life in the ballona: archaeological investigations at the admiralty site (ca-lan-47) and the channel gateway site (ca-lan-1596-h)

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and Richard S. Ciolek-Torrello

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ACKNOWLEDGMENTS

In a project the size and scope of Channel Gateway there are a myriad of people upon whom the project depends. Since its inception in 1989 we have been fortunate to work with a variety of people from all walks of life. Without their support and encouragement the project would not have succeeded. A list of these individuals is provided below. Although all were important, a few must be singled out for their critical participation.

First and foremost, we would like to acknowledge the J.H. Snyder Company, the project sponsor and developer of Channel Gateway, and the Southern California Gabrielino Indian Band, a Los Angeles-based Native American group led by Vera and Manual Rocha. The two groups worked long and hard, overcoming many obstacles. By the end, they had joined forces to support not only the archaeological investigations, but also a monument to the prehistoric Native American inhabitants of the Admiralty site.

The path traveled by these two organizations was long and difficult. They could have easily parted ways many times during the process. It is a testament to the determination of both parties to ensure that modern development be conducted in concert with the preservation of the past. In particular, Jerome Snyder and Vera and Manual Rocha deserve the lion's share of the credit for this project. It would not have happened without their direction and support.

Others within these organizations were also instrumental to the success of the project. Seven members of the Gabrielino People worked in the excavations. While learning about archaeology, the Gabrielinos taught us about their culture.

Logistically, Marsh Holtman of the J.H. Snyder Company was invaluable. Marsh arranged everything from lodging to backhoes and insured that our work was given the highest priority by all connected with the project.

Beyond the two major participants in the project, there were a number of agencies that played important roles. Of these, the Sixth Council District of the City of Los Angeles served as the meeting grounds and often the mediator between the J.H. Snyder Company and the Gabrielino People. Councilwoman Ruth Galanter and the District's Planning Deputy, Rubel Helgeson, provided the necessary neutral atmosphere to reconcile differing points of view.

One of the distinct pleasures of working on the project was the interaction with members of the archaeological community. All gave freely of their knowledge and experience. Of these, a few deserve notable mention. Dr. David Van Horn provided copies of reports concerning his investigations throughout the Ballona region. In the best scholarly tradition, Dave also was generous with his time, agreeing to long conversations with the senior author about the prehistory of the region. Keith Johnson, who directed the UCLA excavations of the Admiralty site in 1961, provided original photographs of that investigation, and kindly provided notes on the nature of the work. Both Dr. Brian Dillon and Dr. E. Gary Stickel, who conducted separate investigations of the site in the late 1980s, provided insight into their work. While working with Statistical Research on another nearby project, Dr. Charles Rozaire provided an important historical perspective on the archaeology of the Ballona area. Similarly, Dr. John Johnson kindly conducted a preliminary examination of the San Gabriel Mission records as they relate to the reported Gabrielino village of **Sa'anga**, and graciously allowed us to reproduce his results in this report.

To all those associated with this project, we offer our sincere appreciation. We have endeavored to create a document that reflects the hard work of all. We are responsible for its specific contents, but share its spirit with everyone.

Name	Affiliation	Role
Jerome H. Snyder	J. H. Snyder Co.	Developer, project sponsor
Marsh Holtzman	J. H. Snyder Co.	Developer, project manager
Milton Swimmer	J. H. Snyder Co.	Developer, project sponsor
Jonah Goldrich	Goldrich & Kest	Developer, project sponsor
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Isabella R. Chick	Gabrielino	Native American Monitor
Earnest Felix	Gabrielino	Native American Monitor
Richard Ramirez	Gabrielino	Native American Monitor
Joseph Rocha	Gabrielino	Native American Monitor
Nick Rocha	Gabrielino	Native American Monitor
Phillip Rocha	Gabrielino	Native American Monitor
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Vera Rocha	Gabrielino	Co-Chairperson
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Juan Jiminez	Los Angeles County Coroner's Office	Supervising Investigator
Larry Myers	Native American Heritage Council	Chairperson
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Richard Perry	U.S. Army Corps of Engineers, Los Angeles District	Archaeologist
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Brian Glenn	Archaeological Information Center, UCLA	Site Records and Archival Information
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Steve Johnson	Local Resident	Volunteer Laboratory Assistant
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Warren Gross	Hydrogeologist	Informant
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CHAPTER 1
INTRODUCTION

The Admiralty site (CA-LAn-47) lies at the edge of the historic Ballona Lagoon. Situated between the mouths of Ballona and Centinela creeks and the Pacific Ocean, the region known as the Ballona was a sheltered environment that hosted a diverse array of terrestrial and aquatic plants and animals. The seasonal rhythms of the lagoon marched in harmony with the never-ending tug-of-war between the ebb and flow of the oceanic tides and the freshwater emptied from the mouths of rivers and streams. Human beings have been part of this rhythm for thousands of years. It is only in the last several hundred years, however, that people have sought to alter this balance to achieve mastery over the environment for their goals alone. To some this achievement is a testament to the success of the human species. To others it is a token of our arrogance that puts ourselves above all others.

The story of the Admiralty site is one of a different time and culture: a time when people were part of the natural cycle, a culture that strove for balance, not dominance. At the time it was occupied, the site was one of many such sites along the coastline of southern California. Today it is one of the few survivors of this lost age. Although the scientific importance of the site can be measured in terms of the information provided about past lifeways and cultures, its cultural value to the descendants of its inhabitants is much harder to calculate.

The 1989 excavations of the Admiralty site strove to maintain a balance between scientific objectives and the preservation of a cultural heritage. Along the way these goals sometimes clashed, and we were forced to make choices. Although we made no pretense that the course chosen was the only one, it was certainly not one charted in haste. To the extent that we have shed light on a heritage shrouded in darkness, we have succeeded.

PROJECT HISTORY

In January 1989, the Southern California Gabrielino Indian Band asked Statistical Research to consider undertaking archaeological investigations on a 16-acre parcel in Marina del Rey (Figure 1). The parcel belonged to the J. H. Snyder Company, which was planning to develop Channel Gateway, a mixed-use project, comprised of residential rental apartments, condominiums, and commercial property (Figure 2).

Beyond its commercial value the property also was prized by the Gabrielino Indians. As early as the 1940s, archaeologists had recorded a large prehistoric site designated by the trinomial CA-LAn-47, in the vicinity of the proposed development. The Gabrielinos believed that the site represented the remnants of **Sa'angna**, by some accounts a Gabrielino village occupied at the time of Spanish contact.

Unfortunately the records of the original site recording have been lost. When the site was actually recorded and by whom remains a mystery. More importantly, how the size of the site was determined and how accurately the site was mapped are questions that cannot be answered. All that is left of the original documentation is a roughly circular area plotted on a USGS 7.5-minute topographic map (Figure 3).

During construction of Marina del Rey in the 1960s archaeologists from UCLA named the site the Admiralty site because much of it now underlies Admiralty Way. Archaeological work during the Marina del Rey construction was perfunctory in nature. Directed by UCLA archaeologists, and based

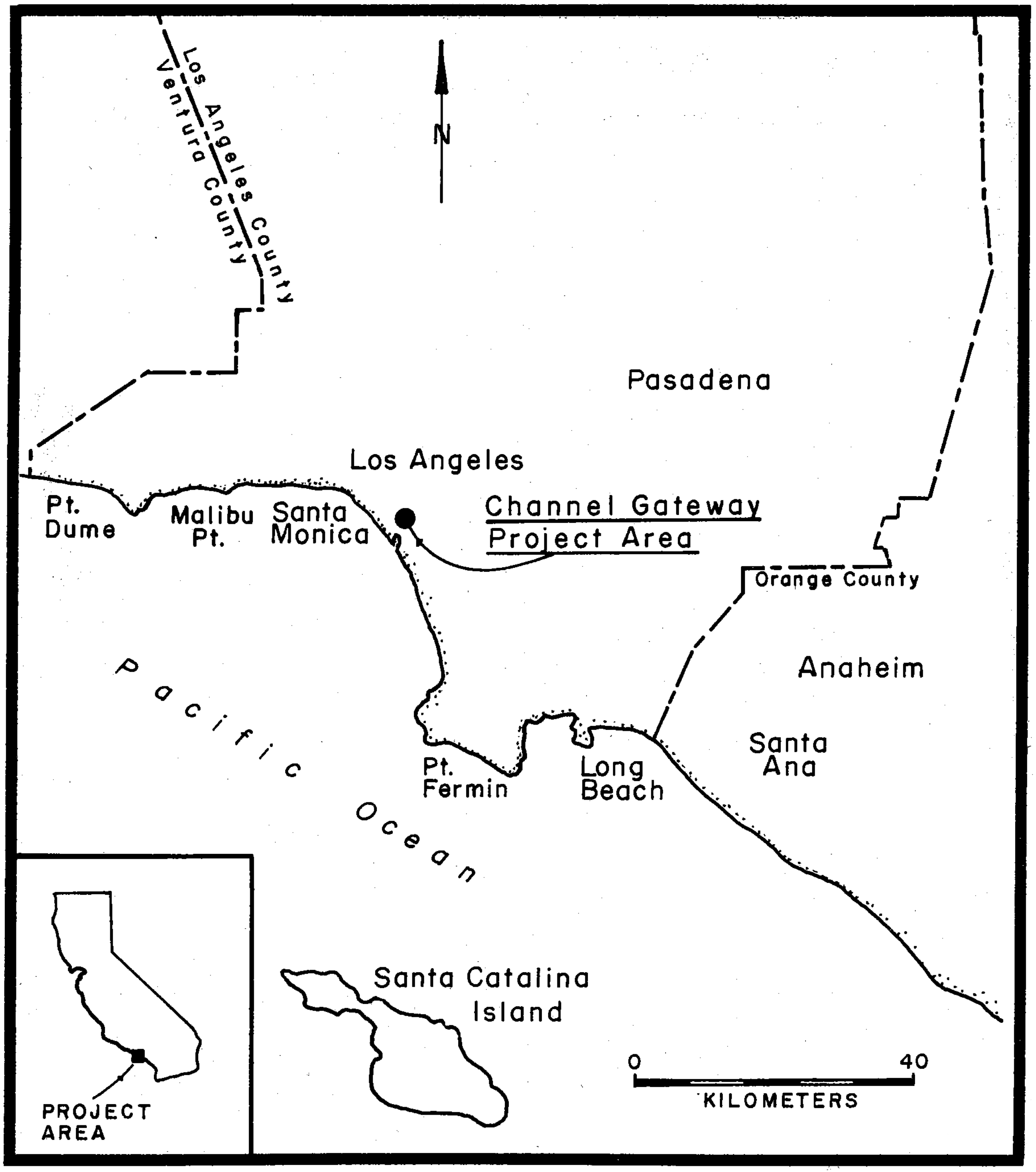


Figure 1. The location of Marina del Rey in relation to the greater Los Angeles metropolitan area.

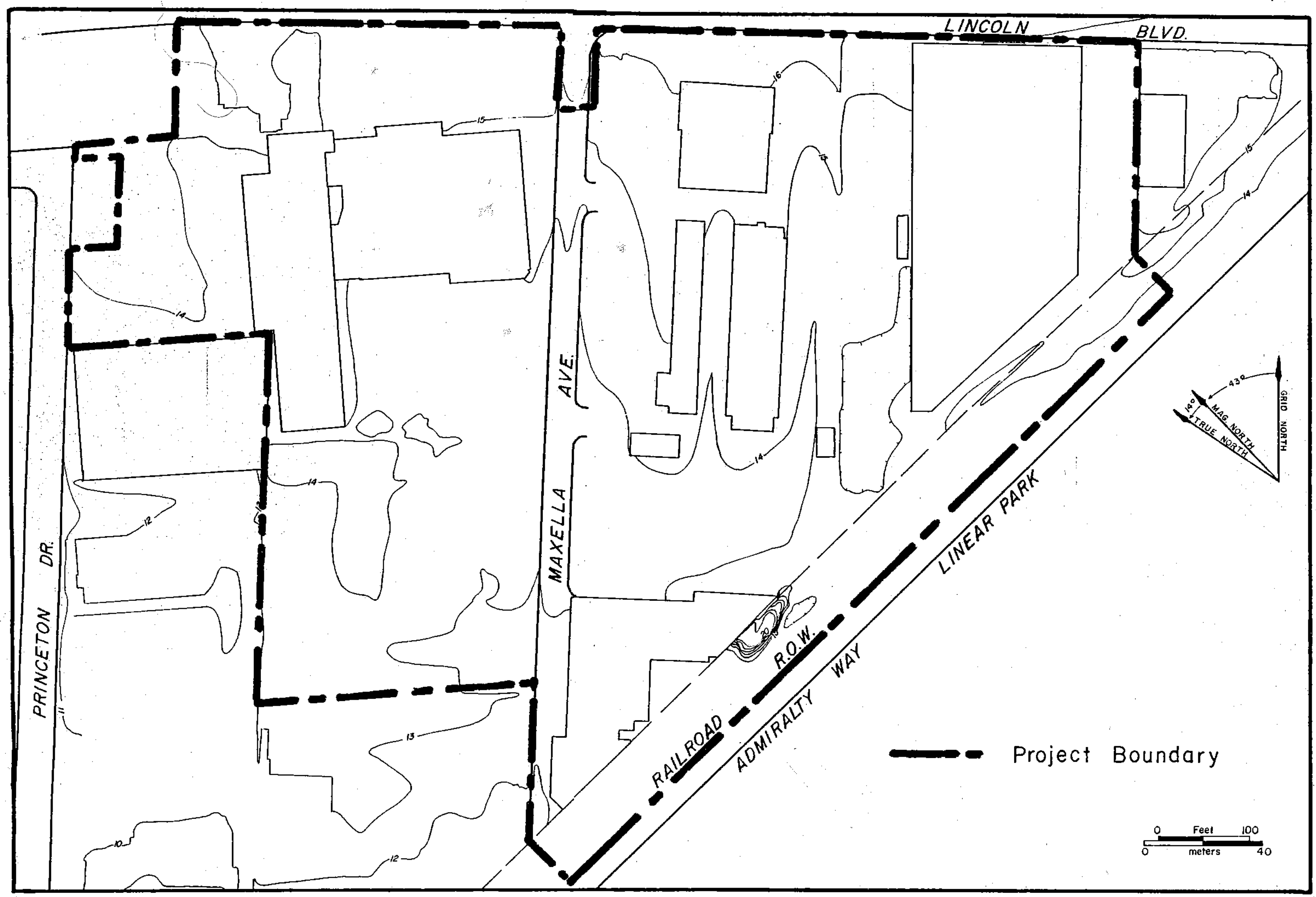


Figure 2. The Channel Gateway parcel.

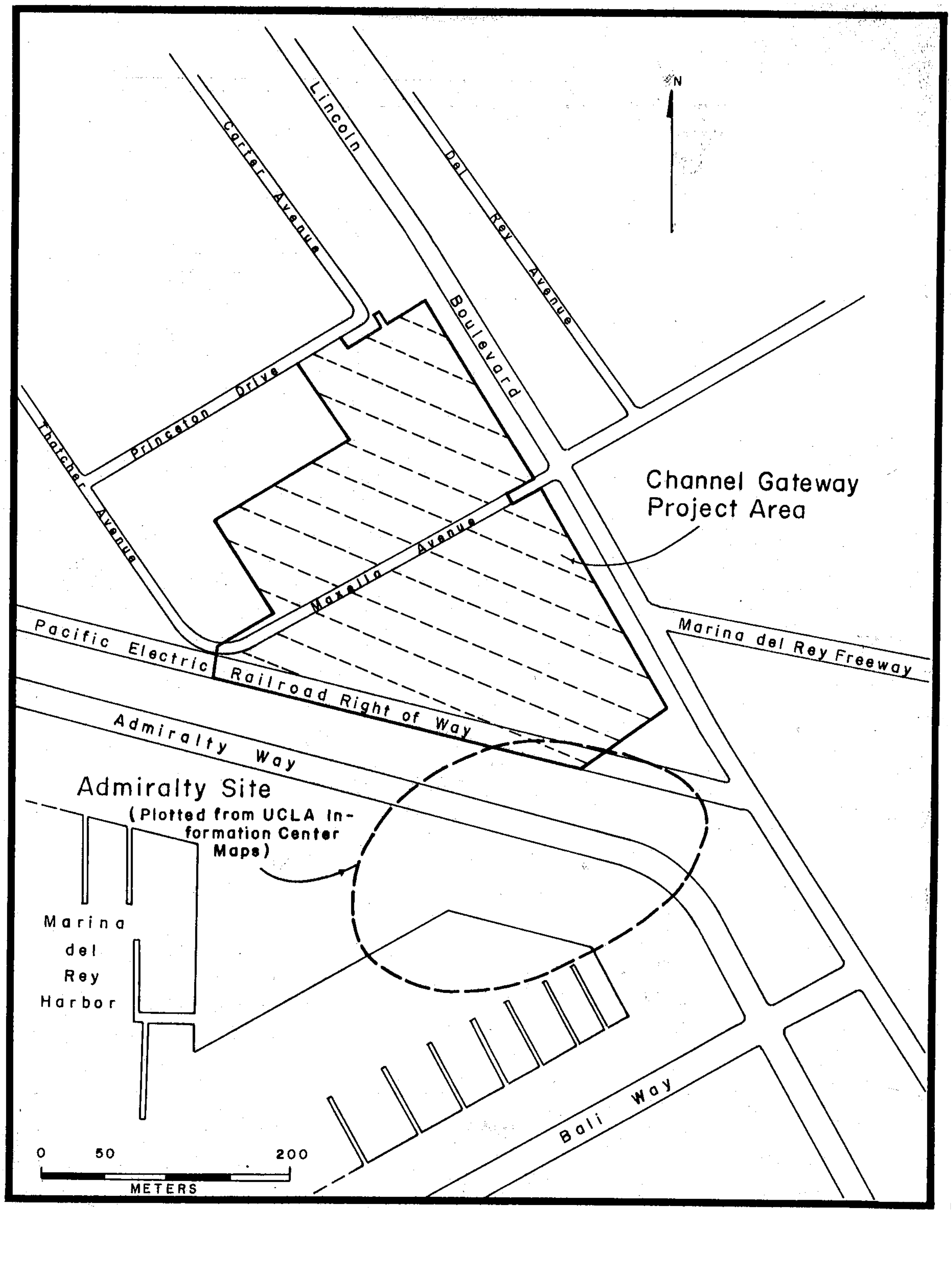


Figure 3. The location of the Admiralty site (CA-LAn-47) according to the Eastern Information Center, UCLA.

largely on volunteer labor and forced to excavate while the marina or buildings were being constructed around them, the excavators labored under tremendous constraints. Even so, the workers carefully documented burials, deposits, and artifacts that conclusively demonstrated the integrity and importance of the site. In 1965 and again in 1969, portions of the site were re-visited as archaeologists scrambled to recover information as buildings and utilities lines were put in.

The site lay dormant until the late 1980s when development of the 16-acre parcel was proposed. A pedestrian survey of the area led Stickel (1988:9) to conclude that the potential for uncovering significant cultural resources on the property was high. Archaeological test excavations performed by Dillon et al. (1988) suggested that the Admiralty site did extend on to the property, but that it covered only the extreme southeastern tip of the 16-acre parcel.

Concerns were raised over the conduct of the work and the conclusions reached by Dillon and his colleagues. The major points of contention revolved around Native American involvement, the issue of human remains, and the northern extent of the site. Dillon's work was monitored by James Velasquez, an individual certified by the Bureau of Indian Affairs as having biological ties to the Gabrielino Indians. Members of the Southern California Gabrielino Indian Band disputed Velasquez's claim of Gabrielino heritage, contending instead that they should have been the ones to monitor the archaeological excavations. Tied to the first point is the issue of human remains. The Southern California Gabrielino Indian Band was particularly upset that the remains recovered in the testing operation were not reburied. Their inability to gain access to the bones curated at UCLA from these and earlier excavations led to suspicion that the archaeologists had not been forthright in their report presentation. Although no evidence exists to support this contention, it certainly contributed to frayed relations. Finally, there was the issue of site size. Stickel (1988) argued that the site extended north of Maxella Avenue into Bruffy's Tow Impound Yard (also referred to as the Los Angeles Police Impound Yard), based on observing shell and one prehistoric artifact on the surface. To test this hypothesis Dillon et al. (1988) excavated 9 backhoe trenches and two 2-m by 2-m test pits in the impound yard. No prehistoric artifacts were recovered in the excavations, although one human tooth was found within a highly mixed stratum of historic fill. The results strongly suggested to Dillon that the artifact and shell observed by Stickel on the surface and the tooth and shell found in the test pits were brought in with historic fill. Although there was no evidence of intact cultural deposits in the impound yard, the equivocal context of the findings, particularly the human tooth, troubled members of the Southern California Gabrielino Indian Band.

To resolve these disputes the interested parties held a series of meetings under the auspices of Los Angeles city councilwoman, Ruth Gallanter. Negotiations between the J. H. Snyder Company and the Gabrielino lasted years, and a resolution that satisfied the tribe's fundamental concerns was not signed until after the archaeology was completed. The J. H. Snyder company agreed, however, to meet one of the tribe's fundamental concerns immediately: an archaeologist approved by the Southern California Gabrielino Indians Band would be retained to test the entire 16-acre parcel.

The Southern California Gabrielino Indian Band submitted the names of four archaeologists, one of which was the senior author's. In March 1989, Statistical Research was selected to conduct the test excavations and subsequently to mitigate adverse impacts to the Admiralty site that would be caused by the proposed construction.

PROJECT GOALS

Our testing and data recovery programs had specific objectives. These are discussed in detail in Chapter 6. Beyond site-specific objectives, the project had three basic overarching goals. Previous work at the Admiralty Site suggested that the occupation of the site was restricted to the Late

Prehistoric period (A.D. 1000-1769). Moreover, based on the site map in the UCLA files it appeared that only a very small portion of the site, about 2 percent, lay on the property proposed for development. A key to the project's success would be the framing of suitable research questions. Because topics requiring data from all areas of the site could not be addressed, we concentrated on more general issues of settlement and subsistence. In particular, we took as our focus of interest the estuarine and marsh environments of the Ballona Lagoon and set about answering the question "how was this physiographic zone utilized during the late prehistoric and protohistoric periods?"

In addressing questions of settlement and subsistence, we were particularly mindful of larger regional issues. As a Late Prehistoric period occupation, the Admiralty site offerred the potential for answering questions concerning the cultural evolution of the Gabrielino. Little is known about the origin of the Gabrielino. Currently it is believed that the tribe derived out of desert cultures which pushed west to the coast. Some archaeologists believe that the so-called "Shoshonean wedge" initially reached the coast through the Los Angeles Basin, with splinter groups then moving further south. The Ballona has been posited by some as one of the coastal points reached by the early desert groups. How these groups adapted to coastal resources, and how these shifts changed the overall culture of these groups is an interesting question: one that data from the Admiralty site could possibly address.

Tied to the issue of cultural adaptation are aspects of the settlement pattern. Previously excavated sites in the Ballona have all been interpreted as temporary camps. Given the size and complexity of the Admiralty site, we initially hypothesized that it was occupied year-round. This hypothesis, consistent with accounts of Gabrielino culture, needed to be tested. Questions concerning how desert groups not only shifted their subsistence practices, but also their residency patterns appeared within reach from our work at the Admiralty site.

Previous attention on the project focused almost exclusively on the prehistoric occupation. Yet, the Channel Gateway parcel hosted a series of historic period agricultural, commerical, and industrial enterprises since at least the middle of the nineteenth century. These resources were to be impacted as well by the proposed construction. Our second stated goal was to identify historic resources through a combination of archival research and archaeological test excavations, frame suitable research questions, and conduct a comprehensive historic archaeological analysis.

Our third goal concerned the interaction between archaeologists and Native Americans. Given the contentious history of the project, it was clear that an atmosphere of mistrust existed among members of the Southern California Gabrielino Indian Band and many archaeologists, museums, and academic institutions. The Gabrielino were upset about their inability either to gain access to collections from the Admiralty site housed at UCLA or to control the excavation and disposition of the material remains of their heritage. For their part, archaeologists were concerned that Native Americans would assert as their right the power to control scientific excavations, including the decisions such as the placement of test units and the size of screen mesh.

As a third goal we undertook to establish a working relationship between the Southern California Gabrielino Indian Band and ourselves. In the short run we wanted to develop a process through which we controlled archaeological decisions. The Gabrielinos were informed of these decisions, and were encouraged to offer suggestions. They also maintained control over the disposition of the recovered artifacts and other project related material. Ultimately, the issue comes down to a matter of trust. No matter how much thought or time is spent developing a framework, unless the parties feel comfortable with each other, the project is doomed to failure.

Although our concern to establish a working relationship with the Indians was narrowly focused on this project, we also hoped that the project could serve as a forum for improved relations between the tribe and archaeologists in general. Much of the problem that existed between archaeologists and the Gabrielinos appeared to stem from a lack of knowledge on the part of the Indians about the goals and methods of archaeology. As a first step in rectifying this situation, we invited the Southern California Gabrielino Indian Band to use the project as a mechanism to train as many members as possible. In all, seven members of the band received training in archaeological field methods. In addition, all members of the band had an open invitation to visit the site.

PROJECT RESULTS

The Admiralty site intrudes into the southern portion of the Channel Gateway project. The 1989 excavations were limited to the northern fringe of the site. In this area, we excavated 77 m^2, about 0.12 percent of the entire Admiralty site.

Although only a small fraction of the site was investigated, the information return was exceedingly high. The site was found to have been occupied for a relatively short time between approximately A.D. 1050 and 1150. By the time the Admiralty site was occupied, the Ballona wetlands were in the final stages of sedimentation, with a estuarine lagoon environment prevailing. Whereas today the area is flat, at the time of occupation, the site was situated on small rise. Streamflow analysis of the Santa Ana drainage system showed that the location protected the inhabitants from the vagaries of Ballona Creek, at the same time providing easy access to the lagoon's edge.

The inhabitants of the Admiralty site subsisted on plants and animals of the marsh, particularly shellfish, waterfowl, fish, small mammals, and various seeds and berries. Surprisingly, little evidence of pelagic exploitation was found. Another surprise was the lack of evidence for permanent occupation. Although it is possible that a more comprehensive examination of the entire site may alter this conclusion, at present it appears that the Admiralty site represents a series of temporary camps that were established along the lagoon at various times throughout the year when resources were available.

To assist the gathering of plants and animals, the inhabitants of the Admiralty site utilized a variety of tools. Four chipped stone technologies were identified at the site, ranging from finely controlled bifacial and microlith industries to the manufacture of expedient flake tools. The variation in technology was mirrored in the range of lithic raw materials used. Fine grained materials, such as chert and chalcedony, were found side-by-side with coarser-grained, locally available basalt and quartzite river cobbles. In addition to stone tools, a variety of shell and bone tools were found. Many of these represent broken tips, presumably from either fishing or sewing tools. Others, however, do not appear economic in nature. A wide variety of shell beads were recovered. No evidence of shell bead manufacture was found, however, indicating that the beads were brought or traded into the Admiralty site.

One of the dangers of investing so much effort into one site is that there is a tendency to lose perspective. To place our work at the Admiralty site into a regional context, we examined the records of other sites in the Ballona area. The result of our work is a settlement model for the last 7,000 years that couples shifts in environmental conditions associated with the sedimentation of the Ballona Lagoon with culture change. The model posits that the original settlement of the Ballona occurred on the bluff tops that form the southern boundary of the area. Through time the inhabitants adapted to environmental changes as the wetlands shifted from an open to a sheltered lagoon. Throughout this period, use of the Ballona was temporary, with small groups revisiting the same camp locations on the bluff tops. The material culture of these groups ties them closely with contemporaneous desert cultures and not with neighboring coastal groups.

By A.D. 1000, continued sedimentation provided locations near the edge of the lagoon where settlements could be established. Shifts in subsistence appear more quantitative than qualitative, with changes in the proportion of various resources reflecting changes in the wetland environment. It is unclear whether occupation of the Ballona after A.D. 1000 was permanent or remained temporary. Unlike virtually all other major lagoons in the area, evidence of permanent villages in the Ballona is lacking. Why the Ballona residents eschewed pelagic resources and chose to exploit other coastal resources on a temporary basis is not known. Documenting the Ballona settlement and subsistence pattern is important for it provides insight into the variability of late prehistoric coastal occupation.

There is about a 600-year gap between the abandonment of the Admiralty site and the arrival of the Spanish. It was not possible with the data obtained from this project to determine the path of Gabrielino cultural evolution during this time period. How Gabrielino culture evolved from a desert oriented to a coastal adapted society remains an important, although elusive, research question.

Beyond prehistory, we uncovered an array of information, both archival and archaeological, about the early history of the Channel Gateway parcel. We were able to trace the historical development of the area from Spanish ranchos through American diaries and Japanese-American truck farms into the industrial era. Contemporary project boundaries do not necessarily correspond with historic properties, and the Channel Gateway project was no exception. Unlike studying a single property that may have changed hands over time, but still retained its integrity as a building, factory, or ranch, the historic properties at Channel Gateway are related solely by proximity. Tying informant and archival information with a diverse set of archaeological features was a challenging task.

The degree of success we reached in addressing our research goals will be judged by the arguments and data presented in this report. Although we are satisfied with our effort, we take greater satisfaction in the achievement of an even more basic goal. The Channel Gateway Archaeological Project was completed. At the time we started, such a statement seemed at best a distant, and unlikely, prospect. Its achievement is a testament to a variety of groups whose interests differ widely. In one of those all to common stories, the goals and aspirations of developers, Native Americans, politicians, and archaeologists had conspired to create a situation in which no party would back down and the path forward seem to lead nowhere.

What was clear, however, was that it was in the best interest of all parties to find a solution. Everyone compromised, and in the end we found a way to go forward. We have done our best to conduct a sound and comprehensive scientific program. Our shortcomings should not reflect on the effort of others who got us here.

REPORT ORGANIZATION

This report is organized in six parts. Part 1 (Chapters 2 through 5) provides background information on environmental conditions, prehistoric and historic cultural developments, and previous archaeological research in the Ballona.

Part 2 (Chapter 6) outlines our research design. Research questions are presented and data needed to address these questions are outlined.

Part 3 presents the field and analytic results. Chapter 7 outlines the evolution of our field strategy from testing through data recovery and into monitoring. Laboratory procedures are detailed as well as the approach used for curation of the collection and its final disposition. Chapter 8 presents the field results. Stratigraphic and chronometric issues are discussed, and all features are described.

Part 4 consists of the analyses and interpretations of the prehistoric materials from the Admiralty site. Chapters 9 through 16 present the objectives, methods, and results of the various analytical studies undertaken as part of the project. In Chapter 17, we integrate the results from the Admiralty site with other prehistoric data from the Ballona region. A settlement model is developed and tied to changes in the local environment.

The historic occupation of the Channel Gateway property is the subject of Part 5 (Chapter 18). The first part of the chapter describes the historic material culture and vertebrate faunal remains recovered during the excavation. The second part places the results of the archival research and the analysis of historic remains in a broader historic context.

Part 6 (Chapter 19) contains the project conclusions. The goals of the project are reassessed in light of its accomplishments, and directions for future research are presented.

CHAPTER 2
ENVIRONMENTAL BACKGROUND

The Channel Gateway project area is located immediately north of the Ballona Lagoon, a low-lying wetland area situated between the Ballona Escarpment to the south, Santa Monica Bay to the west, and the Santa Monica Mountains to the north (Figure 4). Estuarine environments such as the Ballona Lagoon are among the most complex and productive ecological systems (Barnes 1977; Day et al. 1989; Kennish 1986; Knox 1986). Topography within the project area slopes downward very gently toward the south, and elevation ranges between 3.7 m and 5.0 m (12.2 ft and 16.5 ft) above mean sea level (AMSL). The Gabrielino referred to the Ballona Wetlands as *pwinukipar*, which means "full of water" (Caughman and Ginsberg 1987:296). Before much of the area was developed in the 1900s, the wetlands encompassed about 1,700 acres of brackish and freshwater marsh, lagoons, and ephemeral ponds. When the first Spanish settlers grazed cattle in the wetlands, they found the areas along the creeks covered with trees and thickets (Dillon et al. 1988:8). The abundance of water and associated plants and animals made the Ballona one of the most attractive areas in the Los Angeles Basin for settlement during late prehistoric and ethnohistoric times, attracting both Gabrielino Indians and Hispanic ranchers. In an article published by the *Los Angeles Daily Star* (April 9, 1891), the La Ballona region was described as a coastal retreat where "surf, and still-water swimming, baths, sailing, boating, fishing, and hunting . . . cannot be surpassed by any other in southern California" (cited in Friesen et al 1981:M3).

The Ballona Wetlands served as the lower drainage basin for Ballona and Centinella creeks, and at various times in the past, for the Los Angeles River. In the early 1900s much of the wetlands was converted to agricultural lands, which in turn were overtaken by urban development. By 1928, the few remaining freshwater bodies had been drained, leaving a reservoir known as Lake Los Angeles and the Ballona Lagoon as remnants of the once expansive wetlands. When Ballona Creek was channelized in the 1930s by the WPA for flood control, tidal flow into the remaining wetlands was greatly reduced, and the composition of plants and animals was significantly altered.

Further modifications occurred in the early 1960s when Marina del Rey Harbor was constructed in what was known as the Playa del Rey inlet. This marina, one of the largest man-made harbors in the world, encompasses 375 acres of land and 405 acres of water. Historic development has further confined the wetlands to only a few hundred acres immediately east of the community of Playa del Rey. Despite the various modifications in the Ballona Wetlands, the remaining wetlands still serve as a refugium for migratory birds and other animals.

To provide background on the environmental setting of the area surrounding the Admiralty site, the geology, soils, flora, and fauna of the area are described in this chapter. The discussion of biotic resources highlights plants and animals that probably existed in the Ballona prior to historic alterations.

GEOLOGY

Southern California, as well as the entire west coast of North America, is extremely active geologically. Small-scale geologic processes such as earthquakes and volcanic events, and broad-scale tectonic events that have caused uplift and subsidence of large land masses, have shaped California's landscape. These processes, combined with alluvial and aeolian deposition and erosion, and sea level fluctuations reflecting glacial advance and retreat, are responsible for the modern appearance of the coastline. Approximately 150 million years ago, during the Jurassic Period, the California coast was

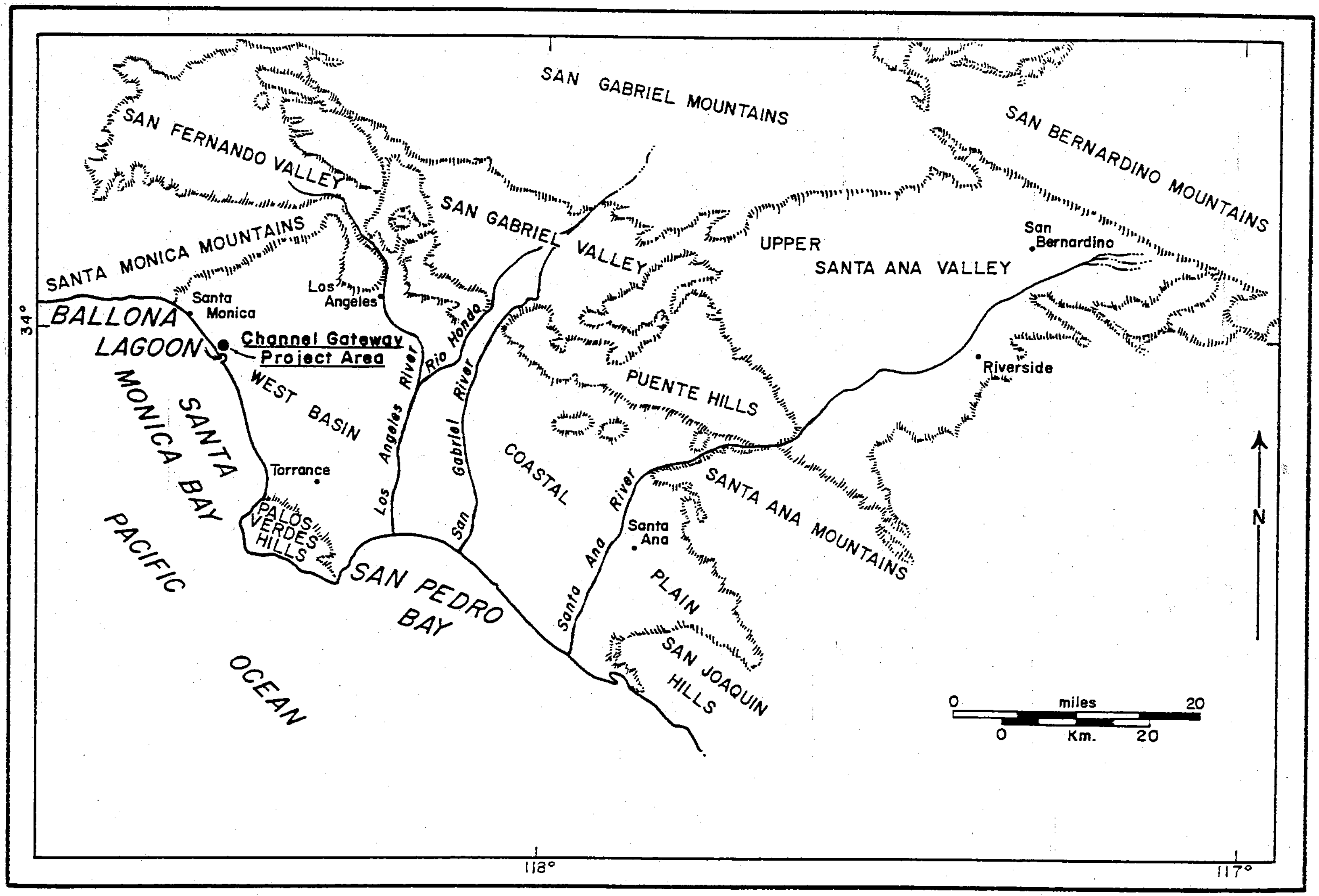


Figure 4. Physiographic map of Los Angeles Basin and surrounding mountains.

situated eastward in the area now occupied by the Sierra Nevada (Caughman and Ginsberg 1981), and the current coastline location is where the Pacific Coast Geosyncline was positioned (Dunbar and Waage 1969). As the North American Plate shifted to the west, it overrode the Pacific Plate. Afterward, the California coast was extended westward over 100 miles and the Coast Ranges were created from sedimentary rock scraped from the Pacific Plate as it slid underneath the western boundary of the North American continent. The San Andreas fault zone marks the boundary between the Pacific and North American plates. The present configuration of the coast was essentially reached by about 6000 to 7000 B.P., a time corresponding to a rapid decline in sea level rise (see Bickel 1978:6; Orme 1990:46).

The Channel Gateway project area lies within the West Basin of the Los Angeles Coastal Plain (see Figure 4). This basin occurs within the Peninsular Ranges Province, a large geomorphic province extending from the Los Angeles Basin southward to Baja California. The Peninsular Province consists of northwest-southeast trending mountains composed mainly of Mesozoic igneous and metamorphic rocks and Cenozoic sedimentary rocks. Younger material in the Peninsular Province are primarily marine and terrestrial sedimentary rocks ranging in age from the Cretaceous Period (80 mya) to the Pleistocene epoch (less than 2 mya) of the Quaternary Period (Sharp 1972).

The project area is situated on the Ballona Creek floodplain, just over 1 km northwest of Ballona Creek and about 1 km south of the Ocean Park Plain (Figure 5). Beverly Hills and the La Brea Plain are located to the northeast of the project area, and the Downey Plain, Baldwin Hills, Rosecrans Hills, and Torrance Plain are located to the east and southeast. The Ballona Escarpment (also referred to as the Del Rey Bluffs), a steep bluff rising between 36 m and 43 m (ca. 120 to 140 ft) above the floodplain, is a prominent landform located approximately 2 km northwest of the project area (see Figure 5). Grant and Sheppard (1939:321) argued that the Ballona Escarpment was formed by erosion when an ancestral, westward-flowing Los Angeles River channel abutted the San Pedro Formation exposed in the lower section of the El Segundo Sand Hills. In contrast, Poland et al. (1959:74) attributed the formation of the Ballona Escarpment to a possible faultline forming where a relict channel of Centinela Creek occurs. The El Segundo Sand Hills that overlook the Ballona Wetlands are capped by a Holocene sand dune field that runs about 20 km along the coast, ranging between 5 km and 10 km in width (Page 1950).

Ballona Creek occupies a remnant channel of the Los Angeles River within the Ballona Gap. Tributaries of Ballona Creek drain the north slopes of the Baldwin Hills, the south slopes of the Santa Monica Mountains east of Sepulveda Boulevard, and a large region east and northeast of Beverly Hills. The Ballona Creek drainage basin encompasses a 120-square-mile area. Despite intermittent periods of heavy flow, Ballona Creek was rarely able to flush out sediment in the gap. Consequently, a protected lagoon was created as sand was deposited along the beach by ocean currents (Dillon et al. 1988:6). Ultimately, this sand deposit resulted in the formation of a barrier feature (or spit) that has since been reworked by the wind to form sand dunes. A complex estuarine environment containing an intricate network of tidal outlets, tidal and mud flats, slightly elevated sandy islands, and freshwater marshes was present under pristine conditions that existed in the Ballona Wetlands in 1861 (Figure 6).

Prior to 1825, the Los Angeles River flowed westward for an undetermined period of time across the Downey Plain and through the Ballona Gap before emptying into the Ballona Wetlands. During a large flood in 1825, the Los Angeles River shifted to a southerly route towards San Pedro Bay via Dominguez Gap (Poland et al. 1959:21). Floods in 1862 and 1884 temporarily returned the Los Angeles River to its western course, but since 1884 it has discharged southward into San Pedro Bay, a route that has been maintained artificially by concrete flood control levees constructed in the 1930s.

An important characteristic of Ballona Creek and the Los Angeles River is their unreliability as water sources. Both are seasonal, intermittent drainages that flow heavily only during flash floods

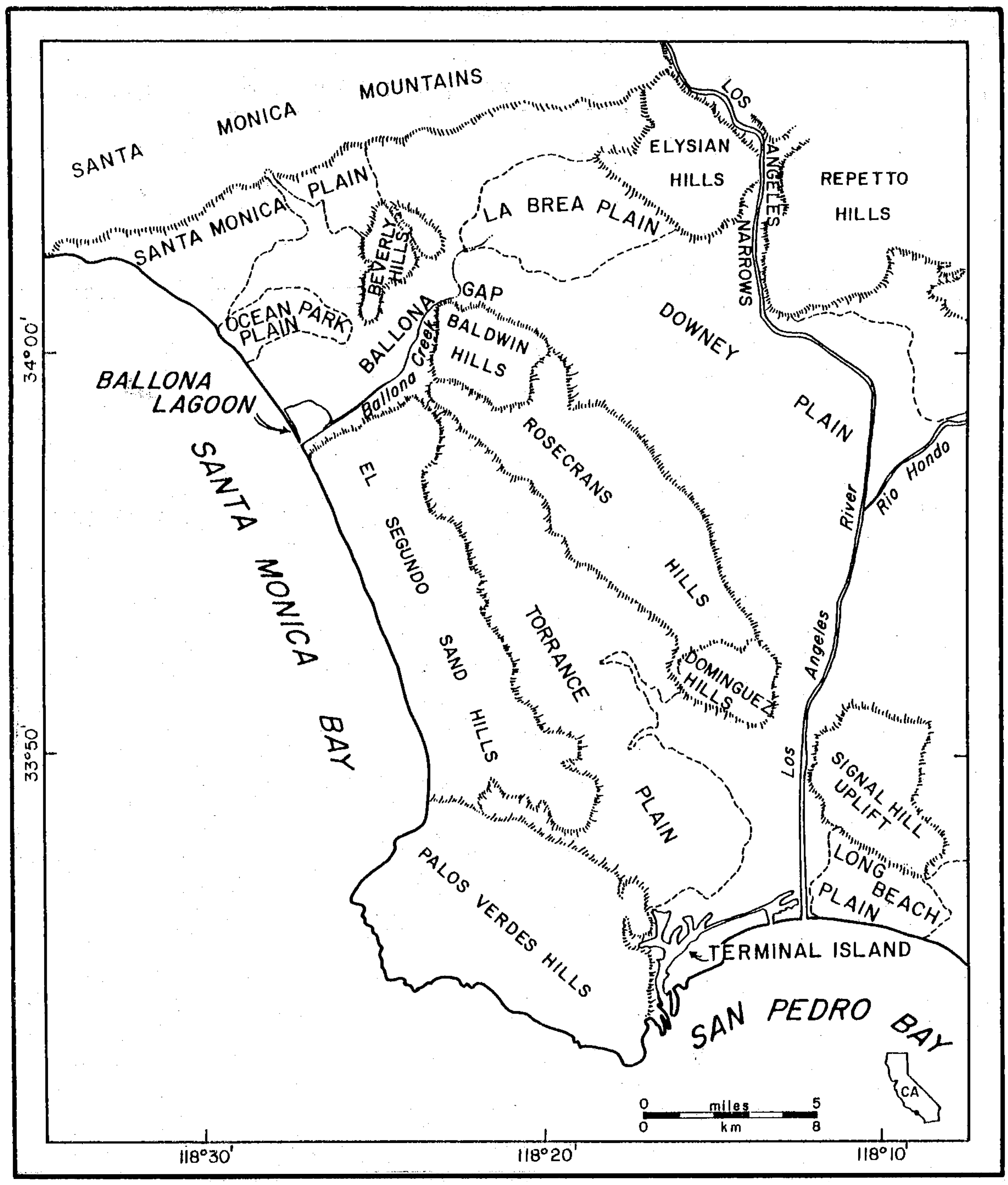


Figure 5. Map of landforms near the Channel Gateway Project area.

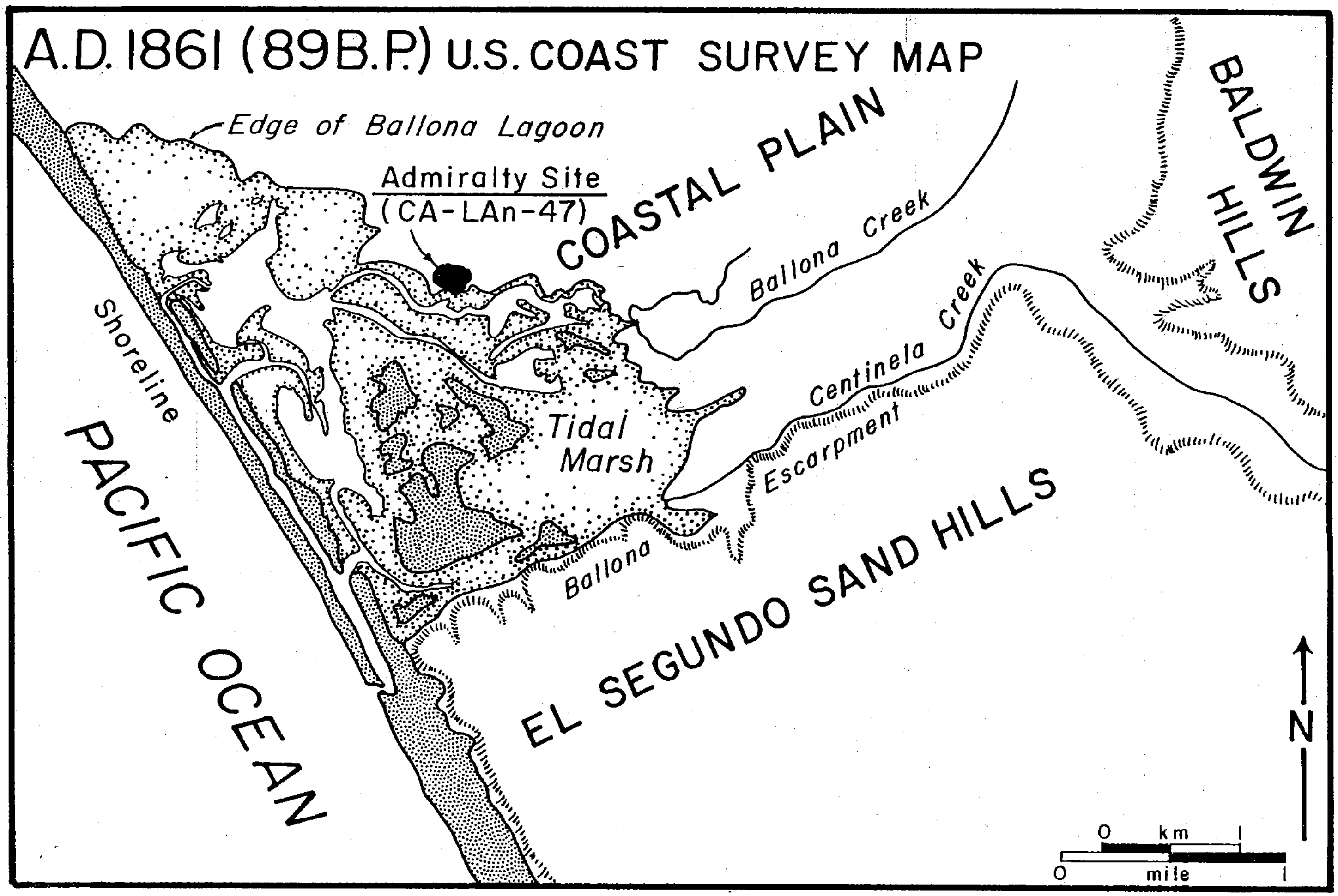


Figure 6. U.S. Coast survey map of Ballona Lagoon in 1861 (adapted from Chase 1861).

accompanying winter storms. Between 1811 and 1891, 13 major floods were recorded on the Los Angeles and San Gabriel rivers (Poland et al. 1959:21). The destruction caused by flooding is illustrated in the following description of the 1884 flood (Reagan 1915:42):

> The first flood that amounted to much, and in Mr. Reeve's estimation, the largest he has ever seen, was that of 1884. In those days the Los Angeles river practically had no banks below Seventy St. and very low ones above that point. . . . The people did not realize how much the water would rise and, therefore, built their houses all over the flats, then when the water did come it did great damage and caused much suffering. A few lives were lost. . . . The floods poured westward along the then Washington Road and Jefferson Street, towards the southeast in Ballona Creek and into the Ballona Bay. All through the soutwest [sic], clear to the sea, was a solid sheet of water. All of the country called Cienega was a great Slough . . . and all of the country back of Venice was a sea of water.

The greatest discharge recorded for the Los Angeles River was in March of 1938 when it reached 1897 cms (67,000 cfs) at 1.7 km upstream of the Main Street Bridge (Troxell et al. 1942:12, 246). Because the area between the Ballona Escarpment and the Santa Monica Mountains is crossed by a number of fault lines, the flow of underground water is often interrupted along its course, thereby forcing water to the surface (Poland et al. 1959:12). Prolonged periods of little or no discharge are common for both Ballona Creek and the Los Angeles River. Dramatic variations in flow have had an important bearing on human settlement patterns in the Ballona Wetlands (see discussions in Chapters 16 and 17).

Centinela Creek, located about 2 km southeast of the project area, is a small but reliable potable water source that drains the southern part of the Baldwin Hills. It flows to the northwest into the Ballona Gap before turning southwestward along the base of the Ballona Escarpment. The lower reach of Centinela Creek roughly parallels Ballona Creek before draining into the freshwater marsh of the Ballona Wetlands. Centinela Creek is a spring-fed drainage that attracted both prehistoric and historic settlers to the area (Kyle 1990:160), and undoubtedly it was important to occupants of the Admiralty site. Kew (1923:157) reported:

> Before the city of Inglewood obtained its water supply from wells at the Centinela Spring, a stream carrying one hundred and twenty-five inches of water issued from this spring, and flowed down Centinela Creek, forming these channels, which are now nearly obliterated. During wet weather it was even possible to row a boat up to the spring from Playa del Rey.

The *aguaje* (or spring) for Centinela Creek was located where Inglewood's Centinela Park is now located. The channel of Centinella Creek has been altered historically so that it now flows within a drainage ditch along the south side of Teale Road, a location that is about 50 m to 200 m north of its former course.

Sediment underlying the Ballona Creek floodplain consists of about 33 m (ca. 100 ft) of Holocene alluvium. The upper 9 m to 18 m (30 ft to 60 ft) are comprised of highly stratified alluvial and lagoonal silt and clay with subordinate quantities of silty sand and interbedded layers of peat. The lower 9 m to 15 m (30 ft to 50 ft) consist of alluvial sand and gravel that Poland et al. (1959) described as the "50-foot gravel" (LeRoy Crandall and Associates 1988:2.4-2.5). Although the regional stratigraphy has been reviewed by Lander (1990) and Poland et al. (1959), high resolution geomorphic interpretations of the Holocene fluvial and estuarine history of the Ballona Wetlands have thus far not been offered. Additional stratigraphic, paleontologic, and chronometric data are needed to address this concern.

In the San Joaquin Marsh at New Port Bay, a similar setting to the Ballona, Davis (n.d.) reconstructed Holocene paleoenvironmental change by analyzing pollen, spores, and charcoal. Sedimentation rates were found to relate closely to rising sea levels during the early Holocene. Davis found that between ca. 7000 and 4500 B.P. the freshwater marsh contained more trees than today, and that regional vegetation was dominated by grasslands. A salt marsh became established as sea level gradually rose and sea waters inundated the San Joaquin Marsh. Davis attributes brief episodes when the freshwater marsh re-established itself around 3800, 2800, 2300, and 560 B.P. to periods of global cooling. The Ballona Wetlands may have experienced similar environmental shifts to those in the San Joaquin Marsh, however, because each coastal marsh has a unique history, such an interpretation requires rigorous testing.

SOILS

Although modern soil survey data is not available for the project area due to extensive urbanization and absence of existing agricultural land in the area, a soil map of Los Angeles was produced by Nelson in 1919. This map depicts soils in the Channel Gateway Project Area as Dublin clay (Figure 7), a type of soil formed in recent alluvium derived from upland sedimentary rock. Nelson (1919:29) describes the Dublin clay as a soil with a dark gray to black surface horizon containing a high organic matter content and a gray to grayish brown or brown subsoil. Dublin soils are normally well drained, but most of the project area consists of poorly drained wetland soils due to its position in a low, flat area where water saturated the soil during the winter months.

Taxonomically, the soils within the Channel Gateway project area are Mollic Haplaquepts. Despite historic modifications, soils within and near the Channel Gateway Project Area have retained many of their characteristics as wetland soils. Wetland soils are defined as soils whose development and physical and chemical properties are strongly influenced by permanent or temporary saturation of the soil (Eswaran and Cook 1985; Kyuma 1985; Moormann and Van De Wetering 1985; Stoops and Eswaran 1985; Wilding and Rehage 1985). Although now artificially drained, the effects of waterlogging persist in the project area as indicated by the gleyed, mottled subsurface horizon that resulted from the reduction of iron and other compounds. This horizon formed when an aquic moisture regime was present for at least several days (see definition of aquic moisture regime in Soil Conservation Service 1975:54-55).

CLIMATE

California's coastal climate is classified as Mediterranean, characterized by two seasons, a temperate wet winter and a moderate dry summer. Only about 1 percent of the world has this type of climate, and it does not occur anywhere else in the United States (Caughman and Ginsberg 1981). Most precipitation falls between October and March, with the majority concentrated in December, January, and February. Rain virtually never falls during the summer months. The coastal climate is primarily influenced by the strong high pressure system located west of California and the presence of the ocean itself. This strong, high pressure system, known as the Pacific High, effectively blocks cool, moist breezes originating in the northern Pacific Ocean from moving onshore. The Pacific High is typically between 30° and 40° north latitude during the summer months. The Pacific High weakens and moves south as winter approaches, allowing storms to occasionally reach land. High pressure systems occasionally form inland and cause a reversal of the prevailing northwesterly winds. These winds, called the Santa Anas, are hot and dry and sometimes very strong. During the summer dry season the Santa Anas sometimes lead to the rapid spread of wild fires.

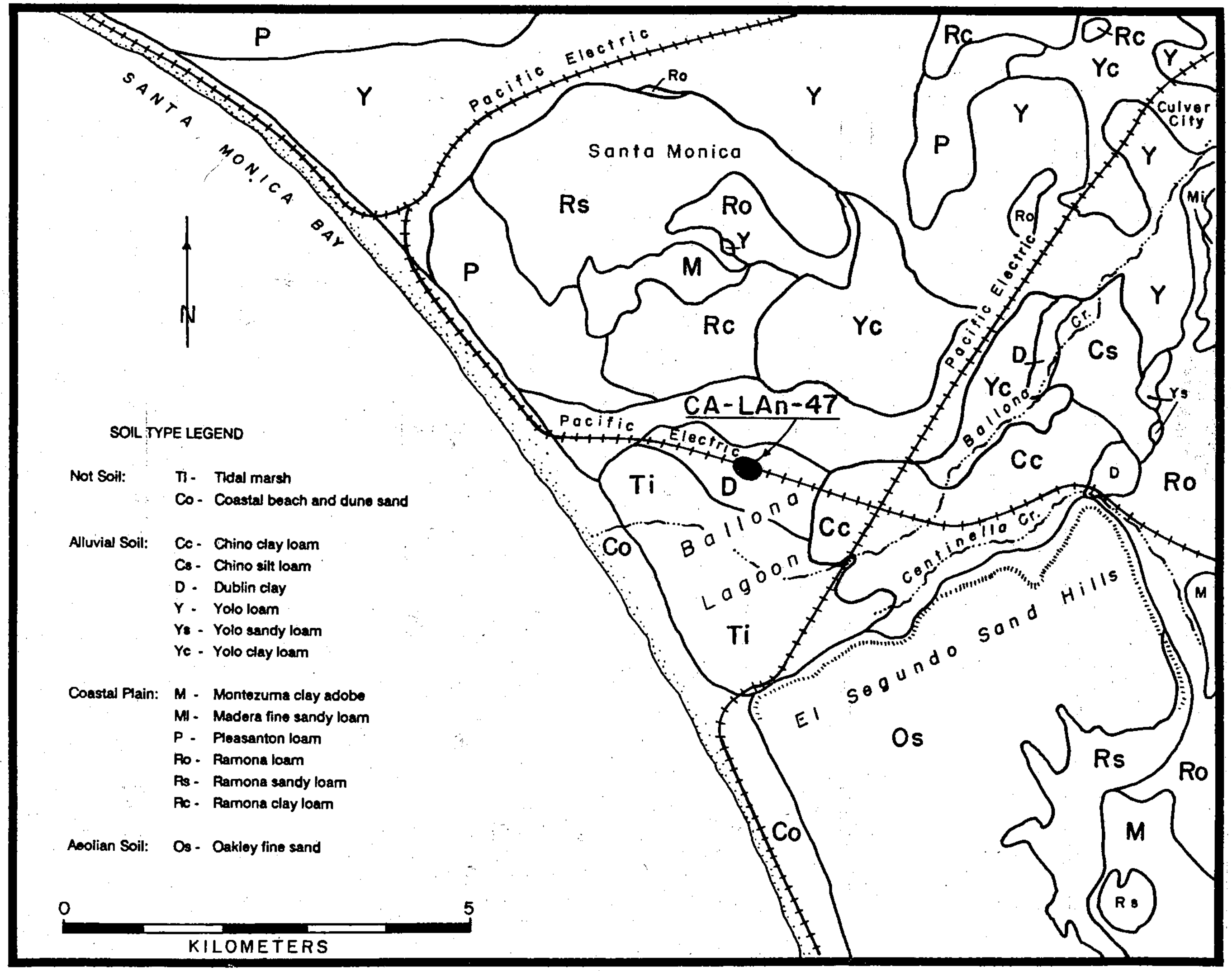


Figure 7. Soil map of area surrounding the Channel Gateway Project.

The average percentage of possible sunshine is 73 percent. There are typically 34 days of rainfall in the Los Angeles area per year (Caughman and Ginsberg 1981:31). Los Angeles International Airport (LAX), located about 4 km southeast of the project area, received an average of 11.57 in (29.4 cm) of rainfall annually (Fay et al. 1987:123) between 1951 and 1980. The greatest monthly precipitation recorded at LAX during this same time was 11.07 in (28.1 cm) in February of 1962, and the greatest daily precipitation was 6.19 in (15.7 cm) in January of 1956 (Fay et al. 1987:123). An important property of the precipitation pattern is the overall unpredictability from one year to the next. It is not uncommon for the annual average rainfall to be greatly exceeded during some years, sometimes resulting in destructive flooding. Conversely, some years have a small fraction of the average, and disastrous droughts sometimes result (see Chapter 16).

Due to the moderating effects of the Pacific Ocean, there is relatively little seasonal and daily variation in temperature along the entire California coast. Temperatures rarely exceed 100° F (37.8° C) or go below freezing in Los Angeles. Coastal areas in southern California average less than five days a year with the mean maximum temperatures above 90° F (32.2° C) and no days below 32° F (0° C) (Fay et al. 1987). The mean minimum temperature in January, the coolest month, is 40°F (4.4° C) at the northwest corner of California, whereas San Diego, at 42° F (5.6° C), is only slightly warmer despite its location at the opposite end of the state (Beck and Haase 1974). Mean annual temperature at LAX is 61.7° F (19.6° C); the record high temperature is 110° F (September 1963) and the record low is 23° F (-5° C) (January 1937). Marine air keeps the relative humidity moderately high year-round, generally about 65 percent. Fog frequently occurs in the spring and summer months, but it generally "burns off" by noon.

VEGETATION

Lush marshland communities in the Ballona Wetlands would have provided a wide variety of plant resources to aboriginal inhabitants. Farming and development related to the construction of buildings, parking lots, roads, and railroad tracks are responsible for removing virtually all native vegetation that once existed on the project area property. Vegetation observed at the time of our field work included a few scattered ornamental pine trees and herbaceous plants such as fennel. A row of eucalyptus trees was planted immediately south of the project area along the edge of the linear park paralleling the north side of Admiralty Way.

A remnant of the Ballona Wetlands, one of the few remaining marshlands in Los Angeles County, is located approximately 1 km south of the Admiralty site. Although many native species persist in this portion of the Ballona, historic land modifications have altered the composition of the vegetation, and a number of exotic species such as castorbean (*Ricinus communis*), pampas grass (*Cortaderia atacamensis*), and ice plant (*Carprobrotus edulis* and *Malephora crocea*) have invaded this environmentally sensitive area. Channelization of Ballona Creek for flood control in 1932 and construction of the Marina del Rey Harbor between 1960 and 1962 are primary factors in reducing the ecological diversity. Construction of roads, oil well pads and berms, and conversion of sections of the marsh to agricultural fields have caused further degradation. The various modifications have reduced water flow into the Ballona Wetlands, resulting in increased stagnation and reduced salinity and temperature fluctuations.

In a recent study of vegetation in the Ballona Wetlands, Gustafson (1981) identified 235 plant species from 50 taxonomic families; these include 105 indigenous and 130 introduced species. Native species and their vegetation communities are listed in Table 1. Common names of the plants were obtained from various references on plant taxonomy (see Abrams 1904; Collins 1978; and Jepson 1975). Gustafson used previous vegetation maps produced by Envicom Corporation (1979) and

Table 1. List of Indigenous Vegetation in the Ballona Wetlands (after Gustafson 1981:Bo18-26).

Scientific Name	Common Name	Habitat					
		SM	FM	CD	WF	DS	BB
Family: Alismaceae							
Sagittaria calycina	Arrowhead		X				
Family: Amaranthaceae							
Amaranthus californicus	Amaranth				X		
Family: Anacardiaceae							
Rhus integrifolia	Lemonade berry					X	
Rhus laurina	Laurel sumac					X	X
Family: Asteraceae							
Ambrosia acanthicarpa	Ragweed			X	X	X	
Ambrosia chamissonis	Ragweed			X		X	
Ambrosia psilostachya	Western ragweed			X	X	X	
Artemisia californica	California sage brush					X	
Artemisia douglasiana	California mugwort	X	X			X	
Artemisia dracunculus	Dragon sagewort				X		
Aster exilis	Slender aster		X				
Baccharis glutinosa	Water Wally		X				
Baccharis pilularis consanguinea	Coyote brush				X	X	
Chaenactis glabriuscula tenufolia	Yellow Chaenactis			X			
Corethrogyne filaginifolia virgata	Corethrogyne				X		
Gnaphalium beneolens	Everlasting				X		
Gnaphalium bicolor	Cudweed			X			
Gnaphalium californicum	California everlasing			X			
Gnaphalium microcephalum	White everlasting					X	X
Gnaphalium ramosissimum	Pink everlasting				X		X
Grindelia robusta	Gum plant				X		
Happlopappus ericoides	Mock heather				X		
Helianthus annus lenticularis	Common sunflower				X	X	
Hemizonia ramosissima	Tarweed				X	X	
Heterotheca grandiflora	Telegraph weed			X	X	X	X
Jaumea carnosa	Jaumea	X					
Malacothrix saxitilis tenuifolia	Malacothrix				X	X	X
Solidago occidentalis	Western goldenrod	X					
Stephanomeria exigua	Stephanomeria			X	X	X	
Stephanomeria vergata	Stephanomeria				X	X	X
Family: Boragninacea							
Crytantha intermidia	White forget-me-not			X			
Heliotrophium curassavicum oculatum	Heliotrope	X	X		X	X	
Family: Brassicaceae							
Erysimum suffrutescens	Hedge mustard			X			

Table 1. List of Indigenous Vegetation in the Ballona Wetlands (continued).

Scientific Name	Common Name	Habitat					
		SM	FM	CD	WF	DS	BB
Lepidium virginicum pubescens	Tall peppergrass				X		
Caryophyllaceae							
Spergularia macrotheca	Sand spurry	X					
Spergularia marina	Sand spurry	X	X		X		
Family: Chenopodiaceae							
Atriplex californica	California saltbush	X					
Atriplex lentiformis breweri	Saltbush	X					
Atriplex patula hastata	Saltbush	X					
Salicornia subterminalis	Pickleweed	X					
Salicornia virginica	Pickleweed	X				X	
Suaeda californica	Sea blite	X					
Suaeda depressa erecta	Sea blite	X					
Family: Convolvulaceae							
Calystegia macrostegia cyclostegia	Wild morning glory					X	
Cressa truxillensis vallicola	Alkali weed	X			X	X	
Cuscuta californica	Dodder			X			
Cuscuta campestris	Dodder				X		
Family: Crassulaceae							
Crassula erecta	Stone crop	X			X	X	
Family: Cucurbitaceae							
Cucurbita foetidissima	Calibazilla				X	X	
Family: Cyperaceae							
Carex praegracilis	Field sedge		X				
Cyperus eragrostis	Galingale		X				
Eleocharis macrostachya	Spike rush		X				
Eleocharis montevidensis	Spike rush		X				
Scirpus californicus	California bulrush		X				
Scirpus olneyi	Olney bulrush		X				
Scirpus robustus	Bulrush		X				
Family: Euphorbiaceae							
Croton californicus	Croton			X		X	
Euphorbia albomarginata	Rattlesnake weed					X	
Euphorbia polycarpa	Euphorbia				X		
Euphorbia serpens	Thyme-leaved spurge				X		
Family: Fabaceae							
Lotus purshianus	Spanish clover			X			
Lotus scoparius	Deerweed			X	X	X	X

Table 1. List of Indigenous Vegetation in the Ballona Wetlands (continued).

Scientific Name	Common Name	Habitat SM	FM	CD	WF	DS	BB
Lotus strigosus	Lotus				X		
Lupinus bicolor microphyllus	Lupine				X		
Lupinus chamissonis	Lupine			X			
Lupinus excubitus hallii	Lupine					X	X
Lupinus succulentus	Lupine				X		
Lupinus truncatus	Lupine				X		
Family: Frankeniaceae							
Frankenia grandiflora	Alkali-heath	X			X		
Family: Hydrophyllaceae							
Phacelia ramosissima austrolitoralis	Phacelia	X					
Family: Juncaceae							
Juncus balticus	Wire rush		X				
Juncus bufonius	Toad rush		X		X		
Family: Malvaceae							
Malacothamnus fasciculatus	Bush mallow				X		
Sida leprosa hederacea	Alkali mallow				X	X	
Family: Nyctaginacea							
Abronia umbellata	Common sand verbena			X			
Family: Olneaceae							
Fraxinus velutina	Arizona ash				X		
Family: Onagraceae							
Camissonia historta	Evening primrose			X			X
Camissonia cheiranthifolia suffrutescens	Evening primrose			X		X	
Camissonia micrantha	Evening primrose			X	X		
Oenothera hookeri grisea	Evening primrose			X		X	
Family: Podaceae							
Bromus marginatus	Brome grass				X		
Distichlis spicata	Saltgrass	X					
Festuca megulura	Fescue grass				X	X	
Leptochloa uninervia	Leptochloa		X				
Melica imperfecta	Melic grass				X		
Family: Polygonaceae							
Eriogonum fasciculatum	Wild buckwheat				X		
Eriogonum gracile	Buckwheat						X

Table 1. List of Indigenous Vegetation in the Ballona Wetlands (continued).

Scientific Name	Common Name	Habitat					
		SM	FM	CD	WF	DS	BB
Eriogonum parvifolium	Dune buckwheat			X		X	X
Polygonum lapathifolium	Common knotweed				X		
Rumex fueginus	Dock				X		
Rumex salicifolius	Willow dock	X	X		X		X
Family: Ranunculaceae							
Clematis ligusticifolia	Virgin's bower						X
Family: Rubiacea							
Galium angustifolium	Bedstraw						X
Family: Ruppiaceae							
Ruppia maritima	Ditch grass	X					
Family: Salicaceae							
Populus fremontii	Fremont cottonwood		X				
Salix laevigata	Red willow		X				
Salix lasiolepis	Arroyo willow		X				
Family: Saururaceae							
Anemopsis californica	Yerba manse				X		
Family: Saxifragaceae							
Ribes malvaceum	Chaparral currant						X
Family: Solanaceae							
Datura meteloides	Jimsonweed				X	X	X
Solanum douglasii	Nightshade				X	X	X
Family: Typhaceae							
Typha domingensis	Cattail		X				
Typha latifolia	Cattail		X				
Family: Urticaceae							
Urtica holosericea	Nettle		X				
Family: Verbenaceae							
Verbena lasiostachys	Dwarf nettle			X	X		

Key: SM = saltmarsh, FM = freshwater marsh, CD = coastal dunes, WF = weedy fields, DS = dredge spoils, BB = bluff base.

Shapiro and Associates, Inc. (1980), which defined the following modern plant habitats and communities:

A) Estuarine Habitats
   1) Pickleweed Saltmarsh
   2) Mudflats and Saltflats
B) Freshwater Habitats
   1) Willow Community
   2) Freshwater Marsh
C) Terrestrial Habitats
   1) Coastal Dune
   2) Coastal Scrub
   3) Transitional Pickleweed and Salt Pan
   4) Coyote Brush and Pampas Grass
   5) Agricultural Areas and Weedy Fields

All but the latter three communities listed above would have been present when the Ballona was in an undisturbed state. Although the boundaries between plant communities would have shifted in response to increasing sedimentation in the Ballona Wetlands, it is likely that all of the above natural communities were well established when the Admiralty site was occupied. Based on the findings of Gustafson (1981), each of the communities are now reviewed.

Estuarine Habitats

Pickleweed Saltmarsh

Pickleweed (*Salicornia* sp.), one of the most common halophytes in California salt marshes, is the dominant plant of the salt marsh. It is essentially limited to areas subject to saltwater intrusion. *Salicornia virginica* is the most abundant pickleweed species in the marsh, but some *Salicornia subterminalis* is also present. Saltgrass (*Distichlis spicata*) grows in the transitional areas around the pickleweed community, particularly in areas bordered by a sand dune community. Jaumea (*Jaumea carnosa*), an abundant composite in less disturbed California saltmarshes, occurs in scattered pockets along sloughs within the Ballona. Iceplant (*Carprobrotus edulis*) and sicklegrass (*Parapholis incurva*), both of which are introduced species, and aggressive weeds such as *Atriplex*, *Beta*, *Conyza*, *Melilotus*, *Picris*, and *Rumex* are actively invading the saltmarsh.

Because of the absence of lower marsh flora in the Ballona Wetlands, the pickleweed community, typically a high marsh community, is situated lower in the landscape than other less disturbed saltmarshes in Southern California. This characteristic is probably the result of flood control projects that have limited water flow into the marsh.

Mudflats and Saltflats

Aside from green algae in the spring and summer months, virtually no vegetation grows in the mudflats and saltflats, which are slightly lower in elevation that the pickleweed community. The salt crusts that form in the salt flats effectively limit plants from intruding. Depending on the amount of rainfall received during the preceding winter and spring months, shallow water often occurs on the mudflats and saltflats.

Willow Community

Red willow (*Salix laevigata*) and arroyo willow (*Salix lasiolepis*), and cottonwood (*Populus fremontii*) are the dominant trees along Centinela Creek, a freshwater, spring-fed drainage located at the base of the Ballona Escarpment. Other species include wire rush (*Juncus balticus*), toad rush (*Juncus bufonius*), field sedge (*Carex praegracilis*), and spike rush (*Eleocharis macrostachya* and *Eleocharis montevidensis*). An Australian shrub (*Myoporum laetum*) grows around the edge of the willow community. Dense stands of castorbean (*Ricinus communis*), which is also an introduced plant, is commonly associated with red willow (*Salix laevigata*).

Freshwater Habitats

Freshwater Marsh

A freshwater marsh occurs along the lower reach of Centinela Creek located west of Lincoln Blvd. Native hydrophilic plants include various species of bulrush (*Scirpus californicus*, *Scirpus olneyi*, and *Scirpus robustus*), spike rush (*Eleocharis macrostachya* and *Eleocharis montevidensis*), arrowhead (*Sagittaria calycina*), and cattail (*Typha domingensis* and *Typha latifolia*). Ditch grass (*Ruppia maritima*), a submerged aquatic plant, is abundant in the westernmost section of Centinela Creek where the water is somewhat brackish. Introduced weedy species of *Chenopodium*, *Paspalum*, and *Polygonum* also occur in the freshwater marsh community.

Terrestrial Habitats

Coastal Dune

Coastal dune vegetation has largely been displaced by urban development in the portion of Playa del Rey located on the sandy barrier dividing the Ballona Lagoon from the Pacific Ocean. Remnants of the coastal dune community occur in undeveloped portions of the barrier as well as on the bluffs above Centinela Creek. Dominant native plants in this community include lupine (*Lupinus chamissonis*), hedge mustard (*Erysimum suffrutescens*), evening primrose (*Camissonia cheiranthifolia suffrutescens*), phacelia (*Phacelia ramosissima austrolitoralis*), common sand verbena (*Abronia umbellata*), croton (*Croton californicus*), and dune buckwheat (*Eriogonum parvifolium*). Portions of the coastal dune community have been invaded by castor bean (*Ricinus communis*), iceplant (*Carprobrotus edulis*), brome grass (*Bromus rubens*), chrysanthemum (*Chrysanthemum coronarium*), and geranium (*Erodium botrys*).

Coastal Scrub

A coastal scrub community occurs in pockets of land along the base of the Ballona Escarpment. Typical species include mock heather (*Happlopappus ericoides*), corethrogyne (*Corethrogyne filaginifolia virgata*), bedstraw (*Galium angustifolium*), and deerweed (*Lotus scoparius*). A number of introduced weedy species such as chrysanthemum (*Chrysanthemum coronarium*), which is abundant in the late spring are also present. A successional scrub community, which is forming in the dredge spoils located just north of Ballona Creek, is dominated by lemonade berry (*Rhus integrifolia*), laurina sumac (*Rhus laurina*), California sage brush (*Artemisia californica*), and white everlasting (*Gnaphalium microcephalum*), in addition to the introduced castorbean (*Ricinus communis*).

Transitional Pickleweed and Salt Pan

This nonnative community has formed next to the dredge spoils north of Ballona Creek. Pickleweed (*Salicornia* sp.) is dominant, sometimes in combination with alkali-heath (*Frankenia grandiflora*) and various introduced halophytes. Artificial salt pans formed as a result of salts being leached out of the dredge spoils and concentrated in the adjacent depressions.

Coyote Brush and Pampas Grass

On the elevated dredge spoils dumped to the north of Ballona Creek, there is a brushy scrub community composed of coyote brush (*Baccharis pilularis consanguinea*) and pampas grass (*Cortaderia atacamensis*), the latter of which was introduced from South America. Alkali mallow (*Sida leprosa hederacea*), and various adventitious, herbaceous perennial plants such as everlasting (*Gnaphalium chilense*), wand mullein (*Verbascum virgatum*), and iceplant (*Carpobrotus edulis*) are also found in this nonnative community.

Agricultural Areas and Weedy Fields

Agricultural fields were created in the higher landscape positions of the Ballona Wetlands by constructing dikes and artificially filling depressions with redeposited sediment (see Chapter 4). Agricultural fields are visible in the southern portion of the Admiralty site as well as the surrounding area in Figure 8 (The Admiralty site is located adjacent to the white building in the upper left center of the photograph). Except for the lowest part of the Ballona Wetlands, virtually all the area is shown as being under cultivation in this 1938 oblique aerial photograph. Although nearby property in the Ballona Wetlands that was owned by Howard Hughes was still under cultivation in the 1970s, these fields have since been left fallow.

The abandoned agricultural fields are now covered by wind-pollinated species, mostly weedy plants. Adventitous species include various grasses (*Avena, Hordeum, Bromus, Festucu, Paspalum*, and other plants), mustards (*Brassica* and *Raphanus*), composites (*Chrysanthemum* and *Picris*), and numerous chenopods (*Bassia, Salsola*, and *Chenopodium*). Scattered ornamental plants such as Canary Island palm (*Phoenix canariensis*), carob (*Ceratonia siliqua*), agave (*Agave attenuata*), jade plant (*Crassula argentea*), Brazilian pepper plant (*Schinus molee*), eucalyptus (*Eucalyptus* sp.), and acacia (*Acacia decurrens*) also occur in the area. A number of cultigens such as lima beans (*Phaseolus limensis*), wheat (*Triticum vulgare*), sorghum (*Sorghum haalepense*), and watermelon (*Citrullus lanatus*) were noted at the time of Gustafson's (1981) vegetation survey.

Figure 8. Oblique aerial view of Channel Gateway Project area and surrounding region in 1938.

FAUNA

Molluscs

The Ballona continues to host a variety of mollusc species. During a recent study of molluscs in the Ballona, Ramirez (1981) used a coring device to collect living and dead specimens from seven different stations within tidal channels. He identified 13 species of Pelecypoda and 6 species of Gastropoda (Table 2), all of which are common surface dwellers (epifauna) or burrowers in southern California salt marshes (see Abbott 1968 and McLean 1978 for habitat descriptions). Ramirez found that there was little difference in shellfish composition between collecting stations. The most abundant species -- bent-nose clam (*Macoma nasuta*), California jackknife clam (*Tagelus californianus*), littleneck clam (*Protothaca staminea*), small acteocina (*Acteocina inculata*), California assiminea (*Assiminea californica*), California horn snail (*Cerithidea californica*), and salt marsh snail (*Melampus olivaceua*) -- were found in about the same proportions at all sampling locales. Of the seven abundant species, only bent-nose clam and littleneck clam are known to have served as subsistence resources for aboriginal populations.

Conditions that existed prior to modern civil engineering projects were undoubtedly favorable to many more species than the 19 species documented recently by Ramirez. The number and types of indigenous species prior to historic modifications is unknown. Moreover, the composition of mollusc populations certainly changed dramatically, though more slowly, in response to dynamic natural environmental processes during the Holocene. Most important of these processes is the formation of the coast-wise barrier feature that limited tidal flow and increased sedimentation, leading to an expansion of shallow water bodies. These conditions would have favored species that could tolerate greater temperature fluctuations, lower variations in salinity, and soft substrates.

Molluscs served as one of the most important food resources to aboriginal inhabitants along the coast. Shell also provided a raw material for the production of beads and tools such as cutting implements. No systematic studies have been undertaken to reconstruct molluscan paleoecology in the Ballona. Although shifts in shellfish availability have been suggested using archaeological data, these interpretations must be considered preliminary in the absence of independent, corroborating data. Nevertheless, an important shift in terms of available food resources is strongly supported by the apparent displacement of native Pacific oyster (*Ostrea lurida*), a species that generally inhabits open water bodies with hard substrates, by Venus species (*Chione* sp.), molluscs that thrives in shallower water (see DiGregorio 1987; also see discussion in Chapters 11 and 17). Stratigraphic data from several archaeological sites suggests that this shift occurred prior to about 1000 B.P.

Fish

The Ballona Lagoon still supports a variety of estuarine fish species. Twenty-three species were recorded by Swift and Frantz 1981), three of which are introduced species -- California killifish (*Fundulus parvipinnis*), yellowfin goby (*Acanthogobius flavimanus*), and mosquitofish (*Gambusia affinis*) (Table 3). Predatory shore birds such as herons and egrets and migratory birds were probably attracted to the lagoon by the fish community of these shallow waters.

Although topsmelt (*Atherinops affinis*), arrow goby (*Clevandia ios*), mudsucker (*Gillichthys mirabilis*), mosquitofish (*Gambusia affinis*), and diamond turbot (*Hypsopsetta guttulata*) were the only species found in abundance, Swift and Frantz (1981:F17) noted that species diversity was certainly much greater before drainage in the area was modified historically. Other factors contributing to the

Table 2. List of Molluscs in the Ballona Wetlands (after Ramirez 1981:Mo1-9).

Scientific Name	Common Name	Usual Habitat
Class: Pelecypoda (Bivalves)		
Family: Cartidae		
Laevicardium substriatum *	Egg cockle	Intertidal sand deposits
Family: Mactridae		
Tresus nuttalli	Pacific gaper	Intertidal mudflats
Family: Myidae		
Cryptomya californica	California glass mya	Intertidal mudflats
Family: Mytilidae		
Mytilus edulis *	Blue mussel	Quiet, shallow coastal waters
Family: Pectinidae		
Leptopecten latiauratus	Wide-eared scallop	Shallow water kelp beds
Family: Pholatidae		
Zirfaea pilsbryi	Rough piddock	Mud and sand deposits
Family: Tellinidae		
Macoma nasuta *	Bent-nose clam	Intertidal mudflats
Tellina carpenteri	Carpenter's clam	Intertidal sandy mudflats
Family: Solecurtidae		
Tagelus californianus	California jacknife clam	Muddy sand deposits
Tagelus subteres	Purplish jacknife clam	Intertidal sandy mudflats
Family: Veneridae		
*Chione californiensis**	California chione	Intertidal mudflats
Protothaca staminea *	Littleneck clam	Intertidal sand deposits
Saxidomus nuttallii *	Washington clam	Intertidal sandy mudflats
Class: Gastropoda		
Family: Assiminea		
Assiminea californica	California assiminea	Intertidal mudflats
Family: Bullidae		
Bulla gouldiana	California paper bubble	Intertidal mudflats
Family: Cerithiidae		
Cerithidea californica	California horn snail	Intertidal mudflats
Family: Haminoeidae		
Haminoea virescens	Green paper bubble	Rocky areas near low tide
Family: Ellobiidae		
Melampus olivaceus	Salt marsh snail	Intertidal mudflats
Family: Scaphandridae		
Acteocina inculta	Small acteocina	Intertidal mudflats

* Species of economic importance to aboriginal populations in California.

Table 3. List of Fish in the Ballona Wetlands (after Swift and Frantz 1981:F6-12).

Scientific Name	Common Name	Usual Habitat	Season			
			W	Sp.	S	F
Family: Atherinidae						
Atherinops affinis *	Topsmelt	Bays and estuaries		X	X	X
Leuresthes tenuis	Grunion	Ocean (rare in marshes)		X	X	
Atherinopsis californiensis	Jacksmelt	Ocean (rare in marshes)	X	X		
Family: Blenniidae						
Hypsoblennius gentilis	Bay blenny	Protected bays		X		
Family: Bothidae						
Paralichthys californicus	California halibut	Shallow bays and marshes			X	
Family: Clinidae						
Heterostichus rostratus	Giant kelp fish	Shallow reefs/kelp beds		X		
Family: Cottidae						
Leptocottus armatus	Staghorn sculpin	Estuaries	X	X		
Family: Cyprinodontidae						
Fundulus parvipinnis **	California killifish	Tidal flats	X	X	X	X
Family: Embiotocidae						
Embiotoca jacksoni	Black perch	Shallow reefs/kelp beds		X		
Cymatogaster aggregata	Shiner perch	Bays and marshes		X		
Family: Engraulidae						
Engraulis mordax	Northern anchovy	Large bays		X		
Family: Gobiidae **						
Acanthogobius flavimanus	Yellowfin goby	Marshes		X		
Clevandia ios *	Arrow goby	Bays and marshes	X	X		
Quietuls y-cauda	Shadow goby	Marsh		X		
Gillichthys mirabilis *	Mudsucker	Tidal flats		X		
Ilypnus gilberti	Cheekspot Goby	Marsh	X	X	X	
Family: Mugilidae						
Mugil cephalus	Stripped mullet	Bays and marshes	X	X		
Family: Poeciliidae						
Gambusia affinis **	Mosquitofish	Shallow tidal pools				X
Family: Pleuronectidae						
Hypsopsetta guttulata *	Diamond turbot	Bays and estuaries	X	X		
Pleuronichthys verticalis	Horny Head turbot	Ocean (rare marshes)		X		
Pleuronichthys ritteri	Spotted turbot	Ocean (rare marshes)		X		

Table 3. List of Fish in the Ballona Wetlands (continued).

Scientific Name	Common Name	Usual Habitat	Season W	Sp.	S	F
Family: Sciaenidae						
Seriphus politus	Queenfish	Shallow marine waters		X		
Genyonemus lineatus	White Croaker	Large bays		X		

* most common species
** introduced species

decrease in species diversity are the small marsh area and its location in an upper marsh habitat. Three species that were not found -- bay pipefish (*Syngnathus leptorhynchus*), starry flounder (*Platichthys stellatus*), and tidewater goby (*Eucyclogobius newberryi*) -- probably lived in the Ballona, but have since been eliminated. Soule and Oguri (1980) suggested that, given the size of the estuary, about 50 species probably once existed in the lagoon.

Of the 23 species documented in the Ballona, seven species -- topsmelt (*Atherinops affinis*), jacksmelt (*Atherinopsis californiensis*, California halibut (*Paralichthys californicus*), black perch (*Embiotoca jacksoni*), striped mullet (*Mugil cephalus*), diamond turbot (*Hypsopsetta guttulata*), and grunion (*Leuresthes tenuis*) -- were probably the most important as food sources. Swift and Frantz's (1981) study of the seasonal availabilty of these seven fish species, as well as species that most likely were not relied on as food sources, indicated that they were most abundant in the late winter and spring when most of them began spawning, and relatively uncommon during the fall (Swift and Frantz 1981). This finding suggests that the late winter and spring months were probably the time when fishing was most commonly practiced in the Ballona.

Amphibians and Reptiles

Amphibians and reptiles, vital components of estuarine ecosystems, were less important as food sources than most other animals because they are generally small, secretive and often difficult to capture. Ecological data on reptiles and amphibians in the Ballona Lagoon were compiled by Hayes and Guyer (1981). Their study was aimed at obtaining information on the geographic distribution, habitat preference, daily and seasonal activity patterns, growth, reproduction, population structure, food preferences, and predators.

Hayes and Guyer (1981) identified nine species -- four lizards, two snakes, a frog, a toad, and a salamander (Table 4). They noted that two reptile species not observed during their survey had previously been documented -- Pacific pond turtle (*Clemmys marmorata*) and the common garter snake (*Thamnophis sirtalis*). The creation of agricultural land and the introduction of nonnative plants and domesticated animals to the area have reduced both the species diversity and overall biomass of herpetofauna inhabiting the lagoon. Like the fishes, amphibians and reptiles are most abundant during the winter and spring; so if reptiles and amphibians were procured by human populations in the area, they were most likely obtained during those seasons.

Table 4. List of Amphibians and Reptiles in the Ballona Wetlands (after Hayes and Guyer 1981:H5-39).

Scientific Name	Common Name	Usual Habitat	Season			
			Winter	Spring	Summer	Fall
Class: Amphibia						
Order: Caudata						
Family: Plethodontidae						
Batrachoseps pacificus	Pacific slender salamander	Abandoned burrows	X	X		
Order: Salienta						
Family: Bufonidae						
Bufo boreas	Western toad	Near freshwater	X	X		
Family: Hylidae						
Hyla regilla	Pacific treefrog	Near freshwater	X	X		
Class: Reptilia						
Order: Squamata						
Suborder: Lacertilia						
Anniella pulchra	California legless lizard	Coastal dunes	X	X	X	
Family: Anguidae						
Gerrhonotus multicarinatus	Southern alligator lizard	Dense woodlands	X	X	X	
Family: Iguanidae						
Sceloporus occidentalis	Western fence lizard	Dry coastal areas	X	X	X	
Uta stansburiana	Side-blotched lizard	Sandy/rocky areas	X	X	X	X
Suborder: Serpentes						
Family: Colubridae						
Lampropeltis getulus	Common kingsnake	Above tidal flux	X	X	X	
Pituophis melanoleucus	Gopher snake	Coastal grasslands		X	X	

Birds

Because the Ballona Lagoon represents one of the few remaining wetlands in Los Angeles County, it still functions as an important refuge for birds, especially transient birds who use the area for foraging and resting. Dock and Schreiber (1981) conducted a two-and-a-half year study of birds in the Ballona to compile data on species present, seasonal abundance, and habitat preferences. In all, 129 species were identified during their investigation (Table 5), a number that is impressive, but probably significantly underestimates the numbers that utilized the lagoon during relatively pristine conditions that existed previously.

Dock and Schreiber (1981) documented dramatic seasonal variations in waterfowl and shorebird populations in the lagoon. The vast majority of species live in the lagoon during the mid-winter months (January and February), a time coinciding with peak rainfall. The lowest numbers are present in the late spring and early summer (May and June). This same seasonal pattern is well documented

Table 5. List of Birds Identified in the Ballona Wetlands (adapted from Dock and Schreiber 1981: Bi30-53).

Scientific Name	Common Name	Usual Habitat	Season W	Sp.	S	F
Order: Anseriformes						
Family: Anatidae						
Branta bernicla	Brant	Offshore	X	X		
Anser anser	Domestic goose	Venice canals	X	X	X	X
Anas platyrhynchos	Mallard	Venice canals	X			
Anas platyrhynchos	Domestic duck	Venice canals	X	X	X	X
Anas strepera	Gadwall	Quiet coastal waters	X			
Anas acuta	Pintail	Marshes	X			
Anas crecca	Green-winged teal	Freshwater marshes	X			
Anas discors	Blue-winged teal	Freshwater marshes	X			
Anas cyanoptera *	Cinnamon teal	Freshwater marshes	X			
Anas americana *	American widgeon	Protected waters	X			
Anas clypeata *	Northern shoveler	Estuaries	X			
Aythya marila	Greater scaup	Lagoons	X			
Aythya affinis *	Lesser scaup	Estuaries	X			
Bucephala albeola	Bufflehead	Lagoons	X			
Clangula hyemalis	Oldsquaw	Coastal waters	X			
Melanitta deglandi *	White-winged scoter	Bays and estuaries	X	X		
Melanitta perspicillata *	Surf scoter	Offshore	X	X		X
Mergus serrator *	Red-Breasted merganser	Coastal waterways	X	X		X
Oxyura jamaicensis *	Ruddy duck	Coastal waterways	X			
Order: Apodiformes						
Family: Apodidae						
Chaetura vauxi	Vaux's swift	Coastline		X		X
Family: Trochilidae						
Calypte anna *	Anna's hummingbird	Open woodlands	X	X	X	X
Order: Charadriiformes						
Family: Charadriedae						
Arenaria interpres *	Ruddy turnstone	Mudflats and beaches	X	X	X	
Arenaria melanocephala *	Black turnstone	Mudflats and beaches	X			
Charadrius alexandrinus	Snowy plover	Sandy beaches	X	X	X	X
Charadrius semipalmatus *	Semi-palmated plover	Mudflats	X	X		X
Chardrius vociferus *	Killdeer	Salt and freshwater	X	X	X	X
Pluvialis dominica	American golden plover	Tidal flats	X			
Pluvialis squatarola *	Black-bellied plover	Mudflats	X			
Family: Laridae						
Larus delawarensis *	Ring-billed gull	Mudflats	X	X	X	X
Larus glaucescens *	Glaucous-winged gull	Coastline	X			

Table 5. List of Birds Identified in the Ballona Wetlands (continued).

Scientific Name	Common Name	Usual Habitat	Season W	Sp.	S	F
Larus heermanni	Heerman's gull	Mudflats	X			X
Larus occidentalis *	Western gull	Coastline	X	X		X
Larus philadelphia *	Bonaparte's gull	Mudflats	X	X		X
Sterna albifrons	Least tern	Saltflats/mudflats		X	X	
Sterna caspia *	Caspian tern	Mudflats		X	X	X
Sterna elegans	Elegant tern	Mudflats	X		X	
Sterna forsteri *	Forster's tern	Bays and lagoons	X	X	X	X
Family: Phalaropodidae						
Lobipes Lobatus	Northern phalorope	Bays and lagoons			X	X
Phalaropus fulicarius	Red phalarope	Mudflats and beaches	X	X		X
Steganopus tricolor	Wilson's phalarope	Mudflats and beaches		X	X	
Family: Recurvirostridae						
Himantopus mexicanus	Black-nested stilt	Mudflats	X	X		X
Recurvirostra americana	American avocet	Mudflats		X	X	X
Family: Scolopacidae						
Aetitis macularia	Spotted sandpiper	Freshwater marsh	X	X		X
Calidris alba *	Sanderling	Mudflats and beaches	X	X		X
Calidris alpina	Dunlin	Mudflats/salt marshes	X			
Calidris bairdi	Baird's sandpiper	Freshwater marshes				X
Calidris canutus	Red knot	Mudflats/salt marshes			X	
Calidris mauri *	Western sandpiper	Mudflats/beaches	X	X	X	X
Calidris minutilla *	Least sandpiper	Mudflats/marshes	X	X		X
Capela gallinago *	Common snipe	Marshes X	X		X	
Catoptrophouous * semipalmatus	Willet	Beaches/marshes	X		X	X
Tringa flavipes	Lesser yellowlegs	Mudflats/marshes		X	X	
Limnodromus griseus	Short-billed dowitcher	Mudflats/beaches	X	X	X	X
Limnodromus scolopaceus	Long-billed dowitcher	Mudflats/beaches	X	X	X	X
Limosa fedoa *	Marbled godwit	Mudflats/beaches	X		X	X
Numenius americanus	Long-billed curlew	Mudflats/marshes	X			
Numenius phaeopus	Whimbrel	Mudflats/beaches	X	X		X
Tringa melanoleuca	Greater yellowlegs	Mudflats/marshes	X			
Family: Stercorariidae						
Stercorarius pomarinus	Pomarine jaeger	Mudflats				X
Order: Ciconiiformes						
Family: Ardeidae						
Ardea herodias *	Great blue heron	Coastal marshes	X			X
Butorides striates *	Green heron	Shallow water	X	X	X	X

Table 5. List of Birds Identified in the Ballona Wetlands (continued).

Scientific Name	Common Name	Usual Habitat	Season W	Sp.	S	F
Casmerodius albus	Great egret	Mudflats/marshes	X	X	X	X
Egretta thula *	Snowy egret	Salt/freshwater streams	X	X	X	X
Nycticorax nycticorax	Black-crowned night heron	Water courses	X			
Order: Columbiformes						
Family: Columbidae						
Columba livia	Rock dove	Open, grassy uplands	X	X	X	X
Streptopelia chinensis *	Spotted dove	Coastline	X	X	X	X
Zenaida macroura *	Mourning dove	Open woodlands	X	X	X	X
Order: Coraciiformes						
Family: Alcedinidae						
Megaceryle alcyon	Belted kingfisher	Coastal waters	X	X	X	X
Order: Falconiformes						
Family: Accipitridae						
Accipiter striatus	Sharp-shinned hawk	Woodlands	X			
Accipiter cooperi	Cooper's hawk	Woodlands	X	X		X
Buteo jamaicensis *	Red-Tailed hawk	Foothills	X	X	X	X
Circus cyaneus	Marsh hawk	Open areas	X			
Elanus leucurus	White-tailed kite	Inlands	X			
Order: Galliformes						
Family: Phasianidae						
Lophortyx californicus *	California quail	Brush/woodlands	X	X	X	X
Order: Gaviiformes						
Family: Gaviidae						
Gavia stellata	Red-throated loon	Offshore/lagoons	X			
Order: Gruiformes						
Family: Rallidae						
Rallus limicola	Virginia rail	Salt/freshwater	X			X
Fulica americana *	American coot	Freshwater marshes	X			
Order: Pelecaniformes						
Family: Pelecanidae						
Pelecanus occidentalis *	Brown pelican	Offshore			X	
Order: Podicipediformes						
Family: Cathartidae						
Cathartes aura	Turkey vulture	Mountains/foothills		X		X

Table 5. List of Birds Identified in the Ballona Wetlands (continued).

Scientific Name	Common Name	Usual Habitat	Season W	Sp.	S	F
Family: Falconidae						
Falco sparverius *	American kestral	Open areas	X	X	X	X
Family: Fregatidae						
Fregata magnificens	Magnificent frigatebird	Coastline			X	
Family: Pandionidae						
Pandion haliaetus	Osprey	Coastal waters				X
Family: Parulidae						
Dendroica coronata *	Yellow-rumped warbler	Brush/woodlands	X	X		X
Geothlypis trichas	Common yellowthroat	Wetlands with sedges	X	X	X	X
Wilsonia pusilla *	Wilson's warbler	Brushlands		X		X
Order: Passeriformes						
Family: Corvidae						
Aphelocoma coerulescens *	Scrub jay	Chapparal/woodlands	X	X	X	X
Corvax corvax	Common raven	Mountains/foothills		X	X	
Family: Fringillidae						
Carduelis psaltria	Lesser goldfinch	Open areas	X	X	X	X
Carpodacus mexicanus *	House finch	Open brush/woodlands	X	X	X	X
Chondestes grammacus	Lark sparrow	Brushlands		X		
Melospiza lincolnii	Lincoln's sparrow	Brushlands				X
Melospiza melodia	Song sparrow	Grasslands near water	X	X	X	X
Passerculus sandwichensis	Savannah sparrow	Saltwater marshes	X		X	X
Pipilo fuscus *	Brown towhee	Dry brushy uplands	X	X	X	X
Zonotrichia leucophrys *	White-crowned sparrow	Brushlands	X	X		X
Family: Hirundinidae						
Hirundo rustica	Barn swallow	Open areas	X	X	X	
Petrochelidon pyrrhonota *	Cliff swallow	Cliffs	X	X		
Riparia riparia	Bank swallow	Open areas				X
Stelgidopteryx ruficollis	Rough-winged swallow	Soft banks		X		
Tachycineta thalasina *	Violet-green swallow	Open areas	X	X		X
Family: Icteridae						
Agelaius phoeniceus *	Red-Winged blackbird	Marshes/ponds	X	X	X	X
Euphagus cyanocephalus *	Brewer's blackbird	Open areas			X	
Sturnella neglecta *	Western meadowlark	Brush/grasslands	X	X	X	X
Xanthocephalus xanthocephalus	Yellow-headed blackbird	Marshes		X		

Table 5. List of Birds Identified in the Ballona Wetlands (continued).

Scientific Name	Common Name	Usual Habitat	Season W	Sp.	S	F
Family: Laniidae						
Lanius leudovicianus *	Loggerhead shrike	Perches X	X	X	X	
Family: Motacillidae						
Anthus spinoletta *	Water pipit	Grasslands/beaches	X			
Family: Mimidae						
Mimus polyglottos *	Mockingbird	Brush/woodlands	X	X	X	X
Family: Paridae						
Psaltriparus minimus *	Common bushtit	Chapparal/sage	X			X
Family: Phalacrocoracidae						
Phalacrocorax auritus *	Double-crested cormorant	Offshore	X	X	X	X
Family: Ploceidae						
Passer domesticus	House sparrow	Dry areas	X	X	X	X
Family: Sturnidae						
Sturnus vulgaris *	starling	Open areas	X	X	X	X
Family: Sylviidae						
Polioptila caerulea *	Blue-gray gnatcatcher	Brushlands/chapparral				X
Regulus calendula *	Ruby-crowned kinglet	Riparian woodlands	X			
Family: Thraupidae						
Piranga leudoviciana *	Western tanager	Mountains		X		X
Family: Troglodytidae						
Cistothorus palustris	Long-billed marsh wren	Freshwater marshes	X		X	X
Family: Tyrannidae						
Contopus sordidulus *	Western wood pewee	Woodlands		X		X
Myiarchis cinerascens	Ash-throated flycatcher	Mountain woodlands		X	X	X
Sayornis nigricans *	Black phoebe	Brush/woodlands	X	X	X	X
Sayornis saya	Say's phoebe	Grasslands	X	X	X	X
Tyrannus vericalis	Western kingbird	Open lowlands		X		X
Order: Piciformes						
Family: Pididae						
Colaptes auratus *	Common flicker	Open woodlands	X	X	X	X

Table 5. List of Birds Identified in the Ballona Wetlands (continued).

Scientific Name	Common Name	Usual Habitat	Season W	Sp.	S	F
Order: Podicipediformes						
Family: Podicipedidae						
Podiceps nigricollis *	Eared grebe	Coastal waters	X	X		
Podiceps nigricolis *	Western grebe	Offshore	X	X		
Podilymbus podiceps	Pied-billed grebe	Salt/freshwater marshes		X	X	
Order: Strigiformes						
Family: Strigidae						
Asio flammeus	Short-eared owl	Salt/freshwater marshes	X			
Asio otus	Long-eared owl	Oak woodlands				X
Athene cunicularia	Burrowing owl	Soft banks	X	X	X	X

* most common species.

throughout coastal regions of southern California (Garret and Dunn 1981; Robbins et al. (1966). Migratory birds, especially waterfowl, abandon the Ballona as the flats begin drying up in March and April. Most species found during the summer include permanent residents that breed in the wetlands. Because homogeneous stands of pickleweed (*Salicornia* sp.) dominate the Ballona saltmarsh of the Ballona, relatively few bird species use the Ballona as a breeding ground.

Most of bird species identified by Dock and Schreiber probably also inhabited the area during prehistoric times. These animals were undoubtedly relied on most heavily during the winter when they were most abundant. Not only did birds provide a predictable food resource for humans, but they also supplied colorful plumage for various uses.

Mammals

Estuarine environments such as the Ballona require certain specialized adaptations for mammals. Although some mammals can drink salt or brackish water, most species have not evolved this capability. Mammals living in this wetland habitat are adapted to this area, which is periodically inundated with tides and floodwaters. Although some marine mammals such as sea otters (*Enhydra lutris*), northern fur seals (*Callorhinus ursinus*), California sea lions (*Zalophus californianus*), harbor seals (*Phoca vitulina*), and northern elephant seals (*Mirounga angustirostris*) are known to come ashore for brief periods, the freshwater and brackish water in the Ballona probably did not provide suitable habitat for these animals (Friesen et al. 1981: M3-4).

Nineteen terrestrial mammal species were recently documented in the Ballona, 6 of which are introduced species; an additional 20 species are known or suspected to have used the area prior to historic alterations (Friesen et al. 1981:M7). These animals include 1 marsupial, 2 insectivores, 8 bats, 3 lagomorphs, 13 rodents, 11 carnivores, and 1 artiodactyl (Table 6). Although some species resided in

Table 6. List of Mammals in the Ballona Wetlands (adapted from Friesen et al. 1981:M10-32).

Scientific Name	Common Name	Comments
Order: Artiodactyla		
Odocoileus hemionus californicus	Mule Deer	Probably occurred in the Ballona
Order: Carnivora		
Canis latrans ochropus	Coyote	Probably occurred in the Ballona
Canis familiaris	Domestic dog	Now runs free in the Ballona
Felis catus	Domestic cat	Feral cats probably common today
Felis rufus californicus	Bobcat	Probably occurred in the Ballona
Mephitis mephitis holzneri	Striped skunk	Common in El Segundo Sand Hills
Mustela frenata latirostra	Long-tailed weasel	Probably occurs in all habitats
Procyon lotor psora	Raccoon	Activity limited to wetland fringe
Spilogale gracilis phenax	Western spotted skunk	Probably occurred in the Ballona
Taxidea taxus jeffersonii	Badger	Probably occurred in the Ballona
Urocyon cinereoargenteus californicus	Gray fox	Common in salt marshes and uplands
Order: Chiroptera		
Antrozous pallidus pacificus	Pallid bat	Probably occurred in the Ballona
Eptesicus fuscus bernardinus	Big brown bat	Probably occurred in the Ballona
Eumops perotis californicus	Western mastiff bat	Probably occurred in the Ballona
Lasiurus borealis teliotus	Red bat	Southern California winter migrant
Lasiurus cinereus cinereus	Hoary bat	Southern California winter migrant
Macrotus californicus	California leaf-nosed bat	Probably occurred in the Ballona
Tadarida brasiliensis mexicana	Brazilian free-tailed bat	Sometimes found in Ballona
Order: Insectivora		
Sorex ornatus californicus	Ornate shrew	Inhabits coastal wetlands
Scapanus latimanus occultus	Broad-footed mole	Inhabits soft soil
Order: Lagomorpha		
Sylvilagus audubonii sactidiegi	Desert cottontail	Found in thick stands of Salicornia
Sylvilagus bachmani cinerescens	Brush rabbit	Most common in coastal sage scrub
Lepus californiacus bennetti	Black-tailed jack rabbit	Found in drier areas of the Ballona
Order: Marsupialia		
Didelphis virginiana virginiana	Virginia opossum	Introduced from Southeastern U.S.
Order: Rodentia		
Dipodomys agilis agilis	Agile kangaroo rat	Probably occurred in the Ballona
Microtus californicus stephensi	California vole	Endemic to S. Cal. coastal marshes
Mus musculus brevirostris	House mouse	Introduced from Spain
Neotoma fuscipes macrotis	Dusky-footed woodrat	Probably occurred in the Ballona
Ondatra ziebethicus	Muskrat	Introduced from fur farms
Onychomys torridus ramona	Southern grasshopper mouse	More common in arid regions
Perognathus californicus dispar	California pocket mouse	Frequent resident of salt marshes

Table 6. List of Mammals in the Ballona Wetlands (continued).

Scientific Name	Common Name	Comments
Perognathus longimembris pacificus	Little pocket mouse	Common in sandy soils
Peromyscus maniculatus gambelli	Deer mouse	Displaced by Mus in the Ballona
Rattus norvegicus norvegicus	Norway rat	Introduced from China
Reithrodontomys megalotis limicola	Western harvest mouse	Playa del Rey is the type locality
Spermophilus beecheyi beecheyi	California ground squirrel	Probably occurred in the Ballona
Thomomys bottae bottae	Botta's pocket gopher	Abundant in drier areas of Ballona

the wetlands, most probably traveled from the nearby uplands to seek food. Mule deer (*Odocoileus hemionus californicus*), rabbits (*Sylvilagus audubonii sactidiegi* and *Sylvilagus bachmani cinerescens*), hares (*Lepus californicus bennetti*), and squirrels (*Spermophilus beecheyi beecheyi*) were probably among the more important food species for humans.

CHAPTER 3
CULTURE HISTORY

The outlines of the prehistoric and ethnohistoric periods are the subjects of this chapter. The prehistory of the Los Angeles Basin has been reviewed a number of times (Dillon et al. 1988; Goldberg and Arnold 1988) and is not discussed in detail here. Instead, the prehistory section focuses on the culture sequence for the Ballona based primarily on recent work in the area. The ethnohistoric period is not well documented either regionally or locally. By virtue of the available data, our discussion is general in nature and broad in scope.

PREHISTORY

Figure 9 presents some of the chronological sequences that have been devised for this portion of coastal California. Unfortunately, no single sequence has won universal acceptance or "best fits" the Gabrielino cultural remains in the coastal region. Given the small number of absolute dates from the region, it is hardly surprising that there is a lingering debate about the timing of cultural events and processes. This problem is exacerbated in the Gabrielino area, where sites have traditionally been cross-dated by placing their assemblages into better defined Chumash cultural sequences. This practice is problematic, but it is the best that can be done at present. Indeed, a major goal of this project was to develop a cultural chronology for the Ballona, the results of which are presented in Chapter 17.

Of the various sequences posited for the coastal region, the one developed by Wallace (1955), because of its general nature, appears to be most useful for the present discussion. The cultural units in this sequence, or a variation of them (see also Wallace 1978), are used here.

The earliest commonly accepted dates for human occupation of the Los Angeles Basin derive from the La Brea site upstream of the Ballona. Skeletal remains from La Brea Woman have been dated to 9000 ± 80 years before present (B.P.) (Dillon et al. 1988:10), which place the find contemporaneous with the Horizon I (Wallace 1955) or "Big Game Hunting tradition" (Wallace 1978). Beyond the skeletal remains, however, few artifacts of this time have been found in Los Angeles County. A Notable exception is Level 1 at Malaga Cove, a large stratified site near Santa Monica Bay about 20 km south of the Admiralty Site (Walker 1951; Moratto 1984). This site which probably predates 6500 B.P. contained a number of flake knives, microliths, hammerstones, a folinte-point fragment, shell artifacts including spoons, scoops, beads and pendants and inlays, and bone items such as tubes and spatualte objects.

Erlandson and Colten (1991:3) point out that there are approximately 75 archaeological southern and central California coastal sites dating in excess of 7500 B.P. These sites fall into two spatial clusters. One group ranges from San Luis Obispo south to the northern and western Santa Barbara coast and includes the north coasts of Santa Rosa and San Miguel islands. The second cluster of early sites is distributed around the ancient lagoons of San Diego County. Curiously, few early sites are found in the intervening areas of Ventura, Los Angeles, or Orange counties. Whether this apparent settlement gap is the result of archaeological research or an accurate representation of settlement trends is unknown.

At present, not enough evidence exists to characterize all but the most rudimentary facets of early culture. All indications are that the economy was a mixture of hunting and gathering with perhaps a

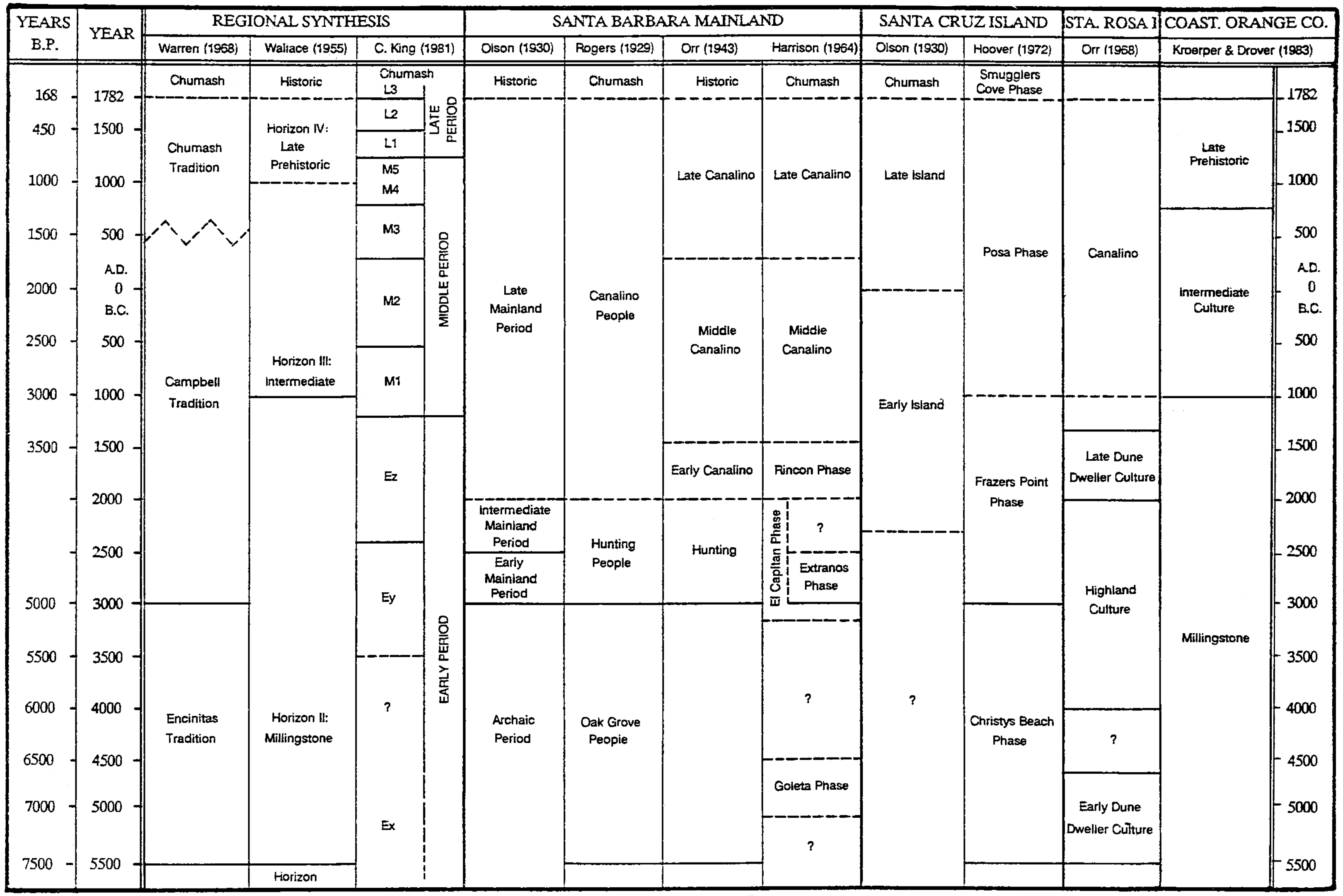


Figure 9. Concordance of southern California coastal chronologies (adapted from Moratto 1984:125, Figure 4.5).

greater overall emphasis on hunting than was true of later periods. Although traditionally researchers (e.g., Wallace 1978:28) argued that the early cultures did not use ocean resources to any great extent, recent findings have shown these conclusions to be in error (Erlandson 1988; Jones 1991). Early subsistence was much more diverse than previously thought, and in many coastal locales included a major emphasis on shellfish and other acquatic resources.

The early cultures disappear around 6000 B.C. The gradual desiccation associated with the onset of the Altithermal, a warm and dry climatic period dated roughly between 6000 and 3000 B.C., probably eliminated or greatly restricted many large game animals. Subsistence patterns shifted, and a greater emphasis was placed on plant foods and small animals.

Although there is no doubt that a correlation exists between changing climatic conditions and the appearance of what has been termed the Millingstone horizon, there is some question about cause and effect. The extent and consistency of climatic change is difficult to assess. Further, it is quite likely that the actual effects in any one area were conditioned in part by microclimatic and topographic features. Moreover, the rapid spread of new technologies has led many archaeologists to invoke some type of migration or diffusion as the major cause of culture change. Some have argued that the resulting culture -- termed variously the Encinitas tradition (Warren 1968), the Millingstone horizon (Wallace 1955), the Pinto complex (Warren and Crabtree 1979), and the Sayles complex (Kowta 1969) -- was an outgrowth of indigenous cultural development that incorporated the millingstone technology from the outside (i.e., from the east). Others have suggested actual westward migration of desert people primarily in response to environmental desiccation (e.g., Kowta 1969).

The two explanations are not mutually exclusive. There is strong evidence in areas such as Diablo Canyon and Rancho Park North of indigenous development with an overlay and then incorporation of millingstone technology (Altschul et al. 1984). Other coastal regions, such as Topanga Canyon, appear to reflect actual migration.

There is little doubt that major culture change occurred at this time. In their haste to systematize the data, archaeologists have tended to view all such change in southern California as part of the same cultural process. Yet if there is any consensus at all about this period, it is that groups became better adapted to their immediate environments, and subsistence patterns were varied. In all, the evidence suggests that rather than becoming culturally homogeneous, southern California actually supported a greater variety of cultural adaptations than ever before. Archaeologists have only made this situation more confusing by emphasizing the "Millingstone horizon" (Wallace 1955). Indeed, to understand this period we will have to concentrate on evaluating local adaptations rather than global explanations.

In the Ballona Lagoon and adjacent Del Rey Hills evidence of Millingstone horizon occupation is restricted to discoidal stones found at four sites. Lambert (1983) suggests that a discoidal found on the surface of CA-LAn-64 indicates that there is an earlier component to this predominantly late Millingstone horizon site. In contrast, Van Horn (1987:135-137) argues that the discoidal found at CA-LAn-63 and the two found in the excavation of CA-LAn-64 either represent heirlooms or that the dating of this particular artifact type is in error. Van Horn (1987:21) is, however, at a loss to explain the discoidals from the Marymount site (CA-LAn-61) and the Berger site (CA-LAn-206). These two Del Rey Hill sites were radiocarbon dated to 4710 ± 80 B.P. and 6750 ± 80 B.P., respectively. Although Van Horn (1987:266) believes that the Del Rey Hills were abandoned at the beginning of the late Millingstone horizon, there are currently not enough data to substantiate this claim.

Van Horn's studies revealed evidence, albeit scanty, suggesting that the area experienced renewed human occupation in the first millennium B.C towards the end of the Intermediate horizon (Wallace 1955). Poor stratigraphic preservation, however, made it difficult for Van Horn and his associates to reconstruct this later occupation and differentiate its materials from the Late Prehistoric horizon occupation that superseded it in the area. Occupation of the Ballona apparently peaked during this

Late Prehistoric horizon, when the entire escarpment overlooking the lagoon was lined with small temporary or seasonal encampments. According to Van Horn, this occupation apparently ended by A.D. 1000 when the area was again abandoned.

Occupations dating more or less continually from 1000 B.C. to A.D. 1000 have been reported from four bluff sites, CA-LAn-59, 61, 63, and 64 (Murray and Van Horn 1983; Van Horn and Murray 1984, 1985; Van Horn 1984, 1987). Based on the excavated data, Van Horn (1987:269-270) has proposed a projectile point sequence for the Ballona area beginning about 500 B.C. The sequence begins prior to the introduction of the bow and arrow (Van Horn's Phase I) when dart points such as the Gypsum Cave, side-notched types, and bipointed foliates were the most common styles. Points made from obsidian or fused shale were rare at this time.

Phase IIa is characterized by the introduction of the bow and arrow between A.D. 350 and 500. Canalino style arrowheads were added to the existing inventory of dart points at this time. These new points showed little indication of expert manufacture and were made from locally available Monterey chert and chalcedony. Phase IIb is distinguished by what appears to be an arrowhead manufacturing industry characterized by an improvement in the quality of arrowhead production and the use of fused shale as a common raw material.

Phase III is distinguished by the addition of the Marymount point, a small tanged type made of fused shale, to the arrowhead assemblage. Van Horn suggests that these points were traded as components of arrowheads and were often reworked when broken. One unusual aspect of the projectile point assemblage is that all the earlier point types apparently continued in use through Phase III.

Van Horn (1990:35) notes that Marymount point is extremely similar to the Rose Spring point.

> Given their apparent contemporaneity and assuming that Rose Spring points harken the introduction of the bow and arrow in the southern California desert, it seems reasonable to suppose that the appearance of Marymount points on the coast has a similar significance. This attractive scenario would have the two tanged point series as the prototype stone arrow point in their respective regions (Van Horn 1990:35).

Van Horn (1990:35) goes on to argue that the appearance of the Marymount point style can be taken as evidence of Shoshonean occupation of the coast sometime after A.D. 500. This conclusion is supported by the occurrence of a small amount of burned human bone at the Marymount site (CA-LAn-61a) -- suggestive of cremation as a mortuary practice -- and the absence of marine shell artifacts. Cremation is generally associated with the desert groups at this time and is not known to have existed among indigenous coastal groups. Van Horn attributes the absence of shell artifacts in the hill top sites as indicative of a people unaccustomed to crafting this material.

In addition to these traits, a split cobble industry is present at the sites on the Del Rey Hills. Van Horn (1987) terms the resulting flake from this technology, a "potato" flake, because it is "peeled" off the core. He claims that the Ballona split cobble industry is unlike other lithic industries found elsewhere on the coast. To date, there is not enough evidence to evaluate Van Horn's claim, although similar split cobble industries have been reported for San Nicolas Island (Clevenger 1982). Towner (this volume, Chapter 9) argues that the "diagnostic" attributes of the potato flake are simply the result of direct free-hand percussion technology used to exploit coarse grain river cobble, and probably are not diagnostic of cultural or temporal traits.

Finally, the Del Rey Hills sites share a microlith tradition completely dissimilar from the contemporary microlith tradition on the Channel Islands. The Del Rey Hills industry utilized a bipolar flaking technology as opposed to the single faceted flaking technology used on the islands. Unlike Santa Cruz island where microblades were used as drills in a specialized shell bead-making endeavor (Arnold 1987), the Ballona microliths appear to have served a variety of functions, such as gravers for cutting wood or stone among other activities (Van Horn 1987:241). The distribution of the coastal microlith tradition is unknown, although similar artifacts have been reported at Malaga Cove (Walker 1951).

Van Horn (1987:270) relates other changes in the occupation of the Del Rey Hills to changes in the environment of the Ballona Lagoon. He found oyster in the earliest levels at the Del Rey site (CA-LAn-63) and the Loyola site (CA-LAn-61b), but the species was completely absent from the later occupied Marymount (CA-LAn-61a) and CA-LAn-61c sites. Chione, which occurs in mudflat situations, dominated the shellfish remains at most of the Late Prehistoric horizon sites in the Del Rey Hills. Van Horn argues that the occurrence of oyster in the earlier levels suggests that the Ballona Lagoon was more of an open lagoon during the earliest phase of occupation and, subsequently, became a more estuarine environment that was more conducive to chione. The Hughes site (CA-LAn-59) was the last site abandoned in the hills. The shellfish remains from this site are dominated by Pismo clam, which inhabits open sandy shoreline habitats. Van Horn concludes from this association that the mudflats had largely silted in after A.D. 1000, resulting in a much more sandy shoreline than is evident today in the area.

At a more general level, Van Horn (1987:271) concludes that the inhabitants of the Del Rey Hills overlooking the Ballona Lagoon employed a generalized subsistence strategy that involved a broad mixture of local terrestrial and marine resources. Exploitation of marine shell and fish species focused on the lagoon with little evidence of exploitation of deep sea resources. That these residents had access to deep sea resources is indicated by the common occurrence in the Del Rey Hills sites of steatite cooking vessels obtained from Catalina Island. Another unusual aspect of the Del Rey Hills occupation is the virtual absence of evidence of shell artifact manufacture throughout the sequence of occupation. Stone beads and bone fishhooks, awls, beads, and pendants are common if not abundant. Only 1 percent of the beads were made of shell, however, and shell fishhooks are completely absent.

Van Horn argues that the numerous encampments along the escarpment of the Del Rey Hills were temporary or recurrent short-term occupations during various seasons. These encampments were rapidly abandoned around A.D. 1000. Van Horn (1987:272) attributes this final abandonment to an environmental shift that made the area unattractive to the local residents. About this time the lagoon upon which these residents depended underwent the final stages of siltation, an event manifested by the development of a sandy spit at the mouth of the lagoon and the deposition of wind blown sands on the escarpment.

Recent data suggest that Van Horn's conclusion that the Ballona was abandoned around A.D. 1000 is in error. Altschul and Ciolek-Torrello (1990) argue that beginning around A.D. 1000, there was a shift in settlement preference in the area from bluffs to the lagoon edge. These investigators point to a number of sites that have been recorded dating sometime in the period from about A.D. 1000 to 1769 when the Spanish explorer Portola entered the Los Angeles Basin.

Economically, the lagoon edge sites differ from those on the bluff primarily in the proportion of different types of resources used, rather than in wholesale shifts from one type of food source to another. The residents of the Del Rey Hills focused primarily on lagoon and nearshore fish, whereas residents on the lagoon edge focused on terrestrial animals, shellfish, and birds.

Culturally, there is much to link the two occupations. Projectile point styles in both settings are dominated by point styles that are believed to derive from the desert. Both collections contain a microlith industry that is rare elsewhere on the coast, and totally lacking in the desert. The presence of this industry at both bluff and lagoon sites suggests that the Ballona area may have hosted a localized cultural tradition. Whereas nonlocal resources such as shell beads and lithic raw materials indicate ties to other areas, these ties may have been rather weak. Groups in the Ballona area, then, may have been culturally isolated leading to a unique cultural expression. Alternatively, the assemblages may simply reflect an emphasis on different resources than found at most other coastal sites.

Why, after 1,500 years, would people shift their residences from the hills to the lagoon? Altschul and Ciolek-Torrello (1990) hypothesize that the settlement shift reflects a generalized adaptational response to changing local environmental conditions. The transition from open lagoon to sediment-choked estuary probably took place over a 3,000-year period. At the beginning of the occupation there were clear advantages to living on the bluffs even though most subsistence pursuits were carried out at the edge of the lagoon. As sedimentation continued to build up in the lagoon, the effects of major floods would have been blunted. At some point after A.D. 1000, the advantages of living on the edge of the marsh outweighed the risks of flooding. Although situated much closer to critical subsistence-related resources, this move placed residents in some peril during late winter and early spring. It is possible that the site was not occupied during these seasons, but this suggestion runs counter to both ethnographic practices and most cultural reconstructions (e.g., Johnston 1962).

Van Horn (1987) argues that the early prehistoric settlements on the bluffs were small temporary camps and processing sites occupied primarily in the winter and spring seasons. Most cultural reconstructions, however, argue that the late prehistoric and protohistoric settlements along this part of the coast were primary villages (Bean and Smith 1978:539) that often rivaled the large and better known coastal Chumash villages in size and wealth of material culture. One of the major goals of the present project is to determine whether the Admiralty site was occupied year-round or seasonally.

A move toward sedentism tied to the shift to the edge of the lagoon may be a response to increased concern over access to resources resulting from demographic pressure, environmental degradation, or both. If demographically inspired, late prehistoric settlements should be larger and closer to critical resources than their predecessors.

As to environmental degradation, although aboriginal adaptations traditionally have been viewed as harmonious with nature, the effects of even small populations on fragile, localized resources, such as a salt marsh, are now being recognized as anything but benign. There is no question that the delicate balance of a lagoon ecosystem can be easily upset by the over-exploitation of resources. Over-exploitation leads to a diminishing resource return and, therefore, should lead to substitution of one resource for another, or in this case abandonment of one lagoon for another. If, however, if there is no substitute resource and other lagoons are already occupied, then intensification of traditional practices might result. One means of intensification might be to move closer to the resource.

ETHNOHISTORY

European exploration of California began in 1542, with the arrival of Juan Rodriguez Cabrillo, but it was not until 1769 that the Spanish presence was felt in the Los Angeles Basin. At that time, Portola first made recorded contact with a group of Indians who later became known as the Gabrielino. Portola reported stopping at an Indian village called **Yang'na** on the Los Angeles River near present day downtown Los Angeles. Portola's route to Monterey did not cross the Ballona.

Although unknown to Portola, there is some evidence that the Ballona was occupied by indigenous groups well into the Historic period. Kroeber (1925) has a Gabrielino village called **Saan** plotted on the north side of Ballona Creek above the delta where this creek meets Santa Monica Bay. Johnston (1962) places the Gabrielino village of **Sa'angna** in a cluster of archaeological sites south of Ballona Creek. Given their location, these sites are probably the Del Rey Hill sites, which had been abandoned for nearly 1,000 years by the time of Johnston's report. Finally, it is worth noting that an early describer of Gabrielino culture, Hugo Reid, could not recall any Gabrielino village in the Ballona area (Dakin 1978:220-221), although he freely admitted he could not remember them all.

Johnson (1991) has recently reviewed the literature pertaining to the locations of ethnohistoric villages in the Los Angeles Basin. His work, conducted as part of a peer review of the Playa Vista Archaeological Project (Altschul et al. 1991), is cursory in nature. Even so, his conclustions bear repeating.

> All of the speculation regarding **Sa'angna** is apparently based on Kroeber's and Johnston's publications, which were in turn based on very late ethnographic research (probably from a single Gabrielino consultant, Jose de los Santos, who was interviewed by both Kroeber and Harrington in the early twentieth century). I have searched to no avail for **Sa'angna** in the lists of Gabrielino village names in mission registers (Merriam 1968; Munoz 1982). My suspicion is that **Sa'angna** is either (1) simply a Gabrielino placename instead of a village name or (2) is the Gabrielino name for a settlement of Indian laborers associated with one of the Spanish/Mexican ranchos in the Ballona vicinity (Johnson 1991).

Although Johnson concludes that **Sa'angna** can be eliminated as a Gabrielino village occupied at the time of Spanish contact, he argues that it does not follow that the area was devoid of early historic Gabrielino settlement. Indeed, given the environmentally rich nature of the Ballona, it would be surprising if the area had been ignored by the indigenous occupants of the region.

These occupants, who called themselves **kumi·vit**, became known as the Gabrielino. They occupied the watersheds of the Los Angeles, San Gabriel, and Santa Ana rivers, several smaller drainages in the Santa Monica and Santa Ana mountains, all of the Los Angeles Basin, the coast from Aliso Creek north to Topanga Creek, and the islands of San Clemente, San Nicolas, and Santa Catalina (Bean and Smith 1978:538). All members of the group spoke Cupan languages of the Takic family. Variations in dialect were known to exist between villages due not only to distance, but also to propinquity as groups close to each other engaged in social and cultural activities regardless of tribal status.

Permanent villages were established along the major drainages and in sheltered areas along the coast. Population for the villages ranged between 50 and 200, with the larger ones spawning nearby satellite villages. The number of mainland villages inhabited simultaneously has been various put at between 50 and 100, with additional villages being occupied on the islands (Bean and Smith 1978:540). Kroeber (1925) estimates the aboriginal population of the Los Angeles area in 1770 in excess of 5,000 people.

Villages were politically autonomous, generally consisting of nonlocalized segementary lineages. Each lineage was headed by its own chief, with the dominant lineage's leader usually acting as the village chief (Bean and Smith 1978:544). Sometimes several nearby villages would be united under one chief. Succession was usually to the chief's eldest son, although if he had none or if the person was unacceptable, a new chief was selected by the community elders from the same kin group as the previous chief. The chief's primary responsibilty was to care for the sacred bundle and insure community solidarity and welfare. In addition, he or she arbitrated disputes, collected "taxes" used to feed guests at ceremonies, led war parties, conducted peace treaties, and generally acted as a role model (Bean and Smith 1978:544). The chief was aided by several assistants who performed various functions, such as announcer, treasurer, and messenger.

Besides the chief, the most powerful positions in the village were held by the shamans. These individuals obtained their power directly from the supernatural through dreams or visions. A shaman possessed the power to cause and to cure illness. He served his own village as a curer, diviner, guardian of the sacred bundle, finder of lost items, collector of poison (used in hunting and war arrows), and rain maker. The populace was generally powerless against a shaman, although if one became to malevolent, other shamans could strip him of his powers.

Gabrielino society was divided into three classes. The chiefs and their immediate families as well as the very rich formed an elite class that was reified through use of a specialized language. A middle class was composed of the economically advantaged and those from long-established lineages. The balance of the population formed the third class.

Social structure was mirrored in village layout. Villages were composed of houses, sweathouses, menstrual huts, and a ceremonial enclosure. Houses were domed, circular structures thatched with various reeds and tules. Houses varied in size from one-family structures to those designed to shelter three to four families, totalling as many as 50 people. Sweathouses were small, semicircular, earth-covered buildings used for pleasure or as a meeting place for adult men. The ceremonial enclosure, known as a **yuva·r**, was placed close to the chief's house. It was basically an oval, open-air area enclosed by a wicker fence of willows that were decorated with various feathers, skins, and flowers.

The **yuva·r** was used primarily for activities and ceremonies associated with the Chingichngish cult (Johnston 1962; Moriarty 1969). Chingichngish is one of the Gabrielino names for the creator. According to one story, Chingichngish created the world out of chaos, fixing it on the shoulders of seven giants he had created for this purpose (Bean and Smith 1978:548). He then created all the animals and finally human beings. After completing his task, Chingichngish ascended to the afterworld. Other stories have Chingichngish mysteriously appearing, pronouncing himself chief, and then setting down tribal law and rules (Johnston 1962:42-44). In all the stories, Chingichngish leaves by ascending to heaven.

By the time the Spanish arrived, belief in Chingichngish had spread from the Gabrielino to their neighbors. The belief took on cult-like properties, with "temples" (i.e., the **yuva·r**) erected in the creator's honor. Only old men possessing great "power" could enter the sacred enclosures, where lengthy and elaborate ceremonies took place.

Gabrielino subsistence consisted of hunting, gathering, and fishing. Often small, specialized groups would leave the village and establish temporary camps in areas where resources were procured prior to returning the main village. Hunting was primarily a male activity. Small game was obtained using deadfalls with acorn triggers, communal drives (for rabbits), and burning rats and small rodent nests to lure the animals into the open (Johnston 1962:33). Large animals, most notably deer, were stalked by hunters in disguises of antlers and skins and shot with arrows. Fishing was conducted from shore or along rivers using hook and lines, nets, basketry traps, spears, bow and arrow, and vegetal poison. Sea mammals were taken with spearthrowers, clubs, and harpoons. Deep sea fishing was not a major subsistence focus, undertaken on a fortuitous basis during trips between the mainland and the islands.

Women gathered plants for both food resources and raw materials. Reeds and grasses were used to make baskets and clothes. Medicines and paints also were derived from certain plants. As with most southern California tribes, acorns formed a major component of the diet, and substantial efforts were made to acquire the nuts during the fall.

Relationships between Gabrielino villages and between the Gabrielino people and their neighbors were generally peaceful. Feuds between families were common, but warfare involving whole villages was relatively rare. Intermarriage between villages and with non-Gabrielinos was common.

Trade was an integral part of the subsistence strategy. From the Serrano and Cahuilla to the west, the Gabrielino received acorns, seeds, obsidian, and deerskins in exchange for shell beads, steatite, fish, sea otter pelts, shells, and possibly salt (Bean and Smith 1978:547). Steatite, available in vast quantities on Santa Catalina Island, was the principal trade item. Steatite was traded as finished goods and raw materials, among the Gabrielinos, and it also was exported to surrounding tribes. Finished steatite items included palettes, arrow straighteners, ornaments, and animal carvings.

Two years after Portola's expedition, an event occurred that had drastic ramifications for the indigenous groups of the Los Angeles Basin. In 1771, Mission San Gabriel was founded. The clerical leaders of San Gabriel encouraged and then forced natives from the Los Angeles area to congregate at the mission. In 1778, mass conversions of villages began, starting with the chiefs and then progressing to their followers. Changes were forced upon the natives, beginning with their name, Gabrielino.

By 1779, mission social structure crystalized, with councilmen and acalades being elected from the neophytes. The severity and rigidity of mission life led to a series of revolts, culminating in 1785 when Toypurina, a chief's daughter, spearheaded a major revolt that was supressed with disproportionate power.

Following the Indian revolts and uprisings, relationships between the Spanish and Gabrielino followed aparthied-like rules. The Gabrielino became financially tied to landed gentry or the missions. In the late 1790s poor economic conditions forced the missions and Spanish community to allow Gabrielinos to use traditional subsistence practices to help feed the general populace. The return to native ways was short-lived. By 1800, most Gabrielinos were missionized, dead, or had fled outside the Los Angeles area.

Between 1800 and 1833, the Spanish mission system expanded, as did the surrounding ranches. The Gabrielino were tied to these economic institutions as a peasant class. In 1833, the missions were secularized. With the exception that the missions were no longer an economic force, shifting instead to insititutions for the aged and infirmed, secularization had little impact on the Gabrielino.

By this time, Gabrielino culture was greatly attenuated. The Gabrielino language remained the lingua franca for discourse between Indians and Euro-Americans, but this practice was rapidly dying. In addition, some of the rituals, games, and crafts were still maintained by a small number of people. For example, the Gabrielino still used shell beads as a form of money between themselves and with other Indian tribes. Steatite stone bowls and baskets remained in relatively high demand by both Indians and Euro-Americans.

In 1852, Hugo Reid, an emigrant from Scotland who settled in Los Angeles and married a Gabrielino woman, published a series of "letters" on the Los Angeles Indians in the *Los Angeles Star*. These letters were extremely influential, resulting in a number of prominent leaders taking up the Gabrielino fight for better treatment. Unfortunately, little of substance resulted.

Between 1860 and 1900, a series of smallpox epidemics decimated the Gabrielino. By the time anthropologists, notably J. P. Harrington and Alfred Kroeber, began study, few Gabrielino remained. Throughout the twentieth century, Gabrielino culture remained in the hands of individuals and families spread throughout southern California. During the late 1970s and 1980s, interest in Gabrielino culture was revived by various individuals. A number of sociopolitical groups emerged, each of which claims ties to Gabrielino culture.

CHAPTER 4
ARCHIVAL RESEARCH

Mark T. Swanson

The historical development of the Channel Gateway project area can be divided into two broad periods. The first is the story of agrarian land use associated with La Ballona Rancho and the Machado family. The second is the gradually accelerating development associated with the growth of Los Angeles and its satellite communities associated with agro-commercial, industrial, and residential development. All of these developments will be discussed in this chapter. The following sections cover the culture history of the general area, as well as the project area itself, which has been designated historic site CA-LAn-1596-H (Altschul 1989).

The project area, also known as the area encompassed by CA-LAn-1596-H, is a 16-acre tract situated at the south end of Venice's "Oxford Triangle." The Oxford Triangle is formed by Washington Boulevard, Admiralty Way, and Lincoln Boulevard (*Argonaut* March 30, 1989). The project area, located within the southernmost extension of this triangle, is itself a smaller, irregularly shaped triangle roughly bounded by Admiralty Way to the south, Lincoln Boulevard to the northeast, and Princeton Drive to the northwest (Figure 10). Thus formed, the project area is situated in the northeast corner of Marina Del Rey, directly north of Basin "F." The project area, which is scheduled to be developed into high-density residential units by the current owner, J. H. Snyder, has been associated with a number of names. It is currently called the Channel Gateway Project (*Argonaut* March 30, 1989).

Because of the presence within the project area of a portion of a late prehistoric shell midden, CA-LAn-47, the vicinity of the project area has been investigated through a number of excavations and cultural resource evaluations over the past few years. The most important of these was conducted by Brian D. Dillon (1988), who, in addition to his work at CA-LAn-47, noted historic loci within the project area according to land use in 1988. For this reason, it is useful to be familiar with the structures and designations current at that time (all structures within the project area were demolished in 1989). These included the Associated Pacific Industries building, the Holt property, the Los Angeles Police Department Impound Yard, Avis Rent-A-Car, Bay Cities Metal Products building, and the Marina Storage building. The former locations of these facilities are presented in Figure 11.

The location of these buildings was in large part determined by prior land divisions within the project area. Beginning in the early twentieth century, the project area was subdivided into various parcels and tracts, a process that was completed by around World War II. The locations of these subdivisions are presented in Figure 12.

In addition to these facilities that were once directly on the property, the tract is surrounded by other structures to the west and south: Rapidway Disposal, Prestige Coach Craft, de Vorss and Company building to the west; and Carver Yachts to the southeast (Figure 13). The tracks of the old Pacific Electric Railroad, which used to lie on the southern boundary of the project area immediately north of and parallel to Admiralty Way, were removed around 1980 (Edward Perry, personal communication 1990, see Appendix A for a list of sources contacted during the archival research). The remains of prehistoric site CA-LAn-47 have been found in the old railroad right-of-way.

The historic research presented in this report is designed to address a number of research concerns posed at the beginning of this project. The first is the need to establish a tighter chronology for land use within the project area. The second is to establish a detailed history of land ownership.

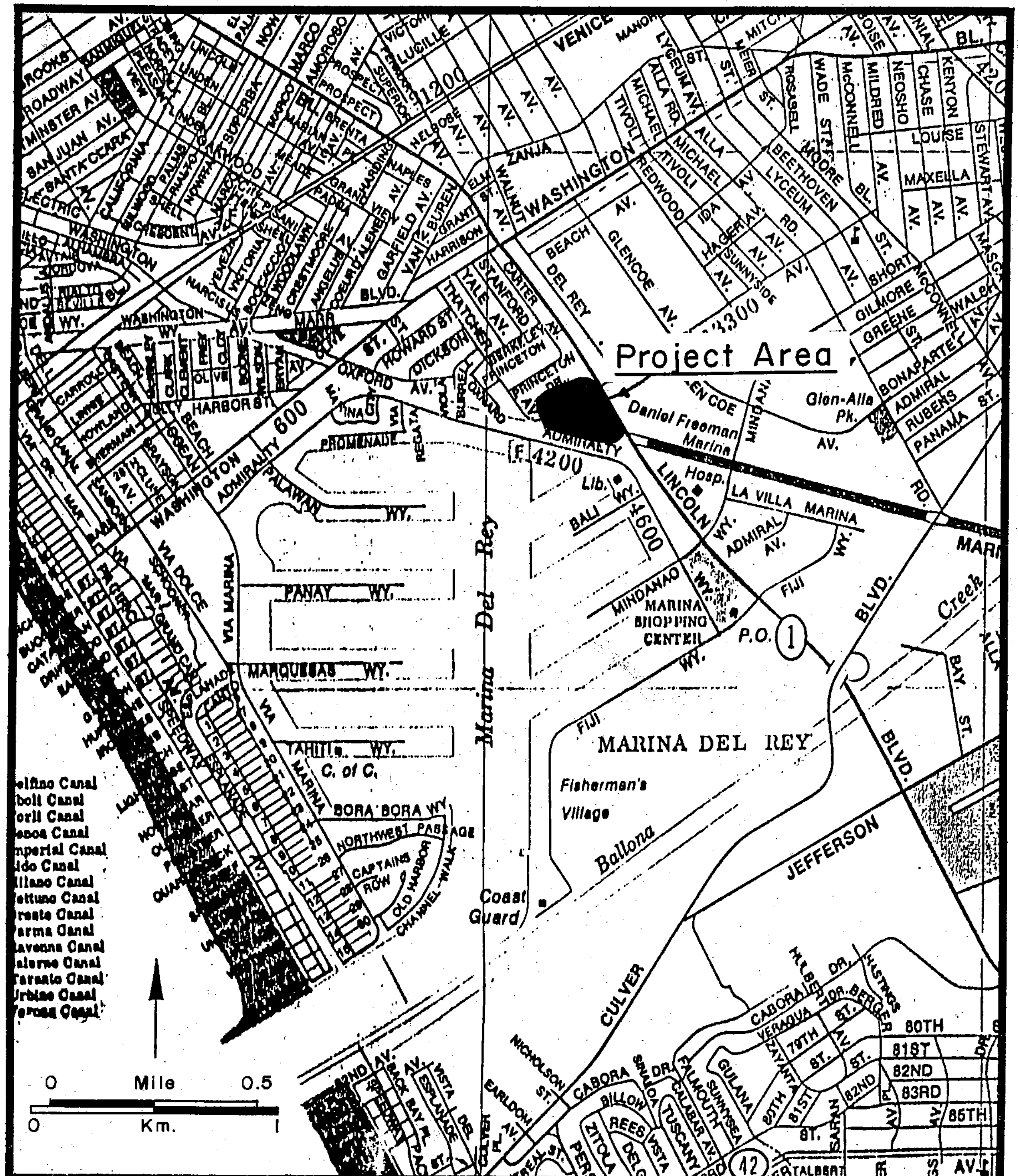


Figure 10. The project area.

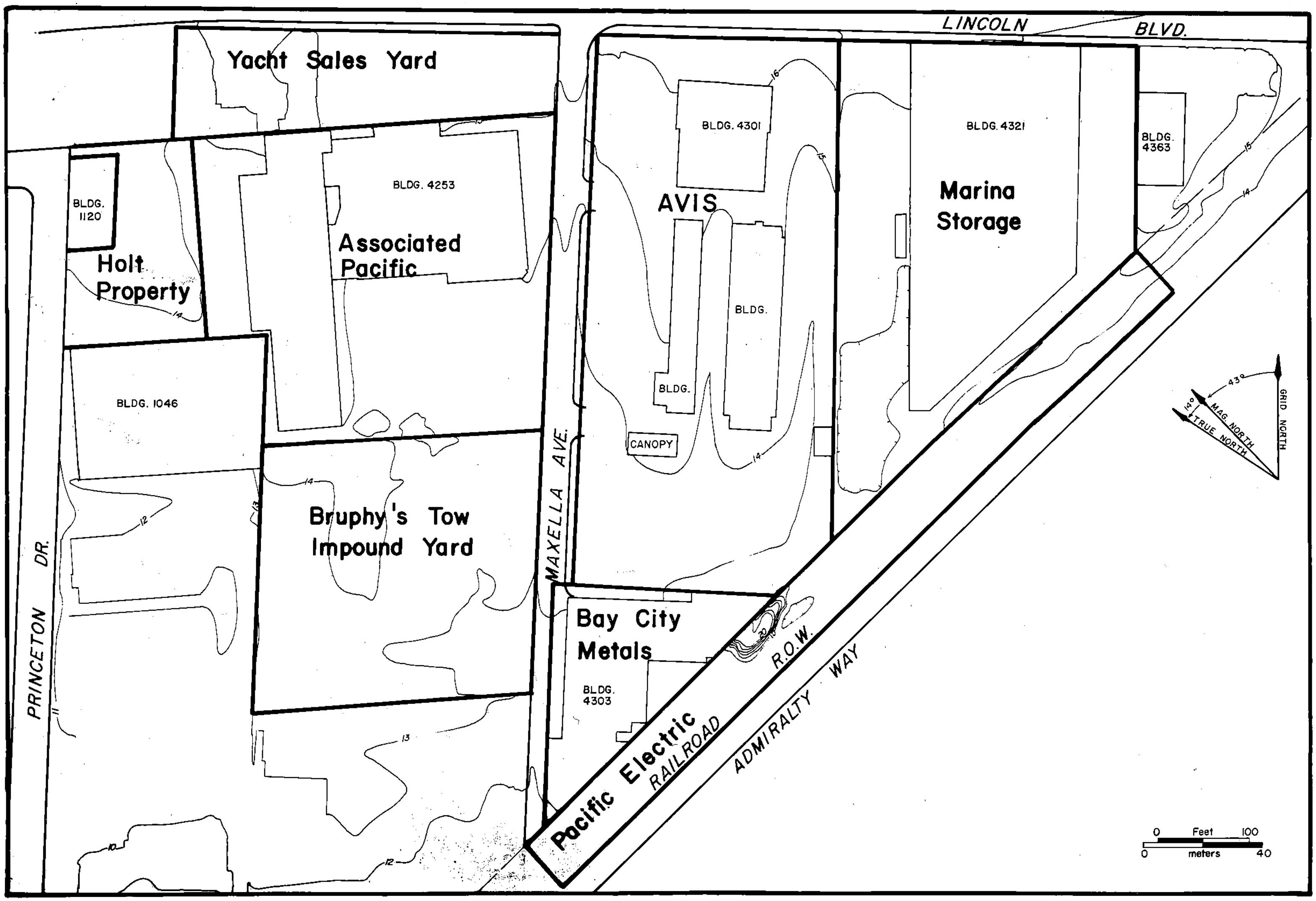


Figure 11. Use of the parcel lots in 1988 (after Dillon 1988:4).

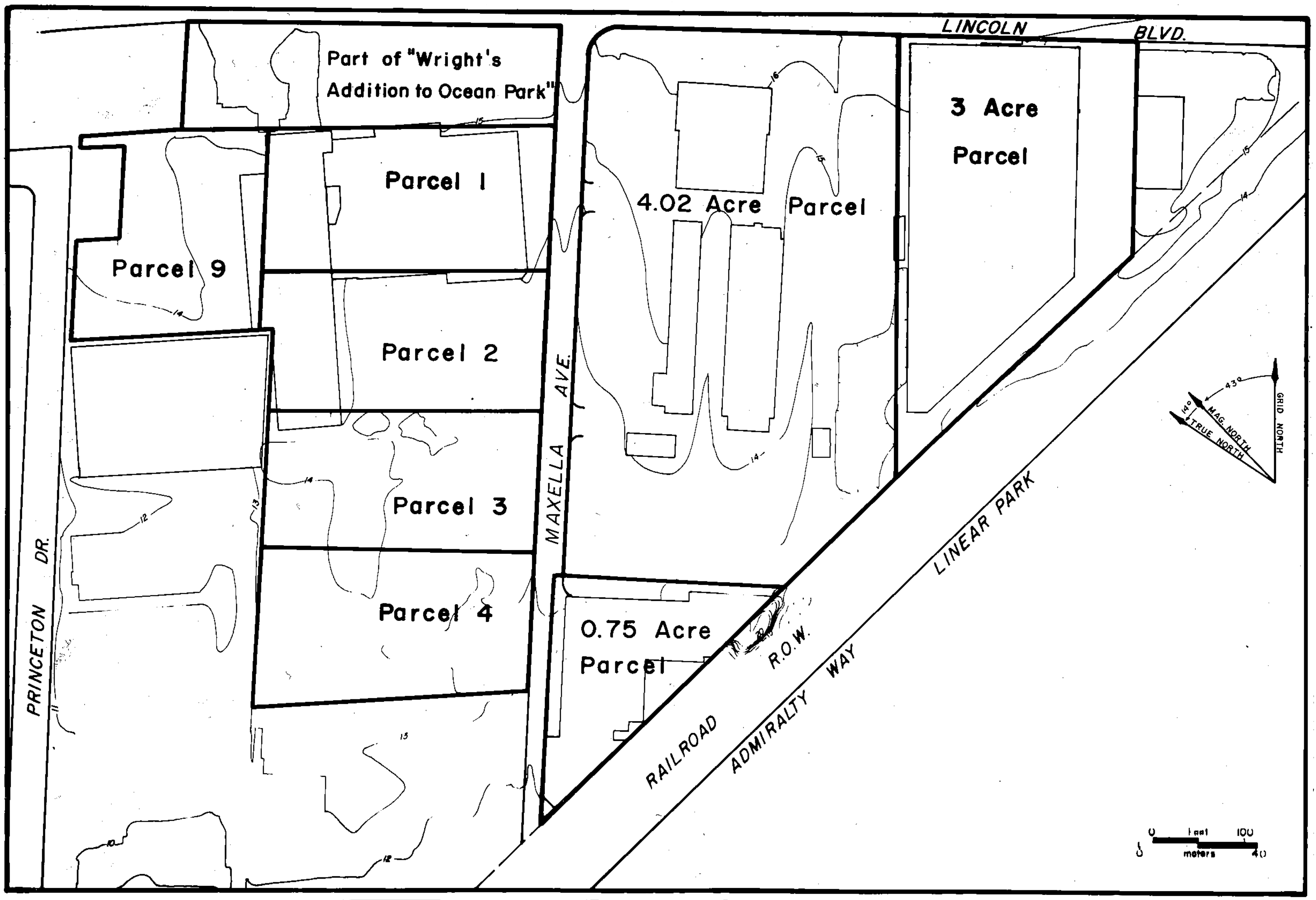


Figure 12. Locations of subdivisions within the project area.

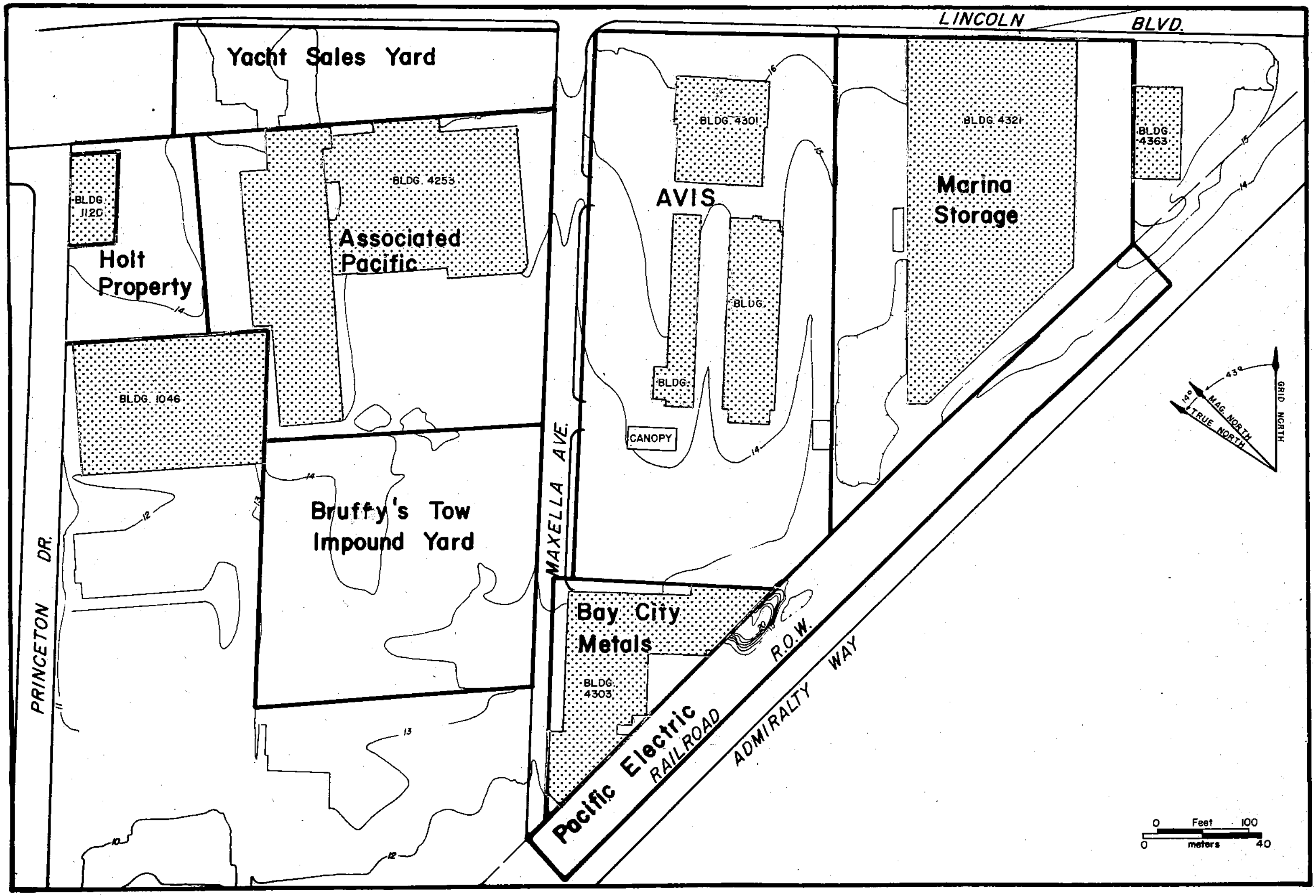


Figure 13. Location of structures around the project area, 1990.

The third is to establish the function of archaeological loci discovered in the course of fieldwork, and determine whether the archaeological record agrees with the available historical data. The fourth is to determine the relationship of the archaeological artifacts to known historic activities, as well as the ethnicity and status of local residents (Altschul 1989). The first three issues are addressed in this section of the report. The fourth is dealt with in Chapter 18.

REGIONAL OVERVIEW

Spanish-Mexican Period

During the period between the naval expedition of Juan Rodriguez Cabrillo in 1542 and the first overland trek through what is now Los Angeles County by Don Gaspar de Portola in 1769, the Spanish presence in California was limited to the coast. During this time, the general project area belonged to the Gabrielino Indians, a Shoshonean group that first moved into Southern California around A.D. 500 (Dillon et al. 1988:22). It was probably during this period that prehistoric site CA-LAn-47 was occupied. By late ethnohistoric times, there was at least one Gabrielino village within the Ballona Gap. Variously identified as "Saan" or "Sa'angna," its location has been the subject of some controversy. Dillon et al. (1988:23) place the village on the north side of Ballona Creek; others have suggested a location where the Ballona Escarpment drops to the ocean (Rios-Bustamante and Castillo 1986:4).

The founding of the San Gabriel Mission in 1771 marked the beginning of the end for the local Gabrielino. The local Indians were encouraged to move to the new mission location, where they were taught the rudiments of agriculture and cattle raising. This process of assimilation accelerated with the founding of the pueblo of Los Angeles in 1781. Soon, the local Indian population was ravaged by European diseases and even drug cults. By the end of the 1800s, the native language of the Gabrielino had been forgotten, and the population had largely merged with the prevailing Hispanic and even Anglo culture (Dillon et al. 1988:24). By this time, the village of Sa'angna had been abandoned for so long that even its general location remains a question.

As the Gabrielino moved out, Ballona Creek and its lagoon began to attract the attention of Spanish stock raisers who fanned out from San Gabriel and Los Angeles in search of pasturage. By the late 1700s and early 1800s, the area was used periodically for cattle grazing, starting a tradition that would continue into the twentieth century with the local dairy industry. By the early 1800s, the creek and the lagoon area were beginning to be associated with two particular settlers: Felipe de Jesus Talamantes and Jose Agustin Antonio Machado (Wittenburg 1973:12). From the beginning, the Machado family would be the name most closely associated with the area around the lagoon.

Jose Agustin Antonio Machado was born in 1794 to Jose Manuel Machado y Yanze and Maria de la Luz Valenzuela y Avilas. By that time, Jose Manuel had spent over 10 years doing garrison duty at the presidio of Santa Barbara. In 1797, the Machado family moved to Los Angeles, which then had a population of just over 300. Like most inhabitants of the pueblo, the Machados had their own cattle herd, and as the settlement grew, the herds were driven further from town in search of pasture. One area that was particularly prized was the small drainage identified as Rio de la Porciuncula, later known as Ballona Creek (Wittenburg 1973:6-11).

The banks of Rio de la Porciuncula were noted for willows, sycamores, oaks, and tules. The Gabrielino that remained in the area built their huts along these banks or on the bluffs immediately south of the creek (Wittenburg 1973:11-12). By 1819, Agustin Machado, his brother Ygnacio, and Felipe and Tomas Talamantes were running long-horned cattle in the area (Adler 1969:2). By the following year, this foursome had obtained from the commandante of the Los Angeles pueblo some kind of exclusive grazing rights along the Rio de la Porciuncula (Pennington and Baxter 1976:7). By 1820 or 1821, stock was moved permanently into the area, which assumed the unofficial name of Paso de las Carretas (Wagon Pass) for the easy road that led from Los Angeles to the coast through the Ballona Gap. An alternative name, La Ballona, would later supersede the first (Wittenburg 1973:15).

Only one of the four ranchers, Agustin Machado, actually lived on the land, and even he was a part-time resident. Around 1820 or 1821, he constructed the first adobe within the area, which was located in what is now Culver City between Overland Avenue and Sawtelle Boulevard. This adobe was washed away in a flood about a year after it was constructed (Pennington and Baxter 1976:8; Wittenburg 1973:19). The second adobe, built later in the 1820s, was located near what is now the intersection of Overland and Jefferson Boulevard (Adler 1969:2; Wittenburg 1973:19; Pennington and Baxter 1976:9-10).

