Appendix H

Geologic/Geotechnical Assessment for the Green Valley Specific Plan Phase 1B Area (August 27, 2020)

EIR-LEVEL GEOLOGIC/GEOTECHNICAL ASSESSMENT
GREEN VALLEY SPECIFIC PLAN PHASE 1B AREA
(PLANNING AREAS 3, 10-14, 19-21, 23 26, 29-39, 45, 46A AND 55-57)
NORTH OF ETHANAC ROAD BETWEEN GOETZ AND CASE ROADS
CITY OF PERRIS, RIVERSIDE COUNTY, CALIFORNIA

RAINTREE INVESTMENT CORPORATION

August 27, 2020
J.N. 18-106

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RAINTREE INVESTMENT CORPORATION
2753 Camino Capistrano, Suite A-201
San Clemente, California 92672

Attention: Mr. Matt Villalobos

Subject: **Environmental Impact Report (EIR) Geologic and Geotechnical Assessment, Proposed *Green Valley Specific Plan Phase 1B Area (*Planning Areas 3, 10-14, 19-21, 23, 26, 29-39, 45, 46a and 55-57), 505± Acres North of Ethanac Road between Goetz and Case Roads, City of Perris, Riverside County, California**

Dear Mr. Villalobos:

Petra Geosciences, Inc. (Petra) is presenting herein our geologic/geotechnical EIR-level assessment for Planning Areas (PA) 3, 10-14, 19-21, 23 26, 29-39, 45, 46a and 55-57 for the proposed Green Valley Specific Plan located in the city of Perris. The purposes of our study are to evaluate the feasibility of the proposed project from a geologic and geotechnical engineering standpoint and to determine if any geotechnical constraints are inherent to the site that may influence the proposed development as depicted on the Green Valley Conceptual Land Use Plan, Figure 2-1, 2020 version. It should be noted that this geotechnical evaluation does not address soil contamination or other environmental issues that may affect the property.

It is a pleasure to be of service to you on this preliminary phase of the project. Should you have any questions regarding the contents of this report, or should you require additional information, please do not hesitate to contact us.

Respectfully submitted,

PETRA GEOSCIENCES, INC.

Douglass Johnston, CEG
Senior Associate Geologist

Grayson R. Walker, GE
Principal Engineer

EXECUTIVE SUMMARY

Site Description

The study area considered under the purview of this report is composed of approximately 505± acres of essentially undeveloped land generally located north of Ethanac Road and between Goetz and Case Roads along Murrieta Road in the city of Perris, Riverside County, California. The proposed development area is designated as being within *Green Valley Specific Plan,* Phase 1B Area consisting of Planning Areas (PA) 3, 10-14, 19-21, 23 26, 29-39, 45, 46a and 55-57 on the 20202 Conceptual Land Use Plan (CLUP).

As of the date of this report, no grading plans or tentative tract maps have been formally developed for the sites; however, based on the CLUP, the proposed development will consist of both single-family and multi-family residential tracts within PA's 11, 12, 13b, 14, 19-21, 26, 30-34, 35-39, 45 and 46a, comprising approximately 356.5 acres of the Phase 1B area. Additionally, PA's 3, 13a and 29 are designated commercial and comprise approximately 24.5 acres. PA-32, comprising 15 acres, will be dedicated to the Romoland School District. Lastly, for public park and/or open-space purposes, approximately 109.5 acres will be dedicated to the City of Perris within PA's 10, 23, 33 and 55-57.

CEQA Guidelines

According to Appendix G of the California Environmental Quality Act (CEQA, California Resources Agency, 2016), geological/geotechnical impacts are deemed significant if the project results in any of the following:

1. Exposure of people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving surface rupture of a known earthquake fault, strong seismic ground shaking, or seismic-related ground failure including liquefaction or landslides.

2. Substantial soil erosion or the loss of topsoil.

3. Location of structures on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse.

4. Location of structures on expansive soils, as defined in Section 1803.5.3 of the 2019 California Building Code (CBC), creating substantial risks to life or property.

5. Soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater.

In addition, if the project substantially alters a topographic feature, or a unique natural physical feature (i.e., significant ridgelines or rock outcroppings) were to be damaged or destroyed by project related activities, project impacts would also be considered significant.

Potentially Significant Geological/Geotechnical Impacts

On the basis of our literature review, the following project activities and geologic hazards have been identified which may potentially affect the proposed development of the site:

- The potential for strong ground motions associated with major earthquakes on one of several nearby active earthquake faults.
- Secondary effects associated with seismic activity, including low to moderate potential for liquefaction and susceptibility to ground subsidence.
- Pre- and post-construction soil erosion.
- The presence of potentially compressible undocumented fill soils and/or natural alluvial soils within the foundation influence zone of the proposed structures.
- Potential hazards related to the inherent engineering characteristics of onsite soils (expansion potential).
- The removal of unidentified stockpiles of soils, i.e. undocumented fill.
- The extent of removals of existing onsite natural alluvial soils to competent natural soils.

The possible impacts of each of these conditions on the proposed development are summarized in the following paragraphs. A more detailed discussion of each of these issues and their potential impact on site development is provided in the "Site-Specific Geologic Impacts and Mitigation Measures" section of this report.

Seismically Related Ground Shaking and Secondary Seismic Effects

As is the case for most locations in southern California, the subject property is susceptible to strong ground shaking as a result of future earthquakes along any of the numerous faults that traverse the region. For this reason, the State and local building codes that govern construction in the area require that the maximum anticipated level of earthquake shaking be taken into consideration in the design of human occupancy structures. Through proper application of the current 2019 California Building Code (CBC) regulations for seismic design, it is expected that the potential for life-threatening damage to the proposed structures as a result of seismically-related ground shaking can be mitigated to a less than significant level.

