Appendix 5.6-F
Paleontologic Resource Inventory and Impact Assessment Technical Report
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SECTION 1

INTRODUCTION

1.1 BACKGROUND

Paleontologic resources include fossil remains, the respective fossil sites, associated specimen data and corresponding geologic and geographic site data, and the fossil-bearing strata. This technical report summarizes the results and findings of the paleontologic resource inventory and impact assessment that were conducted by Paleo Environmental Associates, Inc. (PEAI), personnel in support of the Centennial Specific Plan environmental impact report (EIR). The EIR is being proposed by the Los Angeles County Department of Regional Planning (County), the California Environmental Quality Act (CEQA) lead agency for the EIR. The resource inventory and impact assessment, in turn, are being required by the County because of the potential for fossil remains and fossil sites being encountered by earth-moving activities associated with development of the specific plan area.

1.2 PERSONNEL

This technical report was prepared by Dr. E. Bruce Lander, a principal paleontologist with PEAI of Altadena, California. Dr. Lander has a Ph.D. degree in paleontology and has conducted research, authored published scientific contributions, and prepared environmental impact review documents on the paleontologic resources of southern California in support of numerous other major construction projects. Dr. Lander also conducted the literature review and archival search in support of this report and directed the field survey of the plan area. The survey was conducted by Mr. Mark A. Roeder, a PEAI field supervisor, and Mr. David A. Alexander, a PEAI field technician.
SECTION 2

ENVIRONMENTAL SETTING

The 11,680.7-acre Centenni al Specific Plan area is situated between the Tehachapi and San Gabriel Mountains at the western end of the Antelope Valley in unincorporated northernmost Los Angeles County, California, immediately south of the Kern County line and several miles east of Gorman (Figure 1). The plan area is roughly bisected in a north-south direction by the Western Branch of the California Aqueduct. The western portion of the plan area lies east of Interstate 5 and is bounded to the south by State Route 138 or lies immediately north of Quail Lake. The eastern portion of the plan area lies south of the California Aqueduct and is bounded to the east by 300th Street West. The plan area occupies much of the eastern half of Township 8 North and Range 18 West, and most of the western two thirds of Township 18 North and Range 17 West of the San Bernardino Base and Meridian. Topographic map coverage of the plan area is provided at a scale of 1:24,000 by the United States Geological Survey (USGS) Lebec (1995) and La Liebre Ranch Quadrangles (1995), 7.5-Minute Series (Topographic).

Paleontologic resources of the plan area include a number of rock units that immediately underlie the surface and have a potential for yielding particular types of fossil remains because they have yielded similar remains at previously recorded fossil sites in or near the plan area. Fossils, the remains or indications of once-living organisms, are a very important scientific resource because of their use in 1) documenting the evolution of particular groups of organisms, 2) reconstructing the environments in which they lived, and 3) in determining the ages of the strata in which they occur and of the geologic events that resulted in the deposition of the sediments constituting these strata.

2.1 METHODS

The following tasks were conducted to develop a baseline paleontologic resource inventory of the Centennial Specific Plan area by rock unit, and to assess the potential paleontologic productivity and the paleontologic or scientific importance of each rock unit exposed therein. These assessments were based on the numbers and types of fossil remains recorded from the rock unit in or near the plan area. All tasks were completed in compliance with County (2008) draft general plan guidelines and Society of Vertebrate Paleontology (SVP) standard measures (Reynolds et al. 1995) for assessing the scientific importance of the paleontologic resources in an area of potential environmental effect.

2.1.1 Stratigraphic Inventory

Geologic maps and reports covering the surficial geology of the plan area were reviewed 1) to determine the rock units exposed in the plan area, particularly those rock units known to be fossiliferous, and 2) to delineate their respective areal distributions therein.

2.1.2 Paleontologic Resource Inventory by Rock Unit

Published and unpublished paleontologic and geologic literature was reviewed to document the number and locations of previously recorded fossil sites in or near the plan area from each rock unit exposed therein, and the types of fossil remains the rock unit has produced locally. The literature review was supplemented by an archival search conducted at the Natural History Museum of Los Angeles County Vertebrate Paleontology Department (LACM) (McLeod 2006) for additional information regarding the occurrences of fossil sites and remains in or near the plan area. A field survey of the plan area was conducted to verify the condition of any previously recorded fossil, document the occurrence of any previously unrecorded fossil site, and to determine the presence of strata suitable for preserving fossil remains.

2.1.3 Paleontologic Resource Assessment Criteria by Rock Unit

The paleontologic or scientific importance (high, moderate, low, none, undetermined) of a rock unit exposed in the plan area is the measure most amenable to assessing the scientific importance of the paleontologic resources of the plan area because the areal distribution of a rock unit can be delineated on a topographic map. The paleontologic importance of a rock unit reflects 1) its potential paleontologic productivity and 2) the scientific importance of the fossils it has produced locally.

The potential paleontologic productivity (high, moderate, low, none, undetermined) of a rock unit exposed in the plan area is based on the abundance or densities of fossil specimens or newly and previously
Figure 1.—Topographic and surficial geologic map, Centennial Specific Plan area, Los Angeles County, California, showing locations of previously and newly recorded fossil sites. Base maps: USGS Lebec 7.5-minute and Neenach 15-minute Quadrangles. Surficial geology after Dibblee (2006, 2008). Note: sensitivity of rock unit corresponds to its importance.
recorded fossil sites in exposures of the unit in and near the plan area. Exposures of a specific rock unit in the plan area are most likely to yield fossil remains representing particular species and in quantities or densities similar to those previously recorded from the unit in and near the plan area. The criteria for establishing the potential paleontologic productivity of a rock unit exposed in the plan area are described below.

1) High potential: rock unit contains comparatively high density of newly and previously recorded fossil sites and has produced numerous fossil remains in or near plan area, and is very likely to yield additional similar remains at currently unrecorded fossil sites therein.

2) Moderate potential: rock unit contains relatively moderate density of newly and previously recorded fossil sites and has produced some fossil remains in or near plan area, and is somewhat likely to yield additional similar remains at currently unrecorded fossil sites therein.

