# PALEONTOLOGICAL RESOURCE ASSESSMENT
# OLD TOWN SAN DIEGO
# AND
# MIDWAY-PACIFIC HIGHWAY CORRIDOR
# COMMUNITY PLAN UPDATES
# CITY OF SAN DIEGO
# SAN DIEGO COUNTY, CALIFORNIA

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## 1.0 INTRODUCTION

### 1.1 Scope of Work

This technical report provides an assessment of paleontological resources within the Old Town San Diego Community Plan Area and the adjacent Midway-Pacific Highway Corridor Community Plan Area (collectively referred to as the project area). The purpose of this report is to assist in planning and design efforts for the purposed community plan updates currently underway for both planning areas. Specifically, this report is intended to summarize existing paleontological resource data in the planning areas, discuss the significance of these resources, and discuss and identify mitigation measures to avoid or reduce project-related impacts wherever feasible. Additional discussion of report methodology is provided below. This report was prepared by Shelly L. Donohue and Thomas A. Deméré of the Department of PaleoServices, San Diego Natural History Museum (SDNHM), San Diego, California.

### 1.2 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.

### 1.3 Project Description and Location

The City of San Diego is preparing a comprehensive update of the Midway-Pacific Highway Corridor and Old Town Community Plan Areas. These updates will reflect the long-term vision for these communities, and also implement the goals and objectives of the City of San Diego's General Plan.

The Old Town San Diego Community Plan Area and the Midway-Pacific Highway Corridor Community Plan Area are located at the north end of San Diego Bay south of the San Diego River channel (Figure 1).

The Old Town San Diego Community Plan Area encompasses 230 acres of land at the northwest end of the San Diego Mesa and adjacent to the current and former floodplain of the San Diego River. The community is bounded on the north by Interstate 8 (I-8) and the Mission Valley Community Plan Area, on the south and west by Interstate 5 (I-5) and the Midway-Pacific Highway Corridor Community Plan Area, and on the east by Mission Hills and the Uptown Community Plan Area (Figure 2). Topographically, the Old Town San Diego Community Plan Area is quite varied and includes mesa and canyon lands in Presidio Park, steep hillsides along Juan Street, and relatively level land in the heart of the Old Town historic district. Land use within the community is also varied and includes commercial retail, commercial office, restaurants, hotels, and historic parks, as well as single- and multiple-family residential.

The Midway-Pacific Highway Corridor Community Plan Area encompasses 909 acres of relatively level land at the northeast end of the Point Loma Peninsula and adjacent to the current and former floodplain of the San Diego River. The community is comprised of two general areas: the central Midway Area and the narrow, linear shaped Pacific Highway Corridor. Prior to the construction of I-5, the Pacific Highway Corridor was part of the Uptown community plan area. It was excluded from that community in 1969 and included with the Midway Area during the last community plan update in 1991. The Midway-Pacific Highway Corridor Community Plan Area is generally bounded on the north by I-8, on the east by I-5, on the south by Laurel Street, and on the west by the San Diego Unified Port District properties, San Diego International Airport (SDIA) and the Marine Corps Recruit Depot (MCRD) (Figure 2). Land use within the community varies and includes retail shopping centers, sports arenas, hospitals, hotels, restaurants, both heavy and light industrial uses, and single- and multiple-family residential.

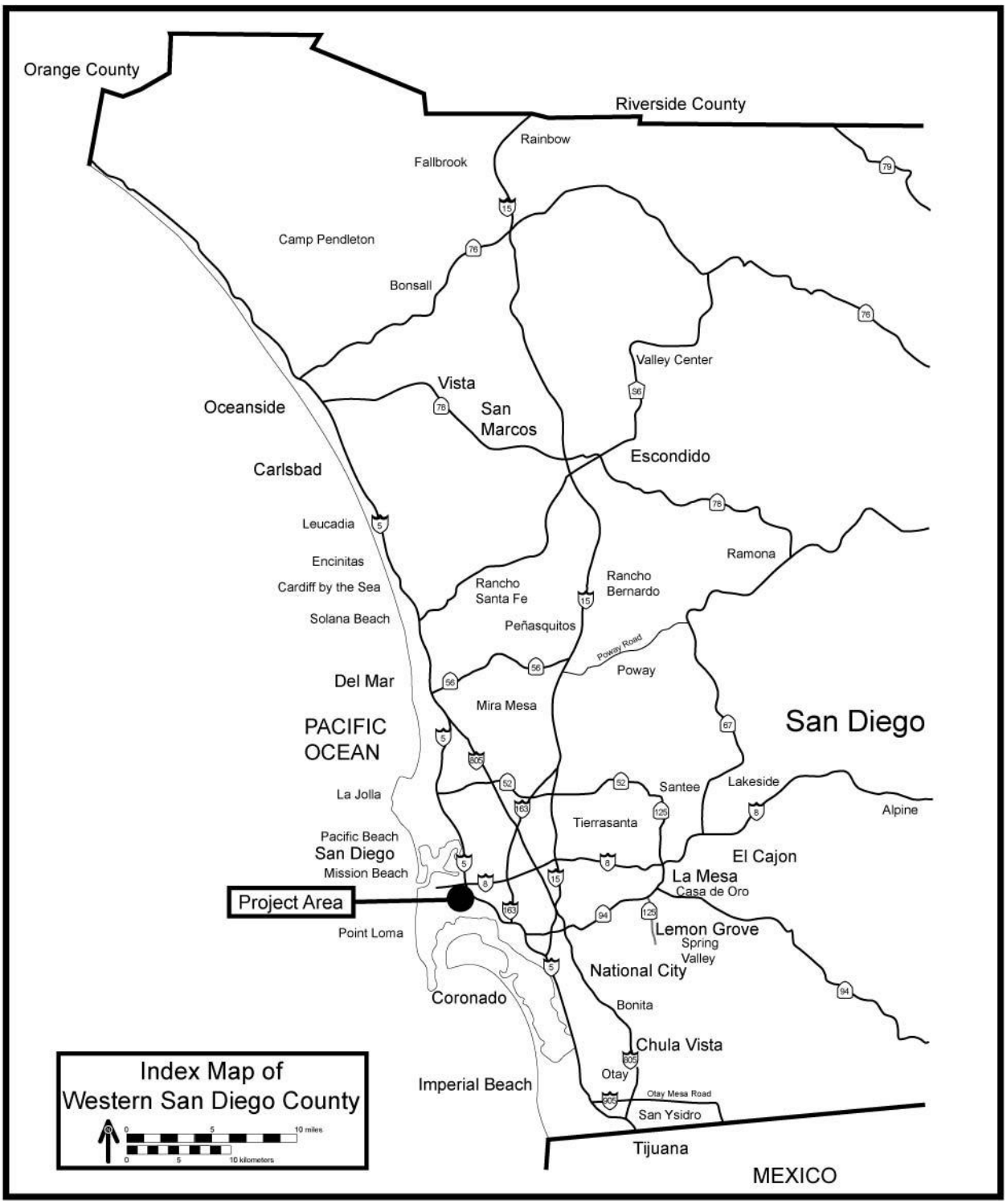



Figure 1. Index map of western San Diego County showing the general location of the Old Town San Diego and Midway-Pacific Highway Corridor Community Plan Areas.

Figure 2. Location map for the Old Town San Diego and the Midway-Pacific Highway Corridor Community Plan Areas, City of San Diego, California.

## 2.0 METHODOLOGY

A review was conducted of relevant published and unpublished geologic reports (e.g., Kennedy, 1975; Kennedy and Tan, 1977; 2008; Givens and Kennedy, 1979), unpublished paleontological reports (e.g., Deméré and Walsh, 1993), and museum paleontological locality data (SDNHM, Department of Paleontology; Figure 3). This approach was followed in recognition of the direct relationship between paleontological resources and the geologic formations within which they are entombed. Knowing the geology of a particular area and the fossil productivity of formations that occur in that area, it is possible to predict where fossils will, or will not, be encountered.

A pedestrian survey of the project area and immediately surrounding areas was conducted on May 23, 2013 by SDNHM personnel to field check the results of the literature and record searches and to determine the paleontological resource sensitivity of the geologic units that may be affected by the proposed improvements.

## 3.0 EXISTING CONDITIONS

### 3.1 Physical Geological Setting

The Coastal Plain region of San Diego County is underlain by a layer cake sequence of marine and non-marine sedimentary rock units that record portions of the last 140 million years of earth history (Deméré and Walsh, 1993). Over this period of time, the relationship of land and sea has drastically fluctuated, such that today, there are ancient marine rocks preserved up to elevations of 900 feet above sea level and ancient river deposits as high as 1,200 feet. Faulting related to the local La Nacion and Rose Canyon fault zones has broken up this sedimentary sequence into a number of distinct fault blocks in the southwestern part of the county (e.g., Kennedy, 1975).

