GEOTECHNICAL DESKTOP STUDY
SAN DIEGO MTS CLEAN TRANSIT ADVANCEMENT CAMPUS PROJECT
METROPOLITAN TRANSIT SYSTEM

Submitted to:

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AGE Project No. 66C105

May 24, 2022

May 24, 2022

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Subject: **GEOTECHNICAL DESKTOP STUDY**
SAN DIEGO MTS CLEAN TRANSIT ADVANCEMENT CAMPUS PROJECT
METROPOLITAN TRANSIT SYSTEM
AGE Project No. 66C105

Dear Mr. Belzman:

In accordance with the request of HELIX Environmental Planning, Inc. (Helix), Allied Geotechnical Engineers, Inc. (AGE) has performed a geotechnical desktop study for the subject project for Metropolitan Transit Service (MTS). The study was performed in conformance with AGE's proposal for additional services dated October 14, 2021, and Amendment No. 1 dated April 6, 2022 of Original Task Order #1 from Helix dated February 5, 2021.

Should you have any questions regarding the contents of the report or if we may be of further assistance, please feel free to contact our office.

Sincerely,

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1.0 SITE AND PROJECT DESCRIPTION

The proposed project site consists of a total of five (5) commercial parcels located on the north side of Federal Boulevard west of 47th Street in San Diego California (See Location Map, Figure 1). Four of these parcels are contiguous, and are identified as County of San Diego Accessor Parcel Nos. (APNs) 541-611-04-00, 31-00, 34-00, and 35-00. These parcels are currently occupied by a variety of commercial/industrial buildings, as well as parking lots, driveways, and security fences. These combined parcels are approximately 9.64 acres in size (www.sdig.sandag.org). The fifth parcel is currently a fenced parking lot, and is identified as APN 541-611-27-00. This 2.41 acre parcel (www.sdig.sandag.org). is located east of the other four parcels, separated by a driveway entrance to a Fedex Shipping Center to the north of the parcel.

A conceptual site plan sketch provided by Metropolitan Transit System (MTS), shown on Figure 2, indicates that the easternmost parcel will be occupied by a 2-story Operations/Administration Building and two-story parking structure. The remaining parcels will have zero emission bus chargers, maintenance bay building, operations/administrations/storage building, and bush wash facilities. The scope of the proposed project may also include the design and construction of double deck bus parking structure. Retaining structures are planned along the south side of the parcel adjacent to Federal Boulevard, and along the east side of the parcel. Entrance and exit driveways from Federal Boulevard will be provided on the east and west sides of the parcel, with a new signalized intersection at the west entrance.

The project site is located within the Mid-City Community Plan Area, east of downtown San Diego in the southeast portion of the neighborhood of City Heights. The various commercial parcels in the project study area were developed on a gentle to moderate sloping mesa top along the southeast rim of Chollas Creek valley. Elevations at the project site range between 170 feet and 235 feet above the mean sea level (msl). Site grading has created a series of relatively level building pad areas in the project study area, with graded slopes constructed between the separate pads. These slopes are on the order of 5 feet to nearly 30 feet in height, and were typically constructed at gradients on the order of 2:1 (horizontal : vertical).

Parcel 541-611-04-00 is approximately 5.45 acres in size and occupied by structures with addresses 4506 through 4520 Federal Boulevard. The parcel overlooks Chollas Creek with a driveway entrance from Federal Boulevard on the west side. Pad elevations range between 170 to 175 feet msl (Google Earth, 2021) with a gentle northwesterly slope. Based on visual observation, as much as

40 feet of fill may be located along the outer perimeter of the parcel where the graded slope descends to Chollas Creek. A cut/fill transition line likely traverses the pad in a southwesterly-northeasterly orientation.

A graded slope on the order of 15 feet in height ascends from Parcel 541-611-04-00 to Parcel 541-611-31-00, and a graded slope approximately 25 feet in height ascends from Parcel 541-611-04-00 to Parcel 541-611-34-00. The slopes are armored in gunite, with drain pipe outlets on the face of the slope. Parcel 541-611-31-00 is a roughly rectangular-shaped, 1.35-acre lot occupied by a warehouse structure at 4550 Federal Boulevard. The pad elevation is approximately 190 feet msl. A graded slope approximately 25 feet in height ascends from the east side of parcel 541-611-31-00 to parcel 541-611-34-00. The toe of the slope is partially supported by masonry retaining walls. A graded slope that varies from approximately 10-feet to 15-feet in height descends from the west side of parcel 541-611-31-00 to the entrance driveway of parcel 541-611-04-00. A gravity (keystone) retaining wall of less than 5 feet in height is located at the toe of the slope. A cut/fill transition line likely traverses the pad in a southwesterly-northeasterly direction.

Parcel 541-611-34-00 is a roughly rectangular-shaped, 2.84 acre lot at 4576-4582 Federal Boulevard. The southerly portion of the pad is situated at approximate elevations of 215 feet to 220 feet msl. A graded slope approximately 20 feet in height descends to a northerly pad area, with a descending driveway along the east side providing access to the lower pad. A graded slope that varies from several feet to approximately 15 feet in height descends from the south side of the upper pad to Federal Boulevard. Cut/fill transition line likely traverse the upper and lower pads in a southwesterly-northeasterly direction.

Parcel 541-611-27-00 is located at the northwest corner of the intersection of Federal Boulevard and 47th street. The parking lot elevation varies from approximately 225 feet to 235 feet msl.

2.0 OBJECTIVE AND SCOPE OF STUDY

The objective of this desktop study is to provide general information and to evaluate potential major geologic and geotechnical issues and constraints which could impact proposed developments at the project site. The scope of the desktop study includes the performance of several tasks/services which are more fully described below.

2.1 Information Review

For this task, we have reviewed information pertaining to the project area that was readily available from a variety of sources which include the following:

- Allied Geotechnical Engineers, Inc. (AGE's) in-house references and aerial photographs;
- Published geologic literature and maps, including geologic and fault maps published by the City of San Diego, Federal Emergency Management Agency, California Geological Survey and United States Geological Survey;
- Pertinent project-related information, including geotechnical reports prepared by others;
- Conceptual Site Plan Sketch provided by MTS, undated; and
- Aerial photography available at Google Earth.

A listing of the references that were reviewed for this study is presented in Section 7.0.

2.2 Site Reconnaissance

The information obtained from our literature review was supplemented with visual observations gathered during our field reconnaissance visit conducted on April 11, 2022. The purpose of the site visit was to observe existing site conditions and geologic exposures within the project study area.

2.3 Data Evaluation and Reporting

This task involved a synthesis and evaluation of the data collected during the information review and field reconnaissance phases of this study, particularly with respect to known and anticipated geotechnical conditions and potential geologic hazards, such as faulting and seismicity, seismic-induced hazards, slope stability issues, and landslides. Based on an evaluation of the data, we have prepared this report to present a summary of our preliminary findings and opinions.

3.0 GEOLOGIC CONDITIONS

3.1 Geologic Setting

The project study area is located in the Peninsular Ranges geomorphic province, a north-south oriented mountain range which extends from the southern edge of the Los Angeles Basin into Baja California, Mexico. Basement rocks of the Peninsular Ranges province include Cretaceous crystalline rocks of the Southern California Batholith and Jurassic metasedimentary and metavolcanic rocks of the Santiago Peak Volcanics.

The project study area is situated in the western portion of the San Diego Embayment, a deep sedimentary-filled basin which is underlain at depth by the basement rock complex. The sedimentary formations consist of nearly flat-lying to gently southwest dipping, marine and non-marine sediments which range from Cretaceous to Holocene in age.

3.2 Tectonic Setting

Tectonically, the San Diego region is situated in a broad zone of northwest-trending, predominantly right-slip faults that span the width of the Peninsular Ranges and extend offshore into the California Continental Borderland Province west of California and northern Baja California. At the latitude of San Diego, this zone extends from the San Clemente fault zone, located approximately 50 miles to the west, to the San Andreas fault located about 90 miles to the east.

Major active regional faults of tectonic significance include the Coronado Bank, San Diego Trough, San Clemente, and Newport-Inglewood fault zones which are located offshore; the faults in Baja California, including the San Miguel-Vallecitos and Agua Blanca fault zones; and the faults located further to the east in Imperial Valley which include the Elsinore, San Jacinto and San Andreas fault zones. The active Rose Canyon Fault Zone (RCFZ) is located 3.3 miles west of the project site. A local fault map is shown on Figure 3, and a regional fault map is shown on Figure 4.

