3.12 PALEONTOLOGICAL RESOURCES

3.12.1 Definitions

Paleontological resources—or fossils—are the remains of ancient plants and animals that can provide scientifically significant information about the history of life on earth. Paleontological "sensitivity" is defined as the potential for a geologic unit to produce scientifically significant fossils. This sensitivity is determined by rock type, history of the geologic unit in producing significant fossils, and fossil localities that are recorded from that unit. Paleontological sensitivity is assigned based on fossil data collected from the entire geologic unit, not just at a specific site. Paleontological sensitivity ratings are described as follows:

- **High Sensitivity.** Indicates fossils are currently observed on site, localities are recorded within the study area, and/or the unit has a history of producing numerous significant fossil remains.
- **Moderate Sensitivity.** Fossils within the unit are generally not unique, or are so poorly preserved as to have only moderate scientific significance.
- **Low Sensitivity.** Indicates significant fossils are not likely to be found because of a random fossil distribution pattern, extreme youth of the rock unit, and/or the method of rock formation, such as alteration by heat and pressure.
- **Marginal Sensitivity.** Indicates the limited probability of the geologic unit composed of either pyroclastic or metasedimentary rocks conducive to the existence and/or preservation of fossils.
- **Zero Sensitivity.** Origin of the geologic unit renders it not conducive to the existence of organisms and/or preservation of fossils, such as high-grade metamorphic rocks, intrusive igneous rocks, and most volcanic rocks.
- **Indeterminate Sensitivity.** Unknown or undetermined sensitivity indicates that the geologic unit has not been sufficiently studied, or lacks good exposures to warrant a definitive rating. An experienced, professional paleontologist can often determine whether the stratigraphic unit should be categorized as having high or low sensitivity after reconnaissance surveys, including observations of road cuts, stream banks, and possible subsurface testing, such as augering or trenching.

Paleontological resources are non-renewable because they are the remains of prehistoric animal and plant life.

3.12.2 Data Collection

Literature Review and Records Search

A paleontological resource inventory report was previously prepared for the proposed project in 2011 (PaleoResource Consultants 2011). The findings in this report were based on the compilation, synthesis, and review of available published and unpublished literature, geologic maps, and two records searches of the University of California Museum of Paleontology on June 24, 2011 and August 17, 2015.

Surveys

PG&E contractors, PaleoResource Consultants and F&F GeoResource Associates, Inc., performed two field surveys to document (1) the presence of sediments suitable for containing fossil remains in project study area, and (2) the presence of any previously unrecorded fossil sites (PaleoResource Consultants and F&F GeoResource Associates, Inc. 2015). The surveys were performed on November 8 and 9, 2012, and August 16 through 20, 2015. The surveys included visual inspection of exposures of potentially fossiliferous strata in the project area. David Haasl, PhD joined the survey team on August 20, 2015, to resolve stratigraphic questions and review the results of the survey.

3.12.3 Environmental Setting

Literature Review and Records Search Results

Neither records search reported any known fossil localities in the project area; however, the records search and supplemental literature review revealed 166 known fossil localities in Sonoma County. The clear majority of these localities were produced by the Wilson Grove and Petaluma Formations, marine geologic formations exposed elsewhere in Sonoma County and not found near the project study area. Ten vertebrate localities were produced by older alluvial fan deposits, and nine plant localities were produced within the sedimentary strata of the greater Sonoma Volcanics. A description of the Sonoma Volcanics is provided below.

