

GEOLOGIC STUDY
BARRIO LOGAN COMMUNITY PLAN UPDATE PEIR
SAN DIEGO, CALIFORNIA

Prepared for:

RECON Environmental

1927 Fifth Avenue
San Diego, California 92101

Project No. 042608-001

October 19, 2012



Leighton and Associates, Inc.

A LEIGHTON GROUP COMPANY



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To: RECON Environmental, Inc.
1927 Fifth Avenue
San Diego, California 92101

Attention: Ms. Donna Steel

Subject: Geologic Study, Barrio Logan Community Plan Update PEIR, San Diego, California

In accordance with your request and authorization, Leighton and Associates, Inc. (Leighton) has performed a geologic study for the Barrio Logan Community Plan Update Programmatic EIR (PEIR), San Diego, California. The accompanying report presents a summary of our study and provides our findings, conclusions, and recommendations regarding the subject community plan area.

If you have any questions regarding our report, please do not hesitate to contact me directly at (858) 300-4090. We appreciate this opportunity to be of service.

Respectfully submitted,

LEIGHTON AND ASSOCIATES, INC.



Robert C. Stroh, CEG 2099
Senior Engineering Geologist

Distribution: (1) Addressee

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
1.0 INTRODUCTION.....	1
1.1 PURPOSE AND SCOPE OF SERVICES.....	1
2.0 COMMUNITY PLAN AREA CONDITIONS.....	3
2.1 SITE RECONNAISSANCE.....	3
2.1.1 Existing Improvements	3
2.1.2 Site Conditions	3
2.2 GEOLOGIC AND TECTONIC SETTING	4
2.3 LOCAL GEOLOGIC SETTING.....	5
2.3.1 Fill Soils (Qaf).....	5
2.3.2 Young Alluvial Deposits (Qya).....	6
2.3.3 Old Paralic Deposits (Map Symbol – Qop6)	6
2.4 LOCAL SEISMIC SETTING	6
2.5 MAPPED FAULT AND HAZARD ZONES.....	7
2.6 GROUND WATER	8
2.7 MINERAL RESOURCES.....	8
2.8 EROSION.....	8
3.0 POTENTIAL GEOLOGIC HAZARDS	10
3.1 SEISMIC HAZARDS	10
3.1.1 Surface Rupture	10
3.1.2 Strong Ground Motion	10
3.1.3 Liquefaction and Seismic Settlement	13
3.1.4 Lateral Spread.....	13
3.1.5 Tsunamis and Seiches	14
3.2 LANDSLIDES	14
3.3 FLOOD HAZARD	15
3.4 EXPANSIVE SOILS	15
3.5 CORROSIVE SOILS	16
4.0 POTENTIAL IMPACTS AND MITIGATION MEASURES	17
4.1 SEISMIC HAZARDS	17
4.2 POTENTIAL INCREASE OF EROSION AND LOSS OF TOPSOIL.....	18
4.3 POTENTIAL DEVELOPMENT ON UNSTABLE SOILS	19
5.0 LIMITATIONS.....	21



TABLE OF CONTENTS (Continued)

FIGURES

FIGURE 1 – SITE LOCATION MAP, REAR OF TEXT

FIGURE 2 – ROSE CANYON FAULT MAP, REAR OF TEXT

APPENDICES

APPENDIX A – REFERENCES

APPENDIX B – ASFE SHEET

PLATES

PLATE 1 – GEOLOGY MAP

PLATE 2 – GEOHAZARDS MAP



1.0 INTRODUCTION

In accordance with your request and authorization, Leighton and Associates, Inc. (Leighton) has performed a geologic study for the Barrio Logan Community Plan Update Programmatic EIR (PEIR), San Diego, California. Specifically, the community is positioned between Downtown San Diego to the north, Interstate 5 to the east, the Unified Port of San Diego and United States Naval Base San Diego along San Diego Bay to the west, and National City to the south (Figure 1).

The recommendations contained in this report are subject to the limitations presented in Section 5.0. An information sheet prepared by ASFE (the Association of Engineering Firms Practicing in the Geosciences) is also included as Appendix B. We recommend that all individuals using this report read the limitations along with the attached document.

1.1 Purpose and Scope of Services

The purpose of our limited study was to evaluate geologic and seismic conditions for the community plan area using available geologic and geotechnical data and to provide a limited geotechnical and seismic evaluation report including providing two GIS based plates summarizing geologic conditions and hazards in the study area. It is our understanding that this study is to not consider the land areas associated with the Port of San Diego and Naval Station San Diego along the western portion of the community. We further understand that information from this report will be used in the preparation of the Barrio Logan Community Plan Update PEIR.

Based on our understanding of the project, we completed three general tasks; Task 1 provided this desktop geology study for the Barrio Logan Community; Task 2 performed an analysis of potential geologic impacts/hazards and mitigation measures; and, Task 3 provided a GIS based geologic map and geohazards map of the Barrio Logan Community. Specifically, Leighton's scope of work consisted of:

- Researching in-house and published geotechnical, geologic, and seismic reports and maps of the area;
- A reconnaissance of the general community plan area area by our engineering geologist to observe surface features and community plan area geologic conditions;
- Stereoscopic analysis of air photos for assisting in the geologic interpretation and identification of faults and other potential hazard-related features;



- Evaluation of geologic conditions from our community plan area visit and data review; and
- Preparation of this written report with a description of the regional and community plan area geology including a geologic map, conclusions, and recommendations regarding geologic hazards in the Community Plan area.

Subsurface exploration and laboratory testing of soil materials were not included in the scope of this limited evaluation.



2.0 COMMUNITY PLAN AREA CONDITIONS

2.1 Site Reconnaissance

A California Certified Engineering Geologist (CEG) from this office conducted a geologic reconnaissance of the Community Plan Area on July 13, 2012 to evaluate and document current community site area conditions. The community is a generally rectangular-shaped area positioned between Downtown San Diego to the north, Interstate 5 to the east, the Unified Port of San Diego and United States Naval Base San Diego along San Diego Bay to the west, and National City to the south (Figure 1).

2.1.1 Existing Improvements

Barrio Logan comprises approximately 1,000 acres. Specifically, Barrio Logan's land use consists of a mixture of maritime and service industrial uses; single family and multi-family residential uses; locally-oriented and chain retail; and open space and community facilities. In addition the community is dissected by freeways to the north and east, and a railroad to the west (Figure 1). Approximately 50 percent of the community area is contained within the properties of the Unified Port of San Diego and United States Naval Base San Diego along San Diego Bay to the west.

2.1.2 Site Conditions

The community plan area is located in an essentially level portion of the San Diego area referred to as Barrio Logan at an average elevation of approximately 40 feet above mean sea level (msl). Topography within the community plan area descends approximately 75 feet msl from the northeast to approximately 10 feet msl to the southwest. The most significant slopes within the community plan area are embankment slopes associated with grading along Interstate 5. In general these slopes have a maximum of 2:1 (horizontal to vertical) inclination and a maximum height of approximately 50 feet near Commercial Street. The western most portion of the community plan area is generally gently sloping toward the southwest. Drainage gradients across the community generally appear to flow gently toward the southwest to south. Las Chollas Creek and South Las Chollas Creek transect the southern portion of the community and have a southwesterly drainage gradient. At the time of our site visit we noted minor flowing water was present in the both creeks.



