

The easement is currently undeveloped, however, the adjacent structure consists of a single-family residence with an attached garage, concrete driveway, and concrete patios, pool deck and walkways. The existing home was likely built in the 1970s and remodeled sometime after. Access to the lot is provided at the southeast corner of the property from Princess Street.

The easement consists of a moderate to steeply sloping hillside extending below an existing concrete stairway on the east side of the existing residence. The lower stairway landing is at an approximate elevation of 46 feet above mean sea level (AMSL). Elevations across the easement range from approximately 46 feet AMSL at the base of the stairway to approximately 11 feet AMSL along the southwest corner of the easement. The beach at the base of the bluff is at an elevation of approximately 1.3 feet AMSL.

Information concerning approximate elevations across the site was obtained from a topographic map prepared by SB&O Planning, Engineering and Surveying dated October 2, 2019.

IV. FIELD INVESTIGATION

Nine (9) exploratory excavations were placed within the easement in the area of the proposed coastal access stairway (refer to the Plot Plan and Site-Specific Geologic Map, Figure No. II, for handpit locations). These handpit/auger holes were excavated to depths ranging from 2 to 5½ feet in order to obtain representative soil samples and to define the soil profile and depth to Point Loma Formation materials across the lot.

The soils encountered in the excavations were logged by our field geologist and samples were taken of the predominant soils throughout the field operation. Exploratory logs have been prepared on the basis of our observations and laboratory testing. The results have been summarized on Figure Nos. IIIa-i and IV. The predominant soils have been classified in general conformance with the Unified Soil Classification System (refer to Appendix A).

V. LABORATORY TESTS AND SOIL INFORMATION

Laboratory tests were performed on retrieved soil samples in order to evaluate their physical and mechanical properties and their ability to support the proposed residence and improvements. Test results are presented on Figure Nos. III and IV. The following tests were conducted on the sampled soils:

1. *Moisture Content (ASTM D2216-19)*
2. *Standard Test Method for Density of Soil In-place by the Drive-Cylinder Method (ASTM D2937-17e2)*
3. *Standard Test Method for Amount of Material in Soil Finer than No. 200 (ASTM D1140-17)*
4. *Standard Test Method for Laboratory Compaction Characteristics of Soil using Modified Effort (ASTM D1557-12e1)*
5. *Standard Test Method for Expansion Index of Soils (ASTM 4829-19)*

Moisture content (ASTM D2216) and density measurements (ASTM D2937) were performed to establish the in-situ moisture and density of samples retrieved from the exploratory excavations.

The –200 sieve size analysis (ASTM D1140) helps to more precisely classify the tested soils based on their fine material content, and provides qualitative information related to engineering characteristics such as expansion potential, permeability, and shear strength. The test results are presented on the exploratory excavation logs at the appropriate sample depths.

Laboratory compaction values (ASTM D1557) establish the Optimum Moisture content and the laboratory Maximum Dry Density of the tested soils. The relationship between the moisture and density of remolded soil samples helps to establish the relative compaction of existing fill soils.

The expansion potential of soils is determined, when necessary, utilizing the Standard Test Method for Expansion Index of Soils (ASTM D4829). In accordance with the Standard (Table 5.3), potentially expansive soils are classified as follows:

EXPANSION INDEX	EXPANSION POTENTIAL
0 to 20	Very low
21 to 50	Low
51 to 90	Medium
91 to 130	High
Above 130	Very high

Based on the test results, the sampled clayey Point Loma Formation on the site have a low expansion potential, with a maximum measured expansion index of 32.

Based on the laboratory test data, our observations of the primary soil types, and our previous experience with laboratory testing of similar soils, our Geotechnical Engineer has assigned values for friction angle, coefficient of friction, and cohesion for those soils which will have significant lateral support or load bearing functions on the project. These values have been utilized in determining the recommended bearing value as well as active and passive earth pressure design criteria.

VI. REGIONAL GEOLOGIC DESCRIPTION

San Diego County has been divided into three major geomorphic provinces: The Coastal Plain, the Peninsular Ranges and the Salton Trough. The Coastal Plain exists west of the Peninsular Ranges. The Salton Trough is east of the Peninsular Ranges. These divisions are the result of the basic geologic distinctions between the areas. Mesozoic metavolcanic, metasedimentary and plutonic rocks predominate in the Peninsular Ranges with primarily Cenozoic sedimentary rocks to the west and east of this central mountain range (Demere, 1997). For a more detailed regional geologic description, refer to Appendix B.

VII. SITE-SPECIFIC GEOLOGIC DESCRIPTION

A. Stratigraphy

Our field work, reconnaissance and review of the "*Geologic Map of San Diego, 30'x60' Quadrangle, CA"* by Kennedy and Tan, 2008, indicate that the site is underlain at depth and to below the beach elevation by dense, Cretaceous-age Point Loma Formation (Kp) materials. These bedrock materials are mapped as being overlain by Quaternary-age Old Paralic Deposits (Qop_7). The upper soil profile for the site includes relatively shallow surficial fill soils (in the upper portion of the easement). Refer to the excavation logs (Figure Nos. IIIa-i).

Figure No. V presents an excerpt of the Kennedy and Tan, 2008, geologic map of the general area of the site and Figure No. VI is an excerpt of the geologic hazards map of the area. Geologic cross section A-A' (from the base of the existing concrete stairs to the bottom of the easement) is included as Figure No. VII.

Fill Soils (Qaf): The upper portion of the easement is overlain by approximately 2 to 4 feet of surficial fill soils encountered within excavations HP-1, HP-2 and HP-3 placed on the upper bluff area. The fill soils consist of gray-brown to dark light brown, clayey sand with gravel and some cobbles. The fill soils are generally loose to medium dense and damp, with low expansion potential. They are not suitable in their current condition for support of loads from the new stairway structure. Refer to Figure Nos. IIIa-i, IV and VII for details.

Old Paralic Deposits (Qop_7): Although not encountered in our exploratory handpits, Old Paralic Deposits are mapped above the Point Loma Formation. Based on previous investigations in the area, the thickness of these materials is estimated to be approximately 10 feet. The Old Paralic Deposits consist of brown to dark red and gray-brown, clayey sand and sandy clay with a trace of gravel and cobble. They are generally medium dense to dense (very stiff to hard), moist, and are considered suitable for support of loads from structures or additional fill. The Old Paralic Deposits mapped in the upper portion of the bluff face overlie the Point Loma Formation (Kp). Refer to Figure Nos. IIIa-i, IV and VII for details.

Point Loma Formation (Kp): Formational materials of the Point Loma Formation are exposed and were encountered in all handpits in the lower portion of the bluff face within the easement. These materials consist of very dense, cemented sandstone and fractured claystone and have excellent bearing strength and erosion resistance characteristics. In addition, the large cobble-armored beach and wide planated bedrock surface help protect the bluff face along this portion of coastline from significant erosion events. Refer to Figure Nos. V and VII for details.

B. Structure

The Cretaceous-age Point Loma Formation (Kp) underlies the site and extends in depth to below the beach elevation. As encountered within our shallow exploratory excavations, bluff observations and review of the "*Geologic Map of San Diego, 30'x60' Quadrangle, CA,"* by Kennedy and Tan (2008) indicates that the structural orientation of the Point Loma formational materials nearest the site strike approximately north 80 degrees west and dips 20 to 30 degrees to the southwest, which results in the dip direction paralleling the bluff face with no out-of-slope dip. This is considered favorable from a stability perspective. Based on bluff observations revealing no out-of-slope bedding in the bluff face, and the lack of faulting or significant jointing, it is our opinion that the subject property bluff face should have the same favorable erosion-resistant characteristics as neighboring properties to the north and south with similar geologic conditions.

VIII. GENERAL GEOLOGIC HAZARDS

A review of the City of San Diego Seismic Safety Study -- Geologic Hazards Map Sheet No. 29 indicates that the site is located in a low- to moderate-risk geologic hazard area, designated as Category 43. Category 43 is identified as "*Generally unstable*" with "*Unfavorable bedding plains*" and "*local high erosion*." The Point Loma Formation materials are considered very stable and the *"Unfavorable bedding plains"* and "*local high erosion*" portion of the descriptions do not apply to the easement area. See Figure No. VI for an excerpt of this hazard map.

A minor unnamed fault is mapped south/southwest of the property and is part of a set of smaller faults that cross the coastline in a southeast direction. We consider these minor southeast-trending faults to be part of a faulting stress system adjacent to the Rose Canyon Fault Zone. We consider this fault and the other similar faults to be inactive and do not consider the site to have unfavorable geologic structure. We also observed several sea caves in the lower portion of the bluff. These sea caves are considered stable, have been present for many years and are formed in the erosion resistant sandstone material of the Point Loma Formation. According to the geologic and geologic hazards maps, no faults are mapped on the subject property. An excerpt of the geologic map with legend is presented as Figure No. V.

The following is a discussion of the geologic conditions and hazards common to the City of San Diego, as well as project-specific geologic information relating to development of the subject property.

A. Local and Regional Faults

Reference to the geologic map of the area (Kennedy and Tan, 2008) and the City of San Diego Seismic Safety Study, Geologic Hazards Map Sheet No. 29, indicate that no faults cross the site. As noted previously, in our professional opinion, neither an active fault nor a potentially active fault underlies the site in the area of the proposed construction.

The site, like most of southern California, is located in a seismically active area and regional faulting is present in San Diego County. The following local and regional fault zones are mapped in southern California in general proximity to the site:

- Rose Canyon Fault Zone: Mapped approximately 3 miles northeast of the site, considered capable of a M6.9 earthquake (Singleton et al., 2019; EERI, 2021).
- Coronado Bank Fault: Mapped approximately 11 miles southwest of the site, estimated to be to be capable of a M7.6 earthquake.
- San Diego Trough Fault Zone: Mapped approximately 21 miles west-southwest of the site. Most recent surface rupture is of Holocene age (SCEDC, 2022).
- Newport-Inglewood Fault: Mapped approximately 26 miles northwest of the site, estimated to be capable of producing a M6.0 to M7.4 earthquake (Grant Ludwig and Shearer, 2004; SCEDC, 2022).
- Elsinore Fault: Mapped approximately 40 miles northeast of the site, estimated to be capable of a M6.0 to M7.0 (Rockwell et al. 1985) and M7.5 (Greensfelder, 1974).
- San Clemente Fault: Mapped approximately 46 miles southwest of the site. Most recent surface rupture is of Holocene age (SCEDC, 2022).
- San Jacinto Fault: Mapped approximately 62 miles east of the site, estimated to have a 31 percent probability of a M6.7 or greater earthquake within the next 30 years (Working Group on California Earthquake Probabilities, 2008).

The potential for strong ground shaking from earthquakes on active southern California faults and active faults in northwestern Mexico should be anticipated at the site. Design of building structures in accordance with the current building codes would reduce the potential for injury or loss of human life. Buildings constructed in accordance with current building codes may suffer significant damage but should not undergo total collapse.

B. Other Geologic Hazards

Ground Rupture: Ground rupture is characterized by bedrock slippage along an established fault and may result in displacement of the ground surface. For ground rupture to occur along a fault, an earthquake usually exceeds M5.0. If a M5.0 earthquake was to take place on a local fault, an estimated surface-rupture length 1 mile long could be expected (Greensfelder, 1974). Our investigation indicates that the subject site is not directly on a known fault trace and, therefore, the risk of ground rupture is remote.

Ground Shaking: Structural damage caused by seismically induced ground shaking is a detrimental effect directly related to faulting and earthquake activity. Ground shaking is considered to be the greatest seismic hazard in San Diego County. The intensity of ground shaking is dependent on the magnitude of the earthquake, the distance from the earthquake, and the seismic response characteristics of underlying soils and geologic units. Earthquakes of M5.0 or greater are generally associated with notable to significant damage. It is our opinion that the most serious damage to the site would be caused by a large earthquake originating on a nearby strand of the Rose Canyon Fault Zone. Although the chance of such an event is remote, it could occur within the useful life of the structure.

Landslides: Based upon our geologic reconnaissance, review of the geologic map (Kennedy and Tan, 2008), review of the City of San Diego Seismic Safety Study -- Geologic Hazards Map and aerial photographs (4-11-53, AXN-8M-1 and 2), there are no known or suspected ancient landslides located on the site.

Slope Stability: Based on our knowledge of the on-site soils and the minimal amount of anticipated grading work required for the proposed public access walkway project, it is our opinion that the site would be adequately stable, and the proposed construction would not adversely affect the stability of the coastal bluff or adjacent properties. Furthermore, our slope stability calculations for gross and shallow analysis yield factors of safety higher than the acceptable minimum of 1.5; 1.15 with seismic loading out to the existing bluff face (refer to Section XIV, Slope Stability Analysis, and Appendix C for details).

Liquefaction: The liquefaction of saturated sands during earthquakes can be a major cause of damage to buildings. Liquefaction is the process by which soils are transformed into a viscous fluid that will flow as a liquid when unconfined. It occurs primarily in loose, saturated sands and silts when they are sufficiently shaken by an earthquake.

On this site, the risk of liquefaction of foundation materials due to seismic shaking is considered to be non-existent due to the very dense Cabrillo Conglomerate Formation underlying the site and the lack of a shallow, static groundwater surface under the site. The groundwater surface is at a minimum of over 30 feet below the ground surface. The site does not have a potential for soil liquefaction or soil strength loss to occur due to a seismic event.

Tsunami: A review of the California Geological Survey's 2009 *"Tsunami Inundation Map for Emergency Planning, La Jolla Quadrangle, San Diego County"* indicates that the site is mapped within a possible inundation zone. The site is adjacent to the Pacific Ocean, which would allow for both near field (Channel Island faults) and far field (Alaska and Japan faults) generated tsunami to approach the site. The State of California (2009) shows that the lower portion of the coastal trail is within the limit of a tsunami inundation zone. However, the limit of the tsunami zone does not reach the location of the proposed stairway landing at elevation +11.5 feet AMSL.

In general, the orientation of the southern California coastline and the bathymetry of the offshore southern California borderland have, during historical times, combined to protect the shoreline from any large magnitude tsunami height increases, as shown by records of tsunami occurrences that have been observed and/or recorded along the southern California shoreline since 1810 (Lander et al., 1993). For this segment of the California coastline (south of Santa Monica), there is no evidence of any high magnitude tsunamis generated during the last 200 years by large-scale regional sea floor movements (Gayman, 1998).

Sea Level Rise: Sea level rise for this area over the next 75 years (design life of the structure) is projected to range from between 1.7 feet to 7.1 feet (or higher). The likely range for the most onerous RCP is 1.8 feet to 3.6 feet, with a 5% probability that SLR meets or exceeds 4.6 feet. The "life" of a coastal access trail is typically less than 75 years.

The maximum historical water elevation at the site including El Niño effects is ~+5.3 feet NGVD29. The top of the beach access stair landing is at ~+12 feet NGVD29 and thus will be ~6.3 feet above the historical El Niño highest water elevation. As a result, the proposed shoreline access landing is located at an elevation that would not expose it to flooding from the ocean under current sea level conditions. The remainder of the trail up to Princess Street would not be subject to waves of flooding under current conditions. The base of the stairs may be subject periodic wetting from wave runup during time of higher tides.

Geologic Hazards Summary: It is our opinion, based upon a review of the available maps and our site investigation, that the site is underlain by stable formational materials, and is suited for the proposed coastal access trail and associated improvements. No active faults are known to cross the easement where the stairway will be built. It is our opinion that shaking from known "active" faults present the greatest seismic risk to the subject site during the lifetime of the proposed residence and additions. Design of structures in accordance with the current building codes will reduce the potential for injury or loss of human life. The structure may suffer significant damage but should not undergo total collapse.

To date, the nearest known "active" faults to the subject site are the northwest-trending Rose Canyon Fault, the Coronado Bank Fault, the Newport-Inglewood Fault and the Elsinore Fault, which are mapped 3.3 miles, 10.8 miles, 25.9 miles and 40 miles, respectively, from the subject property. No significant geologic hazards are known to exist on the site that would prevent the proposed construction. Refer to Section XII (subsection A.1) and Appendix D of this report for seismic design criteria.

IX. GROUNDWATER

No groundwater was encountered during the course of our field investigation and we do not anticipate significant groundwater problems to develop in the future, if the property proposed walkway is developed as proposed and proper drainage is implemented and maintained.

On properties such as the subject site where dense, fine-grained materials exist at relatively shallow depths, even normal landscape irrigation practices or periods of extended rainfall can result in shallow “perched” water conditions. The perching (shallow depth) accumulation of water on a low permeability surface can result in areas of persistent wetting and drowning of lawns, plants, and trees. Resolution of such conditions, should they occur, may require site-specific design and construction of subdrain and shallow "wick" drain dewatering systems.

It must be understood that unless discovered during initial site exploration or encountered during construction operations, it is extremely difficult to predict if or where perched or true groundwater conditions may appear in the future. When site fill or formational soils are fine-grained and of low permeability, water problems may not become apparent for extended periods of time.

X. CONCLUSIONS AND RECOMMENDATIONS

From a geotechnical engineering standpoint, it is our opinion that the site is suitable for the proposed coastal beach access stairway and improvements provided the conclusions and recommendations presented in this report are incorporated into its design and construction. *Care must be taken in the performance of any earthwork operations to protect the bluff face.*

Detailed earthwork and foundation recommendations are presented in the following paragraphs. The opinions, conclusions, and recommendations presented in this report are contingent upon ***Geotechnical Exploration, Inc***. being retained to review the final plans and specifications as they are developed and to observe the site earthwork and installation of foundations. Accordingly, we recommend that the following paragraph be included on the grading and foundation plans for the project.

