3.3 GEOLOGY, SOIL, AND PALEONTOLOGY

This section discusses the surface and subsurface geology for the project area, including the potential to find paleontological resources (fossils) during construction activities. CPUC examined the potential risk for loss of life, injury, or damage to property from the proposed project and project alternatives in case of earthquakes, land subsidence, or landslides. CPUC also examined the potential for the project and project alternatives to cause substantial soil erosion or to destroy, directly or indirectly, valuable paleontological resources.

3.3.1 ENVIRONMENTAL SETTING

REGIONAL SETTING

The Lodi gas storage field and proposed pipeline alignment are situated near the northern boundary of the San Joaquin Valley. The San Joaquin Valley and the Sacramento Valley to the north comprise the Great Valley Geomorphic Province (Great Valley province). The Great Valley province is a large, northwestward-trending, asymmetric structural trough that is bounded by the Sierra Nevada province to the east and south, the Klamath Mountains to the north, the Cascade Range province to the northeast, and the Coast Ranges province to the west (Figure 3.3-1). The Sacramento River and its tributaries drain into the northern portion of the province, and the San Joaquin River and its tributaries drain into the southern portion of the province (Page, 1986). The elevation of the valley floor ranges from below sea level to approximately 400 feet above sea level. The ground surface within the vicinity of the proposed pipeline ranges in elevation from approximately 80 feet above mean sea level within the Lodi gas field, to approximately 10 to 15 feet below mean sea level near the pipeline terminus at the PG&E Line 401 interconnect on Sherman Island.

The Great Valley is an asymmetrical synclinal trough with a more gently dipping eastern slope. Ocean covered the bulk of the province prior to the early Eocene epoch, approximately 58 million years ago. As the seas withdrew, the erosion of the Sierra Nevada to the east caused deposits of increasing amounts of terrestrial sediment. During the Eocene epoch, the margins of the Great Valley province lifted, causing the sea to gradually recede. The Stockton Arch, which divides the northern and southern sections of the Great Valley province, lifted during the same period. Subsidence of the Great Valley during the late Eocene epoch caused the sea to again inundate the province. As the valleys continued to fill with sediment, the sea occupied smaller areas. By the end of the Pliocene epoch, approximately 1.6 million years ago, the seas had withdrawn from the last submerged area of the province, the southwestern portion (Poland and Evenson, 1966).

The Great Valley province is underlain by a thick (up to 80,000 feet) sequence of sedimentary units (the Great Valley Sequence), which range in age from the Jurassic period to the Holocene epoch and include both marine and continental rocks and deposits. The Sierra Nevada to the east of the Great Valley province are composed of igneous and metamorphic rocks from before the Tertiary period, the surface of which slopes in a southwestward direction and underlies the Great Valley, forming the basement complex. The Coast Ranges to the west consist mostly of complexly folded and faulted, consolidated marine and nonmarine sedimentary rocks of the Jurassic, Cretaceous, and Tertiary periods, which slope eastward and overlie the basement complex.

Continental deposits of late Pliocene and Pleistocene age, consisting primarily of poorly to moderately permeable sand, silt, and clay, overlie the consolidated marine and nonmarine sedimentary rocks. The continental deposits are overlain by alluvial deposits of the Quaternary period. The valley floor is composed primarily of post-Eocene coalescing alluvial fan deposits and floodplain deposits interbedded by lake deposits and some volcanics.

LOCAL SETTING

Geology

In the vicinity of the Lodi gas field, the basement complex and consolidated sedimentary rocks are overlain by a thick sequence of unconsolidated sediments deposited on low alluvial plains and fans derived primarily from the Mokelumne River (Figure 3.3-2). Eastward, the basement complex and consolidated sedimentary rocks are overlain by a floodplain, overbank, and channel deposits derived primarily from the San Joaquin and Sacramento Rivers and their tributaries (Figure 3.3-3).

The eastern portion of the project vicinity, the compressor facility site, and the separation facility site are underlain by arkosic sand of the Riverbank and Modesto Formations, deposited as part of the Mokelumne River alluvial fan. These sediments are from the Pleistocene epoch.

