PALEONTOLOGICAL RESOURCE ASSESSMENT
MISSION TRAILS REGIONAL PARK
MASTER PLAN UPDATE
SAN DIEGO COUNTY, CALIFORNIA

PALEOSERVICES
SAN DIEGO NATURAL HISTORY MUSEUM

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EXECUTIVE SUMMARY

This report presents the results of a paleontological resources assessment for the Mission Trails Regional Park (MTRP) and the proposed expansion areas, completed as part of the Master Plan Update (MPU) initiated by the Park Planning Section of the City of San Diego Planning Department. The purpose of this report is to identify and summarize existing paleontological resource data within MTRP, classify and discuss the significance of these resources, assess potential impacts to paleontological resources from expansion of MTRP under the MPU, and provide recommendation for the protection and management of these resources.

Mission Trails Regional Park encompasses nearly 5,800 acres of developed and undeveloped land eight miles northeast of the downtown area of the City of San Diego. The Park spans State Route 52 (SR-52) west of State Route 125 (SR-125), and extends south of Navajo Road towards Interstate 8 (I-8) to surround the Lake Murray Reservoir. The proposed MPU expansion would add an area immediately adjacent to the northeast corner of the Marine Corps Air Station – Miramar and spanning the boundary between Rancho Encantada on the west and Lakeside on the east.

A total of ten geologic rock units occur within MTRP and the proposed expansion areas, and include Holocene-aged landslide deposits and young alluvial flood plain deposits, Pleistocene-aged old alluvial flood plain deposits and the Lindavista Formation, four middle Eocene-aged formations (Pomerado Conglomerate, Mission Valley Formation, Stadium Conglomerate, Friars Formation), and Mesozoic-aged crystalline basement rocks composed of a variety of intrusive igneous rocks, and undivided metasedimentary and metavolcanic rocks. Of these rock units, all the middle Eocene-aged units are assigned a high paleontological sensitivity, while a moderate paleontological sensitivity is assigned to the old alluvial floodplain deposits, and the Lindavista Formation. Although the deformed condition of the landslide deposits might suggest a moderate or low paleontological sensitivity, the fact that they involve rock units of high paleontological sensitivity indicates a corresponding sensitivity assignment. The high and moderate paleontological sensitivity strata primarily occur in low-lying areas of the Park, which include areas to the north of SR-52, along the western margin of the Park, and along the northern shores of the Lake Murray Reservoir. The remaining rock units have a paleontological sensitivity rating of low or zero, and occur primarily in upland exposures to the south of SR-52, including the five mountain peaks located within the Park.

Paleontological resources may be impacted by the MPU only if subsurface ground disturbance is anticipated to occur in areas underlain by rock units with a moderate to high paleontological sensitivity. If no earthwork is planned as part of the MTRP MPU, or earthwork will only occur in areas underlain by rock units with a paleontological sensitivity of low or zero, then the MPU will not significantly impact paleontological resources. In the event that earthwork will impact paleontological resources, these impacts can be minimized through avoidance or the development and implementation of a paleontological mitigation plan.

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1.0 INTRODUCTION

This report presents a paleontological resource assessment for Mission Trails Regional Park (MTRP) and the proposed expansion areas, completed as part of the Master Plan Update (MPU) initiated by the Park Planning Section of the City of San Diego Planning Department. The purpose of this report is to identify and summarize existing paleontological resource data within MTRP, classify and discuss the significance of these resources, assess potential impacts to paleontological resources from expansion of MTRP under the MPU, and provide recommendation for the protection and management of these resources. This report includes the results of a paleontological records search of the collections at the San Diego Natural History Museum (SDNHM).

This report was prepared by Eric G. Ekdale, Shelly L. Donohue, and Thomas A. Deméré of the SDNHM, Department of PaleoServices, under contract to RECON Environmental.

1.1 PROJECT DESCRIPTION

The MTRP MPU update is related to a 1985 Master Plan that was focused on the definition of the Park's setting in terms of physical environment, public plans and policies, land use and ownership; identification of recreational and other open space potentials within the Park; assessment of existing and potential relationships between MTRP and its immediate surroundings; determination of MTRP boundaries; and preparation of a Master Development Plan in consideration of park use, facility sizes, environmental and design concepts, and environmental mitigations (Mission Trails Regional Park, 2008). As part of the MPU, a Natural Resource Management Plan (NRMP) is being prepared to facilitate the protection and management of both environmental and cultural resources that might be impacted during implementation of the NRMP and recommendations in the MPU for MTRP.

Mission Trails Regional Park encompasses nearly 5,800 acres of developed and undeveloped land eight miles northeast of the downtown area of the City of San Diego, and it spans State Route 52 (SR-52) west of State Route 125 (SR-125). The Park extends south of Navajo Road towards Interstate 8 (I-8) to surround the Lake Murray Reservoir. The proposed MPU expansion would add an area immediately adjacent to the northeast corner of the Marine Corps Air Station – Miramar and spanning the boundary between Rancho Encantada on the west and Lakeside on the east (Figure 1).

1.2 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.

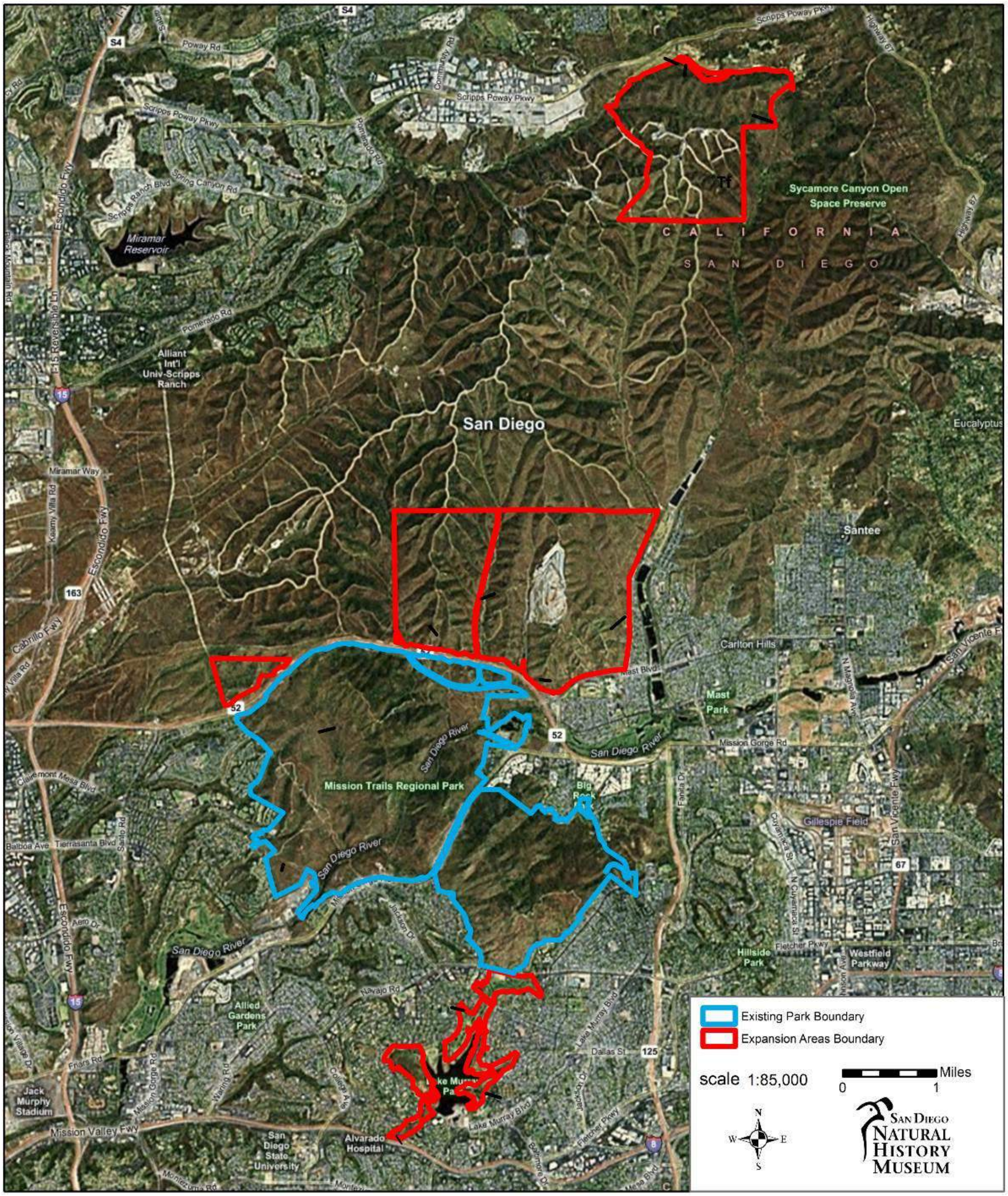

Figure 1. Map displaying existing boundaries of Mission Trails Regional Park (blue outline) and boundaries of proposed expansion areas (red outline).

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 Regulations concerning paleontological resources

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; Public Resources Code), and local (e.g., County of San Diego and City of San Diego Guidelines) laws, regulations, and ordinances. Additionally, established professional standards are in place for the assessment and mitigation of paleontological resources (e.g., SVP, 2010; BLM, 2007; Murphey et al., 2014).

The City of San Diego primarily addresses the protection and management of paleontological resources through CEQA, and has developed specific Significance Determination Thresholds (City of San Diego, 2002; 2011). These guidelines are summarized below, in Section 2.2.

2.0 Methodology

2.1 Paleontological Records Search & Literature Search

A formal paleontological records search of the fossil collections at the SDNHM was conducted to determine if any known paleontological collection localities exist within a 1-mile radius of the Project area.

In order to learn more about the specific geologic rock units within the Project area and their fossil content, a review was conducted of relevant published and unpublished geologic and paleontological reports (Dusenbury, 1932; Milow and Ennis, 1961; Kennedy and Moore, 1971; Steineck et al., 1972; Kennedy, 1973; Kennedy, 1975; Kennedy and Peterson, 1975; Golz and Lillegraven, 1977; Kern, 1978; Givens and Kennedy, 1979; Chandler, 1982; Flynn, 1986; Jefferson, 1991; Roeder, 1991; Squires and Deméré, 1991; Deméré and Walsh, 1993; Majors, 1993; Walsh, 1996; Walsh et al., 1996; Walsh, 1997; Walsh and Gutzler, 1999; Kennedy and Tan, 2005) and museum paleontological site records (Department of Paleontology, SDNHM; Appendix). 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 Significance Determination Thresholds

2.2.1 Paleontological Sensitivity

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 rock units containing those fossils and localities, individual rock units are typically assigned a paleontological sensitivity rating based on the results of the record search and literature search analyses. Criteria used in the assessment include the known abundance of vertebrate fossils and significant non-vertebrate fossils, or the potential for discovery of such fossils. The City of San Diego (2002; 2011) follows the sensitivity ratings outlined below.

High Paleontological Sensitivity – Rock units which, based on previous studies, contain or are likely to contain paleontological collecting 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 units produce vertebrate fossil remains or are considered to have the potential to produce such remains.

Moderate Paleontological Sensitivity – Rock units which, based on previous studies, are known to contain paleontological collecting 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.

Low Paleontological Sensitivity – This category is assigned to rock units that, based on their relatively youthful age and/or high-energy depositional history, are judged unlikely to produce important fossil remains. Typically, low sensitivity units produce poorly-preserved invertebrate fossil remains in low abundance.

Zero Paleontological Sensitivity – This category is assigned to geologic units that are entirely igneous in origin (e.g., plutonic and/or volcanic), which form at temperatures and/or pressures too high to support complex life, and thus have no potential for producing fossil remains. Volcanic ash deposits can represent an exception to this general rule, as they may preserve fossils as either body fossils or natural casts. Additionally, artificial fill material are typically assigned no paleontological sensitivity, as any fossil they may contain have lost their original stratigraphic and geographic contextual data, and thus are not scientifically significant.

2.2.2 Determination of Impact significance

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 significant fossil-bearing sedimentary rocks (i.e., those rated with a moderate to high paleontological sensitivity) have the potential to significantly impact paleontological resources. Under CEQA and City of San Diego guidelines, paleontological mitigation typically is recommended to reduce any negative impacts to paleontological resources to less than significant levels. Alternatively, paleontological resource avoidance is another option to reduce potential impacts.

The purpose of the impact analysis is to identify areas where earthwork activities may disturb potentially fossil-bearing sedimentary rocks, and thus may require avoidance and/or paleontological mitigation.

