3.6 - Geology, Soils, and Seismicity

3.6.1 - Introduction

This section describes the existing geology, soils, and seismicity setting and potential effects from project implementation on the site and its surrounding area. Descriptions and analysis in this section are based on the Yolo County General Plan, the Yolo County General Plan EIR, the City of Woodland General Plan, and the Natural Resource Conservation Service's Web Soil Survey.

3.6.2 - Environmental Setting

Regional Setting

Geology and Topography

The eastern and central portions of Yolo County are located in the Great Valley geomorphic province of California, and primarily consist of gently sloping to level alluvial plains. The remaining western part of the County occurs in the Coast Range geomorphic province. Elevations in the County range from just above mean sea level (msl) in the southeastern corner of the County to more than 3,000 feet above msl in the western Coast Range portion of the County. Geologic units in the Great Valley generally consist of Quaternary alluvium or basin deposits, and the Quaternary Modesto and Riverbank Formations, both of which consist of somewhat older alluvium. Additionally, the Dunnigan Hills project into the Great Valley northwest of Woodland. These consist of dissected and rolling terraces of the Tehama Formation (non-marine sandstone, siltstone, and volcaniclastic rocks).

The western Coast Range portion of the County consists of moderately sloping to very steep uplands and terraces. This part of the County is characterized by parallel ridges and valleys that trend west of north. Geologic features in the Coast Range consist of Quaternary and Cretaceous geologic formations, including upturned marine sandstones, shales, mudstones, and conglomerates, as well as some volcaniclastic rocks. A small area of ultramafic rocks, one of which may contain serpentinite, occurs along Little Blue Ridge, west of Rumsey.

Soils

A soil association is comprised of adjacent soils that occur as areas large enough to be mapped individually, but are shown as a single unit because of time and resources constraints. Although a considerable degree of uniformity may exist within a soil association, the individual soils within the association may differ greatly one from another. The soils found within a soil association are further broken down into soils series. Soils sharing very similar profiles comprise a soil series. With the exception of different texture in the surface layer, all soils within a series contain major horizons that are similar in thickness, arrangement, and other important characteristics.

Twelve soil associations have been identified in Yolo County, as provided below. Seven of the associations are found on lowland alluvial fans or occur in basins. The remaining five associations are found on uplands or terraces.

- Yolo-Brentwood
- Rincon-Marvin-Tehama
- Capay-Clear Lake
- Sycamore-Tyndall
- Sacramento
- Willows-Rescadero
- Capay-Sacramento
- Corning-Hillgate
- Sehorn-Balcom
- Dibble-Millsolm
- Positas
- Rock land

Earthquakes and Surface Rupture

Surface rupture occurs when the ground surface is broken by fault movement during a seismic event (such as an earthquake). The location of surface rupture is generally along an active major fault trace. The only active or potentially active fault in the County as identified by the California Geological Survey (CGS), and therefore subject to surface rupture, is the Hunting Creek Fault (also known as Hunting Creek-Berryessa Fault). This fault is located in the extreme northwestern corner of the County and only a small segment of the fault is located in the County, as a majority of the trace occurs in neighboring Lake and Napa Counties. The Hunting Creek Fault is a right-lateral fault and has an average slip rate of 6 millimeters per year. The maximum expected earthquake for this fault is estimated to be magnitude 6.9.

The only other active or potentially active fault in the County is the Dunnigan Hills Fault, which extends west of I-5 between the Town of Dunnigan and northwest of the Town of Yolo. This fault has caused Holocene (the last 11,000 years) displacement, but not during historic times (approximately the last 200 years). The Dunnigan Hills Fault is considered potentially active, but has not been delineated by the CGS as an Alquist-Priolo Earthquake Fault Zone, indicating that the CGS does not considered the fault to have potential for surface rupture. A number of older faults, including the Capay, Sweitzer, East Valley, and West Valley faults are located in the western portion of the County. However, displacement of these faults occurred more than 1.6 million years ago, and as such, these faults are not generally considered inactive. No known faults occur in any of the major inhabited areas of the County.