The western portion of the project vicinity overlies Holocene-age marsh, swamp, and channel sediments, which are associated with intertidal depositional environments. The Holocene sediments are usually at least 3 feet thick and consist primarily of peat, muck, and mud.

Seismicity and Faults

The project area rests on the eastern edge of the seismically active San Andreas Fault System. The San Andreas Fault System has little potential to damage the project because of the distance to the primary areas of fault activity. The Midland fault (U.S. Geological Survey, 1981) runs beneath the transmission pipeline route in southwestern Sacramento County. The Midland fault has not demonstrated any historic activity, and appears to have been inactive since the early Oligocene period approximately 30 million years ago (U.S. Geological Survey, 1987). Earthquakes along the Great Valley Thrust Fault System have the greatest potential to cause damage in the project area. Figure 3.3-4 shows a map of known and suspected major faults capable of causing strong ground motions in the project area (U.S. Geological Survey, 1996; Jennings, 1994). Table 3.3-1 below gives the potential magnitude and recurrence times for segments of the Great Valley Thrust Fault System that are close to the project site (U.S. Geological Survey, 1996). An example of a Great Valley Thrust Fault earthquake was the 1983 Coalinga quake, with a magnitude of 6.5.

Other fault subsystems capable of producing strong ground motions in the project area include the San Andreas/San Gregorio, Hayward, and Calaveras Fault Subsystems. Fault segments other than the Great Valley Thrust Fault System that are capable of producing a magnitude 6.0 or greater earthquake near the project site are presented in Table 3.3-2.

TABLE 3.3-1
ESTIMATED EARTHQUAKE MAGNITUDES FOR GREAT VALLEY THRUST FAULT SEGMENTS NEAR THE LODI GAS FIELD PROJECT

Fault	Code	Estimated Moment Magnitude	Recurrence Interval (years)
Great Valley_04	GV04	6.6	540
Great Valley_05	GV05	6.5	450
Great Valley_06	GV06	6.7	560

Note: Other fault subsystems capable of producing strong ground motions in the project area include the San Andreas/San Gregorio Fault Subsystem, the Hayward Fault Subsystem, and the Calaveras Fault Subsystem. Fault segments capable of producing a magnitude 6 or greater earthquake near the project site other than the Great Valley Thrust Fault System are presented in Table 3.3-2.

Liquefaction

Loose, water-saturated, unconsolidated sediments that may be adversely affected by strong earthquake shaking are prominent in the Delta. Areas most likely to suffer from liquefaction during earthquake shaking are the low-lying areas underlain by bay mud and marsh deposits.

Subsidence

Groundwater withdrawal during this century has significantly lowered the water table in most of the Central Valley, causing inelastic compaction of fine-grained soil and subsidence. More than half of the San Joaquin Valley has subsided more than 1 foot. Subsidence has essentially ceased in the project area as groundwater levels have stabilized (Bertoldi, 1991).

TABLE 3.3-2
FAULTS CAPABLE OF PRODUCING MAGNITUDE 6 OR GREATER EARTHQUAKES IN THE PROJECT VICINITY NOT IN THE GREAT VALLEY THRUST FAULT SYSTEM

Fault	Code	Moment Magnitude	Recurrence Interval (years)
San Andreas/San Gregorio Fault Subsystem			
San Andreas, 1906 rupture	A1	7.9	210
San Andreas, Peninsula-independent	A2	7.1	400
San Andreas, Santa Cruz Mountains-independent	A3	7.0	40
Sargent	A6	6.8	330
Hayward Fault Subsystem			
Hayward, south	H1	6.9	210
Hayward Southeast Extension	H1a	6.4	220
Hayward, north	H2	6.9	210
Rodgers Creek	H3	7.0	230
Calaveras Fault Subsystem			
Northern Calaveras, entire	C2	7.0	400
Northern Calaveras, Amador Valley	C2a	6.1	200
Northern Calaveras, San Ramon Valley	C2b	6.1	200
Concord	C3	6.5	240
Concord-Green Valley	C34	6.9	330
Green Valley	C4	6.7	330
Hunting Creek-Berryessa	C5	6.9	170
Other Faults in San Andreas Fault System			
Greenville	L02	6.9	550
West Napa	L05	6.9	700

Within the Delta, the ground surface has subsided approximately 25 feet since the early 1900s (approximately 3 inches per year). Subsidence in this area is primarily attributable to oxidation of organic soil materials and removal of soil by wind and water erosion, which has occurred since the area was drained for agriculture. This ground surface subsidence or loss of soil material continues today in the Delta at rates that vary with organic content.

