Paleontological Assessment Report for the Viejo Substation and Transmission Line Project, Orange County, California

Prepared for

AMEC Earth & Environmental

Prepared by

SWCA® Environmental Consultants

March 2003

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SWCA Job #6723-113

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INTRODUCTION

SWCA Environmental Consultants (SWCA) was retained by AMEC Earth and Environmental to evaluate the potential impacts to paleontological resources for the Viejo Substation and Transmission Line Project. The project consists of a proposed substation parcel and three 66kV transmission line alternatives, and is located in the cities of Mission Viejo and Lake Forest, Orange County, California (Figures 1, 2, 3).

Paleontological resources are the fossilized remains of prehistoric plants and animals; common examples include fossilized bones, teeth, shells, tracks, trails, casts, molds and impressions. Paleontological resources are scientifically significant because they provide important morphological and phylogenetic information on extinct organisms, as well as valuable data on ancient paleoenvironments and the local and regional geologic history of an area.

Paleontological resources are limited, non-renewable resources of scientific, cultural and educational value, and are afforded protection under Federal (National Environmental Policy Act [NEPA]), State (California Environmental Quality Act [CEQA]), and local (County of Orange) laws and regulations. This study satisfies project requirements in accordance with the California Environmental Quality Act of 1970 (13 PRC, 2100 et seq), and Public Resources Code, Section 5097.5 (Stats 1965, c 1136, p. 2792). This analysis also complies with guidelines and significance criteria specified by the Society for Vertebrate Paleontology (SVP) and the County of Orange, California.

Paleontologic Sensitivity

Paleontologic sensitivity is defined as the potential for a geologic unit to produce scientifically significant fossils. This is determined by rock type, past history of the rock unit in producing significant fossils, and fossil localities that are recorded from that unit. Paleontologic sensitivity is derived from the fossil data collected from the entire geologic unit, not just from a specific survey.

A three-tiered classification system for paleontological sensitivity, recommended by SVP and recognized in California is listed below:

- High sensitivity – Indicates fossils are currently observed onsite, localities are recorded within the study area and/or the unit has a history of producing numerous significant fossil remains.

- 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.

- Indeterminate Sensitivity – Unknown or undetermined sensitivity indicates that the rock unit has not been sufficiently studied or lacks good exposures to warrant a definitive rating. This rating is treated initially as having a high sensitivity or potential. After study or monitoring, the unit may fall into one of the other categories.

As taken from the paleontological guidelines set forth by Orange County (Cooper and Eisentraut, 2000), fossils are considered to be scientifically significant if they meet or potentially meet any one or more of the following criteria:

- Taxonomy - fossils that are scientifically judged to be important for representing rare or unknown taxa, such as defining a new species.

- Evolution – fossils that are scientifically judged to represent important stages or links in evolutionary relationships, or fill gaps or enhance under represented intervals in the stratigraphic record.

- Biostratigraphy – fossils that are scientifically judged to be important for determining or constraining relative geologic (stratigraphic) age, or for use in regional to interregional stratigraphic correlation problems.

- Paleoecology – fossils that are scientifically judged to be important for reconstructing ancient organism community structure and interpretation of ancient sedimentary environments.

- Taphonomy – fossils that are scientifically judged to be exceptionally well or unusually/uniquely preserved, or are relatively rare in the stratigraphy.

STRATIGRAPHY AND PALEONTOLOGY

Previous geologic mapping of the project area indicates that the proposed project will impact the Middle Miocene Topanga Formation, the Middle to Upper Miocene Monterey Formation, the Upper Miocene Soquel and La Vida Members of the Puente Formation, the Upper Miocene to Lower Pliocene Oso Sand Member of the Capistrano Formation, Quaternary Non-Marine Terrace Deposits, Quaternary Alluvium and Colluvium and Quaternary Landslide Deposits (Figure 4, 5, 6).

Topanga Formation

Based on previous geologic mapping of the area, the oldest formation present in the project area is the middle Miocene (approximately 15 million years old) Topanga Formation. The Topanga Formation was first described by Kew in 1923 from a largely sandstone sedimentary sequence with interbedded shales from Topanga Canyon in the Santa Monica Mountains.

The Topanga Formation was deposited in a deepening marine basin as the mountain and island blocks of the San Gabriel, Santa Ana and Catalina masses were rapidly uplifted (Minch, 1997). As sediments were shed from the rising highlands, the coarser-grained sediments settled out closer to the paleo-shoreline and the finer-grained muds accumulated in the deeper parts of the basin (Minch, 1997). Periodic influxes of coarser-grained cobbles and sands were washed from the land by flash-flooding and then further transported offshore by turbidity currents, resulting in a mixing of terrestrial and marine fossils (Minch, 1997). The presence of both types of fossils in

the same stratigraphic layers is highly important for biocorrelation of terrestrial and marine faunas and time scales, as well as for forming a more complete understanding of the middle Miocene paleoenvironment in Orange County (Minch, 1997).

