5.4 Geologic Hazards and Resources

5.4.1 Introduction

On August 16, 2001, GWF Energy LLC filed an Application for Certification (AFC) with the California Energy Commission (CEC) for the Tracy Peaker Project (TPP). The CEC found the AFC data adequate on October 17, 2001. The CEC released a staff assessment on December 28, 2001, and a supplemental staff assessment on February 1, 2002. The CEC published its Presiding Member's Proposed Decision on May 31, 2002, with the project receiving its Final Decision on July 17, 2002. These documents are incorporated by reference into this AFC and are presented in electronic form in Appendix 1A.

This section evaluates the effect of geologic hazards on the GWF Tracy Combined Cycle Power Plant (GWF Tracy) and geologic resources of commercial, recreational, or scientific value at the project site. Section 5.4.2 presents the laws, ordinances, regulations, and standards (LORS) applicable to geologic hazards and resources. Section 5.4.3 describes the existing environment that could be affected, including regional and local geology and geologic hazards. Section 5.4.4 identifies potential environmental effects from project development. Section 5.4.5 discusses potential cumulative effects. Section 5.4.6 discusses possible mitigation measures. Section 5.4.7 provides agency contacts. Section 5.4.8 describes the required permits. Section 5.4.9 provides the references used to develop this section.

The 2001 TPP AFC included an analysis of the Geologic Resources and Hazards for the project site and vicinity and was presented in Section 8.15 of the AFC. The majority of the data and analysis presented in that AFC are still valid. It is the primary data source for this supplemental AFC and is referenced as "GWF, 2001."

5.4.2 Laws, Ordinances, Regulations, and Standards

The LORS that may apply to geologic resources and hazards are summarized in Table 5.4-1. The local LORS discussed in this section are certain ordinances, plans, or policies of the County of San Joaquin. The San Joaquin County Building department used the California Building Codes as the minimum design standards for construction. Compliance with the California Building Codes will achieve compliance with the San Joaquin County LORS. There are no federal LORS that apply to geologic hazards and resources.

TABLE 5.4-1
Laws, Ordinances, Regulations, and Standards for Geologic Hazards and Resources

LORS	Requirements/ Applicability	Administering Agency	AFC Section Explaining Conformance
State			
California Building Code (CBC) 2007, as amended by the County of San Joaquin	Acceptable design criteria for structures with respect to seismic design and load-bearing capacity	California Building Standards Commission, State of California, and County of San Joaquin	Section 5.4.4.2

TABLE 5.4-1
Laws, Ordinances, Regulations, and Standards for Geologic Hazards and Resources

LORS	Requirements/ Applicability	Administering Agency	AFC Section Explaining Conformance
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	California Building Standards Commission, State of California, and County of San Joaquin	Section 5.4.4.2
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	California Building Standards Commission, State of California, and County of San Joaquin	Section 5.4.4.2
Local			
County of San Joaquin General Plan (San Joaquin County, 1992)	County of San Joaquin General Plan	County of San Joaquin	Section 5.4.4.2

5.4.3 Affected Environment

The site is located immediately southwest of Tracy, California, and approximately 20 miles southwest of Stockton, California. The site is near the western edge of the San Joaquin Valley within the Great Valley Geomorphic province, astride the boundary between the Great Valley to the east and the Coast Ranges to the west (locally the Diablo Range) (CA DMG, 1991). The proposed new and existing transmission lines would run across the foothills of the Diablo Range.

The project site is in an area of Central California known to be seismically active.

5.4.3.1 Regional Geology

The proposed site is located along the boundary between the Coast Ranges and the Great Valley (Central Valley) physiographic provinces. This region is known as the Coast Ranges–Sierran Block boundary zone (CRSBBZ) and is delineated by a series of low hills and complex thrust/reverse faulting. The Great Valley and the adjacent Sierra Nevada form a relatively stable crustal block (Sierran block) composed of Mesozoic crystalline basement that dips gently to the west. The western edge of the Sierra Nevada block, beneath the sediments of the Great Valley, is generally thought to be coincident with the western margin of the Great Valley (GWF, 2001).