On a more local scale, the geology of the project area, as described on the published geologic map of Kennedy and Tan (2008), is dominated by artificial fill and Quaternary alluvium to varying depths. These relatively youthful deposits overlie older geologic deposits, which crop out along the eastern and western margins of the project area. The oldest unit within the study area is the Eocene (48-50 million years old) Mount Soledad Formation, which is unconformably overlain by the Pleistocene (700,000 to 10,000 years old) Bay Point Formation along the northwestern margin of the Midway-Pacific Highway Corridor Community Plan Area. Along the northeastern margin of the Old Town Community Plan Area, the Eocene Scripps Formation is overlain by the Bay Point Formation, and the Plio-Pleistocene (3.5 to 1.5 million years old) San Diego Formation is overlain by the Pleistocene (1.5 million to 700,000 years old) Lindavista Formation.

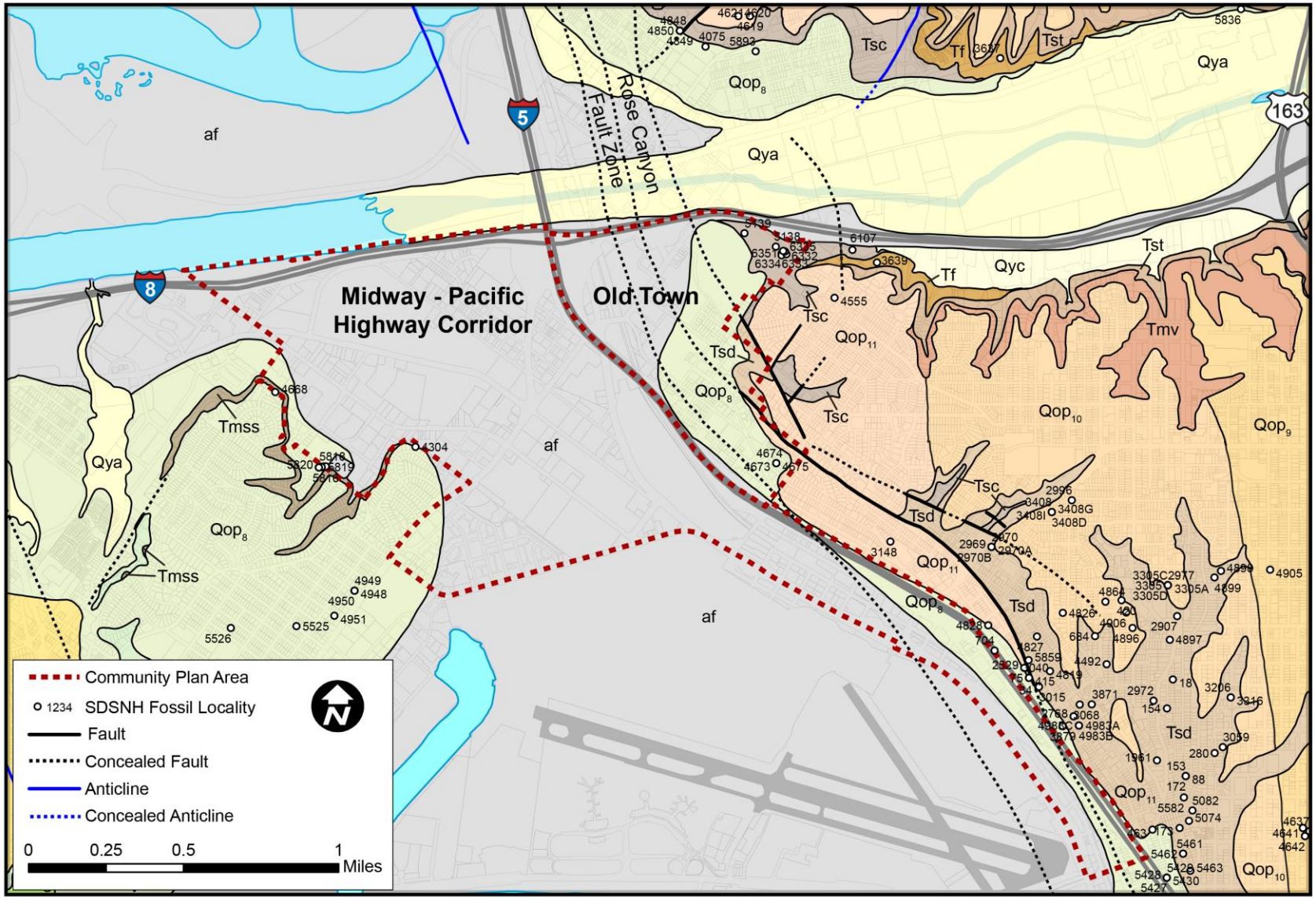
The Rose Canyon Fault Zone is locally mapped in the center of the Old Town San Diego Community Plan (Kennedy and Tan, 2008). Movement along this northwest trending strike-slip fault uplifted strata to the east and down-dropped strata to the west where they now occur at lower topographic levels (Kennedy, 1975). Two smaller fault extensions also occur within the fault zone, the Mission Bay Fault to the west, and the Old Town fault to the east of the Rose Canyon Fault. Movement within the fault zone has caused minor structural folding of adjacent rock units.

### 3.2 Results of the Paleontological Records Search

A search of the paleontological records housed at the SDNHM Department of Paleontology revealed a number of documented fossil collecting sites located within the boundaries of the Old Town San Diego Community Plan Area and the Midway-Pacific Highway Corridor Community Plan Area (Figure 3).

In the northeast corner of the Old Town Community Plan Area, adjacent to Taylor Street in Presidio Park, localities within the Scripps Formation (SDSNH Localities 5138 and 5139) were discovered by San Diego State University students in 1957. Numerous fossils of marine invertebrate species (e.g., clams and snails) were collected here. Strata in part represented by SDSNH Locality 5138 were impacted by roadway improvements to the Inspiration Point service road in Presidio Park during 2009. This work resulted in the discovery of additional fossil collecting localities (SDSNH 6332-6335 and 6351) that produced well-preserved remains of marine invertebrates (e.g., corals, bryozoans, mollusks, and crustaceans). Along the eastern margin of the project area, two clusters of collecting sites have been made from the Plio-Pleistocene San Diego Formation (SDSNH Localities 4673–4675 and 6483–6487). Localities 4673–4675 were discovered during sewer line trenching along the 3900 block of Hortensia Street, in the southeast corner of the Old Town Community Plan Area. Fossils from Localities 6483–6487 were excavated in 2010 during construction of the Laurel and Kettner Parking Structure in the southeast corner of the Midway-Pacific Community Plan Area, and were found in the uppermost portion of the San Diego Formation on either side of the Rose Canyon Fault. Fossils from all localities are primarily marine bivalves (e.g., oyster, scallop), gastropods (e.g., snails) and crustaceans (e.g., barnacles, crabs, shrimp). Just east of the southeastern project area perimeter, dozens of fossil collecting sites have been documented in both the Bay Point Formation and San Diego Formation (Figure 3).

Along the western margin of the Midway-Pacific Highway Corridor Community Plan Area, one large cluster of fossil localities (SDSNH Localities 5761, 5810, and 5816-5819) was discovered in 2006 during construction of the Cabrillo-Point Loma residential development within the Midway Community Plan Area. These localities occur within the Bay Point Formation, and collected fossils are predominantly oysters (*Ostrea lurida*), scallops (*Argopecten* sp.) and jingle shells (*Anomia peruviana*), though fossils of marine vertebrates including fish and ray were also discovered. A nearby fossil locality (SDSNH Locality 4304 = SDSU Locality 2530) discovered in the Bay Point Formation as exposed in cut slopes behind residences along Meadow Grove Drive was described by Kern (1977). This locality produced well-preserved shells of warm water marine invertebrates (e.g., clams and snails). Another nearby Bay Point Formation fossil locality (SDSNH Locality 4668) behind the Point Loma Convalescent Hospital at the south end of Duke Street (3202 Duke Street) has produced fossils of Pleistocene terrestrial mammals including isolated teeth from members of the horse family (Equidae).




