5.4 - GEOLOGY AND SOILS

5.4.1 - Introduction

Information in this section is based on the following documents:

- Preliminary Geotechnical Investigation for Rich Haven Specific Plan, Petra Geotechnical, Inc, September 27, 2005, provided in Appendix C, Geotechnical Report, of this Draft EIR.
- NMC Final EIR, City of Ontario, October 1997.
- NMC General Plan, City of Ontario, January 1998.

The NMC Final EIR identified potential impacts to proposed development from geologic and seismic hazards. These potential impacts included: expansive soils; weak and compressible soils; chemical reactivity in soils; fault rupture; seismicity; liquefaction; subsidence; and near-surface (perched) groundwater.

The NMC Final EIR was prepared at a broad programmatic level and is not sufficient for full and complete evaluation of geologic and soils conditions at an individual project site. Rather, information contained in the NMC Final EIR is intended to supplement detailed studies prepared for the development of individual subareas.

The NMC Final EIR concluded that adequate geotechnical and geological reports will be required prior to the development of individual subareas and that mitigation measures would be developed as a result of these studies. Preparation of this section of the Draft EIR conforms to the recommendations contained in the NMC Final EIR and evaluates additional information specific to the project site that may not have been included in the broad, program-level evaluation of the Final EIR prepared for the NMC.

5.4.2 - Existing Conditions

Regional Conditions

The project site is located in the central portion of the Chino Basin. This basin is an area of large-scale crustal disturbances that exhibit structural faulting and the resultant seismicity. Surficial geology in the Chino Basin generally consists of medium-grained Holocene alluvium, fine-grained Holocene alluvium, and eoloian (wind-blown) sands. Alluvium depth in the region varies from 400 to 1,500 feet below ground surface (BGS). Bedrock is considered comprised of Tertiary sedimentary and igneous rock.

Soils generally consist of the following soil associations: Foster-Grangeville, Tujunga-Delhi, Hanford-Greenfield, and Merrill-Chino. Extensive dairy operations in the region have resulted in the commingling of cow manure and soils, which has affected soil conditions. Manure, which has a very high organic content, mixed with native soil results in materials that are unsuitable for support of structures or for use as compacted fill.

Groundwater depths in the vicinity of the project site have been dropping from 100 feet BGS in 1960 to approximately 550 feet BGS in 1991. Groundwater subsidence ranges from 0.8 to 2.5 feet due to historic groundwater extraction. The Chino Basin Watermaster is implementing a program to monitor subsidence and to control groundwater withdrawals in the region.

Faulting and seismicity in the region could occur from various fault systems. The California Geological Survey (formerly known as the Division of Mines and Geology) of the Department of Conservation requires the identification of faults within 62 miles of a project site that have the potential to affect a proposed project. Table 5.4-1 presents information on faults located in the region that could potentially affect the project site.

Table 5.4-1: Regional Fault Systems

Fault	Distance From NMC	Direction From Project Site	Maximum Magnitude Potential
Chino Fault	6.0 miles	South	6.7
Whittier-North Elsinore	10.0 miles	West	6.5
Cucamonga Fault	10.0 miles	North	7.0
Whittier Fault	11.7 miles	West	6.8
Elsinore Fault	17.0 miles	Southeast	6.8
Sierra Madre Fault	15.0 miles	North-northwest	7.0
San Andreas Fault Zone	21.0 miles	East-northeast	7.1
Source: NMC Final EIR, October 1997.			

Project Site Conditions

The project site is generally level with a very slight slope (0.5 to 1 percent) trending toward the south, and has been primarily disturbed from dairy and agricultural activities that have resulted in modification of surface and below-grade conditions. Secondary site disturbances have resulted from the construction and maintenance of the Southern California Edison high-voltage transmission line corridor and the development of a nursery. There are no significant geologic features or rock

outcroppings that occur on the project site. The Preliminary Geologic Investigation did not detect evidence of active faulting, flooding, or other significant geotechnical issues at the site.

Faulting

No active or potentially active faults are known to project through the site. The project site does not lie within an Earthquake Fault Study Zones as designated by the California Geological Survey in conformance with the State-mandated Alquist-Priolo Act of 1972. An active fault, as defined by state law, is one that has proven movement (offset) within the last 11,000 years. Conversely, inactive faults do not show movement within this same period. Faults are considered potentially active if they lack sufficient proof to conclude either activity or inactivity. The closest faults to the site are located 7 to 19 miles distant.

