5.8 Geology and Soils

This section discusses the geology of the project site and general vicinity, and analyzes issues related to geology and soils such as potential exposure of people and property to geologic hazards, landform alteration, and erosion. A Pavement Design and Evaluation Report was conducted by Wallace Kuhl & Associates, Inc. in March 2005. This section reflects the information provided in the report study regarding the potential for geology and soils impacts within the proposed project site or surrounding vicinity as a result of implementation of the proposed project. Water quality issues are addressed in Section 5.7 (Hydrology and Water Quality). This report is available for review at Elk Grove City Hall.

5.8.1. EXISTING SETTING

LOCAL GEOLOGY AND TOPOGRAPHY

Regional Setting

The majority of Sacramento County lies in the Great Valley geomorphic province. A "geomorphic province" is defined as an area with similar geologic origin and erosional/depositional history. The Great Valley province is further divided into four geomorphic subunits: the Delta, River Floodplain, Alluvial Floodplain, and Low Foothills. The geologic literature indicates that no major active faults transect the County, however, there are several subsurface faults in the Delta. The Great Valley province is a relatively flat alluvial plain comprised of deep sediment. The Klamath and Cascade mountain ranges, on the east by the Sierra Nevada Mountain, and on the west by the California Coast Mountain Range bound the Great Valley province on the north.

The deepest layer of rock underlying the Valley is Mesozoic intrusive igneous rock extending from the Sierra Nevada Mountain Range. Overlying the igneous rock is siltstone, claystone, and sandstone sedimentary rocks at least 10,000 feet thick. The upper 3,000 feet of soil consists of fluvial deposited sediments eroded from the mountains to the north and east. This layer is comprised of silty clay and sand deposits with layers of gravel.

Project Site

The proposed widening area along the eastbound lane of Elk Grove Boulevard contains telephone poles and underground utilities. This part of the roadway is raised above the surrounding grades within the western portion of the project site in order to cross over the Union Pacific Railroad track. The Franklin Boulevard widening area, in most locations, is approximately 2 to 8 feet below the existing road grade and appears to be at original ground surface. The soil types in the project area are shown on **Figure 5.8-1**.

Geologic Setting

The project area is located within the Great Valley geomorphic province of California. The geology of the Great Valley is typified by thick sequences of sedimentary deposits of Jurassic through Holocene age. The California Division of Mines of Geology (CDMG) and the United States Geologic Survey (USGS) have mapped a large portion of the site as being underlain by the lower member of the Quaternary-aged Riverbank formation. The Riverbank formation represents dissected alluvial fans and is generally composed of alluvial gravel, sand and silt derived from the western slopes of the Sierra Nevada Range.

Geological Structure

The Great Valley of California is generally considered to be an elongated sedimentary trough, approximately 450 miles long and 50 miles wide, which has been filled by a thick sequence of Jurassic to Holocene continental and marine sediments. The sediments have been folded into an asymmetric syncline, the axis of which lies immediately east of the interior Coast Ranges. The Great Valley province is further divided into four geomorphic subunits: the Delta, River Floodplain, Alluvial Floodplain, and Low Foothills.

Surface elevations within the Great Valley generally range from several feet below mean sea level (msl) to more than 1,000 feet above sea level. The major topographical feature in the Sacramento Valley is the Sutter Buttes (a volcanic remnant), which rises approximately 1,980 feet above the surrounding valley floor. The ground surface elevation in the vicinity of the project area, as shown on the USGS Topographic Map of the Florin Quadrangle, California (1980), ranges from approximately 30 to 40 feet above msl.

