PALEONTOLOGICAL RESOURCE ASSESSMENT VIA DE LA VALLE EROSION CONTROL MAINTENANCE CITY OF SAN DIEGO SAN DIEGO COUNTY, CALIFORNIA

PROJECT NO. 490737

PALEOSERVICES
SAN DIEGO NATURAL HISTORY MUSEUM

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EXECUTIVE SUMMARY

This Paleontological Resource Assessment was prepared for the Via De La Valle Erosion Control Maintenance project (Project), located near the intersection of Via De La Valle and Via Del Canon in the North City Neighborhood of the City of San Diego, San Diego County, California. The Project involves erosion control maintenance work on two wall sections located on the north side of Via De La Valle, just east and west of Via Del Canon. Both wall sections occur within the City's right-of-way, with the western wall section spanning approximately 360 linear feet, and the eastern section spanning approximately 390 linear feet. Currently, erosion is controlled at both sections through previously installed retaining walls, but erosion has advanced enough such that slope wash sediments derived from hillslope erosion have filled the space behind and above the retaining walls and is spilling onto the adjacent bike lane and roadway. Proposed erosion control maintenance work will focus on removing up to 2 feet of slope wash from behind the wall. Earthwork is not anticipated to extend into the previously undisturbed strata comprising the adjacent hillslope.

Based on a review of published mapping, the Project was initially identified as being underlain by Pleistocene-age old paralic deposits (broadly equivalent to the Bay Point Formation and assigned a high paleontological resource potential), thus this paleontological resource assessment was completed in order to identify whether paleontological resources were present along the Project alignment, determine whether proposed erosion control work would result in impacts to paleontological resources, determine whether fossils could be salvaged from the eroded slope wash deposits, and determine whether future work at the Project might impact paleontological resources, and if measures could be developed to ensure protection of these resources.

Following completion of a more thorough map and literature review, it was determined that the Project additionally includes areas underlain by the middle Eocene-aged Torrey Sandstone and underlying Delmar Formation, which have moderate and high paleontological resource potentials, respectively. During the paleontological field survey conducted for the Project, it was discovered that behind the slope wash deposits, the entirety of the hillslope is comprised of fine-grained sandstones of the Delmar Formation, with the Torrey Sandstone possibly cropping out near the top of the exposures. Likely, the Bay Point Formation and Torrey Sandstone were previously removed during construction of Via De La Valle, exposing the underlying Delmar Formation. One sedimentary layer containing fossilized shells of lagoonal mollusks was discovered in the Delmar Formation during the survey, and 11 existing fossil localities are known from this rock unit to the east at the intersection with El Camino Real, and to the west at Flower Hill Promenade.

Based on the results of the impact analysis, the currently proposed erosion control maintenance work will not impact paleontological resources. Though it is possible that the slope wash deposits may contain fossil remains, these remains will likely represent a mixing of fossils from upslope strata, including the Delmar Formation, Torrey Sandstone, and Pleistocene-age very old paralic deposits (broadly equivalent to the Lindavista Formation), and thus any recovered fossils will lack appropriate contextual data and will not be scientifically significant. Further, fossils discovered in the Delmar Formation during the survey were particularly fragile, and it is likely that the process of erosion and re-deposition in slope wash would destroy or severely damage such fossils.

Future work to control erosion has the potential to impact paleontological resources in the Delmar Formation if this work will involve cutting into the hillslope, or excavating downwards into the underlying strata. If such earthwork should occur, development of a detailed paleontological mitigation and treatment plan addressing these potential impacts is recommended.

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION

This technical report provides an assessment of paleontological resources at the Via De La Valle Erosion Control Maintenance project (Project), located near the intersection of Via De La Valle and Via Del Canon in the North City Neighborhood of the City of San Diego, San Diego County, California (Figure 1). The Project spans the Via De La Valle Community Plan to the west of Via Del Canon, and the San Dieguito (North City Future Urbanizing Area Subarea II) Community Plan Area to the east. The boundary of the City of San Diego occurs immediately north of the Project.

The Project involves proposed erosion control maintenance work on two wall sections located along the north side of Via De La Valle, just east and west of Via Del Canon. Both wall sections occur within the City's right-of-way (ROW), with the western wall section spanning approximately 360 linear feet, and the eastern section spanning approximately 390 linear feet. Currently, erosion is controlled at both sections through previously installed retaining walls that capture sediments as they erode off of the nearly vertical outcrops. The retaining walls consist of mainly double-stacked 2.5 by 2.5 by 5-foot blocks, and thus are 5 feet high. A 130 linear foot section of the eastern section has a single layer of blocks. Currently, erosion has advanced enough to fill the space behind and above the retaining walls with sediment, such that eroded sediment is spilling over the top of the walls and into the adjacent bike lane and roadway.

Proposed erosion control maintenance work will focus on removing previously eroded sediments from behind the retaining walls. The City Transportation & Storm Water Department Street Division crews will be performing this work using a CASE 580 backhoe and a Bobcat 360 to remove the debris. The scraper will remove up to 2 feet of debris from behind the retaining wall, and no cuts will be made into the hillside. A total of 111.1 cubic yards of sediment will be removed and transported to the City's landfill, 53.3 cubic yards from the eastern wall section, and 57.8 cubic yards from the western wall section.

1.2 SCOPE OF WORK

This paleontological assessment report is being completed due to a review of maps that indicate the Project is underlain by sedimentary deposits previously assigned a high paleontological resource potential (City of San Diego, 2011; Deméré and Walsh, 1993). The report is intended to summarize existing paleontological resource data at the Project, discuss the significance of these resources, determine whether the Project will impact paleontological resources, and develop measures to protect paleontological resources during current or future earthwork at the Project.

The assessment includes the results of a formal search of paleontological collections records at the San Diego Natural History Museum (SDNHM), as well as the results of a paleontological field survey of the project site. This report was written by Shelly L. Donohue and Thomas A. Deméré of the Department of PaleoServices, SDNHM.

