Appendix K

Geologic and Seismic Report, East-West Connector Between I-880 and Mission Boulevard (SR 238)

GEOLOGIC & SEISMIC REPORT
EAST WEST CONNECTOR BETWEEN I-880 AND MISSION BLVD. (SR238) ALAMEDA COUNTY, CALIFORNIA

For

TYLIN INTERNATIONAL
1111 Broadway, Suite 2150
Oakland, CA 94607

PARIKH CONSULTANTS, INC.
365 S. Milpitas Blvd., Milpitas, CA 95035
(408) 945-1011

August 2008

Job No. 208104.GEO

TABLE OF CONTENTS

GEOLOGIC & SEISMIC SECTION
EAST WEST CONNECTOR BETWEEN I-880 AND MISSION BLVD. (SR238)
UNION CITY AND FREMONT, ALAMEDA COUNTY, CALIFORNIA

REGIONAL GEOLOGY

The proposed project is within Alameda County (Plate 1), which is located on the East Bay portion of the San Francisco Bay Plain. Alameda County is located at the northern end of the Diablo Range of Central California. It is bounded on the north by the south flank of Mount Diablo, one of the highest peaks in the Bay Area, reaching an elevation of 3,849 ft. San Francisco Bay forms the western boundary, the San Joaquin Valley borders it on the east and an arbitrary line from the Bay into the Diablo Range forms the southern boundary.

GEOLOGIC UNITS

General geologic features pertaining to site were evaluated by reference to the Quaternary Geology of Alameda County and Surrounding Areas, California: Derived from the Digital Database Open-File by E.J. Helley and R.W. Graymer, 1997. Based on the map, different geologic units are present along the alignment. The project site subsoils mainly consist of Basin Deposits (Qhb; Holocene), Natural Levee Deposits (Qhl; Holocene), and Alluvial Fan and Fluvial Deposits (Qhaf; Holocene) in northern alignment of the project vicinity. The subsoil consists of Natural Levee Deposits (Qhl; Holocene) at the intersection of Paseo Padre Parkway and Decoto Road and Alluvial Terrace Deposits (Qhfp; Holocene) towards the south of Decoto Road. Natural Levee Deposits (Qhl; Holocene) are observed on most of the banks of the Old Alameda Creek and Alameda Flood Control Channel. The geologic map of the general project area is shown on Plate 2. Descriptions of the main geologic units are as follows:

Qhb: Basin deposits (Holocene) – Very fine silty clay to clay deposits occupying flat-floored basins at the distal edge of alluvial fans adjacent to the bay mud (Qhbm). Also occupying flat areas in the Brentwood dune field where the basin deposits bury older eroded sand dunes (Qds).

Qhl: Natural Levee deposits (Holocene) -- Loose, moderately to well-sorted sandy or clayey silt grading to sandy or silty clay. These deposits are porous and permeable and provide conduits for transport of ground water. Levee deposits border stream channels, usually both banks and slope away to flatter flood plain and basins.

Qhfp: Alluvial terrace deposits (Holocene) – Deposits are generally less than one meter thick and consist of rounded gravel and historic artifacts in a clayey silt matrix. In several areas these terraces have been used for landfills.

Qhaf: Alluvial Fan deposits (Holocene) -- Alluvial Fan deposits are brown or tan medium dense to dense gravelly sand or sandy gravel that generally grades upward to, sandy to silty clay. The alluvial fan is confined to narrow valley floors.

SUBSURFACE CONDITIONS

Based on readily available soils and geologic literature pertaining to the site, the subsoil generally consists of predominantly clay underlain by sand and gravel material in the northern portion of Alameda Creek. Portions south of the Alameda Creek are similar in formation. The subsoils consist of natural levee deposits which are composed by clayey silt to sandy/silty clay material.

Based on readily available data, groundwater was encountered at Elevation +12.0 to +27.0 feet (Depth of 23.0 to 34.0 feet) at the time of drilling (2003 & 2008). Groundwater may vary with the passage of time due to seasonal groundwater fluctuation, surface and subsurface flows, ground surface run-off, water level in adjacent creeks, and other factors that may not be present at the time of the reference investigations. It is our opinion that the subsurface soil conditions and groundwater conditions within the project limits should be verified during the PS&E phase.

EARTHQUAKE CONSIDERATIONS

SEISMIC SOURCES

The project site is located in a seismically active part of northern California. Many faults exist in the San Francisco Bay Area. These faults are capable of producing earthquakes and may cause strong ground shaking at the site. The attached Fault Map (Plate 3) presents the locations of the fault systems relative to the project site.

