4.6. GEOLOGY AND SOILS

4.6.1 INTRODUCTION

The Geology and Soils chapter of the EIR describes the geologic and soil characteristics of the project site/Biological Resources Preservation Alternative (BRPA) site and evaluates the extent to which implementation of the Proposed Project and BRPA could be affected by unstable earth conditions and various geologic and geomorphic hazards. In addition, the chapter evaluates any adverse impacts on paleontological resources. Information from this chapter is primarily drawn from a Preliminary Geotechnical Evaluation prepared by Geocon Consultants, Inc. (Geocon) (Appendix E).[1] In addition, information was sourced from the City of Davis General Plan[2] and the associated General Plan EIR.[3]

4.6.2 EXISTING ENVIRONMENTAL SETTING

Background setting information regarding the geology, soils, seismicity, and paleontological resources associated with the project site/BRPA site and the surrounding region is provided below.

Regional Setting and Geology

The City of Davis is located in the eastern portion of the Putah Creek Plain, one of the major features of the southwestern Sacramento Valley. According to the City of Davis General Plan, the land slopes at generally less than one percent, and elevations range from 60 feet above mean sea level (amsl) in the western areas of the City to 25 feet amsl in the eastern areas of the City.[4] The foothills of the Coast Range are approximately 14 miles west of the City, and the Sacramento River is located approximately 11 miles east of the City.

Beneath the Sacramento Valley floor is a layer of metamorphic and igneous rock at depths greater than 17,000 feet. Atop this layer is a layer of marine and sedimentary rocks up to 15,000 feet thick; neither layer contains water. The surface layers consist of up to 3,000 feet of water-bearing alluvial sediments, most of which are semi-consolidated. Only the uppermost layer, which is up to 200 feet deep, consists of unconsolidated alluvial deposits.

According to the City of Davis General Plan, due to a high proportion of silt and clay within the City, the soils in the General Plan planning area are only moderately or slowly permeable, which hinders drainage and ground water recharge. Erosion hazards in the City are “none to slight.” Shrink-swell potential, which is the potential for soil to expand and contract due to moisture and temperature, is predominantly “moderate to high” in the City.

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1 Geocon Consultants, Inc. *Preliminary Geotechnical Evaluation, Village Farms Davis, Davis, California*. November 1, 2023.
2 City of Davis. *City of Davis General Plan.* Adopted May 2001. Amended January 2007.
3 City of Davis. *Final Program EIR for the City of Davis General Plan Update and Final Project EIR for Establishment of a New Junior High School.* Certified May 2001.
4 City of Davis. *City of Davis General Plan [pg. 318].* Adopted May 2001. Amended January 2007.

Regional Seismicity

A fault is defined as a fracture or zone of closely associated fractures along which rocks on one side have been displaced with respect to those on the other side. A fault zone is a zone of related faults that is commonly braided and subparallel, but may be branching or divergent. Movement within a fault causes an earthquake. When movement occurs along a fault, the energy generated is released as waves that cause ground shaking. Ground shaking intensity varies with the magnitude of the earthquake, the distance from the epicenter, and the type of rock or sediment the seismic waves move through.

The potential risk of fault rupture is based on the concept of recency and recurrence. The more recently a particular fault has ruptured, the more likely the fault would rupture again. The California Geological Survey (CGS) defines an "active fault" as one that has had surface displacement within the past 11,000 years (Holocene). Potentially active faults are defined as those that have ruptured between 11,000 and 1.6 million years before the present (Quaternary). Faults are generally considered inactive if evidence of displacement is not present during the Quaternary.

According to the City of Davis General Plan, earthquake faults do not run through the General Plan planning area.[5] The City of Davis General Plan planning area consists of approximately 160 square miles and is located 11 miles west of the City of Sacramento and approximately 79 miles northeast of the City of San Francisco. According to the Geotechnical Evaluation prepared for the proposed project, the project site/BRPA site is located approximately eight miles southeast of the Great Valley Segment 3a (Dunnigan Hills) Fault, approximately 36 miles east of the West Napa Fault, and 67 miles east of the San Andreas Fault. The Dunnigan Hills Fault is an active fault trace that is capable of generating an earthquake moment magnitude of approximately 6.4. The West Napa and San Andreas faults are larger and capable of moment magnitudes of approximately 6.6 to 8.0. Numerous earthquakes along the San Andreas fault system have been felt in Davis. Major earthquakes occurred in 1833, 1868, 1892, 1902, 1906, and most recently in 1989; however, Davis did not suffer significant damage during these events.

The Preliminary Geotechnical Evaluation concluded that the project site/BRPA site is not located within any known earthquake fault traces and is not located within an Alquist-Priolo Earthquake Fault Zone. Furthermore, according to the City of Davis General Plan, the Office of Land Use and Climate Innovation (LCI) has placed the Davis area in Seismic Activity Intensity Zone II, which indicates that the maximum intensity of an earthquake would be VII or VIII on the Modified Mercalli Intensity Scale. An earthquake of such magnitude would result in "slight damage in specially designed structures; considerable in ordinary substantial buildings, with partial collapse; great in poorly built structures." The Uniform Building Code (UBC) places all of California in the zone of greatest earthquake severity because recent studies indicate high potential for severe ground shaking.

A low-intensity zone is defined by the U.S. Geological Survey (USGS) as an area that is likely to experience an earthquake measuring a maximum of 5.0 to 5.9 in magnitude on the Richter scale, and a maximum intensity of VII or VIII on the Modified Mercalli scale. The Richter scale measures the amplitude of seismic waves recorded by a seismograph. The Modified Mercalli scale measures the intensity of an earthquake by the way the shaking is felt and responded to by humans, and by the amount of damage the earthquake causes to buildings and structures. The Modified Mercalli scale is shown in Table 4.6-1.

