H. GEOLOGY, SOILS AND SEISMICITY

This section assesses the geotechnical conditions within the Plan area and its vicinity. Impacts associated with implementation of the Draft Specific Plan are analyzed and mitigation measures are recommended as appropriate.

1. Setting

The City of Martinez is located in a relatively geologically young and seismically-active region. The composition of geologic material, soils, topography, and groundwater conditions affect geologic hazards at any given site. The following section describes the existing geologic conditions in the Plan area.

a. Topography. Martinez consists of two general topographic areas: the lowland area and the upland area. The lowland area extends from the Carquinez Strait south throughout most of the Plan area. Outside of the Plan area, it extends along Alhambra Creek in the western portion of Martinez, and along Pacheco Boulevard in the eastern portion of Martinez. The upland areas consist of hills that border the lowland areas on the west, east, and south. These hills represent the surface expression of structural folding and uplift.

The topography of the lowland area is generally level with a gentle increase of surface elevation toward the southeast. Based on the National Geodetic Vertical Datum of 1929, elevations in the lowland areas of the Plan area range from about 7 feet above mean sea level (msl) in the northwestern portion of the Plan area to about 40 feet above msl in the southern portion of the Plan area. Within the Plan area, the upland areas consist of moderate to steeply sloping hills that range in elevation from about 40 to 150 feet above msl.

b. Geology. The geology of Contra Costa County has been mapped by the U.S. Geological Survey. The major part of the Plan area consists of surficial, unconsolidated deposits, as shown in Figure IV.H-1. Along the western margin of the Plan area, Muir sandstone and Vine Hill sandstone support the upland areas. The Muir sandstone also supports the upland areas along the eastern Plan area margin. These geological materials underlie the younger surficial deposits in the center of the Plan area.

c. Soils. Soil is generally defined as the unconsolidated mixture of mineral grains and organic material that mantles the land surface. 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. Soils in Contra Costa County have been mapped by the United States Department of Agriculture (USDA) Soil Conservation Service.

Soils found within the Plan area are primarily loams, which is a soil consisting of sand, clay, silt, and organic matter. Soils found in the lowland areas are formed on level to gently sloping alluvial fans.

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and flood plains. In the lowland area, most of the soil within the Plan area is a clay loam (Botella clay loam). Silty loams are mapped along the western margin (Millsholm complex in cut and fill land and Zamora silty clay loam); and silty clay (Omni sitly clay) is mapped along the northern margin. Soils in the upland areas are composed of a loam that forms on steep hillsides underlain by sandstone and shale (Lodo clay loam) and interbedded sedimentary rock (Los Gatos loam) (see Figure IV.H-2). The Botella, Lodo, and Omni soils are characterized as moderately to highly expansive, with shrink-swell potential that could cause damage to roadways, building foundations, and other improvements over time.

d. Seismicity. The entire San Francisco Bay Area is located in a region of active seismicity. The seismicity of the region is primarily related to the San Andreas Fault Zone (SAFZ). The SAFZ is a complex of active faults forming the boundary between the North American and the Pacific lithospheric plates. Historically, numerous moderate to strong earthquakes have been generated in northern California by several major faults and fault zones in the SAFZ system. Active faults in the region include the Antioch, Calaveras, Concord, Green Valley, Greenville, Hayward, Rodgers Creek, and the San Andreas.3 The Alquist-Priolo Earthquake Faults Act defines an “active” fault as one that shows evidence of fault rupture in the last 11,000 years. No known active faults cross the Plan area. Within the region are additional faults that are not mapped as active, but show evidence of being active within the past two million years. Potentially active faults near the Plan area include the Southampton and the Franklin faults. Regional faults located in the vicinity of the Plan area are shown on Figure IV.H-3.

The total energy release that occurs at the epicenter of an earthquake is measured by motion recorded by seismographs. This measurement is referred to as the magnitude of the earthquake and is generally expressed with reference to the Richter Magnitude Scale. The Richter Magnitude Scale is logarithmic and each successively higher magnitude reflects an increase of about 32 times the amount of energy released by an earthquake.