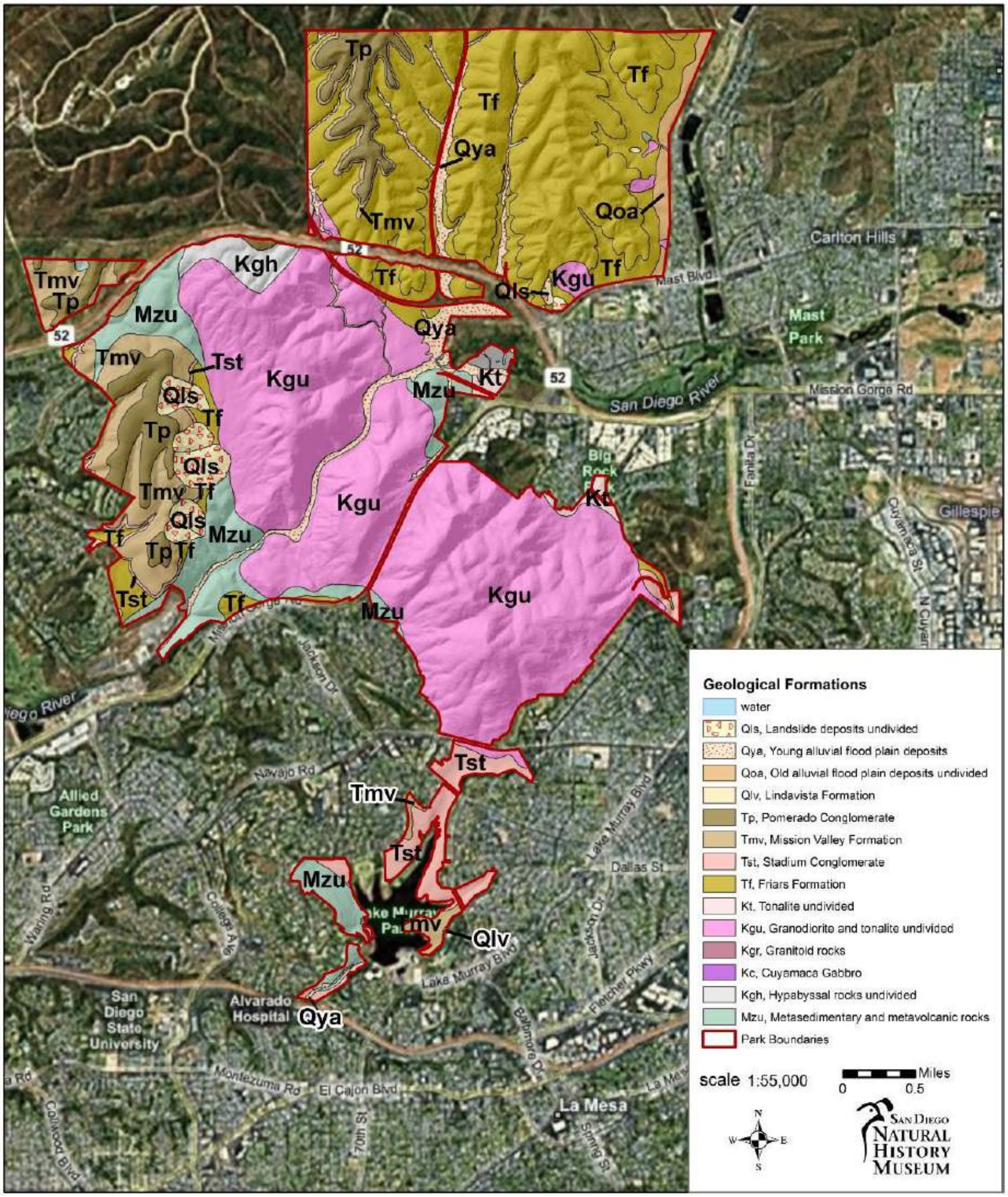

Figure 2. Map displaying existing MTRP boundaries and MTRP southern expansion area with mapped geology based on Kennedy and Tan (2005).

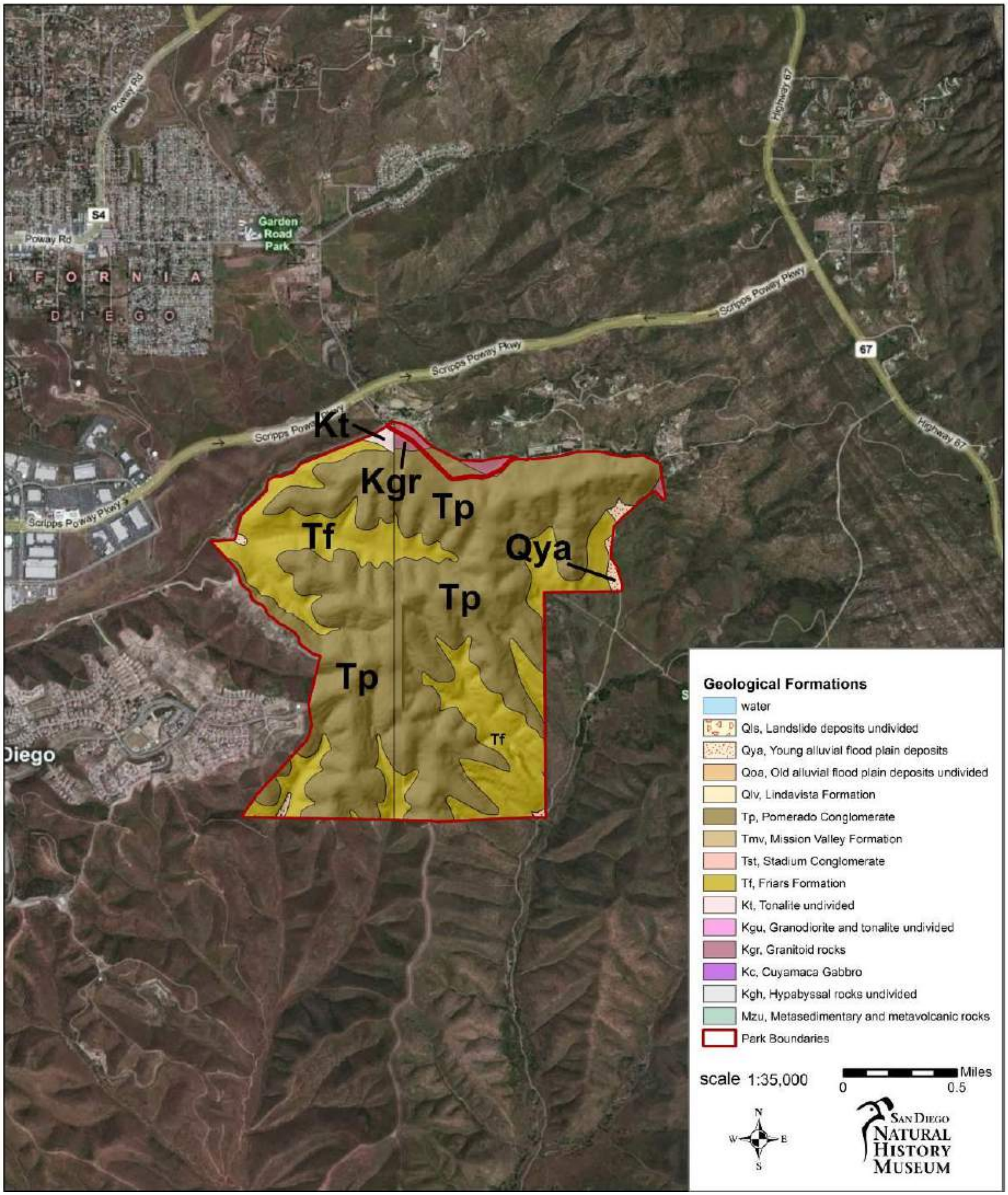

Figure 3. Map displaying MTRP northern expansion area with mapped geology based on Kennedy and Tan (2005).

3.0 REGIONAL GEOLOGICAL SETTING

Topographically, the region of San Diego County in which MTRP is located is characterized by elevated terraces (mesas) punctuated by intervening river valleys, which includes the San Diego River Valley that extends in a northeast to southwest direction north of Mission Gorge Road through the center of the Park. Geologically, this area consists of a layer cake sequence of Cenozoic sedimentary rock units which preserve portions of the last 47 million years of Earth history. These Cenozoic sedimentary rocks overlie a deeply eroded terrain formed in significantly older crystalline basement rocks (e.g., metasediments, metavolcanics, gabbros, granites and tonalities) of the massive Peninsular Ranges Batholith. The oldest sedimentary rocks, which are the rocks in which fossil are most likely to be found, date from the Eocene Epoch and include the Friars Formation, Stadium Conglomerate, Mission Valley Formation, and Pomerado Conglomerate. In two small areas along the western edge of the Park boundaries, the Eocene strata are overlain by Pleistocene-age strata of the Lindavista Formation. The Eocene strata are further overlain by much younger Pleistocene and Holocene-age deposits in river valleys and areas of recent landslides west of North and South Fortuna Mountains (Figures 2 and 3).

4.0 RESULTS

4.1 RESULTS OF THE PALEONTOLOGICAL RECORD SEARCH

A paleontological records search conducted at the San Diego Natural History Museum identified 50 discrete fossil collecting localities within MTRP and vicinity (Appendix Maps 1 through 5, with annotated listing of localities). The geologic distribution of these localities breaks down as follows: Friars Formation (27 localities), Mission Valley Formation (13 localities), Pomerado Conglomerate (one locality), and Lindavista Formation (one locality). Eight localities were discovered in the late Pliocene/early Pleistocene-age San Diego Formation to the west of MTRP and south of SR-52, although the San Diego Formation does not crop out within the Park itself.

The vast majority of the localities discovered in the vicinity of MTRP and the proposed expansion areas do not actually occur within the Park itself. However, three localities were discovered during a previously conducted paleontological field survey along the western portion of Fortuna Saddle Trail (Localities 3693, 3694, and 3886; Appendix). Localities 3693 and 3886 were discovered in the Friars Formation, and Locality 3694 was discovered in the Mission Valley Formation (Appendix). No fossil localities are recorded within either of the two expansion areas.

It should be emphasized that many of the fossil collecting localities recorded within the vicinity of MTRP were discovered during monitoring of excavation activities associated with construction of roadways (e.g., SR-52 and SR-125), construction of residential developments (e.g., Tierrasanta), installation of water pipelines (e.g., San Diego Aqueduct), and improvements to water treatment facilities (e.g., Alvarado Water Treatment Plant). This correlation of fossil collecting localities with construction underscores the fact that paleontological resources may be unknown in a particular region simply because they are currently buried and inaccessible and it isn't until construction-related excavations produce fresh exposures that fossils are unearthed and available for collection.

4.2 RESULTS OF THE PALEONTOLOGICAL SENSITIVITY ANALYSIS

As discussed above in Section 2.2, paleontological sensitivity is assigned to each geologic rock unit as a whole, based on the results of the paleontological records search and literature search. The following sections include a summary of the geology and paleontology of each rock unit within the Project area, as well as the assigned paleontological sensitivity, and description of the areas it can be found within the Project. A summary of these results are presented in Table 1, and depicted in the geologic map for existing MTRP and the northern expansion area (Figures 2 and 3), and the paleontological sensitivity map (Figure 4).

Table 1. Summary of rock units within the Project area, and their paleontological sensitivity.

Geologic Rock Unit	Age	Paleontological Sensitivity
Landslide deposits, undivided (Qls)	Holocene	High
Young alluvial flood plain deposits (Qya)	Holocene	Low
Old alluvial flood plain deposits, undivided (Qoa)	late Pleistocene	Moderate
Lindavista Formation (Qlv)	early Pleistocene	Moderate
Pomerado Conglomerate (Tp)	Eocene	High
Mission Valley Formation (Tmv)	Eocene	High
Stadium Conglomerate (Tst)	Eocene	High
Friars Formation (Tf)	Eocene	High
Intrusive igneous rocks, undivided (Kx[1])	Cretaceous	Zero
Metasedimentary & metavolcanic rocks, undivided (Mzu)	Jurassic – Cretaceous	Zero

[1] Kx refers to: Kt, Kgu, Kgr, Kc, Kgh

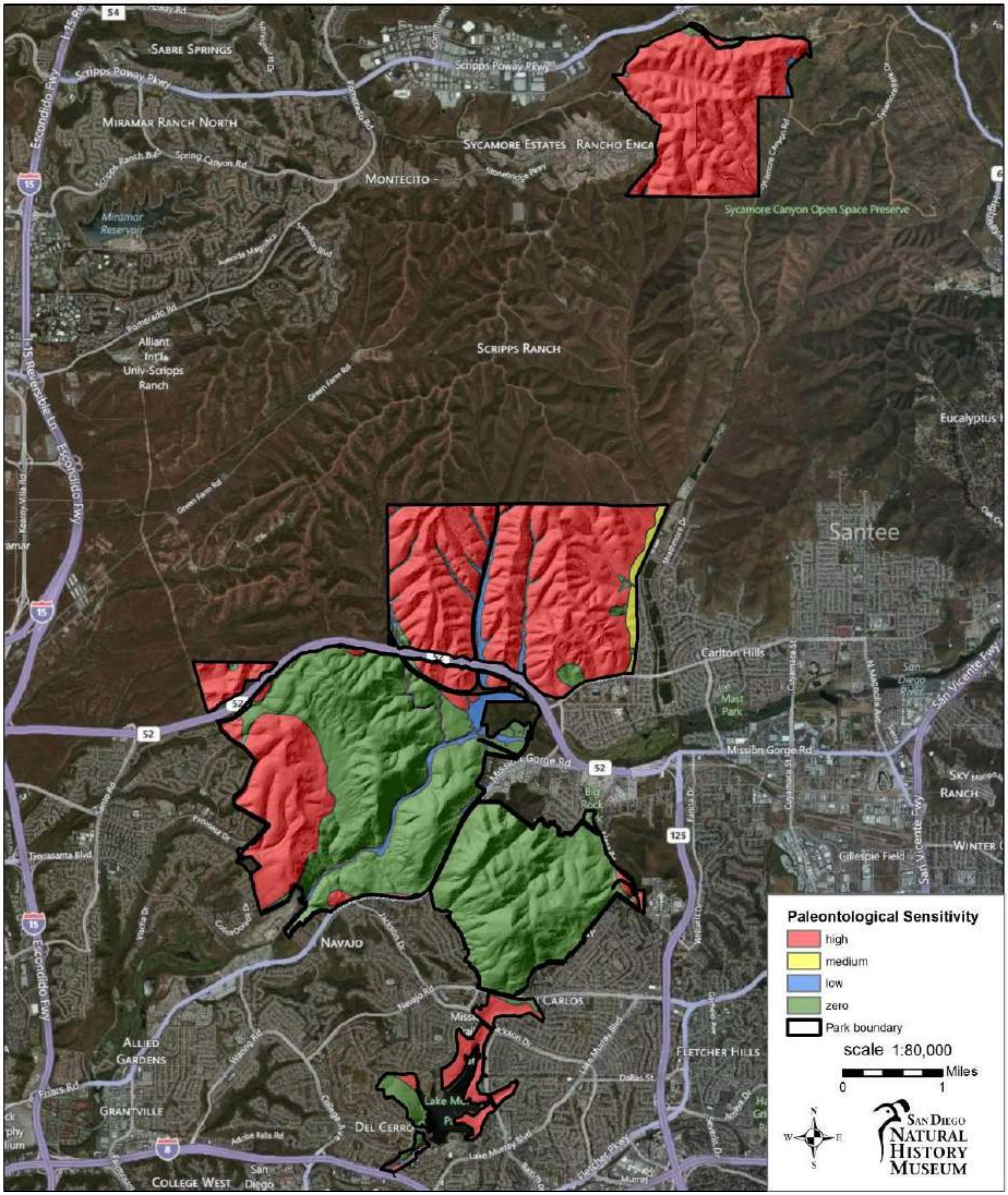

Figure 4. Map of MTRP and proposed expansion areas with paleontological resource sensitivities.