1.3 DEFINITION OF PALEONTOLOGICAL RESOURCES

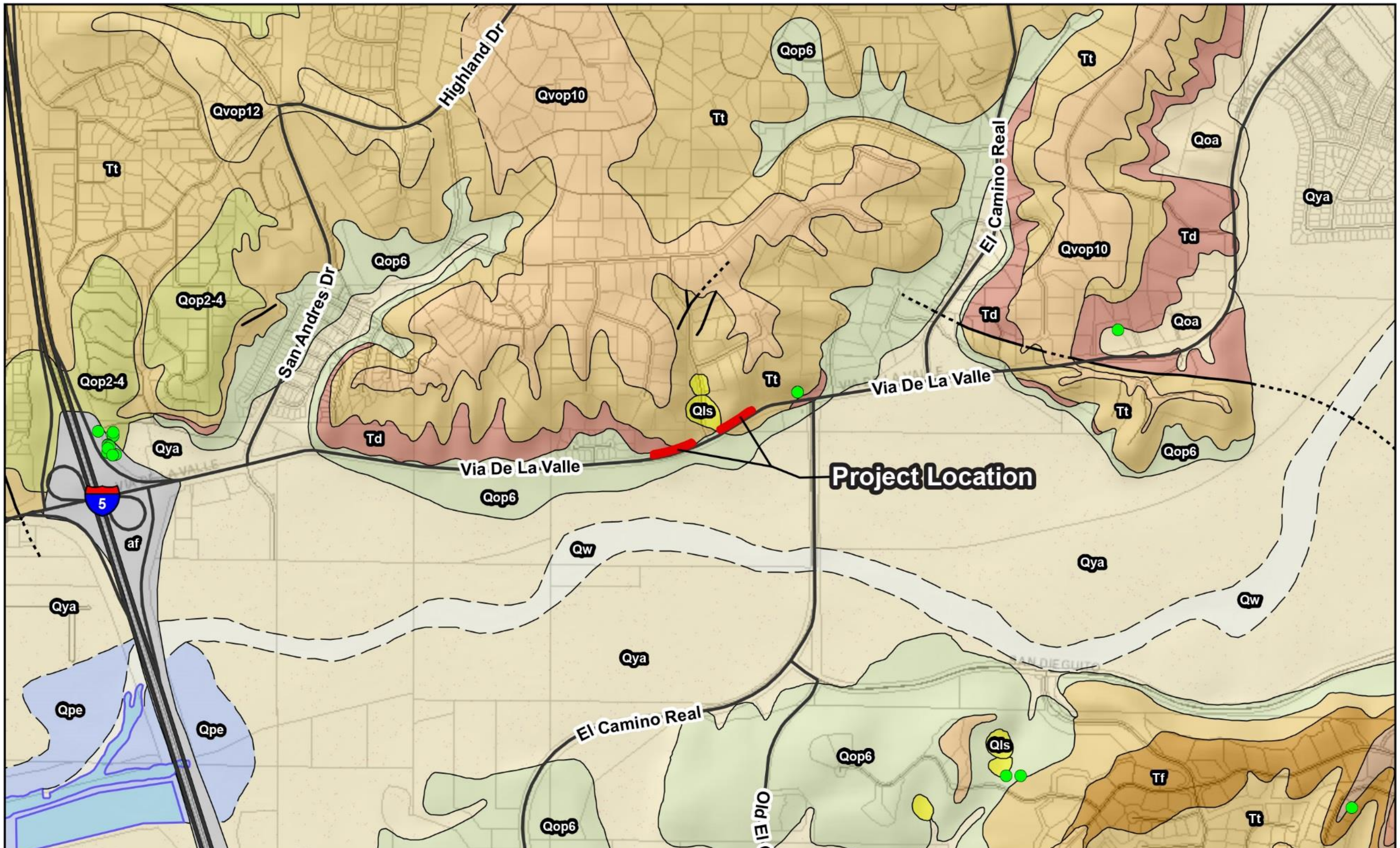
As defined here, paleontological resources (i.e., fossils) are the buried remains and/or traces of prehistoric organisms (i.e., animals, plants, and microbes). Body fossils such as bones, teeth, shells, leaves, and wood, as well as trace fossils such as tracks, trails, burrows, and footprints, are found in the geological deposits (formations) within which they were originally buried. The primary factor determining whether an object is a fossil or not isn't how the organic remain or trace is preserved (e.g., "petrified"), but rather the age of the organic remain or trace. Although typically it is assumed that fossils must be older than ~10,000 years (i.e., the generally accepted end of the last glacial period of the Pleistocene Epoch), organic remains of early Holocene age can also be considered to represent fossils because they are part of the record of past life.

Fossils are considered important scientific and educational resources because they serve as direct and indirect evidence of prehistoric life and are used to understand the history of life on Earth, the nature of past environments and climates, the membership and structure of ancient ecosystems, and the pattern and process of organic evolution and extinction. In addition, fossils are considered to be non-renewable resources because typically the organisms they represent no longer exist. Thus, once destroyed, a particular fossil can never be replaced. And finally, for the purposes of this report, paleontological resources can be thought of as including not only the actual fossil remains and traces, but also the fossil collecting localities and the geological formations containing those localities.

1.4 Regulatory Framework

Because paleontological resources are considered scientifically and educationally significant nonrenewable resources, they are protected under a variety of federal (e.g., Antiquities Act of 1906; National Environmental Policy Act of 1969; Federal Land Policy Management Act of 1976; Paleontological Resources Preservation Act of 2009), state (e.g., California Environmental Quality Act [CEQA]; Public Resources Code), and local (e.g., San Diego County, City of San Diego) laws, regulations, and ordinances.

The Project is located within the City of San Diego, which has developed specific guidelines for the implementation of CEQA regarding the management of paleontological resources within the City's boundaries (City of San Diego, 2011). Specifically, the City provides Initial Study Questions and Significance Thresholds to determine whether a proposed project will significantly impact paleontological resources. If it is determined that a project may impact paleontological resources, the City provides guidelines for the mitigation of these impacts, most commonly through implementation of a monitoring program.



