Desktop Geotechnical and Geologic Hazard Evaluation
Clairemont Community Plan Update
San Diego, California

Prepared For:
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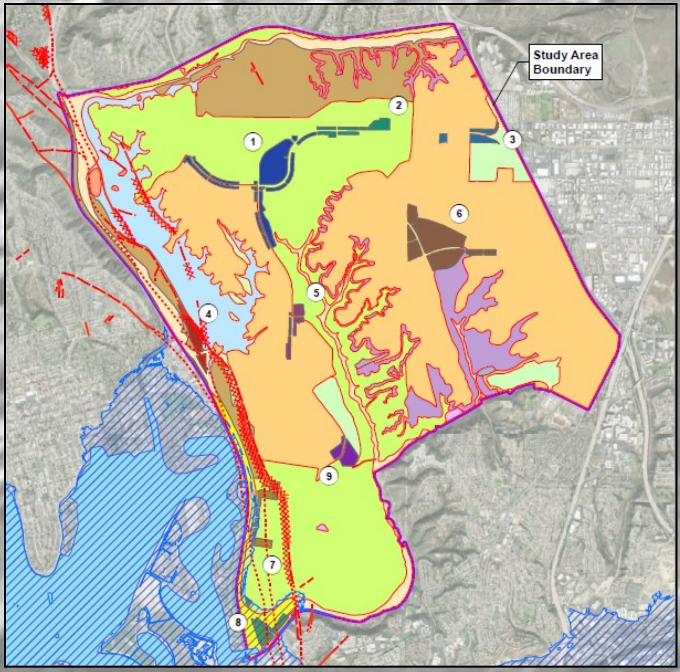

PREPARED BY:
The Bodhi Group Inc.

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May 29, 2020
Project No. 9126004

Mr. Tim Belzman
HELIX Environmental Planning, Inc.
7578 El Cajon Blvd.
La Mesa, CA 91942

Subject: Desktop Geotechnical and Geologic Hazard Evaluation
Clairemont Community Plan Update
San Diego, California

Dear Mr. Belzman,

We are pleased to submit our Geotechnical and Geologic Hazard Study report. The report was prepared in support of the Clairemont Community Plan Update and identifies geotechnical and geologic hazards within the Clairemont Community Plan Update Area and the significance of these hazards to existing and future land uses in the Plan area.

Respectfully submitted,

THE BODHI GROUP, INC.

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EXECUTIVE SUMMARY

This Geotechnical and Geologic Hazard Evaluation (Study) identifies geotechnical and geologic hazards that could have potentially adverse effects on manmade improvements within the Clairemont Community Plan Update (Clairemont CPU) area (Study Area). For this study, we reviewed relevant geologic maps and guidelines published by the City of San Diego, State of California, and the United States Geologic Survey. In-house resources were also reviewed.

A summary of the geology and geologic hazards is provided below.

- In increasing order of age, soils in the Study Area consist of artificial fill (documented and undocumented), young alluvium, landslide deposits, old paralic deposits, very old paralic deposits, and formational materials of the Stadium Conglomerate, Friars Formation, Scripps Formation, and Ardath Shale. Undocumented fill and young alluvium may be subject to consolidation under additional fill or structural loads. The other geologic formations are well consolidated to well cemented and will support most fill and structural loads. The very old paralic deposits and formational materials contain layers of cemented sandstone, gravel and cobbles which may be difficult to excavate and may impact excavations in these materials.
- The westernmost portions of the Study Area are underlain by active faults within the Rose Canyon fault zone. A large earthquake on the Rose Canyon fault zone could rupture and offset the ground surface damaging improvements that straddle active fault traces. The Study Area, like the rest of San Diego, is in a region of active faults and will be subject to strong ground motion in the event of an earthquake on these active faults in the vicinity.
- Liquefaction occurs in soft, saturated soil during moderate to severe ground shaking during earthquakes. According to City of San Diego maps, most of the lower elevation portions of the Study Area (areas close to the bottom of the major canyons) are defined as having a high potential for liquefaction.
- Landslide hazards are mapped in the Study Area by the State of California and the City of San Diego. The State and City of San Diego maps show landslides in the slopes along Tecolote, Rose, and San Clemente Canyons and their tributaries. The formations beneath the bases of these canyon slopes are potentially unstable. The mesa areas between the drainages, however, do not contain steep slopes and are not susceptible to landslide hazards according to the City of San Diego.
- Expansive soils form on very old paralic deposits, Friars Formation, and Ardath Shale. Most of the Study Area consists of soils that range from medium to highly expansive in nature. Expansive soil can adversely affect structures and pavements.
- Potentially corrosive soils may be present in some localized areas on the mesa.
- Infiltration rates for at grade soil will be affected by shallow impermeable formational material and soil types. In general, the earth materials within 10 feet of the current ground surface will have poor infiltration characteristics.

The geologic hazards identified above, that are encroached by planned development in the Study Area, can be mitigated through avoidance or by engineering design in accordance with established State of California and City of San Diego requirements and codes. Locations within the Study Area with the highest potential for new development or redevelopment are identified on Figure 1.

There are no policies or recommendations of the Clairemont CPU that will have a direct or indirect significant environmental effect with regards to geologic hazards. The proposed land uses are compatible

with the known geologic hazards provided geotechnical structural engineering recommendations are incorporated into the siting of improvements, especially along Morena Boulevard. Storm water infiltration into soils may be limited and alternative systems like bioswales or bioretention basins may be needed. Geotechnical investigations are recommended for any construction adding additional loads to soils within 25 feet of the top of slopes exceeding 10 feet in height or on undocumented fills.

1. INTRODUCTION

The Bodhi Group has completed a Geotechnical and Geologic Hazards Study (Study) of the Clairemont Community Plan Update area (Clairemont CPU, Study Area). The Study was performed at a California Environmental Quality Act (CEQA) level for the Study Area. This report presents the results of our "desktop" evaluation of the geotechnical and geologic hazards potentially affecting the Study Area. The purpose of our evaluation was to identify geotechnical and geologic conditions or hazards that might affect future development and/or redevelopment within the Study Area. The following services were provided:

- Reviewed relevant published geologic information including: State of California-issued geologic and hazard maps; the City of San Diego Seismic Safety Study Geologic Hazards and Faults maps; "Guidelines for Preparing Geologic Reports for Regional-Scale Environmental and Resource Management Planning," California Geological Survey (California Division of Mines and Geology) Note 52; the City of San Diego Guidelines for Geotechnical Reports; and the City of San Diego Significance Determination Thresholds.
- Reviewed and summarized regional and local geology and identified potential geotechnical and geologic hazards.
- Researched other City and County resources, and our in-house library of historical vertical aerial photographs, geotechnical and geological hazards such as faulting, seismicity, liquefiable soils, etc.
- Prepared this technical report that identifies geotechnical and geologic hazards. Included in this report is a location map (Figure 1); a map of the regional and Study Area geology showing distribution of surficial deposits and geologic units (Figure 2); a map of the active regional faults in southern California (Figure 3); a map showing known and suspected active and potentially active faults in the Rose Canyon fault zone in the Study Area (Figure 4); a map showing areas in the Study Area susceptible to flooding from a tsunami or dam failure (Figure 5); and a geologic hazards map identifying areas susceptible to the potential geologic hazards described in this report (Figure 6).

1.1. Significant Assumptions

Documentation and data provided by the client or from the public domain, and referred to in the preparation of this study, are assumed to be complete and correct and have been used and referenced with the understanding that the Bodhi Group assumes no responsibility or liability for their accuracy. The conclusions contained herein are based upon such information and documentation. Because Study Area conditions may change and additional data may become available, data reported and conclusions drawn in this report are limited to current conditions and may not be relied upon on a significantly later date or if changes have occurred at the Study Area.

Reasonable CEQA-level efforts were made during the Study to identify geologic hazards. "Reasonable efforts" are limited to information gained from information readily accessible to the public. Such methods may not identify Study Area geologic or geotechnical issues that are not listed in these sources. In the preparation of this report, the Bodhi Group has used the degree of care and skill ordinarily exercised by a reasonably prudent environmental professional in the same community and in the same time frame given the same or similar facts and circumstances. No other warranties are made to any third party, either expressed or implied.

2. PROJECT LOCATION AND DESCRIPTION

This section describes the Project location, setting, and description.

2.1. Project Location and Setting

Clairemont is located in the north central portion of the City of San Diego within San Diego County. The Clairemont CPU Area encompasses approximately 8,500 acres and is bounded by State Route (SR) 52 on the north, Interstate (I-) 805 on the east, I-5 on the west, and the Linda Vista community to the south. Surrounding communities include University to the north; Kearny Mesa to the east; Linda Vista to the south; and La Jolla, Pacific Beach, and Mission Beach to the west.

Clairemont is one of the first post-World War II suburban developments in the City of San Diego, with many of its homes built in the 1950s and 1960s. Developed areas of Clairemont occur primarily atop mesas punctuated by several major canyon systems, including Tecolote Canyon that traverse the center of the CPU area, San Clemente Canyon in the north, and Stevenson Canyon in the west portion of the CPU area.

Clairemont is predominantly comprised of single-family residential neighborhoods. Several community and neighborhood-serving commercial centers are located at the intersections of major transportation corridors, such as Clairemont Drive and Clairemont Mesa Boulevard, as well as Balboa Avenue and Genesee Avenue. Smaller pockets of commercial development are interspersed throughout the community and within corridors along Morena Boulevard and Clairemont Mesa Boulevard.

Transit service currently consists of a number of local and express bus lines. The Mid-Coast Trolley, now under construction, will extend the Blue Line Trolley from Downtown San Diego to the Clairemont community and beyond to the University community.

Topographically, most of the Study Area is situated on a gently rolling mesa top dissected by Tecolote Canyon and its tributaries. The mesa is bound to the north by San Clemente Canyon, Rose Canyon and coastal bluffs along the east side of Mission Bay. The mesa areas are heavily developed. The canyon areas are mostly used for open space and paved roads.

2.2. Project Description

The Clairemont CPU is a comprehensive update to the Clairemont Community Plan, which was originally adopted in 1989 and most recently amended in March 2020. The purpose of the CPU is to continue to guide the future growth and development of Clairemont. The proposed CPU provides community-specific policies that further implement the General Plan with respect to the distribution and arrangement of land uses and the local street and transit network; urban design guidelines; recommendations to preserve and enhance natural open space and historic and cultural resources; strategies to plan for the recreational needs of the community; and the prioritization and provision of public facilities within the Clairemont community. The overall vision of the proposed CPU is to guide the development of active, pedestrian-oriented nodes, corridors, districts, and unique villages that contribute to strong sense of place and community identity, connected through a balanced transportation network that not only emphasizes walking, biking, and transit use, but acknowledges the natural network of canyons and open spaces as an integral part of intra-community connectivity.

The Clairemont CPU has nine Focus Areas as shown on Figure 1: Clairemont Town Square (1); Genesee Avenue/Clairemont Mesa Boulevard and Diane Center (2); Clairemont Mesa Boulevard East (3); City of San Diego Rose Canyon Operations Yard (4); Balboa Avenue/Clairemont Drive (5); Genesee Plaza/Balboa Mesa Commercial Center (6); Morena Boulevard south of Clairemont Drive (7)' Morena Boulevard/Tecolote Road (8); and Clairemont Village (9).

