4.6 GEOLOGY, SOILS, AND MINERAL RESOURCES

This chapter discusses geology, soils, and mineral resources in Vacaville and evaluates potential area-wide geologic hazards and regional seismic characteristics that are relevant to development in Vacaville. This chapter includes evaluations of the impacts resulting from the spatial location of development that would be allowed by the proposed General Plan and Energy and Conservation Action Strategy (ECAS) with regard to these potential hazards and resources, including liquefaction, ground shaking, ground rupture, and landslides. As noted in Chapter 3, Project Description, impacts are determined by comparing the proposed General Plan and ECAS to existing conditions, rather than to the existing General Plan. The following evaluation is based on a spatial analysis and evaluates the impacts associated with the location of new development. The following evaluation assesses, among other things, seismic hazards; while flooding hazards are discussed in Chapter 4.9, Hydrology and Water Quality.

A. Regulatory Framework

This section summarizes key State and local regulations that apply to the geology, soils, and mineral resources of Vacaville.

1. Federal and State Agencies

a. United States Geological Survey

The United States Geological Survey (USGS) is a federal agency focused on providing impartial and reliable earth and life science information.[1] In particular, USGS collects, monitors, and analyzes data on a wide variety of topics, including geology, soils, and related hazards (e.g. earthquakes). As part of its mission the USGS creates a range of maps including some which delineate areas of earthquake hazard, identify faults and fault activity, and describe areas where mineral resources are located.

b. California Department of Conservation

The California Department of Conservation is a State agency which provides services and information that promote environmental health, economic vitality, informed land use decisions and sound management of our state's natural resources.[2] Within the California Department of Conservation are four distinct departments: the Division of Land Resource Protection, the Cali-

[1] USGS, http://www.usgs.gov/aboutusgs/, accessed on August 31, 2012.

[2] California Department of Conservation, http://www.conservation.ca.gov/index/AboutUs/Pages/aboutUs_Vision_Mission.aspx, accessed on August 31, 2012.

fornia Geologic Survey, the Division of Oil, Gas, and Geothermal Resources, and the Office of Mine Reclamation. The California Geologic Survey's role is to provide scientific products and services about the state's geology, seismology and mineral resources that affect the health, safety, and business interests of the people of California.[3] One of the services the California Geologic Survey provides is Alquist-Priolo Earthquake Fault Zone maps, which are described more fully in below in Section A.2.a, Alquist-Priolo Earthquake Fault Zoning Act.

2. State Laws and Regulations

State laws and regulations pertaining to geology, soils, and mineral resources are discussed in this section.

a. Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act was passed by the California Legislature in 1972 to mitigate the hazard of surface faulting to structures. The Act's main purpose is to prevent the construction of buildings used for human occupancy on the surface trace of active faults. The Act addresses only the hazard of surface fault rupture and is not directed toward other earthquake hazards. According to the Act, local agencies must regulate most development in fault zones established by the State Geologist. Before a project can be permitted in a designated Alquist-Priolo Earthquake Fault Zone, the city or county with jurisdiction must require a geologic investigation to demonstrate that proposed buildings would not be constructed across active faults.

b. California Seismic Hazards Mapping Act

The California Seismic Hazards Mapping Act of 1990 (California Public Resources Code Sections 2690 through 2699.6) addresses seismic hazards other than surface fault rupture, such as liquefaction and seismically-induced landslides. The Seismic Hazards Mapping Act specifies that the Lead Agency for a project may withhold development permits until geologic or soils investigations are conducted for specific sites and mitigation measures are incorporated into project plans to reduce hazards associated with seismicity and unstable soils.

c. California Building Code, 2010

The California Code of Regulations (CCR), Title 24, is also known as the California Building Standards Code. The California Building Standards Code combines three types of building standards from three different origins:

[3] California Department of Conservation California Geological Survey, http://www.conservation.ca.gov/cgs/Pages/Index.aspx, accessed on August 31, 2012.

- Building standards that have been adopted by State agencies without change from building standards contained in the International Building Code.
- Building standards that have been adopted and adapted from the national model code standards to meet California conditions.
- Building standards, authorized by the California legislature, that constitute extensive additions not covered by the model codes that have been adopted to address particular California concerns.

Part 2 of Title 24 is the California Building Code (CBC). Title 24 is published in its entirety every three years by order of the California Legislature, and Title 24 building regulations and standards have the force of law. The 2010 CBC incorporates, by adoption, the 2009 International Building Code of the International Code Council, with California amendments. In turn, Division 14.20 of Vacaville's Land Use and Development Code adopts the 2010 CBC as the building code for the city. The CBC requires strict building standards for essential facilities and structures on soft soil where shaking intensity from a potential earthquake is high.

d. Surface Mining and Reclamation Act

The California Surface Mining and Reclamation Act of 1975 (SMARA) was enacted in response to land use conflicts between urban growth and essential mineral production. SMARA requires the State Geologist to classify land according to the presence or absence of significant mineral deposits. Local governments must consider this information before land with important mineral deposits is committed to land uses incompatible with mining.

SMARA provides for the evaluation of an area's mineral resources using a system of Mineral Resource Zone (MRZ) classifications that reflect the known or inferred presence and significance of a given mineral resource.

- **MRZ-1.** Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.
- **MRZ-2.** Areas where adequate information indicates that significant mineral deposits are present, or where it is judged that a high likelihood for their presence exists.
- **MRZ-3.** Areas containing mineral deposits, the significance of which cannot be evaluated from available data.
- **MRZ-4.** Areas where available information is inadequate for assignment into any other MRZ.

3. Vacaville Land Use and Development Code

There are several references to geology and soils in the City of Vacaville's Land Use and Development Code. Standards for public improvements required of developers are set forth in Section 14.12.176. Section 14.26.030 adopts the Stormwater Management Plan's Best Management Practices, including erosion control measures. Additionally, Section 14.26.030 grants the Public Works Director the authority to require monitoring and analysis reports of any person engaged in an activity or owning or operating a facility which, in some way, may contribute to stormwater pollution (e.g. resulting from erosion or loss of topsoil). Chapter 14.19 is the Vacaville Grading Ordinance, which regulates grading and earthmoving in the city, and there are standards establishing appropriate grading methods and requiring erosion control measures in Section 14.19.244. Finally, the Code also stipulates in Section 14.11.152.010 that preliminary geologic and seismic safety reports must be submitted with a tentative map, if a project area is within a geologic or seismic hazard area or in a hillside area.

