Appendix G

Paleontological Resources Impact Evaluation Report

Paleontological Resources Impact Evaluation

Date:	November 17, 2022
Project name:	Northern San Joaquin 230 kV Transmission
Attention:	Starla Lane
Client:	Pacific Gas and Electric Company
Prepared by:	MariaElena Conserva/Earthview Science
Copies to:	Colleen Taylor/Jacobs, Erin Rice/PG&E

Earthview Science
Oakland, California
United States
T +1.510.859.3016
www.earthviewscience.com

1. Summary

This Paleontological Resources Impact Evaluation Report was completed to assess potential paleontological impacts associated with the Northern San Joaquin 230 kilovolt (kV) Transmission Project (project) in San Joaquin County, California, and to assist Pacific Gas and Electric Company (PG&E) in complying with laws, ordinances, regulations, and standards pertaining to paleontological resources. The City of Lodi and its Lodi Electric Utility (LEU) also will modify and construct connecting electric infrastructure as part of the project.

This assessment was conducted according to procedures laid out in PG&E Paleontological Resources Standards and Procedures (PG&E 2015) and includes review of geologic maps, institutional records, scientific literature, aerial imagery, and project plans.

This assessment finds that the study area (at least 0.5 mile beyond the extent of the potential transmission line route) has paleontological sensitivity ranging from low to high (Bureau of Land Management Potential Fossil Yield Classification [PFYC] System Classes 2 to 4). However, all potential PG&E transmission alignment routes and connecting PG&E and LEU station end points would have, at most, a moderate likelihood of impacting scientifically significant vertebrate fossils during project construction. Environmental protection measures (EPMs) are recommended for excavations greater than 3 feet below ground surface (bgs) in previously undisturbed sediment and worker environmental awareness training should cover paleontological resources.

2. Project Description

This project entails constructing a new 230 kV transmission line between an existing PG&E transmission line into the City of Lodi (to LEU facilities) in San Joaquin County, California, extending approximately 8 to 11 miles (refer to Attachment 1). The PG&E transmission line would consist of tubular steel poles (TSPs). The western part of the project also would include construction of a new PG&E Thurman Switching Station and a new LEU Guild Substation adjacent to the existing LEU Industrial Substation, which will be modified within the City of Lodi. Ancillary infrastructure modification and construction by PG&E and by LEU will occur within the City of Lodi. Three existing PG&E 60 kV lines currently connecting into LEU Industrial Substation will be reconfigured within their existing alignments after the new 230 kV transmission line is in service. The existing PG&E Lockeford Substation will be expanded on existing substation property in the central part of the new PG&E 230 kV alignment (refer to Attachment 1).

2.1 Ground-Disturbing Activity

General ground-disturbing work associated with the project would include the following types of activity:

- Some grading may be required to level access roads, work areas, and the new, modified, or expanded substation and switching station locations.

- PG&E TSP installation would require the excavation of approximately 6- to 9-foot-diameter shafts that are approximately 18 to 30-feet deep. Poles would be spaced approximately 740 to 800 feet apart for a total of approximately 73 poles.
- Temporary guard structures would be installed by PG&E where the new lines cross existing infrastructure such as roads (approximately 35 structures) or other electrical lines (approximately 22 crossings). They would require excavation of shafts from approximately 2 to 3 feet in diameter and up to approximately 7 feet in depth.
- Excavation required to install foundations for new equipment at the two LEU substations is not expected to exceed an approximate 4-foot diameter and an approximate 20-foot drilled pier foundation depth. Foundation excavations at PG&E Lockeford Substation and PG&E Thurman Switching Station are expected to be up to approximately 28 feet deep with an approximate 3.5-foot-diameter excavation. Additionally, approximately four grounding wells at the new PG&E Thurman Switching Station are expected to be installed at a depth of approximately 100 feet. Grounding rods typically have an approximately 1- to 1.5-inch diameter and a drill rig would be used to excavate a narrow shaft to install the rod within the well.
- The typical method for shaft excavation would be auguring.

3. Regulatory Setting

This section summarizes the federal, state, and local regulatory context, as well as professional standards that apply to paleontological resources in the project vicinity.

3.1 Federal

The following federal laws protect paleontological resources on federal lands as well as projects funded or overseen by federal agencies.

Antiquities Act of 1906

The Antiquities Act of 1906 (Title 16 United States Code Sections 431–433 [16 USC § 431–433]) was enacted with the primary goal of protecting cultural resources in the U.S. This act explicitly prohibits appropriation, excavation, injury, and destruction of any historic or prehistoric ruin or monument, or any "object of antiquity" located on lands owned or controlled by the federal government, without prior permission of the secretary of the federal department that has jurisdiction over the site. The act also establishes criminal penalties, including fines and imprisonment, for these acts. The Antiquities Act contains a requirement for studies by qualified experts in the subject matter, and contains precise stipulations regarding the management/curation of collected materials. Although the Antiquities Act itself and its implementing regulation (Title 43 Code of Federal Regulations Section 3 [43 CFR § 3]) do not specifically mention paleontological resources, "objects of antiquity" have been interpreted to include paleontological resources by the National Park Service (NPS), Bureau of Land Management (BLM), U.S. Forest Service (USFS), and other federal agencies.

National Environmental Policy Act

The National Environmental Policy Act (NEPA) of 1966, as amended (Pub. L. 91-190, 42 U.S.C. 4321–4347, January 1, 1970, as amended by Pub. L. 94-52, July 3, 1975, Pub. L. 94-83, August 9, 1975, and Pub. L. 97-258 § 4(b), September 13, 1982), recognizes the continuing responsibility of the federal government to "preserve important historic, cultural, and natural aspects of our national heritage..." (Sec. 101 [42 USC § 4321]) (#382). This can be interpreted to refer to paleontological as well as cultural resources. When not on federal lands, requiring paleontological analysis under NEPA is at the discretion of the lead federal agency.