3.3 Geologic Units

Mapped geologic units within the project study area include the early Pleistocene to late Pliocene age San Diego Formation and unit 8 of the very old paralic deposits of middle to early Pleistocene age, which forms a cap on the mesa at the project study area and surrounding areas (Kennedy and Tan, 2008). A generalized geologic map is shown on Figure 5. Based on review of historical topographic maps and aerial photographs, the majority of the project site itself is anticipated to be underlain by filled ground of variable depths. The approximate limits of the filled ground is shown on Figure 6.

The very old paralic deposits generally consist of interfingered strandline, beach, estuarine and colluvial deposits composed of siltstone, sandstone and conglomerate with a distinct reddish-brown color due to ferruginous cement. Very old paralic deposits can pose difficult excavation conditions even for heavy duty construction equipment, due to the combination of strong cementation and locally abundant gravels and cobbles. The unit 8 deposits rest on the Tierra Santa marine terrace.

An unnamed and unmapped mudstone unit informally referred to as the "Normal Heights Mudstone" may overlie the terrace deposits. The mudstone unit generally consists of a highly plastic dark gray clay that is generally massive with a medium stiff to very stiff consistency. However, based on our past experience with other projects in the vicinity of the project site, the mudstone unit is not anticipated to be present at the project site.

The very old paralic deposits are unconformably underlain by the San Diego Formation. The San Diego Formation predominantly consists of a yellow brown and gray, fine to medium grained, poorly indurated, fossiliferous marine sandstone and a reddish brown, transitional marine and non-marine pebble and cobble-conglomerate. Thin beds of bentonite, marl, and brown mudstone may also be encountered in the unit. The San Diego Formation can generally be easily excavated with conventional heavy duty construction equipment.

3.4 Groundwater

The depth of the groundwater table beneath the project site is unknown but is estimated to be in excess of 100 feet below the ground surface (bgs). It must be noted that the local groundwater table is subject to significant seasonal variations. Groundwater is anticipated to occur below the elevation of the bottom of Chollas Creek (approximate elevation 107 feet msl). Chollas Creek is located approximately 350 feet northwest of the project site.

Six (6) test borings extended to a maximum depth of 66 feet bgs (155 feet msl) at the Fedex facility which abuts the northern boundary of the proposed project site did not encounter groundwater. The borings were performed as part of a Phase II Environmental Investigation at the Fedex facility by Groundwater & Environmental Services, Inc (2005).

4.0 GEOLOGIC HAZARDS

Geologic hazards are those hazards that could impact a site due to local and regional geologic and seismic conditions. Based on the results of our study, several potential geologic hazards which may impact the project site are identified and more fully described herein. A review of the City of San

Diego Seismic Safety Study Geologic Hazards and Faults Map Grid 18 (2008) classifies the project site as Hazard Category 52 - "Other level areas, gently sloping to steep terrain, favorable geologic structure, Low risk." The classification is not anticipated to detrimentally affect the proposed project. A copy of the map is shown on Figure 7.

4.1 Local Faulting

San Diego County is located in a seismically active area, typical of the southern California region. The mapped local and regional faults are shown on Figures 3, 4, 5, and 7. The project site is likely to experience moderate to severe ground shaking in response to a local or more distant large magnitude earthquake occurring during the expected life span of the proposed project.

No active or potentially active faults are mapped near the project site (Kennedy and Tan, 2008; City of San Diego 2008). The primary geologic and seismic hazard potentially impacting the project site would be strong ground shaking. The project site is not located within any United States Geological Survey (USGS) special study zones.

The project site is located within the potentially active La Nacion fault zone (LNFZ). The LNFZ is comprised of several en echelon faults within a generally north-south trending broad system of faults across the southern San Diego metropolitan area. The faults are generally dip-slip in nature with a down-to-the-west sense of separation. The main fault trace is mapped approximately 1.0 mile to the east of the project site (Kennedy and Tan, 2008; City of San Diego, 2008). A northwest trending strand of the La Nacion fault is mapped on the side walls of Chollas Creek approximately 1,500 feet northwest of the project site (Kennedy and Tan, 2008). The general trend of this fault strand extends toward the project site.

Geologic studies that have been performed on the LNFZ to date have not discovered any evidence for fault activity within Holocene time (11,000 years BP) (Dowlen, et.al, 1975; Hart, 1974). Based on the California Division of Mines and Geology fault classification criteria, the LNFZ may be considered "potentially active", meaning that it has documented evidence of movement within Pleistocene time (the last 1.5 to 2 million years) but no movement in Holocene time. Based on this information, we believe that there is a low potential for ground rupture resulting from onsite faulting.

Although the LNFZ is not considered to pose a significant risk in terms of seismic activity, the possible presence of a fault splay across the project site poses a potential for secondary movement along the fault as a result of a major earthquake on one of the regional active faults. We therefore recommend that the subsurface geotechnical investigation to be conducted for the final design of the proposed project should include the performance of fault trenching studies to verify the presence, location, and nature (type and age of movement) of the suspected fault at the project site. Although the fault may be considered potentially active, we do not recommend placing a structure directly astride the fault, and appropriate recommendations for a structural setback from the fault should be developed based on the results of the fault trenching studies.

The closest major active fault to the project site is the southern extension of the Rose Canyon fault zone (RCFZ) in downtown San Diego, approximately 3.3 miles west of the project site. Other sources of potential seismic risk include the major regional active faults with recurring magnitude 4.0 and greater earthquakes, such as the Coronado Bank and Elsinore fault zones, which are located about 18 miles to the west-southwest and 36 miles to the northeast, respectively. Other more distant, faults that could pose a potential source of seismic activity in the San Diego metropolitan area include the offshore located San Diego Trough and San Clemente fault zones and the San Jacinto and San Andreas fault zones to the east.

4.2 Historical Seismicity

AGE performed a search of the catalog of historical Southern California earthquakes within a specified radius of 60 miles from the project site going back to the year 1800. The earthquake catalog for events prior to about 1933 is limited to the higher magnitude events. A map of seismic epicenters in relation to the project site is shown on Figure 8.

The search results indicate that the nearest earthquake of magnitude 5.2 occurred on April 8, 1968 in the Terra Blanca Mountain area, which is located 54.1 miles northeast from the project site. The largest magnitude earthquake was a magnitude 6.6 event on August 6, 1889, located 63.5 miles northeast from the project site in Ocotillo Wells.

It is our opinion that the major seismic hazard affecting the project site would be seismic-induced ground shaking. The project site will likely be subject to moderate to severe ground shaking in response to a local or more distant large magnitude earthquake occurring during the life of the proposed facilities. For project design purposes, we recommend that the RCFZ be considered as the dominant seismic source.

4.3 Seismic Design Parameters (CBC 2019/ASCE 7-16)

AGE performed a site response characterization and evaluation of seismic design parameters for the proposed project based on California Building Code (CBC 2019)/American Society of Civil Engineers Minimum Design Loads and Associated Criteria for Buildings and Other Structures (ASCE 7-16) methods. Our study indicates that the project site is underlain by a mix of San Diego formation, very old paralic deposits, and filled ground of variable depths (as much as 40 feet). Therefore, it is anticipated that the project site will be a mix of Site Class C and Site Class D attenuations. The proposed structures are anticipated to have a natural period of less than 0.5 second.

Based on the aforementioned information, a site-specific ground motion hazard analysis will be required for the subject project. Site-specific ground motion hazard analysis should be performed based on a project specific geotechnical investigation. The investigation should include the performance of subsurface geotechnical borings to map the extent and evaluate the conditions of the underlying fill across the project site.

4.4 Liquefaction

Seismic-induced soil liquefaction is a phenomenon during which loose, saturated granular materials undergo matrix rearrangement, develop high pore water pressure, and lose shear strength due to cyclic ground vibrations induced by earthquakes. Manifestations of soil liquefaction can include loss

of bearing capacity below foundations, surface settlements and tilting in level ground, and instabilities in areas of sloping ground. Soil liquefaction can also result in increased lateral and uplift pressures on buried structures.

The project site is underlain by very stiff to hard formational materials which are not considered to be liquefiable. Furthermore, the project site is not located in area with shallow groundwater, and the project site is not mapped in a "Potential Liquefaction Area" as identified by the City of San Diego (2008). Therefore, the potential for seismic-induced liquefaction at the project site is considered negligible.