Source: SanGIS 2010
Modified from Kennedy and Tan, 2008

Figure 3. Geology of the project area and vicinity. Colors represent the areal distribution of mapped geologic rock units: Recent artificial fill (af), Quaternary younger alluvium (Qya), Quaternary older paralic deposits (Qop) including Bay Point Formation ($Qop_8$) and Lindavista Formation ($Qop_{11}$), San Diego Formation (Tsd,), Mission Valley Formation (Tmv), Stadium Conglomerate (Tst), Friars Formation (Tf), Scripps Formation (Tsc), Mount Soledad Formation (Tmss), Cabrillo Formation Sandstone (Kcss).

### 3.3 Results of the Pedestrian Survey

The pedestrian survey of the project area confirmed the geologic mapping of Kennedy (1975) and Kennedy and Tan (2008) with the exception of the referral of strata previously mapped as the Mission Valley Formation to the Scripps Formation (see below; Figure 3). The presence of fossil localities within the project area was also confirmed, and additional fossil resources were newly discovered within the Mount Soledad Formation, Scripps Formation, and San Diego Formation. In depth descriptions and explanations of newly discovered fossil materials for each formation are provided in Section 4.

#### Referral of Mission Valley Strata to the Scripps Formation

Kennedy (1975) and Kennedy and Tan (2008) referred Eocene-age sedimentary rocks that underlie portions of the Old Town San Diego Community Plan Area, including Heritage Park and the lower hill slopes in Presidio Park, as the Mission Valley Formation. However, the surrounding geology, as well as lithological and paleontological aspects of these strata indicate that they should actually be referred to the Scripps Formation. This interpretation is also supported by the Eocene geology mapped on the north side of Mission Valley directly across the valley from Presidio Park. Here Kennedy (1975) and Kennedy and Tan (2008) map a subtle fold in the Eocene strata that exposes the Scripps Formation overlain by the Friars Formation and the Stadium Conglomerate (Figure 3). Importantly, the Mission Valley Formation is not exposed by this folding. Theoretically, these subtly folded rock units should be laterally continuous, and thus also exposed on the south wall of Mission Valley. While the Rose Canyon Fault Zone is just west of the fold, there is no fault to account for the displacement and/or absence of the Scripps Formation on the southern valley walls. Rather, we suggest that the axis of the fold continues to the southwest across Mission Valley, and the unit previously mapped as the Mission Valley Formation (Kennedy and Tan, 2008) is actually the Scripps Formation (Figure 3).

The Scripps Formation is an early-mid Eocene offshore, marine shelf deposit recording a regressive lowering of sea level (Kennedy and Moore, 1971). The offshore depositional environment is reflected in the argillaceous, laminated, fine-grained sandstone with frequent silt to clay interbeds (Kennedy, 1975; Kennedy and Moore, 1971). In contrast, the Mission Valley Formation records a transgressive period representing a shallower, nearshore marine paleoenvironment. The Mission Valley Formation is typically a friable olive-gray sandstone with fewer micaceous grains than the Scripps Formation (Kennedy, 1975). The outcrop along Taylor Street in Presidio Park indeed contains fossiliferous clay interbeds, and is highly micaceous, most similar to the Scripps Formation (Figure 4).

A productive molluscan fossil locality adjacent to the northeast project boundary (SDSNH Locality 6107; Figure 3) was collected from the same strata as those exposed along the flanks of Presidio Park. Mollusks from this site record a Californian Molluscan Stage of the lower-middle Eocene ("Domingine" to "Transitional"), corresponding to the Scripps Formation (Givens and Kennedy, 1979). Some molluscan taxa at this locality are common in the "Transitional" stage (e.g., *Ficopsis remondii crescentensis*, *Miltha packi*, *Tellina soledadensis*, and *Meverita globosa*) and the gastropod *Ectinochilus macilentus* is only known from the earlier "Domingine" stage. The Mission Valley Formation boasts an impressive molluscan fauna of the younger, upper-middle Eocene "Tejon" Stage (Givens and Kennedy, 1979; Deméré et al., 1979), yet key

indicator taxa for this stage are absent from the Locality 6107 assemblage. The presence of the older, lower-middle Eocene molluscan fauna further confirms the Eocene strata in Presidio Park as the Scripps Formation.

Figure 4. Exposure of the Scripps Formation in Presidio Park. The lighter colored resistant units are claystone..

## 4.0 PALEONTOLOGICAL RESOURCE ASSESSMENT

The following section provides a general overview of the types of geologic deposits located within the project area and their paleontological resource sensitivity.

### 4.1 Artificial Fill Materials (af)

**Introduction:** Kennedy and Tan (2008) mapped much of the project area as being underlain by artificial fill. These findings were confirmed during the pedestrian survey. Fill materials presumably were derived from earlier construction activities and were placed in such a way as to provide topographically high areas for current and future development.

**Paleontology:** No fossils of paleontological interest are located in artificial fill materials. Any contained organic remains have lost their original stratigraphic/geologic context due to the disturbed nature of the artificial fill materials.

**Site Specific Assessment:** Artificial fill materials are assigned a zero paleontological resource sensitivity due to the loss of the stratigraphic/geologic context of any contained organic remains (e.g., fossils).

### 4.2 Bay Point Formation ($Qop_8$)

**Introduction:** The Bay Point Formation (Hertlein and Grant, 1939) represents a nearshore marine to onshore fluvial sedimentary deposit of middle to late Pleistocene age (700,000 to 10,000 years old). Typical exposures consist of light gray, friable to partially cemented, fine- to coarse-grained, massive to cross-bedded sandstone. As originally defined by Hertlein and Grant (1939) and mapped by Kennedy (1975), this rock unit includes marine-terrace deposits, as well as valley-fill deposits, and in some cases, river-terrace deposits.

**Paleontology:** The Bay Point Formation has produced large and diverse assemblages of well-preserved marine invertebrate fossils, primarily mollusks, from many localities in the metropolitan San Diego area (Stephens, 1929; Hertlein and Grant, 1939; Valentine, 1959; Deméré, 1981). Remains of fossil marine vertebrates (i.e., sharks, rays, and bony fishes; Deméré and Walsh, 1993) and terrestrial mammals (e.g., horse, camel, deer, mastodon, and mammoth) have also been recovered from this rock unit.

**Site Specific Assessment:** During the pedestrian survey, outcrops of the Bay Point Formation were observed on the northwestern perimeter of the project area, behind the Point Loma Convalescent Hospital at the south end of Duke Street (3202 Duke Street, Figure 5), and behind a vacant commercial building at 3455 Kenyon St. Exposures of the Bay Point Formation in this vicinity occur as brownish-gray, massive to poorly-bedded, bioturbated sandstone, and contact the underlying Mount Soledad Formation with an 11º angular unconformity, indicating the presence of a marine abrasion platform (i.e., ancient sea floor) that formed during interglacial high sea levels (Figure 5). A fossil locality (SDSNH Locality 4668) containing terrestrial mammals including horse (*Equus*) is still accessible within this region of the project area.

Along the northwestern edge of the project area, at least two depositionally distinct sedimentary sequences have been recognized: an older basin-filling marine sequence known as the

"Broadway Faunal Horizon" (Deméré, 1981) and a younger marine-terrace sequence that has not been formally named. Deméré (1981) and Kern and Rockwell (1992) suggested that the age of the composite "Broadway Fauna" was between 500,000 and 600,000 years old, and represents a warm water fauna, indicating interglacial conditions.

Along the northeastern portion of the project area in Presidio Park, outcrops of the Bay Point Formation consist of oxidized, tan-orange interbedded sandstone and conglomerate units (Figure 6). The depositional environment here was fluvial, with conglomerate layers likely deposited during storm or high flow conditions, and sandstone layers deposited during normal flow conditions. No fossil localities within the Bay Point Formation are currently known along the eastern margin of the project area.

Based on the previous collection of marine invertebrate, marine vertebrate, and terrestrial mammal fossils from sites in the western portion of the Midway-Pacific Highway Corridor Community Plan Area (e.g., Cabrillo-Point Loma residential development and the Point Loma Convalescent Hospital), any construction-related earthwork in the Bay Point Formation has the potential to unearth fossil resources. The Bay Point Formation thus is assigned a high paleontological resource sensitivity.