During the 1820s, Agustin Machado maintained his primary residence in Los Angeles, where he married and began to raise a family. On a tract of land adjacent to his townhouse, Machado had vines and fruit trees. From this enterprise, which was soon expanded to La Ballona, Machado developed a white wine that became famous throughout coastal California. In addition to vineyards and fruit trees, La Ballona also contained fields of corn, pumpkin, beans, and wheat (Wittenburg 1973:16, 21).

Despite the introduction of horticulture, most of the ranch was devoted to the Machado and Talamantes cattle herds, which were tended by Indian vaqueros. The trade in hides was one of the most lucrative commercial operations in California, and sun-dried hides were traded to New England merchants in return for manufactured goods (Adler 1969:2). As a result of the hide trade, coastal commerce became an important aspect of the economic life of La Ballona. The most important port for the Los Angeles area proved to be the harbor of San Pedro. Ox-drawn wagons or carretas from further up the coast would pass through La Ballona and up the escarpment at Centinela Creek to San Pedro to trade for goods from New England and the Orient (Wittenburg 1973:19).

By the 1830s, Agustin Machado performed most of the supervisory work at La Ballona. During this period, his brother Ygnacio married and set up another establishment at Canada del Centinela. Felipe and Tomas Talamantes spent most of their energies at another neighboring rancho, Rincon de los Bueyes (Wittenburg 1973:18-19). By the end of the decade, Machado began to make moves toward obtaining legal title to the rancho that had been his for almost 20 years.

When the Machados and Talamantes began working La Ballona in the early 1820s, the land legally belonged to the the Spanish crown through the San Gabriel Mission. Authorization from the commandante of Los Angeles was sufficient to work the land, but did not confer title of ownership. With the collapse of Spanish power in 1821 and the rise of the Mexican Republic in the years to follow came the passage of laws sympathetic to private land ownership. After the outright secularization of the California missions in the mid-1830s, Machado began moves to acquire La Ballona from the Mexican government (Wittenburg 1973:25).

Rancho La Ballona was finally granted to Agustin Machado and Felipe Talamantes in November 1839 by Governor Alvarado in Monterey. By the terms of the grant, the boundaries of the rancho were established to the east by Rancho Rincon de los Bueyes, to the north by Rancho San Jose de Buenos Ayres, to the south by Sausal Redondo, and to the west by the holdings of Jose Sepulveda (Rancho San Vicente y Santa Monica). The grant was to be confirmed on condition that a house was built on the property and that it be occupied within a year (Wittenburg 1973:26).

The *diseno*, or sketch map that accompanied the grant, was actually labeled "El Paso de las Carretas" (Figure 14). The wagon road shown on the map is roughly where modern Washington Boulevard is located (Adler 1969:2). In the center of the rancho is Ballona Creek, labeled as having alders on both sides down to the "estero," or salt marsh. *Tierras de siembra,* or cultivated fields are

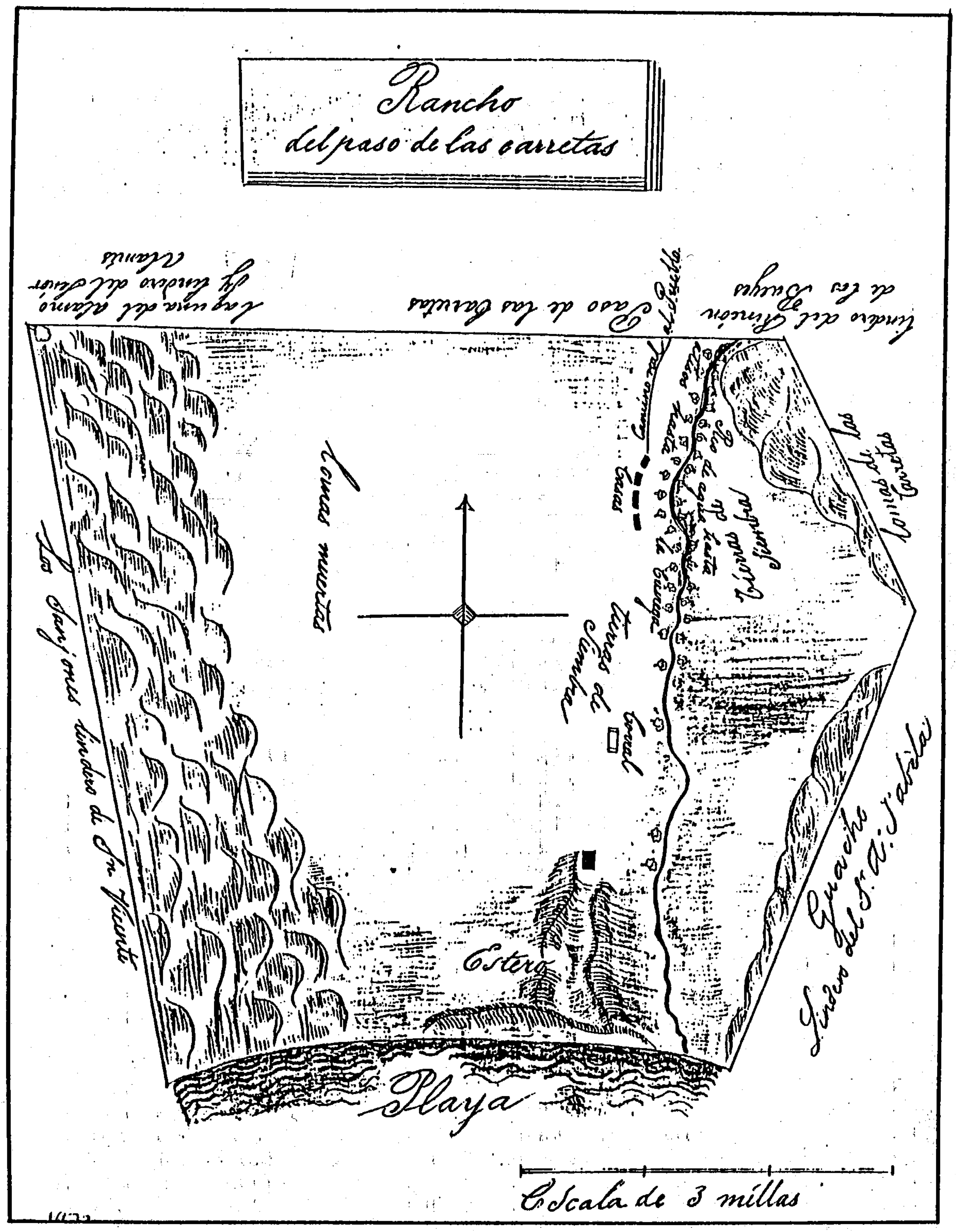


Figure 14. Diseno of Rancho La Ballona, 1839 (from Wittenburg 1973).

found on both sides of the creek. Further from the creek, where there were only *lomas muertas,* the land appears to have been used only for grazing.

The diseno indicates a number of structures on the rancho in 1839. All appear to be on the north side of the creek, which is somewhat surprising since Machado's second adobe was supposed to have been located near the intersection of Overland and Jefferson, south of the creek. North of the creek are indications of four houses near the eastern boundary, connected by the wagon pass road to the pueblo of Los Angeles. Almost two "miles" further downstream was a corral, and one mile below that is the depiction of another structure that was not identified. Located at the edge of the salt marsh and just over one-half mile north of the creek, this structure is relatively close to the project area (Diseno of Rancho La Ballona 1839).

American Transition, 1848-ca. 1880

At the conclusion of the Mexican War (1846-1848), Alta California was ceded to the United States. One of the conditions of the final peace treaty was that native Californios would be allowed to retain their land holdings under the new American regime. The transition from Mexican law to American would not have been nearly so difficult had the Gold Rush not gotten underway in the same year that California passed into U.S. administration. Soon there were occasions for all sorts of controversies as the details of Mexican land grants were challenged by U.S. institutions set up to confirm land ownership.

The Land Act of 1851 established a Board of Land Commissioners at San Francisco to establish the validity of land grants throughout California. After some protest from Californios living in the south, the board finally agreed to meet in Los Angeles in 1852. At that point, the Machados and the Talamantes presented their case for the confirmation of La Ballona (Wittenburg 1973:32). In 1854, the board upheld the La Ballona grant, but this did not prevent the years of litigation and controversy that followed (Adler 1969:2).

As required by American law, La Ballona grant had to be surveyed, and this was performed by Henry Hancock in 1858 (Figure 15). Hancock began his survey near the northeast corner of the grant, near Ballona Creek, and then proceeded to move clockwise around the property, which was then designated Lot No. 37, located within Township 2 South, Range 15 West, of the San Bernardino Meridian. Hancock identified the "inner bay" and the outlet of Ballona Creek, but unfortunately did not indicate any improvements within the interior of the grant (Hancock 1858).

As drawn up by Hancock and finally approved years later, the La Ballona grant was bounded by Rancho San Vicente y Santa Monica to the northwest (along a boundary now formed by Pico Boulevard), the Pacific Ocean to the southwest, and Rincon de los Bueyes to the north (along a boundary now formed by Manning Avenue). To the east, the boundary was formed by the Baldwin Hills and Rancho Paso de la Tijera, and to the south, the boundary was the Ballona Escarpment, beyond which was Sausal Redondo.

In the first of many controversies, the General Land Office failed to approve Hancock's survey because the the configuration of the grant boundaries was not exactly the same as the original diseno, and because the large body of water shown on the Hancock map was not depicted on the original sketch (Wittenburg 1973:34).

It required years of litigation and proofing to straighten the matter out, but it appeared that Machado had sufficient funds to weather the storm. In 1860, Agustin Machado was considered one of the wealthiest citizens in the area: his 14-acre tract in Los Angeles was assessed at 6,000 dollars, and his

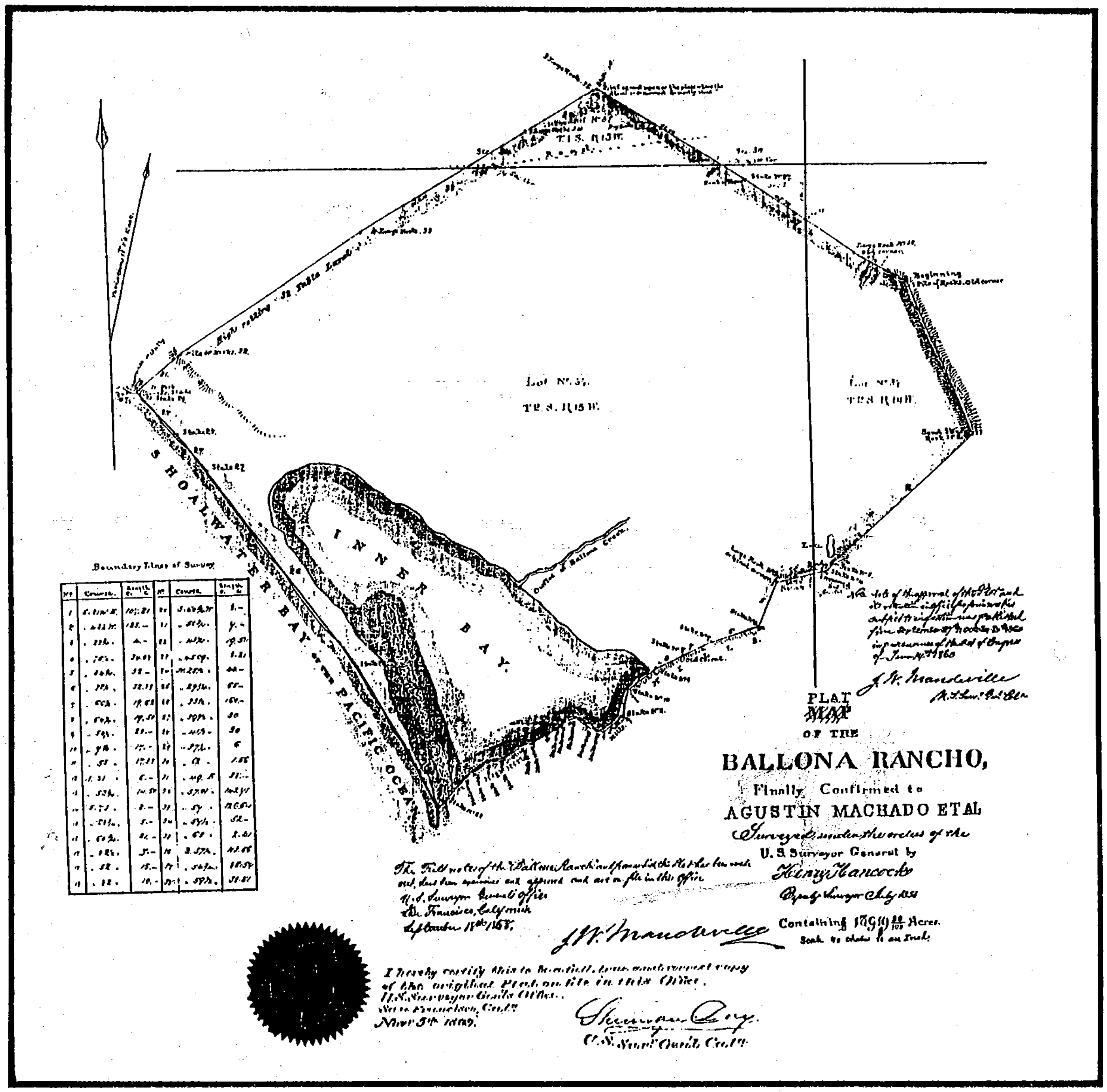


Figure 15. Hancock's survey of Rancho La Ballona, 1858 (from Wittenburg 1973).

one-quarter share of La Ballona was appraised as 13,570 dollars. In addition, Agustin bought three leagues of Rancho Santa Rosa in San Diego County as early as 1855, beginning the slow process of moving the center of family operations to the south (Wittenburg 1973:22).

The American Civil War, in most ways quite distant from the concerns of the rancho, had some unusual repercussions for the project area. The Anglo community in Los Angeles was concerned that the coastal area around the rancho might prove a logical location for a Confederate invasion of southern California from some staging point on the uninhabited Catalina Islands. To counter this improbable threat, Camp Latham was established in September of 1861 on Ballona Creek. Located near the modern intersection of Washington and Sepulveda, over two miles inland from the project area, the camp contained at one point 1,200 trainees for the California Volunteers. The establishment lasted about a year before it was moved to Camp Drum at Wilmington, where the water supply was better (Adler 1969:2-3; Pennington and Baxter 1976:14).

The oldest map that shows details within the immediate project area is dated to 1861 and was compiled by the U.S. Coast Survey (Chase 1861; Figure 16). It was almost surely prepared as a result of the war scare that produced Camp Latham. This map shows the details of the lagoon, the surrounding uplands, and what would appear to be fields and structures in the vicinity of the lagoon. The only details that appear to have been added to the map at a later date are the modern minute demarcations -- and possibly the "race course" that cuts across an older road.

According to the 1861 map, most of what is now Marina Del Rey and Venice was then a series of marshes and open bodies of water connected to the ocean and Ballona Creek. Within the general project area, there were two roads: one about where Lincoln Boulevard/Glencoe Avenue is today; and another roughly approximating Maxella Avenue. Another road, located further to the north, was roughly where Venice Boulevard or Washington Boulevard is today. One large field was situated along the northernmost road, and two smaller fields were found along the road approximating Maxella. The smaller of these two fields would appear to be situated within the immediate project area.

In addition to roads, the 1861 map indicates structures that may be houses or corrals. What would appear to be at least four structures and one open corral are indicated on or near the line marked "118 degrees, 26 minutes." Dotted lines that would appear to be fences radiate from this cluster of structures. This cluster would appear to be located in the vicinity of modern Alla Road, near what is now Glen-Alla Park. This area may well correspond to the southwestern-most structure depicted on the 1839 diseno.

The seemingly impossible task of correlating features on the 1861 map with those of today was greatly facilitated by comparing the 1861 map with a later composite map (Santa Monica Bay 1871-1893/1910; Figure 17) that showed many of the same structures and fence lines from 1861, as well as more recent features such as roads and railroads that could be tied in to a modern map.

The Santa Monica Bay map of 1871-1893/1910, in addition to depicting the four structures and corral, also shows two structures about three-quarters of a mile to the west, immediately adjacent to the label "Machado." The structure closest to the label, immediately south of the project area, does not appear in the 1861 map, but the structure about a quarter mile to the northwest appears within the rectangular field depicted on the 1861 map and very probably within the project area. This structure might well have existed in the 1861, its depiction on the 1861 map obscured by the shading used to identify the field.

If this was the case, then the first structure within the project area was constructed before 1861 and was probably associated with the southern-most of the Machado settlements within the rancho. The earliest road in the project area, the one that roughly approximates modern Maxella, was probably located between Maxella and Princeton within the project area, with a somewhat different orientation

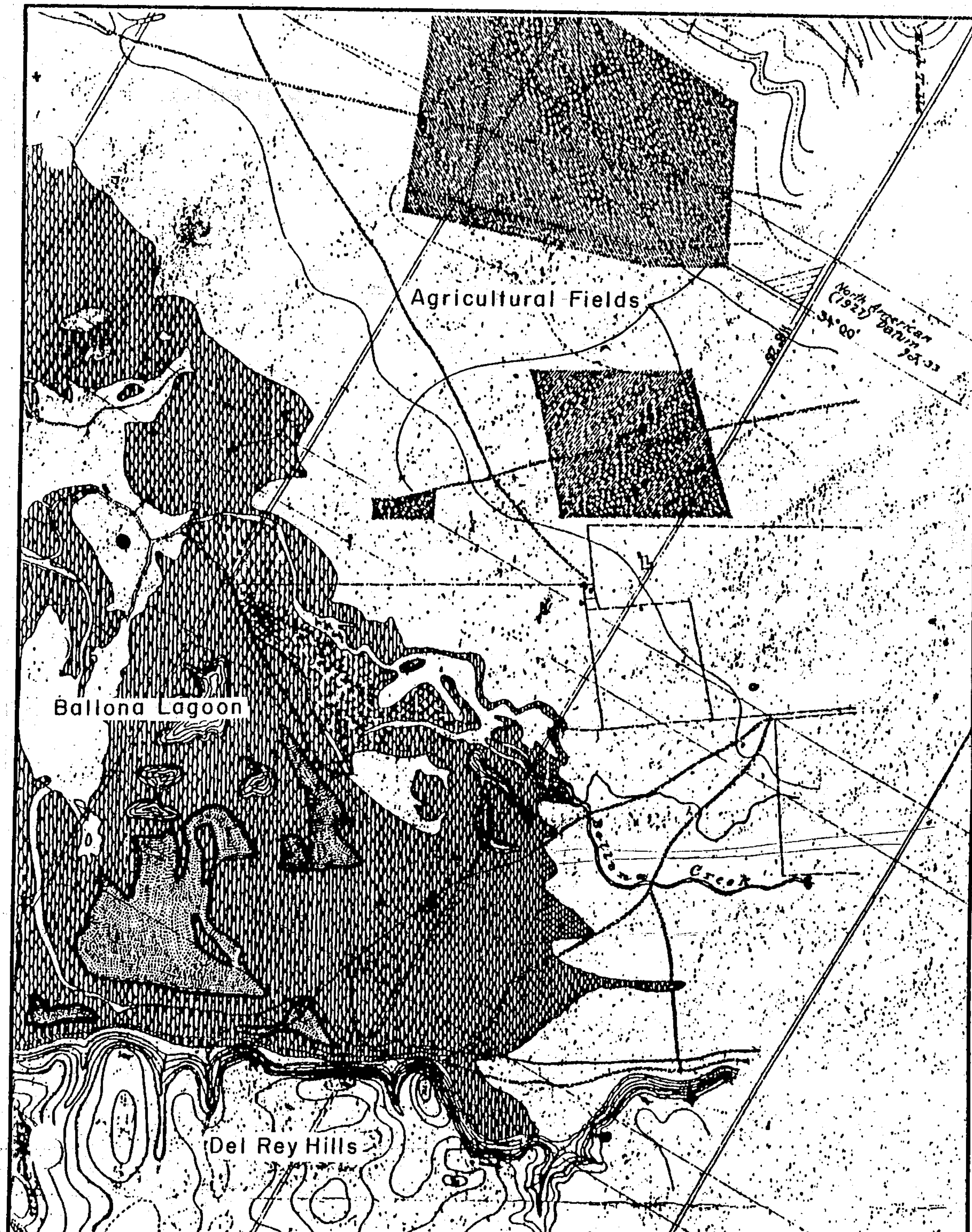


Figure 16. Chase map of the Ballona area (from Chase 1861).

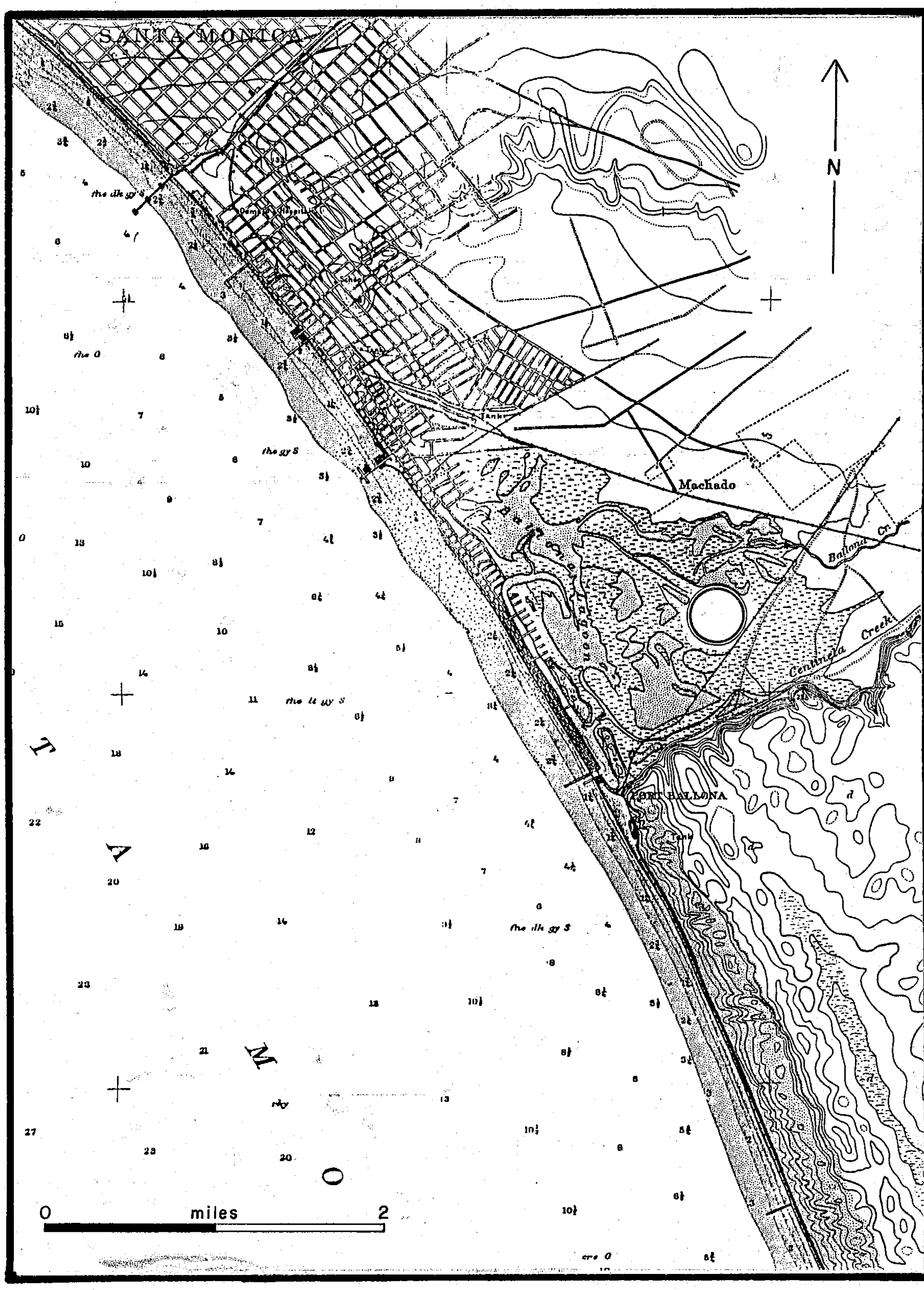


Figure 17. Santa Monica Bay 1871-1893/1910.

than the modern road (see Figure 16). By some point later in the 1800s, a road trending northwest-southeast passed through the project area (see Figure 17). Although this road appears to be in the general location of modern Lincoln Boulevard, its placement is actually more like that of modern Carter Avenue (called Venice Street in the early twentieth century), a parallel road located about 180 feet to the southwest.

In the years after 1861, things began to change dramatically for La Ballona rancho. When Felipe Talamantes died in 1857 he left his share of the land to 25 family members, friends, and creditors. In 1865, the death of Agustin Machado left his share to be divided among 14 heirs. All of this, plus the still questionable legality of the Ballona boundaries, led to an appeal by the various heirs to have the Los Angeles District Court effect a formal partition of the grant. This difficult operation was carried out in 1868 under the direction of George Hansen (Adler 1969:3).

The District Court ruled that the partition survey of La Ballona rancho had to be divided into 22 allotments for the heirs of Felipe Talamantes and Agustin Machado. Each allotment had to contain equal portions of three classes of land. The first class was to be arable land that could be irrigated from Ballona Creek. The second class was to be pasture land. The third class, "overflow lands," was represented by the salt marshes. Hansen himself created a fourth class of land after the survey began, because he found much land capable of agriculture without irrigation (Wittenburg 1973:50).

As per the court's instructions, each allotment was to get equal acreage in each class of land. For whatever reason, by the time of the survey only 17 allotments were made. After Hansen's changes, these 17 had to be spread among the four classes of land: arable first class land; dry-farming second class land; seasonal pasturage third class land; and fourth class land that included the rest -- water courses, the lagoon, the beach (Adler 1969:3-4). The first class land was located in the east of the rancho, along the upper course of the creek; second class land was located below that, to the southwest; third class land was the northern half of the rancho; while fourth class land was found in the extreme south. The project area, while wholly located within second class land, was immediately adjacent to the fourth class marsh and lagoon (Figure 18).

The divisions within second, third, and fourth classes were effectively simple slices of land. Matters were far more complicated in first class, where Hansen attempted to make the improvement allocations agree with the allocations of land. Most improvements would appear to have been located in first class land, but as we have seen, some must have been situated in second class land as well. Apparently Felipe Talamantes left no improvements, while Ygnacio Machado's improvements were assigned to his four sons. The most significant improvement to the rancho was purchased by James T. Young from Rafael Machado in 1859. This complex included a three-room adobe, a vineyard, a nursery of fruit trees, and fencing around the house and vineyard. Another smaller set of improvements was noted by Hansen and were identified as improvements begun by Tomas Talamantes before August 1859. These included the remains of a small, one-room adobe, a small willow grove, 10 fig trees, a few peach trees, and some fencing (Adler 1969:3; Wittenburg 1973:51).

The complex centered around the three-room adobe is almost surely located within first class land (Adler 1969:3) and is of little concern to the immediate project area. At present, the location of the remains of the one-room adobe begun by Tomas Talamantes is not certain; while probably located in first class land as well, it may correspond to some part of the complex noted on the 1861 map, three-quarters of a mile east of the project area. At the very least, it can be said that the Tomas Talamantes improvements were divided among George Sanford, Elenda Young, John D. Young, and Addison Rose: the approximate area of the settlement shown on the 1861 map east of the the project area was similarly divided.

Although absolutely nothing is known about the Ygnacio Machado improvements that were assigned to his four sons, it is certainly worth mentioning that the small field and possible structure

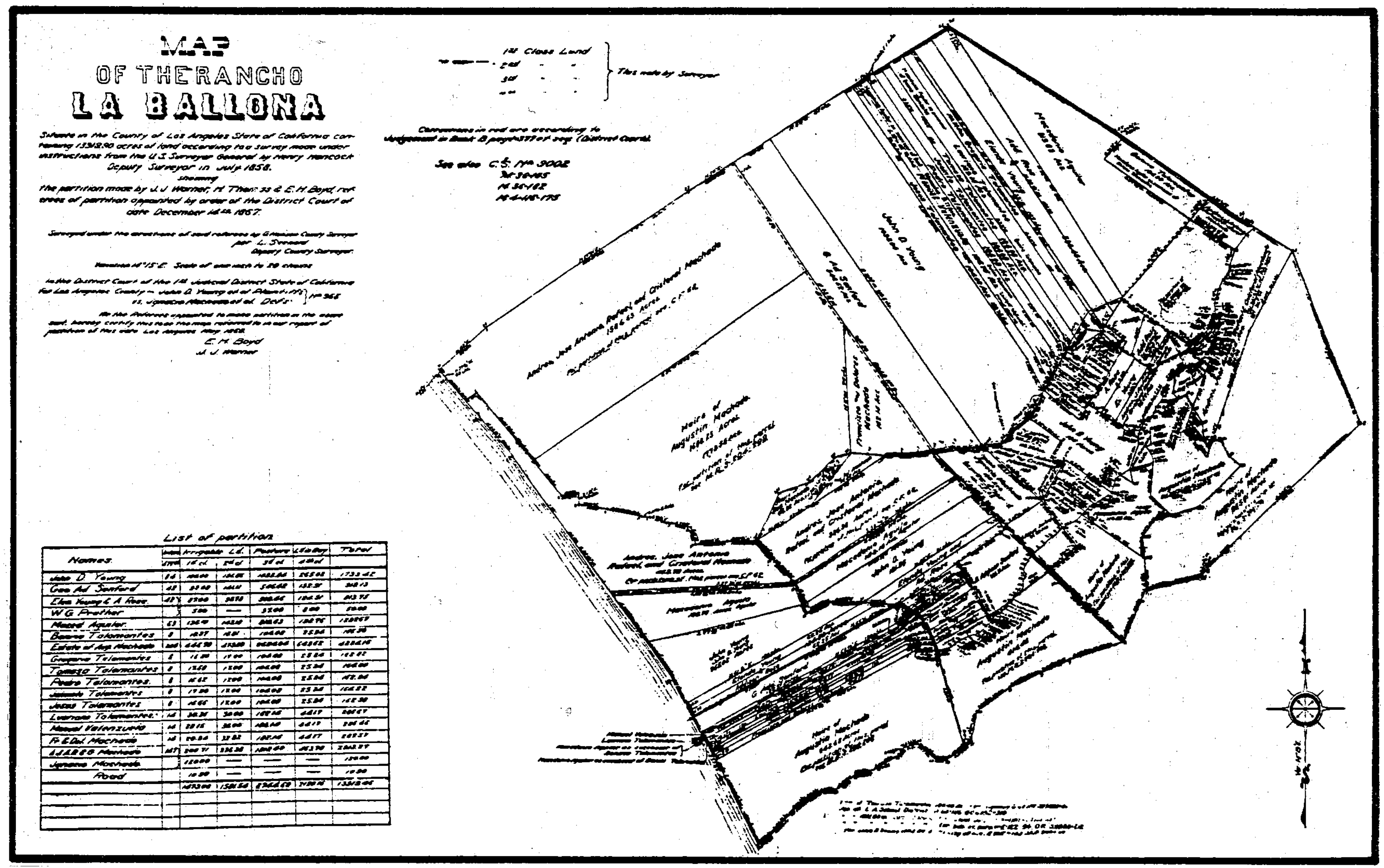


Figure 18. Map of the Rancho La Ballona, 1861.

identified on the 1861 map and found in the northern half of the project area, were located on land that did pass to Andres, Jose Antonio, Rafael, and Cristobal Machado.

As can be seen by looking at the map, the Hansen partition survey was a nightmare of odd-shaped parcels. In addition to that problem, there were a limited number of roads in the rancho at that time, and none of Hansen's parcels was cut by any of them, making access to parcels difficult (Adler 1969:4). The major road, Paso de las Carretas, was located approximately where Washington Boulevard is today. In Hansen's survey, it was labeled Road No. 3. Roads No. 1 and 2 together comprised the coast road, what is now Centinela Avenue (Adler 1969:4). One interesting feature along Road No. 3 was a zanja or ditch (Adler 1969:4). To this day, the zig-zag course of the ditch has been preserved by Zanja Street, located about one-half mile north of the project area.

The Hansen survey had a direct impact on the project area. As a result of the survey, the area became part of three separate parcels. The largest part, south of modern Maxella, was part of the 143.18 acres of second class land awarded to Macedonio Aguilar. The next largest portion at the northern end of the project area, was part of the 336.38 acres awarded to Andres, Jose Antonio, Rafael, and Cristobal Machado. Between the two was a sliver of land awarded to Benina Talamantes and Macedonio Aguilar as successor of Benina Talamantes. It was within this sliver of land that modern Maxella Avenue became situated.

The awkward Hansen allotments paved the way for a round of buying and selling that would eventually lead to viable parcels. This move was accelerated by the wool boom of 1871-72 (Adler 1969:5), which in turn aggravated a boundary dispute with Rancho San Vincente y Santa Monica (Wittenburg 1973:38-39). The late 1860s and 1870s were periods of great confusion over ownership and land use within the rancho and the project area. During these years, the Plaintiff Index for the County of Los Angeles is full of activity on the part of the Machados. Likewise, the Deed Index for those years is full of land transactions, most of which took place to the northwest and east of the project area between the years 1869 and 1874 (Indenture August 10, 1868; August 1, 1869; July 6, 1872a and b; May 15, 1874).

In 1870, Cristobal Machado sold his share of the 336.38 acres of second class land to Rafael Machado for 1000 dollars (Indenture June 28, 1870). As a result of transactions like this, it soon became apparent that much of the land in the rancho would have to be divided yet again. In 1872, the district court of Los Angeles County appointed Manuel Coronel and A. W. Hutton to subdivide the allotments of Andres, Jose Antonio, Rafael, and Cristobal Machado (Los Angeles County 1872). Although no map accompanied the arbitration case, it would appear that Rafael Machado became sole owner of the northern portion of the project area as part of his share of the 336.38 acres of second class land.

The southern portion of the project area changed hands as well during this period. The 143.18 acres of second class land that had been awarded to Macedonio Aguilar in 1868 apparently belonged to Bernardino Machado in 1875, for it was this land that he sold to Anderson Rose on 27 March of that year for 25 dollars an acre (Indenture March 27, 1875).

During this period, changes were also taking place in Rancho San Vicente y Santa Monica to the northwest. Col. R. S. Baker bought the rancho from the Sepulveda family in 1872, paving the way for the development of the town of Santa Monica (Dillon et al. 1988:28). Baker also kept a houseboat, the "Pollywog," on the Ballona Lagoon to entertain his friends (Moran and Sewell 1979:12).

The lagoon also attracted Will Tell, who filed for preemption claim to 150 acres near the mouth of Ballona Lagoon. On this land, he built a house and had eight boats on the lagoon for hunting parties. Ramona Machado, Agustin's widow, began eviction proceedings against him in the early

1870s, but allowed the process to lapse. "Will Tell's Seashore Resort" was finally destroyed by a storm in 1884 (Adler 1969:5; Wittenburg 1973:53).

In December 1873 the final patent for Rancho La Ballona was issued to the heirs of Machado and Talamantes, after years of litigation between the Machados and the Sepulvedas as to the exact northeast boundary of the rancho (Wittenburg 1973:44). By this time, of course, none of the original grantees actually owned the land, and their heirs were in the process of selling most of their holdings. This trend accelerated with the Land Boom of the 1880s (Wittenburg 1973:52). By the end of the century, very little of the original rancho belonged to the Machado or Talamantes families. One of the few Machado heirs to hold on to his first class land was Macedonio Aguilar, and he eventually sold it to form the kernel of what would later be the Palms community and Culver City (Pennington and Baxter 1976:17).

The property owner transition that effected most of the old ranchos in the area helped set the stage for the urban development that would soon engulf the area. To understand the beginning of this development, we must temporarily step back away from the immediate project area and view the phenomenon as a general trend in Southern California.

Early Urban Developments, 1870s-1904

The first urban area to be developed within the vicinity of Rancho La Ballona was Santa Monica, which got its start as a community in the 1870s. In the 1830s, the land grant San Vicente y Santa Monica had been awarded to Francisco Sepulveda, but until the 1870s, settlement had been restricted to the Santa Monica Canyon area. The mesa where the city is now located was used for grazing (Dillon et al. 1988:27).

After the Sepulvedas sold the grant in 1872, it became subject to development as an outlying community close to Los Angeles, which was just beginning its first period of rapid growth. The City of Santa Monica was proposed as early as 1875. By 1876, it had a rail link with Los Angeles, the Los Angeles Independence Railroad, that occupied the course now followed by Exposition Boulevard (Wheeler 1881). The development of Santa Monica was closely associated with the success of the Los Angeles and Independence (Adler 1969:5).

In 1876, the Southern Pacific Railroad was the first transcontinental railroad extension to reach Los Angeles. As part of the deal to entice the Southern Pacific into the area, the railroad company was given Los Angeles's first rail line, the Los Angeles and San Pedro Railroad. This led directly to the increased importance of the San Pedro area as the port of Los Angeles (Adler 1969:5-6). The expansion of the Santa Fe line to southern California in the mid-1880s led to competition and the lowering of rail rates. This directly brought about the Land Boom of the late 1880s that completed the transition of the area from a sparsely populated Hispanic community to an urban and largely Anglo-American series of settlements.

Following closely on the heels of Santa Monica came the development of Ocean Park, immediately to the south. An offshoot of Santa Monica, it was first developed by Abbot Kinney, who was later to become even more renowned as the developer of Venice. Abbot Kinney was an Eastern entrepreneur whose family made its fortune marketing cigarettes. Due to poor health, he traveled extensively in search of the right climate, eventually settling in the Los Angeles area (Moran and Sewell 1979:9). After Kinney married in 1884, he set up a new home on the coastal bluffs of Santa Monica. There he bought up land south of the city and convinced the Santa Fe Railroad to extend a spur line to the property, which was named Ocean Park in 1885. Here Kinney worked with a partner, Francis G. Ryan, to create a small resort community (Moran and Sewell 1979:11).

The most ambitious development scheme concocted during the land boom was Port Ballona, conceived by Moses L. Wicks, a speculator who had previously worked in Pomona and Glendale (Adler 1969:6). After purchasing property around the inlet of Ballona Lagoon, Wicks managed to interest the Santa Fe Railroad in a harbor site that would compete with the Southern Pacific's monopoly on coastal traffic through San Pedro, Wilmington, and Santa Monica. When the Santa Fe agreed to this scheme, Wicks formed the Ballona Harbor and Improvement Company and raised around 300,000 dollars for the venture (Adler 1969:6). By the time the Santa Fe arrived, Wicks planned to have a town and a harbor waiting.

While plans were laid out for the town, engineer Hugh Crabbe began to dredge the harbor according to plans that called for a rectangular basin 300 by 600 feet, between 6 and 20 feet deep. The channel to the ocean was to be 200 feet wide, located where the present mouth of Marina Del Rey is situated. While the ocean channel was being dredged, California Central Railroad, a subsidiary of the Santa Fe, began construction on two wharves built out onto the surf. All of this was going on when the first train rolled into "Port Ballona" in August of 1887 (Dillon et al. 1988:28). Shortly afterward, the land boom bubble burst and the development of Port Ballona was abandoned. The wharves and dredging were never finished, and the town was never built (Adler 1969:6; Thorn 1887; Figure 19). To make the best of a bad situation, the Santa Fe continued its tracks southward from Ballona toward Redondo, which soon became its ocean terminal (Adler 1969:6). As late as 1894, there were only 11 structures located at the mouth of the lagoon to keep the name of Port Ballona alive (Redondo 1894/1905).

Another contemporary development occurred at the far eastern edge of the old rancho. In 1886, during the Land Boom, Joseph Curtis, E. H. Sweeter, and C. J. Harrison bought a 500-acre tract of Macedonio Aguilar's allotment. This area, now bordered by Washington Boulevard, Overland Avenue, and Manning Avenue, was subdivided that same year and became known as the Palms (Wittenburg 1973:53; Pennington and Baxter 1976:20).

After the feverish developments of the land boom, the 1890s were generally a period of slow growth. It was during this period, however, that the railroad came through the southern margin of the project area, immediately north of the lagoon. At the instigation of Abbot Kinney, the Santa Fe Railroad was induced to complete a spur line from the old "Port Ballona" tracks to Ocean Park (Redondo 1894/1905). This was done by California Central Railroad, Santa Fe's local subsidiary in 1892. Before the end of the century, this line was known as the Southern California Railroad, which ran on electricity (Adler 1969:6).

The railroad led to the first beginnings of development within the general area. The first detailed surveys of what would later be the Venice area were conducted about this time (Map 1095, 1892; Wright and Nicholson 1893). The railroad certainly contributed to the development of Ocean Park, which grew steadily throughout the 1890s. The railroad even made changes to the project area. On the Santa Monica Bay map of 1871-1893/1910 (see Figure 17), immediately southeast of the project area on the north side of the tracks, there is indication of a structure. The area around it is labeled "Machado," although it is not clear whether the name refers to the structure or a train stop for the general area. Even though this map is a composite, put together over a 20 year period, the structure along the railroad tracks almost surely postdates 1892; the other features, almost identical to those found on the 1861 map, might not have been present at that late date. It is interesting to note that the road adjacent to this structure on the tracks is not Lincoln Boulevard, but rather a road that would correspond to modern Carter Avenue (Venice Street) if Carter extended through the project area.

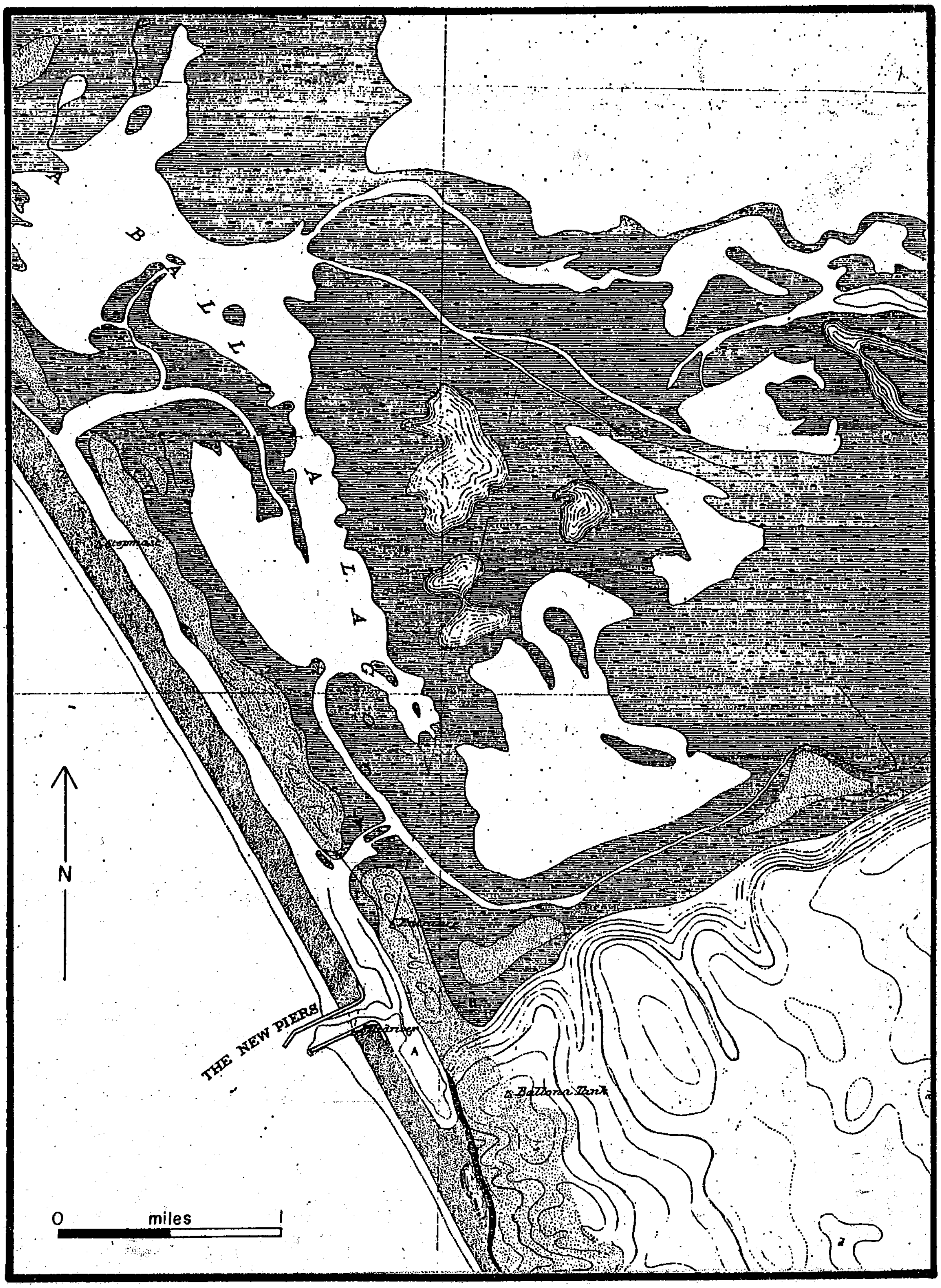


Figure 19. Port Ballona and lagoon, 1887.

Development of Venice, 1904-1910s

The development of Venice began with the death of Abbot Kinney's business partner, Francis Ryan, in 1889. Kinney did not get along with Ryan's successor, the new husband of Ryan's widow, which finally led Kinney to take an interest in land south of Ocean Park (Moran and Sewell 1979:11). In 1901, Kinney persuaded the Los Angeles Pacific to extend tracks south from Santa Monica to a point beyond Ocean Park, and in 1902, a short rail line was extended from Los Angeles along what would later be Venice Boulevard (Stanton 1978:2). In 1904, the year Ocean Park seceded from Santa Monica (Stanton 1978:28), Kinney was ready to begin his planned community of Venice.

Originally known as Kinney's Folly, "Venice of America" was to be modeled vaguely after the Italian city. The buildings were to have pseudo-Italian facades, and of course, canals. In fact, the low, marshy nature of the land south of Ocean Park gave Kinney the whole idea (Stanton 1978:2-3; Moran and Sewell 1979:12). In addition to a pier and pavilion adjacent to Windward Avenue, the area to the south was to be criss-crossed with canals. In August of 1904, work began on the dredging of the Grand Canal, which was to be one-half mile long, 70 feet wide and four feet deep. Six other canals were added later to form a grid pattern that covered less than one square mile. The canals were dug with teams of horses pulling fresnos (Stanton 1978:2).

The following year, a second series of canals were dug off the the Grand Canal, which by this point had been extended southward to the Ballona Lagoon (Stanton 1978:2). By the end of the program, there were 16 miles of canals, averaging a depth of four deep, with the spoils deposited on berms on either side. Aside from the connection with the lagoon, the original grid was connected to the sea through two 30-inch diameter pipes (Moran and Sewell 1979:20). The original grid of canals was opened to sea water in June of 1905, almost seven months after the first residential lots went on the market (Stanton 1978:2).

Venice proved to be a popular concept, even though it developed in ways that Kinney did not anticipate. Hoping for some kind of cultural center, Kinney was mildly disappointed that Venice simply became an amusement park, with rollercoasters, hamburgers, and beauty contests (Stanton 1978:32). Even if the community proved somewhat disappointing, it certainly proved successful. As early as 1907, Venice was trying to separate itself from Ocean Park and become an incorporated city in its own right. This was finally achieved in a round about way in 1911, when Venice actually superseded Ocean Park, changed the name of the whole community to Venice, and relocated the municipal government to Kinney's development (Stanton 1978:31; Adler 1969:14). By this time, it would appear from the available maps that residential development had progressed no closer to the project area than the corner of Washington Street, Zanja Street, and the Los Angeles Pacific right-of-way (Wright 1912). Urban development progressed no closer for almost 50 years.

From a peak in the 1910s, Venice began a slow decline attributable to a number of causes. Water in the canals circulated poorly, and in 1912 the State Board of Health condemned the canals as health hazards. Although it is not clear what was done to remedy this matter, it is clear that no further canals were dredged. Like other communities that grew too fast, the sewage plant was soon overtaxed and the fire protection system was strained. Beach erosion began to take its toll in the pier and pavilion area, which was finally crippled when the whole complex burned in 1920, the year that Kinney died. Finally, the 1920s saw the influx of cars and it was soon demanded that the canals be filled in to accommodate the added traffic (Stanton 1978:31,41). Citizen demands for better services led to the city's annexation to Los Angeles in 1925. By 1929, the original grid of canals had been filled in to make room for streets; the canals to the south were spared only because of the Depression (Stanton 1978:57,60).

Venice continued to decline for the next few decades due to the rise of tenantry. The pattern of residential home ownership gradually changed to one of tenant occupation, which led to decrepit neighborhoods and a fierce animosity between absentee landlords and tenants demanding improvements. All of these matters contributed to the limited growth of Venice in the decades after annexation. It is worth noting that the residential expansion of Venice toward the project area did not resume until the late 1950s and early 1960s.

Other Developments, 1900s-1930s

During the time of Venice's stagnation, other communities farther east continued to grow. Palms and Culver City expanded throughout this period, as evidenced by subdivision maps and improvement companies (James 1906; Wittenburg 1973:54). Culver City, in particular, grew during the 1910s and 1920s. Just two years after Harry Culver bought up the lands that would later make the city, movie producer Thomas Ince filmed a Western along the shores of Ballona Creek. He was so impressed with the area that he later bought land in what soon became Culver City. From this beginning would grow the Metro-Goldwyn-Mayer movie lot already famous by the 1920s (Robinson 1939:123; Alexander 1965:48; Wanamaker 1986). Gail Machado recalled that the small Mexican village known locally as Little Tijuana, located on the escarpment near the Howard Hughes field, was used as a set for the 1930s classic, "Grapes of Wrath" (personal communication 1990).

Closer to the lagoon, the early 1900s saw a renewed interest in "Port Ballona," with the dedication of a new hotel in 1902 near the mouth of the lagoon. Town streets were drawn up by 1917 (Wright 1917). Soon the community had its name changed to Playa Del Rey, by which it is now known (Pennington and Baxter 1976:23-24).

Probably at some point around this time, an unusual circular feature depicted on the Santa Monica Bay map dated 1871-1893/1910 was constructed in the lagoon marsh itself. The feature, about one-half kilometer in diameter, was found immediately northwest of the northeast-southwest trending railroad line to Port Ballona. Since this feature appears to have been added to the map, it could be suggested that it dates to the early 1900s. The function of this feature is completely unknown, and it is not found on subsequent maps.

The increase in urban development led to the channelization of Ballona Creek, whose unspoiled beauty had first led the movie industry to Culver City. In the early 1920s, the upper course of the creek was channelized, a job that was finished by the U.S. Army Corps of Engineers in 1935, at the suggestion of the Los Angeles County Flood Control District. No longer the set for filming canoe attacks as in the 1910s, the creek was soon a 2-mile long rowing course used by sculling crews from the surrounding universities (Robinson 1939:126).

Closer to the project area, in the general vicinity now occupied by the restaurant Charlie Brown's on Admiralty Way, there used to be a two-story hunting lodge, believed to have been constructed around 1900 and demolished about the time of World War II (Perry, Wirrer, Johnson, personal communication). Legal traces of the club's location survived until at least the 1950s (Los Angeles County 1954-1958:12).

One of the most interesting constants in this area of change was the Machado "settlement" located along Alla Road near the present Glen-Alla Park. Located in this area since at least the 1860s if not before, the Machados survived the coming of the railroad to have a settlement or train stop named after them around the turn of the century. A branch of the family still lived near Alla Road and Glen-Alla Park as late as the 1920s (Perry, personal communication 1990).

DEVELOPMENT OF PROJECT AREA, ca. 1905-1990

Significant historic development of the project area, formally identified as CA-LAn-1596-H, really begins with the advent of the railroad along the southern margin of the project area, and the development of neighboring communities like Venice. The bulk of this section of the report has been provided by records preserved in the Los Angeles County Assessor's Map Books. These records cover a period from around 1905 to the mid-1960s. Although some of these books were temporarily unavailable due to the dislocations caused by subway station excavations, most of the property owners within the project area were identified. Just as important, the value of any improvements to the land were carefully noted in each year's assessment. In this manner, it was possible to determine just when constructions took place on the property. Finally, the information obtained from the assessor's map books was fleshed out by the recollections of informants and local residents of the area.

As we have seen, the available record of the project area in the years before 1905 is much less secure. Going through deed transactions is a laborious task, one made more difficult here by the irregular nature of the partition parcels on which all subsequent transactions were based. To complicate matters, many available maps of the area are composites built up over time, making it difficult to determine just when any one structure might have been erected. The Santa Monica Bay map of 1871-1893/1910 is the most glaring example of such a map. Despite all these problems, however, much can still be said about the project area before 1905, and this information should be recapitulated before exploring the developments of the twentieth century.

Recapitulation of Nineteenth-Century Developments

History in the project area began with Rancho La Ballona and the various uses made of the land by the Machado and Talamantes families. As early as the diseno of 1839, it would appear that there was a structure of some kind about one-half mile northwest of the juncture of Ballona Creek and the lagoon. Such a structure could well correspond to one of the structures much more clearly identified on Chase's map of 1861, which shows a cluster of four structures and possibly one corral in the vicinity of what is now Glen-Alla Park. This information is repeated on the Santa Monica Bay map of 1871-1893/1910, which also shows the location of the local rail line, a feature constructed in 1892. It would appear unlikely that all of the "1861" features survived until that time.

The 1861 map shows a fenced-in field and (on the basis of better definition on the Santa Monica Bay map) a structure located in the northern portion of the project area. A road, roughly approximating modern Maxella Avenue, but located farther north, entered the project area from the northeast. The structure, located along the northwest margin of the field, was located on the southwest quarter of the intersection formed by this road and and another that would appear to approximate the modern location of Carter Avenue, if Carter extended further to the southeast to connect with the rail line.

It is logical to assume, but cannot be demonstrated, that this structure, located in the northern half of the project area, was constructed by Ygnacio Machado, brother of Agustin and one of the four grantees of Rancho La Ballona. At the time of George Hansen's partition survey of 1868, when the rancho improvements were formally alloted to the heirs of the grantees, the available information simply says that Ygnacio's improvements were passed to his four sons. While the improvements mentioned in the Hansen survey could well be located on first class land located further upstream, it is worth noting that the northern portion of the project area -- the same area that contained the field and the structure -- was awarded to the sons of Ygnacio Machado: Andres, Jose Antonio, Rafael, and Cristobal.

In 1868, the four brothers obtained the northern portion of the project area, while the southern portion was awarded to Macedonio Aguilar. Between the two was a sliver of land awarded to Benina Talamantes. It was along this sliver that modern Maxella Avenue came to be, indicating that the current orientation of roads within the project area had its beginnings with the Hansen partition survey.

The project area changed hands quickly in the years that followed the 1868 survey. Cristobal Machado sold his share of second class land (which included the north portion of the project area) to Rafael in 1870. Two years later, as the result of another partition survey to divide the lands of the four brothers, it would appear that Rafael Machado became sole owner of the northern portion of the project area. To the south, the lands of Macedonio Aguilar passed to Bernardino Machado by 1875, for in that year this area was sold to Anderson Rose. Even as late as the twentieth century, this area would still be known as a part of the Anderson Rose Tract.

The development of the project area between the 1870s and 1905 can best be seen in the depiction of structures on the two survey maps from this period. In addition to the field and structure shown in the northern part of the project area in the Santa Monica Bay map of 1871-1893/1910 (which is probably more accurately dated to the period of the 1861 map), the Santa Monica Bay map also shows the 1892 rail line and a structure or at least a train stop labeled "Machado," located immediately southeast of the project area. In the second map (Figure 20; Redondo 1894/1905), the features associated with the 1861 map (the field and structure in the northern part of the project area) are no longer shown. The structure or stop labeled "Machada" (sic), however, is still depicted immediately southeast of the project area. Two other structures are shown on the west side of "Carter Avenue," but they are outside of the project area, to the north. By 1905, it would appear that the project area had been totally abandoned. It would be years yet before the area would again be permanently settled.

Rural Development, 1905-1930s

During the period covered by the first available assessor's map book, 1905-1913, there are still definite traces of the ownership pattern last documented in the 1870s. North of Maxella, the project area was part of the 40.2-acre allotment to Francisco Machado, a subdivision of Tract 4 of the allotment to Andres, Antonio (sic), Rafael, and Cristobal Machado, as determined by District Court Case 2000. This land was also identified as the Rafael and Andres Machado Tract (Los Angeles County 1905-1913:9). In 1912, the southeast nine acres of the Francisco Machado allotment was subdivided into nine parcels, henceforth identified in the assessor books as Parcels 1-9. With some minor modifications in the extreme north of the project area (Parcel 9), Parcels 1-4 and 9 henceforth corresponded to the project area north of Maxella.

By 1913, the new owners of these parcels were assessed for the value of the land, each of which was placed at either 350 or 375 dollars. The owners of each parcel are:

Parcel 1: Unknown
Parcel 2: Salome Lonks
Parcel 3: Jesus Cruz
Parcel 4: Martina Morales
Parcel 9: Salome Lonks

No assessments were made for any improvements on any of the parcels, suggesting that no structures or other constructions stood on the property (Los Angeles County 1905-1913).

At this time, the nine parcels were immediately south of the boundary for the City of Venice. To the northeast of the nine parcels (beyond Carter Avenue) was the subdivision known as Wright's

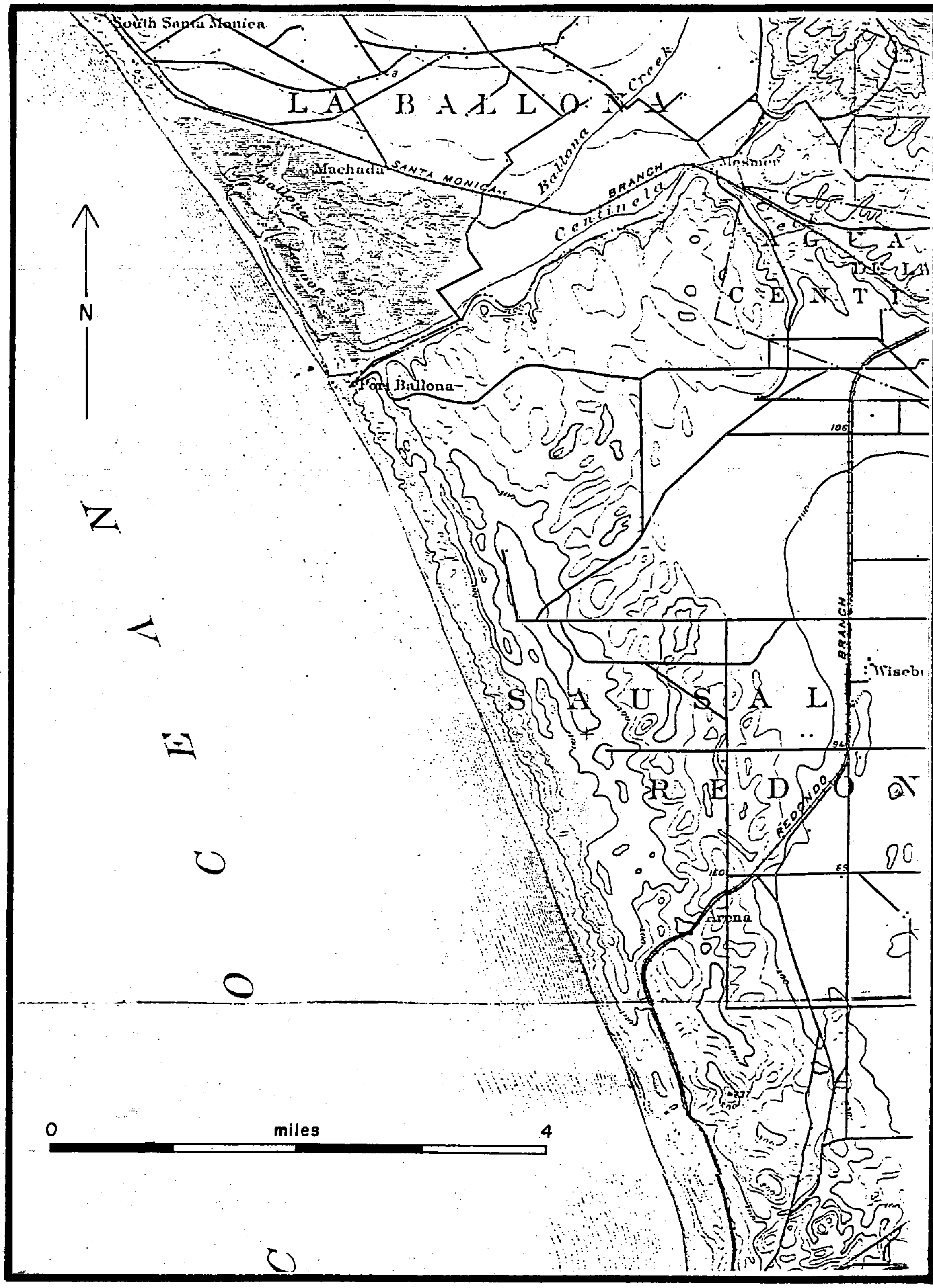


Figure 20. Redondo 1894/1905.

Addition to Ocean Park; it too was outside of Venice. The area south of the nine parcels was the extensive property of Anderson Rose until 1907. At that time, the property, which included the southern portion of the project area, passed to Herman Michel. The jump in land value from 1907 to 1913, from 5,400 to 42,880 dollars, and the beginning of relatively small improvement assessments (1,000 dollars) in 1907, would suggest that the area was perhaps being farmed during that period (Los Angeles County 1905-1913:14). Of course, it cannot necessarily be assumed that any farming was taking place within the project area itself, since the Anderson Rose Tract extended eastward far beyond the project area.

The Assessor's Book for 1912-1919 indicates relatively little change within the nine parcels north of Maxella, but there were additional subdivisions within Wright's Addition to Ocean Park, specifically between Carter and Del Rey Avenues north of Maxella. This area was subdivided into long rectangular blocks oriented with Maxella. The southwest portions of Parcels 32 to 36 would have been located within the northeast portion of the project area. Only Parcel 34, the third parcel north of Maxella, was assessed for improvements during this period, for 100 dollars in 1916, and 420 dollars in 1920 (Los Angeles County 1912-1919:211). Again, there is no guarantee that this improvement was located within our portion of this parcel.

South of Maxella, Herman Michel still owned all of the Anderson Rose Tract. In 1914, this land was assessed at 64,320 dollars, with the improvements pegged at 1,500. This had risen to 3,290 dollars by 1920. At this time, the Rose Tract was being labeled "dry land," which again would suggest either farming or some kind of grazing activity (Los Angeles County 1912-1919:202).

In looking at the general picture of the project area during the period from 1912 to 1919, it is apparent that the boundary of the City of Venice remained stationary, just north west of the project area. The area south of the rail line was an enormous block of land identified as the Pradera Tract.

For the period from 1920 to 1927, the area north of Maxella was recorded in Assessor Book 352, which is not now available due to the dislocations caused by subway station excavation. It is therefore impossible to say what transpired in that portion of the project area during this time. To the south of Maxella, the 143.31 acres of dry land that belonged to Herman Michel, passed to the Santa Monica Dairy Company in 1921. Although this included the southern portion of the project area, most of this tract was located to the east. It was in this area, east of what would later be Lincoln Boulevard, that the dairy was actually constructed. The land itself was assessed at 64,320 dollars in 1920, rising to 114,650 by 1927; the improvements made an even greater jump: from 3,290 to 12,320 dollars (Los Angeles County 1920-1927:4).

It was apparently during this time that much of the project area was used, formally or informally, as a trash dump. Its location just outside the city limits would have made it a convenient location for trash disposal. Informal trash disposal was not unusual during this period, and it was only in the 1930s and 1940s that trash disposal was generally limited to the area south of Washington Street and west of the rail line (Santany, personal communication 1990).

By this time, in the mid-1920s, Maxella Avenue was clearly established at its present location, and "Carter Avenue" no longer extended past it to the rail line. Another road, present Thatcher Avenue, now extends to the rail line. The area is still labeled "Machado," but the structure that used to be at the corner of Carter and the train tracks is no longer present (Figure 21; Venice 1923-1924). In its place are a series of eight structures near the old juncture, on the south side of the tracks. It is not known what function these structures might have served in the 1920s, but it is known that this area would later be part of a Japanese truck farm that prospered from at least the 1930s to the early 1940s.

By the mid-1920s, Lincoln Boulevard is already in place north of Washington Boulevard, coming to a terminus at Washington between Carter and Del Rey. The only structures within the project area

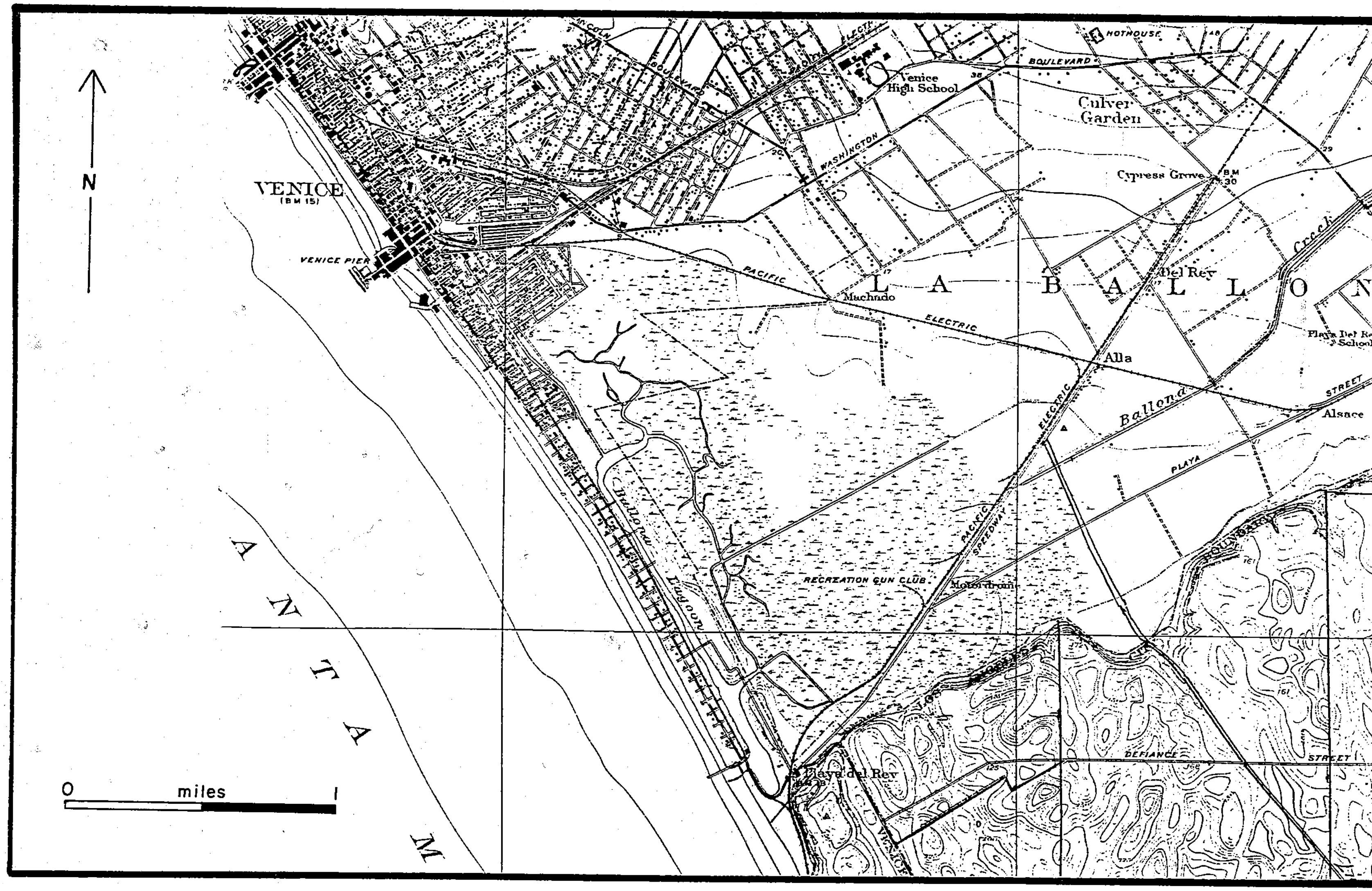


Figure 21. Venice 1923-1924.

or immediately adjacent to it, are located on the northern margin of the property, just southwest of Carter and south of the Venice City limits (Venice 1923-1924). It is unfortunate that we do not have the identity of the owner(s) within this area between 1920 and 1927.

During the period covered by the next assessor map book, 1927-1934, the area north of Maxella is again covered by Book No. 101. Parcels 1 through 4, immediately north of Maxella (1 located in the northeast; 4, in the southwest) are assessed for land, but not improvements, during this entire period. Only Parcel 9, located in the northern extreme of the project area, was assessed for improvements: 240 dollars in 1927 and 110 in 1934. The owners of these parcels are (Los Angeles County 1927-1934:6):

Parcel 1:	Belle J. Machado
Parcel 2:	John R. Lonks
Parcel 3:	Jesus Cruz (1912-1931)
	Perseverancia Cruz (1931-1932)
	Jesus Cruz (1932-)
Parcel 4:	Herman Deutsch
Parcel 9:	Vincent Howard (1927-)

From the evidence provided by the 1923-1924 survey map (see Figure 21), it would appear that the improvement assessment for Parcel 9 was for a structure of some kind. The drop in assessment levels did not necessarily represent the removal of a structure or part of a structure. Due to the Depression, the yearly assessments across the board were more than halved from their 1927 levels.

The area south of Maxella was still part of the large holding of the Santa Monica Dairy Company between 1927 and 1934. The entire holding was assessed at 114,650 dollars in 1927, with the amount dropping to 100,370 by 1934; the improvements, however, must have been substantial, since the assessments actually rose from 12,320 to 17,990 (Los Angeles County 1927-1934).

In 1931-1932, Lincoln Boulevard was extended south of Washington, between Carter and Del Rey, and continued south over the rail line (Perry, personal communication 1990). This had a number of repercussions for the project area. It made Carter Avenue redundant, paving the way for its transformation into a much-shortened residential street. It would also pave the way for the separation of the project area south of Maxella from the holdings of Santa Monica Dairy. Lincoln also brought with it added commercial and industrial development, and this too would affect the project area.

Commercial and Industrial Development, 1930s-1940s

Commercial and industrial activities started to move into the general project area long before the extension of Lincoln Boulevard. As early as 1924-1925, there was an airfield along the south side of Washington Street. This was an informal strip, used by stunt fliers entertaining the crowds at the Venice pavilion. Adjacent to the airstrip was a man-made lake known variously as Venice Lake or Lake Los Angeles (Perry, personal communication 1990; Figure 22). This seawater lake, connected to the lagoon and the Venice canals, was dug in the late 1920s and is today incorporated into Marina Del Rey, serving as the west end of Basin D.

After the airstrip was abandoned, this area became the site of "Hoppy Land," a short-lived amusement center owned by William Boyd who played Hop-along Cassidy (Perry, personal communication 1990). Later still, by the 1930s and 1940s, the area between Washington Street and the lagoon became a large trash dump (Santany, personal communication 1990).

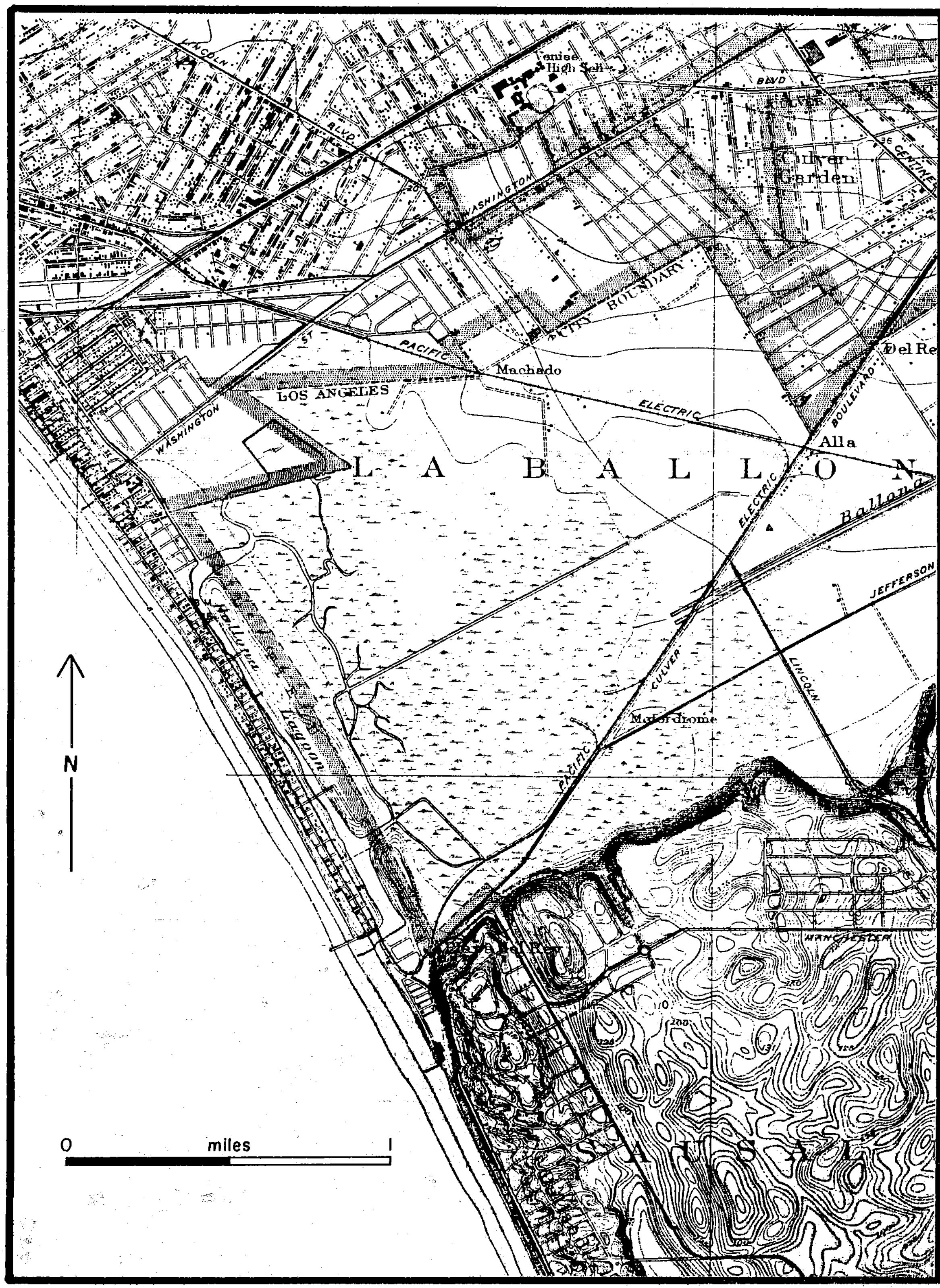


Figure 22. Venice 1930-1934.

Perhaps the biggest overall change to the general area in the 1930s was the introduction of oil wells and refineries. The Ohio Oil Company recovered oil from a wildcat well east of Grand Canal in December of 1929, and drilling was soon permitted throughout the area south of Washington Street. By 1931, there were 325 oil wells active in Ballona Lagoon (Stanton 1978:60), with refineries and tanks built up on islands of fill (Dillon et al. 1988:31). By the end of the 1930s, the oil boom would have a direct impact on the project area.

Mercury Petroleum Corporation began to buy up the parcels north of Maxella during the years covered by Assessor Book 101 (1934-1941). This change is reflected in the listing of the owners of Parcels 1-4 and 9:

Parcel 1:	Belle J. Machado
	Mercury Petroleum Corporation (1938-)
Parcel 2:	John R. Lonks
Parcel 3:	Jesus Cruz
	Mercury Petroleum Corporation (1940-)
Parcel 4:	Herman Deutsch
	Walter F. Watkins (1935-1936)
	Fred & H.W. Mangold (1936-1938)
	Mercury Petroleum Corporation (1938-)
Parcel 9:	Vincent Howard

Because of the Depression, land assessments were low; improvement assessments were even lower. Only two parcels were assessed for improvements of any kind: Parcel 9 for what must have been a small structure (110 dollars), and Parcel 1, assessed for 30 dollars a year starting in 1938 -- possibly an unproductive oil well or auxiliary structure (Los Angeles County 1934-1941:10-11).

Things also began to change for the area south of Maxella. The 3-acre tract at the southeast extreme of the project area (where the Marina Storage Building was in 1989) was separated from the huge tract belonging to the Santa Monica Dairy Company in 1936. At that time, the 3-acre tract was acquired by Roberts Public Markets, Inc., passing directly under the name of Fred L. Roberts in 1939. The land was assessed in 1937 for 3,000 dollars, while the improvements to the land jumped from nothing in 1936 to 15,000 dollars the following year; by 1939, that figure had risen to 38,920 dollars. Such a jump could only mean that a large market building of some sort was constructed between 1936 and 1937.

The area between Maxella and the 3-acre tract remained in the possession of Santa Monica Dairy, which had its total land assessment pegged at 90,810 dollars in 1937; improvements, 18,680. Since the dairy improvement assessment did not substantially change with the separation of the three acres within the project area, it seems clearer that dairy improvements were located east of Lincoln Boulevard. In 1941, the Santa Monica Dairy Company was reformulated under the name Edgemar Farms, but it appears that the dairy operation continued as before (Los Angeles County 1934-1941:8).

Mercury Petroleum reached its height of land acquisition during the period covered by the Assessor Map Book for 1941-1948. All of the project area north of Maxella, with the exception of Parcel 9, belonged to the oil company at some time during this period. A listing of the owners is provided here (Los Angeles County 1941-1948:10-11):

Parcels 1 and 2:	Mercury Petroleum Corporation (1941-1945)
	Vernon C. Brown (1946-)
Parcel 3:	Mercury Petroleum Corporation (1940-1941)
	Cristobal H. Brown (1942-)

Parcel 4:	Mercury Petroleum Corporation (1938-1941)
	H.H. Biber (1942-1946)
	Lincoln G. & Helen J. Anderson (1947-)
Parcel 9:	Vincent Howard (1941-)
	Vernon C. Brown (1945-1946)
	Art Brownies (1946)
	Vernon C. Brown et al. (1947-)

Substantial construction took place on Parcels 1 and 2, obviously combined in the assessment book for that purpose. Assessed for improvements at 30 dollars in 1941, the figure rose to 6,020 in 1942. We know from other sources that the building constructed on the two parcels was the Associated Pacific Industries factory, which supplied munitions and parts for the war effort. This factory grew throughout the war years, until it was assessed at 38,880 dollars in 1946. During this period, there were still no improvements on Parcels 3 and 4. Parcel 9, however, was transformed during this period much like 1 and 2, although at a slightly later date: assessed for 110 dollars in 1941, the figure jumped to 5,730 in 1948 (Los Angeles County 1941-1948:11). It was probably during this period that the brass foundry, known to have been built in the area, was constructed.

The area immediately adjacent to Lincoln Boulevard, part of "Wright's Addition to Ocean Park," also continued to develop commercially. The southwest part of Parcel 36, immediately north of Maxella and now separated from the rest of the parcel by Lincoln Boulevard, was assessed for improvements throughout this period (Los Angeles County 1941-1948:14).

In 1948, the project area south of Maxella was finally subdivided along lines familiar today. In addition to the 3-acre tract located in the far southeast, there was now a 4.02-acre tract immediately northwest of it, and a 0.75-acre tract located in the angle formed by Maxella and the rail line. By this time, Edgemar Farms, which was again assessed under the name of Santa Monica Dairy Company in 1942, was wholly limited to the east side of Lincoln Boulevard.

The 3-acre tract passed through a number of hands during this period: Fred L. Roberts (1939-1942), California Trust Company (1942-1945), Frances G. Hanson (1945), and Francis G. and Lottie H. Hanson (1945-). Land assessment jumped from 3,000 dollars in 1941 to 15,700 in 1948, but the relatively moderate increase in improvements, from 37,040 to 51,850, would suggest that the building constructed on the property in 1936-1937 remained relatively unchanged.

The 4.02-acre tract passed to Arcturus Manufacturing Corporation in 1948. That same year, land assessment was pegged at 12,500 dollars and improvements, 13,610. It is known from local residents that Arcturus constructed a metal working plant that featured a drop hammer that seemed to operate day and night.

The 0.75-acre tract, located in the confining area that would later hold the Bay Cities Metal Products plant, passed to S & S Supply corporation in 1948, with land assessed at 3250 dollars, and improvements, 4100 (Los Angeles County 1941-1948:18). For reasons that will be explained later, it is doubtful that Bay Cities Metal was constructed at this time.

At this point, information from the assessors map books starts to intersect with information provided by area maps and local residents, as well as earlier project area researchers. Edgemar Farms, which appears to have been a subsidiary of Santa Monica Dairy, had its headquarters located on the corner of Lincoln and Maxella, on the east side of Lincoln (Lopez, Vee and Paul Vignolle, personal communication 1989). From this it would appear that the dairy improvements were indeed outside of the project area.

Two survey maps cover this area during the early 1940s. The first (Figure 23; Venice 1940-1942), based on an original survey from 1923 but culture updated to 1940, would not appear to be accurate. The structure built on the 3-acre tract in 1936-1937 is not shown at all. The second survey map (Figure 24; Redondo 1942-1944) appears to be more accurate. The structure on the 3-acre tract is depicted, as is the Associated Pacific Industries factory on Parcels 1 and 2 north of Maxella. Another structure is shown in the extreme north of the project area, in what would be Parcel 9. This was probably the structure assessed as an improvement worth 110 dollars, since the brass foundry mentioned by Dillon et al. (1988:32) does not appear to have been built until 1948. A final structure is shown within the project area immediately to the northwest of the 3-acre tract. Nothing is known about this relatively small construction.

It is known that the Associated Pacific Industries building, constructed on Parcels 1 and 2 in 1942, manufactured ammunition and airplane and submarine parts during the war years (Figure 25; Lopez, personal communication 1989). It is not clear, however, whether the factory always went by the name Associated Pacific Industries, or if that was the name assumed after the complex was purchased by the Brown family in 1946 (Dillon et al. 1988:32). The factory switched to auto body parts after the war, and was finally abandoned in the early 1980s.

The war made changes in other parts of the project area. The large structure on the 3-acre tract, built in 1936-1937 as a wholesale commercial market, was transformed into a manufacturing complex, making use of the railroad spur constructed to the market facility from the main rail line immediately to the south. During this time, if not before, oil and gas storage tanks were placed below the surface throughout this area (Dillon et al. 1988:32), and chemical wastes were dumped rather indiscriminately in the area draining toward the lagoon. At least one 20-foot long tank with a capacity of between 6 and 8 thousand gallons has been found containing heavy oils in the area northwest of the 3-acre tract (near Backhoe Trenches 34 and 35). From plating on the tank, it was put into the ground no earlier than 1946 (Alex Feucht, personal communication 1990).

The rapid industrial development spurred by World War II was hardly limited to the immediate project area. Airplane parts were also manufactured in other areas along Lincoln Boulevard (Johnson, personal communication 1990), and there was the Crawford Airplane Factory on Washington (Perry, personal communication 1990). All of these were eventually dwarfed by the development of the Howard Hughes complex just north of the Ballona Escarpment (Perry, personal communication 1990).

Unfortunately, not all questions of land use have been answered, for some of the information from local residents is contradictory in detail. The most difficult to sort out are accounts of the Japanese truck farm.

All local residents remember a Japanese truck farm within the general project area that was was abruptly removed shortly after the outbreak of World War II. About the only thing most local residents agree upon is that celery was the main, but far from the only, produce. Most residents maintain that the farm was located east of Lincoln Boulevard (Johnson, Wirrer, Perry, Paul Vignolle, personal communication 1990), extending from Lincoln to Alla Road, from about Maxella Avenue south to Jefferson Boulevard. While most informants indicate that the farm got smaller as industrial development moved into the area, only one attempted an explanation as to how the truck farm and the dairy coexisted on the same land: according to Wirrer (personal communication 1990), the truck farm preceded Edgemar Dairy. In light of the assessor records, this would seem impossible.

Norman Santany (personal communication 1990) has offered the most satisfactory explanation. While the truck farm did extend far to the east beyond Lincoln (and presumably south of Edgemar), the shacks, quonset huts, and hot houses of the truck farm were located on the west side of Lincoln Boulevard, immediately south of the rail line that passed through the southern margin of the project area. Santany remembers a total of seven farm buildings in this area, all close to the rail line. This

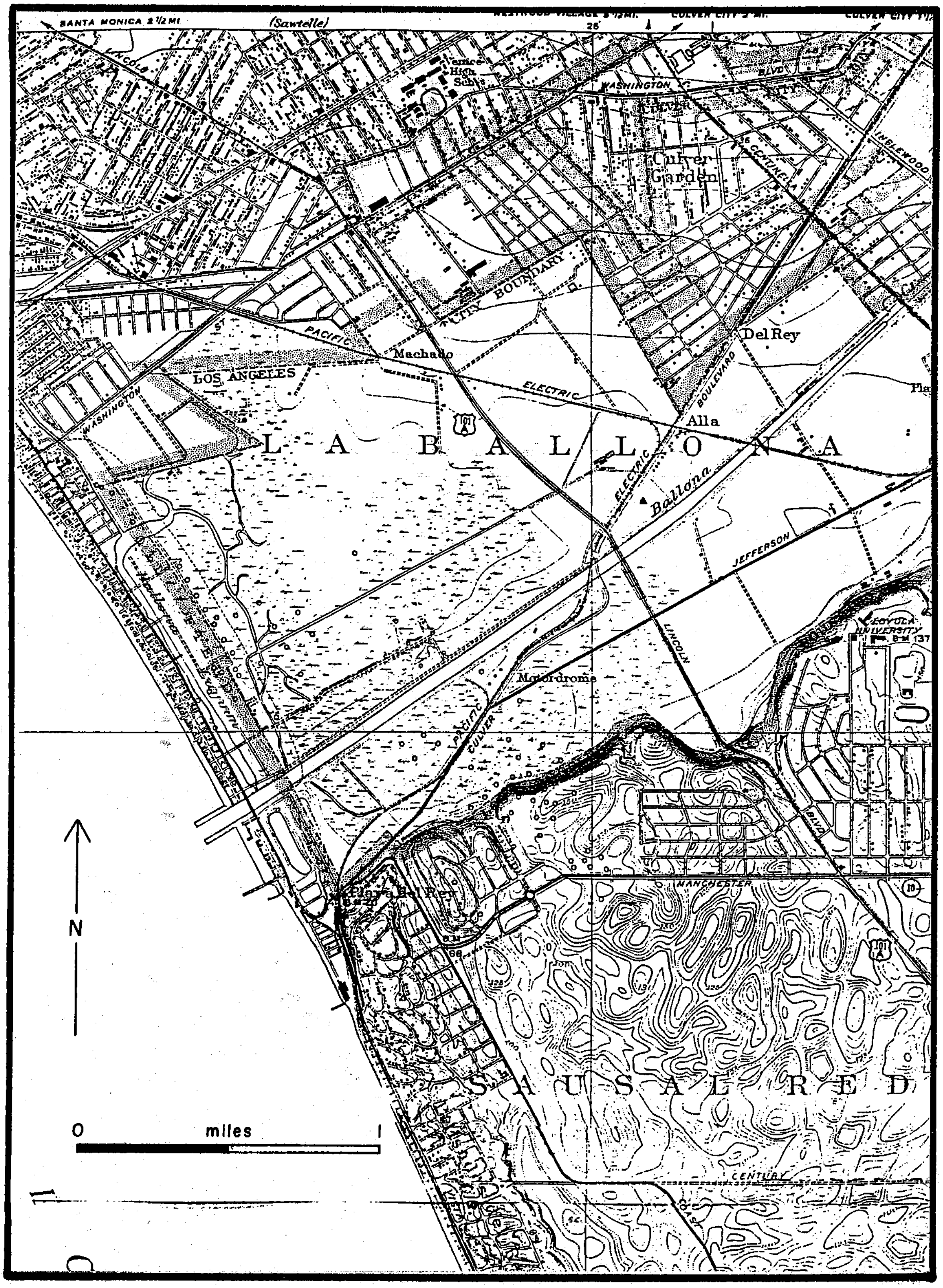


Figure 23. Venice 1940-1942.

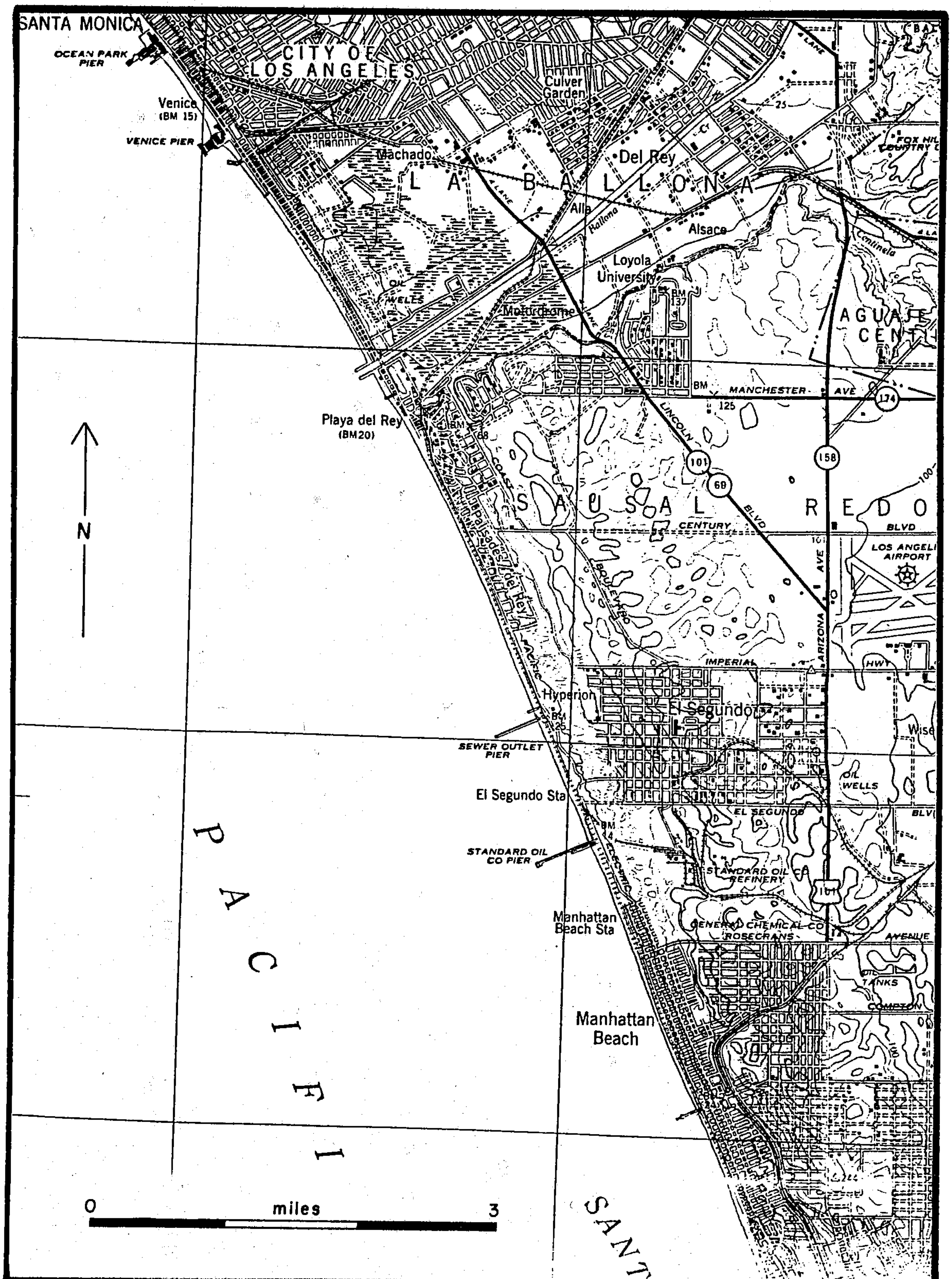


Figure 24. Redondo 1942-1944.

Figure 25. Oblique aerial view of Associated Pacific Building, looking north in 1953. Lincoln Boulevard in background. (Courtesy of UCLA Department of Geography Air Photo Archives, Spence Collection).

essentially agrees with information provided by the two survey maps from this period (Venice 1940-1942; Redondo 1942-1944). Although parts of the project area might have been rented and used by this truck farm in the 1930s, it would appear that none of its major buildings were located within the bounds of the present project area.

Industry and Urban Encroachment, 1950s-1990

By the late 1940s and early 1950s, the Associated Pacific Industries factory was a powerful concern. It was by far the largest assessment on any of the parcels north of Maxella. The assessor records for 1949-1953 indicated that Parcels 1 and 2, now combined, were pegged at a land assessment of 7,600 dollars in 1949, and an improvement assessment of 35,370. Vernon C. Brown remained the owner of the factory throughout this period, and for a while at least, became the owner of the other parcels as well, taking over Parcels 3, 4, and 9 in 1949.

Even as late as 1953, there were no improvements on Parcels 3 and 4, but such was not the case with Parcel 9. When Vernon C. Brown et al. assumed this land, it was assessed for 2,000 dollars, with improvements assessed at 6,000 dollars. This construction, probably the brass foundry identified by Dillon et al. (1988), came into the possession of Tison Engineering in 1951 (Los Angeles County 1949-1953:10).

The project area south of Maxella was also busy during this time. The 3-acre tract belonging to Francis G. and Lottie H. Hanson contained improvements of considerable value, which were assessed at 51,850 dollars. Arcturus Manufacturing Company, located on the 4.02-acre tract, was assessed for improvements at 12,140 dollars. The 0.75-acre tract, which belonged to S & S Supply Corporation until 1951 and Bedol Holding Company thereafter, was assessed for improvements to the tune of 4,160 dollars (Los Angeles County 1949-1953:18).

A survey map dated to this period (Venice 1950) depicts the Associated Pacific Industries complex, which by this point may have included two separate but adjacent buildings, and one (possibly two) structure to the north of that. The northernmost structure almost surely corresponds to Parcel 9. The large structure within the 3-acre tract is clearly depicted, as is Arcturus Manufacturing and a structure in the general location of what would later be Bay Cities Metal.

During the period covered by Assessor Book 101 between 1954 and 1958, Parcels 1-4 belonged to Vernon C. Brown, but improvements (the Associated Pacific Industries building) were limited to Parcels 1 and 2. Parcel 9 became subdivided into four smaller portions. Only a small sliver of this land belonged to Vernon Brown and it was not assessed for improvements. The northern-most portion remained with Tison Engineering, Inc., with improvements assessed at 6340 dollars in 1954, rising to 11,220 dollars in 1958. The southern-most portion passed to Arthur E. Pearson, who was only assessed for about 450 dollars, leaving it very questionable that any substantial structure was erected in that area (Los Angeles County 1954-1958:9).

Development also continued along Lincoln Boulevard, in "Wright's Addition to Ocean Park." Two of these small properties (Parcels 33 and 34) came into the possession of Vernon Brown during this period, and probably served as some sort of entry way for the Associated Pacific Industries building onto Lincoln Boulevard. Parcels 35 and 36, located on the corner of Maxella and Lincoln apparently were assessed as small businesses (Los Angeles County 1954-1958:9).

South of Maxella, the large structure on the 3-acre tract belonged to Francis G. and Lottie H. Hanson between the years 1954 and 1958. It is not known exactly when it assumed the name it bore in 1988, "Marina Storage Building," when Dillon et al. performed their survey. Arcturus Manufacturing

Corporation continued its occupation of the 4.05-acre tract immediately northwest of the Marina Storage Building. Assessments of these two structures rose gradually with inflation (Los Angeles County 1954-1958:18). The jump in assessment of the Bedol Holding Company's improvements, from 5,510 dollars in 1954 to 14,180 in 1957, would suggest that either a new building was constructed on the 0.75-acre tract, or that an old factory was re-tooled. It is from this period, between 1954 and 1957, that we can probably date Bay Cities Metal Products, the structure present on that tract in 1988-1989. This would agree with Henry Lopez's assertion that Bay Cities Metal was built in the 1950s (Lopez, personal communication 1989).

Very little changed during the period covered by the last available assessor map book, 1959 to 1963. The Associated Pacific Industries complex on Parcels 1 and 2 continued under Vernon C. Brown, with improvement assessment reaching an all-time high of 39,920 dollars. In Parcel 9, Tison Engineering sold out to Roy L. Beck and Charles L. Jones, while Vernon Brown acquired the southern part of this parcel from Pearson. Even in 1963, there were no improvements assessed for Parcels 3 and 4. South of Maxella, Arcturus continued as before, as did Bedol Holding Company (Bay Cities Metal Products). The 3-acre tract held by Francis and Lottie Hanson in 1959, passed to Robert S. Le Gage in 1963 (Los Angeles County 1959-1963:18). It is worth noting in passing that the Santa Monica Dairy (Edgemar Farms) still had title to lands east of Lincoln as late of 1963.

The aircraft industries and other industrial operations along Lincoln Boulevard undoubtedly served the war effort and fueled subsequent economic development within the area, but the environmental cost was high. Eventually it became intolerable as residential developments started to edge into the project area. The local beach quarantines of the 1940s, caused partly by oil and industrial waste spills, remained a problem until the 1950s. By this time, oil drilling in the Ballona Lagoon had begun to stop (Adler 1969:20). This began the slow decline of industry within the general area, as the lagoon became more attractive to settlement.

Residential development along Washington Street began to take hold in the years after World War II (Perry, personal communication 1990). It was from this direction that serious residential development began to encroach on the project area. Even as late as 1959, large parts of the area that now forms the Oxford Triangle -- Washington Street, Admiralty Way, Lincoln Boulevard -- were still used as a trash dump (Kamran, personal communication 1990). Residential construction within the Oxford Triangle began around 1960 and soon pressed toward the project area as far as what is now Princeton Drive (Perry, personal communication 1990).

About the time the Oxford Triangle was starting to develop, there was a much larger project afoot to develop the lagoon itself into an enormous marina. Of course, there were earlier attempts to create a viable harbor within Ballona Lagoon, but these failed due to lack of capital or general interest. "Port Ballona" was the first serious attempt to create a local harbor in the 1880s, and Abbot Kinney was interested in similar plans in the early 1900s. It was not, however, until 1949, when the U.S. Army Corps of Engineers published a report favorable to the construction of a harbor for pleasure craft, that the project sustained real interest. Work on the harbor was finally authorized by President Eisenhower in 1954, and Los Angeles County voters approved a bond for public financing two years later. Construction of the marina began in the late 1950s (Moran and Sewell 1979:101).

The marina, which would be designated "Marina del Rey," was designed for 6,000 boats in slip and another 2,000 in dry dock. Apparently, the northern portion of the marina was dredged out of the marsh, while the southern portion was at least partially filled in, to create a uniform depth of 4 to 5 m (Dillon et al. 1988:34). Marina del Rey was opened in 1962, but a bad storm damaged the entrance, necessitating a breakwater. All of this postponed the official dedication until 1965, at which time the marina had eight major basins and was hailed as the "world's largest man-made small craft harbor" (Moran and Sewell 1979:102; Figure 26). The marina quickly became a financial success, which made

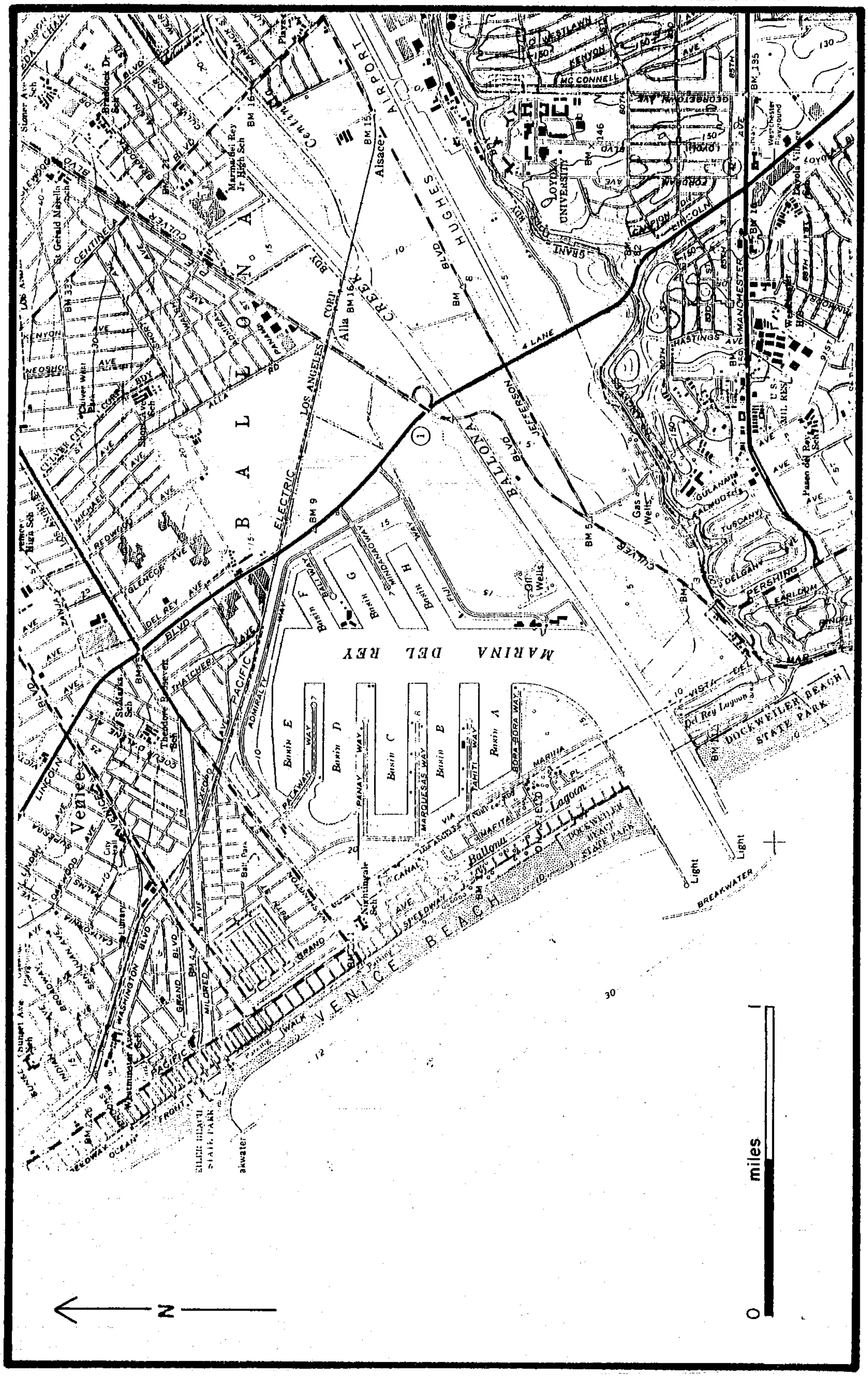


Figure 26. Venice 1964.

the surrounding lands, including the project area, all the more valuable for residential, commercial, and recreational development.

Construction of Marina del Rey had unforeseen consequences in Venice, where pressure began to be applied to improve the remaining canals. Property owners in Venice, fully aware of the lucrative development in neighboring Marina del Rey, sought to improve their own canal system and tie it with the marina. Toward that end, they formed the Venice Canals Improvement Association and petitioned the Los Angeles city council for the funds to effect this work, estimated to cost around 4 million dollars. Tenants and property owners without direct access to the canals were opposed to the idea, and the canal improvement project became a heated local controversy that lasted throughout the 1960s and early 1970s, until the project was finally dropped (Moran and Sewell 1979:102,105).

Survey maps from this period seem to be selective in what they depict within the project area. One map (Venice 1964; see Figure 26) shows a large, irregularly-shaped complex between Maxella and Princeton that corresponds to the Associated Pacific Industries complex. South of Maxella, the "Marina Storage Building" on the 3-acre tract and Arcturus Manufacturing immediately north of it, are depicted, but there is no evidence of a structure on the 0.75-acre tract. In fact, Bay Cities Metal does not appear on the two subsequent maps either (Venice 1964-1972; 1964-1981 or Figure 27). Between 1972 and 1981, however, it should be noted that Arcturus Manufacturing disappeared, evidently demolished during this period.

An even older landmark of the project area disappeared during this period. In 1977, the Southern Pacific Transportation Company abandoned its 60-foot wide railroad right-of-way that had been in place along the southern margin of the project area since 1892 (Johnson 1989). For many years before this move, the rail line had been used only sporadically, no more than three trains a month, hauling lumber to the yards in Venice. The tracks themselves were finally removed around 1980, paving the way for Admiralty Park immediately south of the project area (Perry, personal communication 1990).

The development of Marina del Rey soon led to some direct impacts on the project area. In 1984, a group of investors led by State Senator Alan Robbins formed the Marina East Holding Partnership, which succeeded in acquiring the project area -- 16 acres at the southern end of Oxford Triangle -- in November of 1987. The area was then planned for residential spaces, three department stores, a 19-story office building, restaurants and associated waterscaping. The project was to be called Admiralty Place Development, and the partnership received a loan of 10.7 million dollars for the demolition of three warehouses within the area (*Argonaut* Nov. 5, 1987).

Nothing much came of the development plans, and the following year, the J. H. Snyder Company agreed to buy the 16-acre tract from the Marina East Holding Partnership. Since that time, project plans have become more residential in nature and the project has gone through a number of name changes: Admiralty Way, then Marina Gateway, and finally Channel Gateway. It was also during this period that the first comprehensive cultural resource evaluation of the project area was conducted by Brian Dillon (1988). At the time of Dillon's report, divisions within the project area were identified by structures and features that no longer exist today. These features and their most recent developments, are discussed briefly below.

The Associated Pacific Industries building, still standing as late as 1989, had been largely abandoned since the early 1980s, by which time it was only occasionally used for plant sales and miscellaneous office use (Dillon et al. 1988:32). The Holt Industries parcel, located in the extreme north of the project area, almost surely corresponds to the industrial development formerly owned by Tison Engineering in Parcel 9. "Holt" must have been the name of the one of the owners after 1963, since this name does not appear in the Assessor Map Books. It is generally assumed that this was the location of the brass foundry. The Holt Industries parcel was vacant in 1988 (Dillon et al. 1988:3).

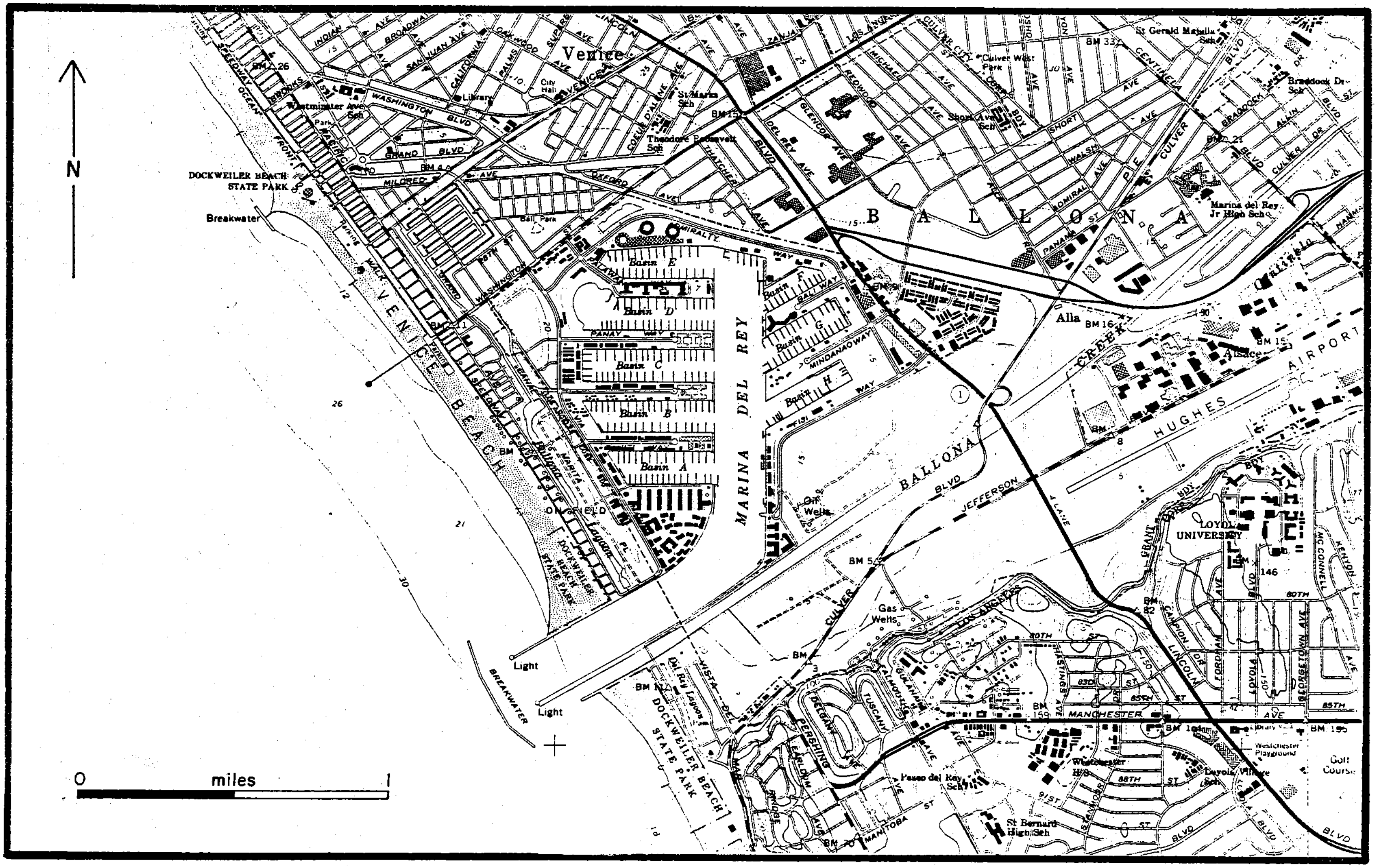


Figure 27. Venice 1964-1981.

Southwest of the Associated Pacific Industries building, the area north of Maxella was rounded out by a Los Angeles Police Department Impound Yard, located in Parcels 3 and 4. In 1988, Bruffy's Towing Company operated a concession from the LAPD (Dillon et al. 1988:3,48). Evidence of this concession was gone by 1989, although the Los Angeles Police Department still conducted training exercises within the compound.

By 1988, the Marina Storage Building was referred to as the Marina Storage Facility and tanning salon (Dillon et al. 1988:3). This structure was demolished in 1989. In the area formerly occupied by Arcturus Manufacturing, there was in 1988 an Avis Rental yard and used car sale and storage facility (Carl Marderosian, personal communication 1990). This area too was cleared out in 1989, as was the Bay Cities Metal Products building (Dillon et al. 1988:3). By 1990, all of the structures within the immediate project area had been demolished, leaving only the buildings to the northwest and southeast as reminders of the historical development of the area.

CHAPTER 5
PREVIOUS ARCHAEOLOGICAL RESEARCH

This chapter summarizes previous archaeological research at the Admiralty site and in the Ballona region in general. Much of the history of archaeological investigations for the Admiralty site has already been presented in Dillon et al. (1988), whereas previous work in the Ballona region has been discussed in Altschul et al. (1991). For more detailed discussions the reader is referred to these sources.

THE BALLONA REGION

Although a large number of sites have been found in the vicinity of the Ballona wetlands, previous archaeological studies in the area have been sporadic and limited in scope. Much of the area has been surveyed since the advent of cultural resource management (CRM) studies in the 1970s, but few new sites were found during the course of these studies. Instead, most of the sites were found at a much earlier date, and subsequently have been obscured by development. Many of these earlier studies were undertaken by interested amateurs. At best, the resulting reports have been of variable quality; at worst they have been poorly documented, second-hand reports of the work of collectors and pothunters.

Table 7 is a summary of previous archaeological projects in the Ballona region that have been recorded at the UCLA information center. Figure 28 plots the general location of recorded sites on the 1861 U. S. Coast Survey map of the Ballona Lagoon. Although relative placement of the sites is correct, locations are not precise to protect site confidentiality. Figure 29 presents the areas known to have been surveyed. It is important to note that Table 7 is not an exhaustive list of projects. Many recent projects, including several testing projects conducted by Van Horn and his associates at sites in the former wetlands south of the Admiralty site, had not been recorded at the information center at the time of the site file search (1990).

Perhaps the first archaeological work conducted and recorded in the Ballona was performed by Malcom Farmer. Farmer was an active avocational archaeologist, who at the request of Edwin Walker of the Southwest Museum, submitted his handwritten notes to that institution in 1936 (Charles Rozaire, personal communication 1991). Farmer recorded sites CA-LAn-67, 68, 69, 70, 71, 72, 73, and 74 (Farmer 1936). Farmer's notes were latter transferred to the Archaeological Survey files at UCLA.

Another early investigator was Stuart Peck (1947), then assistant curator of the museum at UCLA. Gas rationing during WWII forced Peck to curtail his archaeological searches in the desert and focus on an area closer to home. Peck chose to conduct limited excavations from 1945 through 1946 at the Mar Vista site, CA-LAn-62, located on property owned by the Hughes Aircraft Company. Forty years later, Van Horn (Archaeological Associates 1986) renamed the site, the Peck site, in honor of his predecessor.

One of the most active amateurs in the area was William Deane. Deane was a local mechanic and collector who was active during the late 1940s and early 1950s (Van Horn 1984:30). Some of his artifacts were photographed and briefly described by Marlys Thiel who used this information in an unpublished paper (Thiel 1953).

Table 7. Summary of Previous Archaeological Projects in the Vicinity of the Ballona Lagoon, Recorded at the UCLA Information Center.

UCLA Project No. (EIR #)	Project Type	Report	Site Recorded, Tested, or Excavated	Location
L.-27	Survey		no sites	NE of and paralleling Ballona Lagoon and Grand Canal, SW of Marina del Rey.
L.-78	Survey		no sites	Imperial Hwy.
L.-125	Survey		no sites	Sewage plant SE of Imperial Hwy & Vista del Mar.
L.-188	Survey		no sites	Dockweiler Beach State Park, NW of Playa del Rey.
L.-211	Testing	Dillon (1982b)	LAn-61,1018	On Bluff west of Loyola Marymount
L.-253	Survey	Stickel (1988)	LAn-47	NW of Admiralty Way and Lincoln Blvd.
L.-309E	Survey		no sites	Intersection of Sepulveda Blvd. and Lincoln Blvd.
L.-340	Survey		LAn-213	SE of Sepulveda Blvd. and I-405.
L.-436	Survey	Pence (1979)	LAn-54,62,193,203, 204,206,211,212, 213,216,1018	Summa Corp. Property Survey (now owned by MTP).
L.-442	Survey		no sites	Within EIR# L.-27, West of Basin B, Marina del Rey.
L.-462	Survey		no sites	NE of Hwy 90 and Mindanao Way.
L.-513	Survey		no sites	South of Manhattan Ave. and east of Pershing Dr.
L.-624	Survey		no sites	Within EIR# L.-27, west of Basin B, Marina del Rey.
L.-630	Survey		no sites	Within EIR# L.-27, west of Basin B, Marina del Rey.
L.-682	Survey		no sites	West of Grand Canal, 0.25 mi. So. of Washington Blvd.
L.-724	Excavation	King (1967)	LAn-194	North of Hwy 90 and 0.5 mi. east of I-405.
L.-729	Excavation	Peck (1947)	LAn-62	South of McDonnell Douglas complex in project area.
L.-737	Survey		no sites	West of Washington St. and Oxford Ave.
L.-748		Schofield (n.d.)	LAn-61	On bluff west of Loyola Marymount.
L.-750	Site Recording	Thiel (1953)	LAn-54,59-65,67, 206,211	On bluff west of Lincoln Blvd.
L.-751	Site Recording	Rozaire&Belous(1950)	LAn-59-66	On bluff So. of Playa Vista, W. and E. of Lincoln Blvd.
L.-839	Site Recording	Farmer (1936)	LAn-59-65,67	On bluff south of Playa Vista project area
L.-846	Survey		no sites	SE of Washington St. and Pacific Ave.
L.-873	Survey		no sites	On bluff west of Pershing St. and Jefferson Blvd.
L.-876			LAn-216	South of Sepulveda Blvd. and I-405.
L.-1143			LAn-1018	South of bluff and east of Lincoln Blvd.
L.-1157	Survey		no sites	Within EIR# L.-27, west of Basin D, Marina del Rey.
L.-1173	Survey		no sites	East of confluence of Ballona and Centinela creeks.
L.-1202	Survey	Dillon (1982a)	LAn-61,1018	On Bluff west of Loyola Marymount
L.-1249	Survey	Aycock (n.d.)	LAn-63, 64	On bluff west of Lincoln Blvd.
L.-1282	Survey		no sites	Dockweiler Beach State Park, NW of Playa del Rey.
L.-1321A&B			LAn-59	On bluff 0.5 mi. west of Sepulveda Blvd. and I-405.
L.-1443	Testing	Van Horn (1983)	LAn-61, 1018	On bluff west of Loyola Marymount.
L.-1444	Testing	Van Horn et al.(1983)	LAn-62A & B	Below and north of bluff and east of Lincoln Blvd.
L.-1509	Survey		no sites	Approx. 1 mi. SE of Sepulveda Blvd. and I-405.
L.-1512	Data Recovery	Archaeo.Assoc.(1986)	LAn-63, 64	On bluff west of Lincoln Blvd.
L.-1609	Survey		no sites	South of confluence of Ballona and Centinela creeks.
L.-1613	Survey		no sites	NW of Manchester Ave. and Hastings Ave.
L.-1614	Survey		no sites	NW of Manchester Ave. and Hastings Ave.
L.-1626	Survey		no sites	Dockweiler Beach State Park.
L.-1975	Survey	Peak&Assoc.(1989)	LAn-1698,1018	Along Lincoln Blvd. within Playa Vista

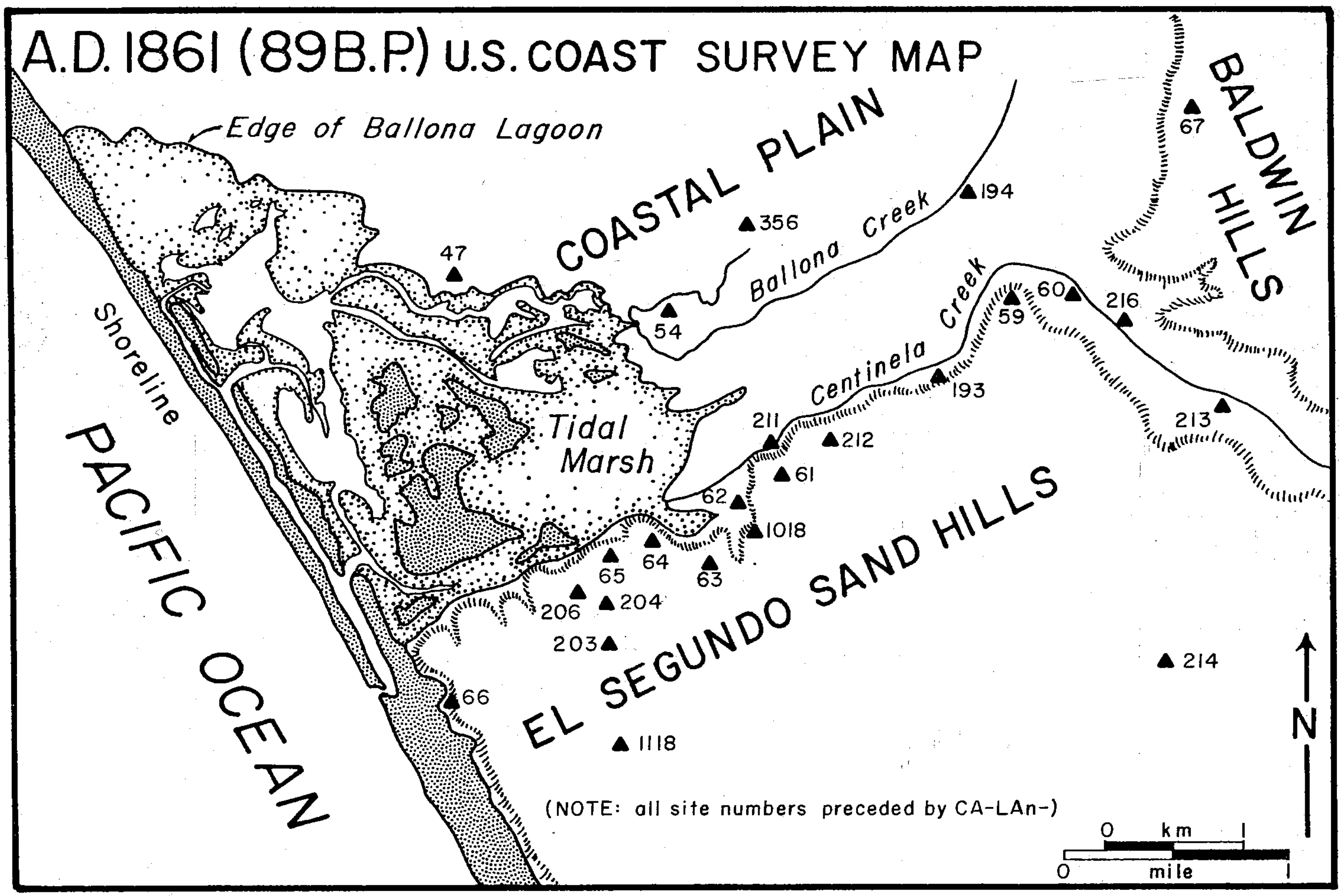


Figure 28. Previously recorded archaeological sites in the Del Rey Hills and Ballona wetlands.

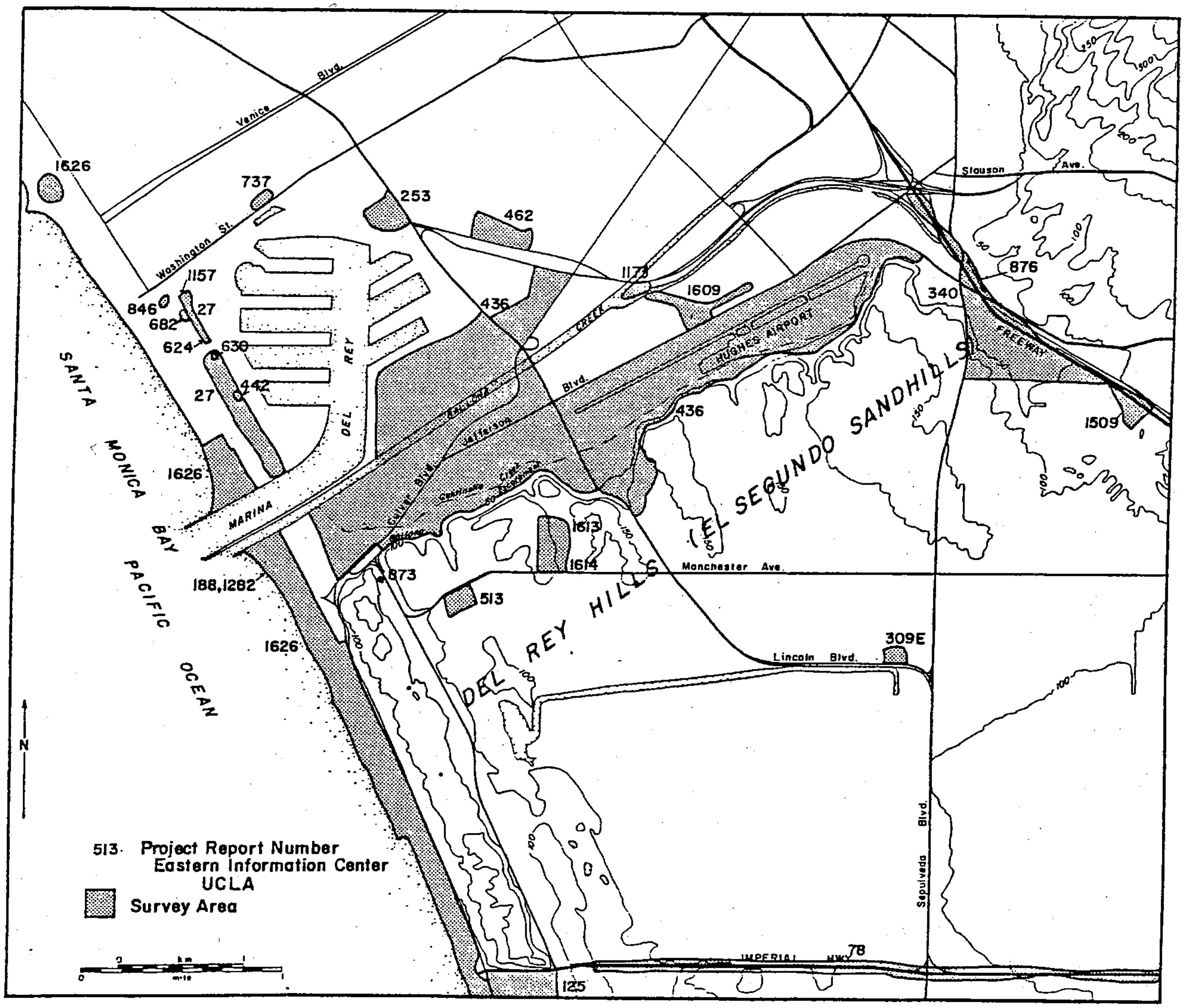


Figure 29. Previous Surveys conducted in the Ballona region, designated by UCLA EIR Number.

In 1950, two other investigators then students at UCLA, Charles Rozaire and Russell Belous, prepared a paper on Ballona Creek archaeology for an anthropology course. The paper is primarily a compilation of primary sources on the geology, environment, and archaeology of the region. The paper does include site forms for 23 sites visited and recorded by these two students (Rozaire and Belous 1950).

The area was essentially ignored by professional investigators until 1979 when R.L. Pence was contracted by Summa Corporation to conduct a reconnaissance survey of the entire parcel now being considered for the Playa Vista development. Pence's survey was cursory in nature, and he states that not all areas were covered systematically. Pence (1979) does briefly describe 17 sites, 16 of which had been previously recorded. In 1984, Van Horn (1984) resurveyed the project area at the request of Engineering Technology, Inc. His findings mirrored those reported by Pence.

Since Pence's survey, there have been a large number of projects conducted in and around the Ballona. Most of these have been small clearance surveys, largely with negative results. Beyond surveys, a few testing and data recovery projects have also been completed in the Ballona. In 1965, Chester King (1967) excavated portions of the Hammack Street site (CA-LAn-194). Nearly 20 years later, King returned to the Ballona with Clay Singer to search for the Peck site (CA-LAn-62), which by now had been buried by fill (King and Singer 1983). Their attempt was unsuccessful. Later in that same year, however, Van Horn and his colleagues were retained by the Koll Company and the Hughes Aircraft Company to monitor and study a series of soil corings in the area of CA-LAn-62. These investigators found a portion of the site (CA-LAn-62a), but given the limited nature of their investigations were unable to assess its research potential. In 1987, Van Horn and his colleagues were contracted by Howard Hughes Properties, Inc., to conduct test excavations both at another locus of CA-LAn-62 (b) and a locus of the nearby site, CA-LAn-211 (b) (Freeman et al. 1987). These sites were found to contain intact deposits, although the nature of the occupations could not be inferred.

The work at the Peck site was one in a series of projects that Van Horn and his colleagues conducted in the Ballona. Other work included the large-scale test excavations and data recovery projects at a series of sites in the Del Rey Hills, including CA-LAn-59, 61, 63, 64, and 206 (Murray and Van Horn 1983; Van Horn and Murray 1984, 1985; Van Horn 1984, 1987). Brian Dillon (1982a, b), who often worked as an associate of Van Horn's, also independently conducted test excavations at CA-LAn-61 and 1018.

ADMIRALTY SITE

The original site record for the Admiralty site is lost. It is not known by who or when the site was first recorded. According to Dillon et al. (1988:35) the site was recognized prior to 1948, when a second site form was placed on file, presumably at UCLA, by Agnes Bierman. By the time of Dillon's work, this record too had been destroyed, leaving Keith Johnson's 1961 updated site record as the "original" site form on file at the Eastern Information Center at UCLA.

Dillon speculates that the original recorders may have been Malcolm Farmer or Eugene Robinson, avocational archaeologists active in the area during the 1930s and 1940s. While possible, Farmer kept a relatively detailed account of his activities and locations of sites, which were later used by professional archaeologists to record formally numerous Ballona sites. The Admiralty site is conspicuously absent from Farmer's 1936 notes. Another possible candidate is Hal Eberhart, for many years professor at California State University, Los Angeles. Eberhart inventoried many sites in coastal Los Angeles County during the 1940s, including several in the Ballona. Even if Eberhart formally recorded the Admiralty site, it is possible that he never visited it. Eberhart often took amateur reports and used them to complete site forms (Charles Rozaire, personal communication, 1990).

The first documented work at the Admiralty site occurred in 1961. During construction of a sewer line to service Yacht Basin F at Marina del Rey, the construction crew uncovered a multiple burial. The Los Angeles County Sheriff's Department was contacted to investigate. After it was determined that the remains were aboriginal, the Sheriff's Department notified the UCLA Archaeological Survey.

Keith Johnson, then a graduate student at UCLA, assembled a crew of students and volunteers from a local archaeological society to conduct salvage excavations. Between January and April 1961, Johnson was able to spend three to four weekends at the site, with a crew composed of 17 volunteer UCLA students and avocational members of a local archaeological society (Keith Johnson, personal communication, 1989). In all, 40 man days were spent excavating the site (Meighan 1961).

On the UCLA site form, Johnson states that the site was about 100 m in diameter. The site had been repeatedly plowed and used to grow corn. After the area had been abandoned by agricultural pursuits, portions of the site were bulldozed for a variety of development projects. By 1961, Johnson believed that most of the original shell midden had been severely disturbed, and that the construction of Marina del Rey would more-or-less completely destroy the rest of the site.

The 1961 excavations involved the placement of 15 5-ft by 5-ft units in a checkerboard fashion in three areas adjacent to the sewer trench. Figure 30 places Johnson's excavations in relation to subsequent work at the site. Figure 31 is a photograph of Johnson's two western excavation. The photographer is standing approximately on the southern edge of the site and looking north. The transmission line in the background units is located within the the Pacific Electric Railroad right-of-way. The northern edge of the Admiralty site lies in the right-of-way, just east, or to the right, of the photograph. Figure 32 is a close-up of one of the western excavation units. The right-of-way is again marked by the transmission line. The white structure north of the transmission line in the right center of the photograph is the Bay City Metals building. The portion of the Admiralty site that was excavated for the project reported herein is located about 200 m east of that building.

The eastern area excavated by UCLA in 1961 is shown in Figure 33. This area is now located in Basin F of the Marina del Rey Harbor. The photograph, taken facing south, shows the Ballona Escarpment, which forms the southern edge of the wetlands, in the far distance.

The methods used in the 1961 excavation reflect the salvage nature of the work. The fill from the 1961 excavation units was not screened, but all units were excavated by trowel. Johnson (personal communication, 1989) remembers the stratigraphy as a dark, organic clay soil with shell intermixed extending from the surface to about 24 inches below grade. This soil was termed a midden, and contained primarily lithic artifacts, faunal remains, and shell.

At the base of the midden, Johnson encountered a white caliche soil, that was sterile except where burial pits had been dug into it. Four burials were encountered. Johnson (personal communication, 1989) remembered two of the pits contained flexed inhumations. One burial had been disturbed by the sewer line, and Johnson could recall little of note about it. The other consisted of two individuals and a possible dog. Accompanying the skeletons were five to eight broken harpoons, relatively rare artifacts that have not been reported since from Ballona sites. Johnson believed that the burials were "randomly" placed, with no central cemetery located at the site.

Artifacts recovered from the 1961 excavations include stone bowl fragments, projectile points, lithic debitage, bone tools, shell beads, antler harpoons, choppers, hammerstones, scrapers, pestle, and ground stone fragments. Johnson (personal communication, 1989) remembered that three to four pieces of modern glass were also found at the base of the midden, evidence of the disturbed nature of the deposit. The 1961 artifact collection and the human remains are presently curated at the Museum of Culture History at UCLA.

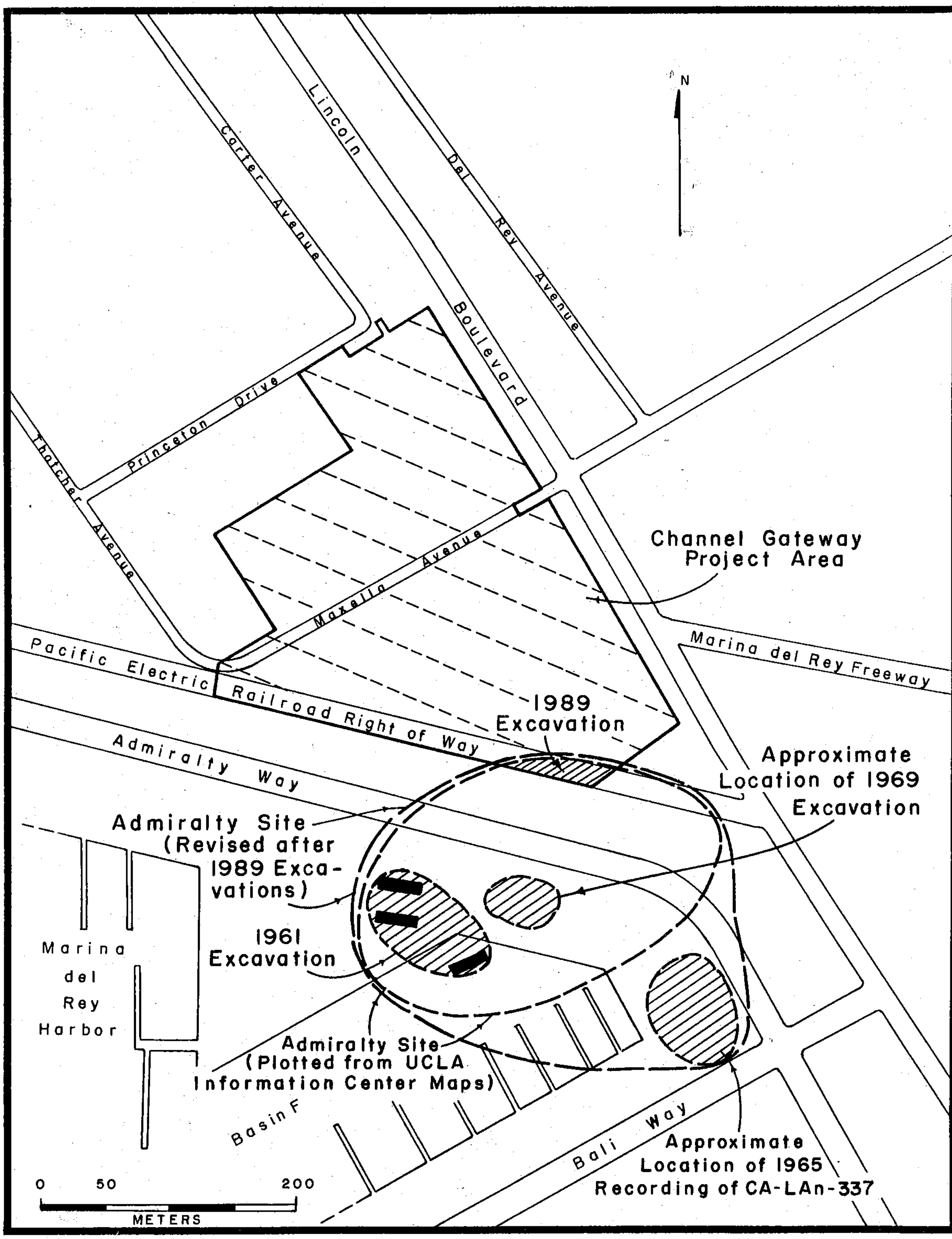


Figure 30. The Admiralty site (CA-LAn-47), showing previous investigations.

Figure 31. View of the two western excavation areas, looking north. Note: Transmission line in center of photograph marks the Pacific Electric Railroad right-of-way (Photograph courtesy of Keith Johnson).

Figure 32. Second UCLA excavation unit, looking north. Note: Transmission line marks the railroad right-of-way and the white building on the right side of photograph is the Bay City Metals Building (Photograph courtesy of Keith Johnson).

Figure 33. View of eastern excavation unit, looking south. Note: This excavation area is now within Basin F of the Marina del Rey Harbor (Photograph courtesy of Keith Johnson).

In 1965, the Admiralty site vicinity was again visited by UCLA archaeologists. Responding to a "possibility of destruction" notification, Burnham and Romoli (1965) recorded a site at 4455 Admiralty Way. At the time an office building was being constructed on the property. The site was described as a "thin shell midden with about one to two feet of overburden (Burnham and Romoli 1965)." The midden was approximately 45 m by 6 m, and composed of "black clay" that extended about 60 cm below the surface into a "yellowish adobe" soil. Several cores and a few flakes were observed. Two disturbed burials were also noted. No mention is made of the final disposition of the artifacts or human remains.

Burnham and Romoli (1965) remark that the site is probably near CA-LAN-47. Even so, the area was originally assigned the site number, CA-LAN-337. Sometime later the site was joined with CA-LAN-47, and the 337 suffix was eliminated.

Dillon et al. (1988) note that the address, 4455 Admiralty Way, is not currently in use. Based on the present numbering system, Dillon and others argue that the most likely location for the 1965 investigations is under the California Yacht Club parking lot (see Figure 30). They do point out, however, that a 1969 article in the Marina del Rey Reporter by Harvey S. Levine (1969) places the 1965 investigations at 4519 Admiralty Way, now the location of the California Overseas Bank.

In 1969, excavations in conjunction with the construction Warehouse Restaurant next to Yacht Basin F uncovered human remains and prehistoric artifacts. Tom King visited the construction and presumably collected the human remains and associated artifacts. According to Dillon et al. (1988:40), King's collection is held by the UCLA Museum of Natural History, although it has not been catalogued. Also in 1969, UCLA took possession of a second collection of human remains and artifacts from the Admiralty site. George Thayer donated about 100 human bones and bone fragments from an estimated four individuals as well as 12 lithic artifacts and some unmodified shell. Thayer's collection presumably also derived from the Warehouse Restaurant construction. The exact provenience of the collection, however, is not recorded at UCLA, leaving Levine's (1969) newspaper article as the only source purporting the location of the artifacts and human remains.

It was nearly 20 years before the Admiralty site was again visited by a professional archaeologist. In 1988, E. Gary Stickel (1988) was contracted by Planning Consultants Research to conduct a cultural resource study of the Admiralty Place Development. This development never occurred and the project area was later sold to the J. H. Snyder Company, who then made plans to develop Channel Gateway, the current project. Stickel's report, therefore, covers the same 16.1 acres as this report.

Stickel conducted an literature and archival search as well as a pedestrian survey of the property. He noted that the bulk of the property had been developed, with the majority of the surface covered by asphalt or concrete pavements. The surface in one area of the property, the Los Angeles Police Impound yard, located north of Maxella Avenue, could be inspected. In this 6-acre lot, Stickel (1988:9) observed

> the remains of a shell midden. . . . The shell pieces were not thickly distributed, but nonetheless the known economic species of chione and pecten were seen as highly fragmented pieces. Shell fragments where (sic) seen throughout the yard but they seem to be more prevalent in the northeastern corner of the yard. It was in that area that 1 quartzite flake was observed.

Based on the survey, Stickel recommended that the Los Angeles Police Impound yard not be further disturbed, that the pavement on the site be removed and that the removal be monitored by an archaeologist, and that test excavations conducted throughout the 16-acre parcel.

In the spring of 1988, Dillon and his colleagues conducted archival research, pedestrian survey, and test excavations on the portion of CA-LAn-47 located within the Admiralty Place development. Dillon et al. (1988) began their work with a walk-over of the property. They re-identified that portion of the Los Angeles Police Impound Yard containing shell on the surface. In addition, they located a second significant shell deposit in the southeast corner of the project site. Situated in a railroad right-of-way that at various times has been owned by either the Pacific Electric Railway or the Southern Pacific Railroad, Dillon's team found 16 chipped stone and 5 ground stone artifacts as well as a dispersed scatter of shell from primarily economic species of chione, oyster, and scallop.

Test excavations were conducted in both shell scatters. In the Los Angeles Police Impound Yard two 2-m by 2-m units were excavated in 10-cm arbitrary levels with the fill dry screened through 1/8-in mesh hardware cloth. The excavations indicated that the shell observed on the surface was not prehistoric in origin. No prehistoric artifacts were found, and much of the shell represented noneconomic species. A single human tooth was recovered in Unit 2, Level 4. This tooth was not found with any prehistoric material. Instead, it was found intermixed with relatively large amounts of asphalt, concrete, glass, brick, and metal. Based on these results, Dillon et al. (1988:126-127) concluded:

> Our own test excavations conducted within the Impound Yard . . . revealed no intact archaeological deposit there whatsoever. Rather, secondary, mixed fill with large amounts of modern garbage that contained some shell obviously imported from some other location, possibly the actual LAN-47 site to the south. In addition to the natural sources, such as is commonly found in fill material from dredging: these shell species have not been reported for that portion of the LAN-47 site known to be relatively intact.

> The Police Impound Yard fill deposit in its lower levels could not have been emplaced prior to 1919, as proven by the coin recovered from Unit 1, Level 7, and the upper parts of this fill layer certainly post-date 1952 (as evidenced by the coin discovered from Unit 1, Level 4) and probably result from the 1961 Marina Del Rey Yacht Harbor excavations. The mixed deposit in the Police Impound Yard overlies the original sterile ground surface that anciently was the silted-in margin of "Ballona Bay." The mixed fill found in units 1 and 2 prove that the northeastern margin of the Police Impound Yard lies beyond the boundaries of archaeological site CA-LAN-47.

To understand the local geological processes that led to the stratigraphy observed in Test Units 1 and 2, Dillon and his colleagues excavated 9 backhoe trenches in the Associated Pacific Industries lot, northeast of the Impound Yard. These trenches documented the pervasive historic disturbance that predominated the stratigraphy of the area, and the lack of intact prehistoric cultural deposits.

In contrast to the findings from the northern part of the parcel were those from the railroad right-of-way. Here, Dillon's team excavated two 1-m by 2-m units. Vertical control was maintained through the use of 10 cm arbitrary levels, with the fill water screened through 1/8-in mesh hardware cloth.

The upper levels of both units contained a mixture of prehistoric and historic material. With depth, however, the amount of historic material dramatically decreased, whereas the density of prehistoric artifacts and economic shell increased. The cultural deposits peaked in richness between 30 cm and 50 cm below surface, steadily declining until the base of the midden was reached about 90 cm below surface.

Ownership of the right-of-way by the railroad appears to have been a mixed blessing. On the one hand, it kept the area from being developed like the surrounding parcels. On the other hand, use of the area as a railroad line for the better part of the twentieth century had greatly disturbed the upper portion of the midden. The test excavations demonstrated, however, that even with the high degree of disturbance in the upper levels, the bulk of the midden remained intact.

The artifact assemblage recovered by Dillon's team was reflective of a Late Prehistoric period occupation. Two projectile points were found that fit comfortably into Late Prehistoric styles. Of the 15 shell beads recovered, 5 were typed as *Olivella* cupped, 4 as *Olivella* saucer, 2 as *Olivella* oval, 1 as *Olivella* lipped, 1 as *Olivella* cylinder, and 2 as *Mytilus* disk. *Olivella* cupped and *Mytilus* disk beads, which have been dated between A.D. 700 and 1800 in western Los Angeles County, are two of the hallmarks of the Late Prehistoric period (Brock 1986). *Olivella* saucer beads, the other major type found at the Admiralty site, can date as early as 1000 B.C., but were also made well into the Late Prehistoric period. Dillon et al. (1988:106) also note that the absence of *Olivella* rough and chipped saucer beads is significant. These two bead types are commonly found in historic deposits, and would be strong indications of a protohistoric or historic period occupation.

In addition to diagnostic material, the test excavations recovered relatively large amounts of chipped stone and ground stone artifacts as well as invertebrate and vertebrate faunal remains. Chipped stone tools were made from basalt, quartzite, chert, and chalcedony. Detailed technological analyses were not conducted. Even so, Dillon et al. (1988:98) observed that large tools tended to be made from the poorer quality basalt and quartzite, whereas the smaller, presumably finer made, tools were knapped from the cherts and chalcedonies. Ground stone generally followed this rule, with most produced from large cobbles of basalt or quartzite. Ground stone artifacts were restricted to mano and stone bowl fragments.

The faunal remains from the railroad right-of-way were surprisingly diverse for such a small collection. Seven mammalian species were identified, including mule deer (*Odocoileus hemionus*), dog (*Canis sp.*), eared seal (*Otariidae*), black-tailed hare (*Lepus californicus*), desert cottontail (*Sylvilagus auduboni*), California ground squirrel (*Citellus beecheyi*), and valley pocket gopher (*Thomomys bottae*). Although most of the gopher remains are probably intrusive, the remainder indicate a major subsistence focus toward terrestrial animals. Birds were represented by three waterfowl species, pacific loon (*Gavia pacifica*), mallard (*Anas platyrynchos*), and common snipe (*Capella gallinago*). Historically, all three were common winter visitors to the estuaries and marshes of the Ballona.

Five fish species were identified from 12 vertebrae. Three were shark and ray species, shovelnose guitarfish (*Rhinobatos productus*), bat ray (*Myliobatis californica*), and leopard shark (*Triakis semifasciata*). These types of sharks and rays prefer sand and mud bottom surfaces, such as those provided by coastal lagoons. Of the two boney fish identified, the sheephead (*Semicossyphus pulcher*) is found in the kelp bed near the coast, whereas the yellowfin croaker (*Umbrina roncador*) is common in lagoonal settings.

The emphasis on lagoonal and nearshore habitats evident in the fish vertebrae was mirrored in the shellfish data. *Chione californensis* was by far the most common species, outnumbering the next common mollusc, *Ostrea lurida* by a margin of 3.5:1. Dillon et al. (1988:19) interpret the predominance of chione, which prefer mud or sandy bottom habitats, as evidence of prehistoric subsistence strategies focused on the lagoon.

In addition to subsistence related material, eight identifiable and four other possible human bones were recovered from the railroad right-of-way. All human remains were found in the midden fill, with no evidence of intact burials observed.

The only feature identified in the 1988 investigations was a possible dog or fox burial. This was the second canid burial found at the Admiralty site, the first discovered by Johnson in 1961 associated with two human interments. Although infrequent, dog burials have been found at other Late Prehistoric sites, notably on the Channel Islands and at Encino Village (CA-LAN-43) (Langenwalter 1986). Bean and Smith (1978:545) note that the Gabrielino sometimes placed dogs in burials over the deceased.

Based on the test excavations, Dillon and his colleagues (1988) argued that the Admiralty site did not extend into the northern portion of Admiralty Place development. They conclude, however, that "an important part of the CA-LAN-47 archaeological site remains on the Admiralty Place Parcel, in the area of the railroad right-of-way, and possibly under adjacent pavements to the northeast in the Marina Storage or other areas" (Dillon et al. 1988:128). To mitigate possible impacts to the site due to construction, Dillon et al. (1988) suggested: (1) the development of a research design; (2) monitoring of construction and the excavation of one 2-m by 2-m unit in the southwest corner of the Los Angeles Police Impound Yard; (3) monitoring of construction in the Associated Pacific Industries parcel; (4) the excavation of between 6 and 10 2-m by 2-m units in the Marina Storage and adjacent parcels south of Maxella Avenue; and (5) the excavation of 20 1-m by 2-m units in the railroad right-of-way.

In September of 1988, Dillon (1988) returned to the Admiralty site. By this time, plans for the Admiralty Place Development had given way to a new development project, known as Channel Gateway. The original plans of Channel Gateway did not incorporate the railroad right-of-way. Because no intact cultural deposits had been found north of the right-of-way, there was the distinct possibility that none of the Admiralty site extended onto the proposed project site.

To test this hypothesis, Dillon (1988) excavated 11 backhoe trenches. Each trench measured 5 ft by 2 ft, and trenches were spaced at 20-ft intervals. No artifacts were observed, and no evidence of intact cultural deposits was discerned. Dillon (1988:6) concluded that "the LAN-47 archaeological site

. . . seems to be confined to the railroad right-of-way and does not extend uninterrupted onto the adjoining Marina Storage parcel to the north." Dillon argued that the site may have originally extended to the north, but that modern construction may have destroyed this portion of the site. As will be demonstrated later in this report, this conclusion was premature.

CHAPTER 6
RESEARCH DESIGN

The Channel Gateway project was conducted in two phases, testing and data recovery. Each phase had its own goals, with methods designed to meet particular objectives. As with many projects that evolve over time, the questions addressed in the Channel Gateway investigations became increasingly specific in nature. To accommodate these shifts, a flexible research design was developed, the structure and content of which is the subject of this chapter.

TESTING PHASE

At the outset, the testing phase had two major goals: (1) to characterize the horizontal extent of the Admiralty site and (2) to determine the integrity of the cultural deposit. Previous investigations had arrived at two divergent interpretations concerning site size. Stickel (1988) contended that the Admiralty site extended northwest of Maxella Drive, an interpretation that approximately doubled the size of the site over previous recordings. In subsurface excavations, Dillon et al. (1988) found no evidence to support this claim. Instead, the data recovered suggested that original recording was relatively accurate.

The conclusions reached by Dillon et al. (1988) regarding the size of the Admiralty site and its horizontal extent onto the Channel Gateway project were based on two 2-m by 2-m test units in the Los Angeles Police Impound Yard, 9 backhoe trenches in the adjoining Associated Pacific Building parcel, two 1-m by 2-m test units in the Pacific Electric Railroad right-of-way, and 11 backhoe trenches on the border between the railroad right-of-way and the Marina Storage lot to the north. Several archaeologists (Singer 1988; Schwartz 1988) argued that the testing was too limited in scope to provide an accurate assessment of site size. They contended that without a systematic subsurface testing program that covered the entire parcel, the issue of site size could not be addressed.

Beyond site size, there is the related issue of site integrity. Dillon et al. (1988) found intact prehistoric cultural deposits, varying between 80 and 90 cm in thickness, in the railroad right-of-way. Although intact, these deposits were clearly disturbed, with modern debris found from the surface to the deepest level in both test pits. These observations match Johnson's recollections of the 1961 excavations (Keith Johnson, personal communication 1989). Within the railroad right-of-way, historic disturbance appeared to be most pervasive in the upper 30 cm of the deposit. Given the limited scope of Dillon's testing program, however, the extent of disturbance could not be effectively demonstrated.

During the testing phase for the current project, it became clear that the historic occupation of the Channel Gateway parcel also had not been adequately assessed. This failure was not the fault of previous investigators, but rather the fact that most of the parcel was sealed with asphalt or concrete. Without subsurface exploration, previous workers had no way to determine the number or nature of historic features on the property. Therefore, as the 1989 testing phase fieldwork was being conducted, a third goal was added to the research design: historic resources had to be identified and their significance assessed.

Research Questions

The three goals of the testing phase were rephrased as the following questions:

1. How large is the Admiralty site? What is the horizontal extent of the Admiralty site on the Channel Gateway property?

2. What is the integrity of the prehistoric deposits? How pervasive are modern disturbances?

3. What historic resources exist on the property? Where are they located? What is their integrity and scientific potential?

Data Requirements

To address issues of size, integrity, and identification, we need sufficient exposures to ensure that cultural materials are observed. To assess site integrity, stratigraphic data must be obtained.

Methodology

To obtain the requisite data, a comprehensive search of the entire parcel needed to be undertaken. Because of modern development, surface observations were not adequate to delineate site size or identify previously unrecorded resources. Instead, a form of subsurface probing had to be devised. In essence, probing became a form of three-dimensional survey. Much like a pedestrian survey, our objective was to inspect the parcel using transects spaced a specified intervals. Instead of walking each transect, however, we used a backhoe to excavate a trench, thereby providing a linear exposure.

Our strategy was to place transects at specified intervals systematically over the entire property. This strategy was complicated by the presence of standing buildings, asphalt and concrete slabs, streets, and on-going established businesses. In some cases, whole transects or individual trenches were moved slightly in one direction or the other to avoid a modern feature.

Whereas trenching provided both the vertical and horizontal parameters of the various prehistoric and historic deposits, this strategy did not supply sufficient information on site content or integrity. To obtain data on these issues, small test units were manually excavated in each identified cultural deposit.

DATA RECOVERY PHASE

Prehistoric Component

Based on the data gathered by previous researchers and during the testing phase, we concluded that the Admiralty site extended from Basin F in Marina del Rey on the south to just north of the Pacific Electric Railroad right-of-way; a distance of approximately 225 m. The width of the site has never been accurately measured. We do know that within the railroad right-of-way the site extends approximately 60 m from its western boundary to the property line. How much further east it extends is unknown. The site files housed at the UCLA Archaeological Information Center indicate that the site is roughly ovoid with a maximum width of 225 m.

Conservatively, we can assume that the width of the site is at least 75 m (a more likely estimate is between 100 and 150), and its shape is roughly rectangular. At a minimum, therefore, the site encompasses 16,875 square meters. Of this total, 1,240 square meters (7.3%) lie within the Channel Gateway project area, and of this smaller subset, approximately 440 square meters (2.6%) will be destroyed by the proposed development.

Given that we are working only on the edge of a much larger site, certain research questions were not appropriate for the data recovery phase of this study. For example, questions involving intrasite patterns, such as the layout of activity areas or the covariation of artifact types, cannot be addressed with the available data set. Although we combined our data with that collected in 1988 by Dillon and others, integrating our data with the material recovered by UCLA in 1961 was not realistic. The two excavations utilized very different methods. Johnson's work was typical of salvage archaeology conducted during the early 1960s. The excavation was poorly funded, and utilized volunteer labor that was available only on the weekends. Given the rush for time, Johnson was unable to screen any of the midden deposit, relying exclusively on people to spot artifacts in the fill.

A second restriction on our research involved the probable nature of the cultural deposits. With the exception of a possible dog burial excavated by Dillon and others, no prehistoric features had been encountered in the railroad right-of-way during the 1988 or 1989 testing phases. The deposit was composed entirely of undifferentiated midden soil, and the likelihood of finding intact features appeared relatively small.

What could we learn from excavated materials deposited in a midden at the edge of a site? Our answers to this question are five research domains detailed here.

Chronology

Our first task was to determine when the site was occupied. Based on the material examined at UCLA and during the testing phase, the site appeared to represent a single component, late prehistoric and/or ethnohistoric occupation. Prior to data recovery, the projectile points recovered from the Admiralty site had been typed as either Cottonwood Triangular or Canalino, both late prehistoric styles. The majority of shell beads were also of styles prevalent during the late prehistoric. Further, no evidence had been found supporting either an earlier occupation or a later, historic period aboriginal occupation. Based on the available data after the testing phase, we suggested a tentative date of occupation between A.D. 1000 and 1750.

Research Questions

Questions of chronology revolve around the hypothesis that the site represents a short-lived, Late Prehistoric period occupation.

1. When was the site occupied? Is there any evidence of occupation prior to A.D. 1000? Similarly, is there any evidence of occupation after Spanish contact?

2. Are there stratified deposits? If so, can distinct occupations be identified?

Data Requirements

To obtain greater control over the time of occupation we need both absolute and relative dates. The former are by far the more critical, as they provide a more-or-less independent means of comparing dates as opposed to the shortcomings of artifact cross-dating.

Methodology

Various absolute and relative dating techniques will be employed. For absolute dating, we will probably rely most heavily on radiocarbon dating of shell, humates, and charcoal. Cross-dated artifacts will probably consist of projectile point styles from both coastal and desert regions in addition to shell bead styles that have been found in well dated contexts primarily along the coast.

The reason for adopting an extensive approach is that all dating techniques have inherent problems that render interpreting the results exceedingly difficult. For example, even within one technique, radiocarbon dating, different problems are associated with different types of samples. Dates on shell must consider the reservoir effect; those on humates, the mean residence time; and those on charcoal, the problem of "old wood." These problems are often exacerbated at coastal sites where often one does not find complementary types of samples. We are left, therefore, relying heavily on inorganic material, carbonate in shell, which unfortunately often produces the most problematic dates.

To compensate for the inherent biases associated with different absolute dating techniques, we intend to analyze a large number of samples from throughout the site. Ideally, paired samples from the top and bottom of the midden will be analyzed from a number of spatially dispersed test units. There are two assumptions associated with this approach. First, the occupational span represented by the deposit is relatively short. The paired dates, then, should bracket a relatively short period. The samples will be mutually reinforcing, increasing our confidence both in the interpretation and the technique. Disparate dates indicate either contamination or that the assumption is faulty.

The second assumption is that the occupational pattern is robust and widespread. Given the large number of absolute dates that were to be analyzed, we reasoned that even if local conditions led to problems with interpreting pairs of dates, overall occupational trends would still emerge.

Temporally sensitive artifacts were to be used as a complementary line of evidence. If the assumption that the site represented a short-lived, single component occupation is correct, then we would expect to find diagnostic artifacts of predominately one time period. Further, we should find no difference in the age of artifacts between the top and the bottom of the midden.

Even if the deposit dates to one time period, it is possible that the site represents a seasonal settlement that was occupied repeatedly. Stratified deposits may be found, with cultural strata separated by lenses of sterile soil. Another possibility is finding caches of milling artifacts such as Van Horn (1987) recovered at the Del Rey (CA-LAn-63) and Bluff sites (CA-LAn-64). These caches were interpreted as stored equipment that were reclaimed by their owners when the site was re-occupied. By searching for stratigraphic or feature data, we may be able to distinguish distinct occupations, and thereby examine possible changes in site function.

Subsistence

Middens generally provide excellent data on subsistence. Vertebrate faunal remains were relatively common in previous work at the Admiralty site, although many of the remains appear to represent intrusive rodents. By definition, a shell midden contains culturally deposited remains of mollusks and/or gastropods, and the Admiralty site is no exception. Finally, the intact nature of the deposit suggests that the potential for recovering other prehistoric subsistence indicators such as plant pollen and macrofossils is also reasonably good.

Beyond simply finding out what people were eating, it is important to determine what was available in the area. Background environmental data are essential for determining why people came to the Admiralty site in the first place; what resources were available and which were utilized; and whether the occupation was permanent or seasonal.

Research Questions

1. What was the nature of the local coastal environment at the time of occupation? What was the probable extent of the lagoon and how was the site located in relation to it?

2. What organic and inorganic resources were locally available at the time of occupation? Which resources were utilized?

3. Was the subsistence emphasis on terrestrial or aquatic resources? How important were avifauna to the diet?

4. Did the procurement of animal and plant species common to the lagoon dominate the subsistence focus? Were oceanic fish and sea mammal species exploited?

5. What plants were utilized? Is there any evidence of non-lagoonal species that would indicate that food was brought into the site from elsewhere?

Data Requirements

There are two basic data sets that need to be marshaled to address these questions. The first focuses on the background environmental setting. To meet this goal, one avenue to pursue is the analysis of plant microfossils from off-site locations. In addition, geomorphic and dendroclimatological data need to be compiled that document the timing and magnitude of Los Angeles River discharges through the Ballona Gap and to reconstruct the extent of the lagoon.