Seismicity

The subject site is located in a seismically active area of the Chino Basin. Seismic-related ground shaking on the project site could result from its proximity to the earthquake faults previously identified. Although the probability of primary surface rupture is considered low, the intensity of ground shaking on the project site depends on factors such as: distance to an identified fault; type of fault; thickness and composition of alluvium; depth to bedrock; and soil characteristics.

Surficial Geology

Figure G-1 of the NMC Final EIR identifies the entire project site as eolian sand. Eolian sand is wind-deposited, has fine to medium sized grains, and has a high potential for erosion. However, much of this sand on the project site has been commingled with manure reducing its erosion potential. Native alluvial soils were observed beneath the fill materials within all of the exploratory tests pits and borings. The alluvial materials consist of alternating layers of sand, silty sand, clayey sand, and sand with gravel. The uppermost layers of alluvium typically consist of fine-grained silty sands that are slightly porous to porous and loose to medium dense in the upper 3 to 6 feet.

Soils

Figure 6-2 of the NMC General Plan identifies most of the entire project site as Delhi Fine Sand with some pockets of Tujunga Loamy Sand, Hanford Sandy Loam, and Hilmar Loamy Fine Sand. The Delhi fine Sand soil is considered a Class III soil, as identified on Figure AG-1 of the NMC Final EIR, and is characterized as reaching depths of 60 inches BGS, has moderate permeability, lacks a clear development profile, and exhibits slow run-off. This soil has a slight potential for hydrocollapse.

Alluvium

Consistent with the regional conditions, the project site is underlain by alluvium consisting of clayey sands with minor amounts of gravelly sands and silts. This alluvium is considered to exhibit slight to moderate potential for hydrocollapse.

Manure Deposits

Localized deposits of manure and manure-rich topsoil exist within the site. The manure deposits within active cattle pens were observed as thick as 12 inches but could be greater in areas between test pits. Manure contains a very high organic content, generally greater than 10 percent by weight and includes pure manure or soil mixed with substantial amounts of manure. Manure stockpiling resulting from on-going dairy operations occurs on various locations of the project site. According to the Preliminary Geotechnical Investigation, stockpiles of manure were noted at the dairies and the pig farm.

Artificial Fill

Artificial fills overlie the majority of the site and consist of surficial soils that were disturbed by previous activities such as plowing agricultural fields. Uncontrolled fill is characterized as loose, dry silty sands, and may contain variable amounts of organic material. These materials are highly susceptible to hydrocollapse. The Preliminary Geotechnical Investigation concluded that the fill materials observed are considered non-engineered and unsuitable for support of additional fill and residential structures and/or improvements.

Groundwater

The Chino Basin is host to an extensive groundwater aquifer that is managed by the Chino Basin Watermaster. Groundwater is relatively deep and historic data indicate that regional water table beneath the site area has fallen significantly since 1933. In calendar year 2000, the groundwater table in the vicinity of the project site was approximately 180 feet BGS. Previous records identified groundwater at 150 feet BGS in 1960, 120 feet BGS in 1933, and approximately 85 feet BGS in 1904. Historically, this latter elevation is considered the shallowest groundwater level at the project site. The Preliminary Geotechnical Investigation reported that no groundwater was encountered at 51.5 feet BGS, which was the maximum depth of the exploratory boring.

Existing Regulations and Standard Conditions:

The City of Ontario enforces a variety of codes and programs to ensure the structural integrity of buildings constructed within the City. The City of Ontario Municipal Code Title 13: Flood Damage Prevention Program incorporates a variety of building and grading controls to reduce flooding and erosion. The City's Building Code incorporates the 2001 California Building Codes and the 1997

Uniform Building Codes that are enforced through the construction permitting and inspection programs of the City's Building Department. These Codes are continually updated by the California Building Standards Commission to reflect the latest techniques to provide structurally sound and earthquake resistant construction. The City's Subdivision Code (Article 2 of the Municipal Code) includes requirements for soil testing, grading design, geological inspections, and similar mechanisms to assure the stability and integrity of foundations, streets, and graded surfaces.