[5] City of Davis. *City of Davis General Plan [pg. 318].* Adopted May 2001. Amended January 2007.

Table 4.6-1
Modified Mercalli Scale of Earthquake Intensity

Scale	Effects
I.	Earthquake shaking not felt.
II.	Shaking felt by those at rest.
III.	Felt by most people indoors; some can estimate the duration of shaking.
IV.	Felt by most people indoors. Having objects swing, windows and doors rattle, wooden walls and frames creak.
V.	Felt by everyone indoors; many estimate duration of shaking. Standing autos rock. Crockery clashes, dishes rattle, and glasses clink. Doors close, open, or swing.
VI.	Felt by everyone indoors and most people outdoors. Many now estimate not only the duration of the shaking, but also its direction and have no doubt as to its cause. Sleepers awaken. Liquids disturbed, some spilled. Small unstable objects displaced. Weak plaster and weak materials crack.
VII.	Many are frightened and run outdoors. People walk unsteadily. Pictures thrown off walls, books off shelves. Dishes or glasses broken. Weak chimneys break at roofline. Plaster, loose bricks, unbraced parapets fall. Concrete irrigation ditches damaged.
VIII.	Difficult to stand. Shaking noticed by auto drivers, waves on ponds. Small slides and cave-ins along sand or gravel banks. Stucco and some masonry walls fall. Chimneys, factory stacks, towers, elevated tanks twist or fall.
IX.	General fright. People thrown to the ground. Steering of autos affected. Branches broken from trees. General damage to foundations and frame structures. Reservoirs seriously damaged. Underground pipes broken.
X.	General panic. Conspicuous cracks in ground. Most masonry and frame structures destroyed along their foundations. Some well-built wooden structures and bridges are destroyed. Serious damage to dams, dikes, and embankments. Railroads bent slightly.
XI.	General panic. Large landslides. Water thrown out of banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flatland. General destruction of buildings. Underground pipelines completely out of service. Railroads bent greatly.
XII.	General panic. Damage nearly total, the ultimate catastrophe. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into air.

Source: California Division of Mines and Geology, 1973

Project Site/BRPA Site Characteristics

The approximately 497.6-acre project site/BRPA site is located north of East Covell Boulevard, east of F Street, and west of Pole Line Road in a currently unincorporated portion of Yolo County, California. The project site/BRPA site consists of generally flat, agricultural land. In addition, one agricultural structure is located in the southern portion of the site/BRPA site. The project site/BRPA site is bisected by a north-to-south private access road ("L Street"), which also pivots to proceed in an east-to-west direction through a portion of the project site/BRPA site. A City of Davis drainage course ("Channel A") also flows east to west through the project site/BRPA site. Additionally, a Pacific Gas and Electric Co. (PG&E) easement occurs along the western and northern project site/BRPA site boundaries.

The geologic conditions on the project site/BRPA site are discussed below in further detail, including descriptions of existing site geology, subsurface soil conditions, seismicity and ground shaking, potential for earthquake-induced liquefaction, expansive soils, and groundwater conditions. In addition, this section includes a description of known paleontological resources within the project area.

Project Site/BRPA Site Geology

The project site/BRPA site is located within the Great Valley Geomorphic Province of California, more commonly referred to as the Central Valley. The Central Valley is a broad depression bounded by the Sierra Nevada mountain range to the east and the Coast Ranges to the west. The Central Valley has been filled with a thick sequence of sediments derived from weathering of the adjacent mountain ranges resulting in a stratigraphic section of Cretaceous, Tertiary, and Quaternary deposits. The project site/BRPA site is located near the southern end of the Sacramento Valley, approximately 11 miles west of the Sacramento River and approximately two miles north of Putah Creek. Published geologic mapping depicts the project site/BRPA site underlain by Quaternary-age, Holocene alluvial fan deposits, basin deposits, alluvium, and older alluvium and Holocene basin deposits, which generally consists of interbedded mixtures of alluvial sand, silt, and clay.

Subsurface Soil Conditions

Based on the U.S. Department of Agriculture (USDA) Web Soil Survey conducted by Geocon as part of the Preliminary Geotechnical Evaluation, the project site/BRPA site is underlain by the following soil units:

- Yolo silt loam (Ya) – A well-drained silt loam that forms on alluvial fans and flood plains, and is derived from igneous, metamorphic, and sedimentary rock;
- Yolo silty clay loam (Yb) – A well-drained silty clay loam to clay loam that forms on alluvial fans, and is derived from igneous, metamorphic, and sedimentary rock;
- Pescadero silty clay (Pb) – A poorly-drained silty clay to silty clay loam that forms as basinfloor remnants from alluvium derived from sedimentary rock;
- Rincon silty clay loam (Rg) – A well-drained silty clay loam that forms on alluvial fans and stream terraces from alluvium derived sedimentary rock;
- Merritt complex (Mp) – A poorly drained silty clay loam to very fine sandy loam that forms on alluvial fans and flood-plain steps, from mixed alluvium derived from sedimentary rock; and
- Sycamore silty clay loam (St) – A somewhat poorly-drained silty clay loam that forms at alluvial fans from alluvium derived by igneous, metamorphic, and sedimentary rock.

The majority of the project site/BRPA site consists of Ya and Yb soil units and the remainder of the project site/BRPA site consists of Pb, Rg, Mp, and St soil units. Based on the Web Soil Survey, the Ya and Yb soil units consist of silty clay soil to depths of at least five feet; such soils are generally classified as lean clay. Surficial soil within the northern and western portions of the project site/BRPA site are classified as Pb, Rg, and Mp, which are derived from alluvium from sedimentary rock. Rb, Rg, and Mp soil units consist of clay to silty clay soils to depths of at least five feet; such soils are generally classified as lean clay and fat clay. The top portion of soil at the project site/BRPA site has been disturbed by discing/tilling operations associated with agricultural activities on the project site/BRPA site.