4.2.1 LANDSLIDE DEPOSITS, UNDIVIDED (QLS)

INTRODUCTION –Landslides that occurred during the Quaternary Period are common occurrences in southern California. Although the landslides occurred relatively recently, the transported sediment may be significantly older based on the age of original deposits that have been incorporated into the body of the landslide. In general, landslide deposits in coastal San Diego County contain highly fragmented to largely cohesive, unconsolidated to moderately well consolidated sediments of Cenozoic age origin (Kennedy and Tan, 2005).

PALEONTOLOGY – Fossil remains have been recovered from landslide deposits that occur in areas underlain by fossiliferous strata. Depending on the scale of the landslide and the various rock units through which it cuts, contained fossils can sometimes be well-preserved and more or less in their original stratigraphic context. However, in other cases fossils contained within landslide deposits can be severely damaged and their stratigraphic context totally scrambled.

REGIONAL DISTRIBUTION – The undivided landslide deposits occur on slopes in various locations throughout San Diego County.

DISTRIBUTION WITHIN THE APE – Landslide deposits occur in three major areas within the existing Mission Trails Region Park boundaries, on the eastern slopes of the ridges west of the Fortuna Mountains (Figure 2). Given the location of the landslide deposits, as well as the geologic formations that the deposits were derived from, this unit likely contains a mixture of rocks from the Pomerado Conglomerate, Mission Valley Formation, Stadium Conglomerate, and Friars Formation.

RESOURCE SENSITIVITY – If a landslide occurs in an area of fossiliferous strata, then the landslide deposits likely will contain fossils. However, the stratigraphic context of the fossils may, or may not be preserved owing to the nature by which these deposits form (transportation and mixture of sediments from their original areas of deposition). Because of the known fossil-bearing potential of the Eocene rock units in the Project area and the small-scale nature of the landslides in the Park, it is suggested that the landslide deposits may contain well-preserved fossils, and so this rock unit is assigned a high paleontological resource sensitivity.

4.2.2 YOUNG ALLUVIAL FLOOD PLAIN DEPOSITS (QYA)

INTRODUCTION – The modern flood plains occupied by Peñasquitos Estuary, San Dieguito Estuary, San Elijo Estuary, Batiquitos Estuary, Agua Hedionda, Buena Vista Estuary, and the estuary at the mouth of the San Luis Rey River are underlain by poorly consolidated alluvial sediments of Holocene age (i.e., younger than 10,000 years old). Lithologies in these deposits consist of dark brown to dark gray, loose, silty fine-grained sands, fine-grained sandy silts, and sandy clayed silts (Kennedy, 1975; Kennedy and Tan, 2005). In general, these deposits were laid down by the ephemeral streams that seasonally occupy these drainages today.

PALEONTOLOGY – Fossils are generally unknown from the younger alluvial deposits in the Coastal Plain of San Diego County, although there are two notable exceptions. A single mammoth tusk was found in Quaternary alluvial deposits in the southwestern portion of El Cajon Valley (SDNHM paleontological locality records) and a mammoth femur was recovered from Quaternary alluvial deposits in the Santa Margarita River channel at the south end of the Camp Pendleton Marine Corps Base. No recorded fossil localities have been discovered in younger alluvium in the vicinity of MTRP.

REGIONAL DISTRIBUTION – Younger alluvial deposits in the Coastal Plain of San Diego County occur in all of the major river valleys. These deposits are the product of erosional and depositional processes currently active within the respective watersheds.

DISTRIBUTION WITHIN THE APE – Younger alluvial sediments occur in various places within the north-to-south oriented river valleys, particularly around the San Diego River and to the west of Kumeyaay Lake (Figures 2 and 3).

RESOURCE SENSITIVITY – Based on its post-Pleistocene age, younger alluvium is assigned a low paleontological resource sensitivity.

4.2.3 OLD ALLUVIAL FLOOD PLAIN DEPOSITS, UNDIVIDED (QOA)

INTRODUCTION – Coarse-grained and gravelly sandstone, pebble and cobble conglomerates, and claystone deposits occur along the margins of many of the larger coastal valleys at levels above active stream channels. In general, these unnamed river terrace deposits represent the courses of prehistoric rivers. The exact age of the terrace deposits is uncertain, but they appear to be related to climatic events of the late Pleistocene (10,000 to 50,000 years old). As mapped, these river deposits probably represent several depositional systems across different periods of time. Unfortunately, there is little stratigraphic data to separate the deposition events, and so they are grouped together here.

PALEONTOLOGY – Fossils have been collected from Pleistocene-age alluvial deposits in various locations around San Diego County from sediments unearthed during construction-related activities. One such location was discovered on the south side of Sweetwater Valley, where well-preserved fossils of pond turtles, passenger pigeons, hawks, moles, gophers, squirrels, rabbits and horses were collected from fluvial sandstone and siltstone (Chandler, 1982; Jefferson, 1991; Majors, 1993). A diverse assemblage of “Ice Age” mammals, such as ground sloths, insectivores, mice, wolves, camels, deer, horses, mastodons, and mammoths, were recovered from the South Bay Freeway (SR-54). Fossils of ground sloths also were collected from sandstones in the San Dieguito River Valley (Deméré and Walsh, 1993). No recorded fossil localities have been discovered in the older alluvium within one mile of MTRP.

REGIONAL DISTRIBUTION – The “unnamed river terrace deposits” occur along the margins of larger coastal river valleys, such as Otay Valley, Sweetwater Valley, Mission Valley, San Dieguito River Valley, San Luis Rey River Valley, and Santa Margarita River Valley, as well as in isolated pockets associated with elevated marine terraces.

DISTRIBUTION WITHIN THE APE – The river terrace deposits occur along the eastern edge of the expansion area of MTRP immediately north of SR-52 (Figure 2).

RESOURCE SENSITIVITY – The generally coarse-grained nature of the unnamed river deposits coupled with the paucity of fossil remains might suggest a low paleontological resource sensitivity. However, significant vertebrate remains have been collected from several areas in southern California, which indicates that significant sites might occur elsewhere in these deposits. Because of this, the unnamed river terrace deposits are assigned a moderate paleontological resource sensitivity.

4.2.4 LINDAVISTA FORMATION (QLV)

INTRODUCTION – The Lindavista Formation (Kennedy, 1975) represents a marine and/or non-marine terrace deposit of early Pleistocene age (approximately 0.5-1.5 million years). Typical exposures of the formation consist of rust-red, coarse-grained, pebbly sandstone to cobble conglomerate with common deposits of green claystone in some locations. The Lindavista Formation has an average thickness of approximately 20 to 30 feet and is thought to have been deposited under fluvial, aeolian, and shallow nearshore marine conditions (Kennedy 1975). The Lindavista Formation likely accumulated on a flat, wave-cut platform (i.e., sea floor) during a period of sea level regression. Today, these deposits form the extensive mesa surfaces characteristic of the Otay Mesa, San Diego Mesa, Linda Vista Mesa, Kearny Mesa, and Mira Mesa areas of the County.

PALEONTOLOGY – Fossil collecting localities are rare in the Lindavista Formation and have only been recorded from a few areas (e.g., Tierrasanta and Mira Mesa). Fossils collected from these sites consist of remains of nearshore marine invertebrates including clams, scallops, snails, barnacles, and sand dollars (Kennedy, 1973), as well as sparse remains of sharks, rays, and baleen whales. According to the records of the SDNHM, one fossil collecting locality (Locality 456) was discovered in the Lindavista Formation within one mile of MTRP in Tierrasanta (Appendix).

REGIONAL DISTRIBUTION – The Lindavista Formation occurs over a large area from the International Border north to the City of San Clemente. Over this region, the formation and its associated series of elevated terraces forms a conspicuous planar surface between the foothills of the Peninsular Range Region and the western edge of the higher coastal terraces (i.e., minimum elevation approximately 300 feet). These higher mesa surfaces are best preserved south of Black Mountain. The higher terraces have been extensively dissected by erosion to the north of Black Mountain and only remain as small, isolated remnants.

DISTRIBUTION WITHIN THE APE – The Lindavista Formation crops out only in a tiny area along the southern part of the eastern shore of the Lake Murray Reservoir, as well as a small region near the Park boundary to the west of the westernmost picnic area (Figure 2).

RESOURCE SENSITIVITY – Based on the scarcity of fossil remains (primarily marine invertebrates) reported from this rock unit, the Lindavista Formation is assigned a moderate paleontological resource sensitivity.

4.2.5 POMERADO CONGLOMERATE (TP)

INTRODUCTION – The Pomerado Conglomerate consists of a lower conglomerate member, the middle Miramar Sandstone member, and an upper conglomerate member (Kennedy and Peterson, 1975). The lower conglomerate member contacts the Mission Valley Formation with local erosional and gradational contacts (Walsh, 2011). In turn, the overlying Miramar Sandstone Member contacts the lower conglomerate member of the Pomerado Conglomerate with a gradational contact. An erosional surface that separates the Miramar Sandstone from the upper conglomerate member is best observed in the Scripps Ranch area, where it achieves an erosional relief of up to five meters (Deméré and Walsh, 1993). The lower and middle members of the Pomerado Conglomerate are late Uintan in age (Middle Eocene, 41 to 42 million years old), while the upper member has been identified as late Duschenean/ early Chadronian in age (latest Middle to Late Eocene, 37 million years ago (Walsh and Gutzler, 1999; Walsh, 2011).

PALEONTOLOGY – Abundant terrestrial mammal fossils have been recovered from the lower conglomerate member of the Pomerado Conglomerate, including insectivores, rodents, primates, and artiodactyls (Walsh, 1996). The Miramar Sandstone Member has produced marine clams and snails and a few terrestrial mammals, including artiodactyls and *Miacis*, an extinct carnivorous mammal (Walsh, 1996). Fossils recovered from the upper conglomerate member include a highly significant fossil assemblage of terrestrial mammals, consisting of opossums, artiodactyls, rodents, and carnivores (Walsh and Gutzler, 1999). A single SDNHM fossil locality (Locality 3614) was discovered in the Pomerado Conglomerate along a portion of SR-52 adjacent to the western side of MTRP (Appendix).

REGIONAL DISTRIBUTION – The Pomerado Conglomerate is exposed from La Mesa in the south to Miramar Reservoir in the north, and east to Santee and Lakeside.

DISTRIBUTION WITHIN THE APE – The Pomerado Conglomerate crops out at the highest elevations along the rim trails in the western third of the existing MTRP (Figure 2), as well as the highest elevations in the expansion areas north of SR-52 and Marine Air Corps Station – Miramar (Figure 3).

RESOURCE SENSITIVITY – The Pomerado Conglomerate as a whole, and particularly the upper member, is assigned a high paleontological resource sensitivity based on discoveries of scientifically significant fossils from the formation, as well as the close proximity of SDNHM Locality 3614 (Appendix).

4.2.6 MISSION VALLEY FORMATION (TMV)

INTRODUCTION – The Mission Valley Formation consists of fine- to very fine-grained marine sandstone in its type area along SR-163 on the south side of Mission Valley. Eastern and southern exposures of the formation consist of fine- to medium-grained, fluvial sandstones, as well as green and brown non-marine siltstone and mudstone. The maximum thickness of the formation is 200 feet near its type location in Mission Valley, although it only reaches a thickness of 60 feet at Scripps Ranch and 45 feet in Tierrasanta (Deméré and Walsh, 1993). Strata of the Mission Valley Formation have been dated at 42.83 million years, using the Ar-Ar radiometric dating method, placing the formation within the middle Eocene Epoch (Walsh, 1996). In fact, this formation is the only Eocene rock unit in southern California to contain fossil mammal localities that are directly associated with a radiometric date (Deméré and Walsh, 1993).

