



## TECHNICAL MEMORANDUM

TO: Brianna Pilkinton, Senior Environmental Scientist  
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FROM: Nancy E. Sikes, Ph.D.

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SUBJECT: Paleontology Setting for Panoche Valley Solar Project Telecommunications Services  
Fresno and San Benito Counties, CA

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### PALEONTOLOGICAL SETTING

The project area is located in the southern Coast Ranges and the western San Joaquin Valley. The Coast Ranges geomorphic province includes many separate ranges, mountain masses, and structural valleys, comprised mainly of marine sedimentary geologic formations (Norris and Webb 1990). The Diablo Range is the easternmost ridge of the Coast Ranges and includes the Call Mountains. Panoche Valley is bounded to the north by the Aguilas Mountains and to the east and south by the low-lying foothills of the Diablo Range, known as the Panoche, Tumey and Griswold Hills. Panoche Mountain is located in the Panoche Hills to the northeast of Panoche Valley. To the east at the base of the foothills and at the western edge of the San Joaquin Valley is the gently inclined Panoche alluvial fan. The topography of the floor of the Panoche Valley and of the portion of the project area in the San Joaquin Valley is relatively level. The elevation ranges from approximately 50 feet above mean sea level (amsl) at the Helm Substation and 520 feet amsl along the transmission line ROW in the San Joaquin Valley to 1,300 feet amsl in the Panoche Valley, 2,097 feet amsl on Panoche Mountain, and 3,840 feet amsl on Call Mountain.

The portion of the project located in the Panoche Valley is underlain by Quaternary Alluvium (Qa) of Holocene (Recent) age (less than 11,000 years old) (Dibblee 2007a). These Recent sediments are, by definition, considered too young to contain fossils and none have been recorded in this portion of the project area (John Minch and Associates [JMA] 2010).

Geologic maps indicate the Tulare Formation (QTt) underlies the belt of low foothills along the northeast and southeast borders of the Panoche Valley, and also forms the edge of the alluvial fan along the western edge of the San Joaquin Valley north and south of Panoche Creek (Dibblee and Minch 2007a, 2007b, 2007c). The formation is crossed by the transmission line ROW in Sections 19, 20 and 21 of T15S, R11E as it heads east from the Panoche Valley. Of Plio-Pleistocene age, the Tulare Formation was deposited as alluvial fans in the Panoche Valley area and as alluvial fan, freshwater lake, and marsh sediments in other parts of the San Joaquin Valley (Dibblee 1971; Dibblee and Minch 2007a, 2007b, 2007c; Woodring et. al. 1940). The rock unit is a sequence of interbedded sandstone,

conglomeratic sandstone, conglomerate, and siltstone deposited during the late Pliocene to middle Pleistocene (4.0 to 1.5 million years ago). This formation is known to contain highly significant vertebrate fossils, including horse, mammoth, saber-toothed cat, deer, and camel, and is considered to have a high paleontological potential. Through much of the San Joaquin Valley the Tulare Formation is generally found at depth below the Riverbank Formation (Lettis and Unruh 1991), but along the margins of the Coast Ranges uplift has brought the formation to the surface.

East of the Panoche Valley, the Panoche, Tumey and Griswold Hills are underlain by the Panoche Formation (Kp, Kps, Kps-jr), comprised of marine sedimentary rocks primarily of Cretaceous age (65 million years) (Dibblee and Minch 2007b, 2007c). The rock unit is a sequence of clay shale, claystone, or sandstone. This formation is crossed by the transmission line ROW as it heads east into Fresno County in Sections 21, 22, 23, 24 and 18 of T15S, R12E. The Panoche Formation (Kp) also underlies the Call Mountain and Panoche Mountain microwave tower sites (Dibblee and Minch 2007d, 2007e). Gastropods have been recorded at three localities in the Panoche Formation in Fresno and Merced Counties. This formation is considered to have a low paleontological potential.

As the transmission line ROW advances from the Panoche Valley to the San Joaquin Valley, it also crosses through the Panoche Creek drainage. Surface geology in the drainage is mainly Holocene alluvial sediments (Qa) with some gravels (Qg) and landslide debris (Qls) (Dibblee and Minch 2007a, 2007b, 2007c). This Recent alluvium is less than 11,000 years old and considered too young to contain fossils. Outcroppings of older surficial sediments of late Pleistocene age also interfinger along the transmission line ROW across the southern base of the Panoche Hills (Dibblee and Minch 2007b, 2007c). This Older Alluvium (Qoa) was deposited between the middle to late Pleistocene (roughly 500,000 to 50,000 years ago) and is generally dissected by recent streams. This rock unit is known to contain significant fossils elsewhere in California, principally southern California, including extinct vertebrate taxa (mammoths, mastodons, ground sloths, dire wolves, short-faced bears, saber-toothed cats, large and small horses, large and small camels, and bison) and has therefore been assigned a moderate paleontologic sensitivity for the project area (JMA 2010). The Older Alluvium may have been exposed by streams between the ridges at the base of the hills where it may be difficult to distinguish from younger alluvial deposits or it may be buried by the younger alluvial deposits and modern soils at a depth of at least five feet.