Landslides

The well pads, compressor facility, separation facility, and the PG&E interconnect and meter stations all rest on nearly level ground surfaces. The transmission pipeline travels beneath levees, which are the only areas susceptible to landslides. Flooding along the Delta has historically caused bank erosion and levee failure. Piping, which is a progressive failure that occurs when seepage flowing under or through the levee carries soil away from the levee or foundation through a created "pipe," also contributes to erosion and levee collapse. Liquefaction of the soil beneath or within the levee may also cause the embankment to slide during strong earthquakes.

Soils

Soil surveys of Sacramento and San Joaquin Counties have been prepared and published by the U.S. Department of Agriculture. These surveys cover the gas field site and the entire pipeline route. Properties of the soils encountered at the separation and compressor facilities and along the pipeline route are included in Appendix B. Also included are potential problems faced in pipeline trenching or designing structures.

Paleontological Resources

A paleontological resources records review was conducted to determine the distribution of known paleontological sites within the project vicinity. The project crosses areas that are typified by Holocene-age fluvial and estuarine sediments and Pleistocene-age alluvial sediments. As shown in Table 3.3-3, approximately half the project area is underlain by sediments that possess low paleontological sensitivity because they are unlikely to yield remains that are of appreciable age (i.e., older than 10,000 years). However, the eastern portion of the project area is underlain by alluvial sediments of Pleistocene age where fossils could be present.

Chemical weathering as a result of soil formation takes place after the deposition of any sedimentary unit and destroys fossils. The depth of soil profiles varies as a function of climate, as well as the age of the sediment; younger Pleistocene sediments (those of Tioga age) will have weathering profiles at least 6 feet deep. Therefore, even though an unweathered sedimentary unit may have moderate to high paleontological sensitivity, the probability of recovering intact fossils from within the soil zone is low. Where the project area is underlain by sediments of moderate to high paleontological potential (Table 3.3-3), scientifically significant fossils may occur at depths greater than 10 feet.

TABLE 3.3-3
PALEONTOLOGICAL SENSITIVITY OF SEDIMENTS IN THE PROJECT AREA

Surficial Geology Unit	Age	Paleontological Sensitivity (depth <10 feet)	Paleontological Sensitivity (depth >10 feet)
Riverbank Formation alluvium	Pleistocene epoch	Low	Moderate to high
Modesto Formation, upper member, alluvium	Pleistocene epoch	Low	Moderate to high
Channel and levee deposits	Holocene epoch	Low	Low
Modesto Formation, lower member, alluvium	Pleistocene epoch	Low	Moderate to high
Modesto Formation alluvium, undifferentiated	Pleistocene epoch	Low	Moderate to high
Intertidal and deltaic deposits	Holocene epoch	Low	Low

3.3.2 REGULATORY SETTING

Several local plans, policies, and goals have been implemented to regulate project development in areas subject to geologic hazards or in areas of agricultural uses. These policies are summarized below.

SAN JOAQUIN COUNTY

The San Joaquin County General Plan has several goals and policies in the Public Health and Safety and Resources Elements regarding geologic hazards and agricultural preservation that are relevant to the project and project alternatives:

- The risk to humans and property from seismic and geologic hazards shall be considered in determining the location and intensity of development and the conditions under which it may occur.

- Facilities necessary for emergency services, major utility lines and facilities “shall not be located within 1/8 mile of any active fault.”

- Agricultural areas shall be used principally for crop production, ranching, and grazing.

- All agricultural support activities and non-farm uses shall be compatible with agricultural operation and shall satisfy the following criteria:

  – The use requires a location in an agricultural area because of unusual site area requirements, operational characteristics, resource orientation, or because it is providing service to surrounding agricultural area.

  – The operational characteristics of the use will not have a detrimental impact on the management or use of the surrounding agricultural properties.