Seismic Shaking

Seismic shaking or ground shaking generally refers to all aspects of motion of the ground surface resulting from a seismic event, and is normally the primary cause of damage during earthquakes. The extent of ground shaking is controlled by the magnitude and intensity of the earthquake, distance from the epicenter, and local geologic conditions. Magnitude is a measure of the energy released by an earthquake and is assessed by seismographs that measure the amplitude of seismic waves. Intensity is a subjective measure of the perceptible effects of seismic energy at a given point and varies with distance from the epicenter and local geologic conditions. The Modified Mercalli Intensity Scale (MMI) is the most commonly used scale for measurement of the subjective effects of earthquake intensity. Intensity can also be quantitatively measured using accelerometers (strong motion seismographs) that record ground acceleration at a specific location, a measure of force applied to a structure under seismic shaking. Acceleration is measured as a fraction or percentage of the acceleration under gravity (g).

In addition to the Hunting Creek and Dunnigan Hills faults, major regional faults outside of the County but in either the Coast Ranges or the Sierra Nevada foothills are capable of producing ground shaking in the County. The April 19, 1892 Vacaville-Winters earthquake measured approximately magnitude 6.9 on the Richter scale, and it caused severe damage in the City of Winters and moderate damage throughout the County. Although previously attributed to the Midland Fault, a large, regional feature that extends into the County a short distance near the City of Winters, the 1892 Vacaville-Winters earthquake is now believed to have originated from the Coast Range-Sierran Block Boundary (CRSBB), a segment of a complex zone of faults located at the western portion of the lower Sacramento Valley. The CRSBB forms the western geomorphic boundary of the Central Valley with the Coast Ranges to the west. The CRSBB is currently recognized as a potential seismic source capable of generating moderate earthquakes that could affect the County.

Recent evaluations of the CRSBB indicate that tectonic compression occurs across the boundary as the Coast Range Block is tectonically pushed beneath the Sierran Block. The result of this active compression is the development of folds and thrust faults within the CRSBB. The faults associated with this zone typically fail to propagate to the ground surface and, therefore, are called "blind thrusts." Because the faults are not expressed at the surface, identification of the locations of the faults typically cannot be determined on the basis of geomorphic evidence. However, the compressional zone is considered capable of generating moderate to large earthquakes that could produce strong seismic shaking throughout the County and surrounding region. Eleven moderate earthquakes ranging from magnitude 5.8 to 6.8 have been documented along the CRSBB zone during the last 150 years. The 1983 Coalinga earthquake, which measured 6.5 magnitude, is a more recent example of an earthquake that occurred on a blind thrust within the CRSBB zone.

Liquefaction

Liquefaction is the temporary transformation of loose, saturated granular sediments from a solid state to a liquefied state as a result of seismic ground shaking. During this process, soil undergoes transient loss of strength, which typically causes ground displacement or ground failure to occur. Since saturated soils are a necessary condition for liquefaction, areas with a higher groundwater table commonly have a higher potential for liquefaction than those in which the water table is located at greater depths. With the exception of intermountain valleys underlain by alluvium and shallow groundwater, upland areas generally have a relatively low risk of liquefaction. The risk of liquefaction is relatively higher in the Great Valley area, particularly along the floodplains of streams, where sediments are generally sandier than in other areas.

Lateral Spreading

Lateral spreading is a form of horizontal displacement of soil toward an open channel or other "free" face such as an excavation boundary. Lateral spreading typically results from liquefaction of either the soil layer or a subsurface layer underlying soil material on a slope, resulting in gravitationally driven movement, but can also occur as a result from the slump of low cohesion unconsolidated material. Areas most prone to lateral spreading are those that consist of fill material that has been improperly engineered; that have steep, unstable banks; and that have high groundwater tables. The banks along the Deep Water Ship Channel and Turning Basin in West Sacramento may have such a condition. Damage caused by liquefaction and lateral spreading is generally most severe when liquefaction occurs within 15 to 20 feet of the ground surface.

Expansive Soils

Expansion and contraction of volume can occur when expansive soils undergo alternating cycles of wetting (swelling) and drying (shrinking). During these cycles, the volume of the soil changes noticeably, and as a consequence, structural damage to building and infrastructure may occur, particularly when considerations for the potentially expansive soils were not incorporated into building design or during construction. Soils found in the County generally have moderate to high shrink-swell potential and are classified as expansive soils.