The 1999 Working Group on California Earthquake Probabilities estimated that there is a 70 percent probability of a magnitude 6.7 or greater earthquake occurring on one of the major faults within the San Francisco Bay region before 2030.4 Furthermore, they determined that there is a 30 percent chance of a magnitude 6.7 or greater earthquake occurring somewhere along the Calaveras, Concord-Green Valley, Mount Diablo, and Greenville faults before 2030.5

e. Geological Effects of Earthquakes. Groundshaking and liquefaction are the primary geological effects of earthquakes.

(1) Ground Shaking. The intensity of ground shaking that would occur in the Plan area as a result of an earthquake in the Bay Area is related to the size of the earthquake, its distance from

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Figure IV.H-1: Geology

8x11 color
back of Figure 1
FIGURE IV.H-2
Downtown Martinez Specific Plan
Soils in the Planning Area

LEGEND
BaA: Botella Clay Loam 0-2% slope
CoE: Cut and Fill Land, Miloholm Complex 9-30% slope
LeF: Lodo Clay Loam 30-50% slope
LeE: Los Gatos Loam 30-50% slope
LhE: Los Osos Clay Loam 15-30% slope
ZaB: Zanora Silty Clay Loam 2-5% slope
Ob: Omnisil Silty Clay 0-2% slope

I:\AS0330 MARTINEZ\FIGURES\FIG IV.H.2.AI (08/02/04)
Martinez, and the response of the geologic materials within the Plan area. As a rule, the larger the earthquake magnitude and the closer the fault rupture to the site, the greater the intensity of ground shaking. Ground motion is strongest at the epicenter and diminishes with distance away from the epicenter. The severity of ground shaking at any particular point is referred to as the earthquake intensity and is a subjective measure of the effects of ground shaking on people, structures, and earth materials.

Maps illustrating the distribution of ground shaking intensity from various active regional faults have been prepared by the Association of Bay Area Governments (ABAG).\(^6\) Ground shaking intensity is described using the Modified Mercalli Scale, which ranges from I (not felt) to XII (widespread devastation). A description of the parameters that define the Modified Mercalli Scale is presented in Table IV.H-1. When various earthquake scenarios are considered, ground shaking intensities will reflect both the effects of strong ground acceleration and the consequences of ground failure. Possible earthquake intensities in the Plan area are described below.

The main trace of the Concord-GreenValley fault is approximately 2.5 miles from the Plan area. A review of current maps published by ABAG indicates the maximum potential ground shaking intensities in Martinez are associated with the Concord-Green Valley fault. A large earthquake on this fault is expected to produce a Modified Mercalli intensity ranging from very strong (VIII) south of the railroad tracks to very violent (X) north of the tracks.

The estimated maximum credible earthquake magnitude for this fault is 6.5, with an estimated maximum probable earthquake magnitude of 5.75 (Contra Costa County, 1991). If the maximum credible earthquake were to occur on this fault, the expected ground shaking intensity at the study area on the Modified Mercalli Scale would be X. This level of intensity is associated with destruction of masonry and wood-framed structures, extensive damage to foundations, water thrown on banks of canals and streams, sand and mud shifted horizontally on beaches and flat land, and rails bent slightly.

(2) **Liquefaction.** Liquefaction is the rapid transformation of saturated, loose, fine-grained sediment to a fluid-like state because of ground shaking during earthquakes. Seismic shaking raises the pore-water pressure so that sediment grains are momentarily forced apart. Liquefaction-induced ground failure can occur on level ground if the liquefied material is unevenly loaded. Liquefaction has resulted in substantial loss of life, injury, and damage to property. In addition, liquefaction increases the hazard of fires because of explosions induced when underground gas lines break, and because the breakage of water mains substantially reduces fire suppression capability.

The potential for liquefaction also depends on soil conditions and groundwater levels, which may fluctuate. In general, where there is any potential for liquefaction, site-specific studies are needed to determine the extent of the hazard if development were to occur in the area. In general, the upland areas have a very low potential for liquefaction. Liquefaction potential increases in the vicinity of major drainage channels where loose granular sediments have accumulated as a result of stream processes.