3. HISTORY

The Study Area is located within the traditional territory of the Kumeyaay. At the time of Spanish colonization in the late 1700s, several major Kumeyaay villages were located in proximity to the Study Area. Following the Mexican-American War, when Mexico ceded California to the United States, the Study Area was part of a large land grant that supported cattle grazing.

While development within San Diego initially occurred in Old Town, it began to shift in the 1860s to the downtown area. Development from downtown subsequently began to spread eastward following natural transportation corridors. In the Clairemont area, a short-lived real estate boom occurred in the late 1880s with the 1,200-acre Morena tract and the area continued to slowly grow as a suburban district.

The influence of military development during World War I resulted in substantial development in infrastructure and industry to support the military. A pause in development occurred in the Clairemont area during the early 1900s as a direct result of this shift towards military-focused infrastructure, with the Study Area remaining largely undeveloped throughout the 1920s.

In the 1940s, military housing was developed in the Clairemont area. Substantial residential development occurred in the 1950s, with close to 80 subdivisions platted within the area between 1950 and 1956 along with commercial uses. Due to its distance from downtown San Diego, Clairemont was planned to include commercial business and retail shopping, schools, libraries, and other amenities. The community provided housing for the military personnel stationed at MCAS Miramar and the aerospace industry within the adjacent Kearny Mesa community to the east. The majority of Clairemont residents during the 1960s worked in the defense industry, which demonstrated the close association with post-World War II defense. Residential and commercial development continued through 1970s, and redevelopment of commercial centers occurred from the 1970s through the late 2010s.

4. GEOLOGY

San Diego is located within the western (coastal) portion of the Peninsular Ranges Geomorphic Province of California. The Peninsular Ranges encompass an area that roughly extends from the Transverse Ranges and the Los Angeles Basin, south to the Mexican border, and beyond another approximately 800 miles to the tip of Baja California (Harden, 1998). The geomorphic province varies in width from approximately 30 to 100 miles, most of which is characterized by northwest-trending mountain ranges separated by subparallel fault zones. In general, the Peninsular Ranges are underlain by Jurassic-age metavolcanic and metasedimentary rocks and by Cretaceous-age igneous rocks of the southern California batholith. Geologic cover over the basement rocks in the westernmost portion of the province in San Diego County generally consists of Upper Cretaceous-, Tertiary-, and Quaternary-age sedimentary rocks. Figure 2 shows the regional geology (modified from Kennedy and Tan, 2008).

Structurally, the Peninsular Ranges are traversed by several major active faults. The Elsinore, San Jacinto, and the San Andreas faults are major active fault zones located northeast of San Diego. The Rose Canyon, San Diego Trough, Coronado Banks, and San Clemente faults are major active faults located within or west-southwest of San Diego. Major tectonic activity associated with these and other faults within this regional tectonic framework is generally right-lateral strike-slip movement. These faults, as well as other faults in the region, have the potential for generating strong ground motions in the Study Area. Figure 3 shows the proximity of the Study Area to nearby mapped Quaternary faults.

4.1. Local Geology

In increasing order of age, soils in the Study Area consist of artificial fill (both documented and undocumented), young alluvium, landslide deposits, Old paralic deposits (Unit 6), Very old paralic deposits (Units 11, 10, 9a, 8, 8a), the Stadium Conglomerate, Friars Formation, Scripps Formation, and Ardath Shale. The distribution of the units and accompanying unit numbers are shown on Figure 2. Descriptions of the general characteristics of these units are presented below.

- *Af Artificial fill (late Holocene).* Although there are no mapped limits of artificial fill on Figure 2, fill underlies large portions of the Study Area. Most areas underlain by fill are associated with construction of buildings or infrastructure. Most of the filling was done in the 1950s and 1960s, when compaction standards were not as stringent as current standards. These fills may be subject to settlement under new building or additional fill. Fills placed since 1980 are likely compacted to current standards and less likely to settle under new loads.
- *Qya – Young alluvial deposits (Holocene and late Pleistocene).* Young alluvial deposits are characterized as poorly consolidated, poorly sorted, permeable canyon deposits of sandy, silty, or clay-bearing alluvium. These deposits occur in the bottoms of the major canyons: Rose Canyon; Tecolote Canyon; and alluvial fans in the westernmost portion of the study area (Kennedy and Tan, 2008). Young alluvial deposits may settle under structural or additional fill. Compacted fill overlying settlement-prone young alluvial deposits may settle under new building or additional fill.
- *Qls – Landslide deposits (late Pleistocene to Holocene).* Landslide deposits are mapped in the slopes of Rose Canyon and Tecolote Canyon (Kennedy and Tan, 2008). The landslides appear related to weak, slide-prone formations (Friars Formation and Ardath Shale) and faulted areas in combination with steep natural slopes.
- *Qop6 – Old paralic deposits, Unit 6 (late to middle Pleistocene).* Old paralic deposits underlie portions of the western most portion of the Study Area, along the old coastal bluffs east of Mission

Bay. The Old paralic deposits consist of poorly sorted, moderately permeable, reddish brown, interfingered strandline, beach, estuarine and colluvial deposits. The deposits are predominately siltstone, claystone, sandstone and conglomerate. The Old paralic Unit 6 deposits are poorly to moderately consolidated (Kennedy and Tan, 2008).

- *Qvop11 – Very old paralic deposits, Unit 11 (middle to early Pleistocene).* The Very old paralic deposits, Unit 11, are found on the western portion of the Study Area and were deposited on the Clairemont Terrace (elevation 300-312 feet). These deposits (Unit 11) consist of poorly sorted, moderately permeable, reddish-brown, interfingered strandline, beach estuarine and colluvial deposits composed of siltstone, sandstone and conglomerate. These deposits are moderately to well consolidated and locally well cemented (Kennedy and Tan, 2008).

  All of the very old paralic deposits (Units 11-8) are exposed on the top of the mesa in the Study Area (Figure 2). They are differentiated by subtle changes in lithology and basal elevation (progressively higher elevation marine-cut terraces upon which the sediments were deposited) and age (oldest units to the east and younger units to the west). The very old paralic deposits are well consolidated and are usually suitable for light structural or thin fill loads. They are locally cemented and may be difficult to excavate. An expansive, highly plastic clay residual soil has formed on these deposits on the mesa tops.

- *Qvop10 – Very old paralic deposits, Unit 10 (middle to early Pleistocene).* The Very old paralic deposits, Unit 10 underlies the western central portion of the Study Area and were deposited on the Tecolote Terrace (elevation 338-344 feet). These Very old paralic deposits consist of poorly sorted, moderately permeable, reddish-brown, interfingered strandline, beach estuarine and colluvial deposits composed of siltstone, sandstone and conglomerate. The Unit 10 deposits are moderately to well consolidated and locally well cemented (Kennedy and Tan, 2008).

- *Qvop9a – Very old paralic deposits, Unit 9a (middle to early Pleistocene).* The Very old paralic deposits, Unit 9a, underlie a subtle ridge in the middle of the Study Area. They were deposited on the Linda Vista Terrace (elevation 367-373 feet). These deposits consist of poorly sorted, moderately permeable, reddish-brown, dune and back beach (beach ridge) deposit. The sediments are composed of cross-bedded sandstone. The Unit 9a deposits are typically, moderately to highly consolidated and locally strongly cemented (Kennedy and Tan, 2008).

- *Qvop8 – Very old paralic deposits, Unit 8 (middle to early Pleistocene).* The Unit 8 deposits are located in the central portion of the Study Area and were deposited on the Tierrasanta Terrace (elevation 399-406 feet). The sediments consist of poorly sorted, moderately permeable, well consolidated, poorly to moderately cemented, reddish brown, interfingered strandline, beach, estuarine, and colluvial deposits composed of siltstone, sandstone, and conglomerate (Kennedy and Tan, 2008).

- *Qvop8a – Very old paralic deposits, Unit 8a (middle to early Pleistocene).* Unit 8a of the very old paralic deposits are located in the eastern portion of the Study Area. The Unit 8a deposits consist of poorly sorted, moderately permeable, reddish-brown, dune and back beach (beach ridge) deposits. The sediments are composed of cross-bedded sandstone. The Unit 8a deposits are typically, moderately to highly consolidated and locally strongly cemented (Kennedy and Tan, 2008).

- *Tst – Stadium Conglomerate (middle Eocene).* The Stadium Conglomerate likely underlies the easternmost portion of the Study Area; immediately below the very old paralic deposits that cap the mesa. It is mostly exposed in the slopes in Tecolote Canyon and its eastern tributaries. The Stadium Conglomerate consists of massive cobble conglomerate with a dark-yellowish brown, coarse-grained sandstone matrix. The conglomerate contains slightly metamorphosed volcanic and volcaniclastic rocks and quartzite. The conglomerate is very well consolidated and locally very well cemented

(Kennedy and Tan, 2008). The conglomerate can typically support very heavy structural and fill loads. The Stadium Conglomerate is difficult to excavate and is at less than 40 feet thick in the Study Area but pinches out to the west.

- *Tf –Friars Formation (middle Eocene).* The Friars Formation is exposed in the central and eastern portion of the Study Area, in Tecolote Canyon, and the eastern portion of San Clemente Canyon. The formation is composed of sandstone and claystone. The claystone is fractured and locally sheared and can create unstable conditions in slopes (Kennedy and Tan, 2008).
- *Tsc – Scripps Formation (middle Eocene).* This formation consists of yellowish-gray, medium-grained, sandstone with lenses of cobble conglomerate and claystone. Within the Study Area, it is exposed in the slopes of San Clemente and Tecolote Canyons and their tributaries in the western and central portions of the Study Area (Kennedy and Tan, 2008). The Scripps Formation is well consolidated and locally very well cemented (concretion beds) and can typically support high structural and fill loads. Bedding is highly variable and can create potential slope instability where adverse structure and local claystone beds combine as evident by landslides in Tecolote Canyon in areas underlain by this formation.
- *Ta – Ardath Shale (middle Eocene).* The Ardath shale is exposed in the lower elevations in the western portion of the Study Area, primarily at the base of slopes along the San Clemente, Rose and Tecolote Canyons as well as the coastal slope east of Mission Bay. The formation is composed of highly fractured silty claystone and intercalated fine sandstone (Kennedy and Tan, 2008). Where fresh, the formation is well consolidated and locally strongly cemented. Where weathered, the formation desiccates into weak, sheared and remolded clay that is expansive and is unstable in slopes. Clay seams and shears and faults in the unweathered formation can create unstable conditions in slopes where the local structure is adverse.