Slope Stability

Slope failure can occur as either rapid movement of large masses of soil (landslide), or slow, continuous movement (creep). The primary factors influencing the stability of a slope are the nature of the underlying soil or bedrock, the geometry of the slope (its height and steepness), precipitation, and the presence of previous landslide deposits. Landslides are typically triggered by unusually high rainfall and the resulting soil saturation, by earthquakes, or a combination of these conditions. The general term “landslide” may include a wide range of slope failures, including but not limited to rock falls, deep failure of slopes, earthflows, and shallow debris flows. Some landslides occur as a result of human activities, such as timber harvest, undermining a slope, and improper drainage water management. Steep slopes underlain by Cretaceous rocks along Cache Creek are susceptible to landsliding and numerous large and small landslides have been mapped in this area. However, with the exception of the communities of Capay and Brooks, landslides are generally not a significant hazard to life or property in the County.

Subsidence

Subsidence is the decrease of ground elevation as a result of both natural and manmade causes. Since the 1950’s, the most common cause of subsidence in the County has been groundwater overdraft, resulting in as much as 4 feet of elevation change in certain areas in the County. The East Yolo subbasin area has been affected most dramatically, with the areas near Zamora, Knights Landing, and Woodland having experienced damage and loss of structural integrity to highways, levees, wells, and irrigation canals.

Project Site Setting

Grasslands Site

The Grasslands site consists of 41 acres of undeveloped land within the 323-acre Grasslands Regional Park in unincorporated Yolo County, roughly 2.5 miles south of the City of Davis (Exhibit 2-1). The Grasslands site is located at 32 feet to 38 feet above msl and is generally flat and featureless, lacking any substantial geological or topographical feature of note. The Grasslands site is primarily underlain by Brentwood silty clay loam (A horizon), although a substantial portion of the northeastern part of site is underlain by Marvin silty clay loam (Exhibit 3.2-2a). The Natural Resource Conservation Service characterizes these soil series as follows:

- **Brentwood silty clay loam.** Disseminated or segregated lime is present in some pedons below a depth of 36 inches and is lacking in all parts of other pedons. The 10 to 40 inch section contains 35 to 40 percent clay and a little more than 15 percent material coarser than very fine sand. Clay films may be few or common but there is less than 20 percent more clay in the B horizon than in the A horizon. A small amount of clay-size minerals has been produced by weathering of primary minerals in some pedons. The mean soil temperature at a depth of 20 inches is about 64 degrees F, and the soil temperature remains above 47 degrees F at all times. The soils are usually moist in some or all parts between depths of 4 and 12 inches from early December until May. The soils are dry, unless irrigated all the rest of the time.

  The A horizon is brown, grayish brown, dark grayish brown or dark brown. It is clay loam, light silty clay, or silt loam. This horizon ranges from slightly acid t moderately alkaline (Natural Resource Conservation Service 1998).

- **Marvin silty clay loam.** The solum thickness ranges from 27 to 66 inches. The mean annual soil temperature is about 62 degrees F. The soil above 20 inches depth is continuously dry in most years from about May 20 to October 15. The soils are temporarily saturated in the upper part due to winter rains, or irrigation and slow subsoil permeability. The exchangeable sodium is less than 15 percent. The A horizon is light brownish gray, grayish brown, or dark grayish brown dry and very dark grayish brown when moist. Hue is 10YR or 2.5Y. The A horizon is mottled. It contains about 2 to 3 percent organic matter. It ranges from silty clay loam to silty clay, and from medium acid (pH 6.0) to mildly alkaline. The soil has an A3 horizon or B1 horizon or both or the boundary between the A horizon and B2 horizon is gradual. The B2t horizon ranges from grayish brown to dark grayish brown dry and is dark grayish brown when moist. Hue is 10YR or 2.5Y. Some pedons have mottles in the B2 horizon. It is silty clay or clay; and mildly to moderately alkaline. The B3 horizon is light olive brown, pale brown, or grayish brown dry and dark grayish brown moist. Hue is 10YR or 2.5Y. It is mildly to moderately alkaline and slightly to strongly calcareous. The C horizon is similar to the B3 horizon in color and reaction. Some areas are affected by salts (Natural Resource Conservation Service 1997).