3) Low potential: rock unit contains no or comparatively low density of previously recorded fossil sites and has yielded very few or no fossil remains near plan area, and is not likely to yield any remains or to contain any currently unrecorded fossil site therein.

4) Undetermined potential: rock unit has limited or no exposure in plan area, is poorly studied, contains relatively very few or no previously recorded fossil sites therein, and has produced comparatively very few no fossil remains near plan area. However, in plan area region, same or correlative and lithologically similar rock unit contains a sufficient number of recorded fossil sites to suggest that rock unit in plan area has at least a moderate potential for yielding fossil remains or containing currently unrecorded fossil sites (note: elsewhere in California, exposures of rock units once having very few or no previously recorded fossil sites subsequently were demonstrated to be highly fossiliferous as a result of surveying, monitoring, or processing fossiliferous rock samples as part of mitigation programs for other earth-moving projects).

5) No potential: unfossiliferous artificial fill and intrusive igneous and high-grade metamorphic rock units with no potential for yielding any fossil remains or containing any currently unrecorded fossil site.

A fossil specimen is considered scientifically highly important if it is 1) identifiable to a low taxonomic level, 2) relatively complete, 3) comparatively well preserved, 4) age diagnostic, 5) useful in habitat or paleoenvironmental reconstruction, 6) a type or topotypic specimen, 7) a member of a new or rare species, 8) a species that is part of a taxonomically diverse assemblage, or 9) a skeletal element different from, or a specimen more complete than, those now available for its respective species. Identifiable fossil land mammal remains, for example, are considered scientifically highly important because they are comparatively rare in the fossil record and have a potential for providing very accurate age determinations and environmental reconstructions for the rock units in which they occur. Moreover, the geologic age of some fossil remains can be determined by carbon-14 dating analysis.

Using the definitions presented above, the paleontologic or scientific importance of a rock unit exposed in the plan area would be assessed using the following criteria.

1) High importance: rock unit has relatively high potential for containing currently unrecorded fossil sites and for yielding scientifically important fossil remains in plan area similar to those previously recorded from rock unit in or near plan area.

2) Moderate importance: rock unit has comparatively moderate potential for containing currently unrecorded fossil sites and for yielding scientifically important fossil remains in plan area similar to those previously recorded from rock unit in or near plan area.

3) Low importance: rock unit has relatively low potential for containing any currently unrecorded fossil site or for yielding any scientifically important fossil remains in plan area.

4) Undetermined importance: rock unit for which too few data are available from plan area and vicinity to allow an
accurate assessment of its potential for containing any currently unrecorded fossil site or for yielding any scientifically important fossil remains in plan area.

5) No importance: unfossiliferous artificial fill and intrusive igneous and high-grade metamorphic rock units having no potential for containing any currently unrecorded fossil site or for yielding any fossil remains.

Note, however, that any fossil site containing identifiable fossil remains and the fossil-bearing strata are considered highly important paleontologically, regardless of the paleontologic or scientific importance of the rock unit in which the site and strata occur.

The following tasks were completed to establish the paleontologic or scientific importance of each rock unit exposed in the plan area.

1) The scientific importance of fossil remains recorded from a particular rock unit exposed in the plan area was assessed.

2) The potential paleontologic productivity of the rock unit was assessed, based on the density of fossil remains or previously recorded and newly documented fossil sites it contains in or near the plan area.

3) The paleontologic importance of the rock unit was assessed, based on its documented or potential fossil content in the plan area.

This method of resource assessment is the most appropriate for an areal paleontologic resource investigation of the plan area because discrete levels of paleontologic or scientific importance can be delineated on a topographic map or on a surficial geologic map of the plan area.

2.2 RESULTS

2.2.1 Stratigraphic Inventory

Regional surficial geologic mapping of the Centennial Specific Plan area and vicinity is provided by Jennings and Strand (1969) at a scale of 1:250,000. Larger-scale (1:62,500, 1:24,000) geologic mapping of the plan area is provided by Dibblee (2006, 2008). The plan area is underlain by a number of stratigraphic or geologic rock units. In ascending stratigraphic order, these rock units include pre-late Cretaceous intrusive igneous rocks; the late Oligocene to earliest Miocene Neenach Volcanic Formation; the late Miocene, marine to brackish-water Quail Lake and continental Oso Canyon Formations; Pleistocene older alluvium; and Holocene younger alluvium (Dibblee 2006, 2008). A surficial geologic map of the plan area is presented at a scale of 1:48,000 in Figure 1 and is after Dibblee (2006, 2008).

2.2.2 Paleontologic Resource Inventory and Assessment by Rock Unit

An inventory of the paleontologic resources of the plan area and of the rock units exposed therein is presented below, and the scientific importance of these resources is assessed by rock unit. The importance of each rock unit is portrayed in Figure 1.

2.2.2.1 Intrusive Igneous Rocks.—Intrusive igneous rocks are exposed only at the northwestern corner of the plan area (Figure 1). These igneous rocks consist of plutonic rocks (granodiorite, quartz monzonite; Dibblee 2006) that are unfossiliferous because of their origin from a molten state deep in the earth’s crust. Consequently, there is no potential for any previously unrecorded fossil site or remains occurring where the plan area is underlain by such rocks. Therefore, the igneous rocks are of no paleontologic importance.

2.2.2.2 Neenach Volcanic Formation.—The Neenach Volcanic Formation is exposed only at the southeastern corner of the plan area (Figure 1). The formation consists of extrusive igneous rocks, primarily andesitic lava flows (Dibblee 2008), that are unfossiliferous because of their origin from a molten state. Eruption of the corresponding flows would have destroyed any remains that otherwise might have been fossilized. Consequently, there is no potential for any previously unrecorded fossil site or remains occurring where the plan area is underlain by such rocks. Therefore, the Neenach Volcanic Formation is of no paleontologic importance.

