8.15 Geologic Hazards and Resources

8.15.1 Introduction

The City of Vernon (City) proposes to develop a power plant (VPP) on a 13.7-acre property at the southeast corner of Fruitland and Boyle avenues. The VPP will be a 914-megawatt (MW) net (at 65 degrees Fahrenheit [°F] with duct burners and evaporative cooling)/943-MW (gross) combined-cycle generating facility configured using three natural-gas-fired combustion turbines and one steam turbine. Two transmission line options are being considered to connect the plant to Southern California Edison's (SCE) Laguna Bell Substation. Natural gas for the facility will be delivered via approximately 2,300 feet of new 24-inch pipeline that will connect to Southern California Gas Company's (SoCalGas) existing gas transmission line (Line 765). Potable water for drinking, safety showers, fire protection, service water, and sanitary uses will be served from the City's potable water system through two 10-inch pipelines connecting to the City's water mains. One would connect in Boyle Avenue and the other in Fruitland Avenue. Recycled water for industrial purposes will be provided by the Central Basin Municipal Water District (CBMWD) through a nominal 16-inch carbon steel (or if using high density polyethylene [HDPE], a 20-inch) water line connecting to its recycled water line in Boyle Avenue, adjacent to the plant site. The blowdown will be sent to Sanitation Districts of Los Angeles County (LACSD) via a new 2,400-foot section of City sanitary sewer line.

This subsection evaluates the effect of geologic hazards and resources that might be encountered on the project site and associated linear facilities. The objective of this analysis is to identify site conditions and potential project impacts resulting from construction or operation of the project. This subsection presents a summary of the relevant laws, ordinances, regulations and standards (LORS), the existing site conditions; and the expected direct, indirect, and cumulative impacts because of construction, operation, and maintenance of the project. Proposed mitigation measures to reduce geologic impacts are also described. Permits that are required and permitting agencies are identified.

8.15.2 Laws, Ordinances, Regulations, and Standards

The LORS that apply to geologic resources and hazards are summarized in Table 8.15-1.

TABLE 8.15-1
Laws, Ordinances, Regulations, and Standards

Jurisdiction	Authority	Administering Agency	Compliance
State/local	California Building Code (CBC), 2001	California Building Standards Commission, State of California, City of Vernon	Acceptable design criteria for structures with respect to seismic design and load-bearing capacity
State/local	Alquist Priolo Earthquake Fault Zoning Act	Title 14, Division 2, Chapter 8, Subchapter 1, Article 3, California Code of Regulations.	Identifies areas subject to surface rupture from active faults
State/local	The Seismic Hazards Mapping Act	Title 14, Division 2, Chapter 8, Subchapter 1, Article 10, California Code of Regulations.	Identifies non-surface fault rupture earthquake hazards, including liquefaction and seismically induced landslides
Local	City of Vernon General Plan	City of Vernon	Compliance with the safety element of the General Plan

8.15.3 Affected Environment

The VPP site located in the City of Vernon, Los Angeles County, California, is zoned for general industrial use. The project site and linears are located approximately 0.75-mile from the Los Angeles River in the central Los Angeles Basin. The Los Angeles Basin is located in the northeast corner of the Peninsular Ranges geomorphic province. The Basin is in the area of transition between the Transverse Ranges and Peninsular Ranges geomorphic provinces. The Los Angeles Basin is an active structural depression that is still receiving sediment eroded from surrounding hills. This portion of the Basin is bounded by the Santa Monica Mountains to the northwest, the Puente Hills blind thrust Fault to the northeast, the San Joaquin Hills to the southeast, and the Newport-Englewood fault zone to the southwest. The proposed power plant site is a relatively flat site (approximate elevation 182 feet above sea level) that is underlain by Quaternary age alluvial sediments. The site, as well as much of southern California, is within a highly active seismic region.

8.15.3.1 Regional Geology

The geology of the VPP vicinity and linears is relatively complex. The Los Angeles Basin is a structural trough overlying bedrock formations between the Western Shelf and the San Gabriel Mountains. This trough has been filled with marine and alluvial deposits of Quaternary and Tertiary age. Deposits nearly 30,000-feet thick are present near the central part of the basin and rise sharply to the east and to the west.

8.15.3.2 Local Geology

The local geology is composed of basin deposits of recent quaternary age underlain by tertiary and continental deposits. The primary geomorphic feature in the project area is relatively deep alluvial deposits derived from surrounding hills and mountains. Figure 8.15-1 shows the geology within a 2-mile radius of the VPP site. The stratigraphy and structure of the local area are discussed below.