The basal Topanga Formation is a nine meter (30 feet) thick, tan-to-grey conglomerate and sandy conglomerate that is well-cemented and resistant to erosion (Schoellhamer et al., 1981). The upper part of the Formation consists mostly of resistant beds of light tan to grey, medium- to coarse-grained, poorly-sorted feldspathic sandstone, concretionary and conglomerate beds, and minor interbeds of massive to poorly-bedded olive-grey siltstone (Schoellhamer et al., 1981).

Paleontology

The Topanga Formation is one of the most fossiliferous formations in Orange County, producing abundant and diverse marine vertebrate and invertebrate faunas, as well as abundant terrestrial plant fossils (Raschke, 1984). The terrestrial (land) plant fossils found indicate that a warm, Mediterranean-type paleoenvironment existed during the middle Miocene in Orange County, similar to the conditions along the Pacific coast of Mexico today (Minch, 1997). Members of the Topanga flora represent two different habitat types (oak woodlands and riparian floodplains) and comprise a variety of taxa including; magnolias, sycamores, maples, alders, birches, oaks, willows, reeds, cattails, ginsengs, grasses, avocados and palms (Minch, 1997). Additionally, an extinct Miocene form of filamentous brown algae seaweed has also been recovered from the Topanga Formation, as well as trace fossils such as coprolites and worm tubes (Minch, 1997).

Marine mollusks are common in the Topanga Formation and include large pectinids (scallops), oysters and gastropods (snails) (Schoellhamer at al., 1981). Corals, sand dollars, sea urchins, brachiopods, barnacles, crabs and shrimp have also been recovered (Minch, 1997). The gastropod index fossil *Turritella ocoyana* constrains the age of the Formation as middle Miocene, approximately 15 million years old.

A diverse vertebrate fauna is known from the Topanga Formation that includes both marine and non-marine animals (Raschke, 1984). Vertebrate fossils found include sharks, rays, bony fish, sea turtles, marine crocodile, desmostylians, sperm whales, shark-toothed whales, baleen whales, dolphins, sirenians, seals, sea lions, walruses, rodents and birds (Raschke, 1984). Several biostratigraphically important terrestrial mammals have also been found in the Topanga Formation that indicate a late Hemingfordian to early late Barstovian Land Mammal Age, approximately 17 to 13.5 million years ago. These include primitive three-toed horse (*Merychippus sp.*), stilt-legged camel (*Aepycamelus sp.*), small pronghorn and primitive deer (paleomerycid) (Fisk and Roeder, 1996). Due to the abundant marine invertebrate, marine and terrestrial vertebrate and plant faunas, the Topanga Formation has been assigned a high to very high sensitivity level in Orange County (Cooper and Eisentraut, 2000).

Monterey Formation

The middle to late Miocene Monterey Formation (15 to 7 million years old) underlies portions of the transmission line route in Alternatives 1A, 1B and 1C, and is one of the most prolific fossil-producing rock units in California (Raschke, 1992). Blake first described the Monterey Formation in 1856 from a sequence of diatomaceous and siliceous shales and siltstones near

Monterey, California. Composed primarily of thinly bedded diatomaceous, silty and siliceous shale and siltstone, interbedded with sandstone and minor inclusions of chert and limestone, the Monterey Formation ranges from approximately 365 to 460 meters thick (1,200 to 1,500 feet) (Morton et al., 1974; Edgington, 1974).

The Monterey Formation was deposited during a period of rapid subsidence and basin formation initiated by the collision of the Pacific Plate with the North American Plate in the early Miocene, approximately 25 million years ago. Continued subsidence of the bathyal basins created by the collision, coupled with the subsequent eustatic drowning of the coastal margins, resulted in the formation of deep, quiet, oxygen deficient basins along the submerged continental shelf of much of California (Ingle, 1981). At the same time, global cooling and the associated build-up of the Antarctic ice cap created a global increase in surface circulation and siliceous diatom productivity (Ingle, 1981). The siliceous shells or tests of diatoms (single-cell flora) and calcareous tests of foraminifera (single-cell fauna) produced a whitish, chalky sediment that filtered to the sea floor with silt and other biogenic debris, including fish bones and scales, sponge spicules, algae and leaves. The gradual accumulation of debris and fine sediments under low-oxygen conditions, which excluded burrowing invertebrates, preserved the laminated sedimentary structure and allowed the distinctive cherty and porcelaneous layers to form (Ingle, 1981). Locally, by the end of the Miocene, the Monterey Formation was being deposited in an approximate 900 meter (3,000 feet) deep basin trough formed by subsidence of the Los Angeles Basin.