Potential secondary effects of strong seismic shaking at the site include liquefaction and associated settlement. The subject site is located within an area that has a potential for liquefaction ranging from low to moderate based on Riverside County mapping; therefore, liquefaction and associated phenomena may have an impact on the development during and after a large seismic event. However, it is our professional

opinion that proper consideration of the anticipated seismically-induced settlement values and application of the current CBC regulations as they apply to seismic design, in combination with proper implementation of the design specifications and required inspections during construction, are expected to reduce the potential damage to site structures to a level that is less than significant.

Recent groundwater levels from data obtained from a well immediately north of PA-36 area, indicated that the depth of groundwater measured has ranged from 48.5 to 55.8 feet below the ground surface (bgs) from 2011 to 2020 and another well immediately east of PA-29 indicated that the depth of groundwater measured has ranged from 49.8 to 57.9 feet bgs also from 2011 to 2020 (California Department of Water Resources). As area groundwater is near or more often just below the 50 foot threshold for liquefaction potential per CGS Bulletin No. SP117 – and the site is not in a defined earthquake zone, it is our preliminary opinion that the liquefaction potential hazard is anticipated to be low and should not significantly impact the development of the site, however site-specific geotechnical data and analysis has not been performed at this time. Further subsurface geotechnical field and laboratory testing is necessary to determine the actual potential for liquefaction-induced settlements.

Soil Erosion

Based on the current topography of the site, it appears that rainfall runoff is presently controlled by sheet flow from the dominant high points to low-lying areas with minor runoff south toward Ethanac Road and, to a lesser extent, to adjacent properties to the northern and western portions of the site. The lack of permanent surface drainage and erosion controls across the site is likely to impact the adjacent areas and possibly the municipal storm drain system prior to and during the construction phase of the project until such time as the permanent Water Quality Management Plan is implemented. The development of an erosion control plan and a site-specific Storm Water Pollution Prevention Plan (SWPPP) is expected to bring the impact of surface erosion to a less than significant level.

Concentrated surface water flow can, over time, cause possible washouts of graded slope areas. The project design is expected to incorporate protective landscaping, positive drainage away from slopes on building pad areas, and an extensive network of area drains as means to prevent erosion and loss of topsoil. Such measures will ultimately be shown on the civil engineer's project plans. As the current topography is consistently flat, the design of significant slopes is not expected. With the design of adequate drainage facilities, the potential for soil erosion is considered to be less than significant during the operational state of the project.

Settlement due to Consolidation of Existing Soils

Based on our prior and recent site reconnaissance, as wells as review of available online aerial and historic imagery, portions of the site contain stockpiled undocumented artificial fill soils, as well as two areas that contained former building structures. In addition, the upper portions of natural site soils may consist of low-density, porous and/or potential compressible alluvium. Such soils existing within the foundation influence zone of the proposed structures may be subject to compression under the loads imposed by newly-placed compacted fills and proposed building foundations.

The aforementioned Riverside County website indicates a susceptibility for general area subsidence primarily across the northerly half of the subject site. For this reason, the design-phase geotechnical report should include recommendations for excavation and recompaction of existing fill soils that are intended to reduce the amount of expected post-construction settlement to within typical construction tolerances for well-designed foundations. Provided that all earthwork is performed in accordance with the recommendations provided in the design-phase report, as well as all applicable requirements set forth by the Municipal Code of the City of Perris and the current revision of the California Building Code, it is the opinion of our firm that this potentially significant impact can be mitigated to less than significant.

Expansive Soils

Based on the boring logs and laboratory test results from the preliminary investigation report covering PA's 11-14, 36-39, 45 and 46a (ESSW, 2015), existing soils in the vicinity of the southerly portion of the Specific Plan area (south of Watson Road) are fine-grained in nature and consist of lean to fat clays and clayey silts that range in classification from "non-expansive" to "expansive" as defined per Section 1803.5.3 of the 2019 CBC. The results of testing for expansion potential by ESSW yielded results ranging from very low to very high and more recently Petra's testing of the adjacent graded tracts within PA's 16, 17, 27 and 28 encountered mostly medium expansion soils with lesser occurrences of low expansion soils. It is likely that expansive soils may be incorporated into onsite fills and ultimately be exposed at finished grades within proposed building pad areas during future grading operations. Additional site-specific subsurface exploration and testing that is will be necessary.

If, after completion of grading, it is determined that near-surface soils within building pad areas exhibit an elevated expansion potential, it is expected that the detrimental impact of expansive soils can be mitigated to a less than significant level through control of soil moisture content, proper design of building foundations, floor slabs and exterior improvements that considers the potential uplift forces that can develop in expansive soils.

GEOTECHNICAL FEASIBILITY STATEMENT

Based on our understanding of the project scope and our review of the referenced literature, it is our conclusion that the subject property constitutes an adequate building site from a geotechnical engineering and engineering geologic standpoint. Furthermore, if properly designed and constructed, the proposed development is not likely to expose people or structures to 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 and secondary hazards such as strong seismic ground shaking or seismic-related ground failure including liquefaction or landslides.

Provided that the projects future geotechnical design-level recommendation reports are implemented and the applicable grading and building codes are adhered to, the potential for substantial risk to life or property is expected to be mitigated for this project. The proposed project is thus considered feasible from a geologic/geotechnical engineering standpoint provided the recommendations for additional site-specific studies are performed.