> If the geotechnical consultant of record is changed for the project, the work shall be stopped until the replacement has agreed in writing to accept the responsibility within their area of technical competence for approval upon completion of the work. It shall be the responsibility of the permittee to notify the governing agency in writing of such change prior to the commencement or recommencement of grading and/or foundation installation work and comply with the governing agency's

requirements for a change to the Geotechnical Consultant of Record for the project

A. Seismic Design Criteria

1. *Seismic Design Criteria:* Site-specific seismic design criteria for the proposed project are presented in the following table in accordance with Section 1613 of the 2022 CBC, which incorporates by reference ASCE 7-16 for seismic design. We have determined the mapped spectral acceleration values for the site based on a latitude of 32.8503 degrees and longitude of -117.2634 degrees, utilizing a program titled *"Seismic Design Map Tool"* provided by the ATC Hazards by Locations, which provides a solution for ASCE 7-16 utilizing digitized files for the Spectral Acceleration maps. Based on our experience with similar conditions, we have assigned a Site Soil Classification of D.

2. *Spectral Acceleration and Design Values*: The structural seismic design, when applicable, should be based on the following seismic soil parameter values, which are based on the site location, soil characteristics, and seismic maps by USGS, as required by the 2022 CBC. Seismic design soil parameters were obtained with the ATC Hazards by Location tool and they are presented in summarized form below. A full computer printout is presented as Appendix D.

TABLE I
Mapped Spectral Acceleration Values and Design Parameters

S_s	S_1	F_a	F_v	S_{ms}	S_{m1}	S_{ds}	S_{d1}
1.4g	0.49g	1.20	1.81	1.68g	0.887g	1.12g	0.591g

B. ***Design Parameters for Proposed Foundations***

We recommend that the stairway structure be supported on 18-inch-diameter piers extended through the 2 to 4 feet of fill soils and 5 feet into adequate bearing formational material. The following design recommendations should be followed:

3. *Pier Design*: The footing bearing piers should be designed by the project Civil/Structural Engineer (including number of piers and pier spacing) to support all vertical and lateral loads of the stairway structure. The project Civil/Structural Engineer should review all reinforcing schedules.

4. *End-bearing Piers*: It is important, when drilling or hand excavating piers that utilize end-bearing strength, to limit the amount of loose material at the bottom of the excavation. For end-bearing piers, no slough over 1 inch in thickness should remain at the bottom of the excavation before steel and concrete placement. The drilling/excavation contractor should provide an appropriate cleaning tool to satisfy this requirement.

5. *End Bearing Capacity*: The recommended allowable end bearing capacity is 10,000 pounds per square foot (psf) for piers penetrating at least 5 feet into the formational material. The pier weight to be considered is one-third the actual weight of the buried pier. The recommended allowable end bearing vertical capacity for the piers already includes any negative friction produced by the existing fills as well as the buried pier weight.

   For lateral load soil resistance calculation, we recommend to use a soil passive resistance of 375 pounds per cubic foot (pcf) times the diameter of the pier, times the depth of fill equal to 5 feet. For the portion of the pier embedded in formational soils, we recommend to use 650 pcf times the diameter of the pier, times the depth of penetration into formational soils. The lateral spacing between piers should be at least 3 times the diameter. The passive resistance of the piers may be measured when the distance to the bluff or firm slope face is at least 5 feet for piers 1.5 feet in diameter.

6. *Pier Drilling/Excavation Observations*: Pier drilling or excavation operations should be performed under the continued observations of a representative of our firm to confirm the penetration into formational soils.

7. *Pier Design Standards:* The design and construction of the piers should be in accordance with the recommendations presented above, the current CBC requirements accepted by the City of San Diego, and also in accordance with ACI 336, 3R-14 Design and Construction of Drilled Piers, of the American Concrete Institute.

8. *Filling of Pier Excavations*: Pier excavations should be filled with concrete within 2 days after the excavations are completed to help reduce the risk of soil caving, mud or slough intrusion, etc. Slough material filling the bottom of drilled holes should be removed prior to concrete placement. If caving occurs while pier excavating (prior to or after reaching the required depth), casing may be required. Casing may be removed while placing concrete using the Tremie method.

9. *Retaining Walls*: If any retaining walls are planned, they must be designed to resist lateral earth pressures and any additional lateral pressures caused by surcharge loads on the adjoining retained surface. We recommend that unrestrained (cantilever) retaining walls with level low expansive backfill be designed for an equivalent fluid pressure of 38 pcf. We recommend that restrained retaining walls (i.e., any retaining walls with angle points or that

are curvilinear or supports that restrain them from rotation) with level backfill be designed for an equivalent fluid pressure of 38 pcf plus an additional uniform lateral pressure of 8H psf where H is the height of backfill above the top of the wall footing, in feet. Alternatively, an equivalent triangular pressure of 56 pcf may be used for restrained retaining walls with level backfill.

For seismic design of unrestrained walls, we recommend that the seismic pressure increment be taken as a fluid pressure distribution utilizing an equivalent fluid weight of 20 pcf. For unrestrained walls we recommend that the seismic pressure increment be taken as a fluid pressure distribution utilizing an equivalent fluid weight of 20 pcf added to the active static fluid pressure utilizing an equivalent fluid weight of 38 pcf. Restrained retaining walls can have the seismic soil increment waived.

Retaining wall foundations should be provided with a setback of at least 7 feet to daylight from the slope face. The allowable soil bearing capacity for the foundations of such walls should not exceed 2,000 psf and should bear into properly compacted fill or dense formational soils at least 18 inches. A soil friction coefficient of 0.35 may be used to calculate frictional resistance at the bottom of foundation, and a passive resistance of 260 pcf may be used in properly compacted fill or dense formational soils, with a lateral daylight distance from the top of foundation of at least 7 feet.

The preceding design pressures assume that there is sufficient drainage behind the walls to prevent the build-up of hydrostatic pressures from surface water infiltration. We recommend that drainage be provided by a composite drainage material such as J-Drain 200/220 and J-Drain SWD or equivalent. No gravel or perforated pipe is used with the J-Drain system. The drain material should terminate 12 inches below the finish surface where the surface is covered by slabs or 18 inches below the finish surface in landscape areas.

Backfill placed behind the walls should be compacted to a minimum degree of compaction of 90 percent using light compaction equipment. If heavy equipment is used, the walls should be appropriately temporarily braced.

10. *Drainage Quality Control*: It must be understood that it is not within the scope of our services to provide quality control oversight for surface or subsurface drainage construction or retaining wall sealing and base of wall drain construction. It is the responsibility of the contractor to verify and provide proper surface drainage at the site at all times and when construction is completed, wall sealing, geofabric installation, protection board (if needed), drain depth below interior floor or yard surface, pipe percent slope to the outlet, etc.

C. General Recommendations

11. *Project Start Up Notification:* In order to minimize any work delays during site development, this firm should be contacted 48 hours prior to any need for observation of footing excavations or field density testing of compacted fill soils. If possible, placement of formwork and steel reinforcement in footing excavations should not occur prior to our observation of the excavations. In the event that our observations reveal the need for deepening or re-designing foundation structures, any formwork or steel reinforcement in the affected footing excavation areas may have to be removed prior to correction of the observed problem (i.e., deepening the footing excavation, recompacting soil in the bottom of the excavation, etc.).

12. *Cal-OSHA*: Where not superseded by specific recommendations presented in this report, trenches, excavations, and temporary slopes at the subject site should be constructed in accordance with Title 8, Construction Safety Orders, issued by Cal-OSHA.

13. *Construction Best Management Practices (BMPs):* Construction BMPs must be implemented in accordance with the requirements of the controlling jurisdiction. At the very least, sufficient BMPs must be installed to prevent silt, mud or other construction debris from being tracked into the adjacent street(s) or storm water conveyance systems due to construction vehicles or any other construction activity. The contractor is responsible for cleaning any such debris that may be in the street at the end of each work day or after a storm event that causes breach in the installed construction BMPs.

    All stockpiles of uncompacted soil and/or building materials that are intended to be left unprotected for a period greater than 7 days are to be provided with erosion and sediment controls. Such soil must be protected each day when the probability of rain is 40% or greater. A concrete washout should be provided on all projects that propose the construction of any concrete improvements that are to be poured in place. All erosion/sediment control devices should be maintained in working order at all times. All slopes that are created or disturbed by construction activity must be protected against erosion and sediment transport at all times. The storage of all construction materials and equipment must be protected against any potential release of pollutants into the environment.

14. *Grading Notes:* ***Geotechnical Exploration, Inc.*** recommends that we be retained to verify the actual soil conditions revealed during site grading work and footing excavations to be as anticipated in this "*Report of Preliminary*

Geotechnical Investigation and Coastal Bluff Edge Evaluation" for the project. In addition, the compaction of any fill soils placed during site grading work must be observed and tested by the soil engineer. It is the responsibility of the grading contractor to comply with the requirements on the grading plans and the local grading ordinance. All retaining wall and trench backfill should be properly compacted. ***Geotechnical Exploration, Inc.*** will assume no liability for damage occurring due to improperly or uncompacted backfill placed without our observation and testing.

XI. SLOPE STABILITY ANALYSIS

Slope stability analysis was performed along cross section A-A' (see Figure No. VII) through the property and coastal bluff. We performed the gross stability calculations using the *SLIDE 6* program by RocScience. This program is a limited equilibrium slope stability program that allows the use of several slope stability methods to calculate the factors of safety against shear failure. On this project, we used the Bishop Simplified method as the basis for calculations when using both circular and a hypothesized block failure surfaces through this geologic cross section. The graphic printouts of our slope stability analyses are provided in Appendix C. For performance of the slope stability analysis, we utilized the following soil strength factors:

	Angle of Internal Friction	***Cohesion***	***Soil Weight***
Existing Fill Soils	32 degrees	150 psf	120 pcf
Point Loma Formation	35 degrees	500 psf	128 pcf

We utilized cross section A-A' for our analysis because of its location through the steepest portion of the slope within the easement where the stairway will be located. We performed our analysis for both static and seismic conditions.

As shown by the printouts provided in Appendix C that address the relevant slope face conditions, neither static or seismic circular or block failure analysis result in a factor of safety below 1.5 out to the existing face of the slope. Bluff recession over a period of 75 years would therefore be limited to our conservatively assigned lower bluff face recession of 5.0 feet in 75 years.

Static and seismic circular and block failure analysis result in the calculated static and seismic setbacks well within the 25-foot bluff edge setback line for the stairway construction. Furthermore, adding 5.0 feet of bluff recession over a period of 75 years to all of the analysis still does not exceed the 25-foot setback.

XII. BLUFF EDGE SUMMARY CONCLUSIONS

Refer to Appendix E, *Coastal Hazard and Wave Run up Analysis,* prepared by Geosoils, Inc., dated September 1, 2022, for the complete analysis. We have listed here the summary conclusions from that report for ease of reference.

- A review of aerial photographs over the last several decades shows about 5 feet of lower bluff retreat over a 69-year period, and no retreat at the base of the bluff below the coastal trail. The pictures do not show measurable movement of the top of the bluff over the 69 years. The large rock beach fronting the site is stable. The mid to upper portions of the trail will not be subject to marine erosion. However, the trail will be a potential surface drainage path and appropriate drainage systems should be part of the project design. While the portion of the bluff seaward at the lowest section (stairs) may be subject to marine erosion, the orientation of this section of stairs (parallel to the shoreline) and setback from the seaward face of the bluff. The lower portion of the trail will not likely be impacted by bluff erosion for several decades. In the future, the trail can adapt to Sea Level Rise (SLR) hazards by simply moving the sections of the trail/stairs that are impacted as needed.

- The lower portions of the trail may be subject to wave runup attack after construction and in the future, in consideration of SLR. The lower section of stairs should be designed in consideration of broken wave forces provided herein. The back beach shows no signs of marine erosion and the beach erosion will likely not increase due to SLR because of the large, immobile, rocks that make up the beach.

- The majority of the proposed coastal trail is above the impact of coastal hazards (above elevation ~+20 feet NGVD29) including a ~5-foot sea level rise over the life.

- No protective devices will be necessary to protect the proposed development from any existing or anticipated future coastal hazards over the life.

Based upon the analysis and discussion herein, the proposed development is reasonably safe from coastal hazards for the next 75 years including shoreline movement, erosion, wave runup, and flooding with future SLR. The proposed stairway construction will neither create nor contribute significantly to erosion, geologic instability, or destruction of the site or adjacent area. There are no recommendations necessary for shore protection.

As is the case with all bluff top construction projects, all surface water drainage systems must include the collection and transmission of collected water to street discharge. *No surface water flow should be allowed over the top of the bluff.*

XIII. LIMITATIONS

Our conclusions and recommendations have been based on available data obtained from our field investigation and laboratory analysis, as well as our experience with similar soils and formational materials located in this area of San Diego. Of necessity, we must assume a certain degree of continuity between exploratory excavations and/or natural exposures. It is, therefore, necessary that all observations, conclusions, and recommendations be verified at the time footing excavations are placed. In the event discrepancies are noted, additional recommendations may be issued, if required.

The work performed and recommendations presented herein are the result of an investigation and analysis that meet the contemporary standard of care in our profession within the County of San Diego. No warranty is provided.

This report should be considered valid for a period of two (2) years, and is subject to review by our firm following that time. If significant modifications are made to the building plans, especially with respect to the height and location of any proposed structures, this report must be presented to us for immediate review and possible revision.

It is the responsibility of the owner and/or developer to ensure that the recommendations summarized in this report are carried out in the field operations and that our recommendations for design of this project are incorporated in the structural plans. We should be retained to review the project plans once they are available to verify that our recommendations are adequately incorporated in the plans.

This firm does not practice or consult in the field of safety engineering. We do not direct the contractor's operations, and we cannot be responsible for the safety of personnel other than our own; the safety of others is the responsibility of the contractor. The contractor should notify the owner if any of the recommended actions presented herein are considered to be unsafe.

The firm of ***Geotechnical Exploration, Inc.*** shall not be held responsible for changes to the physical condition of the property, such as addition of fill soils or changing drainage patterns, which occur subsequent to issuance of this report and the changes are made without our observations, testing, and approval.

Once again, should any questions arise concerning this report, please feel free to contact the undersigned. Reference to our **Job No. 22-13797** will expedite a reply to your inquiries.

Respectfully submitted,

GEOTECHNICAL EXPLORATION, INC.

Leslie D. Reed, President
C.E.G. 999/R.G. 3391

Jaime A. Cerros, P.E.
R.C.E. 34422/G.E. 2007
Senior Geotechnical Engineer

Jay K. Heiser
Senior Project Geologist

PROFESSIONAL GEOLOGIST
LESLIE D. REED
No. 999
Exp. 3/31/25
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER
JAIME A. CERROS
GE 2007
EXP. 9/30/25
GEOTECHNICAL
STATE OF CALIFORNIA

REFERENCES
JOB NO. 22-13797
September 2023

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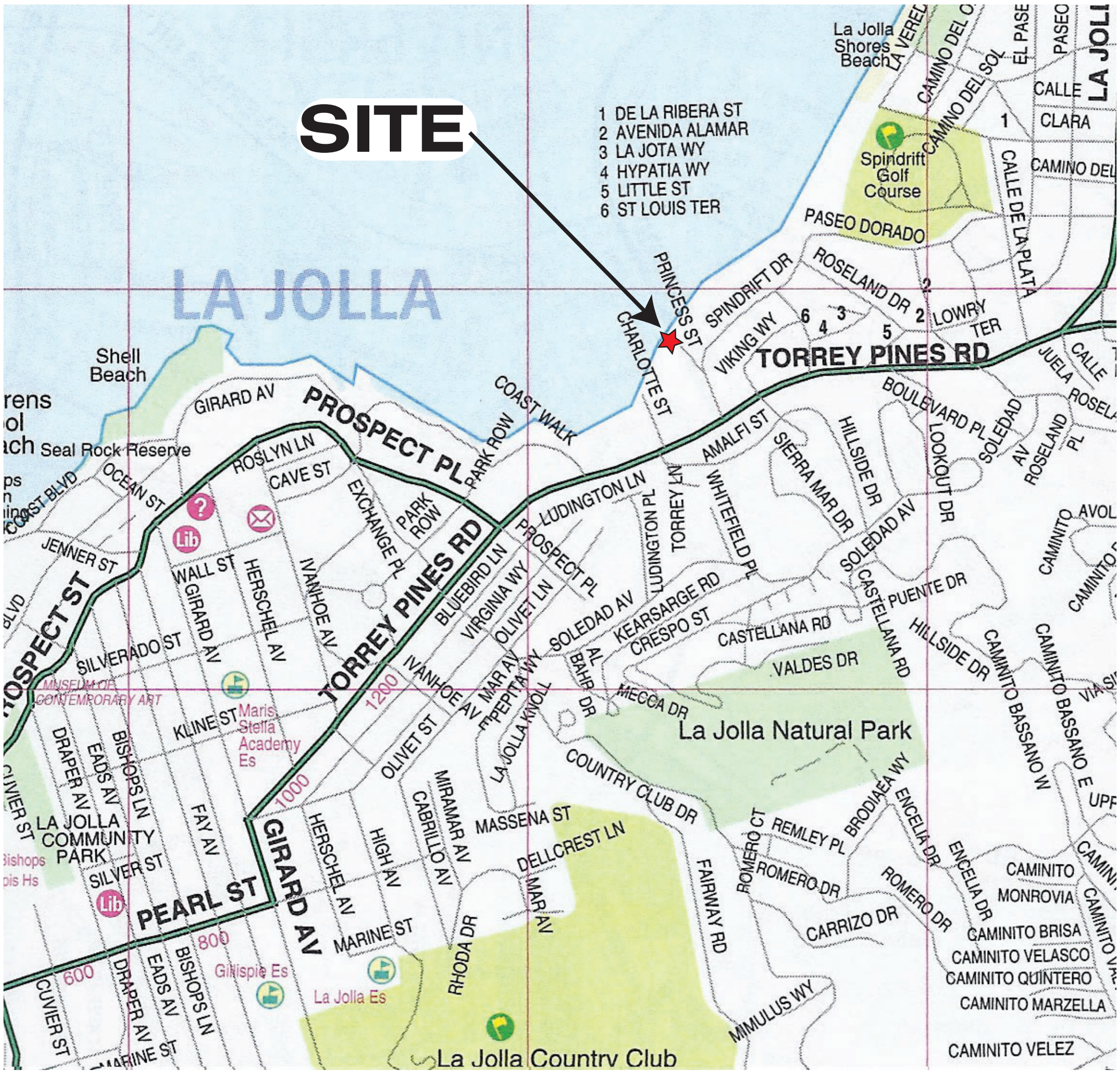
VICINITY MAP

