Final

BALLONA WETLANDS ECOLOGICAL RESERVE RESTORATION PROJECT, LOS ANGELES COUNTY, CALIFORNIA

Geoarchaeological Review

Prepared for

California State Coastal Conservancy

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Prepared for
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1.0 INTRODUCTION

ESA was retained by the California State Coastal Conservancy to conduct a geoarchaeological review for the Ballona Wetlands Restoration Project ("Project") in Los Angeles County, California. The Project lies in unsectioned land within Township 2 South, Range 15 West, of the San Bernardino meridian.

2.0 PROJECT DESCRIPTION

The Ballona Wetland Ecological Reserve Restoration Project proposes to restore native coastal wetland and upland habitats within the 600-acre Ballona Wetlands Ecological Reserve ("Reserve"). The Project would remove portions of the straight, concrete-lined channel of Ballona Creek and adjacent flood control levees. A new, sinuous creek meander channel would be excavated and new levees constructed. In places, previously placed fill would be excavated, while excess cut material would be placed as compacted fill in other areas. Restoration of wetlands would occur between the new levees and the realigned Ballona Creek.

3.0 REGULATORY ENVIRONMENT

The California Department of Fish & Game (CDFG) will serve as lead agency under the California Environmental Quality Act (CEQA).

The project will also require a permit from the U.S. Army Corps of Engineers (USACE), and therefore will be subject to the National Environmental Policy Act (NEPA) and Section 106 of the National Historic Preservation Act (Section 106). USACE follows the procedures outlined in 33 CFR Part 325, Appendix C ("Appendix C") to fulfill the requirements of Section 106. Appendix C requires USACE to consider the effects of this undertaking upon Historic Properties within the project's "Permit Area". For the purposes of this report, "Permit Area" is analogous to "Project Area" and the latter term is used here.

4.0 PROJECT AREA

The Ballona Wetlands Ecological Reserve currently encompasses approximately 600 acres in unincorporated Los Angeles County and the City of Los Angeles, between Marina Del Rey and Playa Del Rey. The Reserve is bisected east-west by the channelized Ballona Creek, which flows into Santa Monica Bay. The wetlands previously covered more than 2,000 acres, but this area has been reduced in size through historic development. A series of events, including channelization of Ballona Creek, oil drilling, road construction, and filling with dredge spoils from nearby development, have substantially altered and obscured natural landforms across the Ballona. For the purposes of the Project, the wetlands have been divided into three areas – Area A, Area B, and Area C (Figure 1).

All elevations are presented in reference to the North American Vertical Datum 1988 (NAVD). Elevation above mean sea level (amsl) may be approximated by subtracting 2.6 feet (i.e., feet amsl = feet NAVD - 2.6 feet).

SOURCE: ESRI Imagery, Vertical Datum 'Feet NAVD 88'

Ballona Wetland Restoration . 120367.00

Figure 1

Current Elevation

4.1 Area A

Area A encompasses approximately 139 acres, north of Ballona Creek, west of Lincoln Boulevard, south of Fiji Way and north of the channelized Ballona Creek (Figure 1). Current elevations range between approximately +12 and +20 feet NAVD (Delta Group 2013:11), although natural historic elevations were approximately +2 to +10 feet NAVD. Area A contains fill, up to 15 feet thick in some areas, most notably along levees placed during construction of the Ballona Creek flood control channel and Marina Del Rey. Area A is largely undeveloped with the exception of a parking lot and several monitoring wells in the western portion of the property. An unlined drainage channel known as the “Fiji Ditch” runs parallel to Fiji Way and drains to the ocean.

4.2 Area B

Area B encompasses approximately 338 acres, south of Ballona Creek, west of Lincoln Boulevard, and north of the Westchester Bluffs, also known as the Ballona Escarpment (Figure 1). On the west, the area extends into dunes at Vista Del Mar. Current elevations for the majority of Area B range between approximately +5 and +8 feet NAVD (Delta Group 2013:11). Portions of Area B along the Ballona Creek flood control channel contain dredged fill, and low oil well pads have been abandoned in several locations. Portions of Area B, particularly in the east, were formerly used for agriculture, but areas of largely unfilled wetlands remain within Area B.

4.3 Area C

Area C is the smallest area, encompassing 66 acres north of Ballona Creek and between Lincoln Boulevard on the west and the Marina Freeway (SR 90) on the east (Figure 1). Current elevations range between approximately +7 and +28 feet NAVD (Delta Group 2013:12). Area C contains extensive amounts of fill from construction of the flood control channel, Marina Del Rey, the Pacific Electric Railroad, and raising of Culver Boulevard and the Marina Freeway (PWA 2006:2).

