Chapter 4

Geologic Hazards and Soils

Chapter 4. Geologic Hazards and Soils

INTRODUCTION

This chapter describes existing geologic and soil conditions in the JOS service area and identifies impacts associated with implementation of the 2010 Plan. Information on geology, soils, and seismicity characteristics and constraints was compiled using information from the U.S. Geological Survey (USGS), U.S. Soil Conservation Service (USSCS), and California Division of Mines and Geology (CDMG). Site-specific information on the JWPCP and the Los Coyotes, San Jose Creek, and Whittier Narrows WRPs was compiled from previously prepared geotechnical reports (Fugro, Consulting Engineers and Geologists 1975; LeRoy Crandall and Associates 1966, 1973; Hinkle 1987; Converse Davis Dixon Associates 1975; and Law/Crandall, Inc. 1994).

As described in Chapter 1, "Introduction", this EIR provides project-specific CEQA compliance for full secondary treatment and solids processing at the JWPCP. Other elements of the 2010 Plan are analyzed on a program level when current site-specific information is unavailable or locations of sites are not identified. Flooding impacts of the 2010 Plan and the Districts' proposed SWPPP are described in Chapter 3, "Hydrology and Water Quality". Impacts of the 2010 Plan related to contaminated soils and groundwater are described in Chapter 10, "Public Health."

SETTING

Regional Setting

Geography and Topography

The JOS provides services to communities within the San Gabriel Valley, the Los Angeles Coastal Plain, and the surrounding mountains and foothills. Geographically, the JOS service area is bounded by the San Gabriel Mountains to the north, the Verdugo Mountains to the west, the Pacific Ocean to the west and south, and the Orange County line and the Puente and San Jose hills to the east. Major geographic and topographic features of the JOS service area are shown in Figure 4-1. Within this area, the Los Angeles and San Gabriel Rivers and the Rio Hondo flow southward into the San Pedro Bay due to the southward topographic gradient. This topography allows the Districts to use gravity flow for most of the sewer network throughout the JOS service area.

The most significant topographic features within the JOS service area are the San Gabriel Valley and the Coastal Plain. The San Gabriel Valley occupies the north-eastern portion of the JOS service area. This broad, triangular piedmont plain descends southward from the San Gabriel Mountains at a slope of roughly 65 feet per mile and covers an area of approximately 170 square miles. The San Gabriel Valley is separated from the Coastal Plain to the south by northwest-trending highlands, including the Puente, Merced, and Repetto hills. The Whittier Narrows, a key hydrologic reference point that is an outlet for the Rio Hondo and San Gabriel River, lies at the gap between the Puente and Merced hills.

The Coastal Plain is an alluviated lowland that occupies an area to the southwest of the Whittier Narrows. The Coastal Plain extends to the Pacific Ocean in all directions, except where interrupted by a few local highlands such as the Baldwin, Dominguez, and Palos Verdes hills. The Los Angeles and San Gabriel Rivers and Rio Hondo flow generally southward through the Coastal Plain to the Pacific Ocean along engineered drainage channels.

Geology

The JOS service area lies within two geomorphic provinces: the Peninsular Ranges geomorphic province and the Transverse Ranges geomorphic province. The Peninsular Ranges geomorphic province extends southward from roughly the southern base of the Santa Monica Mountains and the foothills of the San Gabriel Mountains into Baja California and includes the southern portion of the JOS service area. The Transverse Ranges geomorphic province trends east-west along the northern border of the Peninsular Ranges geomorphic province and includes the northern portion of the JOS service area. The Coastal Plain lies within the Peninsular Ranges geomorphic province, while the San Gabriel Valley lies within the transition zone separating these two geomorphic provinces. Figure 4-2 shows the regional geology of the JOS service area.

The Coastal Plain portion of the JOS service area is characterized by the geologic features of the Peninsular Ranges geomorphic province. This region is typified by a succession of northwest-trending highlands and intervening valleys. This regional configuration of parallel highland areas is the direct result of ongoing crustal wrenching along a series of northwest-trending, predominantly right-lateral strike-slip fault zones such as the Palos Verdes, Newport-Inglewood, and Whittier-Elsinore faults. The geologic units directly underlying the JOS Central Plain service area are comprised primarily of very young alluvial and shallow marine sediments that were shed from local highlands. These recent deposits are underlain by a thick sequence of middle to upper Cenozoic-age marine sedimentary and volcanic rock units, such as the Monterey, Topanga, Puente, and Fernando Formations, that are locally exposed in the highlands. This sedimentary sequence overlies a metamorphic, deep-basement complex.

The portion of the JOS service area that occupies the San Gabriel Valley is characterized by geologic features of the Transverse Ranges geomorphic province. The east-west-trending San Gabriel Mountains that form the northern boundary of the San Gabriel Valley are the result of crustal thickening along predominantly left-lateral strike-slip and reverse faults that bound and transect this geomorphic province. The San Gabriel Valley floor is composed primarily of recent alluvial fan and stream deposits derived from the surrounding mountains and hills. These recent deposits are underlain by a thick sequence of late Cretaceous- to Pleistocene-age marine and nonmarine sedimentary rock units that are locally intruded by middle Miocene-age volcanic rocks. The sedimentary sequence overlies the basement complex that ranges from Miocene-age plutonic rocks in the eastern portion of the San Gabriel Valley to Precambrian-age plutonic rocks in the northern San Gabriel Valley.

Seismicity

The JOS service area is located in a seismically active region. Seismic Risk Zones have been developed based on the known distribution of historic earthquakes, evidence of past earthquakes, proximity to earthquake areas and active faults, and frequency of earthquakes in a given area. These zones are generally classified using either the CDMG Maximum Expected Earthquake Intensity Map or Uniform Building Code Seismic Risk Map of the United States. Because of the number of active faults in Los Angeles County and Southern California, the JOS service area is located in the highest risk zone defined by both the CDMG and UBC standards (Zones III and IV, respectively). Table 4-1 lists the active faults located within the JOS service area and the maximum probable earthquake that might occur along each fault within a 100-year period.

