3.5 Geology and Soils

This section describes the affected environment and regulatory setting for the geologic and soil characteristics of the Project Site. This section also describes the potential geologic and soil impacts that would result from implementation of the Proposed Project and, where necessary to reduce potentially significant impacts, provides mitigation measures to reduce such impacts to less than significant levels. The environmental setting information and analysis in this section is summarized from the geotechnical engineering report (GER) prepared for the Project Site by the Geotechnical Engineering Group (GEO) of the City of Los Angeles Department of Public Works, Bureau of Engineering (LABOE), in December 2015. This technical report (Geotechnical Engineering Report – Venice Auxiliary Pumping Plant, December 14, 2015) is hereby incorporated by reference and included in Appendix G of this Environmental Impact Report (EIR). Information pertaining to locations of abandoned oil wells is based on the *Phase I Environmental Site Assessment (128 Hurricane Street)* (Phase I ESA) prepared by Ninyo & Moore in May 2016 (see Appendix K of this EIR).

This geotechnical investigation was conducted to provide recommendations for design and construction of the Venice Auxiliary Pumping Plant (VAPP or Proposed Project) at the Project Site. Thus, the recommendations presented in the 2015 GER would be incorporated into project design and construction to address issues related to the following: surficial soils, site preparation, site earthwork, foundations, retaining walls, slabs-on-grade, cement type, and corrosion measures. As recommended in the 2015 GER, a representative of the City's GEO would provide observation and testing services during site earthwork and construction of foundations and review the preliminary foundation and earthwork plans and specifications. For groundwater control and discharge, the representative would review proposals for shoring and jet grouting. In addition, to address the on-site abandoned oil well located at 128 Hurricane Street, soil and soil vapor subsurface investigations and confirmation of oil well abandonment would be required. As noted in the analysis below, with adherence with standard construction requirements and the implementation of mitigation measures, direct and indirect impacts associated with geology and soils during construction or operation would be less than significant.

3.5.1 Regulatory Setting

This section describes existing regulations related to geology and soils that are applicable to the Proposed Project and discusses those can be used to determine impacts and consistency with applicable requirements.

3.5.1.1 California Building Standards Code

The California Building Standards Commission is responsible for coordinating, managing, adopting, and approving building codes in California. In January 2014, the 2013 California Building Standards Code (CBSC) went into effect, updating all prior codes under California Code of Regulations (CCR) Title 24. Among the components of the CBSC are the California Building Code (CBC), Building Standards Administrative Code, Residential Building Code, and Green Buildings Standards Code.

The CBC, which has been incorporated by reference into the City of Los Angeles Municipal Code, applies to building design and construction and is based on the federal Uniform Building Code

(UBC), which is used widely throughout the country. The CBC has been modified for conditions in California. It contains numerous provisions that are more stringent than those in the UBC because of California's seismic and environmental conditions. According to Section 1.1 of the CBC, the provisions of the CBC apply to "the construction, alteration, movement, enlargement, replacement, repair, equipment, use and occupancy, location, maintenance, removal, and demolition of every building or structure or any appurtenances connected or attached to such buildings or structures throughout the State of California," except when modified by local ordinance.

3.5.1.2 Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act, passed in 1990, addresses earthquake hazards from nonsurface fault rupture, including hazards related to liquefaction and seismically induced landslides. The purpose of the Seismic Hazards Mapping Act, which went into effect in 1991, is to identify and map seismic hazard zones. Such mapping helps cities and counties when preparing the safety elements of their general plans and encourages land use management policies and regulations that reduce seismic hazards. The Seismic Hazards Mapping Act has resulted in the publication of maps that delineate Liquefaction Zones and Earthquake-Induced Landslide Zones of Required Investigation (State of California Department of Conservation, California Geological Survey 2011). The Project Site is located within a Liquefaction Seismic Hazard Zone but not within a Landslide Seismic Hazard Zone.