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INTRODUCTION

The following EIR-level geologic and geotechnical assessment report presents our findings and opinions with respect to the geotechnical feasibility of the proposed project and geotechnical constraints that may have an impact on the development of the subject property. This evaluation is based on our review of published geotechnical maps and literature pertinent to the area of the subject site. Many of the maps and referenced material were from City, State and Federal sources, as well as a geotechnical study performed within portions of the subject site by Earth Systems Southwest (ESSW, 2015). Additionally, Petra provided geotechnical observation and testing during grading for the adjacent residential tracts within PA's 16, 17, 27 and 28. In addition, Petra is currently providing geotechnical observation and testing related to mass grading within the subject PA's 13 and 14. As previously stated, the proposed project under the purview of this report is based on the referenced Planning Areas in the Conceptual Land Use Plan.

PURPOSE AND SCOPE OF SERVICES

The purpose of this study is to collect regional and local area geotechnical literatures (maps, reports, aerial photographs, data etc.) in order to provide an assessment of potential geologic and seismic-related constraints that may affect the development areas. The results of our assessment, as well as preliminary mitigation measures intended to reduce the impact of the identified geologic constraints, are provided in this report.

This study has been performed in general accordance with relevant provisions of the California Environmental Quality Act (CEQA) of 1970 (revised 2016), and the guidelines for implementation of CEQA as amended. In preparing this report, our scope of services has included the following:

1. Obtain and review of available published and unpublished literature and maps pertaining to regional faulting, seismic hazards and soil and geologic conditions within and adjacent to the site that could have an impact on the proposed development, including potential secondary hazards, such as liquefaction and susceptibility for ground subsidence.

2. Conduct a reconnaissance of the subject site.

3. Preparation of this report presenting our findings and conclusions as pertinent to the geological and geotechnical assessment for EIR purposes.

LOCATION AND SITE DESCRIPTION

The study area considered under the purview of this report is composed of approximately 505 acres of essentially undeveloped land located north of Ethanac Road, south of Case Road and east of Goetz Road in the city of Perris, Riverside County, California. Watson Road, currently a dirt access road extending east-west, intersects Murrieta Road in the east-central portion of the site. The approximate location of the site with respect to nearby roadways and other landmarks is shown on Figure 1. The site is bounded by Case Road to the north and by agricultural land and Existing Eastern Municipal Water District (EMWD) facilities to the east. The San Jacinto River channel is located several hundred feet to the northwest and Ethanac Road is located along the southern boundary. Perris Valley Airport is located just beyond the San Jacinto River to the northwest. The study area is currently accessed via Murrieta Road, which essentially bisects the site and is a two-way connector road from Ethanac Road to Case Road.

Recent and on-going improvements in the immediate area of the site include: excavation for the extension of the Romoland Channel by Riverside County Flood Control District; widening of Ethanac Road by the City of Perris; construction of West Elm Parkway and a portion of Green Valley Parkway (GVP) between Goetz Road and Murrieta Road, including a bridge spanning the Romoland Channel; construction of sewer and water lines within GVP east of Murrieta Road; widening of Murrieta and Goetz Roads between Ethanac Road and GVP; mass grading to complete PA-14, as well as ongoing importing and mass grading for PA-13; grading and related improvements for two large flood control basins at PA-24 and 25; and grading and development of two new residential tracts (PA's 16, 17, 27, 28).

The subject site is essentially vacant with the following exceptions: utilization of PA-26 as a contractor's staging yard; stockpiled concrete rubble and miscellaneous debris associated with demolition of several historical residences/buildings north of Watson Road within PA-32 and 57; numerous historical end-dumped stockpiles of soils and concrete and other debris north of the westerly extension of Watson Road within the southern end of PA-21 and 23; recent stockpiling of large quantities of soils within PA-11 and 12; minor stockpiling of soils may be present in the southerly end of PA-45; possible underground concrete foundation located at the westerly end of the site within PA-23; as well as several surface concrete slabs associated with the former agricultural site. No apparent utilities are evident within the site with the exception of overhead power lines along the westerly and northerly sides of Murrieta Road and Watson Road, respectively. An earthen ditch exists along the westerly extension of Watson Road along the southerly boundary of PA's 21 and 23, as well as along Case Road, that includes a small culvert crossing Murrieta Road.

Topography is characterized by a generally flat surface of approximately 1 percent grade or less, from east to west, with an estimated relief of approximately 5 feet. The highest elevation of approximately 1420 feet above mean sea level (msl) occurs primarily near the raised perimeters of the property and adjacent to Ethanac Road, with the lowest elevation of approximately 1415 feet msl occurring at localized depressions in the interior areas. Based on the current topography of the site, it appears that rainfall runoff is presently directed by sheet flow from the dominant high points toward internal low-lying areas with minor runoff in the direction of Ethanac Road and, to a lesser extent, the adjacent residential properties and the drainage channels toward the west. Vegetation generally consists of a light growth of grass and weeds and occasional areas of thicker brush. Mature trees are located along either side of Murrieta Road generally south of Watson Road, as well as several trees surrounding the former residence(s)

REGULATORY ENVIRONMENT

Construction projects of the type presently being considered in this report are regulated by the local permitting agency, in this case the Building Division of the City of Perris Development Department. Prior to issuing grading and building permits, the City is tasked with ensuring that structural design is in compliance with all applicable provisions of the state and local regulatory standards listed below.