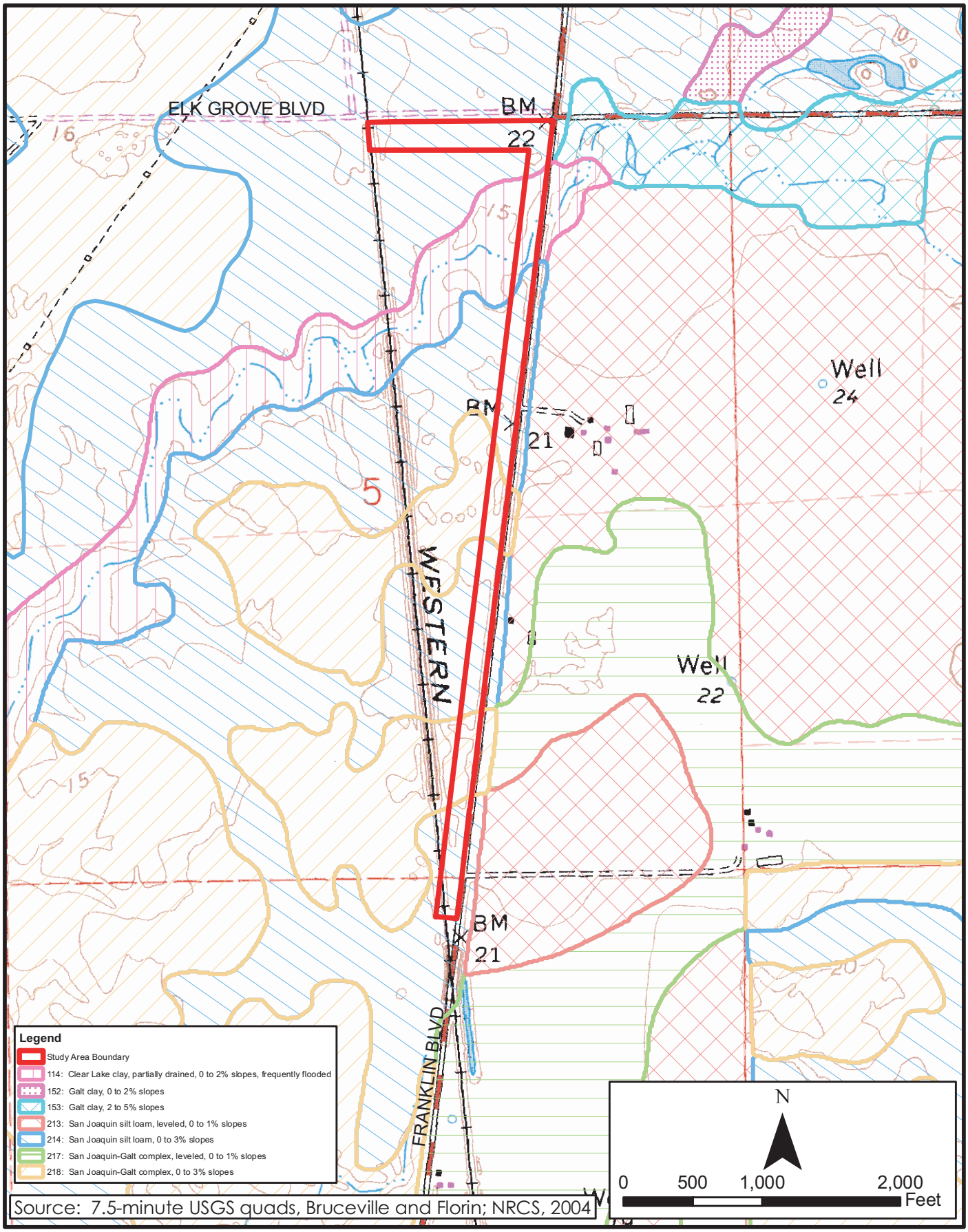
FAULTS AND SEISMICITY

Sacramento County is less affected by seismic events and other geologic hazards than other portions of the state. Nevertheless, some property damage has occurred in the past. The damage that was experienced has largely been the result of major seismic events occurring in adjacent areas, especially the San Francisco Bay area and, to a lesser extent, the foothills of the Sierra Nevada Mountain Range. The areas of Sacramento County most vulnerable to seismic and geologic hazards are those areas subject to liquefaction, to the action of expansive soils, to shaking, and to subsidence. The Central Valley, like most of California, is considered a seismically active region.

Local Seismic Activity

Earthquakes can cause strong ground shaking that may damage property and infrastructure. The severity of ground shaking at any particular point is referred to as intensity and is a subjective measure of the effects of ground shaking on people, structures, and earth materials. The intensity of shaking generally decreases with distance away from the source of an earthquake. The level of intensity is commonly defined by comparison to the Modified Mercalli Scale, as shown in **Table 5.8-1**, that subjectively categorizes the intensity on the basis of observed effects of seismic shaking on people and objects. Quantitative measurements of the level of ground motion during an earthquake are made by strong-motion seismographs that measure the acceleration of objects at the ground surface caused by seismic shaking. These measurements are made relative to, and are expressed as a fraction of, the acceleration of gravity.