3.5.2 Environmental Setting

This section describes the environmental setting or conditions related to geology, soils, and seismicity as well as associated hazards that could affect the Project Site, workers, visitors, or public. The information in this section is used in preparing the evaluation and conclusions of the impact analysis as well as determining the required mitigation measures.

3.5.2.1 Regional Geology

The VAPP site is located within the Los Angeles Basin part of the Peninsular Ranges geomorphic province, which extends from Southern California to the southern tip of Baja California. This province is characterized by elongated northwest-trending mountain ridges separated by straight-sided sediment-filled valleys. The northwest trend is further displayed in the dominant structural features of the province, including the Newport-Inglewood fault zone.

The Project Site is located in an alluviated lowland area in the west portion of the Los Angeles Basin, a northwest-trending alluviated plain about 50 miles long and 20 miles wide. The basin is bound on the north by the Santa Monica Mountains and the Elysian, Repetto, and Puente Hills and on the east and southeast by the Santa Ana Mountains and San Joaquin Hills. This aerially extensive alluviated plain slopes southward and seaward; however, in the vicinity of the Project Site, the plain is interrupted by the Baldwin Hills and Beverly Hills. The Baldwin Hills are the northern extension of the Newport-Inglewood structural block, which has uplifted the Baldwin Hills, Dominquez Hills, and Signal Hill, located to the south.

The Los Angeles Basin is underlain by a deep structural depression. Parts of this depression have been filled with sediments discontinuously since the Late Cretaceous (starting about 85 million years ago). Starting in the middle Miocene (about 20 million years ago), the basin, which extended to the Ventura Basin, continuously subsided as sediments were deposited. The buried basement surface has relief of as much as 4.5 miles over a distance of 8 miles (Yerkes et al. 1965).

3.5.2.2 Local Geologic Setting

The Marina Del Rey and Venice areas were once a large wetland marsh that was fed by the meandering Ballona Creek, which drained into the Santa Monica Bay near the current location. The 1924 U.S. Geological Survey (USGS) map of the Venice quadrangle shows the Project Site adjacent to a large lowland marsh area northeast of the Grand Canal. The elevation of the Project Site is approximately 5 feet above sea level. Surficial geologic exposures are all Quaternary sedimentary units.

3.5.2.3 Stratigraphy

Artificial fill soils exist within the Project Site as the result of previous construction on the site. In general, the depth of fill is expected to be on the order of 3 to 4 feet within the Project Site. The fill materials generally consist of silty sand and sand with some construction debris.

More detailed descriptions of the soils can be found in the boring logs presented in Appendix G of this Draft EIR.

3.5.2.4 Faulting and Seismicity

The Project Site lies within Seismic Zone 4 (highest potential for seismic activity) of the 2010 CBC. Primary seismic hazards that could affect the site include ground motion or shaking, ground surface rupture along faults, liquefaction, and earthquake-induced landslides.

3.5.2.5 Oil Fields and Methane

According to the State of California, Department of Conservation, Division of Oil, Gas, and Geothermal Resources (DOGGR), Well Finder website (DOGGR, 2016), the site lies within the administrative boundaries of the Playa Del Rey Oil Field. One oil well, the 'McDonald 2' was observed on site, with American Petroleum Institute (API) number 03713842. The well is plugged and abandoned originally in 1932. As described in the Phase I ESA (see Appendix K of this EIR), the well may have been re-abandoned in 2002 to current DOGGR standards, but it is not known whether re-abandonment activities were completed. Numerous oil wells, most of which are plugged and abandoned, were observed within one mile of the site. The presence of a historical oil well on site represents a REC (recognized environmental condition). In addition to being within the boundaries of the Playa Del Rey Oil Field, according to the City of Los Angeles Zoning Information and Map Access System (ZIMAS); the project site also lies within a methane zone. This was also identified as a REC in the Phase I ESA.

3.5.2.6 Ground Motion

Given the current understanding of the geologic framework of the area, the seismic hazard that is expected to have the highest probability of affecting the site is ground shaking or motion resulting from an earthquake occurring along any of several major active or potentially active faults in Southern California. Known regional faults that could produce significant ground shaking at the site include the Malibu Coast, Santa Monica, Palos Verdes, and Newport-Inglewood faults, among others and are shown in Figure 3.5-1. According to the City of Los Angeles' ZIMAS, the closest fault to the Project Site is the Santa Monica Fault, which is approximately 6.7 miles away.