2.2 Geologic and Tectonic Setting

The project area is situated in the Peninsular Ranges Geomorphic Province. This geomorphic province encompasses an area that extends approximately 900 miles from the Transverse Ranges and the Los Angeles Basin south to the southern tip of Baja California, and varies in width from approximately 30 to 100 miles (Norris and Webb, 1990). The province is characterized by mountainous terrain on the east composed mostly of Mesozoic igneous and metamorphic rocks, and relatively low-lying coastal terraces to the west underlain by late Cretaceous-age, Tertiary-age, and Quaternary-age sedimentary units. Most of the coastal region of the County of San Diego, including the community plan area, occur within this coastal region and are underlain by sedimentary units. Specifically, the subject community plan area is located within the coastal plain section of the Peninsular Range Geomorphic Province of California, which generally consists of subdued landforms underlain by sedimentary bedrock.

The Peninsular Ranges are traversed by several major active faults. The Whittier-Elsinore, San Jacinto, and the San Andreas faults are major active fault systems located east of the community plan area, and the Rose Canyon, Newport-Inglewood (offshore), and Coronado Bank are active faults located west to southwest of the community plan area (Jennings, 1994).

In Southern California, approximately 50 mm/yr of dextral shear is accommodated across the broad Pacific-North American plate margin (DeMets, et al., 1990), collectively termed the San Andreas fault system. San Diego lies within this fractured margin, resulting in the potential for both local and regional seismic sources. At the latitude of San Diego, strain in southern California and northern Baja California is principally expressed as northwest-trending slivers of crystalline rock separated by the several active faults of the system.

The principal known onshore faults in southernmost California are the San Andreas, San Jacinto, Elsinore, Imperial and Rose Canyon faults, which collectively transfer the majority of this deformation, about 40-45 mm/yr (Savage et al., 1979). The balance of the plate margin slip, about 5-7 mm/yr, is taken by the offshore zone of faults which include the Coronado Bank, Descanso, San Diego Trough, and San Clemente faults off of the San Diego and northern Baja California coastline (Legg, 1985; Rockwell et al., 1993). Most of the offshore faults coalesce south of the international border, where they come onshore as the Agua Blanca fault which transects the Baja California peninsula (Rockwell et al., 1993). These faults, as well as other faults in the region, have the potential for generating strong ground motions at the project community plan area.



2.3 Local Geologic Setting

The community plan area is located near the western limits of a broad structural trough formed by downwarping and normal faulting along the Rose Canyon fault system. To the north and east of Barrio Logan, the early Pleistocene-age Lindavista Formation unconformably overlies the Pliocene-age San Diego Formation. Both the Lindavista and San Diego Formations are generally overlain in the community plan area by the middle to late Pleistocene-age Bay Point Formation (Kennedy, 1975), which generally consists of weakly to moderately cemented sandstone, siltstone, and gravel conglomerates.

Historically, the late Pleistocene marine and non-marine terrace deposits in the downtown San Diego area have been referred to as the Bay Point Formation. Geologic mapping by Kennedy (1975) indicate that the subject community plan area is underlain by the late Pleistocene-age Bay Point Formation, which represents an estuarine and nearshore terrestrial environment. Generally these deposits consist of fossiliferous nearshore fine- to medium-grained sandstones, channel gravel-conglomerates, and estuarine siltstones/claystones.

Geologic mapping by Kennedy and Tan (2008), has revised some of the geologic units in the downtown San Diego Area and elsewhere within the San Diego Metropolitan area. Specifically, the Bay Point Formation has been re-grouped as an old surficial deposit. The new unit classification assigned to the Bay Point Formation in this recent publication is now “Old Paralic Deposit – Qop6”, which correlates to the Nester Terrace (which was laid down approximately 125,000 years ago). Therefore, for the purpose of this study, we will refer to the surficial geologic units exposed at the community plan area as “paralic deposits”. Specifically, within the community plan area, these paralic deposits overlie the San Diego Formation.

A brief description of geologic units mapped by Kennedy and Tan (2008) within the community area is presented below. A geologic map depicting the areal extent of each unit is presented on Plate 1.

2.3.1 Fill Soils (Qaf)

Deposits of fill resulting from human construction activities; includes compacted engineered and non-compacted non-engineered fill. Some large deposits are mapped (specifically along the eastern portion of the San Diego Bay), but in some areas no deposits are shown. As previously mentioned fills are associated with grading along the Interstate 5 corridor. In addition, hydraulic and mechanical non-engineered fills have been placed along the eastern portion of the San Diego Bay that encroach into



the northwestern portion of the community area and locally in the southern portion of the community area.

2.3.2 Young Alluvial Deposits (Qya)

These units consist of mostly poorly consolidated, poorly sorted, permeable flood plain deposits composed of sands to silt and clay (Holocene and late Pleistocene in age). In general this unit is slightly to moderately dissected. This unit has upper surfaces that are capped by slight to moderately developed pedogenic-soil profiles.

2.3.3 Old Paralic Deposits (Map Symbol – Qop6)

Middle to late Pleistocene-aged paralic deposits underlie the majority of the community plan area. These deposits primarily consist interfingered strandline, beach, estuarine and colluvial deposits composed of dark reddish brown to brown, dense to very dense, fine- to medium-grained, silty to clayey sandstone with interbedded siltstone, sandstone and conglomerate.

2.4 Local Seismic Setting

During the late Pliocene, several new faults developed in Southern California, creating a new tectonic regime superposed on the flat-lying section of Tertiary and late Cretaceous rocks in the San Diego region. One of these fault systems is the Rose Canyon Fault Zone.

The Rose Canyon Fault Zone, which bisects the City of San Diego, was first recognized by Fairbanks (1893). He described the feature as an area of uplifting or folding from La Jolla Bay to the Soledad Hills. Since that time, numerous others have mapped the Rose Canyon Fault and have attributed the formation of several physiographic features such as, Mount Soledad, Mission Bay, and San Diego Bay to the activity along the fault. The Rose Canyon Fault Zone (RCFZ) consists of predominantly right-lateral strike-slip faults that extend southwest to southeast through the San Diego metropolitan area (Figure 2). Movement along the fault zone is generally complex and consists of various combinations of oblique, normal and strike-slip motion. The fault zone extends offshore at La Jolla and continues north-northwest subparallel to the coastline. To the south in the San Diego downtown area the fault zone appears to splay out into a group of generally right-normal oblique faults extending into San Diego Bay (Treiman, 1993).



South of downtown San Diego, the major faults making up the southern end of the Rose Canyon fault zone are the Spanish Bight, Coronado, and Silver Strand faults. The east side of the zone is represented by the La Nacion Fault (Treiman, 1993). Together, these faults define a wide and complexly faulted basin occupied by San Diego Bay and a narrow section of the continental shelf west of the Silver Strand.