5.0 REVIEW METHODS

Dr. Christopher Lockwood, Ph.D., R.P.A., ESA Geoarchaeologist, conducted a literature review of the Project Area and surrounding. Information reviewed included previous archaeological survey reports and site records, geological maps, geotechnical borings, hydrologic reports, and historic maps and photos. These documents were reviewed in order to determine the presence of any potentially significant archaeological sites within the Project Area, and to develop an understanding of the potential for the project to encounter subsurface cultural materials. Monica Strauss, M.A., R.P.A., provided senior review and quality control/assurance of the report. Dustin Dirks, ESA Senior GIS Analyst, prepared maps.

6.0 ENVIRONMENTAL SETTING

6.1 Geology

The Ballona Wetlands are situated within the Peninsular Ranges Geomorphic Province of California. Younger bedrock within this Province is composed of marine and terrestrial sedimentary rock dating from the Cretaceous period (approximately 80 million years ago [mya]) to the Pleistocene epoch (less than 2 mya).

The region is a seismically active portion of southern California, which has been subject to several historic earthquakes. The Ballona wetlands are located within the Ballona Gap (also known as the Ballona Plain) between Westchester Bluffs within the Del Rey Hills (also known as the El Segundo Sand Hills) to south and the Ocean Park Plains to the north.

During the last Ice Age, approximately 26,000 to 12,000 years ago, global sea level was substantially lower than current conditions and the coastal plain in the vicinity of the Ballona would have extended several hundred feet west of its current location. Subsequent melting of glacial ice resulted in rapid rise in sea level. The present configuration of coastline was effectively reached around 6,000-7,000 years ago after the rapid rise in sea level slowed dramatically. The gap has been subject to additional natural modification by sea level fluctuations, fluvial process associated with the Los Angeles River and Ballona Creek, and transport of sediments from nearby hills.

On the south, the wetlands are bounded by the Westchester Bluffs (El Segundo Sand Hills), which are Pleistocene-aged sand dunes; the base of the bluffs consists of the San Pedro Sand Formation. A series of erosion gullies along the face of the bluffs, resulting from headward erosion, provided prehistoric access between the uplands and the lowlands. In the vicinity of Lincoln Boulevard and towards the east, this process resulted in formation of a large alluvial fan in the marsh; this elevated landform served as an important human occupation area (CA-LAN-62).

Prior to historic and modern development, the Ballona lowlands were an expansive marsh containing small brackish and freshwater channels. Sediments within the Ballona consist primarily of Holocene-aged (approximately 11,700 years ago to present) alluvial deposits – clay, silt, sand and gravel – laid down by Ballona Creek. These deposits may be more than 100 feet thick in places. Above approximately 50 feet deep, deposits tend to be finer-grained marsh deposits. Below this depth, coarser-grained gravel and sand denote an aquifer known as the Ballona Aquifer or 50 Foot Aquifer.

6.2 Geomorphology

In their comprehensive synthesis of the environmental setting of the Ballona, Homburg et al. (2014:12) note that three primary landforms have been identified in the vicinity of the Ballona – hillslope, alluvial fan, and alluvial plain (floodplain).

The Project Area consists of alluvial plain with small areas of alluvial fan near the toe of the Westchester Bluffs.

The tops of the Westchester Hills south of the Project Area represented favored occupation locations, particularly early in the culture-historical sequence of the area. Erosion of material from these formed alluvial fans and contributed to alluvial plains. Thus, alluvial fans and alluvial plains may contain cultural materials redeposited from the hillslopes. Homburg et al. (2014:12) suggest that archaeological deposits within the Ballona “are strongly associated with the alluvial-fan deposits and the foot-slope deposits of the hillslope facies.” Several, large, long-term occupation sites have been investigated along the base of the Westchester Bluffs to the east of Lincoln Boulevard outside of the boundaries of the Project Area. For much of its history, the area occupied by the low-lying alluvial plain was either open-water or (later) marshland.

Alluvial plain sediments are floodplain deposits from Centinela Creek, Ballona Creek, and, at times, the Los Angeles River and occupy the lowest topographic positions. Formation of the alluvial plain occurred first as fluvial sediments were deposited within the lagoon at creek deltas, progressively filling the lagoon with sediments. Secondarily, overbank flooding resulting from major storms resulted in a more recognizable floodplain facies sequence, with coarser-grained gravels and sands deposited in proximity to stream channels and finer-grained silt and clays deposited further from the channels. Importantly, alluvial fan and alluvial plain deposits can interfinger. When present within the alluvial plain, cultural materials tend to be scattered and sparse. As Homburg et al. (2014:12) caution, extensive human modification of the landscape over the last century, including mechanical excavation and filling, are so widespread in some areas that it can be challenging to distinguish recent and historic-period deposits from natural deposits.