Paleontology

The Monterey Formation has been assigned to a high paleontological sensitivity level due to the numerous invertebrate, fish and marine mammal fossils that have been recovered in Orange County (Cooper and Eisentraut, 2000). Limestone deposits in Aliso Viejo, the Pecten Reef and other Orange County localities have produced a wide array of fossils including coprolites, algae, plant fragments, pollen (pine, primrose, dune grass, willow), foraminiferans, diatoms, sponges, bryozoan colonies, serpulid worms, pectens, oysters, clams, marine snails, ostracods, barnacles, sand dollars, sharks, bat rays, fish, turtles, crocodiles, dolphins, baleen whales, sea lions, manatees, desmostylians, horses, primitive squirrels, primitive dogs, primitive deer and birds (Raschke, 1984).

The Pecten Reef is the name given to the conspicuous mega-invertebrate fossil bearing limestone lenses that occur at the base of the Monterey Formation in Orange County (Fife, 1974). Exposures occur over about a 33 km (10 mile) long area, and may be much more extensive in the subsurface (Fife, 1974). In 1982, a 0.4 hectare (one acre) exposure of the Reef was designated as an Orange County Historical Landmark. The Pecten Reef was not actually, for the most part, a true reef (living in place and then buried), but rather a transported fossil deposit, cemented into bedded-limestone coquinas (deposits of transported shells) (Fife, 1974).

<u>Puente Formation</u>

Upper Miocene (12 to 7 million years old) Puente Formation is up to 230 meters thick and is composed of deep-water marine siltstone with minor interbedded sandstone and conglomerates. This formation is nearly contemporaneous (deposited at the same time) with the Monterey and

the Modelo Formation, but consists of more terrigenous sediments because of the basin's proximity to the continental borderlands. Critelli (1995) suggests that these formations were probably separated by an intrabasinal bathymetric ridge.

The Puente Formation is about 3900 meters thick in its type section in the Puente Hills, and is generally composed of sandstone, conglomerate and mudrock deposited on a submarine fan at bathyal depths (Durham and Yerkes, 1964). Four formal members are recognized: the La Vida, Soquel, Yorba, and Sycamore Canyon. Based on the stratigraphy of the four members, the succession consists of two main upward-thickening and coarsening turbidite megasequences, reflecting submarine-fan progradation (Critelli et al., 1995). Two Members of the Puente Formation, the La Vida and the Soquel, underlie the northern portion of the proposed transmission line in Alternatives 1A and 1B.

The La Vida is the oldest member of the Puente Formation and is characterized by deep-water marine, white to yellowish-gray, well-indurated siltstones and shales with minor sandstone beds (Fife, 1974). The Soquel Member is a sequence of interbedded white to yellow-orange, angular to subangular, medium- to coarse-grained, poorly sorted, arkosic sandstone, with rare thinly bedded diatomaceous shale and siltstone, deposited in a deep-water turbidite system (Fife, 1974). The Puente Formation has produced an extensive collection of both marine invertebrates and vertebrates, including fossil fish and whales, and has been assigned a high paleontological sensitivity level (Cooper and Eisentraut, 2000).

Capistrano Formation

The Capistrano Formation was deposited approximately 10 to 4.5 million years ago during the Late Miocene to Early Pliocene as part of a submarine fan complex associated with the subsidence of the Los Angeles Basin. General lithology is characterized by over 2,100 feet of well-sorted, yellow-gray to light brownish-gray siltstone with interbedded lenticular white fine-grained sandstone. In Orange County, only one formal member, the Oso Sand, is accepted, although two informal facies, a siltstone facies and a turbidite facies, are also recognized in Orange County (Morton and Miller, 1981). The proposed substation site and vicinity, as well as most of the transmission line route in Alternative 1C will impact the Oso Member of the Capistrano Formation.

Lithology of the Oso Sand consists of massive to poorly bedded white to gray arkosic sandstone. The sands are typically poorly sorted with siltstone and conglomeratic lenses frequently interbedded between them, and concretions of well-cemented sand occur throughout the formation. Exposures of this member are limited to the Mission Viejo – Lake Forest area.

