Project-Specific References

Project-Specific Reference #1

PHASE I CULTURAL RESOURCES SURVEY FOR THE LECHUZA BEACH PUBLIC ACCESS IMPROVEMENTS PROJECT, CITY OF MALIBU, CALIFORNIA

July 18, 2015

Prepared for:
Mountains Recreation and Conservation Authority
Ramirez Canyon Park, 5810 Ramirez Canyon Road
Malibu CA 90265

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TABLE OF CONTENTS

Project Number: 2015-004
Type of Study: Phase I Cultural Resources Assessment
Sites: CA-LAN-114
USGS 7.5' Quadrangles: Point Dume, California
Key Words: Encinal Canyon Site, City of Malibu, Lechuza Beach, Broad Beach Road

MANAGEMENT SUMMARY

The purpose of this study was to determine if the proposed Lechuza Beach Public Access Improvements Project could cause negative impacts to known or previously unidentified cultural resources. This study was requested by the Mountains Recreation and Conservation Authority (MRCA) to meet their responsibility as the lead agency under environmental regulations regarding archaeological resources. This report will assist the MRCA in complying with the California Environmental Quality Act (CEQA), the California Coastal Act (CCA), the Malibu Local Coastal Program, and City of Malibu Planning Guidelines. The study included a records search and a field survey.

The project area is located on the beautiful Malibu Coast, in the City of Malibu, California. The project that is proposed is the improvement of three existing MRCA managed public access right-of-ways, which pass through different parts of the Broad Beach neighborhood, and allow the public access to the beach. Most of the area being examined here does not have street addresses, but is listed by the County of Los Angeles by parcel only.

The initial records search was performed by the South Central Coastal Information Center California State University at Fullerton (SCCIC-CSUF), at the request of the MRCA, on June 15, 2015 (SCCIC File # 15098.1198). The records search showed that the western part of the project area is located within the regionally important Encinal Canyon Site (CA-LAN-114), and that there are seven other recorded sites within 1/2 mile. A supplemental records search for the purpose of copying records was made by Albert Knight on June 29, 2015.

The project area itself was directly examined by Albert Knight on June 19, 2015. This survey confirmed that portions of the CA-LAN-114 archaeological site are present in the West Sea Level Drive portion of the project area. No prehistoric artifacts were observed in any part of the survey area. See Report of Findings and Management Recommendations below.

PROJECT PERSONNEL

Albert Knight received his B.A. in Anthropology from the University of California, Santa Barbara in 1983. He has been a Department Associate in Anthropology at the Santa Barbara

Museum of Natural History since 1996. Knight has participated in and directed numerous archaeological survey, monitoring, and excavation jobs, and has done extensive historical and other archival research, on the Santa Monica Mountains and adjacent region. He has done extensive research on regional Native American rock art and is the author of papers on the Rock Art of Los Angeles County (1997), the Rock Art of the Santa Monica Mountains and the Santa Susana Mountains, (2001), and Three Chumash-Style Rock Art Sites in Fernandeño Territory (2012). All of the photos are by Albert Knight.

Patricia Paramoure received her B.A. in Anthropology from the University of California, Santa Barbara in 1991, and her M.A. in Cultural Resources Management from Sonoma State University in 2012. That same year, she was listed with the Register of Professional Archaeologists, and she began working as a Cultural Resources Primary Investigator. She has performed and directed numerous archaeological survey, monitoring, and excavation jobs, and has done extensive historical research focused on the Santa Cruz area, and the surrounding San Francisco Peninsula and Monterey Bay regions.

INTRODUCTION

PURPOSE OF STUDY

The purpose of this study was to determine the potential effects to cultural resources during ground disturbing work performed as part of the Lechuza Beach Public Access Improvements Project. This study was requested by the Mountains Recreation and Conservation Authority (MRCA) to meet their responsibilities under the California Environmental Quality Act (CEQA).

PROJECT LOCATION AND DESCRIPTION

The Lechuza Beach Public Access Improvements Project is located in the Broad Beach community, on the beautiful Malibu Coast, in the City of Malibu, California. The location is in the southwest corner of Los Angeles County. The proposed project is for the improvement of pedestrian access routes between Broad Beach Road and the public right-of-way along the beach, below the mean high-tide line. The project area is located west of Lachuza Point, with the Pacific Coast Highway (PCH) to the north, and the Pacific Ocean to the south. The project area can be seen near the left (west) margin of the Point Dume, California, 1995, 7.5 series topographic quadrangle map, at T1S x R19W, in an unsectioned portion of the Topanga-Malibu-Sequit land grant, San Bernardino Base Meridian. (See Figures 1 and 2, Pages 4 and 5.)

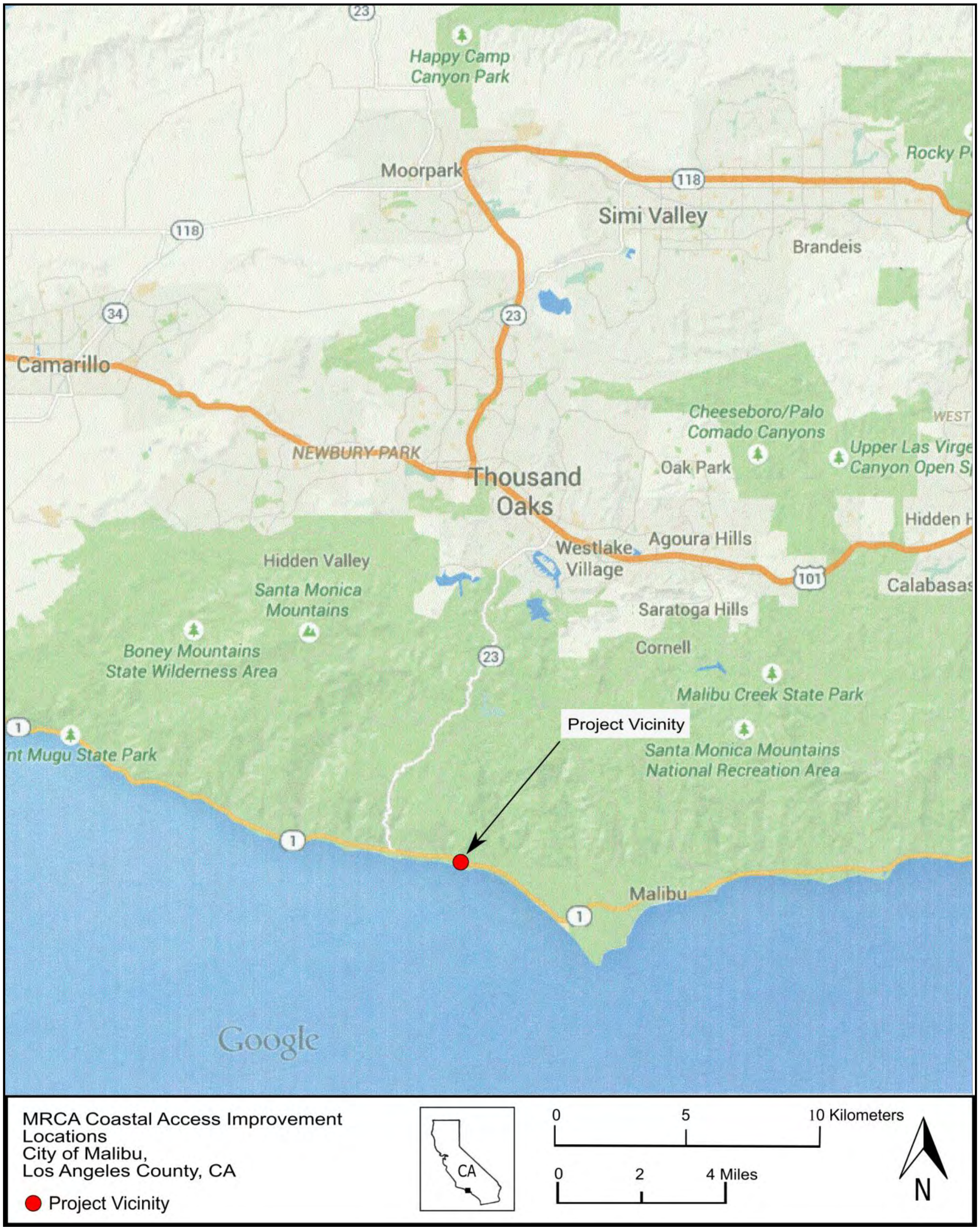

Figure 1. Project Vicinity Map. **(Map By M. Gerbic)**

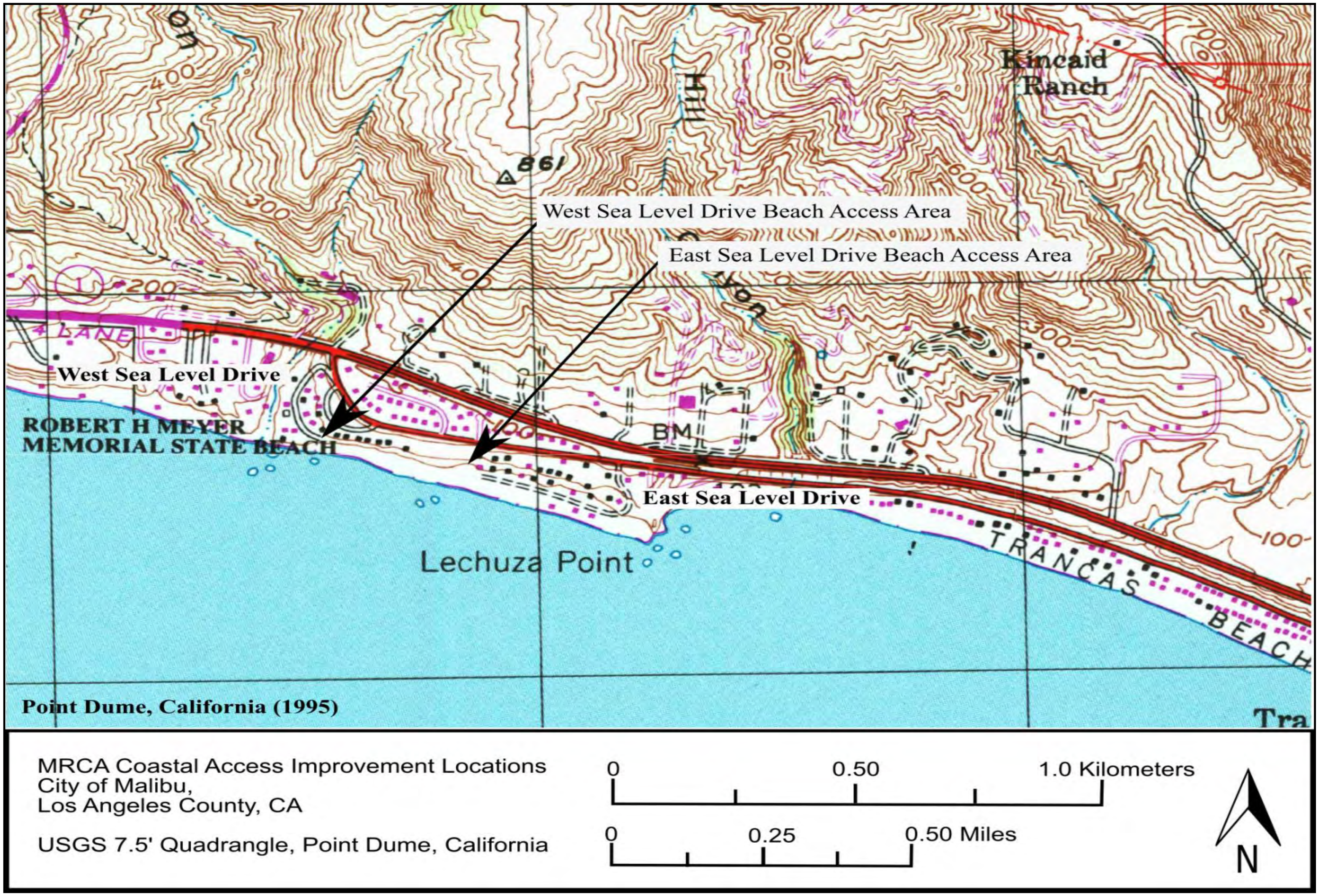

Figure 2. Project Location Map. **(Map by M. Gerbic)**

The residential community along Lechuza Beach covers approximately 1/2 mile. The two MRCA access trails and stairways plus a third pedestrian access via East Sea Level Drive provide public access between the terrace and the beach. (See Figure 3, Page 7.) Note that many of the parcels discussed here are undeveloped and do not have street addresses.

The specific project locations that were examined are:

1- The West Sea Level Drive Beach Access Route (project name = SLW)
This consists of portions of parcels 4470-021-900, 4470-021-007, 4470-021-008, 4470-021-900, and 4470-028-915. Most of the proposed work here is at or near the top of the bluff and includes the proposed improvements to the Fire Department turnaround, and the proposed disabled parking area and aisles. It is also proposed that undocumented fill should be removed from underneath the existing view platform area, and that it be replaced with documented/compacted fill. Footings will need to be excavated to receive a new retaining wall. In addition, it will be necessary to install a deep cast-in-drilled hole (CIDH) pile, in order to support the improved stairway where it meets the sand. The AMEC (2013) engineering report spells out the particulars of the recommended improvements, and how those improvements could be achieved.

2- The East Sea Level Drive Beach Access Route (project name = SLE)
This consists of portions of parcels 4470-021-900, 4470-021-009, 4470-024-061, 4470-024-062, and 4470-024-901. Most of the work here is at the bottom of the bluff, where a public bathroom, a leach field, and disabled parking spaces and access aisles are proposed. The existing vehicle and pedestrian gates on the road at the north end of the parcel are also to be replaced, and new beach access stairs, and a new view platform would be constructed. It will be necessary to install deep CIDH piles, in order to support the improved stairway where it meets the sand, the restroom, and the walkway to the restroom, and it will be necessary to establish protective shoring during construction.

3- Lechuza Beach Generally between the South (Beach) Ends of SLW and SLE
This consists of parcels 4470-028-900 through 4470-028-918, 4470-021-900, and 4470-001-900. This is the sandy beach area and some of the steep area along the south edge(s) of the sea cliffs.

REGULATORY ENVIRONMENT

This Project is subject to various environmental regulations regarding archaeological resources. This report will assist the MRCA in complying with the California Environmental Quality Act (CEQA), the California Coastal Act (CCA), the Malibu Local Coastal Program, and City of Malibu Planning Guidelines.

Figure 3. Project Area MRCA Parcels Map. **(Map Courtesy of MRCA)**

The discussion following concerns the pertinent and applicable state laws, and is an excerpted from the California Department of Transportation's (Caltrans) on-line Environmental Handbook (http://www.dot.ca.gov/ser/envhand.htm). The cited information is a summary of the regulatory section of Volume 2, Cultural Resources (2001).

CALIFORNIA ENVIRONMENTAL QUALITY ACT

CEQA notes that it is state policy to "take all action necessary to provide the people of this state with...historic environmental qualities." CEQA also states that public or private projects financed or approved by the state are subject to environmental review by the state. All such projects, unless entitled to an exemption, may proceed only after this requirement has been satisfied. CEQA requires detailed studies which analyze the environmental effects of proposed projects. In the event that a project is determined to have a potential significant environmental effect, the act requires that alternative mitigation measures be considered.

CEQA includes historic and archaeological resources as integral features of the environment. If paleontological resources are identified in the proposed project area, the sponsoring agency must also take those resources into consideration. The level of consideration will vary with the importance of the resource.

CALIFORNIA REGISTER OF HISTORICAL RESOURCES

The California Register is a list of all properties considered to be significant historical resources in the state. The California Register includes all properties listed or determined eligible for listing on the National Register, including properties evaluated under Section 106, and State Historical Landmarks from No. 770 on. The criteria for listing are the same as those of the National Register. The California Register specifically provides that historical resources listed, determined eligible for listing on the California Register by the State Historical Resources Commission, or resources that meet the California Register criteria, are resources which must be given consideration under CEQA. Other resources, such as resources listed on local registers of historic registers or in local surveys, may be also be listed if they are determined by the State Historic Resources Commission to be significant in accordance with criteria and procedures to be adopted by the Commission and are nominated; their listing in the California Register is not automatic. Resources eligible for listing include buildings, sites, structures, objects, or historic districts that retain historic integrity and are historically significant at the local, state or national level under one or more of the following four criteria:

1- The resource is associated with events that have made a significant contribution to the broad patterns of local or regional history, or the cultural heritage of California or the United States;

2- The resource is associated with the lives of persons important to local, California, or national history; 3- The resource embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of a master or possesses high artistic values; or 4- The resource has yielded, or has the potential to yield, information important to the prehistory or history of the local area, California, or the nation.

In addition to being significance, resources must have integrity for the period of significance for which they are identified. The period of significance is the date or span of time within which significant events transpired, or significant individuals made their important contributions. Integrity is the authenticity of a historical resource's physical identity as evidenced by the presence of characteristics that existed during the resource's period of significance. Certain alterations to a resource, or changes in its use over time, may have historical, cultural, or architectural significance.

Simply put, resources must still have enough of their historic character or appearance to be recognizable as historical resources, and be able to convey the reasons for their significance. A resource that has lost its historic character or appearance may still have sufficient integrity for the California Register, if, under Criterion 4, it maintains the potential to yield significant scientific or historical information or specific data.

NATURAL SETTING

At the time of the *entrada* of the Spanish Empire into southern California, the Malibu Coast environment had the same Mediterranean-like climate that it has today. This part of the coast is characterized by warm, dry summers and cool, moist winters, with rainfall predominantly falling between November and April. Paleoclimatic research indicates that pine forests were present in the Santa Barbara Channel coastal region between 12,000 and 8,000 years ago. Sea level during the terminal Pleistocene was sometimes as much as 350 feet lower than it is today, so that at times the coast was much further to the south that it is now, and today's four Northern Channel Islands were a single large island (*Santa Rosae*). Climatic conditions in this region have varied substantially during the Holocene (i.e. the most recent 10,000 years). As the climate became warmer and drier, the sea rose and the alpine forests were replaced (beginning approximately 5,750 years ago) by Holocene-type grassland and oak woodland communities; today's coastal sage scrub and chaparral communities took the form that we see today by approximately 2,000 years ago. The native vegetation in the project area consists of oak woodland (*Quercus agrifolia* and various shrub oaks), riparian (e.g. sycamore and walnut), and chaparral species (e.g. Laurel Sumac, Sugar Bush, Ceanothus ssp., sage ssp., California Buckwheat, Yucca). Locally, a complex mosaic of mountain, canyon, and shore communities, that includes many small seasonal streams, springs and seeps developed, and archaeological research has demonstrated that, for at least 8,000 thousand years, the Malibu Coast has been a very productive environment, and an ideal place for people to live. According to local archaeologist, Dr. Chester King, "More than 40 separate watersheds are encompassed within the Santa Monica Mountains. The 46 mile long range incorporates coastal, valley, and mountain landforms. The Santa Monica Mountains average 7.5 miles in width and have a mean elevation of 1000 feet. The highest place is "Sandstone" Peak (actually a volcanic formation, elevation 3,111 feet)" (2000:7).

Specifically, the project area is located on a narrow east-west oriented terrace, with the southern foot of the main mass of the Santa Monica Mountains to the immediate north, and the Pacific Ocean to the immediate south. The Los Angeles-Ventura County line is about 5 miles to the west, and Point Dume, the most obvious natural landmark on the Malibu Coast, is located approximately 4 miles to the east. The general project area is characterized by Pleistocene Marine deposits and Marine Terrace deposits, Upper Miocene marine sedimentary rocks, including shale, sandstone, siltstone, and minor conglomerate deposits, and localized Miocene Volcanic rocks, which include inter-bedded agglomerate, flow breccias, tuffs, and volcanic derived sandstones Local soils belong are Gullied Lands, which are essentially barren, with very shallow, very steep, highly erosive soft soil sediments, and Lockwood Series soils, which are deep, well-drained soils, developed in alluvium and derived from older mixed sedimentary deposits (Wlodarski 2003:1). Extensive and detailed information on the project area geology can be found in AMEC (2013).

The project area at Broad Beach is located in what is sometimes called "Malibu's Celebrity Haven", an up-scale beach-side neighborhood which is mostly highly developed, with large spacious homes, abundant gardens and landscaped grounds, and includes various short roads, parking areas, etc. However, overall density is low, and so in selected places the ground can be seen, if only fleetingly, and so it is therefore possible to see traces of the large archaeological site that once, and still partially, occupies the eastern side of Encinal Canyon.

MALIBU COAST HISTORY

PRECONTACT ARCHAEOLOGY

The terms that are used to describe the prehistoric cultures that once existed along the Malibu Coast have evolved and changed since the mid-1950s, when attempts at cultural classification in the region began. In 1955, William Wallace defined the then earliest known archaeological assemblage, the Millingstone Horizon (ca. 7,000 to 3,000 years before present), as a material complex that included an abundance of milling stones (i.e. metates and manos, for grinding food items), but which utilized relatively few projectile points. Regionally, the Millingstone Horizon was subsequently subsumed with what Claude Warren (1968) termed the Encinitas Tradition. Other broad cultural categories like "Early", "Middle", and "Late" have also been used. It is now recognized that these generalized terms have been masking many of the more specific indicators of cultural, spatial and temporal variations, which have the potential to illuminate the movements of peoples throughout space and time; factors that are critical in helping us understand regional cultural adaptation and change (Sutton and Gardner 2010:1-2).

The Encinitas Tradition was therefore redefined by Sutton and Gardner (2010:8-25) as having four patterns. These are (1) Topanga in coastal Los Angeles and Orange counties, (2) La Jolla in coastal San Diego County, (3) Greven Knoll in inland San Bernardino, Riverside, Orange and Los Angeles counties and (4) Pauma in inland San Diego County. According to Sutton (2010), the Topanga Pattern was being supplanted on portions of the mainland part of Los Angeles County starting about 3,500 years ago. Sutton proposed that the new cultural pattern be called the Del Rey Tradition. Each Pattern has Phases that are identified by specific changes in cultural assemblages, through time. These Phases are identified by their archaeological signatures, as components within sites, as follows:

The early Topanga Pattern bands consisted of relatively small, highly mobile families, whose diet was dependent on seed gathering and, along the coast, shellfish collecting. Topanga I is characterized by a scarcity of projectile points, and inhumation are the only method of disposal of the dead. The most important artifact types include abundant manos and metates, core tools, scraper planes/scrapers, charmstones, cogged stones, and early discoidals. Identified faunal remains are minimal, but adequate enough to identify many different species of animal, fish, and shellfish (Sutton and Gardner 2010:9).

Beginning about 3,500 years ago, the newly arrived Del Rey Tradition Angeles Pattern bands were more inventive than the Topanga Pattern had been, they utilized a wider variety of natural resources, and their culture had greater emphases on hunting and near shore fishing. Elko points for atlatls or darts appear in Angeles Phase I, and small steatite objects such as pipes and effigies, made out of Catalina Island soapstone, are found, as are shell beads and shell ornaments. Fishing technologies became more complex, and now include bone harpoons/fishhooks, shell fishhooks, donut stones, and hafted micro blades, for cutting/graving wood or stone. Mortuary practices changed to consist of flexed inhumations. Settlement patterns made a shift from general use sites, to habitation areas separate from functional work areas. Subsistence shifted from mostly collecting of plants and shellfish, to increased hunting and fishing (Sutton 2010). A number of researchers have postulated that these archaeologically demonstrable changes mark the arrival of members of the Takic Language Family, who had migrated south to the coast, from the general region of Southern Sierra Nevada Mountains/Tehachapi Mountains/ Southern San Joaquin Valley, and whose descendants developed into the closely related Gabrielino-Cupan peoples.

Phase II is recognized by killed (broken) artifacts, including manos, metates, bowls, mortars, pestles, and points, often highly fragmented cremated human bones. The cremations were not done at the actual burial site (Sutton 2010).

The Angeles Phase III is the beginning of what has previously been called the Late Period. Small projectile points now appear, as do steatite shaft straighteners; this reflects the introduction of bow and arrow technology. Obsidian sources changed from mostly Coso to Obsidian Butte, and shell beads from Gulf of California species began to appear; the Angeles Pattern begins spread to adjacent areas (Sutton 2010). The ancient Chumash population and the newly arriving Tongva people would have been interacting along the entire zone of their contact, including along the Malibu Coast, by this time.

Angeles Phase IV is marked by new material items including Cottonwood points for arrows, Olivella cupped beads, Mytilus shell disks, birdstones (zoomorphic effigies with magico-religious properties), and trade items from the Southwest, including occasional pottery. It appears that populations increased and the settlement pattern altered to one of fewer, but larger villages. Smaller special-purpose sites continued to be used (Sutton 2010).

Angeles Phase V components contain more and larger steatite artifacts, including larger vessels, more elaborate effigies, and comals. Settlement locations shifted from woodland to open grasslands [Sutton 2010]. Santa Catalina Island steatite bowls and other goods are now being actively transported and sold or traded along the entire Los Angeles-Ventura County coast, and to many inland locations, by sea-going plank canoes (Chumash *Tomol* and Tongva *Tiat*).

Angeles Phase VI reflects the ethnographic mainland populations of the Historic (locally post-1542) Period. Angeles Phase VI is essentially Angeles Phase V augmented by a variety of Euro-American tools and materials, including glass beads and metal tools such as knives and needles (now used in shell bead manufacture). The frequency of Euro-American material culture increased through time until it constituted the vast majority of materials used. Locally produced brownware pottery appears after the Spanish establish themselves (Sutton 2010).

ETHNOGRAPHY

The project area is located at the southeastern corner of Eastern Coastal Chumash territory (Grant 1978). The village of Topanga, just east of Project Location 1, is frequently listed as a Tongva (or Gabrielino) village, but an examination of mission registers shows that all of the few personal names of the inhabitants that were recorded were Chumash. The mission records also show that the only recorded marriage for a person from Topanga, was with someone from Talepop, an interior Chumash village; there are no recorded marriage ties with any Tongva communities. The mission records thus demonstrate that the ethnohistoric village of Topanga was closely associated with the Eastern Chumash, and not with the Tongva (King 2000:53, 56; 2011:161, Figure 6.4). This does not mean that Tongva people were not present in the area, but only that there is no specific record; certainly, based on the distribution of Santa Catalina Island steatite alone, it can be seen that trade to and from that island, by both Chumash and Gabrielino people was common along the Malibu Coast during the last few centuries before the arrival of Euro-American settlers.

The name “Chumash” is derived from an Eastern Coastal Chumash word for the (Chumash) people of Santa Cruz Island. Today, “Chumash” is often used to refer to all of the member languages of the Chumash (or, more properly, "Chumashan") Language Family, which occupied most or all of San Luis Obispo, Santa Barbara, and Ventura Counties, as well as parts of Los Angeles and Kern Counties (Grant 1978; King 2011). Chumash culture was paramount across western south-central California. The Eastern Coastal Chumash (or Ventureno) lived in Ventura and western Los Angeles Counties (Grant 1978). Note that the Chumashan languages are no longer considered part of the Hokan Language Family, but are considered to be an isolate stock that developed in the Santa Barbara Channel region over a period of perhaps 10,000 years (Mithun 1999:304).

Malibu was a capital village for both the Eastern Coastal Chumash (Grant 1978) and for the Fernandeño (King 2000:4; 2011:5-7). The Chumash called the community Humaliwu (or "loud surf"), and the Fernandeno called the village Ongobepet. Malibu (CA-LAN-264, etc.) was the political and ceremonial center for the entire Malibu Coast, as well as for the entire region inland to as far as the western San Fernando Valley (Librado 1981; Knight 2012). By 1805, the Spanish had relocated the majority of the native people from Malibu to Mission San Fernando (established in 1797), and thus almost all of the villagers became part of the historic Fernandeño population. Eventually, Eastern Chumash people would comprise about 25 percent of the population of Mission San Fernando (Johnson 1997:252, 254-255, 259-261, Table 4). Johnson (2006:13) lists 118 baptisms, from the village of Malibu, at Mission San Fernando. Some ethnographic data suggest that, by the time the Spanish arrived on the scene, the mainland Chumash villages along the Santa Barbara Channel had formed a single loose federation-like alliance called the *Lulapin* (Clewlow and Whitley 1979:149-174; Librado 1981).

There are several other significant Native American sites within a short distance of the project area. These include the important Shoban Paul Site, a large Millingstone site that was (before development) located on the inland site of PCH, about 1/2 mile east of the project area, and the site of the village of *Lisiqshi,* at today's Leo Carrillo State Beach, some three miles to the west. The village of *Lojostohni* (or *Lohostohni*) was located at the mouth of Trancas Canyon, some two miles to the east, and the large village of *Sumo* (or Zuma) was located only four miles east of the project area.

A well developed, regional economic system among mainland and island villages linked the Chumash with neighboring tribes, especially the Fernandeño (Grant 1978:517; Johnson 1997:5-6). This exchange system was facilitated by the use of shell bead money, which were made from Olivella biplicata shells, by the Channel Island Chumash (Glassow et al. 2007:207); in fact, the original meaning of the word Chumash, was "shell bead people." In addition to foodstuffs such as fish and acorns, the Chumash traded steatite, basketry, bone tools, lithic materials made from Franciscan or Monterey chert, and milling implements, for obsidian, pigments, salt, animal skins, pine nuts, and other items, from neighboring tribes. It is believed that at the time of historic contact, the Chumash and the neighboring Tongva had “the most complex political and economic organization in California, and, for that matter, in all of western North America” (Glassow et al. 2007:210). Some researchers have identified the Encinal Canyon Site as being the Chumash village known as Lojostohni (or Lohostohni), but the village of that name is now known to have been located at Trancas Canyon, somewhat over two miles to the east (Applegate 1975:34). There is no known Native American name for the site.

POST CONTACT HISTORY

Spanish and Mexican Era

The first recorded direct contact the Eastern Coastal Chumash had with Europeans occurred on October 12, 1542, when the Spanish explorer, Juan Rodriguez Cabrillo came ashore and visited the large village of Shisholop (šišolop, or "port"); a subsequent Spanish naval expedition, led by Sebastian Vizcaino, explored the coast in 1602. The first land expedition to the interior near Malibu was led by Portola (1769); this was followed by the Anza expeditions in 1773 and in 1775-1776. The first Spanish colony in California was established at San Diego in 1769. In 1782, the Spanish established Mission San Buenaventura, near the same village that had been visited by Cabrillo over two centuries earlier. Mission San Fernando, the closest mission to the east, was established in 1797. The Spanish hoped to convert native peoples to Christianity, and turn them into hard-working servants of the Empire. By 1821, the Spanish Empire had colonized the entire California littoral to as far north as Sonoma County, and had established numerous presidios (forts), pueblos (towns), and missions (churches). The primary economic activities during these years were cattle ranching and agriculture.

The first Spanish settlers in the Malibu area were Felipe Santiago Tapia and his family. By 1804 Tapia was granted most of the coastal land extending from near Point Mugu in the west, to Las Flores Canyon in the east. Due to the lack of roads, the only area access to Tapia's land grant at this time was by horse, mule, or boat. The Empire of Mexico, including California, became independent from Spain in 1821, but Mexico soon declared itself to be a republic, which wanted to reduce the power of the Catholic Church. The Secularization Act of 1833 began a process by which the vast church holdings in California were redistributed to private persons, in the form of almost 500 land grants (Robinson 1948). Primary economic activities continued to be cattle ranching and agriculture.

American Period

In 1848 California, along with the rest of northwest Mexico, was acquired by the United States, following the Mexican-American War. In 1857 Matthew Keller purchased the entire 13,315-acre Rancho Topanga-Malibu-Sequit from the Tapia family, for 10 cents an acre. The Malibu Coast remained cattle country until around 1900, when the first modern access roads began to link the area to the rest of Los Angeles County (Wlodarski 2008:5). In 1891 the Rancho was then sold to Frederick Hastings Rindge. Over the subsequent decades, the Rindge family, who had become quite wealthy, subdivided the old grant, and sold off parcels of various sizes. The Malibu Coast did not become easily accessible to the general public until the Roosevelt Highway, now Pacific Coast Highway, was built, beginning in 1929.

The Rindge family soon became embroiled with legal disputes concerning access and ownership in the area, and in order to raise funds, by the late 1920s and early 1930s the family was renting beach front land to a variety of people, many of which were associated with Hollywood and the movie industry; sales of properties, most of which were fairly small, soon followed. This was the beginning of the famous "Malibu Colony", the best-known part of which is located near Malibu Beach proper. Broad Beach, a few miles west of Malibu Beach, is the lesser-well known portion of the more famous "Colony", and it is sometimes referred to as "Malibu's Celebrity Haven."

RECORDS SEARCH

A records search for archaeological and historical records was completed by the South Central Coastal Information Center at California State University Fullerton (SCCIC-CSUF), on behalf of the MRCA, on June 15, 2015 (SCCIC File # 15098.1198). A supplemental records search, in order to obtain additional pertinent information, was performed by Albert Knight on June 29, 2015. See Figure 4, Table 1, Page 16, for Recorded Sites within 1/2 Half-Mile of the Project Area.

The records search showed that the West Sea Level Drive portion of the project is located within CA-LAN-114, and the East Sea Level Drive portion of the project area is located at the recorded east edge of CA-LAN-114. Several additional archaeological sites are recorded within 1/2 mile of the project area. (The SCCIC reported 12 recorded sites within 1/2 mile of the records search area, but the project area is smaller than the area the records search covered.) There are no built-environmental resources within the project area, and only one built resource is located within 1/2 mile. There are no listed State of California Office of Historical Properties, California Points of Historic Interest, California Historic Landmarks, or listed California Register of Historical Resources in the project area or within 1/2 mile of the project area. CA-LAN-114 as a whole is

Figure 4, Table 1. Recorded Sites within 1/2 Half-Mile of the Project Area

Primary Number	Trinomial	Site Description	Distance from Project
P-19-000114	CA-LAN-114	Large village site, with cemetery, and habitation debris; includes very many artifacts and extensive shell midden	West Sea Level Drive IN site; East Sea Level Drive at east edge of site
P-19-000501	CA-LAN-501	Prehistoric site with minor shell midden, 1 flake	+ 1/2 mile NNW
P-19-000958	CA-LAN-958	Prehistoric Millingstone site with many artifacts, hearths, and shell midden	1/2 mile to the east
P-19-001041	CA-LAN-1041	Prehistoric site with a metate, a bowl, and a hopper mortar, burials, shell midden, and lithics	+ 1/2 to the east
P-19-0001081	CA-LAN-1081	Two small rock shelters with shell midden, a tarring pebble, minor lithics, and a small possible piece of Catalina steatite	-1 mile to north
P-19-0001402	CA-LAN-1402	Prehistoric site with shell midden and many artifacts	1/2 mile to NE
P-19-0001714	CA-LAN-1714	Prehistoric site with shell midden and many artifacts	- 1/2 to the NNW
P-19-0002268	CA-LAN-2268	Prehistoric site with shell midden	Immediately west, on west side of Encinal Canyon drainage

usually referred to as the Encinal Canyon Site; certain sub-portions of the site are sometimes referred to as the Broad Beach Site, and as the Cottontail Lane Site.

The Encinal Canyon site was a large and important prehistoric village site; Chester King has estimated the site of the site ay some 82,000 square meters; CA-LAN-2268, on the west side of the Encinal Canyon drainage, probably represents a remaining fragment of the larger site, the west side of the drainage being highly developed, and most of that part of the site having been destroyed by development, or otherwise hidden by structures, driveways, landscaping, and etc.

Specifically the West Sea Level Drive (SLW) project access route is located within CA-LAN-114, while the East Sea Level Drive (SLE) access is located just outside of the site; the beach south of and below the marine terrace portion of the site, is also recorded as part of the site. The northern part of the site, according to Salls, extends well north of PCH, on both sites of the drainage, although the SCCIC topographic maps do not show the site as covering as large of an area in the canyon proper. The site has been dated to be have been occupied from about 200 BC to about 1500 AD (Wlodarski 2008:1).

Site records for various parts of CA-LAN-114 were prepared in 1956 (by Charles Rozaire), in 1966 (by by Nelson Leonard), in 1979 (by Anonymous), in 1982 and 1988 (by Clay Singer), and in 1993 and 2000 (by Chester King). Wlodarski presents an excellent summary of the evolution of recordation of the site (2006:ii-iv). As a result of their records search, the SCCIC-CSUF concluded that, "based on our records, the project area is extremely sensitive for cultural resources. Therefore it is recommended that a qualified archaeological consultant be retained to identify the boundaries of previously recorded sites and monitor all ground-disturbing activities within the project area." The SCCIC-CSUF also recommended that ". . . the Native American Heritage Commission should be consulted to identify if any additional traditional cultural properties or other sacred sites are known to exist in the area."

The archival research shows that numerous studies, including reports on test excavation and monitoring projects, have previously been performed at or in the immediate vicinity of CA-LAN-114. Because they are so numerous, and because many of them do not report information that is germane to the present project, not all of these reports are cited here. Those that are pertinent to the current project include those by: Compass Rose (2004a, 2004b), Dillon (1989a, 1989b, 1990a, 1990b, 1991), King 1992, 1993, 1994, 2000), Knight (2008), Singer (1982, 1988, 2004a, 2004b, 2004c, 2005a, 2005b, 2005c), Rosenthal and Padon (1989), Singer and Atwood (1988), and Wlodarski, (2001, 2003a, 2003b, 2003c, 2005a, 2005b, 2005c, 2006, 2008).

Most of the above researchers feel that much of the west edge of the Encinal Canyon site is intact, at least in places, especially between West Sea Level Drive, west to the drop-off at the east edge of the Encinal Canyon drainage. This area is immediately west of, and to the northwest of, the current proposed project. Note that several studies have shown that this entire is not in pristine condition. Salls 1989 site record notes that an " extensive area has been cut and graded with large portions of the midden displaced by PCH construction, road and house pad cutting and filling along Broad Beach Rd. and both branches of Sea Level drive." Wlodarski (2003c:iii) notes that "fill soils and trash debris such as brick, concrete, asphalt, glass, rubber and plastic" is present in/at several of the parcels on the west side of West Sea Level Drive close-by the MRCA proposed parking and turn-around improvements.

It is noted that the records search showed that the development of the Broad Beach neighborhood and the at times associated archaeological excavations, etc., involved considerable differences of opinion between the developers, the Native American community, and the various archaeologists that were involved, and there was some debate concerning the quality of the archaeological work and the potential significance of the findings (see Bowles 1992).

A records check done by the Native American Heritage Commission (July 8, 2015) shows no State of California Sacred Lands listed within one mile of the project area.

The author also contacted the University of California Los Angeles Fowler Museum at UCLA Curator of Archaeology Wendy Teeter. According to Teeter the museum has an artifact collection from CA-LAN-114, which was recovered from the site in 1991, during site testing by Brian Dillon. This collection is curated at the Fowler as collection #A8710. A second group of artifacts from LAN-114 is curated as collection #950. These artifacts were collected by the author during monitoring of the installation of a new water-line in Broad Beach Road in 2007. In addition, California State University Northridge has file VS-620, which concerns part of the CA-LAN-114 site

Figure 5. Shell Midden by West Sea Level Drive Parking Area. View is to Southwest.

FIELD SURVEY

The pedestrian field survey is an important part of a project's environmental assessment; the survey verifies the exact locations of any known cultural resources, the condition or integrity of the resource(s), and the proximity of the resource to other cultural resources. The survey also attempts to locate previously unrecognized archaeological sites and isolated artifacts. The Lechuza Beach Public Access Improvements Project field survey was performed by Albert Knight on June 19, 2015. The Sea Level Drive West and Sea Level Drive East accesses were examined in single out-and-back transects, while the Lachuza Beach area was walked in a few east-west transects, which were about 3 meters apart; not all areas of the beach were closely checked, due to the need to respect the privacy of various sun-bathers. The specific project locations that were examined were:

1- The West Sea Level Drive Beach Access Route (project SLW)
This consists of portions of parcels 4470-021-900, 4470-021-007, 4470-021-008, and 4470-028-915.

Figure 6. Existing Terrace (L) and Fire Department Turnaround (R). View is to South.

Figure 7. Existing West Sea Level Drive Stairs. View is to Northwest.

Much of this access route is developed with houses, the street, parking areas, gardens and grounds. The field check confirmed information gleaned during the records check, in that the southwest part of CA-LAN-114 is extant in at least part of this area. Specifically, midden with numerous small pieces of marine shell is clearly visible (Figure 5, Page 18.) adjacent to the existing Fire Department turnaround (the area with the visible shell can be seen in Figure 6). The access stairway occupies the steep sea-cliff between the bluff and the beach. (See Figure 7, Page 20.)

In addition, several small pieces of clam and mussel shell were observed, from the edge of the street, in three of the five undeveloped parcels on the northwest edge of West Sea Level Drive. A water line that runs along the west edge of the street may be the reason that shell is visible here, although there is no way, without performing some kind of archaeological testing, to determine from what depth the shell originated; given the presence of CA-LAN-114, it can be generally assumed that the shell is primarily superficial, but that it is likely that some buried material is present, in addition to that exposed on the surface.

Figure 8. Existing Broad Beach Road Access to East Sea Level Drive. View is to South.

2- The East Sea Level Drive Beach Access Route (project SLE)
This consists of portions of parcels 4470-021-900, 4470-021-009, 4470-024-061, 4470-024-062, and 4470-024-901.

The first 100 feet or so of this access trail, which begins immediately south of Broad Beach Road, appears to be fill dirt, which was imported to square-up the trail, and it includes some decomposed granite. (See Figure 8, Page 21.) The access south of the built up area, and just above a steep drop off, appears to have been dug out of the native dirt hillside, to a depth of perhaps two feet, again so as to semi-level the trail. No shell fragments or other possible cultural derived materials were observed on this upper, semi-level part of the access route. The trail quickly leads to and passes through an old chain-link fence, where the trails begins to descend (going towards the ocean) numerous wood stairs, which lead down to a small terrace, where the trail jogs to the right (west), and then almost immediately jogs left (south) again. Almost all of this middle part of the access trail is covered with planted non-native trees and shrubs, with only minor evident of native plants remaining. (See Figure 9, Page 22.) Privacy walls block the view

Figure 9. Existing East Sea Level Drive Access to Beach. View is to South.

into the private properties on both the west and east sides of the access route/trail. The lowest part of the access trail/wood stairs reaches the beach at a point adjacent to the west end of East Sea Level Drive; the lowest steps consist of piles of sandbags (the bottom most wood steps having been washed away by the actions of the sea). The area where a public bathroom is proposed consists of the lower part of the steep hillside and at least some soil would have to be excavated away to make room for the improvement. (See Figure 10, Page 23.) Small amounts on very small pieces of marine shell can be seen in the beach sand here, and elsewhere along the beach (see following). There are no indicators that any of this particular shell is culturally derived.

3- Lechuza Beach Generally between the South (Beach) Ends of SLW and SLE
This consists of parcels 4470-028-900 through 4470-028-918, 4470-021-900, and 4470-001-900.

Very small fragments of marine shell can be seen across much of the beach area, but there are no indicators that any of this particular shell is culturally derived.

Figure 10. Proposed Location of Restroom Facilities, Above Beach at West End of East Sea Level Drive. View is to Northwest.

REPORT OF FINDINGS

1- Sea Level Drive West Access Route (SLW).

Both the archival research and the field research show that site CA-LAN-114 still exists in this part of the project area, and therefore, the proposed MRCA access improvement work has the potential to negatively impact the portion of the site at the south end of West Sea Level Drive (i.e. at the location of the proposed improved "D" and "DD" parking places). Previous research in the area of West sea Level Drive, just north of the current project area, included multiple occasions of extensive sub-soil testing, suggests that much of the west edge of CA-LAN-114 was 1- originally of a minor nature, being located at the very edge of the sea cliff, at the southwest extremity of the village, and 2- that the western edge of the site, being that portion that is located on the east bank of Encinal Canyon, has been "squared up" with fill dirt, some of which appears to be derived from portions of the CA-LAN-114 site, probably from/to a short distance to the northeast (south of PCH, and in the area of today's Cottontail Lane).

2- Sea Level Drive East Access Route (SLE).
No archaeological materials of any kind were observed in this survey area, except at the very bottom (south) end of the access trail, where the trail reaches the beach. Occasional small pieces of marine shell are found in the beach sand here, and these appear to be typical of the local sandy beach environment; these (mostly clam and mussel) are not considered to be culturally derived.

3- Lechuza Beach Generally between the South (Beach) Ends of SLW and SLE.
No archaeological or cultural derived materials of any kind were observed in this area. Although the beach area adjacent to CA-LAN-114 would obviously have been a major area of activity for the people that lived at the site, no evidence of that activity is present today. The rise in Holocene sea-levels, numerous large storms along the coast, and the strong local cross-shore currents, would have washed away any evidence of the many Native American uses of the land at the edge of the sea. And the modern application of a considerable amount of introduced sand by "Malibu's Celebrity Haven", would make the discovery of any archaeological remains on the beach itself very problematic.

MANAGEMENT RECOMMENDATIONS

Wlodarski (2006:v) believes that: "Due to the age of the site (likely over 2,200 years old), the fact that burials were uncovered, its variability and complexity, and that it was a major coastal village, CA-LAN-114 is a significant heritage resource under CEQA." As noted above, based on their examination of the existing archaeological records, the SCCIC-CSUF concluded that ". . . the project area is extremely sensitive for cultural resources. Therefore it is recommended that a qualified archaeological consultant be retained to identify the boundaries of previously recorded sites and monitor all ground-disturbing activities within the project area." This consultant, having examined the existing records, and having examined the proposed Lechuza Beach Public Access Improvements Project area in person, confirms the continuing existence of portions of the CA-LAN-114 site in the area at the south end of West Sea Level Drive. The consultant feels that the existing record adequately describes the site, including the small portions that still exist today, and that at this time no additional recordation is required (however, see following).

Recommendations concerning each of the three sub-areas of the project are as follows:

1- The Sea Level Drive West Access Route (SLW).

Previous archaeological and geologic testing in the area immediately northwest of the proposed SLW improvement area demonstrated that there were no significant intact deposits present in those specific lots. However, given that archaeological materials, including *in situ* deposits of shell midden, and secondary deposits that may have been transported to the project area from elsewhere on the site, are known to be present in some parts of the general area, and taking into consideration that the local Native American community considers the site to be culturally important- Native American human remains having been recovered from the site- it seems prudent to recommend at least limited monitoring of all soil disturbing activities. Therefore, recommended cultural resources monitoring requirements are as follow:

a. A Native American monitor and an archaeological monitor will be retained and both monitors will be present during initial ground disturbing activities. This includes demolition of old pavement and any other natural or man-made objects whose removal has the potential to disturb any under-laying native soil. This task to be performed until such time that both monitors agree that bedrock or sterile soil has been reached and there is no longer any possibility of disturbing intact midden deposits; the excavation of bedrock will not be monitored. Monitoring will also be performed during the removal of any fill soils, so as to ensure that this process does not disturb any underlying midden deposits; the placement of new fill will not be monitored.

   This recommendation does not apply to reconstruction of the stairs on the bluff face or construction of the caisson for the stairs on the sand. This recommendation applies only to the rebuilding of the view platform on the terrace and its retaining wall, constructing the parking spaces, and improvements to the Fire Department turnaround.

b. If any new, previously unrecorded, archaeological deposit or feature is discovered, the monitors will immediately halt the work. Arrangements to formally record the deposit or feature will then be made by the MRCA, and the deposit or feature will be recorded and/or mitigated, according to applicable statutes, before work is allow to resume.

c. If human bone is discovered during the project, the work in the area that the remains are discovered shall cease immediately and the Los Angeles County coroner and the MRCA will be immediately notified. Work in that area will not proceed until the coroner determines that the remains are those of a Native American, or not. In the case where the remains are identified as being those of one or more Native Americans, the MRCA will notify the State of California Native American Heritage Commission as soon as possible. Sections 5097.94 and 5097.98 of the Public Resources Code describe the procedures to be followed after the Native American heritage Commission is notified.

d. Upon completion of site testing and/or construction monitoring, the consulting archaeologist will prepare and submit a report to the MRCA, which will document the results of the monitoring, in order to demonstrate evidence of cultural resource compliance during the project, and so as to establish a data base suitable for referencing by any archaeologists doing work in the project area in the future.

2- The Sea Level Drive East Access Route (SLE).

Neither the records search nor the field survey identified any cultural remains, including marine shell, in this area. Therefore the discovery of any culturally-derive marine shell, any stone artifacts, or any other culturally-derived remains, would constitute a new discovery. However, the proposed bathroom location will have to be cut into a steep hillside, an existing access road already exists and will not have to be improved, and the proposed leach field area is an artificially constructed feature/facility, so there is very little chance that any archaeological deposits will be present in these areas. None of the other proposed project work (e.g. drilling of holes to receive CIDH piles, establishment of shoring to protect workers and the work area) is likely to cause any negative impacts to any cultural resources. Therefore, no monitoring is required in this area.

3- Lechuza Beach Generally Between the South (Beach) Ends of SLW and SLE.

Neither the records search nor the field research identified cultural remains in this area and given the natural condition of the beach environment, none are likely to be present, therefore no monitoring is required. However, it is possible that artifacts may fall to the beach area from the marine terrace above, and MRCA crews and/or subcontractors need to be aware that the discovery of any stone artifacts, or any other culturally-derived remains, would therefore be of interest. In all cases, work crews should be instructed to report any stone artifacts, or anything unusual that might be a prehistoric artifact, to the MRCA immediately upon discovery.

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Project-Specific Reference #2

LECHUZA BEACH PUBLIC ACCESS IMPROVEMENTS PROJECT
RARE AND SENSITIVE PLANT SURVEY
MAY 27, 2015

Prepared by: Fred M. Roberts, P.O. Box 517, San Luis Rey, California
Prepared for: Judi Tamasi, Mountains Recreation and Conservation Authority, Malibu, California.

At the request of the Mountains Recreation and Conservation Authority (MRCA), the author conducted a rare and sensitive plant species survey for the Lechuza Beach Public Access Improvements Project (Project) on 22 April 2015. The survey is a follow-up survey to a previous rare and sensitive plant survey conducted by the author on 12 May 2011.

PREVIOUS STUDIES

The author is aware of two previous studies. The Project area was surveyed for rare and sensitive species by Michael Brandman Associates (2006) and Roberts (2011). No native to the site rare or sensitive plant species were reported within Project area in either study.

Michael Brandman Associates (2006) concluded *"only limited elements of marginal habitat for these species, specifically the remnant coastal bluff scrub vegetation within the ornamental landscape community."* The report went on to conclude that the *"dominance of non-native ornamental plant species, and overall himan disturbance associated with residential development and recreational beach use, these sensitive plant species are considered to have low potential to occur within the site."*

Roberts (2011) concluded *"No rare or sensitive plant species are anticipated to occur within [the project area] due to limited undisturbed natural habitat within the Lechuza Beach project site in its current condition."*

SITE LOCATION

The Project is situated on the immediate coast along Lechuza Beach in Malibu about three miles west of Point Dume, just west of Lechuza Point, near the western end of Los Angeles County, California (See Figure 1). It bordered on the west, near the terminus of West Sea Level Drive and just west of an existing access stair (hereby referred to as the Western Access Stair), south, including the upper beach and coastal bluff slopes paralleling Broad Beach Road s to the Broad Beach Road and Bunnie Lane access stair (Broad Beach Road Access Stair), then continuing south on the coastal side of East Sea Level Drive about 500 feet. The Project also includes the Broad Beach Road Access Stair (See Figure 2).

The Project includes a number of improvements that will expand public parking as at the end of West Sea Level Drive and along East Sea Level Drive, reconstruct the Western Access Stair, expand and improve the Broad Beach Access Stair, and place new restrooms at the base of that stair.

Figure 1. Vicinity Map showing the general location of the Lechuza Beach Public Access Improvements Project.

SITE DESCRIPTION

The Project site is generally located within an urban interface with limited natural vegetation. The general disturbance of the site is roughly unchanged for the last 25-years. The condition of the site along East Sea Level Drive dates from an even earlier time, with the residential housing and road largely in place by 1952 though it appears that improvements on the coastal side of the drive are more recent, at least by 1990 (1947, 1952, 1959, 1967, 1980, 1990, 1994 aerial images available through Historical Aerials by NETRonline, historicaerials.com, more recent images reviewed on Google Earth).

Figure 2. Lechuza Beach. Areas surveyed are bordered in yellow

The entire southern side of the Project area is dominated by beach sands on Lechuza Beach that are devoid of terrestrial vegetation. The western end of the Project area, just west of the Western Access Stair has ornamental plantings or open disturbed habitat on the bluff top with a sharp ocean bluff cliff with relectual coastal bluff scrub heavily invaded by non-natives. The bluff top includes Tasmanian blue gum (*Eucalyptus globulus*), myoporum (*Myoporum laetum*), Monterey cypress (*Hesperocyparis macrocarpa*), Perez's sea-lavender (*Limonium perezii*) and big saltbush (*Atriplex lentiformis*). The last is potentially of native origin but likely planted or re-established.

The coastal bluff cliff side from immediately west of the Western Access Stair and about 20 feet to the east is in closer to natural condition, largely consisting of barren sedimentary exposures with marginal coastal bluff scrub represented by several natives, including prostrate goldenbush (*Isocoma menziesii* var. *sedoides*), and California orach (*Atriplex californica*) but primarily non-native species such as croceum ice plant (*Malephora crocea*), Hottontot fig (*Carpobrotus edulis*), and clipped lime.

The bluff slopes between the Western Access Stair and the Broad Beach Road Access Stair are largely dominated by non-native shrubs including myoporum, Sydney golden wattle (*Acacia longifolia*), myoporum, Pampas grass (*Cortedaria selloana*), tree tobacco (*Nicotiana glauca*), red gum (*Eucalyptus camaldulensis*), and relatively abundant non-native perennials such as Hottontot fig, clipped lime, trailing African daisy (*Dimorphotheca fruticosa* or possibly hybrids), giant reed (Arundo donax), baby sun-rose (*Aptenia cordifolia*), croceum ice plant, and dusty miller (*Centaurea cineraria*). A single date palm (Phoenix dactylifera) is present with recently established Canary Island palms (*Phoenix canariensis*). The native species are mostly scattered with an occasional pocket of dense stands of lemonade berry (*Rhus integrifolia*) and coyote bush (*Baccharis pilularis*) with scattered California bush sunflower (*Encelia californica*), California buckwheat (*Eriogonum californicum*), and laurel sumac (*Malosma laurina*).

The vegetation along the Broad Beach Access Stair is largely ornamental and planted, except at the westward turn on the central portion of the stair, where there is a patch of grassy coastal sage scrub on the western (north) side that is largely dominated by California buckwheat, lemonade berry, California bush sunflower, ripgut grass (*Bromus diandrus*), and anise (*Foeniculum vulgare*). The upper portion of the stair, and on its eastern side, the trees and shrubs are largely ornamental, especially myporum, melaluca (*Melaluca* sp.), Natal plum (*Carissa macrocarpa*), rosemary (*Rosmarinus officinalis*), and clipped lime. Toward the bottom, the walkway and slopes are shaded by large Monterey cypress. The slopes are more open, except for a large patch of lemonade berry and include a number of exotic shrubs such as bicolored tree mallow (*Lavatera maritima*), Cape leadwort (Plumbago auriculata), and herbs such as nettle-leaved goosefoot (*Chenopodium murale*) and giant tickseed (*Leptosyne gigantean*). The latter is native to the area but based on lack of mature individuals, abundance of very young plants, and increase in number since 2011, is likely originating from plantings or becoming re-established here. Just outside the survey area (about 20 feet to 50 feet away from the stair) there is some relectual coastal bluff scrub habitat with Califronia box thorn (*Lycium californicum* [see discussion under rare and sensitive plants]), prickly pear (*Opuntia littoralis*), California buckwheat, and giant wildrye (*Elymus condensatus*).

The habitat along East Sea Level Road is almost entirely planted or of ornamental origin, with lawn adjacent to the road, landscaping, and the slopes overseeing the beach, almost entirely covered with Hottontot fig. Very few native species are present, a small patch of beach-bur (*Ambrosia chamissonis*) growing in ice plant being nearly the sole representative species. Among the diverse species of non-natives include myoporum, pride-of-madera (*Echium candicans*), trailing African daisy, sea-lavender, treasure flower (*Gazania linearis*), blue-eyed African daisy (*Arctotis venusta*), blue marguerite (Felicia *amelloides*), Indian hawthorn (*Rhaphiolepis indica*), sea-rocket (*Cakile maritima*), clipped lime, day lily (*Hemerocallis cultivars*), and New Zealand flax (*Phormium tenax*).

RARE AND SENSITIVE PLANTS

At least 24 species of rare sensitive vascular plant species and one non-vascular plant have been reported from the Point Dume and Triunfo USGS Quadrangles (CNPS 2015, Consortium of California Herbaria 2015). Few of these are expected to occur on the immediate coast. The majority of these species are associated with rocky habitats, chaparral, or coastal sage scrub and generally not known to occur on the immediate coast. Those most likely to occur, or to have historically occurred, in the vicinity of Lechuza Beach include red sand-verbina (*Abronia maritima*), Coulter's saltbush (*Atriplex coulteri*), Orcutt's pincushion (*Chaenactis glabriuscula* var. *orcuttiana*), Blochman's dudleya (*Dudleya blochmaniae* subsp. *blochmaniae*), south coast branching phacelia (*Phacelia ramosissima* var. *austrolitoralis*), and California boxthorn (*Lycium californicum*). All of these species are known to occur in coastal bluff scrub and coastal sage scrub along the immediate coast on bluff tops or at the interface between the beach and the cliffs.

SURVEY RESULTS

No rare or sensitive plant species were observed or anticipated within the survey boundaries due to limited undisturbed natural habitat within the Project site in its current condition. The six species mostly likely to occur, or did occur prior to major disturbance circa 1990, are typically detectable in late April. However, the annual species may not be detectable in dry years such as 2015. Based on the assessment of available suitable natural habitat, it is very unlikely these annuals occur within the Project area.

One sensitive shrub, California boxthorn, a California Rare Plant Rank 4.2 plant was found on the bluff slopes just outside the project area (See Figure 3). The distribution of California boxthorn is poorly known in the vicinity of Malibu. The Consortium of California Herbaria only include one record for just east of Point Dume (*W.O. Griesel s.n., 25 April 1925* [LA 51849]) but likely it is more abundant in the area then this one record would indicate.

Two plants are present at the site neither with flowers or fruit, growing on a moderately steep south-facing slope in disturbed coastal sage scrub/ coastal bluff scrub. The plants are located about 30 feet west of the Broad Beach Access Stair near the Monterey cypress trees. The coordinates are UTM Z11 03 27 730mE, 37 67 752mN.

Figure 3. The red dot labeled LycCaA22-1 indicates the location of California boxthorn (*Lycium californicum*) just outside the Project area and west of the Broadbeach Road Access Stair.

A list of plant species observed at the Lechuza Beach site on 22 April 2015 is included in Appendix A. A total of 101 species were observed including 13 native species (about 13 percent) and 88 non-native species (87 percent). At least 25 of the non-native species likely originated from plantings. Several non-natives are not included on the list as the author was unable to determine their identification below the family level.

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APPENDIX A: A LIST OF SPECIES OBSERVED AT LECHUZA BEACH

LEPTOSPORANGIATE FERNS

DRYOPTERIDACEAE – WOOD FERNS

Cyrtomium falcatum HOLLY FERN

GYMNOSPERMS

CONIFEROPHYTA - CONE-BEARING PLANTS

CUPRESSACEAE - CYPRESS FAMILY

Hesperocyparis macrocarpa MONTEREY CYPRESS. Planted.

PINACEAE - PINE FAMILY

Pinus torreyana TORREY PINE. Planted.

MAGNOLIOPHYTA - FLOWERING PLANTS
EUDICOTYLEDONS - EUDICOTS

AIZOACEAE - CARPET-WEED FAMILY

Aptenia cordifolia BABY SUN ROSE
Carpobrotus edulis HOTTENTOT-FIG. Very abundant, widespread.
Lampranthus multiradiatus RED FLUSH
Malephora crocea CROCEUM ICE PLANT

ANACARDIACEAE - SUMAC FAMILY

Malosma laurina LAUREL SUMAC
Rhus integrifolia. LEMONADE BERRY

APIACEAE - CARROT FAMILY

Foeniculum vulgare SWEET FENNEL

APOCYNACEAE - DOGBANE FAMILY

Carissa macrocarpa NATAL PLUM. Planted.
Nerium oleander OLEANDER. Planted.
Vinca major BLUE PERIWINKLE. Planted.

ARALIACEAE - GINSENG FAMILY

Hedera canariensis CANARY ISLANDS IVY
Hedera helix ENGLISH IVY

ASTERACEAE - SUNFLOWER FAMILY

Ambrosia chamissonis BEACH-BUR
Baccharis pilularis subsp. ***consanguinea*** (COYOTE BRUSH or CHAPARRAL BROOM
Centaurea cineraria DUSTY MILLER
Dimorophotheca fruticosa [*O. ecklonis*, *O. fruticosum*] TRAILING AFRICAN DAISY
Encelia californica CALIFORNIA ENCELIA
Felicia amelloides BLUE MARGUERITE. Planted.
Gazania linearis TREASURE FLOWER. Planted.
Isocoma menziesii aff. var. ***sedoides*** PROSTRATE GOLDENBUSH
Isocoma menziesii aff. var. ***vernonoides*** COAST GOLDEN BUSH
Leptosyne gigantea [*Coreopsis g.*] GIANT COREOPSIS [possibly of natural origin]
Plecostachys serpyllifolia [*Helichrysum serpyllifolium*] CLIPPED LIME or PETITE-LICORICE. Apparently planted and naturalized.
Sonchus oleraceus COMMON SOW-THISTLE
Taraxacum officinale COMMON DANDELION

BALSAMINACEAE – TOUCH-ME-NOT FAMILY

Impatiens cf. walleriana IMPATIENS. Planted.

BIGNONIACEAE – BIGNON FAMILY

Tecomaria capensis CAPE HONEYSUCKLE. Planted.

BORAGINACEAE - BORAGE FAMILY

Echium candicans PRIDE OF MADERA

BRASSICACEAE - MUSTARD FAMILY

Cakile maritima SEA-ROCKET
Hirschfeldia incana SHORTPOD or SUMMER MUSTARD
Lobularia maritima. SWEET-ALYSSUM. Planted.

CAPRIFOLIACEAE – HONEYSUCKLE FAMILY

Lonicera japonica JAPANESE HONEYSUCKLE

CHENOPODIACEAE – GOOSEFOOT FAMILY

Atriplex californica CALIFORNIA ORACH
Atriplex lentiformis BIG SALTBRUSH
Atriplex prostrata SPEARSCALE
Atriplex semibaccata AUSTRALIAN SALTBUSH
Chenopodium murale NETTLE-LEAVED GOOSEFOOT
Salsola tragus RUSSIAN THISTLE

CONVOLVULACEAE - MORNING-GLORY FAMILY

Calystegia macrostegia (MORNING-GLORY

CRASSULACEAE - STONECROP FAMILY

Cotyledon orbiculata var. ***oblongata*** COTYLEDON
Crassula argentea JADE PLANT. Planted and naturalizing.

EUPHORBIACEAE - SPURGE FAMILY

Euphorbia peplus PETTY SPURGE
Ricinus communis CASTOR-BEAN

FABACEAE (LEGUMINOSAE) - PEA FAMILY

Acacia longifolia SYDNEY GOLDEN WATTLE
Melilotus indicus YELLOW SWEET-CLOVER

GERANIACEAE - GERANIUM FAMILY

****Pelargonium Xhortorum*** ZONAL GERANIUM

LAMIACEAE (LABIATAE) - MINT FAMILY

Rosmarinus officinalis ROSEMARY. Planted.

MALVACEAE - MALLOW FAMILY

Lavatera maritima BICOLORED TREE MALLOW
Malva cretica [*Lavatera c*.] CRETAN MALLOW
Malva parviflora CHEESEWEED

MORACEAE- FIG FAMILY

Ficus benjamania WEEPING FIG. Planted.

MYRSINACEAE - MYRSINE FAMILY

Anagallis arvensis SCARLET PIMPERNEL

MYRTACEAE - MYRTLE FAMILY

Eucalyptus camaldulensis RIVER RED GUM
Eucalyptus globulus TASMANIAN BLUE GUM
Melaleuca elliptica GRANITE HONEY MYRTLE. Planted.
Melaleuca sp. MYRTLE. Planted.

NYCTAGINACEAE - FOUR-O'CLOCK FAMILY

Bougainvillea glabra BOUGAINVILLEA. Planted.

ONAGRACEAE – EVENING PRIMROSE FAMILY

Oenothera speciosa MEXICAN PRIMROSE. Planted?

OXALIDACEAE – SORREL FAMILY

Oxalis corniculatus YELLOW SORREL
****Oxalis pres-capre*** BERMUDA BUTTERCUP, SOUR GRASS

PLUMBAGINACEAE - LEADWORT FAMILY

Armeria maritima SEA PINK. Planted.
Limonium perezii PEREZ'S SEA-LAVENDER
Plumbago auriculata [*P. capensis*] CAPE LEADWORT. Planted.

POLYGONACEAE - BUCKWHEAT FAMILY

Eriogonum fasciculatum subsp. ***fasciculatum*** CALIFORNIA BUCKWHEAT
Rumex conglomeratus WHORLED DOCK

ROSACEAE – ROSE FAMILY

Rhaphiolepis indica INDIAN HAWTHORN. Planted.
Rosa sp. CULTIVATED ROSE. Planted.

SCROPHULARIACEAE - FIGWORT FAMILY

Myoporum laetum MYOPORUM. Planted and naturalizing, widespread, common.

SOLANACEAE - NIGHTSHADE FAMILY

Nicotiana glauca TREE TOBACCO

URTICACEAE – NETTLE FAMILY

Soleirolia soleirolii BABY'S TEARS

VERBANACEAE – VERVAIN FAMILY

Verbena sp. VERBENA

MONOCOTYLEDONS – MONOCOTS

AGAVACEAE - AGAVE FAMILY

Agave americana AMERICAN AGAVE
Dracaena sp. DRACAENA. Planted.

ALLIACEAE - ONION FAMILY

Nothoscordum gracile FALSE GARLIC
Tulbaghia violaceae SOCIETY GARLIC. Planted.

AMARYLLIDACEAE - AMARYLLIS FAMILY

***Agapanthus africanus** AFRICAN BLUE LILY or LILY OF THE NILE. Planted.

ARECACEAE (PALMAE) - PALM FAMILY

***Phoenix dactylifera** DATE PALM

ASPARAGACEAE - ASPARAGUS FAMILY

***Asparagus asparagoides** SMILAX

ASPHODELACEAE - ASPHODEL FAMILY

***Aloe arborescens** CANDELABRA ALOE. Planted.

CANNACEAE - CANNA FAMILY

***Canna** sp. CANNA. Planted.

CYPERACEAE - SEDGE FAMILY

***Cyperus involucratus** AFRICAN UMBRELLA-SEDGE.

HEMEROCALLIDACEAE – DAY LILY FAMILY

***Hemerocallis** cultivars DAY LILY. Planted.

IRIDACEAE - IRIS FAMILY

***Dietes iridioides** [*Moraea i.*] FORTNIGHT IRIS. Planted.

JUNCACEAE – RUSH FAMILY

***Juncus** sp. RUSH. Planted.

PHORMIACEAE – NEW ZEALAND FLAX FAMILY

***Phormium tenax** NEW ZEALAND FLAX. Planted.

POACEAE - GRASS FAMILY

***Agrostis viridis** WATER BENTGRASS
***Arundo donax** GIANT REED
Bothrichloa barbinoides CANE BLUESTEM
***Brachypodium distachyon** PURPLE FALSE BROME

***Bromus catharticus** RESCUE GRASS
***Bromus diandrus** COMMON RIPGUT GRASS
***Cortaderia selloana** SELLOW'S PAMPAS GRASS
***Cynodon dactylon** BERMUDA GRASS
***Ehrharta erecta** PANIC VELDT GRASS.
Elymus condensatus GIANT WILD RYE
***Festuca** sp. FESCUE. Lawn planting.
Hordeum murinum** subsp. ***leporinum HARE BARLEY or FOXTAIL BARLEY
Melinis repens** *ssp.* ***repens NATAL GRASS
***Pennisetum clandestinum** KIKUYU GRASS. Planted and naturalizing.
***Pennisetum setaceum** AFRICAN FOUNTAIN GRASS

Project-Specific Reference #3

Terrestrial Biological Resources Study
Lechuza Beach Project
Malibu, Los Angeles County, California

Point Dume, California USGS 7.5-minute Topographic Quadrangle Map
Topanga Malibu Sequit Land Grant, Township 1 South, Range 19 West

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January 17, 2006

TABLE OF CONTENTS

LIST OF TABLES

LIST OF EXHIBITS

SECTION 1: SUMMARY

This report contains the results of a Terrestrial Biological Resources Study conducted by Michael Brandman Associates (MBA) for a 4.1-acre property owned by the Mountains Recreation and Conservation Authority (MRCA). The property, hereinafter referred to as project site or site, is located within Lechuza Beach in the City of Malibu, Los Angeles County, California. The MRCA proposes to expand public access to the beach.

The project site contains suitable habitat for two sensitive wildlife species, California least tern (*Sterna antillarum browni*) and western snowy plover (*Charadrius alexandrinus nivosus*). The site also contains suitable nesting habitat for avian species protected by the Migratory Bird Treaty Act (MBTA) and California Fish and Game (CFG) Code §3503. Prior to any project-related ground disturbance during the nesting season, February to August, a nesting bird survey is required. In addition, a wintering season survey for western snowy plover is recommended prior to any disturbance on or adjacent to the sandy beach from September to January.

The project site does not contain any potentially jurisdictional waters or wetlands. However, the site is located within the vicinity of a potentially jurisdictional drainage feature, as well as the Pacific Ocean. Although impacts are not expected, it should be noted that direct or indirect impacts to jurisdictional waters would require permits from the regulatory agencies.

The project site is located within the City of Malibu's Local Coastal Program (LCP), adjacent to a designated Environmentally Sensitive Habitat Area (ESHA). The type of project that is proposed for the site is permitted within the ESHA.

SECTION 2: INTRODUCTION

At the request of the MRCA, MBA conducted a biological resources study of the Lechuza Beach project site, located in the City of Malibu, Los Angeles County, California. This report provides a detailed description of existing site conditions and was written to comply with all California Environmental Quality Act (CEQA) and local requirements to evaluate biological resources. The information contained herein is intended to provide a baseline for which subsequent evaluations can be made of potential biological resource impacts associated with future projects, based upon the environmental policies and regulations discussed in Appendix D, including the Clean Water Act (CWA), the Federal Endangered Species Act (ESA), the California Endangered Species Act (CESA), and CEQA.

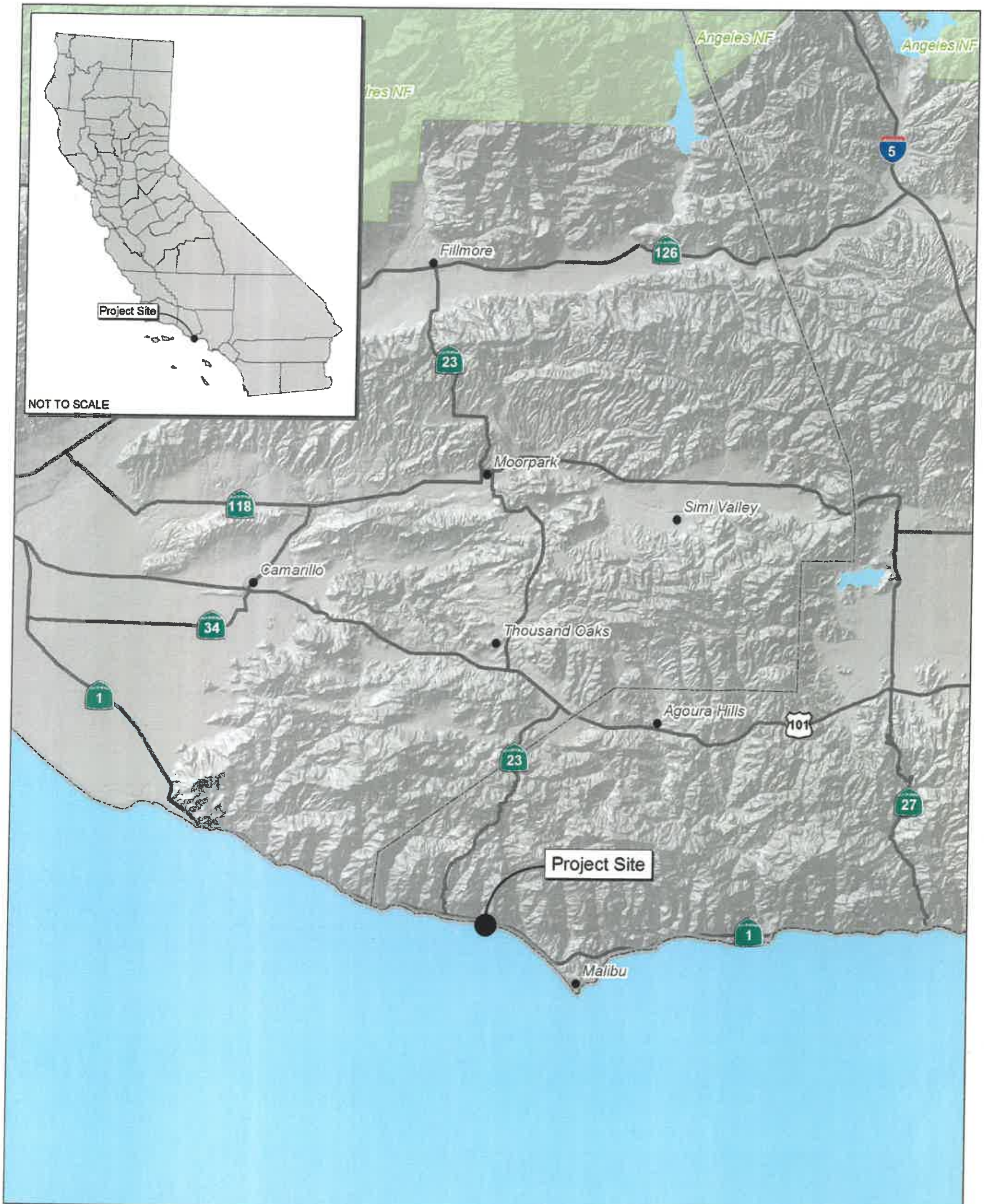
2.1 - PROJECT SITE LOCATION

The project site is generally located south of State Route 1 (Pacific Coast Highway), east of State Route 23, and west of State Route 27, in the City of Malibu, Los Angeles County, California (Exhibit 1). The site is located immediately adjacent to the Pacific Ocean, east of Robert H Meyer Memorial State Beach and west of Lechuza Point, within the southern portion of the Topanga Malibu Sequit Land Grant, Township 1 South, Range 19 West, of the *Point Dume, California*, United States Geological Survey (USGS) 7.5-minute topographic quadrangle map (Exhibit 2).

The project site is comprised of an irregular-shaped parcel approximately 4.1-acres in size, located south of Broad Beach Road, between West Sea Level Drive and East Sea Level Drive (Exhibit 3). It is currently used for public beach access and recreation. Land use adjacent to the site consists of private residential development to the north, east, and west, with the Pacific Ocean located to the immediate south.

2.2 - PROJECT DESCRIPTION

The MRCA proposes to expand public access to Lechuza Beach while protecting and enhancing the Beach's natural resources. Specific project plans are being developed and were not available during the preparation of this report.



Source: Census 2000 Data, The CaSIL, MBA GIS 2006.

Michael Brandman Associates

NORTH

5 2.5 0 5 Miles

Exhibit 1
Regional Location Map

25080002 • 12/2006| 1_regional.mxd

MOUNTAINS RECREATION AND CONSERVATION AUTHORITY • LECHUZA BEACH PROJECT
TERRESTRIAL BIOLOGICAL RESOURCES STUDY

Source: TOPO! USGS Point Dume (1995) 7.5' DRG.

Michael Brandman Associates

NORTH

1,000 500 0 1,000
Feet

Exhibit 2
Local Vicinity USGS Map

25080002 • 12/2006 | 2_local_usgs.mxd

MOUNTAINS RECREATION AND CONSERVATION AUTHORITY • LECHUZA BEACH PROJECT
TERRESTRIAL BIOLOGICAL RESOURCES STUDY

Source: National Agricultural Imagery Program 2005.

Michael Brandman Associates

NORTH

1,000 500 0 1,000 Feet

Exhibit 3
Local Vicinity Aerial Map

25080002 • 12/2006 | 3_local_aerial.mxd

MOUNTAINS RECREATION AND CONSERVATION AUTHORITY • LECHUZA BEACH PROJECT
TERRESTRIAL BIOLOGICAL RESOURCES STUDY

SECTION 3: METHODOLOGY

Analysis of the biological resources associated with the project site began with a thorough review of relevant literature followed by a reconnaissance-level field survey. The primary objective of the field survey was to document existing site conditions, focusing on the terrestrial environment. An assessment of marine resources in the adjacent coastal waters is not included within this study.

3.1 - LITERATURE REVIEW

The literature review provides a baseline from which to evaluate the biological resources potentially occurring on the project site, as well as the surrounding area. For the purposes of this report, sensitive species are defined as those species designated as threatened or endangered under the ESA or CESA; California Species of Special Concern; California Fully Protected; given a status of 1A, 1B, or 2 by the California Native Plant Society (CNPS); or otherwise considered sensitive under CEQA review.

A compilation of sensitive plant and wildlife species recorded in the vicinity of the project site was derived from the California Department of Fish and Game's (CDFG) California Natural Diversity Database (CNDDB), a sensitive species and plant community account database. Additional recorded occurrences of plant species found on or near the site were obtained in the CNPS Electronic Inventory of Rare and Endangered Vascular Plants of California database. The CNDDB GIS database was utilized, together with ArcGIS software, to determine sensitive species located within a 7-mile radius of the site. The CNDDB and CNPS search was based on the *Point Dume* and surrounding *Triunfo Pass* and *Malibu Beach, California*, USGS 7.5-minute topographic quadrangles. Federal register listings, protocols, and species data provided by the United States Fish and Wildlife Service (USFWS) and CDFG were reviewed in conjunction with anticipated federal and state listed species potentially occurring in the vicinity. These and other documents are listed in Section 7, References.

3.2 - RECONNAISSANCE-LEVEL SURVEY

MBA biologist Steve Hongola conducted the reconnaissance-level field survey on November 21, 2006. Special attention was paid to sensitive habitats or those areas potentially supporting sensitive floral and faunal species. The field survey focused on three primary objectives:

- General habitat assessment
- Plant community mapping
- Special status species and plant community assessment

The reconnaissance-level field survey was conducted on foot during daylight hours. The object of the survey was not to extensively search for every species occurring within the project site, but to ascertain general conditions and identify habitat areas that could be suitable for various sensitive plant and wildlife species. Sensitive species are generally considered potentially present on the site if suitable habitat is present, the area lies within a species' geographic range, and the species has been recorded to occur within the vicinity of the site. MBA's biologist inspected habitats for diagnostic wildlife signs such as nests, burrows, tracks, vocalizations, and noted all direct observations. The biologist also inspected surface litter, and occasionally turned over stones, fallen bark, and tree branches to look for secretive reptiles and amphibians.

3.2.1 - Plant Community Mapping

Plant communities were mapped using 7.5-minute USGS topographic base maps and recent aerial photography (ca 2004). Sensitive or unusual biological resources identified during the literature review were ground-truthed during the reconnaissance-level survey for mapping accuracy. Plant communities within the project site were classified at a general level of detail using the widely accepted descriptions provided in Holland's *Preliminary Descriptions of the Terrestrial Natural Communities of California* (1986 and 1996 update), and modifications were made by MBA's biologist where appropriate. Survey results for plant and wildlife species are described in Section 4 of this report.

3.2.2 - Plant Species

Common plant species observed during the reconnaissance-level field survey were identified by visual characteristics and morphology in the field and recorded in a field notebook. Uncommon and less familiar plants were identified offsite using taxonomical guides. A list of all species observed on the project site was compiled from the survey data, shown in Appendix A. Taxonomic nomenclature used in this study follows Hickman (1993). Common plant names, when not available from Hickman (1993), were taken from Munz (1974). In this report, scientific names are provided immediately following common names of plant species for the first reference only.

3.2.3 - Wildlife Species

Wildlife species detected during the reconnaissance-level field survey by sight, calls, tracks, scat, or other signs were recorded in a field notebook. Notations were made regarding general habitats for sensitive species potentially occurring on the project site based on our preliminary assessment of the cited literature. Field guides were used to assist with species identification during surveys and included Stebbins (2003) for amphibians and reptiles, National Geographic Society (1987) for birds, and Burt and Grossenheider (1980) for mammals. Common names of wildlife species are standard; however, scientific names are provided immediately following common names for the first reference only. Appendix A lists all wildlife species observed or detected on the project site during the survey.

A survey for raptors, birds of prey, was conducted simultaneously with the reconnaissance-level field survey. Efforts included direct identification of perched owls or soaring raptors, and incidental observation of sign, including burrows, feathers, nests, pellets, and whitewash.

3.3 - JURISDICTIONAL WATERS AND WETLANDS

Prior to conducting the site visit, MBA's biologists reviewed USGS topographic maps and aerial photography to identify any potential natural drainage features and water bodies that may fall within the jurisdiction of the United States Army Corps of Engineers (USACE), the Regional Water Quality Control Board (RWQCB), and/or the CDFG. In general, all surface drainage features indicated as blue-line streams on USGS maps and linear patches of vegetation expected to exhibit evidence of flows are considered potentially subject to state and federal regulatory authority as "waters of the US and/or state." The assessment was not intended as a formal delineation of waters of the U.S. or State but rather to identify areas that may require a formal delineation.

3.4 - WILDLIFE MOVEMENT CORRIDORS

The project site was evaluated as a potential wildlife movement corridor. The scope of the biological resources survey did not include a formal wildlife movement corridor study, such as the use of track plates, camera stations, scent stations, or snares. However, the focus of this study is to determine if the alteration of current land use on the site will have significant impacts on the regional movement of wildlife. These conclusions are based on the information compiled from the literature review of aerial photographs, USGS topographic maps, and resource maps for the vicinity, and the field surveys combined with knowledge of desired topography and resource requirements for wildlife potentially utilizing the site and vicinity.

3.5 - PROBLEMS AND LIMITATIONS

The reconnaissance-level survey was conducted during the late fall season. As a result, most residual annual plants were withered and dead and some perennial species were dormant, making identifications problematic.

Many amphibians, reptiles, and mammals are secretive by nature and some are only nocturnally active, making diurnal observations problematic. Observations of diagnostic signs may provide evidence of occurrence of these species. Otherwise, conclusions regarding potential occurrence are based on consideration of habitat suitability factors.

SECTION 4: EXISTING CONDITIONS

4.1 - WEATHER CONDITIONS

During the field survey, weather conditions included temperatures ranging from 65 to 68 degrees Fahrenheit and onshore winds averaging 4 to 6 miles per hour. Skies were foggy in the morning with partial clearing in the afternoon.

4.2 - ENVIRONMENTAL SETTING

The project site is located south of Broad Beach Road, between West Sea Level Drive and East Sea Level Drive. The site includes the stretch of beach between these two roads, as well as a narrow stairway access easement on the adjacent bluffs, extending south to the beach from Broad Beach Road at the intersection with Bunnie Lane. The site also includes a small square parcel that extends up a portion of the bluffs from the beach. West Sea Level Drive and East Sea Level Drive and three small isolated square parcels to the east are MRCA access easements.

4.2.1 - Topographic Features

Topographically, the project site is located on the beach and adjacent bluffs above the Pacific Ocean, at the base of the Santa Monica Mountains. The site slopes steeply to the south off the bluffs and then more gently from the beach into the ocean. Lechuza Point extends into the ocean southeast of the site. The site ranges in elevation from mean sea level (msl) to approximately 75 feet above msl.

4.2.2 - Soils

The project site contains two different soils: Abaft-Beaches association and Lockwood-Urban land complex (USDA 1979) (Exhibit 4). The Abaft-Beaches association and the Lockwood-Urban land complex are each mixtures of two different soil series. A soil series is a group of soils with similar profiles. These profiles include major horizons with similar thickness, arrangement, and other important characteristics.

4.2.3 - Level of Disturbance

Overall, the project site is moderately disturbed. The sandy beach area of the site is used for recreational purposes, including walking and sun bathing, although this use is likely heavier during warmer months of the year. Vegetation on the adjacent bluffs has been degraded due to private residential development and associated planting of non-native, ornamental species.

Source: USDA Soils Data and NAIP 2005.

Michael Brandman Associates

NORTH

250 125 0 250 Feet

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Exhibit 4
USDA Soils Map

MOUNTAINS RECREATION AND CONSERVATION AUTHORITY • LECHUZA BEACH PROJECT
TERRESTRIAL BIOLOGICAL RESOURCES STUDY

4.3 - PLANT COMMUNITIES

The project site is dominated by ornamental landscape vegetation associated with surrounding residential development, as well as mostly unvegetated sandy beach (Exhibit 5). The ornamental landscape community is present on the bluffs above the beach, and contains sparsely scattered native coastal scrub species as well as ruderal (weedy) species. The sandy beach contains a narrow stand of ornamental vegetation extending off the bluffs, with a few scattered native species. A complete list of plant species observed during the field survey is provided in Appendix A.

4.3.1 - Ornamental Landscape (0.9 Acres)

Ornamental landscape is a human-influenced assemblage of trees and shrubs usually associated with urban development. Ornamental landscape communities are found within various urban and areas and are usually maintained by periodic pruning and/or artificial irrigation. Non-native, ornamental trees and shrubs typically dominate this community type, but native plant species and grasses may also be present. Ornamental landscape communities provide cover and nesting habitat for wildlife species that have adapted to urban areas.

Ornamental landscape occupies 0.9 acres of the project site. It occurs on the coastal bluff areas, including the access easement stairs, and extends slightly onto the sandy beach. Dominant or common non-native species observed within this community include myoporum (*Myoporum laetum*), fig-marigold (*Carpobrotus* sp.), and iceplant (*Mesembryanthemum* sp.). A small stand of planted Monterey cypress (*Cupressus macrocarpa*) trees occurs at the base of the stairs that extend down to the beach from Bunnie Lane.

The ornamental landscape community also contains small stands of remnant native species as well as invasive, ruderal species. Common native species observed include lemonade berry (*Rhus integrifolia*), laurel sumac (*Malosma laurina*), coast goldenbush (*Isocoma menziesii*), California buckwheat (*Eriogonum fasciculatum*), and giant wild-rye (*Leymus condensatus*). Ruderal species present include pampas grass (*Cortaderia selloana*), castor bean (*Ricinus communis*), and short-pod mustard (*Hirschfeldia incana*).

4.3.2 - Sandy Beach (3.2 Acres)

Sandy beach occupies 3.2 acres of the project site, The majority of the sandy beach present within the site lacks vegetation; however, small stands of the ornamental landscape community extend into the northern portion of the beach from the adjacent coastal bluffs. This narrow stand is dominated by non-native ornamental species such as myoporum and fig-marigold. Other scattered species present include natives such as sand verbena (*Abronia maritima*),

Source: USDA NAIP 2005 and MBA Field Survey 2006.

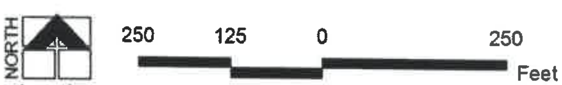

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Exhibit 5
Plant Communities Map

MOUNTAINS RECREATION AND CONSERVATION AUTHORITY • LECHUZA BEACH PROJECT
TERRESTRIAL BIOLOGICAL RESOURCES STUDY

as well as non-natives such as sea rocket (*Cakile maritima*) and purple fountain-grass (*Pennisetum setaceum*).

4.4 - WILDLIFE

Wildlife activity was moderate during the field survey and observations of wildlife consisted mostly of avian species. Common species observed within the ornamental landscape community include Anna's hummingbird (*Calypte anna*), bushtit (*Psaltriparus minimus*), yellow-rumped warbler (*Dendroica coronata*), and house finch (*Carpodacus mexicanus*). Species observed at the interface of the bluffs and the beach include black phoebe (*Sayornis nigricans*), common yellowthroat (*Geothlypis trichas*), and California ground squirrel (*Spermophilus beecheyi*). Shorebirds present along the beach's shoreline included black-bellied plover (*Pluvialis squatarola*), willet (*Catoptrophorus semipalmatus*), whimbrel (*Numenius phaeopus*), and sanderling (*Calidris alba*). California gull (*Larus californicus*) and western gull (*Larus occidentalis*) were observed flying over the beach and adjacent coastal waters. A complete list of wildlife species observed on the project site can be found in Appendix A.

SECTION 5: SENSITIVE BIOLOGICAL RESOURCES

5.1 - SENSITIVE PLANT AND WILDLIFE SPECIES

Based upon the literature and database review, 14 sensitive plant species, 6 sensitive plant communities, and 12 sensitive wildlife species have been recorded to occur in the vicinity of the project site, within roughly 7 miles (CNDDB and CNPS). A discussion of the sensitive plant and wildlife species recorded to occur in the project vicinity is presented in Table 1 and Table 2. These tables identify each sensitive plant and wildlife species, their federal and state status, required habitat, and potential to occur within the site. Based on MBA's literature review, no sensitive species have been previously recorded onsite.

5.1.1 - Sensitive Plant Species

The project site contains marginal habitat for three sensitive plant species that occur in coastal bluff scrub and coastal dune-type communities, Coulter's saltbush (*Atriplex coulteri*), Orcutt's pincushion (*Chaenactis glabriuscula* var. *orcuttiana*), and Blochman's dudleya (*Dudleya blochmaniae* ssp. *blochmaniae*). Each of these species in listed as 1B by the CNPS. However, as discussed in Section 4.3, the site contains only elements of marginal habitat for these species, specifically the remnant native coastal bluff scrub vegetation within the ornamental landscape community. Due to the limited habitat area, dominance of non-native ornamental plant species, and overall human disturbance associated with residential development and recreational beach use, these sensitive plant species are considered to have a low potential to occur within the site. The site does not contain suitable habitat for any of the other 11 sensitive plant species recorded to occur in the vicinity.

Sensitive Plant Communities

Based on MBA's literature review the following sensitive plant communities have been recorded within roughly seven miles of the project site:

- Southern California coastal lagoon
- Southern California steelhead stream
- Southern coast live oak riparian forest
- Southern coastal salt marsh
- Southern sycamore alder riparian woodland
- Valley oak woodland

None of the sensitive plant communities listed above are present on the project site. The site contains elements of coastal bluff scrub, a plant community generally considered sensitive by the resource agencies. However, the site is dominated by ornamental landscape vegetation and the elements of coastal bluff scrub do not account for enough coverage to warrant consideration as a distinct plant community.

5.1.2 - Sensitive Wildlife Species

The project site contains suitable habitat for two sensitive wildlife species that occur in sandy beach habitat, California least tern and western snowy plover. Due to disturbance, the site's sandy beach is only marginally suitable nesting habitat for both species. However, it is moderate quality wintering habitat for western snowy plover. No sensitive wildlife species were observed on the project site during the field survey. Based on MBA's literature review, no sensitive wildlife species have been previously recorded onsite. The site contains no suitable habitat for any of the other nine sensitive wildlife species known to occur in the vicinity.

Table 1: Sensitive Plant Species

Species		Status			Preferred Habitat	Life Form	Blooming Period	Potential to Occur / Known Occurrence / Suitable Habitat
Scientific Name	Common Name	USFWS	CDFG	CNPS				
Astragalus brauntonii	Braunton's milk-vetch	FE	—	1B	Closed-cone coniferous forest, chaparral, coastal scrub, and valley and foothill grassland habitats. Specifically found in recent burns or disturbed areas, in stiff gravelly clay soils overlying granite or limestone. Elevation limits: 4 to 640m.	Perennial herb	February - July	**Low.** Observed approximately 3 miles east of the project site. No suitable habitat present.
Atriplex coulteri	Coulter's saltbush	—	—	1B	Coastal bluff scrub, coastal dunes, coastal scrub, and valley and foothill grassland. Prefers ocean bluffs and ridgetops as well as alkaline low places. Elevation limits: 10 to 440m.	Perennial herb	March - October	**Low.** Observed approximately 4 miles southeast of the project site. Marginal habitat onsite is significantly disturbed and limited in area.
Baccharis malibuensis	Malibu baccharis	—	—	1B	Coastal scrub, chaparral, and cismontane woodland. Found in Conejo volcanic substrates, often on exposed roadcuts. Sometimes occupies oak woodland habitat. Elevation limits: 150 to 260m.	Deciduous shrub	August	**Not likely.** Observed approximately 7 miles northeast of the project site. No suitable habitat present. Site is below species' elevation limits.

Table 1 (Cont.): Sensitive Plant Species

Species		Status			Preferred Habitat	Life Form	Blooming Period	Potential to Occur / Known Occurrence / Suitable Habitat
Scientific Name	Common Name	USFWS	CDFG	CNPS				
Calochortus plummerae	Plummer's mariposa lily	—	—	1B	Coastal scrub, chaparral, valley and foothill grassland, cismontane woodland, lower montane coniferous forest. Occurs on rocky and sandy sites, usually of granitic or alluvial material. Can be very common after fire. Elevation limits: 90 to 1610m.	Bulbiferous herb	May - July	**Low.** Observed approximately 2 miles west of the project site. No suitable habitat present. Site is below species' elevation limits.
Chaenactis glabriuscula var. *orcuttiana*	Orcutt's pincushion	—	—	1B	Coastal bluff scrub and coastal dunes. Prefers sandy sites. Elevation limits: 3 to 100m.	Annual herb	January - August	**Low.** Observed approximately 4 miles west of the project site. Marginal habitat onsite is significantly disturbed and limited in area.
Deinandra minthornii	Santa Susanna tarplant	—	SR	1B	Chaparral and coastal scrub. Found on sandstone outcrops and crevices, in shrublands. Elevation limits: 280 to 760m.	Deciduous shrub	July - November	**Low.** Observed approximately 1.5 miles northeast of the project site. No suitable habitat present. Site is below species' elevation limits.
Delphinium parryi ssp. *blochmaniae*	Dune larkspur	—	—	1B	Chaparral, coastal dunes (maritime). Found on rocky areas and dunes. Elevation limits: 0 to 200m.	Perennial herb	April - May	**Not likely.** Observed approximately 7 miles north of the project site. No suitable habitat present.

Table 1 (Cont.): Sensitive Plant Species

Species		Status			Preferred Habitat	Life Form	Blooming Period	Potential to Occur / Known Occurrence / Suitable Habitat
Scientific Name	Common Name	USFWS	CDFG	CNPS				
Dudleya blochmaniae ssp. *blochmaniae*	Blochman's dudleya	—	—	1B	Coastal scrub, coastal bluff scrub, and valley and foothill grassland. Prefers open, rocky slopes, often in shallow clays over serpentine or in rocky areas with little soil. Elevation limits: 5 to 450m.	Perennial herb	April - June	**Low.** Observed over 7 miles east of the project site. Marginal habitat onsite is significantly disturbed and limited in area.
Dudleya cymosa ssp. *agourensis*	Agoura Hills dudleya	FT	—	1B	Chaparral and cismontane woodland. Found on rocky, volcanic breccia. Elevation limits: 200 to 500m.	Perennial herb	May - June	**Not likely.** Observed approximately 7 miles north of the project site. No suitable habitat present.
Dudleya cymosa ssp. *marcescens*	Marcescent dudleya	FT	SR	1B	Chaparral. Found on sheer rock surfaces and rocky volcanic cliffs. Elevation limits: 180 to 520m.	Perennial herb	April - July	**Not likely.** Observed approximately 4 miles north of the project site. No suitable habitat present.
Dudleya cymosa ssp. *ovatifolia*	Santa Monica Mountains dudleya	FT	—	1B	Chaparral and coastal scrub. Found in canyons on sedimentary conglomerates; primarily north-facing slopes. Elevation limits: 210-500m.	Perennial herb	March - June	**Not likely.** Observed approximately 4 miles northeast of the project site. No suitable habitat present.

Table 1 (Cont.): Sensitive Plant Species

Species		Status			Preferred Habitat	Life Form	Blooming Period	Potential to Occur / Known Occurrence / Suitable Habitat
Scientific Name	Common Name	USFWS	CDFG	CNPS				
Eriogonum crocatum	Conejo buckwheat	—	SR	1B	Chaparral, coastal scrub, and valley and foothill grassland. Found on Conejo volcanic outcrops and rocky sites. Elevation limits: 50 to 580m.	Perennial herb	April - July	**Not likely.** Observed approximately 6.5 miles northeast of the project site. No suitable habitat present.
Pentachaeta lyonii	Lyon's pentachaeta	FE	SE	1B	Chaparral and valley and foothill grassland. Prefers the edges of clearings in chaparral and is usually found at the interface of grassland and chaparral or at the edges of firebreaks. Elevation limits: 30 to 630m.	Annual herb	March - August	**Not likely.** Observed approximately 5 miles. Northwest of the project site. No suitable habitat present.
Thelypteris puberula var. *sonorensis*	Sonoran maiden fern	—	—	2	Meadows and seeps. Found along streams and seepage areas. Elevation limits: 50 to 550m.	Rhizomatous herb	January - September	**Low.** Observed approximately 0.5 miles north of the project site. No suitable habitat present. Site is below species' elevation limits.

U.S. Fish and Wildlife Service
FE Federal Endangered
FT Federal Threatened
PE Proposed Endangered
PT Proposed Threatened
FC Federal Candidate
FSC Species of Concern*
*No longer recognized as a federal designation.

California Department of Fish and Game
SE State Endangered
ST State Threatened
SR State Rare

California Native Plant Society
1A Plants presumed extinct in California.
1B Plants rare, threatened, or endangered in California and elsewhere.
2 Plants rare, threatened, or endangered in California, but more common elsewhere.
3 Plants about which we need more information.
4 Plants of limited distribution.

Table 1 (Cont.): Sensitive Plant Species

Species		Status			Preferred Habitat	Life Form	Blooming Period	Potential to Occur / Known Occurrence / Suitable Habitat
Scientific Name	Common Name	USFWS	CDFG	CNPS				

Not Likely - There are no present or historical records of the species occurring on or in the immediate vicinity, (within 3 miles) of the project site and the diagnostic habitats strongly associated with the species do not occur on or in the immediate vicinity of the site.
Low - There is a historical record of the species in the vicinity of the project site and potentially suitable habitat on site, but existing conditions, such as density of cover, prevalence of non-native species, evidence of disturbance, limited habitat area, isolation, substantially reduce the possibility that the species may occur. The site is above or below the recognized elevation limits for this species.
Moderate - The diagnostic habitats associated with the species occur on or in the immediate vicinity of the project site, but there is not a recorded occurrence of the species within the immediate vicinity (within 3 miles). Some species that contain extremely limited distributions may be considered moderate, even if there is a recorded occurrence in the immediate vicinity.
High - There is both suitable habitat associated with the species and a historical record of the species on or in the immediate vicinity of the project site (within 3 miles).
Species Present - The species was observed on the project site at the time of the survey or during a previous biological survey.

Table 2: Sensitive Wildlife Species

Species		Status			Required Habitat	Potential to Occur / Known Occurrence / Suitable Habitat
Scientific Name	Common Name	Federal	State	Other		
Fish						
Eucyclogobius newberryi	Tidewater goby	FE	—	CDFG: CSC	Brackish water habitats along the California coast from Agua Hedionda Lagoon in San Diego County to the mouth of the Smith River. Found in shallow lagoons and lower stream reaches, the species needs fairly still but not stagnant water and high oxygen levels.	**Not likely.** Observed over 7 miles east of the project site. No suitable habitat present.
Gila orcuttii	Arroyo chub	—	—	CDFG: CSC	Los Angeles basin south coastal streams. Low water stream sections with mud or sand bottoms. Species feeds heavily on aquatic vegetation and associated invertebrates.	**Not likely.** Observed over 7 miles east of the project site. No suitable habitat present.
Oncorhynchus mykiss irideus	Southern steelhead - southern California ESU	FE	—	CDFG: CSC	Populations occur from Santa Maria River south to San Mateo Creek in San Diego County. Southern steelhead likely have greater physiological tolerances to warmer water and more variable conditions.	**Not likely.** Observed approximately 4 miles northwest of the project site. No suitable habitat present.
Reptiles and Amphibians						
Phrynosoma coronatum blainvillii	Coast (San Diego) horned lizard	—	—	CDFG: CSC	Inhabits coastal sage scrub and chaparral in arid and semi-arid climates. Prefers friable, rocky, or shallow sandy soils.	**Not likely.** Observed approximately 4 miles southeast of the project site. No suitable habitat present.
Emmys marmorata pallida	Southwestern pond turtle	—	—	CDFG: CSC	Inhabits permanent or nearly permanent bodies of water in many habitat types, below 2000m. Species requires basking sites such as partially submerged logs, vegetation mats, or open mud banks and needs suitable nesting sites.	**Not likely.** Information on exact occurrences in vicinity of project site not available. No suitable habitat present.

Table 2 (Cont.): Sensitive Wildlife Species

Species		Status			Required Habitat	Potential to Occur / Known Occurrence / Suitable Habitat
Scientific Name	Common Name	Federal	State	Other		
Thamnophis hammondii	Two-striped garter snake	—	—	CDFG: CSC	Coastal California from the vicinity of Salinas to northwest Baja California, from sea level to about 7,000 ft. in elevation. Highly aquatic, found in or near permanent fresh water, often along streams with rocky beds and riparian growth.	**Not likely.** Observed approximately 7 miles northeast of the project site. No suitable habitat present.
Birds						
Aquila chrysaetos	Golden eagle	—	—	CDFG: CSC	(Nesting and wintering) rolling foothills mountain areas, sage-juniper flats, and desert. Cliff-walled canyons provide nesting habitat in most parts of range; will also nest in large trees in open areas.	**Not likely.** Observed approximately 6.5 miles northwest of the project site. No suitable habitat present.
Charadrius alexandrinus nivosus	Western snowy plover	FT	—	CDFG: CSC	(Nesting) Sandy beaches, salt pond levees, and shores of large alkali lakes. Needs sandy, gravelly, or friable soils for nesting.	**Moderate.** Known to nest approximately 15 miles west of the project site. Suitable foraging habitat present. Nesting habitat is marginal in quality due to human disturbance.
Pelecanus occidentalis californicus	California brown pelican	FE	SE	—	(Nesting colonies) Species is a colonial nester on coastal islands just outside the surf line. Nests on coastal islands of small to moderate size that afford immunity from attack by ground-dwelling predators.	**Low.** Observed offshore in vicinity of site during field survey. No suitable nesting habitat present. Suitable foraging habitat present offshore.
Sterna antillarum browni	California least tern	FE	SE	—	(Nesting colonies) Nests along the coast from San Francisco bay south to northern Baja California. Colonial breeder on bare or sparsely vegetated, flat substrates, including sandy beaches, alkali flats, land fills, or paved areas.	**Moderate.** Known to nest approximately 15 miles west of the project site. Suitable foraging habitat present offshore. Nesting habitat is marginal in quality due to human disturbance.

Table 2 (Cont.): Sensitive Wildlife Species

Species		Status			Required Habitat	Potential to Occur / Known Occurrence / Suitable Habitat
Scientific Name	Common Name	Federal	State	Other		
Riparia riparia	Bank swallow	—	ST	—	(Nesting) Colonial nester; nests primarily in riparian and other lowland habitats west of the desert. Requires vertical banks/cliffs with fine-textured/sandy soils near streams, rivers, lakes, ocean to dig nesting hole.	**Not likely.** Observed approximately 7 miles north of the project site. No suitable habitat present.
Mammals						
Neotoma lepida intermedia	San Diego desert woodrat	—	—	CDFG: CSC	Coastal scrub of southern California from San Diego County to San Luis Obispo County. Species prefers moderate to dense canopies and is particularly abundant in rock outcrops and rocky cliffs and slopes.	**Not likely.** Observed over 7 miles east of the project site. No suitable habitat present.

Federal
FE Federal Endangered
FT Federal Threatened
FSC Federal Species of Concern
PFT Proposed Federal Threatened
C Candidate for Federal Listing
D Delisted

State
SE State Endangered
ST State Threatened

Other
CDFG:CSC California Species of Concern
CDFG:FP Fully Protected Species
CDFG: P Protected Species

Not Likely - There are no present or historical records of the species occurring on or in the immediate vicinity, (within 3 miles) of the project site and the diagnostic habitats strongly associated with the species do not occur on or in the immediate vicinity of the site.
Low - There is a historical record of the species in the vicinity of the project site and potentially suitable habitat on site, but existing conditions, such as density of cover, prevalence of non-native species, evidence of disturbance, limited habitat area, isolation, substantially reduce the possibility that the species may occur. The site is above or below the recognized elevation limits for this species.
Moderate - The diagnostic habitats associated with the species occur on or in the immediate vicinity of the project site, but there is not a recorded occurrence of the species within the immediate vicinity (within 3 miles). Some species that contain extremely limited distributions may be considered moderate, even if there is a recorded occurrence in the immediate vicinity.
High - There is both suitable habitat associated with the species and a historical record of the species on or in the immediate vicinity of the project site (within 3 miles).
Species Present - The species was observed on the project site at the time of the survey or during a previous biological survey.

Nesting Birds

The project site contains suitable nesting habitat for several tree and shrub-nesting avian species that are protected by the MBTA and CFG Code §3503. The ornamental landscape vegetation on the bluffs and extending into the upper portions of the beach provides suitable habitat for avian species that nest in disturbed communities, such as mourning dove (*Zenaida macroura*) and northern mockingbird (*Mimus polyglottos*). As previously discussed, the sandy beach is marginal nesting habitat for California least tern and western snowy plover.

5.2 - JURISDICTIONAL WATERS AND WETLANDS

During the field survey, a qualified wetlands delineator evaluated the project site for the presence of potentially jurisdictional waters and wetlands under the USACE, RWQCB, and/or CDFG. No potentially jurisdictional waters or wetlands are present within site boundaries. An unnamed USGS blue-line drainage features occurs in the vicinity of the site, entering the Pacific Ocean to the west (Exhibit 2). The Pacific Ocean itself is considered a navigable water subject to the jurisdiction of the USACE, extending from the mean high water to three nautical miles offshore.

5.3 - WILDLIFE MOVEMENT CORRIDORS

Wildlife movement corridors link areas of suitable wildlife habitat that are otherwise separated by rugged terrain, changes in vegetation, or human disturbance. The fragmentation of open space areas by urbanization creates isolated "islands" of wildlife habitat, separating different populations of a single species. Corridors effectively act as links between these populations.

The project site is surrounded by residential development to the north and the Pacific Ocean to the south. These features currently limit wildlife movement onsite and in the surrounding area, and the site does not occur within a narrow corridor that links large areas of undeveloped open space. Therefore, the site is not located within a significant wildlife movement corridor. Common wildlife species such as skunks, opossums, and raccoons can be expected to travel though the site and neighboring developed areas, but the site does not provide narrow connectivity between large areas of open space on a local or regional scale. However, it should be noted that the sandy beach facilitates the movement of shorebirds along the coast.

5.4 - CITY OF MALIBU LOCAL COASTAL PROGRAM

The project site is located within the City of Malibu LCP. This LCP guides development and protection of natural resources in the coastal zone in partnership with the California Coastal Commission (CCC) under the California Coastal Act of 1976. Areas within the LCP that contain sensitive biological resources or that could be easily degraded by human activities are designated as ESHAs. Although the site is not located within a designated ESHA, near-shore shallow water fish and kelp bed habitat that is designated as an ESHA occurs offshore to the south of the site. The site also provides suitable foraging habitat for western snowy plover. As such, it is considered located within an ESHA based on the ESHA determination in the LCPs Local Implementation Plan.

SECTION 6: RECOMMENDATIONS

6.1 - SENSITIVE PLANT SPECIES

Focused surveys are typically recommended for sensitive plant species that are federally or state-listed as endangered or threatened and have moderate to high potential to occur on the project site. The site does not contain suitable habitat for any federally or state-listed plant species. The site does contain marginal habitat for three CNPS List 1B sensitive plant species, Coulter's saltbush, Orcutt's pincushion, and Blochman's dudleya. Potentially suitable habitat for these species is very limited in area and degraded due to disturbances from adjacent residential development. These sensitive plant species are considered to have a low potential to occur within the site and focused surveys are not recommended.

6.2 - SENSITIVE WILDLIFE SPECIES

Focused surveys are typically recommended for sensitive wildlife species that are federally or state-listed as endangered or threatened and have moderate to high potential to occur on the project site. The site contains suitable habitat for two sensitive wildlife species, both of which are either endangered or threatened.

6.2.1 - California Least Tern

The California least tern is both federally and state-listed as endangered. This species typically nests on open, undisturbed sandy or gravelly beaches and forages nearby in shallow-water coastal areas and estuaries. The least tern is a migratory species that nests along the California coast from April through August but winters in southern latitudes.

The closest recorded California least tern nesting colony occurs approximately 15 miles west of the site. Due to beach disturbance from recreational use during the spring and summer seasons and lack of shallow-water estuarine habitat in the near vicinity, least terns have a low potential to nest within the site, although the species may forage offshore. Given these factors, and that potential projects within the site will be limited to the coastal bluff areas, it is unlikely that project activities will result in direct or indirect take of the species. However, if project-related activities will occur during the nesting season, from February to August, a nesting season survey is recommended to ensure that California least tern will not be impacted. This survey is addressed in detail in Section 6.2.3, below.

6.2.2 - Western Snowy Plover

The western snowy plover is a sensitive avian species that is federally threatened and a California species of special concern. Western snowy plovers nest on open, undisturbed sandy beaches or salt ponds and forage along the shorelines of these habitats. This species is migratory but is present year-round in California. It nests mainly in inland colonies but forms small nesting colonies along the coast and winters on coastal beaches.

Western snowy plovers are known to nest in small colonies adjacent to the California least tern nesting colony mentioned above, approximately 15 miles west of the project site. As with this species, western snowy plovers have a low potential to nest on the site due to disturbance from recreational use. However, the species likely winters along the sandy beach, which provides moderate quality foraging habitat. To ensure that impacts do not occur during the nesting season, a nesting survey is recommended prior to any project-related activities, as described in Section 6.2.3, below. In addition, a pre-construction survey is recommended for project-related activities that occur on the sandy beach during the winter season, from September to January, to determine if wintering snowy plovers are present. Depending on the outcome of this survey, a biological monitor may be required during project activities.

6.2.3 - Nesting Birds

The project site contains suitable nesting habitat for several tree, shrub, and ground-dwelling avian species. Therefore, pursuant to the MBTA and CFG Code, removal of any trees, shrubs, or any other potential nesting habitat should be conducted outside the avian nesting season. The nesting season generally extends from early February through August, but can vary slightly from year to year based upon seasonal weather conditions.

If suitable nesting habitat must be removed during the nesting season, a qualified biologist should conduct a nesting bird survey to identify any potential nesting activity. If active nests are observed, construction activity must be prohibited within a 500-foot buffer around the nest until the nestlings have fledged. All construction activity within the vicinity of active nests must be conducted in the presence of a qualified biological monitor. Construction activity may encroach into the buffer area at the discretion of the biological monitor.

6.3 - JURISDICTIONAL WATERS AND WETLANDS

No potentially jurisdictional waters or wetlands are present within the project site. One unnamed USGS blue-line drainage feature occurs in the vicinity of the site to the west. In addition, the site borders the Pacific Ocean, which is subject to the jurisdiction of the USACE. Proposed projects within the site must avoid direct or indirect impacts (i.e. the deposition of fill) of these jurisdictional waters. Given that no jurisdictional waters or wetlands occur onsite and proposed project activities will likely be limited to coastal bluff areas, impacts to jurisdictional waters are not anticipated.

6.4 - WILDLIFE MOVEMENT CORRIDORS

The project site is not located within a significant wildlife movement corridor. Although the sandy beach provides for migratory shorebird movement along the coast, proposed project activities are not likely to result in any impacts that might obstruct shorebird movement. No further action is recommended.

6.5 - CITY OF MALIBU LOCAL COASTAL PROGRAM

The project site is located within the City of Malibu's LCP, adjacent to a designated ESHA. The designated ESHA is the near-shore shallow water fish and kelp bed habitat that occurs offshore to the south. The site is located within the buffer of the ESHA and therefore, based on the determination of the LCPs Local Implementation Plan, it is considered to be within the ESHA. However, proposed project activities within the site will consist of improving public access to the beach. This type of development is permitted within the ESHA, per the LCPs Local Implementation Plan.