6.3 Hydrology

Historically, the Ballona was an estuarine lagoon, fed both by freshwater from Ballona Creek/Los Angeles River and Centinela Creek, and tidal flow from the Pacific Ocean. In the past, the Los Angeles River periodically switched direction of discharge, at times flowing west through the Ballona and at other times flowing south towards Long Beach. In fact, as late as 1825, the Los Angeles River was discharging into the Ballona. Prior to channelization, Ballona Creek flowed into Ballona lagoon near the intersection of Lincoln and Culver Boulevards. Ballona Creek and Centinela Creek would have been subject to lateral stream migration or movement across the floodplain. Over time, as ocean currents deposited sand across the mouth of the bay a barrier spit was formed, creating an enclosed lagoon. While a hydrological connection to the ocean was maintained through a tidal channel, the new conditions prevented alluvial sediments from being flushed out into the ocean. Over several thousand years, the lagoon filled with flood deposits from Ballona Creek/Los Angeles River and Centinela Creek, as well as material eroded from the tops of the surrounding bluffs. Although smaller than Ballona Creek, spring-fed Centinela Creek was a more reliable source of freshwater, a fact perhaps reflected in the large number of archaeological sites that follow its course. The lagoon evolved into a mosaic of tidal flats and mudflats, elevated sandy bars, freshwater marsh, and tidal outlets. Topographically higher areas on the floodplain could remain relatively dry for extended periods, particularly during summer months, but winter and spring storms could cause episodic flooding that could inundate large portions of the alluvial plain.

Overbank flooding was reduced as a result of channelization of Ballona Creek in 1935; Centinela Creek was channelized in the 1960s. However, even after channelization, the Ballona was still susceptible to flooding. For example, in March 1938, the area was broadly flooded as the result of a large storm event.

6.4 Historical Ecology of the Ballona

Altschul et al. (2005; also Homburg et al. 2014) have constructed an evolutionary model of changes in the physical environment of the Ballona Wetlands, which is summarized here. Following the late glacial maximum of the Late Pleistocene, rising sea level gradually inundated the coastal plain lying between the Playa Del Ray Bluffs, Baldwin Hills, and Santa Monica Mountains, creating an embayment open to the ocean. Around 7,000 years ago, sea levels were approximately 35 to 40 feet below present levels. As the rate of sea level rise slowed during the Holocene, sedimentation from Ballona Creek and Centinela Creek led to infilling of the lagoon and formation of marshes and wetlands along the lagoon edge. By approximately 4,000 years ago, due to continued slowing of sea level rise, fluvial deposition within the lagoon dominated, including expansion of the coastal plain from the north, and westward extension of saltmarshes. Dynamic mid-bay bars likely formed in the transition zone between fluvial- and marine-dominated processes, while coastal processes reworked lagoon sediments into a barrier spit at the mouth of the lagoon. Between 4,000 and 2,000 years ago, establishment of mid-bay bars separated the eastern extent of the lagoon (approximately east of Lincoln Boulevard) from the western portion (approximately west of Lincoln Boulevard), creating an inner lagoon. Periodic discharge from the Los Angeles River into Ballona Creek deposited substantial amounts of sediment into the lagoon, accelerating the formation of coastal plain and saltmarsh within the lagoon. Between 2,000 and 200 years ago, development of the barrier spit and continued fluvial deposition resulted in near complete filling of the lagoon, leading to a mosaic of salt and freshwater marshes, freshwater ponds, and sandy islands behind the lagoon barrier.

6.5 Evolution of the Western Ballona

Based on data gathered from previous coring within the Ballona (such as stratigraphic, organic carbon and particle size, mollusk identification, pollen identification, ostracode identification, foraminifera and diatom identification, and radiocarbon dating), Homburg et al. (2014:85-109) further refined the generalized historical ecological sequence presented above. Prior to approximately 8,500 years ago, the lower drainage of Ballona Creek consisted of terrestrial coastal plain. By 7,500 years ago, the majority of Area A and Area B had become tidal flat as the sea encroached during global sea level rise. An elevated sand spit or beach, possibly an alluvial fan built of materials eroding from the Westchester Bluffs, may have persisted in the western portion of West Area B until approximately 6,000 years ago, but was drowned as sea level continued to rise, reaching areas east of Lincoln Boulevard.

Between 5,800 and 5,550 years ago, isostatic rebound, a tectonic adjustment to removal of the continental glacial ice, caused a short-lived retreat of marine waters. Sea level rose again after 5,500 years ago reaching a highstand by approximately 4,400 years ago; during this time Area A, Area B, and muchof Area C would have been under water. Around 3,800 years ago, a sandy barrier formed across the mouth of the lagoon restricting tidal exchange. Sediments deposited by Ballona Creek/Los Angeles River could no longer be flushed from the lagoon out into the ocean. The area progressively filled with alluvial deposits roughly from east to west. By approximately

1,500 years ago, Area A and Area B evolved to salt marsh, which persisted as a mosaic of tidal channels, mudflats, freshwater pools, and sandy islands into the historic period.