The second set relates to cultural practices. Data on vertebrate and invertebrate faunal exploitation as well as on the utilization of floral resources must be recovered and analyzed. Specifically, representative samples of animal bones, shell remains, and plant microfossils and macrofossils need to be targeted for recovery and analysis.

Methodology

To link our research questions with the pertinent data requires a design that not only ensures adequate spatial coverage, but also controls for biases inherent in the recovery techniques. The assumption underlying research on subsistence at the Admiralty site is that data recovered in the right-of-way are representative of subsistence remains in the rest of the site. Ideally, we could have tested this assumption by comparing the data recovered in the right-of-way with that obtained by UCLA in 1961; however, the recovery techniques used in the previous work, particularly the failure to screen the fill, precludes such a comparison. The only measure of variability in the distribution of subsistence remains is to examine material from all parts of the right-of-way.

To meet this condition, excavation units need to be placed over the entire right-of-way. One approach would be to use a random design. Such a design would allow the results to be used to calculate parameter estimates. For example, we might determine that there are 25 ± 5 deer bones per m^3 at an alpha level of 0.05. The problem with this approach is the sampling frame. If such estimates pertained to the entire site, then this approach would make good sense. In our case, however, the results could only be generalized to the railroad right-of-way. This portion of the site is the only part that is being sampled. There is no possibility of excavating parts of the site south of the right-of-way. Consequently, from a sampling perspective, this portion of the site is not part of the sampling universe. Parameter estimates, therefore, would be meaningless, for they would pertain to a small part of the site which may or may not be representative of the whole.

A better approach would be a systematic design, in which test units were placed at regular intervals over the site. This design is advantageous over a random one when the goal is to ensure that all portions of an area are sampled equally. Complicating our design, however, is the fact that the right-of-way is not to be uniformly impacted. No construction is planned for the southern portion of the right-of-way. Even though the portion of the site located in this area will be avoided, Native American concerns revolving around possible human burials near the 1988 test unit that contained an articulated canid led to the desire to have a low level excavation effort expended here. Given the disparity between the level of efforts between the two parts of the right-of-way, any type of systematic or random design would have been difficult to develop.

Instead, we devised a two-tiered approach. In the impact area, a systematic design was employed to ensure that all areas were equally covered. In the non-impact zone, excavations units were placed judgmentally, focusing on areas of suspected features as well as gaps in our overall coverage.

The placement of excavation units meets the goal of adequate spatial coverage only if it is coupled with the comprehensive analysis of the various data classes. For certain classes, such as animal bones, this condition is easily met, for the entire collection is to be analyzed. For invertebrate remains, pollen samples, and flotation samples, however, it may not be feasible or necessary to analyze the entire collection. If we find undifferentiated midden, then there may be no reason to suspect large degrees of variability in these data classes. A subsampling design (e.g., selecting shell from a sample of test pits which are themselves a sample of all possible units at the site) can then be devised. As with the case of test pit placement, the selection of test pits from which shell remains will be analyzed will follow the basic criterion of ensuring adequate spatial coverage of the entire area investigated. Although this design does not guarantee the representativeness of the collection, a robust pattern certainly increases our confidence in the results. Further, if the assemblages are characterized by a high degree of variability either within or between excavation units, we can always increase the size of the sample to be analyzed.

A second methodological issue concerns our recovery techniques. We must ensure that negative results can be interpreted to mean that certain resources were either not utilized or that their residues did not survive in the archaeological record. This goal is extremely hard to meet, for to satisfy it we must demonstrate that our recovery techniques did not systematically fail to retrieve certain classes of data. This problem is particularly acute in relation to the issue of screen mesh size. Many coastal animals, particularly fish and waterfowl, are composed of very small bones. If the screen mesh is larger than these bones than the faunal collection will be biased in the direction of larger animals.

Our use of 1/8-in mesh to screen the midden fill allows direct comparison of the results with most excavations in the region. We recognized, however, that this mesh size potentially biased the results, particularly underrepresenting many lagoonal fish species. To compensate for this bias, we saved flotation samples from a 25-cm by 25-cm soil column in each test pit. Samples corresponding to each 10 cm level were collected from this column. The samples were floated to recover macrofossils and then screened through 1/32-in mesh to obtain a sample of remains between this size and 1/8 in. Statistical comparisons of the results were then conducted for the invertebrate remains (Chapter 11).

Interpretation of subsistence remains from archaeological sites must be made in relation to a regional context. Usually, the frame of reference is the modern environment. In urban areas, such as Marina del Rey, such an analog is of limited value. An alternative approach is to reconstruct the environment at the time of occupation. For the Admiralty site, we sought to determine the prevailing environment through the use of off-site pollen samples. As a complementary study we reconstructed the hydrological and physiographic history of the Ballona region using dendroclimatological data. Such studies by nature involve large numbers of variables that are difficult to control satisfactorily. Even so, the tentative reconstruction provides a heuristic model from which future archaeological studies can build.

Technology

Once we determine what people were eating, we want to know how these resources were procured and processed. Of particular interest at the Admiralty site is the lithic assemblage. Other sites in the Ballona region have been characterized by as many as four chipped stone industries; bifacial, bipolar, microlith, and flake tool. Why so many industries, and what types of extractive activities required such different technologies are two major unresolved questions.

Beyond the chipped stone assemblage, the diversity of artifact types at the Admiralty site is relatively low. Ground stone has been recovered, primarily in the form of stone vessels and grinding implements, albeit in small numbers. Similarly, an occasional bone and shell artifacts has been recovered from the site, but what is striking is their rarity. What the lack of diversity reflects is a intriguing question.

Research Questions

1. How many chipped stone industries are represented at the Admiralty site? Is each industry represented in approximately the same proportion as similar industries at sites elsewhere in the Ballona?

2. What extractive activities of subsistence practices are reflected in the lithic assemblage?

3. What types of ground stone implements are found at the Admiralty site? Is there evidence of caching of ground stone implements? If so, what types and what activities are represented?

4. What types of shell and bone tools are represented in the collection? Is there any evidence of shell bead manufacture?

Data Requirements

Technological questions revolve around artifacts. To answer them we need to have adequate collections of chipped stone, ground stone, shell, and bone tools and debitage.

Methodology

As with subsistence data, the fundamental issue surrounding technological issues concerns the representative nature of the collection. As with other analyses, we are forced to assume that the portion of the Admiralty site in the right-of-way can be used as a proxy for statements about the entire site. Our strategy for retrieving a systematic and comprehensive sample of artifacts within the right-of-way is exactly the same as discussed above in the previous section.

We anticipate analyzing all artifacts recovered during the excavations. Consequently, issues of subsampling are not germane to research questions pertaining to the technological domain. Issues related to recovery technique, however, are very much a concern. Certain classes of chipped stone debitage and shell beads are extremely small. Use of 1/8-in mesh hardware cloth to screen the fill will recover most, but not all artifacts. There will be a systematic bias in the results in favor of larger artifact classes. To determine the strength of this bias we will examine the heavy fraction of the flotation samples for evidence of artifacts ranging in size between 1/32 in and 1/8 in.

A second recovery issues involves the identification of lithic artifacts. The former bed of the Pacific Electric railroad runs through the middle of the right-of-way. The bed was formed by laying sand and gravel on the surface and then placing the rails on top. Based on the testing results, imported gravels clustered in the upper 20 cm of the deposit, but were found throughout the midden.

The sheer numbers of rock presented two problems. First, the weight of the rocks and their movement through the screening process could chip or break prehistoric artifacts found in the same level. To minimize this problem the midden fill was water-screened. We switched to water-screening during the testing phase when it became obvious that shaking the dry screens was causing considerable damage. Rocks from the railroad were chipping or breaking shell and animal bone as well as chipping the edges of lithics. By shoveling the fill into screens and then separating the matrix from the artifacts by water action, artifact damage became negligible.

The second problem concerned the sorting process. Once water-screened, each provenience lot was sorted and bagged by material type. The large amount of gravel in the upper levels contribute to the problem of identifying culturally modified lithic material. During the initial sort, it was not always possible to distinguish prehistoric artifacts from historically modified lithic material. Thus, in the field, we decided to err on the conservative side, with all possible artifacts bagged for analysis in the laboratory. Although this approach increased processing and analysis time, it provided the necessary control on a potential bias in the collection.

For shell tools, bone tools, and ground stone, standard published analytic procedures were followed. This approach allows the results to be directly comparable with other collections. Unfortunately, these types of analyses are aimed at elucidating descriptive, and not necessarily technological, attributes. Given the small number of artifacts recovered in these categories, we decided that the basic utility of these data would be their comparative value. Thus, the inability to examine technological issues for these classes listed above was outweighed by their use in future comparative research.

Technological analyses by nature focus on those processes that lead to a specific finished tool or product. For the Admiralty site, the emphasis on tool manufacture centered on two artifact categories, shell beads and flaked stone. Shell beads were analyzed through reference to the published typologies Bennyhoff and Hughes (1987), Brock (1986) and King (1981). These typologies are technologically based. By virtue of using well-established typologies, the shell bead analysis provided both technological and comparative data.

Unlike previous artifact categories, a variety of classificatory approaches are available for the analysis of flaked stone. The one devised for this project focused primarily on defining the lithic technologies present at the site. The experimental work conducted by Crabtree (1973), Callahan (1979), and Flenniken (1981) is used to identify various stone tool technologies in the assemblage. Technological attributes are explicitly defined to provide an objective basis for evaluating the results and comparing the collection to others analyzed through different methods. The analysis was augmented with a stylistic component for formal tools to allow comparability with other regional analyses.

The Place of the Admiralty Site in the Settlement System

The Admiralty site did not exist in a cultural vacuum. It is one of many recorded sites in the Ballona region. How this site was utilized and how it fit into the regional settlement system are the subjects of this research domain.

Our approach to these questions is hierarchical. First, we need to determine site specific attributes. Of major concern is the issue of sedentism. Was the site occupied seasonally or permanently? Once determined, we can move on to evaluating the site's position vis-a-vis other contemporaneous sites. Assuming the site represents a single component, this reconstruction will provide a static view of the settlement system. At a third level of abstraction, we want to place the settlement system that contained the Admiralty site into a dynamic, temporal frame that will allow us to analyze the cultural evolution of the Ballona.

Research Questions

1. Was the Admiralty site occupied permanently or seasonally? If seasonally, what seasons?

2. What was the relationship between the sites located on the edge of the lagoon, such as the Admiralty site, and those located on the bluffs?

3. What type of settlement is represented at the Admiralty site - multifamilial village or temporary camp? How was this settlement type integrated into the larger settlement system?

4. Were resources collected only from the local area, or did they come from different locales?

5. Did the Ballona encompass an entire settlement system? Were the sites of the Ballona incorporated into a larger system that included both coastal and interior zones?

Data Requirements

Most of the data collected on subsistence and background environment will also be germane for this topic. In addition, settlement data from the UCLA site files and archaeological reports will need to be integrated into a coherent settlement model.

Methodology

The study of the settlement system will borrow concepts and approaches from site catchment analysis and settlement pattern studies. Environmental data will first be used to reconstruct the prevailing local environment at the time the Admiralty site was occupied. This model will then be coupled with subsistence and technological data to investigate the types of resources actually exploited. A key issue will be to determine whether the site was situated only to exploit local resources or if resources collected from a variety of areas were brought into the site. The issue of seasonality will be addressed by reference to the seasonal availability of exploited resources. The finding of a wide spectrum of resources available throughout the year will be taken as evidence for occupational permanency. In contrast, if the resource reflected in the various classes of subsistence remains are available during only one part of the year, then a strong case can be made for seasonal occupation.

Chronometric data will then be used to place the Admiralty site within a temporal framework. Subsistence and environmental data from other contemporaneous sites in the Ballona will be evaluated to resolve issues of subsistence focus and seasonality. A static settlement model for the time period during which the Admiralty site was occupied will be created. Models for other time periods will similarly be devised. Trends in settlement will then be explored for the entire temporal sequence.

Cultural Interaction and Affiliation

The paramount issue leading to the recent interest in the Admiralty site is the possible identification of the site as the ethnohistoric Gabrielino village of **Sa'angna**. This identification is based on interviews presumably with one individual, nearly 100 years after the village would have been abandoned. The tenuous nature of this information is further shown by the fact that no evidence has been found in the mission records supporting the existence of **Sa'angna**.

Regardless of whether the village of **Sa'angna** ever existed, there are logical reasons to believe that the Ballona would have been occupied by the Gabrielino during the ethnohistoric period. Sheltered inlets, such as the Ballona, were favored locales for Gabrielino settlement. These areas hosted a diverse and rich set of faunal and floral resources, many of which were prized by the Gabrielino.

It is doubtful that data recovered during the excavation can resolve the question of **Sa'angna**. We can, however, use absolute dates to determine whether the site was occupied during the Protohistoric period. If so, an analysis of the remains would provide valuable data on Gabrielino culture.

Beyond ethnohistory, we also want to determine the nature and degree of prehistoric interaction that residents of the Admiralty site had with other groups. The presence of Monterey chert, for example, suggests that the residents traded for this material or that the outcrops were within their seasonal round. Similarly, each raw material can be traced to its likely source.

Van Horn (1987) has recently argued that Shoshonean groups reached the coast prior to the introduction of the bow and arrow. His interpretation is based largely on projectile point styles found on the bluff sites overlooking the Ballona. Van Horn contends that the Shoshoneans established a foothold on the coast, effectively separating indigenous groups to the north and south. Depending on when the Admiralty site was occupied, data recovered from the site could bear on this topic.

Research Questions

1. Was the Admiralty site occupied at the time of the de Portola expedition (A.D. 1769)? Is there any evidence of an ethnohistoric occupation at the site?

2. What types of lithic raw materials are present and where are their source areas? Do the proportions of lithic raw materials change over time?

3. What projectile point styles are present? Do they indicate a coastal or desert origin?

4. Are inhumations and/or cremations present? If both, which is the prevalent custom?

Data Requirements

Resolving questions of ethnohistoric occupation and use will rest heavily on absolute dates and a few diagnostic artifacts, such as certain types of shell beads. If an ethnohistoric occupation is indicated, then a study of the entire assemblage will be useful for elucidating proto-Gabrielino material culture. For the larger issue of regional interaction, we need to enumerate non-local resources (i.e., chert, obsidian, steatite, chalcedony, etc.) as well as determine their relative frequency. Projectile point styles need to be examined in relation to their cultural affinity. In particular the finding of Gypsum Cave or Rose Spring/Marymount points at a relatively early date would be consistent with Van Horn's hypothesis.

Methodology

Beyond absolute dates and shell bead types, there is little we can do to marshal evidence pro or con on the issue of **Sa'angna** or a Gabrielino presence in the Ballona. So little is known about Gabrielino material culture that it is probably not possible to distinguish a Gabrielino component from its predecessors based solely on assemblage content. Our approach, therefore, is inductive by nature. We will first determine the age of the component and then assess its cultural content.

Cultural interaction will be measured by the proportional representation of locally available materials as opposed to those that are exotic to the area. Lithic material will comprise the basic elements of analysis, but other categories, such as shell beads, will also be considered. Projectile point styles will be used as another indicator of cultural interaction.

Historic Component

Archival research has indicated that the Channel Gateway parcel has a long history of use. Archaeological evidence of historic occupation, however, appears to date only from the late 1800s. During the testing phase, five areas of historic activity were identified: the Pacific Electric Railroad right-of-way, the Holt property, the Associated Pacific Industries property, the Los Angeles Police impound yard and the yacht sales yard.

The railroad right-of-way showed two forms of historic use. The first was the railroad bed which cuts through the prehistoric component defined as CA-LAn-47. Associated with the railroad are several features, including poles, gravel lenses, and a ditch running parallel to the railroad. These activities could have started as early as 1887 or as late as 1892. The second form of historic activity is the fill that covers the southwestern edge of the right-of-way and continues to the southwest. This fill is the remnants of dredging activities that resulted from the construction of Marina del Rey. This dredging could have been associated with early attempts (ca. 1887) to create a harbor or the more recent (1961) creation of the marina.

The Holt property, located in the northeast corner of Channel Gateway, was developed as a brass foundry in the 1940s. During testing, we found remnants of this foundry associated with a scatter of historic artifacts. Many of the artifacts appear to be oriental in origin, and may be associated with Japanese truck farmers who resided in the area during the 1930s.

The Associated Pacific Industries (API) factory was built in the 1930s. The area around the factory, but outside the Channel Gateway parcel, was utilized as pasture by Edgemar Farms Dairy, whereas the property itself was devoted to agriculture. The API factory was used to manufacture airframe assemblies and nose cones for submarines. During WWII the factory produced ammunition, and after the war was used to manufacture automobile body parts. The factory was abandoned in the early 1980s.

In testing, evidence of historic dumping was found in the southwest corner of the Los Angeles Police impound yard. Stratified lenses of historic artifacts and animal bone were observed in test trenches.

Research Questions

The historic deposits at the Channel Gateway property represent a variety of historic episodes of use and discard. These episodes are united by proximity, not common function or theme. To provide a manageable design for the historic research, three broad domains were developed that were applicable to all the properties. These were chronology, function, and cultural affiliation.

Chronology

Our first concern with the historic loci is to determine the timing and longevity of the activity. We seek answers to the following questions. When was the railroad line in the right-of-way built and used? When was the lagoon dredged and the spoils placed on the property? Who occupied or used the area? When did development take place?

Function

A second complementary avenue of research focuses on the function of the various archaeological loci. We want to know if the archaeological record can highlight information that is obscure or nonexistent in the written and oral record. For example, how did the brass foundry work? Who did it employ? Are the oriental artifacts located nearby associated with the workers of the foundry? If not, was this scatter the residue of agricultural activities?

Cultural Affiliation

Certain former residents of the Channel Gateway property have been identified, such as the Japanese truck farmers. Others who occupied or used the area are not so readily identifiable. Questions regarding these occupants include: what was the ethnicity of the former occupants, their social status, and their lifestyles?

Data Requirements

Archival documentation in the form of maps, official records, and written accounts form the first line of historic information. These data can then be coupled with informant interviews and the analysis of the archaeological remains.

Methodology

Our first task was to conduct a thorough archival search (see Chapter 4). The goal of this research was to obtain a detailed history of land-use and land ownership. After compiling all the available documents pertaining to the property, we contacted knowledgeable individuals who lived in the area.

As our final step, we need to cross-check our informant and documentary sources with artifactual data. Specifically, are the various sources of information consistent with one another? If the results are complementary, we will then proceed to the final step, associating artifacts with particular historic activities and/or groups.

Artifactual data needed to address the research question involve form, function, and style. Unlike the prehistoric component, most historically significant artifacts are relatively large. Recovery techniques used for historic deposits differed from those devised for the prehistoric component in one significant way. Instead of using 1/8-in mesh screen size was increased to 1/4-in mesh. This alteration increased the efficiency of the screening process, without compromising our ability to address the research questions.

CHAPTER 7

FIELD AND LABORATORY METHODS

Field and laboratory methods for the testing and data recovery phases of the Channel Gateway Archaeological Project are described in this chapter. Procedures for completing the various tasks were designed in consultation with Native American leaders and on-site monitors representing the Southern California Gabrielino Band. Both the testing and data recovery plans were presented at the band meetings for membership approval prior to being implemented. Monitors and band leaders provided constant feedback into these plans and they were modified appropriately as a consequence.

Although a survey (Stickel 1988) and testing program (Dillon et al. 1988) of the proposed development area had already been completed, there remained considerable debate concerning the size, nature, and significance of the site. Our objectives were to resolve these issues. The northern boundary of the Admiralty site and newly discovered cultural deposits that were defined during the testing phase reported here were evaluated to assess their scientific and cultural significance. Following the testing phase, a plan was devised to mitigate proposed adverse impacts to all significant sites.

The testing phase involved the systematic excavation of backhoe trenches over the entire available portion of the project area, and the manual excavation of test pits in the railroad right-of-way along the southeast edge of the property. These tests confirmed previous reports indicating that prehistoric cultural materials associated with the Admiralty site were confined to the latter area (Dillon et al. 1988). In addition, historic materials dating to the early part of the twentieth century were found on several parcels throughout the project area and designated as the Channel Gateway site. During the data recovery phase, hand excavations in the railroad right-of-way were expanded to fully investigate the portion of the Admiralty site contained within the project area. Manual excavations were also undertaken to recover data from several historic features associated with the Channel Gateway site.

TESTING PROGRAM

The testing program was designed to resolve issues, related to the nature and significance of cultural deposits, identified by the cultural resources survey performed by Stickel (1988) and the limited archaeological testing conducted by Dillon et al. (1988) (see Chapter 1 for a review of these issues). Specifically, archaeological testing was aimed at obtaining data for meeting three objectives: 1) delineate the boundary of known and previously undiscovered sites; 2) evaluate the stratigraphic integrity of cultural deposits; and 3) determine if human remains are present. The various mapping and excavation tasks of the testing phase are described below.

The archaeological investigations carried out in the project area were hampered by a number of conditions. In addition to the impediments normally expected in working in an urban area, such as utility lines, roads, and buildings, several of the properties in the project area contained businesses that were still in operation. The timing and placement of excavations often had to be modified to work around these businesses. The southwest corner of the project area was occupied by the Bay Cities Metal operation and the impound yard operated by Bruffy's Del Rey Tow. The latter was fenced off and guarded by dogs. The extreme northeastern corner was occupied by a small garage, while the southeastern corner was largely occupied by the Marina Storage Building. The west end of the Pacific Electric Railroad right-of-way was used as a storage and parking area for the S & S Paving company, while the eastern end was used for parking by Reiter Auto Liquidators and Ryder Trucks. Hazardous waste products were sometimes encountered in trenches and test pits, which made us avoid certain archaeological deposits and re-evaluate our mitigation strategy. Access to several recently abandoned buildings (for example, the Avis and the Associated Pacific buildings) was restricted prior to the removal of asbestos roofing material. During the trenching operation the boom of the backhoe was stolen while parked overnight on the property, thereby leading to a delay as a replacement was being sought. A highly unusual situation occurred when the Los Angeles Police Department carried out training exercises on the abandoned Avis lot, forcing us to suspend operations on that parcel for three days. More common, however, was the constant movement of rental cars and Ryder trucks in the eastern half of the railroad right-of-way, the area where most of the manual excavations were concentrated. The logistical problems caused here remained unchanged from the previous year when Dillon excavated in the railroad right-of-way. Like Dillon (Dillon et al. 1988), we were hampered by the constant movement of cars and large trucks among our excavation units in the right-of-way area. In most cases these various impediments were temporary, or excavations could be easily adjusted around them. In the long-run they did not affect our goal of defining the distribution of cultural remains within the project area or our ability to address our research questions regarding prehistoric and historic use of the area. These impediments nevertheless had a fundamental impact on the efficiency of this archaeological investigation.

Mapping

A topographic map had already been prepared for the entire Channel Gateway project area by C. W. Cook, Co. (1988), a professional surveying and civil engineering firm. Their map was produced photogrammetrically at a 1 ft contour interval using aerial photographs taken in December of 1986. We modified the photogrammetric map to create a base map for plotting archaeological data during the testing and data recovery phases. Modern cultural features such as buildings, roads, fencelines, parking lots, retaining walls, utility lines, easement locations, and property boundaries were depicted on this map.

Field-related mapping tasks included laying out excavation units (test pits and backhoe trenches) and plotting these units on the topographic map. A metric horizontal grid oriented towards magnetic north (14^{o} east of true north) was used in laying out excavation units in the portion of the Admiralty site occurring within the Pacific Electric Railroad right-of-way. A northing and westing grid coordinate system referenced to an arbitrary control point was used to designate the southwest corner of each excavation unit.

Mechanical Excavation

Mechanical excavation was the major component of the testing program in areas outside of the railroad right-of-way. This approach was relied on as the primary means of identifying and delineating buried cultural deposits. At least two individuals (one archaeologist and one Gabrielino observer) monitored the entire trenching operation. Monitors observed each bucket load as it was removed to prevent needlessly damaging cultural features that were exposed.

Prior to beginning fieldwork, the locations of 20-m long backhoe trenches across the approximately 16-acre (58,737 m^2) project area were plotted. The initial plan involved the excavation of 43 trenches, with trench locations being spaced at 40-m intervals within a rectangular grid pattern. There was a 20-m interval between each northwest-southeast row of trenches. The objective of this plan was to cover the entire project area systematically in the search for areas of preserved midden. Although we recognized that isolated pockets of cultural deposits could be missed, each row of trenches was to be offset 20 m diagonally with respect to adjacent rows to maximize the probability that localized areas of cultural deposits would be discovered. Trenches were numbered consecutively from west to east starting from the northernmost row. Each row of trenches was oriented northwest-southeast, paralleling Lincoln Blvd. The trenches themselves were generally positioned 43°-223°, a northeast-southwest orientation that paralleled the long axis of most of the existing buildings as well as roads and fencelines marking property boundaries.

The above plan was designed to be implemented after demolition of all structures. As it turned out, however, it was necessary to implement the plan prior to demolition, and some adjustments were necessary to avoid obstructions such as underground utilities, roads, occupied buildings, and parking lots that were still in use. Figure 34 shows the location of all trenches excavated by Statistical Research in relation to those excavated previously by Dillon et al. (1988). There was no need to excavate additional trenches in a small area south of the Associated Pacific building where eight trenches had been excavated by Dillon. A *Bobcat* with a 1.5-ft (ca. 46-cm) wide bucket (Figure 35) was used to excavate the first few trenches, but we soon switched to a *Case* backhoe with a 2-ft (ca. 61-cm) bucket and front end loader (Figure 36) to provide a larger exposure and to speed up the excavation. The bucket was placed into the trench and removed with care to obtain relatively straight profiles and to keep the trench from collapsing. Figure 37 depicts one of the backhoe trenches, showing a concrete feature (Feature 1) that was exposed.

In all, 35 backhoe trenches totaling 680 m in length were excavated to a depth between 1.4 and about 2 m below surface (see Figure 34). No trenches were deeper than 7 ft (ca. 2.13 m) due to a city ordinance that required a special permit for excavations exceeding this depth. Although the entire property was enclosed by a 6-ft to 8-ft high chain link fence, as an additional safety measure, barriers, and *caution* tape were placed around trenches to minimize the chance of someone accidentally falling into a trench. Sections of a concrete slab had to be extracted inside of the abandoned Associated Pacific Building so that Trenches 11, 12, and 21 could be excavated. In these instances a jackhammer-like punch was attached to the backhoe boom so that the concrete could be broken up and removed.

A number of trenches could not be excavated (Trenches 1, 8, 9, 17, 18, 26, 40, 41, 42, and 43). These were located within the properties occupied by the Marina Storage Building and Bay Cities Metal Building, which housed businesses still in operation at the time fieldwork was in progress. Other trench locations were offset only a few meters to avoid these two buildings, Maxella Road, and other obstructions. Trench 44 was repositioned perpendicular to other trenches to avoid boats and travel homes that were being stored in the Marina Storage Building parking lot. Finally, several of the systematically placed trench locations were altered or abandoned because of the presence of buried utility lines. In addition to the systematically placed trenches, Trenches 45 and 46 were placed judgmentally in the northern section of the Admiralty site to help define the northern site boundary.

Buried industrial waste products, such as noxious hydrocarbons, were occasionally exposed during the trenching operation, particularly on the Holt Property (Trenches 10 and 19) and the Avis parking lot (especially Trench 34). When hazardous materials were encountered, workers were directed to vacate the area immediately and notify their supervisor who then contacted the appropriate authorities so that the chemical composition could be tested. Trench 34 was abandoned without being recorded due to the intensity of the noxious odors.

After a particular backhoe trench was excavated, various activities were undertaken to document the stratigraphy. The first step involved carefully troweling one or both walls of each trench to search for cultural deposits, features, and artifacts. All cultural features and noteworthy artifacts observed while troweling were marked with flagging tape. Except for Trenches 20 and 34, both of which contained hazardous chemicals, one profile wall from each trench was drawn on metric graph paper at a 1:50 scale. The location of strata, soil horizon boundaries, cultural features, artifacts, and visible

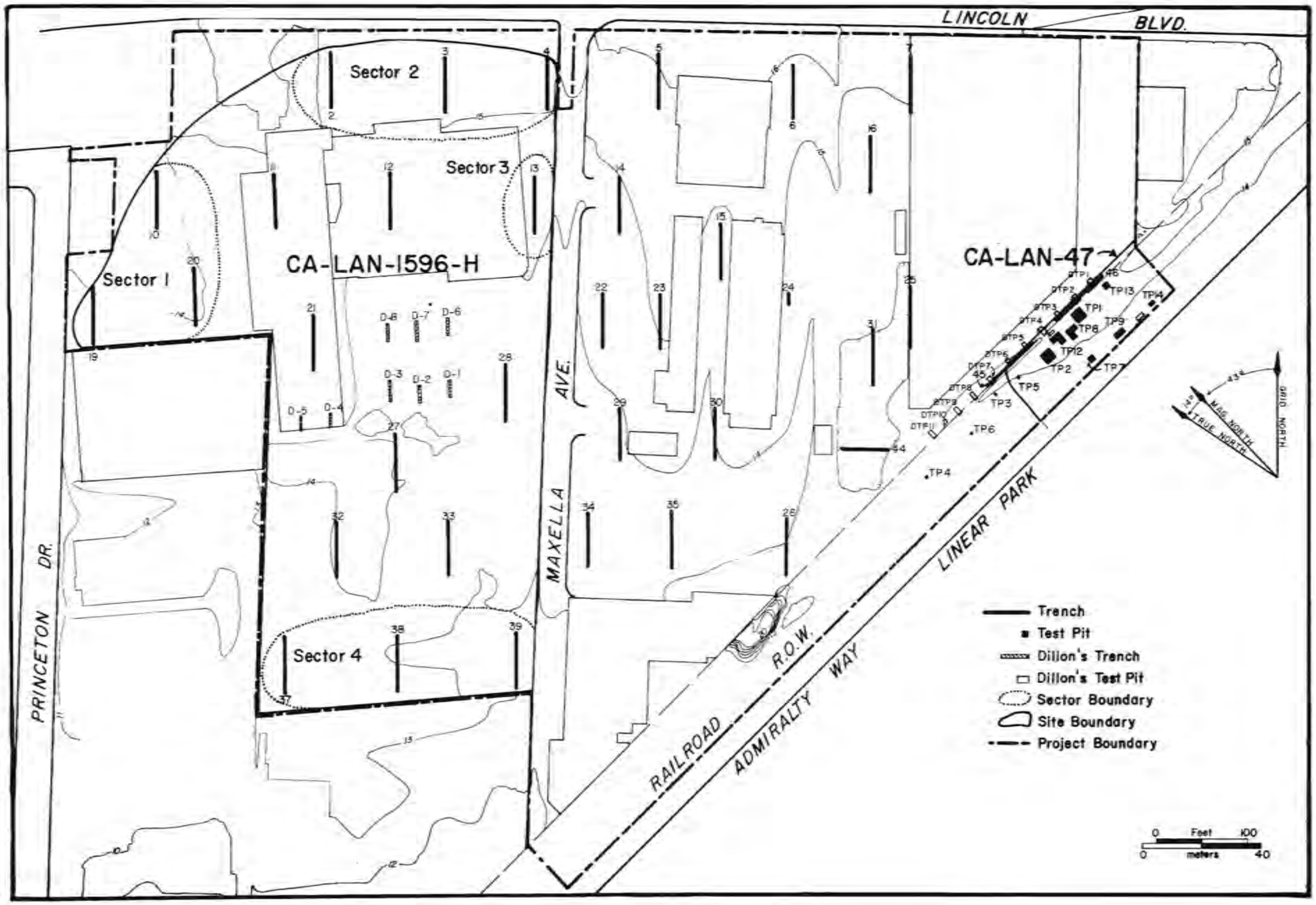


Figure 34. Map of backhoe trench locations, Channel Gateway Archaeological Project.

Figure 35. Photograph of *Bobcat* excavating trench in the Associated Pacific parking lot.

Figure 36. Photograph of *Case* backhoe excavating trench inside the Associated Pacific Building.

Figure 37. Photograph of backhoe Trench 19 on Holt property
(note the concrete footing from Feature 1).

disturbances such as animal burrows and root molds were depicted in these illustrations. A representative sample of profiles was then photographed to provide a permanent record of our findings. Profiles were documented with 35 mm film, including both color slide and black and white print film. Photographs were taken of all cultural features that were identified, and the subject of each photograph was noted on photographic record forms.

Next, the stratigraphy of one profile from each trench was described, and all cultural deposits and features were recorded. A preliminary interpretation of the depositional history of each stratum was noted. Strata representing redeposited overburden were distinguished from those reflecting natural or older cultural depositional processes. A representative sample of trench profiles was formally recorded using the master horizon designations and subscripts suggested by the Soil Conservation Service (see Bettis 1984; Wilding et al. 1983). Each soil horizon was described in terms of its Munsell color, texture, structure, consistence, boundary type, and any special features that were observed such as concretions and mottles. Finally, selected artifacts observed in profile were assigned a point-provenience number and collected. After the trenches had been fully documented they were backfilled with a front-end loader.

Three deep pits where buried gasoline tanks had previously been removed had been left open when our field work began. As a supplement to the trenching, the square-shaped pits, which we designated as geologic pits, enabled us to record information on the deeply buried natural deposits within the northern, eastern, and central portions of the project area (see Figure 34 for locations). These geologic pits ranged between 2.5 and 4 m across, and between 2 and 3 m deep. Each of the geologic pits were documented in a similar manner to the trenches (Figure 38).

Figure 38. Photograph of Geologic Pit 2 in the Associated Pacific parking lot.

Manual Excavation

Test pits were manually excavated in the 6,000 sq. m (1.48 ac.) area of the railroad right-of-way. This is the area where Dillon et al. (1988) had identified a portion of the Admiralty site, and it was the only area where prehistoric artifacts were still observable on the surface. Test pit excavation entailed the following tasks: laying out excavation units, excavating the fill from test pits, transporting fill to the screens, screening, profiling, collecting samples, and backfilling the test pits. Procedures involved in executing these tasks are described in this section.

All test pits were laid out using metric grid coordinates tied to an arbitrary control point (see mapping section above). Six 1-m by 1-m test pits (designated as Test Pits 1 to 6) were excavated during the testing phase. These pits were placed at 20-m intervals in an east-west orientation through the eastern half of the railroad right-of-way (Figure 39). At a minimum, each test pit was excavated until the bottom of the shell midden was reached, a depth of at least 100 cm. One of the excavation units, Test Pit 2, was excavated to 1.8 m below surface to determine if more deeply buried cultural deposits were present. Test pits were excavated in arbitrary 10-cm levels and each level was numbered consecutively from the surface to the bottom of the pit.

Once the fill was excavated, it was loaded into wheelbarrows and transported to one of the water-screening stations set up along the fenceline at the north edge of the site (Figure 40). Because of the moderately high clay content, particularly near the bottom of the midden and just below it, water-screening was used to increase the efficiency of the screening process. The only exception was the disturbed uppermost level of each test pit, which was dry-screened. Water from the city water lines was obtained from the neighboring Marina Storage Building with garden hoses. Waste water from the screening was channeled into either one of two backhoe trenches on the opposite side of the fenceline

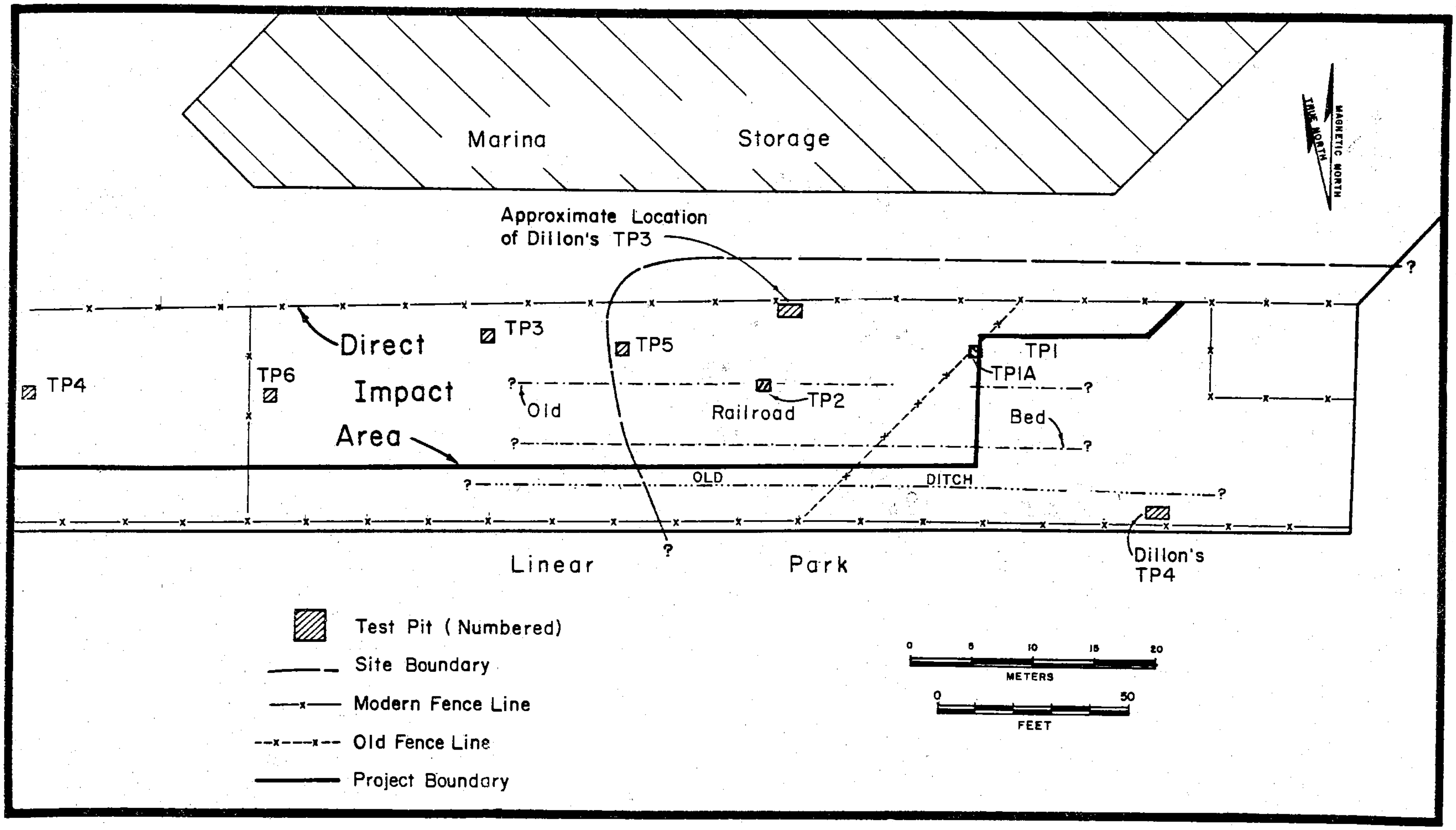


Figure 39. Map showing location of 1-m by 1-m test pits excavated during testing by Statistical Research, Inc. in relation to previous excavations conducted by Dillon et al. (1988).

Figure 40. Photograph of water-screening station.

next to the water-screening stations, where it slowly drained into the subsoil. One-eighth-inch (0.3175 mm) mesh hardware cloth was used for screening, a size considered sufficient for recovering important chronological indicators such as shell beads and small subsistence remains, especially fish vertebrae (see Chapter 6).

Profile drawings were illustrated from two contiguous profiles of each test pit. These profiles were prepared in a similar manner to the trench profiles, except that the scale was enlarged to 1:20 to depict the stratigraphy. A schematic composite profile was also made that linked the stratigraphy of test pits placed across the Admiralty site.

DATA RECOVERY

Based on the results of the testing program, two archaeological sites -- the Admiralty site (CA-LAn-47) and the Channel Gateway site (CA-LAn-1596-H), a newly discovered historic site with several spatially and temporally discrete sectors -- were determined to contain deposits of scientific and cultural significance. A data recovery program was designed to mitigate the sections of each site that were within the proposed direct impact area. For the Admiralty site, the direct impact area included a strip within the northern part of the railroad right-of-way. Testing indicated that the Channel Gateway site was totally encompassed within the direct impact area. The data recovery methods for both sites are described.

Admiralty Site (CA-LAn-47)

Manual Excavation

Excavation methods during data recovery were essentially the same as those employed in the testing phase. A data recovery strategy was planned in consultation with Gabrielino tribal leaders. This plan involved the excavation of 75 m^2 within the shell midden delineated during testing. These excavation units were in addition to the units placed during testing so that the total from both places within the railroad right-of-way was 81 m^2. As with the earlier tests, all units were excavated in 10 cm levels and the fill was water-screened through 1/8-in mesh hardware cloth. The testing program indicated that 1223 m^2 of the Admiralty site was preserved as a shell midden deposit on property to be developed by the J. H. Snyder Company. Of the 1223 m^2 of shell midden, 621 m^2 were in the direct impact area and the remaining 602 m^2 was immediately south in an area where subsurface deposits were to be preserved. Approximately two-thirds of the excavations (about 50 m^2) during data recovery were placed in the direct impact area.

The data recovery excavation strategy involved excavating a series of 1-m by 2-m or 2-m by 2-m units. Initially, two of the 1-m by 1-m test pits (Test Pits 1 and 2) excavated in the richest shell midden areas during the testing program were expanded to 2-m by 2-m units (Figure 41). Additional excavation units were placed judgmentally throughout the midden to achieve wide spatial coverage, especially in the thickest and least disturbed northern part of the midden. Test Pits 1 and 2 were subsequently expanded to 4-m by 4-m block excavations, each consisting of four contiguous 2-m by 2-m units. Each 2-m by 2-m unit was assigned a letter designation after the test pit number (e.g., Test Pit 1A, 1B, 1C, and 1D). Two other smaller block excavations (Test Pits 8 and 12) consisted of three contiguous 2-m by 2-m units forming an L-shaped pattern. The locations of all test pits excavated during data recovery are shown in Figure 42 (see Figure 34 for the relationship of test pits to other excavation areas within the Channel Gateway project area).

Specialized Sample Collection

Specialized soil, pollen-phytolith, and flotation samples were collected during the data recovery phase. In addition, pieces of charcoal exceeding 1 g in weight were saved. Each type of sample was collected using specific column sampling procedures. Sampling columns were chosen by selecting the least disturbed portion of the profile. For example, zones that were visibly altered by bioturbation processes were avoided as much as possible to minimize the effects of contamination.

Two-hundred g soil samples were taken vertically at 5-cm intervals, skipping every other 5-cm level (e.g., 0-5 cm, 10-15 cm, 20-25 cm, etc). When stratigraphic or soil horizon boundaries intersected the 5-cm sampling interval, subsamples of each zone were taken. Soil samples were placed in a bleached muslin, tear-resistant cloth bag, a type of bag that allows the sample to air-dry. In addition, 2-kg soil samples were saved for radiocarbon dating from the top and bottom of organic-rich A horizons in Test Pits 9, 12, and 13. These three test pits were chosen for radiocarbon dating because they appeared to be in the least disturbed sections of the site. Radiocarbon soil samples were removed with a clean trowel, sealed in aluminum foil, and then placed in air-tight, inorganic plastic bags.

Pollen samples were collected in a similar manner to the soil samples except that a larger sample, approximately 500 g, was saved. Pollen samples were removed with a trowel that was rinsed with distilled water after each sample was extracted to avoid contamination. Whirl-Pak bags, a type of sterile polyethylene bag that is air- and moisture-tight, were used for storing pollen samples. Pollen

Figure 41. Photograph of initial expansion of test pit to 2-m by 2-m excavation unit.

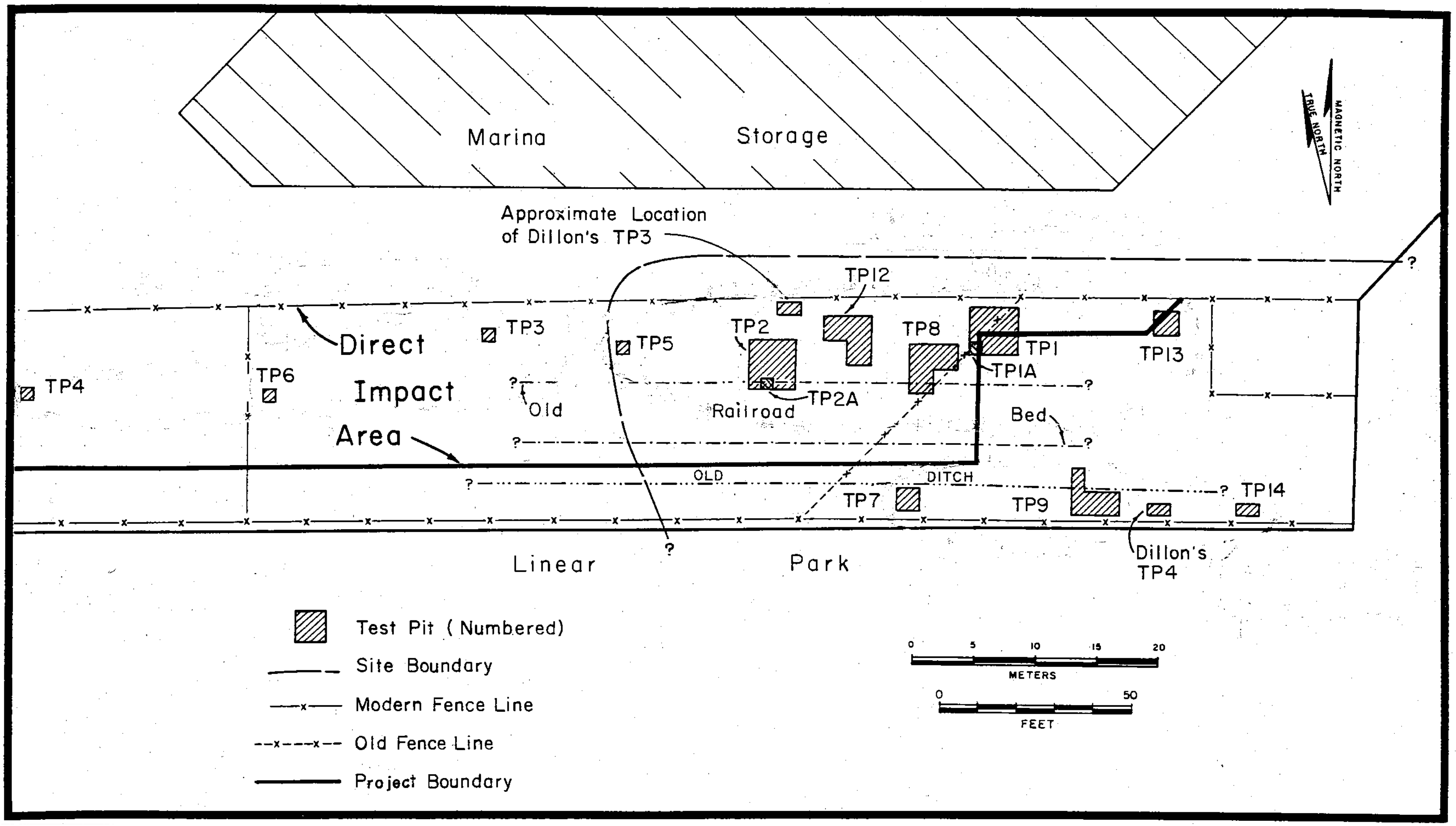


Figure 42. Map of excavation units at the Admiralty site (CA-LAn-47).

samples were placed in the bag as quickly as possible and immediately sealed to minimize contamination with modern pollen rain.

Flotation samples were collected from the least disturbed corner of most of the test pits. These samples were taken at 10-cm intervals from a 25-cm by 25-cm column through the midden and the underlying sediment. Flotation samples were stored in plastic bags.

Human Skeletal Remains

Human skeletal remains recovered during data recovery were treated in accordance with federal and state laws governing their treatment and disposition (see Advisory Council On Historic Preservation 1988; California Native American Heritage Commission [CNAHC] 1988). When the first human skeletal remains were encountered, all excavation on that area of the site was halted, and Mr. Juan Jimeniz, Supervising Investigator for the Los Angeles County Coroner's Office, was immediately notified of the finding by the project director. Mr. Bill Johnson of the CNAHC was then contacted by Mr. Jimeniz, and a joint phone conference was held with the project director. Once it was made known that these remains were associated with a prehistoric archaeological site and that monitors representing the Gabrielino Band were already involved with the recovery, Mr. Jimeniz and Mr. Johnson granted permission to continue archaeological excavations.

All human remains were analyzed on-site by an archaeologist with training in human osteology. When possible, depending on which bones were present, basic information on the age, sex, race, and other notable features was ascertained. Skeletal remains were then photographed, illustrated, and delivered to Ms. Isabel Rocha Chick, an approved Native American monitor representing the Southern California Gabrielino Band, who assumed responsibility for their final disposition.

CHANNEL GATEWAY SITE (CA-LAn-1596-H)

Data recovery was conducted at the Channel Gateway site in three areas where cultural features were identified in backhoe trenches during the testing phase (see Figure 34). The focus of data recovery was on feature excavation. The historic features were excavated in either arbitrary 10 cm levels or natural strata, and the fill was water-screened through 1/4-in (6.35-mm) mesh hardware cloth. Test pits were excavated on the Holt property in the northern section of the project area, and southeast of the Associated Pacific building next to Maxella Avenue. On the Holt Property, a 2-m by 2-m excavation unit (Test Pit 10) was placed next to Trench 19 to encompass Feature 2, a trash pit. A 1-m by 1-m unit (Test Pit 11) was placed adjacent to Trench 13 over Feature 6, a feature that was found to be an infilled animal burrow, not a cultural feature. Test Pit 11 was later expanded to a 2-m by 2-m unit so that Feature 7, a well shaft filled with historic trash, could be excavated.

In addition to test pit excavations, the overburden above Feature 1, a broad concrete platform for a steam drop hammer, was stripped off so that it could be photographed and mapped in plan. Feature 1 was initially exposed in Trench 19 next to Feature 2.

Finally, a dense concentration of historic refuse, including large quantities of cut and sawn animal bone was found in the southwest corner of the impound yard. Initially, it was unclear whether this deposit, which was exposed in Trenches 37 and 38, represented historic or modern refuse. This material was laid directly on top of an A horizon, the surface horizon that was found buried throughout much of the project area. The A horizon in the impound yard contained little artifactual material. Historic artifacts in the A horizon appeared to be intrusive. No prehistoric artifacts were observed in either trench. This A horizon is probably not anthropic, but most likely was formed naturally in stable lagoonal conditions that prevailed in the area. Because a previous survey reported that prehistoric materials were present in the police impound yard (Stickel 1988), we decided to place test pits in the cultural deposit overlying the A horizon. This deposit was overlain by up to 1 m of modern land fill. To expedite the excavations, the overburden was stripped by machine from a 2-m by 10-m area adjacent to each trench. The lower 5 to 10 cm of overburden was manually shovel-skimmed to avoid disturbing the underlying midden.

We initially planned to excavate test pits within each stripping unit, however, because beads of mercury were observed on the neighboring Holt property, data recovery soon ceased throughout the entire site area. Toxic chemicals had also been identified in monitoring wells on surrounding parcels as part of an environmental study authorized by J. H. Snyder Company. Because similar studies had not been completed on the impound yard, we considered it prudent to avoid the area since the possibility of contamination could not be ruled out. Consequently, data recovery tasks were never completed in this portion of the Channel Gateway site. It had become clear, however, in the course of exposing the stripping units and troweling the lower portion of the trench profiles, that the deposit found in the police impound yard was of recent origin. The parcel that was used by Bruffy's Tow as an overflow parking area for impounded vehicles when our fieldwork was in progress had been previously used as a dumping ground by local businesses for many years.

MONITORING

After the data recovery phase, archaeological monitoring was undertaken intermittently over the next three years. This work was conducted during the following time periods: January 29 to June 8, 1990; September 6 to October 24, 1991; May 2 to May 31, 1991; and April 1 to April 16, 1992. Monitoring will continue until all earth-moving activities associated with the Channel Gateway development have been completed. Thus far, monitoring has concentrated on the Holt property, Avis lot, and the Bay City Metals lot. An archaeological monitor, accompanied by a Native American observer, regularly examined areas being excavated to search for human skeletal remains, cultural deposits, and artifacts. Examples of excavations that were monitored are shown in Figures 43 and 44. The progress of monitoring activities was recorded in a daily journal. Additional documentation was compiled through photography, profile drawings, and plan maps.

LABORATORY PROCEDURES

Laboratory tasks related to washing, sorting, cataloging, and curation are described in this section. Analytic methods for the various artifact analyses and paleoenvironmental studies are detailed later in their respective chapters. Materials recovered during the Channel Gateway Archaeological Project were washed, checked in, sorted, and temporarily stored at a field laboratory before being transported to the Statistical Research laboratory in Tucson where processing activities were completed. Once cataloging tasks were finalized, materials were either analyzed by Statistical Research staff members or transferred to project analysts affiliated with other institutions. The tasks conducted at the temporary and permanent laboratories now are described.

Figure 43. Photograph of *John Deere* backhoe removing soil from Avis lot for remediation (note the Marina Storage building in upper right corner).

Figure 44. Photograph of *John Deere* backhoe and front-end loader working in tandem during soil remediation on Bay City Metals lot.

Field Laboratory Organization and Procedures

A field laboratory was set up in the railroad right-of-way in proximity to the archaeological excavations. Nonartifactual gravel associated with the railroad bed was discarded on-site, thereby greatly reducing the amount of material that had to be transported for final laboratory processing. In cases when the sorters were uncertain as to the artifactual or Nonartifactual nature of particular materials, they were collected, thereby erring on the conservative side. The primary function of the field laboratory was to sort materials according to material type categories. Because materials were sorted in the field, a preliminary impression of the density and diversity of artifacts was made, and this information was incorporated into the field notes. Another advantage of having a field laboratory was that of minimizing problems related to inaccurate or incomplete provenience information. Such errors were reduced through constant feedback between excavation and laboratory personnel.

Washing

Because most materials recovered from the excavations had been water-screened, little or no additional washing was necessary before they could be sorted. Nevertheless, some materials, especially those recovered from clayey sediment, required further cleaning. Fragile items observed prior to water-screening were not washed at all to prevent unnecessary destruction. Groundstone artifacts that were to be treated with acid to remove adhering pollen grains were not washed in the field. Instead, they were immediately sealed in plastic. When additional cleaning was needed, it was conducted in a way that minimized physical wear and chemical damage. Water-screening was generally sufficient for washing lithic artifacts, well preserved animal bone, and shell. These items were usually washed in the screen, spread out on trays covered with absorbent paper, and slowly air-dried. Animal bone and shell that were too poorly preserved to withstand washing were dry-brushed. Human skeletal remains observed prior to water-screening were also cleaned by dry-brushing.

Check-In Procedures

It was the responsibility of the crew chiefs to collect all artifact bags and other samples from crew members at the end of each day. It was also the crew chief's duty to check in all project notes and arrange them according to their provenience. The crew chief ensured that these materials were completely and accurately documented, and most errors and omissions were rectified at that time. The crew chief then turned over the artifact bags and completed field records to the field laboratory director who then assumed responsibility for these materials.

The crew chief also submitted empty bags for proveniences not yielding artifacts to the field laboratory director. Even though artifacts were not recovered from certain proveniences, these proveniences were later included on the field specimen (FS) log. The empty bags were labeled with the appropriate provenience data, but no information was listed under material type. These bags were clearly labeled as containing "0" artifacts. This strategy ensured that all proveniences had at least one bag associated with them. This method was sometimes helpful for later differentiating proveniences lacking artifacts from those proveniences for which the artifact bags were simply mislabeled.

Sorting

After bags of materials from a given provenience had been inventoried, they were sorted according to major artifact classes such as chipped stone, groundstone, shell, and animal bone (Figures 45 and 46). Sorting was one of the most time-consuming laboratory procedures. To ensure that materials were reliably and consistently sorted, few laboratory technicians were dedicated to this particular task. Fragile items such as shell beads were placed in plastic vials for protection. Additional bags were filled out and FS numbers were assigned for each artifact class. Bags were then temporarily stored in boxes arranged according to provenience before being transported to Tucson.

The field laboratory director assigned a field specimen (FS) number to each artifact bag after materials from a particular provenience had been sorted. The FS number was a consecutive and unique number that identified the provenience and information on the type of material contained in a particular bag. An FS log of the appropriate provenience information, artifact or material class, date of collection, and initials of the collector was compiled. This log was a running list of materials collected from both on- and off-site locations.

Permanent Laboratory Organization and Procedures

After artifacts and other materials arrived at Statistical Research's permanent laboratory facility, the FS list was checked against items received to ensure that all materials were accounted for. Materials were then cataloged and flotation samples were processed in preparation for analysis. Upon completion of the analyses, the catalog record and analytical data were computerized, and materials were delivered for curation. All of the tasks completed in the Tucson laboratory are reviewed in this section.

Cataloging

Because specific cataloging procedures were not outlined by the curatorial facility, a relatively simple method was designed that would enable easy access to the collections. Most artifacts were stored in plastic bags that were sealed with a string. Provenience and catalog data were recorded on acid-free cardstock stamped with the appropriate information. This cardstock served as a label for each bag and was attached to the bag with the string.

Because materials were previously sorted in the field laboratory according to the various artifact classes, FS numbers had already been assigned to all artifacts from a single bag. For example, a bag of chipped stone artifacts had been assigned a single FS number. All objects that were removed for special treatment or illustration received their own unique FS number. Thus, selected individual items, for example projectile points, were sometimes later assigned their own unique FS number as cataloging was underway. This strategy facilitated tracking of these items using a computer database (see below). It also assisted in retrieval of specific items that had to be re-examined during the analysis stage.

Artifacts were counted by the cataloger, and this number was recorded on the bag label; this information was later entered into the computerized catalog record. Although this number did not always agree with the final counts made later by the analyst (for example, the lithic analyst commonly discarded materials determined not to have been culturally modified), it was helpful to estimate counts to assist in designing appropriate sampling procedures for each type of analysis.

Figure 45. Photograph of sorting operation.

Figure 46. Photograph of field laboratory work area at the Admiralty site (CA-LAn-47).

Flotation

Flotation samples were processed using a water-separation technique. Fragile plant remains and other materials contained in the flotation samples were immersed in water within the flotation tank for as brief a time as possible. Materials were separated into two fractions, a light fraction of materials that floated in water and a heavy fraction. The mesh size of the sieve used to capture the heavy fraction was 0.847 mm, a size that was large enough to permit much of the sediment to pass through, but fine enough to retain most of the lithic microdebitage. After the heavy fraction was air-dried, it was screened through a 2.54-mm sieve, thereby splitting the sample into small (0.846 to 2.54 mm) and large (> 2.54 mm) subsamples. Lithic and shell remains were then sorted with tweezers from the small subsample and by hand from the large subsample. The light fraction, which was captured by decanting the overflow, was also collected in a sieve with 0.846-mm openings.

After the flotation sample was processed, the light fraction was double-bagged in durable paper bags to allow the sample to air-dry before being stored in polyethelene bags. All bags were labeled with two cards, one attached to the exterior and one placed inside.

Temporary Storage of Materials

Materials were separated and boxed in the laboratory prior to analysis. They were packed carefully in a way to prevent the various samples from being unnecessarily damaged. Materials were sorted and boxed initially by material class. Within each material class, items were sorted and boxed according to site, feature, and provenience unit designations, and in the case of samples collected from off-site locations, simply by provenience information. These materials were inventoried at that time and the appropriate data was then entered into the computerized catalog record. The catalog record included the FS number, artifact class, and the number of artifacts. A box number inventory with the FS numbers of bags contained within each box, the type of collection (e.g., cataloged collections, photographic collections, computer archives, etc.), and the material type was also compiled.

Sample Transmittal

Upon completion of the basic inventory, those materials to be analyzed were supplied to the various specialists. The analyses of the materials was conducted either by specialists on the Statistical Research staff or by others who maintain their own laboratory facilities. When possible, materials (for example, vertebrate faunal remains and human skeletal remains) were analyzed in the Los Angeles area; however, most materials (for example, macrofossils, pollen, soil, and radiocarbon samples) were analyzed out of state. In these instances inventory control over the collections was essential so that the location of materials and the progress of the analyses could be closely tracked by the laboratory director. The laboratory director was responsible for transmitting those samples (for example, radiocarbon, flotation, and soil samples) that were not analyzed in the Statistical Research laboratory to the appropriate specialists. An inventory of all samples shipped out for analysis was kept.

Specialists were responsible for their portion of the laboratory work. Each respective specialist was provided with an inventory of all materials submitted for their analysis. In addition, the appropriate contextual data were supplied to the various specialists to provide the background information necessary for their analysis. Upon completion of their analysis, specialists returned samples to Statistical Research. Certain items, such as a small number of shell and soil samples taken for radiocarbon dating, were destroyed as part of the analytical procedure, but all materials that were not destroyed were returned.

Data Entry

The basic provenience data were maintained in a computer file with a single number being assigned to each separate provenience. This number served as a unique abbreviation for the provenience data. The provenience number was assigned by the laboratory director who then placed this number on all bags, documents, and other project materials related to that provenience. This system provided a check for ensuring that the proper provenience information was recorded on the appropriate project materials. At a minimum, provenience data include the site number, location of the collection unit (usually in grid coordinates), test pit or collection unit number, feature number, and depth.

An advantage of using a relational database was that by assigning a unique number to identify each provenience, provenience information needed to be entered only once into the database, and the number could be used to cross-reference all other appropriate data to that provenience. This not only saved data entry time, but it also reduced the number of errors by limiting the amount of information that had to be recorded in defining a provenience.

Most analyses, especially the shell, lithic, and sediment analyses, were conducted using forms designed for computerized data entry. The resulting data were then entered into specialized database files designed for each analysis. For example, the lithic analysis consisted of data files consisting of debitage, tools, cores, and groundstone.

The project database was maintained on MS-DOS desktop computers at Statistical Research's permanent laboratory. Multiple backup copies of the database files were made on a regular basis to ensure that little information could be lost as a result of system failure. Since the database was continually updated, incremental copies of changes and additions were kept at the end of each day when data was entered or modified. The entire database was backed up weekly on a tape backup.

Upon completing the database entry, the information from the database was translated into ASCII. The database included all provenience information, a catalog record for the project, and all important analytical database files. Appropriate documentation was included with the database so that a complete set of files can be used in the future on any computer with a relational database.

Curation and Maintenance of Documentation

The documentation for the project included the original field and laboratory notes, maps, photographs and other materials. These records were compiled, organized, and maintained jointly by the project director, assistant project director, crew chief, and laboratory director. Fieldnotes and laboratory records were duplicated and submitted for curation along with artifacts as part of the permanent project records. Artifacts and other project materials were deeded by the J. H. Snyder Company to a band of the Gabrielino tribe. At the request of Ms. Barbara Casas, Secretary of the Gabrielino Band of Southern California (GBSC), who wrote on behalf of elders and other members of the GBSC, materials to be curated were delivered to Ms. Vera Rocha, Co-Chairperson of the GBSC. These materials, along with an inventory list, were delivered to Ms. Rocha in Baldwin Hills, California, who planned to store them temporarily, pending construction of a permanent curatorial facility. Upon arrival of these materials, all bags were removed from the 53 boxes (each of which were 1 ft^3 in size), and cross-checked with the box inventory sheets and FS list to demonstrate that all materials had been delivered.

Field records, including level forms and test pit summary forms, were organized in a notebook according to test pit and feature numbers. Laboratory records included a listing of all project materials, information on special processing conducted on particular project materials, and a complete listing of all project materials sent to specialists for analysis. Whenever possible, these records were maintained in the computer database.

The photographic record was maintained by the project director. This collection consisted of all black-and-white prints and negatives, and color slides. A photographic log included basic provenience information and the orientation from which each photograph was taken. High quality, stable chemicals were used for all photographic processing. The photographic record was maintained in notebooks using archival quality slide, film, and negative holders. Each set of photographs was accompanied with a copy of the photographic record. Individual slides and prints were labeled with their catalog numbers (roll and exposure number).

The map collection was also maintained by the project director. Plan maps and profile drawings were kept with the appropriate field notes in notebooks arranged by provenience. Larger maps such as site maps and other miscellaneous maps of the proposed development areas were stored in a map case. With the exception of the artifacts, duplicates of all other project-related materials including the computerized database were produced. These documents are housed permanently at Statistical Research in Tucson, and are available upon request to all interested parties.

CHAPTER 8

FIELD RESULTS

This chapter provides pertinent background information for later analytical chapters on various classes of artifacts and paleobotanical remains. Results obtained from the field activities conducted during the Channel Gateway Archaeological Project are described. The first part of this chapter contains specific information on the findings of the trenching program and test pit excavations plus a preliminary review of what was observed and collected. The soil stratigraphy of the project area is interpreted in light of sediment analyses, with an emphasis on reconstruction of the depositional history of the Admiralty site and surrounding off-site areas. Next, the eight cultural features identified in the trenches and excavation units are described. Finally, the results of archaeological monitoring are discussed.

Fieldwork and sediment analyses were focused on providing information for interpreting cultural deposits at the Admiralty site and off-site areas. To better understand the context of the Admiralty site stratigraphy, fieldwork was designed to collect data for addressing research questions outlined in Chapter 6. To answer the research questions, four data sets were obtained: stratigraphic profiles from on-site and off-site; artifacts from excavation units; shell and humate samples for radiocarbon dating; and soil samples for particle size and pH analyses.

Much of the discussion in this chapter emphasizes geoarchaeology, an emerging field that relies on the application of techniques developed in the geosciences (geology, geography, and pedology) to answer archaeological problems (see Butzer 1982; Gladfelter 1981; Hassan 1978; Renfrew 1976). In basic terms, a geoarchaeological approach "places a premium on the dirt as well as the artifacts" (Gladfelter 1981:344), a strategy that is important because "the ubiquitous dirt we labour so hard to remove is itself an artifact that has much information to disclose" (Schiffer 1983:690). Thus, geoarchaeology is focused on the *context* of archaeological remains (Butzer 1982; Gladfelter 1981), an endeavor that Renfrew (1976:2) considers to be of such critical importance that "every archaeological problem starts as a geoarchaeological problem." Formation processes responsible for creating the archaeological record of the Channel Gateway project area are taken into account. These formation processes are viewed by Schiffer (1975:838, 1983, 1987) as complex interactions between both natural and cultural depositional and post-depositional processes, which he termed 1) c-transforms -- cultural activities responsible for transporting materials from their natural context and depositing them into their archaeological context and 2) n-transforms -- noncultural processes such as differential preservation, vertical and horizontal displacement, and erosion that alter the archaeological context of cultural residues.

In addressing many of the research questions, it is important to recognize the difference between *soil* and *sediment*. Although the terms are often used interchangeably, particularly by many archaeologists, there is an important distinction. Stein (1985) defines sediment "as any particulate matter on the surface of the earth that has been deposited by some process under normal conditions." Gravity, fluid flow, and thermodynamics are forces responsible for depositing sediments. Once sediment has been deposited, it is altered by physical and chemical weathering processes, thereby forming soil. Although soils form in sediment near the surface, unweathered sediment does not exhibit horizonation indicative of *in situ* soil development. Dokuchaev (1883), one of the founders of pedology (or soil science), was the first to realize that soils form in sediment under the influence of five interrelated factors; climate, organisms, relief, parent material, and time (Jenny 1941). Dynamic interactions between these factors condition the expression of soil development, and the relative importance of any one factor can vary temporally and spatially. Soil characteristics become altered through time in response to changing environmental conditions, until ultimately, given sufficient time and a stable environment, a state of equilibrium is reached.

EXCAVATIONS

Backhoe Trenches

Backhoe trenches were excavated in all parcels of the project area, except for areas with occupied buildings and active utility lines. Descriptions of the trenches are arranged according to their locations within the following properties: yacht sales yard, Holt property, Associated Pacific, impound yard, Avis lot, Marina Storage, and Bay City Metals. Because the configuration of parcels extant at the time of our fieldwork corresponded closely to those present throughout much of this century (see Chapter 4), it is not surprising that particular parcels share similar histories in terms of land use and disturbance. Consequently, these parcels provide a logical and convenient means for grouping the various subsurface tests in this discussion. Pre-existing excavations, which we designated as geologic pits, that were left exposed at the time of our fieldwork also are described in this section.

A total of thirty-five backhoe trenches were excavated during the testing program (see Figure 34). Occupied buildings precluded the excavation of 11 trenches that were planned initially. Table 8 cross-references all trenches, even those not excavated, with their location. Table 9 shows data on the soil stratigraphy of each excavated trench. The findings of each trench are now described.

Yacht Sales Yard

The yacht sales yard lot included the parking lot area northeast of the Associated Pacific building, southwest of Lincoln Boulevard, and northeast of Maxella Avenue (see Figure 34). Of the four trenches that were planned on this parcel, three were actually excavated, Trenches 2, 3, and 4. Trench 1 could not be excavated because of its location in the small automobile repair shop parking lot that was still in use. In the 1930s this property was part of "Wrights Addition to Ocean Park," an area that was isolated from the rest of the project area by a southeastward extension of Carter Avenue that was later abandoned. The yacht sales yard lot encompassed what was once several smaller store-front properties along Lincoln Boulevard.

The upper sediment of the trenches consisted of about 80 to 90 cm of redeposited overburden. The overburden deposit was the product of grading activity in preparing for the construction of the existing parking lot. Other parking lots were probably built there before. Below a 9-cm thick asphalt slab was a 40- to 60-cm thick layer of very dark grayish brown (10YR3/2) silty clay loam, a stratum representing the redeposition of locally available A horizon material. The overburden contained several thin lenses of imported olive yellow (2.5Y6/6) very fine sand, light grayish brown (10YR5/2) medium sand, brownish yellow (10YR6/6) crushed pea gravel and sand, and dark grayish brown (10YR4/2) pea gravel and fine sand.

Underlying the overburden was a soil marked by a well developed A horizon that ranged between 30 cm and 60 cm in thickness. It was a very dark grayish brown (10YR3/2) clay loam. The thick nature of this A horizon, coupled with its clayey texture and high organic matter content, suggests that it formed in a low-lying landscape position, one characterized by an xeric moisture regime. A xeric moisture regime is common in Mediterranean climates, where summers are warm and dry and

Table 8. Location of Proposed and Excavated Trenches by Parcel.

Trench No.	Yacht Sales Yard	Holt Property	Associated Pacific	Impound Yard	Avis Lot	Marina Storage	Bay City Metals	Pacific Electric Railroad ROW
1 *	X							
2	X							
3	X							
4	X							
5					X			
6					X			
7 *						X		
8 *						X		
9 *						X		
10		X						
11			X					
12			X					
13			X					
14					X			
15					X			
16						X		
17 *						X		
18 *						X		
19		X						
20		X						
21			X					
22					X			
23					X			
24					X			
25						X		
26 *						X		
27				X				
28			X					
29					X			
30					X			
31						X		
32				X				
33				X				
34					X			
35					X			
36					X			
37				X				
38				X				
39				X				
40 *							X	
41 *							X	
42 *							X	
43 *							X	
44						X		
45						X		
46						X		
Totals **	4 (3)	3 (3)	5 (5)	6 (6)	12 (12)	12 (6)	4 (0)	0 (0)

* Trenches not excavated due to occupied buildings.

** Total number of trenches actually excavated shown in parentheses.

Table 9. Types of Soil Horizons Present and Depth Below Surface in Trenches, Geologic Pits, and Test Pits. Depth of Each Horizon Present (in cm below the uppermost surface of the trench or pit).

Excavation Unit Number (a)	Overburden	A	E	Bw1	Bw2	B1	B2	B3	B4	B5	Cg	Location of Unit (b)	Walls Profiled	Location of Depth Measurements (c)	Comments
T2	9-89	89-113	113-119	119-171		171-176+						YS	South	9mE	Contained sparse scatter of historic artifacts
T3	9-81	81-117		117-132+								YS	South	16mE	
T4	25-60	60-120	120-125	125-193+								YS	South	4mE	
T5	8-54	54-79	79-85	85-144+								AL	South	10mE	
T6	5-50	50-75	75-87	87-127	127-132+							AL	South	10mE	
T10	3-33	33-75		75-112	112-145+							HP	South	10mE	
T11	0-15	15-65		65-105		105-149+						AP	South	7mE	
T12	0-6	6-38			93-135+							AP	South	10mE	
T13	5-52	52-87	87-92	92-144		144-179+						AP	South	10mE	
T14	2-54	54-74	74-79	79-120+								AL	South	10mE	
T15	0-99					99-170+						AL	South	3.5mE	Gravel stream deposits below B horiz. 170-190cm depth.
T16	4-20	20-60		60-103		103-165+						MS	South	14mE	
T19	0-25	25-46		46-99		99-142+						HP	South	8mE	
T20												HP			Not drawn due to potentially hazardous material.
T21	0-43	43-65		65-127		127-145+						AP	South	10mE	
T22	3-52	52-92	92-96	96-123+								AL	South	10mE	
T23	0-90	90-120		120-145+								AL	South	16.5mE	
T25	2-25	25-55		55-135+								MS	South	6mE	
T27	3-54	54-80	80-92			92-159	159-192+					IY	South	8mE	
T28	2-51	51-79	79-85	85-115	115-150+							AP	North	4mE	
T29	4-62	62-91	91-95	95-155+								AL	South	14mE	
T30	20-62	62-85	85-89	89-140		140-155+						AL	South	3mE	
T31	0-20	20-43		43-90	90-102	102-140+						MS	South	17mE	
T32	0-96	96-128	128-165+									IY	South	12mE	
T33	0-55	55-98	98-127	127-186+								IY	South	10mE	
T34												AL			Not drawn due to potentially hazardous material.
T35	5-47	47-78		78-135	135-160+							AL	South	5mE	
T36	7-105			105-146+								AL	South	10mE	
T37	0-104	104-134	134-155	155-207+								IY	South	10mE	
T38	5-92	92-113	113-135	135-180+							180-247+	IY	South	16mE	
T39	0-65			65-114	114-140+							IY	North	10mE	
T44	0-9	9-41		41-87	87-130+							MS	West	6mE	
T45	2-25	25-55	55-70	70-150+								MS	North	10mE	
T46	0-15	15-40	40-54	54-115								MS	North	7mE	

Table 9. Types of Soil Horizons Present and Depth Below Surface in Trenches, Geologic Pits, and Test Pits. Depth of Each Horizon Present (continued).

Excavation Unit Number (a)	Overburden	A	E	Bw1	Bw2	B1	B2	B3	B4	B5	Cg	Location of Unit (b)	Walls Profiled	Location of Depth Measurements (c)	Comments
GP1	0-20	20-35				35-120	154-218	218-243	243-309	309-330	330-360+	MS	South,East	SE Corner	stream gravel deposit found between 120-154cm.
GP2	0-33	33-77		77-142	142-184	184-220+						AL	North,East	NE corner	
GP3	0-21	21-60		60-129	129-201	201-234	234-307	307-375				YS	South,West	SW corner	
TP1		10-63	63-70	70-86+								RR	North,West	N107 W21	
TP2	22-54	54-83	83-92	92-127		127-170+						RR	South,East	N100 W40	
TP3		0-51	51-57	57-84	84-95	95-100+						RR	South,West	N104 W62	
TP4	0-50	50-91	91-100+									RR	South,West	N99.2 W100.5	
TP5		0-40	40-50	50-82	82-92	92-100+						RR	South,West	N104 W52	
TP6	0-40	40-62	62-72	72-110+								RR	South,West	N100 W80	
TP7	16-30	30-70	70-80+									RR	South,East	N90 W29	
TP8	11-34	34-75	75-90+									RR	North,West	N104 W29	
TP9	12-16	16-50	50-82	82-130+								RR	South,East West	N90 W13	
TP10	0-25	25-46		46-99		99-142+						HP	North	8mE	
TP11	5-52	52-87	87-92	92-144		144-179+						AP	North	10mE	
TP12		10-78	78-90+									RR	North,East	N106 W32	
TP13		5-74	74-80+									RR	South,East	N105 W7	
TP14		10-62	62-80+									RR	South,West	N90 W2	

a. T = trench
GP = geological pit
TP = test pit

b. HP = Holt property
AP = Associated Pacific
MS = Marina storage
IY = impound yard
RR = Railroad right-of-way
AL = Avis lot
YS = yacht sales yard

c. Depth measurements taken from the least disturbed portion of the trench that contains the most complete stratigraphic section.

winters are cool and moist (Soil Survey Staff 1990). A 5-cm to 6-cm light brownish gray (10YR6/2) E horizon with a silty clay loam texture was found below the A horizon in Trenches 2 and 4. The lighter color and slightly coarser texture of the E horizon relative to the overlying A horizon is due to eluviation (leaching), a soil formation process that resulted in the translocation of organic matter, oxides and mineral clay into the underlying Bw horizon. The presence of an E horizon indicates that at times, probably seasonally, the subsoil was dry enough to permit leaching during periods of rainfall. A grayish brown (10YR5/2) silty clay Bw horizon was noted at or near the bottom of all three trenches. The bottom of the Bw was not reached in Trenches 3 and 4, but in Trench 2 it was 52-cm thick, ranging between 1.19 and 1.71 m in depth below the asphalt-covered surface. As indicated by very thin, discontinuous clay films, this cambic B horizon formed as illuvial clay accumulated on ped surfaces below the A and E horizons. Seasonally moist soil conditions, possibly in combination with a relatively recent (less than 1000 years) age, may have prevented the Bw horizon from developing into a Bt (argillic) horizon, a diagnostic subsurface horizon characterized by greater illuvial clay accumulation than that of a cambic horizon (see Buol et al. 1980:38 for definitions of cambic and argillic horizons). At the base of Trench 2, a weakly developed B horizon was observed below the Bw horizon. This dark brown (10YR3/3) sandy clay loam B horizon exhibited weak structural development and little or no evidence of illuvial clay accumulation. The bottom of the B horizon was not reached in Trench 2.

Evidence of a number of post-depositional disturbances was observed in Trenches 2 to 4; most of these disturbances are related to trenches from abandoned sewage and electric lines paralleling Lincoln Boulevard. Other disturbances included basin-shaped pits ranging between 30 cm and 3.7 m in width, and between about 30 cm and 80 cm in thickness. The stratigraphic point of origin for these modern features varied widely; some originated within the overburden, whereas the oldest ones originated at the top of the A horizon. Trench 2 was the least disturbed of the three trenches, and Trench 4, near the corner of Lincoln Boulevard and Maxella Avenue, was the most heavily disturbed. The A horizon in approximately two-thirds of Trench 4 had been truncated. This situation was exacerbated when a live high pressure water line was struck by the backhoe prior to our investigation during the testing phase. Erosion from the rapid flow of water destroyed much of the trench profile. In the central part of Trench 3, the upper half or so of the A horizon had been scraped off.

No prehistoric artifacts or features were found in the trench profiles, a finding that is consistent with our geomorphic interpretation of this parcel as a naturally low-lying, seasonally inundated area that was unsuitable for occupation. Historic artifacts dating to as early as the 1920s and 1930s, however, were found mixed throughout the overburden, especially near the bottom of the overburden in Trenches 2 and 4. A few historic artifacts were found embedded in the upper part of the A horizon, probably the result of trampling or other types of bioturbation such as animal burrowing. Sixteen artifacts were collected from Trenches 2 and 4, mostly ceramics (yellow ware, porcelain, and sewer tile), clear glass from soda bottles, and miscellaneous pieces of scrap metal. Other materials included a plastic toy truck, wood, charcoal, domesticated animal bone, and chunks of concrete. The paucity of historic artifacts suggests that the yacht sales yard property was peripheral to more intensively occupied areas to the west.

Holt Property

The Holt property was a small parcel sandwiched between Princeton Drive to the northwest and the lot for the Associated Pacific building to the southeast. It is located in the northernmost portion of the Channel Gateway project area. Based on Los Angeles county tax assessment records, this parcel first served as a residence during the 1920s and 1930s, and prior to that time it was used historically as an agricultural field (see Chapter 4). At the time of our fieldwork, no buildings existed on the Holt property. With the exception of monitoring wells being used to obtain water samples there were no obstructions to the placement of trenches. It was possible to excavate all three trenches (Trenches 10, 19, and 20) planned on the property, although Trench 20 had to be moved about 2 m west to avoid one of the monitoring wells.

The stratigraphy, color, and texture of sediment in Trenches 10 and 19 was similar to the profiles observed in the yacht sales yard trenches (Figure 47). An overburden deposit, which was 25- to 33-cm thick, consisted of dark grayish brown (10YR4/2) A horizon material that probably was scraped up from the parcel and redeposited nearby on the same property. Deposits on the Holt Property were much less disturbed than those in the yacht sales yard. Trench 10 was the least disturbed of the three trenches on the Holt property as indicated by its 42-cm thick A horizon. Approximately 20 cm of the A horizon in Trench 19 had been stripped off by heavy equipment used in grading the property. An abrupt boundary between the overburden deposit and the A horizon in Trench 19 was marked by a concentration of historic artifacts in the lower overburden and the high bulk density of sediment at the top of the A horizon. Due to the weight of heavy equipment and buildings once located on the parcel, a traffic pan was created which was similar to the compact agric horizon that commonly forms below plow zones in cultivated fields (see Buol et al. 1980:38; Soil Survey Staff 1990:9-10). Unlike the yacht sales yard trenches, an E horizon was not observed, indicating that soil on the Holt property was formed under conditions of restricted drainage. Directly underlying the A horizon was a dark brown (10YR3/3) Bw horizon that was differentiated into Bw1 and Bw2 subhorizons. The Bw1 subhorizon was separated on the basis of its strong, subangular blocky structure and its very firm, hard consistence. In contrast, the Bw2 subhorizon had a weak, blocky structure and a firm, slightly hard consistence.

Unfortunately, the stratigraphy of Trench 20 could not be documented because potentially hazardous industrial waste products were encountered in the trench. The entire trench was contaminated with a noxious mixture of hydrocarbons and solvents, chemicals that were apparently dumped here by one or more of the businesses that were in operation on or near the Holt Property. Because of the offensive odor and health risk, work on Trench 20 was limited to a cursory examination to search for prehistoric and historic artifacts and features. Although a few historic artifacts, primarily ceramics and metal, were observed, no cultural features were identified in Trench 20. We did, however, find that the subsurface deposits were largely intact and similar stratigraphically to Trenches 10 and 19. Trench 20 had a 50-cm thick overburden deposit overlying a 20-cm thick A horizon and a Bw horizon of unknown thickness.

Trenching on the Holt property showed that the area was used intensively during historic times, thus confirming the findings of our archival research. Historic artifacts were abundant and five of the eight historic features identified in the Channel Gateway project area were found on this property. These five features included a concrete foundation for a steam drop hammer (Feature 1) and four trash pits (Features 2-5) that originated at the top of the A horizon (see feature descriptions in later section of this chapter). Features 1 through 4 were identified in Trench 19 and Feature 5 was found in Trench 10 (see Figure 47). Artifacts included domestic refuse (e.g., Japanese porcelain and earthenware sherds, various types of glass, toys, a tobacco pipe, shoe leather, buttons, tin cans, a fork, a washboard, clam shell fragments, and fruit seeds). Also included were industrial items such as bolts, screws, and lathe-cut metal shavings that were probably associated with a brass foundry established on the property in the 1940s. The age and types of artifacts that were recovered from the Holt Property are consistent with tax assessment records for the property. The oldest artifacts generally date to the 1920s, the time when the property was first occupied (see historic artifact analysis in Chapter 18).

Associated Pacific

The Associated Pacific lot was bounded by the yacht sales yard to the northeast, the Holt property to the northwest, the impound yard to the southwest, and Maxella Avenue to the southeast. Initial historic use of this lot was probably limited to agricultural and dumping activities that began in the

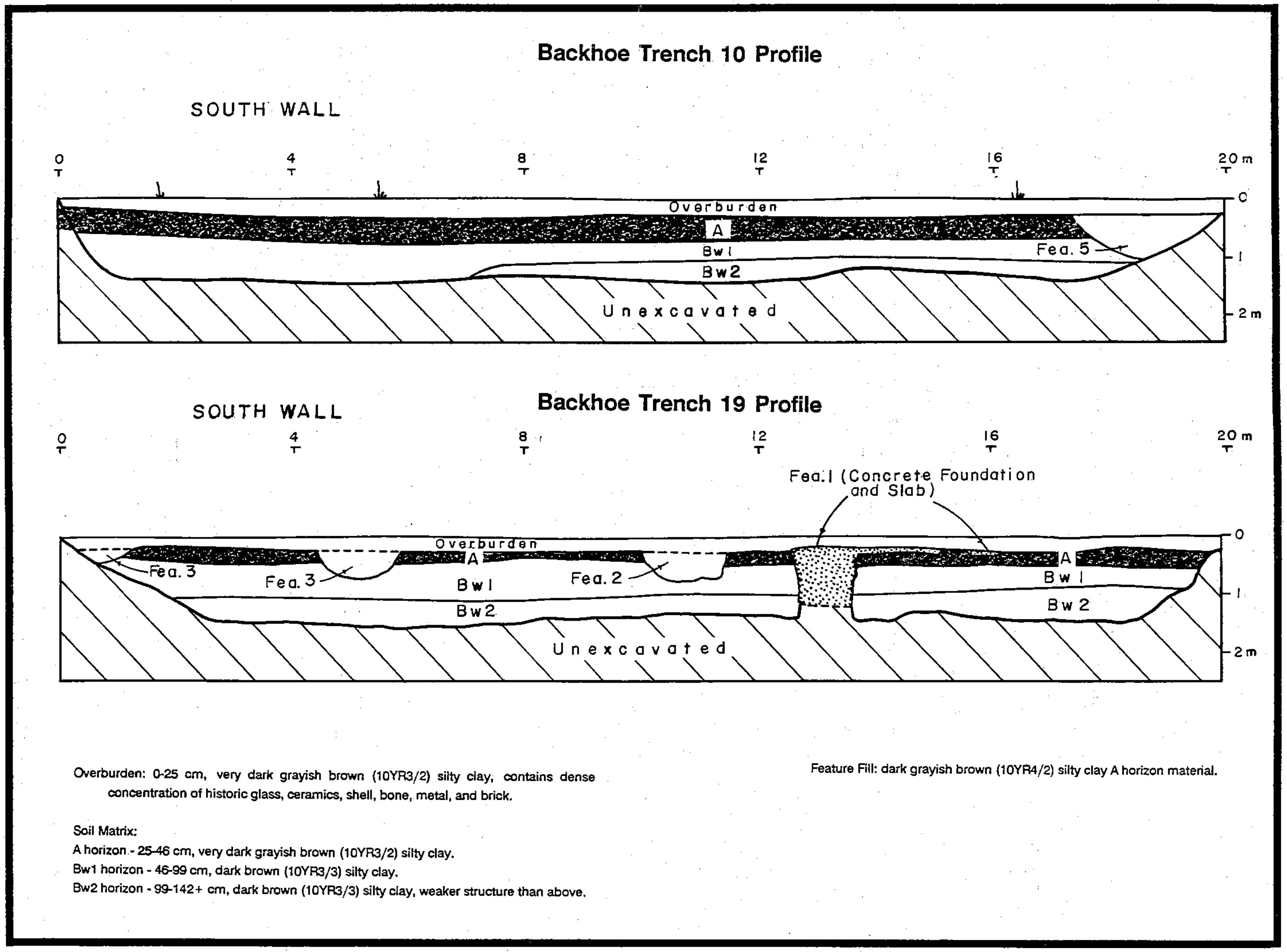


Figure 47. South profiles of Backhoe Trenches 10 and 19.

1920s and 1930s (see Chapter 4). The property was purchased by the Mercury Petroleum Company in the mid-1930s, presumably for oil exploration, and subsequently by the Associated Pacific Industries for construction of a factory that was completed in the early 1940s. All five trenches (Trenches 11, 12, 13, 21, and 28) that were planned on the Associated Pacific lot were excavated, even Trenches 11, 12, and 21 which were located inside of the abandoned Associated Pacific building. Trench 13 was placed between the Associated Pacific building and Maxella Avenue. Trench 28 was located in the extreme southern part of the lot; it had to be moved about 10 m to the north of its originally planned location because of an existing fenceline. It was not necessary to place any trenches in the concrete-covered parking lot to the south of the Associated Pacific building since Dillon, et al. (1988) had previously excavated eight small trenches in that area (see Figure 34)

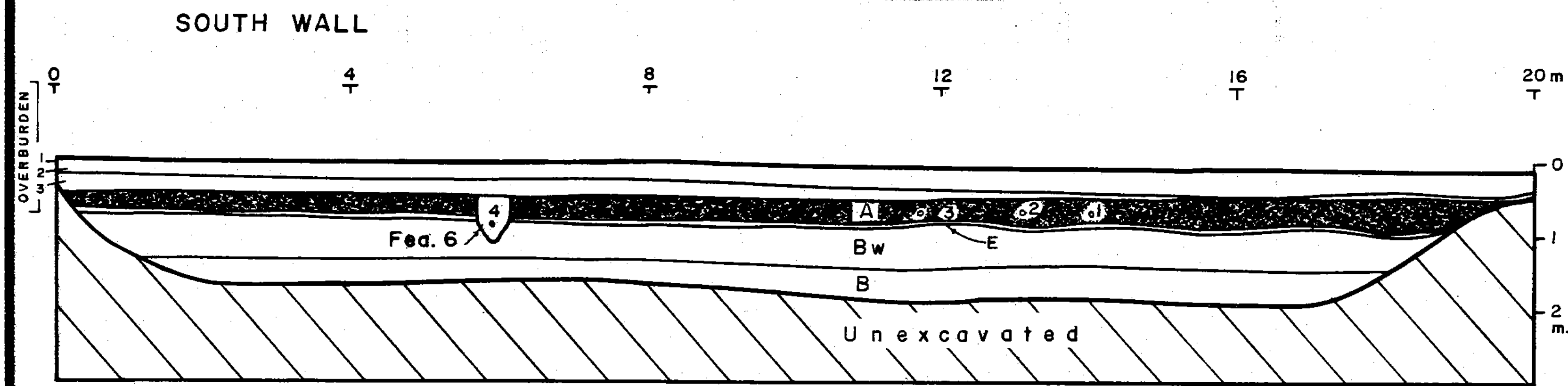
The five trenches on the Associated Pacific lot were similar stratigraphically to those previously described for the yacht sales yard and the Holt property. One difference was that the overburden, which ranged between 6 and 52 cm in thickness, was generally much thinner on the Associated Pacific lot than in other areas, especially in the three trenches placed inside of buildings. The A horizon in Trench 12 was directly overlain by a 6-cm thick concrete slab, and the A horizon in Trenches 11 and 21 was covered by an 8- to 13-cm thick concrete slab and a 7- to 30-cm thick stratum of black (10YR2/1) redeposited A horizon material and/or a dark yellowish brown (10YR4/6) deposit of crushed gravel and sand. The overburden in Trench 13 was comprised of a 5-cm thick asphalt slab, a 25-cm thick deposit of dark yellowish brown (10YR4/6), and a 17-cm thick stratum of redeposited A horizon material (Figure 48). The Trench 28 overburden includes two layers of redeposition of A horizon material to 42 cm in depth, and a 9-cm thick deposit of light olive brown (2.5Y5/6) crushed gravel and coarse sand.

Another difference in the stratigraphy of the Associated Pacific lot relative to neighboring parcels was that the three trenches located within the building (Trenches 11, 12, and 21) had A horizons that were considerably darker in color (black, 10YR2/1) than those of nearby trenches. The black color was associated with a higher organic matter content which resulted from wet conditions that probably existed in a small, localized depression. Also contributing to the dark color of Trench 21 was the presence of diesel oil. The lack of an E horizon in Trenches 11, 12, and 21 further bolsters the contention that they were located in areas with very restricted internal drainage. In contrast, a 5-cm thick gray (10YR4/1) E horizon was found in Trench 13, and a 6-cm thick light brownish gray (10YR6/2) E horizon was noted in Trench 28. Below the A or E horizons in all five trenches were B and Bw horizons that were essentially identical in thickness, color, and texture to those described previously for the yacht sales yard.

Most of the sediment was intact in the trenches excavated on the Associated Pacific lot. This finding was somewhat unexpected, especially for the trenches placed inside the Associated Pacific building. In fact, Trenches 11, 12, and 21 were among the least disturbed trenches in the entire project area. We had expected these trenches to be at least moderately disturbed by grading activity associated with building construction, but instead, it was apparent that earth-moving activity was confined to redeposition of imported sediment, not excavation into the natural sediment. The only trench with noteworthy disturbances was an 8-m long section in Trench 28 where a sewage line trench had been excavated and then filled with imported gravel and a mixture of soil material.

With the exception of Trench 13, no artifacts or cultural features were found on the Associated Pacific lot. One clam shell, an animal bone fragment, and a white earthenware sherd were noted in the A horizon exposed in Trench 13 (see Figure 48, also see Chapter 18). In addition, a pit-like feature, designated as Feature 6, was observed in the Trench 13 wall, originating at the top of the A horizon (see Figure 48). Upon excavation, Feature 6 was determined to be an animal burrow, not a cultural feature. This finding was supported by the presence of rodent bones within it and its irregular tunnel-like, three-dimensional shape (see features description later in this chapter).

Backhoe Trench 13 Profile



Overburden:
1) 5-10 cm, asphalt slab for Avis building parking lot.
2) 10-35 cm, dark yellowish brown (10YR4/6) coarse-very coarse sand and crushed gravel.
3) 35-52 cm, very dark grayish brown (10YR3/2) silty clay A horizon material containing salt encrustation.

Soil Matrix:
A horizon - 52-87 cm, very dark grayish brown (10YR3/2) silt loam.
E horizon - 87-92 cm, gray (10YR4/1) silty clay loam.
Bw horizon - 92-144 cm, brown-dark brown (10YR4/3) silty clay loam.
B horizon - 144-179+ cm, dark brown (10YR3/3) silty clay loam.

Point-provenienced artifacts
1 - clam shell fragment
2 - white ware sherd
3 - animal bone fragment
4 - animal bone fragment

Figure 48. South profile of Backhoe Trench 13.

Impound Yard

The impound yard was bounded by the Associated Pacific lot to the northeast, Maxella Avenue to the southeast, and a number of other properties to the southwest and northwest that lie outside of the Channel Gateway project area. Little is known about early twentieth century use of the impound yard. Like the Associated Pacific lot, the impound yard property also was owned by the Mercury Petroleum Company in the mid-1930s, however, no evidence of oil well drilling was found on the property. The property apparently was an open lot during the 1960s and 1970s, and then purchased for use as an impound yard by Bruffy's Towing Company in the 1980s. It was actively being used for impounding and auctioning automobiles during the time of our fieldwork in 1989. With the cooperation of the impound yard supervisor in moving rows of cars as needed, it was possible to excavate all five of the trenches that were planned on this property. Trench 27 was placed in the northeast section, sandwiched between the locations of two test pits previously excavated by Dillon et al. (1988); Trenches 32 and 33 were located in the central portion of the lot; and Trenches 37, 38, and 39 were excavated in the southwest section of the impound yard.

This lot was of special concern because of a previous dispute as to the nature of the deposits. These issues revolved around the presence or absence of in situ shell midden deposits, and whether or not these deposits might be part of the Admiralty site. Stickel (1988), who conducted the cultural resources survey of the Channel Gateway project area, referred to the impound yard as the "Police Garage Yard." Stickel (1988:9) reported observing sparsely distributed and highly fragmented *chione* and *pecten* throughout the surface of the lot, especially in the northeastern section. He also noted a quartzite flake. In referring to the remains found on the impound yard, Stickel (1988:9) made the following argument:

> The high potential for the presence of a [sic] significant cultural resources for the area is confirmed by two previous reports on a site which covers part of the subject property (site CA-LAn-47). Despite the previous development on the property, at least one portion of the site is still present (within the Police Garage Yard). The [sic] is still the possibility that more of the site lies underneath the paved portions of the property at present.

Based on his interpretation, Stickel recommended that test excavations be undertaken on the property and that any construction activities be monitored by an archaeologist.

As later noted by Dillon et al. (1988:40-43), who conducted test excavations at the impound yard as well as other areas of the Channel Gateway project area, the impound yard was clearly outside of the parts of the Admiralty site that had been identified during previous investigations (see Chapter 5). Based on surface observations alone, Dillon et al. (1988:42) initially concurred with Stickel's report of a shell midden deposit on the property. Upon excavating two test pits, however, Dillon et al. (1988:42) reported finding that the:

> "surface mixing of modern garbage and shell continued all the way to the bottom of the deposit. Consequently, the Impound Yard's northern section must be interpreted as a recently filled area, not a portion of a pristine archaeological site."

Because of the differing opinions reviewed above, one of the primary goals of trenching on this property was to resolve the issue regarding the existence of primary versus secondary shell midden deposits. Consequently, each of the six trenches in the impound yard were scrutinized with particular care.

Again, the soil stratigraphy closely mirrored what was found in the previously described trenches, namely an A-E-B/Bw soil horizon sequence underlying an historic overburden deposit of variable thickness and character. In Trench 27, the overburden consisted of a 42-cm thick stratum of very dark grayish brown (10YR3/2) A horizon material above a 9-cm thick stratum of dark grayish brown (2.5YR2/2) medium to coarse sand. Trench 32, which had the most complex overburden stratigraphy observed in the impound yard, contained the following six strata: 1) 0 to 8 cm, asphalt slab; 2) 8 to 15 cm, dark brown (10YR3/3) A horizon material; 3) 15 to 21 cm, dark reddish gray (5YR4/2) very fine sand; 4) 21 to 49 cm, dark brown (10YR3/3) sandy clay; 5) 49 to 92 cm, very dark grayish brown (10YR3/2) A horizon material; and 6) 92 to 96 cm, yellowish brown (10YR5/6) medium sand mixed with some pea gravel. Although the overburden thickness varied somewhat between Trenches 37, 38, and 39, the overall stratigraphy was consistent between them (Figure 49).

A 26- to 43-cm thick A horizon consisting of very dark brown (10YR2/2) or black (10YR2/1) sandy clay loam was found in five of the trenches. Underlying the A horizon was a very dark brown (10YR3/2) or very dark gray (10YR3/1) E horizon which varied in thickness between 11 and 37 cm. The thickest A horizon was found in Trench 33, which, not incidentally, also had the thickest E horizon of those observed on the property. The presence of thick, well developed A and E horizons (which are indications of long-term landscape stability and good internal drainage) in the impound yard, especially in the vicinity of Trench 33, suggests that this property was slightly higher in relative elevation than all of the previously described areas.

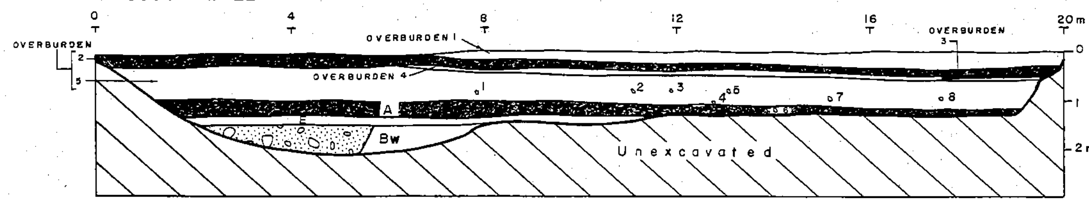
In the lower trench profiles, similar B or Bw horizons to those already described were noted. Interestingly, the Bw horizon in the northeast end of Trench 37 had been incised by a stream channel that was at least 3.5-m wide and 60-cm thick, occurring between 1.55 and 2.15 m below surface. Only a part of its lense-shaped cross section was exposed, so it could be much bigger than what was observed. The sediment within this channel consisted of a dark grayish brown (2.5Y4/2) sand and gravel deposit. Gravel comprised about 15 percent of the volume, almost entirely rounded, tabular pieces of shale that were less than about 8 cm in length along the long axis. The imbricated fabric of the sediment indicated that the channel flowed southwestward into Ballona Lagoon. The relatively small size of the gravel, coupled with the lack of suitable raw materials such as quartzite or chert that could have been used for lithic production, suggests that this channel or other similar channels that might have existed on or near the property were probably not used for procuring these resources prehistorically. Moreover, because of the stratigraphic position of the channel below the E horizon, it was probably already filled with sediment and buried by the time the Admiralty site was first occupied.

Trench 38 was excavated deeper than others at the impound yard. Underlying the Bw horizon was a Cg horizon that extended from 1.8 to at least 2.47 m depth. This gleyed horizon consisted of a dark brown (10YR3/3) silty clay with dark yellowish brown (10YR4/6) and dark gray (5YR4/1) mottles. The color of the mottles indicates that this horizon was within a fluctuating water table zone that experienced alternating conditions of oxidation and reduction. Reducing conditions would have accompanied the winter rainy season when the water table was elevated for a prolonged period of time.

Aside from minor bioturbation, the only notable disturbance was found in Trench 39 where the A and E horizons had been completely removed, probably for use as fill material in other portions of the impound yard. A metal pipe in the center of the A horizon of Trench 33 indicates that some of the sediment had been disturbed, but to a much lesser extent than the trenches excavated next to Lincoln Boulevard where numerous buried utility lines were encountered.

A considerable amount of artifactual material was found in the impound yard, especially in Trenches 37 and 38; however, none of it is attributable to prehistoric or historic aboriginal use of the property. The only diagnostic artifacts were historic glass fragments, most of which date to between the 1910s and 1950s (see discussion in Chapter 18). Most of the glass was clear, but some pieces of sun-colored amethyst (SCA) and "turned pink" glass were noted. Ceramic artifacts included hardpaste

Backhoe Trench 37 Profile



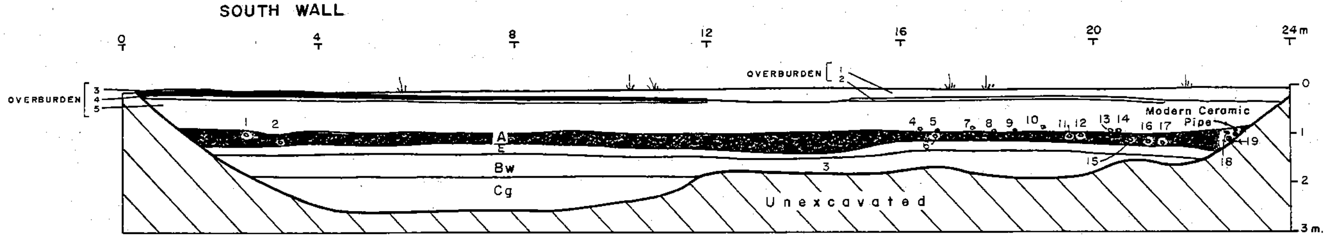
Dark grayish brown (2.5YR4/2) coarse sand and gravel alluvial channel deposit.

Soil Matrix:
A horizon - 104-134 cm, very dark brown (10YR2/2) sandy clay loam.
E horizon - 134-155 cm, very dark gray (10YR3/1) sandy loam.
Bw horizon - 155-207+ cm, dark brown (10YR3/3) silty clay.

Overburden:
1) - 0-21 cm, very compact dark yellowish brown (10YR4/4) sandy loam.
2) - 21-34 cm, very dark grayish brown (10YR3/2) silty clay loam A horizon material mixed with some pea gravel.
3) - 42-51 cm, asphalt slab within Impound Lot.
4) - 34-48 cm, dark yellowish brown (10YR4/4) sandy clay.
5) - 48-104 cm, very dark grayish brown (10YR3/2) silty clay loam, contains numerous ceramics, glass, animal bone, brick fragments, and metal.

Point-provenienced Artifacts
1 - clear glass fragment
2 - animal bone fragment
3 - clear glass fragment
4 - porcelain sherd
5 - ceramic sewer pipe fragment
6 - animal bone fragment
7 - animal bone fragment
8 - porcelain

Backhoe Trench 38 Profile



Overburden:
1) - 5-16 cm, dark yellowish brown (10YR3/4) sandy clay.
2) - 15-24 cm, very dark grayish brown (10YR3/2) silty clay.
3) - 16-22 cm, asphalt slab within Impound Lot.
4) - 22-27 cm, light gray (2.5Y7/2) coarse sand and crushed gravel.
5) - 27-92 cm, very dark brown (10YR2/2) silty clay loam, contains numerous sawn animal bone and some ceramics, metal, glass, bricks, and gravel.

Soil Matrix:
A horizon - 92-113 cm, black (10YR2/1) sandy clay loam.
E horizon - 113-135 cm, dark olive gray (5Y3/2) sandy loam.
Bw horizon - 135-180 cm, dark brown (10YR3/3) silty clay.
Cg horizon - 180-247+ cm, dark brown (10YR3/3) silty clay with dark yellowish brown (5YR4/1) mottles.

Point-Provenienced Artifacts
1-5 - animal bone
6 - porcelain sherd
7 - clear glass fragment
8 - animal bone
9 - porcelain sherd
10 - animal bone
11 - charcoal
12 - animal bone
13 - clear glass fragment
14 - metal fragment
15-16 - animal bone
17 - metal fragment
18 - clear glass fragment
19 - animal bone

Figure 49. South profiles of Backhoe Trenches 37 and 38.

white earthenware bowl, mug, and plate fragments, a porcelain sherd, and pieces of ceramic tile and sewer pipe. Other artifacts included a lipstick tube, a shoe eyelet, barbed wire, nails, a battery core, and miscellaneous unidentifiable pieces of metal and plastic. A substantial amount of animal bone was also identified, mostly cow (*Bos taurus*) and minor quantities of chicken (*Gallus gallus*) and sheep/goat (*Ovis/Capra*). Historic artifacts exposed in Trenches 37 and 38 suggest that the southwestern part of the impound yard probably served as a dump site that was actively used when surrounding businesses were in operation. There was no indication that a residence or any other type of structure ever existed on the impound lot.

Initially, it was unclear whether the deposit in Trenches 37 and 38 represented prehistoric, historic, or modern refuse. The first remains observed in the field consisted of large uncut mammal bone fragments, including Artiodactyl (deer or sheep/goat) mandibles. This material, which did not appear to be typical of modern or historic domestic refuse, was laid directly on top of the A horizon, the relict surface horizon that was found buried below historic overburden throughout much of the project area. The A horizon in this area, however, contained few artifacts. The few artifacts found in the A horizon were observed near the top of this horizon, and these remains were probably translocated downward by the effects of trampling and animal burrowing (see Figure 49). There was no indication that the A horizon was anthropic (that is, a surface horizon containing more than 250 ppm of citric acid soluble P_2O_5); rather, it most likely formed in the lagoonal environment that formerly prevailed in the project area. Because a previous survey reported that prehistoric materials were present in the impound yard, we decided to place test pits in the cultural deposits overlying the A horizon.

In the process of manually removing the overburden and laying out test pits, the recent nature of the deposit became obvious when large amounts of butchered bone and historic artifacts were exposed in the upper portion of the cultural deposit. Recent artifacts were also uncovered along with fragments of fiberglass. Informants who had worked for many years at the adjacent Bay City Metal plant indicated that the latter material was derived from a workshop that had operated on the western edge of the project area within the last 10 years (Henry Lopez, personal communication 1989). Historic artifacts exposed in Trenches 37 and 38 suggest that the southwestern part of the impound yard probably served as a dump site that was actively being used as surrounding businesses were in operation. There was no indication that a residence or any other type of structure ever existed on the impound yard.

Avis Lot

The Avis lot was a large parcel bounded by Lincoln Boulevard to the northeast, Maxella Avenue to the northwest, the Bay City Metals lot to the southwest, and the Marina Storage lot to the southeast. The property, which was owned and operated by Avis Rent-A-Car, was used for storing and servicing rental cars, but was abandoned before our fieldwork began. Although some of the trenches had to be moved slightly to avoid obstructions, it was possible to excavate all 12 of the backhoe trenches (Trenches 5, 6, 14, 15, 22, 23, 24, 29, 30, 34, 35, and 36) planned on the property. Trench 15 had to be moved about 3 m to the west to avoid the abandoned Avis office building and the eastern service bays; Trench 23 was moved about 2 m west to avoid the western service bays; and Trench 34 was moved about 10 m east from Maxella Avenue onto the Avis lot. Only a small portion of Trench 24 was excavated because a series of utility lines were encountered running parallel to the trench. After the first utility line was exposed, the trench was shifted slightly to the southeast, but several more utility lines were found in this location. The trench was abandoned at this point. In Trench 34 noxious hydrocarbons were exposed which made the backhoe operator sick. Because of its extremely offensive odor and its potential as a health hazard, Trench 34 was backfilled without being documented stratigraphically. A quick glance at the Trench 34 profiles revealed a great deal of disturbance and did not indicate that cultural deposits were present.

The stratigraphy of the Avis lot backhoe trenches was similar to those documented in other portions of the project area. All trenches had an historic overburden deposit overlying a well developed A horizon. The uppermost overburden stratum consisted of an asphalt slab, and in a few places, a concrete slab that varied between 5 and 11 cm in thickness. Below the asphalt slab was a light gray (2.5Y7/2) or light olive gray (5Y6/2) deposit of crushed gravel and sand that was brought in when the property was graded prior to constructing the large parking lot around the buildings. Although this crushed gravel and sand deposit was 90-cm thick in Trench 15, it was much thinner in other trenches where it varied between 6- and 13-cm thick. In Trenches 14, 29, and 30, a layer of crushed gravel and sand was found intermixed with very dark brown (10YR2/2) or very dark gray (10YR3/1) sandy loam A horizon material.

The lower overburden layers were highly variable across the Avis lot in terms of their depth, color, texture, origin, degree of mixing, and stratigraphic relationship. These layers consisted of the following homogenous to heterogenous deposits of sediment: 1) dark yellowish brown (10YR3/6) sandy loam mixed with thin layers of yellowish brown (10YR5/8) pea gravel and coarse sand; 2) strong brown (7.5YR5/6) medium sand; 3) dark yellowish brown (10YR4/4) and yellowish brown (10YR5/4) crushed gravel; 4) very dark grayish brown (10YR3/2) or very dark brown (10YR2/2) clay loam A horizon material; and 5) and brown (10YR5/3) sandy clay loam B horizon material. Examples of the historic fill are shown in the Trench 6 and 35 profiles depicted in Figures 50 and 51. Some of the above layers were undoubtedly imported from elsewhere to serve as earthen fill in preparing the parcel for construction. The soil material was probably scraped from the Avis lot and then redeposited on the same property. Modern historic artifacts such as chunks of concrete, brick fragments, nails, pieces of plastic, and metal, asbestos, and ceramic pipe were found intermixed in the overburden and intrusive historic pits (see Figure 50).

Similar to other trenches in the Channel Gateway project area, an A horizon was found in all relatively undisturbed trenches. The top of the A horizon ranged between 47 and 90 cm below surface, although it was typically encountered at depths between 50 and 62 cm below surface. The A horizon was usually between 20 to 30 cm thick; the thickest A horizon was in Trench 22 where it was 40-cm thick. Some of the thickness variations may be artificial, the product of grading activity which may have removed the upper portion of the A horizon; however, since the A horizon thickness is similar to neighboring areas, grading has probably not significantly affected the surface that existed prior to construction. The A horizon varied in color between very dark grayish brown (10YR3/2) and very dark gray (10YR3/1) sandy loam or silt loam. It was similar in structure and consistence to the trenches described previously for the parcels northwest of Maxella Avenue.

Underlying the A horizon was a thin light brownish gray (10YR6/2) or dark grayish brown (10YR4/2) silty clay loam E horizon. The E horizon, which ranged between 4 and 7 cm in thickness, tended to be associated with the thicker A horizons. Furthermore, the darker-colored E horizons were also associated with darker-colored A horizons; that is, those with a higher organic matter content. The above characteristics indicate that the Avis lot, under natural conditions, was neither as poorly drained nor as well drained as other previously described trenches. Although the E horizon was not well developed, its presence is indicative of at least periodic leaching in the Avis lot.

A Bw horizon, which occasionally was subdivided into Bw1 and Bw2 subhorizons, was found below the E horizon throughout the Avis lot. It varied widely in color and texture from a dark yellowish brown (10YR3/4) sandy clay loam to a grayish brown (10YR5/2), yellowish brown (10YR5/4), dark gray (10YR4/1), brown-dark brown (10YR4/3), or dark brown (10YR3/3) silty clay, or a dark yellowish brown (10YR4/4) sandy loam. As with the E horizon, the darker-colored Bw horizons generally were overlain by darker-colored A horizons. Some of the color variations could be

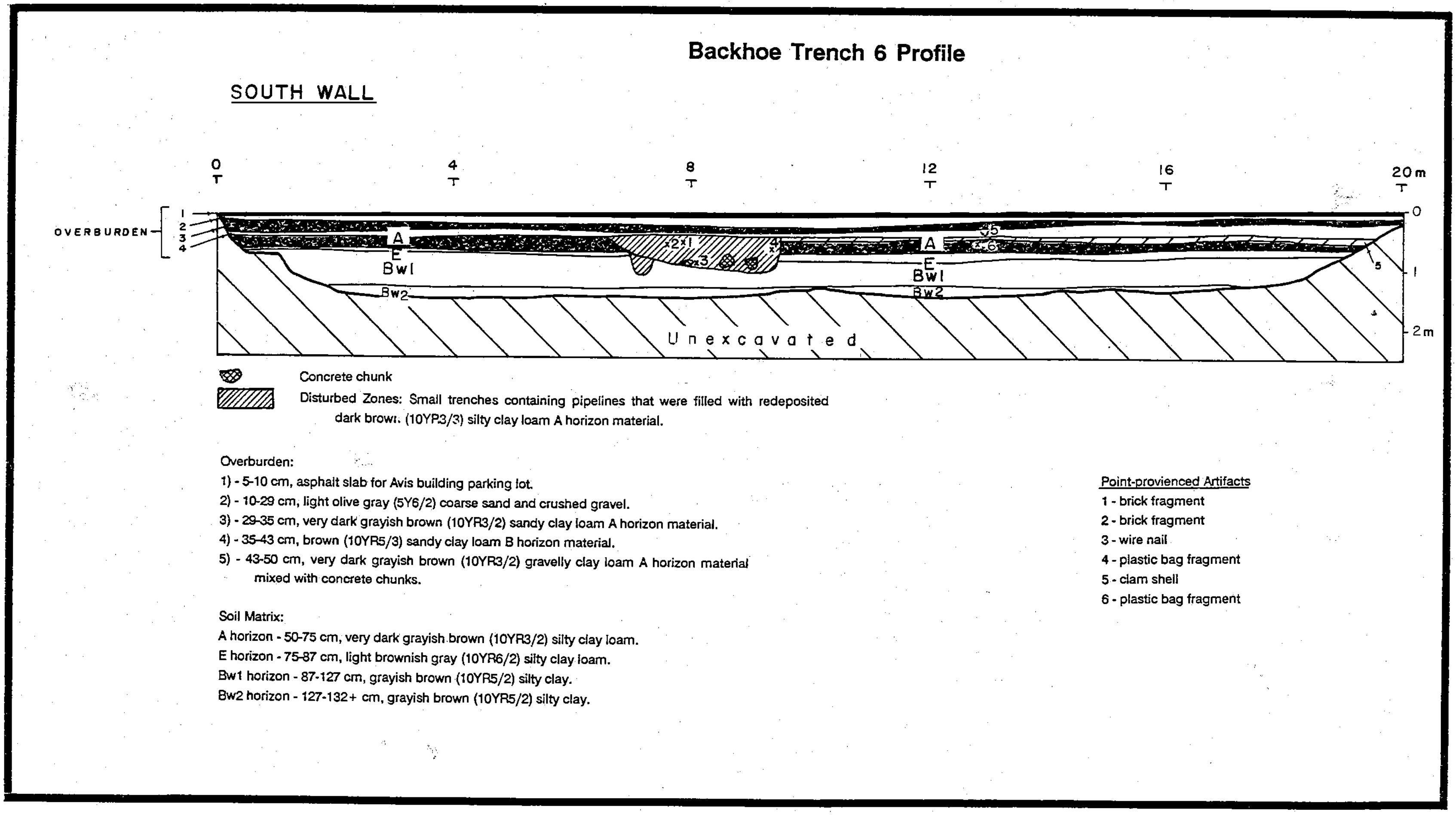


Figure 50. South profile of Backhoe Trench 6.

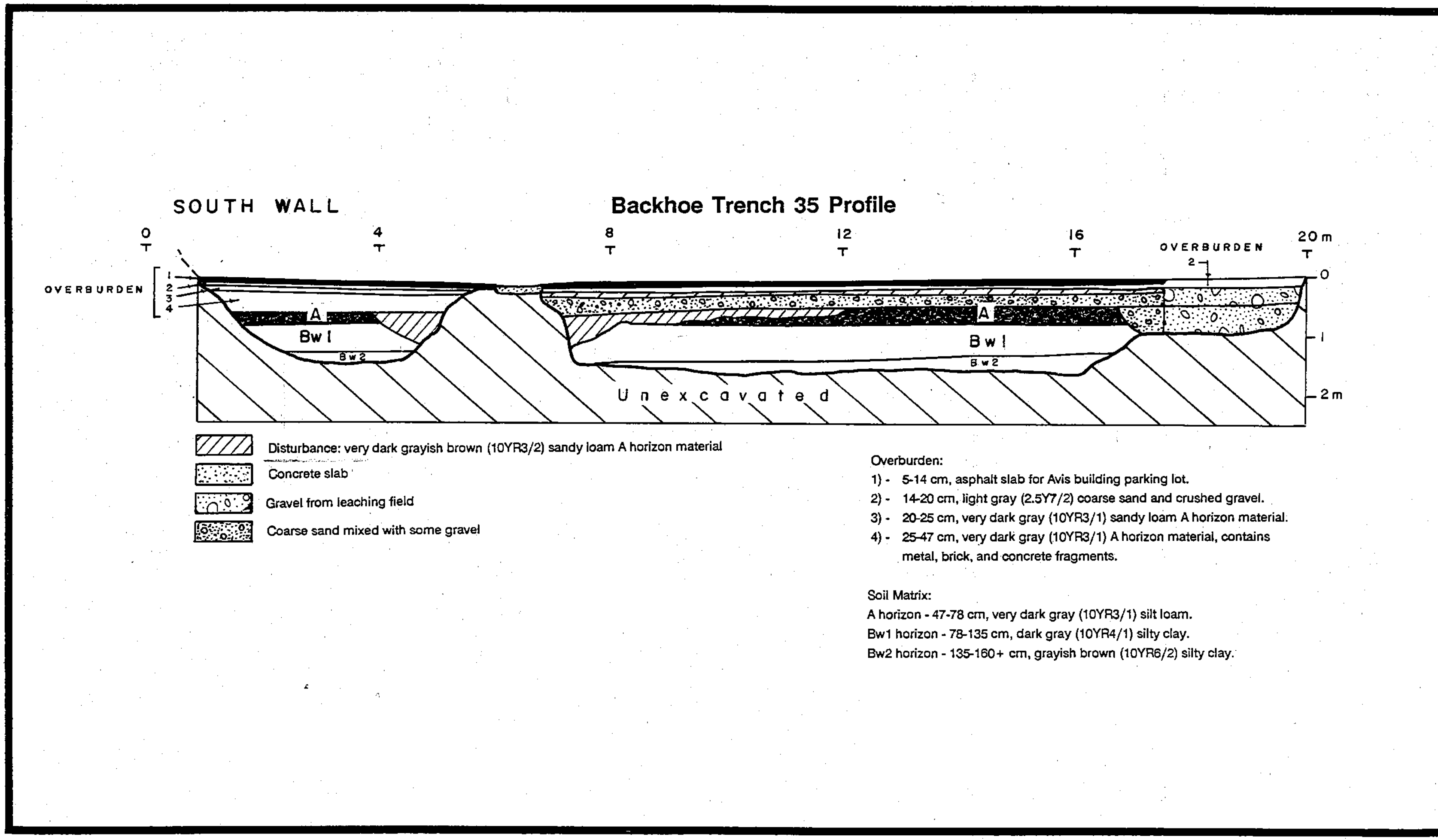


Figure 51. South profile of Backhoe Trench 35.

the result of staining by chemical waste products or other leachants. An alluvial channel filled with a yellowish brown (10YR5/6) coarse to very coarse sand and gravel, the latter consisting of tabular shale, was found in the southern portion of Trench 15. The top of the channel originated within the B horizon.

Three types of disturbance were noted in the Avis lot: grading, intrusive trenches and pits, and bioturbation. Bioturbation resulting from the infilling of animal burrows and root casts did not appear to have significantly affected the stratigraphic integrity. Grading activity has disturbed the A and E horizons to varying degrees. The natural sediment throughout most of the parcel did not appear greatly disturbed by grading, but in some areas, especially in Trenches 15 and 36, grading was responsible for completing removing the A, E, and upper Bw horizons. Small intrusive trenches noted in Trenches 5 and 6 near Lincoln Boulevard probably relate to utility lines. In the southern and western sections of the lot near the Bay Cities Metal building and Maxella Avenue, trenches for sewage lines and large pits filled with sand and gravel were found. A pit in the southeastern end of Trench 35 was associated with a leaching field which was later found to be very extensive when the area was monitored during the soil remediation.

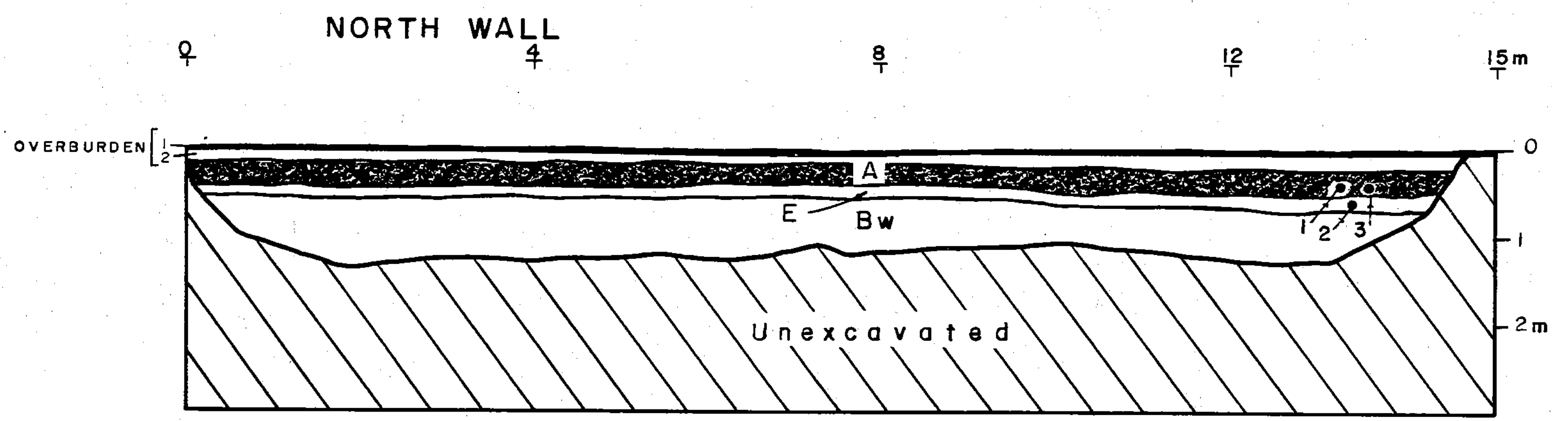
Besides the historic artifacts observed in the overburden that were described above, little cultural material was found. Scattered pismo clam (*Tivela stultorum*) shell fragments were observed in Trenches 5 and 6, however, these materials could not be unequivocally attributed to prehistoric use of the property. The proximity of the Avis lot to the Holt property, where historic pismo clam shell was found in greater abundance, suggests that shell on the Avis lot was probably also related to early twentieth century domestic use of the area.

Marina Storage

The Marina Storage lot was bounded by Lincoln Boulevard to the northeast, the Avis lot to the northwest, the Pacific Electric Railroad right-of-way to the south, and the Reiter Auto Liquidators parcel to the southeast. The latter property was located adjacent to the Channel Gateway project area. Because the Marina Storage building occupied a large central portion of the lot at the time our fieldwork was in progress, 5 of the 9 trenches (Trenches 7, 8, 17, 18, and 26) that were originally planned could not be excavated. A sixth trench, Trench 9, was unnecessary since it crossed a large open pit which we designated as Geologic Pit 1. Of the 9 trenches that were planned, only Trenches 16, 25, and 31 were actually excavated, and all of these had to be moved slightly from their intended location. Trench 16 was moved about 6 m to the east to avoid an area where recreational vehicles and boats were parked; Trench 25 was moved about 3 m to the west because it straddled the northeast edge of the Marina Storage building; and Trench 31 was moved about 10 m to the northeast to avoid parked recreational vehicles. Three backhoe trenches (Trenches 44, 45, and 46) were placed judgmentally in the parking area behind the building. Trench 44 which was perpendicular to the planned location of Trench 31 in a vacant parking space between two boats. Trenches 45 and 46 were placed immediately parallel to and north of the fenceline along the north edge of the Admiralty site to help in delineating the northern site boundary. Dillon et al. (1988) had previously excavated a series of small trenches, but no stratigraphic information was provided. The area was re-examined by excavating Trenches 45 and 46 to obtain information comparable to that from our other excavations. A partially buried railroad spur ran diagonally between Trenches 45 and 46 from the Pacific Electric Railroad right-of-way to a loading ramp at the back of the Marina Storage building. These two trenches were also placed so as to avoid this disturbance. In all, 6 trenches were excavated by Statistical Research on the Marina Storage lot.

The stratigraphy of one of the trenches, Trench 46, is shown in Figure 52. Trenches 16, 25, 45, 46, and the eastern three-quarters of Trench 31 were covered with a 5- to 6-cm thick asphalt slab. Trench

Backhoe Trench 46 Profile



Overburden:

1) - 0-5 cm, asphalt slab for Marina Storage Building driveway.
2) - 5-15 cm, olive (5Y5/3) coarse sand and crushed gravel mixed with brownish yellow (10YR6/6) medium to coarse sand and very dark grayish brown (10YR3/2) sandy loam A horizon material.

Soil Matrix:

A horizon - 15-40 cm, black (10YR2/1) clay loam.
E horizon - 40-54 cm, dark gray (10YR4/1) clay loam.
Bw horizon - 54-115+ cm, very dark gray (10YR3/1) clay loam.

<u>Point-provenienced Artifacts</u>
1-3 - clam shell fragments

Figure 52. North profile of Backhoe Trench 46.

44 and the western quarter of Trench 31 were covered by a 9-cm thick concrete slab. Underlying the asphalt slab was a stratum of olive (5Y5/3) crushed gravel and coarse sand mixed with thin lenses of brownish yellow (10YR6/6) medium to coarse sand and very dark grayish brown (10YR3/2) sandy loam A horizon material. The lower overburden varied between 10 and 17 cm in thickness. It was deposited when grading was undertaken before the asphalt parking lot was built. No fill was observed below the concrete slab in Trenches 31 and 44; the concrete slab was built directly on the underlying A horizon.

An A horizon was observed in all six trenches on the Marina Storage lot. It varied between 9 and 25 cm and between 23 and 40 cm in thickness. The depth of the A horizon indicated that little fill was placed on this property relative to neighboring parcels. Variations in A horizon thickness were primarily attributable to differential effects of grading rather than natural differences. The A horizon ranged between black (10YR2/1) clay loam and very dark grayish brown (10YR3/2) sandy loam. Darker-colored and finer-grained A horizons are indications of moister conditions that were present at the time of soil formation. Conversely, lighter-colored and coarser-textured A horizons formed under drier conditions associated with slightly elevated and better drained, landforms.

A 14- to 15-cm thick E horizon was exposed only in Trenches 45 and 46 below the very dark grayish brown (10YR3/2) A horizon at the north edge of the Admiralty site (see Figure 52). The presence of an E horizon in this section of the Marina Storage lot, but not elsewhere, further bolsters the interpretation that the Admiralty site was somewhat elevated relative to adjacent areas and therefore was better drained.

A Bw horizon varying between 36 and 80 cm in thickness was identified below the A and/or E horizons. Similar to other areas where it was documented within the Channel Gateway project area, it was a very dark gray (10YR3/1) to very dark grayish brown (10YR3/2) sandy clay loam. In Trench 31 the Bw horizons was differentiated into Bw1 and Bw2 subhorizons; the Bw1 subhorizon contained thin, discontinuous clay films on ped surfaces, whereas the Bw2 subhorizon contained a few very small carbonate filaments. A structural B horizon was found below the Bw horizon in Trenches 16, 31, and 44. This B horizon was a dark brown (10YR3/3) clay loam.

The only noteworthy disturbances that were visible in the Marina Storage lot were the result of grading activity. At most, the upper 10 to 15 cm of the A horizon within the southern section of Trench 16, the northern section of Trench 25, and the central and eastern sections of Trench 31 had been scraped off during grading. Unlike the backhoe trenches on other properties within the Channel Gateway project area, no intrusive trenches associated with utility lines or other modern disturbances were found in the Marina Storage lot trenches.

Isolated artifacts and shell were found. Outside of Trenches 45 and 46, no cultural deposits were identified in the trenches described above. A large basalt interior flake, however, was recovered from Trench 31, and a pismo clam shell was noted in Trench 16, both of which were found in the A horizon. This flake, which was the only artifact that probably relates to prehistoric use of the area, may represent an isolated occurrence left by inhabitants of the Admiralty site. The shell from Trench 16 may or may not be the product of aboriginal activity, but given the more common association of this type of shell in the historic deposits at the Holt Property, as well as Trenches 5 and 6 (trenches that yielded small quantities of shell) on the Avis lot, it is perhaps more plausible that the shell is historic. A scatter of shell, primarily *chione*, was noted in Trenches 45 and 46, but the density was so low that it appeared these trenches were near the northern boundary of the Admiralty site. This finding confirms the assessment of the north site boundary that was offered earlier by Dillon et al. (1988). The paucity of shell in Trenches 45 and 46 was somewhat surprising, particularly in consideration of the much greater density observed within a very short distance south of the fenceline.

Bay City Metals

The Bay City Metals lot was a triangular parcel bounded by the Avis Lot to the northeast, Maxella Avenue to the northwest, and the Pacific Electric Railroad right-of-way to the south. Of the four trenches that were planned on the property, none could be excavated because the Bay City Metals building and parking lot area to the south, within the railroad right-of-way, were being used at the time of our fieldwork. Consequently, the only observations of buried deposits in this area were those made later when the soil remediation activities were monitored.

Summary

Backhoe trenching was successful for resolving issues pertaining to the spatial distribution and character of cultural deposits within the Channel Gateway project area. Although a small portion of the Admiralty site extended into the south end of the Marina Storage lot, the major part of the site (at least the part of the site located within the Channel Gateway project area) essentially was confined to the eastern end of the Pacific Electric Railroad right-of-way, the area where Dillon et al. (1988) had previously identified part of the shell midden deposit associated with the Admiralty site. Neither shell midden deposits nor any other type of aboriginal cultural deposit were encountered in trenches excavated in the area north and west of Maxella Avenue. Areas of historic Japanese-American and Anglo-American activity relating to agricultural and industrial land use, however, were documented at parcels located north and west of Maxella Avenue. These historic loci (which are referred to later as sectors) were lumped as part of one large archaeological site, termed the Channel Gateway site, which was designated as CA-LAn-1596-H.

In addition to delineating the location of cultural deposits, backhoe trenching also was useful for obtaining stratigraphic data and information on post-depositional disturbance throughout the project area. The pre-existing surface had been buried below an historic overburden deposit that ranged in thickness from about 20 cm to almost a meter in some places. Although sediments associated with the buried soil had been disturbed by historic land modifications (for example, grading activity, trenching for utility lines, excavation of borrow pits, and construction of a leaching field), as well as natural bioturbation processes (for example, animal burrowing and infilling of voids left by decayed root casts), the vast majority of sediments were surprisingly well preserved, especially in consideration of the intensive development and redevelopment that has already taken place on many of the parcels. Disturbance was found concentrated in certain places, particularly near Lincoln Boulevard. In areal extent, modern disturbance is estimated to have affected between 80 and 90 percent of the property. The fact that an A horizon and various subsurface horizons were clearly identifiable throughout most of the project area, however, attests to the overall stratigraphic integrity below the historic overburden deposit.

Geologic Pits

Large pits, where metal storage tanks had been removed, were left open at the time our fieldwork was begun (see Figure 34 for locations). We took advantage of these deep subsurface exposures and designated them as Geologic Pits 1, 2, and 3.

Geologic Pit 1, located in the extreme eastern part of the Channel Gateway project area in the parking lot immediately east of the Marina Storage building, was the deepest exposure (ca. 3.7 m) examined in the entire project area. Below a 10-cm thick asphalt slab and a 10-m thick deposit of cobbles cemented with asphalt was an A horizon that extended to 35 cm depth (Figure 53). Although a few unidentifiable clam shell fragments were found in the A horizon, it is unknown if these remains were deposited by aboriginal inhabitants. A small trench containing two metal pipes for a water line originated at the top of the A horizon, intruding into the underlying B1 horizon. The lack of an E horizon is an indication that Geologic Pit 1 was situated in a low-lying area, especially in comparison to the Admiralty site to the southwest.

The B horizon of Geologic Pit 1 was differentiated into five subhorizons. It was, however, unlike that observed in most of the backhoe trenches. The primary difference, the lack of a cambic horizon (Bw), was due largely to the influence of an alluvial channel deposit that cut across the pit. The orientation of tabular gravel in this channel deposit indicated that it flowed in an easterly direction. Because the channel originated below the A horizon, it most likely did not actively flow when the Admiralty site was occupied. Subhorizon boundaries within the B horizon were clear or gradual, and there was generally a downward-fining textural sequence throughout the B horizon. The B1 and B2 subhorizons, which were divided from one another by the imbricated sand and gravel-filled channel deposit, had a weak platy structure. In contrast, the B3 subhorizon had a weak granular structure and the B4 and B5 subhorizons had a weak to moderate, subangular blocky structure due to their higher clay content. The B4 subhorizon had dark brown (7.5YR3/2) mottles and the B5 subhorizon had strong brown (7.5YR4/6) mottles. These mottled zones, at a depth between 2.43 and 3.3 m below surface, resulted from being intermittently submerged within a fluctuating water table. Below the B horizon was a Cg horizon, a dark greenish gray (5YG4/1) loam that extended from a depth of 3.3 m to at least 3.69 m. The color of this gleyed C horizon is attributed to the reduction of iron, a pedogenic process that is common in soils that are at least seasonally submerged within the water table.

Geologic Pit 2 was located at the southeast edge of the Associated Pacific lot near Maxella Avenue. Geologic Pit 2 extended to a depth of 2.2 m below surface. An overburden deposit in the upper 33 cm consisted of alternating layers of dark grayish brown (10YR3/2) A horizon material and imported light olive brown (2.5Y5/4) pea gravel and coarse sand (Figure 54). Below the overburden was an A-Bw1-Bw2-B soil horizon sequence that was similar to that already described for nearby trenches on the Associated Pacific lot. The sediment in Geologic Pit 2 was relatively undisturbed except for an historic trench containing a ceramic sewage pipe that extended between the east and west profiles. A light scatter of historic animal bone, unidentifiable metal, clear glass, and pismo clam shell fragments was noted in the A horizon. These artifacts probably relate to historic land use in one of the neighboring sectors of the Channel Gateway site (see discussion in Chapter 18).

Geologic Pit 3 was located in the northwest section of the yacht sales yard near Lincoln Boulevard. Below a 21-cm thick overburden deposit was an A-Bw1-Bw2-B1-B2-B3 soil horizon sequence, one similar to that already described for Trench 2 (Figure 55). Clay films in the Bw1 subhorizon were better expressed than the discontinuous ones observed in the Bw2 subhorizon. Subhorizons in the lower B horizon were differentiated on the basis of the increasing abundance of dark brown (7.5YR3/2) to strong brown (7.5YR4/6) mottles with depth. Zones with more extensive mottling corresponded to layers that were subjected to alternations between moist and dry conditions just above the permanent water table. Most of the sediment in Geologic Pit 3 appeared intact except for three shallow trenches containing metal pipes and part of a concrete slab that intruded into the A horizon. No cultural deposits or artifacts were found in Geologic Pit 3.

Summary

Although a few clam shells were noted in Geologic Pit 1, it is not known for certain if these remains relate to aboriginal activity. It is perhaps more plausible that these shells were associated with the historic occupation of the Channel Gateway site, especially since the unidentifiable shell recovered

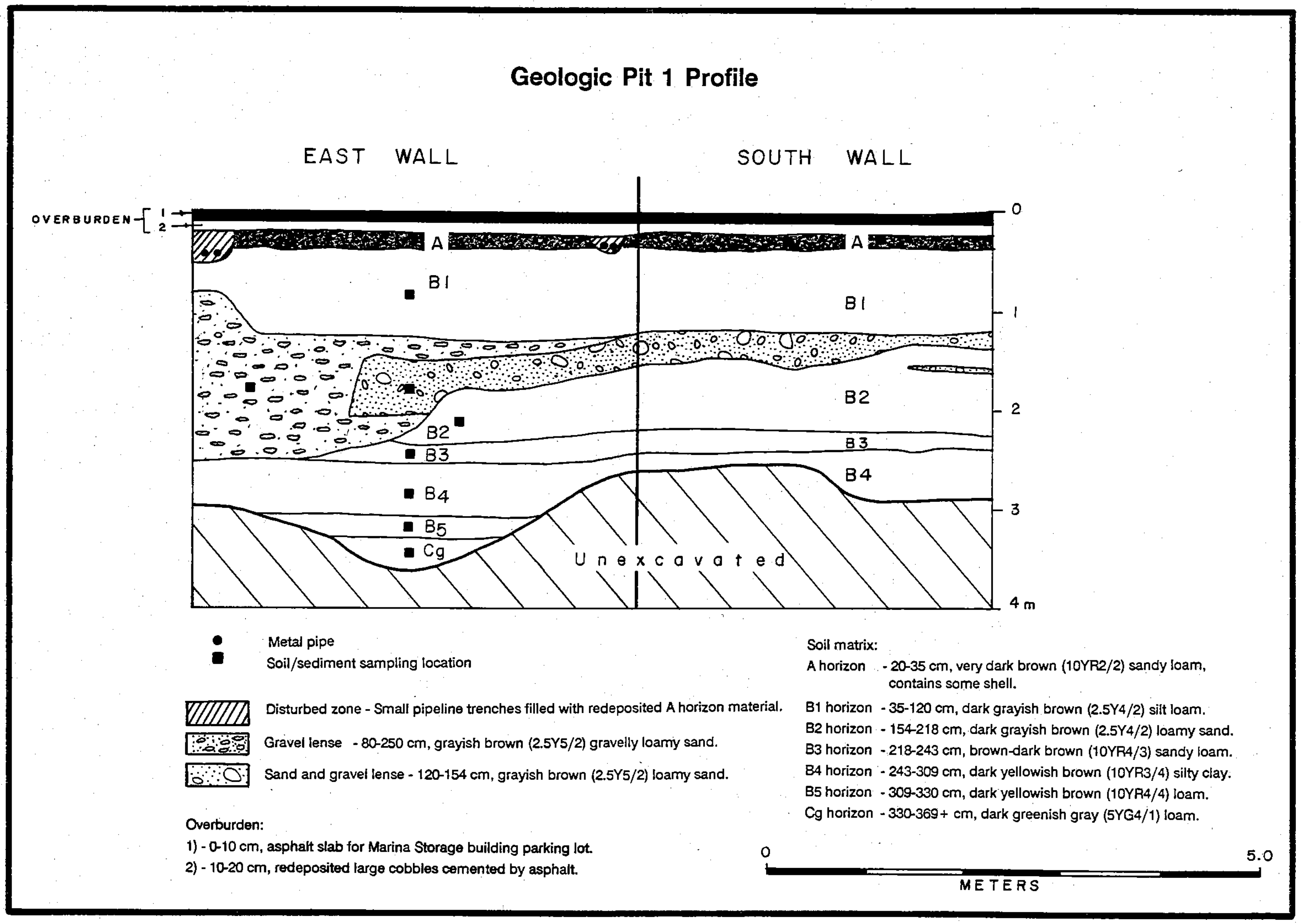


Figure 53. East and south profiles of Geologic Pit 1.

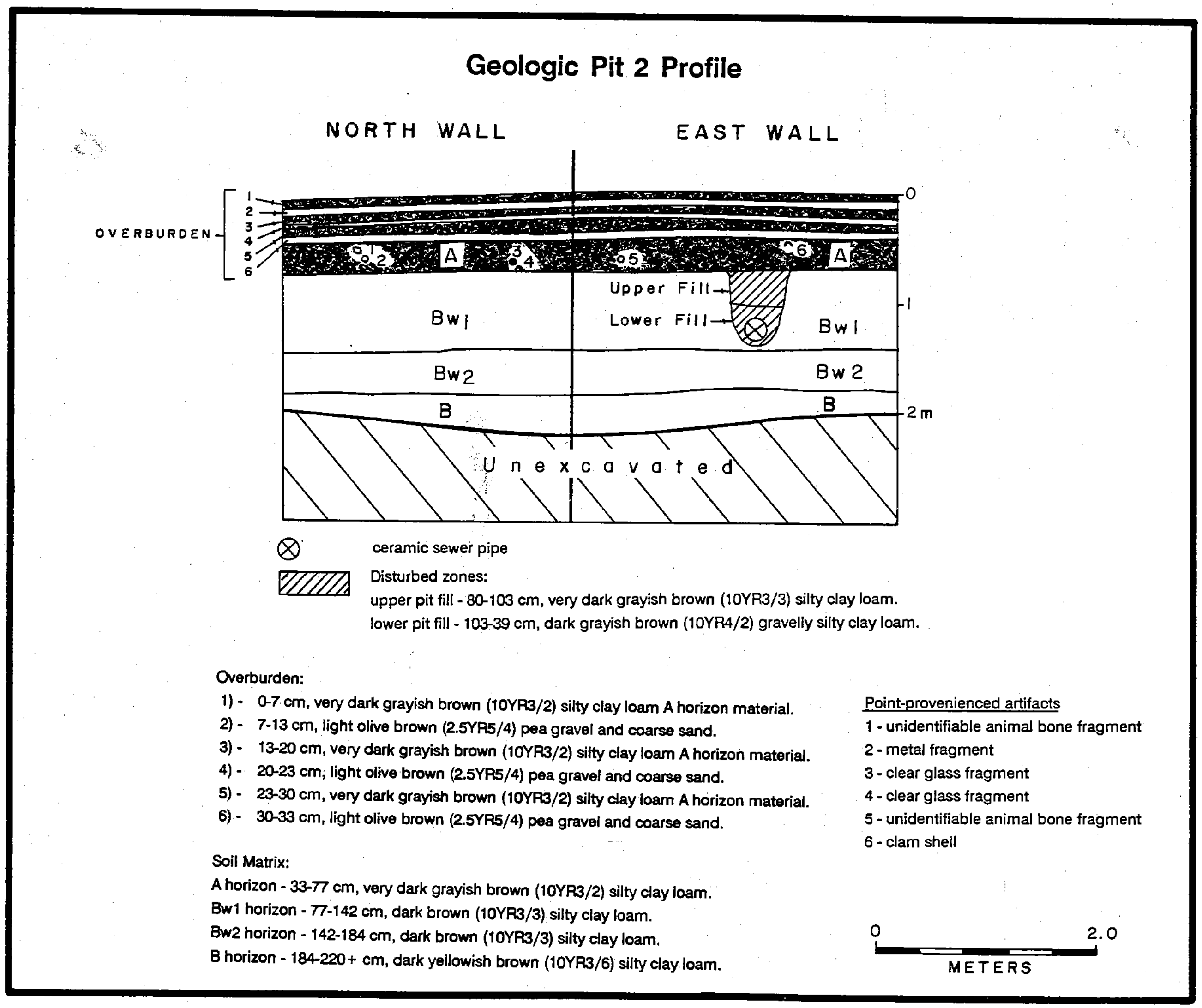
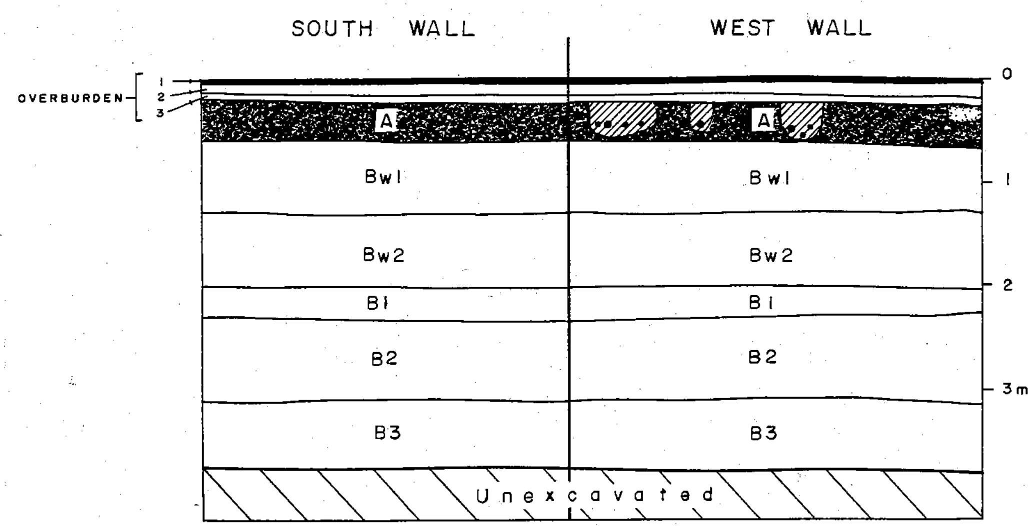


Figure 54. North and east profiles of Geologic Pit 2.

Geologic Pit 3 Profile



● Metal pipes within disturbed zones

Disturbed Zones - Small trenches containing pipelines that were filled with redeposited dark brown (10YR3/3) silty clay loam A horizon material.

Concrete slab

Overburden:

1) - 0-5 cm, aspalt slab for Associated Pacific building parking lot.

2) - 5-14 cm, redeposited brownish yellow (10YR5/4) very coarse sand and crushed gravel.

3) - 14-21 cm, redeposited yellowish brown (10YR5/4) A horizon material.

Soil Matrix:

A horizon - 21-60 cm, dark brown (10YR3/3) silty clay loam.

Bw1 horizon - 60-129 cm, brown-dark brown (10YR4/3) silty clay loam.

Bw2 horizon - 129-201 cm, brown-dark brown (10YR4/3) silty clay loam.

B1 horizon - 201-234 cm, dark yellowish brown (10YR6/3) silty clay loam.

B2 horizon - 234-307 cm, dark yellowish brown (10YR6/3) silty clay loam.

B3 horizon - 307-375+ cm, dark yellowish brown (10YR6/3) silty clay loam.

Figure 55. South and west profiles of Geologic Pit 3.

from Geologic Pit 1 closely resembled the pismo clam shell collected from various parts of the Channel Gateway site. Besides shell, no remains related to cultural activity were observed in the geologic pits. Because of the deep exposures provided by the geologic pits, they were useful for obtaining additional stratigraphic data on the project area, especially for documenting the deeper deposits pre-dating the cultural deposits. In Geologic Pit 1, a Cg horizon, a gleyed ("water-logged") zone occurring at a depth of 3.3 m below surface, was observed. A gleyed horizon was found at only one other subsurface exposure (Trench 38) in the project area.

Test Pits

Fourteen test pits of varying sizes were manually excavated and waterscreened during the Channel Gateway Archaeological Project. Twelve of these test pits were excavated at the Admiralty site and two were at the Channel Gateway site (see Figure 34 for locations). In total area and volume, 88 m^2/72.1 m^3 were excavated, of which 80 m^2/67.3 m^3 were within the Admiralty site boundary and the remainder either just outside of the Admiralty site boundary or at the Channel Gateway site (Table 10). Each of the test pits are described below.

Admiralty Site (CA-LAn-47)

For the purpose of this discussion, descriptions of the 12 test pits from the Admiralty site were divided into the following three clusters: 1) northern test pits, north of the abandoned railroad bed; 2) southern test pits, south of the railroad bed; and 3) western test pits, located off-site to the west of the Admiralty site (Figure 56). Each test pit cluster was defined on the basis of similarities in stratigraphy, disturbance, and the expression of cultural deposits.

Northern Cluster (Test Pits 1, 2, 5, 8, 12, and 13)

Most of the test pits were concentrated to the north of the railroad bed, the area that would be directly impacted by proposed construction activity. Test Pits 1, 2, and 5, three of the six initial 1 m^2 test pits excavated during the testing phase, contained shell midden deposits, and therefore were considered part of the Admiralty site. Because of the richness of the cultural deposits in Test Pits 1 and 2, they were subsequently expanded, first to 2-m by 2-m excavation units, and later to 4-m by 4-m excavation units. Due to the paucity of shell in Test Pit 5, this excavation unit was determined to be at the site boundary; hence, no further excavation was considered warranted in this part of the site. Test Pits 8, 12, and 13 were excavated during data recovery, with these units being placed judgementally to obtain wide coverage within the richest parts of the midden. In total, 61 m^2/53.1 m^3 were excavated in the northern cluster.

An overburden deposit, which was reported earlier by Dillon et al. (1988:95-96) covered the original surface within or directly adjacent to the old railroad bed. In Dillon et al.'s (1988:96, Figure 43) profile drawing of Test Excavation Units 3 and 4 (see Figure 56 for locations), the modern overburden was referred to as Stratum A. The overburden was up to 40-cm thick in Test Pit 2 (Figure 57) and the southern portion of Test Pit 8 (Figure 58). This deposit consisted of three layers: 1) gray (10YR5/1) sand and gravel that was imported for use in the railroad bed; 2) very dark gray (10YR3/1) sandy loam shell midden soil that had been redeposited while grading the railroad bed; and 3) very pale brown (10YR7/3) medium sand brought in to create a compacted base for the railroad bed. The gravelly uppermost overburden layer was found only in the southern section of Test Pits 2

Table 10. Depth and Volume of Each Test Pit.

Test Pit No.	Grid Coordinate	Size (m^2)	Depth (m)	Volume (m^3)	Comments
1A	N103 W20	4	0.7	2.9**	Southwest 1-m by 1-m square excavated to 0.8 m depth.
1B	N103 W22	4	0.7	2.8	
1C	N105 W22	4	0.8	3.2	
1D	N105 W20	4	0.8	3.2	
2A	N100 W40	4	0.9	4.4**	Southeast 1-m by 1-m square excavated to 1.7 m depth.
2B	N100 W38	4	0.9	3.6	
2C	N102 W38	4	0.9	3.6	
2D	N102 W40	4	0.9	3.6	
3	N104 W61	1	1.0	1.0	
4	N99.2 W99.5	1	1.0	1.0	
5	N102 W51	1	1.0	1.0	
6	N100 W79	1	1.1	1.1	
7	N90 W28	4	0.65	2.7**	Southwest 1-m by 1-m square excavated to 0.75 m depth.
8A	N100 W27	4	0.9	3.6	
8B	N102 W27	4	0.9	3.6	
8C	N102 W25	4	0.9	3.6	
9A	N90 W13	4	0.7	2.8	
9B	N90 W11	4	0.7	3.4**	Southeast 1-m by 1-m square excavated to 1.3 m depth.
9C	N92 W14	2	0.7	1.4	
10*	NA	4	0.7	2.8	
11*	NA	4	1.0	2.0+**	The upper 0.5 m were mechanically stripped before beginning manual excavation. Below 1 m depth only the the feature fill was excavated to 2.43 m.
12A	N104 W34	4	0.9	3.6	
12B	N104 W32	4	0.9	3.6	
12C	N102 W32	4	0.9	3.6	
13	N105 W7	4	0.7	3.2**	Southern two 1-m by 1-m squares excavated to 0.9 m depth.
14	N90 W0	2	0.8	1.2**	Because of the slope on the surface resulting from historic truncation, the upper four levels represent only about half the volume of the lower four levels.
Totals		88***		72.5***	

* Test Pits 10 and 11 were excavated at the Channel Gateway site; all other pits were excavated at the Admiralty site.

** Volume represents an adjusted value.

*** A total of 80 m^2/67.7 m^3 were excavated at the Admiralty site, and 8 m^2/4.8 m^3 were excavated at the Channel Gateway site. Of the 80 m^2/67.7 m^3 excavated at the Admiralty site, 77 m^2/64.6 m^3 were actually with the site boundary, and the remainder was adjacent to the shell midden.

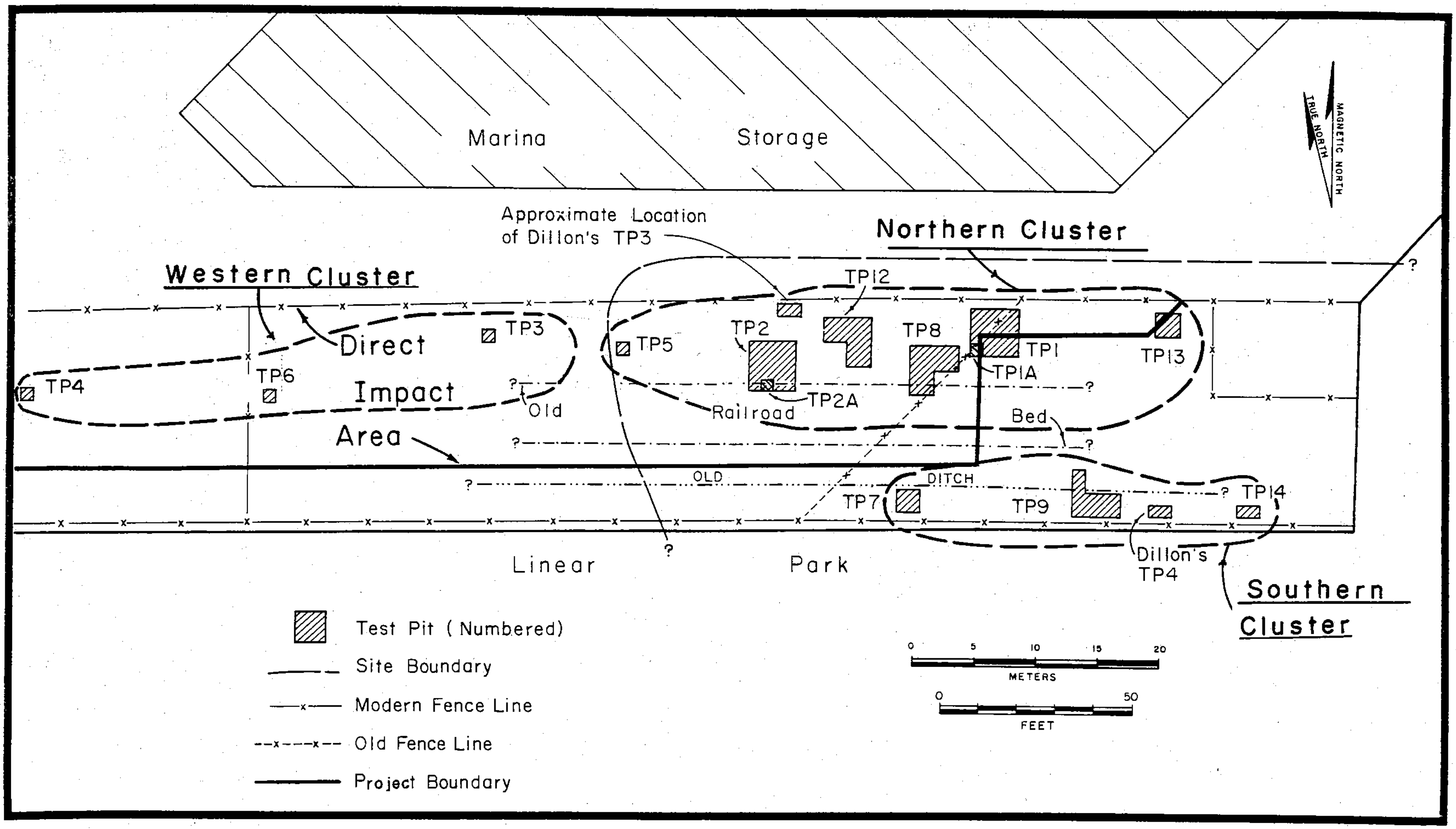


Figure 56. Map of test pit clusters at the Admiralty site.

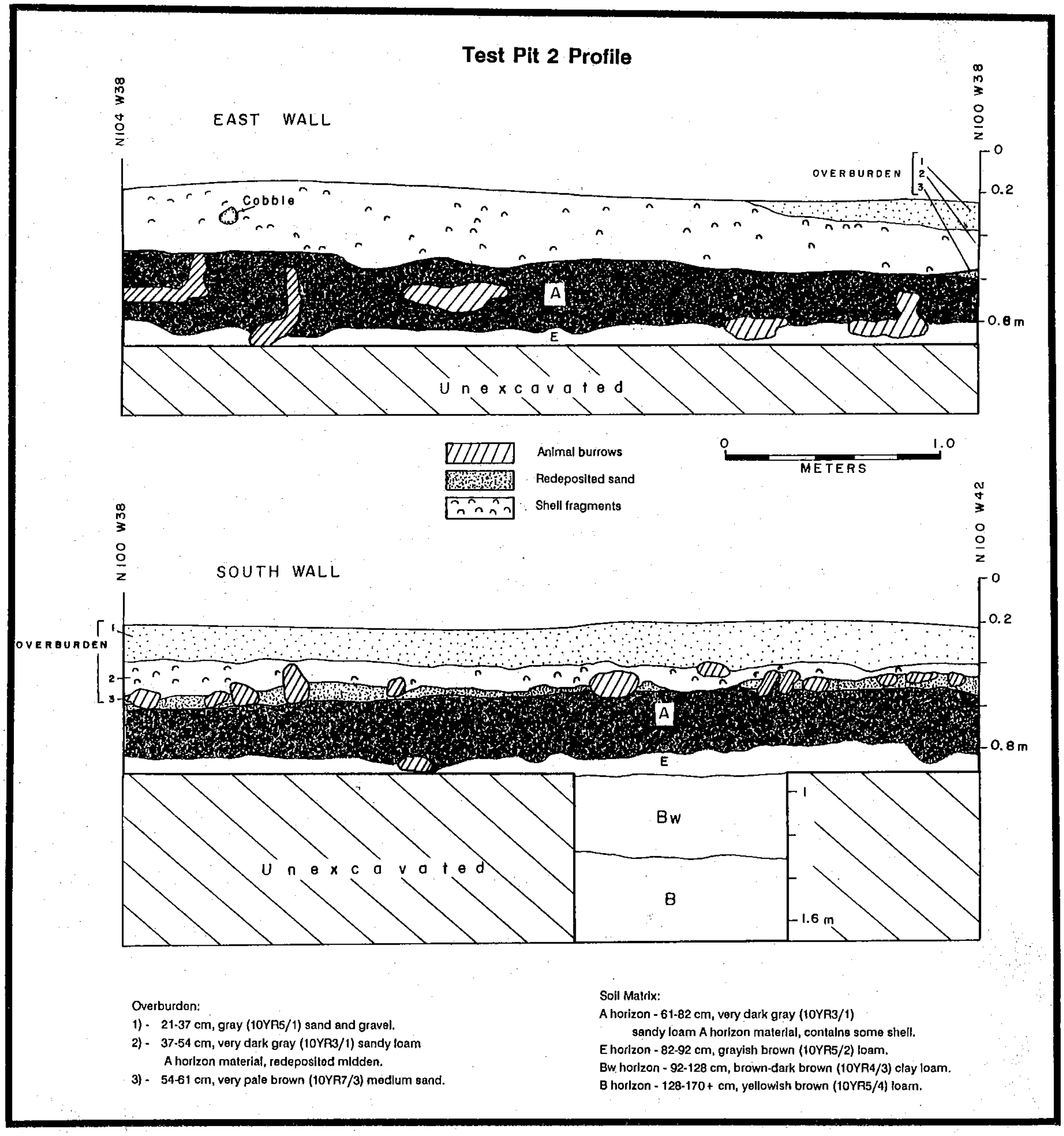


Figure 57. East and west profiles of Test Pit 2.