2.2.2.3 Quail Lake Formation.—The Quail Lake Formation (Santa Margarita Formation of Wiese 1950, Crowell 1952) comprises intervals of light gray to tan, massive to bedded, medium- to coarse-grained sandstone that commonly are conglomeratic at the base, and silty siliceous shale (Dibblee 2006, 2008). This formation is exposed only in the western half of
the western portion of the plan area (Figure 1). The literature review and field survey conducted in support of this inventory documented the occurrence of a number of previously recorded sites and one previously unrecorded fossil site in exposures of the Quail Lake Formation in the plan area (Figure 1). Crowell (1952) mapped six such sites in the plan area, several of which were relocated as a result of the field survey and still found to be productive, and a seventh just beyond the northwestern corner of the area. These sites (Crowell 1952) produced fossilized remains representing extinct species of calcareous marine algae, bryozoans (moss animals), sand dollars, and marine snails and clams. One of these sites probably is the one reported by Wiese (1950) that also yielded fossilized shark teeth in addition to remains representing most of the invertebrate species. Petrified wood was found at the one previously unrecorded site discovered during the survey (Figure 1). Some of the vertebrate and invertebrate remains and the species they represent have been critical in determining the age and brackish-water to marine origin of the fossil-bearing strata. These fossil occurrences indicate that there is a high potential for additional similar fossil remains being encountered at previously recorded fossil sites and at currently unrecorded fossil sites where the plan area is underlain by this rock unit. Therefore, the Quail lake Formation is potentially of high paleontologic importance.

2.2.2.4 Oso Canyon Formation.—The Oso Canyon Formation comprises layers of pebble and cobbles conglomerate; gray to red, fine- to coarse-grained or conglomeratic sandstone; and greenish-gray to red sandy or pebbly siltstone (Dibblee 2008). This formation is exposed in much of the plan area (Figure 1). The archival search conducted in support of this inventory did not document the occurrence of any previously recorded fossil site in the Oso Canyon Formation. However, a fossil-bearing limestone bed near the base of Oso Canyon Formation (continental deposits of Wiese 1950) yielded the remains of freshwater snails and ostracods (bivalved crustaceans) near La Liebre Ranch (Wiese 1950), which lies at the southeastern corner of the plan area (Figure 1). The fossil remains and the species they represent have been critical in determining the freshwater origin of the fossil-bearing strata. Petrified wood was documented at a number of newly recorded fossil sites discovered as a result of the field survey conducted in support of this inventory (Figure 1). Pending further investigation, occurrences indicate that there is an undetermined (but possibly high) potential for additional similar fossil remains being encountered at previously recorded and currently unrecorded fossil sites where the plan area is underlain by this rock unit. Therefore, the Oso Canyon Formation is of undetermined (but possibly high) paleontologic importance.

2.2.2.5 Older Alluvium.—The older alluvium comprises dissected and unconsolidated to weakly consolidated alluvial deposits, including alluvial fan gravel and poorly bedded, alluvial gravel and sand (Dibblee 2006, 2008). This rock unit is exposed in much of the plan area (Figure 1). The literature review, archival search, and field survey conducted in support of this inventory did not document the occurrence of any previously recorded fossil site in the older alluvium in the plan area or its immediate vicinity. However, several sites in the older alluvium (Harold Formation of Noble 1953) near Barrel Springs in Palmdale have yielded fossilized bones and teeth representing a taxonomically diverse faunal assemblage that includes mostly extinct species of early to middle Pleistocene (Ice Age) land mammals. These species include a jackrabbit, a cottontail, a deer mouse, the California vole, a harvest mouse, possibly the dire wolf, the American mastodon, a mammoth, possibly the western horse, and the western camel (Noble 1953, Reynolds 1989, Lander et al. 2007). The remains from the older alluvium are scientifically highly important because of their taxonomic diversity and, particularly with regard to those of the packrat, have allowed the determination of the age of the formation. Pending further investigation, the occurrence of several previously recorded fossil sites in the plan area region indicates that there is an undetermined (but probably no more than a moderate) potential for additional similar fossil remains being encountered at unrecorded fossil sites where the plan area is underlain by this rock unit. Therefore, the older alluvium is of undetermined (but likely no more than moderate) paleontologic importance.

2.2.2.6 Younger Alluvium.—The younger alluvium comprises undissected and unconsolidated layers of alluvial gravel, sand, and silt of valley areas (Dibblee 2008). This rock unit is exposed in much of the plan area (Figure 1). The literature review, archival search, and field survey conducted in support of this inventory did not document the occurrence of any previously recorded fossil site in the younger alluvium in the plan area or its immediate vicinity. However, several sites lie east of Little Rock Wash in Palmdale and near General William J. Fox Airfield in Lancaster, from 0 to 10 feet below the surface and, like the plan area, at elevations above 2,325 feet, the highstand of ancient Lake Thompson (includes Rosamond Lake). The
remains from these sites represent a leopard lizard, a gopher, and a large land mammal, and are of late Pleistocene or Holocene age (Lander 2004 and references cited therein, 2005, Lander et al. 2007). Pending further investigation, the occurrence of several previously recorded fossil sites in the plan area region indicates that there is an undetermined (but probably no more than a moderate) potential for additional similar fossil remains being encountered at unrecorded fossil sites where the plan area is underlain by this rock unit and at depths greater than 5 feet below the current ground surface. Therefore, the younger alluvium is of undetermined (but likely no more than moderate) paleontologic importance at such depths.

On the other hand, at depths less than 5 feet below the current ground surface, any remains probably would be too young to be considered fossilized. Therefore, the younger alluvium is of low paleontologic importance at such shallow depths.
SECTION 3
ENVIRONMENTAL IMPACTS

3.1 CONSTRUCTION PHASE

Paleontologic resources, including an undetermined number of fossil remains and currently unrecorded fossil sites, a number of previously recorded fossil sites, associated specimen data and corresponding geologic and geographic site data, and the fossil-bearing strata, might be adversely affected by (i.e., would be sensitive to) the significant direct and indirect environmental impacts that would result from earth-moving activities associated with development of the Centennial Specific Plan area.

