4.5 GEOLOGICAL RESOURCES

4.5.1 Issues

Although implementation of the DSP will improve buildings in the planning area relative to geologic and seismic safety by upgrading structures or developing new structures subject to current building codes, implementation of the plan will also induce population growth and development in a seismically active area. The evaluation that follows provides a general characterization of the seismic setting, soil types, and associated hazards and risks in the planning area. This analysis is not intended as a substitute for site-specific geotechnical reports that may be required for individual projects in the DSP area under the Uniform Building Code (UBC). Additional study may be required to obtain site-specific data, and to determine the appropriate engineering recommendations based on a particular building's size, design, and use.

4.5.2 Setting

Regional (Structural) Geology
California is divided geologically into several physiographic or geomorphic provinces, including the Sierra Nevada range, the Central (Great) Valley, the Transverse Ranges, the Coast Ranges, and others. Cotati lies within the Coast Ranges geomorphic province of California. The Coast Range was formed at the intersection of two tectonic plates: the Pacific to the west, and the North American to the east. The compressive and shearing motions between the tectonic plates resulted in a complex system of active strike-slip faults, reverse faults, thrust faults and related folds (bends in rock layers). Locally, the Coast Ranges are characterized by northwest trending valleys and basins.

Cotati is located in the topographic area known as the Cotati Valley. The City of Cotati includes areas in and adjacent to the southeast portion of the Santa Rosa Plain (see Figure 4.5-1).

Local Geology

Topography. The topography of the area is relatively flat. The elevation in the planning area is approximately 90 feet above mean sea level (msl). Figure 4.5-2 shows the planning area topography.

Soils. The planning area mainly contains two types of soil – Cotati Fine Sandy Loam (mapped as CtD) and Haire Fine Sandy Loam (mapped as HaB). Haire soil is characterized as moderately well drained clay loams with clay subsoil and underlain by old terrace-alluvium. Haire soils are considered at risk of erosion and exhibit slow or very slow permeability. Cotati Fine Sandy Loam is moderately well drained with slow to rapid runoff potential.