Seismicity and Ground Shaking

Fault rupture hazards are important near active faults and tend to reoccur along the surface traces of previous fault movements. The project site/BRPA site is located approximately eight miles southeast of the Great Valley Segment 3a (Dunnigan Hills) Fault, approximately 36 miles east of the West Napa Fault, and 67 miles east of the San Andreas Fault. The Dunnigan Hills Fault is an active fault trace that is capable of generating an earthquake moment magnitude of approximately

6.4. The West Napa and San Andreas faults are larger and capable of moment magnitudes of approximately 6.6 to 8.0.

Known faults do not extend across the project site/BRPA site, and the project site/BRPA site is not located within an Alquist-Priolo Special Studies Zone. Therefore, the potential for fault rupture, damage from fault displacement, or fault movement directly below the project site/BRPA site is considered low. However, the project site/BRPA site is located within an area where shaking from earthquake generated ground motion waves should be considered likely. According to the City of Davis General Plan EIR, groundshaking is not considered a major geologic hazard in the City of Davis.[6]

Liquefaction

Liquefaction occurs when saturated fine-grained sands and/or silts lose physical strength temporarily during earthquake-induced shaking and behave as a liquid due to the loss of point-to-point grain contact and transfer of normal stress to the pore water. Liquefaction potential varies with water level, soil type, material gradation, relative density, and probable intensity and duration of ground shaking. The CGS has designated certain areas within California as potential liquefaction hazard zones, which are areas considered at risk of liquefaction-related ground failure during a seismic event based upon mapped surficial deposits and the depth to the areal groundwater table.

According to the Preliminary Geotechnical Evaluation, the project site/BRPA site is not located in a currently established State of California Seismic Hazard Zone for liquefaction. In addition, Geocon is not aware of any reported historical instances of liquefaction in the City of Davis area. However, soil and groundwater conditions exist at the project site/BRPA site that may be susceptible to seismic-induced liquefaction under the design-level seismic event. For example, portions of the site are underlain by poorly drained silty clays and groundwater has been encountered in below ground surface borings at the site. Based on the results of the liquefaction susceptibility analyses previously performed by Geocon for nearby sites, and the anticipated subsurface condition at this project site/BRPA site, Geocon concluded that the potential for liquefaction and significant adverse impacts from liquefaction are low.

Expansive Soils

Expansive soils are characterized by their ability to undergo significant volume change due to variation in moisture content. Compressible materials consisting of surficial organic material, loose soils, undocumented fills, debris, rubble, rubbish, etc., are considered unsuitable materials for support of proposed structures as such materials can differentially settle. Changes in soil moisture content can result from rainfall, landscape irrigation, utility leakage, roof drainage, perched groundwater, drought, or other factors and may cause unacceptable settlement of structures. According to the Preliminary Geotechnical Evaluation, expansive clay soils are common in the area and the near-surface soil at the project site/BRPA site is expected to consist of lean and fat clays with a medium to high expansion potential when subjected to moisture variations.

Groundwater

Groundwater monitoring and sampling activities for the Old Davis Landfill, located north of the project site/BRPA site, were conducted as part of the Groundwater Monitoring Report prepared

[6] City of Davis. *Final Program EIR for the City of Davis General Plan Update and Final Project EIR for Establishment of a New Junior High School [pg. 5I-10].* Certified May 2001.

by Universal Engineering Sciences (UES) for the Proposed Project.[7] Seven groundwater monitoring wells occur either on-site or in the immediate site vicinity that are associated with the Old Davis Landfill (DM-MW-1 through -4 and HLA-MW-1 through -3). Six of the monitoring wells (DM-MW-1 through -4 and HLA-MW-1 and -2) are part of the landfill monitoring program conducted by the City of Davis. Three of the monitoring wells (DM-MW-4, HLA-MW-1 through -3) are on-site. On February 21 and 22, 2024, groundwater monitoring and sampling activities occurred at the seven groundwater monitoring wells and one domestic supply well located on the project site/BRPA site. The monitoring wells ranged in depth from 34 feet to 62.5 feet below ground surface (bgs). Reported groundwater depths ranged from 8.95 feet bgs to 15.22 feet bgs, and 25.66 feet amsl to 27.70 feet amsl.

Paleontological Resources

Paleontological resources are the mineralized (fossilized) remains of prehistoric plant and animal life exclusive of human remains or artifacts. Fossil remains such as bones, teeth, shells, and leaves are found in geologic deposits (rock formations) where the resources were originally buried.

A search of the paleontological records in the University of California Museum of Paleontology (UCMP) database was conducted on April 2, 2024, by UCMP Senior Museum Scientist, Patricia A. Holroyd, Ph.D., in order to locate potential fossils documented within the project site/BRPA site and the surrounding area.[8] The UCMP database did not identify any known fossil localities at the project site/BRPA site; however, two localities were recorded within one-mile of the project site/BRPA site. Both localities were discovered during excavations in the Quaternary rocks in the project area.

The first locality (D4049) is located approximately 0.75-mile west of the project site/BRPA site, southwest of the intersection of W. Covell Boulevard and Anderson Road. The location of the UCMP locality D4049 is currently developed with apartments. Fossils of the western ridged mussel (*Gonidea angulate*) were found at UCMP locality D4049 in a fine sandstone lens at eight to 10 feet bgs. A total of 107 shells from UCMP locality D4049 are curated into the UCMP collections.

The second locality (V96015) is located approximately one mile north of the project site/BRPA site, south of Willow Slough, and east of the Union Pacific Railroad tracks. The location of the UCMP locality V96015 is undeveloped. Rodent fossils and a snake fossil were discovered at UCMP locality V96015 in grey silty mudstone at 6.5 to 7.1 feet bgs during a Sacramento Municipal Utility District (SMUD) pipeline excavation. A total of seven rodent fossils and one snake fossil are cataloged in the UCMP collections from locality V96015.