4.5 Fault Ground Rupture

No active or potentially active faults are mapped near the project site (Kennedy and Tan, 2008; Seismic Safety Element, City of San Diego 2008). The LNFZ may be considered "potentially active", meaning that it has documented evidence of movement within Pleistocene time (the last 1.5 to 2 million years) but no movement in Holocene time. Based on this information, we believe that there is a low potential for ground rupture resulting from onsite faulting.

4.6 Landslides

A review of the published geologic map indicates that there are no known (mapped) ancient landslides in the project study area (Kennedy and Tan, 2008), nor is the site in a landslide prone area as identified by the City of San Diego (2008). Therefore, landsliding is not considered a potential risk at the project site.

4.7 Lateral Spread Displacement

Lateral spreading occurs when underlying soil layer liquefies, and blocks of overlying surficial soil displace downslope or towards a sloping surface or unsupported "free face" such as riverbank. The lateral displacement typically ranges from a few inches to several feet and can cause significant damage to structures. Although the project site overlooks the southeast wall of Chollas Creek, due to the presence of very stiff to hard formational materials and the lack of shallow groundwater condition, the risk of lateral spreading impacting the project site is considered to be very low.

4.8 Differential Seismic-Induced Settlement

Differential seismic settlement occurs when seismic shaking causes one type of soil to settle more than another type. It may also occur within a soil deposit with largely homogeneous properties if the seismic shaking is uneven due to variable geometry or thickness of the soil deposit. A review of the conceptual site plan (see Figure 2) indicates that the proposed structures will be underlain but cut/fill situation or deep fill situation. Therefore, it is our opinion that there is a high potential for seismic-induced differential settlement at the project site.

4.9 Ground Lurching

Ground lurching is permanent displacement or shift of the ground in response to seismic shaking. Ground lurching occurs in areas with high topographic relief, and usually occurs near the source of an earthquake. The displacement can result in permanent cracks in the ground surface. Considering that no active fault is mapped in close vicinity to the project site, it is our opinion that ground lurching does not represent a potential hazard at the project site.

4.10 Expansive Soils

The majority of the soil materials underlying the project site are anticipated to be non-expansive or possess a low expansion potential. AGE anticipates that the highly expansive clayey soils of the mudstone deposits would have been removed during the site development. However, the potential of encountering localized highly expansive clayey soils of the mudstone deposits at the project site can not be discounted. Highly expansive soil materials are not considered suitable for use and placement as structural fill in the proposed building areas. We recommend that all highly expansive soil materials be excavated, and either removed from the project site or used in landscaped areas.

4.11 Compressible Soils

The very old paralic deposits and San Diego Formation are considered non-compressible. The deep fill underlying the project site may be compressible.

4.12 Secondary Hazards

A review of the State of California Tsunami Inundation Map for Emergency Planning - La Jolla Quadrangle (2009) indicates that the project study area is not located within the tsunami inundation area. Therefore, the tsunami hazard risk in the project study area is considered very low. Based on

the distance of the project study area from large bodies of water, the potential for inundation from a seiche event occurring as a reis also considered low. In the event of rupture of the nearby Chollas Reservoir Dam, the released water would flow into the canyon north of the project site.

The project site is not located within the 100- and 500-year flood zone (FEMA Flood Insurance Rate Map, 2012). It is our opinion that the potential of property damage due to flooding is considered remote.

4.13 Corrosivity

In accordance with the City of San Diego Water Facility Design Guidelines, Book 2, Chapter 7, soil is generally considered aggressive to concrete if its chloride concentration is greater than 300 parts per million (ppm) or sulfate concentration is greater than 1,000 ppm, or if the pH is 5.5 or less. AGE recommend that analytical testing be performed on representative samples of the onsite soil materials to determine the soil pH, resistivity, soluble sulfate, chlorides and bicarbonates content for evaluation of the types of concrete to be used at the project site.

5.0 GENERAL EARTHWORK

Based on site observations and review of historic aerial photos and topographic maps, AGE estimates that fill thickness at the project site may locally be on the order of 40 feet along the northwest and northeast sides of Parcel 541-611-04-00 which overlooks Chollas Creek. Variable amounts of fill likely exist on the remainder of parcels in the project site, with cut/fill transitions likely traversing the various building pads. However, documentation of the fill placement was not available for review.

We recommend that a site-specific geotechnical investigation be performed to evaluate the support characteristics of the undocumented fill materials. Building pads and footings for the proposed structures should be supported by properly compacted filled ground or undisturbed formation. However, the building pads and footings for the proposed structures should not be supported partially in fill and partially in undisturbed formational material. The potential for long-term settlements for structures underlain by deep fill should be evaluated.

Fill materials should be free of biodegradable materials, hazardous substance contamination, or other deleterious debris. If the fill materials contain rocks or hard lumps, at least 70 percent (by weight) of its particles shall pass a U.S. Standard $^{3}/_{4}$-inch sieve. Fill materials should consist of predominantly granular soil (less than 30 percent passing the U.S. Standard #200 sieve) with Expansion Index of less than 30.

Materials generated from excavation in the very old paralic deposits may have 60 - 70% rock content by volume and are generally not considered suitable for use and placement as structural fill and/or wall backfill materials. Materials generated from excavation in the San Diego Formation are generally considered suitable for use as structural fill and/or wall backfill materials. The properties of the materials of the existing fill throughout the project site are unknown and will need to be evaluated during the performance of the geotechnical investigation.

Prior to placement of fill materials, the firm competent ground which is determined to be satisfactory for the support of filled ground shall be plowed or scarified to a depth of at least 6 inches until the surface is free from ruts, hummocks, or other uneven features which would tend to prevent uniform compaction by the equipment to be used. The fill materials should then be moisture-conditioned, placed and uniformly compacted in layers until final elevations are reached. Unless otherwise specified, each layer should be no thicker than will allow for adequate bonding and compaction, but shall not exceed 8 inches in loose (uncompacted) thickness. Unless otherwise specified, all fills shall be compacted to at least 90 percent of maximum dry density as determined in the laboratory by the ASTM D1557 test method. Field density testing shall be performed in accordance with either the Sand Cone Method (ASTM D1556) or the Nuclear Gauge Method (ASTM D2922 and D3017).

6.0 FOUNDATIONS

Properly compacted filled ground, undisturbed very old paralic deposits and San Diego Formation are considered capable of providing support for shallow foundations for the proposed structures at the project site. Undisturbed very old paralic deposits and San Diego Formation are considered capable of providing support for deep foundations. The existing fill throughout the project site will need further evaluation. The foundation dimensions and reinforcement should be designed by the Project Structural Engineer based on the results of a project-specific subsurface geotechnical investigation, loading conditions and possible concrete shrinkage.

7.0 CONCRETE SLABS-ON-GRADE

Conventional concrete slabs-on-grade may be used for the proposed project. Concrete slabs-on-grade should be supported on either filled ground uniformly compacted to a relative compaction of 95% or undisturbed formational material. Fill materials, placement and compaction should be in accordance with the recommendations presented in Section 5.0 of this report.

The slab dimensions and reinforcement should be designed by the Project Structural Engineer based on the results of a project-specific subsurface geotechnical investigation, loading conditions and possible concrete shrinkage. Reinforcement of exterior concrete slabs-on-grade, such as walkways or sidewalks, should also be determined by the Project Structural Engineer.

8.0 PAVEMENT SECTIONS

Pavement sections for the proposed project may be designed and constructed using either Portland Cement Concrete (PCC) or Asphaltic Concrete (A.C.). We recommend that R-value (CT 301) tests be performed on representative samples of the onsite soil materials. The actual pavement sections should be designed based on the results of the R-Value tests on representative samples of the onsite materials and the anticipated Traffic Index for the proposed project.

New P.C.C. pavement for the parking lot should be constructed with thickened edges. Thickened edges should be at least 1.2 times the pavement thickness, and taper back to the recommended slab thickness three feet behind the edge of the slab. To control the location and spread of concrete shrinkage cracks, it is recommended that crack control joints (weakened plane joints) be included in the design of the concrete pavement. Crack control joints should be constructed at a spacing distance, in feet, of not less than three times the recommended slab thickness in inches, and should be sealed with an appropriate sealant to prevent migration of water through the control joint to the subgrade materials.