California Building Code (CBC)

The 2019 California Building Code (Title 24 of the California Code of Regulations) provides the regulatory framework for building code enforcement within the City of Perris. The various requirements contained within the CBC are based on the International Building Code and are intended to provide minimum standards to protect public property and welfare by regulating the design and construction of excavations, structural foundations and building framing systems to mitigate the effects of strong ground shaking and adverse soil conditions. By order of the California legislature, the CBC is published by the California Building Standards Commission every three years. The regulations contained in each revision take effect 180 days after the publication date. As of the date of this report, the current revision of the CBC that is being implemented is the new 2019 CBC, which encompasses the other building-related codes that will regulate development of the subject site, which are contained in Chapter 16 of the Municipal Code of the City of Perris specified below.

California Alquist-Priolo Earthquake Fault Zoning Act

In December 1972, the State legislature enacted the Alquist-Priolo Earthquake Fault Zoning Act which directed the State Geologist to begin compiling maps of known surface traces of active faults within the urbanized areas of California. The intent of this law was to improve earthquake safety by prohibiting the construction of buildings intended for human occupancy across the traces of known active earthquake faults. The term "Earthquake Fault Zones" refers to areas established by the California Geologic Survey (CGS) wherein comprehensive geologic investigations are required to demonstrate that locations designated for new construction are not traversed by active fault traces. The Alquist-Priolo Earthquake Fault Zoning Act also requires property owners or their representatives to disclose whether their property is situated within an established Earthquake Fault Zone prior to selling the property. Local regulatory agencies (such as city- or county-level building departments) are responsible for local implementation of the Act and must regulate development projects within the zones.

California Seismic Hazards Mapping Act

As a further means to protect public safety and property from seismic hazards, the California legislature adopted the Seismic Hazards Mapping Act in 1990. In contrast to the Alquist Priolo Act, the Seismic Hazards Mapping Act specifically addresses potential hazards posed by secondary effects of seismic activity including strong ground shaking, soil liquefaction and associated ground failure, and seismically induced landslides. Maps showing zones of required investigation for one or more of these hazards are prepared and published by the California Geologic Survey and, like the Alquist-Priolo maps, are available to the public via an online resource. Inclusion within a designated seismic hazard zone does not necessarily indicate that such hazards have been confirmed within the zone, but only that the prevalent soil and groundwater conditions within the zone render the area susceptible to the hazard. The local jurisdictional (i.e., the city or county permitting agency) is responsible for ensuring that the required site-specific geotechnical investigations have been performed for construction projects proposed within these seismic hazard zones.

City of Perris General Plan and Municipal Code

The Safety Element of the City of Perris General Plan provides a means by which known natural and manmade hazards can be related to city planning and land use issues. Natural hazards considered within the Safety Element include flooding, seismicity and associated secondary seismic effects, and inherent geologic conditions such as landslide susceptibility. The ultimate purpose of the Safety Element is to serve

as an official guide to the City Council and the local planning and permitting agencies, and to drive the adoption of official codes and implementation measures to reduce the potential impact of such hazards.

The official codes that govern construction projects within the City of Perris are contained within Chapter 16 of the City's Municipal Code. The State of California building codes have been adopted by reference (and amended by Section 16.08 of that that chapter) as the Building Codes of the City of Perris.

PROPOSED DEVELOPMENT

General Project Design

As of the date of this report, definitive grading plans or tentative tract maps have not yet been developed for the site; however, based on the Conceptual Land Use Plan, it is our understanding that the proposed development will consist of will consist of both single-family and multi-family residential tracts within PA's 11, 12, 13b, 14, 19-21, 26, 30-34, 35-39, 45 and 46a comprising approximately 356.5 acres of the Phase 1B area. Additionally, PA's 3, 13a and 29, comprising approximately 24.5 acres are designated for commercial use. PA-32, comprising 15 acres, will be dedicated to the Romoland School District for a future school onsite and the site balance of approximately 109.5 acres (PA's 10, 23, 33 and 55-57) will be dedicated to the City of Perris for public parks and/or open space uses. Associated exterior improvements are expected to include asphalt-paved access streets, concrete driveways and pedestrian sidewalks, surface drainage controls, perimeter fencing, accent and theme walls, common landscaped areas, extensive underground infrastructure, and required storm water quality facilities.

As noted, grading plans have not been developed for the site, however, due to relatively flat surface across the entire site, it is anticipated that the proposed finished surface elevations within the site will generally correspond to those of the surrounding area. Local grade changes may be accommodated by low-height graded slopes, however no significant graded slopes are anticipated at this time.

FINDINGS

Regional Physiographic Setting and Local Geology

Geologically, the site lies within the Perris Block near the northeastern terminus of the Peninsular Ranges Geomorphic Province. The Perris Block is bounded by the San Jacinto fault zone to the northeast and the Elsinore fault zone to the southwest. Bedrock underlying the site at depth is comprised of pre-Cenozoic crystalline plutonic and metamorphic basement rocks that are a part of the Peninsular Range Batholith. The

subject property is situated within a broad alluvial valley known as the Perris Plain in very close proximity to the San Jacinto river. A regional geologic map of the site and surrounding area is included as Figure 2. The general area of proposed development is underlain predominantly by Holocene-age alluvial deposits, however older alluvial deposits may be located in the southeasterly portion of the site and very old alluvial deposits are mapped in the southwesterly corner of the site (Morton, D. M., 2003). Based on the 2015 ESSW report, local alluvial valley soil materials consist of interlayered clay, sands, silty sands, clayey sands, silts, gravels and cobbles. Additionally, localized surficial areas of the site contain imported stockpiles of undocumented fill soils to various depths.