4.6.3 REGULATORY CONTEXT

The following section is a brief summary of the regulatory context under which soils, geology, seismic hazards, and paleontological resources are managed at the federal, State, and local levels.

[7] Universal Engineering Services. *Groundwater Monitoring Report, Old Davis Landfill, Davis, California.* April 19, 2024.

[8] Patricia A. Holroyd, Ph.D., Senior Museum Scientist, University of California Museum of Paleontology. Personal communication [email] with Megane Browne-Allard, Associate, Raney Planning and Management. April 2, 2024.

Federal Regulations

The following are the federal environmental laws and policies relevant to soils, geology, seismic hazards, and paleontological resources.

Federal Earthquake Hazards Reduction Act

Passed by Congress in 1977, the Federal Earthquake Hazards Reduction Act is intended to reduce the risks to life and property from future earthquakes. The Act established the National Earthquake Hazards Reduction Program (NEHRP). The goals of NEHRP are to educate and improve the knowledge base for predicting seismic hazards, improve land use practices and building codes, and to reduce earthquake hazards through improved design and construction techniques.

International Building Code

The UBC was first published in 1927 by the International Council of Building Officials and is intended to promote public safety and provide standardized requirements for safe construction. The UBC was replaced in 2000 by the new International Building Code (IBC), published by the International Code Council (ICC), which is a merger of the International Council of Building Officials' UBC, Building Officials and Code Administrators International's National Building Code, and the Southern Building Code Congress International's Standard Building Code. The intention of the IBC is to provide more consistent standards for safe construction and eliminate any differences between the three preceding codes. All State building standard codes are based on the federal building codes with California amendments.

Federal Clean Water Act

Section 402 of the federal Clean Water Act (CWA) mandates that certain types of construction activities comply with the requirements of the National Pollutant Discharge Elimination System (NPDES) stormwater program. The Phase II Rule, issued in 1999, requires that construction activities that disturb land equal to or greater than one acre require permitting under the NPDES program. In California, permitting occurs under the General Permit for Stormwater Discharges Associated with Construction Activity, issued to the State Water Resources Control Board (SWRCB), implemented and enforced by the nine Regional Water Quality Control Boards (RWQCBs).

As of July 1, 2010, all dischargers with projects that include clearing, grading or stockpiling activities expected to disturb one or more acres of soil are required to obtain compliance under the NPDES Construction General Permit Order 2009-0009-DWQ. The General Permit requires all dischargers, where construction activity disturbs one or more acres, to take the following measures:

1. Develop and implement a Stormwater Pollution Prevention Plan (SWPPP) to include a site map(s) of existing and proposed building and roadway footprints, drainage patterns and stormwater collection and discharge points, and pre- and post- project topography;
2. Describe types and placement of Best Management Practices (BMPs) in the SWPPP that will be used to protect stormwater quality;
3. Provide a visual and chemical (if non-visible pollutants are expected) monitoring program for implementation upon BMP failure; and
4. Provide a sediment monitoring plan if the area discharges directly to a water body listed on the 303(d) list for sediment.

To obtain coverage, a SWPPP must be submitted to the RWQCB electronically and a copy of the SWPPP must be submitted to the City of Davis. When project construction is completed, the landowner must file a Notice of Termination (NOT).

State Regulations

The following are the State environmental laws and policies relevant to soils, geology, seismic hazards, and paleontological resources.

Alquist-Priolo Earthquake Fault Zone Act

The 1972 Alquist-Priolo Earthquake Fault Zone Act was passed to prevent the new development of buildings and structures for human occupancy on the surface of active faults. The Act is directed at the hazards of surface fault rupture and does not address other forms of earthquake hazards. The locations of active faults are established into fault zones by the Alquist-Priolo Zone Act. Local agencies regulate any new developments within the appropriate zones in their jurisdiction.

The Alquist-Priolo Zone Act regulates development near active faults so as to mitigate the hazard of surface fault rupture. The Alquist-Priolo Zone Act requires that the State Geologist (Chief of the California Department of Mines and Geology [CDMG]) delineate “special study zones” along known active faults in California. Cities and counties affected by the special study zones must regulate certain development projects within the special study zones. The Alquist-Priolo Zone Act prohibits the development of structures for human occupancy across the traces of active faults. According to the Alquist-Priolo Zone Act, active faults have experienced surface displacement during the last 11,000 years. Potentially active faults are those that show evidence of surface displacement during the last 1.6 million years. A fault may be presumed to be inactive based on satisfactory geologic evidence; however, the evidence necessary to prove inactivity sometimes is difficult to obtain and may not exist.

Seismic Hazards Mapping Act

The California Seismic Hazards Mapping Act of 1990 (California Public Resources Code [PRC] Section 2690-2699.6) addresses non-surface rupture earthquake hazards, including liquefaction, induced landslides, and subsidence. A mapping program is also established by this Act, which identifies areas within California that have the potential to be affected by such non-surface rupture hazards. The Seismic Hazards Mapping Act specifies that the lead agency for 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.

California Building Standards Code

The State of California regulates development within the State through a variety of tools that reduce or mitigate potential hazards from earthquakes or other geologic hazards. The California Building Standards Code (CBSC) (California Code of Regulations [CCR], Title 24) governs the design and construction of all building occupancies and associated facilities and equipment throughout California. In addition, the CBSC governs development in potentially seismically active areas and contains provisions to safeguard against major structural failures or loss of life caused by earthquakes or other geologic hazards. The California building standards include building standards in the national building code, building standards adapted from national codes to meet California conditions, and building standards adopted to address particular California concerns. It should be noted that the CBSC is updated on a triennial cycle. The most recent update, the 2022 CBSC, became effective on January 1, 2023.