B. Existing Conditions

This section discusses the existing conditions pertaining to geology, soils, and mineral resources in Vacaville.

1. Regional Seismicity

Vacaville is vulnerable to seismic activity with several prehistoric earthquake faults in the area. Vacaville experienced a magnitude 6.4 earthquake on April 19, 1891, which caused structural damage in Vacaville and surrounding towns.[4] The source of the earthquake is unknown, but it is likely that it originated from an unrecognized or concealed fault in the area.[5]

The Vaca fault zone runs through the EIR Study Area and contains several northwest-southeast trending faults running along the base of the Coast Ranges, including the Vaca-Kirby Hills Fault and unnamed faults, as shown in Figure 4.6-1. The US Geological Survey (USGS) indicates that these faults that run through the EIR Study Area have not been active in the past 11,700 years, but fault displacement has been recorded within the past 700,000 years.[6] The Green Valley Fault system, which lies 12 miles southwest of Vacaville, has been active within the past 200 years. While more likely than the Vaca-Kirby Hills Fault to have seismic impacts on Vacaville, the USGS estimates the probability of a magnitude 6.7 or greater earthquake along this fault prior to 2036 to be only 3 percent. The Cordelia fault lies to the east of the Green Valley fault and is

[4] USGS Earthquake Hazards Program, http://earthquake.usgs.gov/earth quakes/states/events/1892_04_19.php, accessed on December 28, 2011.

[5] Bennett, John H., April 1987, "Vacaville-Winters Earthquakes…1892," *California Geology*, 40(4): pages 75 to 83.

[6] USGS 2010 Fault Activity Map of California, http://www.quake.ca.gov/ gmaps/FAM/faultactivitymap.html, accessed on February 2, 2012.

often assumed to be part of the Green Valley fault system, although the lower slip rate of the Cordelia fault indicates that it may be seismically independent.[7] The Rodgers Creek Fault, part of the Hayward Fault System, lies roughly 24 miles west of Vacaville and has an estimated 16 percent probability of producing a magnitude 6.7 or greater earthquake prior to 2036.[8]

Because the faults within the EIR Study Area are not active, there are no Alquist-Priolo Earthquake Fault Zones within the Study Area, although there are several in western Solano County. Regionally, the Green Valley and Cordelia Faults southwest of Vacaville near Fairfield are active and therefore have Earthquake Fault Zones.[9]

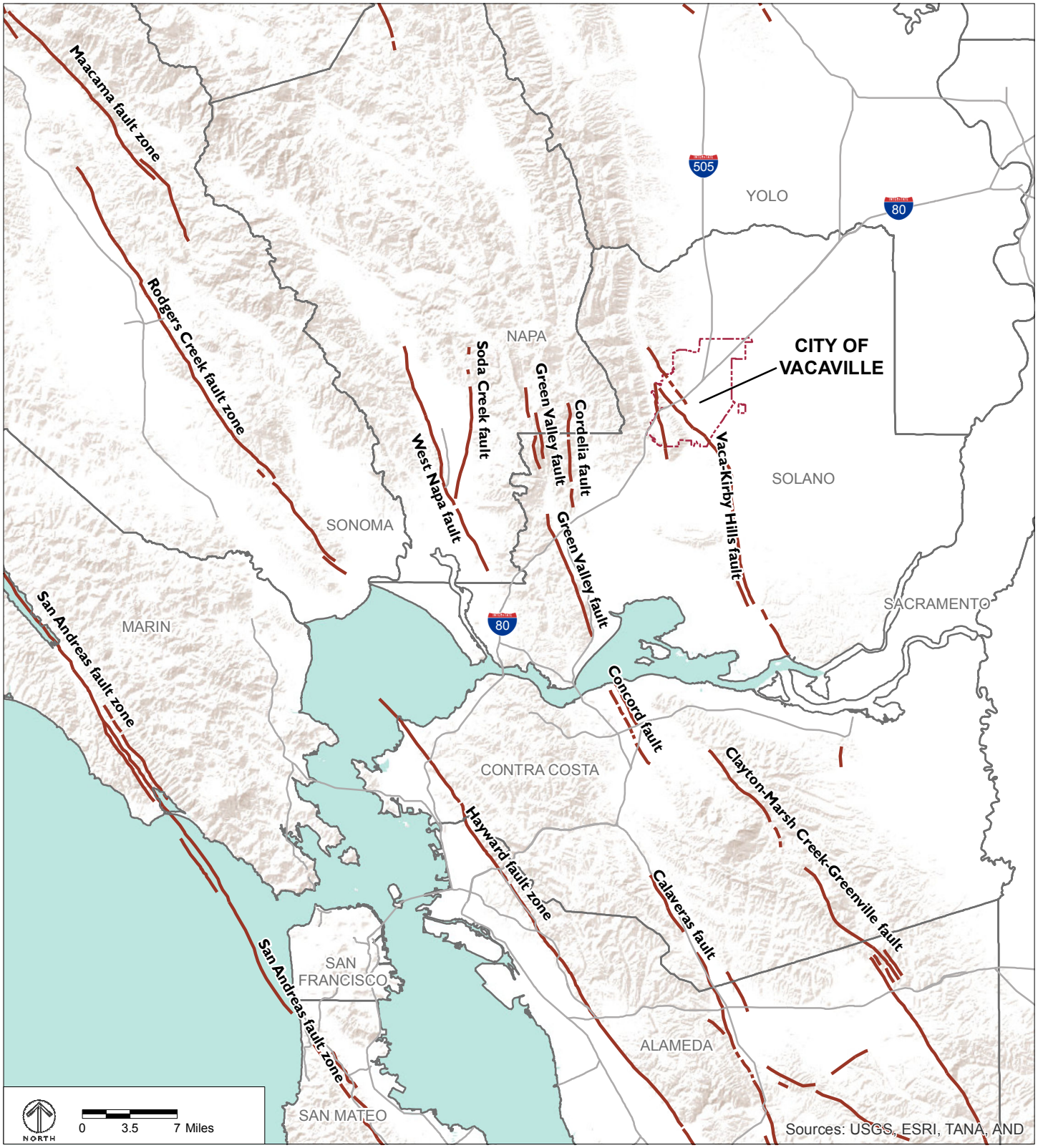
Ground shaking from an earthquake has the potential to produce various types of ground failure, including liquefaction, settlement, lateral spreading, lurch cracking, and earthquake-induced landslides. Liquefaction and landslides are discussed in Sections B.3, Liquefaction, and B.4, Landslides, respectively. The other three phenomena are described in greater detail as follows:

- Settlement, also known as subsidence, refers to the compaction of soils and alluvium as a result of ground shaking. Compaction typically occurs in places that are underlain by soft water-saturated, low-density alluvial material. Subsidence can also occur where water or natural gas is extracted.
- Lurch cracking refers to fractures, cracks, and fissures stemming from ground shaking, settling, compaction of soil, and sliding. Lurch cracking may occur many miles from an earthquake's epicenter. The potential for lurch cracking is greatest in areas where the water table is high.
- Lateral spreading is the horizontal movement or spreading of soil toward a stream bank, the open side of a fill embankment, the side of a levee, or another open face. Areas most likely to be affected are artificial fill areas that were not properly engineered or that have steep and unstable embankments.