Magnitude is related to the amount of seismic energy released at the hypocenter of the earthquake. It is based on the amplitude of the earthquake waves recorded on instruments, which have a common calibration. The magnitude or strength of earth movement associated with seismic activity is typically quantified using the Richter scale. This scale is a measure of the strength of an earthquake or strain energy released by it, as determined by seismographic observations. This is a logarithmic value originally defined by Charles Richter (1935). An increase of one unit of magnitude (for example, from 4.6 to 5.6) represents a 10-fold increase in wave amplitude on a seismogram or approximately a 30-fold increase in the energy released. In other words, a magnitude 6.7 earthquake releases over 900 times (30 times 30) the energy of a 4.7 earthquake.



City of Elk Grove
Development Services

Figure 5.8-1
Soils Map
Franklin Boulevard Widening Project

TABLE 5.8-1
MODIFIED MERCALLI INTENSITY SCALE FOR EARTHQUAKES

Richter Magnitude Scale	Modified Mercalli Scale	Effects of Intensity
0.1-0.9	I	Earthquake shaking not felt.
1.0-2.9	II	Shaking felt by those at rest.
3.0-3.9	III	Felt by most people indoors; some can estimate duration of shaking.
4.0-4.5	IV	Felt by most people indoors. Hanging objects rattle, wooden walls and frames creak.
4.6-4.9	V	Felt by everyone indoors; many estimate duration of shaking. Standing autos rock. Crockery clashes, dishes rattle, and glasses clink. Doors open, close and swing.
5.0-5.5	VI	Felt by all; most estimate duration of shaking. Sleepers awaken, liquids spill, objects displaced, weak materials crack.
5.6-6.4	VII	People frightened and walls unsteady. Pictures and books thrown, dishes/glass are broken. Weak chimneys break. Plaster, loose bricks and parapets fall.
6.5-6.9	VIII	Difficult to stand, waves on ponds, cohesionless soils slump. Stucco and masonry walls fall. Chimneys, stacks, towers and elevated tanks twist and fall.
7.0-7.4	IX	General fright as people are thrown down. Hard to drive, trees broken, damage to foundations and frames. Reservoirs damaged, underground pipelines broken.
7.5-7.9	X	General panic, ground cracks, masonry and frame buildings destroyed. Bridges destroyed, dams, dikes and embankments damaged or destroyed. Railroads bent slightly.
8.0-8.4	XI	Large landslides, water thrown, general destruction of buildings, pipelines destroyed, railroads bent.
8.5+	XII	Total nearby damage, rock masses displaced. Lines of sight/level distorted. Objects thrown into air.

Source: California Division of Mines and Geology

No known active faults or Alquist-Priolo earthquake hazard zones (formerly known as special study zones) occur in the project area, although several inactive subsurface faults are identified in the Delta. According to the *Fault Activity Map of California*, the nearest faults to the City with activity within the last 200 years are the Concord, Hayward, and Cleveland Hill faults. The closest known fault to the City of Elk Grove is the Willows fault zone, located approximately 10 miles north of the City. The *Safety Element of the County of Sacramento General Plan* (1993) identified two major subsurface fault zones on the eastern and western sides of the project area. The Midland Fault Zone is located west of the project area, while the Bear Mountain Fault Zone is located east of the project area. The closest known active subsurface fault is the Dunnigan Hills Fault, located northwest of the City of Elk Grove.

Surface Rupture

In major earthquakes, fault displacement can cause rupture along the surface trace of the fault, leading to severe damage to any structures, roads, and utilities located on the fault trace. Surface rupture generally occurs along an active fault trace, but occasionally displacement

along presumably inactive faults also occurs. No known active faults traverse the project site. Therefore, the risk of surface rupture at the project site is considered to be low.

