Appendix C
Geologic Unit Descriptions

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Geologic Unit	Description	Seismically Induced Ground Shaking	Liquefaction	Ground Subsidence and Settlement	Erosion	Corresponding Soil Map Units
af	Artificial fill (Historic)--Loose to very well consolidated gravel, sand, silt, clay, rock fragments, organic matter, and man-made debris in various combinations. Thickness is variable and may exceed 30 m in places. Some is compacted and quite firm, but fill made before 1965 is nearly everywhere not compacted and consists simply of dumped materials	Very strong to extremely strong for 8.3 magnitude earthquake on San Andreas Fault	No hazard in engineered fills. Possible hazard in uncontrolled fill on Bay mud. Hazard somewhat greater in areas on or near filled tidal channels.	No hazard in properly engineered and constructed fills. Common hazard in poorly constructed or uncontrolled fills. Somewhat greater hazard in areas of filled tidal channels.	Slope protection generally required on fill slopes	134
alf	Artificial levee fill (Historic)--Man-made deposit of various materials and ages, forming artificial levees as much as 6.5 m high. Some are compacted and quite firm, but fills made before 1965 are almost everywhere not compacted and consist simply of dumped materials. The distribution of levee fill conforms to levees shown on the most recent U.S. Geological Survey 7.5-minute quadrangle maps	Very strong to extremely strong for 8.3 magnitude earthquake on San Andreas Fault	No hazard in engineered fills. Possible hazard in uncontrolled fill on Bay mud. Hazard somewhat greater in areas on or near filled tidal channels.	No hazard in properly engineered and constructed fills. Common hazard in poorly constructed or uncontrolled fills. Somewhat greater hazard in areas of filled tidal channels.	Slope protection generally required on fill slopes	134
Qhsc	Stream channel deposits (Holocene)--Poorly to well-sorted sand, silt, silty sand, or sandy gravel with minor cobbles. Cobbles are more common in the mountainous valleys. Many stream channels are presently lined with concrete or rip rap. Engineering works such as diversion dams, drop structures, energy dissipaters and percolation ponds also modify the original channel. Many stream channels have been straightened, and these are labeled Qhasc. This straightening is especially prevalent in the lower reaches of streams entering the estuary. The mapped distribution of stream channel deposits is controlled by the depiction of major creeks on the most recent U.S. Geological Survey 7.5-minute quadrangles. Only those deposits related to major creeks are mapped. In some places these deposits are under shallow water for some or all of the year, as a result of reservoir release and annual variation in rainfall.	Very strong to extremely strong for 8.5 magnitude earthquake on San Andreas Fault	Generally low	Unlikely	Generally low, but locally high along active stream channels; may rill in cuts	134
Qhbm	Bay mud (Holocene)-- Water-saturated estuarine mud, predominantly gray, green and blue clay and silty clay underlying marshlands and tidal mud flats of San Francisco Bay, Pescadero, and Pacifica. The upper surface is covered with cordgrass (Spartina sp.) and pickleweed (Salicornia sp.). The mud also contains a few lenses of well-sorted, fine sand and silt, a few shelly layers (oysters), and peat. The mud interfingers with and grades into fine-grained deposits at the distal edge of Holocene fans, and was deposited during the post-Wisconsin rise in sea-level, about 12 ka to present. Mud varies in thickness from zero, at landward edge, to as much as 40 m near north County line	Extremely strong for 8.5 magnitude earthquake on San Andreas	Generally moderate; locally high where shallow, clean sand beds exist	Likely where drained; differential settlement from compaction of loose or soft sediment possible under surcharge of fill.	Generally low.	134
Qhb	Basin deposits (Holocene)--Very fine silty clay to clay deposits occupying flat-floored basins at the distal edge of alluvial fans adjacent to the bay mud (Qhbm). Also contains unconsolidated, locally organic, plastic silt and silty clay deposited in very flat valley floors	Fair to good stability. Landslides along creek banks possible; unlikely on flat ground.	Generally low; potential liquefiable where shallow, well sorted silt or sand beds occur and are saturated.	Unlikely	Generally low, but locally high along active stream channels.	121, 131
Qhaf	Alluvial fan and fluvial deposits (Holocene)--Alluvial fan deposits are brown or tan, medium dense to dense, gravely sand or sandy gravel that generally grades upward to sandy or silty clay. Near the distal fan edges, the fluvial deposits are typically brown, never reddish, medium dense sand that fines upward to sandy or silty clay	Extremely strong for 8.5 magnitude earthquake on San Andreas	Generally low; potential liquefiable where shallow, well sorted silt or sand beds occur and are saturated.	Unlikely	Generally low, but locally high along active stream channels; may rill in cuts	132, 121
Qcl	Colluvium (Holocene)--Loose to firm, friable, unsorted sand, silt, clay, gravel, rock debris, and organic material in varying proportions	Very strong to extremely strong 8.5 magnitude earthquake on San Andreas	Generally low, but liquefiable when saturated	Unlikely unless seismically induced or loaded; will compact slowly over long periods of time if undisturbed.	Generally moderate; but locally severe gullying may occur in cuts.	