Maximum credible earthquake magnitudes for some of the major faults in the area determined by Mualchin (California Seismic Hazard Map, 1996) are summarized below. These maximum credible earthquake magnitudes represent the largest earthquakes that could occur on the given fault based on the current understanding of the regional tectonic structure.

TABLE 2

Fault	Distance to Fault from Center of Project Site (Mile)	Maximum Credible Earthquake (MCE)
Hayward (HWD) (Strike-Slip)	1.6	7.5
Calaveras-Pacines-Benito (CPS) (Strike-Slip)	8.3	7.5
San Andreas/N (SAN) (Strike-Slip)	16.5	8.0

As shown on the Fault Map, active faults including the Hayward Fault, Calaveras-Pacines-San Benito Fault, and San Andreas Fault are in the vicinity of the site. A major earthquake on these faults can produce strong ground shaking at the proposed site. Based on the seismic hazard map prepared by Mualchin, the governing fault is the Hayward Fault (Mw = 7.50), which is a strike-slip fault, and peak bedrock acceleration of 0.7 g is anticipated at the site. It is our understanding that Caltrans is updating the fault maps and the new seismic design criteria will be available in the near future. These site parameters should be revisited and refined during the design phase.

SEISMIC HAZARDS/LIQUEFACTION POTENTIAL

Potential seismic hazards may arise from three sources: ground shaking; surface fault rupture; and liquefaction. Based on available geological and seismic data, the possibility of the site to experience strong ground shaking may be considered moderate to high.

We have reviewed Alquist-Priolo Special Studies Zones Map, Niles Quadrangle and Newark Quadrangle by The California Conservation (March, 2000). Based on the publication, there are no active faults passing through the project site. Therefore, the potential for fault rupture is considered relatively low. According to the project information provided, there will be five new structures within the project alignment. The anticipated Peak Bedrock Acceleration (PBA) within the five new structures is anticipated to be in the order of 0.7g. The distance from each structure to the Hayward Fault is summarized below:

TABLE 3

Structures	Sta.	Estimated Distance to Hayward Fault (Miles)
Alameda County Flood Control Crossing	10+90 to 13+90	1.4
Alameda Creek Crossing (South)	21+40 to 26+60	1.3
Alameda Creek Crossing (North)	41+00 to 42+50	0.9
UPRR & BART Underpass	59+00 to 60+25	0.6
UPRR Underpass	69+60 to 69+75	0.45

Liquefaction is a phenomenon in which saturated cohesionless soils are subject to a temporary but essentially total loss of shear strength under the reversing, cyclic shear stresses associated with earthquake shaking. Submerged cohesionless sands and silts of low relative density are the type of soils which usually are susceptible to liquefaction. Clays are generally not susceptible to liquefaction. A liquefaction susceptibility map using the database prepared from Preliminary Maps of Quaternary Deposits and Liquefaction Susceptibility, Nine-County San Francisco Bay Region, California, USGS Open File Report 00-444, Knudsen, K.L., Sowers, J.M., Witter, R.C., Wentworth, C.M., and Helley, E.J., 2000 is presented on Plate 5.

Based on the publication, the liquefaction susceptibility along the proposed alignment is considered moderate to very high. Specifically, the liquefaction susceptibility between Paseo

Padre Parkway and Alvarado Niles Road, is mapped as high to very high. However, no boring data is available within this segment. Appropriate investigation should be included during the final design phase to verify the liquefaction potential. Mitigation measures should be included in the design of the improvements as necessary.

Based on the available boring information (Green Street Overcrossing and Parikh's four new borings in 2008), the segment between the two UPRR tracks, is generally underlain by firm to very stiff lean clays overlying dense to very dense sands. In our opinion, the liquefaction potential along the project is generally low to moderate. Detail studies should be included during design phase to verify the liquefaction potential.

Impacts of liquefaction on improvements may vary and will depend on the type of structure. However, these impacts can be mitigated using appropriate design methods. For support of bridge structures the loads can be modified, grounds can be improved and foundations can be designed to allow for such conditions. Liquefaction should not be a significant impact for pavement surfaces since the resulting settlements are generally aerial type and localized.

FOUNDATIONS

The project will require several structures along the alignment. All of the major structures are proposed to the east of Paseo Padre Parkway. These include the Alameda Creek Flood Control Channel crossing, two Old Alameda Creek crossings, separate underpasses that will cross the BART tracks, UPRR tracks (twice), and Green Street.

Based on the general soil information available along the corridor, the foundation systems expected for the Flood Control crossing and creek crossings should be relatively standard (requiring pile foundations). These piles may consist of concrete driven piles, cast-in-steel shell

(CISS) piles or cast-in-drilled-hole (CIDH) piles. The potential geotechnical and seismic impacts will be incorporated in the design of these structures using the Caltrans design guidelines.