SECTION 7: REFERENCES

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Appendix A: Floral and Faunal Compendia

FLORAL COMPENDIUM

Gymnosperms

Cupressaceae	**Cypress Family**
* *Cupressus macrocarpa*	Monterey cypress
* *Juniperus* sp.	juniper

Angiosperms (Dicotyledons)

Anacardiaceae	**Sumac or Cashew Family**
Malosma laurina`	laurel sumac
Rhus integrifolia	lemonade berry
Apiaceae	**Carrot Family**
* *Foeniculum vulgare*	sweet fennel
Araliaceae	**Ginseng Family**
**Hedera helix*	English ivy
Asteraceae	**Sunflower Family**
Ambrosia chamissonis	beach-bur
Encelia californica	bush sunflower
Isocoma menziesii	coast goldenbush
Aizoaceae	**Fig-Marigold Family**
Carpobrotus sp.	fig-marigold
Mesembryanthemum sp.	iceplant
Brassicaceae	**Mustard Family**
* *Cakile maritima*	sea rocket
* *Hirschfeldia incana*	short-pod mustard
* *Lobularia maritima*	sweet alyssum
Chenopodiaceae	**Goosefoot Family**
Atriplex lentiformis	big saltbush
Convolvulaceae	**Morning-glory Family**
Calystegia sp.	morning glory
Euphorbiaceae	**Spurge Family**
* *Ricinus communis*	castor bean
Fabaceae	**Legume Family**
* *Acacia* sp.	acacia
Melilotus sp.	sweetclover
Myoporaceae	**Myoporum Family**
* *Myoporum laetum*	myoporum

FLORAL COMPENDIUM (CONT.)

Angiosperms (Dicotyledons) (cont.)

Myrtaceae	**Myrtle Family**
* *Eucalyptus* sp.	gum tree
Nyctaginaceae	**Four O'Clock Family**
Abronia maritima	sand verbena
Polygonaceae	**Buckwheat Family**
Eriogonum fasciculatum	California buckwheat
Solanaceae	**Nightshade Family**
* *Nicotiana glauca*	tree tobacco

Angiosperms (Monocotyledons)

Arecaceae	**Palm Family**
Phoenix sp.	date palm
Cyperaceae	**Sedge Family**
Cyperus sp.	nutsedge
Poaceae	**Grass Family**
* *Arundo donax*	giant reed
* *Cortaderia selloana*	pampas grass
* *Bromus diandrus*	ripgut brome
* *Hordeum vulgare*	barley
Leymus condensatus	giant wild-rye
* *Pennisetum setaceum*	purple fountain grass

* Non-native species

FAUNAL COMPENDIUM

Invertebrates

Nymphalidae	**Brushfoots**
Danaus plexippus	monarch

Birds

Pelecanidae	**Pelicans**
Pelecanus occidentalis	brown pelican
Charadriidae	**Lapwings, Plovers**
Pluvialis squatarola	black-bellied plover
Scolopacidae	**Sandpipers, Phalaropes**
Calidris alba	sanderling
Catoptrophorus semipalmatus	willet
Numenius phaeopus	whimbrel
Laridae	**Skuas, Gulls, Terns, Skimmers**
Larus californicus	California gull
Larus occidentalis	western gull
Trochilidae	**Hummingbirds**
Calypte anna	Anna's hummingbird
Tyrannidae	**Tyrant Flycatchers**
Sayornis nigricans	black phoebe
Sayornis saya	Say's phoebe
Corvidae	**Jays and Crows**
Corvus brachyrhynchos	American crow
Timaliidae	**Babblers**
Chamaea fasciata	wrentit
Aegithalidae	**Bushtits**
Psaltriparus minimus	bushtit
Troglodytidae	**Wrens**
Thryomanes bewickii	Bewick's wren
Mimidae	**Mockingbirds, Thrashers**
Mimus polyglottos	northern mockingbird

FAUNAL COMPENDIUM (CONT.)

Birds (cont.)

Sturnidae	**Starlings**
* *Sturnus vulgaris*	European starling
Parulidae	**Wood Warblers**
Dendroica coronata	yellow-rumped warbler
Geothlypis trichas	common yellowthroat
Emberizidae	**Emberizids**
Zonotrichia leucophrys	white-crowned sparrow
Fringillidae	**Finches**
Carpodacus mexicanus	house finch

Mammals

Sciuridae	**Squirrels**
Spermophilus beecheyi	California ground squirrel

* non-native species

Appendix B:
Site Photographs

Photograph 1: View of Lechuza Beach facing west with vegetation dominated by ornamental plant species to the right and un-vegetated sandy beach to the center/left.

Photograph 2: View of Lechuza Beach facing east with ornamental vegetation on bluff to left and un-vegetated sandy beach to center/right.

Source: Michael Brandman Associates, 2006.

Michael Brandman Associates

Appendix B
Site Photographs 1 and 2

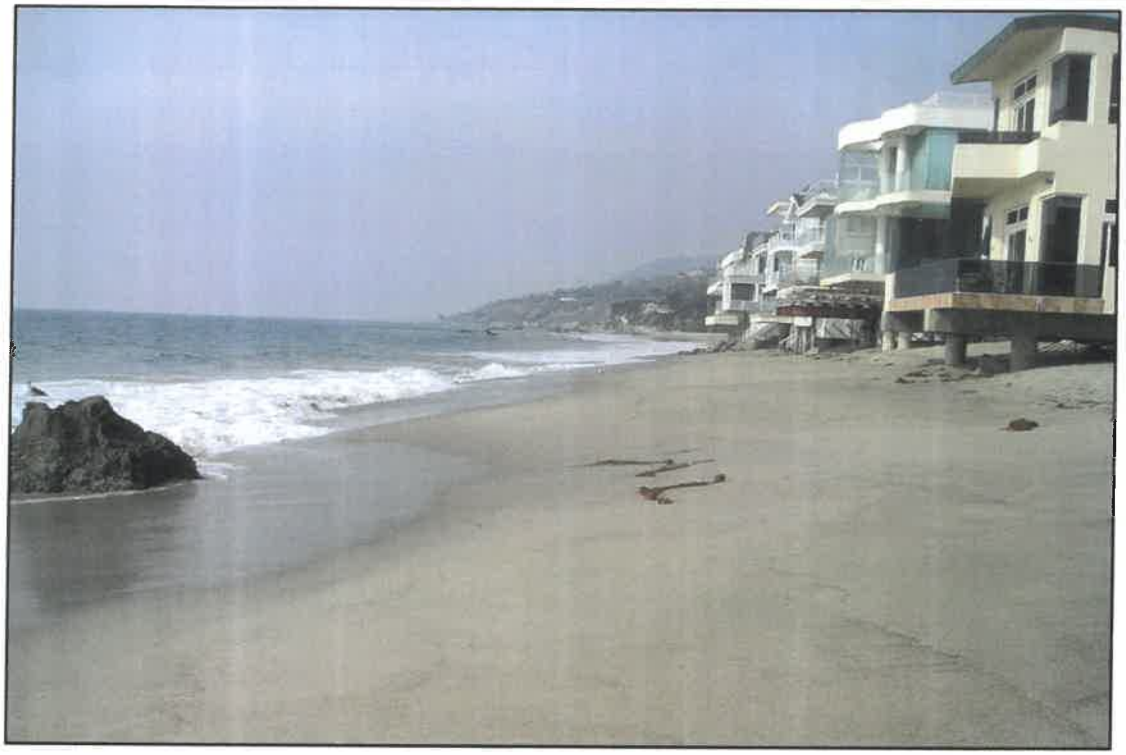
Photograph 3: View of bluff above the central portion Lechuza Beach facing northwest, dominated by ornamental species such as myoporum and iceplant with scattered native species such as laurel sumac.

Photograph 4: View of bluff above the western portion of Lechuza Beach facing northwest, dominated by ornamental vegetation with limited coverage by native species.

Source: Michael Brandman Associates, 2006.

Michael Brandman Associates

Appendix B
Site Photographs 3 and 4



Photograph 5: View of eastern portion of Lechuza Beach facing west, with private lots to the right and un-vegetated sandy beach to center/left.

Photograph 6: View of stairway access to Lechuza Beach facing north with vegetation dominated by ornamental species such as iceplant and planted Monterey cypress trees.

Source: Michael Brandman Associates, 2006.

Michael Brandman Associates

Appendix B
Site Photographs 5 and 6

Appendix C: Regulatory Compliance

REGULATORY COMPLIANCE

SENSITIVE PLANT AND WILDLIFE SPECIES

Sensitive species are native species that have been accorded special legal or management protection because of concern for their continued existence. There are several categories of protection at both federal and state levels, depending on the magnitude of threat to continued existence and existing knowledge of population levels.

Federal Endangered Species Act

The United States Fish and Wildlife Service (USFWS) administers the Federal Endangered Species Act (ESA). The ESA provides a process for listing species as either threatened or endangered, and methods of protecting listed species. The ESA defines as "endangered" any plant or animal species that is in danger of extinction throughout all or a significant portion of its known geographic range. A "threatened" species is a species that is likely to become endangered. A "proposed" species is one that has been officially proposed by the USFWS for addition to the federal threatened and endangered species list.

ESA §9 prohibits "take" of threatened or endangered species. The term "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in such conduct. Take can include disturbance to habitats used by a threatened or endangered species during any portion of its life history. The presence of any federally threatened or endangered species in a project area generally imposes severe constraints on development, particularly if development would result in "take" of the species or its habitat. Under the regulations of the ESA, the USFWS may authorize "take" when it is incidental to, but not the purpose of, an otherwise lawful act.

California Endangered Species Act

The California Department of Fish and Game (CDFG) administers the California Endangered Species Act (CESA). The State of California considers an "endangered" species one whose prospects of survival and reproduction are in immediate jeopardy. A "threatened" species is one present in such small numbers throughout its range that it is likely to become an endangered species in the near future in the absence of special protection or management. A "rare" species is one present in such small numbers throughout its portion of its known geographic range that it may become endangered if its present environment worsens. The rare species designation applies to California native plants. State threatened and endangered species are fully protected against take, as defined above. The term "species of special concern" is an informal designation used by CDFG for some declining wildlife species that are not state candidates for listing. This designation does not provide legal protection, but signifies that these species are recognized as sensitive by CDFG.

California Native Plant Society

The California Native Plant Society (CNPS) is a California resource conservation organization that has developed and inventory of California's sensitive plant species. This inventory summarizes information on the distribution, rarity, and endangerment of California's vascular plants. The inventory is divided into four lists based on the rarity of the species. In addition, the CNPS provides an inventory of plant communities that are considered sensitive by the state and federal resource agencies, academic institutions, and various conservation groups. Determination of the level of sensitivity is based on the number and size of remaining occurrences as well as recognized threats.

Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) protects all common wild birds found in the United States (U.S.) except the house sparrow, starling, feral pigeon, and resident game birds such as pheasant, grouse, quail, and wild turkey. Resident game birds are managed separately by each state. The MBTA makes it unlawful for anyone to kill, capture, collect, possess, buy, sell, trade, ship, import, or export any migratory bird including feathers, parts, nests, or eggs.

California Fish and Game Code - §3503 and §3511

The CDFG administers the California Fish and Game Code (CFG Code). There are particular sections of the CFG Code that are applicable to natural resource management. For example, §3503 of the CFG Code states it is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird that is protected under the MBTA. CFG Code §3503.5 further protects all birds in the orders Falconiformes and Strigiformes, birds of prey such as hawks and owls, and their eggs and nests from any form of take. CFG Code §3511 lists fully protected bird species where the CDFG is unable to authorize the issuance of permits or licenses to take these species.

JURISDICTIONAL WATERS AND WETLANDS

Impacts to natural drainage features and wetland areas are regulated by the United States Army Corp of Engineers (USACE), Regional Water Quality Control Board (RWQCB), and CDFG based upon the policies and regulations discussed below.

United States Army Corp of Engineers Regulations

Federal Clean Water Act - §404

The USACE administers §404 of the federal Clean Water Act (CWA). This section regulates the discharge of dredge and fill material into waters of the U.S. USACE has established a series of nationwide permits that authorize certain activities in waters of the U.S., if a proposed activity can demonstrate compliance with standard conditions. Normally, USACE requires an individual permit for an activity that will affect an area equal to or in excess of 0.5 acre of waters of the U.S. Projects that result in impacts to less than 0.5 acre can normally be conducted pursuant to one of the nationwide permits, if consistent with the standard permit conditions. USACE also has discretionary authority to require an Environmental Impact Statement for projects that result in impacts to an area between 0.1 and 0.5 acre. Use of any nationwide permit is contingent on the activities having no impacts to endangered species.

Waters of the United States

Waters of the U.S., as defined in the Code of Federal Regulations (CFR) §328.3, include all waters or tributaries to waters such as lakes, rivers, intermittent and perennial streams, mudflats, sand-flats, natural ponds, wetlands, wet meadows, and other aquatic habitats. Frequently, waters of the U.S., with at least intermittently flowing water or tidal influences, are demarcated by an ordinary high water mark (OHWM). The OHWM is defined in CFR §328.3(e) as the line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas. In this region, the OHWM is typically indicated by the presence of an incised streambed with defined bank shelving.

In June 2001, the USACE South Pacific Division has issued *Guidelines for Jurisdictional Delineations for Waters of the United States in the Arid Southwest*. The purpose of this document was to provide background information concerning physical characteristics of dryland drainage systems. These guidelines were reviewed and used to identify jurisdictional drainage features within the project site.

Wetlands

According to the USACE *Wetlands Delineation Manual, Technical Report*, three criteria must be satisfied to classify an area as a jurisdictional wetland:

1. A predominance of plant life that is adapted to life in wet conditions (hydrophytic vegetation)

2. Soils that saturate, flood, or pond long enough during the growing season to develop anaerobic conditions in the upper part (hydric soils)
3. Permanent or periodic inundation or soils saturation, at least seasonally (wetland hydrology)

Wetland vegetation is characterized by vegetation in which more than 50 percent of the composition of dominant plant species are obligate wetland, facultative wetland, and/or facultative species that occur in wetlands. As a result of the 2001 Solid Waste Agency of North Cook County (SWANCC) case, a wetland must show connectivity to a stream course in order for such a feature to be considered jurisdictional. Although wetland criteria was used to identify if areas were considered wetlands, the exact limits of jurisdiction were not measured based on the standard wetland delineation protocol as described in the 1987 USACE manual.

United States Army Corp of Engineers Regulated Activities

The USACE regulates the discharge of dredged or fill material including, but not limited to, grading, placing of rip-rap for erosion control, pouring concrete, laying sod, and stockpiling excavated material. Activities that generally do not involve a regulated discharge, if performed specifically in a manner to avoid discharges, include driving pilings, drainage channel maintenance, temporary mining and farm/forest roads, and excavating without stockpiling.

Regional Water Quality Control Board Regulations

Clean Water Act - §401

Per §401 of the CWA, "any applicant for a Federal permit for activities that involve a discharge to waters of the State, shall provide the Federal permitting agency a certification from the State in which the discharge is proposed that states that the discharge will comply with the applicable provisions under the Federal Clean Water Act." Therefore, before the USACE will issue a §404 permit, applicants must apply for and receive a §401 water quality certification from the RWQCB.

Porter-Cologne Water Quality Act

The RWQCB regulates actions that would involve "discharging waste, or proposing to discharge waste, within any region that could affect the water of the state" (water code §13260(a)), pursuant to provisions of the Porter-Cologne Water Quality Act. "Waters of the State" are defined as "any surface water or groundwater, including saline waters, within the boundaries of the state" (water code §13050 (e)).

Regional Water Quality Control Board Regulated Activities

Under §401 of the CWA, the RWQCB regulates all activities that are regulated by the USACE. Additionally, under the Porter-Cologne Water Quality Act, the RWQCB regulates all activities, including dredging, filling, or discharge of materials into waters of the state that are not regulated by the USACE due to a lack of connectivity with a navigable water body and/or lack of an OHWM.

California Department of Fish and Game Regulations

California Fish and Game Code - §1600 to §16003

The CFG Code mandates that "it is unlawful for any person to substantially divert or obstruct the natural flow or substantially change the bed, channel, or bank of any river, stream, or lake designated by the department, or use any material from the streambeds, without first notifying the department of such activity." CDFG jurisdiction includes ephemeral, intermittent, and perennial watercourses, including dry washes, characterized by the presence of hydrophytic vegetation, the location of definable bed and banks, and the presence of existing fish or wildlife resources.

Furthermore, CDFG jurisdiction is often extended to habitats adjacent to watercourses, such as oak woodlands in canyon bottoms or willow woodlands that function as part of the riparian system. Historic court cases have further extended CDFG jurisdiction to include watercourses that seemingly disappear, but re-emerge elsewhere. Under the CDFG definition, a watercourse need not exhibit evidence of an OHWM to be claimed as jurisdiction. However, CDFG does not regulate isolated wetlands; that is, those that are not associated with a river, stream, or lake.

California Department of Fish and Game Regulated Activities

The CDFG regulates activities that involve diversions, obstruction, or changes to the natural flow or bed, channel, or bank of any river, stream, or lake that supports fish or wildlife resources.

Project-Specific Reference #4

LECHUZA BEACH PUBLIC ACCESS IMPROVEMENTS PROJECT
RARE AND SENSITIVE PLANT SURVEY
MAY 2011

Prepared by: Fred M. Roberts, P.O. Box 517, San Luis Rey, California
Prepared for: Judi Tamasi, Mountains Recreation and Conservation Authority, Malibu, California.

The Lechuza Beach Public Access Improvements Project (Lechuza Beach) was examined at the request of the Mountains Recreation and Conservation Authority on 12 May 2011. The author surveyed for rare and sensitive plant species and recorded all recognizable plant species (See Appendix A).

SITE LOCATION

Lechuza Beach is located in the vicinity of Broad Beach Road, East Sea Level Drive, and West Sea Level Drive, Malibu, California. The primary areas examined included Lot I, the stair between Broad Beach Road and East Sea Level Drive, the beach and adjacent slopes at the base of the stair, extending west to the public access point at the end of West Sea Level Drive, the habitat at the top of the access stair at this location focusing on the new view area and proposed parking space "D", and parking lots 1, 2, and 3 along East Sea Level Drive. The site of a reconstructed stair extending on to the beach was also examined at parking lot 3. The project is situated between sea level and about 50 feet elevation (See Figure 1).

SITE DESCRIPTION

The Lechuza Beach site is generally located within an urban interface with limited natural vegetation. Small pockets of coastal sage scrub habitat are found along the stair at Lot I, and along the steep slopes and low cliffs above the beach between West and East Sea Level Drives. These areas are often heavily invaded by exotics, either through natural expansion, or plantings, especially by myoporum (*Myoporum laetum*).

The habitat adjacent to the stair at Lot I supports pockets of natural vegetation, primarily coastal sage scrub dominated by lemonade berry (*Rhus integrifolia*), California encelia (*Encelia californica*), California buckwheat (*Eriogonum fasciculatum*), and prostrate goldenbush (*Isocoma menziesii* aff. var. *sedoides*). The majority habitat within 10 feet of the stair is either planted or disturbed with acacia (*Acacia* sp.), myoporum (*Myoporum laetum*), and other ornamental trees with an understory dominated by panic veldt grass (*Ehrharta erecta*), sowthistle (*Sonchus oleraceus*), yellow sweet clover (*Melilotus indica*), short-pod mustard (*Brassica geniculata*), and scarlet pimpernel (*Anagalis arvensis*).

The vegetation at the base of the stair at the base of Lot I above the beach is dominated by thick carpets of Hottontot fig (*Carpobrotus edulis*) under planted Monterey cypress (*Hysperocyparis macrocapra* [*Cupressus m.*]). At the end of East Sea Level Drive, there is also lawn and plantings. The sandy beach is open and barren of vegetation.

Three proposed parking sites were examined along East Sea Level Drive. Sites one and two are dominated by lawn and ornamental plantings. Parking site 3 and the proposed access stair is currently consists of disturbed roadside, ornamental plantings, iceplant, and a planted path leading with a damaged series of steps leading on to sandy beach. Most of the low terrace above the beach is dominated by Hottentot fig.

Figure 1. Lechuza Beach. Areas surveyed are bordered in yellow

Between East and West Sea Level Drive the site consists of barren sandy beach with a steep coastal bluff slope. The slope has relectual patches of native coastal sage scrub, primarily consisting of lemonade berry and California encelia with scattered patches or individuals of prostrate goldenbush, coyote bush (*Baccharis pilularis*), Brewer's saltbush (*Atriplex lentiformis*), and giant coreopsis (*Coreopsis gigantea*). The later two are possibly planted. The majority of the slope vegetation consists of exotics, especially Hottentot-fig and myoporum, with clipped lime (*Plecostachys serpyllifolia*) with scattered patches of Pampas grass (*Cortedaria selloana*), tree tobacco (*Nicotiana glauca*), dusty miller (*Centaurea cineraria*). A single large date palm (*Phoenix dactylifera*) is near the West Sea Level Drive access stair.

The West Sea Level Drive Access stair is situated on a low sandstone cliff with a mixture of native shrubs and exotic species dominated by Hottontot-fig and lemonade berry with scattered California bush sunflower, sweet clover (*Melilotus indica*), myoporum, prostrate goldenbush, redgum (*Eucalyptus camaldulensis*), laurel sumac (*Malosma laurina*), croceum iceplant (*Malophora crocea*) and Brewer's saltbush. The proposed view point site is primarily dominated by acacia (*Acacia* sp.) with some plantings such as sweet-alyssum (*Loberia maritima*), while the adjacent proposed parking is dominated primarily by recent plantings, includings purple sage (*Salvia leucophylla*), coastal mugwort (*Artemisia suskdorfii*), Cape leadwort (*Plumbago auriculata*), hebe (*Hebe* sp.), and fortnight iris (*Dietes iridioides*).

RARE AND SENSITIVE PLANTS

At least 28 species of rare sensitive plant species have been reported from the Point Dume and Triunfo USGS Quadrangles (CNPS 2011). Few of these are expected to occur on the immediate coast. Those most likely to occur, or to have historically occurred, in the vicinity of Lechuza Beach include red sand-verbina (*Abronia maritima*), Coulter's saltbush (*Atriplex coulteri*), Orcutt's pincushion (*Chaenactis glabriuscula* var. *orcuttiana*), Blochman's dudleya (*Dudleya blochmaniae* subsp. *blochmaniae*), and south coast branching phacelia (*Phacelia ramosissima* var. *austrolitoralis*). All of these species are known to occur in coastal bluff scrub and coastal sage scrub along the immediate coast on bluff tops or at the interface between the beach and the cliffs. These species should also be detectable in mid May.

Previous surveys of Lechuza Beach (Michael Brandman Associates 2006) had not recorded any rare plants. The 2006 report concluded *"only limited elements of marginal habitat for these species, specifically the remnant coastal bluff scrub vegetation within the ornamental landscape community."* The report went on to conclude that the *"dominance of non-native ornamental plant species, and overall himan disturbance associated with residential development and recreational beach use, these sensitive plant species are considered to have low potential to occur within the site."*

SURVEY RESULTS

No rare or sensitive plant species were observed. No rare or sensitive plant species are anticipated to occur within due to limited undisturbed natural habitat within the Lechuza Beach project site in its current condition. Effectively, the speculation and conclusions offered by Michael Brandman's Associates (2006) appears to be accurate, although emphasis should be placed on extensive invasive-exotic cover, especially by Hottontot-fig and myoporum, within the project site for limited habitat availability.

Also of note in terms of exotics, clipped lime, found mostly at the base of the Lot I stair and on the slopes above the beach, was introduced into southern California horticulture during the 1980's and is evidently becoming established near urban areas, especially bordering alkaline wetlands and coastal bluffs (Riefner

& Nesom 2009). It has previously been documented from Zuma Beach to the east of Lechuza Beach and Robert H. Meyer Memorial State Beach to the west.

A list of plant species observed at the Lechuza Beach site on 12 May 2011 is included in Appendix A.

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APPENDIX A: A LIST OF SPECIES OBSERVED AT LECHUZA BEACH

GYMNOSPERMS

CONIFEROPHYTA - CONE-BEARING PLANTS

CUPRESSACEAE - CYPRESS FAMILY

***Hesperocyparis macrocarpa** (Hartw.) Bartel [*Cupressus m.* (Hartw.) D.P. Little] MONTEREY CYPRESS. Planted.

PINACEAE - PINE FAMILY

***Pinus torreyana** Parry ex Carr. TORREY PINE. Planted.

MAGNOLIOPHYTA - FLOWERING PLANTS
MONOCOTYLEDONS – MONOCOTS

AGAVACEAE - AGAVE FAMILY
[Liliaceae, sensu The Jepson Manual, 1993]

***Agave americana** L. AMERICAN AGAVE
***Dracaena** sp. DRACAENA. Planted.

ALLIACEAE - ONION FAMILY
[Liliaceae, sensu The Jepson Manual, 1993]

***Tulbaghia violaceae** L. SOCIETY GARLIC. Planted.

AMARYLLIDACEAE - AMARYLLIS FAMILY
[Liliaceae, sensu The Jepson Manual, 1993]

***Agapanthus africanus** (L.) Hoffm. AFRICAN BLUE LILY or LILY OF THE NILE. Planted.

ARECACEAE (PALMAE) - PALM FAMILY

***Phoenix dactylifera** L. DATE PALM

ASPARAGACEAE - ASPARAGUS FAMILY
[Liliaceae, sensu The Jepson Manual, 1993]

***Asparagus asparagoides** (L.) Druce SMILAX
Asparagus officinalis** L. subsp. ***officinalis COMMON ASPARAGUS

ASPHODELACEAE - ASPHODEL FAMILY [Liliaceae, sensu The Jepson Manual, 1993]

***Aloe arborescens** Mill. *vel aff.* CANDELABRA ALOE. Planted.

CANNACEAE - CANNA FAMILY

***Canna** sp. CANNA. Planted.

CYPERACEAE - SEDGE FAMILY

***Cyperus involucratus** Rottb AFRICAN UMBRELLA-SEDGE.

HEMEROCALLIDACEAE – DAY LILY FAMILY

***Hemerocallis** cultivars DAY LILY. Planted.

IRIDACEAE - IRIS FAMILY

***Dietes iridioides** (L.) Klatt. [*Moraea i.* L.] FORTNIGHT IRIS. Planted.

POACEAE - GRASS FAMILY

***Agrostis viridis** Gouan WATER BENTGRASS
***Arundo donax** L. GIANT REED
***Brachypodium distachyon** (L.) Beauv. PURPLE FALSE BROME
***Bromus catharticus** Vahl RESCUE GRASS
***Bromus diandrus** Roth COMMON RIPGUT GRASS
***Cortaderia selloana** (Schult. & Schuff.) Asch. & Graebmer SELLOW'S PAMPAS GRASS
***Cynodon dactylon** (L.) Pers. BERMUDA GRASS
***Ehrharta erecta** Lam. PANIC VELDT GRASS. Very common, especially along stair at Lot I.
***Festuca** sp. FESCUE. Lawn planting.
***Hordeum murinum** subsp. **leporinum** (Link) Arcangeli [*H. leporinum* Link] HARE BARLEY or FOXTAIL BARLEY
***Pennisetum clandestinum** (Forssk.) Chiov. KIKUYU GRASS. Planted.
***Pennisetum setaceum** (Forssk.) Chiov. AFRICAN FOUNTAIN GRASS
Stipa pulchra A. Hitchc. [*Nassella p.* (A. Hitchc.) Barkworth] PURPLE NEEDLEGRASS

EUDICOTYLEDONS - EUDICOTS

AIZOACEAE - CARPET-WEED FAMILY

***Aptenia cordifolia** (L.f.) N.E. Br. BABY SUN ROSE
***Carpobrotus edulis** (L.) Rotm. HOTTENTOT-FIG. Very abundant, widespread.
***Malephora crocea** (Jacq.) Schwantes CROCEUM ICE PLANT

ANACARDIACEAE - SUMAC FAMILY

Malosma laurina (Nutt. ex Torr. & A. Gray) Nutt. ex Abrams LAUREL SUMAC
Rhus integrifolia (Nutt.) Benth. & Hook.f. ex Rothr. LEMONADE BERRY

APIACEAE (UMBELLIFERAE) - CARROT FAMILY

**Foeniculum vulgare* Mill. SWEET FENNEL

APOCYNACEAE - DOGBANE FAMILY

**Carissa macrocarpa* (Ecklon) A. DC. NATAL PLUM. Planted.
**Jasminium* sp. JASMINEE. Planted.
**Nerium oleander* L. OLEANDER. Planted.
**Vinca major* L. BLUE PERIWINKLE. Planted.

ARALIACEAE - GINSENG FAMILY

**Hedera canariensis* Willd. CANARY ISLANDS IVY
**Hedera helix* L. ENGLISH IVY

ASTERACEAE (COMPOSITAE) - SUNFLOWER FAMILY

Artemisia californica Less. COASTAL SAGEBRUSH
**Artemisia suksdorfi* Piper COASTAL MUGWORT. Planted.
Baccharis pilularis DC. subsp. *consanguinea* (DC.) C.B. Wolf. COYOTE BRUSH or CHAPARRAL BROOM
**Centaurea cineraria* L. DUSTY MILLER
Conyza canadensis (L.) Cronq. COMMON HORSEWEED
Coreopsis gigantea (Kell.) Hall GIANT COREOPSIS [introduced/planted?]
Encelia californica Nutt. CALIFORNIA ENCELIA
**Felicia amelloides* (L.) Voss BLUE MARGUERITE. Planted.
Isocoma menziesii (Hook. & Arn.) Nesom aff. var. *sedoides* (E. Greene) Nesom [*I. m.* var. *s.* (E. Greene) Jepson] PROSTRATE GOLDENBUSH
**Osteospermum ecklonis* (DC.) Norl. [*O. fruticosum* (L.) Norl. of County refs.] TRAILING AFRICAN DAISY
**Plecostachys serpyllifolia* (P.J. Bergius) Hillard & B.L. Burtt [*Helichrysum serpyllifolium* (P.J. Bergius) Less.] CLIPPED LIME or PETITE-LICORICE. Apparently planted and naturalized.
**Sonchus asper* (L.) Hill PRICKLY SOW-THISTLE
**Sonchus oleraceus* L. COMMON SOW-THISTLE
**Taraxacum officinale* F.H. Wigg. COMMON DANDELION

BALSAMINACEAE – TOUCH-ME-NOT FAMILY

**Impatiens cf. walleriana* Hook f. IMPATIENS. Planted.

BIGNONIACEAE – BIGNON FAMILY

***Tecomaria capensis** (Thunb.) Spach. CAPE HONEYSUCKLE. Planted.

BORAGINACEAE - BORAGE FAMILY
[includes Hydrophyllcaeae sensu Jepson (1993)]

***Echium candicans** L. f. PRIDE OF MADERA

BRASSICACEAE (CRUCIFERAE) - MUSTARD FAMILY

***Brassica tournefortii** Gouan SAHARA MUSTARD
***Cakile maritima** Scop. SEA-ROCKET
***Hirschfeldia incana** (L.) Lagr.-Fossatl SHORTPOD or SUMMER MUSTARD
***Lobularia maritima** (L.) Desv. SWEET-ALYSSUM

CARYOPHYLLACEAE - PINK FAMILY

***Silene gallica** L. WINDMILL PINK or COMMON CATCHFLY
***Spergularia** sp. SAND-SPURRY

CHENOPODIACEAE – GOOSEFOOT FAMILY

Atriplex lentiformis (Torr.) S. Watson subsp. **lentiformis** [incl. *A.l.* subsp. *breweri* (S. Watson) Hall & Clements] BREWER'S SALTBRUSH
Atriplex prostrata Boucher ex DC [*A. patula* L. var. *hastata* (L.) Hall & Clements, *A. triangularis* Willd. of auth.] SPEARSCALE
***Atriplex semibaccata** R. Br. AUSTRALIAN SALTBUSH
***Chenopodium murale** L. NETTLE-LEAVED GOOSEFOOT

CONVOLVULACEAE - MORNING-GLORY FAMILY

Calystegia macrostegia (E. Greene) Brummitt MORNING-GLORY

CRASSULACEAE - STONECROP FAMILY

***Cotyledon orbiculata** L. var. **oblongata** (Haw.) DC. COTYLEDON
***Crassula argentea** Thunb. JADE PLANT. Planted and naturalizing.

EUPHORBIACEAE - SPURGE FAMILY

***Euphorbia peplus** L. PETTY SPURGE
***Ricinus communis** L. CASTOR-BEAN

FABACEAE (LEGUMINOSAE) - PEA FAMILY

***_Acacia baileyana_** F. Muell. COOTAMUNDRA WATTLE
***_Medicago polymorpha_** L. BUR-CLOVER
***_Melilotus indicus_** (L.) All. YELLOW SWEET-CLOVER

GERANIACEAE - GERANIUM FAMILY

***_Erodium_** sp. FILAREE. Planted.
***_Erodium botrys_** (Cav.) Bertol. LONG-BEAKED FILAREE

LAMIACEAE (LABIATAE) - MINT FAMILY

***_Rosmarinus officinalis_** L. ROSEMARY. Planted.
Salvia leucophylla E. Greene PURPLE SAGE. Planted.

MALVACEAE - MALLOW FAMILY

***_Lavatera cretica_** L. CRETAN LAVATERA
***_Lavatera maritima_** Gouan. BICOLORED TREE MALLOW. Planted.
***_Malva parviflora_** L. CHEESEWEED

MYRSINACEAE - MYRSINE FAMILY
[Primulaceae, sensu The Jepson Manual, 1993]

***_Anagallis arvensis_** L. SCARLET PIMPERNEL

MYRTACEAE - MYRTLE FAMILY

***_Eucalyptus camaldulensis_** Dehnh. RIVER RED GUM
***_Melaleuca elliptica_** Labill. GRANITE HONEY MYRTLE. Planted.

NYCTAGINACEAE - FOUR-O'CLOCK FAMILY

***_Bougainvillea glabra_** Choisy. BOUGAINVILLEA. Planted.

PLANTAGINACEAE - PLANTAIN FAMILY
[expanded to include some genera traditionally placed in Scrophulariaceae]

***_Hebe_** sp. HEBE. Planted.

PLUMBAGINACEAE - LEADWORT FAMILY

***_Armeria maritima_** (Mill.) Wild. SEA PINK. Planted.
***_Limonium perezii_** (Stapf) Hubb. PEREZ'S SEA-LAVENDER
***_Plumbago auriculata_** Lam. [*P. capensis* Thunb.] CAPE LEADWORT. Planted.

POLYGONACEAE - BUCKWHEAT FAMILY

Eriogonum fasciculatum Benth. subsp. *fasciculatum* CALIFORNIA BUCKWHEAT
**Polygonum arenastrum* Boreau COMMON KNOTWEED

PRIMULACEAE - PRIMROSE FAMILY
[See also Myrsinaceae and Theophrastaceae]

**Primula Xpruhonicensis* PRIMROSE HYBRIDS. Planted.

ROSACEAE – ROSE FAMILY

**Frageria* sp. STRAWBERRY. Planted.
**Prunus* sp. CHERRY. Planted.
**Rhaphiolepis indica* (L.) Lindl. INDIAN HAWTHORN. Planted.

SALICACEAE - WILLOW FAMILY

Salix lasiolepis Benth. ARROYO WILLOW

SCROPHULARIACEAE - FIGWORT FAMILY
[includes Myoporaceae, sensu The Jepson Manual, 1993]

**Myoporum laetum* Forster f. MYOPORUM

SOLANACEAE - NIGHTSHADE FAMILY

**Nicotiana glauca* Grah. TREE TOBACCO

Project-Specific Reference #5

Cooper Ecological Monitoring, Inc.
EIN 72-1598095
Daniel S. Cooper, President
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MEMO

To: Judi Tamasi, MRCA

From: Daniel S. Cooper

Date: May 1, 2015

Re: Nesting bird survey, Lechuza Beach

Background

The Migratory Bird Treaty Act (MBTA) protects all regularly-occurring wild birds found in the United States except the house sparrow, European starling, feral pigeon, and resident game birds such as pheasant, grouse, quail, and wild turkey. Resident game birds, including waterfowl are managed separately by each state. The MBTA makes it unlawful for anyone to kill, capture, collect, possess, buy, sell, trade, ship, import, or export any migratory bird including feathers, parts, nests, or eggs. The California Fish and Game Code (CFG Code) is administered by the California Department of Fish and Wildlife (CDFW). There are particular sections of the CFG Code that are applicable to natural resource management. For example, Section 3505 states it is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird that is protected under the MBTA. The code further protects all birds of prey, such as hawks and owls and their eggs and nests from any form of take.

In coastal southern California, including the Los Angeles area, the nesting bird season typically extends from early February into late summer. Depending on guidance from CDFW and local agencies (e.g., Los Angeles Department of Planning), this period may begin as early as February 1st, and extend as late as September 30th, even though the majority of nesting, for most species, occurs for only a few weeks during April, May and June. Hummingbirds, doves, and raptors, for example, can nest in late winter, and some populations may nest virtually year-round. For this reason, any construction project that has the potential to impact nesting birds is often required to conduct appropriate nesting bird surveys in advance of any work that could impact nesting, such as tree-trimming and removal, demolition, or grading. Indirect impacts, such as loud construction near a tree with a nesting bird, are considered impacts as well.

A qualified biologist may be hired to work with clients to help avoid such impacts, either by delaying construction and other activities around known active nests, and/or by establishing appropriate buffers around such nests so that construction may proceed elsewhere on the project site.

Description of work

I report on one visit to public access routes and beach of Lechuza Beach in Malibu, California, made on 27 April 2015 (Figure 1). I was present at the site for roughly 1 hour (8:14 – 9:15 AM) for purposes of assessing the nesting status of breeding bird species in the vicinity of proposed improvements to the infrastructure there. The temperature was around 72°F during the visit, with wind mostly calm but gusting up to 10 mph and clear skies. My survey consisted of slowly walking the entire subject area, out to roughly 300' in each direction where accessible, examining each tree, shrub, structure and beach feature for nesting activity, and noting any other relevant ecological information (other wildlife, plants, etc.).

The subject area extends along roughly 500 meters of beachfront/coastal strand, and includes two pedestrian staircases at the western and eastern end. The surrounding area is residential homes along Broad Beach Rd. and adjacent streets, and the Pacific Ocean to the south (the latter area was not specifically surveyed). Vegetation in the residential area is nearly 100% non-native landscaping, and along the coastal strand, non-natives also dominate, with occasional hardy natives clinging to the bluff (including *Isocoma menziesii*).

Results and Recommendations

<u>Summary of observations</u>
I observed typical "suburban" species in the residential area, and confirmed just one area of nesting activity, an active black phoebe *Sayornis nigricans* nest under the eave of a house on the northwestern corner of Bunnie Lane and Broad Beach Rd. (adults bringing food).

A likely Northern Mockingbird family (recently-fledged young) was in the area, and several species were detected as paired or singing, but without obvious nests present in the subject area.

I observed no suitable habitat for beach-nesting birds on the beach itself; it is far too narrow for sensitive species such as California least tern *Sternula antillarum browni*, or western snowy plover *Charadrius nivosus nivosus* to occur, much less to breed (both are extirpated or extremely rare as breeders in Los Angeles County).

Lechuza Beach, Los Angeles, US-CA
Apr 27, 2015 8:14 AM - 9:14 AM
Protocol: Traveling
0.5 mile(s)
26 species (+2 other taxa)

loon sp. (Gavia sp.) 2
Western/Clark's Grebe (Aechmophorus occidentalis/clarkii) 20
Brandt's Cormorant (Phalacrocorax penicillatus) 1

Snowy Egret (Egretta thula) 1
Spotted Sandpiper (Actitis macularius) 1
Willet (Tringa semipalmata) 1
Sanderling (Calidris alba) 25
Caspian Tern (Hydroprogne caspia) 1
Eurasian Collared-Dove (Streptopelia decaocto) 30   Flying north/west
White-winged Dove (Zenaida asiatica) 1   [details submitted[
Allen's Hummingbird (Selasphorus sasin) 4
Nanday Parakeet (Aratinga nenday) 6
Black Phoebe (Sayornis nigricans) 2   Nest eave of house
Cassin's Kingbird (Tyrannus vociferans) 2
American Crow (Corvus brachyrhynchos) 4
Swainson's Thrush (Catharus ustulatus) 1
Northern Mockingbird (Mimus polyglottos) 3
European Starling (Sturnus vulgaris) 4
Townsend's Warbler (Setophaga townsendi) 1
Wilson's Warbler (Cardellina pusilla) 1
Spotted Towhee (Pipilo maculatus) 2
Song Sparrow (Melospiza melodia) 6
Dark-eyed Junco (Oregon) (Junco hyemalis [oreganus Group]) 2
Black-headed Grosbeak (Pheucticus melanocephalus) 2
Brewer's Blackbird (Euphagus cyanocephalus) 4
Brown-headed Cowbird (Molothrus ater) 1
Hooded Oriole (Icterus cucullatus) 2
House Sparrow (Passer domesticus) 6

Recommendations

I recommend no accommodation for the black phoebe nest, which will likely fledge soon, and recommend no further surveys in 2015 for work to proceed.

Maps and Photographs

Figure 1. Survey location.

Figure 2. Landscape vegetation of survey area.

Figure 3. Black phoebe nest location (yellow pin). Rough boundary of survey area in green.

Project-Specific Reference #6

July 10, 2012

Project 10978.000

Ms. Judi Tamasi
Mountains Recreation and Conservation Authority
5810 Ramirez Canyon Road
Malibu, California 90265

Re: Results of Slope Stability Analyses
Proposed Parking Space “D”
Lechuza Beach Public and ADA Access – West Sea Level Drive
Malibu, California

Dear Ms. Tamasi:

As requested, AMEC Environment & Infrastructure (AMEC) has prepared this letter to provide the results of our slope stability analyses to the Mountains Recreation and Conservation Authority (MRCA) for the proposed parking space at the southeastern termination of West Sea Level Drive in Malibu, California. AMEC performed this geotechnical investigation in accordance with the current agreement between the MRCA and AMEC.

PROJECT DESCRIPTION

The plans by MRCA dated October 11, 2011, depict two parking spaces near the southeast termination of West Sea Level Drive, an eastern one labeled “D” and a western one labeled “DD”. The south edges of both the east and west parking spaces are set back approximately 7 and 9 feet, respectively, from the top of the bluff. The parking spaces are separated by an approximately 5-foot-wide ADA access path. AMEC had previously recommended to the MRCA that the minimum setback distances should comply with the City of Malibu requirements, which we understand is 15 feet. Since the setback distances are less than the minimum requirement of 15 feet, the City of Malibu is requiring that a quantitative slope stability analysis be performed to evaluate the stability of the terrace deposits overlying the bedrock. In addition, the City of Malibu is requesting an estimate of bluff retreat, which as we understand, will be provided by the project coastal engineer. Based on our recent discussions with MRCA, we understand that Parking Space “DD” has been eliminated from the proposed project and only Parking Space, “D”, is proposed at this time. Furthermore, we understand that the location and/or configuration of Parking Space “D” may be modified in the future.

SCOPE OF WORK

Our scope of work consisted of the following:

- Submitting the application for an excavation permit from the City of Malibu. The actual permit was paid for and obtained by MRCA.

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- Calling Underground Service Alert (USA) before drilling activities to mark buried utilities in the area of the proposed tripod borings. The boring locations were marked by the MRCA prior to calling USA.

- Drilling three limited access tripod borings. Limited access drilling equipment was selected by AMEC instead of a truck-mounted rig due to access constraints associated with setback distances from the bluff, trees and vegetation, and property boundaries.

- Collecting soil samples for geotechnical laboratory testing.

- Performing slope stability analyses.

- Preparing a letter report that summarizes our results.

Our scope of work did not include a quantitative estimate of bluff retreat.

FIELD EXPLORATION AND LABORATORY TESTING

The field exploration program included drilling three tripod borings at the approximate locations shown on Figure 1, and collecting soil samples. Logs of the tripod borings, including a boring log explanation sheet, are provided in Appendix A. DP Reynolds Corp. of San Juan Capistrano, California performed the drilling using limited access motorized drilling equipment on April 4, 2012. Borings Tripod-2 and Tripod-3 were drilled to refusal depths of approximately 8 and 7.5 feet, respectively, below ground surface (bgs). Boring Tripod-1 was terminated at a shallow depth of 3.5 feet bgs to minimize the potential for damaging an adjacent PVC conduit with electrical lines, which was encountered along the side of the borehole during the drilling.

Depth-discrete engineering soil samples were collected at selected intervals from the tripod borings using a 2½ -inch inside diameter (I.D.) modified California split-barrel sampler fitted with six brass rings of 2 1/2 inches in O.D. and 1-inch in height and one brass liner (2½ -inch O.D. by 6 inches long) above the brass rings. The modified California sampler was lowered to the bottom of the boreholes and driven 12 inches into the soil using a 140-pound donut-type hammer falling 24 inches. The number of blows required to drive the sampler 6 inches of the sampling interval is recorded on the blow count column of the boring logs.

After removing the sampler from the boreholes, the sampler was opened and the brass rings and liner containing the soil were removed and observed for soil classification. Brass rings containing the soil were sealed in plastic canisters to preserve the natural moisture content of the soil. Bulk samples of soil cuttings were also collected from the tripod borings and placed in polyethylene bags.

Selected soil samples obtained from the tripod borings were tested by the AMEC Laboratory in Irvine, California, to evaluate the physical characteristics and engineering properties of subsurface soils. Physical tests include in-situ dry density and moisture content, fines content, expansion index, unconfined compression and direct shear. The laboratory test results are presented in Appendix B.

FINDINGS

The following discussion is based on the results of the field exploration and laboratory testing programs.

Subsurface Conditions

Fill was encountered in Borings Tripod-1 and Tripod-3 to depths of approximately 1 and 3 feet, respectively. The fill in Boring Tripod-1 consists of sandy lean clay, and the fill in Boring Tripod-3 mostly consists of sandy silt. The native soils in all three borings consist of sandy lean clay, which extends to a depth of approximately 4.5 to 5.0 feet. The underlying soil consists of clayey sand to a depth of approximately 6.5 to 7.0 feet. Finally, refusal was encountered in Borings Tripod-2 and Tripod-3 at depths of approximately 8.0 and 7.5 feet, respectively. Based on the samples collected at the refusal depths, the material consists of clayey sand with abundant gravel-sized fragments of siltstone and sandstone.

Groundwater Conditions

Groundwater was not encountered in the tripod borings to the maximum explored depth of approximately 8 feet at the time of drilling. It should be noted, however, that groundwater levels can fluctuate with seasonal rainfalls, dry weather and surface runoff infiltration. Groundwater is not expected to affect grading and construction of the proposed parking space.

Soil Engineering Properties and Shear Strength Parameters

Based on the laboratory test results, the in-situ dry density and moisture content of the native sandy lean clay range from about 112 to 118 pounds per cubic foot (pcf), and 11 to 13 percent, respectively. The fines content of this material is between about 53 and 60 percent. Based on one test result, the in-situ dry density and moisture content of the underlying clayey sand is about 113 pcf and 12 percent, respectively. The fines content of the same material is about 29 percent. An expansion index test performed on a bulk sample of the sandy lean clay indicates that this material has a low expansion potential in accordance with ASTM International criteria. The unconfined compressive strength of the sandy lean clay was found to be approximately 5,500 psf.

Direct shear tests were performed on three relatively undisturbed samples from Borings Tripod-2 and Tripod-3. Two direct shear tests (with three points per test) were performed on the upper sandy lean clay, and one test (also with three points) was performed on the underlying clayey sand. Each sample was submerged in water prior to and during the test. Based on linear interpolation, the results of the two direct shear tests on the sandy lean clay indicate that the peak friction angles and cohesion values range from 23 and 35 degrees, and 401 to 560 pounds per square foot (psf), respectively. The test results for the same materials indicate that large displacement friction angles and cohesion values range from 30 to 36 degrees, and 115 to 162 psf, respectively. The results of a direct shear test on the clayey sand indicate that the peak friction angle and cohesion values are 40 degrees and 426 psf, respectively. The test results for the same material indicate that the large displacement friction angle and cohesion values are 43 degrees, and 90 psf, respectively. A detailed discussion on the interpretation of the results of the direct shear tests is provided in the Slope Stability section of this report.

SLOPE STABILITY

The computer program Slope/W (Geo-Slope, 2007) was used to perform Spencer's limit-equilibrium analysis method (Spencer, 1967) because it satisfies both force and moment equilibrium, and accounts for interslice forces. Slope/W is a commercially available computer program with a comprehensive formulation that makes it possible to analyze complex geometric configurations and loading conditions. A user-defined entry and exit slip surface function was selected for the analyses so that the program would only analyze potential failures beyond the current setback distance of 7 feet.

In terms of slope stability, the factor of safety (FS) against sliding is defined as the ratio of resisting strength (friction and cohesion along potential failure surface) to driving stresses (gravitational forces pulling downslope). A FS of unity (1.0) indicates a delicate balance between the resisting and driving stresses and represents incipient failure. A FS below unity indicates instability. The seismic stability was evaluated using the pseudostatic analysis methods within Slope/W. In this method the earthquake forces are represented by a static lateral force equal to the product of the horizontal seismic coefficient (k) and the weight of the slide mass, and a FS is computed using conventional limit-equilibrium analysis.

Discussions on the critical cross-section analyzed, acceptance criteria, surficial slope stability, selected shear strength envelopes, seismic coefficient determinations, and slope stability results are provided in the following sections.

Critical Cross-Section

The location of the critical geologic cross-selection, A-A', is shown on Figure 1, and the geologic cross-section is depicted on Figure 2. This section location was selected as it is thought to represent one of the steepest areas of the bluff and overlying soil, and represents the least setback distance. The actual topography used in the development of the critical cross-section (Figure 2) is based on the surveyed plan by MRCA dated April 25, 2012.

The fill in Tripod-1 is shallow and is likely to be present only in the areas of the backfilled PVC conduit. The fill in Tripod-3, which we expect is associated with the grading of West Sea Level Drive, is located far enough away from the edge of the slope such that it is not expected to affect the results of the analyses. Based on the reasons described above, the existing fill was not incorporated into the geologic cross-section.

Based on previous work by AMEC, the thickness of the native soil above the bedrock (terrace deposits) in the general vicinity of West Sea Level Drive appeared to be in the order of 8 to 12 feet. The results of the current field exploration suggest that the bedrock depth may be closer to 8 feet. However, we conservatively selected the thickness of the terrace deposits to be 10 feet to account for the uncertainty. The slope inclination of the 10-ft thick terrace deposits is approximately 0.75:1 (horizontal:vertical). Based on the relatively hard and clayey nature of the subsurface soils and the lack of groundwater encountered in the borings, groundwater is not expected to play a role in the stability analyses.

Acceptance Criteria
AMEC used the stability criteria provided in the City of Malibu LCP LIP guidelines to evaluate the static and seismic slope stability. These criteria as defined by the City of Malibu are as follows:

Long-term static condition:	FS greater than or equal to (≥) 1.5
Pseudo-static:	FS ≥ 1.1 using a seismic coefficient equal to 0.20
Pseudo-static:	FS ≥ 1.0 using screening method (see below)

For seismic stability, the City of Malibu generally uses the pseudostatic analysis wherein a FS ≥ 1.1 is required based on a minimum seismic coefficient of 0.20. Also, the maximum permanent seismic displacement, according to the City of Malibu LCP LIP, shall be less than 50 mm (2 inches). A screening method, in accordance with the procedures outlined in California DMG Special Publication 117 (ASCE/SCEC, 2002), was used to determine if permanent displacements are expected to exceed 2 inches.

Surficial Slope Stability
Surficial slope stability refers to natural and/or manufactured fill slopes that can be subject to shallow failures, which are often classified as soil slumps or soil slips (ASCE/SCEC, 2002). The failures are typically less than about 4 feet thick and have small thickness to length ratios. A quantitative evaluation of surficial slope stability, which generally consists of using the equation listed below, was not performed. A qualitative discussion is provided in the Slope Stability Results section.

$$FS = (c' + (\gamma - m^*\gamma_w)^*z^*\cos^2 \beta^*\tan \phi') / (\gamma^*z^*\sin \beta^* \cos \beta)$$

where:

- γ = total unit weight of soil (pcf)
- γ_w = unit weight of water (62.4 pcf)
- ϕ' = angle of internal friction (degrees)
- β = slope angle (degrees)
- c' = cohesion (psf)
- z = vertical depth of the slip surface
- m = fraction of z such that mz is the vertical height of the groundwater table above the slip surface.

Selected Shear Strength Envelopes

As mentioned, three direct shear tests (with three points per test) were performed on representative soil samples to determine the long-term drained shear strength of the materials tested. The samples were submerged in water prior to and during shear to simulate an undesirable loading condition, which results in a lower strength compared to the strength of an sample that is not submerged in water. As seen on the individual test results (Appendix B), the maximum shear strength (peak) occurs after the initial nearly elastic behavior point, and the strength subsequently drops to a post-peak value as a result of dilation. The reduced strength is commonly referred to as the ultimate strength (large displacement). California DMG Special Publication guidelines recommend using peak strengths for fine grained materials (i.e. clayey and silty soil) of low plasticity that have not been subjected to previous shear deformations, and are unlikely to experience significant weathering. The guidelines also recommend using lower strengths (i.e. large displacement strengths) for stiff clay and clayey bedrock materials of high plasticity. In addition, California DMG Special Publication 117 guidelines recommend that shear strength parameters be determined at very low stresses for surficial slope stability evaluation. Furthermore, it is recommended that a curved failure envelope, which passes through the origin, be fitted to the test results. Although our analyses were not performed specifically for surficial failures, it is our opinion that this method of selecting a shear strength envelope remains appropriate due to the type of expected failures along the bluff adjacent to West Sea Level Drive and the relatively low confining stresses. We, therefore, adopted the California DMG Special Publication 117 recommendation for fitting the direct shear test results as outlined in their surficial stability section. It is further recommended in Special Publication 117A (CGS, 2008) that the stability analyses should use the lowest values derived from the suite of samples tested. This recommendation was also adopted for our selection of the shear strength envelopes.

Based on our interpretation of the recommendations described above, both the peak and large displacement values may be used in the analyses to provide an upper and lower bound of the real FS. To satisfy the requirements of a curved or bilinear shear strength envelope, we developed both a peak and large displacement envelope for the upper sandy lean clay and the underlying clayey sand. The selected peak and large displacement shear strength envelopes for the sandy lean clay are presented on Figures 3 and 4, respectively. The selected peak and large displacement shear strength envelopes for the clayey sand are presented on Figures 5 and 6, respectively.

For the pseudostatic analyses, the long-term drained strength parameters are appropriate to use for materials in stability analyses where the saturation levels are less than 90 percent (ASCE/SCEC, 2002). Based on the in-situ dry density and moisture content test results, this recommendation remains applicable, and as such, the same shear strength envelopes were used for the pseudostatic analyses.

The shear strength of the Trancas Formation bedrock was assumed to be very high compared to the terrace deposits, and was therefore, assumed to be impenetrable for the purposes of the static and pseudostatic analyses.

Seismic Coefficient Determinations
The most commonly used values for the seismic coefficient are based on the recommendations from Seed (1979), which was developed for application to earth dams and for up to 1 meter of displacement. A number of local regulatory agencies use the Seed (1979) procedure for the seismic coefficient. The Seed (1979) procedure recommends values of k = 0.10 and 0.15 for M = 6.25 and 8.25 earthquakes respectively. The City of Malibu LCP LIP guidelines, however, require a minimum k value of 0.20 for pseudostatic analysis; therefore, this value was used in the analyses.

Also, a screening analysis procedure in accordance with California DMG Special Publication 117 was implemented to determine if the amount of permanent seismic displacement is expected to exceed 50 mm (2 inches). The maximum horizontal acceleration in bedrock was found to be 0.61g using the criteria outlined in the 2010 California Building Code (CBC, 2010). This is based on an earthquake with M=7.0 located 6.5 km from the site (USGS, 2008). Based on these criteria, the pseudostatic coefficient was calculated to be 0.31.

Slope Stability Results
Results of the static, and pseudostatic analyses are summarized in Table 1. Graphical plots of the Slope/W results and the output reports of each analysis are presented in Appendix C.

The results of the long-term static analyses indicate that the factors of safety for the large displacement shear strength and peak shear strength values range from about 1.25 to 1.4 (Cases 1a and 1b), and 1.9 to 2.1 (Cases 2a and 2b), respectively. The factors of safety do not meet the required value of 1.5 for the cases where a large displacement shear strength was used. The factors of safety are greater than 1.5 for the cases where a peak strength value is used. An analysis was performed to assess what a failure surface with a FS=1.5 would look like compared to the other long-term static analyses describe above. As shown in Appendix C (Case 1c), the failure surface encroaches about 1 foot into the edge of the parking space.

The variation of factors of safety for the same analysis (either large displacement or peak strength values) is attributed to the effects of an optimization tool, which is implemented in SLOPE/W. Lower factors of safety are calculated when the optimization function is turned on and vice versa. However, the validity of an optimized solution is not just based on the factor of safety, but also on the shape of the slip surface (Geo-Slope, 2007). Based on our interpretation of the slip surface shape of the optimized analyses, the optimization tool may not be appropriate for the current study.

As mentioned, quantitative surficial slope stability analyses for long-term static conditions were not performed. It is important to note that the calculated factors of safety for both the peak and large displacement strength cases are based on a wedge-like failure with a failure surface entry at the edge of parking space “D” (i.e. 7-foot setback). We understand that the factors of safety for both cases will decrease significantly as the failure surface entry moves closer to the top of slope.

The results of pseudostatic analyses indicate that the FS for the large displacement shear strength was calculated to be 0.99 (technically 1.0) for the screening method (Case 3a). The FS for the large displacement shear strength meet the required FS=1.10 using a seismic coefficient of 0.20 (Case 3b). Both the pseudostatic analyses for the peak strength values exceed FS=1.0 for the screening procedure and FS=1.1 for a seismic coefficient equal to 0.20 (Cases 4a and 4b). The optimized calculated factors of safety were the same as the non-optimized ones for all the pseudostatic analyses. Based on these results, the existing slope is not expected to experience significant deformation (i.e. greater than 2 inches) during the design earthquake.

CONCLUSIONS

We have analyzed the static and pseudostatic stability using saturated shear strength parameters. It is our opinion that, due to relatively low permeability and hard nature of the clayey material, the potential for the terrace deposits to become saturated below a depth of one to two feet is considered low.

We have also analyzed the stability of the slope for the present conditions. However, erosion of the terrace deposits associated with bluff retreat is an ongoing process, and will result in a reduced stability in the future. Failures within the terrace deposits are expected to be episodic during periods of heavy rainfall. The design life of the parking space is controlled by the stability of the terrace deposits, which is highly dependent on the amount of bluff retreat.

Control of surface water and drainage is critical to the long-term stability of the slope. The design of the new parking space should take this into consideration. Surface water should be collected in a solid pipe, and discharged in an area where erosion will be minimized.

As mentioned, the location and/or configuration of Parking Space “D” may be modified during the final design. We understand that the setback distance of the final parking space will be at least 7 feet. The calculated factors of safety for other configurations of Parking Space “D” are expected to be similar to the ones presented in this report for a setback distance of 7 feet and the same slope inclination (0.75H:1V). The factors of safety are expected to be higher for larger setback distances with the same slope inclination or for flatter slopes. However, if the parking configuration analyzed in this report changes, AMEC should be provided an opportunity to review the final parking space location and/or configuration to confirm that the results of our analyses remain applicable.

CLOSURE

The conclusions, recommendations, and opinions presented herein are: (1) based upon our evaluation and interpretation of the limited data obtained from our field and laboratory programs and; (2) based upon an interpolation of soil conditions between and beyond the borings.

We appreciate the opportunity to be of service to the MRCA on this project. Please contact the undersigned if you have questions regarding the content of this letter.

Sincerely yours,
AMEC

Easton R. Forcier, PE, GE
Project Engineer

James J. Weaver, PE, GE
Vice President and Principal Engineer

Enclosures:
References
Table 1 – Summary of Slope Stability Results
Figure 1 – Tripod Boring and Cross-Section Location Map
Figure 2 – Geologic Cross-Section A-A’
Figure 3 – Direct Shear Test Results for Sandy Lean Clay, Peak Values
Figure 4 – Direct Shear Test Results for Sandy Lean Clay, Large Displacement Values
Figure 5 – Direct Shear Test Results for Clayey Sand, Peak Values
Figure 6 – Direct Shear Test Results for Clayey Sand, Large Displacement Values
Appendix A – Tripod Boring Logs
Appendix B – Laboratory Test Results
Appendix C – Results of Slope Stability Analyses

REFERENCES

ASCE Los Angeles Section Geotechnical Group and the Southern California Earthquake Center, 2002, Recommended Procedures for Implementing DMG Special Publication 117 Guidelines for Analyzing and Mitigating Landslide Hazards in California, June.

California Building Code, 2010.

California Geological Survey, 2008, Guidelines for Evaluating and Mitigating Seismic Hazards in California, Special Publication 117A.

GEO-SLOPE International, Ltd., 2007, Slope/W Software for Computing Factor of Safety of Earth and Rock Slopes, Calgary, Alberta, Canada.

Seed, H.B., 1979, Considerations in the Earthquake-Resistant Design of Earth and Rockfill Dams, Geotechnique, Vol. 29, No. 3, p. 236.

Spencer, E., 1967, A Method of Analysis of Embankments Assuming Parallel Interslice Forces, Geotechnique, Vol. 117 (1), pp. 11-26.

United States Geological Survey, 2008, https://geohazards.usgs.gov/deaggint/2008/.

TABLE

TABLE 1

SUMMARY OF SLOPE STABILITY ANALYSIS RESULTS

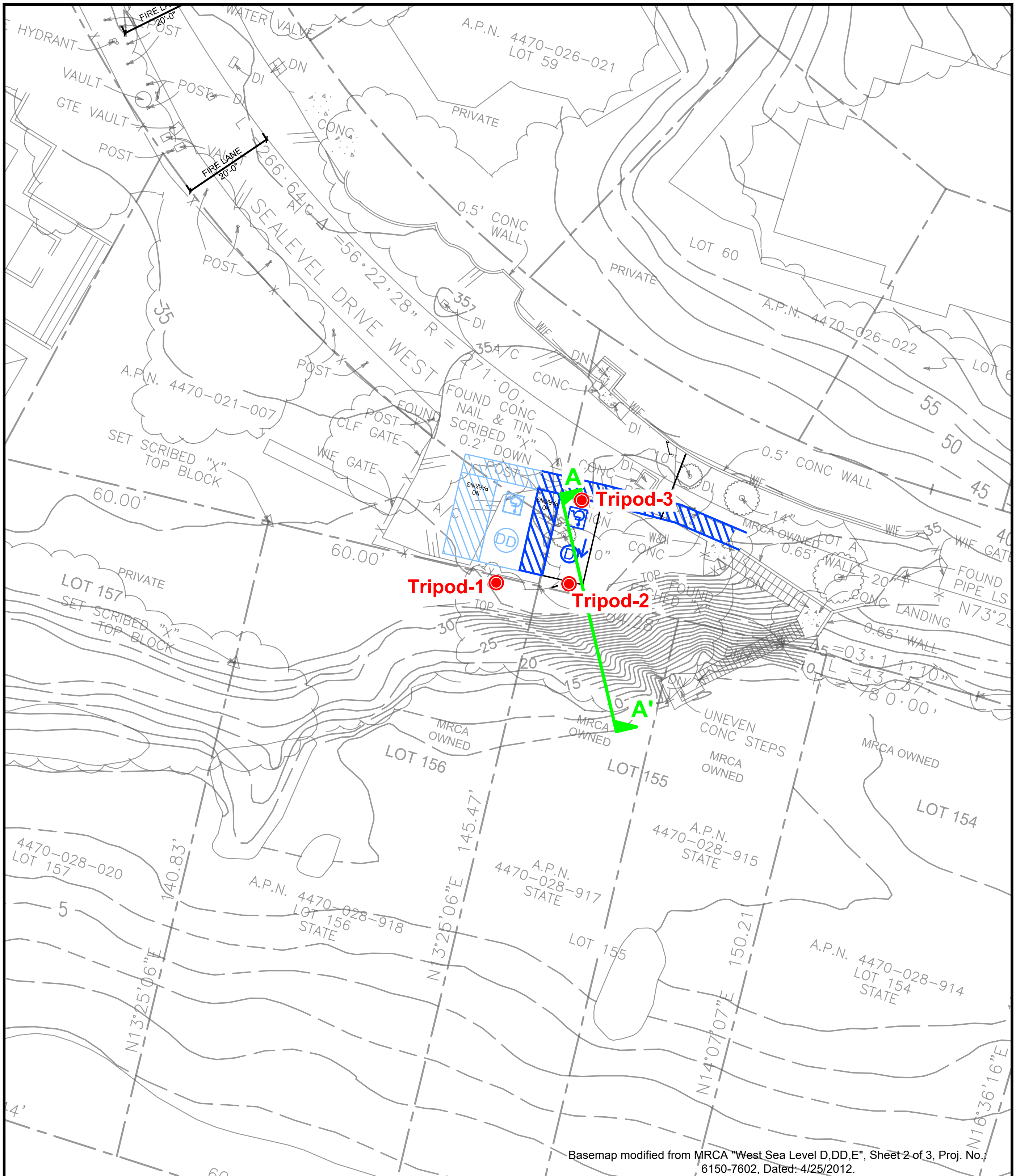
Parking Space "D" - West Sea Level Drive
Lechuza Beach Improvements
Malibu, California

CASE	CONDITION ANALYZED	FACTOR OF SAFETY
1a	Long term static with large displacement shear strength values - Optimization turned on	1.25 [1]
1b	Long term static with large displacement shear strength values - Optimization turned off	1.41 [1]
1c	Long term static with large displacement shear strength values (comparison run)	1.50
2a	Long term static with peak shear strength values - Optimization turned on	1.88
2b	Long term static with peak shear strength values - Optimization turned off	2.12
3a	Pseudostatic with large displacement shear strength values [2]	0.99 [3]
3b	Pseudostatic with large displacement shear strength values [4]	1.10
4a	Pseudostatic with peak shear strength values [2]	1.48
4b	Pseudostatic with peak shear strength values [4]	1.66

Notes:

1. Factor of safety less than acceptable criterion.
2. Based on the screening analysis procedure (ASCE/SCEC, 2002) with a calculated "k" coefficient = 0.31 and a required FS = 1.0.
3. Factor of safety considered to be acceptable by AMEC (i.e. very close to 1.0).
4. Based on the City of Malibu requirement of a "k" coefficient = 0.20 and a required FS = 1.10.

FIGURES



Basemap modified from MRCA "West Sea Level D,DD,E", Sheet 2 of 3, Proj. No.: 6150-7602, Dated: 4/25/2012.

Explanation

Tripod-3 ● Tripod boring location (approximate)

A A' Geologic cross-section location

0 15 30
Approximate Scale in Feet

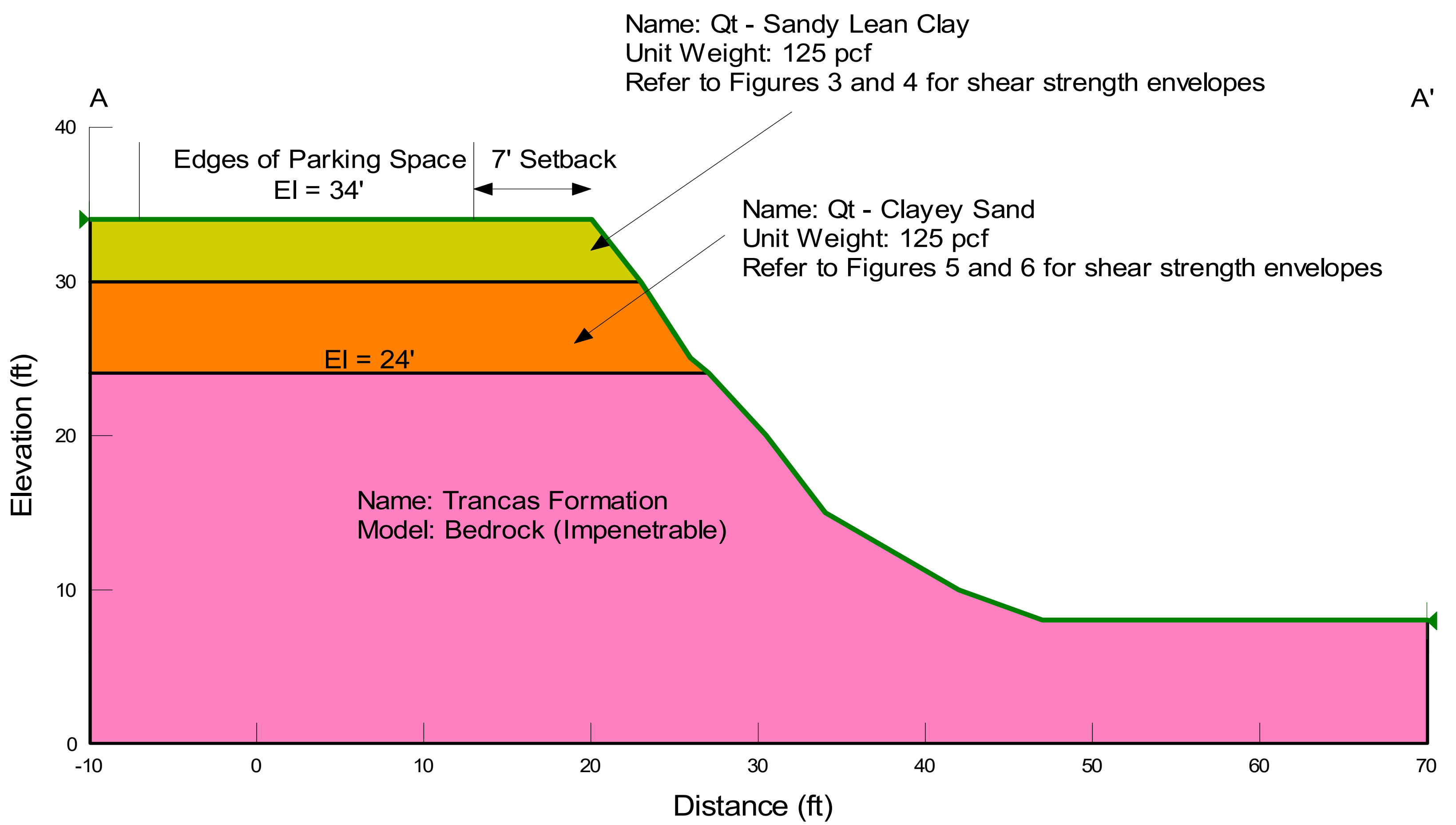
N

TRIPOD BORING & GEOLOGIC CROSS-SECTION LOCATION MAP
PARKING SPACE "D" - WEST SEA LEVEL DRIVE
Lechuza Beach Public Access
Malibu, California

By: jbd	Date: 07/02/2012	Project No. 10978000
amec		Figure 1

Plot Date: 7/02/2012 10:31:34 AM , Plotted by: jim.depoorter Drawing Path: Y:\10978.000.0\ACAD_TB-001_BORING-SECTION LOC.DWG , Figure 1

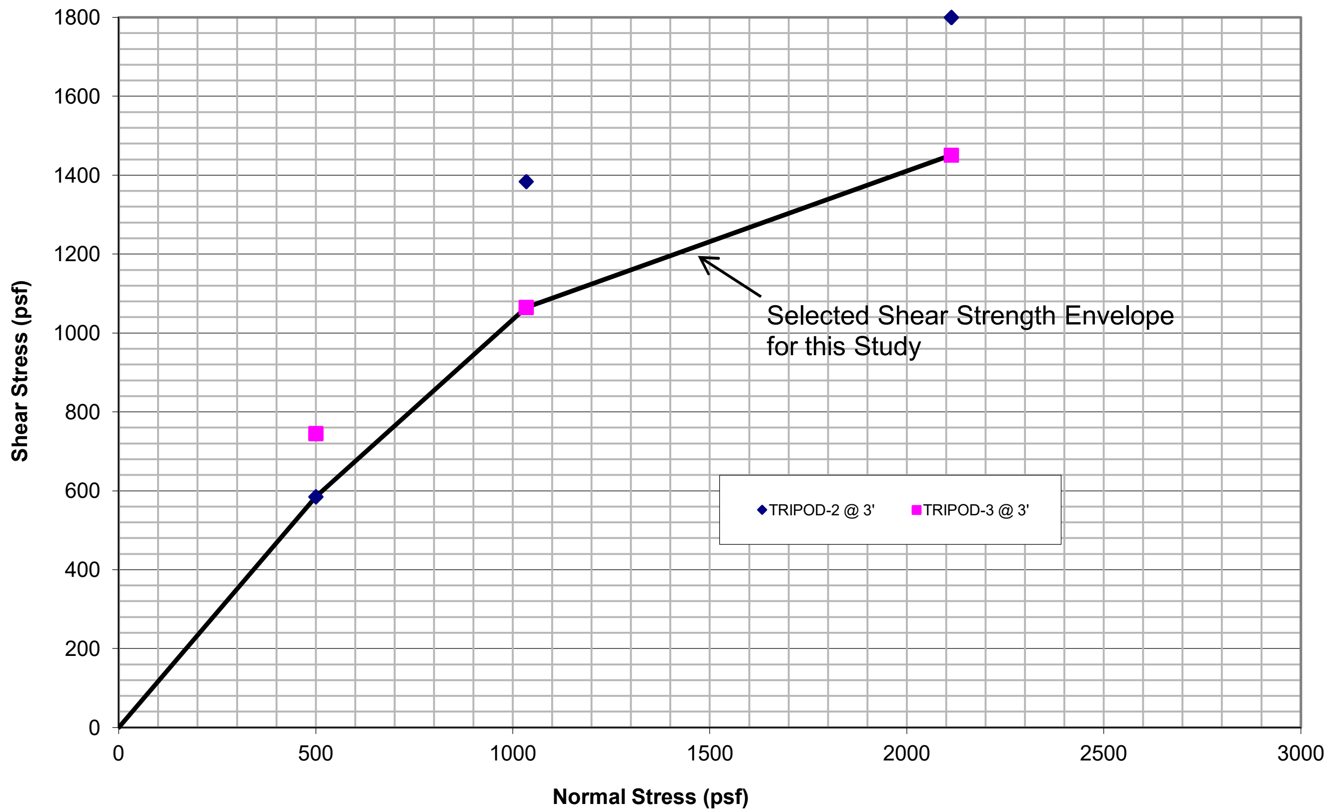
P:\10978.000.0\Docs\Results of Slope Stability Analyses\Figure 2.xls



GEOLOGIC CROSS-SECTION A-A'
Parking Space "D" - West Sea Level Drive
Lechuza Beach Improvements
Malibu, California

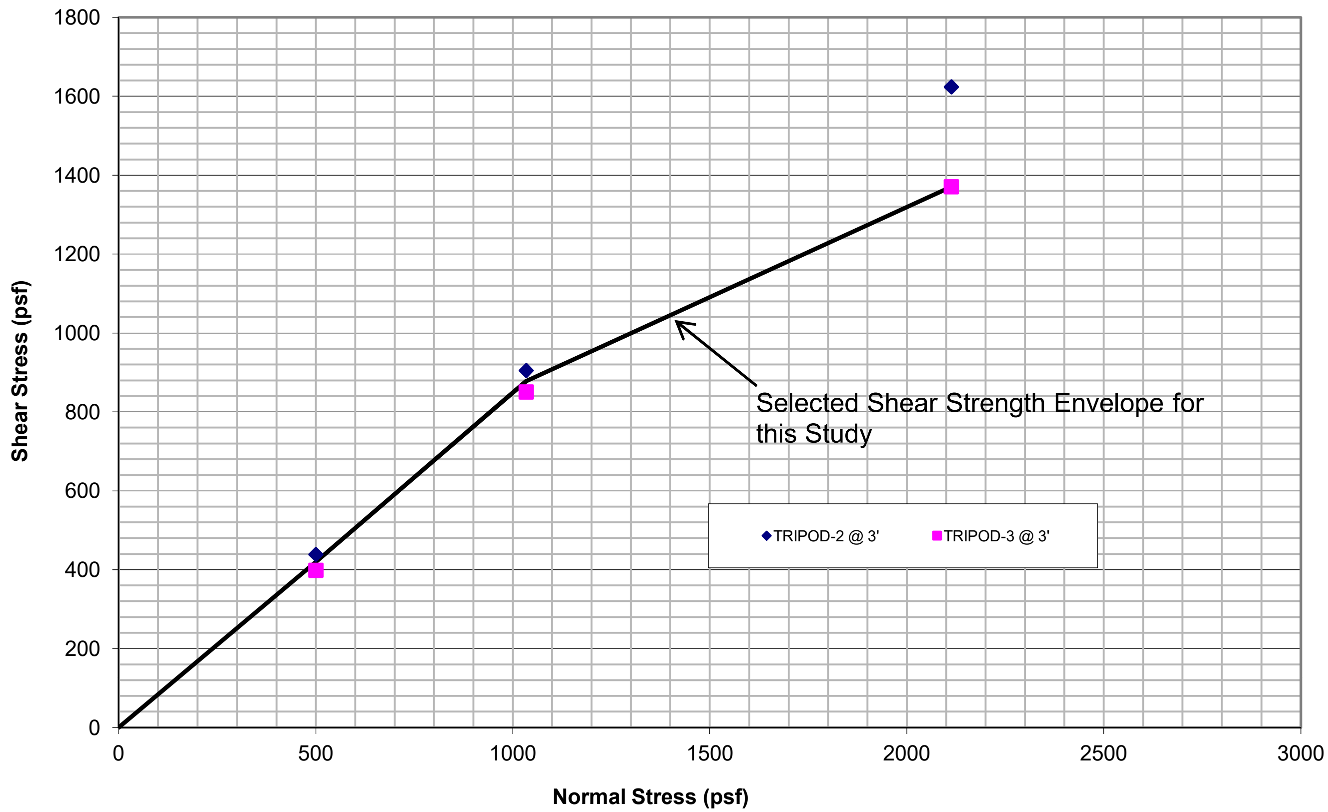
By: EF	Date: 07/10/12	Project No.: 10978000
amec		Figure 2

P:\10978.000.0\Docs\Results of Slope Stability Analyses\Figures 3 through 6.xls



DIRECT SHEAR TEST RESULTS FOR SANDY LEAN CLAY - PEAK STRENGTH
Parking Space "D" - West Sea Level Drive
Lechuza Beach Improvements
Malibu, California

By: EF	Date: 07/10/12	Project No.: 10978000
amec		Figure 3



DIRECT SHEAR TEST RESULTS FOR SANDY LEAN CLAY - LARGE DISPLACEMENT
Parking Space "D" - West Sea Level Drive
Lechuza Beach Improvements
Malibu, California

By: EF	Date: 07/10/12	Project No.: 10978000
amec		Figure 4

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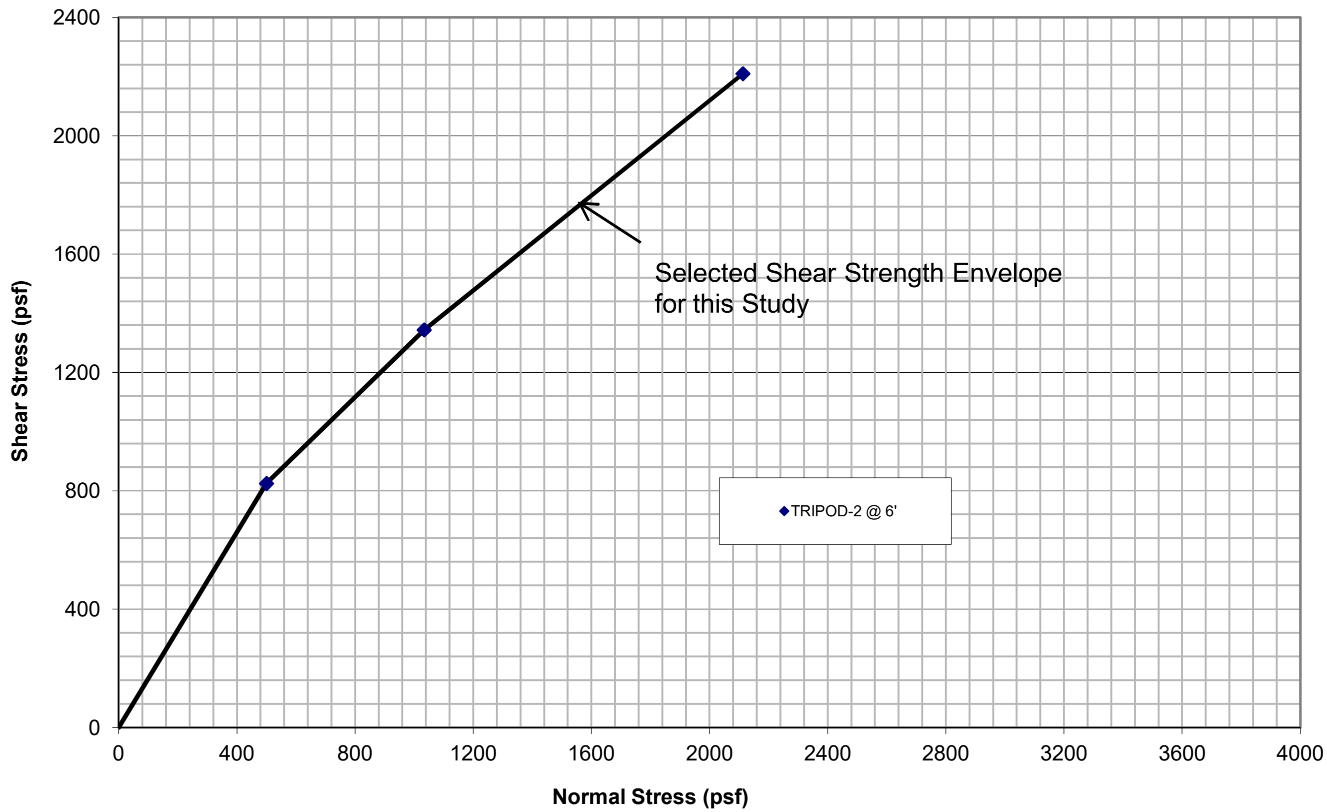

DIRECT SHEAR TEST RESULTS FOR CLAYEY SAND - PEAK STRENGTH Parking Space "D" - West Sea Level Drive Lechuza Beach Improvements Malibu, California		
By: EF	Date: 07/10/12	Project No.: 10978000
amec		Figure 5

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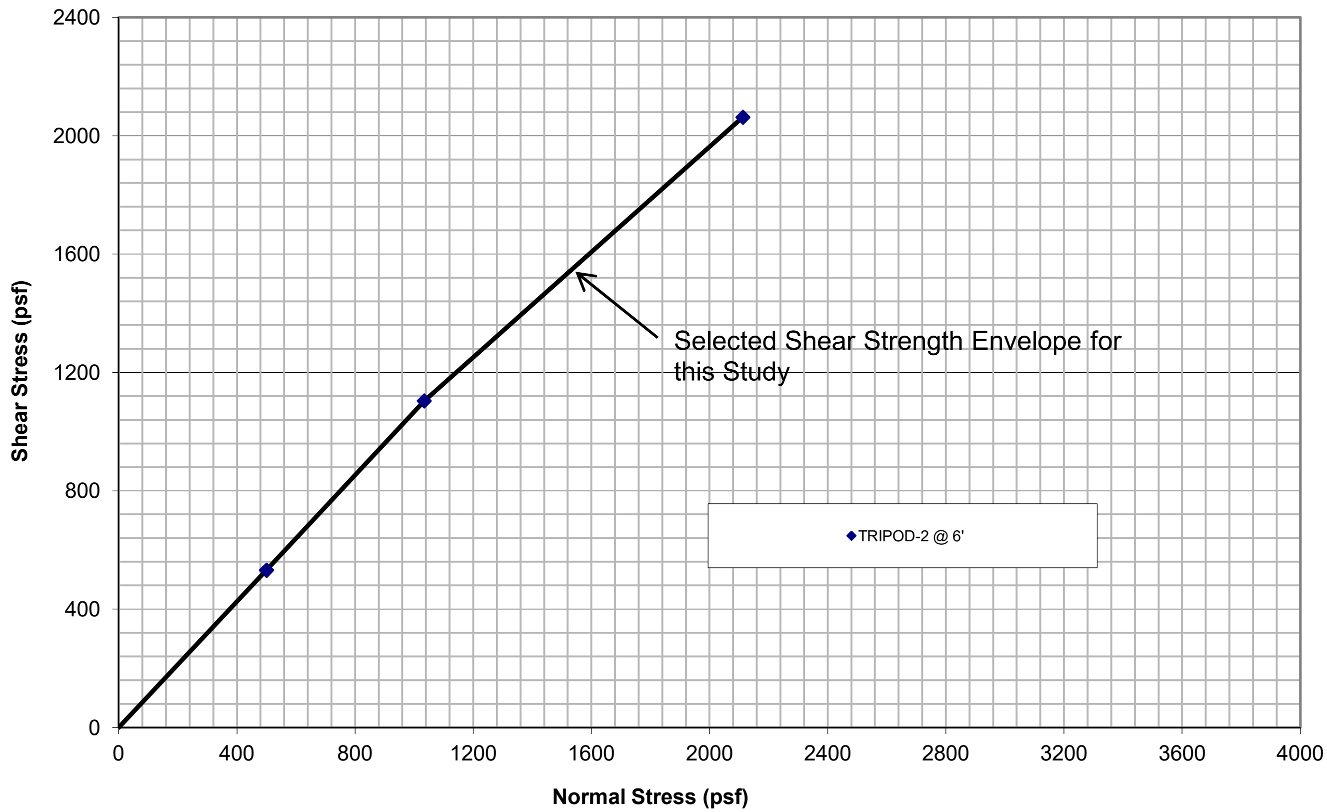


DIRECT SHEAR TEST RESULTS FOR CLAYEY SAND - LARGE DISPLACEMENT
Parking Space "D" - West Sea Level Drive
Lechuza Beach Improvements
Malibu, California

By: EF	Date: 07/10/12	Project No.: 10978000
amec		Figure 6

APPENDIX A

Tripod Boring Logs

EXPLANATION OF BORING LOGS

LECHUZA BEACH IMPROVEMENTS
Malibu, California

MAJOR DIVISIONS		LTR	DESCRIPTION
COARSE GRAINED SOILS	GRAVEL	GW	Well-graded gravels or gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels or gravel-sand mixture, little or no fines
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	SAND	SW	Well-graded sands or sand with gravel, little or no fines
		SP	Poorly-graded sands or sand with gravel, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures

MAJOR DIVISIONS		LTR	DESCRIPTION
FINE GRAINED SOILS	SILTS AND CLAYS LL<50	ML	Inorganic silts and very fine sand, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silt-clays of low plasticity
	SILTS AND CLAYS LL>50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of hogh plasticity, fat clays
		OH	Organic clays of medium to high plasticity
HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils

SAMPLE COLUMN SYMBOLS

Modified California split spoon sample

Bulk

BLOWS/6 INCHES - Summation of blow counts for 6-inch sampling interval

DESCRIPTION COLUMN SYMBOLS

Dashed lines separating soil strata represent inferred boundaries between sampled intervals or no recovery intervals and may be distinct or gradual transitions

Solid lines represent distinct or gradual boundaries observed within sampled intervals

Description right of bracket symbol represents soil conditions within the depth interval defined by the bracket length

Description right of arrow symbol represents soil conditions to the next deeper boundary line unless otherwise noted

LABORATORY TEST ABBREVIATIONS

ATT	Atterberg Limits	CORR	Corrosion	SE	Sand Equivalent
COLL	Collapse Potential	DS	Direct Shear	SG	Specific Gravity
COMP	Compaction	EI	Expansion Index	TX	Triaxial Test
CON	Consolidation	S	Grain Size Analysis	UC	Unconfined Compression Test
R	R-Value	PERM	Permeability	#200	No. 200 Wash Sieve Analysis

NOTES

1. Soil descriptions are in accordance with the USCS as set forth by ASTM D2488 "Standard Practice for Description and Identification Soil (Visual-Manual Procedure)."
2. Soil color described according to Munsell Soil Color Chart.
3. Soil descriptions in these borings are generalized representations and based upon visual classification of cuttings and/or samples during drilling. Descriptions and related information in these borings depict subsurface conditions at the specific location and at the time of drilling only. Soil conditions at other locations may differ from conditions observed at the boring locations. Also, soil and groundwater conditions may change with time at these locations.

PROJECT: LECHUZA BEACH IMPROVEMENTS Malibu, California	**Log of Boring No. Tripod-1**

BORING LOCATION: West Sea Level Drive -- S side of proposed parking space DD			
DATE STARTED: 4/4/12	DATE FINISHED: 4/4/12	NOTES: Drilling Contractor: DP Reynolds Corp Drilling Equipment: Honda GX340 11.0 hydraulic mtr Logged By: E. Forcier	
DRILLING METHOD: 6" solid flight (limited access)			
HAMMER WEIGHT: 140 lb	DROP: 24 in. (non-standard)		
SAMPLER: tripod cathead & pully			

ELEV. (feet)	DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ 6 inches	MATERIAL DESCRIPTION (Surface Elevation: ~34' MSL (not surveyed))	LABORATORY TESTS: Moisture Content (%)	Dry Density (pcf)	Other Tests
	0–1				SANDY LEAN CLAY (CL): very dark grayish brown (10YR 3/2), moist, ~55% fines, ~45% fine sand, medium plasticity [FILL]			EI
	1–2.5	1	B		SANDY LEAN CLAY (CL): very dark grayish brown (10YR 3/2), moist, ~55% fines, ~45% fine sand, medium plasticity [NATIVE]			
	2.5–3.5	2		17 44	dark reddish brown (5YR 3/3)	13.2	117.5	UC
	3.5				Bottom of boring at 3.5' bgs. No groundwater encountered at time of drilling. Boring backfilled with soil cuttings.			

Depth scale: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

PROJECT: LECHUZA BEACH IMPROVEMENTS Malibu, California	**Log of Boring No. Tripod-2**

BORING LOCATION: West Sea Level Drive -- S side of proposed parking space D

DATE STARTED: 4/4/12	DATE FINISHED: 4/4/12	NOTES: Drilling Contractor: DP Reynolds Corp Drilling Equipment: Honda GX340 11.0 hydraulic mtr Logged By: E. Forcier
DRILLING METHOD: 6" solid flight (limited access)		
HAMMER WEIGHT: 140 lb	DROP: 24 in. (non-standard)	
SAMPLER: tripod cathead & pully		

ELEV. (feet)	DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ 6 inches	MATERIAL DESCRIPTION Surface Elevation: ~34' MSL (not surveyed)	LABORATORY TESTS: Moisture Content (%)	Dry Density (pcf)	Other Tests
	0				SANDY LEAN CLAY (CL): very dark grayish brown (10YR 3/2), moist, ~55% fines, ~45% fine sand, medium plasticity			
	1							
	2							
	3	1		20 60	dark reddish brown (5YR 3/3)	10.8	115.5	DS % <#200 =53
	4							
	5				CLAYEY SAND (SC): brown (10YR 4/3), moist, ~65% fine to medium sand, ~30% medium plasticity fines, ~5% fine gravel-sized siltstone fragments			
	6	2		26 36		12.3	113.1	DS % <#200 =29
	7				CLAYEY SAND with GRAVEL (SC): brown (10YR 4/3), moist, ~40% fine to coarse sand and siltstone fragments, ~30% fine to coarse gravel-sized siltstone, ~30% medium plasticity fines			
	8	3		60/6"	Bottom of boring at 8' bgs. No groundwater encountered at time of drilling. Boring backfilled with soil cuttings.			
	9							
	10							
	11							
	12							
	13							
	14							
	15							

PROJECT: LECHUZA BEACH IMPROVEMENTS
Malibu, California

Log of Boring No. Tripod-3

BORING LOCATION: West Sea Level Drive -- N side of proposed parking space D

DATE STARTED: 4/4/12 | DATE FINISHED: 4/4/12

DRILLING METHOD: 6" solid flight (limited access)

HAMMER WEIGHT: 140 lb | DROP: 24 in. (non-standard)

SAMPLER: tripod cathead & pully

NOTES:
Drilling Contractor: DP Reynolds Corp
Drilling Equipment: Honda GX340 11.0 hydraulic mtr
Logged By: E. Forcier

ELEV. (feet)	DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ 6 inches	MATERIAL DESCRIPTION (Surface Elevation: ~34' MSL (not surveyed))	LABORATORY TESTS: Moisture Content (%)	LABORATORY TESTS: Dry Density (pcf)	LABORATORY TESTS: Other Tests
	0–3	1			SANDY SILT (ML): dark brown (10YR 3/3), moist, ~60% fines, ~30% fine to coarse sand, ~10% fine gravel (siltstone fragments), low plasticity [FILL?]			
	3–5	2		18 27	SANDY LEAN CLAY (CL): dark reddish brown (5YR 3/3), moist, ~60% fines, ~40% fine sand, medium plasticity [NATIVE]	12.2	111.7	DS % <#200 =60
	5–6.5	3		22 36	CLAYEY SAND (SC): brown (10YR 3/3), moist, ~55% fine sand, ~45% medium plasticity fines, fragments of coarse gravel-sized siltstone			
	6.5–7.5	4		50/6"	CLAYEY SAND with GRAVEL (SC): brown (10YR 4/3), moist, ~40% fine to coarse sand and siltstone fragments, ~30% fine to coarse gravel-sized siltstone, ~30% medium plasticity fines			
	7.5				Bottom of boring at 7.5' bgs. No groundwater encountered at time of drilling. Boring backfilled with soil cuttings.			

GEO3-6-INCH

amec

APPENDIX B

Laboratory Test Results

MATERIAL IN SOILS FINER THAN No. 200 SIEVE

(ASTM-D1140)

Project Name:	Lechuza Beach Public Access	*Project No.:*	0109780000
Date:	4/05-4/10/2012	*Tested By:*	VC, LT

Boring No.	TRIPOD-2	TRIPOD-2		TRIPOD-3			
Sample No.	1	2		2			
Sample Depth (Ft)	3.0-3.5	5.5-6.0		3.0-3.5			
Tare No.:	1	13		15			
Total Dry Weight and Tare (g):	344.07	277.25		207.11			
Tare Weight (g):	97.23	98.35		97.11			
Total Dry Weight of Sample (g):	246.84	178.90		110.00			
Dry Weight of Soil Retained on No. 200 Sieve (g):	116.53	126.38		44.17			
Percentage of Material Finer Than No. 200 (75 mm) Sieve (%):	52.8	29.4		59.8			
Soil Description	Dark Reddish Brown (5YR, 3/3) Sandy Lean Clay (CL)	Dark Reddish Brown (5YR, 3/3) Clayey Sand (SC)		Dark Reddish Brown (5YR, 3/3) Sandy Lean Clay (CL)			

EXPANSION INDEX TEST

ASTM D4829

PROJECT NAME:	Lechuza Beach Public Access		*PROJECT No.:*	0109780000
BORING No.:	TRIPOD-1	*SAMPLE No.:*	*DEPTH:*	0-2.5 Feet
SOIL DESCRIPTION:	Very Dark Grayish Brown (10YR, 3/2) Sandy Lean Clay (CL)			
			DATE: 4/05-4/09/12	*BY:* LT

SPECIMEN PREPARATION

WET DENSITY CALCULATION	TRIAL 1	TRIAL 2	TRIAL 3	TRIAL 4
RING No.	1			
RING AND WET SOIL, gr.	577.98			
WEIGHT OF RING, gr.	199.54			
WEIGHT OF WET SOIL, gr.	378.44			
WET DENSITY, PCF.	114.7			
MOISTURE CALCULATION				
TARE No.	5			
WET SOIL AND TARE, gr.	386.59			
DRY SOIL AND TARE, gr.	356.72			
TARE WEIGHT, gr.	97.26			
MOISTURE CONTENT, %	11.5			
DRY DENSITY, PCF.	102.9			
SATURATION DEGREE (S), % (1)	48.95			

EXPANSION INDEX (EI) CALCULATION

APPARATUS No.:	1
INITIAL SPECIMEN HEIGHT:	1.0000 inch

		HEIGHT CHANGE, in.	DATE	TIME
INITIAL DIAL READING, in.	0.0500	0.0000	4/6/2012	14:56
PERIODIC DIAL READING, in.	0.0924	0.0424	4/9/2012	10:24

FINAL DIAL READING, in.	0.0924	0.0424	4/9/2012	12:28

EI = 42

FINAL MOISTURE CONTENT, DRY DENSITY AND SATURATION DEGREE

TARE No.	---	MOISTURE CONTENT, %	26.0
WET SOIL AND TARE, gr.	417.77	FINAL VOLUME, cc.	214.66
DRY SOIL AND TARE, gr.	331.54	FINAL DRY DENSITY, PCF.	98.7
TARE WEIGHT, gr.	0.00	FINAL SATURATION, %	99.7

----

(1) $S = \frac{wG_s\gamma_d}{G_s\gamma_w - \gamma_d}$ (S must be 50 ± 2%)

UNCONFINED COMPRESSIVE STRENGTH TEST

(ASTM-D2166)

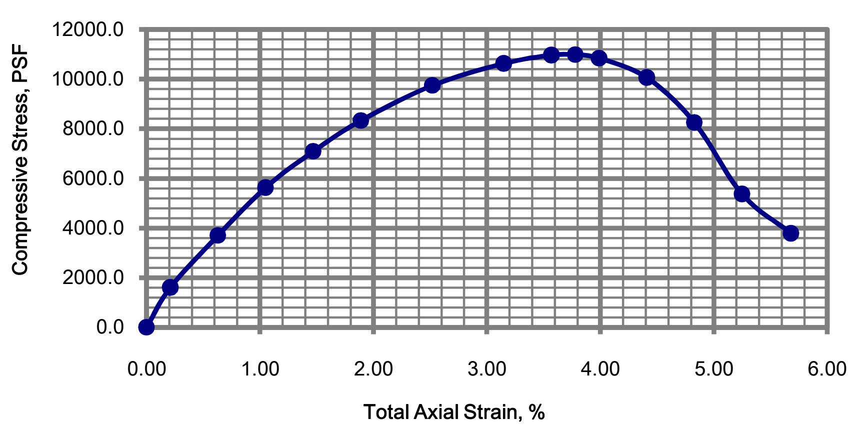
Project Name:	Lechuza Beach Public Access			*Project No.:*	0109780000
Boring No.:	TRIPOD-1	*Sample No.:*	1	*Depth:*	3.0-3.5 Feet
Soil Description:	Dark Reddish Brown (5YR, 3/3) Sandy Lean Clay (CL)				
Date:	4/10/2012		By:	LT	

Initial Diameter, in:	2.416
Initial Area, in^2:	4.584
Initial Height, in:	5.000
Height-to-Diameter Ratio:	2.07
Type of Sample:	Undisturbed
Strain Rate, % / minute:	0.99
Note: Moisture content specimen was obtained after test.	