Paleontological Resources Preservation, Omnibus Public Lands Act

The Omnibus Public Lands Act, (Public Law 111-011, Title VI, Subtitle D [OPLA-PRP 2009]) is legislation directing the Secretaries (of the Interior and Agriculture) to manage and protect paleontological resources on federal land using scientific principles and expertise. OPLA-PRP incorporates most of the recommendations of the report of the Secretary of the Interior entitled Assessment of Fossil Management on Federal and Indian Lands (2000) to formulate a consistent paleontological resources management framework. In passing the OPLA-PRP, Congress officially recognized the scientific importance of paleontological resources on some federal lands by declaring that fossils from these lands are federal property that must be preserved and protected. The OPLA-PRP codifies existing policies of the BLM, NPS, USFS, Bureau of Reclamation (BOR), and U.S. Fish and Wildlife Service (USFWS), and provides the following:

- Uniform criminal and civil penalties for illegal sale and transport, and theft and vandalism of fossils from federal lands
- Uniform minimum requirements for paleontological resource-use permit issuance (terms, conditions, and qualifications of applicants)
- Uniform definitions for “paleontological resources” and “casual collecting”
- Uniform requirements for curation of federal fossils in approved repositories

There are federal legislative protections for scientifically significant fossils for projects that take place on federal lands (with certain exceptions such as the Department of Defense). If any portion of the project occurs on federally managed lands (for instance, BLM lands), federal protections for paleontological resources on those lands apply under NEPA, OPLA_PRP, and the Federal Land Policy and Management Act (FLPMA) of 1976.

3.2 State

California Environmental Quality Act

The California Environmental Quality Act (CEQA) encourages the protection of all aspects of the environment by requiring state and local agencies to prepare multidisciplinary analyses of the environmental impacts of a proposed project, and to make decisions based on the findings of those analyses.

Treatment of paleontological resources under CEQA generally is conducted according to guidance from the Society for Vertebrate Paleontology (SVP) or other agencies (BLM and USFS), and typically includes identification, assessment, and development of mitigation measures for potential impacts to significant or unique resources.

Appendix G of the CEQA Guidelines provides guidance relative to significant impacts on paleontological resources, which states that a project normally will result in a significant impact on the environment if it will disrupt or adversely affect a paleontological resource or site or unique geologic feature, except as part of a scientific study.

California Public Resources Code

The State of California Public Resources Code (Chapter 1.7), Sections 5097.5 and 30244, includes additional state-level requirements for the assessment and management of paleontological resources. These statutes require reasonable mitigation of adverse impacts to paleontological resources resulting from development on state lands, define the removal of paleontological sites or features from state lands as a misdemeanor, and prohibit the removal of any paleontological site or feature from state land without permission of the applicable jurisdictional agency. Section 30244 requires reasonable mitigation for impacts on paleontological resources that occur as a result of development on public lands. Further,

California Penal Code Section 622.5 sets the penalties for damage or removal of paleontological resources.

3.3 Local

City and county general plans may include objectives, policies, and actions for the identification and protection of paleontological resources. However, because the California Public Utilities Commission (CPUC) has exclusive jurisdiction over utility project siting, design, and construction, PG&E is not subject to local discretionary regulations. A description of local policies and regulations for paleontological resources is provided for informational purposes and to assist with CEQA review where applicable.

The City of Lodi is a local agency and must comply with its own local plans and policies for LEU's portion of the project.

General plans of the City of Lodi and San Joaquin County were reviewed for provisions relevant to paleontological resources (City of Lodi 2010; San Joaquin County 2016). No provisions were found for San Joaquin County. The only provision relevant to paleontological resources in the City of Lodi General Plan is the following:

Policy C-P18

In the event that archaeological/paleontological resources are discovered during site excavation, the City shall require that grading and construction work on the project site be suspended until the significance of the features can be determined by a qualified archaeologist/paleontologist. The City will require that a qualified archaeologist/paleontologist make recommendations for measures necessary to protect any site determined to contain or constitute an historical resource, a unique archaeological resource, or a unique paleontological resource or to undertake data recovery, excavation, analysis, and curation of archaeological/paleontologist materials. City staff shall consider such recommendations and implement them where they are feasible in light of project design as previously approved by the City.

3.4 Professional Standards

SVP is an organization of professional and academic paleontologists that established standard guidelines (1995, 1996, 2010) for practices regarding paleontological resource assessments; monitoring and mitigation; data and fossil recovery; sampling procedures, specimen preparation, identification, and analysis; and museum curation. However, these guidelines were developed at an institutional level that is dedicated to scholarship and education rather than resource management or regulatory compliance.

In 2014, a white paper was published that includes best mitigation practices for paleontological studies. The mitigation practices outlined in this paper have a consensus among professional paleontologists regarding field methods, reporting standards, qualifications, and other procedures for conducting paleontological resource management activities (Murphey et al. 2014). PG&E has incorporated many of these findings into its guidance and assumes that professional paleontologists follow standards outlined by SVP, BLM, and other professional organizations except where they conflict with PG&E guidelines.

4. Methods

Existing data were analyzed according to PG&E Paleontological Resources Standards and Procedures (PG&E 2015). The analysis included (1) geologic map review, (2) scientific literature review, (3) institutional paleontological records search, (4) aerial imagery review, and (5) available geotechnical reports. Geological maps were obtained at the smallest unit available (in this case, 1:62,500 scale) (Marchand & Atwater 1979; Marchand & Bartow 1979). Geological and paleontological literature relevant to the northern San Joaquin Valley was reviewed for paleontological finds. Databases from the University of California, Museum of Paleontology (UCMP) and Paleobiology were searched for paleontological records within 1 mile of the project corridor (UCMP 2022; Paleobiology Database 2022) (refer to

Attachment 3). Google Earth aerial imagery also was reviewed for physiographic context and land use of the project site and vicinity. The following geotechnical reports were reviewed:

- Geotechnical Investigation Report for PG&E Lockeford Substation (Kleinfelder 2019a)
- Geotechnical Investigation Report for PG&E Thurman Switching Station (Kleinfelder 2019b)
- Preliminary Subsurface Information for the Electric Industrial Substation Expansion, Lodi, California (Burns and McDonnell 2020)

A study area was established for this evaluation that included the maximum project footprint plus a half-mile buffer beyond the project (Attachment 1).

