

Mission Bay Historical Ecology Reconnaissance Study

Data Collection Summary

Prepared for the San Diego Audubon Society
February 2016



Prepared by the San Francisco Estuary Institute:

Samuel Safran
Emily Clark
Erin Beller
Robin Grossinger



SFEI Publication #777

Cover image: U.S. Coast Survey. San Diego Bay, California. 1857. *Courtesy of the National Oceanic and Atmospheric Administration.*

INTRODUCTION

The goals of the Mission Bay Historical Ecology Reconnaissance Study were to collect and compile high-priority historical data about the Mission Bay landscape, identify sources that could help to develop a deeper understanding of early ecological conditions, and to identify future possible research directions based on the available data. This technical memorandum is intended to document the archives consulted during the reconnaissance study, summarize the collected and compiled data, and to identify potential next steps. A separate technical presentation to project staff and advisors will summarize the preliminary findings and questions generated from a review of the historical dataset. Ultimately, this research is intended to support the San Diego Audubon Society’s Mission Bay Wetlands Conceptual Restoration Plan (CRP) and the ReWild Mission Bay project.

The memo is organized as follows: the **Methods** section describes the study extent and summarizes the data collection and data compilation activities conducted for this study. The **Assessment of Historical Dataset** section summarizes the data obtained for this study, including standard datasets—such as U.S. Coast Survey sheets and U.S. Geographic Survey topographic quadrangles—as well as other photographs, maps, and texts. Illustrative examples of the materials collected are provided throughout the section. Finally, the **Next Steps** section outlines recommended steps for further research.

METHODS

Study area

Mission Bay is located along the Pacific Coast within the city limits of San Diego, California, United States. Our study extent was loosely defined as Mission Bay, the surrounding low-lying coastal plain, and the lower reaches of the Bay’s historical tributaries. Within this study extent, our priority focus area was the northeast corner of Mission Bay, as roughly defined by the ReWild Mission Bay footprint, which covers present-day natural spaces and developed areas east of Crown Point, along Pacific Beach Drive, and on both sides of lower Rose Creek (Figure 1).



Figure 1. The ReWild Mission Bay footprint, which roughly delineated this project’s priority focus area. Image courtesy of the ReWild Mission Bay project.

Data collection

Reconstructing historical landscape characteristics requires a broad range of historical data, as a single data source rarely provides sufficient information to accurately interpret complex landscapes (Grossinger and Askevold 2005). For this project, historical maps, images, and texts were collected from six regional archives (Table 1) and approximately twenty searchable online databases (Table 2). At each of these source institutions, we reviewed available documents for evidence concerning the ecology and hydrogeomorphology of Mission Bay prior to major European-American landscape modifications. Specifically, data collection efforts focused on the period from the first available written records (beginning 1542 with the arrival of Juan Cabrillo) to the onset of major dredging and reclamation activities during the late 1940s. A series of guiding questions developed in coordination with San Diego Audubon staff and the ReWild Mission Bay Wetlands Working Group helped to further focus our data collection efforts.

For this reconnaissance study we focused on searching the highest-priority archives and collecting the most-relevant sources. In total, we reviewed approximately 1,000 documents and collected material from hundreds of unique historical sources, including approximately 100 maps, 300 photographs, and 100 textual documents. We also collected certain contemporary data sources, including geologic maps, elevation datasets, and modern aerial photography, to support our understanding and initial interpretation of the historical sources. Though the data collection process was extensive, it was by no means comprehensive, and a substantial amount of relevant data remains to be collected. Suggested future data collection activities are described in the Next Steps section of this document.

A list of regional search terms (Table 3) was developed at the onset of the project to guide online and other digital data collection efforts. The list was primarily compiled from standard early sources, including the Pueblo Lands of San Diego *diseño* (Fitch 1845), U.S. Coast Survey (USCS) maps (Harrison 1852, Rodgers and Nelson 1889), and the earliest U.S. Geological Survey (USGS) topographic map of the La Jolla Quadrangle (USGS 1903). Additional terms were added as they were discovered during the research process.

