# 4.5 GEOLOGY, SOILS, MINERALS, AND PALEONTOLOGICAL RESOURCES

## 4.5.1 ENVIRONMENTAL SETTING

### GEOLOGY

The Project Site and the off-site improvements areas are located along the southwestern margin of the Sacramento Valley and the northeastern margin of the San Francisco Bay Area. Rock units exposed at the surface of the Project Site and the off-site improvement areas consist of Holocene-age (11,700 years Before Present [B.P.] to Present Day) alluvial fan and Bay Mud deposits, and artificial fill. The alluvial fan deposits are composed of sand, gravel, silt, and clay deposited where streams emanate from upland regions to the north and west onto more gently sloping valley floors or plains. Older late-Pleistocene (129,000 to 11,700 years B.P.) alluvial fan deposits underlie the Holocene fan deposits. Bay Mud is composed of water-saturated estuarine mud, predominantly clay and silty clay, underlying marshlands, and tidal mud flats. The mud also contains lenses of well-sorted, fine sand and silt, a few shell layers (oysters), and peat. The mud interfingers with and grades into fine-grained fan deposits at the distal edge of Holocene fans. Bay Mud generally occupies the area between the modern shoreline and the historical limits of tidal marshland (Graymer et al. 2002). At depth, the Project Site is underlain by the Great Valley Complex, which outcrops at the surface approximately 2 miles to the north. The Great Valley Complex is of Mesozoic age (150 to 65 million years B.P.), and is composed of the Coast Range ophiolite (altered silicic and volcanic rocks) and the Great Valley sequence (sandstone, conglomerate, and shale) (Graymer et al. 2002).

The topography at the Project Site and the off-site improvement areas slopes gently towards the southeast, and ranges from approximately 5 to 15 feet above mean sea level.

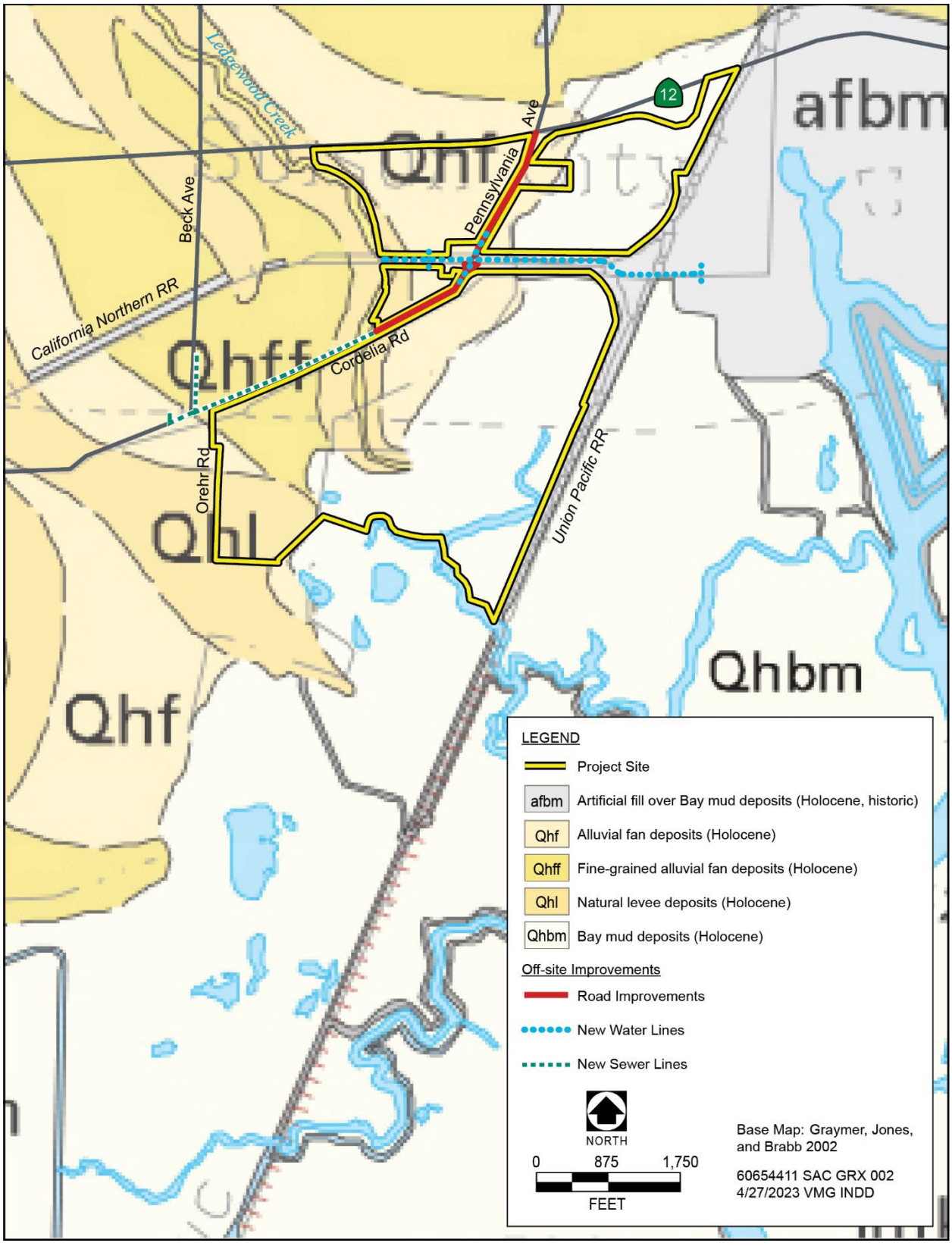
### PALEONTOLOGICAL RESOURCES

Based on a review of the *Geologic Map of the Northeastern San Francisco Bay Region* (Graymer et al. 2002), the Project Site and the off-site improvement areas are underlain by Holocene-age (11,700 years B.P. to Present Day) deposits consisting of artificial fill over Bay Mud deposits, alluvial fan deposits, fine-grained alluvial fan deposits, natural levee deposits, and Bay Mud deposits (Exhibit 4.5-1). Soil borings obtained at the Project Site by Mid Pacific Engineering, Inc. (MPE 2020) confirmed that Holocene deposits are present to the maximum boring depth (i.e., 25 feet below the ground surface), and cone penetration test results to depths of 50–75 feet below the ground surface returned similar results. In order to be considered a fossil, a paleontological resource must be more than 11,700 years old. Holocene deposits contain only the remains of extant, modern taxa (if any resources are present), which are not considered “unique” paleontological resources.

### SEISMICITY

#### Surface Fault Rupture

Geologists have determined that the greatest potential for surface fault rupture and strong seismic ground shaking is from active faults; that is, faults with evidence of activity during the Holocene epoch (the last 11,700 years). Surface rupture is the actual cracking or breaking of the ground surface along a fault during an earthquake, which is generally limited to a linear zone that is only a few yards wide. If surface fault rupture occurs, structures that




Source: Graymer, et al. 2002

**Exhibit 4.5-1. Geologic Formations**

are located across the fault trace can be torn apart, and pipelines can rupture. The Alquist-Priolo Earthquake Fault Zoning Act (Alquist-Priolo Act) was created to help reduce the loss of life and property from an earthquake by prohibiting the construction of structures designed for human occupancy across the traces of active faults.

The Project Site and the off-site improvement areas are not located within an Alquist-Priolo Earthquake Fault Zone, or within or adjacent to the trace of any other known fault. As shown in Exhibit 4.5-2, the nearest active fault (i.e., a fault that has shown evidence of movement during Holocene time) is the Green Valley-Cordelia-Concord Fault Zone approximately 3.2 miles west of the Project Site (California Geological Survey [CGS] 2020, Jennings and Bryant 2010).