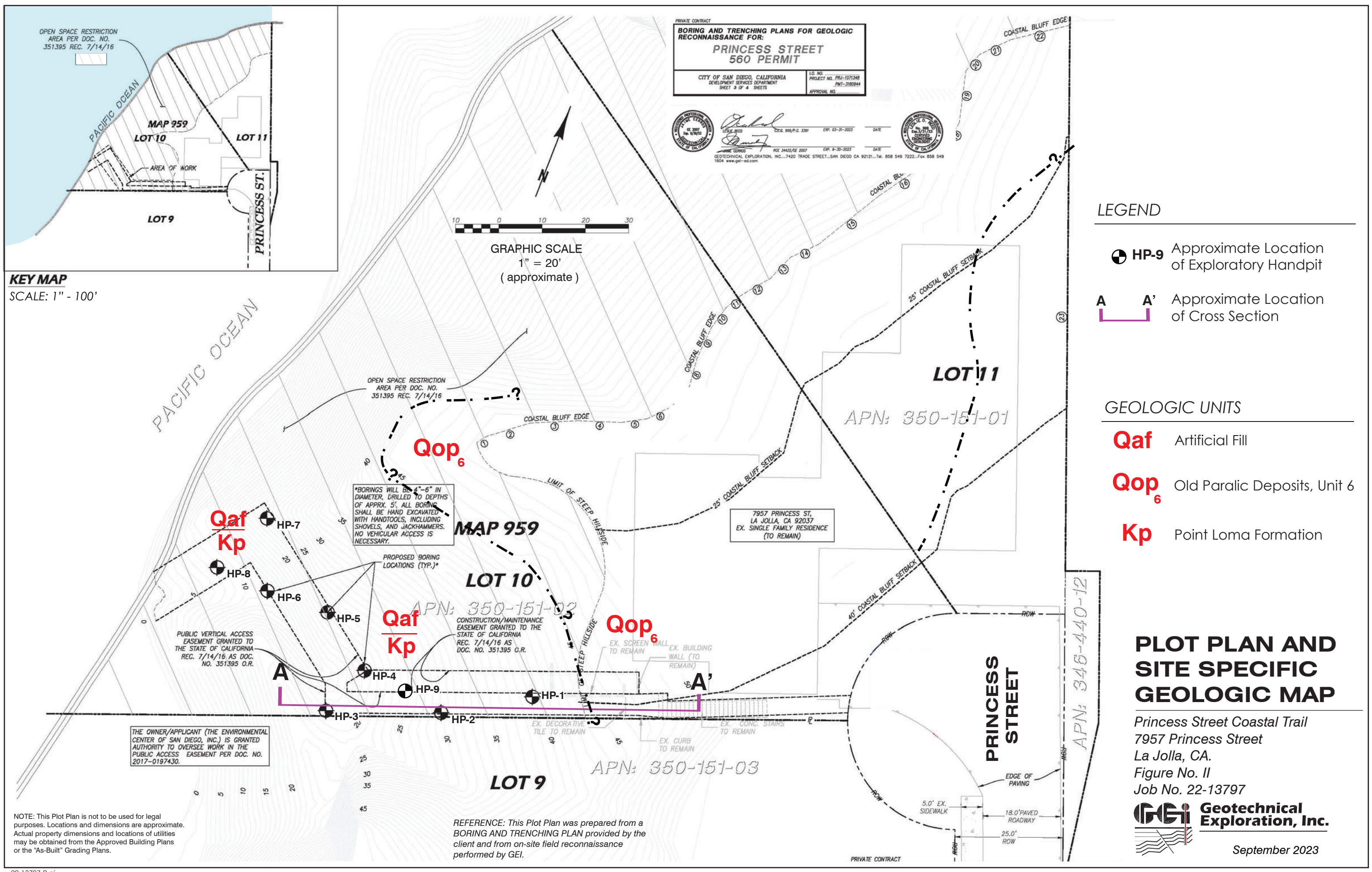


Thomas Bros. Guide San Diego County, pg 1227-G5

Princess Street Coastal Trail
7957 Princess Street
La Jolla, CA.

Figure No. I
Job No. 22-13797

Geotechnical Exploration, Inc.



KEY MAP
SCALE: 1" - 100'
OPEN SPACE RESTRICTION AREA PER DOC. NO. 351395 REC. 7/14/16
PACIFIC OCEAN
MAP 959
LOT 10
LOT 11
AREA OF WORK
LOT 9
PRINCESS ST.
BORING AND TRENCHING PLANS FOR GEOLOGIC RECONNAISSANCE FOR:
PRINCESS STREET 560 PERMIT
CITY OF SAN DIEGO, CALIFORNIA
N
GRAPHIC SCALE
1" = 20'
(approximate)
LEGEND
HP-9 Approximate Location of Exploratory Handpit
A A' Approximate Location of Cross Section
GEOLOGIC UNITS
Qaf Artificial Fill
Qop6 Old Paralic Deposits, Unit 6
Kp Point Loma Formation
COASTAL BLUFF EDGE
25' COASTAL BLUFF SETBACK
40' COASTAL BLUFF SETBACK
LIMIT OF STEEP HILLSIDE
APN: 350-151-01
APN: 350-151-02
APN: 350-151-03
APN: 346-440-12
LOT 11
LOT 10
LOT 9
MAP 959
Qop6
Qaf/Kp
HP-1
HP-2
HP-3
HP-4
HP-5
HP-6
HP-7
HP-8
HP-9
A
A'
*BORINGS WILL BE 4"-6" IN DIAMETER, DRILLED TO DEPTHS OF APPRX. 5'. ALL BORINGS SHALL BE HAND EXCAVATED WITH HANDTOOLS, INCLUDING SHOVELS, AND JACKHAMMERS. NO VEHICULAR ACCESS IS NECESSARY.
PROPOSED BORING LOCATIONS (TYP.)*
PUBLIC VERTICAL ACCESS EASEMENT GRANTED TO THE STATE OF CALIFORNIA REC. 7/14/16 AS DOC. NO. 351395 O.R.
CONSTRUCTION/MAINTENANCE EASEMENT GRANTED TO THE STATE OF CALIFORNIA REC. 7/14/16 AS DOC. NO. 351395 O.R.
THE OWNER/APPLICANT (THE ENVIRONMENTAL CENTER OF SAN DIEGO, INC.) IS GRANTED AUTHORITY TO OVERSEE WORK IN THE PUBLIC ACCESS EASEMENT PER DOC. NO. 2017-0197430.
7957 PRINCESS ST, LA JOLLA, CA 92037 EX. SINGLE FAMILY RESIDENCE (TO REMAIN)
EX. SCREEN WALL TO REMAIN
EX. BUILDING WALL (TO REMAIN)
EX. DECORATIVE TILE TO REMAIN
EX. CURB TO REMAIN
EX. CONC. STAIRS TO REMAIN
PRINCESS STREET
EDGE OF PAVING
5.0' EX. SIDEWALK
18.0' PAVED ROADWAY
25.0' ROW
PRIVATE CONTRACT
NOTE: This Plot Plan is not to be used for legal purposes. Locations and dimensions are approximate. Actual property dimensions and locations of utilities may be obtained from the Approved Building Plans or the "As-Built" Grading Plans.
REFERENCE: This Plot Plan was prepared from a BORING AND TRENCHING PLAN provided by the client and from on-site field reconnaissance performed by GEI.
PLOT PLAN AND SITE SPECIFIC GEOLOGIC MAP
Princess Street Coastal Trail
7957 Princess Street
La Jolla, CA.
Figure No. II
Job No. 22-13797
Geotechnical Exploration, Inc.
September 2023

22-13797-P.ai

EQUIPMENT	DIMENSION & TYPE OF EXCAVATION	DATE LOGGED
Hand Tools	**2' X 2' X 4' Handpit**	**7-11-23**
SURFACE ELEVATION	GROUNDWATER/ SEEPAGE DEPTH	LOGGED BY
± 47' Mean Sea Level	**Not Encountered**	**JKH**

DEPTH (feet)	SYMBOL	SAMPLE	FIELD DESCRIPTION AND CLASSIFICATION — DESCRIPTION AND REMARKS (Grain size, Density, Moisture, Color)	U.S.C.S.	IN-PLACE MOISTURE (%)	IN-PLACE DRY DENSITY (pcf)	OPTIMUM MOISTURE (%)	MAXIMUM DRY DENSITY (pcf)	DENSITY (% of M.D.D.)	EXPAN. + CONSOL. - (%)	BLOW COUNTS/FT.	SAMPLE O.D. (INCHES)
0–3			**CLAYEY SAND** , with roots and rock fragments. Loose to medium dense. Damp. Light brown. **FILL (Qaf)**	SC								
		1	-- 34% passing #200 sieve.		8.4							
3–4		1	**CLAYSTONE** , with silty/sandy claystone fragments; highly fractured. Firm. Damp. Dark gray and orange. **POINT LOMA FORMATION (Kp)** -- 86% passing #200 sieve.	CL	14.3							
			Bottom @ 4'									

EXPLORATION LOG 13798 PRINCESS.GPJ GEO_EXPL.GDT 9/19/23

- PERCHED WATER TABLE
- BULK BAG SAMPLE
- IN-PLACE SAMPLE
- MODIFIED CALIFORNIA SAMPLE
- NUCLEAR FIELD DENSITY TEST
- STANDARD PENETRATION TEST

JOB NAME
Princess Street Coastal Trail

SITE LOCATION
7957 Princess Street, La Jolla, CA

JOB NUMBER	REVIEWED BY	LOG No.
22-13797	**LDR/JAC**	**HP-1**
FIGURE NUMBER **IIIa**	Geotechnical Exploration, Inc.	

EQUIPMENT	DIMENSION & TYPE OF EXCAVATION	DATE LOGGED
Hand Tools	**2' X 2' X 5.5' Handpit**	**7-11-23**
SURFACE ELEVATION	GROUNDWATER/ SEEPAGE DEPTH	LOGGED BY
± 38' Mean Sea Level	**Not Encountered**	**JKH**

DEPTH (feet)	SYMBOL	SAMPLE	FIELD DESCRIPTION AND CLASSIFICATION — DESCRIPTION AND REMARKS (Grain size, Density, Moisture, Color)	U.S.C.S.	IN-PLACE MOISTURE (%)	IN-PLACE DRY DENSITY (pcf)	OPTIMUM MOISTURE (%)	MAXIMUM DRY DENSITY (pcf)	DENSITY (% of M.D.D.)	EXPAN. + CONSOL. - (%)	BLOW COUNTS/FT.	SAMPLE O.D. (INCHES)
0			**CLAYEY SAND** , with some roots and abundant claystone fragments. Loose. Damp. Light brown. **FILL/ SLOPEWASH (Qaf/Qsw)**	SC								
1–2		1	-- 91% passing #200 sieve.		10.5							
2.5			**CLAYSTONE** , with silty/sandy claystone fragments; highly fractured. Firm. Damp. Dark gray and orange. **POINT LOMA FORMATION (Kp)** Hand auger from 2.5'- 5.5'.	CL								
4.5			-- silty sandstone lenses.									
5.5			Bottom @ 5.5'									

Depth scale: 1, 2, 3, 4, 5, 6, 7

▼	PERCHED WATER TABLE
☒	BULK BAG SAMPLE
1	IN-PLACE SAMPLE
■	MODIFIED CALIFORNIA SAMPLE
S	NUCLEAR FIELD DENSITY TEST
▨	STANDARD PENETRATION TEST

JOB NAME		
Princess Street Coastal Trail		
SITE LOCATION		
7957 Princess Street, La Jolla, CA		
JOB NUMBER **22-13797**	REVIEWED BY **LDR/JAC**	LOG No. **HP-2**
FIGURE NUMBER **IIIb**	Geotechnical Exploration, Inc.	

EXPLORATION LOG 13798 PRINCESS.GPJ GEO_EXPL.GDT 9/19/23

EQUIPMENT	DIMENSION & TYPE OF EXCAVATION	DATE LOGGED
Hand Tools	**2' X 2' X 4' Handpit**	**7-11-23**
SURFACE ELEVATION	GROUNDWATER/ SEEPAGE DEPTH	LOGGED BY
± 20' Mean Sea Level	**Not Encountered**	**JKH**

DEPTH (feet)	SYMBOL	SAMPLE	FIELD DESCRIPTION AND CLASSIFICATION: DESCRIPTION AND REMARKS (Grain size, Density, Moisture, Color)	U.S.C.S.	IN-PLACE MOISTURE (%)	IN-PLACE DRY DENSITY (pcf)	OPTIMUM MOISTURE (%)	MAXIMUM DRY DENSITY (pcf)	DENSITY (% of M.D.D.)	EXPAN. + CONSOL. - (%)	EXPANSION INDEX	BLOW COUNTS/FT.	SAMPLE O.D. (INCHES)
0			**SILTY/SANDY CLAYSTONE** , highly fractured. Firm. Damp. Dark gray and orange. **POINT LOMA FORMATION (Kp)**	CL									
1.5–2		Bulk bag sample					13.8	117.8			32		
2–2.5		Modified California sample	-- 81% passing #200 sieve.		8.6	102.3			87				
			-- vertical fractures (70°-80°).										
4			Excavation refusal on sandstone. Bottom @ 4'										

EXPLORATION LOG 13798 PRINCESS.GPJ GEO_EXPL.GDT 9/19/23

Legend:
- PERCHED WATER TABLE
- BULK BAG SAMPLE
- IN-PLACE SAMPLE
- MODIFIED CALIFORNIA SAMPLE
- NUCLEAR FIELD DENSITY TEST
- STANDARD PENETRATION TEST

JOB NAME	**Princess Street Coastal Trail**
SITE LOCATION	**7957 Princess Street, La Jolla, CA**
JOB NUMBER	**22-13797**
FIGURE NUMBER	**IIIc**
REVIEWED BY	**LDR/JAC**
LOG No.	**HP-3**

Geotechnical Exploration, Inc.

EQUIPMENT	DIMENSION & TYPE OF EXCAVATION	DATE LOGGED
Hand Tools	**2' X 2' X 5' Handpit**	**7-11-23**
SURFACE ELEVATION	GROUNDWATER/ SEEPAGE DEPTH	LOGGED BY
± 23' Mean Sea Level	**Not Encountered**	**JKH**

DEPTH (feet)	SYMBOL	SAMPLE	FIELD DESCRIPTION AND CLASSIFICATION: DESCRIPTION AND REMARKS (Grain size, Density, Moisture, Color)	U.S.C.S.	IN-PLACE MOISTURE (%)	IN-PLACE DRY DENSITY (pcf)	OPTIMUM MOISTURE (%)	MAXIMUM DRY DENSITY (pcf)	DENSITY (% of M.D.D.)	EXPAN. + CONSOL. - (%)	BLOW COUNTS/FT.	SAMPLE O.D. (INCHES)
0–4			**SANDY/SILTY CLAY** , with some roots and rock fragments. Soft to firm. Damp. Light gray. **FILL/ SLOPEWASH (Qaf/Qsw)**	CL/SC								
4–5		1	**SILTY SAND** , fine- to medium-grained; poorly cemented. Medium dense. Damp. Light brown. **POINT LOMA FORMATION (Kp)** -- 21% passing #200 sieve.	SM	8.9							
			Bottom @ 5'									

Depth scale: 1, 2, 3, 4, 5, 6

EXPLORATION LOG 13798 PRINCESS.GPJ GEO_EXPL.GDT 9/19/23

▼ PERCHED WATER TABLE

☒ BULK BAG SAMPLE

[1] IN-PLACE SAMPLE

■ MODIFIED CALIFORNIA SAMPLE

[S] NUCLEAR FIELD DENSITY TEST

▨ STANDARD PENETRATION TEST

JOB NAME		
Princess Street Coastal Trail		
SITE LOCATION		
7957 Princess Street, La Jolla, CA		
JOB NUMBER **22-13797**	REVIEWED BY **LDR/JAC**	LOG No. **HP-4**
FIGURE NUMBER **IIId**	Geotechnical Exploration, Inc.	

