RMW Project Number: 01-1829

Paleontological Resources Assessment Report

For

Broadwing Fiber Optic Northern California Interconnection Project

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Introduction

RMW Paleo Associates Inc. was retained to evaluate the paleontological resources along the proposed alignments of the Broadwing Fiber Optic Northern California Interconnection Project Routes. The project consists of seven different routes scattered throughout central California. The routes are in the Cities of Hayward, Modesto, Sacramento, San Francisco, and Santa Clara.

Methods and Personnel

Paleontological record searches were requested from the Museum of Paleontology at the University of California, Berkeley to determine if previous paleontological sites were known within one mile of the proposed alignment. In addition geological maps, geological references, and paleontological references were reviewed for pertinent information. Field reconnaissance was not performed.

Rod Raschke Qualified Paleontologist at RMW Paleo Associates Inc. performed the research and wrote the report.

Paleontological Resources

Paleontological resources are the remains of organisms that lived in the geologic past. These remains are the bones, teeth, tracks, trails, and impressions of animals and plants. Paleontological resources are significant because they provide the only information on extinct organisms from the distant past. Fossils also provide information on the ancient environment and geologic history of a region.

Determination of the scientific significance of paleontologic resources can only be made by qualified, trained paleontologists, preferably those expert with the fossils under consideration. Fossils are considered to be significant if one or more of the following criteria apply:

1. The fossils provide information on the evolutionary relationships and developmental trends among organisms, living or extinct.

2. The fossils provide data useful in determining the age(s) of the rock unit or sedimentary stratum, including data important in determining the depositional history of the region and the timing of geologic events therein.

3. The fossils provide data regarding the development of biological communities or interaction between paleobotanical and paleozoological biotas.

4. The fossils demonstrate unusual or spectacular circumstances in the history of life.

5. The fossils are in short supply and/or in danger of being depleted or destroyed by the elements, vandalism, or commercial exploitation, and are not found in other geographic locations.

As so defined, significant paleontologic resources are determined to be fossils or assemblages of fossils that are unique, unusual, rare, uncommon, or diagnostically important. Significant fossils can include remains of large to very small aquatic and terrestrial vertebrates or remains of plants and animals previously not represented in certain portions of the stratigraphy. Assemblages of fossils that might aid stratigraphic correlation, particularly those offering data for the interpretation of tectonic events, geomorphologic evolution, and paleoclimatology are also critically important. Paleontologic remains are recognized as nonrenewable resources significant to the history of life.

Regulatory Framework

Preservation and salvage of cultural resources, including fossils, are mandated on private and public lands in part by the following federal regulations: Executive Order 12088, October 17, 1978 (43:201, 47707); the Surface Mining Control and Reclamation Act of 1977 (SMCRA, P.L. 95-87, 30 U.S.C. 1201-1328); the Federal Land Management and Policy Act of 1976 (FLPMA, P.L. 94-579, 43 U.S.C. 1701-1782); the National Natural Landmarks Program and Historic Sites Act of 1935 (P.L. 74-292; 49 Stat. 666; 16 U.S.C. 461 *et. seq.*); National Environmental Protection Act of 1969 (P.L. 91-190; 83 Stat. 852; 42 U.S.C. 4321-4327); National Historic Preservation Act of 1966 (P.L. 89-665; 80 Stat. 915; 16 U.S.C. 470 *et. seq.*, am. 1976 P.L. 94-422 and P.L. 94-458); the Montana Power Company decision (Decisions of the Department of the Interior 721.D, A-30310; 518-522, Dec. 3, 1965); Reservoir Salvage Act of 1960, am. 1974 (P.L. 86-523, am. P.L. 93-921); Federal-Aid Highway Act of 1956; U.S. Congress, August 15, 1949 (63 Stat. 606; 20 U.S.C. 78, 78a); Antiquities Act of June 8, 1906 (P.L. 59-209; 34 Stat. 225; 16 U.S.C. 432, 433); the 1872 Mining Law, amended 1962; the Warren Alquist Act, n.b. sec. 25527; and memoranda of opinions, U.S. Department of the Interior, Office of the Solicitor, to Bureau of Land Management, applicability of Antiquities Act to Fossils, 1956-1974.

State of California laws pertaining to paleontologic resources include the California Environmental Quality Act of 1970 (CEQA) (13 PRC: 21000 *et. seq.*); Guidelines for the Implementation of the California Environmental Quality Act as am. May 10, 1980 (14 Cal. Adm. Code: 15000 *et. seq.*, n.b. Chapter 3, Division 6, Title 14, Appendix G); Penal Code Section 622.5 (Stats. 1939, c. 90, p. 1605, S.1); Public Resources Code, Section 5097.5 (Stats. 1965, c. 1136, p. 1791); and Executive Order B-64-80, March 6, 1980.

Results

Geological Overview of Project Area

The projects in San Francisco, Santa Clara, and Hayward are located in the Coast Range Geomorphic Province. Sacramento, Stockton, and Modesto are located in the Central Valley Geomorphic Province. Although the project routes are at seven widely separated sites, the geology is remarkably similar. The majority rock units underlying the routes are Quaternary age sedimentary rocks. Small exposures of Mesozoic sedimentary and metamorphic rocks are present along on route. Some of the rocks were deposited along the margins of San Francisco Bay. Most were deposited by the rivers and streams that have flowed across the project areas. The Mesozoic rocks were deposited in an ancient seaway that covered the area that is now the Coast Ranges more than 150 million years ago. The following is a description of the geology and known paleontological resources along each of the routes.

San Francisco End Link Project Route Figure A-1

The San Francisco End Link Project Route begins near the intersection of Bayshore Boulevard and Geneva Avenue then extends north through the east side of San Francisco to 665 Third Street (Figure A-1). This route crosses the most numerous rock types of the seven project areas (Schlocker 1974, Knudsen et. al. 1997, Wentworth et.al. 1998). Geologic mapping along the route shows the area underlain by several different Quaternary age sedimentary deposits and artificial fill. In the immediate vicinity of the route are exposures of Mesozoic rocks.