Sources: Geology, Kennedy and Tan, 2008; DEM Base Map, SANDAG et al., 2016; USA Major Roads, ESRI et al., 2016

Figure 1: Vicinity Map with Geology, Via De La Valle Erosion Control Maintenance Project, San Diego, CA

af	Artificial fill	Qya	Young alluvial flood plain deposits	Qvop12	Very old paralic deposits, Unit 12		contact, certain
Qw	Wash deposits	Qoa	Old alluvial flood plain deposits, undivided	Qvop10	Very old paralic deposits, Unit 10		contact, approximated
Qpe	Paralic estuarine deposits	Qop6	Old paralic deposits, Unit 6	Tt	Torrey Sandstone		fault, certain
Qls	Landslide deposits	Qop2-4	Old paralic deposits, Units 2-4, undivided	Td	Delmar Formation		fault, concealed
							SDNHM fossil locality

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0 0.25
scale in miles

2.0 METHODS

2.1 PALEONTOLOGICAL RECORDS SEARCH AND LITERATURE SEARCH

A paleontological records search was conducted at the SDNHM in order to determine if any documented fossil collection localities occur at the Project or immediately surrounding area. The records search involved examination of the SDNHM paleontological databases for any records of known fossil collection localities within a 1-mile radius of the Project.

Additionally, a review was conducted of relevant published geologic maps (e.g., Kennedy, 1975; Kennedy and Tan, 2008), published geological and paleontological reports (e.g., Hanna, 1926; Link and Abbott, 1991; Myers, 1991; Miyata and Deméré, 2016), and other relevant literature (e.g., field trip guidebooks, theses and dissertations, unpublished paleontological mitigation reports). This approach was followed in recognition of the direct relationship between paleontological resources and the geologic formations within which they are entombed. Knowing the geologic history of a particular area and the fossil productivity of geologic formations that occur in that area, it is possible to predict where fossils will, or will not, be encountered.

2.2 PALEONTOLOGICAL FIELD SURVEY

A paleontological field survey was conducted on September 6, 2016 by John L. Pfanner of the Department of PaleoServices, SDNHM in order to confirm the mapped geology, to field check the results of the literature and records searches, and to determine the paleontological potential of strata present in the vicinity of the Project. The field survey involved inspection of sedimentary exposures at the two wall sections, as well as other strata in the immediate vicinity in order to collect stratigraphic data (e.g., bedding type, thickness, geologic contacts) and detailed lithologic descriptions of strata (e.g., color, sorting of grains, texture, sedimentary structures, and grain size of sedimentary rocks).

Mr. Pfanner was equipped with standard field equipment (e.g., rock hammer, camera, hand lens, tape measure), and a Garmin Handheld GPS unit.

2.3 RESOURCE ASSESSMENT CRITERIA: PALEONTOLOGICAL POTENTIAL

In recognizing the fact that paleontological resources are considered to include not only actual fossil remains and traces, but also the fossil collecting localities and the geologic rock units containing those fossils and localities, the Society of Vertebrate Paleontology (SVP) has developed a procedure for evaluating the paleontological potential of individual geologic rock units. This procedure assigns ranks to units based on the relative abundance of vertebrate fossils or scientifically significant invertebrate or plant fossils (SVP, 2010). The City of San Diego follows the SVP guidelines, with the exception of a "Moderate Paleontological Potential" category rather than an "Unknown Paleontological Potential" category (City of San Diego, 2011; Deméré and Walsh, 1993). Specific criteria for each paleontological potential rating are outlined below.

2.3.1 HIGH PALEONTOLOGICAL POTENTIAL

Rock units from which vertebrate or significant invertebrate, plant, or trace fossils have been recovered are considered to have a high potential for containing additional significant paleontological resources. Rocks units classified as having high potential include, but are not limited to, sedimentary formations and some volcaniclastic formations (e. g., ashes, tephras), and some low-grade metamorphic rocks which contain significant paleontological resources anywhere within their geographical extent, and sedimentary rock units temporally or lithologically suitable for the preservation of fossils (e. g., middle Holocene and older, fine-grained fluvial sandstones, paleosols, cross-bedded point bar sandstones, fine-grained marine sandstones). Paleontological potential consists of both the potential for yielding abundant or significant vertebrate fossils, or for yielding a few significant fossils, as well as the importance of recovered evidence for new and significant taxonomic, phylogenetic, paleoecologic, taphonomic, biochronologic, or stratigraphic data. Rock units which contain potentially datable organic remains older than late Holocene, including deposits associated with animal nests or middens, and rock units which may contain new vertebrate deposits, traces, or trackways are also classified as having high potential.

2.3.2 Moderate Paleontological Potential

Rock units from which vertebrate, invertebrate, plant, or trace fossils are known but are poorly preserve, common elsewhere, or stratigraphically unimportant are considered to have moderate potential. Moderate potential can also be assigned to rock units for which little information is available concerning their paleontological content, geologic age, and depositional environment.

2.3.3 Low Paleontological Potential

Reports in the paleontological literature or field surveys by a qualified professional paleontologist may allow determination that some rock units have low potential for yielding significant fossils. Such rock units will be poorly represented by fossil specimens in institutional collections, or based on general scientific consensus only preserve fossils in rare circumstances and the presence of fossils is the exception not the rule, e. g. basalt flows or Recent colluvium. Rock units with low potential typically will not require impact mitigation measures to protect fossils.

2.3.4 No Paleontological Potential

Some rock units have no potential to contain significant paleontological resources, for instance high-grade metamorphic rocks (such as gneisses and schists) and plutonic igneous rocks (such as granites and diorites). Rock units with no potential require no protection nor impact mitigation measures relative to paleontological resources.

