

PALEONTOLOGICAL INVENTORY REPORT

WASTEWATER TREATMENT PLANT FACILITY ASSESSMENT PROJECT

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1.0 EXECUTIVE SUMMARY

This Paleontological Inventory Report was prepared by Paleo Solutions, Inc. (Paleo Solutions) under contract to Parsons on behalf of the City of Redlands (City) for the Wastewater Treatment Plant (WWTP) Facility Assessment Project (Project). The purpose of this study is to identify potential impacts to paleontological resources resulting from construction of the Project. The State Water Regional Control Board (SWRCB), Division of Financial Assistance, is the Responsible (Lead) Agency for the Project. None of the federal crosscutting regulations for the Project apply to paleontological resources. The Project is subject to compliance with the California Environmental Quality Act (CEQA), state and local regulations, and best practices in mitigation paleontology (Murphey et al., 2014).

The approximately 80.85-acre Project is located at 1950 Nevada Street in the City of Redlands in San Bernardino County, California. Since 1962, the City has owned and operated the City of Redlands Water Reclamation Facility. The original wastewater treatment plant (WWTP) was constructed in 1962. In 1971, the California Regional Water Quality Control Board (RWQCB) instituted new discharge requirements. The WWTP underwent an extensive expansion and modification. The facility has undergone several updates and additional construction episodes: 1987, 1989, 2003, and 2006. The current plant has an average flow of 5.8 million gallons per day (mgd). The Project involves upgrade to the existing WWTP with a state-of-the-art 9.5 mgd membrane bioreactor (MBR) filtration complex (MBR system) and includes improvements for reliability and redundancy. Utility work and pipeline installation would typically include trenching to a maximum depth of 15 feet in a corridor approximately 15 feet wide. Excavations required for the prefabricated buildings foundations would have a maximum depth of 2 feet.

The paleontological study for the Project consisted of an analysis of existing data, which included a review of geologic maps, published and unpublished literature, and results of a museum records search and online database searches. According to geologic mapping by Morton and Miller (2006), the Project area is underlain by late Holocene-age very young wash deposits (Qw, Qw1) and middle Holocene-age young axial-channel deposits (Qya3). Additionally, previous geotechnical studies have identified unmapped artificial fill varying in thickness from 2 to 15 feet within the Project area. Although not mapped at the surface, Pleistocene-age deposits may underlie the artificial fill or Holocene-age sediments at shallow or unknown depths. Based on the analysis of existing data, there are no documented paleontological localities within the boundaries of the Project area. However, numerous scientifically significant fossils are known from Pleistocene-age deposits throughout San Bernardino County. According to the Bureau of Land Management (BLM) Potential Fossil Yield Classification (PFYC) system (BLM, 2016), late Holocene-age very young wash deposits (Qw, Qw1), middle Holocene-age young axial-channel deposits (Qya3), and unmapped artificial fill all have a low paleontological potential (PFYC 2), increasing with depth. Based on this assessment and the depth of anticipated ground-disturbing activities, Project activities within the Project area may potentially result in significant impacts to paleontological resources during excavation.

Based on the results of this paleontological assessment, we recommend part-time monitoring (i.e., spot-checking) when ground disturbing activities impact sediments at 8 feet below ground surface or deeper to check for the presence of Pleistocene-age deposits. If Pleistocene-age deposits are observed at depth and impacted by Project excavations, then monitoring efforts should be increased to full-time. If only artificial fill, late Holocene-age very young wash deposits (Qw, Qw1), and middle Holocene-age young axial-channel deposits (Qya3) are observed, then spot-checking can be reduced or ceased at the discretion of a Qualified Paleontologist in consultation with the City. Any subsurface bones or potential fossils that are unearthed during construction should be evaluated by a Qualified Paleontologist.



2.0 INTRODUCTION

This Paleontological Inventory Report was prepared by Paleo Solutions under contract to Parsons on behalf of the City. The purpose of this study is to identify potential impacts to paleontological resources resulting from construction of the Project. All work was conducted in compliance of CEQA, state and local regulations, and best practices in mitigation paleontology (Murphey et al., 2014). A Project summary is provided in Table 1.

2.1 PROJECT DESCRIPTION

The purpose of the proposed project is to complete an assessment of the wastewater treatment process components, make recommendations for improvements or repairs necessary to handle existing inflow based on the assessment, prepare an implementation plan for suggested work, and complete the design of resulting projects(s) to maintain the WWTP at its current capacity and allow the City to forgo future improvements for the next 20 to 30 years.

WWTP Facility Upgrades. The Project involves upgrade to the existing WWTP with a state-of-the-art 9.5 mgd MBR filtration complex (MBR system) and includes the necessary improvements for reliability and redundancy. An MBR system is a widely used sanitation system designed to settle solids, use microbes to digest sludge, and separate sludge from treated effluent, which then is clean enough to be discharged back into the water table. Construction of the upgrades and improvements is estimated to require approximately 24 months. This would include earthwork on approximately 75,000 square feet within the current property. Construction would include the installation of five prefabricated buildings, each of which would be approximately 400 square feet in area, a new mixing system for the peak storage ponds as well as proper pedestrian access to the bottom of the ponds, a new centrate equalization tank, and replacement and upgrades of pumps. Excavations required for the prefabricated buildings foundations would have a maximum depth of 2 feet. Proposed landscaping includes planting of approximately 50 trees along the east side of the frontage road and the along the southern and eastern perimeter of the facility. Other site improvements include beautification and an entry monument at the Nevada Street entrance, landscaping along the existing access road from Nevada Street, walkway and patio improvements, informational exhibits, and a small access road west of the main operations building. Project construction would require approximately 6,500 linear feet of utility trenching. Utility work would typically include trenching to a maximum depth of 15 feet in a corridor approximately 15 feet wide.

Redundant Pipelines. The Project also involves construction of four redundant pipelines to increase system reliability. A 300-foot-long pipeline will be constructed from the headworks located at the center of the plant and will trend northeasterly and then northerly to tie-in to the primary clarifiers. A 375-foot-long pipeline will be constructed from the primary clarifiers and will trend westerly to the peak storage ponds at the northwestern section of the plant. A 220-foot-long pipeline will be constructed along the northern edge of the plant from aeration basin to membrane basins. A 1,200-foot-long, 27-inch diameter force main pipeline will be constructed from the effluent pump station and will trend southerly and then easterly through the drying ponds, approximately 10 feet from and roughly parallel to the existing pipeline, and across Alabama Street to the southwest corner of the percolation ponds. The new force main pipeline will end in a valve vault with a tee between the two pipelines before the first percolation pond. Trenching for the pipelines will impact a maximum depth of 15 feet and a width of 15 feet.