Direct impacts would result mostly from earth-moving activities (particularly grading for roadways and building pads, excavation for subterranean structures, and trenching for pipelines) in previously undisturbed strata in areas of commercial and residential development. Direct impacts also would result from any earth-moving activity that buried previously undisturbed strata, making the strata and their paleontologic resources unavailable for future scientific investigation. Although earth-moving activities would be comparatively short term, under CEQA, the possible accompanying loss of some fossil remains and sites, associated specimen data and corresponding geologic and geographic site data, and the fossil-bearing strata would be a potentially significant long-term adverse environmental impact. Although these impacts would be most pronounced in the proposed development areas, they might also occur to a lesser degree in the designated open-space areas.

Indirect impacts could result from the easier access to fresh exposures of fossiliferous strata and the accompanying potential for unauthorized fossil collecting by construction personnel, rock hounds, and amateur and commercial fossil collectors, even in the open-space areas. Such collecting might result in the loss of some additional fossil remains and currently unrecorded fossil sites, a number of previously recorded fossil sites, and associated specimen data and corresponding geologic and geographic site data. The loss of these additional paleontologic resources could be another potentially significant long-term environmental impact under CEQA.

3.1.1 Significance Criteria by Rock Unit

The following tasks were conducted in compliance with County (2008) draft general plan guidelines and SVP standard measures (Reynolds et al. 1995) for assessing the significance of construction-related adverse environmental impacts on paleontologic resources, or the paleontologic sensitivity of a particular rock unit to adverse impacts.

The paleontologic significance (high, moderate, low, none, undetermined) of potential adverse impacts on the paleontologic resources of each rock unit in the plan area was assessed and reflects the impact sensitivity of the rock unit. Impact sensitivity, in turn, primarily reflects the paleontologic or scientific importance of the rock unit and the potential for fossil remains and fossil sites being encountered by development-related earth-moving activities in areas underlain by that rock unit. This method of impact assessment is most appropriate to an areal paleontologic resource investigation of the plan area because discrete levels of paleontologic resource impact sensitivity or significance can be delineated on a topographic map or on a surficial geologic map of the plan area. Note, however, that any impact on a fossil site would be considered potentially highly significant, regardless of the paleontologic or scientific importance of the rock unit in which the site occurred.

A paleontologic resource impact sensitivity assessment of the plan area is presented below and on the surficial geologic map of the plan area that is included as Figure 1.

3.1.2 Impact Assessment by Rock Unit

Sensitivity assessments of each rock unit exposed in the plan area and the corresponding impact significance of development-related earth-moving activities on the paleontologic resources of the rock unit and the plan area are presented below.

3.1.2.1 Intrusive Igneous Rocks.—The intrusive igneous rocks are unfossiliferous and, therefore, insensitive to any impact. Consequently, there would be no impact on the paleontologic resources of the plan area where underlain by these rocks.

3.1.2.2 Neenach Volcanic Formation.—The Neenach Volcanic Formation is unfossiliferous and, therefore, insensitive to any impact. Consequently, there would be no impact on the paleontologic resources of the plan area where underlain by this rocks.
3.1.2.3 **Quail Lake Formation.**—A least six previously recorded fossil sites and one newly recorded fossil site occur in the plan area where underlain by the Quail Lake Formation (Figure 1). Therefore, the Quail Lake Formation would be highly sensitive with regard to any development-related direct or indirect impact. Consequently, there would be highly significant impacts on paleontologic resources where the plan area is underlain by this rock unit.

3.1.2.4 **Oso Canyon Formation.**—Only one previously recorded fossil site and a number of newly recorded fossil sites occur in the plan area where underlain by the Oso Canyon Formation. Therefore, the Oso Canyon Formation and its paleontologic resources would be of undetermined (but possibly high) sensitivity with regard to any development-related direct or indirect impact. Consequently, any such impact on paleontologic resources would be of undetermined (but possibly high) significance where the plan area is underlain by this rock unit.

3.1.2.5 **Older Alluvium.**—No previously recorded fossil site is recorded from the older alluvium in the plan area. However, this rock unit has yielded fossil remains at several previously recorded fossil sites in the plan area region. Therefore, the older alluvium and its paleontologic resources would be of undetermined sensitivity with regard to any development-related direct or indirect impact in the plan area. Consequently, any such impact on paleontologic resources would be of undetermined significance where the plan area is underlain by this rock unit.

3.1.2.6 **Younger Alluvium.**—No previously recorded fossil site is recorded from the younger alluvium in the plan area. However, this rock unit has yielded fossil remains at several previously recorded fossil sites in the plan area region. Therefore, the younger alluvium and its paleontologic resources would be of undetermined sensitivity with regard to any development-related direct or indirect impact in the plan area at depths greater than 5 feet below the present ground surface. Consequently, any such impact on paleontologic resources would be of undetermined significance where the plan area is underlain by this rock unit and at depths greater than 5 feet.

On the other hand, at depths less than 5 feet below the current ground surface, any remains probably would be too young to be considered fossilized. Therefore, the younger alluvium and its paleontologic resources would be of low sensitivity at depths less than 5 feet below the present ground surface. Consequently, any such impact on paleontologic resources would be of low significance where the plan area is underlain by this rock unit.

3.2 **POST-CONSTRUCTION PHASE**

There probably would be no significant direct impact on the paleontologic resources of the plan area during the post-construction phase if there were no earth-moving activity that disturbed previously undisturbed, fossil-bearing strata.

3.3 **CUMULATIVE IMPACTS**

Development of the Centennial Specific Plan area, in combination with other projects in the region where a parcel is underlain by the Quail Lake or Oso Canyon Formation, would lead to the progressive loss of fossil-bearing strata in either rock unit that could be prospected for fossil remains and unrecorded fossil sites. This loss would be a potentially significant cumulative impact.
SECTION 4

MITIGATION MEASURES

4.1 CONSTRUCTION PHASE

The following measures comprise a paleontologic resource impact mitigation program that would reduce the direct and indirect adverse environmental impacts on paleontologic resources of the proposed development areas in the Centennial Specific Plan area to an insignificant level. Such impacts would accompany earth-moving activities (particularly grading for roadways and building pads, excavation for subterranean structures, and trenching for pipelines) associated with development of the plan area. The program would allow for the recovery of some scientifically highly important fossil remains, should any be encountered by these activities; their preservation in a recognized museum repository; the recording of associated specimen data and corresponding geologic and geographic site data, and their archiving at the repository; and the availability of the remains and data for future study by qualified scientific investigators. These specimens and data otherwise might have been lost to such earth-moving activities and to unauthorized fossil collecting. Specimen recovery and preservation for future scientific study would be allowed under CEQA Appendix G (5.c).

