4.1 GEOLOGY, SOILS, AND SEISMICITY

4.1 GEOLOGY, SOILS, AND SEISMICITY

This section presents a description of the geologic, soils, and seismic conditions within Kings County and expected impacts associated with implementation of the proposed project. The description of these conditions is based on published and unpublished reports and maps prepared by the U.S. Geological Survey, the Soil Conservation Service (now known as the Natural Resource Conservation Service), the California Division of Mines and Geology, and the Kings County Planning Agency. Mitigation measures are presented for each identified impact.

SETTING

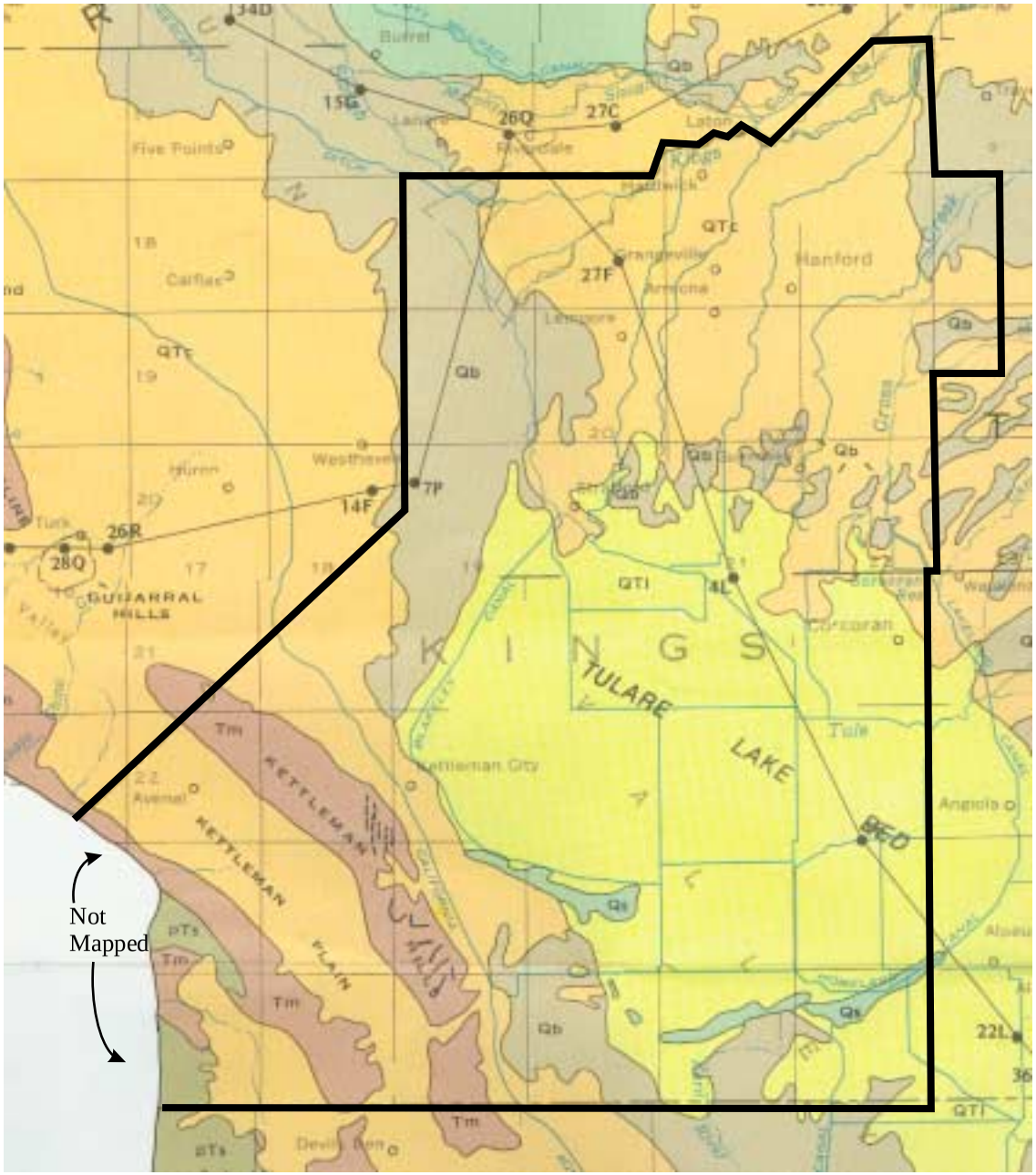
REGIONAL GEOLOGY

Kings County is located in the west-central portion of the San Joaquin Valley, the southern section of the Great Valley Geomorphic Province of California. The Great Valley (also referred to as the Central Valley) is a large, asymmetrical, northwestwardly-trending, structural trough formed between the uplands of the California Coast Ranges to the west and the Sierra Nevada to the east (Figure 4.1-1). The Great Valley is over 400 miles long and approximately 50 to 60 miles wide in the project area. The Valley is subdivided into the Sacramento Valley (north of the Sacramento-San Joaquin Delta) and the San Joaquin Valley (south of the Delta). The southern part of the Valley (including most of Kings County) is internally draining, with the distributaries of the Kings, Tule, and Kaweah rivers and Cross Creek flowing into the Tulare Lake Bed. North of the Kings River, runoff is directed into the San Joaquin River, which flows northward.

The southern San Joaquin Valley is bounded by the low mountains of the Coast Ranges to the west, the San Emiggdio and Tehachapi Ranges to the south, and the foothills of the Sierra Nevada to the east. The valley is filled with up to six vertical miles of sediment (Norris and Webb, 1990). The sediments include marine, alluvial, and lacustrine (lake) deposits. The valley is asymmetric with its axis located to the west of the geographic center of the valley. In general, the rivers lie along the axis and the thickest accumulation of sediments is also located along the axis. The geologic structure in the subsurface produced by folding and faulting and the presence of significant petroleum source rocks and suitable reservoir rocks has resulted in the development of numerous oil and gas fields within the southern San Joaquin Valley (including the Kettleman Hills, west of the project site). This sedimentary sequence is underlain in the west by granitic and metamorphic rocks of the Sierran structural block and by mafic and ultramafic bedrock in the east.

GEOLOGIC MAP

Figure 4.1-1



Legend

- Qs — Sand dunes (Holocene)
- Qb — Flood-basin deposits
- Qr — River deposits (Holocene)
- QTl — Lacustrine and marsh deposits (Pliocene to Holocene)
- QTc — Continental rocks and deposits (Miocene to Holocene)
- Tm — Marine rocks and deposits (Eocene, Oligocene, Miocene, and Pliocene)
- pTs — Marine rocks (Pre-Tertiary)
- Contact approximately located
