Appendix 5.3-1
Geological Study

Appendices

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SUMMARY OF GEOLOGIC/GEOTECHNICAL CONDITIONS AND PRELIMINARY GEOTECHNICAL INPUT FOR **FIESTA ISLAND PRECISE PLAN ALTERNATIVE 5f** SAN DIEGO, CALIFORNIA

Prepared for
PLACEWORKS
Santa Ana, California

Prepared by
TERRACOSTA CONSULTING GROUP, INC.
San Diego, California

Project No. 2970
June 12, 2017
Revised: September 13, 2017

TerraCosta Consulting Group

Geotechnical Engineering
Coastal Engineering
Maritime Engineering

Project No. 2970
June 12, 2017
Revised: September 13, 2017

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SUMMARY OF GEOLOGIC/GEOTECHNICAL CONDITIONS
AND PRELIMINARY GEOTECHNICAL INPUT FOR
FIESTA ISLAND PRECISE PLAN ALTERNATIVE 5f
SAN DIEGO, CALIFORNIA

Dear Ms. Peterson:

In accordance with your request, TerraCosta Consulting Group, Inc. (TerraCosta) has performed a review of pertinent technical documents in our files and at City offices, performed a site-area geologic/geotechnical reconnaissance, attended the March 14, 2017, project kickoff meeting, and prepared this "desktop" study report summarizing existing geologic and geotechnical conditions, as well as offering generalized geotechnical input and recommendations for the currently proposed project uses, facilities, and structures. In accordance with our contract, we have also prepared a separate Wave Runup/Sea Level Rise Analyses report, taking into account the components of projected total maximum water levels as a guide to future design and adaptive strategies.

We appreciate the opportunity to be of service and trust this information meets your needs. If you have any questions or require additional information, please give us a call.

Very truly yours,

TERRACOSTA CONSULTING GROUP, INC.

Walter F. Crampton, Principal Engineer	Braven R. Smillie, Principal Geologist
R.C.E. 23792, R.G.E. 245	C.E.G. 207, P.G. 402

WFC/BRS/ak
Attachments

TABLE OF CONTENTS

SUMMARY OF GEOLOGIC/GEOTECHNICAL CONDITIONS
AND PRELIMINARY GEOTECHNICAL INPUT FOR
FIESTA ISLAND PRECISE PLAN ALTERNATIVE 5f
SAN DIEGO, CALIFORNIA

1 INTRODUCTION AND PROJECT DESCRIPTION

It is our understanding that the Fiesta Island Precise Plan, Alternative 5f amends the Mission Bay Master Plan and updates the Fiesta Island Concept Plan for addressing the 448.9-acre Fiesta Island, which currently includes park land, a youth and primitive camping area, an upland preserve and salt-pan habitat, open beaches, and also contains a few “hard” structures such as the Aquatic Center buildings and restrooms, a two-lane access causeway road, several miles of perimeter and internal roads and pathways, and limited parking in various areas.

Although numerous individual projects have been proposed and considered in planning the project, it is our understanding that the projects described below are those currently under consideration that need geotechnical and coastal engineering design input, and which individually may require site-specific geotechnical reports. Planning/feasibility-level recommendations for these improvements are provided in Section 4, Preliminary Geotechnical Recommendations.

1.1 Roadway and Parking Improvements

1.1.1 *Causeway Improvements*

The existing island access causeway is currently proposed to be widened to various widths ranging from 42 to 50 feet in order to provide safer access in both directions for pedestrian, bicycle, and motor vehicle traffic. Lateral stability for the causeway can be provided by sheet-pile bulkheads on both sides, and restrained near their tops by a series of buried tie rods spanning between the two bulkheads. Alternatively (and possibly more economically), the widened embankment slopes can be stabilized and protected from erosion by a well-designed rock revetment. Also, the causeway improvements are planned to include controlled hydraulic connection between the north and south sides of the causeway by installing culverts or large pipes through the embankment to accommodate imbalances in tidal flows.

1.1.2 *Perimeter Road, Internal Roads, and Parking*

We understand that the perimeter loop road will be regraded and reconstructed to direct storm water drainage away from the shoreline and into the island interior, in order to reduce beach erosion, and to also reduce silt and debris flow into the bay during heavy storm periods. We also understand that all roadways on the island will be widened to a minimum width of 18 feet; that certain intersections and/or “return” roads may be modified to improve traffic flow during special events; and that certain parking areas may be expanded and additional parking areas added around the island to increase overall parking capacity.

1.2 General Grading

General island-wide grading and landscaping are planned to enhance large event-viewing areas, create wind breaks, and to mitigate wave erosion by reducing the inclination of coastal slopes where needed.

1.3 Wetlands Habitat

Dredging and/or grading of shallow east/west channels are planned (with either low-water crossings or prefabricated bridges at the perimeter loop road crossings) to extend into, or through, the North Island Sub-area to restore and/or create significant areas of wetlands habitat.

1.4 Structures

We understand that, although no large structures are planned for the project, planning continues for minor but necessary improvements, such as prefabricated bridges (possible alternatives to low-water crossings) where the perimeter loop road crosses the wetland habitat channels, restrooms with their associated utilities, maintenance equipment storage structures, pavilions, gazebos, and various picnic structures. We understand that no other significant structures are planned at this time.

2 GEOLOGIC SETTING OF MISSION BAY

2.1 Geologic and Recent History

Like all of the major coastal drainage areas in the region, Mission Bay was incised rapidly during the mid to late Quaternary periods of glacial advance when sea level was 300 to 400 feet below present-day levels; and then, during the past 18,000± years, a geologically rapid eustatic rise in sea level caused large volumes of alluvial sediment to fill the coastal drainages to depths on the order of 70 to 120 feet. Figure 1, adapted from Abbott (1999), provides generalized plan and cross-sectional views of the Mission Bay area. Figure 2 presents a map of False Bay, prepared in 1857 as part of the survey of the coast of the United States led by Commander James Alden, U.S. Navy. Among other things, the map indicates the Valley Las Yeguas (now Rose Canyon) to the north, as well as the Valley of Tecolote and Mission Valley to the east. The channels within False Bay are very narrow, and a warning note on the map reads "Bound into San Diego from the northward, care must be taken not to mistake False Point for Point Loma, as they resemble each other, particularly when the weather is hazy. There is nothing more than a boat channel at the entrance of False Bay, and that is impracticable except in very smooth weather." Figure 3 (taken from USDA Photo No. AXN-4M-91, flown March 31, 1953) shows the Fiesta Island site-area as a characteristic "tidal flat" prior to the dredging and grading of the 1950s, which essentially completed the configuration of Mission Bay. Figure 4, flown February 2, 1988, shows the extent to which rectangular sludge-drying ponds (reportedly since abandoned, regraded, and the dried sludge hauled off-site) covered the southwesterly part of the island. Figure 5 presents a Google Earth photo dated November 8, 2016, which illustrates more recent surface conditions on the island. Figure 6 (NOAA) shows currently available bathymetric data for the Fiesta Island area, with depths recorded in fathoms and feet (subtext).

Mission Bay covers most of the former delta of the San Diego River. Historic records indicate that major storm events have periodically diverted the flow of the San Diego River alternatively to the north or south of the Loma Portal rise between San Diego Bay and Mission Bay (previously known as "False Bay").

By the early 1950s, the river levees and the Mission Bay jetties were completed, confining San Diego River flows to a new man-made river channel that discharges into the ocean.

Mission Bay was dredged during the 1950s, approximately to its current configuration in that part of the former river delta north of the existing man-made river channel. Topography within Mission Bay consists of low-lying dredged islands and channels bounded on the south by the Ocean Beach/Sunset Cliffs rise; on the east by the very steep westerly slopes of the Lindavista Terrace; and on the north by Pacific Beach and the La Jolla Terrace. Crown Point, an extension of the La Jolla Terrace, protrudes into the north-central third of Mission Bay. To the west, Mission Bay is bounded by the Mission Beach sand bar, a narrow sand strip extending south from Pacific Beach to the Mission Bay entrance channel.

Surface exposures in the Mission Bay area include late Quaternary-age (geologically recent) fluvial, beach, and embayment deposits, most of which have been transported and placed at least once during several phases of hydraulic dredging. These unconsolidated silts, sands, and clays technically are classified and mapped as artificial fill material. However, fluvial tidal storm wave and wind erosion (natural processes) are constantly re-depositing the dredged soils as "natural" sediments.

2.2 Geologic Structure and Stratigraphy

Figure 1 (mentioned above) presents a generalized geologic map and cross section to illustrate the structural and stratigraphic setting of the Mission Bay area westerly of the Rose Canyon fault zone, currently classified as "active" by the California Geologic Survey. Section 3 of this report, "Geologic Hazards," presents a brief summary of potential project-area geologic hazards related to faulting and seismicity.

Our document review indicates that Fiesta Island is underlain by from 10 to 30 feet of hydraulic fill soils, in turn underlain by an estimated 70 to 80 feet of Holocene-age deltaic fluvial and estuarine deposits, and, at approximately 80 to 110 feet of depth, underlain by Quaternary- and Tertiary-age formational units, shown on the Figure 1 cross section as a down-warped syncline in the Mission Bay area between the Mount Soledad and Point Loma structural highs.

2.3 Island Construction

The dredging and development of Mission Bay spanned a total of 16 years, with the City's first dredging operation commencing in early 1946. Between 1946 and 1956, the City completed dredging in the west bay, west of Ingraham Street, at the same time creating some new land areas with dredged material. In addition, a narrow channel was dredged in the east bay to De Anza Cove, with De Anza Point created by this dredged material. In 1956-57, the City Engineering and Planning Department prepared preliminary drawings of a master plan for the area, which included a series of wash borings taken throughout the area to be dredged, the results of which indicated considerable variability throughout the bay, with soils ranging from relatively clean sands to highly compressible silts and clays. These soft silts and clays were predominantly found in the more northern parts of the East Basin where the finer fraction of the alluvial outwash during flood flows from the San Diego River and Tecolote Creek would eventually settle out in more quiescent waters.

The initial plan as part of the 1956-57 City studies was to dispose of several million cubic yards of compressible silts and clays in the ocean. However, vigorous public opposition to offshore disposal encouraged the City to add an additional island in the bay (Fiesta Island) and make this a disposal area. As originally planned, the island would have, as margins, 200-foot-wide sand levees and the impounded dredge materials would be covered with a minimum of 3 feet of sand.