4.2. Local Structural Geology

In general, the older geology (Stadium Conglomerate, Friars and Scripps Formations, and Ardath Shale) underlying the Study Area dips (tilts) gently to the north. However, faulting on the Rose Canyon fault zone has created local variations in structure, especially along Morena Boulevard in the westernmost portion of the Study Area (Kennedy and Tan, 2008). A series of gently dipping, north-trending anticlines and synclines are present in the pre-Quaternary rocks in the south west corner of the Study Area (Figure 2). The very old paralic deposits are flat lying or dip gently to the west. The structure is considered favorable where it dips into the south facing slopes of the major canyons. Conversely, the structure is adverse in north facing slopes. However, the mapped landslides in the Study Area appear to be more influenced by fracturing and faulting or local variations in bedding than the gross structure.

The Rose Canyon fault zone is located in the westernmost portion of the Study Area (Figure 3). The faults are generally strike slip or orthogonal slip faults (Treiman, 1993). The fault zone is composed of a complex system of subparallel strands, branches and shear zones, most of which have been covered with fill and development of infrastructure and buildings. Three of the subparallel strands have been named; from west to east: the Country Club fault; the Mount Soledad fault; and the Rose Canyon fault (Kennedy and Tan, 2008).

5. TECTONICS AND SEISMICITY

San Diego is affected by the boundary between the North American and Pacific tectonic plates. The North American and Pacific plates are sliding past each other at a rate of about 22-24 inches per year. The North American plate is moving north, and the Pacific plate is moving south, relative to one another. This boundary is called the San Andreas fault system (Wallace, 1990). The boundary, in southern California is characterized by a roughly 150-mile wide zone of predominantly northwest-striking, right-slip faults that span the Imperial Valley and Peninsular Range to the offshore California Continental Borderland Province (from the California continental slope to the coast). The San Clemente fault zone located 50 miles west of San Diego and the San Andreas fault zone 70 miles east of San Diego define the boundary for the Study Area (Figure 3). The most active faults based on geodetic and seismic data are the San Andreas, San Jacinto, and Imperial faults. These faults take up most of the plate motion. Smaller faults, however, are active enough to create damaging earthquakes and these include the Elsinore, Newport-Inglewood-Rose Canyon, and the offshore Coronado Banks, San Diego Trough, and San Clemente fault zones (Singleton, Rockwell, et al, 2019) (Figure 3). The Rose Canyon fault is moving roughly 0.06 inches per year.

5.1. Local and Regional Faults

Table 1 summarizes the local and regional fault characteristics for the active faults that will affect the Study Area. A Quaternary fault is defined by the State of California (2007) as a fault that shows evidence of movement in the last 1.6 million years. Quaternary (Holocene and Pleistocene) faults can be classified as either active or potentially active faults. Active faults are those Quaternary Holocene faults which have been shown to have ruptured in the last 11,000 years. Potentially active faults are those Quaternary Pleistocene faults which have been shown to have ruptured during the past 1.6 million years but do not show evidence of rupture in the last 11,000 years. Potentially active faults have a much lower probability for future activity than active faults. The westernmost portion of Study Area is underlain by active faults and potentially active faults within the Rose Canyon fault zone. Since larger earthquakes occur on faults, generally, the closer the causative fault is to a particular place, the stronger the earthquake shaking. Earthquakes on the faults summarized below will create ground shaking that can affect the Study Area.

Table 1 - Fault Characteristics for Active Faults in the Region

Fault Name	Approximate Distance to Study Area	Slip Rate (mm/yr)	Fault Length (miles)	Estimated Magnitude (Maximum Moment Magnitude (Mw))
Newport-Inglewood-Rose Canyon Fault Zone	0-1.8	1.5	130	7.2
Coronado Bank Fault Zone (offshore)	17	3.0	115	7.6
San Diego Trough Fault Zone (offshore)	35	1.5	106	7.5
San Miguel-Vallecitos Fault Zone (Northern Baja California)	43	0.2	100	6.9
Elsinore Fault Zone	50	5.0	190	7.0
San Clemente Fault Zone (offshore)	55		129	7.7
San Jacinto Fault Zone	80	4.0	152	6.8
Southern San Andreas Fault Zone	115	25	140	7.2

(CDMG 2002; CGS 2010; Hirabayashi, et al., 1996; Kahle, et al., 1984; Ryan et al., 2012).

The Rose Canyon fault has created most of the major landforms in the vicinity of the Study Area. Uplift on the fault has created Mount Soledad and down warping has created San Diego Bay. The Rose Canyon fault zone begins offshore south of Coronado Island where it consists of three discrete fault traces: the Spanish Bight, Coronado, and Silver Strand faults (Figure 3). Moving northward, the faults cross San Diego Bay and intersect the shoreline near the east end of the San Diego Airport runway and into downtown San Diego. The fault zone appears to narrow as it approaches Old Town. The fault crosses the San Diego River and trends northward past the mouth of Tecolote Canyon, up Morena Boulevard and Interstate 5. Just north of Balboa Avenue, the fault separates into two strands, the Mount Soledad fault and Rose Canyon fault. The faults enter the Pacific Ocean near La Jolla Shores and trend northward, offshore until the fault zone appears to connect with the Newport Inglewood fault zone near San Onofre.

5.2. Ground Shaking

Ground shaking is the result of a fault rupturing deep in the earth. The resulting energy is released as seismic waves that propagate away from the focus of the earthquake. The larger the earthquake the more intense the shaking. The shaking attenuates over distance so distant earthquakes will shake less violently than a nearer earthquake of the same magnitude. Earthquakes on the faults listed in Table 1 can cause shaking in the Study Area. The nearest fault capable of causing a large earthquake is the Rose Canyon fault zone.

The Rose Canyon fault is capable of causing a maximum moment magnitude 7.2 earthquake. A recent study was performed to see effects of earthquake shaking by modeling a 6.9 magnitude earthquake occurring on the Rose Canyon fault with an epicenter just offshore of Encinitas (EERI, 2020). The model predicts that the Study Area would experience ground shaking estimated to be 55 percent of gravity. Ground shaking resulting from large earthquake on faults in the vicinity (Table 1) will be significantly less than the modeled acceleration.

5.3. Ground Rupture

Earthquakes occur on faults deep below the ground surface. If the earthquake is large enough, the strain will reach the ground surface causing the ground to rupture, where one side of the fault moves with respect to the other. Ground rupture can span miles along the fault trace. The State of California has created special study zones (Alquist-Priolo Earthquake Fault Zones) to identify faults with the potential for ground rupture. There are traces of the Rose Canyon fault zone that are capable of rupturing the ground during a large earthquake (Rockwell, et al., 1991, Singleton, et al., 2019). There are four Alquist-Priolo Earthquake Fault Zones on the Rose Canyon fault zone in San Diego. One of the zones is located in the Study Area (Figures 3 and 4). The difficulty in predicting which fault trace is capable of ground rupture in the Study Area is complicated by the number of fault traces, shear zones and branches as well as the limited access to explore and evaluate the faults due to development. A recent effort to evaluate the activity of the Rose Canyon fault zone used predevelopment aerial photographs to identify areas with geomorphic features indicative of past ground rupture (SANDAG, 2014). Where subsurface trenches have been able to access these suspected fault traces, they have shown that the faults have ruptured the surface multiple times in the last several thousand years. Unfortunately, the subsurface evidence in the Study Area is wide spaced and therefore a more detailed understanding of the locations of active faults is not available (SANDAG, 2014, TerraCosta, 2018).

5.4. Historical Earthquakes

The available record of historical earthquakes (dating back to the late 1700s) larger than Magnitude 6 in the coastal San Diego area is as complete as other regions in the State of California (Anderson, et al., 1989). Only a small number of earthquakes have been reported in coastal San Diego, whereas other portions of southern California and Baja California, Mexico, have experienced many moderate to large earthquakes in the same historical window.

Strong shaking and minor damage have occurred in the coastal San Diego region as a result of large earthquakes on distant faults or smaller earthquakes on local faults (Agnew, et al., 1979; Toppozada, et al., 1981). Earthquakes in Imperial County and northern Baja California in 1800, 1862, and 1892 are believed to have produced the strongest intensities in the San Diego area. The 1862 earthquake is believed to have occurred on the Rose Canyon fault (Singleton, et al., 2019).

In the 1930s, seismographs were established in San Diego. Since that time, swarms of small to moderate magnitude earthquakes have been recorded in San Diego Bay. In 1964, a swarm of small earthquakes was reported in the south San Diego Bay (Simmons, 1977). In 1985, a swarm of earthquakes with a maximum magnitude of M4.7 occurred just over one-half mile south of the Coronado Bay Bridge (Reichle, et al., 1985). A magnitude M5.3 earthquake and a series of aftershocks occurred about 44 miles west of Oceanside in 1986 (Hauksson and Jones, 1988). The 1986 earthquake was widely felt but did not cause significant damage.

6. LANDSLIDES AND SLOPE STABILITY

Slopes with potentially unstable characteristics in the Study Area are associated with the San Clemente, Rose, and Tecolote Canyons and their tributaries, and the coastal bluffs adjacent to Morena Boulevard. The unstable slopes and existing landslides are associated with the Friars and Scripps Formations, Ardath Shale, and faulted areas within or adjacent to the Rose Canyon fault zone (Figures 2 and 6). The upper portions of the canyon slopes are underlain by Stadium Conglomerate and very old paralic deposits which have high shear strengths and provide the stable cap that creates the mesa on which Clairemont was developed. The combination of steep natural slopes, building and fill loads as well as infiltration of irrigation and storm water can create conditions that result in landslides in an urban development. Figure 6 shows slope inclinations in the Study Area where natural slopes in excess of 2:1 (horizontal:vertical) should be considered potentially unstable. Man-made slopes resulting from grading associated with commercial and residential development are assumed to have been engineered in accordance with City of San Diego requirements.

7. SOILS AND INFILTRATION

Infiltration of storm water into soil is a goal of the San Diego Regional Water Quality Control Board (RWQCB) and the City of San Diego. The United States Department of Agriculture (USDA) has mapped soil types (series) throughout the United States using a complex system of characteristics. The USDA series descriptions are based on natural soil development. Table 2 is a summary of the soil types mapped by the USDA in the Study Area. Most of the soil in the mesa portion of the Study Area has been altered, by grading, to create level building sites and streets. As a result, the permeability estimates in Table 2 can only provide a rough indicator of the infiltration potential of the soils in the Study Area or the nine Focus Areas. Other factors should be considered in evaluating storm water infiltration feasibility including lateral migration of water on impermeable very old paralic deposits and groundwater mounding. A full list of criteria is enumerated in the City of San Diego Storm Water Standards, Part 1, 2017 Edition (City of San Diego, 2017).

Table 2 - USDA Soil Series Descriptions

Name	Description	Thickness (Inches)	Permeability
Huerhuero-Urban land complex 2-9 percent slopes	Sandy loam	N/A	Moderate
Huerhuero-Urban land complex 9-30 percent slopes	Sandy Loam	N/A	Moderate
Chesterton-Urban land complex	Gravelly loam	N/A	Moderate

8. HYDROGEOLOGY

According to the RWQCB San Diego Basin Plan (RWQCB, 1994), the Study Area lies within two separate hydrologic basins. The hydrologic basins and beneficial use information is listed below.