Wet Weight of Sample, grs:	800.62
Moisture Content-	
Tare No.:	MC-57
Wet Weight&Tare, grs:	269.62
Dry Weight & Tare, grs:	244.03
Tare Weight, grs:	50.22
Moisture Content, %:	13.2
Wet Density, pcf:	133.1
Dry Density, pcf:	117.5

Elapsed Time	Axial Load, Pounds	Strain Dial Reading, in	Total Strain, %	Corrected Area, in^2	Compressive Stress, PSF	Remarks
00:00:00	0.0	0.000	0.00	4.584	0.0	
	51.2	0.010	0.21	4.594	1605.3	
	118.6	0.031	0.63	4.613	3701.4	
	181.3	0.052	1.05	4.633	5634.9	
	229.3	0.073	1.47	4.653	7097.2	
	270.5	0.094	1.89	4.673	8337.0	
	318.5	0.126	2.52	4.703	9753.8	
	349.7	0.157	3.15	4.733	10639.3	
	362.3	0.178	3.57	4.754	10973.0	
	363.7	0.189	3.78	4.764	10992.5	
	359.8	0.199	3.99	4.775	10849.6	Cracked;
	335.4	0.220	4.41	4.796	10070.5	Bulge
	276.3	0.241	4.83	4.817	8258.6	
	180.6	0.262	5.25	4.838	5374.5	
00:05:44	127.9	0.284	5.68	4.860	3789.3	

Photo



Unconfined Compressive Strength, PSF = 10992

Shear Strength, PSF = 5496

DIRECT SHEAR TEST

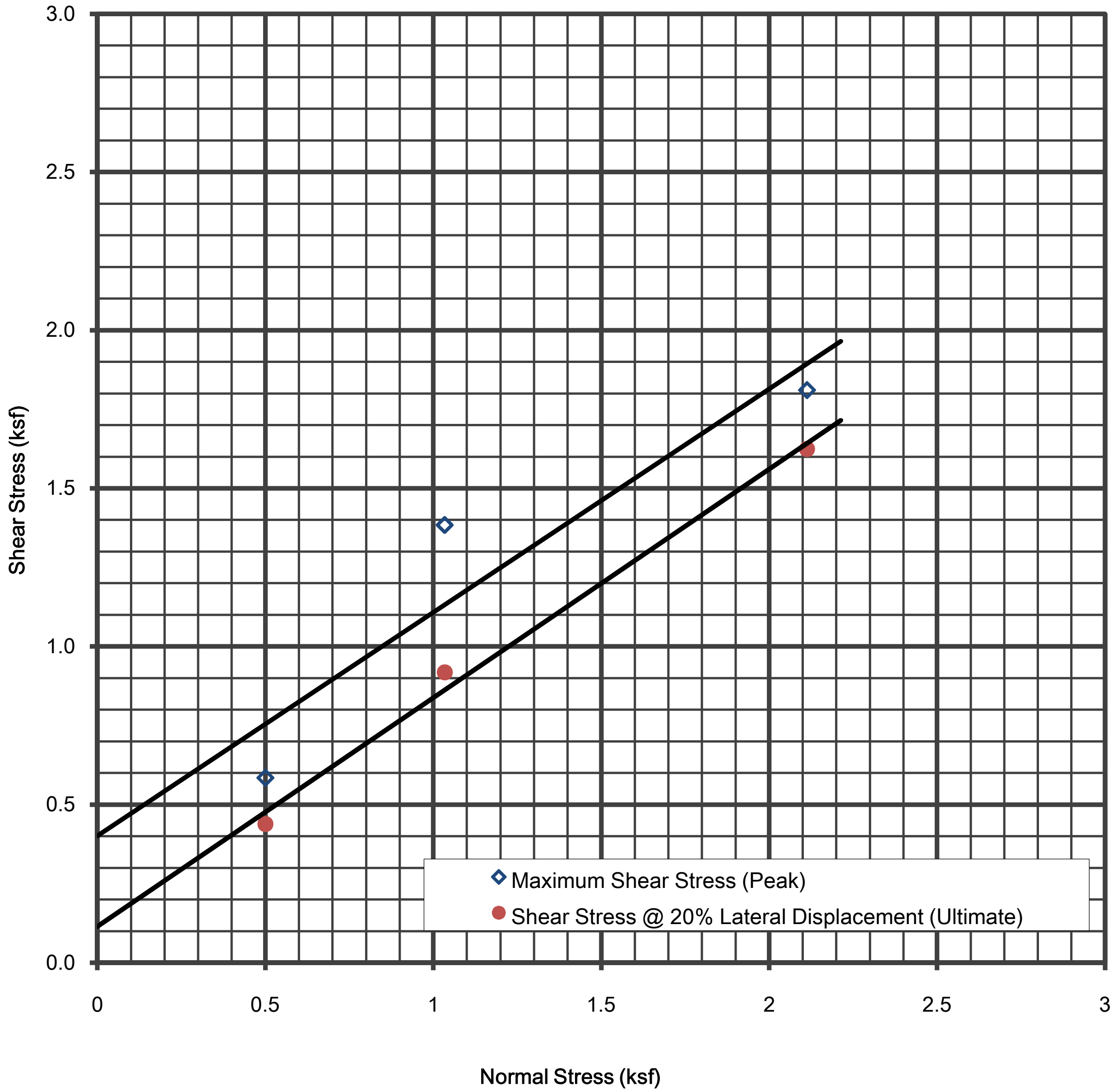
(ASTM-D3080)

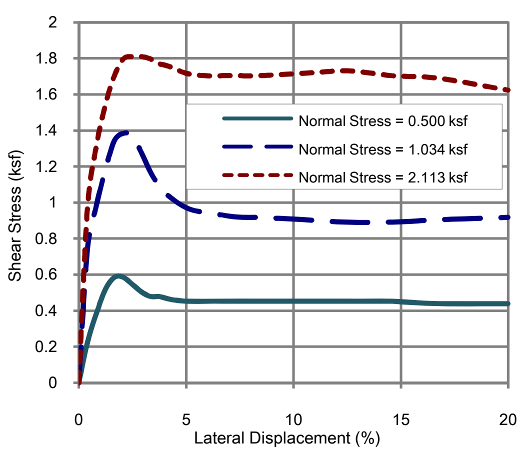
Project Name:	Lechuza Beach Public Access				*Project No.:*		0109780000
Boring No.:	TRIPOD-2	*Sample No.:*	1	*Depth:*	3.0-3.5 Feet	*Date:*	4/05-4/09/2012
Soil Description:	Dark Reddish Brown (5YR, 3/3) Sandy Lean Clay (CL)					*Tested By:*	LT

				Before Test	After Test		
					Load 1	Load 2	Load 3
Sample Diameter, in:	2.416	Weight of Wet Soil & Ring, gr:		596.46	---	---	---
Normal Stress, ksf:	0.5, 1, 2	Weight of Ring, gr:		134.55	---	---	---
Over-burdened @, pcf:		Height of Sample, in:		3.00	0.9854	0.9832	0.9610
Shear Rate, in/min:	0.005	Moisture-	Tare No.:	1	---	---	---
Natural Moisture(x):			Wet Weight and Tare, gr:	370.61	156.97	158.43	153.85
Saturated(x):	X		Dry Weight and Tare, gr:	344.07	135.12	136.47	133.91
Intact(x):	X		Tare Weight, gr:	97.23	0.00	0.00	0.00
Remolded to, pcf:			Moisture Content, %:	10.8	16.2	16.1	14.9
@, %:		Wet Density, pcf:		127.9	136.2	136.4	138.1
Notes:		Dry Density, pcf:		115.5	117.2	117.5	120.2
		Saturation %:	S.G. = 2.70 (Assumed)	63.2	99.7	100.0	100.0

Load 1 (KSF): 0.500				Load 2 (KSF): 1.034				Load 3 (KSF): 2.113			
Shear Deflec -tion (in)	Lateral Displace -ment (%)	Load Ring Reading	Shear Stress (KSF)	Shear Deflec -tion (in)	Lateral Displace -ment (%)	Load Ring Reading	Shear Stress (KSF)	Shear Deflec -tion (in)	Lateral Displace -ment (%)	Load Ring Reading	Shear Stress (KSF)
0.0098	0.406	0.0014	0.226	0.0098	0.406	0.0053	0.745	0.0098	0.406	0.0070	0.971
0.0199	0.823	0.0026	0.385	0.0199	0.823	0.0071	0.985	0.0199	0.823	0.0096	1.318
0.0300	1.241	0.0036	0.519	0.0300	1.241	0.0086	1.184	0.0300	1.241	0.0113	1.544
0.0401	1.659	0.0041	0.585	0.0401	1.659	0.0098	1.344	0.0401	1.659	0.0125	1.704
0.0502	2.077	0.0041	0.585	0.0502	2.077	0.0101	1.384	0.0502	2.077	0.0132	1.797
0.0603	2.495	0.0038	0.545	0.0603	2.495	0.0100	1.371	0.0603	2.495	0.0133	1.810
0.0704	2.912	0.0035	0.505	0.0704	2.912	0.0093	1.278	0.0704	2.912	0.0133	1.810
0.0805	3.330	0.0033	0.479	0.0805	3.330	0.0085	1.171	0.0805	3.330	0.0132	1.797
0.0905	3.748	0.0033	0.479	0.0905	3.748	0.0079	1.091	0.0905	3.748	0.0130	1.770
0.1006	4.166	0.0032	0.465	0.1006	4.166	0.0075	1.038	0.1006	4.166	0.0129	1.757
0.1208	5.002	0.0031	0.452	0.1208	5.002	0.0070	0.971	0.1208	5.002	0.0126	1.717
0.1410	5.837	0.0031	0.452	0.1410	5.837	0.0068	0.945	0.1410	5.837	0.0125	1.704
0.1612	6.673	0.0031	0.452	0.1612	6.673	0.0067	0.931	0.1612	6.673	0.0125	1.704
0.1814	7.509	0.0031	0.452	0.1814	7.509	0.0066	0.918	0.1814	7.509	0.0125	1.704
0.2016	8.344	0.0031	0.452	0.2016	8.344	0.0066	0.918	0.2016	8.344	0.0125	1.704
0.2521	10.433	0.0031	0.452	0.2521	10.433	0.0065	0.905	0.2521	10.433	0.0126	1.717
0.3025	12.523	0.0031	0.452	0.3025	12.523	0.0064	0.891	0.3025	12.523	0.0127	1.730
0.3530	14.612	0.0031	0.452	0.3530	14.612	0.0064	0.891	0.3530	14.612	0.0125	1.704
0.4035	16.701	0.0030	0.439	0.4035	16.701	0.0065	0.905	0.4035	16.701	0.0124	1.690
0.4828	19.982	0.0030	0.439	0.4828	19.982	0.0066	0.918	0.4828	19.982	0.0119	1.624

Max. Shear Stress, ksf:	0.585	1.384	1.810
Shear Deflt.@Max Stress,%.:	2.1	2.1	2.9





Boring No.:	TRIPOD-2
Sample Depth :	3.0-3.5 Feet
Soil Type:	CL
Sample Conditions:	Intact; Saturated
Shear Rate:	0.005 inch/minute
In-Place Dry Density (PCF):	115.5
In-Place Moisture Content (%):	10.8

	◇	●
Cohesion (PSF):	401	115
Friction Angle (Degrees):	35	36

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DIRECT SHEAR TEST
LECHUZA BEACH PUBLIC ACCESS
Malibu, California

Project No.
0109780000

DIRECT SHEAR TEST

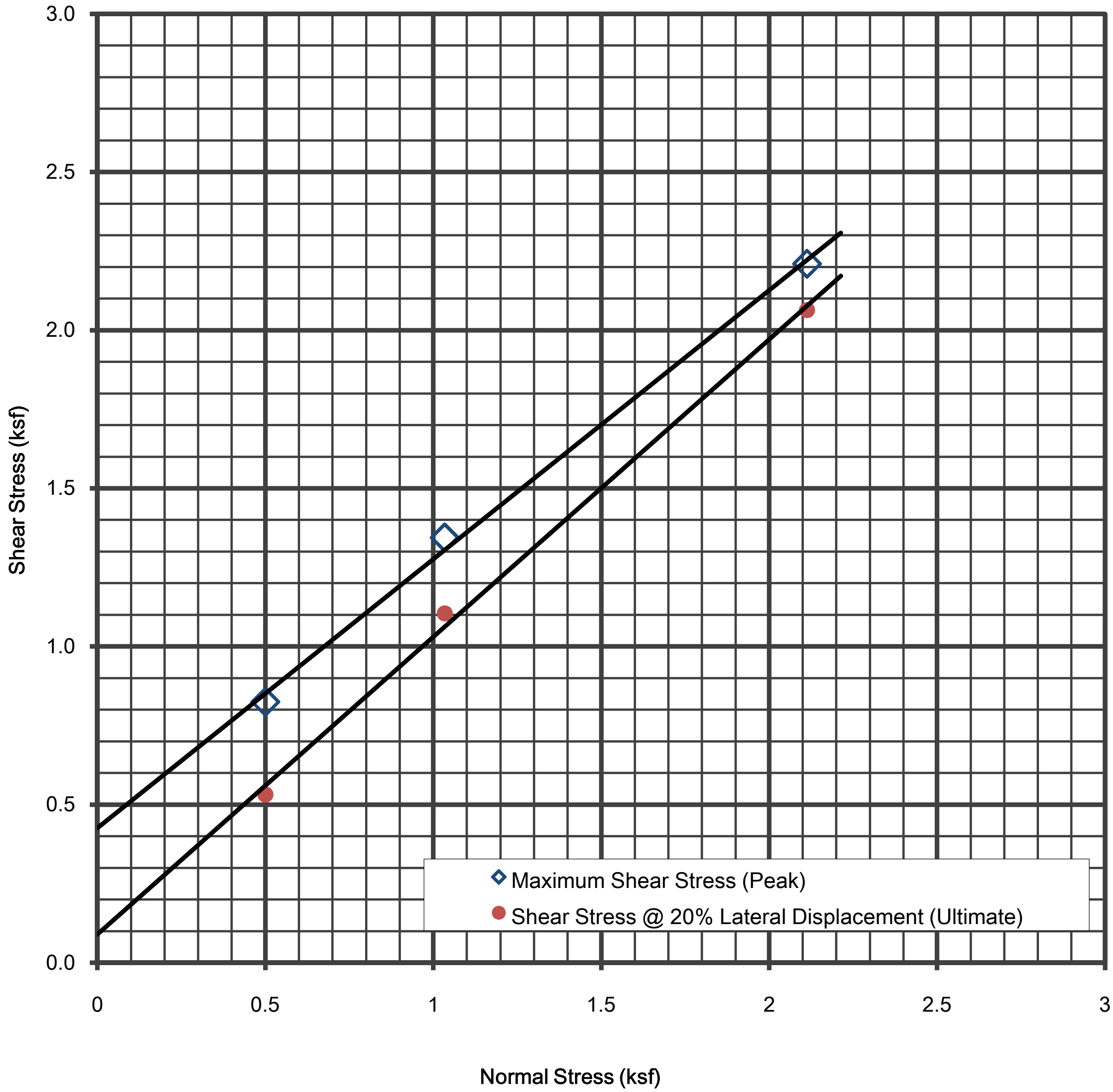
(ASTM-D3080)

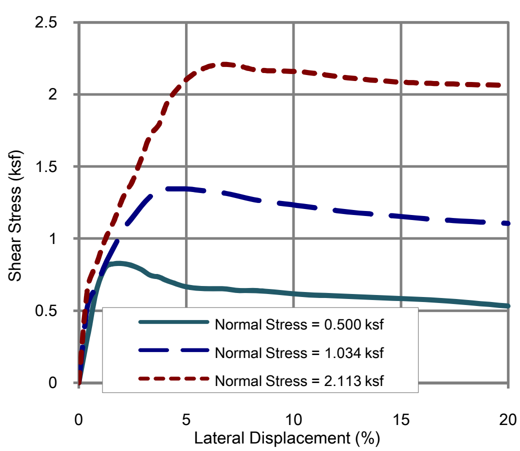
Project Name:	Lechuza Beach Public Access			*Project No.:*		0109780000	
Boring No.:	TRIPOD-2	*Sample No.:*	2	*Depth:*	5.5-6.0 Feet	*Date:*	4/05-4/10/2012
Soil Description:	Dark Reddish Brown (5YR, 3/3) Clayey Sand (SC)					*Tested By:*	LT

				Before Test	After Test Load 1	After Test Load 2	After Test Load 3
Sample Diameter, in:	2.416	Weight of Wet Soil & Ring, gr:		589.55	---	---	---
Normal Stress, ksf:	0.5, 1, 2	Weight of Ring, gr:		131.16	---	---	---
Over-burdened @, pcf:		Height of Sample, in:		3.00	0.9979	0.9881	0.9756
Shear Rate, in/min:	0.005	Moisture-	Tare No.:	13	---	---	---
Natural Moisture(x):			Wet Weight and Tare, gr:	299.17	156.66	156.32	153.56
Saturated(x):	X		Dry Weight and Tare, gr:	277.25	132.72	133.09	131.46
Intact(x):	X		Tare Weight, gr:	98.35	0.00	0.00	0.00
Remolded to, pcf:			Moisture Content, %:	12.3	18.0	17.5	16.8
@, %:		Wet Density, pcf:		127.0	133.8	134.5	135.4
Notes:		Dry Density, pcf:		113.1	113.4	114.5	115.9
		Saturation %:	S.G. = 2.70 (Assumed)	67.5	100.0	99.7	100.0

Load 1 (KSF): 0.500				Load 2 (KSF): 1.034				Load 3 (KSF): 2.113			
Shear Deflec -tion (in)	Lateral Displace -ment (%)	Load Ring Reading	Shear Stress (KSF)	Shear Deflec -tion (in)	Lateral Displace -ment (%)	Load Ring Reading	Shear Stress (KSF)	Shear Deflec -tion (in)	Lateral Displace -ment (%)	Load Ring Reading	Shear Stress (KSF)
0.0098	0.406	0.0021	0.319	0.0098	0.406	0.0037	0.532	0.0098	0.406	0.0046	0.652
0.0199	0.823	0.0045	0.638	0.0199	0.823	0.0047	0.665	0.0199	0.823	0.0059	0.825
0.0300	1.241	0.0057	0.798	0.0300	1.241	0.0059	0.825	0.0300	1.241	0.0072	0.998
0.0401	1.659	0.0059	0.825	0.0401	1.659	0.0068	0.945	0.0401	1.659	0.0082	1.131
0.0502	2.077	0.0059	0.825	0.0502	2.077	0.0077	1.065	0.0502	2.077	0.0094	1.291
0.0603	2.495	0.0058	0.811	0.0603	2.495	0.0083	1.144	0.0603	2.495	0.0102	1.397
0.0704	2.912	0.0056	0.785	0.0704	2.912	0.0089	1.224	0.0704	2.912	0.0114	1.557
0.0805	3.330	0.0053	0.745	0.0805	3.330	0.0094	1.291	0.0805	3.330	0.0126	1.717
0.0905	3.748	0.0052	0.732	0.0905	3.748	0.0098	1.344	0.0905	3.748	0.0132	1.797
0.1006	4.166	0.0050	0.705	0.1006	4.166	0.0098	1.344	0.1006	4.166	0.0144	1.957
0.1208	5.002	0.0047	0.665	0.1208	5.002	0.0098	1.344	0.1208	5.002	0.0155	2.103
0.1410	5.837	0.0046	0.652	0.1410	5.837	0.0097	1.331	0.1410	5.837	0.0161	2.183
0.1612	6.673	0.0046	0.652	0.1612	6.673	0.0096	1.318	0.1612	6.673	0.0163	2.210
0.1814	7.509	0.0045	0.638	0.1814	7.509	0.0094	1.291	0.1814	7.509	0.0162	2.196
0.2016	8.344	0.0045	0.638	0.2016	8.344	0.0092	1.264	0.2016	8.344	0.0160	2.170
0.2521	10.433	0.0043	0.612	0.2521	10.433	0.0089	1.224	0.2521	10.433	0.0159	2.156
0.3025	12.523	0.0042	0.598	0.3025	12.523	0.0086	1.184	0.3025	12.523	0.0156	2.116
0.3530	14.612	0.0041	0.585	0.3530	14.612	0.0084	1.158	0.3530	14.612	0.0154	2.090
0.4035	16.701	0.0040	0.572	0.4035	16.701	0.0082	1.131	0.4035	16.701	0.0153	2.077
0.4828	19.982	0.0037	0.532	0.4828	19.982	0.0080	1.104	0.4828	19.982	0.0152	2.063

Max. Shear Stress, ksf:	0.825	1.344	2.210
Shear Deflt.@Max Stress,%.:	2.1	5.0	6.7





Boring No.:	TRIPOD-2
Sample Depth :	5.5-6.0 Feet
Soil Type:	SC
Sample Conditions:	Intact; Saturated
Shear Rate:	0.005 inch/minute
In-Place Dry Density (PCF):	113.1
In-Place Moisture Content (%):	12.3

	◇	●
Cohesion (PSF):	426	90
Friction Angle (Degrees):	40	43

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DIRECT SHEAR TEST
LECHUZA BEACH PUBLIC ACCESS
Malibu, California

Project No.
0109780000

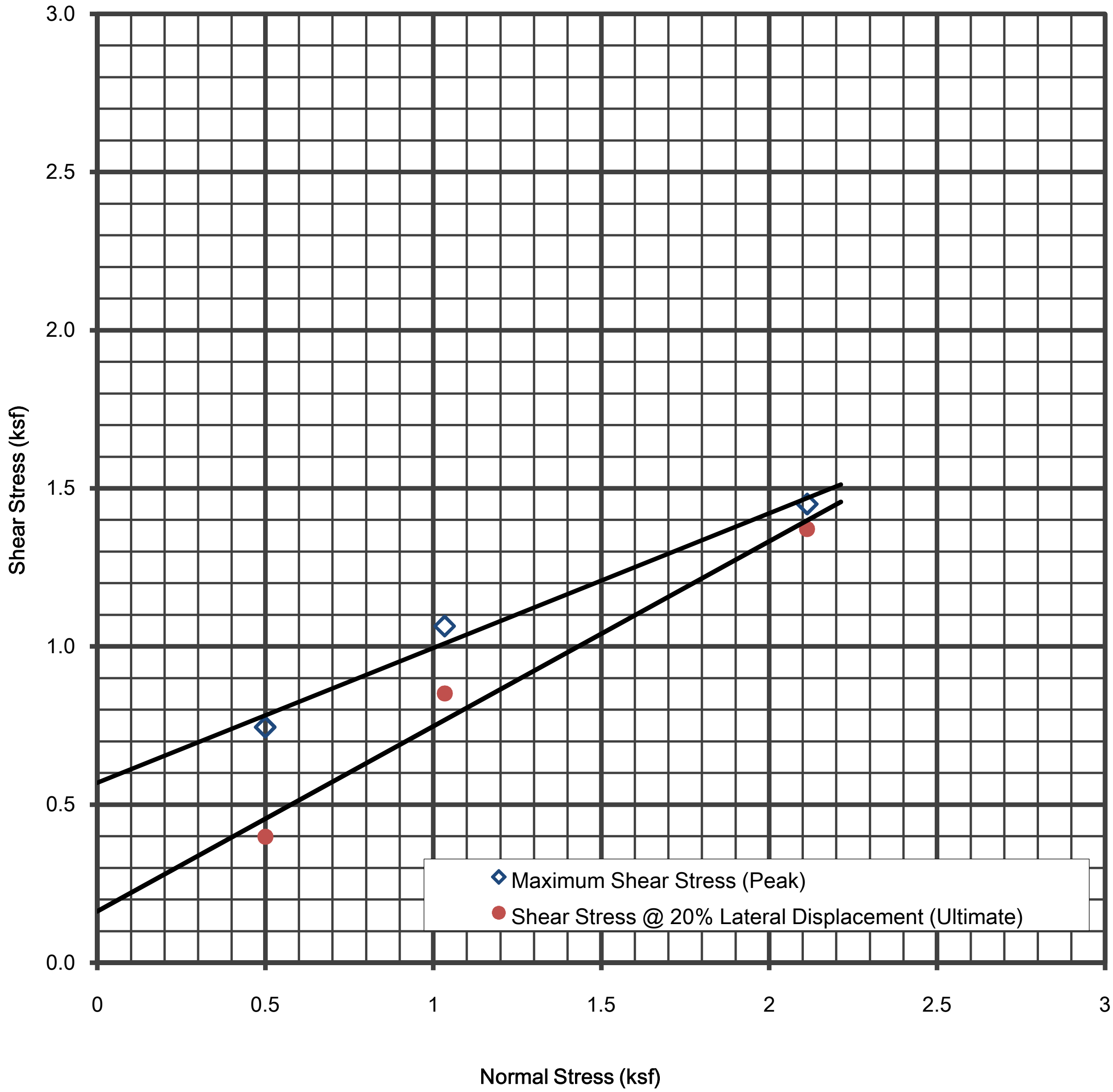
DIRECT SHEAR TEST

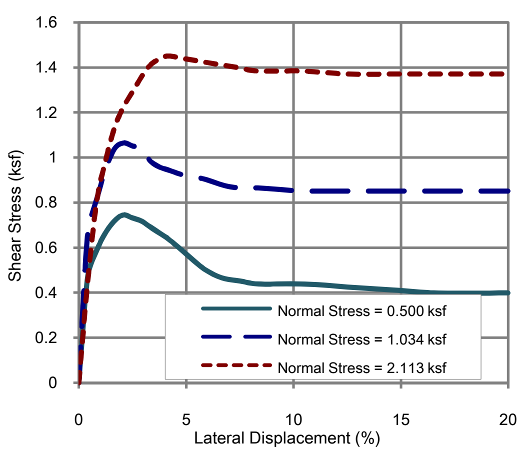
(ASTM-D3080)

Project Name:	Lechuza Beach Public Access			*Project No.:*		0109780000	
Boring No.:	TRIPOD-3	*Sample No.:*	2	*Depth:*	3.0-3.5 Feet	*Date:*	4/05-4/12/2012
Soil Description:	Dark Reddish Brown (5YR, 3/3) Sandy Lean Clay (CL) [Bottom 4 rings]					*Tested By:*	LT

				Before Test	After Test Load 1	After Test Load 2	After Test Load 3
Sample Diameter, in:	2.416	Weight of Wet Soil & Ring, gr:		585.24	---	---	---
Normal Stress, ksf:	0.5, 1, 2	Weight of Ring, gr:		132.82	---	---	---
Over-burdened @, pcf:		Height of Sample, in:		3.00	0.9996	0.9797	0.9747
Shear Rate, in/min:	0.005	Moisture-	Tare No.:	15	---	---	---
Natural Moisture(x):			Wet Weight and Tare, gr:	220.52	156.47	153.28	153.33
Saturated(x):	X		Dry Weight and Tare, gr:	207.11	131.71	130.23	130.63
Intact(x):	X		Tare Weight, gr:	97.11	0.00	0.00	0.00
Remolded to, pcf:			Moisture Content, %:	12.2	18.8	17.7	17.4
@, %:		Wet Density, pcf:		125.3	132.8	134.2	134.5
Notes:		Dry Density, pcf:		111.7	111.7	114.0	114.6
		Saturation %:	S.G. = 2.70 (Assumed)	64.7	99.8	99.9	99.6

Load 1 (KSF): 0.500				Load 2 (KSF): 1.034				Load 3 (KSF): 2.113			
Shear Deflec -tion (in)	Lateral Displace -ment (%)	Load Ring Reading	Shear Stress (KSF)	Shear Deflec -tion (in)	Lateral Displace -ment (%)	Load Ring Reading	Shear Stress (KSF)	Shear Deflec -tion (in)	Lateral Displace -ment (%)	Load Ring Reading	Shear Stress (KSF)
0.0098	0.406	0.0032	0.465	0.0098	0.406	0.0046	0.652	0.0098	0.406	0.0030	0.439
0.0199	0.823	0.0041	0.585	0.0199	0.823	0.0058	0.811	0.0199	0.823	0.0057	0.798
0.0300	1.241	0.0047	0.665	0.0300	1.241	0.0068	0.945	0.0300	1.241	0.0071	0.985
0.0401	1.659	0.0051	0.718	0.0401	1.659	0.0075	1.038	0.0401	1.659	0.0082	1.131
0.0502	2.077	0.0053	0.745	0.0502	2.077	0.0077	1.065	0.0502	2.077	0.0089	1.224
0.0603	2.495	0.0052	0.732	0.0603	2.495	0.0076	1.051	0.0603	2.495	0.0094	1.291
0.0704	2.912	0.0051	0.718	0.0704	2.912	0.0075	1.038	0.0704	2.912	0.0099	1.357
0.0805	3.330	0.0049	0.692	0.0805	3.330	0.0071	0.985	0.0805	3.330	0.0103	1.411
0.0905	3.748	0.0047	0.665	0.0905	3.748	0.0069	0.958	0.0905	3.748	0.0105	1.437
0.1006	4.166	0.0045	0.638	0.1006	4.166	0.0068	0.945	0.1006	4.166	0.0106	1.451
0.1208	5.002	0.0040	0.572	0.1208	5.002	0.0066	0.918	0.1208	5.002	0.0105	1.437
0.1410	5.837	0.0035	0.505	0.1410	5.837	0.0065	0.905	0.1410	5.837	0.0104	1.424
0.1612	6.673	0.0032	0.465	0.1612	6.673	0.0063	0.878	0.1612	6.673	0.0103	1.411
0.1814	7.509	0.0031	0.452	0.1814	7.509	0.0062	0.865	0.1814	7.509	0.0102	1.397
0.2016	8.344	0.0030	0.439	0.2016	8.344	0.0062	0.865	0.2016	8.344	0.0101	1.384
0.2521	10.433	0.0030	0.439	0.2521	10.433	0.0061	0.851	0.2521	10.433	0.0101	1.384
0.3025	12.523	0.0029	0.425	0.3025	12.523	0.0061	0.851	0.3025	12.523	0.0100	1.371
0.3530	14.612	0.0028	0.412	0.3530	14.612	0.0061	0.851	0.3530	14.612	0.0100	1.371
0.4035	16.701	0.0027	0.399	0.4035	16.701	0.0061	0.851	0.4035	16.701	0.0100	1.371
0.4828	19.982	0.0027	0.399	0.4828	19.982	0.0061	0.851	0.4828	19.982	0.0100	1.371
Max. Shear Stress, ksf:			0.745				1.065				1.451
Shear Deflt.@Max Stress,%.:			2.1				2.1				4.2





Boring No.:	TRIPOD-3
Sample Depth :	3.0-3.5 Feet
Soil Type:	CL
Sample Conditions:	Intact; Saturated
Shear Rate:	0.005 inch/minute
In-Place Dry Density (PCF):	111.7
In-Place Moisture Content (%):	12.2

	◇	●
Cohesion (PSF):	569	162
Friction Angle (Degrees):	23	30

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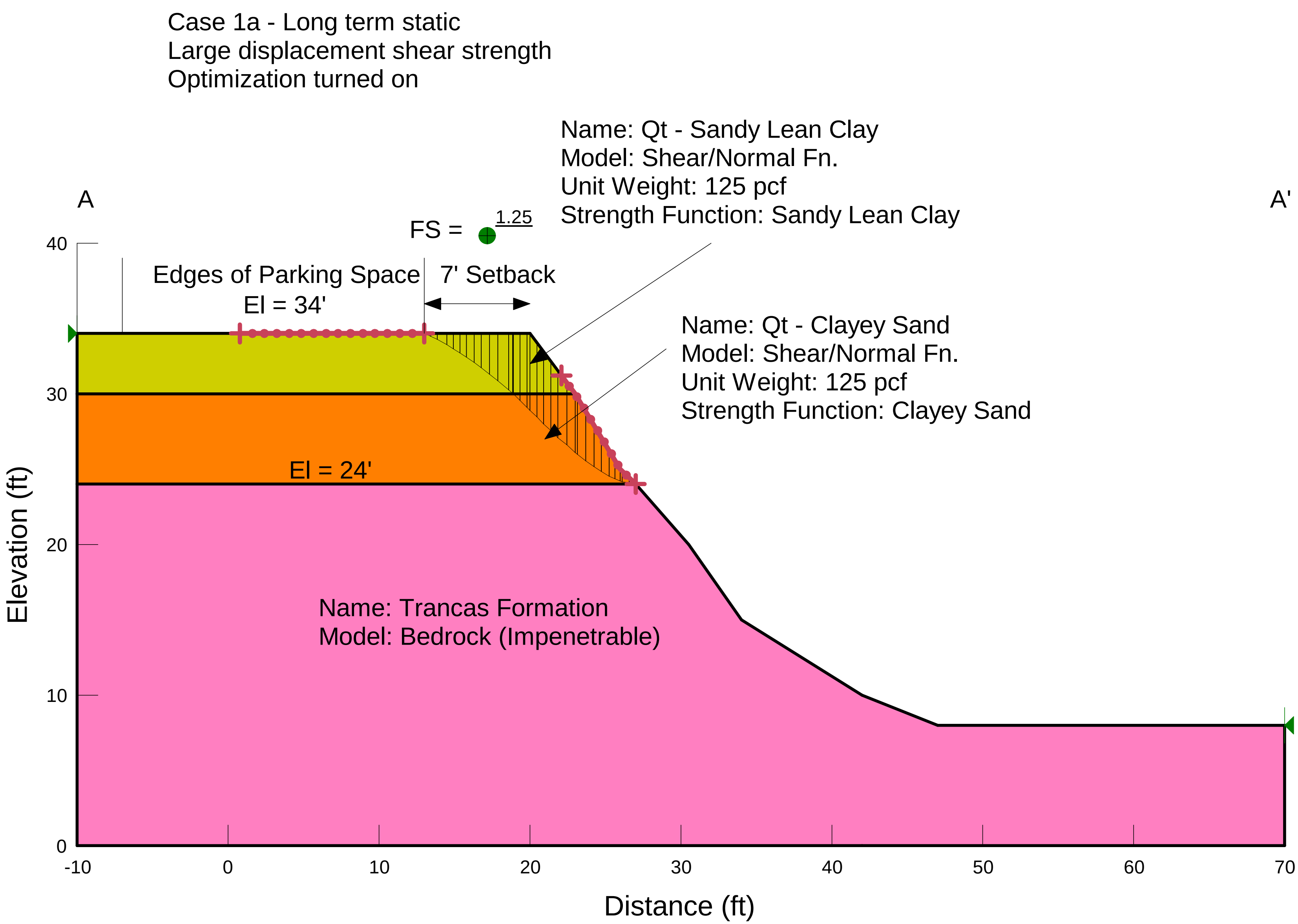
DIRECT SHEAR TEST
LECHUZA BEACH PUBLIC ACCESS
Malibu, California

Project No.
0109780000

APPENDIX C

Results of Slope Stability Analyses



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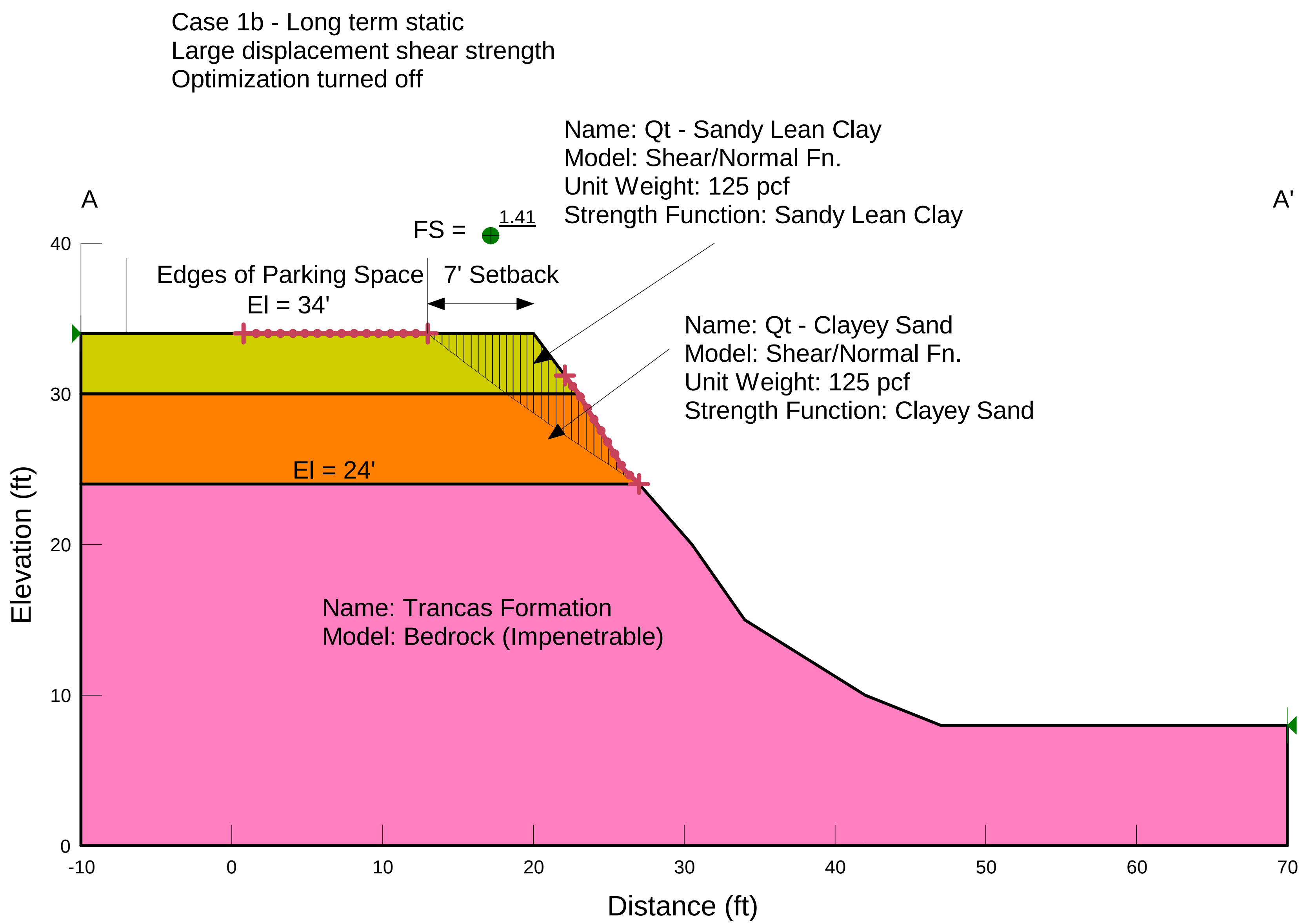

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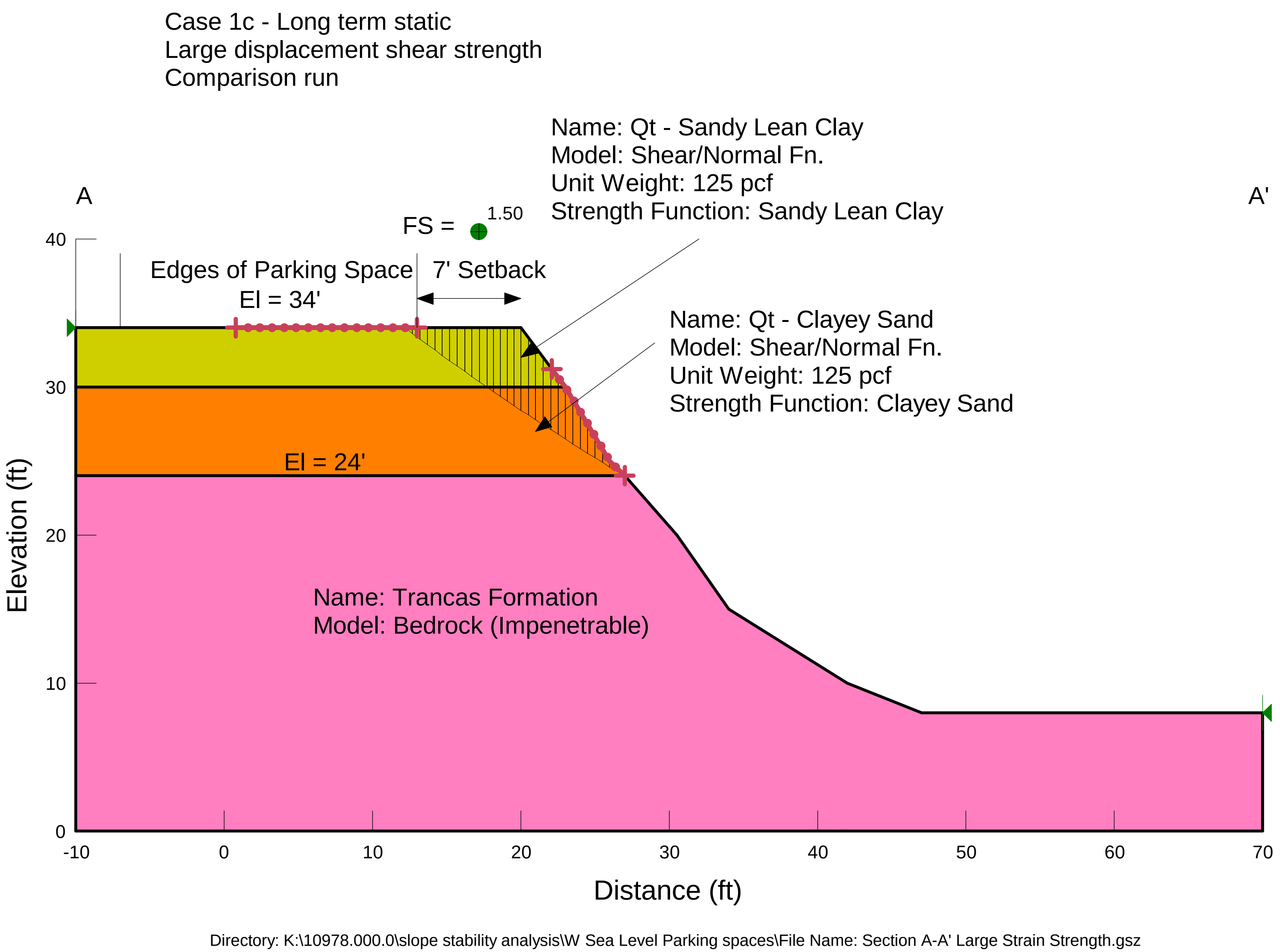
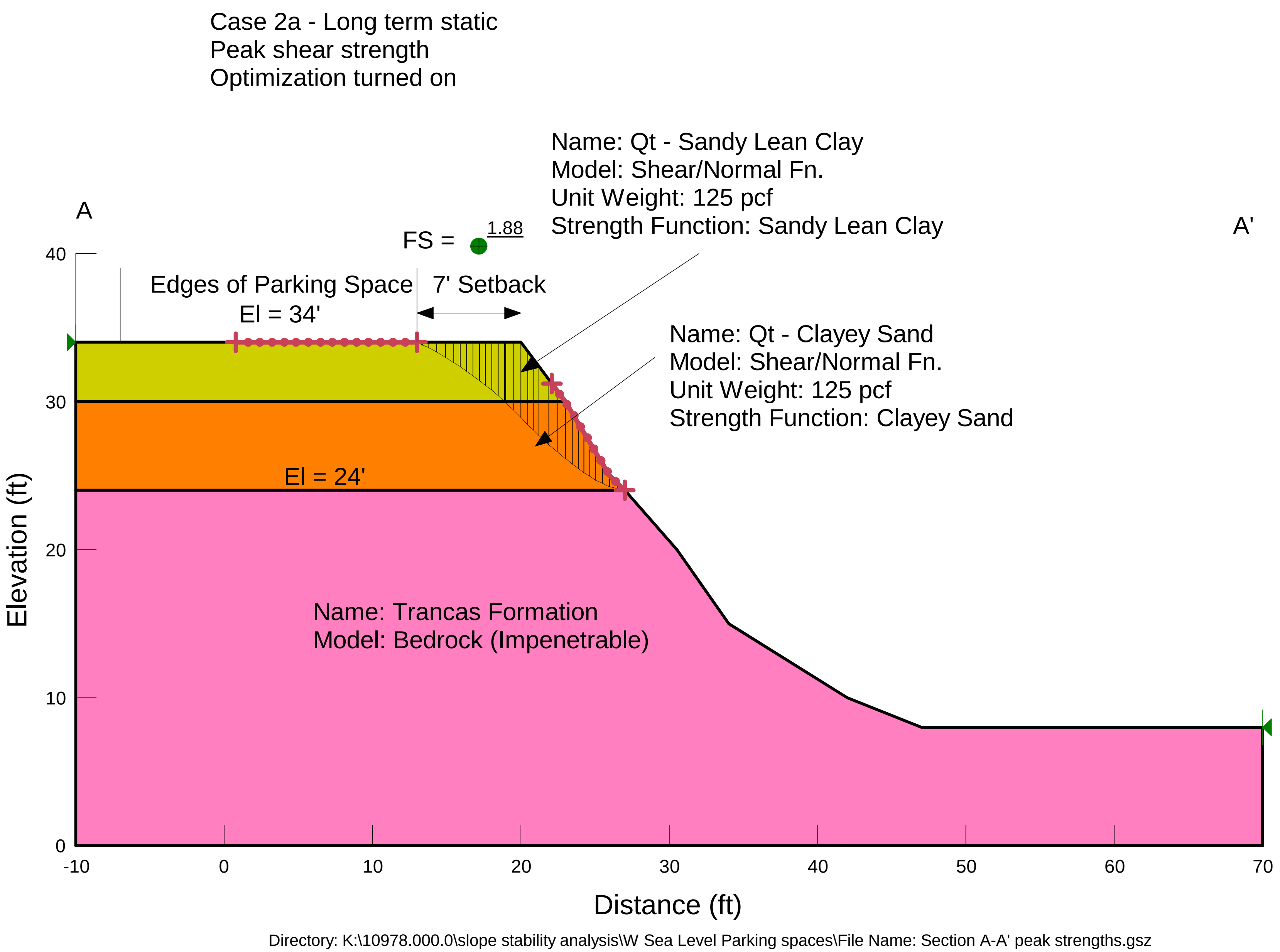
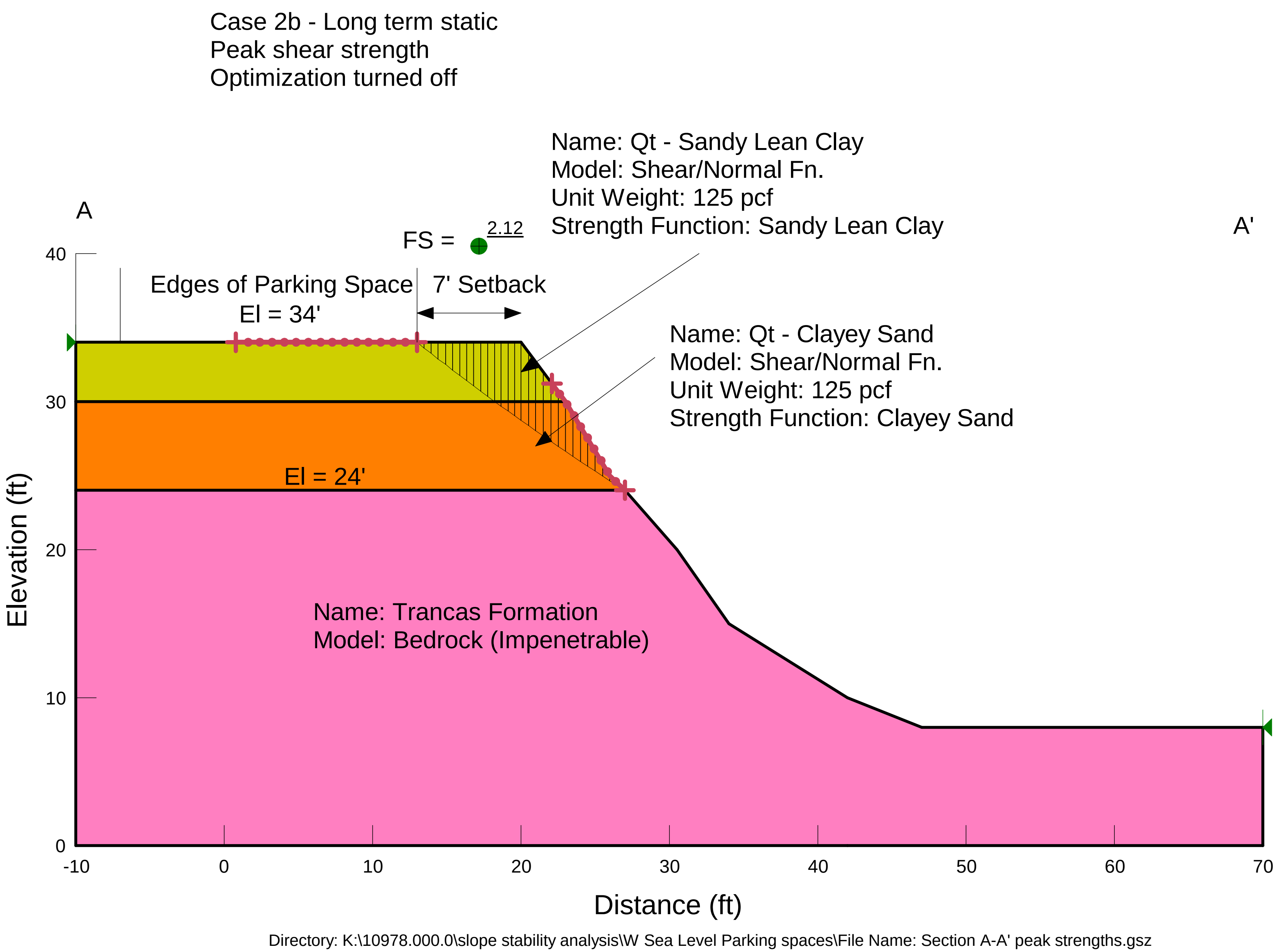
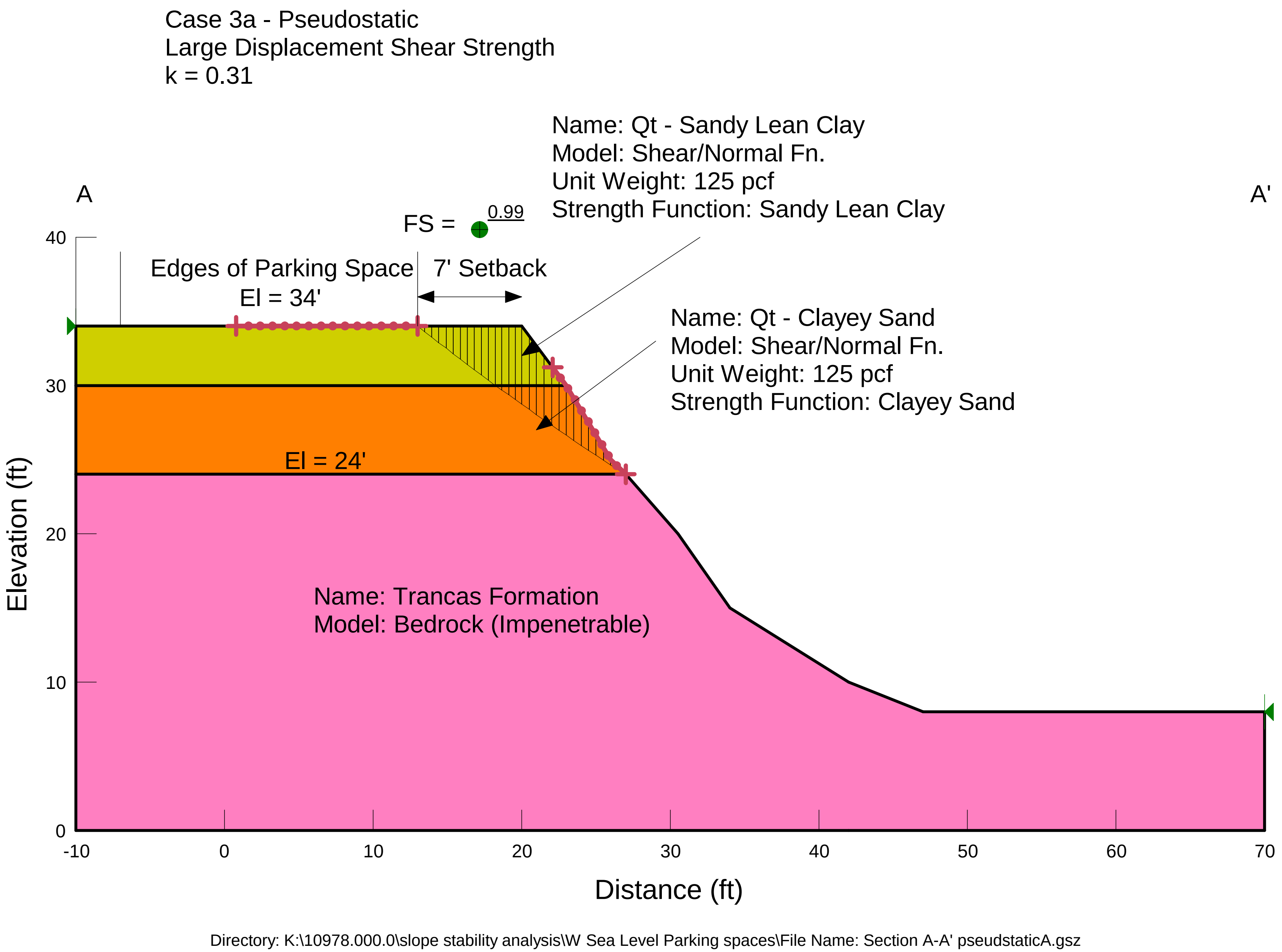

Case 1c - Long term static
Large displacement shear strength
Comparison run
Name: Qt - Sandy Lean Clay
Model: Shear/Normal Fn.
Unit Weight: 125 pcf
Strength Function: Sandy Lean Clay
A
A'
FS = 1.50
Edges of Parking Space
El = 34'
7' Setback
Name: Qt - Clayey Sand
Model: Shear/Normal Fn.
Unit Weight: 125 pcf
Strength Function: Clayey Sand
El = 24'
Name: Trancas Formation
Model: Bedrock (Impenetrable)
Elevation (ft)
Distance (ft)
40
30
20
10
0
-10
0
10
20
30
40
50
60
70
Directory: K:\10978.000.0\slope stability analysis\W Sea Level Parking spaces\File Name: Section A-A' Large Strain Strength.gsz

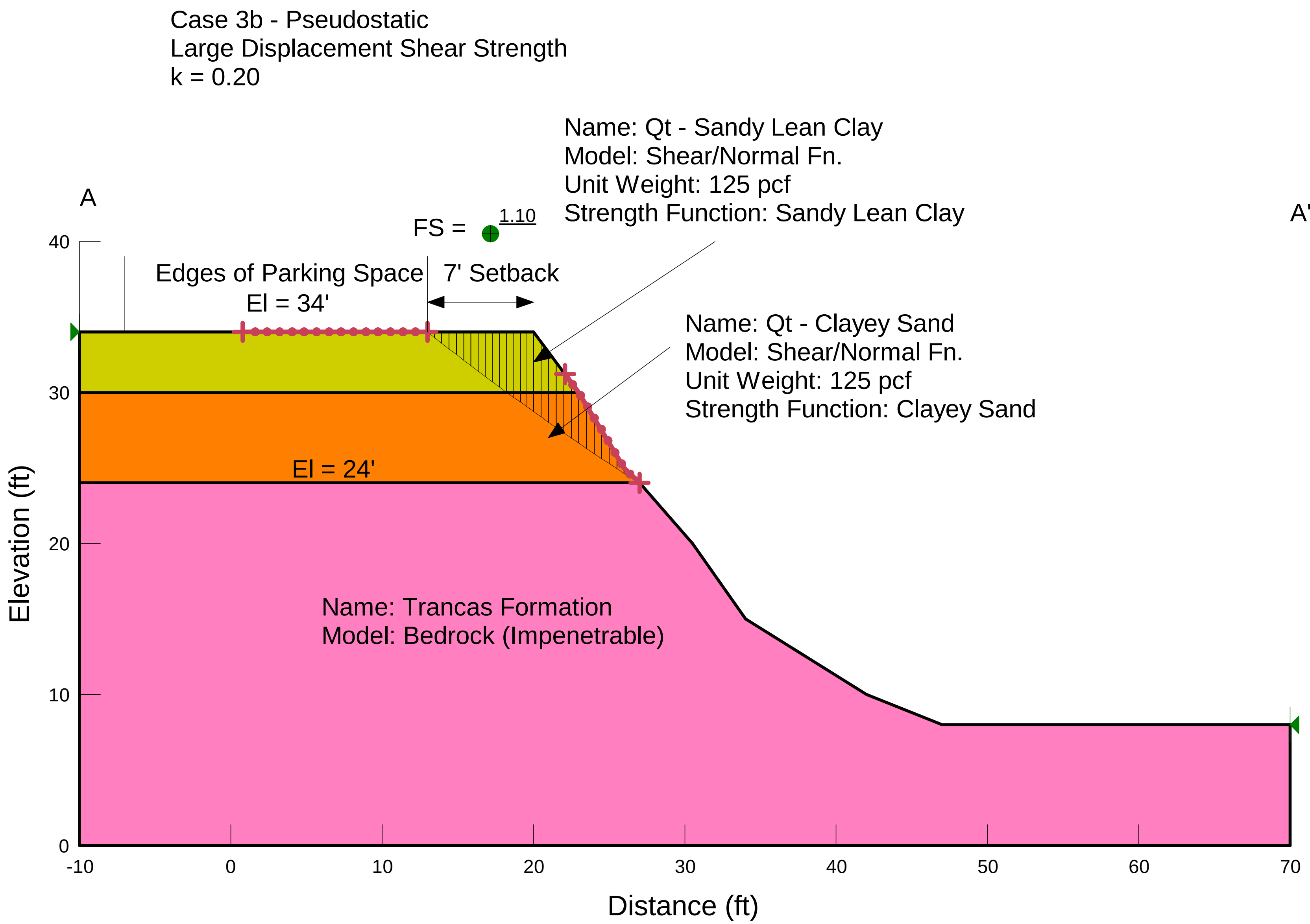

Case 2a - Long term static
Peak shear strength
Optimization turned on
Name: Qt - Sandy Lean Clay
Model: Shear/Normal Fn.
Unit Weight: 125 pcf
Strength Function: Sandy Lean Clay
A
A'
FS = 1.88
Edges of Parking Space
El = 34'
7' Setback
Name: Qt - Clayey Sand
Model: Shear/Normal Fn.
Unit Weight: 125 pcf
Strength Function: Clayey Sand
El = 24'
Name: Trancas Formation
Model: Bedrock (Impenetrable)
Elevation (ft)
40
30
20
10
0
-10
0
10
20
30
40
50
60
70
Distance (ft)
Directory: K:\10978.000.0\slope stability analysis\W Sea Level Parking spaces\File Name: Section A-A' peak strengths.gsz



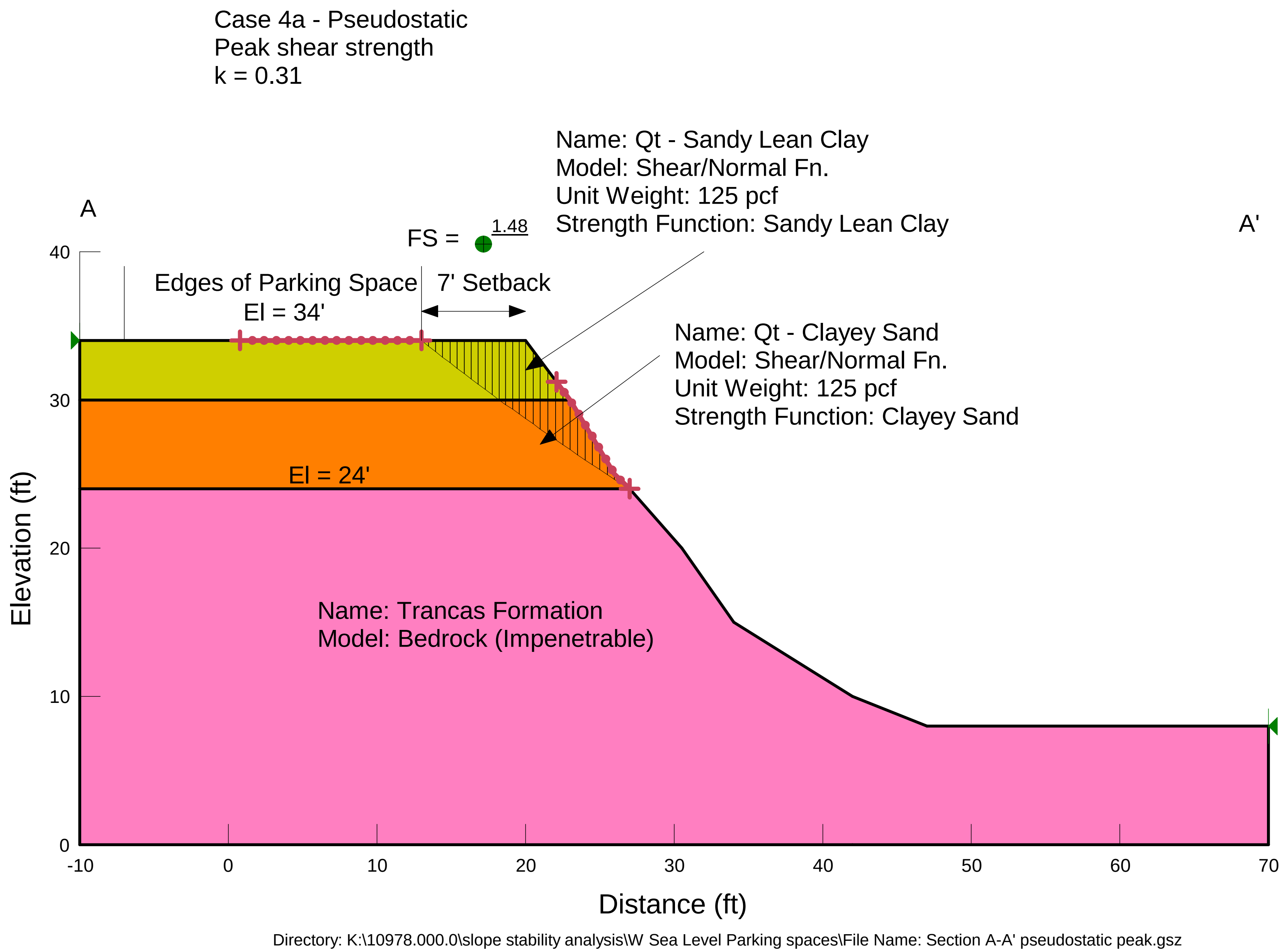
Case 2b - Long term static
Peak shear strength
Optimization turned off
Name: Qt - Sandy Lean Clay
Model: Shear/Normal Fn.
Unit Weight: 125 pcf
Strength Function: Sandy Lean Clay
A
A'
FS = 2.12
Edges of Parking Space
El = 34'
7' Setback
Name: Qt - Clayey Sand
Model: Shear/Normal Fn.
Unit Weight: 125 pcf
Strength Function: Clayey Sand
El = 24'
Name: Trancas Formation
Model: Bedrock (Impenetrable)
Elevation (ft)
Distance (ft)
0
10
20
30
40
-10
0
10
20
30
40
50
60
70
Directory: K:\10978.000.0\slope stability analysis\W Sea Level Parking spaces\File Name: Section A-A' peak strengths.gsz

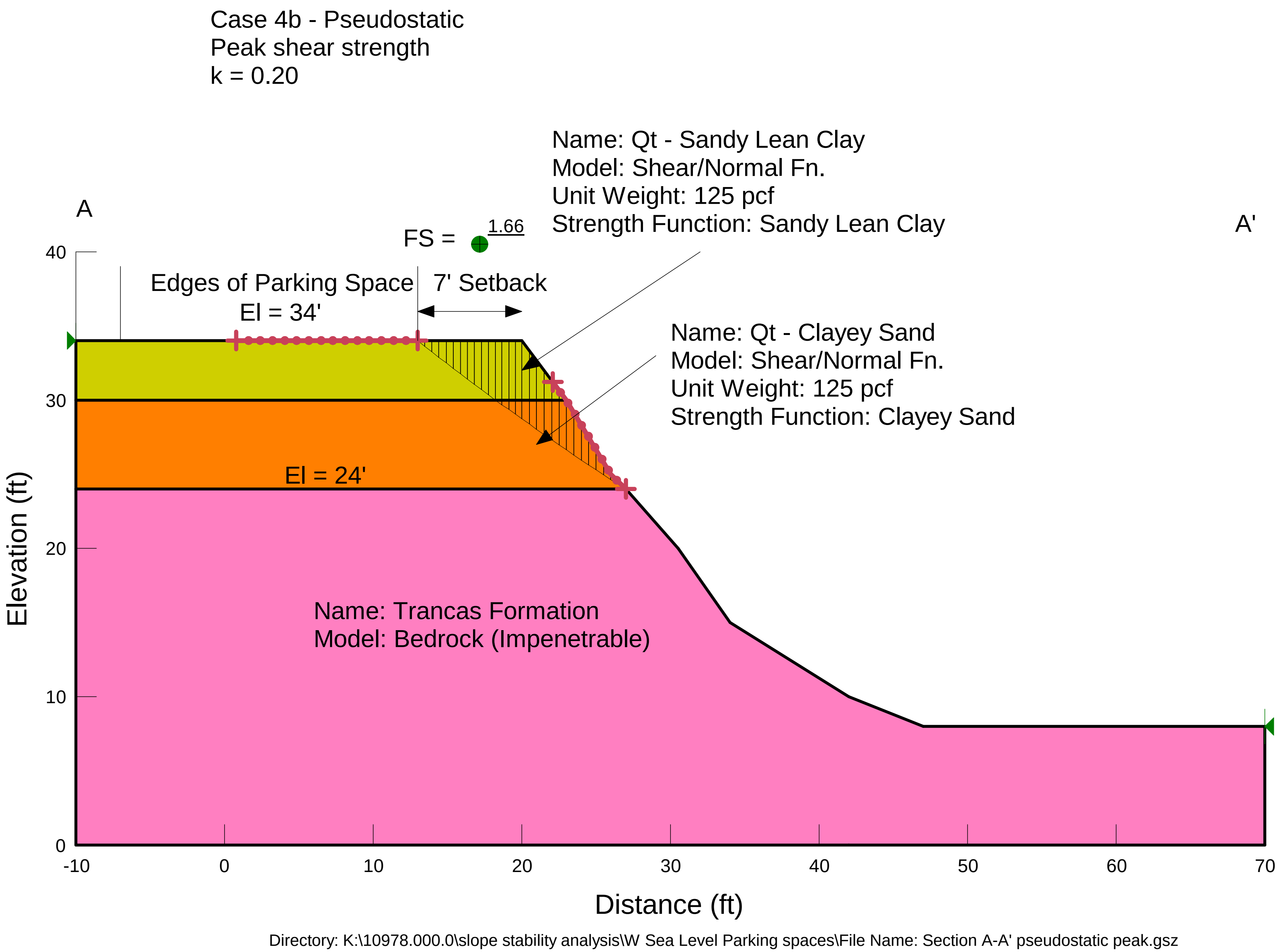


Case 3a - Pseudostatic
Large Displacement Shear Strength
k = 0.31
Name: Qt - Sandy Lean Clay
Model: Shear/Normal Fn.
Unit Weight: 125 pcf
Strength Function: Sandy Lean Clay
A
A'
FS = 0.99
Edges of Parking Space
El = 34'
7' Setback
Name: Qt - Clayey Sand
Model: Shear/Normal Fn.
Unit Weight: 125 pcf
Strength Function: Clayey Sand
El = 24'
Name: Trancas Formation
Model: Bedrock (Impenetrable)
Elevation (ft)
40
30
20
10
0
-10
0
10
20
30
40
50
60
70
Distance (ft)
Directory: K:\10978.000.0\slope stability analysis\W Sea Level Parking spaces\File Name: Section A-A' pseudstaticA.gsz



Directory: K:\10978.000.0\slope stability analysis\W Sea Level Parking spaces\File Name: Section A-A' pseudstaticB.gsz


Case 4a - Pseudostatic
Peak shear strength
k = 0.31
Name: Qt - Sandy Lean Clay
Model: Shear/Normal Fn.
Unit Weight: 125 pcf
Strength Function: Sandy Lean Clay
A
A'
FS = 1.48
40
30
20
10
0
Edges of Parking Space
7' Setback
El = 34'
Name: Qt - Clayey Sand
Model: Shear/Normal Fn.
Unit Weight: 125 pcf
Strength Function: Clayey Sand
El = 24'
Elevation (ft)
Name: Trancas Formation
Model: Bedrock (Impenetrable)
-10
0
10
20
30
40
50
60
70
Distance (ft)
Directory: K:\10978.000.0\slope stability analysis\W Sea Level Parking spaces\File Name: Section A-A' pseudostatic peak.gsz



Case 4b - Pseudostatic
Peak shear strength
k = 0.20
Name: Qt - Sandy Lean Clay
Model: Shear/Normal Fn.
Unit Weight: 125 pcf
Strength Function: Sandy Lean Clay
A
A'
FS = 1.66
Edges of Parking Space
7' Setback
El = 34'
Name: Qt - Clayey Sand
Model: Shear/Normal Fn.
Unit Weight: 125 pcf
Strength Function: Clayey Sand
El = 24'
Name: Trancas Formation
Model: Bedrock (Impenetrable)
Elevation (ft)
0
10
20
30
40
-10
0
10
20
30
40
50
60
70
Distance (ft)
Directory: K:\10978.000.0\slope stability analysis\W Sea Level Parking spaces\File Name: Section A-A' pseudostatic peak.gsz

SLOPE/W Analysis

File Information

Created By: Forcier, Easton
Revision Number: 36
Last Edited By: Forcier, Easton
Date: 4/18/2012
Time: 3:31:07 PM
File Name: Section A-A' Large Strain Strength.gsz
Directory: K:\10978.000.0\slope stability analysis\W Sea Level Parking spaces\
Last Solved Date: 4/18/2012
Last Solved Time: 3:31:28 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Kind: SLOPE/W
Method: Spencer
Settings
    PWP Conditions Source: (none)
SlipSurface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Optimize Critical Slip Surface Location: Yes
    Tension Crack
        Tension Crack Option: (none)
FOS Distribution
    FOS Calculation Option: Constant
Advanced
    Number of Slices: 30

Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Qt - Sandy Lean Clay

Model: Shear/Normal Fn.
Unit Weight: 125 pcf
Strength Function: Sandy Lean Clay
Phi-B: 0 °

Trancas Formation

Model: Bedrock (Impenetrable)

Qt - Clayey Sand

Model: Shear/Normal Fn.
Unit Weight: 125 pcf
Strength Function: Clayey Sand
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0.787402, 34) ft
Left-Zone Right Coordinate: (13, 34) ft
Left-Zone Increment: 15
Right Projection: Range
Right-Zone Left Coordinate: (22.085354, 31.219528) ft
Right-Zone Right Coordinate: (27, 24) ft
Right-Zone Increment: 10
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (-10, 34) ft
Right Coordinate: (70, 8) ft

Shear/Normal Strength Functions

Sandy Lean Clay

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 0 %
Y-Intercept: 0
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (0, 0)
Data Point: (1034, 878)
Data Point: (2113, 1371)
Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Clayey Sand

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 0 %
Y-Intercept: 0
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (0, 0)
Data Point: (1034, 1104)
Data Point: (2113, 2063)
Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Regions

	Material	Points	Area (ft^2)
Region 1	Qt - Sandy Lean Clay	3,2,4,15	126
Region 2	Trancas Formation	12,14,6,7,8,13,11,9,10,1	1355.25
Region 3	Qt - Clayey Sand	15,4,5,14,12	209

Points

	X (ft)	Y (ft)
Point 1	-10	0
Point 2	20	34
Point 3	-10	34
Point 4	23	30
Point 5	26	25
Point 6	30.5	20
Point 7	34	15
Point 8	42	10
Point 9	70	0
Point 10	42	0
Point 11	70	8
Point 12	-10	24
Point 13	47	8
Point 14	27	24
Point 15	-10	30

Critical Slip Surfaces

	Number	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.25	(117.095, 164.933)	11.54789	(13, 34)	(27, 24)
2	1926	1.41	(117.095, 164.933)	167.27	(13, 34)	(27, 24)

Slices of Slip Surface: Optimized

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimized	13.21047	33.90594	0	10.509065	8.9236932	2.9345e-008
2	Optimized	13.631405	33.71782	0	31.527412	26.771264	-8.5628e-007
3	Optimized	14.16512	33.45173	0	55.108979	46.795374	1.5407e-007
4	Optimized	14.707095	33.141505	0	77.222278	65.572715	7.166e-006
5	Optimiz	15.14455	32.865115	0	102.08244	86.682538	7.1743e-

	ed						007
6	Optimized	15.582005	32.58872	0	126.94454	107.794	8.9215e-007
7	Optimized	16.047945	32.273235	0	142.49896	121.00192	1.0015e-006
8	Optimized	16.542375	31.918665	0	171.7548	145.84429	4.466e-006
9	Optimized	17.06486	31.524025	0	190.93946	162.1348	-2.2812e-006
10	Optimized	17.6154	31.08931	0	224.46862	190.60584	-2.6817e-006
11	Optimized	18.22732	30.576385	0	244.47193	207.59149	6.3608e-006
12	Optimized	18.71401	30.15213	0	279.50879	237.34278	7.2713e-006
13	Optimized	18.87604	30.01172	0	262.81176	223.16462	-3.1458e-006
14	Optimized	19.11745	29.7757	0	273.67856	292.20363	-3.9229e-006
15	Optimized	19.576295	29.3271	0	302.74191	323.23425	1.8645e-005
16	Optimized	19.90286	29.004445	0	314.34805	335.626	1.9362e-005
17	Optimized	20.226965	28.6763	0	315.96164	337.34881	-4.5295e-006
18	Optimized	20.6809	28.21672	0	306.79705	327.56387	-4.3981e-006
19	Optimized	21.145295	27.764935	0	316.49498	337.91825	-4.5363e-006
20	Optimized	21.620145	27.320945	0	303.77365	324.33583	1.8707e-005
21	Optimized	22.14318	26.849575	0	305.24448	325.90621	1.8796e-005
22	Optimized	22.714395	26.350825	0	286.545	305.94099	-4.1069e-006
23	Optimized	23.07457	26.03634	0	272.99372	291.47243	1.6811e-005
24	Optimiz	23.42109	25.765995	0	282.35678	301.46927	-4.0466e-

	ed						006
25	Optimized	23.96499	25.355525	0	242.70356	259.13195	-3.4783e-006
26	Optimized	24.48601	24.997865	0	237.40755	253.47747	-3.3983e-006
27	Optimized	24.98415	24.693015	0	188.00829	200.73441	-2.6913e-006
28	Optimized	25.424915	24.46135	0	185.89476	198.47782	-2.6396e-006
29	Optimized	25.808305	24.30287	0	126.23267	134.77725	-1.7924e-006
30	Optimized	26.05738	24.19991	0	92.225351	98.468005	1.5829e-006
31	Optimized	26.33607	24.13214	0	98.999985	105.70121	1.6481e-006
32	Optimized	26.77869	24.044045	0	32.999936	35.233674	-4.0216e-007

Slices of Slip Surface: 1926

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	1926	13.238185	33.811345	0	15.471314	13.13735	4.3224e-008
2	1926	13.71455	33.435435	0	46.452279	39.444602	1.2978e-007
3	1926	14.190915	33.062315	0	77.404584	65.727519	2.5359e-006
4	1926	14.667285	32.691965	0	108.32987	91.987491	7.6051e-007
5	1926	15.14365	32.32436	0	139.22622	118.22289	9.774e-007
6	1926	15.620015	31.95948	0	170.08511	144.42649	4.4179e-006
7	1926	16.096385	31.5973	0	200.91978	170.60951	5.2187e-006
8	1926	16.57275	31.237795	0	231.73025	196.77199	6.0188e-006
9	1926	17.049115	30.88095	0	262.49638	222.89682	-3.1324e-006

10	1926	17.52548	30.52674	0	293.23173	248.99552	7.6163e-006
11	1926	18.001845	30.175145	0	323.94997	275.07968	8.4137e-006
12	1926	18.460025	29.839375	0	336.44286	359.21639	-4.8157e-006
13	1926	18.90002	29.51922	0	363.49599	388.10072	-5.2031e-006
14	1926	19.340015	29.20125	0	390.55627	416.99269	2.4019e-005
15	1926	19.780005	28.885445	0	417.60326	445.87046	-5.9775e-006
16	1926	20.25	28.550555	0	419.16882	447.542	-5.9998e-006
17	1926	20.75	28.19688	0	394.96367	421.69841	-5.6532e-006
18	1926	21.25	27.84594	0	370.3252	395.3922	-5.3008e-006
19	1926	21.75	27.497715	0	345.28566	368.65775	-4.9424e-006
20	1926	22.25	27.152185	0	319.84462	341.49462	1.967e-005
21	1926	22.75	26.80933	0	293.96867	313.86716	1.8079e-005
22	1926	23.25	26.46913	0	260.72028	278.3682	1.6033e-005
23	1926	23.75	26.13156	0	219.9983	234.8898	-3.1488e-006
24	1926	24.25	25.79661	0	178.75576	190.85559	4.217e-006
25	1926	24.75	25.46426	0	136.99101	146.26381	3.2319e-006
26	1926	25.25	25.134485	0	94.717531	101.12888	1.6387e-006
27	1926	25.75	24.80727	0	51.923791	55.438467	8.9837e-007
28	1926	26.25	24.482595	0	22.864069	24.411718	-2.8958e-007
29	1926	26.75	24.160445	0	7.6838905	8.2040064	7.2054e-008

SLOPE/W Analysis

File Information

Created By: Forcier, Easton
Revision Number: 41
Last Edited By: Forcier, Easton
Date: 4/23/2012
Time: 4:28:09 PM
File Name: Section A-A' peak strengths.gsz
Directory: K:\10978.000.0\slope stability analysis\W Sea Level Parking spaces\
Last Solved Date: 4/23/2012
Last Solved Time: 4:28:26 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Kind: SLOPE/W
Method: Spencer
Settings
- PWP Conditions Source: (none)

SlipSurface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: Yes
- Tension Crack
  - Tension Crack Option: (none)

FOS Distribution
- FOS Calculation Option: Constant

Advanced
- Number of Slices: 30

Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Qt - Sandy Lean Clay

Model: Shear/Normal Fn.
Unit Weight: 125 pcf
Strength Function: Sandy Lean Clay
Phi-B: 0 °

Trancas Formation

Model: Bedrock (Impenetrable)

Qt - Clayey Sand

Model: Shear/Normal Fn.
Unit Weight: 125 pcf
Strength Function: Clayey Sand
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0.787402, 34) ft
Left-Zone Right Coordinate: (13, 34) ft
Left-Zone Increment: 15
Right Projection: Range
Right-Zone Left Coordinate: (22.085354, 31.219528) ft
Right-Zone Right Coordinate: (27, 24) ft
Right-Zone Increment: 10
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (-10, 34) ft
Right Coordinate: (70, 8) ft

Shear/Normal Strength Functions

Sandy Lean Clay

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 0 %
Y-Intercept: 0
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (0, 0)
Data Point: (500, 585)
Data Point: (1034, 1065)
Data Point: (2113, 1451)
Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Clayey Sand

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 0 %
Y-Intercept: 0
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (0, 0)
Data Point: (500, 825)
Data Point: (1034, 1344)
Data Point: (2113, 2210)
Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Regions

	Material	Points	Area (ft^2)
Region 1	Qt - Sandy Lean Clay	3,2,4,15	126
Region 2	Trancas Formation	12,14,6,7,8,13,11,9,10,1	1355.25

Region 3	Qt - Clayey Sand	15,4,5,14,12	209

Points

	X (ft)	Y (ft)
Point 1	-10	0
Point 2	20	34
Point 3	-10	34
Point 4	23	30
Point 5	26	25
Point 6	30.5	20
Point 7	34	15
Point 8	42	10
Point 9	70	0
Point 10	42	0
Point 11	70	8
Point 12	-10	24
Point 13	47	8
Point 14	27	24
Point 15	-10	30

Critical Slip Surfaces

	Number	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.88	(117.095, 164.933)	11.54728	(13, 34)	(27, 24)
2	1926	2.12	(117.095, 164.933)	167.27	(13, 34)	(27, 24)

Slices of Slip Surface: Optimized

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimized	13.18403	33.911465	0	9.4195885	11.020739	-3.5463e-007
2	Optimized	13.552085	33.734395	0	28.25901	33.062504	-3.3989e-007
3	Optimized	14.03212	33.49139	0	51.433438	60.176143	-6.1886e-007

4	Optimized	14.615795	33.165875	0	77.497966	90.671145	6.0461e-006
5	Optimized	15.19112	32.82379	0	109.28269	127.85867	2.1076e-006
6	Optimized	15.697295	32.501245	0	125.4202	146.73925	2.4188e-006
7	Optimized	16.134325	32.198235	0	150.77766	176.40699	2.9079e-006
8	Optimized	16.57135	31.895225	0	176.13511	206.07473	3.3969e-006
9	Optimized	16.995695	31.581285	0	184.60655	215.98615	3.5625e-006
10	Optimized	17.40736	31.25641	0	209.39619	244.98956	4.041e-006
11	Optimized	17.81902	30.931535	0	234.2049	274.01527	-1.3276e-005
12	Optimized	18.24332	30.576825	0	241.10941	282.09342	4.6607e-006
13	Optimized	18.68026	30.192275	0	268.18569	313.77215	5.1842e-006
14	Optimized	18.936995	29.96632	0	284.19619	468.93114	4.9656e-006
15	Optimized	19.229385	29.69299	0	285.63936	471.31242	4.9912e-006
16	Optimized	19.741755	29.1894	0	297.14606	490.29877	5.1934e-006
17	Optimized	20.24243	28.67768	0	308.78497	509.50328	5.3969e-006
18	Optimized	20.66743	28.2543	0	316.48868	522.2146	-4.2568e-005
19	Optimized	21.032565	27.903105	0	307.66552	507.65617	5.376e-006
20	Optimized	21.555895	27.41339	0	305.28341	503.72561	5.3343e-006
21	Optimized	22.172495	26.86092	0	303.71945	501.14504	5.3067e-006
22	Optimized	22.724165	26.384225	0	285.1896	470.57031	4.9829e-006

23	Optimized	23.010415	26.13688	0	275.32025	454.28561	4.8105e-006
24	Optimized	23.235225	25.960715	0	285.34357	470.82435	4.9851e-006
25	Optimized	23.66402	25.626385	0	255.58618	421.72388	4.4652e-006
26	Optimized	24.073015	25.33128	0	260.31743	429.53057	4.5429e-006
27	Optimized	24.46221	25.0754	0	224.82838	370.97271	3.9234e-006
28	Optimized	24.85141	24.819525	0	189.32215	312.38651	3.3039e-006
29	Optimized	25.27505	24.58315	0	191.18433	315.45915	3.3101e-006
30	Optimized	25.73313	24.36627	0	126.88009	209.35546	-2.5796e-006
31	Optimized	25.981085	24.25313	0	141.56398	233.58428	2.3665e-006
32	Optimized	26.25	24.186325	0	102.51385	169.15053	2.1069e-005
33	Optimized	26.75	24.06211	0	34.171282	56.383509	-8.3208e-007

Slices of Slip Surface: 1926

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	1926	13.238185	33.811345	0	15.751061	18.428441	-1.8923e-007
2	1926	13.71455	33.435435	0	47.285674	55.323338	-5.6808e-007
3	1926	14.190915	33.062315	0	78.783174	92.174813	1.4144e-006
4	1926	14.667285	32.691965	0	110.24341	128.98269	2.1226e-006
5	1926	15.14365	32.32436	0	141.66598	165.7465	2.7276e-006
6	1926	15.620015	31.95948	0	173.05559	202.47175	3.3318e-006

7	1926	16.096385	31.5973	0	204.38362	239.12495	3.9352e-006
8	1926	16.57275	31.237795	0	235.69002	275.75283	-1.333e-005
9	1926	17.049115	30.88095	0	266.95459	312.33179	5.1397e-006
10	1926	17.52548	30.52674	0	298.17403	348.85794	-1.6863e-005
11	1926	18.001845	30.175145	0	329.34491	385.32728	-1.8626e-005
12	1926	18.460025	29.839375	0	334.20346	551.44445	5.8258e-006
13	1926	18.90002	29.51922	0	361.10409	595.8312	6.2948e-006
14	1926	19.340015	29.20125	0	387.99277	640.19822	6.7636e-006
15	1926	19.780005	28.885445	0	414.88591	684.57261	7.2323e-006
16	1926	20.25	28.550555	0	416.46188	687.173	-5.5878e-005
17	1926	20.75	28.19688	0	392.42954	647.51901	6.8408e-006
18	1926	21.25	27.84594	0	367.98127	607.17872	6.4146e-006
19	1926	21.75	27.497715	0	343.11654	566.15126	5.9812e-006
20	1926	22.25	27.152185	0	317.83478	524.4357	5.5406e-006
21	1926	22.75	26.80933	0	292.15201	482.05846	5.0928e-006
22	1926	23.25	26.46913	0	259.11437	427.54548	4.5169e-006
23	1926	23.75	26.13156	0	218.65402	360.78485	3.8115e-006
24	1926	24.25	25.79661	0	177.67441	293.16743	3.0971e-006
25	1926	24.75	25.46426	0	136.17222	224.68773	2.3737e-006

26	1926	25.25	25.134485	0	94.155896	155.35969	2.0179e-005
27	1926	25.75	24.80727	0	51.618859	85.172468	-1.3107e-006
28	1926	26.25	24.482595	0	22.731402	37.507409	-1.2583e-006
29	1926	26.75	24.160445	0	7.6396228	12.605578	1.3317e-007

SLOPE/W Analysis

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File Information

Created By: Forcier, Easton
Revision Number: 49
Last Edited By: Forcier, Easton
Date: 7/2/2012
Time: 11:38:38 AM
File Name: Section A-A' pseudostatic peak.gsz
Directory: K:\10978.000.0\slope stability analysis\W Sea Level Parking spaces\
Last Solved Date: 7/2/2012
Last Solved Time: 11:39:07 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Kind: SLOPE/W
Method: Spencer
Settings
- PWP Conditions Source: (none)

SlipSurface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: Yes
- Tension Crack
  - Tension Crack Option: (none)

FOS Distribution
- FOS Calculation Option: Constant

Advanced
- Number of Slices: 30

Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Qt - Sandy Lean Clay

Model: Shear/Normal Fn.
Unit Weight: 125 pcf
Strength Function: Sandy Lean Clay
Phi-B: 0 °

Trancas Formation

Model: Bedrock (Impenetrable)

Qt - Clayey Sand

Model: Shear/Normal Fn.
Unit Weight: 125 pcf
Strength Function: Clayey Sand
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0.787402, 34) ft
Left-Zone Right Coordinate: (13, 34) ft
Left-Zone Increment: 15
Right Projection: Range
Right-Zone Left Coordinate: (22.085354, 31.219528) ft
Right-Zone Right Coordinate: (27, 24) ft
Right-Zone Increment: 10
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (-10, 34) ft
Right Coordinate: (70, 8) ft

Seismic Loads

Horz Seismic Load: 0.2
Ignore seismic load in strength: Yes

Shear/Normal Strength Functions

Sandy Lean Clay

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 0 %
Y-Intercept: 0
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (0, 0)
Data Point: (500, 585)
Data Point: (1034, 1065)
Data Point: (2113, 1451)
Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Clayey Sand

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 0 %
Y-Intercept: 0
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (0, 0)
Data Point: (500, 825)
Data Point: (1034, 1344)
Data Point: (2113, 2210)
Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Regions

	Material	Points	Area (ft^2)
Region 1	Qt - Sandy Lean Clay	3,2,4,15	126
Region 2	Trancas Formation	12,14,6,7,8,13,11,9,10,1	1355.25
Region 3	Qt - Clayey Sand	15,4,5,14,12	209

Points

	X (ft)	Y (ft)
Point 1	-10	0
Point 2	20	34
Point 3	-10	34
Point 4	23	30
Point 5	26	25
Point 6	30.5	20
Point 7	34	15
Point 8	42	10
Point 9	70	0
Point 10	42	0
Point 11	70	8
Point 12	-10	24
Point 13	47	8
Point 14	27	24
Point 15	-10	30

Critical Slip Surfaces

	Number	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.66	(117.095, 164.933)	167.2701	(13, 34)	(27, 24)
2	1926	1.66	(117.095, 164.933)	167.27	(13, 34)	(27, 24)

Slices of Slip Surface: Optimized

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimize	13.238185	33.811345	0	13.680276	0	18.429

	d						
2	Optimized	13.71455	33.435435	0	41.106999	0	55.324
3	Optimized	14.190915	33.062315	0	68.552151	0	92.176
4	Optimized	14.667285	32.691965	0	96.013848	0	128.98
5	Optimized	15.14365	32.32436	0	123.49258	0	165.75
6	Optimized	15.620015	31.95948	0	150.98558	0	202.47
7	Optimized	16.096385	31.5973	0	178.49681	0	239.14
8	Optimized	16.57275	31.237795	0	206.00854	0	275.76
9	Optimized	17.049115	30.88095	0	233.54321	0	312.34
10	Optimized	17.52548	30.52674	0	261.0815	0	348.86
11	Optimized	18.001845	30.175145	0	288.62074	0	385.34
12	Optimized	18.460025	29.839375	0	283.32127	0	551.42
13	Optimized	18.90002	29.51922	0	306.47665	0	595.81
14	Optimized	19.340015	29.20125	0	329.67767	0	640.19
15	Optimized	19.780005	28.885445	0	352.90442	0	684.56
16	Optimized	20.25	28.550555	0	354.67504	0	687.15
17	Optimized	20.75	28.19688	0	334.61882	0	647.5
18	Optimized	21.25	27.84594	0	314.16913	0	607.16
19	Optimized	21.75	27.497715	0	293.30877	0	566.14
20	Optimize	22.25	27.152185	0	272.03678	0	524.44

	d						
21	Optimized	22.75	26.80933	0	250.35231	0	482.05
22	Optimized	23.25	26.46913	0	222.31089	0	427.54
23	Optimized	23.75	26.13156	0	187.81841	0	360.77
24	Optimized	24.25	25.79661	0	152.80498	0	293.16
25	Optimized	24.75	25.46426	0	117.25339	0	224.68
26	Optimized	25.25	25.134485	0	81.171412	0	155.36
27	Optimized	25.75	24.80727	0	44.553497	0	85.172
28	Optimized	26.25	24.482595	0	19.643116	0	37.506
29	Optimized	26.75	24.160445	0	6.7328931	0	12.605

Slices of Slip Surface: 1926

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	1926	13.238185	33.811345	0	13.680276	0	18.429
2	1926	13.71455	33.435435	0	41.106999	0	55.324
3	1926	14.190915	33.062315	0	68.552151	0	92.176
4	1926	14.667285	32.691965	0	96.013848	0	128.98
5	1926	15.14365	32.32436	0	123.49258	0	165.75
6	1926	15.620015	31.95948	0	150.98558	0	202.47
7	1926	16.096385	31.5973	0	178.49681	0	239.14
8	1926	16.57275	31.237795	0	206.00854	0	275.76
9	1926	17.049115	30.88095	0	233.54321	0	312.34
10	1926	17.52548	30.52674	0	261.0815	0	348.86
11	1926	18.001845	30.175145	0	288.62074	0	385.34
12	1926	18.460025	29.839375	0	283.32127	0	551.42
13	1926	18.90002	29.51922	0	306.47665	0	595.81

14	1926	19.340015	29.20125	0	329.67767	0	640.19
15	1926	19.780005	28.885445	0	352.90442	0	684.56
16	1926	20.25	28.550555	0	354.67504	0	687.15
17	1926	20.75	28.19688	0	334.61882	0	647.5
18	1926	21.25	27.84594	0	314.16913	0	607.16
19	1926	21.75	27.497715	0	293.30877	0	566.14
20	1926	22.25	27.152185	0	272.03678	0	524.44
21	1926	22.75	26.80933	0	250.35231	0	482.05
22	1926	23.25	26.46913	0	222.31089	0	427.54
23	1926	23.75	26.13156	0	187.81841	0	360.77
24	1926	24.25	25.79661	0	152.80498	0	293.16
25	1926	24.75	25.46426	0	117.25339	0	224.68
26	1926	25.25	25.134485	0	81.171412	0	155.36
27	1926	25.75	24.80727	0	44.553497	0	85.172
28	1926	26.25	24.482595	0	19.643116	0	37.506
29	1926	26.75	24.160445	0	6.7328931	0	12.605

SLOPE/W Analysis

File Information

Created By: Forcier, Easton
Revision Number: 47
Last Edited By: Forcier, Easton
Date: 4/26/2012
Time: 8:36:13 AM
File Name: Section A-A' pseudostatic peak.gsz
Directory: K:\10978.000.0\slope stability analysis\W Sea Level Parking spaces\
Last Solved Date: 4/26/2012
Last Solved Time: 8:37:02 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Kind: SLOPE/W
Method: Spencer
Settings
  PWP Conditions Source: (none)
SlipSurface
  Direction of movement: Left to Right
  Use Passive Mode: No
  Slip Surface Option: Entry and Exit
  Critical slip surfaces saved: 1
  Optimize Critical Slip Surface Location: Yes
  Tension Crack
    Tension Crack Option: (none)
FOS Distribution
  FOS Calculation Option: Constant
Advanced
  Number of Slices: 30

Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Qt - Sandy Lean Clay

Model: Shear/Normal Fn.
Unit Weight: 125 pcf
Strength Function: Sandy Lean Clay
Phi-B: 0 °

Trancas Formation

Model: Bedrock (Impenetrable)

Qt - Clayey Sand

Model: Shear/Normal Fn.
Unit Weight: 125 pcf
Strength Function: Clayey Sand
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0.787402, 34) ft
Left-Zone Right Coordinate: (13, 34) ft
Left-Zone Increment: 15
Right Projection: Range
Right-Zone Left Coordinate: (22.085354, 31.219528) ft
Right-Zone Right Coordinate: (27, 24) ft
Right-Zone Increment: 10
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (-10, 34) ft
Right Coordinate: (70, 8) ft

Seismic Loads

Horz Seismic Load: 0.31
Ignore seismic load in strength: Yes

Shear/Normal Strength Functions

Sandy Lean Clay

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 0 %
Y-Intercept: 0
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (0, 0)
Data Point: (500, 585)
Data Point: (1034, 1065)
Data Point: (2113, 1451)
Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Clayey Sand

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
Curve Fit to Data: 100 %
Segment Curvature: 0 %
Y-Intercept: 0
Data Points: Normal Stress (psf), Shear Stress (psf)
Data Point: (0, 0)
Data Point: (500, 825)
Data Point: (1034, 1344)
Data Point: (2113, 2210)
Estimation Properties
Intact Rock Param.: 10
Geological Strength: 100
Disturbance Factor: 0
SigmaC: 600000 psf
Sigma3: 300000 psf
Num. Points: 20

Regions

	Material	Points	Area (ft²)
Region 1	Qt - Sandy Lean Clay	3,2,4,15	126
Region 2	Trancas Formation	12,14,6,7,8,13,11,9,10,1	1355.25
Region 3	Qt - Clayey Sand	15,4,5,14,12	209

Points

	X (ft)	Y (ft)
Point 1	-10	0
Point 2	20	34
Point 3	-10	34
Point 4	23	30
Point 5	26	25
Point 6	30.5	20
Point 7	34	15
Point 8	42	10
Point 9	70	0
Point 10	42	0
Point 11	70	8
Point 12	-10	24
Point 13	47	8
Point 14	27	24
Point 15	-10	30

Critical Slip Surfaces

	Number	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.48	(117.095, 164.933)	167.2701	(13, 34)	(27, 24)
2	1926	1.48	(117.095, 164.933)	167.27	(13, 34)	(27, 24)

Slices of Slip Surface: Optimized

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimize	13.238185	33.811345	0	12.545327	0	18.429

	d						
2	Optimized	13.71455	33.435435	0	37.72061	0	55.324
3	Optimized	14.190915	33.062315	0	62.943459	0	92.176
4	Optimized	14.667285	32.691965	0	88.215305	0	128.98
5	Optimized	15.14365	32.32436	0	113.5305	0	165.75
6	Optimized	15.620015	31.95948	0	138.89005	0	202.47
7	Optimized	16.096385	31.5973	0	164.29337	0	239.14
8	Optimized	16.57275	31.237795	0	189.73323	0	275.76
9	Optimized	17.049115	30.88095	0	215.22247	0	312.34
10	Optimized	17.52548	30.52674	0	240.7388	0	348.86
11	Optimized	18.001845	30.175145	0	266.29686	0	385.34
12	Optimized	18.460025	29.839375	0	255.34708	0	551.42
13	Optimized	18.90002	29.51922	0	276.44904	0	595.81
14	Optimized	19.340015	29.20125	0	297.6062	0	640.19
15	Optimized	19.780005	28.885445	0	318.85435	0	684.56
16	Optimized	20.25	28.550555	0	320.72408	0	687.15
17	Optimized	20.75	28.19688	0	302.86869	0	647.5
18	Optimized	21.25	27.84594	0	284.5995	0	607.16
19	Optimized	21.75	27.497715	0	265.94818	0	566.14
20	Optimize	22.25	27.152185	0	246.88084	0	524.44

	d						
21	Optimized	22.75	26.80933	0	227.39633	0	482.05
22	Optimized	23.25	26.46913	0	202.09629	0	427.54
23	Optimized	23.75	26.13156	0	170.89035	0	360.77
24	Optimized	24.25	25.79661	0	139.14834	0	293.16
25	Optimized	24.75	25.46426	0	106.86429	0	224.68
26	Optimized	25.25	25.134485	0	74.040643	0	155.36
27	Optimized	25.75	24.80727	0	40.673161	0	85.172
28	Optimized	26.25	24.482595	0	17.946993	0	37.506
29	Optimized	26.75	24.160445	0	5.7697768	0	12.605

Slices of Slip Surface: 1926

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	1926	13.238185	33.811345	0	12.545327	0	18.429
2	1926	13.71455	33.435435	0	37.72061	0	55.324
3	1926	14.190915	33.062315	0	62.943459	0	92.176
4	1926	14.667285	32.691965	0	88.215305	0	128.98
5	1926	15.14365	32.32436	0	113.5305	0	165.75
6	1926	15.620015	31.95948	0	138.89005	0	202.47
7	1926	16.096385	31.5973	0	164.29337	0	239.14
8	1926	16.57275	31.237795	0	189.73323	0	275.76
9	1926	17.049115	30.88095	0	215.22247	0	312.34
10	1926	17.52548	30.52674	0	240.7388	0	348.86
11	1926	18.001845	30.175145	0	266.29686	0	385.34
12	1926	18.460025	29.839375	0	255.34708	0	551.42
13	1926	18.90002	29.51922	0	276.44904	0	595.81

14	1926	19.340015	29.20125	0	297.6062	0	640.19
15	1926	19.780005	28.885445	0	318.85435	0	684.56
16	1926	20.25	28.550555	0	320.72408	0	687.15
17	1926	20.75	28.19688	0	302.86869	0	647.5
18	1926	21.25	27.84594	0	284.5995	0	607.16
19	1926	21.75	27.497715	0	265.94818	0	566.14
20	1926	22.25	27.152185	0	246.88084	0	524.44
21	1926	22.75	26.80933	0	227.39633	0	482.05
22	1926	23.25	26.46913	0	202.09629	0	427.54
23	1926	23.75	26.13156	0	170.89035	0	360.77
24	1926	24.25	25.79661	0	139.14834	0	293.16
25	1926	24.75	25.46426	0	106.86429	0	224.68
26	1926	25.25	25.134485	0	74.040643	0	155.36
27	1926	25.75	24.80727	0	40.673161	0	85.172
28	1926	26.25	24.482595	0	17.946993	0	37.506
29	1926	26.75	24.160445	0	5.7697768	0	12.605

SLOPE/W Analysis

File Information

Created By: Forcier, Easton
Revision Number: 48
Last Edited By: Forcier, Easton
Date: 4/25/2012
Time: 1:27:02 PM
File Name: Section A-A' pseudstaticB.gsz
Directory: K:\10978.000.0\slope stability analysis\W Sea Level Parking spaces\
Last Solved Date: 4/25/2012
Last Solved Time: 1:27:36 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Kind: SLOPE/W
Method: Spencer
Settings
- PWP Conditions Source: (none)

SlipSurface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: Yes
- Tension Crack
  - Tension Crack Option: (none)

FOS Distribution
- FOS Calculation Option: Constant

Advanced
- Number of Slices: 30

Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Qt - Sandy Lean Clay

Model: Shear/Normal Fn.
Unit Weight: 125 pcf
Strength Function: Sandy Lean Clay
Phi-B: 0 °

Trancas Formation

Model: Bedrock (Impenetrable)

Qt - Clayey Sand

Model: Shear/Normal Fn.
Unit Weight: 125 pcf
Strength Function: Clayey Sand
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0.787402, 34) ft
Left-Zone Right Coordinate: (13, 34) ft
Left-Zone Increment: 15
Right Projection: Range
Right-Zone Left Coordinate: (22.085354, 31.219528) ft
Right-Zone Right Coordinate: (27, 24) ft
Right-Zone Increment: 10
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (-10, 34) ft
Right Coordinate: (70, 8) ft

Seismic Loads

Horz Seismic Load: 0.2
Ignore seismic load in strength: Yes

Shear/Normal Strength Functions

Sandy Lean Clay

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
  Curve Fit to Data: 100 %
  Segment Curvature: 0 %
Y-Intercept: 0
Data Points: Normal Stress (psf), Shear Stress (psf)
  Data Point: (0, 0)
  Data Point: (1034, 878)
  Data Point: (2113, 1371)
Estimation Properties
  Intact Rock Param.: 10
  Geological Strength: 100
  Disturbance Factor: 0
  SigmaC: 600000 psf
  Sigma3: 300000 psf
  Num. Points: 20

Clayey Sand

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
  Curve Fit to Data: 100 %
  Segment Curvature: 0 %
Y-Intercept: 0
Data Points: Normal Stress (psf), Shear Stress (psf)
  Data Point: (0, 0)
  Data Point: (1034, 1104)
  Data Point: (2113, 2063)
Estimation Properties
  Intact Rock Param.: 10
  Geological Strength: 100
  Disturbance Factor: 0
  SigmaC: 600000 psf
  Sigma3: 300000 psf
  Num. Points: 20

Regions

	Material	Points	Area (ft^2)

Region 1	Qt - Sandy Lean Clay	3,2,4,15	126
Region 2	Trancas Formation	12,14,6,7,8,13,11,9,10,1	1355.25
Region 3	Qt - Clayey Sand	15,4,5,14,12	209

Points

	X (ft)	Y (ft)
Point 1	-10	0
Point 2	20	34
Point 3	-10	34
Point 4	23	30
Point 5	26	25
Point 6	30.5	20
Point 7	34	15
Point 8	42	10
Point 9	70	0
Point 10	42	0
Point 11	70	8
Point 12	-10	24
Point 13	47	8
Point 14	27	24
Point 15	-10	30

Critical Slip Surfaces

	Number	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.10	(117.095, 164.933)	167.2701	(13, 34)	(27, 24)
2	1926	1.10	(117.095, 164.933)	167.27	(13, 34)	(27, 24)

Slices of Slip Surface: Optimized

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimized	13.238185	33.811345	0	13.324504	0	13.137
2	Optimize	13.71455	33.435435	0	40.047515	0	39.444

	d						
3	Optimized	14.190915	33.062315	0	66.799539	0	65.727
4	Optimized	14.667285	32.691965	0	93.582508	0	91.986
5	Optimized	15.14365	32.32436	0	120.39212	0	118.22
6	Optimized	15.620015	31.95948	0	147.22742	0	144.43
7	Optimized	16.096385	31.5973	0	174.09589	0	170.61
8	Optimized	16.57275	31.237795	0	200.97494	0	196.77
9	Optimized	17.049115	30.88095	0	227.87371	0	222.9
10	Optimized	17.52548	30.52674	0	254.80664	0	249
11	Optimized	18.001845	30.175145	0	281.75445	0	275.07
12	Optimized	18.460025	29.839375	0	286.14806	0	359.21
13	Optimized	18.90002	29.51922	0	309.51253	0	388.11
14	Optimized	19.340015	29.20125	0	332.9051	0	417
15	Optimized	19.780005	28.885445	0	356.36119	0	445.88
16	Optimized	20.25	28.550555	0	358.09949	0	447.54
17	Optimized	20.75	28.19688	0	337.83961	0	421.69
18	Optimized	21.25	27.84594	0	317.15232	0	395.4
19	Optimized	21.75	27.497715	0	296.06948	0	368.67
20	Optimized	22.25	27.152185	0	274.57379	0	341.49
21	Optimize	22.75	26.80933	0	252.68094	0	313.88

	d						
22	Optimized	23.25	26.46913	0	224.34725	0	278.37
23	Optimized	23.75	26.13156	0	189.52781	0	234.88
24	Optimized	24.25	25.79661	0	154.1808	0	190.85
25	Optimized	24.75	25.46426	0	118.30064	0	146.27
26	Optimized	25.25	25.134485	0	81.8885	0	101.13
27	Optimized	25.75	24.80727	0	44.943877	0	55.44
28	Optimized	26.25	24.482595	0	19.812728	0	24.412
29	Optimized	26.75	24.160445	0	6.4196531	0	8.2041

Slices of Slip Surface: 1926

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	1926	13.238185	33.811345	0	13.324504	0	13.137
2	1926	13.71455	33.435435	0	40.047515	0	39.444
3	1926	14.190915	33.062315	0	66.799539	0	65.727
4	1926	14.667285	32.691965	0	93.582508	0	91.986
5	1926	15.14365	32.32436	0	120.39212	0	118.22
6	1926	15.620015	31.95948	0	147.22742	0	144.43
7	1926	16.096385	31.5973	0	174.09589	0	170.61
8	1926	16.57275	31.237795	0	200.97494	0	196.77
9	1926	17.049115	30.88095	0	227.87371	0	222.9
10	1926	17.52548	30.52674	0	254.80664	0	249
11	1926	18.001845	30.175145	0	281.75445	0	275.07
12	1926	18.460025	29.839375	0	286.14806	0	359.21
13	1926	18.90002	29.51922	0	309.51253	0	388.11
14	1926	19.340015	29.20125	0	332.9051	0	417
15	1926	19.780005	28.885445	0	356.36119	0	445.88

16	1926	20.25	28.550555	0	358.09949	0	447.54
17	1926	20.75	28.19688	0	337.83961	0	421.69
18	1926	21.25	27.84594	0	317.15232	0	395.4
19	1926	21.75	27.497715	0	296.06948	0	368.67
20	1926	22.25	27.152185	0	274.57379	0	341.49
21	1926	22.75	26.80933	0	252.68094	0	313.88
22	1926	23.25	26.46913	0	224.34725	0	278.37
23	1926	23.75	26.13156	0	189.52781	0	234.88
24	1926	24.25	25.79661	0	154.1808	0	190.85
25	1926	24.75	25.46426	0	118.30064	0	146.27
26	1926	25.25	25.134485	0	81.8885	0	101.13
27	1926	25.75	24.80727	0	44.943877	0	55.44
28	1926	26.25	24.482595	0	19.812728	0	24.412
29	1926	26.75	24.160445	0	6.4196531	0	8.2041

SLOPE/W Analysis

File Information

Created By: Forcier, Easton
Revision Number: 46
Last Edited By: Forcier, Easton
Date: 4/24/2012
Time: 4:40:04 PM
File Name: Section A-A' pseudstaticA.gsz
Directory: K:\10978.000.0\slope stability analysis\W Sea Level Parking spaces\
Last Solved Date: 4/24/2012
Last Solved Time: 4:40:48 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Kind: SLOPE/W
Method: Spencer
Settings
- PWP Conditions Source: (none)

SlipSurface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: Yes
- Tension Crack
  - Tension Crack Option: (none)

FOS Distribution
- FOS Calculation Option: Constant

Advanced
- Number of Slices: 30

Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Qt - Sandy Lean Clay

Model: Shear/Normal Fn.
Unit Weight: 125 pcf
Strength Function: Sandy Lean Clay
Phi-B: 0 °

Trancas Formation

Model: Bedrock (Impenetrable)

Qt - Clayey Sand

Model: Shear/Normal Fn.
Unit Weight: 125 pcf
Strength Function: Clayey Sand
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0.787402, 34) ft
Left-Zone Right Coordinate: (13, 34) ft
Left-Zone Increment: 15
Right Projection: Range
Right-Zone Left Coordinate: (22.085354, 31.219528) ft
Right-Zone Right Coordinate: (27, 24) ft
Right-Zone Increment: 10
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (-10, 34) ft
Right Coordinate: (70, 8) ft

Seismic Loads

Horz Seismic Load: 0.306
Ignore seismic load in strength: Yes

Shear/Normal Strength Functions

Sandy Lean Clay

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
- Curve Fit to Data: 100 %
- Segment Curvature: 0 %

Y-Intercept: 0
Data Points: Normal Stress (psf), Shear Stress (psf)
- Data Point: (0, 0)
- Data Point: (1034, 878)
- Data Point: (2113, 1371)

Estimation Properties
- Intact Rock Param.: 10
- Geological Strength: 100
- Disturbance Factor: 0
- SigmaC: 600000 psf
- Sigma3: 300000 psf
- Num. Points: 20

Clayey Sand

Model: Spline Data Point Function
Function: Shear Stress vs. Normal Stress
- Curve Fit to Data: 100 %
- Segment Curvature: 0 %

Y-Intercept: 0
Data Points: Normal Stress (psf), Shear Stress (psf)
- Data Point: (0, 0)
- Data Point: (1034, 1104)
- Data Point: (2113, 2063)

Estimation Properties
- Intact Rock Param.: 10
- Geological Strength: 100
- Disturbance Factor: 0
- SigmaC: 600000 psf
- Sigma3: 300000 psf
- Num. Points: 20

Regions

	Material	Points	Area (ft^2)

Region 1	Qt - Sandy Lean Clay	3,2,4,15	126
Region 2	Trancas Formation	12,14,6,7,8,13,11,9,10,1	1355.25
Region 3	Qt - Clayey Sand	15,4,5,14,12	209

Points

	X (ft)	Y (ft)
Point 1	-10	0
Point 2	20	34
Point 3	-10	34
Point 4	23	30
Point 5	26	25
Point 6	30.5	20
Point 7	34	15
Point 8	42	10
Point 9	70	0
Point 10	42	0
Point 11	70	8
Point 12	-10	24
Point 13	47	8
Point 14	27	24
Point 15	-10	30

Critical Slip Surfaces

	Number	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	0.99	(117.095, 164.933)	167.2701	(13, 34)	(27, 24)
2	1926	0.99	(117.095, 164.933)	167.27	(13, 34)	(27, 24)

Slices of Slip Surface: Optimized

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimized	13.238185	33.811345	0	12.190872	0	13.137
2	Optimize	13.71455	33.435435	0	36.664427	0	39.444

	d						
3	Optimized	14.190915	33.062315	0	61.199121	0	65.727
4	Optimized	14.667285	32.691965	0	85.790604	0	91.986
5	Optimized	15.14365	32.32436	0	110.44168	0	118.22
6	Optimized	15.620015	31.95948	0	135.14691	0	144.43
7	Optimized	16.096385	31.5973	0	159.90584	0	170.61
8	Optimized	16.57275	31.237795	0	184.71641	0	196.77
9	Optimized	17.049115	30.88095	0	209.58661	0	222.9
10	Optimized	17.52548	30.52674	0	234.49767	0	249
11	Optimized	18.001845	30.175145	0	259.44748	0	275.07
12	Optimized	18.460025	29.839375	0	259.49548	0	359.21
13	Optimized	18.90002	29.51922	0	280.90167	0	388.11
14	Optimized	19.340015	29.20125	0	302.36436	0	417
15	Optimized	19.780005	28.885445	0	323.90086	0	445.88
16	Optimized	20.25	28.550555	0	325.7466	0	447.54
17	Optimized	20.75	28.19688	0	307.56091	0	421.69
18	Optimized	21.25	27.84594	0	288.97594	0	395.4
19	Optimized	21.75	27.497715	0	269.97421	0	368.67
20	Optimized	22.25	27.152185	0	250.58751	0	341.49
21	Optimize	22.75	26.80933	0	230.78192	0	313.88

	d						
22	Optimized	23.25	26.46913	0	205.07633	0	278.37
23	Optimized	23.75	26.13156	0	173.37977	0	234.88
24	Optimized	24.25	25.79661	0	141.15467	0	190.85
25	Optimized	24.75	25.46426	0	108.38847	0	146.27
26	Optimized	25.25	25.134485	0	75.085353	0	101.13
27	Optimized	25.75	24.80727	0	41.241138	0	55.44
28	Optimized	26.25	24.482595	0	18.193854	0	24.412
29	Optimized	26.75	24.160445	0	5.8514111	0	8.2041

Slices of Slip Surface: 1926

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	1926	13.238185	33.811345	0	12.190872	0	13.137
2	1926	13.71455	33.435435	0	36.664427	0	39.444
3	1926	14.190915	33.062315	0	61.199121	0	65.727
4	1926	14.667285	32.691965	0	85.790604	0	91.986
5	1926	15.14365	32.32436	0	110.44168	0	118.22
6	1926	15.620015	31.95948	0	135.14691	0	144.43
7	1926	16.096385	31.5973	0	159.90584	0	170.61
8	1926	16.57275	31.237795	0	184.71641	0	196.77
9	1926	17.049115	30.88095	0	209.58661	0	222.9
10	1926	17.52548	30.52674	0	234.49767	0	249
11	1926	18.001845	30.175145	0	259.44748	0	275.07
12	1926	18.460025	29.839375	0	259.49548	0	359.21
13	1926	18.90002	29.51922	0	280.90167	0	388.11
14	1926	19.340015	29.20125	0	302.36436	0	417
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18	1926	21.25	27.84594	0	288.97594	0	395.4
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23	1926	23.75	26.13156	0	173.37977	0	234.88
24	1926	24.25	25.79661	0	141.15467	0	190.85
25	1926	24.75	25.46426	0	108.38847	0	146.27
26	1926	25.25	25.134485	0	75.085353	0	101.13
27	1926	25.75	24.80727	0	41.241138	0	55.44
28	1926	26.25	24.482595	0	18.193854	0	24.412
29	1926	26.75	24.160445	0	5.8514111	0	8.2041

Project-Specific Reference #7

GEOTECHNICAL INVESTIGATION FINAL REPORT

Lechuza Beach Public Access Improvements Project

Malibu, California

Prepared for:

Mountains Recreation and Conservation Authority
5810 Ramirez Canyon Road
Malibu, California 90265

Prepared by:

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(949) 642-0245

December 6, 2013

Project No. 10978.000.0

GEOTECHNICAL INVESTIGATION FINAL REPORT
Lechuza Beach Public Access Improvements Project
Malibu, California

December 6, 2013
Project 10978.000.0

This report was prepared by the staff of AMEC Earth and Infrastructure, Inc., under the supervision of the Engineer(s) and/or Geologist(s) whose seal(s) and signature(s) appear hereon.

The findings, recommendations, specifications, or professional opinions are presented within the limits described by the client, in accordance with generally accepted professional engineering and geologic practice. No warranty is expressed or implied.

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TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

FIGURES

APPENDIXES

GEOTECHNICAL INVESTIGATION FINAL REPORT
Lechuza Beach Public Access Improvements
Malibu, California

1.0 INTRODUCTION

AMEC Environment and Infrastructure (AMEC), has prepared this geotechnical investigation report for the Mountains Recreation and Conservation Authority (MRCA) in support of the Lechuza Beach Public and ADA (Americans with Disabilities Act) Access project. The investigation study was completed in general accordance with our Proposal for Phase I Geotechnical Services dated October 4, 2005; and Supplemental Cost Estimate for Phase I Geotechnical Services dated May 22, 2008; and based on our site meetings, discussions, and revisions to the planned scope of work provided to us by the MRCA. A summary of the geotechnical investigation and evaluation is provided in the following section.

2.0 PROJECT DESCRIPTION

MRCA plans to improve public safety and access to Lechuza Beach. Currently, there are three public access points to the beach: (1) a gated and fenced staircase and pathway from Broad Beach Road that extends to the beach opposite Bunnie Lane (Lot I) and (2) a gated path and stairway that extends to the beach off West Sea Level Drive, and (3) a gated path that extends along East Sea Level Drive to the beach. The MRCA would like to improve these access points as well as provide ADA access to the beach. The proposed improvement areas, which are designated East and West Sea Level Drive, are shown on Figure 1.

Construction plans and details showing the proposed improvements for East and West Sea Level Drive are provided in Appendix A. The proposed improvements are discussed in the following sections. It should be noted that some of the proposed improvements, as discussed below, are different than those proposed by MRCA at the start of the project (circa 2005).

2.1 WEST SEA LEVEL DRIVE

As shown on Figures A-1 and A-2 (Appendix A), proposed upgrades and repairs for West Sea Level Drive include reconstructing the existing staircase, rails, and view platform at the beach terminus of West Sea Level Drive. Reconstruction of existing structures will include new foundations. The locations of the proposed improvement areas are shown on Figure 2.

In addition, the plan (A-1) depicts two disabled parking spaces, proposed near the southeast termination of West Sea Level Drive, an eastern one labeled “D” and a western one labeled “DD.” It is our understanding the parking spaces would be constructed with accompanying access aisles that connect to the reconstructed view platform/stairs. The south edges of both the east and west parking spaces are set back approximately 7 and 9 feet, respectively, from the top of the bluff. AMEC prepared a report dated July 10, 2012 that summarized the results of our slope stability analyses for the proposed parking spaces.

2.2 EAST SEA LEVEL DRIVE AND LOT I

As shown on Figure A-3, the existing Lot I staircase and pathway would be improved between the intersection of Bunnie Lane and Broad Beach Road, south (beachward) to the terminus of East Sea Level Drive at the beach. Proposed improvements, as shown on Figures A-4 and A-5, include reconstructing the Lot I stairs and handrails and constructing new retaining walls along portions of the stairs. The remaining improvements, as shown on Figure A-6, include constructing a new public staging area, new stairs, new walkways, a new view platform, and a new restroom with an access walkway. As shown on Figure A-6, the public staging area would be located at the south (beachward) end and on the west side of the reconstructed Lot I staircase. The new stairs would extend from a new walkway down to the beach. The new view platform would be located adjacent to the top of the new stairs, and along the upper portion of a descending slope. The new restroom would be located approximately 28 feet west of the public staging area, and would be accessed by a 5-foot wide walkway. The soil and/or bedrock along the northern edge of the walkway will be retained by walls up to approximately 5 feet high. The new restroom, as depicted on Section A (Figure A-6), is located along a relatively steep portion of the coastal bluff. Walls would be constructed to retain the soil and/or bedrock on the north and west sides of the structure, and based on Section A, the retained portion is up to approximately 10 feet high. A V-ditch would be constructed directly behind the wall to collect surface runoff. The retaining wall, as depicted on Section A, would be part of the restroom structure, however, we understand a porta potty may be installed instead of constructing a permanent restroom. If a porta potty is the preferred alternative, only a northern retaining wall (i.e., no western wall) would be constructed. As part of a permanent restroom, a septic tank would be installed beneath the public staging area. The design drawings and cross-sections indicate deep foundations are anticipated for support of the new view platform, new public staging area, new walkway, and new restroom. The locations of the proposed construction areas are shown on Figure 3.

As shown on Figure A-3 (Appendix A), two new disabled parking spaces, 8 and 11, are planned along the south side of East Sea Level Drive. Parking spaces 8 and 11 would be located approximately 140 and 320 feet, respectively, east of the new view platform. The parking spaces would be constructed with accompanying access aisles and paths leading to the new view platform and/or new stairs. The new parking spaces may require the demolition of various small structures that currently encroach in the MRCA Sea Level Drive easement.

3.0 PURPOSE AND SCOPE

The purpose of the study was to gather data to characterize subsurface conditions and provide preliminary geotechnical data for design of the proposed West and East Sea Level improvement areas described previously.

To accomplish the above objectives, AMEC performed the following tasks:

- Reviewed pertinent geologic and geotechnical data from the City of Malibu made available to us by MRCA;
- Reviewed pertinent geologic data and information available from the California Geological Survey (CGS), United States Geological Survey (USGS), City of Malibu files, California Coastal Commission files, and MRCA files;
- Completed reconnaissance-level geologic mapping of the project area to delineate soil and bedrock units, bedrock structure, landslides and other features of slope instability, and other discernible features;
- Hand excavated and logged six exploratory test pits to evaluate subsurface conditions;
- Drilled three limited access tripod borings and collecting soil samples;
- Performed geotechnical engineering analyses;
- Attended two site meetings and communicated with the MRCA and engineering team through electronic mail and phone conferences to discuss design issues;
- Developed geotechnical recommendations for the proposed design alternatives; and,
- Prepared this geotechnical investigation report.

4.0 FIELD EXPLORATION

The field exploration program included pre-field activities, excavating six exploratory test pits, drilling three tripod borings, and performing reconnaissance-level geologic mapping. The locations of the test pits and tripod borings are shown on Figures 1 through 3. Detailed descriptions of the subsurface conditions encountered in the test pits and tripod borings are provided in the logs in Appendix B. Photographs of the site are presented in Appendix C. It should be noted that the photographs were taken several years ago, and may not represent the current site conditions, particularly along areas of the beach.

Our original proposal dated October 4, 2005, proposed reconnaissance-level geologic mapping, drilling two 50-foot exploratory borings near possible locations of stairways and ADA access ramps, and retrieving relatively undisturbed samples or perform Standard Penetration Tests at 5-foot intervals in the borings. As indicated in our Supplemental Cost Estimate for Phase I Geotechnical Services dated May 22, 2008, the field program was modified to hand excavate the proposed boring locations at the base of the stairs located at both East and West Sea Levels due to difficulties gaining access agreements and permits required for using mechanized equipment on the beach.

Additional modifications to the field exploration program included using hand excavation methods to assess soil and bedrock conditions for the existing view platform and previously proposed view area at West Sea Level and for the proposed viewing platform at East Sea Level, including collection of samples of bedrock or other material for laboratory analysis, where feasible. A test pit was also excavated above the pathway located mid-way in the Lot I stairs to assess the type and depth of geologic materials present behind the existing retaining wall along the path. We also extended the geologic mapping to include a previously proposed view area on Lot 156. A summary of the field exploration programs is provided in the following subsections.

4.1 PRE-FIELD EXPLORATION ACTIVITIES

Prior to beginning any field exploration, AMEC conducted a site reconnaissance to mark the proposed exploration locations, and evaluate site access and logistics. Excavation permit applications were completed and approved by the City of Malibu prior to starting the field programs. Underground Service Alert was notified to identify buried utilities in the vicinity of the borings and test pits at least two working days prior to the start of the field programs.

4.2 TEST PITS

Six test pits (TP-1 through TP-6) were excavated for this project. Excavation services were provided by Bryan Construction of Westchester, California, on October 15 and 16, 2008. The test pits were excavated using electric shovels and by hand to depths ranging from approximately 3.3 to 4.6 feet below ground surface (bgs). The locations of the test pits are shown on Figures 1 through 3. Photographs of the test pit excavations are included in Appendix C.

The excavated materials and exposed pit walls were observed and logged by a field geologist using visual/manual procedures described in ASTM International (ASTM) Standard D 2488, "Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)". These procedures are in accordance with the Unified Soil Classification System. The test pits were backfilled and hand compacted to ground surface with the excavated materials.

4.3 TRIPOD BORINGS

Three borings were drilled near the terminus of West Sea Level Drive on April 4, 2012 at the approximate locations shown on Figures 1 and 2. The purpose of the borings was to collect subsurface information for use in slope stability analyses. Stability analyses were performed for the slopes located adjacent to the new disabled parking spaces (D and DD) at the terminus of West Sea Level Drive. DP Reynolds Corp. of San Juan Capistrano, California performed the drilling using limited access motorized drilling equipment. Tripod-2 and Tripod-3 were drilled to refusal depths of approximately 8 and 7.5 feet, respectively, below ground surface (bgs). Tripod-1 was terminated at a shallow depth of 3.5 feet bgs to minimize the potential for damaging an adjacent PVC conduit with electrical lines, which was encountered along the side of the borehole during the drilling.

Depth-discrete engineering soil samples were collected at selected intervals from the tripod borings using a 2½ -inch inside diameter (I.D.) modified California split-barrel sampler fitted with six brass rings of 2 1/2 inches in O.D. and 1-inch in height and one brass liner (2½ -inch O.D. by 6 inches long) above the brass rings. The modified California sampler was lowered to the bottom of the boreholes and driven 12 inches into the soil using a 140-pound donut-type hammer falling 24 inches. The number of blows required to drive the sampler 6 inches of the sampling interval is recorded on the blow count column of the boring logs.

After removing the sampler from the boreholes, the sampler was opened and the brass rings and liner containing the soil were removed and observed for soil classification. Brass rings containing the soil were sealed in plastic canisters to preserve the natural moisture content of the soil. Bulk samples of soil cuttings were also collected from the tripod borings and placed in polyethylene bags

4.4 ROCK CORE SAMPLING

AMEC attempted to collect rock core samples from several locations including the bottom of test pit TP-1 and from bedrock (sandstone) outcrops near test pit TP-3 using hand-held coring equipment. Because of the uneven nature of the bedrock outcrops, anchoring the coring equipment was not possible. No samples could be collected because the coring equipment was unable to penetrate the hard sandstone bedrock.

4.5 LABORATORY TESTING

Selected soil samples obtained from the tripod borings were tested by the AMEC laboratory in Irvine, California to evaluate the physical characteristics and engineering properties of subsurface soils. Physical tests include in-situ dry density and moisture content, fines content, expansion index, unconfined compression and direct shear. The laboratory test results are presented in Appendix D.

5.0 DISCUSSION OF FINDINGS

The following discussion of findings for the site conditions is based on the results of data review and AMEC's field exploration.

5.1 GEOLOGY AND HYDROGEOLOGY

The site is located within the Transverse Ranges geomorphic province at the base of the east-west trending Santa Monica Mountains. The Santa Monica Mountains consist of Cretaceous and Jurassic age metamorphic and intrusive and extrusive crystalline rock overlain by a sequence of Miocene age marine and non-marine sedimentary rocks. During the Quaternary, the Santa Monica Mountains have undergone rapid uplift from thrust faulting near the coast resulting in placement of Tertiary bedrock over Quaternary marine and non-marine terrace deposits (CDMG, 2001).

5.1.1 Site Geology

The study area is located on a south facing sandy beach and coastal bluff reaching an elevation of 85 feet above mean sea level (msl) at Broad Beach Road (top of the Lot I stairs). Sandstone bedrock of the Miocene age Trancas Formation are exposed along the bluff and as minor headland and stacks along the beach. The top of the bluff is covered with terrace deposits. The bluff slopes are generally overall 1.5:1 (horizontal to vertical) at the east end of the study area and steepen to 1:1 at the west end of the beach. Geologic units exposed at the site include artificial fill, slope wash and surficial soil, beach sand, terrace deposits, and sandstone bedrock. Geologic maps of the East and West Sea Level improvement areas are presented on Figures 2 and 3, respectively. Photographs of the site are presented in Appendix C.

5.1.1.1 Artificial Fill (Af)

Artificial fill was observed in several of the test pits and has been reported in various geotechnical documents reviewed by AMEC. The thickness of the fill ranged from 1 to 4 feet where observed by AMEC. The artificial fill in test pit TP-1 consisted of clayey sand (SC) to poorly graded sand with clay (SP-SC) with gravel-size clasts of sandstone, poorly graded sand with gravel (SP) in test pit TP-2, and silty sand (SM) to clayey sand (SC) in test pit TP-6. Artificial fill consisting of sandy lean clay (CL) and sandy silt (ML) with fine-gravel size siltstone fragments was observed in borings Tripod-1 and Tripod-3. The extent of the fill in these areas appeared to be related to construction of the walkways and overlook/view platforms.

5.1.1.2 Slope Wash (SW)

Slope wash consisting primarily of light brown to gray clayey sand (SC) to poorly graded sand with clay (SP) was observed in test pit TP-1, on the west side of Lot I pathway, and at various locations along the bluff between West Sea Level and East Sea Level. The slope wash is derived from the older alluvial terrace deposits and surficial soil forming on the slope faces. The slope wash in test pit TP-1 was only a few inches thick, but was observed to be up to 3 feet thick in exposures on the slopes in other areas of the site.