Beamer/Cottonwood Site

The Beamer/Cottonwood site includes an approximately 6.53-acre parcel in the City of Woodland. The Beamer/Cottonwood site occurs at 69 feet to 73 feet above msl. The site is generally flat and featureless and lacks any substantial geological or topographical feature of note. Similar to the Grasslands site, the majority of the site is underlain by Brentwood silty clay loam (A horizon). A small portion of the southeast part of the site, however, is underlain by Marvin silty clay loam (Exhibit 3.2-2b).

3.6.3 - Regulatory Framework

Federal

National Earthquake Hazards Reduction Program

The National Earthquake Hazards Reduction Program (NEHRP) was established by the U.S. Congress when it passed the Earthquake Hazards Reduction Act of 1977, Public Law (PL) 95–124. In establishing NEHRP, Congress recognized that losses due to earthquakes could be reduced through improved design and construction methods and practices, land use controls and redevelopment, prediction techniques and early-warning systems, coordinated emergency preparedness plans, and public education and involvement programs. The four basic NEHRP goals remain unchanged:

- Develop effective practices and policies for earthquake loss reduction and accelerate their implementation.
- Improve techniques for reducing earthquake vulnerabilities of facilities and systems.
- Improve earthquake hazards identification and risk assessment methods, and their use.
- Improve the understanding of earthquakes and their effects.

Several key federal agencies contribute to earthquake mitigation efforts. There are four primary NEHRP agencies:

- National Institute of Standards and Technology (NIST) of the Department of Commerce
- National Science Foundation (NSF)
- United States Geological Survey (USGS) of the Department of the Interior
- Federal Emergency Management Agency (FEMA) of the Department of Homeland Security

Implementation of NEHRP priorities is accomplished primarily through original research, publications, and recommendations to assist and guide state, regional, and local agencies in the development of plans and policies to promote safety and emergency planning.

State

California Building Code

The (2009) Uniform Building Code (UBC) is published by the International Conference of Building Officials (ICBO), and serves as the widely adopted model building code in the United States. The (2010) California Building Code (CBC) is another name for the body of regulations known as the California Code of Regulations (CCR), Title 24, Part 2, which is a portion of the California Building Standards Code (CBSC). The CBC incorporates by reference the UBC requirements with necessary California amendments. Title 24 is assigned to the California Building Standards Commission, which, by law, is responsible for coordinating all building standards. Under state law, all building standards must be centralized in Title 24 or they are not enforceable. Compliance with the 2010 CBC requires that, with extremely limited exceptions, structures for human occupancy be designed and constructed to resist the effects of earthquake motions. The Seismic Design Category for a structure is determined in accordance with either CBC Section 1613 - Earthquake Loads, or American Society of Civil Engineers (ASCE) Standard No. 7-05, Minimum Design Loads for Buildings and Other Structures. In brief, based on the engineering properties and soil type(s) of a site, the site is assigned a Site Class ranging from A to F. The Site Class is then combined with Spectral Response (i.e., ground acceleration induced by earthquake) information for the location to arrive at a Seismic Design Category ranging from A to D, with A being the least and D being the most severe conditions. The classification of the site and related calculations must be determined by a qualified person and are site-specific.

Alquist-Priolo Earthquake Fault Zoning Act

The 1972 Alquist-Priolo Earthquake Fault Zoning Act was passed to mitigate the hazard of surface faulting to structures for human occupancy. The Act's primary purpose aims at preventing the construction of buildings for human occupancy upon the surface trace of active faults. The Act only addresses the hazard of surface fault rupture and is not directed toward other earthquake hazards (e.g. strong ground shaking). The Act requires the State Geologist to establish and map regulatory zones, known as Earthquake Fault Zones, around the surface traces of active faults and to issue appropriate maps. The maps are distributed to all affected local, regional, and State agencies for use during planning and controlling new or renewed construction.