5. Results

5.1 Geologic Setting

The study area extends approximately 9 miles from the east side of the City of Lodi across unincorporated San Joaquin County farmland. This area lies within the Great Valley physiographic province of California (also known as the Central Valley), a relatively flat alluvial plain approximately 400 miles long and 50 miles wide. The Central Valley is a structural trough or basin in which sediments have accumulated since the Jurassic Period (about 160 million years ago). The basin filled with thousands of feet of marine sediment up to the early Miocene Period (approximately 20 million years ago). After that, a change in the motion between the Pacific and North American plates resulted in the gradual uplift of the Coast Ranges and the eventual isolation of the basin from the ocean. Subsequently, sediments were derived from the neighboring Coast Ranges and the Sierra Nevada. By the late Pliocene Epoch (2 to 3 million years ago), subaerial depositional conditions prevailed: Sierra Nevada derived sediments were deposited on the east side of the basin, and Coast Range-derived sediments were deposited on the west side of the basin. Because of the greater size and elevation of the Sierra Nevada relative to the Coast Ranges, Sierra alluvial fans are vastly larger than those of the Coast Ranges and therefore tend to dominate Central Valley geology.

The study area is within the San Joaquin Valley (the southern half of the Central Valley), 1 mile south of the Mokelumne River, a major waterway that flows from the central Sierra Nevada into the Sacramento-San Joaquin River Delta. Bear Creek and Paddy Creek cross the project alignment. The study area is mostly farmland dedicated to row crops, except for the western end, which is within an industrial zone of the City of Lodi. As discussed in the following sections, study area geologic units date to the Holocene, Pleistocene, and Pliocene (Figure 1).

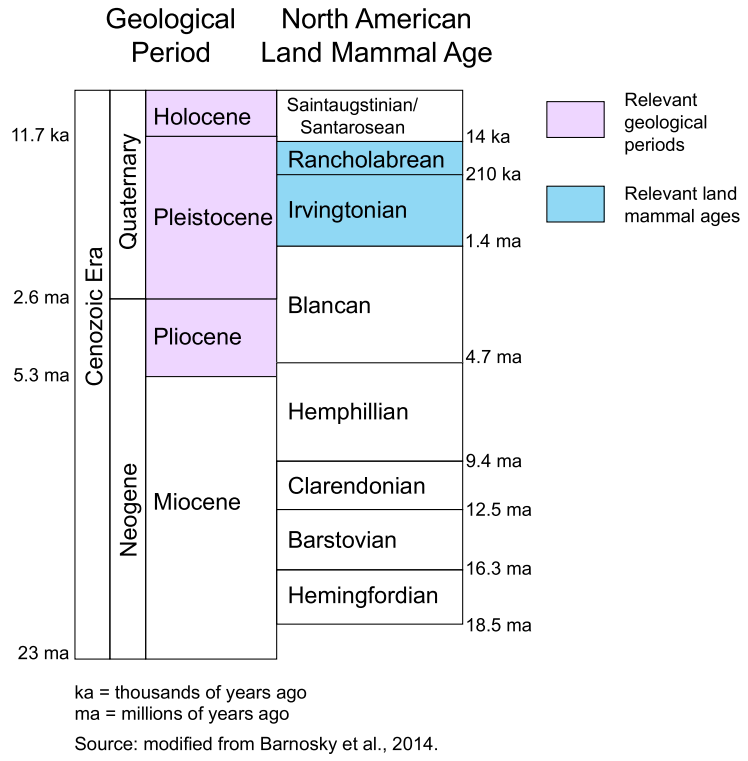

Figure 1. Geologic Periods and Land Mammal Ages Relevant to this Assessment

Geologic Units

Geologic units for the study area are presented in Attachment 1 (Marchand & Atwater 1979; Marchand & Bartow 1979; Dawson 2009). Geologic units are described in the following section from youngest to oldest.

- Alluvium (Qha) – Holocene age (11,700 years ago to present) poorly to moderately sorted sand, gravel, and silt.
- Alluvium/Colluvium (Qu) – Unnamed late Pleistocene age (approximately 2 million years ago to 11,700 years ago) or Holocene age alluvium and colluvium consisting of flat, relatively undissected fan, terrace, basin deposits, and small active streams.
- Modesto Formation – Late Pleistocene arkosic alluvium sand with minor gravel and silt, forming Mokelumne River alluvial fans, low terraces, and high floodplains. This formation includes the following units:
  - Qm2 – upper unit chiefly made of sand, becoming finer-grained toward the fan toe, and is probably glacial outwash.
  - Qm2e – upper unit made of arkosic sand that formed low dunes on the Mokelumne River fan and in the Delta. Although it is not well sorted, this unit is probably eolian.
  - Qm2f – lower unit made of foothill-derived alluvial silt, clay, and minor sand following tributaries across lower fans. It consists of abundant volcanic detritus.
  - Qm1 – lower unit made of arkosic alluvium forming the Mokelumne River alluvial fan. It is probably glacial outwash.
- Riverbank Formation – Middle to late Pleistocene arkosic alluvium sand with silt, forming terraces and alluvial fans along the Mokelumne River. Upper to lower units are as follows:

  - Qr3 – upper unit consisting of arkosic alluvium forming the Mokelumne River alluvial fan. It is primarily sand and probably glacial outwash.
  - Qr3f – upper unit consisting of foothill-derived alluvial sand and silt. It contains abundant volcanic detritus.
  - Qr2 – middle unit consisting of arkosic alluvium from the middle Pleistocene period forming Mokelumne River terraces and alluvial fan. It is chiefly sand and probably glacial outwash.
  - Qr2f – lower unit consisting of foothill-derived alluvial sand and silt. It contains abundant volcanic detritus.
- Turlock Lake Formation (Qt1) – Early to middle Pleistocene period arkosic alluvium, including sand with some silt and minor gravel (Dawson 2009).
- Laguna Formation (Tl) – Pliocene period (approximately 5 to 2.6 million years ago) cobble gravel, sand, and minor silt of mixed metamorphic, granitic, and volcanic sources.

5.2 Literature and Records Search Results

Institutional records searches and scientific literature review were performed for the study area and surrounding areas (UCMP 2022; Paleobiology Database 2022; Jefferson 1991) (refer to Attachment 3). The study area includes the proposed alignment plus a 0.5-mile buffer on each side. No records of fossils were found within 1 mile of the study area. However, because the study area is largely undeveloped, adjacent areas with similar geology were examined. The results are presented by geologic formation.