- Fault dashed where approximately located, dotted where concealed
- D — D′ Line of geologic section
- ● 34A Well and number

0 8 Miles

BASELINE

Source: Page, 1986.

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The alluvial sediments include relatively coarse-grained deposits along river channels and alluvial fans on the margin of the valley. These sediments include the Tulare and San Joaquin Formations, which outcrop along the western margin of the valley and dip toward the center of the valley. These formations are relatively resistant to erosion and form low hills, including the Kettleman Hills in southwestern Kings County.

During the wetter climatic periods of the Pleistocene Epoch (1.8 million to 11,000 years ago), a series of lakes formed in the western, lowest portions of the valley floor. These lakes included, from north to south, Tulare, Buena Vista, and Kern lakes. During the relatively warmer and drier climatic conditions of the Holocene Epoch (the last 11,000 years), the water levels in the lakes receded and the lakes became seasonal lakes or playas. Fine-grained lake deposits are enduring evidence of the presence of the lakes. In historic times, much of the area of the lakes has been drained and put into agricultural production. The central portion of Kings County (Figure 4.1-1) occupies a portion of Tulare Lake, the largest of the Pleistocene lakes. The Kings, Kaweah (Cross Creek), and Tule rivers, as well as other distributaries, terminate within the former Tulare Lake Bed, which partially and temporarily fills during periods of high runoff.

Finer-grained lacustrine and flood basin deposits related to the Pleistocene lakes are found in the central portion of the valley (Page, 1986). The Tulare, Kern, and Buena Vista Lake Beds were sediment deposition centers located within structural depressions on the valley floor. Tectonic subsidence of the surface is caused by down-warping of the earth's crust. The fine-grained sediments underlying the Tulare Lake Bed are more than 3,600 feet thick. These deposits include the E clay, a diatomaceous clay deposited over a very large area of the San Joaquin Valley. The E clay is considered equivalent to the Corcoran Clay Member of the Tulare Formation. Within Kings County the top of the E-clay occurs at depths of approximately 250 to 900 feet and the layer is up to 160 feet thick.

In addition to the E clay, other younger, less extensive but similar clay deposits have been recognized. These deposits are found along the topographic axis of the valley, including the area of the project site. The C clay is mapped from near the town of Mendota in northern Fresno County to the Kern Lake Bed. This unit ranges in depth from about 100 to 330 feet below the ground surface and is 5 to 45 feet thick. The A clay is the youngest of the clay deposits and is also found underlying the axis of the valley. This unit is typically encountered at depths of less than 10 to 70 feet and is generally 5 to 70 feet thick. The presence of the A clay usually results in perching of groundwater at shallow depths.