2.4 Paleontological Impact Analysis

Direct impacts to paleontological resources occur when earthwork activities cut into the geological rock units within which fossils are buried, and physically destroy the fossil remains. As such, only earthwork activities that will disturb potentially fossil-bearing sedimentary rocks (i.e., those rated with a high or moderate paleontological potential) have the potential to significantly impact paleontological resources. Under the California Environmental Quality Act (CEQA) and City of San Diego guidelines, paleontological mitigation (e.g., monitoring and fossil recovery) typically is recommended to reduce any negative impacts to paleontological resources to less than significant levels.

The purpose of the impact analysis is to determine if the proposed erosion maintenance control work may disturb potentially fossil-bearing sedimentary rocks, and whether fossils might be preserved within, and possibly recovered from slope wash deposits at the toe of the hillslopes. The impact analysis also includes a discussion of future impacts that may occur due to continued erosion control. The paleontological impact analysis involved analysis of available project documents and comparison with geological and paleontological data gathered during the records searches, literature search, and field survey.

3.0 EXISTING CONDITIONS: GEOLOGIC SETTING

The Project is located along the coastal plain of San Diego County, within the Peninsular Ranges Geomorphic Province of California. Along the coastal plain, basement rocks of the Jurassic-Cretaceous-age Santiago Peak Volcanics and the Cretaceous-age Peninsular Ranges Batholith are nonconformably overlain by sedimentary strata of late Cretaceous, Eocene, Oligocene, Miocene, Pliocene, and/or Pleistocene age (Givens and Kennedy, 1979; Hanna, 1926; Kennedy, 1975; Kennedy and Moore, 1971; Kennedy and Peterson, 1975; Peterson and Kennedy, 1974; Walsh and Deméré, 1991). Kennedy and Moore (1971) divided the Eocene portion of this sequence into the early middle Eocene La Jolla Group and the late middle Eocene Poway Group, which together include nine geologic rock units or formations.

These Eocene formations record a series of intertonguing marine and terrestrial paleoenvironments deposited in a large depositional basin (the San Diego Embayment) that spanned a relatively short lateral distance (east to west). This depositional basin was actively accumulating sediments over a period of approximately 10 million years (50 to 40 million years ago). A large river system occupied the eastern portion of the embayment, and to the west, these alluvial and fluvial paleoenvironments mixed with nearshore marine paleoenvironments in a river-dominated, braid delta. Farther west were paralic, continental shelf, and slope paleoenvironments.

The Via De La Valley Erosion Control Maintenance project is located in the west-central portion of the Eocene San Diego Embayment, where sediments of the Delmar Formation and overlying Torrey Sandstone were deposited in estuarine to shallow marine paleoenvironments, respectively. A period of erosion and/or nondeposition at the Project extended for approximately 45 million years, until Pleistocene time. In the Pleistocene, complex interactions between rising and falling sea levels and local and regional tectonic uplift led to the flat mesas and deep canyons that characterize the San Diego region today. Rising sea levels led to erosion of broad, horizontal surfaces that represent ancient wave-cut platforms (sea floors), called marine terraces (e.g., Kern and Rockwell, 1992), upon which were deposited the very old paralic deposits (Lindavista Formation) that crop out to the north of the Project, at higher elevations and old paralic deposits (Bay Point Formation) that crop out to the west of the Project. Changes in sea level also led to the carving out of coastal river valleys, such as San Dieguito River Valley immediately south of the Project. The presence of old paralic deposits (Bay Point Formation) along the perimeter of the San Dieguito River and its tributaries represents the remnants of a former high sea level stand, where marine waters flooded the coast, creating a coastal embayment within the river valley. This embayment deposited fossiliferous marine and lagoonal sandstones, creating an erosional buttressed contact against the older Eocene strata exposed in the valley walls. As sea level retreated, fluvial sandstones of the San Dieguito River were deposited overlying the Bay Point Formation, creating its modern floodplain.

3.1 SLOPE WASH DEPOSITS

Slope wash deposits are widespread along the coastal plain of San Diego and are the result of modern erosion and downslope transport of sedimentary particles (e.g., silt, sand, and gravel). Such deposits normally accumulate along the base of steep slopes, are typically unconsolidated, and generally reflect the composition of the bedrock forming the slope. The thickness of slope wash deposits can vary widely depending on a number of factors including the aerial extent of the slope, the rate of erosion, the relative durability of the bedrock, the degree of vegetative cover, and the length of time the slope has been exposed to the elements.

3.2 Bay Point Formation (old paralic deposits)

Old paralic deposits of Pleistocene-age, also referred to as marine terrace deposits, in coastal San Diego County occur on a stair-step succession of uplifted marine abrasion platforms (ancient sea floors) that range in elevation from about 40 feet to over 500 feet above sea level and extend up to nine miles inland from the coast. The oldest platforms/terraces are in the east and may be up to one million years old (Kern and Rockwell, 1992). The old paralic deposits exposed in the vicinity of the Project are correlated with the Bay Point Formation (700,000 to 10,000 years old), a primarily near-shore marine rock unit best known from exposures in and around San Diego Bay and Mission Bay (Kennedy, 1975; Kern, 1977). Typical exposures of old paralic deposits of this age consist of light gray, friable to partially cemented fine- to coarse-grained, massive to cross-bedded sandstone (Hertlein and Grant, 1939; Kennedy, 1975), which locally are overlain by non-marine alluvium and/or colluvium.

3.3 Torrey Sandstone

The Torrey Sandstone (Hanna, 1927) typically consists of yellowish-white, coarse-grained, locally cross-bedded, arkosic sandstones (Hanna 1927). Portions of the Torrey Sandstone were deposited in an ancient nearshore marine environment, while other parts of the deposit formed within a barrier island/protected lagoon setting (Kennedy 1975). The type area for this rock unit is the sea cliffs at Torrey Pines State Reserve, which represents the southernmost extend of its area of outcrop, and extends north to Encinitas. Based upon its stratigraphic position the formation is considered to be early middle Eocene in age, approximately 48-49 million years old.