The Great Valley physiographic province separates the Coast Ranges to the west from the Sierra Nevada to the east. This province is composed of two elongated northwest- to southeast-trending basins: the Sacramento basin to the northwest and the San Joaquin basin

to the southeast. This province is approximately 435 miles (700 kilometers [km]) long and 44 to 56 miles (70 to 90 km) wide, and is characterized by a thick, relatively undeformed sequence of alluvium and volcanic deposits. The present-day basin evolved from a late Jurassic to middle Tertiary (40–150 million years ago [Ma]) marine fore-arc basin. In the late Tertiary (25–30 Ma), a change in the relative motion between the Pacific and North American plates resulted in the gradual uplift of the Coast Ranges and the eventual isolation of the basin from the ocean. More recent Miocene and lower Pliocene sediments were derived from the neighboring Coast Ranges and the Sierra Nevada. By the late Pliocene (2–3 Ma), subaerial depositional conditions prevailed, and Sierra Nevada–derived sediments were deposited in the basins (GWF, 2001).

The Coast Ranges are a north-northwest- to northwest-trending series of mountains and intervening valleys extending for 597 miles (960 km) from the Oregon border, south to the Santa Ynez River near Santa Barbara. Physiographically, the Coast Ranges can be divided into two subprovinces: the northern and southern subprovinces, separated by the San Francisco Bay; and the Sacramento River Delta. The Coast Ranges are underlain by uplifted and intensely deformed Upper Jurassic (150 Ma) and younger rocks of the Franciscan ophiolite complex and the Salinian metamorphic and granitic complex (GWF, 2001).

5.4.3.2 Local Geology and Stratigraphy

Near the project site, the surface slopes gently down at about a 1-percent grade to the northeast. Local drainage is directed toward the northeast. The elevation of the site varies from about 155 to 180 feet (GWF, 2001).

The local area is underlain by a complex series of sedimentary and volcanic rocks ranging in age from Jurassic to Tertiary. Since their deposition, these rocks have been extensively deformed by repeated episodes of folding and faulting. Valleys within the region are generally filled with unconsolidated sedimentary deposits of Quaternary age. A thick sequence of alluvial fan deposits forms the west side of the Great Valley province in the Tracy area. These sedimentary deposits consist of interbedded sand, gravel, silt, and clay. A brief description of the structure and stratigraphy beneath the project facilities is presented below (GWF, 2001).

The site is immediately underlain by Quaternary alluvium deposits (Figure 5.4-1). Past geotechnical investigations have shown that the subsurface at the site consists of a layer of moderately to highly expansive clay underlain by an alluvial sequence of silt, clay, sand, and gravel. The surface expansive clay layer varies from about 2 to 7 feet thick. The material is loose to a depth of 1 to 1.5 feet and is stiff to hard below this depth. The material directly below the clay consists of 4 to 7 feet of silty sand at four locations, and sandy silt or sandy clay at the other locations. This layer is underlain mainly by sandy silt to silty clay to the depths explored. The clay and silt are typically very stiff to hard and contain varying amounts of sand and gravel. Occasional layers of sand and gravel are present to the depths explored. Two layers of dense sand and gravel were encountered at depths of about 30 and 50 feet below ground surface. The two layers appear to be relatively discontinuous across the site. Two of the cone penetration tool (CPT) probes met refusal in the layer at 50 feet. Groundwater levels were estimated by pore pressure dissipation at three of the CPT locations (GWF, 2001).

Depth to groundwater ranges between 25 to 50 feet below ground surface (125 to 142 feet above mean sea level), with a local flow direction toward the southeast (GWF, 2001).

5.4.3.3 Seismic Setting

The project site is located in central California and within the CRSBBZ. The modern tectonic setting of central California is dominated largely by the transform plate boundary contact between the Pacific and North American plates south of the Mendocino triple junction. The Pacific plate is slipping in a north-northwest direction (N35°W to N38°W) at a rate of about 1.81 to 1.95 inches per year (46 to 47 millimeters per year) with respect to the North American plate. Right-lateral strike-slip displacement along the major branches of the San Andreas fault system accommodates most of this plate motion, with the remainder generating Holocene tectonism and seismicity at the western continental margin and to the east in the Sierra Nevada and Basin and Range Provinces (GWF, 2001).

The seismicity of the project site area can be characterized as an area of potentially large-magnitude earthquakes. Active faults within 25 miles of the site include the Segment 7 of the Great Valley, Greenville, Mount Diablo, and Calaveras. These faults are capable of generating maximum credible earthquake (MCE) moment magnitudes of 6.2 to 6.9 (Blake, 2004). These fault zones represent a significant seismic hazard to the project site. No faults have been mapped crossing the project site, and the site is not within an Alquist-Priolo Special Studies Zone (CGS, 2007). The location of these faults relative to the project site is shown on Figure 5.4-2.