The Quaternary age deposits are divided into three units based on their mode of deposition. These units are scatted along the route at several locations, the distribution of these units was determined by the geologic history of the area.

The most widely distributed Quaternary age unit is undivided surficial sediments. These underlie most of the route. Undivided surficial sedimentary units are comprised of sands silt and clay. These rocks are the geologically undetermined in age and probably contain many different age units. The age of these sediments generally increases with depth below the surface. There are no published reports of fossils from these rocks within the vicinity of the route.

Next most abundant are sand dune deposits. These are relics of the undeveloped San Francisco area when winds from the ocean pushed sand across the peninsula. Sand dune deposits are restricted to the portion of the route north of the Central Skyway. There are no reports of fossils from these deposits.

Exposures of slope debris and ravine fill are present at the southern end of the route. These are sediments derived from the weathered underlying materials and transported by mass-movement processes. They include locally developed soils; landslide debris and slope wash materials. The age of these deposits is highly variable, some are geologically Recent while others are thought to be of Pleistocene age. Slope debris and ravine fill deposits are not known to contain fossils near the route.

Artificial fill underlies several portions of this route. These arears are indicated on the sensitivity map in the appendix. These are materials placed by human activity in the greater San Francisco area. Filling of the bay and adjacent areas with artificial materials began as early as 1850. Along Folsom Street, near 20th Street, as much as 25 feet of artificial fill has been report (Schlocker 1974). Because these are human placed deposits they will not contain significant paleontological resources.

Two small exposures along the route contain Jurassic to Cretaceous age metamorphic and sedimentary rocks probably associated with the Great Valley Sequence. The exposures are along the margins of the alignment in the Bayview Park area. The metamorphic rocks are greenstones, altered volcanic rocks. Due to their igneous origins and alterations during the metamorphic process, it is unlikely that any fossils will be preserved within these rocks. The sedimentary rocks are composed of radiolarian cherts, shales, and sandstones. Fossils of a variety of organisms ranging from microscopic plants to extinct marine reptiles have been collected from similar rocks in the Coast Ranges. There are no recorded fossil occurrence in Mesozoic rocks near the proposed route

Santa Clara Data Center 2 Project Route

The Santa Clara Data Center 2 route extends from North First Street and Santa Clara Street in San Jose to Richard Avenue and Martin Avenue in Santa Clara (Figure A-2

The Quaternary age rocks that underlie this route are all Holocene or Recent age flood basin and alluvial fan deposits (Helley et. al. 1994). These deposits are less than 10,000 years old and are geologically too young to contain fossils. No fossils are known from these deposits in the Santa Clara area.

Hayward to Pleasanton Re-Route

The Hayward to Pleasanton Re-Route runs from the intersection of Highway 92 (West Jackson Street) and Santa Clara Street west to the intersection of Calaroga Avenue and Turner Court (Figure A-3).

Exposed along this route are a thick sequence of Quaternary age undivided alluvial deposits (Robinson 1956). These are the products of the weathering and erosion of the surrounding hills sides. The age of these deposits varies greatly from place to place. In general, the age of these deposits increases with depth. The records at UCMP revealed two occurrences of fossil horses in similar rocks within 1.5 miles of the proposed route.

Sacramento End Link Project Route

The Sacramento End Link Project Route extends from the intersection of Folsom Boulevard and Power Inn Road west to 650 J Street in Sacramento (Figure A-4).

This route crosses two Quaternary age sedimentary units. The older unit has been mapped as Quaternary terrace deposits (Strand and Koenig 1965). Olmstead and Davis (1961) considered these deposits to be a portion of the Victor Formation. The Victor Formation underlies the portion of the alignment east of Interstate 80. Fossils of "ice age" or Pleistocene epoch land animals have been reported from these sediments in the greater Sacramento area. Olmstead and Davis (1961) report elephant remains from a depth of 12 feet at one occurrence. These authors also report horse remains from another locality north of Sacramento. Records at UCMP include reports of two fossil occurrences approximately 2 miles north east of the proposed route. One occurrence was the remains of an extinct mammoth, the other the remains of an ice age horses. These occurrences were in river terrace deposits, similar to those exposed in the eastern portion of the proposed route.

Younger alluvial deposits are found in the western portion of the route. These are probably geologically Recent deposits of the American River. No fossils have been reported from these deposits.

Sacramento End Loop Project

The Sacramento End Loop Project is a rectangular area in downtown Sacramento. The study area is bound on the north by I Street, the east by 10th Street, the south by L Street, and on the west by 6th Street (Figure A-5).

Underling this area are stream deposits of the American River (Strand and Koenig 1965, Olmstead and Davis 1961). These are probably geologically Recent deposits (less than 10,000 years old). There are no reports of fossils from these deposits.

Modesto End Loop Project

The Modesto End Loop Project route extends from 1021 14th Street northwest to 1120 13th Street (Figure A-6).

This route is underlain by Quaternary alluvial fan deposits (Robins et. al. 1965). The age of these sediments is undetermined. There are no records of fossils from these deposits.

Stockton End Loop Project Route

The Stockton End Loop Project Route extends from 1426 Bourbon to 4201 Coronado in Stockton (Figure A-7).

Quaternary alluvial fan deposits underlie this route (Robins et. al. 1965). The age of these sediments is undetermined. There are no reports of fossils from these deposits near the route.

Paleontological Sensitivity of Project Segments

Paleontological sensitivity is an estimate of the likelihood that fossils will be discovered during excavations into a given rock unit. However, it does not measure the significance of individual fossils present along the project route, because it is impossible to accurately predict what individual fossils may be discovered. The significance of an individual fossil can only be determined after it is found and evaluated.