8.15.3.2.1 Stratigraphy

Stratigraphically, the Los Angeles Basin in the area of the VPP is underlain by 100 to 200 feet of unconsolidated alluvium and up to about 12,000 feet of Quaternary age (up to 2 million years old) non-marine gravel and sand (Yerkes, et al, 1965). These materials are underlain by an additional 16,000 feet of sedimentary rocks (Yerkes, et al, 1965; and Dibblee, 1989). The sedimentary rocks that underlie the alluvium in the project area are the marine and non-marine units within the Fernando formation. The non-marine rocks consist of sandstone and conglomerate beds. The marine rocks consist of claystone (Yerkes, 1965; and Dibblee, 1989). These sediments fill a basin or elongated trough of folded basement rock. The basement rock consists of metamorphic bedrock.

Sand and gravel resources are present beneath much of the urbanized area along the Los Angeles River. There are oil and gas resources present in the area as well. A generalized geologic stratigraphic column beneath the project site is described in Table 8.15-2.

TABLE 8.15-2
Description of Stratigraphy for Project Site and Linears

Stratigraphy	Description
Undifferentiated Quaternary Alluvium and Marine Deposits	These consist of unconsolidated silt, clay, and fine sand deposits from alluvial and fan systems. Thickness ranges from about 100 to 200 feet.
Upper Fernando Formation	Consists of claystone, sandstone, and conglomerate beds. This layer is approximately 10,000 feet thick.
Lower Fernando Formation	Sandstone and conglomerate. This layer is approximately 10,000 feet thick.
Undivided Tertiary age Sedimentary bedrock	Consists of generally shale, siltstone, sandstone and conglomerate.. Together with the marine deposits, compose a stratigraphic thickness of approximately 16,000 feet.
Cretaceous Marine Deposits	Contains consolidated sandstone, siltstone, and shale deposits.
Pre-Tertiary Basement deposits	Contains metamorphic and igneous rocks and lies approximately 30,000 feet below ground surface.

8.15.3.2.2 Structure

The basement complex, which consists of metamorphic and igneous rocks, slopes similar to those found in the San Gabriel Mountains to the north or the core of the Palos Verdes Hills to the south.

The VPP project site and linears are located in a flat area. No significant topographic structure exists in the vicinity of these project components.

8.15.3.3 Regional Seismicity

Numerous active and potentially active faults considered capable of generating earthquakes have caused and will continue to cause seismic shaking at the site. Over 30 faults have been documented within a 62-mile (100-kilometer) radius of the site as shown on Figure 8.15-2 (Blake, 2004). Principal faults within 10 miles of the site with estimated peak bedrock accelerations are presented in Table 8.15-3.

TABLE 8.15-3
Principal Faults within 20 miles of the Proposed Vernon Power Plant Site

Fault Name	Approximate Distance (mi)	Approximate Distance (km)	Maximum Earthquake Magnitude	Estimated Peak Bedrock Acceleration (g)
Puente Hills Blind Thrust	3.1	5.0	7.1	0.635
Upper Elysian Park Blind Thrust	5.4	8.7	6.4	0.387
Newport-Inglewood (Los Angeles Basin)	6.6	10.7	7.1	0.369
Hollywood	8.8	14.2	6.4	0.262
Raymond	8.9	14.3	6.5	0.279

Source: Blake, 2004

The most recent significant seismic activity that has occurred within 10 miles of the VPP site was the 1989 Montebello Earthquake near East Los Angeles. A Richter Magnitude (M) of 4.4 was measured. Also, the 1987 Whittier-Narrows Earthquake, located approximately 7 miles southeast of Pasadena, resulted in a M 5.9 event. This earthquake occurred on a previously unknown blind thrust fault. Both of these events caused estimated peak bedrock accelerations at the VPP site of 0.160g and 0.183g, respectively.

The most notable event with an epicenter of approximately 23.9 miles northwest from the VPP site was the Northridge Earthquake of 1994. This event caused an estimated VPP site peak bedrock acceleration of 0.102g. The primary fault associated with the Northridge Earthquake is the Northridge Thrust fault. Like the Puente Hills blind thrust discussed below, the Northridge Thrust is a blind thrust fault. Blind thrust faults are faults that have not broken through to the surface of the earth.

8.15.3.3.1 Major Faults

Over 20 faults have been mapped within 30 miles of the site. Two major faults that could impact the site include the Puente Hills blind thrust and the Upper Elysian Park blind thrust, located approximately 3 miles northeast and 5 miles north, respectively, from the site (Blake, 2004). Faults in the site vicinity are shown on Figure 8.15-2.