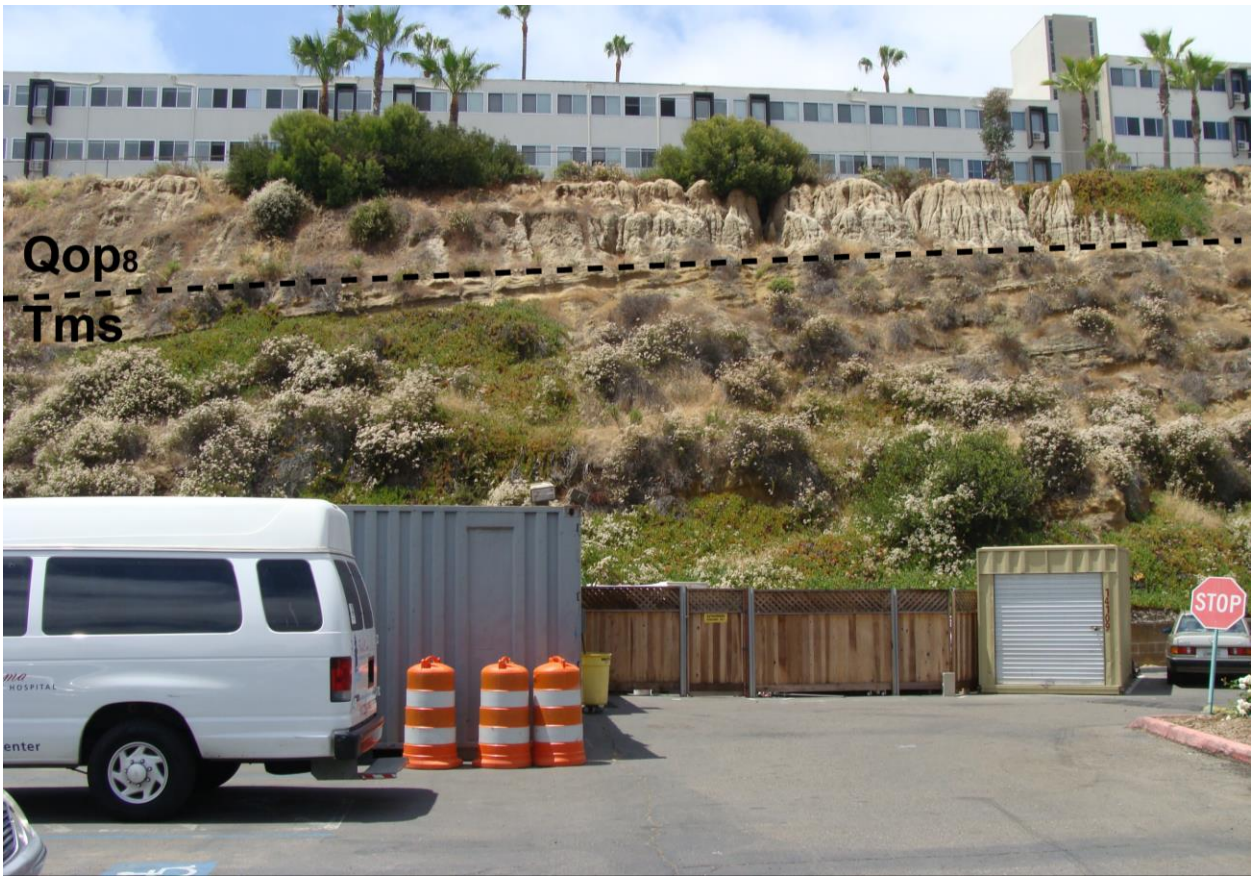



Figure 5. Exposure of the Pleistocene Bay Point Formation ($Qop_6$) and Eocene Mount Soledad Formation (Tms) behind the Point Loma Convalescent Hospital at the south end of Duke Street in the northwestern portion of the Midway-Pacific Highway Corridor Community Plan Area.

Figure 6. Exposure of non-marine sandstones and conglomerates in the Pleistocene Bay Point Formation along Taylor Street, near Presidio Park in Old Town San Diego.

### 4.3 Lindavista Formation ($Qvop_{11}$)

**Introduction:** The Lindavista Formation represents marine and non-marine terrace deposits of early Pleistocene age. Depositional environments were variable, and included fluvial, aeolian, and shallow nearshore marine paleoenvironments (Kennedy, 1975). The Lindavista Formation was deposited during Pleistocene high sea level conditions. Typical exposures of the Lindavista Formation are reddish brown interbedded sandstone and conglomerate, with an average thickness of 20-30 feet (Kennedy, 1975).

**Paleontology:** Fossil localities are rare within the Lindavista Formation, although a few have been discovered in Mira Mesa and Tierrasanta. The fossils that have been collected from the formation include nearshore marine invertebrates such as clams, scallops, snails, and sand dollars (Kennedy, 1973), as well as the occasional remains of sharks and baleen whales (Deméré and Walsh, 1993).

**Site Specific Assessment:** The Lindavista Formation is present in the northeastern portion of the project area, and exposed as a well-oxidized interbedded conglomerate and sandstone unit. In the exposures behind apartment buildings located at 2225 Congress Street, the Lindavista Formation overlies the Plio-Pleistocene San Diego Formation. The base of the formation is an

approximately 10 foot thick poorly sorted conglomerate overlain by a massive, friable, fine- to medium-grained sandstone with conglomerate lenses (Figure 7). Beds within the Congress Street outcrop dip steeply from 51–56º SW due to the close proximity to the Rose Canyon Fault Zone.

Currently, no SDSNH fossil localities within the vicinity of the project area have been revealed through database record searches or pedestrian surveys. Because fossils have been documented previously within the Lindavista Formation, a moderate paleontological resource sensitivity is assigned.

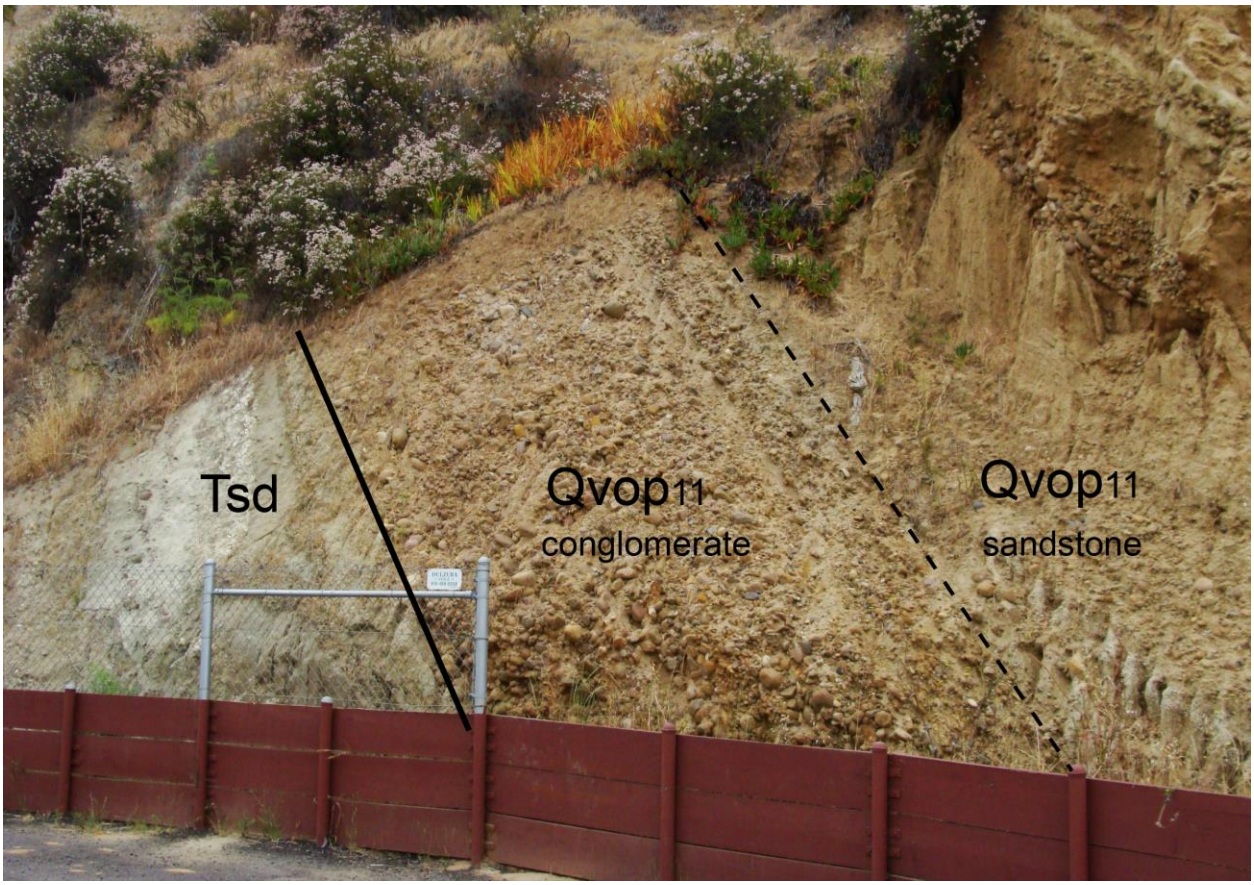



Figure 7. Formational contact (solid line) between Plio-Pleistocene San Diego Formation (Tsd) and the Pleistocene Lindavista Formation ($Qvop_{11}$), as exposed at 2225 Congress St. The dashed line separates the basal conglomerate layer of the Lindavista Formation from the overlying sandstone. Note the steep dip of the strata.