A short segment of the transmission line ROW crosses the southern reaches of belts of the Moreno Shale (Km, Kmd, Kms, Kmm) that interfinger with the Older Alluvium in Sections 17, 18, and 20 of T15S, R12E before reaching the San Joaquin Valley (Dibblee and Minch 2007b). This latest Cretaceous (65 million years ago) formation is approximately 1,000 feet thick and is comprised of marine sedimentary rocks with a four-member sequence of clay shale, claystone, or sandstone. The exposures of the Moreno Shale formation in the Panoche Hills and Tumey Hills north and south of the transmission corridor have the highest diversity of organisms from the late Cretaceous in the western United States. Highly significant terrestrial and marine vertebrate fossils found on public lands managed by the Bureau of Land Management (BLM) include marine reptiles, terrestrial dinosaurs, fish, and sharks (BLM 2014). This formation is thus considered to have a high paleontological potential. Fossil specimens have been found on or near the surface of the uplifted Cretaceous strata, described in this otherwise grassy foothill area as badlands. In the San Joaquin Valley, recent geologic maps indicate the transmission line ROW is underlain by Quaternary Alluvium (Qa) of Holocene (Recent) age (less than 11,000 years old) (Dibblee 1975; Dibblee and Minch 2007c). At the Helm Substation near the City of San Joaquin, the new microwave tower site is underlain by Quaternary Basin deposits (Qb) of Holocene (Recent) age (less than 11,000 years old) (Jennings and Strand 1958). These two groups of Recent sediments are considered too young to contain fossils.

## PALEONTOLOGICAL RESOURCES RESULTS

A review of records maintained by the University of California Museum of Paleontology (UCMP 2014), the PaleoBiology Database (n.d.), Fossilworks (n.d.), fossil lists, published and unpublished literature indicate that no known paleontologic resource localities are recorded in the project area. Significant fossil specimens are known, however, from the project vicinity. Along the northern edge of the Panoche Valley north of the transmission line ROW in Section 13 of T15S, R10E, a horse fossil has been recorded from surface rocks of the Tulare Formation. Vertebrate fossils, including bear, horse, camel, and deer have also been recovered from the Tulare Formation in Little Panoche Valley to the north. Nearly 50 localities are listed in the UCMP database for the Tulare Formation in central California.

No significant fossils have been reported from the Panoche Formation in the project vicinity, although highly significant terrestrial and marine vertebrate fossils have been found in the Panoche Hills and Tumey Hills in the exposures of the neighboring Moreno Shale. Seventy-seven Moreno Shale localities are listed in the UCMP database in Fresno County, although none are currently known to be in the transmission line ROW. Elsewhere in California, older Pleistocene alluvial sediments (Qoa) have been reported to yield significant fossils of extinct animals from the Ice Age.

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## INFO ON FORMATION LOCATIONS IN PROJECT AREA

Tulare Formation: high paleontological potential

- Panoche quadrangle: Sections 19, 20 and 21 of T15S, R11E
- Edge of the alluvial fan outside project: Sections 14, 15, and 16 of T15 S, R12 E
- Along the margins of the Coast Ranges, uplift has brought the formation to the surface.

Panoche Formation: low paleontological potential

- Panoche quadrangle : Sections 21 and 22 T15S, R12E
- Tumey Hills quad: Sections 22, 23, 24, and 18, T15S, R12E
- Call Mountain and Panoche Mountain microwave tower sites

Moreno Shale & Older Alluvium

- Tumey Hills quad: Sections 17, 18, and 20 of T15S, R12E (Moreno Shale interfingers with the Older Alluvium)
- Moreno Shale: high paleontological potential. Fossil specimens have been found on or near the surface of the uplifted Cretaceous strata, described in this otherwise grassy foothill area as badlands.
- Older Alluvium: moderate paleontologic sensitivity for project area. May be exposed by streams between the ridges at the base of the hills where it may be difficult to distinguish from younger alluvial deposits or it may be buried by the younger alluvial deposits and modern soils at a depth of at least five feet.