Not every online archive and database was queried with every search term during this reconnaissance study. Given time and budget constraints, we often prioritized certain search terms that reliably returned high-value sources (e.g. “False Bay,” “Rose Creek,” and “Pacific Beach”). As discussed in the Next Steps section, future data collection efforts should search a greater number of terms at a greater number of online archives.

Data compilation

Once collected, selected data were compiled into useable formats. Textual data were transcribed and organized by topic. Photographs were digitally tagged based on their content with keywords so that they can be quickly and dynamically sorted by theme. High-priority maps—such as USGS topographic maps, soil surveys, and USCS “T-Sheets”—were georeferenced and sorted by type and year to facilitate comparison across space and time. Finally, we georeferenced, orthorectified, and mosaicked the earliest available vertical aerial images of northeast Mission Bay (a total of 12 images, all taken during 1928). Aerial photographs for the remainder of Mission Bay were mosaicked and georeferenced (but not orthorectified).

Table 1. Archives and libraries visited during the data collection phase of this reconnaissance study.

Source Institution	Location	Summary of Collected Materials
San Diego History Center	San Diego, CA	19 th and 20 th c. photographs; 20 th c. regional histories; 1854 survey notes
San Diego State University Special Collections & University Archives	San Diego, CA	newspaper clippings; 20 c. regional planning documents
UC San Diego Special Collections & Archives / Scripps Institution of Oceanography Archives	La Jolla, CA	newspaper clippings; early-20th c. water company records and maps; mid-20 th c. Kendall-Frost reserve records, technical reports
Water Resources Collections and Archives (UC Riverside)	Riverside, CA	early 20 th c. water resource maps and technical reports; hydrologic data; early 20 th c. landscape photographs
The Bancroft Library (UC Berkeley)	Berkeley, CA	Land Grant case files, including 1845 <i>diseño</i> map; early 20 th c. secondary sources; early 20 th c. water resource technical reports and newspaper clippings;
UC Berkeley Earth Sciences and Map Library	Berkeley, CA	late 19 th and early 20 th c. road, real estate, water resource, and geologic maps

Table 2. Online archives and databases searched for this reconnaissance study.

Resource	URL
Online Archive of California	oac.cdlib.org
California Digital Newspaper Collection	cdnc.ucr.edu
Google Books	books.google.com
Google Scholar	scholar.google.com
Library of Congress	loc.gov/library/libarch-digital.html
MVZ Archives	mvz.berkeley.edu/archives_index.php
Smithsonian Archives	library.si.edu/digital-library
Lawrence & Houseworth Albums: Online Photographic Database	californiapioneers.org/lh/index.php
Huntington Digital Library	hdl.huntington.org
NOAA Historical Map & Chart Collection	historicalcharts.noaa.gov
NOS Hydrographic Data Base	ngdc.noaa.gov/mgg/bathymetry/hydro.html
USGS Photographic Library	library.usgs.gov/photo
San Diego Public Library Digital Archive	cdm16736.contentdm.oclc.org
Edward H. Davis Collection of Indian Photographs and Drawings	sandieghistory.org/davis/collection
David Rumsey Map Collection	davidrumsey.com
Digital Sanborn Maps	sanborn.umi.com
Barry Lawrence Ruderman Antique Maps Inc.	raremaps.com
Wieslander Vegetation Type Maps & Photographs	lib.berkeley.edu/BIOS/vtm
Penny Postcards	usgwarchives.net/special/ppcs/ppcs.html

Table 3. Search term list for online data collection efforts. Terms marked with an asterisk were priority terms.