### Strong Seismic Ground Shaking

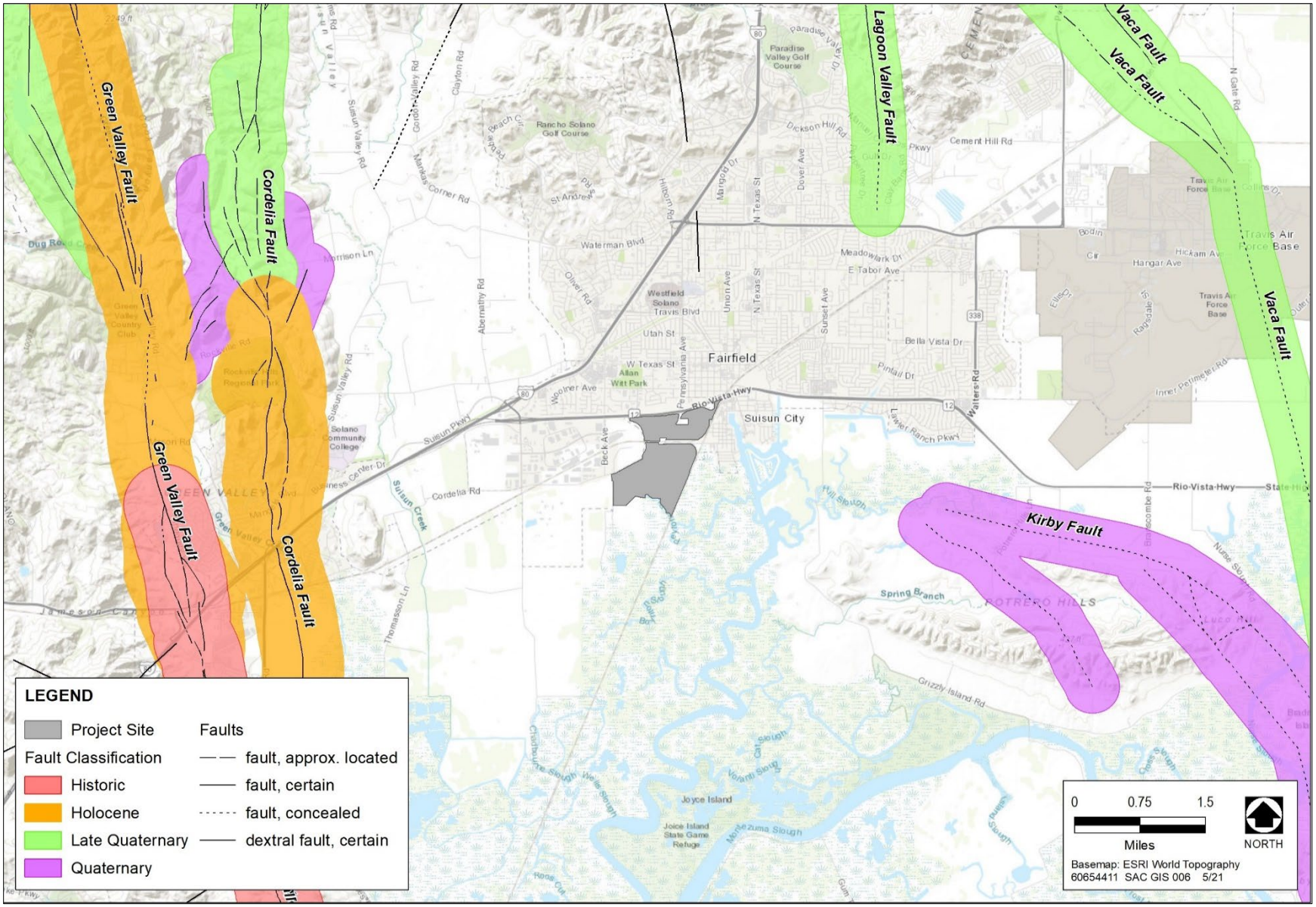
Ground shaking—motion that occurs as a result of energy released during faulting—could potentially result in the damage or collapse of buildings and other structures, depending on the magnitude of the earthquake, the distance to the epicenter, and the character and duration of the ground motion. Other important factors to be considered are the characteristics of the underlying soil and rock and, where structures exist, the building materials used, and the workmanship of the structures.

The Project Site and the off-site improvement areas are located in a seismically active area, as shown in Exhibit 4.5-2. The U.S. Geological Survey indicates that the estimated probability of one or more magnitude 6.7 earthquakes occurring during the 30-year period 2013–2043 in the San Francisco Bay Area is 72 percent (Aagaard et al. 2016). In the project region, the fault with the highest estimated probability of generating damaging earthquakes is the Hayward-Rodgers Creek (33 percent), with a 16 percent probability for the Green Valley Fault.

The Green Valley Fault, which is the easternmost strike-slip fault of the larger San Andreas system in the San Francisco Bay area, is the closest active fault in the project region. It extends from Wooden Valley in the north to Suisun Bay in the south. The southern end of the Green Valley Fault probably connects with the Concord fault along an approximately 0.5-mile-wide extensional jog south across Suisun Bay. The Cordelia Fault may be an eastward extension of the Green Valley Fault. The Green Valley Fault has produced multiple surface-rupturing events in the past 2,700 years.

Although it is not classified as "active," the Vaca-Pittsburg-Kirby Hills Fault Zone, which runs through Travis Air Force Base approximately 5 miles east of the Project Site, has shown evidence of activity during the Late Quaternary (approximately 700,000 years B.P.). In addition, Segment 5 of the Great Valley Fault Zone (which is a blind-thrust fault zone that does not have a surface expression), has also shown evidence of activity during the Late Quaternary and is approximately 5 miles east of the Project Site. Although these faults are not classified as active, they may still be capable of strong seismic ground shaking. Historic earthquake locations and magnitudes near Suisun City are shown in Exhibit GEO-10 in the *Geology and Soils Background Report* (City of Suisun City 2015a) prepared in support of the Suisun City 2035 General Plan.

Peak horizontal ground acceleration, which is a measure of the projected intensity of ground shaking from seismic events, can be estimated using a computer model. As part of the geotechnical report prepared for the Project Site, MPE (2020) determined that a peak ground acceleration of 0.72*g* would be appropriate for use in seismic-related design and engineering for the Project Site. This indicates that a strong level of seismic ground shaking would be anticipated for the Project Site.




Source: Jennings and Bryant 2010

**Exhibit 4.5-2. Fault Activity Map**

### Liquefaction/Subsidence

Soil liquefaction occurs when ground shaking from an earthquake causes a sediment layer saturated with groundwater to lose strength and take on the characteristics of a fluid, thus becoming similar to quicksand. Structures on soil that undergoes liquefaction may settle or suffer major structural damage. Liquefaction is most likely to occur in low-lying areas where the substrate consists of poorly consolidated to unconsolidated water-saturated sediments, recent Holocene-age sediments, or deposits of artificial fill. Additional factors that determine the liquefaction potential are the distance to an active seismic source and the depth to groundwater.

Groundwater was encountered at depths of 7–12 feet below the ground surface during soil borings obtained for the geotechnical report. Because the boreholes were open only for a short period of time, MPE (2020) noted that groundwater may actually be present at a shallower depth. As a result, future excavations deeper than 5 feet below the ground surface for utilities and loading dock excavations may encounter groundwater, requiring construction dewatering (MPE 2020). Because conditions are expected to be similar for the adjacent off-site improvements, which are comprised of the same soil types, construction dewatering may also be required for the off-site improvements.

MPE (2020) performed a site-specific liquefaction analysis as part of the geotechnical report. MPE determined that liquefaction could occur in thin, discontinued layers (3–15 inches thick) of soils encountered at depths between 12 and 18 feet below the ground surface. MPE also determined that liquefaction could occur in discontinuous layers (9 inches to 3 feet thick) of soils encountered at depths greater than 22 feet below the ground surface. However, considering that these soil layers were encountered at depths greater than 12 feet below the ground surface, the relative thinness of the layers, and the fact that these layers are embedded within stiff to very stiff clay soils, MPE found that a loss of bearing capacity of the foundations and surface manifestation associated with liquefaction are not anticipated. Because the off-site improvements would be located in the same soil types and geologic formations, liquefaction is not anticipated for the same reasons described above for the Project Site.

Seismically-induced settlement or subsidence can occur from strong ground motions generated by an earthquake. Seismically-induced settlement can result in cracking of foundations, exterior cladding, and interior finishes. MPE (2020) predicted that seismically-induced settlement ranging from 0.16–2.92 inches could occur at the Project site. However, proper engineering and design of buildings and foundations are required to incorporate the projected amount of settlement to reduce structural damage.