GEOMORPHOLOGY AND TOPOGRAPHY

The most prominent topographic feature in Kings County is the Tulare Lake Bed. The lake bed is a broad, shallow depression covering the central and southern portions of the County. The land surface within the basin is nearly flat but has been modified significantly

by agricultural grading. The average elevation of the lake bed is approximately 175 and 192 feet NGVD. The northern portion of the County is typified by alluvial fan surfaces formed along the Kings and Tule rivers and Cross Creek. The alluvial fan surface slopes gently toward the Tulare Lake Bed.

The Kettleman Hills region, located in the southwestern portion of the County, forms a distinct geomorphic setting. The region of the County is characterized by northwest-southeast trending ridges (i.e., Kettleman Hills, Pyramid Hills, Keryenhagen Hills, and Avenal Ridge) and intervening valleys (i.e., Kettleman Plains and Sunflower Valley). The topography is developed on folded and faulted Pleistocene and Pliocene sedimentary rocks. The ridges rise to a maximum elevation of 3,473 feet NGVD at Table Mountain at the western boundary of Kings County. The slopes are moderately steep to steep.

County Soils

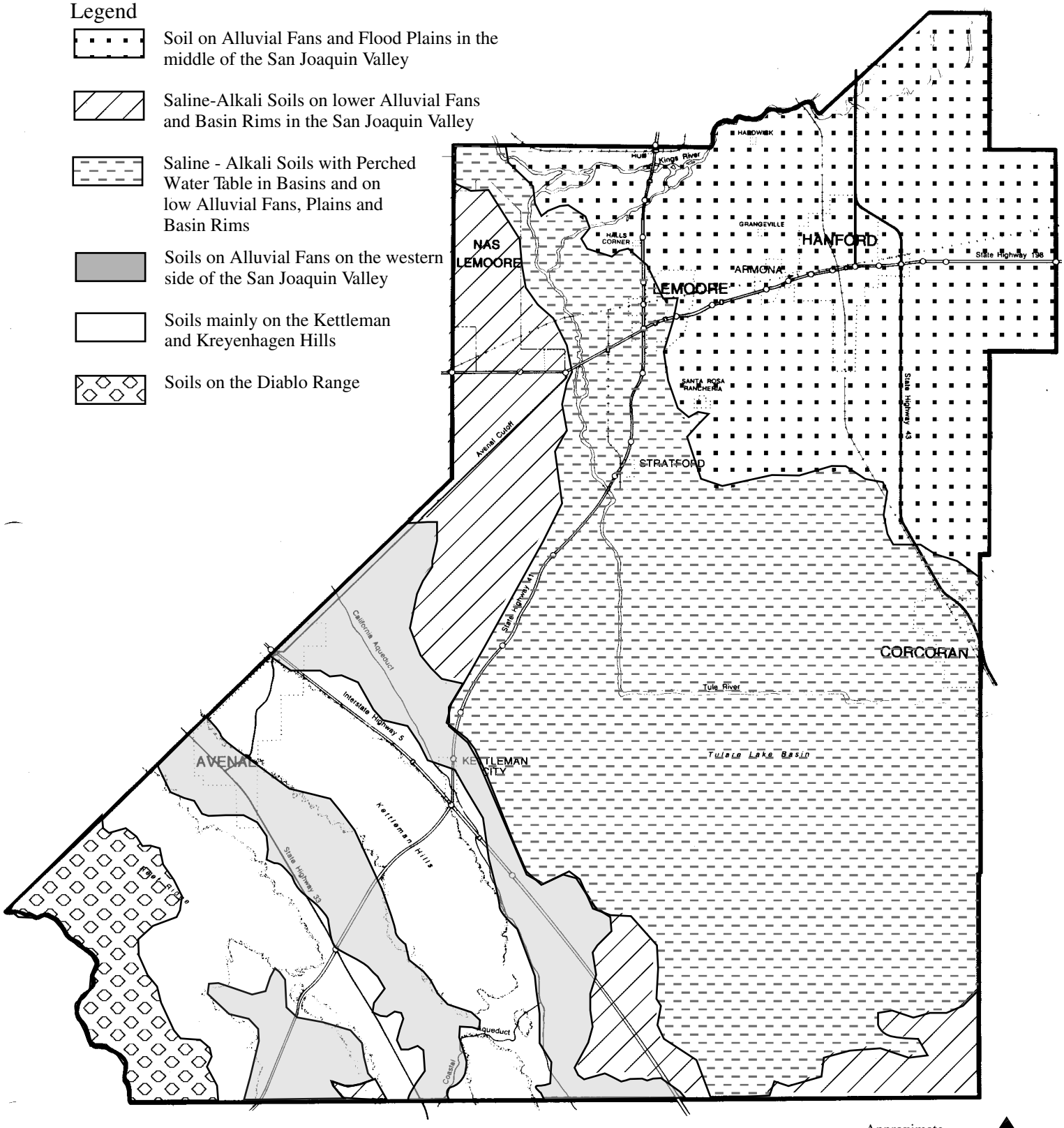
Soil is generally defined as the unconsolidated mixture of mineral grains and organic material that mantles the land surfaces of the earth. Soils can develop on unconsolidated sediments and weathered bedrock. The characteristics of soil reflect the five major influences on their development topography, climate, biological activity, parent (source) material, and time. The surface soils throughout Kings County have been mapped (Figure 4.1-2) by the U.S. Soil Conservation Service (USDA, 1986), an agency now known as the Natural Resource Conservation Service (NRCS). In general, there are six general types of soil (called associations) within the County. The soil associations are comprised of similar specific soil types (called mapping units), which have developed on similar geologic materials and topography.