The sensitivity standards of the Society of Vertebrate Paleontology are used here. These national standards provide four classification levels of sensitivity as follows:

> *High Sensitivity*: Rock units from which vertebrate or significant invertebrate fossils or significant suites of plant fossils have been recovered are considered to have a high potential for containing significant non-renewable fossiliferous resources.
>
> *Low Sensitivity*: These are areas underlain by well-studied sedimentary rock units with little or no history of producing fossils remains or they represent rocks from a depositional environment that is unfavorable to the preservation of fossil remains.

Undermined Sensitivity: Specific areas underlain by sedimentary rock units for which little information is available are considered to have undetermined fossiliferous potential.

No Sensitivity: Metamorphic and granitic rock units do not yield fossils and therefore have no potential to yield significant non-renewable fossiliferous resources. Artificial fill deposits also have no potential for the discovery of fossils.

The proposed project is specified to have no impacts deeper than four feet below the ground surface. The corridor of potential effects runs from the edge of the road to the edge of the right-of-way (about 25 feet). Based on this information, portions of some segments have potential to adversely impact the region's paleontological resources. The potential impacts of each route are discussed below. Sensitivity Maps are in the appendix.

San Francisco End Link Project Route Figure A-1

The majority of rocks along this route are of undetermined age. This suggests that they could be old enough to contain fossils. Other rocks have a history of producing fossil remains in the region. Because of this mixed history of fossil production, the route is assigned a low sensitivity for the discovery of fossils. The portion of the route underlain by artificial fill has no paleontological sensitivity. These areas are delineated on the map in the appendix.

Santa Clara Data Center 2 Project Route

The sensitivity of this route is difficult to determine. The rocks are too young geologically to contain fossil remains. However, they could contain sub-fossil remains that would be important in understanding the evolution of the fauna in California. Therefore, these rocks are assigned a low potential for the discovery of potentially significant sub-fossil remains.

Hayward to Pleasanton Re-Route

Rocks within this route are known to contain Pleistocene age fossils near the project. The history of fossil production indicated a high potential for the discovery of fossils during excavations. Thus, this route has a high paleontological sensitivity.

Sacramento End Link Project Route

There are two Quaternary age rock units underlying this route. Rocks west of Interstate 80 are probably too young geologically to contain significant fossils. Sub-fossil remains may be present in this area. Discovery of this type of remains would add to understanding the biological development of the region. Therefore, the western portion of the project has a low sensitivity for the discovery of significant fossils. Fossils are known from several localities in the river terrace deposits exposed east of Interstate 80. The rocks to the east of Interstate 80 have a high sensitivity for the discovery of significant fossils.

Sacramento End Loop Project

This route is underlain by deposits of the American River. These deposits are probably too young geologically to contain fossils. However, they may contain sub-fossil materials that would be scientifically import. These remains would help in understanding the development of the current California fauna. This route has a low sensitivity for the discovery of fossils in the proposed excavations.

Modesto End Loop Project

The undetermined age of these deposits makes assigning a paleontological sensitivity difficult. These deposits have a low sensitivity because they may contain fossil or sub-fossil materials.

Stockton End Loop Project Route

The undetermined age of these deposits makes assigning a paleontological sensitivity difficult. These deposits have a low sensitivity because they may contain fossil or sub-fossil materials.

Recommended Mitigation Measures

All grading operations in sedimentary rock of undetermined, low, or high sensitivity are likely to result in the destruction of fossils unless proper mitigation measures are implemented. Fossils are an important, nonrenewable scientific resource. 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. While this project will have a relatively small cumulative impact on the region's paleontological resources, it is important to keep in mind the amount of local rock units/fossils already made unavailable for study.

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 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. A qualified paleontologist will be retained to perform monitoring of construction excavations. 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 divert grading away from exposed fossils temporarily in order to recover the fossil specimens.

2. If microfossils are present, the monitor will collect matrix for processing. Testing will consist of screen washing small samples (100 pounds) to determine if significant fossils are present. Productive tests will result in screen washing of additional matrix to procure a scientifically significant sample.

3. All earth moving in areas of high paleontological sensitivity will be monitored full-time. Spot-checking will monitor earth moving in areas of low sensitivity.

4. The qualified paleontologist will prepare monthly progress reports to be filed with the client and the lead agency.

5. Fossils recovered will be prepared, identified by qualified experts, and listed in a database to allow analysis.

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 qualified paleontologist will prepare a final mitigation report to be filed with the client, the lead agency, and the repository.

8. The qualified paleontologist will recommend one or more accredited repositories for fossils collected depending on the abundance and origin of those fossils. All accredited repositories require curation fees.

Each segment will require different levels of implementation of these measures. Table 1 presents the monitoring requirements for each segment.

Table 1. Monitoring requirements for the Broadwing North Fiber Optic Northern California Interconnection Project.

Segment	Sensitivity	Monitoring Requirements
San Francisco End Link	Low/none	Part time/ none
Santa Clara Data Center 2	Low	Part time
Haywood to Pleasanton Re-Route	High	Full time
Sacramento End Link	Low/High	Part time/ Full time
Sacramento End Loop	Low	Part time
Modesto End Loop	Low	Part time
Stockton End Loop	Low	Part time

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Appendix

Confidential

Sensitivity Maps and Locality Information

RMW Project Number: 01-1829

Paleontological Resources Assessment Report

For

Broadwing Fiber Optic Long Haul Project,

Los Angeles to Ontario to San Diego

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Introduction

RMW Paleo Associates Inc. was retained to evaluate the paleontological resources along the proposed alignment of the Broadwing Fiber Optic Long Haul Route in southern California. The route proceeds east from Los Angeles to Ontario (Figure A-8a), and then south to San Diego (Figure A-9a). The route crosses three southern California counties – Los Angeles, San Bernardino, and San Diego.