### Slope Stability

The Project Site, the off-site improvement areas, and the surrounding locale are situated on a broad, nearly flat alluvial plain, and the northern edge of the Suisun Marsh. There are no steep slopes that would be subject to landslide hazards either within or adjacent to the Project Site or the off-site improvement areas.

## SOILS

Soil properties influence the development of building sites, including the engineering design, construction techniques, and site maintenance. Soil properties also influence the potential for erosion and stormwater runoff.

The results of soil borings obtained by MPE (2020) indicate that Project Site soils consist of stiff to very stiff, lean clays to depths of 7–16 feet below the ground surface. These clays are underlain by medium stiff to stiff, sandy

clays and medium stiff to hard, lean silty clays to the maximum depth explored (25 feet below the existing ground surface). To supplement the soil borings, seven cone penetration test[1] soundings were performed to maximum depths of approximately 50–75 feet below the ground surface. The soil conditions encountered at the cone penetration test locations were generally consistent with those encountered in the soil borings (i.e., clay and silty clay).

A review of U.S. National Resources Conservation Service (NRCS 2022) soil survey data indicates that near-surface soils at the Project Site and the off-site improvement areas consist of five soil types, as shown in Exhibit 4.5-3. Pertinent NRCS soil properties for the Project Site and the off-site improvement areas are listed in Table 4.5-1.

In the proposed Development Area and off-site improvement areas, NRCS (2022) has rated the native Alviso, Sycamore, and Pescadero soils as very limited for development due to a high shrink-swell potential, low soil bearing strength, shallow depth to a water-saturated zone, and moderate to high potential for flooding (Table 4.5-1).

### Erosion and Stormwater Runoff

NRCS (2020) has rated the soils in throughout the Project Site with a moderate water erosion hazard and a low wind erosion hazard (Table 4.5-1).

Most soils can be categorized into hydrologic soil groups (which apply only to surface soil layers) based on runoff-producing characteristics. Hydrologic soil groups are factored into calculations of erosion and stormwater runoff potential when drainage plans are prepared for new development. Soils are assigned to groups A, B, C, or D. The soils in the Development Area and off-site improvement areas have been assigned by NRSC to either Hydrologic Group C or D. Group C soils have slow infiltration rate and therefore have a high stormwater runoff potential, and Group D soils have a very slow water infiltration rate and a very high stormwater runoff potential (NRCS 2022). Soils in the proposed Managed Open Space area are assigned to similar hydrologic groups (Table 4.5-1).

### Expansion

Expansive soils are composed largely of clays, which greatly increase in volume when saturated with water and shrink when dried (referred to as “shrink-swell” potential). Soils with a moderate to high expansion potential can result in cracked foundations, structural distortions, and warping of doors and windows. Underground pipelines can also be damaged.

The results of laboratory testing from soil borings obtained as part of the site-specific geotechnical report (MPE 2020) determined that the on-site native surface and near-surface soils consist predominantly of clays with a medium to high expansion potential. However, proper foundation design and soil treatment can generally eliminate the problems caused by expansive soils. Based on NRCS (2022) soil survey ratings for the off-site improvement areas, those soils also have a high expansion potential (see Table 4.5-1).

[1] A method used to determine the geotechnical engineering properties of soils and to delineate soil stratigraphy, which involves pushing an instrumented cone (with the tip facing down) into the ground at a controlled rate, using a hydraulic ram.

**Table 4.5-1. Soil Properties**

| Area of Project Site | Soil Name | Approximate Acreage | Expansion Potential[1] | Water Erosion Potential[2] | Wind Erosion Potential[3] | Drainage Class | Permeability[4] | Hydrologic Soil Group[5] | NRCS Soil Limitations for Building Site Development |
|---|---|---|---|---|---|---|---|---|---|
| Proposed Development Area | Alviso silty clay loam | 0.7 | High | Moderate | 6 | Poorly drained | Moderately low | D | High shrink-swell potential, low soil bearing strength, shallow depth to a water-saturated zone, high potential for flooding. |
| Proposed Development Area | Sycamore silty clay loam, saline | 91.1 | Moderate | Moderate | 6 | Somewhat poorly drained | Moderately high | C | High shrink-swell potential, low soil bearing strength, shallow depth to a water-saturated zone, high potential for flooding. |
| Proposed Development Area | Pescadero silty clay loam, 0% slopes | 51.5 | High | Moderate | 6 | Somewhat poorly drained | Moderately low | D | High potential for shallow soil ponding with water, high potential for flooding, high shrink-swell potential. |
| Proposed Managed Open Space | Alviso silty clay loam | 159.9 | High | Moderate | 6 | Poorly drained | Moderately low | D | Not Applicable – no proposed development |
| Proposed Managed Open Space | Joice muck | 27.2 | NR | NR | 2 | Very poorly drained | High | A/D | Not Applicable – no proposed development |
| Proposed Managed Open Space | Made land[6] | 1.9 | NR | NR | NR | Well drained | NR | NR | Not Applicable – no proposed development |
| Proposed Managed Open Space | Pescadero silty clay loam, 0% slopes | 51.5 | High | Moderate | 6 | Somewhat poorly drained | Moderately low | D | Not Applicable – no proposed development |
| Proposed Managed Open Space | Sycamore silty clay loam, saline | 138.7 | Moderate | Moderate | 6 | Somewhat poorly drained | Moderately high | C | Not Applicable – no proposed development |
| Off-Site Improvement Areas[a] | Alviso silty clay loam | 0.22 | High | Moderate | 6 | Poorly drained | Moderately low | D | High shrink-swell potential, low soil bearing strength, shallow depth to a water-saturated zone, high potential for flooding. |

| Area of Project Site | Soil Name | Approximate Acreage | Expansion Potential[1] | Water Erosion Potential[2] | Wind Erosion Potential[3] | Drainage Class | Permeability[4] | Hydrologic Soil Group[5] | NRCS Soil Limitations for Building Site Development |
|---|---|---|---|---|---|---|---|---|---|
| Off-Site Improvement Areas[a] | Sycamore silty clay loam, saline | 2.92 | Moderate | Moderate | 6 | Somewhat poorly drained | Moderately high | C | High shrink-swell potential, low soil bearing strength, shallow depth to a water-saturated zone, high potential for flooding. |
| Off-Site Improvement Areas[a] | Pescadero silty clay loam, 0% slopes | 0.50 | High | Moderate | 6 | Somewhat poorly drained | Moderately low | D | High potential for shallow soil ponding with water, high potential for flooding, high shrink-swell potential. |

Note: NR = not rated; NRCS = National Resources Conservation Service

[a]Assumes a 6-foot-wide area of disturbance for utility trenching and a 12-foot-wide area of disturbance for roadway work. Acreages of disturbance for off-site improvements are estimated and are not intended to be exact.

[1] Based on percentage of linear extensibility, shrink-swell potential ratings of “moderate” to “very high” can result in damage to buildings, roads, and other structures.

[2] Based on the erosion factor “Kw whole soil,” which is a measurement of relative soil susceptibility to sheet and rill erosion by water.