Groundshaking

Groundshaking is motion that occurs as a result of energy released during faulting. The damage or collapse of buildings and other structures caused by groundshaking is among the most serious seismic hazards. The intensity of shaking and its potential impact on buildings is determined by the physical characteristics of the underlying soil and rock, the building materials and workmanship, the earthquake magnitude and location of epicenter, and the character and duration of ground motion. Much of Sacramento County is located on alluvium which increases the amplitude of the earthquake wave. Ground motion lasts longer and waves are amplified on loose, water-saturated materials as compared to solid rock. As a result, structures located on alluvium typically suffer greater damage than those located on solid rock.

The California Division of Mines and Geology map shows the eastern and central portions of Sacramento County, which includes the project site, in a relatively low intensity groundshaking zone. The intensities shown on the map would not impact modern earthquake-resistant construction.

Liquefaction

Liquefaction is the loss of soil strength due to seismic forces generating various types of ground failure. The potential for liquefaction must account for soil types and density, the groundwater table, and the duration and intensity of ground shaking.

Based upon known soil, groundwater, and ground shaking conditions within the project area, the potential for liquefaction beneath the project site is considered low. The potential for ground lurching, differential settlement, or lateral spreading occurring during or after seismic events in the project area is also considered to be low.

SOILS

According to the Sacramento County Soil Survey prepared by the United States Department of Agriculture (USDA), the project site soils are classified in the San Joaquin soils group. The San Joaquin soils group is a moderately deep, moderately well drained soil that occurs on low terraces and forms in alluvium derived from dominantly granitic rocks. The surface layer is typically strong brown silt loam that is about 23 inches thick, with sublayers of claypan then hardpan. Permeability is very slow in the San Joaquin soil causing water to perch above the claypan for short periods of time after heavy rainfall in winter and early spring and when the soil is over-irrigated. Specific soils types found onsite include:

- Bruella sandy loam – This is a very deep, well-drained soil found on intermediate terrace remnants. The surface layer is typically yellowish brown sandy loam about 18 inches thick.
- San Joaquin silt loam complex – This is a moderately deep, well-drained soil found on low terraces. The subsoil is claypan with a slow permeability.
- San Joaquin-Galt complex – This soil is moderately deep and moderately well drained. The subsoil is claypan with a slow permeability.

- Galt clay complex – This is a moderately well drained soil found on low terraces. The surface layer is typically grayish brown clay with a fine texture surface layer. Permeability is slow in the Galt soil.

5.8.2 REGULATORY FRAMEWORK

LOCAL

Grading Provisions

The City's Buildings and Construction Ordinance (Title 16 Chapter 16.44 of the City Code) establishes administrative procedures, minimum standards of review, and implementation and enforcement procedures for controlling erosion, sedimentation and other pollutant runoff, including construction debris and hazardous substances used on construction sites, and disruption of existing drainage and related environmental damage caused by land clearing, grubbing, grading, filing, and land excavation activities. The ordinance applies to projects that would disturb 350 cubic yards or more of soil. The intent of the ordinance is to minimize damage to surrounding properties and public rights-of-way, minimize degradation of water quality in water courses, minimize disruption of natural or City authorized drainage flows caused by construction activities, and make projects comply with the provisions of the City's National Pollutant Discharge Elimination System (NPDES) Permit Number, CA0082597, issued by the California Regional Water Quality Control Board. The City of Elk Grove is co-permittee on a NPDES Permit along with Sacramento County and the cities of Sacramento, Folsom, Galt, and Citrus Heights.

CITY OF ELK GROVE GENERAL PLAN

The City of Elk Grove General Plan contains goals, objectives, and policies relating to geology, soils, and seismicity, which are contained in the safety and conservation/air quality elements. **Table 5.8-2** identifies the applicable General Plan policies and summarizes the project's consistency with the General Plan. While this EIR analyzes the project's consistency with the General Plan pursuant to CEQA Section 15125(d), the Elk Grove City Council determines the project's consistency with the General Plan.