7.0 CULTURAL SETTING

The cultural setting and archaeological record of the Ballona has been discussed previously as a result of extensive archaeological research (e.g., Grenda and Altschul 1994; Altschul et al. 2005; Homburg et al. 2014). Previous archaeological research of the Ballona has been focused heavily on upland sites within the Westchester Bluffs and lowland areas either east of Lincoln Boulevard or north of Fiji Way (outside of the boundaries of the Reserve). The following section presents a thumbnail summary of the cultural context within the overall Ballona.

Archaeological research suggests that the first people to settle the Ballona area were small groups of mobile foragers who occupied the top of the Westchester Hills (CA-LAN-64) approximately 8,000 to 7,000 years ago (Altschul et al. 2007). At this time, the Ballona was an open water embayment as melting of continental glaciers drove rapid sea level rise (Altschul et al. 1992). A mix of terrestrial and marine food remains dating to this time period suggests a broad-spectrum subsistence. Around 6,500 years ago, people appear to have moved briefly to the lowlands, occupying the Lincoln Gap alluvial fan at the base of the Westchester Hills (CA-LAN-62). Between 6,000 and 4,500 years ago, there is largely a gap in the archaeological record during which time the Ballona was sparsely occupied, if at all. A possible exception could be within the western portion of West Area B (approximately 0.25 miles east of Vista Del Mar), where archaeological analysis of a paleoenviromental core has been interpreted to suggest the possible presence of a very deeply buried (16 feet below suface) archaeological shell deposit (Homburg et al. 2014:Appendix B). No artifacts were observed within the deposit, which has not been formally recorded as an archaeological site; the vicinity of the deposit is not anticipated to be impacted by the wetlands restoration project.

A renewal in occupation in the Ballona occurred around 4,500 to 4,000 years ago with the reestablishment of CA-LAN-62 at the base of the Westchester Hills (outside of the Project Area), and occupation of CA-LAN-54 at the intersection of Culver Boulevard and Marina Freeway at the eastern edge of Area C. (. Between 3,000 and 1,500 years ago, in addition to new bluff top sites, several additional lowlands sites (CA-LAN-60, -193, -211, and -2678, all outside of the Project Area) appear on alluvial fans and other topographic high points above the lagoon and wetlands (Altschul et al. 2007). By 1,000 years ago, a substantial shift in settlement and subsistence occurred, as bluff top sites and most lowland sites were abandoned in favor of just a few lowland sites – CA-LAN-47, -62, and -211 – all of which appear to have been well elevated above the surrounding area. CA-LAN-47, located more than 0.5 miles (0.9 km) north of the Reserve, has been interpreted as a lagoon edge site occupied over the course of less than 500 years during a series of short-term occupations (Altschul et al. 1992).

Data recovery at CA-LAN-2676, immediately east of Lincoln Boulevard, and previously interpreted to be a lagoon edge shell midden dating to this time period, has shown the site to be redeposited (Homburg et al. 2014:xi).

At the time of historical contact, the Los Angeles Basin, including the Ballona, was occupied by the Gabrielino/Tongva (Caughman and Ginsberg 1987:296). By the late 1700s to early 1800s, the Ballona was being used by Spanish ranchers for cattle grazing (Altschul et al. 1992:56). The environmental effects of this activity are unknown, although one plausible outcome might have been increased erosion and redeposition as a result of diminished vegetative cover. Throughout the next century, the area seems to have remained primarily undeveloped ranch land under a series of ownership claims. Even into the early 20th century, the area west of present day Lincoln Boulevard was still a mosaic of marshland.

In 1902, the Los Angeles Pacific (subsequently Pacific Electric Line) was built through the wetlands to provide service between Culver City and Playa del Rey; the line was abandoned in 1940.

In 1910, an area to the west of the present day intersection of Culver Boulevard and Jefferson Boulevard (Area B) was developed into the Los Angeles Motordrome, a wooden racing track for automobiles and motorcycles (ICF 2011). The track, a full mile in circumference and approximately 1,700 feet in diameter, could accommodate up to 40,000 spectators within its massive in-field; all told the Motordrome occupied an area of approximately 50 acres south of Ballona Creek. The track had a 30-foot wide in-field apron composed of crushed granite, and the surface was coated with crushed sea shells to provide traction. To bring spectators to the Motordrome, the Pacific Electric Line railroad built a special purpose rail spur across the wetlands to the track. The Aero Club of California utilized the Motordrome facilities, building hangars and even a paved, one mile-long runway for conducting flight experiments. In 1913, a fire destroyed a portion of the track and it was subsequently dismantled. While no archaeological remains associated with the Motordrome have been discovered, substantial ground disturbance, including installation of pilings and placement of various fill materials, undoubtedly occurred.

Channelization of Ballona Creek occurred in two phases, with work east of Lincoln Boulevard completed by 1923. The stretch west of Lincoln Boulevard was channelized by the USACE in 1935. The path of the approximately 300-foot wide canal likely intersected the former location of the Motordrome (Foster 1991). Spoils from dredging were placed to either side of the canal to build up the protective levees.