Survey Results

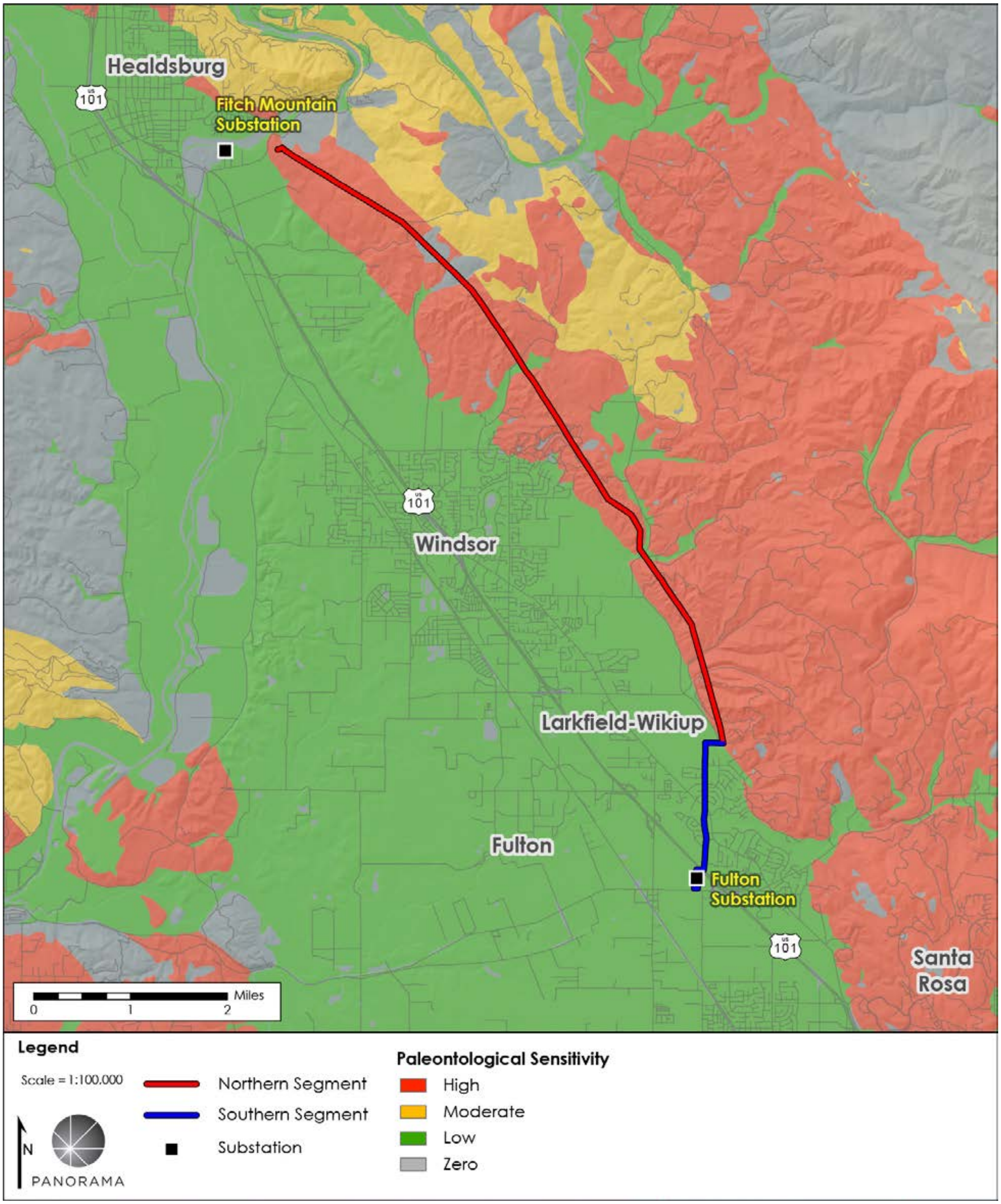
The 2012 field survey found that the geologic units in the project study area are consistent with the geologic maps. Based on the rock exposures observed in the proposed project area, five geologic units were found within the project study area, and a sixth unit was found within 300 feet of the proposed project.

Project Area Geologic Units and Associated Paleontological Sensitivity

The proposed project would be located primarily on Tertiary- and Quaternary-age sedimentary and volcanic rocks. These rocks overlay older sedimentary and metamorphic rocks in a structurally complex area with numerous active and inactive faults. The high temperature and pressure conditions associated with the formation of plutonic (i.e., igneous) rocks are responsible for the absence of fossils in volcanic formations. On the contrary, sedimentary rocks, formed by the deposition and subsequent cementation of sediments, tend to have a high sensitivity for paleontological resources.

Identifying the geologic units and associated fossil productivity allows for prediction of where fossils could or could not be encountered within the project study area. Figure 3.12-1 shows paleontological sensitivity in the project study area. The paleontological sensitivity of geologic units that underlay the proposed project area is shown in Table 3.12-1. A description of each geologic unit is provided below.