Ground motion parameters were determined for the site using the USGS 2008 Probabilistic Seismic Hazard Analysis Interactive Deaggregation web tool. Program input included site longitude and latitude, a 10% probability of exceedance in 50 years, and an average shear wave velocity of 230 meters per second for the upper 100 feet of subsurface. Using these parameters, a peak ground acceleration of 0.4g (acceleration of gravity) was determined for the site. The program also calculated a mean earthquake magnitude of 6.7 at a distance of 20.5 kilometers (12.7 miles) from the site.

3.5.2.7 Other Seismic Hazards

Lateral Spreading

Seismically induced lateral spreading is the lateral movement of earth materials due to ground shaking. It differs from slope failure in that complete ground failure from a large earth movement does not occur because of the relatively low gradient of the ground surface. Lateral spreading is demonstrated by near-vertical cracks and predominantly horizontal movement of the soil mass. The GER prepared for the Proposed Project did not identify lateral spreading as an issue of concern for the Project Site.

Liquefaction

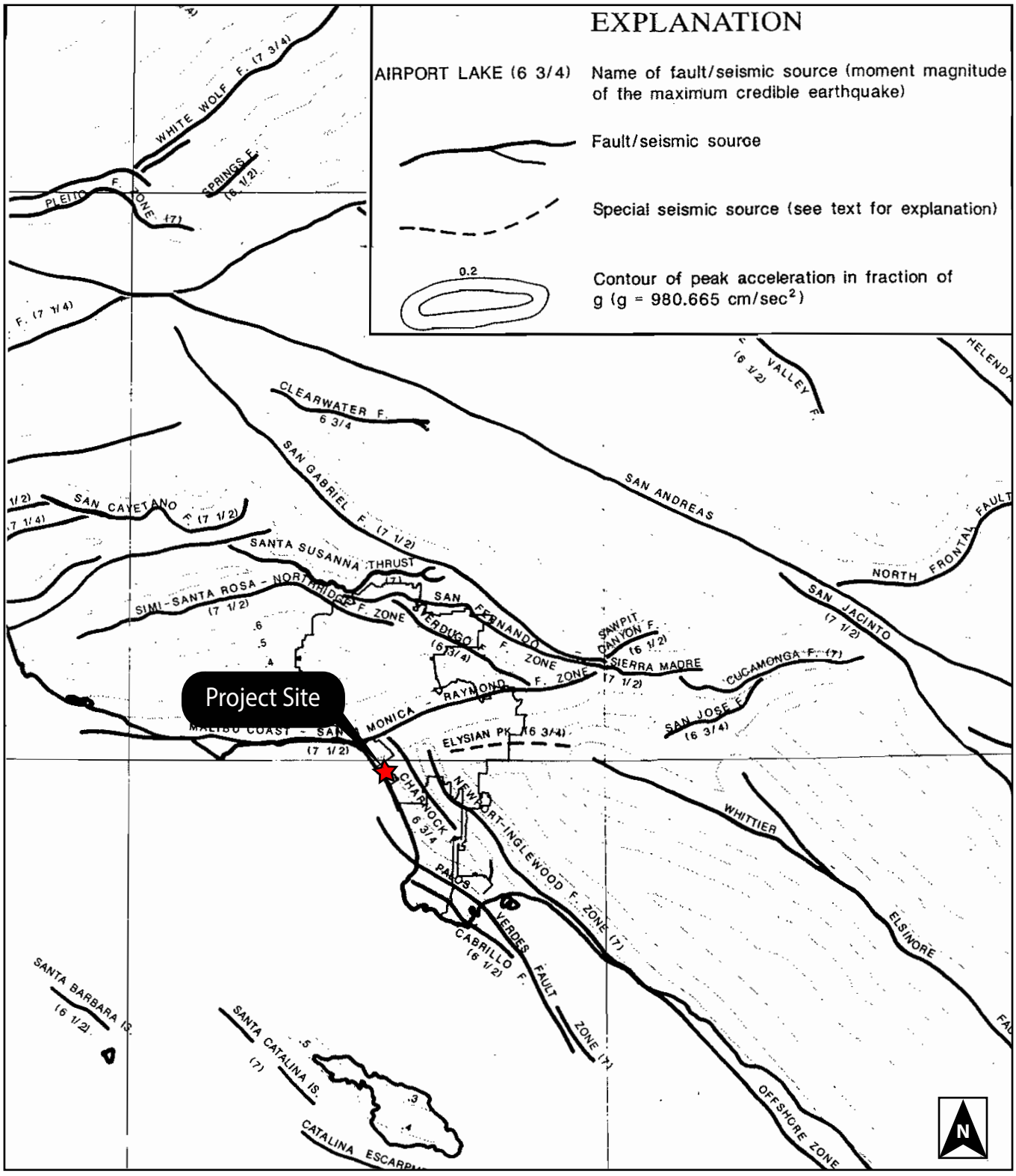
According to the State of California Seismic Hazard Zones Map, the Site is located within an area that has potential for liquefaction. Liquefaction is a process that occurs when saturated sediments are subjected to repeated strain reversals during a seismic event. The strain reversals cause an increase in pore water pressure such that the internal pore pressure approaches the overburden pressure, and the shear strength approaches a low residual value. Liquefied soils are subject to flow, consolidation, or excessive strain. Liquefaction typically occurs in loose to medium-dense sand and silty sand soils below the groundwater table. Predominately fine-grained soils, such as silts and clays, are less susceptible to liquefaction.