PALEONTOLOGY – Well-preserved fossils of microorganisms (e.g., foraminiferans), clams, snails, crabs, sea urchins, sharks, rays, and bony fish have been collected from the marine strata of the Mission Valley Formation (Kern, 1978; Givens and Kennedy, 1979; Deméré et al., 1979; Roeder, 1991). In addition, fluvial deposits of the formation have produced well-preserved fossil remains of wood, as well as a diverse assemblage of terrestrial mammals, including opossums, insectivores, bats, rodents, primates, artiodactyls, and perissodactyls (Golz and Lillegraven, 1977; Walsh, 1996). In fact, fossils of many of these organisms have been recovered from no fewer than 13 SDNHM fossil collecting localities within one mile of the MTRP boundaries (Appendix). One of these localities (Locality 3694) was discovered within the western portion

MTRP at "Hill 781" along the Fortuna Saddle Trail (Appendix). The combined marine and non-marine fossil assemblages that have been recovered from the formation allow for direct correlation of marine and terrestrial faunas of the Eocene of southern California. In this respect, the Mission Valley Formation is scientifically important, and it serves as one of a few instances within North America from which such correlations can be ascertained (Golz and Lillegraven, 1977; Flynn, 1986; Walsh, 1996).

REGIONAL DISTRIBUTION – The Mission Valley Formation is discontinuously exposed between Otay Valley in the south, Scripps Ranch in the north, Old Town in the west, and Spring Valley, Fletcher Hills, and Santee in the east (Deméré and Walsh, 1993). Several distinctive sandstone out crops in the regions of Rancho Bernardo, Rancho Peñasquitos, and Carmel Mountain Ranch that contain vertebrate fossil remains that have been mapped as the Mission Valley Formation more likely belong to the upper sandstone tongue of the Friars Formation, based on paleontology (Walsh, 1996; Walsh et al., 1996).

DISTRIBUTION WITHIN THE APE – The Mission Valley Formation crops out mainly in the western portion of MTRP, to the west of Fortuna Mountain. A smaller outcrop occurs along the eastern shore of Lake Murray Reservoir (Figure 2).

RESOURCE SENSITIVITY – Because diverse fossil assemblages of marine invertebrates and non-marine vertebrates have been recovered from the Mission Valley Formation, particularly within MTRP and the surrounding area, this rock unit is assigned a high paleontological resource sensitivity.

4.2.7 STADIUM CONGLOMERATE (TST)

INTRODUCTION – The stratigraphically complex Stadium Conglomerate (Kennedy and Moore, 1971) is divided into two lithologically distinct members – an upper member and a lower member (Walsh et al., 1996). The lower member is composed of cobble to boulder conglomerates with interbedded siltstone and mudstone, and disconformably underlies the upper member, which is composed of sorted cobble and boulder conglomerates with crossbedded sandstone lenses and thin beds of mudstone. The lower member has a maximum thickness of approximately 100 feet (Deméré and Walsh, 1993). The upper member has a maximum thickness of 60 feet (Walsh, 1996).

PALEONTOLOGY – The western exposures of the upper member of the Stadium Conglomerate in the old Fenton gravel quarry in Mission Valley have yielded microfossils and marine mollusks (Dusenbury, 1932; Steineck et al., 1972; Givens and Kennedy, 1979), although eastern exposures of the formation typically are non-marine. The eastern outcrops have produced fossils of plants and occasional well preserved skeletal remains of opossums, insectivores, primates, rodents, carnivores, rhinoceroses, and artiodactyls. The vertebrate fossils indicate a late Uintan age (middle Eocene), approximately 42 million years ago (Walsh, 1996). Sparse marine fossils are found at the base and near the top of the lower member of the Stadium Conglomerate (Deméré and Walsh, 1993; Walsh, 1996), although a very scientifically important, and somewhat unusual, mammalian fauna was also recovered from the lower member of the Stadium Conglomerate (Walsh, 1996; 1997). The mammal fossil assemblage appears to be transitional between the underlying Friars Formation and the late Uintan terrestrial mammal fauna of the upper member of the Stadium Conglomerate. The lower member is approximately 44 million years old. Although the Stadium Conglomerate has produced numerous scientifically significant fossils, there are no recorded SDNHM fossil collecting localities from within one mile of the MTRP boundaries (Appendix).

REGIONAL DISTRIBUTION – The Stadium Conglomerate is well exposed along the northern wall of Mission Valley between SR-163 and Murphy Canyon, with exposures of the upper member extending eastward from Murphy Canyon to Fletcher Hills, and southward from Mission Valley to Imperial Avenue (Deméré and Walsh, 1993). The upper member also extends to Tierrasanta in the north, but pinches out and does not reach SR-52. Exposures of Eocene conglomerates mapped as the Stadium Conglomerate in the expansion areas north of SR-52 (Kennedy and Moore, 1971; Kennedy, 1975; Kennedy and Tan, 2005) are likely the conglomerate tongue of the Friars Formation.

DISTRIBUTION WITHIN THE APE – The Stadium Conglomerate has a limited area of exposure within the main area of MTRP immediately above the Friars Formation to the west of Fortuna Mountain south of SR-52 (Figure 2). More extensive outcrops of the Stadium Conglomerate occur along the northern shore of Lake Murray Reservoir. Although Kennedy and Tan (2005) identified extensive units north of SR-52 as the Stadium Conglomerate, those exposures more likely belong to the conglomerate tongue of the Friars Formation as described above (Deméré and Walsh, 1993; Walsh, 1996, 1997).

RESOURCE SENSITIVITY – Based on the important terrestrial mammal assemblage from the Stadium Conglomerate, this rock unit is assigned a high paleontological resource sensitivity.

4.2.8 FRIARS FORMATION (TF)

INTRODUCTION – The Friars Formation was named for exposures of sedimentary rocks in Mission Valley along Friars Road (Kennedy and Moore, 1971; Kennedy, 1975). This rock unit generally consists of non-marine to lagoonal sandstones and claystones with interbedded conglomerates. The formation is divided into three members (Walsh et al., 1996), which include lower and upper sandstone and mudstone tongues that are separated by a middle conglomerate tongue. The upper sandstone and mudstone members represent terrestrial paleoenvironments for the most part (Kennedy, 1975), although marginal marine deposits occur within this member in the west (Givens and Kennedy, 1979). The middle conglomerate tongue member is mainly fluvial in origin, but as with the upper member, there are marine facies in western exposures. The middle conglomerate tongue is the thickest of the three members, and is composed of thick layers of light rust-brown and light gray cobbles and boulders, with common thin beds and rip-up clasts of multicolored siltstone and mudstone. The lower tongue member lithologically is similar to the upper member, consisting of light gray, fine- to medium-grained sandstone and greenish and reddish siltstone and mudstone.

PALEONTOLOGY – All three members of the Friars Formation have produced significant vertebrate fossils, including remains of opossums, insectivores, primates, rodents, and ungulates (Golz and Lillegraven, 1977; Walsh, 1996). In addition, microfossils and fossil macroinvertebrates indicative of marine paleoenvironments have been recovered from the Friars Formation (Givens and Kennedy, 1979; Squires and Deméré, 1991), as well as fossilized leaf material (Walsh, 1996). There are 27 SDNHM fossil collecting localities recorded from within a one mile radius of the MTRP boundaries (Appendix) that have produced fossil plants, freshwater invertebrates, and terrestrial vertebrates, including turtles, crocodiles, lizards, brontotheres, and tapirs (in addition to many mammals reported by Golz and Lillegraven [1977] and Walsh

[1996]). Two of these localities (Localities 3886 and 3693) were discovered within the western portion of MTRP along Fortuna Saddle Trail (Appendix).

REGIONAL DISTRIBUTION – The Friars Formation crops out between Mira Mesa and Carmel Valley in the west and Poway, Santee, and El Cajon in the east.

DISTRIBUTION WITHIN THE APE – The Friars Formation is exposed at lower elevations across MTRP, particularly in the valleys and immediately west of Fortuna Mountain (Figure 2). The formation is found on both sides of SR-52, and in a couple of areas along the north side of Mission Gorge Road. The Friars Formation is exposed in the proposed expansion area north of Marine Air Corps Station – Miramar (Walsh, 1996; Walsh et al., 1996; Deméré and Walsh, 1993; Figure 3), although geologic mapping by Kennedy and Tan (2005) mistakenly assigned these strata to the younger Stadium Conglomerate.

RESOURCE SENSITIVITY – Based on the recovery of abundant, well-preserved, diverse, and scientifically significant terrestrial vertebrate fossils and marine and freshwater invertebrate fossils, all members of the Friars Formation are assigned a high paleontological sensitivity.

4.2.9 INTRUSIVE IGNEOUS ROCKS, UNDIVIDED

INTRODUCTION – The Cretaceous intrusive igneous rocks of San Diego County comprise part of the northern end of the Peninsular Ranges Batholith that extends for several hundred miles south into Baja California, Mexico. This complex mixture of plutonic igneous rocks in San Diego County ranges in composition from granite to gabbro, and formed during the Cretaceous Period (about 125 to 95 million years ago), which is coeval with the Sierra Nevada Batholith to the north (Todd, 2004). These rocks formed due to the development of a major subduction zone off the west coast of the North American continent during the Mesozoic. Oceanic crust was thrust below continental crust, and as the cold, water-saturated oceanic crust descended into the earth's mantle, it became superheated and melted into buoyant magma bodies called plutons, which then rose (intruded) through the overlying crust and slowly cooled several miles below the earth's surface to form the plutonic rocks now exposed within portions of MTRP.

Due to the similarity in composition and style of formation, all intrusive igneous rocks within the Project area will be discussed as a single unit. The specific rock formations making up this unit include: undivided hypabyssal rocks (Kgh), the Cuyamaca Gabbro (Kc), granitoid rocks (Kgr), undivided tonalite (Kt), and undivided tonalite and granodiorite (Kgu).

PALEONTOLOGY – No fossils have been recovered from intrusive igneous rocks.

REGIONAL DISTRIBUTION – Undivided intrusive igneous rocks occur over large areas in central San Diego County, and form the eastern margin of the coastal plain in western San Diego County.

DISTRIBUTION WITHIN THE APE – Undivided intrusive igneous rocks contribute most of the rock exposures in MTRP south of SR-52 (Figure 2). Furthermore, the five peaks in the Park (North Fortuna, South Fortuna, Kwaay Paay, Pyles Peak, and Cowles Mountain) are composed of these igneous rocks. Other isolated pockets of igneous rocks crop out along the eastern edge of the Park to the north of SR-52 and along the north border of the northern expansion area (Figure 3).

RESOURCE SENSITIVITY – Based on the high temperature and pressure conditions under which intrusive igneous rocks formed, this unit is assigned a paleontological resource sensitivity of zero (the lowest assignable score).

4.2.10 METASEDIMENTARY AND METAVOLCANIC ROCKS, UNDIVIDED (MZU)

INTRODUCTION – Crystalline basement rocks of late Jurassic to early Cretaceous age (145 to 125 million years old) in western San Diego County consist of low-grade metasedimentary rocks (derived from siltstones, sandstones, and conglomerates) that are intermixed with metavolcanic flows, tuffs and volcanoclastic breccias (Kennedy and Tan, 2005). These rocks have traditionally been referred to as the Santiago Peak Volcanics (Kennedy, 1975).

PALEONTOLOGY – No fossils have been recovered from these rocks in the MTRP.

REGIONAL DISTRIBUTION – The undivided metasedimentary and metavolcanic rocks occur as a discontinuous band in western San Diego County, extending from the San Ysidro Mountains in the south to the northern border of the county.

DISTRIBUTION WITHIN THE APE – Outcrops of the metasedimentary and metavolcanic rocks occur along the western foothills of the North and South Fortuna Mountains and along the north side of Mission Gorge Road, west of Golfcrest Drive. Additional pockets of these crystalline rocks crop out along the southwestern borders of Kumeyaay Lake in the east-central region of the Park, and along the southwestern edge of the Lake Murray Reservoir in the south (Figure 2).

RESOURCE SENSITIVITY – Based on the conditions under which metasedimentary and metavolcanic rocks form, this unit is assigned a paleontological resource sensitivity score of zero (the lowest assignable score).

4.3 RESULTS OF THE IMPACT ANALYSIS

As demonstrated by the results of the paleontological records search, literature search, and paleontological sensitivity analysis, paleontological resources are present within MTRP and vicinity, and thus may be impacted by future construction associated with the MPU. Specific impacts to paleontological resources would be in the form of subsurface ground disturbance in areas underlain by rock units of high paleontological sensitivity (e.g., Pomerado Conglomerate, Mission Valley Formation, Stadium Conglomerate, Friars Formation, and landslide deposits), or moderate paleontological sensitivity (e.g., old alluvial flood plain deposits, Lindavista Formation). The areas of moderate to high sensitivity primarily occur in the low-lying regions of MTRP to the north of SR-52 (including the northern expansion area), in the western portion of MTRP, and along the northern shores of the Lake Murray Reservoir, as outlined in Figures 2 – 4.

Such subsurface ground disturbance may include mass grading (e.g., for new buildings, roads, or trails), trenching (e.g., for underground utilities), drilling with an auger greater than about 18 inches in diameter (e.g., for installation of above ground utility poles), or other miscellaneous earthwork. If no subsurface ground disturbance is anticipated to occur as part of the MTRP MPU, then significant impacts to paleontological resources will not occur.