Local Regulations

Relevant goals and policies from the City of Davis General Plan and various other local guidelines and regulations related to soils, geology, seismic hazards, and paleontological resources are provided below.

City of Davis General Plan

The following goal and policy from the City of Davis General Plan is applicable to the Proposed Project and BRPA:

Hazards Element

Goal HAZ 2 Minimize risks associated with soils, geology and seismicity in Davis.

Policy HAZ 2.1 Take necessary precautions to minimize risks associated with soils, geology and seismicity.

City of Davis Municipal Code

Section 40.42.110 of the City of Davis Municipal Code regulates site grading design. The following guidelines are applicable to the Proposed Project and BRPA, and are outlined below.

Section 40.42.110 Grading design plan

(a) For the efficient use of water, grading of a project site shall be designed to minimize soil erosion, runoff, and water waste. A grading plan shall be submitted as part of the landscape documentation package. A comprehensive grading plan prepared by a civil engineer for other local agency permits satisfies this requirement.
    1) The project applicant shall submit a landscape grading plan that indicates finished configurations and elevations of the landscape area including:
        A. Height of graded slopes;
        B. Drainage patterns;
        C. Pad elevations;
        D. Finish grade; and
        E. Stormwater retention improvements, if applicable.
    2) To prevent excessive erosion and runoff, it is highly recommended that project applicants:
        A. Grade so that all irrigation and normal rainfall remains within property lines and does not drain on to non-permeable hardscapes;
        B. Avoid disruption of natural drainage patterns and undisturbed soil; and
        C. Avoid soil compaction in landscape areas; and
        D. Decompact and break up compacted soil in landscape areas.
    3) The grading design plan shall contain the following statement: “I have complied with the criteria of the ordinance and applied them accordingly for the efficient use of water in the grading design plan” and shall bear the signature of a

licensed professional as authorized by law. (Ord. 2369 § 2, 2010)

4.6.4 IMPACTS AND MITIGATION MEASURES

This section describes the standards of significance and methodology used to analyze and determine the potential impacts of the Proposed Project and BRPA related to geology, soils, and paleontological resources. In addition, a discussion of the project's impacts, as well as mitigation measures where necessary, is also presented.

Standards of Significance

Consistent with Appendix G of the CEQA Guidelines, an impact related to geology and soils is considered significant if the Proposed Project or the BRPA would:

- Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving:
    - Rupture of a known earthquake fault;
    - Strong seismic ground shaking;
    - Seismic-related ground failure, including liquefaction; and
    - 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 landslides, lateral spreading, subsidence, liquefaction or collapse;
- Be located on expansive soil, as defined in Table 118-1-B of the UBC (1994), 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 (see Chapter 5, Effects Not Found to be Significant); or
- Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature.

As noted above, issues related to whether the Proposed Project or BRPA would result in any of the following impacts are discussed in Chapter 5, Effects Not Found to be Significant, of this EIR:

- 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.

Method of Analysis

As discussed in the Project Description chapter of this EIR, the 114.88-acre northern portion of the project site/BRPA site is not currently proposed for development. Accordingly, this chapter includes an analysis of impacts associated with development of only the 382.72-acre parcel and off-site improvement areas.

The analysis presented within this chapter is based primarily on the Preliminary Geotechnical Evaluation prepared for the Proposed Project and BRPA by Geocon. The purpose of the Preliminary Geotechnical Evaluation was to evaluate the subsurface soil and geologic conditions within the project site/BRPA and provide conclusions and recommendations pertaining to the geotechnical and geologic aspects of the Proposed Project and BRPA. The report was intended for project planning and due-diligence purposes only. Additional geotechnical investigation and

analysis would be required for design and construction of the Proposed Project or BRPA. The scope of the Preliminary Geotechnical Evaluation included the following:

- A limited site reconnaissance of the 382.72-acre portion of the project site/BRPA site, which did not include soil borings at the project site/BRPA site;
- A review of USGS topographic maps, geologic maps and reports that included the project site, and available groundwater information; and
- A review of previous environmental assessments completed for other development projects within the City of Davis by Geocon including:
    - *Geotechnical Investigation – Grande Avenue Property, APN 035-097-012-1, Davis, California* (Project No. S9237-06-02). June 2007.
    - *Geotechnical Investigation – Paul's Place – 1111 H Street, Davis, California* (Project No. S2072-05-01). January 5, 2021.
    - *Geotechnical Investigation – Wildhorse Ranch, APN 071-140-11, Davis, California* (Project No. S9235-06-01). April 2007.

Project-Specific Impacts and Mitigation Measures

The following discussion of impacts is based on implementation of the Proposed Project or BRPA in comparison with the standards of significance identified above.

4.6-1 Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault, strong seismic ground shaking, and seismic-related ground failure. Based on the analysis below, the impact is *less than significant*.

The following discussion includes an analysis of potential impacts related to development of the Proposed Project or BRPA, which could directly or indirectly cause substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault, strong seismic ground shaking, and seismic-related ground failure. Because the Proposed Project and BRPA would be developed within the same overall site boundaries, the discussion below applies to both the Proposed Project and the BRPA.