Considerable difficulty was experienced in forming the dikes on the northerly part of Fiesta Island, and since this area was well known to contain the poorest material in the bay (a silty clay), trouble had been expected. The sand settled into the silty clay as much as 6 to 8 feet, causing a mud wave on the outboard side of the dike. The width of the dike in this area was increased and the excess yardage caused by the mud wave was ultimately removed. Between 1959 and 1961, Mission Bay was dredged to its current configuration, with virtually all of the silts and clays being pumped into the interior of Fiesta Island. Subsequently, improvements to De Anza Point in 1963-64 resulted in some additional dredging along the western shores of Fiesta Island, encroaching into the original 200-foot-wide sand dike to provide additional granular fill for De Anza Point (San Diego Historical Society, 2002).

In the southerly part of the island, dredge spoils were pumped into numerous relatively small compartmentalized dike-walled containment or settlement ponds in order to facilitate the dredge disposal, and the geotechnical consequence is that the current composition of Fiesta Island is highly variable with relatively dense clean sands (a containment dike) immediately adjacent to highly compressible silty clays. Because this condition may be encountered across any proposed structure foundation and result in different settlement, a site-specific geotechnical investigation would be required to determine specific geotechnical foundation requirements. Figure 6 (taken from Sheet 20 of the City of San Diego Seismic Safety Study) shows higher elevation topographic contours, which illustrate the remaining erosional remnants of these dike-walled dredge spoil settlement ponds.

2.4 Soil and Geologic Units

Appendix A presents a site plan and logs from Test Boring Nos. 15, 16, 17, 19, and 20, drilled as part of the geotechnical investigation for the "Mission Bay Park Resort" (also called "Ramada Renaissance, Mission Bay"), and reported September 27, 1983, by Woodward-Clyde Consultants, Inc. The approximate locations of these test borings have also been superimposed on Figure 3 of this report and reproduced again in Appendix A. Giving due consideration to the discussion in Island Construction in Section 2.3, we believe the geotechnical characteristics and consistencies reported on the logs are likely to be generally representative of the subsurface soils below the containment dikes and compressible bay muds described in Section 2.3. These soil units are described below.

Hydraulic Fill: As indicated in Section 2.3, Fiesta Island was created entirely by the placement of hydraulically dredged bay deposits, which were then pumped into a series of containment dikes, decanted, and then capped with a minimum of 3 feet of sand. These near-surface, hydraulically placed fills are estimated to be 10 to 30 feet in total thickness and consist of materials ranging from gray to brown, silty fine to coarse sands and fine sandy silts to soft silty clays. Most of the hydraulic fill soils also contain abundant shell fragments. The consistency of these materials, as characterized by blow count, ranges from very loose/soft to medium dense.

Holocene Alluvium: Loose to medium dense, saturated, gray interbeds of silty fine sands and firm to stiff clays (micaceous with shell fragments) characterize, in general, the Holocene fluvial and estuarine alluvial deposits which underlie the hydraulic fill and range in thickness from an estimated 70 to 80 feet.

Quaternary and Tertiary Formational Soils: At depths on the order of 70 to 110± feet, the above-described alluvial sediments are underlain by very dense, saturated, brown, medium to coarse silty to clayey sands, with gravels and cobbles. These very competent formational soils are characteristic of San Diego-area, Quaternary-Tertiary-age sediments.

2.5 Groundwater

The groundwater table was encountered in Woodward-Clyde's test borings at approximately Mean Sea Level, corresponding to, or within a few feet of, the bottom of the hydraulic fill material. Moreover, throughout the island, it should be anticipated that the groundwater will fluctuate with the tide, with increased attenuation as a function of distance from the bay.

3 GEOLOGIC HAZARDS

3.1 Faulting and Seismicity/Liquefaction Potential

Tectonic movement between the North American and Pacific Plates makes Southern California one of the more seismically active regions in the United States. Strain, caused by movement between the North American Plate and the Pacific Plate, is spread across a 150+ mile wide zone between the San Andreas fault zone approximately 100 miles east of San Diego, out to and beyond the San Clemente fault zone located approximately 50 miles west of San Diego.

Nearing the end of the Miocene, approximately 5.5 million years ago, the boundary between the North American and Pacific Plates moved eastward to its present-day position in the Gulf of California (Abbott, 1999). The resultant extension and stretching of the North American continental crust formed a rift between the two plates, creating the Gulf of California, which continues opening through the present day. The San Andreas, San Jacinto, Elsinore, Rose Canyon/Newport-Inglewood, and San Clemente fault zones are just a few of the resultant strain features (faults) created by this tectonic movement. Today, there is an estimated 22 to 24 inches per year of relative plate motion between the North American and Pacific Plates, spread across the faults within this 150+ mile wide zone, of which the Rose Canyon fault zone is estimated to contribute 0.06 inch/year (±0.02 inch).

Of the major active fault systems in Southern California, the Rose Canyon/Newport-Inglewood fault zone has impacted the local San Diego region the most

The project site is located within the Rose Canyon fault zone, which is considered part of the Newport-Inglewood-Rose Canyon fault system. Other significant faults within approximately 60 miles of the site, and which contribute to the overall ground-shaking risk at the site, include the Coronado Bank Fault, the Palos Verdes Connected Fault, the San Diego Trough, the Elsinore Fault (including the Julian, Temecula, Coyote Mountain, Whittier, and Glen Ivy segments), the Earthquake Valley Fault, the San Clemente North and South Faults, the Palos Verdes Fault, the San Jacinto Fault (including the Coyote Creek, Anza, Clark, Borrego, Superstition Mountain, SBV, and SJV segments), and the San Joaquin Fault.

Historically, the project site has been subjected to ground shaking. According to our search of the California historical earthquake database used in the computer program EQSEARCH (Blake, 2001), the site has been subjected to 1,070 earthquakes of magnitude 4 or greater, 122 earthquakes of magnitude 5 or greater, 23 earthquakes of magnitude 6 or greater, and one earthquake of magnitude 7 or greater. In addition, there have been four earthquakes of magnitude 5.5 or greater that have occurred within 31 miles of the site. These four earthquakes occurred prior to 1900. The largest estimated peak ground acceleration that the project site has experienced was approximately 0.26g.

There are five Alquist-Priolo Earthquake Fault Zones (APEFZ) delineated along the Rose Canyon fault zone located within San Diego. Four of the APEFZ are located in the downtown and San Diego Bay area of the City of San Diego, and one begins just to the north of the project and extends up the Interstate 5 corridor to the ocean through La Jolla. The closest APEFZ is located approximately one-quarter of a mile north-northwest of the project limits, as measured from Clairemont Drive. The next closest APEFZ is located approximately 2.4 miles southeast from the southern limits of the project site.

While not located within a delineated APEFZ, numerous fault features (SANDAG, 2013 and City of San Diego, 2008) have been identified near the project site. For example, fault traces of the Rose Canyon Fault are located approximately 1,500 feet to the east of the project site.

Given that the project site is not located within any APEFZ, nor are there any known traces crossing the site, it is our opinion that fault rupture is not a significant hazard to the site. However, we consider ground shaking at the site a significant hazard.

The significance of ground shaking, as it relates to a geologic hazard, is associated with two issues. The most commonly understood issue pertains to the imparting of inertial forces into buildings and structures. The second issue, of equal significance, is related to the stability of the ground during ground shaking.

The characterization of ground shaking is often expressed in terms of either peak ground acceleration (PGA) or the response of a single degree of freedom oscillating mass for various periods or frequencies of motion to the ground shaking produced by an earthquake. This response is generally expressed in terms of a response spectrum that encapsulates the range of motions anticipated at the site for a given set of earthquake events.

A given site is potentially exposed to a wide range of earthquakes events, each having a different likelihood of occurring. As such, the risk of ground shaking is generally expressed in terms of likelihood or probability of exceedance of a particular earthquake event. In addition, the likelihood of a particular event is only one part of the measurement of risk at a site. Another key part of risk is the consequence to a given building or structure associated with a given earthquake event. Thus, both the likelihood of occurrence of a given earthquake and its consequence are generally paired together to form design code requirements. Each class of structure or facility typically has its own design code requirements. For example, buildings in general are designed in accordance with Chapters 16 and 18 of the California Building Code (CBC).

Three key ingredients are required for liquefaction to occur: liquefaction-susceptible soils, sufficiently high groundwater, and strong shaking. Liquefaction is the phenomena associated with ground shaking, which results in the increase of pore pressures within the soil. As the pore pressure increases, the shear strength of the soil is reduced. If the pore pressure is sufficiently increased, the soil takes on a “liquid like” behavior. Consequences commonly associated with soil liquefaction include ground settlements, surface manifestations (sand boils), loss of strength, and possible lateral ground movement typically referred to as lateral spreading, ground oscillations and lurching, and possible ground failure. Soils susceptible to liquefaction generally consist of loose to medium dense sands and non-plastic silt deposits below the groundwater table.

According to the California Building Code, the risk for liquefaction is based on the earthquake scenario corresponding to the Maximum Considered Event. The corresponding peak ground acceleration (PGA) for the MCE earthquake event is approximately 0.57g for this site.

The loose, and loose to medium dense cohesionless soils (sands and silts), which make up a significant part of the 70 to 80 feet of Holocene sediments below the water table, are susceptible to a temporary, but essentially total loss of shear strength due to reversing cyclic shear stresses caused by moderately strong seismic ground shaking. Analyses based on the results of penetration resistance tests in these deposits indicate that they could lose their strength if peak ground surface accelerations were to exceed about 0.15 to 0.2g. In their geotechnical report dated September 27, 1983, Woodward-Clyde Consultants estimated an average recurrence interval of about 100 years peak ground acceleration of 0.15g at the then-proposed Ramada Renaissance Hotel site on the southeast side of Sea World Drive (at Friars Road), approximately 1/2 mile west of the active Rose Canyon fault zone, and immediately southeast of Fiesta Island (Figure 7).

The Woodward-Clyde report also describes the likely manifestations of seismically induced liquefaction at the site, such as the expulsion of sand and water from sand boils, ground cracking, vertical settlement, and lateral displacement, generally toward the shoreline.

3.2 Tsunami and Wind-Driven Waves

Tsunamis and wind-driven waves are considered likely hazards at this project site. A review of the State of California Tsunami Inundation Map for Emergency Planning (2009) indicates that the site would likely be adversely affected by tsunamis caused by both local and distant sources (Figure 8A-8C).