### 4.4 San Diego Formation (Tsd)

**Introduction:** The San Diego Formation (Hertlein and Grant, 1944; Deméré, 1983) is a marine sedimentary rock unit of late Pliocene- to early Pleistocene-age (approximately 3.5 to 1.5 million years old), which was deposited in an open-marine embayment similar in size and shape to modern-day Monterey Bay. The shoreline for this ancient embayment was well to the east of the present shoreline, with beach deposits reported in Bonita, La Mesa, and Lemon Grove. Typical exposures of this formation consist of yellowish-gray, fine-grained, friable sandstone. Poorly-

sorted gravel, pebble conglomerate, and well-laminated claystone also occur within the formation. The maximum thickness of the unit is between 250 and 300 feet.

**Paleontology:** The San Diego Formation has produced fossils from numerous localities discovered in the San Diego coastal plain. The formation is well known for its rich fossil beds that have yielded extremely diverse assemblages of marine clams, scallops (Hertlein and Grant, 1972), snails, crabs, barnacles, sand dollars (Hertlein and Grant, 1960), sharks (Deméré and Cerutti, 1981), rays, bony fishes, sea birds (Chandler, 1990), walrus (Deméré, 1994), fur seal (Berta and Deméré, 1986), sea cow (Domning and Deméré, 1984), dolphins (Barnes, 1973), and baleen whales (Deméré, 1986; Barnes, 1973; 1976). In addition, rare remains of terrestrial mammals, including cat, wolf, skunk, peccary, camel, antelope, deer, horse, and shovel-tusked elephant (gomphothere), have also been recovered from the formation. Rounding out this impressive fossil record is the occurrence of fossil wood and leaves, including remains of pine, oak, laurel, cottonwood, and avocado (Axelrod and Deméré, 1984). Taken together, this diverse assemblage of fossil organisms represents one of the most important sources of information on Pliocene-age marine organisms and environments in the United States (Deméré and Walsh, 1993).

**Site Specific Assessment:** During the pedestrian survey, good exposures of fossil bearing San Diego Formation strata were encountered behind the apartments located at 2225 Congress Street in the Old Town Community Plan Area. Beds of the San Diego Formation are dipping 51–56º SW, and are overlain by the Lindavista Formation (Figure 7). The basal exposure at the northeast edge of the outcrop is a light gray to tan massive, fine-grained micaceous sandstone. Up section to the southwest, the formation transitions to a tan to olive green, fine-grained, micaceous sandstone with cobble and shell hash layers. Three distinct shell beds occur in the Congress Street outcrop. The two most basal cemented shell beds are both bioclast supported, pebbly, poorly sorted, and loosely to closely packed with shells concordant and discordant to bedding (Figure 8). Fossils present are polytypic and include scallops, oysters, snails, brachiopods, and barnacles (Figures 9). Fossils are preserved as single valves and include internal and external molds, as well as some original shell material. Between these shell beds is massive, very fine-grained sandstone with articulated valves of aragonitic bivalves (Figure 10). The uppermost shell bed is comprised mostly of oyster (*Dendostrea vespertina*) and scallop (*Pecten* sp.) shells with valves at all orientations. *Pecten* sp. fossils in the Congress Street outcrop resemble *Pecten bellus*, an index fossil for the early Pleistocene, but cannot be formally identified without collection and further study. Collection of *Pecten* sp. fossils from the Congress Street outcrop may constrain the age of the San Diego Formation in this area, thus offering important insight into the paleoenvironment of Old Town San Diego.

Numerous recorded SDSNH localities are present in the San Diego Formation within the project area, and have produced fossils of predominantly marine mollusks (e.g., oysters, scallops, snails), but include rarer taxa such as brachiopods. Results of the pedestrian survey identified new important fossil resources within the project area that have the potential to contribute greatly to our understanding and interpretation of the prehistory of the City of San Diego. The strata of the San Diego Formation are assigned a high paleontological resource sensitivity due to the high potential for continued fossil discovery during future construction activities within the project area.

Figure 8. Shell beds 1 (lower/left) and 2 (upper/right) in the Plio-Pleistocene San Diego Formation with inset box highligting a portion of the massive sandstone interbed containing articulated bivalves (Figure 10).

Figure 9. Example of fragmentary, single valves of fossil invertebrates from San Diego Formation shell beds 1 and 2 in the Congress Street outcrop, pictured above (Figure 8). Left, fossil oyster (*Dendostrea vespertina*). Right, fossil scallop (*Pecten* sp.).

Figure 10. Articulated bivalves (*Lucinoma annulata*) in cross-sectional view, from massive sandstone (San Diego Formation) pictured above (Figure 8.)

### 4.5 Scripps Formation (Tsc)

### Introduction:

The Scripps Formation is an early middle Eocene (46-47 million years ago) sedimentary rock unit of marine origin, and was deposited offshore on the continental shelf (Givens and Kennedy, 1979). The Scripps Formation in its type area in the sea cliffs north of the Scripps Institution of Oceanography consists of light gray, fine-grained marine sandstone reaching a thickness of 185 feet (Kennedy and Moore, 1971). Sedimentary rocks assigned to the Scripps Formation crop out from Presidio Park in the south, north to Del Mar, and from Clairemont east to La Jolla Valley (Kennedy, 1975). In the eastern and southern portions of its area of outcrop, the formation largely consists of light gray, medium-grained, fluvial sandstones and green and brown non-marine mudstones.

### Paleontology:

The Scripps Formation is considered to be potentially fossiliferous almost everywhere it occurs (Deméré and Walsh, 1993). Most of the fossils known from this formation consist of remains of marine organisms including clams, snails, crabs, sharks, rays, and bony fishes (Givens and

Kennedy, 1979). However, remains of fossil reptiles (e.g., crocodile and turtle) and land mammals (e.g., uintatheres, brontothere, rhinoceros, and artiodactyl) have also been recovered from the formation (Golz and Lillegraven, 1977). Well-preserved pieces of fossil wood and impressions of fossil leaves have also been recovered from the Scripps Formation.

**Site Specific Assessment:**

Eocene strata exposed in Heritage Park and Presidio Park consist of bluish gray, fine-grained sandstones with localized concretionary layers and interbedded with gray siltstones. During the pedestrian survey a 12 cm thick, olive-gray, poorly sorted, very fine-grained sandstone concretionary layer was found to be fossil bearing (Figure 11). This heavily burrowed unit contained internal and external molds of marine gastropod snails including *Turritella* sp. and a moon snail (Nauticidae), as well as unidentified bivalves (Figures 11–14).

In the Presidio Park parking lot adjacent to Taylor Street, a 25 foot thick outcrop of light tan – yellow very fine-grained sandstone interbedded with massive siltstone is exposed. Within the outcrop are shell bed horizons that vary from dispersed to loosely packed and are generally concordant to bedding. Invertebrate fossils from this location include the gastropod *Turritella* sp., bivalves, and trace fossil burrows (*Skolithos*). A single vertebrate bone fragment of either a fossil reptile or mammal was recovered. Precise identification will occur with further study.

Any future earthwork activities that disturb the Scripps Formation within the project area have the potential to unearth and negatively impact fossil resources. The strata of the Scripps Formation are assigned a high paleontological resource sensitivity.

Figure 11. Outcrop of Scripps Formation strata adjacent to the parking lot of Heritage Park. Arrow indicates an exposure of the fossiliferous concretationary bed, pictured in Figures 12-14.