- The northern and western portions of the Study Area are located in the Miramar Hydrologic Subarea (HSA) in the Miramar Hydrologic Area (HA) of the Penasquitos Hydrologic Unit (HU). The Miramar HA is excepted from beneficial use for municipal supply and has potential beneficial use for industrial supply; however, the beneficial uses for the Miramar HU do not apply west of Interstate 15 which includes the Study Area.
- The southeastern portion of the Study Area is located in the Tecolote HSA in the Tecolote HA of the Penasquitos HU. The Tecolote HA is excepted from beneficial use for municipal supply and does not have any other beneficial uses.

Although the Study Area does not have existing beneficial uses, it is the RWQCB's intent that water quality be maintained in conformance with the terms and conditions of Resolution No. 68-18, Statement of Policy with Respect to Maintaining High Quality of Water in California (RWQCB, 1994).

Based on a review of previous environmental investigation reports and monitoring well data collected from State Water Resources Control Board-managed GeoTracker website (Geotracker), groundwater levels vary across the Study Area. Groundwater has been encountered as shallow as 3 feet (or shallower), and as deep as approximately 60 feet below ground surface (bgs). The groundwater flow directions vary within the Study Area.

9. DRAINAGE AND FLOODING

The Study Area is situated mostly on a highly urbanized, gently rolling mesa. Drainage is mainly along streets, gutters, and storm drain pipelines that empty into the canyons incising the mesas. Graded slopes use concrete swales that empty into storm drains for drainage. The natural slopes drain into adjacent canyons or tributaries. Low gradients on streets and storm drains as well as blocked storm drain inlets can create local, short duration flooding during very heavy rainfall. The Study Area and nine Focus Areas are not shown to be in 100- or 500-year Federal Emergency Management Agency flood zones.

In the event of a breach of San Vicente Dam, the southwest corner of the Study Area could be inundated (California Division of Safety of Dams, 2019). Figure 5 shows the extent of the estimated flooding.

10. MINERALOGIC RESOURCES

Data from the U.S. Geological Survey (USGS) Mineral Resource Data System show that there are no mineralogic resources in the Study Area or the nine Focus Areas.

The Conservation Element of the City of San Diego General Plan (City of San Diego 2008b) indicates the eastern portion of the Study Area is mapped in Mineral Resource Zone 2 (MRZ-2) which is described as areas underlain by mineral deposits (sand and gravel) where geologic data show that significant measured or indicated resources are present. The MRZ-2 area is nearly fully developed and is in a highly urbanized area. The Study Area is not considered available for future mining activities.

11. GEOLOGIC HAZARDS AND IMPACTS

This section identifies geologic hazards that may affect proposed policies and programs of the Clairemont CPU and proposed land use. These hazards include seismicity and ground motion; ground rupture; liquefaction; seismically induced settlement; slope instability; subsidence; expansive and corrosive soils; impermeable soils; shallow groundwater; and flooding. These hazards can be mitigated through administrative controls (e.g., avoiding with building in hazard-prone areas or structure setback) and/or engineering improvements (e.g., ground improvement, ground restraints, or appropriate structure foundation). Site-specific and hazard-specific geotechnical investigations would be required to evaluate the appropriate mitigation measure or combination of measures.

The City of San Diego Seismic Safety Study Geologic Hazards and Faults maps document the known and suspected geologic hazards and faults in the region. The maps show potential hazards and rates them by relative risk, on a scale from nominal to high. The Seismic Safety Study is intended as a tool to determine the level of geotechnical review to be required by the City for planning, development, or building permits. The Study Area is shown on portions of map grid tiles 20, 21, 25, 26, 30, and 31 of the City of San Diego Geologic Hazards and Fault maps. Identified hazards are described below.

Figure 6 shows the location of hazards as defined by the City maps. The mesa area is underlain by “level mesas underlain by terrace deposits or bedrock, nominal risk” (No. 51); “other level areas or gently sloping to steep terrain, favorable geologic structure” (No. 52); and “level or sloping terrain, unfavorable geologic structure, low to moderate risk” (No. 53).

Slope areas are underlain by “Friars: neutral or favorable geologic structure” (No. 23); “Friars: unfavorable geologic structure” (No. 24); “Ardath: neutral or favorable geologic structure” (No. 25); “Ardath: unfavorable geologic structure” (No. 26); and “steeply sloping terrain, unfavorable or fault controlled geologic structure, moderate risk” (No. 54). The areas at the top of slopes has been designated No. 53. The bottoms of drainages and low areas adjacent to Mission Bay and the San Diego River are designated as No. 31 or 32 which exhibit a “high potential for liquefaction due to high groundwater” or “low potential for liquefaction due to fluctuating groundwater levels”. Landslide deposits are “Confirmed, known, or highly suspected” (No. 21), “Possible or conjectured” (No. 22).

The westernmost portion of the Study Area contains fault zones described as “Active, Alquist-Priolo Earthquake Fault Zone”; and “Potentially Active, Inactive, presumed inactive, or Activity Unknown”.

11.1. Seismicity and Ground Motion

An active fault is defined by the State Mining and Geology Board as one that has experienced surface displacement within the Holocene epoch, i.e., during the last 11,000 years (California Geological Survey, 2007). The Study Area is subject to potential ground shaking caused by activity along faults located near the Study Area.

Ground shaking during an earthquake can vary depending on the overall magnitude, distance to the fault, focus of earthquake energy, and the type of geologic material underlying the area. The composition of underlying soils, even those relatively distant from faults, can intensify ground shaking. Areas that are underlain by bedrock tend to experience less ground shaking than those underlain by unconsolidated sediments such as artificial fill or unconsolidated alluvial fill.

As noted, the Study Area is subject to ground shaking hazards caused by earthquakes on regional active faults. Based on a Probabilistic Seismic Hazards Ground Motion Interpolator provided by the California Department of Conservation (2008), the Study Area is located in a zone where the horizontal peak ground acceleration having a 10 percent probability of exceedance in 50 years is 0.247g (where g represents the acceleration of gravity). Although much less probable, a large earthquake on the Rose Canyon fault zone could create twice the accelerations and cause much more widespread damage in the Study Area (EERI, 2020). Earthquake shaking will affect all nine Focus Areas.

11.2. Ground Rupture

A significantly large earthquake can rupture the ground surface along the causative fault. If improvements straddle active faults, ground rupture can cause collapse of buildings, bridges, and roads, or rupture of pipelines and other underground utilities (City of San Diego, 2008). The ability to determine where active faults exist is extremely important in reducing the impact of earthquakes and is the reason the State of California created special study areas called Alquist-Priolo Earthquake Fault Zones, to legally require evaluation of ground rupture hazards.

Ground rupture can occur on the Rose Canyon fault zone. The fault zone within the Study Area is shown on Figure 4. A portion of the Rose Canyon fault zone near Balboa Avenue has been placed in an Alquist-Priolo Earthquake Fault Zone where a fault could be documented in age and location (Rockwell, et al., 1991; California Geological Survey, 1991). South of the Alquist-Priolo Earthquake Fault Zone, the distribution of individual faults is difficult to assess as the ground has been heavily modified by construction of roads (Interstate 5, Morena Boulevard, Balboa Avenue, Clairemont Drive), railways, and residential and commercial developments. Historical aerial photographs and scattered subsurface exploration provide a rough understanding of fault locations within the zone (SANDAG, 2014); a lot of this understanding is through extrapolation and not direct subsurface investigation. Older geologic maps and City of San Diego fault hazard maps depict buried faults (Figures 4 and Figure 6) that could not be found in the subsurface. Conversely, active faults not previously mapped have been found (TerraCosta, 2018). As with other portions of the Rose Canyon fault zone, it appears to be composed of both active and potentially active fault traces and branches. Ground rupture will affect Focus Areas 4, 7, and 8.

11.3. Liquefaction, Seismically Induced Settlement

Liquefaction is a phenomenon whereby unconsolidated and/or near-saturated soils lose cohesion as a result of severe vibratory motion. The relatively rapid loss of soil shear strength during strong earthquake shaking results in temporary, fluid-like behavior of the soil. Soil liquefaction causes ground failure that can damage roads, pipelines, underground cables, and buildings with shallow foundations. Research and historical data indicate that loose granular soils and non-plastic silts that are saturated by a relatively shallow groundwater table are susceptible to liquefaction.

Among the potential hazards related to liquefaction are seismically-induced settlement. Seismically-induced settlement is caused by the reduction of shear strength due to loss of grain-to-grain contact during liquefaction and may result in dynamic settlement on the order of several inches to several feet. Other factors such as earthquake magnitude, distance from the earthquake epicenter, thickness of the liquefiable layers, and the fines content and particle sizes of the liquefiable layers will also affect the amount of settlement.

While lateral spreads are also associated with these ground failures, the liquefaction prone soil in the Study Area is confined to existing canyon bottoms and the flat lying area at the mouth of Tecolote Canyon which are not likely to undergo lateral spreading.

Liquefiable soil is located in the bottoms of San Clemente, Rose, and Tecolote Canyon in the Study Area (Figure 6). At the mouth of Tecolote Canyon, the creek has formed a broad alluvial fan which has prograded into the San Diego River and Mission Bay. The alluvium in this area is also liquefiable. Existing or proposed improvements in liquefiable areas include Focus Areas 4 and 8.

11.4. Tsunamis, Seiches, and Dam Failure

A tsunami is a sea wave generated by a submarine earthquake, landslide, or volcanic action. Submarine earthquakes are common along the edge of the Pacific Ocean, thus exposing all Pacific coastal areas to the potential hazard of tsunamis. Only a small portion of the Study Area lies within a mapped tsunami inundation zone (Figure 5). A seiche is an earthquake-induced wave in a confined body of water, such as a lake, reservoir, or bay. However, no portion of the Study Area lies near a confined body of water on which a seiche could be expected to occur.

An earthquake-induced dam failure can result in a severe flood event. When a dam fails, a large quantity of water is suddenly released with a great potential to cause human casualties, economic loss, lifeline disruption, and environmental damage. Based on the California Division of Safety of Dams (2019), the southwest corner of the Study Area is within the inundation zone in the event of failure of San Vicente Dam. Although other dams can also cause inundation in the Study Area, inundation from the failure of San Vicente Dam overlaps failures of any other dams in the San Diego River Basin.

11.5. Slope Instability

According to the City of San Diego Seismic Safety Study, the slopes in the Study Area are underlain by landslides, Friars and Scripps Formations, and Ardath Shale with neutral, adverse to favorable structure (Geologic Hazard Category 21, 22, 23, 24, 25, 26, and 54, Figure 6). Since there are landslides on slopes with neutral and favorable geologic structure, all slopes underlain by the Friars Formation, Scripps Formation, and Ardath Shale should be considered potentially unstable. The tops of the slopes are mapped as being at low to moderate risk for landsliding (Hazard Category 53 and 54). The slopes should be considered potentially unstable. Buildings or infrastructure older than 1985 within 50 feet of the tops of natural slopes may have been designed without consideration of slope stability (this conclusion is in general agreement with Hazard Category 53, City of San Diego, 2008). Additions of new building loads in these locations may not meet current City of San Diego standards for slope stability. Focus Area 4 will be impacted by Slope instability.