Fiesta Island is exposed to wind-driven waves from the southwestern through northern quadrants, with fetches typically limited to about 1/2 mile, except from the southwest through the Mission Bay Channel, and from the north over Kendall Marsh, with both of these quadrants providing maximum fetch lengths approaching 7,500 feet. The presence of shallow water within the bay further limits the height of these fetch-limited wind waves, with wave heights on the order of 2 to 2½ feet, with corresponding wave periods on the order of 2 to 3 seconds from 50-knot sustained winds.

Offshore storm waves propagating into Mission Bay are also major contributors to shoreline erosion within the bay and responsible for the rock revetments lining the entire entrance channel extending to Vacation Isle and on to Stony Point. When coupled with westerly winds, offshore storm waves, propagated through Mission Bay Channel and on to Stony Point, can sustain 3-foot waves with significant transport capacity northerly along the western face of Fiesta Island and easterly along Pacific Passage.

4 PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

4.1 Grading

All project grading, including the grading associated with restoration of the North Island Sub-area wetlands habitat, for widening the island access causeway, all island roadways, and grading associated with the construction of buildings, walls, and minor ancillary structures, must comply with the City grading ordinance and with recommendations for individual projects prepared by the design geotechnical engineer.

4.2 Roadway and Parking Area Pavement Sections

Our previous experience in performing grain size distribution studies on Fiesta Island has been that, overall, the near-surface soils generally consist of relatively coarse sands, which should provide excellent subgrade support for pavements. Although we have not performed any R-value tests of the on-site soils, we anticipate that the near-surface sandy soils may exhibit R-values approaching 50. Assuming a design traffic index (TI) of 4.5 for typical passenger car traffic, a typical pavement section might consist of 3 inches of asphalt concrete on 4 inches of Class II aggregate base. Please note, however, that at least portions, if not all, of the island's roads and parking areas are occasionally trafficked by the City's heavily-loaded sand maintenance and/or trash truck vehicles, and these roadway surfaces will require a substantially thicker design pavement section.

4.3 Mitigation of Variable Foundation Support and Liquefaction Hazards for Lightly Loaded Structures

The hydraulic fill soils within the upper 10 to 30 feet of depth on Fiesta Island are known to be prone to wide variations in settlement potential, both vertically and laterally. This variability is, at least in part, due to the fact that coarser materials (sand and shells) tend to settle out of suspension relatively near the end of the hydraulic dredge discharge pipe, whereas finer materials (silts and clays) tend to settle out of suspension farther away. Also adding to the potential for differential settlement is the fact that there have been generations of grading and regrading to construct and remove various dikes, pits, ponds, stockpiles, and access trails without benefit of any systematic soil compaction, compaction (compliance) testing, and none of the site-specific mapping typically required for engineered cut and fill grading operations.

In order to mitigate, or reduce, the potential for differential settlement of possibly planned small (lightly loaded) bridges or buildings and ancillary structures, future site-specific geotechnical investigation reports may recommend the construction of a uniformly compacted soil mat, by removal and recompaction of the foundation soils to a depth suitable for the proposed building loads (to be determined by the design geotechnical engineer). A structural mat foundation may also be used to structurally accommodate differential soil settlements, thereby eliminating, or at least reducing, the amount of required overexcavation and recompaction. The potential for differential settlement of any walls can be mitigated to some extent by expansion joints, the location and spacing of which should be determined by consultation between the design geotechnical and structural engineers.

Any large or settlement-sensitive structure loads can also be supported on deep foundations consisting of either piles or drilled piers as a means of mitigating liquefaction-related differential settlement.

4.4 Potential Opportunities for Stormwater Infiltration BMPs

Finally, it should be anticipated that, at some point during the design phase of the project, the City may require the evaluation and definition of the current depths to groundwater at locations where infiltration/treatment BMPs may be considered. It will likely be necessary for the project designers to evaluate long-term performance/reliability, and give consideration to the possible need to transition from an infiltration-based system to a permanently lined system as groundwater rises to a level where infiltration is no longer permissible. Also, constraints to implementing stormwater infiltration will require the design disciplines to consider mitigating the effects of the geologic hazards outlined in our report.

REFERENCES

Abbott, P.L., 1999, *The Rise and Fall of San Diego: 150 Million Years of History Recorded in Sedimentary Rocks*, Sunbelt Publications, San Diego.

Everts Coastal, June 2002, *Impact of Sand Retention Structures on Southern and Central California Beaches*, prepared for the California Coastal Conservancy, Contract No. 00-149.

Flick, R.E. and D.R. Cayan, 1984, "Extreme Sea Levels on the Coast of California," *Proceedings of the 19th Coastal Engineering Conference*, pp. 886-898.

Hennessey, G.R. and D. Lawrance, *The Journal of San Diego History*, Vol. 48, Winter 2002, No. 1, San Diego Historical Society.

Gabrielson, E., 2002, "Mission Bay Aquatic Park: The History of Planning and Land Acquisitions," in G.R. Hennessey (ed.) *The Journal of San Diego History*, Vol. 48, Winter 2002, No. 1, San Diego Historical Society.

Galvin, C.J., 1972, "A Gross Longshore Transport Rate Formula," *Proceedings of the 13th Coastal Engineering Conference*, American Society of Civil Engineers.

Group Delta Consultants, Inc., March 1992, *Report of Findings, Mission Bay Beach Stabilization, Sand Test Project, Mission Bay Park, San Diego, California*, prepared for Pountney & Associates, Inc.

Group Delta Consultants, Inc., February 2, 1989, *Results of Additional Field Investigative Work, Mission Bay Shoreline Restoration and Stabilization Master Plan, Mission Bay Park, San Diego, California.*

Group Delta Consultants, Inc., December 1988, *Report of Findings, Mission Bay Shoreline Restoration and Stabilization Master Plan, Mission Bay Park, San Diego, California*, prepared for City of San Diego, Department of Parks and Recreation.

REFERENCES
(continued)

Kuhn, G.G., and F.P. Shepard, 1984, *Sea Cliffs, Beaches, and Coastal Valleys of San Diego County. Some Amazing Histories and Some Horrifying Implications*, University of California Press, Berkeley, CA.

National Oceanic and Atmospheric Administration (NOAA), 1978, *Tidal Bench Marks, La Jolla Pier, San Diego County, 1960-1978*, U.S. Department of Commerce, National Ocean Service.

Ninyo & Moore, May 24, 2001, *Limited Geotechnical Evaluation, De Anza Harbor Resort and Golf Development Program, San Diego, California*, prepared for the City of San Diego.

Rick, W.B., 2002, “Mission Bay: An Engineer’s Vision Come True,” in G.R. Hennessey (ed.) *The Journal of San Diego History*, Vol. 48, Winter 2002, No. 1, San Diego Historical Society.

San Diego, City of, 1994, *Mission Bay Park Master Plan Update*, Adopted 2, 1994, Amended July 9, 2002.

San Diego Testing Laboratory, February 27, 1951, *Soil Investigation, De Anza Point Project, Mission Bay Development, San Diego, California*.

Seymour, R.J., and D.J. King, Jr., Consultants in Oceanography, February 1989, *Beach Renourishment Options in Mission Bay*, prepared for Group Delta Consultants, Inc.

TerraCosta Consulting Group, Inc., February 2, 2007, *Geotechnical Summary Report, Fiesta Island, Mission Bay, San Diego, California*, prepared for KTU+A

U.S. Army Corps of Engineers, 1984, *Shore Protection Manual*, Coastal Engineering Research Center, Vicksburg, MS, Vol. I and II.

U.S. Department of Agriculture Soil Conservation Service, May 1953, Aerial photographs, Series AXN-4M-89 through 92 (scale approximately 1:2,000).

REFERENCES
(continued)

William S. Krooskos & Associates, October 8, 1975, *Geology Report, Miller Mini-Warehouses, 4615 Mission Bay Drive, San Diego, California*, prepared for Mr. Don Miller.

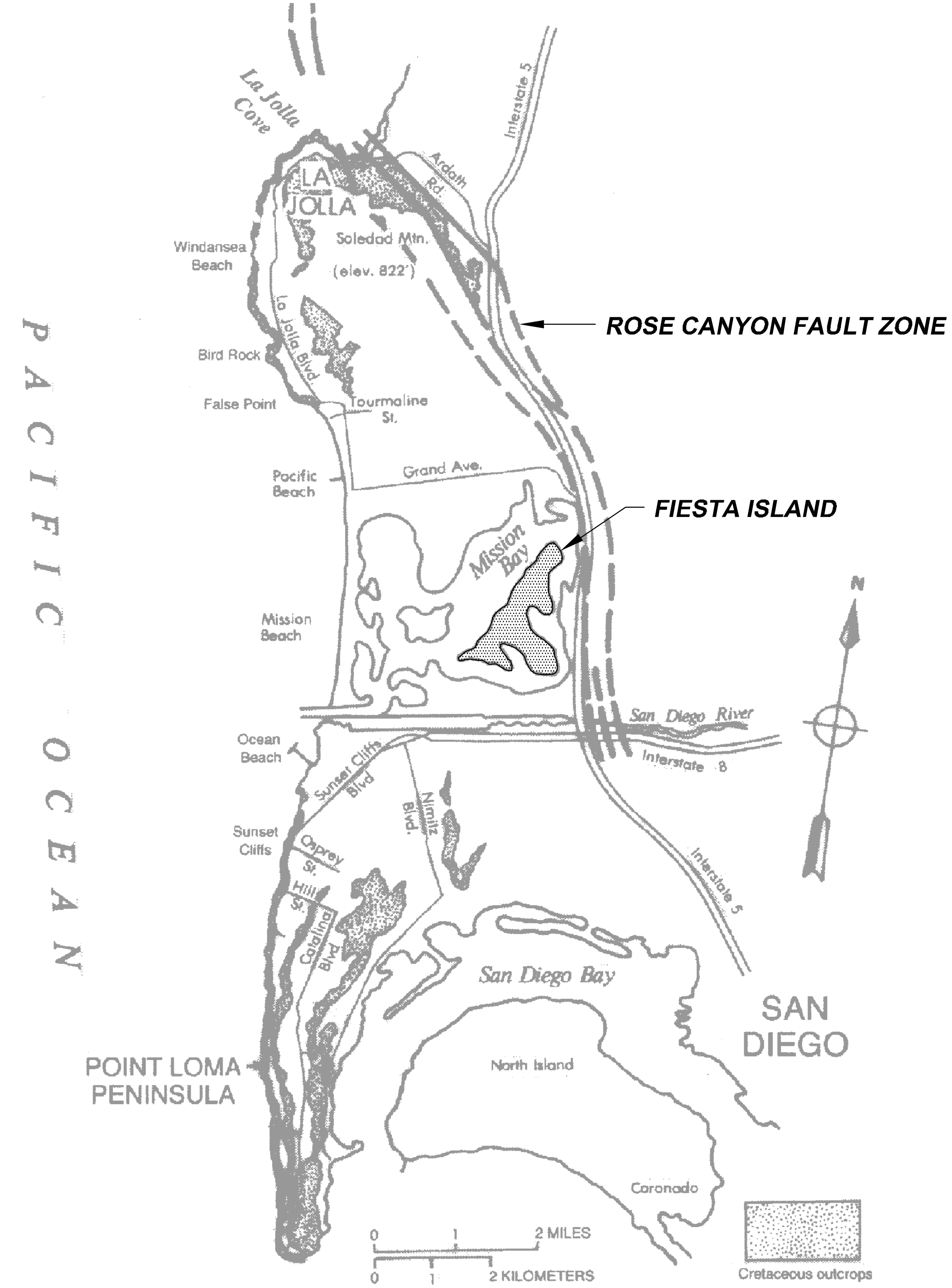
William S. Krooskos & Associates, November 5, 1981, *Geologic Reconnaissance, Existing Residences, 2711, 2717 Magnolia Avenue and 4485 Bond Street, San Diego, California*, prepared for Mr. Reginald D. Stacy.