2.2 PROJECT LOCATION

The Project is located in the City of Redlands, San Bernardino County, California (Figure 1). The Project is located on unsurveyed portion of the San Bernardino Land Grant on the Redlands 7.5' U.S. Geological Survey topographic quadrangle (Figure 2). The approximately 80.85-acre project is the current property of the Redlands WWTP. It is located at 1950 Nevada Street in north Redlands, north of Interstate 10, and west of Interstate 210 (Foothill Freeway). The Project is located on the main WWTP facility and alignment of the force main pipeline extending from the main facility to the percolation ponds east of Alabama Street. The Project is located along the Santa Ana River, which flows from the east to west on the north side of the Project. According to geologic mapping by Morton and Miller (2006), the Project area is underlain by late Holocene-age very young wash deposits (Qw, Qw1) and middle Holocene-age young axial-channel deposits (Qya3).

Table 1. Wastewater Treatment Plant Facility Assessment Project Summary

Project Name	Wastewater Treatment Plant Facility Assessment Project
<p>Project Description</p>	<p>Construction would include the installation of five prefabricated buildings, each of which would be approximately 400 square feet in area, a new mixing system for the peak storage ponds as well as proper pedestrian access to the bottom of the ponds, a new centrate equalization tank, and replacement and upgrades of pumps. Excavations required for the prefabricated buildings foundations would have a maximum depth of 2 feet. Proposed landscaping includes planting of approximately 50 trees along the east side of the frontage road and the along the southern and eastern perimeter of the facility. Other site improvements include beautification and an entry monument at the Nevada Street entrance, landscaping along the existing access road from Nevada Street, walkway and patio improvements, informational exhibits, and a small access road west of the main operations building. Project construction would require approximately 6,500 linear feet of utility trenching. Utility work would typically include trenching to a maximum depth of 15 feet in a corridor approximately 15 feet wide.</p> <p>Additionally, four redundant pipelines will be constructed to increase system reliability. A 300-foot-long pipeline will be constructed from the headworks located at the center of the plant and will trend northeasterly and then northerly to tie-in to the primary clarifiers. A 375-foot-long pipeline will be constructed from the primary clarifiers and will trend westerly to the peak storage ponds at the northwestern section of the plant. A 220-foot-long pipeline will be constructed along the northern edge of the plant from aeration basin to membrane basins. A 1,200-foot-long, 27-inch diameter force main pipeline will be constructed from the effluent pump station and will trend southerly and then easterly through the drying ponds, approximately 10 feet from and roughly parallel to the existing pipeline, and across Alabama Street to the southwest corner of the percolation ponds. The new force main pipeline will end in a valve vault with a tee between the two pipelines before the first percolation pond. Trenching for the pipelines will impact a maximum depth of 15 feet and a width of 15 feet.</p>
<p>Project Area</p>	<p>The Project is located in the City of Redlands, San Bernardino County, California. The approximately 80.85-acre project is the current property of the Redlands WWTP. It is located at 1950 Nevada Street in north Redlands, north of Interstate 10, and west of Interstate 210 (Foothill Freeway). The Project is located on the main WWTP facility and alignment of the force main pipeline extending from the main facility to the percolation ponds east of Alabama Street. The Project is located along the Santa Ana River, which flows from the east to west on the north side of the Project.</p>



Location (PLSS)	Quarter-Quarter	Section	Township	Range
	Unsectioned	Unsectioned	Unsectioned	Unsectioned
	N/A	9	T1S	R3W
	N/A	16	T1S	R3W
Land Owner	City of Redlands			
Topographic Map(s)	Redlands (1978), CA USGS 7.5' Quadrangle			
Geologic Map(s)	Morton, D.M., Miller, F.K., 2006, Geologic Map of the San Bernardino and Santa Ana 30' x 60' quadrangles, California: U.S. Geological Survey, Open-File Report 2006-1217, scale 1:100,000.			
Geologic Unit(s) and Age	Geologic Unit	Map Symbol	Age	Paleontological Potential (PFYC)
	Unmapped artificial fill	N/A	Recent	2 (Low)
	Very young wash deposits	Qw, Qw1	late Holocene	2 (Low)
	Young axial-channel deposits	Qya3	middle Holocene	2 (Low)
Previously Documented Fossil Localities within the Project Area	None			
Recommendation(s)	Based on the results of this paleontological assessment, we recommend part-time monitoring (i.e., spot-checking) when ground disturbing activities impact sediments at 8 feet below ground surface or deeper to check for the presence of Pleistocene-age deposits. If Pleistocene-age deposits are observed at depth and impacted by Project excavations, then monitoring efforts should be increased to full-time. If only artificial fill, late Holocene-age very young wash deposits (Qw, Qw1), and middle Holocene-age young axial-channel deposits (Qya3) are observed, then spot-checking can be reduced or ceased at the discretion of a Qualified Paleontologist in consultation with the City. Any subsurface bones or potential fossils that are unearthed during construction should be evaluated, recorded, and reported by a Qualified Paleontologist.			