Liquefaction analyses were performed for a ground acceleration of 0.43g (two-thirds the maximum considered earthquake-geometric mean ground acceleration of 0.642g). The analyses were performed for the deepest rotary wash boring, RW-2 (see Appendix G of this EIR), located near the center of the site, and with consideration of soil particle size and plasticity information obtained through laboratory testing as well as the measured and anticipated high groundwater levels. Potential liquefaction-induced settlements on the order of 2 inches were calculated for the Project Site and 1 inch between the proposed structures and the pipe header (associated with the diversion structure).

3.5.2.8 Other Hazards

An on-site geotechnical investigation conducted in 2006 identified petroleum hydrocarbons in the soil adjacent to two on-site concrete vaults. Petroleum hydrocarbon analytical results in the upper 2 feet of soil resulted in concentrations of up to 6,500 parts per million. The purpose of the concrete vaults is unknown. Furthermore, there was no documentation summarizing the removal of the vaults and/or contaminated soil.

As part of the Phase I ESA, Ninyo & Moore conducted a preliminary vapor encroachment screening (pVES) to identify potential chemicals of concern (COCs) that could migrate (as vapors) onto the project site as a result of contaminated soil and/or groundwater in nearby properties. The potential for Vapor Encroachment Conditions (VEC) beneath the project site was evaluated and based on the



Source: Peak Acceleration from Maximum Credible Earthquack in California, Maulchin and Jones, 1990, CALTRANS

Scale
One Inch = 16 Miles

Figure 3.5-1
Peak Acceleration From Maximum Credible Earthquake
Venice Auxiliary Pumping Plant Project

concentration of petroleum hydrocarbons detected in soil on the site in 2006, the presence of a historical oil production well and the presence of the site within a methane zone. The Phase I ESA determined that a VEC likely exists beneath the site.

3.5.3 Environmental Impact Analysis

3.5.3.1 Methodology

Potential significant impacts associated with the Proposed Project were identified from the GER prepared by LABOE in December 2015 and the Phase I ESA prepared by Ninyo & Moore in May 2016. The GER and ESA Phase I presented findings, conclusions, and recommendations concerning development of the Project Site that were based on an engineering analysis of the geotechnical properties of the subsurface conditions (described above).