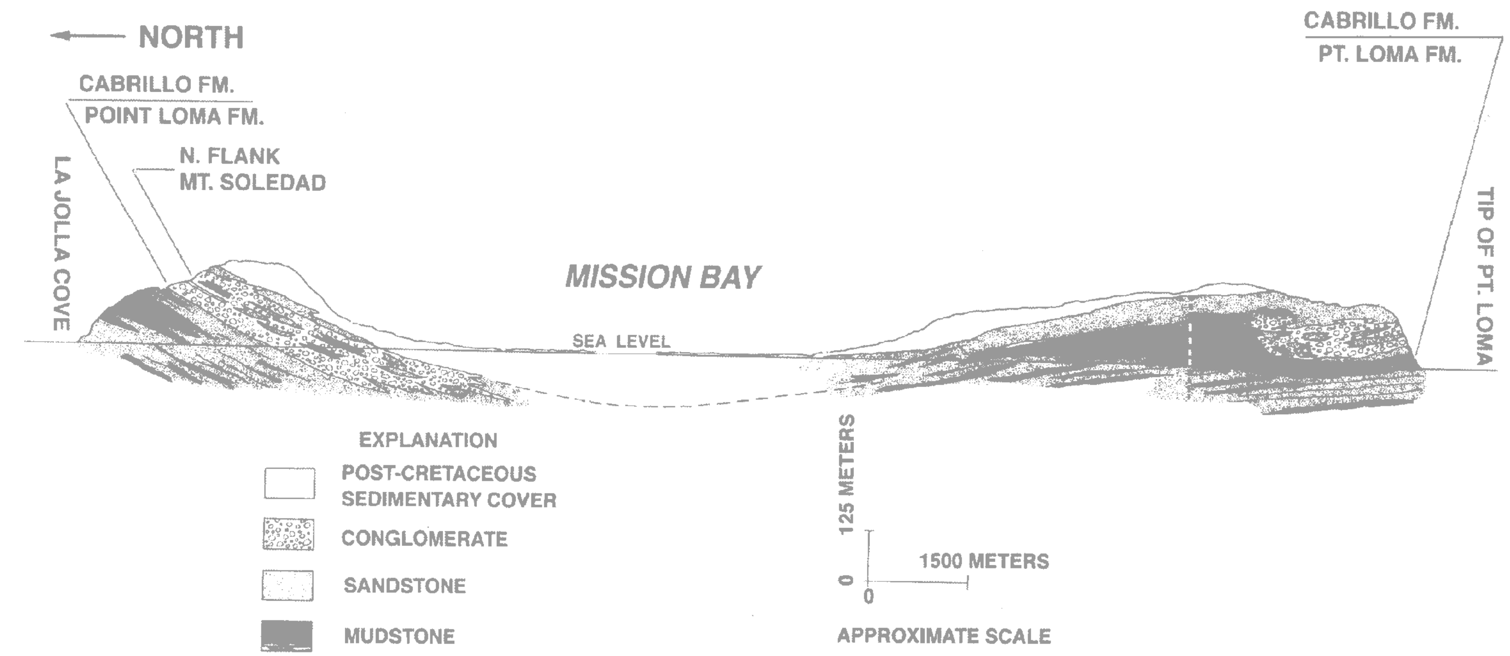
Woodward-Clyde Consultants, September 29, 1972, *Soil Investigation, De Anza View Medical-Dental Building Addition, San Diego, California*, prepared for Robert Platt & Associates.

Woodward-Clyde Consultants, September 27, 1983, *Preliminary Soil and Geologic Investigation for the Proposed Ramada Renaissance Hotel, Sea World Drive, San Diego, California.*

Woodward-Clyde Consultants, March 16, 1989, *Planning Level Geotechnical Investigation, De Anza Property, San Diego, California*, prepared for Rick Engineering.

Woodward-Clyde-Sherard & Associates, July 14, 1961, *Soil Investigation for the Proposed Garnet Avenue Bridge Widening, Garnet Avenue at Rose Creek, San Diego, California*, prepared for the City of San Diego.





Adapted from: The Rise and Fall of San Diego, by Patrick L. Abbott, © 1999, Sunbelt Publications

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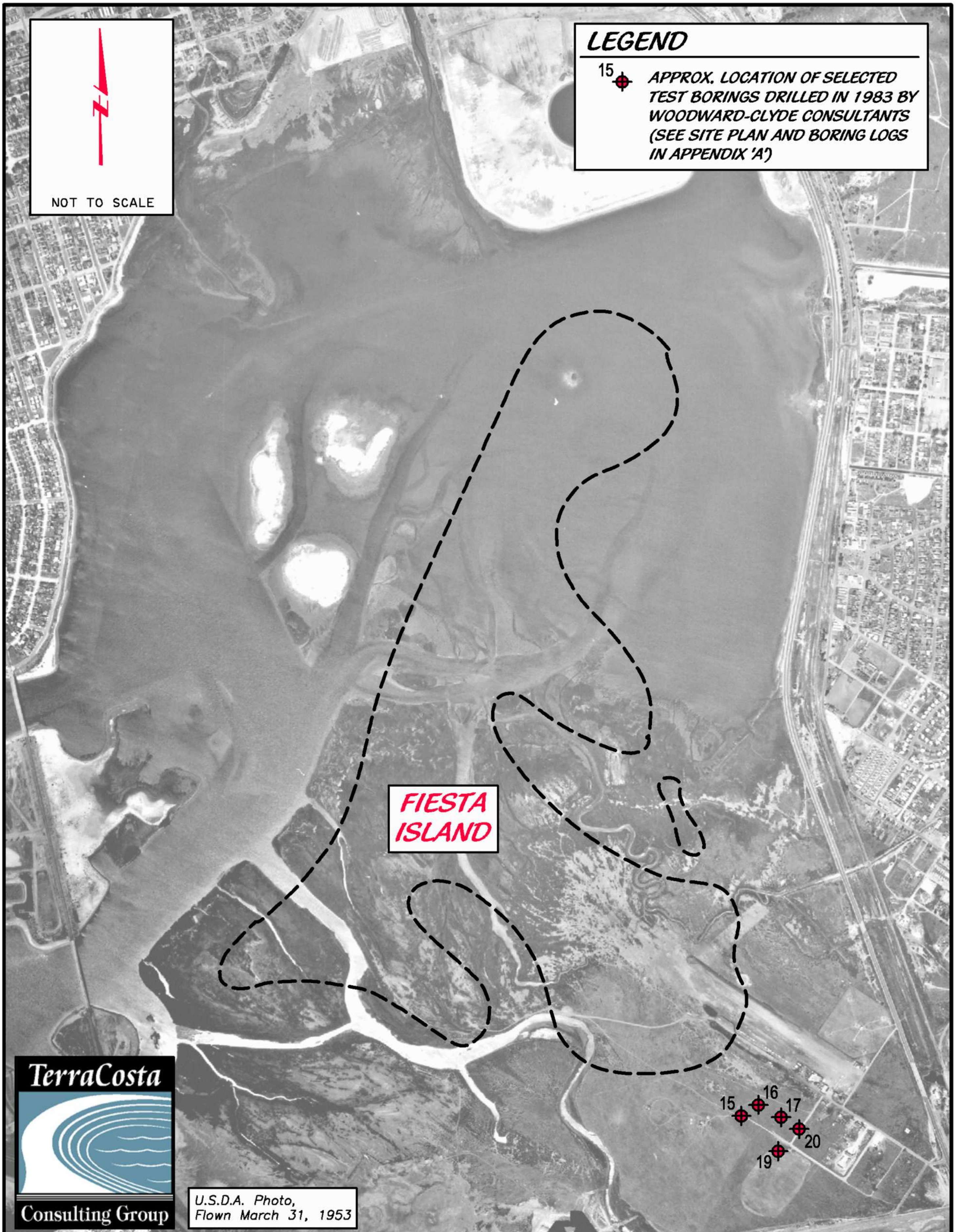
FIGURE NUMBER 1