EQUIPMENT	DIMENSION & TYPE OF EXCAVATION	DATE LOGGED
Hand Tools	**2' X 2' X 4' Handpit**	**7-11-23**
SURFACE ELEVATION	GROUNDWATER/ SEEPAGE DEPTH	LOGGED BY
± 19' Mean Sea Level	**Not Encountered**	**JKH**

DEPTH (feet)	SYMBOL	SAMPLE	FIELD DESCRIPTION AND CLASSIFICATION: DESCRIPTION AND REMARKS (Grain size, Density, Moisture, Color)	U.S.C.S.	IN-PLACE MOISTURE (%)	IN-PLACE DRY DENSITY (pcf)	OPTIMUM MOISTURE (%)	MAXIMUM DRY DENSITY (pcf)	DENSITY (% of M.D.D.)	EXPAN. + CONSOL. - (%)	BLOW COUNTS/FT.	SAMPLE O.D. (INCHES)
0–1			**CLAYEY SAND** , with some roots and claystone fragments. Loose. Damp. Light brown. **FILL/ SLOPEWASH (Qaf/Qsw)**	SC								
1			**CLAYSTONE** , with claystone fragments; highly fractured. Firm. Damp. Dark gray and orange. **POINT LOMA FORMATION (Kp)**	CL								
2		1	-- 69% passing #200 sieve.		13.4							
4		2	-- 31% passing #200 sieve.		12.7							
4			Excavation refusal on sandstone. Bottom @ 4'									
5												

PERCHED WATER TABLE
BULK BAG SAMPLE
1 IN-PLACE SAMPLE
MODIFIED CALIFORNIA SAMPLE
S NUCLEAR FIELD DENSITY TEST
STANDARD PENETRATION TEST

JOB NAME: **Princess Street Coastal Trail**		
SITE LOCATION: **7957 Princess Street, La Jolla, CA**		
JOB NUMBER: **22-13797**	REVIEWED BY: **LDR/JAC**	LOG No. **HP-5**
FIGURE NUMBER: **IIIe**	Geotechnical Exploration, Inc.	

EQUIPMENT	DIMENSION & TYPE OF EXCAVATION	DATE LOGGED
Hand Tools	**2' X 2' X 2' Handpit**	**7-11-23**
SURFACE ELEVATION	GROUNDWATER/ SEEPAGE DEPTH	LOGGED BY
± 17' Mean Sea Level	**Not Encountered**	**JKH**

DEPTH (feet)	SYMBOL	SAMPLE	FIELD DESCRIPTION AND CLASSIFICATION — DESCRIPTION AND REMARKS (Grain size, Density, Moisture, Color)	U.S.C.S.	IN-PLACE MOISTURE (%)	IN-PLACE DRY DENSITY (pcf)	OPTIMUM MOISTURE (%)	MAXIMUM DRY DENSITY (pcf)	DENSITY (% of M.D.D.)	EXPAN. + CONSOL. - (%)	BLOW COUNTS/FT.	SAMPLE O.D. (INCHES)
0–1			**CLAYEY SAND**, with some roots, cobbles and rock fragments. Loose. Damp. Light brown. **FILL/ SLOPEWASH (Qaf/Qsw)**	SC								
1–2		1	**SANDSTONE**, fine- to medium-grained; well cemented. Dense. Damp. Yellow-brown. **POINT LOMA FORMATION (Kp)** Excavation refusal on sandstone. -- 17% passing #200 sieve.	SM	7.4							
2			Bottom @ 2'									
3												
4												

EXPLORATION LOG 13798 PRINCESS.GPJ GEO_EXPL.GDT 9/19/23

- PERCHED WATER TABLE
- BULK BAG SAMPLE
- 1 IN-PLACE SAMPLE
- MODIFIED CALIFORNIA SAMPLE
- S NUCLEAR FIELD DENSITY TEST
- STANDARD PENETRATION TEST

JOB NAME	**Princess Street Coastal Trail**
SITE LOCATION	**7957 Princess Street, La Jolla, CA**
JOB NUMBER	**22-13797**
FIGURE NUMBER	**IIIf**
REVIEWED BY	**LDR/JAC**
LOG No.	**HP-6**

Geotechnical Exploration, Inc.

EQUIPMENT	DIMENSION & TYPE OF EXCAVATION	DATE LOGGED
Hand Tools	**2' X 2' X 2' Handpit**	**7-11-23**
SURFACE ELEVATION	GROUNDWATER/ SEEPAGE DEPTH	LOGGED BY
± 15' Mean Sea Level	**Not Encountered**	**JKH**

DEPTH (feet)	SYMBOL	SAMPLE	FIELD DESCRIPTION AND CLASSIFICATION — DESCRIPTION AND REMARKS (Grain size, Density, Moisture, Color)	U.S.C.S.	IN-PLACE MOISTURE (%)	IN-PLACE DRY DENSITY (pcf)	OPTIMUM MOISTURE (%)	MAXIMUM DRY DENSITY (pcf)	DENSITY (% of M.D.D.)	EXPAN. + CONSOL. - (%)	BLOW COUNTS/FT.	SAMPLE O.D. (INCHES)
0–0.5			**CLAYEY SAND**, with some roots, cobbles and rock fragments. Loose. Damp. Light brown. **FILL/ SLOPEWASH (Qaf/Qsw)**	SC								
0.5–2			**SANDSTONE**, fine- to medium-grained; well cemented. Dense. Damp. Yellow-brown. **POINT LOMA FORMATION (Kp)**	SM								
2			Excavation refusal on sandstone. Bottom @ 2'									

Depth scale: 1, 2, 3, 4

EXPLORATION LOG 13798 PRINCESS.GPJ GEO_EXPL.GDT 9/19/23

- PERCHED WATER TABLE
- BULK BAG SAMPLE
- IN-PLACE SAMPLE
- MODIFIED CALIFORNIA SAMPLE
- NUCLEAR FIELD DENSITY TEST
- STANDARD PENETRATION TEST

JOB NAME: **Princess Street Coastal Trail**

SITE LOCATION: **7957 Princess Street, La Jolla, CA**

JOB NUMBER: **22-13797**

REVIEWED BY: **LDR/JAC**

Geotechnical Exploration, Inc.

FIGURE NUMBER: **IIIg**

LOG No. **HP-7**

EQUIPMENT	DIMENSION & TYPE OF EXCAVATION	DATE LOGGED
Hand Tools	**2' X 2' X 2' Handpit**	**7-11-23**
SURFACE ELEVATION	GROUNDWATER/ SEEPAGE DEPTH	LOGGED BY
± 15' Mean Sea Level	**Not Encountered**	**JKH**

DEPTH (feet)	SYMBOL	SAMPLE	FIELD DESCRIPTION AND CLASSIFICATION — DESCRIPTION AND REMARKS (Grain size, Density, Moisture, Color)	U.S.C.S.	IN-PLACE MOISTURE (%)	IN-PLACE DRY DENSITY (pcf)	OPTIMUM MOISTURE (%)	MAXIMUM DRY DENSITY (pcf)	DENSITY (% of M.D.D.)	EXPAN. + CONSOL. - (%)	BLOW COUNTS/FT.	SAMPLE O.D. (INCHES)
0–1			**CLAYEY SAND** , with some roots, cobbles and rock fragments. Loose. Damp. Light brown. **FILL/ SLOPEWASH (Qaf/Qsw)** Contact varies from 6"- 12".	SC								
1–2			**SANDSTONE** , fine- to medium-grained; well cemented. Dense. Damp. Yellow-brown. **POINT LOMA FORMATION (Kp)**	SM								
2			Excavation refusal on sandstone. Bottom @ 2'									
3												
4												

- PERCHED WATER TABLE
- BULK BAG SAMPLE
- IN-PLACE SAMPLE
- MODIFIED CALIFORNIA SAMPLE
- NUCLEAR FIELD DENSITY TEST
- STANDARD PENETRATION TEST

JOB NAME		
Princess Street Coastal Trail		
SITE LOCATION		
7957 Princess Street, La Jolla, CA		
JOB NUMBER: **22-13797**	REVIEWED BY: **LDR/JAC**	LOG No.
FIGURE NUMBER: **IIIh**	Geotechnical Exploration, Inc.	**HP-8**

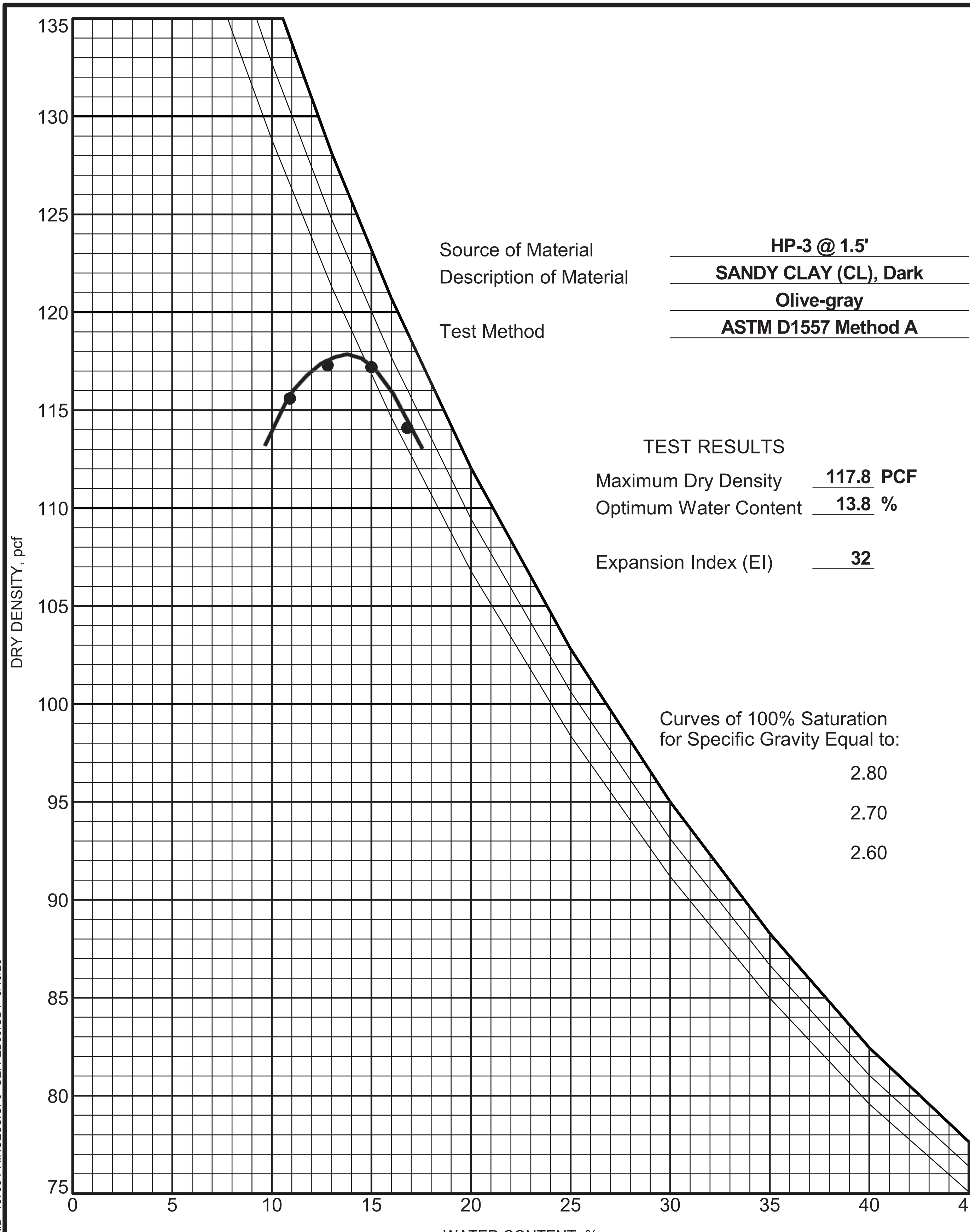
EQUIPMENT	DIMENSION & TYPE OF EXCAVATION	DATE LOGGED
Hand Tools	2' X 2' X 4' Handpit	7-11-23
SURFACE ELEVATION	GROUNDWATER/ SEEPAGE DEPTH	LOGGED BY
± 23' Mean Sea Level	Not Encountered	JKH

DEPTH (feet)	SYMBOL	SAMPLE	FIELD DESCRIPTION AND CLASSIFICATION — DESCRIPTION AND REMARKS (Grain size, Density, Moisture, Color)	U.S.C.S.	IN-PLACE MOISTURE (%)	IN-PLACE DRY DENSITY (pcf)	OPTIMUM MOISTURE (%)	MAXIMUM DRY DENSITY (pcf)	DENSITY (% of M.D.D.)	EXPAN. + CONSOL. - (%)	BLOW COUNTS/FT.	SAMPLE O.D. (INCHES)
0–1			**CLAYEY SAND** , with some roots and claystone fragments. Loose. Dry. Light brown. **FILL (Qaf)**	SC								
1–4		Modified California sample (2–2.5)	**CLAYSTONE** , with some iron oxide staining; highly fractured. Firm. Damp. Dark gray and orange. **POINT LOMA FORMATION (Kp)**	CL								
4			Bottom @ 4'									
5												

PERCHED WATER TABLE
BULK BAG SAMPLE
IN-PLACE SAMPLE
MODIFIED CALIFORNIA SAMPLE
NUCLEAR FIELD DENSITY TEST
STANDARD PENETRATION TEST

JOB NAME		
Princess Street Coastal Trail		
SITE LOCATION		
7957 Princess Street, La Jolla, CA		
JOB NUMBER 22-13797	REVIEWED BY LDR/JAC	LOG No.
FIGURE NUMBER IIIi	Geotechnical Exploration, Inc.	**HP-9**

EXPLORATION LOG 13798 PRINCESS.GPJ GEO_EXPL.GDT 9/19/23



Source of Material: HP-3 @ 1.5'
Description of Material: SANDY CLAY (CL), Dark Olive-gray
Test Method: ASTM D1557 Method A

TEST RESULTS

Maximum Dry Density 117.8 PCF
Optimum Water Content 13.8 %

Expansion Index (EI) 32

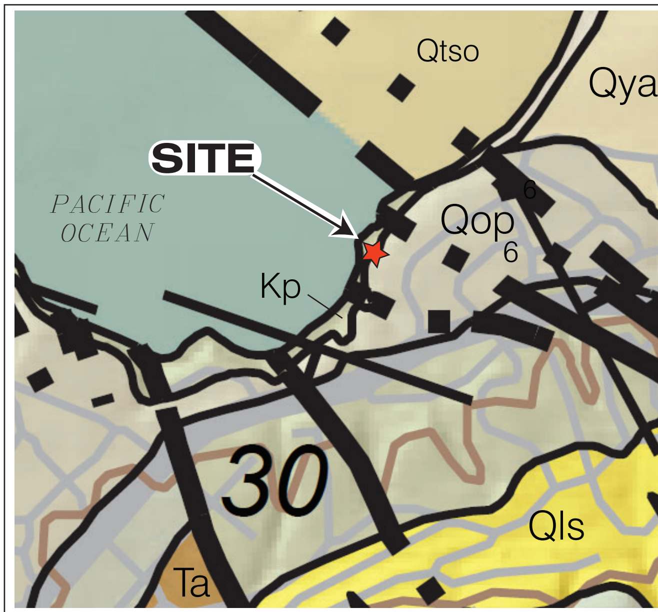
Curves of 100% Saturation for Specific Gravity Equal to:
2.80
2.70
2.60

COMPACTION + EI DARK GRID 13798 PRINCESS.GPJ GEI FEB06.GDT 9/19/23

Geotechnical Exploration, Inc.

MOISTURE-DENSITY RELATIONSHIP

Figure Number: IV
Job Name: Princess Street Coastal Trail
Site Location: 7957 Princess Street, La Jolla, CA
Job Number: 22-13797



Princess Street Coastal Trail
7957 Princess Street
La Jolla, CA.

Base Map

Onshore base (hypsography, hydrography, and transportation) from U.S.G.S. digital line graph (DLG) data, San Diego 30' x 60' metric quadrangle. Shaded topographic base from U.S.G.S. digital elevation models (DEM's). Offshore bathymetric contours and shaded bathymetry from N.O.A.A. single and multibeam data. Projection is UTM, zone 11, North American Datum 1927.

This map was funded in part by the U.S. Geological Survey National Cooperative Geologic Mapping Program, STATEMAP Award no. 98HQAG2049.

Prepared in cooperation with the U.S. Geological Survey, Southern California Areal Mapping Project.

EXCERPT FROM

GEOLOGIC MAP OF THE SAN DIEGO 30' x 60' QUADRANGLE, CALIFORNIA

By

Michael P. Kennedy[1] and Siang S. Tan[1]

2008

Digital preparation by

Kelly R. Bovard[2], Anne G. Garcia[2], Diane Burns[2], and Carlos I. Gutierrez[1]

1. Department of Conservation, California Geological Survey
2. U.S. Geological Survey, Department of Earth Sciences, University of California, Riverside

ONSHORE MAP SYMBOLS

Contact - Contact between geologic units; dotted where concealed.

70 U D Fault - Solid where accurately located; dashed where approximately located; dotted where concealed. U = upthrown block, D = downthrown block. Arrow and number indicate direction and angle of dip of fault plane.

Anticline - Solid where accurately located; dashed where approximately located; dotted where concealed. Arrow indicates direction of axial plunge.

Syncline - Solid where accurately located; dotted where concealed Arrow indicates direction of axial plunge.

Qls? Landslide - Arrows indicate principal direction of movement. Quired where existence is questionable

Strike and dip of beds

70 Inclined

Strike and dip of igneous joints

60 Inclined

Strike and dip of metamorphic foliation

55 Inclined

DESCRIPTION OF MAP UNITS

Qya	Young Alluvial Flood Plain Deposits
Qop_6	Old Paralic Deposits, Unit 6
Qtso	Undivided sediments and sedimentary rocks in offshore region
Ta	Ardath Shale
Kp	Point Loma Formation

Figure No. V
Job No. 22-13797

Geotechnical Exploration, Inc.