3.4 Delmar Formation

The Delmar Formation (Hanna, 1926) typically consists of greenish silty mudstones, brown siltstones, and greenish sandstones, with interbeds of well-cemented oyster-rich shell beds. The Delmar Formation was deposited in a lagoonal/estuarine setting and preserves marsh tidal flat and tidal channel paleoenvironments (Clifton, 1979; Link and Abbott, 1991; Warme, 1991). It crops out from Sorrento Valley to Batiquitos Lagoon, and from the coast inland to La Costa and Rancho Santa Fe. The best exposures of the Delmar Formation occur in the sea cliffs from Torrey Pines State Reserve to Encinitas. The Delmar Formation is late early to early middle Eocene in age, approximately 49-50 million years old.

4.0 Results

4.1 Results of the Paleontological Records and Literature Searches

A records search of paleontological collections data at the SDNHM indicates there are 27 fossil localities within a 1-mile radius of the Project (Figure 1, Appendix). Of these localities 11 are known from the Delmar Formation, and the remainder are known from both nonmarine and marine sediments of the Pleistocene-age Bay Point Formation. A summary of fossils recovered from these localities, as well as the results of the literature search, are described for each rock unit, below.

4.1.1 Slope Wash Deposits

No fossils are currently known from slope wash deposits within or nearby the Project. This fact is not surprising given the modern aspect of these deposits and their origin as the direct result of recent erosion of the adjacent steep hillslopes.

4.1.2 Bay Point Formation (old paralic deposits)

A total of 16 SDNHM localities are known from the Bay Point Formation within a 1-mile radius of the Project, and represent both marine to lagoonal and nonmarine facies. The majority of the marine to lagoonal fossils were discovered during construction of the Flower Hill Promenade in 2011 (SDNHM Localities 6553 – 6563). These localities produced an incredibly diverse assemblage of marine invertebrates, including bryozoans, foraminiferans, annelid worms, clams, oysters, snails, barnacles, crabs, sand dollars, and urchins. Also recovered were a diversity of marine bony fish, mostly gobies, and sparse isolated elements of terrestrial rodents. Other localities from the marine to estuarine facies produced similar faunas. Three of the Bay Point Formation localities were discovered in a nonmarine facies (SDNHM Localities 4164, 4278, 4279). These localities produced remains of freshwater bony fishes (e.g., carp, sticklebacks) and amphibians, and terrestrial land mammals including rodents, horse, and ground sloth.

Elsewhere in coastal San Diego County, deposits of the Bay Point Formation have produced large and exceptionally diverse assemblages of well-preserved marine invertebrate fossils, primarily mollusks (Hertlein and Grant, 1939; Valentine, 1959; Deméré, 1981; 1983). Remains of fossil marine vertebrates (i.e., sharks, rays, and bony fishes) and terrestrial vertebrates (e.g., amphibians, pond turtle, lizard, snake, bird) including important records of land mammals such as rodents, rabbit, horse, tapir, camel, deer, bison and ground sloth have also been recovered (Deméré and Walsh, 1993; unpublished SDNHM paleontological records).

4.1.3 Torrey Sandstone

No fossils are currently known from the Torrey Sandstone within a 1-mile radius of the Project. However, it is noteworthy that elsewhere in San Diego County deposits of the Torrey Sandstone have produced limited, but important remains of fossil plants and marine invertebrates (Givens and Kennedy 1979; Squires 1989; Myers 1991). The well-preserved fossil leaves known from the Torrey Sandstone in San Diego County are especially significant, as they represent taxa related to plant species that today live in subtropical and tropical regions of Southeast Asia and the southeastern United States (Myers, 1991). This pattern suggests that San Diego had a much warmer and wetter climate during early middle Eocene time.

4.1.4 Delmar Formation

A total of 11 SDNHM fossil localities are known from the Delmar Formation within a 1-mile radius of the Project and were collected from two distinct locations. The first location contains 4 localities (SDNHM 5193, 5194, 5314, 5923) and occurs about 450 feet east of the Project at El Camino Real, within the outcrop behind the building containing MARKET Restaurant + Bar, Pacific Sotheby's International Realty, and other office spaces. These localities were discovered by students at San Diego State University in the early 1970s, and yielded remains of estuarine mollusks (clams, oysters, jingle shells, and snails). The second location contains 7 localities (SDNHM 6564 – 6570) and occurs 1 mile east of the Project, at Flower Hill Promenade. These localities were discovered during construction of the Promenade in 2011, and yielded a similar fauna of estuarine mollusks, as well as a tooth of a nurse shark (*Ginglymostoma* sp.) and a tooth of an unidentified brontothere.

Elsewhere in northwestern San Diego County, fossils known from the Delmar Formation include well-preserved to poorly preserved remains of estuarine invertebrates (e.g., clams, oysters, and snails) and estuarine vertebrates (e.g., sharks and rays) (Hanna 1927; Givens and Kennedy 1979; Clifton, 1979; Squires, 1989; Warme, 1991). Well-preserved remains of aquatic reptiles (e.g., crocodile) and terrestrial mammals (e.g., tillodont and archaic rhino-like ungulate) are also known from the Delmar Formation (Miyata and Deméré, 2016; SDNHM unpublished paleontological data).

4.2 Results of the Paleontological Field Survey

During the paleontological field survey, the Project was observed to consist of two near vertical outcrops with 1-block tall or 2-block tall retaining walls at the base. These retaining walls are holding back a partially vegetated toe-of-slope talus pile composed of slope wash derived from hillside erosion (Figure 2).

Each exposure was observed to consist entirely of eroded Eocene sediments, which appear to have been derived from the Delmar Formation. This condition differs from that described by published geologic mapping (Kennedy, 1975; Kennedy and Tan, 2008; Figure 1). This published mapping suggests that the Project occurs in an area also underlain by Pleistocene-age old paralic deposits (informally named the Bay Point Formation) and the Eocene-age Torrey Sandstone. This difference in existing conditions is likely a reflection of the altered landscape resulting from construction of Via De La Valle, which required cutting into the hillside. Construction likely removed the surficial exposures of both the Bay Point Formation and the Torrey Sandstone, revealing the underlying Delmar Formation in the roadside outcrops.