Figure 3.12-1 Paleontological Sensitivity of the Project Area



Sources: (Ludington, et al. 2005)

Table 3.12-1 Paleontological Sensitivity of Geologic Units that Underlay the Proposed Project

Segment	Geologic Formation	Paleontological Sensitivity
Southern Segment	Alluvial Fan and Fluvial Deposits	Low
Northern Segment	Sonoma Volcanics	High
	Glen Ellen Formation	High
	Older Alluvial Fan Deposits	High
	Great Valley Sequence (within 300 feet of the Northern Segment)	Moderate
	Alluvial Fan and Fluvial Deposits	Low
	Landslide Deposits	Zero
Fitch Mountain Substation	Alluvial Fan and Fluvial Deposits	Low

Sources: (Ludington, et al. 2005)

Great Valley Sequence (Undivided)

The Great Valley Sequence is composed of interbedded[1] sandstones, mudstones and shales originally deposited on a submarine fan along the continental margin (Graymer, Jones and Brabb 2002). In the project study area, the Great Valley Sequence consists of Upper Jurassic to Lower Cretaceous marine sandstones and mudstones (Fox 1983, Blake, Graymer and Stamski 2002, Delattre 2011). This unit is not exposed at the surface in the proposed project area, but does appear at the surface less than 300 feet from the proposed project area and could be present at an unknown depth underneath the Sonoma Volcanics.

Concretionary carbonate interbeds within this unit have produced invertebrate fossils, including *Buchia*, belemnites, and radiolarians (Delattre 2011). No vertebrate fossils have been reported from the Great Valley Sequence in Sonoma County; however, Jurassic marine reptile and dinosaur fossils have been reported from Great Valley geologic units on the western side of the Sacramento Valley and in Shasta County (Hilton 2003), and Late Cretaceous marine reptile fossils have been collected from the Great Valley Sequence south of the Bay Area. The Cretaceous Great Valley Sequence has a moderate paleontological sensitivity due to its production of marine invertebrate and vertebrate fossils elsewhere in the Bay Area and Sacramento Valley.

Sonoma Volcanics

The Sonoma Volcanics, interpreted to be Miocene to Pliocene in age (Delattre 2011), are widely distributed throughout Sonoma and Napa Counties. The Sonoma Volcanics are thought to have

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[1] Interbedding occurs when beds (i.e., layers) of rock alternate with beds of a different lithology.

formed as part of a northward series of volcanic centers related to initiation of the San Andreas Fault system (Fox, Fleck, et al. 1985). The Sonoma Volcanics include tuff, obsidian, lava flows, pyroclastic breccia, and mud flows, which range in composition from rhyolite to basalt, along with interbedded volcaniclastic sedimentary rocks. Andesitic and basaltic flows form the most prominent outcrops of the Sonoma Volcanics because of their hard, erosionally resistant qualities (Gealey 1951). Lava flows make up more than 60 percent of the entire sequence (Weaver 1949).

While the lavas of the Sonoma Volcanics are not paleontologically sensitive, the sedimentary strata in the Sonoma Volcanics have a high paleontological sensitivity due to previously recorded plant and animal fossils found within the unit. The volcaniclastic sedimentary units and some of the tuffs have produced highly significant plant fossils (Axelrod 1944, Axelrod 1950), including a petrified forest near Calistoga (Axelrod 1944, Dorf 1930, Fisk, Erwin and Elder 2013). Other fossils found within the Sonoma Volcanics include snails and clams (Kunkel and Upson 1960), horse (Fisk, Erwin and Elder 2013, Woodburne 1966), 21 taxa of silicified chrysophycean algal cysts (Zeeb, Smol and VanLandingham 1996), and palynomorphs (pollen, spores, algal cysts, and dinoflagellates) (Fisk, Erwin and Elder 2013).

Glen Ellen Formation

The Glen Ellen Formation and equivalents (i.e., geologic formations of similar composition and origin) are composed of a heterogeneous mixture of partially cemented, interstratified, buff to yellowish-brown clay, silt, sand, and gravel (Sweetkind, et al. 2010, Wagner and Bortugno 1982, McLaughlin, et al. 2004, Delattre 2011). The Glen Ellen Formation is Plio-Pleistocene in age (Gealey 1951) based on stratigraphic relationships with other stratigraphic units of Pliocene and Pleistocene age (Cardwell 1958). These deposits are largely fluvial in origin and consist of beds and lenses of alluvial fan and piedmont deposits interbedded with conglomerate and silicic tuffs (Cardwell 1958). Obsidian pebbles are characteristic of this unit (Allen 2003, Delattre, Wagner, et al. 2007, Ford 1975, Fox 1983, Jackson 1989).