Table 4-1. Active Faults in the JOS Service Area

Fault Name	Maximum Probable Earthquake
Chino Fault	5.5
Cucamonga Fault	6.25
Elysian Park Seismic Zone	5.75
Newport-Inglewood Fault Zone	5.75
Palos Verdes Fault	6.75
Raymond Fault	4.0
San Gabriel Fault	5.75
Sierra Madre - San Fernando Fault	6.0
Verdugo Fault	4.5
Whittier-Elsinore Fault	6.0

In addition to these faults, other active faults within a 100-km radius of the JOS service area (e.g., the San Andreas and San Jacinto faults) have the potential for generating large earthquakes that could affect facilities within the JOS service area. Therefore, seismic risk zoning laws consider these faults as well. Active faults in the JOS service area are shown in Figure 4-3.

Seismic-Related Geologic Hazards

The potential for injury within populated areas and damage to structures during earthquakes can result from surface rupture along an active fault, ground shaking from a nearby or distant earthquake, surface settlement, or liquefaction of soils. These hazards and their potential effects are described below.

Surface Rupture and Faulting. The hazard of surface rupture is generally limited to land immediately adjacent to an active fault. According to the CDMG, an active fault is one that has experienced surface displacement within approximately the past 11,000 years (defined geologically as the Holocene epoch). The Alquist-Priolo Special Studies Zone Act of 1972 requires that special geologic studies be conducted to locate and assess the activity level of any fault within a potential development site. The intent of the law is to minimize damage from fault rupture by avoiding certain types of construction across an active fault. The law requires that some structures, such as private dwellings, be set back at least 50 feet from the mapped trace of an active fault. The active faults listed in Table 4-1 cross portions of the JOS service area and surface rupture along any of these faults may locally affect the JOS. None of the JOS treatment plants, however, are located across or within 50 feet of the mapped surface trace of an active fault.

Ground Shaking. Earthquake-induced ground shaking is a common phenomenon throughout the JOS service area. The energy released during an earthquake is commonly presented in terms of its Richter scale magnitude (M), which only applies at the epicenter of the earthquake. In the past decade, the Los Angeles region has experienced numerous moderate to large earthquakes, such as the October 1, 1987 Whittier Narrows earthquake (M = 5.9) and the January 17, 1994 Northridge earthquake (M = 6.7). These, in addition to other seismic events, have produced significant damage from ground shaking, sometimes at locations distant from the areas of associated surface ruptures.

The ground acceleration experienced at a particular site during an earthquake may be measured in terms of a fraction or multiple of the normal gravitational acceleration (g). A qualitative assessment of the ground-shaking intensity may be presented using the Modified Mercalli intensity scale, which assigns the Roman numerals I through XII to an area based on observed earthquake damage and personal sensation of the ground-shaking intensity. Mercalli designations are site specific and therefore vary from place to place for a given seismic event.

Potentially damaging ground shaking can occur distant from the event epicenter, depending on several factors, including:

- earthquake magnitude (i.e., a measure of the total energy released during the fault rupture),
- epicentral distance (i.e., the source to site distance),
- subsurface geologic conditions between the source and the site, and
- subsurface geologic conditions at the site.

The U.S. Geological Survey and California Institute of Technology operate hundreds of ground-motion accelerometers throughout Southern California. The data from these recording stations are publicly available. Using the existing ground acceleration data from nearby recording stations seated on similar geologic materials, the expected ground response to seismic events within the JOS service area can be determined. Designs for future JOS facilities will accommodate the anticipated ground accelerations at a given site to minimize damage to structures during future earthquakes.

Liquefaction. Liquefaction in soils and sediments occurs when granular material is transformed from a solid state to a liquid state as a result of loss of grain-to-grain contact generated during earthquake shaking. Earthquake-induced liquefaction most often occurs in areas underlain by unconsolidated, saturated sediments.

The JOS service area covers a large expanse of low-lying, alluvial-filled (unconsolidated granular sediment) basin area. Some areas within the basin are susceptible to liquefaction. In particular, areas adjoining rivers or river channels or areas near the shore may have a higher potential for liquefaction due to a relatively high water table in unconsolidated granular sediments.

Although portions of the JOS service area are susceptible to liquefaction, no incidents of damage to JOS facilities due to liquefying soils have been reported to date. If future systems are constructed over sediments with a high potential for liquefaction, mitigating solutions, such as hydrostatic pressure-relief drains, dewatering systems, support columns, soil removal, or other options will be implemented.

Vertical Amplification. Vertical amplification occurs when earthquake energy waves are magnified in certain types of soils and topographically enclosed areas, causing locally increased ground shaking. Vertical amplification has the potential to occur within JOS service areas that are underlain with younger, unconsolidated alluvial materials, especially when such materials are located in narrow canyons. These conditions result in the transmission earthquake energy at higher shear wave amplitudes than other materials, such as older more consolidated alluvium and competent bedrock. Areas susceptible to vertical amplification have the potential to experience more severe damage during an earthquake than do other areas. Amplification may also be caused by the reflection of shear waves back and forth in a restricted canyon, which would result in the temporary increase in shear wave size.

Tsunamis. A tsunami is a fast-moving, powerful oceanic wave or series of waves generated by an earthquake, underwater landslide, or violent volcanic eruption. The size and speed of these waves can be great and can cause extensive damage to low-lying coastal areas. Although not historically a threat, tsunamis could cause constitute a geologic hazard in the coastal regions of the JOS service area, from the Santa Monica Bay south to San Pedro Bay.