Pleistocene to Holocene geologic formations represent the major Pleistocene formations of the eastern San Joaquin Valley from youngest to oldest: Modesto Formation, Riverbank Formation, and Turlock Lake Formation. During the Pleistocene, also known as the Ice Age, the Central Valley teemed with animals. Late Ice Age fauna is known as the Rancholabrean Land Mammal stage. This group includes herbivores such as mammoth, mastodon, camels, bison, llamas, elk, and horses, as well as predators such as the short-faced bear, saber-tooth cat, scimitar cat, dire wolf, and California lion. Middle and early Ice Age fauna is known as the Irvingtonian Land Mammal stage, which includes mammoths, mastodons, and other members of the elephant family, horses, bone-crushing dogs, hyenas, wolves, saber-toothed cats, and bears. Fossils representing both of these faunas have been found in the San Joaquin Valley.

Alluvium/Colluvium (Qu) represents unnamed Holocene and possibly latest Pleistocene sediment. This formation is widespread across the state of California. It consists of unconsolidated sediment that generally is considered too young to produce significant fossils. Occasionally, significant vertebrate fossils are found in this sediment because it is older than previously thought or because older layers lie close to the surface (Maguire & Holroyd 2016). For this assessment, no fossil localities were found within this type of sediment within 9 miles of the study area.

Modesto Formation and subunits (Qm2, Qm2e, Qm2f, Qm1) are the youngest Pleistocene geologic units in the study area. They are thought to date to the late Ice Age, or the Rancholabrean Land Mammal Age. Modesto Formation sediments are fluvial and, under some circumstances, have been fossiliferous. Fossils are found occasionally in sediment attributed to the Modesto Formation, primarily along major rivers and first-order streams.

Paleontological records search and literature review results for the Modesto Formation fossils closest to the project corridor are listed in Table 1. The nearest fossil localities are in Stockton, approximately 9 to 11 miles from the project, including Lincoln Village, State Route (SR) 99, and Mormon Slough. Other fossil localities are more than 25 miles away.

Table 1. Modesto Formation Fossil Localities within 75 miles of Project

Approx. Distance to Project (miles)	Locality Name and Location	Locality Number	Common Name	Taxon	Age	Geologic Formation	Reference
9	Lincoln Village, Stockton	V4822	horse	Equus	Rancholabrean	Likely Modesto	UCMP 2022
11	South Stockton Six-Lane Project 1, 2, 3, SR 99/Stockton	V2016003, V2016004, V2016005	not listed	not listed	Rancholabrean	Modesto	UCMP 2022
11	Mormon Slough, Stockton	V5107	horse, mammoth	*Equus, Mammuthus*	Rancholabrean	Likely Modesto	UCMP 2022
> 25	Garber Farm, Stanislaus County	V72007	ground sloth, mammoth	*Megalonyx jeffersoni, Mammuthus columbi*	Pleistocene/ Rancholabrean	Modesto	UCMP 2022
> 25	McManis Ranch, Stanislaus County	V72186	bison	*Bison latifrons*	Pleistocene/ Rancholabrean	Modesto	UCMP 2022
45	Walnut Energy Center, Turlock	V99464	camel, bison	*Camelops, Bison*	Pleistocene/ Rancholabrean	Modesto	UCMP 2022
75	Sutter Energy Center, Sutter County	PB1018	plants	not listed	Pleistocene	Modesto	UCMP 2022
75	SR 99 Arboleda Drive, Merced	Not listed	1667 specimen recovered	1667 specimen recovered	Pleistocene/ Rancholabrean	Modesto/ Riverbank	Cogstone 2013

Riverbank Formation and subunits (Qr2, Qr2f, Qr3, Qr3f) date from about 450,000 years ago to 150,000 years ago, covering the late Irvingtonian Land Mammal Age as well as the early and mid Rancholabrean Land Mammal Age (Dundas et al. 1996). The Riverbank Formation has yielded early Rancholabrean and late Irvingtonian mammalian fossils, including the extinct North American camel (Camelops), mammoth (Mammuthus), ground sloth (Megalonyx), and bison (Bison). Some fossil localities attributed to the Modesto Formation have been revealed under scrutiny actually to be from the upper Riverbank Formation. The fossiliferous Riverbank Formation is a compound soil with a strongly gleyed (green-gray-blue wetland soil) horizon with a discontinuous hardpan composed of caliche (calcium carbonate cementing the fine-grained alluvium). Similarly, fossil localities attributed to the Riverbank Formation have sometimes been found to be part of the Turlock Lake Formation (Dundas & Chatters 2013). However, no fossil localities in the Riverbank Formation were found for this assessment within 7 miles of the study area.

Paleontological records search and literature review results for the Riverbank Formation fossils closest to the project are listed in Table 2.

Table 2. Riverbank Formation Fossil Localities within 50 Miles of Project

Approx. Distance to Project (miles)	Locality Name and Location	Locality Number	Common Name	Taxon	Geological Formation	Reference
12	Herald, Sacramento County	V3524	horse	*Equus*	Riverbank	Fisk 2006
25	Erhardt Avenue, City of Sacramento	V74086	mammoth	*Mammuthus columbi*	Riverbank	UCMP 2022
25	Elk Grove Gravel Pit, Sacramento County	not available	horse	*Equus*	Riverbank	Piper et al. 1939
25	Cometa Road, San Joaquin County	V5039	horse	*Equus*	Likely Riverbank	UCMP 2022
>25	Brant Ranch, Stanislaus County	V72008	sloth	*Glossotherium harlani*	Riverbank	UCMP 2022
30	Davis Gravel Pit, City of Sacramento	V6747	camel, horse, mammoth/ mastodon	*Camelops, Mammuthus, Equus*	Riverbank	Hansen and Begg 1970
30	Teichert Gravel Pit, City of Sacramento	V69129	various vertebrate	114 specimen	Riverbank	UCMP 2022
30	Teichert Gravel Pit, City of Sacramento	~ 30	camel, sloth	*Camelops hesternus, Glossotherium*	Riverbank	UCMP 2022
30	Perkins Gravel Pit, City of Sacramento	not available	camel, horse, mammoth/ mastodon	*Camelops, Mammuthus, Equus*	Riverbank	Fisk 2006
35	Chicken Ranch Slough I, City of Sacramento	V67224	mammoth	*Mammuthus columbi*	Riverbank	UCMP 2022
35	Chicken Ranch Slough II, City of Sacramento	V68141	horse	*Equus*	Riverbank	UCMP 2022
40	Arco (Sleep Train) Arena, City of Sacramento	not available	various vertebrate and plant	at least 12 taxa	Riverbank	Hilton et al. 2000

Turlock Lake Formation (Qt1) is an early- to mid-Pleistocene geologic unit corresponding to the Irvingtonian Land Mammal Age, a period not well represented in the fossil record. Since 1993, thousands of vertebrate fossils have been found in the Turlock Lake Formation, approximately 20 miles southeast of the study area at Fairmead Landfill in the City of Chowchilla (Dundas & Chatters 2013). Fossils from more than 72 taxa were found. The Madera County Fossil Discovery Center museum was built to house them. It has been reported that fossils have been discovered periodically by heavy equipment operators since the opening of the landfill (Dundas & Chatters 2013).