It is recommended that all structural pavement sections be constructed in accordance with the guidelines and procedures set forth in Section 302 of the "Green Book". The new pavement section should be placed on a prepared subgrade. We recommend that the upper 24 inches of the underlying subgrade and the Class 2 aggregate base be uniformly compacted to a minimum of 95 percent of maximum dry density as determined in the laboratory by the ASTM D1557 testing procedures.

We recommend that adequate surface drainage be provided to reduce ponding and infiltration of water in the subgrade materials. All paved areas should have a minimum gradient of 1 percent. As much as possible, irrigated areas next to pavement should be avoided; otherwise subdrains should be used to drain the areas to appropriate outlets. It is important to provide adequate drainage to reduce ponding and possible future distress of the pavement sections.

9.0 DRAINAGE CONTROL

Proper control and maintenance of site drainage is critical to the future performance of the project. Infiltration of irrigation and/or storm water into the subsurface soils could adversely affect the performance of the soils.

It is recommended that positive drainage be provided around the perimeter of the proposed structures. Positive drainage is generally defined as a minimum 2 percent slope over a horizontal distance of at least 5 feet away from the perimeter foundations of a structure. No surface water should be allowed to collect or pond anywhere in the building area, especially adjacent to or near foundations and slabs. Roof runoff should be controlled by using eave gutters and downdrains, and

the discharge from the downdrains should be collected in a system of subdrain pipes which carry the water directly into a suitable on-site drainage facility. Landscape irrigation should be monitored and controlled to determine the appropriate amount of irrigation necessary to maintain the landscaping without overwatering.

10.0 CONCLUSIONS AND RECOMMENDATIONS

The findings of this desktop study are based on a cursory evaluation of readily available information which is generally very limited and contain data gaps in many areas. The project site is subject to multiple geologic hazards, we therefore recommend that a site- and project-specific geotechnical investigation be performed for final design of the proposed project. We recommend that a site-specific seismic response analysis be performed for all proposed structures/facilities at the project site. We further recommend that fault trenching study be performed as part of the geotechnical investigation for final design of the proposed project.

Based on the results of our study, it is our opinion that there no known significant geologic hazards within the project study area which cannot be avoided or mitigated provided that the project is designed and constructed in accordance with the City of San Diego codes and regulations. It is our opinion that the proposed land uses are compatible with the known level of geologic hazards, and that the proposed project does not impact or alter the geologic hazards identified in this report.

A summary of the relevant geotechnical criteria which should be considered in the design and construction of proposed project is presented in Table 1.

11.0 LIMITATIONS

This report has been prepared for the sole use of Helix Environmental Planning, Inc. and MTS for the preliminary design of the subject project. This report is intended for preliminary planning purposes only and does not provide sufficient data for design and/or construction.

The geotechnical services provided by AGE for this project have been performed in accordance with generally accepted principles and practices of the local geotechnical profession at the time of report preparation. No other warranty, either expressed or implied, is made by AGE.

TABLE 1

SUMMARY OF GEOTECHNICAL DESIGN CRITERIA

Subsurface Materials	The various parcels in the project study area are underlain with up to an estimated 40 feet of fill placed during the original site development. The fill is anticipated to be underlain by very old paralic deposits and/or San Diego Formation. No documentation was available for review regarding the placement of the fill. AGE recommends a site-specific geotechnical investigation to evaluate the support characteristics of the existing fill materials. If overexcavation is performed, the soils should be evaluated to determine if the materials are suitable for use as compacted backfill. Properly compacted fill, very old paralic deposits and San Diego Formation are considered competent to provide support for shallow foundations. Very old paralic deposits and San Diego Formation are considered capable of providing competent support for deep foundations.
Approximate Depth to groundwater (feet bgs)	Groundwater depth beneath the project site is anticipated to be in excess of 100 feet bgs and to be below the maximum depth of excavations for the proposed project. The need for dewatering is not anticipated for the proposed project. The contractor should, however, anticipate the possible need for sump pumps in the event that localized perched water conditions are encountered during construction.
Fault Crossing	No active or potentially active faults are mapped crossing the project site (Kennedy and Tan, 2008; City of San Diego 2008). The project site is not located within any United States Geological Survey (USGS) special study zones. A northwest trending strand of the La Nacion fault is mapped on the side walls of Chollas Creek approximately 1,500 feet northwest of the project site (Kennedy and Tan, 2008). The general trend of this fault strand extends toward the project site. We recommend that a fault trenching study be performed as part of the geotechnical investigation for the final design of the proposed project. In the event that a fault is exposed at the project site, we recommend that a fault rupture study be performed, and the appropriate setback be developed based on the results of the study.
Liquefaction Susceptibility	The project site is underlain by very stiff to hard formational materials which are not considered to be liquefiable. The site is not in a "Potential Liquefaction Area" as identified by the City of San Diego (2008).
Mapped Landslides	There are no known (mapped) landslides within the limits of the project study area. Landsliding does not appear to pose a significant potential hazard in the study area.
Lateral Spread and Slope Stability	The potential for lateral spread and slope instability are considered low within the project study area.
Differential Seismic Induced Settlement	There is a high potential for seismic-induced differential settlement in the existing fill materials at the project site.
Ground Lurching	Ground lurching is not considered a potential hazard for the proposed project.
Expansive Soil	The majority of soil materials in the study area are considered non-expansive or possess a low expansion potential. In the event that the contractor encounter highly expansive soil materials during construction, the highly expansive materials should be excavated, and, either, disposed off site or placed in non-structural area.
Compressible Soil	The very old paralic deposits and San Diego Formation are considered non-compressible. The existing deep fill underlying the project site may be compressible.
Other Unusual Conditions	Materials generated from excavation in the very old paralic deposits may have 60 - 70% rock content by volume and are generally not considered suitable for use and placement as structural fill and/or wall backfill materials without screening to remove the oversized materials. Structures located in areas underlain by deep fill ground will need to be evaluated for detrimental long-term settlement issues.

12.0 REFERENCES

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American Society of Civil Engineers, ASCE 7 Hazard Tool.

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Patterson, R.H., D.L. Schug, and B.E. Ehleringer, 1986, "Evidence of Recent Faulting in Downtown San Diego, California" in Geological Society of America, Abstracts With Programs, v. 18, No. 2, p. 169.

Rockwell, T.K., et.al., 1991, "Minimum Holocene Slip Rate for the Rose Canyon Fault in San Diego, California" in Environmental Perils in the San Diego Region (P.L. Abbott and W.J. Elliott, editors): San Diego Association of Geologists, pp. 37-46.