Other faults in the vicinity of the site include: the Newport-Inglewood Fault, which lies approximately 6 miles to the southwest; the Hollywood-Raymond Fault, which is approximately 9 miles to the north of the site. The California Building Code (CBC 2001) has identified the project site area to be within Seismic Zone 4. With both transmission line options, the eastern terminus of the transmission linear at the Laguna Bell Substation crosses the mapped location of Puente Hills blind thrust fault.

8.15.3.4 Geologic Hazards

The following subsections discuss the potential geologic hazards that might occur in the project area based on a literature search and initial geotechnical report prepared for the site, a copy of which is attached as Appendix 8.15A. Additional information will be available following preparation of a final site-specific geotechnical report, which will be provided to CEC upon request.

8.15.3.4.1 Surface Fault Rupture

No faults were found to cross the VPP site. However, with both transmission line options the Puente Hills blind thrust is present in the subsurface below the transmission linear that approaches the Laguna Bell Substation.

8.15.3.4.2 Seismic Shaking

The most significant geologic hazard at the VPP site is strong ground shaking due to an earthquake. Blake (2004) estimates that the ground shaking of an M 7.1 earthquake along the Puente Hills blind thrust could produce a peak bedrock acceleration of up to 0.64 g (rounded up, g = acceleration due to gravity) in the vicinity of the VPP. This is the maximum credible earthquake (MCE) event with ground motions associated with a 2,500-year mean return period or a 2 percent probability of exceedance in 50 years. This would affect the plant site, the gas line, sewer line and transmission line connection. Both transmission line options cross the Puente Hills blind thrust zone on their eastern end that terminates at the Laguna Bell

Substation. The eastern end of this linear may experience a peak bedrock acceleration of up to 0.64 g (rounded up, Blake 2004) as a consequence of this fault. Peak bedrock accelerations stated above were cross referenced with the Caltrans California Seismic Hazard Map (Mualchin, 1996) for general verification.

8.15.3.4.3 Liquefaction

Soil liquefaction is a phenomenon in which saturated, cohesionless soils (sand) temporarily lose their strength and liquefy when subjected to dynamic forces such as intense and prolonged ground shaking. Liquefaction typically occurs when the water table is shallow (generally less than 40 feet below ground surface) and the soils are predominantly granular and unconsolidated. The potential for liquefaction increases as the groundwater approaches the surface. Although this portion of the Los Angeles Basin has been identified as a site where geologic conditions are present for liquefaction to occur, a site-specific liquefaction analysis of the subsurface profile at the VPP site determined that the liquefaction potential was low (Appendix 8.15A). However, off-site linears may be subject to greater liquefaction potential.

8.15.3.4.4 Slope Stability

Slope instability depends on steepness of the slope, underlying geology, surface soil strength, and pore pressures in the soil. Significant excavating, grading, or fill work during construction might introduce slope stability hazards at either the VPP site or along linear facility routes. Because the VPP site and linear corridors are relatively flat and no significant vertical excavation is planned during site construction, the potential for direct impact from landslides at the sites is considered nonexistent.

8.15.3.4.5 Subsidence

Subsidence can be caused by natural phenomena during tectonic movement, consolidation, hydrocompaction, or rapid sedimentation. Subsidence can also result from human activities, such as withdrawal of water and/or hydrocarbons in the subsurface soils. Human-induced subsidence recorded in the southwest portion of the Los Angeles (geological) Basin was first observed in the Wilmington oil field south of the project area in 1937. The removal of oil and gas in this and neighboring oil fields allowed the rock and mineral grains in the oil reservoirs to consolidate, reducing bed thickness and causing subsidence of the ground surface. There are no indications that subsidence will affect the project area.

8.15.3.4.6 Expansive Soils

Expansive soils are clay rich soils that have the ability to shrink and swell with wetting and drying. The shrink-swell capacity of expansive soils can result in differential movement beneath foundations. The power plant site and linears are primarily underlain by sandy, granular soils with low expansion potential.

8.15.3.4.7 Geologic Resources of Recreational, Commercial, or Scientific Value

The City of Vernon was developed early in the century as an industrial city and very little land remains undeveloped and little private land has been set aside for open space or landscaping. Areas that were used for sand and gravel quarries have been backfilled and developed. No other mineral resources exist in the City (City of Vernon General Plan, 2001). In addition, there are no known recreational geologic resources associated with the VPP site.