[7] U.C. Berkeley Seismic Guidelines, 2003. Appendix I, available online at http://www.cp.berkeley.edu/BAMPFA/RFQ_12259A/UCBgromo_AppI_PSHA.pdf, accessed on June 26, 2012.

[8] USGS, 2008 Earthquake Probabilities, http://earthquake.usgs.gov/regional /nca/ucerf/, accessed on February 2, 2012

[9] California Department of Conservation, Alquist-Priolo Earthquake Fault Zone Maps, http://www.quake.ca.gov/gmaps/ap/ap_maps.htm, accessed on December 28, 2011.



Source: Solano County, 2008, U.S. and Califonia Geological Surveys and City of Vacaville, 2010.

Faults
Study Area
County Boundaries

FIGURE 4.6-1
REGIONAL FAULTS

2. Geology and Soils

Geologic subunits in Solano County include Quaternary surficial deposits, early Pleistocene and older rocks, and the Franciscan Complex.[10] As shown in Figure 4.6-2, the following geological units are present in the EIR Study Area:

- Paleocene to Oligocene (mudstone and sandstone)
- Paleocene (sandstone and mudstone)
- Late Cretaceous (sandstone and mudstone)
- Pliocene to Holocene (alluvium and terrace)
- Milcene to Pliocene (sandstone and conglomerate)

Certain types of soils have characteristics that make them more susceptible to geotechnical hazards, such as erosion and expansion. Soils subject to expansion increase when water is added and shrink when water dries out. The Solano County Safety Element map classifies most of Solano County as having soils with a high shrink-swell potential, which would indicate that expansive soils could be present.[11] Soils in the EIR Study Area are shown in Figure 4.6-3. The primary soil types in the Vacaville area are silty, sandy, and clay loams, with a smaller portion being made up of purely clay soils. Though not all types of clay are expansive, soils with a clay component are more prone to expansion. Approximately 64 percent of Vacaville's soils contain at least some clay component.

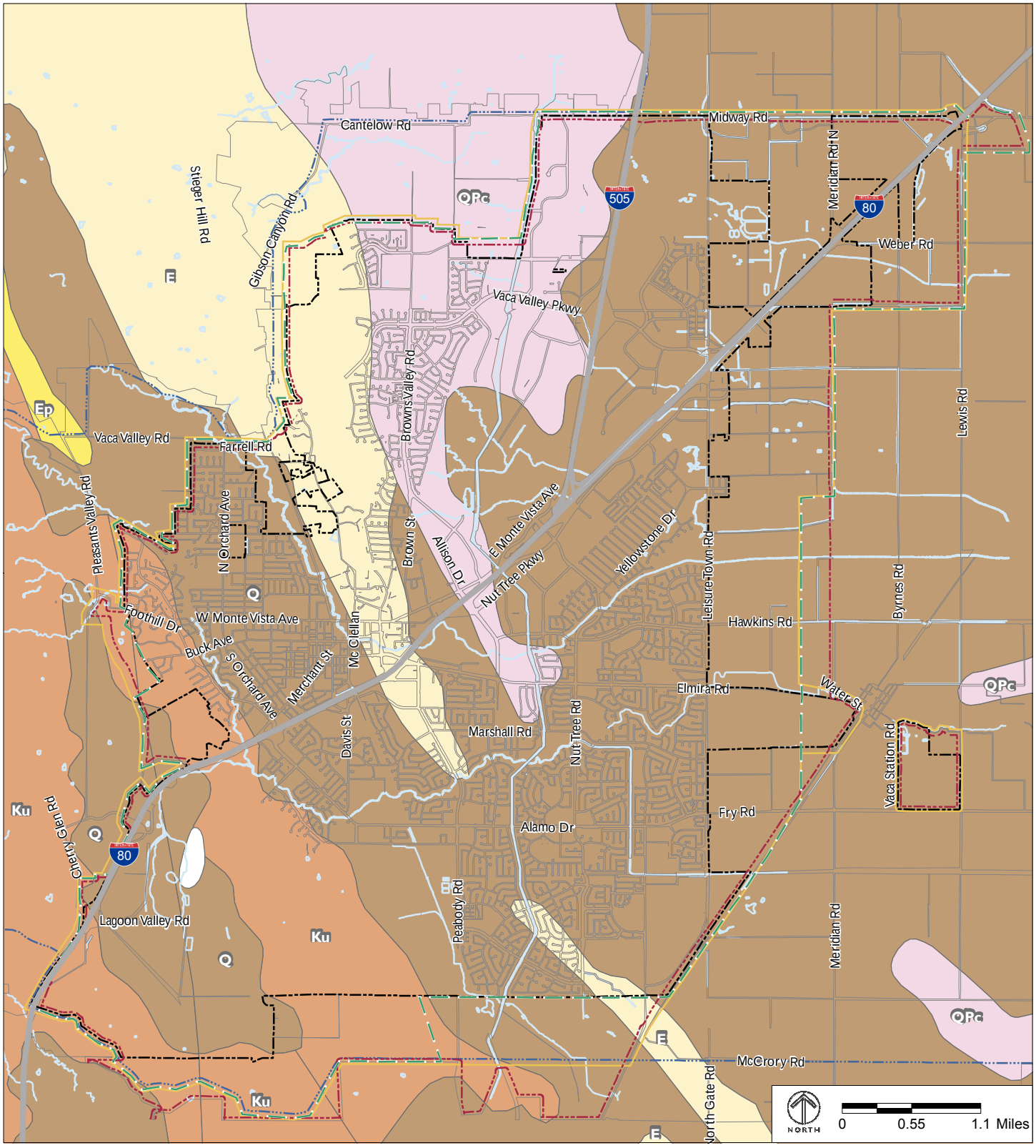
Please see Chapter 4.15, Utilities and Service Systems, for a description of existing topography and soils as they pertain to Vacaville's drainage characteristics.