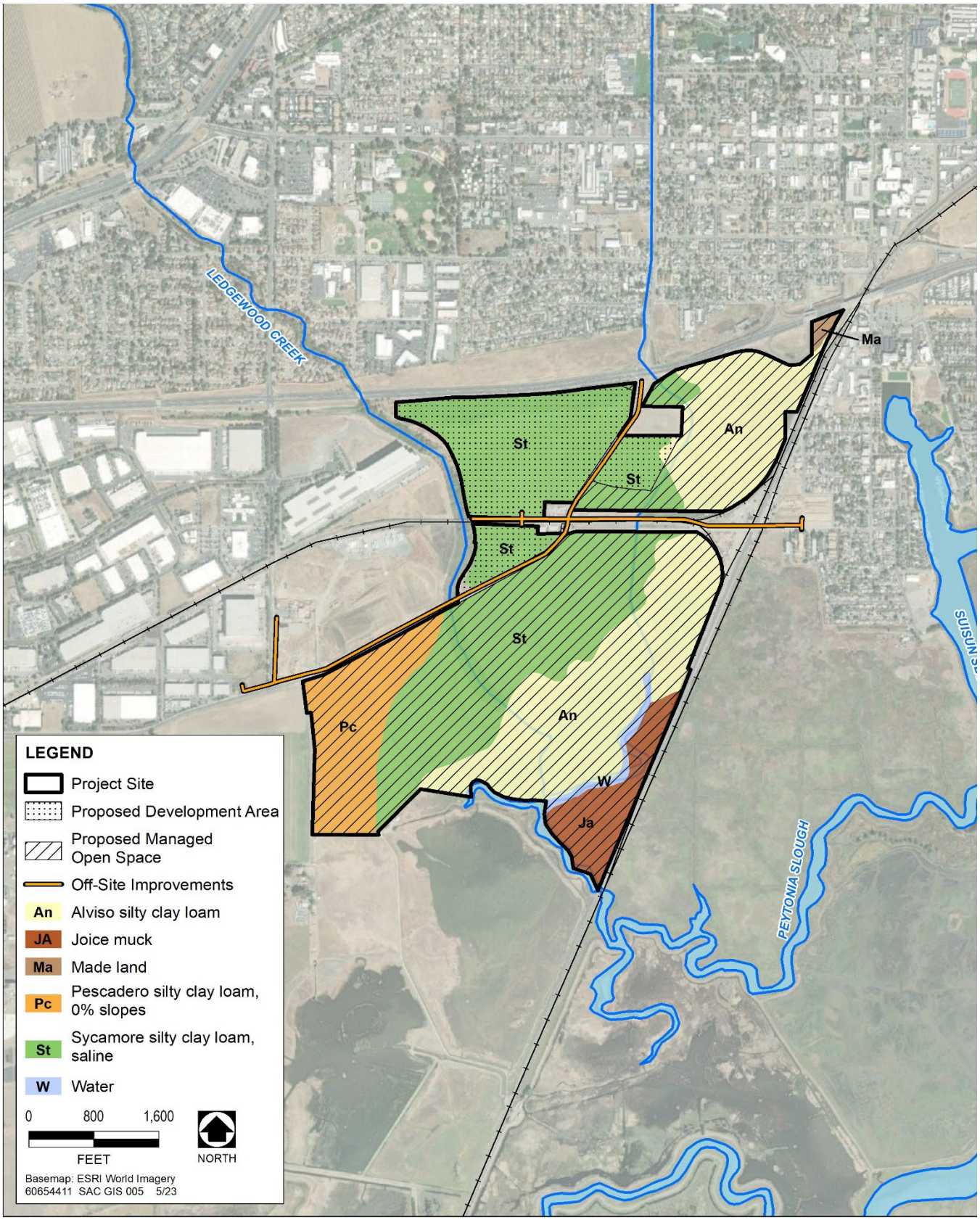
[3] Soils assigned to wind erodibility group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible.

[4] Based on standard NRCS saturated hydraulic conductivity class limits. Saturated hydraulic conductivity refers to the ease with which pores in a saturated soil transmit water.

[5] Soils are assigned to Group A, B, C, or D. Group A soils have the fastest water infiltration rate and therefore have a correspondingly low stormwater runoff potential; Group D soils have a very slow water infiltration rate and therefore have a very high stormwater runoff potential.

[6] “Made land” consists of land that has been substantially modified by human activity and may partially consist of artificial fill.

Source: NRCS 2022




Source: NRCS 2022

**Exhibit 4.5-3. Soil Types within the Project Site**

### Settlement

Static settlement generally occurs under all foundations in all soil conditions. However, the amount of settlement is influenced by a variety of factors such as the weight of the proposed building, the type of underlying soil or rock, and seismic activity. Differential settlement commonly occurs as a result of the non-uniform movement of the underlying soils/rock (i.e., soil settlement at different rates). Too much settlement can result in cracking of foundations, exterior cladding, and interior finishes.

As part of the geotechnical report, MPE (2020) noted that static settlement ranging from 0.5–1.0 inch, and differential settlement ranging from 0.5–1.5 inches, could occur at the Project Site. Foundations constructed over engineered fill will be subject to long-term settlement. Even well-compacted fills may experience minor long-term settlements due to secondary strains or hydrocompression. In addition, shallow foundations constructed over engineered fill and bedrock transitions may experience differential movements under static and seismic loading conditions. However, proper engineering and design of buildings and foundations are required to incorporate the projected amount of settlement to reduce structural damage.

#### MINERALS

Areas of known important mineral deposits are classified by CGS as mineral resource zone (MRZ)-2. As shown on Exhibit GEO-8 in the *Geology and Soils Background Report* (City of Suisun City 2015a) prepared in support of the Suisun City 2035 General Plan, the Project Site and the off-site improvement areas are classified as MRZ-1: areas where adequate information indicates that no significant mineral deposits are present or where it is judged that little likelihood exists for their presence (O'Neal and Gius 2018). Furthermore, the Suisun City 2035 General Plan (City of Suisun City 2015b) has not designated any mineral resource deposits of local importance. The Solano County General Plan (Solano County 2008) considers the potential for locally important mineral resources in areas classified as MRZ-3 (areas containing mineral deposits, the significance of which cannot be evaluated from existing data) in addition to areas classified as MRZ-2.

## 4.5.2 REGULATORY FRAMEWORK

### FEDERAL PLANS, POLICIES, REGULATIONS AND LAWS

### Earthquake Hazards Reduction Act, Public Law 95–124

In October 1977, the U.S. Congress passed the Earthquake Hazards Reduction Act to reduce the risks to life and property from future earthquakes in the United States through the establishment and maintenance of an effective earthquake hazards reduction program. To accomplish this goal, the act established the National Earthquake Hazards Reduction Program (NEHRP). This program was substantially amended in November 1990 by the National Earthquake Hazards Reduction Program Act (NEHRPA), which refined the description of agency responsibilities, program goals, and objectives.

The mission of NEHRP includes improved understanding, characterization, and prediction of hazards and vulnerabilities; improved building codes and land use practices; risk reduction through post-earthquake investigations and education; development and improvement of design and construction techniques; improved mitigation capacity; and accelerated application of research results. The NEHRPA designates the Federal Emergency Management Agency as the lead agency of the program and assigns several planning, coordinating,

and reporting responsibilities. Other NEHRPA agencies include the National Institute of Standards and Technology, National Science Foundation, and United States Geological Survey.

## STATE PLANS, POLICIES, REGULATIONS, AND LAWS

### Alquist-Priolo Earthquake Fault Zoning Act, California Public Resources Code Sections 2621–2630

The Alquist-Priolo Earthquake Fault Zoning Act (Alquist-Priolo Act) (California Public Resources Code Sections 2621–2630) was passed in 1972 to reduce the hazard of surface faulting to structures designed for human occupancy. The main purpose of the law is to prevent the construction of buildings used for human occupancy on the surface trace of active faults. The Alquist-Priolo Act requires the State Geologist to establish regulatory zones around certain active faults, and to issue associated maps delineating Earthquake Zones of Required Investigation (EZRI). The maps are distributed to all affected cities, counties, and state agencies for their use in planning efforts. Site-specific investigations within EZRIs are required for the following: (1) any proposed structure used or intended for supporting or sheltering any human use or occupancy that is expected to have a human occupancy rate of more than 2,000 person-hours per year (California Code of Regulations, Title 14, Division 2, Section 3601[e]); or (2) for a proposed addition or alteration to a structure in existence prior to May 4, 1975, if the proposed change exceeds 50% of the value of the structure (Public Resources Code Division 2, Chapter 7.5, Section 2621.6). If the site-specific investigation determines that a potential for hazard is found to exist, plans to reduce the hazard of surface fault rupture—either through avoidance or engineered design—must be provided prior to a lead agency issuing a permit for construction.

### Seismic Hazards Mapping Act, California Public Resources Code Sections 2690–2699.6

The Seismic Hazards Mapping Act of 1990 (California Public Resources Code Sections 2690–2699.6) addresses earthquake hazards from non-surface fault rupture, including liquefaction and seismically induced landslides. The act established a mapping program for areas that have the potential for liquefaction, landslide, strong ground shaking, or other earthquake and geologic hazards. The act also specifies that respective cities or counties with jurisdiction over a project may withhold development permits until geologic or soils investigations are conducted for specific sites and mitigation measures are incorporated into plans to reduce hazards associated with seismicity and unstable soils.