  – The use will be sited to minimize any disruption to the surrounding agricultural operations.

These policies were adopted and implemented by the County Community Development, Public Health, and Public Works Departments. If approved, the project will be reviewed with respect to these polices (San Joaquin County, 1992).

SACRAMENTO COUNTY

The Sacramento County General Plan has several goals and policies in the Seismic Safety and General Safety Elements regarding geologic hazards and erosion control that are relevant to the project and project alternatives:

- Sacramento County has adopted the Uniform Building Code, which requires that structures be built to withstand groundshaking expected in the applicable seismic risk zone.

- Sacramento County will continue to strictly enforce grading and drainage ordinances.

These policies were adopted and implemented by the County Planning and Community Development, Public Health, and Public Works Departments. If adopted, the project will be reviewed with respect to these policies before issuance of conditional use, building, and encroachment permits (County of Sacramento Planning and Community Development Department, 1993).

3.3.3 SIGNIFICANCE CRITERIA

Criteria for determining the significance of impacts to geology, soils, and paleontological resources were developed based on questions contained in the environmental checklist form in Appendix G of the State

CEQA Guidelines. Based on the checklist questions, a project may have a significant effect on the environment if it would:

- expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
  - rupture of a known earthquake fault
  - strong seismic groundshaking
  - seismic-related ground failure, including liquefaction
  - 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 an onsite or offsite landslide, lateral spreading, subsidence, liquefaction, or collapse;
- be located on expansive soil, creating substantial risks to life or property;
- contain soil incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems; or
- directly or indirectly destroy a unique paleontological resource or site, or unique geologic features.

Section 15064(h) of the State CEQA Guidelines states that a change in the environment is not a significant effect if the change complies with a standard that is a quantitative, qualitative, or a performance requirement found in a statute, ordinance, resolution, rule, regulation, order, or other standard of general application. For the purposes of assessing the significance of geologic impacts associated with the proposed project and project alternatives, an impact will be considered significant if the proposed project or project alternatives would result in a conflict with the goals and policies of the Sacramento County or the San Joaquin County General Plans. The significance of soil and paleontological impacts associated with the proposed project and project alternatives is based on the environmental checklist provided in the State CEQA Guidelines, presented above.

3.3.4 IMPACTS OF THE PROPOSED PROJECT AND MITIGATION MEASURES

Impact 3.3-1: Potential to Cause Substantial Wind and Water Erosion

Construction activities would expose disturbed and loosened soils to erosion from rainfall, water, and wind. Soil erosion is the process by which soil particles are removed from the land surface by wind, water, or gravity. Susceptibility to erosion (erodibility) is the summation of many factors, including terrain, land use, vegetation, soil type, and climate. In the absence of adverse conditions, such as rainfall or lack of vegetative cover, a soil that is classified as highly erodible may not significantly erode.

Accelerated soil erosion would not occur except at isolated locations, such as areas where unusual wind erosion occurs, the slopes are steep, or where a combination of fine, sandy to silty soils or soils make revegetation after disturbance difficult.

Most natural erosion occurs at slow rates. However, the rate increases when the land is cleared or altered and left disturbed. Construction activities remove the protective cover of vegetation and leave the soil susceptible to rainfall impact erosion. However, most effects on soil are short term. In most cases, natural restoration (revegetation) prevents long-term detrimental effects. Sheet erosion occurs when slope length and runoff velocity increase on disturbed areas. As runoff accumulates, it concentrates into rivulets that cut grooves (rills) into the soil surface. If the water flow is sufficient, these rills may develop into gullies.

Because of the nearly level ground surface and the fine texture of the soil in the project area, excessive erosion is not expected. Most of the project alignment would cross existing agricultural fields that are seasonally tilled for seed bed preparation, weed control, or other agricultural practices. Grading for construction of project facilities and installing the pipeline would not substantially differ from current land-disturbing activities. Therefore, this impact is less than significant.

Mitigation Measures

None required.