4.1.1 Mitigation Program Design Criteria

The recommended level and type of mitigation effort in a particular part of the plan area reflects the paleontologic or scientific importance and the corresponding impact sensitivity of the rock unit underlying the area (Figure 1), the corresponding potential for fossil remains being encountered by earth-moving activities therein, the type of rock comprising the rock unit, and the types and magnitudes of the significant impacts that would result from these activities. For example, grading of an area underlain by a paleontologically highly important rock unit or of one containing a fossil site would require more intensive paleontologic construction monitoring than grading of an area underlain by a rock unit of moderate, low, or undetermined paleontologic importance. Monitoring would not be required in an area underlain by artificial fill or a rock unit of no paleontologic importance (unless a rock unit of higher importance would be encountered at depth), or one in which a rock unit of high, moderate, low, or undetermined importance would be buried, but not otherwise disturbed. No rock sample would be recovered or processed if the rock were too coarse grained to contain any fossil remains or were resistant to breaking down in, and processing with, water.

The discovery and subsequent recovery of fossil remains as part of the mitigation program might result in a slight delay of some earth-moving activities. However, the mitigation measures presented below have been designed to eliminate or reduce any delay to the greatest extent possible by 1) ensuring that a paleontologic construction monitor would be present when and where fossil remains were most likely to be uncovered by earth-moving activities; 2) allowing for the rapid recovery of fossil remains, should any be encountered by these activities, and for the recording of associated specimen and site data; and 3), if necessary, diverting the earth-moving activities temporarily around a newly discovered fossil site until the remains had been removed by the monitor and these activities allowed to proceed through the site. Similar paleontologic resource impact mitigation programs usually have resulted in little or no delay of earth-moving activities.

No mitigation measure would be necessary in the designated open-space areas if there were no earth-moving activity. However, any such activity therein would be subject to the same mitigation measures as those activities in the proposed development areas.

4.1.2 Beneficial Environmental Effects of Mitigation Program

If the recommended paleontologic resource impact measures presented below were implemented, earth-moving activities in the plan area might produce some beneficial effects. The fresh exposure of fossil-bearing strata would allow for the discovery of an undetermined number of currently unrecorded fossil sites and the recovery of some scientifically highly important fossil remains that otherwise would never have been exposed without these earth-moving activities and would not have been available for recovery. Moreover, these remains, instead of being lost to earth-moving activities or to unauthorized fossil collecting, would be preserved in a museum repository, where associated specimen data and corresponding geologic and geographic site data would be archived, and where the remains and data would be made available to qualified scientific investigators for future study. There also is the
potential that some of these remains might represent new or rare species; new geologic or geographic records; or skeletal elements different from, or specimens more complete than those now available for their respective species. Finally, these remains would provide a more comprehensive paleontologic resource inventory of the plan area and vicinity than is now available or would have been available without development of the plan area.

4.1.3 Qualifications of Paleontologist Conducting Mitigation Program

All mitigation measures presented below should be directed by a paleontologist approved by the County and the LACM. The paleontologist should have substantial experience designing and conducting paleontologic resource impact mitigation programs in areas underlain by fossil-bearing strata. The paleontologic monitor and other paleontologic staff working under the direction of the paleontologist should have experience monitoring earth-moving activities, recovering large fossil vertebrate skeletons, and recovering and processing large samples of fossiliferous rock.

4.1.4 Compliance with Lead Agency and Professional Society Guidelines

The measures recommended below would be in compliance with County (2008) draft general plan guidelines and SVP standard measures (Reynolds et al. 1995, 1996) for mitigating adverse construction-related environmental impacts on paleontologic resources. The paleontologist would ensure implementation of these measures and verify their effectiveness. The results of the program would be summarized in a final technical report of results and findings that would be submitted to the County.

4.1.5 Mitigation Measures

The literature review, archival search, and field survey, as well as a review of the geologic map covering the plan area, indicated that the plan area is underlain by paleontologically highly sensitive strata, in which earth-moving activities associated with development of the plan area would have a high potential for encountering fossil remains (Figure 1). Mitigation measures that would be implemented in a particular part of the plan area and during a specific development phase are based on the sensitivity of the underlying rock unit and include paleontologic construction monitoring. Monitoring would be conducted in conjunction with other measures, which are provided below.

4.1.5.1 Task 1—Retention of Paleontologist.— Prior to the initiation of earth-moving activities associated with a particular development phase in the plan area, the services of a qualified paleontologist approved by the County and the LACM will be retained to implement the mitigation program.

4.1.5.2 Task 2—Museum Storage Agreement.— The paleontologist will develop a formal agreement with a recognized museum repository, such as the LACM, regarding final disposition and permanent storage and maintenance of any fossil remains that might be recovered as a result of the mitigation program, the archiving of associated specimen data and corresponding geologic and geographic site data, and the level of treatment (preparation, identification, curation, cataloguing) of the remains that would be required before the entire mitigation program fossil collection would be accepted by the repository for permanent storage.

4.1.5.3 Task 3—Preconstruction Field Survey.— Prior to the start of earth-moving activities for each development phase, the paleontologist and another mitigation program staff member will conduct a field survey of that portion of the development phase area underlain by the Quail Lake and Oso Canyon Formations and older alluvium to locate and recover any larger fossil remains that might occur at previously recorded and currently unrecorded fossil sites, and to document the presence of strata suitable for containing larger fossil remains or for the collection and processing of sediment or rock samples to allow for the recovery of smaller fossil remains. All vertebrates fossil remains and representative samples of invertebrate and plant fossil remains will be collected and retained for later treatment.