The Glen Ellen Formation has not produced fossils from the proposed project area, but has produced fossils elsewhere in Sonoma County. Several horse teeth have been temporarily assigned to the Glen Ellen Formation and instead may be from the overlying older alluvial fan deposits. Other studies have indicated the Glen Ellen Formation contains diatoms, sponge spicules, freshwater mollusks (McLaughlin, et al. 2004), and clam shells (Cardwell 1958). The Glen Ellen Formation has a high paleontological sensitivity because it has produced fossils elsewhere in Sonoma County, and because sedimentary facies conducive to the production of fossils were observed during field surveys.

Older Alluvial Fan Deposits

Older alluvial fan deposits are likely late Pleistocene in age. Where exposed, older alluvial fan deposits consist principally of alluvium and likely include some terrace deposits and old valley fill. Clasts (i.e., fragments of rock broken off by physical weathering) include silicic to intermediate volcanics, obsidian, varicolored chert, graywacke, quartzite, quartz, charcoal, and petrified wood (Blake, Graymer and Stamski 2002). The older alluvial fan deposits within the project study area were previously mapped as Glen Ellen Formation (Blake, Smith, et al. 1971) but have been reclassified because (1) they are much less deformed than the Glen Ellen Formation, (2) they are not as lithified as sediments in the Glen Ellen Formation, and (3) they lack the tuffaceous sediments that are widespread in much of the Glen Ellen Formation (Blake, Graymer and Stamski 2002).

Numerous Pleistocene vertebrate fossil localities have been reported from the older alluvial fan deposits within Sonoma County (Hay 1927, Savage 1951, Jefferson 1991). Vertebrates found within this formation include turtle, horse, ground sloth, bison, mastodon, and deer. Older alluvial fan deposits have a high paleontological sensitivity due to the presence of vertebrate fossils localities in Sonoma County.

Alluvial Fan and Fluvial Deposits
Alluvial fan and fluvial deposits are a relatively young formation, latest Pleistocene to Holocene in age. This formation is composed of interbedded deposits of unconsolidated gravel, sand, silt, clay, and peat (Kunkel and Upson 1960). Although similar in composition to the older alluvial fan deposits, the younger alluvial fan deposits can be recognized as distinct deposits on the basis of the degree of consolidation, cementation, and geomorphic expression. The younger alluvial deposits underlie modern stream channels and form flood plains on the valley floor in broader valleys. Younger alluvium is relatively thin, generally less than 30 feet thick (Kunkel and Upson 1960). The younger alluvial fan and fluvial deposits have a low paleontological sensitivity because they are not known to have produced fossils in the past and consist of sediments too young to produce fossils.

Landslide Deposits
Within the project study area, the Quaternary landslide deposits consist of poorly sorted clay, silt, sand, gravel, and boulders. These deposits are not paleontologically sensitive because of their young age and because any fossils they may contain would be displaced.

Unique Geologic Features
The proposed project is not located near or within a unique geologic feature.

3.12.4 Impact Analysis

Summary of Impacts
Table 3.12-2 presents a summary of the CEQA significance criteria and impacts on paleontological resources that would occur during construction, operation, and maintenance of the proposed project.

Table 3.12-2 Summary of Proposed Project Impacts on Paleontological Resources

Would the proposed project:	Potentially Significant Impact	Less than Significant Impact with Mitigation Incorporated	Less than Significant Impact	No Impact
a) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	☐	☒	☐	☐

Impact Discussion

a) Would the proposed project directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	**Significance Determination**
	Less than significant with mitigation

Construction

Impacts on paleontological resources may occur as a result of ground-disturbing activities. Ground-disturbing activities that could damage fossils include removal of existing poles and structures, excavation for pole foundations, and grading or blading. These activities could result in the physical destruction of unique fossil localities, which would constitute a significant impact.

There would be no impact on unique geologic features during construction because none exist in the proposed project area.

Southern Segment

Ground disturbance would occur at one location along the Southern Segment of the proposed project. One pole would be replaced adjacent to Fulton Substation, requiring the removal of the existing structure and excavation for the new pole foundation. As shown in Table 3.12-1 and on Figure 3.12-1, the Southern Segment would be located entirely on younger alluvial fan and fluvial deposits, which have a low paleontological sensitivity because they consist of sediments too young to produce fossils. Ground-disturbing activities are not likely to encounter or damage significant fossils; therefore, impacts on paleontological resources would be less than significant.