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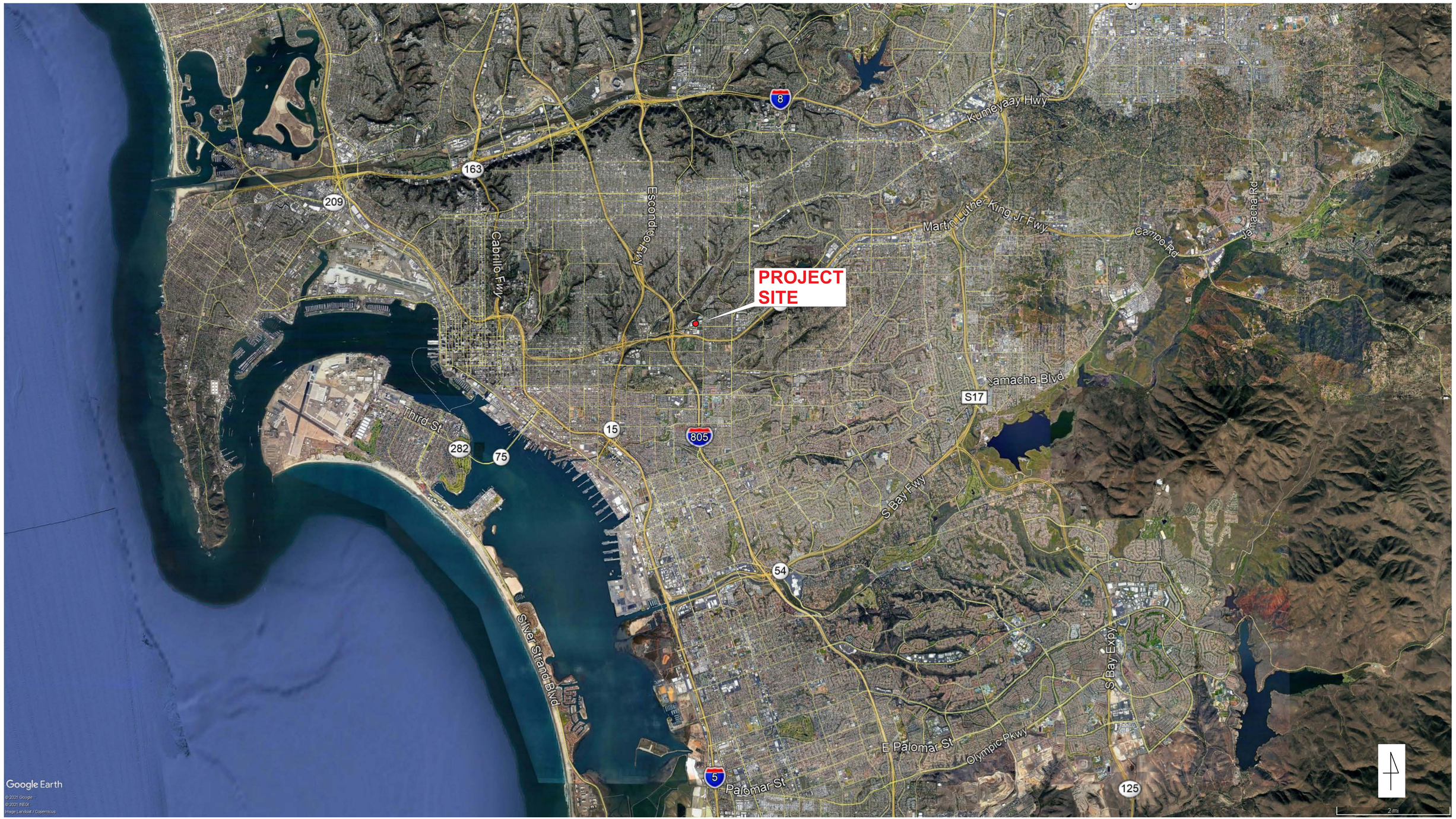
Walsh, S.L. and Demere, T. A., "Age and Stratigraphy of the Sweetwater and Otay Formations, San Diego County, California", in Abbott, P.L., and May, J.A., eds., 1991 Eocene Geologic History San Diego Region Pacific Section SEPM, Vol. 68, p. 131 - 148.

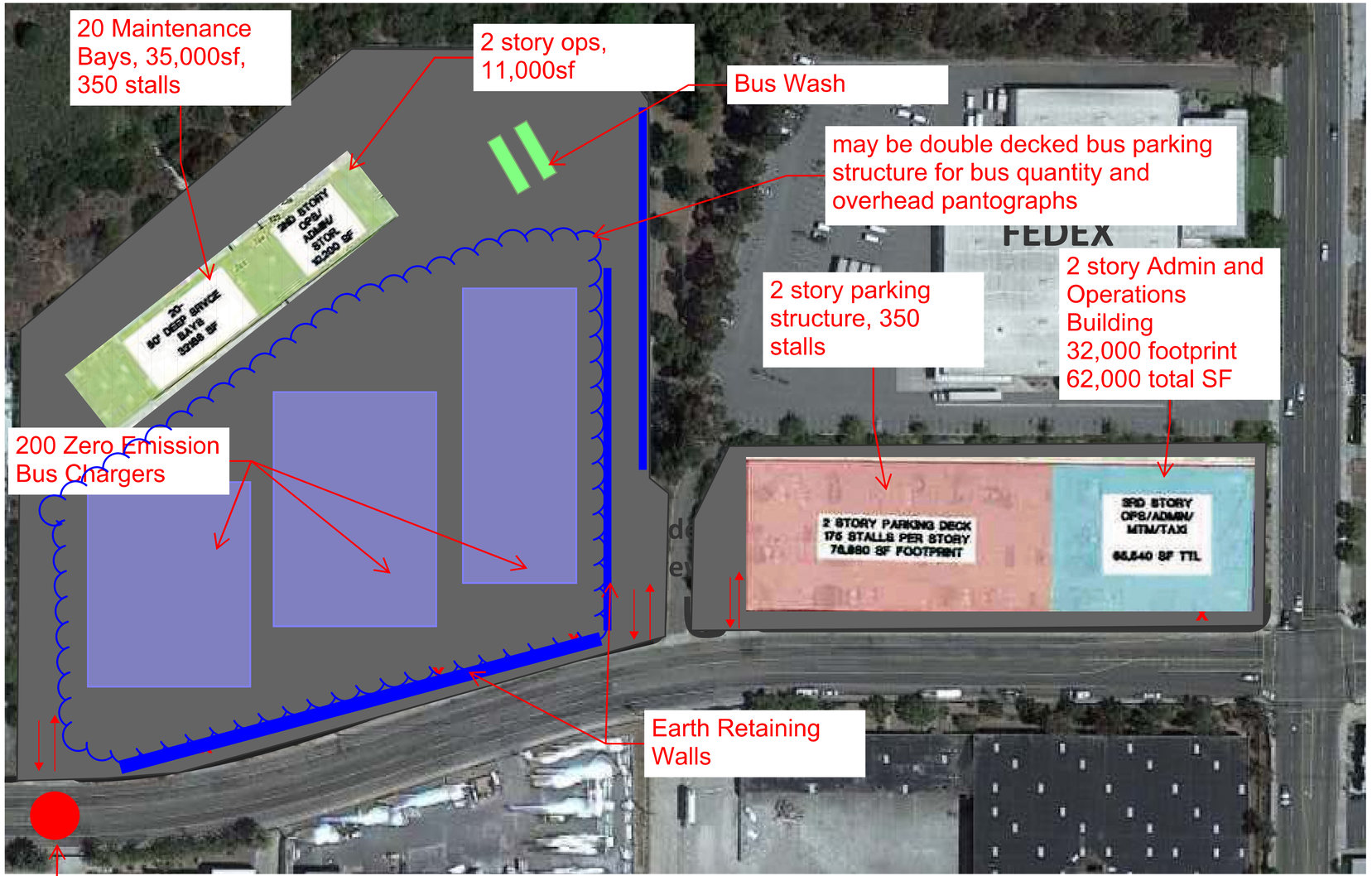
Aerial Photographs

Aerial photographs dated 1949, 1953, 1964, 1966, 1970, 1979, 1985, 1989, 1994, 1996, 2002, 2005, 2009, 2012 and 2016.