11.6. Subsidence

Subsidence typically occurs when extraction of fluids (water or oil) cause the reservoir rock to consolidate. Water extraction is minimal in the Study Area and the geologic materials area well consolidated. Subsidence is not a hazard in the Study Area.

Settlement of unconsolidated soil (fill or alluvium) may occur locally where new loads are imposed on previously uncompacted fill, compacted fill on unconsolidated material such as weathered very old paralic deposits or alluvium, or unconsolidated alluvium.

11.7. Expansive or Corrosive Soils

Other potential geological hazards include expansive or corrosive soils. Expansion of the soil may result in unacceptable settlement or heave of structures or concrete slabs supported on grade. Changes in soil moisture content can result from precipitation, landscape irrigation, utility leakage, roof drainage, perched groundwater, drought, or other factors. Soils with a relatively high clay content are generally considered expansive or potentially expansive. Very old paralic deposits typically on mesa tops typically have a thick clayey weathering profile that can be expansive. Grading has mixed the natural soils with the granular formational materials and will affect the potential for expansive soil greatly. Parking lots subgrades with pavements are less susceptible to the deleterious effects of expansive soils. Building foundations and load-bearing geotechnical structures are more susceptible to the effects of expansive soils. Expansive soil may impact Focus Areas 1, 2, 3, and 6. Corrosive soil can impact all nine focus areas.

11.8. Impermeable Soil

The permeability of soil within 10 feet of the current ground surface is important when evaluating the potential for, and the design of storm water infiltration devices. The soil in the Study Area exhibits very moderate infiltration (Table 2) and the well consolidated, frequently cemented old paralic deposits are typically encountered at very shallow depths. As a result, the use of typical shallow infiltration systems may be problematic in the mesa portion of the Study Area.

11.9. Groundwater

The permanent groundwater table is expected to be too deep to impact the planned developments shown on the Clairemont CPU. Local shallow groundwater and perched groundwater may be present locally due to leaking storm drains, water lines, and irrigation. Deeper excavations and areas with shallow groundwater will affect construction (temporary slope stability, shoring, dewatering and permanent drainage behind walls).

12. IMPACT MITIGATION

The impacts summarized above may be mitigated through administrative controls (e.g., avoiding building in hazard-prone areas or structural setback areas) and/or engineering improvements (e.g., ground improvement, ground restraints, remedial grading or foundation design). Site specific geotechnical investigations are required to recommend the appropriate mitigation measure(s).

12.1. Seismicity and Ground Motion

The entire Study Area will be affected by seismicity and ground motion. Mitigation can be accomplished by geotechnical and structural engineering design. Geotechnical investigations should be conducted in accordance with City of San Diego Guidelines for Geotechnical Reports and State of California requirements. Most mitigation measures will involve foundation design and or ground improvement.

12.2. Ground Rupture

Ground rupture will affect the westernmost portion of the Study Area (Focus Areas 4, 7, and 8) where improvements are planned for areas underlain by the Rose Canyon fault zone. Mitigation can be accomplished by geotechnical recommendations for improvement siting with relation to active faulting. Geotechnical investigations should be conducted in accordance with City of San Diego Guidelines for Geotechnical Reports and Fault Investigations (City of San Diego, 2018) and State of California requirements (California Geological Survey, 2002, California Geological Survey, 2018).

Due to the difficulty in identifying fault traces in the Rose Canyon fault zone in the southwestern portion of the Study Area (SANDAG, 2014; TerraCosta, 2018), it is recommended that each planned structure in the Alquist-Priolo Zone shown on Figure 4 be evaluated for ground rupture as required by the Alquist-Priolo Earthquake Fault Zone Act (California Geological Survey, 2018) and by the City of San Diego’s Downtown special fault zone (2008). In addition, it is recommended to apply the same requirement of evaluating each planned structure in the area designated as Clairemont CPU Seismic Special Studies Zone on Figure 4. These requirements affect Focus Areas 4, 7, and 8.

12.3. Liquefaction, Seismically Induced Settlement

Liquefaction and seismically induced settlement can be mitigated by ground improvement and/or foundation design. Geotechnical investigations should be conducted in accordance with City of San Diego Guidelines for Geotechnical Reports and State of California requirements.

12.4. Tsunamis, Seiches, and Dam Failures

No mitigation measures are necessary for Tsunami or Seiches because the Study Area is not impacted or would have very minor impacts from these hazards. Dam failure inundation may be mitigated through civil design.

12.5. Slope Instability

Mitigation may be achieved by avoidance of development on slopes, stabilizing the slopes through grading, or using specially designed foundations. Geotechnical investigations should be conducted in accordance with City of San Diego Guidelines for Geotechnical Reports with an emphasis on slope stability. Additions to existing structures or development of ancillary structures to existing development will need independent geotechnical investigations if located within 25 feet of slopes in excess of 10 feet high, and on undocumented fills. The investigations should be applied in Hazard Categories 21-25 and 53.

12.6. Subsidence

Construction of improvements in areas underlain by alluvium or fill should be designed to withstand settlement of unconsolidated soil. Geotechnical investigations for design of settlement resistant structures should be conducted in accordance with City of San Diego Guidelines for Geotechnical Reports. Mitigation measures typically include ground improvement and/or foundation design.

12.7. Expansive or Corrosive Soil

Expansive soil measures include specially reinforced foundations or removal and replacement of expansive soil with less expansive material. Roadways may need heavier pavement sections. Remedial grading conducted in the past for current parking lots may not have been suitable for building foundations. Geotechnical investigations should be conducted in accordance with City of San Diego Guidelines for Geotechnical Reports for new development and structures. Corrosive soil should be evaluated by a Corrosion Engineer for recommendations for soil replacement or cathodic protection.

12.8. Impermeable Soil

Infiltration potential should be evaluated in accordance with City of San Diego Storm Water Standards, Part 1, 2017 Edition (City of San Diego, 2017). Cemented subgrade requiring heavier than normal equipment to excavate can be identified through subsurface geotechnical exploration or geophysical surveys.

12.9. Groundwater

The effects of encountering groundwater during construction should be evaluated by geotechnical investigations in accordance with City of San Diego Guidelines for Geotechnical Reports. Mitigation measures include construction (or permanent) dewatering, temporary and permanent slope stabilization, and subsurface drainage.

13. THRESHOLDS OF SIGNIFICANCE

In accordance with Appendix G of the CEQA Guidelines, the project will have a significant effect on the environment if it would:

G-1: Expose people to potential substantial adverse effects, including the risk of loss, injury or death involving: a) fault rupture; b) seismic shaking; c) seismic ground failure; d) landsliding.

G-2: Result in substantial soil erosion or loss of topsoil.

G-3: Be located in a geologic unit or soil that is unstable (landsliding, settlement, lateral spreading) or that would become unstable as a result of the project.

G-4: Be located on expansive soil causing substantial risk to life or property.

G-5: Have soils incapable of supporting the use of septic tanks where sewers are not available.

13.1. Threshold G-1 a) Fault Rupture

Not significant. Improvements within the Rose Canyon fault zone will be required to be located away from active faults in accordance with California and City Standards and codes. If active faults are not avoided, the impact would be significant.

13.2. Threshold G-1 b) Strong Seismic Ground Shaking

Less than significant. Construction of buildings and other civil works will be required to use seismic resistant designs in accordance with California and City standards and codes. If not constructed to these standards, the impact would be significant.

13.3. Threshold G-1 c) Seismic Ground Failure

Less than significant. Buildings will be required to be built in accordance with City and California standards and codes. Foundation or geotechnical ground improvement can be used to reduce the impact of ground failure.

13.4. Threshold G-1 d) Seismic Induced Landsliding

Less than significant. Planned development will be required to have geotechnical recommendations for slope stability mitigation for both static and pseudostatic (i.e., during a seismic event) conditions. Slopes within developed areas have been constructed in accordance with City of San Diego standards and codes and are assumed to be stable under static and pseudostatic conditions.

13.5. Threshold G-2 Substantial Soil Erosion and Loss of Topsoil

Less than significant. The Study Area is almost fully developed with landscaping, buildings, and paving. Areas not developed are dedicated open space areas that are well covered with natural vegetation. Most of the Study Area is located on a mesa where shallow slopes. As a result, the potential for erosion is very low. Since construction will be required to follow City of San Diego standards and code that stipulate protection against temporary and permanent erosion, the impact of erosion and loss of topsoil is less than significant.

13.6. Threshold G-3 Unstable Soil (Landslide, Settlement, Lateral Spreading)

Landslide: Less than significant. Landslides and landslide prone geologic formations are exposed along the slopes of canyons and the coastal bluffs. The Clairemont CPU shows planned development only in areas previously developed. These areas have been stabilized or have utilized suitable setbacks. Any new development in these areas should include geotechnical review of the as-built conditions and evaluation of the impact new construction will have on the stability of new and old structures. New development should be designed in accordance with State and City codes and standards.

Settlement: Less than significant. Settlement prone soil within the Clairemont CPU consists of undocumented fills, fills placed on settlement prone soil (such as the southwestern corner of the Study Area, Focus Area 8) or soils within 25 feet of the tops of slopes 10 feet high or higher. The impact of these settlement prone soils will occur when additions or new fills place new loads on settlement prone soil. Geotechnical reports performed in accordance the City of San Diego Guidelines should be required for any new development that would add additional loads on undocumented fills, fills placed on settlement prone soil, or soil within 25 feet of slopes in excess of 10 feet in height to evaluate the effect of the additional loads. Without changing the requirements for geotechnical investigation for minor additions or fills, the effects of settlement prone soil on the planned development could be significant.

Lateral Spreading: Less than significant. Lateral spreading occurs in sloping liquefaction prone soil or liquefaction prone soil with an open face (slope). Liquefaction prone soil in the Study Area is overlain by fill or is confined to stream channel bottoms. The potential for lateral spreading in the Study Area is insignificant.

13.7. Threshold G-4 Expansive Soil

Less than significant. Expansive soil is present on the mesa portions of the Study Area. This area has been heavily modified by previous development, so the distribution of the expansive soil will be location-dependent. Geotechnical investigations as required by the City of San Diego will identify the effects of expansive soil on the planned development. Typical remediation measures include removal of unsuitable soil and replacement with non-expansive soil, chemical treatment of expansive clay, or specially designed and reinforced foundations.

13.8. Threshold G-5 Soil Unsuitable for Onsite Sewage Disposal Systems

Less than significant. Soil and geologic formations with poor percolation characteristics are widespread in the Study Area. However, the Study Area is currently well served by existing sewer systems. The use of onsite sewage disposal systems is not anticipated.

14. CONCLUSIONS

Conclusions of this Study are listed below.

- There are no geologic hazards that cannot be avoided or mitigated
- There are no policies or recommendations of the Clairemont CPU which will have a direct or indirect significant environmental effect with regard to geologic hazards.
- The proposed land uses are compatible with the known geologic hazards.
- There are no potential impacts related to geologic hazards from the implementation of the Clairemont CPU that can't be avoided, reduced to an acceptable level of risk, or reduced below a level of significance through mandatory conformance with applicable regulatory requirements or the recommendations of this technical report.
- The impact of unstable soil can be reduced to less than significant levels by requiring geotechnical investigations on all construction on ground underlain by settlement prone undocumented fills, fills on settlement prone soil, or soil within 25 feet of the tops of slopes in excess of 10 feet high.