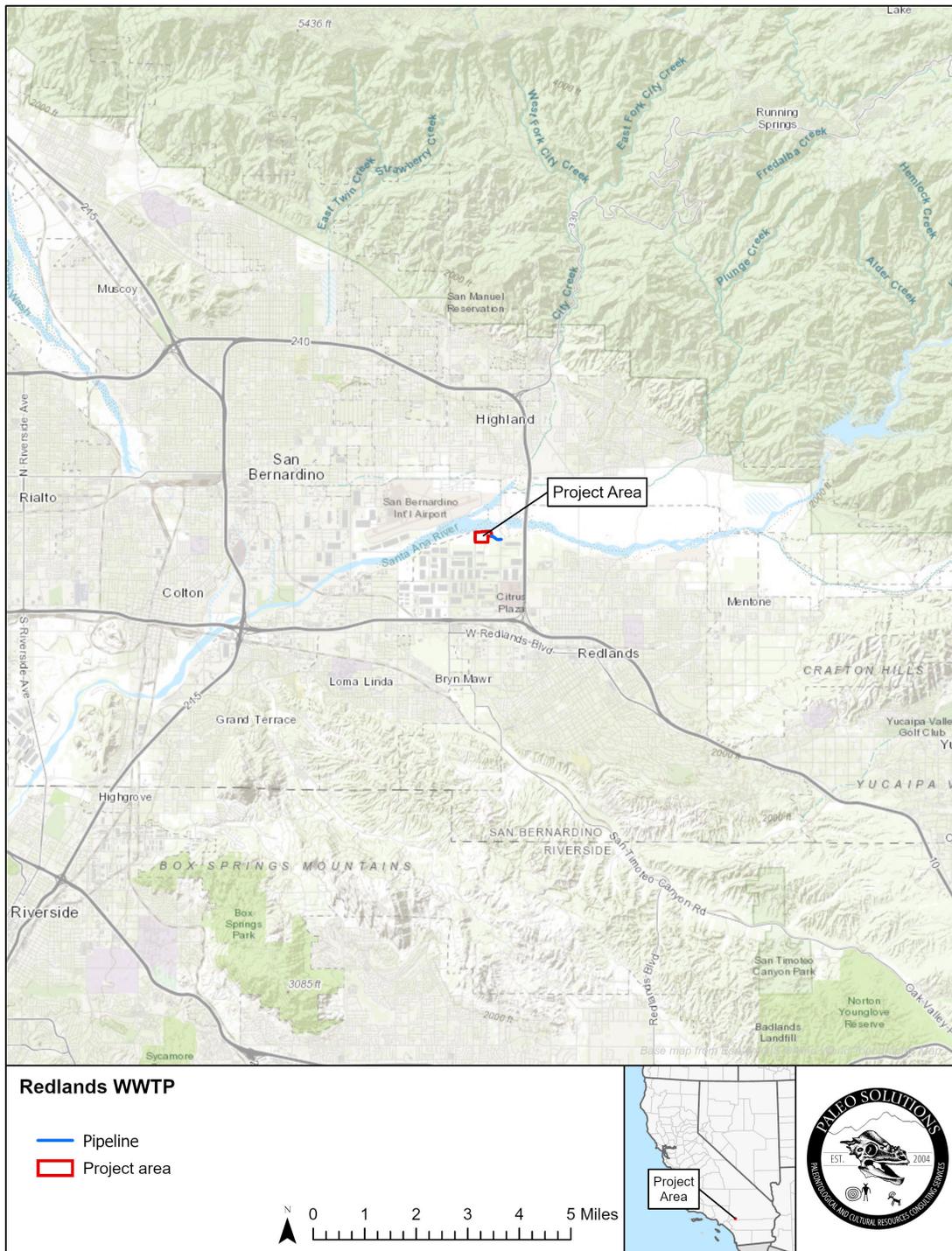


Figure 1. Project Location Map



Figure 2. Project Vicinity Map



3.0 DEFINITION AND SIGNIFICANCE OF PALEONTOLOGICAL RESOURCES

As defined by Murphey and Daitch (2007): “Paleontology is a multidisciplinary science that combines elements of geology, biology, chemistry, and physics in an effort to understand the history of life on earth. Paleontological resources, or fossils, are the remains, imprints, or traces of once-living organisms preserved in rocks and sediments. These include mineralized, partially mineralized, or unmineralized bones and teeth, soft tissues, shells, wood, leaf impressions, footprints, burrows, and microscopic remains. Paleontological resources include not only fossils themselves, but also the associated rocks or organic matter and the physical characteristics of the fossils’ associated sedimentary matrix.

The fossil record is the only evidence that life on earth has existed for more than 3.6 billion years. Fossils are considered non-renewable resources because the organisms they represent no longer exist. Thus, once destroyed, a fossil can never be replaced. Fossils are important scientific and educational resources because they are used to:

- Study the phylogenetic relationships amongst extinct organisms, as well as their relationships to modern groups;
- Elucidate the taphonomic, behavioral, temporal, and diagenetic pathways responsible for fossil preservation, including the biases inherent in the fossil record;
- Reconstruct ancient environments, climate change, and paleoecological relationships;
- Provide a measure of relative geologic dating that forms the basis for biochronology and biostratigraphy, and which is an independent and corroborating line of evidence for isotopic dating;
- Study the geographic distribution of organisms and tectonic movements of land masses and ocean basins through time;
- Study patterns and processes of evolution, extinction, and speciation; and
- Identify past and potential future human-caused effects to global environments and climates.”

Fossil resources vary widely in their relative abundance and distribution and not all are regarded as significant. According to BLM Instructional Memorandum (IM) 2009-011, a “Significant Paleontological Resource” is defined as:

“Any paleontological resource that is considered to be of scientific interest, including most vertebrate fossil remains and traces, and certain rare or unusual invertebrate and plant fossils. A significant paleontological resource is considered to be of scientific interest if it is a rare or previously unknown species, it is of high quality and well-preserved, it preserves a previously unknown anatomical or other characteristic, provides new information about the history of life on earth, or has an identified educational or recreational value. Paleontological resources that may be considered not to have scientific significance include those that lack provenience or context, lack physical integrity due to decay or natural erosion, or that are overly



redundant or are otherwise not useful for research. Vertebrate fossil remains and traces include bone, scales, scutes, skin impressions, burrows, tracks, tail drag marks, vertebrate coprolites (feces), gastroliths (stomach stones), or other physical evidence of past vertebrate life or activities” (BLM, 2008).

Vertebrate fossils, whether preserved remains or track ways, are classified as significant by most state and federal agencies and professional groups (and are specifically protected under the California Public Resources Code). In some cases, fossils of plants or invertebrate animals are also considered significant and can provide important information about ancient local environments. Assessment of significance is also subject to the CEQA criterion that the resource constitutes a “unique paleontological resource or site.”

The full significance of fossil specimens or fossil assemblages cannot be accurately predicted before they are collected, and in many cases, before they are prepared in the laboratory and compared with previously collected fossils. Pre-construction assessment of significance associated with an area or formation must be made based on previous finds, characteristics of the sediments, and other methods that can be used to determine paleoenvironmental and taphonomic conditions.