5.0 RECOMMENDATIONS

The following strategies are recommended to minimize impacts to paleontological resources. It should be noted that these strategies only need to be employed during earthwork operations that will impact areas underlain by rock units of high to moderate paleontological sensitivity (Figure 4). If no earthwork is planned, than paleontological resources will not be significantly impacted by the MTRP MPU.

5.1 AVOIDANCE

Avoidance of project impacts to paleontological resources can, in some instances, be achieved by project redesign so that paleontological resources are completely outside the project's impact area (e.g., moving the location of a proposed project element to an area away from the resource, or developing a construction approach that does not involve excavations into potentially fossiliferous strata).

5.2 DEVELOPMENT OF A PALEONTOLOGICAL MITIGATION PLAN

Development and implementation of a paleontological mitigation plan can minimize impacts through the recovery and conservation of any fossils unearthed during construction. Development of a paleontological mitigation plan commonly involves establishing pre-construction, during-construction, and post-construction procedures and methods designed for the specific conditions of a given project. Pre-construction measures generally address professional qualifications, fossil repository selection, meeting attendance, and workers environmental awareness training. During-construction measures generally address construction monitoring, data recovery, safety considerations, and fossil discovery and recovery. Post-construction measures generally address fossil preparation, fossil curation, fossil storage, and final reporting.

The implementation of the paleontological mitigation plan typically is implemented during construction (e.g., active monitoring of excavations), but in rare cases, monitoring and fossil salvage occur prior to construction (e.g., fossils are readily visible in surficial sediments within the project site, and are collected prior to the start of earthwork). Fossils recovered as a result of mitigation are prepared and curated into a regional fossil repository.

6.0 CONCLUSIONS

1. Portions of the Mission Trails Regional Park Master Plan Update, including the proposed expansion areas, are underlain by geologic units assigned to moderate and high paleontological resource sensitivities. These sensitive regions primarily occur in low-lying areas of the park, which include areas to the north of SR-52, along the western margin of the park, and along the northern shores of the Lake Murray Reservoir.
2. Paleontological resources may be impacted by the MPU only if subsurface disturbances are anticipated to occur in paleontologically sensitive areas. Such subsurface ground disturbance may include mass grading (e.g., for new buildings, roads, or trails), trenching (e.g., for underground utilities), drilling with an auger greater than about 18 inches in diameter (e.g., for installation of above ground utility poles), or other miscellaneous earthwork.
3. If earthwork is anticipated to occur in areas of high to moderate paleontological sensitivity, potential impacts to paleontological resources can be minimized either through avoidance, or through the development and implementation of a paleontological mitigation plan.

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APPENDIX

SAN DIEGO NATURAL HISTORY MUSEUM
BALBOA PARK - SAN DIEGO SOCIETY OF NATURAL HISTORY - ESTABLISHED 1874

15 June 2011

Mr. Mike Nieto
RECON Environmental
1927 Fifth Avenue
San Diego, CA 92101-2358

RE: Mission Trails Regional Park Master Plan Update 2011

Dear Mr. Nieto:

This letter presents the results of a paleontological record search conducted for the Mission Trails Regional Park Master Plan Update 2011, located mostly in eastern City of San Diego. Some small portions of the project do extend east into the Cities of Santee, El Cajon and La Mesa. The project site is within the neighborhoods of Rancho Encantada, Scripps Ranch, Tierrasanta, San Carlos, Lake Murray and Del Cerro and within the Rancho Encantada, East Elliott, Tierrasanta, and Navajo Community Plan Areas of the City of San Diego. The project can be separated into 5 areas. These include the current 5,242 acre Mission Trails Regional Park area, a 1,377 acre portion south of Scripps Poway Parkway and to the west of Sycamore Canyon Open Space Preserve, a 2,697 acre area north of State Route 52 and west of Santee Lakes, a 142 acre area north of State Route 52 and the north of the northwestern corner of the existing Mission Trails Regional Park, and lastly, south of the current park a 378 acre series of open spaces surrounding Lake Murray. The sedimentary rocks underlying the project site have been mapped by Kennedy (1975), Kennedy and Tan (2002), and Tan (2002) and as the Pleistocene-age (approximately 0.5 to 1 million years old) Lindavista Formation, the middle Eocene-age (37 million years old) Pomerado Conglomerate, (43 million years old) Mission Valley Formation, (44 million years old) Stadium Conglomerate and (46-47 million years old) Friars Formation. Walsh, et al. (1996) reassigned the Stadium Conglomerate in the area north of State Route 52 to the older, middle Eocene-age (46 to 47 million years old) Friars Formation based on micro-mammalian fossil assemblages (small rodent teeth).

The San Diego Natural History Museum has fifty recorded fossil localities (see attached list) within a one-mile radius of the project site (see attached maps). One of the localities occurs within the near shore marine deposits of the Lindavista Formation. This locality produced fossils of marine invertebrates (e.g., clams). One locality was in the fluvial Pomerado Conglomerate. This locality produced fossils of flowering plants and freshwater invertebrates (e.g., clams). Thirteen localities were discovered in the marine and fluvial Mission Valley Formation. These localities produced fossils of marine invertebrates (e.g., snails and clams), freshwater invertebrates (e.g. ostacods and insects), marine vertebrates (e.g., sharks), and terrestrial vertebrates (e.g. fish, turtles, crocodiles, lizards, birds, marsupials, insectivores, bats, rodents, carnivores, primates, tapirs, and oreodonts). Twenty Seven of these localities are from the fluvial Friars Formation. These localities produced fossil of plants (e.g. green alge, sumac, willow, and other flowering plants), fresh water invertebrates (e.g., ostracods and snails), and terrestrial mammals (e.g., turtles, crocodiles, lizards, marsupials, insectivores, rodents, primates, carnivores, brontotheres, tapirs, and oreodonts). No fossil localities were discovered in the Stadium Conglomerate. Eight localities were discovered in the San Diego Formation which does not crop out within the project boundaries.

Depending on the depth of excavation, construction activities associated with the proposed project have the potential to impact sedimentary deposits of the Lindavista Formation, Pomerado Conglomerate, Mission Valley Formation, Stadium Conglomerate, and Friars Formation. Based on fossil localities in the region, Deméré and Walsh (1993) assigned the Lindavista Formation to have a moderate paleontological sensitivity and the Pomerado Conglomerate, Mission Valley Formation, Stadium Conglomerate, and Friars Formation to have a high paleontological sensitivity. Any fossils recovered from the excavations made at the project site are likely to be scientifically significant.

If you have any questions concerning these findings please feel free to contact me at 619-255-0310 or krandall@sdnhm.org.

Sincerely,

Kesler A. Randall
Collections Manager, Fossil Vertebrates
Department of Paleontology

Literature Cited:

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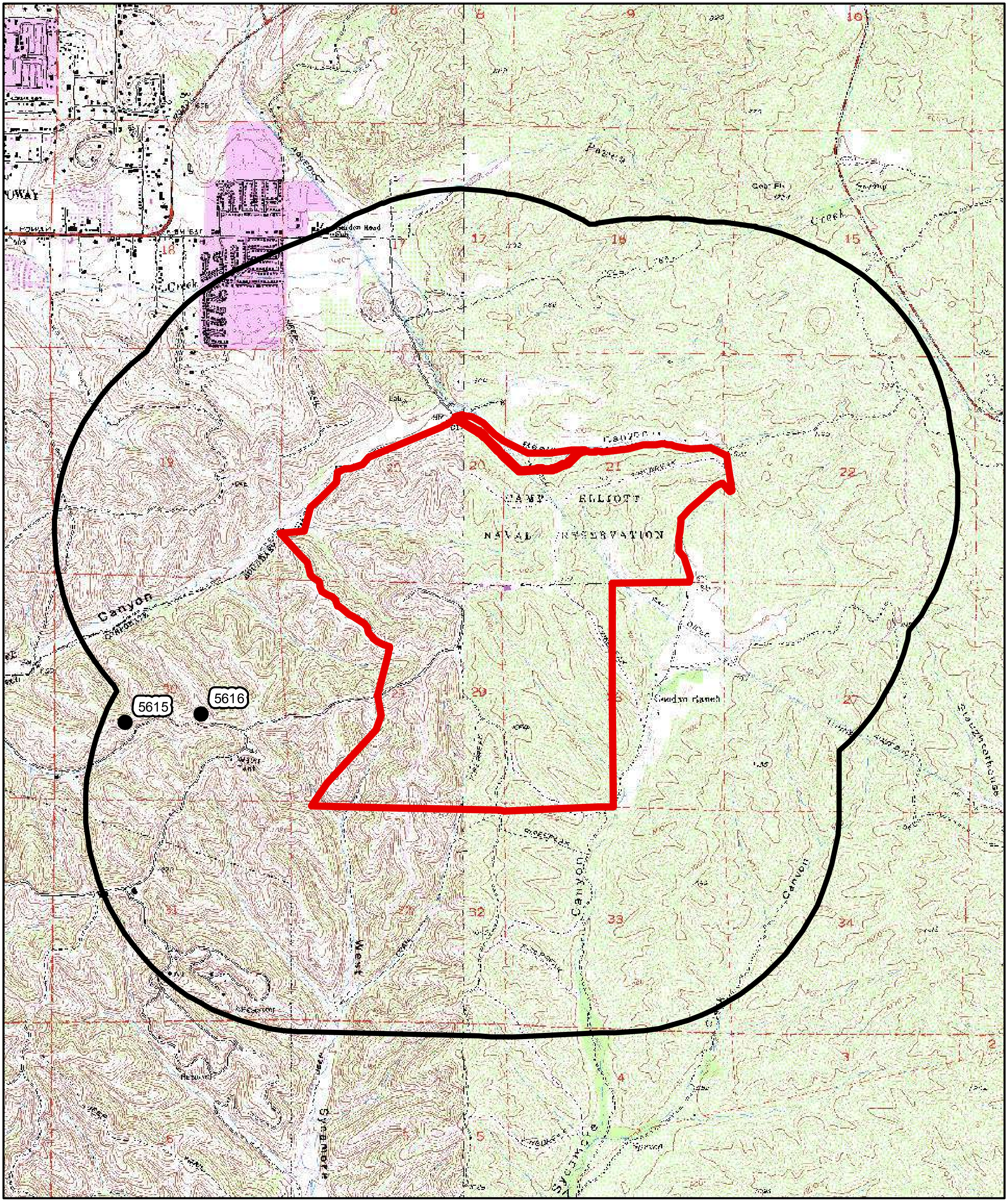
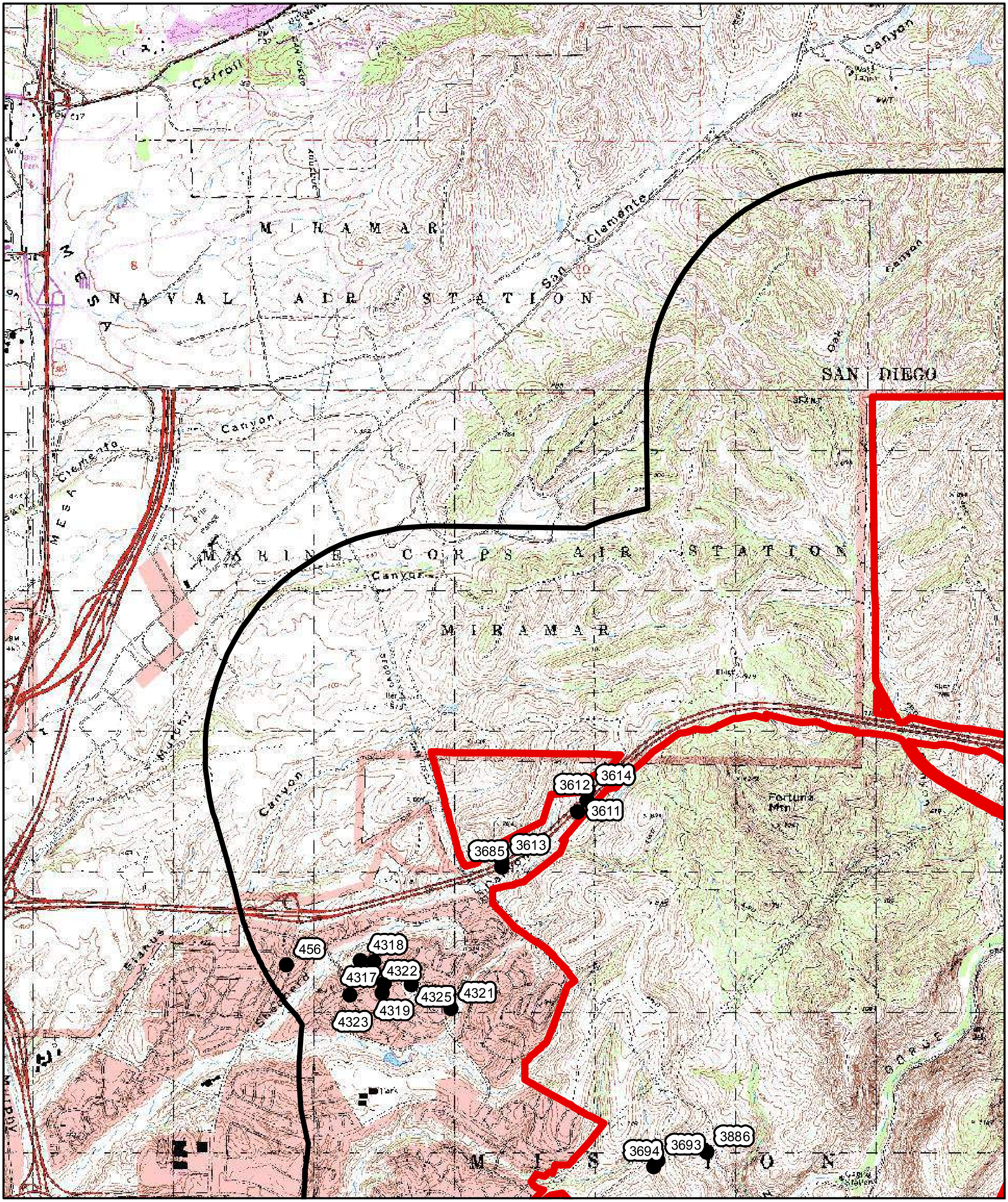