Paleontology

The Oso Sand Member of the Capistrano Formation has yielded some of the most important fossil finds in Orange County and has been assigned a high paleontologic sensitivity level. Raschke (1999) states that the Capistrano Formation is recognized internationally as the source of the second-most scientifically significant Miocene marine mammal collection in the world. Fossils found include shark teeth, littoral mollusks, shore birds and a diverse collection of marine vertebrate fossils that include many previously unknown species of baleen and toothed whales, sea

lions, dolphins, seals, sharks, teleost fish and primitive walrus. Additionally, fossils of terrestrial animals, including horses, rabbits, rhinos, and camels, have also been collected.

Quaternary Non-Marine Terrace Deposits

Quaternary non-marine terrace deposits, dated at between 500,000 to 10,000 years old (Late Pleistocene), underlie parts of the proposed substation parcel, as well as the transmission line route in Alternatives 1A, 1B, and 1C. Non-marine terrace deposits are the fluvially deposited remnants of Pleistocene age stream channels and/or floodplains, left in a stair step sequence, most commonly above an active stream channel that has downcut further into the topography. The non-marine terrace deposits in Orange County are composed of poorly sorted, reddish-brown to yellow-brown silty gravel, with clayey silt and sand lenses, with thicknesses varying from less than 40 feet to over 150 feet (Morton et al., 1974).

Paleontology

Throughout the Los Angeles Basin, terrace deposits have produced Pleistocene age (1.8 million to 10,000 years ago) fossils from numerous localities. Hundreds of Pleistocene fossils have been recovered in Orange County in the Laguna Hills area from the Costeau Pit, in the 1960s, and from the excavation for the Laguna Hills Community Center and Sports Complex in 1989 and 1999 (Gust and Burres, 2000). Pleistocene taxa from terrace deposits include toad, frog, newt, pond turtle, desert tortoise, fence lizard, alligator lizard, rattlesnake, gopher snake, duck, hawk, burrowing owl, quail, coot, sparrow, shrew, ground sloth, jack rabbit, cottontail rabbit, ground squirrel, pocket gopher, pocket mouse, kangaroo rat, deer mouse, mouse, woodrat, vole, muskrat, coyote, dire wolf, weasel, sabertooth cat, mammoth, mastodon, horse, camel antelope, deer and bison (Gust and Burres, 2000). Because of this, Quaternary non-marine terrace sediments are considered to have a high potential to contain non-renewable paleontologic resources throughout Orange County and thus have been assigned high paleontologic sensitivity level.

Quaternary Alluvium and Colluvium and Landslide Deposits

Younger alluvium and colluvium (10,000 years old to recent), present in low lying valleys and stream channels throughout the project area, are generally defined as fluvial sediments in an active stream channel and its flood banks. These sediments are generally considered too young to contain fossils, but have the potential to contain cultural remains. The paleontological sensitivity of the Quaternary Alluvium and Colluvium is considered to be low.

Quaternary Landslide material (10,000 years old to recent), present in the southern end of the transmission line routes in Alternative 1A, 1B, and 1C, generally has a low paleontological sensitivity rating; however, the actual sensitivity of the deposit is dependent on a number of factors, including the source rock parent material. Because of the variability of factors surrounding the size, age, distance travelled, shear forces, subsequent erosion and weathering of landslides, landslide deposits must be considered on an individual basis in terms of the possibility of recovery and potential significance of paleontological resources.

METHODS AND PERSONNEL

Cara Corsetti, Program Director of SWCA's paleontology program, conducted the field survey of the project site on February 21, 2003, and was the primary author of this report. Evan Crabtree created computer graphics for this report. All work was performed under Rod Raschke, Orange County Certified Paleontologist.

RESULTS

Records And Literature Search

SWCA examined records maintained by the Natural History Museum of Los Angeles County (LACM), as well as previous technical studies in the region to complete this study. Numerous fossil localities are located within a one-mile radius surrounding the substation parcel and the transmission line routes. Additionally, based on the sensitivity of the geologic units underlying the project site, there is a potential for significant fossils to occur at depth within the project area based on the units' previous history of producing significant paleontological resources (Cooper and Eisentraut, 2000).