Nonseismic Geologic Hazards

Geologic hazards that could occur in the JOS service area independent of seismic activity include landsliding and subsidence, which are described below. Other hazards, including volcanic and geothermal activity, do not occur in the JOS service area and are not discussed here.

Landslides. Landslides occur in areas with unstable slopes. Unstable slopes could experience rapid earth movement in the form of a landslide with or without a seismic trigger. Landslides can occur as rock falls, mud and debris flow, and creep. The movement can be sudden or gradual. Areas in the JOS service area bounded by slopes that are unstable because of erosion, improper construction, overwatering, deep weathering, or structural orientation of geologic formations could create landslide hazards for nearby JOS facilities.

Subsidence. Measurable ground subsidence occurs in areas where groundwater extraction, oil production, or other mining activities have created subsurface voids, resulting in the sinking of the ground surface. Portions of the JOS service area, in the southwestern Coastal Plain, are subsiding from oil production in the Wilmington Oil Field.

Soils

One soil group is found in the JOS service area: the alluvial fans, plains, and terraces group. This group consists of 17 soil associations. A soil association is a landscape that has a distinctive proportional pattern of soils. Normally, a soil association consists of one or more major soils and at least one minor soil. Figure 4-4 shows the historic soil associations of the JOS service area and is based on information from the Los Angeles County area soil survey (USSCS 1969). Table 4-2 indicates the general properties of these associations, including the soil type, depth, slope, and associated hazards, including soil erosion and soil expansion, or shrink-swell potential. Soil erosion and expansion are described below.

Table 4-2. General Physical Properties of Soils in the JOS Service Area

JOS Facility	Association Number	Soil Association	Soil Type	Depth (inches)	Slope (%)	Erosion Potential	Shrink-Swell Potential
	10	Oceano	Sand	60	2-5	Moderate-high	Low
	11	Marina-Carey	Sand and sandy loam	60	2-15	High	Low
Whittier Narrows WRP	13	Tujunga-Sobaba	Fine sand and fine sandy loam	60	0-5	Low-moderate	Low
Los Coyotes WRP and San Jose Creek WRP	14	Hanford	Sandy loam	60	2-5	Low	Low
Los Coyotes WRP	15	Yolo	Silty loam	60	0	Low	Moderate
	16	Macho-Sorrento	Silty loam	60	2-9	Low-moderate	Moderate
	17	Cropley	Clay	60	0	Low	High
	18	Foster	Sandy loam	60	0	Low	Low
Whittier Narrows WRP	20	Chino (with inclusions of the Foster and Grangeville Associations)	Clay loam	60	0	Low	Moderate
JWPCP	21	Agoura-Placentia	Sandy loam	18-60	2-5	Low-moderate	High
	22	Agoura-Placentia	Sandy loam	18-60	5-9	Moderate	High
	23	Ramona-Placentia	Sandy loam	9-60	9-15	High	High
	24	Perkins-Rincon	Gravelly loam and silty clay loam	60	0-15	Low-moderate	High
	32	Vista-Amargoss	Sandy loam	14-38	30-50	High	Low
	33	Oak Glen-Gorman	Sandy loam	60	9-30	Moderate-high	Low
	34	Diablo-Altamont	Clay	22-51	2-9	Low	High
	35	Altamont-Diablo	Clay	20-39	9-30	High	High
	36	Altamont-Diablo	Clay	20-39	30-50	High	High
	37	San Andreas-San Benito	Sandy loam and clay loam	24-48	30-75	High	Low-moderate
	38	San Benito-Soper	Clay loam	36-48	30-50	High	Moderate
	41	Beaches	Sand	Very deep	Varies	Very high	Low

Source: U.S. Soil Conservation Service 1969.

Erodible Soils. Erosion is defined as the "wearing away of the land surface by running water, wind, ice, or other geological agents" (USSCS 1969). Accelerated erosion occurs where natural erosion has been significantly increased by human or domestic animal activity (USSCS 1969). High erosion potential in soils is primarily associated with loose textures (i.e., sand-size particles) and steep slopes. Loose soils can be eroded by water or wind, whereas clay soils are normally susceptible only to water erosion because of the strong cohesive forces that bind clay particles together. Generally, if wind and water conditions are the same, loose soil erodes at a faster rate than clay soil. (Marsh 1983.)

Soil associations that have a moderate to high erosion potential include the Oceano, Marina-Carey, steeper slope Augora-Placentia, Oak Glenn-Gorman, steeper slope Altamont-Diablo, and San Andreas-San Benito Associations. The Beaches association has a very high erosion potential. Generally, land in the JOS service area that is developed is not highly susceptible to erosion. Areas that are the most susceptible to erosion include steep, unvegetated slopes with erodible soils, which are concentrated in the Puente, Merced, and Repetto hills between the San Gabriel Valley and Coastal Plain, and the Palos Verdes hills located in the southwest portion of the JOS service area. However, a low-lying area in the Coastal Plain located immediately north of the Palos Verdes hills is composed of wind-eroded soils from the Oceano Association.

Expansive Soils. Shrink-swell is that quality of the soil that determines its volume change with change in moisture content. Shrink-swell in soils is measured by the volume change resulting from the shrinking soil when it dries and by the expansion of the soil as it takes up moisture (USSCS 1969). The volume change behavior of soils is influenced by the amount of moisture change, the amount of clay in the soil, and the type of mineral (e.g., montmorillinite) in the clay. In general, the soil with the highest clay content shrinks and swells the most, although the type of clay is an important contributing factor (USSCS 1969). Damage to structures, such as cracking of foundations, could result from differential movements and several alternating periods of shrink and swell. In the JOS service area, three soil associations (Cropley, Ramona-Placentia, and Diablo-Altamont) have soils that are considered highly expansive.