TABLE 5.8-2
PROJECT CONSISTENCY WITH GENERAL PLAN GEOLOGY, SOILS, AND SEISMICITY OBJECTIVES AND POLICIES

General Plan Policies	Consistency with General Plan	Analysis
Policy CAQ-5: Roads and structures shall be designed, built and landscaped so as to minimize erosion during and after construction.	Yes	The project would be subject to the City Buildings and Construction Ordinance, and the requirements of the Clean Water Act, which require the use of erosion control devises and Best Management Practices (BMPs) to minimize soil erosion.
Policy SA-25: The City supports efforts by Federal, State, and other local jurisdictions to investigate local seismic and geological hazards and support those programs that effectively mitigate these hazards.	Yes	There are no known seismic or geological hazards identified for the project site. The project would be subject to all building codes for the construction of roadways.
Policy SA-26:	Yes	The project would be subject to the City

General Plan Policies	Consistency with General Plan	Analysis
The City shall seek to ensure that new structures are protected from damage caused by geologic and/or soil conditions.		Buildings and Construction Ordinance, which would result in consistency with this policy.

5.8.3 IMPACTS AND MITIGATION MEASURES

STANDARDS OF SIGNIFICANCE

The impact analysis provided below is based on the following State CEQA Guidelines Appendix G thresholds of significance:

1) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault.

2) Strong seismic ground shaking.

3) Seismic-related ground failure, including liquefaction.

4) Landslides.

5) Result in substantial soil erosion or the loss of topsoil.

6) 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 off-site landslide, lateral spreading, subsidence, liquefaction or collapse.

7) Locating on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property.

8) Have soils incapable of adequately supporting the use of septic tanks or alternative waste ate disposal systems where sewers are not available for the disposal of wastewater.

METHODOLOGY

Evaluation of potential geologic and soil impacts of the proposed project was based on review of the USDA Soil Survey of Sacramento County, the Elk Grove City Code, Development Regulations, City of Elk Grove General Plan, City of Elk Grove General Plan EIR and field review of the project site and surrounding area. Based on the pavement and design evaluation (Wallace, Kuhl and Associates, 2005), fill soil will be required to achieve the soil subgrade elevation in much of the widening areas.

PROJECT IMPACTS AND MITIGATION MEASURES

Impact 5.8.1 Soil Erosion and Ground Stability

PP, AB, AC, AD Development of the project improvements could involve grading, the use of heavy machinery, and other earth movement. There is the potential for soil erosion due to excavation and grading activities. This would be a **less than significant** impact.

AA Under the No Project alternative, there would be **no impact** regarding soil erosion and ground stability because there would be no construction.

DISCUSSION

The proposed project would include widening an approximately 1,200 feet long stretch on the south side of Elk Grove Boulevard and an approximately 5,600 feet long stretch along Franklin Boulevard, including a free right turn lane on the southwestern corner of the intersection, and one or two bus turnouts along the west side of Franklin Boulevard. In order to accomplish these tasks, grading, cut, and fill would take place as part of the project construction. It is estimated that project construction would require approximately 7600 cubic yards of excavation, and 2,400 cubic yards of fill. These activities would occur primarily in unpaved areas adjacent to the existing roads. Project work will include filling an earthen roadside drainage ditch adjacent to the west side of the existing Franklin Boulevard.

The project is subject to the City Buildings and Construction (Title 16 Chapter 16.44 of the City Code) and the requirements of the Clean Water Act. Under the requirements of the Clean Water Act amendments of 1972, the project construction contractor would be required to file a Notice of Intent under the State's NPDES General Constriction Permit. The construction contractor would be required to adhere to conditions under the City's NPDES permit set forth by the Regional Water Quality Control Board (RWQCB), and also prepare and submit a Storm Water Pollution Prevention Plan (SWPPP) to be administered throughout all phases of grading and project construction. The SWPPP would incorporate Best Management Practices (BMPs) to ensure that potential water quality impacts during construction are minimized. Implementation of these measures as a part of the project would result in a less than significant impact regarding erosion and sedimentation.

Mitigation Measure

None Required.

Impact 5.8.2 Unstable and Expansive Soils

PP, AB, AC, AD Proposed pavement and utilities could incur significant damage as a result of underlying expansive or unstable soil properties. The project would be required to comply with all codes and standards relative to soils and foundation engineering. Therefore, this impact is considered **less than significant**.

AA Under the No Project alternative, there would be **no impact** regarding unstable and expansive soils because there would be no construction.

DISCUSSION

The project site is located on a relatively flat area with deep groundwater that is not subject to substantial seismic activity, and at which is at low risk of landslide, lateral spreading, subsidence, liquefaction or collapse. The construction of the project would not result in unstable earth conditions, significant changes to the geologic substructure, or substantially change the topography of the area. The project is not located on a geological unit or soil that is unstable. However, the project site contains soils with high clay content that have been identified as having a high shrink-swell potential.