Fairmead Landfill fossils were found in the upper unit of the Turlock Lake Formation in a large deposit of greenish clay a half-meter thick. The discovery occurred 40 feet bgs, under approximately 30 feet of Riverbank Formation sediment, including the middle and upper unit. The fossils were found in the first 10 feet of Turlock Lake Formation sediment.

Outside of the Fairmead Landfill discovery, fossil discoveries in the Turlock Lake Formation seem to be limited. Although there is evidence that some Turlock Lake Formation fossils, including the Fairmead Landfill site, are mistakenly attributed to Riverbank Formation in UCMP (Dundas et al. 1996; Dundas & Chatters 2013), no other vertebrate fossil localities in the Turlock Lake Formation were found for this assessment. Several plant fossil localities are attributed to Turlock Lake Formation, but all are in eastern Fresno County, approximately 120 miles from the study area (UCMP 2022).

Laguna Formation is a Pliocene period formation dating from 5 to 2.6 million years ago, described in detail in Marchand and Allawart (1981). No fossil localities are attributed to Laguna Formation in UCMP (UCMP 2022). For this assessment, no other evidence was found that the Laguna Formation is fossiliferous.

6. Paleontological Significance and Sensitivity

PG&E uses definitions of significance and sensitivity based on the FLPMA as well as standards developed by agencies and professional societies, including the BLM, SVP, and the California Department of Transportation (PG&E 2015).

6.1 Definition of Significance and Significance Criteria

Significance refers to the scientific importance of fossils. PG&E (2015) considers an individual fossil specimen to be significant if it is identifiable and if it meets one of the following criteria:

- A type specimen (the individual from which a species or subspecies has been described)
- A member of a rare species
- A species that is part of a diverse assemblage (for instance, a site where more than one fossil has been discovered) and from which important information regarding life histories of individuals can be drawn
- An element different from, or more complete than, those now available for its species
- A complete specimen

More specifically, PG&E uses the following research criteria to determine whether a fossil is significant:

- Taxonomy – Fossils that represent rare or unknown taxa, such as defining a new species
- Evolution – Fossils that represent important stages in evolutionary relationships, to fill gaps or enhance under-represented intervals in the stratigraphic record
- Biostratigraphy – Fossils that are important for determining relative geologic age, or for use in stratigraphic correlation
- Paleoecology – Fossils that are important for reconstructing ancient community structure and ancient sedimentary environment
- Taphonomy – Fossils that are exceptionally well or uniquely preserved

6.2 Sensitivity Criteria

PG&E uses the PFYC developed by BLM to assess paleontological sensitivity (Table 3). In this system, geologic units are classified based on the relative abundance of scientifically significant invertebrate or plant fossils and their sensitivity to adverse impacts. It is important to note that although significant localities may occasionally occur in a geologic unit, a few widely scattered important fossils or localities do not necessarily indicate a higher class. The relative abundance of significant localities is the primary determinant for the class assignment.

Table 3. Paleontological Sensitivity of Geologic Units Using BLM Potential Fossil Yield Classification System

Class 1 – Very Low
Geologic units not likely to contain fossil remains that include: ▪ Igneous or metamorphic units ▪ Units precambrian in age or older ▪ Artificial or imported fill material
Class 2 – Low
Geologic units not likely to contain vertebrate or scientifically significant nonvertebrate fossils that include: ▪ Vertebrate or significant invertebrate or plant fossils not present or very rare ▪ Geologic units younger than 10,000 years before present ▪ Recent aeolian deposits ▪ Sediments that exhibit significant physical and chemical changes
Class 3 – Moderate or Unknown
Fossiliferous sedimentary units in which fossil content varies in significance, abundance, and occurrence, or are of unknown fossil potential. These units have the following subclassifications: ▪ Class 3a – Moderate potential: relatively low potential to impact significant fossils but high potential to impact common fossils. They generally exhibit the following characteristics: - Marine in origin with sporadic occurrences of vertebrate fossils - Vertebrate and scientifically significant invertebrate or plant fossils occur intermittently, with low predictability ▪ Class 3b – Unknown potential: sedimentary unit is poorly studied or documented but conditions suggest significant fossils could be present.
Class 4 – High
Geologic units that have a high occurrence of significant fossils that vary in occurrence and predictability. These units have the following subclassifications: ▪ Class 4a – Unit is exposed with little soil or vegetative cover or has extensive outcrop areas with exposed bedrock ▪ Class 4b – Unit is buried by extensive soil or vegetation cover. Exposed outcrops are less than contiguous 2 acres.
Class 5 – Very High
Geologic units that consistently produce scientifically significant fossils. Fossils can be reasonably expected to occur within the impacted area.
Source: Adapted from PG&E 2015.

6.3 Determination of Sensitivity for Geologic Units within Study Area

PFYC criteria from Table 3 were applied to the geologic units in the study area as summarized in Table 4. These sensitivity ratings incorporate the geologic unit description in Section 5.1 and literature and records search in Section 5.2. The ratings also incorporate the extent of proposed earth-moving activities discussed in Section 2.