4.0 LAWS, ORDINANCES, REGULATIONS, AND STANDARDS

This section of the report presents the applicable state and local regulatory requirements pertaining to paleontological resources that apply to this Project. None of the federal crosscutting regulations for the Project apply to paleontological resources.

4.1 STATE REGULATORY SETTING

4.1.1 California Environmental Quality Act (CEQA)

The procedures, types of activities, persons, and public agencies required to comply with the CEQA are defined in the Guidelines for Implementation of CEQA (State CEQA Guidelines), as amended on March 18, 2010 (Title 14, Section 15000 et seq. of the California Code of Regulations) and further amended January 4th, 2013 and again December 28, 2018. One of the questions listed in the CEQA Environmental Checklist is: “Would the project directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?” (State CEQA Guidelines Appendix G, Section VII, Part F).

4.1.2 State of California Public Resources Code

The State of California Public Resources Code (Chapter 1.7), Sections 5097 and 30244, includes additional state level requirements for the assessment and management of paleontological resources. These statutes require reasonable mitigation of adverse impacts to paleontological resources resulting from development on state lands, and define the excavation, destruction, or removal of paleontological “sites” or “features” from public lands without the express permission of the jurisdictional agency as a misdemeanor. As used in Section 5097, “state lands” refers to lands owned by, or under the jurisdiction of, the state or any state agency. “Public lands” is defined as lands owned by, or under the jurisdiction of, the state, or any city, county, district, authority, or public corporation, or any agency thereof.



4.2 LOCAL REGULATORY SETTING

4.2.1 San Bernardino County

The Conservation Element of the San Bernardino County General Plan (2007) contains one goal (CO 3) and one map (Paleontologic Resources Overlay Map, noted in the General Plan as “not available yet”), as well as three programs regarding paleontological resources within the County. Goal CO 3 requires that the County will preserve and promote its historic and prehistoric cultural heritage. Three programs within the General Plan delineate the required County actions regarding paleontological resources. In areas of potential but unknown sensitivity, field surveys prior to grading will be required to establish the need for paleontologic monitoring. Projects requiring grading plans that are located in areas of known fossil occurrences, or demonstrated in a field survey to have fossils present, will have all rough grading (cuts greater than 3 feet) monitored by trained paleontologic crews working under the direction of a qualified professional, so that fossils exposed during grading can be recovered and preserved. Fossils include large and small vertebrate fossils; the latter recovered by screen washing of bulk samples. Finally, a report of findings with an itemized accession inventory will be prepared as evidence that monitoring has been successfully completed. A preliminary report will be submitted and approved prior to granting of building permits, and a final report will be submitted and approved prior to granting of occupancy permits. The adequacy of paleontologic reports will be determined in consultation with the Curator of Earth Science, San Bernardino County Museum.

4.2.2 City of Redlands

The City of Redlands General Plan 2035 (City of Redlands, 2017) contains two policies and two actions regarding paleontological resources within the Cultural Resources section. Policy 2-P.16 states project proponents shall work with local paleontologists to identify significant non-renewable paleontological resources, and Policy 2-P.17 states that archaeological and paleontological resources shall be protected for their aesthetic, scientific, educational, and cultural values. Action 2-A.75 states that as a standard condition of approval, that project applicants shall provide an assessment as to whether grading for the proposed project would impact underlying soil units or geologic formations that have a moderate to high potential to yield fossiliferous materials, prior to issuance of a grading permit. If the potential for fossil discovery is moderate to high, the City shall require applicants to provide a paleontological monitor during rough grading of the project. Action 2-A.76 requires establishment of a procedure for the management of paleontological materials found on-site during a development, including the following provisions:

- If materials are found on-site during grading, require that work be halted until a qualified professional evaluates the find to determine if it represents a significant paleontological resource;
- If the resource is determined to be significant, the paleontologist shall supervise removal of the material and determine the most appropriate archival storage of the material; and
- Appropriate materials shall be prepared, catalogued, and archived at the applicant’s expense and shall be retained within San Bernardino County if feasible.

5.0 METHODS

The paleontological study for the Project consisted of an analysis of existing data, which included a review of geologic maps, published and unpublished literature, and results of a museum records



search and online database searches. The goal of this report is to identify potential impacts to paleontological resources resulting from construction of the Project. Mathew Carson, M.S., authored this report. Barbara Webster, M.S., prepared the GIS maps. Geraldine Aron, M.S., oversaw all work as the Paleontological Program Director and Principal Investigator.

Copies of this report were submitted to Parsons, the City, and SWRCB. Paleo Solutions retained an archival copy of all Project information.

5.1 ANALYSIS OF EXISTING DATA

Paleo Solutions reviewed geologic mapping of the Project area by Morton and Miller (2006). The geology underlying the Project area was reviewed, as well as any geologic units occurring within a quarter-mile radius. The literature reviewed included published and unpublished scientific papers. The museum records search was performed at the Western Science Center (WSC). The results of the museum records search were received by the WSC on May 7, 2019 (see confidential Appendix A). The museum records search was supplemented by a review of the online University of California Museum of Paleontology (UCMP) database and the Paleobiology Database (PBDB).

5.2 CRITERIA FOR EVALUATING PALEONTOLOGICAL POTENTIAL

The PFYC system was developed by the BLM (BLM, 2016). Because of its demonstrated usefulness as a resource management tool, the PFYC has been utilized for many years for projects across the country, regardless of land ownership. It is a predictive resource management tool that classifies geologic units on their likelihood to contain paleontological resources on a scale of 1 (very low potential) to 5 (very high potential). This system is intended to aid in predicting, assessing, and mitigating paleontological resources. The PFYC ranking system is summarized in Table 2.