The discussion below identifies potential project impacts and the measures that would be required to mitigate impacts that are found to be potentially significant.

3.5.3.2 Screening Analysis

As noted in Chapter 1.0, Introduction, the analysis and conclusions contained in the Initial Study (see Appendix A [Notice of Preparation/Initial Study] of this EIR) prepared for the Proposed Project considered and then eliminated a number of impacts from further analysis, including those contained in the *L.A. CEQA Thresholds Guide* (2006). Therefore, only those impacts and the corresponding thresholds of significance noted below were determined to require further analysis and are addressed in this EIR.

3.5.3.3 Thresholds of Significance

In accordance with Appendix G of the State CEQA Guidelines, a project would normally have a significant impact related to geology and soils if it would:

GEO-1. Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:

- Strong seismic ground shaking;
- Seismically related ground failure, including liquefaction;

GEO-2. Be located on a geologic unit or soil that is unstable or that would become unstable as a result of the project and potentially result in an on-site or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse; or

GEO-3. 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.

Additionally, due to environmental concerns described in sections 3.5.2.5 and 3.5.2.8 in the project area, in accordance with Appendix G of the State CEQA Guidelines, a project would normally have a significant impact related to hazards and hazardous materials if it would:

HAZ-1. Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous chemicals into the environment.

3.5.3.4 Construction Impacts

During construction of the proposed Project, construction workers, equipment, and structures that are under construction could be exposed to the geologic and soils hazards described below.

GEO-1. Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving strong seismic ground shaking and/or seismically related ground failure, including liquefaction.

Although the Project Site is not located on or near a known active fault (see Figure 3-5.1), it could be subject to significant seismic ground shaking from regional faults and therefore, impacts are considered potentially significant related to strong ground shaking hazard. However, the VAPP would be designed by California-licensed professional civil and structural engineers, and construction work would be performed by licensed professional contractors who would comply with all required safety standards to reduce the risk of seismic hazards during construction. The Proposed Project would also be required to conform to the City of Los Angeles Building Code, which considers seismic risk associated with building construction and design requirements. Therefore, the Proposed Project would not expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving strong seismic ground shaking and as such, **impacts are considered less than significant and no mitigation measures are required.**

The analysis of the Project Site in the GER indicates that the primary geotechnical issue of concern is related to the uncertified fill soils and the potential for liquefaction. Impacts related to seismically related ground failure, including liquefaction, at the Project Site are therefore considered potentially significant. Potential liquefaction-induced settlement would be on the order of up to 2 inches for the Project Site and 1 inch between the proposed structures and the pipe header. In addition, the Project Site is located in an area identified as having fill material, generally consisting of silty sand and sand with some construction debris, which could expand when saturated. However, the Proposed Project design and construction would incorporate the geotechnical engineering recommendations prescribed in the 2015 GER that assessed the potential for liquefaction at the Project Site and developed recommendations to address this issue. The recommendations focus on surficial soils, site preparation, site earthwork, foundations, retaining walls, slabs-on-grade, cement type, and corrosion measures. **In particular, Mitigation Measure MM-GEO-1 (supporting project structures on concrete mat foundations) would reduce these impacts to less than significant.**

Further, a representative of the City's GEO would review plans and specifications to ensure the proper interpretation and application of these recommendations prior to start of construction and provide observation and testing services to determine if any supplemental recommendations are warranted. Thus, all grading, excavation, and foundation construction would be performed under the observation and testing of the geotechnical engineer or representative of the GEO, as outlined in the 2015 GER. Designs and plans would also be reviewed, per local, state, and federal laws. **Given these measures and the application of Mitigation Measure MM-GEO-1, all impacts associated with seismically related ground failure, including failure related to liquefaction, would be less than significant with mitigation.**

GEO-2. Be located on a geologic unit or soil that is unstable or that would become unstable as a result of the project and potentially result in an on-site or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse.