PROJECT NAME
FIESTA ISLAND PRECISE PLAN ALTERNATIVE 5F

PROJECT NUMBER 2970

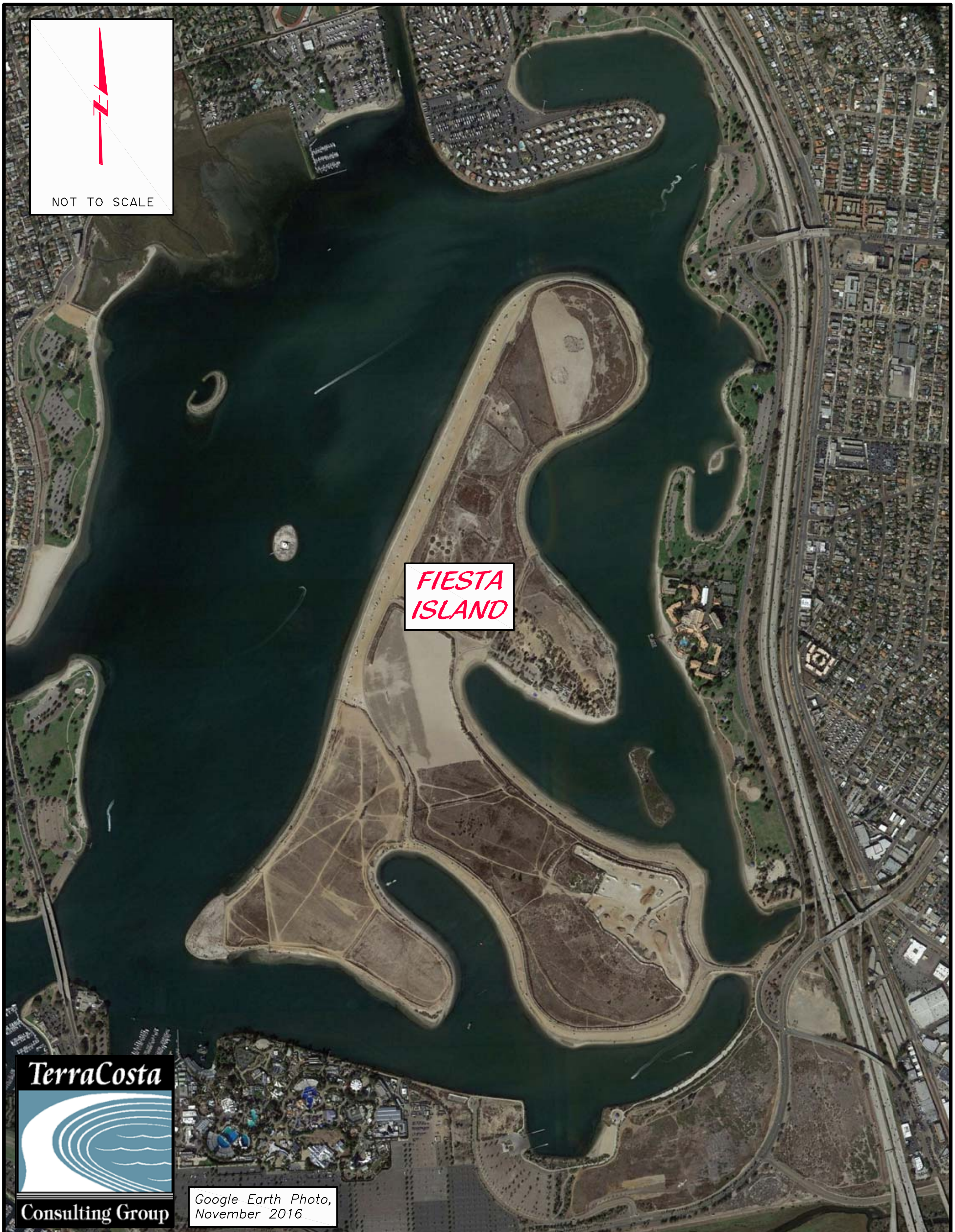
GENERALIZED GEOLOGIC MAP AND CROSS-SECTION OF MISSION BAY

Statute Miles
Nautical Miles
DE ANZA COVE
PROJECT SITE
Approx. Outline of Current Mission Bay
VACATION ISLE
FIESTA ISLAND
SAN DIEGO RIVER
Valley of Tecolote
Mission Valley
San Diego
Bar
SAN DIEGO BAY
CALIFORNIA
From a Trigonometrical Survey
under the direction of A.D.BACHE Superintendent of the
SURVEY OF THE COAST OF THE UNITED STATES
Triangulation by R.D.CUTTS Asst.
Topography by A.M.HARRISON Sub-Assistant
Hydrography by the Party
under the command of Comdr. JAMES ALDEN U.S.N. Asst.
1857
SAN DIEGO BAY - 1857
TerraCosta
Consulting Group

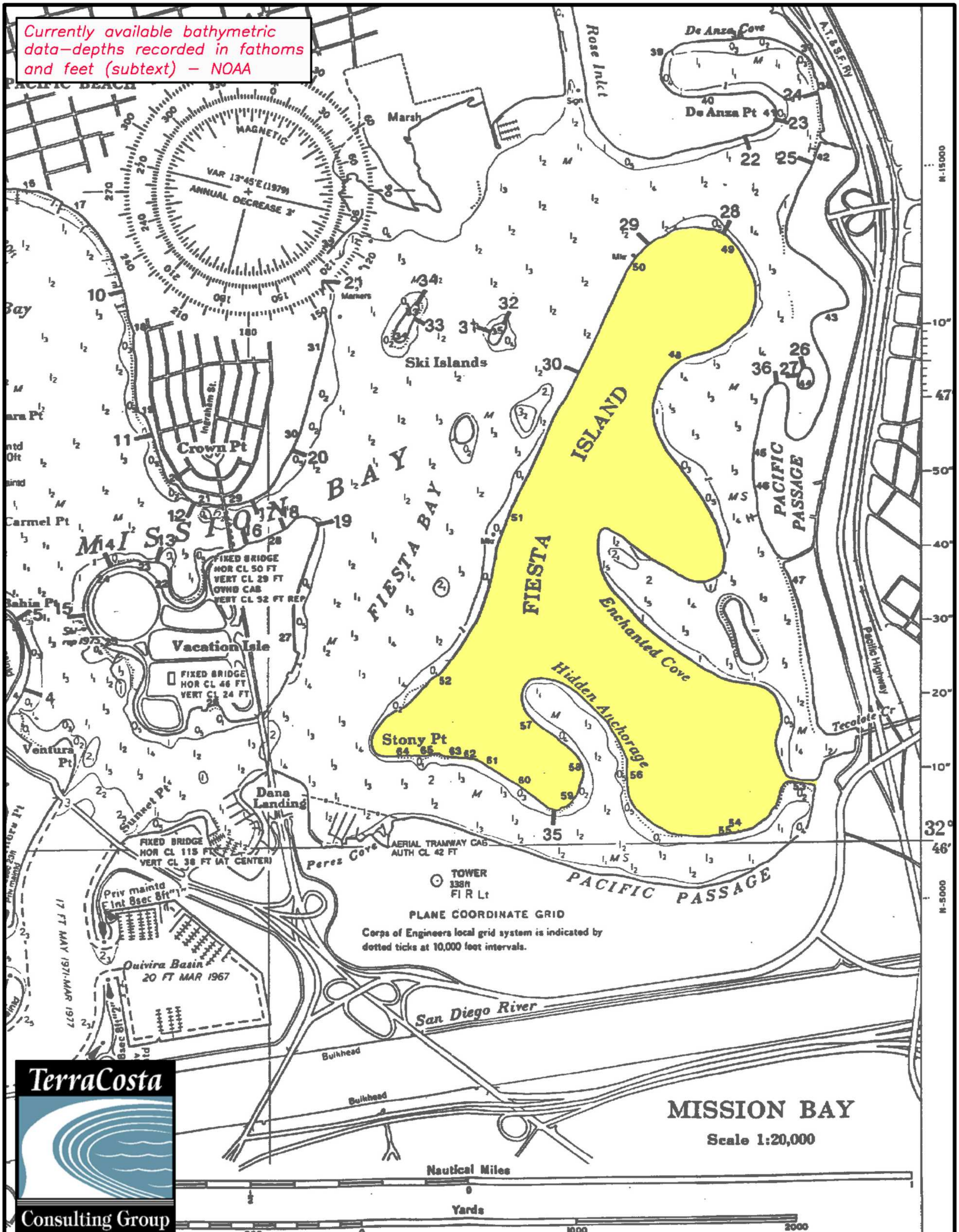


Project: Fiesta Island Precise Plan Alternative 5f - Proj. No. 2970 - Figure 3

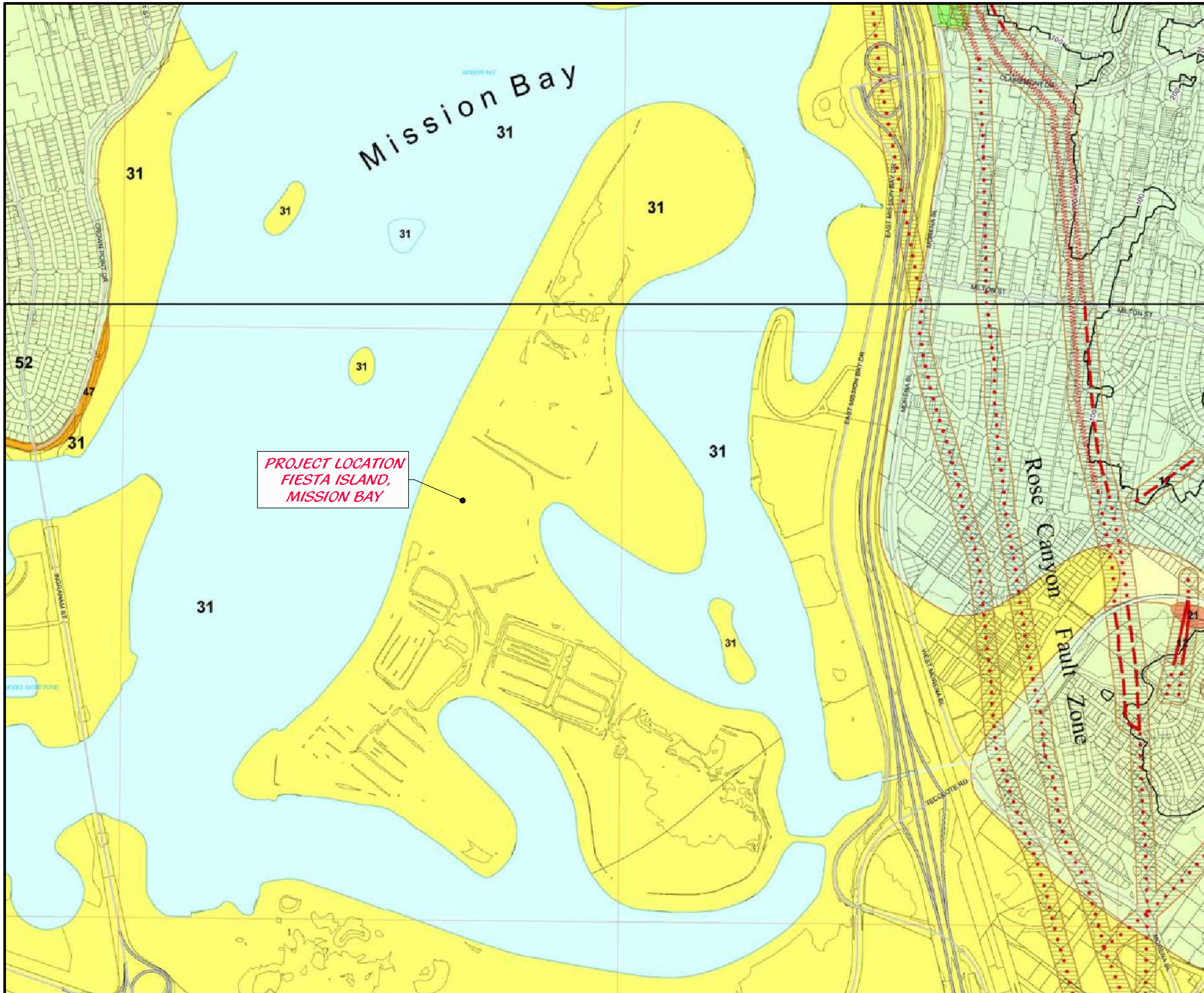
Project: Fiesta Island Precise Plan Alternative 5f - Proj. No. 2970 - Figure 4