Table 4. Paleontological Sensitivity of Geologic Units in Study Area

Geologic Unit	Paleontological Sensitivity – PFYC Category	Basis for Sensitivity Rating
Qha – Alluvium (Holocene)	2: low	Holocene age sediment generally is considered too young to contain scientifically significant fossils.
Qu – Alluvium/Colluvium (Holocene/ Pleistocene)	2: low	Qu sediment represents Holocene and latest Pleistocene periods. Significant fossils are occasionally found in Qu sediment. However, this geologic unit is relatively widespread at the surface in the San Joaquin Valley and no fossil localities attributed to this unit were found within 7 miles of the study area. Qu is considered to be of low sensitivity.
Qm_2 – Modesto Formation (Pleistocene)	2 to 3: low to moderate	Modesto Formation is the uppermost Pleistocene geologic unit in the study area. Significant fossils are found only occasionally in Modesto Formation as can be seen in Table 1, which shows fossils at only 8 localities with 75 miles of the study area. However, at anticipated project excavation depths of 30 feet or more, encountering the upper Riverbank Formation (below the Modesto Formation) is likely because it lies below the Modesto Formation. The Riverbank Formation has moderate sensitivity.
Qm_2e – Modesto Formation (Pleistocene)		
Qm_2f – Modesto Formation (Pleistocene)		
Qm_1 – Modesto Formation (Pleistocene)		
Qr_3 – Upper Riverbank Formation (Pleistocene)	3: moderate	Riverbank Formation has yielded significant vertebrate fossils of early Rancholabrean or late Irvingtonian age. However, no fossil localities in Riverbank Formation were found for this assessment within 7 miles of the study area. Overall, scientifically significant fossils occur in this formation intermittently and with low predictability outside of major river channels. The Riverbank Formation is determined to have moderate sensitivity.
Qr_3f – Upper Riverbank Formation (Pleistocene)		
Qr_2f – Middle Riverbank Formation (Pleistocene)		
Qr_2 – Lower Riverbank Formation (Pleistocene)		
Qt_1 – Turlock Lake Formation (Pleistocene)	3: moderate	As discussed in Section 5.2, a significant Irvingtonian Land Mammal Age fossil discovery occurred approximately 20 miles southeast of the study area at Fairmead Landfill. However, evidence for other vertebrate fossil localities in this formation is limited. Several plant fossil localities from this formation were found, but they are all approximately 120 miles from the study area. Turlock Lake Formation has yielded occasional fossils with predictability. At project excavation depths, this formation is determined to have moderate paleontological sensitivity in the study area.
Tl – Laguna Formation (Pliocene)	2: low	As discussed in Section 5.2, this formation is not known to be fossiliferous. Accordingly, sensitivity is determined to be low.

7. Findings and Recommendations

7.1 Findings

Attachment 2, Paleontological Sensitivity Map, is based on Table 4 and shows the paleontological sensitivity of geologic units underlying proposed transmission alignments and substations. From Attachment 2 and Table 4, the following conclusions can be made:

- The LEU portion of the project, and the PG&E portion of the project when west of PG&E Lockeford Substation, except for PG&E transmission line structures W1, W2, W7, and W9, would be constructed on sediment that has been determined to have low to moderate paleontological sensitivity, with moderate sensitivity beginning at an approximate depth of 30 feet.
- The expanded PG&E Lockeford Substation, PG&E transmission line structures W1, W2, W7, and W9, and the majority of new PG&E transmission lines east of PG&E Lockeford Substation, would be constructed on sediment with moderate paleontological sensitivity. These PG&E portions of the project are located where Riverbank formation occurs at the surface.
- East of PG&E Lockeford Substation, two PG&E transmission line structures (E5 and E19) are mapped as being located on sediment with low paleontological sensitivity.
- None of the proposed project features would be constructed on geologic units of high paleontological sensitivity according to surface mapping.

However, because there is potential to encounter geologic units of greater sensitivity at depth and also potential – although relatively low – for unanticipated fossil discovery in geologic units determined to be of low to moderate sensitivity, EPMs described in the following sections, are recommended.

7.2 Recommendations

The following EPMs are recommended for ground-disturbing activities greater than 3 feet bgs. No measures are recommended in soil or sediment that is imported or previously disturbed. No measures are recommended for drilling/augering excavation with a drill that is 3 feet or less in diameter.

EPM PAL–1a: Retain a PG&E Qualified Paleontological Principal Investigator. A PG&E Paleontological Principal Investigator who meets the standards set forth by the Society of Vertebrate Paleontology will be retained to ensure that all EPMs related to paleontological resources are properly implemented. The Paleontological Principal Investigator will have a master's degree or Ph.D. in geology or paleontology, have knowledge of the local paleontology, and be familiar with paleontological procedures and techniques. Qualifications of PG&E's Paleontological Principal Investigator will be confirmed by the CPUC prior to retention.

EPM PAL–1b: Retain an LEU Qualified Paleontological Principal Investigator. An LEU Paleontological Principal Investigator who meets the standards set forth by the Society of Vertebrate Paleontology will be retained to ensure that all EPMs related to paleontological resources are properly implemented. The Paleontological Principal Investigator will have a master's degree or Ph.D. in geology or paleontology, have knowledge of the local paleontology, and be familiar with paleontological procedures and techniques.

EPM PAL–2a: PG&E Workers Environmental Awareness Training. Training on paleontological resources protection will be administered for excavation deeper than 3 feet bgs at all PG&E work locations. It may be provided by the PG&E project Paleontologist or Archaeologist as a stand-alone training or it may be included as part of the overall environmental awareness training as required by the project.

The training will include the following:

- The types of fossils that could occur at the project site
- The types of lithologies in which the fossils could be preserved

- The procedures that should be taken in the event of a fossil discovery
- Penalties for disturbing paleontological resources

EPM PAL–2b: LEU Workers Environmental Awareness Training. Training on paleontological resources protection will be administered for excavation deeper than 3 feet bgs at all LEU work locations. It may be provided by the LEU project Paleontologist or Archaeologist as a stand-alone training or it may be included as part of the overall environmental awareness training as required by the project.

The training will include the following:

- The types of fossils that could occur at the project site
- The types of lithologies in which the fossils could be preserved
- The procedures that should be taken in the event of a fossil discovery
- Penalties for disturbing paleontological resources

EPM PAL-3a: Paleontological Resource Monitoring for Select PG&E Construction Activities. A paleontological monitor will be present to monitor for paleontological resources in areas where Riverbank formation occurs at the surface and excavation is greater than 3 feet deep and, for excavations involving drilling or augering, uses a drill diameter that is larger than 3 feet. The paleontological monitor will be able to: (1) recognize fossils and paleontological deposits, and deposits that may be paleontologically sensitive; (2) take accurate and detailed field notes, photographs, and locality coordinates; and (3) document project-related ground-disturbing activities, their locations, and other relevant information, including a photographic record.