Northern Segment

In the Northern Segment, construction would occur almost entirely within geologic units with moderate to high paleontological sensitivity (Sonoma Volcanics, Glen Ellen Formation, older alluvial fan deposits, and Great Valley Sequence [within 300 feet of the Northern Segment]; refer to Figure 3.12-1 and Table 3.12-1). Ground-disturbing activities that could damage fossils would involve removal of existing structures and poles, excavation for pole foundations, and grading of access roads. While there are no known paleontological resources within the proposed project area, paleontological resources could be encountered and damaged during excavation and ground disturbance in areas with high paleontological sensitivity. Damage to previously undiscovered, unique paleontological resources from construction activities would be a significant impact.

~~SD~~PG&E has proposed APMs PAL-1, PAL-2, PAL-3, and PAL-4 to reduce impacts on paleontological resources. APM PAL-1 would require PG&E to halt construction and evaluate any discovered resources. APM PAL-2 requires all construction personnel to receive training on how to identify fossil remains, the types of geologic units that fossil remains may be found within, and the procedures to follow should a paleontological resource be discovered. APM PAL-3 would require monitoring of pole hole excavation within geologic units of high paleontological sensitivity. PG&E would also notify appropriate personnel and develop a recovery strategy for any newly discovered paleontological resources per APM PAL-4. The APMs do not fully mitigate impacts on paleontological resources because they do not require monitoring of all ground-disturbing activities that could disturb paleontological resources and do not specify measures to protect or document any discovered paleontological resources. APM PAL-3 is superseded by MM Paleontology-1, which requires paleontological monitoring for all construction activities that involve cutting of previously undisturbed soils within geologic units with moderate to high paleontological sensitivity. APMs PAL-1 and PAL-4 are superseded by MM Paleontology-2, which requires PG&E to stop work around a discovered resource, evaluate the resource, and, if the resource is unique, mitigate impacts through preservation in place or recovery and submit a report on recovered resources. Impacts on discoveries of paleontological resources would be less than significant with implementation of MM Paleontology-1 and MM Paleontology-2.

Fitch Mountain Substation

Construction at the Fitch Mountain Substation would involve replacing the existing control building and conductor support structures within the existing gravel-covered footprint. New dead-end structures would require foundations composed of concrete drilled shafts that would be approximately 3 to 4 feet in diameter and of varying depth, depending on geotechnical parameters that would be determined prior to construction. Fitch Mountain Substation is located in an area with zero to low paleontological sensitivity. Significant fossils are not likely to be encountered or damaged by ground-disturbing activities; therefore, impacts on paleontological resources would be less than significant.

Operation and Maintenance

Operation and maintenance activities associated with the proposed project would be conducted in areas that would be disturbed during project construction. Operation and maintenance activities would not differ from those currently conducted for the existing power line. The potential to encounter and impact paleontological resources from project operation and maintenance would therefore not differ from existing conditions. No impact would occur.

There would be no impact on unique geologic features during operation and maintenance because none exist in the proposed project area.

Required APMs and MMs: APM PAL-2, MM Paleontology-1, and MM Paleontology-2

3.12.5 Required Applicant Proposed Measures and Mitigation Measures

APM PAL-2: Worker Environmental Awareness Training

PG&E shall provide environmental awareness training on the recognition and protection of paleontological resources to project personnel. Training shall be required for all personnel before construction commences and repeated for all new personnel before they begin work on the proposed project. This training may be administered by the CPUC-approved, qualified Principal Paleontologist as a stand-alone training or included as part of the overall environmental awareness training as required by the project. The training will include at minimum, the following:

- Types of fossils that could occur at the project site.
- Types of lithologies in which the fossils could be preserved.
- Procedures that should be followed in the event of a fossil discovery.
- Penalties for disturbing paleontological resources.

The training materials shall be submitted to the CPUC for approval at least 30 days prior to the start of construction.