The discovery of oil in the Ballona Wetlands in 1929 resulted in rapid development of wells, and by 1930, 325 wells were in operation within the Ballona. Topographic maps show that portions of Area A and Area B contained wells. Wells were built on low pads constructed of sand and gravel fill. However, the oil boom in the Ballona was short lived with most wells dismantled by 1960. Also during this time, plowed agriculture occurred within the Ballona, most extensively in the eastern portion of Area B.

Dredging for Marina Del Rey began in 1961. Much of the remaining lagoon was lost, and dredge spoils were placed as fill across Area A.

7.1 Archaeological Sites within the Reserve

As of November 2014, there were five previously recorded archaeological sites within the Reserve (CA-LAN-54, -1698, -1970H, -3784, and -3982). The single site within Area A is CA-LAN-1698, southwest of the intersection of Lincoln Boulevard and Fiji Way, which was originally recorded as shell midden. This site was later reinterpreted to represent redeposited construction fill and removal of the site designation was recommended (Altschul et al. 1991:124-125). Area B contains three archaeological sites – CA-LAN-1970H, CA-LAN-3784, and CA-LAN-3982 – all historic in age. CA-LAN-1970, west of the intersection of Jefferson and Culver, is a surface site containing the remains of several oil derrick pads and associated debris; based on its location, it is possible this site overlaps with the former site of the Motordrome. CA-LAN-3982, at the intersection of Culver and Jefferson, contains the shallowly buried (i.e., 1-2 feet deep) remains of the Playa Street station of the Pacific Electric Line; this station was purpose-built to bring spectators to the Motordrome. CA-LAN-3982 also contained a scatter of shell remains, including species used by Gabrielino/Tongva and their forebears; however, as with CA-LAN-1698, the shell has been interpreted to be the result of dredging (Minor 2007). CA-LAN-3784 is a historic refuse dump (circa 1880s-1920s) buried beneath 7 feet of fill at the toe of the Westchester Hills at the southern edge of Area B, in an area not expected to be impacted by construction.

The single recorded precontact archaeological site – CA-LAN-54 – is located in Area C, immediately south of the intersection of Culver Boulevard and the Marina Freeway. The site, dated approximately from 4,000 to 2,000 years ago, appears to have occupied an elevated, stable landform (approximately +15 feet NAVD) near the edge of the lagoon consistent with the time period in which lowland occupation reappears in the archaeological record after a 2,000 year hiatus. During the period of this site's occupation, localized conditions would have shifted from a salt/brackish water environment to a more freshwater environment.

8.0 REVIEW OF PREVIOUS GEOTECHNICAL STUDIES

The Ballona Wetlands have been subject to multiple geotechnical investigations including Converse Consultants (1981, cited in PWA 2006:31), Law and Crandall, Inc. (1988, 1991a, 1991b, 1991c), Weston Solutions (2009), Diaz Yourman & Associates (2010), and Group Delta Consultants (2013).

As a whole, the boring logs generally explicitly identify "fill" layers as such. In a very few cases cultural debris, such as trace concrete or asphalt, is noted. No prehistoric or historic artifacts are noted in any of the logs. However, because the geotechnical work was performed for the purposes of engineering, rather than archaeology, the logs should not be presumed to reliably reflect the presence or absence of cultural materials. Similarly, while the logs commonly note the presence of "shells" or "sea shells," no taxonomic identifications are provided. While semi-quantitative estimates of shell and shell fragment abundance, such as *trace*, *few*, *some*, and in a very few cases *large amount*, are provided, these estimations and the terms used, vary according to the geotechnical engineering firm performing the work and even the year in which the work was performed, making it challenging to compare shell abundance between different studies. A review of the most recent geotechnical studies - Diaz Yourman & Associates (2010) and Group Delta Consultants (2013), which use consistent terms for shell abundance (i.e., *trace* and *few*) – suggests that whole and fragmented shells are distributed almost ubiquitously throughout the Reserve in both fill and native ("pre-fill") deposits.

Review of geotechnical logs resulted in interpolated thickness of placed fill deposits (Figure 2) and interpolated top elevation of native soils (Figure 3) for the Project Area.