15. LIMITATIONS

This report was prepared in general accordance with current guidelines and the standard-of-care exercised by professionals preparing similar documents near the Study Area. No warranty, expressed or implied, is made regarding the professional opinions presented in this document. As this report represents a review of existing documentation on geotechnical conditions of the planning areas rather than in-depth on-site investigation, it cannot account for variations in individual site conditions or changes to existing conditions. Please also note that this document did not include an evaluation of environmental hazards.

The conclusions, opinions, and recommendations as presented in this document are based on a desktop analysis of data, some of which were obtained by others. It is our opinion that the data, as a whole, support the conclusions and recommendations presented in the report.

The purpose of this study was to evaluate geologic and geotechnical conditions within the planning area to assist in the preparation of environmental impact documents for the project. Comprehensive geotechnical evaluations, including subsurface exploration and laboratory testing, should be performed prior to design and construction of structural improvements. Any future projects on individual sites in the planning area will require site-specific geotechnical studies as required by State and City regulations.

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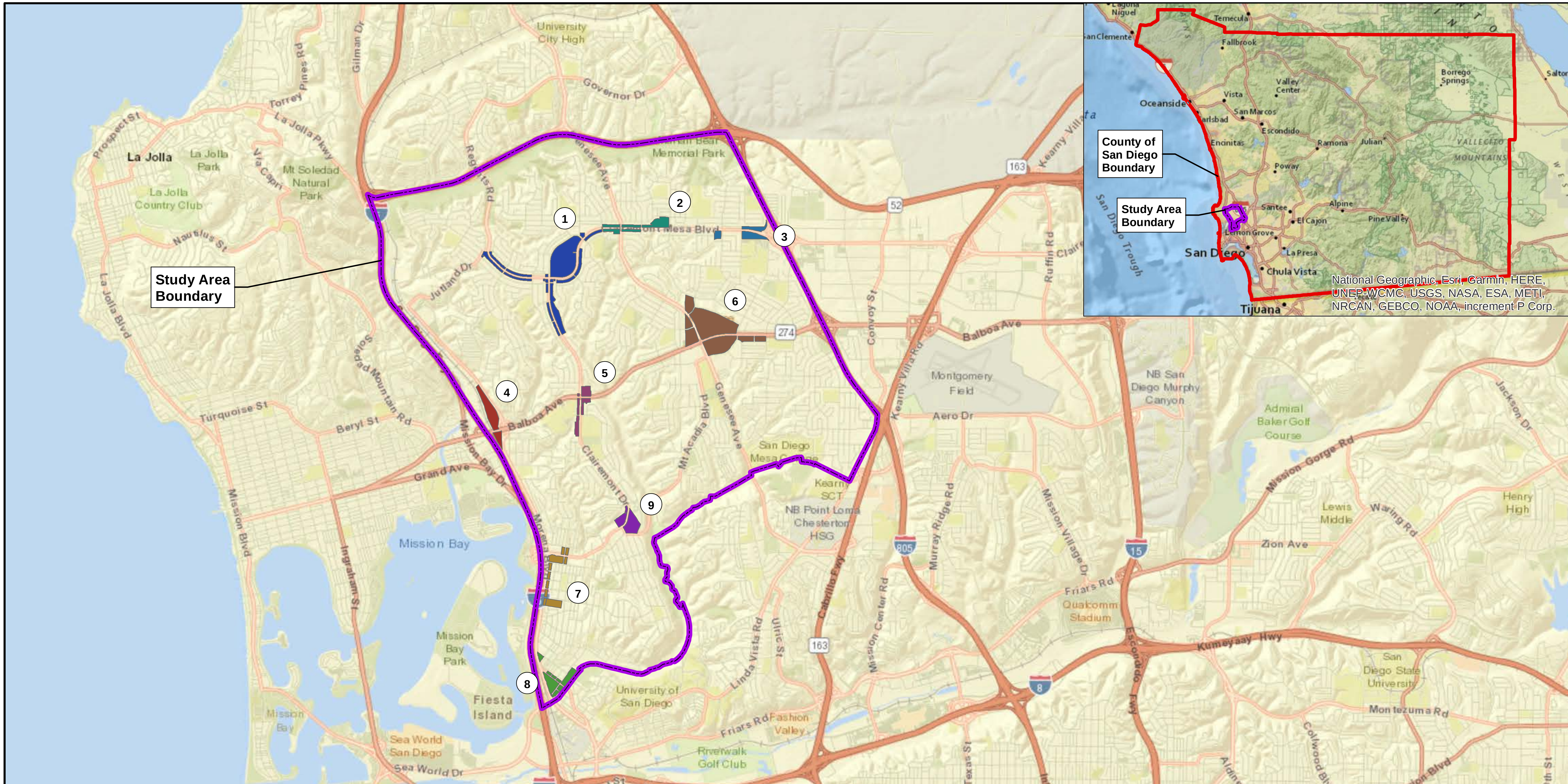
FIGURES



Legend

- Clairemont CPU Boundary (Study Area Boundary)
- 1-Clairemont Town Square
- 2-Genesee Avenue/Clairemont Mesa Boulevard and Diane Center
- 3-Clairemont Mesa Boulevard East
- 4-City of San Diego Rose Canyon Operations Yard (near future trolley stop)
- 5-Balboa Avenue/Clairemont Drive
- 6-Genesee Plaza/Balboa Mesa Commercial Center
- 7-Morena Boulevard south of Clairemont Drive (near future trolley stop)
- 8-Morena Boulevard/Tecolote Road (near future trolley stop)
- 9-Clairemont Village