Please see the discussion of seismically related impacts and the conclusions above associated with liquefaction. As noted in that analysis, **impacts were determined to be less than significant with Mitigation Measure MM-GEO-1**. In addition, the Initial Study (see Appendix A) and the GER (see Appendix G) determined that the Project Site is not within a zone of earthquake-induced landslide potential, as shown by the State of California Seismic Hazard Zones Map, nor is it located on a slope. The GER also did not identify lateral spreading, subsidence, or collapse as issues of concern. Therefore, geologic and seismic hazards (excepting liquefaction) identified for the Project Site are less than significant related to an on-site or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse. As such, impacts would be **less than significant, and no mitigation measures are required.**

GEO-3. 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.

As noted above, the GER indicated that the Project Site is located in an area that has been identified as having fill material, generally consisting of silty sand and sand with some construction debris, which could expand when saturated. It did not, however, identify on-site soils as any of those identified in Table 18-1-B of the UBC. Impacts related to expansive soils were previously addressed above in the analysis regarding the potential for liquefaction. As noted in that analysis, the geologic and seismic hazards identified for the Project Site would be reduced by employing required standard engineering practices, including CBC standards, as well as the geotechnical engineering recommendations in the design and construction of the Proposed Project. Adherence to those provisions and standards would reduce risks related to creating substantial risks to life or property due to the presence of expansive soils, including those identified in Table 18-1-B of the UBC (1994). Therefore, potential impacts would be **less than significant, and no mitigation measures are required.**

HAZ-1. Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous chemicals into the environment.

As previously stated, the 128 Hurricane Street site lies within the administrative boundaries of the Playa Del Rey Oil Field. One oil well 'McDonald 2' was observed on site, with American Petroleum Institute (API) number 03713842. The well was originally plugged and abandoned in 1932. However, as mentioned above, the well may have been re-abandoned in 2002, but it is not known whether re-abandonment activities were completed. Numerous oil wells, most of which are plugged and abandoned, were observed within one mile of the site. In addition to being within the boundaries of an oil field, the site also lies within a methane zone (according to the City of Los Angeles ZIMAS website). As such, the project would have the potential to result in impacts associated with releases of methane or oil from the abandoned oil well during excavation activities. **Mitigation Measure MM-HAZ-1** would reduce potentially significant impacts to less than significant.

Additionally, an on-site geotechnical investigation conducted in 2006 identified petroleum hydrocarbons in the soil adjacent to two concrete vaults. There was no documentation summarizing the removal of the vaults and contaminated soil, thus there is potential for exposure to contaminated soil during construction activities. **Mitigation Measure MM-HAZ-1** would reduce potentially significant impacts to less than significant.

Lastly, the potential for VEC beneath the project site was evaluated. Based on the concentration of petroleum hydrocarbons detected in soil on the site in 2006, the presence of a historical oil production well and the presence of the site within a methane zone, the Phase I ESA determined that a VEC likely exists beneath the site and which is considered a potentially significant impact. **Mitigation Measure MM-HAZ-1** would reduce potentially significant impacts to less than significant.

3.5.3.5 Operational Impacts

Once the VAPP is completed and operational, LABOE personnel, visitors, and structures on the site could be exposed to the geologic and soils hazards, as described below.

GEO-1. Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving strong seismic ground shaking and/or seismically related ground failure, including liquefaction.

As noted previously, the Project Site is located within Southern California, a seismically active region that is capable of generating earthquakes (including ground shaking) of considerable magnitude. Although the proposed Project is not located near an active fault (see Figure 3.5-1), movement along active regional faults could generate an earthquake that would be capable of causing damage to buildings and infrastructure located on site and therefore, impacts are potentially significant. The Project Site could also experience liquefaction, including up to 2 inches for structures and up to 1 inch associated with the pipe header, and these impacts are also considered potentially significant. However, the City of Los Angeles Building Code and CBC requires that structures built in the City and state, respectively, be constructed to address the seismic nature of their areas. In addition, the GER has evaluated and considered these factors in the construction and operation of the proposed Project and has identified standard engineering measures and recommendations to address these known regional and localized conditions. As identified within the GER, project implementation does have the potential to result in significant geologic and seismic hazard impacts, including seismically-induced liquefaction. The geologic and seismic hazards identified for the Project Site for employees and visitors would therefore be potentially significant. These can be reduced to less than significant levels, however, through adherence to the City of Los Angeles Building Code and CBC requirements and the implementation of **Mitigation Measure MM-GEO-1**. As such, adherence to these standards and measure would reduce the risks posed by potential hazards from strong seismic ground shaking and/or seismically related ground failure, including failure related to liquefaction, to an acceptable level. Therefore, impacts would be **less than significant and no additional mitigation measures beyond Mitigation Measure MM-GEO-1 are required**.