3. Liquefaction

Liquefaction refers to the loss of soil strength resulting from shaking of water-saturated, granular soils. This weakening of the soil can make the soil act like quicksand.

As shown in Figure 4.6-4, Vacaville is generally characterized by areas of very low, low, and moderate risk of liquefaction. However, areas along and adjacent to Vacaville's major water ways, Ulatis and Alamo Creeks, feature high and very high levels of liquefaction susceptibility. These creeks and the associated areas of increased liquefaction susceptibility cross through the community, and include central areas of the city.

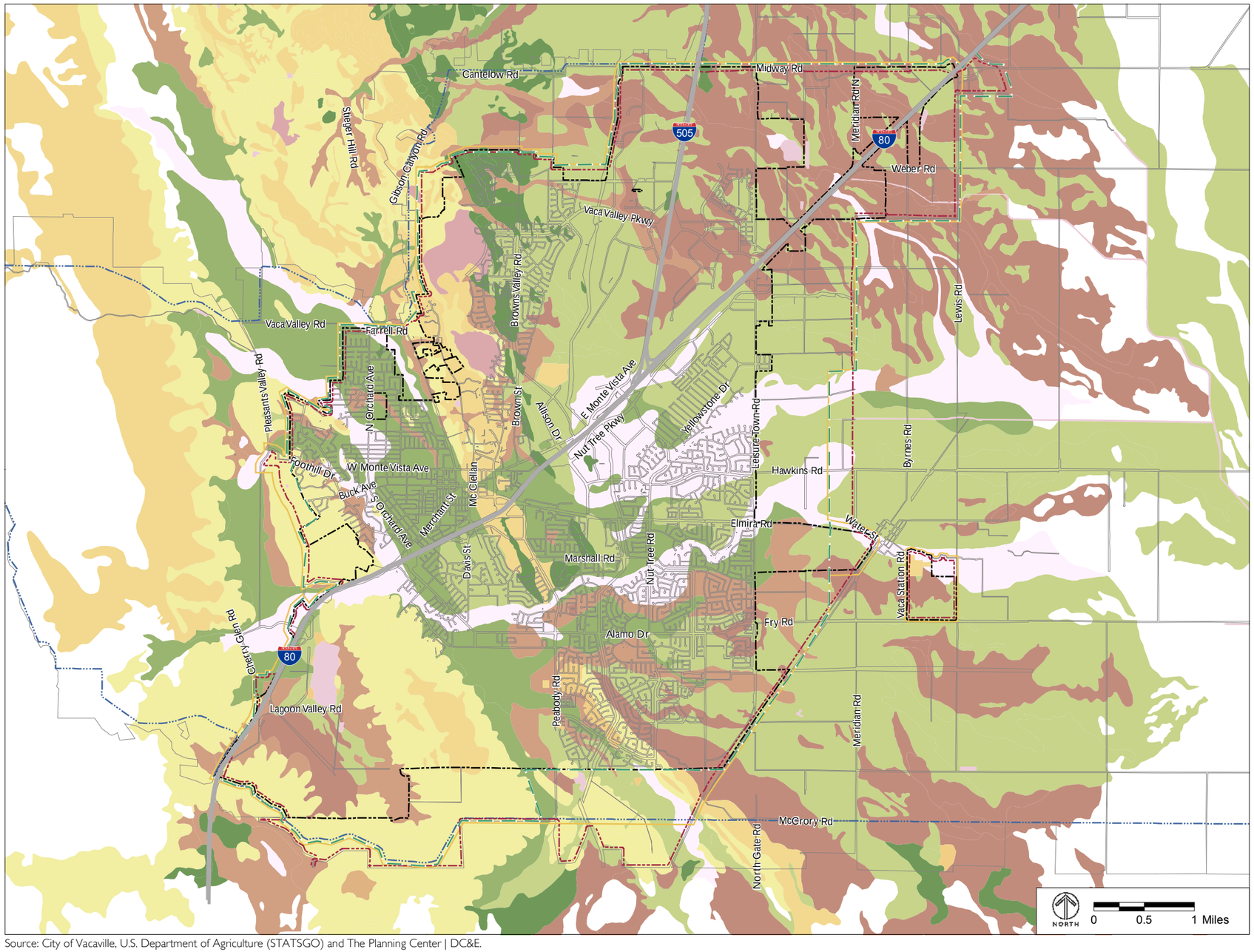
[10] Solano County, 2008. *Solano County 2008 Draft General Plan Draft Environmental Impact Report*, page 4.7-1.
[11] Solano County, 2008. *Solano County Safety Element*, Figure HS-7, page HS-31.



Source: NAIP 2009, City of Vacaville, U.S. and Califonia Geological Surveys and The Planning Center | DC&E.

- E - Paleocene to Oligocene
- Ep - Paleocene
- Ku - Late Cretaceous
- Q - Pliocene to Holocene
- QPc - Miocene to Pliocene
- City Limits
- Study Area
- Urban Growth Boundary
- Planned Sphere of Influence
- Planning Area

FIGURE 4.6-2
SOLID GEOLOGY



Source: City of Vacaville, U.S. Department of Agriculture (STATSGO) and The Planning Center | DC&E.

Soils

AcC, Altamont clay, 2 to 9 percent slopes
AcE, Altamont clay, 9 to 30 percent slopes
AcF2, Altamont clay, 30 to 50 percent slopes eroded
AoA, Antioch-San Ysidro complex, 0 to 2 percent slopes
AsA, Antioch-San Ysidro complex, thick surface, 0 to 2 percent slopes

BP, Borrow pit
BrA, Brentwood clay loam, 0 to 2 percent slopes
BrC, Brentwood clay loam, 2 to 9 percent slopes

Ca, Capay silty clay loam
Cc, Capay clay
CeA, Clear Lake clay, 0 to 2 percent slopes
CeB, Clear Lake clay, 2 to 5 percent slopes
CvD2, Corning gravelly loam, 2 to 15 percent slopes, eroded
CvE2, Corning gravelly loam, 15 to 30 percent slopes, eroded