8.15.3.4.8 Oil and Gas

There are numerous oil resources in the Los Angeles Basin. Based on review of the *Oil, Gas, and Geothermal Fields in California Map* (2001) there is one oil field within 2 miles of the project area. This is the Bandini field located approximately 1.5 miles east of the proposed VPP site. The next closest oil field is at Boyle Heights, approximately 2.5 miles to the north. No gas fields are mapped within 2 miles of the site.

There are no known geologic resources that provide a significant scientific value in the vicinity of the site.

8.15.4 Environmental Analysis

8.15.4.1 Generating Facility

8.15.4.1.1 Geologic Hazards

Ground shaking presents the most significant geologic hazard to the proposed VPP facility and linear facilities. Liquefaction may also impact linear facilities as a result of ground shaking. Mitigation measures proposed in Section 8.15.5 should be implemented in the design of the facilities to reduce risk associated with these hazards. Table 8.15-4 summarizes the geologic hazards associated with the VPP site and linear facilities.

TABLE 8.15-4
Summary of Potential Geologic Hazards

Project Component	Area of Potential Concern	Geologic Hazards of Potential Concern
Proposed VPP Facility Site	Entire site (13.7 acres)	Seismic ground shaking
Transmission Line	Entire route	Seismic ground shaking; liquefaction
Natural gas line and sewer line	Entire route	Seismic ground shaking; liquefaction

8.15.4.1.2 Geologic Conditions and Topography

The project site will be delivered to the City with all existing structures removed and the site remediated and leveled. Construction may require minor grading of the site for proper drainage. Impacts to the geologic environment involve dust generation and possible change in drainage. Since the site is generally level, site grading is not expected to adversely impact the geologic environment.

8.15.4.2 Linear Facilities

Linear facilities associated with the VPP site include electricity transmission, natural gas, water, and reclaimed water lines discussed below. The geologic hazards associated with the linear facilities are summarized in Table 8.15-3.

8.15.4.2.1 Electric Transmission Line

Seismically induced ground shaking and possible liquefaction potential could affect the stability of the transmission lines. With implementation of the mitigation measures proposed in Section 8.15.5, the hazards will be reduced to acceptable levels.

8.15.4.2.2 Natural Gas, Water and Sewer Lines

Seismically induced ground shaking and possible liquefaction potential could affect the stability of the natural gas, water and sewer lines. These possible hazards present along the proposed natural gas, water and other linear routes could affect the stability of the lines. With implementation of the mitigation measures proposed in Section 8.15.5, the hazards will be reduced to acceptable levels.

8.15.4.3 Geologic Resources of Recreational, Commercial, and Scientific Value

The project site is relatively flat and is primarily composed of recent alluvial sediments of little recreational value. Sand, gravel and mineral deposits are one of the resources of Los Angeles County but are not present in the vicinity of the project site. Oil and gas production also occurs in the County. Construction and operation of the VPP site would not affect these resources. Also, there are no known geologic resources that provide a significant scientific value in the vicinity of the site. Therefore, the VPP project would not affect these resources.

8.15.5 Mitigation Measures

The following subsections describe mitigation measures that could be used to reduce impacts from geologic hazards.

8.15.5.1 Surface Faulting Rupture

No active faults were noted to cross the VPP site.

The eastern terminus of the transmission linear at the Laguna Bell Substation crosses the mapped location of Puente Hills blind thrust fault. This is a deep-seated, implied fault, and no surface expression exists. Therefore, no mitigation measure is required to reduce the hazard from surface faulting rupture.

8.15.5.2 Ground Shaking

The VPP generating facility and water linear facilities will need to be designed and constructed to withstand strong earthquake shaking as specified in the 2001 CBC for Seismic Zone 4—in accordance with City of Vernon and County of Los Angeles requirements.

8.15.5.3 Liquefaction

An initial geotechnical investigation has been completed at the VPP site and indicates that liquefaction potential is low at the site. Additional analyses to evaluate liquefaction potential will be conducted as part of the final geotechnical investigation that will be completed prior to construction.

8.15.5.4 Subsidence

Subsidence potential at the project site is considered low. A final geotechnical engineering report required by the County will specify the actual degree of subsidence and any mitigation that may be required.

8.15.5.5 Expansive Soils

Expansive soils were not encountered in the initial geotechnical investigation of the site and are not expected under both the linear facilities and the VPP site.