Impact 3.3-2: Location of Project Facilities on a Geological Unit or Soil that Is Unstable, Potentially Resulting in Exposure of the Pipeline to Loss of Support and Damage

As described previously, the ground surface in the Delta has subsided approximately 25 feet since the early 1900s (about 3 inches per year). Subsidence caused by oxidation of organic soil materials and removal of soil materials by wind and water erosion continues today in the Delta at rates that vary with organic content. Pipeline segments buried in soil materials subject to this type of subsidence may become exposed or shallow enough to be damaged by agricultural practices common in the region during the useful life of the project. However, the project proponent has included in the project design (see Chapter 2, "Project and Alternatives Description") the development and implementation of a site restoration plan for the field and transmission pipelines. The plan specifically addresses covering the pipeline with a minimum of 4 feet of soil in non-row crop/vineyard use and additional soil where negotiated with the landowner.

Although the project proponent has committed to burying the pipeline to meet the agricultural requirements of individual landowners, it is possible in some areas with high subsidence rates that the pipeline cannot be buried at a depth that would preclude potential future interference with agricultural practices. Because of the shallow depth to groundwater and the low strength of the soil materials in these areas it may not be possible in all locations to excavate a trench deep enough to keep the pipeline at a minimum of 4 feet below ground surface during the useful life of the project. Therefore this impact is significant. Implementation of Mitigation Measure 3.3-1 will reduce this potential impact to less-than-significant levels.

Mitigation Measure 3.3-1: Identify potential areas of concern regarding potential future interference of the pipeline with agricultural practices and undertake remedial actions as necessary

Prior to project construction, LGS will be required to prepare a report identifying specific areas where soil conditions are such that placement of the pipeline could lead to potential future interference with agricultural practices because of unstable soils. LGS will submit this report to CPUC for review and approval. LGS will be required to monitor the depth of the pipeline in these areas annually during the life of the project and submit annual reports to CPUC each January 31. The intent of this mitigation measure is to ensure that the pipeline remains 4 feet below the ground surface. In areas where monitoring during the life of the project shows that the pipeline has become shallower than 3.5 feet below the ground surface, LGS will be required by CPUC to implement remediation measures that may include:

- reburying the pipeline to an appropriate depth;
- looping the pipeline segment by placing a replacement pipeline segment at a greater depth and removing the shallow segment;
- importing additional soil cover to maintain the depth of pipeline at least 4 feet below the ground surface; however, importation of additional soil cover will not be permitted if it would interfered with then-existing agricultural practices, such as furrow irrigation; and
- other measures proposed by LGS and approved by CPUC.

Additionally, when the project is abandoned, pipeline segments in subsiding lands will be removed to prevent future interference with agricultural operations.

Alternatively, at any time during the life of the project, LGS may provide the CPUC with proof of mutually acceptable agreements with individual landowners that indicate that the measures described above are not necessary and that any such potential interference with agricultural operations are acceptable to the landowners.

Mitigation Monitoring Action ¾ CPUC will review the submittals from LGS to ensure compliance with the measures outlined above.

Responsible Agency ¾ CPUC

Timing ¾ The report identifying potential areas of concern shall be submitted to CPUC prior to the start of construction. Annual reports will be submitted by LGS and promptly reviewed by CPUC. Remedial actions needed will be completed within 1 year of identification of specific problem areas.

A 1-year time frame for corrective action was selected to minimize effects on agricultural activities. A 30-day corrective action period would require that fill be imported as the only practicable solution. Immediate action may directly damage crops in the field or indirectly damage them by interfering with the local drainage and irrigation systems or inhibit the farmers ability to harvest their crop. However with a 1-year time frame, upon identification of a problem area, the Applicant would have the opportunity to complete detailed engineering designs, retain contractors, and schedule construction activities to minimize the disturbance of ongoing agricultural activities. In addition, even at the highest rate of ground surface subsidence reported in the Delta (approximately 3 inches per year) the impact would be mitigated before the depth of the pipe exceeded the minimum federal safety standards (3 feet below ground level).