5.4.3.4 Potential Geologic Hazards

The following subsections discuss the potential geologic hazards that might occur in the project area.

5.4.3.4.1 Ground Rupture

Ground rupture is caused when an earthquake event along a fault creates rupture at the surface. Since no known active faults cross the project site, the likelihood of ground rupture occurring is considered low.

5.4.3.4.2 Seismic Shaking

The project area has experienced seismic activity with strong ground motion during past earthquakes, and it is likely that strong earthquakes causing seismic shaking will occur in the future. The significant geologic hazard at the GWF Tracy site is strong groundshaking due to an earthquake. Groundshaking from a magnitude 7.8 earthquake could occur within a 45-mile radius of the site (Blake, 2004).

The controlling fault impacting the GWF Tracy site is Segment 7 of the Great Valley Fault, located approximately 4.3 miles southwest of the site. This is a reverse-type fault dipping approximately 15 degrees west with a slip rate of approximately 1.5 millimeters per year (CGS, 2002) and is capable of generating a peak bedrock acceleration (PBA) of 0.50g (Blake, 2004) based on the MCE event. Other faults noted above, which are located within a 10-mile radius of the GWF Tracy site, are capable of generating a PBA range of 0.18g to 0.27g. Faults capable of generating a PBA greater than 0.1g are located within a 26-mile radius of the site (Blake, 2004).

5.4.3.4.3 Liquefaction

During strong groundshaking, loose, saturated, cohesionless soils can experience a temporary loss of shear strength and act as a fluid. This phenomenon is known as liquefaction. Liquefaction is dependent on the depth to water, grain size distribution, relative soil density, degree of saturation, and intensity and duration of the earthquake. The potential hazard associated with liquefaction is seismically induced settlement. Soil conditions at the site predominately consist of clay and dense sands, with a relatively deep groundwater level (between 25 and 50 feet). Therefore, the hazard potential for liquefaction is considered low (GWF, 2001).

5.4.3.4.4 Mass Wasting

Mass wasting depends on steepness of the slope, underlying geology, surface soil strength, and moisture in the soil. Significant excavating, grading, or fill work during construction might introduce mass wasting hazards at the project site. Because the site is relatively flat and no significant excavation is planned during site construction, the potential for direct impact from mass wasting at the site is considered low to negligible (GWF, 2001).

5.4.3.4.5 Subsidence

Subsidence can be caused by natural phenomena during tectonic movement, consolidation, hydrocompaction, or rapid sedimentation. Subsidence can also occur from human activities, such as withdrawal of water or hydrocarbons in the subsurface soils. No known subsidence problems exist in the project area. According to the San Joaquin County General Plan, the project area is not within an area prone to subsidence (San Joaquin County, 1992).

5.4.3.4.6 Expansive Soils

The soil profile at the site consists of a surface expansive clay layer underlain by relatively dry soils to depths up to 50 feet. At the plant boring locations, liquid limits and plastic limits results obtained from two soil samples between 0 and 5 feet deep are 50 and 51 percent and 30 and 42 percent, respectively, indicating that the surface clay layer has a moderate to high expansion potential. The underlying materials have lower potential for expansion. Expansive soils change volume with changes in their moisture content. As the moisture content increases, expansive soils swell; as they dry, these soils shrink. Moisture content increases during winter months and from heavy irrigation. Moisture content decreases from summer drying and extraction by tree root systems. Structures located directly on expansive soils will heave and settle in response to these movements. Placing a slab over expansive soil will cut down evapotranspiration losses during dry months, tending to retain moisture content beneath the central portion of the slab. The moisture content near the edges of the slab tends to vary with the season and with irrigation practices. Engineering measures will be taken to minimize the impacts of expansive soils at the GWF Tracy site (GWF, 2001).

5.4.3.4.7 Seiches and Tsunamis

Seiches are wave oscillations in enclosed bodies of water that may be caused by earthquakes. Since there are no large bodies of water near the project site, the potential impact of a seiche on the site is negligible.