Joint Water Pollution Control Plant

The geologic, seismic, and soil conditions at the JWPCP are described based on four previously prepared geotechnical studies. The most recent and comprehensive of these studies was conducted in 1975 and includes information on the subsurface conditions and recommendations for construction of facilities at the JWPCP. (Fugro, Consulting Engineers and Geologists 1975.)

Geologic Units

The JWPCP site is located on alluvium consisting of sand and thin clay interbeds (Qt in Figure 4-2); the alluvium overlies the Pico, Repetto, and Puente Formations, which consist of porous sand with sandstone and shale interbeds. These formations commonly contain oil deposits. Catalina Schist, formed during the Jurassic period, composes the basement geologic units near the JWPCP. (Fugro, Consulting Engineers and Geologists 1975.)

Seismicity

Information on surface rupture, ground shaking, liquefaction, and vertical amplification at the JWPCP is derived from the soils analysis conducted by Fugro (1975) and maps from CDMG and the USSCS Soil Survey (USSCS 1969). The active faults nearest the JWPCP include the offshore portions of the Palos Verdes and Cabrillo fault, and the Newport-Inglewood fault. Surface locations of these faults are more than 5 miles from the plant. Because of this distance, the primary seismic hazard of surface rupture is unlikely to occur onsite. Secondary seismic hazards are described below.

Onsite ground shaking is probable because the JWPCP is located in Seismic Risk Zone III (California Division of Mines and Geology 1973). During the most recent earthquakes, ground shaking near the JWPCP reached an acceleration of 0.15 g; however, ground shaking at accelerations many times this magnitude in both the horizontal and vertical directions is possible. Liquefaction potential is low because foundations of structures are above groundwater elevations. This could fluctuate temporarily, but in the long term, the groundwater level will most likely drop. Also, interlayered sediments have high plastic limits and liquid limits above the groundwater table. Because the plant is located in a low-lying area with gentle slopes, the potential for landsliding is negligible.

Soils

Naturally occurring soils at the JWPCP have been extensively altered from several years of excavation associated with operations and construction of facilities and the introduction of artificial fill. The analysis of soil borings conducted by Fugro, Consulting Engineers and Geologists (1975) indicates that the site soils are generally dense and stiff and provide suitable foundation support. Most of the soil consists of clay, silt, and sand (Figure 4-5). A low-plasticity clay layer approximately 14 feet deep overlies a sandy silt zone. Beneath the silt is silty sand. The clay, silt, and sand exhibit different properties. Near surface clays are slightly compressible and moderately expansive. The sandy soils are not cohesive, compressible, or easily hydro-consolidated. Silty materials exhibit some cohesion when moist, but not when dry. Some artificial fill soils are also present in areas throughout the site.

Fugro, Consulting Engineers and Geologists (1975) indicates that the soils below the JWPCP have a moderate expansion potential, although the general area has high expansion potential affiliated with the Ramona-Placentia Association (USSCS 1969).

Los Coyotes Water Reclamation Plant

Geologic and soils conditions at the Los Coyotes WRP are described based on soil borings and conclusions for a foundation investigation prepared for the existing onsite facilities (LeRoy Crandall and Associates 1966).

Geologic Units

The Los Coyotes WRP is located in the broad alluvial floodplain of the San Gabriel River, with alluvial fan deposits of Holocene age (deposition occurring 11,000 years ago to present). Site geology consists of Holocene alluvial deposits composed mostly of silty sand and sand and, to a lesser degree, silt (LeRoy Crandall and Associates 1966).

Seismicity

The Newport-Inglewood and Whittier faults, the active faults closest to the Los Coyotes WRP, are 8 miles or more from the plant site. Thus, the primary seismic hazard of surface rupture is not likely to occur onsite. Because the plant is located on younger alluvium, secondary seismic hazards, including vertical amplification, have the potential to occur. The potential for landsliding onsite is negligible because of the low-lying area and gentle slopes. The potential for liquefaction is also low because the foundations of structures are above groundwater elevations. Ground shaking has previously caused damage to the Los Coyotes WRP, but operations at the facility have never been interrupted.

Soils

The USSCS Soil Survey (USSCS 1969) determined that the Hanford Association underlies the area surrounding the Los Coyotes WRP. Soils of the Hanford Association are typically more than 60 inches deep and have surface layers of pale brown sandy loam. Below the upper 8 inches, the substratum is likely to consist of light yellow-brown coarse sandy loam and gravel. Slopes are generally shallow (2-5%) and both the erosion and shrink-swell potential are low. Approximately 5% of the Hanford Association consists of the Hesperia soils, which are well drained and moderately permeable. The slightly acidic sand and sandy loam surface layers are underlain by pale brown, mildly alkaline sandy loam. The soils are moderately erodible and shrink-swell potential is low.

Similar to the conditions at the JWPCP, naturally occurring soils at the Los Coyotes WRP have been altered substantially from the introduction of artificial fill and extensive grading for the existing onsite facilities. Borings to depths of 40 feet indicate that the soils beneath the site consist primarily of silty sand and sand, which are moderately firm to firm. Lesser deposits of moderately firm silt also occur onsite. (LeRoy Crandall and Associates 1966 and 1973.)

San Jose Creek Water Reclamation Plant

The geologic, seismic, and soil conditions at the San Jose Creek WRP are described in a geotechnical report prepared for the Stage III expansion of the plant in 1987 (Hinkle 1987).

Geologic Units

The San Jose Creek WRP is located on floodplain alluvium (approximate thickness of 200 feet) deposited by the San Gabriel River (Figure 4-2). The Repetto and Puente formations underlie the sediments at the San Jose Creek WRP and form the nearby hills.

Seismicity

Seismic considerations previously addressed in a site-specific geotechnical report (Hinkle 1987) include surface rupture, ground shaking, and liquefaction. The report identifies a nearby active fault (the Whittier-Elsinore Fault). The Raymond Hill Fault is a potentially active fault located near the San Jose Creek WRP. The Whittier-Elsinore Fault is approximately 3.5 miles to the south, but it dies out and does not cross the site. Therefore, there should be little danger of surface rupture onsite.