Figure 58. Photograph of south profile of Test Pit 8 showing thick overburden deposit. (Note: Holes in test pit floor are historic pits associated with Feature 8).

and 8, that portion directly overlain by the railroad bed. Although Test Pits 1, 5, 12, and 13 did not contain a distinctive overburden deposit, gravel from the upper overburden within or near Test Pits 2 and 8 had been spread and intermixed into the A horizon soil exposed on the surface of areas adjacent to the railroad bed. The incorporation of gravel, as well as historic glass, metal, and other materials, into the A horizon probably resulted from vehicles traveling within the railroad right-of-way, trampling, and animal burrowing.

Throughout the northern test pit cluster, the A horizon was fairly homogenous, characterized as a very dark gray (10YR3/1) sandy loam with a moderate, granular structure and a very friable, moist consistence. Although it ranged in thickness from 29 cm in Test Pit 2 to 69 cm in Test Pit 13, some of these differences are undoubtedly artificial, the product of historic grading activity in the railroad right-of-way area. The 40-cm thick A horizon observed in Test Pit 5 was probably where it was naturally the thinnest within the site area investigated. A gradual, somewhat wavy to smooth boundary divided the A horizon from the underlying E horizon, and in the area where it was overlain by the overburden deposit, the A horizon had a clear, smooth upper boundary.

The A horizon had a moderate to sparse distribution of shell and lesser quantities of lithic artifacts, shell and bone tools and ornaments, animal bone, and paleobotanical remains (see Chapters 9-14). Dillon et al. (1988:96) referred to the midden deposit within the A horizon as Stratum Dm in their testing report. Shell, faunal, and artifactual remains were slightly more concentrated in the upper half or so of the A horizon. Other than volumetric differences in the density of shell and other cultural remains, there was no discernible stratigraphic difference between the upper and lower portions of the A horizon, thus the division between the two is somewhat arbitrary. The lower part of the A horizon, which was probably no thicker than about 30 cm based on comparisons with other similar, better drained sections of the Channel Gateway project area, is interpreted as the original surface on which cultural residues were deposited. The presence of artifacts in the lower A horizon is probably accounted for by bioturbation processes, an explanation that is strongly supported by the abundant infilled burrows and root casts. The upper A horizon was enriched primarily with invertebrate and vertebrate subsistence remains as fresh surfaces were created episodically by continued, though infrequent, alluviation throughout the occupational sequence. Test Pit 13 in the northeastern section of the railroad right-of-way appeared to be the least disturbed of all test pits in the northern cluster, but even there, infilled animal burrows were visible (Figures 59 and 60).

Underlying the A horizon was a loamy, grayish brown (10YR5/2) E horizon that varied in thickness from 7 cm in Test Pit 1 to at least 15 cm in Test Pit 8. Because the E horizon occurred below the midden deposit, which was the primary target of our excavations, the bottom of the E horizon was not reached in all of the test pits. Thus, the bottom of the E horizon in Test Pits 12 and 13, located in an area where the E horizon may have been the thickest of all within the northern test pit cluster, was never reached. As with the E horizon documented in backhoe trenches excavated in other areas of the Channel Gateway project area, the thickness of the E horizon is an excellent indicator of the degree of internal drainage. Greater eluviation would have been associated with the highest, most stable landscape positions of the Ballona wetlands. Except for low-lying areas where thick, dark-colored A horizons occurred above either a thin E horizon or no E horizon, the thickest A horizons were correlated with the thickest E horizons. Although some artifacts were recovered from the E horizon, their density dropped dramatically from the A horizon, and as with the lower part of the A horizon, their occurrence is probably the result of downward translocation related to bioturbation.

Below the E horizon were Bw and B horizons that were identical to that observed elsewhere in the project area. The Bw horizon consisted of a homogenous very dark gray (10YR3/1) loam throughout most of the site area. But at the edge of the site and just off-site, it generally graded into a very dark grayish brown (10YR3/2) loam, and in these cases it was differentiated into Bw1 and Bw2 subhorizons. The top of the Bw horizon was encountered at a depth of 57 cm in Test Pit 5 at the edge of the site, 70 cm in Test Pit 1, and 92 cm in Test Pit 2. Thickness of the Bw horizon varied between about 35 and 42 cm. Excavation in the other three test pits in the northern cluster was stopped before the Bw horizon was reached since there were no indications that it contained in situ cultural residues. As with the E horizon, a few lithic artifacts were recovered from the Bw horizon, but it seems likely that these materials also had been translocated downward from the shell midden. The only unit where the B horizon was excavated in the northern cluster was a 1 m^2 unit within Test Pit 2, and there it was reached at a depth of 1.27 m. The bottom of the B horizon, a yellowish brown (10YR5/4) loam with little evidence of illuvial clay, was not observed in Test Pit 2 nor any other excavation unit on the site. No artifacts were recovered from the portions of the B horizon that were excavated.

Southern Cluster (Test Pits 7, 9 and 14)

All three test pits in this cluster abutted the east-west fenceline that marked the southern boundary of the Channel Gateway project area (see Figure 56). Because this part of the Admiralty site was not to be impacted and was to be incorporated into a Gabrielino heritage monument, we originally planned no excavation there. Leaders from the Southern California Band of Gabrielino Indians were troubled by this decision for they believed the testing results reported by Dillon et al. (1988) were problematic in the area, especially regarding human remains. In an attempt to determine whether human remains were present, we altered the original plan and placed three excavation units (Test Pits 7, 9, and 14) in the area. Each pit was of variable size. Test Pit 7 was a 2-m by 2-m unit; Test Pit 9 was initially a 2-m by 2-m unit that was expanded to a 4-m by 2-m unit plus a 2-m by 1-m extension (for a total of 10 m^2). The extension was placed north-south so as to cross-cut an old ditch and hopefully intersect the old railroad bed (the latter goal was not achieved). Test Pit 14, a 2-m by 1-m unit,

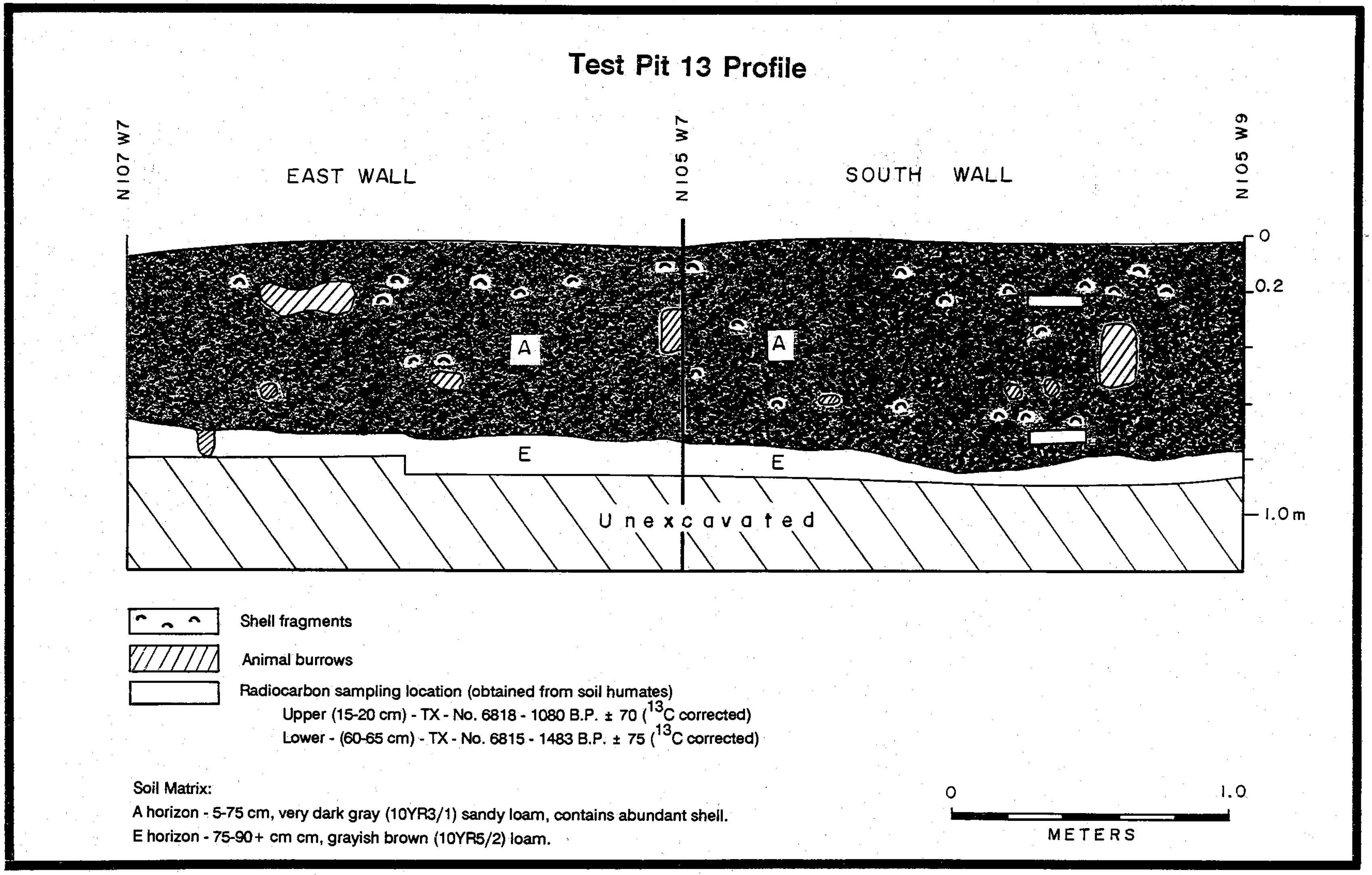


Figure 59. East and south profiles of Test Pit 13.

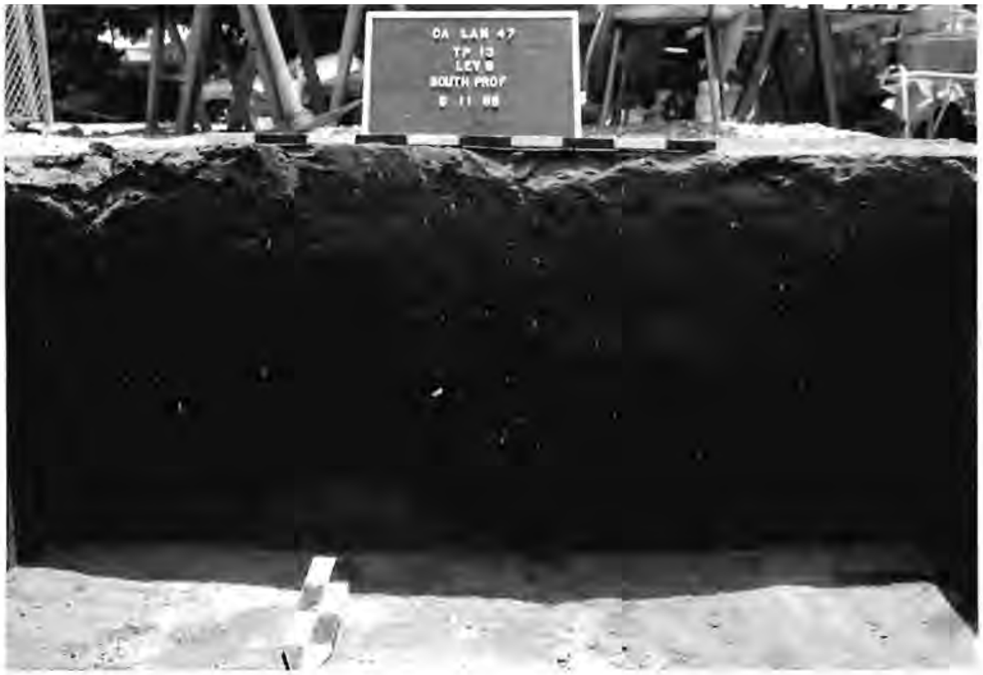


Figure 60. Photograph of south profile of Test Pit 13.

was placed on the eastern edge of the Channel Gateway property to determine if the eastern boundaries of the site corresponded with the project boundary (the site was found to continue eastward from the project boundary). In all, 16 m^2/11.5 m^3 were excavated in the southern cluster.

Test Pits 7 and 9, the two westernmost units in the southern cluster, contained up to about 20 cm of overburden (Figure 61). The overburden, unlike that in Test Pits 2 and 8 of the northern cluster, consisted almost entirely of very dark gray (10YR3/1) sandy loam midden soil. This redeposited A horizon material was probably scraped up from nearby and then placed on top of intact midden, most likely when the area was graded during the railroad construction. A 36-cm thick deposit of gray (10YR5/1) sand and gravel from the old railroad bed was found in the small area in the extreme northern end of Test Pit 9, the only place where it was observed in the southern cluster of test pits. Intact midden soil was exposed at the surface in the southern half of Test Pit 14, but the northern half, that portion on the lower slope, was covered by a thin (5 to 9 cm) mantle of laminated colluvium (Figure 62).

Below the overburden the soil stratigraphy was essentially identical to that described for the northern test pit cluster, namely an A-E-Bw-B soil horizon sequence. The A horizon in all three test pits appeared to be slightly richer in terms of shell density than most of the northern cluster test pits. Each of the test pits had been truncated downward to the north at an angle varying between 15° to 30° (see the east wall profile of Test Pit 7 in Figure 61 and the west wall profile of Test Pit 14 in Figure 62). Based on thickness differences in the A horizon between the north and south walls, at least 34 cm of the A horizon has been removed from the north edge of Test Pit 7, as well as 30 cm from Test Pit 9 and 38 cm from Test Pit 14. It is probable, given the amount of disturbance in the area, that even more of the upper A horizon had been shaved off, either when the railroad was constructed or when the linear park between the north side of Admiralty Way and the Admiralty site was built. The cultural deposit became increasingly thicker and richer closer to the fenceline, suggesting that a substantial

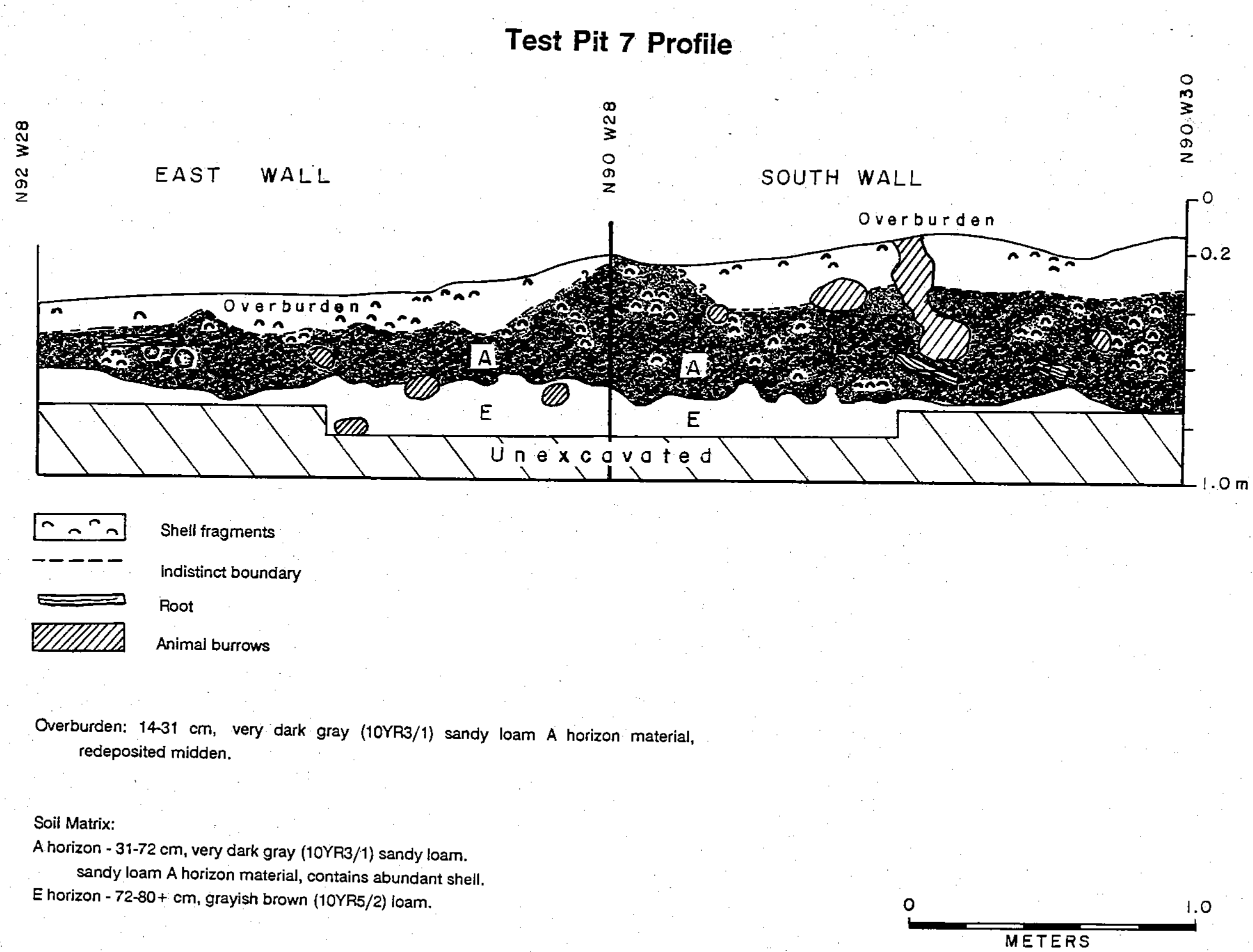


Figure 61. East and south profiles of Test Pit 7.

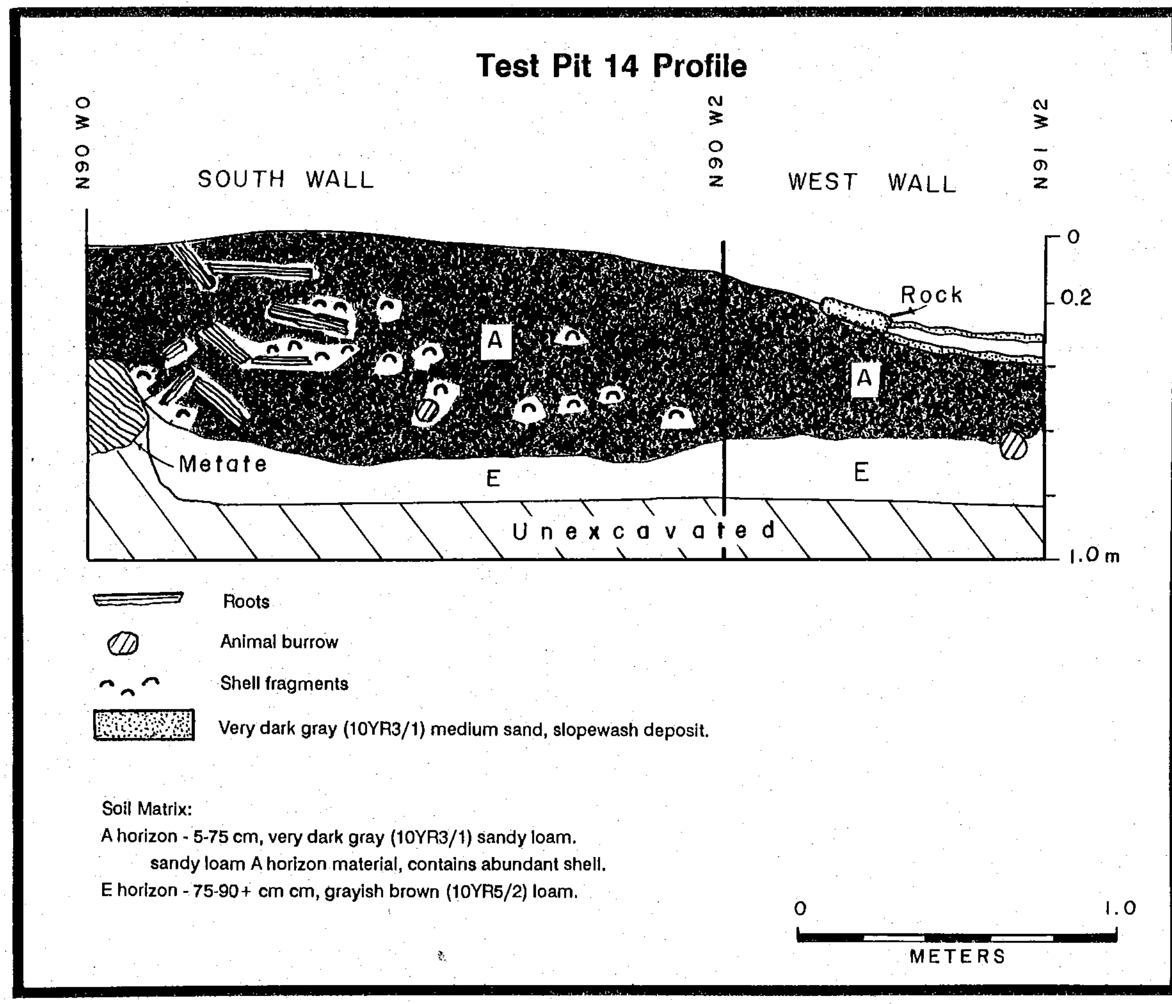


Figure 62. South and west profiles of Test Pit 14.

intact midden deposit continues southward from the fenceline, below the earthen fill that was brought in for the linear park.

A basin metate turned upside down was found at the base of the A horizon in Test Pit 14 (see Figure 62). No other artifacts were directly associated with the metate. Similar ground stone artifacts found at sites along the bluff at the top of the Ballona Escarpment have been interpreted as caches that were stored for later use when the site was revisited (Van Horn 1987). Once the metate was exposed, it was immediately sealed in plastic. A pollen wash was later taken in the laboratory and the sample was submitted for analysis (see Chapter 13 for the results).

Below the A horizon were E, Bw, and B horizons. Excavation stopped after the first 10-cm level into the E horizon was encountered in Test Pits 7 and 14, but a 1-m by 1-m unit in Test Pit 9 was continued to a depth of 1.3 m to sample the Bw horizon. As with Test Pit 2 in the northern cluster, the Bw horizon in Test Pit 9 yielded very few artifacts and those that were recovered were probably also translocated downward from the midden.

Western Cluster (Test Pits 3, 4, and 6)

These units, three of the original six 1-m by 1-m units excavated during the testing phase, were determined to be outside of the Admiralty site boundary. All three test pits were placed within or near the railroad bed (see Figure 56). In area and volume, the western cluster of test pits totaled 3 m^2/3.1 m^3. Stratigraphically, the soils were similar to those described above for the Admiralty site in that they had A-E-Bw profiles. The primary difference of archaeological importance is the lack of shell midden deposits in the A horizon, the criterion which was used in defining the boundary of the Admiralty site.

Overburden was not observed in Test Pit 3. Test Pit 4, however, was covered by 50 cm of overburden and Test Pit 6 was covered by 39 cm of overburden (Figures 63, 64, and 65). Test Pit 4, the westernmost test pit of the 12 placed within or near the Admiralty site, was covered by a concrete slab and four layers of asphalt, which were divided from one another by 3- to 9-cm thick layers of sandy loam or gravelly sandy loam of various colors. Test Pit 6 contained two layers of overburden, a 21 cm thick upper one which consisted of B horizon material and a lower 18 cm thick stratum represented by redeposited A horizon material.

Besides the paucity or total absence of shell in the A horizon, which varied from 23 to 51 cm thick in the western cluster, the A horizon was differentiated from the on-site test pits by its black (10YR2/1) color, an indication that it had a higher organic matter content. In Test Pit 4, the A horizon was impregnated with diesel oil, which contributed to its black color. The high organic matter content of Test Pits 3 and 6 (which did not contain hydrocarbons) is strong evidence that the sandy loam soil in this section of the railroad right-of-way formed in a low-lying area of restricted drainage. This area was probably a freshwater marsh at the time the Admiralty site was occupied. At the time of our fieldwork, water drained into this low-lying section, an area which was marked by a luxurious growth of weedy vegetation compared to surrounding parcels.

Channel Gateway Site (CA-LAn-1596-H)

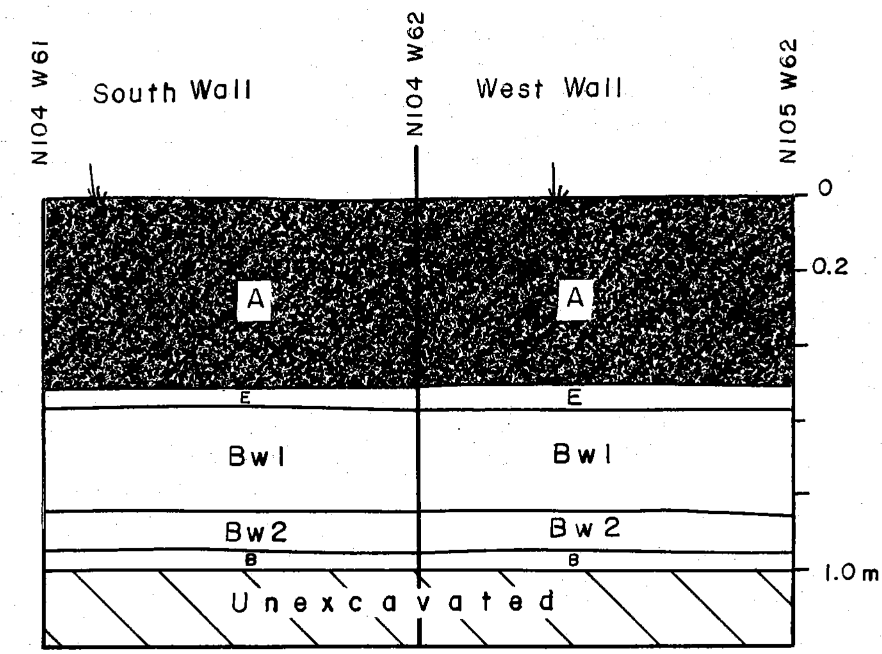
The two test pits excavated at the Channel Gateway site were positioned to encompass historic features. Test Pit 10 was placed next to Trench 10 on the Holt Property and Test Pit 11 was placed next to Trench 13 on the Associated Pacific lot. The stratigraphy of these areas was described earlier in this chapter in the section on backhoe trenching. In addition, the findings of these two test pits in terms of artifact types and the age and function of the two features are addressed later in this chapter in the section on feature descriptions as well as in Chapter 18. Consequently, this information will not be repeated here.

Geoarchaeological Analyses

Soil/Sediment Analyses

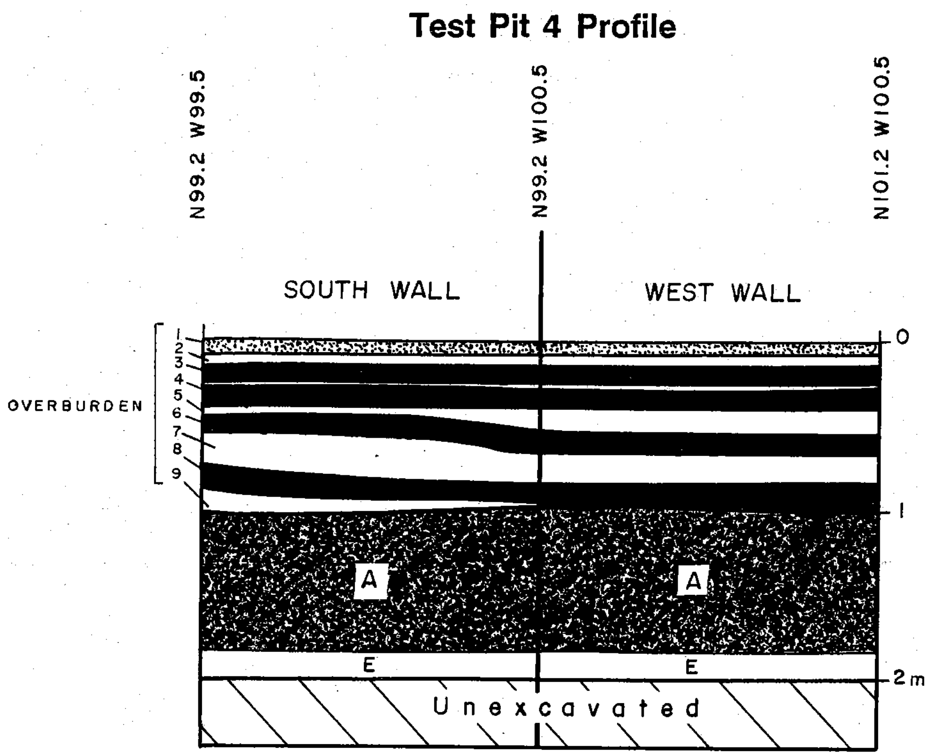
This study is concerned with assessing both the sedimentary and soil formation processes responsible for the character of natural and cultural deposits observed at the Admiralty site. Two types of soil/sediment analyses were conducted, particle size and soil reaction (or pH) analysis. The methods and results are described below.

Test Pit 3 Profile



Soil Matrix:
A horizon - 0-51 cm, black (10YR2/1) sandy loam.
E horizon - 51-57 cm, dark gray (10YR4/1) loam.
Bw1 horizon - 57-84 cm, very dark gray (10YR3/1) clay loam.
Bw2 horizon - 84-95 cm, very dark grayish brown (10YR3/2) loam.
B horizon - 95-100+ cm, dark brown (10YR3/3) loam.

Figure 63. South and west profiles of Test Pit 3.



Overburden:

1) - 0-4 cm, concrete slab in the S&S Paving Company storage lot.
2) - 4-7 cm, dark brown (10YR3/3) sandy loam impregnated with diesel oil.
3) - 7-12 cm, asphalt slab.
4) - 12-20 cm, asphalt slab.
5) - 20-27 cm, dark brown (10YR3/3) gravelly sandy loam.
6) - 27-33 cm, asphalt slab.
7) - 33-42 cm, dark yellowish brown (10YR4/4) gravelly sandy loam, contains chunks of concrete and asphalt.
8) - 42-48 cm, asphalt slab.
9) - 48-50 cm, very dark brown (10YR2/2) gravelly sandy loam, contains chunks of concrete and asphalt.

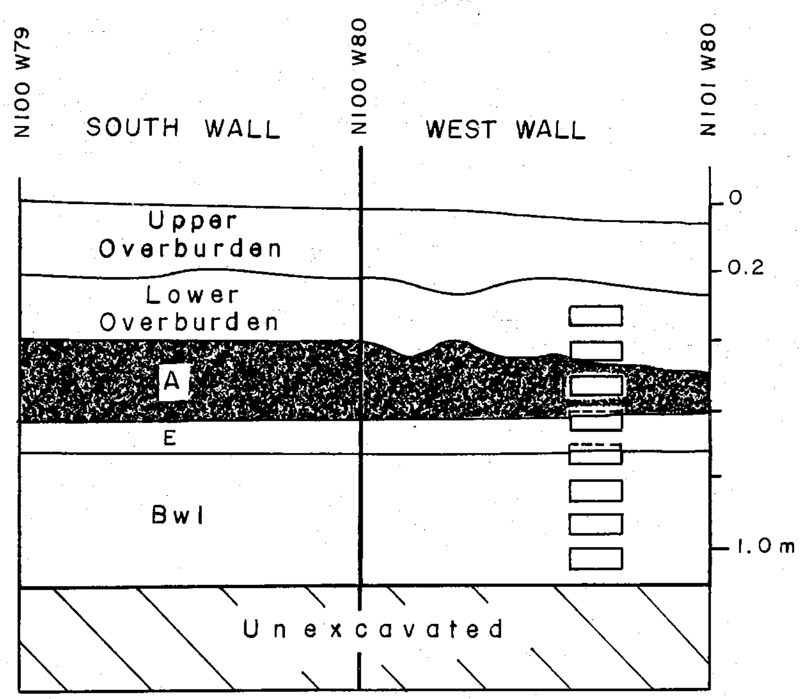
Soil Matrix:

A horizon - 50-91 cm, black (10YR2/1) sandy loam, contains some gravel, impregnated with diesel oil.

E horizon - 91-100+ cm, dark gray (10YR4/1) silty clay loam.

Figure 64. South and west profiles of Test Pit 4.

Test Pit 6 Profile



Pollen and soil sampling location

Upper Overburden: 0-21 cm, dark brown (10YR3/3) gravelly clay loam B horizon material.
Lower Overburden: 21-39 cm, very dark grayish brown (10YR2/2) gravelly sandy loam A horizon material.

Soil Matrix:
A horizon - 39-62 cm, black (10YR2/1) sandy loam.
E horizon - 62-72 cm, dark gray (10YR4/1) loam.
Bw1 horizon - 72-110+ cm, very dark gray (10YR3/1) clay loam.

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Figure 65. South and west profiles of Test Pit 6.

Particle Size Analysis

Particle size analysis, a method for determining the relative proportions of the various soil separates, was used to aid in interpreting the geomorphology of the Admiralty site. In particular, we were interested in compiling data for comparing the depositional environment of on- and off-site locations. Most of the sediment within the wetlands encompassing the project area is the product of alluvial deposition from the Los Angeles River, Ballona Creek, and their tributaries. Particle size analysis was conducted for samples from the following three areas: Test Pit 12A, located on the Admiralty site; Test Pit 6, located less than 30 m west of the Admiralty site; and Geologic Pit 1, located about 50 m northeast of the Admiralty site (see Figure 56). These sampling locations were selected because they appeared to have been less affected by disturbance processes than other units, and because they represented a variety of environmental settings.

The size distribution of particulate soil matter is referred to as soil texture. The significance of particle size distributions rests on the fact that virtually all processes in which particles are involved depend on their particle size (Murphey 1984). Particle size determinations are useful for reconstructing the source area(s) of sediments, the mode of transport, the depositional environment (Bullen and McManus 1972; Folk and Ward 1957; Krumbein 1934; Visher 1969), the degree of pedogenic development, and past cultural activities at archaeological sites (see Butzer 1982; Debusschere et al. 1989; Gagliano et al. 1982; Hassan 1978; Johnson 1983; Kraft et al. 1980; Stein and Ferrand 1985 for examples). Particle size determinations for the Admiralty site and surrounding areas were used primarily to reconstruct the depositional history of the site.

Methods. Particle size determinations were made for 26 samples using the pipette and sieve methods outlined by Day (1965). The pipette method is a sedimentation technique for estimating the percentages of the silt and clay fractions. This method assumes complete particle dispersion, sphericity of particles, a uniform applicability of Stokes Law to different size fractions, and a specific gravity of 2.65 for soil particles. A vibratory shaker holding nested sieves was used to separate the sand fractions. Five samples were analyzed in duplicate as a means of testing the replicability of the pipette and sieve methods. The percentages of nine size fractions (total clay (<2 microns), three silt (2-50 microns), and five sand (>50 microns and < 2mm) fractions were expressed as averages for the samples analyzed in duplicate.

Based on the percentages of clay, silt, and sand, the textural class was defined and plotted on triangular graph paper. The percentages of the three silt fractions and total clay were estimated from oven-dried sediment using a 25-ml pipette, and sand samples were dry-sieved for two minutes with the vibratory shaker. Pretreatment procedures involved defloculating each soil sample overnight on a reciprocating shaker in a sodium hexametaphosphate solution. A 30 percent hydrogen peroxide reagent was used to digest organic matter for samples exceeding about 1 percent organic matter. The hydrogen peroxide treatment is required to prevent organic matter from binding mineral soil and thereby significantly skewing the results.

Results. Of the 26 samples analyzed, six different textural classes were represented -- sandy loam, loam, silt loam, clay loam, loamy sand, and gravelly loamy sand. Data for all nine size fractions are presented for each sample in Table 11. Results are shown graphically on textural triangles in Figure 66. Because of the importance of focusing on particles ranging between coarse sand and coarse silt for reconstructing depositional environments (Visher 1969), cumulative graphs were used to display this information (Figure 67, 68, and 69). These cumulative graphs make it easier to study the populations corresponding to the three different modes of sediment transport -- suspension, saltation, and traction (or surface creep). All sediment samples vary systematically in the number, amount, range, mixing,

Table 11. Results of Particle Size Analysis.

UNIT # AND STRATUM	HORIZON	DEPTH (cm)	Percentage of Separates* VCS	CS	MS	FS	VFS	TOTAL SAND	CSI	MSI	FSI	TOTAL SILT	TOTAL CLAY	TEXTURAL CLASS
Test Pit 12A II	A	5-10	2.0	6.9	18.8	13.2	19.3	60.2	19.3	8.2	3.7	31.2	8.6	Sandy loam
	A	15-20	2.2	6.1	20.0	14.3	14.2	56.8	17.5	11.0	4.4	32.9	10.3	Sandy loam
	A	25-30	2.0	7.6	20.8	14.1	14.0	58.5	18.0	10.4	4.5	32.9	8.6	Sandy loam
	A	35-40	2.5	6.1	19.3	14.3	14.6	56.8	11.7	17.6	4.0	33.3	9.9	Sandy loam
	A	45-50	2.5	5.1	18.1	14.9	15.0	55.6	19.6	11.8	3.9	35.3	9.1	Sandy loam
III	A	55-60	1.3	3.8	14.0	13.0	14.8	46.9	28.7	11.0	4.2	43.9	9.2	Loam
	A	65-70	0.5	3.2	13.7	13.3	15.5	46.2	28.4	11.9	4.5	44.8	9.0	Loam
	A	75-80	1.1	3.7	13.7	12.7	14.3	45.5	30.5	10.1	3.9	44.5	10.0	Loam
IV	E	85-90	1.1	2.9	17.4	14.1	16.7	52.2	19.7	13.9	4.1	37.7	10.1	Sandy loam
Test Pit 6 III	A**	30-35	3.6	8.8	25.9	15.0	11.5	64.8	11.6	8.9	4.0	24.5	10.7	Sandy loam
	A**	40-45	2.9	7.3	21.7	13.7	11.8	57.4	24.0	10.2	3.3	37.5	5.1	Sandy loam
	A**	50-55	1.6	4.1	14.9	12.8	14.5	47.9	19.7	14.5	4.9	38.1	13.0	Loam
IV	E**	62-65	0.7	2.0	9.6	12.9	15.8	41.0	22.1	18.5	6.0	46.5	12.4	Loam
V	Bwl**	72-75	0.4	1.4	6.7	10.3	13.5	32.3	18.9	15.6	5.4	39.9	27.8	Clay loam
	Bwl	80-85	0.6	1.4	7.6	10.9	10.8	31.3	21.1	14.5	6.7	42.3	26.4	Loam
	Bwl	90-95	0.4	1.0	8.5	11.7	7.9	29.5	22.1	17.0	5.8	44.9	25.6	Loam
	Bwl	100-105	0.5	1.0	9.8	11.5	5.9	28.7	20.1	17.6	5.9	43.6	27.7	Clay loam
Geologic Pit 1 III	A	25-30	3.7	6.7	22.7	15.1	13.9	62.1	16.5	7.9	3.9	28.3	9.6	Sandy loam
V	B1	80-90	1.2	3.5	19.1	16.2	13.9	53.9	23.3	8.9	1.1	33.3	12.8	Loam
	B2	205-215	12.7	19.5	32.8	10.3	5.2	80.5	7.8	5.0	1.7	14.5	5.0	Loamy sand
	B3	240-250	1.1	2.3	16.0	31.4	16.9	67.7	16.3	7.9	1.1	25.3	7.0	Sandy loam
	B4**	280-290	0.6	1.2	3.1	2.2	7.5	14.6	31.1	32.0	8.1	71.2	14.2	Silt loam
	B5	315-325	3.9	7.3	17.6	8.7	10.2	50.5	19.9	12.4	4.2	36.5	13.0	Loam
VI	Cg	340-350	3.3	9.8	18.3	8.9	10.2	50.5	19.9	12.4	4.2	36.5	13.0	Loam
--	Gravel** Lense	170-180	42.6	26.7	7.1	1.3	0.9	78.6	15.2	2.8	0.9	18.9	2.5	Gravelly loamy sand
--	Sand and gravel lense	170-180	11.5	21.2	30.0	7.2	4.7	74.6	13.8	6.9	1.0	21.7	3.7	Loamy sand

* VCS-Very Coarse Sand (2.0-1.0 mm), CS-Coarse Sand (1.0-0.5 mm), MS-Medium Sand (0.5-0.25mm), FS-Fine Sand (0.25-0.1 mm) VFS-Very Fine Sand (0.1-0.05mm), CSi-Coarse Silt (50-20mi), MSi-Medium Silt (20-5mi), FSi-Fine Silt (5-2mi), Clay (<2mi).

** Analyzed in duplicate; Values represent an average.

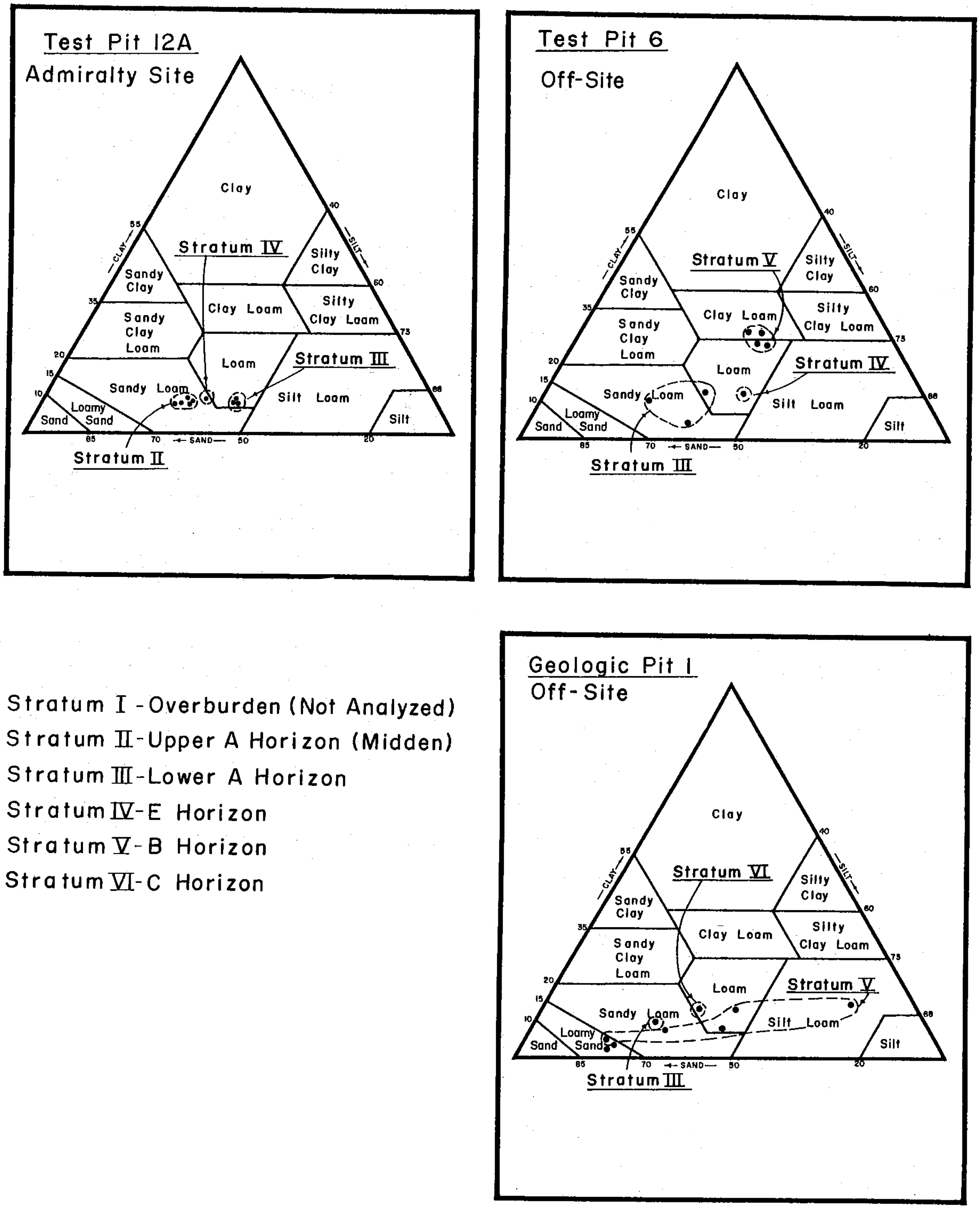


Figure 66. Distributions of particle size data according to strata.
(Note: Strata are defined in next section of this chapter.)

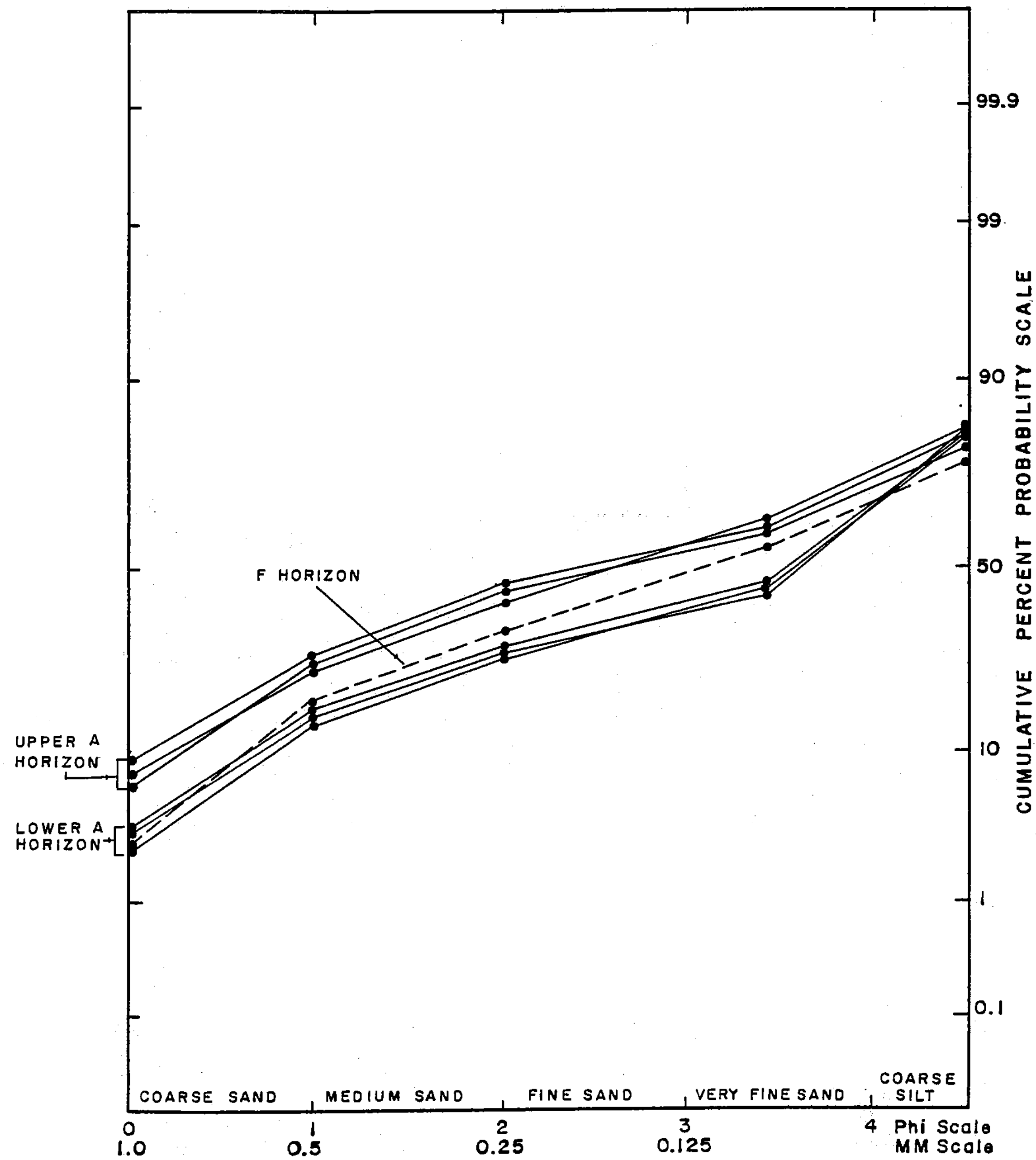


Figure 67. Cumulative graph of particle size data for Test Pit 12A.

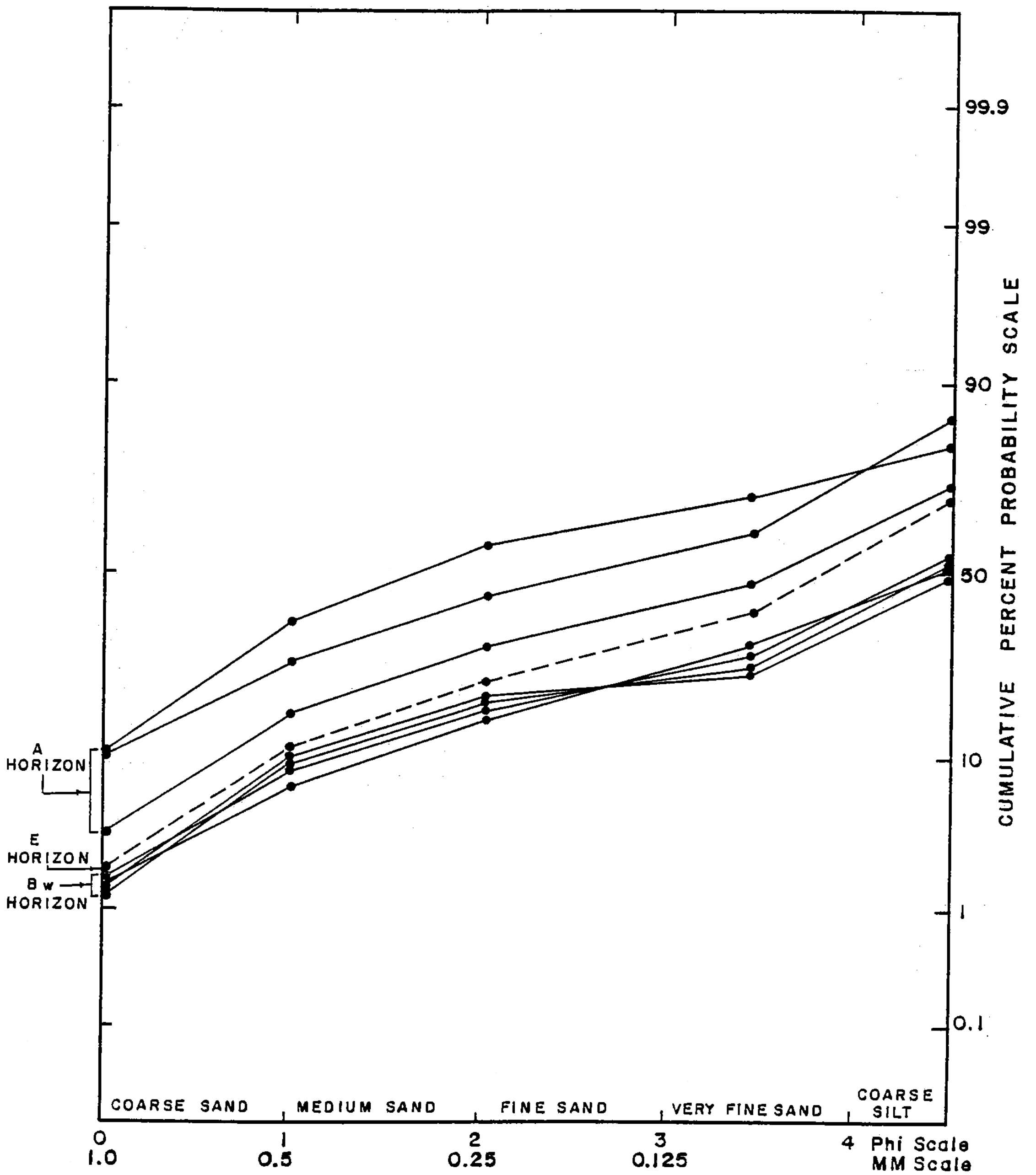


Figure 68. Cumulative graph of particle size data for Test Pit 6.

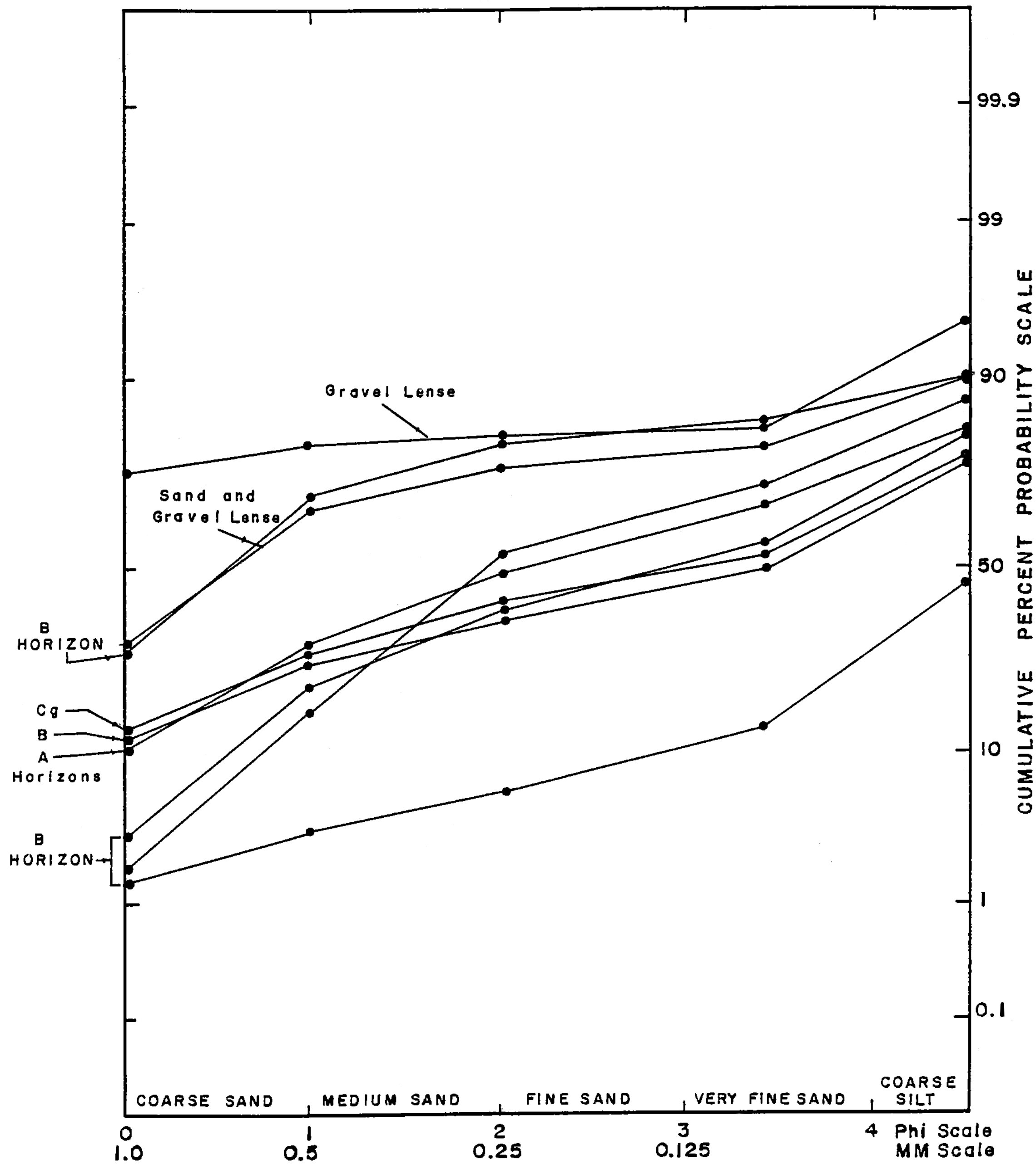


Figure 69. Cumulative graph of particle size data for Geologic Pit 1.

and sorting of these three modes of transport, and each mode follows a lognormal distribution (Lewis 1984; Visher 1969:1074). Consequently, particle size analysis is a tool that permits us to make interpretations about the depositional environments within and near the Admiralty site.

A number of interesting textural contrasts were noted between sampling locations as well as within particular sampling locations, and these will be examined in this section. For example, each of the sampling locations had an upward coarsening sequence, an indication that sediment in the lower stratigraphic sections was deposited in a lower energy environment relative to the overlying sediment. In Test Pit 12A, the upper 50 cm of the A horizon consisted of sandy loam and the lower 30 cm of the A horizon had a loamy texture. Total sand content, which consisted primarily of medium to very fine sand, decreased fairly systematically from 60.2 percent at the top of the A horizon to 55.6 percent at the bottom of the A horizon. Within the A horizon sand content decreased abruptly to 46.9 percent, and it continued to decrease slightly to 45.5 percent at the bottom of the A horizon. Corresponding to the regular decrease in sand content from the top to the bottom of the A horizon was an increase in silt content. Clay content varied little within the A horizon, ranging between 8.6 and 10.3 percent. The break between the sandy loam and loam at about 50 cm depth corresponds roughly with the division between the upper and lower portions of the A horizon. There was a slight increase in the sand content of the E horizon relative to the overlying A horizon, which is explained primarily by pedogenic rather than depositional processes. As a result of eluviation, organic matter, oxides, and mineral clay and silt particles were translocated downward in the profile into the B horizon, thereby concentrating sand in the E horizon. Although vertical differences in the percentages of the different soil separates were identified between the A and E horizons, it is important to note that the samples were relatively homogenous compared to off-site locations (see Figure 66).

In Test Pit 6, the A, E, and Bw horizons were analyzed. Similar to Test Pit 12A, Test Pit 6 also had a downward fining textural sequence. The sand content in the A horizon was highly variable, ranging from 64.8 percent at 30 cm depth to 47.9 percent at 50 cm depth. Mirroring the decrease in sand content was an increase in silt content from 24.5 percent at 30 cm depth to 39.1 percent at 50 cm depth. These trends corresponded with a shift from sandy loam at the top of the A horizon to a loam at the bottom of the A horizon. The E horizon was a loam that was finer textured than the one analyzed in the E horizon of Test Pit 12A. There was a dramatic increase in clay content in the underlying Bw horizon, which reflects a greater contribution of clay deposition in this stratum, as well as translocation of clay from above. All four samples analyzed from the Bw horizon were near the loam-clay loam boundary, with two being classified as loams and two as clay loams (see Figures 66 and 68). In comparison to Test Pit 12A, there were greater textural variations in the samples analyzed from Test Pit 6, which indicates that the landscape was less stable than at the neighboring Admiralty site. The area around Test Pit 6 would certainly have been subjected to greater flooding than the area where Test Pit 12A was located.

Geologic Pit 1 had the greatest textural variations of the three sampling locations. Like the upper A horizon in Test Pits 12A and 6, the upper A horizon of Geologic Pit 1 was a sandy loam. Below the A horizon, however, there were wide variations in the textural classes represented, which included loam, loamy sand, sandy loam, silt loam, and gravelly sandy loam (see Figures 66 and 69). The coarse nature of the sediments sampled from Geologic Pit 1 is primarily a reflection of deposition within or in close proximity to active alluvial channel deposits, thus explaining the high sand content in most of the soil horizons. An exception was the sample between 2.8 m and 2.9 m depth that was obtained from the B4 horizon; this sample was a silt loam with a 71.2 percent silt content, indicating that it was deposited in a low energy alluvial setting.

In summary, the particle size analysis demonstrated that the Admiralty site was situated in a relatively stable environment, especially in comparison to nearby surrounding areas. This finding bolsters the argument made previously in the descriptions of the soil stratigraphy of the project area. The cumulative graphs (see Figures 67, 68, and 69) showed that there was less textural variation in the

Test Pit 12A samples than those from Test Pit 6 and Geologic Pit 1. At the time the Admiralty site was occupied, it would have rarely been flooded, certainly much less frequently than low-lying landforms in adjacent areas.

Soil Reaction

Soil reaction, commonly called pH (potential of hydrogen), refers to the degree of alkalinity or acidity of a soil. Determinations of pH values were used to further support the stratigraphic interpretation of the Admiralty site. A logarithmic measure of soil reaction is the concentration of hydrogen ions present. Acidity and the corresponding hydrogen concentration increases logarithmically as pH decreases. A pH of 7.0 is precisely neutral in reaction, being neither acid nor alkaline. Dominant cations contributing to soil pH are sodium, potassium, calcium, and magnesium. Consequently, pH is a useful estimator of the concentration of certain important soil constituents. Analysis of pH provides a useful tool in archaeological research by supplying information on preservation biases and intrasite variability (Deetz and Dethlefsen 1963; Weide 1966).

Methods. The pH analysis was conducted on the same 26 samples analyzed for particle size determinations. Soil reaction was recorded from a 10 g sample using a 1:1 soil and distilled water slurry. The sample was stirred at regular intervals for one hour, then restirred before immersing an electrode into the solution. Two pH readings per sample were recorded and then averaged.

Results. Several noteworthy trends were identified in the pH values between the three sampling locations (Table 12). All of the samples from Test Pit 12A yielded pH values exceeding 7.0, indicating that the soil conditions were basic, thus explaining the excellent preservation of shell and bone at the Admiralty site. The incorporation of shell into the A horizon was undoubtedly an important contributing factor to the basic soil conditions. The average pH values for the A horizon was 7.45. If the upper sample with a pH of 7.01 (which is notably lower than the other samples) is excluded, the average pH values for the A horizon increases 7.51. The lower pH at the top of the A horizon is probably due to a slightly higher humic acid content resulting from the continued decay of organic matter from plants after the Admiralty site was abandoned.

From just off-site, the samples from the A horizon of Test Pit 6 had an average pH value of 6.37. Samples with a pH below 6.5 lack free carbonates, and the slightly acidic condition near the surface of Test Pit 6 almost assuredly reflects the higher contribution of humic acid to the organic matter. As discussed previously in this chapter, off-site test pits had a higher organic matter content which probably reflects a rapid rate of organic matter turnover within a freshwater marsh environment. Below the A horizon there was a regular increase in pH values from 6.52 at 62 cm depth in the E horizon to 7.61 at 100 cm depth in the Bw horizon. This increase is attributable to the accumulation of soluble bases that have leached from above.

All of the samples from Geologic Pit 1 but the one from the Cg horizon at a 3.4 m depth had pH values exceeding 7.0, with the average being 7.39. The high pH values probably reflect relatively rapid deposition in this area from parent material high in bases, whereby relict surfaces were buried by alluvium before significant weathering processes could affect them. The Cg horizon, with a ph of 5.78, was the most acidic of all samples analyzed. Its low pH is due to the effects of leaching or gleying.

Table 12. Results of pH Analysis.

Excavation Unit	Stratum	Soil Horizon	Level	Depth (cm)	pH Values		
					1st Reading	2nd Reading	Average*
Test Pit 12 A							
a	II	A	1	0-5	7.00	7.02	7.01
b	II	A	2	10-15	7.55	7.57	7.56
c	II	A	3	20-25	7.38	7.34	7.36
d	II	A	4	30-35	7.68	7.65	7.67
e	II	A	5	40-45	7.64	7.68	7.66
f	III	A	6	50-55	7.47	7.43	7.45
g	III	A	7	60-65	7.46	7.43	7.45
h	III	A	8	70-75	7.48	7.40	7.44
i	IV	E	9	80-85	7.48	7.40	7.44
Test Pit 6**							
a	III	A	4	30-35	6.21	6.50	6.52
b	III	A	5	40-45	6.40	6.21	6.21
c	III	A	6	50-55	6.53	6.36	6.38
d	IV	E	7	62-65	6.63	6.51	6.52
e	V	Bw1	8	72-75	6.92	6.56	6.60
f	V	Bw1	9	80-85	6.92	6.94	6.93
g	V	Bw1	10	90-95	7.22	7.10	7.16
h	V	Bw1	11	100-105	7.62	7.59	7.61
Geologic Pit 1**							
a	III	A	--	25-30	7.23	7.25	7.24
b	VI	B1	--	80-90	7.53	7.58	7.56
c	VI	B2	--	205-215	7.62	7.53	7.58
d	VI	B3	--	240-250	7.48	7.49	7.49
e	VI	B4	--	280-290	7.24	7.22	7.23
f	VI	B5	--	315-325	7.28	7.24	7.26
g	VII	Cg	--	340-350	5.78	5.77	5.78
h	--	Gravel Lense	--	170-180	7.56	7.43	7.50
i	--	Sand and Gravel Lense	--	170-180	7.29	7.27	7.28

*Rounded up to the nearest 0.01 pH value.

**The upper levels of these units were within the modern overburden and were therefore not analyzed.

Summary and Conclusions

After descriptive data were compiled on the soil stratigraphy of all backhoe trenches, geologic pits, and test pits, comprehensive stratigraphic designations were made that apply to the entire project area. The following seven strata were defined: 1) Stratum I -- modern overburden deposit; 2) Stratum II -- upper A horizon, shell midden deposit; 3) Stratum III -- lower A horizon; 4) Stratum IV -- E horizon, zone of eluviation; 5) Stratum V -- Bw horizon, zone of illuviation; 6) Stratum VI -- B horizon, a zone with weak structural development; and 7) Stratum VII -- Cg horizon, gleyed zone within the fluctuating water table. Figure 70 graphically depicts all of these strata but Stratum VII along an east-west composite profile drawing. This figure is a stratigraphic cross section of the Admiralty site and the adjacent low-lying area to the west.

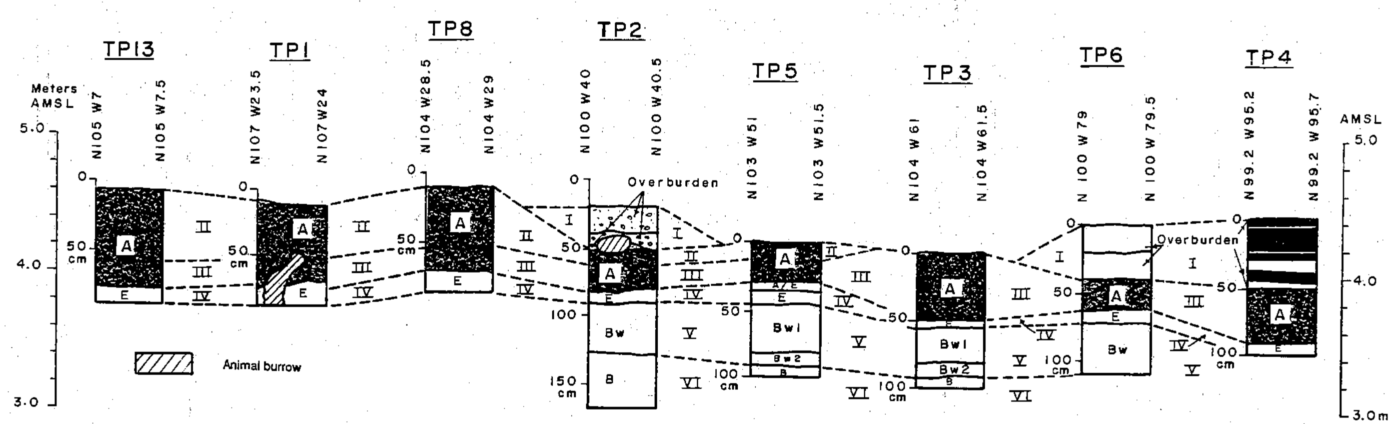
Stratum I, the modern overburden deposit, varied horizontally across the project area. There were only a few areas (for example, areas adjacent to the railroad bed in the Pacific Electric Railroad right-of-way) within the Channel Gateway project area where Stratum I did not exist. A number of discrete depositional units were actually lumped as part of Stratum I, including deposits of imported sand and crushed gravel as well as redeposited soil material. Stratum I often contained artifacts, especially historic artifacts. Artifacts were most abundant in lenses of redeposited soil material, but since the original context was lost due to grading and/or dumping activity, these artifacts had virtually no scientific value.

Stratum II, the most significant archaeological deposit in the project area, corresponded to the culturally enriched upper A horizon at the Admiralty site. Stratum II occurred only within the Pacific Electric Railroad right-of-way. The shell midden was designated as Stratum II because it was situated on top of Stratum III, the natural A horizon identified throughout the entire project area. Because of their archaeological significance, it is important to treat Strata II and III in greater detail than others. These strata formed as a result of slow accretional deposition, and because of the slow rate of sedimentation, soil formation in the A horizon was able to keep pace (that is, maintain a state of equilibrium) with the deposition of fresh alluvium. Biological mixing processes have blurred the boundaries between what were once multi-storied, relict surfaces within Strata II and III. Burrowing animals were probably attracted to these strata because of the ease of tunneling relative to the clayier underlying B and Bw horizons. The drier conditions of Strata II and III relative to underlying layers, as well as an abundance of plant food resources, were also important factors that undoubtedly attracted burrowing animals to the Admiralty site.

Soils that are episodically buried by thin mantles of sediment, such as those in Strata II and III of the Admiralty site, are referred to as compound soils, soils that become *welded* together through time. Soil welding is a common pedogenic process in soils formed in sediment that has been superimposed onto another soil (Bryan and Albritton 1943; Homburg 1991; Hunt 1972; Ruhe and Olson 1980). Bos and Sevink (1975) describe the relationship of compound soils as "polypedomorphic." An unfortunate consequence of soil welding processes is that stratigraphic reconstructions based on field evidence alone are hampered because horizon boundaries typically become obscured, as was the case at the Admiralty site. Furthermore, because of secondary enrichment with soluble minerals, soil chemistry is often not useful for interpreting welded soils (Ruhe and Olson 1980). Consequently, the concentration of cultural residues are probably the best, though not a precise, basis for delineating Strata II and III, that is, between the upper and lower sections of the A horizon.

Despite the visible disturbance within Stratum II and the vertical and horizontal translocation of artifacts that occurred as a result, the cultural deposit retained some degree of stratigraphic integrity, an interpretation that supports a previous assessment by Dillon et al. (1988). In evaluating the Admiralty site shell midden, Dillon et al. (1988:95), noted that it "was not pristine, as the abundant historic garbage admixed in the upper levels of Units 3 and 4 testifies, but nevertheless, the quality

Schematic Profile Drawing of Test Pits 1, 2, 3, 4, 5, 6, 8, and 13



Test Pit 13

A horizon - 5-75 cm, very dark gray (10YR3/1) sandy loam, contains abundant shell.

E horizon - 75-90+ cm cm, grayish brown (10YR5/2) loam.

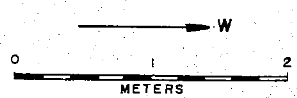
Test Pit 1

A horizon - 10-67 cm, very dark gray (10YR3/1) sandy loam, sandy loam A horizon material, contains abundant shell.

E horizon - 67-84+ cm, grayish brown (10YR5/2) loam.

Strata

I - Modern overburden deposit
II - Upper A horizon, midden deposit
III - Lower A horizon
IV - E horizon, eluvial (leached) zone
V - Bw horizon, cambic (illuvial) zone
VI - B horizon, weakly developed
VII - Cg horizon, gleyed zone



Note: scale pertaining to test pits only.

Test Pit 8

A horizon - 11-74 cm, very dark gray (10YR3/1) sandy loam, sandy loam A horizon material, contains abundant shell.

E horizon - 74-90+ cm, grayish brown (10YR5/2) loam.

Test Pit 2

Overburden: 21-37 cm, gray (10YR5/1) sand and gravel; 37-54 cm, very dark gray (10YR3/1) sandy loam A horizon material, redeposited midden; 54-61 cm, very pale brown (10YR7/3) medium sand.

A horizon - 61-82 cm, very dark gray (10YR3/1) sandy loam A horizon material, contains some shell.

E horizon - 82-92 cm, grayish brown (10YR5/2) loam.

Bw horizon - 92-128 cm, brown-dark brown (10YR4/3) clay loam.

B horizon - 128-170+ cm, yellowish brown (10YR5/4) loam.

Test Pit 5

A horizon - 0-31 cm, black (10YR2/1) sandy loam.

A/E horizon - 31-40, dark gray (10YR4/1) loam.

E horizon - 40-50 cm, gray (10YR5/1) loam.

Bw1 horizon - 50-82 cm, very dark gray (10YR3/1) clay loam.

Bw2 horizon - 82-91 cm, very dark grayish brown (10YR3/2) loam.

B horizon - 91-100+ cm, dark brown (10YR3/3) loam.

Test Pit 3

A horizon - 0-51 cm, black (10YR2/1) sandy loam.

E horizon - 51-57 cm, dark gray (10YR4/1) loam.

Bw1 horizon - 57-84 cm, very dark gray (10YR3/1) clay loam.

Bw2 horizon - 84-95 cm, very dark grayish brown (10YR3/2) loam.

B horizon - 95-100+ cm, dark brown (10YR3/3) loam.

Test Pit 6

Overburden: 0-21 cm, dark brown (10YR3/3) gravelly clay loam B horizon material; 21-39 cm, very dark grayish brown (10YR2/2) gravelly sandy loam A horizon material.

A horizon - 39-62 cm, black (10YR2/1) sandy loam.

E horizon - 62-72 cm, dark gray (10YR4/1) loam.

Bw1 horizon - 72-110+ cm, very dark gray (10YR3/1) clay loam.

Test Pit 4

Overburden: 0-4 cm, concrete slab; 4-7 cm, dark brown (10YR3/3) sandy loam impregnated with diesel oil; 7-12 cm, asphalt slab; 12-20 cm, asphalt slab; 20-27 cm, dark brown (10YR3/3) gravelly sandy loam; 27-33 cm, asphalt slab; 33-42 cm, dark yellowish brown (10YR4/4) gravelly sandy loam, contains chunks of concrete and asphalt; 42-48 cm, asphalt slab; 48-50 cm, very dark brown (10YR2/2) gravelly sandy loam, contains chunks of concrete and asphalt.

A horizon - 50-91 cm, black (10YR2/1) sandy loam, contains some gravel, impregnated with diesel oil.

E horizon - 91-100+ cm, dark gray (10YR4/1) silty clay loam.

Figure 70. Schematic profile drawing of Test Pits 1, 2, 3, 4, 5, 6, 8, and 13.

and quantity of archaeological finds made is suggestive of an archaeological site deposit of comparatively good integrity." The extent of disturbance is addressed with quantitive data in later chapters describing the analysis of faunal remains (see Chapters 11 and 12), botanical remains (see Chapters 13 and 14), and historic artifacts (see Chapter 18).

Stratigraphic evidence allows us to assess the extent of disturbance processes that have affected the soil. In particular, the strong degree of horizonation in the A horizon, as well as underlying horizons, is powerful evidence that the deposits, although affected by disturbance, are largely intact. The degree and expression of horizonation results from the following four factors: 1) accumulation of organic matter, 2) leaching of soluble carbonates and bases, 3) reduction, solution, and transfer of iron and manganese, and 4) formation and vertical translocation of silicate clay minerals. If Strata II and III had been totally churned by biological agents, then the horizon boundaries that result from the combined pedogenic processes outlined above would not have been so readily distinguished from the overburden and the underlying Stratum IV (the E horizon). The regularity of the vertical stratigraphic heterogeneity is conclusive evidence that processes that promoted horizonation were dominant over processes that acted to mix the soil.

Stratum IV refers to the E horizon, an intensively leached zone at the bottom of the A horizon. The lighter color of Stratum IV is due to the reduction of free iron and aluminum compounds. As stated previously, this zone is not significant archaeologically since any artifacts occurring in it were probably the product of downward translocation. Because E horizons only form in better drained areas, they are excellent indicators of geomorphic position relative to neighboring areas. For example, areas with greater E horizon thicknesses correspond closely to higher landscape positions, whereas areas lacking an E horizon represented low-lying areas such as depressions or sloughs. The E horizon was relatively thick at the Admiralty site, but it was thin or nonexistent in most other areas, indicating the latter were more poorly drained.

Figure 71 depicts the E horizon thickness in 10-cm intervals across the project area. Areas lacking an E horizon were considered very poorly drained. These were areas of depressions or sloughs where ponding was frequent, and probably permanent in some places. Freshwater marshes were probably well established in the very poorly drained areas, which encompassed slightly over half of the project area. Areas where the E horizon was between 1-cm and 10-cm thick are interpreted as poorly drained. Water was removed so slowly from these areas that the soils were probably saturated during the winter. Poor drainage conditions resulted from the seasonally high water table and a slowly pervious underlying Bw horizon. Areas with an E horizon between 11-cm and 20-cm thick are considered somewhat poorly drained. Soil in these areas was probably saturated for significant, though not continuous, periods of time during the winter. Areas where the E horizon exceeded 20 cm in thickness were in all likelihood moderately well drained. Although water was probably removed somewhat slowly from the moderately well drained soils during the winter, the water table probably never reached the surface except during the highest floods. Moderately well drained areas were confined to the impound yard in the southwest portion of the project area and the southeast portion of the project area where the northern section of the Admiralty site was located. Even better drained areas may have been present to the south of the project area, and this area was probably the main focus of the Admiralty site occupation. This interpretation is supported by the E horizon thickness in test pits (especially Test Pit 9) along the southern edge of the railroad right-of-way, which greatly exceeded that found in excavation units located north of the railroad bed.

Stratum V was the Bw horizon, a cambic zone that has weathered as a result of pedochemical and physical processes. Clay films were present, but they were very weak and discontinuous, and the soil structure was not well developed. Stratum V occurred throughout all but the most poorly drained areas of the project area. Occasional artifacts were recovered from Stratum V within the Admiralty site, but as with the Strata III and IV, these artifacts probably were moved downward in the profile as a result of bioturbation. Shuttling of aluminum from clay lattices to hydrous oxides via exchange sites

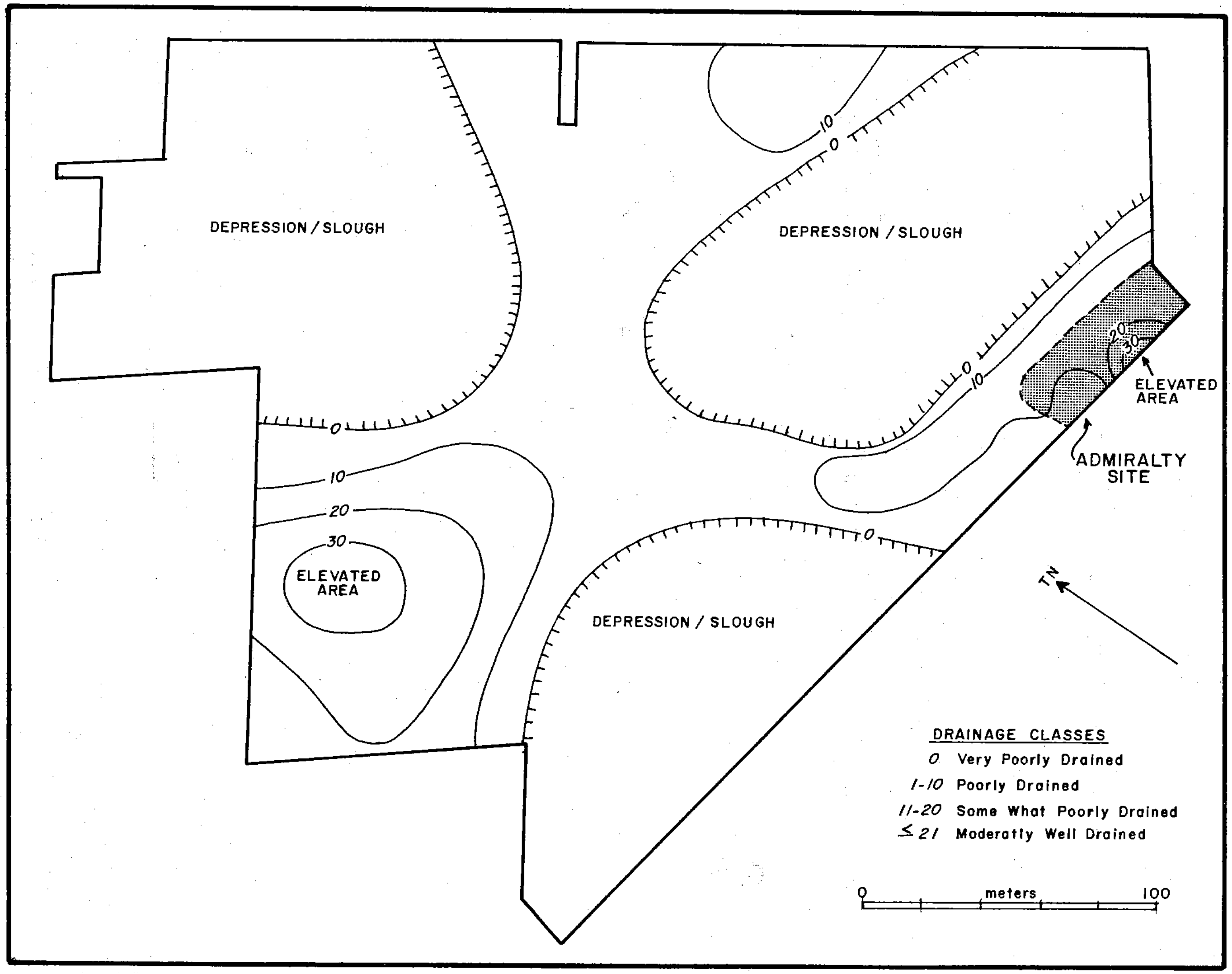


Figure 71. E Horizon thickness and estimated drainage classes at the Channel Gateway project area. (Note: Contour interval = 10 cm.)

and the removal of potassium from micaceous clay minerals were probably the most important pedochemical weathering processes in Stratum V.

Stratum VI refers to the B horizon that was usually found below Stratum V, or less commonly, directly below Strata III or IV. In areas where Stratum VI did not occur underneath Stratum V, drainage was generally poor or very poor, conditions that were not conducive to illuviation. The lack of artifacts in Stratum VI indicate that it has no archaeological significance. Stratum VI has undergone some pedochemical weathering that related primarily to oxidation and reduction cycles corresponding to alternating wet and dry periods. Iron and manganese was released from primary minerals and concentrated in localized, mottled areas. In coastal areas with restricted drainage, such as the project area, oxidation and reduction are probably the only mechanisms for the destruction and disintegration of silicate clay particles (Buol et al. 1980).

Stratum VII was the Cg horizon exposed in Geologic Pit 1. This gleyed zone probably formed under conditions within the fluctuating, but semi-permanent, water table. As with Strata III-VI, Stratum VII also does not represent an archaeological deposit. Characteristics of this gleyed zone have persisted, even though the area has been artificially drained since Ballona Creek was channelized in the 1930s and the marina was constructed in the 1960s. Reduction of iron and hydration are the primary geochemical weathering processes that have occurred in Stratum VII.

Chronometric Analysis

Chronometric analysis was conducted on two types of samples: soil humates and shell samples, both of which were radiocarbon dated. Unfortunately, very little charcoal was recovered from the Admiralty site excavations. None of the charcoal samples exceeded 1 g in weight, and the few samples that exceeded this amount were recovered were from visibly disturbed areas; therefore, no charcoal samples were submitted for radiocarbon dating. Certain biases are associated with the composition and decay of radioactive carbon in both shell and soil. Because of the importance of absolute dating for estimating the time the Admiralty site was occupied, it is important to review some of the factors that must be accounted for in interpreting the dates. Several problems inherent to the process of dating soils and shell have a bearing on the reliability and implications of the dates.

Radiocarbon Determinations from Soil Samples. Interpreting the radiocarbon dates of soil humate samples requires an understanding of the process of organic matter accumulation and decomposition. Organic matter is continually added to the surface of actively forming A horizons, but once the surface is buried, it is removed from receiving fresh plant additions. Organic matter in the newly buried surface is preserved, and if buried to a sufficient depth (about 1.5 m), organic matter is not subjected to the destructive effects of oxidation. The accuracy of radiocarbon dates obtained from soil humates depends on several factors including 1) contamination by water percolation and downward translocation of young organic carbon (Caseldine and Mathews 1985; Geyh et al. 1971; Herrara and Tamers 1971), 2) the particular organic fraction(s) dated and difficulties in isolating biologically inert organic carbon (Campbell et al. 1967a, 1967b; Sharpenseel 1971, 1977), 3) the rate of organic matter turnover (Ruhe 1970), and 4) the depth of post-depositional disturbances such as bioturbation (Wood and Johnson 1978).

To utilize the radiocarbon dates from soil samples, we need to estimate the mean residence time (MRT) of organic matter in A horizons formed at the Admiralty site. MRT represents a combination of all organic carbon fractions (for example, gray and brown humic acids, humine, charcoal, fulvic acids, and humatomelanic acid). Paul and McGill (1977:155) argued that no one fraction "can be expected to fully characterize the turnover rates of soil organic constituents." Ruhe et al. (1967) found that the MRT of organic carbon in soils formed in grassland areas in Iowa varied from less than 100 years to 420 ± 120 years. In sharp contrast, however, Jenkinson and Rayner (1977) dated the MRT of organic matter of soils in England to 1450 years. The MRT of soils in the Ballona wetlands probably more closely approximate the dates obtained by Ruhe in Iowa grasslands, an assessment that is supported by the abundance of non-arboreal pollen and macrofossils at the Admiralty site (see Chapters 13 and 14). We estimate that there is between a 200 to 300 year turnover rate for A horizon formation on the Admiralty site, thus an average of 250 years should be added to the radiocarbon dates to estimate the time of occupation.

Table 13 shows the uncorrected C^{14}, C^{13} corrected, and MRT corrected dates for the Admiralty site soil samples. These samples were taken from the top and bottom of the A horizon, based on the initial belief that these dates would bracket the occupation of the site. As discussed previously, however, the A horizon actually encompasses two strata that could not be clearly differentiated in the field. Consequently, the soil samples from the upper A horizon, which was later called Stratum II to designate the midden deposit, and the lower A horizon, which was referred to as Stratum III to identify the surface horizon on which the first occupants lived, do not truly bracket the occupation range. The only dates that relate directly to the time of occupation are the samples from the top of Stratum II, which should reflect the approximate time the site was abandoned.

The top of Stratum II yielded more internally consistent dates (MRT corrected: A.D. 1317 ± 55, A.D. 1070 ± 77, and A.D. 1110 ± 77) than did the bottom of Stratum III (MRT corrected: A.D. 1325 ± 76, A.D. 975 ± 83 and A.D. 704 ± 75. The variations in dates from the bottom of Stratum III are probably related to bioturbation, and the variations in the dates from the top of Stratum II may or may not be the product of bioturbation. The average for all three samples from the top of Stratum II is A.D. 1166.7 ± 69.7, which seems reasonable as an estimate for the abandonment of the Admiralty site, especially in consideration of the artifact analyses presented in later chapters of this report. The average date for the initial formation of Stratum III is A.D. 1001.3 ± 78, however, given the widely disparate readings, this date is probably not an accurate estimate. In particular, the A.D. 1325 ± 76 year date from the bottom of Stratum II in Test Pit 9A is almost assuredly due to disturbance since this date is eight years younger than the date obtained from the top of Stratum II in the same pit. Consequently, an average of the two other dates, at A.D. 839 ± 79, is probably closer to the actual age of the bottom of Stratum III.

Radiocarbon Determinations from Shell Samples. There are also a number of problems with radiocarbon determinations obtained from shell. Shell is comprised of an organic matrix (referred to as conchiolin) which incorporates inorganic salts, primarily calcium carbonate and lesser quantities of magnesium carbonate and calcium phosphate (Taylor 1987:49). Because conchiolin comprises less than a few percent of the shell, virtually all of the C^{14} determinations are based on the inorganic fraction. Marine shell can yield reasonably accurate dates if the *reservoir effect* is taken into account (Taylor 1987:50). The reservoir effect correction factor must be subtracted from the uncorrected date to factor out the effect of carbonates "upwelled" from deeper sections of the ocean. This correction factor varies from one segment of coastline to the next, depending on the degree of mixing between near surface and "upwelled" carbonates. As suggested by Robinson and Thompson (1981:48) for southern California, Freeman (1991) used a correction factor of 690 ± 35 years. The 690 ± 35 year correction factor, however, pertains to marine shell, not estuarine shell, such as the *chione* dated from the Admiralty site.

No studies have been conducted to determine what the specific correction factor is for estuarine versus marine shells along the southern California coast. In a recent study comparing the radiocarbon age of *Rangia cuneata* (a brackish water species) with nearby marine shell along the Texas coast, *Rangia cuneata* was found to yield a date between 250 and 300 years younger than its marine counterpart (Sam Valastro, Director of University of Texas-Austin Radiocarbon Laboratory, personal communication, 1991). Because of the similar habitats of *Rangia cuneata* and *chione* sp., it is

Table 13. Radiocarbon Determinations for the Shell and Soil Humate Samples from the Admiralty Site.

Test Pit	Level	Depth (cm)	Laboratory Number	Material Dated	Uncorrected	C14 Age	C13 Adjusted Age		Reservoir Effect Corrected 415+35 Year Rate		Mean Residence Time Corrected, 250 Years	
					B.P.	A.D.	B.P.	A.D.	B.P.	A.D.	B.P.	A.D.
9A	2*	10-20	TX-6971	shell	850 ± 70	1100 ± 70			435 ± 70	1515 ± 70		
	2*	15-20	TX-6819	soil	883 ± 55	1067 ±55	873 ± 55	1077 ± 55			633 ± 55	1317 ± 55
	5**	40-50	TX-6972	shell	810 ± 60	1140 ±60			395 ± 60	1555 ± 70		
	5**	45-50	TX-6814	soil	875 ±76	1075 ± 76	885 ± 76	1065 ± 76			625 ± 76	1325 ±76
12	3*	20-30	TX-6973	shell	790 ± 70	1160 ± 70			375 ± 70	1575 ± 70		
	3*	25-30	TX-6816	soil	1130 ± 77	820 ± 77	1140 ± 77	810 ± 77			880 ± 77	1070 ± 77
	8**	70-80	TX-6974	shell	760 ± 70	1190 ± 70			345 ± 70	1605 ± 70		
	8**	70-75	TX-6817	soil	1225 ± 83	725 ±83	1230 ± 83	720 ± 83			975 ± 83	975 ±83
13	2*	10-20	TX-6975	shell	790 ± 70	1160 ±70			375 ± 70	1575 ± 70		
	2*	15-20	TX6818	soil	1090 ± 77	860 ± 77	1080 ±77	870 ± 77			840 ± 77	1110 ± 77
	7**	60-70	TX-6976	shell	880 ± 70	1070 ± 70			465 ± 70	1485 ± 70		
	7**	65-70	TX-6815	soil	1494 ± 75	456 ± 75	1483 ±75	467 ± 75			1240 ± 75	704 ± 75

* = From top of stratum II
** = From bottom of stratum III

reasonable to subtract a median of 275 years from the 690 ± 35 year correction factor used for marine shell. Thus, at least on a tentative basis, a 415 ± 35 year correction factor was used for the reservoir effect.

Another factor that bears on radiocarbon determinations for shell is the C^{13} adjustment for isotopic fractionation. "Fractionation" refers to the differential absorption rates for certain radioactive isotopes (Freeman 1991:2). Marine shell is thought to be especially prone to modifications in isotopic absorption, with the result being a younger C^{13} age than the actual age of the shell. In Freeman's (1991:4, Table 1) review of 19 radiocarbon dates of marine shell obtained from five sites along the Ballona Escarpment, the C^{13} adjustment was 421.6 ± 32.9 years. Freeman (1991:4) reported that the combined isotopic and reservoir effect corrected readings were 268.3 years younger than the uncorrected C^{14} dates.

Unfortunately, the C^{13} correction data were not obtained for the estuarine shell samples from the Admiralty site. Because the reservoir effect correction factor for estuarine shell is estimated at approximately 275 years, however, the expected difference between the uncorrected and the combined isotopic and reservoir effect corrected dates appears to be negligible, only about a 13-year difference. Consequently, the uncorrected date is probably a reasonably good estimator of the actual age of occupation for the Admiralty site.

There was generally good internal agreement among all of the shell dates, including those from both the top of Stratum II as well as the bottom of Stratum III (see Table 13). The uncorrected dates from the top of Stratum II were A.D. 1100 ± 70 and two dates of A.D. 1160 ± 70; the average for these three dates is A.D. 1140 ± 70, which is less than 30 years younger than the estimate obtained from the soil samples relating to the end of the Admiralty site occupation. The bottom of Stratum III yielded the following uncorrected dates, A.D. 1140 ± 60, A.D. 1190 ± 70, and A.D. 1070 ± 70, for an average of A.D. 1130 ± 67.7. Because the shell from the bottom of Stratum III was translocated downward from Stratum II, the dates of shell obtained from Stratum III are not really meaningful in terms of making any archaeological interpretation. Based on absolute dating alone, there is no way of reliably determining the date of the initial occupation of the site. Nonetheless, we would estimate that the site was inhabited for no longer than about 50 to 100 years, which would place the initial occupation to sometime between the mid- to late eleventh century. The tight clustering of all six radiocarbon dates from the shell supports the interpretation that the occupation span was short-lived.

HISTORIC FEATURE DESCRIPTIONS

The only cultural features identified in the field during the Channel Gateway Project were historic. Each feature is described in this section. In all, eight features were identified, one at the Admiralty site (CA-LAn-47) and seven at the Channel Gateway site (CA-LAn-1596-H). These include a concrete foundation (Feature 1), four pits filled with trash (Features 2-5), a shallow pit that was found to be an infilled animal burrow (Feature 6), a wood-lined shaft (Feature 7), and a cluster of large wooden posts (Feature 8). Data on each of these features are summarized in Table 14.

Feature 1

Feature 1, a 4-in (ca. 10-cm) thick concrete slab with a concrete footing at least 4-ft 1-in (125 cm) deep, was located on the Holt Property within the Channel Gateway site (Figure 72). It was first encountered while excavating Trench 19. Feature 1 initially was thought to represent part of a foundation for a large building. After stripping off approximately 20 cm of overburden above the

Table 14. Summary of Historic Features Identified at the Admiralty and Channel Gateway Sites.

Test Pit/ Trench	Feature Number	Feature Type	Presumed Function	Depth (cm)	Dimensions (cm) (LxWxH)*	Soil Texture	Munsell Color	Comments
Trench 19	1	Concrete slab and foundation	Structural support for a steam drop hammer	20-145	460x240x125	no soil	no soil	The deep foundation supported the bulk of a steam drop hammer used to forge steel.
Trench 19	2	Trash-filled pit	Trash deposition	53-103	200x187x50	silty clay loam	10YR3/3 (dark grayish brown)	Artifacts in the fill include industrial and domestic refuse.
Trench 19	3	Trash-filled pit	Trash deposition	20-70	190x?x50	silty clay loam	10YR3/3 (dark grayish brown)	Not excavated.
Trench 19	4	Trash-filled pit	Trash deposition	20-45	100x?x25	silty clay loam	10YR3/3 (dark grayish brown)	Not excavated.
Trench 10	5	Trash-filled pit	Trash deposition	30-100	120x?x70	silty clay loam	10YR3/1 (dark grayish brown)	Not excavated.
Trench 13	6	Pit	Animal burrow	45(?)-115	50x50x70	silt loam	10YR2/2 (very dark brown)	This pit was found to be an infilled animal burrow, not a cultural feature.
Trench 13	7	Wood-lined Vertical Shaft	Water well	102-243+	157x144x141	silt loam silty clay	10YR3/1 (very dark gray) 10YR4/3 (brown-dark brown)	The wood-lined shaft occurs within a larger pit. The bottom of the shaft was not reached.
Test Pit 8A	8	Large Wooden Posts	Structural Support	30-150	125x79x120	sandy loam sandy loam fine sand	10YR3/2 (very dark grayish brown) 10YR3/1 (very dark gray) 10YR6/6 (brownish yellow)	These posts occur next to the old railroad bed. This feature is only one identified at CA-LAn-47.

* LxWxH = Length x Width x Height

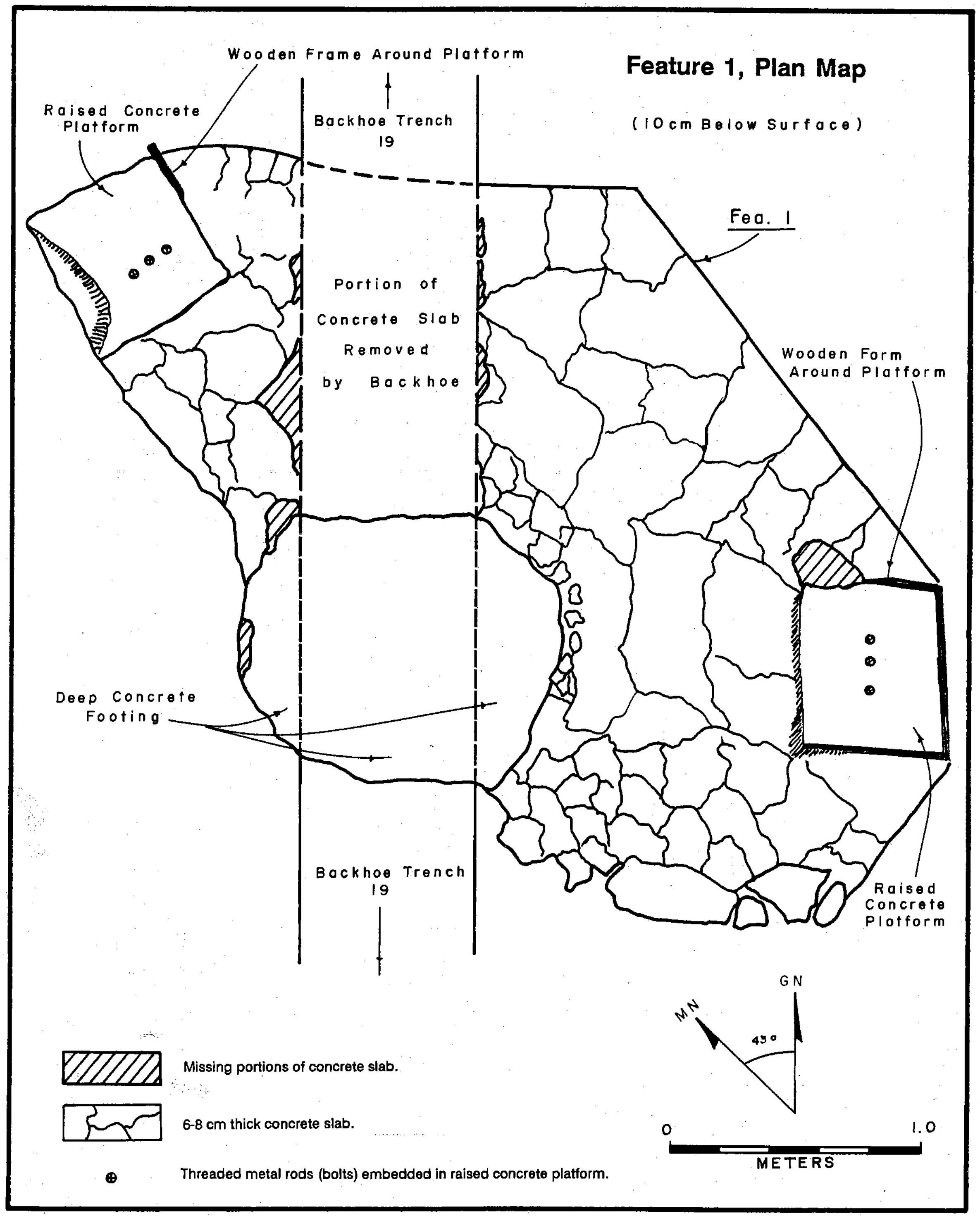


Figure 72. Plan map of Feature 1.

concrete slab, we found that the slab was irregularly shaped on the west side where much of the concrete had been previously removed. The configuration of the east side of the feature was roughly a half of a octagon. The slab measured about 13 ft 9 in by 8 ft 6 in (4.2-m by 2.6-m) in horizontal extent. Two 2-ft 4-in by 2-ft (70-cm by 60-cm) rectangular platforms located about 9 ft 10 in (3 m) apart were raised about 1.6 in (4 cm) above the slab. Three vertical bolts were embedded in each platform, with the threaded portion of the bolts projecting 0.8 in (2 cm) above the platform.

A number of artifacts, mostly glass bottle fragments, were observed while shovel-skimming the overburden in preparing the feature for a photograph. Although these artifacts were collected, there is no evidence that they are directly associated with the feature.

According to Paul Vignolle (personal communication, 1989), a local resident and crew member on the Channel Gateway Archaeological Project, Feature 1 functioned as a structural support for a steam drop hammer used at a brass foundry that was in operation beginning in the late 1940s. The deep concrete footing supported the bulk of the weight of the machine, and the two raised platforms served as attachments for two arms connected to the drop hammer. Local residents noted that the machine was loud and annoying, seemingly in operation around the clock.

Feature 2

Feature 2 was a trash-filled pit located on the Holt property of the Channel Gateway site (Figure 73). This feature was the only one excavated of four trash pits at the site. It was identified in the east wall of Trench 19 where it first appeared in profile as an irregular, basin-shaped pit measuring 1.48 m wide by 50-cm deep. It originated at the top of the A horizon below a 12-cm thick overburden deposit. Feature 2 intruded into the underlying Bw1 horizon. An uncarbonized peach pit, and clear glass, brick, and bone fragments observed in profile clearly indicated it was an historic feature.

A 2-m by 2-m excavation unit, Test Pit 10, was placed adjacent to the east wall of Trench 19 to encompass Feature 2. The overburden was initially dry-screened through 1/8-in mesh hardware cloth, but after the first two levels were completed, we shifted to water-screening through 1/4-in mesh to speed up the process. The pit outline was not clearly defined in plan until 53 cm below surface, approximately 20 cm below the A horizon. Feature 2 measured 2.0 m by 1.87 m in plan. From the point of detection at 53 cm depth, the feature fill was excavated in 10-cm levels down to 1.03 m, the bottom of the pit.

Artifacts recovered from Feature 2 are summarized in Table 15. Because these remains included domestic artifacts dating primarily to the 1920s and 1930s mixed with industrial materials dating after the 1940s, the pit was probably excavated and filled sometime after the area began to be used for industrial activity (see Chapter 18). Domestic artifacts included a variety of ceramic bowl, plate, and cup sherds (primarily of Japanese origin), glass bottle and window pane fragments, miscellaneous bone from domesticated animals (cow, pig, and goat/sheep), and minor amounts of fish bone and peach pits. Industrial materials included various lathe-cut metal shavings, metal tubing, welding rods, and miscellaneous hardware.

The close proximity of Feature 2 to Feature 1 suggests that the two are probably temporally related. This contention is bolstered by the stratigraphic context of two features; both features originated just below a thin overburden deposit at the top of the A horizon. If Features 1 and 2 were associated, then Feature 2 probably dates to the 1940s. Earlier historic remains from the previous Japanese-American occupation of the property apparently were incorporated incidentally with later materials when the pit was filled.

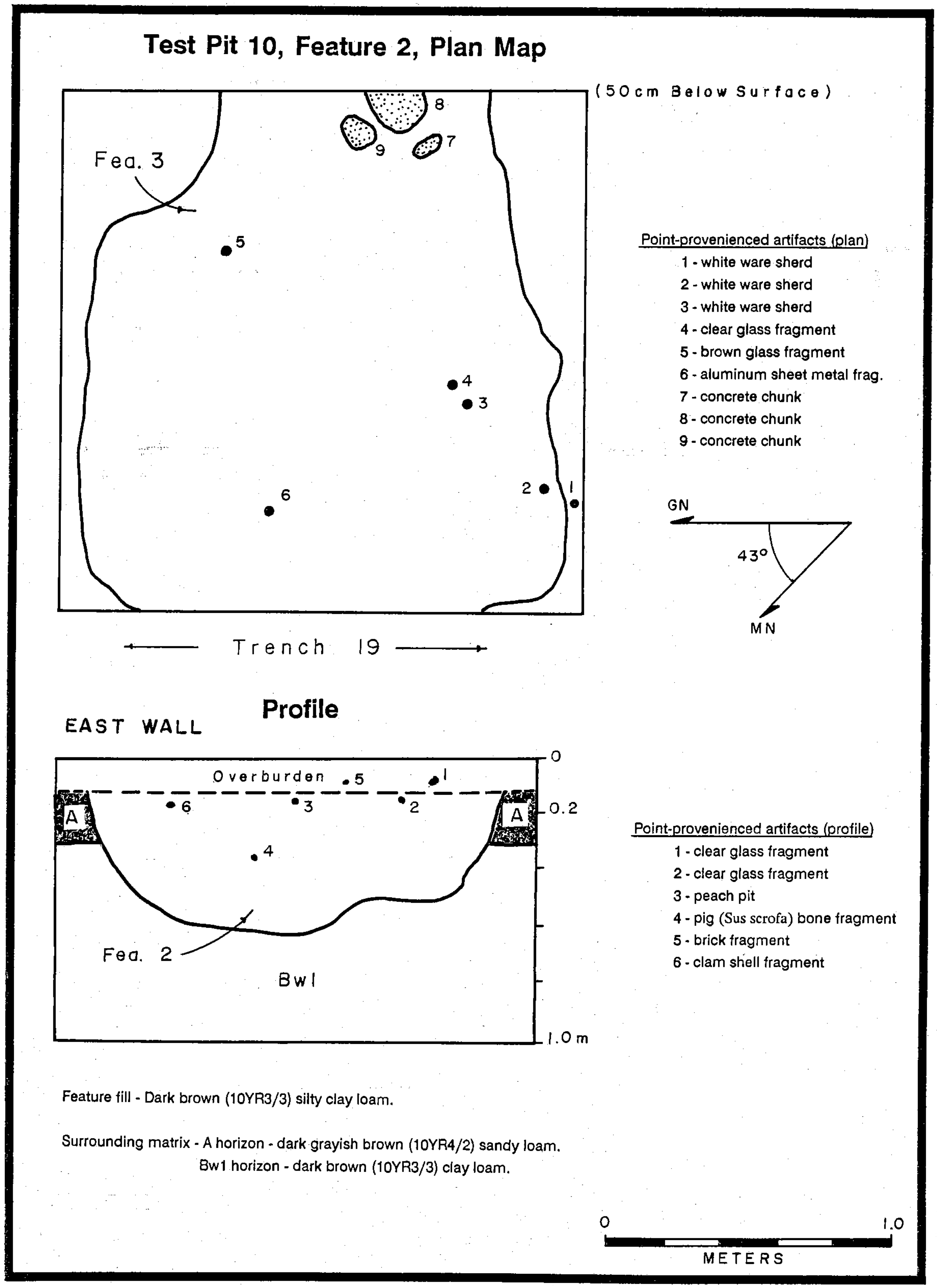


Figure 73. Plan and profile maps of Feature 2.

Table 15. Artifacts Recovered from Feature 2, Channel Gateway Site.

Level	Depth (cm)	Artifacts
6A	53-60	Clear, sun-colored amethyst, turned pink, cobalt blue, brown, aqua, and dark and light green glass; Japanese Kaga redware, porcelain with molded rim decoration, porcelain with blue underglaze decoration, porcelain with orange hand-painted decoration, and blue willowware; copper tubing, 10 and 16 penny nails, stainless steel sheet, welding rod, amorphous lead chunk, wire, and lathe-cut aluminum; tar paper roofing material; ceramic brick and concrete fragments; cow and fish bones; pismo clam shell fragments; and peach pit and wood fragments.
7A	60-70	Clear, sun-colored amethyst, turned, cobalt blue, blue, aqua, amber, dark and light green, and milk glass; Japanese white earthenware, porcelain (some with floral transfer prints), Japanese Kaga redware, and yellow ware; copper tubing, washer, safety pin, 10 and 16 penny nails, fencing nail, wire, amorphous piece of lead, band saw, welding rod, lathe-cut stainless steel, and misc. pieces of sheet metal; ceramic brick and concrete fragments; plastic sheet with drill holes (similar to Plexiglas), and unidentified plastic fragments; sawn animal bone (mostly small and burned); pismo clam and abalone shell; and peach pit, wood fragments, and cork.
8A	70-80	Clear, light and dark green, and brown glass; Japanese Kaga redware, porcelain with molded rim decoration, porcelain with gold on rim edge and molded rim decoration, porcelain with green glaze, and porcelain with printed, blue floral design; 6, 8, and 10 penny nails, roofing and fencing nails, welding rod, wire, bolt, miscellaneous iron fragments, and an unidentified, stainless steel machine part; ceramic brick and concrete fragments; tar paper roofing material; fiberglass boat fragment (?); pig, sheep, and one fish bone; pismo clam shell; and wood fragments.
9A	80-90	Clear, sun-colored amethyst, turned pink, brown, cobalt blue, light and dark green, and aqua glass; Japanese Kaga redware, porcelain with blue transfer decoration, and porcelain with blue underglaze decoration; 6 and 8 penny nails, copper sheet metal, and miscellaneous unidentified iron fragments; concrete fragments; ceramic sewage pipe; pismo clam shell fragments; and mammal and fish bone fragments.
10A	90-100	Clear, brown, turned pink, cobalt blue, blue, and light green glass; porcelain with floral decal, and porcelain with blue glaze on both sides; fencing nails, wire, sheet copper, and miscellaneous iron fragments; concrete fragments; pismo clam and abalone shell; mammal and fish bone; and an unidentified carbonized seed.
11A	100-103	Clear, brown, aqua, and turned pink glass; Japanese Kaga redware, and porcelain with blue decorated underglaze; 16 penny nails, miscellaneous unidentifiable iron fragments; brick fragment; and pismo clam shell fragments.

Features 3-5

Features 3, 4 and 5 (Figures 74 and 75) were trash-filled pits similar to Features 2. These features were identified on the Holt property of the Channel Gateway site. Each pit originated below an overburden deposit at the top of the A horizon, and intruded into the underlying Bw1 horizon. Features 3 and 4 were encountered in the east wall of Trench 19, and Feature 5 was found in the southern portion of the east wall of Trench 10. Feature 3, located about halfway between Features 2 and 4, was 1.9 m wide in profile, extended between 20 and 70 cm below surface. Artifacts observed in the Feature 2 profile included clear glass bottle fragments, and pismo clam shell. Feature 4 was 1.0 m wide in profile and between 20 and 46 cm in depth. The only artifacts observed in Feature 4 included two clear glass fragments and several small pieces of concrete. The Feature 5 profile measured 1.2 m wide and between 30 cm and 98 cm deep. Two pieces of clear glass, two pismo clam shell fragments, and pieces of wood, brick, and concrete were noted in the Feature 5 profile.

Although the horizontal extent of Features 3, 4, and 5 was not determined, they were all probably similar in size to Feature 2, the only trash pit excavated at the site. Differences in the vertical size of each pit are undoubtedly the result of the particular portion of the pit exposed in cross section by the backhoe trenches.

In all likelihood, Features 3, 4, and 5 are contemporaneous with Feature 2. They were probably all excavated during the late 1940s, and then filled with a mixture of industrial materials and domestic refuse dating to as early as ca. 1920. This interpretation is supported by the proximity, stratigraphic similarities, and artifact associations.

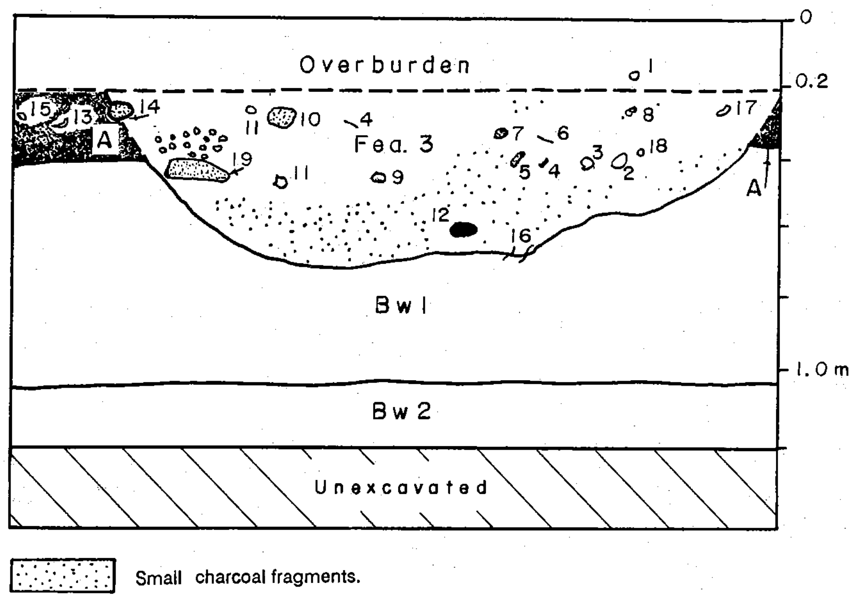
Feature 6

Feature 6 was a small pit that was identified in the east wall of Trench 13 between the Associated Pacific building and Maxella Avenue (Figure 76). In profile, the feature appeared as a basin-shaped pit at 72 cm depth at the base of the A horizon, extending into the underlying Bw horizon at 115 cm depth. Although not clearly defined, the pit seemed to originate higher in the profile at 45 cm depth, corresponding to the top of the A horizon. The fill consisted of a very dark brown (10YR3/3) silt loam, indicating that the pit was filled with A horizon material. A small mammal bone and a ceramic sewer pipe fragment were observed in the profile.

A 1-m by 1-m excavation unit, Test Pit 11, was placed to encompass Feature 6 so that it could be investigated further. After removing the upper 50 cm of overburden with a backhoe, manual excavation and screening was begun. The overburden deposit consisted of an asphalt slab between 0 and 5 cm depth, a dark yellowish brown (10YR4/6) crushed gravel and coarse sand layer from 5 to 42 cm depth, and a stratum of redeposited very dark grayish brown (10YR3/2) silty clay loam A horizon material between 42 cm and 50 cm depth. When the feature was exposed in plan at about 68 cm depth, the contact between the A and E horizons, it became obvious that it was not a cultural pit feature. The irregular shape of the feature in plan indicated that it represented an infilled animal burrow connected to several horizontal burrows that were filled primarily with E horizon material. Not surprising, small quantities of rodent bones were recovered from the infilled burrows.

Backhoe Trench 19, Feature 3, Profile

SOUTH WALL



Feature fill - Dark brown (10YR3/3) silty clay loam.

Surrounding matrix - A horizon - dark grayish brown (10YR4/2) sandy loam.
Bw1 horizon - dark brown (10YR3/3) clay loam.

<u>Point-provenienced artifacts</u>

1 - milk glass fragment
2 - clear glass fragment
3 - clam shell
4 - clear glass fragment
5 - concrete chunk
6 - clear glass fragment
7 - concrete chunk
8 - charcoal fragment
9 - brown glass fragment
10 - concrete chunk
11 - clear glass bottle frag.
12 - charcoal fragment
13 - clam shell fragment
14 - concrete fragment
15 - clear glass bottle
16 - metal wire
17 - clear glass fragment
18 - animal bone fragment
19 - concrete chunk

Figure 74. Profile of Feature 3.

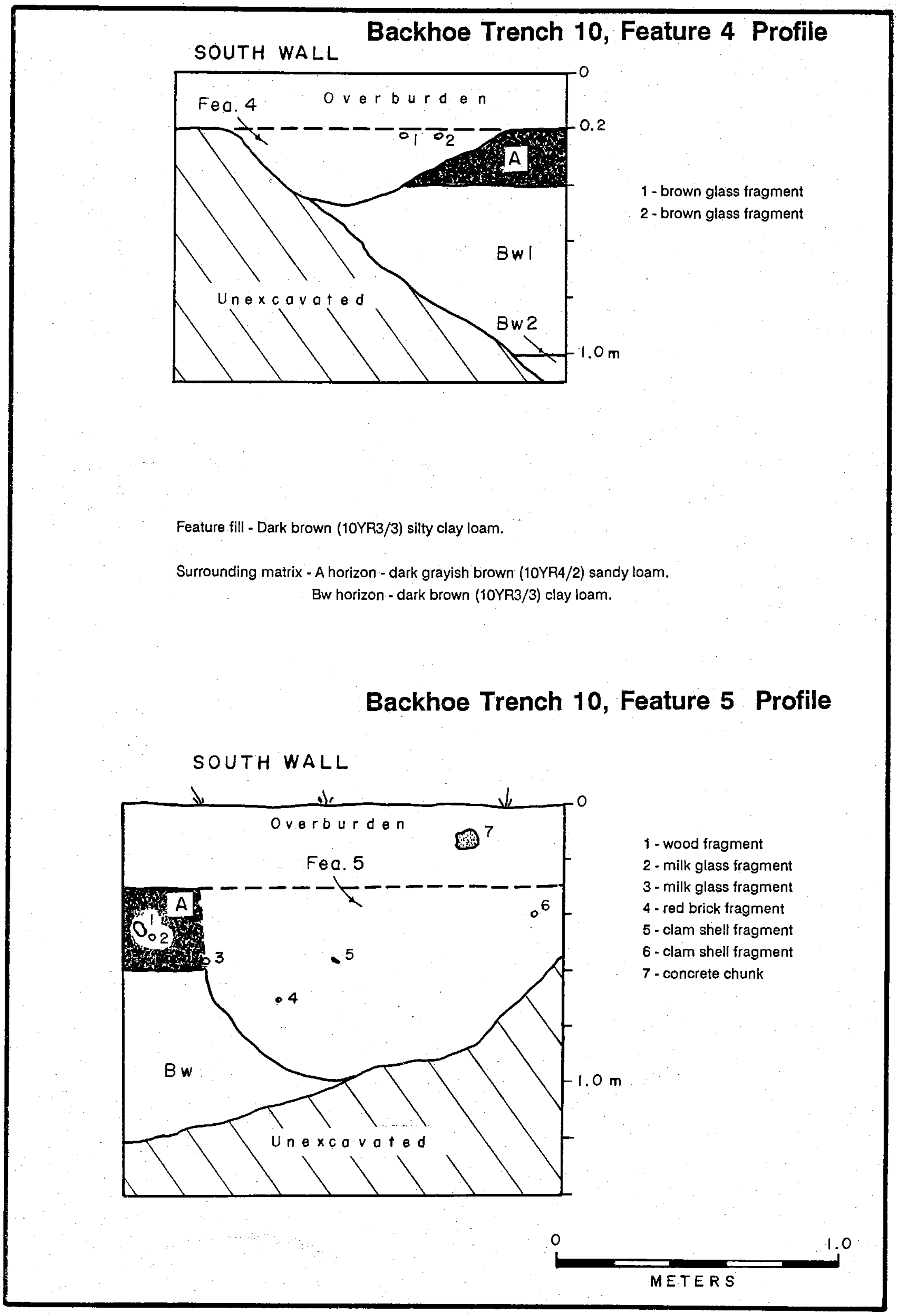


Figure 75. Profiles of Features 4 and 5.

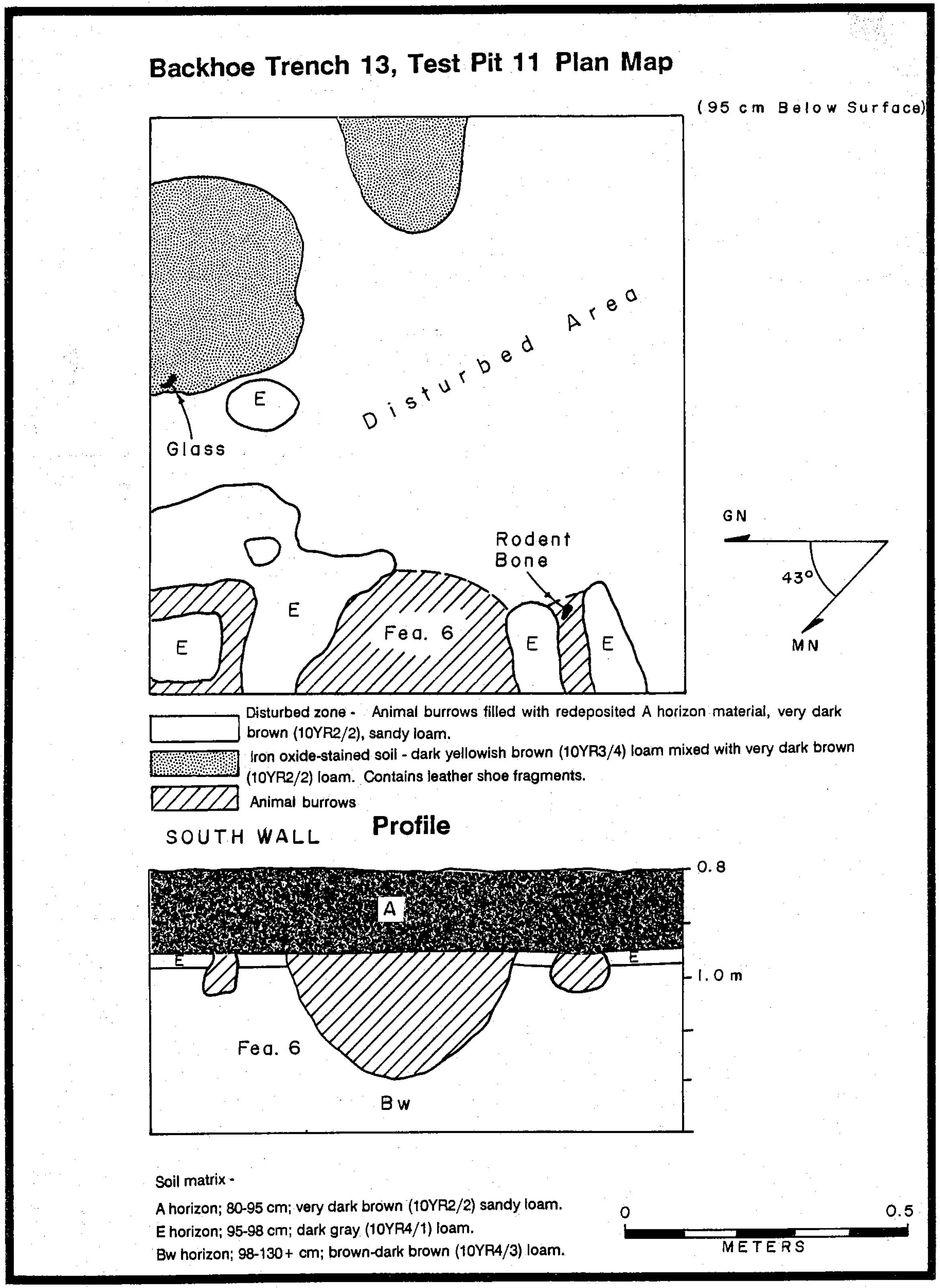


Figure 76. Plan and profile maps of Feature 6.

Feature 7

Feature 7 was a wood-lined well shaft within a larger pit (Figures 77, 78 and 79). It was exposed in the southeast corner of Test Pit 11, the excavation unit placed next to Trench 13 over Feature 6. Feature 7 appeared at 120 cm depth as a large void that we initially thought was a collapsed animal burrow. Part of a large pit filled with very dark gray (10YR3/1) silt loam and brown-dark brown (10YR4/3) silty clay loam was found at 130 cm depth. A variety of historic glass, ceramic, and metal artifacts were mixed throughout the fill, which consisted primarily of redeposited A horizon material.

A portion of the top of a wooden box measuring 30 cm by 55 cm was encountered at 102 cm depth. After exposing more of the box at 140 cm depth, Test Pit 11 was expanded towards the southeast to a 2-m by 2-m unit to encompass Feature 7. The pit that contained the wooden box was found to be roughly circular in plan; it measured 1.57 by 1.44-m in size. After fully exposing the wooden box in plan at 102 cm, it extended over a 0.9 m by 0.9 m square area. The fill within the box was excavated in natural strata and water-screened through 1/4-in mesh hardware cloth.

The following four natural strata were identified as part of the feature fill: 1) 90 - 110 cm, a deposit of unconsolidated, very dark gray (10YR3/1) silt loam (caved-in sediment below the large void), 2) 110-184 cm, a very dark gray (10YR3/1) silt loam; 3) 184-217 cm, a brown-dark brown (10YR4/3) silty clay mixed with very dark gray (10YR3/1) silt loam; and 4) 2.17-2.43+ cm, a very dark gray (10YR3/1) silt loam.

Artifacts were recovered from each of the above strata (Table 16, see Chapter 18 for historic artifact analysis). A mixture of industrial and domestic artifacts were collected, especially ceramic, glass, and metal items. Ceramic artifacts included yellow ware bowls and crocks, and a variety of white earthenware sherds from unidentifiable forms. The incidence of recognizable Japanese ceramics was much lower (about 10%) than at Feature 2 (about 30%). A variety of colors of glass was recovered, but most was not identifiable as to function. Identifiable glass included tumblers, beer and wine bottles, medicine bottles, and window pane fragments. In contrast to Feature 2, Feature 7 yielded a greater proportion of metal items. Metal artifacts included wire, bolts, a variety of wire nails, bolts, grommets, rivets, a chisel, horseshoes, handles, .22 short cartridges, shoe eyelets, a button, and tin can fragments. Although some residential metal artifacts were recovered, the vast majority consisted of industrial materials. An industrial-sized motor or pump was found wedged in the bottom of the excavation unit.

Because the feature fill was found to continue to at least 2.43 m below surface, we determined that Feature 7 was not simply a buried box. It was a wood-lined shaft that probably functioned as a well, possibly a water, or less likely, a gas or oil well. The shaft was filled with a variety of industrial/commercial items and lesser quantities of residential refuse. Based on archival research (see Chapter 4), the Mercury Petroleum Company was assessed a 30 dollar tax per year between 1938 and the early 1940s when the Associated Pacific Industries factory was built on the property. Presumably, the tax was for an oil well, so it is possible that Feature 7 was the remnant of an oil well. The archival research indicated that the property containing Feature 7 never had a residential structure. The property was, however, periodically used as a trash dump during the 1920s and 1930s, which may explain the presence of domestic items in the feature fill. The "turned pink" glass, the most temporally sensitive materials recovered from the feature fill, date to between ca. 1919 and 1940s. Aside from minor amounts of sun-colored amethyst glass that could represent heirloom items and cartridges that may or may not date to before 1919, no artifacts were encountered that clearly pre-date or post-date the age of the "turned pink" glass. If Feature 7 actually represents the abandoned oil well described above, then trash was probably deposited into the shaft sometime between 1938 and the early 1940s.

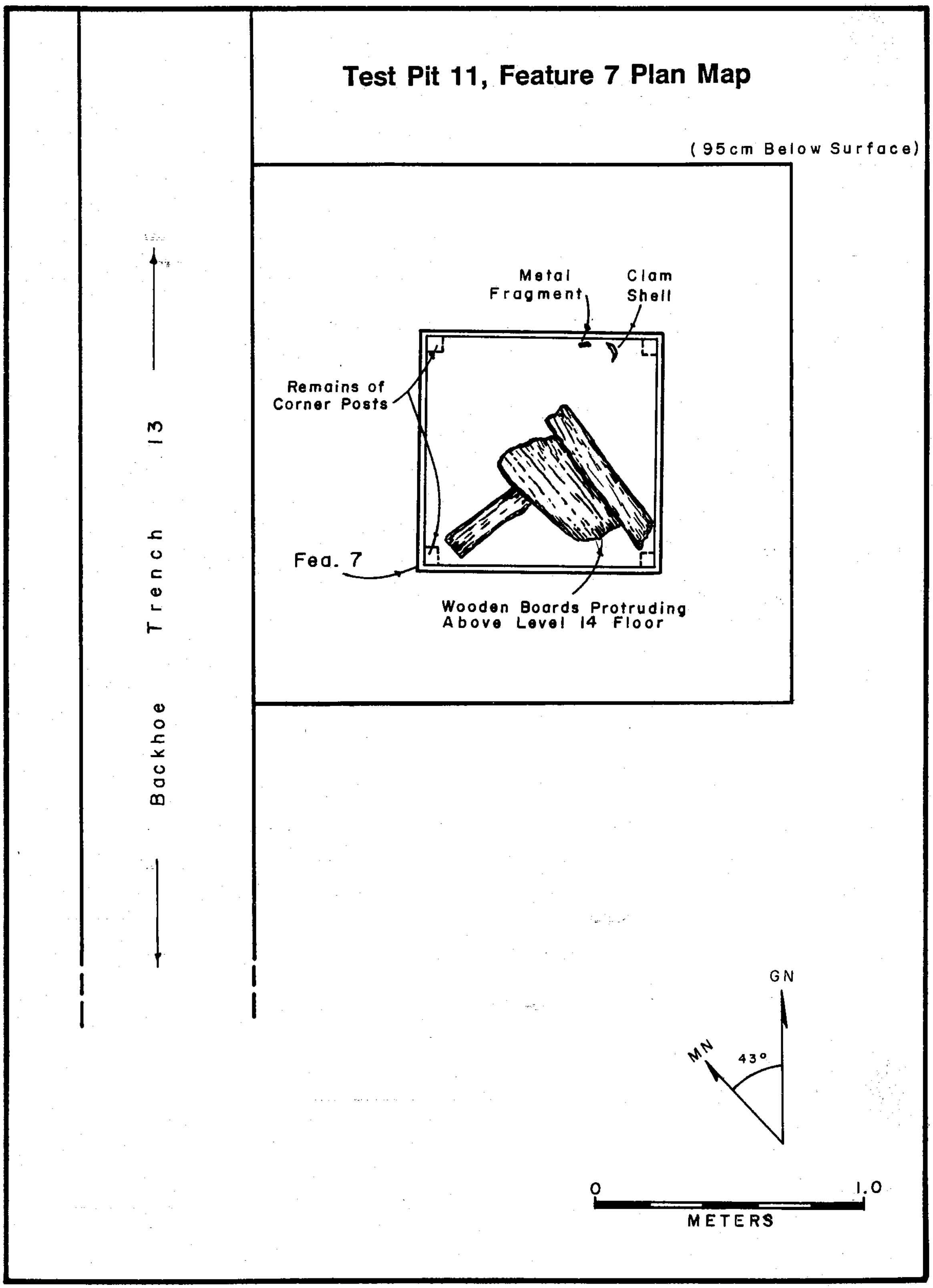


Figure 77. Plan map of Feature 7.

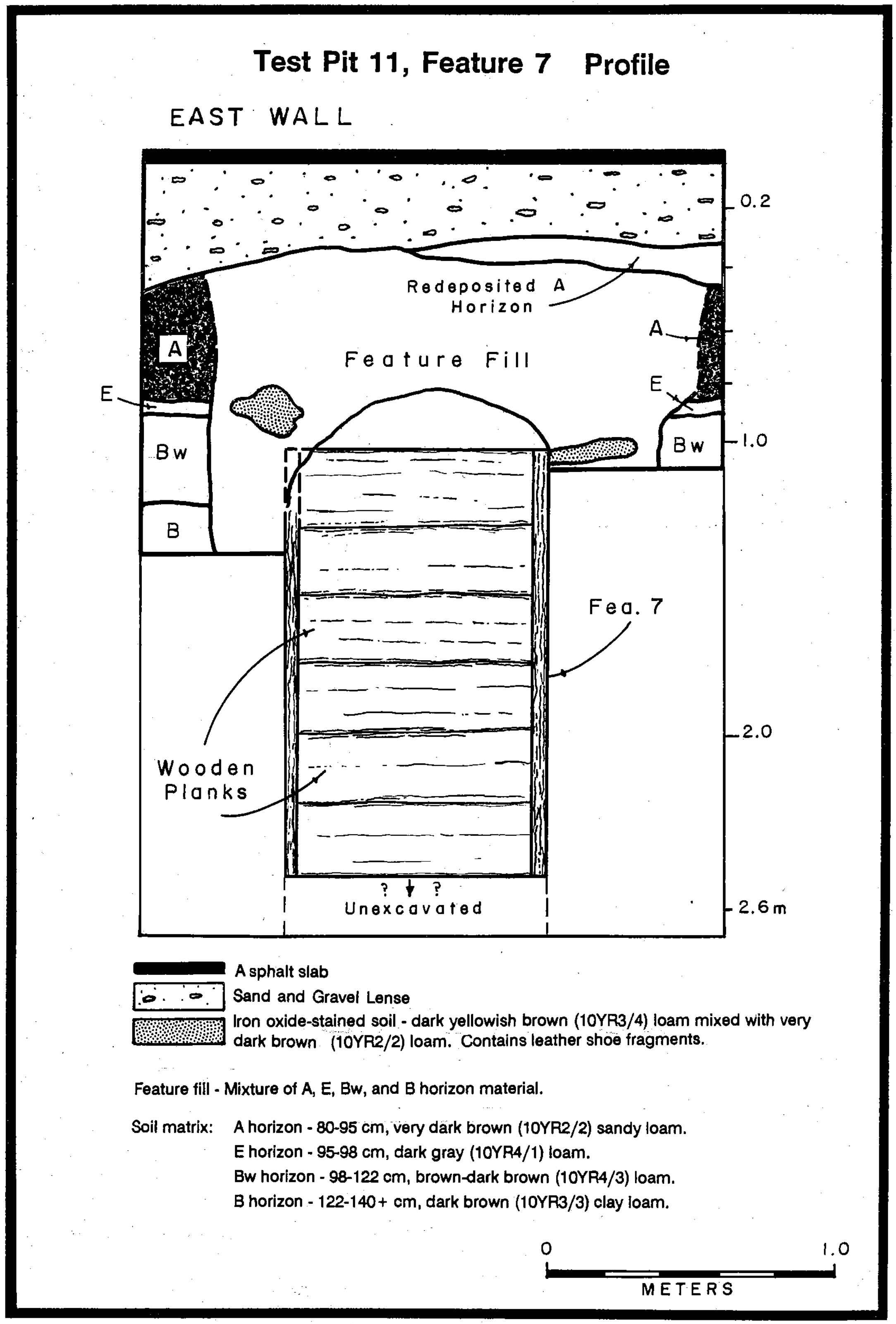


Figure 78. Profile of Feature 7.

Figure 79. Photograph of Feature 7.

Table 16. Artifacts Recovered from Feature 7, Channel Gateway Site.

Depth (cm)	Artifacts
90-110	Clear, turned pink, brown, and aqua glass; nails, bolt, barbed wire, horseshoe, pan handle, single tree center clip, 2- or 4-hole button, enamel ware cake pan, and miscellaneous unidentifiable metal fragments; and shoe leather fragments.
110-184	Clear, turned pink, brown, aqua, light green, and amber glass; porcelain with pink interior glaze and yellow and green exterior glaze, yellow ware with molded exterior design, ceramic sewage pipe, and red ceramic brick fragments; nails (some attached to wood fragments), bolt, railroad spike, copper rivets, brass shoe lacing eyelet, brass washer, .22 short cartridge with an "H" headstamp, tin can, and miscellaneous unidentifiable metal fragments; coal, wood, and charcoal fragments; pismo clam shell fragments; and sawn cow and sheep bones.
184-217	Porcelain with pink interior glaze and yellow and green exterior glaze, and plain porcelain; round bar with a flattened end containing two bolts and miscellaneous unidentifiable metal fragments; shoe leather fragments; shell button and pismo and abalone shell fragments; and sawn cow and sheep bones.
217-243	Clear, turned pink, amber, aqua, light and dark green, and milk glass; yellow ware with molded exterior design, solid porcelain doll leg with orange/red slipper, and red ceramic brick fragment; nails, iron handle, shovel blade, tin can fragments, and miscellaneous unidentifiable metal fragments; wood fragments; and sawn cow and sheep bones.

Although at least four depositional episodes were indicated by the stratigraphy, no clear evidence was found in the artifact assemblage to indicate that the feature was filled gradually.

Feature 8

Feature 8 was the only feature identified at the Admiralty site. It consisted of three upright posts (similar to telephone poles) and a horizontal railroad tie fragment (Figure 80, also see Figure 58). Feature 8 was encountered in Test Pit 8A, within 2 m to the north of the abandoned Southern Pacific Railroad track intersecting the northern section of the site.

The posts were about 11 in. (28 cm) in diameter. They each extended from 30 cm to at least 1.5 m below surface, intruding into the prehistoric shell midden at the Admiralty site. The tops of the posts were apparently sawed off during grading activities sometime after the railroad was abandoned. The two western posts were about 10 cm from each other, and the third post was 52 cm to the east. The two southernmost posts were almost entirely decayed, leaving a void where they had decomposed. In plan, the hole where all three posts were placed extended over a 125-cm by 79-cm area that was highly irregular in outline. The hole was filled with a variety of types of sediment. This fill consisted of a mixture of redeposited soil material from the site and fine sand that was probably brought in from elsewhere.

Prehistoric basalt and quartzite debitage, fire-cracked rock, miscellaneous animal bone, a shell bead, and a large quantity of shell representing food remains were included incidentally as part of the post hole fill. Historic materials consisted primarily of clear glass with a railroad spike and a large bolt. An aqua insulator, patented in 1893, was recovered from the adjacent Test Pit 8B. The historic artifacts found in direct association with Feature 8 could not be precisely dated, but they date to no earlier than the 1920s.

Although the exact function of Feature 8 was not determined, the close proximity to the railroad bed plus the presence of a railroad tie and a railroad spike suggest that it was somehow associated with the operation of the railroad. Feature 8 may represent the remnant of a loading dock, signal light posts, or some other type of railroad feature.

MONITORING

As part of the Channel Gateway Archaeological Project, all earthmoving activities will continue to be monitored by an archaeologist and a Native American. The objective of the monitoring program is to identify human remains and grave goods in the areas disturbed by construction. If any such remains are encountered, these remains will be removed and turned over to representatives of the Gabrielino tribe for reburial.

To date archaeological monitoring has been conducted in conjunction with three activities: soil remediation, the placement of various utilities, and the initial construction in the north portion of the project area (Figure 81). Remediation was conducted in areas of contaminated soil. Areas subjected to remediation include the southwestern portion of the Avis lot and the northern half of the Bay City Metals lot, and three relatively isolated areas in the Holt property. Remediation involved the excavation of the fill in designated areas to the water table, treating the soil, and then placing the "clean" soil back in the excavated area.

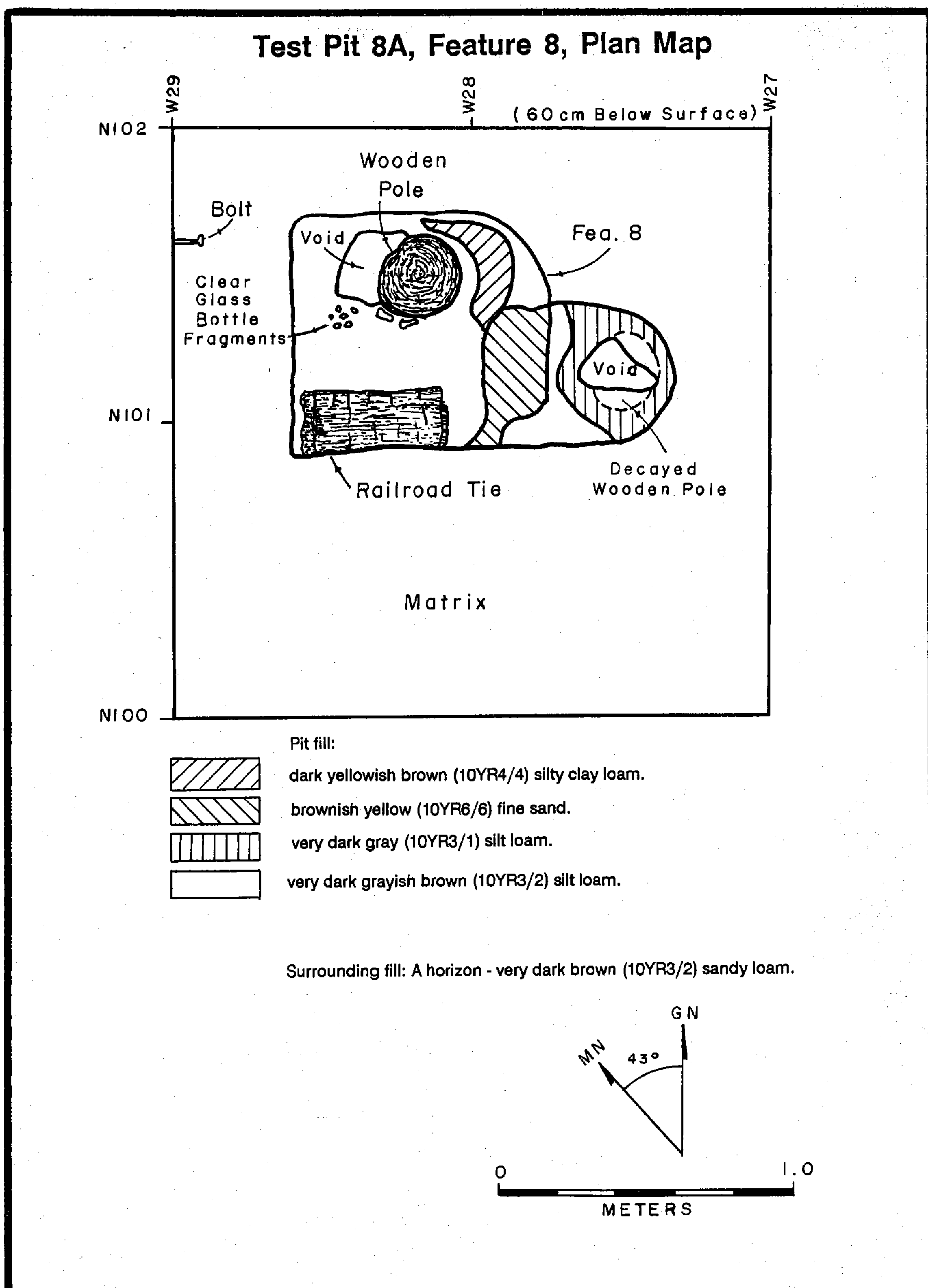


Figure 80. Plan map of Feature 8.

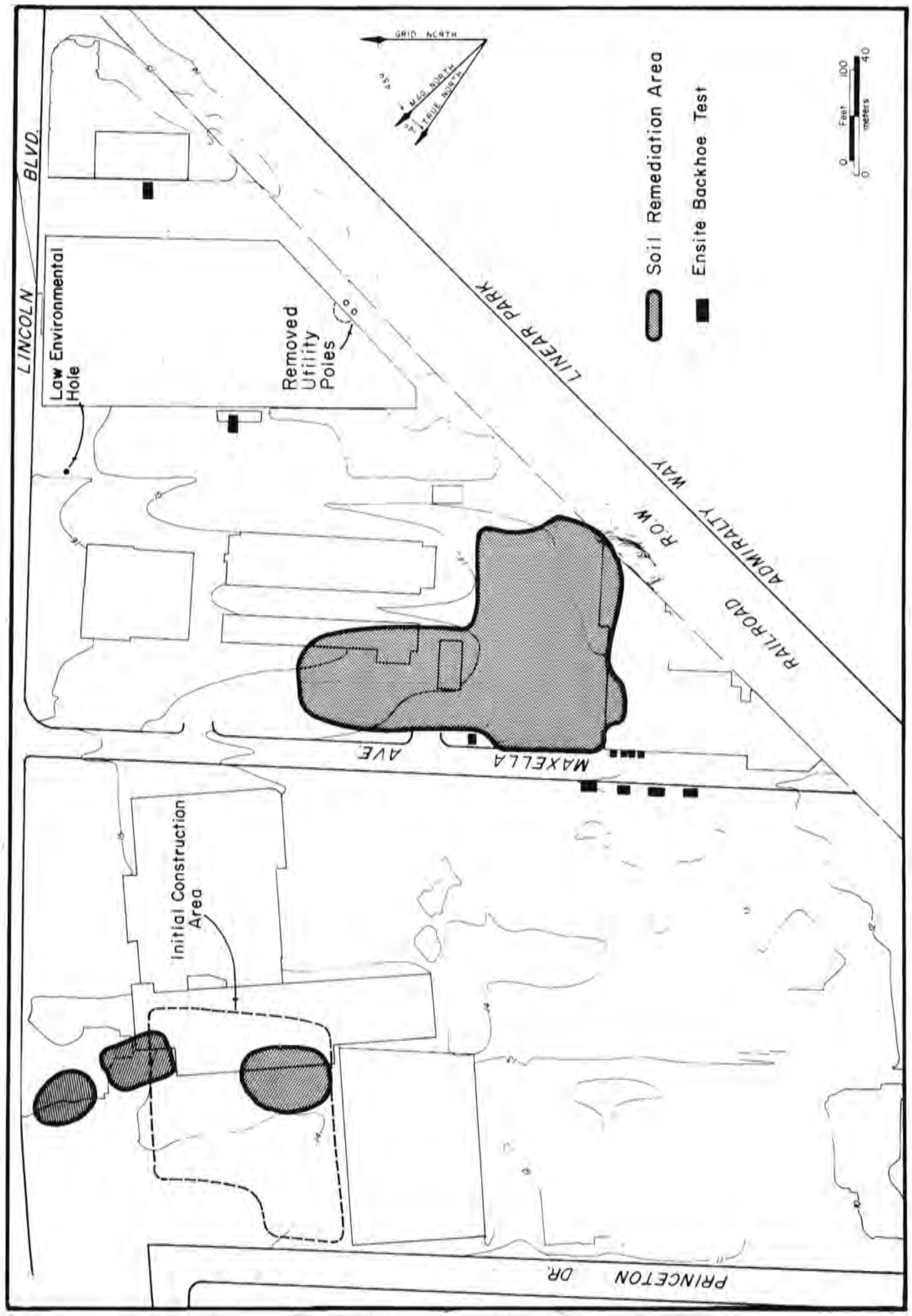


Figure 81. Map of monitored areas.

Due to the potentially hazardous nature of the work, the monitors were only allowed to view the excavations from a distance. Detailed profiles were not drawn nor were soil samples collected. Photographs of the operation and profiles, however, were taken.

Although field observations were cursory at best, some useful information was gathered. In the Avis and Bay City Metals lots, we were able to confirm that the basic stratigraphic sequence found throughout the entire property also pertained to this area. Overburden was observed lying on top of an A and E horizon which in turn rested on a Bw horizon. Contamination in these areas was clearly visible in the profile as dark, oily stains that were pervasive throughout the excavation.

Remediation in the Holt property reinforced observations made in the backhoe trenches. Large amounts of historic material, primarily in the form of glass, metal, and ceramics, were observed in the contaminated soil. Although examined from a distance, no artifacts were handled and none were collected.

Subsequent excavation for construction in the Holt area also confirmed early observations. While various historic artifacts were observed, no additional historic features were found. One pestle was found among the historic artifacts. This artifact could be prehistoric in origin, although its placement indicates that it was probably collected from elsewhere.

Further monitoring of utilities, primarily transmission lines, also reinforced previous interpretations. No prehistoric material was observed in any excavation. Of particular note were the two poles placed just north of Admiralty site boundary for an electric line. These excavations were closely monitored, and the backdirt was examined for artifacts. No artifacts were found and no evidence of midden soil was found in the excavation, thus supporting our previous estimate of the northern boundary of the Admiralty site.

CHAPTER 9

ADMIRALTY SITE LITHIC ANALYSIS

Ronald H. Towner

INTRODUCTION

The lithic analysis for the CA-LAn-47 project involved the individual analysis of 7,742 individual lithic items. The goal of the analysis was to generate a body of data relevant to the overall research questions of the project. Research questions specific to the lithic assemblage include: What raw materials were exploited and what technologies were used to exploit them? Were the lithic materials exploited in an expedient fashion or as part of a curated technology? And are there technological and/or functional differences in raw material use? An important part of all these research questions includes identification of differences in raw materials and technologies that may have stratigraphic and possibly temporal significance and identification of spatial differences that may have functional significance. These research questions are used to generate hypotheses concerning the settlement and subsistence patterns and trade and exchange systems of the site inhabitants.

There are three broad categories of lithic items recovered from the site: flaked stone, ground stone, and fire-cracked rock. Each of these categories was analyzed separately and some categories were further subdivided. Flaked stone items are defined as the products and by-products of flint working. Ground stone items are defined as the products of a ground stone technology, no by-products of this technology were identified. Fire-cracked rock is defined as unmodified lithic material which has been thermally fractured.

The flaked stone assemblage comprises the bulk of the lithic assemblage (n=6,053) and includes bifacially worked items (n=69), cores (n=109), drills (n=4), microliths (n=21), edge-modified flakes (n=44) and debitage (n=5,806). The ground stone assemblage is relatively small (n=79) and includes possible metates (n=3), possible manos (n=13), possible pestles (n=3), and a large number of unidentifiable ground stone fragments (n=60). There are 1,617 pieces of fire-cracked rock in the lithic assemblage.

FLAKED STONE

The theoretical basis for much of the flaked stone analysis is derived from the work of Crabtree (1972, 1973), Callahan (1979), and Flenniken (1981). The objective of this type of analysis is to identify and quantify the relative proportions of different technological systems present in the assemblage. This approach, based on the experimental replication of various stone tool technologies, has generated a body of knowledge concerning key attributes that are specific to different stone working technologies (Gilreath 1983; Raymond 1984; Walker 1980). Although no formal replication experiments were conducted as part of this analysis, the attributes identified by previous researchers were used to identify the technologies present in the CA-LAn-47 assemblage.

The use of specific technologies and techniques of lithic reduction by prehistoric groups may be indicative of temporal or cultural differences (Flenniken 1985) or may be responses to specific environmental adaptations (Parry and Kelly 1987). These technologies, and thus possible prehistoric adaptations, may be identified in the debitage from an assemblage even in the absence of formal tools. This approach is particularly appropriate when dealing with large amounts of debitage as is the case with the Admiralty site assemblage.

Methods

The flaked stone artifacts in the assemblage were divided into seven categories for the analysis: biface tools, cores, debitage, microliths, edge-modified flakes, drills, and flotation sample flakes. Flotation sample flakes are sometimes included with the other debitage, but were analyzed separately due to their very small size. This separation can aid in identifying primary work areas and locations of secondary disposal (Behm 1983; Fladmark 1982; Metcalfe and Heath 1990).

Some attributes, such as lithic raw material, were recorded for all lithic items regardless of their analytic category. Raw materials present in the assemblage include basalt, quartzite, chert, chalcedony, petrified wood, obsidian, quartz, andesite, rhyolite, fused shale, and glass. Operational definitions of these raw materials can be found in Crabtree (1967) and Hamilton et al. (1974).

Biface tools are defined as any lithic item that has pressure-flake scars on two faces (Crabtree 1972:38). Attributes recorded for the 69 bifaces in the assemblage include biface type, material type, length, width, thickness, weight, heat treatment, completeness, number of fractures, fracture locations, fracture types, notch location, base type, blade type, serration, resharpening, and projectile point type, if applicable.

Biface type was used to distinguish between projectile points and bifaces; with the exception of Canalino points (Van Horn and Murray 1985) to be discussed later, projectile points were defined on the basis of an identifiable haft element. If a haft element was not present, the artifact was classified as a biface. Length, width, and thickness were measured to the nearest tenth of a millimeter using Vernier calipers. Bifaces were weighed on an O'Haus Triple Beam Balance scale to the nearest tenth of a gram. The presence of heat treatment was a subjective evaluation on whether or not the item had been burned, intentionally thermally altered, or was unaltered. Visual characteristics such as color, luster, pot lids, and crazing were used to make the evaluations (Crabtree and Butler 1964). The completeness of each biface was also recorded; if a biface was fractured, the number and location of the fractures were recorded. Fractures were classified into four categories: bending, perverse, impact, and fire-induced fractures. Bending fractures (Johnson 1979) can occur during manufacture, use, or after deposition in the archaeological record. Perverse fractures (Johnson 1979; Titmus and Woods 1986) are indicative of a manufacturing error. Impact fractures (Odell and Cowan 1986; Titmus and Woods 1986; Towner and Warburton 1990) are produced during use. Fire-induced fractures generally occur after deposition in the archaeological record. If a projectile point was notched, the location of the notch was recorded (side, corner, basal, and stemmed). Four base types were also recorded for the bifaces: straight, concave, convex, and indented. Blade types identified include straight, incurvate, and excurvate-converging (Loy and Powell 1977). Serrated blades were noted on three of the projectile points. An attempt was made to identify resharpening of a biface; the qualitative categories recorded include not resharpened, resharpened, and unknown. Finally, all projectile points were classified into projectile point types common to the local area (Van Horn and Murray 1985).

Four "drills" were identified in the assemblage. The attributes recorded for these artifacts include raw material, length, width, thickness, weight, presence of polish and location, presence of microflaking and location, and presence of retouch and location.

Attributes recorded for the cores include raw material type, core type, cortex type, cortex amount, and presence or absence of battering. Raw material types are the same as those used for the other analytic categories. Core types include multidirectional, unidirectional, bidirectional, bipolar, bifacial, hammerstone, and edge-ground cobble. Multidirectional cores possess multiple striking platforms and have negative flake scars that originate from multiple directions. They often are termed expedient or amorphous cores (Parry and Kelly 1987). Unidirectional cores have only one striking platform and all negative flake scars originate from that platform. Bidirectional cores have only two striking platforms and the negative flake scars originate from opposite directions. Bipolar cores are usually relatively small, have crushed ends, and have negative flake scars that originate at opposite ends of the core (Parry 1987; Flenniken 1981). These cores are often called wedges (Young and Harry 1989; Fagan 1989) or Pieces Esquillees (Macdonald 1968). Bifacial cores have negative flake scars that originate from two margins. In this analysis, bifacial cores were distinguished from bifacial tools on the basis of type of flake removal. Pressure flaked bifaces were identified as bifaces (or projectile points) and percussion flaked bifaces were identified as bifacial cores. Hammerstones were included in the core analysis, but are not actually cores. They must exhibit some battering on one or more surfaces. Neither are edge-ground cobbles cores, but they were included in the core analysis because only one was found and the information recorded for cores is also useful for describing this single artifact.

Three types of cortex, or weathering rind, were identified on artifacts: incipient cone cortex, primary geologic cortex, and rounding and smoothing cortex. Incipient cone cortex is indicative of geologic transport of a raw material and may indicate aboriginal procurement of the material from a secondary or tertiary geologic source. Primary geologic cortex is often chalky and unsuitable for flaking and indicates aboriginal procurement from a primary geologic source. Rounding and smoothing cortex indicates some geologic transport of the material and may imply aboriginal procurement from a secondary geologic source.

The amount of cortex on a biface was classified into five subjective quantitative categories: 0 percent, 1 to 24 percent, 24 to 49 percent, 50 to 7 percent, 75 to 99 percent, and 100 percent cortex on the core. Only hammerstones and edge-ground cobbles retain 100 percent cortex on their surfaces. Battering was recorded as a simple bivariate, yes/no variable. It may be useful in determining whether cores were also used as hammerstones, choppers, or other heavy use items.

Attributes recorded for the debitage include raw material, completeness, size, color, heat treatment, cortex type, cortex amount, platform type, technology, flake type, polish presence and location, and microflaking presence and location. Raw material, heat treatment, cortex type, and cortex amount were recorded using the same variable classes as for the bifaces and cores. The amount of cortex on a flake was recorded as the proportion of cortex on the dorsal surface of the flake.

The completeness of a flake was classified into five categories: complete, platform bearing proximal flake fragment, non-platform bearing flake fragment, split flake, and shatter or debris. The operational definitions of these categories can be found in Sullivan and Rosen (1985) and Towner (n.d.). The size of the debitage pieces was recorded to the nearest centimeter in any maximum dimension. A template of concentric rings placed 1 cm apart was used to classify the debitage into size categories.

The type of striking platforms identified in the debitage include cortex covered, natural facet, single facet, multiple facet, crushed, and bifacial platforms. The proportions of different types of platforms can be used to measure the technological diversity of an assemblage, the intensity of lithic reduction, and possible the cultural homogeneity of an assemblage (Fagan 1989).

The variable of technology was classified into five categories depending on the attributes of any particular piece of debitage. The five categories include an unknown category, a flake-core technology, a biface technology, a bipolar technology, and a microlith technology. All of the nonplatform bearing flake fragments and most of the shatter were classified in the unknown category. Flakes that retained platforms or other features diagnostic of a particular technology (i.e. biface thinning flakes) were classified accordingly. Flake type is a combination of most of the previous variables and was used to distinguish flake types within the same technology from each other. This classification was used to distinguish separate reduction stages within a single technology (Muto 1971). For example, biface thinning flakes, defined here as whole flakes or proximal flake fragments which retain a bifacial striking platform, usually are cortex-free. However, occasionally small amounts of cortex are present on the dorsal surface of biface thinning flakes. In this analysis, those flakes which contain less than 75 percent cortex on their dorsal surfaces were classified as secondary flakes. Thus, the biface thinning flake with some cortex on its dorsal surface would be classified as a secondary biface thinning flake. Figure 82 shows the hierarchical nature of the flake type classification in relation to the various technologies present in the assemblage.

Two different attributes were used to identify potentially used flakes in the assemblage: edge polish and edge microflaking. Edge polish was recorded as present, absent, or unknown. Edge microflaking was recorded as unifacial or bifacial. The location of edge polish and/or edge microflaking was recorded as lateral edge only, distal edge only, bilateral edges, one lateral and distal edges, and bilateral and distal edges. Edge-modified flakes were identified in the field, often on the basis of invasive retouch or very heavy microflaking along one edge. The other attributes recorded for these items are the same as those recorded for the debitage.

Attributes recorded for the microliths included raw material, length, width, thickness, and weight. Raw material was the same as for the other analytic categories. The linear measurements were recorded to the nearest tenth of a millimeter and the mass was recorded to the nearest one-hundredth of a gram. All of the microliths retain polish on at least one end, but other use-related attributes which require high magnification to identify were not recorded.

RESULTS

Raw Materials

A critical factor in the analysis of any flaked stone assemblage is the identification of the lithic raw materials exploited by the prehistoric flintknappers. At least eleven different raw materials were used by the flintknappers at the Admiralty Site. Table 17 and Figure 83 show the distribution of these raw material types within the flaked stone assemblage.

As can be seen, two material types, chert and chalcedony, comprise 65 percent of the assemblage. Due to the color and texture variability of the chert artifacts, it is probable that several raw material sources are present. The majority of the chert, however, resembles Monterey chert described elsewhere (Arnold 1987). Basalt and quartzite represent substantial portions of the flaked stone assemblage while other materials contribute relatively small proportions to its overall configuration.