DaC, Diablo-Ayar clays, 2 to 9 percent slopes
DaE2, Diablo-Ayar clays, 9 to 30 percent slopes, eroded
DbC, Dibble-Los Osos loams, 2 to 9 percent slopes
DbE, Dibble-Los Osos loams, 9 to 30 percent slopes
DbF2, Dibble-Los Osos loams, 30 to 50 percent slopes

GaG2, Gaviota sandy loam, 30 to 75 percent slopes, eroded

M-W, Miscellaneous water
MkA, Millsap sandy loam, 0 to 2 percent slopes
MmE, Millsholm loam, 15 to 30 percent slopes
MmG2, Millsholm loam, 30 to 75 percent slopes, eroded
MnC, Millsholm loam, moderately deep variant, 2 to 9 percent slopes
MnE, Millsholm

Pc, Pescadero clay loam

QU, Quarry

Ra, Reiff fine sandy loam; RnC, Rincon loam, 2 to 9 percent slopes
RoA, Rincon clay loam, 0 to 2 percent slope
RoC, Rincon clay loam, 2 to 9 percent slopes
Rw, Riverwash

SeA, San Ysidro sandy loam, 0 to 2 percent slopes
SeB, San Ysidro sandy loam, 2 to 5 percent slopes
SfA, San Ysidro sandy loam, thick surface , 0 to 2 percent slopes
Sh, Solano loam

TrE, Trimmer loam, 9 to 30 percent slopes
TsF2, Trimmer cobbly clay loam, shallow variant , 15 to 50 p ercent slopes , eroded

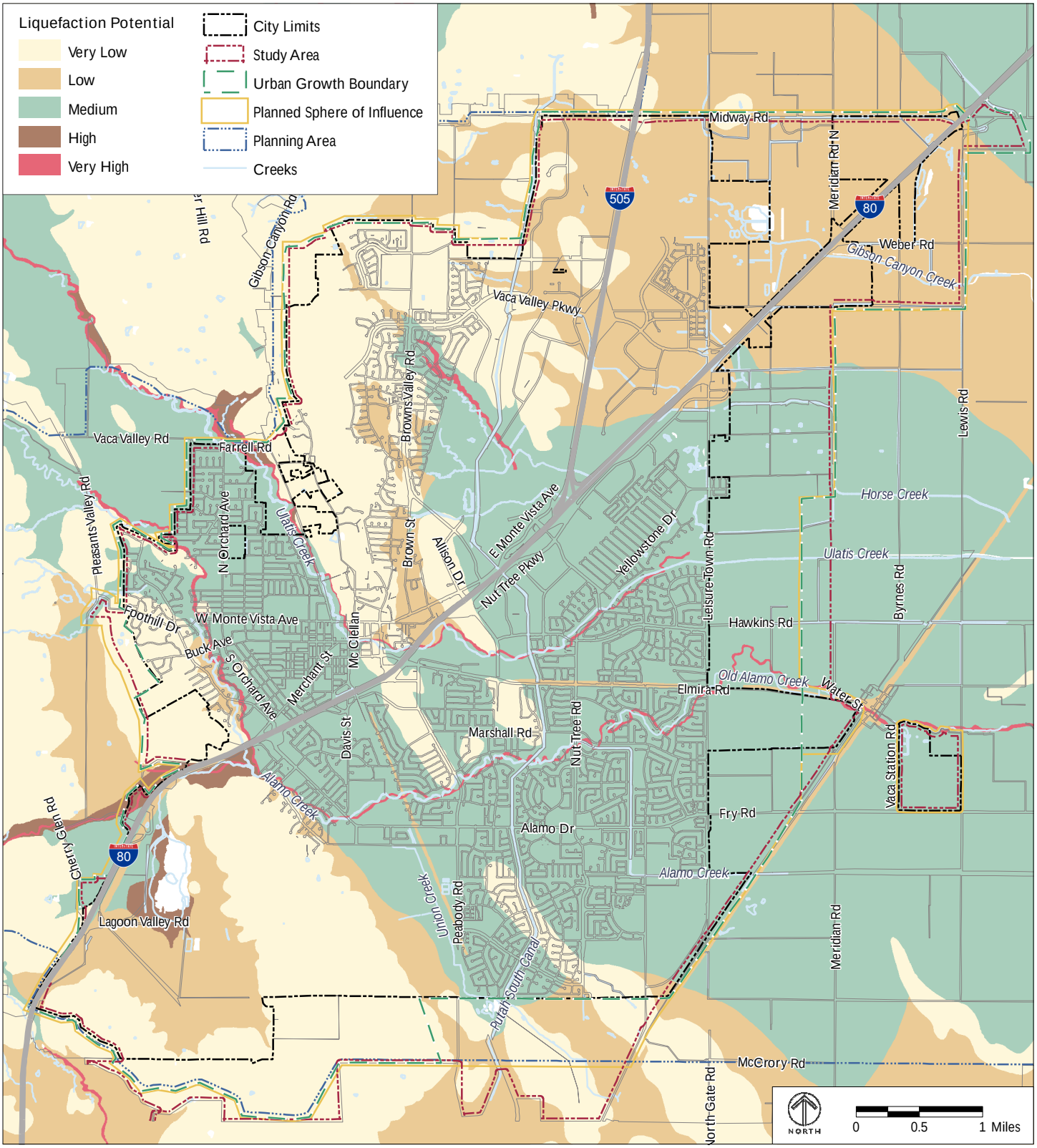
W, Water

Yo, Yolo loam
Yr, Yolo loam, clay substratum
Ys, Yolo silty clay loam

Boundaries

Study Area
Urban Growth Boundary
Planned Sphere of Influence
Planning Area
City Limits

FIGURE 4.6-3
SOILS



Source: Solano County, 2008, U.S. and Califonia Geological Surveys and City of Vacaville, 2010.

FIGURE 4.6-4
LIQUEFACTION POTENTIAL

4. Landslides

Landslides and slope instability are characterized by the movement of soils and surficial deposits and bedrock down steep slopes. This movement results from wet weather, adverse structures, seismic shaking, and/or improper grading and drainage. Other factors include steep slopes where extensive grading or vegetation removal has occurred and weak or shallow soils. Because Vacaville includes portions of the foothills of the Vaca Mountains, there is a potential for landslides throughout the western portions of Vacaville.

Figure 4.6-5 shows mapped landslides in Vacaville. The vast majority of the EIR Study Area is flatland with some sloped areas having had small scattered landslides. Very small areas on the northern and western edges of the city limit have had mapped landslides; however, these areas are sparsely developed.