4.1.5.4 Task 4—Preconstruction Coordination and Environmental Awareness Training.— Prior to the start of earth-moving activities for each development phase, the paleontologist or another mitigation program staff member will coordinate with appropriate construction contractor personnel to provide information regarding any County requirement concerning the protection of paleontologic resources. The contractor personnel will be informed that unauthorized fossil collecting is prohibited. The contractor’s heavy-equipment operators will be briefed on procedures to be followed in the event that fossil remains and a fossil site are encountered by earth-moving activities, particularly when the monitor is not on site. The briefing will be presented to new contractor personnel as necessary. Names and telephone
numbers of the monitor and other appropriate mitigation program personnel will be provided to appropriate contractor personnel.

4.1.5.5 Task 5—Paleontologic Monitoring and Fossil or Sample Recovery.—Earth-moving activities for each development phase will be monitored by the monitor to allow the recovery of larger fossil remains. Monitoring will be implemented only in those parts of the plan area where such activities will disturb previously undisturbed strata. This task will be conducted on a full-time basis in areas underlain by Quail Lake Formation, and on a half-time basis in areas underlain by the Oso Canyon Formation, older alluvium, and, at depths greater than 5 feet below the current ground surface, younger alluvium. If fossil remains are encountered in an area underlain by one of the three latter rock units, particularly the Oso Canyon Formation, the monitoring level will be increased to full time, particularly in the immediate vicinity of the fossil site. On the other hand, if too few or no fossil remains are found once 50 percent of earth-moving activities for a development phase have been completed in an area underlain by a particular rock unit, monitoring can be reduced in the remainder of the area underlain by that unit following approval from the County.

Monitoring will consist of visually inspecting debris piles and freshly exposed strata for larger fossil remains. As soon as practicable, the monitor will recover all larger vertebrate fossil specimens, a representative sample of invertebrate or plant fossils, or any potentially fossiliferous, fine-grained rock or sediment sample that can be recovered easily. The total weight of all samples collected from any one rock unit during a particular development phase will not exceed 6,000 pounds. Sampling will emphasize lacustrine deposits and paleosols in the Quail Lake and Oso Canyon Formations. If the recovery of a large or unusually productive fossil occurrence is warranted, earth-moving activities will be diverted temporarily around the fossil site and a recovery crew will be mobilized and the assistance of heavy equipment and an operator will be enlisted as necessary to expedite the recovery of the occurrence. If the monitor is not on site when a fossil occurrence is uncovered by such activities, the activities will be diverted temporarily around the fossil site and the monitor called to the site to evaluate and, if warranted, recover the occurrence. If the fossil site is determined too unproductive or the fossil remains not worthy of recovery, no further action will be taken to preserve the fossil site or remains, and earth-moving activities will be allowed to proceed through the site immediately. The location and proper geologic context of any fossil occurrence or rock sample will be documented, as appropriate. Monitoring will reduce the potential for unauthorized fossil collecting.

4.1.5.6 Task 6—Final Laboratory Tasks.—Any recovered rock or sediment sample will be processed to allow for the recovery of smaller fossil remains that normally are too small to be observed by the monitor. All fossil specimens recovered from the plan area as a result of the monitoring or sample processing will be treated (prepared to point allowing identification and museum storage, identified to lowest taxonomic level possible by knowledgeable paleontologists, curated, catalogued) in accordance with designated museum repository requirements. As appropriate, splits of the rock or sediment samples will be submitted to commercial laboratories for pollen or microfossil identification and analysis, and samples of fossil remains will be submitted for carbon-14 dating analysis.

4.1.5.7 Task 7—Reporting.—The monitor will maintain daily monitoring logs that record the particular tasks accomplished, the earth-moving activities monitored, the rock units encountered, the locations where monitoring was conducted and where fossil remains or sediment or rock samples were recovered, and associated specimen or sample data and corresponding geologic and geographic site data. A final technical report of results and findings will be prepared by the paleontologist in accordance with any County requirement.

4.2 ENVIRONMENTAL COMPLIANCE

The Centennial Specific Plan paleontologic resource impact mitigation program will comply with any applicable environmental law, ordinance, regulation, standard, or guideline regarding paleontologic resources. Paleontologic resources, including fossil remains, associated specimen data and corresponding geologic and geographic site data, the respective fossil sites, and the fossil-bearing strata, are a limited, nonrenewable, and very sensitive scientific and educational resource and, particularly with regard to fossil sites, are afforded protection under federal and state environmental regulations and guidelines, including the following California legislation.

California Environmental Quality Act of 1970 (Division 13, California Public Resources Code: 21000 et seq.).—Requires that a public agency or private interest identify the environmental consequences of its proposed project on any
object or site of significance to the scientific annals of California (Division I, Public Resources Code: 5020.1 [b]).

Guidelines for the Implementation of CEQA, as amended May 10, 1980, and March 29, 1999 (Title 14, Chapter 3, California Administrative Code: 15000 et seq.).—Define procedures, types of activities, persons, and public agencies required to comply with CEQA, and include definitions of significant impacts on a fossil locality (Section 15023, Appendix G [5.c]).

California Public Resources Code, Section 5097.5 (Statute 1965, Chapter 1136, Paragraph 2792).—Defines any unauthorized disturbance or removal of a fossil locality or remains on public land as a misdemeanor.

California Public Resources Code, Section 30244.—Requires reasonable mitigation of adverse environmental impacts that result from development of public land and affect paleontologic resources.

In response to CEQA and a number of subsequent acts, many regulatory and permitting agencies in California, including the County, have developed their own environmental guidelines for protecting paleontologic resources in areas under their respective jurisdictions. Under its own guidelines, as specified in the draft general plan, the County can require that a paleontologic resource inventory and impact assessment be conducted for an area of potential effect that will be adversely impacted by a discretionary project deemed nonexempt under its guidelines. As part of such an assessment, the County can require that a qualified paleontologist inventory and map fossil-bearing rock units and previously recorded and newly documented fossil sites in the area to be affected, evaluate the scientific importance of these paleontologic resources, determine the adverse environmental impacts that might arise from the project and appraise their significance, and formulate measures to mitigate these impacts to a less-than-significant level.