Geologic maps covering the Community Plan Area (see References), and fault maps by Treiman (1993) and CGS (2003) indicate that the northern most portions of the community plan area are underlain by active or potentially active faults.

2.5 Mapped Fault and Hazard Zones

By definition of the California Mining and Geology Board has defined an active fault has a fault which has had surface displacement within Holocene time (about the last 11,000 years). The State Geologist has defined a potentially active fault as any fault considered to have been active during Quaternary time (last 1,600,000 years). This definition is used in delineating Special Studies Zones as mandated by the Alquist-Priolo Geologic Hazards Zones Act of 1972 and as subsequently revised in 1975, 1985, 1990, 1992, 1994, 1997, and 2007 (CGS, 2007)). The intent of this act is to assure that unwise urban development does not occur across the traces of active faults.

Within downtown San Diego, there are currently two recognized areas of active faulting, the Downtown Graben and the San Diego Fault. Specifically, the community plan area is located approximately 4,000 feet southeast of the San Diego Fault (CGS, 2003). However, the northern portion of the community plan area is transected by the Downtown Graben.

In 2003, the California Geologic Survey (CGS) revised the existing fault zones that were originally established in 1991. Included in this revision were the addition of the Silver Strand, Coronado, Spanish Bight and San Diego Faults as active Earthquake Fault Zones (EFZ), and an extension to the south of the EFZ located in downtown San Diego. Plate 2 shows the currently revised boundaries of the EFZ's. The northern most portion of the community plan area is located within a State mapped EFZ, also mapped as City of San Diego Zone 11.

Also, in response to recognized active faulting in the downtown San Diego Metropolitan area, the City of San Diego created a Downtown Special Study Zone (Zone 13) for the evaluation of area faulting (Plate 2). The City has added this downtown zone as an amendment to the utilized 1991 Uniform Building



Code thus requiring that a fault study be performed prior to community plan area development or a change in use affecting ownership or human habitation within that zone. Although similar to the State definition, the City of San Diego (1999) defines a Potentially Active fault, as a fault that has had activity within the last 1.6 million years (Quaternary Period) and can be demonstrated to be inactive during the last 11,000 years (Holocene Epoch). The northern roughly half of the community plan area is located within the City Downtown Special Study Zone.

Additionally, our review of the City of San Diego Seismic Safety Study – Geologic Hazards and Faults, dated 2008, indicates that the community plan area is also located in Zones 31, 32, and 52. The following are descriptions for the various zones within mapped within the community: Zone 31 High Potential for Liquefaction, shallow groundwater, major drainages, hydraulic fills; Zone 32 Low Potential for Liquefaction, fluctuating groundwater, minor drainages; and Zone 52 is described as other level areas, gently sloping to steep terrain, favorable geologic structure, and low risk, respectively.

2.6 Ground Water

Seeps, springs, or other surface indications of shallow ground water were not indicated in our background review or observed during our community plan area visit. Based on our review, the depth to ground water is anticipated to range from 10 feet to roughly 60 feet below the existing ground surface. In general, shallow ground water levels are located near the San Diego Bay and creeks. The ground water table may fluctuate with seasonal variations and irrigation and local perched conditions may exist.

2.7 Mineral Resources

There are no active mines and no known areas with mineral resource deposits within the community plan area. Also, no minerals or aggregate resources of statewide importance are located within the community plan area.

2.8 Erosion

The NRCS classifies soils based on the hazard of soil loss from off-road and off-trail areas after disturbance activities that expose the soil surface. Erosion hazard is described as “slight,” “moderate,” “severe,” or “very severe.” A rating of slight indicates that erosion is unlikely under ordinary climatic conditions; moderate indicates that some erosion is likely under ordinary climatic conditions and that erosion-control measures may be needed; severe indicates that erosion is very



likely and that erosion-control measures, including revegetation of bare areas, are advised; and very severe indicates that significant erosion is expected, loss of soil productivity and off-site damage are likely, and erosion-control measures are costly and generally impractical.

The potential for soil erosion is variable throughout the community plan area. Soil with high amounts of silt can be easily eroded, while sandy soils are less susceptible to erosion. Erosion is most likely on sloped areas with exposed soil, especially where unnatural slopes are created by cut-and-fill activities. Typically, the soil erosion potential is reduced once the soil is graded and covered with concrete, structures, or asphalt.



3.0 POTENTIAL GEOLOGIC HAZARDS

Potential geologic hazards across the community plan area may include, surface rupture, seismic shaking, landslides, liquefaction, seismically induced settlement, flooding, and expansive and corrosive soils. The following sections discuss these hazards and their potential in more detail:

3.1 Seismic Hazards

Severe ground shaking is most likely to occur during an earthquake on one of the regional active faults in Southern California. The effect of seismic shaking may be mitigated by adhering to the California Building Code or state-of-the-art seismic design parameters of the Structural Engineers Association of California. Secondary effects associated with severe ground shaking following a relatively large earthquake which may affect the site shallow ground rupture, soil liquefaction and dynamic settlement, lateral spreading, seiches, and tsunamis. These secondary effects of seismic shaking are discussed in the sections below.

3.1.1 Surface Rupture

As previously discussed, Potentially Active or Active faults are mapped transecting or projecting toward the northern portions of the Community Plan area. Therefore, due to the presence of mapped of active faults within the community plan area, surface rupture hazard due to faulting is considered possible.

Ground lurching is defined as movement of low density soil materials on a bluff, steep slope, or embankment due to earthquake shaking. Since the community plan area is generally level to gently sloping, the general risk of ground lurching is low.

3.1.2 Strong Ground Motion

Like all of Southern California, severe ground shaking is most likely to occur during an earthquake on one of the regional active faults in the area. The effect of seismic shaking may be mitigated by adhering to the California Building Code or state-of-the-art seismic design parameters of the Structural Engineers Association of California.

As discussed above, the Rose Canyon Fault, located along the northern portion and west of the community plan area, is the 'active' fault



considered having the most significant effect at the community plan area from a design standpoint due to the close proximity. Based on a deterministic analysis, a maximum credible earthquake of moment magnitude M7.2 on the fault could produce an estimated peak horizontal ground acceleration of 0.66g within the community plan area.

The most commonly used magnitude scale today is the moment magnitude (M_w) scale. Moment magnitude is related to the physical size of fault rupture and the movement (displacement) across the fault, and it is therefore a more uniform measure of the strength of an earthquake. The seismic moment of an earthquake is determined by the resistance of rocks to faulting multiplied by the area of the fault that ruptures and by the average displacement that occurs across the fault during the earthquake. The seismic moment determines the energy that can be radiated by an earthquake and hence the seismogram recorded by a modern seismograph (CGS, 2002). With regard to the active faults located within and adjacent to the Community Plan Area, the Rose Canyon Fault, the Coronado Bank Fault, and the Newport-Inglewood (offshore) Fault are capable of producing earthquakes having magnitudes of 7.2, 7.6, and 7.1, respectively (Blake, 2000).