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### Table IV.H-1: Modified Mercalli Scale

<table>
<thead>
<tr>
<th>MB</th>
<th>Intensity</th>
<th>Effects</th>
<th>$v_c$ cm/s</th>
<th>$g^d$</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td>Not felt. Marginal and long-period effects of large earthquakes.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Felt by persons at rest, on upper floors, or favorably placed.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Felt indoors. Hanging objects swing. Vibration like passing of light trucks. Duration estimated. May not be recognized as an earthquake.</td>
<td></td>
<td>0.0035-0.007</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>Hanging objects swing. Vibration like passing of heavy trucks; or sensation of a jolt like a heavy ball striking the walls. Standing motor cars rock. Windows, dishes, doors rattle. Glasses clink. Crockery clashes. In the upper range of IV, wooden walls and frame creak.</td>
<td></td>
<td>0.007-0.015</td>
<td></td>
</tr>
<tr>
<td>V.</td>
<td>Felt outdoors; direction estimated. Sleepers wakened. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters, pictures move. Pendulum clocks stop, start, change rate.</td>
<td>1-3</td>
<td>0.015-0.035</td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knickknacks, books, etc., off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry D cracked. Small bells ring (church, school). Trees, bushes shaken visibly, or heard to rustle.</td>
<td>3-7</td>
<td>0.035-0.07</td>
<td></td>
</tr>
<tr>
<td>VII</td>
<td>Difficult to stand. Noticed by drivers of motor vehicles. Hanging objects quiver. Furniture broken. Damage to masonry D, including cracks. Weak chimneys broken at roof line. Fall of plaster, loose bricks, stones, tiles, cornices, also unbraced parapets and architectural ornaments. Some cracks in masonry C. Waves on ponds; water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged.</td>
<td>7-20</td>
<td>0.07-0.15</td>
<td></td>
</tr>
<tr>
<td>VIII</td>
<td>Steering of motor vehicles affected. Damage to masonry C; partial collapse. Some damage to masonry B; none to masonry A. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes.</td>
<td>20-60</td>
<td>0.15-0.35</td>
<td></td>
</tr>
<tr>
<td>IX</td>
<td>General panic. Masonry D destroyed; masonry C heavily damaged, sometimes with complete collapse; masonry B seriously damaged. General damage to foundations. Frame structures, if not bolted, shifted off foundations. Frames racked. Serious damage to reservoirs. Underground pipes broken. Conspicuous cracks in ground. In alluviated areas, sand and mud ejected, earthquake foundations, sand craters.</td>
<td>60-200</td>
<td>0.35-0.7</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>Most masonry and frame structures destroyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land. Rails bent slightly.</td>
<td>200-500</td>
<td>0.7-1.2</td>
<td></td>
</tr>
<tr>
<td>XI</td>
<td>Rails bent greatly. Underground pipelines completely out of service.</td>
<td>&gt;1.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XII</td>
<td>Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into the air.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: To avoid ambiguity of language, the quality of masonry, brick or otherwise, is specified by the following lettering (which has no connection with the conventional Class A, B, C construction).

- **Masonry A:** Good workmanship, mortar, and design, reinforced, especially laterally, and bound together by using steel, concrete, etc; designed to resist lateral forces.
- **Masonry B:** Good workmanship and mortar, reinforced, but not designed to resist lateral forces.
- **Masonry C:** Ordinary workmanship and mortar; no extreme weaknesses such as non-tied-in corners, but masonry is neither reinforced nor designed against horizontal forces.
- **Masonry D:** Weak materials, such as adobe; poor mortar; low standards of workmanship; weak horizontally.

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\(a\) Source: Richter, 1958.

\(b\) Richter magnitude correlation.

\(c\) Average peak ground velocity, cm/s.

\(d\) Average peak acceleration (away from source).
A review of current maps published by ABAG indicates that the liquefaction potential in the Plan area is greatest for a large earthquake occurring on the Concord-Green Valley fault. Under the scenario of a large earthquake, most of the Plan area is mapped as a moderate liquefaction hazard level, with the northern boundary of the Plan area being mapped as a high liquefaction hazard level.

Lateral spreading (lurching) may also occur where open banks and unsupported cut slopes provide a free face. Ground shaking, especially when inducing liquefaction, may cause lateral spreading toward unsupported slopes. In the event of a large earthquake, banks along sections of Alhambra Creek that are not supported by concrete retaining walls may fail.

f. **Landsliding/Slope Instability.** Most lowland areas with relatively level ground surface are not prone to landslides. Other forms of slope instability, such as the formation of slumps, translational slides, or earth flows, are also unlikely to occur except along stream banks and terrace margins. The highland areas are more susceptible to slope instability. The strong ground motion that occurs during earthquakes is capable of inducing landslides and debris flow (mudslides). These types of failure generally occur where unstable slope conditions already exist.