Impact 3.3-3: Potential to Expose People or Structures to Substantial Adverse Geologic Hazards

Although the pipeline alignment or other facilities would not be located on or cross any known active fault zones, large faults in the project area are capable of producing strong ground motion. Secondary effects of seismic activity, such as groundshaking and liquefaction, may adversely effect the pipeline and ancillary facilities. Though risk of damage from seismic activity in project area is moderate (seismic risk zones 2 and 3). Generally below ground pipelines are safe as they are flexible and can move with the ground. Buried pipelines resist strong groundshaking. However, the ground accelerations could be sufficiently strong to effect the aboveground facilities. Above ground facilities are at greater risk because the ground motion can be amplified depending on the design of the structure and the underlying geologic materials. Failures typically occur at joints connecting the above ground facilities to the below ground facilities due to the difference in motion.

Secondary affects of seismic activity such as liquefaction may damage above and below ground facilities due to lateral or vertical displacement. The project crosses nearly level ground where potential for landslides is nil. However, areas of deep, unconsolidated sediments, particularly where the water table is high, are prone to indirect seismic effects from liquefaction. If liquefaction of the sediments covering the pipeline occurs, the buoyancy of the pipeline could cause the pipeline to float, resulting in vertical displacement of the pipeline. Vertical displacement in excess of design limits may affect the pipeline.

Geologic hazards such as seismic activity and secondary effects must be considered in the design of the project. Seismic hazards and liquefaction potential in the project area is well documented and it can be assumed that this information is being considered in the engineering design of the project. When the detailed engineering design of the project is completed, it will be submitted to several responsible agencies for approval. Numerous federal, state, and local agencies have oversight responsibilities to ensure the safety of the proposed project, including:

- U.S. Department of Transportation, Office of Pipeline Safety, which provides oversight of pipeline construction, operation, and safety;

- California Division of Oil, Gas, and Geothermal Resources, which provides oversight of design, installation, and operation of gas wells; and

- San Joaquin County, which provides oversight of aboveground structures and buildings.

At a minimum, the project will be designed to meet the seismic safety standards of the Uniform Building Code. Specific design measures may include, but are not limited to, special foundation design, additional bracing and support of upright facilities (e.g., tanks, exhaust stacks), and weighting the pipeline in areas of potential liquefaction. In addition, automated leak detection, isolation, and shutdown controls would limit the secondary effects of equipment damage.

Office of Pipeline Safety records of natural gas leaks in California show that proper design can effectively mitigate potential seismic hazards. The incident reports show no relationship between leaks and major seismic events that have occurred since 1985: Palm Springs (7/8/86), Whittier (10/4/87), Loma Prieta (10/17/89), Upland (2/28/90), Sierra Madre (6/28/91), Cape Mendocino (4/25/92), Big Bear (6/28/92), Northridge (1/17/94), Eureka (9/1/94), South Lake Tahoe (9/12/94), and Parkfield (12/20/94). No pipeline leaks due to any type of failure (outside forces, corrosion, or operator error) were reported within 60 days in any region affected by a major seismic event.

Because of the effectiveness of the mandated design requirements of the project and the multiple responsible agency oversight of the design and construction of the project, this impact is less than significant.

Mitigation Measures
None required.

Impact 3.3-4: Potential Destruction of Unique Paleontological Resources

Implementation of the project may adversely affect paleontological resources as a result of mechanical excavation and boring during construction of the pipeline. As described previously, scientifically significant fossils may occur at depths greater than 10 feet where the project area is underlain by sediments of moderate to high paleontological potential (Table 3.3-3). This impact is significant. As described in Chapter 2, "Project and Alternatives Description," the proposed project includes the development and implementation of a paleontological resources discovery and management plan as part of a construction monitoring program. This plan will include review of final construction plans to determine which portions of the project will effect paleontologically sensitive sediments that lie deeper than 10 feet below the surface.

A qualified paleontologist will monitor construction in those areas with moderate to high paleontological sensitivity, where mechanical excavation at depths greater than 10 feet are anticipated. If potentially significant fossils (defined as deposits that are unique, or that may reasonably be expected to assist in the evaluation of specific areas of research or expand our understanding of prehistory) are encountered, LGS will initiate the following measures:

- Construction will be stopped in the immediate vicinity of the fossil find until they are removed.
- Fossils will be recovered by a team of qualified paleontologists.
- Recovered materials will be scientifically prepared.
- Recovered and prepared specimens will be curated in an accredited institution.

Mitigation Measures

None required.