Methods and Personnel

Paleontological record searches were requested from the San Bernardino County Museum, the San Diego Natural History Museum, and the Natural History Museum of Los Angeles County, to determine if previous paleontological sites were known within one mile of the proposed alignment. In addition geological maps, geological references, and paleontological references were reviewed for pertinent information.

Cara Corsetti, RMW Paleo Associates Inc. staff geologist and paleontologist researched and wrote the sections on Tertiary geology. Sherri Gust, Principal Investigator for Paleontology at RMW Paleo Associates Inc., performed the remainder of the research and wrote the majority of the report.

Paleontological Resources

Paleontology is a biologic and geologic scientific discipline involving the study of fossils. Despite the tremendous volume of sedimentary rock deposits preserved world-wide, and the enormous number of organisms that have lived through time, preservation of plant or animal remains as fossils is an extremely rare occurrence.

Each fossil is the rare biological record of a unique individual life. Fossils can provide information about the relationships of living and extinct organisms, their ancestry, their development and change through time, and their geographic distribution. Progressive morphologic changes observed in fossil lineages may provide critical information on the ways in which new species arise and adapt, or fail to adapt, to changing environmental circumstances.

Fossils can also serve as important guides to the ages of the rocks and sediments in which they are contained, and may prove useful in determining the temporal relationships of rock deposits from one area to another and the timing of geologic events. Time scales established by fossils provide chronological frameworks for geologic studies of all kinds.

Regulatory Framework

Preservation and salvage of cultural resources, including fossils, are mandated on private and public lands in part by the following federal regulations: Executive Order 12088, October 17, 1978 (43:201, 47707); the Surface Mining Control and Reclamation Act of 1977 (SMCRA, P.L. 95-87, 30 U.S.C. 1201-1328); the Federal Land Management and Policy Act of 1976 (FLPMA, P.L. 94-579, 43 U.S.C. 1701-1782); the National Natural Landmarks Program and Historic Sites Act of 1935 (P.L. 74-292; 49 Stat. 666; 16 U.S.C. 461 *et. seq.*); National Environmental Protection Act of 1969 (P.L. 91-190; 83 Stat. 852; 42 U.S.C. 4321-4327); National Historic Preservation Act of 1966 (P.L. 89-665; 80 Stat. 915; 16 U.S.C. 470 *et. seq.*, am. 1976 P.L. 94-422 and P.L. 94-458); the Montana Power Company decision (Decisions of the Department of the Interior 721.D, A-30310; 518-522, Dec. 3, 1965); Reservoir Salvage Act of 1960, am. 1974 (P.L. 86-523, am. P.L. 93-921); Federal-Aid Highway Act of 1956; U.S. Congress, August 15, 1949 (63 Stat. 606; 20 U.S.C. 78, 78a); Antiquities Act of June 8, 1906 (P.L. 59-209; 34 Stat. 225; 16 U.S.C. 432, 433); the 1872 Mining Law, amended 1962; the Warren Alquist Act, n.b. sec. 25527; and memoranda of opinions, U.S. Department of the Interior, Office of the Solicitor, to Bureau of Land Management, applicability of Antiquities Act to Fossils, 1956-1974.

State of California laws pertaining to paleontologic resources include the California Environmental Quality Act of 1970 (CEQA) (13 PRC: 21000 *et. seq.*); Guidelines for the Implementation of the California Environmental Quality Act as am. May 10, 1980 (14 Cal. Adm. Code: 15000 *et. seq.*, n.b. Chapter 3, Division 6, Title 14, Appendix G); Penal Code Section 622.5 (Stats. 1939, c. 90, p. 1605, S.1); Public Resources Code, Section 5097.5 (Stats. 1965, c. 1136, p. 1791); and Executive Order B-64-80, March 6, 1980.

Southern California counties have local regulations that reflect state law and require appropriate archaeological and paleontological work as part of the building permit process. Reconnaissance, mitigation monitoring, specimen collection, analysis, reporting, and curation are generally required. Most cities have adopted ordinances that mirror those of the counties they are located in.

Paleontological Sensitivity

Paleontological sensitivity is an estimate of the likelihood that fossils will be discovered during excavations into a given rock unit. However, it does not measure the significance of individual fossils present along the project route, because it is impossible to accurately predict what individual fossils may be discovered. The significance of an individual fossil can only be determined after it is found and evaluated.

The sensitivity standards of the Society of Vertebrate Paleontology are used here. These national standards provide four classification levels of sensitivity as follows:

> *High Sensitivity*: Rock units from which vertebrate or significant invertebrate fossils or significant suites of plant fossils have been recovered are considered to have a high potential for containing significant non-renewable fossiliferous resources.
>
> *Low Sensitivity*: Reports in the paleontologic literature of field survey by a qualified vertebrate paleontologist may allow determination that some area or units have low potentials for yielding significant non-renewable fossiliferous resources.
>
> *Undermined Sensitivity*: Specific areas underlain by sedimentary rock units for which little information is available are considered to have undetermined fossiliferous potential.
>
> *No Sensitivity*: Metamorphic and granitic rock units do not yield fossils and therefore have no potential to yield significant non-renewable fossiliferous resources.

Results

Geological Overview of Project Area

Due to the high tectonic activity in southern California, the geological formations do not have a simple stratigraphy and have substantial amounts of local deformation. Many formations older than 2 million years are marine in origin. Both deep water and coastal expansion-and-contraction of shoreline environments are well represented. The majority of fossiliferous terrestrial deposits are fluvial (stream/river transported) in origin. In the last million years there has been substantial uplift and episodes of orogeny (mountains being created). The topography of southern California has changed radically so that in some cases oceanic sediments now lie on mountain tops. The information presented here is based on the most up-to-date geologic information available.

The proposed project reportedly has no impacts deeper than four feet below the ground surface and each impact corridor is approximately 25 feet wide. Each geological formation along the project route that might potentially be impacted is summarized here along with its history of producing fossils.