### National Pollutant Discharge Elimination System

In California, the State Water Resources Control Board (SWRCB) administers regulations promulgated by the U.S. Environmental Protection Agency (55 Code of Federal Regulations 47990) requiring the permitting of stormwater-generated pollution under the National Pollutant Discharge Elimination System (NPDES). In turn, the SWRCB's jurisdiction is administered through nine regional water quality control boards. Under these federal regulations, an operator must obtain a permit through the NPDES Stormwater Program for all construction activities with ground disturbance of 1 acre or more. SWRCB's statewide storm water general permit for construction activity (Construction General Permit) (Order WQ 2022-0057-DWQ (SWRCB 2022) requires the implementation of best management practices (BMPs) to reduce sedimentation into surface waters and to control erosion. One element of compliance with the NPDES permit is preparation of a storm water pollution prevention plan (SWPPP) that addresses control of water pollution, including sediment, in runoff during construction.

Construction-related stormwater discharges from Caltrans properties, including Caltrans rights-of-way, are regulated under the SWRCB's Statewide NPDES Permit CAS000003, SWRCB Order 2012-0011-DWQ as amended in 2017 (Caltrans Construction NPDES Permit) (State Water Resources Control Board 2017). During construction, projects that are within the Caltrans right-of-way must use the *Stormwater Pollution Prevention Plan (SWPPP) and Water Pollution Control Program (WPCP) Preparation Manual* (Caltrans 2016) to design stormwater control plans and implement BMPs that comply with Caltrans' *Construction Site Best Management Practices (BMP) Manual* (Caltrans 2017), which incorporates the SWRCB's requirements contained in the Caltrans Construction NPDES Permit and the Clean Water Act. To comply with the Caltrans Construction NPDES Permit, a SWPPP must be prepared and implemented if 1 acre or more of soil would be disturbed; if the disturbance would encompass less than 1 acre, a Water Pollution Control Program (WPCP) must be implemented. Caltrans' stormwater pollution control requirements are intended to be implemented on a year-round basis at an appropriate level. The requirements must be implemented in a proactive manner during all seasons while construction is ongoing. (See Section 4.8 of this EIR, "Hydrology and Water Quality," for more information about the NPDES permit program and SWPPPs.)

### California Building Standards Code, California Code of Regulations Title 24

The California Building Standards Commission is responsible for coordinating, managing, adopting, and approving building codes in California. The State of California provides minimum standards for building design through the California Building Standards Code (CBC) (California Code of Regulations Title 24). Where no other building codes apply, Chapter 29 of the CBC also regulates excavation, foundations, and retaining walls. The CBC applies to building design and construction in the state and is based on the Federal Uniform Building Code used widely throughout the country (generally adopted on a state-by-state or district-by-district basis). The CBC has been modified for California conditions with numerous more detailed or more stringent regulations.

The state earthquake protection law (California Health and Safety Code Section 19100 et seq.) requires that structures be designed to resist stresses produced by lateral forces caused by wind and earthquakes. The CBC requires an evaluation of seismic design that falls into Categories A–F (where F requires the most earthquake-resistant design) for structures designed for a project site. The CBC philosophy focuses on "collapse prevention," meaning that structures are designed for prevention of collapse for the maximum level of ground shaking that could reasonably be expected to occur at a site. Chapter 16 of the CBC specifies exactly how each seismic design category is to be determined on a site-specific basis through the site-specific soil characteristics and proximity to potential seismic hazards.

Chapter 18 of the CBC regulates the excavation of foundations and retaining walls. This chapter regulates the preparation of a preliminary soil report, engineering geologic report, geotechnical report, and supplemental ground-response report. Chapter 18 also regulates analysis of expansive soils and the determination of the depth to groundwater table. For Seismic Design Category C, Chapter 18 requires analysis of slope instability, liquefaction, and surface rupture attributable to faulting or lateral spreading. For Seismic Design Categories D, E, and F, Chapter 18 requires these same analyses plus an evaluation of lateral pressures on basement and retaining walls, liquefaction and soil strength loss, and lateral movement or reduction in foundation soil-bearing capacity. The Project Site has been identified as Seismic Design Category D, based on the site-specific Geotechnical Engineering Report (MPE 2020). It also requires mitigation measures to be considered in structural design. Mitigation measures may include ground stabilization, selection of appropriate foundation type and depths,

selection of appropriate structural systems to accommodate anticipated displacements, or any combination of these measures. The potential for liquefaction and soil strength loss must be evaluated for site-specific peak ground acceleration magnitudes and source characteristics consistent with the design earthquake ground motions. Peak ground acceleration must be determined from a site-specific study, the contents of which are specified in CBC Chapter 18.

Finally, Appendix Chapter J of the CBC regulates grading activities, including drainage and erosion control and construction on unstable soils, such as expansive soils and areas subject to liquefaction.

## REGIONAL AND LOCAL PLANS, POLICIES, REGULATIONS, AND ORDINANCES

### Solano County General Plan

The Solano County General Plan (Solano County 2008) contains the following policies related to short-term erosion and associated water quality degradation that are applicable to the proposed Project (see Section 4.8, "Hydrology and Water Quality," for policies and impacts associated with long-term stormwater runoff, erosion, and water quality). There are no policies related to geology, seismicity, or mineral resources that are applicable to the proposed Project, because buildings would be constructed within an area proposed to be annexed into the City of Suisun City and are not proposed to be constructed in the Managed Open Space area. The Solano County General Plan does not contain any policies related to paleontological resources.

#### *Resources Element*

- **Policy RS.P-65:** Require the protection of natural water courses.
- **Policy RS.P-70:** Protect land surrounding valuable water sources, evaluate watersheds, and preserve open space lands to protect and improve groundwater quality, reduce polluted surface runoff, and minimize erosion.
- **Policy RS.P-71:** Ensure that land use activities and development occur in a manner that minimizes the impact of earth disturbance, erosion, and surface runoff pollutants on water quality.

### City of Fairfield General Plan

Because a portion of the Ledgewood Creek Open Space area, which is within the city of Fairfield, is immediately adjacent to the western property boundary of the Project Site, where project-related development is proposed, the City of Suisun City has considered the following City of Fairfield General Plan (City of Fairfield 2002) policy related to construction-related erosion and water quality.

#### *Health and Safety Element*

- **Policy HS 2.8:** Require an erosion control and rehabilitation plan to be prepared for projects requiring substantial groundbreaking activities to control short-term and long-term erosion and sedimentation in nearby streams and rivers.

## Fairfield Municipal Code Chapter 22B, Stormwater Management and Discharge Control

Because a portion of the Ledgewood Creek Open Space area, which is within the city of Fairfield, is immediately adjacent to the western property boundary of the Project Site, where Project-related development is proposed, the City of Suisun City has considered the following sections of the City of Fairfield Municipal Code.

### *Section 22B.130 Construction Site Controls*

B. All construction sites must implement and maintain at least the following minimum best management practices:

1. Erosion control at the site;

2. Run-on and run-off controls to and from the site;

3. Control of sediments and fines on the site;

4. Active treatment systems (as necessary);

5. Good site management; and

6. Non-stormwater management.

### *Section 22B.150, Watercourse Protection*

B. No person shall permit or cause to be committed any of the following acts, unless a written approval has first been obtained from the Public Works Director:

1 Discharge into or connect any pipe or channel to a watercourse;

2 Modify the natural flow of water in a watercourse;

3 Carry out development within thirty (30) feet of the center line of any creek or twenty (20) feet of the top of a bank;

4 Deposit in, plant in, or remove any material from a watercourse including the banks, except as required for necessary maintenance;

5 Construct, alter, enlarge, connect to, change, or remove any structure in a watercourse; or

6 Place any loose or unconsolidated material along the side of or within a watercourse or so close to the side as to cause a diversion of the flow, or to cause a probability of such material being carried away by stormwaters passing through such watercourse.