This paleontologic resource inventory and impact assessment has been conducted in support of development of the plan area because earth-moving activities associated with development might result in the loss of scientifically important fossil remains at a number of previously recorded fossil sites and an undetermined number of currently unrecorded fossil sites. This paleontologic resource assessment technical report is in compliance with County (2008) draft general plan guidelines and SVP standard measures (Reynolds et al. 1995, 1996) for assessing the scientific importance of the paleontologic resources in an area of potential effect, developing measures to mitigate significant adverse construction-related impacts on these resources, and with conditions for the acceptance of a mitigation program fossil collection by a museum repository.

4.3 POST-CONSTRUCTION PHASE

No mitigation measure would be required during the post-construction phase of development if there were no earth-moving activity that disturbed previously undisturbed strata in the Centennial Specific Plan area. If there were no such activity, then there would be no significant direct impact on paleontologic resources.

4.4 CUMULATIVE IMPACTS

Development of the Centennial Specific Plan area, in combination with other projects in the region where a parcel is underlain by the Quail Lake or Oso Canyon Formation, would lead to the progressive loss of fossil-bearing strata in either rock unit that could be prospected for fossil remains and fossil remains and sites. This loss would be a potentially significant impact that would be mitigated by the measures presented above.
SECTION 5

ACRONYMS

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SECTION 6

LITERATURE CITED

Los Angeles County Department of Regional Planning. 2008. Draft general plan—Planning tomorrow’s great places.


APPENDIX

RESUMES OF
PALEO ENVIRONMENTAL ASSOCIATES, INC.,
KEY PERSONNEL

E. Bruce Lander, Ph.D., Principal Investigator
Mark A. Roeder, Field Supervisor
David A. Alexander, Field Technician
Resume of

E. BRUCE LANDER, Ph.D.
Principal Investigator, Senior Vertebrate Paleontologist

Paleo Environmental Associates, Inc.
2248 Winrock Avenue
Altadena, CA 91001-3205

Experience Summary
Extensive paleontologic resource management experience conducting and managing paleontologic resource/impact assessments and impact mitigation programs for large construction projects in California, Nevada, Utah, Wyoming, Arizona, New Mexico, Texas, and Maryland. Projects include municipal solid waste landfills; aggregate quarries; dams and reservoirs; flood control and groundwater recharge facilities; irrigation systems; cogeneration plants; solar energy and electrical generating plants; oil refineries; water pipelines/tunnels; oil and natural gas pipelines; electrical transmission lines; freeways, tunnels, and other roadways; subways; tramways; waste water treatment facilities; housing developments; planned communities; hotels; office buildings/complexes; business and industrial parks; shopping centers; hospitals and medical centers; convention centers; movie studios; parking lots/structures; marinas and marine supply facilities; space vehicle launch facilities; landslide stabilization and lagoon enhancement projects; geotechnical drilling programs; land exchanges; regional overviews; and conditional use permit, specific plan, and general plan revisions. Clients include private industry, public utilities, and federal, state, county, city, and regional agencies. Paleontologic resource assessments entailed data searches (literature reviews, archival searches, field surveys, consultation with other paleontologists) to develop baseline inventories, evaluation of scientific importance of resources and potential for disturbance by adverse project-related impacts, and formulation of mitigation measures to reduce these impacts to an acceptable level. Paleontologic resource impact mitigation programs required monitoring of earth-moving activities, recovery of fossil remains and fossiliferous rock samples, supervision of field personnel, and preparation of progress and final reports. Projects involved extensive coordination and consultation with project proponents, other consulting firms, and permitting agencies; adherence to strict delivery schedules; and completion within specified budget limits. Over 30 years of professional experience as a paleontologist and 20 years as a paleontologic consultant involved in paleontologic resource management and NEPA/CEQA compliance. Extensive paleontologic research background in land mammal faunas and vertebrate biostratigraphy of Tertiary continental formations of the southeastern, central, and western United States. Research entailed literature reviews, archival searches, field surveys, and consultation with other paleontologists.

Experience Record
1988-Date  Paleo Environmental Associates, Inc., Altadena, California. Principal Investigator. Developed and manages paleontologic resource management consulting program; prepared paleontologic resource assessments and corresponding EIR/EIS sections for numerous major earth-moving projects in California, including China Shipping and Yang Ming Project, Puente Hills, Weldon Canyon, Marsh Canyon, Elsmere Canyon, and Altamont Landfill EIRs; Eastern Transportation Corridor EIR/EIS; Luz Solar Energy Generating System III to XII, Texaco Sunrise Cogeneration and Power Project, Kern River Transmission Line, Etiwanda Peaking Power Project, La Jolla Energy Project, Mountain View Power Plant Project, Malburg Generating Station Project, and Elk Hills Power Project AFCs; Anaverde/City Ranch EIR (Palmdale) Playa Vista EIR; Metropolitan Water District of Southern California (MWD) Eastside Reservoir and Inland Feeder EIRs; Santa Monica Mountains National Recreation Area Land Exchange EIS; and City Ranch, West End Area, Santa Fe Ranch Specific Plan and Keystone Development EIRs (Santa Clarita); managed Simi Valley Landfill expansion, Santiago Canyon Landfill, Foothill Ranch, Shell Oil Company Wilmington Manufacturing Complex SCOT unit, Eastern Transportation Corridor, Los Angeles Metro Rail Red Line, Sutter Power Plant, Malburg Generating Station, Meridian Oil Inc. 16-Inch Natural Gas Pipeline (Southern California Edison Cool Water Generating Station), Western Fox Field Property Development (Lancaster), Anaverde/City Ranch (Palmdale), CalTrans Red Rock (SR 14) Four-Lane Upgrade Project (09V129), and MWD Inland Feeder, Cajalco Dam and Detention Basin, and Headquarters Facility paleontologic resource impact mitigation programs. Conducted paleontologic mitigation monitoring compliance and reporting for Los Banos-Gates 500kV (Path 15) Transmission Line Project. Presented prepared testimony before California Energy Commission.