5.1.1.3 Beach Sand (Qb)

The beach sand deposits consist of fine to medium grained pale yellowish brown poorly graded sand (SP) that is unconsolidated and loose. Localized zones of boulders up to 2 feet in diameter and several feet in thickness were exposed along the base of the bluff at West Sea Level starting at the base of the stairs and extending westward along the base of the bluff as far as Lot 159. The thickness of the beach sand varies, seasonally covering or exposing rock outcrops and the boulder zones along the base of the bluff.

5.1.1.4 Surficial Soil/Terrace Deposits (Qt)

Surficial soil consisting of dark reddish gray silty sand (SM) with gravel-size clasts of sandstone was observed in test pit TP-5 to a depth of 4 feet at West Sea Level and was derived from weathering of the underlying terrace deposits.

Test pit and boring logs by others completed during construction on various lots across Lechuza Beach indicate the terrace deposits range from approximately 5 to 50 feet in thickness. Logs for test pits previously excavated in Lot 156 (location of test pit TP-5), indicated the surficial soil/terrace deposits extended 8 to 12 feet bgs (Geolabs, 1978). Borings drilled to the east of West Sea Level and at East Sea Level indicated the terrace deposits were up to 50 feet thick (Kovacs-Byer, 1979; 1980). Surface soil and terrace deposit materials encountered in borings Tripod-1, Tripod-2, and Tripod-3 consisted primarily of 4.5 to 5 feet of grayish brown to reddish brown sandy lean clay (CL) overlying brown clayey sand (SC) to clayey sand (SC) with gravel-size fragments of siltstone and sandstone. Terrace deposits underlying the ascending slope at East Sea Level consist primarily of clayey sand and grades to fine-grained clean sand at the contact of the sandstone bedrock (G.C. Masterman & Associates, Inc., 1993 and Robert Stone & Associates, 1986)

5.1.1.5 Trancas Formation (Ttrs) - Sandstone

Where exposed the sandstone is yellowish brown to light olive gray, fine grained, massive, hard, moderately strong, slightly weathered, well cemented, and closely fractured. The sand grains are primarily sub-rounded to sub-angular quartz with plagioclase and trace mafic minerals. The weathered surface has minor iron oxide staining around the sand grains.

5.2 Geologic Structure

In general, the sandstone at the site is massive. Few bedding attitudes were observed within the study area and, where observed, they had a general east-west orientation and dipped steeply to the south (Figure 2).

Minor discontinuous faults and shears were observed in the sandstone bedrock across this site. In general, the minor faults and fractures are oriented north/south and dip 30 to 80 degrees to the west. Where exposed, these features are discontinuous extending inches to several feet and are filled (healed) with what appeared to be dolomitic material. Several small faults and an approximate 50-foot wide shear zone were observed at the west end of the beach where the bedrock was brecciated. Some of the small faults and shears within the shear zone were lined with up to 1" of dark gray clay gouge (Figure 2).

The Malibu Coast Fault is located approximately ¼-mile north of the study area. It is an east-west trending, north-dipping reverse fault with significant lateral displacement (CDMG, 2001). No active faults have been mapped at the site and the study area is not located within an Alquist-Priolo earthquake fault zone.

6.0 SUBSURFACE AND SURFACE CONDITIONS

The subsurface conditions encountered in the test pits were used to assess the engineering properties and to make design recommendations. A summary of the subsurface conditions encountered in the exploration areas at East Sea Level and West Sea Level are described in the following sections.

6.1 East Sea Level

Three test pits (TP-1, TP-2, and TP-4) were excavated to assess subsurface conditions for the East Sea Level improvements. Test pit TP-1 was excavated adjacent to the retaining wall located on the Lot I pathway. Fill materials consisting of light brown to gray clayey sand (SC) and poorly graded sand with clay (SP) were encountered to a depth of 3 feet bgs. A 12-inch corrugated polyvinyl chloride drain was observed in the excavation at a depth of 2 feet. This subsurface drain appeared to flow to the east and was connected to several surface grates located along the wood retaining wall east of test pit TP-1. The materials became sandier with depth. The test pit was terminated at a depth of approximately 3.3 feet bgs (the maximum depth that could be excavated by hand) in a sandy material that may have been weathered bedrock.

Test pit TP-2 was excavated near the proposed public staging area to East Sea Level Drive to a depth of 4.6 feet bgs. Fill materials consisting of light gray poorly graded sand with gravel (SP) were observed to a depth of 3.4 feet where a 1-inch thick layer of dark brown soil was encountered. Underlying the soil was unconsolidated, light gray, poorly graded sand that appeared to be beach sand to the maximum depth of the test pit. A metal probe was pushed below the bottom of the test pit to a depth of 5.5 feet bgs to assess if bedrock was present below bottom of the test pit. No hard material was encountered with the probe indicating bedrock is below a depth of 5.5 feet bgs (approximately 13.5 feet msl).

Test pit TP-4 was excavated to a depth of approximately 4.2 feet in the beach sand at the base of the existing East Sea Level stairs. Material encountered in test pit TP-4 consisted of unconsolidated light gray poorly graded sand (SP). Excavation of the test pit was terminated because the sidewalls of the trench were bowing the wooden shoring. A metal probe was pushed below the bottom of the test pit to a depth of approximately 7 feet bgs to assess if bedrock was present below the maximum depth of the excavation. No hard material was encountered with the probe indicating bedrock is below a depth of 7 feet bgs (approximately 7 feet msl).

It should be noted at the time of the field exploration and previous site visits, the elevation of the sand was at the base of the East Sea Level stairs (approximately 14 feet msl). In January and February 2010, high energy wave action removed approximately 5 feet of sand (Photo 28 in Appendix C) exposing the materials adjacent to and beneath the stairs. As shown in the photo, the bedrock exposed on the west side of the stairs and rip rap on the east side of the stairs extends to the level of scour and the fill material beneath the stairs has been eroded away.

Based on AMEC test pit TP-4 and previous boring log information by others (Borings B-2 and B-4 by Strata-tech [1992) shown on Figure 1), we anticipate the depth to bedrock to range from approximately 5 to 20 feet bgs (approximately -5 to 5 feet msl) with the shallowest bedrock closest to the base of the existing East Sea Level stairs. The thickness of sand overlying the bedrock depends significantly on the time of year and the effects of any recent storms.

6.2 WEST SEA LEVEL

Three test pits (TP-3, TP-5, and TP-6) were excavated to explore the subsurface conditions for the West Sea Level improvements. Test pit TP-3 was excavated near the base of the existing West Sea Level stairs. Beach sand consisting of poorly graded sand (SP) was encountered to a depth of 4 feet bgs. A layer of cobbles and boulders up to 24-inch diameter was encountered at 2 feet bgs. Bedrock was encountered at a depth of 4 feet bgs, the maximum depth of the test pit. Several boulders were also present on top of the bedrock. Water was encountered at a depth of 3.9 feet bgs, which was about ocean level at the time of the excavation (low tide).

Test pit TP-5 was excavated in the proposed viewing area on Lot 156. Surficial soils derived from weathering of the terrace deposits consisting of dark reddish gray silty sand (SM) with gravel-size clasts of sandstone were observed to the maximum depth of the test pit at 4 feet bgs. The material was dense, had a blocky texture, and had clay development in the upper 2 to 3 feet. Test pit logs completed by others indicated the depth of soil/terrace deposits in this area ranged from 8 to 12 feet bgs (Geolabs, 1978).

Test pit TP-6 was excavated in the existing view platform at the top of the West Sea Level stairs. Fill materials consisting of brown to dark gray to black silty sand (SM) to clayey sand (SC) with fragments of sandstone was encountered to a depth of 3.2 feet, the maximum depth of the trench. A steel rail, wood fragments, and a metal spike were encountered on the south side of the trench at a depth of 1.4 feet bgs. The rail trended parallel to the beach. The test pit was terminated due to difficulty in excavating the materials by hand. Based on our observations, the base of the existing retaining wall for the West Sea Level stairs appears to be founded on bedrock (approximately elevation 25 msl) indicating the depth of the fill in this area is approximately 8 to10 feet thick.

Based on previous boring log information by others (Borings B-8 and B-9, Strata-tech, 1992), we expect the depth to bedrock at beach level to be approximately 10 to 15 feet (approximately 1 to -6 feet msl). Boring logs by others also indicate that an approximate 2- to 4-foot thick layer of gravels and cobbles overlies the bedrock on Lot 155. The cobbles and boulders are seasonally covered by beach sand.

In addition, three tripod borings (Tripod-1 through Tripod-3) were drilled to explore the subsurface conditions in the area of the proposed disabled parking spaces designated “D and DD”. Undocumented fill was encountered in Borings Tripod-1 and Tripod-3 to depths of approximately 1 and 3 feet, respectively. The fill in Boring Tripod-1 consists of sandy lean clay, and the fill in Boring Tripod-3 mostly consists of sandy silt. The native soils in all three borings consist of sandy lean clay, which extends to a depth of approximately 4.5 to 5.0 feet. The underlying soil consists of clayey sand to a depth of approximately 6.5 to 7.0 feet. Finally, refusal was encountered in Borings Tripod-2 and Tripod-3 at depths of approximately 8.0 and 7.5 feet, respectively. Based on the samples collected at the refusal depths, the material consists of clayey sand with abundant gravel-sized fragments of siltstone and sandstone interpreted to be weathered terrace deposits.

6.3 GROUNDWATER CONDITIONS

No groundwater or seeps were observed in the test pits, except for, TP-3 which was excavated at the base of the West Sea Level stairs (Figure 2). The water observed in test pit TP-3 was likely related to tidal fluctuation as test pit TP-3 was excavated during low tide.

Groundwater was not encountered in the tripod borings, and no seeps were observed along the exposed bluff at the time of the field exploration programs. Based on our review of geotechnical reports for nearby sites, groundwater may be locally present within the terrace deposits, and primarily along the terrace/bedrock contact. As reported by the California Division of Mines and Geology (CDMG), the historical-high depth to groundwater along the beach is anticipated to be no more than five feet bgs (CDMG, 2001).

6.4 SLOPES

Most of the slopes along Lechuza Beach are covered with surficial soils and/or slope wash that is several inches to several feet thick. The surficial soils and/or slope wash are underlain by terrace deposits and/or bedrock. No landslides were observed within the study area at the time of our investigation. Small surficial failures/slumps were present in the shallow soil/terrace deposits at various locations along the bluff, including adjacent to the existing retaining wall located on the pathway mid-way down the Lot I stairs at East Sea Level and along the top of the slope for the proposed viewing area for Lot 156 at West Sea Level (Figures 2 and 3).

Bluff retreat is an on-going process that has been documented for the study area. A review of aerial photographs from 1928, 1975, and 2002 indicates there has not been significant erosion of the bluffs. However, an erosion study was not conducted as part of this investigation and the rate of bluff retreat in the study area is unknown. The cause and rate of bluff retreat is dependent on varying factors including geologic materials, groundwater, surface water, wave action, and seismic events. The CGS has delineated the bluff areas as prone to seismically induced landsliding (CDMG, 2001). The surficial failures observed appear to be primarily related to surface water runoff eroding the terrace deposits and weathered bedrock. This process can be reduced by providing adequate site-draining-control including eliminating surface runoff over the bluff face. Based on our document review and observation of the slopes within the proposed improvement areas, it appears the slopes are grossly stable.

7.0 ENGINEERING PROPERTIES

The main engineering property required for our geotechnical analyses is the effective shear strength (i.e., friction angle and cohesion) of the surficial soil, terrace deposits, bedrock, and engineered fill. The engineering properties of the undocumented fill are not required for reasons that are described in the General Recommendations (Section 9.0). Shear strength values were estimated based on the results of previous laboratory test results presented in geotechnical reports by others, AMEC laboratory test results, and our engineering judgment and assumptions.

Direct shear tests were performed on three relatively undisturbed samples of terrace deposits collected from Borings Tripod-2 and Tripod-3. Two direct shear tests (with three points per test) were performed on the upper sandy lean clay, and one test (also with three points) was performed on the underlying clayey sand. The direct shear test results indicate that large displacement friction angles and cohesion values of the sandy lean clay range from 30 to 36 degrees, and 115 to 162 psf, respectively. The results of a direct shear test on the clayey sand indicate that the large displacement friction angle and cohesion values are 43 degrees, and 90 psf, respectively.

Based on our experience with similar soil conditions, we expect the terrace deposits to have a minimum friction angle and cohesion of approximately 30 degrees and 50 pounds per square foot (psf), respectively.

A direct shear test was conducted on a bedrock sample collected from Lot 155 (31840 Sea Level Drive), and the results indicate the friction angle and cohesion values are approximately 40 degrees and 800 psf, respectively (West Coast Soils, 1991). Failures within the weaker sections of rock are expected to be blocky in nature and occur along discontinuities. Conservatively, the bedrock was assumed to have minimum friction angle of 40 degrees and cohesion of 800 psf.

Based on our experience, a friction angle and cohesion of 34 degrees and 100 psf, respectively, is appropriate for an engineered fill consisting of silty or clayey sand.

8.0 GEOTECHNICAL ISSUES

The following discussion of geotechnical issues is based on the data review and field exploration performed for this project.

8.1 WAVE RUNUP AND EROSION

As outlined in the Coastal Hazard and Wave Runup Study prepared for MRCA (GeoSoils, 2007), stairway landings will be subject to wave runup as high as elevation +16 feet National Geodetic Vertical Datum of 1929. Additionally, the 25-year recurrence vertical scour is 10 feet, and therefore, the beach can be scoured down to bedrock. Based on these recommendations, significant beach erosion and sand loss is expected to occur during a major storm event. There is significant potential for this erosion to result in displacements beyond tolerable limits within the beach sand, and possibly the undocumented fill. These movements are expected to adversely impact the proposed improvements. The recommendations provided in this report are designed to help mitigate the effects of beach erosion and scour as a result of wave runup.

8.2 EXISTING UNDOCUMENTED FILL

Existing undocumented fill was encountered in test pits excavated in areas of both East and West Sea Level Drive improvements (TP-1, TP-2 and TP-6). Also, the presence of undocumented fill is corroborated by previous boring log information by others for nearby properties. The fill is random in nature and contains deleterious material in some areas. The fill is considered to be prone to settlement and soil creep along the slopes.

8.3 SLOPE STABILITY

It should be anticipated that localized failures may occur within the weaker and more weathered sections of rock. Also, other localized failures may occur along the steeper sections of slope, particularly in areas of thick soil, slope wash, or fills with uncontrolled surface water runoff. We understand that MRCA does not own or have easements for all of the properties, and as a result, mitigation against these hazards can only be performed in the areas that are owned/maintained by MRCA. The proposed retaining walls should not be expected to reduce the potential for localized failures to occur along sections of slopes that are outside the MRCA property boundaries.

As referenced in Section 4.3, an evaluation of the steep slopes was performed by AMEC for the proposed disabled parking spaces “D” and “DD” located at West Sea Level Drive. Results of the quantitative slope stability analyses are discussed in our report dated July 10, 2012. The results of these analyses should not be extrapolated to other areas of the project. Erosion of the terrace deposits, which is associated with bluff retreat, is an ongoing process, and will result in a reduced stability in the future. Failures within the terrace deposits are expected to be episodic, and occur during periods of heavy rainfall.

Slope stability analyses were performed at the East Sea Level area by G.C. Masterman Associates, Inc. (1993) and Robert Stone & Associates, Inc. (1986) for lots adjacent to the proposed improvements. These consultants conducted laboratory shear strength testing of the site soils including fill soils, terrace deposits and sandstone bedrock, and performed stability analyses for critical slopes at the respective lots they were investigating. The consultants found the slopes analyzed to be grossly stable with a factor of safety against slope instability greater than 1.5. Based on the review of the analyses performed, the shear strength parameters and geologic cross sections used in the analyses appear to be reasonable. Therefore, AMEC performed a stability analysis of the slopes ascending above the proposed restroom area at the East Sea Level by adapting the shear strength parameters from these investigations. AMEC also reviewed the elevations of contacts between geologic units from Harley Tucker Incorporated (1993), a geologic investigation of the lot that is above the restroom area. The geologic contacts were adjusted based on our observations in the field of geologic features, including rock outcrops. Based on our review and analyses, the slopes ascending behind the proposed restroom area at East Sea Level appear to exhibit a factor of safety against slope instability greater than 1.5, and are considered grossly stable. The results of our analysis are included in Appendix E.

8.4 SEISMIC CONSIDERATIONS

Based on our knowledge of the area as well as the Seismic Hazard Zone Report for the Point Dume Quadrangle (CDMG, 2001), a qualitative discussion of the expected hazards is provided in the following subsections.

8.4.1 CBC Seismic Design Parameters

A site-specific probabilistic seismic hazard analysis (PSHA) was not in the scope of the current investigation. The following seismic design parameters for the project were developed in accordance with 2010 California Building Code (CBC 2010), based on mapped spectral acceleration parameters in the CBC, and the site conditions:

- Mapped spectral accelerations for short periods S_S: 2.30 g
- Mapped spectral accelerations for a 1-s period S_1: 0.94 g
- Site Class: C
- Site Coefficient F_a: 1.0
- Site Coefficient F_v: 1.3
- Adjusted MCE spectral acceleration for short periods $S_{MS}= F_aS_S = 2.30$ g
- Adjusted MCE spectral acceleration for a 1-s period $S_{M1}= F_vS_1 = 1.22$ g
- Five-percent damped design spectral response acceleration at short periods S_{DS}: 1.53 g
- Five-percent damped design spectral response acceleration at 1-second period S_{D1}: 0.81 g
- Long-period transition period T_L: 8 seconds

8.4.2 Surface Fault Rupture

As there are no known active or potentially active faults beneath the site, the risk of surface fault rupture is considered remote.

8.4.3 Seismically-Induced Displacements

There is the potential for liquefaction to occur in the saturated beach sands during an earthquake, and this could result in lateral spreading of slopes that are underlain by these deposits. We expect that, in addition to the (East and West Sea Levels) beach areas, the slopes along the outboard edge of East Sea Level Drive and the slopes adjacent to the East Sea Level view platform will be prone to significant displacements due to liquefaction and lateral spreading. Additionally, there is potential for displacements to occur in dry (unsaturated) sands as a result of ground shaking. With the exception of the East Sea Level parking spaces, we do not expect these hazards to adversely affect the proposed improvements, provided the foundation recommendations presented herein are adhered to. A discussion of the potential impact due to liquefaction and lateral spreading on the parking spaces is provided in Section 9.1.4.

9.0 GENERAL RECOMMENDATIONS

Based on the results of our limited investigation, the proposed Lechuza Beach improvements are considered geotechnically feasible provided the recommendations presented herein are incorporated into the design and construction. As such, the project site is suitable for the proposed development, the development will be safe from geologic hazard, and the development will not contribute to instability on or off the subject site. If changes in the design of the structures are made, or variations or changed conditions are encountered during construction, AMEC should be contacted to evaluate their effects on these recommendations.

A major factor for the construction of this project will be limited/difficult access to construction equipment. Current access restrictions have already limited collection of relevant geotechnical data to support the design of the various structures. As such, some of the recommendations provided herein should be considered preliminary. The recommendations should be reevaluated by conducting additional field exploration once access to the beach and neighboring properties is granted to motorized equipment.

9.1 EAST SEA LEVEL IMPROVEMENTS

A discussion of the geotechnical design issues as well as general recommendations for the East Sea Level improvements are provided in the following subsections.

9.1.1 Lot I Staircase and Pathway

The existing Lot I staircase and pathway improvements are expected to extend from the intersection of Bunnie Lane and Broad Beach Road to the terminus of East Sea Level Drive at the beach. The proposed concrete pad footings associated with the staircase may be prone to differential settlement and soil creep if they are supported on existing undocumented fill and/or slope wash.

The proposed structurally connected concrete pad footings, as shown on Figure A-5, are suitable provided that there is adequate bearing capacity and the pad footings are underlain by either undisturbed terrace deposits or engineered fill. If encountered, undocumented fill or slope wash should be removed and replaced with engineered fill. If terrace deposits are encountered, the upper one foot should be scarified, moisture conditioned, and recompacted as an engineered fill.

9.1.2 New Beach Access Stairs, Public Staging Area and View Platform

New beach access stairs, a public staging area, and a new view platform would be constructed near the south (beachward) end of Lot I, and the new stairs would extend down to the beach (Figure A-6). A septic holding tank is also planned beneath the Public Staging Area and, based on the conceptual drawing (Figure A-6), the top of the tank will be at Elevation 16 with its lower portion extending into bedrock. The findings of a wave runup study completed by GeoSoils, Inc. (2007) indicate there is significant potential for erosion and scour to impact these improvements. Additionally, there is the potential for significant displacements to occur in the event of an earthquake as a result of liquefaction and lateral spreading.

We recommend the proposed improvements be supported on cast-in-drilled hole (CIDH) piles embedded into bedrock. Due to the potential for large static and seismically-induced displacements, slab-on-grade construction is not recommended. We recommend the view platform be designed as either a reinforced concrete structural slab, wooden deck platform, or other type of floor supported directly on piles. If a concrete slab is selected, slab thickness and reinforcement would need to be determined by the structural engineer. Pile design recommendations are provided in Section 10.1. The septic tank should also be “anchored’ into rock to keep it in place and protected from wave uprush. MRCA has discussed possibly surrounding the tank with robust retaining walls or placing the tank behind the existing rip rap to resist the wave actions and reduce potential for sewage spills. To be effective, the walls should extend into rock or, at a minimum, below the depth of scour. If the tank is not founded into rock, design measures should be implemented to prevent washing away of the soil supporting the tank.

9.1.3 New Restroom and Access Walkway

The construction of the new restroom and access walkway to the restroom will require the construction of retaining walls. The new restroom and access walkway would be located along a relatively steep portion of the coastal bluff, and the retaining walls shown on Section A-A (Figure A-6) depict wall heights up to approximately 10 feet. The inclination of the slope in the area of the wall is currently in the order of 1:1 (horizontal:vertical) up to approximate Elevation 29. The slope inclination above approximate Elevation 29 feet is about 2:1 (H:V).

Also, the plans indicate the adjacent northern property boundary is only 3 feet away from the restroom wall and within about 1 foot of the access walkway wall.

Due to the close proximity of the retaining walls in relation to the northern property boundary, we expect shoring will be required during construction. Similar to the improvements described in Section 9.1.2, the restroom and adjacent view platform structure, including the retaining walls, should be supported on CIDH piles embedded into bedrock. We understand MRCA is considering using a soldier pile wall in place of the proposed retaining wall. A permanent soldier pile wall could be constructed in place of the retaining wall as long as the piles extend into bedrock as previously recommended. However, if the soldier pile wall is selected the cantilevered portion of the wall will be subject to lateral deflection and the structural engineer will need to verify such displacements are tolerable.

9.1.4 Parking Spaces

Two new disabled parking spaces (8 and 11) may be constructed along existing East Sea Level Drive (Figure A-3). The parking spaces would be constructed with accompanying access aisles and paths leading to the new view platform and/or new stairs. The proposed parking spaces and pathway may be prone to static settlement if underlain by undocumented fill, differential movement due to erosion/scour, and possibly seismic displacements due to liquefaction and lateral spreading. The intent of the recommendations in this report is not to mitigate the effects of these hazards for the parking areas as it would not be cost effective for the design and construction of the project. It should be expected that the parking spaces may need to be repaired following a storm or earthquake. However, we recommend subgrade preparation beneath parking spaces. Aggregate base is not required for unpaved parking spaces; however, a gravel base could facilitate using the spaces during wet weather conditions.

9.2 West Sea Level Improvements

A discussion of the geotechnical design issues as well as general recommendations for the West Sea Level improvements are provided in the following sections.

9.2.1 Beach Access Stairs

It is our understanding that the existing stairs that extend from the new view platform to the beach will be reconstructed as shown on Figure A-2. Similarly to the East Sea Level improvements, we recommend that the new stairs along the beach be supported on CIDH piles embedded into bedrock.

9.2.2 View Platform

The existing view platform retaining walls will be reconstructed as shown on Figure A-2. To limit settlement in the view platform area, we recommend that the existing undocumented fill be removed and replaced with engineered fill. The existing fill may be suitable for reuse provided all debris, deleterious material, and any oversize particles are removed. The proposed reconstructed retaining wall for the existing view platform should be supported on footings that are embedded into bedrock. Based on the exposed outcrops, we expect the bedrock to be very close to the foundation level of the wall.

9.2.3 Parking Spaces D and DD

The primary geotechnical issue associated with the construction of parking spaces “D” and “DD” is the potential for slope instability along the adjacent bluff. The results of our slope stability analyses are presented in our previous report. Another geotechnical issue is the presence of undocumented fill. If feasible, all undocumented fill beneath the proposed unpaved and new pavement areas should be removed and recompacted as an engineered fill. In addition, native soil should be recompacted as an engineered fill, if feasible.

10.0 DESIGN RECOMMENDATIONS

Design recommendations for the East and West Sea Level improvements are provided in the following sections.

10.1 EAST SEA LEVEL IMPROVEMENTS

The, new beach access stairs, new public staging area, new restroom, and new view platform should be supported on CIDH piles. The Lot I staircase and pathway may be supported on reinforced concrete pad footings.

10.1.1 Beach Access Stairs, View Platform, Public Staging Area, and Restroom and Access Walkway

The beach access stairs, view platform, public staging area, and restroom and access walkway should be founded on drilled cast-in-place piles designed for the following criteria:

1. Minimum pile embedment should be at least 3 feet into bedrock, and minimum pile size should be 18 inches in diameter. Actual pile sizes and depths will also depend on the required lateral capacity.

2. Allowable passive pressures will depend on the location of the structures being supported by the piles. More specifically, the passive resistance should be reduced if the pile is to be installed on a slope or adjacent to a slope. Based on the conceptual drawing (Figure A-6), piles for the public staging area and for the view platform may be significantly offset from the bedrock slope face whereas for the restroom area, these piles may be directly adjacent to the bedrock slope (assumed

to be at an inclination of 2:1). As such, allowable bearing pressures of 550 psf per foot of depth may be considered as acting over a plane equivalent to one pile diameter for piles in the public staging area and the view platform area. The allowable passive resistance should be reduced to 240 psf per foot of depth for piles in the restroom area. The contribution to passive resistance from all soil above the bedrock should be neglected. A safety factor of 3.0 has been incorporated in development of allowable passive pressures.

3. The allowable axial bearing capacity for a CIDH pile embedded at least 3 feet into bedrock is 1,400xD (psf), where D is the depth of the pile in feet measured from the top of bedrock elevation. The maximum end bearing capacity is limited to 8,000 psf. A one-third increase for wind or seismic loading may be used in the design. A safety factor of 3.0 has been incorporated in the allowable bearing capacity.

4. The allowable pullout resistance for a drilled CIDH pile embedded at least 3 feet into bedrock is given by $14xD^2xd$ (pounds) where D is the depth of the pile in feet measured from the top of bedrock elevation, and d is the pile diameter. The weight of the pile may be added to this force. For the maximum pullout resistance, D is limited to 20xd.

5. Piles should contain steel reinforcement as determined by the project structural engineer.

The piles should be constructed in accordance with the following criteria:

1. All pile holes should be free of loose material on the bottom.

2. The soils along the beach consist of loose beach sand. It should be anticipated that the piles will need to be cased during drilling and that the concrete will have to be placed through a tremie, particularly if groundwater is present in the drilled hole. For concrete tremie placement, the end of the tube should remain embedded a minimum of 5 feet into the concrete at all times. During the concrete pour, casing should be pulled slowly with a minimum of 5 feet of casing remaining embedded within the concrete at all times.

3. The bedrock is relatively hard and intact. Therefore, it should be anticipated that difficult drilling conditions may be encountered in the bedrock. Difficult drilling conditions should also be expected along the beach due to rip rap and/or boulders.

10.1.2 Lot I Staircase and Pathway

The Lot I staircase and pathway may be supported on structurally connected concrete pad footings that are underlain by at least one foot of engineered fill. Slope wash and/or undocumented fill, if encountered, should be removed and replaced with engineered fill. The footings should be embedded a minimum of one foot below lowest adjacent grade. Footings may be designed using an allowable (net) bearing capacity of 1,500 psf. An additional 500 psf may be added for each 6-inch increase greater than 24 inches up to a maximum of 3,500 psf.

The maximum allowable bearing capacities presented above are based on the assumed engineering properties described in Section 7.0. A safety factor of 3.0 was incorporated in the bearing values, which were also adjusted in order to limit total settlement to less than 1 inch. The allowable bearing value applies to combined dead and sustained live loads. The allowable bearing pressure may be increased by one-third when considering transient live loads, including seismic and wind forces.

Based on the allowable bearing value recommended above, total settlement of the footings are anticipated to be less than one inch, provided foundation preparations conform to the recommendations described in this report.

Since the embedment depth of the pad footings is expected to be relatively shallow, lateral load resistance will be developed by friction only, which acts at the base of the footing. An allowable coefficient of friction of 0.35 may be used for dead and sustained live load forces to compute the frictional resistance of footings constructed directly on compacted fill. Safety factors of 2.0 and 1.5 have been incorporated in development of allowable passive and frictional resistance values, respectively. Under seismic and wind loading conditions, the passive pressure and frictional resistance may be increased by one-third.

10.2 WEST SEA LEVEL IMPROVEMENTS

The reconstructed beach access stairs may be supported on CIDH piles embedded into bedrock while the new view platform retaining walls may be supported on continuous footings embedded into bedrock.

10.2.1 Beach Access Stairs

The beach stairs should be designed and constructed with the recommendations provided in Section 10.1.

10.2.2 View Platform

The reconstructed view platform retaining wall foundations should consist of continuous spread footings that are a minimum of 24 inches wide. Footings situated along or adjacent to slopes should be embedded to a depth that allows for a minimum horizontal distance of H/3 from the outboard edge of the footing to the face of the slope, where H is the height of the slope (CBC, 2010). The minimum footing depth should be the greater of either: 18 inches measured from the lowest adjacent grade, or the minimum depth required to achieve a horizontal distance of H/3 from the outboard edge of the footing to the face of the slope. Continuous spread footings which are placed on bedrock may be designed using an allowable (net) bearing capacity of 5,000 psf. It should be expected that difficult excavation conditions may be encountered in the bedrock.

Lateral load resistance for the continuous spread footings will be developed by passive soil pressure against the sides of footings below grade and by friction acting at the base of the concrete footings bearing on bedrock. For continuous footings embedded into bedrock (west view platform), an allowable passive pressure of 275 psf per foot of depth may be used for design purposes. Neglect passive pressure in the upper foot. An allowable coefficient of friction of 0.40 may be used for dead and sustained live load forces to compute the frictional resistance of footings constructed directly on bedrock. Safety factors of 2.0 and 1.5 have been incorporated in development of allowable passive and frictional resistance values, respectively. Under seismic and wind loading conditions, the passive pressure and frictional resistance may be increased by one-third.

10.3 RETAINING WALLS

Both the East and West Sea Level retaining walls should be designed and constructed in accordance with the following recommendations.

10.3.1 Lateral Earth Pressures

Retaining walls should be designed to withstand "active" or at-rest earth pressures depending on whether active or at-rest conditions are determined by the structural engineer. The magnitude of the lateral earth pressures will also depend on whether horizontal or sloping ground conditions exist above the retaining walls. For horizontal ground conditions behind the retaining wall (inclination of 5:1 or flatter), an equivalent fluid pressure load of 40 pounds per cubic foot (pcf) for active and 60 pcf for at-rest conditions should be used for design. For sloping ground conditions (assumed to be 2:1 inclination), the recommended lateral earth pressure values should be increased to 64 and 96 pcf, respectively for active and at-rest conditions. The lateral pressures also assume drained conditions behind the wall. These pressures were estimated assuming the walls will be retaining fill materials or terrace deposits. These pressures may be refined following additional investigation.

We expect that view platform retaining walls, particularly the West Sea Level wall, will be subjected to surcharge loads. Surcharge loads (live or dead) should be added to the lateral earth pressures above by applying a uniform (rectangular) pressure. Lateral earth pressure coefficients for a uniform vertical surcharge load applied behind walls are 0.3 for active (cantilever wall) conditions. Surcharge pressures due to concentrated loads should be evaluated after geometric constraints and loading conditions are determined.

Seismically induced earth pressures, in addition to static earth pressures, have been calculated based on a horizontal acceleration equal to one-half the PGA, which is approximately 0.61g. Based on these results, the recommended seismically induced earth pressure increment is 15H where H is the height of the wall in feet. The pressures induced by this additional force can be approximated by a uniform distribution along the height of the wall.

10.3.2 Wall Backfill and Drainage

Wall backfill should be protected against infiltration of surface water. Backfill adjacent to walls should be sloped so that surface water drains freely away from the wall and will not pond.

The design earth pressures were also developed assuming that no buildup of hydrostatic pressure occurs behind the walls. To prevent hydrostatic pressures a subsurface drainage system should be installed behind the walls. For walls that are at least 3 feet high and have exposed soil backfill, the subsurface drainage system should consist of granular filter material and a perforated subdrain pipe. A 12-inch-thick layer of filter material should be placed against the wall and extended up to approximately 12 inches below the backfill surface. The filter material should be a clean, well-graded mixture of sand and gravel meeting the following grading requirements:

Sieve Size	Percentage Passing Sieve
1 inch (")	100
¾"	90-100
⅜"	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

An alternative to graded filter material is to use clean gravel (¾-inch size) with a geotextile placed between the gravel and backfill soil. The geotextile should be Mirafi 140NC or similar material.

The perforated subdrain pipe should be installed within the filter material near the bottom of the wall (below the elevation of adjacent floor slabs, if present). The pipe should be at least 4 inches in diameter and be placed with the perforations downward. The pipe should be surrounded with granular material. The subdrain pipe should lead to a free discharge outlet.

10.4 EARTHWORK

All earthwork, including excavation, backfill and preparation of subgrade, should be performed in accordance with the geotechnical recommendations presented in this report and applicable portions of the grading code of local regulatory agencies. All earthwork should be performed under the observation and testing of a qualified geotechnical engineer.

The initial site preparation for the reconstructed improvements will involve the removal of the existing stairs and retaining walls. These materials should be removed from the planned construction area and hauled to a suitable disposal area. All active and inactive underground utilities should be removed or relocated. Any excavations resulting from the removal of underground utilities or old foundations should be backfilled with properly compacted soil.

The construction area should be cleared of any vegetation and stripped of miscellaneous debris and other deleterious material. Organic matter and other material that may interfere with the completion of the work should be removed from the limits of the construction area. Large roots from trees, if any, should be removed to a depth of at least 3 feet below finished grade. Vegetation, debris, and organic matter should not be incorporated into engineered fill. Organic rich soil may be stockpiled for future landscaping.

As mentioned, the site soils are expected to consist of either undocumented fill, terrace deposits, and/or bedrock. The excavation and recompaction in both the new slab areas and unpaved parking spaces should, as a minimum, consist of 12 inches of recompacted subgrade unless this conflicts with underground utilities or contributes to bluff destabilization. In such cases, the geotechnical engineer should be consulted for alternate solutions. Recompacted sections should extend at least 2 feet beyond all paved parking spaces.

All trenches and excavations should conform to the current California Occupational Safety and Health Administration requirements for work safety. In addition, excavations should be located so that no structures existing at the time of construction are located above a plane projected 45 degrees upward from any point in an excavation.

10.5 BACKFILL AND COMPACTION REQUIREMENTS

The existing fill may be suitable for reuse as engineered fill provided that it meets the criteria listed below.

Engineered fill material should be free of organic material, debris, and other deleterious substances, and not contain fragments greater than 3 inches in maximum dimension and have an Expansion Index less than 40. Highly pervious materials, such as sand, are not recommended for utility trench backfill.

All fill and backfill materials should be placed in uniform lifts not exceeding 8 inches in uncompacted thickness. Each lift should be brought to uniform moisture content prior to compacting by either spraying the soil with water if it is too dry or aerating the material if it is too wet. The existing fill and imported fill materials should be moisture-conditioned to within two percent above optimum moisture content. Clayey soil, if left-in-place, should be moisture-conditioned to within three percent above optimum moisture content. Fill should be compacted to the following degree of compaction, as determined by ASTM Test Method D 1557 (latest edition):

Fill Location	Degree of Compaction
General engineered fill	90
Utility trench backfill	90
Aggregate base and subgrade beneath pavements (upper 12 inches)	95

Grading operations during the wet season or in areas where the materials are saturated may require special provisions for drying of soil prior to compaction.

10.5.1 Utilities

Utility backfill should be placed and compacted in accordance with the recommendations provided in section 10.5. Compaction of trench backfill should be by mechanical means; jetting or flooding is not recommended.

10.5.2 Drainage

The control of surface drainage and landscape irrigation is critical to the long-term stability of the slopes. Uncontrolled surface drainage and landscape irrigation could accelerate erosion and slope retreat at the site. Surface water should not be allowed to drain over the top of slope face. Discharge outlets should be located in areas where the potential for the discharged water to erode slopes is minimal.

Final grades and pavements should be sloped to direct surface water away from retaining wall foundations and slabs and toward suitable discharge facilities. Ponding of surface water should not be allowed anywhere on site. The contractor should implement drainage provisions during construction to divert rain and construction water away from open excavations.

11.0 CONSTRUCTION CONSIDERATIONS

The following paragraphs discuss key considerations during construction of the East and West Sea Level improvements.

11.1 EXCAVATION DIFFICULTY

Based on our field exploration program, earthwork may be performed with conventional construction equipment. However, drilling and excavation of the bedrock may be locally difficult. For drilled pile installation, the contractor should be prepared to provide adequate rock coring bucket when necessary. Difficult drilling/excavation conditions should also be expected in areas where boulders and/or rip rap are present.

11.2 TEMPORARY DEWATERING

It is our understanding that groundwater may be encountered below Elevation 4. Therefore, as needed, the contractor should be prepared to provide temporary dewatering of excavations.

11.3 TEMPORARY CONSTRUCTION SLOPES

Excavations should be conducted so that slope failure and excessive ground movement are prevented from occurring during construction. The short-term stability of excavations depends on factors that include slope angle, engineering characteristics of the subsurface soils, height of the excavation, and length of time the excavation remains unsupported and exposed to equipment vibrations, rainfall, and desiccation.

In general, unsupported slopes for temporary construction excavations should not be expected to stand at an inclination steeper than the angle of repose for sand, i.e., corresponding to a gradient on the order of 2:1 (horizontal: vertical) in beach sand; 1:5:1 for terrace deposits, and 1:1 for bedrock. These slope inclinations may be adjusted based on actual conditions in the construction areas.

Surcharge loads from vehicle parking and travel lanes or stockpiled materials should be kept away from the top of temporary excavations a horizontal distance equal to at least one-half the depth of excavation. Surface drainage should be controlled along the top of temporary excavations to preclude wetting of the soils and erosion of the excavation faces. Even with the implementation of the above recommendations, sloughing of the surface of the temporary excavations may still occur, and workmen should be adequately protected from such sloughing.

Where there is insufficient space for sloped excavations, shoring should be used to support excavations.

11.4 TEMPORARY SHORING

Where there is insufficient space for sloped excavations and existing structures, have to be protected in place, or when excavation is limited by property boundaries, shoring may be used to support excavations. Cantilever or braced shoring may be considered. Cantilevered shoring can be utilized where some deflection is acceptable. However, where shoring will support adjacent improvements or facilities and excessive deflection can lead to settlement, braced shoring should be utilized.

11.5 POST INVESTIGATION SERVICES

It is recommended that final project plans and specifications be reviewed by AMEC to determine the extent that the recommendations presented herein have been properly interpreted and incorporated into the contract documents. Following review of plans and specifications, observation and testing should be performed by the Geotechnical Engineer during demolition and construction to confirm that foundation and shoring elements are founded on and penetrate the recommended soils, and that suitable backfill soils are placed upon competent materials and properly compacted at the recommended moisture content.

12.0 CLOSURE

The conclusions, recommendations, and opinions presented herein are: (1) based upon our evaluation and interpretation of the limited data obtained from our field program; (2) based upon an interpolation of soil conditions between and beyond the test pits and borings; (3) are subject to confirmation of the actual conditions encountered during construction; and, (4) are based upon the assumption that sufficient observation and testing will be provided during construction.

If parties other than AMEC are engaged to provide construction geotechnical services, they must be notified that they will be required to assume complete responsibility for the geotechnical phase of the project by concurring with the findings and recommendations in this report or providing alternate recommendations.

If pertinent changes are made in the project plans or conditions are encountered during construction that appear to be different than indicated in this report, please contact this office. Significant variations may necessitate a re-evaluation of the recommendations presented in this report.

13.0 REFERENCES

AMEC Environment and Infrastructure, 2012, Results of Slope Stability Analyses, Proposed Parking Space "D", Lechuza Beach Public and ADA Access – West Sea Level Drive, Malibu, California, July 10, Project No. 10978.000.0.

California Divison of Mines and Geology (CDMG), 2001, Seismic Hazard Zone Report for the Point Dume 7.5-Minute Quadrangle, Los Angeles and Ventura Counties, California, Seismic Hazard Zone Report 056.

California Building Code, 2010

G.C. Masterman & Associates, Inc., 1993, Soils Engineering Investigation, Proposed Guest House and Swimming Pool, 31736 Broadbeach Road, Malibu, California, M2488, November 10.

Geolabs-Westlake Village Foundation and Soils Engineering Geology, 1978, Geotechnical Investigation, Lot 157 and Adjacent Portion of Lot A, Tract 10630, 31834 Sea Level Drive, Malibu, California, Project No. 5725, March 17.

GeoSoils, Inc., 2007, Coastal Hazard and Wave Runup Study, Beach Access Improvements, Lechuza Beach, Malibu, California, August 3.

Harley Tucker Incorporated, 1993, Report of Limited Engineering Geologic Investigation and Seismicity Study, Proposed Guesthouse and Swimming Pool, 31736 Broadbeach Road, City of Malibu, California, Proj. No. 7030-1.93, November 4.

Kovacs-Byer-Robertson, Inc., 1979, Geologic and Soils Engineering Investigation, Proposed Single Family Residence, Portions of Lots 20 and 87, Tract 10670, 31712 Broad Beach Road, Malibu, Los Angeles County, California, Project No. M005-G, February 2.

Kovacs-Byer-Robertson, Inc., 1980, Geologic and Soils Engineering Investigation, Proposed Single Family Residence, Lot 63 and Portions of Lots 61 and 62, Seafield Drive, Malibu, California, Project No. M252-G, November 7.

Robert Stone & Associates, Inc., 1986, Geotechnical Investigation, Proposed Residence, 31725 Sea Level Drive, Trancas Area, Malibu, Los Angeles County, California, Job No.: 3068-00, July 30.

Strata-Tech Geotechnical Consultants, 1992, Geotechnical Engineering Investigations of Liquefaction Potential, Lots 140-156, Tract 10630 Sea Level Drive, Malibu, California, Project No. 31690-B, October 4.

West Coast Soils, 1991, Geotechnical Engineering Report, Proposed Residential Development, Lot 155 East, Tract 10630, Vicinity of 31840 Sea Level Drive, Malibu, Project No. 2507-91, March 12.

United States Geologic Survey, 2008, Interactive Deaggregations (http://eqint.cr.usgs.gov/deaggint/2008/index.php).

FIGURES

Explanation

Tripod-3 ◉ Tripod boring location and designation (AMEC, 2012)

TP-6 Test pit location and designation (AMEC, 2008)

B-9 ⊕ Boring location and designation (Strata-Tech, 1992)

Approximate area of proposed improvements

Parcel line and lot number

Notes:

1. Boring and test pit locations are approximate.
2. Test pits were excavated using hand-held equipment and generator operated shovels. Excavated materials were used for backfill and compacted manually.

Approximate Scale in Feet: 0, 50, 100

Approximate Scale in Meters: 0, 15, 30

SITE MAP SHOWING
IMPROVEMENT AREAS AND
FIELD EXPLORATION LOCATION MAP
Lechuza Beach Public Access Improvements
Malibu, California

By: pah/jbd	Date:12/06/2013	Project No: 10978.000.0
amec		Figure 1

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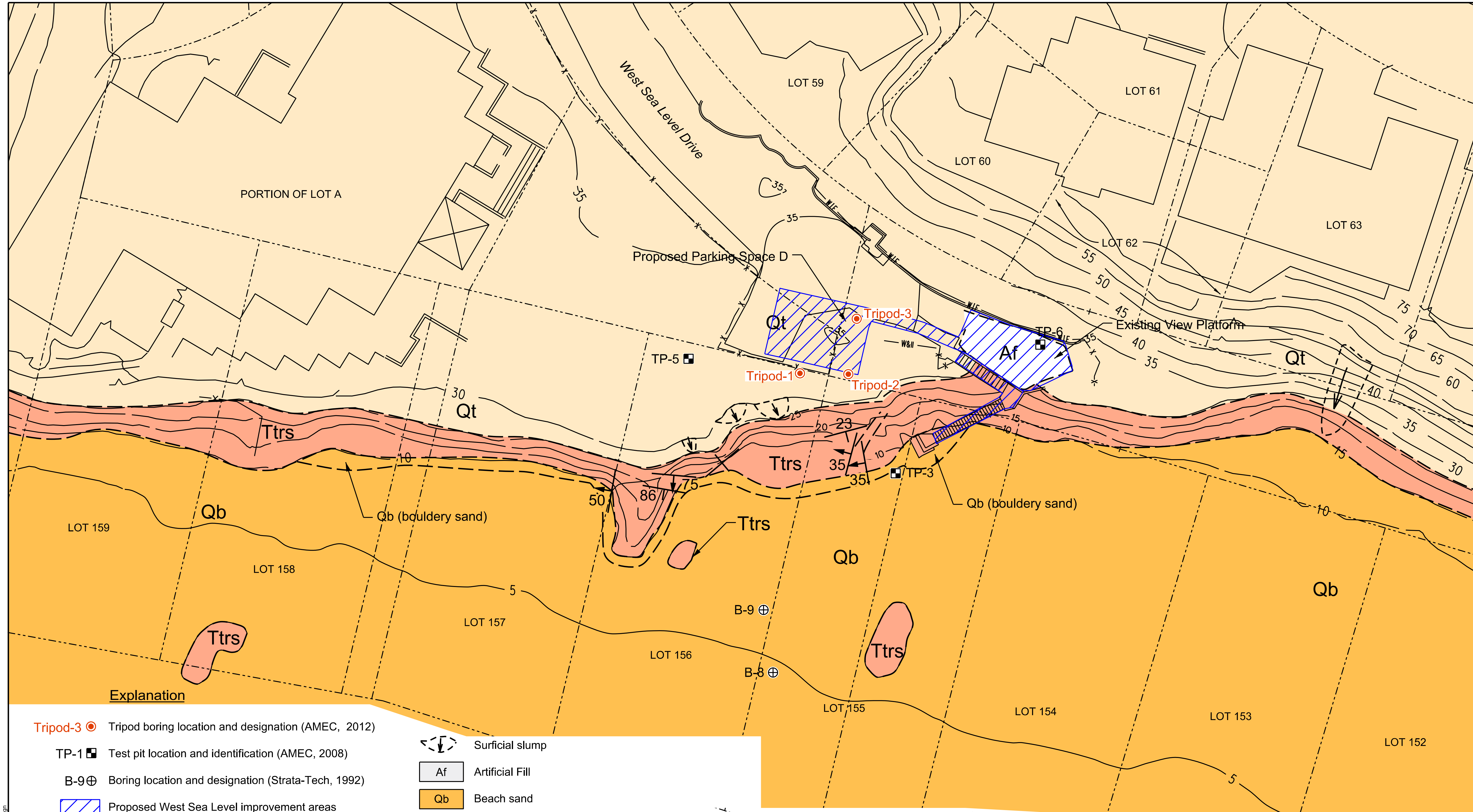


Explanation

Tripod-3 Tripod boring location and designation (AMEC, 2012)

TP-1 Test pit location and identification (AMEC, 2008)

B-9 Boring location and designation (Strata-Tech, 1992)

Proposed West Sea Level improvement areas

23 Bedding strke and dip

50 Fault or shear strike and dip

Vertical fault or shear

Bedding contact, dashed where approximate

Fault contact, dashed where approximate

Surficial slump

Af Artificial Fill

Qb Beach sand

Qt Terrace Deposits

Ttrs Sandstone bedrock (Trancas Formation)

Notes:

1. Boring and test pit locations are approximate.
2. Test pits were excavated using hand-held equipment and generator operated shovels. Excavated materials were used for backfill and compacted manually.

Approximate Scale in Feet 0 15 30

Approximate Scale in Meters 0 4.5 9

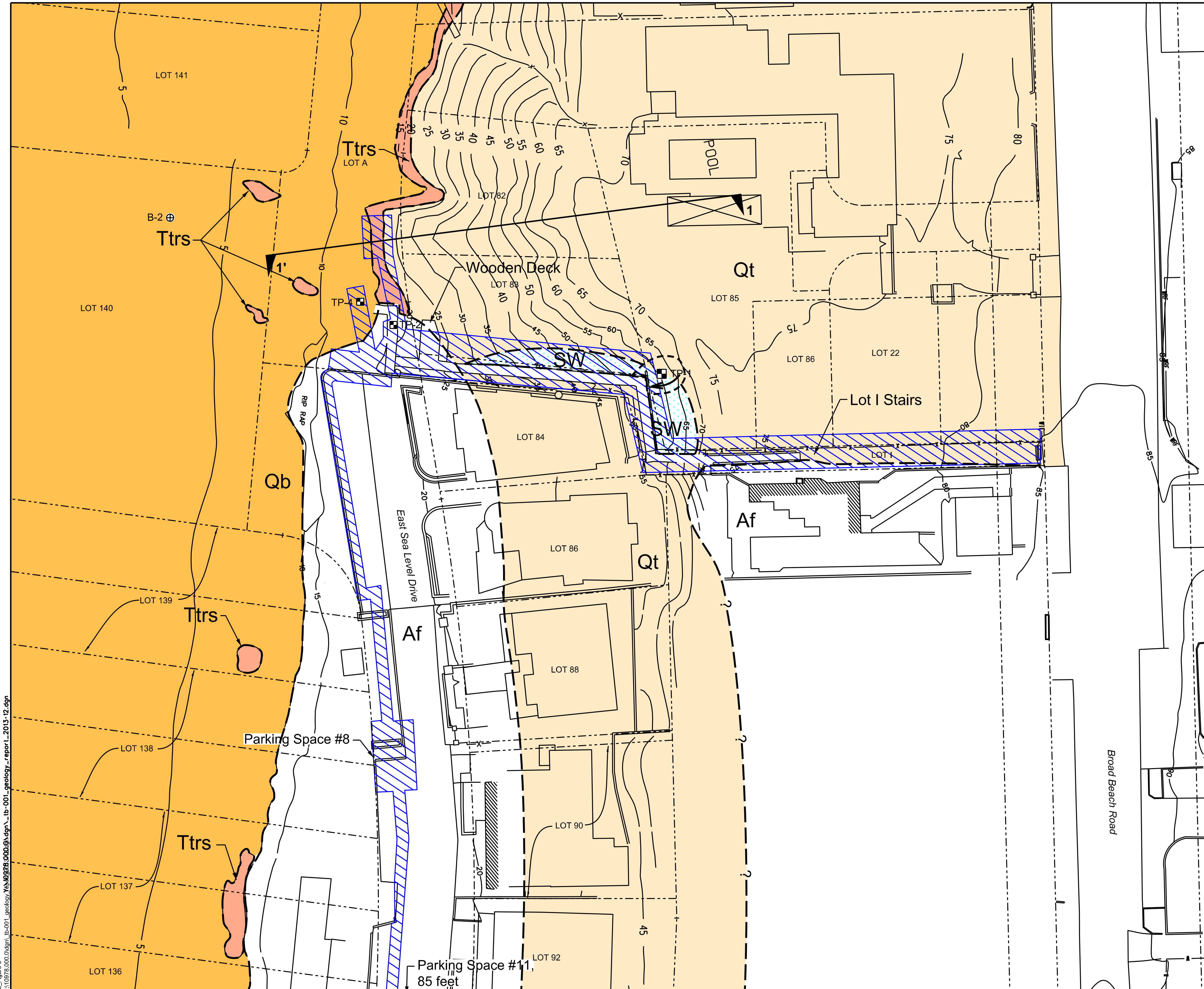
Basemap modified from Site Survey Plan dated July 9, 2007 provided by Mountains Recreation & Conservation Authority

GEOLOGIC AND FIELD EXPLORATION LOCATION MAP
WEST SEA LEVEL DRIVE
Lechuza Beach Public Access Improvements
Malibu, California

By: pah/jbd | Date:12/06/2013 | Project No: 10978.000.0

amec

Figure 2



Explanation

TP-1 Test pit location and identification (AMEC, 2008)

B-4 Boring location and designation (Strata-Tech, 1992)

Proposed East Sea Level improvement areas

Bedding contact, dashed where approximate, queried where uncertain

Surficial slump

Af Artificial Fill

SW Slope wash

Qb Beach sand

Qt Terrace Deposits

Ttrs Sandstone bedrock (Trancas Formation)

1 1' Cross section location

Notes:

1. Boring and test pit locations are approximate.
2. Test pits were excavated using hand-held equipment and generator operated shovels. Excavated materials were used for backfill and compacted manually.

Approximate Scale in Feet
0 20 40
0 6 12
Approximate Scale in Meters

Basemap modified from Site Survey Plan dated July 9, 2007 provided by Mountains Recreation & Conservation Authority

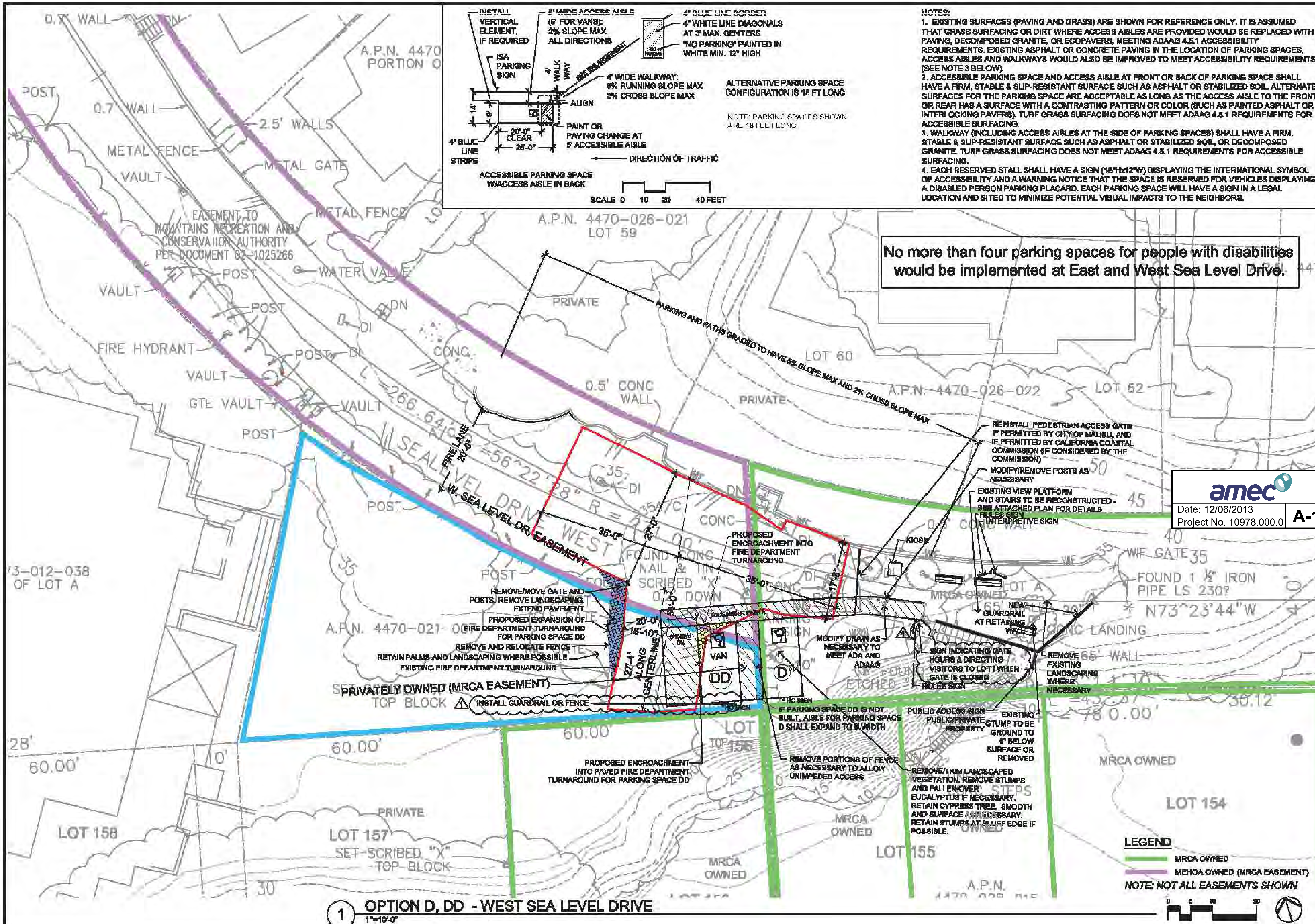
GEOLOGIC AND
FIELD EXPLORATION LOCATION MAP
EAST SEA LEVEL DRIVE
Lechuza Beach Public Access Improvements
Malibu, California

By: pah/jbd	Date:12/06/2013	Project No: 10978.000.0
amec	Figure	3

12/6/2013 9:48:48 AM jim.depoorter

APPENDIX A

Proposed Improvement Options and Design Drawings



1 OPTION D, DD - WEST SEA LEVEL DRIVE
1"=10'-0"

NOTES:

1. EXISTING SURFACES (PAVING AND GRASS) ARE SHOWN FOR REFERENCE ONLY. IT IS ASSUMED THAT GRASS SURFACING OR DIRT WHERE ACCESS AISLES ARE PROVIDED WOULD BE REPLACED WITH PAVING, DECOMPOSED GRANITE, OR ECOPAVERS, MEETING ADAAG 4.5.1 ACCESSIBILITY REQUIREMENTS. EXISTING ASPHALT OR CONCRETE PAVING IN THE LOCATION OF PARKING SPACES, ACCESS AISLES AND WALKWAYS WOULD ALSO BE IMPROVED TO MEET ACCESSIBILITY REQUIREMENTS (SEE NOTE 3 BELOW).
2. ACCESSIBLE PARKING SPACE AND ACCESS AISLE AT FRONT OR BACK OF PARKING SPACE SHALL HAVE A FIRM, STABLE & SLIP-RESISTANT SURFACE SUCH AS ASPHALT OR STABILIZED SOIL. ALTERNATE SURFACES FOR THE PARKING SPACE ARE ACCEPTABLE AS LONG AS THE ACCESS AISLE TO THE FRONT OR REAR HAS A SURFACE WITH A CONTRASTING PATTERN OR COLOR (SUCH AS PAINTED ASPHALT OR INTERLOCKING PAVERS). TURF GRASS SURFACING DOES NOT MEET ADAAG 4.5.1 REQUIREMENTS FOR ACCESSIBLE SURFACING.
3. WALKWAY (INCLUDING ACCESS AISLES AT THE SIDE OF PARKING SPACES) SHALL HAVE A FIRM, STABLE & SLIP-RESISTANT SURFACE SUCH AS ASPHALT OR STABILIZED SOIL, OR DECOMPOSED GRANITE. TURF GRASS SURFACING DOES NOT MEET ADAAG 4.5.1 REQUIREMENTS FOR ACCESSIBLE SURFACING.
4. EACH RESERVED STALL SHALL HAVE A SIGN (18"Hx12"W) DISPLAYING THE INTERNATIONAL SYMBOL OF ACCESSIBILITY AND A WARNING NOTICE THAT THE SPACE IS RESERVED FOR VEHICLES DISPLAYING A DISABLED PERSON PARKING PLACARD. EACH PARKING SPACE WILL HAVE A SIGN IN A LEGAL LOCATION AND SITED TO MINIMIZE POTENTIAL VISUAL IMPACTS TO THE NEIGHBORS.

amec
Date: 12/06/2013
Project No. 10978.000.0
A-1

LECHUZA BEACH PUBLIC ACCESS IMPROVEMENTS

West Sea Level Drive

Malibu, California

A PROJECT OF:
Mountains Recreation and Conservation Authority
570 West Avenue 26, Suite 100
Los Angeles, CA 90065
(323) 221-8944

SITE DESIGN:
Mountains Recreation and Conservation Authority
570 West Avenue 26, Suite 100
Los Angeles, CA 90065
(323) 221-8944

SURVEYOR:
Land & Air Surveying
22741 Pacific Coast Highway
Suite 400A
Malibu, CA 90265
(310) 456-8381

NOT FOR CONSTRUCTION

ISSUED:
6/12/2012
3/15/2013
5/31/2013
EDIT 9/11/2013

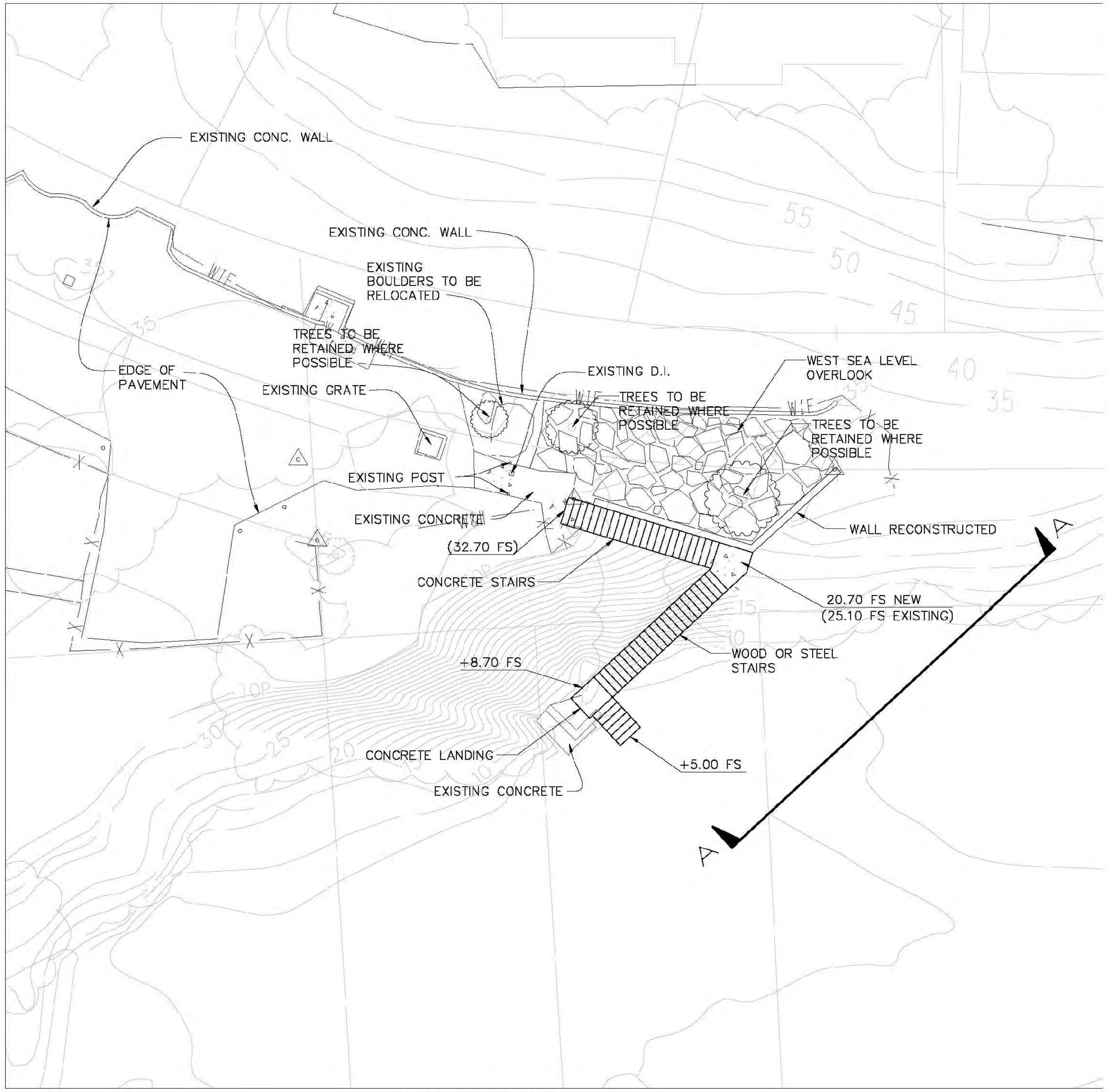
DRAWN: CM
CHECKED: JT
PROJECT:
SCALE: As noted

WEST SEA LEVEL D, DD

Project Area II
Project Elements II-1 to II-5

2 OF 3

Plot Date: 12/06/2013 1:25:15 PM, Plotted by: jim.depoorter Drawing Path: Y:\10978.000.0\ACAD_TB-003_GEO RPT-APPENDIX.DWG , A-1

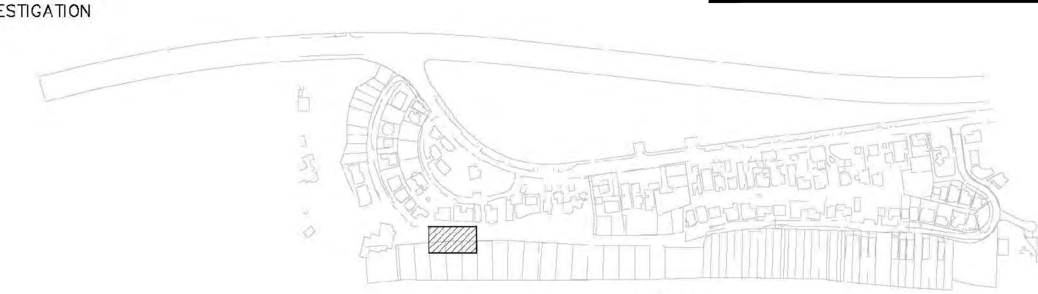


PLAN VIEW
SCALE: 1"=10'

ELEVATION A–A
SCALE: NONE

amec
Date: 12/06/2013
Project No. 10978.000.0
A-2

THIS EXHIBIT IS ISSUED FOR CONCEPTUAL PLANNING ONLY, NOT FOR CONSTRUCTION. CONSTRUCTIBILITY OF ALL IMPROVEMENTS SHOWN SHALL BE DETERMINED AFTER DETAILED SURVEY, GEOTECHNICAL INVESTIGATION AND DURING DESIGN DEVELOPMENT STAGE.



KEYMAP

SEE ADDITIONAL PLANS FOR OTHER IMPROVEMENTS ALONG WEST SEALEVEL DRIVE

May 21, 2013

SCALE 0 5 10 20 FEET NORTH

URS
Golden Shore, Suite 100
Long Beach, CA 90802
Tel: (562) 308-2311
Fax: (562) 256-7905

WEST SEA LEVEL OPTION AA

LECHUZA BEACH
MALIBU, CALIFORNIA

MOUNTAINS RECREATION AND CONSERVATION AUTHORITY
LOS ANGELES, CALIFORNIA

Plot Date: 12/06/2013 1:25:50 PM , Plotted by: jim.depoorter Drawing Path: Y:\10978.000.0\ACAD_TB-003_GEO RPT-APPENDIX.DWG , A-2

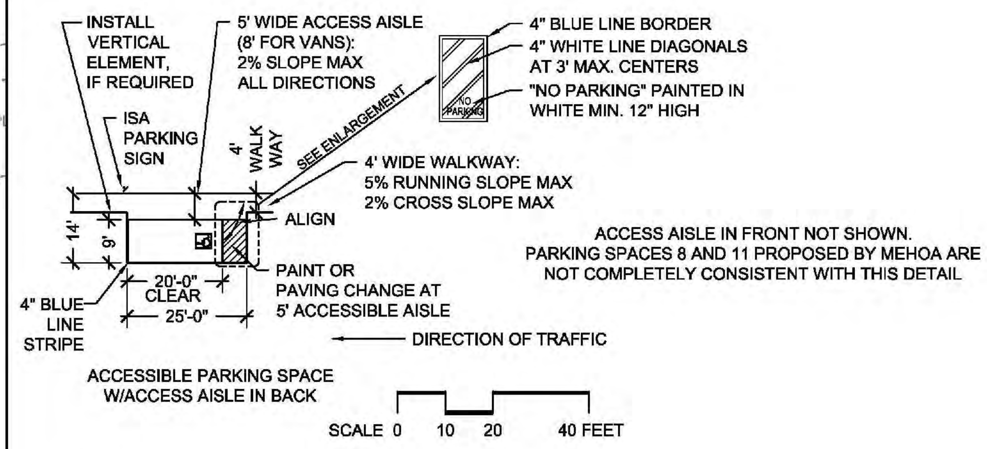
LECHUZA BEACH PUBLIC ACCESS IMPROVEMENTS

East Sea Level Drive
Malibu, California

A PROJECT OF:
Mountains Recreation and Conservation Authority
570 West Avenue 26, Suite 100
Los Angeles, CA 90065
(323) 221-9944

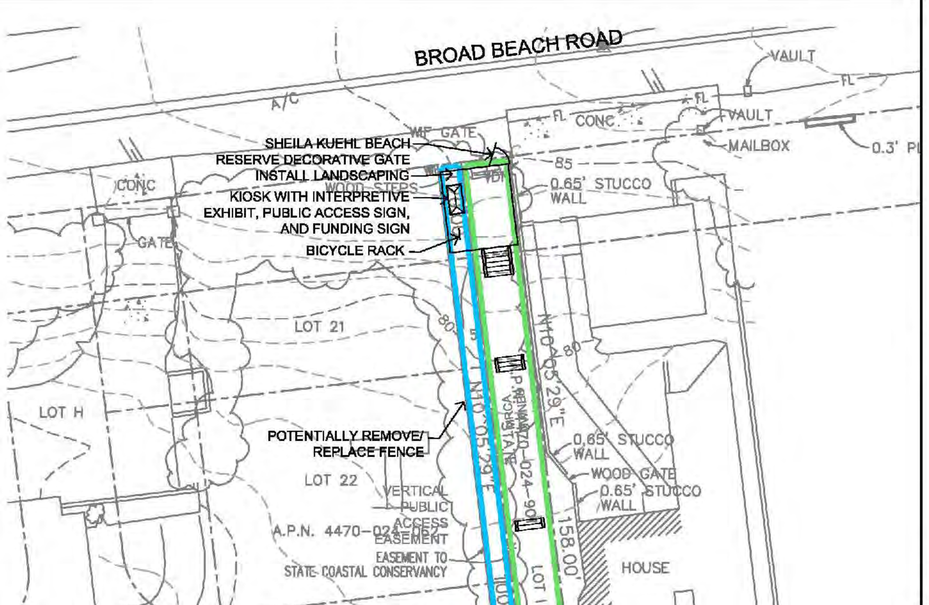
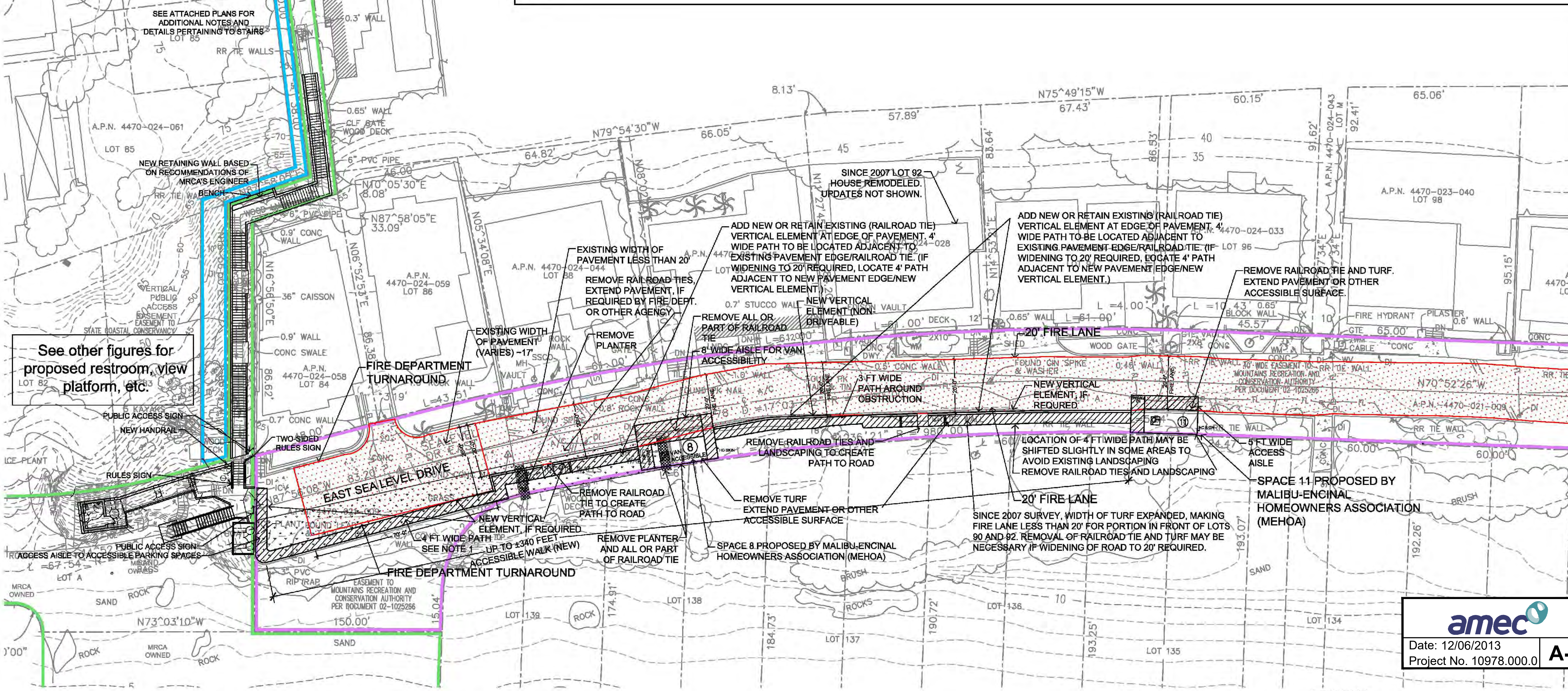
SITE DESIGN:
Mountains Recreation and Conservation Authority
570 West Avenue 26, Suite 100
Los Angeles, CA 90065
(323) 221-9944

SURVEYOR:
Land & Air Surveying
22741 Pacific Coast Highway
Suite 400A
Malibu, CA 90265
(310) 456-9381



2 ACCESSIBLE PARKING DETAIL
1"=20'-0"

NOTES:
1. EXISTING SURFACES (PAVING AND GRASS) ARE SHOWN FOR REFERENCE ONLY. IT IS ASSUMED THAT GRASS SURFACING OR DIRT WHERE ACCESS AISLES ARE PROVIDED WOULD BE REPLACED WITH PAVING, DECOMPOSED GRANITE, OR ECOPAVERS, MEETING ADAAG 4.5.1 ACCESSIBILITY REQUIREMENTS. EXISTING ASPHALT OR CONCRETE PAVING IN THE LOCATION OF PARKING SPACES, ACCESS AISLES AND WALKWAYS WOULD ALSO BE IMPROVED TO MEET ACCESSIBILITY REQUIREMENTS (SEE NOTE 3 BELOW).
2. ACCESSIBLE PARKING SPACE AND ACCESS AISLE AT FRONT OR BACK OF PARKING SPACE SHALL HAVE A FIRM, STABLE & SLIP-RESISTANT SURFACE SUCH AS ASPHALT OR STABILIZED SOIL. ALTERNATE SURFACES FOR THE PARKING SPACE ARE ACCEPTABLE AS LONG AS THE ACCESS AISLE TO THE FRONT OR REAR HAS A SURFACE WITH A CONTRASTING PATTERN OR COLOR (SUCH AS PAINTED ASPHALT OR INTERLOCKING PAVERS). TURF GRASS SURFACING DOES NOT MEET ADAAG 4.5.1 REQUIREMENTS FOR ACCESSIBLE SURFACING.
3. WALKWAY (INCLUDING ACCESS AISLES AT THE SIDE OF PARKING SPACES) SHALL HAVE A FIRM, STABLE & SLIP-RESISTANT SURFACE SUCH AS ASPHALT OR STABILIZED SOIL, OR DECOMPOSED GRANITE. TURF GRASS SURFACING DOES NOT MEET ADAAG 4.5.1 REQUIREMENTS FOR ACCESSIBLE SURFACING.
4. EACH RESERVED STALL SHALL HAVE A SIGN (18"Hx12"W) DISPLAYING THE INTERNATIONAL SYMBOL OF ACCESSIBILITY AND A WARNING NOTICE THAT THE SPACE IS RESERVED FOR VEHICLES DISPLAYING A DISABLED PERSON PARKING PLACARD. EACH PARKING SPACE WILL HAVE A SIGN IN A LEGAL LOCATION AND SITED TO MINIMIZE POTENTIAL VISUAL IMPACTS TO THE NEIGHBORS.

1 OPTION 8, 11 (PROPOSED BY MEHOA) - EAST SEA LEVEL DRIVE
1"=20'-0"

Note: Parking spaces 8 and 11 proposed by Malibu-Encinal Homeowners Association (MEHOA).

LEGEND
- MRCA OWNED
- MEHOA OWNED (MRCA EASEMENT)
- VERTICAL PUBLIC ACCESS EASEMENT

NOTE: NOT ALL EASEMENTS SHOWN

See other figures for other Project Elements. See attached plans for details.

NOT FOR CONSTRUCTION

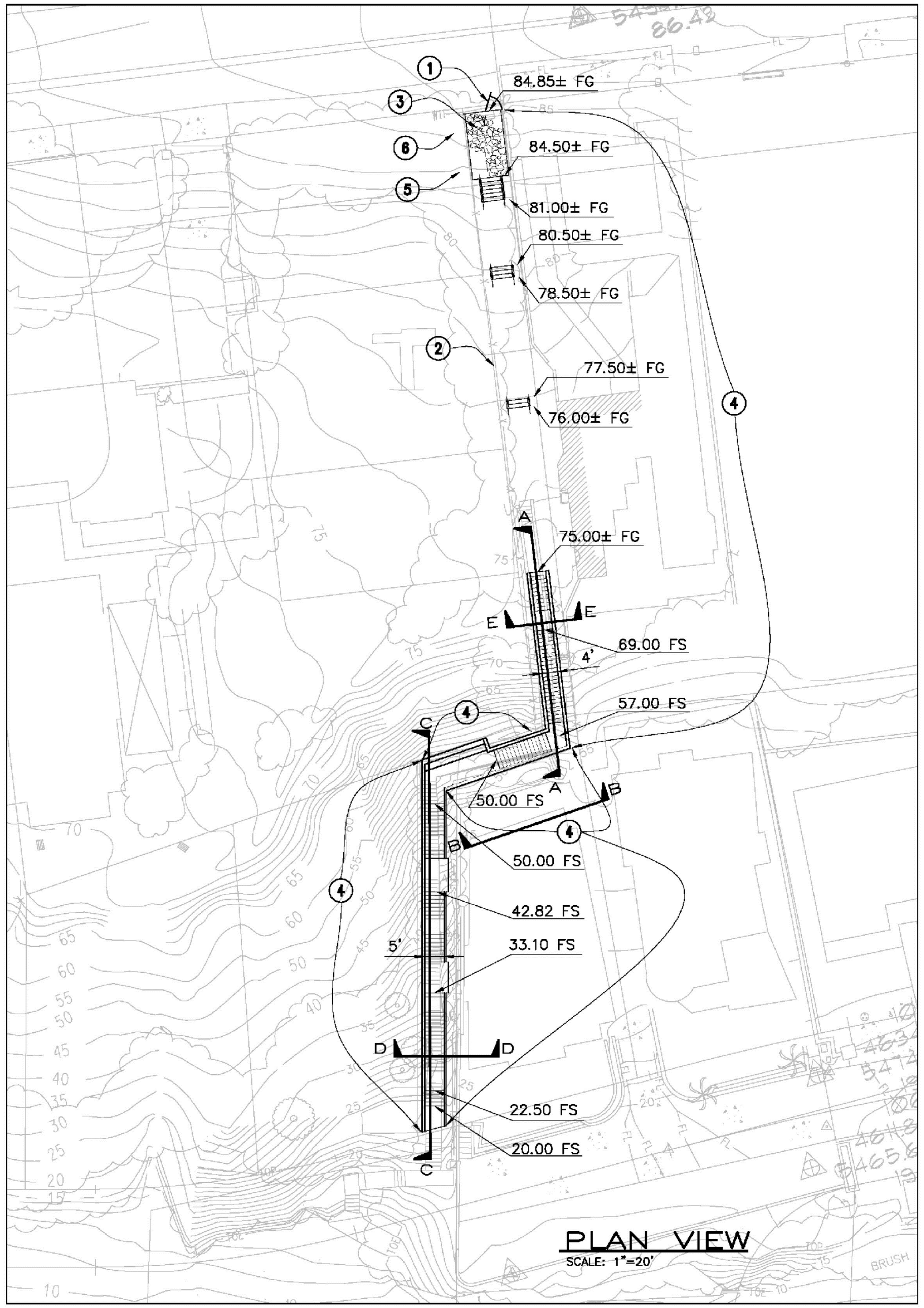
amec
Date: 12/06/2013
Project No. 10978.000.0
A-3

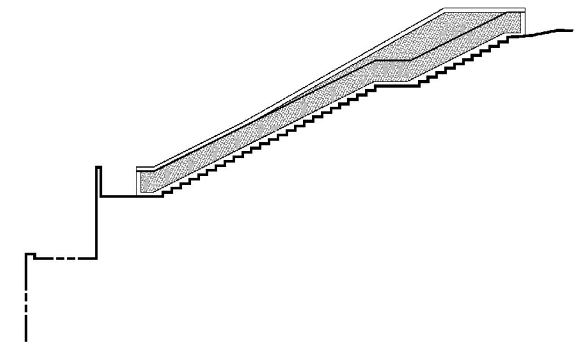
ISSUED:
5/31/2013

DRAWN: CM
CHECKED: JT
PROJECT: 24.404.444.3221.261
SCALE: As noted

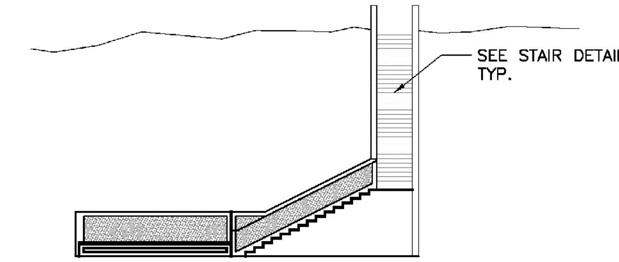
EAST SEA LEVEL 8, 11

Project Area III
Project Elements III-1 to III-5

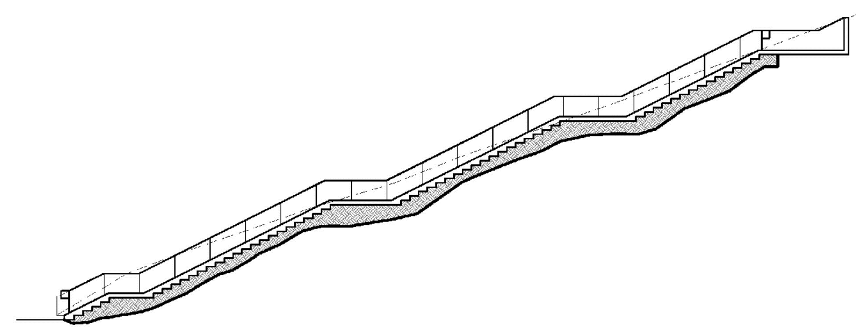




ELEVATION A—A
SCALE: 1"=10'



ELEVATION B—B
SCALE: 1"=10'



ELEVATION C—C
SCALE: 1"=10'

THIS EXHIBIT IS ISSUED FOR CONCEPTUAL PLANNING ONLY, NOT FOR CONSTRUCTION. CONSTRUCTIBILITY OF ALL IMPROVEMENTS SHOWN SHALL BE DETERMINED AFTER DETAILED SURVEY, GEOTECHNICAL INVESTIGATION AND DURING DESIGN DEVELOPMENT STAGE.

REGISTERED PROFESSIONAL ENGINEER
WILFRIDO B. SIMBOL
C29699
EXP. 3-31-15
CIVIL
STATE OF CALIFORNIA

amec
Date: 12/06/2013
Project No. 10978.000.0
A-4

KEYNOTES:

1. TRIM LANDSCAPING. NEW SELF CLOSING GATE (APPROX. 4 FT. WIDE)
2. POTENTIALLY REMOVE/REPLACE FENCE
3. RETAIN EXISTING TREES/LANDSCAPING AS POSSIBLE
4. POTENTIAL NATIVE LANDSCAPING
5. BIKE RACK
6. INTERPRETIVE EXHIBIT

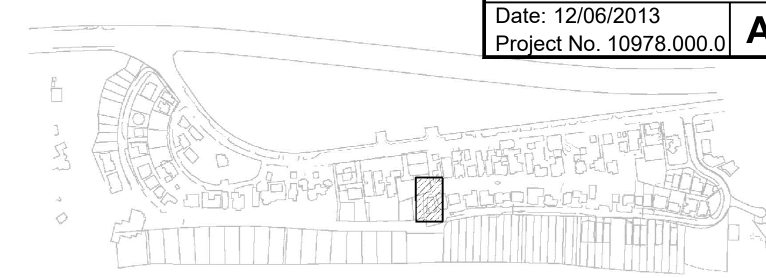
SEE ADDITIONAL PLANS FOR IMPROVEMENTS IN THIS AREA ALONG EAST SEALEVEL DRIVE

May 21, 2013

SCALE 0 10 20 40 FEET

NORTH

NOTE:
WIDTH OF STAIRS TO BE 5 FEET WIDE WHERE POSSIBLE. WIDTH OF STAIRS MAY BE 4 FEET WIDE IN SOME AREAS, TO BE DETERMINED DURING CONSTRUCTION.



KEYMAP

URS
Golden Shore, Suite 100
Long Beach, CA 90802
Tel: (562) 308-2311
Fax: (562) 256-7905

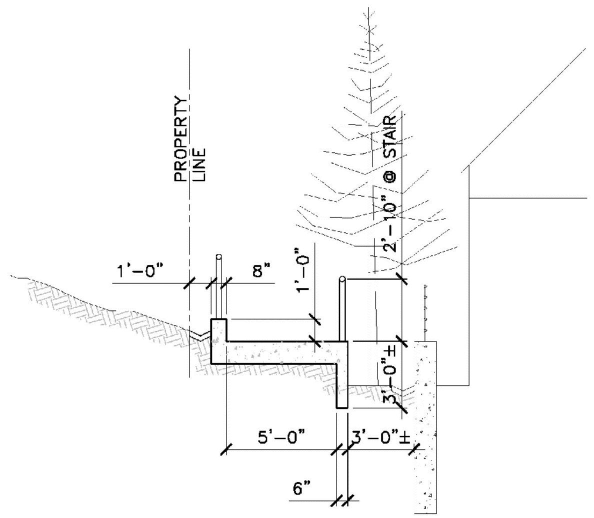
LOT I STAIRS EXHIBIT

SHEET 1 OF 2

LECHUZA BEACH
MALIBU, CALIFORNIA

MOUNTAINS RECREATION AND CONSERVATION AUTHORITY
LOS ANGELES, CALIFORNIA

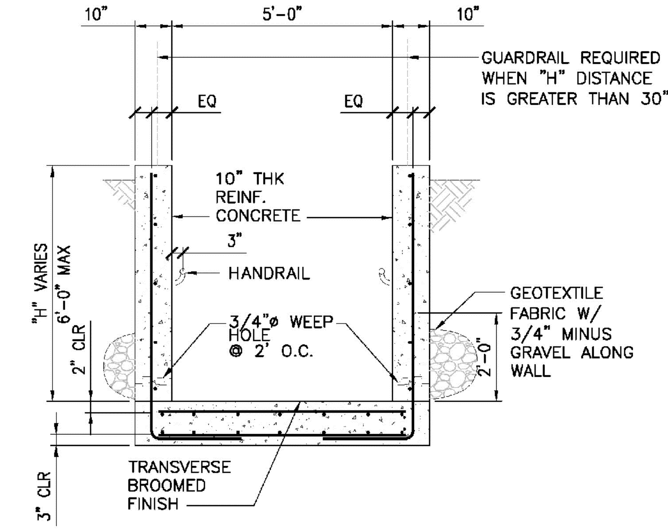
Plot Date: 12/06/2013 1:27:24 PM , Plotted by: jim.depoorter   Drawing Path: Y:\10978.000.0\ACAD_TB-003_GEO RPT-APPENDIX.DWG , A-4



SECTION D–D

SCALE: NTS

SCALE: NTS



SECTION E–E

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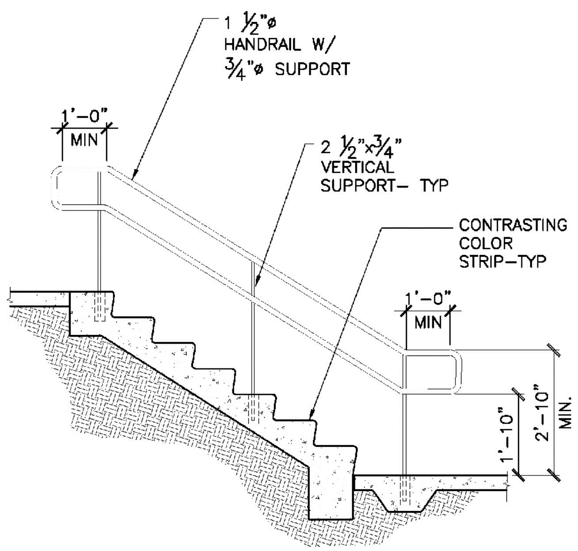
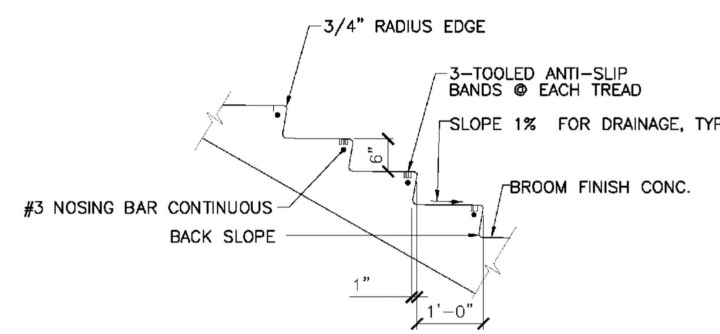


HANDRAIL DETAIL

SCALE: NTS



STAIR DETAIL

SCALE: NTS

amec

Date: 12/06/2013

Project No. 10978.000.0

A-5

THIS EXHIBIT IS ISSUED FOR CONCEPTUAL PLANNING ONLY, NOT FOR CONSTRUCTION. CONSTRUCTIBILITY OF ALL IMPROVEMENTS SHOWN SHALL BE DETERMINED AFTER DETAILED SURVEY, GEOTECHNICAL INVESTIGATION AND DURING DESIGN DEVELOPMENT STAGE.

REGISTERED PROFESSIONAL ENGINEER WILFRIDO B. SIMBOL C29699 EXP. 3-31-15 CIVIL STATE OF CALIFORNIA

SEE ADDITIONAL PLANS FOR IMPROVEMENTS IN THIS AREA ALONG EAST SEALEVEL DRIVE

May 21, 2013

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Long Beach, CA 90802
Tel: (562) 308-2311
Fax: (562) 256-7905

LOT I
STAIRS EXHIBIT

SHEET 2 OF 2

LECHUZA BEACH
MALIBU, CALIFORNIA

MOUNTAINS RECREATION AND CONSERVATION AUTHORITY
LOS ANGELES, CALIFORNIA

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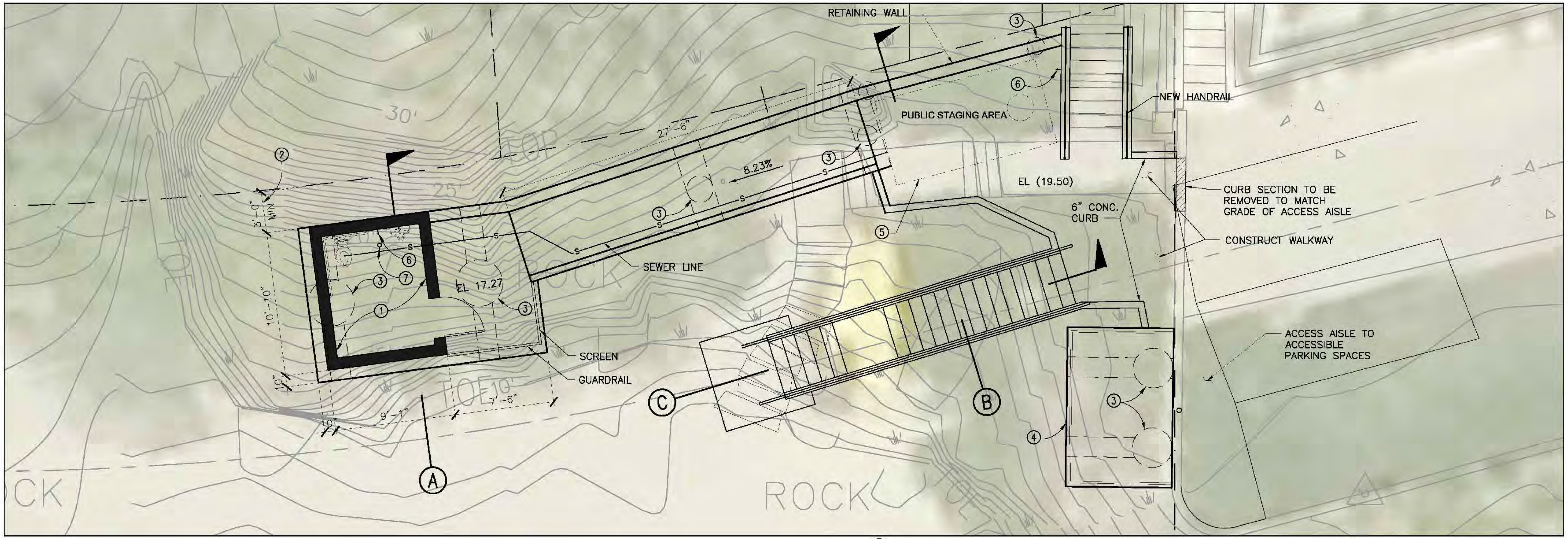


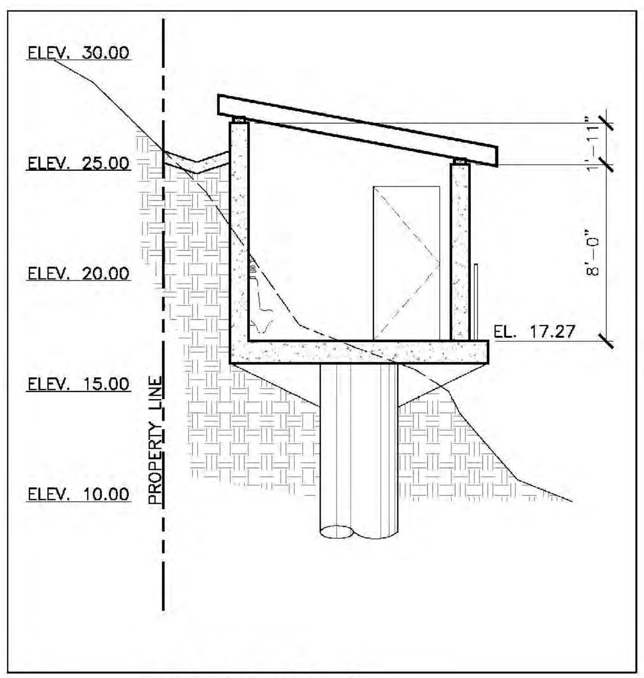
PLAN VIEW
SCALE: 1/4"=1'-0"

NORTH

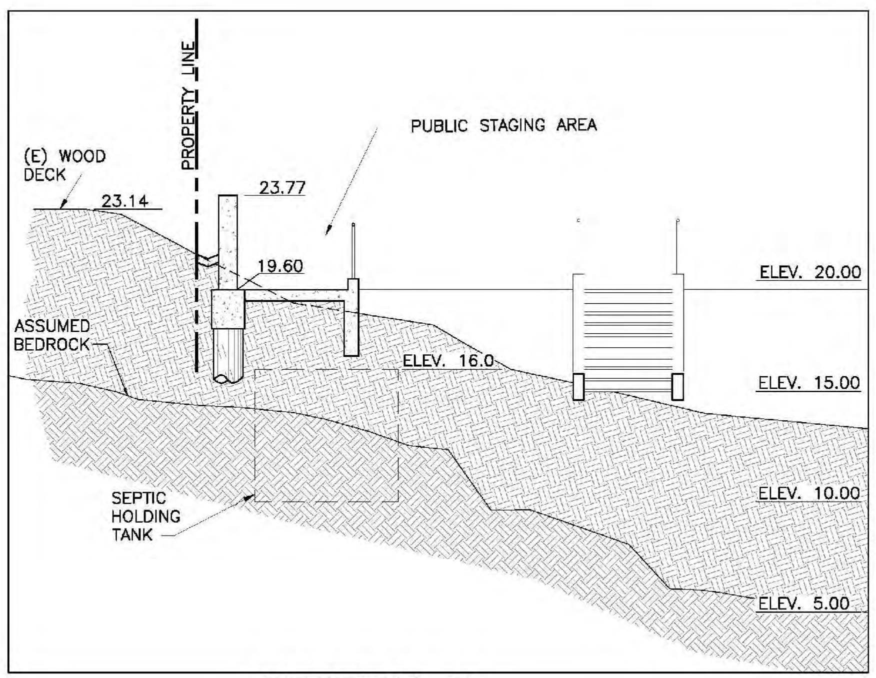
SCALE 0 1 2 3 4 5 10 FEET

NOTES:

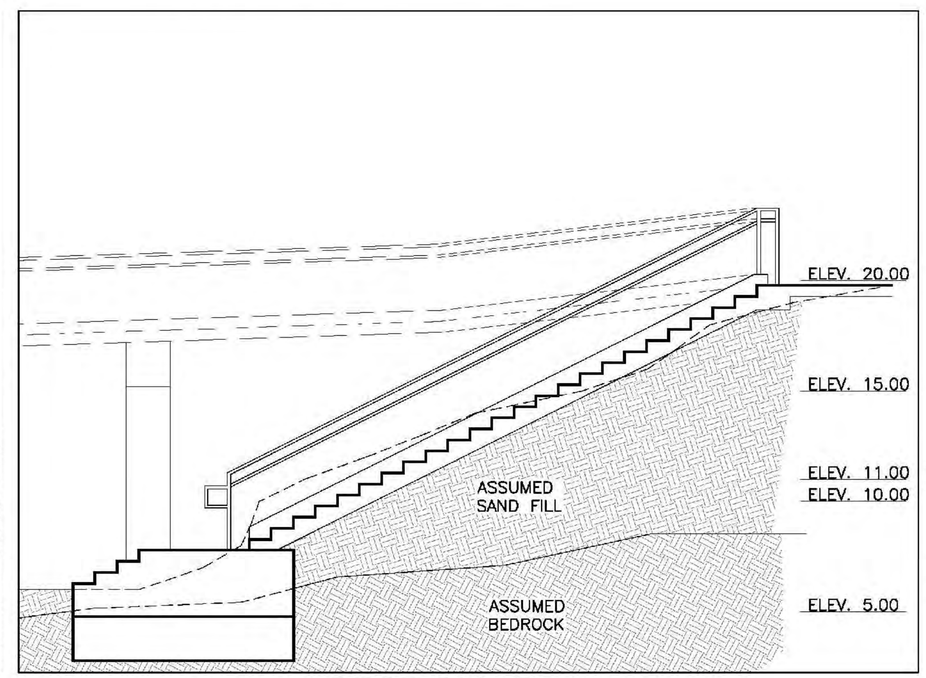
1. PERMANENT RESTROOM IS SHOWN. OPTIONAL PORTO POTTY MAY BE PLACED INSTEAD OF PERMANENT RESTROOM. IF PORTO POTTY IS PLACED, EAST WALL, SOUTH WALL, AND PORTION OF WEST WALL OF PERMANENT RESTROOM WOULD BE REMOVED.
2. MINIMUM DISTANCE FROM PROPERTY LINE WILL BE VERIFIED DURING DESIGN STAGE AND WILL DEPEND ON THE TYPE OF SHORING REQUIRED AT THE PROPERTY LINE DURING CONSTRUCTION, WORKING SPACE NEEDED TO CONSTRUCT THE RETAINING WALL AND SIZE OF DRAINAGE INTERCEPTOR.
3. SIZE AND LOCATION OF CAISSONS WILL BE DETERMINED BY STRUCTURAL ENGINEER DURING DESIGN STAGE.
4. 8'x12' VIEW PLATFORM WITH 2 CAISSONS, FOUNDATION, BENCHES, TELESCOPE, INTERPRETIVE EXHIBIT, RULE SIGN, PUBLIC ACCESS SIGN, TRASH CANS. A MINIMUM OF 50 PERCENT OF FIXED BENCHES SHALL MEET ACCESSIBILITY REQUIREMENTS.
5. SEPTIC HOLDING TANK. SIZE OF LARGEST TANK TO FIT THE SITE BASED ON CONSTRUCTIBILITY WILL BE VERIFIED DURING DESIGN DEVELOPMENT STAGE. A 1250 GALLON FIBERGLASS IS SHOWN.
6. HOSE BIBB
7. FLOOR DRAIN
8. ALL PROPOSED IMPROVEMENTS SHOWN SHALL BE CONSTRUCTED WITHOUT ENCROACHING ON ADJACENT PRIVATE PROPERTIES UNLESS PERMISSION IS OBTAINED.
9. THE LOCATION OF THE VEGETATION IS BASED ON AERIAL PHOTOGRAPHS AND ACTUAL LOCATION OF VEGETATION WILL BE VERIFIED DURING DESIGN.



SECTION A
SCALE: 1/4"=1'-0"



SECTION B
SCALE: 1/4"=1'-0"



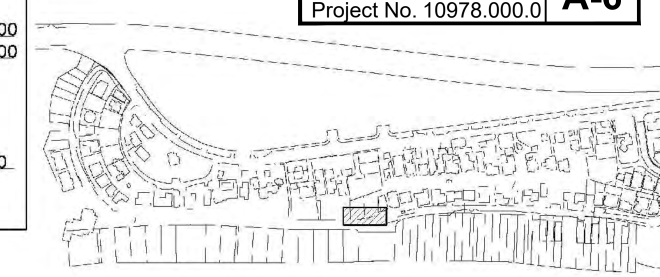
SECTION C
SCALE: 1/4"=1'-0"

THIS EXHIBIT IS ISSUED FOR CONCEPTUAL PLANNING ONLY, NOT FOR CONSTRUCTION. CONSTRUCTIBILITY OF ALL IMPROVEMENTS SHOWN SHALL BE DETERMINED AFTER GEOTECHNICAL INVESTIGATION AND DURING DESIGN DEVELOPMENT STAGE.

REGISTERED PROFESSIONAL ENGINEER WILFRIDO B. SIMBOL C29699 EXP. 3-31-15 CIVIL STATE OF CALIFORNIA

amec

Date: 12/06/2013
Project No. 10978.000.0
A-6



KEYMAP

May 21, 2013

URS
Golden Shore, Suite 100
Long Beach, CA 90802
Tel: (562) 308-2311
Fax: (562) 256-7905

EAST SEA LEVEL DRIVE
RESTROOM OPTION #2

LECHUZA BEACH
MALIBU, CALIFORNIA

MOUNTAINS RECREATION AND CONSERVATION AUTHORITY
LOS ANGELES, CALIFORNIA

Plot Date: 12/06/2013 1:28:32 PM , Plotted by: jim.depoorter Drawing Path: Y:\10978.000.0\ACAD_TB-003_GEO RPT-APPENDIX.DWG , A-6

APPENDIX B

Field Exploration Program

EXPLANATION OF BORING LOGS

LECHUZA BEACH IMPROVEMENTS
Malibu, California

MAJOR DIVISIONS		LTR	DESCRIPTION
COARSE GRAINED SOILS	GRAVEL	GW	Well-graded gravels or gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels or gravel-sand mixture, little or no fines
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	SAND	SW	Well-graded sands or sand with gravel, little or no fines
		SP	Poorly-graded sands or sand with gravel, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures

MAJOR DIVISIONS		LTR	DESCRIPTION
FINE GRAINED SOILS	SILTS AND CLAYS LL<50	ML	Inorganic silts and very fine sand, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silt-clays of low plasticity
	SILTS AND CLAYS LL>50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of hogh plasticity, fat clays
		OH	Organic clays of medium to high plasticity
HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils

SAMPLE COLUMN SYMBOLS

Modified California split spoon sample

Bulk

BLOWS/6 INCHES - Summation of blow counts for 6-inch sampling interval

DESCRIPTION COLUMN SYMBOLS

Dashed lines separating soil strata represent inferred boundaries between sampled intervals or no recovery intervals and may be distinct or gradual transitions

Solid lines represent distinct or gradual boundaries observed within sampled intervals

Description right of bracket symbol represents soil conditions within the depth interval defined by the bracket length

Description right of arrow symbol represents soil conditions to the next deeper boundary line unless otherwise noted

LABORATORY TEST ABBREVIATIONS

ATT	Atterberg Limits	CORR	Corrosion	SE	Sand Equivalent
COLL	Collapse Potential	DS	Direct Shear	SG	Specific Gravity
COMP	Compaction	EI	Expansion Index	TX	Triaxial Test
CON	Consolidation	S	Grain Size Analysis	UC	Unconfined Compression Test
R	R-Value	PERM	Permeability	#200	No. 200 Wash Sieve Analysis

NOTES

1. Soil descriptions are in accordance with the USCS as set forth by ASTM D2488 "Standard Practice for Description and Identification Soil (Visual-Manual Procedure)."
2. Soil color described according to Munsell Soil Color Chart.
3. Soil descriptions in these borings are generalized representations and based upon visual classification of cuttings and/or samples during drilling. Descriptions and related information in these borings depict subsurface conditions at the specific location and at the time of drilling only. Soil conditions at other locations may differ from conditions observed at the boring locations. Also, soil and groundwater conditions may change with time at these locations.

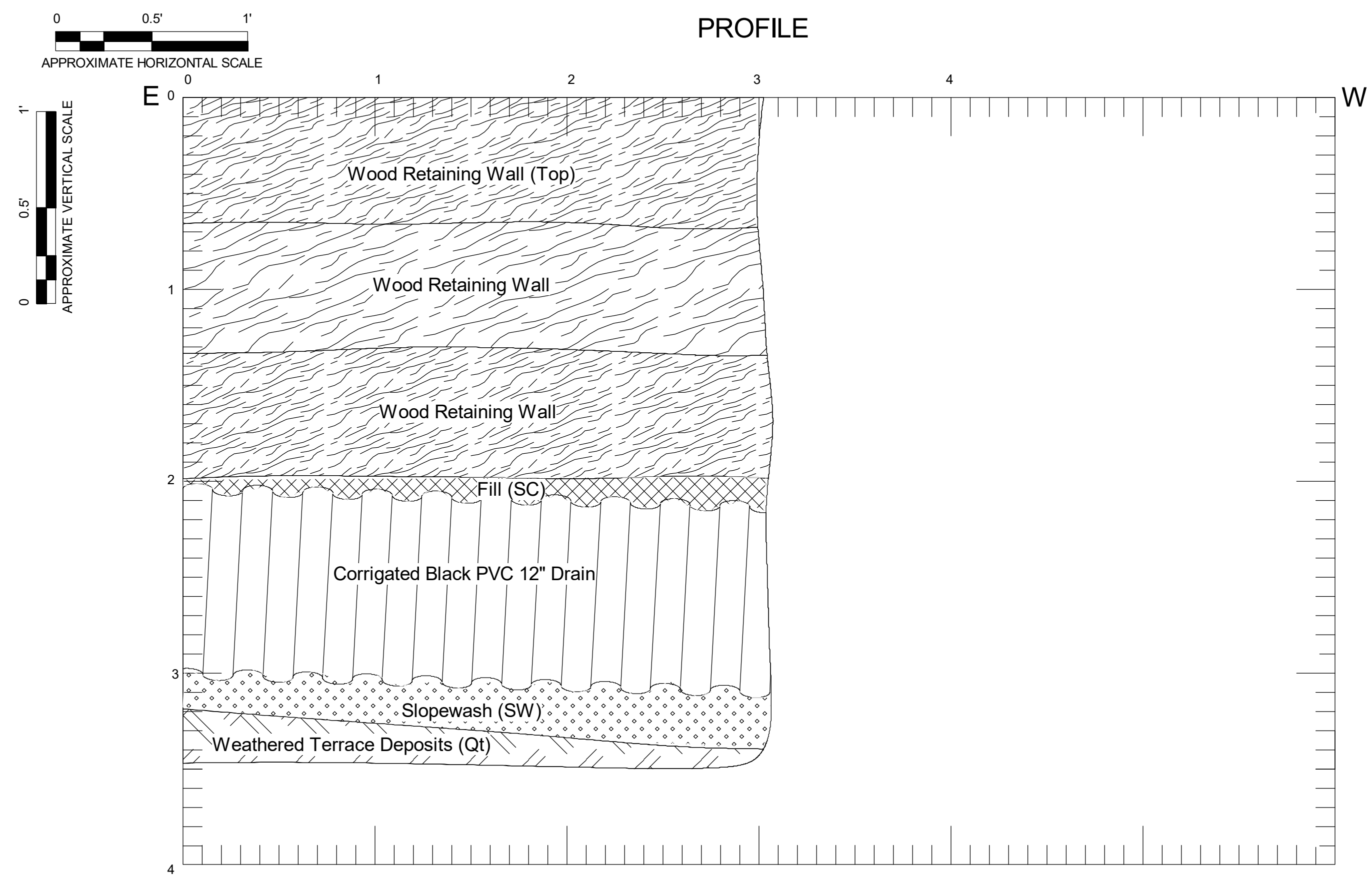
LOG OF TEST PIT No. TP-1

Project No.: 10978.000.0 Project Name: Lechuza Beach | Date Excavated: 10/15/2008

Ground Elev.: 56' MSL | Responsible Professional: E. Bailiff | Ex. Method: Hand Excavation | Logged By: E. Bailiff

DEPTH (feet)	Sample	Symbol	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.
0–2			Wood timber retaining wall. Three stacked 8-inch beams of treated wood.
2–3			ARTIFICIAL FILL (Af) CLAYEY SAND to POORLY GRADED SAND with CLAY (SP): Light brown (7.5YR 6/4) to gray (7.5YR 5/1), moist, 70-85% fine sand, 15-30% low plasticity fines, up to 20% is sand to gravel size clasts of sandstone and silty sandstone. Encountered black corrigated drain on south side of excavation at 2'. Fill materials derived underlying slopewash.
3–4			SLOPEWASH (SW): CLAYEY SAND to POORLY GRADED SAND with CLAY (SP): Light brown (7.5YR 6/4) to gray (7.5YR 5/1), moist, 70-85% fine sand, 15-30% low plasticity fines, up to 20% is sand to gravel size clasts of sandstone and silty sandstone. Abundant clay on surfaces from soil development, darker color, becomes sandier with depth.
4			WEATHERED TERRACE DEPOSITS (Qt): CLAYEY (CL), Gray, moist
			Bottom of test pit at 3.3', (~4' on north wall), unable to hand excavate deeper, hard, limited access. Test pit backfilled with spoils to ground surface. No groundwater encountered.