The underpass structures are expected to require excavations on the order of 30 feet below ground and will also require retaining walls. This excavation will be impacted by the groundwater conditions. Alameda County Water District has certain requirements to maintain a minimum soil cover over their aquifer zone. Based on the available geotechnical information and groundwater data, it appears that one of the construction options for the underpass may require building a system of concrete structural mat and retaining walls that is generally known as 'boat slab'. The slab would be subject to groundwater pressures and therefore would require a pile foundation system. There is also a possibility that the site may use a Deep Soil Mix (DSM) type of wall system around the perimeter of the excavation that restricts groundwater flow across the excavation foot print. This DSM system is a below ground soil-cement wall that is mixed in-place using special equipment. The system reduces the water in-flow into the excavation. Detail studies and engineering analyses will be conducted to mitigate such conditions.

The underpass structures for the BART and UPRR lines may be supported on concrete driven piles, CISS piles, Steel H piles, CIDH piles or on special spread footings such as a reinforced concrete box. The construction staging of the structures underneath the rail lines will also dictate the type of structure that can be constructed so that minimum interruptions are created to the BART and UPRR operations. The right-of-way limitations for the tracks will also impact the type of foundation system that can be used. The structure can be constructed by temporarily relocating the tracks while the structure is constructed in its permanent location. It is also feasible to construct deep foundation systems in stages during 'off hours' and build the complete bridge structure, including tracks, adjacent to the active tracks. At the appropriate stage the bridge can be moved over the new foundation system. A concrete box consisting of a structurally reinforced slab and walls can also be constructed that can be built under the tracks. However, since there is no existing structure at this time, an underpinning system may require first building a temporary bridge for the tracks.

Miscellaneous structures including retaining walls, culverts, etc will be supported on foundations that are designed based on geotechnical studies during the design phase.

Pavement construction is expected to be based on detail studies and Caltrans design standards. In general, pavement may consist of concrete pavement, Hot Mix Asphalt pavement, rubberized pavement and other effective systems as deemed appropriate for the site conditions.

EROSION & SEDIMENTATION

The project site area was evaluated based on Soil Survey Map, obtained from National Cooperative Soil Survey; Natural Resources, Conservative Service, USAD, and Web Soil Survey 1.1 URL (Plates 4). The underlying native soil units and their impact from drainage and permeability standpoint are mentioned in the following table:

TABLE 4

Soil Unit	Map Unit Name	Surface texture	Permeability	Slope (%)	Drainage
DaB	Danville Loam	Silty Clay Loam	Moderately low to moderately high	10-Mar	Well drained
107	Clear Lake	Clay	Moderately low to moderately high	0-2	Poorly drained
111	Danville Loam	Silty Clay Loam	Moderately low to moderately high	0-2	Well drained
131	Omni Loam	Silty Clay Loam	Moderately low to moderately high	-	Poorly drained
135	Pits	Gravel	-	-	-
143	Sycamore Loam	Silt	Moderately high to high	-	Poorly drained
161	Yolo Loam	Silt	Moderately high to high	0-2	Well drained

Based on the table and Soil Survey Map (Plates 4), the soils in the project vicinity are mainly silt to silty clay loam and the permeability ranges from moderately low to moderately high. Drainage characteristic of the soils in the project vicinity is classified as poorly drained to well drained.

The improved areas within the corridor should have low erosion potential. Normal maintenance of surface drainage and slope maintenance is important and should be incorporated in the project plans. Landscaping should be planned to protect any new slopes.

STUDY LIMITATIONS

Our services consist of professional opinions based on our site reconnaissance, researched data and the assumption that the subsurface information does not deviate from observed/researched conditions. All work done is in accordance with generally accepted geotechnical engineering principles and practices. No warranty, expressed or implied, of merchantability or fitness, is made or intended in connection with our work or by the furnishing of oral or written reports or findings.

The geologic and seismic information and geotechnical discussions provided in this report are intended for project environmental and planning phase only. The contents of this report are not intended for design input, nor directly form the basis in preparation of construction cost estimates for bidding purposes. The scope of our services did not include any detail geotechnical investigations (such as bridge foundation report or materials report, California Test Method 130), or any environmental assessment/investigation for the presence or absence of hazardous or toxic materials in structures, soil, surface water, groundwater or air, below or around this site. Unanticipated subsurface conditions are commonly encountered and cannot be fully determined without taking soil samples and drilling/excavating test borings. Additional expenditures should be allowed during the design phase for investigation services so that a properly designed project can be attained.