8.15.6 Involved Agencies and Agency Contacts

There are no specific state or local agencies having specific jurisdiction over geologic resources. However, in accordance with the safety element of the City of Vernon and Los Angeles County General Plans, the respective planning departments are responsible for ensuring compliance with building standards.

TABLE 8.15-5
Local Agency Contacts

Agency	Contact	Title	Telephone
City of Vernon	Kevin Wilson	Director of Community Services and Water	(323) 583 8811 ext. 245

8.15.7 Permits Required and Permit Schedule

Compliance of building construction to 2001 CBC standards is covered under engineering and construction permits for the project. No other permit requirement that specifically addresses geologic resources and hazards is identified.

8.15.8 References

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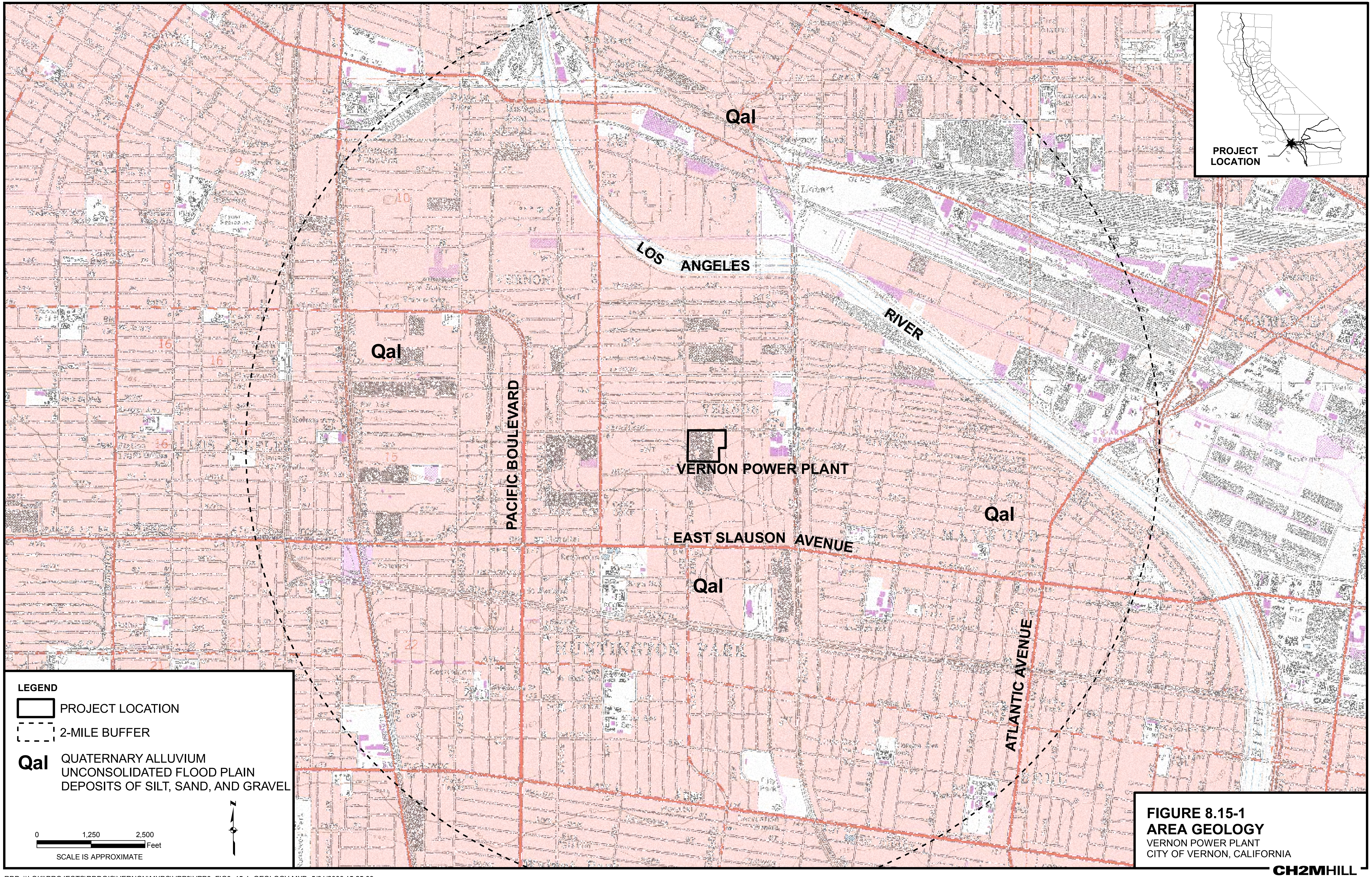