Groundwater

The 2015 study by ESSW encountered groundwater near Ethanac Road at 50 feet bgs, however, they noted there is a potential for perched groundwater conditions and that water levels should be closely monitored with future subsurface exploration in conjunction with laboratory analysis of liquefaction potential that apparently varies across the site, as discussed further below. In addition, both historic and recent groundwater levels from data obtained from nearby wells indicate that the depth of groundwater measured in the nearest well within ¼ mile easterly of the site is 55.2 feet bgs.

Based on our review, recent groundwater levels from a well immediately north of PA-36 area indicated the depth of groundwater measured ranged from 48.5 to 55.8 feet bgs from 2011 to 2020. Another well, immediately east of PA-29, indicated the depth of groundwater has ranged from 49.8 to 57.9 feet bgs, also from 2011 to 2020 (California Department of Water Resources).

Seismic Exposure

The site is located in a seismically active area of southern California and will likely be subjected to very strong seismically related ground shaking during the anticipated life span of the project. Structures within the site should therefore be designed and constructed to resist the effects of strong ground motion in accordance with the 2019 California Building Code (CBC).

Liquefaction Settlement and Lateral Spreading Potential

The site is mapped as having areas of very low, low and moderate potential for liquefaction by Riverside County, closely mimicking the extent of the younger and older alluvial units by published geologic mapping. As indicated in the 2015 ESSW geotechnical report, the liquefaction potential within the adjacent site to the south was considered low, with the maximum dynamic settlement calculated to be approximately

0.8 inches. Differential settlement potential was estimated to be ½ of the total estimated settlement, or 0.4 inches. ESSW considered the potential for lateral spreading at the adjacent southerly site to be low. This was supported by the observed presence of older alluvium underlying the entire site. While it is our opinion that these preliminary findings by ESSW may be similarly encountered within the subject site, further site-specific field investigation and analysis utilizing both Cone Penetration Test (CPT) soundings and hollow-stem auger borings will be necessary.

Active Fault Zonation

No portion of the area of proposed construction is located within the boundaries of an "Earthquake Fault Zone" as defined by the State of California in the Alquist-Priolo Earthquake Fault Zoning Act (Hart and Bryant, 1997), nor within a County of Riverside fault hazard zone. The site is located approximately 14 miles northeast from an earthquake fault zone that has been established around the active traces of the Elsinore fault.

On the basis of our review of the current revision of the Safety Element of the City of Perris General Plan, no active faults have been identified with the project boundaries. In addition, the City has not independently designated any zones wherein additional subsurface investigation would be required to determine the presence and level of activity of suspected active branches of local fault systems (City of Perris Planning Division, 2000).

Secondary Seismic Hazard Zonation

Based on our additional review of the U.S.G.S. Romoland and Perris 7.5-minute quadrangles and the California Geologic Survey (CGS), the subject site does not lie within a designated fault zone. Given the essentially flat topography that characterizes the southern portion of the city of Perris, the site has not been included within a State-designated seismically induced landslide hazard zone.

The County of Riverside “Map My County” website has identified the Green Valley Ranch SP site, as an area of Very Low, Low and Moderate liquefaction potentials. In addition, approximately the northerly half of the subject portion of the overall SP site has been classified as “Susceptible to Subsidence.”

Our review of the current revision of the Safety Element of the City of Perris General Plan indicates that the City has adopted the seismic hazards special studies zones prepared by the County of Riverside and has not independently designated additional zones that are considered susceptible to secondary seismic hazards such as liquefaction and earthquake-induced landslides.

Seismically Induced Flooding

The types of seismically induced flooding which may be considered as potential hazards to a particular site normally includes flooding due to a tsunami (seismic sea wave), a seiche, or failure of a major reservoir or other water retention structure upstream of the site. Since the site lies approximately 34 miles inland from the Pacific Ocean at an average elevation of approximately 1416 feet msl or greater, the probability of flooding from a tsunami or seiche is considered to be nil.

The flood control dam for Lake Perris lies approximately 6 miles upstream of the subject site. However. Exhibit S-13 of the Safety Element of the City of Perris General Plan clearly puts the subject site within the inundation area of not only this dam, but 3 others further upstream of the Perris Valley. The mitigation of risk due to dam failure is beyond the scope of this study and report. The potential for seismically induced flooding consequent to dam failure within the boundaries of the city of Perris is addressed in the Safety Element of the City's General Plan.

SITE-SPECIFIC GEOLOGIC IMPACTS AND MITIGATION MEASURES

The following paragraphs provide our assessment of the potential geologic impacts of the proposed project in consideration of the significance thresholds described above. This assessment is based on our review of available geologic literature and maps. Specific impacts are ranked as less than significant and potentially significant. Proposed mitigation measures are provided where appropriate that, in the opinion of our firm, would reduce the effect of potentially significant impacts to a less than significant level.

Impact No. 1(a) - Surface Fault Rupture

Level of Significance: Less than Significant

Discussion:

No portion of the area of proposed construction is located within the boundaries of an "Earthquake Fault Zone" as defined by the State of California in the Alquist-Priolo Earthquake Fault Zoning Act (Hart and Bryant, 1997) nor within a County of Riverside fault hazard zone. The site is, however, located approximately 14 miles to the northeast of the earthquake fault zone that has been established around the Elsinore fault.

Impact No. 1(b) - Strong Ground Motion

Level of Significance: Potentially Significant

Discussion:

The subject site is located in a seismically active area of southern California. The type and magnitude of seismic hazards that may affect the site are dependent on both the distance to causative faults and the intensity and duration of the seismic event. Although the probability of primary surface rupture is considered very low, ground shaking hazards posed by earthquakes occurring along regional active faults do exist and should be taken into account in the design and construction of the proposed structures within the subject site.