4.2.1 Slope Wash Deposits

Slope wash deposits largely contained behind the retaining walls were observed to consist of tan to yellowish, poorly consolidated silts and sands with angular to subangular blocks of sandstone and mudstone (Figure 2).

4.2.2 Bay Point Formation (old paralic deposits)

No deposits of the Bay Point Formation were observed during the field survey. Because the Bay Point Formation contacts the underlying Eocene units with an erosional buttress unconformity, it is possible that it may be either be present at the very base of the hillslope (concealed by slope wash), or underlying the existing roadway of Via De La Valle.

4.2.3 Torrey Sandstone

No deposits of the Torrey Sandstone were examined during the pedestrian survey. As discussed below in Section 4.2.4, it is possible that the Torrey Sandstone crops out at the top of the hillslope exposures, overlying the Delmar Formation. Due to the steep nature of the slope and lack of visible outcrop in the immediate vicinity, these strata could not be closely examined.

4.2.4 Delmar Formation

In the hillside outcrop east of Via Del Canon, the observed Delmar Formation consists of light gray to very pale orange, massive to thinly bedded, compacted, micaceous, very fine- to fine-grained sandstone (Figure 3). To the west of Via Del Canon, similar sandstones were observed, with the exception of a 2 – 3 foot thick stratum that occurred about 5 feet above the top of the concrete barrier. This stratum was a light brown to dusky yellowish brown, laminated, fissile, fine-grained sandstone with abundant gypsum and woody debris. Within this sandstone was an approximately 10 inch thick horizon containing fossils of lagoonal mollusks, primarily the venus clam *Pelecyora* sp. (Figure 4). The discovered shells appeared to be weathered, with some individuals preserving shell material, and others represented only by internal or external molds. A voucher specimen of this horizon was collected during the field survey, and will be placed in the Museum's archives.

Near the top of the outcrops was a prominent, flat-lying erosional surface marked by a thin cobble horizon (Figure 2). It is unclear whether this represents an erosional surface within the Delmar Formation created by a migrating tidal channel, or the contact between the Delmar Formation and overlying Torrey Sandstone. Because the contact between siltstone-dominated Delmar Formation and sandstone-dominated Torrey Sandstone is gradational, the precise contact between them can be difficult to identify.

Figure 2. Overview of the Project outcrops, on the west and east sides of Via Del Canon. **Left:** western outcrop, photo taken facing west. Note the blocks of sandstone and fine-grained sediment forming the slope wash deposits at the toe of the steep slope. **Right:** eastern outcrop, photo taken facing east. Note the layered sedimentary rocks of the Delmar Formation exposed in the steep slope above the retaining wall.

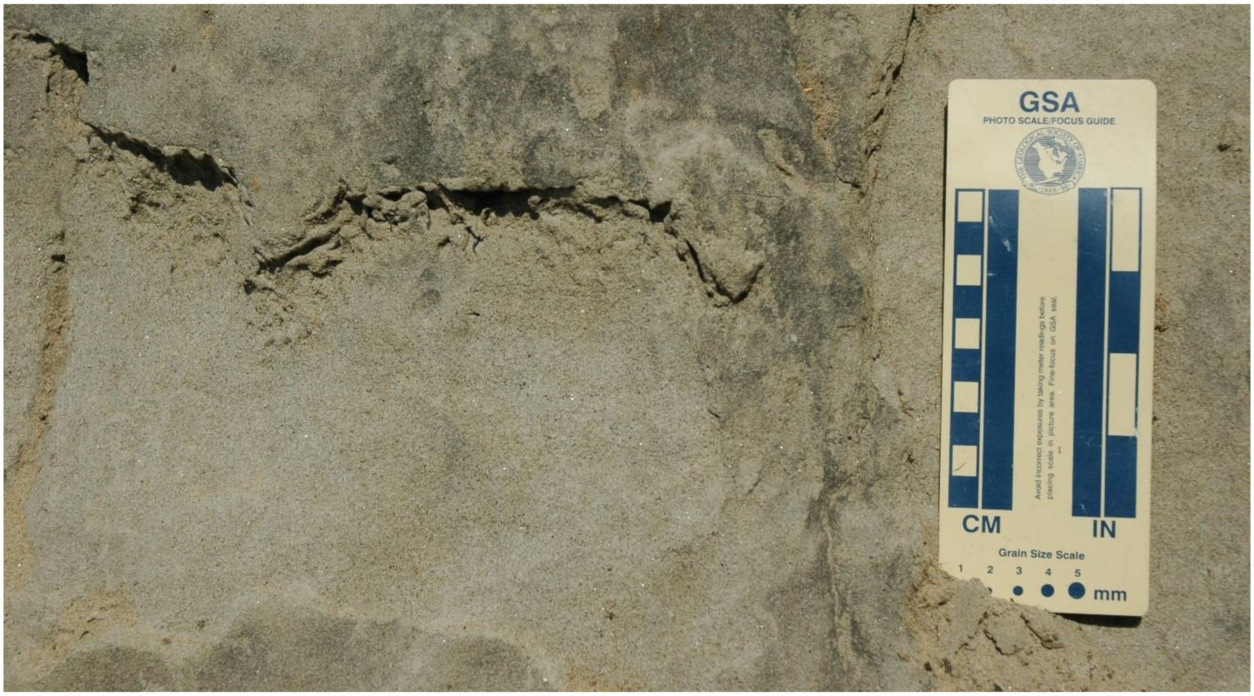

Figure 3. The majority of the observed Delmar Formation strata consisted of light gray, massive, fine-grained sandstone, similar to the above pictured exposure from the eastern cutslope.