Stratigraphy and Paleontology of Project Geological Formations

The geological formations are discussed from youngest and most superficial to oldest and deepest. Fossils are generally found only in sedimentary deposits such as those listed below. Volcanic and igneous (heat-transformed) rocks, including granite, are not known to contain fossils.

Common geological terms are described for the reader in this paragraph. A formation is a formally (published in scientific literature) named deposit of bedrock. A rock unit is equivalent to a formation. Alluvium consists of particles of rock, from silt-size to boulder-size, that are deposited by streams and rivers. Fan Deposits are particles of rock, from silt-size to boulder-size, that are moved downslope by gravity. Terrace Deposits are stepped deposits laid down near oceans as the waters ingress and regress. They can be marine or terrestrial sediments.

Recent (Younger Quaternary) Deposits

Geological deposits less than 10, 000 years old are considered to have archaeological, rather than paleontological, potential. The time period from 10,000 years ago to the present is called the Holocene or the Recent (GSA 1999). Various sedimentary deposits including Recent Alluvium, Recent Fan Deposits, and Recent Wind-blown Sands are included in this group. All Recent deposits are too young to contain paleontological resources.

Pleistocene (Older Quaternary) Deposits

The Pleistocene Epoch is a unit of geological time from 1.8 million years ago to 10, 000 years ago (GSA1999). Pleistocene Deposits include Older Alluvium, Older Fan Deposits, and Pleistocene Terrace Deposits. These deposits are geographically widespread.

Older Alluvium and Pleistocene Terrace Deposits have high potential to contain paleontological resources (Cooper & Eisentraut 2000, Demere & Walsh 1993, Jefferson 1991, Scott 1997, Scott 2001, Spring & Scott 1994, Springer & others 1998, Springer & others 1999, Reynolds & Reynolds 1991, Van de Kamp 1973, Woodburne 1991). At the depths exposed by the proposed project, significant Pleistocene fossils might be recovered.

Pauba Formation

The Pauba Formation consists of a cross-bedded sequence of sandstones and siltstones with poorly sorted fanglomerates (Mann 1955). Recent work indicates that Pauba fossils are Late Pleistocene - 0.6 to 0.12 million years old (Pajak & others 1996). The formation is best known in southern Riverside County but also occurs in the Warner Basin of San Diego County.

The Pauba Formation is highly fossiliferous. Almost 50 localities are known within one mile of the proposed Broadwing alignment alone. Fossils known from these localities include gopher, tree frog, lizard, snake, tapir, camel, horse, ground sloth, mastodon and mammoth (McLeod

2001, Pajak & others 1996, Scott 2001). At depths exposed by the proposed project, significant Pleistocene fossils might be recovered.

Lindavista Formation

The Lindavista Formation is a marine and nonmarine terrace deposit consisting of coarse sandstones, pebble conglomerates, and green claystone (Kennedy 1975). Lindavista faunas date Early-Middle Pleistocene, about 1.8 to 0.5 million years ago (Demere and Walsh 1993). This formation accumulated on flat sea floors during periods of falling sea level (Demere and Walsh 1993). The Lindavista Formation forms the extensive mesa surfaces of San Diego (Kennedy 1975).

Fossil localities are relatively rare in the Lindavista Formation and consist largely of marine invertebrates (Demere and Walsh 1993). At the depths exposed by the proposed project, it is unlikely that significant fossils will be encountered.

Fernando Formation

The Fernando Formation is shallow-marine to coastal nonmarine deposits consisting of sandy siltstone, conglomerate and sandstone (Jennings and Strand 1969). Fernando Formation fossils date to the Pliocene or about 5 to 1.8 million years ago (Cooper & Eisentraut, McLeod 2001). The Fernando Formation outcrops across the Los Angeles basin.

Fossil localities in this formation have produced an assortment of marine fishes and sharks, as well as invertebrates (Cooper & Eisentraut, McLeod 2001). At the depths exposed by the proposed project, it is likely that significant fossils might be recovered.

Puente Formation

The 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. Four formal members are recognized: the La Vida, Soquel, Yorba, and Sycamore Canyon. The

La Vida is the oldest member of the Puente Formation, and is characterized by deep-water marine siltstones and shales with minor sandstone beds (Fife 1974). The Soquel Member is a sequence of interbedded sandstones, with rare, thinly bedded diatomaceous shale and siltstone, deposited in a deep-water turbidite system (Fife 1974). The Yorba contains deep-water shales, siltstones and diatomites. The Sycamore Canyon is the uppermost member of the Puente Formation and is comprised of conglomerates and coarse sandstone with minor siltstone beds, all deposited on the outer shelf of a deep marine basin. At the depths exposed by the proposed project, it is likely that significant fossils might be recovered.

The Puente Formation has produced an extensive collection of both marine invertebrates and vertebrates and thus has been assigned a high paleontologic resource sensitivity level (Cooper & Eisentraut 2000).

Friars Formation

The middle Eocene (46 million years old) Friars Formation is the uppermost unit in the La Jolla Group of San Diego (Kennedy 1975, Kennedy & Peterson 1975). The upper and lower tongues of the Friars Formation are composed of up to 50 meters of nonmarine and nearshore marine sandstone, interbedded with dark greenish-gray claystone (Kennedy & Peterson 1975; Demere & Walsh 1993). The edges of an intervening conglomeratic member were recognized by Kennedy (1975) and substantially extended into the Poway region later (Walsh & others 1996).

The Friars Formation in San Diego County has produced an extensive collection of both marine invertebrates and terrestrial vertebrates from over a hundred localities (Demere and Walsh 1993; Walsh 1996). At the depths exposed by the proposed project, significant fossils are likely to be recovered.

Silverado Formation

The Paleocene (63 to 55 million years old) Silverado Formation is comprised of four informal units deposited during nonmarine, brackish water and shallow marine conditions (Lander 1989). Tan and Edgington (1976) describe the general lithology of the Silverardo Formation as consisting of marine sandstone with some interbeds of conglomeratic sandstone, sandy clay and claystone.