Table 2. Potential Fossil Yield Classification (BLM, 2016)

BLM PFYC Designation	Assignment Criteria Guidelines and Management Summary (PFYC System)
1 = Very Low Potential	Geologic units are not likely to contain recognizable paleontological resources.
	Units are igneous or metamorphic, excluding air-fall and reworked volcanic ash units.
	Units are Precambrian in age.
	Management concern is usually negligible, and impact mitigation is unnecessary except in rare or isolated circumstances.
2 = Low Potential	Geologic units are not likely to contain paleontological resources.
	Field surveys have verified that significant paleontological resources are not present or are very rare.
	Units are generally younger than 10,000 years before present.
	Recent eolian deposits.
	Sediments exhibit significant physical and chemical changes (i.e., diagenetic alteration) that make fossil preservation unlikely.
	Management concern is generally low, and impact mitigation is usually unnecessary except in occasional or isolated circumstances.
3 = Moderate Potential	Sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence.
	Marine in origin with sporadic known occurrences of paleontological resources.
	Paleontological resources may occur intermittently, but these occurrences are widely scattered.
	The potential for authorized land use to impact a significant paleontological resource is known to be low-to-moderate.



BLM PFYC Designation	Assignment Criteria Guidelines and Management Summary (PFYC System)
	<p>Management concerns are moderate. Management options could include record searches, pre-disturbance surveys, monitoring, mitigation, or avoidance. Opportunities may exist for hobby collecting. Surface-disturbing activities may require sufficient assessment to determine whether significant paleontological resources occur in the area of a proposed action and whether the action could affect the paleontological resources.</p>
4 = High Potential	Geologic units that are known to contain a high occurrence of paleontological resources.
	Significant paleontological resources have been documented but may vary in occurrence and predictability.
	Surface-disturbing activities may adversely affect paleontological resources.
	Rare or uncommon fossils, including nonvertebrate (such as soft body preservation) or unusual plant fossils, may be present.
	Illegal collecting activities may impact some areas.
	Management concern is moderate to high depending on the proposed action. A field survey by a qualified paleontologist is often needed to assess local conditions. On-site monitoring or spot-checking may be necessary during land disturbing activities. Avoidance of known paleontological resources may be necessary.
5 = Very High Potential	Highly fossiliferous geologic units that consistently and predictably produce significant paleontological resources.
	Significant paleontological resources have been documented and occur consistently.
	Paleontological resources are highly susceptible to adverse impacts from surface disturbing activities.
	Unit is frequently the focus of illegal collecting activities.
	Management concern is high to very high. A field survey by a qualified paleontologist is almost always needed and on-site monitoring may be necessary during land use activities. Avoidance or resource preservation through controlled access, designation of areas of avoidance, or special management designations should be considered.
U = Unknown Potential	Geologic units that cannot receive an informed PFYC assignment.
	Geological units may exhibit features or preservational conditions that suggest significant paleontological resources could be present, but little information about the actual paleontological resources of the unit or area is unknown.
	Geologic units represented on a map are based on lithologic character or basis of origin, but have not been studied in detail.
	Scientific literature does not exist or does not reveal the nature of paleontological resources.
	Reports of paleontological resources are anecdotal or have not been verified.
	Area or geologic unit is poorly or under-studied.
	BLM staff has not yet been able to assess the nature of the geologic unit.
	Until a provisional assignment is made, geologic units with unknown potential have medium to high management concerns. Field surveys are normally necessary, especially prior to authorizing a ground-disturbing activity.

6.0 ANALYSIS OF EXISTING DATA

The Project area is located within the northern-most portion of the Peninsular Ranges Geomorphic Province (Harden, 2004). A geomorphic province is a geographical area of distinct landscape character, with related geophysical features, including relief, landforms, orientations of valleys and



mountains, type of vegetation, and other geomorphic attributes (Harden, 2004). Attributes of the Peninsular Ranges Geomorphic Province consist of northwest-southeast-trending, fault-bounded discrete blocks, with mountain ranges, broad intervening valleys, and low-lying coast plains (Yerkes et al., 1965; Norris and Webb, 1990). Specifically, the Project area is located along the Santa Ana River within the San Bernardino Basin, which is bound by the San Andreas Fault Zone to the northeast and the San Jacinto Fault Zone to the southwest. The San Bernardino Basin is one of the several blocks making up the Peninsular Ranges Geomorphic Province.

Within California, the province extends approximately 125 miles from the Transverse Ranges and the Los Angeles Basin south to the Mexican border, extending southward approximately 775 miles toward to the tip of Baja California, and it is bound on the east by the right-slip San Andreas Fault Zone, the Eastern Transverse Ranges, and the Colorado Desert (Norris and Webb, 1990; Hall, 2007). Most of the geomorphic province is located offshore and includes the Santa Catalina and San Clemente islands (Hall, 2007). Topographically on the mainland, the Peninsular Ranges are steeper on the eastern slopes, where they are truncated by normal faults like the Elsinore or San Jacinto faults, and are more gradual on their western slopes toward the Pacific Ocean, similar to the topography of the Sierra Nevada (Norris and Webb, 1990; Prothero, 2017). Within the province, the highest elevations are found in the eastern-most block, with San Jacinto Peak reaching approximately 10,805 feet in elevation and various summits of the Santa Rosa Mountains averaging 6,000 feet in elevation (Norris and Webb, 1990). Westward toward the coast, elevations are less dramatic.

The pre-Phanerozoic history of the Peninsular Ranges is not represented within the province, and few locations contain rocks older than the Mesozoic (Norris and Webb, 1990), and sparse Paleozoic strata within the Peninsular Ranges is in stark contrast to the Sierra Nevada, which contains thick sections of Paleozoic rocks. The oldest pre-batholithic rocks in the Peninsular Ranges are Paleozoic in age and consist of metamorphosed remnants of a stable carbonate platform (now marble and schist) on a passive continental margin that existed along western North America at that time (Harden, 2004). Moreover, late Paleozoic limestone is present near Riverside (Norris and Webb, 1990), further supporting the presence of a shallow marine environment prior to the Mesozoic. Most of the geologic history of the Peninsular Ranges is represented by Mesozoic-age plutonic rocks and Cenozoic-age uplift, erosion, and sedimentary deposition in basins (Sylvester and O'Black Gans, 2016).