Map 1 of 5: SDNHM fossil localities within one mile of the Mission Trails Regional Park Master Plan Update 2011, City of San Diego. (Base maps USGS, Poway and San Vicente Reservoir, CA, 7.5 minute quadrangles)

0 1 Miles

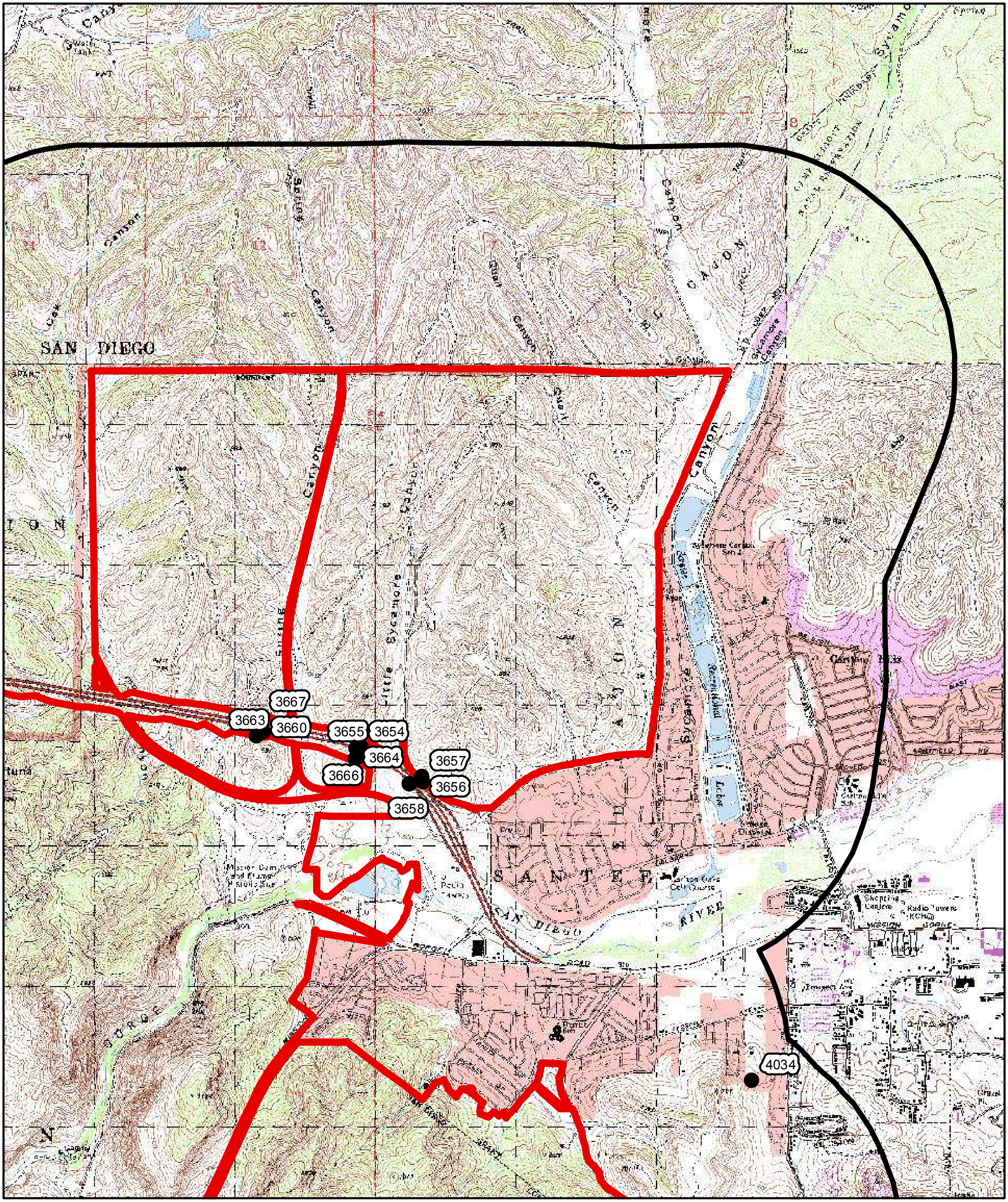
N



Map 2 of 5: SDNHM fossil localities within one mile of the Mission Trails Regional Park Master Plan Update 2011, City of San Diego. (Base maps USGS, Poway and La Mesa, CA, 7.5 minute quadrangles)

0 1 Miles

N



Map 3 of 5: SDNHM fossil localities within one mile of the Mission Trails Regional Park Master Plan Update 2011, City of San Diego. (Base maps USGS, Poway, La Mesa, San Vicente Reservoir, and El Cajon, CA, 7.5 minute quadrangles)

0 1 Miles

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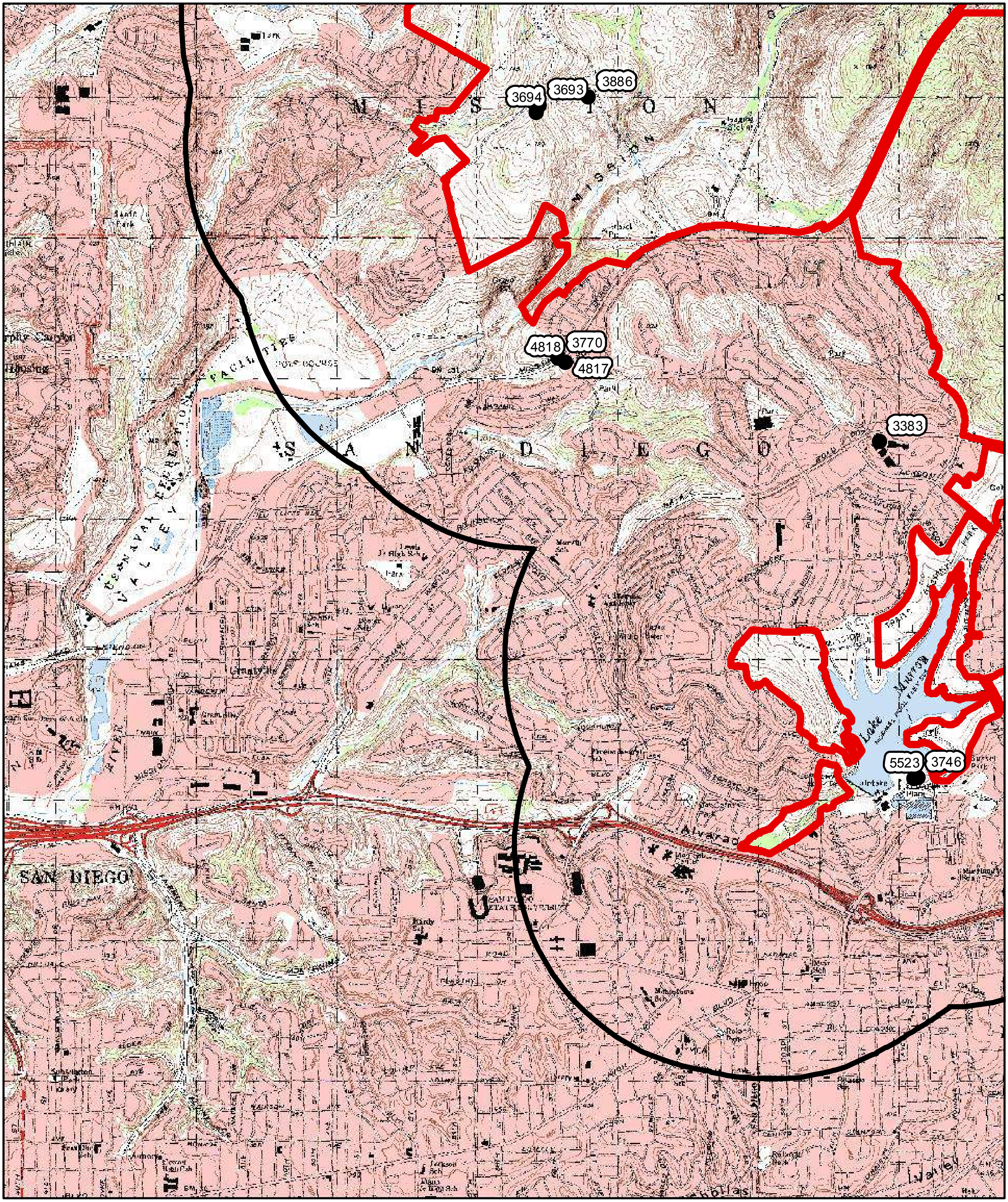
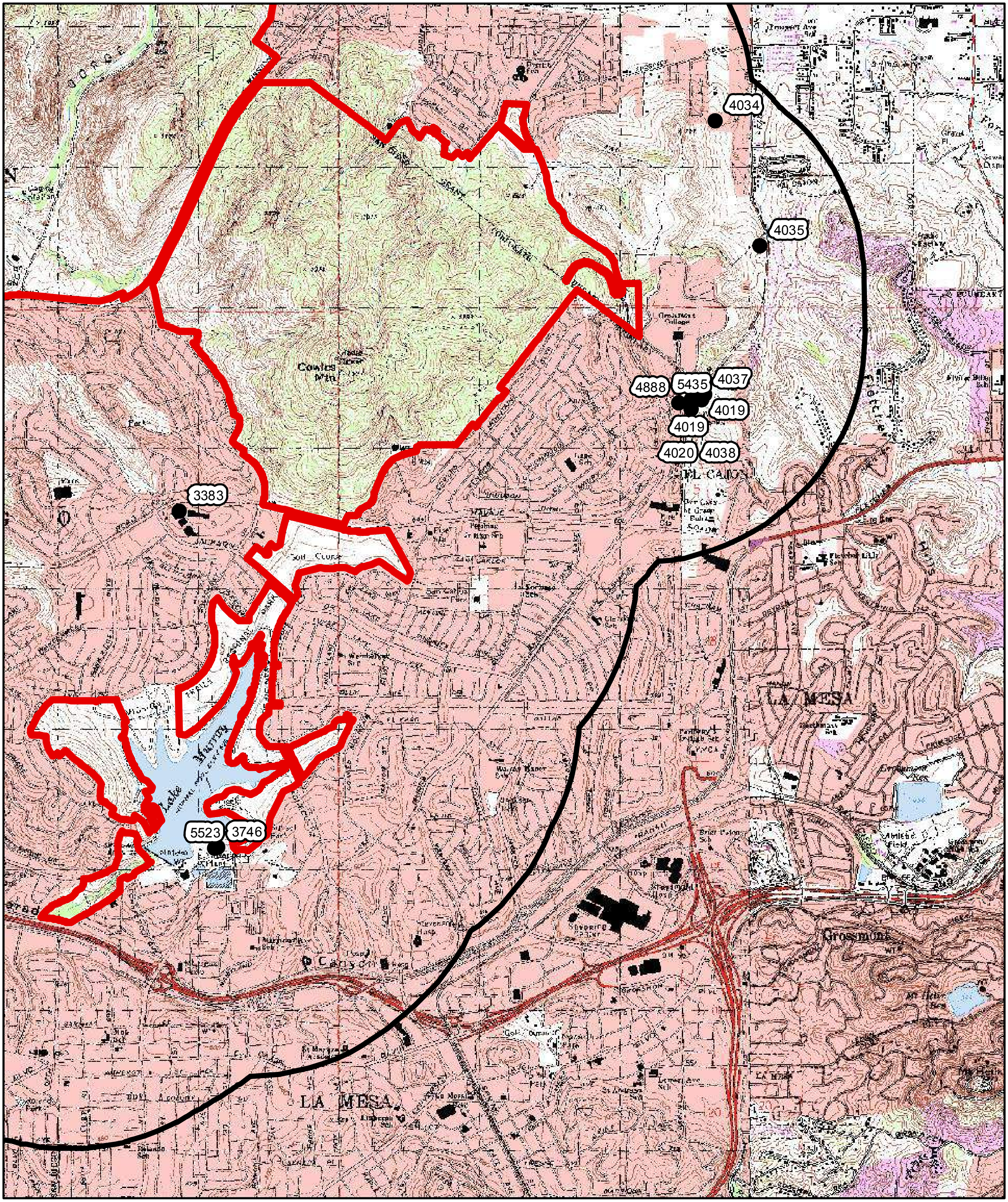


Map 4 of 5: SDNHM fossil localities within one mile of the Mission Trails Regional Park Master Plan Update 2011, City of San Diego. (Base map USGS La Mesa, CA, 7.5 minute quadrangle)