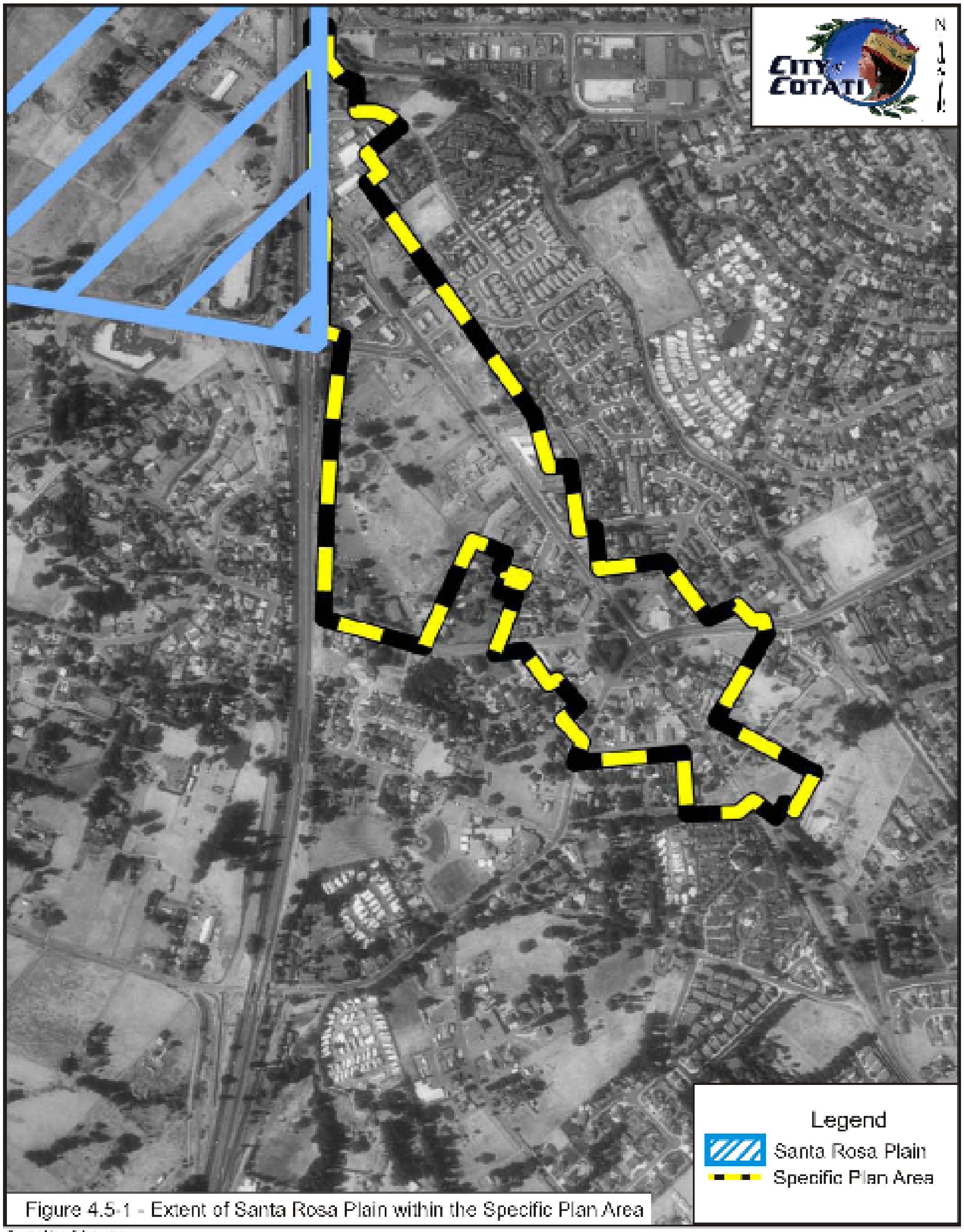

Figure 4.5-1 - Extent of Santa Rosa Plain within the Specific Plan Area

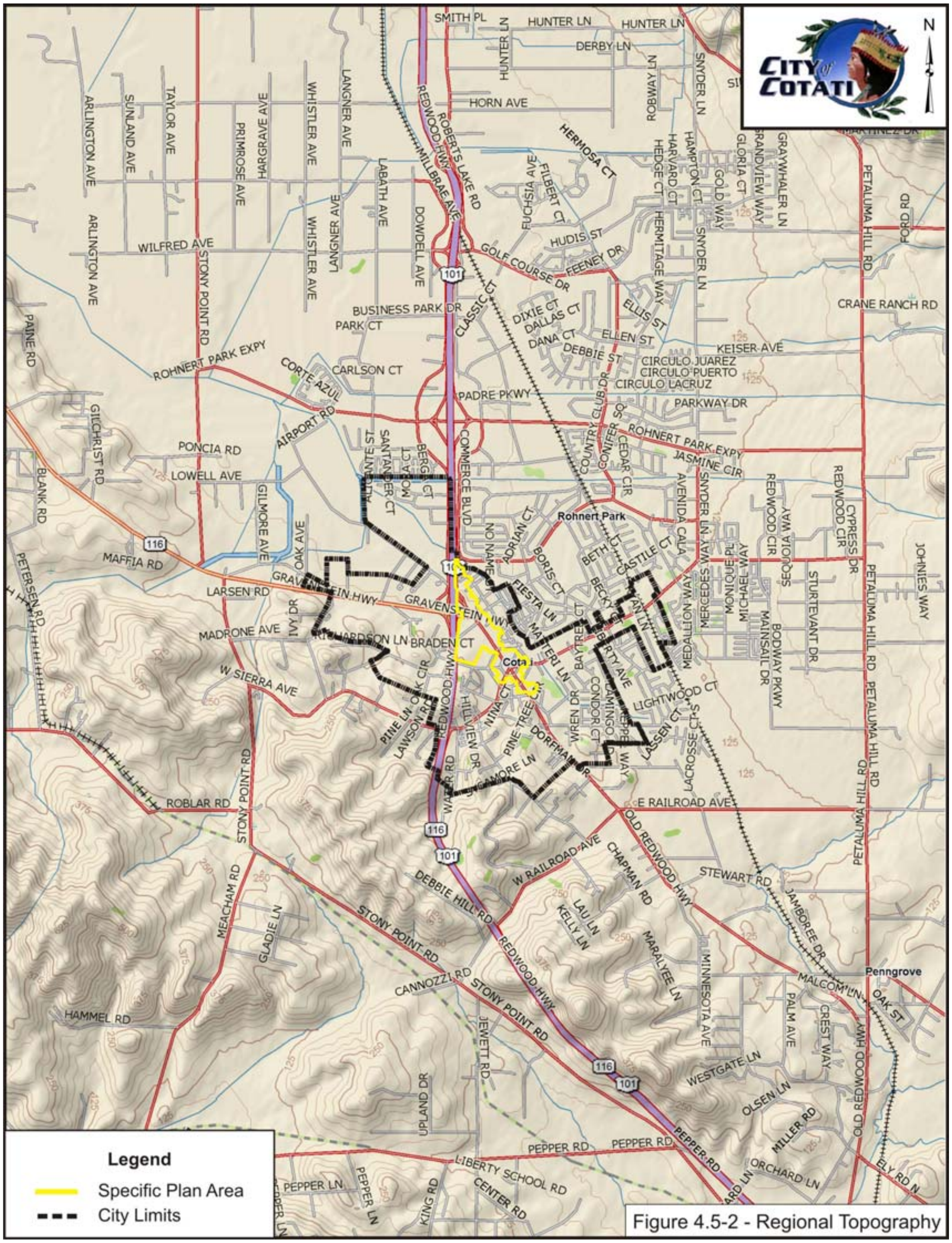

Figure 4.5-2 - Regional Topography

Geologic Hazards

Erosion. Erosion is a natural process that occurs over time and can be caused by either wind or water moving over soils. The natural erosion process is an important factor in building up fertile valley soils. However, soil erosion can become a problem when human activities accelerate the rate at which soils are being displaced. Non-point sources including impervious surfaces, unsound farming practices, over-grazing, construction activities, and road construction (particularly unpaved roads) can all accelerate the rate at which soils are removed from hillsides. Point sources such as industrial wastewater discharges, mining activities, wastewater treatment plants, commercial and residential land uses, and agricultural operations can affect erosion rates through increased stormwater velocity, disturbance of natural drainage patterns, and water discharges. Soil erosion can leave silt-choked streams, gullied hillsides, and damaged farmland.

Landslides. The occurrence of landslides is generally influenced by a number of factors, including slope angle, soil moisture content, vegetative cover and the physical nature of the underlying strata. Landslides can be triggered by one or more specific events including development-related construction, seismic activity, and soil saturation. Landslides are not a significant issue in the project area due to the relatively level slope throughout.

Subsidence. One of the consequences of excessive groundwater withdrawal from an aquifer that lacks a rigid framework is compaction of the aquifer. The water itself supports part of the load of the overlying materials and keeps the grains of the aquifer loosely packed. When water is removed from the intergranular spaces, the weight of the overlying rocks packs the grains of soil together more closely. This cannot only permanently reduce the capacity of the aquifer, but also cause serious lowering, or subsidence, of the ground overlying the aquifer. Areas most vulnerable to subsidence are those underlain by loose, compressible clay-rich soils, in an area with excessive groundwater withdrawal and general lowering of the water table.

Expansive Soils/Differential Settlement. Expansive soils tend to swell with seasonal increases in soil moisture and shrink during the dry season as soil moisture decreases. The volume changes that the soils undergo in this cyclical process can stress and damage slabs and foundations if precautionary measures are not taken. Differential settlement can result from expansive soils if a foundation is constructed on two materials having different settling/expansion characteristics, such as rock and soil. Methods commonly used for slab protection include placement of nonexpansive material beneath the slab or premoistening of subslab materials.