Proposed Project, Biological Resources Preservation Alternative

Known faults do not extend across the project site/BRPA site, and the project site/BRPA site is not located within an Alquist-Priolo Special Studies Zone. Therefore, the potential for fault rupture, damage from fault displacement, or fault movement directly below the project site/BRPA site is considered low. The project site/BRPA site is located within an area where shaking from earthquake generated ground motion waves should be considered likely; however, according to the City's General Plan EIR, groundshaking is not considered a major geologic hazard in the City of Davis.[9]

While lower-intensity earthquakes could potentially occur at the project site/BRPA site, the design of project structures would be required to adhere to the provisions of the 2022 CBSC. The 2022 CBSC contains provisions to safeguard against major

[9] City of Davis. *Final Program EIR for the City of Davis General Plan Update and Final Project EIR for Establishment of a New Junior High School [pg. 5I-10].* Certified May 2001.

structural failures or loss of life caused by earthquakes or other geologic hazards. Specifically, projects designed in accordance with the CBSC should be able to: 1) resist minor earthquakes without damage; 2) resist moderate earthquakes without structural damage, but with some non-structural damage; and 3) resist major earthquakes without collapse, but with some structural, as well as non-structural damage. Although conformance with the CBSC does not guarantee that substantial structural damage would not occur in the event of a maximum magnitude earthquake, conformance with the CBSC can reasonably be assumed to ensure structures would be survivable, allowing occupants to safely evacuate in the event of a major earthquake.

Furthermore, according to the Preliminary Geotechnical Evaluation, slope instability is not a hazard for the project site/BRPA site and the potential for liquefaction and significant adverse impacts from liquefaction are low. As noted in the Preliminary Geotechnical Evaluation, due to the relatively low seismicity of the project area, the potential for seismically induced damage to the proposed structures due to surface rupture and settlement is minimal. Impacts related to liquefaction and landslide are discussed further in Impact 4.6-3 of this chapter.

Overall, the proposed development would not be subject to substantial risks related to fault rupture hazards. Due to the relatively low seismicity of the area, compliance with CBSC requirements related to seismic design, and the lack of substantial natural slopes at the project site/BRPA site, the potential for the project to expose people or structures to the risk of loss, injury, or death involving rupture of an earthquake fault, strong ground shaking, or ground failure would be ***less-than-significant***.

Mitigation Measure(s)

None required.

4.6-2 Result in substantial soil erosion or the loss of topsoil. Based on the analysis below, the impact is *less than significant*.

The following discussion includes an analysis of potential impacts associated with the Proposed Project or BRPA, which may result in substantial soil erosion or loss of topsoil. Because the Proposed Project and BRPA would be developed within the same overall site boundaries, the discussion below applies to both the Proposed Project and the BRPA.

Proposed Project, Biological Resources Preservation Alternative

Erosion refers to the removal of soil from exposed bedrock surfaces by wind or water. Although naturally occurring, erosion is often accelerated by human activities that disturb soil and vegetation. Grading, excavation, removal of vegetation cover, and loading activities associated with construction could temporarily increase erosion, runoff, and sedimentation. Buildout of the Proposed Project or BRPA would require grading, excavation, and other construction-related activities, which, during the early stages of construction, could cause topsoil to be exposed, potentially resulting in wind erosion or an accelerated rate of erosion during storm events. However, the topography of the project site/BRPA site is relatively level, and upon development of the project site/BRPA site with buildings and structures, the amount of exposed soil

that may be lost due to wind or stormwater runoff would be minimized, as the project site/BRPA site would be largely covered with impervious surfaces.

NPDES permits are required for the discharge of pollutants to waters of the United States, which includes any discharge to surface waters, including lakes, rivers, streams, bays, dry stream beds, wetlands, and storm sewers. The RWQCB issues permits in lieu of direct issuance by the Environmental Protection Agency (EPA). The terms of the NPDES permits implement pertinent provisions of the Federal CWA. Section 30.03.010 of City of Davis Municipal Code adopts by reference the standards of the State of California's NPDES Construction General Permit for Stormwater Discharges Associated with Construction Activity (NPDES General Permit No. CAS000002). In accordance with the NPDES General Construction Permit, a SWPPP is required for any project that disturbs at least one acre of soil. Because the Proposed Project and BRPA would disturb more than one acre of soil, a SWPPP in compliance with the NPDES would need to be prepared.

Pursuant to NPDES requirements, a SWPPP would be prepared for the Proposed Project or BRPA, which would include the site plan, drainage patterns and stormwater collection and discharge points, BMPs, and a monitoring and reporting framework for implementation of BMPs, as necessary. In addition, a Notice of Intent (NOI) would be filed with the RWQCB. Construction activities would be required to comply with the conditions of this permit, including the implementation of multiple erosion and sediment control BMPs identified in the SWPPP. A Qualified SWPPP Practitioner (QSP) would ensure compliance with the SWPPP through regular monitoring and visual inspections during construction activities. The QSP for the project would amend the SWPPP and revise project BMPs, as determined necessary through field inspections, to protect against substantial erosion or siltation on- or off-site.

Compliance with a project-specific SWPPP would help ensure that soil erosion during construction and rain events is limited to the maximum extent feasible. Therefore, the potential for erosion and associated hazards would be low. During project operations, vehicles would be limited to paved areas of the project site/BRPA site, and all surfaces would be either paved or landscaped; thus, the potential for erosion to occur during project operations is also limited. Implementation of the SWPPP and BMPs would ensure that the Proposed Project and BRPA would not result in substantial erosion or the loss of topsoil.

Therefore, the Proposed Project and BRPA would not result in substantial soil erosion or the loss of topsoil, and thus, a ***less-than-significant*** impact could occur.

Mitigation Measure(s)

None required.

4.6-3 Be located on a geological 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 18-1B of the Uniform Building Code, creating substantial risks to life or property. Based on the analysis below and with implementation of mitigation, the impact is *less than significant*.

The following discussion includes an analysis of potential impacts related to unstable geologic units and/or soils, including landslide, lateral spreading, subsidence, liquefaction, collapse, and expansive soils as a result of development of the Proposed Project or BRPA. Because the Proposed Project and BRPA would be developed within the same overall site boundaries, the discussion below applies to both the Proposed Project and the BRPA.