Tsunamis are seismically induced sea waves that can be triggered by submarine, earthquakes, landslides, or volcanic eruptions. Since the site is more than 90 miles from the Pacific Ocean, the occurrence of a tsunami along the coast of California impacting the site is negligible.

5.4.3.5 Geologic Resources of Recreational, Commercial, or Scientific Value

No information was found to indicate that GWF Tracy would adversely affect geologic resources of recreational, commercial, or scientific value. At the project site, the geologic units at the surface and in the subsurface are widespread alluvial deposits that occur throughout the southwestern part of the San Joaquin Valley; these units are not unique in terms of recreational, commercial, or scientific value. The potential for rare mineral or fossil deposits is very low, given the geologic environment in the area. In addition, the GWF Tracy site has been previously disturbed by historical agricultural activities (GWF, 2001). According to the San Joaquin County General Plan, the project area is not within an area of significant geologic resources (San Joaquin County, 1992).

There are no oil and gas extraction facilities at or near the project site (CDOGGR, 2008). The project would have no effect on oil and gas production, or on other geologic resources of commercial value or on the availability of such resources.

5.4.4 Environmental Analysis

The potential environmental effects from construction and operation of GWF Tracy on geologic resources and risks to life and property from geologic hazards are presented in the following sections.

5.4.4.1 Significance Criteria

According to Appendix G of the California Environmental Quality Act statutes, the project would have a significant environmental impact in terms of geologic hazards and resources if it would do the following:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
  - Rupture of a known earthquake fault (Alquist-Priolo Fault Zone)
  - Strong seismic ground shaking
  - Seismic-related ground failure, including liquefaction
- Be located on a geologic unit or soil that is unstable or that would become unstable as a result of the project, and potentially result in on- or offsite landslide, lateral spreading, subsidence, liquefaction, or collapse.
- Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state.
- Result in the loss of availability of a locally important mineral resource recovery site delineated on a local plan, specific plan, or other land use plan.

5.4.4.2 Geologic Hazards

There is significant potential for seismic groundshaking to affect the project site in the event of a large-magnitude earthquake occurring on fault segments near the project. GWF Tracy, however, is not located within an Alquist-Priolo Special Studies Zone or within the trace of any known active fault. The project would, therefore, not be likely to cause direct human exposure to ground rupture. Seismic hazards and potential adverse foundation conditions

will be minimized by conformance with the recommended seismic design criteria of the 2007 California Building Code (CBC). In addition, as stated previously, the probability of liquefaction, mass wasting, subsidence, or flooding at the project site is low.

GWF Tracy structures, equipment, and natural gas supply system will be designed in accordance with the 2007 CBC requirements. Compliance with the 2007 CBC requirements will minimize the exposure of people to the risks associated with large seismic events. In addition, major structures will be designed to withstand the strong ground motion of a Design Basis Earthquake (DBE), as defined by the 2007 CBC.

5.4.4.3 Geological Resources

GWF Tracy would not result in a loss of availability of a known mineral resource that would be of value to the region and the residents of the state. In addition, GWF Tracy would also not result in the loss of availability of a locally important mineral resource recovery site delineated on a local plan, specific plan, or other land use plan. There are no such resources on or near the site.

5.4.5 Cumulative Effects

A cumulative impact refers to a proposed project's incremental effect together with other closely related past, present, and reasonably foreseeable future projects whose impacts may compound or increase the incremental effect of the proposed project (Public Resources Code § 21083; California Code of Regulations, tit. 14, §§ 15064(h), 15065(c), 15130, and 15355).

GWF Tracy will not cause adverse impacts to geological resources, nor will it cause an exposure of people or property to geological hazards. There are no minor impacts, in addition, that could combine cumulatively with those of other projects.

5.4.6 Mitigation Measures

Mitigation measures proposed for the project are as follows:

- Structures will be designed to meet seismic requirements of the 2007 CBC. Moreover, the design of plant structures and equipment will be in accordance with 2007 CBC earthquake design requirements to withstand the ground motion of a DBE.
- A geotechnical engineer will be assigned to the project to carry out the duties required by the CBC, to assess geologic conditions during construction and approve actual mitigation measures used to protect the facility from geologic hazards.

With the implementation of these mitigation measures, GWF Tracy will not result in significant direct, indirect, or cumulative geology-related impacts.