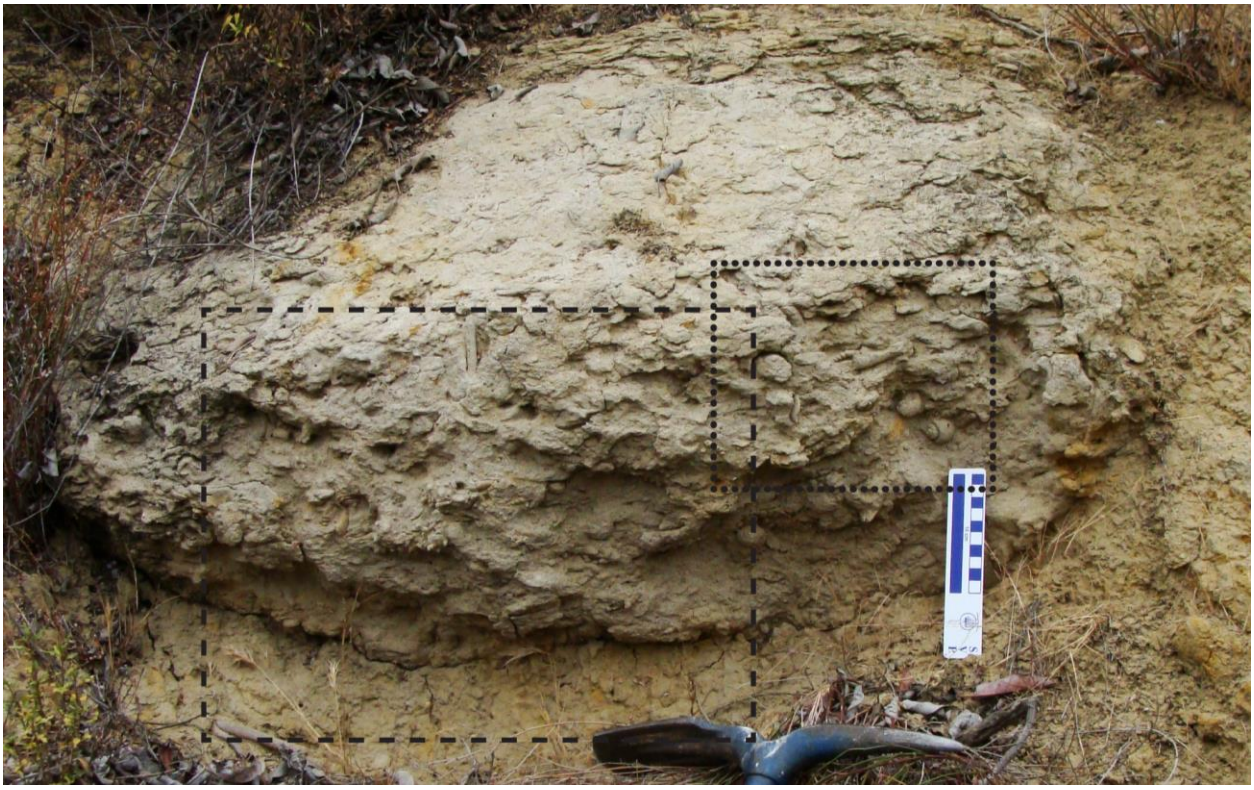


Figure 12 .Exposure of concretionary bed within the Scripps Formation at Heritage Park (see Figure 11). The dashed box and dotted box enclose the areas pictured in Figures 13 and 14, respectively. Scale bar=10cm.

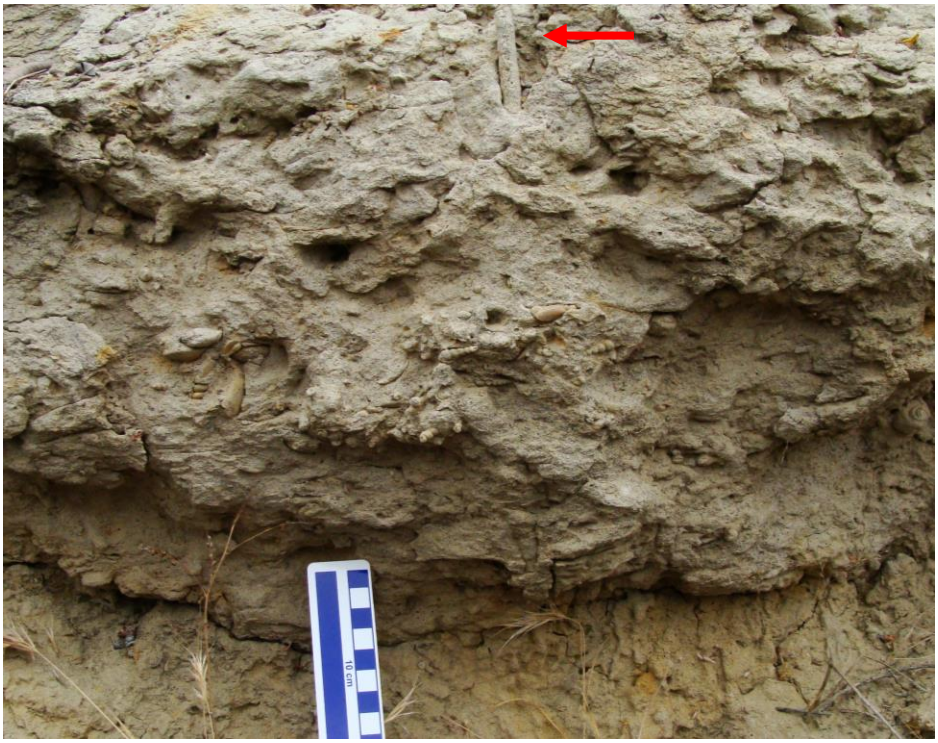



Figure 13. Heavily burrowed outcrop within the Scripps Formation (dashed box, Figure 12). Arrow indicates Trace fossil burrows (*Skolithos*). Scale bar is in cm.

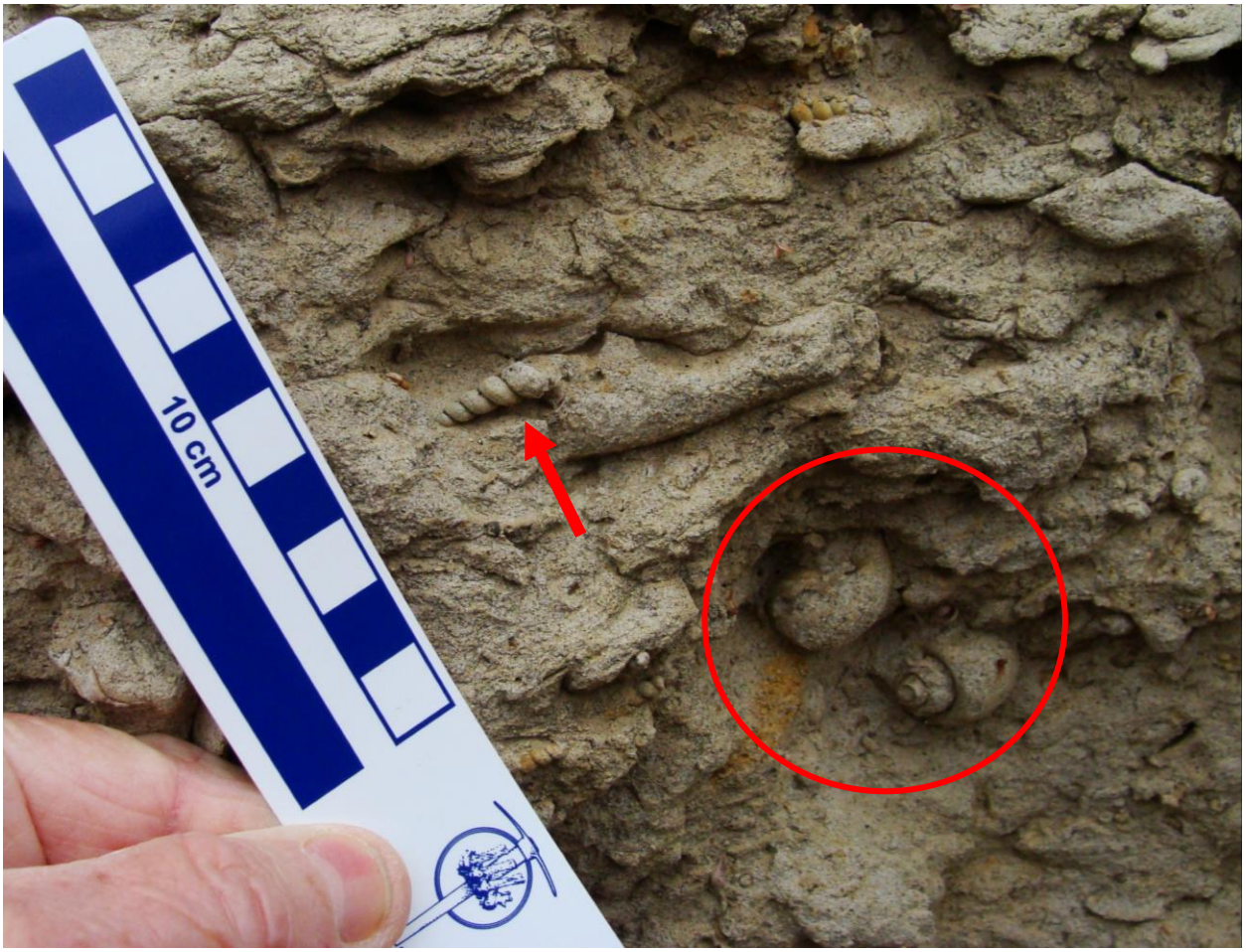



Figure 14. Internal molds of marine gastropods (dotted box, Figure 12). Arrow indicates *Turritella* sp.; circle highlights two moon snail internal molds (Nauticidae). Scale bar is in cm.