## City of Suisun City General Plan

The Suisun City General Plan (City of Suisun City 2015b) includes the following policies related to geology, soils, and paleontological resources that apply to the proposed Project. The Suisun City General Plan does not

contain any policies related to mineral resources (because no significant mineral deposits are known to be present).

### *Public Health and Safety Element*

- **Policy PHS-14.1:** The City will implement state and local building code requirements, including those related to structural requirements and seismic safety criteria, in order to reduce risks associated with seismic events and unstable and expansive soils.

- **Policy PHS-14.2:** The City will require the preparation of a geotechnical site investigation for new development projects, which will be required to implement recommendations to reduce the potential for ground failure due to geologic or soil conditions.

- **Policy PHS-14.3:** The City will require new developments that could be adversely affected by geological and/or soil conditions to include project features that minimize these risks.

    - **Program PHS-14.1: Geotechnical Investigations.** The City will require geotechnical evaluation and recommendations before development or redevelopment activities. Such evaluations will be required to focus on potential hazards related to liquefaction, erosion, subsidence, seismic activity, and other relevant geologic hazards and soil conditions for development. New development would be required to incorporate project features that avoid or minimize the identified hazards to the satisfaction of the City.

- **Policy PHS-5.1:** New development shall incorporate site design, source control, and treatment measures to keep pollutants out of stormwater during construction and operational phases, consistent with City and Fairfield-Suisun Urban Runoff Management Program standards.

    - **Program PHS-5.1: Stormwater Development Requirements.** The City will review new developments for applicable requirements of the National Pollutant Discharge Elimination System (NPDES) permit. New developments must use BMPs during construction to mitigate impacts from construction work and during post construction to mitigate post-construction impacts to water quality. Long-term water quality impacts must be reduced using site design and source control measures to help keep pollutants out of stormwater. The City will encourage proactive measures that are a part of site planning and design that would reduce stormwater pollution as a priority over mitigation measures applied to projects after they are designed. Some of the many ways to reduce water quality impacts through site design include: reduce impervious surfaces; drain rooftop downspouts to lawns or other landscaping; and use landscaping as a storm drainage and treatment feature for paved surfaces.

### *Open Space and Conservation Element*

- **Policy OSC-5.1:** The City will use geologic mapping and cultural and paleontological resource databases to determine the likely presence of resources and the appropriate level of cultural and paleontological resources analysis and mitigation required for new developments.

- **Policy OSC-5.2:** New developments shall be designed to avoid adverse impacts to any known archaeological and paleontological resources, wherever feasible.

- **Policy OSC-5.3:** New developments in areas underlain by Pleistocene Alluvium and the Tehama Formation shall include training, notification, and recovery procedures for fossils.

### Suisun City Grading, Erosion Control, and Creekside Development Ordinance

Suisun City Municipal Code Title 15, Chapter 15.12 regulates grading, erosion control, and development adjacent to surface water bodies. A grading permit is required for projects that exceed 50 cubic yards of material or include more than 5,000 square feet of surface area. The application for a grading permit requires submittal of a site plan; grading map; and an erosion, sediment, and runoff control plan. The erosion, sediment, and runoff control plan must include the land treatment, structural measures, and timing requirements that would be implemented at the Project Site to effectively minimize soil erosion and sedimentation. The runoff control plan must also indicate the calculated runoff from the site under pre- and post-development conditions, using City drainage standards. The runoff control plan must demonstrate that peak runoff from the site would not increase after development and must include all necessary measures to ensure this result to the satisfaction of the City engineer. All materials must be prepared by a registered civil engineer.

In addition, the following sections of Chapter 15.12 related to grading, erosion control, and creekside development are applicable to the proposed Project.

- **15.12.100 Soil disturbance to minimize erosion.** Stripping or burning of vegetation, grading or other soil disturbance shall be done in a manner which will minimize erosion.

- **15.12.110 Vegetation retention and supplementation.** Existing natural vegetation shall be retained, protected and supplemented when feasible. Site development shall be accomplished so that existing trees can be preserved whenever possible and practical.

- **15.12.120 Soil exposure.** Exposure of soil to erosion by removal of vegetation shall be limited to the smallest area practical and for the shortest time practical. Soil exposure shall not exceed an area in which development can be completed during a single construction season to ensure that soils are stabilized and vegetation is established in advance of the rainy season (October 15th-April 15th). When necessary, an extension of the time may be granted by the Director of Public Works.

- **15.12.130 Retention of sediment.** Facilities shall be constructed to retain sediment produced on the site.

- **15.12.140 Installation of required measures.** Sediment basins, sediment traps or similar required measures shall be installed in advance of any clearing or grading and maintained until removal is authorized in written form by the director of public works.

- **15.12.150 Temporary Stabilization.** Temporary seeding, mulching or other suitable stabilization shall be used to protect exposed erodible areas during development and in advance of the rainy season (October 15th-April 15th).

- **15.12.180 Slopes.** Slopes, both cut and fill, shall not be steeper than two horizontal to one vertical unless a thorough geological and engineering analysis indicates that steeper slopes are safe and appropriate erosion control measures are specified.

- **15.12.190 Disposal and storage of slash and excavated materials.** disposal and/or storage of cleared vegetation and excavated materials shall be accomplished in a manner which reduces the risk of erosion and strictly conforms to the provisions of the approved grading permit. Topsoil shall be conserved for reuse in revegetation of disturbed areas whenever possible.

- **15.12.200 Development and roadway design.** Proposed development and roadway alignments should be designed to minimize erosion.

- **15.12.210 Waterway design.** Waterways shall be designed to avoid erosion as much as practical. Channels and slopes should be lined with grass or other appropriate vegetation. Every effort will be made to preserve natural channels and drainageways.

- **15.12.211 Diversion of runoff.** Runoff shall be diverted away from denuded slopes or other critical areas with barriers or ditches.

- **15.12.212 Construction access routes.** Construction access routes should be limited and access points should be stabilized.

- **15.12.213 Delineation of limits.** Clearing limits, easements, setbacks, sensitive or critical areas and their buffers; trees and drainage courses shall be delineated by marking them in the field.

- **15.12.214 Contingency Plan.** A contingency plan shall be prepared in the event of unexpected rain or Best Management Practice (BMP) failure including, but not limited to, an immediate response plan, storing extra or alternative control materials on-site, notifying the local agency, etc.

- **15.12.230 Development plan (Creekside Development).** Whenever development is proposed for an area within three hundred feet of the centerline of a designated watercourse, the designation to be as provided by resolution of the city council, a detailed plan of the proposed development shall be submitted to the city for approval. The plan shall include, but not be limited to, the following:

  A. Volume and extent of grading, filling and excavation;

  B. Placement of drainage outflows. Such outflows and associated drainage facilities shall be designed so as to eliminate or minimize increases in the rate and amount of stormwater discharge;

  C. Type and amount of native vegetation. If any is to be removed, the type and method of replacement.

## 4.5.3 ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

### METHODOLOGY

Evaluation of potential impacts related to geology, soils, minerals, and paleontological resources was based on a review of documents pertaining to the Project Site, including soil survey data (NRCS 2020), published geologic literature (including maps), and aerial photographs. Geologic and soils information relating to the Project Site was also obtained from the *Geotechnical Engineering Report, Gentry Project, Highway 12 and Pennsylvania Avenue, Suisun City, California* prepared by MPE in 2020.

The information obtained from these sources was reviewed and summarized to document existing conditions and to identify the potential environmental effects of the proposed Project.

## THRESHOLDS OF SIGNIFICANCE

### Geology, Soils, or Mineral Resources

Based on Appendix G of the CEQA Guidelines, the proposed Project would have a significant impact related to geology, soils, or mineral resources if it would:

- directly or indirectly cause 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; or
  - landslides;
- result in substantial soil erosion or the loss of topsoil;
- 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 on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse; or
- be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994, as updated), creating substantial risks to life or property;
- have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water;
- directly or indirectly destroy a unique paleontological resource or site or unique geologic feature;
- result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state; or
- result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan.

### Paleontological Resources

Based on Appendix G of the CEQA Guidelines, the proposed Project would have a significant impact on paleontological resources if it would directly or indirectly destroy a unique paleontological resource or site. A

"unique paleontological resource or site" is one that is considered significant under the following professional paleontological standards.