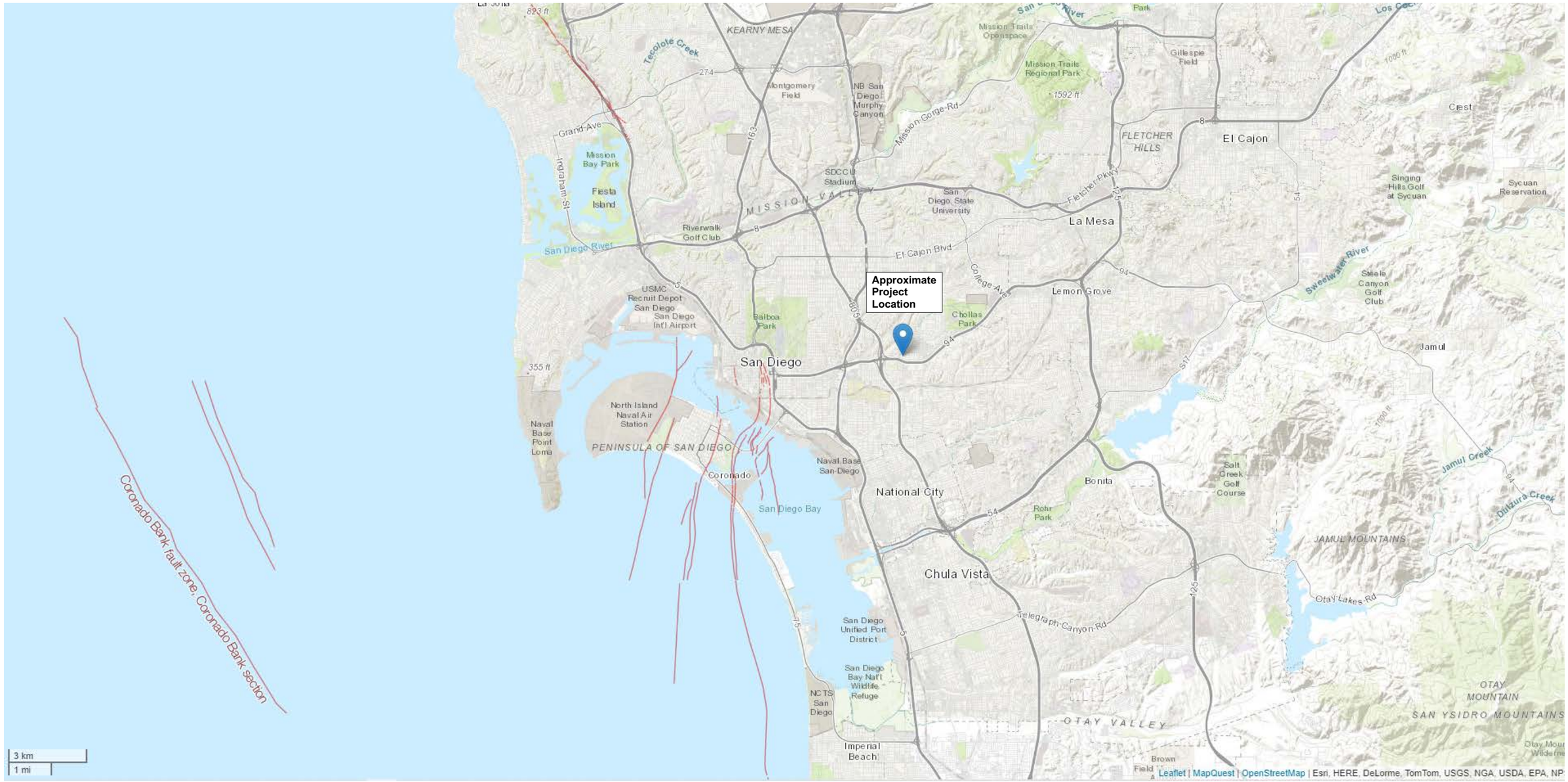
FIGURES



SAN DIEGO MTS CLEAN TRANSIT ADVANCEMENT CAMPUS PROJECT	LOCATION MAP
PROJECT NO. 66C105	ALLIED GEOTECHNICAL ENGINEERS, INC. — FIGURE 1

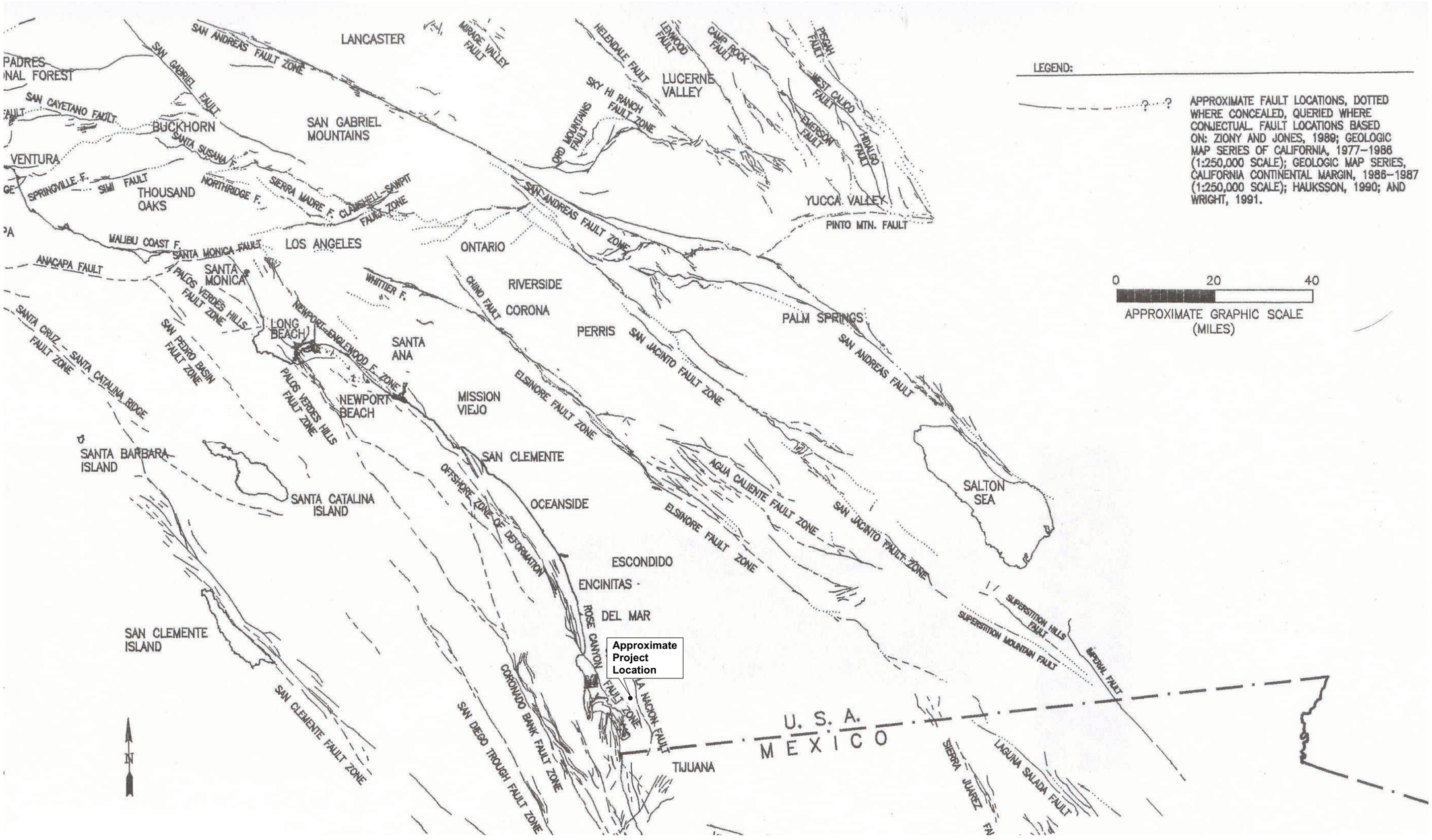


SAN DIEGO MTS CLEAN TRANSIT ADVANCEMENT CAMPUS PROJECT		CONCEPTUAL SITE PLAN SKETCH
PROJECT NO. 66C105	ALLIED GEOTECHNICAL ENGINEERS, INC.	FIGURE 2