PROFILE



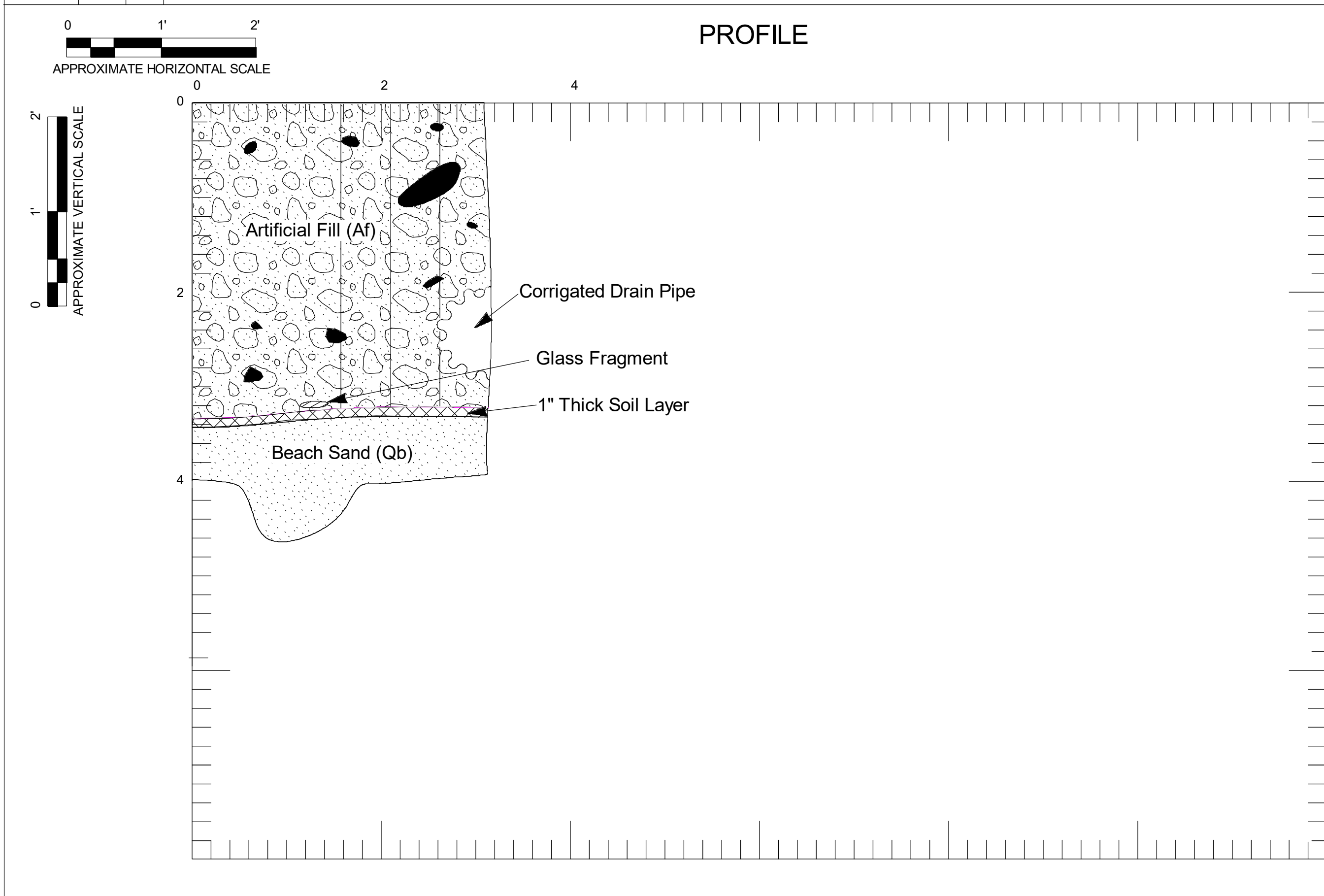
TESTPIT4

LOG OF TEST PIT No. TP-2

Project No.: 10978.000.0 Project Name: Lechuza Beach Date Excavated: 10/15/2008
Ground Elev.: 19' MSL Responsible Professional: E. Bailiff Ex. Method: Hand Excavation Logged By: E. Bailiff

DEPTH (feet)	Sample	Symbol	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.
0–3.5			ARTIFICIAL FILL (Af) POORLY GRADED SAND with GRAVEL (SP): light gray (2.5Y 7/2), dry to moist, 80% fine sand, 20% fine to coarse gravel consisting of sandstone and basalt clasts, trace cobbles to 8 inches and fragments of red clay pipe and glass
3.5–4.6			BEACH SAND (Qb): POORLY GRADED SAND (SP): light gray (2.5Y 7/2), moist, 100% fine sand, trace fines, loose, soft. Pushed metal probe additional 18", bedrock not encountered. @ 3.7 ; ~1" thick brown SOIL layer with abundant rootlets, appeared to be old soil surface, sharp upper and lower contact, overlies POORLY GRADED SAND (beach sand)
			Bottom of test pit at 4.6' (probed to ~5.5'), could not hand excavate deeper, sand sloughing Test pit backfilled with spoils to ground surface. No groundwater encountered.

PROFILE



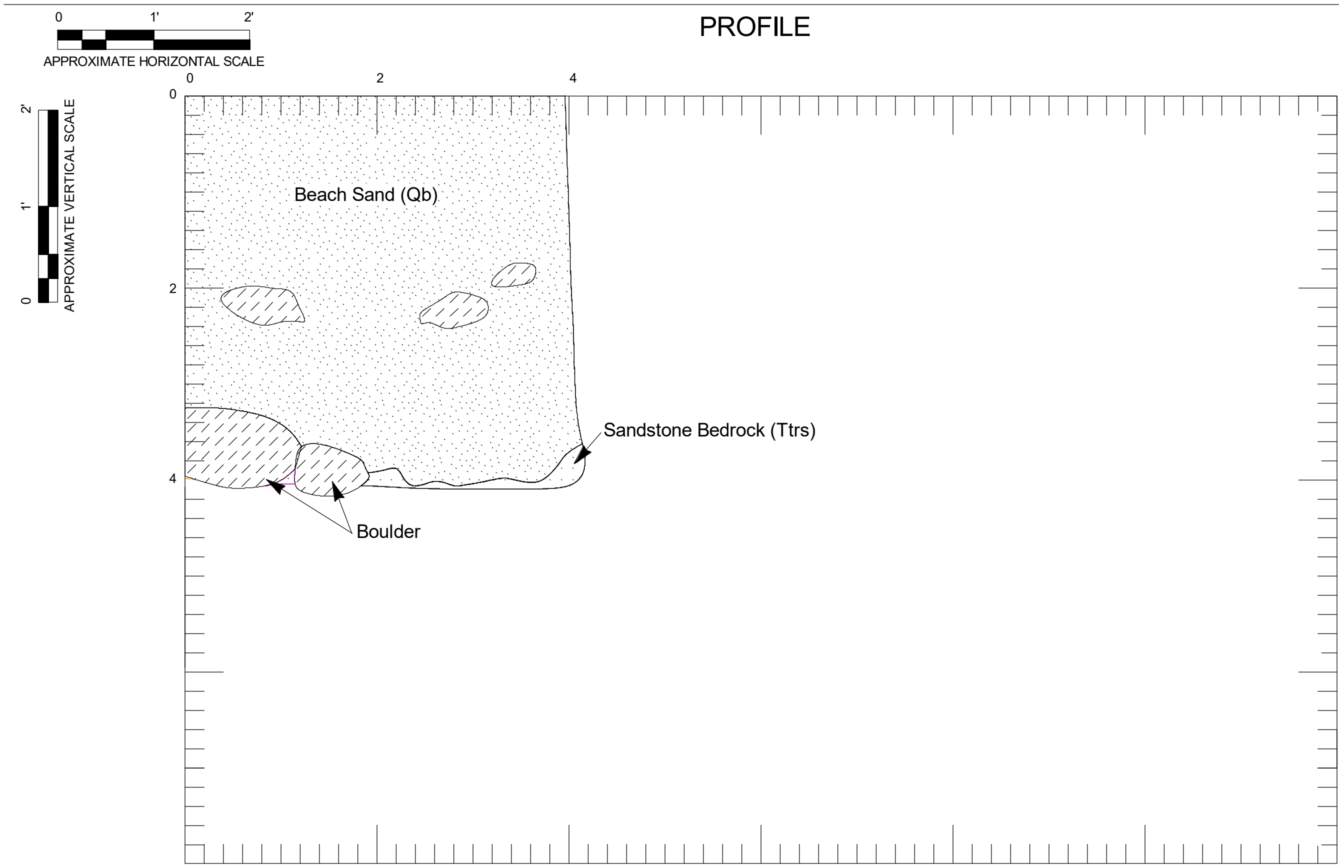
TESTPIT4

LOG OF TEST PIT No. TP-3

Project No.: 10978.000.0 Project Name: Lechuza Beach Date Excavated: 10/15/2008
Ground Elev.: 8' MSL Responsible Professional: E. Bailiff Ex. Method: Hand Excavation Logged By: E. Bailiff

DEPTH (feet)	Sample	Symbol	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.
			BEACH SAND (Qb): POORLY GRADED SAND (SP): light gray (2.5Y 7/2), moist, 100% fine sand, trace fines, loose, soft. Encountered boulders and cobbles up to 12" diameter at approximately 2 and 4 feet bgs.
1			
2			
3			
4			BEDROCK (Ttrs) : Sandstone, uneven surface that extends from western wall across most of trench bottom. Did not appear to be boulders.
			Bottom of test pit at 4', encountered bedrock. Encountered water at 3.9' Excavated at low tide. Test pit backfilled with spoils to ground surface.

PROFILE



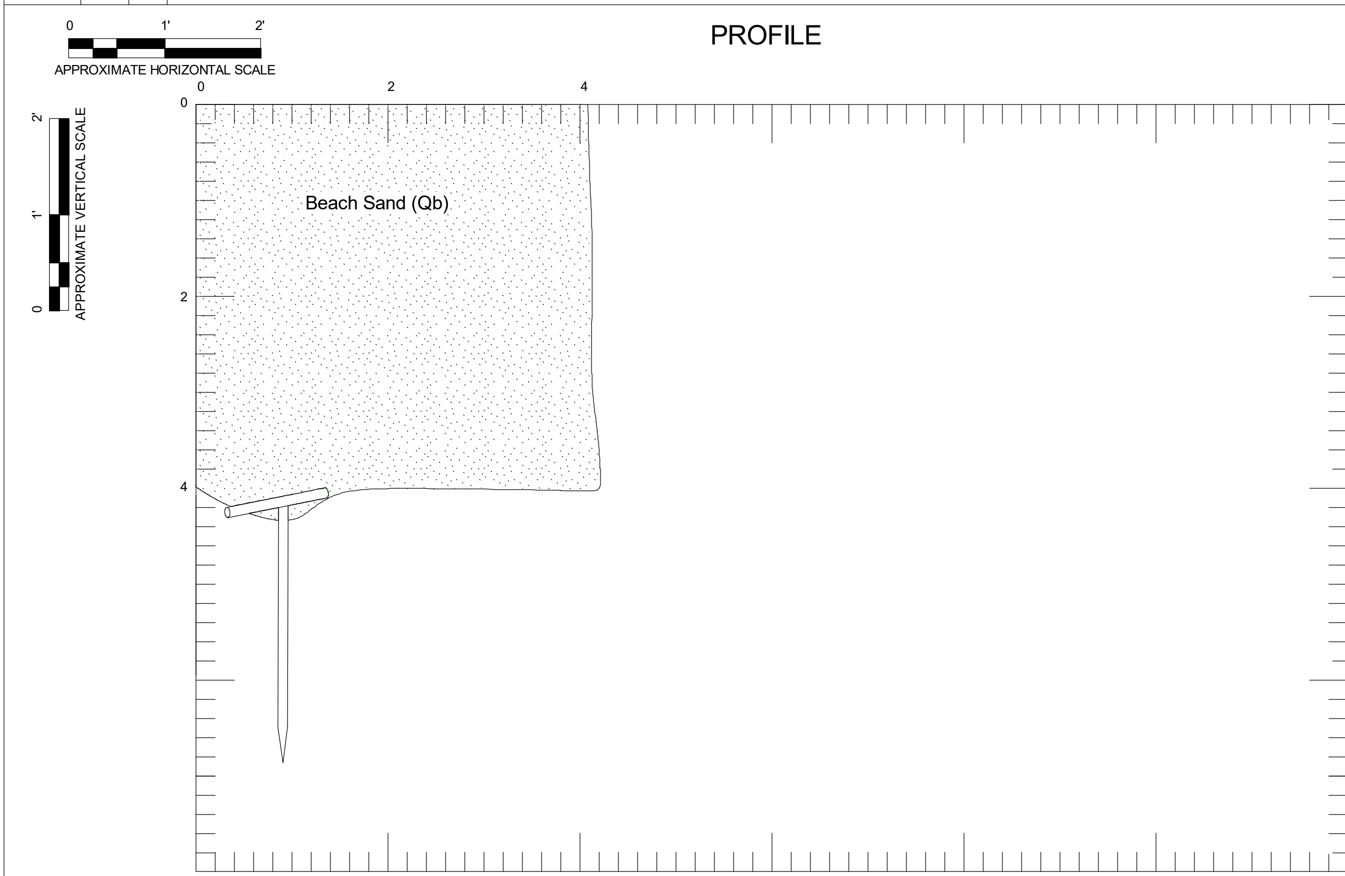
TESTPIT4

LOG OF TEST PIT No. TP-4

Project No.: 10978.000.0 Project Name: Lechuza Beach Date Excavated: 10/16/2008
Ground Elev.: 14' MSL Responsible Professional: E. Bailiff Ex. Method: Hand Excavation Logged By: E. Bailiff

DEPTH (feet)	Sample	Symbol	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.
			BEACH SAND (Qb): POORLY GRADED SAND (SP): light gray (2.5Y 7/2), moist, 100% fine sand, loose, soft
1			Note: Bryan Construction made a plywood box to shore test pit when they reached ~3.6'. The south side of shoring started to bow, excavated small area to ~4.2' and used metal probe (3' long) to test for rock. Buried probe to handle, no rock encountered.
2			
3			
4			
			Bottom of test pit at ~4.2', unable to hand excavate deepr, sand sloughing. No water encountered (high tide at time of excavation) Test pit backfilled with spoils to ground surface.

PROFILE



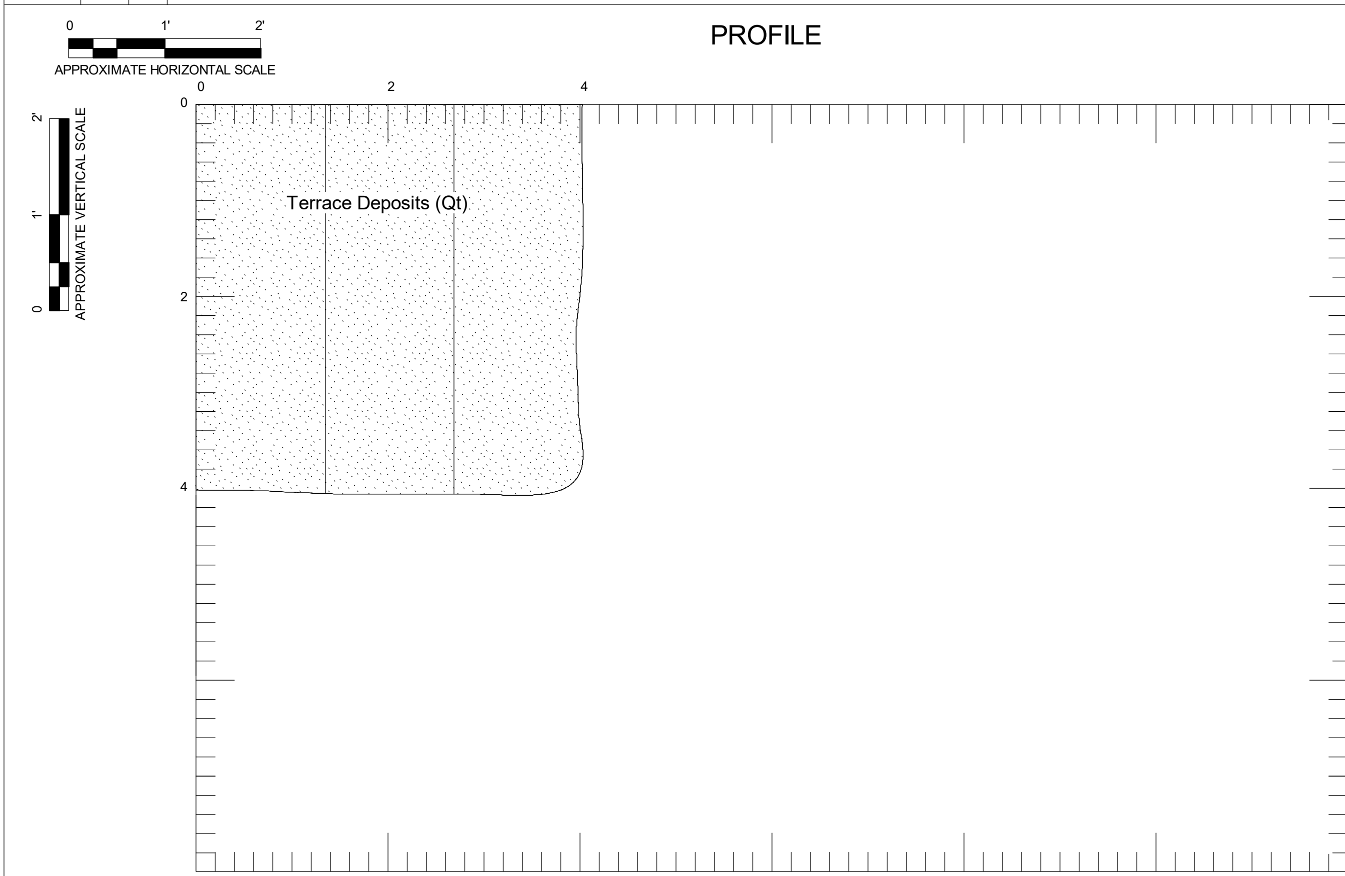
TESTPIT4

LOG OF TEST PIT No. TP-5

Project No.: 10978.000.0 Project Name: Lechuza Beach Date Excavated: 10/16/2008
Ground Elev.: 34' MSL Responsible Professional: E. Bailiff Ex. Method: Hand Excavation Logged By: E. Bailiff

DEPTH (feet)	Sample	Symbol	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.
0–4			TERRACE DEPOSITS (Qt): SILTY SAND (SM): dark reddish gray, (5YR 4/2), moist, 80% fine sand, 20% non to low-plasticity fines, dense, clay developing soil. ~10% gravel size sandstone clasts and rootlets in upper 14", very uniform from 1' to 4'. Some dark clay partings observed in upper 2' to 3', blocky texture. Surficial soil dervied from weathering of terrace deposits.
4			Bottom of test pit at 4', unable to hand excavate deeper, hard. Test pit backfilled with spoils to ground surface. No groundwater encountered.

PROFILE



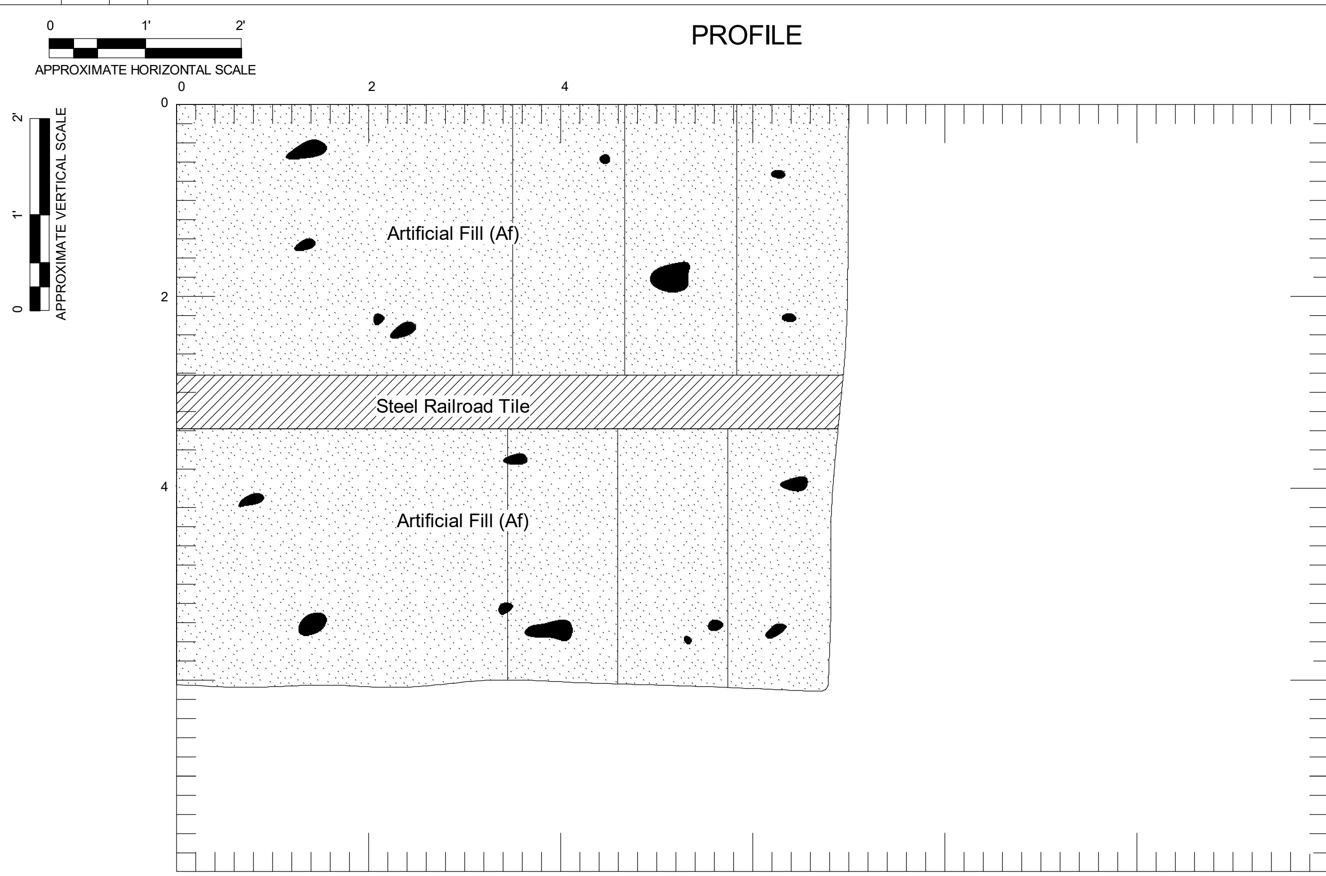
TESTPIT4

LOG OF TEST PIT No. TP-6

Project No.: 10978.000.0 Project Name: Lechuza Beach Date Excavated: 10/16/2008
Ground Elev.:35' MSL Responsible Professional: E. Bailiff Ex. Method: Hand Excavation Logged By: E. Bailiff

DEPTH (feet)	Sample	Symbol	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.
			ARTIFICIAL FILL (Af) SILTY SAND (SM) to CLAYEY SAND (SC): brown (10YR 5/3) to dark gray (7.5YR 4/1) to black (7.5YR 2.4/1), moist, 70 to 75% fine sand, 20% non to low plasticity fines, 5-10% sand to coarse gravel size sandstone clasts. Trace black asphalt-like material near bottom of test pit, no petroleum odor.
1			
			@1.4', steel rail tranding parallel to beach encountered on south side of excavation, rotted wood for ties, steel railroad spike.
2			
3			
			Bottom of test pit at 3.2', unable to excavate deeper, hard. Test pit backfilled with spoils to ground surface. No groundwater encountered.

PROFILE



TESTPIT4

PROJECT: LECHUZA BEACH IMPROVEMENTS Malibu, California	**Log of Boring No. Tripod-1**

BORING LOCATION: West Sea Level Drive - South side of proposed parking space DD		
DATE STARTED: 4/4/12	DATE FINISHED: 4/4/12	NOTES: Drilling Contractor: DP Reynolds Corp Drilling Equipment: Honda GX340 11.0 hydraulic mtr Logged By: E. Forcier
DRILLING METHOD: 6" solid flight (limited access)		
HAMMER WEIGHT: 140 lb	DROP: 24 in. (non-standard)	
SAMPLER: tripod cathead & pulley		

ELEV. (feet)	DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ 6 inches	MATERIAL DESCRIPTION Surface Elevation: ~34' MSL (not surveyed)	LABORATORY TESTS: Moisture Content (%)	Dry Density (pcf)	Other Tests
	0–1				SANDY LEAN CLAY (CL): very dark grayish brown (10YR 3/2), moist, ~55% fines, ~45% fine sand, medium plasticity [FILL]			EI
	1–2.5	1	B		SANDY LEAN CLAY (CL): very dark grayish brown (10YR 3/2), moist, ~55% fines, ~45% fine sand, medium plasticity [NATIVE]			
	2.5–3.5	2		17 44	dark reddish brown (5YR 3/3)	13.2	117.5	UC
	3.5				Bottom of boring at 3.5' bgs. No groundwater encountered at time of drilling. Boring backfilled with soil cuttings.			

Depth scale: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

GEO3-6-INCH

PROJECT: LECHUZA BEACH IMPROVEMENTS
Malibu, California

Log of Boring No. Tripod-2

BORING LOCATION: West Sea Level Drive - South side of proposed parking space D

DATE STARTED: 4/4/12 | DATE FINISHED: 4/4/12

DRILLING METHOD: 6" solid flight (limited access)

HAMMER WEIGHT: 140 lb | DROP: 24 in. (non-standard)

SAMPLER: tripod cathead & pulley

NOTES:
Drilling Contractor: DP Reynolds Corp
Drilling Equipment: Honda GX340 11.0 hydraulic mtr
Logged By: E. Forcier

ELEV. (feet)	DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ 6 inches	MATERIAL DESCRIPTION (Surface Elevation: ~34' MSL (not surveyed))	LABORATORY TESTS: Moisture Content (%)	LABORATORY TESTS: Dry Density (pcf)	LABORATORY TESTS: Other Tests
	0				SANDY LEAN CLAY (CL): very dark grayish brown (10YR 3/2), moist, ~55% fines, ~45% fine sand, medium plasticity			
	1							
	2							
	3	1		20, 60	dark reddish brown (5YR 3/3)	10.8	115.5	DS % <#200 =53
	4							
	4.5				CLAYEY SAND (SC): brown (10YR 4/3), moist, ~65% fine to medium sand, ~30% medium plasticity fines, ~5% fine gravel-sized siltstone fragments			
	5	2		26, 36		12.3	113.1	DS % <#200 =29
	6							
	7				CLAYEY SAND with GRAVEL (SC): brown (10YR 4/3), moist, ~40% fine to coarse sand and siltstone fragments, ~30% fine to coarse gravel-sized siltstone, ~30% medium plasticity fines			
	7.5	3		60/6"				
	8				Bottom of boring at 8' bgs. No groundwater encountered at time of drilling. Boring backfilled with soil cuttings.			
	9							
	10							
	11							
	12							
	13							
	14							
	15							

GEO3-6-INCH

PROJECT: LECHUZA BEACH IMPROVEMENTS
Malibu, California

Log of Boring No. Tripod-3

BORING LOCATION: West Sea Level Drive - North side of proposed parking space D

DATE STARTED: 4/4/12	DATE FINISHED: 4/4/12	NOTES: Drilling Contractor: DP Reynolds Corp; Drilling Equipment: Honda GX340 11.0 hydraulic mtr; Logged By: E. Forcier
DRILLING METHOD: 6" solid flight (limited access)		
HAMMER WEIGHT: 140 lb	DROP: 24 in. (non-standard)	
SAMPLER: tripod cathead & pulley		

Surface Elevation: ~34' MSL (not surveyed)

ELEV. (feet)	DEPTH (feet)	Sample No.	Sample	Blows/ 6 inches	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other Tests
	0–3	1			SANDY SILT (ML): dark brown (10YR 3/3), moist, ~60% fines, ~30% fine to coarse sand, ~10% fine gravel (siltstone fragments), low plasticity [FILL?]			
	3–5	2		18 27	SANDY LEAN CLAY (CL): dark reddish brown (5YR 3/3), moist, ~60% fines, ~40% fine sand, medium plasticity [NATIVE]	12.2	111.7	DS % <#200 =60
	5–6.5	3		22 36	CLAYEY SAND (SC): brown (10YR 3/3), moist, ~55% fine sand, ~45% medium plasticity fines, fragments of coarse gravel-sized siltstone			
	6.5–7.5	4		50/6"	CLAYEY SAND with GRAVEL (SC): brown (10YR 4/3), moist, ~40% fine to coarse sand and siltstone fragments, ~30% fine to coarse gravel-sized siltstone, ~30% medium plasticity fines			
					Bottom of boring at 7.5' bgs. No groundwater encountered at time of drilling. Boring backfilled with soil cuttings.			

GEO3-6-INCH

amec

Project No. 10978.000.0

APPENDIX C

Site Photographs

West Sea Level - existing overlook, retaining wall and stairs

West Sea Level - existing stairs and retaining wall

APPENDIX C
WEST SEA LEVEL PHOTOGRAPHS
Lechuza Beach Public Access
Improvements Project
Malibu, California

By: db	Date: 04/20/10	Project No.: 10978.000.0
amec		Photos **1 and 2**

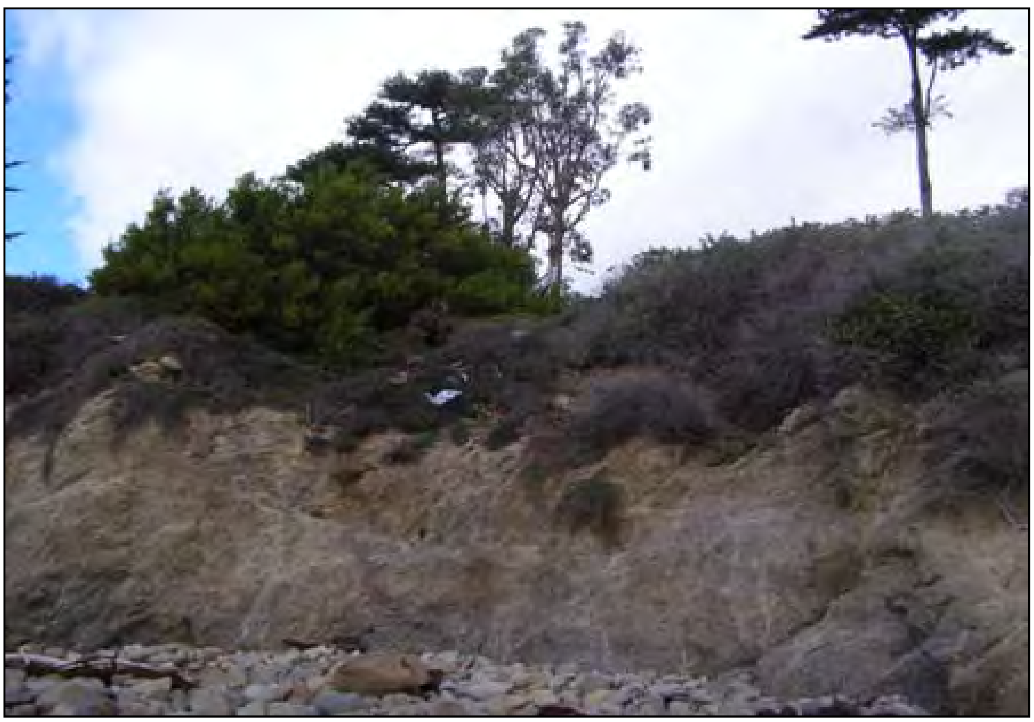
West Sea Level - base of stairs, January 2010

West Sea Level - existing retaining wall at overlook

APPENDIX C
WEST SEA LEVEL PHOTOGRAPHS
Lechuza Beach Public Access
Improvements Project
Malibu, California

By: db	Date: 04/20/10	Project No.: 10978.000
	amec	Photos **3 and 4**

West Sea Level - proposed new viewing area (vegetated area)



West Sea Level - sandstone slope below proposed new viewing area
(green vegetated area)

APPENDIX C
WEST SEA LEVEL PHOTOGRAPHS
Lechuza Beach Public Access
Improvements Project
Malibu, California

By: db	Date: 04/20/10	Project No.: 10978.000
amec		Photos **5 and 6**

West Sea Level - sandstone slope below proposed new viewing area (green vegetated area)

West Sea Level - brecciated sandstone bedrock adjacent to existing stairs and retaining wall

APPENDIX C
WEST SEA LEVEL PHOTOGRAPHS
Lechuza Beach Public Access
Improvements Project
Malibu, California

By: db	Date: 04/20/10	Project No.: 10978.000
amec		Photos **7 and 8**

West Sea Level - test pit TP-3 located at base of West Sea Level stairs

West Sea Level - test pit TP-3 located at base of West Sea Level stairs

APPENDIX C
WEST SEA LEVEL PHOTOGRAPHS
Lechuza Beach Public Access
Improvements Project

By: db	Date: 04/20/10	Project No.: 10978.000
amec		Photos **9 and 10**

West Sea Level - test pit TP-3 located at base of West Sea Level stairs

West Sea Level - test pit TP-5 located in proposed new viewing area

APPENDIX C
WEST SEA LEVEL PHOTOGRAPHS
Lechuza Beach Public Access
Improvements Project
Malibu, California

By: db	Date: 04/20/10	Project No.: 10978.000
amec		Photos **11 and 12**

P:\10978.000.0\Docs\Geotechnical Investigation Report\Final Report\Appendix C\Photo Log

West Sea Level - test pit TP-6 located in existing overlook area

West Sea Level - test pit TP-6 located in existing overlook area

APPENDIX C
WEST SEA LEVEL PHOTOGRAPHS
Lechuza Beach Public Access
Improvements Project
Malibu, California

By: db	Date: 04/20/10	Project No.: 10978.000
amec		Photos **13 and 14**

sandstone outcrop near West Sea Level

sandstone outcrop near West Sea Level

APPENDIX C
WEST SEA LEVEL PHOTOGRAPHS
Lechuza Beach Public Access
Improvements Project
Malibu, California

By: db	Date: 04/20/10	Project No.: 10978.000
amec		Photos **15 and 16**

East Sea Level - slopewash and retaining wall located mid-point on Lot I stairs

East Sea Level - slopewash at mid-point of Lot I stairs (location of TP-1)

APPENDIX C
EAST SEA LEVEL PHOTOGRAPHS
Lechuza Beach Public Access
Improvements Project
Malibu, California

By: db	Date: 04/20/10	Project No.: 10978.000
amec		Photos **17 and 18**

East Sea Level - test pit TP-1 located midway on Lot I stairs

East Sea Level - test pit TP-1 located midway on Lot I stairs

APPENDIX C
EAST SEA LEVEL PHOTOGRAPHS
Lechuza Beach Public Access
Improvements Project
Malibu, California

By: db	Date: 04/20/10	Project No.: 10978.000
amec		Photos **19 and 20**

East Sea Level - test pit TP-2 proposed view platform of bottom of Lot I stairs

East Sea Level - test pit TP-2 proposed view platform at bottom of Lot I stairs

APPENDIX C
EAST SEA LEVEL PHOTOGRAPHS
Lechuza Beach Public Access
Improvements Project
Malibu, California

By: db	Date: 04/20/10	Project No.: 10978.000
amec		Photos **21 and 22**

East Sea Level - view east, proposed view platform, parking space "Z" and path areas

East Sea Level - view west, propsed view platform/beach access and parking space "Z"

APPENDIX C
EAST SEA LEVEL PHOTOGRAPHS
Lechuza Beach Public Access
Improvements Project
Malibu, California

By: db	Date: 04/20/10	Project No.: 10978.000
amec		Photos **23 and 24**

East Sea Level - base of Lot I stairs, October 2009

APPENDIX C
EAST SEA LEVEL PHOTOGRAPHS
Lechuza Beach Public Access
Improvements Project
Malibu, California

By: db	Date: 04/20/10	Project No.: 10978.000
amec		Photos **25**

East Sea Level - test pit TP-4 located at base of Lot I stairs

East Sea Level - test pit TP-4 located at base of Lot I stairs

APPENDIX C
EAST SEA LEVEL PHOTOGRAPHS
Lechuza Beach Public Access
Improvements Project
Malibu, California

By: db	Date: 04/20/10	Project No.: 10978.000
amec		Photos **26 and 27**

East Sea Level - base of Lot I stairs, February 2010

East Sea Level - base of Lot I stairs, February 2010

APPENDIX C EAST SEA LEVEL PHOTOGRAPHS Lechuza Beach Public Access Improvements Project Malibu, California		
By: db	Date: 04/20/10	Project No.: 10978.000
amec		Photos **28 and 29**

East Sea Level - base Lot I stairs, February 2010

APPENDIX C
EAST SEA LEVEL PHOTOGRAPHS
Lechuza Beach Public Access
Improvements Project
Malibu, California

By: db	Date: 04/20/10	Project No.: 10978.000
amec		Photos 30

APPENDIX D

Laboratory Testing Program

MATERIAL IN SOILS FINER THAN No. 200 SIEVE

(ASTM-D1140)

Project Name:	Lechuza Beach Public Access	*Project No.:*	0109780000
Date:	4/05-4/10/2012	*Tested By:*	VC, LT

Boring No.	TRIPOD-2	TRIPOD-2		TRIPOD-3			
Sample No.	1	2		2			
Sample Depth (Ft)	3.0-3.5	5.5-6.0		3.0-3.5			
Tare No.:	1	13		15			
Total Dry Weight and Tare (g):	344.07	277.25		207.11			
Tare Weight (g):	97.23	98.35		97.11			
Total Dry Weight of Sample (g):	246.84	178.90		110.00			
Dry Weight of Soil Retained on No. 200 Sieve (g):	116.53	126.38		44.17			
Percentage of Material Finer Than No. 200 (75 mm) Sieve (%):	52.8	29.4		59.8			
Soil Description	Dark Reddish Brown (5YR, 3/3) Sandy Lean Clay (CL)	Dark Reddish Brown (5YR, 3/3) Clayey Sand (SC)		Dark Reddish Brown (5YR, 3/3) Sandy Lean Clay (CL)			

amec

EXPANSION INDEX TEST

ASTM D4829

PROJECT NAME:	Lechuza Beach Public Access	*PROJECT No.:*	0109780000
BORING No.:	TRIPOD-1 *SAMPLE No.:*	*DEPTH:*	0-2.5 Feet
SOIL DESCRIPTION:	Very Dark Grayish Brown (10YR, 3/2) Sandy Lean Clay (CL)		
		DATE: 4/05-4/09/12	*BY:* LT

SPECIMEN PREPARATION

WET DENSITY CALCULATION	TRIAL 1	TRIAL 2	TRIAL 3	TRIAL 4
RING No.	1			
RING AND WET SOIL, gr.	577.98			
WEIGHT OF RING, gr.	199.54			
WEIGHT OF WET SOIL, gr.	378.44			
WET DENSITY, PCF.	114.7			
MOISTURE CALCULATION				
TARE No.	5			
WET SOIL AND TARE, gr.	386.59			
DRY SOIL AND TARE, gr.	356.72			
TARE WEIGHT, gr.	97.26			
MOISTURE CONTENT, %	11.5			
DRY DENSITY, PCF.	102.9			
SATURATION DEGREE (S), % (1)	48.95			

EXPANSION INDEX (EI) CALCULATION

APPARATUS No.:	1
INITIAL SPECIMEN HEIGHT:	1.0000 inch

		HEIGHT CHANGE, in.	DATE	TIME
INITIAL DIAL READING, in.	0.0500	0.0000	4/6/2012	14:56
PERIODIC DIAL READING, in.	0.0924	0.0424	4/9/2012	10:24

FINAL DIAL READING, in.	0.0924	0.0424	4/9/2012	12:28

$\boxed{\text{EI = 42}}$

FINAL MOISTURE CONTENT, DRY DENSITY AND SATURATION DEGREE

TARE No.	---	MOISTURE CONTENT, %	26.0
WET SOIL AND TARE, gr.	417.77	FINAL VOLUME, cc.	214.66
DRY SOIL AND TARE, gr.	331.54	FINAL DRY DENSITY, PCF.	98.7
TARE WEIGHT, gr.	0.00	FINAL SATURATION, %	99.7

----

(1) $S = \dfrac{wG_s\gamma_d}{G_s\gamma_w - \gamma_d}$ (S must be 50 ± 2%)

UNCONFINED COMPRESSIVE STRENGTH TEST

(ASTM-D2166)

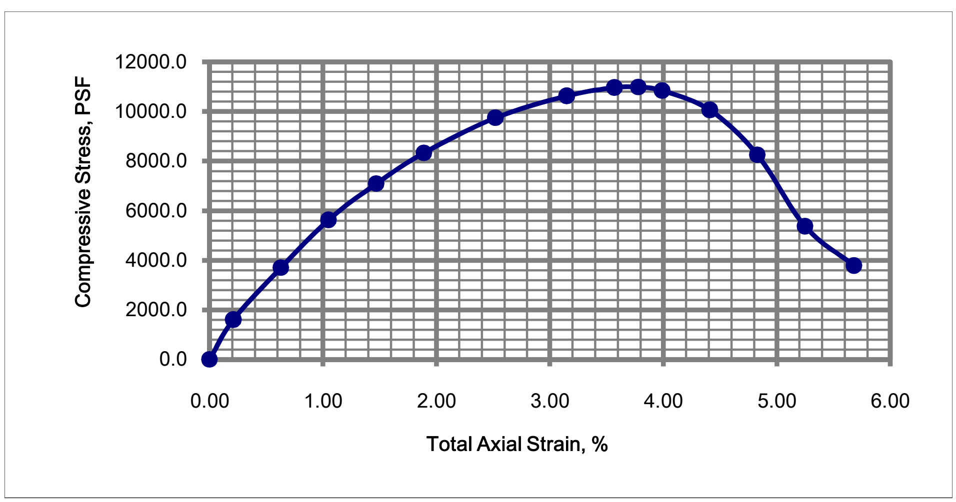
Project Name:	Lechuza Beach Public Access			*Project No.:*	0109780000
Boring No.:	TRIPOD-1	*Sample No.:*	1	*Depth:*	3.0-3.5 Feet
Soil Description:	Dark Reddish Brown (5YR, 3/3) Sandy Lean Clay (CL)				
Date:	4/10/2012			By:	LT

Initial Diameter, in:	2.416
Initial Area, in^2:	4.584
Initial Height, in:	5.000
Height-to-Diameter Ratio:	2.07
Type of Sample:	Undisturbed
Strain Rate, % / minute:	0.99
Note: Moisture content specimen was obtained after test.	

Wet Weight of Sample, grs:	800.62
Moisture Content-	
Tare No.:	MC-57
Wet Weight&Tare, grs:	269.62
Dry Weight & Tare, grs:	244.03
Tare Weight, grs:	50.22
Moisture Content, %:	13.2
Wet Density, pcf:	133.1
Dry Density, pcf:	117.5

Elapsed Time	Axial Load, Pounds	Strain Dial Reading, in	Total Strain, %	Corrected Area, in^2	Compressive Stress, PSF	Remarks
00:00:00	0.0	0.000	0.00	4.584	0.0	
	51.2	0.010	0.21	4.594	1605.3	
	118.6	0.031	0.63	4.613	3701.4	
	181.3	0.052	1.05	4.633	5634.9	
	229.3	0.073	1.47	4.653	7097.2	
	270.5	0.094	1.89	4.673	8337.0	
	318.5	0.126	2.52	4.703	9753.8	
	349.7	0.157	3.15	4.733	10639.3	
	362.3	0.178	3.57	4.754	10973.0	
	363.7	0.189	3.78	4.764	10992.5	
	359.8	0.199	3.99	4.775	10849.6	Cracked;
	335.4	0.220	4.41	4.796	10070.5	Bulge
	276.3	0.241	4.83	4.817	8258.6	
	180.6	0.262	5.25	4.838	5374.5	
00:05:44	127.9	0.284	5.68	4.860	3789.3	

Photo



Unconfined Compressive Strength, PSF = 10992

Shear Strength, PSF = 5496

DIRECT SHEAR TEST

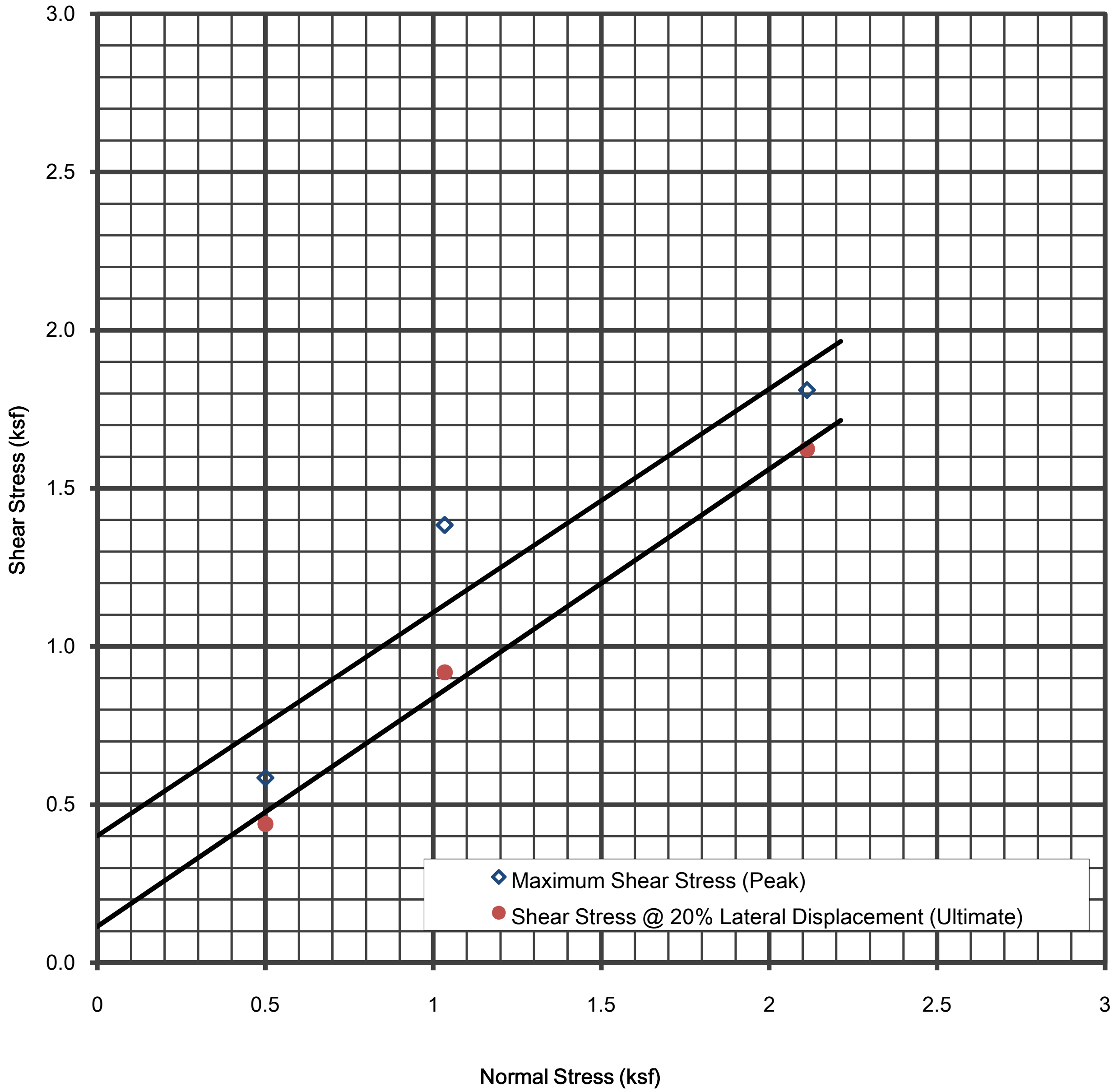
(ASTM-D3080)

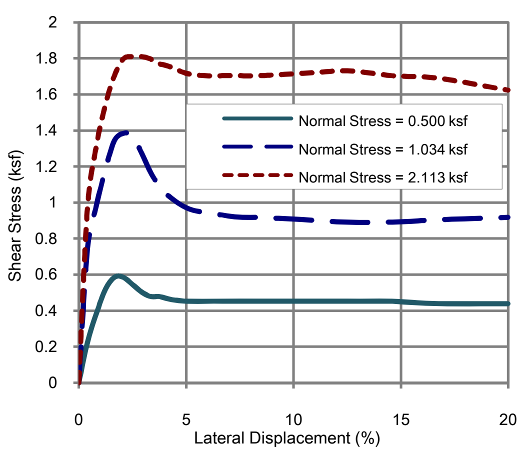
Project Name:	Lechuza Beach Public Access				*Project No.:*		0109780000
Boring No.:	TRIPOD-2	*Sample No.:*	1	*Depth:*	3.0-3.5 Feet	*Date:*	4/05-4/09/2012
Soil Description:	Dark Reddish Brown (5YR, 3/3) Sandy Lean Clay (CL)					*Tested By:*	LT

				Before Test	After Test Load 1	After Test Load 2	After Test Load 3
Sample Diameter, in:	2.416	Weight of Wet Soil & Ring, gr:		596.46	---	---	---
Normal Stress, ksf:	0.5, 1, 2	Weight of Ring, gr:		134.55	---	---	---
Over-burdened @, pcf:		Height of Sample, in:		3.00	0.9854	0.9832	0.9610
Shear Rate, in/min:	0.005	Moisture-	Tare No.:	1	---	---	---
Natural Moisture(x):			Wet Weight and Tare, gr:	370.61	156.97	158.43	153.85
Saturated(x):	X		Dry Weight and Tare, gr:	344.07	135.12	136.47	133.91
Intact(x):	X		Tare Weight, gr:	97.23	0.00	0.00	0.00
Remolded to, pcf:			Moisture Content, %:	10.8	16.2	16.1	14.9
@, %:		Wet Density, pcf:		127.9	136.2	136.4	138.1
Notes:		Dry Density, pcf:		115.5	117.2	117.5	120.2
		Saturation %:	S.G. = 2.70 (Assumed)	63.2	99.7	100.0	100.0

Load 1 (KSF): 0.500				Load 2 (KSF): 1.034				Load 3 (KSF): 2.113			
Shear Deflec -tion (in)	Lateral Displace -ment (%)	Load Ring Reading	Shear Stress (KSF)	Shear Deflec -tion (in)	Lateral Displace -ment (%)	Load Ring Reading	Shear Stress (KSF)	Shear Deflec -tion (in)	Lateral Displace -ment (%)	Load Ring Reading	Shear Stress (KSF)
0.0098	0.406	0.0014	0.226	0.0098	0.406	0.0053	0.745	0.0098	0.406	0.0070	0.971
0.0199	0.823	0.0026	0.385	0.0199	0.823	0.0071	0.985	0.0199	0.823	0.0096	1.318
0.0300	1.241	0.0036	0.519	0.0300	1.241	0.0086	1.184	0.0300	1.241	0.0113	1.544
0.0401	1.659	0.0041	0.585	0.0401	1.659	0.0098	1.344	0.0401	1.659	0.0125	1.704
0.0502	2.077	0.0041	0.585	0.0502	2.077	0.0101	1.384	0.0502	2.077	0.0132	1.797
0.0603	2.495	0.0038	0.545	0.0603	2.495	0.0100	1.371	0.0603	2.495	0.0133	1.810
0.0704	2.912	0.0035	0.505	0.0704	2.912	0.0093	1.278	0.0704	2.912	0.0133	1.810
0.0805	3.330	0.0033	0.479	0.0805	3.330	0.0085	1.171	0.0805	3.330	0.0132	1.797
0.0905	3.748	0.0033	0.479	0.0905	3.748	0.0079	1.091	0.0905	3.748	0.0130	1.770
0.1006	4.166	0.0032	0.465	0.1006	4.166	0.0075	1.038	0.1006	4.166	0.0129	1.757
0.1208	5.002	0.0031	0.452	0.1208	5.002	0.0070	0.971	0.1208	5.002	0.0126	1.717
0.1410	5.837	0.0031	0.452	0.1410	5.837	0.0068	0.945	0.1410	5.837	0.0125	1.704
0.1612	6.673	0.0031	0.452	0.1612	6.673	0.0067	0.931	0.1612	6.673	0.0125	1.704
0.1814	7.509	0.0031	0.452	0.1814	7.509	0.0066	0.918	0.1814	7.509	0.0125	1.704
0.2016	8.344	0.0031	0.452	0.2016	8.344	0.0066	0.918	0.2016	8.344	0.0125	1.704
0.2521	10.433	0.0031	0.452	0.2521	10.433	0.0065	0.905	0.2521	10.433	0.0126	1.717
0.3025	12.523	0.0031	0.452	0.3025	12.523	0.0064	0.891	0.3025	12.523	0.0127	1.730
0.3530	14.612	0.0031	0.452	0.3530	14.612	0.0064	0.891	0.3530	14.612	0.0125	1.704
0.4035	16.701	0.0030	0.439	0.4035	16.701	0.0065	0.905	0.4035	16.701	0.0124	1.690
0.4828	19.982	0.0030	0.439	0.4828	19.982	0.0066	0.918	0.4828	19.982	0.0119	1.624

Max. Shear Stress, ksf:	0.585	1.384	1.810
Shear Deflt.@Max Stress,%.:	2.1	2.1	2.9





Boring No.:	TRIPOD-2
Sample Depth :	3.0-3.5 Feet
Soil Type:	CL
Sample Conditions:	Intact; Saturated
Shear Rate:	0.005 inch/minute
In-Place Dry Density (PCF):	115.5
In-Place Moisture Content (%):	10.8

	◇	●
Cohesion (PSF):	401	115
Friction Angle (Degrees):	35	36

amec	DIRECT SHEAR TEST LECHUZA BEACH PUBLIC ACCESS Malibu, California	Project No. 0109780000

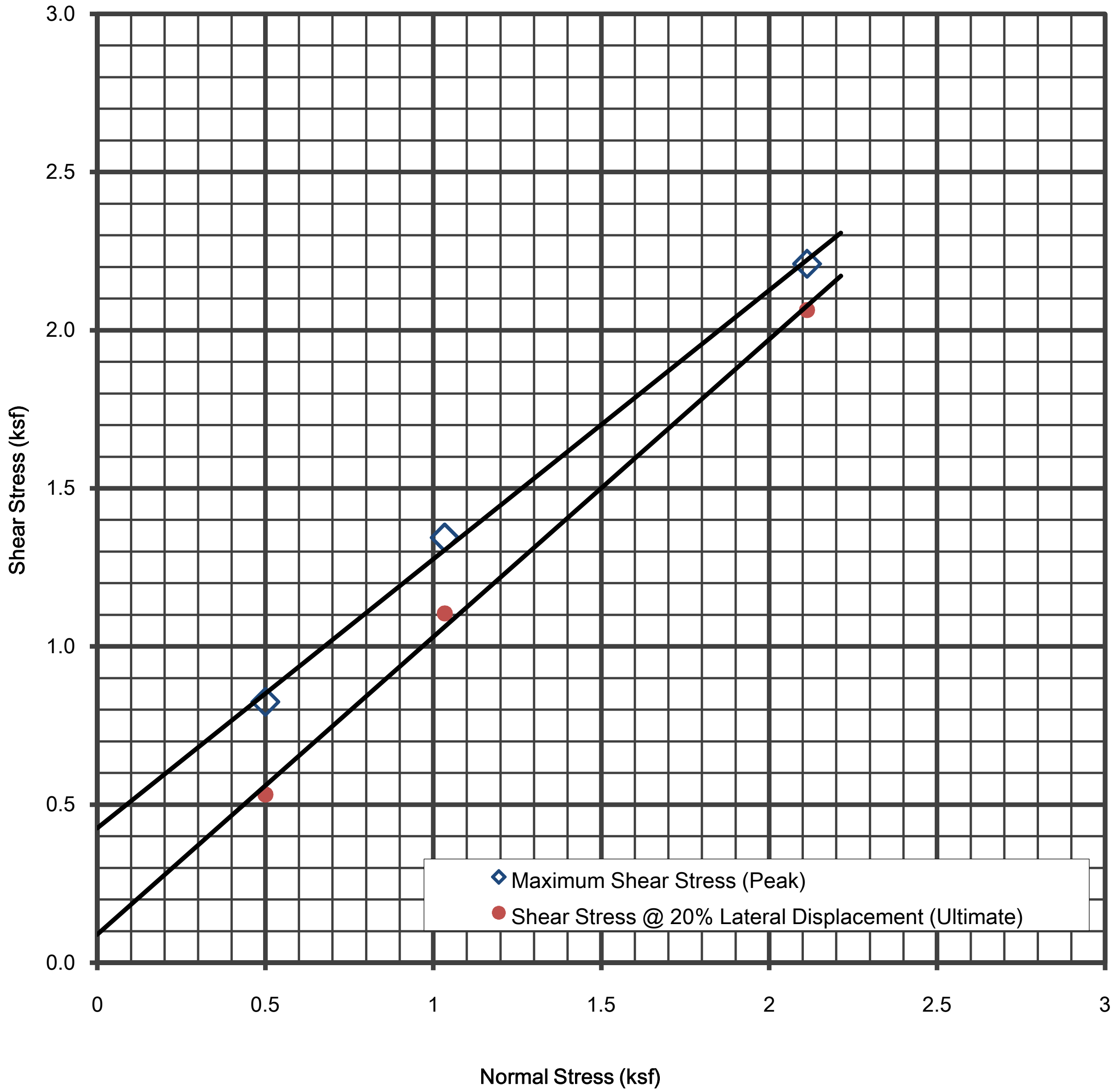
DIRECT SHEAR TEST

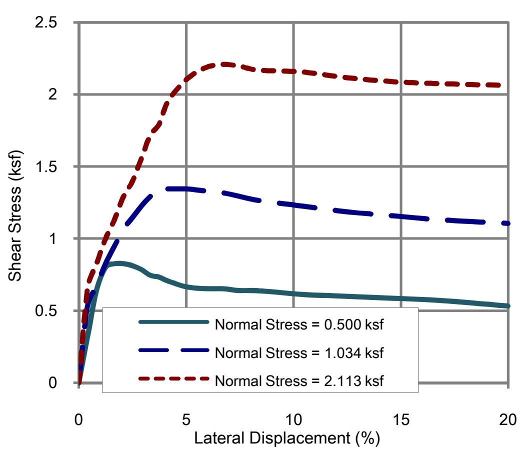
(ASTM-D3080)

Project Name:	Lechuza Beach Public Access			*Project No.:*		0109780000	
Boring No.:	TRIPOD-2	*Sample No.:*	2	*Depth:*	5.5-6.0 Feet	*Date:*	4/05-4/10/2012
Soil Description:	Dark Reddish Brown (5YR, 3/3) Clayey Sand (SC)					*Tested By:*	LT

				Before Test	After Test Load 1	After Test Load 2	After Test Load 3
Sample Diameter, in:	2.416	Weight of Wet Soil & Ring, gr:		589.55	---	---	---
Normal Stress, ksf:	0.5, 1, 2	Weight of Ring, gr:		131.16	---	---	---
Over-burdened @, pcf:		Height of Sample, in:		3.00	0.9979	0.9881	0.9756
Shear Rate, in/min:	0.005	Moisture-	Tare No.:	13	---	---	---
Natural Moisture(x):			Wet Weight and Tare, gr:	299.17	156.66	156.32	153.56
Saturated(x):	X		Dry Weight and Tare, gr:	277.25	132.72	133.09	131.46
Intact(x):	X		Tare Weight, gr:	98.35	0.00	0.00	0.00
Remolded to, pcf:			Moisture Content, %:	12.3	18.0	17.5	16.8
@, %:		Wet Density, pcf:		127.0	133.8	134.5	135.4
Notes:		Dry Density, pcf:		113.1	113.4	114.5	115.9
		Saturation %:	S.G. = 2.70 (Assumed)	67.5	100.0	99.7	100.0

Load 1 (KSF): 0.500				Load 2 (KSF): 1.034				Load 3 (KSF): 2.113			
Shear Deflec -tion (in)	Lateral Displace -ment (%)	Load Ring Reading	Shear Stress (KSF)	Shear Deflec -tion (in)	Lateral Displace -ment (%)	Load Ring Reading	Shear Stress (KSF)	Shear Deflec -tion (in)	Lateral Displace -ment (%)	Load Ring Reading	Shear Stress (KSF)
0.0098	0.406	0.0021	0.319	0.0098	0.406	0.0037	0.532	0.0098	0.406	0.0046	0.652
0.0199	0.823	0.0045	0.638	0.0199	0.823	0.0047	0.665	0.0199	0.823	0.0059	0.825
0.0300	1.241	0.0057	0.798	0.0300	1.241	0.0059	0.825	0.0300	1.241	0.0072	0.998
0.0401	1.659	0.0059	0.825	0.0401	1.659	0.0068	0.945	0.0401	1.659	0.0082	1.131
0.0502	2.077	0.0059	0.825	0.0502	2.077	0.0077	1.065	0.0502	2.077	0.0094	1.291
0.0603	2.495	0.0058	0.811	0.0603	2.495	0.0083	1.144	0.0603	2.495	0.0102	1.397
0.0704	2.912	0.0056	0.785	0.0704	2.912	0.0089	1.224	0.0704	2.912	0.0114	1.557
0.0805	3.330	0.0053	0.745	0.0805	3.330	0.0094	1.291	0.0805	3.330	0.0126	1.717
0.0905	3.748	0.0052	0.732	0.0905	3.748	0.0098	1.344	0.0905	3.748	0.0132	1.797
0.1006	4.166	0.0050	0.705	0.1006	4.166	0.0098	1.344	0.1006	4.166	0.0144	1.957
0.1208	5.002	0.0047	0.665	0.1208	5.002	0.0098	1.344	0.1208	5.002	0.0155	2.103
0.1410	5.837	0.0046	0.652	0.1410	5.837	0.0097	1.331	0.1410	5.837	0.0161	2.183
0.1612	6.673	0.0046	0.652	0.1612	6.673	0.0096	1.318	0.1612	6.673	0.0163	2.210
0.1814	7.509	0.0045	0.638	0.1814	7.509	0.0094	1.291	0.1814	7.509	0.0162	2.196
0.2016	8.344	0.0045	0.638	0.2016	8.344	0.0092	1.264	0.2016	8.344	0.0160	2.170
0.2521	10.433	0.0043	0.612	0.2521	10.433	0.0089	1.224	0.2521	10.433	0.0159	2.156
0.3025	12.523	0.0042	0.598	0.3025	12.523	0.0086	1.184	0.3025	12.523	0.0156	2.116
0.3530	14.612	0.0041	0.585	0.3530	14.612	0.0084	1.158	0.3530	14.612	0.0154	2.090
0.4035	16.701	0.0040	0.572	0.4035	16.701	0.0082	1.131	0.4035	16.701	0.0153	2.077
0.4828	19.982	0.0037	0.532	0.4828	19.982	0.0080	1.104	0.4828	19.982	0.0152	2.063
Max. Shear Stress, ksf:			0.825				1.344				2.210
Shear Deflt.@Max Stress,%.:			2.1				5.0				6.7





Boring No.:	TRIPOD-2
Sample Depth :	5.5-6.0 Feet
Soil Type:	SC
Sample Conditions:	Intact; Saturated
Shear Rate:	0.005 inch/minute
In-Place Dry Density (PCF):	113.1
In-Place Moisture Content (%):	12.3

	◇	●
Cohesion (PSF):	426	90
Friction Angle (Degrees):	40	43

amec

DIRECT SHEAR TEST
LECHUZA BEACH PUBLIC ACCESS
Malibu, California

Project No.
0109780000

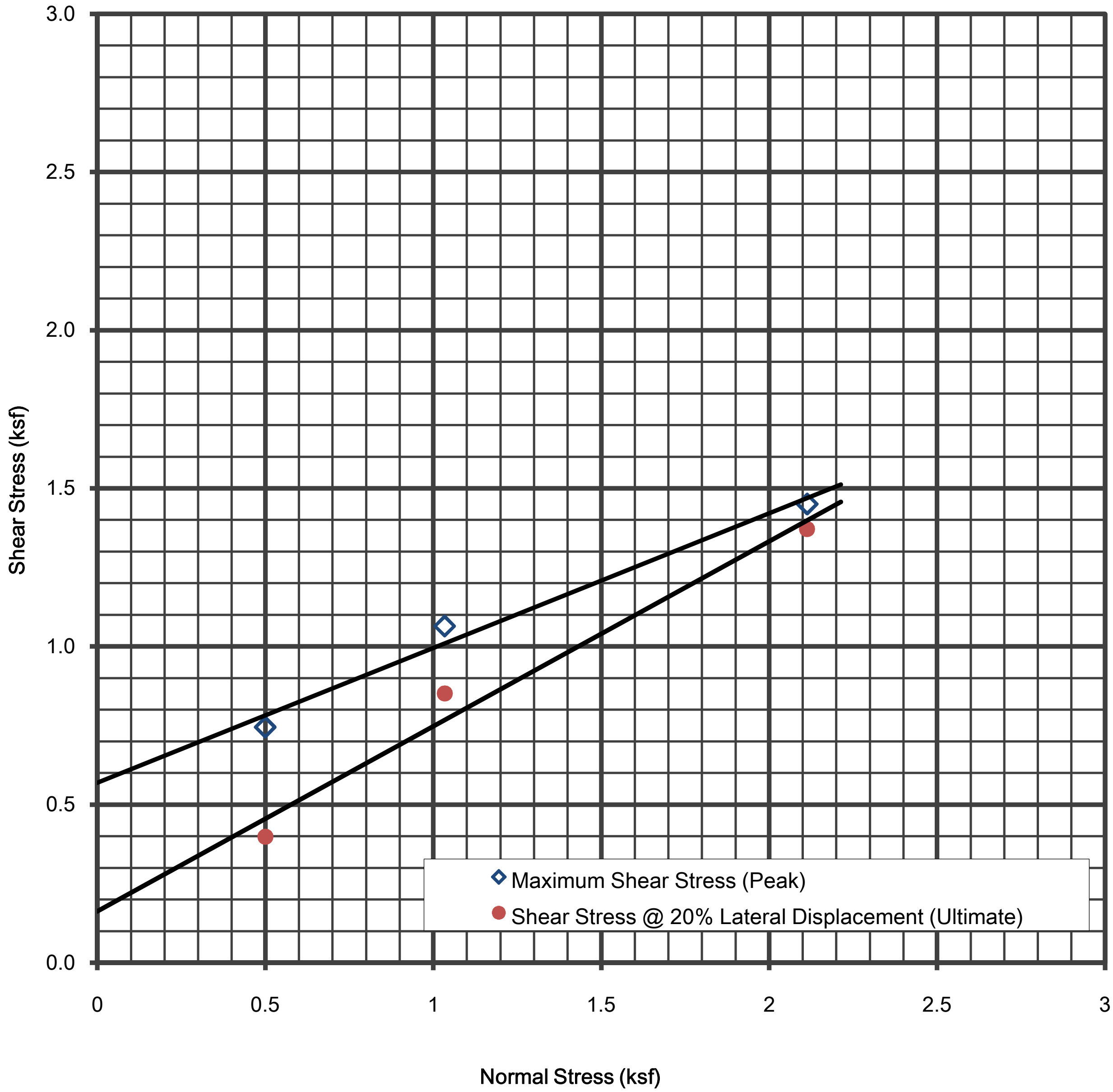
DIRECT SHEAR TEST

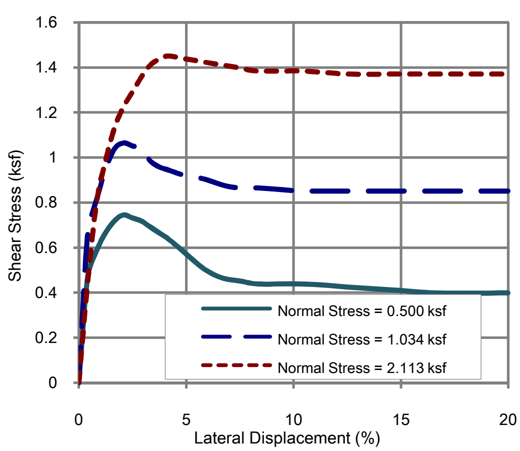
(ASTM-D3080)

Project Name:	Lechuza Beach Public Access			*Project No.:*		0109780000
Boring No.:	TRIPOD-3	*Sample No.:* 2	*Depth:*	3.0-3.5 Feet	*Date:*	4/05-4/12/2012
Soil Description:	Dark Reddish Brown (5YR, 3/3) Sandy Lean Clay (CL) [Bottom 4 rings]				*Tested By:*	LT

				Before Test	After Test Load 1	Load 2	Load 3
Sample Diameter, in:	2.416	Weight of Wet Soil & Ring, gr:		585.24	---	---	---
Normal Stress, ksf:	0.5, 1, 2	Weight of Ring, gr:		132.82	---	---	---
Over-burdened @, pcf:		Height of Sample, in:		3.00	0.9996	0.9797	0.9747
Shear Rate, in/min:	0.005	Moisture-	Tare No.:	15	---	---	---
Natural Moisture(x):			Wet Weight and Tare, gr:	220.52	156.47	153.28	153.33
Saturated(x):	X		Dry Weight and Tare, gr:	207.11	131.71	130.23	130.63
Intact(x):	X		Tare Weight, gr:	97.11	0.00	0.00	0.00
Remolded to, pcf:			Moisture Content, %:	12.2	18.8	17.7	17.4
@, %:		Wet Density, pcf:		125.3	132.8	134.2	134.5
Notes:		Dry Density, pcf:		111.7	111.7	114.0	114.6
		Saturation %:	S.G. = 2.70 (Assumed)	64.7	99.8	99.9	99.6

Load 1 (KSF): 0.500				Load 2 (KSF): 1.034				Load 3 (KSF): 2.113			
Shear Deflec -tion (in)	Lateral Displace -ment (%)	Load Ring Reading	Shear Stress (KSF)	Shear Deflec -tion (in)	Lateral Displace -ment (%)	Load Ring Reading	Shear Stress (KSF)	Shear Deflec -tion (in)	Lateral Displace -ment (%)	Load Ring Reading	Shear Stress (KSF)
0.0098	0.406	0.0032	0.465	0.0098	0.406	0.0046	0.652	0.0098	0.406	0.0030	0.439
0.0199	0.823	0.0041	0.585	0.0199	0.823	0.0058	0.811	0.0199	0.823	0.0057	0.798
0.0300	1.241	0.0047	0.665	0.0300	1.241	0.0068	0.945	0.0300	1.241	0.0071	0.985
0.0401	1.659	0.0051	0.718	0.0401	1.659	0.0075	1.038	0.0401	1.659	0.0082	1.131
0.0502	2.077	0.0053	0.745	0.0502	2.077	0.0077	1.065	0.0502	2.077	0.0089	1.224
0.0603	2.495	0.0052	0.732	0.0603	2.495	0.0076	1.051	0.0603	2.495	0.0094	1.291
0.0704	2.912	0.0051	0.718	0.0704	2.912	0.0075	1.038	0.0704	2.912	0.0099	1.357
0.0805	3.330	0.0049	0.692	0.0805	3.330	0.0071	0.985	0.0805	3.330	0.0103	1.411
0.0905	3.748	0.0047	0.665	0.0905	3.748	0.0069	0.958	0.0905	3.748	0.0105	1.437
0.1006	4.166	0.0045	0.638	0.1006	4.166	0.0068	0.945	0.1006	4.166	0.0106	1.451
0.1208	5.002	0.0040	0.572	0.1208	5.002	0.0066	0.918	0.1208	5.002	0.0105	1.437
0.1410	5.837	0.0035	0.505	0.1410	5.837	0.0065	0.905	0.1410	5.837	0.0104	1.424
0.1612	6.673	0.0032	0.465	0.1612	6.673	0.0063	0.878	0.1612	6.673	0.0103	1.411
0.1814	7.509	0.0031	0.452	0.1814	7.509	0.0062	0.865	0.1814	7.509	0.0102	1.397
0.2016	8.344	0.0030	0.439	0.2016	8.344	0.0062	0.865	0.2016	8.344	0.0101	1.384
0.2521	10.433	0.0030	0.439	0.2521	10.433	0.0061	0.851	0.2521	10.433	0.0101	1.384
0.3025	12.523	0.0029	0.425	0.3025	12.523	0.0061	0.851	0.3025	12.523	0.0100	1.371
0.3530	14.612	0.0028	0.412	0.3530	14.612	0.0061	0.851	0.3530	14.612	0.0100	1.371
0.4035	16.701	0.0027	0.399	0.4035	16.701	0.0061	0.851	0.4035	16.701	0.0100	1.371
0.4828	19.982	0.0027	0.399	0.4828	19.982	0.0061	0.851	0.4828	19.982	0.0100	1.371
Max. Shear Stress, ksf:			0.745				1.065				1.451
Shear Deflt.@Max Stress,%.:			2.1				2.1				4.2





Boring No.:	TRIPOD-3
Sample Depth :	3.0-3.5 Feet
Soil Type:	CL
Sample Conditions:	Intact; Saturated
Shear Rate:	0.005 inch/minute
In-Place Dry Density (PCF):	111.7
In-Place Moisture Content (%):	12.2

	◇	●
Cohesion (PSF):	569	162
Friction Angle (Degrees):	23	30

amec

DIRECT SHEAR TEST
LECHUZA BEACH PUBLIC ACCESS
Malibu, California

Project No.
0109780000

APPENDIX E

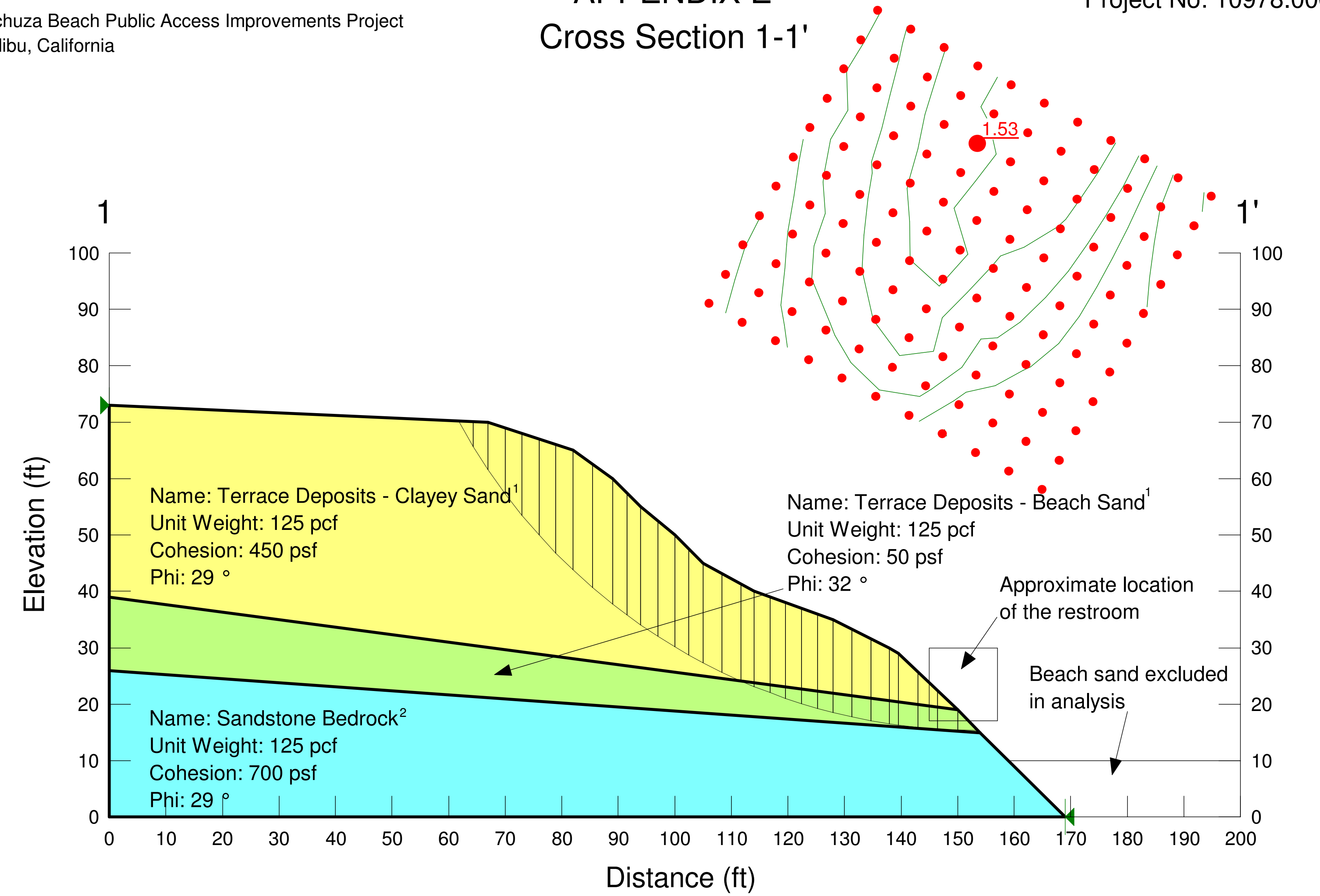
Slope Stability Analysis

GEOTECHNICAL INVESTIGATION REPORT

Lechuza Beach Public Access Improvements Project
Malibu, California

APPENDIX E
Cross Section 1-1'

Project No: 10978.000.0



Notes:
1. Shear strength parameters for Terrace Deposits adopted from G.C. Masterman & Associates (1993)
2. Shear strength parameters for Sandstone Bedrock adopted from Robert Stone & Associates (1986)

Project-Specific Reference #8

<u>SUPPORTING GEOTECHNICAL REPORT</u>

Proposed Advanced On-Site Wastewater Treatment System (AOWTS)
APN 4470-021-009
Vicinity: 31725-31721 East Sea Level Drive
Malibu, California
LA-01618-01

Prepared For

MOUNTAINS RECREATION AND CONSERVATION AUTHORITY (MRCA)

March 18, 2016

Prepared By

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March 23, 2016

LA-01618-01

Mountains Recreation and Conservation Authority (MRCA)
C/O Judi Tamasi, Project Manager
5810 Ramirez Canyon Road
Malibu, California 90265

Subject: **Supporting Geotechnical Report**
Proposed Advanced On-Site Wastewater Treatment Systems (AOWTS)
APN 4470-021-009
Vicinity: 31725-31721 East Sea Level Drive
Malibu, California

Presented herewith is the Preliminary Supporting Geotechnical Report, as authorized, for the site of a proposed advanced on-site wastewater treatment system (AOWTS) in the City of Malibu, California. A design level report will be prepared by others under a separate cover. The conclusions and recommendations contained in this report are based upon Earth Systems' understanding of the proposed AOWTS and on analyses of the data obtained from the field and laboratory testing programs. The recommendations provided in this report generally pertain to criteria for City of Malibu Environmental Health Division conformance review. Earth Systems strives to provide analyses and recommendations in accordance with the applicable standards of care for the geotechnical engineering profession at the time the study is conducted.

The submittal of this report marks the completion of the scope of geotechnical engineering services described in Earth Systems' proposal dated May 8, 2015 (revised May 14, 2015) and authorized on May 5, 2015. Other services which may be required, such as consultation and plan review, are additional services that will be billed according to the Fee Schedule in effect at the time such services are provided. Budgets for these services, which are dependent upon design and construction schedules, can be provided when requested. Earth Systems appreciates this opportunity to provide professional geotechnical engineering services for this project. If you need clarification of the information contained in this report, or if Earth Systems can be of additional service, please contact the undersigned.

Respectfully submitted,
Earth Systems

Wm. LaChapelle

William LaChapelle, P.G., E.G.
Project Engineering Geologist

Distribution:
- 3 – Addressee (hard copy)
- 1 – Addressee (CD, pdf copy)

TABLE OF CONTENTS

PAGE

March 18, 2016 LA-01618-01

SUPPORTING GEOTECHNICAL REPORT
PROPOSED ADVANCED ON-SITE WASTEWATER TREATMENT SYSTEM (AOWTS)
APN 4470-021-009
VICINITY: 31725-31721 EAST SEA LEVEL DRIVE
MALIBU, CALIFORNIA

INTRODUCTION

As requested, Earth Systems Southern California has prepared this Supporting Geotechnical Report to provide a geologic evaluation of the proposed leachfield on the above referenced property. This report was prepared with the intention of submitting for review and approval by Environmental Health prior to completion of Conformance Review.

This report is aimed at meeting the requirements of the City of Malibu Environmental Health Division "Submittal Requirements for an Alternative Onsite Wastewater Treatment System" §4) Supporting Geology/Soils Report. It is intended to provide information to be used by the System Designer Barbara Bradley, PE (Advanced Onsite Water Co.) for design of the AOWTS. Local geology, soils, groundwater, anticipated effluent path and site stability are addressed. The information provided in this report is intended to allow the AOWTS design to meet the standards of the City of Malibu Policy for "Onsite Wastewater Treatment System Design Requirements for Beachfront Properties" as well as the standards of the City of Malibu Local Coastal Plan (LCP) and Local Implementation Plan (LIP) as adopted by the California Coastal Commission.

SITE DESCRIPTION

The subject property is located in westernmost Los Angeles County, about 40 miles west of the Los Angeles Civic Center and ten miles west of the Malibu Civic Center. State Highway 1 or Pacific Coast Highway (PCH) is located approximately 600 feet north of the subject property and U.S. Highway 101 is located approximately 8.5 miles farther north. Kanan-Dume Road (3.5 miles east) traverses the distance between these two major east-west routes by following Triunfo Canyon on the north slope of the Santa Monica Mountain Range and Escondido Canyon on the south. Eight miles east of the site, Las Virgenes Canyon Road follows Malibu Canyon, the only antecedent drainage between the Los Angeles River and the Oxnard Plain that traverses the entire Santa Monica Mountain Range. Kanan-Dume Road and Las Virgenes Canyon Road serve as the main north-south arteries between Highway 101 and PCH. Encinal Canyon Road comprises a secondary route that intersects PCH approximately 1-mile west of the subject property.

Residential development in Malibu is primarily concentrated along the beaches and the major arterial roads described above. Small residential communities are also present in the Malibu and the unincorporated County of Los Angeles area along and adjacent to roadways, including the area of the subject site along Broad Beach Road and along PCH between Encinal Canyon and Kanan-Dume Road. The majority of the surrounding undeveloped upland terrain in the area of the site is parkland managed by the National Park Service.

Access to the area of the site is provided from State Highway 1 (Pacific Coast Highway – PCH) by way of East Sea Level Drive on the north side of the lot. Topographically, the north part of the property (adjacent to the paved portion of East Sea Level Drive) consists of relatively flat ground at an elevation of approximately 20 feet above mean sea level (msl), while the southerly part is a beach that slopes gently down to sea level from elevation 10' msl. The above-cited descriptions are intended to be illustrative, and are specifically not intended for use as a legal description of the subject property.

The property is situated at the westerly terminus of East Sea Level Drive on the southerly side of Pacific Coast Highway in the City of Malibu, California. The subject property is currently occupied by a concrete access driveway, utility service lines and by cultivated grass area that is protected from wave erosion by a graded boulder revetment on the south and west.

The leachfield site occupies the grassy area within the alignment of East Sea Level Drive (a private street) adjacent to the beach in the City of Malibu, California. The leachfield site is located west of Lechuza Point and Trancas Beach, and is approximately a quarter mile east of Encinal Canyon (Plates I and II). The narrow project site is currently occupied by a privately maintained access driveway known as East Sea Level Drive. The front (north side) of the lot consists of relatively level ground at approximately street level.

This level grassy area terminates at small (approximately seven-feet high at the time of this investigation) west- and south-facing uniform stone and graded-stone revetment that descends to the beach for protection against wave attack. The Coastal Engineering Report (David C. Weiss Engineering, 10-28-1988) presents design details for a coastal revetment that extends from elev.=-2.5'msl to elev.=14.0'msl. The visible rock of the revetment consists of angular graded sandstone armor rock that ranges from 1.5-feet to larger than 3.5 feet longest dimension. This size range roughly corresponds to the design-specified 4-ton revetment armor that was specified in the Coastal Engineering Report (David C. Weiss Engineering, 1988).

PROJECT DESCRIPTION

The MRCA has requested a geotechnical investigation to provide a preliminary report to support the design of a leachfield for the proposed public restroom disposal system on the subject property. A Site Evaluation Report (SER) is required by the City of Malibu to contain results of geotechnical (soils) analysis and/or percolation tests.

Earth Systems has been informed that a geotechnical report has already been prepared by AMEC dated 12/6/13. The scope of that report includes the project improvements that include reconstruction of stairs and view platform, new view platform, new disabled parking spaces available by reservation, and a new single-stall public restroom with advanced onsite wastewater treatment system (AOWTS) located on MRCA-owned land beyond (west of) the beach terminus of East Sea Level Drive.

Earth Systems is only addressing the disposal system (leachfield) that is to be located in/near the grasscrete by the paved East Sea Level Drive, near the beach terminus of the road, on property owned by Malibu-Encinal Homeowners Association (HOA). The road and grasscrete are protected by an existing rip-rap revetment that borders the beach.

Due to the relatively gently sloping site topography in the area of proposed leach field, Earth Systems has assumed that conventional cut and fill methods will be used to install AOWTS. This supporting Geology/Soils Report is intended to satisfy the referenced City of Malibu guidelines and to provide data that will form the basis of the AOWTS design.

These assumptions were used as the basis for the analyses programs, and for the recommendations contained in this report. If the anticipated development or other site conditions vary significantly from the values stated herein, the recommendations should be reconfirmed prior to completing project plans.

PURPOSE AND SCOPE OF SERVICES

The revised scope of services that is presented in this report was based on our review of published documents, other maps and literature, and reviews by the City of Malibu and L.A Co. City approval for the Planning Stage and for the Building Plan Check Stage approval will be provided by a combined effort of the Applicant and other consultants, (the design Civil Engineer, Environmental OWTS design Engineer, Coastal Engineer and the Geotechnical Consultant). The scope of this report was developed in conjunction with Judi Tamasi, Project Director, Mountains Recreation and Conservation Authority (MRCA) based on the issues raised following review with the design team of the Earth Systems preliminary proposal dated 5/8/15. Earth Systems general scope of services was designed in part to address the requirements of the City of Malibu and to perform evaluation of the condition of the soil profile across the site of the proposed leachfield area on the subject property.

The following scope of services is based on the requirements of engineering practice and the City of Malibu requirements for this type of report that includes geotechnical and geologic assessment of the proposed leachfield construction. This geologic report was prepared in accordance with the 2014 City of Malibu Building Code and Local Implementation Program (LIP) and in accordance with the referenced City of Malibu *Guidelines for the preparation of Engineering Geologic and Geotechnical Engineering Reports, On-site Wastewater Treatment System Design Requirements for Beachfront Properties,* and *Submittal Requirements for Conventional On-site Wastewater Treatment Systems.*

The preliminary phase for geotechnical and geologic profiling of the soil and bedrock in the leachfield area was intended to be performed by drilling two or three hollow stem borings that penetrated to bedrock. According to the existing data reported in prior test pits and borings for the adjacent residences, the proposed leachfield area consists of artificial fill overlying natural soil and bedrock; the profile was shown in the research section geologic cross sections. Owing to the potential presence of large revetment boulders within the area of the proposed leachfield the MRCA field representative requested that Earth systems direct the subcontracted drilling company to extend the area of exploration to cover the entire area of the leachfield with additional borings.

It should be understood that the findings from this preliminary phase identified that the fill profile contained portions of the rip-rap boulders that were placed during the prior reconstruction of this area following substantial erosion in the 1982/3 storms only at the location of boring B1. Such interference of the boulders prevented profiling to the bedrock elevation from being performed at that location. However, the consistency of the remaining planned and supplemental borings allow confident depiction of the underlying soil profile.

Earth Systems scope of services for this investigation include the following:

A. City of Malibu document research. Any available records that were not previously obtained from the City of Malibu were reviewed and information plotted on an extended topographic map of the project area.

B. Consultation with the owner, permit expeditor, AOWTS design Engineer and the City of Malibu geologist to discuss our findings.

C. The Site Plans, topographic maps and cross sections were provided to Earth Systems for use as a base during the research and exploration phase of our services.

D. A site reconnaissance, marking the boring locations and notification of Underground Service Alert was performed by Earth Systems professional staff. The property owner provided authorization to access and excavate on the property including confirmation of clearance for the proposed boring locations. More boring locations than necessary were marked (seven) as described above.

E. City of Malibu Exploratory Drilling Permits were obtained from the City of Malibu.

F. An “Access License” to the property was negotiated by the property owner’s attorney and Earth Systems’ legal counsel.

G. Earth Systems conducted an exploratory program of the subsurface site conditions and materials within the area of the proposed leachfield by drilling and sampling seven hollow stem borings. One of these boring locations encountered refusal on rip-rap boulders. The intent of the borings was to confirm the artificial fill, natural soil and bedrock profile. Soil samples were obtained from the borings for visual examination and potential laboratory testing. The borings were logged by a California Certified Engineering Geologist in order to document the encountered soil conditions.

H. A meeting was convened with the City of Malibu prior to preparation of this Preliminary Report.

I. Following the City meeting, the findings of the study were set forth in this written report based on data obtained from the prior and the new exploration and testing program, evaluation of these data and other knowledge and past experience and judgment.

PUBLIC RECORDS RESEARCH

No construction records or details of revetment construction beyond those that are visible are unknown. According to the referenced Coastal Engineering Report wave run-up on the graded revetment is different than that on the beach and its ability to prevent overtopping was considered as a design element.

The terrain that extends from the rear (south side) of the lot consists of a sand beach that extends from the toe of the revetment into the surf zone (see Site Geologic Map and Cross Section, Plates III and IV).

The subject property is identified as APN 4470-021-009, a privately dedicated street per the Los Angeles County Assessor. The street alignment intersects Broad Beach Road on the east. A portion of the dedicated alignment lies within the ephemeral beach and is not paved. The remaining paved portions are designated East Sea level Drive. The subject area of investigation lies at the western end of East Sea Level Drive adjacent (south) to 31725 and 31721 East Sea Level Drive.

The original site grading and construction of the existing, adjacent residences identified as 31725 and 31721 East Sea Level Drive was reportedly performed and constructed in 1990. Earth Systems has researched the records and obtained geotechnical reports and OWTS data from the City of Malibu for the original development.

Following the storm damage described above, minor grading was performed for placement of road fill along the northern site boundary for the creation of the level area within the limits of the proposed leachfield and to support the western terminus of East Sea Level Drive.

Public record documents were researched at the City of Malibu for properties within a 300-foot radius of the subject leachfield. Those files indicate that the nearby properties were recently developed starting with roadway grading in the early 1980's. Geology and Soil Engineering reports were obtained for the neighboring adjacent properties on East Sea Level Drive that initiated the planning and permitting process in the mid 1980's. Public record documents were obtained for nearby development at the following properties:

- 31725 East Sea Level Drive
- 31721 East Sea Level Drive
- 31715 East Sea Level Drive

The existing residential structures that are adjacent to the area of the proposed MRCA project are identified as 31725 and 31721 East Sea Level Drive and were reportedly constructed in 1990. Based on preliminary record research in the City of Malibu archives, geotechnical reports were prepared for these properties (Robert Stone & Assoc., Inc., 1988) and geotechnical and geologic information relates to the subject project. Based on this detailed data, the scope of services for the subject leachfield area only is presented herein appears to be reasonably accurate.

Both of these residential structures are served by Private On-site Wastewater Treatment Systems that incorporate 6' diameter seepage pits. County of Los Angeles Health Division permit records do not indicate the capping depth or total depth of these systems. The County granted a reduction of Plumbing Code-specified property line setbacks to allow the seepage pits to be sited immediately adjacent to the southern site boundary. These pits are shown on the attached Site Geologic Map (Plate III).

It should be noted that this property has been subjected to relatively recent storm damage (1982/83) that reportedly encroached northward into the area of the existing residential OWTS area – it is understood that due to this information the systems were constructed on the northerly edge of the storm damage zone. Reports indicate that the soil profile was inadequate to support the residential structures and thus requirements were to deepen all foundations into the sound underlying bedrock.

The cross sections included with the above referenced reports indicate that the area of the proposed leachfield is predominantly non-engineered artificial fill that is in a relatively loose condition. Earth Systems could not identify any records demonstrating that the access road or the grassy area on the south side of East Sea Level Drive was reconstructed to Building Code standards.

FIELD EXPLORATION

The field exploration for this study was conducted on September 23 and 24, 2015. Field exploration consisted of drilling and sampling seven exploratory hollow-stem borings to bedrock. The approximate location of the exploratory borings, as indicated on the attached Site Geologic Map, Plate III, were determined by sighting and tape measuring from existing surrounding improvements. The locations of the borings should be considered accurate only to the degree implied by the measurement method used.

Bulk disturbed samples of the subsurface soil and bedrock were obtained from tailings generated during drilling. These samples were secured for classification and testing purposes and represent mixtures of soils and rock within the noted depths. Additional soil and rock samples ("ring samples") were secured from within the test borings using a three-inch outside diameter ring sampler (ASTM D 3550) with a shoe similar to the drive cylindersampler (ASTM D 2937). A 140-pound hammer falling approximately 30 inches (ASTM D 1586) drove the sampler.

Additional soil samples ("ring samples") were secured from within the test borings using a three-inch outside diameter ring sampler (ASTM D 3550) with a shoe similar to the drive cylinder sampler (ASTM D 2937). A 140-pound hammer falling approximately 30 inches (ASTM D 1586) drove the sampler. The hammer was operated by an automatic trip mechanism that operated at a rate of approximately 40 blows per minute. The number of blows required to drive the sampler 12 or 18 inches was recorded in six-inch increments and recorded on the boring logs. Recovered ring samples were sealed in plastic containers and transported to the Earth Systems laboratory for further classification and testing.

Further sampling and collection of disturbed soil samples was accomplished using the Standard Penetration Test (SPT) sampler in accordance with ASTM D 1586. The SPT sampler is a split barrel sampler with a 1-3/8 inch inside diameter. This sampler was also driven by a 140-pound hammer falling approximately 30 inches. The number of blows required to drive the sampler 18 inches was recorded in six-inch increments and recorded on the attached boring logs. Soil samples recovered by this method were sealed in plastic bags. Recovered soil samples were transported to the Earth Systems laboratory for further classification and testing.

The Logs of Borings for this report, included in Appendix A, represent Earth Systems' interpretation of the field logs prepared for each boring by Earth Systems' staff, along with their interpretation of soil and bedrock conditions between samples and results of laboratory tests. While the noted stratification lines represent approximate boundaries between soil and bedrock types, the actual transitions may be gradual.

COASTAL ENVIRONMENT

The wave climate is well documented for the Santa Barbara Channel and northern Santa Monica Bay (O'Reilly and Guza, 1983). Existing data from wave-gage records and wave hindcasts show that deep water waves have a mean height of 3.9 ft and a mean period of 13 seconds. The waves most frequently arrive from the northwest, but they range in approach from due south through north-northwest. During El Niño winters, storm waves arrive more frequently from the west and southwest than during non-El Niño winters, and heights of 10 feet are common.

Wave refraction studies (O'Reilly, et al., 1993) show that for the Trancas Beach section of northern Santa Monica Bay waves approaching from the northwest diverge significantly around Point Conception at the northwestern entrance to the Santa Barbara Channel, changing direction by as much as 100° to approach the shore from the southwest. When approaching from the northwest, wave height (and consequently wave energy) is also subjected to island blocking within the Santa Barbara Channel and thus further reduced before reaching the shoreline. However, waves approaching from the southwest (i.e., during El Niño storms) undergo less refraction because there is no island blocking and no headland to dissipate wave energy by diffraction. As a result, waves from the southwest have greater heights and more energy upon reaching the south-facing Trancas-Encinal shoreline. The highest waves reaching the shoreline in northern Santa Monica Bay are commonly storm waves approaching from the southwest to west.

Tides in this region are diurnal and have a mean range of 5.2 feet; the highest high water is 7.8 feet and the lowest low is -2.6 feet (U.S. Army Corps of Engineers, 1985). The highest monthly tides occur in the winter and summer; it is not unusual for the highest tides to coincide with large, winter storm waves.

Rainfall in this region occurs predominantly from December through March, and high rainfall frequently coincides with large waves. The average annual precipitation since 1895 is 21.05 inches, although large climatic perturbations such as El Niño can bring excessive precipitation to the area. Based on data compiled by Griggs (1998a, 1998b), the large majority of historical storms that caused significant coastal erosion or damage occurred during El Niño years.

The U.S. Geological Survey (USGS) Multi-Hazards Demonstration Project in Southern California (Barnard, et al., 2007) is a five-year project to produce information that can be used to create more disaster-resilient communities. The hazards being evaluated include coastal hazards wave run-up and shoreline retreat that were not available at the time of this report.

COASTAL GEOMORPHOLOGY

The primary geomorphic agent active in the creation of shore forms in the Encinal Canyon-Broad Beach coastline segment is the combination of storm waves and littoral drift. The long-shore sediment transport cell has a net direction of drift along the Malibu coast from west to east. The two most significant lines of evidence for this are stream course diversion and the formation and maintenance of geologically ephemeral shore forms.

The dominance of eastward littoral drift is evident in the geomorphology of Lechuza Beach along the section of coastline from Encinal Creek to Trancas Beach coastline. The stream course of each of the major drainages along this section of coast from Zuma Creek to Encinal Creek displays the influence of eastward littoral drift. The combined effects of littoral sediment supply, southwest winter storm cycles and shore form have effected Lechuza Beach. The subject site is located midway along an accretionary segment of cuspate-shaped broad shoreline strand between two rocky headlands at Encinal Creek on the west and Lechza Point on the east. The strong littoral transport cell creates a broad sandy beach during the summer months.

The broad beach is periodically attacked by high energy winter storms from the south and dramatically reduced in size. The effects of intensified winter storm erosion is accentuated along this coastal segment owing in part to limited sand supply. Strong winter storms intermittently produce a cobble and shingle beach with very little sand that is seasonally replenished. The resistant cobble and bolder bed load fraction of Encinal Ceek has created an armored beach to the west that extends offshore.

Although Encinal Creek is a relatively large drainage it does not supply an appreciable amount of sand to replenish Lechuza Beach. The closely confined mouth of the Encinal creek lacks the sediment supply and competence to build a lagoon or recognizable alluvial deposits beyond the floor of its own drainage. Stream incision at the mouth of the creek is minimal and the axis of the drainage is roughly at the modern (summertime) beach elevation. The resistant Topanga formation bedrock intermittently outcrops along the coast from Encinal Canyon to Lechuza Point, together with the protective cobble sediment supply from the unnamed creek a prominent rocky, relatively steep-to coastline that is extremely resistant to coastal erosion.

Earth Systems interprets that the slopes descending from the developed portion of the referenced adjacent (North) properties are were subject to wave action prior to construction of the graded rock revetment. A small area exists at the extreme southwestern corner of the subject property where rock of the sea cliff is currently subject to “wave action” (i.e., the effects of normal wave inundation). The extreme southern part of the leachfield has been subject to “wave action” (i.e., the effects of normal wave inundation) in the recent past. That area is defined as a “ephemeral” and is depicted on the attached Site Map (Plate III) south of the protective revetment as discussed above. The area retained by and north of the protective revetment is considered suitable to support the proposed OWTS effluent dispersal leachfield.

SUBSURFACE CONDITIONS

Artificial fill (af) was observed to mantle the northerly, relatively level portion of the site. The depth of fill observed ranged from approximately four to six feet. These fill soils were found to consist predominantly of poorly to moderately compacted sands and silts with gravel (SM soil type based upon the Unified Soil Classification System). These upper on-site fill soils are considered to have a "very low" (EI = 0 to 20) expansion potential.

Artificial fill is not considered suitable to support the proposed leach field. It is our understanding that the proposed OWTS leachfield will incorporate a sand bed replacement disposal field that will require removal of all existing fill and replacement with a select graded filter sand with properties that will compliment the OWTS design.

Native soils; Quaternary Beach Deposits (Qb) were found to consist predominantly of fine to medium grained sand and poorly graded sands (SM and SP soil types) which graded down to predominantly gravel with sand (GP soil type) at 14.0 to 14.6 feet below existing ground surface. These soils were observed to be primarily medium dense to dense.

The entire site is underlain at depth by a modern transgressive marine sequence. This deposit is comprised of a sequence of well-sorted granular sediments that grade coarser with depth. The medium grained beach sand found at the surface grades to a coarse cobble conglomerate at depth. The basal contact of the cobble conglomerate was found overlying bedrock. The basal contact of the beach sequence comprises a major unconformity and may therefore, may be considered a dateable marker. However, it must also be considered an active geomorphic surface that is potentially subject to the effects of scour during major storms. While the bedrock platform represents early Holocene at the limit of the Flandrian transgression, the unconformity extends to the present.

Bedrock; early to middle Miocene Trancas Formation (Ttr) underlies the basal cobble conglomerate of the beach sequence. Because of the difficulty drilling through the cobble layer bedrock was encountered in only one of the borings at depth of 25 feet below existing ground surface. The bedrock was observed to consist of hard, dark gray to black marine siltstone with thin bluish-gray fine sandstone interbeds and locally prominent sedimentary breccia. Breccia is distinctive for abundant medium to coarse sand and gravel clasts of Mesozoic Catalina Schist, including chlorite and glaucophane bearing schist clasts. Bedrock comprises a wave-cut platform that slopes gently seaward. The Logs of the Borings in Appendix A contain more detailed descriptions of the soils encountered. Based on the bedrock profile that has been interpreted on the subject and neighboring properties, it is anticipated that no bedrock will be encountered during leachfield construction excavation.

GROUNDWATER

Groundwater levels observed in the borings varied from approximately 14.0 to 15.9 feet below grade during this investigation. Based on observations made for this study, unconfined conditions are interpreted to exist within the subsurface profile across the subject property.

This data indicates fluctuations in groundwater levels that may occur due to variations in tidal elevation, rainfall, regional climate, and other factors. Tides in this region are diurnal and have a mean range of 5.2 feet; the highest high water is 7.8 feet and the lowest low is -2.6 feet (U.S. Army Corps of Engineers, 1985). The highest monthly tides occur in the winter and summer; it is not unusual for the highest tides to coincide with large, winter storm waves.

No attempt has been made to identify the source of these fluctuations or to correlate these fluctuations with tidal influence although that is the most likely cause. Rainfall in this region occurs predominantly from December through March, and high rainfall frequently coincides with large waves. The average annual precipitation since 1895 is 21.05 inches, although large climatic perturbations such as El Niño can bring excessive precipitation to the area.

Based on data compiled by Griggs (1998), the large majority of historical storms that caused significant coastal erosion or damage occurred during El Niño years and may be expected to affect seasonal groundwater elevations.

CONCLUSIONS AND RECOMMENDATIONS

Existing On-Site Wastewater Treatment System

The existing residences on adjacent property to the north are served by a conventional On-Site Wastewater Treatment Systems (OWTS) that consists of a septic tank of unknown capacity and a single 6’diameter seepage pit of unknown depth that is located near the south end of the property.

Proposed On-Site Wastewater Treatment System (OWTS) Effluent Dispersal

Sewage disposal for the proposed development will be provided by an on-site septic system to be designed by others. The anticipated location of the shallow leach field type system will be beneath the parking area (north side of site). The proposed treatment system is intended to meet the City of Malibu Local Implementation Plan requirements.

Groundwater Statement

Because of relatively high permeability of the subsurface materials, “mounding” of groundwater due to recharge from the leach field is anticipated to be minimal. Earth Systems does not anticipate that effluent will “daylight” on the adjacent beach-side slope nor are any adverse geologic effects anticipated due to the on-site wastewater treatment system provided the system is designed under commonly practiced setback requirements. The neighboring site on the north has two borings with data that corroborate that presented on the attached boring logs and on the attached Geologic Cross-Sections (Plate IV).

Historic High Groundwater

The referenced Seismic Hazard Evaluation Report for the Malibu Beach Quadrangle indicates the presence of an historic high ground water level of five feet below existing ground elevation. In the general area of the subject parcel (California Geological Survey, 2001). The scale of this map, the lack of detailed data makes the reliability of this referenced data questionable.

Highest Anticipated Site Groundwater Conditions

The groundwater observations that are outlined in Table 1 below give an indication of the static groundwater surface in the vicinity of the subject leachfield. This data was considered important because of the poor high-groundwater redoximorphic signature and other textural features that could indicate the presence of groundwater are generally not present in the unweathered fresh faces of mineral grains such as those within the beach sand profile of this study. Accordingly, clear evidence of historically higher groundwater conditions than those currently present on the site was not observed.

Groundwater elevations are consistently lower to the east (boring B7 was drilled out of sequence). Earth Systems interprets this to be a result tidal variation during the exploration interval. These observations are outside the zone of influence from seepage pits on adjacent property and show no evidence of influence. Although no mounding or breakout analyses have been performed, these phenomena have not been observed on the site in the past. The Project Environmental Engineer confirms minimal system loading is anticipated in the designed AOWTS.

Based on the known hydrogeologic conditions of the aquifer that underlies the subject site as well as location and elevation of the groundwater elevations recorded below in Table 1 Earth Systems interprets that the underlying groundwater surface fluctuates with tidal influences in addition to normal seasonal fluctuation. Based on the findings of our subsurface investigation and analysis of observed groundwater record data, Earth Systems interprets the mean groundwater elevation = +6.0' (msl) observed in boring B6 to be the "Highest Anticipated Groundwater Level" beneath the subject site.

TABLE 1
Groundwater Measurements

Boring	Natural Ground (ft)	Groundwater depth (ft)	Bedrock Depth (ft)	Total Depth (ft)
B1	---	---	---	3.0
B2	14.0	15.9	25	26.0
B3	14.1	15.9	---	21.5
B4	14.6	15.1	---	20.5
B5	14.0	14.5	---	20.5
B6	14.5	14.0	---	20.0
B7	14.0	14.7	---	19.2

Anticipated Path of Effluent

Geologic cross section of the site is provided (Plate IV) which depict the existing development, existing and proposed wastewater treatment systems, and anticipated paths of effluent. The anticipated path of effluent assumes a hydraulic gradient of 1 and 5' cap depth for seepage pits on adjacent property. The underlying beach sequence is considered to have conductivity that exceeds system design parameters.

Cap Depth Statement

Seepage pits are not considered appropriate for the OWTS design on this property. Therefore, no cap depth will be prescribed.

Stability Statement

Based on the findings summarized in this report, and provided the recommendations in this report are incorporated into the project, it is Earth Systems' opinion that the proposed leachfield on the subject property will not be subject to a geologic hazard from landslides, settlement, or slippage beyond that described herein. It is also Earth Systems' opinion that the proposed leachfield will not adversely affect the geologic stability of the site or adjacent properties provided our recommendations are followed. Test findings and statements of professional opinions do not constitute a guarantee or warranty, expressed or implied.

OWTS Layout and Setbacks

The proposed OWTS components should be located so as to comply with all of the restrictions of the County of Los Angeles Plumbing Code as adopted by the City of Malibu (City of Malibu Plumbing Code §15.12.050). All system components must be situated so as to meet the setback requirements of Table H: 1.7. As required by *On-site Wastewater Treatment System Design Requirements for Beachfront Properties* (Malibu, 2012), shoreline protection devices shall be made water proof. This may be achieved with waterproofing material placed during excavation or a cut off wall. A cut off wall may consist of a waterproofed shoring wall, sheet piles, secant piles, slurry walls or some other approved method.

Domestic Water Supply Wells

No permitted wells are known to exist within 250 feet of the proposed drip systems. The Los Angeles County Waterworks District No. 29 supplies domestic water in the project area.

City of Malibu Section 111 Statement

In accordance with the City of Malibu Engineering Geologic and Geotechnical Engineering Report Preparation Guidelines §5.7- Mandatory Building Code Statements, Earth Systems provides the following findings. Based on the findings summarized in this report, and provided the recommendations in this report are incorporated into the project, it is Earth Systems' opinion that the proposed residential development on the subject property will not be subject to a geologic hazard from landslides, settlement, or slippage beyond that described herein. It is also Earth Systems' opinion that the proposed structures and associated grading will not adversely affect the geologic stability of the site or adjacent properties provided our recommendations are followed. Test findings and statements of professional opinions do not constitute a guarantee or warranty, expressed or implied.

CLIENT OPTIONAL SERVICES

This report was based on the assumption that an adequate program of client consultation, construction monitoring, and testing will be performed during the final design and construction phases to check conformance with the recommendations of this report. Maintaining Earth Systems as the geotechnical engineering consultant from beginning to end of this project will help provide continuity of services. The recommended services include, but are not necessarily limited to, the following:

a. Consultation as required during the final design stages of the project.

b. Review of grading and/or building plans.

c. Observation and testing during site preparation, grading, placement of engineered fill, and backfill of utility trenches.

d. Consultation as required during construction.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

The conclusions and recommendations submitted in this report relative to the proposed AOWTS are based, in part, upon the data obtained from site observations during the field exploration operations, and past experience. The nature and extent of variations between the borings may not become evident until construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report.

In the event of any change in the assumed nature or design of the proposed project as planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report modified or verified in writing. This report is issued with the understanding that it is the responsibility of MRCA to insure that the information and recommendations contained in this report are called to the attention of the architects and engineers for the project and incorporated into the plan. It is also the responsibility of T MRCA, and its representatives, to insure that the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

As the geotechnical engineers for this project, Earth Systems strives to provide its services in accordance with generally accepted geotechnical engineering practices in this community at this time. No warranty or guarantee is expressed or implied. This report was prepared for the exclusive use of MRCA for the purposes stated in this document for the referenced project only. No third party may use or rely on this report without the express written authorization of Earth Systems for such use or reliance.

It is recommended that Earth Systems be provided the opportunity for a general review of final design and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design specifications. If Earth Systems is not accorded the privilege of making this recommended review, it can assume no responsibility for misinterpretation of the recommendations.

The scope of current services for this report did not include any environmental assessment or investigation for the presence or absence of wetlands, or hazardous or toxic materials in the soil, surface water, groundwater or air, on or below or around the site.

The statements contained in this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they be due to natural processes or to the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards occur, whether they result from legislation or the broadening of knowledge. Accordingly, the conclusions of this report may be invalidated, wholly or partially, by changes outside of Earth Systems' control, and should therefore be reviewed after one year.

CLOSURE

Earth Systems trusts this report is sufficient at this time and meets your current needs. Earth Systems appreciates this opportunity to provide professional geotechnical engineering services for this project. If you have any questions regarding the information contained in this report, or if you require additional geotechnical engineering services, please contact the undersigned.

Respectfully submitted,

Earth Systems

CERTIFIED ENGINEERING GEOLOGIST
WILLIAM A. LA CHAPELLE
No. 1311
exp. 5/17
STATE OF CALIFORNIA

William A. LaChapelle, P.G., E.G.
Project Engineering Geologist

Reviewed by:

Christopher F. Allen, P.G., E.G.
Senior Geologist

END OF TEXT

REFERENCES

PLATES

APPENDICES

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PLATES

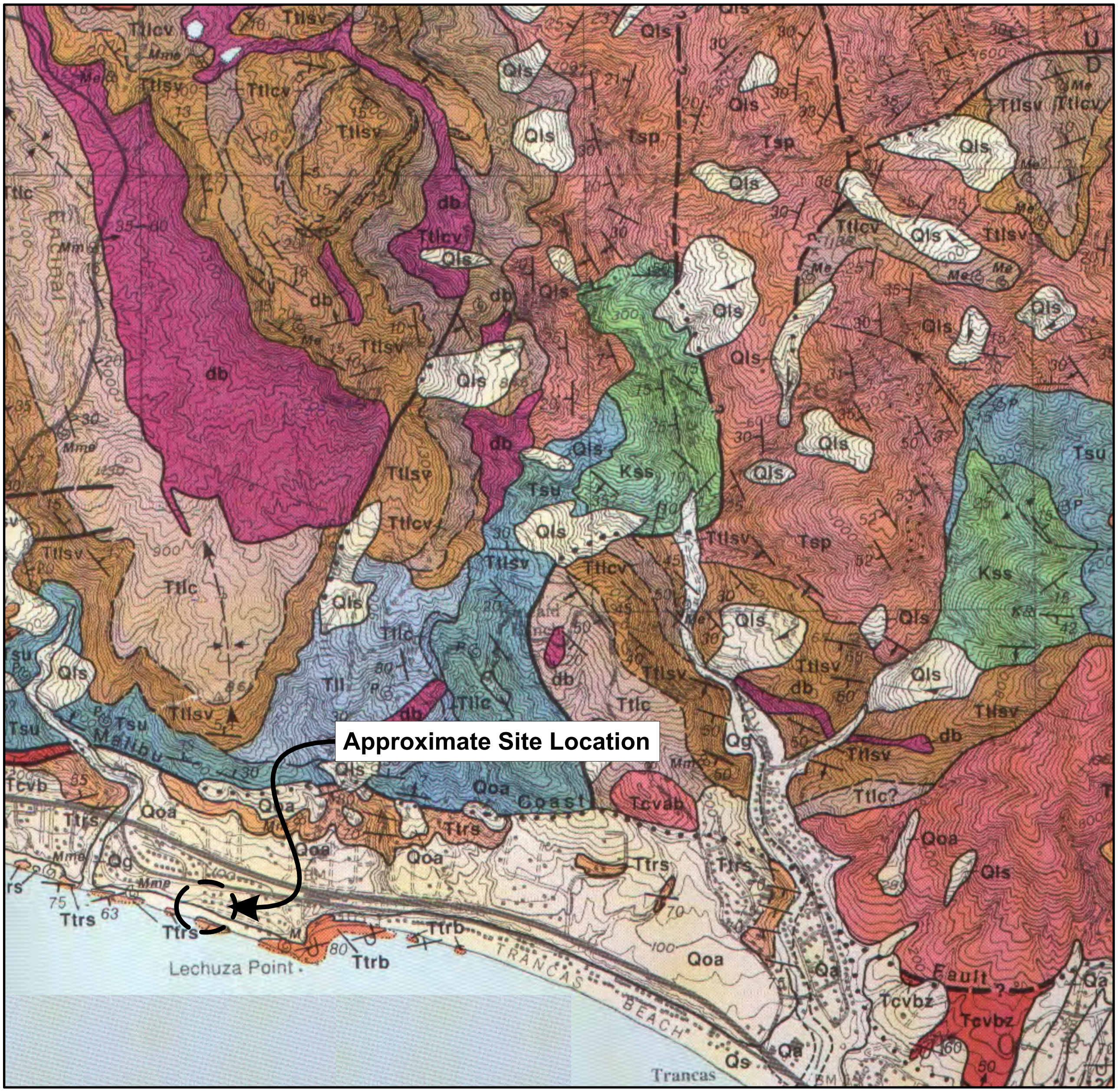
Source: USGS, Point Dume 7.5 Minute Quadrangle, dated 1951, Photorevised 1981.

0 ft. ~ 1,000 ft. ~ 2,000 ft.