Seismic Setting

Cotati is located in a seismically active region that includes several active earthquake faults of both local and regional significance, most notably the San Andreas Fault Zone. The fault closest to the planning area is the potentially active Rodger Creek Fault, which is part of the larger San Andreas Fault system.[1] Other significant faults in the region include the Healdsburg and Mayacamas Faults (see Figure 4.5-3). An active fault is defined as a fault that has a historic seismic record (activity in the last 100 years) or displaces Holocene (11,000 years and younger) deposits. Faults that exhibit signs of geologically recent (active within the past

[1] *Cotati General Plan EIR, 1998.*

11,000 years) are considered the most likely to experience movement in the near future. Therefore, active faults are generally thought to have the greatest fault rupture potential. Most agencies, however, will consider potentially active faults (active within the past two million years) as being capable of generating future earthquakes. Faults classified as inactive are not considered a significant fault rupture hazard or seismic event source.

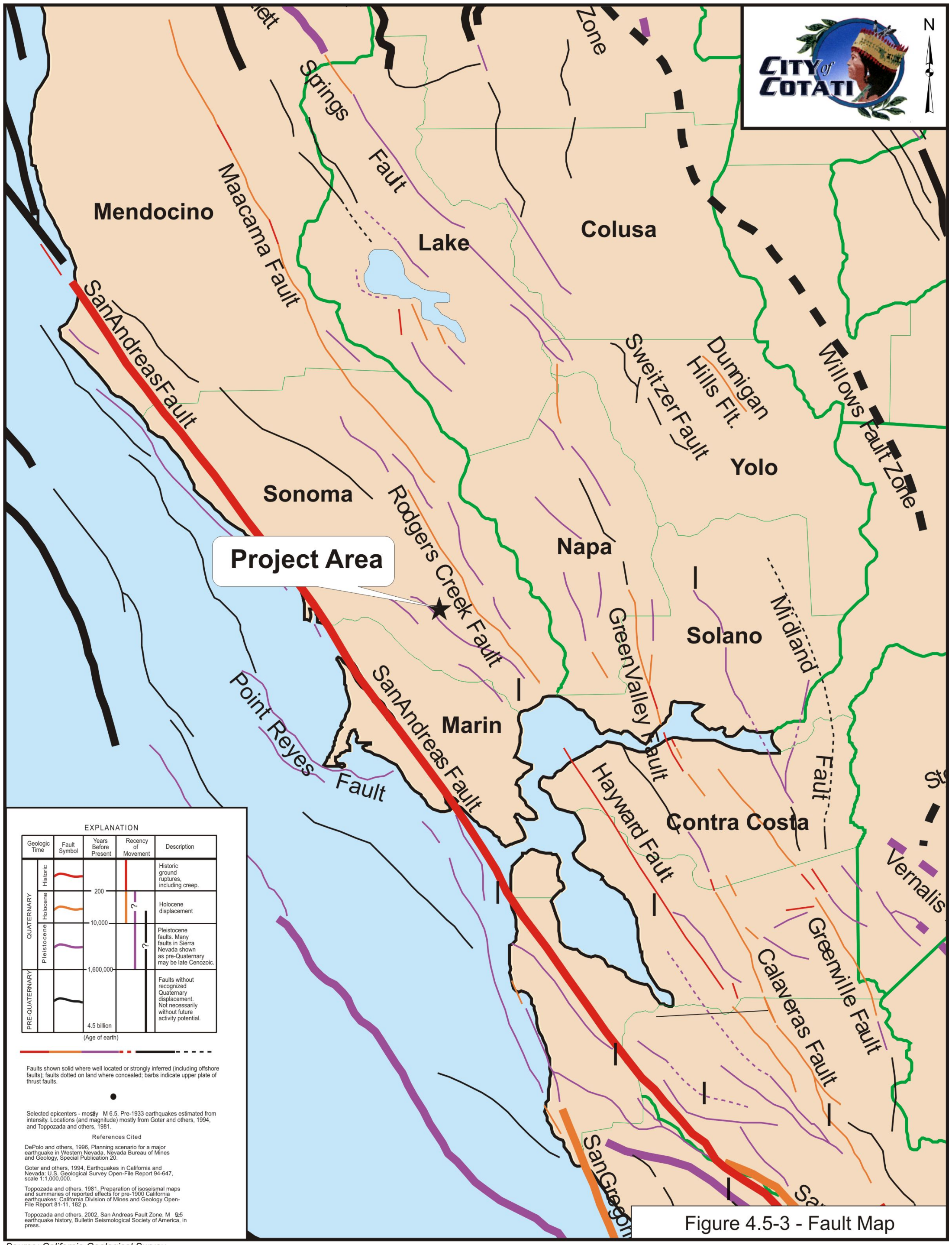

Figure 4.5-3 - Fault Map

Source: California Geological Survey

Earthquakes along faults are described in terms of Moment Magnitude (M), which is the measure of total energy released. Moment Magnitude is the measurement and term generally preferred by scientists to the Richter scale because Moment Magnitude is more precise. Moment Magnitude is not based on instrumental recordings of a quake, but on the area of the fault that ruptured in the quake. This means that the Moment Magnitude describes something physical about an earthquake. Moment Magnitude is calculated in part by multiplying the area of the fault's rupture surface by the distance the earth moves along the fault. A brief description of major active faults in the region follows.

- **San Andreas Fault System.** The San Andreas Fault system (active) is oriented in a northwest-southeast direction and lies along the coast of Sonoma County. It is approximately 15 miles west from the planning area. [2] The San Andreas Fault is capable of an 8.0 M earthquake and is characterized as a right-lateral strike-slip fault. The last reported land rupture was recorded on April 18, 1906 (in the Northern segment) and on January 9, 1857 (in the Mojave segment).[3]

- **Rodgers Creek Fault.** The Rodgers Creek Fault (potentially active) runs roughly parallel to the San Andreas Fault, but is three miles east of the planning area. The Rodgers Creek Fault is directly connected to the active Healdsburg Fault. Additionally, its proximity to the project site makes the Rodgers Creek Fault the most likely fault to have a direct impact on the planning area.