Results from the literature and records search indicate that many fossil localities have been discovered within a one-mile radius of the proposed project. Raschke (1984) reports the occurrence of numerous significant vertebrate and invertebrate fossils at the Upper Oso Dam, which is located within one mile east of the proposed substation parcel. Twenty-three Natural History Museum of Los Angeles County (LACM) fossil localities are present at the Upper Oso Dam site (Raschke, 1984). The fossils at Upper Oso Dam were discovered in the Vaqueros Formation (not exposed in the project area), the Topanga Formation, and the Monterey Formation, and include such diverse groups as sharks, bat rays, camels, primitive horses, dolphins, sirenians, baleen whales, bony fish, pinnipeds and several types of mollusks (Raschke, 1984). Another important site, located within one mile southwest in the Oso Member of the Capistrano Formation, contains over 53 individual fossil localities (Gust et al., 2001). Fossils found include rorqual whales, porpoises, long-nosed dolphins, killer whales, walruses, sea lions, sea cows, great white sharks, bat rays, bony fish, sea tortoises, giant pelicans, camels, horses, and rhinos (Gust et al., 2001).

Field Survey

The field survey was conducted on February 21, 2003. During the field survey the substation parcel and the transmission line alternatives were examined for fossils and to determine the geology of the site. No significant paleontological resources were found on the surface during the field survey. Results of the field survey indicated that the entire substation parcel and transmission line corridors have been previously disturbed.

CONCLUSIONS

Based on the information contained in the geologic and paleontologic reports of the region, the geologic units potentially impacted by project grading have a high potential to contain highly

significant nonrenewable scientific resources and should be monitored closely by a qualified paleontologist.

An analysis of the three proposed alternatives indicates that the same percentage of high sensitivity geologic units underlies Alternative 1A, Alternative 1B and Alternative 1C; therefore, all three alternatives would impact high paleontological sensitivity units at the same rate, and all three alternatives would likely result in the destruction of significant paleontological resources unless proper mitigation measures are proposed. The following mitigation measures were designed to address adverse impacts to paleontological resources in the project area, and should be applied to all three potential alternatives.

RECOMMENDED MITIGATION MEASURES

All grading operations within Alternatives 1A, 1B and 1C are likely to result in the destruction of fossils unless proper mitigation measures are implemented. Fossils are an important, nonrenewable scientific resource, and the destruction of these fossils would represent a significant adverse impact on the region's paleontological resources.

Cumulative impacts on paleontological resources result when rock units become unavailable for study and observation by scientists. The destruction of fossils has a significant cumulative impact as it makes biological records of ancient life unavailable for study by scientists; however, implementation of proper mitigation measures can reduce the impacts to the paleontological resources.

The following mitigation measures have been developed to reduce the adverse impacts of project construction on paleontological resources to a less than significant level. The measures are derived from the guidelines of the Society of Vertebrate Paleontologists and meet the requirements of Orange County and the California Environmental Quality Act (CEQA). These mitigation measures have been used throughout California and have been demonstrated to be successful in protecting paleontological resources while allowing timely completion of construction.

1. An Orange County Certified Paleontologist will be retained to supervise monitoring of construction excavations and to produce a mitigation plan for the proposed project. Paleontological monitoring will include inspection of exposed rock units and microscopic examination of matrix to determine if fossils are present. The monitor will have authority to temporarily divert grading away from exposed fossils in order to recover the fossil specimens.

2. If microfossils are present, the monitor will collect matrix for processing. In order to expedite removal of fossiliferous matrix, the monitor may request heavy machinery assistance to move large quantities of matrix out of the path of construction to designated stockpile areas. Testing of stockpiles will consist of screen washing small samples (approximately 200 pounds) to determine if significant fossils are present. Productive tests

will result in screen washing of additional matrix from the stockpiles to a maximum of 6000 pounds per locality to ensure recovery of a scientifically significant sample.

3. Quaternary Alluvium, Colluvium and Quaternary Landslide Deposits have a low paleontological sensitivity level, and will be spot-checked in a periodic basis to insure that older underlying sediments are not being penetrated. All earth-moving in the Topanga Formation, the Monterey Formation, the La Vida and Soquel Members of the Puente Formation, the Oso Sand Member of the Capistrano Formation, and Quaternary Non-Marine Terrace Deposits will be monitored full-time. The high paleontological sensitivity of these formations requires a maximum effort to recover fossils.

4. The Orange County Certified Paleontologist will prepare monthly progress reports to be filed with the client and the lead agency.

5. Recovered fossils will be prepared to the point of curation, identified by qualified experts, listed in a database to allow analysis, and deposited in a designated repository such as the Interpretive Center at Ralph Clark Regional Park, an Orange County facility, which shall have the first right-of-refusal of the collection, or the Natural History Museum of Los Angeles County.

6. At each fossil locality, field data forms will record the locality, stratigraphic columns will be measured and appropriate scientific samples submitted for analysis.

7. The Orange County Certified Paleontologist will prepare a final mitigation report to be filed with the client, the lead agency, and the repository.

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