Seismic Hazards Mapping Act (SHMA)

Following the 1989 Loma Prieta earthquake, the California Legislature enacted the 1990 Seismic Hazards Mapping Act (SHMA) to protect the public from the effects of strong ground shaking, liquefaction, landslides and other seismic hazards. The SHMA established a statewide mapping program to identify areas subject to violent shaking and ground failure. The program is intended to assist local and regional agencies in protecting public health and safety. The SHMA requires the State Geologist to delineate various seismic hazard zones and requires cities, counties, and other local permitting agencies to regulate certain development projects within these zones. As a result, the California Geologic Survey is mapping SHMA Zones and has completed seismic hazard mapping for the portions of California most susceptible to liquefaction, ground shaking, and landslides; primarily the San Francisco Bay area and Los Angeles basin.

Local

County of Yolo

General Plan

The General Plan establishes the following goals and policies associated with geology, soils, and seismicity that are applicable to the proposed project:

- **Goal HS-1:** Protect the public and reduce damage to property from earthquakes and other geologic hazards.
- **Policy HS-1.1:** Regulate land development to avoid unreasonable exposure to geologic hazards.
- **Policy HS-1.2:** All development and construction proposals shall be reviewed by the County to ensure conformance to applicable building standards.
- **Policy HS-1.3:** Require environmental documents prepared in connection with CEQA to address seismic safety issues and to provide adequate mitigation for existing and potential hazards identified.
- **Action HS-A1:** Require a geotechnical analysis for construction in areas with potential geological hazards and/or for purposes of environmental analysis. Recommendations of the geotechnical analysis shall be implemented.
- **Action HS-A2:** Rely upon the most current and comprehensive geological hazard mapping available in the evaluation of potential seismic hazards associated with proposed new development.
- **Policy CO-2.31:** Protect wetland ecosystems by minimizing erosion and pollution from grading, especially during grading and construction projects.
- **Action CO-A93:** Require the implementation of Best Management Practices (BMPs) to minimize erosion, sedimentation, and water quality degradation resulting from new development and increases in impervious surfaces.

City of Woodland

General Plan

The General Plan establishes the following goals and policies associated with geology, soils, and seismicity that are applicable to the proposed project:

- **Goal 8.A:** To minimize the loss of life, injury, and property damage due to seismic and geological hazards.
- **Policy 8.A.1:** The City shall require the preparation of a soils engineering and geologic-seismic analysis prior to permitting development in areas prone to geological or seismic hazards (i.e., groundshaking, liquefaction, expansive soils).
- **Policy 8.A.2:** The City shall require submission of a preliminary soils report, prepared by a registered civil (geotechnical) engineer and based upon adequate test borings, for every major subdivision.
- **Policy 8.A.3:** The City shall require that new structures intended for human occupancy be designed and constructed to minimize risk to the safety of occupants due to groundshaking.
- **Policy 8.A.4:** City shall continue to support scientific geologic investigations which refine, enlarge, and improve the body of knowledge on active fault zones, unstable areas, severe groundshaking, and other hazardous conditions in the Woodland area.

- **Policy 8.A.5:** The City shall require that new structures and alterations to existing structures comply with the current edition of the Uniform Building Code and the City Security Ordinance.
- **Policy 8.A.6:** The City shall support ways to improve the structural safety and stability of older structures of designated historic significance while maintaining their historical character through the use of the State Historic Building Code.
- **Policy 8.A.7:** The City shall continue to implement the Uniform Code for the Abatement of Dangerous Buildings to address older buildings that may at risk for seismic or geologic hazards.
- **Policy 8.A.8:** The City shall avoid siting of structures across soil materials of substantially different expansive properties.
- **Policy 8.A.9:** The City shall require the use of special bending-resistant designs where foundations must be slab-on-grade in areas with expansive soil.

3.6.4 - Thresholds of Significance

According to Appendix G, Environmental Checklist, of the CEQA Guidelines, geology, soils, and seismicity impacts resulting from the implementation of the proposed project would be considered significant if the project would:

a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury or death involving:

   i. 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? Refer to Division of Mines and Geology Special Publication 42. (Refer to Section 7, Effects Found Not To Be Significant.)

   ii. Strong seismic ground shaking?

   iii. Seismic-related ground failure, including liquefaction?

   iv. Landslides? (Refer to Section 7, Effects Found Not To Be Significant)

b) Result in substantial soil erosion or the loss of topsoil?

c) 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?

d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?

e) Have 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?