N

Plate I

SITE LOCATION MAP	
MRCA LEACHFIELD SEA LEVEL DRIVE MALIBU, CALIFORNIA	
Earth Systems Southern California	
3/18/2016	LA-01618-01



Source: Dibblee Geologic Maps, Point Dume Quadrangle, DF-48, 1993

LEGEND

Quaternary

Qs	beach sand
Qa	alluvium
Qls	landslide
Qoa	older alluvium

Tertiary

Ttrs	Trancas Formation sandstone
Ttrb	Trancas Formation blueshist
Tcvab	andesitic breccia
Ttlc	Lower Topanga Formation clay shale
Ttlsv	Lower Topanga Formation sandstone
Tsu	Santa Susana Formation sandstone-silty claystone

Syncline

Anticline

Geologic contact

Fault

25 Bedding Attitude

20 Inclined Approximate

20 Overturned Bedding

N

0 ft. ~ 1,000 ft. ~ 2,000 ft.

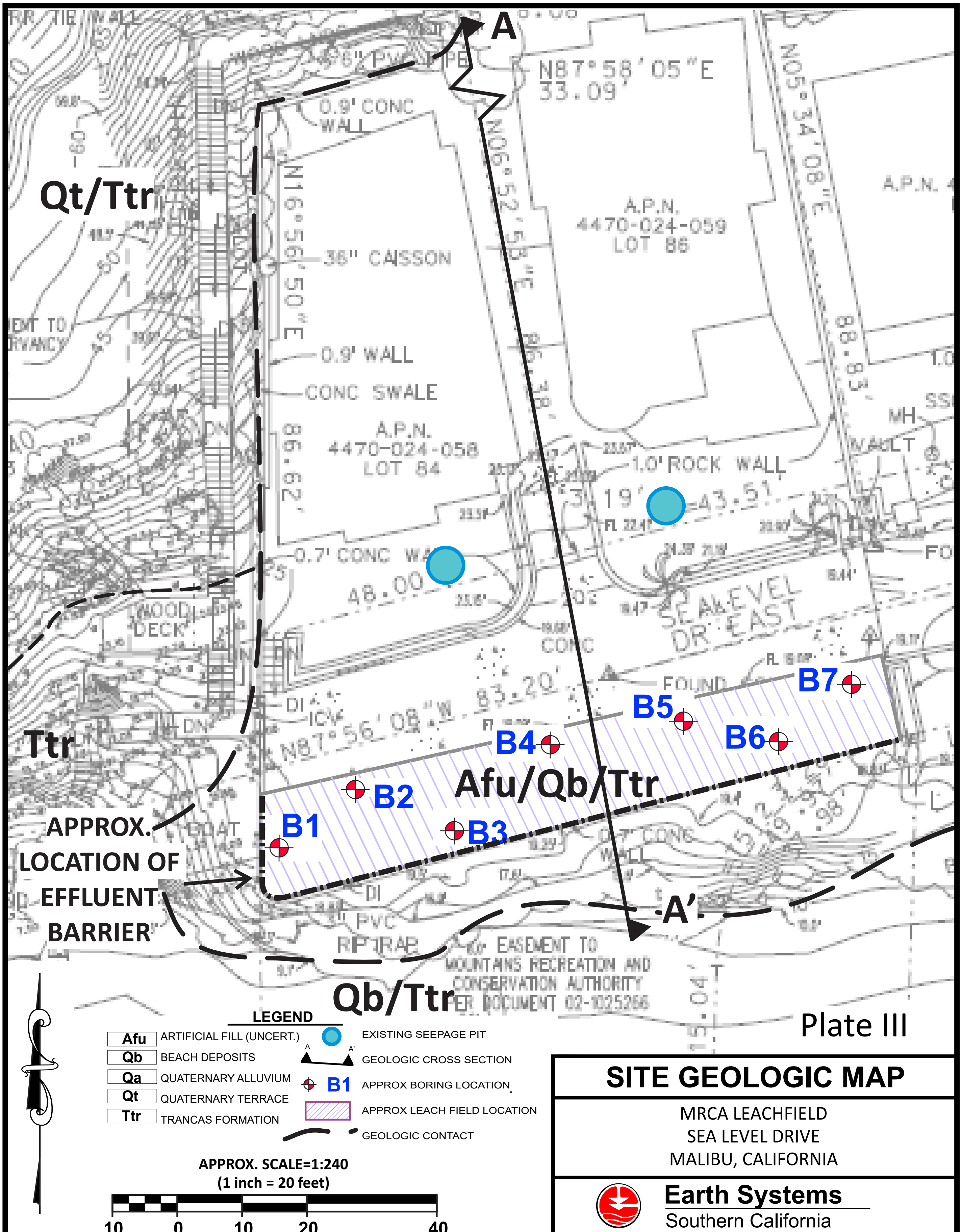
Plate II

REGIONAL GEOLOGIC MAP

MRCA LEACHFIELD
SEA LEVEL DRIVE
MALIBU, CALIFORNIA

Earth Systems
Southern California

3/18/2016	LA-01618-01



BASE MAP: Land & Air Surveying, 4-9-13, Aerial Topo Edit, Sheet 3 of 7, Proj. No. MTREC113

SITE GEOLOGIC MAP

MRCA LEACHFIELD
SEA LEVEL DRIVE
MALIBU, CALIFORNIA

Earth Systems
Southern California

3/18/2016	LA-01618-01

A A'

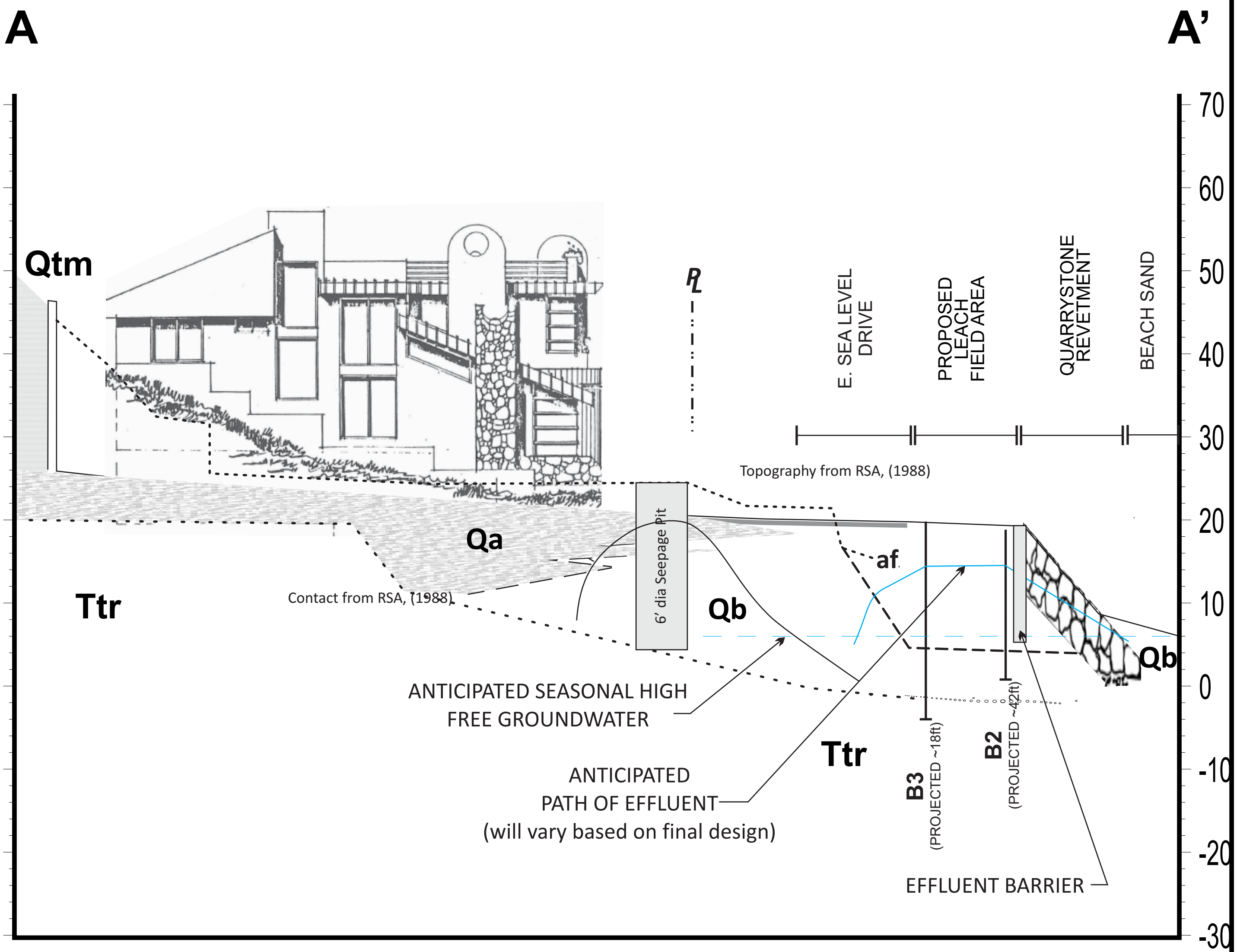


Plate IV

SCALE = 1:240
(1 inch = 20 feet)

GEOLOGIC CROSS SECTION

MRCA LEACHFIELD
SEA LEVEL DRIVE
MALIBU, CALIFORNIA

Earth Systems
Southern California

3/18/2016	LA-01618-01

APPENDIX A

Logs of Test Borings

Earth Systems
Southern California

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Phone: (626) 356-0955 Fax: (626) 356-0956

BORING NO:	**B1**	DRILLING DATE:	9/23/2015
PROJECT NAME:	MRCA	DRILL RIG:	2R Drilling Track CME 75
PROJECT NUMBER:	LA-01618-01	DRILLING METHOD:	8-inch dia. hollow stem auger
BORING LOCATION:	See Map	LOGGED BY:	BL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	Penetration Resistance (Blows/6-inches)	Symbol	USCS Classification	Unit Dry Weight (pcf)	Moisture Content (%)	DESCRIPTION OF UNITS
0									Artificial Fill (Afu) 2-1/2 inches of turf on 2 in hexagonal polypropylene reinforcement mat.on dark brown (10YR,3/8-moist) fine sandy SILT, slightly moist, dense, slightly sticky, non-plastic, heavy root mat at the surface decreases with
5									-Total Depth 3 feet -Refusal on resistant boulder
10									
15									
20									
25									
30									
35									
40									

Total depth 3 feet, refusal on resistant boulder
No groundwater encountered. Backfilled with soil cuttings.
Note: The stratification lines shown represent approximate boundaries between soil layers and may be gradational.

Earth Systems
Southern California

2122 East Walnut Street, Suite 200, Pasadena, California
Phone: (626) 356-0955 Fax: (626) 356-0956

BORING NO:	B2	DRILLING DATE:	9/23/2015
PROJECT NAME:	MRCA	DRILL RIG:	2R Drilling Track CME 75
PROJECT NUMBER:	LA-01618-01	DRILLING METHOD:	8-inch dia. hollow stem auger
BORING LOCATION:	See Map	LOGGED BY:	BL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	Penetration Resistance (Blows/6-inches)	Symbol	USCS Classification	Unit Dry Weight (pcf)	Moisture Content (%)	DESCRIPTION OF UNITS
0									**Artificial Fill** (Afu) 4-inches of turf on 2-in hexagonal polypropylene reinforcement mat. on 4-in CMB.on dark yellowish brown (10YR,4/4-moist) fine to medium, well-sorted SANDY CLAY LOAM, slightly moist, dense, slightly sticky, non-plastic, heavy root mat at the surface decreases
	X		X	6 10			124.5	8.0	
5		X		10 13 15					Olive brown (2.5Y,4/4-moist) SANDY CLAY LOAM with scattered oxidizing organic debris , root fiber and leaf mould, few worm casts decreasing with depth, slightly sticky, slightly plastic , thickly layered, clear smooth boundary
			X	9 13		SW	127.8	7.4	
10		X		16 21 26					
			X	24 30			107.3	12.3	
15	X	X		4 7 14				▽	**Natural Ground** - Quaternary Beach Deposit (Qb) Pale brown (10YR 6/3- moist) thinly stratified loamy SAND, grades to light gray (10YR 7/1.5- moist); loose, nonsticky, nonplastic; neutral, excessively drained , gradual smooth basal boundary
			X	30 38		SP			
20									
			X	24 50/2"					
25						GW			Dark Gray (10YR, 4/1- moist) Rounded GRAVEL conglomerate supported in light grayish brown (10YR 6/2-moist) fine to medium SAND matrix; nonsticky , nonplastic, gravel size and fraction increase to cobble conglomerate at the abrupt basal contact
									Bedrock early to middle Miocene **Trancas Formation, (Ttr)** dark gray to black marine siltstone with thin bluish-gray fine sandstone interbeds and prominent sedimentary breccia that is distinctive for abundant detritus of Mesozoic Catalina Schist, including chlorite and glaucophane bearing schist clasts.
30									
35									-Total Depth =26-feet , Groundwater at 15.9-ft -Difficult drilling & refusal on resistant cobbles -Water pressure used to maintain boring -Backfilled with drill tailings
40									

Earth Systems
Southern California

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Phone: (626) 356-0955 Fax: (626) 356-0956

BORING NO:	**B3**	DRILLING DATE:	9/23/2015
PROJECT NAME:	MRCA	DRILL RIG:	2R Drilling Track CME 75
PROJECT NUMBER:	LA-01618-01	DRILLING METHOD:	8-inch dia. hollow stem auger
BORING LOCATION:	See Map	LOGGED BY:	BL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	Penetration Resistance (Blows/6-inches)	Symbol	USCS Classification	Unit Dry Weight (pcf)	Moisture Content (%)	DESCRIPTION OF UNITS
0									**Artificial Fill** (Afu) 4-inches of turf on 2-in hexagonal polypropylene reinforcement mat. on 4-in CMB.on dark yellowish brown (10YR,4/4-moist) fine to medium, well-sorted SANDY CLAY LOAM, slightly moist, dense, slightly sticky, non-plastic, heavy root mat at the surface decreases
5		■		11 11 16					
						SW			Olive brown (2.5Y,4/4-moist) SANDY CLAY LOAM with scattered oxidizing organic debris , root fiber and leaf mould, few worm casts decreasing with depth, slightly sticky, slightly plastic ,clear smooth boundary
10		■		13 18 22					
		■		14 29 33					
		■		22 25 21					
15		■		13 22 29				▽	**Natural Ground** - Quaternary Beach Deposit (Qb) Pale brown (10YR 6/3- moist) thinly stratified loamy SAND, grades to light gray (10YR 7/1.5- moist); loose, nonsticky, nonplastic; neutral, excessively drained , gradual smooth basal boundary
						SP			
20		■		50/5"					Dark Gray (10YR, 4/1- moist) Rounded GRAVEL
25									
30									-Total Depth =21.5-feet , Groundwater at 15.9-ft -Difficult drilling & refusal on bedrock -Water pressure used to maintain boring -Backfilled with drill tailings
35									
40									

Earth Systems
Southern California

2122 East Walnut Street, Suite 200, Pasadena, California
Phone: (626) 356-0955 Fax: (626) 356-0956

BORING NO:	B4	DRILLING DATE:	9/23/2015
PROJECT NAME:	MRCA	DRILL RIG:	2R Drilling Track CME 75
PROJECT NUMBER:	LA-01618-01	DRILLING METHOD:	8-inch dia. hollow stem auger
BORING LOCATION:	See Map	LOGGED BY:	BL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	Penetration Resistance (Blows/6-inches)	Symbol	USCS Classification	Unit Dry Weight (pcf)	Moisture Content (%)	DESCRIPTION OF UNITS
0						ML/ SM			**Artificial Fill** (Afu) 4-inches of turf on 2-in hexagonal polypropylene reinforcement mat. over 8-in well-sorted sand with 20-percent unrecognizable organics on yellowish brown (10YR,5/4-moist) fine to medium, well-sorted SANDY CLAY LOAM, slightly moist, dense, slightly sticky, non-plastic, heavy root mat at the surface decreases with depth, smooth,
5		X		18 23 28		SW			Olive brown (2.5Y,4/4-moist) SANDY CLAY LOAM with scattered oxidizing organic debris , root fiber and leaf mould, few worm casts decreasing with depth, slightly sticky, slightly plastic ,clear smooth boundary
10		X		13 24 30					
		X		27 30 32					
		X		13 15 18					
15		X		12 22 24		SP			**Natural Ground** - Quaternary Beach Deposit (Qb) Pale brown (10YR 6/3- moist) thinly stratified loamy SAND, grades to light gray (10YR 7/1.5- moist); loose, nonsticky, nonplastic; neutral, excessively drained , gradual smooth basal boundary
20		X		50/2"					Dark Gray (10YR, 4/1- moist) Rounded GRAVEL conglomerate supported in light grayish brown (10YR 6/2- moist) fine to medium SAND matrix; nonsticky , nonplastic
25									-Total Depth =20.5-feet , Groundwater at 15.1-ft -Difficult drilling & refusal on resistant cobbles -Water pressure used to maintain boring -Backfilled with drill tailings
30									
35									
40									

Earth Systems
Southern California

2122 East Walnut Street, Suite 200, Pasadena, California
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BORING NO:	**B5**	DRILLING DATE:	9/23/2015
PROJECT NAME:	MRCA	DRILL RIG:	2R Drilling Track CME 75
PROJECT NUMBER:	LA-01618-01	DRILLING METHOD:	8-inch dia. hollow stem auger
BORING LOCATION:	See Map	LOGGED BY:	BL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	Penetration Resistance (Blows/6-inches)	Symbol	USCS Classification	Unit Dry Weight (pcf)	Moisture Content (%)	DESCRIPTION OF UNITS
0									**Artificial Fill** (Afu) 4-inches of turf on 2-in hexagonal polypropylene reinforcement mat. on 4-in CMB.on dark yellowish brown (10YR,4/4-moist) fine to medium, well-sorted SANDY CLAY LOAM, slightly moist, dense, slightly sticky, non-plastic, heavy root mat at the surface decreases
5		■		1E 20 22					
						SW			Olive brown (2.5Y,4/4-moist) SANDY CLAY LOAM with scattered oxidizing organic debris , root fiber and leaf mould, few worm casts decreasing with depth, slightly sticky, slightly
10		■		16 22 26					
		■		19 26 30					
		■		23 27 29				▽	**Natural Ground** - Quaternary Beach Deposit (Qb) Pale brown (10YR 6/3- moist) thinly stratified loamy SAND, grades to light gray (10YR 7/1.5- moist); loose, nonsticky, nonplastic; neutral, excessively drained , gradual smooth basal boundary
15		■		23 32 40		SP			
		■		24 50/2"		GW			Dark Gray (10YR, 4/1- moist) Rounded GRAVEL conglomerate supported in light grayish brown (10YR 6/2-moist) fine to medium SAND matrix; nonsticky , nonplastic, gravel size and fraction increase to cobble conglomerate at the abrupt basal contact
20									
25									-Total Depth =20.5-feet , Groundwater at 14.5.ft -Difficult drilling & refusal on resistant cobbles -Water pressure used to maintain boring -Backfilled with drill tailings
30									
35									
40									

Earth Systems
Southern California

2122 East Walnut Street, Suite 200, Pasadena, California
Phone: (626) 356-0955 Fax: (626) 356-0956

BORING NO:	**B6**	DRILLING DATE:	9/23/2015
PROJECT NAME:	MRCA	DRILL RIG:	2R Drilling Track CME 75
PROJECT NUMBER:	LA-01625-01	DRILLING METHOD:	8-inch dia. hollow stem auger
BORING LOCATION:	See Map	LOGGED BY:	BL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	Penetration Resistance (Blows/6-inches)	Symbol	USCS Classification	Unit Dry Weight (pcf)	Moisture Content (%)	DESCRIPTION OF UNITS
0									**Artificial Fill** (Afu) 4-inches of turf on 2-in hexagonal polypropylene reinforcement mat. on 4-in CMB.on dark brown (10YR,4/3-moist) SILT LOAM, slightly moist, dense, slightly sticky, non-plastic, heavy root mat at the surface decreases with depth, smooth, diffuse basal boundary
5		X		10 13 15		SW			Dark grayish brown (2.5Y,4/2-moist) SANDY CLAY LOAM with scattered oxidizing organic debris , root fiber and leaf mould, few worm casts decreasing with depth, slightly sticky, slightly plastic ,clear smooth boundary
10		X		16 21 26					
		X		10 11 13					
		X		6 9 9		SP		▽	**Natural Ground** - Quaternary Beach Deposit (Qb) Pale brown (10YR 6/3- moist) thinly stratified loamy SAND, grades to light gray (10YR 7/1.5- moist); loose, nonsticky, nonplastic; neutral, excessively drained , gradual smooth basal boundary
15		X		8 9 15					
		X		50/2"		GW			Dark Gray (10YR, 4/1- moist) Rounded GRAVEL conglomerate supported in light grayish brown (10YR 6/2-moist) fine to medium SAND matrix; nonsticky , nonplastic, gravel size and fraction increase to cobble conglomerate at
20									
25									-Total Depth =20.0-feet , Groundwater at 14.5-ft -Difficult drilling & refusal on resistant cobbles -Water pressure used to maintain boring -Backfilled with drill tailings
30									
35									
40									

Earth Systems
Southern California

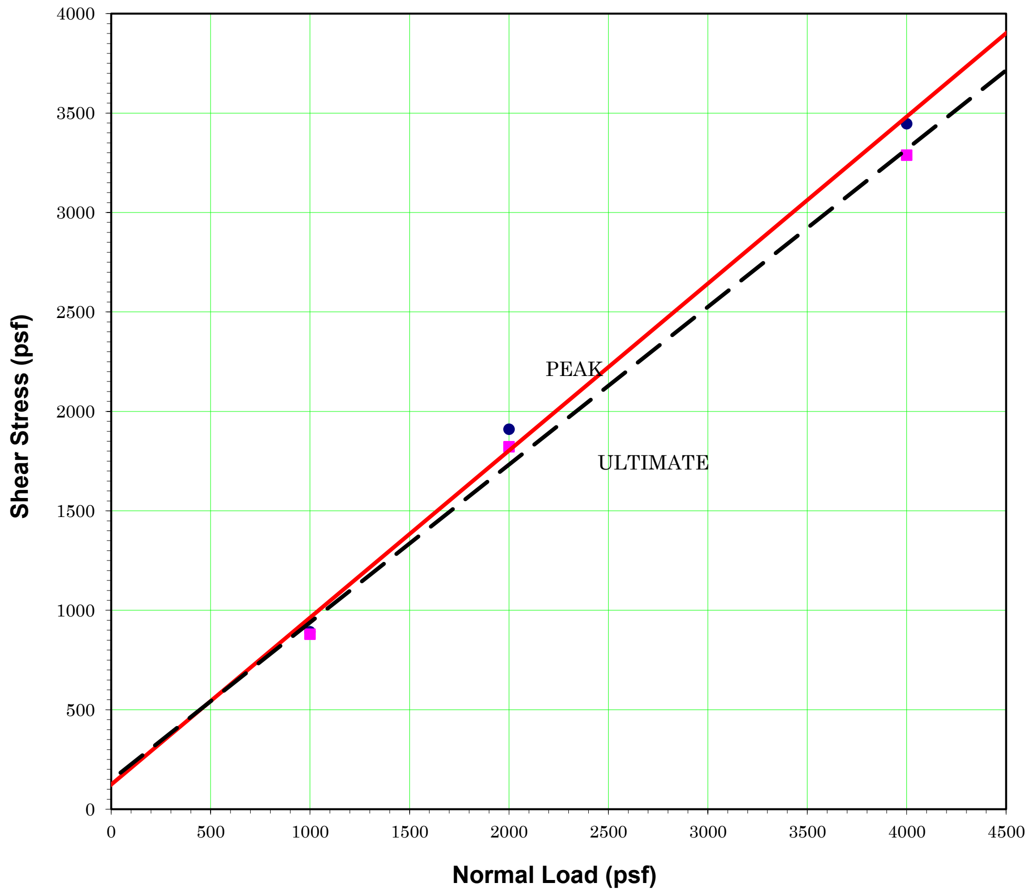
2122 East Walnut Street, Suite 200, Pasadena, California
Phone: (626) 356-0955 Fax: (626) 356-0956

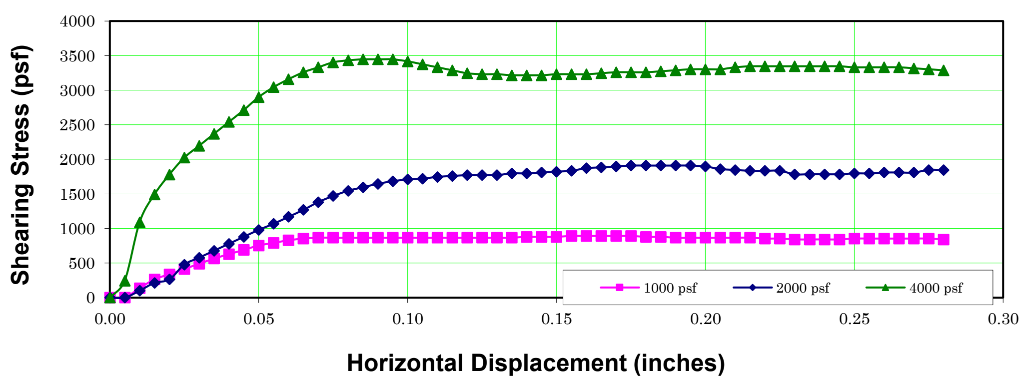
BORING NO:	**B7**	DRILLING DATE:	9/23/2015
PROJECT NAME:	MRCA	DRILL RIG:	2R Drilling Track CME 75
PROJECT NUMBER:	LA-01618-01	DRILLING METHOD:	8-inch dia. hollow stem auger
BORING LOCATION:	See Map	LOGGED BY:	BL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	Penetration Resistance (Blows/6-inches)	Symbol	USCS Classification	Unit Dry Weight (pcf)	Moisture Content (%)	DESCRIPTION OF UNITS
0									**Artificial Fill** (Afu) 4-inches of turf on 2-in hexagonal polypropylene reinforcement mat. on 6-in CMB.on dark yellowish brown (10YR,4/4-moist) fine to medium, well-sorted SANDY CLAY LOAM, slightly moist, dense, slightly sticky, non-plastic, heavy root mat at the surface decreases
							114.1	8.6	
5				3 7 9					
						SW	101.6	5.6	Olive brown (2.5Y,4/4-moist) SANDY CLAY LOAM with scattered oxidizing organic debris , root fiber and leaf mould, few worm casts decreasing with depth, slightly sticky, slightly plastic ,clear smooth boundary
10				4 5 6					
				2 5 7					
				6 30 50(4")					**Natural Ground** - Quaternary Beach Deposit (Qb) Pale brown (10YR 6/3- moist) thinly stratified loamy SAND, grades to light gray (10YR 7/1.5- moist); loose, nonsticky, nonplastic; neutral, excessively drained , gradual smooth basal boundary
15				14 27 34		SP			
				20 22 27			115.3	13.6	
20									Dark Gray (10YR, 4/1- moist) Rounded GRAVEL conglomerate supported in light grayish brown (10YR 6/2- moist) fine to medium SAND matrix; nonsticky , nonplastic, gravel size and fraction increase to cobble conglomerate at the abrupt basal contact bedrock in the sampler shoe
25									-Total Depth =19.2-feet , Groundwater at 14.7-ft -Difficult drilling & refusal on resistant cobbles -Water pressure used to maintain boring -Backfilled with drill tailings
30									
35									
40									

APPENDIX B

Laboratory Test Results





DIRECT SHEAR DATA*

Sample Location: B2 at 7.5 feet
Material: Artificial fill; SW
Dry Density: 127.8 pcf

	Initial	Final
Moisture Content:	7.4%	8.4%
Saturation:	67%	75%

	Peak	Ultimate
ϕ Angle of Friction (degrees):	40	38
c Cohesive Strength (psf):	120	140

Test Type: Peak and Ultimate Shear Rate (in/min): 0.005

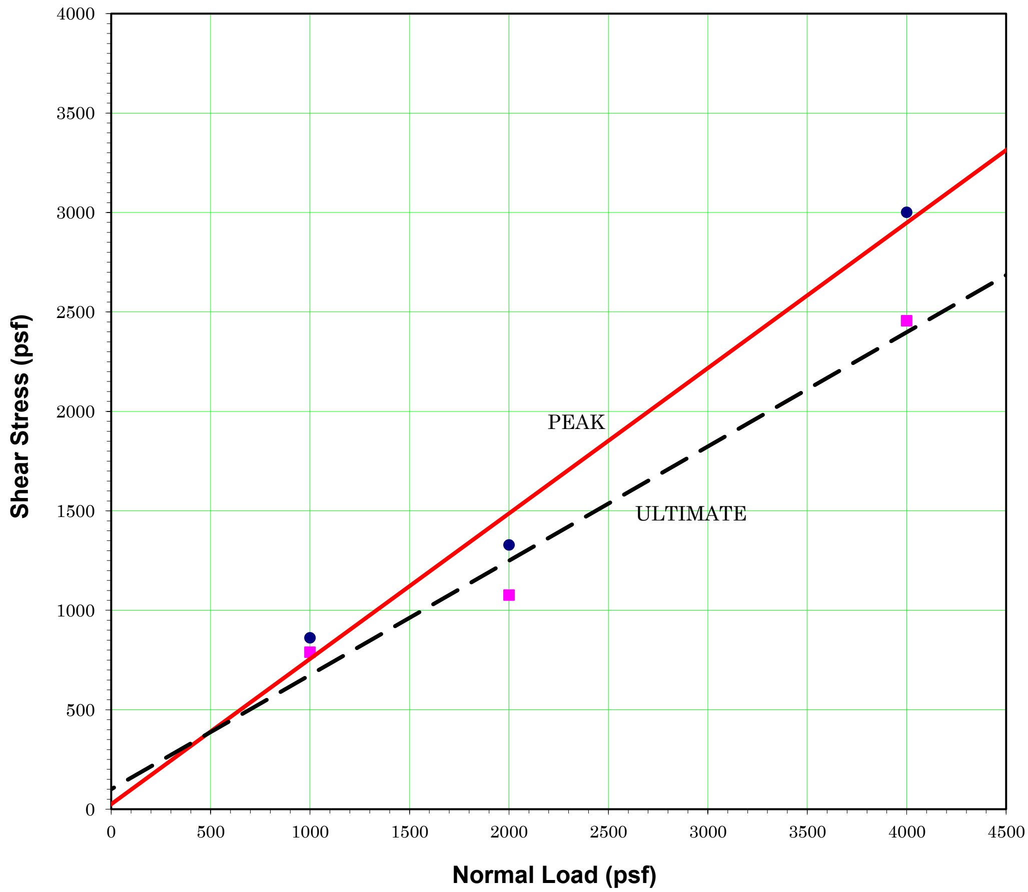
* Test Method: ASTM D-3080

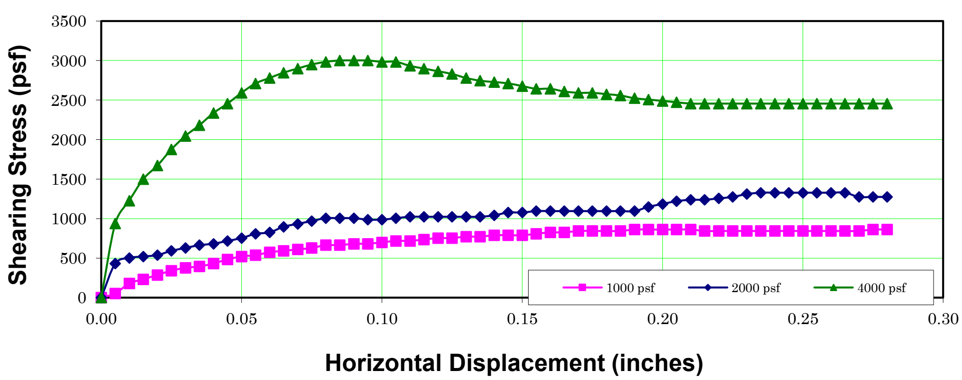
DIRECT SHEAR TEST

MRCA LEACHFIELD
SEA LEVEL DRIVE
MALIBU, CALIFORNIA

Earth Systems
Southern California

3/18/2016 | LA-01618-01





DIRECT SHEAR DATA*

Sample Location: B7 at 7.5 feet
Material: Artificial fill; SW
Dry Density: 101.6 pcf

	Initial	Final
Moisture Content:	5.6%	17.8%
Saturation:	24%	75%
	Peak	Ultimate
φ Angle of Friction (degrees):	36	30
c Cohesive Strength (psf):	20	100

Test Type: Peak and Ultimate   Shear Rate (in/min): 0.005

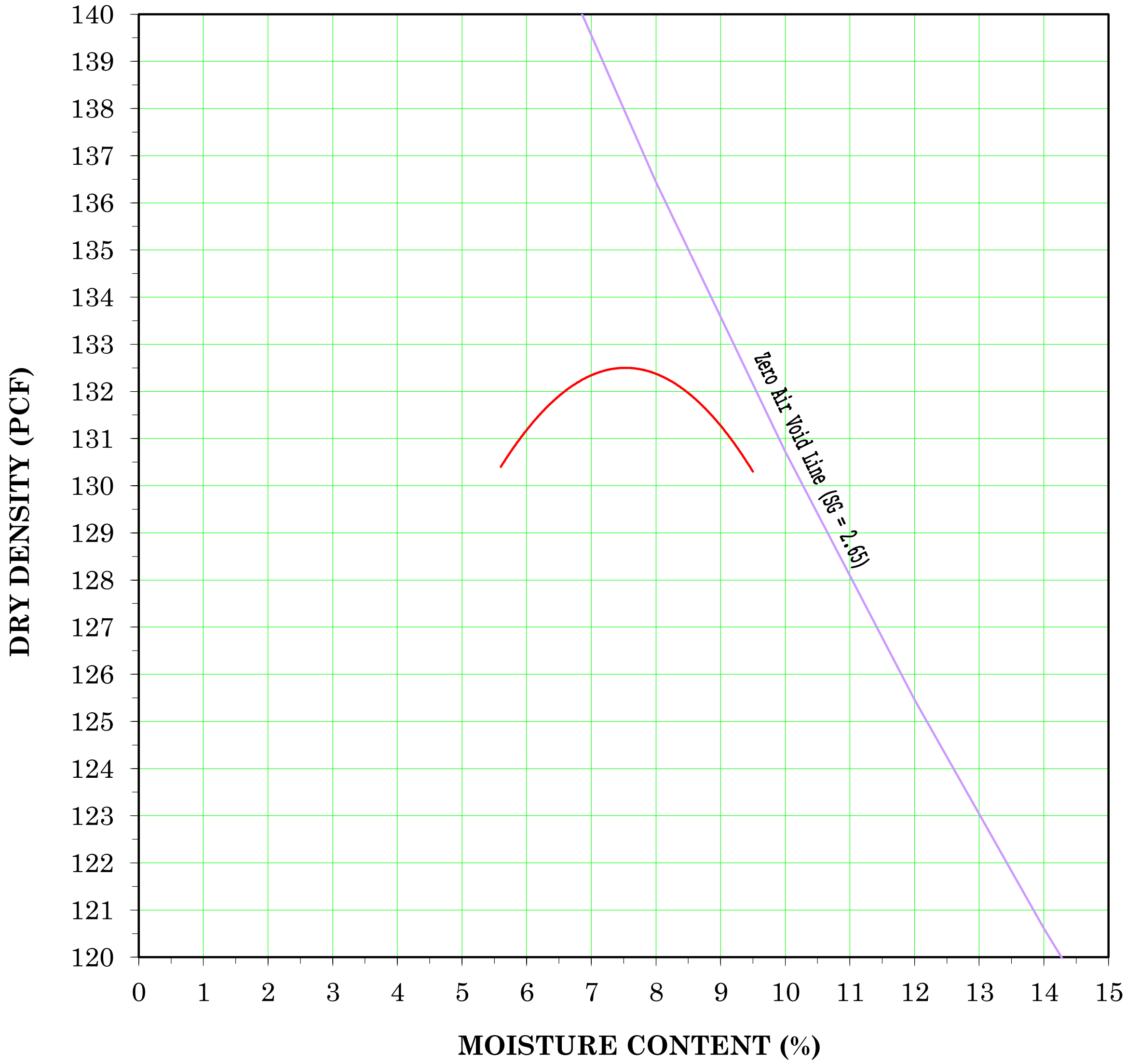
* Test Method: ASTM D-3080

DIRECT SHEAR TEST

MRCA LEACHFIELD
SEA LEVEL DRIVE
MALIBU, CALIFORNIA

Earth Systems
Southern California

3/18/2016	LA-01618-01



Maximum Density - Optimum Moisture Characteristics*

Sample Location: B2 at 2 to 5 feet

Material: Silty SAND some gravel (SM), brown to olive brown

Maximum Density: 132.5 pcf

Optimum Moisture: 7.5%

* Test Method: ASTM D-1557

MAXIMUM DENSITY - OPTIMUM MOISTURE	
MRCA LEACHFIELD SEA LEVEL DRIVE MALIBU, CALIFORNIA	
Earth Systems Southern California	
3/18/2016	LA-01618-01

Project-Specific Reference #9

November 3, 2016

Project 0109780000

Ms. Judi Tamasi
Mountains Recreation and Conservation Authority
5810 Ramirez Canyon Road
Malibu, California 90265

Re: Geotechnical Assessment of Proposed Setback
Advanced Onsite Wastewater Treatment System (AOWTS)
Lechuza Beach Public Access Improvements
Malibu, California

Dear Ms. Tamasi:

At your request, Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler), has prepared this letter to provide an opinion on the setback for the proposed AOWTS.

Based on the conceptual design drawing prepared by URS and dated August 2, 2016 (Revised October 26, 2016), it is planned to locate the AOWTS below the view platform and inside a concrete vault. The vault and view platform will be supported together on pile foundations extending into bedrock. Setback dimensions provided by URS indicate that the north side of the treatment tank will be between 3.18 feet and 3.75 feet away from the property line and do not meet the City of Malibu's requirement of a minimum 5-foot setback from adjacent property lines. Setback dimensions provided by URS indicate that the southeast corner of the treatment tank will be 9 inches from the removable stairs and do not meet the City of Malibu's requirement of a minimum 5-foot setback from structures (including steps).

Amec Foster Wheeler has evaluated the stability of the proposed AOWTS and found that the existing slope and proposed improvements meet or exceed the City's criteria for gross stability both statically and seismically. It is, therefore, our opinion that the reduced setbacks will not adversely impact the proposed development, steps, or the adjacent properties, provided that the vault foundations extend into bedrock as recommended in the geotechnical investigation report.

Amec Foster Wheeler Environment & Infrastructure, Inc.
121 Innovation Drive, Suite 200
Irvine, CA
USA 92617-3094
Tel (949) 642-0245
Fax (949) 642-4474
www.amecfw.com

If changes in the design of the structures are made, or variations or changed conditions are encountered during construction, Amec Foster Wheeler should be contacted to evaluate their effects on our geotechnical recommendations and opinions expressed in this letter.

Sincerely,
Amec Foster Wheeler Environment & Infrastructure, Inc.

Anthony Blanc, PE, GE
Senior Associate Geotechnical Engineer

Eileen Bailiff, PG, CEG
Senior Associate Engineering Geologist

Project-Specific Reference #10

ADDENDUM NO. 1
GEOTECHNICAL ENGINEERING REPORT
RESPONSE TO CITY REVIEW

Proposed Advanced On-Site Wastewater Treatment System (AOWTS)
APN 4470-021-009
Vicinity: 31725-31721 East Sea Level Drive
Malibu, California
LA-01618-01

Prepared For

MOUNTAINS RECREATION AND CONSERVATION AUTHORITY (MRCA)

December 2, 2016

Prepared By

Earth Systems Southern California
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December 2, 2016 LA-01618-01

Mountains Recreation and Conservation Authority (MRCA)
C/O Judi Tamasi, Project Manager
5810 Ramirez Canyon Road
Malibu, California 90265

Subject: **Addendum No. 1 Geotechnical Engineering Report**
Response to City Review
Proposed Advanced On-Site Wastewater Treatment Systems (AOWTS)
APN 4470-021-009
Vicinity: 31725-31721 East Sea Level Drive
Malibu, California

References: Earth Systems Southern California, 3-18-2016, *Supporting Geotechnical Report Proposed Advanced On-Site Wastewater Treatment Systems (AOWTS), APN 4470-021-009, Vicinity 31725-31721 East Sea Level Drive, Malibu, California*: Project No. LA-01618-01.

Advanced Onsite Water, 11-8-2016, *Lechuza Beach AOWTS* Plans*, 31725.5 East Sea Level Drive, Malibu, CA*: for Mountains Recreation and Conservation Authority (MRCA): 6 Sheets.

City of Malibu, 8-29-2016, *Geotechnical Review Sheet* of New Advanced On-site Wastewater Treatment System (AOWTS) for Lechuza Beach Public Access Improvements, Log Number 3922 (3498).

This addendum report has been prepared per your request. It provides a documented response to the review letter dated August 29, 2016 (Log # 3922 (3498) from the City of Malibu. A copy of the review letter is included as Attachment A.

GEOMORPHOLOGY

The extreme southern part of the subject property is subject to “wave action” (i.e., the effects of normal wave inundation). That area is defined as “ephemeral” and is south of the AOWTS discussed above. The soil retained by and north of the protective quarry rock revetment supports the area of the proposed AOWTS disposal field.

The primary geomorphic agent active in the creation of shore forms along the coastline segment west of Lechuza point is the combination of storm waves and littoral drift. The long-shore sediment transport cell has a net direction of drift along the Malibu coast from west to east. The two most significant lines of evidence for this are the common local eastward stream course diversion and the formation and maintenance of geologically ephemeral shore forms along the coast.

The dominance of eastward littoral drift is evident in the geomorphology of the modern Lechuza Beach coastline. The shore forms at the mouth of the stream course of each of the Malibu Creek drainage course displays the influence of eastward littoral drift. The combined effects of littoral sediment supply, southwest winter storm cycles and shore form have resulted in an accretionary segment of stable, cuspate shaped broad shoreline strand between two rocky headlands at Lechuza point on the east and Encinal Creek at the western end of Lechuza State Beach.

The strong littoral transport cell creates a broad sandy beach during the summer months that is periodically attacked by high energy winter storms and dramatically reduced in size. The effects of intensified winter storm erosion are accentuated along this coastal segment owing in part to limited sand supply. Strong winter storms intermittently produce a cobble and shingle beach with very little overlying sand that is seasonally replenished. The resistant cobble and boulder bed load fraction of Encinal Creek has created an armored beach on the west that provides a source for cobbles of the beach depositional sequence that were observed in exploratory borings to bedrock.

PROJECT DESCRIPTION

A geotechnical report (Earth Systems Southern California, 3-18-2016) was submitted to the City of Malibu in support of a new AOWTS system at the subject site. That report partially forms the basis of the City review.

A geotechnical report was also prepared by AMEC dated 12/6/13 for the project. The scope of that report is for the project improvements that include reconstruction of stairs, new view platform, new disabled parking spaces available by reservation, and a new single-stall public restroom located on MRCA-owned land beyond (west of) the beach terminus of East Sea Level Drive.

Earth Systems is only addressing the disposal system (leach field) that is to be located in/near the grasscrete by the paved East Sea Level Drive, near the beach terminus of the road, on property owned by Malibu-Encinal Homeowners Association (HOA). The road and grasscrete are protected by an existing rip-rap revetment that borders the beach.

RESPONSE TO REVIEW COMMENTS FOR AOWTS:

The following text provides a documented response to the City of Malibu review letter dated August 29, 2016 (Log # 3922 (3498) from the City of Malibu. Each review comment is presented in the same order as the review followed by Earth Systems' response. A copy of the review letter is included as Attachment A.

Comment 1: *It does not appear that the borings were projected onto the Cross-Section properly. Please review and correct the Section to show the correct earth unit profile and depth of the borings.*

Response: An updated Map and Cross-Section is attached to this response.

Comment 2. *The Project Geotechnical Consultant needs to review the waterproof effluent barrier proposed by the AOWTS designer and accept the recommendation, or provide alternative recommendations, as appropriate.*

Response: An effluent barrier was recommended by Earth Systems for the purpose of complying with the City of Malibu policy that applies to Environmental Health review of onsite wastewater treatment system plans submitted in connection with development and wastewater system projects on beachfront properties (City of Malibu, 2-8-2012). Oceanside Requirement No. 5 of that document specifies that shoreline protection devices shall be made waterproof when a potential for the horizontal seepage of effluent from an onsite wastewater treatment system dispersal area is determined.

The referenced AOWTS Plans by Advanced Onsite Water, (11-8-2016) were provided to evaluate the effects of the proposed waterproof effluent barrier. The infiltration chambers will sit adjacent to the paved private street with a minimum five-foot setback from the existing riprap. The setback extends on each end of the leach field to further protect the disposal area.

Based on discussions with the systems designer, the proposed barrier is a waterproof synthetic barrier suitable for placement on riprap. Specifically, a 1.14 mm Firestone reinforced EPDM geomembrane for water containment membrane is specified. The high elasticity and puncture resistance of this membrane was selected for placement along riprap which has jagged edges. This puncture resistance means that minor breaks may occur with very little effluent transmitted thought the barrier.

The effluent barrier is illustrated on the referenced AOWTS Plans as follows:

1. Sheet C-3 shows a "Vertical Effluent Barrier" (Firestone EPDM Geomembrane)
2. Sheet C-4 has "Geomembrane Effluent Barrier" callouts that (per system designer) should connect to outboard vertical sand bed replacement material contact only.
3. Sheet C-4 has an additional callout to the same vertical line indicating "4 oz. Filter Fabric".

The system designer confirms that the barrier will only be installed along the vertical portion of the south, east and west sides of the excavation as shown on C-3. Additionally, the detail "Section A (north)" on sheet C-4 will be amended to include the barrier only along the vertical portion and not along the bottom of the system. The AOWTS will rely on direct contact of the new leach field with the beach sand deposits (Qb) underlying the site.

Filter fabric will wrap the gravel fill over the infiltration galleries and will line the excavation prior to placing the barrier. The filter fabric is intended protect the membrane and to assist in wicking the effluent down and under the riprap.

Percolation tests are not necessary for beach sand deposits. The underlying beach sand falls under USDA classification "Sand." Typical City of Malibu practice allows a design beach sand infiltration rate of up to 2 gallons per square foot per day (GPSFD). As a conservative measure the AOWTS designer has selected a design rate of 1.2 GPSFD. Given these conservative AOWTS design parameters, it is Earth Systems' professional opinion that the physical characteristics of the underlying beach sequence are not likely to produce adverse groundwater mounding or side slope breakout of effluent. The vertical membrane was included in the system design to ensure optimal long-term performance of the system and minimal impact on public health and environmental quality. The geomembrane barrier system shall be installed per the manufacturer's specifications.

Comment 3. *Please provide copies of all responses to the referenced Environmental Health Review Sheet dated 8-25-16.*

Response: Earth Systems has been requested to respond only to the City of Malibu review comments above. The remaining comments will be responded to by others.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

The conclusions and recommendations submitted in this report relative to the proposed OWTS are based, in part, upon the data obtained from the site observations during the field exploration, and past experience. The nature and extent of variations between the borings may not become evident until construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this addendum report.

This addendum should be made part of the referenced Preliminary Geotechnical Engineering report dated March 18, 2016. All conclusions, recommendations, and limitations of that report, except as specifically amended in this addendum report, remain valid and apply to the currently proposed project.

CLOSURE

Earth Systems trusts this report is sufficient at this time and meets your current needs. Earth Systems appreciates this opportunity to provide professional geotechnical engineering services for this project. If you have any questions regarding the information contained in this report, or if you require additional geotechnical engineering services, please contact the undersigned.

Respectfully submitted,

Earth Systems

For

William A. LaChapelle, P.G., E.G.
Senior Engineering Geologist

Reviewed by:

CERTIFIED ENGINEERING GEOLOGIST
CHRISTOPHER FRASER ALLEN
No. 2648
Exp. 8/2018
STATE OF CALIFORNIA

Christopher F. Allen, P.G., E.G.
Project Engineering Geologist

END OF TEXT

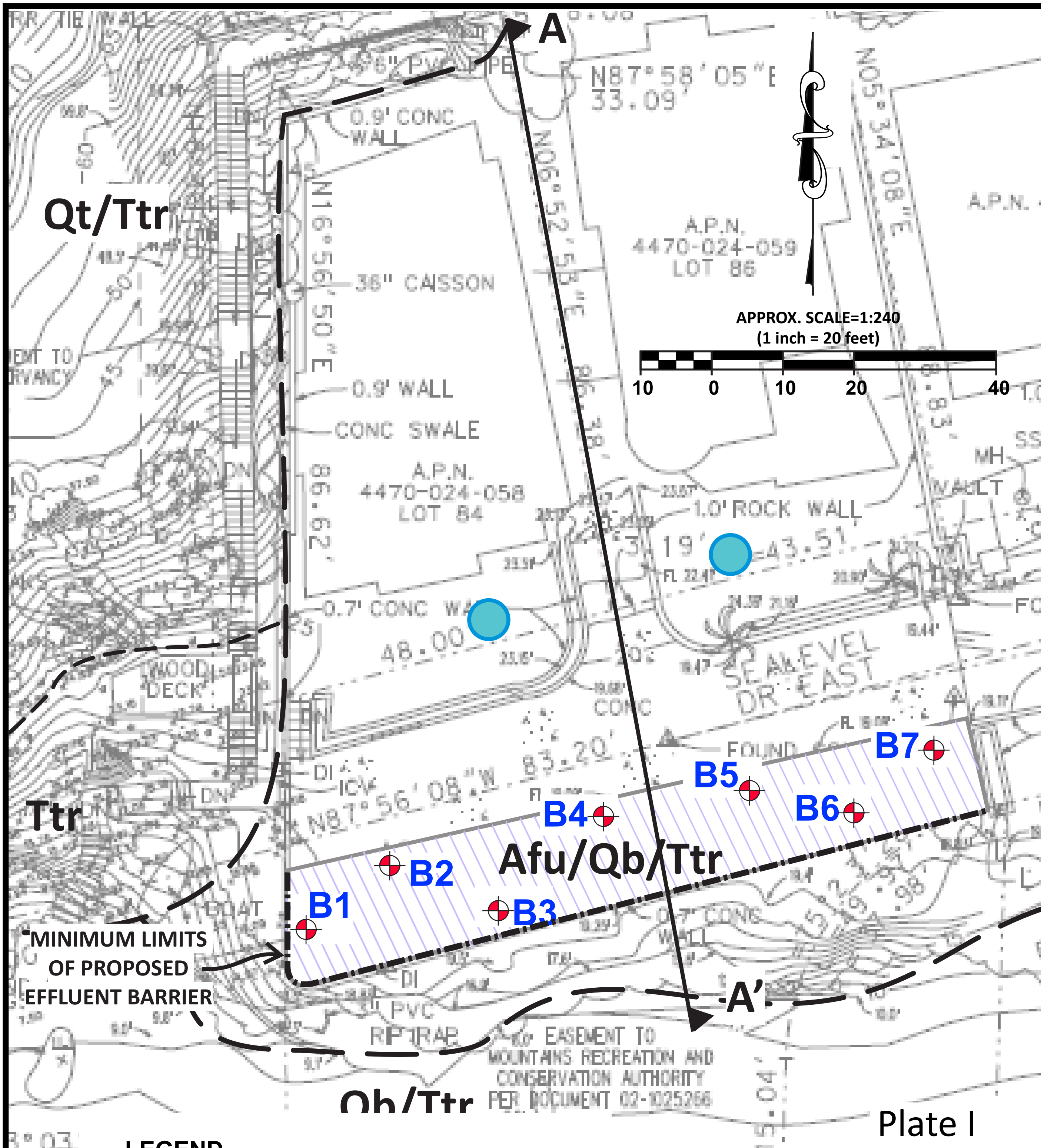
REFERENCES

PLATES
Plate I Updated Geologic Site Map
Plate II Updated Geologic Cross-Section

ATTACHMENTS
Attachment A - City of Malibu Review Sheet

Distribution:
3 – Addressee (hard copy)
1 – Addressee (CD, pdf copy)

PLATES



LEGEND

Afu	ARTIFICIAL FILL (UNCERT.)		EXISTING SEEPAGE PIT
Qb	BEACH DEPOSITS	A A'	GEOLOGIC CROSS SECTION
Qa	QUATERNARY ALLUVIUM	B1	APPROX BORING LOCATION
Qt	QUATERNARY TERRACE		APPROX LEACH FIELD LOCATION
Ttr	TRANCAS FORMATION		GEOLOGIC CONTACT

BASE MAP: Land & Air Surveying, 4-9-13, Aerial Topo Edit, Sheet 3 of 7, Proj. No. MTREC113

SITE GEOLOGIC MAP

MRCA LEACHFIELD
SEA LEVEL DRIVE
MALIBU, CALIFORNIA

Earth Systems
Southern California

12/2/2016	LA-01618-01

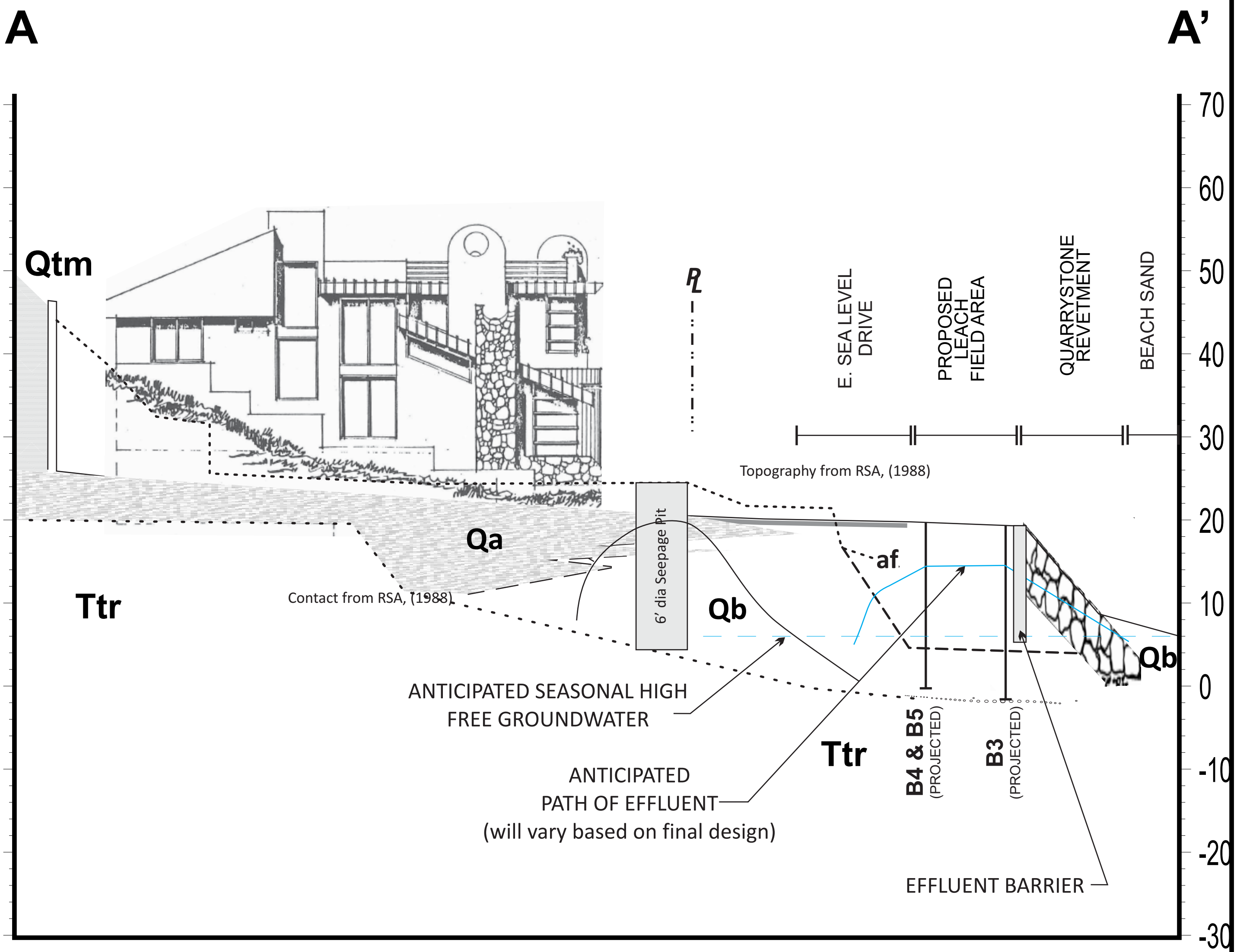


Plate II

SCALE = 1:240
(1 inch = 20 feet)

GEOLOGIC CROSS SECTION	
MRCA LEACHFIELD SEA LEVEL DRIVE MALIBU, CALIFORNIA	
Earth Systems Southern California	
12/2/2016	LA-01618-01

ATTACHMENT A

City of Malibu Review Sheet

City of Malibu

23825 Stuart Ranch Road • Malibu, California 90265-4861
(310) 456-2489 • Fax (310) 317-1950 • www.malibucity.org

GEOTECHNICAL REVIEW SHEET

Project Information

Date:	August 29, 2016	**Review Log #:**	**3922** (3498)
Site Address:	31720.5 Broad Beach Road		
Lot/Tract/PM #:	n/a	**Planning #:**	**CDP 07-087**
Applicant/Contact:	Judi Tamasi, judi.tamasi@mrca.ca.gov	**BPC/GPC #:**	
Contact Phone #:	310-589-3230, x121 **Fax#:** 310-589-2408	**Planner:**	**Stephanie Hawner**
Project Type:	**New Advanced Onsite Wastewater Treatment System (AOWTS) for**: Lechuza Beach Public Access Improvements		

Submittal Information

Consultant(s) / Report Date(s):
*(Current submittal(s) in **Bold.**)*

Earth Systems Southern California (LaChappell, CEG 1311): **3-18-16**
AMEC Environmental and Infrastructure (Bailiff, CEG 2252 ; Blanc, GE 2615): 12-6-13
AMEC Environmental and Infrastructure (Forcier, GE): 7-10-12
Advanced Onsite Water (Bradley, RCE 53105) : **8-9-16**
GeoSoils, Inc. (Skelly, RCE 47857) : **8-10-16**

Lechuza Beach Public Access Improvements East Sea Level Drive plans prepared by Mountains Recreation and Conservation Authority dated May 21-31, 2013 (4 sheets).
Lechuza Beach Public Access Improvements West Sea Level Drive plans prepared by Mountains Recreation and Conservation Authority dated May 31, 2013 and September 11, 2013 (2 sheets).

Previous Reviews: Environmental Health Review Sheet dated August 25, 2016, 12-27-13, 6-19-13, Cursory review of slope stability analyses in May 2012; Geology Review Referral Sheets dated 8-10-09 and 10-4-07

Review Findings

Coastal Development Permit Review

☐ The AOWTS and beach access project is **APPROVED** from a geotechnical perspective.

☒ The AOWTS and beach access project is **NOT APPROVED** from a geotechnical perspective. The listed 'Review Comments' shall be addressed prior to approval.

Building Plan-Check Stage Review

☒ Awaiting Building plan check submittal. Please respond to the listed 'Building Plan-Check Stage Review Comments' AND review and incorporate the attached 'Geotechnical Notes for Building Plan Check' into the plans.

- [ ] **APPROVED** from a geotechnical perspective. Please review the attached 'Geotechnical Notes for Building Plan Check' and incorporate into Building Plan-Check submittals.
- [ ] **NOT APPROVED** from a geotechnical perspective. The listed 'Building Plan-Check Stage Review Comments' shall be addressed prior to Building Plan-Check Stage approval.

Remarks

The referenced supporting geologic report and design report for the AOWTS were reviewed by City geotechnical staff. Based on the information submitted, the beach access project now includes a new AOWTS consisting of a treatment tank system and two leach lines totaling 498 square feet to service the restroom facility. The septic holding tank is no longer proposed. The treatment tank system will be supported by a pile-supported concrete slab and concrete protection walls. A waterproof synthetic effluent barrier (Firestone reinforced EPDM geomembrane for water containment structures) is proposed between the leach lines and the rip rap on the southern face of the excavation.

The beach access project includes new retaining walls, access stairways/ramps, view platforms on pile foundations, and a restroom facility that includes piles for the facility and access way. No grading is proposed.

Review Comments for AOWTS:

1. It does not appear that the borings were projected onto the Cross-Section properly. Please review and correct the Section to show the correct earth unit profile and depth of the borings.
2. The Project Geotechnical Consultant needs to review the waterproof effluent barrier proposed by the AOWTS designer and accept the recommendation, or provide alternative recommendations, as appropriate.
3. Please provide copies of all responses to the referenced Environmental Health Review Sheet dated 8-25-16.

Review Comments for Beach Access Project:

1. It appears from Cross Section 1-1' in Appendix E that the restroom structure walls will retain earth loads associated with the ascending slope. The Consultant needs to run additional slope stability analysis that incorporates the 'truncated' vertical face at the retaining wall so that any wall loading associated with slope stability can be identified and incorporated into the wall design. Loading should be checked for both static and pseudo-static conditions.
2. Provide input and output files for the slope stability analysis for review.
3. Provide copies of the direct shear test results that were utilized from the previous consultant's reports, including related displacement curves.
4. The Project Geotechnical Consultant needs to provide cross-sections across the proposed treatment tank structure and verify that the static and seismic slope stability are adequate for their intended use.
5. The Project Geotechnical Consultant needs to provide a finding in accordance with Section 111 of the Malibu Building Code regarding the proposed AOWTS and beach access improvements.
6. Since the West Sea Level Drive parking spaces are set back only 7 and 9 feet from the top of the coastal bluff, an estimate of the 100-year bluff retreat is required as per Chapter 10.4(D) of the City's Local Implementation Plan. Show the estimated bluff retreat line on the Site plan.

Building Plan-Check Stage Review Comments:

1. The Project Geotechnical Consultant states in their latest report that, due to access restrictions that prohibited the collection of geotechnical data to support the design of the improvements, their recommendations should be re-evaluated by conducting additional field exploration once access to the beach and neighboring properties is granted. Please provide the additional data and update the recommendations, as appropriate.

2. The applicant needs to sign, record at the County of Los Angeles Recorder's office, and submit to City geotechnical staff a certified copy of an "Assumption of Risk and Release" for geotechnical hazards prior to permit issuance.

3. Please discuss the necessity for additional freeboard on the restroom structure retaining walls.

4. Provide bearing capacity and passive pressure calculations per section 7.1 of the City's Geotechnical Guidelines.

5. Please provide the GE number for Easton Forcier and James Weaver.

6. Will any grading be necessary for the proposed parking areas, pathways, or new structures? Provide grading plans for review, as necessary.

7. Include the following note on the AOWTS plans: "*The Project Engineering Geologist shall observe and approve the installation of the leach lines and provide the City inspector with a field memorandum(s) documenting and verifying that the dispersal area was installed per the approved AOWTS plans.*"

8. Include the following note on the building plans: "*The Project Geotechnical Consultants shall prepare an as-built report documenting the installation of the pile foundation elements for review by City Geotechnical staff. The report shall include total depths of the piles, depth into the recommended bearing material, minimum depths into the recommended bearing material, depth below ground water, and a map depicting the locations of the piles*".

9. Section 7.2.1 of the City's geotechnical guidelines requires a minimum thickness of 10 mils for vapor barriers beneath slabs-on-grade. Building plans shall reflect this requirement.

10. If shoring is required for the installation of any of the proposed improvements, provide shoring plans for review.

11. Two sets of final beach access improvement plans (**APPROVED BY BUILDING AND SAFETY**) incorporating the Project Geotechnical Consultant's recommendations and items in this review sheet must be **reviewed and wet stamped and manually signed by the Project Engineering Geologist and Project Geotechnical/Civil Engineer.** City geotechnical staff will review the plans for conformance with the Project Geotechnical Consultants' recommendations and items in this review sheet over the counter at City Hall. **Appointments for final review and approval of the plans may be made by calling or emailing City Geotechnical staff.**

Please direct questions regarding this review sheet to City Geotechnical staff listed below.

Engineering Geology Review by:

Christopher Dean, C.E.G. #1751, Exp. 9-30-18
Engineering Geology Reviewer (310-456-2489, x306)
Email: cdean@malibucity.org

Date 8/29/16

This review sheet was prepared by representatives of Cotton, Shires and Associates, Inc. and GeoDynamics, Inc., contracted through Cotton, Shires and Associates, Inc., as an agent of the City of Malibu.

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GeoDynamics, Inc.
Applied Earth Sciences
Geotechnical Engineering & Engineering Geology Consultants

Project-Specific Reference #11

City of Malibu

23825 Stuart Ranch Road · Malibu, California · 90265-4861
Phone (310) 456-2489 · Fax (310) 456-3356 · www.malibucity.org

ELECTRONIC GEOTECHNICAL SUBMITTAL SIGNATURE PAGE

PROJECT ADDRESS:
(One address per line)
31720.5 Broad Beach Road, Malibu, CA 90265 (CDP 07-087)*

PROPERTY OWNER(S) NAME(S): Mountains Recreation and Conservation Authority

GEOTECHNICAL CONSULTANT:

NAME: Anthony Blanc
FIRM: Amec Foster Wheeler Environment & Infrastructure, Inc
ADDRESS: 121 Innovation Drive, Suite 200
Irvine, CA 92617
TELEPHONE: (949)642-0245
FAX: (949)642-4474
EMAIL: anthony.blanc@amecfw.com

LIST OF DOCUMENTS SUBMITTED:

DOCUMENT DATE	DOCUMENT DESCRIPTION
02/17/17	Amendment to 12/6/2013 Geotechnical Investigation Report
	and Response to City Review Comments Dated 12/27/2013

GEOTECHNICAL LICENSE STAMP WITH WET SIGNATURE:

REGISTERED PROFESSIONAL ENGINEER
ANTHONY BLANC
No. GE 2615
Exp. 12-31-18
GEOTECHNICAL
STATE OF CALIFORNIA

Recycled Paper

February 21, 2017

Project 0010978000

Ms. Judi Tamasi
Mountains Recreation and Conservation Authority
5810 Ramirez Canyon Road
Malibu, California 90265

Re: Amendment to 12/6/2013 Geotechnical Investigation Report and Response to City Review comments dated 12/27/2013 (Review Log # 3498)
Lechuza Beach Public Access Improvements
Malibu, California

Dear Ms. Tamasi:

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler), formerly AMEC Environment & Infrastructure (AMEC), has prepared this letter to respond to review comments provided by the City of Malibu (City) on December 27, 2013. The geotechnical report reviewed is entitled, "Geotechnical Investigation Final Report, Lechuza Beach Public Access Improvements Project" and is dated December 6, 2013. This letter also serves as an addendum to the above referenced 2013 Geotechnical Investigation report.

1.0 REVISED PROJECT DESCRIPTION

Following submittal of the 2013 report, several components of the project were revised by the Mountain Recreation and Conservation Authority (MRCA)'s project team. Most of the revisions are in the form of notes and clarifications to the previous drawings, copies of which were contained in Appendix A of the 2013 geotechnical report. A copy of the revised drawings is included in Attachment A of this letter. The revisions generally do not affect the design recommendations provided in the report. A brief summary of the proposed improvements and associated changes is presented below.

1.1 West Sea Level Drive Terminus

As indicated in the 2013 report, previously proposed upgrades consisted of:

- Reconstruction of existing staircase and rails
- Reconstruction of existing view platform
- Construction of two new ADA parking spaces designated as D and DD
- Improvements to Fire Department turnaround.

Figures A-1 and A-2 in Attachment A show these project elements.

Amec Foster Wheeler Environment & Infrastructure, Inc.
121 Innovation Drive, Suite 200
Irvine, CA
USA 92617-3094
Tel (949) 642-0245
Fax (949) 642-4474
www.amecfw.com

The proposed lower stairs will be of steel with wood treads and the concrete stair landing at the beach will be supported on drilled caisson foundation embedded into bedrock.

1.2 East Sea Level Drive Terminus and Lot I

Previously proposed improvements at the East Sea Level Drive terminus included constructing a new public staging area, new/relocated beach stairs, new walkways, a new view platform, and a new restroom connected to the public staging area by an access walkway. In addition, two new ADA parking spaces, designated as spaces 8 and 11 were planned along East Sea Level Drive (Attachment A, Figure A-5).

Notable changes to the previously proposed improvements include the following:

- Deletion of the new view platform west of the beach terminus of East Sea Level Drive;
- Renaming of the public staging area as Public Viewing Area (Attachment A, Figure A-3);
- Deletion of the septic holding tank and replacement by new advanced onsite wastewater treatment system (AOWTS) tank. Revised drawings indicate the location of the AOWTS tank, beneath the public viewing area (previous public staging area) is essentially the same as the previously proposed septic holding tank. However, the conceptual support is better defined and shows the concrete enclosure around the tank on the same deep foundation system that supports the public viewing area.
- Along with the new AOWTS tank, addition of approximately 500 square feet of leach field along the south side of East Sea Level Drive, just east of Lot I (Attachment A, Figures A-3 and A-4). It is our understanding that the design of the AOWTS and leach field are being handled by a specialty designer.
- Slight raising of the proposed restroom floor elevation by approximately 9 inches.

The above changes reflect no significant alterations of structures or locations; therefore, the proposed revisions are considered to have no significant impact on the geotechnical recommendations provided in the December 2013 geotechnical report. In general, all slabs constructed below the design water level (historic high water depth of 5 feet, as discussed in the 2013 report) will need to be designed to resist uplift due to the hydrostatic head.

Previously proposed improvements to Lot I remain unchanged (Attachment A, Figure A-6 and Figure A-7).

2.0 RESPONSES TO CITY REVIEW COMMENTS

This section of the letter is in response to comments provided by the City on December 27, 2013, following their review of the AMEC December 6, 2013 geotechnical report. This letter addresses only Comments 1 through 5. Comment No. 6 will be addressed by MRCA under separate cover. For clarity of presentation, we reiterate below the City comments followed by our responses.

City Comment 1

It appears from Cross Section 1-1' in Appendix E that the restroom structure walls will retain earth loads associated with the ascending slope. The Consultant needs to run additional slope stability analysis that incorporates the 'truncated' vertical face at the retaining wall so that any wall loading associated with slope stability can be identified and incorporated into the wall design. Loading should be checked for both static and pseudo-static conditions.

Amec Foster Wheeler Response to Comment 1

Additional slope stability analyses were performed and are summarized in Attachment B. Slope stability figures for Cross-section 1-1' indicate the factor of safety (FS) against gross instability is greater than 1.5. Analyses that included the truncated vertical face at the retaining wall indicate that the retaining wall will need to resist a resultant horizontal force of approximately 1 kip per foot of wall length (measured in the direction perpendicular to the paper) to achieve a FS of 1.5. The proposed restroom is approximately 9 feet by 12 feet in plan dimensions. The per-foot measurement would be in the 9-foot direction. The resultant force should be applied at the center of the wall height.

The seismic stability was evaluated using the pseudostatic analysis methods within Slope/W. In this method the earthquake forces are represented by a static lateral force equal to the product of the horizontal seismic coefficient (k) and the weight of the slide mass, and a FS is computed using conventional limit-equilibrium analysis. A pseudo-static analysis was performed for the truncated vertical face to estimate the loading associated with slope stability. For the seismic coefficient of 0.35 recommended by the City of Malibu in the City's geotechnical guidelines, the restroom wall will need to resist a resultant horizontal force of 6.5 kips per foot to achieve a FS of 1.0. The resultant force should be applied at the center of the wall height.

City Comment 2

Provide input and output files for the slope stability analysis for review.

Amec Foster Wheeler Response to Comment 2

Input and output files for the slope stability analyses are provided in Attachment B.

City Comment 3

Provide copies of the direct shear test results that were utilized from the previous consultants' reports, including related displacement curves.

Amec Foster Wheeler Response to Comment 3

Copies of relevant laboratory test results utilized from previous consultants' reports, including the direct shear test results, are included in Attachment C.

City Comment 4

The Project Geotechnical Consultant needs to provide cross-sections across the proposed septic holding tank structure and verify that the static and seismic slope stability are adequate for their intended use.

Amec Foster Wheeler Response to Comment 4

As indicated earlier, the proposed septic holding tank has been deleted and replaced by an AOWTS tank beneath the Public View Platform. The proposed concrete enclosure for the tank will be approximately 9 feet deep and 8 feet by 20 feet in plan dimensions. Additional slope stability analyses, similar to analyses reported under Comment 1, were performed for Cross-section 2-2', and the results are included in Attachment B. The approximate location of Cross-section 2-2' was plotted on Figure 3 of the 2013 report and is attached to this letter for easy reference. The results of the analyses indicate that the static FS for gross stability is greater than 1.5. The enclosure wall behind the AOWTS tank will need to resist a resultant horizontal force of 2 kips per foot under static conditions and 8 kips per foot under seismic conditions. The resultant force should be applied at the center of the enclosure height.

City Comment 5

The Project Geotechnical Consultant needs to provide a finding in accordance with Section 111 of the Malibu Building Code regarding the proposed beach access improvements.

Amec Foster Wheeler Response to Comment 5

Provided that the design conforms to the recommendations of the geotechnical report, the proposed beach access improvements will be safe from the hazards of landsliding, settlement, or slippage and will not adversely impact properties outside the developed areas. The design conforms to the requirements of Section 111 of the Los Angeles County and City of Malibu Building Codes.

Sincerely,
Amec Foster Wheeler Environment & Infrastructure, Inc.

REGISTERED PROFESSIONAL ENGINEER
ANTHONY BLANC
No. GE 2615
Exp. 12-31-18
GEOTECHNICAL
STATE OF CALIFORNIA

Anthony Blanc, PE, GE
Senior Associate Geotechnical Engineer

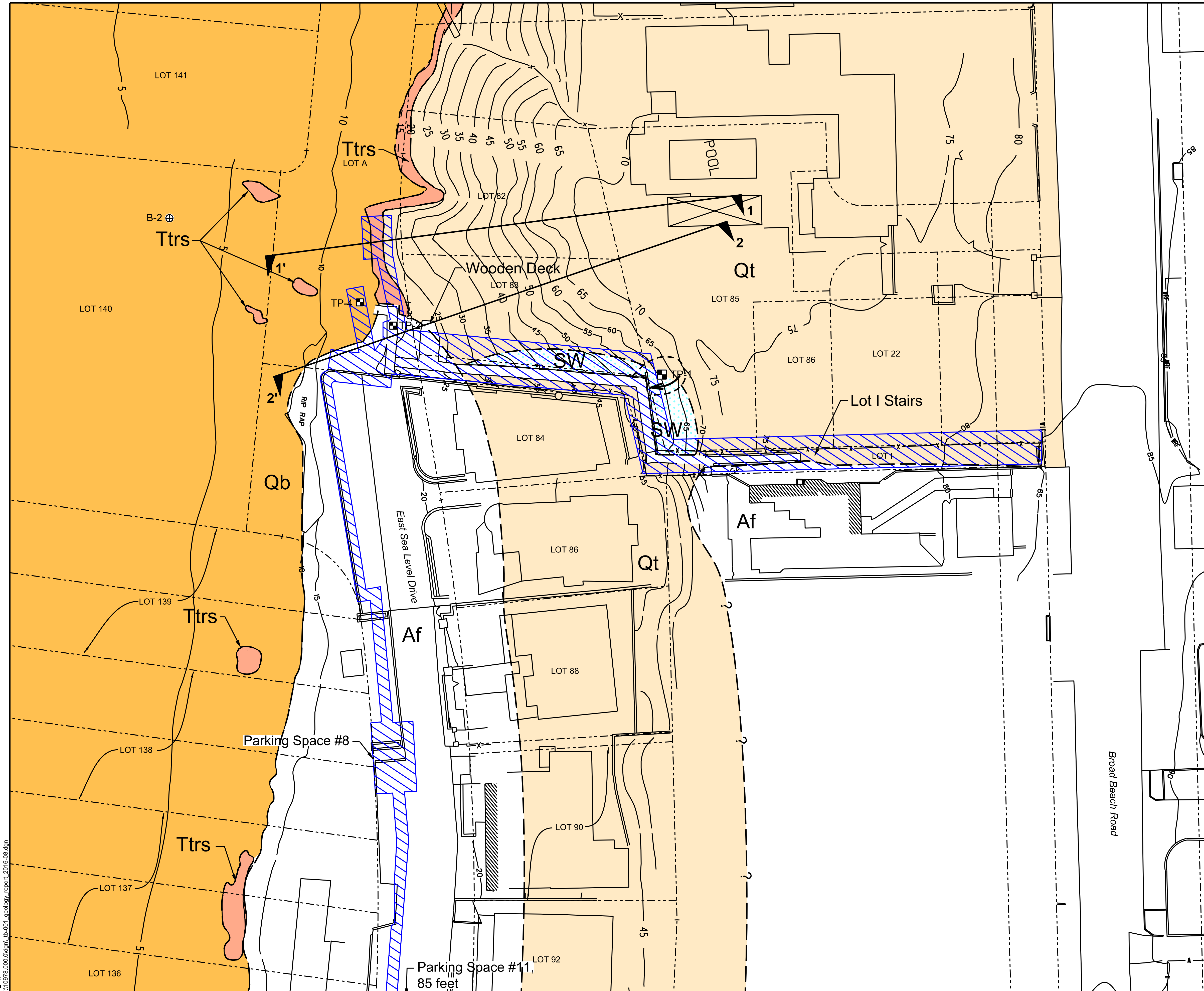
PROFESSIONAL GEOLOGIST
EILEEN BAILIFF
No. 2252
Exp. 7/31/17
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

Eileen Bailiff, PG, CEG
Senior Associate Engineering Geologist

Enclosures:

Figure 3-REV: Geologic and Field Exploration Location Map
Attachment A: Proposed Improvements and Design Drawings
Attachment B: Slope Stability Results and Input and Output Files
Attachment C: Copies of Laboratory Data from Previous Consultants

FIGURE



Explanation

TP-1 Test pit location and identification (AMEC, 2008)

B-4 Boring location and designation (Strata-Tech, 1992)

Proposed East Sea Level improvement areas

Bedding contact, dashed where approximate, queried where uncertain

Surficial slump

Af Artificial Fill

SW Slope wash

Qb Beach sand

Qt Terrace Deposits

Ttrs Sandstone bedrock (Trancas Formation)

2 2' Cross section location

Notes:

1. Boring and test pit locations are approximate.
2. Test pits were excavated using hand-held equipment and generator operated shovels. Excavated materials were used for backfill and compacted manually.

Approximate Scale in Feet
0 20 40
0 6 12
Approximate Scale in Meters

Basemap modified from Site Survey Plan dated July 9, 2007 provided by Mountains Recreation & Conservation Authority

GEOLOGIC AND
FIELD EXPLORATION LOCATION MAP
EAST SEA LEVEL DRIVE
Lechuza Beach
Public Access Improvements
Malibu, California

amec foster wheeler

Date: 08/12/2016	Project No. 10978.000.0	Figure
Submitted By: bb	Drawn By: jdp/pah	3-REV

8/12/2016 2:33:07 PM pat.herring
03_Figure 3
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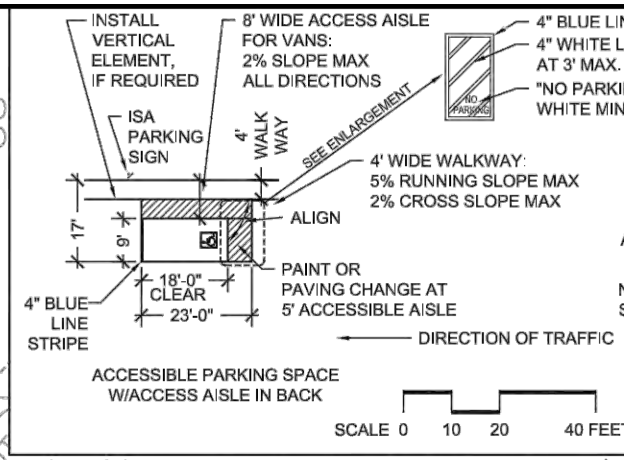
ATTACHMENT A

Proposed Improvements and Design Drawings

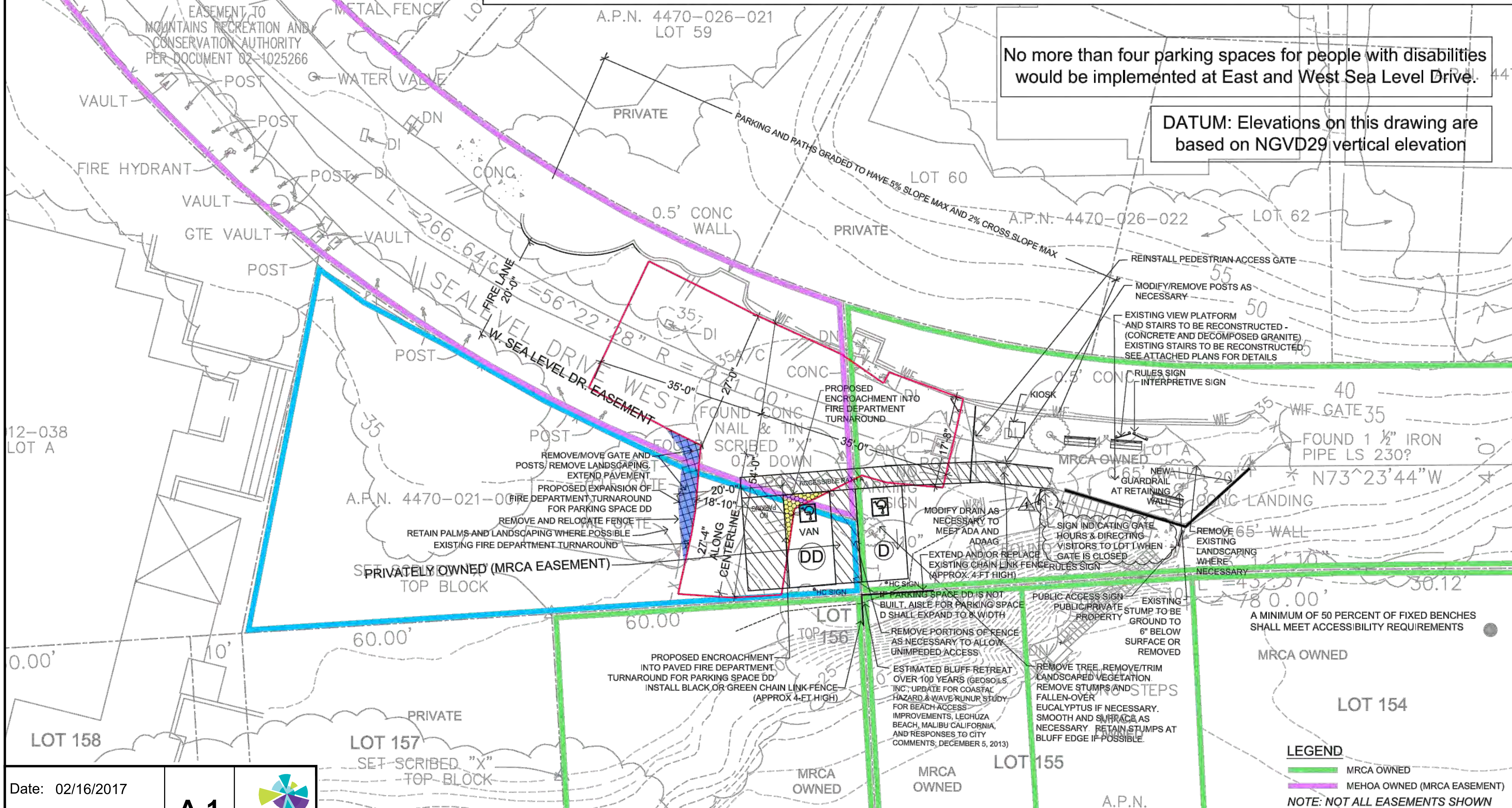


NOTES:

1. EXISTING SURFACES (PAVING AND GRASS) ARE SHOWN FOR REFERENCE ONLY. IT IS ASSUMED THAT GRASS SURFACING OR DIRT WHERE ACCESS AISLES ARE PROVIDED WOULD BE REPLACED WITH PAVING, DECOMPOSED GRANITE, OR ECOPAVERS, MEETING ADAAG 4.5.1 ACCESSIBILITY REQUIREMENTS. EXISTING ASPHALT OR CONCRETE PAVING IN THE LOCATION OF PARKING SPACES, ACCESS AISLES AND WALKWAYS WOULD ALSO BE IMPROVED TO MEET ACCESSIBILITY REQUIREMENTS (SEE NOTE 3 BELOW).
2. ACCESSIBLE PARKING SPACE AND ACCESS AISLE AT FRONT OR BACK OF PARKING SPACE SHALL HAVE A FIRM, STABLE & SLIP-RESISTANT SURFACE SUCH AS ASPHALT OR STABILIZED SOIL. ALTERNATE SURFACES FOR THE PARKING SPACE ARE ACCEPTABLE AS LONG AS THE ACCESS AISLE TO THE FRONT OR REAR HAS A SURFACE WITH A CONTRASTING PATTERN OR COLOR (SUCH AS PAINTED ASPHALT OR INTERLOCKING PAVERS). TURF GRASS SURFACING DOES NOT MEET ADAAG 4.5.1 REQUIREMENTS FOR ACCESSIBLE SURFACING.
3. WALKWAY (INCLUDING ACCESS AISLES AT THE SIDE OF PARKING SPACES) SHALL HAVE A FIRM, STABLE & SLIP-RESISTANT SURFACE SUCH AS ASPHALT OR STABILIZED SOIL, OR DECOMPOSED GRANITE. TURF GRASS SURFACING DOES NOT MEET ADAAG 4.5.1 REQUIREMENTS FOR ACCESSIBLE SURFACING.
4. EACH RESERVED STALL SHALL HAVE A SIGN (18"Hx12"W) DISPLAYING THE INTERNATIONAL SYMBOL OF ACCESSIBILITY AND A WARNING NOTICE THAT THE SPACE IS RESERVED FOR VEHICLES DISPLAYING A DISABLED PERSON PARKING PLACARD. EACH PARKING SPACE WILL HAVE A SIGN IN A LEGAL LOCATION AND SITED TO MINIMIZE POTENTIAL VISUAL IMPACTS TO THE NEIGHBORS.

No more than four parking spaces for people with disabilities would be implemented at East and West Sea Level Drive.

DATUM: Elevations on this drawing are based on NGVD29 vertical elevation



1 OPTION D, DD - WEST SEA LEVEL DRIVE

1"=10'-0"

LECHUZA BEACH PUBLIC ACCESS IMPROVEMENTS

West Sea Level Drive

Malibu, California

A PROJECT OF:
Mountains Recreation and Conservation Authority
570 West Avenue 26, Suite 100
Los Angeles, CA 90065
(323) 221-9944

SITE DESIGN:
Mountains Recreation and Conservation Authority
570 West Avenue 26, Suite 100
Los Angeles, CA 90065
(323) 221-9944

SURVEYOR:
Land & Air Surveying
22741 Pacific Coast Highway
Suite 400A
Malibu, CA 90265
(310) 456-9381

NOT FOR CONSTRUCTION

ISSUED:
6/12/2012, 1 3/15/2013
EDIT 9/11/2013
5/2/2014; 5/15/2015
7/23/2015; 8/9/2016
2/7/2017

DRAWN: CM
CHECKED: JT
PROJECT: 24.404.444.3221.26
SCALE: As noted

WEST SEA LEVEL D, DD

Project Area II
Project Elements
II-1 to II-5

2 OF 3

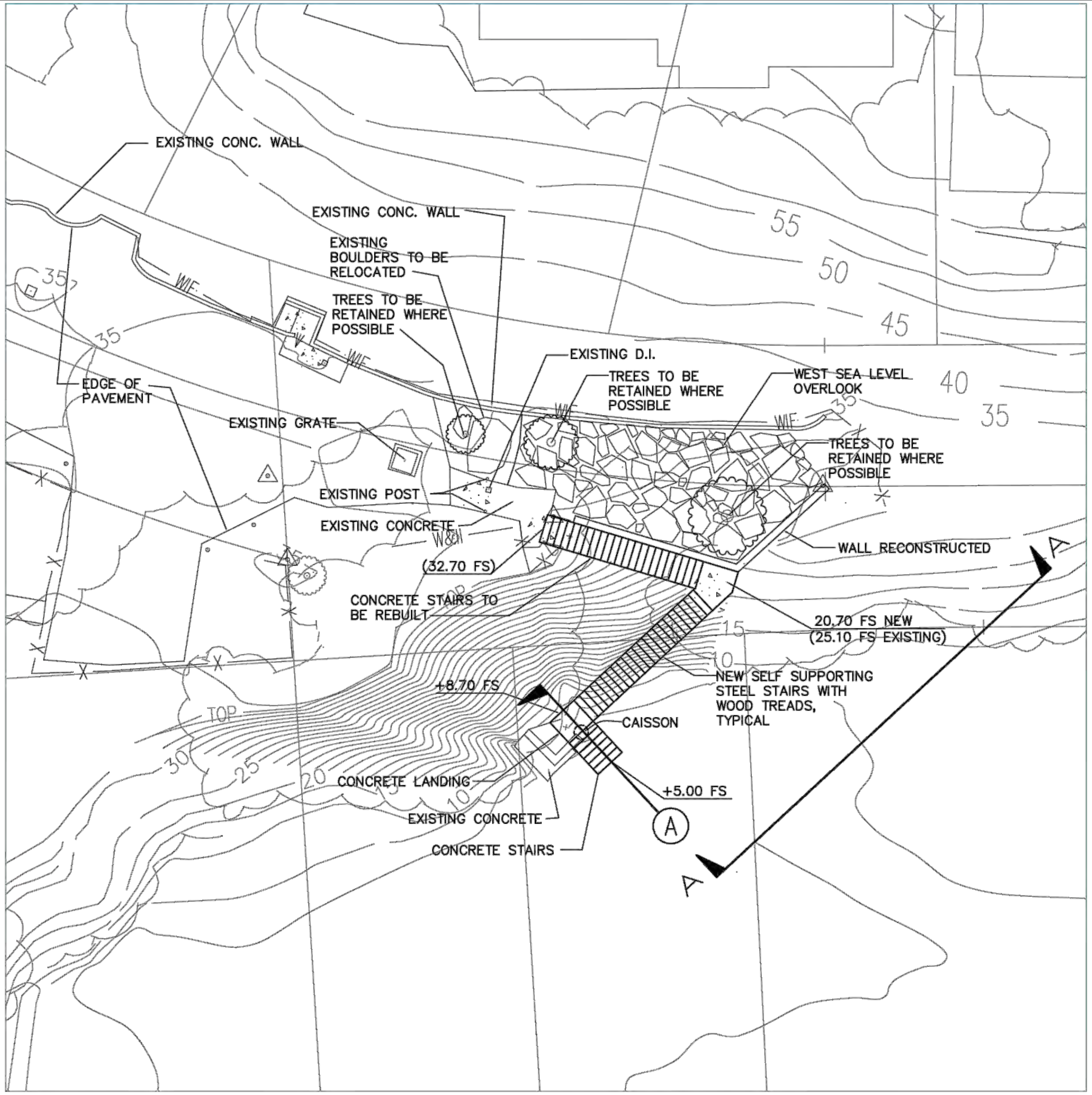
Date: 02/16/2017

Project No. 109780000

A-1

amec foster wheeler

Plot Date: 2/16/2017 4:10:25 PM, Plotted by: joanna.worker Drawing Path: W:\Projects\10978.000.0 (Lechuza Beach)\Fig\A-1_WSL 170207.dwg Rev A-1 2017



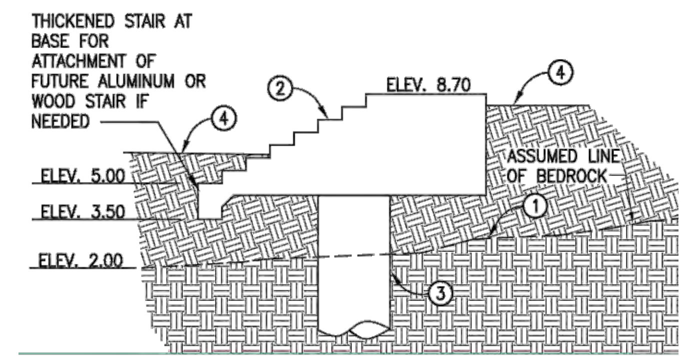
PLAN VIEW
SCALE: 1"=10'

SCALE 0 5 10 20 FEET NORTH

SEE ADDITIONAL PLANS FOR OTHER IMPROVEMENTS ALONG WEST SEA LEVEL DRIVE

January 23, 2017

ELEVATION A—A
SCALE: NONE



SECTION A
SCALE: 1/4"= 1'-0"

PILES:
THE PROJECT GEOTECHNICAL ENGINEER SHALL PREPARE AN AS-BUILT REPORT DOCUMENTING THE INSTALLATION OF THE PILE FOUNDATION ELEMENTS FOR REVIEW BY CITY GEOTECHNICAL STAFF. THE REPORT SHALL INCLUDE TOTAL DEPTHS OF PILES, DEPTH INTO RECOMMENDED BEARING MATERIAL, MINIMUM DEPTH INTO RECOMMENDED BEARING MATERIAL, DEPTH BELOW GROUND WATER AND A MAP DEPICTING THE LOCATIONS OF THE PILES.

FOUNDATIONS:
ALL FOUNDATION EXCAVATIONS MUST BE OBSERVED AND APPROVED BY THE PROJECT GEOTECHNICAL ENGINEER PRIOR TO PLACEMENT OF REINFORCING STEEL.

MATERIALS:

LANDINGS: CONCRETE

VIEW PLATFORM: CONCRETE AND DECOMPOSITION GRANITE

DATUM:
ELEVATIONS SHOWN ON THIS DRAWING ARE BASED ON NGVD29 VERTICAL ELEVATION.

NOTES:

1. LOCATION OF BEDROCK SHOWN IS APPROXIMATE. CONTRACTOR SHALL VERIFY LOCATION DURING CONSTRUCTION. DURING CONSTRUCTION, GEOTECHNICAL ENGINEER SHALL OBSERVE THE WORK AND UPDATE ANY RECOMMENDATIONS AS APPROPRIATE.
2. CONCRETE STAIR LANDING SUPPORTED BY CAISSON. CAISSON SHALL BE EMBEDDED INTO BEDROCK AS RECOMMENDED BY GEOTECHNICAL ENGINEER.
3. CONCRETE CAISSON. SIZE AND LOCATION OF CAISSONS WILL BE DETERMINED BY STRUCTURAL ENGINEER DURING DESIGN DEVELOPMENT STAGE.
4. APPROXIMATE LOCATION OF SAND

REGISTERED PROFESSIONAL ENGINEER BLAKE ECKERLE No. 30379 EXP. 3-31-2018 CIVIL STATE OF CALIFORNIA

Date: 02/16/2017	A-2	amec foster wheeler
Project No. 109780000		

URS
Golden Shore, Suite 100
Long Beach, CA 90802
Tel: (562) 308-2311
Fax: (562) 256-7905

THIS EXHIBIT IS ISSUED FOR CONCEPTUAL PLANNING ONLY, NOT FOR CONSTRUCTION. CONSTRUCTIBILITY OF ALL IMPROVEMENTS SHOWN SHALL BE DETERMINED AFTER DETAILED SURVEY, GEOTECHNICAL INVESTIGATION AND DURING DESIGN DEVELOPMENT STAGE.

WEST SEA LEVEL DRIVE

LECHUZA BEACH
MALIBU, CALIFORNIA

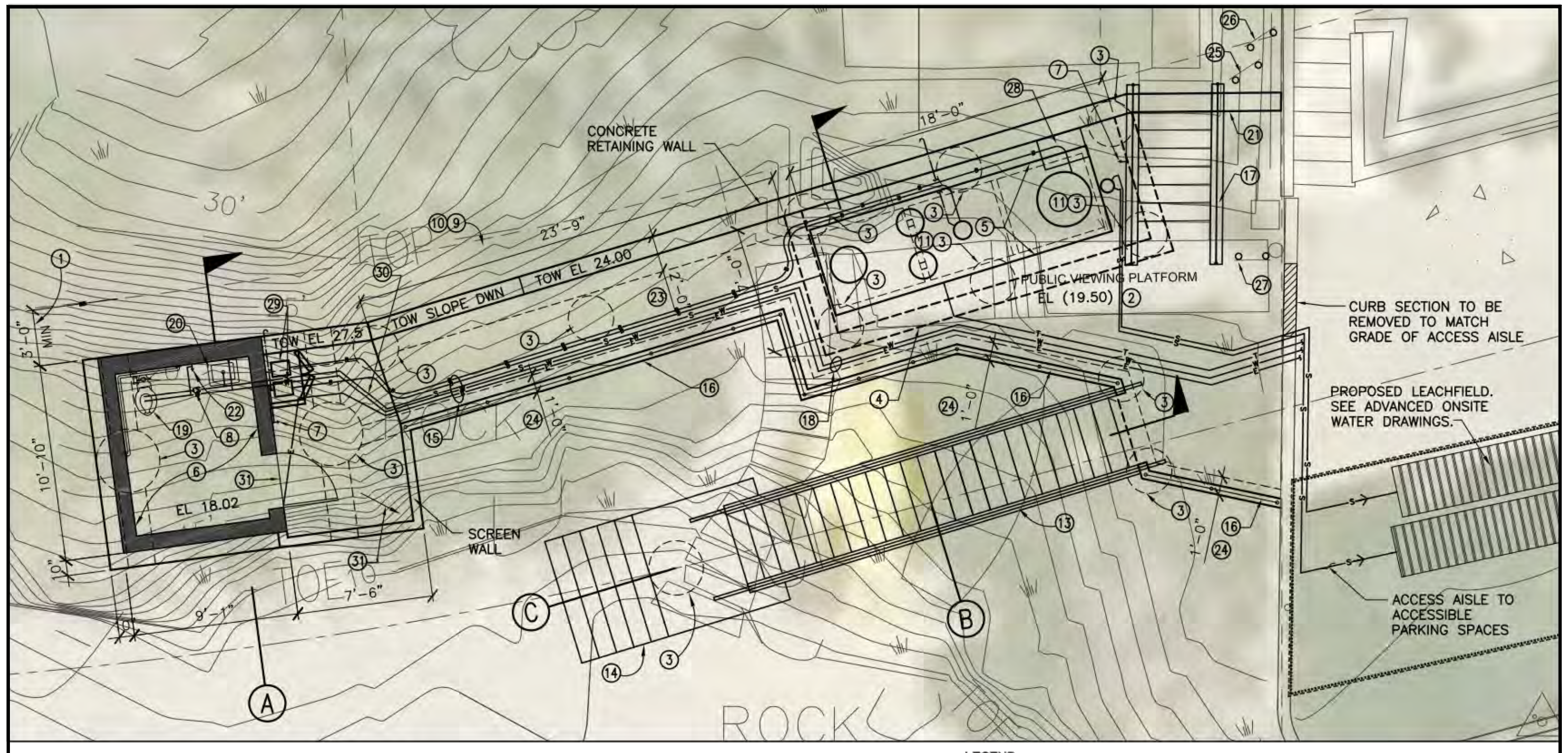
MOUNTAINS RECREATION AND CONSERVATION AUTHORITY
LOS ANGELES, CALIFORNIA

UTILITY NOTES:
SOLAR ELECTRICITY CONNECTIONS TO BE INSTALLED WHERE POSSIBLE. ALTERNATELY CONNECTION TO EXISTING ELECTRICAL LINES WALL BE MADE. SPECIFIC LOCATIONS OF UTILITY CONNECTIONS TO BE MADE BASED ON FINAL DETERMINATION BY SOUTHERN CALIFORNIA EDISON, WATER DISTRICT 29, AND PHONE COMPANY (OR EQUIVALENT UTILITY ENTITIES). IF SPECIFIC AND DETAILED LOCATIONS ARE NOT AVAILABLE, DIGGING TO LOCATED LINES WILL BE DONE BY HAND AND WITH HAND–HELD EQUIPMENT. IF NECESSARY FOR RESTROOM FUNCTION, INSTALL WIRELESS CONNECTIONS, WHERE POSSIBLE. ALTERNATELY, INSTALL NEW TELEPHONE LINES.

PILES:
THE PROJECT GEOTECHNICAL ENGINEER SHALL PREPARE AN AS–BUILT REPORT DOCUMENTING THE INSTALLATION OF THE PILE FOUNDATION ELEMENTS FOR REVIEW BY CITY GEOTECHNICAL STAFF. THE REPORT SHALL INCLUDE TOTAL DEPTHS OF PILES, DEPTH INTO RECOMMENDED BEARING MATERIAL, MINIMUM DEPTH INTO RECOMMENDED BEARING MATERIAL, DEPTH BELOW GROUND WATER AND A MAP DEPICTING THE LOCATIONS OF THE PILES.

FOUNDATIONS:
ALL FOUNDATION EXCAVATIONS MUST BE OBSERVED AND APPROVED BY THE PROJECT GEOTECHNICAL ENGINEER PRIOR TO PLACEMENT OF REINFORCING STEEL.

DATUM:
ELEVATIONS SHOWN ON THIS DRAWING ARE BASED ON NGVD29 VERTICAL ELEVATION.



PLAN VIEW
SCALE: 1/4"=1'-0"

NORTH

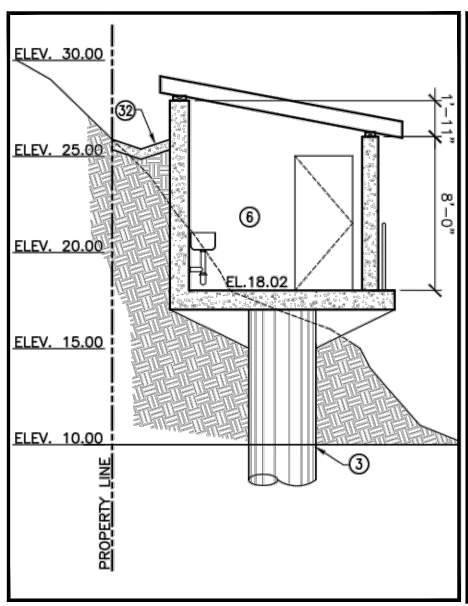
SCALE 0 1 2 3 4 5 10 FEET

LEGEND
—S— STAINLESS STEEL SEWER LINE
—W— STAINLESS STEEL WATER LINE
—E— STAINLESS STEEL ELECTRICAL LINE
—T— STAINLESS STEEL TELEPHONE LINE
—B— STAINLESS STEEL BLOWER LINE

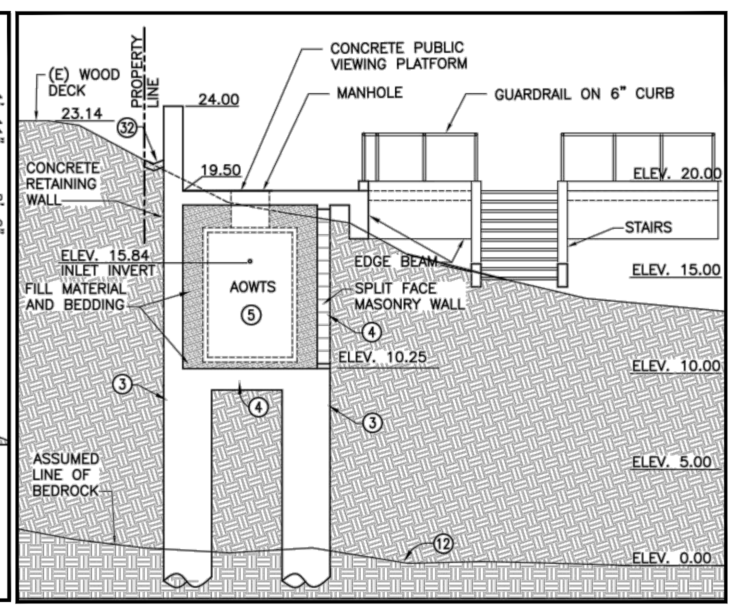
MATERIALS:
RESTROOM AND RETAINING WALL AT WALKWAY: TEXTURED CONCRETE, COLOR – LIGHT GREY/BROWN (CYPRESS TREE TRUNK COLOR)
VIEWING PLATFORM: CONCRETE
RAMP: CONCRETE

NOTES:
1. MINIMUM DISTANCE FROM PROPERTY LINE WILL BE VERIFIED DURING DESIGN DEVELOPMENT STAGE AND WILL DEPEND ON THE TYPE OF SHORING REQUIRED AT THE PROPERTY LINE DURING CONSTRUCTION, WORKING SPACE NEEDED TO CONSTRUCT THE RETAINING WALL AND SIZE OF DRAINAGE INTERCEPTOR.
2. NEW CONCRETE VIEWING PLATFORM WITH BENCHES AND INTERPRETIVE EXHIBIT. A MINIMUM OF 50 PERCENT OF FIXED BENCHES SHALL MEET ACCESSIBILITY REQUIREMENTS.
3. CONCRETE CAISSON (13 PLACES). SIZE AND LOCATION OF CAISSONS WILL BE DETERMINED BY STRUCTURAL ENGINEER DURING DESIGN DEVELOPMENT STAGE.
4. PROTECTION WALL SUPPORTED BY CONCRETE SLAB AND CONCRETE CAISSONS. PROTECTION WALL SHALL BE AROUND ALL SIDES OF THE TREATMENT TANK. INSIDE PROTECTION WALL DIMENSIONS SHALL BE A 7'–0" WIDE, 18'–0" LONG. BASE SLAB, TOP SLAB AND NORTH WALL SHALL BE CONCRETE. WEST WALL, SOUTH WALL AND EAST WALL SHALL BE SPLIT FACE BROWN SOLID GROUTED MASONRY WALL. BASE SLAB SHALL HAVE A 2% SLOPE TO CENTER DRAIN.
5. INSTALL ADVANCED ONSITE WASTEWATER TREATMENT SYSTEM. INSTALL RISERS TO THE VIEWING PLATFORM SLAB AS DIRECTED BY ENGINEER. INSTALL ADA COMPLIANT GRILL, COVER, OR SIMILAR OVER THE RISERS SO THE SERVICE PROVIDER CAN ACCESS THE TANKS. PROVIDE VENTS AND FILTERS AS DIRECTED BY THE ENGINEER.
6. RESTROOM BUILDING.
7. INSTALL LOW FOOT RINSE SPIGOT WITH AUTOMATIC TURN–OFF (2 PLACES).
8. FLOOR DRAIN. SLOPE RESTROOM FLOOR TO DRAIN.
9. ALL PROPOSED IMPROVEMENTS SHOWN SHALL BE CONSTRUCTED WITHOUT ENCROACHING ON ADJACENT PRIVATE PROPERTIES UNLESS PERMISSION IS OBTAINED.
10. THE LOCATION OF THE VEGETATION IS BASED ON AERIAL PHOTOGRAPHS AND ACTUAL LOCATION OF VEGETATION WILL BE VERIFIED DURING DESIGN DEVELOPMENT PHASE.
11. IF RIP–RAP IS ENCOUNTERED DURING THE INSTALLATION OF THESE CAISSONS (2 PLACES), STEEL CASINGS SHALL BE USED THROUGH THE RIP–RAP.
12. LOCATION OF BEDROCK SHOWN IS APPROXIMATE. CONTRACTOR SHALL VERIFY LOCATION DURING CONSTRUCTION. DURING CONSTRUCTION, GEOTECHNICAL ENGINEER SHALL OBSERVE THE WORK AND UPDATE ANY RECOMMENDATIONS AS APPROPRIATE.
13. SELF SUPPORTING STEEL STAIRS WITH WOOD TREADS.
14. CONCRETE STAIR LANDING SUPPORTED BY CAISSON, CAISSON SHALL BE EMBEDDED INTO BEDROCK AS RECOMMENDED BY THE GEOTECHNICAL ENGINEER.
15. UTILITIES, CONNECTIONS AND BRACES SHALL BE COMPOSED OF ENGINEER APPROVED CORROSION–RESISTANT MATERIALS (SUCH AS STAINLESS STEEL) AND SHALL BE LOCATED ALONG THE INSIDE FACE OF THE 12" WIDE X 30" DEEP EDGE BEAM AND OUTSIDE EDGE OF RAMP SLAB. THE LOCATION OF THE UTILITIES IS CONCEPTUAL.
16. GUARDRAIL ON 6 INCH CONCRETE CURB
17. REMOVABLE STAIRS. STAIRS SHALL BE BOLTED TO THE SUPPORTING STRUCTURE SO IT CAN BE REMOVED.
18. ELECTRICAL AND WATER LINES TO RUN AROUND TREATMENT TANK ON EDGE BEAM.
19. INSTALL TOILET. INVERT OF SEWER PIPE SHALL BE A MINIMUM OF 18" BELOW RESTROOM SLAB. ELEVATION. SLOPE OF SEWER LINE SHALL NOT BE LESS THAN 1.5%.
20. INSTALL WALL MOUNTED SINK.
21. EXTEND RETAINING WALL UNDER STAIRS
22. LOCKED HOSE BIBB CONNECTION IN LOCKED ENCLOSURE FOR ACCESS BY MAINTENANCE STAFF ONLY.
23. 24" WIDE X 30" DEEP CONTINUOUS CONCRETE GRADE BEAM UNDER RETAINING WALL.
24. 12" WIDE X 30" DEEP CONTINUOUS CONCRETE EDGE BEAM ALONG EDGE OF WALKWAY.
25. RULES SIGN ON TWO POSTS.
26. PUBLIC ACCESS AND PARING SIGN ON TWO POSTS.
27. RULES SIGN, PUBLIC ACCESS AND PARING SIGN ON TWO POSTS.
28. 42" LONG X 20" WIDE WALL MOUNTED ADA COMPLIANT BENCH.
29. BLOWERS ON RAISED EQUIPMENT PAD. INSTALL DECORATIVE WOOD OR STAINLESS STEEL VENTED AND INSULATED ENCLOSURE (TWO SIDES AND ROOF). MINIMUM THICKNESS OF ENCLOSURE SHALL BE 3 INCHES. ENCLOSURE SHALL HAVE LOCKING ACCESS DOORS FOR MAINTENANCE. ENCLOSURE MAY ATTACHED TO RESTROOM AND RETAINING WALLS.
30. PROVIDE TWO WAY CLEAN–OUT AT SEWER LINE.
31. PROVIDE ½" THRESHOLD AT RESTROOM DOOR AND SLOPE EXTERIOR SLAB 1% MINIMUM TO CORNER OF SCREEN WALL.
32. CONTINUOUS CONCRETE V–DRAIN BEHIND RETAINING WALL.

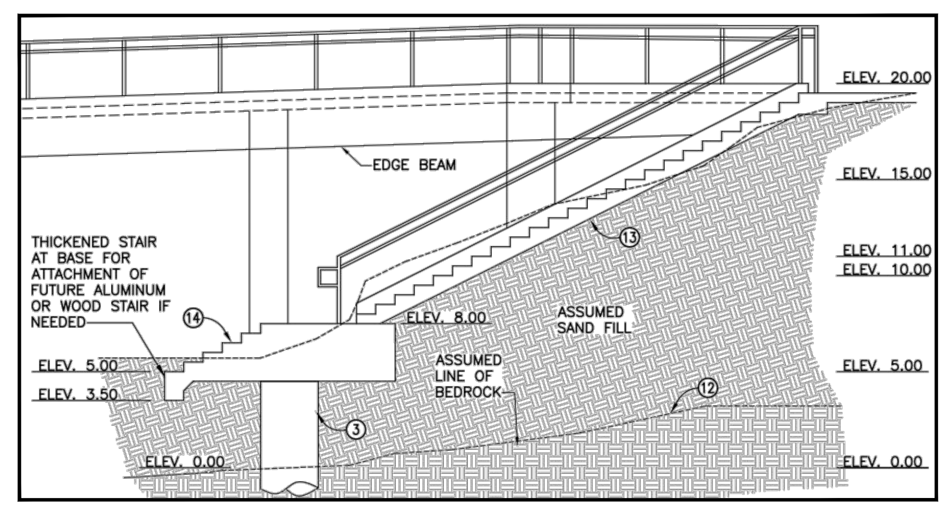
REGISTERED PROFESSIONAL ENGINEER
BLAKE ECKERLE
No. 30379
EXP. 3-31-2018
CIVIL
STATE OF CALIFORNIA



SECTION A
SCALE: 1/4"=1'-0"



SECTION B
SCALE: 1/4"=1'-0"



SECTION C
SCALE: 1/4"=1'-0"

Date: 02/16/2017
Project No. 109780000
A-3
amec foster wheeler

August 2, 2016 (Revised October 26, 2016)

URS
Golden Shore, Suite 100
Long Beach, CA 90802
Tel: (562) 308-2311
Fax: (562) 256-7905

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EAST SEA LEVEL DRIVE
RESTROOM OPTION A

LECHUZA BEACH
MALIBU, CALIFORNIA
MOUNTAINS RECREATION AND CONSERVATION AUTHORITY
LOS ANGELES, CALIFORNIA

INDEX

DATUM:
ELEVATIONS SHOWN ON THESE PLANS ARE BASED ON NGVD29 VERTICAL ELEVATION.