- **Healdsburg Fault.** The Healdsburg Fault (active) is a northern extension of the Rodgers Creek Fault. It is located northwest of Santa Rosa, and trends parallel to the San Andreas Fault. The largest earthquake since 1906 occurred on the Healdsburg Fault in 1969. The magnitude on the Richter scale registered 5.6-5.7 for these series of earthquakes. It is located approximately six miles north of the planning area.

- **Mayacama Fault.** The Mayacama (also known as the Maacama) Fault (potentially active) passes approximately 3.5 miles east of the Healdsburg Fault, and is nearly four miles away from the planning area at its closest point.

There are no known active or potentially active faults located in or adjacent to the planning area boundary.

Seismic Hazards

Ground Rupture. Seismically induced ground rupture is defined as the physical displacement of surface deposits in response to an earthquake's seismic waves. Ground rupture is most likely to occur along active faults. However, the potential for ground rupture also exists along potentially active faults. Therefore, development in areas overlying fault zones, whether active or potentially active, should be avoided. Any development that does take place within these areas should be required to perform a fault hazard study to assess the potential for damage associated with fault rupture and to establish setbacks to mitigate the potential for such damage. There are no active or potentially active faults located in or adjacent to the planning area.

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[2] TOPO!® Accessed 8/4/07.
[3] SCEDC website www.data.scec.org , San Andreas

Liquefaction. Liquefaction is a phenomenon where near surface soils lose cohesion and convert to a fluid state because of severe vibration such as may be caused by a seismic event. Liquefaction potential varies according to soil type, with recent, unconsolidated alluvial soils overlying shallow groundwater having the highest potential. The potential for liquefaction decreases with increased consolidation of soil particles; therefore, soils with a greater propensity for consolidation, such as finely grained clays, have a reduced liquefaction hazard. Areas underlain by bedrock have the lowest potential for liquefaction. Soils in Cotati are considered at risk of liquefaction. Areas of liquefaction are shown in Figure 4.5-4. Although the planning area has limited liquefiable soils, they are abundant immediately to the east in Cotati and Rohnert Park.