### 4.6 Mount Soledad Formation (Tmss)

**Introduction:**

The Mount Soledad Formation (Kennedy and Moore, 1971) is the lowest member of the Eocene La Jolla Group, with an estimated age of 48-50 million years old. At the type locality on Mount Soledad, the formation is approximately 225 feet thick, composed mainly of cobble conglomerate (Kennedy, 1975), and lies unconformably over the Cretaceous Cabrillo Formation (Kcss, Kccg; Figure 3). The Mount Soledad conglomerate is differentiated from the underlying Cretaceous Cabrillo conglomerate by the presence of red rhyolite-tuff clasts. To the southeast of Mission Bay the formation is locally composed entirely of medium-grained sandstone (Kennedy, 1975), and overlies the "Unnamed Formation". Marine, fine-grained sandstones and siltstones exposed in the sea cliffs of northern Pacific Beach (Tourmaline Beach) have also been assigned to the Mount Soledad Formation (Kennedy, 1975). The paleoenvironment of the Mount Soledad Formation is interpreted as a submarine channel (Link et al., 1979), deposited during a period of rapid sea level rise (Kennedy and Moore, 1971).

**Paleontology:** The Mount Soledad Formation contains fossils of marine mollusks (e.g., snails *Turritella uvasana applinae, Ficopsis cooperiana, Tejonia lajollaensis*) indicating an early Eocene Age (Kennedy, 1975). Other marine invertebrates collected from this rock unit include bivalves (clams, oysters), foraminifers (single celled protists), echinoderms (sea stars, sea urchins, sand dollars), arthropods (crabs, lobsters, barnacles) and bryozoans (moss animals). Rare fossils of bony fish and leaves have also been recovered from the Mount Soledad Formation. Fossils of the Mount Soledad Formation are less well known than those of younger, more fossiliferous rock units in San Diego County. Their scientific value is high, as continued discovery and interpretation greatly increases our knowledge of the early Eocene of San Diego.

**Site Specific Assessment:** During the pedestrian survey, outcrops of the Mount Soledad Formation were observed in the northwestern portion of the Midway-Pacific Highway Corridor Community Plan Area, behind the Point Loma Convalescent Hospital at the south end of Duke Street (3202 Duke Street). Exposures of the Mount Soledad Formation in this vicinity occur as yellow-orange to tan, friable, very fine-grained sandstone with indurated concretionary layers and lenses of silty-clay throughout. This formation is well-bedded with localized massive sections that have been heavily bioturbated (Figure 15). Strata are dipping 11º SW and are sharply overlain by flatlying strata of the Pleistocene Bay Point Formation (Figure 7). The erosional contact between these two sedimentary rock units represents an angular unconformity.

Previously undocumented fossil material was discovered during the pedestrian survey within the Mount Soledad Formation behind the Point Loma Convalescent Hospital (Figures 15-18). Within the lower portion of the formation is a concretionary shell bed that is bioclast supported with densely packed fragmentary shell material (Figures 17-18). Fossils discovered were marine mollusks including single recrystallized valves of large veneroid clams (Figure 16), and internal molds of the gastropod snail *Turritella* sp. Trace fossils (burrows) were abundant and well-preserved within the exposed strata (Figure 15).

The strata of the Mount Soledad Formation are assigned a high paleontological resource sensitivity due to the discovery of fossil material which have high scientific value. There is a high potential for continued fossil discovery within the project area.

Figure 15. Heavily burrowed massive sandstone of the Mount Soledad Formation behind Point Loma Convalescent Hospital. Black arrow indicates well-preserved infilled burrow exposed in side-view. The darker circles present on the underside of the outcrop represent the basal exposure of numerous burrows.

Figure 16. Concretionary shell bed within the Mount Soledad Formation behind the Point Loma Convalescent Hospital. Shell material is highly fragmentary. Scale bar is in cm.

Figure 18. Concretionary shell bed within the Mount Soledad Formation behind the Point Loma Convalescent Hospital. Despite the fragmentary nature of the shell material, recognizable mollusks include veneroid clams (at center) and the gastropod snail *Turritella* sp. (bottom left). Scale bar is in cm.

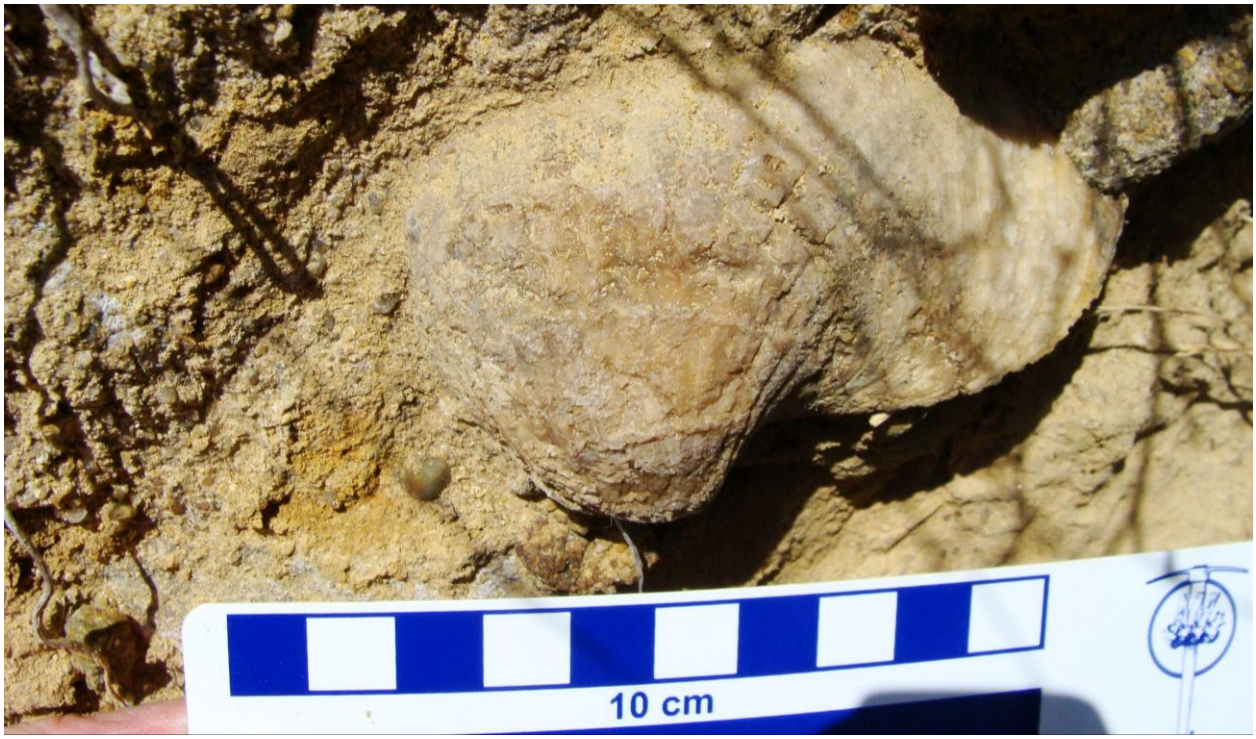



Figure 19. Recrystallized shell of a veneroid clam (*Venericardia* sp.) partially exposed within a shell bed of the Mount Soledad Formation behind the Point Loma Convalescent Hospital.

# 5.0 IMPACT ANALYSIS

## 5.1 Introduction

Direct impacts to paleontological resources occur when earthwork activities, such as mass grading operations, cut into the geological deposits (formations) within which fossils are buried. These direct impacts are in the form of physical destruction of fossil remains. Since fossils are the remains of prehistoric animal and plant life they are considered to be nonrenewable. Such impacts can be significant and, under CEQA guidelines, require mitigation.

Impacts to paleontological resources are typically rated from high to zero depending upon the resource sensitivity of impacted formations. Figure 20 summarizes the paleontological sensitivity of rock units occurring in the Old Town San Diego and Midway-Pacific Highway Corridor Community Plan Areas.