During the Triassic and Jurassic, marine sedimentary rocks composed of sandstone and shale were deposited in turbidite sequences along a submarine fan (Harden, 2004). Throughout the Jurassic and Cretaceous, the continental margin became active as the Farallon Plate, which ferried old island arcs, subducted beneath the North American Plate, creating a large pluton complex (i.e., batholith) beneath the surface that rose into the upper crust and intruded into Paleozoic and Mesozoic sedimentary and volcanic rocks (Harden, 2004; Sylvester and O'Black Gans, 2016). The large complex of batholiths resulted in the formation of the San Marcos Gabbro, Bonsall Tonalite, and Woodson Mountain Granodiorite among others in the Peninsular Ranges (Norris and Webb, 1990). Contact metamorphism from the plutons metamorphosed older sedimentary and volcanic rocks into marble, slate, schist, quartzite, gneiss, and metavolcanic rocks (Sylvester and O'Black Gans, 2016). The timing of the Peninsular Ranges Batholith is similar to that of the Sierra Nevada, ranging in age from 70 to 120 million years ago (Norris and Webb, 1990). The batholith complex originally formed south of the Mexican border but has since moved along the right-slip San Andreas Fault over the past 40 million years (Prothero, 2017). During the Late Cretaceous through the Paleogene, the Peninsular Ranges Batholith was uplifted and eroded into a broad plain, where fluvial systems transported sediments westward across the plain and onto the seafloor (Sylvester and O'Black Gans, 2016). Sedimentary rocks were deposited in a forearc basin by turbidity currents representing both deep and shallow marine and nonmarine environments, including the marine Williams, Ladd, and



Rosario formations and the nonmarine Trabuco Formation, with extensive exposures in the western flank of the Santa Ana Mountains (Norris and Webb, 1990; Harden, 2004).

Throughout the Cenozoic, thick sections of sedimentary rocks were deposited in large basins, such as the Los Angeles, Imperial, and offshore basins, due to erosion (Norris and Webb, 1990). Most exposures of early Tertiary strata are restricted to the coastal margins, with a maximum thickness of approximately 4,500 feet in the Santa Ana Mountains (Norris and Webb, 1990). Most Cenozoic strata represent nonmarine depositional environments; however, approximately 600 feet of marine sediments are present near San Diego (Norris and Webb, 1990). Thick nonmarine deposits formed during the Oligocene, followed by a pause of sedimentation at the end of the Oligocene due to tectonic uplift (Norris and Webb, 1990). By the beginning of the Miocene, most of the Farallon Plate had been subducted beneath the North American Plate, and the Pacific Plate came into contact with the North American Plate (Sylvester and O'Black Gans, 2016). As the Pacific Plate slid northwest along the North American Plate, a section of forearc basin was rafted, rotated clockwise approximately 110 degrees, and carried north approximately 130 miles; while carried northward, the forearc basin was compressed and formed the Transverse Ranges located immediately north of the Peninsular Ranges (Sylvester and O'Black Gans, 2016). Additionally, movement along the San Jacinto Fault Zone, which bifurcates from the San Andreas Fault Zone in an area north of the Peninsular Ranges, occurred in the middle to late Tertiary through the Quaternary, with a right-slip and vertical motion resulting in approximately 18 miles of lateral displacement (Norris and Webb, 1990). During this time, thick accumulations of nonmarine sediments filled basins, as well as coastal and offshore areas, in the northern Peninsular Ranges during the Pliocene, with up to 7,000-foot-thick sections of siltstone, sandstone, and conglomerate in the Mount Eden and San Timoteo canyons (Norris and Webb, 1990). Despite widespread volcanism elsewhere in southern California during the late Tertiary, little volcanism occurred within the Peninsular Ranges during this time (Norris and Webb, 1990). Throughout the Quaternary, fluvial and lacustrine sediments continued to fill basins within the province, with restricted volcanic and marine terrace deposits along the coast (Norris and Webb, 1990).

6.1 LITERATURE SEARCH

Geologic mapping by Morton and Miller (2006) indicates that the Project area is immediately underlain by late Holocene-age very young wash deposits (Qw, Qw1) and middle Holocene-age young axial-channel deposits (Qya3) at the surface (Figure 3). However, older (e.g., Pleistocene-age) deposits may underlie the Holocene-age sediments at shallow or unknown depths within the Project area. Additionally, although not mapped at the surface, artificial fill is also present within the Project area based on the results of previous geotechnical studies of the site (LeRoy Crandall and Associates, 1972; 1987).

6.1.1 Very Young Wash (Qw, Qw1) and Axial-Channel Deposits (Qya3)

According to Morton and Miller (2006), late Holocene-age very young wash deposits (Qw, Qw1) and middle Holocene-age young axial-channel deposits (Qya3) are mapped at the surface within the Project area (Figure 3).

Very young wash deposits (Qw, Qw1) consist of unconsolidated sand and gravel deposits in active washes, including ephemeral river channels of axial-valley streams and channels on active surfaces of alluvial fans, with fresh flood scours and channel-and-bar morphology (Morton and Miller, 2006). Grain shape ranges from angular to rounded, with larger clasts tending to be more rounded than smaller clasts, and clasts derived from local bedrock or reworked older alluvial deposits (Morton and Miller, 2006). Low elevation terraces in or marginal to channelized washes or streams and rivers are