Ground shaking and liquefaction potential were evaluated for earthquake magnitudes of 7.5, 6.75, and 6.0 (Hinkle 1987). The results of the analysis indicate that foundation and footing design can compensate for soil shear waves and that there is little potential for liquefaction onsite. Shear waves were assumed to reach a velocity of 1,300 feet per second with the depth to bedrock being 200 feet. Liquefaction analysis was based on the conservative assumption that onsite soils would consist of uniform fine sandy material (Hinkle 1987). The analysis concluded that, even with deep sandy material, liquefaction is not likely to occur.

Soils

Similar to the conditions at the Los Coyotes WRP, naturally occurring soils at the San Jose Creek WRP have been altered substantially from introduction of artificial fill and grading for the existing onsite facilities. The USSCS Soil Survey (USSCS 1969) determined that the Hanford Association underlies the San Jose Creek WRP. Borings from the 1987 geotechnical survey indicate four subsurface conditions (Hinkle 1987). The first condition includes shallow soils between 5 and 10 feet deep. Soils at this level are similar throughout the site, with various types of silty and fine to medium sands, which are generally moist and have little cohesion. Because of the shallow nature of these surface soils, liquefaction is not likely to occur.

The second condition includes soils at depths between 10 and 15 feet. This level includes silty sands and sandy silts. These soils vary in density from medium dense to dense. They are moderately permeable and saturated. Perched water layers less than 2 feet thick were found at depths between 5 and 15 feet in areas with silt. Perched water occurring onsite was attributable to heavy irrigation associated with a nursery that no longer is in operation.

The third condition consists of soils below a depth of 15 feet. These soils alternate between sand, gravelly sand, fine sand, and sandy silts and are generally dry to a depth of 20 feet. The density of the sands at this depth increases and the sands still have little cohesion.

The fourth condition is groundwater. The report indicates that there is a high water table encountered at depths as shallow as 22 feet that can make excavation difficult.

Whittier Narrows Water Reclamation Plant

Geologic, seismic, and soils conditions at the Whittier Narrows WRP are described based on a previously prepared foundation investigation and statistical seismicity report for the plant site (Converse Davis Dixon Associates 1975) and soil investigation report prepared for the proposed expansion (Law/Crandall, Inc. 1994).

Geologic Units

The Whittier Narrows WRP is located in the Rio Hondo floodplain. The underlying material is Holocene alluvium varying in thickness from 20 to 200 feet and consisting mostly of sand and gravel with varying amounts of clay. Oligocene nonmarine sediments are adjacent to and possibly under the Holocene alluvium. (Converse Davis Dixon Associates 1975.)

Seismicity

Seismic considerations addressed in the site-specific geotechnical reports prepared for the Whittier Narrows WRP include surface rupture, ground shaking, and liquefaction potential. The active faults closest to the Whittier Narrows WRP are the same as those near the San Jose Creek WRP: the Whittier and Raymond Hill faults. The Whittier fault is the closest, at approximately 2.5 miles to the southeast. A maximum probable earthquake of 7 magnitude on the nearby Whittier fault could generate an acceleration of 0.5 g at the Whittier Narrows WRP. Therefore, although surface rupture is not likely to occur at the plant site, damage from ground shaking could occur. Past earthquakes in the region have not affected the operation of the plant. (Law/Crandall, Inc. 1994.)

A liquefaction investigation was recently completed for the Whittier Narrows WRP and concluded that the groundwater table is relatively high and there is a potential for liquefaction to occur in the sandy materials underlying the site (Law/Crandall, Inc. 1994).

Soils

Similar to the conditions at the Los Coyotes WRP, naturally occurring soils at the Whittier Narrows WRP have been altered substantially from the introduction of artificial fill and extensive grading for the existing onsite facilities. The USSCS Soil Survey (USSCS 1969) determined that the Chino Association underlies the Los Coyotes WRP. Chino soils are typically more than 60 inches deep. Surface layers of these soils typically consist of gray and dark gray loam, silt loam, or clay loam 16 inches thick. Subsurface soils are lighter brown-gray loam. Some areas have a high water table and some saline- and alkali-affected soils. Erosion potential is low and shrink-swell is moderate. These soils tend to have gentle slopes.

Borings from the 1975 foundation investigation and more recent 1994 soil investigation indicate that the existing site is currently covered with fill ranging in depth from 2 to 10 feet. Most of the fill is not considered suitable for foundation or additional fill support. Natural soils occur below the fill and consist of a layer firm and medium-dense sandy silt with varying thickness between 0.5 and 3 feet. Deeper soils consist of dense to very dense sands and silty sands with some lenses of gravel. The native sandy soils are slightly compressible and have moderate shear-strength and the native fine-grained soils have moderate to moderately high compressibility. (Converse Davis Dixon Associates 1975.)

IMPACTS AND MITIGATION MEASURES OF THE 2010 PLAN ALTERNATIVES

Methodology and Assumptions for Impact Analysis

The impacts in this section were evaluated based on standard geologic and soil practices, a published soil survey of the Los Angeles area (USSCS 1969), and geotechnical studies conducted at the JWPCP and the inland WRPs. This impact analysis is based on the assumption that all structures and facilities will be constructed according to UBC standards for Seismic Risk Zone IV to minimize the potential for injury caused by structural failure from primary and secondary hazards during an earthquake.