Several aspects of the distribution of raw material types within the analytic units warrant additional attention. First, a large majority of the biface tools are made of chert, far exceeding the proportion of chert debitage in the assemblage. Second, basalt and quartzite, two of the more coarse-grained raw materials, comprise a majority of the flakes that exhibit some edge modification. Third, these same two raw materials, basalt and quartzite, are substantially under-represented in the debitage from the flotation sample. Finally, quartz, a raw material that is relatively rare in the flaked stone assemblage, comprises two-thirds of the microlith specimens. Each of these departures from the overall raw material distribution has important behavioral and technological implications that will be discussed later.

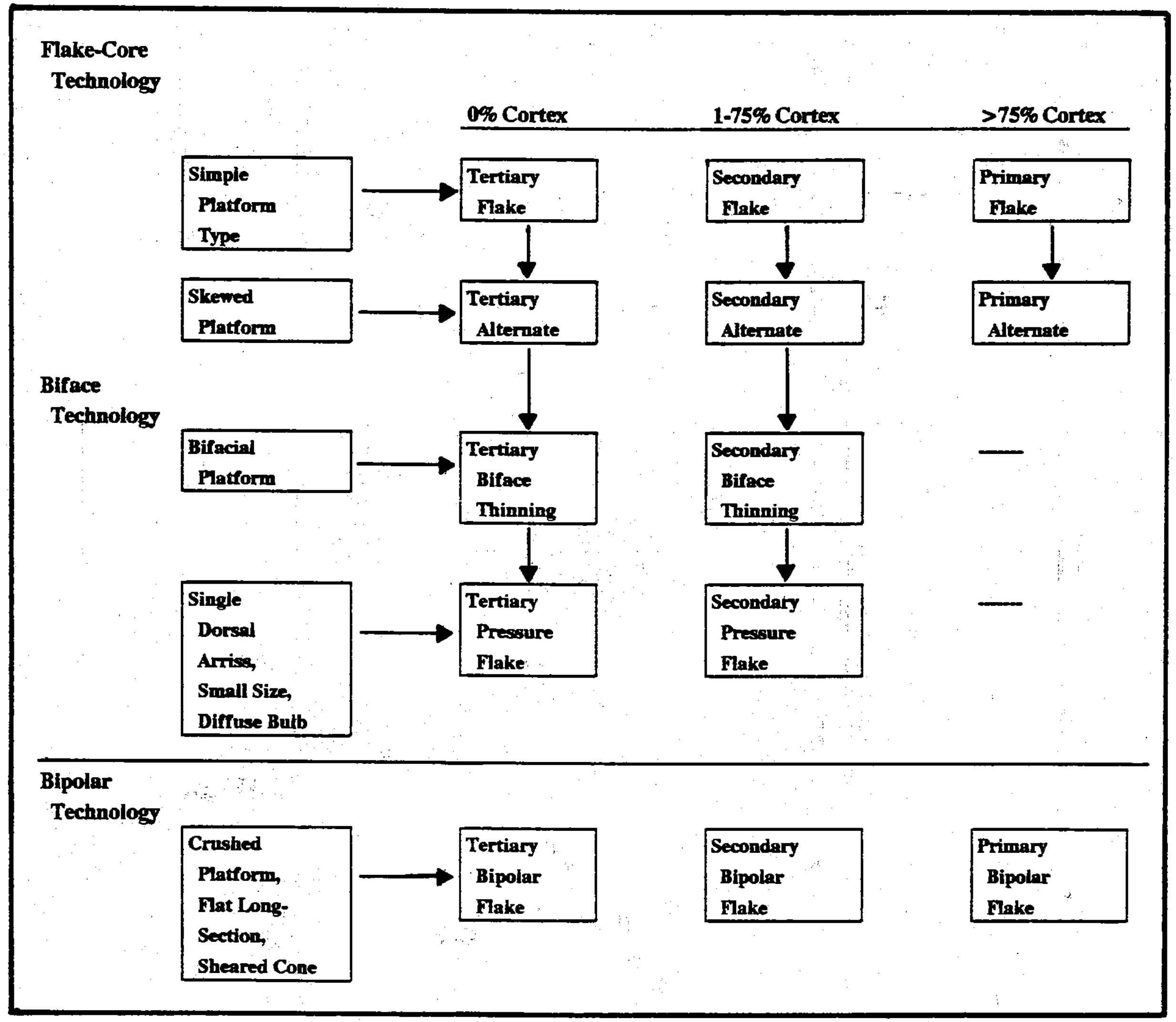


Figure 82. Flake classification system used in the analysis.

Table 17. Lithic Raw Materials in the Flaked Stone Assemblage.

	ANALYTIC UNIT							
Material	DB	BF	EMF	CR	FL	DR	ML	Total
Basalt	1017	1	13	51	19	0	0	1098(18%)
Quartzite	872	0	16	22	14	0	0	924(15%)
Chert	1676	52	2	20	103	4	3	1860(31%)
Chalcedony	1840	8	1	11	168	0	4	2032(34%)
Petrified Wood	17	5	2	0	0	0	0	24(.4%)
Andesite	12	0	1	2	0	0	0	15(.3%)
Obsidian	21	2	3	0	3	0	0	29(.5%)
Quartz	40	0	5	3	2	0	14	64(1%)
Glass	2	0	1	0	0	0	0	3(.05%)
Rhyolite	0	1	0	0	0	0	0	1(.02%)
Fused Shale	0	3	0	0	0	0	0	3(.05%)
Total	5498	72	44	109	309	4	21	6053

KEY: DB = Debitage BF = Bifaces and Projectile Points EMF = Edge Modified Flakes DR = Drills FL = Materials from the Flotation Sample ML = Microliths CR = Cores

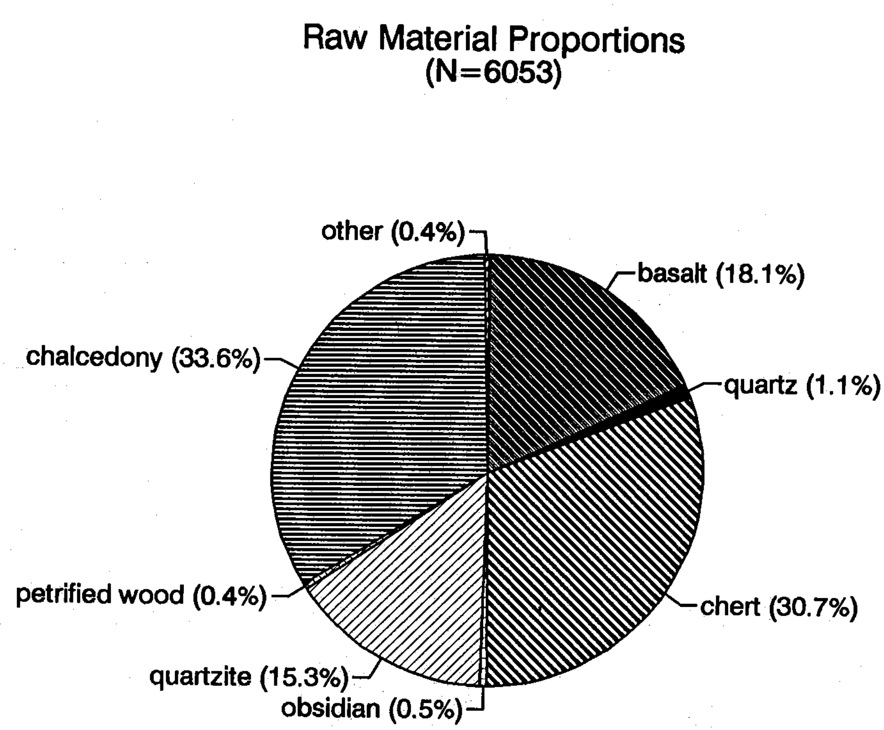


Figure 83. Raw material proportions in the lithic assemblage.

At this point, it is useful to examine the distribution of raw material types recovered from the flotation samples. The majority of this debitage is less than 1 cm in diameter and is not recovered using 1/4-inch mesh screen (Kahlin 1981; Towner and Warburton 1990). Even the use of 1/8-inch mesh, as used at the Admiralty site, may discriminate against some raw material classes. Thus, an analysis of the flotation sample debitage augments the picture of raw material selection gained from the excavated sample. Table 18 compares the frequency and proportion of raw materials in the flotation sample with those recovered during the excavation. Figure 84 shows the proportion of raw materials in the float sample assemblage. The major differences between the flotation and excavated samples are the lower frequencies of basalt and quartzite and much higher proportion of chalcedony in the flotation sample. As will be explained in more detail below, these differences are the result of the different technologies used to exploit different raw materials.

Cortex

Analysis of the type an amount of cortex present in the flaked stone assemblage can help answer questions concerning the geologic nature of a raw material source and the extent of aboriginal procurement systems, either through direct procurement or trade and exchange systems. It must be noted, however, that aboriginal trade networks cannot be substantiated with data from a single site. The distribution of cortex types within the assemblage is shown in Table 19.

Several interesting trends can be seen in the data from Table 19. First, the large amounts of chert and chalcedony debitage which retain no cortex may be indicative of a non-local source for these raw materials. Because these materials are the most common in the assemblage, a non-local source does not seem to be a plausible explanation. This problem is discussed more fully below. The complete lack of cortex on the obsidian, however, probably indicates an exotic source for this raw material. Chemical sourcing studies of artifacts from the site would be necessary to identify specific obsidian sources. Unfortunately, such studies were precluded from this analysis due to time constraints. Further research in the area should include such studies to determine the breadth of prehistoric procurement networks.

The relatively large proportion (39%) of incipient cone cortex in the quartzite debitage is indicative of aboriginal lithic procurement from a nearby tertiary geologic source. Likewise, the relatively large percentage (56%) of basalt debitage that retains rounding and smoothing cortex also is indicative of aboriginal procurement from a close secondary or tertiary geologic deposit. Due to the hardness of basalt, it rarely possesses incipient cone cortex even after geologic transport for considerable distances.

The amount of cortex present on various raw materials is indicative of the relative distance from the geologic source an item has been transported by the aboriginal procurement system. Table 20 shows that the majority of all the lithic materials retain small proportions of cortex.

Chert and chalcedony, the two most common raw materials in the flaked stone assemblage, have relatively large amounts of debitage that are free of cortex. Although the large proportions of cortex-free chert and chalcedony debitage may indicate a nonlocal source for these materials, it is also possible that other factors have conditioned the configuration of the assemblage. The large sample sizes and more complex and intensive lithic reduction technologies used to exploit these materials may also explain the proportions of noncortical debitage. Chert and chalcedony may have been procured from more distant sources than the quartzite and basalt, but it is unlikely they were acquired from truly "exotic" sources (Gould and Saggars 1985). Other raw materials, such as petrified wood, occur in very small proportions. Although they may be local in origin, their contribution to the overall assemblage is negligible.

Table 18. Excavated and Flotation Sample Raw Materials.

	Flotation (N=309)		Excavated (N=5498)	
	No.	%	No.	%
Basalt	19	6.1	1017	18.5
Quartzite	14	4.5	872	15.9
Chert	103	33.3	1676	30.5
Chalcedony	168	54.4	1840	33.5
Petrified Wood	0	--	12	.2
Andesite	0	--	17	.3
Obsidian	3	1.0	21	.4
Quartz	2	.6	40	.7
Glass	0	--	3	.05

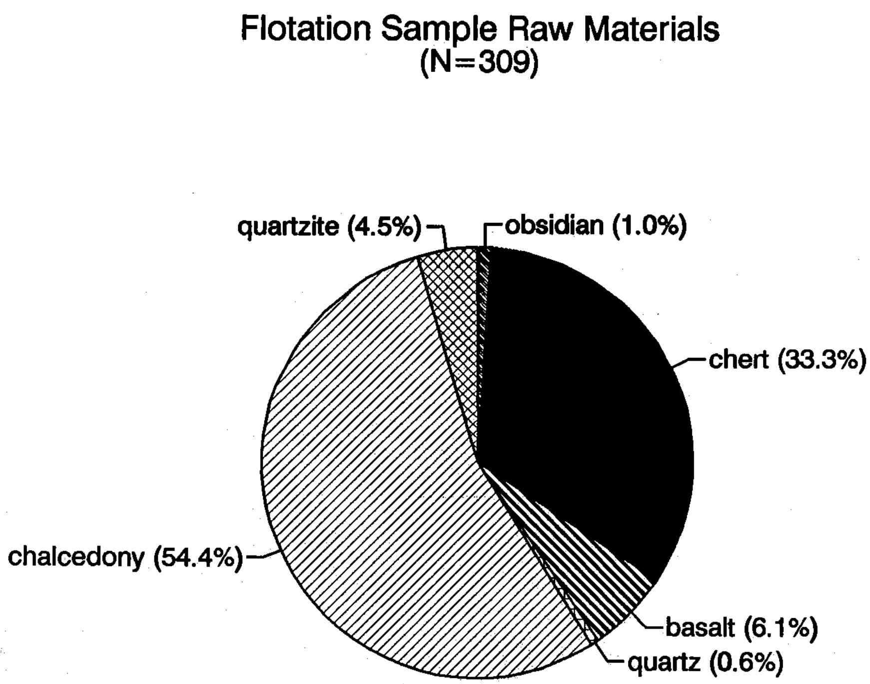


Figure 84. Raw material proportions in the flotation sample assemblage.

Table 19. Cortex Type per Raw Material Type (Does not include flotation sample debitage).

Raw Material	Cortex Type			
	None	Incipient Cone	Geologic	Smoothing
Basalt	437 (43%)	8 (.8%)	7 (.7%)	565 (56%)
Quartzite	495 (56%)	334 (39%)	13 (1.5%)	30 (3.5%)
Chert	1359 (81%)	225 (13%)	90 (5%)	6 (.4%)
Chalcedony	1460 (79%)	321 (17%)	61 (3%)	0
Petrified Wood	10 (59%)	4 (24%)	3 (18%)	0
Andesite	9 (75%)	2 (17%)	0	1 (8%)
Obsidian	21 (100%)	0	0	0
Quartz	30 (75%)	10 (25%)	0	0
Glass	3 (100%)	0	0	0
Total	3824 (69.5%)	904 (16.4%)	174 (3.2%)	602 (10.9%)

Table 20. Cortex Amount per Raw Material (Does not include flotation sample debitage).

Raw Material	Cortex Amount					
	None	1-24%	25-49%	50-74%	74-99%	100%
Basalt	437(43%)	257(25%)	125(12%)	54(5%)	111(11%)	33(3%)
Quartzite	495(56%)	219(25%)	53(6%)	47(5%)	36(4%)	22(3%)
Chert	1359(81%)	146(9%)	50(3%)	58(3%)	31(2%)	36(2%)
Chalcedony	1460(79%)	180(10%)	61(3%)	59(3%)	40(2%)	32(2%)
Petrified Wood	10(59%)	3(18%)	1(6%)	1(6%)	0	2(12%)
Andesite	9(75%)	0	1(8%)	2(17%)	0	0
Obsidian	21(100%)	0	0	0	0	0
Quartz	30(75%)	4(10%)	0	3(8%)	1(3%)	2(5%)
Glass	3(100%)	0	0	0	0	0
Total	3824(69.5%)	809(14.7%)	291(5.3%)	224(4.1%)	219(4%)	127(2%)

Flake Size

Flake size in another way of estimating the distance of the site from a procurement location. Simply put, if debitage is truly "waste material," it should not be transported over long distances by pedestrian hunter-gatherers. Table 21 shows the distribution of various size classes for the raw material types in the assemblage. These data support the inferences drawn from the data on cortex proportions presented above. The local origin of both the basalt and quartzite seem to be substantiated. Flakes larger than 2 cm comprise 80.6 percent of the basalt debitage and 72.1 percent of the quartzite debitage. In contrast, 91.3 percent of the chalcedony debitage and 82.3 percent of the chert debitage is smaller than 2 cm. Again, this may indicate a more distant source for these materials or it may be due to the technologies used to exploit the chert and chalcedony. Other aspects of these data are informative regarding some of the less frequent raw material types. The obsidian debitage (n=21) is probably from a truly exotic source since all of this material is less than 2 cm long. The petrified wood, although constituting a very small proportion of the assemblage, is probably a local source since the majority (59.9%) of the flakes are larger than 2 cm and many (42%) retain some cortex. Although the petrified wood source may be close to the site, it apparently was not heavily exploited due to the poor quality of this material. It appears as if quartz, on the other hand, is nonlocal in origin. Most of the quartz flakes (87.5%) are less than 2-cm long and the majority (75%) are free of cortex.

The size class differences between the durable materials (basalt and quartzite) and the more brittle materials (chert and chalcedony) may indicate differences in the technologies used to exploit them. Figure 85 presents the cumulative proportions for each of these raw materials. It is apparent that these flakes come from two different populations. A series of Komolgorov-Smirnov tests (Blalock 1972) were conducted matching each raw material against the other three (Table 22). There are statistically significant differences between all of the possible combinations due to the large sample sizes (n=5,405) used in the test. The largest differences, however, are between the brittle and durable materials.

Table 21. Raw Material Size Classes from the Admiralty Site (Does not include Flotation Sample).

	Maximum Size (cm)									
	1	2	3	4	5	6	7	8	9	10
Basalt	27	170	230	266	166	93	46	13	4	2
Quartzite	126	205	210	145	97	58	23	7	1	0
Chert	798	581	223	63	8	2	1	0	0	0
Chalcedony	1129	550	132	28	0	1	0	0	0	0
Petrified Wood	3	4	4	4	1	0	1	0	0	0
Andesite	1	4	1	2	2	0	1	0	1	0
Obsidian	20	1	0	0	0	0	0	0	0	0
Quartz	26	9	3	1	0	1	0	0	0	0
Glass	3	0	0	0	0	0	0	0	0	0
Total	2133	1524	803	509	274	155	72	20	6	2

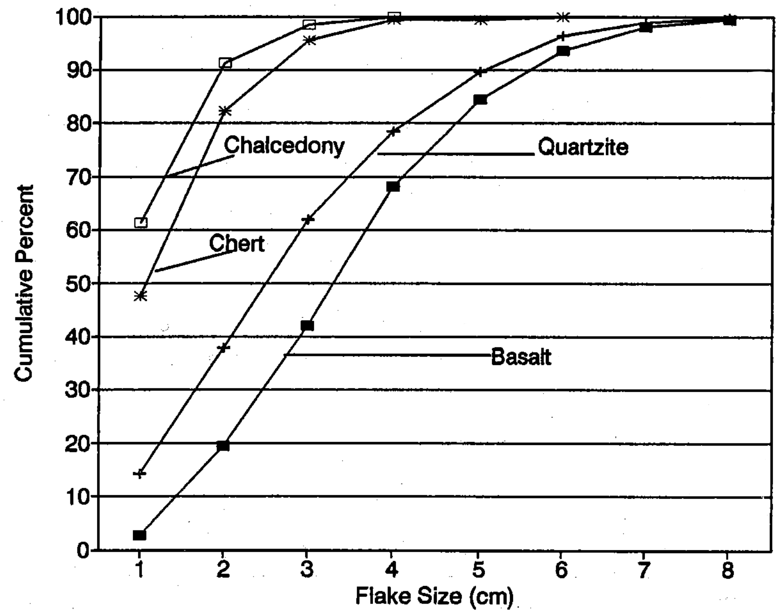


Figure 85. Cumulative percentages of flake sizes for selected raw materials.

Table 22. Komolgorov-Smirnoff Test of Flake Size.

Null Hypothesis: No Difference in Flake Size.

Material	Size	Proportion	Sup.	.05 level	Accept/Reject Hypothesis
Basalt	3 cm	42.0	.200	.063	Reject
Quartzite		62.0			
Basalt	2 cm	19.4	.629	.054	Reject
Chert		82.3			
Basalt	2 cm	19.4	.719	.053	Reject
Chalcedony		91.3			
Quartzite	2 cm	37.9	.444	.057	Reject
Chert		82.3			
Quartzite	2 cm	37.9	.534	.053	Reject
Chalcedony		91.3			
Chert	1 cm	37.9	.138	.046	Reject
Chalcedony		61.4			
Coarse	2 cm	28.7	.581	.002	Reject
Brittle		86.8			

Statistically, these raw materials represent different flake populations; the interpretation offered here is that they were procured from different sources and were exploited using different technologies.

The preceding discussion of lithic raw materials present in the Admiralty site assemblage is an important prerequisite for examining the lithic technologies present on the site. Basalt and quartzite were exploited in moderate quantities from nearby secondary or tertiary geologic sources. The sources of the chert and chalcedony, the two most prevalent raw materials in the assemblage, are still somewhat problematic and will be discussed in more detail later. Obsidian is present in very small quantities and was derived from an exotic location, either through trade or direct procurement. Likewise, quartz appears to have its source outside the local area. Other raw materials are present in small amounts and probably were procured from local secondary geologic deposits.

Special mention should be made concerning three flakes of yellow glass found at the site. All of these flakes are less than 1-cm long and none show any weathered exterior. One of the flakes is a fragment, but the other two retain single facet striking platforms. One glass flake exhibits microflaking along one lateral flake edge. All three flakes were found in buried contexts. These flakes may have been produced fortuitously by some modern process. If so, they represent modern intrusive artifacts and may indicate serious site disturbances. It is possible, however, that these small glass flakes were produced by aboriginal flint workers who found Japanese glass fishing floats as flotsam in this coastal environment. If such artifacts are found during future projects, chemical analyses may be helpful in determining the age and origin of the glass.

TECHNOLOGIES

Technology is the sum and organization of the techniques used to manufacture a specific item (Crabtree 1972:94). Identifying the technologies in the Admiralty site assemblage and the raw materials used to execute those technologies is a critical part of this analysis. This aspect of the analysis can provide information about how the prehistoric occupants of the site exploited their lithic raw materials and may provide insight into why certain resources were exploited in particular ways.

Tools and debitage from the Admiralty site assemblage indicate the presence of at least four different technological systems: a flake-core technology, a biface technology, a bipolar technology, and a microlith technology. Most technologies include both tools and debitage, but the microlith technology is represented solely by tools. Because debitage is the most prevalent artifact class in the assemblage, the identification of technologies was completed using mostly debitage data.

The raw materials present in the debitage differ from those present in the overall assemblage (Figure 86). Two raw materials, fused shale and rhyolite, are present as tools but not as debitage. Other materials, notably obsidian, glass, and andesite, are represented primarily by debitage. While these differences may have important behavioral implications, it is the configuration of the debitage assemblage that provides most of the information concerning the technological strategies used by the inhabitants of the site.

Two analytical methods were used to examine the technologies present in the debitage assemblage. The first is the "flake status" approach adapted from Sullivan and Rosen (1985). In this approach, debitage is classified into five categories based on the morphological attributes of an individual piece of debitage. The categories used in this analysis include complete flake, broken flake with a platform, flake fragment without a platform, longitudinally split flake, and nondiagnostic shatter. For operational definitions of these categories see Sullivan and Rosen (1985) and Towner (n.d.). Table 23 presents the results of this classification system on a raw material specific basis.

Debitage Raw Materials
(N=4065)

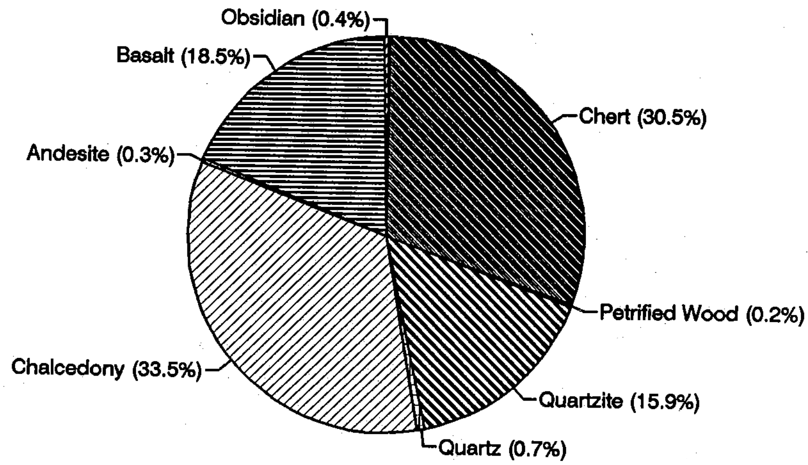


Figure 86. Debitage raw material proportions.

Table 23. Flake Status and Raw Materials.

	Complete	Broken	Fragment	Split	Shatter
Basalt	455(45%)	102(10%)	266(26%)	141(14%)	53(5%)
Quartzite	239(27.4%)	112(13%)	294(34%)	150(17%)	77(9%)
Chert	514(31%)	215(13%)	590(35%)	101(6%)	260(15%)
Chalcedony	696(38%)	252(14%)	616(33%)	96(5%)	182(10%)
Petrified Wood	5(29%)	3(18%)	4(24%)	4(24%)	1(6%)
Andesite	4(33%)	1(8%)	4(33%)	2(17%)	1(8%)
Obsidian	9(43%)	4(19%)	7(33%)	0	1(5%)
Quartz	8(20%)	0	13(33%)	3(8%)	16(40%)
Glass	2(67%)	0	1(33%)	0	0
Total	1932(35%)	689(13%)	1795(33%)	497(9%)	591(11%)

Several trends are apparent in the data from Table 23. Complete flakes are present in all raw material types, but do not appear to be more frequent in any particular pattern. Similar, relatively uniform, distributions are apparent in the broken flake and flake fragment categories, although basalt and quartzite exhibit slightly lower proportions of flake fragments than chert and chalcedony. The two remaining debitage categories, split flakes and shatter, show more definitive patterns. Basalt quartzite, petrified wood, and andesite show much higher percentages of split flakes than do the less durable raw materials, chert, chalcedony, and obsidian.

Conversely, the more brittle raw materials, chert and chalcedony, show higher relative frequencies of shatter than do basalt and quartzite. Obsidian does not fit this pattern, but this may be due to the nature of the obsidian artifacts brought onto the site and the stage of reduction of these artifacts. Specifically, the obsidian flakes are either pressure flakes (n=5), small biface thinning flakes (n=5), or notching flakes (n=2). These flake types are all produced relatively late in the manufacturing process under more controlled applications of force. Thus, less shatter would be expected during these flaking processes.

The results of the flake status classifications are at variance with those used by Sullivan and Rosen (1985) to develop the model. In this assemblage, the flake tool reduction technology used to exploit the basalt and quartzite produced less shatter and a comparable number of whole flakes. The biface tool technology, used primarily to exploit the chert and chalcedony, produced fewer broken flakes (broken + split flakes) and more nondiagnostic shatter. The most parsimonious explanation for this trend is that the hardness and durability of the raw materials is structuring the variability of these attributes. Simply put, the more brittle materials, chert and chalcedony, have a tendency to shatter more often during any type of lithic reduction.

Concurrent with the flake status approach to the debitage, a technological classification system was employed. In this system, those flakes which retained striking platforms (whole flakes, broken flakes, and split flakes) were classified into four technological categories: a biface technology, a flake tool technology, a bipolar technology, and a microlith technology. The determination of a specific technology for an individual flake was based primarily on attributes of the striking platforms and dorsal surface morphology (Gilreath 1983; Raymond 1984; Towner 1986; Walker 1980). The distribution of flakes in each technological category for each raw material is presented in Table 24.

Several important tendencies are shown in Table 24. First, nearly all of the basalt and quartzite flakes with platforms can be assigned to a flake tool reduction technology. These flakes are predominately decortication and non-cortical flakes with cortex covered or single facet striking platforms. Very few (n=10) of these flakes are biface thinning flakes. They resemble the "potato flakes" described by Van Horn (1985) and are the result of a simple direct freehand percussion technique applied to small, rounded cobbles of locally available, durable materials.

The chert and chalcedony, on the other hand, were exploited using a wider range of technologies. The most frequent technology used to exploit these brittle materials was a biface technology. I suspect that the proportion of biface technology flakes should be higher; this is due to the uncertainty of classifying flakes with single and simple multiple-facet platforms. In this analysis, a bifacial platforms and multiple dorsal flake scars were prerequisites for a flake to be classified in the biface technology category. Since the early stages of biface reduction may resemble flake tool reduction technologies (Gilreath 1983; Callahan 1979), many of these flakes may indeed represent a biface technology.

It is also important to note the presence of flakes produced by bipolar reduction in the chert and chalcedony assemblages. The use of a bipolar technology to exploit the chalcedony and, to a lesser extent, the chert, is probably responsible for the higher proportion of these raw materials in the flotation sample since its use tends to create smaller flakes. Bipolar flakes are produced with the use of a hammerstone and an anvil (see Flenniken 1981; Parry 1987), and are usually linear and flat in

Table 24. Proportion and Frequency of Known Technologies per Raw material.

Raw Material	Flake Tool #	Flake Tool %	Biface #	Biface %	Bipolar #	Bipolar %	Microlith #	Microlith %
Basalt	695	99.7	2	.3	0		0	
Quartzite	438	97.6	8	1.8	3	.6	0	
Chert	261	42.2	282	45.6	75	12.1	0	
Chalcedony	196	27.0	372	51.3	151	21.4	2	0.3
Petrified Wood	7	70.0	2	20.0	1	10.0	0	
Andesite	7	100.0	0		0		0	
Obsidian	0		12	100.0	0		0	
Quartz	4	50.0	0		4	50.0	0	
Total	1608		678		235		2	

longitudinal cross-section. These flakes may have been used at the Admiralty site as substitutes for the more formally produced microliths produced at other sites in the area. Such differences in response to raw material size, shape, and quality have been noted elsewhere (Flenniken 1981) and may represent local adaptations in the Ballona Lagoon.

The less frequent raw materials in the assemblage follow these same trends. The durable materials, andesite and petrified wood, were reduced using a flake tool technology and the brittle glass, obsidian, was exploited using exclusively a biface technology. Pure quartz was exploited using both a flake tool and a bipolar technology.

Cores

There are 106 cores in the Admiralty site lithic assemblage. A core is defined as a piece of lithic material that has had flakes removed from it. It is a nucleus that exhibits negative flake scars from previous flake removals (Crabtree 1972:46). There is, however, one exception to this definition as used in this analysis. Those items which have been pressure flaked (i.e. biface tools and projectile points) are considered separately.

Four core types were identified in the site assemblage: unidirectional, multidirectional, bifacial, and bipolar. Unidirectional cores (Figure 87) exhibit flake removals from a single direction and, usually, a single striking platform. Although unidirectional cores resemble, and are sometimes confused with, blade cores, they show neither the regularity of flake removal nor the intensive platform preparation and rejuvenation of true blade cores (Crabtree 1968). Multidirectional cores (Figure 88) exhibit negative flake scars from multiple directions and multiple striking platforms. These cores are often called amorphous or expedient cores (Parry and Kelly 1987). Both unidirectional and multidirectional cores are part of an expedient flake core reduction technology identified in the Admiralty site assemblage.

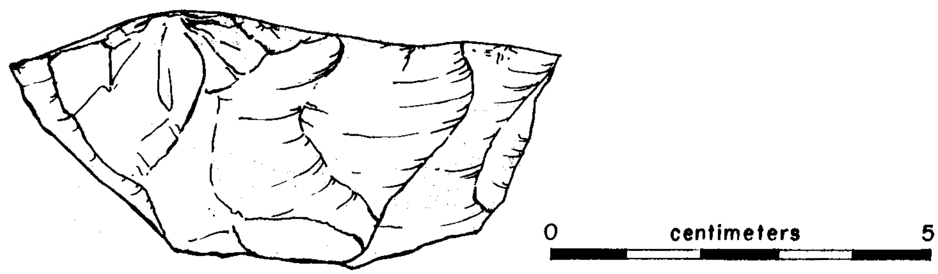


Figure 87. Unidirectional core from the Admiralty site.

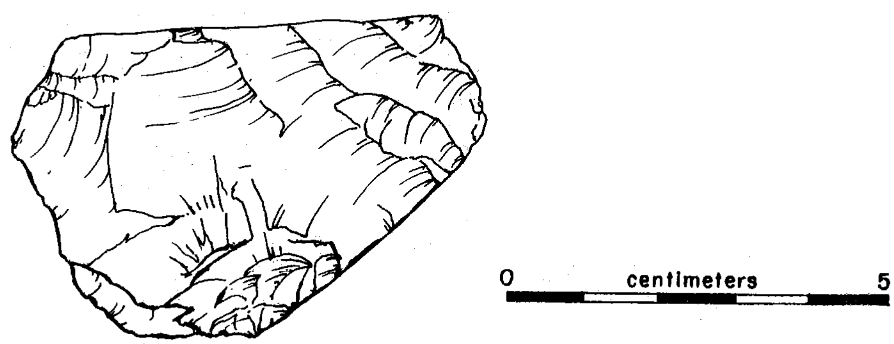


Figure 88. Multidirectional core from the Admiralty site.

Bifacial cores (Figure 89) can be identified by flake removals from opposite margins and opposite faces (Crabtree 1972; Callahan 1979). As previously mentioned, those bifacial items that have been percussion flaked only are considered bifacial cores in this analysis. Bifacial items that have been pressure flaked are considered separately.

Bipolar cores (Figure 90) can be identified by flake removals from opposite directions and extreme crushing on the striking platforms (Flenniken 1981; Parry 1987). Bipolar cores have been termed Piece Esquilles (Macdonald 1968) and identified as wedges (Young and Harry 1989; Fagan 1989) although their function has not been demonstrated. Quite the contrary, recent studies (Flenniken 1981; Parry 1987) indicate that these items function quite poorly when used as wedges. It appears as if these items are best interpreted as cores.

The use of the bipolar technique does, however, produce flakes which have straight margins that are more efficient cutting edges than the curved edges produced by biface reduction or other techniques (Flenniken 1981). More important in terms of the Admiralty site assemblage, the use of the bipolar technique also produces copious amounts of linear shatter. When selected from the bipolar debitage, these pieces of linear shatter may have functioned as expedient awls, drills, or other tools requiring a pointed end.

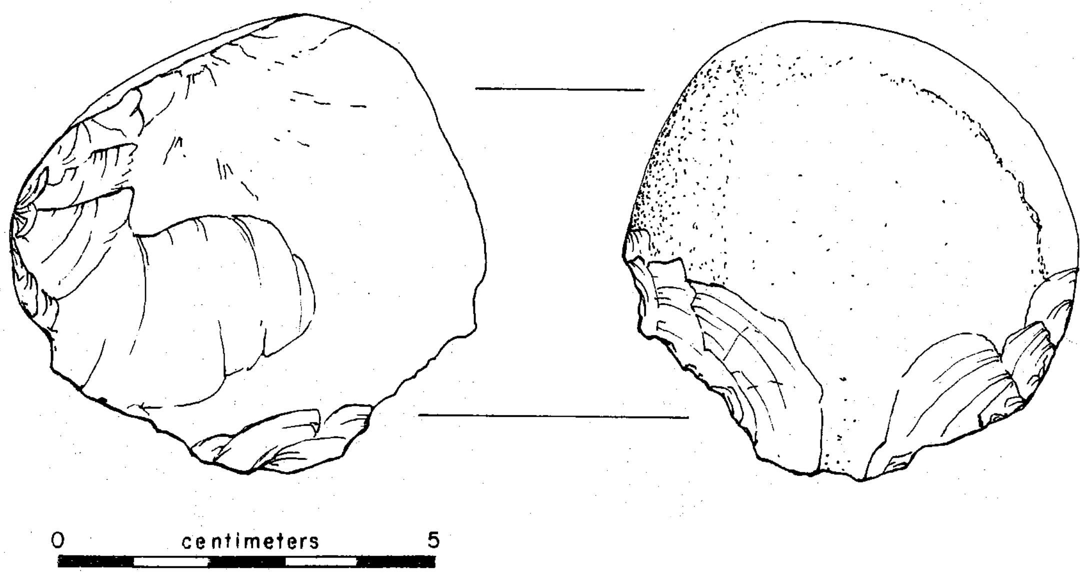


Figure 89. Bifacial core from the Admiralty site.

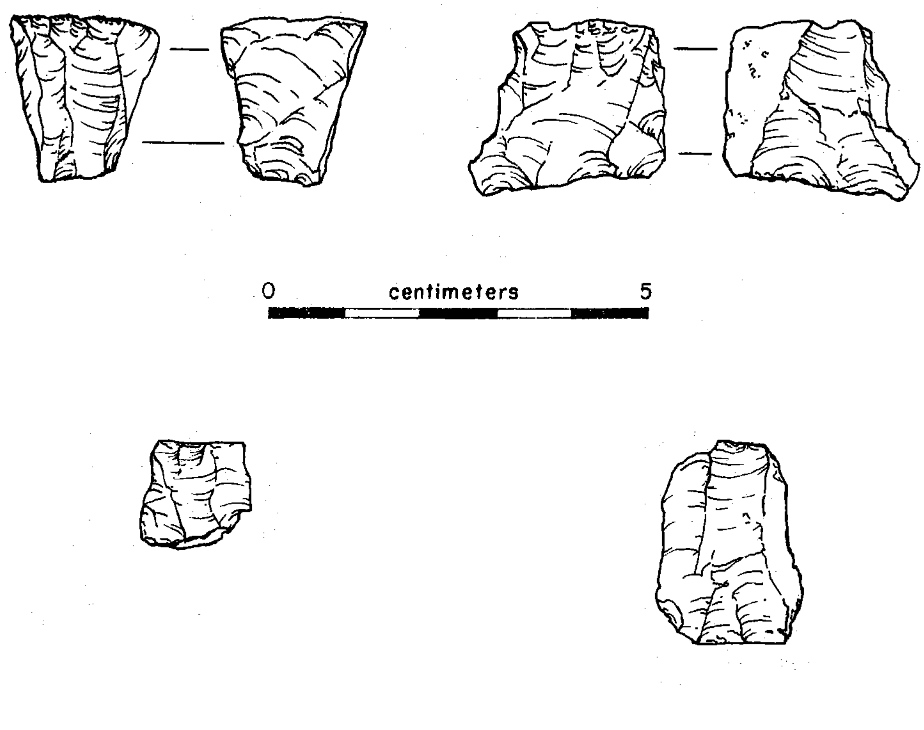


Figure 90. Bipolar cores from the Admiralty site.

The distribution of each core type within each raw material is presented in Table 25 and Figure 91. The overall distribution of raw materials in the core assemblage is worth noting. Basalt (46.2%) is the dominant raw material with relatively even contributions from quartzite (19.2%), chert (18.3%), and chalcedony (10.6%). Other raw materials are present, but only in minor proportions. It is important to note the absence of obsidian cores, which indicates that obsidian was imported onto the site in the form of finished or almost finished tools. The raw material distribution in the core assemblage is different than the debitage distribution where chert and chalcedony dominate the assemblage and basalt and quartzite are secondary components. The significance of this difference will be discussed in more detail later.

Technologically, the basalt and quartzite cores are predominately multidirectional or unidirectional. Again, this supports the interpretation that these materials were local in origin and exploited using an expedient flake core technology. The chalcedony and quartz cores, on the other hand, are almost exclusively bipolar. The chert cores are a mix of multidirectional, unidirectional, and bipolar cores. These data support the inferences drawn from the debitage assemblage concerning the use of the bipolar technique to exploit the chalcedony and, to a minor extent, the chert.

The most striking technological difference between the core and debitage assemblages is the paucity of bifacial cores. Bifacial debitage comprises a substantial proportion of the chert and chalcedony debitage, yet only two bifacial cores were recovered during the excavation. The definition of a core versus a bifacial tool provided above make provide a partial explanation of this discrepancy, but there may also be a more important behavioral explanation as well.

It appears as if nearly finished bifaces of chert and chalcedony were imported onto the site and made into finished tools. Several lines of evidence support this interpretation. First, despite its abundance, the chert and chalcedony debitage is uniformly small (see Table 21) and relatively free of cortex (see Table 20). The technological flake types identified in the chert and chalcedony debitage are indicative of the later stages of biface production. Cortex-free biface thinning flakes and pressure flakes comprise substantial portions of the chert and chalcedony debitage. Finally, a large majority of the pressure flaked bifaces and projectile points, are made of these raw materials. All of these factors, combined with the lack of bifacial cores in the assemblage, indicate that chert and, to a lesser extent chalcedony, were imported onto the site in an advanced stage of biface reduction and were made into finished tools on the site.

Table 25. Raw Materials in the Core Assemblage

		M-D		U-D		Biface		Bipolar	
	N	No.	%	No.	%	No.	%	No.	%
Basalt	48	17	35.4	30	62.5	1	2.1	0	-
Quartzite	20	10	50.0	9	45.0	1	5.0	0	-
Chert	19	6	31.5	1	5.3	0	-	12	63.1
Chalcedony	12	1	8.3	0	-	0	-	11	91.7
Quartz	4	0	-	0	-	0	-	4	100.0
Andesite	2	1	50.0	0	-	0	-	1	50.0
Rhyolite	1	1	100.0	0	-	0	-	0	-
Total	106	36	33.9	40	37.7	2	1.7	28	26.4

Core Raw Materials
(N=106)

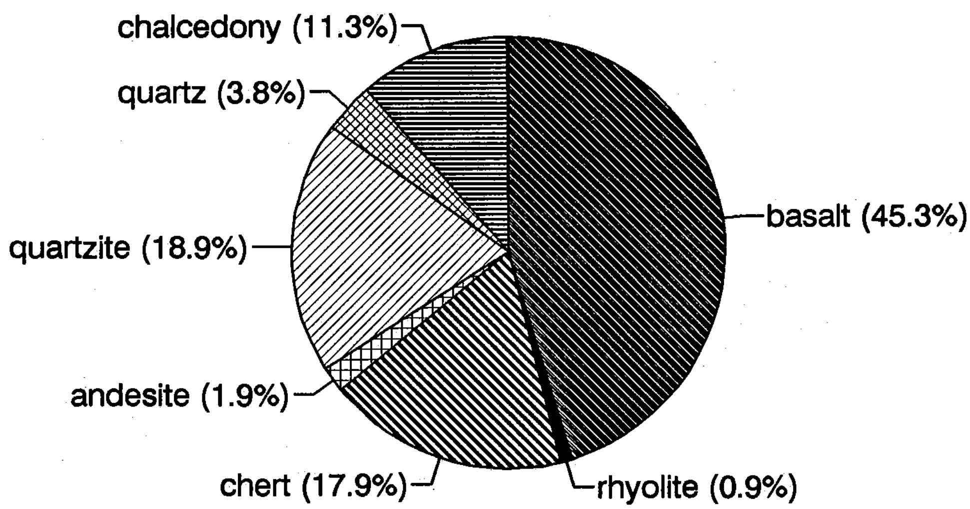


Figure 91. Proportion of raw material types in the core assemblage.

Another way to document the differential exploitation of raw materials is to examine the weight of the cores. As Table 26 shows, the basalt and quartzite cores are substantially larger than the chert and chalcedony cores. This difference may indicate differences in raw material size, but may also be a function of the technologies used to exploit a particular raw material and/or the intensity of that reduction.

Table 26. Average Core Weight per Raw Material (in grams).

	Total		M-D		U-D		Bifacial		Bipolar	
	No.	Mean	No.	Mean	No.	Mean	No.	Mean	No.	Mean
Basalt	48	136.2	17	156.5	30	128.3	1	--	0	--
Quartzite	20	105.4	10	109.1	9	108.0	1	--	0	--
Chert	19	17.6	6	33.3	1	--	0	--	12	7.9
Chalcedony	11	6.2	1	--	0	--	0	--	11	4.5
Quartz	4	8.9	0	--	0	--	0	--	4	8.9
Andesite	2	104.8	1	204.5	0	--	0	--	1	5.1
Rhyolite	1	--	1	--	0	--	0	--	0	--

The difference between the average size of the basalt (x=136.2 g) and the quartzite (x=105.4 g) cores is interpreted as a function of the size of the naturally occurring cobbles. Simply put, the basalt cobbles were probably larger than the quartzite cobbles. The difference between the average size of the chert (x=17.6 g) and the chalcedony (6.2 g) cores does not appear to be a function of raw material size. Rather, the type of lithic reduction may be the controlling factor. The larger number of bipolar cores made of chalcedony is probably responsible for the smaller average core weight. The large difference between the average core weight of the durable versus brittle materials is indicative of both the local nature of the durable materials and the expedient nature of the flake core reduction system. The predominately bipolar reduction of the chalcedony, chert, and quartz cores produced smaller cores and may indicate a conservative, intensive approach to the exploitation of these raw materials.

The data presented in this section compliment those derived from the analysis of the debitage. The proportion of cores for each raw material (see Table 23) confirms the local nature of the basalt. The core data do not, however, strongly support the interpretation of a local source for the quartzite. These data do support the interpretation that 1) a flake core technology was used to exploit the basalt and quartzite, 2) a flake core and bipolar technology was used to exploit the chert, and 3) a bipolar technology was used to exploit the chalcedony. There is no evidence, however, of a bifacial technology in the core assemblage. This lack of bifacial cores demonstrates the necessity of using a technological analysis of debitage to compliment other types of analyses.

Edge-Damaged Flakes

There are 44 edge-damaged flakes in the assemblage, six of which are shown in Figure 92. These flakes exhibit microflaking and/or polish on one or more margins, but rarely show intentional invasive retouch. Because these flakes were identified only by the naked eye, no functional interpretations are offered for them. In order to make such functional inferences, examination of the flake edges under either low-power (Odell and Odell-Verekeen 1980) or high-power (Keeley 1980) microscopes would have been necessary. Because such damage must be extensive to be visible to the naked eye, this should be considered a minimum number of edge-damaged flakes.

The distribution of edge-damaged flakes in terms of lithic raw materials and technologies is informative. Table 27 and Figure 93 show the frequency and proportions of edge-damaged flakes for each raw material. The largest proportion of these flakes is made of basalt and quartzite. This distribution supports the interpretation that these raw materials were exploited to produce flakes for use in an unmodified state. The proportion of edge-damaged flakes made of chert indicates that a similar flake-core technology was used to exploit some, but not all, of this raw material. Although these figures are based on somewhat subjective criteria and may be subject to considerable variation (Bamforth et al. 1990), I feel that they do represent the overall patterns in the Admiralty sites data. This is especially true because the most durable materials, basalt and quartzite, exhibit the highest frequency of edge-damage, exactly the opposite of what one would expect in natural formation processes were responsible for the damage.

The distribution of edge-damaged flakes within various technologies is presented in Table 28. Once again, these data support the interpretation that a simple flake-core technology was used to produce usable flakes. It is significant that no biface thinning flakes exhibit edge-damage. This indicates that bifaces were not used as flake cores at the Admiralty site, but were imported onto the site and pressure flaked into finished tools.

It is important to note the presence of bipolar flakes among those that exhibit edge damage. Although bipolar flakes comprise only 4.4 percent of the identifiable technologies, they comprise 9.1 percent of the edge damaged flakes. Although this difference is not statistically significant, it does

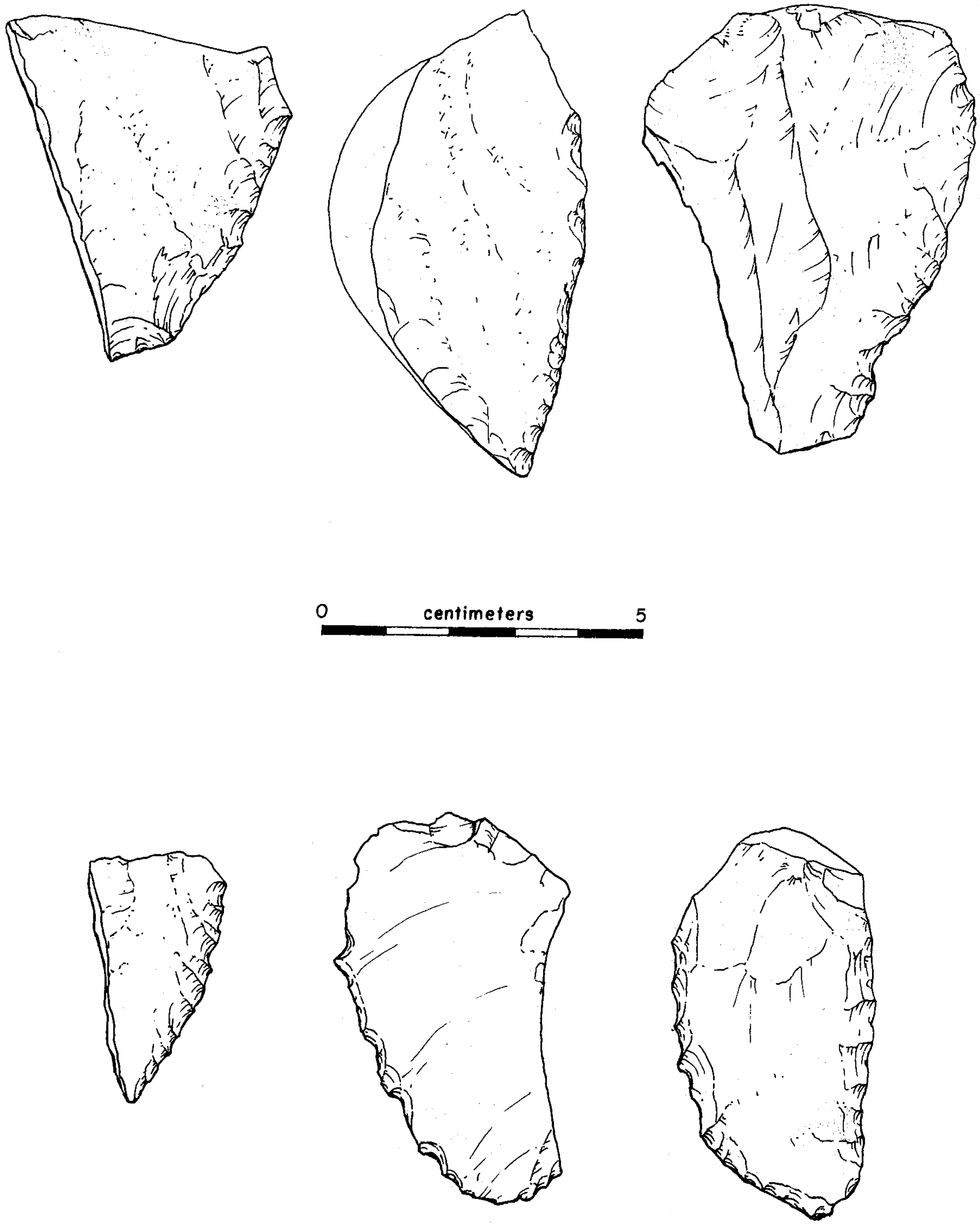


Figure 92. Examples of edge-damaged flakes from the Admiralty site.

Table 27. Edge-Damaged Flakes per Raw Material (n=44).

	Number	Percent
Basalt	13	29.5
Quartzite	16	36.4
Chert	8	18.2
Chalcedony	3	6.8
Andesite	2	4.5
Petrified Wood	1	2.3
Obsidian	1	2.3

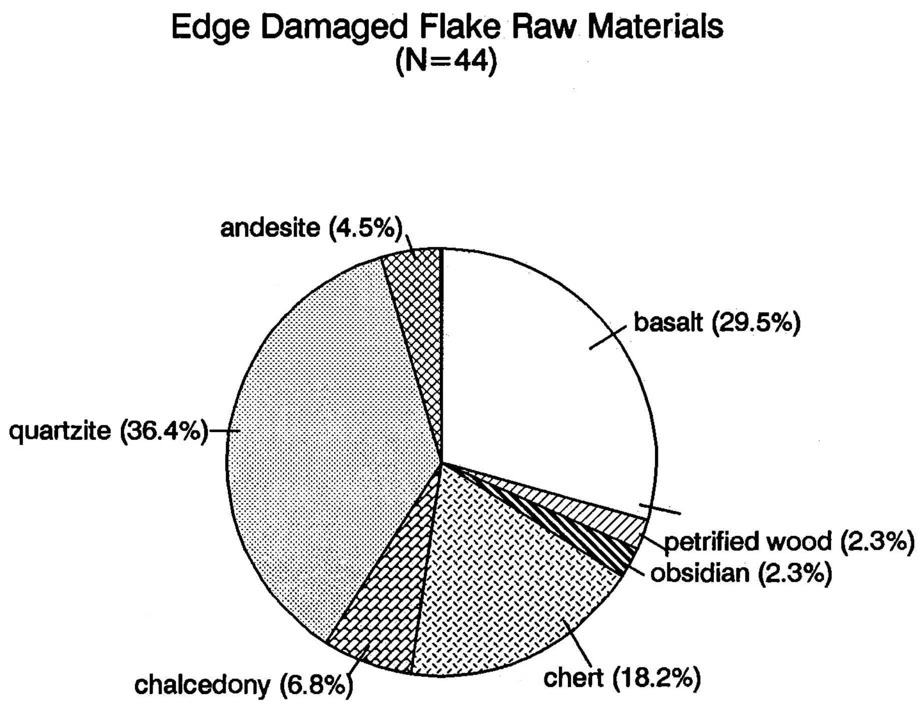


Figure 93. Proportion of raw material types in the edge-damaged flake assemblage.

Table 28. Edge-Damaged Flakes per Technology (n=44).

Technology							
Unknown		Flake-Core		Biface		Bipolar	
#	%	#	%	#	%	#	%
5	11.4	35	79.5	0	-	4	9.1

indicate that the bipolar technique was being used to produce usable flakes in small numbers. Furthermore, the location of the edge modification on the bipolar flakes is significant. All four of these bipolar flakes show heavily polished distal ends. The flakes are pieces of linear shatter and may have been used as awls, drills, or small punches. They may have been used as substitutes for the more formally produced microliths used at other sites in the area (Arnold 1987).

Microliths

There are 21 microliths in the Admiralty site assemblage, eighteen of which are shown in Figure 94. These artifacts are identified by single-facet platforms, a greater length than width, and a least one dorsal arriss parallel to the long axis of the artifact. They are small, linear artifacts that have been systematically produced (as opposed to the linear bipolar shatter) and which exhibit polish on their distal ends. The microliths are usually triangular or trapezoidal in cross section. For additional information concerning microlith production in the Southern California area see Arnold (1985, 1987).

There are two very important aspects of the CA-LAn-47 microlith assemblage. First, no microlith cores were found in the assemblage. Given the small proportion of the site that has been excavated, it is possible that the lack of microlith cores is simply a result of small sample size. The presence of four other core types in the assemblage, however, indicates that sample size may not be the most plausible explanation.

The second significant aspect of the microlith assemblage is the distribution of raw materials in the microliths (Figure 95). Of the 21 microliths in the assemblage, 14 (67%) are made of quartz. Although quartz is present in other analytic categories, its contribution to the overall assemblage composition is negligible (1%). There is certainly a significant difference between the proportion of quartz in the flaked stone assemblage and the proportion of quartz in the microlith assemblage.

A behavioral explanation may account for both the lack of microlith cores and the preponderance of quartz in the microlith assemblage; I suggest that the quartz microliths were imported onto the site as *finished tools*. They were produced at another location where the exhausted cores were discarded. The microliths themselves, however, were curated and transported to the Admiralty site for future use. Although no evidence of shell bead production has been documented at the site, the microliths may have been used for this or other similar functions. These microliths were discarded on the site when no longer functional. When replacements were needed, they were produced using a bipolar technology, probably due to the physical constraints of the available raw materials. The above hypotheses should be tested through additional research at the Admiralty site and other locations in the Ballona area.

Drills

Four drills were identified in the Admiralty site assemblage (Figure 96). These artifacts are all made of chert, have single or multiple facet platforms, are triangular in cross-sections, have converging distal ends, and show invasive retouch and polish on their distal ends. Both microflaking and polish striations indicate their use in a back-and-forth "drilling" motion.

Although the polish on their distal ends is similar, it is unlikely that the drills and microliths performed the same functions. This interpretation is based upon a comparison of the metric attributes of the two artifact classes (Table 29). It is apparent from these data that the two artifact classes represent different populations. The drills are larger in every measured category, often by a factor of two or more. While comparing averages is sometimes deceptive, it appears justified in this instance.

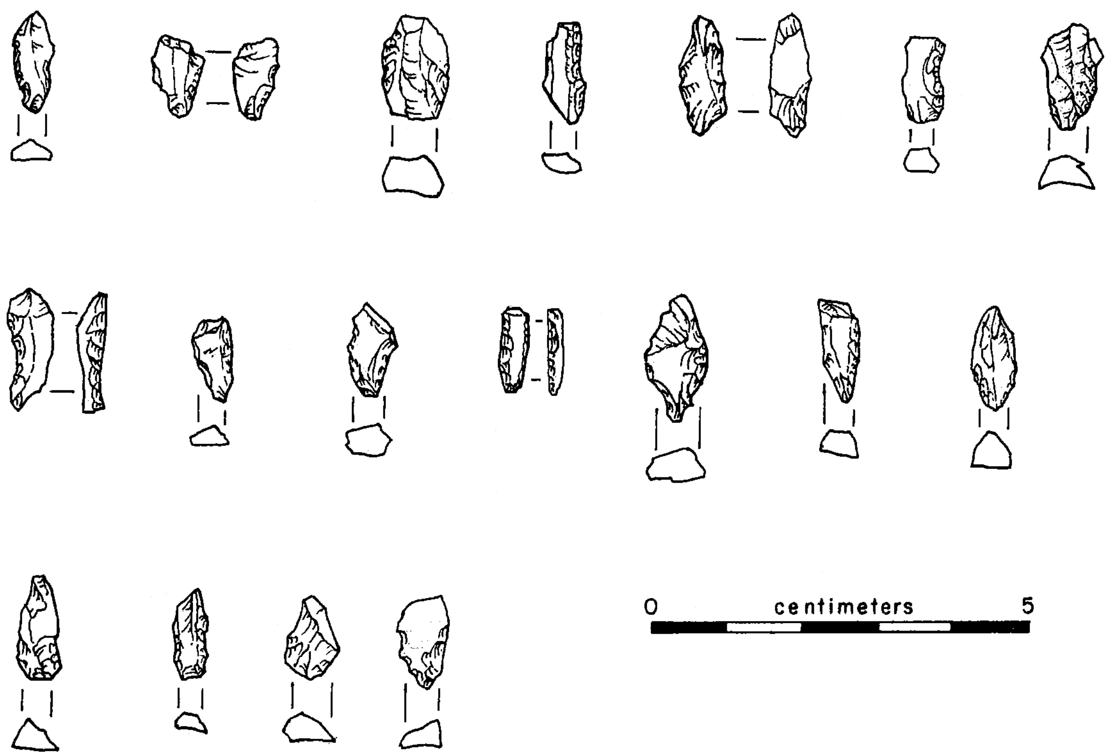


Figure 94. Typical microliths from the Admiralty site.

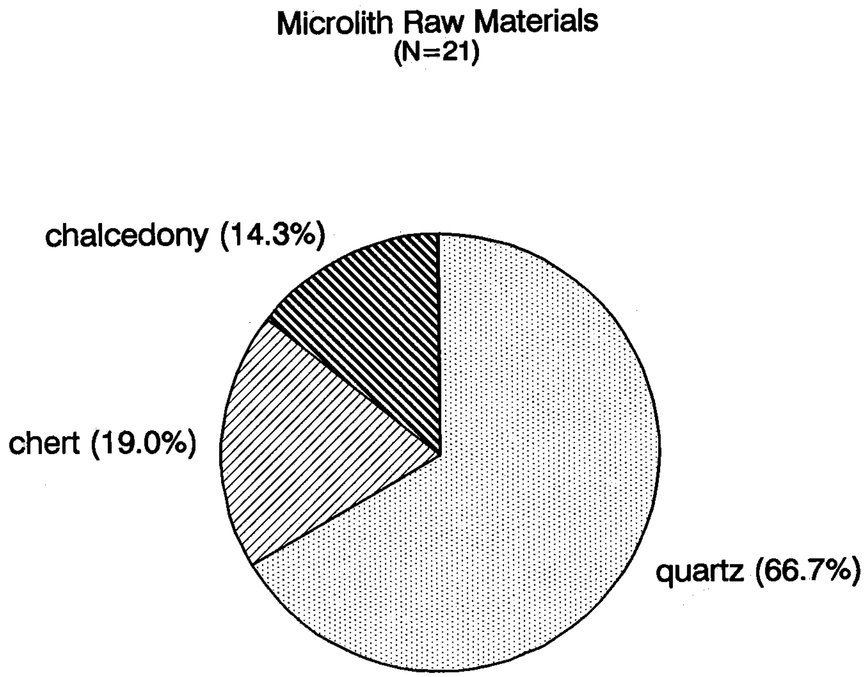


Figure 95. Proportion of raw material types in the microlith assemblage.

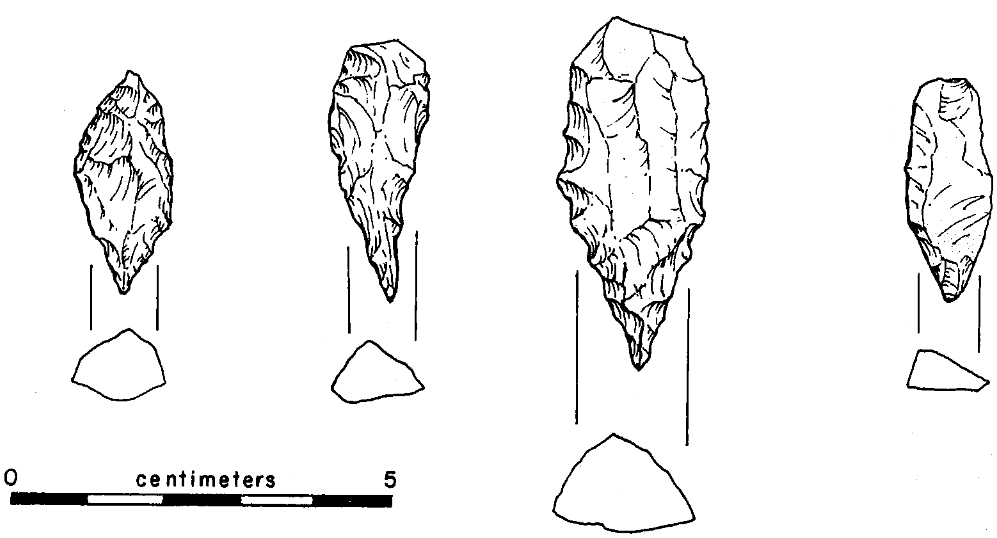


Figure 96. Drills from the Admiralty site.

Table 29. Metric Attributes of Drills and Microliths.

	N	Length (cm) X=	Width (cm) X=	Thickness (cm) X=	Weight X=
microliths	21	1.28	.59	.41	.38
drills	4	3.32	1.35	.86	5.05

The only attribute that shows an overlap in the range of the two classes is thickness; microliths range from .23- to .69-cm thick and drills range from .51- to 1.22-cm thick. Thus, we can conclude that the drills and microliths are functionally dissimilar artifacts.

Bifaces

There are 37 bifaces in the assemblage, nine of which are shown in Figure 97. All of these items have been pressure flaked, but do not contain formal haft elements. The distribution of raw materials in the biface assemblage is presented in Table 30 and Figure 98. It is obvious from these data that chert was the preferred material for making bifaces.

It is interesting to note the presence and absence of certain raw materials in the biface assemblage. Two raw materials, fused shale and rhyolite, are represented only in the biface assemblage. These few bifaces (n=4) probably represent curated items imported onto the site. Four raw materials, quartzite, andesite, quartz, and glass, are absent from the biface assemblage. The absence of glass and andesite bifaces is probably a function of the lack of available raw material. The absence of quartz may be a result of the paucity of raw material of appropriate size and shape to make bifaces. Quartzite, on the other hand, was available in sufficient quantities and suitable sizes and shapes to make perfectly functional bifaces. The lack of quartzite bifaces, therefore, must have been a deliberate cultural choice. Likewise, the use of small amounts of petrified wood to make bifaces apparently was a deliberate choice. Although never a dominant raw material, petrified wood was apparently selected for making bifaces. It comprises only .4 percent of the total assemblage, but accounts for 7 percent of the bifaces (n=4).

Additional data applicable to the research questions can be derived from the fracture patterns in the biface assemblage. Most of the bifaces are broken (31 out of 37). Fracture types identified include bending fractures (n=21), perverse fractures (n=4), and fire-induced fractures (n=6). It is important to note than none of the bifaces has been broken by an impact fracture. The fracture types present in the biface assemblage are indicative of failures during the manufacturing process (Johnson 1979; Crabtree 1972). Although the use of the bifaces cannot be totally discounted, these data indicate that they were broken during the final stages of manufacture and discarded on the site.

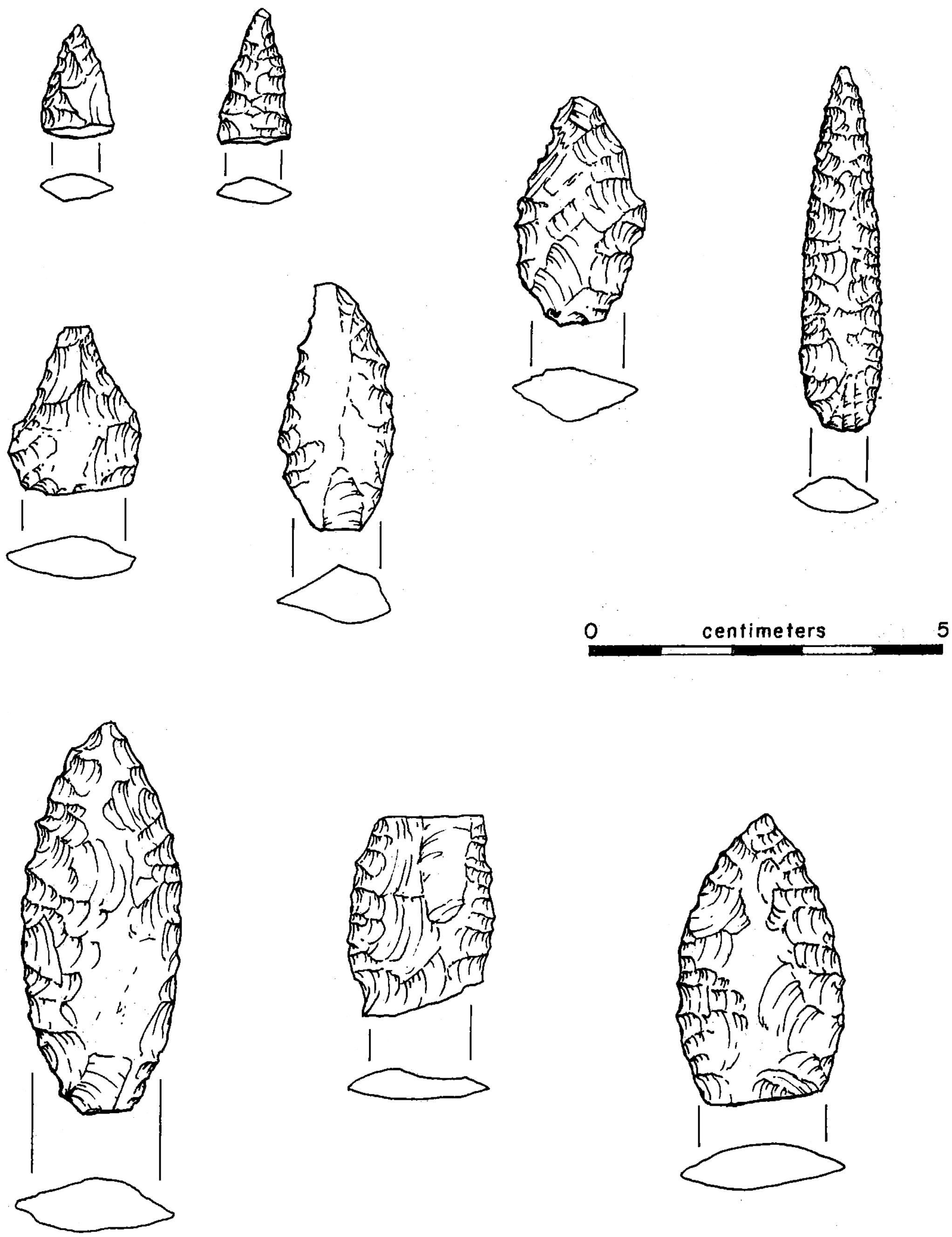


Figure 97. Typical bifaces and biface fragments from the Admiralty site.

Table 30. Raw Materials in the Biface Assemblage.

	Chert	Chalcedony	Petrified Wood	Fused Shale	Basalt	Rhyolite
N=	24(65%)	5(14%)	4(11%)	2(6%)	1(3%)	1(3%)

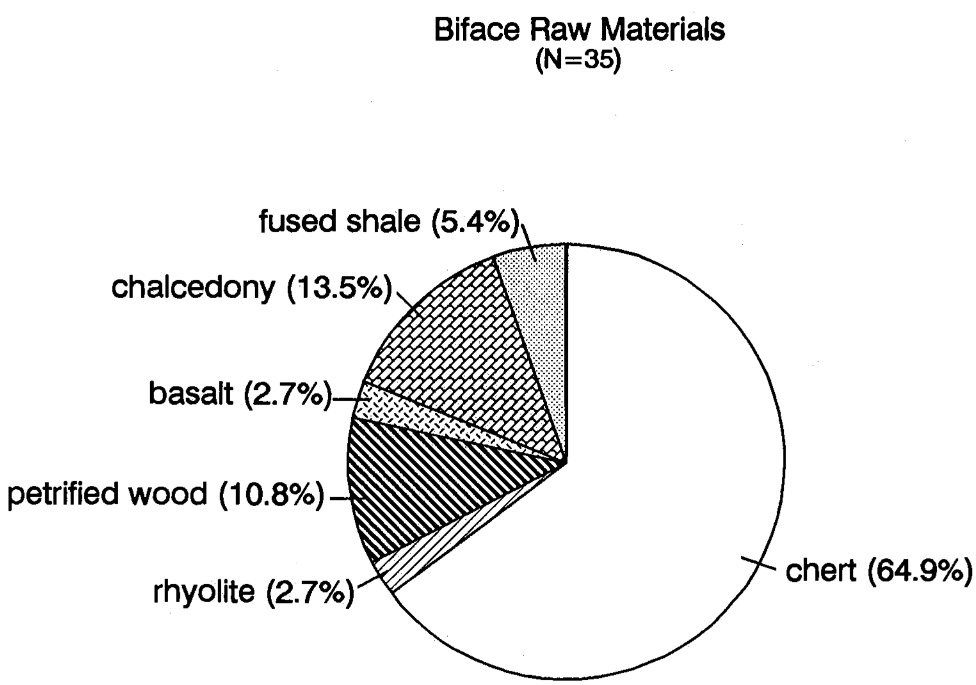


Figure 98. Raw material proportions in the biface assemblage.

Projectile Points

There are 36 projectile points or projectile point fragments in the CA-LAn-47 flaked stone assemblage. These points were divided into five different classes: Canalino points (n=21), Cottonwood Triangular points (n=9), a single Gypsum/Pinto point, a single Marymount point, and several untypeable specimens (n=4).

Canalino points (Figure 99) have been defined by Van Horn and Murray (1985) as a local projectile point type. They are characterized by finely pressure flaked faces, a rounded or convex base, and converging sides. They are relatively small, tear-drop shaped points without a discernible haft element. In this assemblage they are made of chert (n=18), chalcedony (n=1), obsidian (n=1), and fused shale (n=1). Twelve of the Canalino points are complete, five exhibit bending fractures, two exhibit impact fractures, one was broken by a perverse fracture, and one has a fracture typical of burning. Eight of the Canalino points (40%) show some evidence of having been resharpened and one has serrated margins which may be an extreme form of resharpening (Flenniken and Wilke 1989). These data are somewhat at variance with the debitage data in terms of the manufacture of projectile points on the site. While Canalino points may have been imported onto the site as nearly complete items, it is apparent that some of the points were used and resharpened, not just produced on the site.

The second most numerous projectile point type in the assemblage is the Cottonwood Triangular point (Figure 100). These points are finely pressure flaked, unnotched projectile points typical of the late prehistoric period (Thomas 1981). They are triangular in plan view and have slightly indented or concave bases. In the Admiralty site assemblage, Cottonwood Triangular points are made of chert (n=6), chalcedony (n=2), and petrified wood (n=1). Five of the points are complete, one was broken by a bending fracture, one by an impact fracture, one by a perverse fracture, and one point was broken by a fire-induced fracture. It is important to note that five of the Cottonwood Triangular points appear to have been resharpened and two have serrated margins.

One Gypsum/Pinto point was identified in the assemblage (Figure 101). This point is made of chert and has been broken by a fire-induced fracture. Gypsum/Pinto points are thought to date much earlier than the occupation of the Admiralty site. If this is the case, this single specimen may have been picked up off of an earlier site by the Admiralty site occupants and may be an example of the "heirloom hypothesis" (Thomas 1976).

One projectile point in the assemblage is classified as a Marymount point (Figure 102). This is a local projectile point type defined by Van Horn and Murray (1985; see also Van Horn 1990). This single specimen is made of chert, exhibits an impact fracture on one lateral margin, and shows some evidence of resharpening. It is important that this point is the only tool in the CA-LAn-47 assemblage that shows unmistakable evidence of having been intentionally heat treated. It is also one of only three projectile points which have evidence of notches. Two notch flakes (Austin 1986; Titmus 1985) were identified in the debitage and indicate that notching of projectile points occurred only rarely on the site.

Four projectile points could not be classified into any type (Figure 103). Three of the points are made of chert and one is made of obsidian. One of these points is complete and three are broken, two by fire-induced fractures and one by a bending fracture. All of these projectile points show some evidence of resharpening.

The projectile points in the Admiralty site assemblage contribute to our understanding of the prehistoric occupants in several ways. Taken as temporal markers, the Canalino and Cottonwood Triangular points indicate an occupation during the late prehistoric period. Taken as functional tools, the projectile points indicate that hunting played an important role in the prehistoric subsistence systems. The lithic raw materials used to make the projectile points (Figure 104) offer a drastically

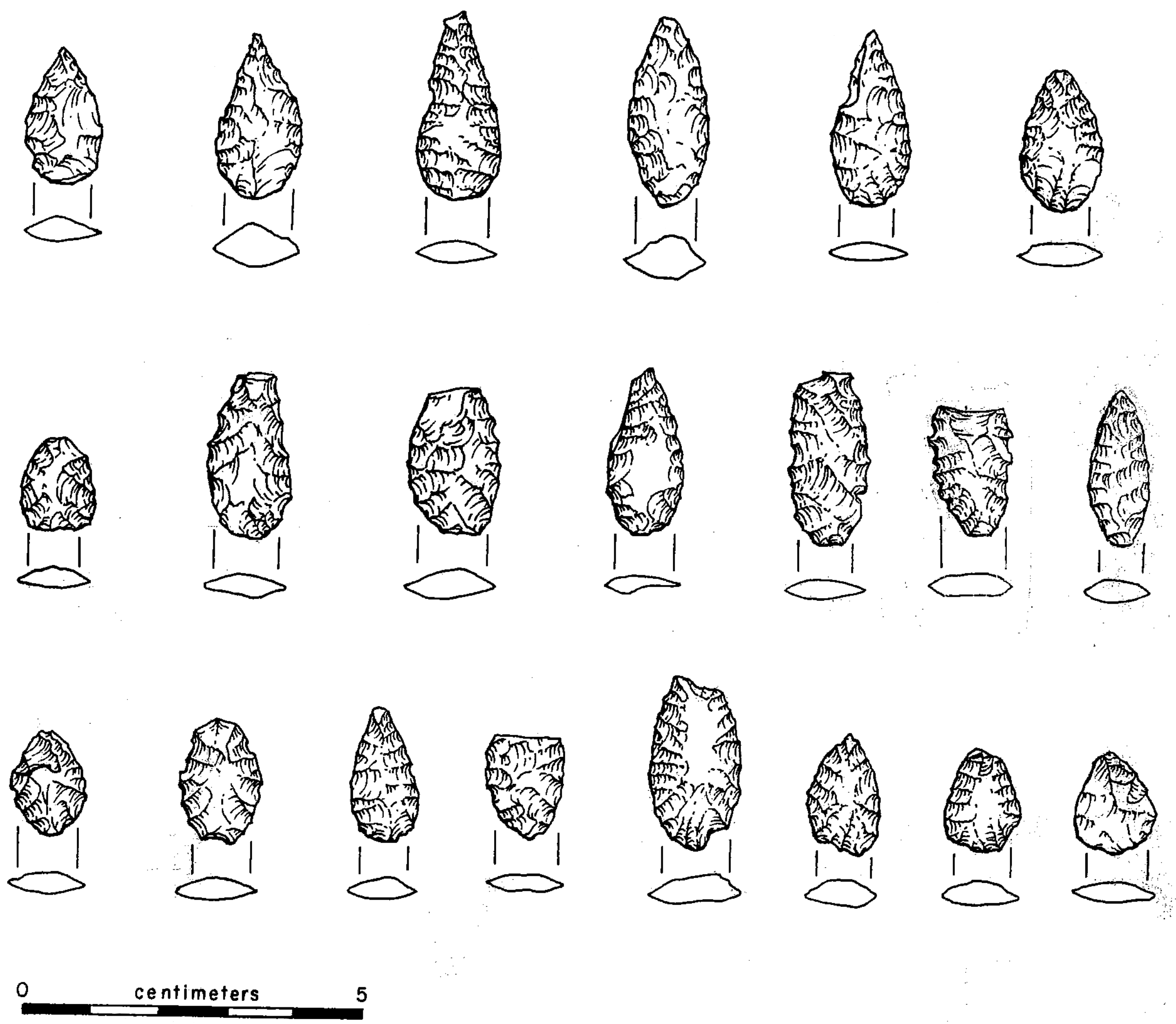


Figure 99. Canalino type projectile points from the Admiralty site.

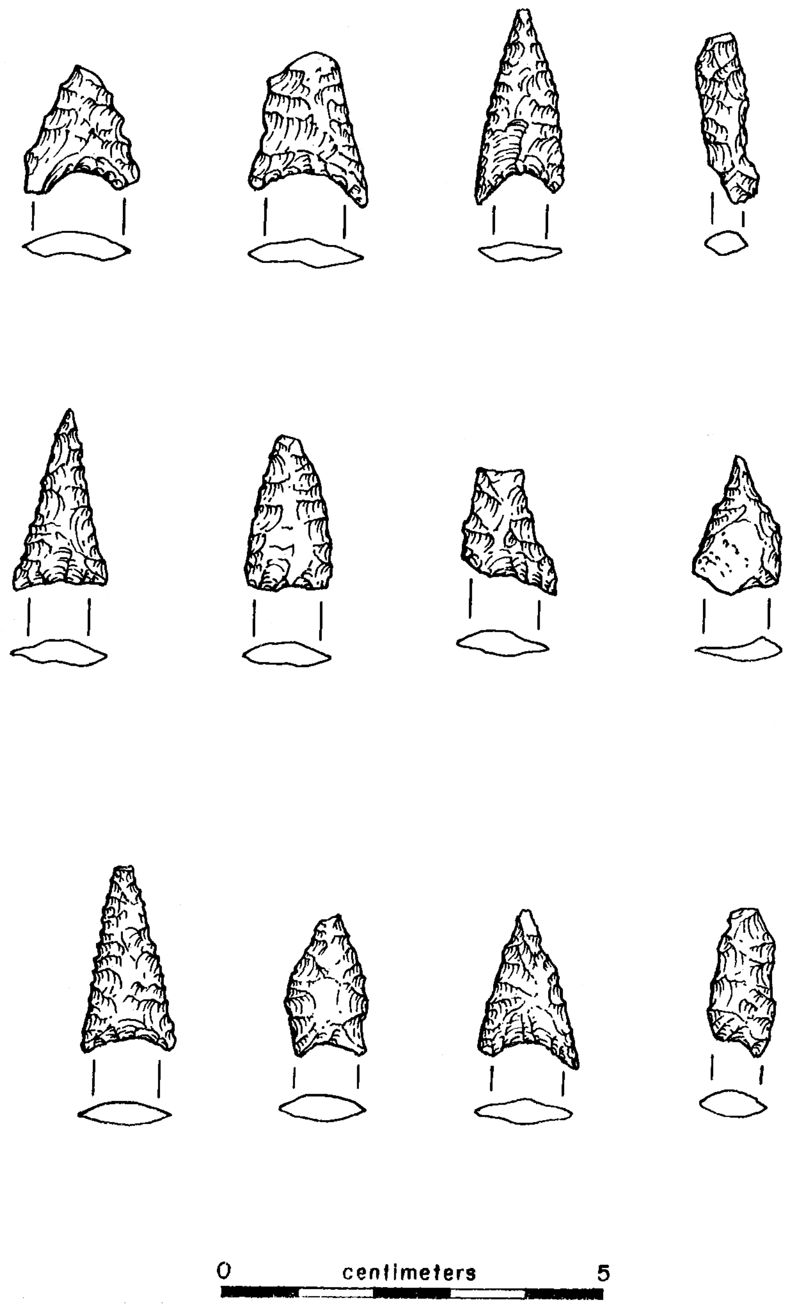


Figure 100. Cottonwood Triangular type projectile points from the Admiralty site.

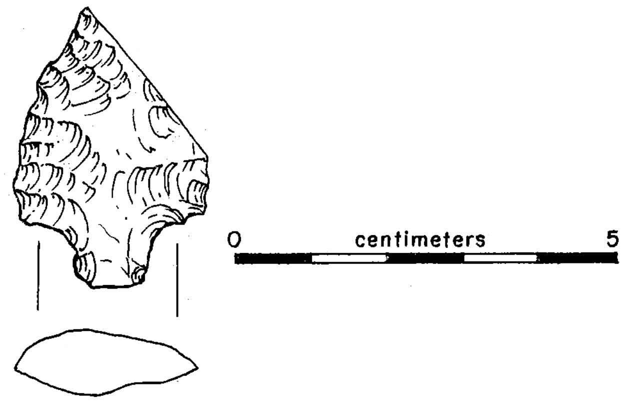


Figure 101. Gypsum/Pinto type projectile point.

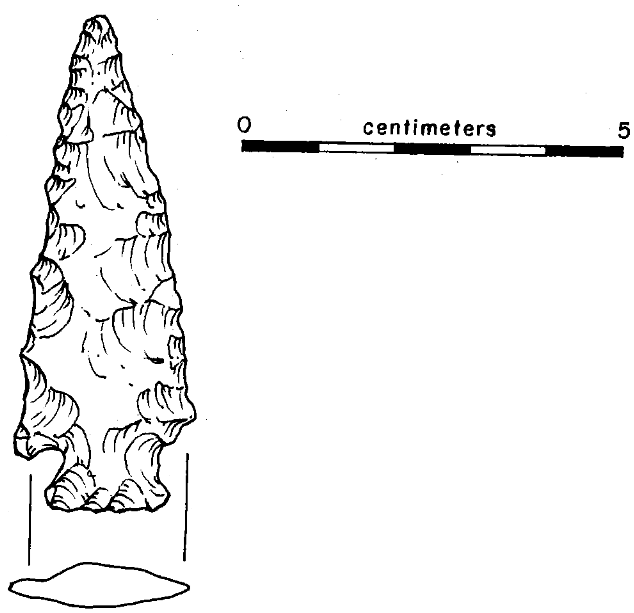


Figure 102. Marymont type projectile point.

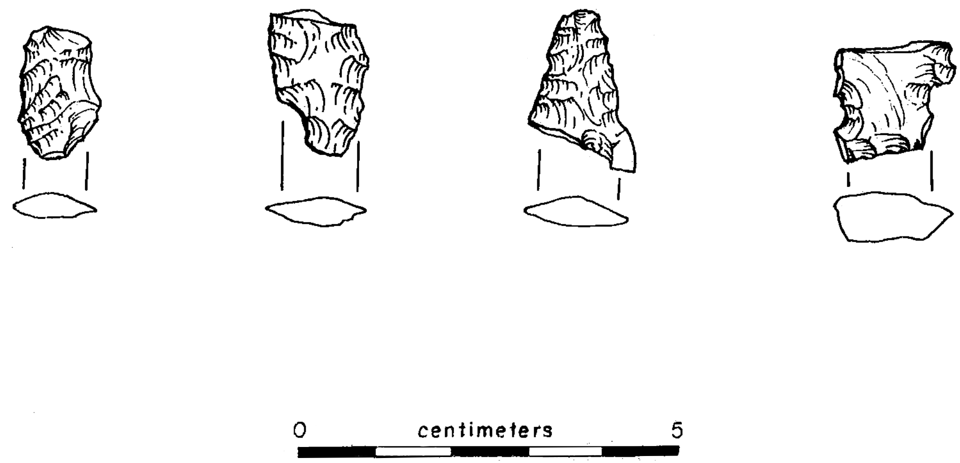


Figure 103. Untypeable projectile point fragments from the Admiralty site.

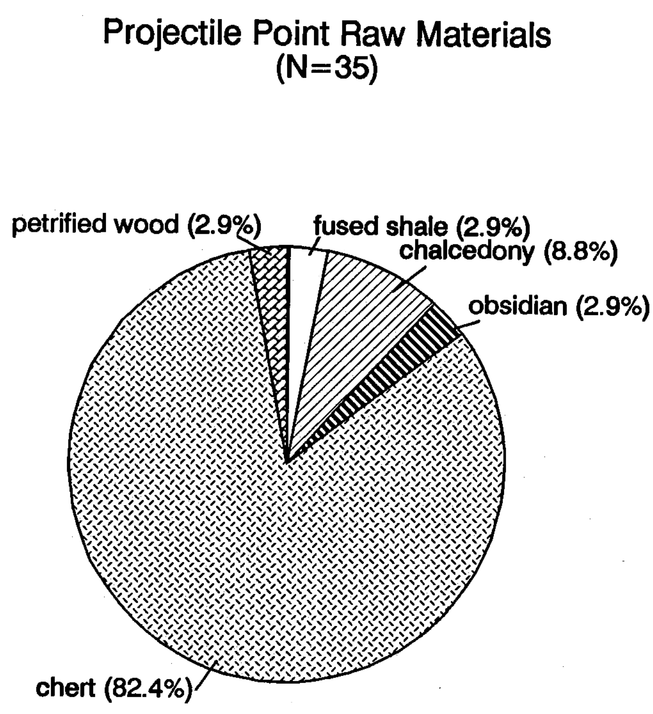


Figure 104. Raw material proportions in the projectile point assemblage.

different picture of lithic exploitation than the debitage. The projectile points are mostly made of fine-grained materials such as chert and chalcedony. the debitage, on the other hand, is comprised of a wider variety of coarse- and fine-grained raw materials.

Hammerstones

Four hammerstones were identified in the Admiralty site assemblage. Two hammerstones are made of basalt, one is made of quartzite, and one is made of dark chert. One of the basalt hammerstones is shown in Figure 105. All the hammerstones retain cortex and exhibit extensive battering on their surfaces. The metric data concerning these artifacts is presented in Table 31. Little behavioral information can be derived from this small sample of hammerstones. The basalt and quartzite items were probably procured locally from the same tertiary geologic deposits as the flakes and cores. The chert hammerstone is very battered and may have been a curated item imported from another site.

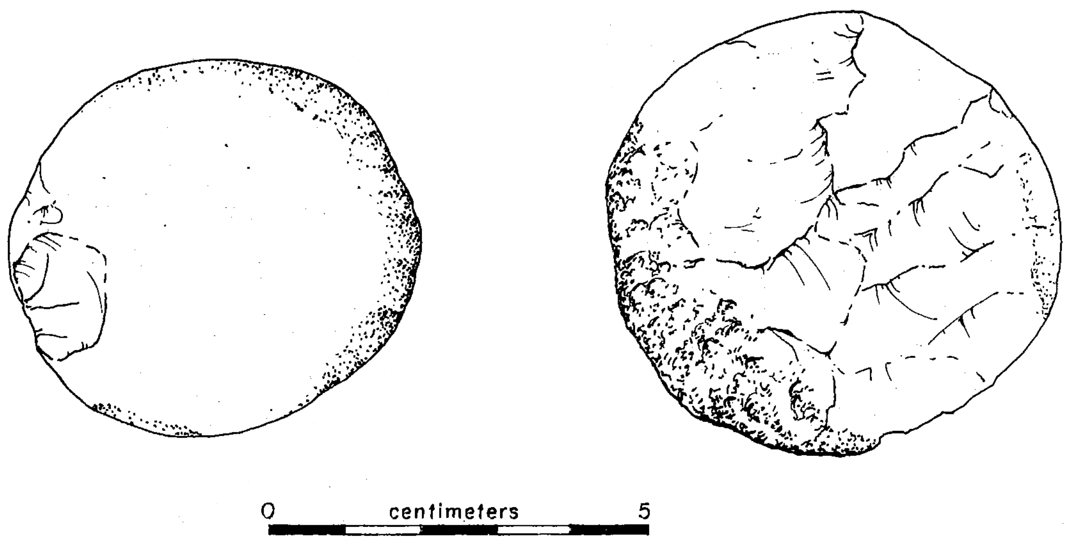


Figure 105. Typical hammerstone from the Admiralty site.

Table 31. Hammerstone Metric Data.

Raw Material	Length(cm)	Width(cm)	Thickness(cm)	Weight(gm)
basalt	7.30	7.42	5.81	420.8
basalt	6.58	4.47	2.89	122.6
quartzite	6.43	5.40	3.95	139.4
chert	5.95	5.11	5.01	173.3

Edge-Ground Cobbles

Three edge-ground cobbles were found during the excavation of the site. These artifacts are small cobbles which have been ground to a flat facet around the circumference of the artifact. In this assemblage, there is one each of basalt, quartzite, and rhyolite. All retain smoothing and rounding cortex on their surfaces, but do not exhibit battering typical of hammerstones. Their function remains problematic. Metric data for these artifacts is presented in Table 32.

Table 32. Edge-Ground Cobble Metric Data.

Cobble	Length(cm)	Width(cm)	Thickness(cm)	Weight(gm)
basalt	6.04	5.69	4.30	156.2
quartzite	5.18	4.77	2.03	69.7
rhyolite	4.05	3.69	1.91	44.3

Flaked Stone Distribution

The vertical and horizontal distributions of the flaked stone artifacts may help in identifying occupation zones and activity areas. Table 33 shows the vertical distribution of the four major raw material types at the site. As can be seen, there are no major variations in the proportions of different raw materials used throughout the occupation of the site. In a general sense, this distribution indicates that there was a single occupation at this site. Allowing for displacement of artifacts due to natural formation processes, the occupation zone at the site apparently was concentrated between 10 cm and 60 cm below surface, which corresponds well with Stratum II.

The horizontal distribution of debitage across the site is shown in Tables 34 and 35 (see discussion on stratigraphy in Chapter 8). Table 34 lists the distribution of the four major raw material types and Table 35 shows the distribution of the three major technological categories. Like the vertical distribution, the horizontal distributions show little differentiation across the site. There are, however, some slight differences in raw material frequency which may have behavioral significance. Test Pit 1 has a relatively high proportion (27%) of basalt debitage. Test Pit 14 has a small percentage of quartzite debitage and Test Pits 12 and 13 have relatively high proportions of brittle materials (chert and chalcedony) when compared to other excavation units.. Not surprisingly, these same excavation units exhibit differences in technological flake categories. Test Pit 1 has a relatively high proportion of flake-core technology debitage and Test Pits 12 and 13 have relatively large proportions of biface reduction debitage. These trends may indicate that there was some separation of reduction activities between the eastern part of the site and other areas. It should be remembered, however, that the excavated sample of the site is small and large contiguous areas of the site have not been excavated. These data can only suggest avenues of future inquiry and should not be interpreted as identifying segregated reduction locations or chipping stations (Flenniken and Stanfill 1980).

Table 33. Vertical Debitage Distribution of Four Major Raw Material Types.

Level	Basalt %	Quartzite %	Chert %	Chalcedony %
1	14	10	11	9
2	11	10	13	11
3	18	17	16	14
4	18	18	20	17
5	15	15	17	20
6	11	12	11	13
7	5	7	6	8
8	3	5	3	4
9	1	1	1	1
10	1	2	1	1
11	0	0.1	0	0
12	0	0.1	0	0
13	0	0	0.1	0
14	0	0	0	0

Table 34. Horizontal Debitage Distribution by Four Major Raw Materials.

	N	Basalt %	Quartzite %	Chert %	Chalcedony %
TP 1	920	27	19	22	31
TP 2	961	18	21	25	25
TP 3	2	0	100	0	0
TP 4	0	0	0	0	0
TP 5	20	0	20	5	75
TP 6	26	4	23	19	54
TP 7	188	12	19	30	38
TP 8	790	17	16	29	36
TP 9	756	11	13	35	40
TP 12	973	15	11	37	39
TP 13	789	13	16	40	30
TP 14	294	21	9	33	36

Table 35. Horizontal Debitage Distribution by Technology.

	N	Flake-Core %	Biface %	Bipolar %
TP 1	920	36	8	5
TP 2	961	39	8	4
TP 3	2	100	0	0
TP 5	20	25	10	5
TP 6	26	4	4	4
TP 7	188	26	9	2
TP 8	790	29	11	4
TP 9	756	26	12	4
TP 12	973	28	22	4
TP 13	789	24	19	5
TP 14	294	22	15	5

FLAKED STONE CONCLUSIONS

The flaked stone assemblage from CA-LAn-47 comprises 11 different raw materials, 4 different technological systems, 6 different tool types, and over 6,000 individual items. Because flaked stone technology was intermediate between prehistoric populations and their environment, we can use flaked stone technology as an indicator of the types of adaptations and exploitation of the environment by past human groups. In behavioral terms, the CA-LAn-47 flaked stone assemblage represents the material remains of a complex strategy for the exploitation of subsistence resources from the environment.

The raw materials in the flaked stone assemblage were derived from raw materials that may be classified into three categories: local, nonlocal, and exotic (Gould and Saggars 1985). Local materials include basalt, quartzite, andesite, probably petrified wood, and possibly rhyolite. These materials retain secondary geologic cortex (rounding and smoothing) indicating they were procured from secondary or tertiary geologic deposits. The relative abundance of cortex and large size of the basalt and quartzite debitage indicates that these materials were procured within 5 km of the site. Nonlocal materials in the assemblage include chert and chalcedony. Debitage from these raw materials is smaller and retains less cortex than the more durable materials. The chert and chalcedony occasionally retain small amounts of incipient cone and primary geologic cortex which indicates their procurement from primary and tertiary geologic sources. Truly exotic raw materials in the assemblage include obsidian, quartz, glass, and fused shale. Obsidian does not occur in the southern California area and, although sourcing studies were not conducted as part of this analysis, we assume that most of our obsidian came from the Coso area in south-central California. The source of the quartz remains problematic; much of the quartz in the assemblage occurs as finished tools and we assume it was imported onto the site in finished form. Likewise, fused shale is represented by almost complete tools; three fused shale bifaces in the assemblage must have been procured from distant and/or rarely used sources. Finally, the source of the three glass flakes, either modern or prehistoric, is unknown.

Four different reduction technologies were used to exploit these raw materials. A simple flake-core reduction system in which the desired end-product was a usable flake was employed to exploit the local basalt and quartzite. Diagnostic attributes of this technology include primary, secondary, and tertiary flakes with cortex-covered or simple, low-energy input striking platforms and unidirectional or multidirectional cores. The flakes were struck from locally available basalt and quartzite cobbles in an expedient fashion. The flake platforms often retain a remnant of the cobble morphology and have been termed "potato flakes" by Van Horn and Murray (1985). These flakes exhibit the largest proportion of unmistakable evidence of use, despite being the most durable raw materials in the assemblage. A biface reduction technology was used to exploit the chert and chalcedony from nonlocal sources. This technology is identified by bifacial striking platforms and multiple negative flake scars on the dorsal surface of flakes. Bifacial cores are rare in the assemblage; the low frequency of bifacial cores and prevalence of biface reduction debitage indicates that percussion-flaked bifaces were imported onto the site and further reduced by pressure-flaking into finished products. A bipolar technology was used to exploit some of the chalecdony, chert, and petrified wood. Diagnostic attributes of this technology include crushed or sheared platforms and flakes that are relatively flat in longitudinal cross section. Bipolar cores are present in small frequencies, exclusively in the chalcedony and chert raw material groups. This technology, used to exploit nonlocal materials, is commonly used as a strategy for conserving raw materials. While this strategy may account for some of the bipolar reduction in the assemblage, I feel that other factors also contribute. Several of the pieces of linear bipolar shatter in the assemblage exhibit use polish on their distal ends. I suspect, and this should be tested by future research, that the bipolar technology at the Admiralty site was used as an expedient way to produce usable "microliths." The last technology identified at the site is a microlith technology. The diagnostic attributes of this technology include single-facet striking platforms, a lack of cortex on flake surfaces, and a single dorsal arriss on the microliths. No microlith cores were found on the site and only 21 microliths were recovered. A majority of the microliths were made of quartz, a material that is not common in the rest of the assemblage. I suspect that the quartz microliths were imported onto the site as finished tools and replaced by the expedient linear bipolar shatter items when no longer efficient. Both the formal microliths and the linear bipolar shatter were probably used as part of a shell bead manufacturing process.

Tools in the assemblage include drills, projectile points, bifaces, and edge-damaged flakes. Only four drills were recovered and little can be said about so few artifacts. The projectile points indicate a late prehistoric occupation. Canalino and Cottonwood Triangular points are both representative of the post-A.D. 1000 time period. Relative to other sites in the area, there is a relatively large number of projectile points (n=35) and pressure-flaked bifaces (n=37) in the assemblage. A large majority of these items (>65%) are made of the nonlocal chert. Although many of these projectile points and bifaces are broken, less than 6 percent exhibit fractures typical of use damage. I suspect that these items were imported onto the site as preforms and finished during the occupation of the site. The function of these artifacts in a site-specific sense is somewhat problematic. Certainly, they were designed as part of a hunting technology, but the species hunted is unknown. It is possible that many of these projectile points and bifaces were manufactured as part of a "gearing up" process (Binford 1979) and have not been used. This hypothesis should be tested during future research.

Finally, there are no vertical or horizontal differences in raw material or technology distributions. The uniform distribution of these variables indicates that the site is a single component site. There are no changes in technology or raw material exploitation over time and it is probable that the site was used by a single cultural group throughout the duration of the site occupation.

GROUND STONE

The ground stone assemblage from CA-LAn-47 consists of 79 items. Included in this total are 3 possible metates, 13 possible manos, 3 possible pestle fragments, and 41 unidentifiable ground stone fragments. The most complete metate (Figure 106) is made of weathered quartzite, is oval in plan view and tabular in cross section. It has an oval grinding surface on one side only and shows no evidence of pecking or resurfacing. The most complete mano (Figure 107) is a one-hand variety made of sandstone. It has been ground on both surfaces but does not show evidence of battering or other heavy use. The most complete pestle (Figure 108) is made of basalt and tapers from top to bottom but does not show any other shaping modifications. Another pestle fragment (Figure 109) is made of quartzite and shows purposeful shaping of a handle.

The raw materials comprising the ground stone assemblage are generally medium-grained durable materials. Included in the assemblage are sandstone with hematitic cement (n=21), sandstone with an unknown cement (n=21), basalt (n=12, quartzite (n=8), granite (n=9), siltstone (n=5), steatite (n=1), conglomerate (n=1), and limestone conglomerate (n=1).

The three metate fragments large enough to identify positively are all slab-type metates. All have been ground on one surface only and show no evidence of pecking or battering. They have not been used as anvils and it is assumed that they were used to processes vegetable matter, but the type or quality of such use cannot be determined.

The three mano fragments large enough to positively identify are all one-hand manos that have been utilized on both sides. The surfaces are ground and show some striations, but do not exhibit battering or pecking. They do not appear to have been used as hammers and it is assumed that they functioned with the metates to process vegetable matter. Like the metates, the specific function of the manos cannot be determined.

Ground Stone Conclusions

The ground stone assemblage from the Admiralty site is relatively small and consists mostly of nondiagnostic fragments. Although manos (n=13), metates (n=3), and pestles (n=3) are present in the assemblage, their relatively infrequent occurrence at the site indicates that the inhabitants were not utilizing vegetable matter that required high-energy processing. Although the site inhabitants undoubtedly utilized vegetable products, the products they selected from the environment apparently did not require much processing on the site.

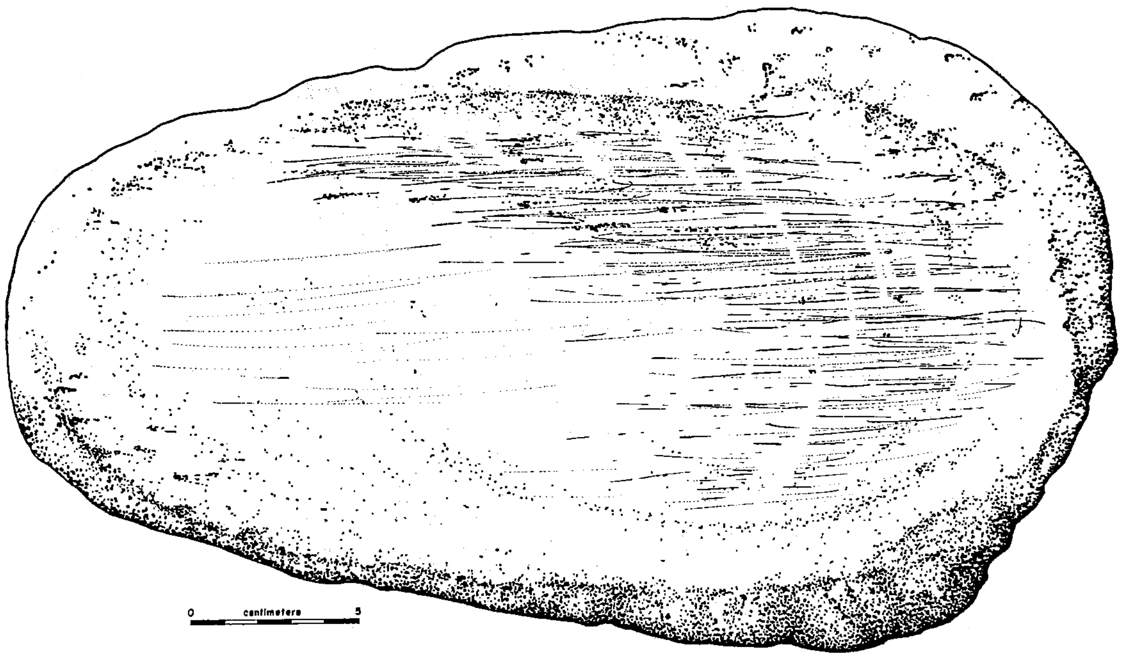


Figure 106. Single complete metate in the ground stone assemblage.

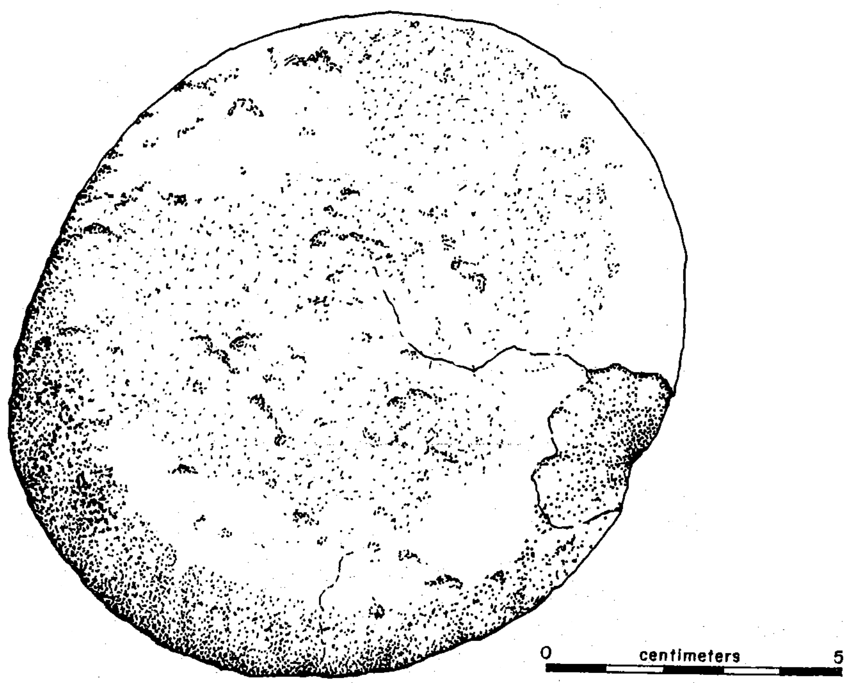


Figure 107. Single complete mano in the ground stone assemblage.

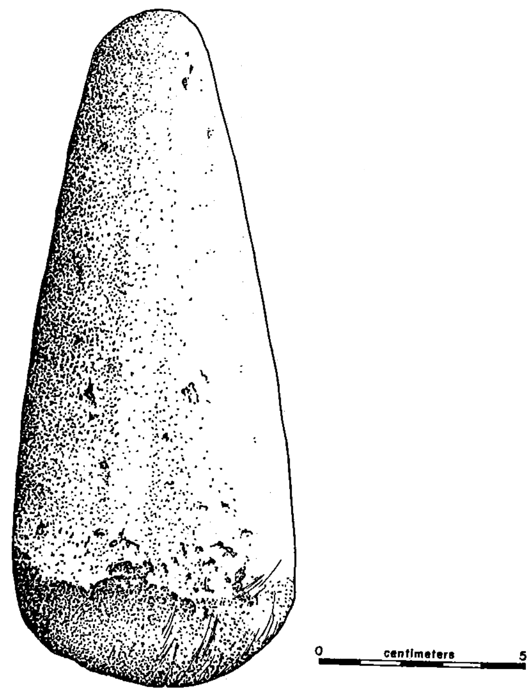


Figure 108. Single complete pestle in the ground stone assemblage.

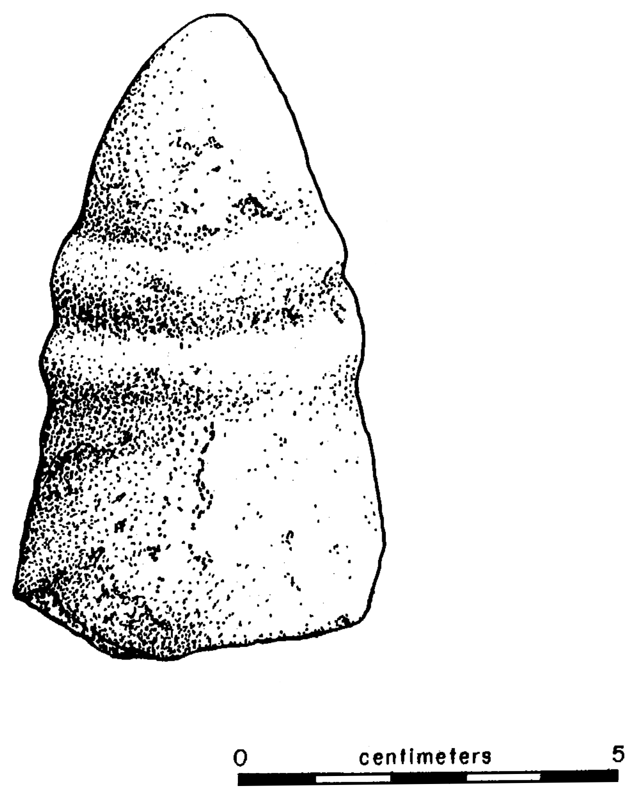


Figure 109. Pestle handle fragment from the Admiralty site.

CHAPTER 10

BONE AND SHELL TOOLS AND ORNAMENTS

Steven Troncone and Jeffrey H. Altschul

During the 1989 excavations, 479 shell, stone and bone beads, 11 shell tools, and 21 bone tools were recovered. In this chapter these artifacts are described and interpretations are offered.

RESEARCH QUESTIONS

The shell and bone tool analysis was guided by questions related to two basic research domains, time and function. In particular, we addressed the following in the analysis:

1. Based on the shell bead types, what time period was the site occupied? Is there any evidence of shell bead production? If the shell beads were imported, where was their likely origin?

2. What types of shell and bone tools were produced at the Admiralty site? Are the tools similar in number and nature to assemblages from other sites in the Ballona?

METHODS

Beads were typed according to the classifications developed by Bennyhoff and Hughes (1987), Brock (1986), and King (1981). These classifications generally are based on raw material (shell, bone or lithic material), portion of the shell used, shape and mode of production. In typing the beads, macroscopic attributes, such as grinding, were noted. In addition to recording stylistic and technological attributes, measurements of the diameter of the whole bead and the perforation were taken using calipers to a precision of ± 0.01 mm.

Shell and bone tools were classified along three dimensions. Artifacts were first divided by species, then by general morphology, and finally by production or use attributes. The length and width of all artifacts were measured with a vernier caliper to a precision of ± 0.01 mm.

BEADS

Of the 479 beads recovered during the 1989 excavations at the Admiralty site, 448, or 93.5 percent, represented 6 shell bead types. The remaining 31 beads were distributed among 4 other shell bead types, 2 stone bead types, and 3 bone bead types, with 6 shell beads not being typed to any category. Table 36 provides a list of the bead types and their associated frequencies. Tables 37 and 38 provide information on the horizontal and vertical distribution of beads, with Table 37 presenting frequency and percentage information by level and Table 38 providing similar information by test pit. Each bead type is described below. Metric and provenience information is provided for each bead analyzed in Appendix B.

Table 36. Beads from the 1989 Excavations at the Admiralty Site.

Type	Frequency
Olivella Cupped	186
Olivella Saucer	116
Abalone Disc	100
Abalone Cylinder	26
Olivella Lipped	18
Olivella Cylinder	17
Keyhole Limpet	3
Olivella Spire Ground	2
Abalone Barrel	1
Shell Tubular	2
Unknown Shell	6
Bone Disc	4
Tubular Bone	2
Fish Vertebra	1
Schist	8
Stone Disc	2
Total	479

Shell Beads

Olivella Cupped

The most prevalent bead type recovered at the Admiralty site was *Olivella* cupped (Figure 110t-aa). The characteristic of this bead type is that the ventral surface of the bead is more curved than the dorsal surface, yielding a cupped shape when viewed from inside the shell. The concave surface of the bead is usually ground so that the edges are roughly equal in thickness and circular in outline. In all, 186, or 38.8 percent of the beads, were classified to this type. Made from the top of the callus of *Olivella biplicata*, the cupped beads have an average diameter of 4.39 mm, with a range between 2.8 and 6.6 mm. Perforations average 1.09 m in diameter, and range between 0.8 and 1.5. All beads were conically drilled. Asphaltum was found on two beads.

Olivella cupped beads were found in all levels and all test pits at the Admiralty site. They were found in relatively large numbers in Test Pit 2, followed by Test Pits 8, 9, 12, and 14. Stratigraphically, *Olivella* cupped beads followed a nearly "normal" distribution, peaking in frequency in Levels 3 and 4 and dropping off in both directions.

According to King (1981), *Olivella* cupped was the most popular type of shell bead during Phase L1 of the Late period, or between A.D. 1150 and 1500. This interpretation is consistent with the

Table 37. Bead Totals by Type and Level.

Level	*Olivella* Cupped		*Olivella* Saucer		*Olivella* Lipped		*Olivella* Cylinder		Abalone Disc		Abalone Cylinder		Other		Unknown		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
1	18	9.68	5	4.31	0	0.00	1	5.88	2	2.00	0	0.00	3	11.54	0	0.00	29	6.05
1&2	18	9.68	13	11.21	2	11.11	1	5.88	12	12.00	1	9.09	1	3.85	0	0.00	48	10.02
2	21	11.29	8	6.9	2	11.11	0	0.00	8	8.00	2	18.18	2	7.69	0	0.00	43	8.98
3	50	26.88	36	31.03	3	16.67	5	29.41	26	26.00	4	36.36	7	26.92	1	20.00	132	27.56
4	45	24.19	14	12.07	2	11.11	4	23.53	19	19.00	3	27.27	6	23.08	1	20.00	94	19.62
5	18	9.68	21	18.10	6	33.33	3	17.65	14	14.00	0	0.00	5	19.23	1	20.00	68	14.2
6	5	2.69	9	7.76	1	5.56	1	5.88	6	6.00	0	0.00	1	3.85	1	20.00	24	5.01
7	9	4.84	6	5.17	1	5.56	2	11.76	7	7.00	0	0.00	1	3.85	1	20.00	27	5.64
8	1	0.54	3	2.59	1	5.56	0	0.00	6	6.00	1	9.09	0	0.00	0	0.00	12	2.51
9	1	0.54	1	0.86	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	2	0.42
Total	186.00	100.00	116	100.00	18	100.00	17	100.00	100.00	100.00	11	100.00	26	100.00	5	100.00	497	100.00
Mean	18.60		11.6		1.80		1.70		10.00		1.10		2.60		0.50			
Standard Deviation	16.08		9.86		1.66		1.68		7.52		1.37		2.42		0.50			

Table 38. Bead Totals by Type and Test Pit.

Test Pit	*Olivella* Cupped		*Olivella* Saucer		*Olivella* Lipped		*Olivella* Cylinder		Abalone Disc		Abalone Cylinder		Other		Unknown		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
1A	1	0.54	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.21
1B	6	3.23	2	1.72	0	0.00	0	0.00	1	1.00	0	0.00	0	0.00	0	0.00	9	1.88
1C	6	3.23	7	6.03	2	11.11	2	11.76	3	3.00	0	0.00	0	0.00	1	20.00	21	4.38
1D	4	2.15	2	1.72	0	0.00	0	0.00	1	1.00	0	0.00	1	3.85	0	0.00	8	1.67
2A	4	2.15	0	0.00	0	0.00	0	0.00	3	3.00	0	0.00	0	0.00	0	0.00	7	1.46
2B	7	3.76	3	2.59	0	0.00	1	5.88	5	5.00	3	27.27	3	11.54	1	20.00	23	4.80
2C	21	11.29	8	6.90	1	5.56	2	11.76	9	9.00	2	18.18	2	7.69	0	0.00	45	9.39
2D	16	8.60	7	6.03	1	5.56	3	17.65	3	3.00	0	0.00	3	11.54	0	0.00	33	6.89
7	3	1.61	4	3.45	0	0.00	0	0.00	2	2.00	0	0.00	2	7.69	0	0.00	11	2.30
8A	12	6.45	10	8.62	1	5.56	1	5.88	9	9.00	0	0.00	3	11.54	0	0.00	36	7.52
8B	5	2.69	3	2.59	0	0.00	0	0.00	5	5.00	1	9.09	0	0.00	0	0.00	14	2.92
8C	12	6.45	6	5.17	2	11.11	0	0.00	16	16.00	0	0.00	1	3.85	0	0.00	37	7.72
9A	8	4.30	10	8.62	1	5.56	0	0.00	1	1.00	0	0.00	1	3.85	0	0.00	21	4.38
9B	12	6.45	5	4.31	1	5.56	0	0.00	1	1.00	0	0.00	0	0.00	1	20.00	20	4.18
9C	10	5.38	6	5.17	0	0.00	0	0.00	3	3.00	0	0.00	1	3.85	0	0.00	20	4.18
12A	10	5.38	15	12.93	3	16.67	2	11.76	17	17.00	0	0.00	2	7.69	0	0.00	49	10.23
12B	13	6.99	5	4.31	0	0.00	4	23.53	5	5.00	2	18.18	1	3.85	1	20.00	31	6.47
12C	10	5.38	4	3.45	3	16.67	1	5.88	8	8.00	1	9.09	2	7.69	0	0.00	29	6.05
13	9	4.84	6	5.17	1	5.56	0	0.00	2	2.00	0	0.00	2	7.69	0	0.00	20	4.18
14	17	9.14	13	11.21	2	11.11	1	5.88	6	6.00	2	18.18	2	7.69	1	20.00	44	9.19
Total	186	100.00	116	100.00	18	100.00	17	100.00	100	100.00	11	100.00	26	100.00	5	100.00	479	100.00
Mean	9.3		5.8		0.9		0.85		5		0.55		1.3		0.25		23.95	
Standard Deviation	4.95		3.87		0.99		1.15		4.64		0.92		1.05		0.43		13.36	

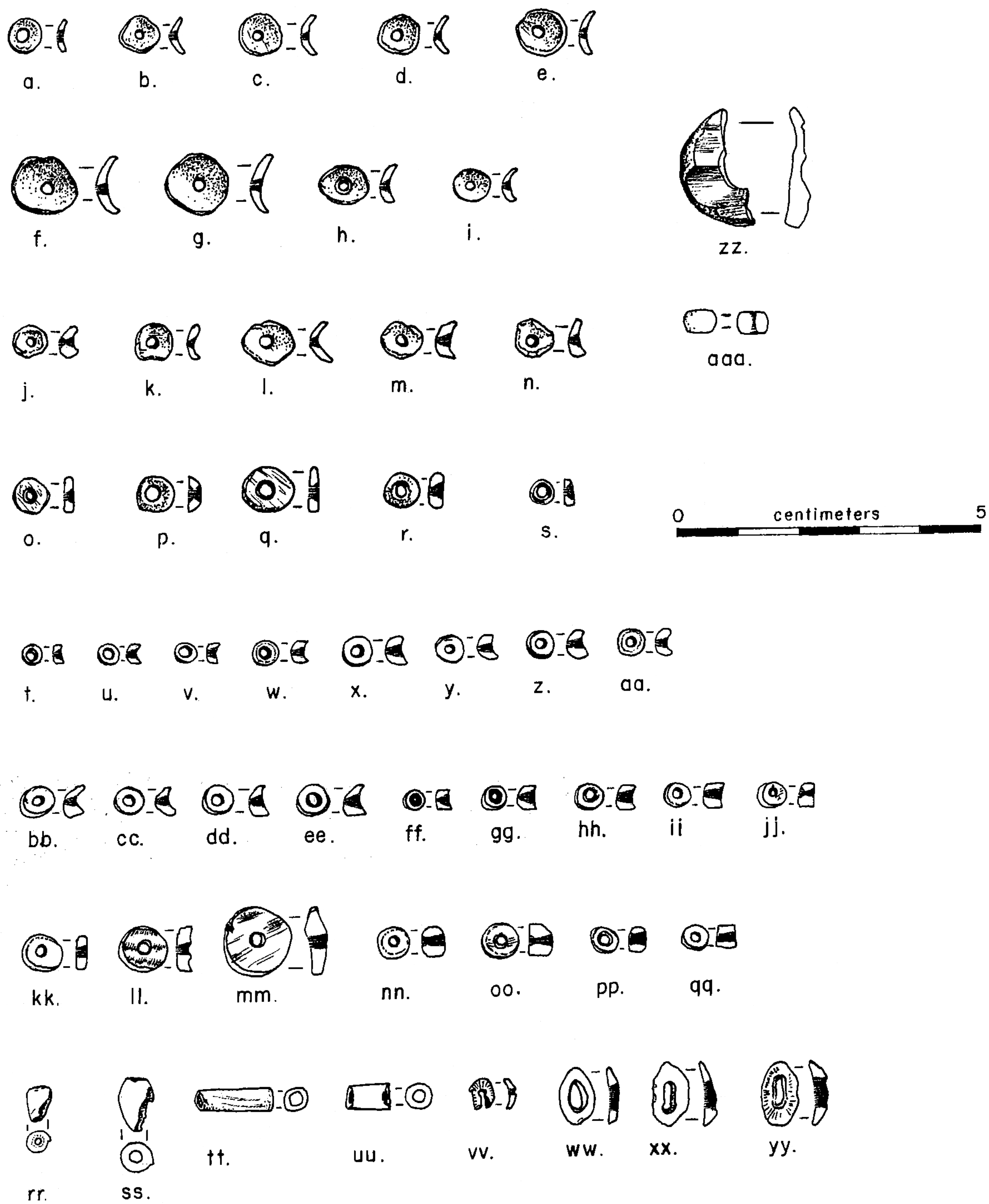


Figure 110. Shell beads from the Admiralty Site.

radiocarbon dates obtained from the Admiralty site, which places the end of the occupation to about A.D. 1150.

Although *Olivella* cupped beads have been found in association with burials at Medea Creek and other sites in the Santa Barbara area, no such association could be made at the Admiralty site. Because all beads, as well as all other artifacts, were recovered from the midden, the contextual relationship between beads and features or activity areas could not be established.

Olivella Saucer

Olivella saucer beads (Figure 110f-n) account for 24.4 percent (n=116) of the Admiralty site collection. Saucer, or disc, beads were made from the walls of ***Olivella biplicata***. The dorsal and ventral surfaces are curved and parallel to one another. At the Admiralty site, the beads average 6.72 mm in diameter, with a range between 3.9 and 10.9 mm. Perforations average 1.32 mm in diameter, and range between 0.7 and 1.9 mm. The vast majority of perforations are conically drilled, although a few biconically drilled beads were recovered. Of the 116 saucer beads, 11 had rough or chipped edges around less than half of their peripheries. These were classified as rough saucer beads (see Figure 110j-k). Another three were chipped along most of their periphery; these were classified as chipped saucer beads (see Figure 110l-n).

Saucer beads were found in all test pits, except Test Pit 1A, and in all levels. At first glance, the vertical distribution of saucer beads appears confusing. The beads have a sharp peak in Level 3 with minor peaks in Level 1&2 and Level 5. One interpretation is that the the distribution is trimodal, with peaks oscillating in intensity in both directions from Level 3. A careful reading of the data, however, indicates a more normal distribution. Level 1&2 is a designation used primarily along the southern edge of the site, where an artificial slope in the test pits was created when the midden was mechanically truncated to the south of the railroad bed. The matrix from most of this level relates topographically to Level 2 in the rest of the site. This category, then, can safely be collapsed with Level 2. Once accomplished, we find that the distribution of saucer beads is quasi-normal, characterized by a sharp peak in Level 3 and falling off dramatically in both directions.

The horizontal distribution of saucer beads shows no clear patterning. Beads were relatively frequent in Test Pits 8 and 12, but found in lesser quantities in adjacent Test Pits 1 and 9. Saucer beads were slightly more numerous along the southeastern edge of the railroad right-of-way, the area that contained most of the human remains and which is closer to the center of the midden. These trends, however, are slight and not statistically significant.

Olivella saucer beads were produced from the Middle period into historic times. Medium-sized saucer beads, such as those found at the Admiralty site, were most common during Phase M4 of the Middle period, Phases L1b, L1c and L2 of the Late period, and the early historic period ending around A.D. 1782 (King 1990:8-14). The presence of rough and chipped saucer beads may be indicative of an historic occupation, although in the absence of other lines of supporting evidence, such as a conclusion is premature.

Olivella Lipped

Eighteen *Olivella* lipped beads, 3.7 percent of all shell beads, were recovered (Figure 110bb-ee). These beads are distinguished from cylinder beads soley on the basis of size. King (1981:261) observed that during Phase L2a lipped beads were made from larger portions of shells, whereas by the end of

Phase L2b perforations of lipped beads were almost extensively restricted to the line dividing the wall portion of the shell from the callus. These later lipped beads are characterized by a thin edge composed of the shell wall and a thicker edge consisting of the callus.

The Admiralty site lipped beads are similar to the early style described by King (1981). The beads are relatively small with an average diameter of 4.69 mm, and perforations averaging 1.17 mm. The beads range from 3.2 to 5.9 mm in diameter, with perforations ranging from 0.9 to 1.4 mm. All beads are conically drilled.

Given the small number recovered, little can be gleaned from either their horizontal or vertical distributions. On the whole, they appear to be evenly spread across the site and through the midden.

Lipped beads were produced during Phase L2a of the Late period, or about A.D. 1500, through historic times (Bennyhoff and Hughes 1987; King 1981). The beads form the Admiralty site are similar to those described by King (1981) dating early in the sequence.

Olivella Cylinder

Of the total number of shell beads, 17, or 3.5 percent, were classified as *Olivella* cylinder beads (Figure 110ff-gg). Like lipped beads, cylinder beads are distinguished from cupped beads on the basis of larger perforations. They are distinguished from lipped beads primarily on the basis of size. Cylinder beads have an average diameter of 3.55 mm, with a range from 2.8 to 4.7 mm. Perforations average 1.11 mm, and range from 0.8 to 1.4 mm. Beads are conically and biconically drilled. Of all the bead types, *Olivella* cylinder tends to be the least variable.

Olivella cylinder beads were concentrated in adjoining Test Pits 2 and 12, primarily in Levels 3 through 5. Given the small number of beads, these distributions could just as easily be due to chance as to cultural practices.

Olivella cylinder beads are dated by King (1981) to Phase L2a of the Late period, or from A.D. 1500 into historic times.

Olivella Spire Ground

Two beads classified as *Olivella* spire ground (Figure 110rr-ss) were recovered from the Admiralty site. One specimen (see Figure 110rr), recovered from Test Pit 12B, Level 1, was ground to the point where the spire was completely removed. The other specimen (see Figure 110ss), from Test Pit 8A, Level 5, had been ground to the apex of the shell.

Olivella spire ground beads were common during the later portions of the Middle period. King (1981:220) states that spire ground beads with their bases removed were most common in Phases M5a and M5b, or between about A.D. 1000 and 1150.

Abalone Disc

Abalone (*Haliotis* sp.) disc beads (Figure 110kk-mm, zz) represent the third most common bead type at the Admiralty site, with 100 specimens recovered, accounting for 20.9 percent of the collection.

Unlike abalone disc beads made from nacre ("Mother-of-pearl") that is separated from the epidermis, the abalone disc beads from the Admiralty site were made from the colored outer non-nacreous portion of the shell. King (1981:303) terms this style abalone epidermis disc. Bead diameter average 6.04 mm, with a range from 3.9 mm to 12.2 mm. Perforations average 1.45 mm in diameter, and range from 0.9 mm to 2.6 mm. Perforations were conically or biconically drilled.

Abalone disc beads were found in all test pits, except Test Pit 1A, and from all levels. Eighty percent of the beads were found in Test Pits 2, 8, and 12, all located along the northern edge of the site. Surprisingly, few beads were found in Test Pit 1, which was located just east of the three test pits listed previously. The association of these beads with the edge of the midden, and in areas where human remains were conspicuously absent is intriguing. This distribution is substantially different from that exhibited by other *Olivella* cupped or saucer beads. This finding is surprising, for ethnohistorically, abalone epidermis disc beads were strung with other types of beads and ornaments. As King (1981:304) states:

> Abalone epidermis beads were probably the only type of bead outside of the categories of Olivella biplicata callus and columella beads commonly strung with olivella cupped beads. They differ from callus and columella types in that they were also commonly strung with olivella wall disc beads and beads made of clam and mussel shells. Abalone epidermis beads were unique because they were strung in combination with all bead types commonly used during the Late Period.

Given the relatively confined area of the 1989 excavations, it is probably not worthwhile to make too much of spatial distinctions. All test pits were located within about 50 m of each other, and relative to other portions of the site, such as the areas excavated in 1961, the 1989 units can be considered to derive from the same area. Without clear association with burials or features, the spatial covariations in bead types could just as easily be explained as the result of random processes occurring during midden formation as the consequence of patterned cultural activities. Future work in other areas of the site is needed to evaluate the covariation of bead types.

Stratigraphically, abalone disc beads follows a relatively normal distribution. As with the other dominant bead types, *Olivella* cupped and saucer, frequency of abalone disc beads peaks in Level 3 and falls off both toward the top and bottom of the midden.

Abalone epidermis disc beads were produced during the Late period. They appeared in small quantities during Phase 1b of the Late period (ca. A.D. 1250), and then had a resurgence of popularity during Phase 1b of the Late period (ca. A.D. 1250), and then had a resurgence of popularity during Phase 2 (ca. A.D. 1500). This bead style was extremely popular during the Late period, with a widespread distribution throughout southern and central California.

Abalone Cylinder

Another non-nacreous abalone bead type of the Late period is the cylinder bead (Figure 110nn-qq). Eleven abalone cylinder beads were recovered during the 1989 excavations at the Admiralty site. These have an average diameter of 4.83 mm, and a range from 3.9 to 5.6 mm. Perforations average 1.38 mm, with a range from 1.0 to 1.5 mm. Most cylinders are biconically drilled.

The spatial distribution of abalone cylinder beads mirrored that of abalone disc beads. Nearly 82 percent were found along the northern edge of the midden in Test Pits 2, 8 and 12. Vertically, the beads followed a normal distribution, concentrated in Level 3 with lesser amounts in Levels 1 and 2 and Level 4.

One explanation of the covariation, both vertically and horizontally, of abalone epidermis beads is that the cylinders and the discs were strung together. This hypothesis is supported with extremely weak data, based as it is on the results from only the 1989 excavations. As stated previously, spatial covariations could easily be the result of random processes. Even so, the fact that abalone epidermis bead types are strongly associated at the site, and that others, particularly *Olivella* cupped and saucers, are not as intriguing and worthy of further study.

Abalone cylinder beads were popular at the same time as other non-nacreous abalone bead types, such as abalone disc beads. For the Santa Barbara area, King (1981:303) argues that the styles were relatively rare during Phase 1, and then quite frequent during Phases 2 and 3 of the Late period.

Abalone Barrel

One abalone barrel bead (Figure 110aaa) was recovered from Test Pit 2C, Level 1&2. The bead has a maximal diameter of 5.6 mm, a minimal diameter of 4.6 mm, was 3.5 mm in height, and had a perforation with a 1.5 mm diameter. The perforation is biconically drilled.

Keyhole Limpet

Four keyhole limpet beads (Figure 110vv-yy) were recovered from the 1989 excavations. The artifacts were termed beads due to their small size as opposed to other possible types of ornaments that were made from *Megathura crenulata*. The small size of the perforations indicate that the beads were made from juveniles. Two were recovered from Level 1 from Test Pits 2B and 7, whereas the other two were found in Level 5 in Test Pits 2B and 12A. Limpet ornaments were most common during the Middle period, although they continue unabated through Phase 2 of the Late period.

Tubular and Unknown Shell Beads

Two tubular beads from unidentified shell species were recovered from Levels 3 and 4 and from Test Pits 2C and 8C, respectively. The beads were similar in size. The one recovered from Test Pit 2C has a diameter of 4.0 mm, a perforation of 2.0 mm, and a length of 12.7 mm. The Test Pit 8C bead has a diameter of 4.2 mm, a perforation of 2.0 mm, and a length of 7.5 mm.

Six shell bead fragments were found that could not be identified to species or shape.

Bone Beads

Seven bone beads were recovered during the 1989 excavations. Of these, 4 were disc beads and two were tubular beads from unidentified animals. The remaining bead was made from a fish vertebra. Pertinent information on these beads is presented in Table 39.

The four unidentifiable disc beads probably were made from vertebrae of small mammals, similar to the fish vertebra bead (Figure 110x-y). The tube beads appear to derive from bird bone (see Figure 110w).

Even with the small collection, the bone beads appear to be distributed evenly over the site. Most of the beads were found in Levels 3 and 4, much like the shell beads.

Table 39. Metric Data on Bone Beads.

Test Pit	Level	Diameter (mm)	Perforation Diameter (mm)	Length (mm)
Disc Beads				
8A	4	5.6	1.5	
9C	3	5.3	1.6	
12B	3	6.7	1.9	
12C	4	5.9	1.7	
Tubular Beads				
13	3	6.6	4.2	12.0
14	4	3.2	1.6	11.3
Fish Vertebrate				
13	5	2.9	0.8	

Stone Beads

Ten stone beads were recovered from the midden excavated in 1989 (Table 40). These beads were made primarily of black chlorite schist, although the raw material of two beads could not be determined macroscopically. The beads were either conically or biconically drilled. All were disc-shaped and most were highly polished (see Figure 111v). There was no strong pattern to the spatial distribution of the beads, with individual specimens found throughout the site. Vertically, most of the beads were found in Levels 3 and 4, with the frequency tapering off both above and below these levels.

Stone and bone beads were made beginning in the Middle period throughout the Late period. King (1981:287) notes a trend toward decreasing size through time. He also attributes a decrease in popularity of stone and bone beads during the Late period to their replacement by other types of beads, notably abalone rim tubes, small columella beads, and decorative types of olivella callus beads.

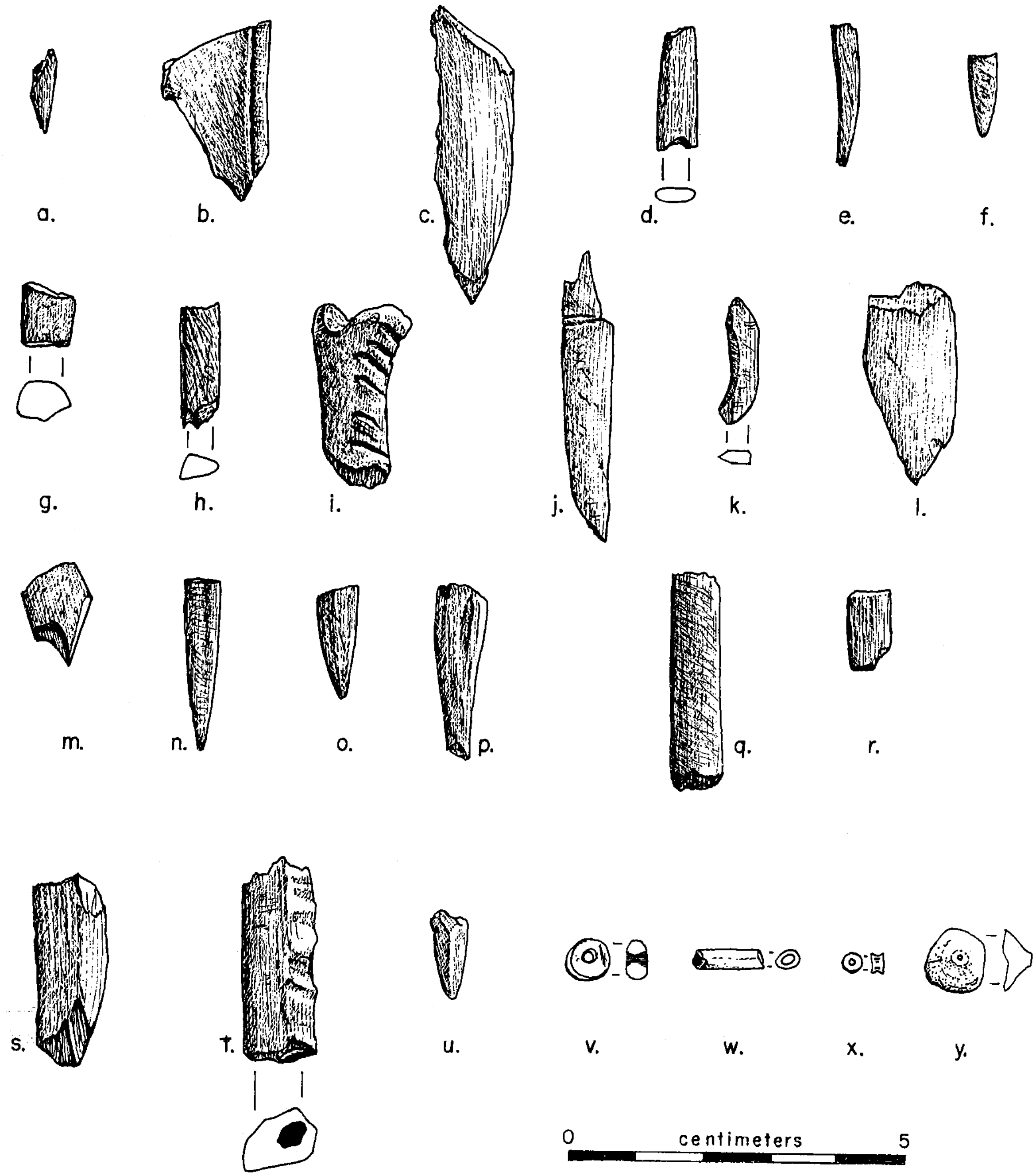


Figure 111. Bone artifacts and stone beads from the Admiralty Site.

Table 40. Stone Beads.

Test Pit	Level	Diameter (mm)	Perforation Diameter (mm)	Raw Material
1D	3	6.3	1.8	Schist
2D	2	5.3	1.4	Unknown
2D	4	5.0	1.4	Schist
7	4	4.5	1.7	Schist
8A	7	6.3	1.2	Schist
9A	5	4.5	1.6	Schist
9B	4	4.5	1.8	Unknown
12A	6	6.8	2.1	Schist
12B	3	7.9	1.9	Schist
12C	3	4.8	1.2	Schist

The Admiralty site stone beads appear to date to the Late period. All are relatively small, disc-shaped, and polished, attributes that King (1981:287) assigns to the Late period. Moreover, most are made from black chlorite schist, a favored Late period material.

SHELL ARTIFACTS

In addition to beads, 11 pieces of ground or flaked shell were recovered from the Admiralty site (see Figure 112a-k). Evidence of grinding was found on eight pieces of *Chione*. Grinding was always restricted to the lower edge of the dorsal side and ranged between 6 and 12 mm in width. The ground area varied from a small portion of the shell to the entire shell margin. Striations indicate that the grinding was generally perpendicular to the shell edge, but oblique striations were also noted on a few pieces. Grinding appears to have been conducted by movement away from the edge of the shell, resulting in a beveled edge, rather than a sharp one. Without detailed microscopic edge-wear analysis, it is not possible to determine the function of the tools with any certainty. Even so, it appears that the shell tools were used primarily for cutting and scraping.

Four shells, including one of the ground shells (see Figure 112h), contained evidence of flaking (see Figure 112i-k). The ground and flaked shell was a species of *Chione*, whereas the other flaked shells were all Washington clam (*Saxidomus nuttalli*) remains. The flakes were relatively small, ranging in size between 3 and 15 mm. Pressure flaking appears to be the most likely technique of manufacture. One piece had been flaked bifacially; all others were flaked only on their dorsal side.

Ground and flaked shell pieces were recovered from only four test pits (Table 41). These test pits, 9, 12, 13, 14, were distributed throughout the site, so the restriction of shell tools to a small number of units does not appear to correspond with one discrete activity area. Further, shell tools were distributed vertically between Level 2 and 5, with no strong pattern emerging.

Grinding is not well documented on shell tools along the southern California coast. Treganza and Malamud (1950:149) describe a small mussel shell with one ground edge recovered from the Tank site

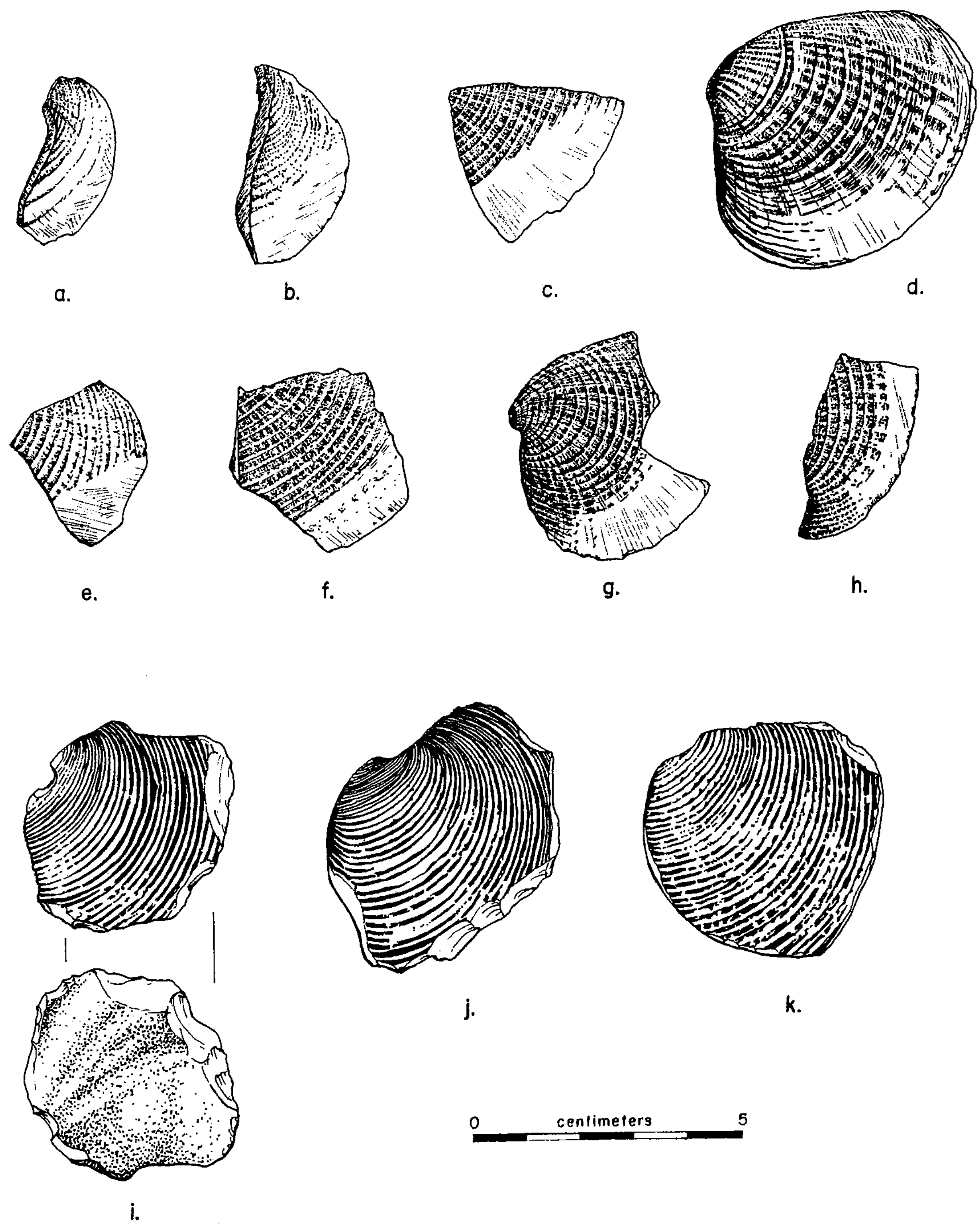


Figure 112. Shell artifacts form the Admiralty site.

Table 41. Ground and Flaked Shell Tools

Test Pit	Level	Figure	Grinding or Flaking	Comment
9A	1	10.3i	Flaked	Large fragment of *Saxidomus nuttalli* that has been bifacially flaked along the lower edge of the shell. Flaking is discontinuous with some portions of ventral side flaked along corresponding areas of the dorsal side and other portions in areas absent of flaking from the other side.
9A	1&2	10.3h	Ground and Flaked	*Chione* sp. shell fragment ground on lower portion of the dorsal side; striations are ground at a 45^{o} angle from the edge; pressure flaking is evident along the edge of the shell; flake scars have been ground.
9A	4	10.3	Flaked	Large portion of *Saxidomus nuttalli* shell with three small areas of flaking on the dorsal side.
9A	5	10.3d	Ground	Whole *Chione californiensis* shell with grinding along a small portion of the lower margin of the dorsal surface. Striations are ground perpendicular from the shell edge.
12	4	10.3b	Ground	Unknown shell fragment ground along the entire margin of the dorsal side; striations are ground in two direction, one perpendicular to the edge, the other at about a 45^{o} angle.
12A	2	10.3c	Ground	*Chione* sp. shell fragment ground along the entire lower margin of the dorsal side; striations are ground perpendicular to the edge.

Table 41. Ground and Flaked Shell Tools (continued).

Test Pit	Level	Figure	Grinding or Flaking	Comment
12A	5	10.3f	Ground	*Chione* sp. shell fragment ground along the entire lower margin of the dorsal side; striations are ground perpendicular to the edge.
13	2	10.3a	Ground	Unknown shell fragment ground along the entire dorsal margin; striations found in all directions away from the edge.
13	3	10.3e	Ground	*Chione* sp. shell fragment ground on one portion of the dorsal edge; striations are ground both perpendicular to the edge and at a 40° angle.
14	2	10.3g	Ground	*Chione californiensis* sp. shell fragment ground on a large portion of the lower dorsal surface; striations are ground perpendicular to the edge; artifact may have been broken in use, although this conclusion cannot be demonstrated.
14	5	10.3j	Ground	Almost complete *Saxidomus nuttalli* shell with discontinuous flaking along most of the edge.

in Topanga Canyon. The authors state that the artifact resembled mussel shell scrapers from northwestern California (see also Gifford 1947). At the Little Sycamore Shellmound in Ventura County, Wallace et al. (1956) describe a spatulate object made from Washington clam (*Saxidomus nuttalli*) that had a broad round blade at one edge and a tip smoothed from wear. The natural curve of the hinge provided an upturned handle that was cut off at the end. The artifact was interpreted as a smoothing or polishing device. At the Thousand Springs site (CA-SNi-11), which dates from the Intermediate through the Late period on San Nicholas Island, Reiman (1982) recovered 68 modified shell tools and fragments. Modifications included cutting, pecking, grinding, polishing and perforation. Twenty artifacts appear to be parts of pendants or disks. One complete and one fragment of a spoon were also found. The presence of shell tools from early sites, such as the Tank site and the Little Sycamore Shellmound, as well as from the relatively late Admiralty site suggests that the use of shell as tools has a long history along the coast.

The shell tools found at at the Admiralty site appear to be expedient tools. No artifact shows a high degree of preparation or evidence of formal production. Instead, all artifacts probably were made for immediate use with an abundant raw material. Whether a shell tool was worked by grinding or flaking appears to relate to the thickness of the shell. Thicker shells were flaked, whereas thinner ones were ground. All shell tools at the Admiralty site appear to have been used in scraping or cutting activities, although this hypothesis needs to be studied through use-wear analysis.

BONE TOOLS

The 21 bone tools can be divided into five categories: points, tips, tubes, incised, and miscellaneous. The first two categories both represent 13 artifacts that have been worked to a point at one end. They are distinguished by the mode of production and the sharpness of the point. Tips are bone tool fragments that generally have been worked to a point by grinding or polishing, whereas points are produced by flaking or breaking the bone. Tips correspond to artifacts that commonly are termed awls, needles, or fishhooks. Awls and needles are perforating tools used in the manufacture of basketry, textiles and other clothing as well as in some food preparation (Gifford 1940). Needles are distinguished from awls on the basis that the former have eye-holes, whereas the latter are solid without and eye or groove for cord attachment (Gifford 1940:168). In the admiralty site collection, there was only one specimen that contained evidence of an eye-hole, and therefore could definitely classified as a needle. Other tips may have derived from needles, but without the proximal end of the artifact there is no way to distinguish whether the piece is an awl or needle.

Tips also could have been part of fishhooks. Bone fishhooks are common artifacts in costal sites throughout California (Gifford 1940). Johnson recovered a harpoon fishhook, a relatively rare artifact in the Los Angeles Basin, from the Admiralty site in 1961. Without microscopic analysis it is impossible to determine function, but given the relatively large number of fish remains at the site, the use of tips as fishhooks cannot be dismissed.

Six bone artifacts were classified as points. One point may have been used as a projectile (see Figure 111u). It was relatively small and triangular in shape, not unlike many of the chipped stone points. The other five bone points appear to have been used as cutting tools. All were made from medium or large animal long bones. Two of the points (see Figure 111b and j) had incisions that may have been scoring marks for planned breakage. One specimen (see Figure 111m) had been flaked to a point, whereas the other five had been shaped by grinding.

One hollowed tube was recovered. Likewise, one incised artifact (other than a point) was found during the excavations. The functions of these artifacts are unknown. The incised piece was the proximal end of a small mammal long bone that had parallel cut marks running across the width of the bone. The cut marks would have provided grooves for a ratchet-like tool. The tube also contained grooves on the outside; however, these were probably the result of rodent chewing, and not cultural modification.

Six bone artifacts were recovered that had clear evidence of cultural modification. Most of these artifacts were midsections, and are probably parts of sewing or fishing implements. However without more of the tool being present, no function can be inferred.

The vertical and horizontal distribution of bone tools mirrors that of other artifact types. Bone artifacts were found in all test pits, except Test Pit 7 (Table 42). No spatial pattern in the distribution of artifacts could be discerned. Bone artifacts were concentrated in Levels 3 and 4, with a range between Levels 1 and 7. The vertical pattern appears to follow a normal distribution.

Table 42. Bone Tools.

Test Pit	Level	Figure	Type	Comment
1A	6	10.2d	tip	Small mammal bone fragment that has been polished and shaped to create an oval cross section; the piece probably represents the distal end of a needle or awl; the end of the piece had been had been drilled through the shaft; the resulting hole or eye of the needle had been fractured, leaving only the upper half of the hole.
1B	2	10.2t	tube	Medium mammal fragment that has been hollowed into a tube; incisions on the side are probably rodent marks.
1B	3	10.2n	tip	Small mammal bone fragment worked on one end into a tip; lightly polished; probably used as an awl tip or fishhook.
1C	1&2	10.2o	tip	Small mammal bone fragment worked on one end into a tip; lightly polished; probably used as an awl tip or fishhook.
1C	1&2	10.2p	tip	Small mammal bone midsection fragment worked on one end into a tip; the tool was not polished or smoothed indicating that it was probably never finished.
2A	4	10.2b	point, incised	Medium mammal bone (probably scapula) with incised line along one edge; breaks in the bone had created a point at one end, whether this was the result of natural forces or cultural activity could not be determined.
2D	2	10.2c	point	Large mammal long bone fragment sharpened at one end to a point.
8A	6	10.2g	miscellaneous	Polished small mammal fragment that appears to be a midsection of a larger tool.
8C	4	10.2h	miscellaneous	Triangular small mammal midsection fragment; lightly polished.

Table 42. Bone Tools (continued).

Test Pit	Level	Figure	Type	Comment
8C	4	10.2i	incised	Proximal end of a small mammal long bone; cut (not rodent chewed) marks perpendicular to the long axis on the interior.
9A	1	10.2u	point	Small mammal bone that has been worked into a point; possibly used as a projectile point.
9A	3	10.2a	point	Small broken point; may have been used as an awl tip or part of a fishhook.
12A	4	10.2m	point	Medium mammal bone fragment flaked on the dorsal side at one end to create a point.
12B	4	10.2e	tip	Highly polished small mammal fragment; the piece is rounded and appears to be the end of an fishhook; the curvature of the piece is consistent with this interpretation.
12B	5	10.2l	point	Large mammal bone fragment worked on one end to a point.
12B	7	10.2j	point, incised	Medium mammal long bone worked to a tip or point at one end; incisions around the shaft were noted at the other end of the piece; these incisions may have been used as scoring marks for breakage.
12C	3	10.2f	tip	Polished small mammal fragment worked to a rounded tip at one end; possible awl tip or composite fishhook.
13	1	10.2s	miscellaneous	Medium mammal bone fragment that has been flaked on both edges of the dorsal surface.

Table 42. Bone Tools (continued).

Test Pit	Level	Figure	Type	Comment
13	3	10.2r	miscellaneous	Small mammal midsection fragment beveled cut observed along one end.
13	7	10.2q	miscellaneous	Highly polished small mammal midsection fragment.
14	3	10.2k	miscellaneous	Small mammal tabular fragment that has been ground on the dorsal surface and cut on the ventral surface into a crescent shape.

DISCUSSION

Based on cross dating with the Santa Barbara Channel sequence, the beads recovered at the Admiralty site represent types manufactured from the later part of the Middle period (ca. A.D. 900) to historic times. The age ranges for most of the bead types overlap with the early portion of the Late period. This period corresponds well with the radiocarbon dates from the site, placing the occupation between A.D. 1050 and 1150. There are a few anomalies. *Olivella* spire ground beads are dated in the Santa Barbara region between A.D. 900 and 1050, whereas production of *Olivella* lipped and *Olivella* cylinder beads begins after A.D. 1500. Further, rough and chipped *Olivella* disc beads have often been found in protohistoric and historic contexts.

While anomalies exist, they should not overshadow the fact that over 90 percent of the beads date comfortably within the range of the absolute dates obtained for the site. Instead of questioning the radiocarbon dates, a more profitable line of inquiry may be to investigate the cross-dates. Bead type seriations from the Santa Barbara Channel are likely to be similar, yet slightly out of phase with the Los Angeles Basin. It is possible that some bead types, such as *Olivella* spire ground beads, continued to be made in the Los Angeles area after their use was discontinued further north, whereas the manufacture of abalone lipped and cylinder beads may have begun earlier south of Santa Barbara and then moved north. Resolving these issues requires synthesizing and integrating bead data from a number of securely dated sites throughout the Los Angeles Basin.

In addition to beads, a small number of bone and shell artifacts, representing a surprisingly diverse set of functions, were recovered at the Admiralty site. The shell tools all appear to have been used either as expedient knives or scrapers. Similar tools have not been documented elsewhere in the Ballona, nor in the immediate region along the coast.

The number of bone tools recovered at the Admiralty site is substantially lower than that obtained from sites on the bluffs. For example, 1,588 bone tools were recovered from the Loyola-Marymount site (CA-LAn-61). Even though the collection was small, the same types of bone tools were found at the Admiralty site as represented elsewhere in the Ballona. Most of the bone tools represent either awls, needles, or fishing implements. Based on the analysis of bone tools from the Marymount

(CA-LAn-61A), Loyola (CA-LAn-61B) and Del Rey (CA-LAn-63) sites, DiGregorio (1987:171) outlines seven attributes that are helpful in distinguishing whether broken bone tips are fishing or sewing implements. In order of importance, these attributes are:

1. cordage impressions present on the shank
2. asphaltum stains
3. shank with a rectangular cross-section grading to a point with a round or oval cross section
4. notched, beveled, or wedge-shaped base
5. recurved tip
6. semi-circular shank with one flat side
7. lack of scars typically found on basketry awl tips

DiGregorio (1987) states that if two or more of the above attributes are present on a tip, then it was probably used as a gorge, fishhook, or fishing arrowpoint. One artifact recovered at the Admiralty site had a recurved tip, but otherwise none of the tips were characterized by these attributes. At present, it appears both sewing and fishing implements are represented in the Admiralty site collection, although the proportions of tips deriving from one activity or the other cannot be determined without further study.

CHAPTER 11

INVERTEBRATE FAUNAL ANALYSIS OF THE ADMIRALTY SITE

Steven Troncone, Chester W. Shaw, Jr., and Jeffrey H. Altschul

Research Questions

The vast majority of archaeological material recovered from the Admiralty site consists of invertebrate faunal remains. Most of these are the remains of shellfish that were used as food, although other noneconomic invertebrate species also were recovered. The invertebrate collection is described and analyzed in this chapter. The shell analysis was guided by the following research questions:

1) What is the comparability of the shell assemblage between excavation units and flotation columns? As compared to the shell from excavation units, do the flotation columns provide a representative sample size for analysis?

2) What is the nature of intrasite variability? Does the shell distribution vary horizontally and vertically at the Admiralty site? What is the degree of correspondence between shell spectra from comparable vertical levels at the site? What are the implications of vertical variations in terms of environmental, dietary, or cultural charge through time? What are the implications of horizontal variations for reconstructing cultural site formation processes?

3) What shell species are represented at the Admiralty site? What are the relative proportions of shell species? What are the implications of the shell assemblage regarding environmental conditions in the Ballona Lagoon at the time the Admiralty site was occupied?

4) How does the diversity and relative abundance of shell from the Admiralty site compare to other sites in the Ballona Lagoon?

5) Based on the caloric value of the meat procured from different shell species and the length of time the site was occupied as indicated by the absolute dates obtained from shell and humates, how many people might have been sustained in the portion of the site that was mitigated?

Methods

Shell remains were recovered from the fill and flotation samples from each test pit. The sediment of each 10-cm level from a test pit was water-screened through 1/8-inch mesh (3.175 mm) hardware cloth screens. Shell was sorted initially from the water-screened residue in the field to separate whole shell, shell fragments larger than about 12 mm (that is, larger than a nickel), and whole or fragmentary exotic shell from the other materials recovered from the screens.

One corner of each test pit was left for a flotation column, which measured 25-cm by 25-cm. Flotation samples were taken in 10-cm increments. Shell from from each flotation sample was obtained from the heavy fraction. Because the heavy fraction was recovered from a 30-mesh (0.847 mm) sieve, virtually all of the whole and fragmentary shell contained within the flotation columns was recovered. Consequently, these samples served as controls that allowed us to determine the representativeness of shell from the test pits. Because no shell smaller than 3.175 mm was recovered from the test pits and because much of the shell smaller than 1.2 cm was not collected, certain biases were inherent. The flotation samples provided data for determining the effects of methodological biases, thereby enabling the recovery methods to be assessed.

After drying the heavy fractions from the flotation samples, they were dry-sieved through a 10-mesh (2.54 mm) sieve, thereby splitting the sample into a small (0.847 to 2.54 mm) and large (>2.54 mm) subsamples (or fractions). Shell was then separated from the small fraction using a pair of tweezers and a luminated magnifying glass. Shell was sorted by hand from the large subsample.

Because the shell material recovered from the test pits had been water-screened in the field, little or no additional cleaning for identification was necessary. The material recovered from the flotation columns was cleaned as needed with water using a soft toothbrush.

Species identifications were aided by referring to standard shell references (e.g., Abbott 1968; McLean 1978; Rehder 1981). Based on illustrations and descriptions contained in the various references, a comparative type collection was compiled. The type collection was submitted to Dr. James McLean, malacologist at the Los Angeles County Museum of Natural History, to verify the identifications.

Shell remains were analyzed and the data recorded on a level-by-level basis. For ease in computer coding, each species was assigned a numeric code (Table 43). After identification, four attributes were recorded for each species: minimum number of individuals (MNI), total weight by species, total weight of these individuals, and total weight of the remaining fragments (of that species). Weights were determined using an Ohaus triple-beam balance with an accuracy of ± 0.1 g. MNI was calculated for each analytic unit, defined as a 10-cm level within a 2-m by 2-m test pit. The calculation consisted of counting all whole shells and fragments containing more than half of the umbo (or hinge). Because most species were bivalves, this number was then divided by two to obtain the MNI. The MNI of gastropod species was determined by counting the number of fragments that appeared to represent more than half of the shell.

Sampling Strategy

The sampling strategy was designed to analyze a representative sample of shell remains from the Admiralty site. The strategy evolved in response to ongoing analytic results. Initially, we wanted to determine whether there were significant differences between the proportional representation of shellfish species obtained from test pit levels and their associated flotation samples. Significant differences could stem from two causes. First, recovery techniques differed, with test pit levels screened through 1/8-in mesh and flotation samples screened through 1/32-in mesh. Smaller species, then, might be absent or underrepresented in the test pit material. Second, the volume of the samples differed dramatically. Test pits levels consisted of 0.4 m^3 of fill, whereas flotation samples were only 0.006 m^3.

If we found that there were no significant differences between the test pit levels and the flotation samples in the types of shellfish species and their proportional representation, then we could argue that the analysis of shellfish could be restricted only to the flotation samples. This result would greatly

Table 43. Species Numerical Code for CA-Lan-47 Shell Analysis.