1985-1990  Engineering-Science, Inc., Pasadena, California. Project Manager, Paleontologist/Geologist. Developed and managed paleontologic resource management consulting program; prepared numerous paleontologic resource assessments for projects in California, Arizona, Utah, Wyoming, New Mexico, Texas, Nevada, and Maryland, including Simi Valley Landfill Expansion EIR, Pacific Texas Pipeline Project EIR/EIS, Mojave-Kern River-El Dorado Natural Gas Pipeline Projects EIR/EIS, Los Angeles Metro Rail MOS-2 EIR/EIS, and Orange County Foothill Transportation Corridor EIR; prepared paleontologic resource assessment overviews of southern Ventura County for Ventura County Resource Management Agency, City of Simi Valley sphere of influence for City of Simi Valley Department of Community Development, Southern California Edison BiCep Project; supervised Los Angeles Metro Rail MOS-1 and interim Simi Valley Landfill paleontologic resource impact mitigation programs; assisted in preparing public relations program for Waste Management of California; prepared geology/seismicity sections of environmental documents for numerous construction projects.

1984-1985  San Bernardino County Museum, Redlands, California. Paleontologist. Identified vertebrate fossil remains; prepared educational fossil exhibits; assisted in docent training, preparation of technical reports regarding results of paleontologic resource impact mitigation program for Los Angeles Department of Water and Power Intermountain Power Project transmission line corridor and Western Association of Vertebrate Paleontologists 1985 Field Trip Guidebook and Volume.

1982-1985  Marine and Environmental Science Associates, Inc. (MESA², Inc.), La Crescenta, California. Project Manager, Paleontologist/Geologist. Developed and managed paleontologic resource management consulting program; prepared paleontologic resource assessments for projects throughout California, including Sacramento Municipal Utility District's Geothermal Public Power Line Project (NOI and AFC) and ARCO's Coal Oil Point Project EIS/EIR; assisted in preparing geologic reports and maps on southern California continental borderland; assisted in preparing expert testimony for presentation before California Energy Commission.


Education

B.S., Geology, 1969, University of California, Los Angeles
M.A., Paleontology, 1972, University of California, Berkeley
Ph.D., Paleontology, 1977, University of California, Berkeley

Professional Registrations

Certified Paleontologist, County of Orange, California

Professional Societies

Paleontological Society
Society for Sedimentary Geology
Society of Vertebrate Paleontology
Geological Society of America
American Association for the Advancement of Science
Association of Environmental Professionals

Institutional Affiliations

Research Associate, Natural History Museum of Los Angeles County
EXPERIENCE SUMMARY

Extensive paleontologic resource management experience conducting and managing paleontologic resource/impact assessments and impact mitigation programs for large construction projects in California. Projects include municipal solid waste landfills; aggregate quarries; flood control facilities; oil refineries; natural gas pipelines; freeways and other roadways; subways; waste water treatment facilities; housing developments; planned communities; office buildings/complexes; shopping centers; hospitals and medical centers; industrial complexes; parking lots/structures; land exchanges; and conditional use permit and specific plan revisions. Clients include private industry, public utilities, conservancies, and federal, state, county, city, and regional agencies. Paleontologic resource assessments entailed data searches (literature reviews, archival searches, field surveys, consultation with other paleontologists) to develop baseline inventories, evaluation of scientific importance of resources and potential for disturbance by adverse project-related impacts, and formulation of mitigation measures to reduce these impacts to an acceptable level. Paleontologic resource impact mitigation programs required monitoring of earth-moving activities, recovery of fossil remains, supervision of field personnel, and preparation of progress and final reports. Projects involved extensive coordination and consultation with project proponents, other consulting firms, and permitting agencies; adherence to strict delivery schedules; and completion within specified budget limits. Approximately 25 years of experience as a paleontologist and paleontologic consultant involved in NEPA and CEQA compliance. Extensive paleontologic research background in fish faunas of Cenozoic marine and lacustrine formations of southern California. Research entailed literature reviews, archival searches, field surveys, and consultation with other paleontologists.

EXPERIENCE RECORD


1969-1976    Natural History Museum of Los Angeles County, Los Angeles, California. Student Professional Worker/Field Associate.

EDUCATION

B.A., Anthropology, 1977, San Diego State University

PROFESSIONAL REGISTRATION

Registered Paleontologic Consultant, County of Orange, California

PROFESSIONAL SOCIETIES

Society of Vertebrate Paleontology
Resume of

DAVID A. ALEXANDER

Paleontologic Monitor/Laboratory Technician

Paleo Environmental Associates, Inc.
2248 Winrock Avenue
Altadena, CA 91001

Experience Summary
Paleontologic resource management experience as paleontologic construction monitor as part of paleontologic resource impact mitigation programs for large construction projects in Orange County. Projects include landfills, toll roads, and residential developments. Clients include private industry and local and regional agencies. Programs required monitoring of earth-moving activities and recovery of fossil remains.

Project Experience

   Paleontologic construction monitor for Prima Deshecha Landfill, Amerige Heights and The Presidential Collection residential developments, Orange County, CA (1997 to present)
   Projects included monitoring of earth-moving activities, fossil recovery and preparation, and recording locations of fossil sites.

2000-date Chambers Group, Inc., 17671 Cowan Ave., Ste. 100, Irvine, CA 92614.
   Projects included monitoring of earth-moving activities and fossil recovery.

   Paleontologic construction monitor for Eastern Transportation Corridor, Orange County (1997-2000).
   Projects included monitoring of earth-moving activities and fossil recovery.

   Paleontologic construction monitor for San Joaquin Hills Transportation Corridor, Orange County (1995-1997).
   Projects included monitoring of earth-moving activities and fossil recovery.

   Paleontologic construction monitor for San Joaquin Hills Transportation Corridor, Orange County (1989-1995).
   Projects included monitoring of earth-moving activities and fossil recovery.