3.6.5 - Project Impacts and Mitigation Measures

This section discusses potential impacts associated with the development of the project and provides mitigation measures where appropriate.

Seismic Hazards

Impact GEO-1:	**The project would not expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:** **ii) Strong seismic ground shaking** **iii) Seismic-related ground failure, including liquefaction**

Impact Analysis

Grasslands and Beamer/Cottonwood Sites

Strong Seismic Ground Shaking

Known faults in the general project region include the East Valley fault, which terminates approximately 4 miles west of the Grasslands site, and the Dunnigan Hills fault, which is located roughly 6 miles northwest of the Beamer/Cottonwood site. The East Valley fault is considered an inactive fault, with the last known displacement activity having occurred more than 1.6 million years ago. The Dunnigan Hills fault has caused Holocene (the last 11,000 years) displacement, but not during historic times (approximately the last 200 years), and is considered potentially active.

In addition to the Hunting Creek and Dunnigan Hills faults, major regional faults outside of the County but in either the Coast Ranges or the Sierra Nevada foothills are capable of producing ground shaking in the County, including the Coast Range-Sierran Block Boundary (CRSBB), a segment of a complex zone of faults located at the western portion of the lower Sacramento Valley. Eleven moderate earthquakes ranging between magnitude 5.8 to 6.8 have been documented along the CRSBB zone during the last 150 years, and the fault zone is currently recognized as a potential seismic source capable of generating moderate earthquakes that could affect the project region.

According to Figure IV. L-4, Regional Ground Shaking Hazard, of the Yolo County General Plan EIR, both the Grasslands and Beamer/Cottonwood sites are located within areas identified as being distant from known active faults, and as a result would likely experience lower levels of ground shaking during an earthquake. In addition, design requirements for PV facilities, including the solar panels, inverters, transformers, and other electrical equipment, are generally more stringent than those design requirements typically employed to address strong seismic ground shaking for other traditional structures. Furthermore, the CBC requires that project structures be designed with adequate strength to withstand the lateral dynamic displacements induced by the Design Basis Ground Motion, which the CBC defines as the earthquake ground motion that has 2 percent chance of being exceeded in 50 years. The CBC would apply to the environmental education center and its structural components. Therefore, potential impacts associated with ground shaking would be less than significant.

Seismic-Related Ground Failure/Liquefaction

Severe ground shaking can cause loose, saturated, subsurface materials to liquefy. Soil liquefaction occurs when increased water pressure results in the loss of friction between grains in sandy deposits, causing them to lose strength and temporarily behave like a thick fluid. According to the Yolo County General Plan Health and Safety Element, the risk of liquefaction is relatively higher in the Great Valley area of the County, particularly along the floodplains of streams and/or on sites underlain by saturated soils as a result of a higher groundwater table. However, as previously noted, according to Figure IV. L-4, Regional Ground Shaking Hazard of the Yolo County General Plan EIR, both the Grasslands and Beamer/Cottonwood sites are located within areas identified as being distant from known active faults, and as a result would likely experience lower levels of ground shaking during an earthquake. The expected minimal amount of ground shaking during an earthquake at each project site would reduce the potential for seismic-related ground failure or liquefaction. Moreover, the proposed project would not include permanent residential uses. Therefore, potential impacts associated with ground failure and liquefaction would be less than significant.

Level of Significance Before Mitigation

Less than significant impact.

Mitigation Measures

Grasslands Site

No mitigation is necessary.

Beamer/Cottonwood Site

No mitigation is necessary.

Level of Significance After Mitigation

Less than significant impact.

Erosion

Impact GEO-2: The project would not result in substantial soil erosion or the loss of topsoil.