Proposed Project, Biological Resources Preservation Alternative

Issues associated with unstable geologic units and/or soils, including landslide, lateral spreading, subsidence, liquefaction, collapse, and expansive soils are discussed below.

Landslides

A landslide is defined as the movement of a mass of rock, debris, or earth down a slope. Almost every landslide has multiple causes. Slope movement occurs when forces acting down-slope exceed the strength of the earth materials that compose the slope. Landslides in California occur mainly due to intense rainfall or are triggered by earthquakes. According to the CGS, the project site/BRPA site is not currently within a State of California Seismic Hazard Zone for seismically induced landsliding.[10] In addition, the project site/BRPA site is relatively level and flat with elevations ranging from 31 to 43 feet amsl. Furthermore, constructed slopes are not located on or adjacent to the project site/BRPA site. Given that the project site/BRPA site is not mapped in a landslide zone and the project site/BRPA site does not contain any slopes that could be subject to landslide risks, development of the project site/BRPA site with residential uses and associated improvements would not result in on- or off-site landslide hazards.

Lateral Spreading

Lateral spreading is associated with terrain near free faces such as excavations, channels, or open bodies of water. As discussed above, the project site/BRPA site is relatively level, with elevations ranging from approximately 31 to 43 feet amsl. Given that the proposed development area and the surrounding area do not contain any steep slopes or free faces, the Proposed Project and BRPA would not be subject to substantial risks related to lateral spreading.

[10] California Geological Survey. *Landslide Inventory Map.* Available at: https://maps.conservation.ca.gov/cgs/lsi/app/. Accessed March 2024.

Subsidence/Settlement

Subsidence is the settlement of soils of very low density, generally from either oxidation of organic material, desiccation and shrinkage, or both, following drainage. Subsidence takes place gradually, usually over a period of several years, and is a common consequence of liquefaction. Due to the project site's/BRPA site's low potential for liquefaction, the potential for seismically-induced settlement to occur at the project site/BRPA site is also considered to be low. Nonetheless, the Preliminary Geotechnical Evaluation concluded that the results of the liquefaction analysis are preliminary, and should be further evaluated with a design-level geotechnical exploration. Without confirmation from such a report, the potential exists for the Proposed Project or BRPA to be exposed to substantial risks related to subsidence or settlement.

Liquefaction

Liquefaction occurs when saturated fine-grained sand and/or silts lose their physical strength temporarily during earthquake-induced shaking and behave as a liquid. The project site/BRPA site is not currently mapped for potential liquefaction hazard by the CGS. In addition, Geocon is not aware of any reported historical instances of liquefaction in the Davis area. However, soil and groundwater conditions exist at the project site/BRPA site that may be susceptible to seismic-induced liquefaction under the design-level seismic event. For example, portions of the project site are underlain by poorly drained silty clays and groundwater has been encountered in below ground surface borings at the project site. Based on the results of liquefaction susceptibility analyses performed by Geocon for nearby sites, and the anticipated subsurface condition at the project site/BRPA site, Geocon concluded that the potential for liquefaction and significant adverse impacts from liquefaction are low. Nonetheless, the Preliminary Geotechnical Evaluation concluded that the results of the liquefaction analysis are preliminary, and should be further evaluated with a design-level geotechnical exploration. Without confirmation from such a report, the potential exists for the Proposed Project or BRPA to be exposed to substantial risks related to liquefaction.

Collapse

As discussed above, the project site/BRPA site is not located in an area that would likely be subject to strong ground shaking, and is not underlain by any active faults or located within an Alquist-Priolo Fault Study Zone. Additionally, all structures constructed as part of the Proposed Project or BRPA would be required to adhere to the provisions of the most recent version of the CBSC in effect at the time of building permit issuance. Structures built according to the seismic design provisions of current building codes would be able to resist major earthquakes without collapse, but with some structural, as well as non-structural damage. Given the project's adherence to the CBSC requirements, the Proposed Project or BRPA would not be subject to substantial risks associated with building collapse.

Expansive Soils

According to the Preliminary Geotechnical Evaluation, expansive clay soils are common in the area and the near-surface soil at the project site/BRPA site is expected to consist of lean and fat clays with a medium to high expansion potential when subjected to moisture variations. Expansive soils have the potential to compromise the

structural integrity of project features, which could result in a significant impact. The Preliminary Geotechnical Evaluation includes recommendations to reduce potential damage to the Proposed Project or BRPA, such as proper moisture conditioning and compaction control during site grading of the project site/BRPA site and designing foundations to resist differential soil movement. Without implementation of recommended measures, on-site expansive soils could cause differential movement (either shrink or swell) and significant damage to overlying structures. Thus, the Proposed Project or BRPA would have the potential to be exposed to substantial risks related to expansive soils.

Conclusion

From a geotechnical standpoint, provided that the recommendations included in the Preliminary Geotechnical Evaluation prepared for the Proposed Project or BRPA are implemented into the project design and specifications, the geological and soil conditions on the project site/BRPA site would be adequate to support development of the Proposed Project or BRPA. However, conformance with such recommendations cannot be ensured and a final design-level geotechnical engineering report has not yet been prepared. As a result, a ***significant*** impact could occur related to subsidence/settlement, liquefaction, and/or expansive soils.

Mitigation Measure(s)

Implementation of the following mitigation measure would reduce the above impact to a *less-than-significant* level.