GEO-2. Be located on a geologic unit or soil that is unstable or that would become unstable as a result of the project and potentially result in an on-site or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse.

Please see the discussion of seismically related impacts and the conclusions above associated with liquefaction. As noted in that analysis, impacts were determined to be less than significant with **Mitigation Measure MM-GEO-1**. In addition, the Initial Study (see Appendix A of this EIR) and the GER (see Appendix G of this EIR) determined that the Project Site is not within a zone of earthquake-induced landslide potential, as shown by the State of California Seismic Hazard Zones Map, nor is it located on a slope. The GER also did not identify lateral spreading, subsidence, or collapse as issues of concern. Therefore, geologic and seismic hazards (excepting liquefaction) identified for the Project Site are less than significant related to an on-site or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse. Therefore, potential impacts would be **less than significant, and no mitigation measures are required.**

GEO-3. 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.

Please see the discussion of expansive soil–related impacts and conclusions above for construction. As noted in that analysis, the GER indicated that the site is located in an area that has been identified as having fill material, generally consisting of silty sand and sand with some construction debris, which could expand when saturated, potentially resulting in significant impacts. It did not, however, identify the on-site soils as any of those identified in Table 18-1-B of the UBC. Moreover, the analysis related to expansive soils (i.e., related to liquefaction) determined that the geologic and seismic hazards identified for the project study area would be reduced by employing required standard engineering practices, including CBC standards, as well as the geotechnical engineering recommendations in the design and construction of the proposed Project. Adherence to those provisions and standards would reduce risks related to creating substantial risks to life or property due to the presence of expansive soils, including those identified in Table 18-1-B of the UBC (1994). Therefore, potential impacts would be **less than significant and no mitigation measures are required.**

HAZ-1. Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous chemicals into the environment

As mentioned, the proposed project is located within a City of Los Angeles ZIMAS methane zone. As such, long term operations of the proposed project could encounter potential impacts related to the encroachment/seepage of methane into the VAPP structure and as such, impacts are considered potentially significant. However, implementation of **Mitigation Measure MM-HAZ-2** would reduce potential impacts to less than significant.

3.5.4 Mitigation Measures

The following mitigation measure was developed to avoid or minimize potential impacts on the proposed Project related to geology and soils. It should be noted that there are also specific recommendations contained in the *Geotechnical Engineering Report – Venice Auxiliary Pumping Plant*, December 14, 2015 (see Appendix G of this EIR) and *Phase I Environmental Site Assessment (128 Hurricane Street)*, May 2016 (see Appendix K of this EIR).

Mitigation Measure MM-GEO-1 noted below has been abbreviated. The complete text is provided in Appendix G of this EIR.

MM-GEO-1: Liquefaction Considerations

Given the data presented in Section 3 of the *Geotechnical Engineering Report – Venice Auxiliary Pumping Plant*, December 14, 2015, and the results of the liquefaction calculations, potential liquefaction induced settlements on the order of 1.75 inches are estimated for the site. A potential liquefaction induced differential settlement of 1 inch is estimated between the proposed structures and the pipe header. These potential liquefaction induced settlements shall be considered and accounted for in the design of the Proposed Project.