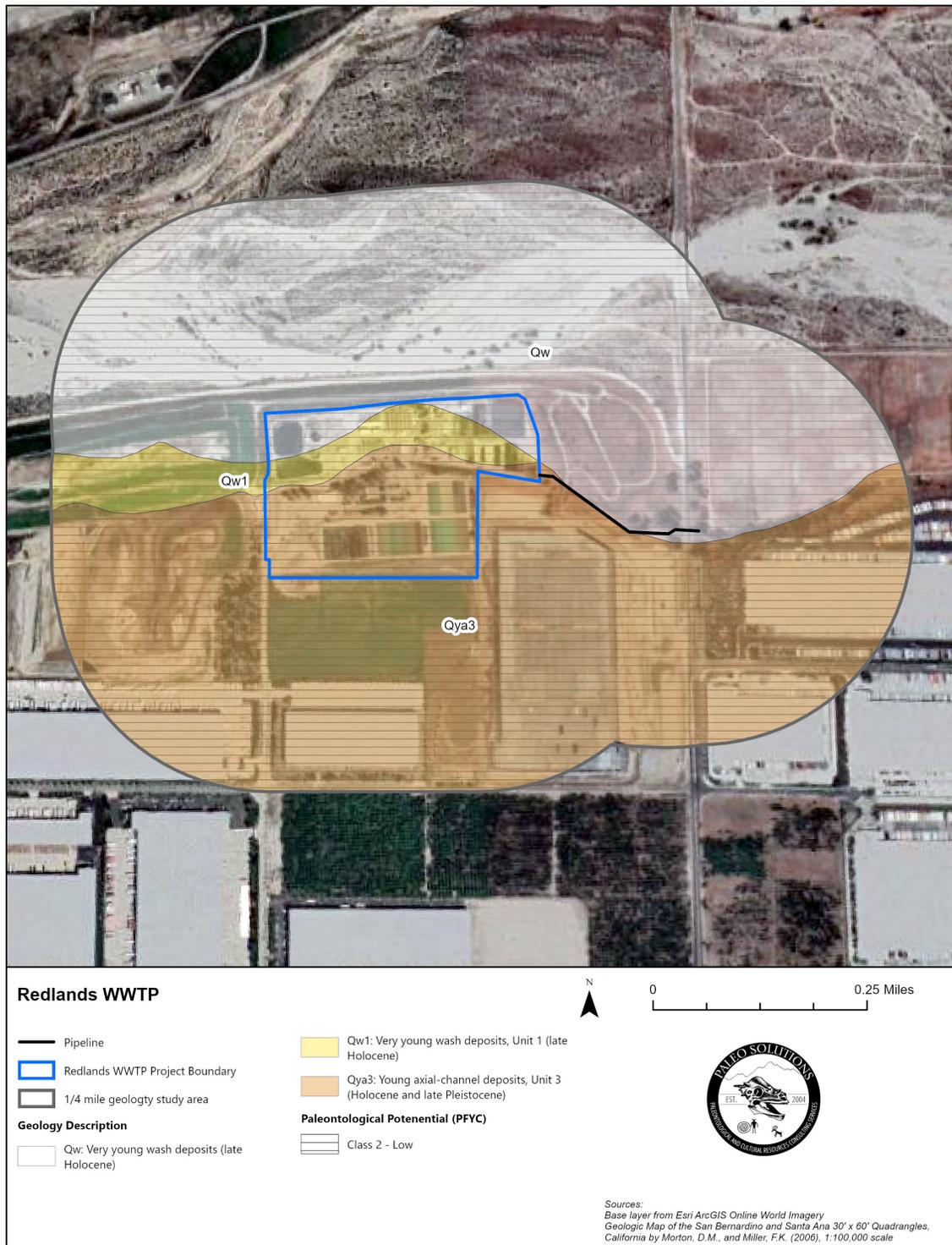


Figure 3. Project Geology and Paleontological Potential



also present and consist of vegetated channels abandoned by modern stream flows (Morton and Miller, 2006).

Young axial-channel deposits (Qya3) consist of terrace risers standing 1 to 2 meters above active washes and are approximately 2 to 5 meters thick (Morton and Miller, 2006). These deposits consist of pale brown and very pale brown, fine- to coarse-grained sand and pebbly sand that coarsens upstream to poorly sorted fine- to coarse-grained sand and sandy pebble to small-cobble gravel (Morton and Miller, 2006).

Holocene-age sediments are typically too young to contain fossilized material (Society of Vertebrate Paleontology [SVP], 2010), but they may overlie sensitive older (e.g., Pleistocene-age) deposits at shallow or unknown depths. Ice Age taxa have been recovered from Pleistocene-age deposits of San Bernardino County, including specimens of rodents (*Peromyscus* sp., *Dipodomys ordii*, *Neotoma* sp., *Thomomys* sp., among others), rabbits (*Lepus* sp.), horse (*Equus conversidens*), badger (*Taxidea taxus*), cats (*Smilodon* sp., *Puma concolor*), mammoth (*Mammuthus* sp.), camel (*Camelops* sp.), llama (*Hemiauchenia* sp.), giant ground sloth (*Nothrotheriops* sp., *Megalonyx* sp.), and tortoise (*Ophelus agassizii*), as well as bison, antelope, and many other taxa of mammals (Jefferson, 1991; Reynolds, 1991; Brattstrom, 1961). A review of the UCMP (2019) paleontological locality database indicates that Pleistocene-age fossils have been recovered from San Bernardino County, including plants (*Juniperus* sp.) and vertebrates, such as wolf (*Canis* sp., *Canis dirus*), bobcat (*Lynx rufus*), fox (*Urocyon cinereoargenteus*), horse (*Equus* sp.), camel (*Camelops* sp., *Camelops besternus*, *Camelus* sp.), llama (*Tanupolama stevensi*), bighorn sheep (*Ovis canadensis*), skunk (*Spilogale* sp.), rabbit (*Lepus californicus*), pika (*Ochotona* sp.), ring-tailed cat (*Bassariscus astutus*), rodent (*Marmota flaviventris*, *Microtus* sp., *Lemmings curtatus*, *Neotoma cinerea*, *Dipodomys* sp., *Chaetodipus* sp., *Baiomys* sp., *Sciurus* sp., *Spermophilus* sp., *Otospermophilus* sp., *Thomomys* sp.), bird (*Buteo* sp.), lizard (*Crotaphytus* sp., *Cnemidophorus tigris*, *Sceloporus occidentalis*), tortoise (*Hesperotestudo* sp., *Gopherus agassizii*), and amphibian. According to the PBDB (2019) fossil locality database, there are no Pleistocene-age fossil locality records within the vicinity of the Project area.

Late Holocene-age very young wash deposits (Qw, Qw1) and middle Holocene-age young axial-channel deposits (Qya3) are assigned low paleontological potential (PFYC 2) at the surface using BLM (2016) guidelines. However, they have a moderate paleontological potential in the subsurface since there is potential for these deposits to be conformably underlain by older, paleontologically sensitive geologic units at shallow or unknown depths.

6.1.2 Unmapped Artificial Fill

Although it is not mapped at the surface by Morton and Miller (2006), the Project area is at least partially underlain by artificial fill. Geotechnical studies previously conducted at the wastewater treatment facility indicate that the Project area is underlain by artificial soils ranging between 2 to 15 feet thick (LeRoy Crandall and Associates, 1972; 1987). At the time of these geotechnical studies, artificial fill soils consisted of poorly compacted silty sand, silt, and sand containing some debris (LeRoy Crandall and Associates, 1972; 1987). Fossils discovered in artificial fill lack scientific context, and therefore, are generally not considered to be scientifically significant. Thus, artificial fill and any previously disturbed sediments have low paleontological potential (PFYC 2). However, there is potential for these deposits to be conformably underlain by Holocene-age sediments or older paleontologically sensitive geologic units at shallow or unknown depths.