Project: Fiesta Island Precise Plan Alternative 5f - Proj. No. 2970 - Figure 5



Project: Fiesta Island Precise Plan Alternative 5f - Proj. No. 2970 - Figure 6



0 500 1000 2000
FEET
2.00 in

Geologic Hazard Categories

FAULT ZONES

11 Active, Alquist-Priolo Earthquake Fault Zone

12 Potentially Active, Inactive, Presumed Inactive, or Activity Unknown

LIQUEFACTION

31 High Potential -- shallow groundwater major drainages, hydraulic fills

Water (Bays and Lakes)

FAULTS

Fault

Inferred Fault

Concealed Fault

Shear Zone

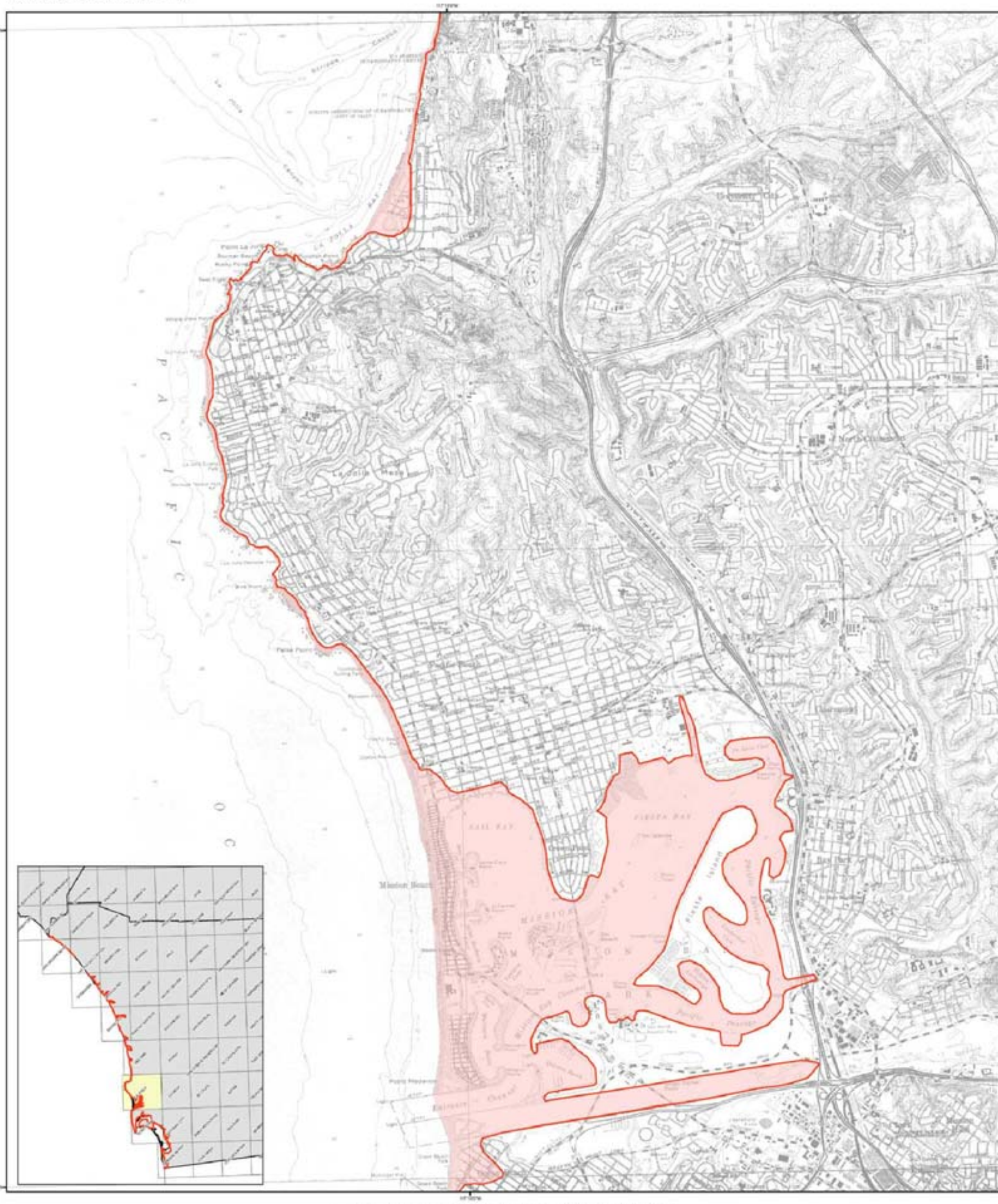
BASE MAP SOURCE:
Adapted from a portion of "City of San Diego Seismic Safety Study, Geologic Hazards & Faults, Grids 20 & 25," dated 4-3-2008.

TerraCosta Consulting Group	TERRACOSTA CONSULTING GROUP ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900	FIGURE NUMBER 7
	PROJECT NAME FIESTA ISLAND PRECISE PLAN ALTERNATIVE 5F	PROJECT NUMBER 2970
	GEOLOGIC HAZARDS & FAULT MAP	

California Emergency Management Agency
California Geological Survey
University of Southern California

Tsunami Inundation Map for Emergency Planning
La Jolla Quadrangle

State of California
County of San Diego



METHOD OF PREPARATION

Initial tsunami modeling was performed by the University of Southern California (USC) Tsunami Research Center funded through the California Emergency Management Agency (CalEMA) by the National Tsunami Hazard Mitigation Program. The tsunami modeling process utilized the MOST (Method of Splitting Tsunamis) computational program (Version 0), which allows for wave evolution over a variable bathymetry and topography used for the inundation mapping (Titov and Gonzalez, 1997; Titov and Synolakis, 1998).

The bathymetric/topographic data that were used in the tsunami models consist of a series of nested grids. Near-shore grids with a 3 arc-second (75- to 90-meters) resolution or higher, were adjusted to "Mean High Water" sea-level conditions, representing a conservative sea level for the intended use of the tsunami modeling and mapping.

A suite of tsunami source events was selected for modeling, representing realistic local and distant earthquakes and hypothetical extreme undersea, near-shore landslides (Table 1). Local tsunami sources that were considered include offshore reverse-thrust faults, restraining bends on strike-slip fault zones and large submarine landslides capable of significant seafloor displacement and tsunami generation. Distant tsunami sources that were considered include great subduction zone events that are known to have occurred historically (1960 Chile and 1964 Alaska earthquakes) and others which can occur around the Pacific Ocean "Ring of Fire."

In order to enhance the result from the 75- to 90-meter inundation grid data, a method was developed utilizing higher-resolution digital topographic data (3- to 10-meters resolution) that better defines the location of the maximum inundation line (U.S. Geological Survey, 1993; Intermap, 2003; NOAA, 2004). The location of the enhanced inundation line was determined by using digital imagery and terrain data on a GIS platform with consideration given to historic inundation information (Lander, et al., 1993). This information was verified, where possible, by field work coordinated with local county personnel.

The accuracy of the inundation line shown on these maps is subject to limitations in the accuracy and completeness of available terrain and tsunami source information, and the current understanding of tsunami generation and propagation phenomena as expressed in the models. Thus, although an attempt has been made to identify a credible upper bound to inundation at any location along the coastline, it remains possible that actual inundation could be greater in a major tsunami event.

This map does not represent inundation from a single scenario event. It was created by combining inundation results for an ensemble of source events affecting a given region (Table 1). For this reason, all of the inundation region in a particular area will not likely be inundated during a single tsunami event.

References:

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TSUNAMI INUNDATION MAP FOR EMERGENCY PLANNING

State of California ~ County of San Diego

LA JOLLA QUADRANGLE

June 1, 2009

SCALE 1:24,000

Table 1: Tsunami sources modeled for the San Diego County coastline.

Sources (M = moment magnitude used in modeled event)		Areas of Inundation Map Coverage and Sources Used		
		Dana Point	Oceanside	San Diego
Local Sources	Carlsbad Thrust Fault		X	X
	Catalina Fault	X	X	X
	Coronado Bank Fault			X
	Lasuen Knoll Fault	X		X
	San Clemente Fault Bend Region			X
	San Clemente Island Fault			X
	San Mateo Thrust Fault	X	X	
	Coronado Canyon Landslide #1			X
Distant Sources	Cascadia Subduction Zone #3 (M9.2)	X		X
	Central Aleutians Subduction Zone#1(M8.9)	X	X	X
	Central Aleutians Subduction Zone#2(M8.9)	X		X
	Central Aleutians Subduction Zone#3(M9.2)	X	X	X
	Chile North Subduction Zone (M9.4)	X		X
	1960 Chile Earthquake (M9.3)	X		X
	1952 Kamchatka Earthquake (M9.0)	X		
	1964 Alaska Earthquake (M9.2)	X	X	X
	Japan Subduction Zone #2 (M8.8)	X		X
	Kuril Islands Subduction Zone #2 (M8.8)	X		X
	Kuril Islands Subduction Zone #3 (M8.8)	X		X
	Kuril Islands Subduction Zone #4 (M8.8)	X		X

Cal EMA

CGS

USC University of Southern California

MAP EXPLANATION

Tsunami Inundation Line

Tsunami Inundation Area

PURPOSE OF THIS MAP

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National Oceanic and Atmospheric Agency Center for Tsunami Research (MOST model):
http://nctr.pmel.noaa.gov/time/background/models.html

MAP BASE

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DISCLAIMER

The California Emergency Management Agency (CalEMA), the University of Southern California (USC), and the California Geological Survey (CGS) make no representation or warranties regarding the accuracy of this inundation map nor the data from which the map was derived. Neither the State of California nor USC shall be liable under any circumstances for any direct, indirect, special, incidental or consequential damages with respect to any claim by any user or any third party on account of or arising from the use of this map.