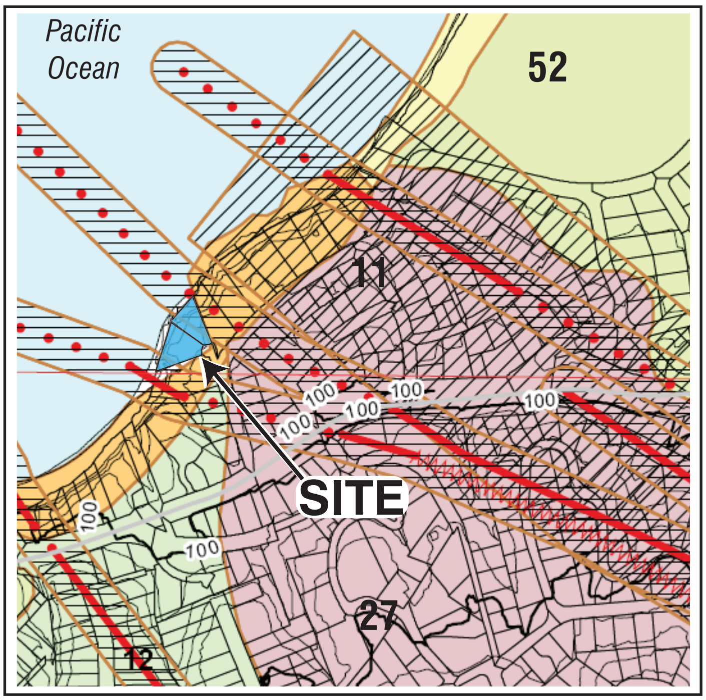
September 2023

PRINCESS-ST-TRAIL-GEO.ai

Geologic Hazards Map Excerpt from City of San Diego Geologic Hazards and Fault Map Sheet 29

Development Services Department

DATE: 4/3/2008



Princess Street Coastal Trail
7957 Princess Street
La Jolla, CA.

LEGEND

Geologic Hazard Categories

FAULT ZONES

- 11 Active, Alquist-Priolo Earthquake Fault Zone
- 12 Potentially Active, Inactive, Presumed Inactive, or Activity Unknown
- 13 Downtown special fault zone

LANDSLIDES

- 21 Confirmed, known, or highly suspected
- 22 Possible or conjectured

SLIDE-PRONE FORMATIONS

- 23 Friars: neutral or favorable geologic structure
- 24 Friars: unfavorable geologic structure
- 25 Ardath: neutral or favorable geologic structure
- 26 Ardath: unfavorable geologic structure
- 27 Otay, Sweetwater, and others

LIQUEFACTION

- 31 High Potential -- shallow groundwater major drainages, hydraulic fills
- 32 Low Potential -- fluctuating groundwater minor drainages

COASTAL BLUFFS

- 41 Generally unstable Numerous landslides, high steep bluffs, severe erosion, unfavorable geologic structure
- 42 Generally unstable Unfavorable bedding plains, high erosion
- 43 Generally unstable Unfavorable jointing, local high erosion
- 44 Moderately stable Mostly stable formations, local high erosion
- 45 Moderately stable Some minor landslides, minor erosion
- 46 Moderately stable Some unfavorable geologic structure, minor or no erosion
- 47 Generally stable Favorable geologic structure, minor or no erosion, no landslides
- 48 Generally stable Broad beach areas, developed harbor

OTHER TERRAIN

- 51 Level mesas -- underlain by terrace deposits and bedrock nominal risk
- 52 Other level areas, gently sloping to steep terrain, favorable geologic structure, Low risk
- 53 Level or sloping terrain, unfavorable geologic structure, Low to moderate risk
- 54 Steeply sloping terrain, unfavorable or fault controlled geologic structure, Moderate risk
- 55 Modified terrain (graded sites) Nominal risk

Water (Bays and Lakes)

FAULTS

- Fault
- Inferred Fault
- Concealed Fault
- Shear Zone

Figure No. VI
Job No. 22-13797

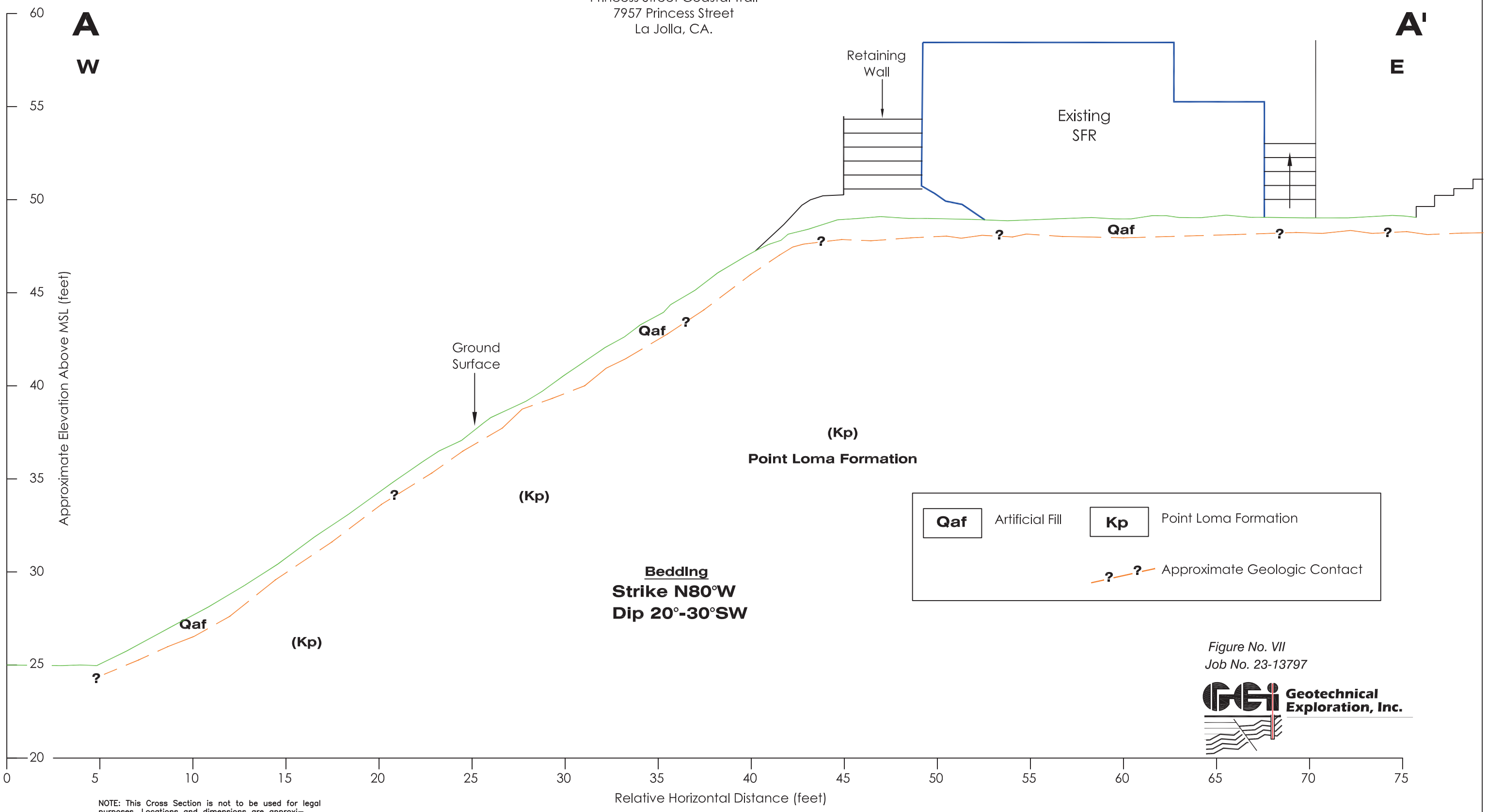
Geotechnical Exploration, Inc.

September 2023

22-13797-VI.ai

GEOLOGIC CROSS SECTION A-A'

Princess Street Coastal Trail
7957 Princess Street
La Jolla, CA.



Scale: 1" = 5'
(Horizontal and Vertical)

Figure No. VII
Job No. 23-13797

Geotechnical Exploration, Inc.

NOTE: This Cross Section is not to be used for legal purposes. Locations and dimensions are approximate. Actual property dimensions and locations of utilities may be obtained from the Approved Building Plans or the "As-Built" Grading Plans.

23-13797-AA.dwg

September 2023

APPENDIX A
UNIFIED SOIL CLASSIFICATION SYSTEM (U.S.C.S.)
SOIL DESCRIPTION

Coarse-grained (More than half of material is larger than a No. 200 sieve)

GRAVELS, CLEAN GRAVELS (More than half of coarse fraction is larger than No. 4 sieve size, but smaller than 3")	GW	Well-graded gravels, gravel and sand mixtures, little or no fines.
	GP	Poorly graded gravels, gravel and sand mixtures, little or no fines.
GRAVELS WITH FINES	GC	Clay gravels, poorly graded gravel-sand-silt mixtures
SANDS, CLEAN SANDS (More than half of coarse fraction is smaller than a No. 4 sieve)	SW	Well-graded sand, gravelly sands, little or no fines
	SP	Poorly graded sands, gravelly sands, little or no fines.
SANDS WITH FINES	SM	Silty sands, poorly graded sand and silty mixtures.
	SC	Clayey sands, poorly graded sand and clay mixtures.

Fine-grained (More than half of material is smaller than a No. 200 sieve)

SILTS AND CLAYS

Liquid Limit Less than 50	ML	Inorganic silts and very fine sands, rock flour, sandy silt and clayey-silt sand mixtures with a slight plasticity
	CL	Inorganic clays of low to medium plasticity, gravelly clays, silty clays, lean clays.
	OL	Organic silts and organic silty clays of low plasticity.
Liquid Limit Greater than 50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
	CH	Inorganic clays of high plasticity, fat clays.
	OH	Organic clays of medium to high plasticity.
HIGHLY ORGANIC SOILS	PT	Peat and other highly organic soils

APPENDIX B

REGIONAL GEOLOGIC DESCRIPTION

In the Coastal Plain region, where the subject property is located, the "basement" consists of Mesozoic crystalline rocks. Basement rocks are also exposed as high relief areas (e.g., Black Mountain northeast of the subject property and Cowles Mountain near the San Carlos area of San Diego). Younger Cretaceous and Tertiary sediments lap up against these older features. These sediments form a "*layer cake*" sequence of marine and non-marine sedimentary rock units, with some formations up to 140 million years old. Faulting related to the La Nación and Rose Canyon Fault zones has broken up this sequence into a number of distinct fault blocks in the southwestern part of the county. Northwestern portions of the county are relatively undeformed by faulting (Demere, 1997).

The Peninsular Ranges form the granitic spine of San Diego County. These rocks are primarily plutonic, forming at depth beneath the earth's crust 140 to 90 million years ago as the result of the subduction of an oceanic crustal plate beneath the North American continent. These rocks formed the much larger Southern California batholith. Metamorphism associated with the intrusion of these great granitic masses affected the much older sediments that existed near the surface over that period of time. These metasedimentary rocks remain as roof pendants of marble, schist, slate, quartzite and gneiss throughout the Peninsular Ranges. Locally, Miocene-age volcanic rocks and flows have also accumulated within these mountains (e.g., Jacumba Valley). Regional tectonic forces and erosion over time have uplifted and unroofed these granitic rocks to expose them at the surface (Demere, 1997).

The Salton Trough is the northerly extension of the Gulf of California. This zone is undergoing active deformation related to faulting along the Elsinore and San Jacinto Fault Zones, which are part of the major regional tectonic feature in the southwestern portion of California, the San Andreas Fault Zone. Translational movement along these fault zones has resulted in crustal rifting and subsidence. The Salton Trough, also referred to as the Colorado Desert, has been filled with sediments to depth of approximately 5 miles since the movement began in the early Miocene, 24 million years ago. The source of these sediments has been the local mountains as well as the ancestral and modern Colorado River (Demere, 1997).

The San Diego area is part of a seismically active region of California. It is on the eastern boundary of the Southern California Continental Borderland, part of the Peninsular Ranges Geomorphic Province. This region is part of a broad tectonic boundary between the North American and Pacific Plates. The actual plate boundary is characterized by a complex system of active, major, right-lateral strike-slip faults, trending northwest/southeast. This fault system extends eastward to the San Andreas Fault (approximately 70 miles from San Diego) and westward to the San Clemente Fault (approximately 50 miles off-shore from San Diego) (Berger and Schug, 1991).

In California, major earthquakes can generally be correlated with movement on active faults. As defined by the California Division of Mines and Geology (Hart et al., 1980), an "active" fault is one that has had ground surface displacement within Holocene time (about the last 11,000 years). In addition, "potentially active fault" has been amended to Pre-Holocene fault: a fault whose recency of past movement is older than 11,700 years, and thus does not meet the criteria of Holocene-Active fault as defined in the State Mining and Geology Board regulations.

A three-tier fault classification is used as follows:

- *Active Faults*: Faults that have demonstrable surface displacement during Holocene time.
- *Potentially Active Faults*: Faults with Quaternary displacement but Holocene surface displacement is indeterminate.
- *Inactive Faults*: Pre-Quaternary faults.

During recent history, prior to April 2010, the San Diego County area has been relatively quiet seismically. The youngest paleoearthquake that cuts the early historical living surface is likely the 1862 San Diego earthquake that had an estimated magnitude of M6 (Singleton et al., 2019). Paleoseismic trenches at the Presidio Hills Golf Course on the main trace of the Rose Canyon Fault contained evidence for historical ground rupturing earthquakes as recently as 1862 and the mid-1700s. Results of the study also suggest the Rose Canyon Fault has a ~700-800-year recurrence interval (Singleton et al., 2019).

On June 15, 2004, a M5.3 earthquake occurred approximately 45 miles southwest of downtown San Diego (26 miles west of Rosarito, Mexico). Another widely felt earthquake on a distant southern California fault was a M5.4 event that took place on July 29, 2008, west-southwest of the Chino Hills area of Riverside County.

Several earthquakes ranging from M5.0 to M6.0 occurred in northern Baja California, centered in the Gulf of California on August 3, 2009. A M5.8 earthquake followed by a M4.9 aftershock occurred on December 30, 2009, centered about 20 miles south of the Mexican border city of Mexicali.

On April 4, 2010, a large earthquake occurred in Baja California, Mexico. It was widely felt throughout the southwest including Phoenix, Arizona and San Diego in California. This M7.2 event, the Sierra El Mayor earthquake, occurred in northern Baja California, approximately 40 miles south of the Mexico-USA border at shallow depth along the principal plate boundary between the North American and Pacific plates. According to the U. S. Geological Survey this is an area with a high level of historical seismicity, and it has recently also been seismically active, although this is the largest event to strike in this area since 1892. The April 4, 2010, earthquake appears to have been larger than the M6.9 earthquake in 1940 or any of the early 20th century events (e.g., 1915 and 1934) in this region of northern Baja California.

This event's aftershock zone extends significantly to the northwest, overlapping with the portion of the fault system that is thought to have ruptured in 1892. Ground motions for the April 4, 2010, main event, recorded at stations in San Diego and reported by the California Strong Motion Instrumentation Program (CSMIP), ranged up to 0.058g.

On July 7, 2010, a M5.4 earthquake occurred in Southern California at 4:53 pm (Pacific Time) about 30 miles south of Palm Springs, 25 miles southwest of Indio, and 13 miles north-northwest of Borrego Springs. The earthquake occurred near the Coyote Creek segment of the San Jacinto Fault. The earthquake exhibited right lateral slip to the northwest, consistent with the direction of movement on the San Jacinto Fault. It was followed by more than 60 aftershocks of M1.3 and greater during the first hour.

In the last 50 years, there have been four other earthquakes in the magnitude M5.0 range within 20 kilometers of the Coyote Creek segment: M5.8 in 1968, M5.3 on 2/25/1980, M5.0 on 10/31/2001, and M5.2 on 6/12/2005. The biggest earthquake near this location was the M6.0 Buck Ridge earthquake on 3/25/1937.