An individual vertebrate fossil specimen may be considered unique or significant if it is identifiable and well preserved, and it meets one of the following criteria:

- a type specimen (i.e., the individual from which a species or subspecies has been described);
- a member of a rare species;
- a species that is part of a diverse assemblage (i.e., a site where more than one fossil has been discovered) wherein other species are also identifiable, and important information regarding life history of individuals can be drawn;
- a skeletal element different from, or a specimen more complete than, those now available for its species; or
- a complete specimen (i.e., all or substantially all of the entire skeleton is present).

The value or importance of different fossil groups varies, depending on several factors: the age and depositional environment of the rock unit that contains the fossils; their rarity; the extent to which they have already been identified and documented; and the ability to recover similar materials under more controlled conditions (such as for a research project). Marine invertebrates generally are common, the fossil record is well developed and well documented, and they would generally not be considered a unique paleontological resource. Identifiable vertebrate marine and terrestrial fossils generally are considered scientifically important because they are relatively rare.

## ISSUES NOT DISCUSSED FURTHER

**Risks to People or Structures Caused by Surface Fault Rupture**—The Project Site and the off-site improvement areas are not located within an Alquist-Priolo Earthquake Fault Zone or within or immediately adjacent to the trace of any other known fault (CGS 2020, Jennings and Bryant 2010). Thus, there would be **no impact** related to fault rupture and this issue is not evaluated further in this EIR.

**Risks to People or Structures Caused by Liquefaction**—MPE (2020) performed a site-specific liquefaction analysis and determined that liquefaction would not pose a hazard for structures at the Project Site. Because the off-site improvement areas are comprised of the same soil types, the same geologic formations, and are adjacent to the Project Site where groundwater conditions would be similar, liquefaction would likely also not pose a hazard for the off-site improvements. Furthermore, site-specific investigations for the off-site improvements would be conducted by geotechnical engineers, with implementation of the resulting engineering and construction methods as recommended by the geotechnical engineers per local city and CBC requirements. Thus, there would be **no impact** related to liquefaction and this issue is not evaluated further in this EIR.

**Risks to People or Structures Caused by Landslides**—Because the Project Site and the off-site improvement areas are flat and are not adjacent to any steep slopes subject to potential landslides, there would be **no impact** from landslide hazards and this issue is not evaluated further in this EIR.

**Soil Suitability for Septic Systems**—The proposed Project does not include the use of septic systems or other alternative means of wastewater disposal. Therefore, construction of the proposed Project would have **no impact** related to soil suitability for septic tanks or alternative wastewater disposal systems, and this issue is not evaluated further in this EIR.

**Destruction of a Unique Paleontological Resource or Site**—The Project Site and the off-site improvement areas are composed of Holocene-age deposits (Exhibit 4.5-1) to depths of at least 25 feet below the ground surface (MPE 2020), which is well below the anticipated maximum depth of excavation. Holocene deposits contain only remains of extant, modern taxa (if any resources are present) that are not considered unique paleontological resources. Furthermore, a records search performed at the University of California Museum of Paleontology (UCMP) on April 22, 2021, indicated there are no recorded fossil localities within the Project Site or the off-site improvement areas (UCMP 2021). Therefore, Project construction would have **no impact** on unique paleontological resources and this issue is not evaluated further in this EIR.

**Destruction of a Unique Geologic Feature**—Unique geologic features consist of outstanding natural landforms such as mountain peaks, deep scenic canyons and gorges, scenic rock formations, large waterfalls, volcanic cinder cones, lava fields, or glaciers. There are no unique geologic features within or adjacent to the Project Site or the off-site improvement areas. Thus, there would be **no impact** on unique geologic features and this issue is not evaluated further in this EIR.

**Loss of Mineral Deposits of Statewide or Local Importance**—The Project Site and the off-site improvement areas are classified by CGS as MRZ-1 (areas where no significant minerals deposits are present). There are no City- or County-designated areas of locally important mineral resources within or adjacent to the Project Site or the off-site improvement areas. Thus, there would be **no impact** from loss of mineral resources and this issue is not evaluated further in this EIR.

## IMPACT ANALYSIS

**Impact 4.5-1. Risks to People and Structures Caused by Strong Seismic Ground Shaking.** *Project implementation would subject structures and people to risks from strong seismic ground shaking. However, all Project-related structures, utilities, and roads would be designed in accordance with the CBC, the recommendations of a licensed engineer, and the requirements of the City. This impact would be* ***less than significant****.*

The Project Site and the off-site improvement areas are located in a seismically active area, and there is a 72 percent probability of a major, damaging earthquake occurring in the San Francisco Bay Region during the 30-year timeframe of 2013–2043. As shown in Exhibit 4.5-2, the Green Valley-Cordelia-Concord Fault System is located approximately 3.2 miles west of the Project Site and is classified by CGS as active. The Green Valley Fault System (connected) has the potential to generate a magnitude 6.8 earthquake (MPE 2020). Although the Vaca-Pittsburg-Kirby Hills Fault Zone and the Great Valley Fault Zone Segment 5 are not classified as active by CGS, they have exhibited evidence of movement within the last 700,000 years (which is relatively recent in geologic terms) and are located approximately 5 miles east of the Project Site. A large magnitude earthquake on any of these faults, or along other active faults such as the West Napa (11 miles west of the Project Site) or Hayward-Rodgers Creek (22 miles west of the Project Site), would subject people and structures at the Project Site and the off-site improvement areas to risks from strong seismic ground shaking. Suisun City General Plan Policies PHS-14.1, 14.2, and 14.3 require compliance with state and local building code requirements, preparation

of a geotechnical report, and incorporation of site design measures to reduce seismic and geotechnical risks. All structures and infrastructure at the Project Site and the off-site improvement areas must be designed and built according to the requirements of the seismic design parameters specified in the CBC. The CBC philosophy focuses on "collapse prevention," meaning that structures must be designed for prevention of collapse for the maximum level of ground shaking that could reasonably be expected to occur at a site. MPE (2020) has performed a preliminary geotechnical engineering report for the Project Site and has calculated the site's seismic response spectrum as required by the CBC. A final geotechnical report would be prepared prior to preparation of detailed construction plans and prior to building permit application to inform final design and construction. Therefore, the potential damage to the proposed development from strong seismic ground shaking would be addressed through proper design as determined by a licensed engineer. The City would review the Project's building permit applications for compliance with the CBC and implementation of recommendations in the geotechnical study to address seismic hazards. Therefore, impacts related to strong seismic ground shaking would be **less than significant**.

#### *Mitigation Measures*

No mitigation measures are required.

**Impact 4.5-2. Construction-Related Soil Erosion.** *Construction activities during Project implementation would involve excavation, grading, and movement of earth, which could expose soils to erosion. However, the Project applicant would be required to implement BMPs specifically designed to reduce erosion as part of the SWPPP and the grading and erosion control permit obtained from the City. This impact would be* ***less than significant****.*

As discussed in detail in Section 4.8, "Hydrology and Water Quality," Ledgewood Creek is immediately adjacent to the western Project Site boundary where development is proposed (see Exhibit 4.5-3). South of the proposed Development Area, Ledgewood Creek crosses through the proposed Managed Open Space portion of the Project Site, in a northwest to southeast direction. The proposed 8- to 10-inch sewer line that would be installed in Cordelia Road, tying in with the existing sewer line in Beck Road, would either be attached to the side of the existing Cordelia Road bridge crossing over Ledgewood Creek, or a jack-and-bore technique would be used to install the pipeline underneath the creek. Ledgewood Creek discharges into Peytonia Slough at the southern property boundary, which in turn discharges to Suisun Marsh.