6.2 PALEONTOLOGICAL RECORDS SEARCH RESULTS

According to the WSC, no paleontological resources have been recorded from within the bounds of the Project area or within a 1-mile buffer of the Project area (Radford, 2019).



7.0 IMPACTS TO PALEONTOLOGICAL RESOURCES

Impacts on paleontological resources can generally be classified as either direct, indirect, or cumulative. Direct adverse impacts on surface or subsurface paleontological resources are the result of destruction by breakage and crushing as the result of surface disturbing actions including construction excavations. In areas that contain paleontologically sensitive geologic units, ground disturbance has the potential to adversely impact surface and subsurface paleontological resources of scientific importance. Without mitigation, these fossils and the paleontological data they could provide if properly recovered and documented, could be adversely impacted (damaged or destroyed), rendering them permanently unavailable to science and society.

Indirect impacts typically include those effects which result from the continuing implementation of management decisions and resulting activities, including normal ongoing operations of facilities constructed within a given project area. They also occur as the result of the construction of new roads and trails in areas that were previously less accessible. This increases public access and therefore increases the likelihood of the loss of paleontological resources through vandalism and unlawful collecting. Human activities that increase erosion also cause indirect impacts to surface and subsurface fossils as the result of exposure, transport, weathering, and reburial.

Cumulative impacts can result from incrementally minor but collectively significant actions taking place over a period of time. The incremental loss of paleontological resources over time as a result construction-related surface disturbance or vandalism and unlawful collection would represent a significant cumulative adverse impact because it would result in the destruction of non-renewable paleontological resources and the associated irretrievable loss of scientific information.

Based on the analysis of existing data, there are no documented paleontological localities within the boundaries of the Project area. The Project area is underlain by late Holocene-age very young wash deposits (Qw, Qw1) and middle Holocene-age young axial-channel deposits (Qya3), as mapped by Morton and Miller (2006), and unmapped artificial fill, which varies in thickness and is present from 2 to 15 feet within the WWTP Facility area; however, older (e.g., Pleistocene-age) deposits may underlie the Holocene-age sediments and artificial fill at shallow or unknown depths within the Project area. Throughout San Bernardino County, numerous scientifically significant fossils have been recorded from Pleistocene-age deposits. Based on this assessment, Project activities within the Project area at depths greater than 8 feet below ground surface may potentially result in significant impacts to paleontological resources during excavation.

8.0 RECOMMENDATIONS

The Project area is underlain by late Holocene-age very young wash deposits (Qw, Qw1), middle Holocene-age young axial-channel deposits (Qya3), and unmapped artificial fill. These geologic units have a low paleontological potential within the Project area; however, they may be underlain by Pleistocene-age geologic units, which have a moderate potential for paleontological resources, at shallow or unknown depth. Based on the depth of artificial fill, which varies from 2 to 15 feet below ground surface, the maximum depth of planned ground-disturbing activities (e.g., approximately 15 feet), and the policies and actions stated in the City of Redlands General Plan 2035 (City of Redlands, 2017), we recommend part-time monitoring (i.e., spot-checking) when ground disturbing activities impact sediments at 8 feet below ground surface or deeper to check for the presence of Pleistocene-



age deposits. If Pleistocene-age deposits are observed at depth and impacted by Project excavations, then monitoring efforts should be increased to full-time. If only artificial fill, late Holocene-age very young wash deposits (Qw, Qw1), and middle Holocene-age young axial-channel deposits (Qya3) are observed, then spot-checking can be reduced or ceased at the discretion of a Qualified Paleontologist in consultation with the City. Any subsurface bones or potential fossils that are unearthed during construction should be evaluated, recorded, and reported by a Qualified Paleontologist. Paleontological resources determined to be significant, or potentially significant, shall be subject to fossil recovery, laboratory analysis, and museum curation (through a curation agreement with the San Bernardino County Museum, or another appropriate repository).



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APPENDIX A. MUSEUM RECORDS SEARCH

Confidential Appendix

The logo for the Western Science Center, consisting of a stylized 'W' and 'C' in a square followed by the text "WESTERN SCIENCE CENTER" in a serif font.

WESTERN SCIENCE CENTER

May 7, 2019

Paleo Solutions
Barbara Webster
911 S. Primrose Ave., Unit N
Monrovia, CA 91016

Dear Ms. Webster,

This letter presents the results of a record search conducted for the Parsons Wastewater Treatment Facility Project in San Bernardino, San Bernardino County, California. The project site is located north of San Bernardino Avenue and west of Interstate 210 on both sides of Alabama Street partially in Section 16, Township 1 South, Range 3 West on the Redlands USGS 7.5 minute quadrangle.

The geologic units underlying this project are mapped primarily as very young alluvial wash deposits dating from the late Holocene period, with the southern border of the project area mapped as young axial channel deposits dating from the late Pleistocene to Holocene period (Morton & Miller, 2006). While alluvial wash deposits can be paleontologically sensitive, it is unlikely that any paleontological material will be found in the relatively modern late Holocene units. These units are considered to be of low paleontological sensitivity, with the exception of the older deposits dating to the late Pleistocene on the southern border of the project area. The Western Science Center does not have localities within the project area or within a 1 mile radius, but does have fossil localities in similarly mapped late Pleistocene units associated with numerous projects in Riverside County that resulted in fossil specimens.

Any fossils recovered from the Parsons Wastewater Treatment Facility Project area would be scientifically significant. If significant excavation activity associated with development of the project area would impact the paleontologically sensitive late Pleistocene alluvial units at the southern end of the project area it would be the recommendation of the Western Science Center that a paleontological resource mitigation program be put in place to monitor the site.

If you have any questions, or would like further information about similar late Pleistocene alluvial deposit projects, please feel free to contact me at dradford@westerncentermuseum.org

Sincerely,

A handwritten signature in black ink, appearing to read "Darla Radford".

Darla Radford
Collections Manager