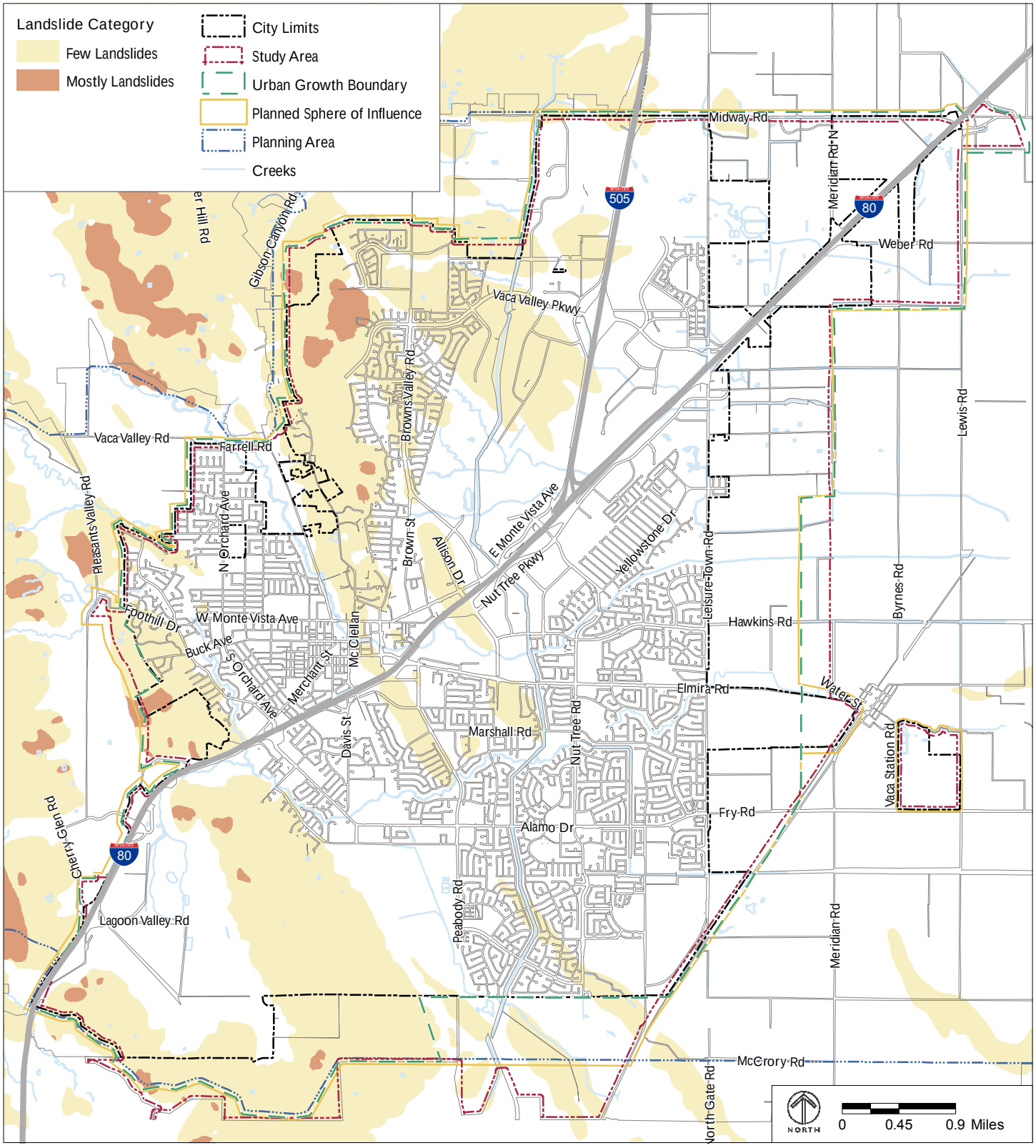
5. Mineral Resources

According to the USGS, the EIR Study Area contains limited mineral resources that are being extracted. Near the southern boundary of the EIR Study Area, in the vicinity of Cement Hill (which is located in unincorporated Solano County), limestone deposits show evidence of some historic use. Stone quarries in the Vaca Mountains produced dimensioned and ornamental stone. Although the western hills contain sandstone and conglomerates that may be used for sands, gravel, and stone, none of these resources are currently being mined. There are no MRZ-2 zones mapped in the EIR Study Area, but there are some MRZ-3 zones.

C. Standards of Significance

Implementation of the proposed General Plan and ECAS would have a significant impact related to geology, soils, and mineral resources if they would:

- ♦ 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.
  - Strong seismic ground shaking.
  - Seismic-related ground failure, including liquefaction.
  - Landslides.



Source: Solano County, 2008, U.S. and Califonia Geological Surveys and City of Vacaville, 2010.

*Few Landslides consists of few, if any, large mapped landslides, but locally contains scattered small landslides in questionably identified larger landslides.

**Mostly Landslides consists of mapped landslides with intervening areas typically narrower than 1500 feet and narrow borders around landslides.

FIGURE 4.6-5

HISTORIC MAPPED LANDSLIDES

- Result in substantial soil erosion or the loss of topsoil.
- 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.
- Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code, creating substantial risks to life or property.
- Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water.
- 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, or of a locally-important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan.

D. Impact Discussion

This section discusses potential impacts of the proposed General Plan related to geology, soils, and mineral resources. The measures in the proposed ECAS do not affect seismic risks, soils, or mineral resources; therefore, implementation of the proposed ECAS would have no negative geology, soils, or mineral resource impacts and is not discussed further in this section.

1. Project Impacts

The discussion of potential project impacts is organized by and responds to each of the potential impacts identified in the Standards of Significance.

a. 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.

Although the Vaca fault zone contains several faults, the USGS indicates that none of the faults have been active in the past 11,700 years.[12] Therefore, none of the faults mapped within the EIR Study Area are active or potentially active – defined as having recorded earth movement or displacement within the last 10,000 years. In addition, the California Geological Survey does not include Vacaville on its list of cities that are affected by Alquist-Priolo Fault Zones.[13] Neverthe-

[12] USGS 2010 Fault Activity Map of California, http://www.quake.ca.gov/ gmaps/FAM/faultactivitymap.html, accessed on February 2, 2012.