Impact Analysis

Grasslands and Beamer/Cottonwood Sites

Short-Term Construction Impacts

Grading, excavation, and similar ground-disturbing, earthmoving construction activities could potentially increase water and wind erosion on the Grasslands and Beamer/Cottonwood sites. In order to reduce the potential for erosion, the County or its contractor would first apply for a National Pollutant Discharge Elimination System (NPDES) Permit, and subsequently prepare a Stormwater Pollution Prevention Plan (SWPPP) that would address erosion. Under the NPDES, the Applicant would apply for a Construction Activities Storm Water General Permit (Order 2009-0009-DWQ) through the Central Valley Regional Water Quality Control Board (RWQCB). The General Permit would pertain to stormwater discharges associated with all construction activities, including clearing, grading, and excavation, that results in the disturbance of at least one acre of total land area. Since construction of the proposed project would disturb more than one acre, an NPDES permit and a SWPPP would be required. The SWPPP prepared for the proposed project would detail erosion and sediment control measures, including a series of best management practices (BMPs) designed to control erosion physically from the disturbed areas on the project site. BMPs would include the following, or similar, efforts: fiber rolls, street sweeping, sandbag barriers, straw bale barriers, and storm drain inlet protection. Therefore, with the mandatory compliance with the SWPPP, short-term impacts associated with erosion and sedimentation would be less than significant.

Long-Term Operations Impacts

Both the Grasslands and Beamer/Cottonwood sites are generally flat and featureless, lacking any substantial geological or topographical feature of note. Since the project sites are flat and featureless, minimal grading would be required to level the areas where the proposed physical improvements would be located, which would help maintain the natural topography and contours currently found on the sites. By preserving these natural, undisturbed portions of the project sites, operation of the proposed project would not continuously encourage erosion. Therefore, long-term impacts associated with erosion would be less than significant.

Level of Significance Before Mitigation

Less than significant impact.

Mitigation Measures

Grasslands Site

No mitigation is necessary.

Beamer/Cottonwood Site

No mitigation is necessary.

Level of Significance After Mitigation

Less than significant impact.

Unstable Geologic Units and Soils

Impact GEO-3:	**The project would not 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.**

Impact Analysis

Grasslands and Beamer/Cottonwood Sites

Landslide

As addressed in Section 7, Effects Found Not To Be Significant, the relatively flat, featureless topography on and adjacent to the Grasslands and Beamer/Cottonwood sites reduces the opportunity for landslides to occur. Therefore, no impact associated with landslide would occur.

Lateral Spreading

Lateral spreading of the ground surface usually occurs within liquefiable beds during seismic events. Lateral spreading generally requires an abrupt change in slope (e.g., a nearby steep hillside, a deeply eroded stream bank), but can occasionally occur on gentle slopes or relatively featureless topography. Other factors such as distance from the seismic event, magnitude of the seismic event, and thickness and depth of liquefiable layers also affect the degree of lateral spreading.

As previously discussed, the risk of liquefaction is relatively higher in the Great Valley area of the County, particularly along the floodplains of streams and/or on sites underlain by saturated soils as a result of a higher groundwater table. However, according to Figure IV. L-4, Regional Ground Shaking Hazard of the Yolo County General Plan EIR, both the Grasslands and Beamer/Cottonwood sites are located within areas identified as being distant from known active faults, and as a result would likely experience lower levels of ground shaking during an earthquake. The expected minimal amount of ground shaking during an earthquake at each project site would reduce the potential for liquefaction. Since the threat of liquefaction occurring at the project site is minimal, the potential for lateral spreading of the ground surface is similarly minimal. Therefore, potential impacts associated with lateral spreading would be less than significant.

Subsidence

The most common cause of subsidence in the general project region is groundwater overdraft, which has resulted in several feet of elevation change in certain areas in the County since the 1950s. The East Yolo subbasin area has been affected most dramatically, with the areas near Zamora, Knights Landing, and Woodland having experienced damage and loss due to subsidence. The Grasslands site is not in the vicinity of these identified subsidence areas and, therefore, would not be expected to experience subsidence. The Beamer/Cottonwood site is located in Woodland and therefore may be exposed to subsidence. As indicated by the City of Woodland General Plan Background Report, subsidence has occurred in central areas of the City. However, the Beamer/Cottonwood site is located in the northwest corner of Woodland, away from identified areas of subsidence. Furthermore, the proposed project would not include residential uses and none of the construction personnel or employees would reside on the project site. Therefore, potential impacts associates with subsidence would be less than significant.