APPENDIX C

SLOPE STABILITY CALCULATIONS WITH SLIDE 6 COMPUTER PROGRAM

Princess Street Coastal Trail

Job No. 22-13797

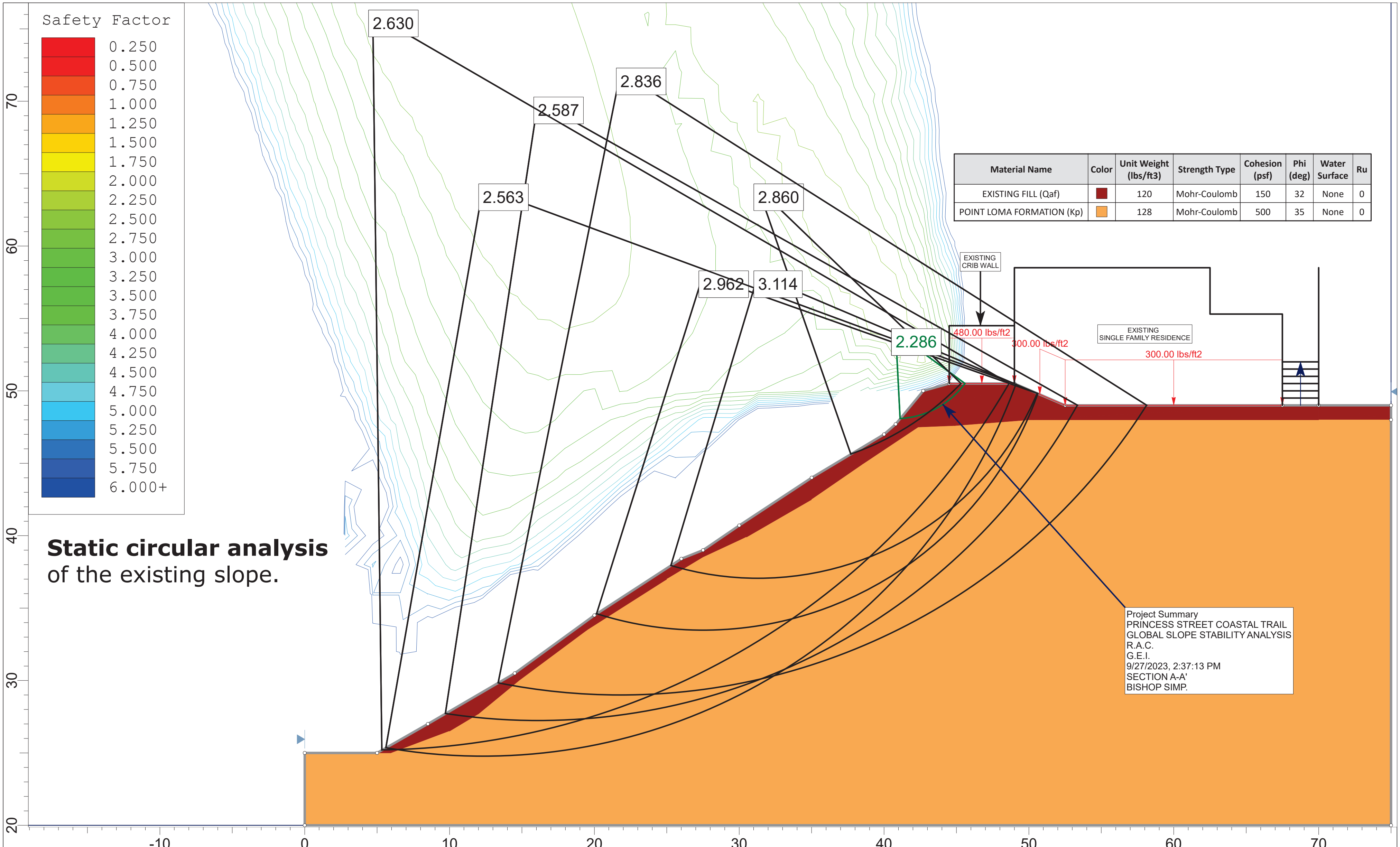
We performed gross slope stability calculations using the *SLIDE 6* program by Roc Science. The program is a limit equilibrium method, slope stability program that allows the use of several slope stability methods to calculate the factors of safety against shear failure. On this project, the Bishop Simplified method was used as the basis for calculations when using circular slide surfaces for analysis through the site geologic cross sections.

The program calculates the factor of safety against shear failure for potential slide surfaces over a selected range. We chose the range of slide surfaces where failures are most likely to occur. The printout shows a block with contours of different colors and shades that correspond to the representative factors of safety calculated that can be obtained for the analyzed range of slide surfaces for Section A-A', which includes the most unfavorable slope conditions at the site (see attached printouts). The green circular surface displayed in the printout is the lowest possible factor of safety located within the specified search range of each analysis. Soil strength values, geometry, and water conditions (seepage was not encountered) used in the program were based on geological information at the site, obtained by our project geologist. Shear strength parameters used for the gross slope stability analysis were determined per our professional experience with similar on-site soils by the project geologist and geotechnical engineer. Shear strength values were conservatively adjusted.

The static gross slope stability factors of safety were calculated and yielded a factor of safety value above 1.5 and greater Once the static gross stability was determined, a seismic analysis was performed for the same analyzed sections. The seismic analysis yielded a factor of safety value above 1.15 as required by the City of San Diego and the State of California.

The surficial slope stability calculations were performed on the slope face using a geotechnical accepted equation for infinite slopes with a saturated upper layer. The calculations were performed by assuming that the upper fill soils were saturated. It is our professional opinion that the surficial failures are likely to occur in the upper saturated fill wedge. The calculated wedge thickness used in the calculations are shown in the analyzed section along with the inclination angle (**α**). The analyzed slope segment was assumed to have an infinite length. Based on the current existing slope, the calculations yielded a factor of safety against shear failure above 1.5 for a sliding block with the exception of a thicker wedge near the existing crib wall. feet high against the soil shear strength frictional and cohesion strength opposing the driving force.

For remediation of the fill wedge slope located in front of the existing crib wall, the soil should be removed and recompacted using an A-B-C slot cut method as not to undermine the existing crib wall. Once recompacted, the surficial slope stability will have a factor of safety greater than 1.50.



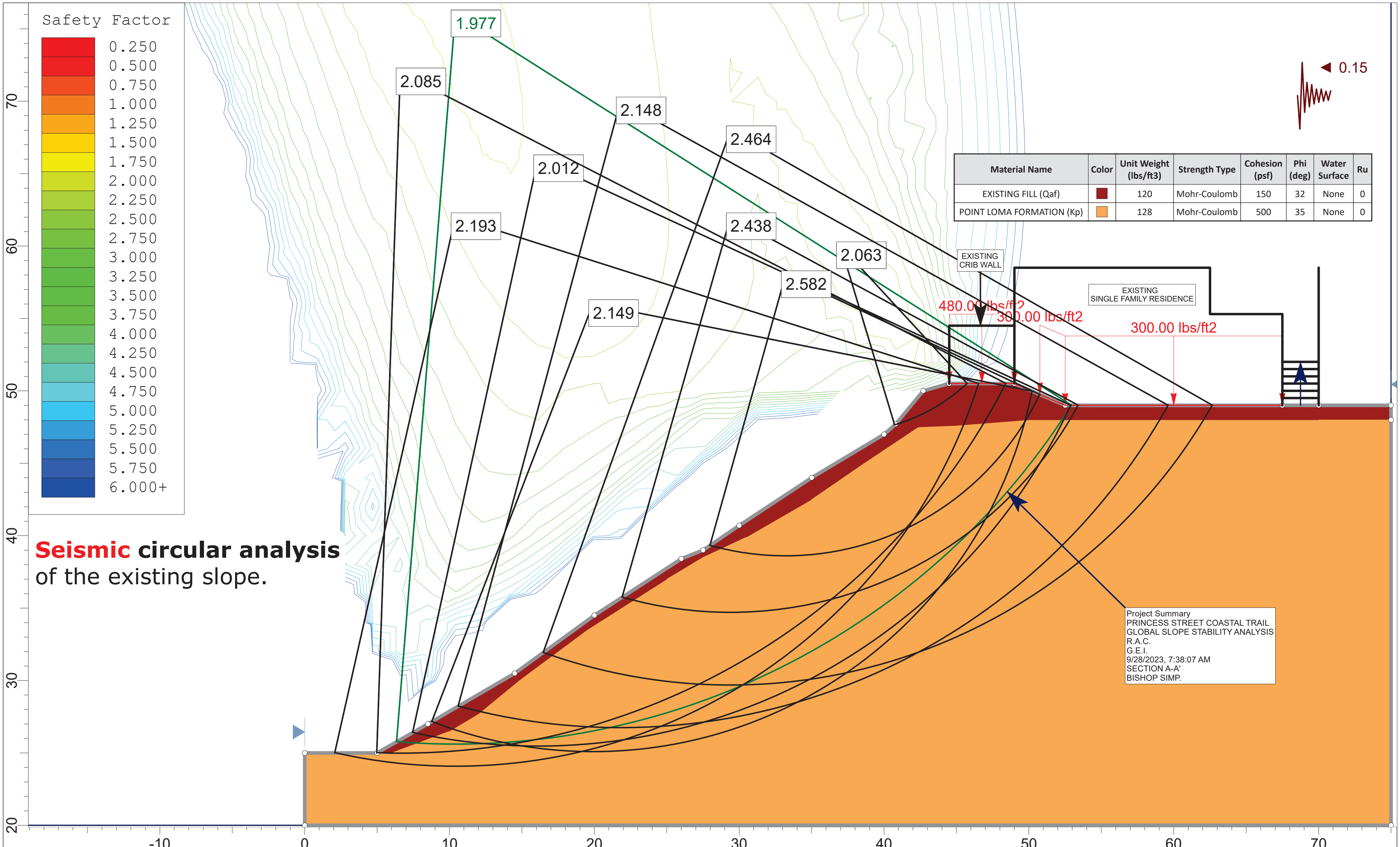
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
EXISTING FILL (Qaf)		120	Mohr-Coulomb	150	32	None	0
POINT LOMA FORMATION (Kp)		128	Mohr-Coulomb	500	35	None	0

Static circular analysis
of the existing slope.

Geotechnical Exploration, Inc.

SLIDEINTERPRET 6.039

Project	PRINCESS STREET COASTAL TRAIL		**SECTION A-A'**
Analysis Description	GLOBAL SLOPE STABILITY ANALYSIS		
Drawn By R.A.C.	*Scale* 1:110	*Company*	G.E.I.
Date	9/27/2023, 2:37:13 PM	*File Name*	JOB NO. 22-13797_S(A)_01.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
EXISTING FILL (Qaf)		120	Mohr-Coulomb	150	32	None	0
POINT LOMA FORMATION (Kp)		128	Mohr-Coulomb	500	35	None	0

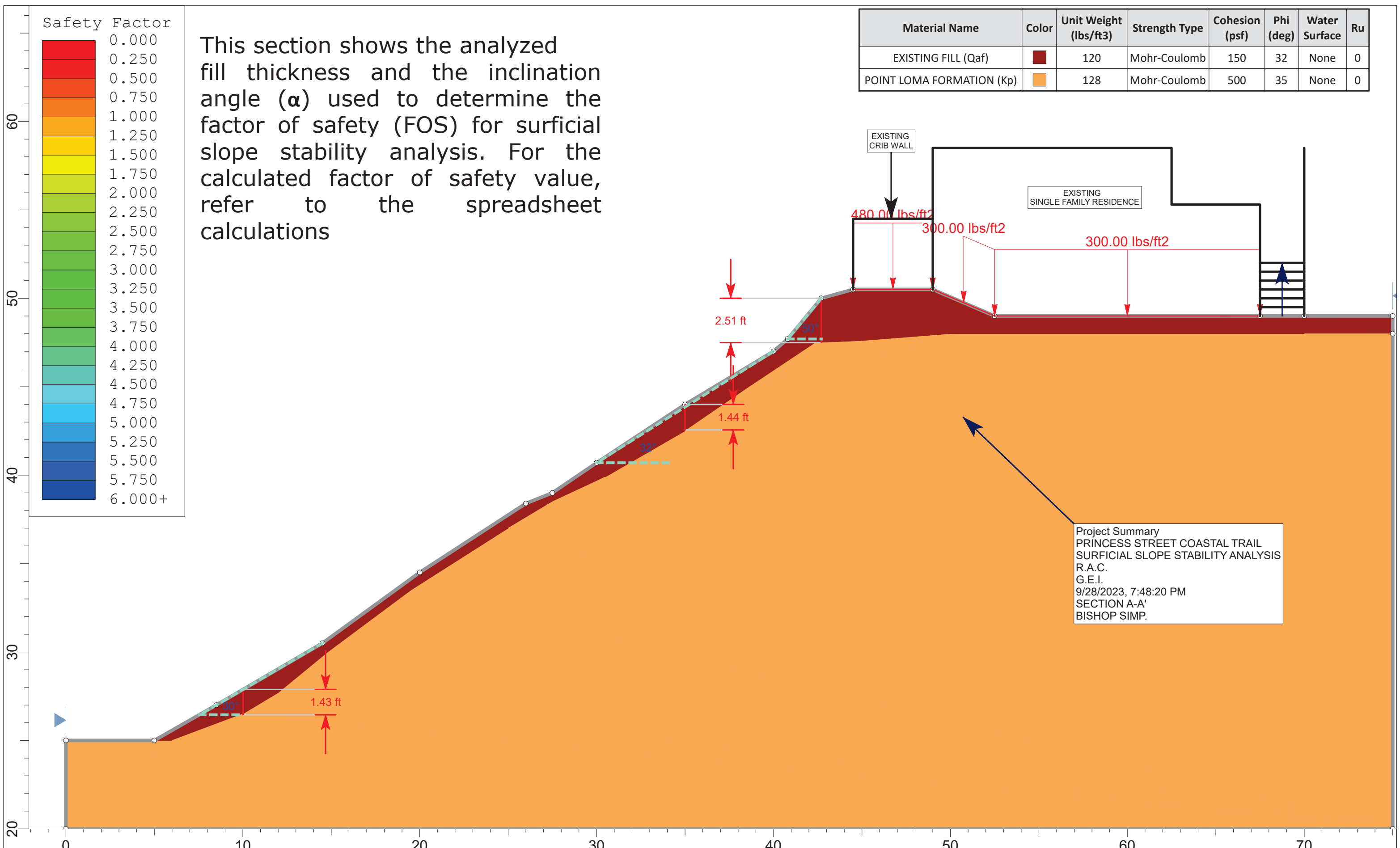
Geotechnical Exploration, Inc.

SLIDEINTERPRET 6.039

Project	PRINCESS STREET COASTAL TRAIL		**SECTION A-A'**
Analysis Description	GLOBAL SLOPE STABILITY ANALYSIS		
Drawn By R.A.C.	*Scale* 1:110	*Company*	G.E.I.
Date 9/28/2023, 7:38:07 AM		*File Name*	JOB NO. 22-13797_S(A)_01w_0.15gSHAKE.slim

This section shows the analyzed fill thickness and the inclination angle (**α**) used to determine the factor of safety (FOS) for surficial slope stability analysis. For the calculated factor of safety value, refer to the spreadsheet calculations

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
EXISTING FILL (Qaf)	(dark red)	120	Mohr-Coulomb	150	32	None	0
POINT LOMA FORMATION (Kp)	(orange)	128	Mohr-Coulomb	500	35	None	0



Geotechnical Exploration, Inc.

SLIDEINTERPRET 6.039

Project	PRINCESS STREET COASTAL TRAIL		**SECTION A-A'**
Analysis Description	SURFICIAL SLOPE STABILITY ANALYSIS		
Drawn By R.A.C.	*Scale* 1:90	*Company* G.E.I.	
Date 9/28/2023, 7:48:20 PM		*File Name* JOB NO. 22-13797_S(A)_02.slim	

SURFICIAL FAILURE

γ_t	γ_w	γ'	z_w
pcf	pcf	pcf	ft
120	62.4	57.6	1.43
			1.44
			2.51

EQUATION 1

$$FOS = \frac{c' + (\gamma_T - \gamma_W) z_W \cos(\alpha)^2 \tan\varphi'}{\gamma_T z_W \sin\alpha \cos\alpha}$$

SURFICIAL SLOPE STABILITY ANALYSIS IS BASED ON EQUATION (1) FOR THE CALCULATED VALUES. Reference: Abramson L.W., Lee T.S., Sharma S., Boyce G.M., 2002, Slope Stability and Stabilziation Methods, 2nd Edition, John Wiley and Sons, Inc.,

SECTION A-A'

SOIL TYPE	c (psf)	ϕ'(°)	α(°)	F.O.S.
FILL (Q_{af})	150	32	30	2.538
FILL (Q_{af})	150	32	32	2.412
FILL (Q_{af})	150	32	50	1.263

To remediate, recompact the slope in front of the existing retaining wall using A-B-C slot method as not to undermine existing wall. Also lay the slope back a few degrees.

Remediation

RECOMPACTED FILL (Q_{af})	200	32	47	1.611

α	The slope angle; (inclination angle) with respect to the horizontal plane
ϕ'	The effective friction angle of the soil
c'	The effective cohesion of the soil
γ_t	The total unit weight (Soil with moisture)
γ_w	The unit weight of the water
γ'	Submerged unit weight of the soil (Saturated unit weight - unit weight of water)
z_w	Vertical depth of the saturated soil
F.O.S.	Factor of Safety

1 meter = 3.28 feet

Special Publication 117A (2008, page 27): for infinite slope analysis, the minimum assumed depth of soil saturation is the smaller of either a depth of one meter or depth to firm bedrock.

The Factor of Safety values are **ABOVE** 1.50 and are adequate.

This is a beta release of the new ATC Hazards by Location website. Please contact us with feedback.

The ATC Hazards by Location website will not be updated to support ASCE 7-22. Find out why.

APPENDIX D

ATC Hazards by Location

Search Information

Coordinates: 32.8503, -117.2634

Elevation: 56 ft

Timestamp: 2023-09-28T22:10:30.550Z

Hazard Type: Seismic

Reference Document: ASCE7-16

Risk Category: II

Site Class: D

Basic Parameters

Name	Value	Description	
S_S	1.4	MCE_R ground motion (period=0.2s)	
S_1	0.49	MCE_R ground motion (period=1.0s)	
S_{MS}	1.4	Site-modified spectral acceleration value	
S_{M1}	* null	Site-modified spectral acceleration value	0.887
S_{DS}	0.933	Numeric seismic design value at 0.2s SA	
S_{D1}	* null	Numeric seismic design value at 1.0s SA	0.591

* See Section 11.4.8

Additional Information

Name	Value	Description	
SDC	* null	Seismic design category	D
F_a	1	Site amplification factor at 0.2s	
F_v	* null	Site amplification factor at 1.0s	1.81
CR_S	0.866	Coefficient of risk (0.2s)	
CR_1	0.886	Coefficient of risk (1.0s)	
PGA	0.639	MCE_G peak ground acceleration	
F_{PGA}	1.1	Site amplification factor at PGA	
PGA_M	0.703	Site modified peak ground acceleration	
T_L	8	Long-period transition period (s)	
SsRT	1.4	Probabilistic risk-targeted ground motion (0.2s)	
SsUH	1.616	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)	
SsD	2.264	Factored deterministic acceleration value (0.2s)	
S1RT	0.49	Probabilistic risk-targeted ground motion (1.0s)	
S1UH	0.553	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)	
S1D	0.797	Factored deterministic acceleration value (1.0s)	
PGAd	0.939	Factored deterministic acceleration value (PGA)	

* See Section 11.4.8

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Please note that the ATC Hazards by Location website will not be updated to support ASCE 7-22. Find out why.