Because debris flows travel downslope and downstream from source areas, hazards commonly extend beyond the sloped areas. Common areas of hazard are: 1) near the base of steep hillsides, 2) near the mouths of steep side hill drainages, and 3) in and near the mouths of canyons that drain steep terrain.

A review of current maps published by the USGS indicates landslides and debris flows are not shown as being present in the Plan area or in adjacent areas.

g. **Relevant Policies.** Relevant policies from the Martinez General Plan related to geology, soils, and seismicity are listed below.

24.212: Development shall be precluded along any fault trace where surface rupture is deemed possible. Fault traces which are considered to be inactive should be evaluated for special foundation problems prior to the construction of any buildings, utilities, roads, or paving on or across their trace.

24.213: The City shall adopt structural design criteria and codes and other programs applicable to other seismic effects, specifically, liquefaction of ground materials, seismic response of such unconsolidated geologic formations as alluvial deposits and collapse-hazard buildings and other seismic-induced failures of existing structures.

24.222: All slopes which are over 30% in grade should be precluded from development unless it can be demonstrated that alteration of the topography and hazards to public safety will not be incurred.

24.223: Construction in areas containing soils with high “shrink-swell” properties will require employment of special foundation techniques to offset these effects.

24.224: The use of septic tanks, tile filter fields, or sewerage ponds in areas where soil conditions constitute a severe limitation for such practices should be precluded for reasons of public health.

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8 Ibid.
24.225 Areas where moderate soil limitations are present must be studied on a site specific basis with respect to technique and density suitability.

2. Draft Specific Plan

The Draft Specific Plan does not include any goals or policies that specifically relate to geology, soils, or seismicity. The General Plan policies that relate to these issues would be applicable to the plan area and are listed in Section IV.H.1.f., Relevant Policies.

3. Impacts and Mitigation Measures

This section begins with a description of the criteria utilized to determine whether significant geology soils or seismicity impacts would result from implementation of the Draft Specific Plan, followed by a discussion of potential impacts and recommended mitigation measures.

a. Criteria of Significance. Implementation of the Draft Specific Plan would result in a significant geology, soils, or seismicity impact if it would:

- Expose people or structures to substantial risk of loss, injury, or death involving (Geology Criterion A):
  - Rupture of a known active or potentially active earthquake fault;
  - Strong seismic ground shaking;
  - Seismic-related ground failure, including liquefaction; or
  - Landslides.
- Result in substantial soil erosion or loss of topsoil (Geology Criterion B).
- Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the implementation of the Draft Specific Plan, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse (Geology Criterion C).
- Be located on expansive or corrosive soils, which could cause substantial damage to building foundations, pavements, utilities, and/or other improvements (Geology Criterion D).

According to Appendix G of the CEQA Guidelines, a potentially significant impact would result if implementation of the Plan would result in or expose people to any of the following: fault rupture; seismic ground shaking or ground failure including liquefaction, or volcanic hazards; landslides or mudflows; erosion or unstable soil conditions; subsidence; and expansive soils.

Geologic hazards that may result from development of projects that may occur under Plan buildout during the construction and post-construction periods include ground shaking and associated ground failure. For the purpose of this EIR, significant geologic hazards would pertain to soil and/or seismic conditions so unfavorable that they could not be overcome by reasonable design, construction, and maintenance practices; in addition, exposing an increased number of people to risk of injury would constitute a significant impact.
b. **Less-than-Significant Impacts.** Implementation of the Draft Specific Plan would not be affected by slope instability or contribute to regional subsidence or long-term erosion hazards (*Criterion B and C*).