The City anticipates that fill would be required to achieve the soil subgrade elevation in much of the widening areas. Imported fill materials for the widening phase may consist of clays similar to the native clays but shall be free of organic material, rubbish, rubble, and particles greater than four inches in largest dimension. According to the *Pavement Design and Evaluation Report, Franklin Boulevard Widening Project* by Wallace Kuhl & Associates, Inc., March 18, 2005, a portion of the existing Franklin Boulevard between Percheron and Noriker Drives has settled approximately 2 to 3 inches, most likely caused by utility trench backfll in this area. Removal of existing pavement and aggregate base, backfilling with new imported fill material, moisture conditioning, and recompaction would occur in this area, and in an area of Franklin Boulevard between the Laguna South Channel culvert and Elk Grove Boulevard, where resistance values calculated from core samples of the existing pavement subgrade collected by Wallace Kuhl indicate a structural deficiency. The slope along the south side of the Elk Grove Boulevard roadway ramp leading to the UPRR overcrossing would not require any major alterations or grading. The construction of the project would not result in unstable earth conditions, significant changes to the geologic substructure or substantially change the topography.

All roadway improvements completed as a part of the proposed project would be designed so that grades are constructed in such a way as to prevent water from collecting on or adjacent to pavements, thereby discouraging soil saturation adjacent to the roadbed. Therefore, the project would result in a less than significant impact regarding unstable and expansive soils.

Mitigation Measure

None required.

5.8.4 CUMULATIVE SETTING, IMPACTS, AND MITIGATION MEASURES

CUMULATIVE SETTING

Impacts associated with geology and soils generally are site-specific rather than cumulative in nature. Individual development projects would be subject to, at a minimum, uniform site development and construction standards relative to seismic and other geologic conditions that are prevalent in the region. Impacts regarding surficial deposits, namely erosion and sediment deposition, can be cumulative in nature within a watershed. The reader is referred to Section 5.7 (Hydrology and Water Quality) regarding cumulative water quality impacts from soil erosion.

CUMULATIVE IMPACTS AND MITIGATION MEASURES

Impact 5.8.3 Cumulative Unstable and Expansive Soils and Soil Erosion Impacts

PP, AB, AC, AD The proposed roadway improvements could incur significant damage as a result of underlying expansive or unstable soil properties. Individual projects must comply with city requirements for roadways. Therefore, cumulative geology and soils impacts are considered **less than significant**.

AA Under the No Project alternative, there would be **no impact** regarding cumulative unstable and expansive soils because there would be no construction.

DISCUSSION

Cumulative development impacts would be less than significant given known geologic considerations. In addition, development of each individual project site would have to be consistent with requirements of the City (Section 16.04.030) as they pertain to protection against known geologic hazards. Impacts regarding erosion and sediment deposition can be cumulative in nature if located in a watershed. Buildout of approved and planned uses in the City have the potential to impact water quality. However, with implementation of Best Management Practices required by the NPDES permit and City Land Grading and Erosion Control Ordinance for each development project, including the Franklin Boulevard Widening Project, cumulative erosion is not expected to exceed natural levels and significant cumulative impacts related to erosion would not occur. The proposed project is not anticipated to contribute to cumulative significant impacts related to geology and soils. Therefore, such impacts are considered less than significant.

Mitigation Measure

None required.

REFERENCES

City of Elk Grove, 2005. *City of Elk Grove General Plan, Safety Element.* Elk Grove, CA. Adopted November 2003; amended January 2005.

City of Elk Grove, 2003. *City of Elk Grove General Plan Draft Environmental Impact Report*. Elk Grove, CA. August 2003.

City of Elk Grove, 2002. City Code, Title 16 Buildings and Construction. *Elk Grove, CA. November 2002.*

U.S. Department of Agriculture, Soil Survey of Sacramento County, California. April, 1993

U.S. Geological Service, 2000. Soil Coverage Maps*, Elk Grove. 2000.*

Wallace, Kuhl and Associates, 2005. Pavement Design and Evaluation Franklin Boulevard Widening Project. March 2005.