The findings in this report are valid as of the present date. However, changes in environmental conditions in the project area can occur with the passage of time, whether they are due to natural processes or to the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or from the broadening of knowledge. Accordingly, the findings in this report might be invalidated, wholly or partially, by changes outside of our control.

Very truly yours,
PARIKH CONSULTANTS, INC.

Lam Tran
Staff Engineer

Gary Parikh, P.E., G.E. 666
Project Manager

REGISTERED PROFESSIONAL ENGINEER
GAURANG R. PARIKH
No. 666
EXP. 12-31-09
GEOTECHNICAL
STATE OF CALIFORNIA

S:\Ongoing Projects\208104.PGR\Report\Geologic & Seismic Report

REFERENCES

GEOLOGIC REFERENCES

1. Quaternary Geology of Alameda County and Surrounding Areas, California: Derived from the Digital Database Open-File by E.J. Helley and R.W. Graymer, 1997.

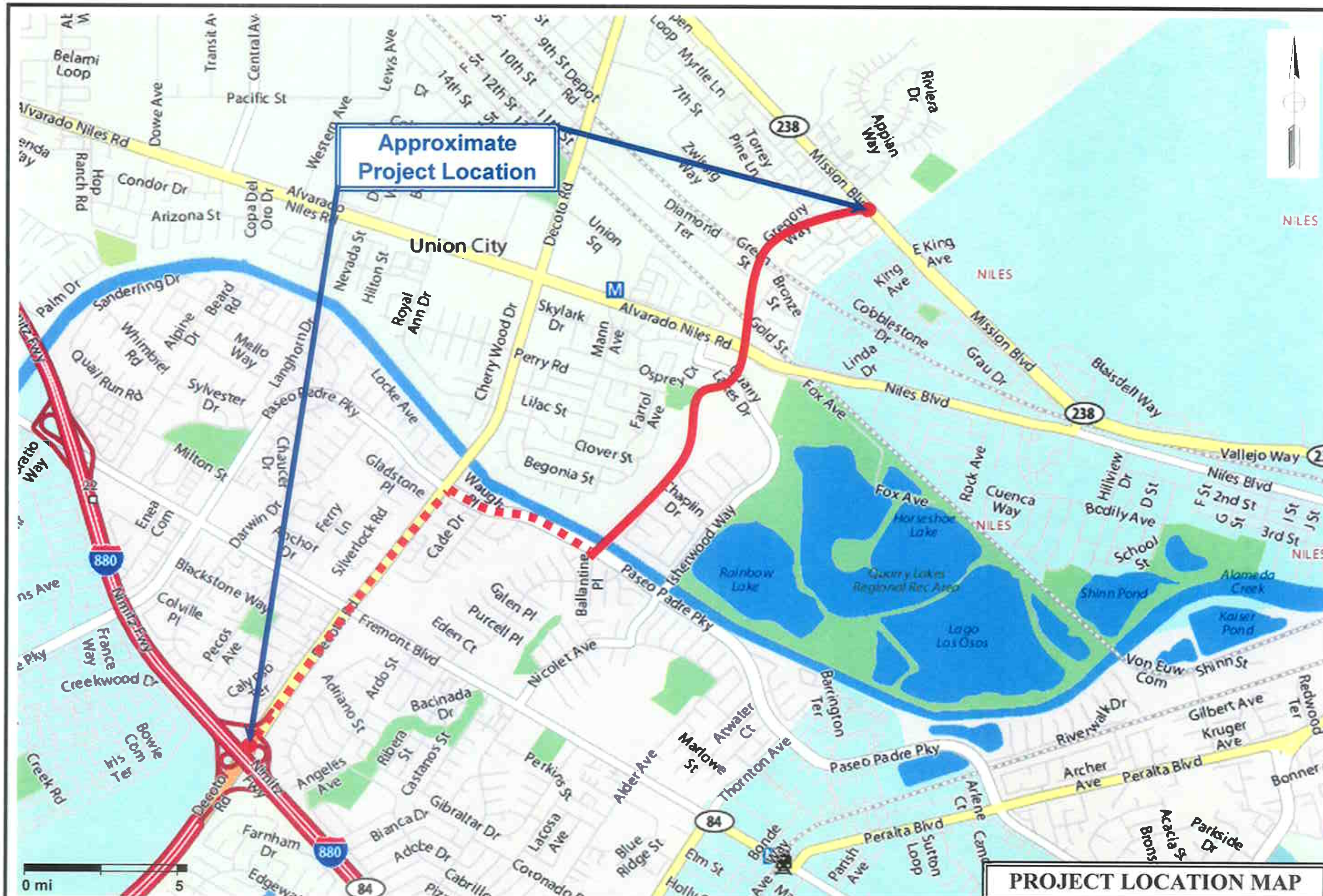
2. Preliminary Maps of Quaternary Deposits and Liquefaction Susceptibility, Nine-County San Francisco Bay Region, California by Keith L. Knudsen, Janet M. Sowers, Robert C. Witter, Carl M. Wentworth and Edward J. Helley, 2000 (USGS Open-File Report 00-444)