Silverado localities have produced an extensive suite of significant invertebrate and plant fossils (Cooper & Eisentraut 2000, Scott 2001). At the depths exposed by the proposed project, significant fossils might be recovered.

Definition of Significance for Paleontological Resources

Determination of the scientific significance of paleontologic resources can only be made by qualified, trained paleontologists, preferably those expert with the fossils under consideration. Fossils are considered to be significant if one or more of the following criteria apply:

1. The fossils provide information on the evolutionary relationships and developmental trends among organisms, living or extinct.
2. The fossils provide data useful in determining the age(s) of the rock unit or sedimentary stratum, including data important in determining the depositional history of the region and the timing of geologic events therein.
3. The fossils provide data regarding the development of biological communities or interaction between paleobotanical and paleozoological biotas.
4. The fossils demonstrate unusual or spectacular circumstances in the history of life.
5. The fossils are in short supply and/or in danger of being depleted or destroyed by the elements, vandalism, or commercial exploitation, and are not found in other geographic locations.

As so defined, significant paleontologic resources are determined to be fossils or assemblages of fossils that are unique, unusual, rare, uncommon, or diagnostically important. Significant fossils can include remains of large to very small aquatic and terrestrial vertebrates or remains of plants and animals previously not represented in certain portions of the stratigraphy. Assemblages of fossils that might aid stratigraphic correlation, particularly those offering data for the interpretation of tectonic events, geomorphologic evolution, and paleoclimatology are also critically important. Paleontologic remains are recognized as nonrenewable resources significant to the history of life.

Paleontological Sensitivity of Project Segments

Paleontological sensitivity is an estimate of the likelihood that fossils will be discovered during excavations into a given rock unit. However, it does not measure the significance of individual fossils present along the project route, because it is impossible to accurately predict what individual fossils may be discovered. The significance of an individual fossil can only be determined after it is found and evaluated.

The proposed project is specified to have no impacts deeper than four feet below the ground surface and the corridor of potential effects runs from the edge of the road to the edge of the right-of-way (about 25 feet). Based on this information, portions of some segments have potential to negatively impact significant paleontological resources due to the unique geology of the region. Specific fossiliferous formations crossed by each segment are listed below along with known records of fossil localities within one mile of the route.

<u>Segment A-8b</u>

The East Los Angeles to Alhambra segment crosses surface exposures of the Puente Formation (Jennings & Strand 1969, McLeod 2001). This Late Miocene marine rock unit has high sensitivity for paleontological resources (Cooper & Eisentraut 2000). There are known fossil localities within ½ mile of the proposed alignment that have yielded fossil whale and fishes (McLeod 2001).

In some locations, there are pockets of terrestrial Pleistocene Terrace Deposits and Older Alluvium (Jennings & Strand 1969, McLeod 2001). These formations have a high sensitivity for paleontological resources (McLeod 2001). One locality, located within ¼ mile of the proposed alignment in Pleistocene Terrace Deposits, has produced fossil horse (McLeod 2001).

<u>Segment A-8c</u>

In the San Gabriel to El Monte segment the alignment crosses surface exposures of terrestrial Pleistocene Terrace Deposits and Older Fan deposits (Jennings & Strand 1969, McLeod 2001). These formations have a high sensitivity for paleontological resources (McLeod 2001).

<u>Segment A-8d</u>

The alignment runs diagonally in this segment from Hacienda Heights to Baldwin Park, then horizontally across West Covina. The initial segment crosses surface exposures of the Fernando Formation (Jennings & Strand 1969, McLeod 2001). This Pliocene marine formation is known to produce significant vertebrate fossils and has a high sensitivity (McLeod 2001).

The remainder of the segment is again in surface exposures of terrestrial Pleistocene Terrace Deposits and Older Fan deposits (Jennings & Strand 1969, McLeod 2001). These formations have a high sensitivity for paleontological resources (McLeod 2001).

<u>Segment A-8e</u>

The alignment from Covina to La Verne crosses surface exposures of terrestrial Older Fan Deposits and Recent Fan Deposits (Jennings & Strand 1969, McLeod 2001). Older Fan Deposits have a low sensitivity for paleontological resources. Recent Fan Deposits are too young to contain fossils.

<u>Segment A-8f</u>

Around Claremont the alignment crosses surface exposures of terrestrial Older Fan Deposits (Jennings & Strand 1969, McLeod 2001). This rock unit has a low sensitivity for paleontological resources.

East of Claremont, Recent Alluvium is encountered (Jennings & Strand 1969, McLeod 2001). The Upland area consists of Recent Fan Deposits (Jennings & Strand 1969, McLeod 2001). These formations are too young to contain paleontological resources.

<u>Segment A-8g</u>

The Cucamonga region again consists of Recent Alluvium (Jennings & Strand 1969, McLeod 2001). This deposit is too young to contain paleontological resources.

Segment A-9b

The alignment crosses surface exposures of Recent Fan Deposits, Recent Wind-blown Sands, and Recent Alluvium in the Guasti region (Rodgers 1965, Scott 2001). These sediments are Holocene and therefore too young to have potential for paleontological resources. At the depths expected on the Broadwing project, underlying Pleistocene sediments should remain undisturbed (Scott 2001).

Segment A-9c

In the region north of Corona, the alignment crosses surface exposures of Older Alluvium (McLeod 2001, Rodgers 1965, Scott 2001). This formation has high potential to contain significant paleontological resources (Cooper & Eisentraut 2000, McLeod 2001, Scott 2001). Late Pleistocene animals recovered from the formation include sabertooth cat, dire wolf, short-faced bear, mammoth, mastodon, ground sloth, horse, camel, and bison (Jefferson 1991, Reynolds & Reynolds 1991, Scott 1997, Springer and Scott 1994, Springer & others 1998, Springer & others 1999, Woodburne 1991). One locality is known within one mile of the proposed alignment (McLeod 2001). It produced fossil deer.