EPM PAL–4a: PG&E Unanticipated Paleontological Discovery. If significant paleontological resources are discovered during PG&E's construction activities, the following procedures will be followed:

- Stop work immediately within 100 feet of the fossil find.
- Contact the designated project inspector and Cultural Resource Specialist (CRS) immediately.
- Protect the site from further impacts, including looting, erosion, or other human or natural damage.
- Arrange for a PG&E Paleontological Principal Investigator to evaluate the discovery. If the discovery is determined to be significant, PG&E will implement measures to protect and document the paleontological resource. Work may not resume within 100 feet of the find until approved by the paleontologist and CRS.
- Curate all fossils discovered in an appropriate repository.
- A qualified paleontologist will be notified to review the need for paleontological monitoring during subsequent ground-disturbing activities with the potential to affect paleontologically sensitive sediments at that location. The qualified paleontologist will be responsible for the reassessment of paleontological sensitivity upon the receipt of additional information from ongoing excavations, which may result in reducing or increasing the amount of monitoring required.

EPM PAL–4b: LEU Unanticipated Paleontological Discovery. If significant paleontological resources are discovered during LEU's construction activities, the following procedures will be followed:

- Stop work immediately within 100 feet of the fossil find.
- Contact the designated project inspector and LEU Cultural Resource Lead immediately.
- Protect the site from further impacts, including looting, erosion, or other human or natural damage.
- Arrange for an LEU Paleontological Principal Investigator to evaluate the discovery. If the discovery is determined to be significant, LEU will implement measures to protect and document the paleontological resource. Work may not resume within 100 feet of the find until approved by the paleontologist and LEU Cultural Resource Lead.

- Curate all fossils discovered in an appropriate repository.
- A qualified paleontologist will be notified to review the need for paleontological monitoring during subsequent ground-disturbing activities with the potential to affect paleontologically sensitive sediments at that location. The qualified paleontologist will be responsible for the reassessment of paleontological sensitivity upon the receipt of additional information from ongoing excavations, which may result in reducing or increasing the amount of monitoring required.

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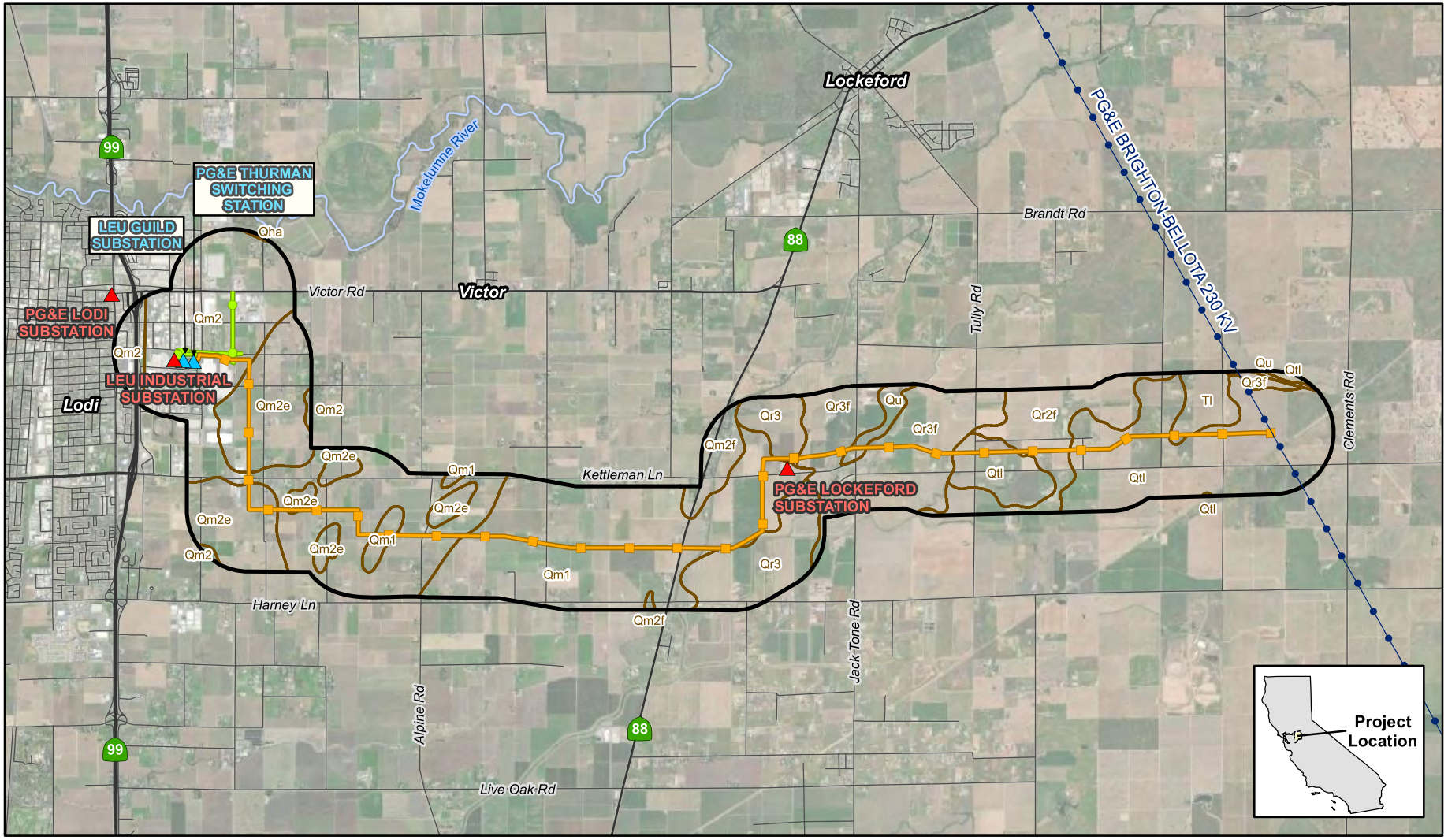

Legend

- Exsting Substation
- New Substation/ Switching Station
- PG&E New 230 kV Transmission Line
- Existing PG&E 60 kV Power Line Modification
- Existing PG&E 230 kV Transmission Line
- 0.5-mile Radius Around Project Components
- Geologic Unit*