Disclaimer

Hazard loads are provided by the U.S. Geological Survey Seismic Design Web Services.

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APPENDIX E

Coastal Hazard and Wave Run Up Analysis
Princess Street Coastal Access Trail and Stairs
La Jolla, California

September 1, 2022

By Geosoils, Inc.

GeoSoils, Inc.
Geotechnical • Geologic • Coastal • Environmental
5741 Palmer Way • Carlsbad, California 92010 • (760) 438-3155 • FAX (760) 931-0915 • www.geosoilsinc.com

September 1, 2022 WO S8435

Mr. Jay Heiser
Geotechnical Exploration Inc.
7420 Trade Street
San Diego, CA 92121

SUBJECT: Coastal Hazard and Wave Runup Analysis, Princess Street Coastal Access Trial and Stairs, La Jolla, San Diego County, California.

Dear Mr. Heiser:

GeoSoils Inc. (GSI) is pleased to provide this coastal hazard analysis for the proposed coastal access trail and shoreline access stairs at the ocean end of Princess Street in La Jolla. The purpose of this analysis is to provide the City of San Diego and the California Coastal Commission (CCC) the necessary hazard information typically requested for coastal development. The access site is a coastal bluff fronted by a primarily rocky beach. The proposed project is to constructed a series of stairs and landings from the top of the bluff at about elevation +60 feet NGVD29 to the bottom of the bluff at about elevation 0 feet NGVD29. Our scope of work includes a review of the CCC Sea-Level Rise (SLR) Guidance (updated November 2018), a review of the National Oceanographic and Atmospheric Administration (NOAA) latest SLR science (NOAA, 2022), a review of the site elevations, a review of the preliminary access plans, a site inspection, and preparation of this letter report. This report constitutes an investigation of the wave and water level conditions expected at the site as a result of extreme storm and wave action over the next 75 years. It also provides conclusions and recommendations regarding the susceptibility of the proposed development to wave attack and erosion. The analysis uses design storm conditions typical of the January 18-19, 1988, and the winters of 1982-83, and 1998 type storm waves and beach conditions.

SITE INSPECTION

The shoreline fronting the site was inspected by GSI personnel on August 24, 2022. In addition, the bluff and shoreline in this area of La Jolla have been observed periodically by the undersigned for the last five decades while working at Scripps Institution of Oceanography and on new bluff top residential development projects nearby. The subject site is an access easement from the ocean terminus of Princess Street to the shoreline below. There were no signs of recent bluff erosion in the area of the proposed beach stair landing. There were signs of marine erosion at the base of the bluff nearby to the west, in the form of large blocks of failed bedrock. There where no signs of recent or significant bluff top erosion. The site is in a unique area of bluff/shoreline that is fronted by a broad shore platform and significantly protected by waves from the submarine canyon just offshore. Figure 1 is an aerial photograph of the site taken in 2021 downloaded from the Google Earth. The figure shows the approximate trial location in relation to Princess Street, the bluff, and the shoreline.

Figure 1. Subject trail location, bluff, and shoreline in 2022.

Site elevations were taken from a topographic map prepared by SB&O, Inc. dated 1/17/20, using NGVD29 as the vertical datum. Preliminary project plans prepared by Rana Creek Living Architecture were reviewed. The top of the access trail is at about elevation +60 feet NGVD29, and the bottom stair landing is at about elevation +0.5 feet NGVD29. The beach is primary large rounded rock that overly the erosion resistant broad shore platform. Site geology was investigated by Geotechnical Exploration Inc.

The site is close to an approximate 90 turn in the shoreline to the west . The bedrock below the site is jointed, which over time results in the formation of sea caves and arches. Figure 2 shows the very broad shore platform which significantly limits the size of the wave that reaches near the shoreline. Ocean swell is refracted by the submarine canyon away from this section of shoreline, focusing the waves to Point La Jolla and La Jolla Shores. Figure 2 also shows the irregular bluff toe and bluff face in this area along with a recently failed portion of a cave or arch near the access site.

Figure 2. Site photograph showing the coastal bluff, rock beach, and broad shore platform.

HAZARD ANALYSIS

There are three different potential oceanographic hazards identified at this site: bluff erosion, flooding, and waves (extreme waves and tsunami). For ease of review, each of these hazards will be analyzed and discussed separately, followed by a summary of the analysis, including conclusions and recommendations.

Bluff Erosion Hazard

The typical coastal-bluff profile is divided into three zones: the shore platform; a lower near-vertical cliff surface termed the sea cliff; and an upper bluff slope generally ranging in inclination between about 20 and 80 degrees (measured from the horizontal). The upper bluff typically transitions into a relatively flat-lying coastal terrace. The bluff edge is the boundary between the upper bluff and coastal terrace. Offshore from the sea cliff is an area of indefinite extent termed the near-shore zone. The bedrock surface in the near-shore zone, which extends out to sea from the base of the sea cliff, is the shore platform. Prior to the development of La Jolla the steep topography resulted in subaerial erosion determining the location of the top of the bluff. After development, with landscaping and drainage control the top of the bluff is essentially stabilized. The impact of marine erosion is minimal due to the broad shore platform and the refraction of wave energy away from this section of shoreline.

The bluff and shoreline in front of the site have been observed on several occasions in the past five decades during regular visits to La Jolla. Sea cave or arch collapse occurs sporadically but typically these are very local failures do not extend up to the top of the bluff. One of the best was to estimate shoreline and bluff erosion is by comparing historical aerial photographs. Figure 3 is a vertical aerial photograph of the trail site taken in 1952 downloaded with permission from the University of Santa Barbara Aerial Photograph website (Flight C 18080, Frame 4-25). Figure 4 is a 2021 vertical aerial photograph of the same area as Figure 3. These images can be used to compare changes in the bluff face and shoreline position over the 69 year period between the time the photographs were taken. Because the public streets and some of the individual houses have not moved measurements of the images can be scaled and the distance from the shoreline or bluff to street centerline or other objects can be compared. The areas denoted with an “A” are homes, along with the public street, that have not moved between the 1952 and 2021 images. The area denoted “B” is the actual bluff that the trail is on. This bluff is at an angle of almost 90 degrees to the shoreline and not significantly impacted by marine erosion. The area denoted “C” is the portion of the bluff near the trail that has changed as a result of marine erosion (cave and arch collapse along weak joints in the bedrock). The approximate location of the bluff trail is shown in red in the figures.

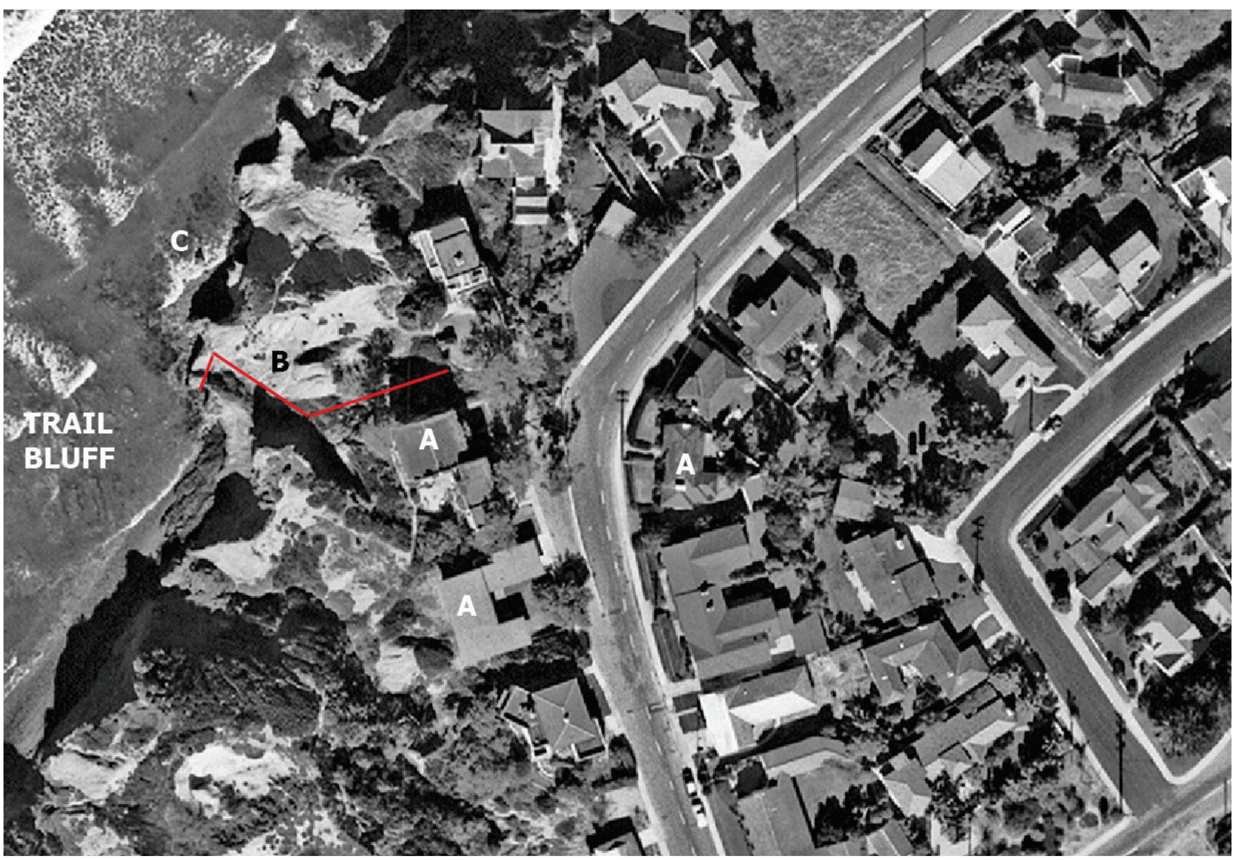


Figure 3. Princess St. Coastal Trail area in November 1952 for comparison to Figure 4.

Figure 4. Princess St. Coastal Trail area in November 2021 for comparison to Figure 3.

Current Flooding Hazard

The historical water levels (tides) in the La Jolla area are well documented. The National Oceanographic and Atmospheric (NOAA) National Ocean Survey tidal data station closest to the project site is at the Scripps Institution of Oceanography La Jolla Pier Station. The current (last tidal epoch) tidal datum elevations in feet are as follows:

MEAN HIGHER HIGH WATER (MHHW)	= 3.03
MEAN HIGH WATER (MHW)	= 2.30
MEAN TIDE LEVEL (MTL)	= 0.45
MEAN SEA LEVEL (MSL)	= 0.43
NGVD29	= 0.00
MEAN LOW WATER (MLW)	=-1.39
MEAN LOWER LOW WATER (MLLW)	=-2.30

The maximum historical water elevation at the site including El Niño effects is ~+5.3 feet NGVD29. The top of the beach access stair landing is at ~+12 feet NGVD29 and thus will be ~6.3 feet above the historical El Niño highest water elevation. As a result, the proposed shoreline access landing is located at an elevation that would not expose it to flooding from the ocean under current sea level conditions. The remainder of the trail up to Princess Street would not be subject to waves of flooding under current conditions. The base of the stairs may be subject periodic flooding from wave runup during time of higher tides.

The 2018 Coastal Commission Sea Level Rise Guidance (CCCSLRG) requires the use of the "best available science" with regards to sea level rise (SLR) projections. The CCCSLRG is based upon the California Ocean Protection Council (COPC) update to the State's Sea-Level Rise Guidance in March 2018. These COPC estimates are based upon a 2014 report entitled "Probabilistic 21st and 22nd century sea-level projections at a global network of tide-gauge sites" by Kopp, et al., 2014. The Kopp et al. paper used 2009 to 2012 SLR modeling by climate scientists for the probability analysis, which means the "best available science" used by the CCC is over 10 years old. There is more current "best available science" (measurements, models and projections) provided by NOAA (NOAA, 2022).

NOAA has been measuring SLR globally, and specifically in La Jolla, which is the closest NOAA tide station to Beach Road. The NOAA La Jolla SLR rate is 2.13 mm/yr as shown in Figure 5. The rate can be used to calculate a sea level rise of 46.9mm (0.15ft) over the last 22 years (2000 through December 2021). If the La Jolla rates do not change significantly in the next 8 years (which is likely), the amount of La Jolla SLR to the year 2030 will be about 0.21 feet.

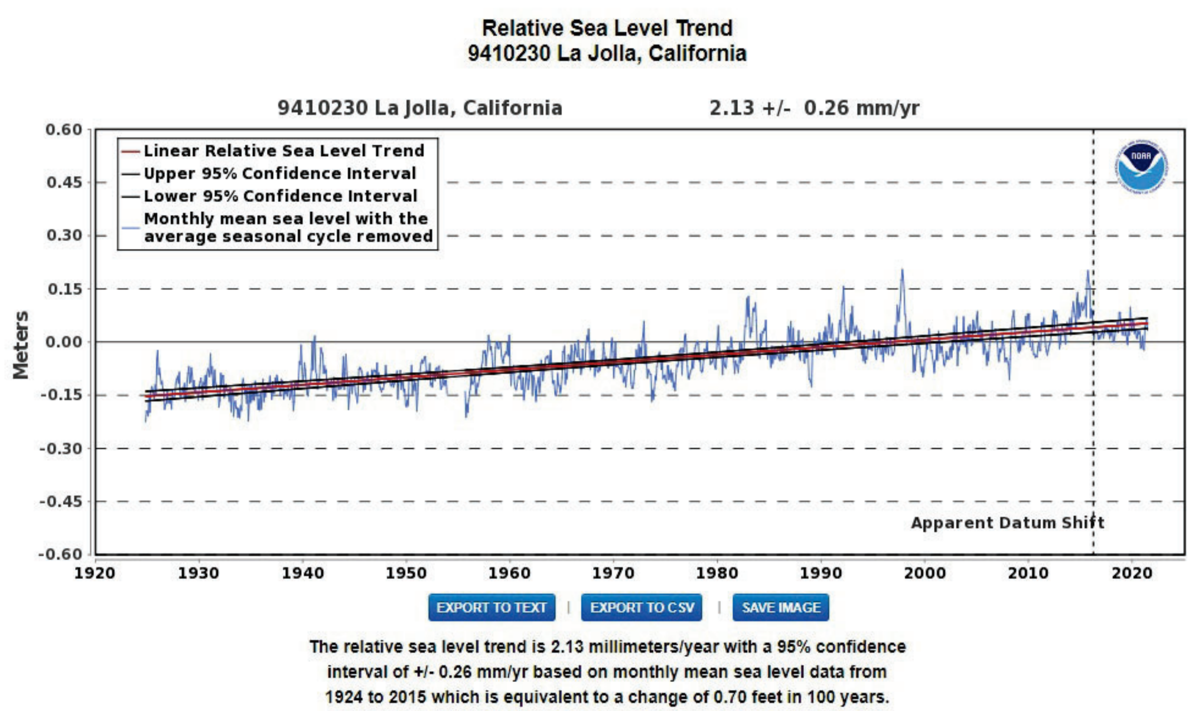
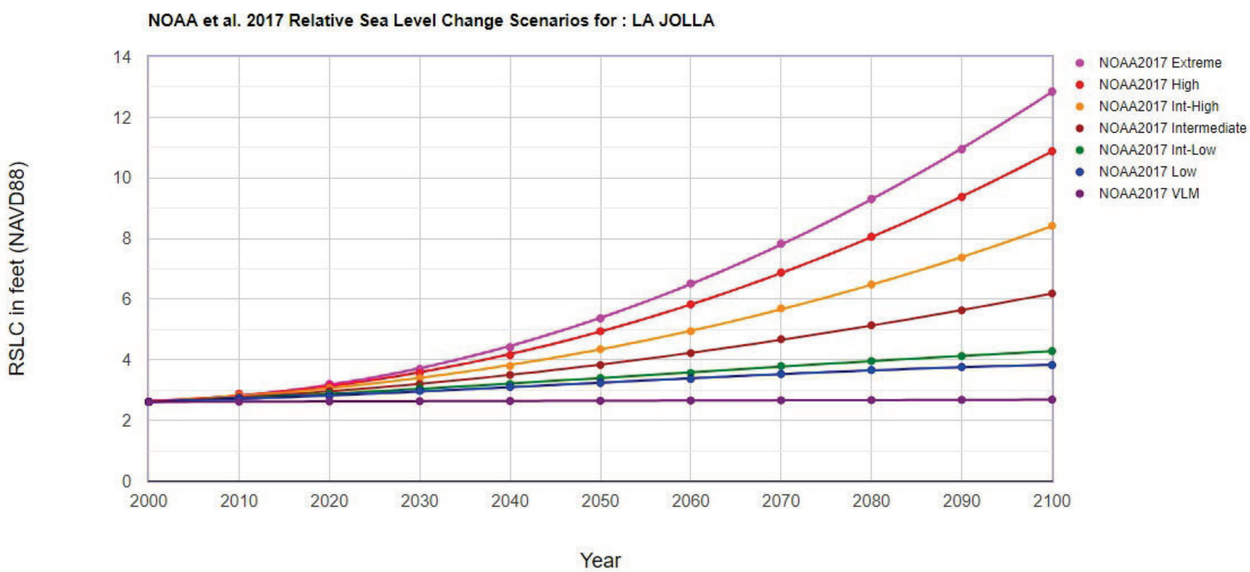


Figure 5. Latest measure SLR at La Jolla from NOAA.