N

0 1 Miles



Map 5 of 5: SDNHM fossil localities within one mile of the Mission Trails Regional Park Master Plan Update 2011, City of San Diego. (Base maps USGS La Mesa and El Cajon, CA, 7.5 minute quadrangles)

0 1 Miles

N

NUMBER	---LOCALITY NAME AND GEOGRAPHIC LOCATION---	----------ROCK AND TIME UNITS-ROCK TYPE-FIELD NOTES----------	-----------COLLECTORS-COMPILED BY-ENTERED BY-DONOR----------
456	Tierrasanta San Diego San Diego Co. CA U.S.A. 32°50'17"N--117° 5'51"W La Mesa, CA 1:24000 USGS 1967	Lindavista Formation Cenozoic Quaternary early Pleistocene congl-	Arnold Ross and J.W. Tobiska 13 Jul 1976 Jan W. Tobiska 11 Jul 1978 H.P. Don Vito 12 Jan 1995 0 0
3614	State Route 52 West San Diego San Diego Co. CA U.S.A. 32°50'58"N--117° 4'28"W La Mesa, CA 1:24000 USGS 1967	Poway Group Pomerado Conglomerate Cenozoic Paleogene Eocene late Uintan sltst-fluvial S.L.Walsh Notebook # 5, p. 105	R.A.Cerutti 29 Oct 1991 S.L. Walsh 24 May 1993 M.W. Colbert 28 May 1993 CalTrans 29 Oct 1991
4317	Tierrasanta Norte - Unit II San Diego San Diego Co. CA U.S.A. 32°50'10"N--117° 5'25"W La Mesa, CA 1:24000 USGS 1967(1975)	San Diego Formation? Cenozoic Quaternary early Pleistocene sdst-marine	Marilyn Morgan 22 Feb 1988 T.A. Demere 26 Jul 1999 H.P. Don Vito 27 Jul 1999 Lusk Homes 0 Aug 1990
4318	Tierrasanta Norte - Unit II San Diego San Diego Co. CA U.S.A. 32°50'18"N--117° 5'31"W La Mesa, CA 1:24000 USGS 1967(1975)	San Diego Formation? Cenozoic Quaternary early Pleistocene sdst-marine	Marilyn Morgan 24 Mar 1988 T.A. Demere 26 Jul 1999 H.P. Don Vito 27 Jul 1999 Lusk Homes 0 Aug 1990
4319	Tierrasanta Norte - Unit II San Diego San Diego Co. CA U.S.A. 32°50'13"N--117° 5'24"W La Mesa, CA 1:24000 USGS 1967(1975)	San Diego Formation? Cenozoic Quaternary early Pleistocene sdst-marine	Marilyn Morgan and Mike McDowell 27 Apr 1988 T.A. Demere 26 Jul 1999 H.P. Don Vito 27 Jul 1999 Lusk Homes 0 Aug 1990
4320	Tierrasanta Norte - Unit II San Diego San Diego Co. CA U.S.A. 32°50'12"N--117° 5'17"W La Mesa, CA 1:24000 USGS 1967(1975)	San Diego Formation? Cenozoic Quaternary early Pleistocene sdst-marine	Marilyn Morgan 30 Mar 1988 T.A. Demere 26 Jul 1999 H.P. Don Vito 27 Jul 1999 Lusk Homes 0 Aug 1990
4321	Tierrasanta Norte - Unit II San Diego San Diego Co. CA U.S.A. 32°50' 7"N--117° 5' 6"W La Mesa, CA 1:24000 USGS 1967(1975)	San Diego Formation? Cenozoic Quaternary early Pleistocene sdst-marine	Marilyn Morgan 24 May 1988 T.A. Demere 26 Jul 1999 H.P. Don Vito 27 Jul 1999 Lusk Homes 0 Aug 1999
4322	Tierrasanta Norte - Unit II San Diego San Diego Co. CA U.S.A. 32°50'17"N--117° 5'27"W La Mesa, CA 1:24000 USGS 1967(1975)	San Diego Formation? Cenozoic Quaternary early Pleistocene sdst-marine	Marilyn Morgan 30 Mar 1988 T.A. Demere 26 Jul 1999 H.P. Don Vito 27 Jul 1999 Lusk Homes 0 Aug 1990
4323	Tierrasanta Norte - Unit II San Diego San Diego Co. CA U.S.A. 32°50'10"N--117° 5'33"W La Mesa, CA 1:24000 USGS 1967(1975)	San Diego Formation? Cenozoic Quaternary early Pleistocene sdst-marine	D.L. Gage 11 Feb 1988 T.A. Demere 26 Jul 1999 H.P. Don Vito 27 Jul 1999 Lusk Homes 0 Aug 1990
4325	Tierrasanta Norte - Unit II San Diego San Diego Co. CA U.S.A. 32°50'15"N--117° 5'17"W La Mesa, CA 1:24000 USGS 1967(1975)	San Diego Formation? Cenozoic Quaternary early Pleistocene sdst-marine	Marilyn Morgan 17 Mar 1988 T.A. Demere 26 Jul 1999 H.P. Don Vito 27 Jul 1999 Lusk Homes 0 Aug 1990
5523	Alvarado WTP San Diego San Diego Co. CA USA 32°46'56"N--117° 2'26"W La Mesa, CA 1:24000 USGS 1967(1975)	Poway Group Mission Valley Formation Cenozoic Paleogene middle Eocene late Uintan mdst-shallow marine, estuarine RAC book # 37	R.A. Cerutti, D.R. Swanson, S.L. Walsh 19 Jul 2004 K.A. Randall 20 Jan 2005 K.A. Randall 21 Jan 2005 City of San Diego 19 Jul 2004
3746	Alvarado Water Filtration Plant La Mesa San Diego Co. CA U.S.A. 32°46'56"N--117° 2'25"W La Mesa, CA 1:24000 USGS 1967	Poway Group Mission Valley Formation Cenozoic Paleogene middle Eocene late Uintan mdst-marine R.A. Cerutti	R.A. Cerutti 3 Mar 1999 R.A. Cerutti 4 Mar 2000 H.M. Wagner 7 Mar 2000 City of San Diego Water Treatment District 3 Mar 1999
3383	Aqueduct Tower San Diego San Diego Co. CA U.S.A. 32°48'14"N--117° 2'37"W La Mesa, CA 1:24000 USGS 1967	Poway Group Mission Valley Formation Cenozoic Paleogene middle Eocene late Uintan slst-	S.L. Walsh 21 Dec 1985 S.L. Walsh 16 Jan 1988 H.P. Don Vito 8 Mar 1995 0 0

NUMBER	---LOCALITY NAME AND GEOGRAPHIC LOCATION---	----------ROCK AND TIME UNITS-ROCK TYPE-FIELD NOTES----------	-----------COLLECTORS-COMPILED BY-ENTERED BY-DONOR----------
4020	SR 125 North (Unit I) Grossmont Summit El Cajon San Diego Co. CA U.S.A. 32°48'34"N--117° 0'16"W La Mesa, CA 1:24000 USGS 1975PR	Poway Group Mission Valley Formation Cenozoic Paleogene middle Eocene late Uintan mdst-fluvial	R.A. Cerutti, R.L. Clark, B.O. Riney, S.L. Walsh 0 0 R.A. Cerutti 15 Jul 1997 H.M. Wagner 11 Oct 1999 CalTrans 0 0
4038	SR 125 North (Unit I) Grossmont Summit Santee San Diego Co. CA U.S.A. 32°48'34"N--117° 0'16"W La Mesa, CA 1:24000 USGS 1975PR	Poway Group Mission Valley Formation Cenozoic Paleogene middle Eocene late Uintan sdst-fluvial	B.O. Riney 17 Dec 1996 H.M. Wagner 15 Oct 1999 H.M. Wagner 15 Oct 1999 CalTrans 17 Dec 1996
4715	SR 125 N. Grossmont Unit II, Lwr Green Sdst El Cajon San Diego Co. CA U.S.A. 32°48'37"N--117° 0'16"W La Mesa, CA 1:24,000 USGS 1967(1975)	Poway Group Mission Valley Formation Cenozoic Paleogene middle Eocene late Uintan sdst-fluvial S.L. Walsh Notebook #10	RAC, SDJ, HMW, TWR, JAO, JLP, BOR, PJS, SLW 12 Mar 2001 K.A. Randall 26 Jun 2002 K.A. Randall 26 Jun 2002 Caltrans 12 Mar 2001
4888	SR 125 North Unit II, Mid Brown Siltstone El Cajon San Diego Co. CA USA 32°48'39"N--117° 0'19"W La Mesa, CA 1:24000 USGS 1967(1975)	Poway Group Mission Valley Formation Cenozoic Paleogene middle Eocene late Uintan mdst-fluvial MHS book #1, pgs 24-25, 29-31, 35, 51, 59, 61, 62	MHS, RAC, HMW, JLP, JAO, SLW 9 Oct 2002 K.A. Randall 26 Nov 2003 K.A. Randall 26 Nov 2003 Caltrans 9 Oct 2002
4019	SR 125 North (Unit I) Grossmont Summit El Cajon San Diego Co. CA U.S.A. 32°48'40"N--117° 0'13"W La Mesa, CA 1:24000 USGS 1975PR	Poway Group Mission Valley Formation Cenozoic Paleogene middle Eocene late Uintan mdst-fluvial R. Clark Ntbk # 1, p. 1-3. S.Walsh Ntbk #9, p. 103	R.A. Cerutti, T.A. Wirths, R.L. Clark, S.L. Walsh 16 Aug 1996 R.A. Cerutti 15 Jul 1997 S.L. Walsh 15 Jul 1997 CalTrans 16 Aug 1996
4019A	SR 125 North (Unit I) Grossmont Summit El Cajon San Diego Co. CA U.S.A. 32°48'40"N--117° 0'13"W La Mesa, CA 1:24000 USGS 1975PR	Poway Group Mission Valley Formation Cenozoic Paleogene middle Eocene late Uintan sltst-fluvial R.Clark Notebook #1:1-3. S.Walsh Notebook #9:103	R.L. Clark 20 Aug 1996 S.L. Walsh 14 Dec 1999 S.L. Walsh 14 Dec 1999 CalTrans 20 Aug 1996
5435	SR 125 North (Unit II) North Grossmont Summ El Cajon San Diego Co. CA USA 32°48'40"N--117° 0'16"W La Mesa, CA 1:24000 USGS 1967(1975)	Poway Group Mission Valley Formation Cenozoic Paleogene middle Eocene late Uintan sdst-fluvial RAC Book #35 pgs. 82, 87, 90, 93	R.A. Cerutti 12 Mar 2001 K.A. Randall 2 Jun 2004 K.A. Randall 3 Jun 2004 Caltrans 12 Mar 2001
4037	SR 125 North (Unit I) Grossmont Summit El Cajon San Diego Co. CA U.S.A. 32°48'41"N--117° 0'12"W La Mesa, CA 1:24000 USGS 1975PR	Poway Group Mission Valley Formation Cenozoic Paleogene middle Eocene early Uintan mdst-fluvial R.A. Cerutti	R.A. Cerutti, B.O. Riney, R.L. Clark 28 Aug 1996 S.L. Walsh 18 Aug 1997 S.L. Walsh 18 Aug 1997 Caltrans 28 Aug 1996
3694	Hill 781 Saddle Cut 2 San Diego San Diego Co. CA U.S.A. 32°49'30"N--117° 4'10"W La Mesa, CA 1:24000 USGS 1975PR	Poway Group Mission Valley Formation Cenozoic Paleogene middle Eocene late Uintan sltst-fluvial S.L. Walsh Ntbk #3 and Ntbk #9:24-26	S.L. Walsh 30 Jan 1989 S.L. Walsh 27 Aug 1997 S.L. Walsh 27 Aug 1997 0 0
3613	State Route 52 West San Diego San Diego Co. CA U.S.A. 32°50'40"N--117° 4'53"W La Mesa, CA 1:24000 USGS 1967	Poway Group Mission Valley Formation Cenozoic Paleogene middle Eocene late Uintan sdst-fluvial S.L.Walsh ntbk 5, p.104,105; ntbk 6, p.5,9,19.	B.O.Riney, S.L.Walsh, R.A.Cerutti 28 Oct 1991 S.L. Walsh 24 May 1993 M.C. Colbert 28 May 1993 CalTrans 28 Oct 1991
3611	State Route 52 West site 1 San Diego San Diego Co. CA U.S.A. 32°50'52"N--117° 4'32"W La Mesa, CA 1:24000 USGS 1975PR	La Jolla Group Friars Formation upper tongue Cenozoic Paleogene middle Eocene early Uintan sdst-fluvial S.L.Walsh Notebook # 5, p. 101,102, 104.	S.L. Walsh 11 Oct 1991 S.L. Walsh 11 May 1993 M.W. Colbert 28 May 1993 Caltrans 11 Oct 1991
3612	State Route 52 West Site 2 San Diego San Diego Co. CA U.S.A. 32°50'55"N--117° 4'28"W La Mesa, CA 1:24000 USGS 1975PR	La Jolla Group Friars Formation upper tongue Cenozoic Paleogene middle Eocene early Uintan sltst-fluvial S.L. Walsh Notebook #5	R.A. Cerutti, B.O. Riney, S.L. Walsh 28 Oct 1991 S.L. Walsh 22 Feb 1994 S.L. Walsh 22 Feb 1994 CalTrans 28 Oct 1991
3653	State Route 52 East Site 3 San Diego San Diego Co. CA U.S.A. 32°50'59"N--117° 1'57"W La Mesa, CA 1:24000 USGS 1975PR	La Jolla Group Friars Formation lower tongue Cenozoic Paleogene middle Eocene early Uintan sdst-fluvial S.L.Walsh Notebk 6,p.55; R.A.Cerutti 10 Sept. 1991	R.A.Cerutti 10 Sep 1991 S.L. Walsh 10 May 1993 M.W. Colbert 28 May 1993 CalTrans 10 Sep 1991