4.5.3 Regulatory Setting

Cotati General Plan
Government Code §65302.1 requires that a Safety Element be included in every General Plan which establishes policies and programs for the protection of the community from fires, flooding, geologic and other natural and human caused hazards. The Quality of Life Chapter of the Cotati General Plan contains goals, objectives, and implementing policies designed to protect the community from risks associated with earthquakes, flooding, and other hazards. Applicable policies include, but are not limited to:

> *Development in areas subject to liquefaction, such as along East and West Cotati Avenues, Wilford Lane, and Redwood Drive (formerly known as South Santa Rosa Avenue), shall be reviewed by qualified soils engineers and geologists in order to ensure the safety and stability of all construction.*
>
> *Goal 7 Maintain a safe environment by providing adequate protection from traffic, fire, crime, natural disaster and hazardous materials*
>
> *Objective 7.1 Ensure that essential facilities are located and deigned so that they will remain operable in the event of an emergency or natural disaster.*
>
> *7.1.1 Identify all areas of potential natural hazards and areas of probably greatest jeopardy for each type of disaster and ensure that these areas are developed for hazard-compatible uses.*
>
> *a) Areas of the City which pose the greatest potential danger from landslides and seismic activity, including liquefaction have been identified. Prior to development within these areas, a soils study shall be submitted for review by a qualified soils engineer.*
>
> *7.1.2 Future sites of public and critical use buildings, shall be in areas of low environmental hazards.*
>
> *a) Strict adherence to the requirements of the Uniform Building Code shall be required in all areas of the City. Public and Critical Use buildings shall not be located in areas susceptible to potential natural hazards.*