3. Soil Survey Map of Alameda County, California by National Cooperative Soil Survey, Natural Resources Conservation Service, USDA and Web Soil Survey 1.1 URL: http://websoilsurvey.nrcs.usda.gov

GEOTECHNICAL REFERENCES

4. California Seismic Hazard 1996, by L. Mualchin, California Department of Transportation, 1996, Scale 1:500,000, Revision 1

5. Special Studies Zones, Delineated in Compliance with Chapter 7.5, Division 2 of the California Public Resource Code (Alquist-Priolo Special Studies Zones Act), Niles Quadrangle and Newark Quadrangle, The California Conservation, 2000, Scale 1:24,000

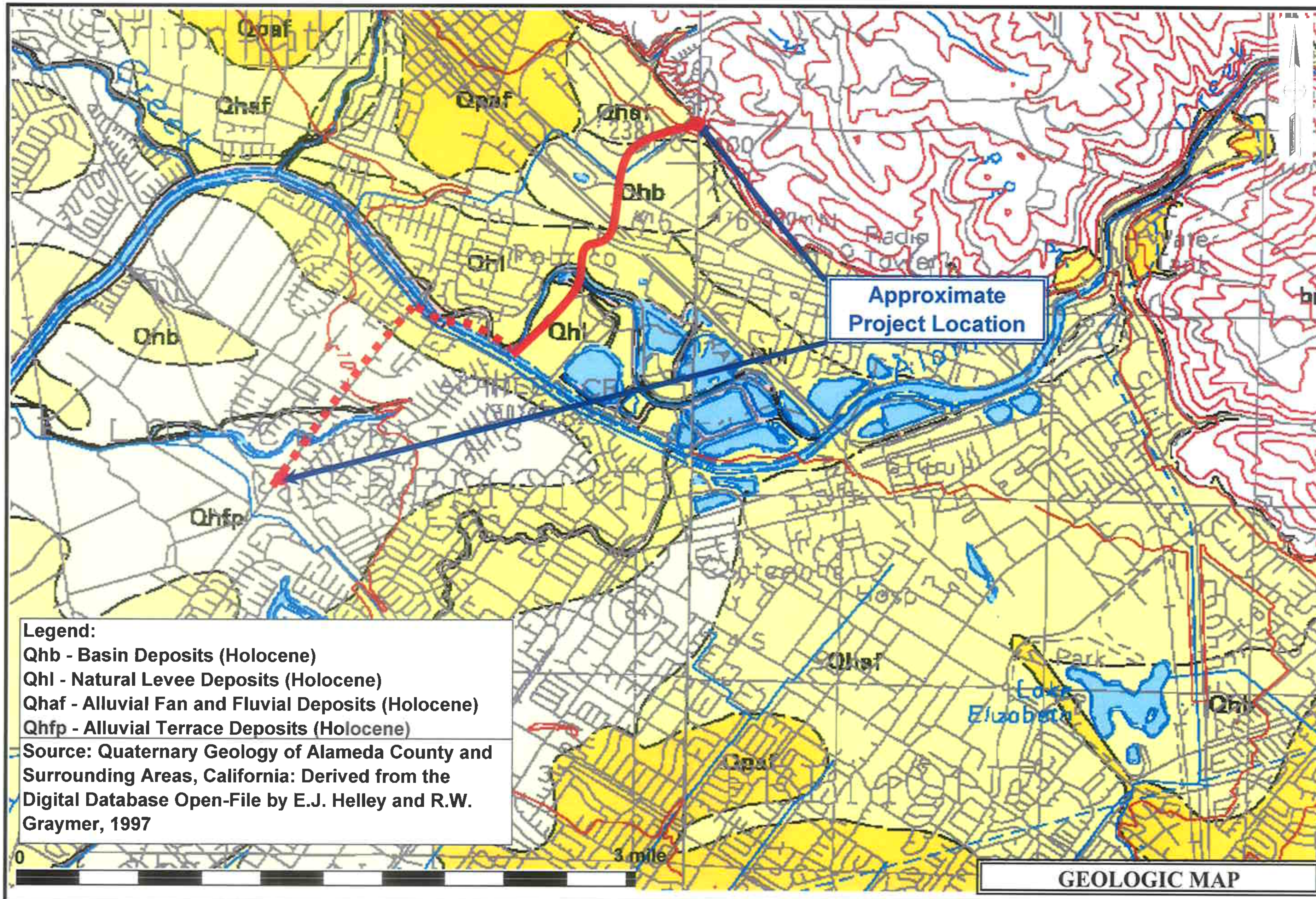


PROJECT LOCATION MAP

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS TESTING

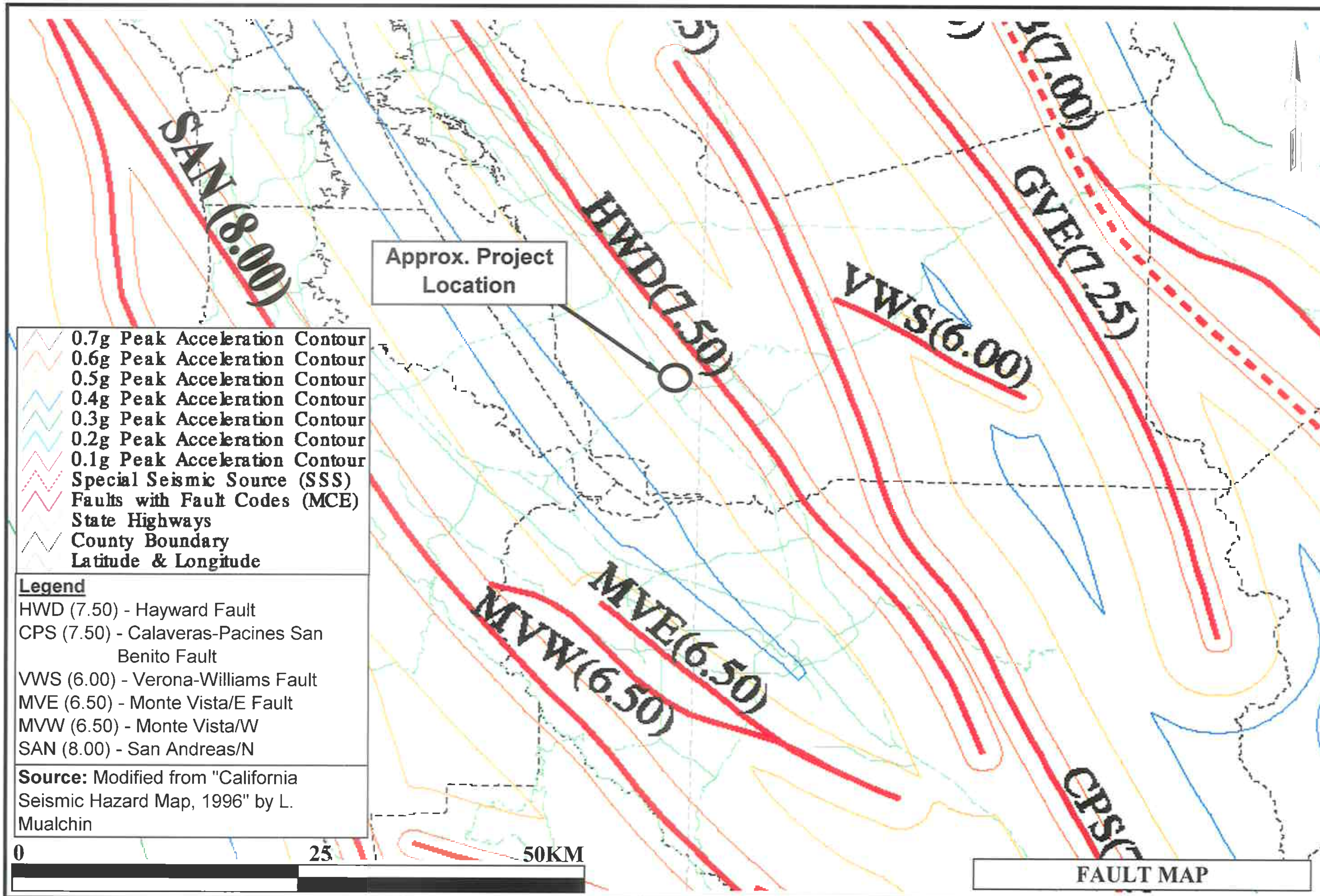
EAST WEST CONNECTOR BETWEEN
I-880 AND MISSION BLVD (SR 238)
UNION CITY AND FREMONT, ALAMEDA COUNTY, CALIFORNIA