Applicable Locations: N/A

Performance Standards and Timing:

- **Before Construction:** The training program materials are submitted to the CPUC 30 days prior to construction
- **During Construction:** All project personnel undergo the training
- **After Construction:** N/A

MM Paleontology-1: Paleontological Monitoring (Supersedes APM PAL-3)

Paleontological monitoring shall be required for all construction that involves cutting of previously undisturbed soils within geologic units with moderate to high paleontological sensitivity, as identified in Table 3.12-1. Paleontological monitoring shall be conducted by qualified paleontological monitors under the direction of a CPUC-approved, qualified paleontologist. The qualified paleontologist shall have a Master's or PhD in geology or paleontology, have knowledge of the local paleontology, and be familiar with paleontological procedures and techniques. Paleontological monitors shall have experience in the collection and salvage of fossil remains. At a minimum, spot-check monitoring shall occur during pole hole augering more than 3 feet in diameter (limited to TSPs) within qualifying geologic units until the maximum depth has been reached. The tailings from such pole hole augering shall be temporarily preserved in place until the paleontological monitor can inspect them for presence of paleontological resources.

Full-time monitoring shall be required during grading activities that are greater than 6 inches in depth in previously undisturbed areas, and greater than 2 feet in depth in previously disturbed areas (i.e., historically disked areas, etc.), or beyond the known depth of disturbance, in qualifying geologic units. If no paleontological resources are found after at least 50 percent of qualifying grading is completed at a work site, then full-time monitoring shall be reduced to spot-check monitoring at the discretion of the paleontologist with notification to the proponent's specialists and the CPUC.

If a potential paleontological resource is identified when the monitor is not present, the monitor shall be contacted immediately and work shall temporarily stop in the immediate area until the potential resource can be evaluated by the monitor per provisions in MM Paleontology-2.

Monitoring activities shall be documented in monitoring logs and reports, which shall include the activities observed, geology encountered, description of any paleontological resources encountered, and measures taken to protect or salvage discovered resources. Photographs and other supplemental information shall be included as necessary.

Applicable Locations: Qualifying excavation within geologic units that have a moderate or high paleontological sensitivity

Performance Standards and Timing:

- **Before Construction:** N/A
- **During Construction:** (1) Construction activities are monitored where qualifying excavation occurs, and (2) Monitoring activities are documented and reported adequately
- **After Construction:** N/A

MM Paleontology-2: Previously Undiscovered Paleontological Resources (Supersedes APM PAL-1 and APM PAL-4)

In the event that a previously undiscovered paleontological resource is uncovered during project implementation, all ground-disturbing work within 50 feet of the discovery shall be halted and the paleontological resource specialist shall be immediately notified. A CPUC-approved, qualified paleontologist shall inspect the discovery and determine whether further investigation is required. If the discovery can be avoided and no further impacts will occur, no further effort shall be required. If the resource cannot be avoided and may be subject to further impact, the qualified paleontologist shall evaluate the resource and determine whether it meets the definition of "unique" under CEQA, Appendix G, Part V. If the resource is determined to be unique, a determination and associated plan for protection of the resource shall be provided to CPUC for review and approval. If the resource is determined not to be unique, work may commence in the area.

If the resource is determined to be a unique paleontological resource, work shall remain halted, and the qualified paleontologist shall consult with PG&E staff, CPUC staff, and the landowner regarding methods to ensure that no substantial adverse change would occur to the significance of the resource pursuant to CEQA. Preservation in place (i.e., avoidance) is the preferred method of mitigation for impacts on paleontological resources and shall be required unless there are other equally effective methods. Other methods may be used but must ensure that the fossils are recovered, prepared, identified, catalogued, and analyzed according to current professional standards under the direction of the CPUC-approved, qualified paleontologist. All recovered fossils shall be curated at an accredited and permanent scientific institution according to the 2010 Society of Vertebrate Paleontology standard guidelines, or as relevant at the time of project implementation. Work may commence upon completion of treatment, as approved by CPUC.

If a unique paleontological resource is discovered, a final summary report shall be completed and submitted to the CPUC. This report shall include discussions of the methods used, stratigraphy exposed, fossils collected, and significance of recovered fossils. The report shall also include an itemized inventory of all collected and catalogued fossil specimens.

Applicable Locations: All project areas

Performance Standards and Timing:

- **Before Construction:** N/A
- **During Construction:** (1) Activities within 50 feet of a discovery halts and the qualified paleontologist is notified, (2) Resources are evaluated by the qualified paleontologist if they cannot be avoided, (3) Unique resources are preserved in place or treated appropriately, (4) Recovered fossils are curated appropriately, (5) Work does not resume within 50 feet of a discovery until authorized by CPUC, and (6) A final summary report is submitted to CPUC
- **After Construction:** N/A

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