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3654	State Route 52 East Site 4 San Diego San Diego Co. CA U.S.A. 32°51' 0"N--117° 1'57"W La Mesa, CA 1:24000 USGS 1975PR	La Jolla Group Friars Formation lower tongue Cenozoic Paleogene middle Eocene early Uintan siltst-fluvial S.Walsh Ntbk 5:90-91; Ntbk 6:53. R. Cerutti 1991.	S.L.Walsh, R.A.Cerutti 12 Sep 1991 S.L. Walsh 11 May 1993 M.W. Colbert 28 May 1993 CalTrans 12 Sep 1991
3655	State Route 52 East Site 5 San Diego San Diego Co. CA U.S.A. 32°51' 0"N--117° 1'57"W La Mesa, CA 1:24000 USGS 1975PR	La Jolla Group Friars Formation lower tongue Cenozoic Paleogene middle Eocene early Uintan mdst-fluvial S.L. Walsh, Ntbk 5,p.12; ntbk 6,p4,5,27,28,53	S.L. Walsh, R.A. Cerutti 25 Feb 1992 S.L. Walsh 10 May 1993 M.W. Colbert 28 May 1993 CalTrans 25 Feb 1992
3656	State Route 52 East Site 6 San Diego San Diego Co. CA U.S.A. 32°50'53"N--117° 1'40"W La Mesa, CA 1:24000 USGS 1975PR	La Jolla Group Friars Formation lower tongue Cenozoic Paleogene middle Eocene early Uintan sltst-fluvial S.L.Walsh Notebk # 5, p.96; Notebk # 6, p. 32 & 39	R.A. Cerutti, S.L. Walsh 17 Sep 1991 S.L. Walsh 10 May 1993 M.W. Colbert 28 May 1993 CalTrans 17 Sep 1991
3657	State Route 52 East Site 7 San Diego San Diego Co. CA U.S.A. 32°50'53"N--117° 1'40"W La Mesa, CA 1:24000 USGS 1975PR	La Jolla Group Friars Formation lower tongue Cenozoic Paleogene middle Eocene early Uintan sdst-fluvial S.L.Walsh Notebk #5, p.96-8; Notebk #6, p.32 & 39	S.L. Walsh, R.A. Cerutti 18 Sep 1991 S.L. Walsh 10 May 1993 M.W. Colbert 28 May 1993 CalTrans 18 Sep 1991
3658	State Route 52 East Site 8 San Diego San Diego Co. CA U.S.A. 32°50'53"N--117° 1'40"W La Mesa, CA 1:24000 USGS 1975PR	La Jolla Group Friars Formation lower tongue Cenozoic Paleogene middle Eocene early Uintan mdst-Fluvial S.L.Walsh notebook #5, p. 96,99; #6 p. 32, 39	R.A. Cerutti, S.L. Walsh 18 Sep 1991 S.L. Walsh 10 May 1993 M.W. Colbert 28 May 1993 CalTrans 18 Sep 1991
3659	State Route 52 East Site 9 San Diego San Diego Co. CA U.S.A. 32°50'52"N--117° 1'43"W La Mesa, CA 1:24000 USGS 1975PR	La Jolla Group Friars Formation lower tongue Cenozoic Paleogene middle Eocene early Uintan sltst-fluvial R.A.Cerutti, orange Brunton Notebk, 25 Nov 91	R.A.Cerutti 2 Dec 1991 S.L. Walsh 22 May 1993 M.W. Colbert 28 May 1993 CalTrans 2 Dec 1991
3660	State Route 52 East site 10 San Diego San Diego Co. CA U.S.A. 32°51' 7"N--117°22' 2"W La Mesa, CA 1:24000 USGS 1975PR	La Jolla Group Friars Formation lower tongue Cenozoic Paleogene middle Eocene early Uintan mdst-fluvial	S.L. Walsh 25 Aug 1992 S.L. Walsh 12 Jul 1995 S.L. Walsh 12 Jul 1995 CalTrans 25 Aug 1992
3661	State Route 52 East site 11 San Diego San Diego Co. CA U.S.A. 32°51' 0"N--117° 1'58"W La Mesa, CA 1:24000 USGS 1975PR	La Jolla Group Friars Formation lower tongue Cenozoic Paleogene middle Eocene early Uintan congl-fluvial S.L.Walsh Notebk 6, p. 4, 26, 28.	S.L. Walsh, R.A. Cerutti 30 Jan 1992 S.L. Walsh 10 May 1993 M.W. Colbert 28 May 1993 CalTrans 30 Jan 1992
3662	State Route 52 East Site 12 San Diego San Diego Co. CA U.S.A. 32°50'52"N--117° 1'43"W La Mesa, CA 1:24000 USGS 1975PR	La Jolla Group Friars Formation lower tongue Cenozoic Paleogene middle Eocene early Uintan mdst-fluvial S.L.Walsh Notebk 6, p. 26, 31, 32, 39.	R.A. Cerutti, S.L. Walsh 8 Jun 1992 S.L. Walsh 10 May 1993 M.W. Colbert 28 May 1993 CalTrans 8 Jun 1992
3663	State Route 52 East Site 13 San Diego San Diego Co. CA U.S.A. 32°51' 4"N--117° 2'26"W La Mesa, CA 1:24000 USGS 1975PR	La Jolla Group Friars Formation lower tongue Cenozoic Paleogene middle Eocene early Uintan sdst-fluvial S.L.Walsh notebook 6, p.36	R.A.Cerutti 15 Jun 1992 S.L. Walsh 10 May 1993 M.W. Colbert 28 May 1993 CalTrans 15 Jun 1992
3664	State Route 52 East Site 14 San Diego San Diego Co. CA U.S.A. 32°51' 0"N--117° 1'58"W La Mesa, CA 1:24000 USGS 1975PR	La Jolla Group Friars Formation lower tongue Cenozoic Paleogene middle Eocene early Uintan sdst-fluvial channel R.A. Cerutti 26 Jun 1992	R.A. Cerutti 26 Jun 1992 S.L. Walsh 9 Mar 1994 S.L. Walsh 9 Mar 1994 CalTrans 26 Jun 1992
3665	State Route 52 East Site 15 San Diego San Diego Co. CA U.S.A. 32°50'59"N--117° 1'57"W La Mesa, CA 1:24000 USGS 1975PR	La Jolla Group Friars Formation lower tongue Cenozoic Paleogene middle Eocene early Uintan sdst-fluvial S.L. Walsh (Blue) Notebook # 6,p. 34 & 55	S.L. Walsh 30 Jun 1992 S.L. Walsh 10 May 1993 M.W. Colbert 28 May 1993 CalTrans 30 Jun 1992
3666	State Route 52 East Site 16 San Diego San Diego Co. CA U.S.A. 32°51' 0"N--117° 1'58"W La Mesa, CA 1:24000 USGS 1975PR	La Jolla Group Friars Formation lower tongue Cenozoic Paleogene middle Eocene early Uintan sdst-fluvial S.L.Walsh Notebook 6, p.34, 53.	S.L.Walsh 30 Jun 1992 S.L. Walsh 22 May 1993 M.W. Colbert 28 May 1993 CalTrans 30 Jun 1992

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3667	State Route 52 East Site 17 San Diego San Diego Co. CA U.S.A. 32°51' 8"N--117° 2'23"W La Mesa, CA 1:24000 USGS 1975PR	La Jolla Group Friars Formation lower tongue Cenozoic Paleogene middle Eocene early Uintan congl-fluvial S.L.Walsh Notebook # 6, p.48.	S.L.Walsh 10 Aug 1992 S.L. Walsh 22 May 1993 M.W. Colbert 28 May 1993 CalTrans 10 Aug 1992
3685	State Route 52 West site 5 San Diego San Diego Co. CA U.S.A. 32°50'39"N--117° 4'53"W La Mesa, CA 1:24000 USGS 1967	La Jolla Group Friars Formation upper tongue Cenozoic Paleogene middle Eocene early Uintan sdst-fluvial S.L.Walsh Notebook # 6, p. 9, 19.	S.L. Walsh 27 Apr 1992 S.L. Walsh 24 May 1992 M.W. Colbert 28 May 1993 CalTrans 27 Apr 1992
3693	Hill 781 Saddle Cut 1 San Diego San Diego Co. CA U.S.A. 32°49'31"N--117° 4' 9"W La Mesa, CA 1:24000 USGS 1975PR	La Jolla Group Friars Formation Cenozoic Paleogene middle Eocene early Uintan sdst-fluvial S.L. Walsh Ntbk #9:24-26	S.L. Walsh, G. Calvano 7 Feb 1995 S.L. Walsh 27 Aug 1997 S.L. Walsh 27 Aug 1997 0 0
3770	Mission Gorge and Margerum San Diego San Diego Co. CA U.S.A. 32°48'33"N--117° 4' 4"W La Mesa, CA 1:24000 USGS 1967/1975	La Jolla Group Friars Formation Cenozoic Paleogene middle Eocene early Uintan mdst-fluvial SLW Notebook 8 p. 4	S.L. Walsh and R.A. Cerutti 4 Apr 1994 S.L. Walsh 14 Apr 1995 H.P. Don Vito 26 May 1995 0 0
3886	SDCWA 96" Pipeline 4B Phase II San Diego San Diego Co. CA U.S.A. 32°49'34"N--117° 3'56"W La Mesa, CA 1:24000 USGS 1975PR	La Jolla Group Friars Formation upper tongue Cenozoic Paleogene middle Eocene early Uintan siltst-fluvial B.O. Riney 28 Aug 1995	B.O. Riney, S.L. Walsh 28 Aug 1995 S.L. Walsh 27 Dec 1995 S.L. Walsh 27 Dec 1995 San Diego County Water Authority 28 Aug 1995
4034	SR 125 North (Unit I) Grossmont Summit San Diego San Diego Co. CA U.S.A. 32°49'44"N--117° 0' 9"W La Mesa, CA 1:24000 USGS 1975PR	La Jolla Group Friars Formation lower tongue Cenozoic Paleogene middle Eocene early Uintan sltst-fluvial R.A. Cerutti	R.A. Cerutti 24 Apr 1996 S.L. Walsh 17 Aug 1998 S.L. Walsh 17 Aug 1998 CalTrans 24 Apr 1996
4035	SR 125 North (Unit I) Grossmont Summit El Cajon San Diego Co. CA U.S.A. 32°49'15"N--116°59'57"W El Cajon, CA 1:24000 USGS 1975PR	La Jolla Group Friars Formation lower tongue Cenozoic Paleogene middle Eocene early Uintan mdst-fluvial R.A. Cerutti	R.A. Cerutti, R.Q. Gutzler 26 Apr 1996 H.M. Wagner 11 Oct 1999 H.M. Wagner 15 Oct 1999 CalTrans 26 Apr 1996
4817	The Trails Apartments, Site 1 San Diego San Diego Co. CA USA 32°48'33"N--117° 4' 2" La Mesa, CA 1:24000 USGS 1975PR	La Jolla Group Friars Formation Cenozoic Paleogene middle Eocene early Uintan sdst-fluvial R.A. Cerutti 2002 Notebook	R.A. Cerutti, P.J. Sena 3 Jul 2002 S.L. Walsh 11 Feb 2003 S.L. Walsh 11 Feb 2003 Del Mar Development, LLC 3 Jul 2002
4818	The Trails Apartments, Site 2 San Diego San Diego Co. CA USA 32°48'33"N--117° 4' 2"W La Mesa, CA 1:24000 USGS 1975PR	La Jolla Group Friars Formation Cenozoic Paleogene middle Eocene early Uintan mdst-fluvio-lacustrine	S.L. Walsh, R.A. Cerutti 8 Aug 2002 S.L. Walsh 11 Feb 2003 S.L. Walsh 11 Feb 2003 Del Mar Development, LLC 8 Aug 2002
5615	McMillin Sycamore Estates Phase 1, site 1 San Diego San Diego Co. CA USA 32°55'30"N--117° 1'33"W Poway, CA 1:24000 USGS 1967(1975)	La Jolla Group Friars Formation conglomerate tongue Cenozoic Paleogene middle Eocene early Uintan sltst-fluvial MHS book #3 pgs.23, 27-29, BOR book #29 pg 48, MKB	MHS, MKB, IDB, HMW, SLW, BOR, KAR 6 May 2004 M.H. Stevens 14 Feb 2005 M.K. Soetaert 11 May 2005 McMillin Land Development 6 May 2004
5616	McMillin Sycamore Estates Phase 1, site 2 San Diego San Diego Co. CA USA 32°55'32"N--117° 1'12"W Poway, CA 1:24000 USGS 1967(1975)	La Jolla Group Friars Formation conglomerate tongue Cenozoic Paleogene middle Eocene early Uintan sltst-fluvial MHS book #3, MKB, BOR	M.H. Stevens 9 Jun 2004 M.H. Stevens 14 Feb 2005 M.K. Soetaert 11 May 2005 McMillin Land Development 9 Jun 2004