N W E S

0 2,500 5,000 Feet

Project No. 9126004

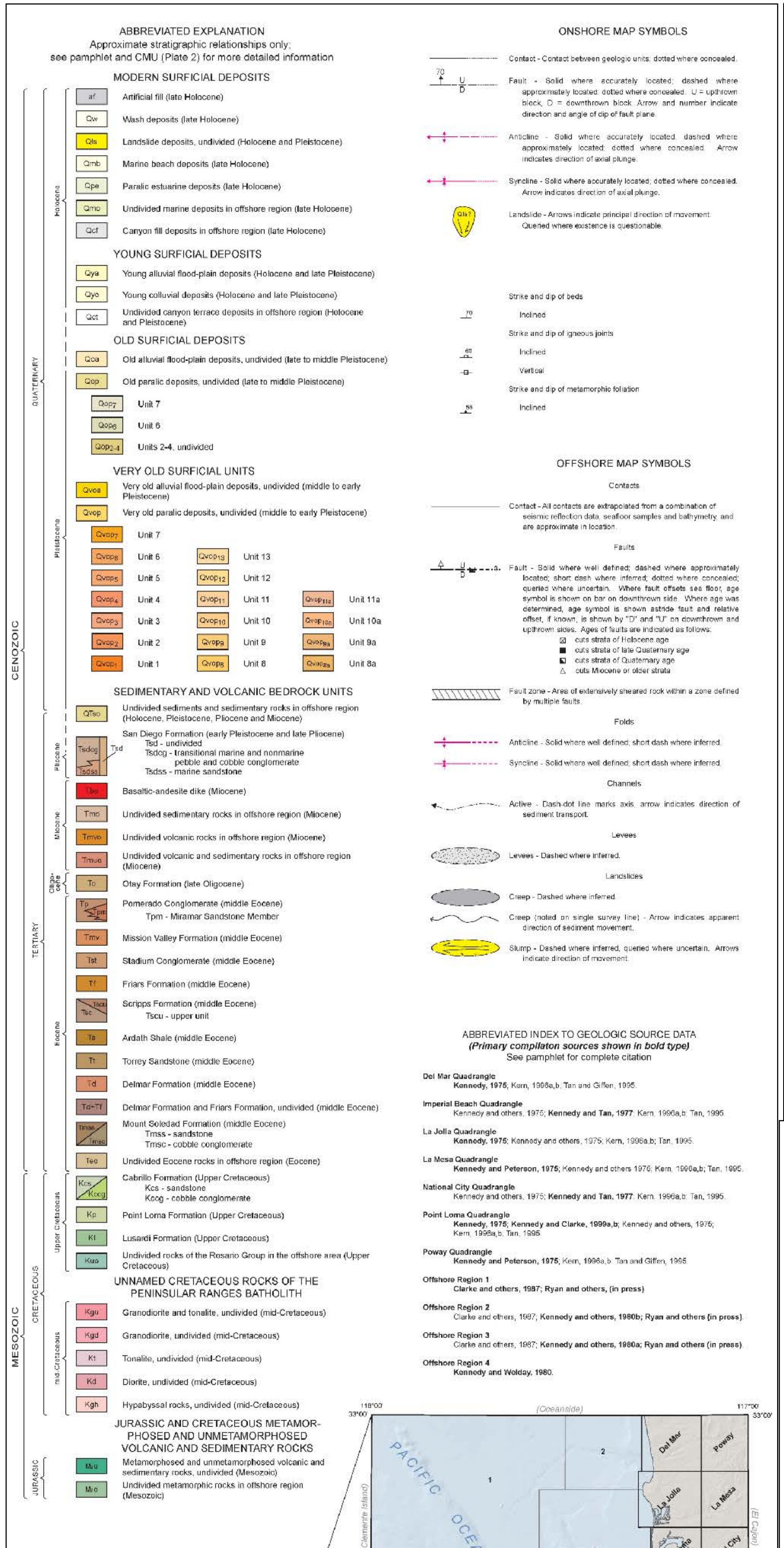
Date: 03/2020

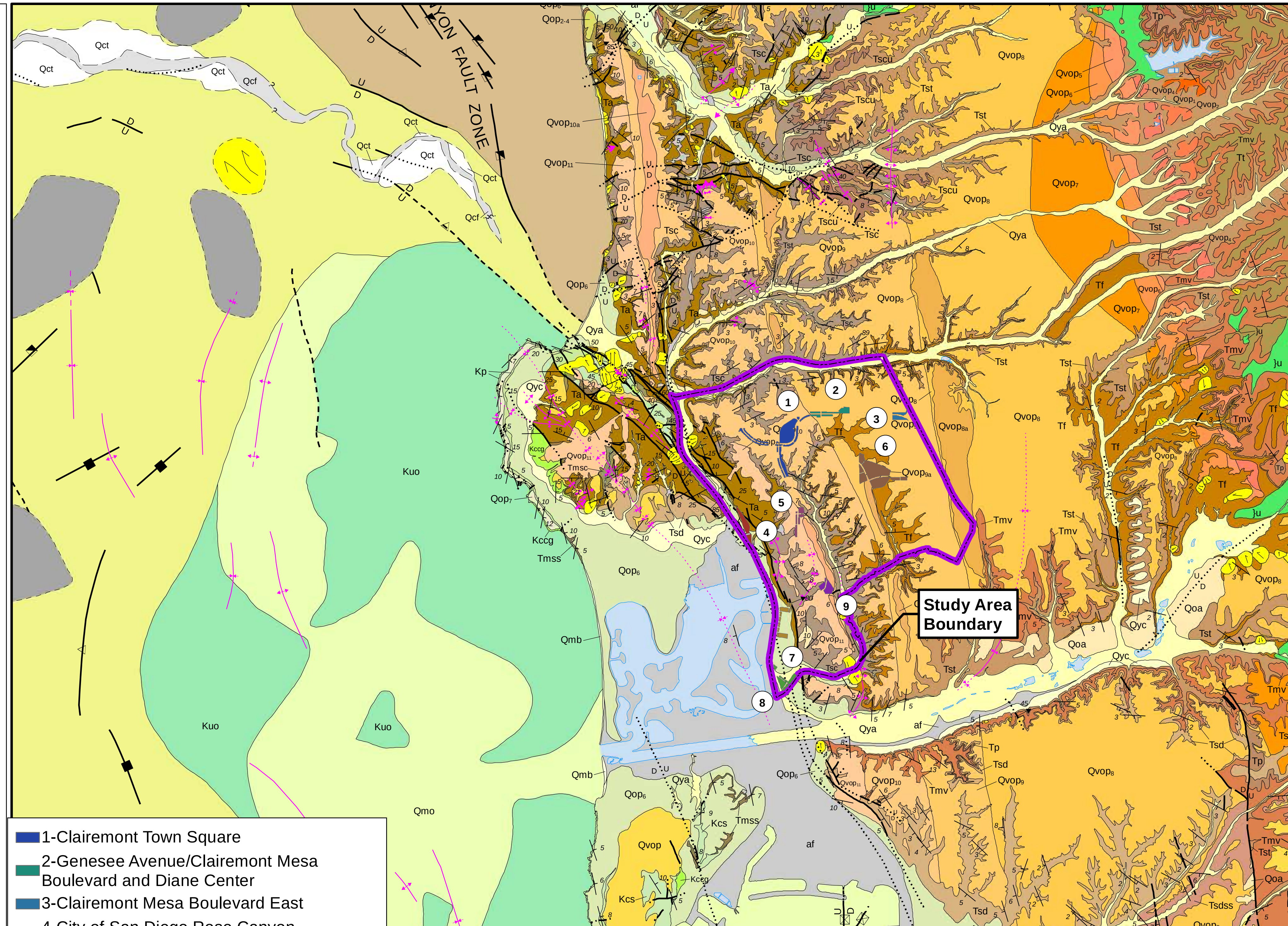
Drawn By: SG

Study Area Location Map

Clairemont Community Plan Update
San Diego, California

Figure 1





1-Clairemont Town Square
2-Genesee Avenue/Clairemont Mesa Boulevard and Diane Center
3-Clairemont Mesa Boulevard East
4-City of San Diego Rose Canyon Operations Yard (near future trolley stop)
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8-Morena Boulevard/Tecolote Road (near future trolley stop)
9-Clairemont Village

N
W E
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0 5,000 10,000 Feet

Project No. 9126004

Date: 03/2020

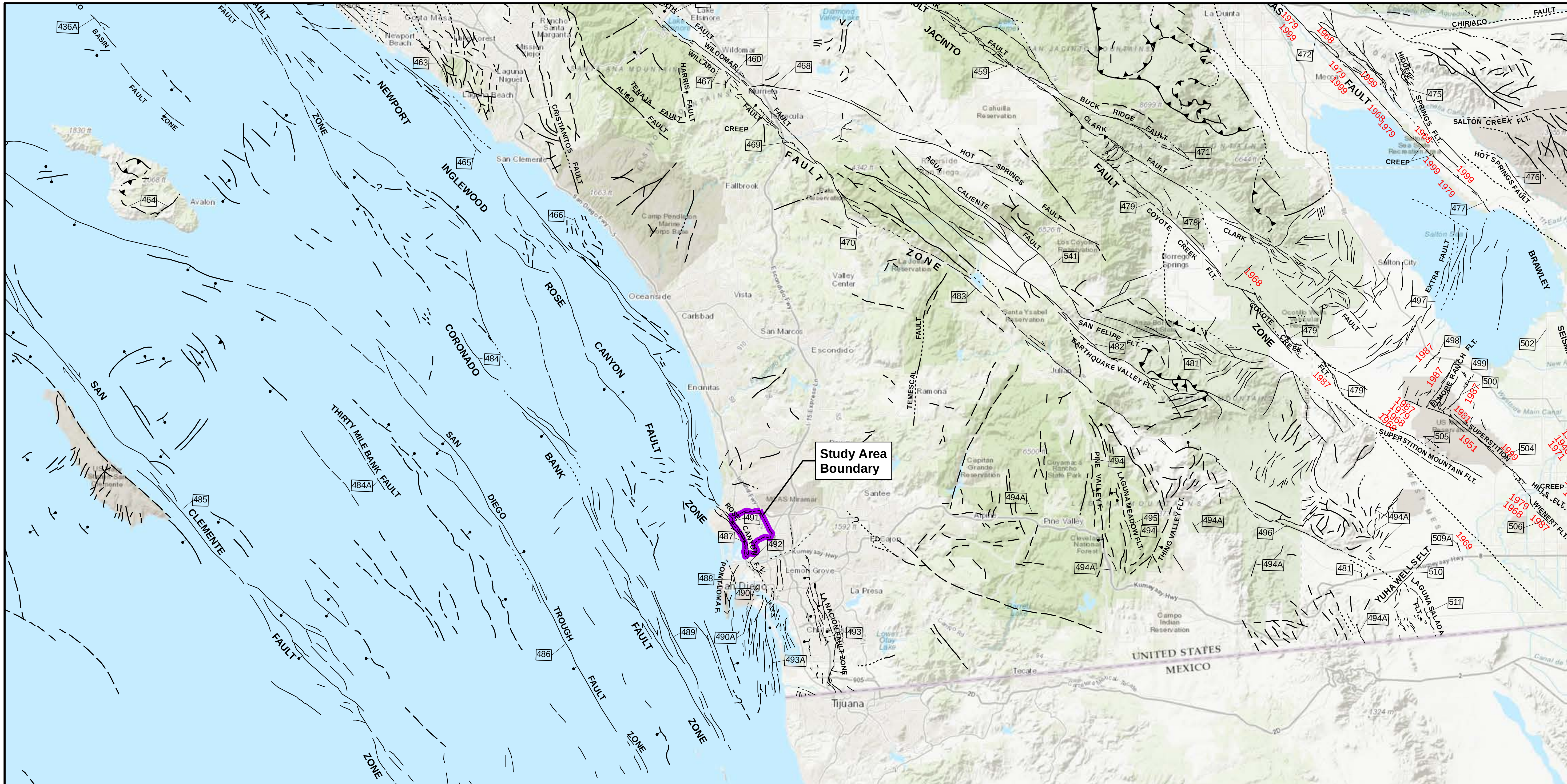
Drawn By: SG

Study Area
Regional Geology

Clairemont Community Plan Update
San Diego, California

Figure 2

THE BODHI GROUP
INNOVATING | SUSTAINING | SOLVING



Legend

- Study Area
- fault, approx. located
- fault, approx. located, queried
- fault, certain
- fault, concealed
- fault, concealed, queried
- fault, inferred, queried
- thrust fault, certain
- thrust fault, approx. located
- thrust fault, concealed
- dextral fault, certain
- dextral fault, approx. located
- dextral fault, concealed
- sinistral fault, certain
- sinistral fault, approx. located
- sinistral fault, concealed
- thrust fault, certain (2)
- thrust fault, approx. located (2)
- thrust fault, concealed (2)
- fault, certain (ball and bar)
- fault, approx. located (ball and bar)
- fault, concealed (ball and bar)
- dextral fault, certain (ball and bar)
- fault, concealed, queried (ball and bar)
- fault, concealed, queried (ball and bar, 2)
- fault, certain (dip)
- fault, approx. located (dip)
- fault, concealed (dip)
- reverse fault, certain
- reverse fault, approx. located
- reverse fault, concealed

N E S W

0 6 12 Miles

Project No. 9126004

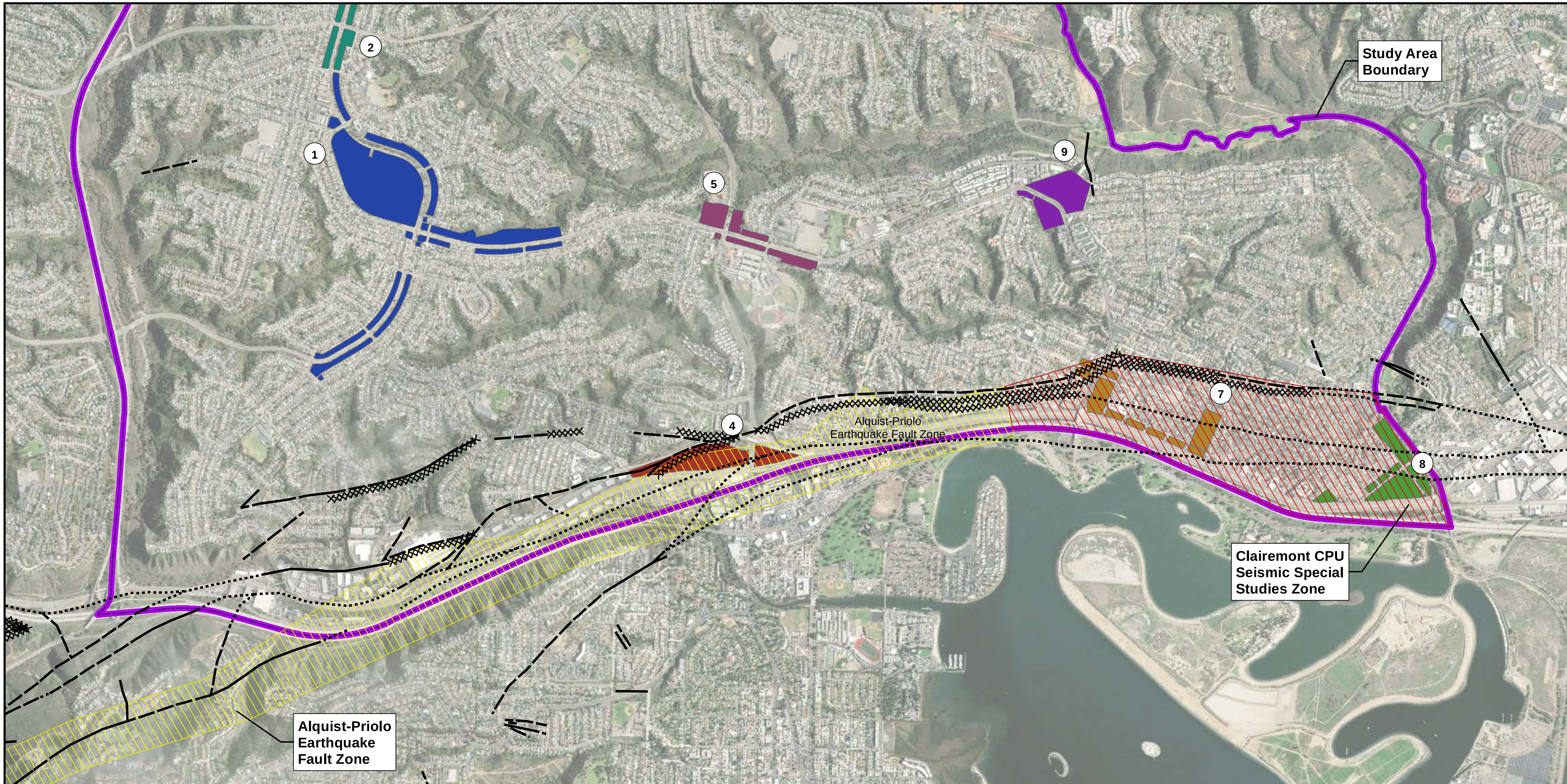
Date: 03/2020

Drawn By: SG

Study Area Regional Fault Map

Clairemont Community Plan Update San Diego, California

Figure 3



Legend

- Clairemont CPU Boundary
- 1-Clairemont Town Square
- 2-Genesee Avenue/Clairemont Mesa Boulevard and Diane Center
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- 8-Morena Boulevard/Tecolote Road (near future trolley stop)
- 9-Clairemont Village
- Fault
- Inferred Fault
- Concealed Fault
- Shear Zone
- Alquist-Priolo Earthquake Fault Zone
- CCPU Seismic Special Studies Zone