5.4.3 - Thresholds of Significance

According to the Initial Study, the project would have a significant effect on the environment if it would:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury or death involving:
    - Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning map issued by the State Geologist for the area or based on other substantial evidence of a known fault.
    - Strong seismic ground shaking.
    - Seismic-related ground failure, including liquefaction.
- Result in substantial soil erosion or loss of topsoil.
- Be located on a geologic unit or soil that is unstable or would become unstable as a result of the project, and potentially result in onsite or offsite landslide, lateral spreading, subsidence, liquefaction, or collapse.
- Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property.

5.4.4 - Project Impacts

Following is a discussion of the project impacts that correspond to the thresholds of significance previously identified in Section 5.4-3, Thresholds of Significance.

Impacts Related to Seismic Events

The proposed project would develop the project site with urban uses that would expose persons living and working on the project site to potential seismic events and development of structures on potentially unstable ground. Fault rupture would directly expose structures to damage as a result of

movement (offset) along an identified fault. Seismicity that occurs as a result of fault movement would expose structures to damage from ground shaking and expose persons to falling objects that become dislodged during a seismic event. Development located on unstable ground would expose buildings to potential structural damage.

Earthquake Fault Rupture

The potential for fault rupture on the project site is very low due to the distance from the identified faults identified in Table 5.4-1. The absence of an active or potentially active fault on or adjacent to the project site, according to the Preliminary Geotechnical Investigation, precludes impacts to structures directly related to fault rupture. Therefore, implementation of the proposed project would result in less than significant impacts related to fault rupture.

Seismic Ground Shaking

The subject site is located in a seismically active area of southern California. Primary surface rupture is considered low; however, ground shaking hazards caused by earthquakes along regional active faults do exist and should be taken into account in the design and construction of the proposed facilities.

Seismically Induced Ground Failure

The project site is not subject to ground failure resulting from fault rupture and is not subject to ground failure from landslides. Therefore, implementation of the proposed project would result in less than significant impacts related to seismically induced ground failure.

Strong ground shaking can result in settlement of the soils by allowing sediment particles to become more tightly packed thereby reducing pore space. Because the project site contains unconsolidated soils and poorly compacted artificial fills, structures built on these materials could be damaged as a result of a seismic event. Refer to the following sub-section entitled Impacts Related to Unstable Geologic Units for a discussion on seismically related liquefaction.

Impacts Related to Soil Erosion or Loss of Topsoil

The project site is generally level and not subject to high erosion potential that would result in down cutting, sheet wash, slumping, or bank failures from heavy rain events. In addition, the project design does not propose significant changes in site elevation or excessive stormwater discharges that would result in a high potential for erosion. The fine sandy soil currently on the site does have a potential for wind erosion; however, the proposed project will replace most soils with engineered fill before the construction of foundations, streets, and landscaped areas. Therefore, implementation of the proposed project would result in less than significant impacts related to soil erosion.

The proposed project would result in a loss of topsoil due to the conversion of a majority of the project site to urban uses as a result of site grading. Because the project would ultimately be converted to urban uses and no longer used for agricultural production, which would require topsoil, less than significant impacts due to the loss of topsoil would result from project implementation. Refer to Section 5.1, Agriculture, of this document for a discussion on the potential impacts related to agriculture, which includes loss of topsoil. In addition, refer to Section 5.2, Hydrology and Water Quality, of this document for a discussion related to project site drainage, which would include erosion control measures, and Section 5.8, Air Quality, of this document for a discussion on potential impacts related to air quality, which would include a discussion on ground-disturbing activities.

Impacts Related to Unstable Geologic Units

This section addresses the potential for various impacts related to unstable soils and foundations.

Preliminary Geotechnical Investigation

The Preliminary Geotechnical Investigation indicated that volumetric changes will occur when surficial fill and alluvial soils are removed and replaced as properly compacted fill. Subsidence at 0.10 to 0.15 feet is anticipated as a result of the scarification and recompaction of the exposed ground surfaces. This is a potentially significant impact, and mitigation measures GS-1, GS-2, and GS-4 are provided.

Compressible Soils

The Preliminary Geotechnical Investigation indicated that the site is mantled by surficial soil materials that are generally loose and porous that extends to 3 to 6 feet below the existing ground surface. The Preliminary Geotechnical Investigation concluded that the fill materials observed are considered non-engineered and unsuitable for support of additional fill and residential structures and/or improvements. This is a potentially significant impact and mitigation in the form of excavation and removal is provided.