Proposed Mitigation:

The proposed structures within the site should be designed and constructed to resist the effects of seismic ground motions as provided in the applicable portions of Section 1613 of the 2019 California Building Code (CBC).

Impact No. 1(c) – Seismically-Induced Ground Failure

Level of Significance: Potentially Significant

Discussion:

Secondary effects of seismic activity that are typically considered as possible hazards to a particular site include several types of ground failure, as well as induced flooding. The general types of ground failure that can occur as a consequence of severe ground shaking include landsliding, ground subsidence, ground lurching, shallow ground rupture, lateral spreading, liquefaction, and soil strength loss. The probability of occurrence of each type of ground failure depends on the severity of the earthquake, distance from the causative fault, topography, soil and groundwater conditions, in addition to other factors.

Of the seismically induced ground failure modes listed above, liquefaction and liquefaction-related surface phenomena appear to be the primary concerns with respect to the subject site. Liquefaction occurs when dynamic loading of a saturated sand or silt causes pore-water pressures to increase to levels where grain-to-grain contact is lost, and material temporarily behaves as a viscous fluid. Liquefaction can cause settlement of the ground surface, settlement and tilting of engineered structures, flotation of buoyant buried structures and fissuring of the ground surface. A common surface manifestation of liquefaction is the formation of sand boils – short-lived fountains of soil and water that emerge from fissures or vents and leave freshly deposited conical mounds of sand or silt on the ground surface.

Assessment of liquefaction potential for a particular site requires knowledge of a number of regional as well as site-specific parameters including the estimated design earthquake magnitude, the distance to the assumed causative fault and the associated probable peak horizontal ground acceleration at the site, subsurface stratigraphy, depth to groundwater, and soil characteristics. Parameters such as distance to causative faults and estimated probable peak horizontal ground acceleration were determined using published references and by utilizing online computer programs by the U.S. Geological Survey (USGS). Stratigraphy and soil characteristics were determined by means of a site-specific subsurface investigation combined with appropriate laboratory analysis of representative samples of onsite soils.

As noted previously herein, groundwater from well data near Ethanac road was is near a depth of 50 feet below the ground surface at the time of the ESSW 2015 field investigation and nearby well data over the past 9 years indicates groundwater fluctuates from approximately 49 to 55 feet bgs.

Taking into consideration the very flat topography that characterizes the area of the subject site, the potential for liquefaction-related lateral spreading would otherwise be considered to be insignificant. Due to the proximity of the site to the Romoland Flood Control Channel, this assessment may be downgraded to a low potential for lateral spreading and appropriate setbacks established.

Proposed Mitigation:
The potential detrimental effects of liquefaction-induced differential settlement can be reduced to a less than significant level for engineering purposes through the use of properly designed and constructed, foundation systems for proposed 1- to 2-story structures.

Foundations for residential structures may lose a portion of the available bearing capacity during a strong seismic event that results in surface manifestation of liquefaction; however, it is the opinion of this firm that the detrimental effects of potential bearing failure can also be reduced to a less than significant level through proper remedial grading combined with the use of a properly designed post-tensioned or strengthened conventional concrete foundation system. Specific recommendations for site grading and building foundation design should be provided in the comprehensive design-phase geotechnical report.

Impact No. 1(d) – Slope Instability and Landslides

Level of Significance: Less than Significant

Discussion:
As mentioned previously in this report, our review of the pertinent Seismic Hazard Zone Report for the area of the subject site indicates that the property does not lie within a designated seismically induced landslide

hazard zone. Given the essentially flat topography that characterizes the site and given the absence of any existing or proposed slopes of significant height within or adjacent to the site, the potential for gross or surficial slope instability is considered to be essentially non-existent.

Impact 2 – Soil Erosion

Level of Significance: Potentially Significant

Discussion:

There are no existing or proposed slopes of significant height within the project site; therefore, the potential for significant erosion and downslope transport of soil material is considered to be minimal. Nonetheless, under conditions where runoff from precipitation or uncontrolled irrigation is concentrated over an extended period of time, some localized erosion of graded areas could occur that would result in offsite transport of the non-cohesive (sandy) near-surface soils within the site. This would be particularly problematic during the rough grading phase of the project when permanent storm water controls have not yet been constructed.

Proposed Mitigation:

It is expected that the potential impact of localized minor soil erosion will be mitigated to a less than significant level through the implementation of proper storm water Best Management Practices (BMP's) prior to commencement of earthwork operations within the site, as well as diligent maintenance of erosion control devices throughout the early phases of construction until such time as the permanent storm water conveyance system has been constructed and activated. During the post-construction and occupancy period, the less than significant impact of soil erosion would be maintained through proper maintenance of irrigation systems and permanent storm water conveyance devices.

Impact No. 3 – Compressible Near-Surface Soil Units

Level of Significance: Potentially Significant

Discussion:

Where existing undocumented fill and stockpiles occurs or where low-density, porous or unsuitable natural alluvial soils occur in areas where new engineered fills or structures are proposed, the existing soils will require excavation and subsequent re-compaction as part of remedial grading operations. The conclusions from the ESSW report is that as much as 5 to 10 feet of the upper native soils may be unsuitable in their current state and require over-excavation, i.e., removal, and re-compaction. Excavated soils may be re-used as engineered fill source material, provided they are free of deleterious material. Although this is presumably a conservative estimate, it should not be discounted with the absence of exploration that is site-

specific. Detailed recommendations for remedial and design grading should be provided in the comprehensive design-phase geotechnical report.