[13] California Department of Conservation, 1999. Cities and Counties Affected by Alquist-Priolo Earthquake Fault Zones as of January 2010, http://www.quake.ca.gov/gmaps/ap/ap_maps.htm, accessed on March 17, 2012.

less, due to the sheer number of faults in the region, the possibility of a rupture in the future exists. The City generally understands this risk and includes appropriate response measures in the proposed General Plan. The Safety Element of the proposed General Plan includes the following policies and actions to minimize risks associated with fault rupture:

- Policy SAF-P1.1 directs the City to consider geologic conditions when designating land use and designing development in Vacaville, and where potential geologic or seismic risks are high and unmitigable, retain low-occupancy or open space forms of use.
- Policy SAF-P1.5 requires geotechnical studies prior to approving rezoning requests, specific plans, or subdivision maps in areas that have experienced landslides in the past or that are within one quarter mile of a fault.
- Policy SAF-P1.7 requires comprehensive geologic and engineering studies of critical structures such as hospitals, fire and police stations, utility centers and substations, emergency communications facilities, overpasses, and bridges, regardless of location.
- Policy SAF-P1.8 directs the City to avoid locating structures intended for human occupancy over the trace of an inactive fault to the extent practical, and to only allow roads to be built over active faults where alternatives are impractical.
- Policy SAF-P1.9 prohibits facilities and structures that are public, high-occupancy, or critical in disaster situations (e.g. hospitals, fire and police stations, and bridges) from being sited in areas highly susceptible to damage resulting from earthquakes, to the extent practical. If locating such a facility or structure in a high-risk area is deemed essential to the public welfare, this policy requires that they be sited, designed, and constructed with due consideration of the potential for damage.
- Policy SAF-P1.13 requires the formation of geological hazard abatement districts or other methods to reduce potential exposure to geologic hazards prior to development approval in a high risk area.
- Action SAF-A1.1 directs the City to consider implementing a hazard reduction program for existing development in high-risk zones. This would include inspection of structures for conformance with the Building Code and could give priority for inspection to emergency and critical facilities, older structures, and public facilities.

In addition, new development in Vacaville is required to comply with the California Building Code (CBC), which contains criteria and standards that are designed to reduce ground rupture risks to acceptable levels.

Through the implementation of the policies and actions discussed above, along with compliance with the CBC, the City would mitigate the risks associated with fault rupture, and the impact would be *less than significant*.

b. Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving strong seismic ground shaking.

An earthquake of moderate to high magnitude generated within Solano County or the surrounding region could cause considerable ground shaking in the Vacaville area. The effects of earthquake-related ground shaking could include possible damage to structures, changes in groundwater levels, and damage to streets and utilities.

New structures must be designed to meet the 2010 CBC requirements at a minimum, taking into consideration the proposed use of the structures to be built. Based on these requirements, structures should be able to: (1) resist minor earthquakes without damage, (2) resist moderate earthquakes without structural damage but with some nonstructural damage, and (3) resist major earthquakes without collapse but with some structural as well as nonstructural damage. In addition, implementation of the proposed General Plan policies and actions described in Section D.1.a of the Impact Discussion would reduce the effect of ground shaking on development in the city. In particular, Policies SAF-P1.5, SAF-P1.6 and SAF-P1.7 require geotechnical studies for projects to determine geologic suitability. As a result of CBC requirements and the aforementioned policies, the impacts of ground shaking are considered *less than significant*.

c. Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving seismic-related ground failure, including liquefaction.

Vacaville is generally characterized by areas of very low, low, and moderate risk of liquefaction, although areas along and adjacent to Ulatis and Alamo Creeks feature high and very high levels of liquefaction susceptibility. These creeks and the associated areas of increased liquefaction susceptibility include central areas of the city.

As described in Sections D.1.a and D.1.b of the Impact Discussion, the Safety Element of the proposed General Plan includes policies to reduce risks associated with seismic activity, including fault rupture and ground shaking. Implementation of these policies would also reduce risks associated with ground failure and liquefaction during ground shaking. In addition, the proposed General Plan includes the following policies that further address seismic hazards such as liquefaction:

- Policy SAF-P1.3 directs the City to evaluate and consider the geologic and soil hazards for any proposed extension of urban or suburban land uses into areas that are characterized by slopes from 15 to 25 percent, as shown on Figure SAF-4 of the General Plan.

- Policy SAF-P1.4 directs the City to determine the geologic suitability of proposed development sites during the earliest stages of the planning process through analysis of the potential structural engineering needs of the project and the impacts development activities may have on adjacent lands.
- Policy SAF-P1.6 requires preparation of a soils report prior to issuing a building permit, except where the Building Official determines that a report is not needed.

In addition, new development in Vacaville is required to comply with the CBC, which contains seismic building criteria and standards that are designed to reduce liquefaction risks to acceptable levels.

The policies listed above would require that geological stability be considered when reviewing development allowed by the proposed General Plan. With the implementation of these policies and the policies described in Sections D.1.a and D.1.b of the Impact Discussion, along with compliance with the CBC, the impact from ground failure and liquefaction would be *less than significant*.

d. Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving landslides.

As shown in Figure 4.6-5, most of the EIR Study Area has not experienced landslides in the past, with the exception of some areas in the western and northern areas of Vacaville. As previously described, the Safety Element of the proposed General Plan includes policies intended to reduce risks associated with seismic and geological hazards. The proposed General Plan also includes the following policies to address the potential for landslides:

- Policy SAF-P1.2 prohibits development on ridges and slopes at or exceeding 25 percent.
- Policy SAF-P1.10 limits cut slopes to 2:1 (50 percent slope) except where an engineering geologist can establish that a steeper slope would perform satisfactorily over the long term. Where practicable, this policy requires more gentle slopes than the 2:1 standard. It also encourages use of retaining walls, rock-filled crib walls, or stepped-in buildings as alternatives to high cut slopes.
- Policy SAF-P1.11 requires contour rounding and revegetation to preserve natural qualities of sloping terrains, mitigate the artificial appearance of engineered slopes, and control erosion.

In addition, new development in Vacaville is required to comply with the CBC, which contains building criteria and standards that are designed to reduce landslide risks to acceptable levels.

With the implementation of the policies discussed above and in Sections D.1.a, D.1.b, and D.1.c of the Impact Discussion, along with compliance with the CBC, hazards associated with landslides would be mitigated and the impact is *less than significant*.

e. Result in substantial soil erosion or the loss of topsoil.

The proposed General Plan would have a significant environmental impact if it would allow development that would cause substantial soil erosion or loss of topsoil, which would hinder proper drainage and stormwater management. Erosion control, particularly during grading, is necessary to avoid downstream sedimentation and flooding. Typically, erosion impacts are greatest in the first two years after construction, the time generally required to establish suitable vegetation cover on areas of disturbed soil.