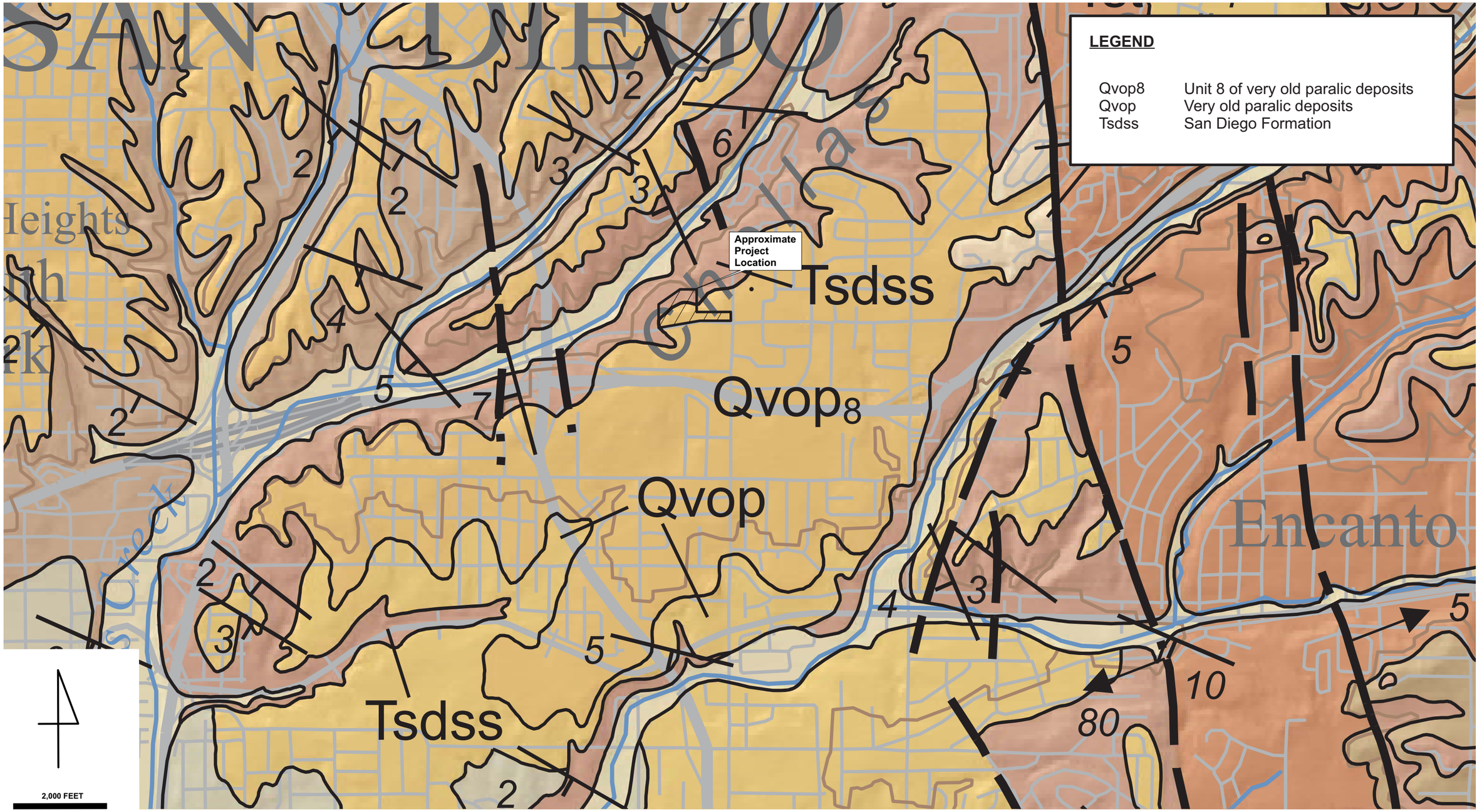


NOTE: Faults shown limited to those which were active in the past 15,000 years.
Data source: USGS Quatenary Fault and Fold Database.

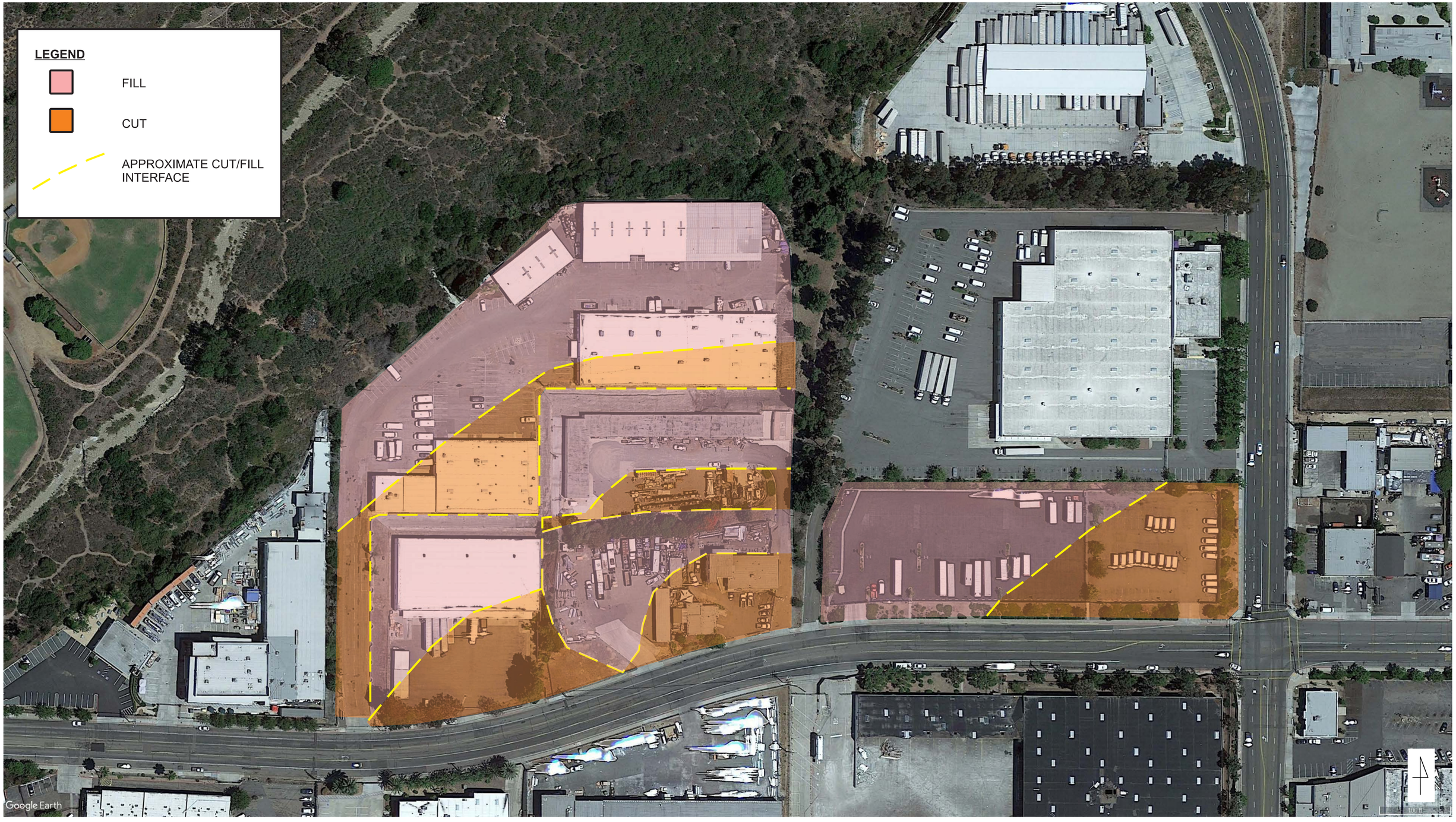
SAN DIEGO MTS CLEAN TRANSIT ADVANCEMENT CAMPUS PROJECT	LOCAL FAULT MAP	
PROJECT NO. 66C105	ALLIED GEOTECHNICAL ENGINEERS, INC.	FIGURE 3



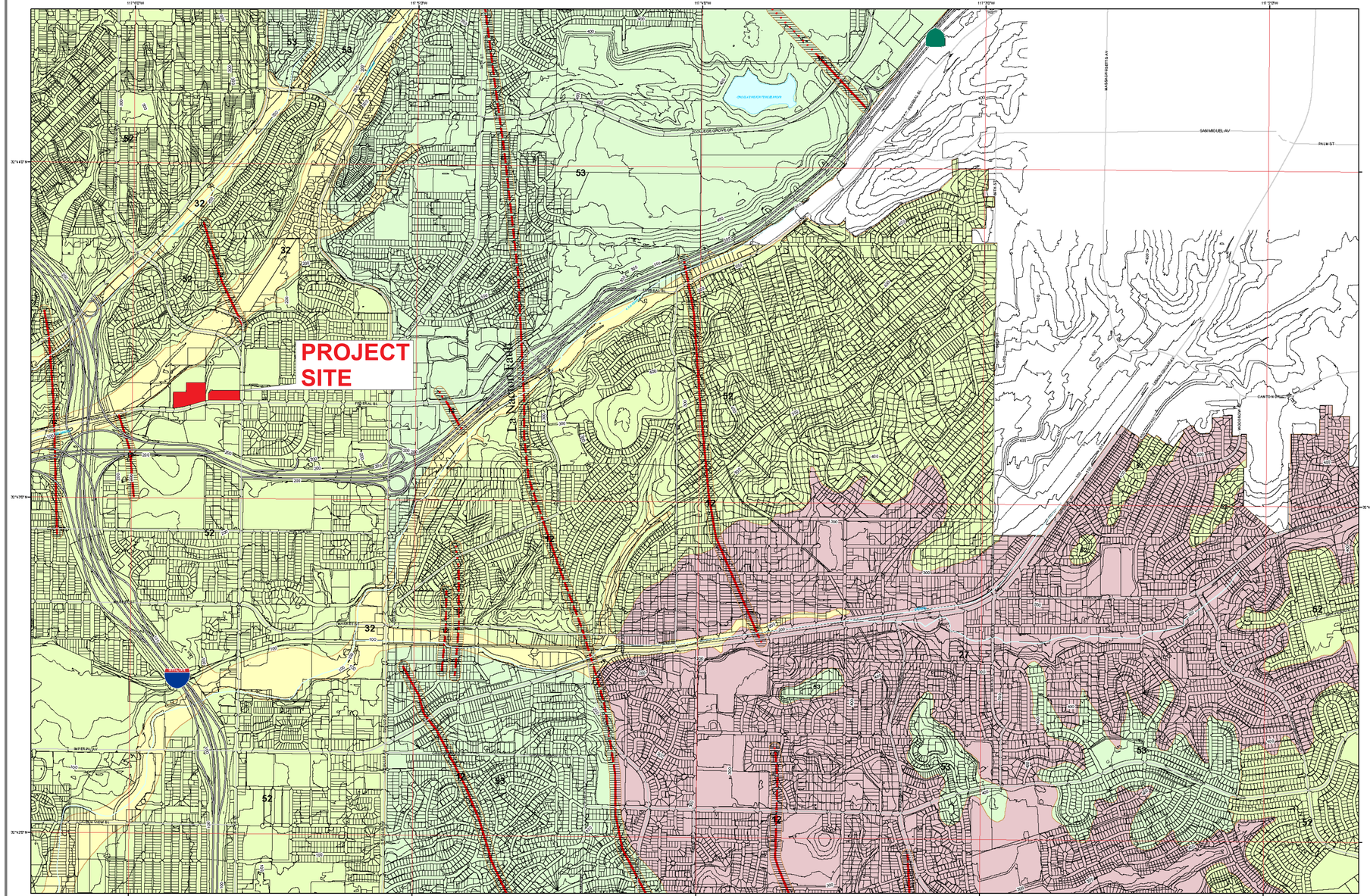
SAN DIEGO MTS CLEAN TRANSIT ADVANCEMENT CAMPUS PROJECT	REGIONAL FAULT MAP
PROJECT NO. 66C105	ALLIED GEOTECHNICAL ENGINEERS, INC. — FIGURE 4