Erosion along the Alhambra Creek could potentially result in creek bank failure and damage to adjacent improvements (*Criterion B*). Alhambra Creek flows through the central portion of the Plan area. Alhambra Creek meanders through the Plan area mainly in an open channel. In general, the creek is incised and portions of the channels banks are unprotected from erosion. Continued erosion could cause localized bank failures. However, the recently approved Alhambra Creek Enhancement Plan includes a long-term plan to stabilize and restore the portion of Alhambra Creek that flows through the Plan area. In addition, the Draft Specific Plan establishes a 100-foot setback for new development:

**Development Standard 11.5.1:** No structure, street, or alley is permitted within 100 feet of any marsh area, including marshlands within the floodplain of Alhambra Creek and marshlands within the Martinez Regional Shoreline. This marshland setback area shall be designed and landscaped as a vegetated buffer to the marshland.

This setback would minimize potential for new development within the Plan area to be damaged by bank failures that may occur along the creek or in the vicinity of the marsh and would ensure that new development does not conflict with potential future stabilization and restoration activities under the Alhambra Creek Enhancement Plan.

c. **Significant Impacts.** Two potentially significant impacts related to seismic hazards could result from implementation of the Draft Specific Plan.

**Impact GEO-1:** Occupants of development proposed under the Plan would be subject to seismic hazards. (S)

All structures in the Bay Area could potentially be affected by ground shaking in the event of an earthquake (*Criterion A*). The amount of ground shaking depends on the magnitude of the earthquake, the distance from the epicenter, and the type of earth materials in between the epicenter and the Plan area. Very strong to violent ground shaking is expected at the Plan area during expected earthquakes on the Concord-Green Valley fault and other regional faults. This level of seismic shaking could cause moderate to extensive structural damage and extensive non-structural damage to improvements within the Plan area. Liquefaction of loose saturated sediments under portions of the Plan area could result in destabilization of building foundations, rupture of underground utilities, and failure of roads and pavements.

**Mitigation Measure GEO-1:** Prior to the issuance of any site-specific grading or building permits, a design-level geotechnical investigation shall be prepared and submitted to the City of Martinez Public Works Department for review and confirmation that the proposed development fully complies with the California Building Code. The report shall determine the project site’s surface geotechnical conditions and address potential seismic hazards such as liquefaction and subsidence. The report shall identify building techniques appropriate to minimize seismic damage. In addition, the following requirement for the geotechnical and soils report shall be met:
• Analysis presented 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 mitigation measures, design criteria, and specifications set forth in the geotechnical and soils report shall be followed.

It is acknowledged that seismic hazards cannot be completely eliminated even with site-specific geotechnical investigation and advanced building practices (as provided in the mitigation measure above). However, exposure to seismic hazards is a generally accepted part of living in the San Francisco Bay Area and therefore the mitigation measure described above reduces the potential hazards associated with seismic activity to a less-than-significant level. (LTS)

**Impact GEO-2**: Damage to structures or property related shrink-swell potential and/or settlements of Plan area soils could occur. (S)

Soils underlying portions of the Plan area have moderate to high shrink/swell potential (Criterion D). This condition occurs when expansive soils undergo alternate cycles of wetting (swelling) and drying (shrinking). During these cycles, the volume of the soil changes significantly. In addition, it is likely that non-uniformly compacted imported fill has been placed within the Plan area that could experience settlements under a new building loads. Structural damage, warping, and cracking of roads and sidewalks, and rupture of utility lines may occur if the potential expansive soils and the nature of the imported fill were not considered during design and construction of improvements.

**Mitigation Measure GEO-2**: In accordance with Section 1804.4 of the California Building Code, in areas where expansive soils are present, the Building Official may require special provisions be made to safeguard against damage due to expansiveness, locations underlain by expansive soils and/or non-engineered fill, the designers of proposed building foundations and improvements (including sidewalks, roads, and utilities) shall consider these conditions. The design-level geotechnical investigation shall include measures to ensure potential damages related to expansive soils and non-uniformly compacted fill are minimized. Mitigation options may range from removal of the problematic soils and replacement, as needed, with properly conditioned and compacted fill to design and construction of improvements to withstand the forces exerted during the expected shrink-swell cycles and settlements. There is no basic performance standard to require other than that each situation be evaluated and a design prepared to mitigate (requirements would differ for a building foundation vs. a sidewalk, for example).

• All mitigation measures, design criteria, and specifications set forth in the geotechnical and soils report shall be followed to reduce impacts associated with shrink-swell soils to a less-than-significant level. (LTS)