SOURCE: ESRI Imagery

Ballona Wetland Restoration . 120367.00

Figure 2

Fill Thickness

SOURCE: ESRI Imagery, Vertical Datum 'Feet NAVD 88'

Ballona Wetland Restoration . 120367.00

Figure 3

Elevation of Top of Native Soil

8.1 General Stratigraphic Conditions

Surficial deposits within the Ballona (and within the depth of planned ground disturbance for the Project) primarily result from progressive in-filling of Ballona lagoon during the Holocene. Floodplain aggradation from sediment transport by Ballona Creek/Los Angeles River and Centinela Creek is the dominant geomorphic process that has been in operation since slowing of sea level rise approximately 7,000 years ago. Deposits consist of sand and gravel in proximity to former channel locations, and silt and clay further from the channel. Organic silts and peat characterize wetland areas. Along the base of the Westchester Hills, sediments eroded from the bluffs (alluvial fan or colluvial) override and interfinger with floodplain deposits. Transport of aeolian deposits from the coast also contributes sandy material to the Ballona. Placed fill, the result of a series of historic activities, is found broadly and in highly varied thicknesses across the Ballona Wetland. Because the sources of fill materials are generally either locally-derived (and therefore resemble "native" deposits from the Ballona) or are unknown, and because natural soil formation processes have continued to operate, recognizing fill deposits from native deposits may be challenging.

8.2 Area A

Area A has been subject to geotechnical investigations by Converse Consultants (1981, cited in PWA 2006:31), Law and Crandall, Inc. (1991a, 1991b), Weston Solutions (2009), and Group Delta Consultants (2013).

Converse Consultants (1981) advanced 28 borings (type unknown) in Area A, with depths varying between 20 and 100 feet. LCI (1991a) installed 20 borings, which recover sediments, and 5 cone penetration tests (CPTs), which do not. LCI's results suggested the presence of 9-17 feet of fill (silt, clay and silty sand) underlain by Holocene alluvium (primarily silty clay and clay, with silt and sand layers) to a depth of 90-100 feet below ground surface. Later, LCI (1991b) installed 4 borings to investigate a former dump site, known as the Celery Dump, operated between 1945 and 1953. Weston Solutions (2009) installed 20 direct push borings to a depth of approximately 24 feet for chemical and geotechnical testing. Group Delta Consultants (2013) conducted 11 rotary wash borings, 8 hollow-stem auger borings, and 12 CPTs within Area A. In total, Area A has been subject to 91 non-CPT borings, for a density of approximately 0.65 per acre.

Surface conditions within Area A consist of relatively level surface covered with brush . The results of the borings suggest relatively consistent stratigraphy across Area A. Artificial fill, primarily dredge spoils from the Ballona Creek channel and Marina Del Rey, ranges from 8 to 20 feet in the west, to near 0 feet in some eastern portions (Figure 2). Fill soils are dry and loose, and are predominantly composed of sandy silts, sandy clays, and silty sands, with isolated areas of poorly graded sands and gravels. Below the fill are marsh (alluvial) deposits consisting of 35 to 50 feet of silty clay to clay with smaller amounts of silt and sand; trace organics and trace shell fragments are noted in multiple boring logs. Between 55 and 70 feet, the marsh deposits are underlain by dense to very dense sands and gravels (50 Foot Aquifer).

8.3 Area B

Area B has been subject to geotechnical investigations by Law and Crandall, Inc. (1991a), Diaz Yourman and Associates (2010), and Group Delta Consultants (2013).

LCI (1991a) installed a total of 53 borings in Area B in two phases between 1987 and 1991. According to the report, surface soils towards the west consist of Holocene dune sands that extend to a depth of at least 30 feet. Diaz Yourman and Associates (2010) installed 13 hollow stem borings in Area B in 2009. Depth of borings ranged between 16 and 32 feet. Group Delta Consultants (2013) conducted 13 rotary wash borings, 1 hollow-stem auger boring, 1 hand auger boring, and 17 CPTs within Area B in 2012. In total, Area A has been subject to 81 non-CPT borings, for a density of approximately 0.24 per acre.

The results of the borings reveal 0 to 15 feet (Figure 2) of heterogeneous fill ranging from silty sands to clays. Some wetlands in Area B are recognized as unfilled, but, as noted above, meaningfully distinguishing native from fill deposits may be difficult, particularly when the latter are thin or mixed. Below the fill are marsh (alluvial) deposits consisting approximately 40 to 50 feet of clays and silts with interbedded sand layers; trace organics and trace shell fragments are noted in boring logs. Between 60 and 70 feet, the marsh deposits are underlain by dense to very dense sands and gravels associated with the 50 Foot Aquifer.

8.4 Area C

Area C has been subject to geotechnical investigations by Law and Crandall, Inc. (1988, 1991a), Diaz Yourman and Associates (2010), and Group Delta Consultants (2013).

LCI (1988) installed 16 borings and 5 monitoring wells in 1987, and 5 rotary wash borings in 1991. Diaz Yourman and Associates (2010) installed 17 hollow stem borings in Area B in 2009. Group Delta Consultants (2013) conducted 1 hollow-stem auger boring and 3 CPTs within Area C. In total, Area A has been subject to 44 non-CPT borings, for a density of approximately 0.67 per acre.