In addition, the alignment crosses the Recent Alluvium of the Santa Ana River (Rodgers 1965, Scott 2001). The Recent Alluvium is too young to contain paleontological resources.

Segment A-9d

Older Alluvium will be encountered in the southern Corona region also (Rodgers 1965, Scott 2001). This formation has high potential to contain significant paleontological resources. Latest Pleistocene animals recovered from the formation include sabertooth cat, dire wolf, short-faced bear, mammoth, mastodon, ground sloth, horse, camel, and bison (Jefferson 1991, Reynolds & Reynolds 1991, Woodburne 1991, Springer and Scott 1994, Scott 1997, Springer & others 1998 & 1999).

Near the City of El Cerito the alignment crosses surface exposures of the Puente Formation, a middle Miocene marine rock unit (Gray 1961, Rodgers 1965, Scott 2001). This formation has a high potential to contain significant paleontological resources (Cooper & Eisentraut, McLeod 2001, Scott 2001).

South of Temescal Canyon, the alignment encounters surface exposures of the Silverado Formation (Gray 1961, Rodgers 1965, Scott 2001). The Silverado has high sensitivity for paleontological resources (Cooper & Eisentraut, McLeod 2001, Scott 2001). Plant fossils have been recovered from localities within ½ mile of the proposed alignment (Scott 2001).

<u>Segment A-9e</u>

In the Temescal Valley, the alignment continues in surface exposures of the Silverado Formation (Rodgers 1965, Scott 2001). This formation has high potential to contain significant paleontological resources (Cooper & Eisentraut 2000, McLeod 2001, Scott 2001). Multiple paleontological localities within ½ mile of the proposed alignment have yielded fossils of bivalve, shark, and plants (Scott 2001).

In some spots, Older Alluvium partially overlies the Silverado (Rodgers 1965, Scott 2001). This formation has high potential to contain significant paleontological resources (Cooper & Eisentraut 2000, McLeod 2001, Scott 2001). At one paleontological locality fossils were recovered from both formations close to the alignment (Scott 2001).

<u>Segment A-9f</u>

The alignment continues in surface exposures of the Silverado Formation in this segment (Rodgers 1965, Scott 2001). This formation has high potential to contain significant paleontological resources (Cooper & Eisentraut 2000, McLeod 2001, Scott 2001). One locality is known within a mile of the alignment near Alberhill (Scott 2001). It yielded fossil wood and other plant materials.

<u>Segment A-9g</u>

The alignment continues in surface exposures of the Silverado Formation past Lake Elsinore (Rodgers 1965, Scott 2001). This formation has high potential to contain significant paleontological resources (Cooper & Eisentraut 2000, McLeod 2001, Scott 2001). Six paleontological localities are known within one mile of the alignment near Lake Elsinore (McLeod 2001, Scott 2001). They have produced fossil camel, shells and plants.

Segment A-9h

In this segment the alignment crosses mostly surface exposures of Recent Alluvium (Rodgers 1965, Scott 2001). This formation is too young to contain paleontological resources.

The southern portion crosses surface exposures of the Pauba Formation (Rodgers 1965, Scott 2001). This Pleistocene terrestrial rock unit has a high sensitivity for paleontological resources (McLeod 2001, Pajak & others 1996, Scott 2001).

Segment A-9i

In and around Murrieta the alignment crosses surface exposures of the Pauba Formation, a Pleistocene terrestrial rock unit (Rodgers 1965, Pajak & others 1996, Scott 2001). This formation has a high sensitivity for paleontological resources (McLeod 2001, Pajak & others 1996, Scott 2001). Three paleontological localities are located directly on the proposed alignment. Fossils known from these localities include tapir, camel, horse, ground sloth, mastodon and mammoth (Pajak & others 1996). An additional 44 fossil localities are known in the Pauba Formation within one mile of the alignment in this segment (McLeod 2001, Scott 2001).

Segment A-9j

Most of the alignment crosses surface exposures of the Pauba Formation, a Pleistocene terrestrial rock unit (Rodgers 1965, Pajak & others 1996). This rock unit has a high sensitivity for paleontological resources (McLeod 2001, Pajak & others 1996, Scott 2001). Three paleontological localities are known within one mile of the alignment (McLeod 2001, Scott 2001). The localities yielded fossil horse, gopher, tree frog, lizard and snake.

The southernmost portion of the alignment crosses granitic rocks (Rodgers 1965). These types of rocks do not contain fossils.

Segment A-9k

As this segment of the alignment crosses the county line between Riverside and San Diego, it courses through granitic rocks (Rodgers 1965). Along Rice Canyon Road, it again encounters granitic rocks. Since granitic rocks do not contain fossils, there is no sensitivity for paleontological resources.

Only in the Rainbow Valley does the route cross Recent Alluvium overlying Older Alluvium (Rodgers 1965). Recent alluvium is too young to contain paleontological resources. Older Alluvium has a high sensitivity to contain fossils (Cooper & Eisentraut, Demere & Walsh 1993, McLeod 2001, Scott 2001).

Segment A-9l

The portions of the alignment through Rice Canyon and Courser Canyon cross granitic rock units (Rodgers 1965). They have no sensitivity for paleontological resources.

Along the San Luis Rey River drainage, Recent Alluvium is present (Rodgers 1965). This rock unit is too young to contain fossils.

Segment A-9m

This entire segment of the alignment crosses granitic rocks (Rodgers 1965). They have no sensitivity for paleontological resources.

Segment A-9n

The ends of the alignment, along Valley Center Road, cross igneous rock units (Rodgers 1965). This rock type has no sensitivity for paleontological resources.

Around the town of Valley Center, Recent Alluvium is present (Rodgers 1965). This rock unit is too young to contain fossils.

Segment A-9o

This entire segment of the alignment crosses granitic and other igneous rocks (Rodgers 1965). Igneous rocks have no sensitivity for paleontological resources.