Fault classifications follow the City of San Diego convention (City of San Diego, 2008)

N E S W

0 1,000 2,000 Feet

Project No. 9126004

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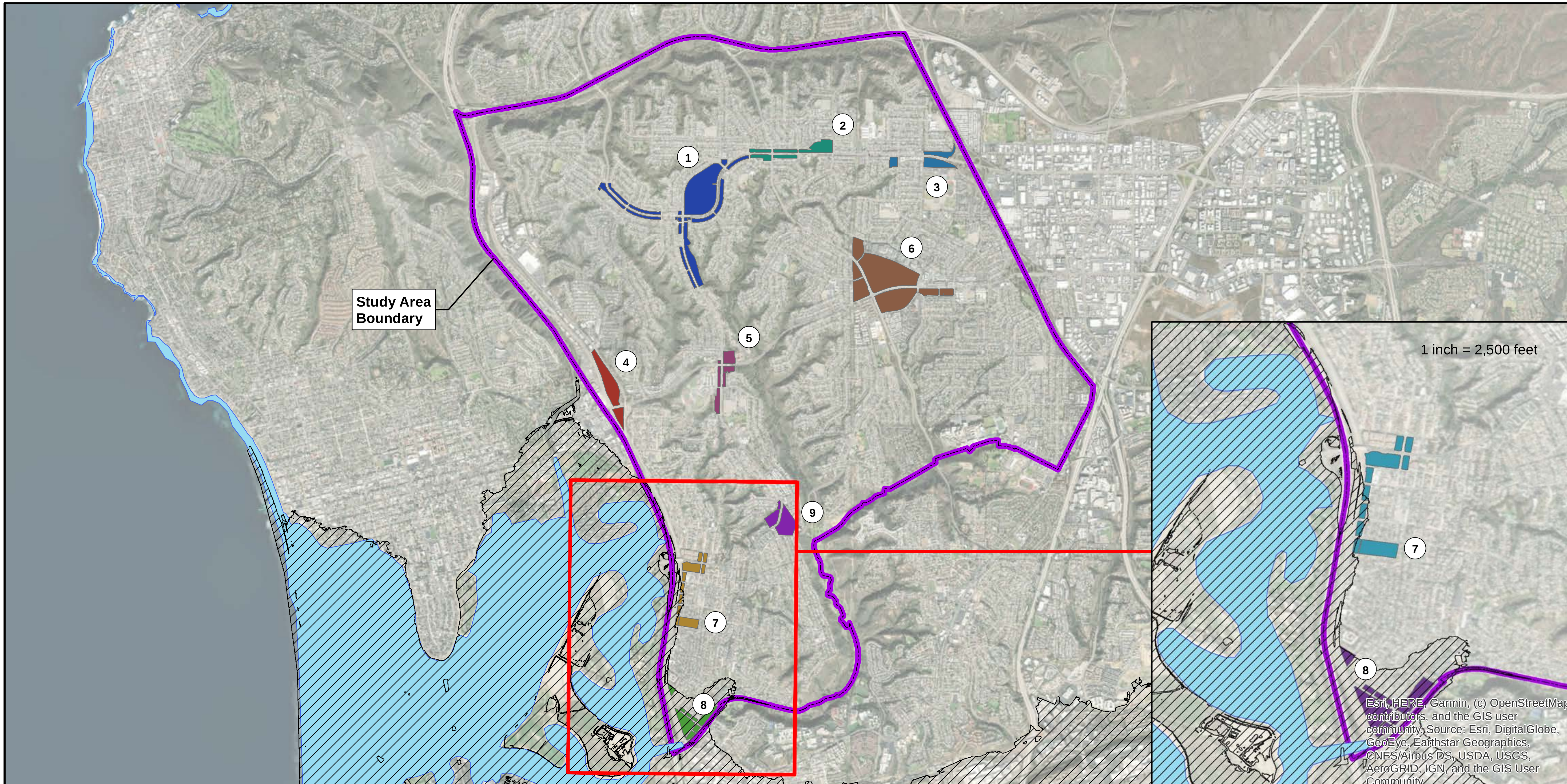
Study Area
Rose Canyon Fault Zone Map

Clairemont Community Plan Update
San Diego, California

Figure 4



Legend

- Clairemont CPU Boundary
- Areas subject to Dam Failure Inundation Flooding
- Areas Subject to Tsumani Inundation Flooding
- 1-Clairemont Town Square
- 2-Genesee Avenue/Clairemont Mesa Boulevard and Diane Center
- 3-Clairemont Mesa Boulevard East
- 4-City of San Diego Rose Canyon Operations Yard (near future trolley stop)
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- 8-Morena Boulevard/Tecolote Road (near future trolley stop)
- 9-Clairemont Village

N S W E

0 2,000 4,000 Feet

Project No. 9126004

Date: 03/2020

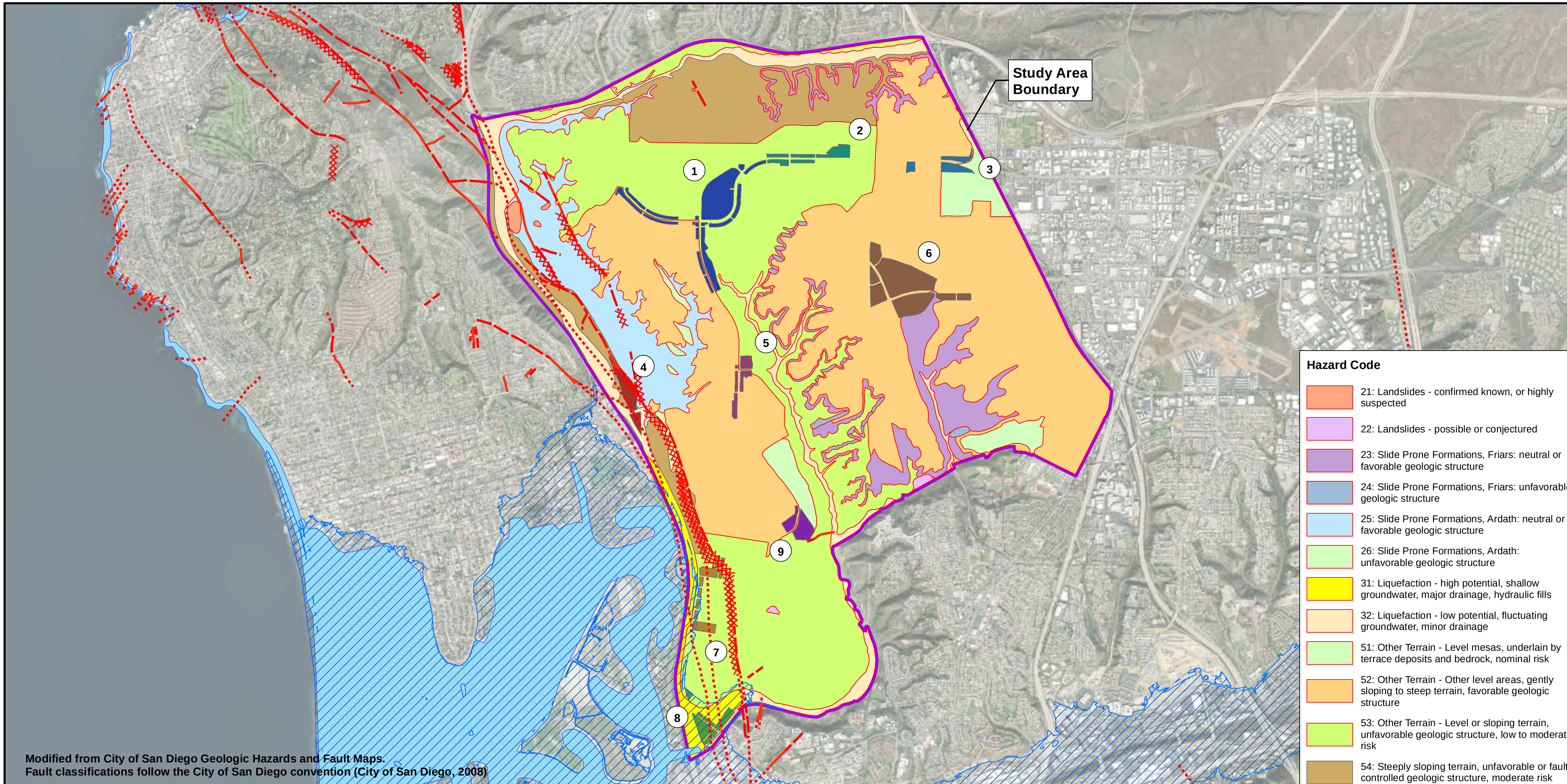
Drawn By: SG

Study Area Inundation Map

Clairemont Community Plan Update San Diego, California

Figure 5

THE BODHI GROUP
INNOVATING | SUSTAINING | SOLVING



Legend

- Clairemont CPU Boundary
- 1-Clairemont Town Square
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- 6-Genesee Plaza/Balboa Mesa Commercial Center
- 7-Morena Boulevard south of Clairemont Drive (near future trolley stop)
- 8-Morena Boulevard/Tecolote Road (near future trolley stop)
- 9-Clairemont Village
- Areas Subject to Dam Inundation Flooding
- Areas Subject to Tsunami Inundation Flooding
- Fault
- Inferred Fault
- Potentially Active Concealed Zone
- Potentially Active Shear Zone

N
W E
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0 2,000 4,000 Feet

Project No. 9126004

Date: 03/2020

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Study Area Summary of Geohazards

Clairemont Community Plan Update San Diego, California

Figure 6

THE BODHI GROUP
INNOVATING | SUSTAINING | SOLVING