Criteria for Determining Significance

The significance criteria of this analysis were developed from Appendices G and I of the State CEQA Guidelines and from professional practice. The project would result in a significant impact if it would:

- cause substantial flooding, erosion, or siltation;
- expose, people, structures, or property to major geologic hazards such as earthquakes, landslides, mudslides, or ground failure;
- result in unstable earth conditions or changes in geologic substructure;
- result in disruptions, displacements, compaction, or overcovering of soil;
- result in change in topography or ground surface relief features;
- result in an increase in wind or water erosion of soils, either onsite or offsite;
- be located in an Earthquake Fault Zones, a known active fault zone, or an area characterized by surface rupture that might be related to a fault;
- be located in substrate consisting of material that is subject to liquefaction or other secondary seismic hazards in the event of ground shaking;
- display evidence of static hazards, such as having the potential for landsliding or having excessively steep slopes, that could result in slope failure; or
- be located in soil characterized by shrink-swell potential that might result in deformation of foundations or damage to structures.

Impacts that did not meet one or more of these criteria were considered less than significant.

Comparison of Alternatives

Table 4-3 at the end of this chapter shows that the impacts associated with Alternatives 2, 3, and 4 are similar to those associated with Alternative 1 with some variation. This variation is described below for each alternative.

Alternative 1: Upgrade JWPCP/Expand Los Coyotes WRP/San Jose Creek WRP

Construction Impacts

Impact: Potential for Increased Short-Term Erosion during Construction at the JWPCP. During construction of new facilities and modification of existing facilities at the JWPCP, earthmoving operations could cause the potential for increased short-term erosion. The storage and movement of soil greatly affects the amount of erosion that occurs. If soil is improperly stored or transported, wind and water can erode soil. Although the JWPCP site is nearly level (there is less than a 20-foot elevation gain throughout the site), there would be an increase in wind and water erosion and an increase in sedimentation rates associated with construction. This impact is considered significant.

Mitigation. Implementation of the following mitigation measure would be required to reduce this impact to a less-than-significant level:

- **Mitigation Measure 4-1. Prepare and implement an erosion control and rehabilitation plan.**

  The Districts propose to develop and implement an erosion control and rehabilitation plan to reduce the effects of construction activities on increased wind and water erosion rates. The plan would be prepared by a soils engineer before construction activities begin. Elements of the plan could include, but would not be limited to, the following:

  - goals for grading, stabilization, and revegetation consistent with the final grading concept plan;

  - instructions to use berms on graded material, where possible, to reduce surface water flows across graded areas;

  - provisions to direct any necessary drainage runoff onto stable surfaces in a manner that does not cause soil erosion;

- use of bales or silt fences where appropriate;

- use of soil stabilization products, such as mulch jute netting, geotextile mats, or excelsior blankets, on cut-and-fill slopes that require aggressive erosion control measures;

- application of a chemical soil binder, used alone or in combination with mulches, if immediate stabilization is required;

- location and function of sediment traps and debris basins and provisions for removing sediment after construction;

- provisions for long-term maintenance of cut or filled areas after construction ends and during ongoing operations, if needed;

- species lists and planting density for restored areas;

- locations of all areas where vegetation will be removed;

- methods to stabilize these areas;

- locations of areas to be revegetated and types, quantities, and methods of seeding, mutating, planting, and fertilizing planted areas;

- dust-reducing and wind erosion control measures that will be implemented during construction to reduce wind erosion across graded areas; and

- a schedule for implementation so that all erosion control measures will be installed and maintained throughout the rainy or windy season of each construction year.

Developing and implementing an erosion control and rehabilitation plan before the start of construction activities would reduce this impact to a less-than-significant level because it would ensure that wind and water erosion would be minimized during and after the construction phase.

Impact: Potential for Creation of Unstable Temporary Slopes during Construction at the JWPCP. Construction of new facilities could result in the creation of temporary slopes at excavation sites. These sites could be greater than 15 feet deep and have steep and potentially unstable angles. Figure 4-5 shows that there are localized deposits of sands and silty sands near the proposed aeration and sedimentation tanks. Clay soils are cohesive and can support steeper slopes, but sands are less cohesive and require shallower slopes. Construction equipment operating near the slopes can cause slope failure on or adjacent to excavated areas. This impact is considered less than significant because the Districts will implement construction safety standards, including construction setbacks and, where necessary, shoring to ensure the safety of construction workers.

Mitigation. No mitigation is required.

Impact: Minimal Potential for Structural Damage and Injury Resulting from Construction at the JWPCP in Seismic Risk Zone IV. Implementing the 2010 Plan would result in construction in Seismic Risk Zone IV, a zone of high earthquake severity where damage to structures from ground shaking caused by earthquakes would be high. Structures built according to seismic safety standards are less susceptible to damage than are structures that are not built according to these standards and therefore pose less risk of injury to people. The Districts will comply with the State of California and UBC in all facility construction.

Previous geotechnical studies indicate that seismic design can minimize the effects of compressional and longitudinal shock waves of earthquakes and minimize the effects of strong ground shaking. The engineering recommendations made in these studies were incorporated into existing building design; the studies incorporate earthquake acceleration levels and site-structure resonance factors to maximize the structural integrity of buildings during an earthquake. (Fugro, Consulting Engineers and Geologists 1975.) This impact is considered less than significant because compliance with the requirements of the State of California and UBC will minimize exposure of people, structures, or property to geologic hazards.

Mitigation. No mitigation is required.

Impact: Minimal Potential for Structural Damage at the JWPCP Resulting from Construction on Ground Subject to Liquefaction. The JWPCP site contains a combination of alluvial sediments and thin clay interbeds that have high liquid and plastic limits, and the onsite materials are considered stiff and dense (Fugro, Consulting Engineers and Geologists 1975). Liquefaction potential is low because the foundations of structures are above groundwater elevations; although the groundwater elevations may fluctuate temporarily, in the long term, the groundwater elevation will likely drop. Because of the low liquefaction potential of the site, this impact is considered less than significant.

Mitigation. No mitigation is required.