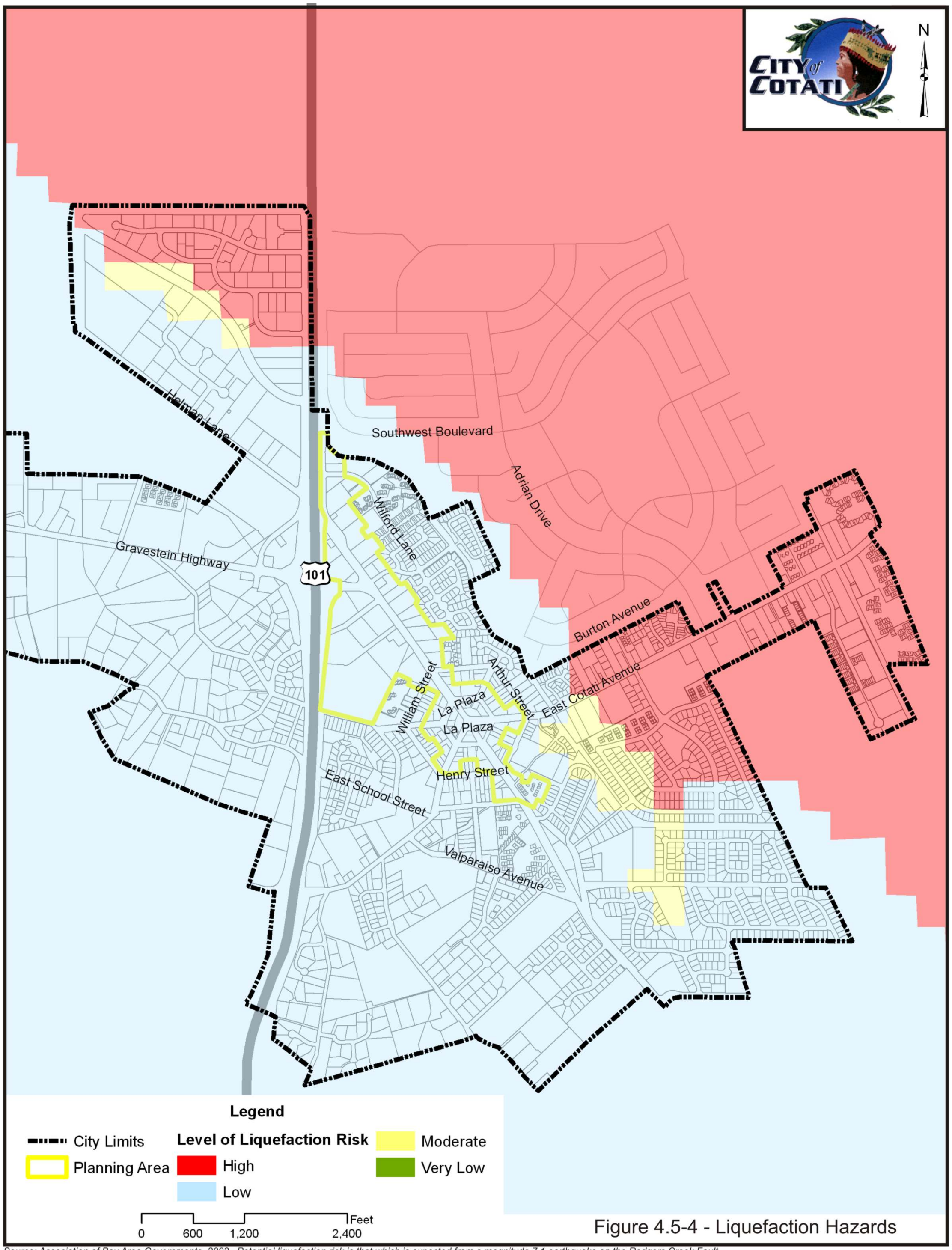

Figure 4.5-4 - Liquefaction Hazards

Source: Association of Bay Area Governments, 2003. Potential liquefaction risk is that which is expected from a magnitude 7.1 earthquake on the Rodgers Creek Fault.

7.1.3 Critical facilities in the Cotati Planning Area shall be designed and constructed to withstand the "maximum probable" earthquake and remain in service.

Objective 7.2 Protect the citizens from flooding, seismic activity and other natural disasters.

7.2.2 All new development in the city shall be designed to minimize vegetation removal, soil compaction and site coverage

7.2.3 Adequate drainage and erosion control shall be provided during construction of all new developments.

Objective 7.3 Reduce the potential for human injury and property damage which may result from earthquake and other geologic hazards.

7.3.1 Identify potential geologically hazardous areas and ensure that these areas have development limits.

a) The submission of geologic and soils reports shall be required for all new developments…

7.3.3 Remedial measures are to be employed to reduce erosion.

Public Resources Code §2621 et seq (Alquist-Priolo Earthquake Fault Zoning Act of 1994)
The State of California enacted the Alquist-Priolo Act in 1972 (amended 1974, 1975, 1976, 1979, 1994) to assist cities and counties in the regulation of land uses adjacent to active earthquake faults. The State Mining and Geology Board has established Special Study Zones in which land uses are regulated under this Act. The Act requires preparation of a geological investigation before approving development within a Special Study Zone, which are typically less than one-quarter mile in width. For purposes of implementing the Act, it is assumed that active branches of the fault underlie areas within 50 feet of an active fault unless proven otherwise by geologic investigation.

§17922 and §17951-17958.7 of the State Government Code
These sections require cities and counties to adopt and enforce the Uniform Building Code, including a grading section (Chapter 70) providing minimum protection against some geologic hazards.

Regional Water Quality Control Board (RWQCB)
Projects which exceed one acre in size are required to comply with the RWQCB NPDES permit requirements for construction activities. Proponents of such projects will be required to prepare and implement erosion control plans for each site, during and post-construction.

4.5.4 Methodology

The discussion in this section is based upon a review of existing information contained in reports and databases, as set forth in the references below. No site-specific geological investigations were made for the DSP.

4.5.5 Significance Thresholds

The CEQA Guidelines state that a project will normally have a significant geology, soils, and seismicity impact if it would:

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

    (1) Rupture of a known earthquake fault, as delineated in 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; or

    (4) Landslides.

b. Result in substantial soil erosion or loss of topsoil.

c. Be located on a geologic unit or soil that is unstable, or that would become unstable because of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse.

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

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

4.5.6 Impacts and Mitigation Measures

Less than Significant Impacts
As indicated above, there are no known fault traces within the City limits; therefore, there is no direct threat of fault rupture within the City (threshold a(1)). The planning area is relatively flat, so the risk of unstable soils resulting in landslides is negligible (thresholds a(4) and c). There would be no impact from septic tanks or alternative wastewater disposal systems as these systems are not part of the DSP(threshold e).

Significant Impacts
Development of the DSP could result in two significant impacts to geological resources, as described below.