The most commonly used scale to measure earthquake intensities (ground shaking and damage) is the Modified Mercalli Intensity (MMI) Scale, which measures the intensity of an earthquake's effects in a given locality and is based on observations of earthquake effects at specific places. On the Modified Mercalli Intensity Scale, values range from I to XII (see Table 1). While an earthquake has only one magnitude, it can have various intensities, which decrease with distance from the epicenter (CGS, 2002). With regard to the active faults located within and adjacent to the Community Plan Area, the Rose Canyon Fault, the Coronado Bank Fault, and the Newport-Inglewood (offshore) Fault are capable of producing Mercalli Intensities of up to approximately XI, IX, VII, respectively (Blake, 2000).

Table 1 below provides descriptions of the effects of ground shaking intensities along with a general range of moment magnitudes that are often associated with those intensities.



TABLE 1
EFFECTS OF RICHTER MAGNITUDE AND MODIFIED MERCALLI INTENSITY

Richter Magnitude	Modified Mercalli Scale	Effects of Intensity
1.0 – 3.0	I	I. Not felt except by a very few under especially favorable conditions.
3.0 – 3.9	II – III	II. Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing. III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
4.0 – 4.9	IV – V	IV. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably. V. Felt by nearly everyone, many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbances of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop.
5.0 – 5.9	VI – VII	VI. Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight. VII. Everybody runs outdoors. Damage negligible in building of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motor cars.
6.0 – 6.9	VIII – IX	VIII. Damage slight in specially designed structures; considerable in ordinary substantial buildings, with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving motor cars disturbed. IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.
7.0 and higher	X or higher	X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks. XI. Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly. XII. Damage total. Practically all works of construction are damaged greatly or destroyed. Waves seen on ground surface. Lines of sight and level are distorted. Objects are thrown upward into the air.

Modified From: CGS, 2002



3.1.3 Liquefaction and Seismic Settlement

The term liquefaction describes a phenomenon in which saturated, cohesionless soils temporarily lose shear strength (liquefy) due to increased pore water pressures induced by strong, cyclic ground motions during an earthquake. Structures founded on or above potentially liquefiable soils may experience bearing capacity failures due to the temporary loss of foundation support, vertical settlements (both total and differential), and undergo lateral spreading. The factors known to influence liquefaction potential include soil type, relative density, grain size, confining pressure, depth to groundwater, and the intensity and duration of the seismic ground shaking. The cohesionless soils most susceptible to liquefaction are loose, saturated sands and some silts.

The majority of the community plan area located east of the BNSF and San Diego Trolley tracks is underlain at depth by dense to cemented sandstone materials of Old Paralic Deposits. Based on the dense nature of the Old Paralic Deposits, it is our opinion that the overall potential for liquefaction and seismic related settlement is generally low within the community plan area. However, locally within minor drainages of Chollas Creek, and along the western portion of the San Diego Bay located generally west of the tracks there is a potential for liquefaction to occur within young alluvium and non-compacted fill during strong ground motion.

3.1.4 Lateral Spread

Empirical relationships have been derived to estimate the magnitude of lateral spread due to liquefaction. These relationships include parameters such as earthquake magnitude, distance of the earthquake from the community plan area, slope height and angle, the thickness of liquefiable soil, and gradation characteristics of the soil.

The overall susceptibility to earthquake-induced lateral spread is considered to be generally low for the community plan area because of the generally low susceptibility to liquefaction and relatively level ground surface in the community plan area vicinity. However, locally along the eastern portion of the San Diego Bay, generally west of the tracks, there is a potential for lateral spreading to occur within young alluvium and non-compacted fill during strong ground motion.



3.1.5 Tsunamis and Seiches

Tsunamis are long wavelength seismic sea waves (long compared to the ocean depth) generated by sudden movements of the ocean bottom during submarine earthquakes, landslides, or volcanic activity. A seiche is an oscillation (wave) of a body of water in an enclosed or semi-enclosed basin that varies in period, depending on the physical dimensions of the basin, from a few minutes to several hours, and in height from several inches to several feet. A seiche is caused chiefly by local changes in atmospheric pressure, aided by winds, tidal currents, and occasionally earthquakes.

Specifically, southern California is oriented obliquely (i.e., not directly in line) with the major originating tsunami zones, and it has a relatively wide (about 220 kilometers) and rugged continental shelf (or borderland) that acts as a diffuser and reflector of remotely generated tsunami wave energy (Joy, 1968). These conditions, in addition to the geologic and seismic conditions (such as the strike-slip fault regime and the infrequent large submarine earthquakes) along the coastline, also tend to minimize the likelihood of a large tsunami at the community plan area. For example, tsunami wave heights and runup elevations experienced along the San Diego coastline during the last 170 years have fallen within the normal range of tidal fluctuations.

Based on the factors discussed above, our review of Tsunami Inundation Maps (CalEMA, 2009), elevations ranging between roughly 10 to 70 feet msl, and the distance the community plan area is located from the Pacific coastline (approximately 2 miles), there is a low potential for flood damage to occur within the community plan area from a tsunami or seiche.

3.2 Landslides

Landslides are deep-seated ground failures (several tens to hundreds of feet deep) in which a large arcuate shaped section of a slope detaches and slides downhill. Landslides are not to be confused with minor slope failures (slumps), which are usually limited to the topsoil zone and can occur on slopes composed of almost any geologic material. Landslides can cause damage to structures both above and below the slide mass. Structures above the slide area are typically damaged by undermining of foundations. Areas below a slide mass can be damaged by being overridden and crushed by the failed slope material.

Several formations within the San Diego region are particularly prone to landsliding. These formations generally have high clay content and mobilize



when they become saturated with water. Other factors, such as steeply dipping bedding that project out of the face of the slope and/or the presence of fracture planes, will also increase the potential for landsliding.

No active landslides or indications of deep-seated landsliding were noted at the community plan area during our field reconnaissance or our review of available geologic literature, topographic maps, and stereoscopic aerial photographs. Furthermore, our field reconnaissance and the local geologic maps indicate the community plan area is underlain by favorable oriented geologic structure. Therefore, the potential for significant landslides or large-scale slope instability within the community plan area is considered low.

3.3 Flood Hazard

According to a Federal Emergency Management Agency (FEMA) flood insurance rate map (FEMA, 1997) the community plan area is not located within a floodplain. Based on review of topographic maps, the community plan area is generally not located downstream of a dam or within a dam inundation area with the exception of the Chollas Creek drainage area (downstream from Chollas Dam). Based on this review and our reconnaissance, the potential for flooding of the general community plan area is considered low. However, locally within the northwestern portion of the community plan area along with the Chollas Creek drainage area in the southern portion of the community plan area there is a potential for flooding to occur.

3.4 Expansive Soils

Expansive soils are characterized by their ability to undergo significant volume changes (shrink or swell) due to variations in moisture content. Changes in soil moisture content can result from precipitation, landscape irrigation, utility leakage, roof drainage, perched groundwater, drought, or other factors and may result in unacceptable settlement or heave of structures or concrete slabs supported on grade. At the time of our community plan area reconnaissance, we noted sandy medium- to coarse-grained sands characteristic of decomposed granitic materials present at the ground surface. Therefore, based on the results of our background review and community plan area reconnaissance, we anticipate that the impact of expansive soils to the community plan area is low.