Proposed Project, Biological Resources Preservation Alternative

4.6-3 *Prior to final design approval and issuance of building permits for the Proposed Project or BRPA, the project applicant shall submit a design-level geotechnical engineering report produced by a California Registered Civil Engineer or Geotechnical Engineer to the City of Davis Community Development Department and Public Works Department, for review and approval. The report shall include the results of a site-specific subsurface exploration, laboratory testing, and engineering analysis. The design-level report shall be performed after site configuration/layout has been established. The investigation shall include several exploratory borings and test pits throughout the project site/BRPA site to evaluate the potential presence of undocumented fill, tilled/disturbed soil thickness, liquefaction potential, and excavation characteristics. The design-level geotechnical engineering report shall evaluate soil expansion potential and include the results of a laboratory plasticity index and expansion index testing. The report shall include the geotechnical recommendations specified in the Preliminary Geotechnical Evaluation prepared for the Proposed Project and BRPA, unless it is determined in the design-level report that one or more recommendations need to be revised.*

The design-level geotechnical engineering report shall address, at a minimum, the following:

- *Compaction specifications and subgrade preparation for on-site soils;*
- *Structural foundations;*
- *Grading practices;*
- *Liquefaction potential; and*
- *Expansive/unstable soils, including fill.*

Prior to issuance of any improvement plans, the foundation and improvement plans shall incorporate design-level recommendations. All foundation and improvement plans shall be reviewed and approved by the City of Davis Public Works – Engineering and Transportation Department, and the City of Davis Community Development Department – Building Division prior to issuance of any building permits.

4.6-4 Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature. Based on the analysis below and with implementation of mitigation, the impact is *less than significant*.

The following discussion includes an analysis of potential impacts related to the direct or indirect destruction of a unique paleontological resource or site or unique geologic feature as a result of development of the Proposed Project or BRPA. Because the Proposed Project and BRPA would be developed within the same overall site boundaries, the discussion below applies to both the Proposed Project and the BRPA.

Proposed Project, Biological Resources Preservation Alternative

As previously discussed, the project site/BRPA site is underlain by Quaternary-age, Holocene alluvial fan deposits, basin deposits, alluvium, and older alluvium and Holocene basin deposits, which generally consists of interbedded mixtures of alluvial sand, silt, and clay. A Paleontological Records Search for the Proposed Project and BRPA was conducted by Senior Museum Scientist, Patricia A. Holroyd, Ph.D., at the UCMP in order to determine the presence of paleontological resources on the project site/BRPA site. Results of the records search determined that two localities have been discovered within one mile of the project site/BRPA site. Although the project site/BRPA site does not contain any known paleontological resources or unique geologic features, given the undeveloped nature of the project site, the potential exists that a unique paleontological resource or site could be unearthed during project construction activities. It should be noted that the BRPA would have a reduced potential (relative to that of the Proposed Project) to directly or indirectly destroy a unique paleontological resource or site or unique geologic feature due to the preservation of the Natural Habitat Area.

Based on the above, development of the Proposed Project or BRPA could directly or indirectly destroy a unique paleontological resource or site or unique geologic feature. As a result, a ***significant*** impact could occur.

Mitigation Measure(s)

Implementation of the following mitigation measure would reduce the above potential impact to a *less-than-significant* level.

Proposed Project, Biological Resources Preservation Alternative

4.6-4 *Should paleontological resources be discovered during ground-disturbing activities, work shall be halted in the area within 50 feet of the find. Construction may continue in areas outside of the buffer zone. The applicant shall notify the Public Works Department and the City of Davis Community Development Department and retain a qualified paleontologist to inspect the discovery. If deemed significant under criteria established by the Society for Vertebrate Paleontology with respect to authenticity, completeness, preservation, and identification, the resource(s) shall then be salvaged and deposited in an accredited and permanent scientific institution (e.g., University of California Museum of Paleontology [UCMP] or Sierra College), where the discovery would be properly curated and preserved for the benefit of current and future generations. The language of this mitigation measure shall be included on any future grading plans, utility plans, and improvement plans approved by the City of Davis Public Works – Engineering and Transportation Department and the City of Davis Public Works – Utilities and Operations Department for the Proposed Project or BRPA, where excavation work would be required.*

Cumulative Impacts and Mitigation Measures

As defined in Section 15355 of the CEQA Guidelines, "cumulative impacts" refers to two or more individual effects which, when considered together, are considerable, compound, or increase other environmental impacts. The individual effects may be changes resulting from a single project or a number of separate projects. The cumulative impact from several projects is the change in the environment that results from the incremental impact of the project when added to other closely related past, present, and reasonably foreseeable probable future projects. Additional detail regarding the cumulative project setting can be found in Chapter 6, Statutorily Required Sections, of this EIR.

4.6-5 Cumulative increase in the potential for geological related impacts and hazards. Based on the analysis below, the cumulative impact is *less than significant*.

The following discussion includes an analysis of potential cumulative impacts associated with cumulative increases in the potential for geological related impacts and hazards as a result of development of the Proposed Project or BRPA. Because the Proposed Project and BRPA would be developed within the same overall site boundaries, the discussion below applies to both the Proposed Project and the BRPA.

Proposed Project, Biological Resources Preservation Alternative

Impacts to geology, soils, seismicity, and paleontological resources related to implementation of the Proposed Project or BRPA are analyzed throughout this chapter. As discussed above, existing geological and soil conditions on the project site/BRPA site would generally be adequate to support development of the Proposed

Project or BRPA. In addition, Mitigation Measure 4.6-3, which requires the preparation of a final design-level geotechnical engineering report, would ensure the appropriate recommendations are implemented to reduce project-specific impacts related to geology and soils to a less-than-significant level.

While some geologic characteristics may affect regional construction practices, impacts and mitigation measures are primarily site-specific and project-specific. For example, impacts resulting from development on expansive soils at one project site are not worsened by impacts from development on expansive soils or undocumented fill at another project site. Rather, the soil conditions, and the implications of such conditions for each project, are independent.

As such, the potential for cumulative impacts related to geology, soils, seismicity, and paleontological resources, to which implementation of the Proposed Project or BRPA might contribute, is ***less than significant***.

Mitigation Measure(s)

None required.