The results of the borings reveal 8 to 15 feet (Figure 2) of heterogeneous fill ranging from loose to medium dense silty sands and soft to stiff sandy silts and clays, with areas of poorly graded sand and clayey sand. Below the fill are marsh (alluvial) deposits consisting of approximately 40 to 50 feet of clays and silts with interbedded sand layers. Between approximately 50 and 60 feet, the marsh deposits are underlain by dense to very dense sands and gravels of the 50 Foot Aquifer.

8.5 Archaeological Implications

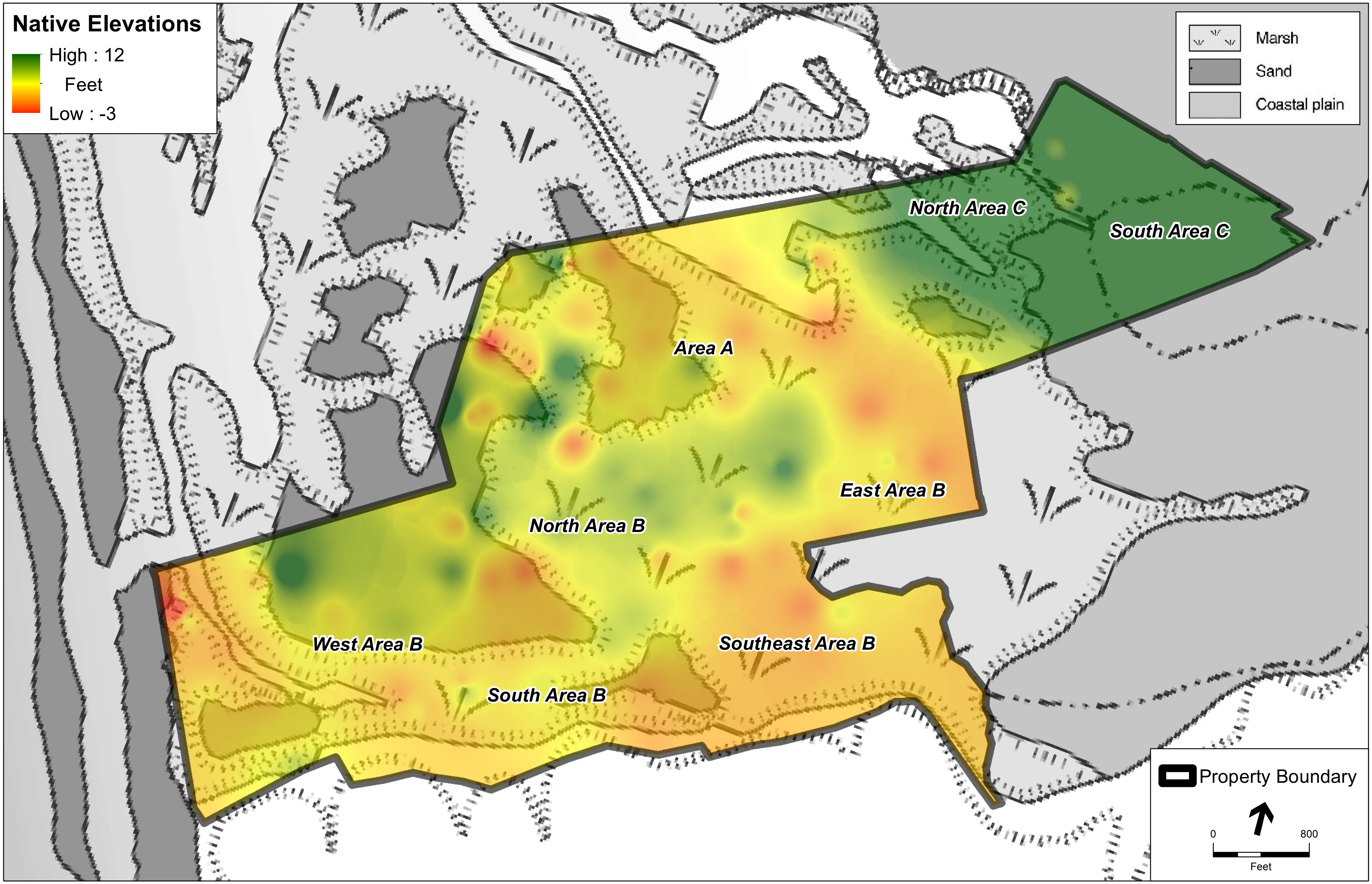
The top of the original native surface appears elevated (higher than +10 feet NAVD) across much of Area C (Figure 3). An overlay with the 1861 US Coastal Survey map (Figure 3A) illustrates that a majority of Area C had developed into coastal plain by the historic period, and probably well before. The location of CA-LAN-54 within Area C and near the mouth of the natural channel of Ballona Creek is understandable. Area C would have represented a relatively high and dry spot overlooking the lagoon and (later) marsh. In fact, other nearby precontact occupation sites within non-Reserve portions of the Ballona lowlands, including CA-LAN-47 (Altschul et al. 1992), -62, and -211 exhibit a similar pattern of being elevated+10 feet NAVD or higher, on knolls or alluvial fans above low-lying portions of the floodplain.