SCALE: 1" = 20'

SITE PLAN
SCALE: 1"=20'

Date: 08/16/2016
Project No. 109780000

A-4

amec foster wheeler

NOT FOR CONSTRUCTION

Revisions:

ADVANCED ONSITEWATER
WWW.ADVANCEDONSITEWATER.COM
1704 SUMMIT DRIVE
ESCONDIDO, CA 92027
(760) 743-8777

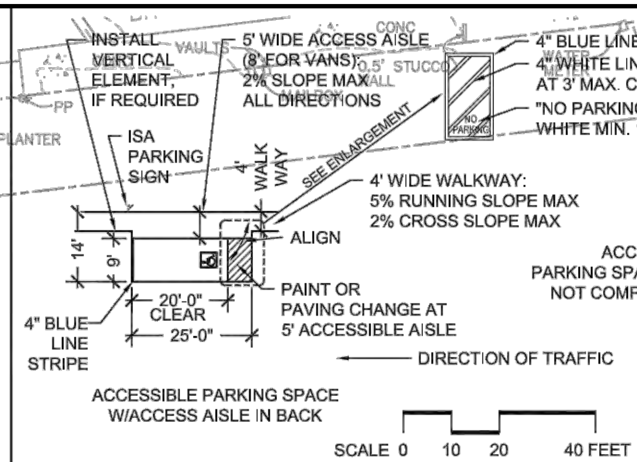
REGISTERED PROFESSIONAL ENGINEER
BARBARA RIGHTER BRADLEY
No. C–53105
Exp.6/30/17
CIVIL
STATE OF CALIFORNIA

Job No.	
Designed By	B. BRADLEY PE
Drawn By	A. HERNANDEZ
Checked By	B. BRADLEY PE
Date	NOVEMBER 8, 2016
Scale	1"=20'

MOUNTAINS RECREATION AND CONSERVATION AUTHORITY
5810 RAMIREZ CANYON ROAD
MALIBU, CA 90265

PLOT PLAN
LECHUZA BEACH AOWTS
31725.5 EAST SEA LEVEL DRIVE, MALIBU, CA

Sheet
G-1
1 OF 6



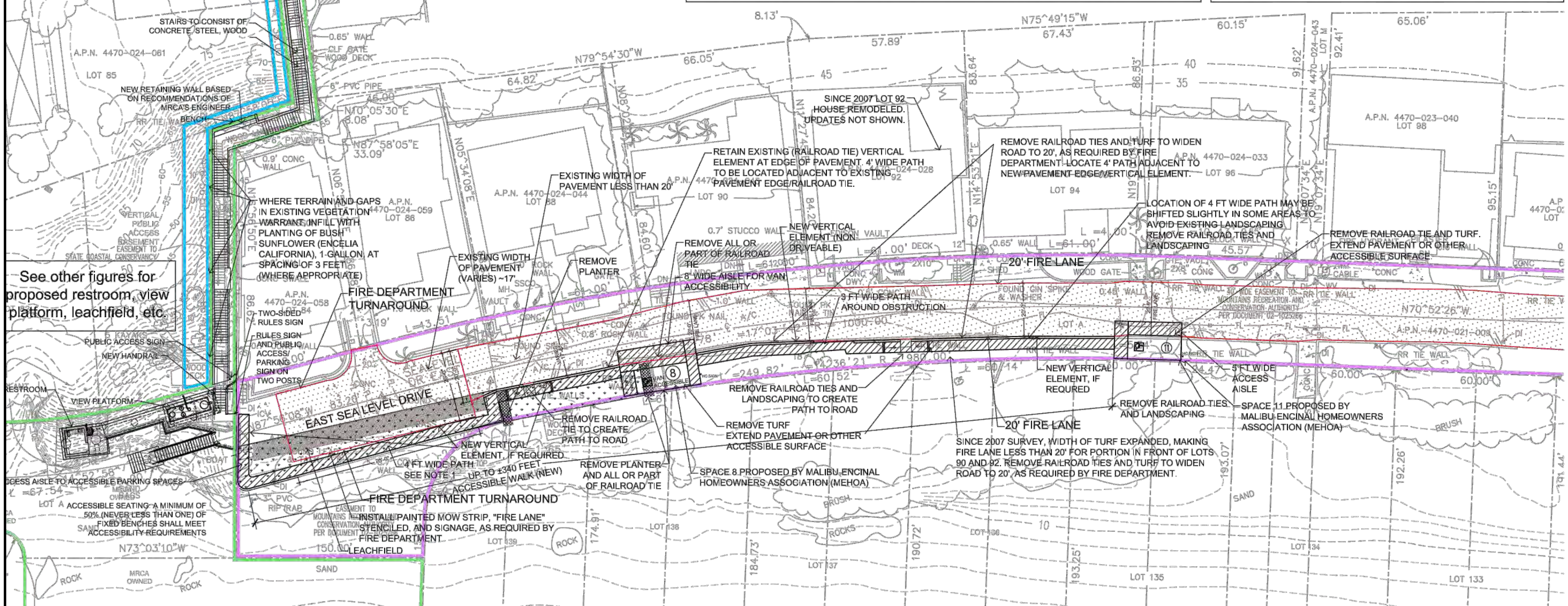
NOTES:
1. EXISTING SURFACES (PAVING AND GRASS) ARE SHOWN FOR REFERENCE ONLY. IT IS ASSUMED THAT GRASS SURFACING OR DIRT WHERE ACCESS AISLES ARE PROVIDED WOULD BE REPLACED WITH PAVING, DECOMPOSED GRANITE, OR ECOPAVERS, MEETING ADAAG 4.5.1 ACCESSIBILITY REQUIREMENTS. EXISTING ASPHALT OR CONCRETE PAVING IN THE LOCATION OF PARKING SPACES, ACCESS AISLES AND WALKWAYS WOULD ALSO BE IMPROVED TO MEET ACCESSIBILITY REQUIREMENTS (SEE NOTE 3 BELOW).
2. ACCESSIBLE PARKING SPACE AND ACCESS AISLE AT FRONT OR BACK OF PARKING SPACE SHALL HAVE A FIRM, STABLE & SLIP-RESISTANT SURFACE SUCH AS ASPHALT OR STABILIZED SOIL. ALTERNATE SURFACES FOR THE PARKING SPACE ARE ACCEPTABLE AS LONG AS THE ACCESS AISLE TO THE FRONT OR REAR HAS A SURFACE WITH A CONTRASTING PATTERN OR COLOR (SUCH AS PAINTED ASPHALT OR INTERLOCKING PAVERS). TURF GRASS SURFACING DOES NOT MEET ADAAG 4.5.1 REQUIREMENTS FOR ACCESSIBLE SURFACING.
3. WALKWAY (INCLUDING ACCESS AISLES AT THE SIDE OF PARKING SPACES) SHALL HAVE A FIRM, STABLE & SLIP-RESISTANT SURFACE SUCH AS ASPHALT OR STABILIZED SOIL, OR DECOMPOSED GRANITE. TURF GRASS SURFACING DOES NOT MEET ADAAG 4.5.1 REQUIREMENTS FOR ACCESSIBLE SURFACING.
4. EACH RESERVED STALL SHALL HAVE A SIGN (18"Hx12"W) DISPLAYING THE INTERNATIONAL SYMBOL OF ACCESSIBILITY AND A WARNING NOTICE THAT THE SPACE IS RESERVED FOR VEHICLES DISPLAYING A DISABLED PERSON PARKING PLACARD. EACH PARKING SPACE WILL HAVE A SIGN IN A LEGAL LOCATION AND SITED TO MINIMIZE POTENTIAL VISUAL IMPACTS TO THE NEIGHBORS.

2 ACCESSIBLE PARKING DETAIL
1"=20'-0"

No more than four parking spaces for people with disabilities would be implemented at East and West Sea Level Drive.

DATUM: Elevations on this drawing are based on NGVD29 vertical elevation

See other figures for proposed restroom, view platform, leachfield, etc.



1 OPTION 8, 11 (PROPOSED BY MEHOA) - EAST SEA LEVEL DRIVE
1"=20'-0"

LEGEND
MRCA OWNED
MEHOA OWNED (MRCA EASEMENT)
VERTICAL PUBLIC ACCESS EASEMENT
NOTE: NOT ALL EASEMENTS SHOWN

Note: Parking spaces 8 and 11 proposed by Malibu-Encinal Homeowners Association (MEHOA).

See other figures for other Project Elements. See attached plans for details.

LECHUZA BEACH PUBLIC ACCESS IMPROVEMENTS

East Sea Level Drive
Malibu, California

A PROJECT OF:
Mountains Recreation and Conservation Authority
570 West Avenue 26, Suite 100
Los Angeles, CA 90065
(323) 221-9944

SITE DESIGN:
Mountains Recreation and Conservation Authority
570 West Avenue 26, Suite 100
Los Angeles, CA 90065
(323) 221-9944

SURVEYOR:
Land & Air Surveying
22741 Pacific Coast Highway
Suite 400A
Malibu, CA 90265
(310) 456-9381

NOT FOR CONSTRUCTION

ISSUED:
6/13/2016
8/9/2016
2/7/2017

DRAWN: CM
CHECKED: JT
PROJECT: 24.404.444.3221.261
SCALE: As noted

EAST SEA LEVEL 8, 11

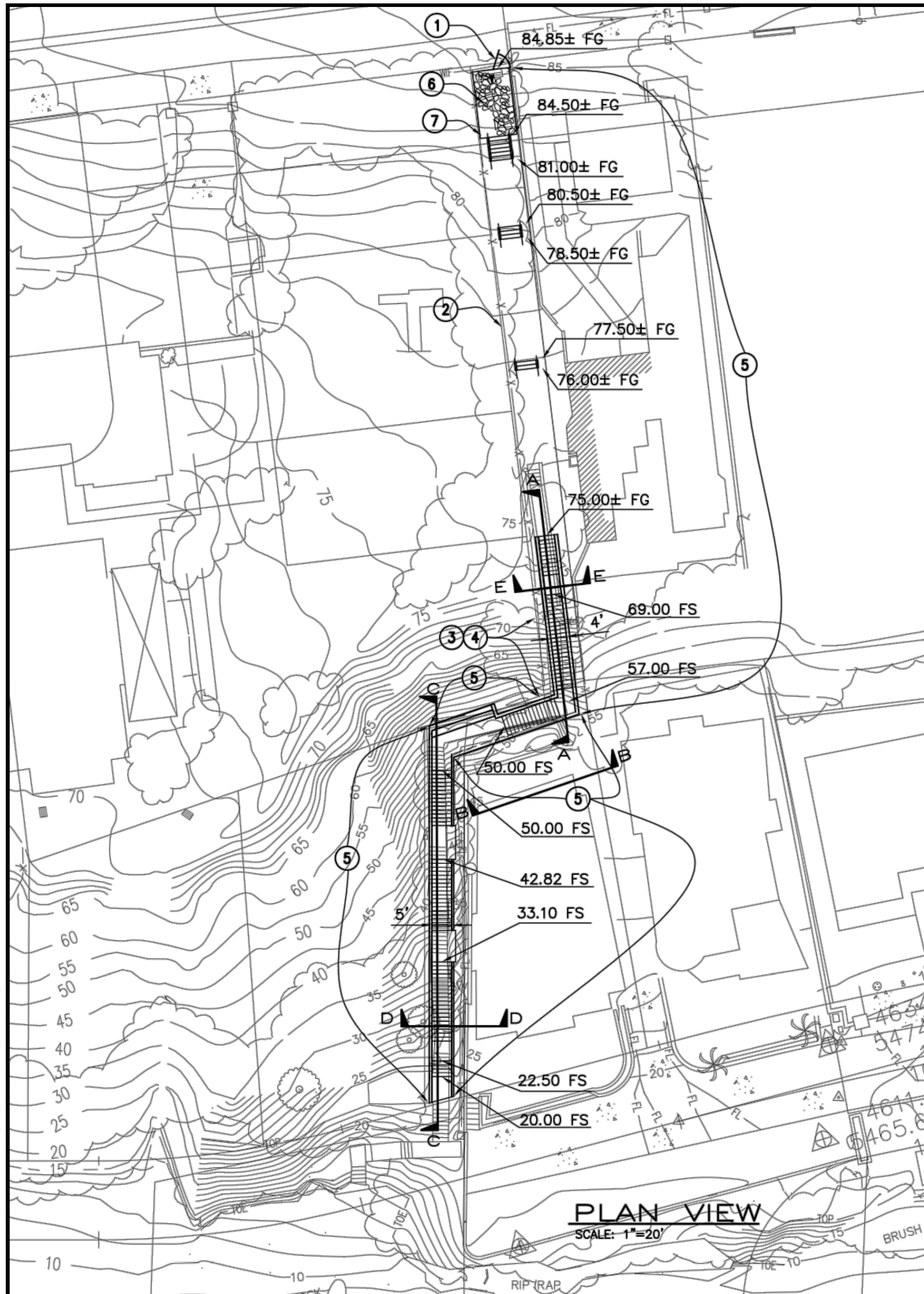
Project Area III
Project Elements
III-1 to III-5
3 OF 3

Date: 03/10/2017
Project No. 109780000

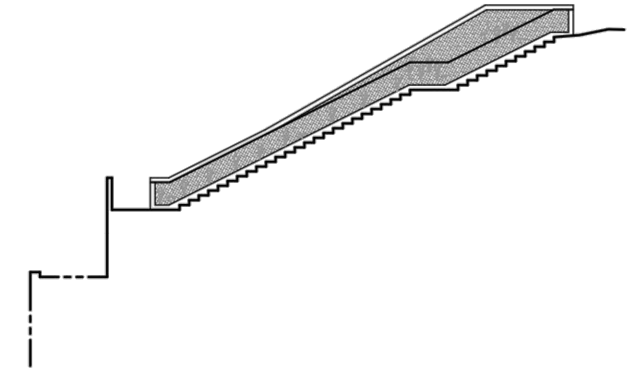
A-5

amec foster wheeler

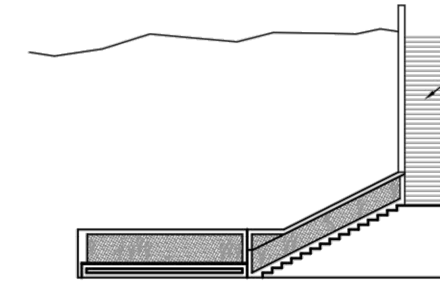
Plot Date: 3/10/2017 9:26:52 AM, Plotted by: joanna.worker Drawing Path: W:\Projects\010978.000.0 (Lechuza Beach)\FigA-5_ESL 170207.dwg A-5 2017



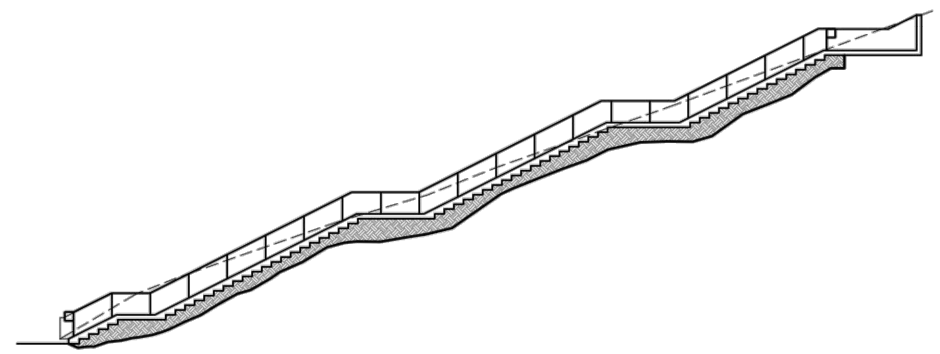
PLAN VIEW
SCALE: 1"=20'



ELEVATION A—A
SCALE: 1"=10'



ELEVATION B—B
SCALE: 1"=10'



ELEVATION C—C
SCALE: 1"=10'

NOTE:
WIDTH OF STAIRS TO BE 5 FEET WIDE WHERE POSSIBLE.
WIDTH OF STAIRS MAY BE 4 FEET WIDE IN SOME AREAS, TO BE DETERMINED DURING CONSTRUCTION.

DATUM:
ELEVATIONS SHOWN ON THIS DRAWING ARE BASED ON NGVD29 VERTICAL ELEVATION.

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KEYMAP

KEYNOTES:

1. TRIM LANDSCAPING. NEW SELF CLOSING GATE (APPROX. 4 FT. WIDE)
2. EXISTING FENCE TO REMAIN, PROTECT IN PLACE.
3. NATIVE LANDSCAPING
4. REMOVE PORTIONS OF FENCE ON MRCA PROPERTY AS NECESSARY TO CONSTRUCT STAIRS
5. POTENTIAL NATIVE LANDSCAPING
6. BIKE RACK
7. INTERPRETIVE EXHIBIT

SEE ADDITIONAL PLANS FOR IMPROVEMENTS IN THIS AREA ALONG EAST SEA LEVEL DRIVE

JANUARY 23, 2017

SCALE 0 10 20 40 FEET

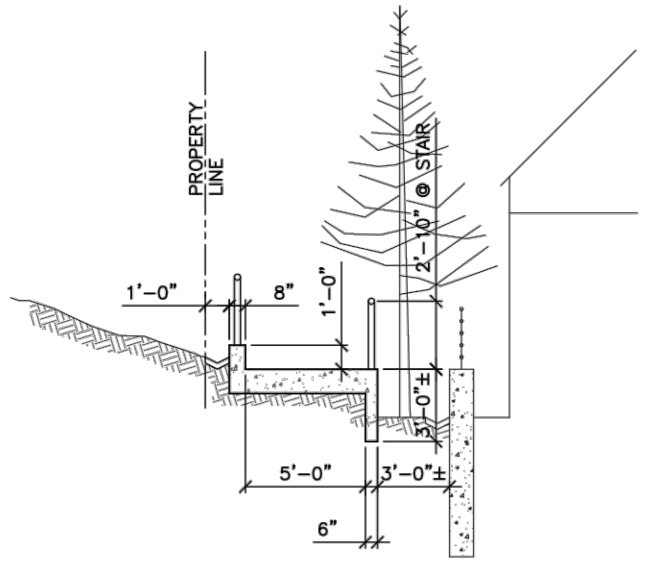
NORTH

URS
Golden Shore, Suite 100
Long Beach, CA 90802
Tel: (562) 308-2311
Fax: (562) 256-7905

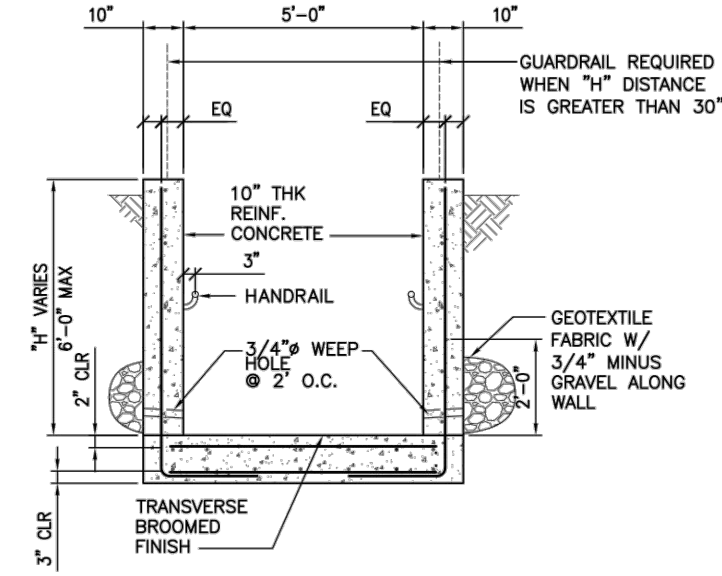
LOT I STAIRS EXHIBIT

Date: 03/10/2017 Project No. 109780000	A-6	amec foster wheeler

LECHUZA BEACH
MALIBU, CALIFORNIA
MOUNTAINS RECREATION AND CONSERVATION AUTHORITY
LOS ANGELES, CALIFORNIA



SECTION D–D
SCALE: NTS



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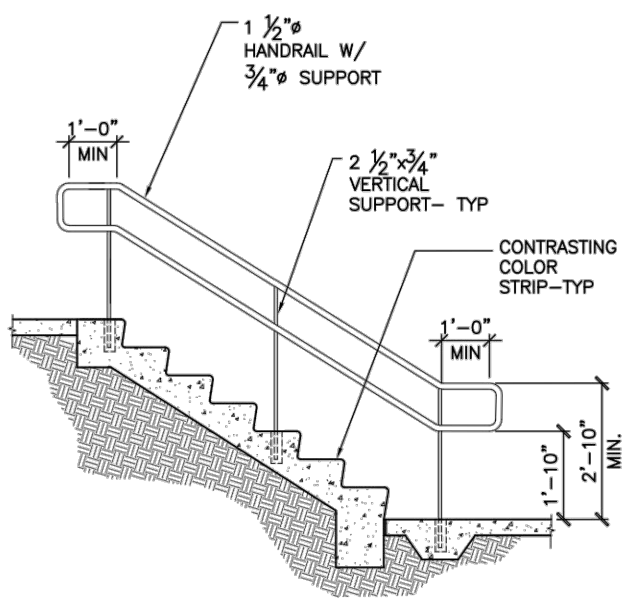

HANDRAIL DETAIL
SCALE: NTS

REGISTERED PROFESSIONAL ENGINEER
BLAKE ECKERLE
No. 30379
EXP. 3-31-2018
CIVIL
STATE OF CALIFORNIA

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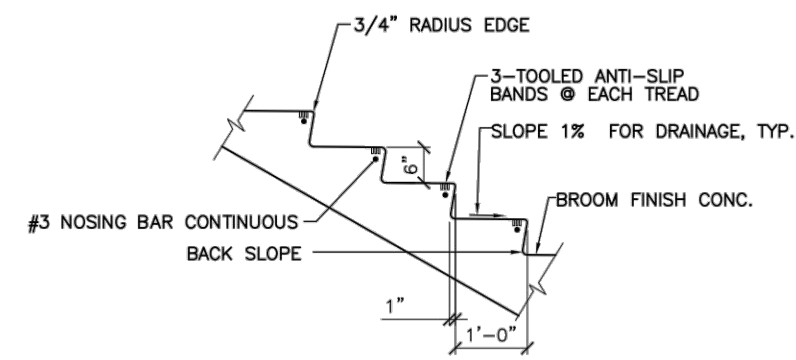

STAIR DETAIL
SCALE: NTS

SEE ADDITIONAL PLANS FOR IMPROVEMENTS IN THIS AREA ALONG EAST SEA LEVEL DRIVE

JANUARY 23, 2017

Date: 03/10/2017 Project No. 109780000	A-7	amec foster wheeler

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LOT I
STAIRS EXHIBIT

LECHUZA BEACH
MALIBU, CALIFORNIA
MOUNTAINS RECREATION AND CONSERVATION AUTHORITY
LOS ANGELES, CALIFORNIA

Plot Date: 3/10/2017 9:52:14 AM, Plotted by: joanna.worker Drawing Path: W:\Projects\010978.000.0 (Lechuza Beach)\FigA-7_LOT I Sheet 2_1-23-17.dwg, A-7 Sht 2of2_2017

ATTACHMENT B

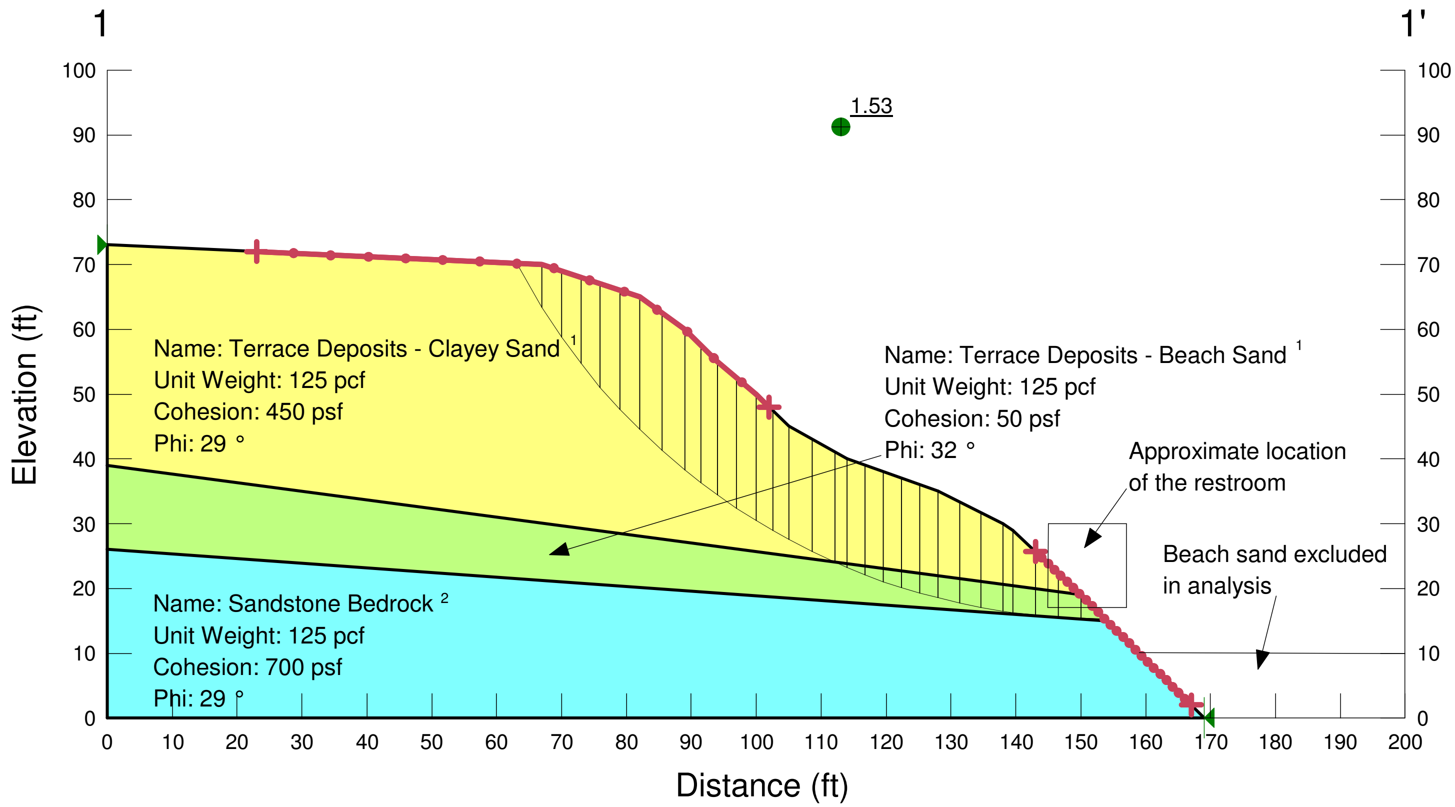
Slope Stability Results and Input and Output Files

GEOTECHNICAL INVESTIGATION REPORT

Lechuza Beach Public Access Improvements Project
Malibu, California

Cross Section 1-1'
Static

Project No: 10978.000.0



Notes:

1. Shear strength parameters for Terrace Deposits adopted from G.C. Masterman & Associates (1993)
2. Shear strength parameters for Sandstone Bedrock adopted from Robert Stone & Associates (1986)

K:\10978.000.0\slope stability analysis\August 2016 Revisions\Cross Section 1-1'.gsz

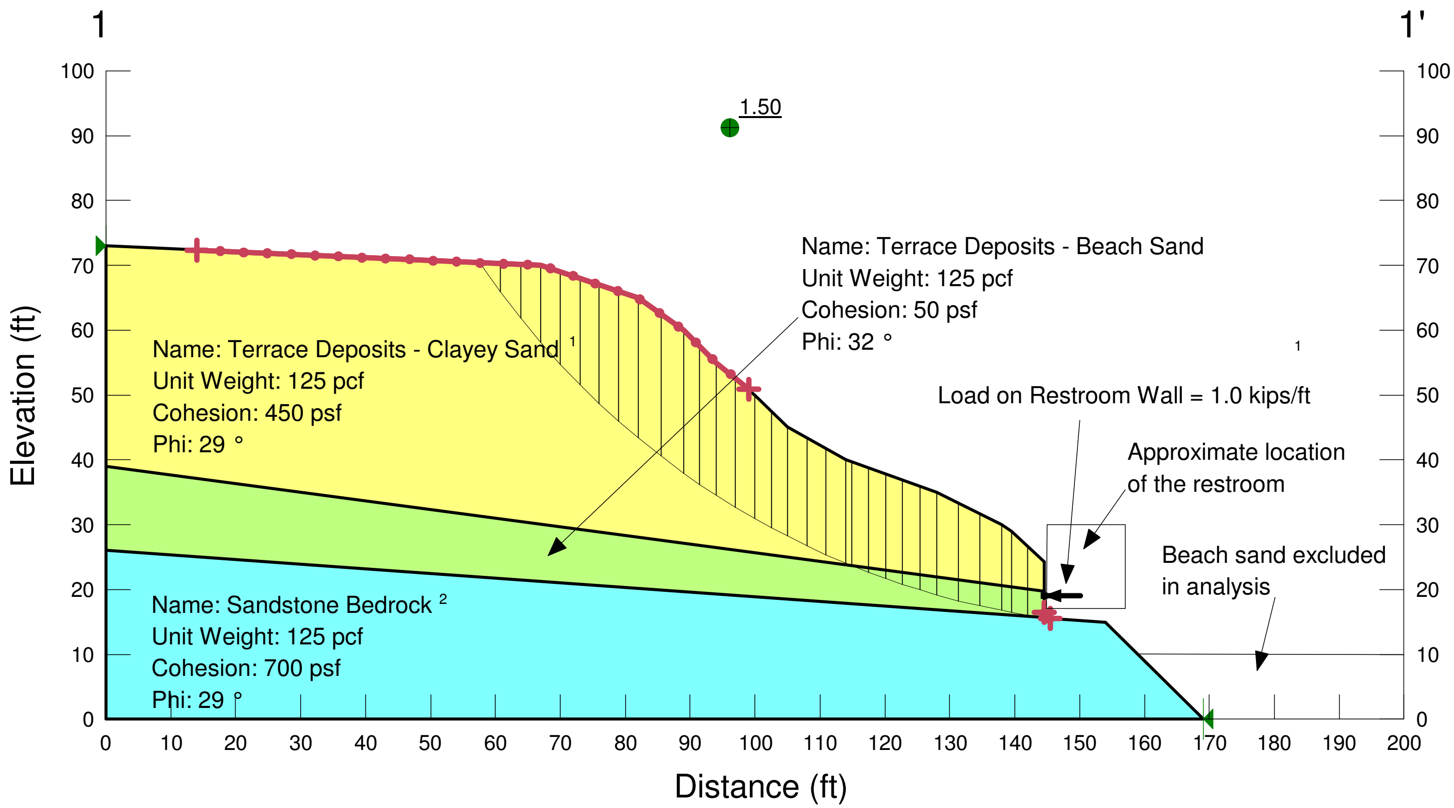
Amec Foster Wheeler

GEOTECHNICAL INVESTIGATION REPORT

Lechuza Beach Public Access Improvements Project
Malibu, California

Cross Section 1-1'
Static

Project No: 10978.000.0



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K:\10978.000.0\slope stability analysis\August 2016 Revisions\Cross Section 1-1' wo restroom static.gsz

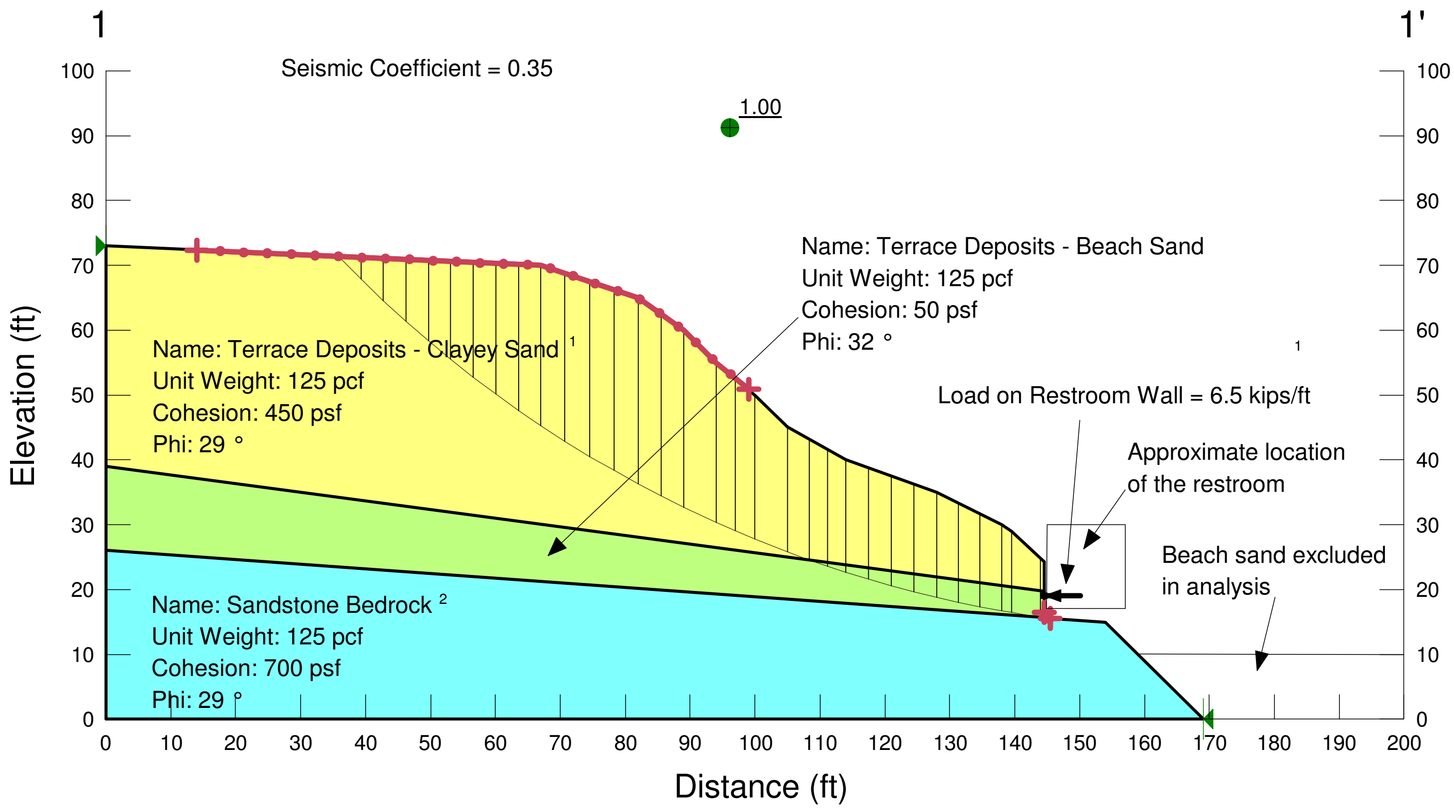
Amec Foster Wheeler

GEOTECHNICAL INVESTIGATION REPORT

Lechuza Beach Public Access Improvements Project
Malibu, California

Cross Section 1-1'
Pseudostatic

Project No: 10978.000.0



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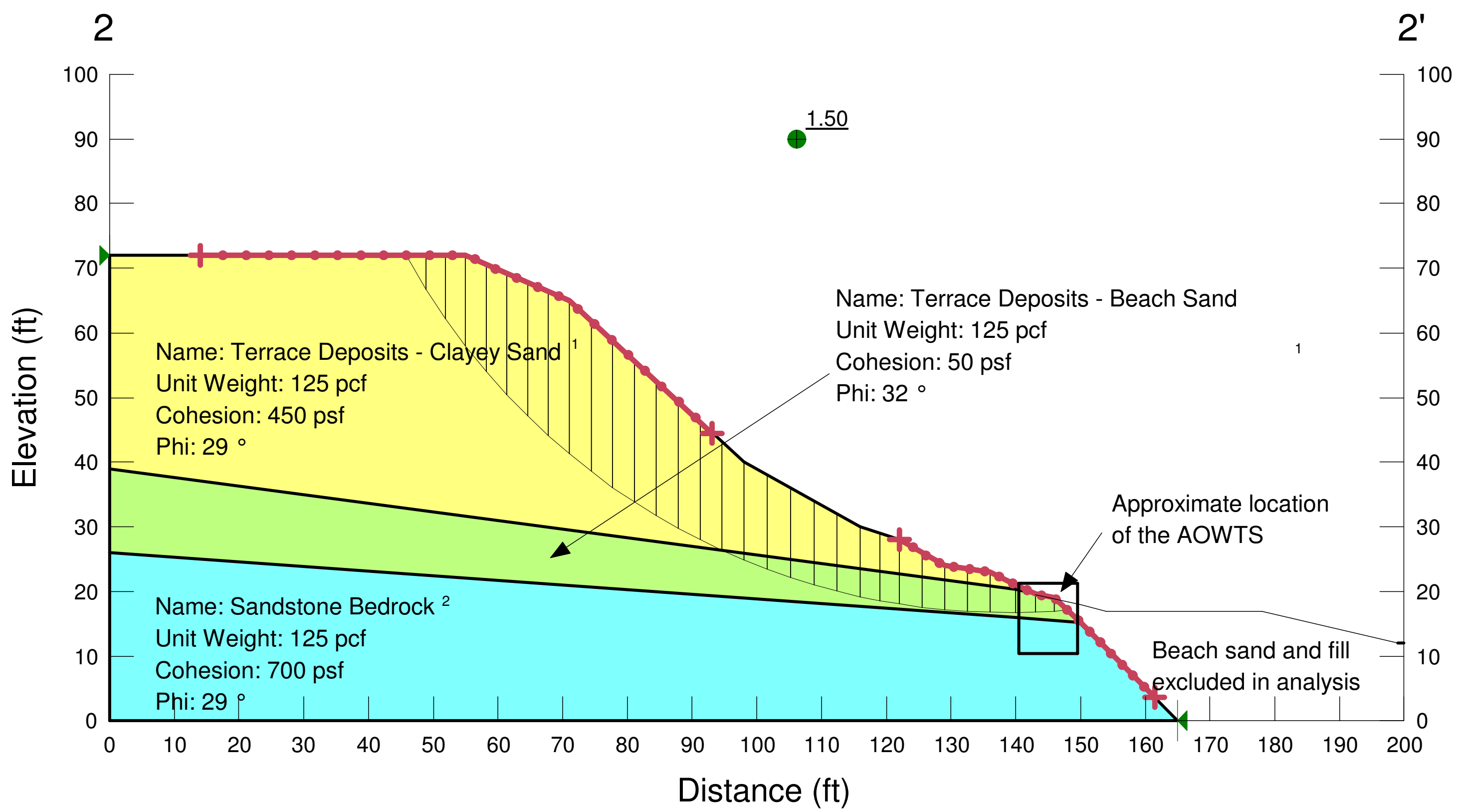
Amec Foster Wheeler

GEOTECHNICAL INVESTIGATION REPORT

Lechuza Beach Public Access Improvements Project
Malibu, California

Cross Section 2-2'
Static

Project No: 10978.000.0



Notes:
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2. Shear strength parameters for Sandstone Bedrock adopted from Robert Stone & Associates (1986)

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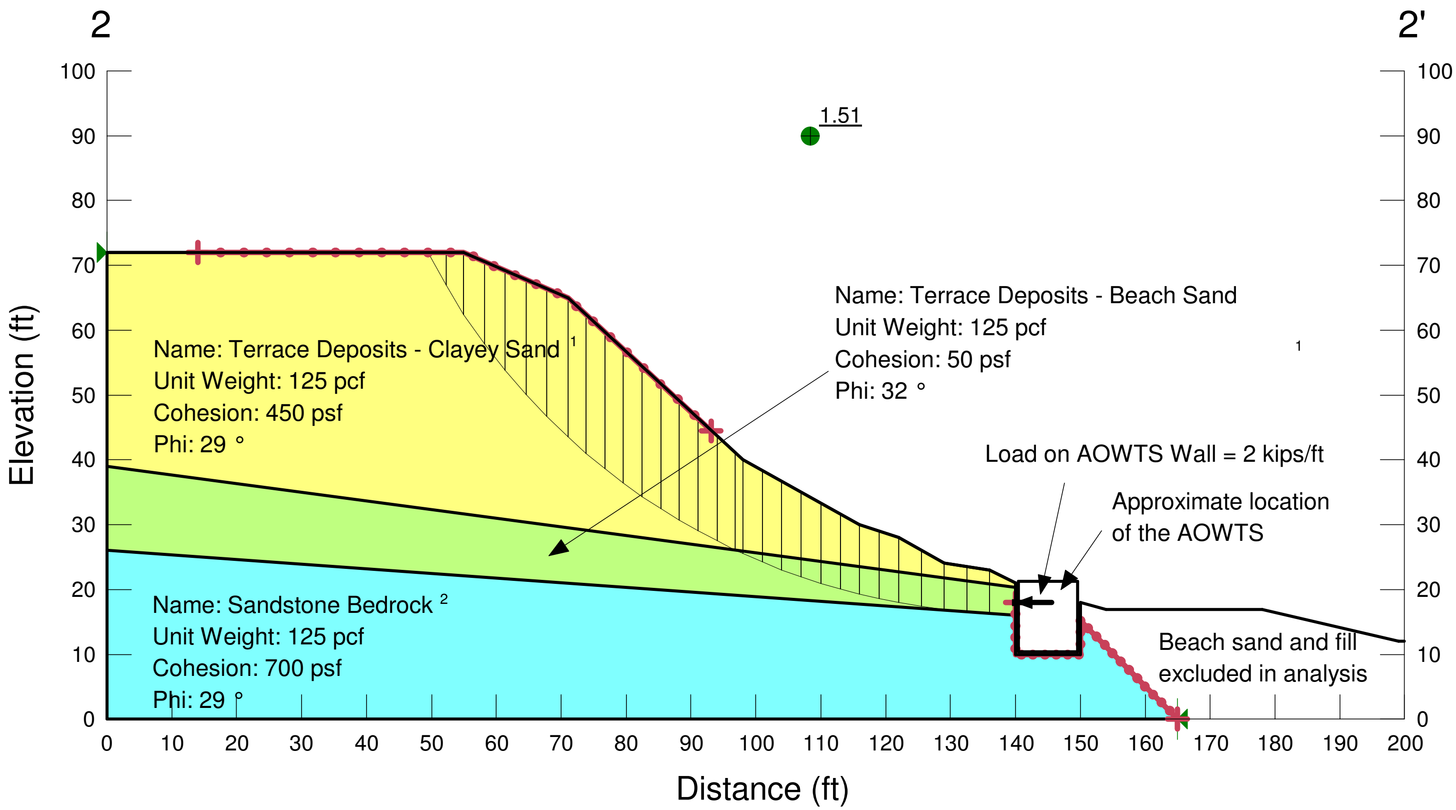
Amec Foster Wheeler

GEOTECHNICAL INVESTIGATION REPORT

Lechuza Beach Public Access Improvements Project
Malibu, California

Cross Section 2-2'
Static

Project No: 10978.000.0



Notes:

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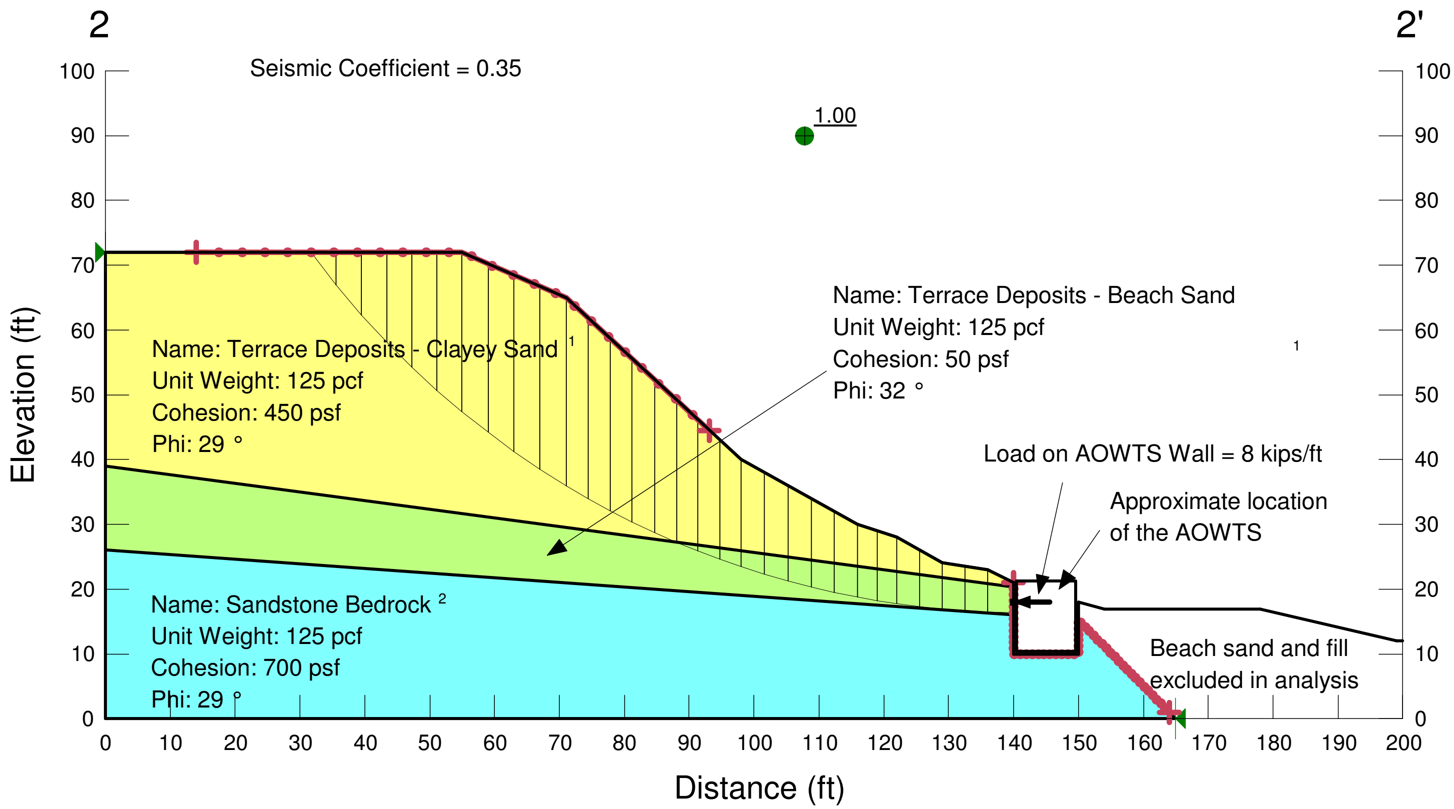
Amec Foster Wheeler

GEOTECHNICAL INVESTIGATION REPORT

Lechuza Beach Public Access Improvements Project
Malibu, California

Cross Section 2-2'
Pseudostatic

Project No: 10978.000.0



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2. Shear strength parameters for Sandstone Bedrock adopted from Robert Stone & Associates (1986)

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Amec Foster Wheeler

Slope Stability

File Information

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Revision Number: 58
Last Edited By: Baturay, Bora
Date: 8/3/2016
Time: 2:26:46 PM
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Last Solved Date: 8/3/2016
Last Solved Time: 2:26:56 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability

- Kind: SLOPE/W
- Method: Spencer
- Settings
  - PWP Conditions Source: (none)
- Slip Surface
  - Direction of movement: Left to Right
  - Use Passive Mode: No
  - Slip Surface Option: Entry and Exit
  - Critical slip surfaces saved: 1
  - Optimize Critical Slip Surface Location: No
  - Tension Crack
    - Tension Crack Option: (none)
- FOS Distribution
  - FOS Calculation Option: Constant
- Advanced
  - Number of Slices: 30
  - Optimization Tolerance: 0.01
  - Minimum Slip Surface Depth: 0.1 ft

Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Terrace Deposits - Clayey Sand

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 450 psf
Phi: 29 °
Phi-B: 0 °

Terrace Deposits - Beach Sand

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 50 psf
Phi: 32 °
Phi-B: 0 °

Sandstone Bedrock

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 700 psf
Phi: 29 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (23, 71.97015) ft
Left-Zone Right Coordinate: (102, 48) ft
Left-Zone Increment: 15
Right Projection: Range
Right-Zone Left Coordinate: (143, 25.66667) ft
Right-Zone Right Coordinate: (167, 2) ft
Right-Zone Increment: 25
Radius Increments: 8

Slip Surface Limits

Left Coordinate: (0, 73) ft
Right Coordinate: (169, 0) ft

Regions

	Material	Points	Area (ft^2)
Region 1	Terrace Deposits - Clayey Sand	1,2,3,4,5,6,7,8,9,10,17,11,12	4259.25
Region 2	Terrace Deposits - Beach Sand	11,13,14,12	1261
Region 3	Sandstone Bedrock	13,15,16,14	3269.5

Points

	X (ft)	Y (ft)
Point 1	0	73
Point 2	67	70
Point 3	82	65
Point 4	89	60
Point 5	94	55
Point 6	100	50
Point 7	105	45
Point 8	114	40
Point 9	128	35
Point 10	138	30
Point 11	150	19
Point 12	0	39
Point 13	154	15
Point 14	0	26
Point 15	169	0
Point 16	0	0
Point 17	139.5	29

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	1742	1.53	(153.212, 116.697)	101.35	(63.1713, 70.1714)	(153.652, 15.3478)

Slices of Slip Surface: 1742

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	1742	65.085635	66.790995	0	17.331364	9.6069318	450
2	1742	68.5	61.124065	0	348.04031	192.9219	450
3	1742	71.5	56.791575	0	604.68172	335.18055	450
4	1742	74.5	52.89505	0	854.09717	473.43379	450
5	1742	77.5	49.35803	0	1095.2354	607.0989	450
6	1742	80.5	46.12604	0	1327.5808	735.89007	450
7	1742	83.75	42.932635	0	1517.0532	840.91632	450
8	1742	87.25	39.783905	0	1655.8393	917.84669	450

9	1742	90.25	37.291945	0	1729.3706	958.60575	450
10	1742	92.75	35.37149	0	1740.1124	964.56007	450
11	1742	95.5	33.402885	0	1757.1163	973.98546	450
12	1742	98.5	31.40144	0	1779.2626	986.26135	450
13	1742	101.25	29.692755	0	1765.4006	978.57753	450
14	1742	103.75	28.24722	0	1716.8371	951.65834	450
15	1742	106.78	26.630585	0	1716.2805	951.34983	450
16	1742	110.34	24.881805	0	1763.0302	977.26362	450
17	1742	113.06	23.64506	0	1778.5306	1111.3492	50
18	1742	115.4	22.676435	0	1814.1152	1133.585	50
19	1742	118.2	21.59799	0	1872.9918	1170.3752	50
20	1742	121	20.613225	0	1922.7572	1201.472	50
21	1742	123.8	19.71929	0	1963.0621	1226.6574	50
22	1742	126.6	18.913695	0	1993.5641	1245.7171	50
23	1742	129.66665	18.13455	0	1985.2809	1240.5412	50
24	1742	133	17.397175	0	1932.5451	1207.5882	50
25	1742	136.33335	16.776415	0	1859.607	1162.0114	50
26	1742	138.75	16.386765	0	1778.0837	1111.07	50
27	1742	141.25	16.070615	0	1568.2165	979.9304	50
28	1742	144.75	15.715955	0	1200.1084	749.91097	50
29	1742	148.25	15.48353	0	785.97045	491.12884	50
30	1742	151.8261	15.372775	0	296.88961	185.51722	50

Slope Stability

File Information

Created By: Chrysovergis, Pavlo
Revision Number: 104
Last Edited By: Baturay, Bora
Date: 8/3/2016
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File Name: Cross Section 1-1' wo restroom static.gsz
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Last Solved Date: 8/3/2016
Last Solved Time: 2:23:10 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability

Kind: SLOPE/W
Method: Spencer
Settings
    PWP Conditions Source: (none)
Slip Surface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Optimize Critical Slip Surface Location: No
    Tension Crack
        Tension Crack Option: (none)
FOS Distribution
    FOS Calculation Option: Constant
Advanced
    Number of Slices: 30
    Optimization Tolerance: 0.01
    Minimum Slip Surface Depth: 0.1 ft

Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Terrace Deposits - Clayey Sand

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 450 psf
Phi: 29 °
Phi-B: 0 °

Terrace Deposits - Beach Sand

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 50 psf
Phi: 32 °
Phi-B: 0 °

Sandstone Bedrock

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 700 psf
Phi: 29 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (14, 72.37313) ft
Left-Zone Right Coordinate: (99, 50.83333) ft
Left-Zone Increment: 25
Right Projection: Range
Right-Zone Left Coordinate: (144.5, 16.5) ft
Right-Zone Right Coordinate: (145.5, 15.5) ft
Right-Zone Increment: 10
Radius Increments: 8

Slip Surface Limits

Left Coordinate: (0, 73) ft
Right Coordinate: (169, 0) ft

Seismic Loads

Horz Seismic Load: 0

Point Loads

	Coordinate (ft)	Magnitude (lbs)	Direction (°)
Point Load 1	(144.5, 19)	1000	0

Regions

	Material	Points	Area (ft²)
Region 1	Terrace Deposits - Clayey Sand	1,2,3,4,5,6,7,8,9,10,17,20,19,12	4246.8622
Region 2	Terrace Deposits - Beach Sand	21,14,12,19	1232.2064
Region 3	Sandstone Bedrock	13,15,16,14,21,22	3268.991

Points

	X (ft)	Y (ft)
Point 1	0	73
Point 2	67	70
Point 3	82	65
Point 4	89	60
Point 5	94	55
Point 6	100	50
Point 7	105	45
Point 8	114	40
Point 9	128	35
Point 10	138	30
Point 11	150	19
Point 12	0	39
Point 13	154	15
Point 14	0	26
Point 15	169	0
Point 16	0	0
Point 17	139.5	29
Point 18	152.5	16.5
Point 19	144.5	19.73333
Point 20	144.5	24.2381
Point 21	144.5	15.67857
Point 22	145.5	15.5
Point 23	144.5	13.5
Point 24	145.5	13.5

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	1237	1.50	(162.2, 140.005)	125.583	(57.6585, 70.4183)	(144.596, 15.6615)

Slices of Slip Surface: 1237

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	1237	59.21545	68.18575	0	12.73759	0	446.26
2	1237	62.32927	63.909865	0	275.72	0	603.97
3	1237	65.44309	59.98397	0	550.13935	0	762.3
4	1237	68.5	56.41992	0	794.62219	0	900.7
5	1237	71.5	53.171605	0	1001.5371	0	1016.5
6	1237	74.5	50.14093	0	1202.9479	0	1128.8
7	1237	77.5	47.306475	0	1398.3469	0	1237.3
8	1237	80.5	44.650695	0	1587.4655	0	1342
9	1237	83.75	41.965165	0	1729.9366	0	1420.1
10	1237	87.25	39.262875	0	1819.3476	0	1468
11	1237	90.25	37.087035	0	1852.7054	0	1484.7
12	1237	92.75	35.383385	0	1831.8817	0	1471.4
13	1237	95.5	33.61322	0	1818.284	0	1462.2
14	1237	98.5	31.789865	0	1810.8609	0	1456.3
15	1237	101.25	30.212975	0	1772.1943	0	1433.2
16	1237	103.75	28.86168	0	1703.2661	0	1393.5
17	1237	106.5	27.46193	0	1680.3916	0	1379.4
18	1237	109.5	26.026	0	1705.0956	0	1391.7
19	1237	112.5	24.685985	0	1719.077	0	1398.1
20	1237	114.43085	23.86231	0	1732.5388	0	1404.7
21	1237	116.17555	23.16756	0	1746.3495	0	1139.2
22	1237	118.8032	22.166175	0	1791.5634	0	1166
23	1237	121.43085	21.23136	0	1830.1787	0	1188.8
24	1237	124.0585	20.36155	0	1861.9996	0	1207.2
25	1237	126.68615	19.55534	0	1886.7739	0	1221.2
26	1237	129.66665	18.720905	0	1876.6094	0	1213.3
27	1237	133	17.875355	0	1826.5494	0	1180.5
28	1237	136.33335	17.126035	0	1760.3407	0	1137.8
29	1237	138.75	16.632645	0	1686.734	0	1091.1
30	1237	140.7377	16.2754	0	1540.1523	0	999.65
31	1237	143.2377	15.86789	0	1530.7183	0	980.17
32	1237	144.54785	15.668275	0	191.65947	0	791.88

Slope Stability

File Information

Created By: Chrysovergis, Pavlo
Revision Number: 101
Last Edited By: Baturay, Bora
Date: 8/3/2016
Time: 2:20:13 PM
File Name: Cross Section 1-1' wo restroom seismic.gsz
Directory: K:\10978.000.0\slope stability analysis\August 2016 Revisions\
Last Solved Date: 8/3/2016
Last Solved Time: 2:21:10 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability

Kind: SLOPE/W
Method: Spencer
Settings
    PWP Conditions Source: (none)
Slip Surface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Optimize Critical Slip Surface Location: No
    Tension Crack
        Tension Crack Option: (none)
FOS Distribution
    FOS Calculation Option: Constant
Advanced
    Number of Slices: 30
    Optimization Tolerance: 0.01
    Minimum Slip Surface Depth: 0.1 ft

Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Terrace Deposits - Clayey Sand

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 450 psf
Phi: 29 °
Phi-B: 0 °

Terrace Deposits - Beach Sand

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 50 psf
Phi: 32 °
Phi-B: 0 °

Sandstone Bedrock

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 700 psf
Phi: 29 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (14, 72.37313) ft
Left-Zone Right Coordinate: (99, 50.83333) ft
Left-Zone Increment: 25
Right Projection: Range
Right-Zone Left Coordinate: (144.5, 16.5) ft
Right-Zone Right Coordinate: (145.5, 15.5) ft
Right-Zone Increment: 10
Radius Increments: 8

Slip Surface Limits

Left Coordinate: (0, 73) ft
Right Coordinate: (169, 0) ft

Seismic Loads

Horz Seismic Load: 0.35

Ignore seismic load in strength: Yes

Point Loads

	Coordinate (ft)	Magnitude (lbs)	Direction (°)
Point Load 1	(144.5, 19)	6500	0

Regions

	Material	Points	Area (ft²)
Region 1	Terrace Deposits - Clayey Sand	1,2,3,4,5,6,7,8,9,10,17,20,19,12	4246.8622
Region 2	Terrace Deposits - Beach Sand	21,14,12,19	1232.2064
Region 3	Sandstone Bedrock	13,15,16,14,21,22	3268.991

Points

	X (ft)	Y (ft)
Point 1	0	73
Point 2	67	70
Point 3	82	65
Point 4	89	60
Point 5	94	55
Point 6	100	50
Point 7	105	45
Point 8	114	40
Point 9	128	35
Point 10	138	30
Point 11	150	19
Point 12	0	39
Point 13	154	15
Point 14	0	26
Point 15	169	0
Point 16	0	0
Point 17	139.5	29
Point 18	152.5	16.5
Point 19	144.5	19.73333
Point 20	144.5	24.2381
Point 21	144.5	15.67857
Point 22	145.5	15.5
Point 23	144.5	13.5
Point 24	145.5	13.5

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	687	1.00	(171.242, 201.545)	187.818	(35.8293, 71.3957)	(145.5, 15.5)

Slices of Slip Surface: 687

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	687	37.56098	69.640675	0	1189.5327	0	465.77
2	687	41.024395	66.219315	0	836.85517	0	616.71
3	687	44.487805	62.96901	0	632.29031	0	766.12
4	687	47.95122	59.877965	0	540.01746	0	913.81
5	687	51.414635	56.93595	0	533.19988	0	1059.6
6	687	54.87805	54.13403	0	591.55278	0	1203.5
7	687	58.341465	51.46435	0	699.70392	0	1345.3
8	687	61.80488	48.919965	0	845.87615	0	1484.9
9	687	65.268295	46.494695	0	1021.1004	0	1622.4
10	687	68.875	44.092095	0	1212.5346	0	1734.8
11	687	72.625	41.71618	0	1404.9171	0	1820.7
12	687	76.375	39.461845	0	1597.4075	0	1901.9
13	687	80.125	37.32408	0	1787.9944	0	1978.3
14	687	83.75	35.362415	0	1934.2247	0	2010.7
15	687	87.25	33.566055	0	2025.2534	0	1997.6
16	687	91.5	31.51854	0	2067.1483	0	1931.4
17	687	95.5	29.68497	0	2064.4955	0	1847.6
18	687	98.5	28.393735	0	2064.8854	0	1795.8
19	687	102.5	26.78023	0	2010.6516	0	1692.7
20	687	106.71355	25.169965	0	1965.9097	0	1604.7
21	687	109.8203	24.0609	0	1742.9663	0	1324.9
22	687	112.60675	23.120895	0	1747.0145	0	1297.1
23	687	115.75	22.121805	0	1775.9448	0	1285.2
24	687	119.25	21.076405	0	1830.9872	0	1288.7
25	687	122.75	20.104535	0	1878.0554	0	1286.5
26	687	126.25	19.20502	0	1916.6856	0	1278.6
27	687	129.66665	18.394875	0	1917.7113	0	1247.3
28	687	133	17.669915	0	1877.5731	0	1191.8
29	687	136.33335	17.00801	0	1823.402	0	1129.8
30	687	138.75	16.56099	0	1759.1366	0	1071.2
31	687	141.7462	16.072035	0	1529.5167	0	913.07
32	687	144.2462	15.67796	0	21478.269	0	4119.1
33	687	145	15.57055	0	888.18167	0	755.8

Slope Stability

File Information

Created By: Chrysovergis, Pavlo
Revision Number: 128
Last Edited By: Baturay, Bora
Date: 8/5/2016
Time: 11:44:03 AM
File Name: Cross Section 2-2'.gsz
Directory: K:\10978.000.0\slope stability analysis\August 2016 Revisions\
Last Solved Date: 8/5/2016
Last Solved Time: 11:44:22 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability

Kind: SLOPE/W
Method: Spencer
Settings
- PWP Conditions Source: (none)

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No
- Tension Crack
  - Tension Crack Option: (none)

FOS Distribution
- FOS Calculation Option: Constant

Advanced
- Number of Slices: 30
- Optimization Tolerance: 0.01
- Minimum Slip Surface Depth: 0.1 ft

Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Terrace Deposits - Clayey Sand

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 450 psf
Phi: 29 °
Phi-B: 0 °

Terrace Deposits - Beach Sand

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 50 psf
Phi: 32 °
Phi-B: 0 °

Sandstone Bedrock

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 700 psf
Phi: 29 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (14, 72) ft
Left-Zone Right Coordinate: (93.13774, 44.50209) ft
Left-Zone Increment: 25
Right Projection: Range
Right-Zone Left Coordinate: (122, 28) ft
Right-Zone Right Coordinate: (161.45331, 3.60232) ft
Right-Zone Increment: 20
Radius Increments: 8

Slip Surface Limits

Left Coordinate: (0, 72) ft
Right Coordinate: (165, 0) ft

Seismic Loads

Horz Seismic Load: 0

Regions

	Material	Points	Area (ft²)
Region 1	Terrace Deposits - Clayey Sand	7,8,9,10,11,12,13,14,18,15,2,6	3559.6669
Region 2	Terrace Deposits - Beach Sand	16,3,2,15	1213.3331
Region 3	Sandstone Bedrock	19,5,3,16,17	3210.4411
Region 4	Terrace Deposits - Beach Sand	15,16,17,20,18	30.194115

Points

	X (ft)	Y (ft)
Point 1	0	73
Point 2	0	39
Point 3	0	26
Point 4	199	0
Point 5	0	0
Point 6	0	72
Point 7	55	72
Point 8	71	65
Point 9	98	40
Point 10	116	30
Point 11	122	28
Point 12	129	24
Point 13	136	23
Point 14	140	21
Point 15	140	20.33333
Point 16	140	16
Point 17	150	15.23529
Point 18	143	19.63333
Point 19	165	0
Point 20	146	19

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	1814	1.50	(138.717, 122.307)	105.566	(45.9084, 72)	(147.969, 17.1471)

Slices of Slip Surface: 1814

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)

1	1814	47.423685	69.38603	0	-21.526448	0	437.81
2	1814	50.45421	64.46007	0	300.94473	0	613.79
3	1814	53.484735	60.07286	0	615.71224	0	791.6
4	1814	56.6	56.015675	0	891.53005	0	948.28
5	1814	59.8	52.231825	0	1122.2853	0	1079
6	1814	63	48.782235	0	1342.2388	0	1202.9
7	1814	66.2	45.621505	0	1551.11	0	1319.9
8	1814	69.4	42.715035	0	1748.8178	0	1430.2
9	1814	72.688905	39.96726	0	1872.1782	0	1498.1
10	1814	76.066715	37.36722	0	1912.8545	0	1519.4
11	1814	79.44453	34.975245	0	1930.6193	0	1527.6
12	1814	82.822345	32.774605	0	1925.5336	0	1523.1
13	1814	86.200155	30.751465	0	1897.5869	0	1505.7
14	1814	89.577965	28.89427	0	1846.5903	0	1475.6
15	1814	92.955775	27.193275	0	1772.2662	0	1432.6
16	1814	96.32234	25.644915	0	1664.6469	0	1092.2
17	1814	99.8	24.195135	0	1602.4309	0	1051.7
18	1814	103.4	22.84203	0	1586.4365	0	1040.1
19	1814	107	21.635815	0	1550.0847	0	1015.9
20	1814	110.6	20.57125	0	1492.3335	0	978.46
21	1814	114.2	19.64393	0	1411.9634	0	927.06
22	1814	117.5	18.906295	0	1360.3905	0	893.76
23	1814	120.5	18.335695	0	1344.3548	0	882.69
24	1814	123.75	17.822205	0	1254.6225	0	825.91
25	1814	127.25	17.380285	0	1081.3619	0	717.56
26	1814	130.75	17.056575	0	986.77725	0	658.07
27	1814	134.25	16.84999	0	980.00707	0	652.83
28	1814	138	16.76229	0	839.35569	0	565.16
29	1814	141.5	16.788275	0	595.85951	0	414.74
30	1814	144.5	16.91015	0	429.15441	0	311.99
31	1814	146.98435	17.06979	0	200.16762	0	171.52

Slope Stability

File Information

Created By: Chrysovergis, Pavlo
Revision Number: 123
Last Edited By: Baturay, Bora
Date: 8/5/2016
Time: 11:47:22 AM
File Name: Cross Section 2-2' wo AOWTS static.gsz
Directory: K:\10978.000.0\slope stability analysis\August 2016 Revisions\
Last Solved Date: 8/5/2016
Last Solved Time: 11:47:42 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability

Kind: SLOPE/W
Method: Spencer
Settings
    PWP Conditions Source: (none)
Slip Surface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Optimize Critical Slip Surface Location: No
    Tension Crack
        Tension Crack Option: (none)
FOS Distribution
    FOS Calculation Option: Constant
Advanced
    Number of Slices: 30
    Optimization Tolerance: 0.01
    Minimum Slip Surface Depth: 0.1 ft

Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Terrace Deposits - Clayey Sand

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 450 psf
Phi: 29 °
Phi-B: 0 °

Terrace Deposits - Beach Sand

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 50 psf
Phi: 32 °
Phi-B: 0 °

Sandstone Bedrock

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 700 psf
Phi: 29 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (14, 72) ft
Left-Zone Right Coordinate: (93.13774, 44.50209) ft
Left-Zone Increment: 25
Right Projection: Range
Right-Zone Left Coordinate: (140, 18) ft
Right-Zone Right Coordinate: (165, 0) ft
Right-Zone Increment: 25
Radius Increments: 8

Slip Surface Limits

Left Coordinate: (0, 72) ft
Right Coordinate: (165, 0) ft

Seismic Loads

Horz Seismic Load: 0

Point Loads

	Coordinate (ft)	Magnitude (lbs)	Direction (°)
Point Load 1	(140, 18)	2000	0

Regions

	Material	Points	Area (ft²)
Region 1	Terrace Deposits - Clayey Sand	7,8,9,10,11,12,13,14,17,2,6	3558.6669
Region 2	Terrace Deposits - Beach Sand	18,3,2,17	1213.3331
Region 3	Sandstone Bedrock	4,5,3,18,15,16,19	3154.2647

Points

	X (ft)	Y (ft)
Point 1	0	73
Point 2	0	39
Point 3	0	26
Point 4	165	0
Point 5	0	0
Point 6	0	72
Point 7	55	72
Point 8	71	65
Point 9	98	40
Point 10	116	30
Point 11	122	28
Point 12	129	24
Point 13	136	23
Point 14	140	21
Point 15	140	10
Point 16	150	10
Point 17	140	20.33333
Point 18	140	16
Point 19	150	15.23529

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	2354	1.51	(140.778, 118.855)	102.642	(49.4538, 72)	(140, 21)

Slices of Slip Surface: 2354

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	2354	50.84035	69.474635	0	-45.09242	0	431.02
2	2354	53.61345	64.71686	0	258.05202	0	594.97
3	2354	56.6	60.18867	0	544.5581	0	749.63
4	2354	59.8	55.83689	0	801.77767	0	889.7
5	2354	63	51.92165	0	1045.0854	0	1023
6	2354	66.2	48.36951	0	1274.6637	0	1149.4
7	2354	69.4	45.127595	0	1490.7841	0	1268.7
8	2354	72.43622	42.2965	0	1627.9217	0	1345
9	2354	75.30866	39.824645	0	1681.2688	0	1375.4
10	2354	78.181105	37.5294	0	1716.7568	0	1396
11	2354	81.05355	35.39615	0	1734.7663	0	1406.9
12	2354	83.92599	33.41273	0	1735.4911	0	1408.3
13	2354	86.79843	31.5689	0	1719.1034	0	1400.3
14	2354	89.67087	29.85597	0	1685.5671	0	1382.7
15	2354	92.54331	28.2665	0	1634.9374	0	1355.6
16	2354	95.415755	26.794085	0	1567.0706	0	1319
17	2354	97.42599	25.81893	0	1513.2566	0	994.06
18	2354	99.5	24.892505	0	1497.0472	0	984.56
19	2354	102.5	23.630585	0	1495.8688	0	984.66
20	2354	105.5	22.478555	0	1480.8751	0	976.11
21	2354	108.5	21.432515	0	1451.5696	0	958.6
22	2354	111.5	20.489075	0	1407.4459	0	931.78
23	2354	114.5	19.6453	0	1347.9184	0	895.25
24	2354	117.5	18.89867	0	1313.3239	0	874.29
25	2354	120.5	18.24702	0	1306.2321	0	870.56
26	2354	123.75	17.65025	0	1228.8142	0	822.69
27	2354	127.25	17.123105	0	1072.1056	0	724.9
28	2354	130.75	16.718585	0	991.66038	0	674.94
29	2354	134.25	16.43523	0	995.86496	0	678.22
30	2354	138	16.269535	0	1142.5812	0	780.07

Slope Stability

File Information

Created By: Chrysovergis, Pavlo
Revision Number: 119
Last Edited By: Baturay, Bora
Date: 8/5/2016
Time: 11:50:44 AM
File Name: Cross Section 2-2' wo AOWTS seismic.gsz
Directory: K:\10978.000.0\slope stability analysis\August 2016 Revisions\
Last Solved Date: 8/5/2016
Last Solved Time: 11:51:16 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability

Kind: SLOPE/W
Method: Spencer
Settings
  PWP Conditions Source: (none)
Slip Surface
  Direction of movement: Left to Right
  Use Passive Mode: No
  Slip Surface Option: Entry and Exit
  Critical slip surfaces saved: 1
  Optimize Critical Slip Surface Location: No
  Tension Crack
    Tension Crack Option: (none)
FOS Distribution
  FOS Calculation Option: Constant
Advanced
  Number of Slices: 30
  Optimization Tolerance: 0.01
  Minimum Slip Surface Depth: 0.1 ft

Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Terrace Deposits - Clayey Sand

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 450 psf
Phi: 29 °
Phi-B: 0 °

Terrace Deposits - Beach Sand

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 50 psf
Phi: 32 °
Phi-B: 0 °

Sandstone Bedrock

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 700 psf
Phi: 29 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (14, 72) ft
Left-Zone Right Coordinate: (93.13774, 44.50209) ft
Left-Zone Increment: 25
Right Projection: Range
Right-Zone Left Coordinate: (140, 21) ft
Right-Zone Right Coordinate: (164.01544, 1) ft
Right-Zone Increment: 50
Radius Increments: 8

Slip Surface Limits

Left Coordinate: (0, 72) ft
Right Coordinate: (165, 0) ft

Seismic Loads

Horz Seismic Load: 0.35
Ignore seismic load in strength: Yes

Point Loads

	Coordinate (ft)	Magnitude (lbs)	Direction (°)
Point Load 1	(140, 18)	8000	0

Regions

	Material	Points	Area (ft²)
Region 1	Terrace Deposits - Clayey Sand	7,8,9,10,11,12,13,14,17,2,6	3558.6669
Region 2	Terrace Deposits - Beach Sand	18,3,2,17	1213.3331
Region 3	Sandstone Bedrock	4,5,3,18,15,16,19	3154.2647

Points

	X (ft)	Y (ft)
Point 1	0	73
Point 2	0	39
Point 3	0	26
Point 4	165	0
Point 5	0	0
Point 6	0	72
Point 7	55	72
Point 8	71	65
Point 9	98	40
Point 10	116	30
Point 11	122	28
Point 12	129	24
Point 13	136	23
Point 14	140	21
Point 15	140	10
Point 16	150	10
Point 17	140	20.33333
Point 18	140	16
Point 19	150	15.23529

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	2344	1.00	(141.351, 152.202)	135.83	(31.7269, 72)	(140, 21)

Slices of Slip Surface: 2344

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	2344	33.666325	69.475465	0	306.65977	0	470.8
2	2344	37.545175	64.651425	0	301.19611	0	675.75
3	2344	41.424025	60.24442	0	407.26943	0	879.27
4	2344	45.302875	56.196635	0	583.11503	0	1080.5
5	2344	49.181725	52.4641	0	804.18655	0	1279
6	2344	53.060575	49.012455	0	1055.479	0	1474.4
7	2344	57	45.768025	0	1291.3175	0	1627.2
8	2344	61	42.715215	0	1492.6249	0	1733.4
9	2344	65	39.88785	0	1688.5778	0	1831
10	2344	69	37.269245	0	1877.8107	0	1919.8
11	2344	72.70734	35.01018	0	1992.2261	0	1950
12	2344	76.122025	33.07526	0	2022.4409	0	1919.8
13	2344	79.53671	31.267705	0	2033.9556	0	1879.4
14	2344	82.95139	29.581875	0	2026.5307	0	1828.9
15	2344	86.366075	28.012805	0	1999.7847	0	1768.2
16	2344	89.72785	26.577025	0	1857.3287	0	1459.5
17	2344	93.03671	25.267455	0	1781.8684	0	1368.7
18	2344	96.34557	24.056695	0	1684.8042	0	1266.5
19	2344	99.8	22.897235	0	1625.2867	0	1194.6
20	2344	103.4	21.79499	0	1608.2801	0	1154.5
21	2344	107	20.800605	0	1573.8062	0	1104
22	2344	110.6	19.91164	0	1520.3545	0	1043
23	2344	114.2	19.125985	0	1446.343	0	970.85
24	2344	117.5	18.491175	0	1400.5921	0	921.25
25	2344	120.5	17.99057	0	1390.684	0	897.27
26	2344	123.75	17.52882	0	1310.3705	0	829.46
27	2344	127.25	17.117435	0	1148.1047	0	713.94
28	2344	130.75	16.79775	0	1065.454	0	649.45
29	2344	134.25	16.56912	0	1074.6997	0	639.5
30	2344	138	16.42814	0	3205.5239	0	1103.5

ATTACHMENT C

Copies of Laboratory Data from Previous Consultants

GEOTECHNICAL INVESTIGATION
Proposed Residence
31725 Sea Level Drive
Trancas Area, Malibu
Los Angeles County, California

Job No.: 3068-00
Log No.: 9890
July 30, 1986

Prepared For:

Mr. Stuart Miller
15501 San Fernando Mission Boulevard
Mission Hills, CA 91345

Robert Stone & Associates

Robert Stone & Associates, Inc.

SUB-SURFACE DATA

Log No. B-1

PROJECT: Mr. Stuart Miller 31725 Sea Level Dr., Malibu

Method of Drilling: 8" Flight Auger **Logged by** TC **Job No.** 3068-00

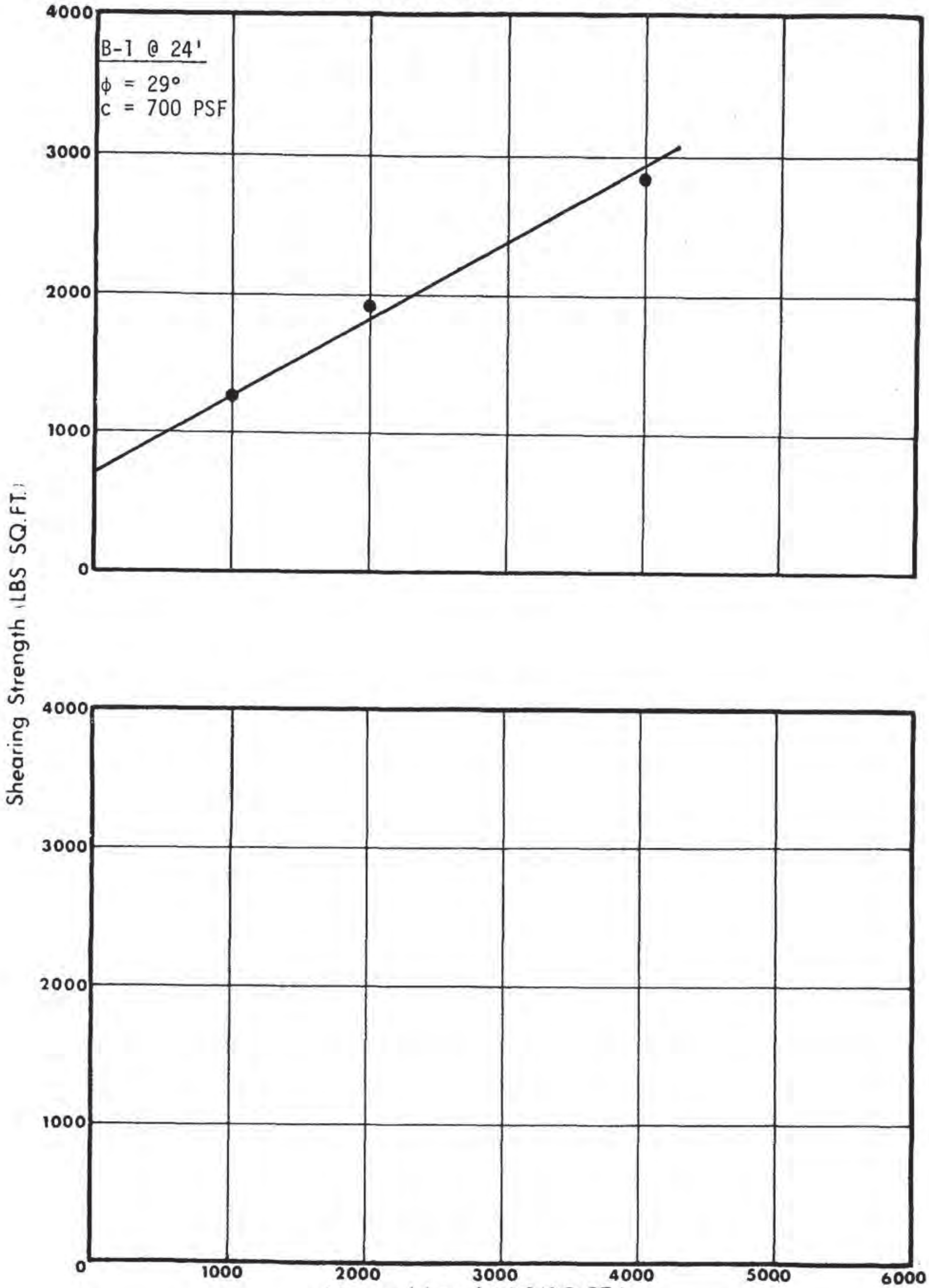
Ground Elevation: **Location:** See Plot Plan **Date Observed:** 7/15/86

Depth in Feet	CLASSIFICATION Unified Soil System	SYMBOL	UNDISTURBED SAMPLE	BULK SAMPLE	MOISTURE CONTENT %	IN PLACE DRY DENSITY lbs/cu. ft.	Blow Count	Description	Soil Test
0	SC							4" A.C. Fill: Light brown clayey SAND with gravel and pieces of brick (moist, moderately compact)	
	SM	42	☒		5.3	117			
5		17	☒		9.7	105		Dark to light brown to brown silty SAND with small brick fragments (moist, moderately compact)	
10	SP	41	☒		5.3	102		Natural Ground - Beach Sand: Light brown to gray, medium to fine SAND Slightly clayey, well-sorted, well-rounded	
15								Wet @ 16'	
		50/ 6"	☒					Cobbly @ 19'	
20									
25		150/ 6"	☒		13.2	113		Bedrock: Grayish medium grained SANDSTONE (wet, hard) Well cemented, difficult drilling Refusal @ 24'	Shear
30								T.D. 25' Water @ 17' No Caving	
35									
40									

(0011B)

RESULTS OF SHEARING STRENGTH TESTS

Undisturbed, Saturated Samples



EXPLANATION:

B-9 @ 12' = Sample taken from Boring 9 at 12 Feet in Depth.

ROBERT STONE & ASSOCIATES
Job No. 3068-00

9-14-94

G. C. MASTERMAN & ASSOCIATES, INC.

SOILS ENGINEERS

9970 Glenoaks Boulevard, Suite A
Sun Valley, California 91352
(818) 768-9991
(818) 768-6579 Fax

SOILS ENGINEERING INVESTIGATION

PROPOSED GUEST HOUSE AND SWIMMING POOL

31736 BROADBEACH ROAD

MALIBU, CALIFORNIA

FOR

MR. & MRS. EDWARD VAN HALEN

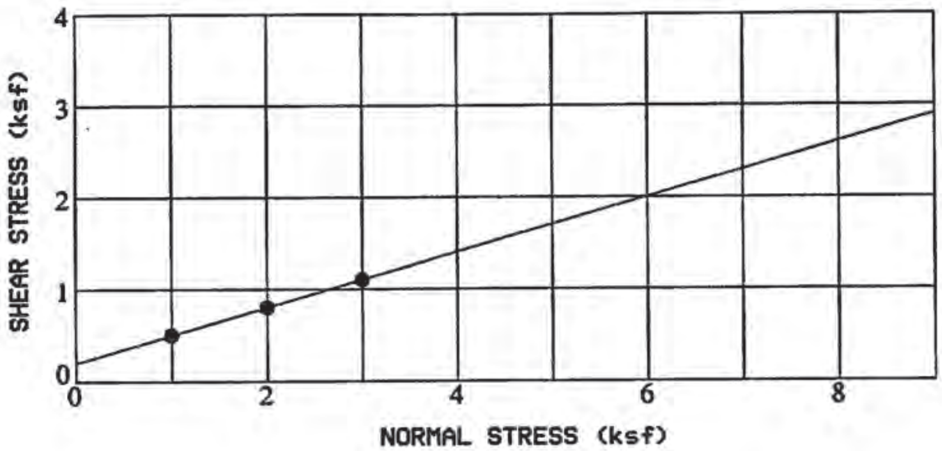
31736 BROADBEACH ROAD

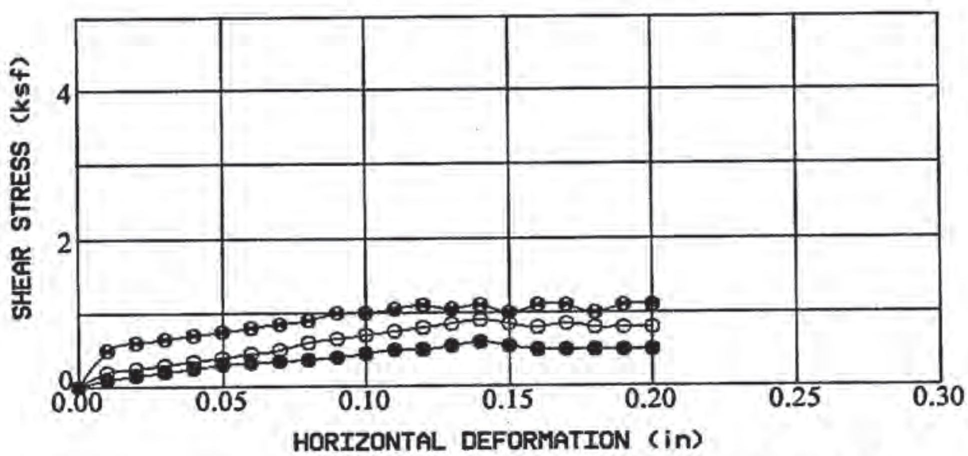
MALIBU, CALIFORNIA 90265

M 2488

SHEAR TEST DIAGRAM

PROJECT NAME: *Van Halen/Broad Beach Road*	SAMPLE ID: *B 1 @ 2.00*
PROJECT NUMBER: *M 2488*	TEST METHOD: *Saturated Shear*
Material Description: *Soil*	





SYMBOL	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
●	1.00	0.60	0.50
○	2.000	0.90	0.80
⊖	3.00	1.10	1.10

MOISTURE CONTENT (%)		DENSITY (pcf)		RESIDUAL RESULTS	
In Situ:	*11.0*			Phi (deg.):	*17.0*
Saturated:	*36.3*	Dry Density:	*99.5*	Cohesion (kips):	*0.200*

G.C. MASTERMAN & ASSOCIATES, INC.

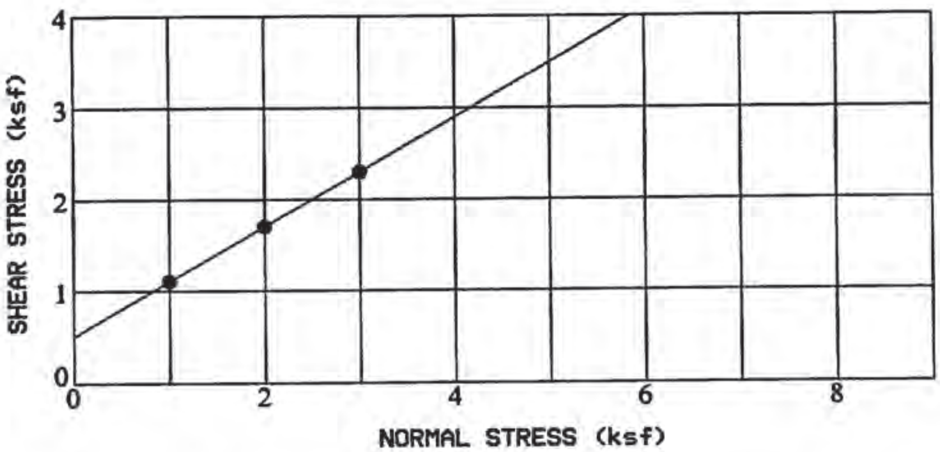
SOILS ENGINEERS

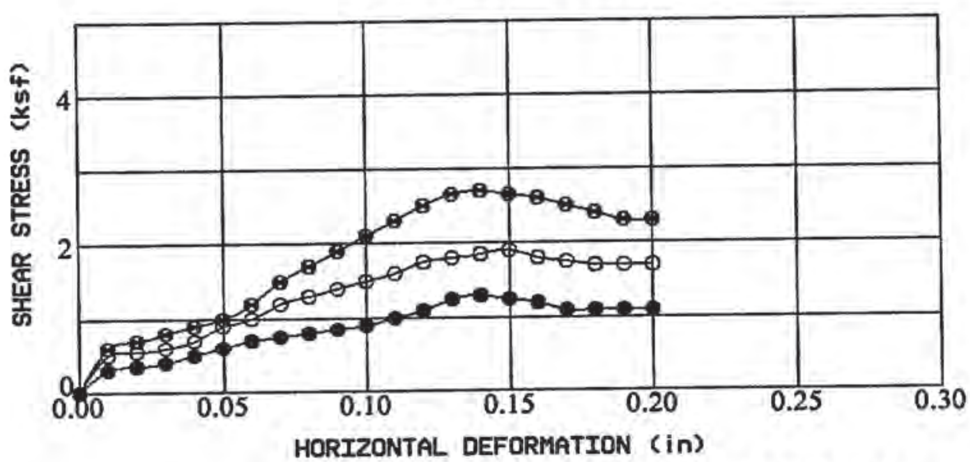
Sun Valley

Figure A-2.1

SHEAR TEST DIAGRAM

PROJECT NAME: *Van Halen/Broad Beach Road*	SAMPLE ID: *B 1 @ 10.00*
PROJECT NUMBER: *M 2488*	TEST METHOD: *Saturated Shear*
Material Description: *Non-Marine Terrace Deposits*	





SYMBOL	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
●	1.00	1.30	1.10
○	2.00	1.90	1.70
⊖	3.00	2.60	2.30

MOISTURE CONTENT (%)		DENSITY (pcf)		RESIDUAL RESULTS	
In Situ:	*9.1*			Phi (deg.):	*31.0*
Saturated:	*36.8*	Dry Density:	*111.9*	Cohesion (kips):	*0.500*

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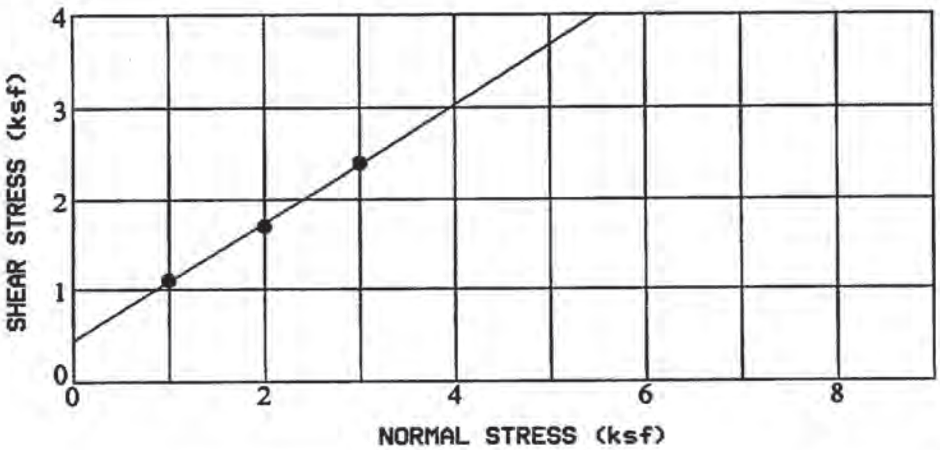
S O I L S   E N G I N E E R S

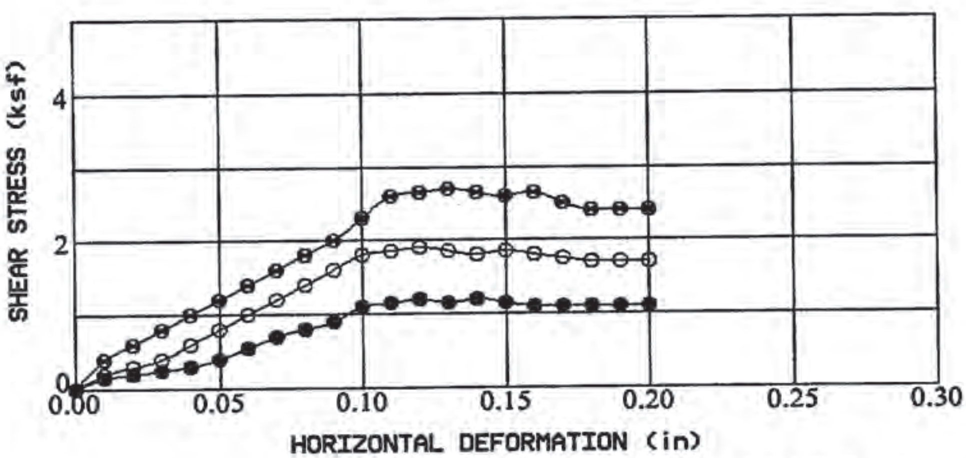
Sun Valley

Figure A-2.2

SHEAR TEST DIAGRAM

PROJECT NAME: *Van Halen/Broad Beach Road*	SAMPLE ID: *B 1 @ 20.00*
PROJECT NUMBER: *M 2488*	TEST METHOD: *Saturated Shear*
Material Description: *Non-Marine Terrace Deposits*	





SYMBOL	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
●	1.00	1.20	1.10
○	2.00	1.90	1.70
⊖	3.00	2.70	2.40

MOISTURE CONTENT (%)		DENSITY (pcf)		RESIDUAL RESULTS	
In Situ:	*11.7*			Phi (deg.):	*32.0*
Saturated:	*37.8*	Dry Density:	*110.5*	Cohesion (kips):	*0.450*

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S O I L S   E N G I N E E R S

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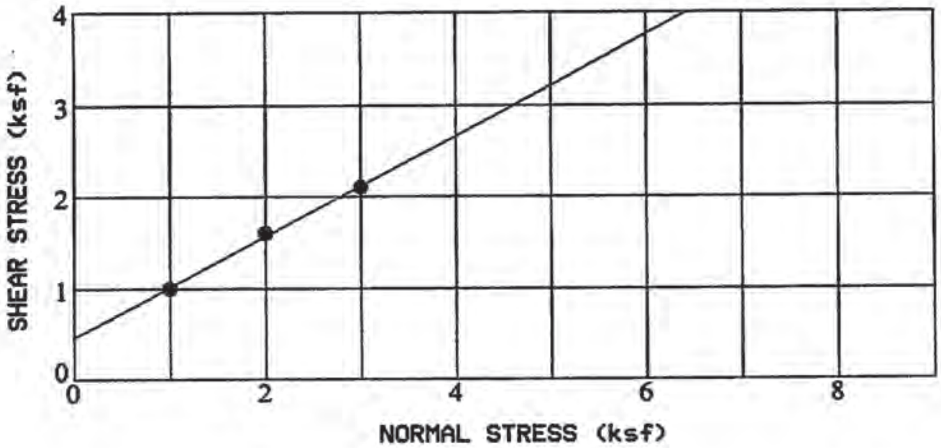
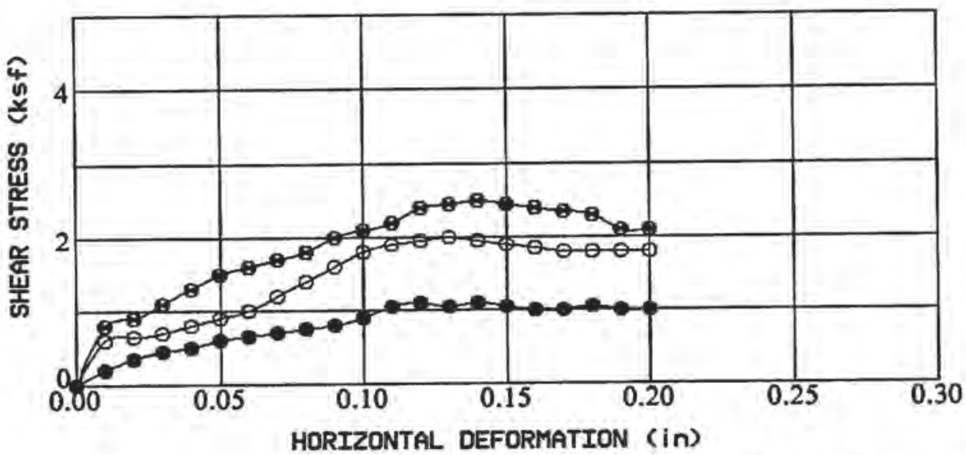
Figure A-2.3

SHEAR TEST DIAGRAM

PROJECT NAME: *Van Halen/Broad Beach Road*	SAMPLE ID: *TT A @ 6.00*
PROJECT NUMBER: *M 2488*	TEST METHOD: *Saturated Shear*
Material Description: *Non-Marine Terrace Deposits*	





SYMBOL	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
●	1.00.	1.10	1.00
○	2.00	2.00	1.80
⊖	3.00	2.50	2.10

MOISTURE CONTENT (%)		DENSITY (pcf)		RESIDUAL RESULTS	
In Situ:	*13.3*			Phi (deg.):	*29.0*
Saturated:	*29.9*	Dry Density:	*106.8*	Cohesion (kips):	*0.465*

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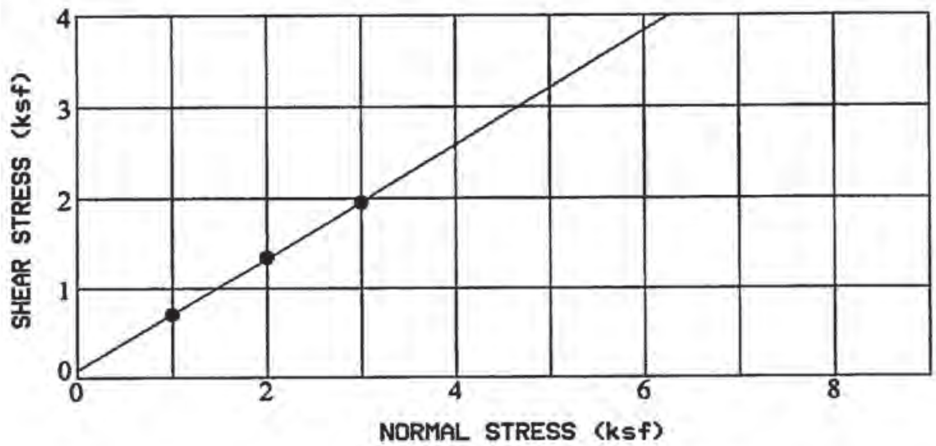
S O I L S   E N G I N E E R S

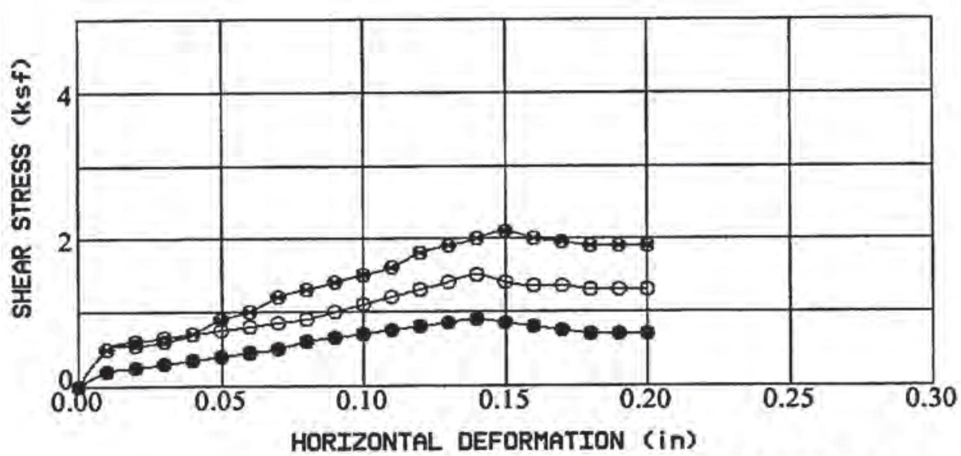
Sun Valley

Figure A-2.4

SHEAR TEST DIAGRAM

PROJECT NAME: *Van Halen/Broad Beach Road*	SAMPLE ID: *B 1 @ 33.00*
PROJECT NUMBER: *M 2488*	TEST METHOD: *Saturated Shear*
Material Description: Marine Terrace Deposits	





SYMBOL	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
●	1.00	0.90	0.70
○	2.00	1.50	1.30
⊖	3.00	2.10	1.90

MOISTURE CONTENT (%)	DENSITY (pcf)	RESIDUAL RESULTS
In Situ:		Phi (deg.): *32.0*
Saturated: *30.1*	Dry Density: 110.2	Cohesion (kips): *0.050*

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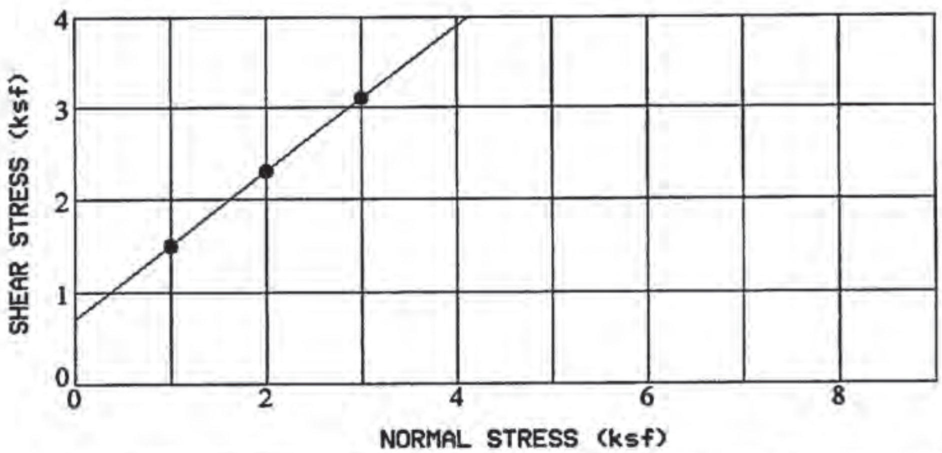
S O I L S   E N G I N E E R S

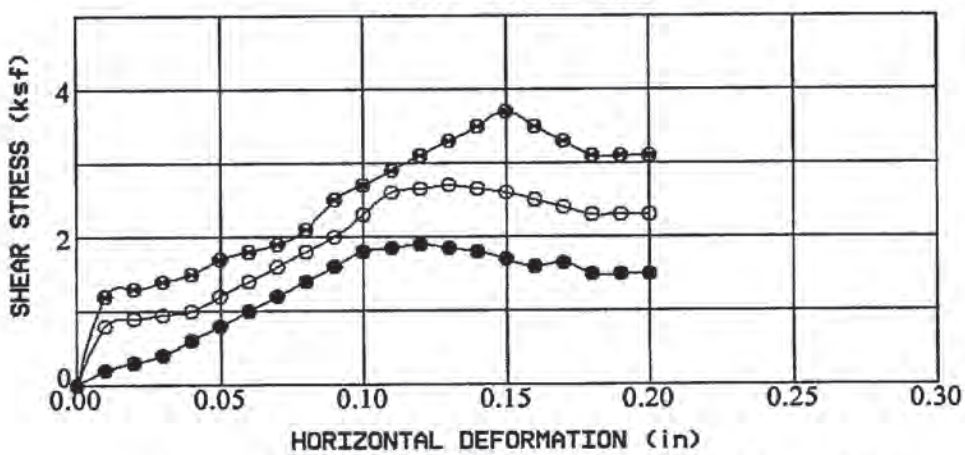
Sun Valley

Figure A-2.5

SHEAR TEST DIAGRAM

PROJECT NAME: *Van Halen/Broad Beach Road*	SAMPLE ID: *BULK @ 0.00*
PROJECT NUMBER: *M 2488*	TEST METHOD: *Saturated Shear*
Material Description: Bulk Sandstone	





SYMBOL	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
●	1.00	1.90	1.50
○	2.00	2.70	2.30
⊖	3.00	3.70	3.10

MOISTURE CONTENT (%)	DENSITY (pcf)	RESIDUAL RESULTS
In Situ:		Phi (deg.): *38.0*
Saturated: *26.4*	Dry Density: 118.3	Cohesion (kips): *0.700*

G.C. MASTERMAN & ASSOCIATES, INC.

S O I L S   E N G I N E E R S

Sun Valley

Figure A-2.6

Project-Specific Reference #12

City of Malibu

23825 Stuart Ranch Road · Malibu, California · 90265-4861
Phone (310) 456-2489 · Fax (310) 456-3356 · www.malibucity.org

ELECTRONIC GEOTECHNICAL SUBMITTAL SIGNATURE PAGE

PROJECT ADDRESS:
(One address per line) 31720.5 Broad Beach Road, Malibu, CA 90265 (CDP 07-087)*

PROPERTY OWNER(S) NAME(S): Mountains Recreation and Conservation Authority

GEOTECHNICAL CONSULTANT:
NAME: Anthony Blanc
FIRM: Amec Foster Wheeler Environment & Infrastructure, Inc.
ADDRESS: 121 Innovation Drive, Suite 200
Irvine, CA 92617
TELEPHONE: (949)642-0245
FAX: (949)642-4474
EMAIL: anthony.blanc@amecfw.com

LIST OF DOCUMENTS SUBMITTED:

DOCUMENT DATE	DOCUMENT DESCRIPTION
02/17/17	Update of the Results of Slope Stability Analyses
	Parking Space "D"

GEOTECHNICAL LICENSE STAMP WITH WET SIGNATURE:

REGISTERED PROFESSIONAL ENGINEER
ANTHONY BLANC
No. GE 2615
Exp. 12.31.18
GEOTECHNICAL
STATE OF CALIFORNIA

Recycled Paper

O:\COUNTER FORMS\Geology\updated city geo forms\GEO Electronic Submittal Signature Page 130729.doc

February 21, 2017

Project 0109780000

Ms. Judi Tamasi
Mountains Recreation and Conservation Authority
5810 Ramirez Canyon Road
Malibu, California 90265

Re: Update of the Results of Slope Stability Analyses
Parking space "D"
Lechuza Public and ADA Access – West Sea Level Drive
Lechuza Beach Public Access Improvements
Malibu, California

Dear Ms. Tamasi:

At your request, Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler), has prepared this letter to update the results of slope stability analyses performed for Mountains Recreations and Conservation Authority (MRCA) in 2012 in relation to the subject Parking Space "D." The referenced report is dated July 10, 2012 and titled, "Results of Slope Stability Analyses, Proposed Parking Space 'D', Lechuza Beach Public and ADA Access – West Sea Level Drive, Malibu, California."

In 2012, Amec Foster used information provided by MRCA to analyze slope stability considering a 7-foot minimum setback from the edge of the bluff. This setback has been revised and now shows the southeast corner of Parking Space D is 5.2 feet from the edge of the bluff.

To remain consistent with the report that was submitted in 2012, the same types of analyses and conditions are analyzed with the 5.2-foot setback. The results are summarized in the attached Table 1, along with a revised Figure 2 showing the revised setback, and graphical representations of the various conditions analyzed.

As expected, with the reduced setbacks, the factors of safety (FS), are generally lower, and the results indicate that the FS is below the acceptable minimum for the "large displacement" shear strength cases (see Cases 1a, 1b, 3a, and 3b) in Table 1. Case 1c indicates the parking space would need to be moved 2 to 2 ½ feet to the north (i.e., away from the bluff) to achieve a factor of safety of 1.5 under large displacement shear strength conditions. If the peak shear strength is used, however, the FS for both static and pseudo-static conditions meet the acceptance criteria (Cases 2a, 2b, 4a, and 4b).

Construction of Parking Space D should not alter the stability of the existing bluff and the parking space will stand as long as the slope stands. Should MRCA decide to proceed with constructing the parking space, conclusions and recommendations in the 2012 report should be

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reviewed and applied, particularly regarding preventing water infiltration that would saturate slope materials.

We hope this letter meets the project needs at this time. Please contact the undersigned if you have questions regarding the content of this letter.

Sincerely,
Amec Foster Wheeler Environment & Infrastructure, Inc.