3.5 Corrosive Soils

Corrosive soils are characterized by their ability to degrade concrete and corrode ferrous materials in contact with water or soil. In particular, concrete is susceptible to corrosion when it is in contact with soil or water that contains high concentrations of soluble sulfates which can result in chemical deterioration of the concrete. In addition, regarding ferrous metals, electrical resistivity of the soil can affect the soils corrosive effects. At the time of our community plan area reconnaissance, we noted sandy medium- to coarse-grained sands characteristic of decomposed granitic materials present at the ground surface. Therefore, based on the results of our background review and community plan area reconnaissance, we anticipate that the impact of corrosive soils to the community plan area is low.



4.0 POTENTIAL IMPACTS AND MITIGATION MEASURES

The geology and soils analysis is based on a review of published information, surveys, and reports regarding regional geology and soils. Information was obtained from private and governmental agencies and Internet websites, including the USDA Natural Resources Conservation Service, the California Geological Survey (formerly the California Department of Mines and Geology), and the United States Geological Survey. This material was then compared to the proposed PEIR specific geology and soil-related impacts.

4.1 Seismic Hazards

Subsequent land use activities associated with implementation of the proposed PIER Update could result in the exposure of more people, structures, and infrastructure to seismic hazards. However, continued implementation of the City of San Diego Municipal Code would ensure that people, structures, and infrastructure are not adversely impacted by seismic hazards. This is considered a less than significant impact.

All new development and redevelopment would be required to comply with the current adopted CBC, which includes design criteria for seismic loading and other geologic hazards, including design criteria for geologically induced loading that govern sizing of structural members and provide calculation methods to assist in the design process. Thus, while shaking impacts could be potentially damaging, they would also tend to be reduced in their structural effects due to CBC criteria that recognize this potential. The CBC includes provisions for buildings to structurally survive an earthquake without collapsing and includes measures such as anchoring to the foundation and structural frame design.

The Seismic Hazards Mapping Act requires that cities use the Seismic Hazard Zone Maps in their land use planning and building permit processes and that site-specific geotechnical investigations be conducted within the Zones of Required Investigation in order to identify and evaluate seismic hazards and formulate mitigation measures prior to permitting most developments designed for human occupancy. In general, mitigation of surface rupture hazard is accomplished by the use of structural setbacks established adjacent to the mapped fault location. This impact is therefore considered to be less than significant and no further mitigation is required.



4.2 Potential Increase of Erosion and Loss of Topsoil

Implementation of the proposed PEIR Update would allow for intensification of some land uses that could lead to construction and grading activities that could expose topsoil and increase soil erosion. However, continued implementation of the City's Municipal Code would ensure that there are no adverse impacts from erosion and loss of topsoil. This impact is considered to be less than significant. Implementation of the proposed PEIR Update would result in the potential construction of new roadways and of substantial infrastructure (water and sanitary sewer facilities), improvements to existing roadways, and the potential for additional commercial, residential, and industrial development within the city. The grading and site preparation activities associated with such development would remove topsoil, disturbing and potentially exposing the underlying soils to erosion from a variety of sources, including wind and water. In addition, construction activities may involve the use of water, which may further erode the topsoil as the water moves across the ground.

All demolition and construction activities within the City would be required to comply with CBC Chapter 18 and Chapter 33, which would ensure implementation of appropriate measures during grading activities to reduce soil erosion. Furthermore, any development involving clearing, grading, or excavation that causes soil disturbance of one or more acres, or any project involving less than one acre that is part of a larger development plan and includes clearing, grading, or excavation, is subject to National Pollutant Discharge Elimination System (NPDES) General Construction Storm Water Permit (CGP) provisions. Any development of this significant size within the City would be required to prepare and comply with an approved stormwater pollution prevention plan (SWPPP) that provides a schedule for the implementation and maintenance of erosion control measures and a description of the erosion control practices, including appropriate design details and a time schedule. The SWPPP would consider the full range of erosion control best management practices, including any additional site-specific and seasonal conditions. NPDES requirements would significantly reduce the potential for substantial erosion or topsoil loss to occur in association with new development.

In addition, the City's grading standards (City of San Diego Municipal Code) specify that when grading will create a nuisance or hazard to other properties, public way, or public facilities due to erosion from storm runoff or rainfall no grading shall commence or continue without specific consent in writing from the director of public works or the director of community development. The grading standards also regulate gradients for cut and fill slopes. The City's grading regulations would further ensure that all public and private development projects would include the necessary control measures for erosion and sediment control as well as permanent features to minimize stormwater pollution from



development projects. The City's current development review process also ensures that construction projects have the necessary permits and that on-site regional control measures are considered for new development projects.

Since erosion impacts are often dependent on the type of development, intensity of development, and amount of lot coverage of a particular project site, impacts can vary. However, compliance with adopted City grading regulations and NPDES and SWPPP requirements would ensure that soil erosion and related impacts would be less than significant, and no further mitigation is required.

4.3 Potential Development on Unstable Soils

Implementation of the proposed PIER Update could allow for development on a geologic unit or soil that is unstable, thus creating substantial risks to life and property. However, continued implementation of the City's Municipal Code and compliance with the CBC would ensure that potential development is not adversely impacted by unstable soils. This is considered a less than significant impact.

Barrio Logan's surficial soils are largely composed of expansive clays, which swell when wet and shrink when dry, producing ground surface desiccation cracks. Many of the soils found within areas identified for development under the proposed PIER Update have a slight to moderate shrink-swell potential, which could result in development constraints. Structures or improvements constructed on expansive soils can suffer damage as the expansive soils shrink and swell. A soil's potential to shrink and swell depends on the amount and types of clay in the soil, since certain clays expand when wet and disproportionately shrink when dry. Future structures and improvements associated with the proposed PIER Update could experience stresses on various sections of foundations and connected utilities, as well as structural failure and damage to infrastructure if located on expansive or unstable soils.

To improve the seismic safety of buildings in the less stable soil areas of the City, geotechnical reports are required for developments in the City. (City of San Diego, 2011) Furthermore, the CBC and other related construction standards apply seismic requirements and address certain grading activities. The CBC includes common engineering practices requiring special design and construction methods that reduce potential expansive soil-related impacts. Compliance with CBC regulations would ensure the adequate design and construction of building foundations to resist soil movement.



The City also requires all new development to conduct geotechnical soils reports. Such a report is a tool used by public agencies and developers to identify specific site conditions and to develop design and construction recommendations for infrastructure improvements and commercial and residential development projects. Geotechnical reports generally contain a summary of all subsurface exploration data including a subsurface soil profile, exploration logs, laboratory or on-site test results, and groundwater information. The reports also interpret and analyze the subsurface data, recommend specific engineering design elements, provide a discussion of conditions for the solution of anticipated geotechnical problems, and recommend geotechnical special provisions. These provisions would address any site-specific expansive soil conditions, compressive (settlement) soil conditions, and seismic hazards such as strong ground motion and liquefaction hazard for future development under the proposed PEIR Update.