Provided that remedial and design grading within the site are performed in accordance with local grading ordinances, current standards of practice in the area, and the site-specific recommendations to be provided by the project geotechnical professional, it is expected that excessive settlement resulting from compression of any existing undocumented fill soils or unsuitable native soils will be reduced to a less than significant level.

Impact No. 4 – Expansive Soils

Level of Significance: Potentially Significant

Discussion:

Expansive soils are soils that experience volumetric changes in response increases or decreases in moisture content. Relatively thin, rigid structural elements such as building floor slabs and exterior concrete flatwork may experience uplift, shifting, or cracking as a result of swelling or contraction of expansive soils. In recognition of these issues, the California Building Code contains provisions for design of building foundations and floor slabs to mitigate the potential detrimental effects of expansive soils.

Given the nature of near-surface soils, encountered in the adjacent PA-2 16, 17, 27 and 28 (ESSW, 2015, Petra), it is likely the onsite soils materials will be classified as "expansive" as defined per Section 1803.5.3 of the 2019 CBC.

Proposed Mitigation:

If, after completion of grading, it is determined that near-surface soils within building pad areas exhibit an elevated expansion potential, it is expected that the detrimental impact of expansive soils can be mitigated to a less than significant level through proper design of building foundations, floor slabs and exterior improvements that takes into account the potential uplift forces that can develop in expansive soils.

FINAL ANALYSIS AND RECOMMENDATIONS FOR ADDITIONAL STUDY

General Project Feasibility

Based on the results of our review of available geologic and geotechnical literature and maps, it is our opinion that development of the subject site for the residential, commercial, park/recreation, and school uses now proposed is feasible from a geotechnical standpoint, however a comprehensive design-phase geotechnical report will be required for the proposed development that will thoroughly address the potential

geologic hazards that may impact development of the subject site. That report should be based on the preliminary grading concept that is shown on tentative plans that have been made available by the project civil engineer

Level of Significance of Impacts Following Mitigation

Assuming that the mitigation measures described in this report and the forthcoming comprehensive design-phase geotechnical report are fully implemented during the project planning and construction phases, it is the opinion of our firm that the potentially significant geologic and seismic impacts described herein can be reduced to a less than significant level.

REPORT LIMITATIONS

This report is based on the proposed project areas and the geologic/geotechnical research as described herein. The local area soil materials and groundwater conditions, described in other literature, may be representative of soil within the project area, however site-specific field and laboratory testing and geotechnical analysis have not yet been performed.

This report has been prepared consistent with that level of care being provided by other professionals providing similar services at the same locale and time period. The contents of this report are professional opinions and as such, are not to be considered a guarantee or warranty. This report should be reviewed and updated after a period of one year or as project plans are developed.

The information contained herein has not been prepared for use by parties or projects other than those named or described herein. This report may not contain sufficient information for other parties or other purposes.

Should you have any questions, please do not hesitate to call.

Respectfully submitted,

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Attachments: References
Figure 1 – Site Location Map
Figure 2 – Geologic Map

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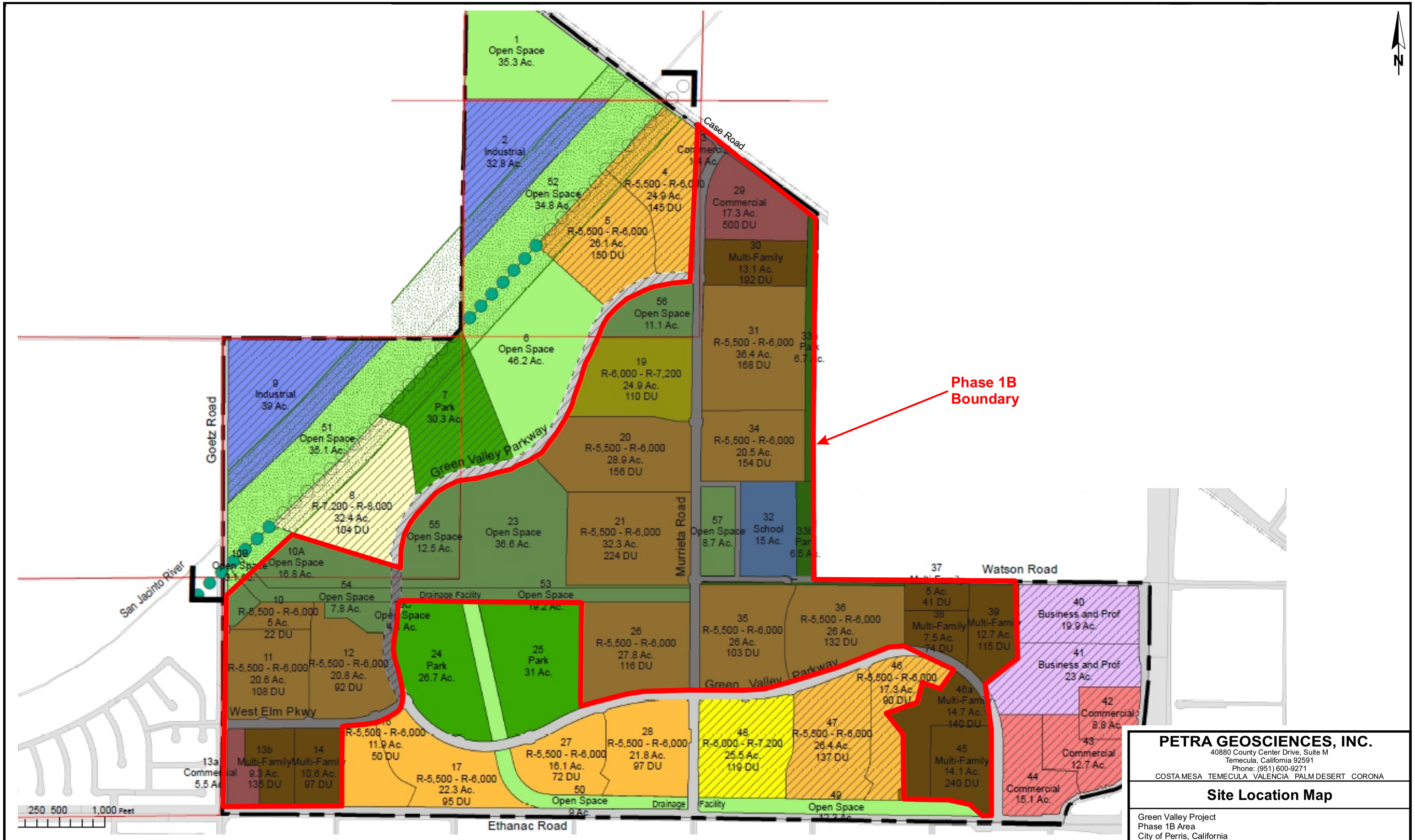