Anthony Blanc, PE, GE
Senior Associate Geotechnical Engineer

Eileen Bailiff, PG, CEG
Senior Associate Engineering Geologist

PROFESSIONAL GEOLOGIST EILEEN BAILIFF No. 2252 Exp. 7/31/17 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

Attachments

REGISTERED PROFESSIONAL ENGINEER ANTHONY BLANC No. GE 2615 Exp. 12.31.18 GEOTECHNICAL STATE OF CALIFORNIA

TABLE 1

SUMMARY OF SLOPE STABILITY ANALYSIS RESULTS

Parking Space "D" - West Sea Level Drive
Lechuza Beach Improvements
Malibu, California

CASE	Conditions Analyzed				FACTOR OF SAFETY
	Static or Pseudostatic	Shear Strength	Horizontal Seismic Coefficient, k	Optimization	
1a	Long Term Static	Large Displacement	Not Applicable	on	1.10 [1]
1b	Long Term Static	Large Displacement	Not Applicable	off	1.21 [1]
1c	Long Term Static	Large Displacement	Not Applicable	off	1.51 [4]
2a	Long Term Static	Peak	Not Applicable	on	1.64
2b	Long Term Static	Peak	Not Applicable	off	1.80
3a	Pseudostatic	Large Displacement	0.31 [2]	on	0.88 [1]
3b	Pseudostatic	Large Displacement	0.20 [3]	on	0.97 [1]
4a	Pseudostatic	Peak	0.31 [2]	on	1.31
4b	Pseudostatic	Peak	0.20 [3]	on	1.45

Notes:
1. Factor of safety less than acceptable criterion.
2. Based on the screening analysis procedure (ASCE/SCEC, 2002) with a calculated "k" coefficient = 0.31 and a required FS = 1.0.
3. Based on the City of Malibu requirement of a "k" coefficient = 0.20 and a required FS = 1.10.
4. The failure surface encroaches about 2.5 feet into the edge of the parking space

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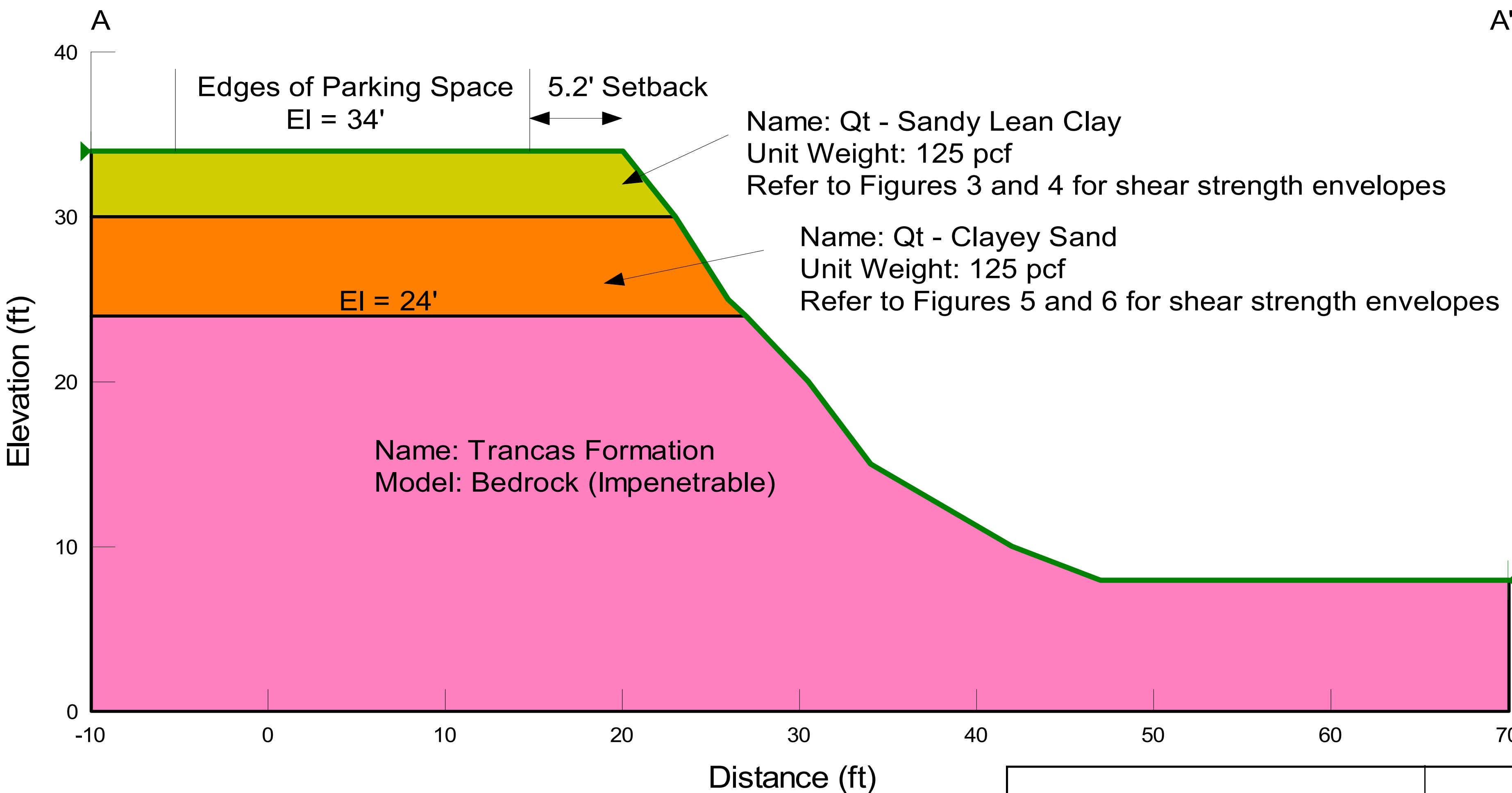

GEOLOGIC CROSS-SECTION A-A'
Parking Space "D" - West Sea Level Drive
Lechuza Beach Improvements
Malibu, California

amec foster wheeler

Date: 08/25/2016	Project No.: 10978000	Figure
Submitted By: AB	Drawn By: LH	2

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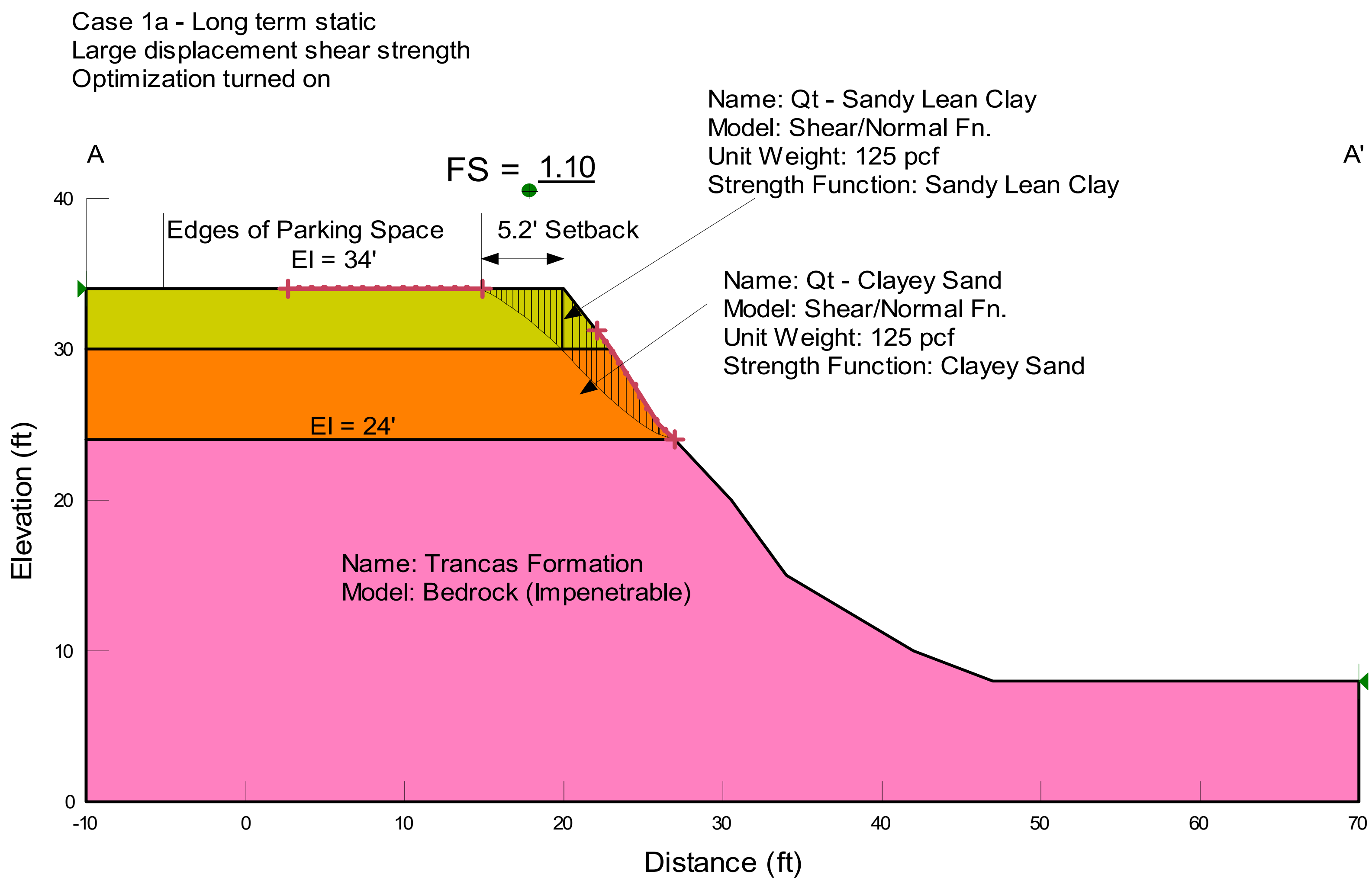

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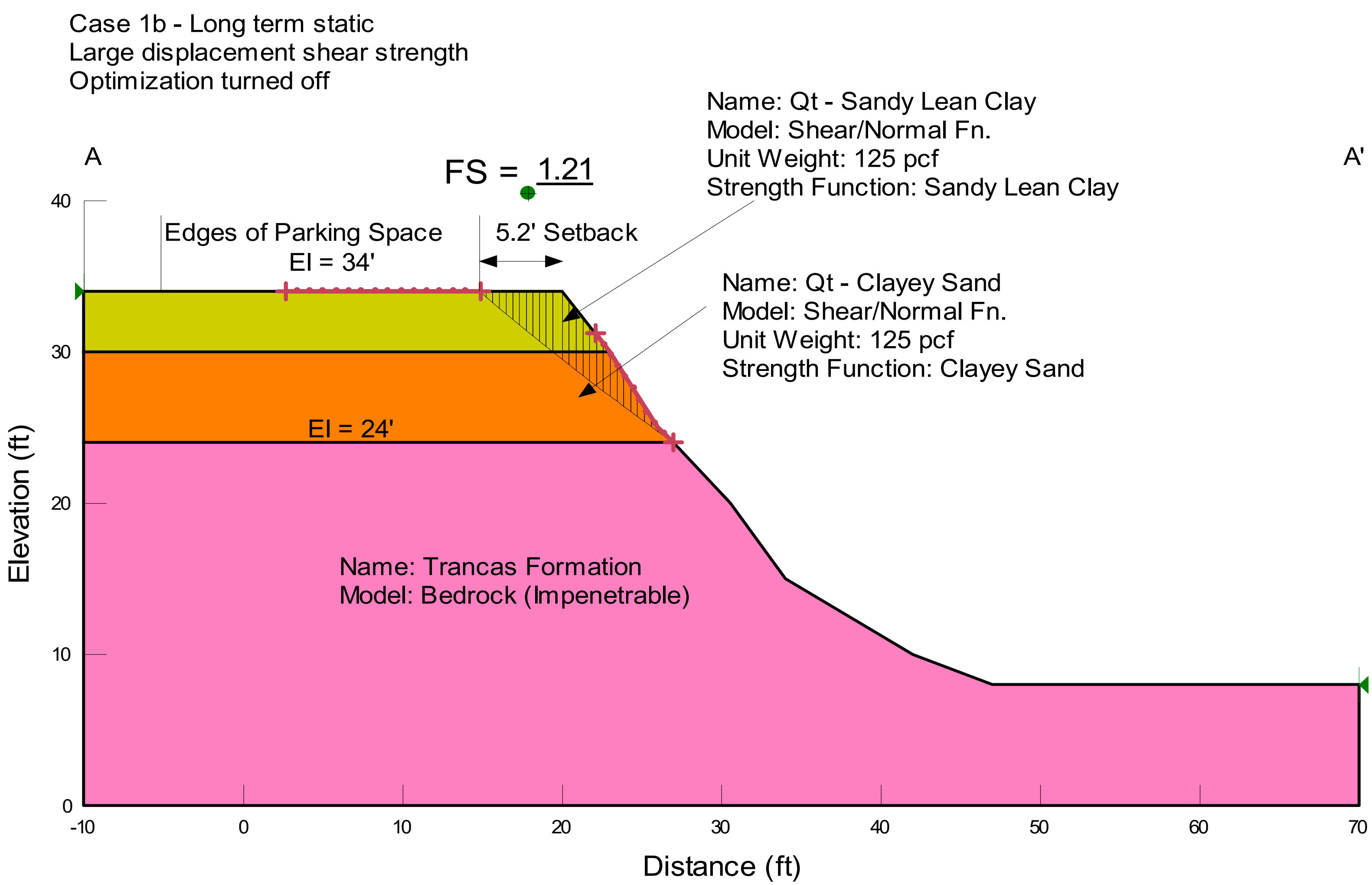

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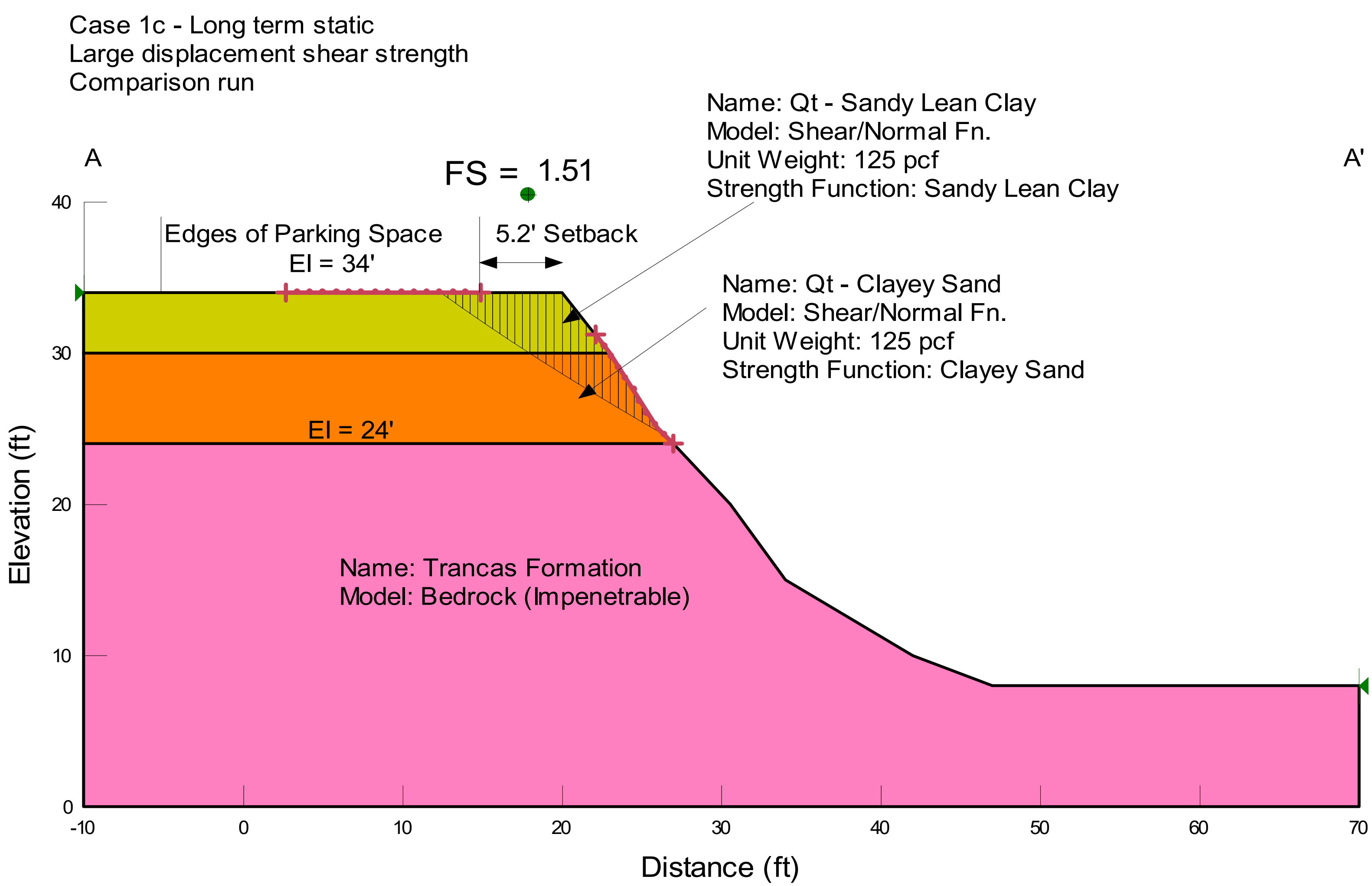

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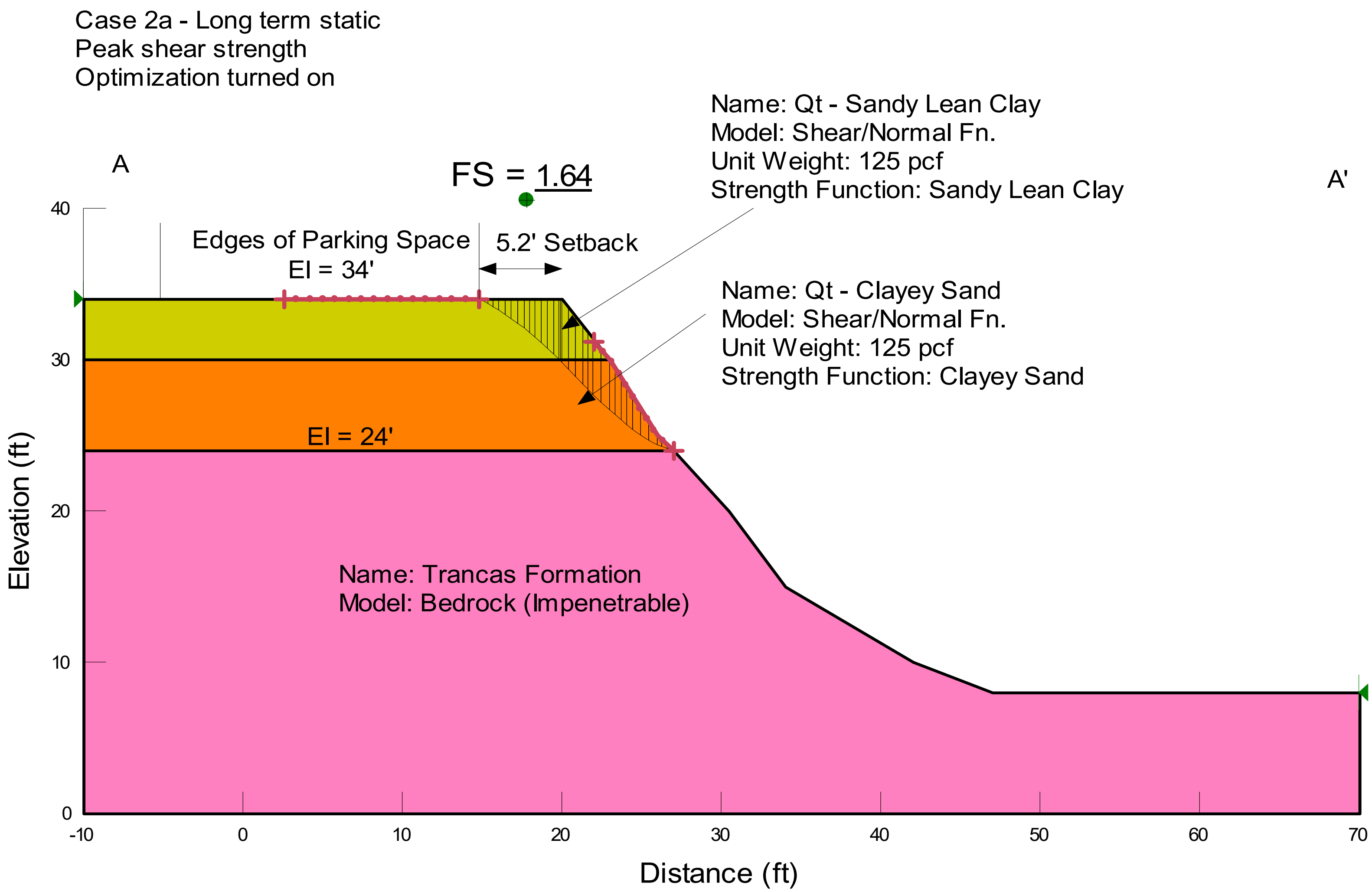

Case 2a - Long term static
Peak shear strength
Optimization turned on
Name: Qt - Sandy Lean Clay
Model: Shear/Normal Fn.
Unit Weight: 125 pcf
Strength Function: Sandy Lean Clay
A
FS = 1.64
A'
Edges of Parking Space
El = 34'
5.2' Setback
Name: Qt - Clayey Sand
Model: Shear/Normal Fn.
Unit Weight: 125 pcf
Strength Function: Clayey Sand
El = 24'
Name: Trancas Formation
Model: Bedrock (Impenetrable)
Elevation (ft)
0
10
20
30
40
-10
0
10
20
30
40
50
60
70
Distance (ft)

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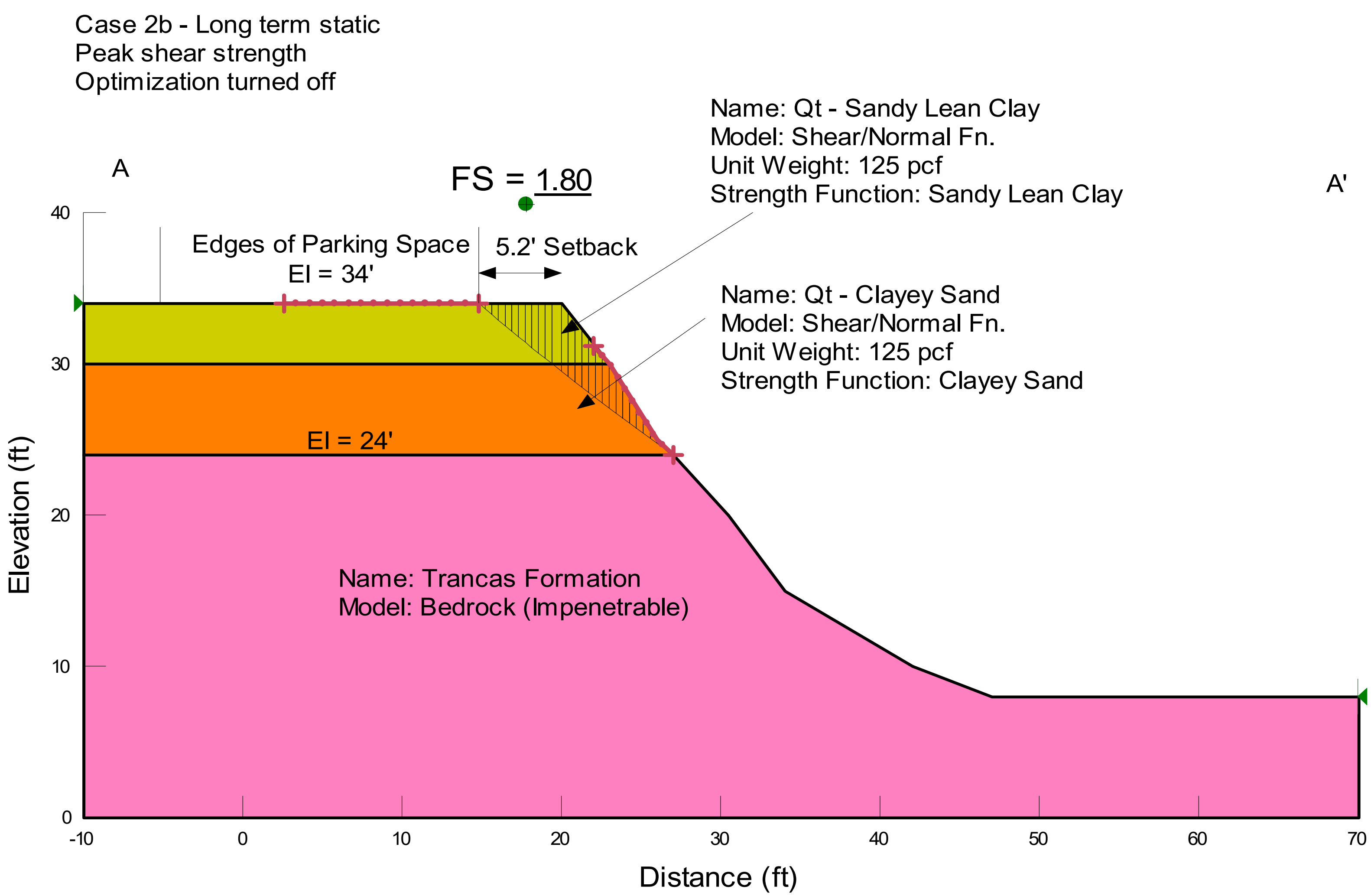

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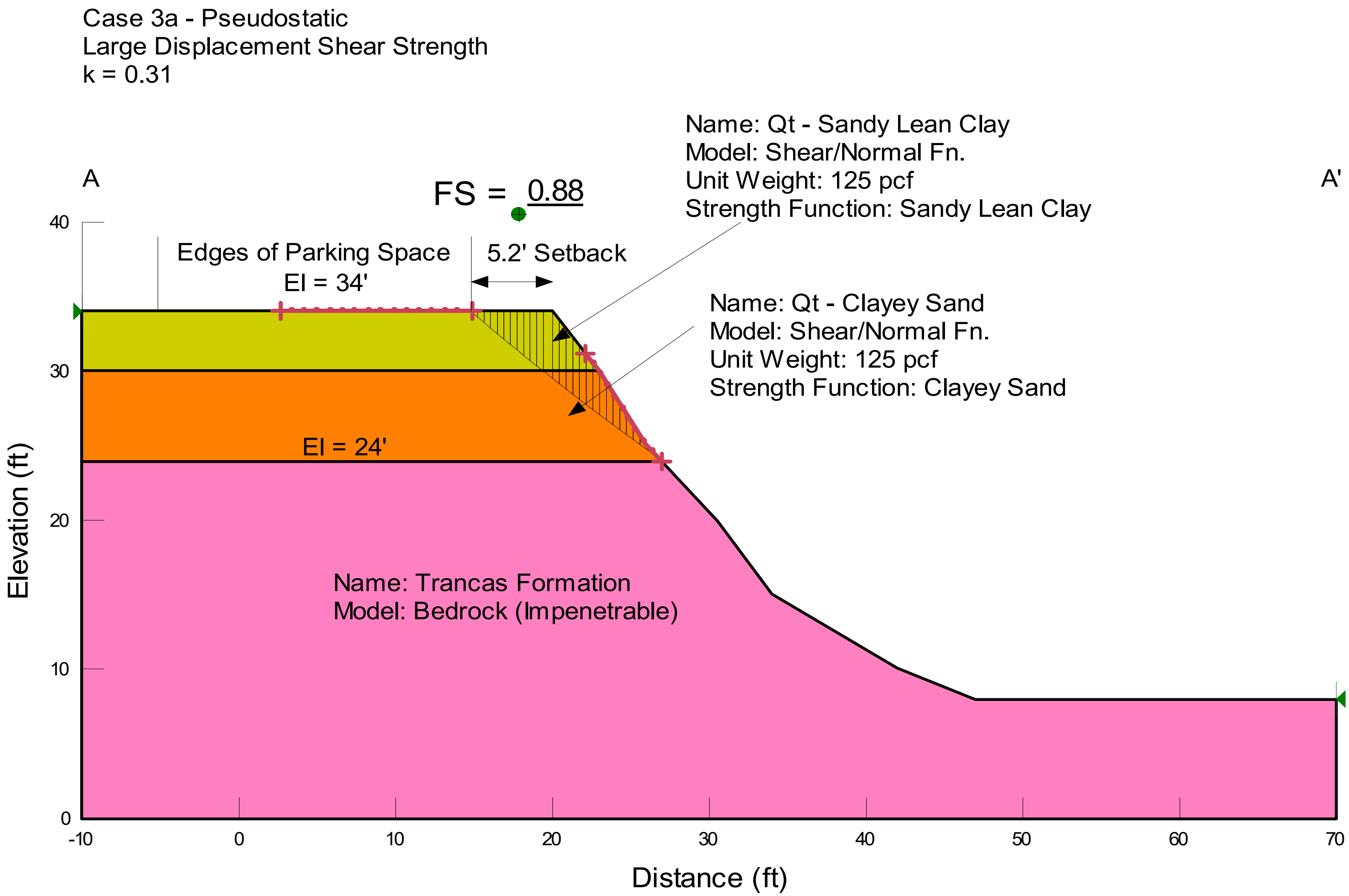

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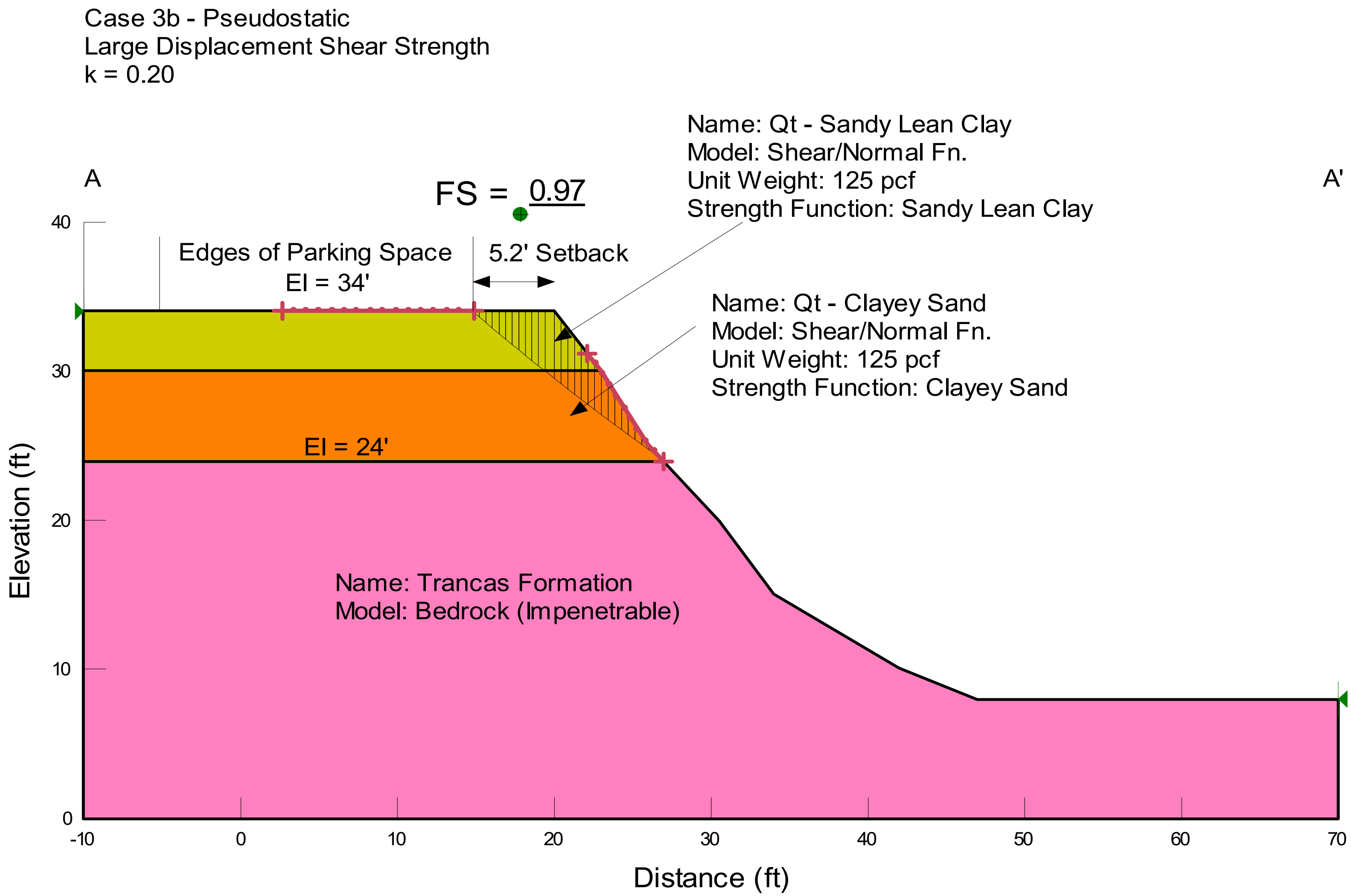
Case 3b - Pseudostatic
Large Displacement Shear Strength
k = 0.20
A
A'
FS = 0.97
Name: Qt - Sandy Lean Clay
Model: Shear/Normal Fn.
Unit Weight: 125 pcf
Strength Function: Sandy Lean Clay
Edges of Parking Space
El = 34'
5.2' Setback
Name: Qt - Clayey Sand
Model: Shear/Normal Fn.
Unit Weight: 125 pcf
Strength Function: Clayey Sand
El = 24'
Name: Trancas Formation
Model: Bedrock (Impenetrable)
Elevation (ft)
Distance (ft)
0
10
20
30
40
-10
0
10
20
30
40
50
60
70

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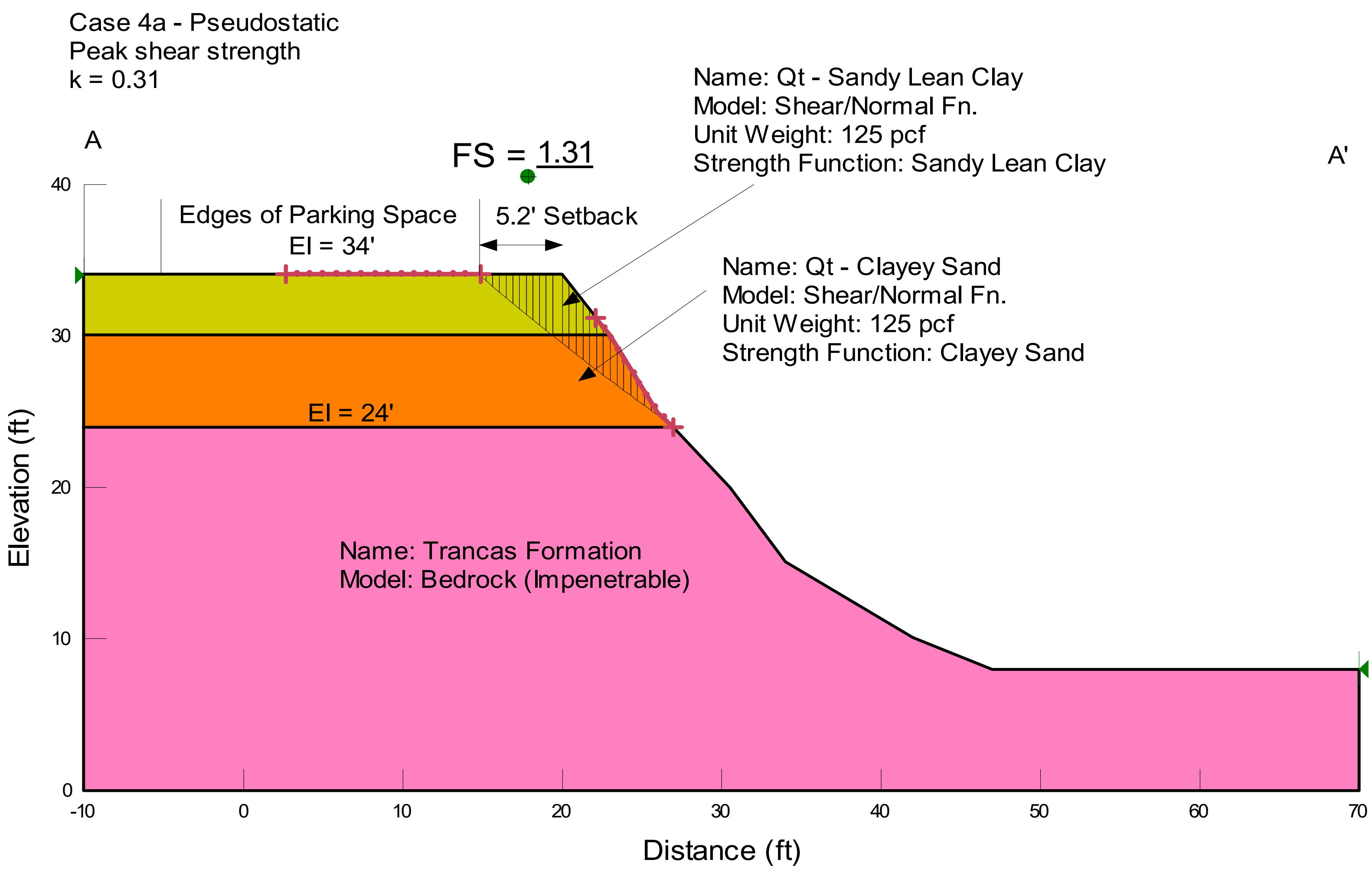

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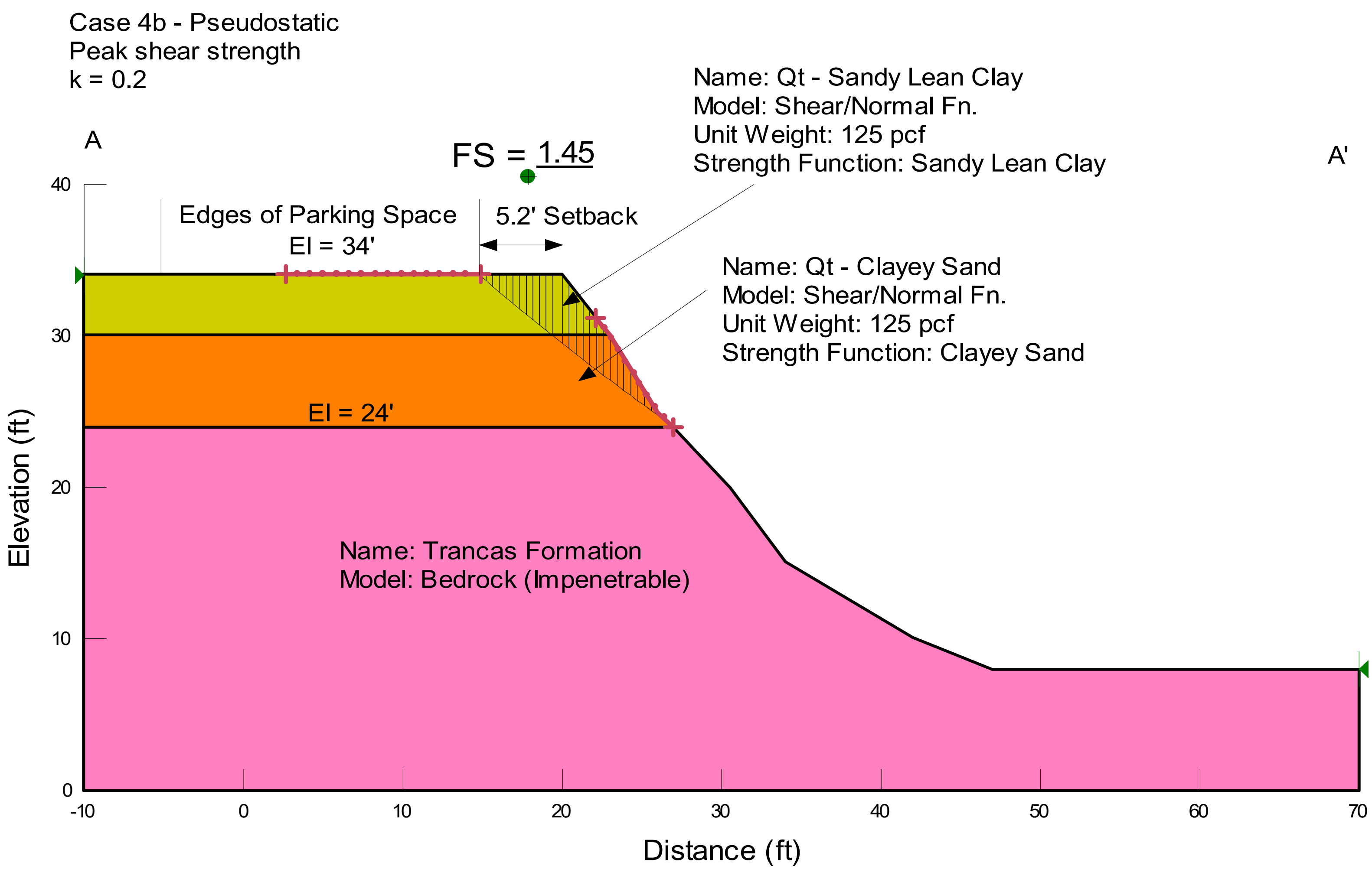

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Project-Specific Reference #13

GeoSoils, Inc.

COASTAL HAZARD
&
WAVE RUNUP STUDY

BEACH ACCESS IMPROVEMENTS
LECHUZA BEACH

MALIBU, CA

August 2007

Prepared For

Mountains Recreation & Conservation Authority

5741 Palmer Way, Suite D, Carlsbad CA 92010 Phone 760-438-3155 Fax 760-931-0915

GeoSoils Inc.

August 3 , 2007

Mountains Recreation & Conservation Authority
Ramirez Canyon Park
5810 Ramirez Canyon Road
Malibu, California 90265

SUBJECT: Coastal Hazard & Wave Runup Study for Beach Access Improvements Lechuza Beach, Malibu, California.

Dear Sirs:

At your request GeoSoils Inc. (GSI) is pleased to provide the following Coastal Hazard and Wave Runup Study for the proposed public access improvements at Lechuza Beach, Malibu. The wave runup and hazard analysis is based upon our conversations with your representative, Judi Tamasi, regarding the site conditions, our site inspection, existing published reports concerning the regional coastal processes, historical photographs, and our knowledge of local coastal conditions. This report constitutes an investigation of the wave and water level conditions expected at the site in consequence of extreme storm and wave action. It also provides conclusions and recommendations regarding the susceptibility of the site and proposed public access improvements to coastal erosion and wave attack.

INTRODUCTION

This report concerns three public access improvement locations along the Lechuza Beach shoreline. The first public access improvement is a new beach stairway and landing located at the west end of the beach. The second improvement is a new stairway and beach landing at the west end of Sealevel Drive. The third access improvement is a handicap accessible ocean view platform also located at the west end of Sealevel Drive. The proposed access improvements and neighboring Lechuza Beach shoreline are situated along a moderately high wave energy portion of the southern California coast. The shoreline of Lechuza Beach lies within the Santa Monica Littoral Cell. A littoral cell is a coastal compartment that contains a complete cycle of littoral sedimentation including sources, transport pathways, and sediment sinks. The Santa Monica Littoral Cell extends from Point Dume to Palos Verdes, a distance of 40 miles. The source of beach sediment for the cell is bluff erosion, numerous seasonal streams and creeks, and artificial beach nourishment from major civil works projects such as the dredging of Marina Del Rey. The sink for sediments is the Redondo Submarine Canyon, with the coastal harbors/marinas serving as a temporary sink for beach sediments. The beach sediment is moved along the shoreline by wave action. The predominant wave energy comes from the southwest and west, with some energy from the northwest. As a result of the wave energy direction, the beach sands move from west to east as they travel along the shoreline.

Moffatt & Nichol Engineers (1992) performed a shoreline change study as part of the City of Malibu General Plan. The study examined the time period from 1938-1988, and showed that the shoreline in the vicinity of the site is eroding at a rate of about 1.0 ft/yr. The US Army Corps of Engineers 1994 study (USACOE, 1994) characterized this reach of shoreline (Reach 1) as "stable to slow erosion." Reach 1 extends from the county line (just west of Sequit Point) to Lachuza Point a distance of about 5 miles. The beaches in the Lechuza area are narrow (~ 75 feet), with a relatively thin (~ 12 feet), veneer of sand over bed rock material.

DATUM INFORMATION

The datum used in this report is Nation Geodetic Vertical Datum 1929 (NGVD29), which is about 0.2 feet below Mean Sea Level (MSL) and +2.6 feet Mean Lower Low Water (MLLW). In the open ocean waters of the Santa Monica Bay, Mean High Water (MHW) is 1.94 feet above MSL. For the purposes of this investigation, MSL and NGVD29 are considered essentially equal. The units of measurement in this report are feet (ft), pounds force (lbs), and second (sec). Elevations on the site were provided by a survey performed by Land & Air Surveying with a datum of NGVD29. Plans of the three access improvements were provided by Mountains Recreation & Conservation Authority (MRCA). For the purpose of this analysis, the expected life of the access improvements is 25 years. The National Oceanographic and Atmospheric National Ocean Survey tidal data station closest to the site is the Santa Monica Station (NOAA 1999). The NOAA elevations relative to MSL are as follows:

Highest Water November 30, 1982	5.81 feet
Mean Higher High Water	2.68 feet
Mean High Water	1.94 feet
Mean Sea Level (MSL)	0.00 feet
Mean Low Water	-1.87 feet
Mean Lower Low Water	-2.81 feet
Lowest Water December 17, 1933	-5.53 feet

SITE CONDITIONS

The site conditions were determined using the available reports, historical photographs of the area, and our site inspection. The general site for the access improvements is at the back beach between Encinal Canyon and Lechuza Point. Figure 1, from Google

Earth, shows the locations of the proposed access improvements. Figures 2 and 3, downloaded from the California Coastal Records Project web site (http://www.californiacoastline.org/), show the access sites and adjacent shoreline in September 2006. Figure 2 shows the existing public access stairway at the end of the west end beach. The proposed new stairway and landing are to be approximately in the same location. The landing of the star is at about elevation +9 NGVD29 and appears to be founded on/near or into the bedrock soils. The base of the stairs shows signs of significant cobble abrasion. Figure 3 shows the location of the viewing platform and the new public access stair way. The stair landing is proposed to be located at the base of the bluff on the beach. The viewing platform is to be built atop a quarry stone revetment that protects East Sealevel Drive.

Figure 1. Lechuza Beach and location of public access improvements.

Figure 2. Location of western stairway public access improvement/replacement of stairway and landing. Note the narrow beach and rock outcropping denoting a relatively shallow bedrock below the beach sands.

Figure 3. Location of proposed public access and view platform at the east end of Lechuza Beach. Note the narrow beach and the rock revetment which protects East Sealevel Drive.

GeoSoils Inc.

WAVE RUNUP AND OVERTOPPING ANALYSIS

As waves encounter the beach in front of this section of shoreline, they break and rush up the beach. In addition, waves can runup on, or possibly over, the quarry stone revetment that protects East Sealevel Drive. Often, wave runup strongly influences the design and the cost of coastal projects. Wave runup is defined as the vertical height above the still water level to which a wave will rise on a structure (beach) of infinite height. Overtopping is the flow rate of water over the top of a finite height structure (sand dune) as a result of wave runup. The beach fronting the access stair landings and the revetment are finite height structures, so overtopping will be considered.

Wave runup and overtopping for the proposed project is calculated using the United States Army Corps of Engineers 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 (2004). Figure 4, taken from the ACES manual, shows the runup variables.

The empirical expression for the monochromatic-wave overtopping rate is:

$$Q = C_w \sqrt{g Q_0^* H_0^3} \left(\frac{R+F}{R-F} \right)^{\frac{-0.1085}{a}}$$

where

Q	= overtopping rate/unit length of structure
C_w	= wind correction factor
g	= gravitational acceleration
Q_0^*, α	= empirical coefficients (see SPM Figure* = 7-27)
H_0	= unrefracted deepwater wave height
R	= runup
F	= $h_s - d_s$ = freeboard
h_s	= height of structure
d_s	= water depth at structure
a	= an empirical coefficient

The correction for offshore winds is:

$$C_w = 1 + W_f\left(\frac{F}{R}+0.1\right)\sin\theta$$

where

$$W_f = \frac{U^2}{1800}$$

U = onshore wind speed (mph)

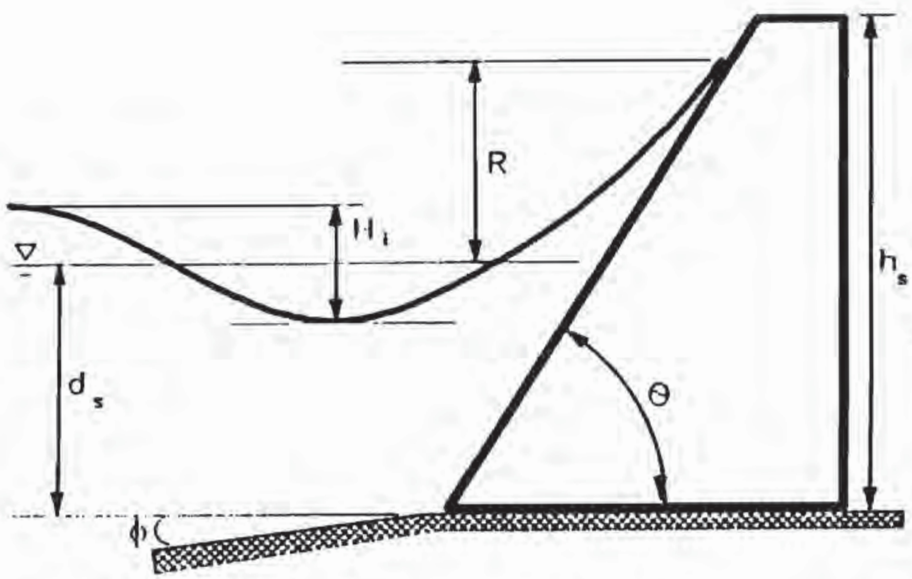

Figure 4. Wave runup terms from ACES manual.

The wave, wind, and water level data used as input to the ACES runup and overtopping application was taken from the historical data reported by the Corps (USACOE, 1986 & 1994) and updated with data from recent storms. The Malibu shoreline has experienced a series of storms over the years. These events have impacted coastal property and beaches depending upon the severity of the storm, the direction of wave approach, and the local shoreline orientation. The ACES analysis was performed on oceanographic conditions that represent a typical 100-year recurrence storm similar to those of the1982-83 El Niño, January 1988, and February 1998. The onshore wind speed was chosen to be 40 knots. During storm conditions, the sea surface rises along the shoreline (super-elevation) and allows waves to break closer to the shoreline and runup on the beach. Superelevation of the sea surface can be accounted for by: wave set-up (1 to 2 feet), wind set-up and inverse barometer (0.5 to 1.5 feet), wave group effects (1 to 2 feet) and El Niño and climate effects (0.5 to 1.5 feet). These conditions rarely occur simultaneously. The extreme water elevation used in this analysis is +6.5 feet MSL (100-year recurrence water level). This still water elevation uses EPA (Titus & Narayanan 1995) estimates of 8 inches of sea level rise in the next 75 years. Considering that the stair landing and viewing platform have an expected life of 25 years, this can be considered a conservative analysis.

The wave that has the greatest runup is the wave that has not yet broken when it reaches the toe of the beach, or the revetement. It is not the largest wave to come into the coastal area. The larger waves break offshore of the site and lose most of their energy before reaching the shoreline. The maximum scour at the beach toe is estimated to be at about 0.0 NGVD29 based on the observed shallow bedrock. This is in agreement with Table 3.3 of the 1994 USACOE reconnaissance report. If the total water depth is 6.5 feet, then the design wave height would be about 5.0 feet. The design wave period is chosen to be 16 to 18 seconds because the longer the wave period the higher the wave runup. The top of the beach is at about elevation +10 feet NGVD29, and the top of the revetement is at about elevation +19 feet NGVD29. The slope of the beach is about 1/10 and the revetment slope is about 1/2. The nearshore slope was chosen to be 1/60 based upon the National Ocean Survey, Coast and Geodetic Survey, prepared by the National Oceanic and Atmospheric Administration. Table I is the output for the overtopping of the beach and Table II is the overtopping for the revetment.

Table I

AUTOMATED COASTAL ENGINEERING SYSTEM ... Version 1.02 7/25/2007 12:38
Project: LECUHZA PUBLIC ACCESS IMPROVEMENTS mrca

WAVE RUNUP AND OVERTOPPING ON IMPERMEABLE STRUCTURES

Item		Unit	Value	
Wave Height at Toe	Hi:	ft	5.000	Smooth Slope Runup and Overtopping
Wave Period	T:	sec	18.000	
COTAN of Nearshore Slope			60.000	
Water Depth at Toe	ds:	ft	6.500	
COTAN of Structure Slope			10.000	
Structure Height Above Toe	hs:	ft	10.000	
Deepwater Wave Height	H0:	ft	2.784	
Relative Height	(ds/H0):		2.335	
Wave Steepness	(H0/gT^2):		0.267E-03	
Wave Runup	R:	ft	9.126	
Onshore Wind Velocity	U:	ft/sec	67.512	
Overtopping Coefficient	Alpha:		0.700E-01	
Overtopping Coefficient	Qstar0:		0.700E-01	
Overtopping Rate	Q:	ft^3/s-ft	2.104	

Table II

AUTOMATED COASTAL ENGINEERING SYSTEM ... Version 1.02 7/25/2007 13: 1
Project: LECUHZA PUBLIC ACCESS IMPROVEMENTS mrca

WAVE RUNUP AND OVERTOPPING ON IMPERMEABLE STRUCTURES

Item		Unit	Value	
Wave Height at Toe	Hi:	ft	5.000	Rough Slope
Wave Period	T:	sec	18.000	Runup and
COTAN of Nearshore Slope			60.000	Overtopping
Water Depth at Toe	ds:	ft	6.500	
COTAN of Structure Slope			2.000	
Structure Height Above Toe	hs:	ft	18.000	
Rough Slope Coefficient	a:		0.956	
Rough Slope Coefficient	b:		0.398	
Deepwater Wave Height	H0:	ft	2.784	
Relative Height	(ds/H0):		2.335	
Wave Steepness	(H0/gT^2):		0.267E-03	
Wave Runup	R:	ft	9.413	
Onshore Wind Velocity	U:	ft/sec	67.512	
Overtopping Coefficient	Alpha:		0.800E-01	
Overtopping Coefficient	Qstar0:		0.200	
Overtopping Rate	Q:	ft^3/s-ft	0.000	

Based upon the ACES analysis, the beach can be overtopped at about 2.1 ft^3/s-ft of beach. This is several gallons of water per wave when the extreme design conditions occur (once every few decades). The calculated maximum wave runup is about +16 feet NGVD29. Based upon the ACES analysis, the revetment at elevation +18 feet NGVD29 will not be overtopped. However, direct observation verifies that the revetment may be subject to minor overtopping.

TSUNAMI

Tsunami are waves generated by submarine earthquakes, landslides, or volcanic action. Lander et al. (1993) discusses the frequency and magnitude of recorded or observed tsunami in the southern California area. James Houston (1980) predicts a tsunami of less than 5 feet for a 500 year recurrence interval for this area. Legg et al. (2002) examined the potential tsunami wave runup in southern California. While this study is not specific to the Lechuza Beach and Sealevel Drive, it provides a first order analysis for the area. Figure 5 shows the tsunami runup in the southern California bight. The maximum tsunami runup in the Lechuza Beach area is about 0.5 meters in height. The Legg et al. (2002) report determined a maximum open ocean tsunami height of less than 2 meters. The wave runup analysis performed herein can be used to calculated the expected runup due to a tsunami about 1.5 meters in height. This analysis is conservative because the open ocean tsunami wave height is used instead of the expected lower tsunami wave height inside Santa Monica Bay. While a tsunami can overtop the beach and possible the revetement, and temporarily flood Sealevel Drive, the event does not significantly erode the shoreline and will have little, if any, long term impact on the public access improvements if they are built to the Uniform Building Code.

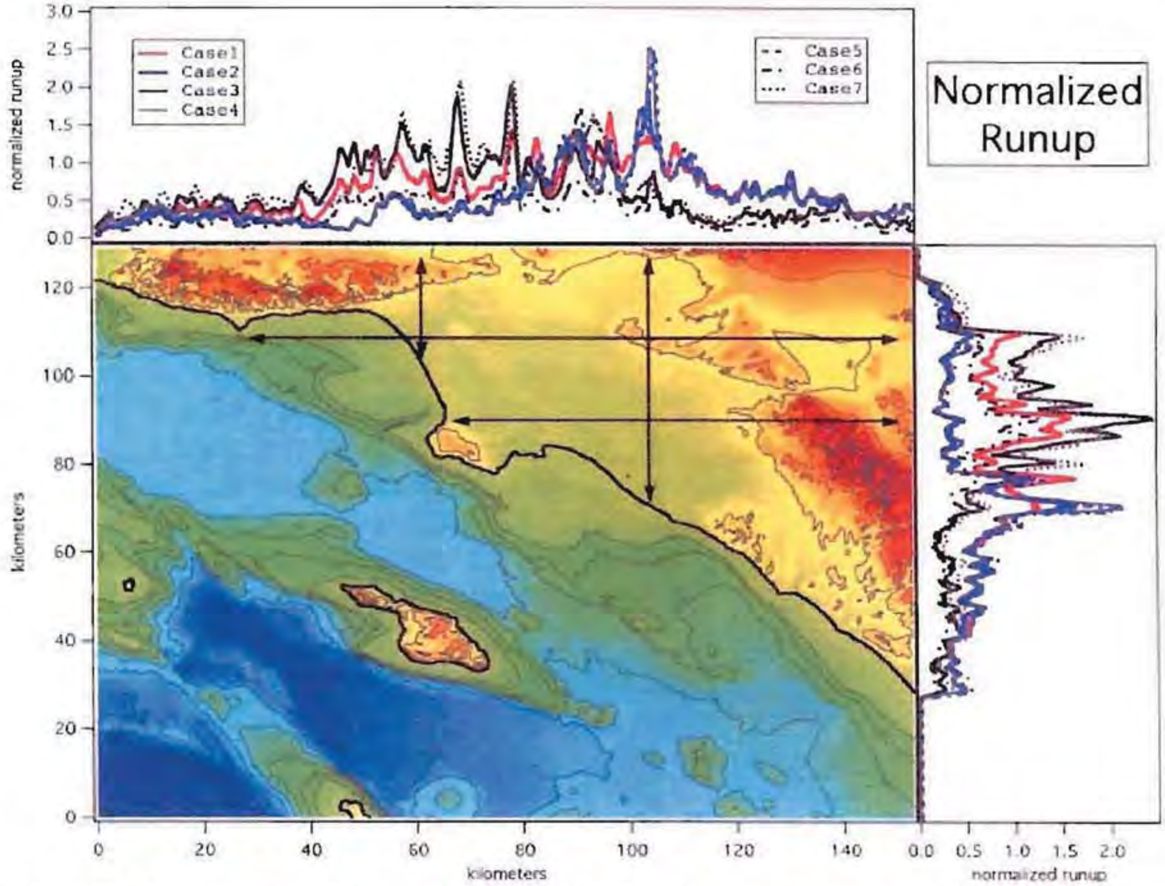

Figure 10. Map showing maximum runup normalized to the maximum seafloor/island uplift for each of the seven Catalina Fault tsunamigenic earthquake scenarios modeled in this study (fault parameters in Table 4).

Figure 5. Taken from Legg et al. (2002). Note the maximum wave runup in the Malibu area is about 0.5 meters.

BREAKING WAVE ELEVATION

The maximum breaking wave crest elevation is important for establishing the maximum vertical extent of wave forces on the structure (revetment and viewing platform). Typical coastal design practice would require that the lowest horizontal structural member connecting the pile to the viewing platform be above the maximum breaking wave crest elevation or be designed to withstand wave forces. The maximum breaking wave crest elevation is calculated using the US Army Corps of Engineers Shore Protection Manual (1984). Figure 6 shows the variables for calculating the maximum breaker height. The variables for the analysis are as follows:

m	= the nearshore slope = 1:60 or 0.017
H_b	= the height of the breaker.
d_s	= depth of water at the structure = 6.5 feet.
d_b	= depth of water at the break point.
H'_b	= the elevation of the breaker

The nearshore slope was based upon the NOAA bathymetric chart # 18744. The depth of water at the structure is based upon a maximum scour of 0.0 feet NGVD29 (due to quarry stone in front of the structure), and a maximum still water elevation of +6.5 feet NGVD29. The actual equations for determining the breaker, H_b, and the elevation of the breaker, H'_b, are complex. However, the Shore Protection Manual and Coastal Engineering Manual contain graphs that will determine solutions based upon the identified maximum variables. For the purpose of this analysis, a graphical solution will be used. The graph is found on page 7-10 of the Shore Protection Manual, and is reproduced here as Figure 7 for the convenience of the reviewer.

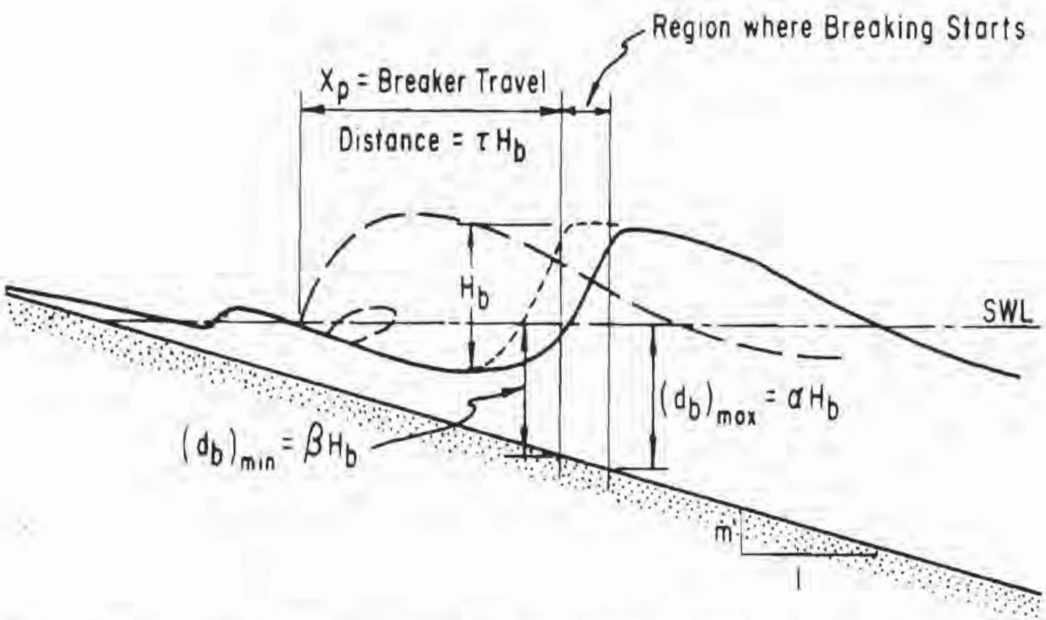

Figure 6. From US Army Corps Engineers Shore Protection Manual Chapter 7, page 7-5, Figure 7-1.

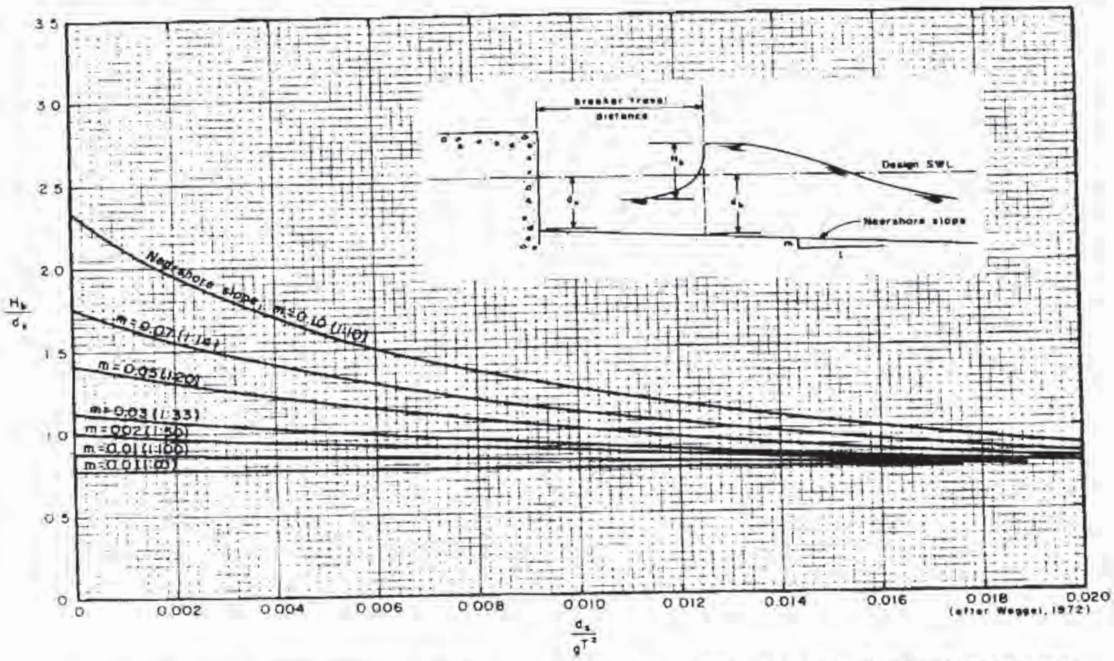

Figure 7-4. Dimensionless design breaker height versus relative depth at structure.

Figure 8. US Army Shore Protection Manual breaker height nomograph.

The maximum breaking wave that can occur at the access structure is when $d_s/(gT^2) = 0.0$. So for m=0.017, H_b/d_s = about 0.9. Therefore H_b= 6 feet. A review of Figure 6 reveals that the breaker height is not of equal distribution about the still water line. More of the height is above the still water line than below the still water line. A conservative estimate of the distribution would be that about 65 percent of the height is above the still water line. So, $H'_b = d_s + 0.65(H_b) = 10$ feet. The calculated maximum wave crest elevation at the revetment structure for the subject site is +10 feet NGVD29.

CONCLUSIONS

A. The shoreline fronting the site is relatively stable with a small erosion trend. However, the beach may erode back to both stairway access landings at the base of the bluff and erode to the toe of the revetment fronting the view platform. The USACOE 1994 has a 25-year recurrence horizontal erosion of 105 feet along this reach, and the typical beach width at the site is only 75 feet. This means the beach is lost back to the toe of the bluff typically every 20 years, or so. The 25-year recurrence vertical scour is 10 feet, which means that the beach can be scoured down to bedrock.

B. During extreme wave events, including tsunamis, coinciding with an extreme high tide wave runup can overtop the existing beach and the revetment and impact the access improvements.

RECOMMENDATIONS

Stairway Landings

A. Both of the stairway landings will be subject to wave runup as high as elevation +16 feet NGVD29. The base of the landing should be founded a minimum of 18 inches into bedrock.

B. The stairway should encroach a minimum distance onto the beach, seaward of the bluff toe. The stairway should be oriented so that wave runup cannot directly travel up the stairs.

C. The stairway landing should be reinforced with epoxy coated steel with at least 4 inches of concrete cover. The concrete should have a water cement ratio of 0.5.

Viewing Platform

A. The lowest horizontal structural member of the viewing platform should be above elevation +11 feet NGVD29.

B. The 36 inch piles will need to be founded into bedrock per the geotechnical engineers recommendations. The piles and view platform should be reinforced with epoxy coated steel with at least 4 inches of concrete cover. The concrete should have a water cement ratio of 0.5.

In closing, the subject public access improvements are reasonably safe from coastal hazards provided the recommendations contained in this study are properly implemented. Final plans for the development should be reviewed by this office for conformance with the recommendations of this report.

LIMITATIONS

Coastal engineering is characterized by uncertainty. Professional judgements presented herein are based partly on our evaluation of the technical information gathered, partly on our understanding of the proposed construction, and partly on our general experience. Our engineering work and judgements have been prepared in accordance with current accepted standards of engineering practice; we do not guarantee the performance of the project in any respect. This warranty is in lieu of all other warranties expressed or implied.

Respectfully Submitted,

REGISTERED PROFESSIONAL ENGINEER
DAVID W. SKELLY
No. C 47857
Exp. 12/31/07
CIVIL
STATE OF CALIFORNIA

GeoSoils Inc
David W. Skelly, MS
RCE #47857

REFERENCES

Coastal Construction Manual, 2000 FEMA (Federal Emergency Management Agency) Ref # FEMA-55

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USACOE, 1994, Reconnaissance Report, Malibu/Los Angeles County Coastline, Los Angeles County, California

Project-Specific Reference #14

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December 5, 2013 WO S5495

Mountains Recreation & Conservation Authority
Ramirez Canyon Park
5810 Ramirez Canyon Road
Malibu, California 90265

SUBJECT: Update for Coastal Hazard & Wave Runup Study for Beach Access Improvements Lechuza Beach, Malibu, California, and Responses to City Comments.

REFERENCES: "Coastal Hazard & Wave Runup Study for Beach Access Improvements Lechuza Beach, Malibu, California," dated August 3, 2007, by Geosoils Inc.

"Geotechnical Investigation Final Report, Lechuza Beach Public Access Improvements Project, Malibu, California," dated December 6, 2013, prepared by AMEC Environment & Infrastructure, Inc.

Dear Sirs:

At your request, GeoSoils, Inc (GSI) is pleased to provide this coastal hazard study update letter and responses to City review comments for the proposed beach access improvements at Lechuza Beach in Malibu. This update is provided based upon our review of the above referenced AMEC report and the latest project plans (referenced at the end of this update). Unless specifically superceded herein, all of the conclusions and recommendations of the above referenced Coastal Hazard & Wave Runup Study remain valid and pertinent.

The Mountains Recreation and Conservation Authority (MRCA) project proposes beach access improvements at the east end and west end of Lechuza Beach, including reconstruction of existing stairways at both ends, disabled parking at both ends, reconstruction of an existing view platform at the west end, new view platform at the east end, and a restroom/septic holding tank/walkway option at the east beach. The project plans proposed by the Mountains Recreation and Conservation Authority (MRCA) have changed over the years due to input from interested parties and regulatory agencies. This letter updates the GSI referenced 2007 report and addresses the currently proposed plans. The 2007 report and this letter constitute the updated assessment for the currently proposed project. GeoSoils, Inc. has reviewed the most recent project plans for both improvement locations. Several project elements have not changed in any significant way since the originally proposed project contemplated in the 2007 report. GeoSoils, Inc. recommendations for those project elements remain the same. Those project elements which have not changed in any significant way are the following:

EAST SEA LEVEL DRIVE TERMINUS-NO PROJECT CHANGES
-reconstruction of the existing stairs and pathway (along Lot I) from Broad Beach Road (at the intersection at Bunnie Lane) to the intersection with the western terminus of East Sea Level Drive. (The stairs that reach the sand are addressed below, where project changes are discussed.)

WEST SEA LEVEL DRIVE TERMINUS-NO PROJECT CHANGES
-reconstruction of the existing view platform;
-reconstruction of the existing stairs to the beach.

The following project elements have changed since the 2007 report:

EAST SEA LEVEL DRIVE TERMINUS-PROJECT CHANGES
-new restroom, septic holding tank, public staging area, and walkway connecting the restroom and septic tank;
-view platform location has changed (relocated landward);
-beach stairs location has changed (relocated slightly seaward);
-parking space along East Sea Level Drive locations have changed.

WEST SEA LEVEL DRIVE TERMINUS-PROJECT CHANGES
-new parking spaces D and DD.

These project changes noted above are in conformance with the recommendations in the 2007 report. No additional analysis or recommendations are necessary.

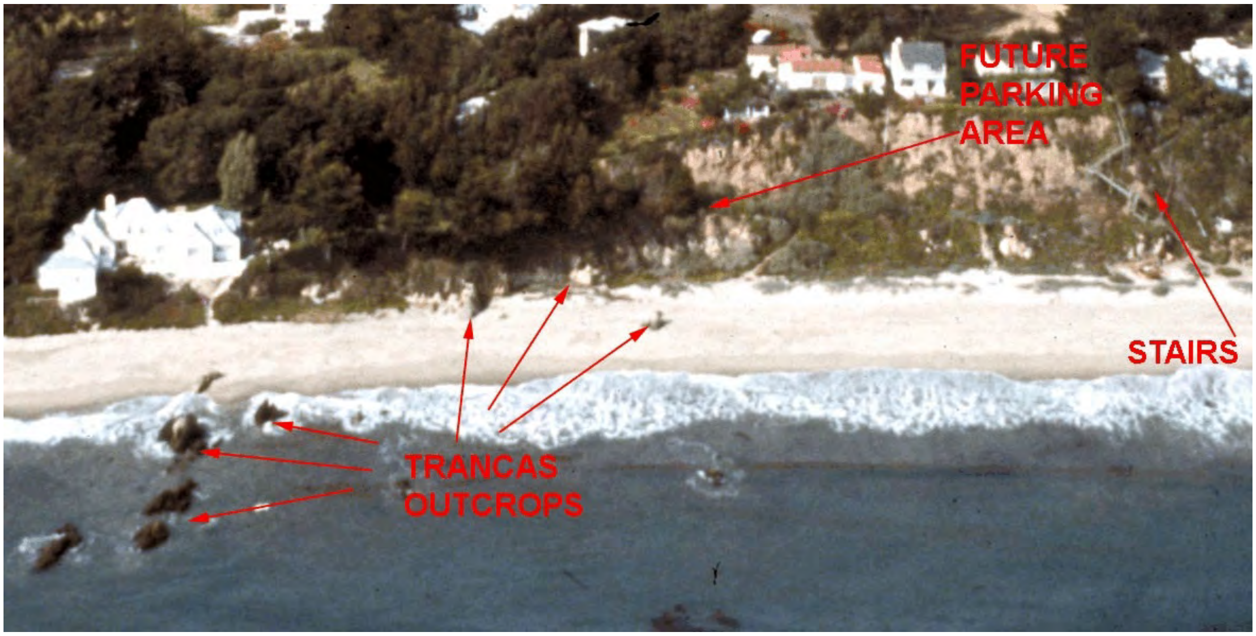
CITY OF MALIBU ADDITIONAL COMMENTS

1. The West Sea Level Drive terminus project changes include new parking spaces D and DD: At the request of City staff, MRCA commissioned AMEC Environment and Infrastructure to prepare a slope stability analysis for the proposed parking spaces D and DD at the terminus of West Sea Level Drive. MRCA submitted a draft to the City, incorporated the City's comments, then submitted a final. Christopher Dean's (City engineering geologist's) outstanding comment #1 on the Geotechnical Review Sheet (signed 6/20/13) for the slope stability analysis is: "Since the parking spaces are set back only 7 feet and 9 feet from the top of the coastal bluff, an estimate of the 100 year bluff retreat is required as per Chapter 10.4(D) of the City's LIP. Show the estimated bluff retreat line on the Site plan."

The long term bluff retreat at this location can be estimated by a review of historical aerial photographs. The City's LIP requires the determination of the 100 year bluff retreat based upon a typical expected life of 100 years for new bluff top development. It should be noted the expected life of public access improvements and public beach restrooms is typically only about 25 years. The bluff at the location of the proposed parking is composed of three geologic layers. The top two layers are about 10 feet thick and are Quaternary Terrace deposits with differing sand and clay composition. The bottom layer, from about elevation

+24 feet down, is a very erosion resistant bedrock known as Trancas Formation. There are two primary sources of water that cause the erosion of the bluff. The first source is wave action on the lower bedrock and the second is surface water runoff over the upper terrace deposits.

The erosion rate of the Trancas bedrock at the site can be estimated by looking at historical photographs of the site. Photograph 1 is an aerial photograph of the site and adjacent shoreline taken in 1972 downloaded with permission from the California Coastal Records Project web site (http://www.californiacoastline.org/). Photograph 2 is an aerial photograph of the site and adjacent shoreline taken in September 2013 downloaded from the same website. These photographs are taken 41 years apart and show the same section of shoreline. Visual comparison of bedrock outcrops and other features on the bluff face in the two photographs such as stairs confirm that very little if any erosion of the bedrock formation has occurred over the last 41 years. Even the bedrock outcrops show very little erosion or change between the photographs and unlike the base of the bluff these bedrock features are impacted by water and waves on a daily basis. The back of the beach, which is the base of the bluff, is only subject to water and wave action a few times a year. A conservative estimate of the erosion of the bedrock material over the 41 year period would be about 2 feet. This would translate into a retreat of the bedrock of about 5 feet over the 100 period required in the Malibu LCP-LIP. Comparing the photographs shows very little change in the bluff top over the 41 year period. The presence of vegetation does obscure the actual bluff top. Based upon our review of the proposed parking spaces and the site drainage in general, the project eliminates the flow of water over the bluff at the site. Provided site drainage is maintained the bluff top should retreat about 5 feet over the next 100 years.



Photograph 1. Parking area, adjacent shoreline, and features in 1972.

Photograph 2. Parking area, adjacent shoreline, and features in 2013.

2. East Sea Level Drive terminus project changes are a new restroom, and septic holding tank. Mr. Craig George, Environmental Sustainability Manager, made the following comments regarding the proposed septic holding tank near the terminus of East Sea Level Drive. "Is the holding tank adequately protected from tidal influences such as wave up-rush? The City has codified the requirement to protect any septic system, including septic tanks, from wave uprush. This can be achieved by a seawall or revetment or by placement of the tank out of the scour zone. Has a coastal engineer not been consulted? It must be demonstrated by a report the tank is adequately protected. We will need confirmation of this, and not simply an expectation."

The holding tank would be located behind (landward) of the existing rip-rap that is used to protect East Sea Level Drive. The existing revetment is still functioning; the road is still there. Our wave runup analysis shows that the revetment in its current condition will not be overtopped. Wave run-up will not reach the holding tank due to the protection provided by the existing rip-rap. No additional shoreline protection is anticipated to be needed to protect the tank.

In addition, a new underground wall is not necessary surrounding the septic tank. The holding tank would be anchored into bedrock. It is unlikely over the life of the project that it will be subject to wave run-up. The tank will be below grade behind an existing revetment, with only the porthole on top, which can withstand any spray and splash. If there is extreme wave runup, it is expected that the tank would be adequately protected because of its location behind the shore protection and below grade.

CONCLUSIONS AND RECOMMENDATIONS

It is GSI's opinion that the project as currently proposed is in conformance with Malibu LCP Chapter 9 Section 9.3 and Chapter 10 Section 10.3. The proposed beach access improvements at the east end and west end of Lechuza beach are in significant conformance with our Coastal Hazard & Wave Runup Study. This includes reconstruction of existing stairways at both ends, disabled parking at both ends, reconstruction of an existing view platform at the west end, new view platform at the east end, and a restroom/septic holding tank/walkway option at the east beach. In addition, GSI would like to certify* the proposed access improvements will neither create nor contribute significantly to erosion, geologic instability, or destruction of the sites, or adjacent areas. There are <u>no</u> recommendations necessary for additional wave runup protection.

We appreciate this opportunity to be of service. Should you have any questions, please do not hesitate to contact the undersigned at (760) 438-3155.

Respectfully submitted,

GeoSoils, Inc.
David W. Skelly MS, PE

***** The term "certify" is used herein as defined in Division 3, Chapter 7, Article 3, section 6735.5 of the California Business and Professions Code.

PLAN REFERENCES

East Sea Level 8, 11, Lechuza Beach Public Access Improvements, dated 5/31/13.

East Sea Level Drive Restroom Option #2, Lechuza Beach, dated 5/21/13, prepared by URS.

Lot I Stairs Exhibit (Sheet 1 of 2), Lechuza Beach, dated 5/21/13, prepared by URS.

Lot I Stairs Exhibit (Sheet 2 of 2), Lechuza Beach, dated 5/21/13, prepared by URS.

West Sea Level Option AA, Lechuza Beach, dated 5/21/13, prepared by URS.

West Sea Level D, DD, Lechuza Beach Public Access Improvements, dated 9/11/13.

Project-Specific Reference #15

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August 10, 2016 WO S5495

Mountains Recreation & Conservation Authority
Ramirez Canyon Park
5810 Ramirez Canyon Road
Malibu, California 90265

SUBJECT: Second Update, Coastal Hazard & Wave Runup Study for Beach Access Improvements Lechuza Beach, Malibu, California, and Responses to City Comments.

REFERENCES: "Coastal Hazard & Wave Runup Study for Beach Access Improvements Lechuza Beach, Malibu, California," dated August 3, 2007, by Geosoils Inc.

"Geotechnical Investigation Final Report, Lechuza Beach Public Access Improvements Project, Malibu, California," dated December 6, 2013, prepared by AMEC Environment & Infrastructure, Inc.

"Update for Coastal Hazard & Wave Runup Study for Beach Access Improvements Lechuza Beach, Malibu, California, and Responses to City Comments," dated December 5, 2013,by GeoSoils Inc.

Supporting Geotechnical Report, Proposed Advanced On-Site Wastewater Treatment System (AOWTS) APN 4470-021-009, Vicinity: 31725-31721 East Sea Level Drive, Malibu, CA, dated March 18, 2016, prepared by Earth Systems Southern California.

Plot Plan, Lechuza Beach AOWTS, 31725.5 East Sea Level Drive, Malibu California, prepared by Advanced OnsiteWater, dated August 9, 2016.

Dear Sirs:

At your request, GeoSoils, Inc (GSI) is pleased to provide this coastal hazard study update letter and response to City of Malibu review comments for the proposed beach access improvements at Lechuza Beach in Malibu. This second update is provided based upon our review of the above referenced reports and the latest project plans. Unless specifically superceded herein, all of the conclusions and recommendations of the above referenced Coastal Hazard & Wave Runup Study, and December 2013 update report, remain valid and pertinent.

BACKGROUND

The Mountains Recreation and Conservation Authority (MRCA) project proposes beach access improvements at the east end and west end of Lechuza Beach, including reconstruction of existing stairways at both ends, disabled parking at both ends, reconstruction of an existing view platform at the west end, new view platform at the east end, new leach field, and a restroom/treatment tank/walkway option at the east beach. The project plans proposed by the Mountains Recreation and Conservation Authority (MRCA) have changed over the years due to input from interested parties and regulatory agencies. This letter updates the GSI referenced 2007 and 2013 reports, and addresses the currently proposed plans. The 2013 report and this letter constitute the updated assessment for the currently proposed project. GeoSoils, Inc. has reviewed the most recent project plans for both improvement locations. Several project elements have not changed in any significant way since the originally proposed project contemplated in the 2007 report. The GSI recommendations for those project elements remain the same.

PROJECT CHANGES SINCE 12/5/2013 COASTAL ENGINEERING REPORT

EAST SEA LEVEL DRIVE TERMINUS – PREVIOUSLY PROPOSED
-new restroom
-new septic holding tank
-new public staging area
-walkway connecting restroom and septic tank
-new view platform
-relocated beach stairs
-new accessible parking spaces 8, 11 along East Sea Level Drive

EAST SEA LEVEL DRIVE TERMINUS – PROJECT CHANGES
-for new restroom, restroom slab raised slightly in elevation (septic line slope changed from 1% to 1½%); urinal replaced with sink
-septic holding tank deleted; new advanced onsite wastewater treatment system (AOWTS) tank; new protection wall around treatment tank
-new leachfield overlapping grasscrete area at terminus of East Sea Level Drive
-public staging area deleted; now called public viewing area
- view platform deleted
-notes added and updated
-relocated beach stairs- NO CHANGE
-new accessible parking spaces 8, 11 along East Sea Level Drive-NO CHANGE

WEST SEA LEVEL DRIVE TERMINUS – PREVIOUSLY PROPOSED
-reconstruction of existing view platform
-reconstruction of existing stairs
-new accessible parking spaces D and DD

WEST SEA LEVEL DRIVE TERMINUS – PROJECT CHANGES
-for reconstruction of existing view platform: cross section/notes added to clarify caisson for concrete landing for stairs on sand to be embedded into bedrock; piles/foundations notes added
-for reconstruction of existing stairs: clarification notes added for stairs materials
-for new parking spaces D and DD: install fence segment near parking spaces

The project changes noted above, with the exception of the new leach field behind the existing revetment, are in conformance with the recommendations in the 2007 and 2013 reports. No additional analysis or recommendations are necessary for those changes. However, a wave runup analysis on the existing revetment shore protection needs to be performed to determine if it is adequate to protect the proposed leach field.

WAVE RUNUP AND OVERTOPPING ANALYSIS

As waves encounter the shore protection at the East Sea Level Drive street end, the waves can rush up the rocks, and sometimes into the area of the proposed leach field. The existing shore protection may have, in the past, been subject to overtopping. However, the site drainage is likely capable of conveying these waters back into the ocean. 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. Overtopping is the flow rate of water over the top of a finite height structure (the revetment) as a result of wave runup.

Wave runup and overtopping on the existing shore protection is calculated using the US Army Corps of Engineers Automated Coastal Engineering System, ACES. The methods to calculate runup and overtopping implemented within this ACES application are discussed in greater detail in the Coastal Engineering Manual.

Wave runup analysis assumes that the structure slope the wave is running up is higher than the actual wave runup elevation. When the slope is lower that the wave runup elevation, the wave runup becomes wave overtopping. At the location of the proposed leach field, the revetment is at about elevation +20 feet NGVD29. The wave runup analysis on the revetment rock uses a "rough slope" methodology.

Based upon the boring data in the referenced 2016 Earth Systems Southern California report, the maximum scour at the revetment is about elevation -1.0 feet NGVD29. The historical highest water in Santa Monic Bay is +5.8 feet NGVD29. The "design life" of a public restroom and AOWTS is 25 to 50 years. The California Coastal Commission (CCC) predicted sea level rise (SLR) range in the year 2050 is 5 - 24 inches. The wave runup design water elevation will be 5.8 feet NGVD29 plus 1.2 feet of SLR or 7.0 feet NGVD29. The design wave will break at the revetment toe when the ratio of the breaker height to water depth is 0.78. Therefore, the design wave height is 6.24 feet (0.78X[7.0-(-1.0)]). The wave period is 16 seconds, which is typical of wave period for extreme wave events in the area (California Coastal Data Information Program [CDIP]). **TABLE I** contains the ACES output for the analysis.

TABLE I

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	6.240
Wave Period	T:	sec	16.000
COTAN of Nearshore Slope	COT(ø):		60.000
Water Depth at Structure Toe	ds:	ft	8.000
COTAN of Structure Slope	COT(θ):		1.500
Structure Height Above Toe	hs:	ft	21.000
Rough Slope Coefficient	a:		0.956
Rough Slope Coefficient	b:		0.398
Wave Runup	R:	ft	11.895
Onshore Wind Velocity	U:	ft/sec	0.000
Deepwater Wave Height	H0:	ft	3.868
Relative Height	ds/H0:		2.068
Wave Steepness	H0/(gT^2):		0.000470
Overtopping Coefficient	α:		0.060000
Overtopping Coefficient	Qstar0:		0.150000
Overtopping Rate	Q:	ft^3/s-ft	0.000

Rough Slope Runup and Overtopping

Lechuza East Sea Level Dr.

Leach Field Overtopping

1.2 feet SLR

The maximum wave runup elevation for the design wave condition over the design life of the project is +18.9 feet NGVD29 (11.895 feet + 7 feet NGVD29). This is below the top of the revetment at elevation +19.35 feet NGVD29. Based upon the wave runup analysis the proposed leach field, protected by the existing quarry stone revetment, is safe from inundation by wave runup.

CITY OF MALIBU ADDITIONAL COMMENTS

The following are response to the City of Malibu January 30, 2014 coastal engineering review comments. For ease of consideration by the reviewer, the comment will be provided in italics followed by our response.

Planning Stage Review Comments:

1. Based on the anticipated beach erosion estimates provided by GeoSoils, the "assumed sand fill" supporting the beach access stairs and providing soil cover for the wastewater tank appears to be susceptible to erosion to the bedrock surface. Sections B and C (URS, East Sea Level Drive Restroom Option #2) and any other applicable section should reflect the anticipated eroded beach profile as recommended by the Project Coastal Engineer.

The project has been changed to eliminate the susceptibility of the tank and stairs. The treatment tank is now proposed to be surrounded by a concrete protection wall on all four sides, bottom, and top (with riser lids and access for treatment tank maintenance). This structure is founded in bedrock on concrete piles. The stairs are founded in bedrock on concrete piles.

2. The limits of the revetment necessary for protection of the septic holding tank referenced by GeoSoils (12-5-2013) should be shown on the project plans. Based on the plan *provided, it appears the revetment only extends about 16 feet west of East Sea Level Drive. This appears to leave the septic holding tank potentially exposed to direction wave runup from the south to west directions.*

A septic holding tank is no longer being proposed. A treatment tank is proposed instead. The treatment tank is now proposed to be surrounded by a concrete protection wall on all four sides, bottom, and top (with riser lids and access for treatment tank maintenance). This structure is founded in bedrock on concrete piles.

3. If the revetment does not extend far enough west to provide adequate protection for the tank and piping against direct and flanking wave action, please provide alternative shore protection recommendations so that the tank and associated piping will not be exposed under the anticipated beach erosion conditions.

The treatment tank is now proposed to be surrounded by a concrete protection wall on all four sides. The structure is supported on concrete piles that are founded into bedrock. The potential for piping to impact the tank is mitigated thru the design. The field is adequately protected.

CONCLUSIONS AND RECOMMENDATIONS

It is GSI's opinion that the project as currently proposed is in conformance with Malibu LCP Chapter 9 Section 9.3 and Chapter 10 Section 10.3. The proposed beach access improvements at the east end and west end of Lechuza beach are in significant conformance with our Coastal Hazard & Wave Runup Study and updates. This includes reconstruction of existing stairways at both ends, disabled parking at both ends, reconstruction of an existing view platform at the west end, new view platform at the east end, the leach field, and a restroom/treatment tank/walkway option at the east beach. In addition, GSI would like to certify* the proposed access improvements will neither create nor contribute significantly to erosion, geologic instability, or destruction of the sites, or adjacent areas. There are <u>no</u> recommendations necessary for additional wave runup protection.

We appreciate this opportunity to be of service. Should you have any questions, please do not hesitate to contact the undersigned at (760) 438-3155.

Respectfully submitted,

GeoSoils, Inc.
David W. Skelly MS, PE

***** The term "certify" is used herein as defined in Division 3, Chapter 7, Article 3, section 6735.5 of the California Business and Professions Code.

ADDITIONAL REFERENCES

East Sea Level 8, 11, Lechuza Beach Public Access Improvements, dated 8/9/16.

East Sea Level Drive Restroom Option A, Lechuza Beach, dated 8/2/16, prepared by URS.

Lot I Stairs Exhibit (Sheet 1 of 2), Lechuza Beach, dated 5/21/13, prepared by URS.

Lot I Stairs Exhibit (Sheet 2 of 2), Lechuza Beach, dated 5/21/13, prepared by URS.

West Sea Level, Lechuza Beach, dated 8/9/16, prepared by URS.

West Sea Level D, DD, Lechuza Beach Public Access Improvements, dated 8/9/16.

Project-Specific Reference #16

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November 9, 2016 WO S5495

Mountains Recreation & Conservation Authority
Ramirez Canyon Park
5810 Ramirez Canyon Road
Malibu, California 90265

ATTENTION: Ms. Judi Tamasi

SUBJECT: City of Malibu Coastal Engineering Review Response 31720.5 Broad Beach Road, for Beach Access Improvements Lechuza Beach, Malibu, California, CDP 07-087.

REFERENCES: "Coastal Hazard & Wave Runup Study for Beach Access Improvements Lechuza Beach, Malibu, California," dated August 3, 2007, by Geosoils Inc.

"Update for Coastal Hazard & Wave Runup Study for Beach Access Improvements Lechuza Beach, Malibu, California, and Responses to City Comments," dated December 5, 2013,by GeoSoils Inc.

"Second Update for Coastal Hazard & Wave Runup Study for Beach Access Improvements Lechuza Beach, Malibu, California, and Responses to City Comments," dated August 10, 2016,by GeoSoils Inc.

Supporting Geotechnical Report, Proposed Advanced On-Site Wastewater Treatment System (AOWTS) APN 4470-021-009, Vicinity: 31725-31721 East Sea Level Drive, Malibu, CA, dated March 18, 2016, prepared by Earth Systems Southern California.

Plot Plan, Lechuza Beach AOWTS, 31725.5 East Sea Level Drive, Malibu California, prepared by Advanced OnsiteWater, dated November 8, 2016.

"East Sea Level Drive Restroom Option A, Lechuza Beach, prepared by URS, dated August 2, 2106 (Revised October 26, 2016)"

Dear Sirs:

At your request, GeoSoils, Inc. (GSI) is pleased to provide this response to City of Malibu review comments for the proposed beach access improvements at Lechuza Beach in Malibu. Unless specifically superceded herein, all of the conclusions and recommendations of the all of the above referenced GSI reports remain valid and pertinent. For ease of review, we are providing the City comment in **bold** lettering followed by our response. Additional GSI comments and conclusions follow the responses.

Planning Stage Review Comments:

1. The Consultant should provide a site-specific design beach profile (or profiles) to address the various project elements, and include the items consistent with Section 4.3.2 of the City's guidelines for coastal engineering reports (2014).

The attached 11" X 17" profile is the existing revetment which will protect the proposed leach field. It also provides a "design beach profile" without the revetment in place. The section provides the necessary project elements to determine if the proposed field and other proposed improvements are safe from coastal hazards. The proposed restroom and access stairs are located at the back beach and the proposed caissons are to be founded into the existing bedrock. The design beach profile (depicted on the attached 11" X 17" profile) for these improvements is basically the slope as shown on the topographic maps, and as used in the August 2007 wave runup input data. It is GSI's professional judgement that the only necessary coastal engineering information is the potential wave loading on the improvements. This will be provided in this review response.

2. In the recent report (GSI, 2016), the Consultant indicates the existing rock revetment slope is ½ (aka 2:1 gradient, horizontal to vertical) and that value is used in the ACES analysis (COTAN of structure slope = 2.0). In their 2007 report, the Consultant indicated that the rock revetment slope was 1.5:1 gradient and that value was used in the ACES analysis (COTAN of structure slope = 1.5). Direct measurement from the topography suggests the rock revetment slope is approximately 1:1 gradient and it is depicted as a 1:1 slope on the recently provided geologic cross section (Earth Systems, 2016). Please clarify this discrepancy regarding the revetment slope and provide revised wave runup and overtopping analyses as appropriate.

The GSI 2016 ACES analysis has the COTAN of the rock slope as 1.5 and the 2007 ACES analysis has the COTAN of the rock slope as 2 (reviewer has these slopes backwards). The 2007 report was prepared for the proposed viewing platform at the terminus of East Sea Level Drive, and not for the proposed leach field behind the revetement to the east of the terminus. The terminus of the revetment had a measured/observed flatter slope at the time of the analysis. As the reviewer understands, revetments are mobile structures, which move over time resulting in changes to the structure slope. The reviewer has been provided the original design profile (1/1.5) for the revetment on an adjacent property from the coastal development permit (email dated 9/23 to Mike Phipps and Ali Abdel-Haq). GSI has rerun the ACES overtopping calculation for a 1/1 slope and with a lower top of rock (+18.3 feet NGVD29) for discussion purposes. The following **Table** is the output for this revetment configuration.

Table

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	6.240
Wave Period	T:	sec	16.000
COTAN of Nearshore Slope	COT(ø):		60.000
Water Depth at Structure Toe	ds:	ft	8.000
COTAN of Structure Slope	COT(θ):		1.000
Structure Height Above Toe	hs:	ft	20.000
Rough Slope Coefficient	a:		0.956
Rough Slope Coefficient	b:		0.398
Wave Runup	R:	ft	12.774
Onshore Wind Velocity	U:	ft/sec	0.000
Deepwater Wave Height	H0:	ft	3.868
Relative Height	ds/H0:		2.068
Wave Steepness	H0/(gT^2):		0.000470
Overtopping Coefficient	α:		0.060000
Overtopping Coefficient	Qstar0:		0.150000
Overtopping Rate	Q:	ft^3/s-ft	0.032

Rough Slope Runup and Overtopping

Lechuza East
Sea Level Dr.

1/1 slope
TOR +18.35

The results show for a lower and steeper revetment some overtopping may occur. The impact of this overtopping on the proposed leach field will be discussed further in this review response.

3. In the 2007 report, the Consultant indicates that the top of the rock revetment is at about +19 feet NGVD, but analyzed overtopping using a top of revetment elevation of +18 feet NGVD. In the 2016 report, the Consultant stated that the top of the revetment is at about elevation +20 feet NGVD and analyzed overtopping based on this elevation. Please clarify these inconsistent statements and input parameters in the overtopping analysis, and rerun the analysis as appropriate.

Please see the response to comment 2 above. As the response shows, small changes in the structure slope and the height of the structure DO NOT result in significant differences in the results and conclusions of the analysis.

4. The revised overtopping analysis (GSI, 2016) indicates that no overtopping of the rock revetment will occur. In the 2007 report, the Consultant also concluded that the revetment at elevation +18 feet NGVD29 will not be overtopped, but stated: "…*direct observation verifies that the revetment may be subject to minor overtopping."* The reviewers assume that this conclusion, based on direct observation, is still valid. Based on Comments 2 and 3 above which may result in revised overtopping analysis

and updated conclusions, the Consultant should ultimately re-state their conclusions regarding the potential for overtopping of the existing revetment, and whether the proposed leach field located directly behind the revetment will be safe from overtopping-related erosion, and/or whether additional mitigation measures are necessary to protect the proposed leach field. When evaluating the impacts of any overtopping discharge, the Consultant should consider whether the proposed effluent barrier, to be located between the leach field and the revetment, will affect drainage.

The type and apparent function of improvements in the area would tend to imply that these improvements have been subject to overtopping in the past. The best example is the block walls, as shown in the photograph below. These walls are along the East Sea Level Drive right of way. It is GSI's experience that these may be to prevent wave overtopping from impacting site improvements.

We respectfully point out to the reviewer that the protection for the leach field is NOT solely the revetment. The end of East Sea Level Drive is required to have the capability for a fire truck to turn around. In order to accomplish this, a paver system is proposed to cover the area from the top of the revetment to the road. The anticipated load of the fire truck dictates a robust paver system. The paver system will also serve as protection of the field from any overtopping that may occur in the future. This type of paver-vegetation system has been successfully used to prevent overtopping water (both wave and flood) from impacting the soils behind a reinforced slope. These systems typically provide protection for velocities up to 25 feet/sec. For critical flow (~overtopping flow) the depth of this water is over 10 feet. The calculated water depth for the overtopping rate in the previous Table above is less than 1 foot. The potential for overtopping of the revetment, in the future, over the design life is small. In the event of overtopping in the future, the leach filed will not be impacted due to the presence of the paver system.

5. The "East Sea Level Drive-Restroom Option A" plan prepared by URS (Aug 2, 2016) shows an assumed bedrock elevation that is significantly higher than the depth of bedrock encountered in adjacent borings to the east (Earth Systems Southern California, 2016). Furthermore, the depth of "assumed bedrock" is inconsistent between Sections B and C, where they intersect. Based on the available data, it appears unlikely that the stair landing will encounter bedrock as shown on the cross-section. Additional geotechnical information appears necessary in this area.

This comment should be directed to the geotechnical consultant. It is our understanding that the stair landing will be founded on a pile that will be founded into bedrock.

6. The Project Coastal Engineer should provide recommendations, as appropriate, for hydrostatic and hydrodynamic loading on the foundation elements of the proposed project.

Due to the location of the restroom and access stairs at the back of the beach, and the pile supported design, it is GSI's professional judgement that the design wave force on both of the structures can conservatively be determined using FEMA methods.

The pile loads are taken from FEMA equation 8.5, provided below, using a depth limited design wave height of 5 feet (0.78X6.5 feet) at the structure and a 30-inch round pile.

EQUATION 8.5. BREAKING WAVE LOAD ON VERTICAL PILES

$$F_{brkp} = \frac{1}{2} C_{db} \gamma_w D H_b^{\,2} \qquad \text{(Eq. 8.5)}$$

where:

F_{brkp} = drag force (lb) acting at the stillwater elevation

C_{db} = breaking wave drag coefficient (recommended values are 2.25 for square and rectangular piles and 1.75 for round piles)

γ_w = specific weight of water (62.4 lb/ft³ for fresh water and 64.0 lb/ft³ for saltwater)

D = pile diameter (ft) for a round pile or 1.4 times the width of the pile or column for a square pile (ft)

H_b = breaking wave height (0.78 d_s), in ft, where d_s = design stillwater flood depth (ft)

F = 1/2(1.75)(64)(2.5)(5)(5) = 3,500 lb acting at the still water elevation of 7 feet NGVD29.

The relationship between the diameter of the pile and the wave force are linear and provided in the equation.

7. All project plans shall include notes indicating that the existing and proposed grades, and all elevations shown, are based upon the NGVD29 vertical datum.

Comment noted and directed to project designer.

8. The long term safety and stability of the proposed leach field will rely on the existing rock revetment for shore protection. The applicant shall submit information identifying what party (or parties) own(s) the existing rock revetment, and who will be responsible for its maintenance in the future. If the rock revetment is on MRCA property, then a shoreline protection device monitoring program shall be submitted by the Project Coastal Engineer, and a covenant and agreement regarding maintenance of the shoreline protection device shall be recorded by MRCA. If the rock revetment is on MEHOA and/or other private property, then MRCA shall record an "Assumption of Risk, Release, Indemnification and Hold Harmless Agreement for Hazards Related to Development Utilizing an Offsite Shoreline Protection Device(s) on a Beach or on a Bluff". Available information suggests that the rock revetment is jointly owned, and in such case, an agreement should be drafted and recorded identifying which party(ies) will be responsible for implementation of the shoreline protection device monitoring program, and which party will be responsible for restoring, repairing, or redesigning new shore protection, should the existing shore protection on either property be damaged or removed.

Comment noted and directed to the applicant.

9. Please submit information regarding the design and construction of the existing rock revetment, if available.

Information will be provided by the applicant.

THIRD PARTY ANALYSIS

A current tool for site hazard determination (used by the California Coastal Commission) is the USGS model called the Coastal Storm Modeling System (CoSMoS) for assessment of the vulnerability of coastal areas to SLR & the 100-year storm, http://walrus.wr.usgs.gov/coastal_processes/cosmos/. The modeling assumes that the shoreline can move (based upon historical trends). Using the most current refined modeling program, the vulnerability of the site and proposed restroom, beach access, and leach field to four different SLR scenarios and the 100-year storm can be assessed. The model flow chart is shows the variables that are involved in the calculations. The model output includes wave runup, flooding, and shoreline erosion. The program provides information on a 1-meter grid scale. The output of the CoSMoS provides an additional validation of the conclusions and recommendations of the GSI report. The following figure is the output for the CoSMoS for the East Sea Level Drive site. It should be noted that even under 200-cm (6.5 feet) of SLR the proposed development (restroom, stairs and leach field) are not in the flooding or inundation zone. The 50-cm to 200-sm SLR induration and flood zones are seaward of the proposed development. It should also be noted that the area to the east of the project is more vulnerable based upon CoSMoS.

CONCLUSIONS AND RECOMMENDATIONS

It is GSI's opinion that the project as currently proposed, is in conformance with Malibu LCP Chapter 9 Section 9.3 and Chapter 10 Section 10.3. The proposed beach access improvements at the east end and west end of Lechuza Beach are in significant conformance with our Coastal Hazard & Wave Runup Study and updates. This includes reconstruction of existing stairways at both ends, disabled parking at both ends, reconstruction of an existing view platform at the west end, new view platform at the east end, the leach field, and a restroom/treatment tank/walkway option at the east beach. In addition, GSI would like to certify*, for a second time, that the proposed access improvements will neither create nor contribute significantly to erosion, geologic instability, or destruction of the sites, or adjacent areas. There are <u>no</u> recommendations necessary for additional wave runup protection.

***** The term "certify" is used herein as defined in Division 3, Chapter 7, Article 3, section 6735.5 of the California Business and Professions Code.

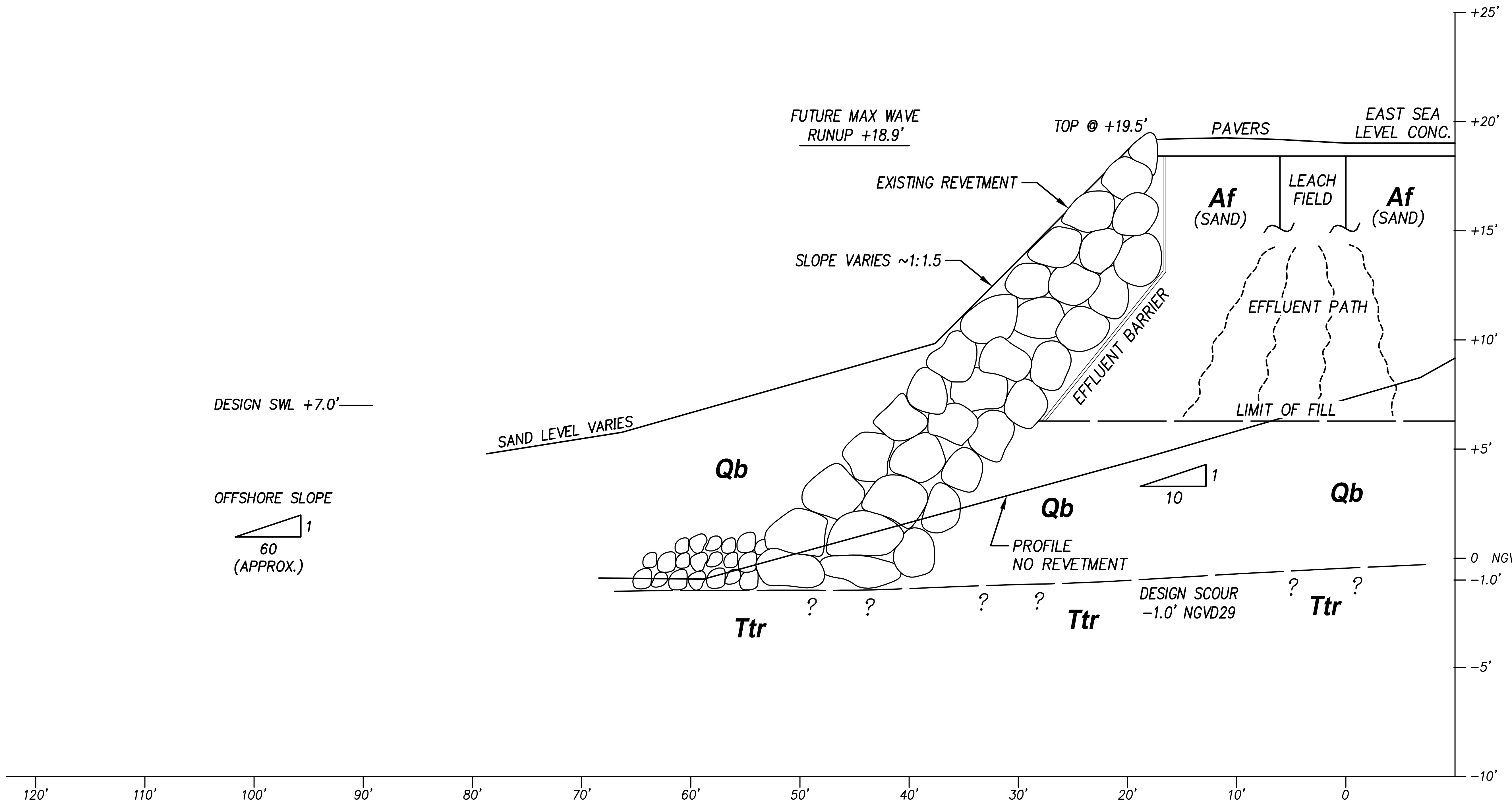
We appreciate this opportunity to be of service. Should you have any questions, please do not hesitate to contact the undersigned at (760) 438-3155.

Respectfully submitted,

GeoSoils, Inc.
David W. Skelly MS, PE

East Sea Level Improvements

Mountains Recreation & Conservation Authority
5810 Ramirez Canyon Rd., Malibu, CA 90265



GRAPHIC SCALES (AS SHOWN)
HORIZONTAL: 1" = 10'
VERTICAL: 1" = 5'

REVISIONS	BY

DRAFTING BY: SCHMAHL DRAFTING
DAVE SCHMAHL (760)484-8966

REGISTERED PROFESSIONAL ENGINEER
DAVID W. SKELLY
No. C 47857
EXP. 12/31/17
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STATE OF CALIFORNIA

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5741 Palmer Way, Carlsbad, CA 92010
760-438-3155

W.O. S5495-SC

TITLE: Mountains Recreation and Conservation Authority
5810 Ramirez Canyon Rd., Malibu, CA 90265

CLIENT:

DRAWN
CHECKED
DATE 09/21/16
SCALE
JOB NO.
SHEET
DBP1
OF 1 SHEETS

Project-Specific Reference #17

August 9, 2016

Ms. Stephanie Hawner
City of Malibu Planning Department
23825 Stuart Ranch Road
Malibu, CA 90265

Subject: Proposed Lechuza Beach AOWTS, End of East Sea Level Drive, Malibu, CA. Coastal Development (Coastal Development Permit App. No. 07-087, 31725.5 Broad Beach Road, Los Angeles County Waterworks District 29 references project restroom address as 31725.5 East Sea Level Drive)

Dear Ms. Hawner:

On behalf of the Mountain Recreation and Conservation Authority (MRCA), Advanced Onsite Water has prepared this Engineering Report for Conformance Review of an advanced onsite wastewater treatment system (AOWTS) to treat and dispose of wastewater generated by a single proposed restroom next to the beach. The purpose of the restroom is to provide sanitation to a public beach under MRCA's administration. The MRCA property is narrow with a steep side slope connecting the beach to Broad Beach Road to the north. The stairway that provides access will be extended at the beach end to include a walking platform with room for public viewing and a single restroom. The estimated peak visitorship is 200 people in a day. The estimated wastewater generated is 554 gpd. The AOWTS would be located within a poured-in-place concrete vault below the viewing platform. The proposed treatment technology is a BioMicrobics BioBarrier 1.0-N. The proposed absorption bed comprises two infiltrator chambers within an easement area at the end of East Sea Level Drive.

This submittal is for conformance review only. A number of supporting engineering efforts are needed to take this project to plan check, such as the design and construction drawings for the structural aspects of the viewing platform and associated stairs and restroom. These features will be designed in earnest once the conformance review for the wastewater system has been approved in concept and allowed to proceed to plan check.

For more information, please contact me directly at barbara.bradley@advancedonsitewater.com, 760-743-8777 (direct), or 760-500-2849 (cell).

Sincerely,

Advanced Onsite Water

Barbara Bradley

Barbara Bradley, PE

Attachment: Conformance Review Engineering Report

Copies: Judi Tamasi/MRCA, David Skelly/GeoSoils, Blake Eckerle/AECOM

PROPOSED ADVANCED ONSITE WASTEWATER TREATMENT SYSTEM FOR LECHUZA BEACH

Project Description

The Mountain Recreation and Conservation Authority (MRCA) proposes to upgrade facilities at Lechuza Beach at the end of Sea Level Drive and south of Broad Beach Road. The facilities include extending the stairs and providing a viewing deck with a restroom. The restroom will have one toilet and one washbasin. An advanced onsite wastewater treatment system (AOWTS) is needed to treat and dispose of wastewater generated by a proposed restroom next to the beach. The purpose of the restroom is to provide sanitation to a public beach under MRCA's administration. Access to Lechuza Beach is via a steep narrow slope connecting the beach to Broad Beach Road. Additional accesses to the beach are along East Sea Level Drove and West Sea Level Drive. The AOWTS would be located within a poured-in-place concrete vault below the viewing platform. A conceptual plan of the structural improvements is attached. The attached plan was based on a holding tank concept. The plan will be updated pending conformance review acceptance of the AOWTS.

Wastewater Flow and Quality

The wastewater flow rate was based on visitorship using MRCA's experience of current visitorship and projected changes. The maximum design population is 200 visitors per day. Table 1 provides the flow rate estimate. The restroom usage per person uses a factor of 1.25 for toilet usage. Because not all users wash the hands afterward, that factor was not applied to wash basin usage.

Table 1. Estimated Peak Wastewater Generation from Restroom

Peak Visitorship per day	*Restroom Usage per Person/Day*	*Toilet Flush Rate, gpf*	*Toilet Wastewater, gpd*	*Wash Basin, gpm*	*Washing Duration, min.*	*Wash Basin Wastewater, gpd*	*Total Gallons per Day*
200	1.25	1.6	400	0.77	1.00	154	554

Table 2 provides an estimate of the pollutant loading. The high biochemical oxygen demand (BOD) and total suspended solids (TSS) loading rates reflect the use of low flow fixtures and the lack of dilution from other sources. The BOD and TSS loading rates are both estimated at 2.2 lb./day.

Table 2. Pollutant Loading Estimate

Population	*Source*	*Flow, gpd*	*BOD Concentration, mg/L*	*TSS Concentration, mg/L*	*Ammonia, mg/L*	*TKN Concentration, mg/L*	*Nitrate, mg/L*	*TN Concentration, mg/L*	*Fecal Coliform Concentration, MPN/100 mL*
200	Toilet	400	600	400	124	150	0	150	10^7
200	Wash Basin	154	129	53	8	12	2	14	10^5
Blended Influent Flow and Loadings		554	469	304	92	112	0	112	10^6
Effluent Concentrations		554	30	20	2	2	8	10	10^2

Wash basin reference: Veneman (2002) re commercial greywater

Ammonia estimated at 2/3 TKN

Treatment

The wastewater will be treated in one tank, a BioMicrobics BioBarrier MBR 1.0-N. The advantage to this treatment system is its capacity to fit within the extraordinarily constrained site conditions. This model is suitable for flows up to 1,000 gallons per day (gpd), which is significantly larger than the projected flow. The extended hydraulic residence time (HRT) will provide greater treatment efficiency for this higher strength wastewater. This model has three compartments: a settling chamber and two aerated chambers used for BOD reduction and total kjeldahl nitrogen (TKN) conversion. The final third chamber contains membranes which filter the water, reducing both turbidity and bacteria. The BioBarrier meets NSF 350 effluent criteria for the typical strength of residential wastewater. Relevant effluent criteria match the highest standards to Title 22, which are as follows in Table 3.

Table 3. NSF 350 Effluent Criteria

Pollutant	*Test Average*	*Single Sample Maximum*
CBOD, mg/L	10	25
TSS, mg/L	10	30
Turbidity, NTU	5	10
E. coli	14	240
pH, SU	6.0 - 9.0	N/A

For this project's wastewater conditions, effluent concentrations were developed by BioMicrobics. Projected effluent concentrations were reported above in Table 2. To meet these treatment objectives, additional aeration is required. The BioBarrier will be equipped with a Lixor aeration system. The Lixor 0.5 model is proposed for use in this application. The Lixor 0.5 model has a maximum water depth of 5.5 feet and maximum BOD loading rate of 6 lb./day. The influent BOD loading of 2.2 lb./day meets the requirements for the Lixor 0.5. Manufacturer's data sheets are attached to this report.

A custom tank is required for the BioMicrobics treatment systems. For the BioBarrier 1.0-N, a Jensen Precast tank is specified with a custom exterior height of 6.5 feet as shown in Table 4.

Table 4. Treatment Tank Sizing

Fixed Design Factors		*Volumes Required for Wastewater Treatment*			*Min. Req'd.Tank Surface Area (sf)*	*Std. Tank Length (ft.)*		*Standard Tank Width (ft.)*		*Std Tank Area (sf)*	*Final*	*Jensen Precast Base Model*
Flow (gpd)	*Total Height (ft)*	*Settling Zone (gal)*	*Treatment Zone (gal)*	*Total Volume (gal)*	*Area (ft^2)*	*Feet*	*Inches*	*Feet*	*Inches*	*Area (ft^2)*	*Tank Volume (gal)*	*Nominal Tank Base Model*
554	6.5	700	3,000	3,700	76	15	11	4	11	78	3,805	KJP2000

Notes

The Jensen tank base model is a standard tank. The tank for this project has the same surface area, but the custom depth is deeper.

The final tank volume is a close match to the requried tank volume.

Please refer to the accompanying drawings that show the various features of topography, conceptual facilities, treatment, and disposal.

Disposal

The location for the disposal field is on the adjacent property adjacent to East Sea Level Drive. To the north of the street are residences. Grasscrete, Tufftrack or equivalent porous pavers installed to the Los Angeles County Fire Department's standards will cover the ground over the leach field. This type of paving is required by the Fire Department because this area is designated as a fire truck turnaround. Attached to this report is a paving plan with the Fire Department's approval for this application. Also attached is a Grasscrete detail. The East Sea Level Drive and the adjacent disposal area to the south are underlain with beach sand. Riprap protects the seaward perimeter of the street and landscaped strip from damage by wave uprush.

Earth Systems Southern California (ESSC) conducted a geotechnical investigation and prepared a report of findings dated March 18, 2016. The report identified the soils types as artificial fill, quaternary beach deposits, and early to middle Miocene Trancas Formation bedrock. Groundwater was estimated with a mean range of 5.2 feet with the highest high tide at 7.8 feet. Groundwater was measured in six borings at a depth of 14.0 to 15.9 feet below grade in the proposed leach field area. ESSC recommended removal of the artificial fill and replacement of the fill with beach sand. This approach was adopted as shown on Sheet C-4.

Table 5 provides an estimate of the proposed absorption area using the beach sand classification which indicated an absorption area range of 277 sf to 369 sf needed for disposal.

Table 5. Beach Sand Absorption Area

Available Disposal Area				
Design Loading Rate	2	to	1.5	gpd/sf
Required absorption area range	277	to	369	sf
Disposal Area Fit				
Total Length of Infiltrator Chambers			176	ft. each
Width			2.8	ft. each
Disposal Area with Two Chambers			499	sf

The leach field would consist of two 88-foot long infiltrator chambers with a total available disposal area of 499 sf. See Sheet C-3. The proposed chambers are 34-inch H-20 traffic rated high capacity chambers. Specific installation requirements are required by the manufacturer to achieve the H-20 rating. These requirements include gravel fill below and above the chambers as well as wrapping the gravel in a filter material and placing a geogrid (geotechnical textile) over the chambers. Similarly, specific installation practices are required for the Grasscrete or similar product. The Grasscrete installation requirements were integrated into the overall design of the leach field. The design shown on Sheets C-4 and C-5 of the drawings illustrate the installation requirements. See also the attached manufacturer's data sheets.

The chambers will sit adjacent to the paved private street with a five-foot setback from the existing riprap. The setback extends on each end of the leach field to further protect the disposal area. An effluent barrier was recommended by ESSC. The proposed barrier is a waterproof synthetic barrier suitable for placement on riprap. Specifically a 1.14 mm Firestone reinforced EPDM geomembrane for water containment structures is specified. The high elasticity and puncture resistance of this membrane was selected for placement along riprap which has jagged edges. This puncture resistance means that minor breaks may occur with very little effluent transmitted thought the barrier. The barrier can withstand hydrostatic pressures of 1150 ft. of head. It is resistant to root penetration and has a friction angle of 27.5 degree. Firestone provides extensive installation instructions for subbase preparation, barrier stability, and barrier cover. See the attached manufacturer's data sheets.

The barrier would be installed along the southern wall of the excavation as shown on C-4 and extend to wrap each end of the disposal field. The same filter fabric used to wrap the gravel fill over the infiltrators will line the excavation prior to placing the barrier. The filter fabric will assist in wicking the effluent down and under the riprap.

Attachments

1. Conceptual Restroom Option B, URS. August 9, 2016

2. BioBarrier brochure and Lixor aeration brochure

3. Fire Department Approved Paving Submittal with Grasscrete and Tufftrack Attachments

4. Typical Grasscrete Detail

5. High Capacity Infiltrator Chamber H-20

6. Firestone Geomembrane General Technical Guide for Water Reservoirs

Concurrent Submittal

Supporting Geotechnical Report, ESSC. March 23, 2016