Terms for Mission Bay
False Bay*
False Port
Puerto Falso
Mission Bay*
Terms for Rose Creek and Canyon
Rose Creek* / Rose's Creek
Rose Canyon / Rose's Canyon / Rose Creek Canyon
Las Yeguas / Las Lleguas
San Buenaventura
Soledad
Cañada de San Diego
Other Mission Bay tributaries
Tecolote
Cudahy
San Diego River*
Towns
San Diego
Pacific Beach*
Mission Beach
Ocean Beach
Duckville
Morena
Atwood
Ladrillo
Selwyn
Other topographic and hydrographic features
San Diego Bay
Famosa Slough
Point Meganos / Point Medanos
Point Loma
Bay Point
El Rincon
Dutch Flats
Mission Valley
Other search terms
Pueblo Lands of San Diego
Derby's Dike
California Southern Railroad Company
San Diego, Pacific Beach, and La Jolla Railroad

ASSESSMENT OF HISTORICAL DATASET

Standard datasets

Although each historical ecology study draws upon a unique suite of sources, most draw on a few key standard datasets. These high-value datasets—including early U.S. Coast Survey maps, USGS topographic quadrangles, historical soil surveys, historical aerial photographs, and General Land Office records—are generally available for all of coastal California and offer a great deal of ecologically relevant and spatially accurate information. As such, their acquisition was a priority of this reconnaissance study. The availability and utility of these standard datasets within the project study extent are described below.

U.S. Coast Survey maps

The U.S. Coast Survey (USCS; later known as the U.S. Coast and Geodetic Survey [USCGS]) was established in 1807 by Thomas Jefferson to survey and map the American coastline. USC[G]S maps covering the landward portion of the coastline, known as “topographic sheets” or “T-sheets,” are a highly valuable for understanding the physical and ecological characteristics of the coastline prior to extensive Euro-American modification (cf. Grossinger 2005, Grossinger et al. 2007). The earliest T-Sheet depicting Mission Bay was surveyed by A.M. Harrison in the winter of 1851-2, and was one of the first T-sheets produced in the young state of California (see Table 4). Mapped at a scale of 1:10,000 (more than twice the resolution of modern USGS topographic quadrangles), the T-sheet offers a detailed look at the beaches, dunes, sloughs, flats, marshes, and creeks of Mission Bay (Figure 2; Harrison 1852). The 1889 T-Sheet resurvey covers the northern half of Mission Bay from the Pacific west to the modern-day location of Campland on the Bay (Figure 3; Rodgers and Nelson 1889). Although a portion of the northeast corner of Mission Bay is cut off, the T-Sheet is valuable since it extends north to La Jolla and depicts the majority of Rose Creek and Canyon. Forty-five years after the resurvey, the T-Sheet was again remapped by USCGS from 1933 aerial photographs (USCGS 1933). Because this later T-sheet is annotated and covers the entire study extent, it serves as a useful “ground truth” for features visible in the 1928 historical aerals. Early USC[G]S hydrographic sheets (“H-sheets”) depicting the bathymetry and substrate types were also obtained for Mission Bay (Table 4).

Table 4. US Coast Survey maps of Mission Bay collected for this project. All maps were drawn at a scale of 1:10,000.

Sheet	Year	Surveyor	Notes
Topographic sheets (“T-sheets”)			
T-363	1852	A.M. Harrison	Covers full extent of False Bay; depicts beaches, dunes, subtidal areas, unvegetated flats, sloughs, creeks, and other coastal wetlands.
T-2013	1889	A.F. Rodgers and J. Nelson	Covers northern portion of Mission Bay, as well as upland areas North into La Jolla
T-5374	1933	USCGS	Covers full extent of False Bay; depicts tidal marshes, sloughs, creeks.
Hydrographic sheets (“H-sheets”)			
H-567	1856	J. Alden	Covers full extent of False Bay as well as adjacent nearshore areas; depicts soundings, depth contours, and shoreline.
H-5665	1934	K. McBean	Covers full extent of Mission Bay; depicts soundings, depth contours, substrate type, and shoreline.