JOB NO.: 208104.GEO | PLATE NO.: 1

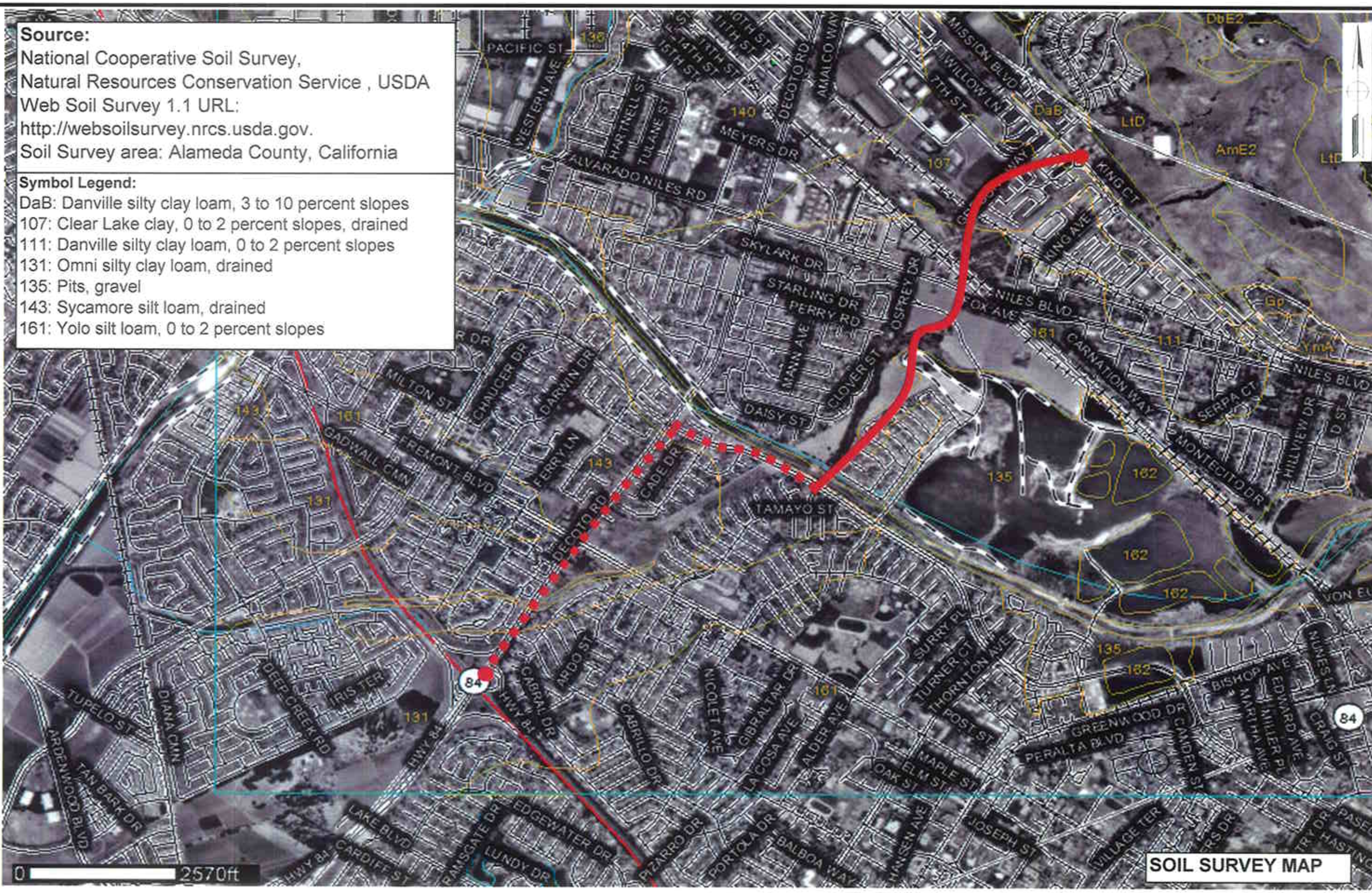


GEOLOGIC MAP

PARIKH CONSULTANTS, INC. GEOTECHNICAL CONSULTANTS MATERIALS TESTING	**EAST WEST CONNECTOR BETWEEN I-880 AND MISSION BLVD (SR 238)** **UNION CITY AND FREMONT, ALAMEDA COUNTY, CALIFORNIA** **JOB NO.: 208104.GEO** **PLATE NO.: 2**



PARIKH CONSULTANTS, INC. GEOTECHNICAL CONSULTANTS MATERIALS TESTING	EAST WEST CONNECTOR BETWEEN I-880 AND MISSION BLVD (SR 238) UNION CITY AND FREMONT, ALAMEDA COUNTY, CALIFORNIA	
	JOB NO.: 208104.GEO	PLATE NO.: 3