Adherence to the City's Municipal Code and the CBC, would reduce the effects resulting from developing on unstable soils to a minimum. This impact is therefore considered to be less than significant, and no further mitigation is required.

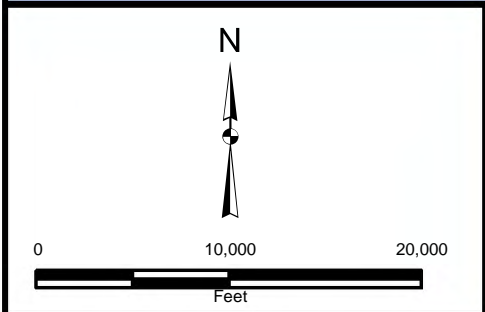
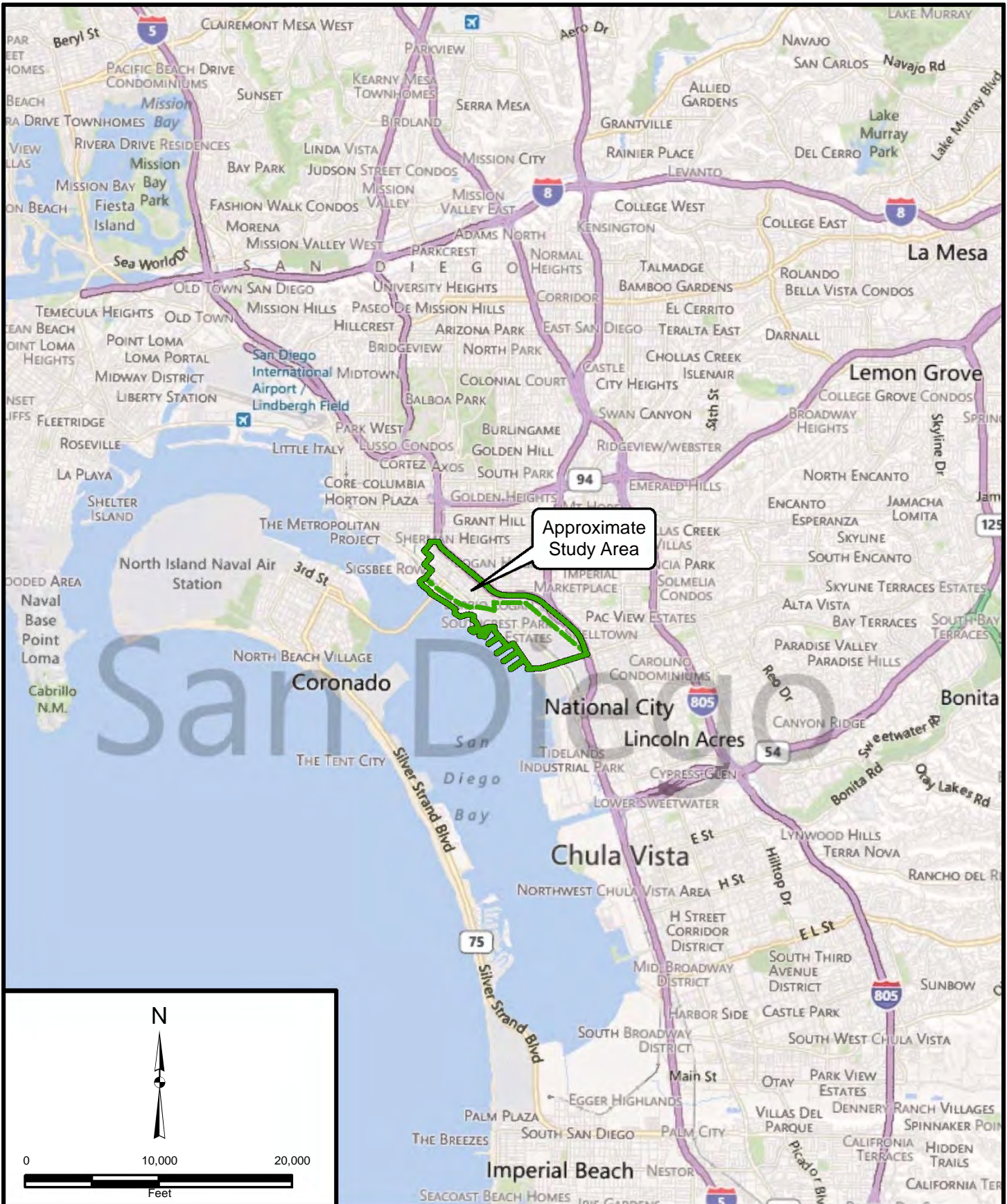


5.0 LIMITATIONS

The geologic analyses presented in this geologic report have been conducted in general accordance with current practice and the standard of care exercised by geologic consultants performing similar tasks in the project area. No other warranty, expressed or implied, is made regarding the conclusions, recommendations, and opinions presented in this report.

Please also note that our evaluation was limited to assessment of the geologic aspects of the project, and did not include evaluation of structural issues, environmental concerns or the presence of hazardous materials. Our study did not have the benefit of the performance of subsurface exploration across the community plan area. Our conclusions, recommendations and opinions are based on an analysis of the observed community plan area conditions, and our review of the referenced geologic literature and reports. If geologic conditions different from those described in this report are encountered, our office should be notified and additional recommendations, if warranted, will be provided upon request.