Limited earthmoving activities are proposed in the Managed Open Space area to construct wetlands. Project-related construction activity in the Development Area and the off-site improvement areas would include soil removal, trenching, excavation, pipe and footing installation, grading, and revegetation. No work would be performed in the bed or bank of Ledgewood Creek. Construction activities would result in the temporary disturbance of soil and would expose disturbed areas to winter storm events. Rain of sufficient intensity could dislodge soil particles from the soil surface. Once particles are dislodged and the storm is large enough to generate runoff, localized erosion could occur. In addition, soil disturbance during the spring and summer months could result in loss of topsoil because of wind erosion. As indicated in Table 4.5-1, the NRCS (2022) has rated the soils at the Project Site, the off-site improvement areas, and the Managed Open Space area as having a moderate water erosion hazard, a low wind erosion hazard, and a high stormwater runoff potential. However, the Project applicant must comply with the Suisun City Grading, Erosion Control, and Creekside Development Ordinance (Title 15, Chapter 15.12 of the Suisun City Municipal Code). The ordinance requires project applicants to obtain a grading permit, which must include submittal of engineered grading plans and a soils and engineering geology report. The

report also must include a suite of BMPs to control runoff and erosion such as settlement basins, dust palliatives, drainage swales, check dams, and rip rap. As described in detail in Subsection 4.5.2, "Regulatory Framework," the Project applicant must implement a suite of measures (Suisun City Municipal Code Sections 15.12.100 through 15.12.230) that are specifically designed to control and reduce construction-related erosion and stormwater runoff and protect water quality. Furthermore, because the Project includes construction activities that would disturb more than 1 acre, the Project applicant must obtain a Construction General Permit from the San Francisco Bay RWQCB through the NPDES Stormwater Program. The Construction General Permit requires the implementation of BMPs to reduce sedimentation into surface waters and to control erosion, as well as preparation of a SWPPP that addresses control of water pollution, including sediment, in runoff during construction.

Suisun City General Plan Policy PHS-5.1 requires new development to incorporate site design, source control, and treatment measures to keep pollutants out of stormwater during the construction phase, consistent with City and Fairfield-Suisun Urban Runoff Management Program standards. Suisun City General Plan Program PHS-5.1, "Stormwater Development Requirements," requires the City to review new developments for applicable requirements of the NPDES permit. New developments must use BMPs during construction to reduce water quality impacts from construction work. These General Plan policies and programs would be implemented for the proposed Project by requiring compliance with the submittal requirements and design standards in the City's Grading, Erosion Control, and Creekside Development Ordinance.

For off-site road improvements to SR 12, which are under the jurisdiction of Caltrans, contractors must use the *Stormwater Pollution Prevention Plan (SWPPP) and Water Pollution Control Program (WPCP) Preparation Manual* (Caltrans 2016) to design and implement site-specific BMPs as required by the *Construction Site Best Management Practices (BMPs) Manual* (Caltrans 2017) to meet the requirements set forth in the Caltrans Construction NPDES Permit (SWRCB 2017). The requirements set forth in these manuals would be followed, as required by the SWRCB, to reduce construction-related erosion, sediment transport, and water quality degradation.

Finally, as described in Chapter 2, "Project Description," the Managed Open Space portion of the Project Site would be managed consistent with the Suisun Marsh Protection Plan and in accordance with required permit conditions (including conditions related to installation of constructed wetlands) imposed by applicable regulatory agencies such as the U.S. Fish and Wildlife Service, California Department of Fish and Wildlife, and San Francisco Bay Conservation and Development Commission.

Through compliance with the above-described requirements, construction-related water quality impacts related to soil erosion and stormwater runoff would be **less than significant**. (See also EIR Section 4.3, "Biological Resources," for further analyses related to water quality from constructed wetlands in the Managed Open Space.)

#### *Mitigation Measures*

No mitigation measures are required.

**Impact 4.5-3. Potential Damage to Structures and Infrastructure from Construction in Unstable/Expansive Soils.** *Soils at the Project Site and the off-site improvement areas are likely to experience settlement and have a moderate to high shrink-swell potential, which could result in damage to Project facilities. However, all project-related structures, utilities, and roads*

*would be designed in accordance with the CBC, the recommendations of a licensed engineer, and the requirements of the City. This impact would be* ***less than significant.***

As a result of soil borings and laboratory analyses prepared in support of the geotechnical report, MPE (2020) predicted that seismically-induced settlement ranging from 0.16–2.92 inches could occur at the Project Site. MPE also noted that static settlement ranging from 0.5–1.0 inch could occur, and differential settlement ranging from 0.5–1.5 inches could occur at the Project Site. Foundations constructed over engineered fill would be subject to long-term settlement; even well-compacted fills may experience minor long-term settlements due to secondary strains or hydrocompression. In addition, shallow foundations constructed over engineered fill and bedrock transitions may experience differential movements under static and seismic loading conditions. However, final engineering and design of buildings and foundations would incorporate the projected amount of settlement to reduce structural damage.

Groundwater was encountered at depths of 7–12 feet below the ground surface during soil borings obtained for the geotechnical report. Because the boreholes were open only for a short period of time, MPE (2020) noted that groundwater may actually be present at a shallower depth (i.e., approximately 5 feet below the ground surface). Therefore, soils excavated from near or below the groundwater table will be in a saturated condition. The near-surface soils also may be in a near-saturated condition during and for a period of time following the rainy season, due to the water being unable to penetrate through the clay soils below existing site grade. If grading operations are to proceed shortly after the rainy season, and before prolonged periods of warm dry weather, the near-surface soils may be at moisture contents where substantial aeration or lime-treatment may be required to dry the soils to moisture content where the specified degree of compaction can be achieved (MPE 2020). A similar situation is likely to exist with regards to shallow groundwater at the off-site improvement areas because these areas are immediately adjacent to the Project Site in the same low-lying area and with the same soil types.

In addition, due to the high water table, groundwater is likely to exert substantial pressure on building slabs. This problem could result in soils-related cracking of the slab-on-grade floors. In the site-specific preliminary geotechnical report, MPE (2020) included the following recommendations. Slabs should be coated with a moisture barrier and be underlain by a layer of free-draining gravel to prevent moisture from migrating upward. Additional moisture protection for office and warehouse interior slabs may be provided by placing a plastic water vapor directly over the crushed rock. Retaining walls should be fully drained to prevent the build-up of hydrostatic forces behind the wall. If loading dock slabs will extend below existing grade, they may be affected by seasonal variations in groundwater levels subject to buoyant forces and/or flooding. Occasional seasonal flooding of the depressed loading docks may be possible. The slabs may be either designed to resist groundwater rising to an assumed level of 3 feet below the ground surface, or relief valves could be provided in the slab to relieve the water pressure and allow flooding of the dock.

Based on a review of site-specific soil borings obtained for the geotechnical report, MPE (2020) found that the soils at the Project Site have a moderate to high expansion potential. Soil expansion, including volume changes during seasonal fluctuations in moisture content, could adversely affect interior slabs-on-grade, landscaping hardscapes, and underground pipelines. However, the geotechnical report prepared by MPE (2020) includes recommendations for appropriate engineering and design of proposed buildings and asphalt pavement in areas of expansive soil. These recommendations include replacement of expansive soil with engineered fill, aggregate base, or soil treatment with lime, to depths 18 to 24 inches below the ground surface for building pads and exterior flatwork, and should also extend at least 5 feet beyond the building foundations and at least 2 feet beyond

exterior flatwork areas. Expansion joints should be provided to allow for minor vertical movement of the flatwork. Reinforcement for the slabs should consist of at least heavy duty welded wire fabric (flat sheets), or equivalent steel reinforcing bars, placed mid-depth of the slab. Areas adjacent to new foundations and slabs-on-grade should be fully landscaped to prevent near-surface drying and maintain more uniform soil moisture conditions adjacent to and under the foundations and slabs. Soil expansion could also affect the off-site improvement areas but would be handled in a similar manner from a geotechnical perspective, including either replacement of expansive soil with engineered fill or aggregate base, or soil treatment with lime.

The Project applicant would be required to implement the measures that are determined by the soils and civil/structural engineering studies to be appropriate for the Project, in accordance with the requirements of the CBC and the City. Furthermore, off-site SR 12 roadway improvements would be implemented in accordance with Caltrans' Standard Specifications and Standard Plans (Caltrans 2022), which include measures to ensure geologic and soil stability. With adherence to Caltrans' Standard Specifications for off-site SR 12 improvements, the requirements of the CBC as applicable to the site-specific nature of the soils, and the required permit application and design review for on-site improvements by the City, Project-related impacts related to construction in unstable/expansive soils would be **less than significant**.

#### *Mitigation Measures*

No mitigation measures are required.