Source: Marchand and Atwater, 1979; Marchand and Bartow, 1979

*Geologic Units
Qha – alluvium (Holocene)
Qu – alluvium/colluvium (Holocene/Pleistocene)
Qm2 – Modesto Formation – upper (Pleistocene)
Qm2e – Modesto Formation – upper (Pleistocene)
Qm2f – Modesto Formation – upper (Pleistocene)
Qm1 – Modesto Formation – lower (Pleistocene)
Qr2 – Riverbank Formation – middle (Pleistocene)
Qr2f – Riverbank Formation – middle (Pleistocene)
Qr3 – Riverbank Formation – upper (Pleistocene)
Qr3f – Riverbank Formation – upper (Pleistocene)
Qtl – Turlock Lake Formation (Pleistocene)
Tl – Laguna Formation (Pliocene)

N

0 0.5 1 2
Miles

Figure 1
Geologic Units
Northern San Joaquin 230 kV Transmission Project

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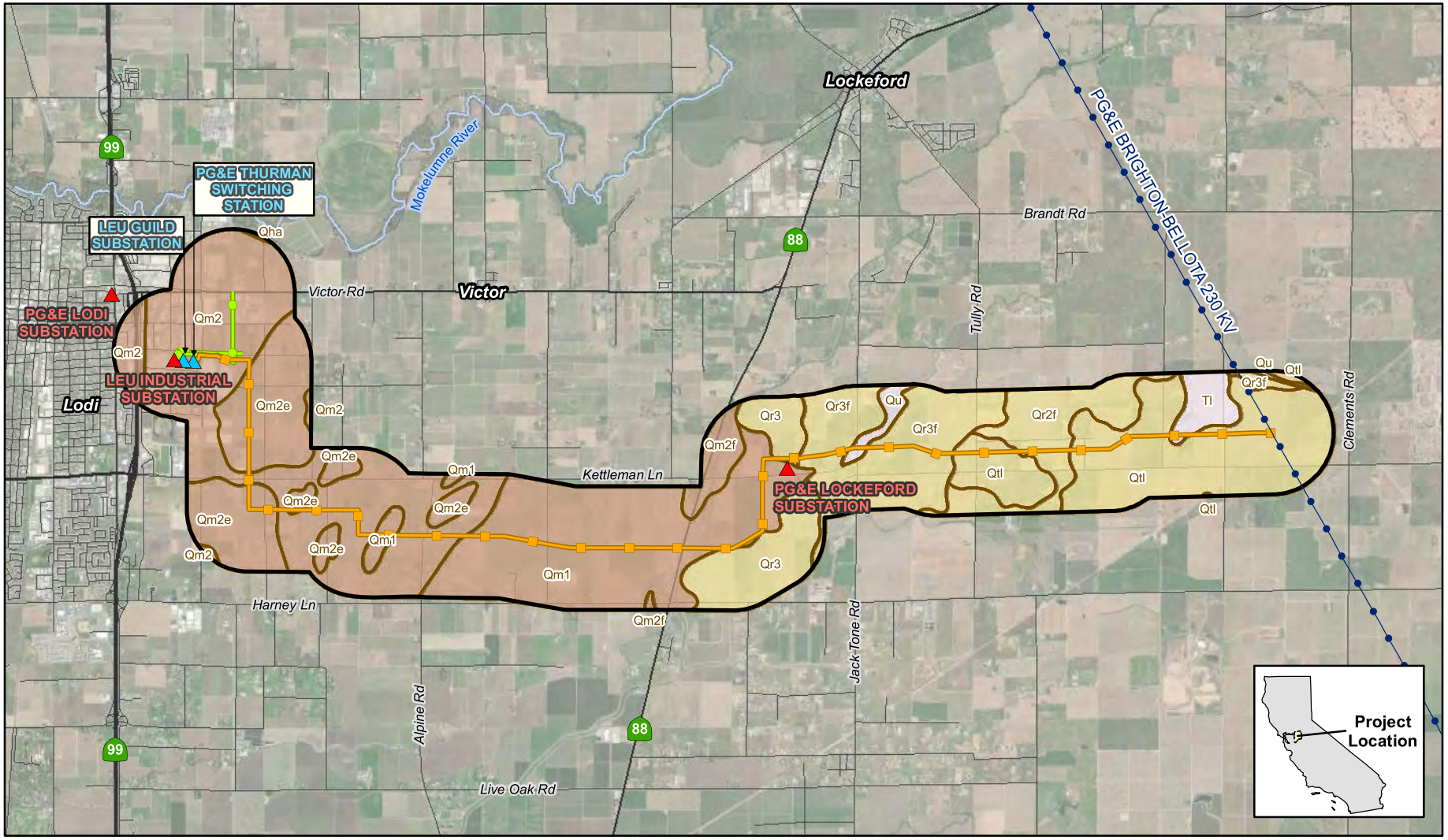

Legend

- Exsting Substation
- New Substation/ Switching Station
- PG&E New 230 kV Transmission Line
- Existing PG&E 60 kV Power Line Modification
- Existing PG&E 230 kV Transmission Line
- 0.5-mile Radius Around Project Components

Paleontological Sensitivity

- Moderate
- Low to Moderate
- Low

Source: Marchand and Atwater, 1979; Marchand and Bartow, 1979

*Geologic Units
Qha – alluvium (Holocene)
Qu – alluvium/colluvium (Holocene/Pleistocene)
Qm2 – Modesto Formation – upper (Pleistocene)
Qm2e – Modesto Formation – upper (Pleistocene)
Qm2f – Modesto Formation – upper (Pleistocene)
Qm1 – Modesto Formation – lower (Pleistocene)
Qr2 – Riverbank Formation – middle (Pleistocene)
Qr2f – Riverbank Formation – middle (Pleistocene)
Qr3 – Riverbank Formation – upper (Pleistocene)
Qr3f – Riverbank Formation – upper (Pleistocene)
Qtl – Turlock Lake Formation (Pleistocene)
Tl – Laguna Formation (Pliocene)

N

0 0.5 1 2
Miles

Figure 2
Paleontological Sensitivity
Northern San Joaquin 230 kV Transmission Project

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