5.4.7 Agencies and Agency Contacts

Compliance of building construction with CBC standards is covered under engineering and construction permits for the project. There are no other permit requirements that specifically address geologic resources and hazards. However, excavation/grading and inspection permits may be required prior to construction and will be included in the overall project construction permit (see Subsection 5.6, Land Use).

5.4.8 Permits and Permit Schedule

No permits are required for compliance with geological LORS. However, the County of San Joaquin Building Department is responsible for enforcing compliance with building standards.

5.4.9 References

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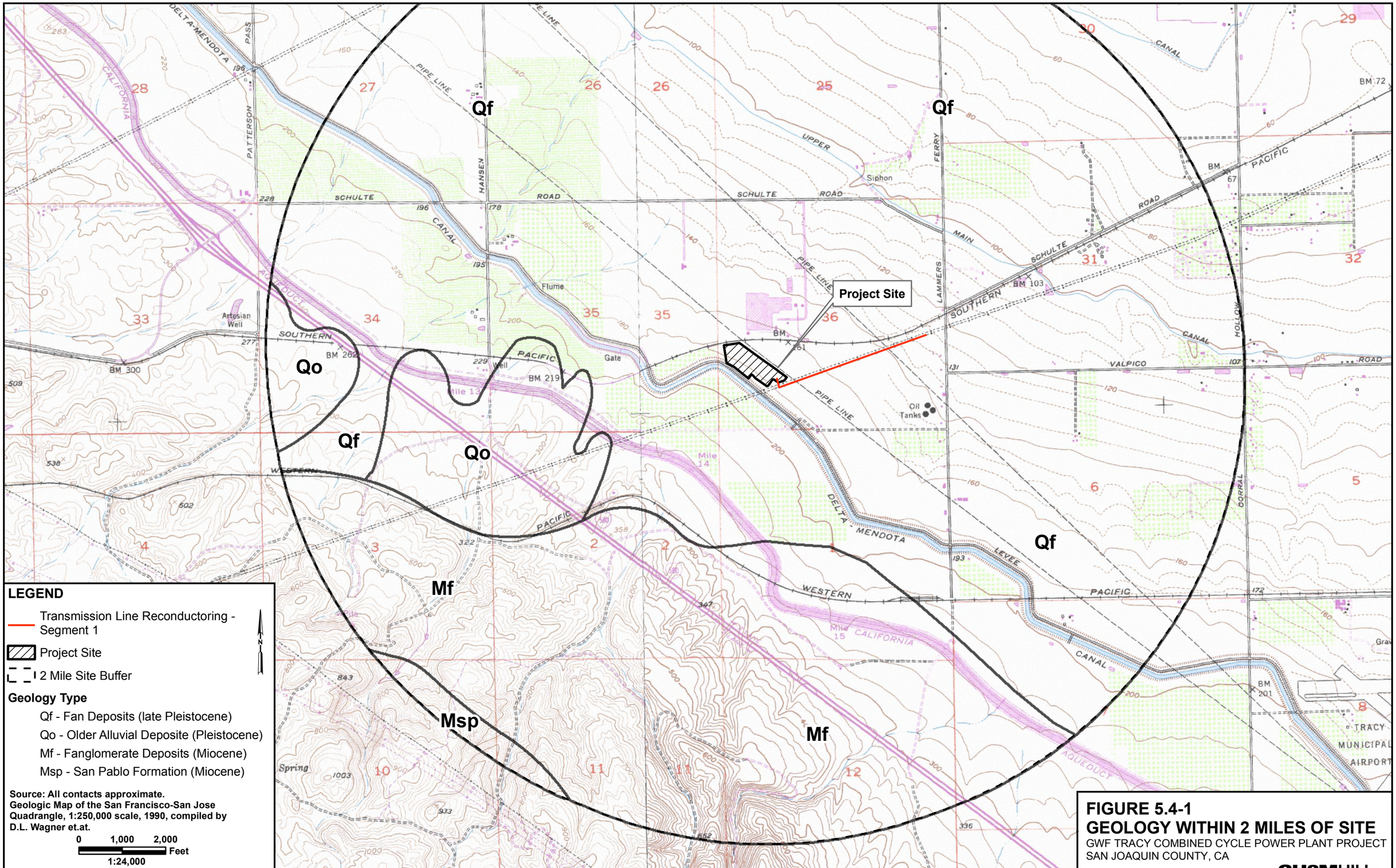