3.3.5 IMPACTS OF THE PUBLIC RIGHT-OF-WAY ROUTE ALTERNATIVE AND MITIGATION MEASURES

IMPACTS

Geologic, soil, and paleontological impacts of the Public Right-of-Way Route Alternative would be essentially identical to those of the proposed project. The eastern portion of the pipeline alignment and alternative compressor facility site would be located on similar soils derived from Pleistocene-age alluvial materials from the Mokelumne River. The western portion of the pipeline would be underlain by Holocene-age marsh, swamp, and channel sediments. Although the proportions of specific geologic formations or soil map units traversed by this alternative may differ somewhat from those of the proposed project, the potential impacts would be the same.

Because this alternative is located on nearly level ground, as is the proposed project, substantial wind and water erosion are not expected to occur.

The Applicant's site restoration plan and the U.S. Department of Transportation Office of Pipeline Safety design requirements (described in Chapter 2, "Project and Alternatives Description") would reduce the potential impact of locating project facilities on unstable soils and exposing people or structures to geologic hazards to a less-than-significant level.

The Applicant's paleontological resources discovery and management plan (described in Chapter 2, "Project and Alternatives Description") would reduce the potential to destroy unique paleontological resources to a less-than-significant level.

Mitigation Measures

Implementation of Mitigation Measure 3.3-1, described previously, would reduce potential impacts associated with the pipeline interfering with future agricultural activities to a less-than-significant level.

3.3.6 IMPACTS OF THE EXISTING PIPELINE CORRIDOR ALTERNATIVE AND MITIGATION MEASURES

IMPACTS

Geologic, soil, and paleontological impacts of the Existing Pipeline Corridor Alternative would be essentially identical to those of the proposed project. The eastern portion of the pipeline alignment and alternative compressor facility site would be located on similar soils derived from Pleistocene-age alluvial materials from the Mokelumne River. The western portion of the pipeline would be underlain by Holocene-age marsh, swamp, and channel sediments. Although the proportions of specific geologic formations or soil map units traversed by this alternative may differ somewhat from those of the proposed project, the potential impacts would be the same.

Because this alternative is located on nearly level ground, as is the proposed project, substantial wind and water erosion are not expected to occur.

The Applicant's site restoration plan and the U.S. Department of Transportation Office of Pipeline Safety design requirements (described in Chapter 2, "Project and Alternatives Description") would reduce the potential impact of locating project facilities on unstable soils and exposing people or structures to geologic hazards to a less-than-significant level.

The Applicant's paleontological resources discovery and management plan (described in Chapter 2, "Project and Alternatives Description") would reduce the potential to destroy unique paleontological resources to a less-than-significant level.

Mitigation Measures

Implementation of Mitigation Measure 3.3-1, described previously, would reduce potential impacts associated with the pipeline interfering with future agricultural activities to a less-than-significant level.

3.3.7 IMPACTS OF THE COMPOSITE ROUTE ALTERNATIVE AND MITIGATION MEASURES

IMPACTS

Geologic, soil, and paleontological impacts of the Composite Route Alternative would be essentially identical to those of the proposed project. The eastern portion of the pipeline alignment and alternative compressor facility site would be located on similar soils derived from Pleistocene-age alluvial materials from the Mokelumne River. The western portion of the pipeline would be underlain by Holocene-age marsh, swamp, and channel sediments. Although the proportions of specific geologic formations or soil map units traversed by this alternative may differ somewhat from those of the proposed project, the potential impacts would be the same.

Because this alternative is located on nearly level ground, as is the proposed project, substantial wind and water erosion are not expected to occur.

The Applicant=s site restoration plan and the U.S. Department of Transportation Office of Pipeline Safety design requirements (described in Chapter 2, AProject and Alternatives Description@) would reduce the potential impact of locating project facilities on unstable soils and exposing people or structures to geologic hazards to a less-than-significant level.

The Applicant=s paleontological resources discovery and management plan (described in Chapter 2, AProject and Alternatives Description@) would reduce the potential to destroy unique paleontological resources to a less-than-significant level.

Mitigation Measures

Implementation of Mitigation Measure 3.3-1, described previously, would reduce potential impacts associated with the pipeline interfering with future agricultural activities to a less-than-significant level.

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