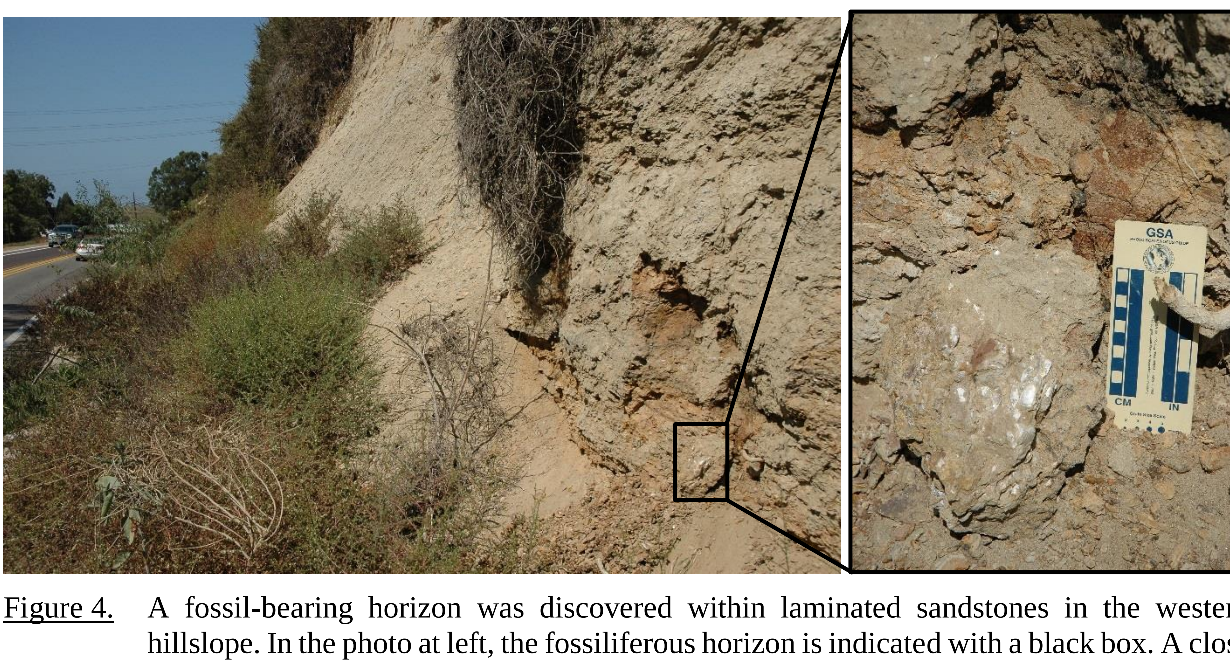

Figure 4. A fossil-bearing horizon was discovered within laminated sandstones in the western hillslope. In the photo at left, the fossiliferous horizon is indicated with a black box. A close up image of white fossil shells from this horizon is depicted at right.

4.3 Results of Paleontological Resource Potential Analysis

4.3.1 Slope Wash Deposits

Slope wash deposits are assigned a low paleontological resource potential based on the fact that they are the product of modern erosion and are not known to contain in place fossil remains. Although fossils may occasionally occur in slope wash deposits, these fossils are most likely reworked from adjacent (upslope) exposures of sedimentary bedrock, and thus lack appropriate geographic and stratigraphic contextual data.

4.3.2 Bay Point Formation (old paralic deposits)

The Bay Point Formation (old paralic deposits) is assigned a high paleontological resource potential based on the existence of known fossil localities within a 1-mile radius of the Project, as well as fossils known from these deposits elsewhere in northern San Diego County.

4.3.3 Torrey Sandstone

The Torrey Sandstone is assigned a high paleontological resource potential based on the recovery of scientifically significant fossils, particularly plant fossils, in northwestern San Diego County. It should be noted that fossils are less abundant in the Torrey Sandstone than in the Delmar Formation, but that the fossils that have been recovered from the Torrey Sandstone are of high importance.

4.3.4 Delmar Formation

The Delmar Formation is assigned a high paleontological resource potential based on the existence of known fossil localities within a 1-mile radius of the Project, as well as the discovery of fossils during the field survey. This assignment is further confirmed based on the results of the literature search indicating that scientifically significant fossils are somewhat abundant within the Delmar Formation elsewhere in northwestern San Diego County.

4.4 Results of Paleontological Impact Analysis

4.4.1 Currently Proposed Work

The currently proposed erosion control maintenance work at the Project is not anticipated to directly impact paleontological resources. This is primarily due to the fact that the work will only involve removal of slope wash deposits generated from recent hillslope erosion, and will not require excavations into the adjacent hillslope which is composed of the Delmar Formation. Although it is possible that fossils may have been eroded from the Delmar Formation and redeposited within the slope wash deposits, these fossils would not be scientifically significant because they have lost their original stratigraphic geographic contextual data. In addition, the fragile and weathered nature of the Delmar Formation fossils observed in outcrop during the field survey, suggests that it is likely that the erosion process and downslope movement will have destroyed or significantly damaged any such fossil remains.

4.4.2 Future Work

Future erosion control maintenance, or other roadway work have the potential to directly impact paleontological resources, if this work will involve excavations into previously undisturbed sedimentary strata. Such impacts may occur to the Delmar Formation and overlying Torrey

Sandstone if excavations will extend into the hillslope adjacent to the retaining wall. Direct impacts also may occur to the Bay Point Formation or the Delmar Formation if future excavations will extend into the subsurface, below existing grade at or adjacent to the Project.

Protection of paleontological resources during future erosion control maintenance should involve one of the following:

1.) Development and implementation of a paleontological mitigation and treatment plan (PMTP) that includes paleontological monitoring of earthwork that will impact paleontologically sensitive sedimentary strata, particularly the fossiliferous horizon discovered during the paleontological field survey. The PMTP should focus on mitigation measures that will outline the steps of a paleontological mitigation program (i.e., monitoring, fossil discovery and evaluation, fossil and data recovery, treatment of recovered fossils, storage, and final report of findings). These measures should be developed after specific earthwork plans have been devised.

2.) Avoidance of the resource. Paleontological resources may be preserved through avoidance of earthwork and landscaping of the hillslopes.

5.0 Conclusions and Recommendations

Though paleontologically sensitive resources are present within the Delmar Formation strata exposed in the hillslope wall sections at the Via De La Valle Erosion Control Maintenance project, these resources are unlikely to be directly impacted by currently proposed erosion work. The proposed work will only impact the slope wash deposits that have eroded from the hillslopes, and any contained fossils are not believed to be scientifically significant. As such, no paleontological mitigation strategies are recommended for the Project.