FIGURE 8.15-1
AREA GEOLOGY
VERNON POWER PLANT
CITY OF VERNON, CALIFORNIA

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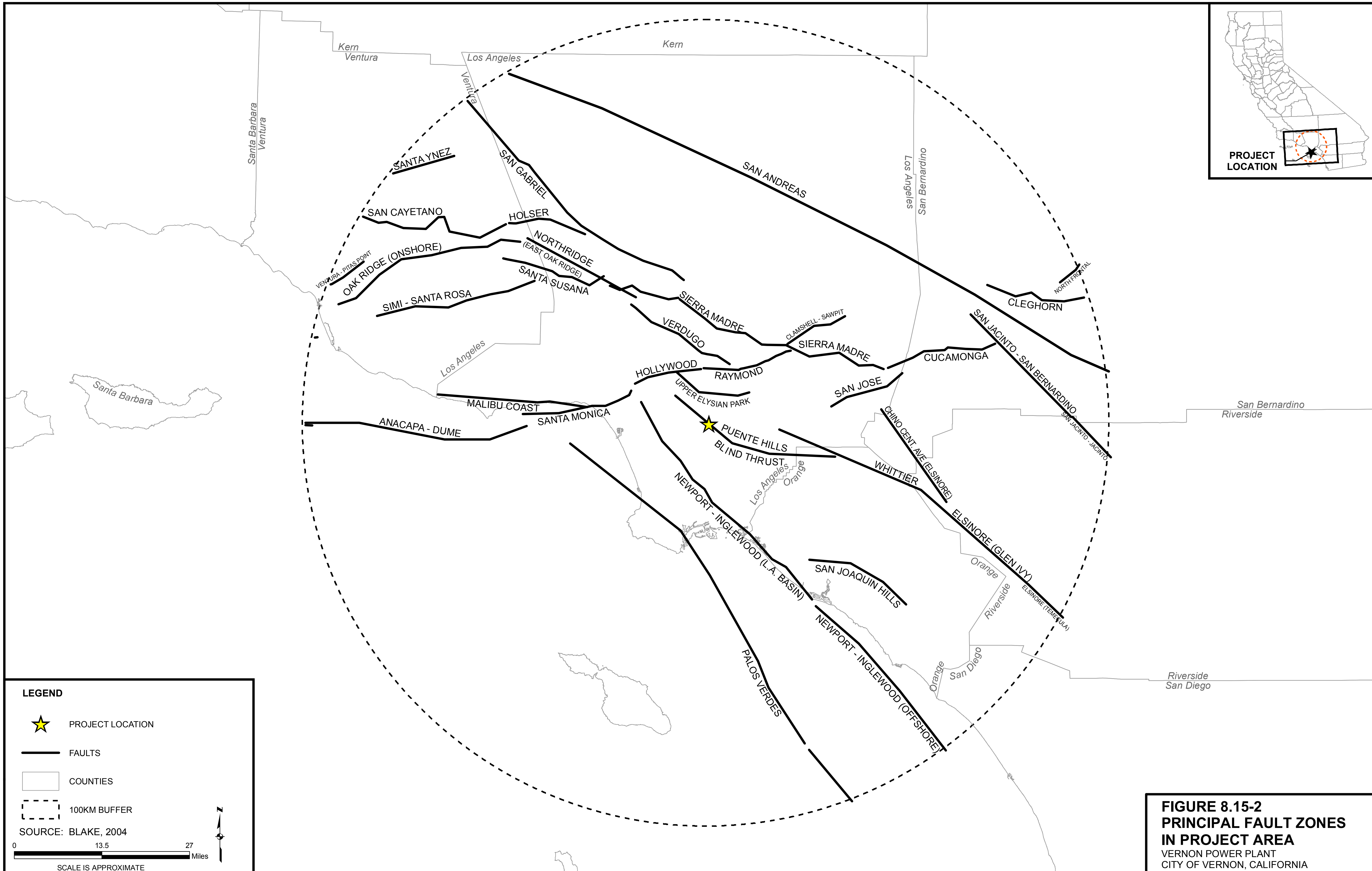

FIGURE 8.15-2
PRINCIPAL FAULT ZONES IN PROJECT AREA

VERNON POWER PLANT
CITY OF VERNON, CALIFORNIA

CH2MHILL

RDD \\LOKI\PROJECTS\RDDGIS\VERNON\MXDS\VPP3\VPP3_FIG8_15-2_FAULTS.MXD 5/31/2006 15:17:21