Liquefaction

As previously addressed, both project sites would be expected to experience minimal amounts of ground shaking during an earthquake, thereby resulting in a reduced potential for liquefaction. Moreover, the proposed project would not include permanent residential uses. Therefore, potential impacts associated with liquefaction would be less than significant.

Collapse

No natural or manmade subsurface features that are known to encourage collapse, including mines, aggregate extraction operations, or karst topography, are known to underlay or occur adjacent to the Grasslands or Beamer/Cottonwood sites. Therefore, impacts associated with collapse would be less than significant.

Level of Significance Before Mitigation

Less than significant impact.

Mitigation Measures

Grasslands Site

No mitigation is necessary.

Beamer/Cottonwood Site

No mitigation is necessary.

Level of Significance After Mitigation

Less than significant impact.

Expansive Soils

Impact GEO-4:	**The project could potentially be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property.**

Impact Analysis

Grasslands and Beamer/Cottonwood Site

According to Figure HS-3, Expansive Soils, of the Yolo County General Plan's Health and Safety Element, both the Grasslands and Beamer/Cottonwood sites are potentially underlain by soils susceptible to expansion. Soil expansiveness, or shrink-swell potential, usually occurs within soils containing a high percentage of expansive clay minerals. These soils, when subjected to an increase in water content, are prone to expansion. Expansive soils are usually measured with an index test such as the expansive index potential. In order for a soil to be a candidate for testing, the soil must have high clay content, and the clay must have a high shrink-swell potential and a high plasticity index. As indicated by the National Resource Conservation Service's Web Soil Survey, onsite soils at each project site do not have a high clay content or high plasticity rating. Moreover, the proposed project would not include permanent residential uses. Therefore, potential impacts associated with expansive soils would be less than significant.

Level of Significance Before Mitigation

Less than significant impact.

Mitigation Measures

Grasslands Site

No mitigation is necessary.

Beamer/Cottonwood Site

No mitigation is necessary.

Level of Significance After Mitigation

Less than significant impact.

Wastewater Disposal System

Impact GEO-5:	The project would not be located on soils incapable of adequately supporting the use of a septic tank or alternative wastewater disposal system.

Impact Analysis

Grasslands and Beamer/Cottonwood Site

A maximum of 16 acre-feet of water would be required during construction for dust control and moisture conditioning onsite soils for required compaction, and roughly 0.049 acre-foot per year of water would be used for panel washing. Minimal amounts of water would also be used to establish screening vegetation. Largely depending on temperature conditions, the excess water from these activities would be allowed to either evaporate or percolate into the permeable surfaces found on both project sites. These activities would not require wastewater disposal. During the construction phase of the proposed project, construction workers would use temporary, portable restroom facilities that would not be connected to a municipal sewer system. The effluent produced from these portable restroom facilities would be removed by a licensed pumping service and processed at a permitted wastewater treatment facility.

Restroom facilities would be provided via the existing portable facilities located within the main Grasslands Regional Park north of the Soaring Society Flying Field, while the existing facilities within the adjacent County buildings would serve the Beamer/Cottonwood site. The environmental educational center would not include a restroom facility onsite and, therefore, would not require the use of groundwater. Although the County may determine at a future date that additional or permanent restroom facilities are warranted at the Grasslands site, the location, permitting, design requirements, and groundwater use of any future permanent facilities requiring wastewater disposal would be determined at that time.

The park host site would include the construction of a small septic system to accept wastewater from the park host's personal travel trailer. As indicated by the Natural Resources Conservation Service's Web Soil Survey, the Grasslands site's soils have a slow percolation rate, which may impede the appropriate function of a septic system. However, the septic system would be designed and constructed as appropriate for onsite soils and in accordance with Yolo County Code Title 6, Chapter 5, Article 6 and the recommendations of the Department of Public Health of the State and the Public Health Director. Compliance with these regulations would ensure the onsite septic system would be design appropriately so that onsite soils are capable of supporting such a system. Impacts would be less than significant.

Level of Significance Before Mitigation

Less than significant impact.

Mitigation Measures

Grasslands Site

No mitigation is necessary.

Beamer/Cottonwood Site

No mitigation is necessary.

Level of Significance After Mitigation

Less than significant impact.