TerraCosta Consulting Group

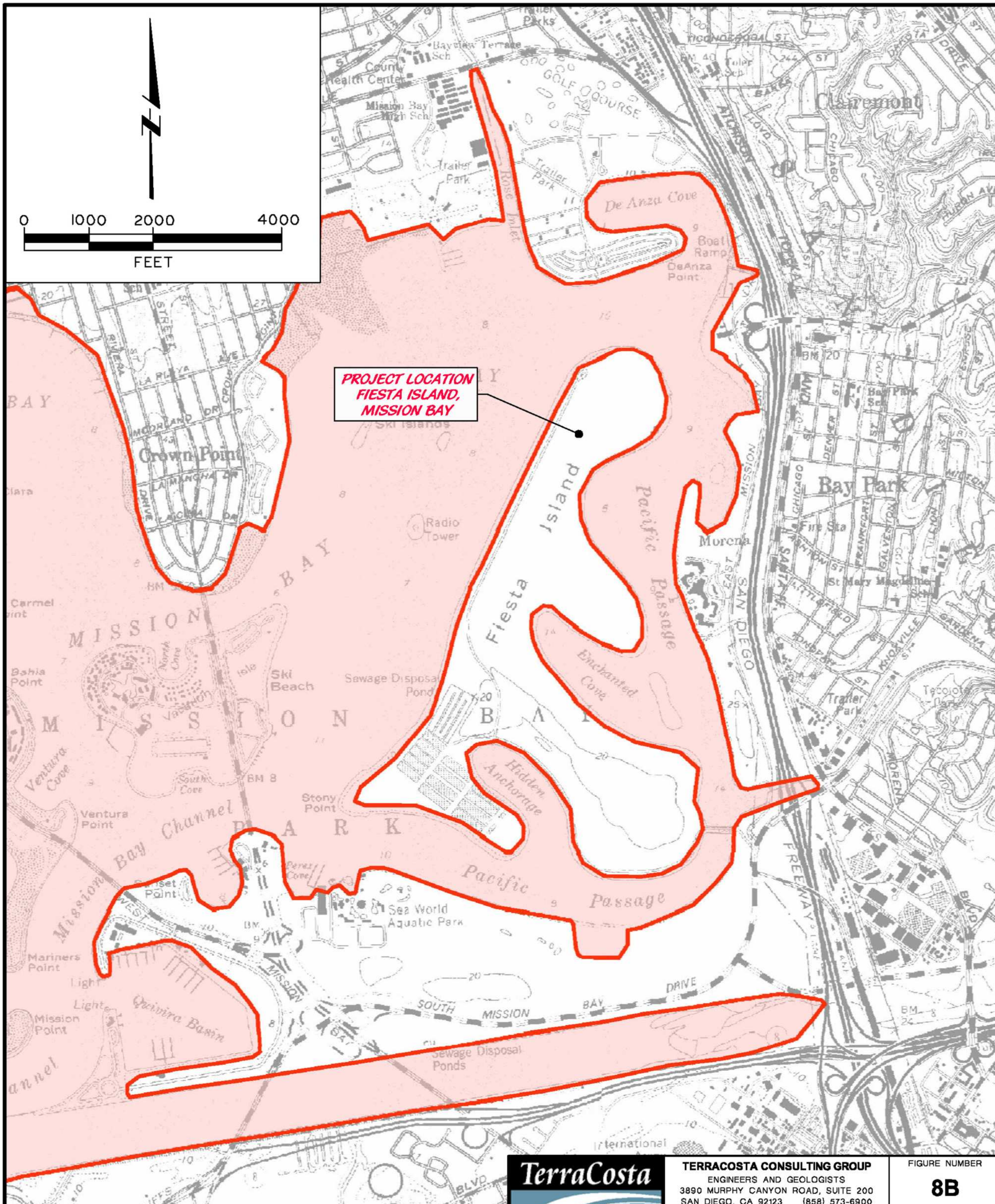
FIGURE NUMBER

8A

PROJECT NUMBER

2970

TSUNAMI INUNDATION MAP LA JOLLA



Reproduced from: "Tsunami Inundation Map for Emergency Planning, La Jolla Quadrangle," by the State of California, County of San Diego, dated June 1, 2009.

TerraCosta Consulting Group

TERRACOSTA CONSULTING GROUP ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900	FIGURE NUMBER **8B**
PROJECT NAME **FIESTA ISLAND PRECISE PLAN ALTERNATIVE 5F**	PROJECT NUMBER **2970**

TSUNAMI INUNDATION MAP

METHOD OF PREPARATION

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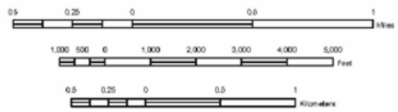
TSUNAMI INUNDATION MAP FOR EMERGENCY PLANNING

State of California ~ County of San Diego

LA JOLLA QUADRANGLE

June 1, 2009

SCALE 1:24,000



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	Lasuen Knoll Fault	X		X
	San Clemente Fault Bend Region			X
	San Clemente Island Fault			X
	San Mateo Thrust Fault	X	X	
	Coronado Canyon Landslide #1			X
Distant Sources	Cascadia Subduction Zone #3 (M9.2)	X		X
	Central Aleutians Subduction Zone#1(M8.9)	X	X	X
	Central Aleutians Subduction Zone#2(M8.9)	X		X
	Central Aleutians Subduction Zone#3(M9.2)	X	X	X
	Chile North Subduction Zone (M9.4)	X		X
	1960 Chile Earthquake (M9.3)	X		X
	1952 Kamchatka Earthquake (M9.0)	X		
	1964 Alaska Earthquake (M9.2)	X	X	X
	Japan Subduction Zone #2 (M8.8)	X		X
	Kuril Islands Subduction Zone #2 (M8.8)	X		X
	Kuril Islands Subduction Zone #3 (M8.8)	X		X
	Kuril Islands Subduction Zone #4 (M8.8)	X		X

Cal EMA CALIFORNIA EMERGENCY MANAGEMENT AGENCY

CGS CALIFORNIA GEOLOGICAL SURVEY

USC UNIVERSITY OF SOUTHERN CALIFORNIA

MAP EXPLANATION

Tsunami Inundation Line

Tsunami Inundation Area

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State of California Geological Survey Tsunami Information:
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DISCLAIMER

TerraCosta Consulting Group

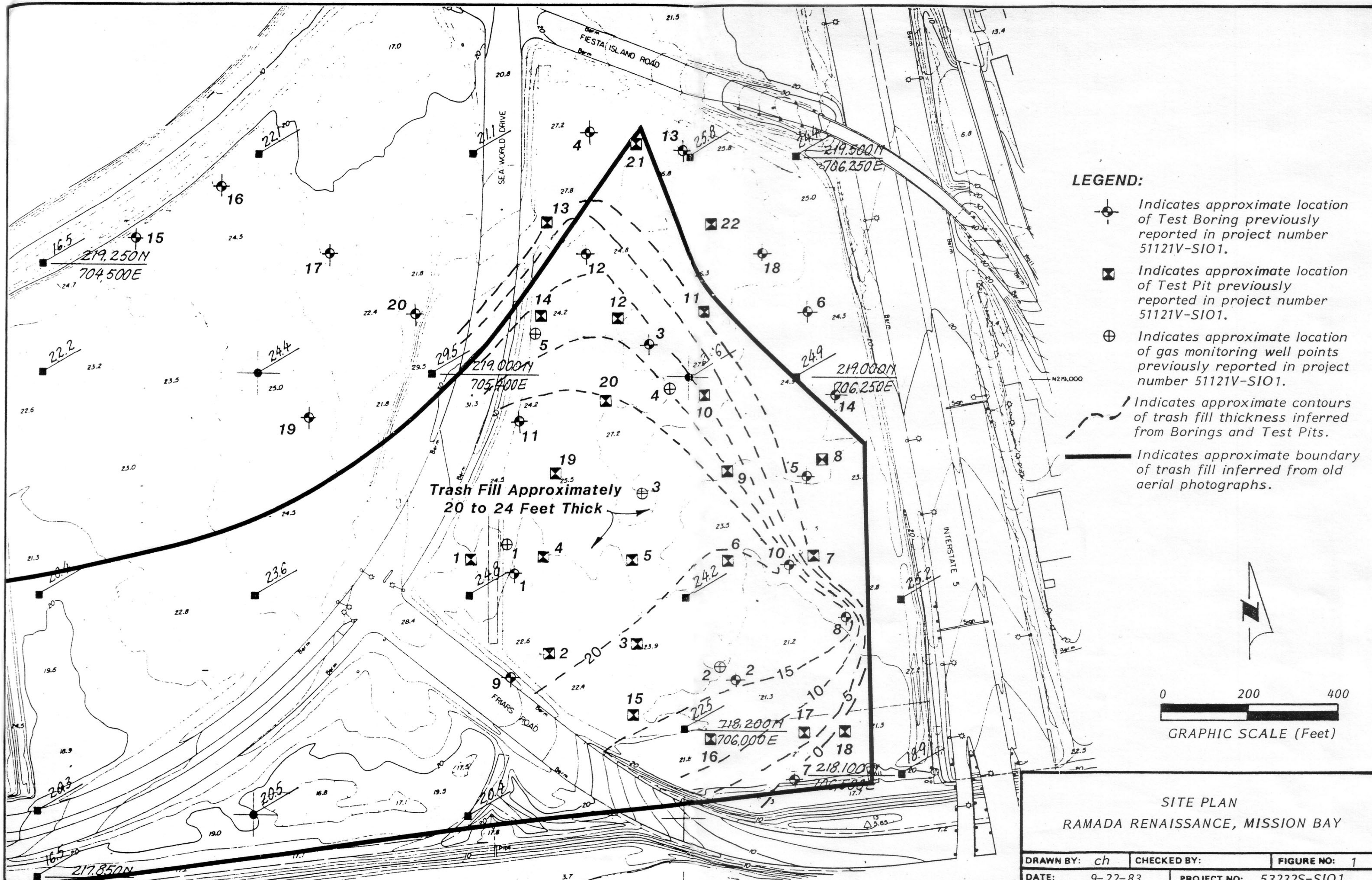
TERRACOSTA CONSULTING GROUP
ENGINEERS AND GEOLOGISTS
3890 MURPHY CANYON ROAD, SUITE 200
SAN DIEGO, CA 92123 (858) 573-6900