Figures

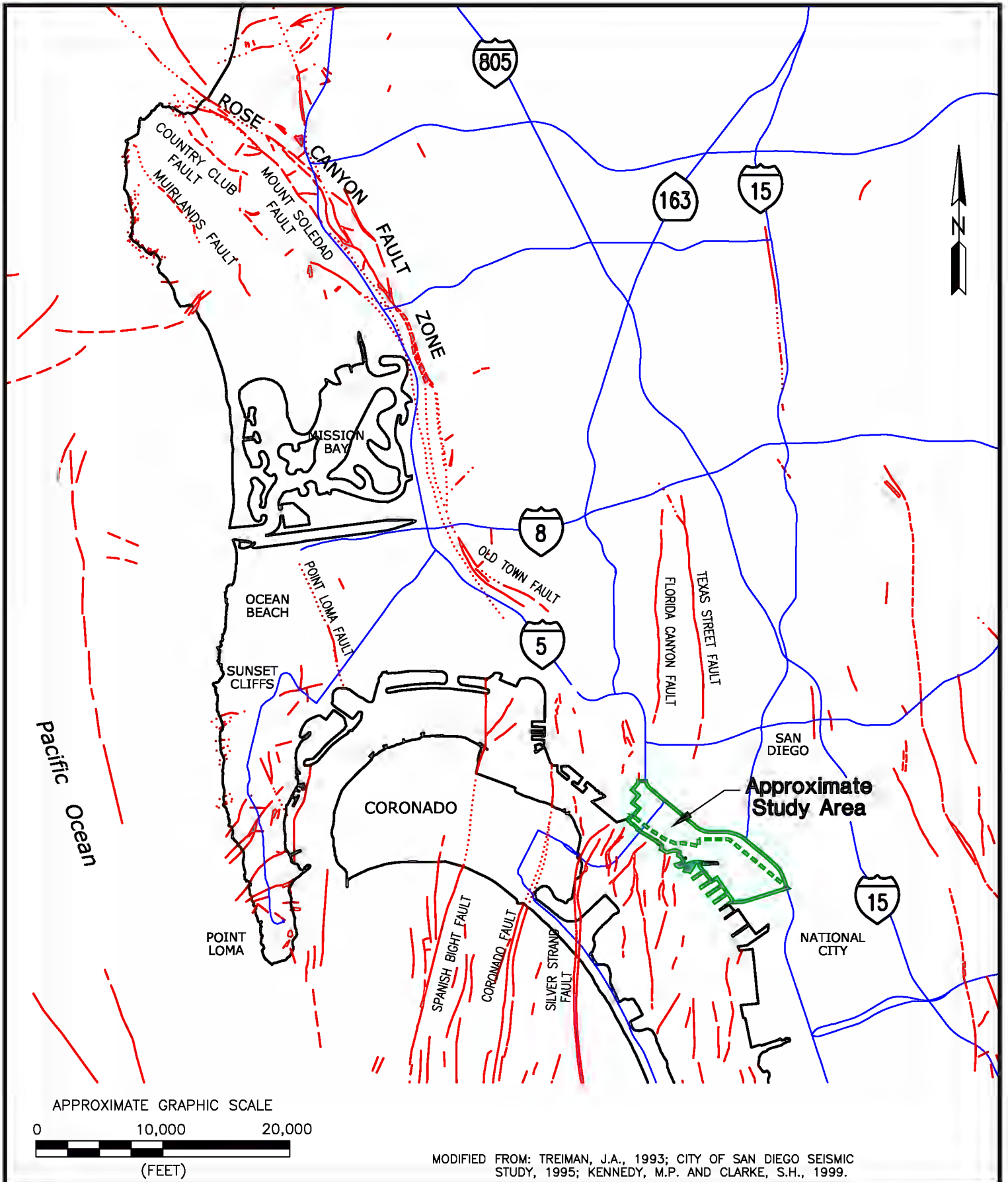


Project: 042608-001	Eng/Geol: WDO/RCS
Scale: 1" = 10,000 feet	Date: August, 2012
Base Map: ESRI Resource Center, 2010 Thematic Info: Leighton Author: mmurphy (mmurphy)	

SITE LOCATION MAP
 Barrio Logan Community Plan Update
 Programmatic EIR (PEIR)
 San Diego, California

Figure 1

Leighton



MODIFIED FROM: TREIMAN, J.A., 1993; CITY OF SAN DIEGO SEISMIC STUDY, 1995; KENNEDY, M.P. AND CLARKE, S.H., 1999.

ROSE CANYON FAULT MAP
 BARRIO LOGAN COMMUNITY PLAN UPDATE
 PROGRAMMATIC EIR (PEIR)
 SAN DIEGO, CALIFORNIA

FIGURE 2



Proj: 042608-001	Eng/Geol: WDO/RCS
Scale: 1"=10,000'	Date: 08/2012
Drafted By: MAM	Checked By:

P:\DRA\710304\0801\01\2012-08-08\FIG_02.DWG (8/12 3:04:32PM) Plotted by: rmm/ply

Appendix A
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Appendix B
ASFE Sheet

Important Information about Your Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you — should apply the report for any purpose or project except the one originally contemplated.*

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,

- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual

subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that

have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely on Your ASFE-Member Geotechnical Engineer for Additional Assistance

Membership in ASFE/The Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE THE GEOPROFESSIONAL BUSINESS ASSOCIATION

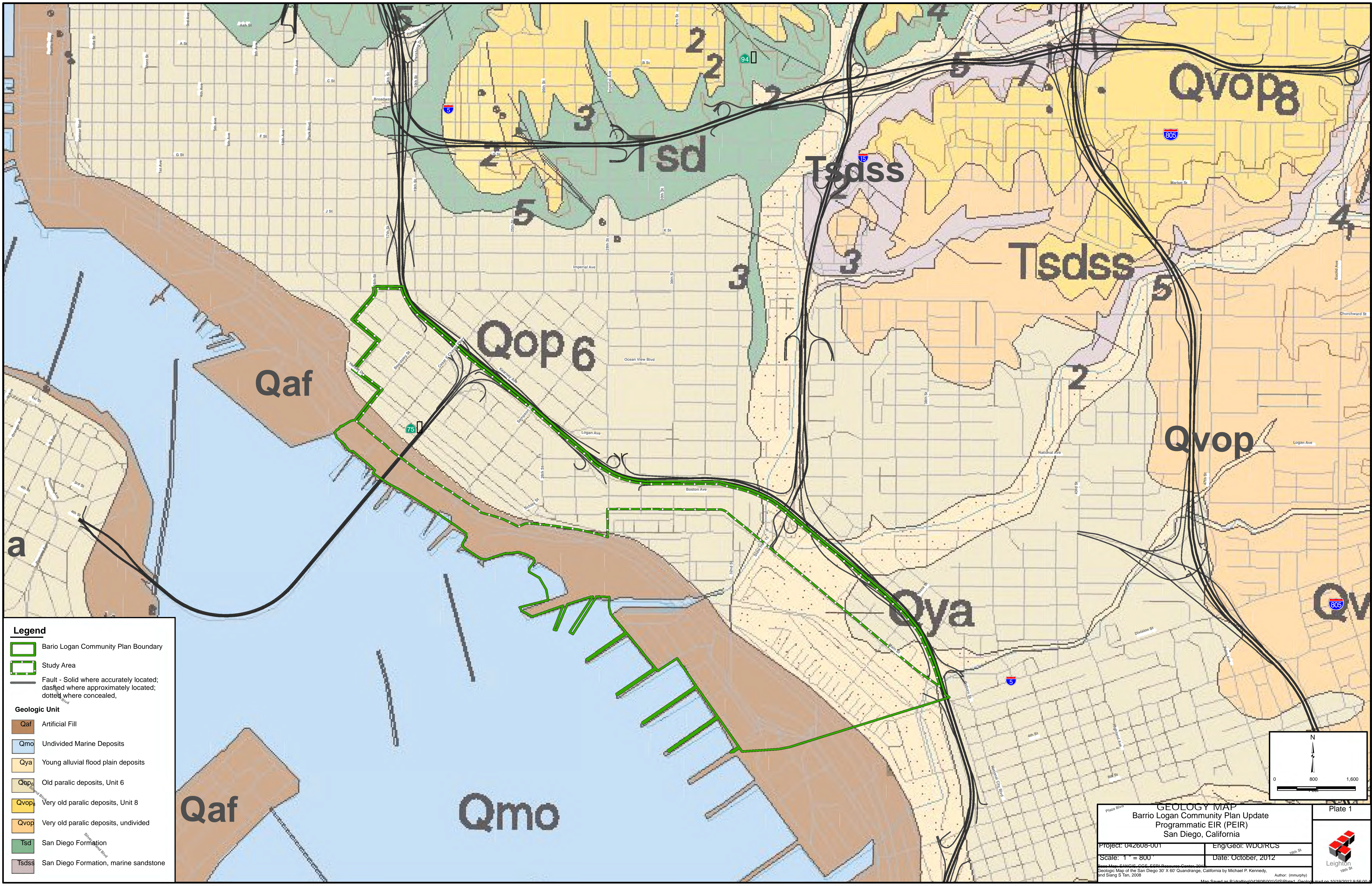
8811 Colesville Road/Suite G106, Silver Spring, MD 20910