Code	Common Name	Scientific Name
1	Common California venus	*Chione californiensis*
2	Frilled California venus	*Chione undatella*
3	Native Pacific oyster	*Ostrea lurida*
4	Common Pacific littleneck	*Protothaca staminea*
5	Pacific smooth venus	*Chione fluctafraga*
6	Pacific gaper	*Tresus nuttalli*
7	Scallop sp.	*Argopecten* sp.
8	Pismo clam	*Tivela stultorum*
9	Onyx slipper shell	*Crepidula onyx*
10	California jacknife clam	*Taegelus californianus*
11	Common Washington clam	*Saxidomus nuttalli*
12	Black abalone	*Haliotis cracherodii*
13	Bent-nose macoma	*Macoma nasuta*
14	Spiney or Pacific cockle	*Trachycardium quadragenarium*
15	Lewis moon shell	*Polinices lewisii*
16	Purple clam	*Nuttallia nuttallia*
17	California mussel	*Mytilus californianus*
18	Pacific white venus (white amiantes)	*Amiantis collosa*
19	Western mud whelk	*Nassarius tegula*
20	Kellet's whelk	*Kelletia kelletii*
21	California donax	*Donax californica*
22	Gould's wedge shell	*Donax gouldii*
23	Gilded tegula	*Tegula aureotincta*
24	Black tegula	*Tegula funebralis*
25	Barnacle	Various
26	Purple dwarf olive	*Olivella biplicata*
27	Western lean nassa	*Nassarius mendicus*
28	Polson's dwarf triton	*Ocenebra polsoni*
29	Hairy or mossy mopalia (chiton)	*Mopalia ciliata*
30	California horn shell	*Cerithidae californica*
31	Livid macron	*Macron lividus*
32	Western scaled worm shell	*Serpulorbis squamigerus*
33	Wavy turban	*Astraea undosa*
34	Tinted wentletrap	*Epitonium tinctum*
35	California cone	*Conus californicus*
36	Unidentifiable species	

decrease analysis and processing time, for only 1/64 of the volume would have to be examined per level.

Initially four test pits and their associated flotation columns were analyzed. The units, Test Pits 2A, 12A, 13, and 14, were chosen to provide spatial coverage of the entire site. We hypothesized that if the deposit in the right-or-way represented a single homogeneous component, then the percentages of various shellfish species should be relatively similar between the test pits. Statistical summaries in the forms of percentages and frequencies indicated that the expected trend was met, but that the pattern was not as strong as anticipated. As a consequence, we expanded the analysis to 4 more units, Test Pits

1A, 7, 8B, and 9A. Thus, eight 2-m by 2-m test pits were analyzed, representing 32 of the 60 sq m (53.3%) excavated at the Admiralty site in 1989.

Excavation Unit-Flotation Column Comparison

The comparison between the invertebrate faunal results from test pit levels and their associated flotation columns had two basic objectives. First, we wanted to determine whether significant differences in either the types of species identified or the proportional representation of species existed between the samples. Second, we wanted to evaluate whether significant differences occurred in shellfish distribution between similar arbitrary levels across the site.

As discussed above, the first objective relates to the issues of recovery techniques and volume analyzed. Although of importance to the interpretation of this data class at the Admiralty site, this statistical analysis is of greater utility as a methodological study. After all, to complete the study over half of all the shellfish remains at the Admiralty site had to be analyzed. Although the results indicate that great confidence can be placed in the representativeness of the collection analyzed for the Admiralty site, they can also be used by other investigators in determining appropriate volumetric sample sizes of shellfish remains to analyze at similar shell middens.

The second objective focused on the use of arbitrary levels to characterize vertical differences in shell distribution throughout the site. Level designations were made sequentially in all test pits excavated at the site. Once excavations were completed questions arose about whether the level designations made in one test pit could be viewed as representing the same depositional activities as levels assigned similar designations in other units. Topographically, the site area varied from one location to another and legitimate questions were raised regarding the comparability of vertical levels in the different test pits.

In order to address the research objectives two pairs of attributes recorded during the course of shell analysis were selected for closer examination. The first pair was total shell weight for all excavation units and total shell weight for all associated flotation units. The second pair was MNI values for excavation units and MNI values for corresponding flotation units.

To examine the issue of comparability, information on shell from separate levels in excavation and flotation units at the site was grouped so test pits could be treated as single analytical units. We reasoned that if significant differences existed between test pits and flotation columns, then these patterns could be discerned statistically regardless of the nature of information contained in separate levels.

Comparability was evaluated according to a specific set of procedures. First, total weight and MNI values for all shell assemblages from excavation and flotation units were standardized by calculating means and standard deviations (Table 44) for all shell assemblages and then determining z-scores for all assemblages. Z-scores were calculated using the formula

$$Z = (\bar{x}-x)/s$$

where Z is the standardized score, $\bar{x}$ is the mean weight or MNI for each test pit, x is the weight or MNI for a particular level, and s is the standard deviation (Blalock 1972:100).

Standardizing the shell data sets was essential because the total shell weight for excavation units varies from that for flotation units simply because the latter units represent smaller volumes. It was the objective of the analysis to determine whether the shell assemblages from excavation units displayed

Table 44. Means and Standard Deviations for Total Shell Weights and MNI for Excavation Units and Flotation Columns at the Admiralty Site.

	Total Weight (g) (Excavation Units)		Total Weight (g) (Flotation Columns)		MNI (Excavation Units)		MNI (Flotation Columns)	
Test Pit	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
1A	53.2	79.8	6.7	8.1	4.0	5.8	0.6	1.0
2A	93.6	148.9	21.8	44.9	6.3	10.7	0.9	1.0
7	68.2	121.9	5.4	3.3	7.2	14.5	0.2	0.4
8B	112.0	248.5	10.4	15.2	12.3	24.0	0.8	1.0
9A	96.3	216.7	12.8	26.3	9.8	20.8	0.9	1.2
12A	200.4	324.9	15.8	22.9	14.1	22.0	1.4	2.3
13	117.2	221.9	9.6	13.4	8.7	17.1	0.7	0.7
14	166.0	287.0	44.0	90.2	18.3	39.4	1.9	2.3

the same distributional properties as assemblages from flotation units. In other words, is it feasible to view flotation units as mirroring the corresponding excavation units? Accordingly, information for both of the variables selected for the study were standardized so that similar scales were used for comparison.

Three statistical tests were used in examining comparability, t-test, Wilcoxon ranked pair sign-test, and Pearson's correlation coefficient (r). The first two tests evaluate whether there is a significant difference between the shell results from the test pits and the flotation columns. The difference between the tests involves their assumptions. A t-test is a parametric statistical test that assumes the data sets being compared are normally distributed. In contrast, the Wilcoxon ranked pair sign-test can does not make assumptions about the distribution of the data being compared. Because few of the shell assemblages from excavation or flotation units were, in fact, normally distributed in terms of total weight and MNI, the Wilcoxon ranked pair sign-test relied more heavily in evaluating the data. The third statistical test, Pearson's correlation coefficient, was used to measure the variation in scores between the two sampling methods. Like the t-test, Pearson's correlation coefficient assumes normally distributed data sets. By squaring the results, we obtain the percentage of variance shared in common between shell assemblages from excavation and their corresponding flotation units.

In terms of total shell weight, significant statistical differences were identified between excavation units and associated flotation columns using an alpha level of 0.5. Although excavation units and flotation columns at the Admiralty site were associated spatially, statistically significant differences in shell weight were found in four out of eight cases using the t-test and six out of eight cases using the

Wilcoxon test (Table 45). At the same time, r values generated from the comparison of excavation units and flotation columns revealed little variation was shared in common between shell assemblages from the two contexts. Twenty-three percent of the variance was shared in common between test pits and flotation columns in Test Pit 1-A: otherwise, no other test pit showed a shared variance above 10 percent. These results demonstrate that as far as weight is concerned the the types of units are quite dissimilar.

The MNI results mirrored the previous findings. Significant differences were found between test pits and flotation columns in five out of eight cases using t-tests, and six out of eight cases using the Wilcoxon test. Pearson's correlation coefficients were somewhat higher, generally ranging between 0.5 and 0.8, with two exceptions, Test Pits 13 and 14, which had scores of 0.4 and 0.5, respectively. The percentage of shared variation was still low, with only Test Pit 9A having a score of over 50 percent.

Statistically, the shell results from flotation columns are not representative of the results from the larger excavation units. The discrepancy between the analytic units is greater for shell weight than MNI, but even for the latter there is less than a 50 percent chance that flotation units could be reliably used to determine MNI values for excavation units. This problem is aggravated further when we move beyond numeric measures, such as weight and MNI, and examine the issue of species diversity. For example, a plot of the Z-scores of total shell weight for excavation units and flotation columns by number of identified species is depicted in Figure 113. This plot reveals an obvious difference between the excavation and flotation data, namely, there is less species diversity in the flotation columns relative to comparable levels from excavation units. Shell species occurring in the lowest weights in excavation units are often not present in the associated flotation columns. This finding is counterintuitive, for we expected to find more species represented in the flotation column because of the smaller screen mesh size used. The statistical results, however, indicate that the controlling factor in shell analysis is the volume of the sample. Although 2-m by 2-m units may be more than is needed to produce consistent and reliable results, it is clear that 25-cm by 25-cm units are too small.

In order to evaluate the second research question outlined, that of determining the similarity of shell recovered from comparable levels in different test pits at the Admiralty site, Wilcoxon ranked pair sign tests were used to compare all levels from different test pits in relation to total shell weight (Table 46). It was reasoned that this latter attribute of shell assemblages would likely be one of the most robust values for gauging level comparability at the site.

Table 45. Results of Statistical Tests Comparing Total Shell Weight and MNI for Excavation Units and Flotation Columns.

	TOTAL WEIGHTS								MNIs								
Statistical Test	Test Pits								Test Pits								
	1-A	2-A	7	8-B	9-A	12-A	13	14	1-A	2-A	7	8-B	9-A	12-A	13	14	
T-Test	2.51	1.54	2.07	2.03	1.4	2.86	1.22	2.12	2.56	2.04	1.98	2.56	2.8	3.37	1.19	1.75	Score
	28	36	8	37	23	59	36	53	28	36	7	34	23	59	36	53	D.F.
	0.02	0.13	0.07	0.05	0.18	0.01	0.23	0.04	0.02	0.05	0.09	0.01	0.01	.00	0.24	0.09	(P)
Wilcoxon	-2.90	-1.70	-1.60	-3.30	-3.00	-3.40	-2.10	-3.10	-1.80	-1.90	-2.00	-2.50	-2.10	-2.50	-0.9	-3.60	Score
	29	37	9	38	24	60	37	54	29	37	8	37	24	60	37	54	D.F.
	.00	0.69	0.11	.00	.00	.00	0.03	.00	0.07	0.05	0.05	0.01	.03	0.01	0.38	.00	(P)
Pearson's	0.48	0.27	0.03	0.23	0.11	.50	.40	0.27	0.59	0.64	0.56	0.51	.80	0.55	0.4	0.5	Score
	0.01	.00	.00	.00	.00	.001	.00	.00	0.001	0.001	0.01	0.001	0.001	0.001	0.01	0.001	(P)
R2	23.0	7.3	0.1	5.3	1.2	2.5	1.6	7.3	3.48	41.0	31.4	26.0	64.0	30.2	0.2	0.3	90%

Total weights:
T-Significant: 1A, 8B, 12A, 14
Wilcoxon Significant: 1A, 8B, 9A, 12A, 13, 14
Pearson's Significant: All Units

MNIs:
T-Significant: 1A, 2A, 8B, 9A, 12A,
Wilcoxon Significant: 2A, 7, 8B, 9A, 12A, 14
Pearson's Significant: All Units

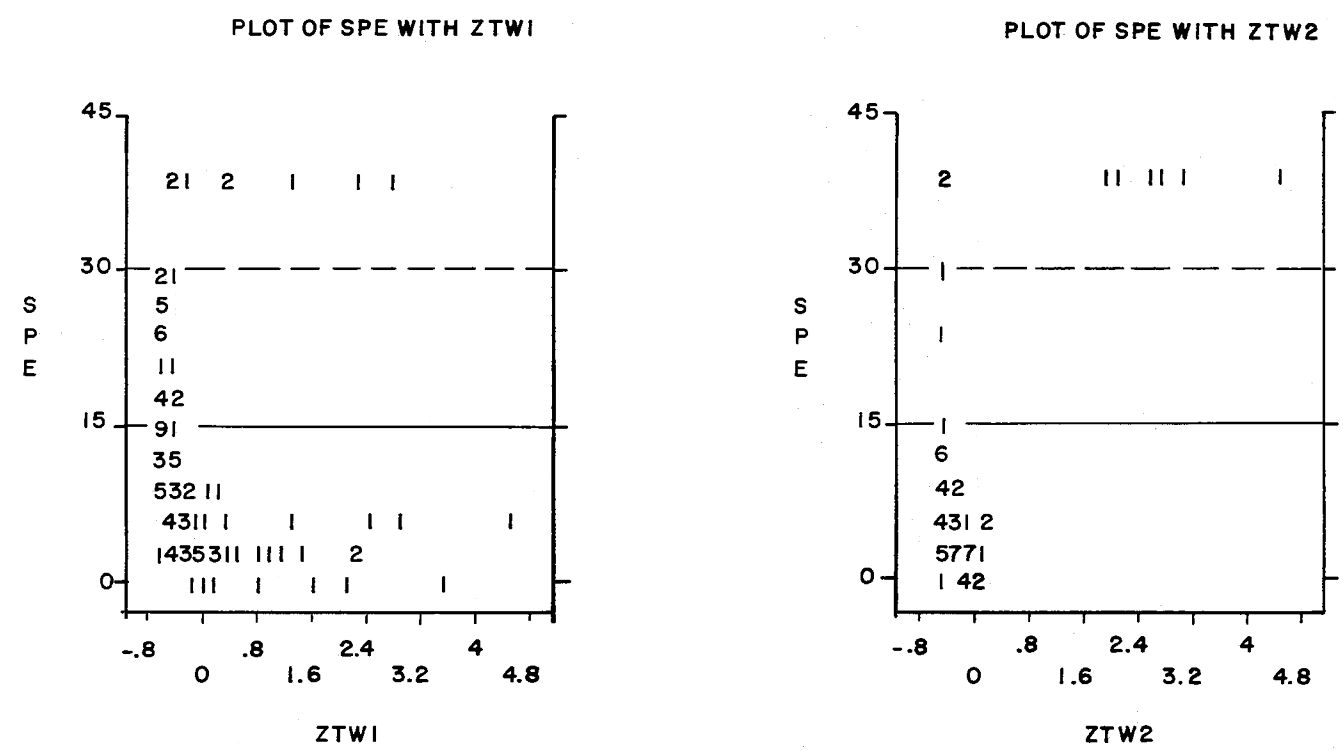


Figure 113. Plot of Z-scores of shell weight for flotation samples and excavation units by number of identified shellfish species.

Table 46. Summary of Wilcoxon Ranked Sign-Test Results From Comparison of Levels in Test Pits Excavated at CA-LAn-47.

Level	Test Pit	1A	2A	7	8B	9A	12A	13	14
1	1A	-							
	2A	*	-						
	7	*	*	-					
	8B		*	*	-				
	9A					-			
	12A	*		*	*		-		
	13							-	
	14	*	*	*	*				-
2	1A	-							
	2A	*	-						
	7	*	*	-					
	8B	*	*	*	-				
	9A					-			
	12A	*	*	*	*		-		
	13	*	*	*	*		*	-	
	14		*	*	*		*	*	-
3	1A	-							
	2A		-						
	7		*	-					
	8B	*	*	*	-				
	9A	*	*	*	*	-			
	12A				*	*	-		
	13		*	*	*	*	*	-	
	14		*		*	*	*	*	-
4	1A	-							
	2A	*	-						
	7	*	*	-					
	8B		*		-				
	9A		*						
	12A				*		-		
	13		*	*	*	*		-	
	14				*	*	*		-

* Statistically significant match.

Table 46. Summary of Wilcoxon Ranked Sign-Test Results From Comparison of Levels in Test Pits Excavated at CA-LAn-47 (continued).

Level	Test Pit	1A	2A	7	8B	9A	12A	13	14
5	1A	-							
	2A	*	-						
	7	*		-					
	8B				-				
	9A		*		*	-			
	12A						-		
	13	*	*	*	*	*		-	
	14						*		-
6	1A	-							
	2A	*	-						
	7			-					
	8B				-				
	9A	*	*			-			
	12A	*	*		*		-		
	13	*	*	*	*	*	*	-	
	14			*					-
7	1A	-							
	2A		-						
	7			-					
	8B	*			-				
	9A	*				-			
	12A						-		
	13	*			*	*		-	
	14	*			*	*	*	*	-
8	1A	-							
	2A		-						
	7			-					
	8B				-				
	9A				*	-			
	12A				*	*	-		
	13				*	*	*	-	
	14				*	*	*	*	-
9	1A	-							
	2A		-						
	7			-					
	8B				-				
	9A					-			
	12A				*		-		
	13							-	
	14								-

* Statistically significant match.

Due to the sheer volume of test results generated in evaluating the second research question results are summaried in Table 47. This table shows that the greatest amount of similarity shared between different test pits occurred in Levels 2 and 3 at the site. In addition, there is a significant drop off in the amount of similarity shared between levels directly above these two levels and in those below.

At first glance, one might conclude that the arbitrary levels are not comparable. With the exceptions of Levels 2 and 3, less than 50 percent of the cases match per level. This result, however, needs to be placed in the overall context of the site. This is especially so since the midden was buried by historic overburden in some areas, whereas in other areas the midden was truncated. Level 1 was especially disturbed, and this disturbance commonly continued to Level 3 in test pits along the old railroad bed. Some test pits were covered by fill imported for the former Pacific Electric railroad bed, sometimes in combination with shell midden graded from elsewhere on the Admiralty site. Others contained dredge spoils from Marina del Rey; and still others were relatively undisturbed. The low level of correspondance between shell weight from level 1 of the various test pits is, therefore, not surprising.

Levels 2 and 3 contained the bulk of the prehistoric shell (53.7%). The relatively high degree of correspondance between shell weights in these levels indicates that Stratum II, the midden deposit was also largely contained within these levels throughout much of the site especially in the less disturbed test pits. If we assume that the midden deposit represents material discarded on prevailing land surface, then the fact most of the cultural deposit lies between 10 cm and 30 cm below the current surface implies that the bulk of the occupation was confined to that zone.

Below Level 3, correspondance between levels in test pits from about 35 to 45 percent until Level 9 where the base of the A horizon (the bottom of Stratum III) is reached. Much of the shell in these levels represents bioturbation processes, such as rodent holes or roots, or historic grading activity, that have carried material to these depths. These processes have affected the site differentially, with the greatest disturbance found near the railroad bed and along the southern edge of the right-of-way. The relatively low level of correspondance between arbitrary levels in this situation is not surprising.

In sum, the analysis of the vertical distribution of shell weight by arbitrary level suggest that reliable comparisons of material found in the same arbitrary levels can be made across the site for

Table 47. Ratios of Statistically Significant Sign-Test Matches Out of All Possible Matches (28) for Total Weight in Levels Across Test Pits Excavated at CA-LAn-47.

Level	Number of Matches	Ratio
1	12	42.8
2	20	71.4
3	20	71.4
4	13	46.4
5	10	35.7
6	13	46.4
7	10	35.7
8	10	35.7
9	1	3.6

Levels 2 and 3, which encompassed the bulk of the shell midden. Materials in other levels, especially below levels 5 or 6, are more likely to have been displaced by natural or man-induced processes, and comparisons between test pits for such levels are suspect.

Habitat Reconstruction

Historically, the Ballona Lagoon exhibits characteristics of both an estuarine lagoon and an estuarine delta. Although an estuarine lagoon is one that is fed by freshwater drainages such as Ballona and Centinela creeks, much of its form is the result of interaction with the the sea. An estuarine lagoon is differentiated from other types of lagoons by the presence of a barrier feature, which limits water exchange.

Because the lagoon received sediment deposited by Ballona Creek, and at times from the Los Angeles River, an estuarine delta resulted. An estuarine delta is a coastal inlet filled with sediment. Drainages typically bifurcate around higher landforms, thereby creating its characteristic braided stream system. The 1861 U.S. Coastal Survey (see Figure 16) map depicts an estuarine lagoon in an advanced stage of development. Large areas of intertidal mud flats are apparent in its delta-like configuration, and the areal extent of open water is limited.

All shell from the Admiralty site was of marine or estuarine origin. The lowest salinity levels that each shellfish species can tolerate are unknown. Nevertheless, relative tolerance of various species are known. For example, oyster is more sensitive than clam species to low levels of salinity. Ballona Lagoon was a large body of water, protected from the ocean by a double barrier. Although subject to tidal fluctuations, the amount of fresh water entering the lagoon varied seasonally and annually. Chapter 17 elaborates on the periodicity of flooding. Because the Ballona Lagoon was fed by fresh water, the degree of salinity and rate of sediment acculumulation varied seasonally. These two factors significantly influenced the species diversity within the lagoon.

Because of the relatively low rate of discharge of Centinela Creek, it had a minor impact on the Ballona. In contrast, Ballona Creek, with its greater flow, had a much greater impact on variations in sedimentation and salinity. Not only does Ballona Creek drain a much larger area (ca. 111 sq mi), but at times the Los Angeles River, which drains much of the Los Angeles Basin, emptied directly into the Ballona Lagoon (Poland et al. 1959:21). The precise impact of the Los Angeles River on the shellfish ecology of the lagoon is unknown, but it probably functioned to eradicate species less tolerant to freshwater conditions, especially after major flood events effectively flushed brackish water out of the lagoonal system. Shellfish collection was probably diminished substantially for several years after major flood episodes.

When the lagoon was mapped in 1861, sedimentation was already great (see Figure 16). Shellfish certainly would have been available in 1861, especially within the extensive network of intertidal mud flats. But species that prefer a more open, sandy environment would have been uncommon. At the time the Admiralty site was occupied, the lagoon was characterized by a complex of geomorphic features, including a protected open water and intertidal mud flats. This type of environmental situation would have been conducive for a variety of shellfish species such as oyster and clam. Because the lagoon would have contained more open water at later times, salinity would have been generally higher than at present.

Coastal environments can be divided into different ecologic zones based on tidal fluctuations, depth of water, and the amount of light. For the purpose of this study, eight environmental zones were defined: open ocean, rocky shoreline, abyssal, sublittoral (shelf bottom), sandy beaches, protected bays, lagoons, and intertidal mud flats. These zones overlap and it is common for a species to inhabit more that one habitat. Although particular species often range between two or more habitats, they commonly inhabited a preferred environment.

As environmental conditions change within a habitat, so too do shellfish assemblages. It is common for a beach to be dominated by a particular shellfish species in one year, while the next it is absent, seemingly replaced by another species. The dynamics governing the distribution of shell are poorly understood. Suffice it to say that shellfish ecology is complex in nature and cannot be adequately explained at present. Not only is there a lack of data regarding the specific environment each species of shellfish will inhabit, but there is virtually no information concerning the relative frequencies or abundance of particular species within a given ecologic zone. Interpretation of the environmental implications of the shellfish data must be at a very general level.

A brief description of each of the eight ecologic zones is described in the following discussion.

1) Open Ocean: The open ocean supports a wide variety of shellfish as well as a planktonic community. Most bivalves and many snails go through a temporary floating veliger (or larval) stage within the pelagic (open ocean) environment. This environmental setting would probably not have been exploited for shellfish by the residents of the Admiralty site.

2) Rocky Shoreline: Just above the normal reach of the high tide is a zone that supports a few tenacious marine snails. Sporadic rainwater and occasional saltwater drenching during storms provide some water to this zone. Periwinkles and limpets commonly inhabit the upper reaches of the rocky shoreline. Just below this relatively arid zone are tidal pools which become isolated at low tide but are flushed with sea water during high tide. Within this temperate zone, tide pools support top shells such as dog winkles, limpets, mussels, and chitons. The rocky shoreline and adjoining tidal pools do not support the types of shellfish species likely to be sought as food resources by the residents of the Admiralty site.

3) Sandy Beaches: Sandy beaches provide a suitable habitat for few mollusks. Conditions are dependent upon the degree of slope as well as the size distribution of sand grains. Mollusks that do exist include wedge clams (*Donax* sp.) and a few carnivorous augers. This habitat probably would not have been exploited by the inhabitants of the Admiralty site.

4) Deep Sea or Abyssal: Abyssal life consists of animals living at depths of 6,000 feet and greater. There are more than 1,200 species of mollusks living at these depths, most are less than one inch in size. They feed on plant detritus and animal matter. Water at these depths is extremely cold and sunlight is absent. Rarely do abyssal mollusks venture into shallow waters. Because of the great depth, the abyssal zone would not have been exploited by the residents of the Admiralty site.

5) Protected Bays: Protected bays are similar to estuarine lagoons with regard to the species they support, however, they are less subject to changes in shellfish assemblages. The surrounding geomorphic structure protects the bay interior from heavy wave action, while at the same time allowing easy access to fish and other aquatic life. Barriers associated with protected bays are not continuous in nature as is the case with estuarine lagoons. Estuarine barriers are composed of sand or other unconsolidated material and therefore are more susceptible to geomorphic change. Shellfish species common to protected bays include *Chione* sp. (venus clams), cockles, gaper, washington clam, onyx slipper, and to a lesser degree *Pecten* sp. and oyster depending upon the composition of the bed. Because the Admiralty site occurs within a protected lagoon, it is reasonable to assume that species indigenous to both protected bays and estuarine lagoons were collected from the Ballona Lagoon.

6) Sublittoral or Shelf Bottoms: Immediately below the low tide to a depth of approximately 300 feet is the continental shelf or sublittoral zone. The edge of this zone drops off steeply into the abyssal

zone. The shelf bottom is composed of a variety of submarine surfaces and ecological niches. The substrate commonly is composed of sand, rock, corral rubble, ooze, or a combination of these. Many intertidal shellfish species also inhabit portions of the shelf bottom down to a depth of approximately 100 feet. Mollusks may be very abundant or entirely absent, depending on the type of sediment as well as other environmental factors. The sublittoral zone may have been exploited for scallop, oyster, and clam species, but collection would have been limited to shallow waters just below the low tide line. The sublittoral area near the Admiralty site may have been rich in mollusks, but the likelihood that people dove to great depths to obtain shellfish is remote. Not only would it have been physically taxing to dive to great depths without modern breathing equipment, but with the abundance of shellfish available within lagoon system, it would have been much easier to procure mollusks from areas closer to the Admiralty site.

7) Lagoons: Lagoons are "shallow bodies of brackish or sea water partially separated from an an adjacent coastal sea by barriers of sand or shingle (clasts larger than 2 mm), which only leave narrow openings through which sea water can flow" (Colombo 1977:63). Lagoons generally are associated with coastlines that have experienced or are experiencing changes in relative land-sea level. Although subject to inundation, lagoons are highly protected from wave action. The biotic community of a lagoon is dependent upon many factors, the most important of which is the water depth. Within newly formed lagoons where water is deep, shellfish such as pismo clam, scallop, lewis moonshell, white venus, mussel, and occasionally oyster, are common. Aside from scallops and oysters, mollusks are less frequent in older, shallow lagoons that are laden with sediment. As streams deposit more and more sediment, a lagoon becomes shallower, and stream systems become braided and bifurcated around areas of mud flats. Shellfish that are common to the shallow, older lagoons include *Chione* sp., (for example, venus, frilled venus, and smooth venus), scallops, jackknife clam, and oyster. The bottom substrate plays a major role in the types of shellfish that can grow. The shallow waters of Ballona Lagoon and the associated mud flats would have provided an ample and usually reliable shellfish food resource. The shellfish species available would have varied somewhat through time. The amount of seawater entering the lagoon would affect the density of shellfish populations. Increased sedimentation would have provided a favorable environment to some species, whereas others would have been limited, if not eliminated. For example, oysters, which are known to prefer rocky substrates and higher salinities, are sensitive to brackish water. Consequently, as the Ballona Lagoon matured, it became less conducive to oyster growth.

8) Intertidal Mud flats: Sand and mud flats are unusually rich in mollusks as well as gastropods. Physical conditions such as temperature, salinity, length of intertidal exposure, sediment type, and barrier stability heavily influence the distribution and abundance of shellfish. Brackish water and muddy sand are favorable to burrowing clams and cerith snails, whereas rocky bottoms are preferred by oysters, drills, and tritons. In areas that support eelgrass, scallops and onyx slipper shells are typically found. In mud flats near the ocean, cockles, moonsnails, tellins, mactra, gaper, jacknife, and razor clams are more abundant. Intertidal mud flats are often divided into a lower zone in which sand is the main deposit, and an upper one in which mud is predominant. With regard to invertebrate fauna, the lower sand flats generally have a low species diversity, but a high biomass. Mollusks found here include *Chione* sp., *Pecten* sp., littleneck, razor clam, cockle, and in some instances oyster. The muddy nature of the upper intertidal zone is the result of brief inundation during high tide. Currents are of greatly diminished during high tide, thereby promoting the deposition of clay particles. Muddy sediment provides a favorable environment for burrowing mollusks, gastropods, and crustaceans, particularly smaller species that were generally of little to no economic value to human populations. The intertidal mud flats within the interior of Ballona Lagoon and its surrounding periphery would have provided an ideal habitat for large amounts of economic shellfish. The intertidal mud flats, together with the lagoon itself, would have produced vast numbers of mollusks which would have been easily procured by the residents of the Admiralty site.

Shellfish Identified from the Admiralty Site

A total of 110.9 kg of shell was examined from the eight test pits analyzed from the 1989 excavations at the Admiralty site. A minimum of 7,544 individuals were identified, representing 35 shellfish species (Tables 48 and 49; species present in quantities less than 1 g are deleted from these tables, but are listed in Table 43). Data from the invertebrate analysis are presented here, and are described in finer detail in Appendix C.

Of the 35 shellfish species represented in the collection, 7 accounted for 98.4 percent of the total shell weight analyzed and 94.7 percent of the MNI identified from the test pits. These same species represented 98.2 percent of the total shell weight and 87.4 percent of the MNI identified from the corresponding flotation columns analyzed. The habitat and range of each of these mollusk are described.

Common California Venus (*Chione californiensis*)

Habitat: Valves of this species are found in the sand and mud flats of shallow bays and lagoons near the low tide line. Although less common in deep water, Common California venus also occur in waters up to 200 feet deep. The shellfish also commonly grows in large numbers near the surface of muddy and sandy deposits.
Range: Santa Barbara, California, to Panama.
% MNI: 22.9

Frilled California Venus (*Chione undatella*)

Habitat: This species is found in the intertidal sand and mud flats of bays and lagoons. Frilled California Venus commonly occur in shallow waters, where they are easy to procure.
Range: Santa Barbara, California, to Peru.
% MNI: 17.0

Pacific Smooth Venus (*Chione fluctafraga*)

Habitat: A fairly common species found in intertidal mud flats and sand of bays and lagoons.
Range: Northern California to Baja California.
% MNI: 2.9

Native Pacific Oyster (*Ostrea lurida*)

Habitat: This species is found in intertidal mud flats and gravel bars. It is also found in estuaries, bays and lagoons, attached to a hard substrate.
Range: Southern Alaska to Southern Baja.
% MNI: 31.8

Table 48. Shell Weight Identified from the Test Pits.

Scientific Name	Common Name	1A		2A		7		8B		9A		12A		13		14		Total	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Chione californiensis	Common California Venus	1168	42.6	1754	38.2	1408	40.7	4398	33.1	3264	38.9	5657	34.1	3012	37.7	4344	28.4	25005	34.6
Chione undatella	Frilled California Venus	1021	37.3	1661	36.2	840	24.3	3921	29.5	1967	23.5	5346	32.2	2585	32.3	2968	19.4	20309	28.1
Chione fluctrifraga	Pacific Smooth Venus	91	3.3	69	1.5	116	3.4	478	3.6	334	4.0	469	2.8	285	3.6	477	3.1	2319	3.2
Amiantis callosa	Pacific White Venus			23	0.5					40	0.5					18	0.1	81	0.1
Tresus nuttalli	Pacific Gaper	74	2.7	118	2.6	122	3.5	337	2.5	270	3.2	670	4.0	149	1.9	599	3.9	2339	3.2
Tivela stuitorum	Pismo Clam	4	0.1	36	0.8	20	0.6	25	0.2	7	0.1	6	0.0			5	0.0	103	0.1
Argopecten sp.	Calico Scallop			161	3.5	92	2.7	310	2.3	198	2.4	472	2.8	209	2.6	852	5.6	2294	3.2
Ostrea lurida	Native Pacific Oyster	76	2.8	517	11.3	482	13.9	2001	15.1	1434	17.1	2229	13.4	1069	13.4	4182	27.4	11990	16.6
Crepidula onyx	Onyx Slipper Shell	3	0.1	7	0.2			13	0.1	10	0.1	20	0.1	5	0.1	19	0.1	77	0.1
Protothaca staminea	Common Pacific Littleneck	283	10.3	218	4.8	325	9.4	1623	12.2	779	9.3	1572	9.5	621	7.8	1660	10.9	7081	9.8
Tagelus californianus	California Jackknife Clam	3	0.1	5	0.1	12	0.3	37	0.3	33	0.4	83	0.5	11	0.1	99	0.6	283	0.4
Macoma nasuta	Bent-nose Macoma			2	0.0			6	0.0	6	0.1	5	0.0	2	0.0	8	0.1	29	0.0
Saxidomus nuttailli	Common Washington Clam			10	0.2	5	0.1	16	0.1	2	0.0	7	0.0					40	0.1
Tegula aureotincta	Gilded Tegula			1	0.0			1	0.0			1	0.0			1	0.0	4	0.0
Ocenebra poulsoni	Poulson's Dwarf Triton													2	0.0			2	0.0
Cerithidea californica	California Horn Shell							1	0.0					1	0.0	1	0.0	3	0.0
Mytilus californianus	California Mussel							21	0.2	4	0.0	1	0.0			5	0.0	31	0.0
Polinices lewisii	Lewis' Moon Shell	7	0.3					3	0.0									10	0.0
Mopalia ciliata	Hairy Mopalia							31	0.2	3	0.0	2	0.0					36	0.0
Haliotis cracherodii	Black Abalone	1	0.0	6	0.1	2	0.1	13	0.1	11	0.1	5	0.0	21	0.3	19	0.1	78	0.1
Olivella biplicata.	Purple Dwarf Olive																	0	0.0
Astraea undosa	Wavy Turban							2	0.0									2	0.0
Tegula funebralis	Black Tegula					2	0.1			1	0.0	1	0.0			5	0.0	9	0.0
Serpulorbis sp.	Western Scaled Worm Shell											1	0.0			1	0.0	2	0.0
Trachycardium quadragenum	Spiny Cockle					11	0.3	13	0.1			2	0.0					26	0.0
Nuttallia nuttallia	Purple Clam	9	0.3	1	0.0	19	0.5	35	0.3	21	0.3	54	0.3	23	0.3	13	0.1	175	0.2
Total Identified		2740	100.0	4589	100.0	3456	100.0	13285	100.0	8384	100.0	16603	100.0	7995	100.0	15276	100.0	72328	100.0
Total Unidentified		511	--	989	--	438	--	609	--	278	--	5440	--	2642	--	2845	--	13752	--

Note: All percentages rounded to nearest 0.1%.

Scientific Name	Common Name	1A		2A		7		8B		9A		12A		13		14		Total	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Chione californiensis	Common California Venus	78	29.3	117	31.5	100	25.6	297	20.5	225	25.8	376	24.6	213	27.0	324	17.3	1730	22.9
Chione undatella	Frilled California Venus	65	24.4	110	29.6	59	15.1	276	19.0	120	13.7	284	18.6	148	18.8	220	11.7	1282	17.0
Chione fluctrifraga	Pacific Smooth Venus	12	4.5	3	0.8	7	1.8	31	2.1	24	2.7	49	3.2	39	5.0	50	2.7	215	2.9
Amiantis callosa	Pacific White Venus			1	0.3					1	0.1							2	0.0
Tresus nuttalli	Pacific Gaper	5	1.9	4	1	8	2.1	33	2.2	20	2.3	54	3.5	14	1.8	46	2.5	184	2.4
Tivela stuitorum	Pismo Clam			2	0.5	3	0.8	1	0.0	4	0.5	2	0.1			1	0.0	13	0.2
Argopecten sp.	Calico Scallop	10	3.7	21	5.7	11	2.8	66	4.5	32	3.7	67	4.4	35	4.5	122	6.5	364	4.8
Ostrea lurida	Native Pacific Oyster	71	26.7	77	20.7	136	34.9	420	29.0	301	34.5	376	24.6	242	30.7	773	41.2	2397	31.8
Crepidula onyx	Onyx Slipper Shell	2	0.8	2	0.5			11	0.8	6	0.7	36	2.4	2	0.3	33	1.8	92	1.2
Protothaca staminea	Common Pacific Littleneck	15	5.6	27	7.3	54	13.8	252	17.4	104	11.9	204	13.3	65	8.3	251	13.4	972	12.9
Tagelus californianus	California Jackknife Clam	1	0.4	1	0.3			21	1.4	25	2.9	21	1.4	4	0.5	26	1.4	99	1.3
Macoma nasuta	Bent-nose Macoma			1	0.3			4	0.3	1	0.1	6	0.4	2	0.3	8	0.4	22	0.3
Saxidomus nuttailli	Common Washington Clam							1	0.0									1	0.0
Tegula aureotincta	Gilded Tegula			1	0.3			1	0.0			3	0.2			1	0.0	6	0.1
Ocenebra poulsoni	Poulson's Dwarf Triton													1	0.1			1	0.0
Nassarius mendicus	Western Lean Nassa			1	0.3			3	0.2									4	0.0
Cerithidea californica	California Horn Shell							2	0.1	1	0.1	2	0.1	5	0.6	2	0.1	12	0.2
Mytilus californianus	California Mussel							2	0.1	1	0.1					2	0.1	5	0.1
Polinices lewisii	Lewis' Moon Shell	1	0.4					3	0.2					1	0.1	1	0.0	6	0.1
Mopalia ciliata	Hairy Mopalia											1	0.0	1	0.1	1	0.0	3	0.0
Haliotis cracherodii	Black Abalone							6	0.4					1	0.1	1	0.0	9	0.1
Olivella biplicata	Purple Dwarf Olive			1	0.3													1	0.0
Astraea undosa	Wavy Turban			1	0.3			2	0.1							1	0.0	2	0.0
Tegula funebralis	Black Tegula					2	0.5			2	0.2	3	0.2	1	0.1	3	0.2	11	0.2
Macron lividus	Livid Macron													1	0.1	2	0.1	3	0.0
Conus californicus	California Cone											1	0.0					1	0.0
Trachycardium quadragenum	Spiny Cockle											2	0.1					2	0.0
Nuttallia nuttallia	Purple Clam	6	2.3	1	0.3	10	2.6	25	1.7	6	0.7	43	2.8	13	1.6	10	0.6	114	1.5
Total Identified		266	100.0	371	100.0	390	100.0	1448	100.0	873	100.0	1530	100.0	788	100.0	1878	100.0	7544	100.0

Note: All percentages rounded to the nearest 0.1%.

Table 49. Minimum Number of Individuals Identified from the Test Pits.

Speckled Scallop (*Argopecten aeqisulcatus*)

This species usually is considered a northern subspecies of the panamic species *Argopecten circularis* (Pacific calico scallop). McLean (1978) regards them as separate species pending unequivocal proof to the contrary.

Habitat: Valves occur on the sandy or muddy bottoms of bays and lagoons below low tide line. They also can be found in protected areas of the open coast in water 10 to 150 feet deep, although less frequently.
Range : Santa Barbara, California, to southern Baja.
% MNI: 4.8

Common Pacific Littleneck (*Protothaca staminea*)

Habitat: This species is common in sandy intertidal areas of bays and lagoons. It also occurs in the middle and lower intertidal zone in deposits of mud, sand, and coarse gravel along the open coast. Littlenecks are often sold commercially as hard-shell clams.
Range: The Aleutian Islands, Alaska, to Southern Baja California.
% MNI: 12.9

Pacific Gaper (*Tresus nuttalli*)

Habitat: Individuals are found in the sandy bottoms of bays and lagoons at low tide. They also occur in intertidal deposits of mud and sand and on sheltered, offshore bottoms up to a depth of 100 feet.
Range: Puget Sound, Washington, to Central Baja California.
% MNI: 2.4

All seven major food species would have been easily obtainable within the Ballona Lagoon. Not only were these shellfish readily available, but they occurred in abundance.

In addition to the seven species that served as major food resources, 11 other mollusks of economic value were recovered (Table 50). All of these species occurred in very small quantities and contributed an insignificant amount to both the total weight of shell and the MNI. All but four of the mollusk species are common in lagoonal environments. Pismo clam, abalone, mussel, and white venus, which are uncommon in lagoons, were found in such small numbers that they are a minor component of this analysis.

Seventeen species of noneconomic mollusks were recovered from the Admiralty site (Table 51). Although some of these species are atypical of lagoonal environments, their presence at the Admiralty site does not preclude their collection outside the lagoon. Not only were these species found in extremely small amounts, but they would not have been a focus of shellfish collecting activities. Furthermore, many of these species are known to attach themselves to larger shells and therefore it is likely that most, if not all, were carried to the Admiralty site by other shellfish.

Table 50. Economic Shellfish Species Recovered In Small Amounts from the Admiralty Site.

Common Name	Scientific Name	Habitat
Pismo clam	*Tivela stultorum*	Intertidal zone of sandy beaches
Onyx slipper shell	*Crepidula onyx*	Shallow waters of bays and lagoons
Jacknife clam	*Tagelus californianus*	Sandy mud flats of bays and lagoons
Washington clam	*Saxidomus nuttalli*	Buried in sandy areas of bays and lagoons
Black abalone	*Haliotis cracherodii*	on rocks intertidally, common in breakwater
Bent-nose macoma	*Macoma nasuta*	Intertidal zone of bays and lagoons
Spiney cockle	*Trachycardium quadragenarium*	Sandflats of bays and lagoons; sandy open coast
Lewis moon shell	*Polinices lewisii*	Intertidal to 600', also sand of bays and lagoons
Purple clam	*Nuttallia nuttallia*	Sand and gravel of bays and lagoons at 12 inches
California mussel	*Mytilus californianus*	On rock from intertidal zone to 150', not in lagoons
Pacific white venus	*Amiantis collosa*	Low tide to 25' along sand beaches, not in lagoons

Table 51. Noneconomic Shellfish Species Recovered from CA-LAn-47.

Common name	Scientific name	Habitat
Western mud whelk	*Nassarius tegula*	Sand and mud of lagoons, also intertidally
Kelletts whelk	*Kelletia kelletii*	Sand and mud of lagoons
California donax	*Donax californica*	Sandy intertidal zone of bays and lagoons
Goulds wedge clam	*Donax gouldii*	Sandy intertidal zone of surf washed beaches
Gilded tegula	*Tegula aureotincta*	On rocks in bays & lagoons, also in intertidal zone
Black tegula	*Tegula funebralis*	On rocks in pools in intertidal zone
Barnacle	Unknown species	On rock substrate or attached to other shells
Purple dwarf olive	*Olivella biplicata*	Common in lagoon entrances, & sandy open coast
Western lean nassa	*Nassarius mendicus*	Sand and mud of lagoons, also in deep water
Poulson's dwarf triton	*Ocenebra polsoni*	On rocks in shallow pools or intertidal waters
Hairy or mossy mopalia	*Mopalia ciliata*	On rocks in tidal pools, also intertidally
California horn shell	*Cerithidea californica*	Very common in intertidal mud flats of lagoons
Livid macron	*Macron lividus*	Rocky areas of intertidal zone
Scaled worm shell	*Serpulorbis squamigerus*	On rocks in breakwater and intertidal zone
Wavy turban	*Astraea undosa*	Rocky shallow waters, also in kelp beds
Tinted wendeltrap	*Epitonium tinctum*	Near sea anemones intertidally to water 150' deep
California cone	*Conus californicus*	Rock & sandy shore of open water, low tide to 100'

Intrasite Comparisons

Based on percentages alone, the distribution of the seven major species of economic shellfish is fairly homogenous throughout all levels at the Admiralty site (Table 52; see Appendix C). Level 1, a disturbed zone containing large amounts of gravel from the historic railroad bed, yielded shell of dubious stratigraphic integrity. Although a slight rise in the percentage of oyster was identified in Levels 8 and 9, the increase does not appear significant, especially in consideration of the reduced shell weight of the assemblage of the lower levels relative to the upper levels. Based on MNI, Levels 7, 8, and 9 made up only 6.1 percent of the total economic food shell recovered from the site. Not only was the material recovered from these lower levels found in small quantities, but it was in an advanced state of decay. The higher frequency of oyster, which has a larger and more durable shell than many of the other species, may simply reflect differential preservation rates.

The distribution of shellfish across the site appears to vary in unpredictable ways. This distribution can be studied using the MNI calculated for each test pit (see Table 48). Test Pit 14 produced the greatest percentage of shell valves, which amounted to 39.9 percent after adjustments had been made for its smaller size (it was a 1-m by 2-m test pit, whereas the others all measured 2-m by 2-m). It is interesting to note that this unit also contained the only metate and pestle recovered, and the majority of the sparsely distributed human remains. In contrast, Test Pit 7, located adjacent to Test Pit 14, produced only 4.1 percent of the total valves recovered. This apparently random distribution of shell may be due to the fact that the portion of the site that was mitigated by Statistical Research represents approximately 2 percent of the site as a whole. The majority of the site was either paved over by Admiralty Way and the adjacent linear park or removed when the marina was constructed. We were limited only to the outer edge of a much larger site, and it is quite possible that the distribution of shellfish may reflect an the outer edge where localized shellfish concentrations were present.

A weak horizontal pattern can be discerned in the distribution of various species presented in Table 48. Oyster is more common in test pits located along the south edge of the right-of-way (Test Pits 7, 9A, and 14) than elsewhere. To test the likelihood that this distribution was due to chance, a chi-square test was calculated in which the total MNIs for the three southern test pits were combined for three species of chione (*Chione californiensis, Chione undatella*, and *Chione fluctafraga*) and separately for oyster. The remaining test pits were likewise combined for chione and oyster. The resulting chi-square of 136.24 with one degree of freedom is significant at an alpha level of 0.001. The distribution of chione and oyster between the south and north portions of the right-of-way is extremely unlikely to be due to chance alone; however, the *strength* of the relationship is also extremely weak,

Table 52. Percentage Vertical Distribution of Major Shellfish Species.

Levels	1	2	3	4	5	6	7	8	9
Common Venus	37.4	37.3	35.5	36.9	39.3	31.7	35	33.1	19.7
Frilled Venus	30.6	27.5	26.5	28.7	23.5	30.9	24	32.4	36.8
Smooth Venus	3.7	2.5	6.3	3.5	2.4	2.8	2.5	2.2	2.7
Pacific Gaper	2.5	3.4	3.1	2.9	2.4	2.6	3.1	1.4	0.0
Scallop	2.9	4.0	2.7	2.3	2.5	3.0	8.4	2.8	2.2
Oyster	13.1	16.1	12.4	15.4	16.3	15.7	9.8	21.4	21.1
Littleneck	6.3	7.9	9.1	9.1	9.7	11.8	15.5	6.5	14.4
Other	3.5	1.3	4.4	1.2	3.9	1.5	1.7	6.2	3.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

with a phi-square score of 0.024. This result suggests that the patterns, while not random, do not reflect strong behavioral activities. Instead, they are probably the result of numerous dumping episodes, many of which may have emphasized either chione or oyster. There is no evidence to suggest that clams were favored over oyster or vice versa, rather the data indicate that shellfish collection was opportunistic, focusing on whatever species were most abundant.

Intersite Comparisons

The Admiralty site differs in several respects from other archaeological sites within or near the Ballona Lagoon. First, the Admiralty site contains large amounts of shellfish representing food remains. Although not uncommon for other coastal shell middens, it is, surprisingly, unique when compared to the recorded sites located nearby.

We found that the Admiralty site produced an average of 595.4 valves per cubic meter. Test Pit 14 contained the densest concentration, producing 1173.3 valves per cubic meter. In marked contrast to the Admiralty site are all the other sites that have been excavated in the Ballona. For example, the Del Rey site (CA-LAn-63) contained about 117.4 valves per cubic meter within what was considered to be primary midden (DiGregorio 1987:220, 223). The Bluff Site (CA-LAn-64) yielded a total of 187 valves, or about 19.9 valves per cubic meter (DiGregorio 1987:259). The Loyola Marymount site (CA-LAn-61) contained only 0.7 valves per cubic meter (DiGregorio 1984:197). These three sites all predate the Admiralty site, but even the Hughes site (CA-LAn-59), which was occupied at the same time, contained an average of only 28.5 valves per cubic meter (Van Horn 1984:39). Consequently, it is apparent that the density of shell recovered from the Admiralty site is much greater than that of the neighboring sites. It is important to note that these nearby sites are located on the edge of the El Segundo Sandhills (also called the Del Rey Bluffs) overlooking the Ballona Lagoon. Although other prehistoric sites are known to exist within the lagoon, few have been systematically tested. No data on presence or abundance of shellfish species are available regarding the known sites within the area adjacent to the lagoon.

The shell remains recovered from the Admiralty site represent 35 species. Dillon's 1988 test excavations at the Admiralty site produced 17 species of shell (Dillon 1988), all of which were also included within the 35 species documented by this study. It is interesting to note that Dillon did not report the presence of either Littleneck clam or Pacific gaper (Dillon 1988:118), whereas the eight test pits from our excavations produced 12.9 percent Littleneck clam and 2.4 percent Pacific gaper. Also absent from Dillon's findings are Frilled venus (*Chione undatella*) and Smooth venus (*Chione fluctafraga*). It is possible that these related species simply were lumped together along with Common California venus (*Chione californiensis*). By combining the three *Chione* species identified during the data recovery phase at the Admiralty site, the total percentage of shell weight represented is 69.2 percent as compared to the 74.3 percent reported by Dillon. These percentages are more comparable. The Loyola Marymount site (CA-LAn-61) produced similar percentages, despite the smaller sample size.

The contemporaneous Hughes site (CA-LAn-59) produced shell that is very different than the Admiralty site. The Hughes site yielded 86 percent Pismo clam (*Tivela stultorum*), 8 percent Venus clam (*Chione* sp.), and 6 percent scallop (*Argopecten* sp.) (Van Horn 1984:40). This shellfish assemblage is unusual for a site located so close to an abundant source of *Chione*, for Pismo clam is known to inhabit sandy beaches exposed to strong surf (McLean 1978:77-78). Van Horn argued that the predominance of Pismo clam at this site indicated that during the Late Prehistoric, the Ballona had been entirely filled with sediment. The results from the Admiralty site do not support this hypothesis. The findings from the Hughes site remain enigmatic.

The shellfish assemblage at Del Rey site (CA-LAn-63) is similar to the Admiralty site in that only seven species representing three genera were recovered in amounts exceeding 2 percent of the total. With the exception of gaper, the relative proportions are very similar as those identified for the Admiralty site. The Del Rey site differs from the Admiralty site in terms of the vertical distribution, in that it produced larger amounts of oyster and littleneck in lower levels, whereas the upper levels contained larger amounts of venus clam (*Chione* sp.). As noted by DiGregorio (1987:228):

> When the vertical distributions of the other genera are compared with the *Chione*, they form a distinct contrast which manifests itself in level 7 where the number of *Chione* rises dramatically, but each of the other genera exhibited an equally dramatic decline. It is interesting to note that the total quantity of shell per unit volume does not change as this shift takes place. Thus, it appears that the decreases in frequency of *Ostrea*, *Protothaca*, and *Plagioctenium* was compensated for by an increase in the quantity of *Chione* harvested.

DiGregorio and others attribute the shift from harvesting oyster during the early occupation of the Del Rey site to *Chione* during later times to changing environmental conditions. DiGregorio (1987:229) concludes that:

> The fluctuations in the shellfish species frequencies through time, which are recorded in the vertical sequence of the shell midden at the Del Rey site, suggest that a change in the lagoonal environment may have caused corresponding changes in the shellfish population. Specifically, it is hypothesized that flooding or some other relatively rapid change in the lagoon's environment discouraged the oyster population but did not affect the *Chione*.

It is plausible that this shift was a response to the Ballona Lagoon becoming choked with sediments. As previously mentioned, oysters prefer a more open environment with a sandy or rocky substrate, whereas *Chione* prefer a more shallow environment with a fine-grained substrate. As the lagoon filled with sediment, we would expect to find less oyster and more chione, but just how quickly this shift would have happened is unknown. Because the Los Angeles River intermittently emptied in the lagoon, it is possible that large amounts of sediments were rapidly deposited. If the shell at the Del Rey site was deposited incrementally over a long period of time, the changes in shellfish would be more obvious than if the shell represented only a few years of deposition.

Nutritional Value of Shellfish

The caloric value of the shellfish remains recovered from the Admiralty site provides one means of estimating the number of people that this resource could have sustained and the possible length of occupation. We made this estimate by applying a given caloric value to each type of shell represented and then multiplying this value by the MNI. The first step in this process was to classify the seven shellfish species representing the major food resources into three types of shellfish (Table 53). The caloric value of each of these three classes of shellfish was determined by referencing a USDA food composition guide (Exler 1987). These values are shown in Table 54.

It was then necessary to determine how much meat each individual may have contributed within each of the three classes. This estimate was made by obtaining approximately 25 living specimens of each class and weighing them (Table 55). Given the approximate amount of meat each individual would have contained and the caloric content in 100 grams of meat, it was possible to estimate the amount of calories each individual would have provided. By multiplying the caloric values for the MNI of each shellfish class, an estimate of the total amount of calories represented by shellfish was obtained (Table 56).

Table 53. Economic Species Representing Three Shellfish Classes.

Common Name	Scientific Name	Shellfish Class
Common California venus	*Chione californiensis*	Clam
Frilled California venus	*Chione undatella*	
Pacific smooth venus	*Chione fluctafraga*	
Pacific gaper	*Tresus nuttalli*	
Pacific littleneck clam	*Protothaca staminea*	
Native Pacific oyster	*Ostrea lurida*	Oyster
Pacific scallop sp.	*Argopecten* sp.	Scallop

Table 54. Caloric Value of Shellfish Classes.

Type	Kcal*	Protein (g)	Fat (g)	Carbohydrates (g)
Clam	74	12.77	0.97	2.57
Oyster	8	9.45	2.30	4.95
Scallop	88	16.78	0.76	2.36

* kilocalories per 100 g of meat

Table 55. Average Meat Weight of Shellfish Classes.

Type	Average Meat Weight (g)	Kilocalories
Clam	21.5	16.1
Oyster	11.8	9.6
Scallop	10.0	8.8

Table 56. Caloric Calculations for Each Shellfish Class.

Type	MNI	x	Kilocalories	=	Total Kilocalories
Clam	2293	x	16.1	=	44,967
Oyster	2154	x	9.6	=	20,678
Scallop	638	x	8.8	=	5615

Combining the estimated kilocalories in Table 55, we arrive at 71,259 as a total estimate of kilocalories represented by the shellfish analyzed at the Admiralty site. Because the excavated portion of the Admiralty site is but 2 percent of the whole, and because only about 50 percent of the shell recovered was analyzed, the amount of shell analyzed is an estimated 1 percent of the entire site. Multiplying the estimated kilocalories by 100, then, produces a figure of 7,125,900 kcal for the site as a whole.

According to Speth and Spielman (1983:6-7), among hunter-and-gatherer populations, an average adult male requires between 1,800 and 1,900 kcal per day, and an adult female requires about 1,600 kcal per day. If we assume an equal distribution between males and females at the Admiralty site, then we arrive at a figure of 1,750 kcal per day for an adult. Dividing this figure into the total estimated amount of kilocalories, 7,125,900, suggests that there are enough calories from shellfish represented at the Admiralty site to support an adult for 4,071 days.

Shellfish was not the only food eaten. If we assume that shellfish represented 20 percent of the diet at the Admiralty site, then the number of person days that the site could have been occupied increases to 20,359. This figure represents 55.7 person years. Another way to look at these data is to say that if shellfish represented 20 percent of the diet, a group of 10 would have been sustained for 5.5 years. Finally, it is worth pointing out that the current evidence indicates that the site was not permanently occupied, but rather occupied only seasonally. If we assume that the site was occupied for 4 months, or 120 days, during the winter, then the site could have been reoccupied annually by a group of 10 for about 17 years. This figure seems realistic in light of all the other data analyzed as part of this project.

CHAPTER 12

VERTEBRATE FAUNAL ANALYSIS

Elsie C. Sandefur and Susan M. Colby

A large faunal sample from prehistoric site CA-LAn-47 excavated by Statistical Research was analyzed at the UCLA Zooarchaeological Laboratory. Inferences about the diet of the inhabitants of these sites, their subsistence strategies and the ecological zones they exploited for food and animal products are presented. The sample includes all the vertebrate faunal remains excavated from nine test pits at CA-LAn-47.

RESEARCH QUESTIONS

The major questions addressed in this study are: 1) Which ecozones in and around Ballona Bay were exploited for fauna? 2) Were the hunters specialized or generalized in their strategy? 3) Is there evidence of seasonal usage of the site? 4) How do patterns at CA-LAn-47 compare with those of other sites of the Ballona lagoon, escarpment, and bluff areas?

METHODS

The Zooarchaeology Laboratory of the Institute of Archaeology at UCLA received the well labeled, excavated bone from Statistical Research. The specimens had been recovered from one-eighth inch (3.175 mm) screening and from the heavy fraction of flotation samples. The bones were identified to the highest taxon possible by qualified zooarchaeologists through the use of the laboratory's comparative collection. Fish bones and some of the reptile and amphibian bone were identified at the laboratory at California State University, Northridge.

The specimens were in good condition. They were non-friable and most of the fragments did not require further washing for identification. The bone was, however, highly fragmented; the average weight of individual fragments was 0.13 g. The sample consisted of 19,644 fragments, weighing 2,639.54 grams from nine test pits.

The bone was sorted into identifiable and nonidentifiable fragments. The nonidentifiable bone was further classified as fish, reptile or amphibian (herpefauna), bird, mammal, or shell. The shell fragments included in this analysis represent only a small sample of the recovered shell. Unidentifiable bird and mammal bones were classified into size categories: very large mammal (cow size), large mammal (deer size), medium mammal (dog size), small mammal (hare size and smaller), very small mammal (gopher/mouse size), large bird (duck/goose size), medium bird (hawk size), and small bird (passerine size). It is not always possible to separate these categories precisely with a highly fragmented sample. For example, some thin-walled mammal bone, such as that from the rabbit, could have been misidentified as bird bone and vice versa, and "small" versus "very small" is not always discernable. Careful and close examination of each bone fragment with 10-x handlenses allowed cultural modifications such as cuts, burning, and tooling marks, as well as animal-gnawed bone to be determined. The computer program "dBASE III PLUS" was used to catalog, sort, and tabulate the data.

In order to compare classes of fauna and to determine the importance of various types of animals to the diet, each class was grouped as follows: A = avian, E = elasmobranchs (shark/ray), H = herpefauna, M = mammals, O = osteichthyes (bony fish), I = invertebrates, V = unidentifiable vertebrate; P and R are incidental plant and wood fragments.

RESULTS

In contrast to the small sample from CA-LAn-1596-H (see Chapter 18), the CA-LAn-47 sample is very large and diverse. Identified taxa include 32 species of mammals, 17 species of birds, 7 species of shellfish, 10 species of elasmobranch fish, and 42 species of bony fish.

Only three historic domesticate species were found: one sheep bone, one domestic rabbit bone, and three pig bones. The *Canis* sp. specimens most likely are primarily those of domestic dog; some, however, may be coyote. (In most cases *Canis* sp. elements cannot be identified to species level.) Otherwise, all taxa present at CA-LAn-47 represent wild resources.

Table 57 lists all fauna with minimum numbers of individuals (MNI) and the number of identified bones (NISP) for the combined analytical units. The number of identified bones does not usually correlate with the minimum number of individuals, which has been calculated from the most frequently recovered bone of each species. Table 58 gives the weight, NISP and MNI percentages of each taxon. Table 59 presents these percentages for each unit of analysis.

Although the species used by the inhabitants of CA-LAn-47 were from various ecozones, all (excepting the bear) are known to range within the catchment area of the bay or in the ocean. The two black bear elements (MNI=1) may represent trade or hunting in the mountains or canyons.

Gopher, mole, and mouse or rat can be considered as probable intrusive species because few remains were fragmented (indicating natural death or owl pellets) and only three pieces were burned (two woodrat bones and one mouse bone). Likewise, the opossum, sheep, domestic rabbit and pig must be considered intrusive since all were introduced in historic times. The high percentage of gopher bones (62% of all identified mammal bones) suggests the deposit has been greatly disturbed.

Mammals

Mammals represent about 82 percent of the total bone mass, 85 percent of the total number of bones, and 37 percent of the MNI (see Table 58). Even though this is a coastal site, terrestrial mammalian resources seem to have been exploited more than those of the sea. There were 26 identified sea mammal bones (60.01 grams). This represents only about 4 percent of the total number of unintrusive identifiable mammal bone fragments, and includes sea lions, fur seals, harbor seals, sea otters, and dolphins.

Terrestrial mammals most frequent in the sample include ground squirrel (349 fragments, 50% of all unintrusive mammalian bones), canid (64 fragments, 9%), hare (62 fragments, 9%), rabbit (87 fragments, 12%), and mule deer (9 fragments, 1%). All other mammalian species contributed less than 1 percent each to the total, non-intrusive, mammalian bone sample.

The importance of ground squirrel should not be overemphasized here. Only seven squirrel bones (2% of all squirrel bones) were burned and it is likely that some squirrels were intrusive. Canid bones need not all represent subsistence debris, but the presence of 12 burned specimens (19% of the

Table 57. Admiralty Site Species List.

COMMON NAME	GENUS AND SPECIES	UNIDENTIFIED	NISP	MNI
AVES (BIRDS)				
Pintail	*Anas acuta*		8	6
American Wigeon	*Anas americana*		46	14
Cinnamon Teal	*Anas cyanoptera*		82	34
Mallard	*Anas platyrhynchos*		111	31
Duck genus	*Anas sp.*		158	11
Duck/Goose order	Anseriformes		1	1
Hawk genus	*Buteo sp.*		1	1
Sage Grouse	*Centroceros urophasianus*		1	1
Plover order	Charadriiformes		1	1
Snow Goose	*Chen hyperboreus*		4	3
Grebe genus	*Colymbus sp.*		6	4
Coot	*Fulica americana*		38	20
Domestic chicken	*Gallus gallus cf.*		1	1
Arctic Loon	*Gavia arctica*		4	4
Gull genus	*Larus sp.*		2	2
California Quail	*Lophortyx californicus*		1	1
Sparrow family	Passerinae		12	7
Ring-necked Pheasant	*Phasianus torquatus*		1	1
Red-necked Grebe	*Podiceps grisegena cf.*		3	3
Eared Grebe	*Podiceps nigricollis*		1	1
Bird, unidentified, all sizes		bird	202	0
Small duck-sized		bird, med	95	7
Duck-sized		bird, large	492	4
Quail-sized		bird, small	72	17
Goose-sized		bird, very large	1	1
Sparrow-sized		bird, very small	3	2
Subtotal			1347	178
ELASMOBRANCHS (SHARKS AND RAYS)				
Great White Shark	*Carcharodon carcharias*		1	1
Shark or Ray	Elasmobranchii		5	2
Bullhead Shark	*Heterodontus francis*		2	2
Mako Shark	*Isurus oxyrhincus*		3	3
Bat Ray	*Myliobatis californica*		38	29
Thornback Guitarfish	*Platyrhinoidis triseriata*		4	4
Great Blue Shark	*Prionace glauca*		3	2
Shovel-nose Guitarfish	*Rhinobatos productus*		36	25
Monkfish	*Squatina californica*		5	5
Leopard Shark family	Triakididae		2	2
Leopard Shark	*Triakis semifasciata*		2	2
Round Stingray	*Urolophus halleri*		1	1
Subtotal			102	78
HERPEFAUNA (REPTILES AND AMPHIBIANS)				
Lizard genus	*Anicola sp.*		1	1
Frog, unidentified	Anura		3	1
Western Toad	*Bufo borealis*		18	10
Toad family	Bufonidae		3	3
Western Pond Turtle	*Clemmys marmorata*		6	5
Western Whiptail	*Cnemidophorus tigris*		1	1
Racer	*Coluber constrictor*		18	11
Racer family	Colubridae		59	11

Table 57. Admiralty Site Species List (continued).

COMMON NAME	GENUS AND SPECIES	UNIDENTIFIED	NISP	MNI
Rattlesnake family	Crotalidae		9	2
Western Diamondback Rattlesnake	*Crotalus atrox*		19	14
Western Rattlesnake	*Crotalus viridis*		37	18
Desert Iguana	*Dipsosaurus dorsalis*		2	2
Corn Snake	*Elaphe guttata*		1	1
Southern Alligator Lizard	*Gerrhonotus multicarinatus*		3	2
Lizard family	Lacertilia		2	2
Common Kingsnake	*Lampropeltis getulus*		8	6
Coachwhip	*Mastcophis flagellum*		2	2
Whipsnake genus	*Masticophis sp.*		89	32
Pacific Gopher Snake	*Pituophis catenifer*		2	2
Gopher Snake	*Pituophis melanoleucus*		15	8
Gopher Snake genus	Pituophis sp.		15	7
Bullfrog	*Rana catesbeiana*		5	2
Frog or Toad	*Salientia*		34	4
Western Fence Lizard	*Sceloporus occidentalis*		3	2
Spiny Lizard genus	*Sceloporus sp.*		1	1
Snake	Serpentes		50	0
Common Garter Snake	*Thamnophis sirtalis*		10	8
Garter Snake genus	*Thamnophis sp.*		7	4
Side-blotched Lizard	*Uta stansburiana*		4	4
Amphibian, probably Frog		amphibian	1	0
Frog, Turtle, or Snake		herpefauna	3	0
Turtle		turtle	1	1
Subtotal			432	167
MAMMALS				
Beechey Ground Squirrel	*Amnospermophilus beecheyi*		341	60
Ground Squirrel genus	*Amnospermophilus sp.*		21	2
Rock Squirrel	*Amnospermophilus variegatus*		5	1
Guadalupe Fur Seal	*Arctocephalis townsendi*		2	2
Dog & Coyote genus	*Canis sp.*		64	29
Common Dolphin	*Delphinus delphis*		1	1
Opposum	*Didelphis virginianis*		14	8
Kangaroo Rat genus	*Dipodomys sp.*		5	4
Sea Otter	*Enhydra lutris*		6	5
Black Bear	*Euarctos americanus*		2	1
Rabbit/Hare family	Leporidae		2	1
Black-tailed Hare	*Lepus californicus*		60	28
Striped Skunk	*Mephitis mephitis*		2	2
California Vole genus	*Microtus sp.*		69	20
Old World Mouse/Rat family	Muridae		1	1
Longtail Weasel	*Mustela frenata*		3	2
Woodrat genus	*Neotoma sp.*		42	20
Mule Deer	*Odocoileus hemionus*		48	26
Domestic Rabbit	*Oryctolagus cuniculus*		1	1
Eared Seal family	*Otariidae*		3	3
Domestic Sheep	*Ovis aries*		1	1
Pocket Mouse genus	*Perognathus sp.*		16	9
California Mouse	*Peromyscus californicus*		1	1
Deer Mouse	*Peromyscus maniculatus*		2	1
Deer Mouse genus	*Peromyscus sp.*		6	5
Pinon Mouse	*Peromyscus truei*		1	1
Harbor Seal	*Phoca vitulina*		1	1
Seal	Pinnepedia	seal	6	2

Table 57. Admiralty Site Species List (continued).

COMMON NAME	GENUS AND SPECIES	UNIDENTIFIED	NISP	MNI
Raccoon	*Procyon lotor*		8	6
Black Rat	*Rattus rattus*		2	2
Mole genus	*Scapanus sp.*		6	5
Western Gray Squirrel	*Sciurus griseus*		13	7
Water Shrew	*Sorex palustris*		1	1
Domestic Pig	*Sus scrofa*		3	2
Desert Cottontail	*Sylvilagus auduboni*		57	18
Cottontail genus	*Sylvilagus sp.*		35	15
Badger	*Taxidea taxus*		2	2
Pocket Gopher	*Thomomys bottae*		1407	133
California Sea Lion	*Zalophus californicus*		7	5
Herbivore		artiodactl	1	1
Dog-sized		carnivore	2	1
Deer-sized		mammal, large	3021	25
Dog-sized		mammal, medium	205	9
Rabbit/Hare-sized		mammal, small	10938	22
Large Sea Mammal sized		mammal, very large	3	1
Mouse-sized		mammal, very small	278	9
Gopher-sized		rodent, small	232	2
Seal/Sea Lion-sized		sea mammal	5	3
Large Hooved Animal		ungulate, very large	1	0
Subtotal			16953	507
OSTEICHTHYS (FISH)				
Barred Surfperch	*Amphisticus argenteus*		27	18
Surfperch	*Amphisticus sp.*		3	2
Sargo	*Anistremus davidsonii cf.*		1	1
Top Smelt	*Atherinops affinis*		1	1
Jack Smelt	*Atherinopsis californiensis*		10	8
White Seabass	*Atractoscion nobilis*		1	1
Flounder family	Bothidae		1	1
Black Croaker	*Cheilotrema saturnum*		1	1
Blacksmith	*Chromis punctipinnis*		10	10
Herring family	Clupeidae		1	1
Sculpin family	Cottidae		1	1
California Flying Fish	*Cypselurus californicus*		1	1
Pile Perch	*Damalichthys vacca*		22	15
Black Perch	*Embiotoca jacksoni*		12	9
Striped Seaperch	*Embiotoca lateralis*		4	3
Seaperch family	Embiotocidae		29	10
California Kingfish	*Genyonemus lineatus*		2	1
Opaleye	*Girella nigricans*		6	5
Walleye Surfperch	*Hyperprosopon argenteum*		25	14
Diamond Turbot	*Hypsopsetta guttulata*		63	27
Rainbow Seaperch	*Hypsurus caryi*		9	8
Wrass family	Labridae		1	1
California Grunion	*Leuresthes tenuis*		121	36
Halfmoon	*Medialuna californiensis*		4	3
Calfornia Corbina	*Menticirrhus undulatus*		1	1
Striped Mullet	*Mugil cephalus*		10	9
Cusk Eel	*Ophidion scrippsae*		4	3
Spotted Sandbass	*Paralabrax maculatofasciata*		5	3
Sandbass genus	*Paralabrax sp.*		3	2
California Halibut	*Paralichthys californicus*		17	13
White Seaperch	*Phanerodon furcatus*		7	7

Table 57. Admirlaty Site Species List (continued).

COMMON NAME	GENUS AND SPECIES	UNIDENTIFIED	NISP	MNI
Plainfin Midshipman	*Porichthys notatus*		10	8
Toadfish	*Porichthys sp.*		3	2
Rubberlip Seaperch	*Rhacochilus toxotes*		20	13
Spotfin Croaker	*Roncador stearnsii*		2	2
Steelhead	*Salmo gardinerii*		2	2
Bonito	*Sarda chiliensis*		1	1
Pacific Sardine	*Sardinops sagax*		42	25
Croaker family	Sciaenidae		8	7
Pacific Mackrel	*Scomber japonicus*		1	1
Cabezon	*Scorpaenichthys marmoratus*		3	2
Brown Rockcod	*Sebastes auriculatus*		1	1
Vermilion Rockcod	*Sebastes miniatus*		4	3
Bocaccio	*Sebastes paucispinnis*		1	1
Grass Rockcod	*Sebastes rastrelliger*		1	1
Rockcod genus	*Sebastes sp.*		2	1
California Sheephead	*Semicossyphus pulcher*		15	13
Yellowtail	*Seriola lalandi*		1	1
Barracuda	*Sphyraena argentea*		8	8
Tuna genus	*Thunnus sp.*		2	2
Jack Mackrel	*Trachurus symetricus*		1	1
Yellowfin Croaker	*Umbrina roncador*		1	1
fish, unidentified, all sizes		bony fish	202	2
Subtotal			734	314
UNIDENTIFIABLE VERTEBRATE				
Vertebrate		vertebrate	52	0
Subtotal			52	0
Total			19620	1244

Key: NISP= Number of identified specimens; MNI= Minimun number of individuals.

Table 58. Admiraly Site Vertebrate Frequency and Percent All Classes.

GENUS AND SPECIES	UNIDENTIFIED	NISP	%NISP	GRAMS	%GRAMS	MNI	%MNI
AVES (BIRDS)							
Anas acuta		8	0.041	2.20	0.082	6	0.477
Anas americana		46	0.234	10.69	0.400	14	1.114
Anas cyanoptera		82	0.417	17.90	0.670	34	2.705
Anas platyrhynchos		111	0.565	40.60	1.519	31	2.466
Anas sp.		158	0.804	36.74	1.374	11	0.875
Anseriformes		1	0.005	0.09	0.003	1	0.080
Buteo sp.		1	0.005	0.10	0.004	1	0.080
Centroceros urophasianus		1	0.005	0.20	0.007	1	0.080
Charadriiformes		1	0.005	0.07	0.003	1	0.080
Chen hyperboreus		4	0.020	3.00	0.112	3	0.239
Colymbus sp.		6	0.031	1.80	0.067	4	0.318
Fulica americana		38	0.193	6.90	0.258	20	1.591
Gallus gallus cf.		1	0.005	0.10	0.004	1	0.080
Gavia arctica		4	0.020	1.62	0.061	4	0.318
Larus sp.		2	0.010	0.44	0.016	2	0.159
Lophortyx californicus		1	0.005	0.10	0.004	1	0.080
Passerinae		12	0.061	1.30	0.049	7	0.557
Phasianus torquatus		1	0.005	0.80	0.030	1	0.080
Podiceps grisegena cf.		3	0.015	1.10	0.041	3	0.239
Podiceps nigricollis		1	0.005	0.30	0.011	1	0.080
	bird	202	1.028	22.20	0.830	0	0.000
	bird, medium	95	0.483	12.51	0.468	7	0.557
	bird, large	492	2.504	75.00	2.805	4	0.318
	bird, small	72	0.366	6.48	0.242	17	1.352
	bird, very large	1	0.005	2.00	0.075	1	0.080
	bird, very small	3	0.015	0.30	0.011	2	0.159
Subtotal		1347	6.855	244.54	9.147	178	14.161
ELASMOBRANCHS (SHARKS AND RAYS)							
Carcharadon carcharias		1	0.005	0.20	0.007	1	0.080
Elasmobranchii		5	0.025	0.36	0.013	2	0.159
Heterodontus francis		2	0.010	0.24	0.009	2	0.159
Isurus oxyrhinchus		3	0.015	0.14	0.005	3	0.239
Myliobatis californica		38	0.193	4.31	0.161	29	2.307
Platyrhinoidis triseriata		4	0.020	0.19	0.007	4	0.318
Prionace glauca		3	0.015	0.39	0.015	2	0.159
Rhinobatos productus		36	0.183	3.41	0.128	25	1.989
Squatina californica		5	0.025	0.23	0.009	5	0.398
Triakididae		2	0.010	0.51	0.019	2	0.159
Triakis semifasciata		2	0.010	0.73	0.027	2	0.159
Urolophus halleri		1	0.005	0.03	0.001	1	0.080
Subtotal		102	0.519	10.74	0.402	78	6.205
HERPEFAUNA (REPTILES AND AMPHIBIANS)							
Anicola sp.		1	0.005	1.30	0.049	1	0.080
Anura		3	0.015	0.25	0.009	1	0.080
Bufo borealis		18	0.092	1.76	0.066	10	0.796
Bufonidae		3	0.015	0.28	0.010	3	0.239
Clemmys marmorata		6	0.031	1.52	0.057	5	0.398
Cnemidophorus tigris		1	0.005	0.02	0.001	1	0.080
Coluber constrictor		18	0.092	2.50	0.094	11	0.875
Colubridae		59	0.300	4.50	0.168	11	0.875
Crotalidae		9	0.046	0.80	0.030	2	0.159

Table 58. Admiralty Site Vertebrate Frequency and Percent All Classes (continued).

GENUS AND SPECIES	UNIDENTIFIED	NISP	%NISP	GRAMS	%GRAMS	MNI	%MNI
Crotalus atrox		19	0.097	2.00	0.075	14	1.114
Crotalus viridis		37	0.188	4.77	0.178	18	1.432
Dipsosaurus dorsalis		2	0.010	0.20	0.007	2	0.159
Elaphe guttata		1	0.005	0.20	0.007	1	0.080
Gerrhonotus multicarinatus		3	0.015	0.09	0.003	2	0.159
Lacertilia		2	0.010	0.05	0.002	2	0.159
Lampropeltis getulus		8	0.041	0.62	0.023	6	0.477
Masticophis flagellum		2	0.010	0.14	0.005	2	0.159
Masticophis sp.		89	0.453	12.00	0.449	32	2.546
Pituophis catenifer		2	0.010	0.20	0.007	2	0.159
Pituophis melanoleucus		15	0.076	1.31	0.049	8	0.636
Pituophis sp.		15	0.076	1.90	0.071	7	0.557
Rana catesbeiana		5	0.025	0.52	0.019	2	0.159
Salientia		34	0.173	1.54	0.058	4	0.318
Sceloporus occidentalis		3	0.015	0.12	0.004	2	0.159
Sceloporus sp.		1	0.005	0.01	0.000	1	0.080
Serpentes		50	0.254	3.42	0.128	0	0.000
Thamnophis sirtalis		10	0.051	1.20	0.045	8	0.636
Thamnophis sp.		7	0.036	0.83	0.031	4	0.318
Uta stansburiana		4	0.020	0.13	0.005	4	0.318
	amphibian	1	0.005	0.26	0.010	0	0.000
	herpefauna	3	0.015	0.14	0.005	0	0.000
	turtle	1	0.005	0.50	0.019	1	0.080
Subtotal		432	2.198	45.08	1.666	167	13.286
MAMMALS							
Amnospermophilus beecheyi		341	1.735	82.51	3.086	60	4.773
Amnospermophilus sp.		21	0.107	9.70	0.363	2	0.159
Amnospermophilus variegatus		5	0.025	0.50	0.019	1	0.080
Arctocephalis townsendi		2	0.010	5.50	0.206	2	0.159
Canis sp.		64	0.326	42.40	1.586	29	2.307
Delphinus delphis		1	0.005	5.11	0.191	1	0.080
Didelphis virginianis		14	0.071	11.20	0.419	8	0.636
Dipodomys sp.		5	0.025	0.60	0.022	4	0.318
Enhydra lutris		6	0.031	7.60	0.284	5	0.398
Euarctos americanus		2	0.010	3.60	0.135	1	0.080
Leporidae		2	0.010	3.70	0.138	1	0.080
Lepus californicus		60	0.305	14.61	0.546	28	2.228
Mephitis mephitis		2	0.010	0.60	0.022	2	0.159
Microtus sp.		69	0.351	6.00	0.224	20	1.591
Muridae		1	0.005	0.10	0.004	1	0.080
Mustela frenata		3	0.015	0.40	0.015	2	0.159
Neotoma sp.		42	0.214	3.33	0.125	20	1.591
Odocoileus hemionus		48	0.244	120.00	4.488	26	2.068
Oryctolagus cuniculus		1	0.005	0.90	0.034	1	0.080
Otariidae		3	0.015	4.70	0.176	3	0.239
Ovis aries		1	0.005	6.60	0.247	1	0.080
Perognathus sp.		16	0.081	1.41	0.053	9	0.716
Peromyscus californicus		1	0.005	0.10	0.004	1	0.080
Peromyscus maniculatus		2	0.010	0.20	0.007	1	0.080
Peromyscus sp.		6	0.031	0.50	0.019	5	0.398
Peromyscus truei		1	0.005	0.10	0.004	1	0.080
Phoca vitulina		1	0.005	3.10	0.116	1	0.080
Pinnepedia		6	0.031	11.50	0.430	2	0.159
Procyon lotor		8	0.041	8.80	0.329	6	0.477
Rattus rattus		2	0.010	0.20	0.007	2	0.159

Table 58. Admiralty Site Vertebrate Frequency and Percent All Classes (continued).

GENUS AND SPECIES	UNIDENTIFIED	NISP	%NISP	GRAMS	%GRAMS	MNI	%MNI
Scapanus sp.		6	0.031	0.50	0.019	5	0.398
Sciurus griseus		13	0.066	3.00	0.112	7	0.557
Sorex palustris		1	0.005	0.10	0.004	1	0.080
Sus scrofa		3	0.015	3.80	0.142	2	0.159
Sylvilagus auduboni		57	0.290	10.20	0.382	18	1.432
Sylvilagus sp.		35	0.178	8.20	0.307	15	1.193
Taxidea taxus		2	0.010	2.70	0.101	2	0.159
Thomomys bottae		1407	7.160	187.30	7.006	133	10.581
Zalophus californicus		7	0.036	22.50	0.842	5	0.398
	artiodactl	1	0.005	0.20	0.007	1	0.080
	carnivore	2	0.010	0.64	0.024	1	0.080
	mammal, large	3021	15.373	1056.20	39.506	25	1.989
	mammal, medium	205	1.043	60.17	2.251	9	0.716
	mammal, small	10938	55.661	532.51	19.918	22	1.750
	mammal, very lg.	3	0.015	31.20	1.167	1	0.080
	mammal, very sm.	278	1.415	19.30	0.722	9	0.716
	rodent, small	232	1.181	16.94	0.634	2	0.159
	sea mammal	5	0.025	10.70	0.400	3	0.239
	ungulate, very lg.	1	0.005	10.80	0.404	0	0.000
Subtotal		16953	86.270	2332.50	87.245	507	40.334
OSTEICHTHYS (FISH)							
Amphisticus argenteus		27	0.137	1.64	0.061	18	1.432
Amphisticus sp.		3	0.015	0.12	0.004	2	0.159
Anistremus davidsonii cf.		1	0.005	0.02	0.001	1	0.080
Atherinops affinis		1	0.005	0.01	0.000	1	0.080
Atherinopsis californiensis		10	0.051	0.18	0.007	8	0.636
Atractoscion nobilis		1	0.005	2.26	0.085	1	0.080
Bothidae		1	0.005	0.06	0.002	1	0.080
Cheilotrema saturnum		1	0.005	0.02	0.001	1	0.080
Chromis punctipinnis		10	0.051	0.16	0.006	10	0.796
Clupeidae		1	0.005	0.01	0.000	1	0.080
Cottidae		1	0.005	0.01	0.000	1	0.080
Cypselurus californicus		1	0.005	0.02	0.001	1	0.080
Damalichthys vacca		22	0.112	1.37	0.051	15	1.193
Embiotoca jacksoni		12	0.061	0.29	0.011	9	0.716
Embiotoca lateralis		4	0.020	0.07	0.003	3	0.239
Embiotocidae		29	0.148	0.68	0.025	10	0.796
Genyonemus lineatus		2	0.010	0.14	0.005	1	0.080
Girella nigricans		6	0.031	0.51	0.019	5	0.398
Hyperprosopon argenteum		25	0.127	0.28	0.010	14	1.114
Hypsopsetta guttulata		63	0.321	1.28	0.048	27	2.148
Hypsurus caryi		9	0.046	0.14	0.005	8	0.636
Labridae		1	0.005	0.01	0.000	1	0.080
Leuresthes tenuis		121	0.616	0.93	0.035	36	2.864
Medailuna californiensis		4	0.020	0.08	0.003	3	0.239
Menticirrhus undulatus		1	0.005	0.04	0.001	1	0.080
Mugil cephalus		10	0.051	1.12	0.042	9	0.716
Ophidion scrippsae		4	0.020	0.08	0.003	3	0.239
Paralabrax maculatofasciata		5	0.025	0.34	0.013	3	0.239
Paralabrax sp.		3	0.015	0.38	0.014	2	0.159
Paralichthys californicus		17	0.087	1.37	0.051	13	1.034
Phanerodon furcatus		7	0.036	0.13	0.005	7	0.557
Porichthys notatus		10	0.051	0.59	0.022	8	0.636
Porichthys sp.		3	0.015	0.11	0.004	2	0.159
Rhacochilus toxotes		20	0.102	0.67	0.025	13	1.034

Table 58. Admiralty Site Vertebrate Frequency and Percent All Classes (continued).

GENUS AND SPECIES	UNIDENTIFIED	NISP	%NISP	GRAMS	%GRAMS	MNI	%MNI
Roncador stearnsii		2	0.010	0.07	0.003	2	0.159
Salmo gardinerii		2	0.010	0.10	0.004	2	0.159
Sarda chiliensis		1	0.005	0.01	0.000	1	0.080
Sardinops sagax		42	0.214	0.40	0.015	25	1.989
Sciaenidae		8	0.041	0.40	0.015	7	0.557
Scomber japonicus		1	0.005	0.01	0.000	1	0.080
Scorpaenichthys marmoratus		3	0.015	0.66	0.025	2	0.159
Sebastes auriculatus		1	0.005	0.14	0.005	1	0.080
Sebastes miniatus		4	0.020	1.17	0.044	3	0.239
Sebastes paucispinnis		1	0.005	0.17	0.006	1	0.080
Sebastes rastrelliger		1	0.005	0.06	0.002	1	0.080
Sebastes sp.		2	0.010	0.30	0.011	1	0.080
Semicossyphus pulcher		15	0.076	4.44	0.166	13	1.034
Seriola lalandi		1	0.005	0.22	0.008	1	0.080
Sphyraena argentea		8	0.041	1.50	0.056	8	0.636
Thunnus sp.		2	0.010	0.15	0.006	2	0.159
Trachurus symetricus		1	0.005	0.01	0.000	1	0.080
Umbrina roncador		1	0.005	0.29	0.011	1	0.080
	bony fish	202	1.028	5.92	0.221	2	0.159
Subtotal		734	3.735	31.14	1.165	314	24.980
UNIDENTIFIABLE VERTEBRATES							
	vertebrate	52	0.265	6.50	0.243	0	0.000
Subtotal		52	0.265	6.50	0.243	0	0.000
Total		19620	99.842	2670.50	99.868	1244	98.966

Key: NISP= Number of identified specimens; MNI= Minimum number of individuals.

Table 59. Admiralty Site Spatial Comparison of Nine Test Pits by Faunal Class.

TEST PIT #	CLASS OF VERTEBRATE	#NISP	%NISP	#GRAMS	%WEIGHT	MNI	%MNI	#BURNE	%BURNE	GMBRN	%GMSBRND
1											
	Aves	175	0.89	55.50	2.08	21	1.67	7	0.16	1.90	0.31
	Elasmobranchs	4	0.02	0.55	0.02	3	0.24	3	0.07	0.51	0.08
	Herpefauna	13	0.07	2.25	0.08	8	0.64	0	0.00	0.00	0.00
	Mammals	1087	5.53	173.23	6.48	34	2.70	224	5.15	47.04	7.75
	Osteichthys	14	0.07	0.74	0.03	10	0.80	1	0.02	0.01	0.00
	Vertebrate	42	0.21	2.20	0.08	0	0.00	16	0.37	1.00	0.16
	Subtotal	1335	6.79	234.47	8.77	76	6.05	251	5.77	50.46	8.31
2											
	Aves	212	1.08	33.16	1.24	23	1.83	20	0.46	3.17	0.52
	Elasmobranchs	18	0.09	2.65	0.10	11	0.88	11	0.25	1.35	0.22
	Herpefauna	68	0.35	7.73	0.29	28	2.23	4	0.09	0.27	0.04
	Mammals	2601	13.24	380.30	14.22	78	6.21	722	16.61	93.98	15.49
	Osteichthys	117	0.60	5.90	0.22	46	3.66	39	0.90	4.48	0.74
	Vertebrate	1	0.01	0.20	0.01	0	0.00	1	0.02	0.20	0.03
	Subtotal	3017	15.37	429.94	16.08	186	14.81	797	18.33	103.45	17.04
5											
	Mammals	2	0.01	0.20	0.01	1	0.08	2	0.05	0.20	0.03
	Subtotal	2	0.01	0.20	0.01	1	0.08	2	0.05	0.20	0.03
7											
	Aves	28	0.14	5.44	0.20	6	0.48	1	0.02	0.10	0.02
	Elasmobranchs	2	0.01	0.24	0.01	2	0.16	1	0.02	0.20	0.03
	Herpefauna	8	0.04	1.15	0.04	4	0.32	0	0.00	0.00	0.00
	Mammals	408	2.08	71.81	2.69	27	2.15	77	1.77	13.10	2.16
	Osteichthys	4	0.02	0.04	0.00	3	0.24	1	0.02	0.01	0.00
	Subtotal	450	2.29	78.68	2.94	42	3.34	80	1.84	13.41	2.21
8											
	Aves	236	1.20	41.31	1.55	33	2.63	10	0.23	2.12	0.35
	Elasmobranchs	19	0.10	2.66	0.10	13	1.03	12	0.28	1.37	0.23
	Herpefauna	106	0.54	10.48	0.39	36	2.86	8	0.18	1.32	0.22
	Mammals	2784	14.17	383.44	14.34	94	7.48	626	14.40	71.04	11.71
	Osteichthys	80	0.41	3.41	0.13	42	3.34	25	0.57	1.49	0.25
	Subtotal	3225	16.41	441.30	16.51	218	17.34	681	15.66	77.34	12.74
9											
	Aves	280	1.42	35.00	1.31	22	1.75	28	0.64	6.70	1.10
	Elasmobranchs	9	0.05	1.32	0.05	9	0.72	7	0.16	1.27	0.21
	Herpefauna	46	0.23	3.61	0.14	18	1.43	1	0.02	0.10	0.02
	Mammals	1442	7.34	287.77	10.76	58	4.61	413	9.50	81.13	13.37
	Osteichthys	100	0.51	5.17	0.19	32	2.55	27	0.62	1.45	0.24
	Vertebrate	3	0.02	2.30	0.09	0	0.00	0	0.00	0.00	0.00
	Subtotal	1880	9.56	335.17	12.54	139	11.06	476	10.95	90.65	14.94
12											
	Aves	290	1.48	46.07	1.72	35	2.78	28	0.64	9.00	1.48
	Elasmobranchs	22	0.11	1.44	0.05	18	1.43	20	0.46	1.29	0.21
	Herpefauna	109	0.55	10.36	0.39	40	3.18	11	0.25	1.07	0.18
	Mammals	4513	22.97	553.02	20.68	101	8.04	896	20.61	131.97	21.75
	Osteichthys	174	0.89	7.60	0.28	92	7.32	56	1.29	3.79	0.62
	Vertebrate	5	0.03	0.80	0.03	0	0.00	1	0.02	0.20	0.03
	Subtotal	5113	26.01	619.29	23.16	286	22.75	1012	23.28	147.32	24.27
13											
	Aves	71	0.36	13.94	0.52	21	1.67	7	0.16	1.20	0.20
	Elasmobranchs	14	0.07	0.46	0.02	10	0.80	5	0.11	0.20	0.03
	Herpefauna	38	0.19	4.91	0.18	17	1.35	1	0.02	0.09	0.01
	Mammals	2304	11.72	247.23	9.25	72	5.73	391	8.99	52.22	8.60
	Osteichthys	52	0.26	1.34	0.05	23	1.83	12	0.28	0.88	0.15
	Vertebrate	1	0.01	1.00	0.04	0	0.00	0	0.00	0.00	0.00
	Subtotal	2480	12.62	268.88	10.06	143	11.38	416	9.57	54.59	9.00
14											
	Aves	55	0.28	14.12	0.53	17	1.35	5	0.11	0.70	0.12
	Elasmobranchs	14	0.07	1.42	0.05	12	0.95	13	0.30	1.32	0.22
	Herpefauna	44	0.22	4.59	0.17	16	1.27	4	0.09	0.37	0.06
	Mammals	1812	9.22	235.51	8.81	42	3.34	572	13.16	65.00	10.71
	Osteichthys	193	0.98	6.94	0.26	66	5.25	35	0.80	1.39	0.23
	Subtotal	2118	10.77	262.58	9.82	153	12.17	629	14.47	68.78	11.33
	Total	19620	99.83	2670.51	99.89	1244	98.98	4344	99.92	606.20	99.87

Key: NISP= Number of Identified Specimens, MNI= Minimum Number of Individuals.

total canid sample) suggests some use of dogs for food. Hare and rabbit are common prey in prehistoric sites: about 21 percent of the hare bones and 9 percent of the rabbit bones were burned.

Only 9 bones could definitely be attributed to mule deer. Three of them were burned. It is likely, however, that this underestimates the importance of deer at the site. In an extensively fragmented sample, many elements of large animals are reduced to an unidentifiable state. It is probable that a high percentage of the unidentifiable large mammal bone represents deer as much of it had the texture and general appearance of deer bone.

Data on the habitats, ranges, and other attributes of specific, identified mammals are given in Appendix C for all taxa identified to the species level with an MNI greater than 1.

Birds

Birds represent 9 percent of the bone mass at the site, 7 percent of the total number of bones and 14 percent of the MNI (see Table 58). The most common bird remains at CA-LAn-47 are those of pond and marsh birds. The genus *Anas* represents 84 percent of the identifiable bird sample. The genus next highest in frequency is that of the coot with 8 percent of the bird total. If all duck-like water fowl (duck, teal, widgeon, coot, loon, grebe, goose) are combined, they represent 96 percent of all identified bird bones. Clearly, the hunting of marsh birds was an important pursuit at this site.

Most of the duck-like birds are winter visitors. Pintail ducks, snow geese, loons, grebes, and widgeons are common in the area only in the winter. Mallards and coots are most common in the winter but are year-round residents as well. Cinnamon teals are abundant from March to October and some winter there as well. From this, it can be readily deduced that the site was definitely in use in the winter to take advantage of migrating water fowl, but use in other seasons cannot be ruled out.

Data on habitats, ranges and other attributes of specific, identified bird species are given in Appendix D for all species with an MNI greater than one.

Amphibians and Reptiles

Amphibians and Reptiles represent less than 2 percent of the total mass at the site, about 2 percent of the total number of bones and 13 percent of the MNI (see Table 58). A wide variety of snake species are present. Although many may have been intrusive, some were probably used for food. Burned vertebrae of racers, whipsnakes, rattlesnakes, and gopher snakes were recovered. Pond turtle specimens were infrequent. They probably supplemented the diet on occasion; three specimens were burnt. Frogs and toads also may have been used occasionally for food. Four toad bones, two frog bones and one frog or toad (Salienta) were burned. No lizard bones were burned and they may have been intrusive.

Fish

Fish represent 1 percent of the total bone mass, less than 4 percent of the total number of bones, and 25 percent of the MNI. Fifty-two species were identified. Although a wide variety of fish are present, their numbers are smaller than would be expected in a coastal site. Comparing CA-LAn-47 with other Ballona sites (Table 60) reveals a lower frequency of fish elements per cubic meter at

Table 60. Comparison of CA-LAn-47 with Other Ballona Lagoon Area Sites as to Fish Frequencies.

SITE	NUMBER OF SHARK/RAY	% OF S/R	NUMBER OF BONY FISH	TOTAL FISH	ELEMENTS PER M^3
CA-LAN-59	2230	78%	628	2858	74.5
CA-LAN-61A	2900	86%	480	3380	19.8
CA-LAN-61B	1824	70%	764	2588	19.2
CA-LAN-61C	56	85%	10	66	4.0
CA-LAN-63	3137	43%	4188	7325	31.0
CA-LAN-64	108	76%	34	142	3.0
CA-LAN-206	120	65%	65	185	13.4
CA-LAN-47	102	12%	732	834	12.8

Note: S/R = shark/ray; all of the above sites used 1/8th-inch screening. Data for the first seven sites are from Salls 1988: Table 24. For CA-LAn-47, total cubic meters were calculated by multiplying Statistical Research's figure of 77 m^2 (total volume excavated) by 0.84 (average depth of units). The result was a total of 65 m^3 of sediment excavated (containing the faunal sample under study).

CA-LAn-47 than for all sites but the small CA-LAn-61C and CA-LAn-64 samples. Elasmobranchs also were underrepresented at CA-LAn-47 compared with the other sites. Only 12 percent of the CA-LAn-47 sample represents shark/ray while, at the other sites, shark/ray represents 43 to 86 percent of all fish remains. The residents of CA-LAn-47 were moving beyond the shallow bay, where sharks and rays are easily taken, and into the open coast and kelp bed zones, but there is little evidence for deep sea fishing.

Habitats were identified for all fish with an MNI exceeding 1. All of the fish identified for CA-LAn-47 (except one) are common tidepool and nearshore species (Fitch and Lavenberg 1975). The only exclusively pelagic fish is tuna (*Thunnus* sp.). All other species are near shore at least part of the time. Even tuna are sometimes found in nearshore, submarine canyons. There is no reason to assume use of a deep sea fishing strategy for this site.

The high frequency of grunion suggests March to September exploitation when these fish are spawning on shore and are most easily taken. Spring and summer are also seasons when the highest frequencies of shovel-nose guitarfish occur, whereas the relatively high frequency of pile perch suggests October and November fishing when these fish are most common in this area (Salls 1988:295). The fish data suggest the site was not occupied exclusively in the winter as indicated by the bird and shell data, but instead was utilized year-round.

Unidentifiable Bone

Many factors control bone fragmentation and thus bone identifiability, for example, the size and density of the bone, the age of the site, the amount of overburden, and trampling. The percentage of identifiable bone, 30 percent by weight and 19.4 percent by bone frequency, was not high, and reflects the highly fragmented nature of the sample.

When articulating ends are present, the fragment usually can be identified. When only the center sections of small bones are recovered, they can rarely be identified to genus or species, but usually can be classified into broad categories, such as "very large mammal," for example. Some fragments cannot be placed in a class and are designated only as "vertebrate."

Burned and Modified Bone

Of the total sample at CA-LAn-47, 22 percent of all fragments were burned. This is a high frequency, considering the large percentage of intrusives. Roasting must have been a common food preparation technique.

Table 61 lists modifications (other than by burning) to bones. Sawing is found on historic era bones. Several bones of large mammals, such as seal and other pinnepeds and deer, were cut or scraped with knife-like tools. One *Canis* sp. bone had been cut at the base of the skull. Five duck bones and one bone of a smaller bird had also been cut or scraped; one gopher and one hare bone had been cut, as well. Some bones had been gnawed by rodents or canids. Three bone artifacts were identified -- a bone ring and two bone tools.

SUMMARY AND CONCLUSIONS

The 108 different species recovered from CA-LAn-47 reflect the wide variety of animals hunted at the site. Terrestrial, avian, and marine resources were used. Fish elements are less frequent (per cubic meter of excavated sediment) at CA-LAn-47 than at the other Ballona area sites, and there was far less exploitation of sharks and rays at CA-LAn-47. There is little evidence for deep sea fishing but a variety of nearshore ecozones were used.

Changes in subsistence patterns over time could not be studied because of the heavy disturbance caused by gophers. It is very probable that the midden was so rearranged by gopher activity that relative depth of bones would not indicate actual relative age of deposits.

Looking at spatial comparisons (see Table 59), the bulk of the faunal material comes from Test Pits 2, 8, and 12, the central "old railroad bed" area. These three units contain 58 percent of all fragments. Different classes of fauna appear to be relatively evenly distributed throughout the site.

This large sample can also be compared with a much smaller faunal sample from the site excavated in 1988 (Dillon et al. 1988). That sample consisted of approximately 330 grams from four units. The findings there were generally consistent with those reported here. One interesting find in the earlier sample was an apparent canid burial. No similar feature was found in the larger sample, but it appears that canids (probably dogs) were abundant at the site and were used for food.

Table 61. CA-LAn-47 Modified Bones.

TEST PIT #	LEVEL	DEPTH (cm)	CLASS OF VERTEBRATE	GENUS AND SPECIES	UNIDENTIFIED	#FRAGS	#GRAMS	BONE NAME	MODIFICATION	COMMENTS
1D	overburden	0-06	Mammal	*Phoca vitulina*		1	3.1	metapodial	cut, knife, burned	
1C	1-2	0-20	Aves	*Anas platyrhynchos*		1	0.9	carpometacarpus	scraped	mallard
1		0-10	Aves	*Anas platyrhynchos*		2	2.1	humerus fragment	cut, knife	mallard
1C	1-2	0-20	Aves	*Anas platyrhynchos*		2	1.6	ulna fragments	scraped	rodent gnawed
1B		10-20	Aves		bird, large	1	1.0	humerus fragment	cutr, knife	duck sized, proximal shaftcut
1D		10-20	Mammal	*Ovis aries*		1	6.6	humerus fragment	handsawed	
1C	1-2	0-20	Mammal		mammal, large	1	1.4	indeterminate fragment	cut	
1C	4	30-40	Mammal		mammal, large	1	0.5	longbone fragment	cut	
1C	5	40-50	Mammal		mammal, large	1	0.8	flatbone fragment	cut, knife	
2D		10-20	Mammal		mammal, large	1	1.5	longbone fragment	tool wear	tool fragment
7	1-2	25-35	Mammal		mammal, large	15	8.5	indeterminate fragments	cut	deer sized, 2 pieces cut
7	1-2	25-35	Mammal		mammal, large	2	3.2	irregular fragments	burned, sawed	1 piece handsawed
7	2	25-35	Mammal		mammal, large	2	4.3	longbone fragments	burned, cut	deer sized, 1 piece cut
7	3	20-30	Aves		bird, small	1	0.1	furculum	cut	cut through in 2 places
7	3	20-30	Mammal		mammal, large	1	0.6	indeterminate fragment	cut	cut through in 2 places
8B	2	10-20	Mammal	*Lepus californicus*		1	0.6	vertebra thoracic	cut, knife	
8C	2	10-20	Mammal		mammal, large	1	0.3	longbone fragments	burned, cut	cut marks
8B	3	20-30	Mammal	*Odocoileus hemionus*		1	1.9	radius fragment	cut, knife	lots of cuts
8B	3	20-30	Mammal	*Thomomys bottae*		1	0.2	humerus fragment	cut, knife	
8C	4	30-40	Mammal		mammal, large	1	1.0	flatbone fragment	cut	sharp cleaver-like cut
8B	4	30-40	Mammal		mammal, small	1	0.2	longbone fragment	cut, knife	
8C	4	30-40	Mammal		mammal, small	1	0.1	longbone fragment	burned, cut	3 cut marks
8C	5	40-50	Aves	Anas sp.		1	0.4	tibia fragment	cut marks	teal sized transverse cut
8B	6	50-60	Mammal		mammal, large	1	1.1	indeterminate fragments	scraped	
8A	6	50-60	Mammal		mammal, small	73	3.5	longbone fragments	burned, cut	2 pieces cut and burned
9A	1-2	00-20	Mammal		mammal, large	10	4.9	indeterminate fragments	cut	2 cut
9B	3	20-30	Mammal	*Pinnepedia*		1	3.0	longbone fragment	knife cuts	
9B	3	20-30	Mammal	*Pinnepedia cf.*		1	0.3	longbone fragment	sliced with knife	
9B	3	20-30	Mammal		mammal, large	1	9.5	epiphyseal fragment	burned, cut	
9A	3	20-30	Mammal		mammal, large	1	0.2	indeterminate fragment	cut	cancellous bone
9A	3	20-30	Mammal		mammal, large	4	2.5	indeterminate fragments	cut	1 piece cut, 0.7gm
9B	3	20-30	Mammal		mammal, large	1	2.0	longbone fragment	cut, burned	
9B	3	20-30	Mammal		mammal, large	2	1.8	longbone fragments	sliced with knife	2 pieces = 1 bone
9A	3	20-30	Mammal		mammal, sea	1	0.5	longbone fragment	cut	
9A		20-30	Mammal		mammal, very large	1	14.9	indeterminate fragments	cut	
9A		20-30	Mammal		mammal, very large	1	11.5	vertebra, thoracic	cut	
9B	4	30-40	Mammal	*Pinnepedia*		1	3.7	longbone fragment	cut, knife	
9B	4	30-40	Mammal		mammal, large	1	0.1	indeterminate fragment	cut, knife	knife slice
9B	4	30-40	Mammal		mammal, large	1	1.2	longbone fragment	sawed	
9C	4	30-40	Mammal		mammal, large	1	1.7	longbone fragment	burned, handsawed	
12B	1	0-10	Mammal		mammal, large	1	1.2	longbone fragment	cut, knife	
12B	2	10-20	Mammal		mammal, large	1	0.3	longbone fragment	abraded	artifact, awl
12A	4	30-40	Mammal		mammal, large	1	0.8	indeterminate fragment	gnawed	
12C	4	30-40	Mammal		mammal, small	1	0.1	indeterminate fragment	gnawed, rod	
12C	5	40-50	Mammal		mammal, medium	1	1.0	femur fragment	cut, cleaved	head
12C	6	50-60	Mammal	*Arctocephalus/Crhins*		1	1.5	radius fragment	cut	
12A	7	60-70	Aves		bird, medium	1	0.6	indeterminate fragment	gnawed	
12A	8	70-80	Mammal		mammal, large	1	3.2	longbone fragment	artifact	ring, or modified cut
13	2	10-20	Mammal		mammal, large	1	0.4	indeterminate fragment	cut, knife	deer-size
13A	2	10-20	Mammal		mammal, large	1	1.7	indeterminate fragment	cut	
13	5	40-50	Mammal		mammal, large	1	0.3	indeterminate fragment	cut, gnawed	
13	5	40-50	Mammal		mammal, medium	1	0.2	longbone fragment	gnawed	
13	6	50-60	Mammal	*Canis sp. cf.*		1	1.0	occipital condyle	cut	from flotation
14	5	40-50	Mammal		mammal, large	1	2.8	indeterminate fragment	handsawed	
TOTAL						157	118.40			

As in the present sample, the earlier sample reflected less use of fish than expected and much use of water fowl. In that sample, only one marine mammal bone was found. More evidence of use of a variety of sea mammals was present in the larger sample, but the relatively low frequency suggests opportunistic, rather than specialized, sea mammal hunting. Exploitation of the resources of many ecozones based on seasonal abundance appears to have been the main subsistence strategy at CA-LAn-47.

This generalized use of many ecozones may reflect a pattern Van Horn (1987:272) suggests for nearby CA-LAn-63 -- temporary occupations at various times of the year to exploit seasonally specific resources, such as migratory bird and fish species, as well as annually productive local plants. Fishing patterns at CA-LAn-47 are somewhat different here than at the other Ballona area sites, with less emphasis on procuring fish while, at the same time, taking a greater variety, especially of bony fish. These comparisons will be examined in greater detail in Chapter 17.

CHAPTER 13

POLLEN ANALYSIS OF THE ADMIRALTY SITE

Linda Scott-Cummings

INTRODUCTION

The pollen record was investigated at the Admiralty Site to address issues of subsistence and to identify elements of the vegetation communities at the time of occupation. During the 1989 field work close interval pollen samples were analyzed for three test pits. Two of the columns derive from test pits within the midden, Test Pit 12A and 13. The third column was obtained off-site and used as a control. It was recovered from Test Pit 6, excavated during the testing phase and determined to be outside the midden. In addition, pollen obtained from a wash of an inverted metate was analyzed.

METHODS

A chemical extraction technique based on flotation was the standard preparation technique used in this study for the removal of the pollen from the large volume of sand, silt, and clay particles with which they are mixed. This particular process was developed for extraction of pollen from soils where preservation is less than ideal and pollen density is low.

Hydrochloric acid (10%) was used to remove calcium carbonates present in the soil, after which the samples were screened through 150-micron mesh. Zinc bromide (density 2.0) was used for the flotation process. The samples were mixed with zinc bromide while still moist, immediately after centrifugation to remove the dilute hydrochloric acid and water. All samples received a short (10 minute) treatment in hot hydrofluoric acid to remove any remaining inorganic particles. The samples were then acetolated for 3 minutes to remove any extraneous organic matter.

A light microscope was used to count the pollen to a total of 100 to 200 pollen grains at a magnification of 500x. Pollen preservation in these samples varied from good to poor. Comparative reference material collected at the Intermountain Herbarium at Utah State University and the University of Colorado Herbarium was used to identify the pollen to the family, genus, and species level, where possible.

Pollen aggregates were recorded during identification of the pollen. Aggregates are clumps of a single type of pollen, and may be interpreted to represent pollen dispersal over short distances, or the actual introduction of portions of the plant represented into an archaeological setting. Aggregates were included in the pollen counts as single grains, as is customary. The presence of aggregates is noted by an "A" next to the pollen frequency on the pollen diagram. A "T" on the pollen diagram indicates that the pollen type was observed outside the regular count while scanning the remainder of the microscope slide.

Indeterminate pollen includes pollen grains that are folded, mutilated, and otherwise distorted beyond recognition. These grains are included in the total pollen count, as they are part of the pollen record.

Ground stone was washed with distilled water and dilute hydrochloric acid to recover any pollen from the ground surface. Concentrations of pollen from the ground surfaces may represent plants ground using manos and metates. The ground surfaces had no appreciable quantity of dirt adhering to them. The surfaces were washed with distilled water and dilute hydrochloric acid, and scrubbed with a brush to release all trapped pollen. The resulting liquid was saved, and processed in a similar manner to the soil samples, with the exception that the zinc bromide separation was not used.

DISCUSSION

The Admiralty site is located next to a tidal marsh that has formed along Ballona Creek before it enters Santa Monica Bay. The site appears to represent a single component occupation during the Late Prehistoric period (see Chapter 8). A tentative occupation date has been assigned between ca. A.D. 1050 and 1150.

The midden was expected to provide excellent subsistence data in the pollen record. Because the pollen record represents wind transport of regional vegetation, it also functioned to identify elements of local vegetation that were available for exploitation. Specific evidence of actual utilization also was sought in the pollen record.

The pits through the midden were excavated in arbitrary 10-cm units, which were designated levels. One pollen sample was collected from each level in three test pits using (Test Pit 12A, 13, and 6) (Table 62). The samples, approximately 1.0 kg in weight, were collected from columns in the least disturbed portion of each test pit. Samples were obtained at 5-cm intervals, skipping every other interval (e.g., 0-5 cm collected [Level 1], 5-10 not collected, 10-15 collected [Level 2], etc.). In addition, a single piece of ground stone was washed for pollen. It was recovered from an area of concentrated midden deposits.

In Test Pit 12A three strata are represented in the pollen record. They include Stratum E at the base of the record, Stratum A throughout most of the bottom half of the column, and Stratum A1 in the upper half of the record. In Test Pit 13 only Strata E and A are represented. In Test Pit 6 the bottom portion of the record represents a B horizon (70 to 105 cm). The middle section, represented by the sample collected from 60 to 65 cm, represents the E horizon. The overlying A horizon is represented only by sample 5 (50 to 55 cm). The upper two samples from this column were collected from a matrix composed of a disturbed A horizon mixed with sands and gravels.

The pollen records from these three test pits, which are widely separated on the east-west axis across the site, are vastly different. Test Pit 6 is the westernmost, whereas Test Pit 13 is the easternmost. Test Pit 12A falls nearly midway between. Both Test Pits 12A and 13 represent areas of dense midden deposits. These test pits vary only a few meters on the north-south axis.

The off-site pollen record from Test Pit 6 is characterized by moderate frequencies of high-spine Compositae in the lower levels (Figure 114, Table 63). Increased quantities of indeterminate pollen and fluctuating quantities of Tubuliflorae pollen, which represent eroded Compositae, probably high-spine Compositae pollen. Cheno-am frequencies are relatively low throughout the entire depth of this pit. Cruciferae pollen is noted briefly in the lower levels, and is absent until the upper samples. Gramineae pollen is observed sporadically throughout the column, and increases dramatically in the upper two samples, suggesting that grasses are much more abundant on the midden in the present and

Table 62. Provenience of Pollen Samples from the Admiralty Site.

Sample No.	Level No.	Depth (cm below surface)	Description	Pollen Counted
Test Pit 6 (N100, W80)				
359	3	30-35		200
360	4	40-45		200
361	5	50-55		100
362	6	60-65		100
363	7	70-75		200
364	8	80-85		100
365	9	90-95		100
366	10	100-105		100
Test Pit 12A (N104, W34)				
1395	1	0-10		200
1396	2	10-20		200
1397	3	20-30		200
1398	4	30-40		200
1399	5	40-50		100
1400	6	50-60		100
1401	7	60-70		201
1402	8	70-80		200
1403	9	80-90		100
Test Pit 13 (N105, W7)				
1413	1	0-10		200
1414	2	10-20		200
1415	3	20-30		202
1416	4	30-40		200
1417	5	40-50		200
1418	6	50-60		200
1419	7	60-70		201
1420	8	70-80		200
1421	9	80-90		100
1285			Metate wash	200

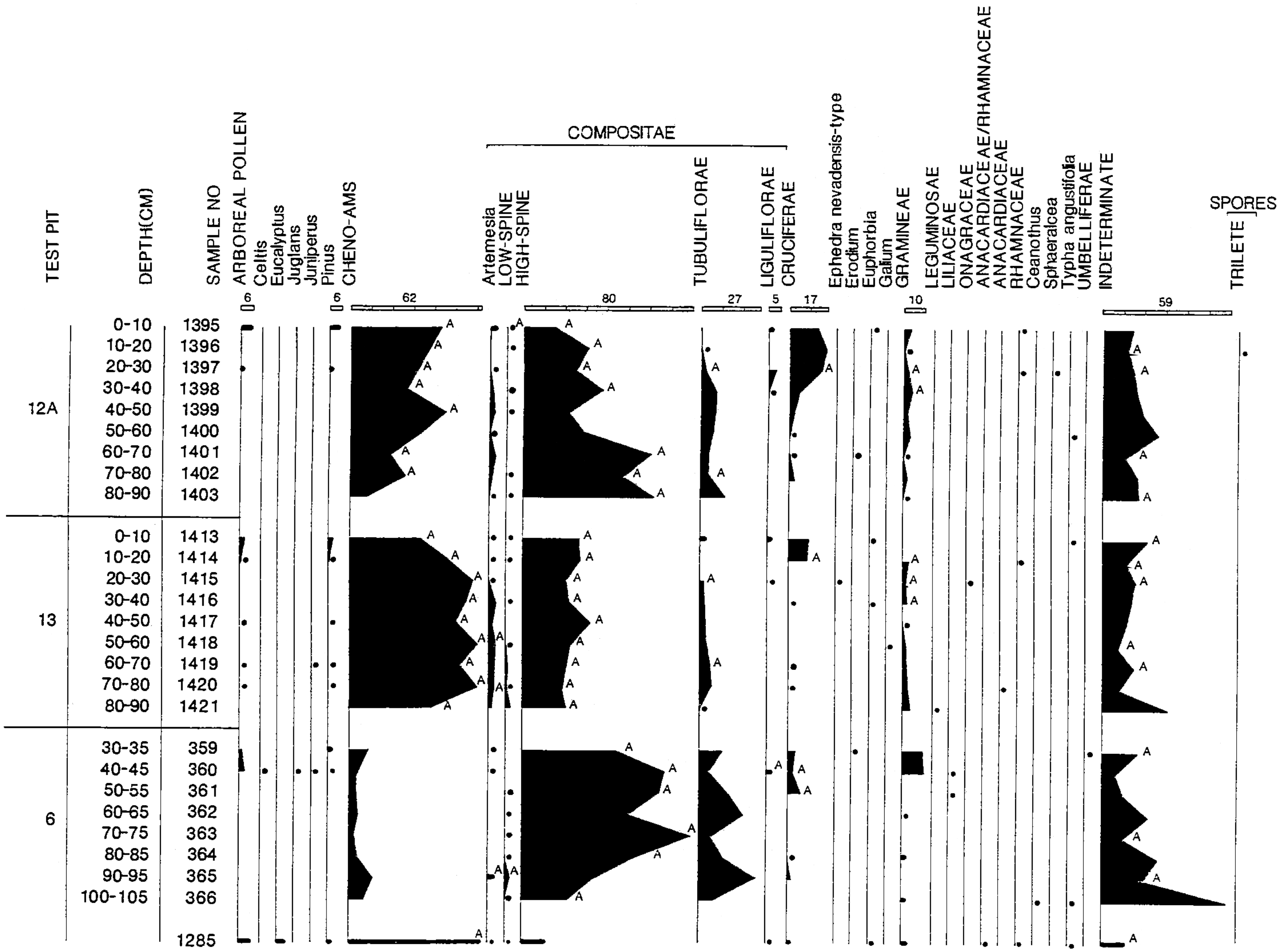


Figure 114. Pollen diagram from CA-LAn-47.

Table 63. Pollen Types Observed in Samples from the Admiralty Site.

Scientific Name	Common Name
ARBOREAL POLLEN:	
Celtis	Hackberry
Eucalyptus	Eucalyptus
Juglans	Walnut
Juniperus	Juniper
Pinus	Pine
NON-ARBOREAL POLLEN:	
Cheno-ams	Includes goosefoot family and pigweed
Artemisia	Sagebrush
Low-spine	Includes ragweed, cocklebur, etc.
High-spine	Includes aster, rabbitbrush, snake-weed, sunflower, etc.
Tubuliflorae	Includes eroded low- and high-spine
Liguliflorae	Includes dandelion and chicory
Cruciferae	Mustard family
Ephedra nevadensis-type	Mormon tea
Erodium	Heron-bill
Euphorbia	Spurge
Gramineae	Grass family
Leguminosae	Legume or pea family
Liliaceae	Lily family
Onagraceae	Evening primrose family
Anacardiaceae/Rhamnaceae	Sumac/buckthorn families
Anacardiaceae	Sumac family
Rhamnaceae	Buckthorn family
Ceanothus	Buckbrush
Sphaeralcea	Globe mallow
Typha angustifolia	Cattail
Umbelliferae	Parsley/carrot family
Indeterminate	
SPORES: Trilete	

recent past than they were earlier. Liliaceae pollen was observed in samples 360 and 361. *Ceanothus* and *Typha angustifolia*-type pollen are observed in the lowest sample (366), while Umbelliferae pollen is noted only in the uppermost sample (359). *Artemisia* pollen is noted sporadically in this column, being present in samples 365, near the base, and 359 and 360 in the upper portion. Relatively few trees are represented, but include *Celtis*, *Juglans*, *Juniperus*, and *Pinus* in sample 360 and *Pinus* only in sample 359. The pollen record in this column appears to be severely affected by deterioration and erosion of pollen. High-spine Compositae and Tubuliflorae-type Compositae pollen comprise the majority of the identifiable pollen from this column. Liguliflorae-type Compositae pollen is noted only in sample 360. Low-spine Compositae pollen was noted throughout most of the record in small quantities. *Erodium* pollen was present only in the uppermost sample.

The pollen record indicates that plants available for exploitation by the native population included *Celtis*, *Juglans*, Cheno-ams, Compositae, some Cruciferae, Gramineae, Liliaceae, *Ceanothus*, *Typha angustifolia*, and possibly Umbelliferae, if the top sample is associated with occupation. The pollen assemblage and frequencies from this test pit appear to represent primarily native vegetation. High-spine Compositae are a very common component of many vegetation communities and hence the pollen records, in this part of California.

Test Pit 12A is the center test pit represented in the pollen record. This test pit displays a very different pollen signature than that in Test Pit 6. Cheno-am and High-spine Compositae frequencies fluctuate in opposition to one another in this test pit. Cheno-am frequencies start relatively low, increase to a peak in the middle of the column, then decrease sharply prior to increasing steadily toward the present. Aggregates of Cheno-ams indicate the presence of these plants directly in this vicinity or discard of processed food remains in this area. Cheno-ams are weedy annuals known to colonize and thrive in disturbed areas, such as middens. High-spine Compositae exhibits a reverse pattern, with the largest frequencies noted at the base of the stratigraphic column, a sharp decline towards the center of the column, followed by a slight increase, then decrease towards the present. This pattern suggests that High-spine Compositae were elements of the native vegetation that were displaced by Cheno-ams, which increased as a result of the disturbance of the midden. Aggregates of High-spine Compositae pollen were noted in this column, as they were in Test Pit 6. Tubuliflorae-type Compositae were note as numerous in this test pit, and indeterminate frequencies were not as large, indicating that the pollen was better preserved.

Cruciferae pollen was noted in relatively low frequencies throughout most of the record, increasing abruptly in sample 1397 between 20 and 30 cm below the surface. This high level continued until the surface. Some members of the Cruciferae family were introduced into California from the Mediterranean during the historic period (West 1989). This suggests that these upper levels represent historic period occupation or accumulation. Gramineae pollen is noted consistently in relatively low frequency throughout samples in this test pit. Aggregates of Gramineae pollen are noted in samples 1397 and 1398. The Gramineae pollen frequency peaks in sample 1398. Grasses appear to have been most abundant at this time. Liguliflorae-type Compositae is noted only in the upper portion of the record at this site, peaking in sample 1397. *Artemisia* pollen is noted throughout most of the record in small quantities. Low-spine Compositae pollen was observed sporadically in small frequencies. *Pinus* pollen is the only arboreal pollen noted in this test pit, and is observed in the upper samples only. *Erodium* pollen was noted in sample 1401, relatively deep in the column. One type of *Erodium* is native to California, while others are introduced. This pollen was not in a sufficiently good state of preservation to determine whether it represents a native or introduced species. *Euphorbia* pollen was observed only in the uppermost sample. Rhamnaceae and *Sphaeralcea* pollen were recorded only in upper samples, while *Typha angustifolia*-type pollen was observed towards the middle of the record.

In this test pit, Cheno-ams appear to have been relatively abundant, and could easily have served as a ready food source for the occupants of this site. Their abundant frequencies might represent either growth of these weedy annuals on the midden itself, or might represent food processing and subsequent disposal of the remains in this area. Decline of High-spine Compositae suggests replacement in the vegetation community by Cheno-ams. The modern vegetation community appears to be represented by the dramatic increase in Cruciferae pollen in the upper three samples, as well as the increase in Liguliflorae pollen at the same time. Liguliflorae pollen frequencies, however, are not sustained in the upper levels. Pollen representing edible plants include: Cheno-ams, Compositae, Cruciferae, Gramineae, Rhamnaceae, and *Typha angustifolia*.

Test Pit 13 is the easternmost pit examined. This pit bears some similarities to Test Pit 12A, although frequency distribution is not repeated. Arboreal pollen represented includes *Juniperus* pollen only in sample 1419, relatively low in the column. *Pinus* pollen is noted sporadically in these samples, but is more abundant near the surface. Preservation in this column is only slightly better than that observed in Test Pit 12A, as measured by quantities of indeterminate and Tubuliflorae-type Compositae pollen. Cheno-am frequencies are relatively high throughout most of the pollen record. They are noted at moderately high frequencies in the lowest samples in this column, increase and remain high between samples 1420-1415. Aggregates are noted in all samples, indicating local growth of these plants, or discard of processed plant remains. After sample 1415, the Cheno-am frequencies decline rapidly towards the surface.

Artemisia pollen is noted in relatively low frequency, declining slightly prior to the present ground surface, as in Test Pit 12A. Low-spine Compositae pollen is also noted in very low frequencies and sporadically throughout the column. High-spine Compositae are noted only in moderate frequencies throughout the entire record, although aggregates are noted in all samples. Although members of the Compositae family are apparently growing in the local vegetation, they are not as abundant as they were to the west. Liguliflorae-type Compositae pollen is noted only in the upper samples at this site, as it was in Test Pit 12A. Cruciferae pollen increases dramatically in the upper portion of this column, as it did in Test Pit 12A. Prior to these levels it was noted only sporadically in small quantities.

The only evidence of *Ephedra nevadensis*-type pollen at this site was recovered from sample 1415. These pollen are extremely aerodynamic and this presence could result from wind transport from distances of several hundred miles. *Euphorbia* pollen is noted from the middle and upper portion of this record. The only note of *Galium* pollen in this project is made in sample 1418, 50 to 60 cm below the surface. *Galium* is noted to be edible and have medicinal uses. This plant might have grown in the area of the midden, or might have been processed and the remains discarded here. Gramineae pollen is noted regularly throughout the record in small quantities, with the exception of the uppermost sample. Aggregates are noted toward the top of the column, as they were in Test Pit 12A. Leguminosae and Anacardiaceae pollen are noted in the portion of the record, while Onagraceae, Rhamnaceae, and *Typha angustifolia*-type are noted in the upper portion of the record.

Pollen present representing edible plants in this pit includes Cheno-ams, Compositae, Cruciferae, *Galium*, Gramineae, Rhamnaceae, and *Typha angustifolia*. *Galium* is also noted to have medicinal uses, as does *Ephedra nevadensis*.

A single metate (#1285) was washed to recover pollen that might indicate what was ground using this tool. The ground stone exhibited *Eucalyptus* pollen, which indicates that it is contaminated with modern pollen, probably at the time of excavation. The metate was recovered near a modern eucalyptus tree. Other pollen types recovered include *Pinus*, Cheno-ams, *Artemisia*, Low-spine and High-spine Compositae, Liguliflorae, Cruciferae, *Euphorbia*, Gramineae, Anacardiaceae/Rhamnaceae, Rhamnaceae, and *Typha angustifolia*-type. It is possible that the large quantity of Cheno-am pollen, accompanied by numerous aggregates (8 aggregates ranging up to 10 grains a piece) reflects grinding Cheno-am seeds. Although it is possible that other remains were processed using this ground stone, no other frequencies are notable or unusual. The presence of *Typha angustifolia*-type pollen might reflecting grinding or merely presence through wind transport, as this pollen type was also recovered from the midden.

ETHNOGRAPHIC USES OF NATIVE PLANTS RECOVERED AT THE ADMIRALTY SITE

The ethnobotanic literature provides evidence of the exploitation, in historic times, of numerous plants, both by broad categories, such as greens, seeds, roots, and tubers and by specific example, such as seeds parched and ground into meal that was formed into cakes and fried in grease. Repetitive evidence of the exploitation of resources indicates a widespread utilization and strengthens the possibility that the same or similar resources were used in prehistoric times. The ethnobotanic literature serves only as a guide indicating that the potential for utilization existed in prehistoric times--not as conclusive evidence that the resources were used. Pollen and macrofloral remains, when compared with the material culture (artifacts and features) recovered by the archaeologists, become indicators of use.

Celtis (hackberry) fruits may be eaten raw, cooked, or dried. The thin pulp is tasty and sweet and attracts birds and small animals (Angell 1981:162-164).

Walnuts were used less intensively than either hickory nuts or acorns (Reidhead 1981:186), although if they were processed at this site some macrofloral evidence of their presence would be expected. Walnuts may be collected quickly and efficiently, as the entire crop stays on the ground for some time. Animals provide little competition for this resource (Reidhead 1981:186).

Cheno-ams are a group of plants that include the goosefoot family (Chenopodiaceae) and pigweed (*Amaranthus*) and were exploited for their greens (cooked as potherbs) and seeds. The greens are most tender when young, in the spring, but may be used at any time. The seeds were ground and used to make a variety of mushes and cakes. The seeds usually are noted to have been parched prior to grinding. *Chenopodium* and *Amaranthus* are both weedy annuals capable of producing large quantities of seeds. *Atriplex*, which occurs as both an annual herb and perennial shrub, may also be exploited for its greens and seeds. Saltbush leaves have a salty taste and have been used as a seasoning. Saltbush seeds do not ripen until mid-fall and may remain on the shrubs throughout the winter into the next growing season (Chamberlain 1964:366; Gallagher 1977:12-16; Gilmore 1977:26; Harrington 1967:55, 57, 71; Rogers 1980:43, 66; Schopmeyer 1974).

Suaeda is a common member of the Cheno-am group in wet areas or sloughs and is known to have been exploited for both its greens and seeds. Greens may be collected from May through September, while seeds were available from late June until October. *Atriplex*, if locally abundant, would have contributed greens from January through October and seeds from April until December (Brandoff 1980).

Helianthus (sunflower) is a member of the morphological pollen group of High-spine Compositae. Sunflower seeds are very rich in oil, and may be ground into paste for batter or roasted and eaten. Other members of the Compositae were used in a variety of ways, including as medicine and as food. Another species of *Helianthus*, Jerusalem artichoke, produces roots that can be boiled or baked and eaten (Harrington 1967:313-315). Most composite seeds ripen in the late summer and fall. Numerous members of the High-spine Compositae group are noted to have been collected for their seeds and include such diverse plants as *Achyrnachaena*, *Aster*, *Blenosperma*, *Chaenactis*, *Eriophyllum*, *Happlopappus*, *Helianthus*, *Hemizonia*, *Heterotheca*, *Lasthenia*, *Layia*, *Madia*, *Malacothryx*, *Senecio*, and *Solidago* (King n.d.:16).

Cruciferae were exploited for their greens primarily during the rainy season in California, which occurs during the months of November and December (Priestley 1972:50). Both tansy mustard (*Descurainia*) and peppergrass (*Lepidium*) seeds are noted to have been eaten in pinole after being roasted (King n.d.:12).

Galium leaves and stems are noted to have been used medicinally, while the seeds may be ground and roasted to produce a beverage (Kirk 1975:127; Mead 1972:95).

Members of the Gramineae (grass family) have been widely used as a food resource. Several grasses common to the emergent wetlands produced seeds that were gathered and utilized. These include *Bromus* and *Elymus*. *Bromus* seeds were available from May through September, while *Elymus* seeds were available from June through September (Brandoff 1980). Grass seeds constitute an abundant food source for the Luiseno (Bean and Shipek 1978:552). *Phalaris* seeds were apparently important in one of the Chumash villages (King n.d.:13).

Members of the lily family may include brodiaea (*Brodiaea* or *Dichelostemma pulchellum*) and others. This bulb was an important food for many California Indians. The nut-like bulbs were eaten raw or cooked (roasted in hearths). Mariposa lily bulbs (*Calochortus*) were processed in a manner similar to those of brodiaea. Several parts of the sego lily are edible, including the greens, seeds, bulbs, and flowers. The bulbs constitute the most usable portion of the plant, and were frequently boiled. They may also be stored for future use (Harrington 1967:159-161). Brodiaea is available from mid-February through mid-July (King n.d.:11). Amole or soap plant (*Chlorogalum*) was prized among the Chumash. "The bulb was roasted and eaten, the green bulb furnished lather for washing, the dry husks could be frayed and bound into brushes, and the crushed plant was used as a fish poison" (Grant 1978:516). Wild onion (*Allium*) was used as a relish by the Tipai and Ipai (Luomala 1978:600). King (n.d.:6) notes that soap plant or amole was collected for its shoots between May and July.

The Rhamnaceae (buckthorn) family includes several shrubs such as *Condalia*, *Rhamnus*, and *Ceanothus*. These shrubs are a source of browse for deer. In addition, *Condalia* roots are noted to have been used medicinally by the Pima Indians. *Rhamnus* produces bright red fruits, which the Apaches are noted to have eaten with meat (Kearney and Peebles 1960:530-534).

Typha is a rich source of nutrients. Steward (1938) and Chamberlin (1964) note the utilization of cattail as food; and Harrington (1967) describes the use of both pollen and the seed-like fruits of cattail as food resources. The young pollen-producing flowers may be stripped from the spikes, or the pollen may be removed by shaking the mature flowers. The resulting flowers and pollen may be mixed with flour. Flour made from cattail roots, which are best harvested in the fall, is similar with respect to quantities of fats, proteins, and carbohydrates to flour obtained from wheat, rice, and corn (Harrington 1967). Claasen (1919) has estimated that a single acre of cattails may produce as much as 6,475 pounds of flour. The Chumash used cattail seeds and roots to make flour from which pinole or gruel was made (Grant 1978:516). Cattail roots and pollen were also used as food by the Tipai and Ipai (Luomala 1978:600).

SUMMARY AND CONCLUSIONS

Differences in patterns were observed in samples from the three test pits examined. The pollen record indicates that in Test Pit 6 at the western edge of the site vegetation was probably relatively undisturbed, with members of the high-spine Compositae group being common. Test Pits 12A and 13 represent denser areas of midden where the vegetation had been disturbed by cultural activity. In these areas members of the high-spine Compositae group were replaced by Cheno-ams, a weedy annual that provides edible greens and seeds. The disturbance of the midden would have provided a concentrated source of Cheno-am greens and seeds for exploitation by the occupants of this site. Similarly large quantities of Cheno-am pollen were recovered from the metate wash sample, and aggregates were recovered, suggesting the possibility that Cheno-am seeds were ground. While large quantities and numerous and/or large aggregates of pollen were not present to indicate definite use of specific plants, a variety of plants were noted in the pollen record as available for exploitation, including: *Celtis*, *Juglans*, Cheno-ams, High-spine Compositae, Cruciferae, *Galium*, Gramineae, Liliaceae, Rhamnaceae, *Ceanothus*, and *Typha*.

CHAPTER 14

MACROBOTANICAL ANALYSIS OF THE ADMIRALTY SITE

Ralph E. Brooks and Wiliam C. Johnson

METHODS AND GENERAL OBSERVATIONS

Flotation samples extracted from test pits at the Admiralty site (CA-LAn-47) were scanned for botanical remains using a conventional stereozoom dissecting microscope. Because the samples in many cases were quite bulky, there was no attempt to sort wood remains or collect all seeds observed. Instead, representative materials were encapsulated after sample evaluation and returned with the matrix to the sample bag. Wood identifications were grouped as either dicot or gymnosperm based on whether or not border pitting (gymnosperm) could be observed in the cells using a compound microscope at 100x. Further identification of the wood was not possible, in most instances, without scanning electron microscopy due to the small, fragmentary nature of the specimens. Although the uncharred seeds generally had good color retention, it should be noted that many of the uncharred botanical materials have been blackened through fungal and bacterial activity. In all instances we were certain to differentiate between this blackening and true fire charring. Although the definition of the term *carbonization* is clear, there is often confusion in its use; the terms *charred* and *uncharred* were therefore used herein to avoid possible ambiguity.

When considering the entire suite of samples collectively, four major observations emerge:

1. Grass (Hordeae): These wheat-type grasses were found in many samples. The seeds, or "grains," are large and could be from something like oats (cf. *Avena barbata*), wheat (*Triticum aestivum*), or brome (*Bromus spp*). Interestingly, these were always charred samples; matching, uncharred remains were never found. Also, grains were "puffed," or enlarged, due to expansion that occurs in these species upon heating.

2. Mallows (Malvaceae): These seeds were found both charred and uncharred. They are most likely from the genus *Sidalcea*, a perennial herb. There are a number of species presently growing in California. Most of the seeds are smooth, shiny, and brown, but in a very few the delicate and reticulate outer coat remains. That particular feature places the plant in its family and genus. The seed is so common through these samples that it was likely a common weedy species. We are not, however, sufficiently familiar with the local environement to speculate as to which one it might be. Particular habitat would depend on the species, although most grow in somewhat moist situations.

3. Panicoid grass: Because the genera *Panicum* (panic grasses) *and Paspalum* (the paspalums) are not common in California, this grass is probably an *Echinochloa* (barnyard grass) because these are common in that region. These seeds show up in many of the samples but are usually not charred. These plants grow in low areas such as streamside or along the edges of ponds, lakes, lagoons, or marshes. They also would have provided a prime food source for birds and rodents.

4. Euphorbia: Two of the *Euphorbia* seeds were uncharred, but at least one charred sample was found. There are two types of Euphorbias -- the upright and prostrate, or mat, types. The upright species produce a large, plain seed, whereas the mat species produce a small, ornately scultured

one. Both the size and sculpturing of the seed is definitely that of the mat spurges, of which there are a number of species in California. These can be found in a variety of sites from low, disturbed sites to dry, exposed hillsides.

Without exception, the seeds identified in these samples could all be placed in an environment where water would have been perennially available. Also, most plants belong to genera containing numerous species that occur in environments disturbed either naturally or culturally. The presence of gymnosperm and dicot wood in the samples is not surprising for that area, because both could be collected in the vicinity today.

INTERPRETATION OF MACROFOSSIL DISTRIBUTION

The historical ecology of the study area has, to the best of our knowledge, contained a dominant fire element. The presence of fire would serve to enrich the soil in charcoal and charred plant remains, not only at the surface, but within the upper 10 to 15 cm. Bioturbation of various types could then redistribute these remains. Fire is clearly indicated by the fact that the majority of the samples contain greater than 50 percent charred (burnt) material, many being as high as 80 to 90 percent. Macro- and microscale bioturbation has been sufficient to distribute the results of the surface fires throughout the solum and below. If the samples from the test pits represent bona fide midden deposition, the amount of charred material could easily relate to hearth activities. Consequently, it has proven to be very difficult, if not impossible, to assess whether or not the various macrobotanical remains are historic or prehistoric, natural or cultural. The entire perspective is clouded even further by the assumption that fire was a natural element prior to and during the period of prehistoric occupation.

The frequency of material found in the 67 samples examined from 12 test pits is presented in Table 64. The table indicates the number of samples a given plant taxa or other material occurs within, not the total number of individual occurrences.

Amaranthus seeds are the most common, generically identifiable botanical macrofossil in the flotation samples from the site. They occur within 8 of the 12 test pits (1, 6, 7, 8B, 9A, 12, 13, and 14) and are documented to a depth of 80 cm, but predominately to 30 to 40 cm. The eight pits are concentrated, with the exception of Test Pit 6, at the eastern end of the site. The only charred specimen was found in Test Pit 9A, Level 3. The lack of charred remains in these samples is due either to the seed's fragile nature (near-instantaneous combustion) and/or pervasive modern contamination. Therefore, because the seeds are uncharred, in high concentrations, and have good color retention, many of them may be historical contaminants.

A single *Bidens* element, a charred seed, occurred at 20 to 30 cm depth in Test Pit 12.

Curiously, the *Euphorbia* were present only in the samples from Test Pit 13 (eastern part of the site), Levels 1, 5, and 6, or to a depth of 60 cm. The single charred specimen was situated in the upper 10 cm, that is, at or very near the surface. This plant produces a seed with a heavy coat which could look modern when it is not, due to the durability of the seed.

The seed of *Glycine*, or soybean, was found between 20 and 30 cm depth in Test Pit 8B. It is very fresh-looking, seemingly modern, and presumably introduced in recent history, perhaps from a nearby field or fall from a railroad car.

Hordeae, the tribe of grain grasses, is well represented, occurring in at least 17 samples, 15 of them with seeds. Remains, all charred, appeared primarily along the north side of the Direct Impact Area in Test Pits 1, 3, 5, 7, 8B, 12, and 13, with the greatest concentrations and vertical distribution in

Table 64. Frequency of Presence of Materials Identified in Flotation Samples. (The tallies represent the number of samples the material appears in, not the total number of occurrences in the samples as a whole.)

Material	Uncharred	Charred
Amaranthus (pigweeds) seed	15	1
Bidens (beggars tick) seed	0	1
Euphorbia (mat spurges) seed	2	1
Glycine (soybean) seed	1	0
Hordeae (wheat-type grains) seed	0	15
Hordeae (wheat-type grains) fragments	0	2
Helianthus (sunflower) seed	0	1
Helianthus (sunflower) fragments	0	1
Juniperus (juniper/cedar) fruit	0	2
Malvaceae (mallow) seed	8	5
Melilotis (sweet clover) seed	1	0
Panicoid (panicum grass) seed	10	0
Panicoid (panicum grass) fragments	1	1
Picea (spruce) twig	0	1
Portulaca (purselane) seed	0	1
Rumex (dock) seed	1	2
Scirpus (sedge) seed	0	6
Setaria (foxtail) seed	1	0
Solanum (black nightshade) seed	4	1
Viola (violets) seed	0	1
Dicot wood (undifferentiated)	3	28
Gymnosperm wood (undifferentiated)	4	39
legume seed (undifferentiated)	0	1
Seeds (undifferentiated)	0	5
Herbaceous stem fragments (undifferentiated)	0	1
Grass stem fragments (undifferentiated)	1	3
Grass leaf blades (undifferentiated)	17	4
Grass culm (undifferentiated)	0	1
Leaf fragments (undifferentiated)	3	0
Wood and/or roots (undifferentiated)	50	17
Charcoal (undifferentiated)	--	3

pits 12 and 13. Depth of the grass remains ranged from the surface 10 cm in pits 1, 3, and 5 to at least 80 cm in pit 12.

Helianthus, the sunflower genus, occurs in Test Pits 5 and 12, Levels 1 and 3, respectively.

The two charred *Juniperus* fruits were retrieved from the 10 to 20 cm depth in pits 7 and 13.

The mallows, or Malvaceae family, are the third most common plant, charred or uncharred, represented in the flotation samples. They occur in Test Pits 1, 2C, 6, 7, 12, and 13, with charred specimens restricted to Test Pits 12 and 13. Charred and uncharred specimens are found at depths of 0 to 10 and 70 to 80 cm. This plant, although native, is an increaser, that is, a weedy species that expands upon disturbance of the local plant community, naturally or culturally (prehistoric or historic). Also, the moderate size of the seed makes it a good possibility for rodent caches.

One uncharred seed from *Melilotis*, sweet clover, occurred between 70 and 80 cm in Test Pit 12. This is an introduced species and is therefore historical.

Panicoid grasses also are very well represented, particularly as uncharred seeds, in Test Pits 1, 2A, 2C, 3, 5, 6, 8B, and 9A. They are found at depths between 10 and 110 cm. Like *Amaranthus*, the panicoid grasses may be in large part historically intruded; their ubiquity, good state of preservation, and probable growth on-site today or in the very recent past could argue against appreciable antiquity. It must be borne in mind that this type of grass, like Hordeae, has, however, probably been on-site for the last few thousand years; it is found at a depth of 80 to 90 cm in Test Pit 3.

The single *Picea* (spruce) find, a twig, was in Level 5 of Test Pit 13. Our experience with wood, this genus in particular, leads us to conclude that this specimen is prehistoric in age.

The charred *Portulaca*, or purselane, seed was retrieved from 10 to 20 cm in Test Pit 7.

Rumex, or curly dock, seed came from Test Pits 3, 6, and 8B, levels 3, 7, and 8, respectively.

Seeds of sedge, *Scirpus*, appeared in Test Pits 2A, 8B, 9A, and 13, the latter two producing multiple specimens.

Setaria, the common foxtail, was represented by a single uncharred seed, at 30 to 40 cm in Test Pit 9A. This is clearly historic material, as it is an introduced species.

Uncharred and charred seeds of *Solanum*, the black nightshade genus, were recovered from Test Pits 3, 8B, 12, and 14, within the upper 40 cm.

Viola, or violet, seed (charred) occurred once in Level 4 of Test Pit 8B.

The remaining material was not identifiable to the genus level, but is nonetheless of interpretational value. Dicot and gymnosperm wood occurs predominantly in a charred state and was found intermixed, through all levels, in most excavation units. The large amount of undifferentiated wood and root material was found, both charred and uncharred. Most root material is quite fresh-looking and likely modern, presumably from immediate pre-excavation vegetative cover. The fine gravel comes both from within and without the abandoned railroad right-of-way, and may represent grade ballast. Although early railroad construction used readily available resources, the size and rounded (alluvial) nature of the sediment seems to make that a questionable source. The depth of historical intrusion is certainly demonstrated by the presence of paper and plastic fragments at a depth of 50 to 60 cm in Test Pit 3.

It seems, from the preceding discussion, that there are no readily apparent horizontal patterns evident, given the depth and density of sampling within test pits. No particular plant or assemblage of plants clusters within the field of sampling, except for singular occurrences such as that of *Euphorbia* in Test Pit 13. There is, however, significant variation in the vertical profiles among the test pits.

A summary of flotation sample contents is presented by test pit, level, and depth in Table 65. Each of the 12 test pits has a relatively unique assemblage of macrobotanical materials. Test Pit 1 produced primarily uncharred remains, although surface fires have occurred, as evidenced by the charcoal and charred Hordeae seeds in the surface to 10 cm level. Thereare also uncharred Panicoid

Table 65. Flotation Materials Identified by Test Pit, Level, and Depth.

TEST PIT	1						2A					2C	3									5						6					
LEVEL	1	2	4	5	6	7	1	2	3	5	6	5	1	2	3	4	5	6	7	8	9	1	2	3	4	5	9	4	5	6	7	10	11
Seeds																																	
Amaranthus	U																					U						U					
Bidens																																	
Euphorbia																																	
Glycine																																	
Helianthus																						C											
Hordeae	C							C					C	C		C						C											
Legume																																	
Malvaceae			U		U							U																	U				
Melilotis																																	
Panicoid	U						U	U				C	U							U	U	U											U
Portulaca																											U						
Rumex															C																C		
Scirpus								C																									
Setaria																																	
Solanum															U																		
Viola																																	
Undifferentiated		C					C																										
Wood																																	
Dicot		C						C	C	C	C		C	C	C									C/U				C/U		C	C		
Gymnosperm	C	C	U	U	U	U	C	C	C	C	C	C	C	C	C			C					C	C/U				C/U		C	C		
Undifferentiated	U		U	U	U	U	U					U	U			C/U	C/U		C		C	C	U		C/U				C/U	U	U		C
Stems & Twigs																																	
Grass stems																C	C																
Herbaceous stems																						C											
Hordeae stems																																	
Picea twig																																	
Undifferentiated stems																																	
Miscellaneous																																	
Grass leaves		U					U					U	U	U				U	U						C/U					U			
Juniperus fruit																																	
Undifferentiated roots	U		U	U	U	U	U					U	U	U			U	U	U	U	U		U		C/U		U		C/U	U	U	U	U
Undifferentiated	C																									C/U							

C = charred U = uncharred

Table 65. Flotation Materials Identified by Test Pit, Level, and Depth (continued).

TEST PIT	7				8B							9A			12							13						14							TOTAL
LEVEL	1	2	3	4	1	2	3	4	6	7	8	1	2	4	1	2	3	4	5	6	8	1	2	3	5	6	7	1	2	3	4	5	6	7	
Seeds																																			
Amaranthus		U			U		U	U				U	C		U			U	U			U						U							1C/15U
Bidens																	C																		1C
Euphorbia																						C			U	U									1C/2U
Glycine							U																												1U
Helianthus																	C																		2C
Hordeae		C							C									C	C	C	C		C	C	C	C	C								17C
Legume																							C												1C
Malvaceae		C/U													C	U				C/U	C/U				C										5C/8U
Melilotis																					U														1U
Panicoid		C			U								U																						1C/10U
Portulaca																																			1C/1U
Rumex								U																											2C/1U
Scirpus								C		C			C												C	C									6C
Setaria														U																					1U
Solanum								U								C/U												U							1C/4U
Viola								C																											1C
Undifferentiated																							C	C		C									5C
Wood																																			
Dicot	C/U		C				C	C	C	C		U			C	C		C		C	C			C			C		C		C	C			28C/3U
Gymnosperm	C/U	C/U						C	C	C		U			C	C	C	C	C	C	C	C		C	C	C	C	C	C	C	C	C			39C/4U
Undifferentiated				C	C/U	C/U	C	U	U			U		C		U	U	U		U	U	U	U		U		U		U	U	U	U	U	U	12C/35U
Stems & Twigs																																			
Grass stems		C/U																																	3C/1U
Herbaceous stems																																			1C
Hordeae stems															U																				1U
Picea twig																									C										1C
Undifferentiated stems			U										U																						2U
Miscellaneous																																			
Grass leaves	C/U	C/U							U								U	U	U		U		U						C						4C/17U
Juniperus fruit		C																					C												2C
Undifferentiated roots				U	C/U	C/U	U	U'	U			U	U		U	U	U	U	U	U	U	U	U	U	U	U	U		U	U	U	U	U	U	4C/49U
Undifferentiated											C	C																							4C/1U

C = charred   U = uncharred

grass seeds and *Amaranthus* seeds in the upper 10 cm. Below 30 cm there is very little charred material, and fine gravel persists from that level down.

Materials from Test Pit 2A exhibit increased charring with depth, but below 20 cm there is little botanical material quantitatively and little diversity, at least preserved. Charred and uncharred grass remains and seeds and sedge dominate the upper 20 cm. Test Pit 2C is represented by a single sample from a depth of 40 to 50 cm. Uncharred grass leaves and Malvaceae seeds at this depth are probably the result of rodent activity. The seeds are of sufficient size to be incorporated in a rodent cache and are consistent in appearance.

The majority of material from Test Pit 3 is charred to a depth of 50 cm, and then is mostly uncharred. Paper and plastic fragments at a depth of 50 to 60 cm indicate certain disturbances to at least that depth at the particular location of this pit. Grass materials are common throughout the profile, with Hordeae seeds to at least 40 cm and Panicoid seeds appearing to 90 cm, the lowest level of the pit. Unless disturbance has occurred to a depth of 80 cm or more, the presence of Panicoid grass this deep suggests long-term occupancy of the site by this species. *Rumex*, the dock, and *Solanum*, the ground cherry, are found together between 20 and 30 cm, without identifiable grass remains. The fact that they are singular finds and that the former is charred and the latter uncharred precludes any meaningfull paleoenvironmental interpretation, except to note that they may have been cohorts.

A decrease in charring with depth characterizes Test Pit 5. There is a concentration of charred and uncharred herbaceous material within the upper 10 cm, with charred material dominating. Between 40 and 50 cm there is little charred material, and from 80 to 90 cm virtually none exists. Interestingly, Panicoid grass seed is present as deep as 80 to 90 cm, as with Test Pit 3, indicating prehistoric presence.

Test Pit 6 exhibits no recognizable trend in charring with depth, although the upper three levels are not represented; charred gymnosperm and dicot wood fragments are found throughout, with some uncharred from 30 to 50 cm. *Rumex* once again occurs charred in a level without attendant recognized grass remains; this may, as in Test Pit 3, indicate a particular environment (less grass, more woody shrubs?) persisting at the site for a brief period of time. *Amaranthus* and Malvaceae, possible cohorts, exist, uncharred, in Levels 4 and 5, respectively. Panicoid grass seed was recovered between 100 and 110 cm, the deepest level examined from the site. This presence is again interpreted as long-term site occupancy.

Decreased charring is evident with depth in Test Pit 7. Level 1 was uninspiring with only a mixture of charred and uncharred plant fragments. Level 2 was, however, one of the most diverse of the entire suite of samples from the site. Grass is represented by a diverse assemblage of stem components, charred and uncharred, and by charred Hordeae seeds (the Panicoids are unexpectedly absent). *Amaranthus* and Malvaceae seeds once again co-occur. *Portulaca*, the purselane of moist environments, occurs with charred fruit of *Juniperus*, the juniper. The plant material recovered from this level suggests that it may have been a stable surface for a inderterminate period of time, and that the assemblage of species could potentially be culturally related. From 20 to 40 cm there are some wood fragments, but it is mostly recent-looking root material.

Decreased charring is evident with depth in Test Pit 7. Level 1 was uninspiring with only a mixture of charred and uncharred plant fragments. Level 2 was, however, one of the most diverse of the entire suite of samples from the site. Grass is represented by a diverse assemblage of stem components, charred and uncharred, and by charred Hordeae seeds (the Panicoids are unexpectedly absent). *Amaranthus* and Malvaceae seeds once again co-occur. *Portulaca*, the purselane of moist environments, occurs with charred fruit of *Juniperus*, the juniper. The plant material recovered from this level suggests that it may have been a stable surface for a inderterminate period of time, and that

the assemblage of species could potentially be culturally related. From 20 to 40 cm there are some wood fragments, but it is mostly recent-looking root material.

As a test pit, 8B had the greatest diversity of plant material. There was no trend in the proportion of charred remains with depth: charred and uncharred elements persist throughout. Panicoid grass and *Amaranthus* seeds occurred within the upper 10 cm, along with the typical root and wood fragments. While the second level contained little material, Levels 3 and 4 were extremely productive and diverse, consistent with Level 2 in Test Pit 7. Contamination seems at least partially responsible for the diversity of Level 3: *Glycine*, or soybean, seeds are intrusive, as are uncharred, modern-appearing *Amaranthus* seeds. Level 4 contained a variety of charred and uncharred seeds: the singular occurrence of *Viola*, or violet, seeds (charred), several *Scirpus*, or sedge, seeds (charred), uncharred *Solanum*, or black nightshade, seeds, uncharred *Rumex* seeds, and uncharred *Amaranthus* seeds. This assemblage and diversity is suggestive of surface stability and potential human activity. Specifically identifiable material in Level 6 includes a charred Hordeae seed and small bone, possibly of a rodent. A charred *Scirpus* seed and uncharred *Amaranthus* seed were again present in Level 7. Modern-appearing *Amaranthus* seeds were common in Level 8.

Level 1 of Test Pit 9A was primarily charred, unidentifiable plant material, indicative of surface fire(s); the exceptions were a single uncharred *Amaranthus* seed and uncharred wood and roots. The only charred *Amaranthus* seed found in materials from the entire site was in Level 3; we have no particular interpretation for this single charred occurrence. Charred *Scirpus* seeds were also found in the level. Perhaps the two plants were co-existing during fire. Contamination is confirmed by the existence of a *Setaria* (foxtail) seed in Level 4.

Test Pit 12 clearly becomes increasingly charred with depth. On the whole, the pit is dominated by remains of herbaceous plants indicating a disturbed grassland environment. *Helianthus*, the sunflower, and *Bidens*, the beggars tick, and *Melilotis*, sweet clover, are good indicators. Because sweet clover is an introduced species, this single uncharred seed represents contamination to at least a depth of 70 to 80 cm. *Amaranthus* and Hordeae seeds are found throughout the profile; this combined with the presence of uncharred grass leaf blades to 80 cm (the bottom of the test pit) suggests a long history of grass dominance. The same may be assumed for Malvaceae, which occurs in the upper two levels and lower two levels sampled.

Test Pit 13 exhibits a relatively high degree of plant diversity. It stands out in that it is the only pit to contain *Euphorbia*, or the mat spurges, and *Picea*, or spruce, remains. The former, recognized as charred and uncharred seeds, indicates a moist environment and occurs at three different levels, down to a depth of 50 to 60 cm. The co-existence of spruce, mat spurges, sedge, and probably the mallows within a single level (Level 5) suggests a surface with persistent high moisture, perhaps a wetter period of time locally or regionally. This is also expressed, to a lesser extent, by the next lower level. Hordeae seeds (charred) are found in all levels below the first, attesting to this species persistence at the site.

Botanically, Test Pit 14 was not very productive. The profile material is charred near the top and increasingly uncharred downward (cf. Test Pit 12). A single uncharred seed each of *Amaranthus* and *Solanum* was recognized in the first level, but no other material from the samples of this pit was specifically identifiable. As with the other pits, remaining material indicates a woody shrub grassland.

SUMMARY AND CONCLUSIONS

The macrobotanical material contained within the flotation samples indicates the site has been mesic for at least the last several hundred to few thousand years. It appears the site has been seasonally and, at times, perennially moist. The seasonality of the moisture regime is suggested by the charring of the botanical remains and by the historic fire ecology of the region, at least under natural conditions. A seasonaly wet, woody shrub grassland best describes the assemblage: gymnosperm and dicot wood and the Panicoid and Hordeae grasses, with a few increasers and mesic plant types. In addition to the grasses, the primary mesic plants documented are the mat spurges, purselane, and sedge. Short-term variation in the local or perhaps regional environment may have occurred based upon particular assemblages represented (for example, Test Pit 7, Level 2; Test Pit 8B, Level 4; and Test Pit 13, Level 5). Disturbance, natural or cultural, is recorded through the presence of disturbance species such as beggars tick, sunflower, the mallows, and, to a lesser extent, the pigweeds.

Despite the fact that little is known regarding the aboriginal use of wetlands in this region, the use of plants on-site by prehistoric peoples was probable. *Amaranthus*, or pigweed, is an excellent candidate because of its long history in the plant community of the region and its robust growth under the prevailing climate. This botanical macrofossil study does not deny or confirm the aboriginal use of the plant: as noted above, there may have been cultural burning of the plant, but the fragile nature of the seed under burning could be obscuring the cultural record. Another plant group that may have been utilized prehistorically is that of the grain grasses, or Hordeae. Many of these seeds were found and were always charred. Consequently, they may have been used culturally, but the fire ecology is likely creating unresolvable noise in the data. A similar statement may be made regarding the Panicoid, or panic, grasses. The seeds are 2 to 3 mm in length and millable; millet is, in fact, one of the panicoid grasses. Use may have been made of a few other species such as *Juniperus* (the fruit), *Euphorbia*, or the Malvaceae (mallows), but given the small sample size and the limited knowledge of aboriginal plant use in the region, nothing more can be extracted from the data. It does, however, seem reasonable that there could very well have been at least seasonal harvesting taking place at the site.

Contamination of the various levels within the excavation units has most certainly occurred, a result of natural bioturbation and historic earthworking activity. this disturbance is most evident in the upper two or three levels. Modern grass and shrub roots extend through most of the test pit profiles, as would be expected. The contamination that is disconcerting relates to the discovery of the introduced plants, that is, sweet clover at 70 to 80 cm, foxtail at 30 to 40 cm, and soybean at 20 to 30 cm. Paper and plastic recovered at a depth of 50 to 60 cm create a more severe time-stratigraphic problem. This can largely be explained through rodent activity. Because mixing has been extensive and to considerable depth, it is not possible to intepret independently single levels except in the few instances noted. This data set can nevertheless help clarify and be clarified by the archaeological information (cultural stratigraphy) and by other environmental data, such as the pollen and spore content.

CHAPTER 15

HUMAN SKELETAL REMAINS

As mentioned in Chapter 7, analysis of human skeletal remains was limited to a brief descriptive study conducted in the field by the junior author. Although no human burials were identified in the test pits excavated at the Admiralty site, four isolated human bones were recovered from the shell midden of three different test pits, one each from Test Pits 9A and 12C, and two from Test Pit 14. These remains included three fragmentary teeth and a cranial fragment, each of which are described in this section and summarized in Table 66.

DESCRIPTION OF INDIVIDUAL SPECIMENS

An incisor was recovered from Level 3 of Test Pit 9. Given its size and color, it was clearly from an adult. Approximately two-thirds of the root was missing due to post-mortem breakage. This fragment was 12 mm from the long axis, and on the occlusal surface it was 5.5 mm by 7.0 mm in size. The occlusal edge was somewhat shovel-shaped, but not markedly so, indicating a probable Native American biological affinity. The small size, narrow crown, and lack of a cingulum indicated it was a lower incisor (Bass 1971:216). The angle between the mesial and occlusal edge, plus the fan-shaped crown surface, suggested this was probably a right lateral incisor. A small amount of calculus adhered to the lingual portion of the tooth, but no caries were present. Hypoplasias, though not prominent, were observed, indicating that some unknown metabolic stress (that is, disease) occurred during childhood when the enamel of the tooth was forming. Enamel on the occlusal surface was heavily worn as a result of grit that was incidently included in the diet, probably from plant food that was processed by grinding. Although age could not be ascertained with any degree of accuracy, this incisor was probably from a young adult, possibly someone in their twenties. The relatively small size of the tooth indicated it might be from a female.

A molar was recovered from Level 3 of Test Pit 12 C. The size and color indicate it was from an adult. It measured 10.0 mm by 9.5 mm in size on the occlusal surface. Most of the root was absent due to post-mortem breakage. Three cusps were present on the occlusal surface, suggesting that it was probably an upper molar. But because virtually no roots were left, it was impossible to determine its side with much certainty. The presence of mesial and distal contact facets indicated it was a second molar. The occlusal surface was highly polished, probably the result of a high fiber content in the diet. No caries were observed. Size was relatively small, suggesting the molar may be from a female, however, such an assessment is tentative.