New construction activities allowed by the proposed General Plan could result in the loss of topsoil and the creation of erosion in the EIR Study Area. However, Section 14.26.030 of the Vacaville Land Use and Development Code establishes Best Management Practices (BMPs) to control erosion; development allowed by the General Plan would be required to comply with these BMPs. Additionally, Section 14.19.244 of the Land Use and Development Code contains grading standards describing required erosion control techniques.

The proposed General Plan also includes policies that address soil erosion and the loss of topsoil. Policy SAF-P1.11 requires contour rounding and revegetation to preserve the natural qualities of sloping terrains and control erosion. In addition, Policy COS-P14.5 requires the implementation of BMPs to minimize erosion resulting from construction or from new impervious surfaces.

Compliance with existing requirements in the Land Use and Development Code and implementation of proposed General Plan policies would reduce potential impacts from erosion and the loss of topsoil to a *less-than-significant* level.

f. 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.

Impacts from liquefaction and landslides are discussed in Sections D.1.c and D.1.d of the Impact Discussion, respectively. Lateral spreading is a phenomenon in which relatively flat land areas undergo sudden lateral movement generally toward a slope or channel margin during an earthquake. Lateral spreading occurs most frequently where liquefiable layers are present at depth and a slope, such as a riverbank, is located nearby. Subsidence and soil collapse refer to the compaction of soils and alluvium as a result of ground shaking. Compaction typically occurs in places that are underlain by soft water-saturated, low-density alluvial material. Subsidence can

also occur where water or natural gas is extracted. The proposed General Plan would have a significant environmental impact if it would locate people or structures on soils prone to such phenomena.

As described in Sections D.1.c and D.1.d of the Impact Discussion, geologic risks from landslides, lateral spreading, subsidence, liquefaction, or collapse would be reduced by proposed General Plan policies and actions. In particular, these policies would consider the site-specific potential for geologic stability and seismic hazards when reviewing development projects under the proposed General Plan. In addition, new construction would be required to comply with the CBC, which contains building criteria and standards that are designed to reduce geologic risks to acceptable levels. Implementation of proposed General Plan policies and compliance with the CBC would reduce the impact related to unstable geologic conditions to a *less-than-significant* level.

g. Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code, creating substantial risks to life or property.

The proposed General Plan would have a significant environmental impact if it would locate people or structures on expansive soils. Expansive soils undergo a significant volume change as a result of wetting or drying, and this volume change can cause damage to improperly designed foundations and pavements. The primary soil types in the Vacaville area are silty, sandy, and clay loams, with a smaller portion being made up of purely clay soils. Though not all types of clay are expansive, soils with a clay component are more prone to expansion. Approximately 64 percent of Vacaville's soils contain at least some clay component. Therefore, the potential for locating people or structures on expansive soils exists in the EIR Study Area.

Policy SAF-P1.6 in the proposed General Plan requires a soils report prior to issuing a building permit. Policies SAF-P1.5 and SAF-P1.7 require geotechnical studies for projects to determine geologic suitability. These policies would ensure that the site-specific potential for hazards due to expansive soils would be considered when issuing building permits for development projects allowed by the proposed General Plan.

In addition, new development is required to comply with the CBC, which contains structural design standards for foundations. CBC requirements ensure design and construction in accordance with recommendations from a geotechnical or soils investigation. This includes procedures for handling expansive soils through such techniques as replacement of expansive soils with non-expansive engineered fill, lime treatment, moisture conditioning, and other techniques.
With the implementation of the policies discussed above and compliance with the CBC, the impact associated with expansive soils would be *less than significant*.

h. Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water.

The City of Vacaville owns and operates the Easterly Wastewater Treatment Plant (WWTP), which is located east of the city. The City also owns and operates the wastewater collection system for the Easterly WWTP. Under the proposed General Plan, the City would maintain adequate wastewater collection and treatment services to serve existing and new development. Proposed Policy PUB-P13.1 directs the City to maintain wastewater conveyance, treatment, and disposal infrastructure in good working condition in order to supply municipal sewer service to the City's residents and businesses. In addition, the proposed General Plan requires that new development within the city connect to the public sewer system. Proposed Policy PUB-P13.3 requires that new habitable structures located within the city limits connect to the public wastewater collection system. Because the proposed General Plan requires that future development under the General Plan connect to public sewer services, no impacts associated with the use of septic tanks or alternative wastewater systems would occur, and the impact would be *less than significant*.

i. 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, or of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan.

As indicated in Section B.5, Mineral Resources, there are no MRZ-2 zones mapped in Vacaville. MRZ-2 zones are defined as "areas where adequate information indicates that significant mineral (aggregate) deposits are present or where it is judged that there is a high likelihood for their presence." However, MRZ-3 zones do occur in the EIR Study Area, indicating that there is not adequate data to determine the significance of mineral deposits.

The lack of an MRZ-2 zone indicates that there are no known mineral resources that would be of value to the region and the residents of the state. In addition, the proposed General Plan, existing specific plans, and the Solano County General Plan do not delineate any locally-important mineral resource recovery sites.

Furthermore, the proposed General Plan includes Policy COS-P16.1, which directs the City to take into account potentially available mineral resources on the property or in the vicinity of the project site when reviewing land use proposals. Therefore, impacts related to mineral resources would be *less than significant*.

2. Cumulative Impacts

The proposed General Plan would allow development that would bring more structures, residents, and visitors to Vacaville, an area vulnerable to seismic activity and geologic hazards. Together with other growth in Solano County, the proposed General Plan would add cumulatively

to the overall population growth and development in this seismically active region. However, risks related to geologic and soil hazards tend to be site-specific, and the application of the geotechnical and engineering standards found in the CBC and the Land Use and Development Code, together with the implementation of the policies in the proposed General Plan, is considered sufficient to reduce the cumulative risk to residents and other occupants of Vacaville and Solano County to a *less-than-significant* level.

E. Full Buildout

The full buildout anticipated under the proposed General Plan would include significantly more development than the 2035 horizon-year development projection analyzed in Section D, Impact Discussion, in terms of both the amount and the extent of development. Therefore, the potential for impacts related to geology, soils, and mineral resources would increase. However, as discussed in Chapter 3, Project Description, it is extremely unlikely that full buildout would ever occur under the proposed General Plan. Therefore, an analysis of full buildout is not required by CEQA.

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