Northeast Alluvial Fans

The alluvial fan surfaces in the northeastern portion of the County are mantled with very deep, well-drained, saline-alkali soils. These soils include three soil associations. The Nord association soils are located in the northeast corner of the County, in the higher portions of the Cross Creek alluvial fan. The Kimberlina-Garces association mantles the lower portions of this alluvial fan. The soils developed on the alluvial fan along the Kings River are mapped as Remnoy-Melga-Youd association. The soils of the Kimberlina-Garces and Remnoy-Melga-Youd associations are very deep, nearly level saline-alkali soils. The surface horizons are sandy loams and fine sandy loams. The Remnoy-Melga-Youd association soils have a prominent hardpan. The permeability is moderately slow to very slow. Runoff is usually very slow and the erosion potential is slight. The Nord soils are similar although typically less saline and alkaline.

GENERALIZED SOILS MAP

Figure 4.1-2



Source: USDA, 1986

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BASELINE

The agricultural Capability Class ranges from I to III and the predominant land use on these soils is primarily for row and field crop production. The soils of the Kimberlina-Garces and Remnoy-Melga-Youd associations are best suited for salt- and alkali-tolerant, drought-resistant crops. Generally, soils in this group present only slight restrictions to building site development.

Low Alluvial Fans and Basin Rim

The lower portions of alluvial fans that border the northeastern and southeastern margins of the Tulare Lake Basin are transitional in character relative to the upper portions of the alluvial fans and the lake basin. The Lethent, Lethent-Garces-Panoche, and Lethent-Excelsior soil associations are found in these areas. Soils of these associations typically have loam, clay loam, or sandy clay loam surface soils and clay, clay loam, or silt loam subsurface soils. Most of the horizons are alkaline and saline and have high corrosivity for steel and concrete. Some mapping units within this group of soils are calcareous. The permeability is moderate to very slow and runoff is slow or very slow.

The soils are used primarily for irrigated row and field crop production. The soils are best suited for salt- and alkali-tolerant, drought-resistant crops. Most of the soils are Capability Class I through III. The primary limitation, when present, is the droughty nature of these soils. Building site limitations are primarily high shrink-swell potential and high corrosivity.

Tulare Lake Basin and Basin Rim

The soils within and at the margins of the Tulare Lake Basin saline-alkali soils developed in areas of perched shallow groundwater. These soils characterize most of the central portion of the County. Three soil associations are represented, Gepford-Westcamp-Houser, Tulare, and Armona-Lakeside-Grangeville. These soils are very deeply developed on nearly flat alluvial deposits and are typically somewhat poorly drained to poorly drained. The nearly level topography results in slow runoff and negligible erosion potential. The surface horizon is typically fine-grained, ranging from fine sandy loam to clay. Subsurface horizons are also fine-grained. The permeability is slow to very slow and shrink-swell potential is high. The saline-alkali soils cause high corrosivity to concrete and steel.

The soils are used primarily for irrigated row and field crop production. The soils are best suited for salt- and alkali-tolerant, drought-resistant crops. Most of the soils are Capability Class III with the primary limitation being shallow groundwater.

Southwestern Valleys

The Kettleman Plain, Sunflower Valley, and the western margin of the Kettleman Hills contain some of the best quality agricultural soils in Kings County. Although the texture