In Level 2 of Test Pit 14, a parietal fragment of the cranium measuring 62 cm by 60 cm in size was recovered. Thickness varied between 3 and 9 mm. Orientation of the grooves for the middle meningeal artery on the cerebral surface indicated that this fragment was from the right parietal bone (see Bass 1971:36). Post-mortem breakage along the edge of most of the bone was responsible for removing the posterior (lambdoidal suture), inferior (squamosal suture), and medial (saggital sutures) borders, leaving only part of the anterior border (coronal suture). A post-mortem crack observed on the external surface did not continue to the cerebral surface. Although fragmentary, the overall bone preservation was fairly good. Based on cortical thickness and the lack of sutural fusion, this parietal fragment was estimated as being from a young adult, possibly a male.

Table 66. Human Remains Positively Identified in the Field.

Field Specimen Number	Provenience	Level	Depth (cm)	Size (mm) (L x W x T)	Description
854	Test Pit 9A	3	20-30	12 x 7 x 5.5	Lower Right Lateral Incisor Adult, Female (?)
1476	Test Pit 12C	3	20-30	10 x 9.5 x 7	Upper (side ?) Second Molar Adult, Female (?)
1122	Test Pit 14	2	10-20	62 x 60 x 3/9	Right Parietal Fragment Young Adult, Male (?)
1477	Test Pit 14	3	20-30	11.5 x 10 x 9	Upper Left Third Molar Adult, Male (?)

Key: L x W x T = length x width x thickness

A molar was recovered from Level 3 of Test Pit 14. The size, color, and thickness of the roots indicated that this molar was from an adult. On the occlusal surface it measured 11 mm by 10 mm in size. Although the lower three-fourths of the roots from this tooth were missing, three fused roots were present, suggesting that it was an upper tooth (Bass 1971:224). The orientation of the roots suggested that it was a left molar, and the mesial contact facet and the lack of a distal contact facet indicated that it was a third molar. The occlusal surface was so heavily worn that the number of cusps could not be determined with certainty, but it appeared to have four cusps. No hypoplasias were observed, but the tooth was carious; a 1.5-mm wide cavity was present at the juncture between the buccal and occlusal surfaces. An enamel extension occurred on the buccal surface. Because of the relatively large size of this tooth for a third molar, it was tentatively interpreted as being from a male. Given the high level of attrition on the occlusal surface, and since the third molar is the last to erupt (typically after the age of 18), this tooth is estimated as being from an individual in their mid- to late-twenties. It is possible that the tooth came from the same individual as the parietal fragment described above.

HUMAN REMAINS AT THE ADMIRALTY SITE AND WITHIN OR NEAR THE BALLONA WETLANDS

Four isolated human bone fragments were recovered during the 1989 excavations at the Admiralty site. Combined with the 7 positively identified and 4 possible human remains found by Dillon et al. (1988), there was a maximum total of 15 human bone specimens recovered in the railroad right-of-way. The vast majority of these were found in test pits along the fenceline marking the southern end of the Channel Gateway project area.

Although the possibility exists that burials occur in the part of the Admiralty site located on the Channel Gateway property that has still not been excavated, the absence of burials in the excavated portion of the site within the project area suggests this likelihood is remote. It is common for teeth, which represented three of the four human skeletal fragments recovered by Statistical Research, to become detached from the cranium and incorporated in archaeological deposits, either by natural or cultural processes. The context of human skeletal remains at the Admiralty site is clouded further since all of these fragments were from Level 3 or above, a zone that has been subjected to various disturbance processes, especially grading and bioturbation. Because a tooth and a parietal fragment were recovered from Test Pit 14, and because it is possible that they were derived from the same individual, the area near Test Pit 14 would have to be considered the most likely candidate for where a burial might occur. This hypothesis is supported by Dillon et al.'s (1988) results. At most, 11 human remains were found in Dillon's Test Pit 4, located about 5 m west of Test Pit 14. Most of these remains were cranial fragments, presumed to be from the same individual (Dillon et al. 1988:120). It is possible that the remains derive from one individual or one burial containing several individuals. Because the remains were primarily recovered Levels 2 and 3, it is possible that a burial has already been removed when grading activity was undertaken to build the railroad bed. Alternatively, a burial may still be preserved if the bulk of it lies south of the fenceline marking the project area boundary.

Based on the 15 isolated human remains found in the railroad right-of-way, little can be concluded in terms of mortuary patterns and the health of the aboriginal inhabitants of the Admiralty site. However, when combined with the results of excavations led by Johnson in 1961 as well as the observations and collections made during monitoring of construction in 1965 by Burnham and Romoli and in 1969 by King and Thayer (see Dillon et al. 1988), some patterns can be inferred. First, there is no evidence that cremation was a mode of burial at the Admiralty site. Instead, the preferred mortuary practice apparently was inhumation. Although the supporting data are weak, none of the human bones recovered at the site were calcined or otherwise thermally altered. Further, the six burials previously noted at the site have all been inhumations, with those recorded by Johnson being flexed and placed in burial pits (Keith Johnson 1989, personal communication). Second, there is no evidence of burials being clustered within a centralized cemetery. Human bone has been recovered as isolated fragments from all parts of the site that have been examined. No clusters of burials have been found. Here again the evidence is tenuous, based on excavations in a small part of the site.

The pattern of flexed inhumations at the Admiralty site is different from most other sites in the Ballona region, particularly those located on the bluff marking the southern edge of the El Segundo Sandhills. The Loyola Marymount site (CA-LAn-61), located on top of the Ballona Escarpment, is interpreted by Van Horn (1987) as hosting a series of seasonally occupied temporary camps that date primarily between 1000 B.C. and A.D. 1000. At the site, one burial and 256 human remains were found dispersed throughout the midden (White 1985:229-233). While human bone was found in all parts of the site, six clusters of bone were identified, which probably derive from distinct individuals. About 95 percent of the remains had been cremated. White (1985:233) also suggests that the one inhumation may be a secondary burial, although the poor condition of the bone precluded a definitive assessment. The prevalence of cremation as a burial practice is consistent with Van Horn's (1987) contention that occupants at the site were relatively recent migrants to the coast who had brought with them a strong desert culture influence.

Immediately below the Loyola Marymount site is the Peck site (CA-LAn-62). Located on the banks of Centenial Creek near where it emptied into the Ballona Lagoon, the Peck site represents one of the major village sites in the Ballona wetlands. In 1945 and 1946, Peck (1947) excavated portions of the site uncovering cremations and at least two inhumations. Collectors have also been active at the Peck site. In the late 1940s and early 1950s as many as 20 flexed inhumations were reported to archaeologists (Altschul et al. 1990). Although private collections were observed by various archaeologists, no systematic analysis was undertaken and the present location(s) of these collections is unknown. Based on diagnostic artifacts recovered from the Peck site, it appears to date to the Late Prehistoric period (Altschul et al. 1990). The artifact assemblage is consistent with the preponderance of flexed inhumations. The presence of cremations at the site led Peck (1947) to argue that an earlier component also exists. Until further work is conducted at the site, this proposition cannot be tested.

Although weak, an evolutionary pattern in mortuary practices appears to be represented in the Ballona. During the Middle period, cremation, and possibly secondary burials, was the preferred burial custom. By the Late period, cremation apparently gave way to inhumation as the dominant mode of burial. This trend may be part of a larger shift in the Ballona from a desert-oriented culture to one with ties predominantly with neighboring coastal groups.

CHAPTER 16

STREAMFLOW STUDY

Chester W. Shaw, Jr. and Jeffrey A. Homburg

In this study, estimates of past streamflow for the Santa Ana River Basin (SARB) are presented. These estimates are then used to explore whether or not moisture deficits or periods of sustained moisture abundance impacted aboriginal populations residing in southern California coastal regions during early historic times. Significant modifications to the Los Angeles River and its tributaries precluded use of this source for producing past streamflow estimates for southern California. Consequently, the SARB -- a drainage basin located southwest of the San Bernardino Mountains -- was chosen as a "proxy" source for determining the nature of past streamflow in southern California.

Modern records of annual streamflow for the SARB are calibrated with tree-ring width measures dating to a comparable time period. The reliability of calibrating modern streamflow and tree-ring widths is evaluated statistically. Results obtained from the calibration/verification process are used to estimate past streamflow for the SARB using a climate-sensitive tree-ring chronology for southern California.

METHODOLOGY

For this study two sources of information were required. The first source of information related to yearly measures of past streamflow runoff for waterways draining the mountains in southern California (the San Bernardino, San Jacinto and San Gabriel Mountains - Figure 115). The second source of information included tree-ring width measures for long-living conifers growing in the mountains of southern California. The nature of these complementary data sets is first described. Next, approaches used to transform tree-ring width measures into estimates of past streamflow are described.

Streamflow Runoff

Modern streamflow runoff measures for the SARB were obtained using a California Department of Water Resources (CDWR) (1959) publication titled "Santa Ana River Investigations." The first objective in the study was to compile data regarding the amount of "natural" yearly streamflow flowing through the SARB in the modern era (streamflow measured in thousands of acre feet per year). Information about the amount of natural runoff flowing through the SARB was obtained using records from gaging stations located at crucial flow points where water first enters the basin as streamflow (see Figure 115). Those gaging stations located along the streams that drain the basin, but closest to the mountains encircling the basin, were considered most critical for the study. Information from these stations is more reliable than that from stations in the basin proper since they are closer to natural streamflow source areas and, therefore, less subject to water loss resulting from soil infiltration or evapotranspiration.

The mountains that encircle the SARB provide two important sources for streamflow runoff: 1) water originating as rainfall during the winter and spring; and 2) water originating as snowfall during

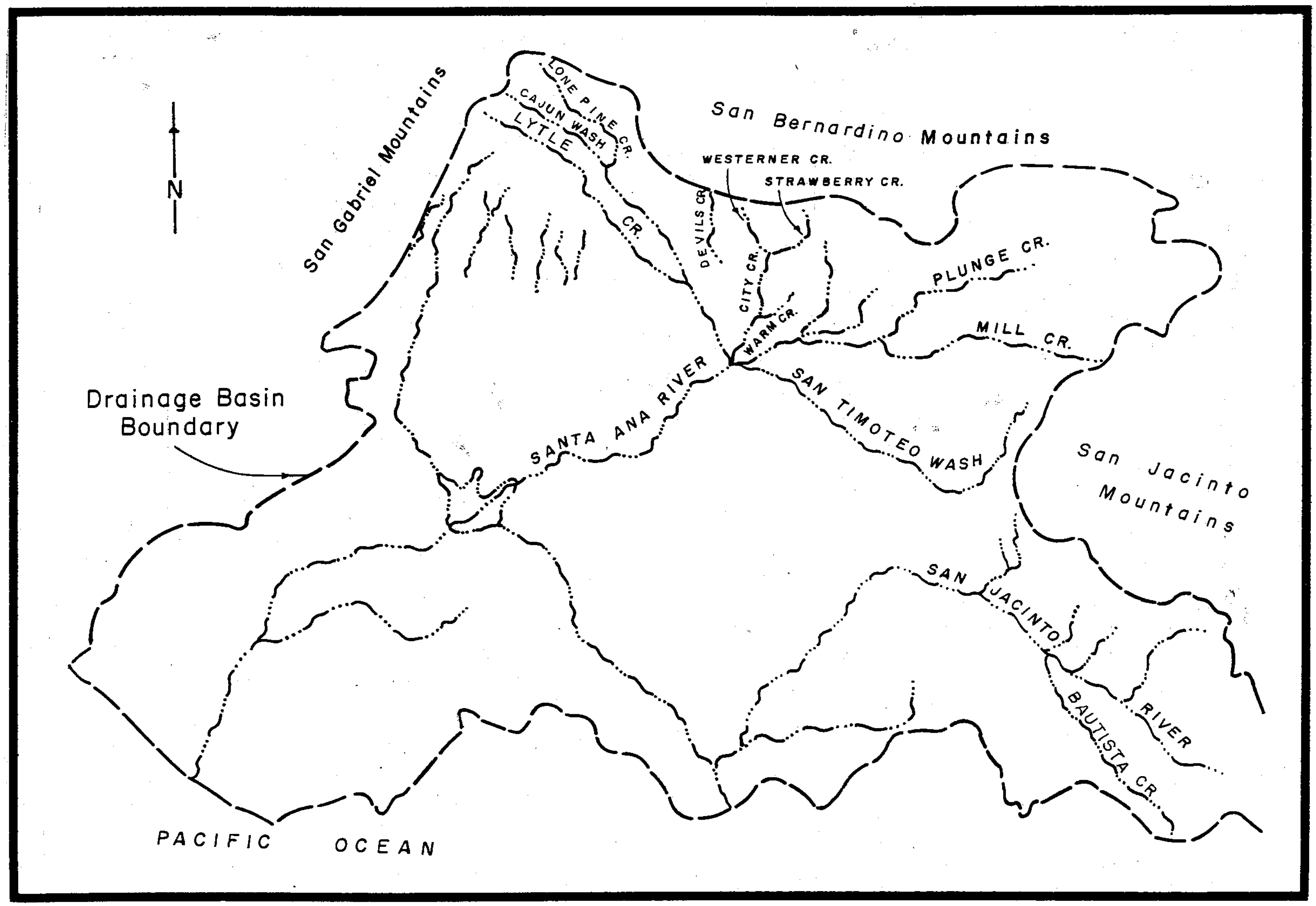


Figure 115. The Santa Ana river basin and streamflow runoff gaging stations used in the study.

the winter (California Department of Water Resources 1959:141-145). Figure 115 shows the SARB, the mountain ranges that function as the primary sources for streamflow runoff in the basin and, finally, the network of drainages that dissect the basin. Also shown are the gaging stations and station identification numbers assigned by the CDWR. Gaging station locale descriptions are presented in Table 67.

Annual streamflow runoff measures for selected gaging stations were compiled for the period between 1895 and 1947 (California Department of Water Resources 1959:179-180, Appendix D); information from these stations was reported for the California water year, which extends from October in one year to September in the next. Annual streamflow values for all 18 gaging stations were then averaged to produce a time series of streamflow measures spanning the 1895 to 1947 interval. This series thus served as the basis for calibrating streamflow measures with tree-ring width values dating to the same period.

Santa Ana River streamflow runoff measures are available for a gaging station located just above Pardu, where most tributary runoff empties into the Santa Ana River channel (California Department of Water Resources 1959:178; Figure 116). However, the California Department of Water Resources (1959:179-180) excluded information from this station in their compilation of *natural* streamflow runoff for the SARB. As a result of modern alternations to the SARB at this location the CDWR exluded information from this gage. Likewise, information for this gage was not used in this study.

Tree-Ring Chronology

A climate-sensitive tree-ring chronology for southern California was established at the Laboratory of Tree-Ring Research in Tucson, Arizona (Drew 1972; Stokes et al. 1973). This chronology was established for use in a study of past climate across western North America (Fritts 1976:161-175; Fritts and Gordon 1981; Fritts et al. 1979). The southern California tree-ring chronology was constructed using ring-width samples acquired from four different mountain locations where long-living big-cone spruce (*Pseudotsuga macrocarpa*) grow (see Figure 116).

At the Tree-Ring Laboratory all ring-width samples were treated uniformly before being used to produce a regional tree-ring chronology for southern California (Table 68). That is, ring-width specimens were cross-dated, with ring-widths being measured on the basis of standardized procedures (Fritts 1976:56-63; Stokes and Smiley 1968; Robinson and Evans 1979). Next, ring width measured values were standardized using techniques to ensure all ring-widths conform to the same measurement scale, thereby resulting in a uniform set of tree-ring "indices" (see Fritts 1976:25-27; Graybill 1982); standardization techniques were also used to minimize the effects outlier values can have on measures as well as to minimize the effect early growth surges in conifers can have on the youngest dated rings in a chronology (see Fritts 1976:27; Graybill 1982:52).

Following standardization, all four sets of ring-width specimens from separate collection sites were averaged together to produce single site chronologies. Next, all site chronologies were averaged together to create a regional chronology relevant to a broad area of southern California. This final, regionalized, chronology was the basis for the dendroclimatic estimates of past streamflow runoff.

Before explaing how the tree-ring width chronology for southern California was used to produce annual measures of streamflow runoff for the SARB, a final analytical procedure is described. Meko (1981) first identified the problems arising in dendroclimatic investigations when measures of past climate are produced using tree-ring chronologies significantly influenced by statistical autocorrelation. A review of the techniques typically used to deal with autocorrelation in tree-ring series led Meko to conclude that these were not always adequate for factoring out the effects of autocorrelation. In order

Table 67. Location of Santa Ana River Streamflow Runoff Gaging Stations.

Station No.	Location
5638	San Antonio Creek near Claremont
9572	Cucamonga Creek near Upland
18561	Day Creek near Etawanda
18704	Lytle Creek near Fontana
19433A	Lone Pine Creek near Keenbrook
19433B	Cajon Creek near Keenbrook
19569	Devils Canyon Creek near San Bernadino
18820	Waterman Canyon Creek near Arrowhead Springs
18832	Strawberry Creek near Arrowhead Springs
18915	City Creek near Highland
18957	Plunge Creek near East Highland
19008	Santa Ana River near Mentone
18261	Mill Creek near Craftonville
18128	San Timoteo Creek near Redlands
15586	San Jacinto River near San Jacinto
13913	San Jacinto River near Elsinore
15728	Santiago Creek near Villa Park
15985	Temescal Creek near Corona

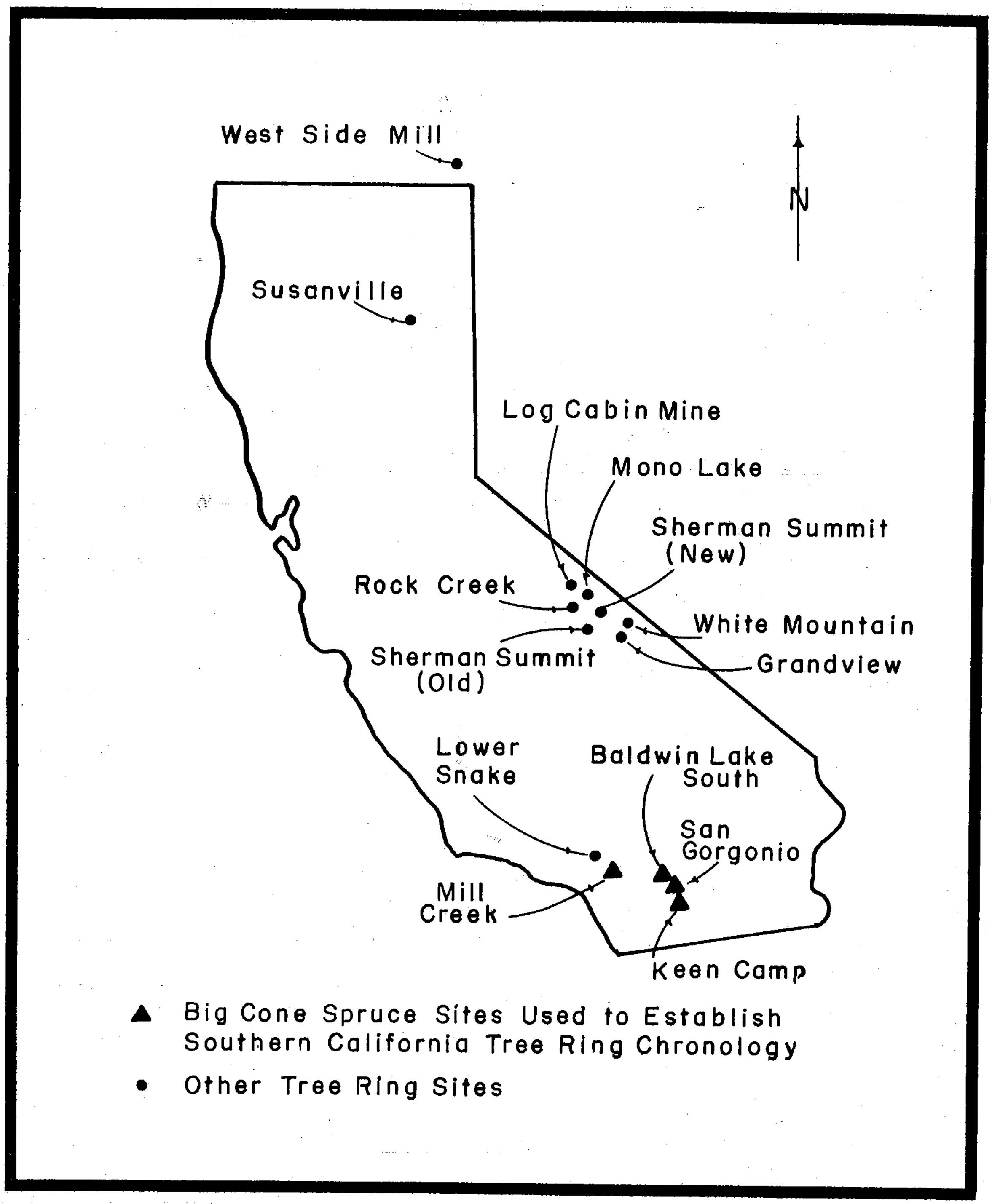


Figure 116. Locations of the four southern California Big-Cone Spruce sites used to establish the tree-ring chronology (also shown are other tree-ring sites in California and southern Oregon -- from Fritts and Gordon 1981).

Table 68. Tree-Ring Indices and Sample Depth.

	TREE RING INDICES										NUMBER OF SAMPLES									
DATE	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1458									120	64									1	1
1460	56	88	109	100	18	58	97	82	57	116	1	1	1	1	1	1	1	1	1	1
1470	114	102	78	105	95	76	89	147	114	92	1	1	1	1	1	1	1	1	1	1
1480	96	95	101	104	126	119	160	152	116	78	1	1	1	1	1	2	2	2	2	2
1490	117	109	41	114	106	93	86	64	132	59	2	2	2	2	2	2	2	2	2	2
1500	82	81	88	101	124	86	22	79	107	135	2	2	2	2	2	3	3	3	3	3
1510	38	133	97	91	123	55	79	96	61	104	3	3	4	4	4	4	4	4	4	5
1520	33	49	39	73	88	81	125	55	88	65	5	5	5	5	5	5	5	5	5	5
1530	110	109	32	88	114	147	156	139	135	188	5	5	5	5	5	5	5	5	5	5
1540	190	142	11	114	74	92	88	72	88	107	6	7	7	7	7	7	7	7	7	7
1550	140	151	106	139	126	152	144	155	137	147	7	7	8	8	8	8	8	8	8	8
1560	102	85	130	84	121	216	179	184	271	140	8	8	8	8	8	8	8	9	9	9
1570	132	29	92	69	72	79	88	129	140	26	9	9	9	9	9	9	9	9	9	9
1580	12	99	68	73	25	0	68	78	56	84	9	9	9	9	9	9	9	9	9	9
1590	33	60	41	79	80	92	114	61	105	125	9	10	10	10	10	10	10	10	10	11
1600	60	143	135	161	177	151	119	95	142	93	11	11	11	11	11	11	11	11	11	11
1610	144	188	109	28	99	93	132	164	106	52	11	11	11	11	11	11	11	11	11	11
1620	133	109	54	71	60	81	50	76	79	72	11	11	12	12	12	12	13	13	13	13
1630	97	73	70	34	45	103	100	36	83	112	13	13	13	13	13	14	14	14	14	14
1640	126	162	170	76	106	82	66	125	81	117	14	14	15	15	15	15	16	16	16	16
1650	86	139	85	47	14	53	68	83	108	121	16	16	17	17	17	18	20	20	20	20
1660	125	159	117	96	121	50	78	55	57	40	20	20	20	20	20	20	20	20	20	20
1670	9	54	67	98	119	126	45	93	115	143	20	20	20	20	20	20	20	20	20	20
1680	152	94	159	140	122	136	80	142	132	105	21	21	21	21	21	21	21	21	21	21
1690	100	120	120	108	105	91	119	108	71	140	21	21	21	21	21	22	22	22	23	24
1700	137	127	158	77	87	108	84	49	59	91	25	25	25	25	25	25	26	26	26	26
1710	115	93	132	102	113	69	80	88	128	165	28	28	28	28	28	28	28	28	28	28
1720	134	106	76	142	102	106	132	123	86	66	28	28	29	29	29	29	29	29	29	30
1730	85	96	95	75	105	57	85	82	100	56	30	30	30	30	30	30	30	30	30	30
1740	78	143	109	128	118	140	210	169	78	160	30	30	30	30	30	30	30	30	30	30
1750	152	113	40	84	23	57	54	91	102	98	30	30	30	30	30	30	30	30	30	30
1760	118	104	119	90	97	35	144	130	152	121	31	31	31	31	31	31	32	33	33	33
1770	102	154	139	109	133	125	127	36	90	78	34	35	35	35	35	35	36	37	37	37
1780	88	115	8	78	96	99	142	155	56	102	37	37	37	37	37	37	37	37	37	37
1790	88	133	115	151	55	56	65	109	84	130	37	37	38	38	38	38	38	38	38	38
1800	101	101	109	62	135	97	112	57	92	30	38	38	38	38	38	38	38	38	38	38
1810	90	98	45	32	71	65	100	94	143	131	38	38	38	38	38	38	38	38	38	38
1820	57	135	63	32	44	82	149	121	166	17	38	38	38	38	38	38	38	38	38	38
1830	145	143	200	166	119	68	78	101	131	159	38	38	38	38	38	38	38	38	38	38
1840	171	9	124	25	90	9	100	55	70	96	38	38	38	38	38	38	38	38	38	38
1850	126	151	188	239	171	192	99	31	77	85	38	38	38	38	38	38	38	38	38	38
1860	78	84	107	46	14	87	113	123	186	129	38	38	38	38	38	38	38	38	38	38
1870	17	45	49	44	74	67	82	19	104	51	38	38	38	38	38	38	38	38	38	38
1880	84	68	63	38	102	102	137	120	138	137	38	38	38	38	38	38	38	38	38	38
1890	145	181	144	136	62	107	70	86	19	14	38	38	38	38	38	38	38	38	38	38
1900	49	73	61	97	49	113	159	171	135	175	38	38	38	38	38	38	38	38	38	38
1910	144	109	105	102	135	141	136	149	78	67	38	38	38	38	38	38	38	38	38	38
1920	136	122	145	136	92	67	113	110	99	77	38	38	38	38	38	38	38	38	38	38
1930	111	56	119	83	36	129	102	148	149	147	38	38	38	38	38	38	38	38	38	38
1940	157	152	140	169	167	178	170	138	69	59	38	38	38	38	38	38	38	38	38	38
1950	65	36	89	80	101	89	80	87	138	37	38	38	38	38	38	38	38	38	38	38
1960	62	1	77	36	75	99	100				38	38	38	38	38	38	38			

SERIAL CORRELATION = .447 STANDARD DEVIATION = .413 MEAN SENSITIVITY = .409 N = 509 to rectify this situation, Meko proposed using more appropriate statistical techniques designed to remove autocorrelation from time series (Bos and Jenkins 1976).

Briefly, statistical autocorrelation in a time series means that the measured value for any interval of time (for example, for year t) influences measured values during later intervals (for example, during $t+1$); it also means that measured values for longer intervals of time can be influenced by earlier values (for example, during $t+1$, $t+2$ or $t+1...t+n$). When the measured values in a time series are partial products of earlier values complex additive processes then characterize the series. These processes, in turn, operate in a way that can inflate or depress the measured values that would have been recorded for a series if autocorrelation had not been a factor.

The presence of statistically significant levels of autocorrelation in a time series really becomes a problem when that series is used with other series in regression analysis. If autocorrelation is present in either a dependent or independent time series, and these series are regressed against each other, regression terms become spurious since regression estimates are generated that are larger and/or smaller than what would have been generated if autocorrelation was not in the regression series in the first place (see Wonnocott and Wonnocott 1981:115-117). Because of this problem, statistical autocorrelation in a time series subject to regression must be modeled and the effects removed.

Figure 117 shows the autocorrelation and partial autocorrelation functions for the southern California big-cone spruce chronology (calculated up to 20 lags). Significant autocorrelation was identified at both lags 1 and 2. Consequently, the chronology was modeled using a number of diagnostic autoregressive-moving average models (known as ARMA models; see McCleary and Hay 1980).

Based on the Q-statistic at lag 20 (see Wonnocott and Wonnocott 1981:125 and McCleary and Hay 1980:79-83 for discussions about the diagnostic value of the Q-statistic in ARMA modeling) it was apparent that several ARMA models could be used to generate residual time series significantly different from the original, autocorrelated series. Only six of these models, however, had Q-statistics significant at the 95 percent confidence interval; these models are shown in Table 69. Of the six models producing statistically significant results, the AR 1,2 model was selected to remove statistical autocorrelation from the tree-ring chronology for southern California.

The sources for autocorrelation in tree-ring chronologies can be numerous and different sources produce different autoregressive-moving average effects (see Meko 1981:28). Fritts (1976:79), however, has cautioned against overmodeling tree-ring chronologies in efforts to remove statistical autocorrelation. Overmodeling, in these instances, could potentially diminish portrayal of actual trends and variations in climate. In light of this particular concern, the simplest ARMA model was chosen to remove statistical autocorrelation. This strategy was also advocated by McCleary and Hay (1980:127) when several models could be used for removing statistical autocorrelation from a time series.

Calibration/Verification

Initial correlation of the ARMA modeled southern California tree-ring series and the Santa Ana River streamflow series indicated at least 40 percent of the variance in these series was shared in common (Pearson's correlation coefficient = 0.65; $p = .001$; and $r^2 = 44.2$). Consequently, we determined that the degree of correspondence between the tree-ring width series and the streamflow series warranted development of transfer functions to be used in estimating measures of past streamflow based on the southern California tree ring chronology. First, however, the earliest segment of the longer tree-ring chronology (A.D. 1458 to 1519) was eliminated due to small sample size representation. Studies reveal that when tree-ring width values are based on limited samples

AUTOCORRELATIONS

```
              -.6       -.4       -.2       .0        .2        .4        .6

CORR.

.468        +   I X + X X X X X X X X X X
.348      +     I X X + X X X X X X
.162      +     I X X + X
.095      +     I X X +
.046      +     I X   +
.044      +     I X   +
-.037     +   X I     +
-.100     X X X I     +
-.087     + X X I     +
-.084     + X X I     +
-.115     X X X I     +
-.045     +   X I     +
-.008     +     I     +
-.047     +   X I     +
-.035     +   X I     +
-.080     + X X I     +
-.068     + X X I     +
-.089     + X X I     +
-.044     +   X I     +
-.061     + X X I     +
-.004     +     I     +
-.013     +     I     +
-.049     +   X I     +
-.072     + X X I     +
-.032     +   X I     +
-.054     +   X I     +
-.017     +     I     +
-.016     +     I     +
-.016     +     I     +
-.025     +   X I     +
-.041     +   X I     +
-.037     +   X I     +
-.042     +   X I     +
.033      +     I X   +
.013      +     I     +
.021      +     I X   +
```

PARTIAL AUTOCORRELATIONS

```
              -.6       -.4       -.2       .0        .2        .4        .6

CORR.

.468      +   I X + X X X X X X X X X X
.165      +   I X + X X
.067      X X I   +
.007      +   I   +
.002      +   I   +
.026      +   I X +
.085      X X I   +
.096      X X I   +
.017      +   I   +
.003      +   I   +
.079      X X I   +
.054      +   I X +
.053      +   I X +
.074      X X I   +
.021      + X I   +
.062      X X I   +
.003      +   I   +
.053      + X I   +
.007      +   I   +
.013      +   I   +
.061      +   I X X
.032      + X I   +
.074      X X I   +
.036      + X I   +
.026      +   I X +
.049      + X I   +
.000      +   I   +
.006      +   I   +
.001      +   I   +
.022      + X I   +
.053      + X I   +
.004      +   I   +
.017      +   I   +
.018      +   I X +
.021      + X I   +
.001      +   I   +
```

Figure 117. Plots of autocorrelation and partial autocorrelation functions for the tree-ring chronology used in the study.

Table 69. Significant ARMA Models for the Southern California Tree-Ring Chronology.

ARMA Process	Q-20	Sig. Q	RSS	AIC	% Var.
AR 1,2	20	0.33	61.3	878	25
AR 1,2,3	20	0.33	61.0	876	25
AR 1 MA 1	23	0.19	61.8	877	24
AR 1,2 MA 1	20	0.33	61.0	878	25
AR 1,3 MA 1	20	0.33	61.0	878	25
AR 1,4 MA 1	24	0.15	61.6	874	24

usually less than five) significant potential for sensitivity to outlier values exists (see Wigley et al. 1981). Therefore, the earliest segment of the chronology was eliminated.

The calibration period for the tree-ring chronology (A.D. 1895-1947) was standardized on the basis of the calibration period for the streamflow funoff series. Transfer functions describing tree-ring widths in quantitative terms relevant to past streamflow runoff were thus produced. Similar approaches for producing measures of past climate using tree-ring chronologies have become standard in dendroclimatic investigations (for example, Fritts 1976; Graybill 1986; Fritts et al. 1971, 1979; Rose et al. 1981; Stockton and Boggess 1980).

Table 70 and Figure 118 show the actual and estimated streamflow values for the SARB during the calibration period. The statistical tests comparing actual and estimated streamflow values indicate statistically significant levels of correspondence between actual and estimated series (Table 71). Hence, transfer functions were used to estimate earlier stramflow runoff measures on the basis of the remaining years represented in the southern California tree-ring chronology (A.D. 1520 to 1966).

RESULTS

Description of Past Streamflow Regimes

Figure 119 illustrates the nature of both high and low frequency variations in Santa Ana River streamflow from 1520 to 1966. Both high and low frequency series were plotted after calculating standard normal variants in runoff using the estimated series mean and standard deviation (242.9 and 148.5, respectively, with estimates reported for thousands of acre feet of runoff per year).

Tables 71 and 72 summarize the different streamflow regimes that characterized the SARB from 1520 to 1966. Table 73 lists the most salient aspects of streamflow for the SARB during distincitive runoff episodes.

Several significant differences exist between Fritts and Gordon's (1981) reconstructed precipitation series for all of California and the streamflow reconstruction for the SARB. These

Table 70. Actual Yearly Streamflow Totals for the Santa Ana River Basin and Southern California Tree-Ring Data Based on Estimates for the Calibration Period (1895-1947).

Year	Actual Streamflow (1,000 acre ft/year)	Estimated Streamflow (1,000 acre ft/year)
1895	496.3	304.4
1896	48.7	136.1
1897	278.7	227.6
1898	42.5	39.3
1899	95.2	35.1
1900	75.6	226.4
1901	558.4	270.6
1902	23.9	162.0
1903	284.9	308.0
1904	36.3	68.9
1905	334.7	374.4
1906	496.3	489.4
1907	546.0	422.5
1908	247.6	230.0
1909	378.2	437.7
1910	353.3	275.7
1911	403.0	158.0
1912	197.9	217.7
1913	104.7	235.2
1914	434.1	374.0
1915	483.9	348.1
1916	707.6	296.8
1917	291.2	353.5
1918	316.0	53.0
1919	123.3	111.4
1920	328.5	450.4
1921	204.1	294.4
1922	626.8	361.7
1923	247.6	299.2
1924	98.5	123.0
1925	17.7	98.3
1926	260.1	349.7
1927	521.2	282.5
1928	36.3	212.9
1929	48.7	144.5
1930	129.5	321.5
1931	17.7	64.1
1932	359.5	378.0
1933	67.4	173.1
1934	5.2	0.5
1935	204.1	467.9
1936	148.2	246.3
1937	564.7	409.8
1938	608.2	359.7
1939	247.6	319.5
1940	197.9	361.7
1941	533.6	327.5
1942	185.5	280.9
1943	440.3	418.6
1944	322.2	373.2
1945	303.6	400.7
1946	222.8	352.9
1947	185.5	230.8

Results of Statistical Comparisons Between Actual Streamflow Values and Tree-Ring Chronology Based Estimates: Pearson Correlation Coefficient (r) = 0.64; Percentage of Variance Shared in Common (R^2) = 40.9 (41%); T-test for Sample Means = 0.00 (p = 0.768); Wilcoxon Ranked Pairs Sign Test (Z-score) = 0.73 (p = 0.001)

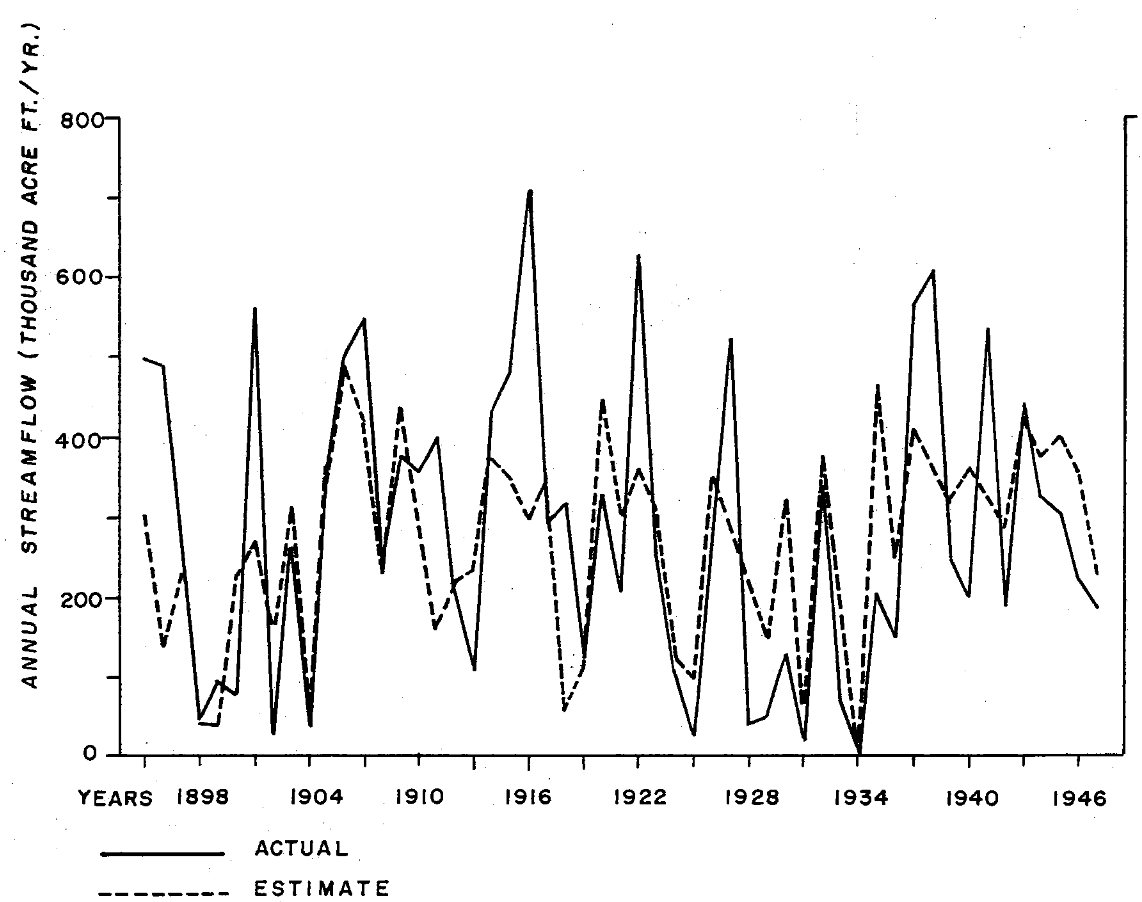


Figure 118. Plot of actual and estimated streamflow runoff measures (in thousands of acre feet/year) for the Santa Ana River Basin.

Table 71. Summary of High-Frequency Characteristics for the Santa Ana River Basin.

Late 1530s - Late 1570s:	One of the best periods on record with few flow years at, or below, one standard deviation. Flows for all years are well above the long-term mean for the series.
1580 - Early 1600s:	Numerous low-flow years with upper level values (high flow years) significantly dampened. Regime begins some time during the 1570s, but becomes accentuated by the 1580s.
Early 1600s - Late 1610s:	Most flows are well above the long-term mean for the series, and low flows appear dampened.
Late 1610s - Late 1670s:	The frequency of low-flow years increases to a point greater than that characteristic between the 1580 and 1600s time period. There is a protracted period of low-flow years extending from 1620 into the early 1630s. Most of the flow values during these two decades are well below the long-term mean for the series, but the deviations are not extreme.
1670s - Mid-1740s:	Low flow years less frequent and the troughs are more shallow than during the interval immediately preceding this one. The high flows during this interval of time, however, do not exceed levels reached in the previous period.
Late 1740s - Mid-1760s:	Period begins with worst low-flow years in some seven decades, bottoming out in the early 1750s and continued low-flow (mostly below the long-term mean of the series) until amelioration in the late 1760s.
Late 1760s - Mid-1790s:	Brief amelioration from the low-flow years in the previous interval, with high flow years significantly increased.
Mid-1790s - Early 1800s:	Amelioration continues through the early 1800s, but then see high frequency variations with several closely spaced troughs (low flow years) until the 1810s.
Early 1800s - Early 1900s:	The 1800s were characterized by a specific streamflow runoff regime not very common during the seventeenth and eighteenth centuries. From about 1810 to the end of record witnessed extremes at both positive and negative ends of the spectrum, alternating about every 10 to 15 years. That is, a 10- or 15-year period of protracted low flow years were alternating with a ten or fifteen year period of protracted high flow years. Distinctive low-flow subperiods during this broader interval occurred at the following times: 1840s, late 1850s to early 1860s, late 1860s to early 1880s, and early 1890s to early 1900s. Distinctive high flow subperiods occurred during these times: mid-1820s to early 1830s, late 1830s to early 1840s, 1850s, late 1860s, mid 1880s to early 1890s, and early 1900s to late 1910s.
Early-1900s - Late 1920s:	A return to stable flow conditions with most year close to, or just above, the long-term mean for the series.
1930s:	A time of frequent low-flows, some of which were probably associated with broader regional drought.
Mid-1940s - 1960s:	Generally a pronounced low-flow interval with most years below the long-term mean.

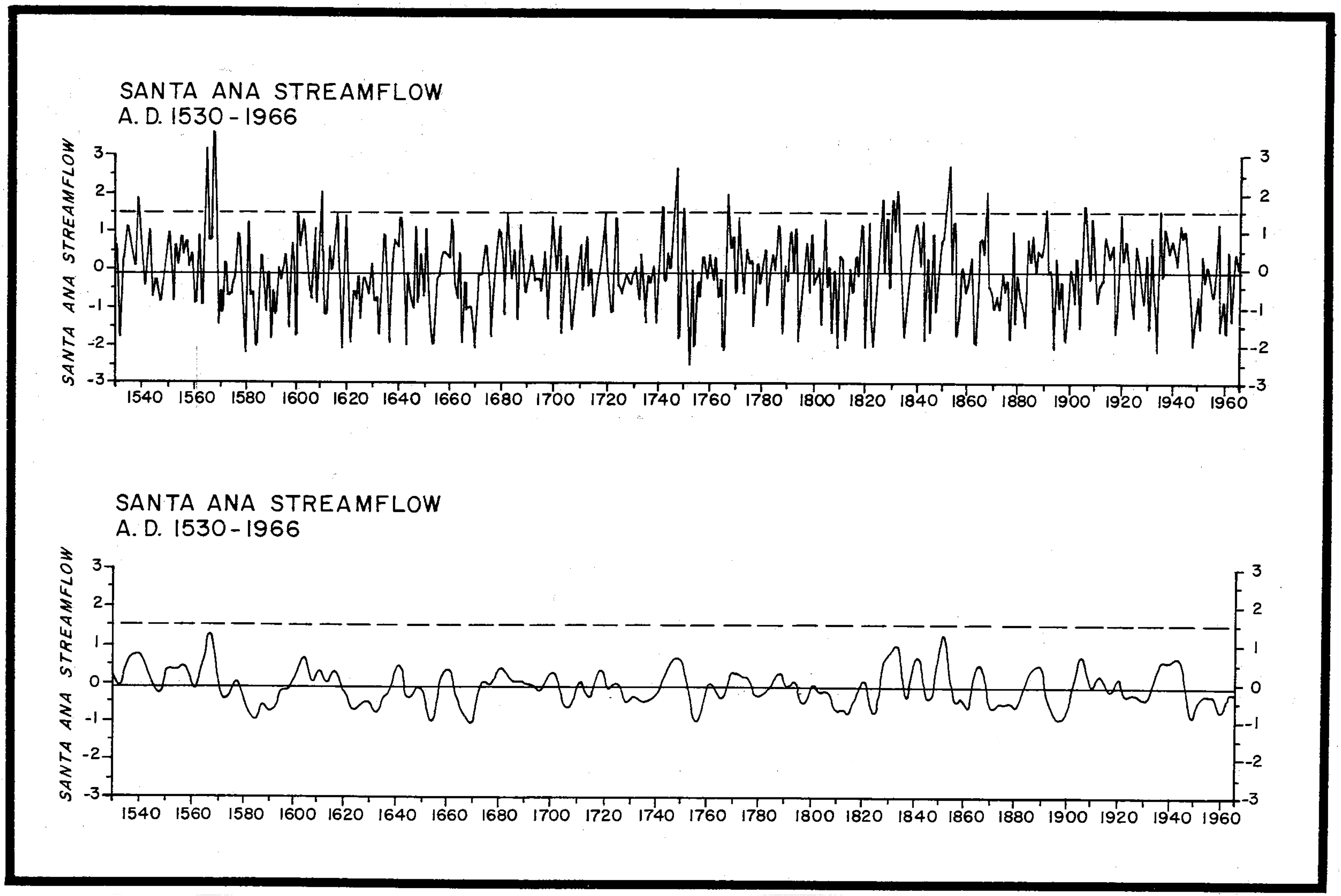


Figure 119. Plot of high and low frequency streamflow runoff measures (standard normal variants) for the calibration period.

Table 72. Summmary of Low-Frequency Characteristics for the Santa Ana River Basin.

1530 - Mid-1570s:	Streamflow at this time well above the long-term mean for the series.
1580s - 1590s:	Started out well above the mean, but there was a steady decrease in good flow conditions continuing through the 1590s.
1600 to Mid-1610s:	A reversal of the trend characterizing the previous interval with a marked upward trend to above the long-term mean.
Early-1620s to Mid-1630s:	A reveral of the previous trend to one associated with deteriorated conditions as during the 1580s to 1590s period.
1640 to 1680:	A time of questionable stability with two deep troughs (low-flow years) during the 1650s and the 1670s.
1675 - Mid-1740s:	A phase of remarkable stability in streamflow with most flow years close to the long-term mean. Deviations (either above or below the mean), at the same time, do not appear as marked as during previous time intervals.
Early 1750s:	Previous period of relatively stable streamflow conditions ends with deterioration to frequent low-flows during this time.
1760 - Early 1800s:	Santa Ana streamflow regime characterized by re-entry into fairly stable circumstances.
1800s - 1810s:	A time of environmental deterioration with return to low-flow years.
1820s:	Low-flow years were most common during this decade.
Mid-1820s - Late 1850s:	A return to high flow years of protracted duration with some of the highest flow years on record occurring at this time.
1860s - 1890s:	A phase of long-term oscillation (both above and below the mean) until it bottomed out in the late 1890s.
1900s - 1950s:	A period of relative stability with most flow year close to, or above, the mean for the series.
Late 1950s - 1960s:	A time of protracted low flow with a number of years likely indicative of drought conditions throughout southern California.

Table 73. Summary of Streamflow Characteristics of the Santa Ana River Basin for Different Time Periods.

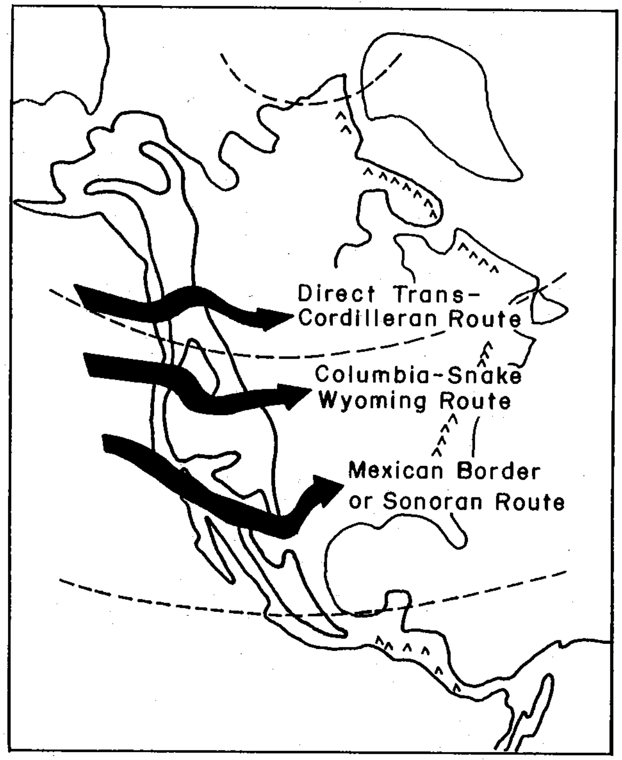
Stable or High Flow Intervals:	1530s to Mid-1570s 1600 to Mid-1610s 1675 to Mid-1740s Late 1760s to Mid-1790s/1800 Late 1820s to Late 1850s 1900s to 1940s
Unpredictable or Low Flow Intervals:	1580s to 1590s Late 1610s to Mid-1670s (with the most severe conditions occurring between 1620 and early-1630s) Late 1740s to 1760s Mid-1800s to 1810s Mid-1820s 1860s to 1890s Late 1940s to 1966

differences have important implications for interpreting climatic variations and assessing the role climate had in influencing aboriginal adaptive behavior in southern California.

Fritts and Gordon's (1981) reconstructed precipitation series for California was based on a tree-ring chronology for western North America established using 52 different stands of conifers from at least nine western states. These investigators also compared their precipitation reconstruction for California with California lake level records (Harding 1965) and crop yield records from California missions (Lynch 1931; also see Altschul et al. 1984:39). On the basis of the reconstructed precipitation series, and attendant comparisons with proxy records, Fritts and Gordon identified five intervals of protracted moisture shortfall; these intervals included the years 1600 to 1625, 1665 to 1670, 1720 to 1730, 1760 to 1820, and 1865 to 1885. Interestingly, the precipitation short-fall intervals identified here contrast with the results obtained using our tree-ring based streamflow reconstruction for the SARB.

First, Fritts and Gordon's precipitation record indicates that the low-flow interval dating to the late 1610s and the mid-1670s was much less severe than what is reflected in the streamflow record for the SARB. According to Fritts and Gordon, while the first 25 years of the seventeenth century were associated with sharp precipitation shortfalls, the next 40 years were characterized by a return to more stable moisture conditions (Fritts and Gordon 1981:191). In addition, according to Fritts and Gordon, the last five years of this interval were associated with below normal precipitation.

Fritts and Gordon's next two precipitation short-fall intervals (that is, from 1720 to 1730 and 1760 to 1820) appear far more severe than indicated by the reconstructed streamflow record for the SARB. In fact, the streamflow reconstruction for southern California identifies the interval between 1720 and 1730 as a time of streamflow stability. Moreover, the long dry period dating to the interval between 1760 and 1820 in the precipitation record for California (Fritts and Gordon 1981:191) contrasts sharply with the southern California streamflow record. On the basis of the latter record the interval between the late 1760s and the early 1800s was a time of relative stability in streamflow runoff. During this interval yearly flow values remained remarkably close to the long-term series mean with extremes in deviation (either above or below the mean) significantly moderated (Figure 120). Interestingly, the



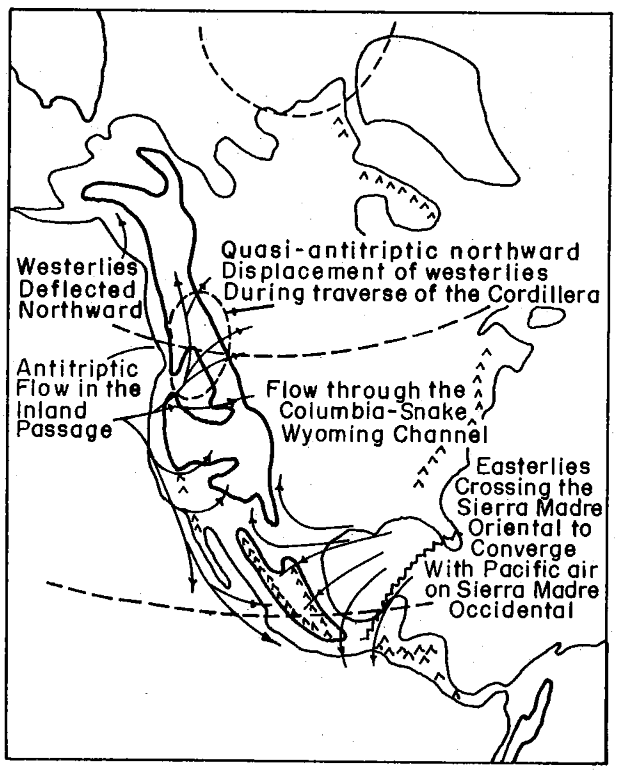


Figure 120. (a) Major routes over which the westerly jet stream crosses North America; and (b) the variable routes over which air masses can travel at lower elevations in the upper atmosphere (after Bryson and Hare 1974:3-4).

reconstructed streamflow record for the SARB indicates that the last 21 years in this interval (1800-1821) coincide with Fritts and Gordon's precipitation record. This particular time period thus appears to have been one when precipitation short-falls coincided with diminished streamflow runoff levels across most of California.

Both of the climate records alluded to are closely associated in terms of moisture deficits during the final interval of time represented. Fritts and Gordon report precipitation shortfalls for California between 1865 and 1885. At the same time, streamflow estimates for the SARB point to a distinct low-flow interval between the 1860s and the 1890s.

Finally, in contrast to the precipitation record presented by Fritts and Gordon, the last time interval represented in the streamflow record for the SARB (late 1940s to 1966) was a time of periodic low-flows, with extreme positive values being very infrequent.

Two factors can explain the differences noted between the California precipitation record and the SARB streamflow record. Because these records report on past moisture availabilities for the state of California and, because both dated to an overlapping interval of time, far greater agreement in climate was anticipated. Differences noted between these two records can be reconciled by understanding the biological and climatological factors that influence tree-ring chronologies. Fritts and Gordon's (1981:73) tree-ring chronology was based on multiple, composite tree species from across western North America. In contrast, the chronology for southern California was based on a single species of conifer. As a result, differences between the precipitation reconstruction for California and the streamflow reconstruction for the SARB probably reflect variations in the climate-signal of a multiple species tree-ring chronology versus a single species chronology. Studies in the Southwest demonstrate that the growth rates of different species of conifers vary in response to similar climatic conditions (Fritts et al. 1965). Consequently the differences in climate apparent in these two chronologies relate, in part, to differences in the composition of tree species and their attendant responses to climate. The reconstructed precipitation record is, in all likelihood, a better reflection of climate trends and variations impacting most of western North America. In contrast, the reconstructed streamflow record for the SARB reflects variations and trends exclusive to southern California. The varying scales of geographic reference these two climate series relate to may be linked to actual differences in climate.

Figure 120 illustrates the various routes where winter and spring air masses pass over western North America. Three of these routes, it will be noted, do not cross southern California. It is therefore probable that the climatic differences obtained from the precipitation and streamflow reconstructions reflect real variations in climate. In other words, differences relate to times in the west when climate was *out-of-phase*. As previously noted, two of the precipitation short-fall intervals reported by Fritts and Gordon do not appear in the SARB streamflow reconstruction (1720 to 1730 and 1760 to 1780). In contrast, the final precipitation short-fall identified by Fritts and Gordon is well represented in the streamflow record (1860s to 1880s). Given the different geographic scales of reference it is possible that the first two shortfall intervals indicate periods of diminished moisture for most of western North America, but not for southern California. The third and final precipitation short-fall interval, an interval apparent in both precipitation and streamflow series, was a time of diminished moisture over much of western North America.

Anthropological Relevance of Past Streamflow Estimates

The contrasting findings about moisture availabilities in southern California as opposed to all of California are relevant for interpreting the early historic record. Before outlining how streamflow runoff estimates f characteristics of tree-ring width response to climate during the Late Holocene (4,000/3,000 years ago to present) needs to be underscored. In so doing, a more coherent model regarding tree-ring growth response to climate and human adaptive responses to variations in climate can be developed.

Figure 121 illustrates the four primary patterns characterizing tree-ring growth responses to climate during the Late Holocene. Each of these patterns was first recognized by Schulman (1938, 1956). The relevance of these patterns for understanding past human adaptive behavior in the west has only recently been recognized (Dean 1988; Graybill 1989; Shaw 1991; Dean and Robinson 1977; Dean et al. 1985; Euler et al. 1979).

The four different patterns of tree-ring response to Late Holocene climate indicate the following:

1) The first pattern reflects a time of environmental uncertainty, with the effectiveness of moisture in terms of impacts on plant and animal populations highly unpredictable from one year to the next. This pattern is indicative of times when precipitation was irregularly oscillating from one year to the next, both above and below the long-term series mean.

2) The second pattern also constitutes a time of environmental uncertainty; numerous negative departures in annual precipitation indicate low effective moisture levels year after year. Under these conditions the deepest departures are frequently associated with meteorological drought (see Dean et al. 1985:39-41). For those years not associated with negative precipitation departures, times when this overall pattern is nonetheless pervasive, there is a tendency for diminished effective moisture conditions to persist. There are, therefore, carry-over effects from earlier years when moisture stress was more pronounced. As a result, even though a region might receive above normal moisture in years when such a pattern is in effect, moisture effectiveness for plant and animal life actually diminished.

3) The third pattern identified reflects a time of moderated high frequency variation in climate. Whenever this was the dominant pattern, environmental conditions were highly stable and, therefore, highly predictable on an annual basis in terms of the quantities and qualities of available foods. Although high and low departures in moisture could occur when this pattern was in effect, negative departures were not significant enough to reduce the level of effective moisture. In other words, carry-over effects from a generally salubrious phase in climate persisted year after year.

4) The fourth and final pattern relates to a time of highly effective moisture when environmental conditions were most favorable to human exploitation. As with the previous pattern, moisture effectiveness may have become diminished in some years but, overall, any amount of moisture would help support existing plant and animal life and, in all likelihood, help promote population expansion and broadening of established territorial ranges.

The first two patterns described above represent times of stress on human populations with respect to food procurement. In accord with the first pattern identified, since the effectiveness of moisture was highly unpredictable from one year to the next, uncertainty would have arisen in terms of the amount and quality of food available. As a result, decision-making processes impacting food acquisition should reflect broad uncertainties and, as well, archaeological evidence should point to exploitation of a wider range of plant and animal resources than when the environment offered more optimal circumstances. In accord with the second pattern identified, since the overall effectiveness of moisture from one year to the next was significantly diminished, a similar cycle of stress is expected.

Altschul et al. (1984:45-53) outlined the anticipated cultural responses among southern California coastal populations during periods of protracted moisture stress. The behavioral patterns identified in

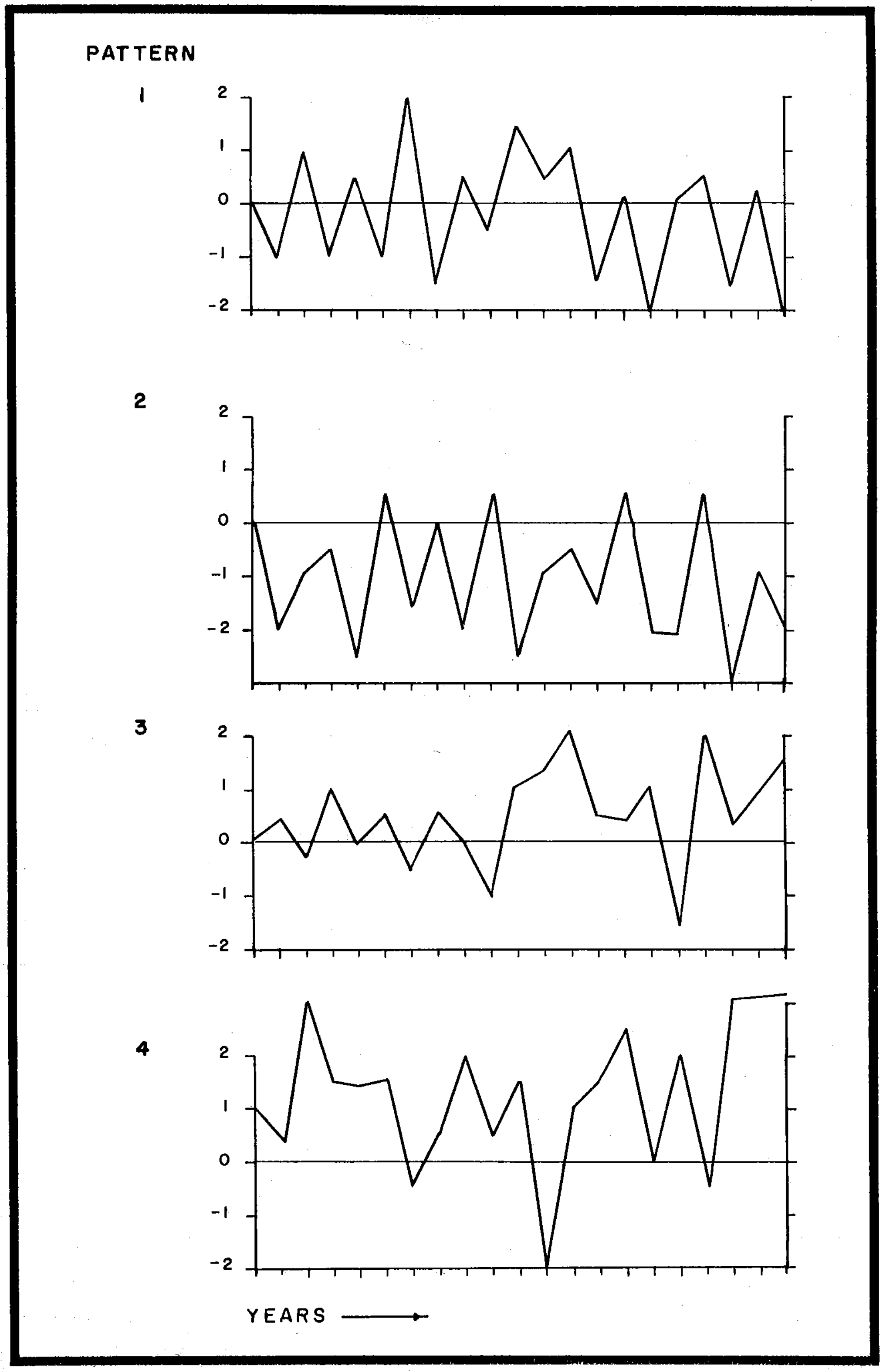


Figure 121. Schematic pattern showing tree-ring width responses to climate during the late Holocene interval (Departures from the mean 0 are shown in standard deviation intervals).

this last source are thought applicable whenever the first or second moisture patterns were in effect. Both of these patterns indicate levels of uncertainty with respect to the amount of effective moisture that would have been available from one year to the next. Uncertainty among human populations must have arisen when procuring food sources. The range of expectations anticipated during times of environmental stress in southern California are outlined in accord with evidence for population increase in southern California during early historic times. As Altschul et al. (1984:52) suggest:

> the demographic increases would put the cultural system in stress during sustained periods of below average precipitation. In response to this stress there may have been growing awareness of social boundaries. Through time, then, we might expect to find a pattern of increasing rigidity and standardization in village layout. Social distance between villages may have increased, leading to wide and more uniform spacing between major villages. Alternatively, large interaction spheres may have developed, as evidenced by pan-regional symbols and ceremonial items. Economic practices are expected to become increasingly diversified with greater emphasis placed on survival food sources. Further intensification of the main components of the subsistence strategy should lead to a wider dispersal of individual groups. Thus, we would expect to find smaller sites located in previously unused areas.

It is important to stress the view here that not only would negative environmental effects impact early historic aboriginal populations in southern California, but that positive environmental effects -- those encouraging plant and animal population growth and expansion -- would have influenced behavior as well. The third and fourth patterns shown in Figure 121 would constitute ideal times for procuring wild foods along the coast during the Late Holocene. During intervals characterized by these climatic patterns effective moisture regimes made the environment highly stable and, at the same time, extremely effective at supporting plant and animal life. Thus, it is conceivable that during either one of these climatic patterns groups began spreading out into previously unoccupied or little used areas. During the course of either of these two patterns, areas once considered "marginal" for food may have become more productive given attendant increases in effective moisture. It is also probable that these would have been times of economic specialization, population expansion, and long-distance trade linked to social differentiation in larger communities. Under these environmental circumstances the need for cooperative group efforts to obtain food frequently diminish and, concurrently, evolutionary tendencies in cultural systems toward growth, productive specialization, and social diversification are more common. Consequently, institutions often emerge to provide incentives for groups not to disperse but to maintain closer cultural identities and maintain residential stability. Therefore, ceremonial activities within and among communities may have intensified during times characterized by either of the last two climatic patterns.

Studies on the southern Colorado Plateaus in the Southwest indicate that whenever effective moisture conditions were optimized population movement throughout extensive areas resulted, provided that localized, elevated population levels were encouraging such expansion (Dean 1988; Dean et al. 1985). Likewise, whenever optimal environmental circumstances prevailed in areas on the Plateaus, and in the mountain areas immediately to the south, not only was human territorial expansion facilitated, but social alliances emerged that cross-cut diverse cultural groups. Both of these processes, probably contributed to broad human movement throughout areas less optimal for human exploitation during earlier times (see Shaw 1991, n.d.).

Hypothetically, it is conceivable that whenever optimal environmental conditions emerged in the past, smaller groups of coastal foragers would have enjoyed increased success in procuring food and, as a result, cultural processes may have emerged to prevent larger social groupings from fissioning and becoming more socially and economically autonomous. Similar processes of population amalgamation -- the emergence of small-scale social formations -- occur most commonly under conditions where environmental uncertainties are least pronounced (Sahlins 1972:101-102, 130-148).

It is important to underscore archaeological efforts aimed at better understanding of human behavior during times when optimal environmental circumstances prevailed. If much of the behavior that takes place in communities associated with self-reliant subsistence communities can be viewed in relation to expected, yet unpredictable, risks from the environment (Winterhalder 1980; Winterhalder and Smith 1979; Dean et al. 1985), a corollary must be that behavior contradictory to those observed during times of environmental stress should emerge when optimal conditions prevail. Some of the anticipated forms of human behavior, given the kind of environmental circumstances being discussed, have already been outlined. It is possible that the emergence of more optimal environmental circumstances at the beginning of the historic period in southern California help explain observed demographic trends.

It has been suggested that aboriginal population increases during the historic period in southern California (post-1700) can be linked to diversion of the Colorado River into southern California. Such a diversion is considered to have been related to fault-block movement in the extreme southern reaches of western North America (Wilke 1974, 1978; Wilke and Lawton 1975:10). Shifts in the Colorado River from its present course to one flowing through the Salton Trough were triggered by tectonic movements that created a freshwater lake, known as Lake Cahuilla, in the subareal Colorado River delta. Waters (1983) has documented four filling episodes: A.D. 700, ca A.D. 940, A.D. 1210 and A.D. 1430. During these stands, Lake Cahuilla attracted human settlement on a relatively large scale. In contrast, when the river shifted back to its present course, the lake dried rapidly and human populations abandoned the area. The last lake stand terminated around A.D. 1580. Wilke (1974:28) suggests that most of the resident lake population migrated to surrounding areas. Although such movements undoubtedly occurred, exactly how other areas were in a position, both culturally and environmentally, to receive these immigrants has not been adequately addressed (see Altschul et al. 1984:49-50). Information from the streamflow and precipitation reconstructions discussed herein provide useful baseline information on the environmental context for the aboriginal population increases in southern California.

On the basis of Fritts and Gordon's precipitation reconstruction, and on the basis of the SARB streamflow estimates, it is apparent that there were times during the Late Holocene when moisture availabilities across the west were not synchronous. Fritts and Gordon identified three major periods of precipitation shortfall during the seventeenth and eighteenth centuries (1665 to 1670, 1720 to 1730 and 1760 to 1820). These intervals do not, however, completely correspond with the SARB streamflow estimates during overlapping intervals. In fact, one of Fritts and Gordon's shortfall intervals (1760 to 1820) contradicts what was found by the SARB reconstruction; alternatively, streamflow evidence points to a highly stable moisture regime from 1675 to the mid-1740s.

Evidence for contrasting moisture regimes between southern California and areas farther north during several significant intervals (as well as over a more protracted time frame) suggests aboriginal population increases in southern California might be linked to diminished moisture regimes in areas to the north. This hypothesis is bolstered when combined with evidence for increased moisture to the south. Studies concerned with modern climate indicate that atmospheric conditions can vary significantly enough so that air is funnelled over different regions of the west coast (Altschul et al. 1984:13-14). It is thus conceivable that the stable moisture conditions identified for southern California during this longer interval of time, combined with evidence for a protracted period of moisture stress further north, help explain an expanding population base in southern California at the beginning of the historic era.

CONCLUSIONS

The streamflow reconstruction of the SARB provided data on runoff for the last 450 years. Interpretations of this reconstruction were offered at two levels. At the level of the hydrologic basin, the sequence was broken down into temporal intervals during which similar streamflow conditions prevailed. These intervals, defined for both high and low frequency variation, provide a history of streamflow conditions which can then be examined relative to historically documented cultural events.

At the regional level, the streamflow reconstruction for southern California was compared to similar records for central and northern California. In contrast to previous studies, the SARB reconstruction indicates that climatic conditions during the protohistoric and early historic period were more favorable for human occupation in southern California than conditions further north. This finding is of interest, although its relevance to local cultural dynamics is in need of further investigation. This topic is one of the major issues addressed in the next chapter.

CHAPTER 17

PREHISTORIC SETTLEMENT AND SUBSISTENCE IN THE BALLONA

In the preceeding chapters, the analytic results of a variety of data sets recovered during the 1989 excavations at the Admiralty site have been presented. The focus of these chapters has been narrow in scope. Interpretations have been limited to observations about the general nature of the assemblage, intrasite vertical and horizontal distributions, and comparisons with assemblages of the same data classes from other sites in the Ballona. Thus far, no attempt has been made to integrate the various analyses and synthesize the results for the entire region. That is the objective of this chapter.

The presentation begins with a review of the environment and ecology of the Ballona. The discussion proceeds to place cultural events within this setting. A model of cultural evolution is posited that accounts for changes in settlement and subsistence that are observed in the archaeological record.

BALLONA ENVIRONMENTS AND ECOLOGY

In 1861, the United States Coast Survey created a detailed topographic map of the Ballona (Figure 122d). The map depicts landforms in the wetland during the final stages of sedimentation. Lagoonal environments such as the historic Ballona Lagoon are highly productive ecosystems. Lagoons are basically shallow brackish or salt water bodies that are partially separated from the sea by a barrier with narrow openings through which salt water can flow (Colombo 1977). The 1861 Ballona Lagoon was no exception. It was characterized by a double barrier, an unusual geomorphic feature for the southern California coast. This feature is probably indicative of two episodes of barrier development, reflecting a combination of changes in sea level and subsidence. Behind the barrier was an intricate network of open water, islands, and tidal marshes extending about 3 km along the coast and 1.5 km upstream. The southern edge of the Ballona is formed by a sharp escarpment that rises 45 m above the gap. At the base of the escarpment flowed Centinela Creek, a spring-fed, perennial stream that created an estuary along its lower course. About 1 km north of Centinela Creek flowed Ballona Creek, a stream that drained over 110 square miles between the Baldwin Hills on the south to just east of the Beverly Hills.

Historically, the Ballona consisted of six basic microenvironments. Located on the high tidal flats were salt marshes, dominated by various species of pickleweed (*Salicornia* sp.) and salt grass (*Distichlis spicata*). Several species common in high marshes did not grow in the Ballona, indicating that the barrier greatly restricted tidal flow into the marsh (Gustafson 1981). Below the marshes were mudflats and saltflats, habitats conducive to shellfish. Along the banks of Centinela and Ballona creeks was a riparian community, dominated by willows (*Salix lasiolepis and Salix laevigata*) and cottonwoods (*Populus fremontii*). At the mouths of the streams, a freshwater marsh prevailed, supporting cattail (*Typha latifolia*), reeds, and grasses. On the bluffs overlooking the wetland, coastal dune communities were found along the coast, giving way to coastal scrub vegetation to the east.

During the historic period, the Ballona supported rich and diverse floral and faunal communities. One can easily imagine that such a setting would have been a prized area for settlement. But the Ballona is a dynamic system, with the historic lagoon being a rather recent phenomenon. To study how cultures adapted to the region, we first need to understand its development from an open bay to a tidal

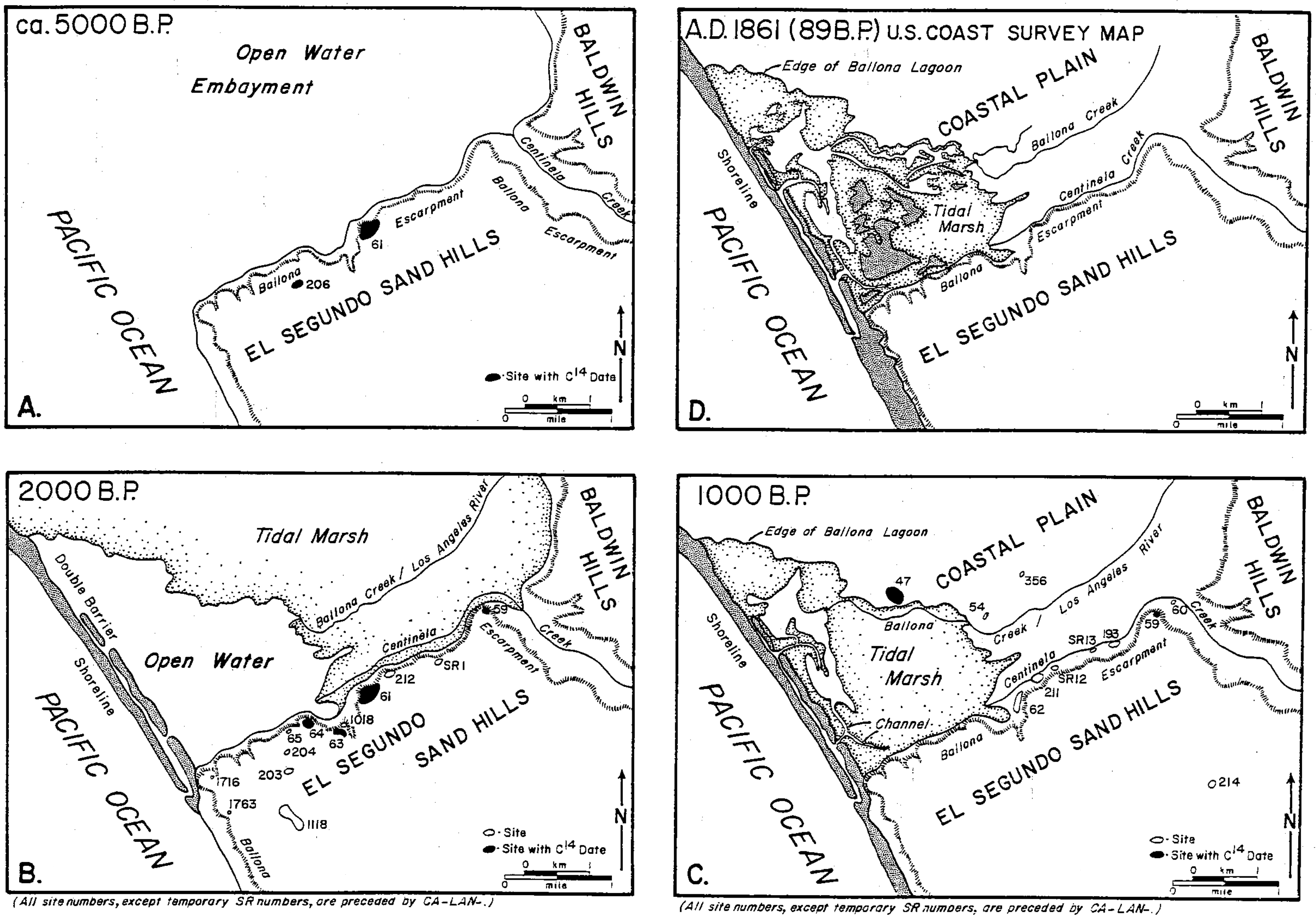


Figure 122. Natural and cultural development of the Ballona.

lagoon and estuary. To do so, we have divided the last 7,000 years into three periods corresponding to environmental conditions and prevailing settlement patterns.

CULTURE HISTORY AND CULTURAL DYNAMICS

Early Period: 7000 - 5000 B.P.

In late Pleistocene times, sea level began to rise as continental glaciers retreated, the transgression continuing into earlier Holocene times and probably culminating around 5000 B.P. (Orme 1990:47). The coastal plain west of the Baldwin Hills and north of the El Segundo Sand Hills would have been inundated, creating a large open water embayment. Based on topography and conjectures about sea level, our conception of this environment is presented in Figure 122a.

It is this embayment that the first residents of the Ballona would have viewed sometime between 5,000 and 6,000 years ago. Two sites on the bluffs have been dated to this period. The Berger site (CA-LAn-206) appears to be a single component site. One radiocarbon date obtained from a shell sample indicates the occupation of this site took place around 6750 B.P. (all dates in this chapter are uncorrected). The Loyola-Marymount site (CA-LAn-62), located about 2 km west of the Berger site, also has a component that dates to this period. Although most of the Loyola-Marymount site dates to a later period, one radiocarbon assay from a shell sample was dated to 4310 B.P., which Van Horn (1987) and Freeman (1991) believe is reliable. Isolated discoidal stones, artifacts that also could date to the Early period, have been found on several other nearby bluff sites (Van Horn 1987; Lambert 1983). Radiocarbon dates from these sites, however, are either nonexistent or reflect later occupations, which has led Van Horn (1987) to surmise that the discoidals may be hierlooms or date to a later period.

Little is known about the Early period. Excavations at the Berger site (CA-LAN-206) revealed a low density shell midden associated with small numbers of fish and terrestrial animal remains. The sparse nature of the remains at the Berger site, coupled with the failure to find deposits dated to this time period during excavations at most other nearby bluff sites, led Van Horn (1987:266) to conclude that the early occupation of the Ballona was of low intensity and opportunistic.

The Middle Period: 3000 - 1000 B.P.

The Ballona was either abandoned or utilized only sporadically by small groups until around 3000 B.P. According to Antony Orme (personal communication, 1991), sea level largely would have stabilized by this time, barrier sand would have partially blocked the lagoon entrance, but one or more connections between the lagoon and the sea would have survived. A sheltered wetland environment, characterized by a small bay and surrounding tidal marshes, would have prevailed. Our reconstruction of this environment is presented in Figure 122b.

The onset of intense occupation coincides with the development of the lagoon. Beginning around 3000 B.P. and continuing to around 1000 B.P., occupation of the Ballona was more-or-less continuous. Occupation appears to have been restricted to the bluff top, with many sites found along erosional gullies in the bluffs, which provide easy access to the lagoon below. Although evidence of Middle period sites has not been found along the edge of the lagoon, it is possible that temporary camps were established at the lagoon margin that subsequently have been buried. Recent excavations have securely dated four sites to this period; the Hughes site (CA-LAn-59), the Loyola-Marymount site

(CA-LAn-61), the Bluff site (CA-LAn-64), and the Del Rey Hills site (CA-LAn-63) (Van Horn 1987; Freeman 1991). Nineteen radiocarbon assays and 150 obsidian hydration readings indicate that occupation during this period intensified through time, with the most intense settlement occurring between 1500 and 1000 B.P. (Freeman 1991).

We tentatively have dated nine others to this time based on their artifact assemblages and site constituents. Characteristic of this period are sites composed of large, extensive middens that contain relatively few artifacts and little shell. Lithics predominate in the collections, with the split cobble industry that utilized locally available quartzites being dominant.

Data from excavations suggest that occupation was intermittent throughout the year. Economic practices focused on terrestrial animals, sharks and rays, bony fish, and waterfowl. Surprisingly, shellfish were little used. Subsistence practices do not appear to have been specialized, but rather opportunistic. The terrestrial, avian, and marine faunal assemblages are diverse, but do not indicate a concentration on individual species.

Settlements apparently were repeatedly used by small groups for short durations. Many of the features identified during excavation are caches of ground stone, steatite cooking vessels, and shell dishes. Van Horn (1987:272) argues that these articles were purposely left to provide equipment to be used at a later date.

The bluff top sites, however, were used for more than just temporary camps from which food resources were gathered. Brown (1989) has demonstrated that the avian faunal collections from the Hughes site and the Loyola-Marymount site contain disproportionate numbers of coracoids, scapulae, and other wing elements. She contends that the dominance of these elements in the collection cannot be accounted for by biases due to bone preservation, recovery techniques, or identification methods. Moreover, the birds in the Ballona site collections represent only a small sample of the species that would have been present in the wetlands, those with especially brilliant plumage and colorful feathers. Brown (1989:42) concludes that the primary reason for hunting birds during the Middle period, was to obtain feathers, and that their use as a food resource was secondary.

Shell recovered from the bluff top sites provides one clue to the nature of environmental change during this period. Oyster, which prefers rocky habitats, was found in significant numbers at the base of several middens. Chione, which favors mudflats, are the dominant species near the top of these middens. Van Horn (1987) argues that the occurrence of oyster in the earlier levels suggests that the Ballona was more of an open lagoon during the earlier portion of this period, later shifting to a more estuarine environment conducive to chione. This shift, first noted by Warren and Pavesic (1963) for Batiquitos Lagoon in San Diego County and latter by Cottrell (1978:49) for Los Alamitos Bay near Long Beach, may be part of a larger, regional environmental trend.

The Late Period: 1000 B.P.

The shift noted by Van Horn (1987) suggests that by the end of the bluff top occupation the lagoon had reached the final stages of sedimentation. By 1000 B.P., the Ballona was probably choked with sediment, resulting in the development of an intricate network of islands, marshes, and narrow open waterways that characterized the area during the historic period. Figure 122c depicts the probable environmental situation.

The dramatic ecological change was mirrored in shifts in the settlement pattern. The bluff top, occupied for the preceding 2,000 years was virtually abandoned, with settlements being established at the base of the bluffs along Centinela Creek and north of Ballona Creek. Two sites have radiocarbon dates from this period. Six shell and six humate samples have been radiocarbon dated from the Admiralty site (CA-LAn-47). Dates were obtained from paired samples with a humate and shell sample taken from the bottom of the cultural deposit and another pair from the top of the deposit in three test pits dispersed over the site (see Chapter 8). The shell dates all formed a tight cluster, ranging from 850 B.P. to 760 B.P, whereas the humate dates were more variable (1494 B.P. to 873 B.P.). The fact that the humate dates were generally consistent in each test pit (i.e., the base of the midden being no more than 200 or 300 years earlier than the top), but variable across the site suggested to us that these dates were contaminated by bioturbation processes, and thus were providing unreliable dates of the occupation. The shell dates appear to be more reliable indicators of the date of occupation, which appears relatively short-lived, centered sometime around A.D. 1150.

The other Late period component that has been radiocarbon dated is found at the Hughes site (CA-LAn-59), located on the west end of the Ballona Escarpment. Although most of the absolute dates point to an intense Middle period occupation, the Hughes site also returned one radiocarbon date from a shell sample at 620 B.P. (A.D. 1330) and 12 obsidian hydration readings ranging between 990 and 220 B.P. (A.D. 1000 - 1770) (Freeman 1991). The latter dates all use the rate of 220 years per micron established by Meighan (1978) for the Malibu site (see also Meighan 1988). Of the 12 readings, seven form a tight cluster between A.D. 1000 and 1200, dates corresponding to the occupation at the Admiralty site. Based primarily on the large number of pre-A.D. 1000 dates, Van Horn (1984) believes that the primary occupation of the site was between A.D. 400 and 1000, with a much smaller occupation lasting another several hundred years.

The Hughes site is intriguing for it is the only site on the bluff top that has a Late period occupation. The site is located near the Centinela Creek, which would have provided the site with nearby potable water, whereas its bluff top location would have protected it from the vicissitudes of seasonal flooding. A nearby site, CA-LAn-60, is located directly below and to the west of the Hughes site at the edge of Centinela Creek. Although little is known about the age of CA-LAn-60, its constituent midden is very similar to that found at the Hughes site. It is possible that the two sites are related, with temporary groups occupying one site or the other depending on local conditions. The Late period Hughes site occupation, then, may have been no more than an occasionally occupied offshoot of an adjoining creek edge settlement.

Seven other sites have been tentatively assigned to the Late period. Test excavations have been conducted at two of these sites, the Peck site (CA-LAn-62) and CA-LAn-211 (Archaeological Associates 1988). Both are located along Centinela Creek near its mouth with the Ballona Lagoon. The two sites both contained small side-notched and triangular projectile points indicative of this time period along the coast. Another similar point was found on the surface further upstream at artifact scatter given the temporary designation of SR 13 (Altschul et al. 1991) All data indicate an intense Late period occupation along the banks of Centinela Creek.

Three other sites, however, are located away from the bluffs and Centinela Creek. The settlements in the northern portion of the Ballona (CA-LAn-47, CA-LAn-54, and CA-LAn-356) are intriguing for they are located at least 0.5 km away from Ballona Creek, the nearest source of potable water.

Ballona Creek was not only larger than Centinela Creek but also much more unpredictable. In part the stream's more volatile nature was due to the larger size of its drainage basin, but another contributing factor was its placement in the Los Angeles River drainage system. Periodically, the Ballona Creek channel was captured by the Los Angeles River. An event was recorded in 1815, when at high flood stage, the Los Angeles River shifted from its present-day course, which empties into the ocean at Long Beach, to a more westerly route. The waters of the Los Angeles River flowed into Ballona Creek, and emptied into Santa Monica Bay. A second major flood in 1825 returned the Los Angeles River to its southerly outlet at Long Beach. During the floods of 1862 and 1884, portions of the Los Angeles River's load were again diverted into Ballona Creek, although as the floodwaters receded the original courses of the two streams were maintained. Since 1884, the Los Angeles River has been confined to its present channel, largely as a consequence of civil engineering projects.

Certainly throughout prehistory, the course of the Los Angeles River changed many times. Major floods would have punctuated the prehistoric period, periodically flushing out the Ballona Gap. Several high velocity alluvial events have been documented by Weide (1967) at the Hammock Street site (CA-LAn-194), located along Ballona Creek just upstream from the wetlands. Such events would have radically altered the ecology of the area for brief periods. Within a few months to a year, however, the barrier would have re-stabilized and within a few years the wetlands restored (Antony Orme, personal communication, 1991).

To understand the nature and frequency of flood events in the Ballona, we reconstructed the streamflow history of the Santa Ana River (see Chapter 16). Because the gaging records are better, we decided to model the Santa Ana rather than the Los Angeles River. Because both streams drain the Los Angeles Basin, the history of the Santa Ana River serves as a reasonable proxy of streamflow and paleofloods for the Los Angeles River.

Figure 119 presented the high and low frequency streamflow predictions for the period A.D. 1520 to 1966. The high frequency model predicts streamflow on a yearly basis, whereas the low frequency predictions are based on a ten-year moving average. Dean (1988) has argued that groups and individuals make short-term subsistence-related decisions based on the local availability of resources, such as acorns at oak stands or shellfish in marshes. Because these decisions were influenced by existing environmental conditions, they are best reflected in the high frequency model. Overall adaptations, however, respond to long-term environmental trends. Dean argues that these trends, best reflected in the low frequency model, generally have cycles of greater than a generation. These trends result in long-term shifts in subsistence practices, such as changes in procurement and consumption of aquatic as opposed to terrestrial resources. Individuals probably would not be cognizant of these long-term trends; instead, they would view the major environmental and subsistence patterns as constant throughout their lifetime.

Dean's distinction between high and low frequency patterns has direct relevance for understanding settlement and use of the Ballona after 1000 B.P. The local prehistoric population adapted to the formation of the Ballona Wetland after 1000 B.P. by building large settlements around the lagoon and near the mouths of the two creeks. Once this new settlement and subsistence pattern was established, the population would have been influenced by high frequency events, such as annual fluctuations of lagoonal resources. At the same time, they were affected by low frequency events, such as catastrophic flooding. For example, a major flood event occurred in 1938. Figure 123 is an oblique aerial photograph of the Ballona during the height of the flood. Water approached the site, but never reached it. Other sites further inland along Ballona Creek also remained above the water level during the flood.

Just as the floodwaters of 1938 did not reach the sites along Ballona Creek, Figure 123 also shows that floodwaters did not impinge on the sites at the base of the bluffs. Of critical importance in this regard is the fact that the Peck site (CA-LAn-62), located next to the mouth of Centinela Creek and adjoining the Ballona Lagoon, remained barely above water. This is the largest site in the Ballona during the Late period, and of those sites located along the base of the bluffs, is the most vulnerable to floods.

In 1938, approximately 600,000 acre feet of water flowed down the Santa Ana River. Figure 123 reveals that the 1938 streamflow was approximately 1.5 standard deviations above the mean. Since A.D. 1520, streamflows are predicted to have exceeded this amount 11 times, or about once every 40

Figure 123. Aerial photograph of the Ballona in flood in 1938.

years using the high frequency model. This mark was approached, but never reached with the low frequency model. Decisions as to the location of midden sites, therefore, appear to have taken into account the vagaries of the stream's behavior.

It is important to point out that the streamflow reconstruction presented in Figure 119 represents annual river flow. Floods, however, are much more ephemeral events, and do not correlate directly with yearly flow. For example, a major flood occured in 1884, although streamflow for the year as a whole was only slightly above normal. Unlike other parts of the west, however, the Los Angeles Basin is characterized by a unimodal precipitation pattern. Most precipitation falls between October and March. Floods usually occur in the late winter or spring, and generally are immediate responses to heavy precipitation. Disastrous floods also are associated with heavy precipitation, but occur in combination with warmer weather that melts snowpacks in the mountains. Because on average there are only 34 days of rainfall in the Los Angeles area, it stands to reason that streamflow is at least weakly correlated with flooding. Further, this correlation should be stronger as deviations from the mean increase. That is, years with large amounts of precipitation (on the order of two standard deviations above the mean) should almost always be associated with floods, whereas those of such magnitude below the mean should be associated with severe droughts.

Based on the streamflow reconstruction, then, it is also possible to predict the frequency of floods with sufficient magnitude to have flushed out the Ballona. Such events can be defined as those that are about 2 standard deviations above the mean streamflow. These events are predicted for the years, A.D. 1540, 1563, 1567, 1610, 1747, 1767, 1831, 1852, and 1867. We know that in 1862 (not 1867 as predicted by the tree-rings) the Ballona was flooded, although the severity of the flood was not recorded. No flood was recorded in or near 1852, suggesting that the Los Angeles River maintained its course toward Long Beach.

Let us assume that for half the major flood events, the Los Angeles River maintains its present course toward Long Beach and that for the other half the river discharges through the Ballona Gap. Of the nine severe flood events between A.D. 1540 and 1966, then, five would have flowed through Ballona Creek and would have been of a magnitude to flush out the Ballona Gap. Thus, on average we would expect such an event every 84 years. If we further assume that it took the wetlands 5 years to recover fully from such an event, then we can hypothesize that the Ballona was abandoned or, at a minimum, use of its resources was greatly restricted about every 80 years. As Figure 119 shows, however, there is a tremendous amount of variability in the periodicity of floods. Major floods sometimes occurred in pairs, such as in the years A.D. 1562 and 1564 and nearly two hundred years later in the years A.D. 1741 and 1743. In contrast, there was no major flood event during the 110-year period between A.D. 1610 and 1741.

Both the frequency and unpredictability of major floods probably conditioned settlement during the Late period in the Ballona. By virtue of their bluff top locations, Middle period settlements would have been protected from these dynamic fluvial events. Further, because Middle period adaptation was based on seasonal settlements and a high degree of mobility, short-term environmental degradation of the Ballona could have been buffered by movement elsewhere. The dramatic shift in settlement from the bluff top to the lagoon edge around A.D. 1000, however, may have heralded a new adaptive strategy, one based on permanent residence.

The most likely candidate for a Late period permanent village in the Ballona is the Peck site (CA-LAn-62). In limited excavations at the site, Van Horn and his colleagues (Archaeological Associates 1988) found cultural deposits up to 2 m in thickness, with dense concentrations of artifacts and faunal remains. Van Horn (personal communication, 1991) is of the opinion, based primarily on the richness of the deposit, that the Peck site was occupied on a year-round basis. Such a hypothesis is certainly consistent with evidence from other coastal lagoons in southern California during the late prehistoric and protohistoric period. Nearly every major lagoon from the Santa Barbara Channel south to at least San Pedro hosted a major permanent settlement.

Yet, excavations at the Peck site and throughout the Ballona have failed to uncover convincing evidence of permanent residences. Features are extremely rare at sites along the Ballona Lagoon. In fact, beyond burials, most of which were reported by amateurs with little if any reliable provenience information, Ballona Lagoon sites have produced no features. The presence of burials is certainly consistent with permanency, although to date burials have been found as isolated internments or cremations with no central cemetery as found elsewhere along the coast. More excavation will be needed to resolve the issue of sedentism, but it is fair to conclude that currently, beyond ethnographic analogy, there is little to support the permanent presence of a social group in the Ballona during the Late period.

As an alternative hypothesis it is possible that the Ballona was never utilized on a permanent basis. Settlements may have been reoccupied repeatedly for short time periods throughout the year. Support for this position can be derived from subsistence data obtained from excavated contexts. Between the Middle and Late periods, the focus of subsistence changed in terms of specific resources, but not with respect to overall adaptation. A wide spectrum of locally available resources were used, with no indication of specialized use. There was a dramatic shift away from fish toward shellfish, terrestrial animals, and waterfowl. This shift can be discerned in Tables 74 and 75, which present data from four Middle period bluff sites (Hughes, Loyola-Marymount, Del Rey, and the Bluff sites) and one Late period lagoon edge site (Admiralty site). The Hughes site has been grouped with the Middle period sites in this table because the bulk of the deposit predates A.D. 1000, although a minor Late period component is also recognized.

A perusal of Table 74 leads to two observations. First, the bluff top Middle period sites contain between four and six times the proportion of sharks and rays as the lagoon edge Late period site. Sharks and rays are easily taken in shallow bays. The dominance of elasmobranchs in the fish remains from Middle period sites and their notable lack in Late period contexts supports the contention that the open bay environment that characterized the Middle period (Figure 122b) had largely silted in by the onset of the Late period (Figure 122c).

Second, in terms of absolute numbers the use of bony fish remains relatively constant through time. The Admiralty site's mean of 11.4 elements of bony fish per cubic meter compares favorably with the slightly larger figures of 16.5 for the Hughes site and 17.7 for the Del Rey site (see Table 1). This finding suggests that throughout the occupational sequence, the inhabitants of the Ballona focused on fish in the open coast and kelp bed zones. During the Middle period, inhabitants also had access to marsh or lagoonal species, habitats largely destroyed by sedimentation by the Late period. A corollary observation is that the importance of fishing was highly variable. Whereas the Hughes site and the Del Rey site have yielded approximately the same number of fish remains per cubic meter, the contemporaneous Loyola-Marymount and Bluff sites contained on average less than one-fifteenth the amount of bony fish. Indeed, there is much greater variability in amounts and proportions of fish remains between Middle period sites than between those sites and the Late period Admiralty site.

Table 75 highlights the changes in subsistence practices between the Middle and Late periods. Terrestrial animal use increased dramatically, which may account for the relatively large number of projectile points found at the Admiralty site. Beyond shifts in the average number of elements per cubic meter, however, there is little to distinguish the bluff top sites from those in the lagoon. The types and relative diversity of terrestrial fauna exploited remains approximately the same throughout the entire prehistoric sequence.

Shellfish also assume much greater importance during the Late period. The Admiralty site yielded about about 5 times the number of valves per cubic meter as the Del Rey site, 20 times more

Table 74. Comparison of Fish Remains from Excavated Sites in the Ballona.

	# of Shark and Ray	% of Shark and Ray	Mean Shark and Ray Elements per cubic meter	# of Bony Fish	% of Bony Fish	Mean Bony Fish Elements per cubic meter
Bluff Sites						
Hughes Site CA-LAN-59	2230	78	58.0	628	22	16.5
Loyola-Marymount Site CA-LAN-61	4780	79	13.4	1254	21	3.5
Del Rey Site CA-LAN-63	3137	43	13.3	4188	57	17.7
Bluff Site CA-LAN-64	108	76	2.3	34	24	0.7
Lagoon Site						
Admiralty Site CA-LAN-47	102	12	1.6	732	88	11.4

Table 75. Comparison of Vertebrate and Invertebrate Fauna from Ballona Sites.

	# of Terrestrial Elements	Mean Identifiable Terrestrial Elements per cubic meter	# of Sea Mammal Elements	Mean Identifiable Sea Mammal Elements per cubic meter	# of Avian Elements	Mean Identifiable Avian Elements per cubic meter	# of Fish Elements	Mean Identifiable Fish Elements per cubic meter	# of Shell Valves	Mean Shell Valves per cubic meter
Bluff Sites										
Hughes Site CA-LAN-59	n/a	n/a	n/a	n/a	675	17.8	2858	74.5	683	28.5
Loyola-Marymount Site CA-LAN-61	1818	7.7	224	0.6	1281	3.6	6034	16.9	789	0.7
Del Rey Site CA-LAN-63	2951	5.1	30	0.1	249	1.1	7325	31.0	23792	117.4
Bluff Site CA-LAN-64	76	1.1	4	0.1	49	0.7	142	3.0	187	19.9
Lagoon Site										
Admiralty Site CA-LAN-47	2150	33.5	21	0.3	480	7.5	834	13	14290	595.4

Note: Different faunal analyses at the various Ballona sites often analyzed different percentages of the total collections. Below we provide the number of cubic meters of bone identified for each analysis for each of the Ballona sites. In some cases, these volumes are estimated, based on the description of the sampling technique provided in the report.

Terrestrial and Sea Mammal Faunal Analysis: Hughes site - not reported; Loyola Marymount - 234.6 cubic meters (terr), 356 (sea mammal); Del Rey - 574; Bluff - 69; Admiralty - 64.2
Avian and Fish Faunal Analysis: Hughes - 38; Loyola-Marymount - 356; Del Rey - 236; Bluff - 69; Admiralty 64.2
Shell Analysis: Hughes - 24; Loyola-Marymount - 1213.5; Del Rey - 202; Bluff - 9; Admiralty - 24

than the Hughes site, 30 times more than the Bluff site, and about 850 times the number recovered at the Loyola-Marymount site. As with the data on bony fish, Middle period shell assemblages are highly variable, although they all had significantly lower shell densities than the Late period Admiralty site.

The avian data are more difficult to interpret than other classes of faunal data. The Hughes site had twice as many bird bones per cubic meter as the Admiralty site, which in turn had more than twice the proportion of any of the other Ballona sites. It is possible that bones from the Hughes site, which dates to the late Middle and early Late periods, signal the beginning of the estuarine phase of the Ballona Lagoon. Estuary development would have started upstream, near the Hughes site, leading to ideal waterfowl habitat. As sedimentation continued, a network of braided channels favored by migratory waterfowl, would have become established downstream. The continued emphasis on birds at the Admiralty site suggests that this subsistence focus followed the development of the estuary during the Late period.

The avian data from the Admiralty site also suggest a shift in resource use. Unlike the bluff sites, the avian fauna from the Admiralty site consisted primarily of waterfowl that would not have provided colorful plummage. Colby (personal communication, 1991; see also Chapter 12) found that only 18 percent of the avian remains from the Admiralty site represented wing elements. This percentage is consistent with hunting practices in which the entire bird was returned to the site. In contrast to the Middle period bluff sites, then, it appears that birds at the Admiralty site were used primarily as a food resource, and secondarily, if at all, for their feathers.

The paucity of sea mammal remains in the Ballona sites throughout the prehistoric sequence is particularly notable. These resources were an extremely important component of the subsistence strategies adopted at large coastal settlements further north. The relative unimportance of sea mammal is probably attributable to the lack of natural habitats conducive to these species in the Ballona vicinity. The absence of this predictable and nutritionally important resource may well be one factor in the apparent lack of permanent settlements in the Ballona.

Beyond the exploitation of animals, pollen and macrofossil data from the Admiralty site indicate a focus on grasses and plants available along the margin of the lagoon during the Late period. Pollen gathered from controlled samples off-site point to a surrounding vegetative community containing hackberry, walnut, goosefoot, pigweed, mustard, lily, buckbush, cattail, parsley, and marsh grasses (ragweed, cocklebur, aster, snakeweed, sunflower, rabbitbush, etc.). Pollen recovered from columns within the midden indicates the use of many of these plants, suggesting that a wide spectrum of native plants in the adjoining wetlands were exploited. Scott-Cummings (see Chapter 13) noted that within the midden high-spine Compositae, a group of marsh plants that dominate the off-site pollen record, is replaced by Cheno-ams, a weedy annual that provides edible greens and seeds. Because Cheno-ams thrive in disturbed contexts, such as those provided by cultural occupation, their presence in the pollen record does not necessarily imply an economic relationship. A pollen wash of a metate from the Admiralty site, however, revealed numerous aggregates of Cheno-ams. Scott-Cummings suggested that Cheno-ams seeds may have been parched, then ground: an interpretation consistent with both the macro- and microfossil data (see Chapter 12).

Discussion

In one sense explaining settlement in the Ballona for the last 3,000 years is relatively simple. The area was used on a short-term basis throughout the year by small groups that came to the Ballona to exploit the abundant, locally available plant and animal resources. Shifts in settlement patterns can be correlated directly with changes in the lifecycle of the wetland.

Although accounting for trends in settlement, the model presented above is not completely satisfying. Basically it fails to address a fundamental question: if the Ballona was so rich in natural resources, why were no permanent settlements established? Some archaeologists have suggested that this perception is simply a sampling problem. The large midden sites along the edge of the lagoon have largely been left unexcavated. It is possible that when these sites are excavated, especially the Peck site (CA-LAn-62), evidence will be found to support the interpretation of permanent settlement during the Late period.

Sedentism during the Late period would bring the Ballona in line with cultural events in similar coastal environmental settings to the north in Ventura and Santa Barbara counties. Anthropologists have long argued that next to the Chumash, their northern neighbors, the Gabrielino, the group indigenous to the Ballona and the Los Angeles Basin, were the wealthiest, most populous, and most complex of the southern California tribes (e.g., Bean and Smith 1978; Johnston 1962). Little is known about the Gabrielino, and many of their traits have been inferred from studies of the better-known Chumash. One such trait is permanent settlements. Hudson (1969, 1971) has argued that the proto-Gabrielino occupied permanent villages in sheltered coastal areas, such as the Ballona, based on a modicum of archaeological work and scanty historic data.

Although plausible, we believe that the issue of permanency, at least in the Ballona, has not been resolved. In the preceding section we offered an alternative hypothesis. We argued that the dynamic nature of the ecosystem may have been so volatile that long-term dependence on the resources of the Ballona may have been perceived as too risky to base a sedentary subsistence strategy. Instead, the area may have been viewed as important, but exploited only on an opportunistic basis. Although consistent with existing data, this hypothesis too needs to be tested with more refined geomorphic data and more excavated data from midden sites in the Ballona. Geomorphic data need to be gathered from elsewhere to demonstrate that other lagoonal areas were not as volatile as the Ballona.

A second and related intriguing issue is the cultural affiliation of the Ballona groups. Between 3000 and 1000 B.P. the bluff top occupants appear to be associated with desert groups. The presence of cremations, Gypsum Cave projectile points, and the absence of shell beads led Van Horn (1987) to conclude that desert-affiliated groups established settlements in the Ballona prior to the introduction of the bow-and-arrow (ca. A.D. 500). The use of Gypsum Cave points continued along with Canalino, Marymount, and Cottonwood triangular point styles until the end of prehistoric occupation.

The conservative nature reflected in point styles is mirrored in other aspects of the lithic assemblage. All excavated Ballona sites have been characterized by four basic lithic technologies: flake tool, bifacial, bipolar, and a microlith technology. Flake tools were primarily made from local quartzite and basalt. Bifacial and bipolar technologies were practiced primarily on cherts and chalcedonies that were imported into the Ballona. Lithic analysis indicates that most bifacial tools were brought into the area as finished or nearly finished tools. Microliths were also brought into the region largely as finished tools (Chapter 9; see also Van Horn and Murray 1985; Van Horn 1984, 1987). Ground stone implements in the form of manos, metates, pestles, and mortars made from locally available stone, have also been found at both bluff-top and lagoon-edge sites.

The shift from bluff-top to lagoon-edge occupation around A.D. 1000 was accompanied by changes in specific aspects of the material culture. There was a dramatic shift from stone to shell beads. There is no evidence that beads were manufactured in the Ballona, so this shift does not appear related to a change in raw material from lithic sources on the bluffs to shell near the lagoon. Instead, the introduction of shell beads may reflect the incorporation of the Ballona into interaction spheres of other coastal groups. Concomitant with a change to shell beads was an increase in the use of inhumation, although cremation as a burial practice may never have completely disappeared.

By A.D. 1100, cultural assemblages appear to be a melange of older desert-like features overlain with newer coastal traits. Changes in subsistence practices appear to be environmentally induced, and not technologically or culturally driven. The continued sedimentation in the lagoon forced residents to shift their focus between resources, but these shifts were quantitative (changes in the proportions of various resources) not qualitative (deleting or adding whole classes of resources).

Where the permanent villages, if any, were located and how these may have shifted between 3000 and 1000 B.P. remains unknown. Given the large amount of excavation on the bluffs, it is reasonably clear that no permanent settlements were established in the Ballona during the Early or Middle periods. These groups may have been linked with villages located further up on Ballona Creek, perhaps near present-day downtown Los Angeles, where several major Gabrielino villages were encountered by the Spanish in A.D. 1769. Whether the inland sites were in fact more permanent than coastal ones and what the exact relationship between inland and coastal settlements during these early periods are research topics worthy of further study.

During the Late period, it is possible that permanent settlements were established within the Ballona. At present there is no firm evidence for such settlements. Much like the earlier periods, the Ballona appears to have been visited by small groups on short-term forays that targeted a wide spectrum of the region's abundant resources. This focused use of the land and its resources reflects a flexibility in cultural adaptation that characterizes the entire cultural sequence. The apparent cultural conservatism suggests that the desert origins of the Ballona population strongly influenced cultural patterns. It is possible that the population never fully adapted to coastal resources, in part because of their terrestrial orientation and in part because of a natural absence of predictable and dependable pelagic resources. What makes the Ballona adaptation so remarkable is its apparent success in the face of dramatic and dynamic environmental change.

CHAPTER 18

HISTORIC ARCHAEOLOGY OF THE CHANNEL GATEWAY PROJECT

Mark T. Swanson and James E. Ayres

METHODS

In presenting the results of the historic artifact analysis, there will be recourse to both tables and verbal description. Artifacts have been counted both as individual specimens and the estimated number of objects present. They have also been sorted by material category (for example, glass, ceramics, metal, etc.) and by functional category. Due to space considerations, the functional categories have been abbreviated for use in the tables. The functional categories and the abbreviations used to identify them are listed in Table 76.

Table 76. Codes for Functional Historic Artifact Categories.

Code	Functional Artifact Category
LR	Leisure and Recreation
HHF	Household Furnishings
F	Food
FPC	Food Preparation and Consumption
MH	Medical and Health
P	Personal
Comm.	Communications
Trans.	Transporation
TH	Tools and Hardware
Arch.	Architecture
Mach.	Machinery
Misc.	Miscellaneous
Unid.	Unidentified

Historic artifacts from each individual test pit or group of test pits are discussed separately. Within these discussions is the treatment of each material category. The artifacts within each material category are first presented in tabular form to identify their location within the levels of the test pit, and their identification as to functional type. The discussion that follows each table summarizes the tabular results and the temporal significance of the artifacts. After the discussion of each test pit or group of test pits, the historic artifacts from the site as a whole are discussed and summarized.

CA-LAn-47

Material Culture

CA-LAn-47 is located along the southeastern edge of the Channel Gateway project area, largely within what used to be a railroad right-of-way. The railroad tracks were installed around 1892 and later removed around 1980. CA-LAn-47 is predominantly prehistoric, but has a minor historic component. Whereas the prehistoric component of the site has been disturbed by the impact of the railroad, the dumping and earth-moving activity associated with the railroad right-of-way has probably led to the deposition of most of the historic artifacts.

In all, 932 whole and fragmentary historic artifacts were recovered from CA-LAn-47. These remains represent over 200 individual items from 11 test pits. The vast majority of artifacts were heavily fragmented, and therefore yielded relatively little useful information. Many could not be assigned to a specific functional category. Those that could be categorized by function were confined to 11 of the 13 functions listed in Table 76. The "food preparation and consumption," household furnishings," "medical and health," and "communications" categories contained only one or two artifacts each. Most artifacts fell into the "leisure and recreation" (beer, wine, whiskey bottles, for example), "architecture" (bricks), "transportation" (railroad spikes, automobile safety glass), "tools and hardware" (nails, bolts), "miscellaneous" (tin cans, coal), or "unidentified." Artifacts in the miscellaneous category included those whose form could be determined, but not their function. Those artifacts for which both function and form could not be determined were classified as "unidentified." Most artifacts fell into the latter two functional categories.

In the tables used in this chapter, each entry is associated with two numbers. The first refers to the number of specimens identified for that provenience and functional category. The second number, which follows a -, represents the minimum number of whole artifacts possible.

There were 14 test pits excavated within CA-LAn-47. Of this number, 11 contained historic materials. The size of these 11 test pits varied, but most began as 1-m by 1-m units. Some units were expanded to such a size that they were divided into the subdivisions identified as A, B, C, etc. Most of these subdivisions covered a 2-m by 2-m area. The discussion of artifacts found at CA-LAn-47 has been arranged into groups of test pits based on geographical location and density of cultural material (Figure 124). The central test pits (Test Pits 1, 2, 8, and 12) were generally the largest and contained the greatest density of artifacts. These four pits accounted for 83 percent of the artifacts recovered from CA-LAn-47. They also represented an area of great disturbance. Test pits located along the southern margin of the railroad right-of-way, southeast of the central pits, represented another area of the site (Test Pits 7, 9, and 14). The last area of the site was represented by the small test pits along the west side (Test Pits 3, 4, 5, and 6).

Central Test Pits (Test Pits 1, 2, 8, and 12)

Test Pit 1 was located near the center of CA-LAn-47, well within the railroad right-of-way. Test Pit 2 was another large composite unit located near the center of CA-LAn-47, well within the railroad right of way, about 20 m west of Test Pit 1. Test Pit 8 was located near the center of CA-LAn-47, between Test Pits 1 and 2. Like those test pits, Test Pit 8 had a relatively high density of historic artifacts, the vast majority of which were glass and metal. Test Pit 12 was situated near the center of

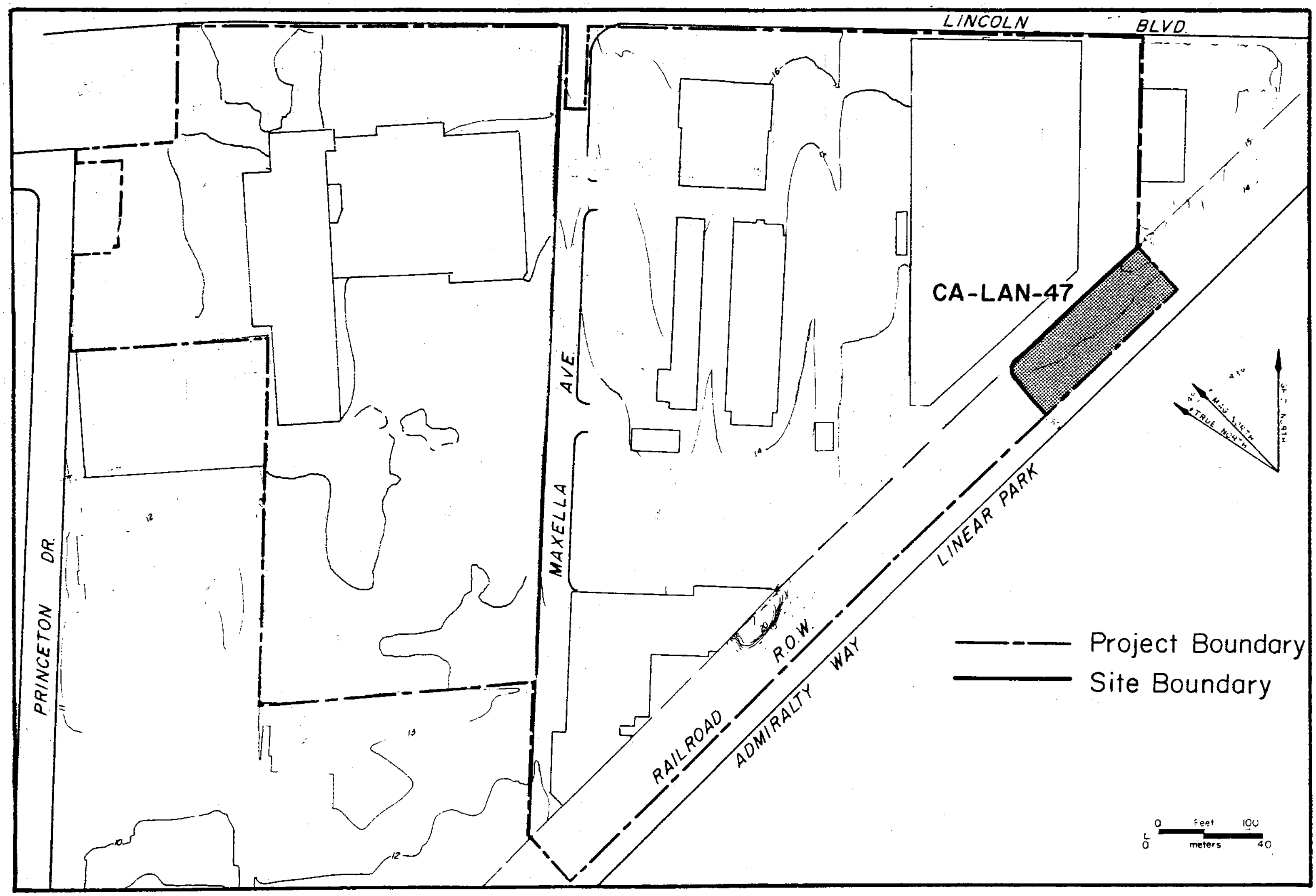


Figure 124. CA-LAn-47, the historic component.

CA-LAn-47, between Test Pits 2 and 8. The vast majority of the artifacts recovered from this unit consisted of glass artifacts, with ceramic and metal materials trailing far behind.

Most of the identifiable glass artifacts recovered from Test Pits 1, 2, 8, and 12 fell into the classification of "leisure and recreation" (LR) (Table 77). More specifically, they were the remnants of liquor, wine, and beer bottles. In addition to these bottles, there was a single green marble recovered from Level 4 of 8C. The two household (HHF) items recovered were light bulb bases with the attached glass disc associated with the base. An aqua glass insulator, patented in 1893, was recovered from Level 2 of 8C ("communications"). There were also numerous fragments of light green automobile safety glass (Trans.) recovered from Test Pit 12C.

The glass artifacts certainly date to the period of railroad use. All bottle glass was of automatic manufactured (machine-made), which indicates it dates after 1903. The glass that can be more specifically dated exhibits a tighter range. Three Owens-Illinois-made bottles were recovered from Test Pit 1: two dating to 1934, 1944, or 1954; and one dating to 1930, 1940, or 1950 (Toulouse 1971:403). Test Pit 1 also yielded a "turned pink" glass fragment, circa 1919 to the 1940s; machine-made bottles, 1903 to the present; a Tummis Glass Company bottle, 1940 to 1952 (Toulouse 1971:333); an Anchor Hocking-made bottle dated to 1942; and whiskey bottles with the embossing "Federal Law Prohibits," dated 1933 to 1964 (Munsey 1970:126). The other identifiable alcohol containers fall within a period between around 1930 and 1970. The "Unidentified" fragments were probably bottle sherds, ranging in color from blue and aqua, to brown and clear. These, too, were probably twentieth century.

The sun-colored amethyst water pitcher fragments recovered from Test Pit 12C (FPC) date to sometime between ca. 1880 and 1919. They are the only glass artifacts that might be earlier than the twentieth century. Interestingly enough, they were not recovered from the lowest levels of Test Pit 12.

Most of the artifactual material, which was recovered from near the top of most of the excavation units, was probably deposited as the result of landfill activities associated with the railroad. Test Pit 8 was something of an anomaly, with many glass artifacts found in levels lower than the first two. There is no indication that these artifacts are earlier than those recovered from the surface: the unidentified glass fragment recovered from Level 9 was clear, suggesting that it was post circa 1920 (if it had never been exposed to the sun, it might have been earlier); all identifiable bottle glass was machine-made, including the brown beer bottle found in Level 7.

From an examination of the glass artifacts from Test Pit 8, it would appear that this portion of CA-LAn-47 had been badly disturbed, with soil and artifacts either being overturned by disturbance related to railroad operations, or was the result of fill brought in to elevate the railroad right-of-way.

Of the two historic ceramic sherds recovered from Test Pit 2, both belonged to the "food preparation and consumption" category and were recovered from the top level (Table 78). The bowl fragment recovered from TP 2B was an undecorated hard-paste white earthenware; the fragment from 2D was part of an unknown form, but it too was an undecorated hardpaste white earthenware that showed signs of having been burned. There is no way to specifically date these two specimens, but both probably date to the twentieth century. It is interesting to note that absolutely no historic ceramic artifacts were recovered from Test Pit 1.

Within Test Pit 8, Level 2 yielded an undecorated hard-paste white earthenware and an unidentified redware fragment. Level 3 yielded a brown glazed Chinese rice wine bottle ("leisure and recreation") and a fired red brick fragment. The small number of domestic ceramic artifacts suggests that this area was not used as a residential area throughout most of the twentieth century. The presence of the Chinese rice wine bottle, however, may have ties to the Japanese truck farms known to have been located to the south of the project area in the 1920s and 1930s.

Table 77. Glass Artifacts Recovered From Test Pits 1, 2, 8, and 12.

Provenience	Function							
	LR	HHF	FPC	MH	Comm.	Trans.	Misc.	Unid.
Test Pit 1A								
Overburden	1-1							
Level 1							2-2	
Level 3								1-1
Level 4							1-1	
Test Pit 1B								
Level 1	17-5							43-12
Level 2								30-3
Test Pit 1C								
Levels 1 and 2								1-1
Test Pit 1D								
Level 1							1-1	
Test Pit 2A								
Level 2	1-1							1-1
Test Pit 2B								
Level 2								9-3
Level 4		1-1						
Test Pit 2C								
Level 6								1-1
Test Pit 2D								
Level 1	8-1							1-1
Test Pit 8A								
Feature 8 pedestal							1-1	
Test Pit 8B								
Level 3	27-1						7-3	
Test Pit 8C								
Level 1								25-3
Level 2					1-1			16-5
Level 3								8-4
Level 4	9-2							
Level 5								3-1
Level 6								1-1
Level 7	1-1							
Level 9								1-1
Test Pit 12A								
Level 1	2-2							7-3
Level 2	6-1							
Level 3								4-1
Level 4		1-1						
Level 8	1-1							
Test Pit 12B								
Level 2								18-7
Test Pit 12C								
Level 1	11-1					245-1		6-5
Level 2			3-1					
Level 3			1-1			9-1		6-4
Totals	84-17	2-2	4-2		1-1	254-2	1-1	193-65
Grand Total	539-90							

Key: LR = leisure and recreation, HHF = household furnishings, FPC = food preparation and consumption, MH = medical and health, Comm. = communication, Trans. = transportation, Misc. = miscellaneous, Unid. = unidentified.

Table 78. Ceramic Artifacts Recovered From Test Pits 1, 2, 8, and 12.

Provenience	Function			
	FPC	LR	Arch.	Unid.
<u>Test Pit 2B</u>				
Level 1	1-1			
<u>Test Pit 2D</u>				
Level 1	1-1			
<u>Test Pit 8C</u>				
Level 2	1-1			1-1
Level 3		1-1	1-1	
<u>Test Pit 12A</u>				
Level 1				1-1
Level 2			1-1	
Level 3	2-1			
<u>Test Pit 12C</u>				
Level 1	1-1			
Level 3				1-1
Level 4			1-1	
Totals	6-5	1-1	3-3	3-3
Grand Total	13-12			

Key: FPC = food preparation and consumption, LR = leisure and recreation, Arch. = architecture, Unid. = unidentified.

Test Pit 12 yielded seven historic ceramic artifacts. Among the ceramic vessel sherds were a clear glazed stoneware crock fragments, a hardpaste white earthenware small bowl fragment decorated with a blue line 5/16ths of an inch below the rim (FPC), and two unidentified redware sherds (Unid.). Two fired red brick fragments (Arch.) also were recovered.

With the exception of the three barbed wire fragments found in the second level of TP 1B, the metal artifacts recovered from TP 1 consisted of iron "tools and hardware" materials recovered from the first level of TP 1B: bolts, a fence staple, wire, and wire nails (Table 79). These materials are of a general nature and do not suggest a specific activity area.

Wire nails are roughly post-1890. While the other artifacts cannot be more specifically dated, there is no reason to assume that any of the metal artifacts recovered from TP 1A-D predate the twentieth century.

All metal artifacts from Test Pit 2 were recovered from the top two levels. Even though 75 fragments of a single large tin can were recovered, the total number of artifacts represented by this collection is relatively low and was probably the result of casual deposition. The other specimen in the "miscellaneous" category was a tin can. The materials in the category of "tools and hardware" consisted of a wrought iron square-cut nail, copper wire, and a machine bolt with square nut. Within the category of "transporation" were 5.25-inch railroad spikes. With the possible exception of the wrought iron square nail, all metal artifacts probably date to the twentieth century.

With the exception of a 6-inch railroad spike ("transportation"), an iron upholstery fastener (HHF), and a .22 shell cartridge (LR), the identifiable metal artifacts recovered from Test Pit 8 were in the nature of iron bolts, wire, brass washers, wire nails, and other items that could be listed under tools and hardware. The miscellaneous category included tin can fragments and barbed wire. The mix of artifacts throughout the levels of the test pit would suggest that this area had been badly disturbed.

Most of the "tools and hardware" artifacts from Test Pit 12 consisted of wire nails. The "transportation" artifact was a 5.25-inch railroad spike. The remaining artifacts consisted of tin can fragments and an aluminum tag.

Glass and metal artifacts make up the vast majority of the 772 artifacts recovered from the central test pits (70%). In Test Pit 1, the only artifacts that could be identified in the "other" material category were coal fragments recovered from relatively deep levels (Table 80). In Test Pit 2, the "miscellaneous" artifacts were charcoal and coal fragments; the "unidentified" category consisted of wood and charcoal fragments. It is likely that these were associated with the railroad. The "other" category of artifacts recovered from Test Pit 8 supports the assumption that this was an industrial/commercial activity area rather than a residential. Aside from coal and charcoal fragments (Misc.), there was a battery cell recovered from Level 6 of 8B. Fragments of a phonograph record were found in Level 2 of 8C (LR). The unidentified materials were either leather-like or plastic-like materials that could not be further identified.

Southeastern Test Pits (Test Pits 7, 9, and 14)

Test Pit 7 was located south of Test Pits 1 and 2, on the south side of the railroad right-of-way, adjacent to Admiralty Way Linear Park, which was outside the project area. Test Pit 7 represents the southern edge of CA-LAn-47 within the project area. Test Pit 9, like Test Pit 7, was located along the southern margin of both the railroad right-of-way and the project area. This test pit was located roughly half way between Test Pits 7 and 14, which was the southeasternmost unit at CA-LAn-47. The vast majority of the artifacts recovered from Test Pit 9 were glass fragments, with the remaining

Table 79. Metal Artifacts Recovered From Test Pits 1, 2, 8, and 12.

Provenience	Function							
	TH	Trans.	Mach.	HHF	Arch.	LR	Misc.	Unid.
<u>Test Pit 1A</u>								
Level 4	1-1							
<u>Test Pit 1B</u>								
Level 1	10-8							
Level 2							3-1	
<u>Test Pit 2A</u>								
Level 2	1-1	3-3						
<u>Test Pit 2B</u>								
Level 1	1-1							
Level 2	1-1							
<u>Test Pit 2C</u>								
Levels 1 and 2								2-1
<u>Test Pit 2D</u>								
Level 1		2-2					75-1	
<u>Test Pit 8A</u>								
Feature 8 Pedestal		1-1	1-1					
Level 4								1-1
<u>Test Pit 8B</u>								
Level 3	5-3							3-2
<u>Test Pit 8C</u>								
Level 1	7-7							1-1
Level 2	7-6			1-1		1-1	8-2	1-1
Level 3	2-2						3-1	4-3
Level 4	2-2							10-1
Level 6	1-1							
Level 7								6-2
<u>Test Pit 12A</u>								
Level 3		1-1						
Level 4	2-1							
Level 5	1-1							
Level 6	1-1							1-1
Test Pit 12B								
Level 1	1-1						5-1	
Totals	44-38	7-7		1-1		1-1	96-7	27-12
Grand Total	176-66							

Key: TH = tools and hardware, Trans. = transportation, Mach. = machinery, HHF = household furnishings, Arch. = architecture, LR = leisure and recreation, Misc. = miscellaneous, Unid. = unidentified.

Table 80. Other Artifacts Recovered From Test Pits 1, 2, 8, and 12.

Provenience	Function		
	LR	Misc.	Unid.
<u>Test Pit 1D</u>			
Levels 6-7		2-1 (coal fragments)	
<u>TP 2B</u>			
Level 1		2-1	
Level 2			7-1
Level 3		1-1	
<u>Test Pit 2C</u>			
Levels 1-2		1-1	
<u>TP 2D</u>			
Level 3		2-1	
<u>TP 8A</u>			
Level 4			1-1
<u>TP 8B</u>			
Level 3			1-1
Level 6		1-1	
<u>TP 8C</u>			
Level 2	5-1		
Level 3		1-1	3-2
Level 4		5-1	1-1
Level 7		6-1	1-1
Level 8		4-1	
Totals	5-1	25-10	14-7
Grand Total	44-18		

Key: LR = leisure and recreation, Misc. = miscellaneous, Unid. = unidentified.

material classes trailing far behind. Test Pit 14 was the southeasternmost unit placed at CA-LAn-47, and was located on the southern edge of the railroad right-of-way. Relatively few historic artifacts were recovered from this unit.

The single glass fragment recovered from Test Pit 7 was a miniature or sample whiskey bottle (brown) that was machine-made (Table 81). The bottle, though twentieth century in date, was recovered from Level 3, suggesting that this area has been disturbed by land alteration, probably as a result of railroad construction or right-of-way improvement.

The vast majority of the glass fragments recovered from Test Pit 9 were unidentified bottle fragments consisting of the following colors: aqua, amber, lime green, and clear. The whiskey bottle fragment (LR) was dated to between 1933 and 1964. The single clear prescription bottle (MH) was 3-oz. and graduated; from the base mark, it was dated to between 1911 and 1929.

Table 81. Glass Artifacts Recovered From Test Pits 7, 9, and 14.

Provenience	Function							
	LR	HHF	FPC	MH	Comm.	Trans.	Misc.	Unid.
Test Pit 7								
Level 3	1-1							
Test Pit 9B								
Level 1				1-1				
Level 3						25-1	1-1	5-2
Level 5			1-1					11-3
Test Pit 9C								
Levels 1-2								26-4
Level 3								22-3
Level 4	1-1							8-3
Test Pit 14								
Level 1								4-2
Level 6								1-1
Level 8								1-1
Totals	2-2		1-1	1-1		25-1	1-1	77-19
Grand Total	107-25							

Key: LR = leisure and recreation, HHF = household furnishings, FPC = food preparation and consumption, MH = medical and health, Comm. = communication, Trans. = transportation, Misc. = miscellaneous, Unid. = unidentified.

The machine-made fruit jar (FPC) was dated by its mark to between 1915 to the present. The remaining artifacts consisted of aqua automobile safety glass fragments ("transportation") and a glass head pin (Misc.).

The glass fragments from Test Pit 14 were unidentified; most were clear, suggesting a twentieth-century date.

Of the southeastern pits, only Test Pit 9 yielded historic ceramic material (Table 82). Aside from the fired red brick fragment (Arch.), all other ceramic materials recovered from Test Pit 9 were hard-paste white earthenwares, probably of a twentieth-century origin. One fragment had a floral decal decoration, while another exhibited signs of a maker's mark that was too small and fragmentary to identify.

The salient characteristic of the artifact collection from Test Pit 7 is the preponderance of metal and railroad-related materials recovered from the first level (Table 83). Among the metal artifacts were an iron hinge pin, two wire nails, a heavy cast iron wheel (5-inch diameter), five iron fragments, and a brass object.

The metal artifacts recovered from Test Pit 9 were all relatively modern and included a six-sided bolt head fragment, iron wire nails, a screw cap, a fragment of a wire-mesh screen, and a piece of aluminum foil. The artifacts from Test Pit 14 consisted of wire nails.

Among the "other" artifacts recovered from Test Pit 7 were five railroad-related cinder fragments (Table 84). In Test Pit 9, the "other" category consisted of a cloth fragment and a leather fragment, both from unknown objects.

Table 82. Ceramic Artifacts Recovered From Test Pits 7, 9, and 14.

Provenience	Function			
	FPC	LR	Arch.	Unid.
<u>Test Pit 9B</u>				
Level 1	1-1			
Level 4			1-1	
Level 5	7-1			
<u>Test Pit 9C</u>				
Level 3	2-1			
Totals	10-3		1-1	
Grand Total	11-4			

Key: FPC = food preparation and consumption, LR = leisure and recreation, Arch. = architecture, Unid. = unidentified.

Table 83. Metal Artifacts Recovered From Test Pits 7, 9, and 14.

Provenience	Function							
	TH	Trans.	Mach.	HHF	Arch.	LR	Misc.	Unid.
<u>Test Pit 7</u>								
Level 1	2-2		1-1		1-1			6-6
<u>Test Pit 9B</u>								
Level 4	1-1						1-1	
<u>Test Pit 9C</u>								
Level 3	2-2						2-2	
Level 4	3-3							
Level 6	1-1							
<u>Test Pit 14</u>								
Level 1	2-1							
Totals	11-10		1-1		1-1		3-3	6-6
Grand Total	22-21							

Key: TH = tools and hardware, Trans. = transportation, Mach. = machinery, HHF = household furnishings, Arch. = architecture, LR = leisure and recreation, Misc. = miscellaneous, Unid. = unidentified.

Table 84. Other Artifacts Recovered From Test Pits 7, 9, and 14.

Provenience	Function		
	LR	Misc.	Unid.
<u>Test Pit 7</u>			
Level 1		5-5	
<u>Test Pit 9C</u>			
Level 3			2-2
Totals		5-5	2-2
Grand Total	7-7		

Key: LR = leisure and recreation, Misc. = miscellaneous, Unid. = unidentified.

Western Test Pits (Test Pits 3, 5, & 6)

Thirteen historic artifacts were recovered from Test Pits 3, 5, and 6 (Tables 85-88). These represent the western periphery of CA-LAn-47. Test Pit 3 was a 1-m by 1-m unit located about 20 m west of Test Pit 2. It was located toward the western margin of CA-LAn-47, in an area outside the prehistoric component. Only one historic artifact was recovered from this unit: a single cartridge case for a .22-short shell.

Test Pit 5, located between Test Pits 3 and 2 within the right-of-way, was a 1-m by 1-m unit that were only marginally more productive than Test Pit 3. Six historic artifacts, representing only three items, were recovered from the top three levels. From Level 1, four straw-colored glass fragments were part of a single bottle, possibly Golden Wedding Whiskey. From Level 2, a crown bottle cap dating to between 1892 and the present was recovered; and from the level below that, a coal fragment.

Test Pit 6 was located outside the prehistoric component, about 20 m west of Test Pit 3. As with Test Pit 3, the historic remains recovered from this unit were meager. Only glass and historic ceramic artifacts were found. Four clear bottle fragments were found in Level 3, possibly representing a whiskey bottle. An amber whiskey bottle fragment, automatic-manufactured, was found in Level 4, and an undecorated porcelain fragment of unknown form was recovered from Level 9. The location of these artifacts from such relatively low levels would suggest that their presence is the result of being buried by earthen fill within this vicinity.

Table 85. Glass Artifacts Recovered From Test Pits 3, 5, and 6.

Provenience	Function							
	LR	HHF	FPC	MH	Comm.	Trans.	Misc.	Unid.
Test Pit 5								
Level 1								4-1
Test Pit 6								
Level 3								4-1
Level 4	1-1							

Key: LR = leisure and recreation, HHF = household furnishings, FPC = food preparation and consumption, MH = medical and health, Comm. = communication, Trans. = transportation, Misc. = miscellaneous, Unid. = unidentified.

Table 86. Ceramic Artifacts Recovered From Test Pits 3, 5, and 6.

Provenience	Function			
	FPC	LR	Arch.	Unid.
Test Pit 6				
Level 9				1-1

Key: FPC = food preparation and consumption, LR = leisure and recreation, Arch. = architecture, Unid. = unidentified.

Table 87. Metal Artifacts Recovered From Test Pits 3, 5, and 6.

Provenience	Function							
	TH	Trans.	Mach.	HHF	Arch.	LR	Misc.	Unid.
Test Pit 3								
Level 1					1-1			
Test Pit 5								
Level 2						1-1		

Key: TH = tools and hardware, Trans. = transportation, Mach. = machinery, HHF = household furnishings, Arch. = architecture, LR = leisure and recreation, Misc. = miscellaneous, Unid. = unidentified.

Table 88. Other Artifacts Recovered From Test Pits 3, 5, and 6.

Provenience	Function		
	LR	Misc.	Unid.
Test Pit 5			
Level 3		1-1	

Key: LR = leisure and recreation, Misc. = miscellaneous, Unid. = unidentified.

Summary

It is clear that most of the artifacts recovered from CA-LAn-47 dated to the twentieth century. The preponderance of glass and metal artifacts also suggests that the site was not the remains of a residence or dwelling. Much, if not most, of the artifactual material found at CA-LAn-47 was probably the result of landfill deposition associated with the railroad, which extended through the site area between 1892 and 1980.

Most of the glass and metal artifacts were recovered from the uppermost two levels of the test pits across the site, and the central test pit area in particular. These upper artifacts were representative of the site as a whole. Even though a substantial percentage of artifacts were recovered from lower levels, there was absolutely no temporal significance to their placement. As a rule, the earliest artifacts were not found in the lowest levels, a result suggesting that much of the historic component of the site had been disturbed and the soil reworked, probably as a result of railroad construction and repair. This would appear to be particularly true for Test Pit 8C. Some soil may even have been brought in as fill.

Much of the same situation was found in the southeastern test pits on the south side of the railroad right-of-way. Disturbance appeared to have been particularly marked at Test Pit 9B. There, more glass artifacts were recovered from Levels 3 and 5 than from Levels 1 and 2. Ceramic artifacts were also found in the lower levels.

It is interesting to note that more domestic ceramic artifacts were recovered from the southeastern test pits than in the central pits (10-3 vs. 6-5). Even though the numbers involved in both cases are small, and the minimum number of objects represented by the artifacts was greater for the central pits than for the southeastern pits, it should be noted that the central test pits were much larger than most of the southeastern pits. Based on the volume of sediment removed from both portions of the site, the ratio of artifacts, all other factors being equal, should have been 3.5 to 1.0, in favor of the central test pit area. The fact that the number of domestic artifacts was actually greater in the area of the southeastern pits, almost surely has significance.

The greater concentration of domestic ceramic artifacts in the southeastern pits is probably due to the greater proximity of this area to the Machado rail stop -- a scattered settlement located on the south side of the railroad right-of-way, just outside of the project area. This settlement was in place by the early years of the twentieth century and was generally coterminous with the use of the railroad itself.

It is generally believed that the Machado rail stop settlement was predominantly Japanese during this period, supplying living quarters and work areas for the local Japanese truck farm employees. Whether this was the case is an issue that could not really be addressed with the domestic ceramics recovered from the southeastern pits, or CA-LAn-47 as a whole. The only vessel fragment of clearly Far Eastern derivation was a fragment of a Chinese rice wine ceramic bottle, and it was recovered from one of the central test pits, not those along the southeastern margin of the site. The remaining fragments were Anglo-American. If the Machado rail stop settlement was predominantly Japanese during the 1920s and 1930s, and if they used mostly Anglo-American ceramic vessels, it would suggest a greater degree of acculturation than has often been suggested for the local Japanese community.

CA-LAn-1596-H

Material Culture

CA-LAn-1596-H is the historic site encompassing that portion of the Channel Gateway project area west of Maxella Street. CA-LAn-1596-H effectively covers most of the project area north of the railroad right-of-way. Based on the background research, it is known that the first sustained occupation of the project area occurred in the 1920s, near the northern margin. From this beginning, occupation and use of the site spread to the south and southeast, toward Lincoln Boulevard and the railroad. The historic materials recovered from these portions of the project area essentially agree with the dates established by the background research. Even though the background research suggests that a small cultivated field and possibly a structure were located within the project area in 1861, no evidence of nineteenth-century occupation and use was recovered in the archaeological record.

Results

CA-LAn-1596-H produced 3,835 whole and fragmentary artifacts, representing over 1,800 individual items from 14 backhoe trenches, two test pits, and two stripping areas. Ninety-three percent of all artifacts were recovered from Trench 19 and the excavations that were conducted in the vicinity of that trench. Trench 19 was located in the northern portion of the project area -- in that section first occupied in the 1920s. Though the remainder of the project area yielded relatively few artifacts, these were generally isolated to specific locations that represented different activity areas identified through the background research.

In order to obtain the maximum information on intrasite variation, the discussion of the material culture from CA-LAn-1596-H has been divided into four discrete activity areas (Figure 125). The oldest area of sustained occupation and use within CA-LAn-1596-H is the north margin of the project area. This area was exposed by Trenches 10, 19, and 20. Test Pit 10 was excavated adjacent to Trench 19, and it was from this area that over half of the artifactual material from CA-LAn-1596-H was recovered. The area around Trenches 10, 19, and 20 is the oldest and most significant of the site, and has been designated Sector 1.

Sector 2 is the narrow strip southwest of Lincoln Boulevard and northwest of Maxella Street known in the assessor books as "Wright's Addition to Ocean Park." This sector used to be separated from the rest of the project area by an extension of Carter Avenue that no longer exists. This sector was exposed by Trenches 2 through 4.

Sector 3 is the area around Trench 13, which included Feature 6 (which proved to be a small animal burrow, not a cultural feature) and the well (Feature 7) discovered in Test Pit 11. This sector is of interest because the background research did not indicate the existence of any structure or use within this area before requisition by Mercury Petroleum Company in the mid-1930s and the construction of the Associated Pacific Industries factory in 1941 and 1942.

Sector 4 is the westernmost corner of the project area, corresponding to Trenches 37 through 39. The background research suggests that this area was not developed before the 1950s, so it would appear that most of the artifactual material recovered from Sector 4 was the result of trash dumping.

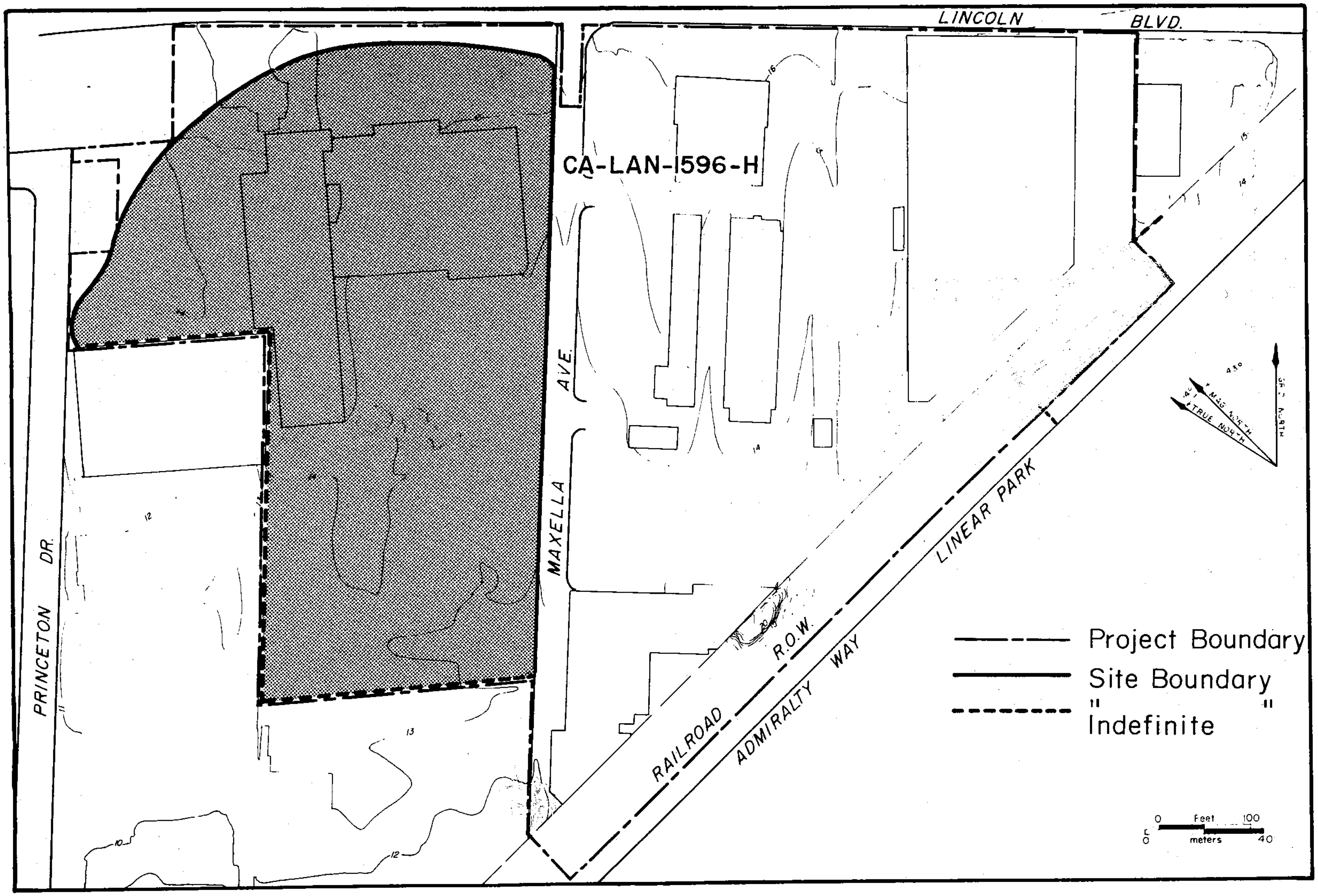


Figure 125. CA-LAn-1596-H.

Most other trenches within the project area did not yield significant deposits of historic artifacts. Out of the 23 trenches not covered by one of the four sectors discussed previously, only two contained historic materials. These deposits have been lumped under the category of "general site."

The artifactual material from each of these sectors and the general site are discussed next. Most of the artifacts were badly fragmented, but most could still be assigned to a specific functional category. The relatively few artifacts for which form and function could not be determined were classified as unidentified. Artifacts were assigned to 13 functional categories, including "unidentified." The categories are identified by the abbreviations established in the methods section.

Sector 1: Trenches 10, 19, and 20

Trenches 10, 19, and 20, the features found adjacent to them (Features 1-3, and 5), and Test Pit 10 (located on the southeast side of Trench 19), were located in an area identified in Dillon et al. (1988) as the "Holt Property," located near the northern extreme of the project area. This area conforms to what was known as Parcel 9 during the 1920s and 1930s and identified here as Sector 1. It was during the 1920s and 1930s that the area was first occupied and used as a residence, according to Los Angeles County tax assessment records. This agrees with the material culture recovered from the area archaeologically.

Sector 1 contained 61 percent of the artifacts recovered from CA-LAn-1596-H. Presented below are tables showing the historic ceramic, glass, metal, and other artifacts recovered from Sector 1. A discussion of the remains from each material category follows each table.

Most of the ceramic artifacts fell into the category of food preparation and consumption (FPC) (Table 89). These artifacts ranged from butter dishes, to cups, bowls, plates, and saucers. The large quantity of domestic artifacts indicates that much of the trash found in Sector 1 was probably derived from domestic habitation contexts. The presence of children's toys under the category of recreation and leisure: a porcelain doll's leg, a toy cup, a wooden pipe, and a hollow head fragment, would suggest that the site had been occupied by one or more families.

Approximately one-third of the FPC ceramics recovered from Sector 1 were porcelain. Although the small size of the pieces precluded positive identification in every case, many of these appear to have been of Japanese origin. Many of the hard-paste white earthenwares (HWE) were also Japanese. One porcelain and one HWE fragment were marked "Made in Japan" on the base. A wide range of underglaze blue decorated pieces and examples of Kaga redware were also common. The latter post-dates 1850 (Stitt 1974:68). The large amount of Japanese domestic ceramics suggests that Japanese-Americans were largely responsible for the deposition of artifacts within Sector 1.

The dates of identifiable artifacts do not contradict county tax assessment records the suggest that Parcel 9 was not occupied until the mid-1920s. The two "Made in Japan" marks were in use from 1921 to 1940 (Stitt 1974:176). Two Mercer China Company marks were dated to between 1868 and 1937 (Lehner 1980:106). An Edwin Knowles China Company mark was found that dated to between 1900 and 1948 (Gates and Ormerod 1982:99). The only identifiable mark that was clearly earlier than the 1920s was a Knowles, Taylor, and Knowles ceramic mark dated to between 1890 and 1907 (Gates and Ormerod 1982:119-121), and this could easily have been an heirloom piece.

The remaining ceramic fragments fell into the architecture, miscellaneous, and unidentified categories. The architecture category consisted wholly of brick fragments, while the miscellaneous items ranged from sewer tile to electrical fuse and insulator fragments.

Table 89. Ceramic Artifacts Recovered From Sector 1.

Provenience	Function					
	FPC	LR	P	Arch.	Misc.	Unid.
General Surface	6-6					
Trench 10	14-13	1-1				
Trench 19	26-23			1-1	3-3	
Feature 5				1-1		
Test Pit 10, Near Fea. 1	2-2					
TP 10, Level 1	59-34	3-3		4-1		14-1
TP 10, Level 2	54-32			25-1	3-3	
TP 10, Level 3	91-42			2-1	3-2	1-1
TP 10, Level 4	104-50				3-2	
TP 10, Level 5	90-57			4-1	1-1	
Feature 2	1-1			2-1		
Fea. 2, Level 6A	28-19			4-2		
Fea. 2, Level 7A	67-43			4-1		
Fea. 2, Level 8A	54-34			5-1		
Fea. 2, Level 9A	22-16					
Fea. 2, Level 10A	8-6					
Fea. 2, Level 11A	7-7			1-1		
Totals	633-385	4-4	0	53-12	13-11	15-2
Grand Total	718-414					

Key: FPC = food preparation and consumption, LR = leisure and recreation, P = personal, Arch. = architecture, Misc. = miscellaneous, Unid. = unidentified.

The vast majority of the glass fragments recovered from Sector 1 was unidentified (87 percent), but out of the identifiable pieces, the categories of food, food preparation and consumption, leisure and recreation, and architecture contained by far the greatest number (Table 90). This is indicative of the domestic setting already established by the historic ceramic analysis -- and the later commercial tranformation of the area in the 1940s and 1950s, as indicated by the architecture category (every item in this category consisted of light green flat glass).

The food preparation and consumption category consisted of glass bowls (Depression glass), tumblers (both clear and "turned pink"), stemmed ware, pitcher fragments, and pressed glass. "Turned pink" fragments were very common, comprising around one-third of the glass fragments within the FPE category. The food category consisted of numerous "turned pink" food bottles, machine-made

Table 90. Glass Artifacts From Sector 1.

Provenience	Function								
	FPC	F	LR	Arch.	P	MH	Comm.	HHF	Unid.
General Surface	3-2	23-6	9-2	6-2	2-1				95-31
Trench 10	1-1		1-1						5-5
Trench 19	6-5	3-3	1-1		5-2	1-1	1-1		28-22
Feature 2									6-3
Level 1									114-24
Level 2		2-1	10-1	8-2					110-21
Level 3				1-1					1-1
Feature 4									1-1
Feature 5									1-1
Test Pit 10,									
Near Fea. 1			2-2					1-1	1-1
Level 3	3-3	4-2		9-2					146-28
Level 4	3-1		2-1	6-2					136-26
Level 5	4-3	1-1		6-1					101-26
Feature 2									
Level 6A	1-1	1-1						1-1	40-13
Level 6B		1-1							4-3
Level 7A		1-1						1-1	70-16
Level 8A			3-3						3-3
Level 9A				1-1					32-15
Level 10A									16-7
Level 11A									11-6
Totals	21-16	36-16	29-12	36-10	7-3	1-1	1-1	3-3	921-253

Grand Total 1055-315

Key: FPC = food preparation and consumption, F = food, LR = leisure and recreation, Arch. = architecture, P = personal, MH = medical and health, Comm. = communication, HHF = household furnishings, Unid. = unidentified

milk bottles, jars, and a Worstershire sauce bottle. Beer bottle fragments, whiskey bottles, shot glasses, and soda bottles made up most of the leisure and recreation category. All were machine-made.

The other items consisted of a perfume bottle and a cream jar (personal), a cobalt blue eye cup (medical and health), a green glass insulator (Comm.), a bluing bottle and two glass washboard fragments (HHF).

The ethnicity of the inhabitants of Sector 1 cannot be established with any certainty through an examination of the glass artifacts. Ceramics did a much better job of that. The dates of use and occupation, however, are tighter with the glass artifacts. All bottle glass fragments were machine-made, dating to 1903 or later. A sizable percentage, roughly one-third, of the food and food preparation and consumption artifacts were "turned pink," which is bracketed by the dates 1919 and the 1940s. This agrees well with the tax assessment records that suggest that Sector 1 was first occupied in the mid-1920s and was finally transformed in the late 1940s for commercial use as a brass foundry.

Some of the datable glass artifacts could be earlier than the mid-1920s, suggesting that Sector 1 was possibly in use agriculturally before that period or was used as a dumping area before it was finally occupied. A few pieces of sun-colored amethyst glass were found (c. 1880-1919), and the Worstershire bottle dated to between 1877 and 1920 (Zumwalt 1980:269). One of the soda bottles was a Coca Cola bottle dating to between 1916 and 1923 (Munsey 1972:62). The cream jar was an Ingram's Milkweed Cream jar dated to between 1895 and 1948 (Periodical Publishers Association 1934).

As might be expected from an area that was used as a residence and later as a commercial manufacturing center (brass foundry), most of the identifiable metal artifacts were classed as tools and hardware (Table 91). These artifacts included wire nails, copper and other wire, bolts, washers, and an aluminum lid (found in Level 2 of Test Pit 10). The one HHF artifact, recovered from Level 2, was an alarm clock. The miscellaneous artifacts included tin cans and a bottle opener; the sole FPC artifact was a table fork. The unidentified artifacts consisted of scraps and fragments. The sole leisure and recreation artifact from Test Pit 10 was a U.S. Cartridge Company shotgun shell, dated to between 1869 and 1936 (Bearse 1966:56; Hogg 1982:151).

Another leisure and recreation artifact, a wooden pipe bowl fragment, was recovered from Trench 10 (Table 92). The food category was presented by peach pits and a single indeterminant fruit pit. Under architecture, the materials were fragments of roofing paper and part of a composition shingle. Personal objects consisted of a pale blue glass bead, shoe leather, and two buttons. One of the buttons was a four-hole shell button, 17 lignes; and the other was a shell button, shank, 20 lignes. The miscellaneous category consisted of coal fragments and single unknown seed. The rest were unidentified fragments of rubber, cloth, paper, plastic, and wood fragments.

Sector 2: Trenches 2-4

Sector 2 consisted of the narrow strip of land immediately adjacent to Lincoln Boulevard and northwest of Maxella Avenue. This sector was represented by Trenches 2 through 4.

Back in the 1920s and 1930s, Sector 2 was identified as part of "Wright's Addition to Ocean Park," which was separated from the rest of the project area by an extension of Carter Avenue that no longer exists. This area was divided into very small parcels that became store-front properties with the expansion of Lincoln Boulevard in the early 1930s. Carter Avenue was gradually abandoned as Lincoln became the major thoroughfare, and with the development of the Associated Pacific Industries factory in the 1940s and 1950s, this sector became fully integrated into the rest of the project area.

Table 91. Metal Artifacts From Sector 1.

Provenience	Function					
	TH	LR	Misc.	HHF	FPC	Unid.
General Surface					1-1	
Test Pit 10						
Level 1	35-31					25-15
Level 2	81-62			5-1		
Level 3	48-40		2-2			40-20
Level 4	28-28	1-1				11-11
Level 5	26-17		1-1			9-5
Level 6A	13-10					10-10
Level 6B			1-1			
Level 7A	18-18		2-1			6-6
Level 8A	16-14		1-1			3-3
Level 9A	10-7					5-5
Level 10A	3-3					3-2
Level 11A						1-1
Totals	278-230	1-1	7-6	5-1	1-1	113-78
Grand Total	405-317					

Key: TH = tools and hardware, LR = leisure and recreation, Misc. = miscellaneous, HHF = household furnishings, FPC = food preparation and consumption, Unid. = unidentified.

Table 92. Other Artifacts From Sector 1.

Provenience	Function					
	LR	F	P	Arch.	Misc.	Unid.
General Surface			1-1			
Trench 10	1-1					
Test Pit 10						
Level 1			1-1		2-1	14-5
Level 2						14-4
Level 3		2-1	2-1	1-1	3-1	15-5
Level 4		1-1	1-1			25-6
Level 5					1-1	33-4
Level 6				1-1		
Feature 2		1-1				
Level 6A		4-1				4-3
Level 6B						4-2
Level 7A		1-1		10-1		8-5
Level 8A				1-1		4-3
Level 10A					2-2	
Totals	1-1	9-5	5-4	13-4	8-5	121-37
Grand Total	157-56					

Key: LR = leisure and recreation, F = food, P = personal, Arch. = architecture, Misc. = miscellaneous, Unid. = unidentified.

Due to the small number of artifacts recovered from Sector 2 (n=16), the material culture from this area will simply be described rather than presented in tabular form. Four historic ceramics were recovered from this area: one yelloware bowl fragment (FPC); two unidentified (Unid.) porcelain vessel fragments (one plain and the other with yellow and brown overglaze decoration); and a single sewer tile fragment (Misc.). With the exception of the sewer tile, which came from Trench 3, these artifacts were recovered from Trench 2.

Only seven glass artifacts were recovered from this area, all from Trench 2. One was a machine-made soda bottle (LR), while the remainder were unidentified clear fragments. The one piece of metal recovered from this area, a piece of scrap (Unid), came from Trench 4. The other materials consisted of charcoal, wood fragments, a plastic toy truck, and a piece of unknown material.

The paucity of artifacts from Sector 2 suggests that this area was not used as living quarters. The few domestic artifacts recovered (the yelloware bowl, the plastic truck) suggest that the area was merely adjacent to areas that were more intensively occupied.

Sector 3: Trench 13 and Test Pit 11

A sizable percentage (35%) of the artifacts recovered from CA-LAn-1596-H came from Trench 13 and Test Pit 11 that was adjacent to it. Test Pit 11 was originally set up to expose Feature 7, which turned out to be a small animal burrow. By the time this was discovered, excavators had exposed a well or well-like feature that yielded a great quantity of cultural material. Although logistical problems prevented the complete excavation of this well feature, archaeologists dug the feature to a depth of 2.43 m below surface. The vast majority of the artifacts from Sector 3 (99.9%) were recovered from Test Pit 11.

Most of the historic ceramic artifacts recovered from Sector 3 fit into the food preparation and consumption category (Table 93). This groups consisted of two yelloware bowls, yelloware crocks with a molded exterior design, plain cups, and a tremendous number of unidentified forms, mostly plain. The vast majority of these ceramic artifacts were hard-paste white earthenwares.

Table 93. Ceramic Artifacts From Sector 3.

Provenience	Function						
	FPC	LR	HHF	P	Arch.	Misc.	Unid.
Trench 13							1-1
Test Pit 11							
Feature 7	1-1						
Level 5		1-1			4-1		
Level 6					4-1		6-5
Level 7	15-11		1-1		3-1		
Level 8	9-9						
Level 9	9-5				1-1		
Level 10	11-8					1-1	
Level 11	2-2				1-1		
Level 12	2-2						
Level 13	1-1						
Level 14A	1-1			1-1			1-1
Levels 12-19	17-8	1-1			1-1		
Levels 19-22	5-3				1-1		
Levels 22	9-7			1-1			
Levels 22-25					1-1		
Totals	82-58	2-2	1-1	2-2	16-8	1-1	8-7
Grand Total	112-79						

Key: FPC = food preparation and consumption, LR = leisure and recreation, HHF = household furnishings, P = personal, Arch. = architecture, Misc. = miscellaneous, Unid. = unidentified.

The leisure and recreation category was represented by a Chinese rice wine bottle made of stoneware, with dark brown glaze and a gray body; and a doll's leg made of porcelain. The personal group consisted of a button with a metal shank, and a clay pipe stem fragment. The HHF artifact was a fragment of a redware flower pot. All of the architecture category consisted of brick fragments, with the exception of two sewer tile fragments. The miscellaneous artifact was possibly a divided tray, made of porcelain, with part of the mark "Made in Ger. . ." (probably Germany).

It is interesting to note that the incidence of recognizable Japanese ceramics is almost negligible. In fact, the percentage of porcelains for the total ceramic population is much lower in Sector 3 than was the case in Sector 1: roughly 10 percent compared to 33 percent. This would suggest that while Sector 3 contained domestic ceramic artifacts, the residents that used them might not have been Japanese, as was almost surely the case at Sector 1.

Most of the glass artifacts recovered from Sector 3 were unidentified (88%) (Table 94). Out of the remaining categories, food and food preparation and consumption produced the greatest number of artifacts. Unlike the historic ceramics, a comparison of glass artifacts from Sector 1 and 3 produced relatively little variation. Most of the FPC category artifacts were clear tumblers; most of the food category artifacts were bottles that were either clear or "turned pink." The LR artifacts were beer and wine bottles. The MH category contained an aqua proprietary bottle, whereas the architecture category consisted wholly of light green flat glass. The unidentified fragments ran the gamut of colors from aqua, green, amber, and brown, to "turned pink" and clear.

The "turned pink" fragments were the most temporally significant group of artifacts recovered from Sector 3. Bracketed by the dates ca. 1919 and the 1940s, "turned pink" glass was found in Test Pit 11 in almost all levels from Level 5 to Levels 22-25. Although this is certainly no guarantee that the well feature found in Test Pit 11 was filled in a single episode, this depositional pattern would suggest that the well was not filled gradually over a long period of time.