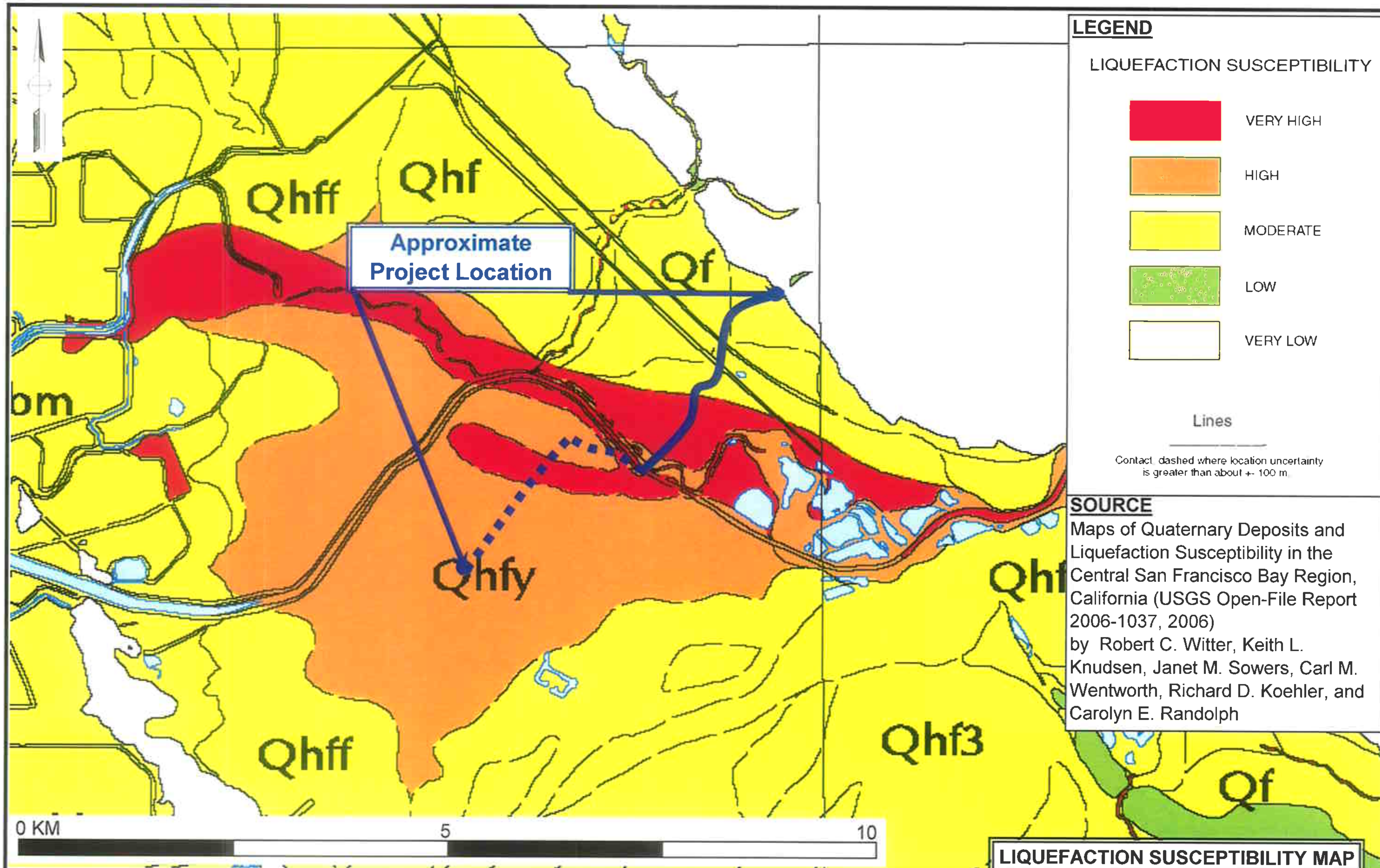


PARIKH CONSULTANTS, INC.

GEOTECHNICAL CONSULTANTS
MATERIALS TESTING

EAST WEST CONNECTOR BETWEEN
I-880 AND MISSION BLVD (SR 238)
UNION CITY AND FREMONT, ALAMEDA COUNTY, CALIFORNIA

JOB NO.: 208104.GEO	PLATE NO.: 4



PARIKH

Practicing in the Geosciences

EAST WEST CONNECTOR BETWEEN
I-880 AND MISSION BLVD (SR 238)
UNION CITY AND FREMONT, ALAMEDA COUNTY, CALIFORNIA

JOB NO.: 208104.GEO

PLATE NO.: 5