FIGURE 5.4-1
GEOLOGY WITHIN 2 MILES OF SITE
GWF TRACY COMBINED CYCLE POWER PLANT PROJECT
SAN JOAQUIN COUNTY, CA

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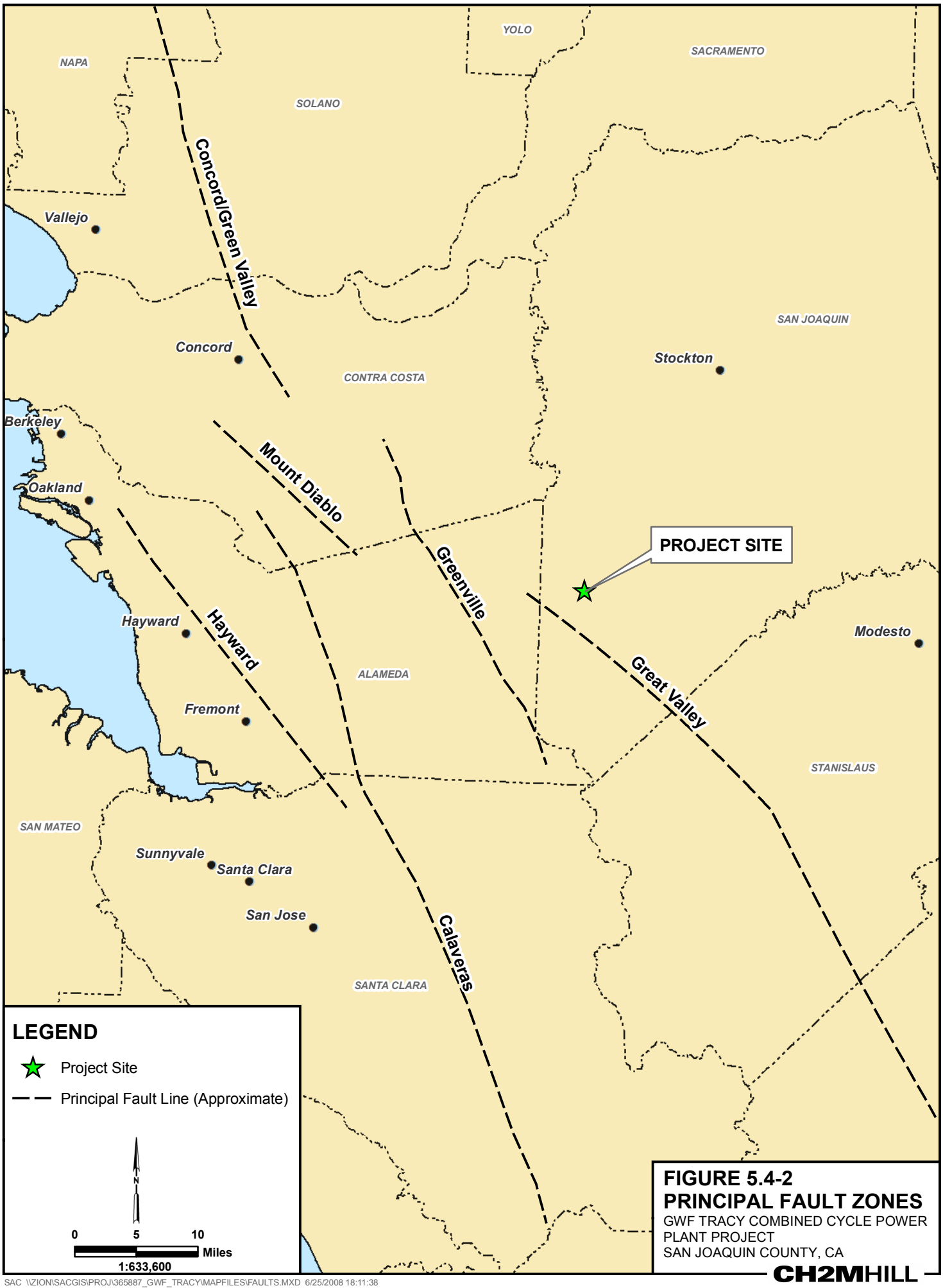

FIGURE 5.4-2
PRINCIPAL FAULT ZONES
GWF TRACY COMBINED CYCLE POWER PLANT PROJECT
SAN JOAQUIN COUNTY, CA

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