Impact GEO-1: Implementation of the DSP will result in additional development and population that would be subject to seismic hazards including ground shaking, liquefaction, and expansive soils (thresholds a(2)(3), c and d).

All structures in the greater Bay Area could be affected by ground shaking in the event of an earthquake. The amount of ground shaking depends on the magnitude of the earthquake, the distance from the epicenter, and the type of earth materials between the receptor and the epicenter. As mentioned above, a number of active and potentially active faults could affect the City. An earthquake of sufficiently high magnitude along any of the faults could damage buildings or infrastructure or lead to loss of life within the City.

Mitigation GEO-1: Prior to issuance of any site-specific grading or building permits within the DSP area, a design-level geotechnical investigation shall be prepared by the developer/applicant and submitted to the City of Cotati for review and confirmation that the proposed development complies with the California Building Code and other applicable regulations. Each geotechnical report shall determine the surface geotechnical conditions and address potential seismic hazards. Analysis in the geotechnical report shall conform with the California Division of Mines and Geology recommendations presented in the *Guidelines for Evaluating Seismic Hazards in California*. All measures, design criteria, and specifications set forth in the geotechnical reports shall be implemented as a condition of individual project approval.

Significance after Mitigation: It is acknowledged that seismic hazards cannot be completely eliminated, even with site-specific geotechnical investigations and advanced building practices. However, buildings constructed in accordance with the required mitigation would incorporate standards known to reduce the risk of building damage and collapse in the event of an earthquake, thereby, reducing potential impacts to people and property. Therefore, the mitigation measure described above would reduce the potential hazards associated with seismic activity to a less than significant level.

Impact GEO-2: Implementation of the DSP could expose soils to erosion as specific projects are developed (threshold b).

Grading and construction of buildings and infrastructure throughout the planning area would expose soils to potential erosion impacts. The greatest potential for erosion is in the initial grading stages, as surfaces are denuded and soil is exposed. Although the potential for erosion is limited by the relatively shallow slope in the planning area, the possibility for erosion impacts exists.

Mitigation GEO-2: All construction activities within the DSP area will be required to comply with construction Best Management Practices (BMPs) and strategies established by the City of Cotati the Regional Water Quality Control Board (which will be included in project Storm Water Pollution Prevention Plans),[4] and the California Stormwater Quality Association.[5] Examples of recommended BMPs include:

- Schedule construction activities during dry weather.
- Protect and establish vegetation.
- Stabilize construction entrances and exits to prevent tracking onto roadways.
- Protect exposed slopes from erosion through preventative measures such as covering slopes to avoid contact with stormwater.

[4] San Francisco Regional Water Quality Control Board. *Erosion and Sediment Control Field Manual and Guidelines.* Revised 2002.

[5] California Stormwater Quality Association. *Stormwater Best Management Practice Handbooks. 2002*

- Install straw wattles (fiber rolls) and silt fences on contour to prevent concentrated flow.

Significance after Mitigation: Implementation of construction BMPs will reduce the amount of erosion at project sites within the planning area to the maximum extent practicable, thereby reducing the impact to a less than significant level.

4.5.7 Cumulative Impacts

Impact GEO-3: Implementation of the DSP would not make a cumulatively considerable contribution to any significant cumulative geological impacts in the region.

The existing cumulative impact is not significant. This conclusion is based in part on the conclusion in the EIR for the current Cotati General Plan. The General Plan EIR concluded that there would not be significant impacts to these resources.

The DSP's impacts are less than significant and it does not result in a significant cumulative impact. Specifically, the impact of the project will not make a cumulatively considerable contribution to the significant cumulative impact. The reason for this conclusion is implementation of the project, when considered along with continued development in the City of Cotati, will increase the total population and number of structures at risk of damage or loss from geologic and seismic hazards. Geologic risks are project- and site-specific; therefore, cumulative impacts are limited to the stated increase in risk during seismic events. In addition, the measures utilized, especially in the building code, will reduce all projects in the region to a less than significant impact. By reducing erosion to the maximum extent feasible, the project will not contribute to any cumulative impacts in the area. Cumulative impacts are considered less than significant, similar to the project, with implementation of the mitigation measures identified above.

4.5.8 References

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