NOAA also provides plots of the most current SLR model projections (best available science) over time starting in the year 2000. Figure 6, is the model projections taken from NOAA, which is more current SLR science and better SLR science than the 2018 COPC Guidance. To determine which model is accurately predicting SLR, the data for La Jolla can be either plotted onto the curves or estimated from the table below the curves. The model that is most accurate now should be considered the "best available science" SLR model for the project, at this time.



La Jolla SLR
Scenarios for LA JOLLA
NOAA2017 VLM: 0.00072 feet/yr
All values are expressed in feet

Year	NOAA2017 VLM	NOAA2017 Low	NOAA2017 Int-Low	NOAA2017 Intermediate	NOAA2017 Int-High	NOAA2017 High	NOAA2017 Extreme
2000	2.61	2.61	2.61	2.61	2.61	2.61	2.61
2010	2.62	2.71	2.71	2.78	2.84	2.87	2.87
2020	2.63	2.81	2.87	2.97	3.07	3.14	3.20
2030	2.63	2.97	3.07	3.20	3.40	3.56	3.70
2040	2.64	3.10	3.20	3.50	3.79	4.15	4.42
2050	2.65	3.24	3.40	3.83	4.35	4.94	5.37
2060	2.66	3.37	3.56	4.22	4.94	5.83	6.52
2070	2.66	3.53	3.79	4.68	5.70	6.88	7.83
2080	2.67	3.66	3.96	5.14	6.48	8.06	9.31
2090	2.68	3.76	4.12	5.63	7.37	9.37	10.95
2100	2.68	3.83	4.29	6.19	8.42	10.88	12.85

Figure 6. NOAA 2021 SLR projections for La Jolla.

Recognizing that in the year 2000 the SLR zero line is 2.61 feet, and using the current La Jolla SLR data (trends), La Jolla SLR should be (2.61 + 0.21 feet) 2.82 feet in the year 2030. Looking at the table in Figure 6 for the year 2030 (~8.5 years from now) reveals that La Jolla SLR is tracking below the NOAA 2017 Low SLR model curve. The Low model predicts a SLR rise total in the year 2100 of about 1.22 feet.

The CCCSLRG document recommends that a project designer determine the range of SLR using the "best available science." The California Ocean Protection Council (COPC) update included SLR estimates and probabilities for La Jolla, the closest SLR estimates to Dana Point. Table I provides the March 2018 COPC data (from the Kopp, et al., 2014 report) with the SLR adopted estimates (in feet), and the probabilities of those estimate to meet or exceed the 1991-2009 mean, based upon the outdated best available science.

The NOAA SLR information provided above is more current than the CCCSLRG (2018 COPC). The 2022 NOAA SLR science/data is the “best available science” for SLR prediction and is required to be used by the CCC.

Table I

		Probabilistic Projections (in feet) (based on Kopp et al. 2014)					H++ scenario (Sweet et al. 2017) *Single scenario
		MEDIAN	LIKELY RANGE		1-IN-20 CHANCE	1-IN-200 CHANCE	
		50% probability sea-level rise meets or exceeds…	66% probability sea-level rise is between…		5% probability sea-level rise meets or exceeds…	0.5% probability sea-level rise meets or exceeds…	
				Low Risk Aversion		Medium - High Risk Aversion	Extreme Risk Aversion
High emissions	2030	0.5	0.4 -	0.6	0.7	0.9	1.1
	2040	0.7	0.5 -	0.9	1.0	1.3	1.8
	2050	0.9	0.7 -	1.2	1.4	2.0	2.8
Low emissions	2060	1.0	0.7 -	1.3	1.7	2.5	
High emissions	2060	1.2	0.9 -	1.6	1.9	2.7	3.9
Low emissions	2070	1.2	0.9 -	1.6	2.0	3.1	
High emissions	2070	1.5	1.1 -	2.0	2.5	3.6	5.2
Low emissions	2080	1.4	1.0 -	1.9	2.4	4.0	
High emissions	2080	1.9	1.3 -	2.5	3.1	4.6	6.7
Low emissions	2090	1.6	1.0 -	2.2	2.9	4.8	
High emissions	2090	2.2	1.6 -	3.0	3.8	5.7	8.3
Low emissions	2100	1.7	1.1 -	2.5	3.3	5.8	
High emissions	2100	2.6	1.8 -	3.6	4.6	7.1	10.2

In contrast to the measured SLR at La Jolla, the model the CCC is recommending to be analyzed (2018 COPC) is the high emissions scenario and the 0.5% probability shown in Table 1. For the year 2030 the CCC recommended SLR is 0.9 feet, which is about 4 times greater than the 0.209 feet that is being measured. Over the 75-year life of the development this results in a very significant difference between what the SLR the CCC suggests based upon older science and what SLR is currently occurring. The current best available science using measured SLR data shows that the La Jolla SLR trend is tracking more closely to the likely range than the low probability 0.5% range. There is no current SLR science/measurements that supports the CCCSLRG (2018 COPC) 0.5% probability use. There is current/best science that supports the use of a much lower SLR estimate over the 75 year life of the development.

Table I illustrates that SLR in the year 2100 could be any where between 1.7 feet to 7.1 feet (or higher). The likely range for the most onerous RCP is 1.8 feet to 3.6 feet, with a 5% probability that SLR meets or exceeds 4.6 feet. The “life” of a coastal access trail is typically less than 75 years.

Wave Runup

As waves encounter the shore platform, rocky beach and bluff in front of the proposed coastal trail, the wave runup rushes up the bluff and proposed stair and trail landings. There is no current visible evidence that wave runup has impacted the bluff above elevation ~+12 feet NGVD29. Historically, marine caused bluff erosion is negligible along the section of shoreline below the trail. However, in the future with SLR, wave runup, spray, and splash may reach higher up the bluff during extreme events. Wave runup is defined as the vertical height above the still water level to which a wave will rise on a structure of infinite height (bluff/stairs). Wave runup on the beach/slope is calculated using the USACOE Automated Coastal Engineering System, ACES. ACES is an interactive computer based design and analysis system in the field of coastal engineering. The methods to calculate runup and overtopping implemented within this ACES application are discussed in greater detail in Chapter 7 of the Shore Protection Manual (1984) and the Coastal Engineering Manual. The input variables for the ACES wave runup are based upon the fact that the maximum wave runup occurs when the design wave is breaking at the toe of the bluff. This requires a depth limited determination of the design breaker height. Four different SLR conditions will be considered for the wave runup analysis 2 feet, 3 feet, 4 feet and 5 feet of SLR. For the high emissions 0.5% SLR these SLR amounts correspond to the year 2050, 2065, 2083, and 2093 respectively.

The maximum design water depth is the maximum historical water depth plus the amount of SLR. The design breaker height is then 78% of the water depth. The wave period data for the analysis will be taken from Coastal Data Information Program (CDIP) at Scripps Institution of Oceanography. The CDIP Station is the deepwater station, Mission Bay West (#220), to the south of the site. The design period is 15 seconds which is a dominant wave period in the CDIP data. The nearshore slope was taken from the NOAA nautical chart and is 1/100 (vertical/horizontal) and the runup zone average slope is 1/1 (v/h) based upon the site topography (slope from scour elevation to mid bluff). The ACES output is in the tables below.

ACES	Mode: Single Case	Functional Area: Wave - Structure Interaction

Application: Wave Runup and Overtopping on Impermeable Structures

Item		Unit	Value
Incident Wave Height	Hi:	ft	7.100
Wave Period	T:	sec	15.000
COTAN of Nearshore Slope	COT(ø):		100.000
Water Depth at Structure Toe	ds:	ft	9.100
COTAN of Structure Slope	COT(θ):		1.000
Structure Height Above Toe	hs:	ft	60.000
Rough Slope Coefficient	a:		0.950
Rough Slope Coefficient	b:		0.690
Wave Runup	R:	ft	8.777
Deepwater Wave Height	H0:	ft	4.681
Relative Height	ds/H0:		1.944
Wave Steepness	H0/(gT^2):		0.001

Rough Slope Runup

PRINCES ST COASTAL TRAIL

DESIGN RUNUP

2 FT SLR

ACES	Mode: Single Case	Functional Area: Wave – Structure Interaction

Application: Wave Runup and Overtopping on Impermeable Structures

Item		Unit	Value
Incident Wave Height	Hi:	ft	7.900
Wave Period	T:	sec	15.000
COTAN of Nearshore Slope	COT(ø):		100.000
Water Depth at Structure Toe	ds:	ft	10.100
COTAN of Structure Slope	COT(θ):		1.000
Structure Height Above Toe	hs:	ft	60.000
Rough Slope Coefficient	a:		0.950
Rough Slope Coefficient	b:		0.690
Wave Runup	R:	ft	9.711
Deepwater Wave Height	H0:	ft	5.338
Relative Height	ds/H0:		1.892
Wave Steepness	H0/(gT^2):		0.001

Rough Slope Runup

PRINCES ST COASTAL TRAIL

WAVE RUNUP

3 FT SLR

ACES	Mode: Single Case	Functional Area: Wave – Structure Interaction

Application: Wave Runup and Overtopping on Impermeable Structures

Item		Unit	Value
Incident Wave Height	Hi:	ft	8.700
Wave Period	T:	sec	15.000
COTAN of Nearshore Slope	COT(ø):		100.000
Water Depth at Structure Toe	ds:	ft	11.100
COTAN of Structure Slope	COT(θ):		1.000
Structure Height Above Toe	hs:	ft	60.000
Rough Slope Coefficient	a:		0.950
Rough Slope Coefficient	b:		0.690
Wave Runup	R:	ft	10.638
Deepwater Wave Height	H0:	ft	6.011
Relative Height	ds/H0:		1.847
Wave Steepness	H0/(gT^2):		0.001

Rough Slope Runup

PRINCES ST COASTAL TRAIL

WAVE RUNUP

4 FT SLR

ACES	Mode: Single Case	Functional Area: Wave – Structure Interaction

Application: Wave Runup and Overtopping on Impermeable Structures

Item		Unit	Value
Incident Wave Height	Hi:	ft	9.400
Wave Period	T:	sec	15.000
COTAN of Nearshore Slope	COT(ø):		100.000
Water Depth at Structure Toe	ds:	ft	12.100
COTAN of Structure Slope	COT(θ):		1.000
Structure Height Above Toe	hs:	ft	60.000
Rough Slope Coefficient	a:		0.950
Rough Slope Coefficient	b:		0.690
Wave Runup	R:	ft	11.444
Deepwater Wave Height	H0:	ft	6.627
Relative Height	ds/H0:		1.826
Wave Steepness	H0/(gT^2):		0.001

Rough Slope Runup

PRINCES ST COASTAL TRAIL

WAVE RUNUP

5 FT SLR

The proposed landing for the shoreline access stair leg is at elevation +11.5 NGVD29. There is a series of landing along the trail stairs at 15.6 feet NGVD29, 16.9 feet NGVD29, and 18.7 feet NGVD29. The mid bluff landing and proposed viewing area is at about elevation +23 feet NGVD29. The wave runup elevation for a given SLR is provided in the table below. It should be noted that the highest wave runup will only occur under the highest tides and design waves for less than 1 hour.

SEA LEVEL RISE (FT)	WAVE RUNUP ELEVATION (FT)
2	17.8
3	19.8
4	21.7
5	23.1

Under 2 feet of SLR the landing at the top of the shoreline access stairs could be subject to wave runup. With 5 feet of SLR the viewing area landing at about elevation +23 is at the highest limit of potential wave runup.

The lowest section of stairs and adjacent landings, one on the shoreline and the other at about elevation +11.5 feet, will be subject to broken wave forces over the life of the development. The bottom landing and lower stairs should be designed to withstand a broken wave force from a 4 foot wave bore. Using Equation VI-5-184 from the Coastal Engineering Manual the surge force per unit horizontal width of the structure is ~4,600 lbs.

Tsunami

The site is adjacent to the Pacific Ocean, which would allow for both near field (Channel Island faults) and far field (Alaska and Japan faults) generated tsunami to approach the site. The State of California (2009) shows that the lower portion of the coastal trail is within the limit of a tsunami inundation zone. However, the limit of the tsunami zone does not reach the location of the proposed cabana as shown in Figure 6. It should be advised that the site is mapped within the limits of the California Office of Emergency Services tsunami innundation map, La Jolla Quadrangle (State of California 2009). The tsunami inundation maps are very specific as to their use. Their use is for evacuation planning only. The limitation on the use of these maps is clearly stated in the **PURPOSE OF THIS MAP** on every quadrangle of California coastline. In addition, the following two paragraphs were taken from the CalOES Local Planning Guidance on Tsunami Response concerning the use of the tsunami inundation maps.

> *In order to avoid the conflict over tsunami origin, inundation projections are based on worst-case scenarios. Since the inundation projections are intended for emergency and evacuation planning, flooding is based on the highest projection of inundation regardless of the tsunami origin. As such, projections are not an assessment of the probability of reaching the projected height (probabilistic hazard assessment) but only a planning tool.*

> *Inundation projections and resulting planning maps are to be used for emergency*

planning purposes only. They are not based on a specific earthquake and tsunami. Areas actually inundated by a specific tsunami can vary from those predicted. The inundation maps are not a prediction of the performance, in an earthquake or tsunami, of any structure within or outside of the projected inundation area.

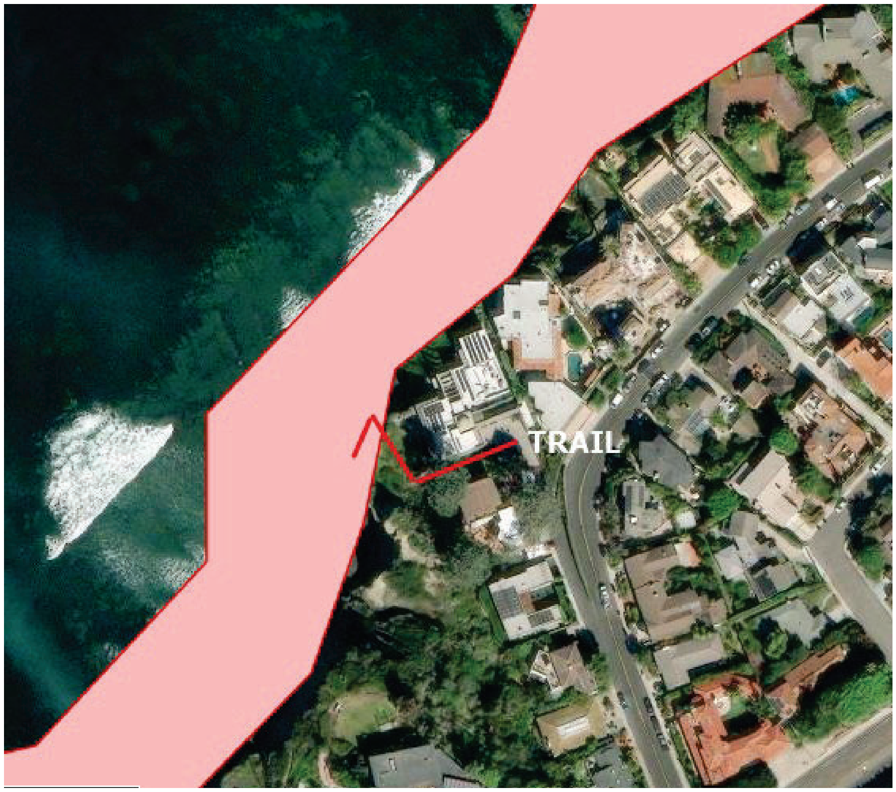


Figure 6. CalOES site tsunami map on Google Earth overlay.

The Princess Street Coastal Trail will serve as a vertical tsunami evacuation route from the shoreline in the area. The community of La Jolla and the County of San Diego have developed a tsunami alert and evacuation plan. This plan recommends that coastal communities within the potential areas of inundation upgrade their tsunami education programs. The City of San Diego has posted signs throughout the community showing tsunami evacuation routes, tsunami evacuation center locations, and the limits of the tsunami hazard zones.

CONCLUSIONS

- A review of aerial photographs over the last several decades shows about 5 feet of lower bluff retreat over a 69 year period, and no retreat at the base of the bluff below the coastal trail. The pictures do not show measurable movement of the top of the bluff over the 69 years. The large rock beach fronting the site is stable. The mid to upper portions of the trail will not be subject to marine erosion. However, the trail will be a potential surface drainage path and appropriate drainage systems should be part of the project design. While the portion of the bluff seaward at the lowest section (stairs) may be subject to marine erosion, the orientation of this section of stairs (parallel to the shoreline) and setback from the seaward face of the bluff. The lower portion of the trail will not likely be impacted by bluff erosion for several decades. The trail can adapt to SLR hazards by simply moving the sections of the trail/stairs that are impacted, in the future as needed.

- The lower portions of the trail may be subject to wave runup attack after construction and in the future, in consideration of SLR. The lower section of stairs should be designed in consideration of broken wave forces provided herein. The back beach shows no signs of marine erosion and the beach erosion will likely not increase due to SLR because of the large, immobile, rocks that make up the beach.

- The majority of the proposed coastal trail is above the impact of coastal hazards (above elevation ~+20 feet NGVD29) including a ~5-foot sea level rise over the life.

- No protective devices will be necessary to protect the proposed development from any existing or anticipated future coastal hazards over the life.

RECOMMENDATIONS

Based upon the analysis and discussion herein, the proposed development is reasonably safe from coastal hazards for the next 75 years including shoreline movement, erosion, wave runup, and flooding with future SLR. The proposed development will neither create nor contribute significantly to erosion, geologic instability, or destruction of the site or adjacent area. There are no recommendations necessary for shore protection. The final plans should be reviewed by this officee for conformance with our report .

The opportunity to be of service is sincerely appreciated. If you should have any questions, please do not hesitate to contact our office.

Respectfully submitted,

GeoSoils Inc.

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David W. Skelly MS, PE

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