Segment A-9p

The northern 2/3 of the alignment continues in granitic and other igneous rocks (Rodgers 1965). Igneous rock has no sensitivity for paleontological resources.

Along Sunset Drive the alignment crosses surface exposures of Recent Alluvium (Rodgers 1965). This deposit is too young to contain paleontological materials.

Segment A-9q

The alignment crosses the drainage of Lake Hodges next to the freeway (Kennedy 1975 [Escondido]). The sediments consist of Recent Alluvium. These sediments are too young to be sensitive for paleontological resources.

Most of the remaining alignment in this segment crosses surface exposures of granitic rocks (Kennedy 1975 [Escondido]). These rocks have no sensitivity for paleontological resources.

At the southern end the alignment crosses surface exposures of the Friars Formation (Kennedy 1975 [Escondido]). The Friars Formation has a high sensitivity for paleontological resources (Demere & Walsh 1993, Walsh & others 1996).

Segment A-9r

The alignment crosses surface exposures of the Friars Formation in four locations (Kennedy & Peterson 1975 [Poway]): at the northernmost end of the segment, at the bend in the northern half, just past the bend and in the portion past Poway Creek. The Friars Formation has a high sensitivity for paleontological resources (Demere & Walsh 1993, Walsh & others 1996). Eight fossil localities are known within a mile of the alignment (Wagner 2001). They have yielded brontothere, deer, opossum, hedgehog, rodent, and primate fossils. In addition, fossil leaves and other plant materials were recovered.

The alignment passes through nonfossilierous granitic rocks north of the bend in the northern half of the segment (Kennedy & Peterson 1975 [Poway]). Granitic rocks have no sensitivity for paleontological resources.

From the "bend" in the northern portion of the alignment to Poway Creek, the alignment encounters surface exposures of Recent Alluvium (Kennedy & Peterson 1975 [Poway]). This deposit is too young to contain paleontological resources.

Segment A-9s

Almost the entire segment crosses surface exposures of the Friars Formation (Walsh & others 1996, revising Kennedy & Peterson 1975 [Poway]). The Friars Formation has a high sensitivity for paleontological resources (Demere & Walsh 1993, Walsh & others 1996). Numerous fossil localities are known just west of the alignment in the northern half of the segment (Wagner 2001). They contained fossil rodents and insectivores.

Portions of the alignment along Carrol Canyon briefly cross, or border, Recent Alluvium (Kennedy & Peterson 1975 [Poway]). This formation is too young to contain paleontological resources.

At the southernmost end, the alignment encounters the Lindavista Formation (Kennedy & Peterson 1975 [La Mesa]). This Pleistocene marine terrace formation has a low sensitivity for paleontological resources (Demere & Walsh 1993).

Segment A-9t

Most of the alignment continues in the Lindavista Formation (Kennedy 1975 [La Jolla]). This Pleistocene marine terrace formation has a low sensitivity for paleontological resources (Demere & Walsh 1993). Two localities are known in the Linda Vista Formation within one mile of Kearny Villa Road (Wagner 2001). They have yielded six different bivalves and preserved burrows.

The portions of the alignment that cross Rose Canyon and San Clemente Canyon encounter Recent Alluvium (Kennedy & Peterson 1975 [Poway]). This formation is too young to contain paleontological resources.

Summary of Sensitive and Nonsensitive Segments

The following segments have a high sensitivity for paleontological resources and should be monitored full-time during all earthmoving activities: -8b, -8c, -8d, -9c, -9d, -9e, -9f, -9g, -9h, -9i, -9j, -9r and -9s. The following segments have small portions with high sensitivity for paleontological resources and during earthmoving in those portions only, monitoring should be full-time: -9k and –9q. The following segments have low sensitivity for paleontological resources and should be monitored by spot-checking: -8e, -8f and -9t. The following segments have no sensitivity for paleontological resources and do not require the presence of a monitor: -8g, -9b, -9l, -9m, -9n, -9o and -9p.

No Action/No project Alternative Impacts

A no project alternative would prevent destruction of fossils and protect the paleontological resources for future scientific inquiry. However, in that instance, no fossils or other paleontological materials would be available to help unravel the complex geological history of the project area. No scientific or educational materials would be developed or made available to increase knowledge of the region’s geology or fossils.

Recommended Mitigation Measures

All grading operations are likely to result in the destruction of fossils unless proper mitigation measures are implemented. Fossils are an important, nonrenewable scientific resource. 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. While this project will have a relatively small cumulative impact on the region's paleontological resources, it is important to keep in mind the amount of local rock units/fossils already made unavailable for study.

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 the meet requirements of the Counties of Los Angeles, Riverside, San Bernardino, San Diego plus CEQA. These mitigation measures have been used throughout southern California and have been demonstrated to be successful in protecting paleontological resources while allowing timely completion of construction.

1. A qualified paleontologist will be retained to perform monitoring of construction excavations. 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 divert grading away from exposed fossils temporarily in order to recover the fossil specimens.

2. If microfossils are present, the monitor will collect matrix for processing. Testing will consist of screen washing small samples (100 pounds) to determine if significant fossils are present. Productive tests will result in screen washing of additional matrix to procure a scientifically significant sample.

3. All earth moving in areas of high paleontological sensitivity will be monitored full-time. Spot-checking will monitor Earth moving in areas of low sensitivity.

4. The qualified paleontologist will prepare monthly progress reports to be filed with the client and the lead agency.

5. Fossils recovered will be prepared, identified by qualified experts, and listed in a database to allow analysis.

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 qualified paleontologist will prepare a final mitigation report to be filed with the client, the lead agency, and the repository.

8. The qualified paleontologist will recommend one or more accredited repositories for fossils collected depending on the abundance and origin of those fossils. All accredited repositories require curation fees.

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CONFIDENTIAL APPENDIX 1:
RECORD SEARCHES

(not included)