Elevations of the top of native soils within Area A and Area B are noticeably lower and more varied than in Area C, and range between approximately -3 and +12 feet NAVD (Figure 3). Placement of fill on top of wet, loose marsh soils may have resulted in deformation and compaction of native soils in some areas. When overlaid with the 1861 US Coastal Survey map (Figure 3A), the locations of Area A and Area B topographic high spots appear relatively consistent with mapped locations of isolated sandy “islands” that formed naturally within the marsh. While it seems unlikely that these high spots would have been favored for sustained human occupation, it is possible that they were visited for periods of time during subsistence gathering activities, such as collection of shellfish, and possibly used for temporary occupation.

Conversely, portions of Area A and Area B with lower elevation native soils (approximately below +10 feet NAVD) generally correspond with salt marsh, mud flats, and channels (Figure 3A). These lower-lying areas seem unlikely to be places that would have been used except during conduct of subsistence activities and are therefore not likely to contain well-developed archaeological deposits.

9.0 ARCHAEOLOGICAL SENSITIVITY

Based on review of geotechnical logs, historic maps, and the locations of archaeological sites elsewhere within the Ballona area, ESA considers portions of the Project Area containing native soils with top elevations of +10 feet NAVD or higher to have the highest potential to contain prehistoric archaeological sites. Compared with lower elevation areas, landforms at +10 feet NAVD or higher would have been drier and more stable, and may have been conducive to more frequent and sustained human occupation and, thus, formation of archaeological sites. To account for the interpolation applied in this analysis and any margin of inaccuracy that it would produce, ESA has identified portions of the Project Area containing native soils with top elevations of +7 feet NAVD (3 feet [or 30 percent] lower than the approximate elevation of known human occupation sites in the vicinity) as areas where an abundance of caution would be appropriate. For the purposes of this study, areas possessing +7 feet NAVD native soil elevations are identified as “Higher Sensitivity” for prehistoric archaeological resources.



SOURCE: Chase 1861, Paleo Environmental, Vertical Datum 'Feet NAVD 88'

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Figure 3A

Elevation of Top of Native Soil with 1861 US Coastal Survey

Conversely, ESA considers portions of the Project Area containing native soils with top elevations below +7 feet NAVD to possess a “Lower Sensitivity” for prehistoric archaeological resources. Low-lying areas would have been periodically to perpetually saturated, making them unsuitable for occupation. While there is little doubt that people visited low-lying areas of the marsh to hunt and forage, they are unlikely to have lived here, and the types of subsistence activities conducted would not be expected to result in large or diverse accumulations of cultural materials. Rather, archaeological sites, if present in these areas, are expected to be small, ephemeral, and challenging to recognize using traditional archaeological survey techniques, such as shovel probes and borings, which provide very limited subsurface exposures.

In applying these sensitivity values (“Lower Sensitivity” [Figure 4; green shading] and “Higher Sensitivity” [Figure 4; red shading]) to the areas of proposed Project disturbance, ESA identified two categories (or degrees) of disturbance: (1) where ground disturbance would approach within 3 feet of (but not intersect) native soil (Figure 4; black single hatching); and (2) where ground disturbance would extend into native soil (Figure 4; black cross hatching). Areas where “Higher Sensitivity” overlaps with disturbances into native soil are depicted on Figure 4 as areas where red shading and cross hatching overlap. Areas where “Lower Sensitivity” overlaps with disturbances, either within 3 feet of or where it extends into native soil, are depicted on Figure 4 as areas where green shading overlaps with either single hatching or cross hatching, respectively.

10.0 RECOMMENDATIONS

Two areas have been identified where Project ground disturbance would intersect with areas of Higher Sensitivity for prehistoric archaeological resources. At location SA1, the native soil is buried beneath fill averaging 7.5 feet thick (min. = 6.3, max. = 8.6). The depth of proposed ground disturbance in this area will be between 9.9 and 11.1 feet below current ground surface. At location SA2, the native soil is buried beneath fill averaging 8.6 feet thick (min. = 5.7, max = 15.3). The depth of proposed ground disturbance in this area will be between 9.5 and 17.2 feet below current ground surface. The top of native soil at SA1 and SA2 (7.5 and 8.6 feet, respectively) is beyond the reach of conventional archaeological hand excavation techniques and would be more conducive to archaeological mechanical coring techniques. In the event, pre-construction investigations of these Higher Sensitivity areas are deemed appropriate, an optimal coring approach would consist of large-diameter (6-8 inch) sonic coring.

SOURCE: ESRI Imagery, Vertical Datum 'Feet NAVD 88'

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Figure 4

Proposed Disturbance Relative to Archaeological Sensitivity

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