Unlike Sector 1, where glass artifacts comprised the greatest single material class (45 percent of all artifacts), Sector 3 had more metal artifacts than glass and historic ceramics combined (Table 95). The TH category contained bolts, grommets, wire, a chisel fragment, a shovel blade fragment, a dish pan handle, and above all, wire nails. The LR category wholly consisted of cartridge and shell fragments: there were two shotgun shell fragments, and at least five .22-short cartridges. The transporation category contained copper rivets, two horseshoes, a railroad spike, and several copper harness rivets. The FPC category contained an enamelware cake pan and another unidentified enamelware object. The personal category consisted of a rusted button with either two or four holes, and brass shoe eyelets. The single HHF item was a cast iron stone lid. The miscellaneous category consisted of barbed wire fragments, large can fragments, an iron handle, and numerous tin can fragments. The unidentified materials were listed as scrap.

The two shotgun shells bore the mark of the Union Metallic Cartridge Company (UMC). Although this company was in business from 1867 until 1911 (Steward 1969:62), its successor probably continued to use the UMC mark after 1911. The wire nails and the other materials appear to have been twentieth century in date.

The preponderance of metal artifacts at Sector 3 would suggest that this area was not a residence -- or at the very least, that the earth used to fill the well found at Test Pit 11 was not taken from a wholly residential area. Although the metal artifacts did contain domestic materials, they were not representative of the collection. The fact that there were so many metal artifacts within this fill, and the fact that they were of a nondomestic nature, would suggest that the fill was taken from a largely commercial or industrial area. This would certainly describe Sector 3 by the early 1940s with the development of the Associated Pacific Industries factory.

Table 94. Glass Artifacts From Sector 3.

Provenience	Function								
	FPC	F	LR	Arch.	P	MH	Comm.	HHF	Unid.
Test Pit 11									
Level 5	1-1								10-7
Level 6			2-2						21-9
Level 7									43-11
Level 8		5-1							12-6
Level 9									26-7
Level 10	6-1					1-1			18-10
Level 11	4-1	9-2		1-1					7-1
Levels 10-11									8-4
Level 12									5-4
Level 13									3-2
Level 14									3-2
Level 15A									2-2
Level 12-19				2-1					27-9
Level 22-25									14-6
Level ?									13-4
Totals	11-3	14-3	2-2	3-2		1-1			212-84
Grand Total	243-95								

Key: FPC = food preparation and consumption, F = food, LR = leisure and recreation, Arch. = architecture, P = personal, MH = medical and health, Comm. = communication, HHF = household furnishings, Unid. = unidentified

Table 95. Metal Artifacts From Sector 3.

Provenience	Function							
	TH	LR	HHF	P	FPC	Misc.	Trans.	Unid.
Test Pit 11								
Level 5	1-1							3-1
Level 6	15-10							
Level 7	22-15	1-1				1-1		17-2
Level 8	20-14						2-2	14-5
Level 9	20-15	1-1				24-1	4-4	23-6
Level 10	35-29	3-3		1-1	1-1	10-1	1-1	56-9
Level 10B								1-1
Level 10-11	15-13					1-1		3-1
Level 11	15-11					17-1	2-2	7-2
Level 12	10-8	1-1		1-1				
Level 13	10-10	1-1						12-2
Level 14	13-11				1-1		1-1	1-1
Level 14A	4-2		1-1				1-1	
Level 15A	15-10							3-3
Level 15B								20-1
Levels 12-19	103-101	1-1	2-2			78-2	5-4	12-7
Levels 19-22	55-47	1-1				8-1	1-1	32-27
Levels 22-25	66-51					34-3		10-10
Totals	419-348	9-9	1-1	4-4	2-2	173-11	17-16	214-78
Grand Total	839-469							

Key: TH = tools and hardware, LR = leisure and recreation, HHF = household furnishings, P = personal, FPC = food preparation and consumption, Misc. = miscellaneous, Trans. = transportation, Unid. = unidentified.

With the exception of four button parts, all of the personal artifacts were shoe fragments (Table 96). Most of these were leather, belonging to men's shoes. The miscellaneous category consisted of coal and one projectile point fragment. The unidentified fragments were mostly wood.

According to the background research information, Sector 3 was probably never the site of a residence. The area probably was farmed and periodically used as a trash dumping site during the 1920s and 1930s. By the mid-1930s, this area, identified as Parcel 1, passed to the Mercury Petroleum Corporation. Starting in 1938, Parcel 1 was assessed 30 dollars a year, presumably for an oil well of some kind. This assessment continued until the development of the Associated Pacific Industries factory in the early 1940s pushed Mercury Petroleum out of the picture. This factory was finally abandoned in the 1980s.

Nothing recovered from the well (Test Pit 11) contradicts the results of the background search. The heavy preponderance of metal artifacts within the well fill is not a normal indication of domestic occupation. It seems more likely that the materials used to fill the well were gathered from a relatively wide area, encompassing areas that would produce industrial/commercial materials and some domestic artifacts.

Table 96. Other Artifacts From Sector 3.

Provenience	Function					
	LR	F	P	Arch.	Misc.	Unid.
Test Pit 11						
Feature 7						1-1
Level 7			2-2			3-1
Level 8			6-1			
Level 9			7-1			
Level 10			58-4			5-2
Level 11			12-2			1-1
Levels 10-11					1-1	
Level 12			1-1			1-1
Level 14A					1-1	5-1
Level 15A						1-1
Levels 12-19			2-2		7-2	21-4
Levels 22-25						1-1
Totals			88-13		9-4	39-13
Grand Total	136-30					

Key: LR = leisure and recreation, F = food, P = personal, Arch. = architecture, Misc. = miscellaneous, Unid. = unidentified.

At present, it is not known whether this well was for water or for gas and oil. If it was the remains of an oil or gas well shaft, it may be the one that was assessed for 30 dollars in the years between 1938 and 1941. Whether gas or water, the well probably was filled after the well had served its purpose. There is nothing to suggest that this well was filled after the early 1940s. If local trash dump materials were used to fill it, that would easily explain some of the earlier artifacts.

Sector 4: Trenches 37-39

The last discernable concentration of cultural materials was recovered from the westernmost three trenches. These trenches, numbered 37 through 39, were located in an area identified in the county tax assessment books as Parcel 4. Little is known about this area. Sector 4 was probably farmed during the 1920s and 1930s, and it is believed that trash also was dumped in the area during this time. Mercury Petroleum owned this area by the early 1940s, but there is no indication that wells were drilled. Even after the development of Associated Pacific Industries on Parcels 1 and 2 to the northeast, and the Bay Cities Metal building to the south, it is believed that this area remained unoccupied until sometime in the 1960s or 1970s. Even in 1988, Sector 4 was identified as an "auto auction site." It is doubtful that a building ever occupied this area, although it was surely graded and leveled before the auto auction site was put into place.

The ceramics recovered from Sector 4 consisted of bowl fragments, mugs, plates, and numerous unidentified forms (Table 97). There was at least one porcelain fragment of probable Oriental

Table 97. Ceramic Artifacts From Sector 4.

Provenience	Function						
	FPC	LR	HHF	P	Arch.	Misc.	Unid.
General Surface	2-1						
Trench 37							
Overburden	4-4						
Lower Overburden		2-2					
Stripping Unit	6-4						
Trench 38							
Overburden	1-1						
A Horizon							1-1
Stripping Unit	9-8					3-3	
Totals	24-20					4-4	
Grand Total	28-24						

Key: FPC = food preparation and consumption, LR = leisure and recreation, HHF = household furnishings, P = personal, Arch. = architecture, Misc. = miscellaneous, Unid. = unidentified.

make. Most of the fragments were hard-paste white earthenwares. The miscellaneous artifacts consisted of tile fragments and part of a ceramic pipe.

The LR artifacts were mostly soda bottles, including one Pepsi Cola bottle (Table 98). Also found were four marbles and a possible "crack" pipe. The two personal artifacts were milk glass cosmetic jars. Most of the unidentified glass was clear, but at least one fragment was sun-colored amethyst (SCA). It is interesting to note that the more domestic glass artifacts (FPC) were wholly lacking from this area.

Datable material was recovered from Trenches 37 and 38. In Trench 37, the following material was identified: Ingram's jar, dated to between 1895 and 1948; a Tummis Glass Company mark, 1940 to 1955 (Toulouse 1971:333); and a Long Beach Glass Company mark, 1920 to 1933 (Toulouse 1971:318). In Trench 38, there was a piece of SCA glass (ca. 1880-1919). An Alexander Kerr and Company mark was found, dated to between 1944 and the present (Toulouse 1971:44). A Latchford Glass Company mark was found, dated 1957 to the present (Toulouse 1971:316). Also found was a Fairmont Glass Company mark, dated to between 1945 and 1960 (Toulouse 1971:201). In addition to these specific marks, there were pieces of "turned pink" glass, dated to between ca. 1919 and the 1940s.

The metal artifacts recovered from Sector 4 were rather varied (Table 99). They included a lipstick tube, a shoe lacing eyelet, barbed wire fragments, nails, and unidentified scrap.

Table 98. Glass Artifacts From Sector 4.

Provenience	Function								
	FPC	F	LR	Arch.	P	MH	Comm.	HHF	Unid.
Trench 37									
General Surface			2-2						
Overburden									2-1
Stripping Unit			2-1		1-1				22-13
Trench 38			2-2						
Overburden			5-3						1-1
Lower Overburden									2-2
A Horizon			3-1						
Stripping Unit			2-2		1-1				14-10
Trench 39									1-1
Totals			16-11		2-2				42-28
Grand Total	60-41								

Key: FPC = food preparation and consumption, F = food, LR = leisure and recreation, Arch. = architecture, P = personal, MH = medical and health, Comm. = communication, HHF = household furnishings, Unid. = unidentified

Table 99. Metal Artifacts From Sector 4.

Provenience	Function							
	TH	LR	HHF	P	FPC	Misc.	Trans.	Unid.
Trench 37								
General					1-1			
Stripping Unit	21-21					1-1		
Trench 38								
Overburden	1-1							2-2
Stripping Unit	26-25			1-1		1-1		6-6
Totals	48-47			2-2		2-2		8-8
Grand Total	60-59							

Key: TH = tools and hardware, LR = leisure and recreation, HHF = household furnishings, P = personal, FPC = food preparation and consumption, Misc. = miscellaneous, Trans. = transportation, Unid. = unidentified.

The other artifact category consisted of a battery core (Misc.) and several unidentified pieces of plastic (Table 100).

It is clear from the artifact assemblage recovered from Sector 4 that this area was not used as a residence. Domestic artifacts are not well represented in the collection; even though most of the historic ceramics fit into the food preparation and consumption category, they were not present in great numbers, nor were they complemented by domestic glass artifacts. It is much more likely that Sector 4 was a dump site. From the comparatively late date of the glass artifacts recovered from this sector, it would appear that it was open to trash deposition long after Sectors 1 and 3 were developed.

Remainder of Site CA-LAn-1596-H

The materials recovered from Sectors 1 through 4 comprised the vast majority of the artifactual material found at CA-LAn-1596-H. Only four artifacts were recovered from trenches outside of these sectors. Three glass artifacts were recovered from the general site: an unidentified clear glass fragment from Trench 27 and two unidentified fragments (one clear and one blue) from Geological Pit 2. One piece of metal scrap was recovered from Geological Pit 2. From this paucity of the material across most of the site, it is clear that most of the material recovered from CA-LAn-1596-H came from the northern half of the site, which bore the first local settlement in the 1920s and the full brunt of industrialization some twenty years later.

Table 100. Other Artifacts From Sector 4.

Provenience	Function				
	F	P	Arch.	Misc.	Unid.
Trench 37					
General				1-1	2-2
Trench 38					
Stripping Unit					3-3
Totals				1-1	5-5
Grand Total	6-6				

Key: F = food, P = personal, Arch. = architecture, Misc. = miscellaneous, Unid. = unidentified.

FAUNAL REMAINS

Bruce A. Jones

Methods

The analysis of the historic fauna from CA-LAn-1596-H was conducted with two goals in mind. The first objective was to identify the taxa and determine the relative abundance of species by computing the number of individual specimens (NISP) and the minimum number of individual specimens (MNI). A secondary objective consisted of estimating the socioeconomic status of the population who deposited the animal remains at the site. These estimations were based on the butchering patterns on certain domesticated animals.

NISP represents the number of bones that can be identified to a particular taxon. This figure and the unidentified fragments constitute the total bone count for the site. The MNI is simply the frequency of the most commonly occurring bone for each species represented in the sample needed to comprise one individual. For example, two right deer femurs would be representative of two individuals (MNI = 2) because a deer possesses only one right femur. MNI counts reflect a more accurate estimate of species abundance at an archaeological site than the NISP, a measure that is extremely sensitive to bone fragmentation as is common in archaeological contexts.

Functional analysis was performed by observing domestic animal bone with modifications such as cut-marks, chopping marks, breakage, and sawing. The dismemberment patterns for beef, sheep, and pork carcasses generally are predicated on the distribution of meat cuts recognized by certain bone elements. Sawn portions of the lumbar vertebrae, for example, would be indicative of a sirloin steak. Considerations of cost and meat yield reflected in the meat cut extrapolated from excavated animal bone remains may then be used as a measure of social and economic status of the consumers.

Additional information on ethnicity can be inferred from butchering practices. For example, techniques such as chopping and breaking of bones are common practices for many non-Anglo-American populations, whereas sawing is more common among Anglo-Americans. A preference for certain types of meat also can provide data on ethnicity. For instance, certain marine food resources, fowl, and pork are common in oriental diets.

Results

A total of 699 bone fragments was recovered from 14 proveniences located in the northern portion of CA-LAn-1596-H (Table 101). The bone sample included two species of fish (*Paralichthys californica* and *Hyperprosopon argenteum*), at least one toad (Salienta), one lizard (Lacertilia), domestic chicken (*Gallus gallus*), a pocket gopher (*Thomomys* sp.), squirrel (*Sciurus* sp.), domestic rat (*Rattus* sp.), and rabbit (*Sylvilagus* sp.), as well as domestic pig (*Sus scrofa*), sheep/goat (*Ovis/Capra*), and cow (*Bos taurus*).

A large percentage of the sample consisted of unidentified large and small mammal and bird categories. These unidentified bone fragments comprised nearly 78 percent of the total faunal distribution. Large unidentified mammal bones were probably cow and lesser amounts of pig. The majority of these fragments are sawn or burned. These modifications are consistent with historic butchering and waste disposal patterns for Anglo-American localities.

Domestic chicken and unidentified avian bone comprised nearly 7 percent of the distribution. unidentified bird bone most likely is from chicken. Most of the bird bone was unmodified, but at least 12 bones exhibited snap breaks and spiral fractures, suggesting a dismemberment technique conducive to oriental cooking. This butchering technique involves the chopping or breaking of bones into small pieces for cooking in a pot, or other vessel.

The gopher, amphibian, lizard, squirrel, rat, and possibly rabbit bones may be intrusive. The halibut (*Paralichthys californicus*) and walleye surf-perch (*Hyperprosopon argenteum*) may have been caught locally or purchased from a market. Both species are common locally in shallow, coastal waters.

A major research question relating to the CA-LAn-1596-H faunal data concerns the nature of the Japanese association with the northern section of the site represented by Sector 1 (Trenches 10 and 19), Sector 3 (Trench 13) and Trench 36 just north of the Southern Pacific Railroad right-of-way (see Figure 125). No faunal material was recovered from Trench 36. Local residents confirm that this area was occupied by a Japanese truck farm that produced mainly celery and was abruptly removed shortly after the outbreak of World War II. Artifacts recovered from Trenches 10, 13, 19 and 36 comprised examples of oriental ceramics, including underglaze blue decorated pieces and Kaga redware. On the basis of these finds, the historic trash was considered to be Japanese-American in origin.

The faunal remains from these proveniences adds little to support or deny Japanese-American occupation. Species preference relating to meat consumption appeared to be highest in beef cuts while mutton, pork and chicken were less commonly utilized. Pork and chicken are staple meat sources in many oriental dishes, but constituted less than 3 percent of the faunal remains recovered from the inferred Japanese-American proveniences (Trenches 10, 13, and 19). Identifiable cattle bone was more common comprising nearly 8 percent of the fauna from these three test units. The relative abundance of cow bone probably is due to the presence of the Edgemor Dairy, which existed on the property after 1941. The high concentration of beef bone is inconsistent with the expected occurrence of animal foods traditionally associated with oriental foodways, such as pork, chicken and fish.

Table 101. Animal Bone Recovered from CA-LAn-1596-H.

TAXON	SECTOR 1				SECTOR 2						SECTOR 3		SECTOR 4						GENERAL SITE						TOTAL NISP	PERCENT NISP
	Trench 19		Trench 10		Trench 2		Trench 3		Trench 4		Trench 13		Trench 37		Trench 38		Trench 39		Trench 27		Trench 32		Trench 33			
	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI		
PICES																										
Paralichthys californicus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0.2
Hyperprosopon argenteum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0.2
AMPHIBIA																										
Salienta	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0.3
REPTILIA																										
Lacertilia	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0.2
AVES																										
Gallus gallus	0	0	0	0	0	0	0	0	11	1	0	0	0	0	2	1	1	1	1	1	0	0	0	0	15	2.1
Unidentified bird	14	N/A	0	0	0	0	0	0	0	0	14	N/A	0	0	1	N/A	0	0	0	0	0	0	0	0	29	4.1
MAMMALIA																										
RODENTIA																										
Thomomys sp.	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.3
Sciurus sp.	0	0	0	0	0	0	0	0	0		1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0.2
Rattus sp.	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0.3
LAGAMORPHA																										
Sylvilagus sp.	4	1	0	0	0	0	0	0	0	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	8	1.1
SUIDAE																										
Sus scrofa	9	1	0	0	0	0	1	1	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	12	2.0
BOVIDAE																										
Ovis/Capra	10	1	0	0	1	1	1	1	0	0	27	1	3	1	1	1	0	0	0	0	0	0	0	0	43	6.0
Bos taurus	2	1	1	1	0	0	0	0	0	0	8	1	1	1	51	1	0	0	0	0	0	0	0	0	63	9.0
UNIDENTIFIED	185		0		0		3		0		173		3		29		0		0		0		1		394	56
SMALL MAMMAL	1		0		0		1		1		13		0		8		0		0		1		0		25	3.6
LARGE MAMMAL	5		0		1		0		0		8		5		79		0		1		0		1		100	14
TOTAL	230		3		2		6		12		255		12		171		1		2		3		2		699	100.0

NISP = Number of identified species; MNI = Minimum number of individuals

Butchering techniques inferred from domestic bone scrap from Test Pit 10 (next to Trench 19) and Test Pit 11 (next to Trench 13) and Trench 10 suggest a preference for beef cuts over pork (Table 102). The meat cuts represented by sawn pig and cow bones were dominated by distal portions of axial bone elements represented by tibia, radius-ulna, humerus and shoulder cuts. These sections represent less costly cuts of meat, suggesting that these remains were probably purchased by individuals of lower economic status. The large majority of the beef and pork bones were sawn, a characteristic of meat purchased at a retail butcher outlet. Sheep bone occurred sporadically, primarily in the form of chops or cutlets from the loin and arm.

The bone data presented above suggests a Japanese community utilizing a broad selection of domestic mammal meat sources over fish protein. This shift in traditional food preferences may be indicative of Japanese community that had been acculturated to Anglo American food preferences. The excavated bone from Sector 2 (Trench 3) and Sector 4 (Trenches 37 and 38) yielded one pork bone and low quantities of chicken bone. Butchered beef and sheep bone occurred in about equal proportions. Most of the beef bone is sawn limb, rib and pelvic skeletal elements representing socioeconomic consumption patterns relating to above average cost and high yield cuts. The bones recovered from these archaeological units are most likely associated with a shift from agricultural to commercial use of the site area after 1940. This realignment was most likely accompanied by a new Anglo-American presence and greater affluence manifesting itself in the bone distribution in Sector 4.

CONCLUSIONS - CA-LAn-1596-H

CA-LAn-1596-H displays many developmental traits typical of a rural area in southern California adjacent to the large metropolitan center of Los Angeles. As demonstrated in both the background research and the archaeological record, urban development encroached upon the site from the north (from Venice) and from the east (from Lincoln Boulevard). The first development was agricultural, with Japanese farmers moving into the area in the 1920s and 1930s. This development can be seen in Sector 1, with its relatively early concentration of Japanese and Oriental domestic ceramics. The second development was more commercial and was rather poorly represented by the archaeological materials recovered from Sector 2 adjacent to Lincoln Boulevard. The third development was industrial, represented most prominently by the materials (especially metal) recovered from Sector 3, adjacent to the Associated Pacific Industries factory.

Certainly by the time of local industrial development, spurred on by World War II, much of the rest of the site was used as a trash dump. This probably continued for many years after Sectors 1 through 3 were developed. Most of these areas, including Sector 4, finally were developed in a final wave of urban sprawl that has only intensified with time. In microcosm, the four sectors of CA-LAn-1596-H represent one of the patterns of development for the Greater Los Angeles Area.

Table 102. Meat Cuts and Osteological Equivalents at CA-LAn-1596-H.

SECTOR 1 (Trenches 10 and 19, Test Pit 10)

BEEF	PIG	SHEEP
1 7-bone steak = scapula	1 ham steak = femur	1 neck = cervical vertebrae
1 pot roast = humerus	1 hocks = distal ulna	3 chop = lumbar vertebrae
1 round steak = femur	1 chop = thoracic vertebrae	
3	3	4

SECTOR 2 (Trench 13)

PIG	SHEEP
1 chop = proximal rib	1 arm chop = humerus

SECTOR 3 (Trench 13, Test Pit 11)

BEEF	SHEEP
2 arm roasts = scapula	1 arm chop = humerus
1 foreshank = radius	1 arm chop = radius
1 short rib = rib	1 flank = rib
2 hind shanks = tibia	
1 rump roast = illium	
7	3

SECTOR 4 (Trenches 37 and 38)

BEEF	SHEEP
1 foreshank = radius	1 rib chop = thoracic vertebrae
1 foreshank = ulna	1 shank = tibia
3 sirloin tip = sacrum	1 leg chop = femur
2 sirloin steaks = illium	
27 short ribs = rib	
1 hind shank = tibia	
3 loin steaks = lumbar vertebrae	
38	3

CHAPTER 19

CONCLUSIONS

For nearly 50 years the Admiralty site has loomed large as a major archaeological site of the Los Angeles Basin. Variously ascribed as a large prehistoric midden, an ethnohistoric village, and a totally destroyed deposit, the site has proven highly resilient to both development and archaeological interpretation.

Whereas portions of the site clearly have been destroyed, such as those sections now lying within the harbor, other parts remain intact. For example, based on surface observations, the site extends east of the project area within and just north of the Pacific Electric Railroad right-of-way, perhaps as far as Lincoln Boulevard. Our work, as well as that of Dillon and his colleagues, demonstrates that although the railroad disturbed the upper portion of the midden, the underlying deposits are relatively undisturbed. Apparently, the railroad acted to limit disturbance to the site within the right-of-way by protecting it from the massive development that occurred on all sides.

Even beyond the linear segment of the site encompassed by the right-of-way, however, large portions of the midden may still remain intact, especially to the south. Admiralty Way and the adjoining linear park are built on the dredge spoils placed here during the construction of Marina del Rey harbor. These spoils may have acted as a cap, effectively preserving the prehistoric midden. We estimate that as much as 50 percent of the original site may still be intact. Future development in the area should proceed cautiously.

Our work was restricted to 1,223 sq m of the extreme northern portion of the site. In this area we excavated 77 sq m, or roughly 6.3 percent of the site in the project area. Even within the project area, however, our excavations were not evenly distributed. Excavation units were disproportionately placed in the 457 sq m portion of the Admiralty site that will be covered by the Channel Gateway project. In this more restricted area we excavated 52 sq m, or approximately 12 percent of the deposit. In total, the 1989 Channel Gateway Archaeological Project excavated 0.12 percent of the Admiralty site, all of which was confined to the northern fringe of the shell midden.

Just as our work brought the physical parameters of the site into focus, it also clarified the site's archaeological position. For the data recovery portion of the project, we identified five research domains for the prehistoric component that we believed could be addressed with data from the Admiralty site. These were chronology, subsistence, technology, settlement, and cultural affiliation. For each domain, a series of research questions were outlined that structured our field and analytic strategies and tactics.

ADDRESSING THE RESEARCH QUESTIONS

Temporal Considerations

At the most basic level, we wanted to know when the site was occupied and whether distinct occupations could be identified. Based on radiocarbon dates, it appears that the site was occupied for a short period, probably sometime between A.D. 1050 and 1150. No evidence was found of distinct components, with the portion of the midden excavated in 1989 being homogeneous and devoid of prehistoric features. Combining our results with those of earlier projects does not alter this interpretation. Throughout the site, the midden appears to be about the same thickness. Although none were found on the Channel Gateway property, burial pits were periodically excavated into the underlying sterile sediment in most areas of the site. Our conclusion is that the Admiralty site is a single component settlement, occupied during the Late Prehistoric period.

Subsistence and Technology

Once the temporal parameters of the prehistoric component were established, our strategy was to proceed to more abstract questions of environment and subsistence. In particular, we wanted to determine the environmental conditions prevailing at the time of occupation, the available local resources, and those resources utilized by the prehistoric occupants. Issues relating to paleoenvironmental setting were addressed through a combination of soils, geomorphological, paleobotanical, and dendroclimatological analyses. From these various data sources, an interpretation for the placement of the Admiralty site was offered. At the time of occupation, the site was situated on a slightly elevated rise near the edge of the lagoon. The rise was of sufficient height to protect the occupants from all but the most horrific floods. Thus, even during most flood events when the Los Angeles River captured the Ballona Creek channel, the Admiralty site was not inundated.

By the time the Admiralty site was occupied, sediment-laden rivers and streams had transformed the Ballona from an open lagoon to an enclosed estuary. Pollen remains indicate that the site was located near the margin of the marsh. Composites, reeds, and grasses dominate the pollen diagrams. A pollen wash of a metate found in the midden suggests that these plants were heavily utilized by the occupants of the site.

As expected for such an environment, the faunal remains indicate that the occupants of the Admiralty site focused on estuarine resources. Migratory waterfowl, lagoonal fish, shellfish, and small mammals and reptiles of the marsh compose the vast majority of faunal remains recovered from archaeological contexts. Surprisingly, there is little evidence that the occupants ventured into the open ocean in search of food. Pelagic resources, such as deep water fish or sea mammals, constitute an extremely small proportion of the faunal remains. Similarly, there is little evidence that the occupants brought subsistence resources from the interior to the site. Macro- or microfossils of commonly used plants from the interior, such as acorns or juniper berries, were totally absent from the analyzed samples. In short, all evidence suggests that the occupants of the Admiralty site came to the site to utilize the locally available resources of the wetlands, and left when these resources were either exhausted or when resources in other areas became available.

To exploit the resources of the wetland, the occupants of the Admiralty site employed a variety of technologies. Four flaked stone reduction strategies were recognized in the collection; microlith, bifacial, flake-core, and bipolar. Eleven lithic raw materials ranging from local river cobbles to exotic obsidian nodules were utilized in the production of the flake tools. Some of the tools, such as the quartz microliths, were probably imported into the site as finished tools. Given the seasonal nature of the site occupation, these tools were most likely part of the "baggage" that the residents brought with them each year. Similarly, the large number of projectile points and pressure-flaked bifaces made of nonlocal material suggests that these tools were also brought into the site as preforms and finished as the need arised. Other tools were clearly expedient in nature. Produced of local rock with generally poor knapping qualities, these tools probably were made and used for cutting and scraping tasks of a routine and immediate nature.

In addition to flake tools, the occupants of the Admiralty site used a variety of ground stone, shell, and bone tools. Ground stone tools, consisting of manos, metates, and pestles, are relatively infrequent in the collection. Unlike the bluff top sites, no caches of ground stone were found at the Admiralty site. The rarity of ground stone suggests that the inhabitants were not utilizing large quantities of vegetal material requiring high-energy processing, such as nuts or pulpy plants. This interpretation is consistent with the types of reeds and grasses available in the wetlands.

Bone and shell tools also appear to have been used in obtaining wetland resources. Bone tools in the collection are primarily tips that could have been used for sewing or fishing activities. Most tips exhibit breaks near the distal end of the tool, suggesting that the majority of these artifacts were originally parts of fishhooks that were broken when the fish were brought back to the site and processed.

Shells were sometimes used as scrapers or cutting implements. The crude flake patterns on the shells indicate that they were used as expedient cutting tools. Evidence of grinding on shells is generally limited to the dorsal side. We suspect that these tools were used as scrapers, although the exact function of these implements could not be determined. Although the use of shell as tools makes intuitive sense, such items rarely have been documented in the archaeological literature. This observation suggests that these tools have either been overlooked or that conditions in the Ballona were different than elsewhere, requiring the use of shell as a raw material when otherwise it was avoided. At present, the latter explanation seems unlikely, for the occupants of the Admiralty site had access to large amounts of local lithic raw material that was used to create tools for the same or similar purposes as those proposed for the shell tools.

In addition to tools of an economic nature, ornamental artifacts, presumably of social or ritualistic value, also were found. Shell, bone, and stone beads were recovered in relatively large numbers at the Admiralty site. Most of the shell beads date between A.D. 900 to the historic period, a range consistent with the radiocarbon dates. No evidence of bead manufacture was found at the Admiralty site, suggesting that the artifacts were either brought or traded into the site. Incised fragments of bone and ground stone artifacts with symbolic representations also were found in small numbers at the site. The nature and function of these artifacts is not known.

Seasonality

The lack of diversity and relative sparseness of subsistence and technological remains found at the Admiralty site suggests that the site was occupied on a temporary basis. Only seven flaked stone tool types and three ground stone tool types were identified, while certain types commonly associated with habitation sites, such as stone bowls, were conspicuously absent. Moreover, the paucity of fire-cracked rock is inconsistent with a long term, permanent occupation. Although the site covers a large area, the sparsity of the remains and the relatively thin deposit argues against intense occupation by large numbers of people. Instead, we suggest that no more than a few families occupied the Admiralty site at any one time.

The relatively large proportion of migratory waterfowl in the collection suggests that the site was occupied during the winter. Occupation during other seasons are also possible. The most common fish species at the Admiralty site is California grunion, which is most easily collected when it spawns on shore between March and September. A fall occupation also is suggested by the relatively large numbers of pile perch that are abundant between October and November.

The only time the area would probably have been avoided is for short periods during the summer when the saltwater microorganism *Gonyaulax* is abundant. This microorganism causes red tide, which makes some filter feeders, such as mussels, clams, and oysters as well as small fish, poisonous. Heizer and Elsasser (1980:129) state that the red tide generally occurs between May 1 and October 31. The tide does not last for this entire period, however, and is unpredictable in its duration or strength from year to year.

Settlement and Cultural Affiliation

The Admiralty site appears to have been occupied on a temporary basis by small groups at various times throughout the year. We suggest that people were drawn to the wetlands for specific resources, and after acquiring them left for other regions. The other portions of the seasonal round are not known. We also cannot determine the position of the Admiralty site in the settlement pattern. Were there permanent settlements farther inland or along the coast that served as bases for groups exploiting the Ballona? Was the Ballona used by more than one such permanent settlement? If so, how did groups from different villages interact? These and other similar questions must await the results of future research.

The Admiralty site is one of many prehistoric sites located along the lower reaches of Ballona and Centinela creeks. Locational analysis of dated components indicates that a distinct break in settlement patterns occurs between the Middle and Late periods. Whereas during the Middle period, settlement was restricted to the bluff tops, Late period settlement appears to be confined to the margins of the wetlands. This shift was probably triggered by environmental causes. As sedimentation increased in the Ballona, the open lagoon was transformed into a chock-filled estuary and marsh. Elevated landforms, such as terraces and sandy islands, were created that provided relatively stable and protected shelter from the vagaries of Ballona Creek's behavior.

The settlement shift, however, probably also had a cultural component. Among the most common artifacts recovered at the Admiralty site were shell beads. Yet, these same artifacts are virtually absent from the bluff-top Middle period sites. Further, the only type of burials encountered at the Admiralty site in 30 years of archaeological investigation are inhumations, whereas cremation was commonly practiced in the bluff-top sites. The prevalence of shell beads, along with the use of inhumation as a burial custom, suggests that by the Late period, residents of the Ballona had made the switch culturally from a desert to coastal affiliation.

This shift, however, was not complete. The bulk of the Admiralty site collection is similar to those of the bluff-top sites. Reduction strategies, lithic raw material types, and subsistence remains found at the Admiralty site parallel those identified at bluff-top sites. The occupants of the Admiralty site, therefore, appear to have been participating in a coastal cultural interaction sphere, while adapting to coastal resources with a desert-oriented technology.

No evidence was recovered to suggest occupation of the site much after A.D. 1200. The site almost certainly is not the named Gabrielino village of **Sa'angna**. Indeed, archival work has called into question the existence of this village. While it is probable that the Ballona was occupied during the Protohistoric period, the locations of the settlements and the nature of the occupation remain unknown.

Historical Issues

Historically, the Channel Gateway property can be considered a microcosm of west Los Angeles. Archaeological remains relating the railroad, oil exploration and development, agriculture, industrial development, small-scale ethnic occupation, and urban trash disposal were all found on the 16-acre parcel.

The earliest historic occupation was found in the railroad right-of-way. The railroad, which was active through the property from 1892 to 1980, left behind artifacts and features associated with its use. Domestic artifacts found in the southeastern cluster of test pits were associated with a Japanese community located near the Machado rail stop during the early portion of the twentieth century. The mixture of domestic and oriental artifacts in this area may indicate that by the 1920s and 1930s the local Japanese community was more acculturated than previously thought.

At the time that the Machado rail stop was in operation, Japanese farmers moved into the northern portion of the Channel Gateway property. These farmers left the property by the end of the 1930s when the area took on commercial activities. World War II brought industry to the Associated Pacific Industries parcel, while devaluing the land in other parcels that were then used as local trash dumps. Development followed the war and the area became part of the general urban sprawl of greater Los Angeles.

As perhaps fitting the industrial character of the property, isolated archaeological deposits were set in a soil matrix contaminated with hazardous chemicals and solvents. The extent of the soil contamination was not known prior to fieldwork. Otherwise, no archaeological research would have been conducted outside the railroad right-of-way. Archaeological testing and limited data recovery had only begun in the historic deposits when the nature of the contamination became clear. Work was immediately shut down. Thus, although archaeological and archival research provided glimpses into the historic occupation of the property, much more remains to be learned about this era, particularly from other portions of the Oxford Triangle.

DIRECTIONS OF FUTURE RESEARCH

As with many scientific endeavors, the Channel Gateway project provides a better foundation for future research than it does a culmination of thought. The Admiralty site is the only lagoon-edge site that has been systematically excavated in the Ballona. One can only guess whether it is representative of a settlement type or larger cultural processes. On the bluffs overlooking the Ballona, four sites recently have been excavated. Although for the most part the data from these sites complement each other, here too we are left with a small sample from which to judge over 7,000 years of human occupation.

This report represents the culmination of over three years of effort. Yet, we believe it is more fitting to end it with a look to the future than a glance at what has come. We conclude the report with a number of suggestions, both site specific and regional in scope, as to the direction of future research.

1. The Admiralty site has been declared an historic landmark by the City of Los Angeles. This designation is restricted to the portion of the site within the city limits, or the narrow segment north of and including the Pacific Electric Railroad right-of-way. Most of the site, however, lies south of the city limits, on land owned by the County of Los Angeles. We believe it is proper that the portion of the site owned by the county also be included as part of the landmark.

2. To date, archaeological research at the Admiralty site has focused around the edges of the midden. In 1961, excavations were confined to the southern border of the site, whereas the 1988 and 1989 excavations were restricted to the northern edge. It is possible that the relatively shallow and sparse nature of the midden is a reflection of the areas investigated, and does not represent the site as a whole. Future research at the Admiralty site needs to focus closer to the center of the site, or those portions south of Channel Gateway under the linear park, Admiralty Way, and the property adjoining the

marina. Research should focus on three issues: (1) the spatial distribution of artifacts and activities; (2) determining whether the pattern of isolated burials characterizes the entire site, or whether a central cemetery exists; and (3) testing the hypothesis forwarded from the data recovered in 1989 that the site was a seasonal occupation and not a permanent village.

3. The edges of the historic lagoon and the banks of Ballona and Centinela creeks need to be surveyed for sites. Based on the settlement model presented here, these would be favored locations for occupation during the Late period. Survey techniques will have to include a subsurface component. Recent pedestrian surveys of the area have shown the inadequacy of identifying sites based on surface observations alone.

4. Identifying sites at the edge of the lagoon presupposes that these edges also can be identified. The paleoenvironmental models presented in Chapter 17 are based primarily on regional data about sea level and sedimentation. Local data need to be collected within the Ballona to test and refine these models.

5. A sample of lagoon and creek edge sites need to be excavated. The focus of these excavations should be centered on determining the time of occupation, the prevailing subsistence strategies and associated technology, and cultural affiliation. These data, then, can be combined with those recovered at the Admiralty site and compared with similar data sets collected at sites on the bluffs. Additional excavations should also be conducted on the bluffs to determine the nature of settlement during the Early period. Further, certain data classes, such as pollen and macrofossil data, were not obtained during excavations of bluff-top sites. These data gaps need to be filled.

6. The nature of the Gabrielino presence in the Ballona needs to be established. Archival research should first be performed to determine if settlements during the mission period can be identified for the Ballona. These data can then be augmented and tested with archaeological data, if such sites can be identified.

7. The historic use of the area is tied to the establishment of the Machado rail stop, a scattered settlement immediately south of the railroad right-of-way and outside the project area. Further archaeological exploration of this site could provide valuable information on early twentieth-century Japanese communities in the Los Angeles area. The site is currently under the linear park owned by the County of Los Angeles, which should be made aware of its existence and importance.

8. Archival and archaeological work at the Channel Gateway site indicates that the Oxford Triangle has supported waves of historic development over the last hundred years. Beginning with agriculture, the area was transformed into a commercial center and finally an industrial area. How this transformation occurred and how these various commercial enterprises interacted with the residential areas to the west are intriguing questions that should be pursued.

The Channel Gateway Archaeological Project represents a beginning, not an ending. The project worked through a myriad of potential pitfalls and challenges to forge a coalition of developers, Native Americans, elected officials, and archaeologists in a program of historic preservation. That the program worked is a testament to the energies of all those involved. But our task is not done. To preserve the dwindling vestiges of the past, this coalition needs to be strengthened and committed anew to the goals that brought it forth.

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APPENDIX A

SOURCES

Culver City Public Library
Los Angeles County Public Library System
4975 Overland Ave.
Culver City, CA 90230
(213) 559-1676

Alex Feucht, geologist
LeRoy Crandall & Associates
Geotechnical Consulting Firm
Channel Gateway Development Project

Steve Johnson
25 1/2 Voyage St.
Marina Del Rey, CA 90292
(213) 301-9929
Telephone Interview: March 27, 1990

"Kamran"
Prestige Coach Craft, Inc.
1024 Princeton Dr.
Marina Del Rey, CA 90292
(213) 305-1777
Personal Interview: March 27, 1990

Henry Lopez, Plant Supervisor
Bay Cities Metal Products
4303 Lincoln Boulevard
Venice, CA 90291
Personal Interview: May 17, 1989

Los Angeles Central Library
433 South Spring St.
Los Angeles, CA 90013
(213) 612-3356

Security Pacific Photo Collection Maps
Contact: Caroline Kozo

Los Angeles City Hall
Room 803
Bureau of Engineering
Central Records Section
Public Reference Center

Los Angeles County Hall of Records
Recorder
Room 700
227 North Broadway
Los Angeles, CA
contact: Phil Kamm

Los Angeles County Records Center
Room 212
222 North Hill St.
Los Angeles, CA 90012
(213) 974-1196

Loyola Marymount University
Charles Von der Ahe Library
Special Collections Department
Loyola Boulevard at West 80th St.
Los Angeles, CA 90045
(213) 338-3048

E.T. Wright & Nicholson Map Collection
(Office of Surveyor,
County of Los Angeles, 1880-82, 1885-86)
contact: Justine V. Clancy

Loyola Village Branch
Los Angeles Public Library
7114 West Manchester Ave.
Los Angeles, CA 90045
(213) 670-5436

Gail Machado
Culver City
(213) 827-3223
Telephone Interview: March 22, 1990

Map Book Archives
Los Angeles County Assessor's Map Books
Room B-103
230 West Temple
Los Angeles, CA
(213) 974-3429
Assessor's map information, circa 1905-1963
contact: Walter Scank, Mark Hancock

Carl Marderosian
Rapidway Disposal
Corner of Maxella and Thatcher
Marina Del Rey, CA
Personal Interview: March 27, 1990

Marina Del Rey Library
County of Los Angeles Public Library
4533 Admiralty Way
Marina Del Rey, CA 90292

Edward Perry (born 1913)
721 Oxford Ave.
Venice, CA 90291
(213) 821-6288
Telephone Interview: March 26, 1990

Records Management Division
Piper Technical Center
555 Ramirez St., No. 320
Los Angeles, CA 90012
(213) 485-3510
Index to Historic Maps of Greater Los Angeles
contact: Robert Freeman, Los Angeles City Archivist

Santa Monica Public Library
1343 Sixth St.
Santa Monica, CA 90401

Norman Santany
2801 Oak Ave.
Manhattan Beach, CA 90266
(213) 545-0026
Telephone Interview: March 16, 1990

University of California, Los Angeles
Department of Geology Library & Map Room

University of California, Santa Barbara Library

Paul Vignolle
624 Venezia
Venice, CA 90291
(213) 827-1315
Telephone Interview: March 31, 1990

Vee Vignolle
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Venice, CA 90291
(213) 821-3523
Telephone Interview: March 26, 1990

Frank Wirrer (born 1929)
415 Pacific St.
Santa Monica, CA 90405
(213) 392-2430
Telephone Interview: March 26, 1990

APPENDIX B
SHELL BEAD DATA

Table B.1. Shell Bead Data.

Field Specimen	Test Pit	Level	Bead Shape	Bead Diameter	Hole Diameter	Comments
115	1A	1	B	4	1	
302	1B	1	B	5.8	1.3	Charred
346	1B	2	E	6.4	1.2	
353	1B	3	A	4	1	
353	1B	3	B	3.9	0.8	
353	1B	3	B	4	1	
424	1B	4	A	8	1.5	
424	1B	4	B	5	1.2	
424	1B	4	B	3.9	0.9	
424	1B	4	B	4.7	1	
474	1C	1&2	A	8.5	1.2	
474	1C	1&2	A	6.2	1.3	
474	1C	1&2	A	6.6	1.3	
474	1C	1&2	A	6.9	1.7	
474	1C	1&2	A	5.2	1.5	
474	1C	1&2	A	4.3	0.8	
474	1C	1&2	B	4.8	1.3	
474	1C	1&2	B	4.2	1.2	
474	1C	1&2	B	4.7	1.1	Has asphaltum
474	1C	1&2	C	5	1.2	
474	1C	1&2	C	4.6	1.2	
474	1C	1&2	D	3	1.2	
474	1C	1&2	E	4.5	1.4	
474	1C	1&2	E	5.8	1.6	
474	1C	1&2	E	4.4	1.2	
515	1C	3	B	4.7	1.1	
515	1C	3	B	3.3	1	
515	1C	3	D	3.4	1	
515	1C	3	H	-	-	Unknown type of modified bead
523	1C	4	B	4.3	1.2	
525	1C	5	A	8.9	1.5	
645	1D	1	A	6.9	1.2	
645	1D	1	B	4.5	1.2	
645	1D	1	B	3.2	1	
649	1D	2	A	5.8	1.2	Rough
649	1D	2	B	3.9	1	
649	1D	2	B	3.6	1.2	
677	1D	2	G	6.3	1.8	Schist disk with round edges
709	1D	5	E	7.9	1.6	
216	2A	2	B	6.2	1.2	
216	2A	2	B	4.2	1	
216	2A	2	E	8.2	1.6	
216	2A	2	B	4.5	1.1	
218	2A	3	E	7	1.8	
218	2A	3	E	6.7	1.6	

Table B.1. Shell Bead Data (continued).

Field Specimen	Test Pit	Level	Bead Shape	Bead Diameter	Hole Diameter	Comments
739	2A	3	C	4.8	0.8	
218	2A	3	B	3.8	1.2	
303	2B	1	G	7.9	1.5	Large shell disk, possibly clam
303	2b	1	b	4.4	1	
303	2b	1	b	6.6	1.4	
303	2b	1	A	6.2	?	Broken
331	2B	2	F	4.6	1.2	
331	2B	2	B	4.2	1.2	
331	2B	2	A	4.9	1.5	
331	2B	2	A	8.7	2.2	
331	2B	2	F	4	1.2	
331	2B	2	E	-	-	Fragment
343	2B	3	B	3.4	1.2	
343	2B	3	E	6.9	1.6	
343	2B	3	E	5.5	1.4	
343	2B	3	F	4.7	1.3	
343	2B	3	G	4.5	1.1	Shell disk, dorsal and ventral grinding
343	2B	3	B	3.9	0.9	
343	2B	3	B	4.6	0.9	
387	2B	4	E	6.7	1.2	
395	2B	5	H	6	1	Unknown shell disk
395	2B	5	G	-	-	Keyhole limpet bead
395	2B	5	D	3.6	1.2	
395	2B	5	B	5	1.3	
399	2B	6	E	?	1.4	
446	2C	1&2	E	5.2	1.4	
446	2C	1&2	E	6.7	1.5	
446	2C	1&2	E	5.6	1.4	
446	2C	1&2	E	5.2	1.2	
446	2C	1&2	E	6.5	1.6	
446	2C	1&2	E	6.8	1.4	
446	2C	1&2	E	7	1.2	
446	2C	1&2	B	3.7	1.1	
446	2C	1&2	E	7.6	2.2	
446	2C	1&2	B	3.2	0.9	
446	2C	1&2	F	4.4	1.1	
446	2C	1&2	G	-	1.5	Ab Barrel--max. dia. 5.6, min. dia. 4.6, 3.5L
446	2C	1&2	B	3.9	0.9	
446	2C	1&2	B	3.3	0.9	
446	2C	1&2	B	4	1.8	
446	2C	1&2	E	6.8	1.7	
446	2C	1&2	B	4	1.2	
446	2C	1&2	B	4.3	1.4	
446	2C	1&2	B	4.4	1	
446	2C	1&2	B	4.7	1	

Table B.1. Shell Bead Data (continued).

Field Specimen	Test Pit	Level	Bead Shape	Bead Diameter	Hole Diameter	Comments
446	2C	1&2	B	4.7	1	
446	2C	1&2	B	5	0.9	
446	2C	1&2	B	5	1.4	
446	2C	1&2	B	5.3	1	
446	2C	1&2	A	3.9	0.8	
446	2C	1&2	A	5.8	1	
446	2C	1&2	A	6.3	1.1	
446	2C	1&2	A	6.4	0.8	
446	2C	1&2	A	6.3	1	Rough
446	2C	1&2	A	6.9	1.4	
446	2C	1&2	A	9.7	1.6	
444	2C	3	G	4	2	Length=12.7; Tubular shell bead
446	2C	4	F	6	1.6	
446	2C	4	D	4.6	1.3	
446	2C	4	B	2.9	0.8	
446	2C	4	D	4.5	1	
446	2C	4	B	4.4	0.9	
446	2C	4	B	3.2	1	
446	2C	4	B	3.6	0.9	
464	2C	4	A	8.2	1.9	Rough--contains some callus; top drilled
446	2C	4	B	3.6	0.9	
472	2C	5	B	4.6	0.9	
534	2C	6	B	3.9	0.9	
534	2C	6	C	5.6	1.3	
1169	2C	7	B	4.2	1	
592	2D	1	E	7.2	1.7	
592	2D	1	D	3.5	1.2	
592	2D	1	G	-	-	Unmeasured keyhole limpet dead
592	2D	1	A	7.7	1.5	
592	2D	1	B	5	1.5	
592	2D	1	B	4.6	1.2	
607	2D	2	A	6	1.4	Rough
607	2D	2	B	3.7	1	
607	2D	2	B	4.1	0.9	
607	2D	2	B	4	1	
607	2D	2	G	5.3	1.4	Hard black disk stone
607	2D	2	E	4.4	1.5	
632	2D	3	B	6.2	1	
632	2D	3	B	3.7	1.2	
632	2D	3	B	4.5	0.9	
632	2D	3	B	4.5	1.1	
632	2D	3	B	4	1.2	
632	2D	3	C	3.5	0.9	
632	2D	3	A	7.7	1.3	Chipped
632	2D	3	A	7.4	1.6	

Table B.1. Shell Bead Data (continued).

Field Specimen	Test Pit	Level	Bead Shape	Bead Diameter	Hole Diameter	Comments
632	2D	3	B	4.6	-	
632	2D	3	D	3.2	1.2	
632	2D	3	B	4.5	1.5	
658	2D	4	G	5	1.4	Stone disk (soapstone?)
658	2D	4	D	4.2	1.1	
658	2D	4	E	7.3	1.8	(Both sides drilled)
658	2D	4	A	6.4	1	
658	2D	4	B	5.3	1.2	
669	2D	5	B	5.1	1.1	
669	2D	5	A	8	1.6	
669	2D	5	B	3.7	0.9	
669	2D	5	B	3.5	1.3	
690	2D	7	A	1.6	1	
719	7	1	G	-	-	Keyhole limpet bead
719	7	1	A	7.7	?	Broken
719	7	1	B	4.1	1	
719	7	1	B	4	1.2	
749	7	2	A	10.4	1.8	
749	7	2	E	6	1.5	
752	7	3	E	5.6	1.1	
752	7	3	A	6.5	1.5	
787	7	4	B	3.9	1.2	
787	7	4	G	4.5	1.7	Schist disk or ring
787	7	4	A	5.2	1	
777	8A	3	A	4.6	1.5	
777	8A	3	B	3.8	1.2	
777	8A	3	B	5.2	1.1	
777	8A	3	E	7.3	1.6	
777	8A	3	A	4.5	1.5	
777	8A	3	A	9.1	1.6	
783	8A	4	D	1.85	1	
783	8A	4	B	3.8	1.1	
783	8A	4	B	3.6	1.2	
783	8A	4	B	5.6	1	
783	8A	4	E	6.2	1.8	
783	8A	4	G	5.6	1.5	Bone disk
815	8A	5	A	7.6	1.5	Chipped
815	8A	5	A	5.6	0.8	
815	8A	5	A	5.3	1.6	
815	8A	5	A	6.3	1.3	Rough
815	8A	5	A	4	0.9	
815	8A	5	B	4.6	1.1	
815	8A	5	B	5.7	1.3	
815	8A	5	G	-	-	Olivella spire ground
815	8A	5	E	6.1	2.6	

Table B.1. Shell Bead Data (continued).

Field Specimen	Test Pit	Level	Bead Shape	Bead Diameter	Hole Diameter	Comments
815	8A	5	E	7	1.4	
844	8A	6	B	6.3	1.4	
844	8A	6	B	3.9	1	
844	8A	6	E	7	1.4	
849	8A	7	G	6.3	1.2	Schist disk
849	8A	7	E	4.9	1.2	
849	8A	7	A	8	1.7	
849	8A	7	B	4.3	1.2	
849	8A	7	B	4.2	0.8	
849	8A	7	E	5.6	1.4	
1545	8A	8	E	-	-	Rectangular pendant (not an artifact)?
872	8A	8	B	4.3	1.1	
1545	8A	8	E	7.1	2	
872	8A	8	A	6.6	1.2	
872	8A	8	C	3.4	1	
890	8B	2	B	4.3	0.9	
890	8B	2	E	6.3	1.3	
904	8B	3	B	5.6	1	
904	8B	3	B	4.5	0.9	Asphaltum
923	8B	4	A	11.5	0.9	
923	8B	4	E	3.9	1.2	
923	8B	4	B	4.9	1.5	
923	8B	4	B	4.8	1	
923	8B	4	E	5.9	1.4	
923	8B	4	E	4.9	-	
923	8B	4	A	4.4	0.9	
923	8B	4	F	3.9	1.4	
933	8B	5	E	6.9	1.7	
970	8B	9	A	7	1	
1298	8C	1	B	3.9	1.1	
1303	8C	2	E	5.5	-	Small disk of abalone?
1307	8C	3	C	5.5	1.2	
1307	8C	3	B	3.2	0.8	
1307	8C	3	B	4.6	1.2	
1307	8C	3	E	6.3	1.4	With dorsal and ventral grinding
1307	8C	3	A	6.2	1.5	Rough
1307	8C	3	A	7.9	1	
1307	8C	3	B	4.3	1.2	
904	8C	3	B	4.6	1.3	
904	8C	3	E	6.6	1.4	
904	8C	3	E	5.5	1.2	
904	8C	3	E	6	1.2	
904	8C	3	E	6.4	1.4	
904	8C	3	E	5.2	1.4	Drilled two-way
1315	8C	4	E	5.4	1.6	

Table B.1. Shell Bead Data (continued).

Field Specimen	Test Pit	Level	Bead Shape	Bead Diameter	Hole Diameter	Comments
1315	8C	4	E	5.3	1.5	
1315	8C	4	G	4.2	2	Length=7.5; Tubular shell
1315	8C	4	E	5.4	0.9	
1315	8C	4	E	6.3	1.8	
1315	8C	4	C	4.7	1.2	
1315	8C	4	A	6.2	1.3	
1315	8C	4	B	4.7	1.3	
1315	8C	4	B	4.9	1.2	
1315	8C	4	E	5	1.2	
1315	8C	4	B	4.4	1	
1315	8C	4	B	3.4	1.3	
1326	8C	5	A	7.4	1.3	
1326	8C	5	E	5.1	1.2	
1326	8C	5	B	4.6	1.4	
1340	8C	6	A	7.5	1.6	
1347	8C	7	B	4	0.8	
1347	8C	7	B	4.4	0.8	
1347	8C	7	E	5.3	1.3	
1347	8C	7	A	6.8	1	
1347	8C	7	E	7.7	1.6	
1347	8C	7	E	5.7	1.5	
824	9A	1&2	B	3.7	1.2	
824	9A	1&2	B	4.6	1.3	
1555	9A	3	A	9	1.6	
1555	9A	3	A	7.4	1.3	Rough
1555	9A	3	A	5.4	1.2	
1555	9A	3	A	8.8	1.7	
1555	9A	3	B	4.5	1.2	
1555	9A	3	C	4	1	
1555	9A	3	A	8	1.6	
1555	9A	3	B	4.3	1	
1555	9A	3	A	3.6	1.3	
1044	9A	3	E	4.6	1.1	
1555	9A	3	B	3.6	1	
1555	9A	3	A	5.6	1.1	
1555	9A	3	A	6.8	1.5	
1555	9A	3	B	5.5	0.9	
836	9A	4	B	4.2	1.3	
855	9A	5	B	5.4	0.8	
855	9A	5	A	6.8	1.2	
855	9A	5	A	8.6	1.9	
855	9A	5	E	5.9	1.4	
855	9A	5	G	4.5	1.6	Schist disk
897	9B	2	B	4.8	?	Broken
897	9B	2	E	6.8	2	

Table B.1. Shell Bead Data (continued).

Field Specimen	Test Pit	Level	Bead Shape	Bead Diameter	Hole Diameter	Comments
897	9B	2	B	4.2	1.2	
897	9B	2	B	5.2	1.2	
918	9B	3	B	3.4	1	
918	9B	3	B	4.2	1.1	
918	9B	3	A	9.3	1.2	
918	9B	3	A	8	1.3	Rough
918	9B	3	B	4.8	-	
953	9B	4	C	5.9	1.4	
953	9B	4	B	4.4	0.4	
953	9B	4	B	3.8	0.8	
953	9B	4	H	4.5	1.8	Disk of unknown material stone
953	9B	4	B	4.7	1.2	
953	9B	4	B	4.7	0.9	
953	9B	4	B	5.2	0.9	
953	9B	4	A	8.7	1.7	
960	9B	5	B	4.3	1	
960	9B	5	A	5	1.3	
974	9B	6	A	4.9	0.9	
1461	9C	3	B	3.8	1.1	
1461	9C	3	E	4.6	1.4	
1461	9C	3	E	5.4	1.2	
1461	9C	3	G	5.3	1.6	
1461	9C	3	B	3.7	1.3	
1461	9C	3	B	4.7	1.1	
1461	9C	3	B	5.2	1	
1461	9C	3	B	6	1	
1461	9C	3	A	5.2	1.3	
1461	9C	3	A	6.2	1.1	
1461	9C	3	A	5.5	1.2	Rough
1461	9C	3	A	6.9	1.2	Rough
1461	9C	3	A	7.4	1.6	Rough
1471	9C	4	B	4.6	1.1	
1471	9C	4	B	5.1	1.3	
1471	9C	4	B	4.3	0.8	
1471	9C	4	E	5.6	1.1	
1471	9C	4	A	6.5	1.1	Has asphaltum
1471	9C	4	B	5.2	1.2	
1471	9C	4	B	4	1.2	
992	12A	3	E	4.9	1.5	
992	12A	3	E	4.8	1.2	
992	12A	3	D	3.4	1.2	
992	12A	3	E	4.7	1.2	
992	12A	3	E	6.9	1.4	
992	12A	3	E	6.9	1.2	
992	12A	3	E	5.6	1.2	

Table B.1. Shell Bead Data (continued).

Field Specimen	Test Pit	Level	Bead Shape	Bead Diameter	Hole Diameter	Comments
992	12A	3	E	6.2	1.6	
992	12A	3	A	4	0.9	
992	12A	3	B	3.7	0.9	
992	12A	3	D	4.7	1.4	
992	12A	3	B	3.8	1.1	
992	12A	3	B	4.7	0.9	
992	12A	3	A	6.7	1	
992	12A	3	A	5.5	1.9	
1006	12A	4	A	8.3	1.6	
1006	12A	4	A	3.9	1	
1006	12A	4	A	4.8	0.9	
1006	12A	4	B	2.8	0.9	
1006	12A	4	E	6.2	1.8	Two-way drilling
1013	12A	5	A	7	1.2	
986	12A	5	A	7.6	1.9	
1013	12A	5	E	5.7	1.3	
1013	12A	5	B	5.9	?	Broken
986	12A	5	C	7.1	1.9	
986	12A	5	C	4.4	1	
986	12A	5	B	4.6	0.9	
1013	12A	5	E	4.9	1.1	
986	12A	5	E	4.6	1.5	
1013	12A	5	E	6	1.2	
1013	12A	5	G	-	-	Keyhole limpet present
1013	12A	5	B	4	1	
1013	12A	5	C	5	1	
1030	12A	6	E	5.3	1.3	
1030	12A	6	E	6.5	1.4	
1030	12A	6	A	8.7	1.5	
1030	12A	6	A	7.3	1.4	
1382	12A	6	A	9.5	1.6	
1030	12A	6	G	6.3	2.1	Schist disk
1058	12A	7	E	5.2	1.8	
1058	12A	7	A	7.1	1.2	
1058	12A	7	B	5.1	1	
1058	12A	7	E	6.9	1.7	
1058	12A	7	A	4.9	1.3	
1383	12A	7	C	3.2	1	
1058	12A	7	A	8.3	1.4	
1058	12A	7	B	3.9	1.1	
1052	12A	8	E	4	1	May be charred cupped bead
1052	12A	8	A	5.6	1.7	
1052	12A	8	A	5.6	1.2	
1067	12A	9	B	5.5	1.2	
1022	12B	1	B	5.2	1	

Table B.1. Shell Bead Data (continued).

Field Specimen	Test Pit	Level	Bead Shape	Bead Diameter	Hole Diameter	Comments
1022	12B	1	B	4.7	1	
1022	12B	1	B	-	-	One spire ground olivella
1022	12B	1	B	4.8	1.3	Charred
1087	12B	3	B	4.7	1	
1087	12B	3	E	6.7	1.9	
1087	12B	3	G	7.9	1.9	Schist disk
1087	12B	3	B	4.3	1.3	
1087	12B	3	B	4.2	1.2	
1087	12B	3	B	5.4	1.8	
1087	12B	3	A	8.5	1.6	
1087	12B	3	A	7.1	1.3	
1087	12B	3	A	6.5	1.2	Rough
1087	12B	3	D	3.9	0.8	
1087	12B	3	F	6.5	1.6	
1087	12B	3	B	5.4	0.9	
1096	12B	4	E	5.6	1.5	Double drilled
1096	12B	4	B	3.8	1.2	
1096	12B	4	B	3.4	0.9	
1096	12B	4	F	5.6	1.6	Double drilled
1096	12B	4	A	7.4	1.4	
1096	12B	4	E	5.4	1.4	Double drilled
1096	12B	4	E	6.2	1.2	Double drilled
1096	12B	4	A	6	1.1	
1096	12B	4	B	3.9	1.1	
1102	12B	5	B	5.5	1.6	Burned
1102	12B	5	D	3.2	1	
1108	12B	6	E	6.4	1.5	
1112	12B	7	H	6	1.2	Unknown shell disk--poor shape
1112	12B	7	D	3.9	1.4	
1112	12B	7	D	3.2	1	
1144	12C	3	A	5.4	1.9	
1144	12C	3	B	3.9	1	
1144	12C	3	G	4.8	1.2	Schist disk
1144	12C	3	B	4	1	
1144	12C	3	E	7.2	1.7	
1144	12C	3	A	6.3	1.6	
1144	12C	3	B	3.3	0.9	
1144	12C	3	E	4.3	1.4	
1144	12C	3	A	5.8	1.1	
1152	12C	4	B	4	1.3	
1152	12C	4	G	5.9	1.7	Bone disk
1152	12C	4	B	5.6	0.8	
1152	12C	4	E	12.2	1.9	
1152	12C	4	B	5	1.2	
1152	12C	4	B	4.4	1	

Table B.1. Shell Bead Data (continued).

Field Specimen	Test Pit	Level	Bead Shape	Bead Diameter	Hole Diameter	Comments
1152	12C	4	E	6.2	1.2	
1152	12C	4	B	4.5	0.9	
1176	12C	5	D	3.5	0.8	
1176	12C	5	C	3.2	1	
1176	12C	5	C	4.3	1.5	
1176	12C	5	C	3.8	0.9	
1176	12C	5	B	4.8	1.1	
1176	12C	5	B	3.2	1.1	
1176	12C	5	A	7.7	1.3	
1176	12C	5	E	7	1.8	Drilled from both sides
1166	12C	6	E	8.2	1.6	
1256	12C	8	F	4.8	1.5	
1180	12C	8	E	5.7	1.3	
1256	12C	8	E	5.4	1	
1128	13	1	B	3.9	1.3	
1128	13	1	A	6.5	1.4	
1128	13	1	B	4.4	1.1	
1128	13	1	B	4	1.1	
1133	13	2	B	4.5	1	
1133	13	2	B	4.7	1	
1133	13	2	A	7.7	1.4	
1133	13	2	B	6.4	1	
1133	13	2	A	5	1.6	
1133	13	2	C	5.6	1.1	
1190	13	3	A	10	1.5	
1190	13	3	A	7.2	1.6	
1190	13	3	B	5.3	1	Dorsally ground
1190	13	3	B	6.2	1.1	
1193	13	3	G	6.6	4.2	Tubular bone bead; Length=12
1199	13	4	B	3.5	1.2	
1204	13	5	A	8.1	1.7	
1204	13	5	E	5.2	1	
1204	13	5	G	2.9	0.8	Fish vertebrae
1428	13	7	B	4.6	1.4	Bone cylinder fragment
1219	13	8	E	6.4	1.3	Two-way drilling
1226	14	1	E	4.4	1.4	
1231	14	2	B	3.7	0.8	
1231	14	2	B	4.6	1.2	
1231	14	2	B	4.3	1.3	
1231	14	2	C	4.3	1.1	
1231	14	2	B	4.7	1.3	
1231	14	2	A	4.6	1	
1231	14	2	B	4.4	1.2	Charred
1236	14	3	A	6.4	1.5	
1236	14	3	B	4	1.2	

Table B.1. Shell Bead Data (continued).

Field Specimen	Test Pit	Level	Bead Shape	Bead Diameter	Hole Diameter	Comments
1236	14	3	B	5.9	0.9	
1236	14	3	E	6.9	1.7	
1236	14	3	E	5.9	1.3	
1236	14	3	G	2	1.2	Bone disk
1236	14	3	F	4.2	1	
1236	14	3	F	3.9	1.5	
1245	14	4	B	6.4	1.6	
1256	14	4	E	4.6	1.3	
1256	14	4	G	3.2	1.6	Length=11.3; Bone tube bead
1256	14	4	B	3.4	0.9	
1256	14	4	B	4.6	?	
1256	14	4	B	4	1.2	
1256	14	5	B	5	1.2	
1256	14	5	A	6.5	1.3	
1256	14	5	E	6	1.5	
1256	14	5	B	3	0.9	
1256	14	5	E	5.2	1.4	
1256	14	5	A	7.4	1.3	
1256	14	5	A	7.6	1.3	
1256	14	5	A	6	0.8	
1256	14	5	A	6.8	1.4	
1256	14	5	A	4	1.8	
1275	14	6	D	2.8	1.1	
1275	14	6	H	5.9	1.3	Disk of unknown hard shell, possibly abalone
1275	14	6	B	4	1	
1275	14	6	B	3.5	1.1	
1275	14	6	A	8.6	1.7	Broken
1275	14	6	A	6.7	1	
1275	14	6	A	7.3	?	Broken
1275	14	6	A	3.9	0.7	
1275	14	6	A	10.9	1.4	
1290	14	7	B	5.1	1.2	
1290	14	7	C	5.4	1.3	
1290	14	7	B	5	1.2	

APPENDIX C

SHELL ANALYSIS RAW DATA

Table C.1. Test Pit 1A Excavation Number of Individual Specimens.

Scientific Name	Common Name	Level							Totals
		1	2	3	4	5	6	7	
Chione californiensis	Common California Venus	309	248	217	204	131	56	3	1168
Chione undatella	Frilled California Venus	330	244	144	187	68	47	1	1021
Chione fluctrifraga	Pacific Smooth Venus	22	24	19	18	6	2		91
Amiantis callosa	Pacific White Venus								
Tresus nuttalli	Pacific Gaper	16	12	17	15	7	7		74
Tivela stuitorum	Pismo Clam					3	1		4
Argopecten sp.	Calico Scallop	27	25	9	7	5	3		
Ostrea lurida	Native Pacific Oyster	92	99	22	70	14	19		76
Crepidula onyx	Onyx Slipper Shell	2			1				3
Protothaca staminea	Common Pacific Littleneck	63	66	40	55	7	49	3	283
Tagelus californianus	California Jackknife Clam			2	1				3
Macoma nasuta	Bent-nose Macoma								
Saxidomus nuttailli	Common Washington Clam								
Tegula aureotincta	Gilded Tegula								
Donas gouidii	Gould's Wedge Shell								
Donas californicus	California Donax								
Ocenebra poulsoni	Poulson's Dwarf Triton								
Kelletia kellitii	Kellett's Welk								
Nassarius tegula	Western Mud Welk								
Nassarius mendicus	Western Lean Nassa								
Cerithidea californica	California Horn Shell								
Mytilus californianus	California Mussel								
Polinices lewisii	Lewis' Moon Shell				7				7
Mopalia ciliata	Hairy Mopalia								1
Hailotis cracherodii	Black Abalone			1					
Olivella biplicata	Purple Dwarf Olive								
Astraea undosa	Wavy Turban								
Tegula funebralis	Black Tegula								
Macron lividus	Livid Macron								
Serpulorbis sp.	Western Scaled Worm Shell								
Conus californicus	California Cone								
Trachycardium quadragenum	Spiny Cockle								
Nuttallia nuttallia	Purple Clam	4	1	2	1	1			9
Total Identified		865	719	473	566	242	184	7	2740
Total Unidentified		89	192	119	27	23	54	7	511

Table C.2. Test Pit 2A Excavation Number of Individual Specimens.

Scientific Name	Common Name	Level						Totals
		1	2	3	4	5	6	
Chione californiensis	Common California Venus	351	675	413	132	100	83	1754
Chione undatella	Frilled California Venus	261	668	409	153	99	116	1661
Chione fluctrifraga	Pacific Smooth Venus	27	4	30	8			69
Amiantis callosa	Pacific White Venus	13	10					23
Tresus nuttalli	Pacific Gaper	38	64		7	9		118
Tivela stuitorum	Pismo Clam		36					36
Argopecten sp.	Calico Scallop	37	62	36	8	9	9	161
Ostrea lurida	Native Pacific Oyster	69	214	116	34	43	41	517
Crepidula onyx	Onyx Slipper Shell		7					7
Protothaca staminea	Common Pacific Littleneck	8	111	73		14	12	218
Tagelus californianus	California Jackknife Clam		4			1		5
Macoma nasuta	Bent-nose Macoma			2				2
Saxidomus nuttailli	Common Washington Clam		10					10
Tegula aureotincta	Gilded Tegula		1					1
Donas gouidii	Gould's Wedge Shell							
Donas californicus	California Donax							
Ocenebra poulsoni	Poulson's Dwarf Triton							
Kelletia kellitii	Kellett's Welk							
Nassarius tegula	Western Mud Welk							
Nassarius mendicus	Western Lean Nassa							
Cerithidea californica	California Horn Shell							
Mytilus californianus	California Mussel							
Polinices lewisii	Lewis' Moon Shell							
Mopalia ciliata	Hairy Mopalia							
Hailotis cracherodii	Black Abalone		2	4				
Olivella biplicata	Purple Dwarf Olive							
Astraea undosa	Wavy Turban							
Tegula funebralis	Black Tegula		0					
Macron lividus	Livid Macron							
Serpulorbis sp.	Western Scaled Worm Shell							
Conus californicus	California Cone							
Trachycardium quadragenum	Spiny Cockle							
Nuttallia nuttallia	Purple Clam						1	1
Total Identified		804	1868	1083	342	275	262	4583
Total Unidentified		156	299	287	132	80	35	989

Table C.3. Test Pit 7 Excavation Number of Individual Specimens.

Scientific Name	Common Name	Level					Totals
		1	2	3	4	5	
Chione californiensis	Common California Venus	163	657	449	119	20	1408
Chione undatella	Frilled California Venus	94	378	270	90	8	840
Chione fluctrifraga	Pacific Smooth Venus	13	50	40	13		116
Amiantis callosa	Pacific White Venus						
Tresus nuttalli	Pacific Gaper	6	76	27	11	2	122
Tivela stuitorum	Pismo Clam	9	6	5			20
Argopecten sp.	Calico Scallop	9	36	40	6	1	92
Ostrea lurida	Native Pacific Oyster	36	198	194	46	8	482
Crepidula onyx	Onyx Slipper Shell						
Protothaca staminea	Common Pacific Littleneck	33	133	126	28	5	325
Tagelus californianus	California Jackknife Clam		2	3	7		12
Macoma nasuta	Bent-nose Macoma						
Saxidomus nuttailli	Common Washington Clam		2	3			5
Tegula aureotincta	Gilded Tegula						
Donas gouidii	Gould's Wedge Shell						
Donas californicus	California Donax						
Ocenebra poulsoni	Poulson's Dwarf Triton						
Kelletia kellitii	Kellett's Welk						
Nassarius tegula	Western Mud Welk						
Nassarius mendicus	Western Lean Nassa						
Cerithidea californica	California Horn Shell						
Mytilus californianus	California Mussel						
Polinices lewisii	Lewis' Moon Shell						
Mopalia ciliata	Hairy Mopalia						
Hailotis cracherodii	Black Abalone	1		1			2
Olivella biplicata	Purple Dwarf Olive						
Astraea undosa	Wavy Turban						
Tegula funebralis	Black Tegula		1	1			2
Macron lividus	Livid Macron						
Serpulorbis sp.	Western Scaled Worm Shell						
Conus californicus	California Cone						
Trachycardium quadragenum	Spiny Cockle	4	7				11
Nuttallia nuttallia	Purple Clam	2	11	6			19
Total Identified		370	1557	1165	320	44	3456
Total Unidentified		59	194	115	64	6	438

Table C.4. Test Pit 8B Excavation Number of Individual Specimens.

Scientific Name	Common Name	Level									Totals
		1	2	3	4	5	6	7	8	9	
Chione californiensis	Common California Venus	324	528	1119	1516	293	294	176	140	8	4398
Chione undatella	Frilled California Venus	259	511	1039	1335	303	242	122	89	21	3921
Chione fluctrifraga	Pacific Smooth Venus	19	27	142	189	33	43	14	8	3	478
Amiantis callosa	Pacific White Venus										0
Tresus nuttalli	Pacific Gaper	23	74	78	106	14	22	14	6		337
Tivela stultorum	Pismo Clam		9	8	6	2					25
Argopecten sp.	Calico Scallop	6	32	74	116	28	33	8	12	1	310
Ostrea lurida	Native Pacific Oyster	106	213	458	741	187	187	67	31	11	2001
Crepidula onyx	Onyx Slipper Shell			1	4	7	1				13
Protothaca staminea	Common Pacific Littleneck	72	153	389	578	153	182	61	24	11	1623
Tagelus californianus	California Jackknife Clam		3	8	13	5	7	1			37
Macoma nasuta	Bent-nose Macoma				6						6
Saxidomus nuttailli	Common Washington Clam				12	4					16
Tegula aureotincta	Gilded Tegula						1				1
Donas gouidii	Gould's Wedge Shell										0
Donas californicus	California Donax										0
Ocenebra poulsoni	Poulson's Dwarf Triton										0
Kelletia kellitii	Kellett's Welk										0
Nassarius tegula	Western Mud Welk										0
Nassarius mendicus	Western Lean Nassa										0
Cerithidea californica	California Horn Shell										0
Mytilus californianus	California Mussel				1						1
Polinices lewisii	Lewis' Moon Shell			7	14						21
Mopalia ciliata	Hairy Mopalia			1	2						3
Hailotis cracherodii	Black Abalone			3	2	23					28
Olivella biplicata	Purple Dwarf Olive	7	6								13
Astraea undosa	Wavy Turban										0
Tegula funebralis	Black Tegula				2						2
Macron lividus	Livid Macron										0
Serpulorbis sp.	Western Scaled Worm Shell										0
Conus californicus	California Cone										0
Trachycardium quadragenum	Spiny Cockle			13							13
Nuttallia nuttallia	Purple Clam				20	3	9		2	1	35
Total Identified		816	1556	3340	4663	1055	1021	463	312	56	13282
Total Unidentified		61	76	71	160	81	87	38	23	12	609

Table C.5. Test Pit 9A Excavation Number of Individual Specimens.

Scientific Name	Common Name	Level							Totals
		1&2	3	4	5	6	7	8	
Chione californiensis	Common California Venus	522	1459	781	303	124	63	12	3264
Chione undatella	Frilled California Venus	382	856	411	156	99	51	12	1967
Chione fluctrifraga	Pacific Smooth Venus	45	113	115	46	13	2		334
Amiantis callosa	Pacific White Venus		20	20					40
Tresus nuttalli	Pacific Gaper	26	113	104	21	1	5		270
Tivela stuitorum	Pismo Clam	1	2			4			7
Argopecten sp.	Calico Scallop	27	80	65	16	10			198
Ostrea lurida	Native Pacific Oyster	215	544	414	182	42	20	17	1434
Crepidula onyx	Onyx Slipper Shell		6				4		10
Protothaca staminea	Common Pacific Littleneck	78	299	262	91	27	19	3	779
Tagelus californianus	California Jackknife Clam	3	10	11	6	2	1		33
Macoma nasuta	Bent-nose Macoma		6						6
Saxidomus nuttailli	Common Washington Clam				1	1			2
Tegula aureotincta	Gilded Tegula								0
Donas gouidii	Gould's Wedge Shell								0
Donas californicus	California Donax								0
Ocenebra poulsoni	Poulson's Dwarf Triton								0
Kelletia kellitii	Kellett's Welk								0
Nassarius tegula	Western Mud Welk								0
Nassarius mendicus	Western Lean Nassa								0
Cerithidea californica	California Horn Shell								0
Mytilus californianus	California Mussel		1	2				1	4
Polinices lewisii	Lewis' Moon Shell								0
Mopalia ciliata	Hairy Mopalia			3					3
Hailotis cracherodii	Black Abalone		8	3					11
Olivella biplicata	Purple Dwarf Olive								0
Astraea undosa	Wavy Turban								0
Tegula funebralis	Black Tegula				1				1
Macron lividus	Livid Macron								0
Serpulorbis sp.	Western Scaled Worm Shell								0
Conus californicus	California Cone								0
Trachycardium quadragenum	Spiny Cockle								0
Nuttallia nuttallia	Purple Clam	3	8	6	2	1	1		21
Total Identified		1302	3525	2197	825	324	166	45	8384
Total Unidentified		34	92	78	56	14	12	1	287

Table C.6. Test Pit 12A Excavation Number of Individual Specimens.

Scientific Name	Common Name	Level									Totals
		1	2	3	4	5	6	7	8	9	
Chione californiensis	Common California Venus	85	678	1224	939	781	744	520	335	30	5336
Chione undatella	Frilled California Venus	52	418	1389	822	1102	763	549	325	44	5464
Chione fluctrifraga	Pacific Smooth Venus	15	21	84	62	984	41	71	55		1333
Amiantis callosa	Pacific White Venus					120					120
Tresus nuttalli	Pacific Gaper	2	47	338	76		64	63	8		598
Tivela stuitorum	Pismo Clam				3	72	3				78
Argopecten sp.	Calico Scallop	5	34	99	73		96	45	22	3	377
Ostrea lurida	Native Pacific Oyster	34	187	439	677	95	266	180	80	27	1985
Crepidula onyx	Onyx Slipper Shell		4	4	2	339	3		6		358
Protothaca staminea	Common Pacific Littleneck	8	124	240	485	1	184	121	84	11	1258
Tagelus californianus	California Jackknife Clam		9	55	12	315	2				393
Macoma nasuta	Bent-nose Macoma			5		5					10
Saxidomus nuttailli	Common Washington Clam							2		5	7
Tegula aureotincta	Gilded Tegula		1								1
Donas gouidii	Gould's Wedge Shell										0
Donas californicus	California Donax										0
Ocenebra poulsoni	Poulson's Dwarf Triton										0
Kelletia kellitii	Kellett's Welk										0
Nassarius tegula	Western Mud Welk										0
Nassarius mendicus	Western Lean Nassa										0
Cerithidea californica	California Horn Shell										0
Mytilus californianus	California Mussel		1								1
Polinices lewisii	Lewis' Moon Shell										0
Mopalia ciliata	Hairy Mopalia				2						2
Hailotis cracherodii	Black Abalone			1		1	3				5
Olivella biplicata	Purple Dwarf Olive										0
Astraea undosa	Wavy Turban										0
Tegula funebralis	Black Tegula								1		1
Macron lividus	Livid Macron										0
Serpulorbis sp.	Western Scaled Worm Shell					1					1
Conus californicus	California Cone										0
Trachycardium quadragenum	Spiny Cockle					2					2
Nuttallia nuttallia	Purple Clam		2	30	7	15					54
Total Identified		201	1526	3908	3160	3833	2169	1551	916	120	17384
Total Unidentified		41	607	868	348	1243	1003	667	598	77	5452

Table C.7. Test Pit 13 Excavation Number of Individual Specimens.

Scientific Name	Common Name	Level								Totals
		1	2	3	4	5	6	7	8	
Chione californiensis	Common California Venus	1016	641	438	370	352	70	122	3	3012
Chione undatella	Frilled California Venus	1384	600	316	189	183	82	125	6	2885
Chione fluctrifraga	Pacific Smooth Venus	111	61	52	20	18	13	10		285
Amiantis callosa	Pacific White Venus									0
Tresus nuttalli	Pacific Gaper	65	35	21	3	13	6	5	1	149
Tivela stuitorum	Pismo Clam									0
Argopecten sp.	Calico Scallop	90	55	40	10	11		2	1	209
Ostrea lurida	Native Pacific Oyster	382	372	194	33	44	17	19	8	1069
Crepidula onyx	Onyx Slipper Shell	5								5
Protothaca staminea	Common Pacific Littleneck	223	101	200	17	59	8	8	5	621
Tagelus californianus	California Jackknife Clam	2	4	5						11
Macoma nasuta	Bent-nose Macoma			2						2
Saxidomus nuttailli	Common Washington Clam									0
Tegula aureotincta	Gilded Tegula									0
Donas gouidii	Gould's Wedge Shell									0
Donas californicus	California Donax									0
Ocenebra poulsoni	Poulson's Dwarf Triton		2							2
Kelletia kellitii	Kellett's Welk									0
Nassarius tegula	Western Mud Welk									0
Nassarius mendicus	Western Lean Nassa									0
Cerithidea californica	California Horn Shell	1								1
Mytilus californianus	California Mussel									0
Polinices lewisii	Lewis' Moon Shell									0
Mopalia ciliata	Hairy Mopalia									0
Hailotis cracherodii	Black Abalone	11	1				9			21
Olivella biplicata	Purple Dwarf Olive									0
Astraea undosa	Wavy Turban									0
Tegula funebralis	Black Tegula									0
Macron lividus	Livid Macron									0
Serpulorbis sp.	Western Scaled Worm Shell									0
Conus californicus	California Cone									0
Trachycardium quadragenum	Spiny Cockle									0
Nuttallia nuttallia	Purple Clam	14	6	2				1		23
Total Identified		3304	1878	1270	642	680	205	292	24	8295
Total Unidentified		575	339	448	476	381	183	231	9	2642

Table C.8. Test Pit 14 Excavation Number of Individual Specimens.

Scientific Name	Common Name	Level								Totals
		1	2	3	4	5	6	7	8	
Chione californiensis	Common California Venus	109	416	755	1098	1161	634	171		4344
Chione undatella	Frilled California Venus	105	277	398	823	803	445	101	16	2968
Chione fluctrifraga	Pacific Smooth Venus	23	45	63	144	120	59	23		477
Amiantis callosa	Pacific White Venus					18				18
Tresus nuttalli	Pacific Gaper	19	79	95	204		166	36		599
Tivela stuitorum	Pismo Clam					5				5
Argopecten sp.	Calico Scallop	22	201	82	126	222	135	62	2	852
Ostrea lurida	Native Pacific Oyster	79		547	978	1460	840	266	12	4182
Crepidula onyx	Onyx Slipper Shell		5	4			9	1		19
Protothaca staminea	Common Pacific Littleneck	36	139	212	478	581	310	85	10	1851
Tagelus californianus	California Jackknife Clam	2	8	13	27		30	18	1	99
Macoma nasuta	Bent-nose Macoma		1		1		6			8
Saxidomus nuttailli	Common Washington Clam									0
Tegula aureotincta	Gilded Tegula				1					1
Donas gouidii	Gould's Wedge Shell									0
Donas californicus	California Donax									0
Ocenebra poulsoni	Poulson's Dwarf Triton									0
Kelletia kellitii	Kellett's Welk									0
Nassarius tegula	Western Mud Welk									0
Nassarius mendicus	Western Lean Nassa									0
Cerithidea californica	California Horn Shell					1				1
Mytilus californianus	California Mussel		1	1			2	1		5
Polinices lewisii	Lewis' Moon Shell									0
Mopalia ciliata	Hairy Mopalia									0
Hailotis cracherodii	Black Abalone		15			3		1		19
Olivella biplicata	Purple Dwarf Olive									0
Astraea undosa	Wavy Turban									0
Tegula funebralis	Black Tegula		1			3	1			5
Macron lividus	Livid Macron									0
Serpulorbis sp.	Western Scaled Worm Shell		1							1
Conus californicus	California Cone									0
Trachycardium quadragenum	Spiny Cockle									0
Nuttallia nuttallia	Purple Clam		2		4		7			13
Total Identified		395	1191	2170	3884	4377	2644	765	41	15467
Total Unidentified		63	250	251	816	930	520	8	7	2845

Table C.9. Test Pit 1A Excavation Number of Individual Specimens.

Scientific Name	Common Name	Level						Totals
		1	2	3	4	5	6	
Chione californiensis	Common California Venus	23	16	14	15	5	5	78
Chione undatella	Frilled California Venus	17	16	10	10	10	2	65
Chione fluctrifraga	Pacific Smooth Venus	2	3	2	3	1	1	12
Amiantis callosa	Pacific White Venus							0
Tresus nuttalli	Pacific Gaper	1	1	2			1	5
Tivela stuitorum	Pismo Clam							0
Argopecten sp.	Calico Scallop	3	3	2	1		1	10
Ostrea lurida	Native Pacific Oyster	17	19	14	15	4	2	71
Crepidula onyx	Onyx Slipper Shell	1			1			2
Protothaca staminea	Common Pacific Littleneck	3	3	3	3	1	2	15
Tagelus californianus	California Jackknife Clam			1				1
Macoma nasuta	Bent-nose Macoma							0
Saxidomus nuttailli	Common Washington Clam							0
Tegula aureotincta	Gilded Tegula							0
Donas gouidii	Gould's Wedge Shell							0
Donas californicus	California Donax							0
Ocenebra poulsoni	Poulson's Dwarf Triton							0
Kelletia kellitii	Kellett's Welk							0
Nassarius tegula	Western Mud Welk							0
Nassarius mendicus	Western Lean Nassa							0
Cerithidea californica	California Horn Shell							0
Mytilus californianus	California Mussel							0
Polinices lewisii	Lewis' Moon Shell				1			1
Mopalia ciliata	Hairy Mopalia							0
Hailotis cracherodii	Black Abalone							0
Olivella biplicata	Purple Dwarf Olive							0
Astraea undosa	Wavy Turban							0
Tegula funebralis	Black Tegula							0
Macron lividus	Livid Macron							0
Serpulorbis sp.	Western Scaled Worm Shell							0
Conus californicus	California Cone							0
Trachycardium quadragenum	Spiny Cockle							0
Nuttallia nuttallia	Purple Clam	3	1	1	1			6
Total Identified		70	62	49	50	21	14	266

Table C.10. Test Pit 2A Excavation Number of Individual Specimens.

Scientific Name	Common Name	Level						Totals
		1	2	3	4	5	6	
Chione californiensis	Common California Venus	23	47	30	8	6	3	117
Chione undatella	Frilled California Venus	16	45	30	8	8	3	110
Chione fluctrifraga	Pacific Smooth Venus			2	1			3
Amiantis callosa	Pacific White Venus		1					1
Tresus nuttalli	Pacific Gaper		3			1		4
Tivela stuitorum	Pismo Clam		2					2
Argopecten sp.	Calico Scallop	2	10	5	1	2	1	21
Ostrea lurida	Native Pacific Oyster	13	32	14	8	5	5	77
Crepidula onyx	Onyx Slipper Shell		2					2
Protothaca staminea	Common Pacific Littleneck		15	9		1	2	27
Tagelus californianus	California Jackknife Clam					1		1
Macoma nasuta	Bent-nose Macoma			1				1
Saxidomus nuttailli	Common Washington Clam							0
Tegula aureotincta	Gilded Tegula		1					1
Donas gouidii	Gould's Wedge Shell							0
Donas californicus	California Donax							0
Ocenebra poulsoni	Poulson's Dwarf Triton							0
Kelletia kellitii	Kellett's Welk							0
Nassarius tegula	Western Mud Welk							0
Nassarius mendicus	Western Lean Nassa						1	1
Cerithidea californica	California Horn Shell							0
Mytilus californianus	California Mussel							0
Polinices lewisii	Lewis' Moon Shell							0
Mopalia ciliata	Hairy Mopalia							0
Hailotis cracherodii	Black Abalone		1					1
Olivella biplicata	Purple Dwarf Olive			1				1
Astraea undosa	Wavy Turban							0
Tegula funebralis	Black Tegula							0
Macron lividus	Livid Macron							0
Serpulorbis sp.	Western Scaled Worm Shell							0
Conus californicus	California Cone							0
Trachycardium quadragenum	Spiny Cockle							0
Nuttallia nuttallia	Purple Clam							0
Total Identified		54	159	92	26	24	15	370
Total Unidentified							1	1

Table C.11. Test Pit 7 Excavation Minimum Number of Individuals.

Scientific Name	Common Name	Level					Totals
		1	2	3	4	5	
Chione californiensis	Common California Venus	10	56	27	7		100
Chione undatella	Frilled California Venus	6	33	14	5	1	59
Chione fluctrifraga	Pacific Smooth Venus	1	5	1			7
Amiantis callosa	Pacific White Venus						0
Tresus nuttalli	Pacific Gaper	1	6		1		8
Tivela stuitorum	Pismo Clam			3			3
Argopecten sp.	Calico Scallop	1	5	4	1		11
Ostrea lurida	Native Pacific Oyster	12	76	36	10	2	136
Crepidula onyx	Onyx Slipper Shell						0
Protothaca staminea	Common Pacific Littleneck	5	28	16	3	2	54
Tagelus californianus	California Jackknife Clam						0
Macoma nasuta	Bent-nose Macoma						0
Saxidomus nuttailli	Common Washington Clam						0
Tegula aureotincta	Gilded Tegula						0
Donas gouidii	Gould's Wedge Shell						0
Donas californicus	California Donax						0
Ocenebra poulsoni	Poulson's Dwarf Triton						0
Kelletia kellitii	Kellett's Welk						0
Nassarius tegula	Western Mud Welk						0
Nassarius mendicus	Western Lean Nassa						0
Cerithidea californica	California Horn Shell						0
Mytilus californianus	California Mussel						0
Polinices lewisii	Lewis' Moon Shell						0
Mopalia ciliata	Hairy Mopalia						0
Hailotis cracherodii	Black Abalone						0
Olivella biplicata	Purple Dwarf Olive						0
Astraea undosa	Wavy Turban						0
Tegula funebralis	Black Tegula		1	1			2
Macron lividus	Livid Macron						0
Serpulorbis sp.	Western Scaled Worm Shell						0
Conus californicus	California Cone						0
Trachycardium quadragenum	Spiny Cockle						0
Nuttallia nuttallia	Purple Clam	1	6	3			10
Total Identified		37	216	105	27	5	390
Total Unidentified							0

Table C.12. Test Pit 8B Excavation Minimum Number of Individuals.

Scientific Name	Common Name	Level									Totals
		1	2	3	4	5	6	7	8	9	
Chione californiensis	Common California Venus	26	32	72	104	22	25	12	3	1	297
Chione undatella	Frilled California Venus	22	39	67	89	21	19	10	8	1	276
Chione fluctrifraga	Pacific Smooth Venus	2	2	11	8	4	3	1		1	32
Amiantis callosa	Pacific White Venus										0
Tresus nuttalli	Pacific Gaper	3	6	6	9	4	2	2	1		33
Tivela stuitorum	Pismo Clam		1		1						2
Argopecten sp.	Calico Scallop	2	4	14	29	6	8	1	2		66
Ostrea lurida	Native Pacific Oyster	28	59	89	138	37	42	16	6	5	420
Crepidula onyx	Onyx Slipper Shell			1	6	1	1		1	1	11
Protothaca staminea	Common Pacific Littleneck	8	21	67	104	17	21	9	4	1	252
Tagelus californianus	California Jackknife Clam		1	4	6	4	4	2			21
Macoma nasuta	Bent-nose Macoma		1		3						4
Saxidomus nuttailli	Common Washington Clam				1						1
Tegula aureotincta	Gilded Tegula						1				1
Donas gouidii	Gould's Wedge Shell										0
Donas californicus	California Donax										0
Ocenebra poulsoni	Poulson's Dwarf Triton										0
Kelletia kellitii	Kellett's Welk										0
Nassarius tegula	Western Mud Welk										0
Nassarius mendicus	Western Lean Nassa										0
Cerithidea californica	California Horn Shell			2	1						3
Mytilus californianus	California Mussel				1		1				2
Polinices lewisii	Lewis' Moon Shell			1	1						2
Mopalia ciliata	Hairy Mopalia			1		1	1				3
Hailotis cracherodii	Black Abalone										0
Olivella biplicata	Purple Dwarf Olive	5	1								6
Astraea undosa	Wavy Turban										0
Tegula funebralis	Black Tegula				1				1		2
Macron lividus	Livid Macron										0
Serpulorbis sp.	Western Scaled Worm Shell										0
Conus californicus	California Cone										0
Trachycardium quadragenum	Spiny Cockle										0
Nuttallia nuttallia	Purple Clam										0
Total Identified		96	167	335	502	117	128	53	26	10	1434
Total Unidentified				6	10	2	4	1	1	1	25

Table C.13. Test Pit 9A Excavation Minimum Number of Individuals.

Scientific Name	Common Name	Level							Totals
		1&2	3	4	5	6	7	8	
Chione californiensis	Common California Venus	50	104	49	18	8	4	1	234
Chione undatella	Frilled California Venus	25	57	22	8	4	3	1	120
Chione fluctrifraga	Pacific Smooth Venus	5	8	7	4				24
Amiantis callosa	Pacific White Venus		1						1
Tresus nuttalli	Pacific Gaper	3	9	4	4		1		21
Tivela stultorum	Pismo Clam			4					4
Argopecten sp.	Calico Scallop	3	13	9	5	1	1		32
Ostrea lurida	Native Pacific Oyster	49	110	81	41	11	7	2	301
Crepidula onyx	Onyx Slipper Shell		6						6
Protothaca staminea	Common Pacific Littleneck	11	37	33	13	5	4	1	104
Tagelus californianus	California Jackknife Clam	2	10	4	6	2	1		25
Macoma nasuta	Bent-nose Macoma		1						1
Saxidomus nuttailli	Common Washington Clam								0
Tegula aureotincta	Gilded Tegula								0
Donas gouidii	Gould's Wedge Shell								0
Donas californicus	California Donax								0
Ocenebra poulsoni	Poulson's Dwarf Triton								0
Kelletia kellitii	Kellett's Welk								0
Nassarius tegula	Western Mud Welk								0
Nassarius mendicus	Western Lean Nassa								0
Cerithidea californica	California Horn Shell		1						1
Mytilus californianus	California Mussel			1					1
Polinices lewisii	Lewis' Moon Shell								0
Mopalia ciliata	Hairy Mopalia								0
Hailotis cracherodii	Black Abalone								0
Olivella biplicata	Purple Dwarf Olive								0
Astraea undosa	Wavy Turban								0
Tegula funebralis	Black Tegula	1			1				2
Macron lividus	Livid Macron								0
Serpulorbis sp.	Western Scaled Worm Shell								0
Conus californicus	California Cone								0
Trachycardium quadragenum	Spiny Cockle								0
Nuttallia nuttallia	Purple Clam		2	1		1	1	1	6
Total Identified		149	359	215	100	32	22	6	883
Total Unidentified									0

Table C.14. Test Pit 12A Excavation Minimum Number of Individuals.

Scientific Name	Common Name	Level								Totals
		1	2	3	4	5	6	7	8	
Chione californiensis	Common California Venus	7	42	77	67	68	47	37	31	376
Chione undatella	Frilled California Venus	4	25	38	61	59	47	26	24	284
Chione fluctrifraga	Pacific Smooth Venus	2	1	13	13	9		5	6	49
Amiantis callosa	Pacific White Venus									0
Tresus nuttalli	Pacific Gaper	1	4	24	10	7	2	4	2	54
Tivela stuitorum	Pismo Clam				1		1			2
Argopecten sp.	Calico Scallop	1	3	13	10	17	12	9	2	67
Ostrea lurida	Native Pacific Oyster	8	35	72	138	47	42	23	11	376
Crepidula onyx	Onyx Slipper Shell		2	10	12	4	4		4	36
Protothaca staminea	Common Pacific Littleneck	2	18	38	56	52	19	11	8	204
Tagelus californianus	California Jackknife Clam		1	14	2	4				21
Macoma nasuta	Bent-nose Macoma			6						6
Saxidomus nuttailli	Common Washington Clam									0
Tegula aureotincta	Gilded Tegula		1			1			1	3
Donas gouidii	Gould's Wedge Shell									0
Donas californicus	California Donax									0
Ocenebra poulsoni	Poulson's Dwarf Triton									0
Kelletia kellitii	Kellett's Welk									0
Nassarius tegula	Western Mud Welk									0
Nassarius mendicus	Western Lean Nassa									0
Cerithidea californica	California Horn Shell						1		1	2
Mytilus californianus	California Mussel									0
Polinices lewisii	Lewis' Moon Shell									0
Mopalia ciliata	Hairy Mopalia						1			1
Hailotis cracherodii	Black Abalone									0
Olivella biplicata	Purple Dwarf Olive									0
Astraea undosa	Wavy Turban									0
Tegula funebralis	Black Tegula			1		1			1	3
Macron lividus	Livid Macron									0
Serpulorbis sp.	Western Scaled Worm Shell									0
Conus californicus	California Cone			1						1
Trachycardium quadragenum	Spiny Cockle			1		1				2
Nuttallia nuttallia	Purple Clam		2	30	5	6				43
Total Identified		25	134	338	375	276	176	115	91	1530
Total Unidentified										0

Table C.15. Test Pit 13 Excavation Minimum Number of Individuals.

Scientific Name	Common Name	Level								Totals
		1	2	3	4	5	6	7	8	
Chione californiensis	Common California Venus	82	50	32	12	23	8	5	1	213
Chione undatella	Frilled California Venus	65	34	18	8	14	1	8		148
Chione fluctrifraga	Pacific Smooth Venus	12	13	5	3	2	2	2		39
Amiantis callosa	Pacific White Venus									0
Tresus nuttalli	Pacific Gaper	6	3	3				1	1	14
Tivela stuitorum	Pismo Clam									0
Argopecten sp.	Calico Scallop	15	8	7	2	2			1	35
Ostrea lurida	Native Pacific Oyster	91	53	46	9	10	26	3	4	242
Crepidula onyx	Onyx Slipper Shell	2								2
Protothaca staminea	Common Pacific Littleneck	30	10	15	2	4	1	2	1	65
Tagelus californianus	California Jackknife Clam	2		2						4
Macoma nasuta	Bent-nose Macoma			2						2
Saxidomus nuttailli	Common Washington Clam									0
Tegula aureotincta	Gilded Tegula									0
Donas gouidii	Gould's Wedge Shell									0
Donas californicus	California Donax									0
Ocenebra poulsoni	Poulson's Dwarf Triton		1							1
Kelletia kellitii	Kellett's Welk									0
Nassarius tegula	Western Mud Welk									0
Nassarius mendicus	Western Lean Nassa									0
Cerithidea californica	California Horn Shell	3		1	1					5
Mytilus californianus	California Mussel									0
Polinices lewisii	Lewis' Moon Shell	1								1
Mopalia ciliata	Hairy Mopalia			1						1
Hailotis cracherodii	Black Abalone	1								1
Olivella biplicata	Purple Dwarf Olive									0
Astraea undosa	Wavy Turban									0
Tegula funebralis	Black Tegula									0
Macron lividus	Livid Macron		1							1
Serpulorbis sp.	Western Scaled Worm Shell			1						1
Conus californicus	California Cone									0
Trachycardium quadragenum	Spiny Cockle									0
Nuttallia nuttallia	Purple Clam	7	3	2				1		13
Total Identified		317	176	135	37	55	38	22	8	788
Total Unidentified										

Table C.16. Test Pit 14 Excavation Minimum Number of Individuals.

Scientific Name	Common Name	Level								Totals
		1	2	3	4	5	6	7	8	
Chione californiensis	Common California Venus	9	29	67	78	85	46	10		324
Chione undatella	Frilled California Venus	9	20	50	52	56	26	6	1	220
Chione fluctrifraga	Pacific Smooth Venus	3	4	11	13	12	5	1		49
Amiantis callosa	Pacific White Venus					1				1
Tresus nuttalli	Pacific Gaper	1	5	15	15		12	3		51
Tivela stuitorum	Pismo Clam					1				1
Argopecten sp.	Calico Scallop	4	37	20	23	4	24	9	1	122
Ostrea lurida	Native Pacific Oyster	13		108	154	290	159	45	4	773
Crepidula onyx	Onyx Slipper Shell		2	8			20	2	1	33
Protothaca staminea	Common Pacific Littleneck	7	26	52	51	79	22	12	2	251
Tagelus californianus	California Jackknife Clam	1		1	5		13	6		26
Macoma nasuta	Bent-nose Macoma		1		2		5			8
Saxidomus nuttailli	Common Washington Clam									0
Tegula aureotincta	Gilded Tegula				1					1
Donas gouidii	Gould's Wedge Shell									0
Donas californicus	California Donax									0
Ocenebra poulsoni	Poulson's Dwarf Triton									0
Kelletia kellitii	Kellett's Welk									0
Nassarius tegula	Western Mud Welk									0
Nassarius mendicus	Western Lean Nassa									0
Cerithidea californica	California Horn Shell		1			1				2
Mytilus californianus	California Mussel		1					1		2
Polinices lewisii	Lewis' Moon Shell	1								1
Mopalia ciliata	Hairy Mopalia				1					1
Hailotis cracherodii	Black Abalone		1							1
Olivella biplicata	Purple Dwarf Olive									0
Astraea undosa	Wavy Turban						1			1
Tegula funebralis	Black Tegula			1		1	1			3
Macron lividus	Livid Macron				1		1			2
Serpulorbis sp.	Western Scaled Worm Shell									0
Conus californicus	California Cone									0
Trachycardium quadragenum	Spiny Cockle									0
Nuttallia nuttallia	Purple Clam		2		3		5			10
Total Identified		48	129	333	399	530	340	95	9	1883
Total Unidentified										

Table C.17. Test Pit 1A Flotation Number of Individual Specimens.

Scientific Name	Common Name	Level							Totals
		1	2	3	4	5	6	7	
Chione californiensis	Common California Venus	24	8		1				33
Chione undatella	Frilled California Venus	12	14	4	2	1		5	38
Chione fluctrifraga	Pacific Smooth Venus	2	5	1					8
Amiantis callosa	Pacific White Venus								0
Tresus nuttalli	Pacific Gaper		3						3
Tivela stuitorum	Pismo Clam								0
Argopecten sp.	Calico Scallop	2		2		1			5
Ostrea lurida	Native Pacific Oyster	10	7	4	2				23
Crepidula onyx	Onyx Slipper Shell								0
Protothaca staminea	Common Pacific Littleneck	8	7	5	1				21
Tagelus californianus	California Jackknife Clam								0
Macoma nasuta	Bent-nose Macoma								0
Saxidomus nuttailli	Common Washington Clam								0
Tegula aureotincta	Gilded Tegula								0
Donas gouidii	Gould's Wedge Shell								0
Donas californicus	California Donax								0
Ocenebra poulsoni	Poulson's Dwarf Triton								0
Kelletia kellitii	Kellett's Welk								0
Nassarius tegula	Western Mud Welk								0
Nassarius mendicus	Western Lean Nassa								0
Cerithidea californica	California Horn Shell								0
Mytilus californianus	California Mussel								0
Polinices lewisii	Lewis' Moon Shell								0
Mopalia ciliata	Hairy Mopalia								0
Hailotis cracherodii	Black Abalone								0
Olivella biplicata	Purple Dwarf Olive								0
Astraea undosa	Wavy Turban								0
Tegula funebralis	Black Tegula								0
Macron lividus	Livid Macron								0
Serpulorbis sp.	Western Scaled Worm Shell								0
Conus californicus	California Cone								0
Trachycardium quadragenum	Spiny Cockle								0
Nuttallia nuttallia	Purple Clam								0
Total Identified		58	44	16	6	2	0	5	131
Total Unidentified		35	26	9	2	5	1	1	79

Table C.18. Test Pit 2A Flotation Number of Individual Specimens.

Scientific Name	Common Name	Level						Totals
		1	2	3	4	5	6	
Chione californiensis	Common California Venus	26	45	10	1	2	34	118
Chione undatella	Frilled California Venus	32	8	8	1	3	3	55
Chione fluctrifraga	Pacific Smooth Venus							0
Amiantis callosa	Pacific White Venus	1						1
Tresus nuttalli	Pacific Gaper	2						2
Tivela stuitorum	Pismo Clam							0
Argopecten sp.	Calico Scallop	11	5	3			1	20
Ostrea lurida	Native Pacific Oyster	12	13	14	1	1	6	47
Crepidula onyx	Onyx Slipper Shell							0
Protothaca staminea	Common Pacific Littleneck	9	5	7			2	23
Tagelus californianus	California Jackknife Clam		1					1
Macoma nasuta	Bent-nose Macoma							0
Saxidomus nuttailli	Common Washington Clam							0
Tegula aureotincta	Gilded Tegula							0
Donas gouidii	Gould's Wedge Shell							0
Donas californicus	California Donax							0
Ocenebra poulsoni	Poulson's Dwarf Triton							0
Kelletia kellitii	Kellett's Welk							0
Nassarius tegula	Western Mud Welk							0
Nassarius mendicus	Western Lean Nassa							0
Cerithidea californica	California Horn Shell							0
Mytilus californianus	California Mussel							0
Polinices lewisii	Lewis' Moon Shell							0
Mopalia ciliata	Hairy Mopalia							0
Hailotis cracherodii	Black Abalone							0
Olivella biplicata	Purple Dwarf Olive							0
Astraea undosa	Wavy Turban							0
Tegula funebralis	Black Tegula							0
Macron lividus	Livid Macron							0
Serpulorbis sp.	Western Scaled Worm Shell							0
Conus californicus	California Cone							0
Trachycardium quadragenum	Spiny Cockle							0
Nuttallia nuttallia	Purple Clam							0
Total Identified		93	77	42	3	6	46	267
Total Unidentified		210	155	122	9	12	32	540

Table C.19. Test Pit 7 Flotation Number of Individual Specimens.

Scientific Name	Common Name	Level				Totals
		1	2	3	4	
Chione californiensis	Common California Venus		6	6		12
Chione undatella	Frilled California Venus			2		2
Chione fluctrifraga	Pacific Smooth Venus					0
Amiantis callosa	Pacific White Venus					0
Tresus nuttalli	Pacific Gaper					0
Tivela stuitorum	Pismo Clam					0
Argopecten sp.	Calico Scallop					0
Ostrea lurida	Native Pacific Oyster		2			2
Crepidula onyx	Onyx Slipper Shell					0
Protothaca staminea	Common Pacific Littleneck		2			2
Tagelus californianus	California Jackknife Clam					0
Macoma nasuta	Bent-nose Macoma					0
Saxidomus nuttailli	Common Washington Clam					0
Tegula aureotincta	Gilded Tegula					0
Donas gouidii	Gould's Wedge Shell					0
Donas californicus	California Donax					0
Ocenebra poulsoni	Poulson's Dwarf Triton					0
Kelletia kellitii	Kellett's Welk					0
Nassarius tegula	Western Mud Welk					0
Nassarius mendicus	Western Lean Nassa					0
Cerithidea californica	California Horn Shell					0
Mytilus californianus	California Mussel					0
Polinices lewisii	Lewis' Moon Shell					0
Mopalia ciliata	Hairy Mopalia					0
Hailotis cracherodii	Black Abalone					0
Olivella biplicata	Purple Dwarf Olive					0
Astraea undosa	Wavy Turban					0
Tegula funebralis	Black Tegula					0
Macron lividus	Livid Macron					0
Serpulorbis sp.	Western Scaled Worm Shell					0
Conus californicus	California Cone					0
Trachycardium quadragenum	Spiny Cockle					0
Nuttallia nuttallia	Purple Clam					0
Total Identified			10	8	0	18
Total Unidentified			11	10	5	26

Table C.20. Test Pit 8B Flotation Number of Individual Specimens.

Scientific Name	Common Name	Level									Totals
		1	2	3	4	5	6	7	8	9	
Chione californiensis	Common California Venus				24	12	3	1	12		52
Chione undatella	Frilled California Venus			9	28	3	6		7		53
Chione fluctrifraga	Pacific Smooth Venus				2		6	4			12
Amiantis callosa	Pacific White Venus										0
Tresus nuttalli	Pacific Gaper				1				3		4
Tivela stuitorum	Pismo Clam										0
Argopecten sp.	Calico Scallop			1	4	2					7
Ostrea lurida	Native Pacific Oyster			8	10	10		4	8		40
Crepidula onyx	Onyx Slipper Shell										0
Protothaca staminea	Common Pacific Littleneck			11	169	3	2	1	9		195
Tagelus californianus	California Jackknife Clam				1						1
Macoma nasuta	Bent-nose Macoma										0
Saxidomus nuttailli	Common Washington Clam										0
Tegula aureotincta	Gilded Tegula										0
Donas gouidii	Gould's Wedge Shell										0
Donas californicus	California Donax										0
Ocenebra poulsoni	Poulson's Dwarf Triton										0
Kelletia kellitii	Kellett's Welk										0
Nassarius tegula	Western Mud Welk										0
Nassarius mendicus	Western Lean Nassa										0
Cerithidea californica	California Horn Shell										0
Mytilus californianus	California Mussel										0
Polinices lewisii	Lewis' Moon Shell										0
Mopalia ciliata	Hairy Mopalia										0
Hailotis cracherodii	Black Abalone										0
Olivella biplicata	Purple Dwarf Olive										0
Astraea undosa	Wavy Turban										0
Tegula funebralis	Black Tegula										0
Macron lividus	Livid Macron										0
Serpulorbis sp.	Western Scaled Worm Shell										0
Conus californicus	California Cone										0
Trachycardium quadragenum	Spiny Cockle										0
Nuttallia nuttallia	Purple Clam					1					1
Total Identified				29	239	31	17	10	39	0	365
Total Unidentified				43	83	31	9	5	15	4	190

Table C.21. Test Pit 9A Flotation Number of Individual Specimens.

Scientific Name	Common Name	Level					Totals
		1&2	3	4	5	6	
Chione californiensis	Common California Venus		48	8			56
Chione undatella	Frilled California Venus		31	7			38
Chione fluctrifraga	Pacific Smooth Venus		2	5			7
Amiantis callosa	Pacific White Venus						0
Tresus nuttalli	Pacific Gaper		2				2
Tivela stuitorum	Pismo Clam						0
Argopecten sp.	Calico Scallop		6	2			8
Ostrea lurida	Native Pacific Oyster		21	17	2		40
Crepidula onyx	Onyx Slipper Shell		1				1
Protothaca staminea	Common Pacific Littleneck		6	6			12
Tagelus californianus	California Jackknife Clam		1	1			2
Macoma nasuta	Bent-nose Macoma						0
Saxidomus nuttailli	Common Washington Clam						0
Tegula aureotincta	Gilded Tegula						0
Donas gouidii	Gould's Wedge Shell						0
Donas californicus	California Donax						0
Ocenebra poulsoni	Poulson's Dwarf Triton						0
Kelletia kellitii	Kellett's Welk						0
Nassarius tegula	Western Mud Welk						0
Nassarius mendicus	Western Lean Nassa						0
Cerithidea californica	California Horn Shell						0
Mytilus californianus	California Mussel						0
Polinices lewisii	Lewis' Moon Shell						0
Mopalia ciliata	Hairy Mopalia						0
Hailotis cracherodii	Black Abalone						0
Olivella biplicata	Purple Dwarf Olive						0
Astraea undosa	Wavy Turban						0
Tegula funebralis	Black Tegula						0
Macron lividus	Livid Macron						0
Serpulorbis sp.	Western Scaled Worm Shell						0
Conus californicus	California Cone						0
Trachycardium quadragenum	Spiny Cockle						0
Nuttallia nuttallia	Purple Clam			1	1		2
Total Identified			118	47	3	0	168
Total Unidentified			111	79	6	3	199

Table C.22. Test Pit 12A Flotation Number of Individual Specimens.

Scientific Name	Common Name	Level								Totals
		1	2	3	4	5	6	7	8	
Chione californiensis	Common California Venus	26	20	28	65	1	1	2	5	148
Chione undatella	Frilled California Venus	15	8	61	71	9	7	19		190
Chione fluctrifraga	Pacific Smooth Venus			10	17	1				28
Amiantis callosa	Pacific White Venus	2								2
Tresus nuttalli	Pacific Gaper			12	18	2	6			38
Tivela stuitorum	Pismo Clam		1		3					4
Argopecten sp.	Calico Scallop	1	2	6	9					18
Ostrea lurida	Native Pacific Oyster	4	16	22	28	3	7	4		84
Crepidula onyx	Onyx Slipper Shell				6					6
Protothaca staminea	Common Pacific Littleneck	9	6	20	36	5	7	2		85
Tagelus californianus	California Jackknife Clam			1	5					6
Macoma nasuta	Bent-nose Macoma			2						2
Saxidomus nuttailli	Common Washington Clam									0
Tegula aureotincta	Gilded Tegula									0
Donas gouidii	Gould's Wedge Shell									0
Donas californicus	California Donax									0
Ocenebra poulsoni	Poulson's Dwarf Triton									0
Kelletia kellitii	Kellett's Welk									0
Nassarius tegula	Western Mud Welk									0
Nassarius mendicus	Western Lean Nassa									0
Cerithidea californica	California Horn Shell			1						1
Mytilus californianus	California Mussel									0
Polinices lewisii	Lewis' Moon Shell									0
Mopalia ciliata	Hairy Mopalia									0
Hailotis cracherodii	Black Abalone									0
Olivella biplicata	Purple Dwarf Olive									0
Astraea undosa	Wavy Turban									0
Tegula funebralis	Black Tegula						2			2
Macron lividus	Livid Macron									0
Serpulorbis sp.	Western Scaled Worm Shell									0
Conus californicus	California Cone									0
Trachycardium quadragenum	Spiny Cockle									0
Nuttallia nuttallia	Purple Clam				3					3
Total Identified		57	53	163	261	21	30	27	5	617
Total Unidentified		91	101	69	?	37	53	23	7	381

Table C.23. Test Pit 13 Flotation Number of Individual Specimens.

Scientific Name	Common Name	Level								Totals
		1	2	3	4	5	6	7	8	
Chione californiensis	Common California Venus	34	10	7	15	6	6	14		92
Chione undatella	Frilled California Venus		4	2	9	10		21	4	50
Chione fluctrifraga	Pacific Smooth Venus					4			1	5
Amiantis callosa	Pacific White Venus									0
Tresus nuttalli	Pacific Gaper		2							2
Tivela stuitorum	Pismo Clam									0
Argopecten sp.	Calico Scallop				1	1		1		3
Ostrea lurida	Native Pacific Oyster	2	2	4	3		1	3	3	18
Crepidula onyx	Onyx Slipper Shell									0
Protothaca staminea	Common Pacific Littleneck	5	2	3	4	3	3	3	5	28
Tagelus californianus	California Jackknife Clam									0
Macoma nasuta	Bent-nose Macoma									0
Saxidomus nuttailli	Common Washington Clam									0
Tegula aureotincta	Gilded Tegula									0
Donas gouidii	Gould's Wedge Shell									0
Donas californicus	California Donax									0
Ocenebra poulsoni	Poulson's Dwarf Triton									0
Kelletia kellitii	Kellett's Welk									0
Nassarius tegula	Western Mud Welk									0
Nassarius mendicus	Western Lean Nassa									0
Cerithidea californica	California Horn Shell									0
Mytilus californianus	California Mussel									0
Polinices lewisii	Lewis' Moon Shell									0
Mopalia ciliata	Hairy Mopalia									0
Hailotis cracherodii	Black Abalone									0
Olivella biplicata	Purple Dwarf Olive									0
Astraea undosa	Wavy Turban									0
Tegula funebralis	Black Tegula									0
Macron lividus	Livid Macron									0
Serpulorbis sp.	Western Scaled Worm Shell									0
Conus californicus	California Cone									0
Trachycardium quadragenum	Spiny Cockle									0
Nuttallia nuttallia	Purple Clam									0
Total Identified		41	20	16	32	24	10	42	13	198
Total Unidentified		36	64	45	29	9	24	19	1	227

Table C.24. Test Pit 14 Flotation Number of Individual Specimens.

Scientific Name	Common Name	Level							Totals
		1	2	3	4	5	6	7	
Chione californiensis	Common California Venus	27	25	26	25	45	39	1	188
Chione undatella	Frilled California Venus	22	25	15	23	20	18	6	129
Chione fluctrifraga	Pacific Smooth Venus			2	1	7		4	14
Amiantis callosa	Pacific White Venus								0
Tresus nuttalli	Pacific Gaper		3	22	11	8			44
Tivela stuitorum	Pismo Clam								0
Argopecten sp.	Calico Scallop	5	4	24	14	15	3	1	66
Ostrea lurida	Native Pacific Oyster	22	22	56	53		37	9	199
Crepidula onyx	Onyx Slipper Shell	3				2			5
Protothaca staminea	Common Pacific Littleneck	34	26	42	26	23	21		172
Tagelus californianus	California Jackknife Clam	1	2	5	3	5	7		23
Macoma nasuta	Bent-nose Macoma								0
Saxidomus nuttailli	Common Washington Clam								0
Tegula aureotincta	Gilded Tegula								0
Donas gouidii	Gould's Wedge Shell								0
Donas californicus	California Donax								0
Ocenebra poulsoni	Poulson's Dwarf Triton								0
Kelletia kellitii	Kellett's Welk								0
Nassarius tegula	Western Mud Welk								0
Nassarius mendicus	Western Lean Nassa								0
Cerithidea californica	California Horn Shell								0
Mytilus californianus	California Mussel								0
Polinices lewisii	Lewis' Moon Shell								0
Mopalia ciliata	Hairy Mopalia					1			1
Hailotis cracherodii	Black Abalone								0
Olivella biplicata	Purple Dwarf Olive								0
Astraea undosa	Wavy Turban								0
Tegula funebralis	Black Tegula								0
Macron lividus	Livid Macron								0
Serpulorbis sp.	Western Scaled Worm Shell								0
Conus californicus	California Cone								0
Trachycardium quadragenum	Spiny Cockle								0
Nuttallia nuttallia	Purple Clam								0
Total Identified		114	107	192	156	126	125	21	841
Total Unidentified		283	279	455	321	235	224	4	1801

Table C.25. Test Pit 1A Flotation Minimum Number of Individuals.

Scientific Name	Common Name	Level							Totals
		1	2	3	4	5	6	7	
Chione californiensis	Common California Venus	2							2
Chione undatella	Frilled California Venus	3		1				1	5
Chione fluctrifraga	Pacific Smooth Venus	1							1
Amiantis callosa	Pacific White Venus								0
Tresus nuttalli	Pacific Gaper		1						1
Tivela stuitorum	Pismo Clam								0
Argopecten sp.	Calico Scallop								0
Ostrea lurida	Native Pacific Oyster	3	3	2					8
Crepidula onyx	Onyx Slipper Shell								0
Protothaca staminea	Common Pacific Littleneck	1		1					2
Tagelus californianus	California Jackknife Clam								0
Macoma nasuta	Bent-nose Macoma								0
Saxidomus nuttailli	Common Washington Clam								0
Tegula aureotincta	Gilded Tegula								0
Donas gouidii	Gould's Wedge Shell								0
Donas californicus	California Donax								0
Ocenebra poulsoni	Poulson's Dwarf Triton								0
Kelletia kellitii	Kellett's Welk								0
Nassarius tegula	Western Mud Welk								0
Nassarius mendicus	Western Lean Nassa								0
Cerithidea californica	California Horn Shell								0
Mytilus californianus	California Mussel								0
Polinices lewisii	Lewis' Moon Shell								0
Mopalia ciliata	Hairy Mopalia								0
Hailotis cracherodii	Black Abalone								0
Olivella biplicata	Purple Dwarf Olive								0
Astraea undosa	Wavy Turban								0
Tegula funebralis	Black Tegula								0
Macron lividus	Livid Macron								0
Serpulorbis sp.	Western Scaled Worm Shell								0
Conus californicus	California Cone								0
Trachycardium quadragenum	Spiny Cockle								0
Nuttallia nuttallia	Purple Clam								0
Total Identified		10	4	4	0	0	0	1	19
Total Unidentified									0

Table C.26. Test Pit 2A Flotation Minimum Number of Individuals.

Scientific Name	Common Name	Level						Totals
		1	2	3	4	5	6	
Chione californiensis	Common California Venus	2	2	2	1		2	9
Chione undatella	Frilled California Venus	3	1	2	1	1	1	9
Chione fluctrifraga	Pacific Smooth Venus							0
Amiantis callosa	Pacific White Venus							0
Tresus nuttalli	Pacific Gaper				1			1
Tivela stuitorum	Pismo Clam							0
Argopecten sp.	Calico Scallop	1	2	1				4
Ostrea lurida	Native Pacific Oyster	2	3	3	1		1	10
Crepidula onyx	Onyx Slipper Shell							0
Protothaca staminea	Common Pacific Littleneck		1	2				3
Tagelus californianus	California Jackknife Clam							0
Macoma nasuta	Bent-nose Macoma							0
Saxidomus nuttailli	Common Washington Clam							0
Tegula aureotincta	Gilded Tegula							0
Donas gouidii	Gould's Wedge Shell							0
Donas californicus	California Donax							0
Ocenebra poulsoni	Poulson's Dwarf Triton							0
Kelletia kellitii	Kellett's Welk							0
Nassarius tegula	Western Mud Welk							0
Nassarius mendicus	Western Lean Nassa							0
Cerithidea californica	California Horn Shell							0
Mytilus californianus	California Mussel							0
Polinices lewisii	Lewis' Moon Shell							0
Mopalia ciliata	Hairy Mopalia							0
Hailotis cracherodii	Black Abalone							0
Olivella biplicata	Purple Dwarf Olive							0
Astraea undosa	Wavy Turban							0
Tegula funebralis	Black Tegula							0
Macron lividus	Livid Macron							0
Serpulorbis sp.	Western Scaled Worm Shell							0
Conus californicus	California Cone							0
Trachycardium quadragenum	Spiny Cockle							0
Nuttallia nuttallia	Purple Clam							0
Total Identified		8	9	10	4	1	4	36
Total Unidentified								

Table C.27. Test Pit 7 Flotation Minimum Number of Individuals.

Scientific Name	Common Name	Level						Totals
		1	2	3	4	5	6	
Chione californiensis	Common California Venus			1				1
Chione undatella	Frilled California Venus							
Chione fluctrifraga	Pacific Smooth Venus							
Amiantis callosa	Pacific White Venus							
Tresus nuttalli	Pacific Gaper							
Tivela stuitorum	Pismo Clam							
Argopecten sp.	Calico Scallop							
Ostrea lurida	Native Pacific Oyster		1					1
Crepidula onyx	Onyx Slipper Shell							
Protothaca staminea	Common Pacific Littleneck							
Tagelus californianus	California Jackknife Clam							
Macoma nasuta	Bent-nose Macoma							
Saxidomus nuttailli	Common Washington Clam							
Tegula aureotincta	Gilded Tegula							
Donas gouidii	Gould's Wedge Shell							
Donas californicus	California Donax							
Ocenebra poulsoni	Poulson's Dwarf Triton							
Kelletia kellitii	Kellett's Welk							
Nassarius tegula	Western Mud Welk							
Nassarius mendicus	Western Lean Nassa							
Cerithidea californica	California Horn Shell							
Mytilus californianus	California Mussel							
Polinices lewisii	Lewis' Moon Shell							
Mopalia ciliata	Hairy Mopalia							
Hailotis cracherodii	Black Abalone							
Olivella biplicata	Purple Dwarf Olive							
Astraea undosa	Wavy Turban							
Tegula funebralis	Black Tegula							
Macron lividus	Livid Macron							
Serpulorbis sp.	Western Scaled Worm Shell							
Conus californicus	California Cone							
Trachycardium quadragenum	Spiny Cockle							
Nuttallia nuttallia	Purple Clam							
Total Identified		0						2
Total Unidentified								

Table C.28. Test Pit 8B Flotation Minimum Number of Individuals.

Scientific Name	Common Name	Level									Totals
		1	2	3	4	5	6	7	8	9	
Chione californiensis	Common California Venus			1	2	2		1	1		7
Chione undatella	Frilled California Venus			1	2				1		4
Chione fluctrifraga	Pacific Smooth Venus										0
Amiantis callosa	Pacific White Venus										0
Tresus nuttalli	Pacific Gaper										0
Tivela stuitorum	Pismo Clam										0
Argopecten sp.	Calico Scallop				1						1
Ostrea lurida	Native Pacific Oyster				2	5		1	3		11
Crepidula onyx	Onyx Slipper Shell					2					2
Protothaca staminea	Common Pacific Littleneck				3				1		4
Tagelus californianus	California Jackknife Clam				1						1
Macoma nasuta	Bent-nose Macoma										0
Saxidomus nuttailli	Common Washington Clam										0
Tegula aureotincta	Gilded Tegula										0
Donas gouidii	Gould's Wedge Shell										0
Donas californicus	California Donax										0
Ocenebra poulsoni	Poulson's Dwarf Triton										0
Kelletia kellitii	Kellett's Welk										0
Nassarius tegula	Western Mud Welk										0
Nassarius mendicus	Western Lean Nassa										0
Cerithidea californica	California Horn Shell										0
Mytilus californianus	California Mussel										0
Polinices lewisii	Lewis' Moon Shell										0
Mopalia ciliata	Hairy Mopalia										0
Hailotis cracherodii	Black Abalone										0
Olivella biplicata	Purple Dwarf Olive										0
Astraea undosa	Wavy Turban										0
Tegula funebralis	Black Tegula										0
Macron lividus	Livid Macron										0
Serpulorbis sp.	Western Scaled Worm Shell										0
Conus californicus	California Cone										0
Trachycardium quadragenum	Spiny Cockle										0
Nuttallia nuttallia	Purple Clam										0
Total Identified		0	0	2	11	9	0	2	6	0	30
Total Unidentified											0

Table C.29. Test Pit 9A Flotation Minimum Number of Individuals.

Scientific Name	Common Name	Level							Totals
		1	2	3	4	5	6	7	
Chione californiensis	Common California Venus			2	1				3
Chione undatella	Frilled California Venus			2					2
Chione fluctrifraga	Pacific Smooth Venus				1				1
Amiantis callosa	Pacific White Venus								0
Tresus nuttalli	Pacific Gaper			1					1
Tivela stuitorum	Pismo Clam								0
Argopecten sp.	Calico Scallop			2					2
Ostrea lurida	Native Pacific Oyster			4	5	1			10
Crepidula onyx	Onyx Slipper Shell			1					1
Protothaca staminea	Common Pacific Littleneck			1					1
Tagelus californianus	California Jackknife Clam			1	1				2
Macoma nasuta	Bent-nose Macoma			1					1
Saxidomus nuttailli	Common Washington Clam								0
Tegula aureotincta	Gilded Tegula								0
Donas gouidii	Gould's Wedge Shell								0
Donas californicus	California Donax								0
Ocenebra poulsoni	Poulson's Dwarf Triton								0
Kelletia kellitii	Kellett's Welk								0
Nassarius tegula	Western Mud Welk								0
Nassarius mendicus	Western Lean Nassa								0
Cerithidea californica	California Horn Shell								0
Mytilus californianus	California Mussel								0
Polinices lewisii	Lewis' Moon Shell								0
Mopalia ciliata	Hairy Mopalia								0
Hailotis cracherodii	Black Abalone								0
Olivella biplicata	Purple Dwarf Olive								0
Astraea undosa	Wavy Turban								0
Tegula funebralis	Black Tegula								0
Macron lividus	Livid Macron								0
Serpulorbis sp.	Western Scaled Worm Shell								0
Conus californicus	California Cone								0
Trachycardium quadragenum	Spiny Cockle								0
Nuttallia nuttallia	Purple Clam				1				1
Total Identified		0	0	15	9	1	0	0	25
Total Unidentified									0

Table C.30. Test Pit 12A Flotation Minimum Number of Individuals.

Scientific Name	Common Name	Level							Totals
		1	2	3	4	5	6	7	
Chione californiensis	Common California Venus	2	1	2	9			1	15
Chione undatella	Frilled California Venus	3	1	5	5	1	1	2	18
Chione fluctrifraga	Pacific Smooth Venus	1		1	2				4
Amiantis callosa	Pacific White Venus								0
Tresus nuttalli	Pacific Gaper			1	1				2
Tivela stuitorum	Pismo Clam		1						1
Argopecten sp.	Calico Scallop			2	1				3
Ostrea lurida	Native Pacific Oyster	2	1	2	5	1	2	1	14
Crepidula onyx	Onyx Slipper Shell				14				14
Protothaca staminea	Common Pacific Littleneck	2	1	3	5	1	2	1	15
Tagelus californianus	California Jackknife Clam				2				2
Macoma nasuta	Bent-nose Macoma			1					1
Saxidomus nuttailli	Common Washington Clam								0
Tegula aureotincta	Gilded Tegula								0
Donas gouidii	Gould's Wedge Shell								0
Donas californicus	California Donax								0
Ocenebra poulsoni	Poulson's Dwarf Triton								0
Kelletia kellitii	Kellett's Welk								0
Nassarius tegula	Western Mud Welk								0
Nassarius mendicus	Western Lean Nassa								0
Cerithidea californica	California Horn Shell			1	1				2
Mytilus californianus	California Mussel								0
Polinices lewisii	Lewis' Moon Shell								0
Mopalia ciliata	Hairy Mopalia								0
Hailotis cracherodii	Black Abalone								0
Olivella biplicata	Purple Dwarf Olive								0
Astraea undosa	Wavy Turban								0
Tegula funebralis	Black Tegula								0
Macron lividus	Livid Macron								0
Serpulorbis sp.	Western Scaled Worm Shell								0
Conus californicus	California Cone								0
Trachycardium quadragenum	Spiny Cockle								0
Nuttallia nuttallia	Purple Clam				2				2
Total Identified		10	5	18	47	3	5	5	93
Total Unidentified									0

Table C.31. Test Pit 13 Flotation Minimum Number of Individuals.

Scientific Name	Common Name	Level								Totals
		1	2	3	4	5	6	7	8	
Chione californiensis	Common California Venus	3	2	1	1	1		1		9
Chione undatella	Frilled California Venus		2		2	1		1		6
Chione fluctrifraga	Pacific Smooth Venus					1				1
Amiantis callosa	Pacific White Venus									0
Tresus nuttalli	Pacific Gaper									0
Tivela stuitorum	Pismo Clam									0
Argopecten sp.	Calico Scallop					1		1		2
Ostrea lurida	Native Pacific Oyster		1	1	1		1		1	5
Crepidula onyx	Onyx Slipper Shell									0
Protothaca staminea	Common Pacific Littleneck	1			1	1		1	1	5
Tagelus californianus	California Jackknife Clam									0
Macoma nasuta	Bent-nose Macoma									0
Saxidomus nuttailli	Common Washington Clam									0
Tegula aureotincta	Gilded Tegula									0
Donas gouidii	Gould's Wedge Shell									0
Donas californicus	California Donax									0
Ocenebra poulsoni	Poulson's Dwarf Triton									0
Kelletia kellitii	Kellett's Welk									0
Nassarius tegula	Western Mud Welk									0
Nassarius mendicus	Western Lean Nassa									0
Cerithidea californica	California Horn Shell									0
Mytilus californianus	California Mussel									0
Polinices lewisii	Lewis' Moon Shell									0
Mopalia ciliata	Hairy Mopalia									0
Hailotis cracherodii	Black Abalone									0
Olivella biplicata	Purple Dwarf Olive									0
Astraea undosa	Wavy Turban									0
Tegula funebralis	Black Tegula									0
Macron lividus	Livid Macron									0
Serpulorbis sp.	Western Scaled Worm Shell									0
Conus californicus	California Cone									0
Trachycardium quadragenum	Spiny Cockle									0
Nuttallia nuttallia	Purple Clam									0
Total Identified		4	5	2	5	5	1	4	2	28
Total Unidentified										0

Table C.32. Test Pit 14 Flotation Minimum Number of Individuals.

Scientific Name	Common Name	Level							Totals
		1	2	3	4	5	6	7	
Chione californiensis	Common California Venus	2	3	3	2	2	3		15
Chione undatella	Frilled California Venus	2	3	1	2	2	2		12
Chione fluctrifraga	Pacific Smooth Venus					1		2	3
Amiantis callosa	Pacific White Venus								0
Tresus nuttalli	Pacific Gaper			3	1	1			5
Tivela stuitorum	Pismo Clam								0
Argopecten sp.	Calico Scallop	1	1	1	3	2	1		9
Ostrea lurida	Native Pacific Oyster	4	3	10	7		5	3	32
Crepidula onyx	Onyx Slipper Shell	2				2			4
Protothaca staminea	Common Pacific Littleneck	13	2	4	3	4	2		28
Tagelus californianus	California Jackknife Clam				1	3	2		6
Macoma nasuta	Bent-nose Macoma								0
Saxidomus nuttailli	Common Washington Clam								0
Tegula aureotincta	Gilded Tegula								0
Donas gouidii	Gould's Wedge Shell								0
Donas californicus	California Donax								0
Ocenebra poulsoni	Poulson's Dwarf Triton								0
Kelletia kellitii	Kellett's Welk								0
Nassarius tegula	Western Mud Welk								0
Nassarius mendicus	Western Lean Nassa								0
Cerithidea californica	California Horn Shell								0
Mytilus californianus	California Mussel								0
Polinices lewisii	Lewis' Moon Shell								0
Mopalia ciliata	Hairy Mopalia					1			1
Hailotis cracherodii	Black Abalone								0
Olivella biplicata	Purple Dwarf Olive								0
Astraea undosa	Wavy Turban								0
Tegula funebralis	Black Tegula			1					1
Macron lividus	Livid Macron								0
Serpulorbis sp.	Western Scaled Worm Shell								0
Conus californicus	California Cone								0
Trachycardium quadragenum	Spiny Cockle								0
Nuttallia nuttallia	Purple Clam								0
Total Identified		24	12	23	19	18	15	5	116
Total Unidentified									0

APPENDIX D
VERTEBRATE SPECIES DESCRIPTIONS

MAMMALS

Valley pocket gopher (*Thomomys bottae*) MNI: 133, NISP: 1407

Identification: Extremely variable in size, weighing from 2 1\2 to 9 ounces. Dental formula: 20 teeth, 1-0-1-3. The upper incisors have a single indistinct groove near the inner border.

Habitat: Valleys and mountain meadows; it prefers a loam soil, but also occurs in sandy or rocky situations.

Behavior: A burrower, seldom seen above ground. Feeds largely on roots and tuvers as well as some surface vegetation. Gestation period: about 19 days. five to seven young born from October to June.

Economics: They bring subsoil to the surface and aid in water conservation and aeration of the soil, however they are considered harmful wherever they occur in cultivated areas where they prey on root crops and surface vegetation.

The relatively high number of gophers in the site suggests that unit contents may have been disturbed by these busy rodents. In cases where a bone from a modern species is found within a level which might otherwise be considered prehistoric, the explanation might well be gopher disturbance.

Black-tailed hare (*Lepus californicus*) MNI: 28, NISP: 60

Identification: Weighs from three to seven pounds, measures 17 to 21 inches in length. Dental formula: 28 teeth, 2-0-2-3, 1-0-2-3. Members of the rabbit and hare family have double upper incisors.

Habitat: Throughout the grasslands and open areas of the West and in sparsely vegetated deserts.

Behavior: This common "jackrabbit" is most active early evenings through early mornings and sits in its lair at the base of bushes or clumps of grass during the day. Gestation period: Two to four fully furred-young are born with eyes open.

Economics: Consumes considerable vegetation that could be used by livestock. A fair game animal.

Audubon cottontail (*Sylvilagus audubonii*) MNI: 18, NISP: 57

Identification: A 12 - 15 inch rabbit, this is the common cottontail rabbit of the valleys in the arid Southwest. Dental formula: 28 teeth, 2-0-2-3, 1-0-2-3.

Habitat: Open plains, foothills, and low valleys with grass, sagebrush, scattered trees and bushes.

Behavior: This rabbit may be seen at any time of day but it is most active from late afternoon throughout the night. It seeks safety in thickets or in burrows. Gestation period: Two to six young are born throughout the year. The young are not precocious like the hare but are born blind and cared for by the female.

Economics: The rabbit in considered an important small game mammal. It does little damage to gardens and green crops.

The relative percentages of hares and rabbits indicate that these specimens were commonly hunted for food and would not represent opportunistic captures.

Mule deer (*Odocoileus hemionus*) MNI: 26, NISP: 48

Identification: The length ranges from four feet to nearly six feet, depending on the subspecies. Two sub-species of the mule deer range into the Southern California area (Ingles 1965), *Odocoileus hemionus*, *fulginata* and *Odocoileus hemionus*, *inyoensis*. Besides the dichotomously branched antlers which distinguish the mule deer, these sub-species cannot be determined osteologically. There are no upper canines. Dental formula: 32 teeth, 0-0-3-3, 3-1-3-3.

Habitat: The mule deer occupies several types of habitat where there are browse plants; it can be found in coniferous forests, desert shrubs, chaparral, and grasslands with shrubs.

Behavior: The mule deer feeds singly or in small groups on shrubs and twigs, but adds grass and herbs. It follows definite trails, noticeably in winter. Gestation period: 195 to 212 days, one to two fawns are born by late June.

Economics: Today the mule deer is considered the most important game mammal of the West. It can do considerable damage to crops, range, and forest lands if it becomes too numerous.

Dog/Coyote (*Canis* sp.) MNI: 29, NISP: 64

Coyote (*Canis latrans*)

Identification: The size of a medium-sized dog, Weight 20 to 50 lbs. Dental Formula: 42 teeth, 3-1-4-2, 3-1-4-3.

Habitat: Prairies, open woodlands, brushy or boulder-strewn areas.

Behavior: Chiefly nocturnal. A true scavenger, the coyote will eat almost anything animal or vegetable. Food in predominantly small rodents and rabbits. Normally dens in the ground, but often uses other shelter, usually not more than 6 miles from water. Gestation period: 60-63 days. Five to ten young born from April to May.

Economics: Kills many rodents and rabbits but may also occasionally kill sheep and calves.

Unfortunately, without a complete mandible, maxilla, or tooth row, the coyote cannot be distinguished from a domestic dog of the same size. The identified canid remains were predominantly those of the skull and feet, however, no fragment was large enough to be measured.

California ground squirrel (*Amnospermophilus beecheyi*) MNI:60, NISP:341

Identification: A small squirrel weighing one to two and one-half pounds. Dental formula: 22 teeth, 1-0-2-3, 1-0-1-3.

Habitat: Pastures, grainfields, slopes with scattered trees; rocky ridges. It avoids thick chaparral and dense woods.

Behavior: Diurnal and colonial. Eats green vegetation, seeds, acorns, mushrooms, fruits, berries, birds, eggs, and insects. Lives in long burrows on gentle slopes. Gestation period: 25 to 30 days. About 7 young born throughout spring, summer, and fall; ussually March to April.

Economics: Considered detrimental to crops and pastureland.

California meadow mouse (vole) (*Microtus californicus*) MNI:20,NISP:69

Identification: Weight is 1 1/2 to 3 1/2 ounces. Dental formula: 16 teeth, 1-0-0-3.

Habitat: Marshy ground, saltwater and fresh, wet meadows, dry, grassy hillsides from seashore to mountains, wherever there is good grass cover.

Behavior: The California Vole is active day and night. It feeds on grasses, sedges, and other green vegetation. Gestation period: 21 days, Four to eight young born throughout the year.

Economics: They can damage fruit trees and hay and grain crops, but they provide food for many fur-bearing mammals as well as for hawks and owls.

Raccoon (*Procyon lotor*) MNI: 6, NISP: 8

Identification: Medium sized, about that of a small dog. Weight twelve to thirty-five pounds. Five toes on each foot with nonretractile claws. Dental formula: 40 teeth, 3-1-4-2, 3-1-4-3.

Habitat: Along streams and lake borders near woode areas or rock cliffs.

Behavior: Chiefly nocturnal, it feeds along streams and lakes; omnivorous, eats fruits, nuts, grains, insects, frogs, crayfish, bird eggs and anything else available. Dens in hollow trees, hollow logs, rock crevices, or ground burrows. Gestation period: 63 days. Two to seven young born in April or May.

Economics: Valued for pelts and meat. May damage corn fields and raid poultry yards.

Pocket mouse (*Perognathus* sp.) MNI: 9, NISP: 16

Several species of pocket mice are in the area. These primarily include the California Pocket Mouse (*Perognathus californicus*), but also the San Diego Pocket Mouse (*Perognathus fallax*), the Little Pocket Mouse (*Perognathus longimembris*) and the Longtail Pocket Mouse (*Perognathus formosus*).

Identification: These are small mice weighing from 1/4 to 1 3/4 ounces. Their front feet are weak but hind feet and legs are strong and well developed. Dental formula: 20 teeth, 1-0-1-3, 1-0-1-3. The upper incisors are grooved on the front faces.

Habitat: Valleys and slopes covered with chaparral or live oaks. The San Diego Pocket Mouse is usually found at lower altitudes on the desert.

Behavior: All pocket mice are adapted for arid or semiarid conditions; they do not need drinking water. They burrow into ground for nest sites. All store food, chiefly seeds. Gestation period: Three to seven young are born from April through July.

Economics: Pocket mice usually occupy uncultivated ares. Their eating of weed seeds is considered beneficial.

Western gray squirrel (*Sciurus griseus*) MNI: 7, NISP: 13

Identification: A large squirrel weighing 1 1/4 to 1 3/4 pounds. Dental formula: 22 teeth, 1-0-2-3, 1-0-1-3.

Habitat: Oak and pine-oak forests; fairly open.

Behavior: Arboreal, but often seen on the ground. Feeds mostly on acorns and seeds of conifers. Morning is the most active period. The Western Gray Squirrel nests usually 20 feet from the ground in tree cavities or tree nests built of bark and sticks. Gestation period: More than 43 days. Three to five young born from February to June.

Economics: A game animal which sometimes damages walnut and almond crops.

Opossum (*Didelphis virginiana*) MNI: 8, NISP: 14

Identification: Weighs from 9-13 pounds, measures 15-20 inches. Dental formula: 50 teeth, 5-1-3-4, 4-1-3-4.

Habitat: Farming areas preferred, also found in woodlands and along streams.

Behavior: Usually active only at night. A very generalized feeder. Marsupial.

Economics: Sometimes hunted for sport, especially in the South. Edible, but meat oily. Fur salable, but of small value.

First introduced in California at San Jose in 1910. Intrusive to sites of earlier dates.

Sea Otter (*Enhydra lutris*) MNI: 5, NISP: 6

Identification: Weighs from 30-85 pounds, measures 30-36 inches. Dental formula: 32 teeth, 3-1-3-1, 2-1-3-2.

Habitat: Kelp beds and rocky shores from California to Aleutian Islands.

Behavior: Mostly rests and feeds in kelp beds, goes ashore in severe storms; feeds on abalone and sea urchins.

Economics: Fur valuable.

Longtail weasel (*Mustela frenata*) MNI: 2, NISP: 3

Identification: Weighs from 7-12 ounces (males) and from 3-7 ounces (females), measures 8-10 inches. Dental formula: 34 teeth, 3-1-3-1, 3-1-3-2.

Habitat: Not restricted; found in all land habitats near water throughout the U.S.

Behavior: Chiefly nocturnal, but also active by day, mostly on the ground, carnivorous.

Economics: Beneficial -- kills vermin; fur (ermine) of some value.

Roof rat or Black rat (*Rattus rattus*) MNI: 2, NISP: 2

Identification: Weighs from 5-10 ounces, measures 7-8 inches. Dental formula: 16 teeth, 1-0-0-3.

Habitat: Mostly in tops of buildings, mainly near sea ports.

Historic intrusive.

Badger (*Taxidea taxus*) MNI: 2, NISP: 2

Identification: Weighs 13-25 pounds, measures 18-22 inches. Dental formula: 34 teeth, 3-1-3-1, 3-1-3-2.

Habitat: Open grasslands and deserts.

Behavior: Mostly nocturnal, digs out rodents, dens in burrows.

Economics: Destroys rodents, fur of little value.

California Sea Lion (*Zalophus californicus*) MNI: 5, NISP: 7

Identification: Males to 600 pounds and 8 feet in length; females to 200 pounds and 6 feet in length. Dental formula: 3-1-4-2,1; 3-1-4-1.

Habitat: Marine, occasionally seen on sandy beaches of Pacific Coast; breeds from Channel Islands south to Baja.

Behavior: Aggregate in breeding season on offshore islands, pups born in early summer with mating following in about 2 weeks.

Economics: Prehistoric subsistence use.

Otariidae (sea lions and fur seals) ranging in this area include California sea lion, Guadalupe fur seal and Alaskan fur seal. Other Pinnipedia (sea lions and seals) in this area include harbor seals and elephant seals.

White-footed mice (*Peromyscus sp.*) MNI: 8, NISP:10

Several species of white-footed mice are in this area: cactus mouse (*Peromyscus eremicus*); California mouse (*Permomyscus californicus*); deer mouse (*Peromyscus maniculatus*); brush mouse (*Peromyscus boylei*); pinon mouse (*Peromyscus truei).*

Identification: Medium-sized mice; Dental formula: 16 teeth, 1-0-0-3.

Habitat: Woods, prairies, rocks; mostly ground dwellers.

Behavior: Nocturnal.

NATIVE BIRDS

Ducks (*Anas* sp.) MNI: 11, NISP: 158

Pintail (*Anas acuta*) MNI: 6, NISP: 8

Cinnamon teal (*Anas cyanoptera)* MNI: 34, NISP: 82

American widgeon (*Anas americana*) MNI: 14, NISP: 46

Mallard (*Anas platyrhynchos*) MNI: 31, NISP: 111

The mallard is the most widespread duck in the world. It inhabits shallow ponds, marshes, and sheltered salt-water, nesting near the water's edge. It is a fairly common resident in California but is much commoner in the winter. The cinnamon teal prefers the borders of marshes or sloughs. It is abundant in summer (March-October) on fresh water with some remaining through the winter. The pintail prefers the reedy edges of sloughs or ponds and estuaries. It is abundant in California August to May. The Pacific loon is common September-May along the coast and in estuaries. The eared grebe is common September-May along the coast. Holboell's grebe is found along the coast from October-May. The American widgeon is found chiefly on fresh water but occasionally on large shallow bays from October-April.

Snow goose (*Chen hyperboreus*) MNI: 3, NISP: 4

Prefers marshy meadows. Abundant October-April in the interior valleys, less frequent near the coast.

Coot (*Fulica americana)* MNI: 20, NISP: 36

Abundant resident in marshy areas and lakes throughout California; more numerous in winter in the coastal region southward.

Pacific loon (*Gavia arctica pacifica*) MNI: 4, NISP: 4

Common in California from September-May along the coast and in estuaries.

English sparrow (*Passer domesticus*) MNI: 7, NISP: 12

Historic intrusive.

HERPEFAUNA

Western pond turtle (*Clemmys marmorata*) MNI: 5, NISP: 6

A fresh-water turtle with a shell length of four to seven inches. The carapace is smooth and flattened and usually has dark lines or spots that radiate from plate centers. This aquatic turtle inhabits still and slow-moving water, and sometimes lives in brackish water.

Western toad (*Bufo boreas*) **MNI: 10, NISP: 18**

The common garden toad of the west, found in a great variety of habitats.

Bullfrog (*Rana catesbeiana*) **MNI: 2, NISP: 5**

Size from 3 1/2 to 8 inches. Largest western frog; highly aquatic.

Desert iguana (*Diposaurus dorsalis*) **MNI: 2 NISP: 2**

Size from 4 to 5 1/2 inches. Sandy habitats but also along rocky streambeds, on bajadas, silty floodplains and clayey soils.

Southern alligator lizard (*Gerrhonotus multicarinatus*) **MNI: 2, NISP: 3**

Size from 4-6 1/2 inches. Frequents grasslands, chaparral, oak woodland, and forests.

Western fence lizard (*Sceloporus occidentalis*) **MNI: 2, NISP: 3**

Size from 2 1/4 to 3 1/2 inches. One of the most common western lizards; found in a great variety of habitats.

Side-blotched lizard (*Uta stansburiana*) **MNI: 4, NISP: 4**

Size from 1 1/2 to 2 1/3 inches. Common in many habitats.

APPPENDIX E
DESCRIPTIONS OF INDIVIDUAL FLOTATION SAMPLES

Ralph E. Brooks and William C. Johnson

Identifiable contents of the samples include by test pit, level, and depth:

Test Pit 1

Level 1 (0-10 cm) - Film canister contains minute pieces of charcoal, some recognizable as grass leaf blades and uncharred pieces of decayed wood and a few seeds of *Amaranthus*, the pigweeds. The bag contains an abundance of uncharred wood and roots, plus a few seeds of a panicoid grass; charred material present consists primarily of small pieces of gymnosperm wood and a few seeds of wheat-type grass (Hordeae).

Level 2 (10-20 cm) - Small fragment of tooth; charred, small undetermined seeds and gymnosperm and dicot wood. Uncharred wood, roots and grass leaves are also present.

Level 4 (30-40 cm) - Mostly fragments of gymnosperm wood with uncharred remains of roots and wood and gravel, plus a few seeds of a single species of Malvaceae.

Level 5 (40-50 cm) - Mostly uncharred fragments of gymnosperm wood with uncharred remains of roots and wood, and gravel.

Level 6 (50-60 cm) - Mostly fragments of gymnosperm wood with uncharred remains of roots, wood and gravel, plus a few seeds of a species of Malvaceae.

Level 7 (60-70 cm) - Mostly uncharred fragments of gymnosperm wood with uncharred remains of roots, wood and gravel.

Test Pit 2A

Level 1 (0-10 cm) - Indeterminate, miscellaneous charred seeds, and gymnosperm wood. Uncharred fragments of wood, roots, grass leaves and many panicoid grass seeds.

Level 2 (10-20 cm) - Charred *Scirpus,* cf. *americanus* (single seed): one of the common sedges (a near-aquatic type), namely the small bullrushes; few seeds of wheat-type grass (Hordeae), dicot and gymnosperm wood. Uncharred seeds of a Panicoid grass.

Level 3 (20-30 cm) - Abundant charcoal: all small fragments of dicot and gymnosperm wood.

Level 5 (40-50 cm - Mostly gravel and charred fragments of wood, gymnosperm and dicot, alike.

Level 6 (50-60 cm) - Mostly charred wood remains, gymnosperm and dicot, alike.

Test Pit 2C

Level 5 (40-50 cm) - Charred panicoid grass seeds and gymnosperm wood. Uncharred wood, root, and grass leaf fragments; many seeds of a species of Malvaceae.

Test Pit 3

Level 1 (0-10 cm) - Charred remains of wood (dicot and gymnosperm) and a very few seeds of a wheat-type grass (Hordeae). Uncharred remains include grass blades, roots, wood, seed of panicoid grass.

Level 2 (10-20 cm) - Charred gymnosperm wood, seed of a wheat-type grass (Hordeae), and grass stems. Uncharred roots and wood fragments.

Level 3 (20-30 cm) - Charred dicot and gymnosperm wood, seed of *Rumex*, or curly dock. Uncharred seed of *Solanum*: black nightshades, or ground cherries, of the *S. nigra* complex, with its dark purple berries.

Level 4 (30-40 cm) - Charred gymnosperm and dicot wood, few wheat-type (Hordeae) seeds. Uncharred root and grass blade fragments.

Level 5 (40-50 cm) - Fragments of charred wood and grass stems; uncharred roots and small wood fragments.

Level 6 (50-60 cm) - Mostly uncharred root and leaf fragments with some paper and plastic. Charred material rare and mostly unrecognizable, some gymnosperm woods.

Level 7 (60-70 cm) - Mostly uncharred plant remains: roots, fragments of grass blades. Some gravel and one piece of charred wood.

Level 8 (70-80 cm) - Mostly gravel, fine clastics, uncharred pieces of roots, and seed of a panicoid grass.

Level 9 (80-90 cm) - Few charred fragments, mostly wood. Uncharred Panicoid grass seed, roots.

Test Pit 5

Level 1 (0-10 cm) - Charred material abundant, although recognizable fragments are few: *Helianthus* sp. (sunflower), rye grass ? (Hordeae), stem fragments of herbs, a few pieces of wood. Uncharred material is abundant and includes seeds of a panicoid grass, *Amaranthus*, roots, and leaf fragments.

Level 2 (10-20 cm) - Few charred fragments of gymnosperm wood, uncharred roots and wood.

Level 3 (20-30 cm) - Fine clastic sediment plus an abundance of small charred and uncharred fragments of wood, dicot and gymnosperm, alike.

Level 4 (30-40 cm) - Small charred and uncharred fragments of wood, roots and grass blades.

Level 5 (40-50 cm) - Very few charred fragments; the remainder is not charred or identifiable.

Level 9 (80-90 cm) - Primarily uncharred root fragments and two seeds of a panicoid grass. Practically no charred remains.

Test Pit 6

Level 4 (30-40 cm) - Large quantity of charred and uncharred gymnosperm and dicot wood. Much silt and clay size material with a few uncharred seeds of *Amaranthus*.

Level 5 (40-50 cm) - Small charred and uncharred pieces of wood and roots. Few seeds of a Malvaceae (uncharred).

Level 6 (50-60 cm) - Large charred fragments of wood and twigs, dicots and gymnosperms, alike. Uncharred leaf, wood and root fragments.

Level 7 (60-70 cm) - Charred gymnosperm and dicot wood, seed of *Rumex* sp. (cf. *crispus)*, or curly dock; uncharred wood, roots.

Level 10 (90-100 cm) - Fine clastic sediment and uncharred roots.

Level 11 (100-110 cm) - Tiny charred wood fragments. Uncharred roots and seed of panicoid grass.

Test Pit 7

Level 1 (0-10 cm) - Uncharred gymnosperm and dicot wood, roots, and grass blade fragments. Similar charred remains.

Level 2 (10-20 cm) - Charred gymnosperm wood, grass culms and leaf blades, seeds of *Portulaca, Juniperus* (fruit) and grass seeds (Hordeae), and a species of Malvaceae. *Portulaca*, or purselane, is a small, low-growing herb found in semi-moist to moist, disturbed lowlands; it produces distinctive seed capsules with a highly ornate, coiled embryo. Uncharred gymnosperm wood, grass blades, and seed of *Amaranthus* and a species of Malvaceae.

Level 3 (20-30 cm) - Abundance of fine clastic sediments and modern roots. A small amount of charred dicot wood.

Level 4 (30-40 cm) - Mostly uncharred roots. Very little charred wood.

Test Pit 8B

Level 1 (0-10 cm) - Charred wood fragments; uncharred Panicoid grass seed, *Amaranthus* seed, and root and wood fragments.

Level 2 (10-20 cm) - A few charred and uncharred pieces of wood and roots.

Level 3 (20-30 cm) - Modern (fresh-looking) *Amaranthus and Glycine* (soybean) seeds, roots, and grass blades. Charred dicot wood and a good deal of unrecognizable wood fragments.

Level 4 (30-40 cm) - Charred gymnosperm and dicot wood, seeds of *Viola* and *Scirpus*; uncharred roots, wood, and other debris including seeds of *Solanum, Rumex, Amaranthus.* Many species of *Viola*, the violets, are found in this region, but the tear-drop shaped seeds are very difficult to differentiate to the species level.

Level 6 (50-60 cm) - Charred gymnosperm and dicot wood, grass seed (Hordeae). Uncharred wood, roots, and a small mammal/rodent(?) bone.

Level 7 (60-70 cm) - Charred wood of dicots and gymnosperms, seed of *Scirpus*; uncharred *Amaranthus*.

Level 8 (70-80 cm) - A few charred fragments, but nothing recognizable. The seeds appear to be modern *Amaranthus* (sp.).

Test Pit 9A

Level 1 (0-10 cm) - Numerous, small, charred unidentifiable plant fragments, gymnosperm and dicot wood. Uncharred seed of *Amaranthus* with some wood and roots.

Level 3 (20-30 cm) - Charred seeds of *Scirpus and Amaranthus*, wood of gymnosperm. This sample produced the only charred specimen of *Amaranthus*. Uncharred remains of roots, panicoid grass, and twig fragments.

Level 4 (30-40 cm) - Few charred pieces of wood. Uncharred seed of a grass, probably *Setaria*, the foxtail.

Test Pit 12

Level 1 (0-10 cm) - Charred remains include dicot and gymnosperm wood, seed of a Malvaceae. Uncharred remains include grass stems (look like oats or brome), roots, seed of *Amaranthus*.

Level 2 (10-20 cm) - Charred gymnosperm and dicot wood, seed of *Solanum*, a Malvaceae, and a grass (Hordeae). Uncharred remains of wood and roots, seed of the same *Solanum* and Malvaceae.

Level 3 (20-30 cm) - Charred gymnosperm wood, many unrecognizable charcoal fragments, seed of *Helianthus*, seed of a composite that is probably a *Bidens* (beggars tick); uncharred wood, grass leaf fragments, and roots.

Level 4 (30-40 cm) - Modern wood, leaf blades, roots, seeds of *Amaranthus*. Charred wood of dicots and gymnosperm; large grass seeds, possibly a type of wheat or rye (Hordeae).

Level 5 (40-50 cm) - Charred gymnosperm wood and other fragments, including a grass seed, possibly wheat-like (Hordeae). Uncharred wood, *Amaranthus* seed, roots, grass leaf blades.

Level 6 (50-60 cm) - Charred seed of grass (Hordeae) and Malvaceae, dicot and gymnosperm wood. Uncharred wood, roots, grass leaf blades, and a seed of Malvaceae.

Level 8 (70-80 cm) - Charred seed of grass (Hordeae) and Malvaceae, dicot and gymnosperm wood. Uncharred wood, roots, grass leaf blades, and a seed of a legume (*Melilotis*, or sweet clover) and a Malvaceae.

Test Pit 13

Level 1 (0-10 cm) - Charred seed of *Euphorbia*, gymnosperm wood, uncharred seed of *Amaranthus*, wood and roots.

Level 2 (10-20 cm) - Charred seed of several plants, not all determinable, two grasses (one probably Hordeae), a legume, and a probable fruit of *Juniperus*. Uncharred wood, roots and leaf blades of grass.

Level 3 (20-30 cm) - Charred dicot and gymnosperm wood; graminoid caryopses that appear to be wheat (Hordeae); unidentified seed. Uncharred remains include mostly root fragments.

Level 5 (40-50 cm) - Charred remains of a spruce twig (*Picea*), seeds of *Scirpus*, a species of Malvaceae, a grass (Hordeae), and wood of gymnosperms. Uncharred remains of woods, roots, seed of *Euphorbia*. The *Picea* find, represented by a single 1/4 inch-long twig, was unique to this sample.

Level 6 (50-60 cm) - Charred wood of gymnosperm, seed of grass (Hordeae), *Scirpus*, and one unknown seed. Uncharred root fragments and seed of *Euphorbia*.

Level 7 (60-70 cm) - Charred dicot and gymnosperm wood, one seed of grass (probably Hordeae). Gravel and uncharred wood and root fragments.

Test Pit 14

Level 1 (0-10 cm) - Charred gymnosperm wood, wood fragments. One uncharred seed each of *Amaranthus* and *Solanum*.

Level 2 (10-20 cm) - Small chunks of charred gymnosperm and dicot wood and grass leaf fragments. Uncharred wood and roots.

Level 3 (20-30 cm) - Many large and some small chunks of charred gymnosperm wood. Uncharred abundance of root and wood fragments.

Level 4 (30-40 cm) - Little charcoal, gymnosperm and dicot wood. Considerable uncharred root and wood fragments.

Level 5 (40-50 cm) - Uncharred fragments of roots, gymnosperm wood, and grass blades. Some carbonized gymnosperm wood present.

Level 6 (50-60 cm) - Mostly uncharred root and wood fragments (gymnosperm?).

Level 7 (60-70 cm) - Mostly uncharred root and wood fragments (gymnosperm?).