Mat foundations are recommended for support of the project structures, with the understanding that the foundation would be susceptible to liquefaction-induced settlements. Mat foundations for the wetwell/valve structure and diversion structures shall be founded on jet-grouted columns constructed within the natural soils. The mat foundation for the electrical building shall be founded on compacted fill soil. Mat foundations shall be designed and constructed to bear at a depth of at least 24 inches below the lowest adjacent grade. Mat foundations can be designed for an allowable bearing capacity of 1,500 pounds per square foot (psf). A coefficient of vertical subgrade reaction, for a 1-foot-square loaded area, of 100 kips per cubic foot (kcf) may be used for design of the mats.

Total static settlement of the proposed foundations, designed and constructed in accordance with the recommendations presented herein, shall not exceed 1 inch. Differential static settlement shall not exceed one-half of the total settlement.

Resistance to lateral loads can be provided by friction at the base of the foundation and passive earth pressure. A coefficient of friction of 0.35 may be assumed with dead-load forces. An allowable passive lateral earth pressure of 250 psf per foot of depth up to a maximum of 2,500 psf may be used for sides of the foundation poured against undisturbed natural soil or properly compacted fill. The allowable passive pressure may be increased by 33% of lateral loading due to wind or seismic forces.

MM-HAZ-1a: Soil and Soil Vapor Subsurface Investigation.

Prior to construction, a soil and soil vapor subsurface investigation shall be conducted by a qualified environmental consultant specializing in the identification and handling of hazardous materials. The subsurface investigation may include, but would not be limited to:

- A scope of work consisting of Pre-Field Activities, such as preparation of a Health and Safety Plan (HASP), determining and marking sampling/boring locations and obtaining utility clearance, and Field Activities, such as identifying appropriate sampling procedures, health and safety measures, chemical testing methods, and quality assurance/quality control (QA/QC) procedures in accordance with the ASTM Standard.
- Necessary permits for boring advancement.
- A Sampling and Analysis Plan (SAP) in accordance with the scope of work.
- Laboratory analyses conducted by a State-certified laboratory.
- Disposal process including transport by a State-certified hazardous material hauler to a State-certified disposal or recycling facility licensed to accept and treat hazardous waste.

MM-HAZ-1b: Confirmation of Oil Well Abandonment.

Prior to construction, the applicant shall obtain confirmation via DOGGR of the proper abandonment of oil well 'McDonald 2'. If re-abandonment of McDonald 2 was not performed to current DOGGR requirements, the applicant shall seek the assistance of a qualified environmental consultant to abandon the oil well to current standards.

MM-HAZ-2: Methane Encroachment.

If the analytical results of the subsurface investigation under Mitigation Measure HAZ-1a determine that methane encroachment has the potential to affect VAPP operational activities, the environmental consultant shall provide recommendations during construction of the proposed project to mitigate long term potential impacts.

3.5.5 Significant Unavoidable Adverse Impacts

With implementation of the mitigation measure identified above, no significant and unavoidable adverse impacts related to geology and soils would occur as a result of the Proposed Project.

3.5.6 Cumulative Impacts

The study area for potential cumulative geology and soil impacts consists of the Project Site and the immediate surrounding area, which encompasses the related projects identified in Chapter 2, Project Description. This study area was selected because it encompasses neighborhoods with similar geologic conditions and areas that could be affected by cumulative soil impacts (e.g., cumulative geology, seismically and soil-related impacts).

In general, the proposed Project, in combination with the related projects, would not contribute to significant cumulative geologic impacts because all geologic/seismic impacts would be generally site specific. Project-related impacts deal primarily with hazards at the Project Site that are speculative in nature (e.g., the possibility of an earthquake, liquefaction, landslide). The proposed and related projects would not change the geologic properties of the area. There would continue to be some level of seismic and other geologic risks during operation of the proposed and related projects because of their locations within a seismically active region; however, these risks would not increase or decrease as a result of the proposed and related projects. Additionally, similar to the Proposed Project, the related projects would be subject to applicable seismic standards, safety requirements, and standard design specifications to keep the potential risk of damage from seismic and other geologic hazards to an acceptable level. Therefore, construction and operation of the Proposed and related projects would not result in cumulatively considerable impacts with respect to geology, seismicity, or soils, and no mitigation measures are required.