FIGURE NUMBER	PROJECT NAME	PROJECT NUMBER
8C	FIESTA ISLAND PRECISE PLAN ALTERNATIVE 5F	2970

TSUNAMI INUNDATION MAP LEGEND

APPENDIX A

SITE PLAN AND LOGS FROM TEST BORINGS
BY WOODWARD-CLYDE CONSULTANTS
FOR PROPOSED "MISSION BAY PARK RESORT"
SEPTEMBER 27, 1983



WOODWARD-CLYDE CONSULTANTS

Location | Boring Number | Elevation

DEPTH IN FEET	TEST DATA			*OTHER TESTS	SAMPLE NUMBER	SOIL DESCRIPTION
	*MC	*DD	*BC			
	12	110	65		1	Very dense, damp, brown silty sand (SM)
					2	

WATER LEVEL
At time of drilling or as indicated.

SOIL CLASSIFICATION
Soil Classifications are based on the Unified Soil Classification System and include color, moisture and consistency. Field descriptions have been modified to reflect results of laboratory analyses where appropriate.

DISTURBED SAMPLE LOCATION
Obtained by collecting the auger cuttings in a plastic or cloth bag.

DRIVE SAMPLE LOCATION
MODIFIED CALIFORNIA SAMPLER
Sample with recorded blows per foot was obtained with a Modified California drive sampler (2" inside diameter, 2.5" outside diameter) lined with sample tubes. The sampler was driven into the soil at the bottom of the hole with a 140 pound hammer falling 30 inches.

SPLIT SPOON SAMPLER
Sample with recorded blows per foot was obtained with a Split Spoon wampler (1-3/8" inside diameter. 2" outside diameter) The sampler was driven into the soil at the bottom of the hole with a 140 pound hammer falling 30".

INDICATES SAMPLE TESTED FOR OTHER PROPERTIES

- GS – Grain Size Distribution
- LC – Laboratory Compaction Test
- PI – Atterberg Limits Test
- ST – Loaded Swell Test
- CC – Confined Compression Test
- CT – Consolidation Test
- UCS – Unconfined Compression Test
- SDS – Slow Direct Shear Test
- DS – Direct Shear Test
- TX – Triaxial Compression Test
- 'R' – R-Value

NOTE: In this column the results of these tests may be recorded where applicable.

BLOW COUNT
Number of blows needed to advance sampler one foot or as indicated.

DRY DENSITY
Pounds per Cubic Foot

MOISTURE CONTENT
Percent of Dry Weight

NOTES ON FIELD INVESTIGATION

1. REFUSAL indicates the inability to extend excavation, practically, with equipment being used in the investigation.

KEY TO LOGS MISSION BAY PARK RESORT				
DRAWN BY: mrk	CHECKED BY:	PROJECT NO: 51121V-SI01	DATE: 4-21-81	FIGURE NO: A-1

WOODWARD-CLYDE CONSULTANTS

Boring 15

Approximate El. 24'

DEPTH IN FEET	TEST DATA •MC	•DD	•BC	•OTHER TESTS	SAMPLE NUMBER	SOIL DESCRIPTION
0–30						Loose to medium dense, moist, gray interbeds of silty fine sand and sandy silt; micaceous HYDRAULIC FILL
~3.5			10		15-1	
~8.5			5		15-2	
~13.5			5		15-3	
~18.5			7		15-4	
~23.5			13		15-5	
~28.5			9		15-6	
30						Bottom of Hole

•For description of symbols, see Figure A-1

LOG OF TEST BORING 15
MISSION BAY PARK RESORT

DRAWN BY: mrk | CHECKED BY: [illegible] | PROJECT NO: 51121V-SI01 | DATE: 4-17-81 | FIGURE NO: A-26

WOODWARD-CLYDE CONSULTANTS

Boring 16

Approximate El. 24'

DEPTH IN FEET	TEST DATA *MC	*DD	*BC	*OTHER TESTS	SAMPLE NUMBER	SOIL DESCRIPTION
0–2						Loose, moist, light brown silty fine sand; micaceous HYDRAULIC FILL
2–6	65		4	LL=79 PI=47	16-1	Loose, moist, dark gray, sandy silt to sandy clay; micaceous HYDRAULIC FILL
6–29			13		16-2	Loose to medium dense, light brown to gray interbeds of silty fine sand and sandy silt to clay; micaceous HYDRAULIC FILL
			9		16-3	
			19		16-4	▽
			*		16-5	*Hammer pumping water, inaccurate blow counts
29–36						Medium dense, saturated, dark gray sandy clay and silt (ML-CL); micaceous ALLUVIAL DEPOSITS
36–40	53		*	GS	16-6	Medium dense to dense, saturated, light brown to gray silty fine to coarse sand (SM-SP) with scattered gravels and pebbles ALLUVIAL DEPOSITS

Continued on Next Page

*For description of symbols, see Figure A-1

LOG OF TEST BORING 16
MISSION BAY PARK RESORT

DRAWN BY: mrk	CHECKED BY: [illegible]	PROJECT NO: 51121V-SI01	DATE: 4-17-81	FIGURE NO: A-27

WOODWARD-CLYDE CONSULTANTS

DEPTH IN FEET	TEST DATA *MC	*DD	*BC	*OTHER TESTS	SAMPLE NUMBER	SOIL DESCRIPTION
						Medium dense to dense, saturated, light brown to gray silty fine to coarse sand (SM-SP) with scattered gravels and pebbles ALLUVIAL DEPOSITS
45						Becoming very dense
			50/4"		16-7	
50						Dense, saturated, dark gray, fine sandy silt (ML); micaceous ALLUVIAL DEPOSITS
55						
60						
65						
70						
75						
80						

*For description of symbols, see Figure A-1

LOG OF TEST BORING 16 (CONT'D)
MISSION BAY PARK RESORT

DRAWN BY: mrk	CHECKED BY:	PROJECT NO: 51121V-SI01	DATE: 4-17-81	FIGURE NO: A-28

WOODWARD-CLYDE CONSULTANTS

Boring 17

Approximate El. 22'

DEPTH IN FEET	TEST DATA *MC	*DD	*BC	*OTHER TESTS	SAMPLE NUMBER	SOIL DESCRIPTION
						Loose, moist, gray, fine sandy silt and clay with some silty sand HYDRAULIC FILL
			4		17-1	
5						
			6		17-2	
10						
			5		17-3	
15						
20						
						Dense, saturated, light gray silty fine to medium sand (SM-SP) ALLUVIAL DEPOSITS
			33		17-4	
25						
30						
						Stiff, saturated, dark gray sandy silt and clay (ML-CL); micaceous ALLUVIAL DEPOSITS
			14		17-5	
35						
40						

Continued on Next Page

*For description of symbols, see Figure A-1

LOG OF TEST BORING 17
MISSION BAY PARK RESORT

DRAWN BY: mrk	CHECKED BY: [illegible]	PROJECT NO: 51121V-SI01	DATE: 4-17-81	FIGURE NO: A-29

WOODWARD-CLYDE CONSULTANTS

Boring 17 (Continued)

DEPTH IN FEET	TEST DATA *MC	*DD	*BC	*OTHER TESTS	SAMPLE NUMBER	SOIL DESCRIPTION
						Stiff, saturated, dark gray, sandy silt and clay (ML-CL); micaceous ALLUVIAL DEPOSITS
			64		17-6	
45						
50						Shell fragments
			29		17-7	
55						Bottom of Hole
60						
65						
70						
75						
80						

*For description of symbols, see Figure A-1

LOG OF TEST BORING 17 (CONT'D)
MISSION BAY PARK RESORT

DRAWN BY:	CHECKED BY:	PROJECT NO:	DATE:	FIGURE NO:
mrk		51121V-SI01	4-17-81	A-30

WOODWARD-CLYDE CONSULTANTS

Boring 19

Approximate El. 25'

DEPTH IN FEET	TEST DATA *MC	*DD	*BC	*OTHER TESTS	SAMPLE NUMBER	SOIL DESCRIPTION
					19-1	Loose, moist, light brown silty fine sand; micaceous HYDRAULIC FILL
			8		19-2	
5						Loose, moist, gray fine sandy silt and clay; micaceous HYDRAULIC FILL
			12		19-3	Medium dense, moist, light brown to gray silty fine sand; micaceous HYDRAULIC FILL
10						
						Medium dense, damp, gray fine sandy silt and clay (ML-CL) with interbeds of silty fine sand (SM); micaceous ALLUVIAL DEPOSITS
15						
20						
25						▽
30						Bottom of Hole
35						
40						

*For description of symbols, see Figure A-1

LOG OF TEST BORING 19
MISSION BAY PARK RESORT

DRAWN BY: mrk	CHECKED BY:	PROJECT NO: 51121V-SI01	DATE: 4-17-81	FIGURE NO: A-34

WOODWARD-CLYDE CONSULTANTS

Boring 20

Approximate El. 21'

DEPTH IN FEET	TEST DATA *MC	*DD	*BC	*OTHER TESTS	SAMPLE NUMBER	SOIL DESCRIPTION
				"R"	20-1	Loose to medium dense, moist, light brown silty fine sand with shell fragments HYDRAULIC FILL
			18		20-2	
5						
						Loose, moist, gray, fine sandy silt; micaceous HYDRAULIC FILL
			6		20-3	
10						Bottom of Hole
15						
20						
25						
30						
35						
40						

*For description of symbols, see Figure A-1

LOG OF TEST BORING 20
MISSION BAY PARK RESORT

DRAWN BY: mrk	CHECKED BY:	PROJECT NO: 51121V-SI01	DATE: 4-17-81	FIGURE NO: A-35

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