Additionally, the Preliminary Geotechnical Investigation indicated that boundary conditions after excavation and removal could result in a wedge of unsuitable soil remaining in place, and that significant impacts could occur regarding the placement of screen walls, retaining walls, swimming pools, and spas. Mitigation measures GS-5 is provided for this potential significant impact.

Liquifaction

The Preliminary Geotechnical Investigation indicated that the site is not located within a zone of potential liquefactions, and that liquefaction and associated dynamic settlement resulting from the effects of strong ground shaking are not expected to occur at the site due to the depth to ground water

of greater than 50 feet. Therefore, implementation of the proposed project would result in less than significant impacts related to liquefaction.

Corrosive Soils

The Preliminary Geotechnical Investigation indicated that laboratory testing determined that a negligible to moderate exposure to sulfates can be expected for concrete placed in contact with the onsite earth materials. Corrosive soils contain physical characteristics that react with concrete or some metals that cause corrosion and damage to these materials over time. This is considered a potentially significant impact and mitigation measure GS-6 is provided.

Impacts Related to Expansive Soils

The Preliminary Geotechnical Investigation stated that laboratory tests suggest that the earth materials that will be exposed at proposed finish grade elevations will likely exhibit expansion potentials which fall between Very Low and Low. This is a potentially significant impact and mitigation measure GS-3 is proposed.

5.4.5 - Cumulative Impacts

Future development within the NMC would result in the conversion of predominantly agricultural uses to urban uses, consistent with the vision of the NMC General Plan. This would contribute to a cumulative increase in the number of people and amount of structures exposed to similar geologic hazards previously described. While these impacts are expected to be potentially significant, development of these subareas will require geotechnical studies, similar to those completed for the proposed project that would include mitigation measures to reduce potentially significant impacts to less than significant levels, as recommended by the NMC Final EIR.

Therefore, implementation of the Rich Haven Project, in combination with other related projects, would not result in cumulatively considerable impacts.

5.4.6 - Mitigation Measures

The Geology Section of the NMC Final EIR identified a single mitigation measure (G-1) that required the development of a Grading and Geotechnical Investigation Standards manual that would be available to developers and consultants. The manual would include topics related to the following: soils; engineering and foundations; slope stability; erosion; liquefaction and dynamic settlement; groundwater elevation; and location to active faults Application of the recommendations contained in such a study would mitigate potential hazards on a given project site.

Implementation of the NMC Final EIR mitigation measures and the following mitigation measures would reduce potentially significant impacts to a less than significant level.

GS-1 Future development of the site shall be based on evaluation of property-specific conditions by a geotechnical consultant following their review of the grading plans for a specific property.

GS-2 Site-specific seismic design parameters determined in accordance with Section 16 of the 2001 California Building Code shall be provided in project-specific geotechnical investigation reports.

GS-3 Compressible surficial materials unsuitable for construction shall be removed or overexcavated prior to construction in accordance with the standards of the City of Ontario.

GS-4 As part of the site grading and prior to the commencement of building construction, unconsolidated fill materials, organic rich soils shall be excavated and removed offsite and shall be replaced with engineered fill.

GS-5 Improvements along the boundary of the site where unsuitable soils may remain shall be designed and constructed with deepened and/or strengthened foundations systems to withstand relative movement that is likely to result from consolidation of these potentially compressible surficial soils.

GS-6 Soils shall be tested to determine their corrosive potential. Some foundations may need to be constructed using Type V cement to mitigate deterioration from water-soluble sulfates. Additional testing for corrosivity shall be performed as part of property-specific investigations and a final evaluation shall be performed at or near the completion of rough grading to more accurately assess soil corrosivity, and a certified corrosion engineer shall be consulted to prepare project specific recommendations to protect against corrosion.

GS-7 Contingencies shall be made for balancing earthwork quantities based on actual shrinkage and subsidence that occurs during construction.

5.4.7 - Level of Significance After Mitigation

All of the mitigation measures require implementation prior to implementation of site preparation activities or building construction. This eliminates the potential for construction-related activities to commence without the benefit of the recommended mitigation measures.

Mitigation measures GS-5 through GS-8 would prevent buildings on the project site from being constructed on soil that is improperly compacted, corrosive, or subject to expansion. This would eliminate the potential for buildings to become damaged during the long-term operational phase of the project.

Mitigation measures GS-1 through GS-4 would prevent structures from becoming damaged during seismically induced ground shaking.

With the implementation of the recommended mitigation measures, the proposed project would result in less than significant impacts related to geology and soils.