Reference: Conceptual Land Use Plan, 2020

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Site Location Map

Green Valley Project
Phase 1B Area
City of Perris, California

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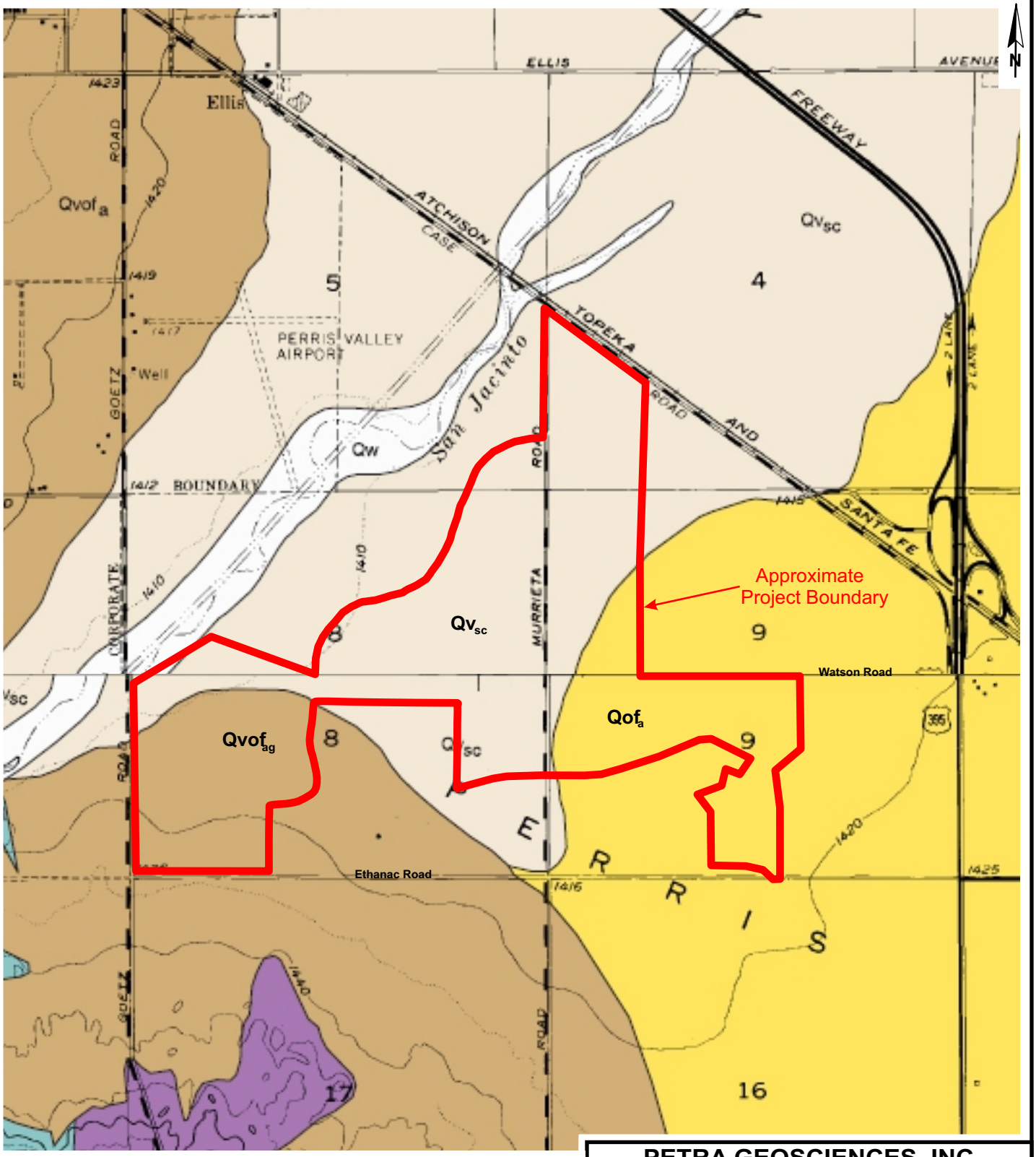
DATE: August 2020
J.N.: 18-106

Figure 1



Approximate Scale
1 Mile

Qv_{sc}	Active Valley Deposits
Qof_a	Old Alluvial Fan Deposits
$Qvof_{ag}$	Very Old Alluvial Fan Deposits

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Geologic Map

Green Valley Project
Phase 1B Area
City of Perris, California

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Figure 2