SAN DIEGO MTS CLEAN TRANSIT ADVANCEMENT CAMPUS PROJECT	GENERALIZED GEOLOGIC MAP
PROJECT NO. 66C105	ALLIED GEOTECHNICAL ENGINEERS, INC. — FIGURE 5



SAN DIEGO MTS CLEAN TRANSIT ADVANCEMENT CAMPUS PROJECT	EXISTING DEVELOPMENT APPROXIMATE CUT/FILL MAP
PROJECT NO. 66C105	ALLIED GEOTECHNICAL ENGINEERS, INC. — FIGURE 6



LEGEND

Geologic Hazard Categories

FAULT ZONES

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

LANDSLIDES

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

SLIDE-PRONE FORMATIONS

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

LIQUEFACTION

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

COASTAL BLUFFS

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

OTHER TERRAIN

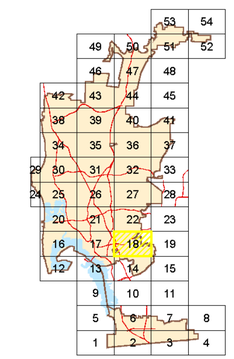
- 51 Level mesas -- underlain by terrace deposits and bedrock nominal risk
- 52 Other level areas, gently sloping to steep terrain, favorable geologic structure, Low risk
- 53 Level or sloping terrain, unfavorable geologic structure, Low to moderate risk
- 54 Steeply sloping terrain, unfavorable or fault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

Water (Bays and Lakes)

FAULTS

- Fault
- Inferred Fault
- Concealed Fault
- Shear Zone

Index Map



SanGIS Basemap Accuracy

SanGIS Land (Lot) basemap data for the City of San Diego tested 20.7' horizontal accuracy at the 95% confidence level.

This data meets the ASPRS Standard for Class 1 Map Accuracy at a scale of 1:2,000 (1"=1,000').

This assessment assumes utilization of the data on a citywide basis. Localized data may exceed or fail to meet this accuracy with errors in excess of 100' possible.

City of San Diego
SEISMIC SAFETY STUDY
Geologic Hazards and Faults

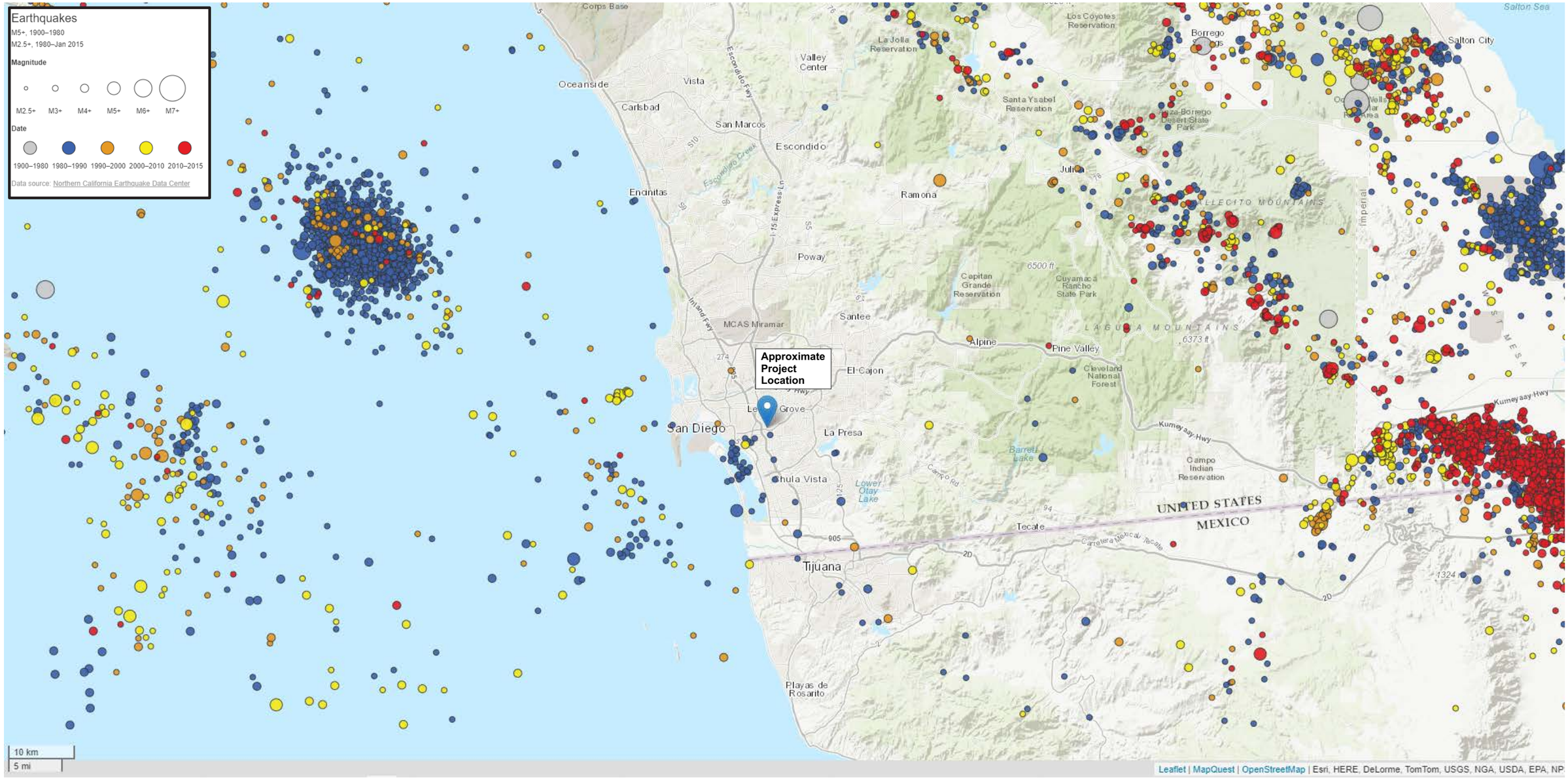
Development Services Department

0 400 800 1,600 2,400 Feet

0 120 240 480 720 960 Meters

GRID TILE: 18
GRID SCALE: 800
DATE: 4/3/2008

SAN DIEGO MTS CLEAN TRANSIT ADVANCEMENT CAMPUS PROJECT	**CITY OF SAN DIEGO SEISMIC SAFETY STUDY MAP GRID 18**
PROJECT NO. 66C105	**ALLIED GEOTECHNICAL ENGINEERS, INC.** — **FIGURE 7**



SAN DIEGO MTS CLEAN TRANSIT ADVANCEMENT CAMPUS PROJECT	SEISMIC EPICENTER MAP
PROJECT NO. 66C105	ALLIED GEOTECHNICAL ENGINEERS, INC. — FIGURE 8