Impact: Potential for Structural Damage Resulting from Construction at the JWPCP on Expansive Soils. The previously prepared geotechnical study indicates that some soils on the JWPCP site have a moderate expansion potential. Several samples were taken for analysis from the JWPCP site at various depths. The soil samples showed relatively high expansion potential (Fugro, Consulting Engineers and Geologists 1975). Construction of facilities on expansive soils may result in damage caused by the movement and settlement that accompanies shrinking and swelling. This impact is considered significant.

Mitigation. Implementation of the following mitigation measure would be required to reduce this impact to a less-than-significant level:

- **Mitigation Measure 4-2. Implement appropriate engineering considerations for facilities.**

  The Districts propose to use a soils engineer to determine the physical properties of soils at the plant site. If the studies indicate that the soils exhibit liquefaction potential or moderate to high shrink-swell potential, the Districts would implement appropriate engineering or construction siting considerations. Such considerations could include, but would not be limited to, the following:

  - constructing thicker pavements or slabs for facilities,

  - relocating facilities to avoid construction on soils with liquefaction potential or expansive soils, or

  - excavating soils with high liquefaction potential or highly expansive soils and replacing them with engineering-quality fill.

Implementing appropriate engineering or siting considerations would reduce the effects of construction on expansive soils to a less-than-significant level.

Impact: Potential for Increased Short-Term Erosion during Construction at the Los Coyotes and San Jose Creek WRPS. During construction of new facilities at the Los Coyotes and San Jose Creek WRPs earthmoving operations would cause the potential for increased short-term erosion rates. This impact is considered significant for reasons described above in the discussion of JWPCP impacts.

Mitigation. Implementation of the following mitigation measure would be required to reduce this impact to a less-than-significant level:

- **Mitigation Measure 4-1. Prepare and implement an erosion control and rehabilitation plan.**

  This mitigation measure is described above under "JWPCP".

Impact: Minimal Potential for Structural Damage and Injury Resulting from Construction at the Los Coyotes and San Jose Creek WRPs in Seismic Risk Zone IV. This impact is considered less than significant for reasons described above in the discussion of JWPCP impacts.

Mitigation. No mitigation is required.

Impact: Minimal Potential for Structural Damage at the San Jose Creek WRP Resulting from Construction on Ground with Liquefaction Potential. Liquefaction of soils at the San Jose Creek WRP site is considered unlikely because the site contains a combination of alluvial sediments and thin clay interbeds that have high liquid and plastic limits. Liquefaction potential is low because the foundations of structures are above groundwater elevations. Because of the low liquefaction potential of the site, this impact is considered less than significant.

Mitigation. No mitigation is required.

Impacts of Biosolids Disposal and Reuse

Impact: Minimal Potential for Soil and Topographic Disturbance Resulting from Biosolids Disposal and Reuse. Implementation of the 2010 Plan would increase the amount of biosolids currently generated by the Districts, which would result in increased disposal and reuse activities. Previously undisturbed soil and topography could be disturbed to accommodate additional or expanded sites for composting and land application. Land application could cause slight changes in the physical and chemical characteristics of soil. Increasing the amount of biosolids to be landfilled would increase the volume of material sent to a landfill and could require additional soil cover material. However, the Districts will only use sites that are properly permitted and that have mitigated all site-specific impacts to the extent possible through either the preparation of site-specific environmental documents or compliance with other federal, state, and local regulations.

Mitigation. No mitigation is required.

Alternative 2: Upgrade JWPCP/Expand Los Coyotes WRP

Under Alternative 2, impacts at the JWPCP and the Los Coyotes WRP would be the same as under Alternative 1. No impacts would occur at the San Jose Creek or Whittier Narrows WRPs. An additional impact would occur from construction of a relief sewer, which is described below.

Impact: Potential for Increased Short-Term Erosion during Construction of Sewer Lines. Relief of the conveyance system along JO "B" from the Whittier Narrows WRP to the Los Coyotes Interceptor and JO "H" between the San Jose Creek WRP and the Los Coyotes Interceptor would involve earthmoving operations that would disrupt soil and could lead to increased short-term erosion. However, the Districts' standard methods for constructing sewer relief lines (including disturbing less-than-0.1-acre areas at any given time, minimizing construction schedules, and employing standard construction procedures for erosion control) would ensure that this impact is less than significant.

Mitigation. No mitigation is required.

Impact: Potential for Structural Damage Resulting from Construction of Sewer Lines over Expansive Soils. The potential for structural damage from construction of sewer lines over expansive soils has not been assessed specifically for the proposed alignments. This impact is considered less than significant because the sewer line will be constructed according to UBC standards.

Mitigation. No mitigation is required.

Alternative 3: Upgrade JWPCP/Expand Whittier Narrows WRP

Under Alternative 3, impacts at the JWPCP would be the same as under Alternatives 1 and 2. No impact would occur at the Los Coyotes or San Jose Creek WRPs or on sewer lines. Impacts at the Whittier Narrows WRP are described below.

Impact: Potential for Increased Short-Term and Long-Term Erosion during Construction and Ongoing Operations at the Whittier Narrows WRP. Construction of new facilities at the Whittier Narrows WRP would involve earthmoving operations that would lead to increased erosion rates. Approximately 90,000 cubic yards of fill would be required to elevate the proposed expansion area about 15 feet to elevations above the 100-year flood level. The construction activities for the Whittier Narrows WRP expansion would result in increases in wind and water erosion during construction and could result in increased long-term erosion in areas where high fill is introduced. This impact is considered significant.

Mitigation. Implementation of the following mitigation measure would be required to reduce this impact to a less-than-significant level:

- **Mitigation Measure 4-1. Prepare and implement an erosion control and rehabilitation plan.**

  This mitigation measure is described above under Alternative 1.