Qpaf	Alluvial fan and fluvial deposits (Pleistocene)--Brown dense gravely and clayey sand or clayey gravel that fines upward to sandy clay. These deposits display variable sorting and are located along most stream channels in the county. All Qpaf deposits can be related to modern stream courses. They are distinguished from younger alluvial fans and fluvial deposits by higher topographic position, greater degree of dissection, and stronger soil profile development. They are less permeable than Holocene deposits, and locally contain fresh water mollusks and extinct late Pleistocene vertebrate fossils. They are overlain by Holocene deposits on lower parts of the alluvial plain, and incised by channels that are partly filled with Holocene alluvium on higher parts of the alluvial plain. Maximum thickness is unknown but at least 50 m.	Extremely strong for 8.5 magnitude on San Andreas; ground amplification possible during earthquake.	Generally low; potentially liquefiable where shallow, well sorted silt and sand beds occur.	Unlikely	Generally low.	
QTsc	Santa Clara Formation (lower Pleistocene and upper Pliocene)--Gray to red-brown poorly indurated conglomerate, sandstone, and mudstone in irregular and lenticular beds. Conglomerate consists mainly of subangular to subrounded cobbles in a sandy matrix but locally includes pebbles and boulders. Cobbles and pebbles are mainly chert, greenstone, and graywacke with some schist, serpentinite, and limestone. On Coal Mine Ridge, south of Portola Valley, conglomerate contains boulders of an older conglomerate as long as one meter. Gray to buff claystone and siltstone beds on Coal Mine Ridge contain carbonized wood fragments as large as 60 cm in diameter. Included in Santa Clara Formation are similar coarse-grained clastic deposits near Burlingame. Thickness of Santa Clara Formation is variable but reaches a maximum of about 500 m along Coal Mine Ridge	Strong to extremely strong for 8.3 magnitude earthquake on San Andreas	No hazard.	Unlikely	Generally low; locally moderate to where natural surface disturbed or removed, particularly where highly fractured or weathered.	
QTm	Merced Formation (lower Pleistocene and upper Pliocene)--Medium-gray to yellowish gray and yellowish orange, medium- to very fine-grained, poorly indurated to friable sandstone, siltstone, and claystone, with some conglomerate lenses and a few friable beds of white volcanic ash. In many places sandstone is silty, clayey, or conglomeratic. Some of the conglomerate, especially where fossiliferous, is well cemented. Volcanic ash is in beds as much as 2 m thick and consists largely of glass shards. In type section of Merced Formation, the ash was originally reported by Sarna-Wojcicki (1976) to be 1.5+0.8 m.y. old, but more recent work by Sarna-Wojcicki and others (1991) indicates that the formation contains both the 738+3 ka Bishop ash and the 435 ka Rockland ash (Sarna-Wojcicki, oral comm., 1997). Merced Formation is about 1525 m thick in the sea cliffs north of Mussel Rock	Strong to extremely strong for 8.3 magnitude earthquake on San Andreas	No hazard.	Unlikely	Generally low; locally moderate to where natural surface disturbed or removed, particularly where highly fractured or weathered.	
fs	Sandstone--Greenish-gray to buff, fine- to coarse-grained sandstone (graywacke), with interbedded siltstone and shale. Siltstone and shale interbeds constitute less than 20 percent of unit, but in places form sequences as much as several tens of meters thick. In many places, shearing has obscured bedding relations; rock in which shale has been sheared to gouge constitutes about 10 percent of unit. Gouge is concentrated in zones that are commonly less than 30 m wide but in places may be as much as 150 m wide. Total thickness of unit is unknown but is probably at least many hundreds of meters	Strong to extremely strong for 8.3 magnitude earthquake on San Andreas	No hazard.	Unlikely	Generally low; locally moderate to where natural surface disturbed or removed, particularly where highly fractured or weathered.	

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Geologic Unit	Description	Seismically Induced Ground Shaking	Liquefaction	Ground Subsidence and Settlement	Erosion	Corresponding Soil Map Units
fg	Greenstone--Dark-green to red altered basaltic rocks, including flows, pillow lavas, breccias, tuff breccias, tuffs, and minor related intrusive rocks, in unknown proportions. Unit includes some Franciscan chert and limestone bodies that are too small to show on map. Greenstone crops out in lenticular bodies varying in thickness from a few meters to many hundreds of meters		No hazard.	Unlikely	Generally low; locally moderate to where natural surface disturbed or removed, particularly where highly fractured or weathered.	
fc	Chert--White, green, red, and orange chert, in places interbedded with reddish-brown shale. Chert and shale commonly are rhythmically banded in thin layers, but chert also crops out in very thick layers. In San Carlos, chert has been altered along faults to tan- to buff-colored clay. Chert and shale crop out in lenticular bodies as much as 75 m thick; chert bodies are commonly associated with Franciscan greenstone.		No hazard.	Unlikely	Generally low; locally moderate to where natural surface disturbed or removed, particularly where highly fractured or weathered.	
fsr	Sheared rock (melange)--Predominantly graywacke, siltstone, and shale, substantial portions of which have been sheared, but includes hard blocks of all other Franciscan rock types. Total thickness of unit is unknown, but is probably at least several tens of meters		No hazard.	Unlikely	Generally low; locally moderate to where natural surface disturbed or removed, particularly where highly fractured or weathered.	
sp	Serpentinite		No hazard.	Unlikely	Generally low; locally moderate to where natural surface disturbed or removed, particularly where highly fractured or weathered.	