However, any future erosion control work that may involve lateral excavations into the hillslopes or ground disturbance below existing grade has the potential to directly impact paleontologically sensitive strata of the Bay Point Formation (below grade), Torrey Sandstone (upper hillslope exposures), and Delmar Formation (hillslope exposures and below grade). If such earthwork will occur in the future, it is recommended that a paleontological mitigation and treatment plan should be developed. Specific measures tailored to future earthwork should be created once future projects are designed.

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APPENDIX

APPENDIX: LOCALITY LIST

SAN DIEGO NATURAL HISTORY MUSEUM
DEPARTMENT OF PALEONTOLOGY

Locality Number	Locality Name	Location	Elevation	Geologic Unit	Era	Period	Epoch	North American Land Mammal Age	Depositional Environment
69	San Dieguito Valley	City of San Diego, San Diego County, CA	60	Bay Point Formation, unnamed marine deposit	Cenozoic	Quaternary	late Pleistocene		estuarine
2904	Flower Hill Shopping Center	City of San Diego, San Diego County, CA	60	Bay Point Formation, unnamed marine deposit	Cenozoic	Quaternary	late Pleistocene		lagoonal
5009	San Dieguito Valley - I-5 & Via de la Valle	City of San Diego, San Diego County, CA	36	Bay Point Formation, unnamed marine deposit	Cenozoic	Quaternary	late Pleistocene		lagoonal
6553	Flower Hill Promenade	City of San Diego, San Diego County, CA	48	Bay Point Formation, unnamed marine deposit	Cenozoic	Quaternary	late Pleistocene		lagoonal
6554	Flower Hill Promenade	City of San Diego, San Diego County, CA	47	Bay Point Formation, unnamed marine deposit	Cenozoic	Quaternary	late Pleistocene		lagoonal
6555	Flower Hill Promenade	City of San Diego, San Diego County, CA	45	Bay Point Formation, unnamed marine deposit	Cenozoic	Quaternary	late Pleistocene		lagoonal
6556	Flower Hill Promenade	City of San Diego, San Diego County, CA	47	Bay Point Formation, unnamed marine deposit	Cenozoic	Quaternary	Pleistocene		lagoonal
6557	Flower Hill Promenade	City of San Diego, San Diego County, CA	45	Bay Point Formation, unnamed marine deposit	Cenozoic	Quaternary	late Pleistocene		lagoonal
6558	Flower Hill Promenade	City of San Diego, San Diego County, CA	45	Bay Point Formation, unnamed marine deposit	Cenozoic	Quaternary	late Pleistocene		lagoonal
6560	Flower Hill Promenade	City of San Diego, San Diego County, CA	43	Bay Point Formation, unnamed marine deposit	Cenozoic	Quaternary	late Pleistocene		lagoonal
6561	Flower Hill Promenade	City of San Diego, San Diego County, CA	42	Bay Point Formation, unnamed marine deposit	Cenozoic	Quaternary	late Pleistocene		lagoonal
6562	Flower Hill Promenade	City of San Diego, San Diego County, CA	36	Bay Point Formation, unnamed marine deposit	Cenozoic	Quaternary	late Pleistocene		lagoonal
6563	Flower Hill Promenade	City of San Diego, San Diego County, CA	43	Bay Point Formation, unnamed marine deposit	Cenozoic	Quaternary	late Pleistocene		estuarine
4164	Georgaklis' Sloth	San Diego County, CA	85	Bay Point Formation, unnamed nonmarine deposit	Cenozoic	Quaternary	late Pleistocene	Rancholabrean	fluvial
4278	Del Mar Highlands Estates #2	City of Del Mar, San Diego County, CA	95	Bay Point Formation, unnamed nonmarine deposit	Cenozoic	Quaternary	late Pleistocene		lacustrine
4279	Del Mar Highlands Estates #3	City of Del Mar, San Diego County, CA	100	Bay Point Formation, unnamed nonmarine deposit	Cenozoic	Quaternary	late Pleistocene	Rancholabrean	nonmarine
5193	Mary's Tack Shop - San Dieguito Valley	San Diego County, CA	50	Delmar Formation	Cenozoic	Paleogene	middle Eocene		estaurine
5194	Mary's Tack Shop - San Dieguito Valley	San Diego County, CA	50	Delmar Formation	Cenozoic	Paleogene	middle Eocene		estaurine
5314	Mary's Tack Shop - San Dieguito Valley	San Diego County, CA	50	Delmar Formation	Cenozoic	Paleogene	middle Eocene		estaurine
5923	Mary's Tack Shop - San Dieguito Valley	San Diego County, CA	50	Delmar Formation	Cenozoic	Paleogene	middle Eocene		estaurine
6564	Flower Hill Promenade	City of San Diego, San Diego County, CA	45	Delmar Formation	Cenozoic	Paleogene	middle Eocene		lagoonal
6565	Flower Hill Promenade	City of San Diego, San Diego County, CA	42	Delmar Formation	Cenozoic	Paleogene	middle Eocene		estuarine
6566	Flower Hill Promenade	City of San Diego, San Diego County, CA	41	Delmar Formation	Cenozoic	Paleogene	middle Eocene		estuarine
6567	Flower Hill Promenade	City of San Diego, San Diego County, CA	37	Delmar Formation	Cenozoic	Paleogene	middle Eocene		estuarine
6568	Flower Hill Promenade	City of San Diego, San Diego County, CA	42	Delmar Formation	Cenozoic	Paleogene	middle Eocene		estuarine
6569	Flower Hill Promenade	City of San Diego, San Diego County, CA	52	Delmar Formation	Cenozoic	Paleogene	middle Eocene		estuarine
6570	Flower Hill Promenade	City of San Diego, San Diego County, CA	36	Delmar Formation	Cenozoic	Paleogene	middle Eocene		estuarine