## 5.2 Levels of Paleontological Resource Sensitivity

The following levels of paleontological resource sensitivity are rated for individual formations, since it is the formation that contains the fossil remains:

**High Sensitivity**

High sensitivity is assigned to geologic formations known to contain paleontological localities with rare, well-preserved, critical fossil materials for stratigraphic or paleoenvironmental interpretation, and fossils providing important information about the paleobiology and evolutionary history (phylogeny) of animal and plant groups. Generally speaking, highly sensitive formations produce vertebrate fossil remains or are considered to have the potential to produce such remains.

High sensitivity rock units in the project area: Bay Point Formation, San Diego Formation, Scripps Formation, Mount Soledad Formation

**Moderate Sensitivity**

Moderate sensitivity is assigned to geologic formations known to contain paleontological localities with poorly preserved, common elsewhere, or stratigraphically unimportant fossil material. The moderate sensitivity category is also applied to geologic formations that are judged to have a strong, but unproven potential for producing important fossil remains.

Moderate sensitivity rock units in the project area: Lindavista Formation

**Low Sensitivity**

Low sensitivity is assigned to geologic formations that, based on their relative youthful age and/or high-energy depositional history, are judged unlikely to produce important fossil remains. Typically, low sensitivity formations produce invertebrate fossil remains in low abundance.

Low sensitivity rock units in the project area: None

**Zero Sensitivity**

Zero sensitivity is assigned to geologic formations that are entirely igneous in origin and therefore have no potential for producing fossil remains, or to artificial fill materials which lose the stratigraphic/geologic context of any contained organic remains (e.g., fossils).

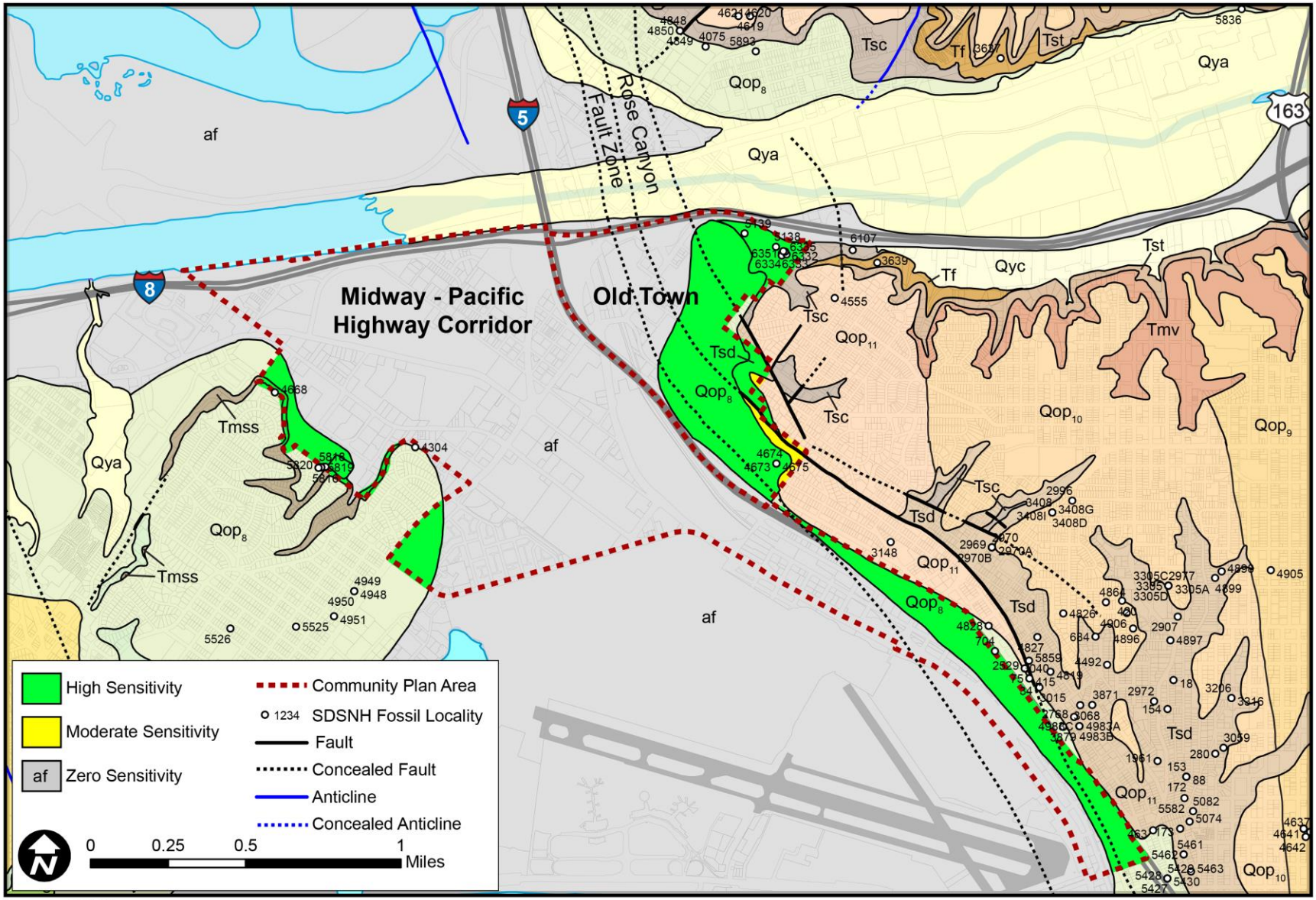
Zero sensitivity rock units in the project area: artificial fill

### 5.3 Site Specific Impacts

Any updates to the Old Town San Diego and Midway-Pacific Highway Corridor Community Plans will likely include proposals for new construction, which in turn will likely involve earthwork activities. Any excavations into the high sensitivity fossil-bearing strata (Figure 20) of the Bay Point Formation, Lindavista Formation, San Diego Formation, Scripps Formation, or Mount Soledad Formation should be mitigated. The potential negative impacts to paleontological resources can be reduced to below the level of significance through implementation of a paleontological mitigation plan as outlined below.

### 5.4 Mitigation Measures

1. A qualified paleontologist should attend the pre-construction meeting to consult with the grading and excavation contractors concerning excavation schedules, paleontological field techniques, and safety issues. (A qualified paleontologist is defined as an individual with an MS or Ph.D. in paleontology or geology that is familiar with paleontological procedures and techniques, who is knowledgeable in the geology and paleontology of San Diego County, and who has worked as a paleontological mitigation project supervisor in the county for at least one year.)
2. A paleontological monitor should be on-site on a full-time basis during the original cutting of previously undisturbed deposits of high paleontological resource potential (Bay Point Formation, San Diego Formation, Scripps Formation, Mount Soledad Formation) to inspect exposures for contained fossils. (A paleontological monitor is defined as an individual who has experience in the collection and salvage of fossil materials. The paleontological monitor should work under the direction of a qualified paleontologist.)
3. When fossils are discovered, the paleontologist (or paleontological monitor) should recover them. In most cases this fossil salvage can be completed in a short period of time. However, some fossil specimens (such as a complete large mammal skeleton) may require an extended salvage period. In these instances the paleontologist (or paleontological monitor) should be allowed to temporarily direct, divert, or halt grading to allow recovery of fossil remains in a timely manner. Because of the potential for the recovering of small fossil remains, such as isolated mammal teeth, it may be necessary to set up a screen-washing operation on the site.
4. Fossil remains collected during monitoring and salvage should be cleaned, repaired, sorted, and cataloged as part of the mitigation program.
5. Prepared fossils, along with copies of all pertinent field notes, photos, and maps, should be deposited (as a donation) in a scientific institution with permanent paleontological collections such as the San Diego Natural History Museum. Donation of the fossils should be accompanied by financial support for initial specimen storage.
6. A final summary report should be completed that outlines the results of the mitigation program. This report should include discussions of the methods used, stratigraphic section(s) exposed, fossils collected, and significance of recovered fossils.




Source: SanGIS 2010
Modified from Kennedy and Tan, 2008

Figure 20. Paleontological sensitivity map. Highlighted regions indicate sensitivities above zero within the project area. Recent artificial fill (af), Quaternary younger alluvium (Qya), Quaternary older paralic deposits (Qop) including Bay Point Formation ($Qop_8$) and Lindavista Formation ($Qop_{11}$), San Diego Formation (Tsd,), Mission Valley Formation (Tmv), Stadium Conglomerate (Tst), Friars Formation (Tf), Scripps Formation (Tsc), Mount Soledad Formation (Tmss), Cabrillo Formation Sandstone (Kcss).

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