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Plates

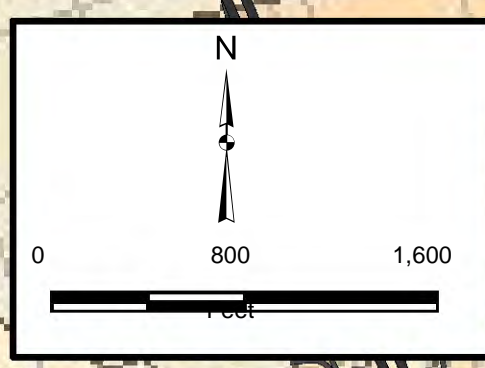


Legend

- Barrio Logan Community Plan Boundary
- Study Area
- Fault - Solid where accurately located; dashed where approximately located; dotted where concealed.

Geologic Unit

- Qaf Artificial Fill
- Qmo Undivided Marine Deposits
- Qya Young alluvial flood plain deposits
- Qop6 Old paralic deposits, Unit 6
- Qvop8 Very old paralic deposits, Unit 8
- Qvop Very old paralic deposits, undivided
- Tsd San Diego Formation
- Tsds San Diego Formation, marine sandstone

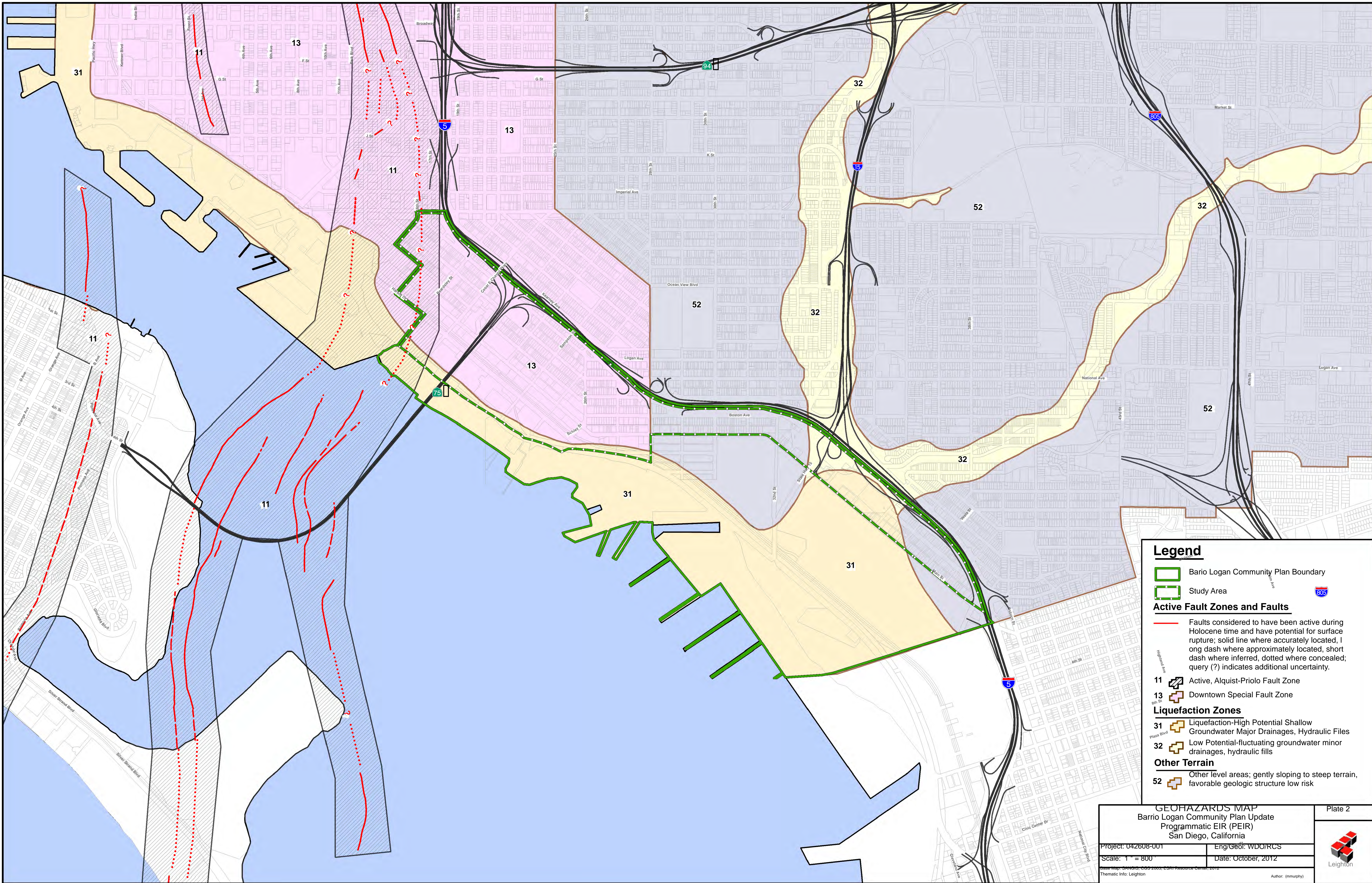


GEOLOGY MAP
 Barrio Logan Community Plan Update
 Programmatic EIR (PEIR)
 San Diego, California

Project: 042608-001	Eng/Geol: WDU/RCS
Scale: 1" = 800'	Date: October, 2012

Author: (mmurphy)
 and Siang S Tan, 2008
 Map Saved as: D:\projects\042608\001\GIS\Map1_Geology.mxd on 10/19/2012 9:56:01 AM

Plate 1



Legend

- Barrio Logan Community Plan Boundary
- Study Area

Active Fault Zones and Faults

- Faults considered to have been active during Holocene time and have potential for surface rupture; solid line where accurately located, 1 long dash where approximately located, short dash where inferred, dotted where concealed; query (?) indicates additional uncertainty.
- 11 Active, Alquist-Priolo Fault Zone
- 13 Downtown Special Fault Zone

Liquefaction Zones

- 31 Liquefaction-High Potential Shallow Groundwater Major Drainages, Hydraulic Fills
- 32 Low Potential-fluctuating groundwater minor drainages, hydraulic fills

Other Terrain

- 52 Other level areas; gently sloping to steep terrain, favorable geologic structure low risk

GEOHAZARDS MAP		Plate 2
Barrio Logan Community Plan Update Programmatic EIR (PEIR) San Diego, California		
Project: 042608-001	Eng/Geol: WDO/RCS	
Scale: 1" = 800'	Date: October, 2012	
Thematic Info: Leighton		