Impact: Minimal Potential for Structural Damage and Injury Resulting from Construction at the Whittier Narrows WRP in Seismic Risk Zone IV. This impact is considered less than significant for reasons described for the JWPCP under Alternative 1.

Mitigation. No mitigation is required.

Impact: Potential for Structural Damage at the Whittier Narrows WRP from Construction on Ground with Liquefaction Potential. The plant site is located in low-lying alluvium near a river channel with a relatively high water table. A recently completed liquefaction investigation for the Whittier Narrows WRP indicates that, although some of the underlying soils have coarse texture and high density, there is a potential for liquefaction to occur in the sandy materials underlying the area proposed for expansion (Law/Crandall, Inc. 1994). This impact is considered significant.

Mitigation. Implementation of the following mitigation measure would be required to reduce this impact to a less-than-significant level:

- **Mitigation Measure 4-2. Implement appropriate engineering considerations for facilities.**

  This mitigation measure is described above under Alternative 1.

Impact: Potential for Unstable Earth Conditions from Construction on High Fill on Compressible Soils. Under Alternative 3, the areas proposed for expansion at the Whittier Narrows WRP would be constructed on fill approximately 6 feet high to avoid interruption of operation in the event of a flood. If the height of the fill exceeds the shear strength of the saturated soils, settlement and ground failure could occur. Settlement and ground failure generally occur during or shortly after construction. This impact is considered potentially significant because it could result in damage to structures or injury to people.

Mitigation. Implementation of the following mitigation measure would be required to reduce this impact to a less-than-significant level:

- **Mitigation Measure 4-2. Implement appropriate engineering considerations for facilities.**

  This mitigation measure is described above under Alternative 1.

Alternative 4: Upgrade JWPCP/Expand Los Coyotes WRP/ San Jose Creek WRP/Whittier Narrows WRP

Under Alternative 4, impacts at the JWPCP and Los Coyotes and San Jose Creek WRPs would be the same as under Alternative 1; impacts on sewers would be the same as under Alternative 2; and impacts at the Whittier Narrows WRP would be the same as under Alternative 3. No additional impacts would occur under this alternative.

No-Project Alternative

No geologic or soils impacts would occur under this alternative.

Table 4-3. Comparison of Geologic and Soils Impacts by Alternative

	Alternative 1			Alternative 2			Alternative 3		Alternative 4				
Impacts and Mitigation Measures	JWPCP	LC	SJC	JWPCP	LC	Sewers	JWPCP	WN	JWPCP	LC	SJC	WN	Sewers
Construction Impacts													
Impact: Potential for increased short-term erosion during construction at the JWPCP (S) Mitigation Measure 4-1. Prepare and implement an erosion control and rehabilitation plan	✓			✓			✓		✓				
Impact: Potential for creation of unstable temporary slopes during construction at the JWPCP (LT) No mitigation is required.	✓			✓			✓		✓				
Impact: Minimal potential for structural damage and injury resulting from construction at the JWPCP in Seismic Risk Zone IV (LT) No mitigation is required	✓			✓			✓		✓				
Impact: Minimal potential for structural damage at the JWPCP resulting from construction on ground subject to liquefaction (LT) No mitigation is required	✓			✓			✓		✓				
Impact: Potential for structural damage resulting from construction at the JWPCP on expansive soils (S) Mitigation Measure 4-2. Implement appropriate engineering considerations for facilities	✓			✓			✓		✓				
Impact: Potential for increased short-term erosion during construction at the Los Coyotes and San Jose Creek WRPs (S) Mitigation Measure 4-1. Prepare and implement an erosion control and rehabilitation plan		✓	✓		✓					✓	✓		

LT = less than significant. S = significant.

Table 4-3. Continued

Impacts and Mitigation Measures	Alternative 1			Alternative 2			Alternative 3		Alternative 4				
	JWPCP	LC	SJC	JWPCP	LC	Sewers	JWPCP	WN	JWPCP	LC	SJC	WN	Sewers
Impact: Minimal potential for structural damage and injury resulting from construction at the Los Coyotes and San Jose Creek WRPs in Seismic Risk Zone IV (LT) No mitigation is required		✓	✓		✓					✓	✓		
Impact: Minimal potential for structural damage at the San Jose Creek WRP resulting from construction on ground with liquefaction potential (LT) No mitigation is required			✓								✓		
Impact: Potential for increased short-term erosion during construction of sewer lines (LT) No mitigation is required						✓							✓
Impact: Potential for structural damage resulting from construction of sewer lines over expansive soils (LT) No mitigation is required						✓							✓
Impact: Potential for increased short-term and long-term erosion during construction and ongoing operations at the Whittier Narrows WRP (S) Mitigation Measure 4-1. Prepare and implement an erosion control and rehabilitation plan								✓				✓	
Impact: Minimal potential for structural damage and injury resulting from construction at the Whittier Narrows WRP in Seismic Risk Zone IV (LT) No mitigation is required								✓				✓	

LT = less than significant. S = significant.

Impacts and Mitigation Measures	Alternative 1			Alternative 2			Alternative 3		Alternative 4				
	JWPCP	LC	SJC	JWPCP	LC	Sewers	JWPCP	WN	JWPCP	LC	SJC	WN	Sewers
Impact: Potential for structural damage at the Whittier Narrows WRP from construction on ground with liquefaction potential (S) Mitigation Measure 4-2. Implement approprite engineering considerations for facilities								✓				✓	
Impact: Potential for unstable earth conditions from construction on high fill on compressible soils Mitigation Measure 4-2								✓				✓	
Impacts of Biosolids Disposal and Reuse Impact: Minimal potential for soil and topographic disturbance resulting from biosolids disposal and reuse (LT) No mitigation is required	✓			✓			✓		✓				

No significant and unavoidable geologic hazard and soil impacts would occur.

LT = less than significant. S = significant.