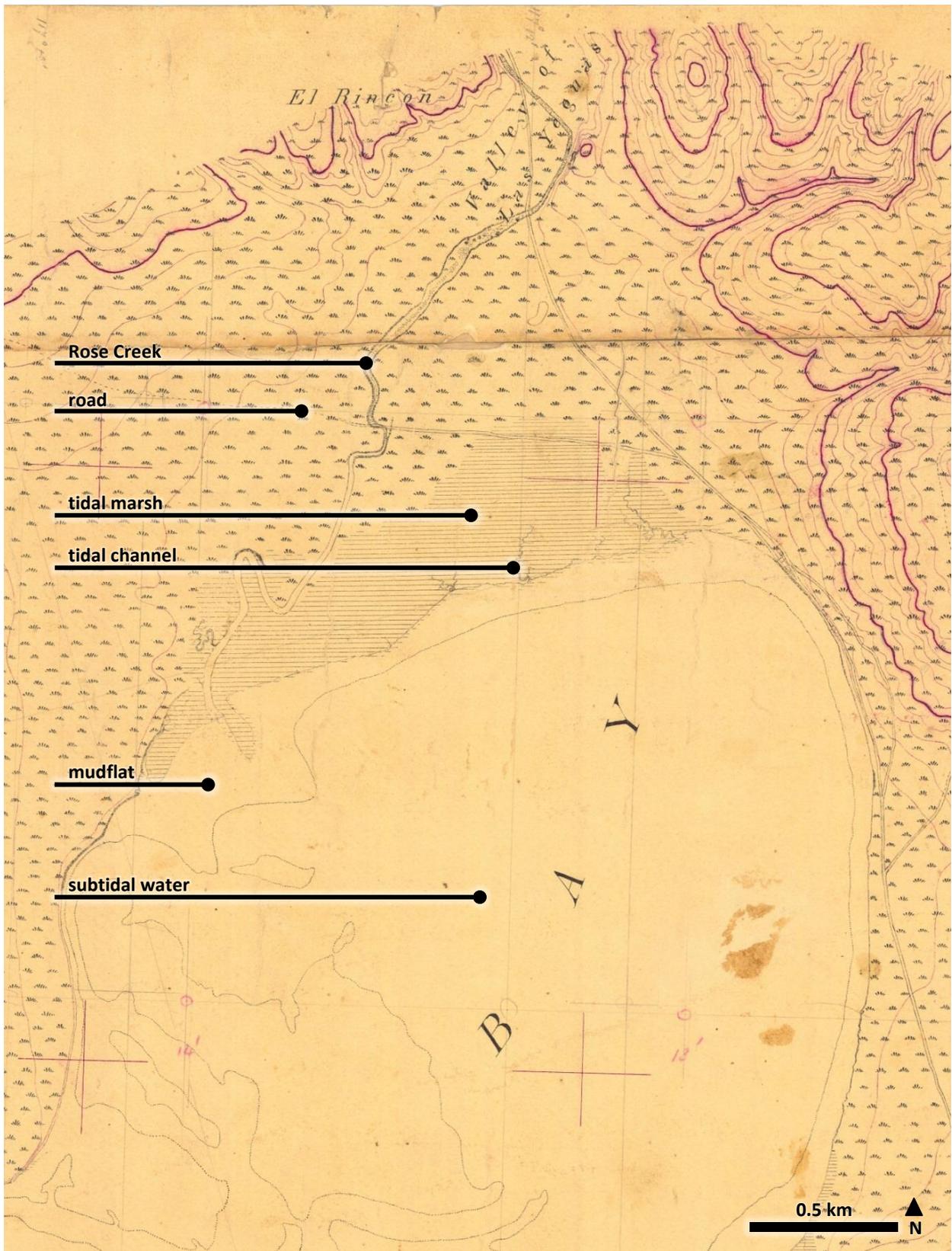


Figure 2. Crop of T-363 (Harrison 1852), depicting the northeast corner of Mission Bay during the mid-19th century. The map shows the extent and distribution of tidal marsh, tidal channels, mudflat, and subtidal habitats. The position of the road and downstream extent of the stipple patterning within Rose Creek (which likely symbolizes a dry sandy bed) suggest the normal upstream limit of the tides. Image courtesy of the National Oceanic and Atmospheric Administration (NOAA).

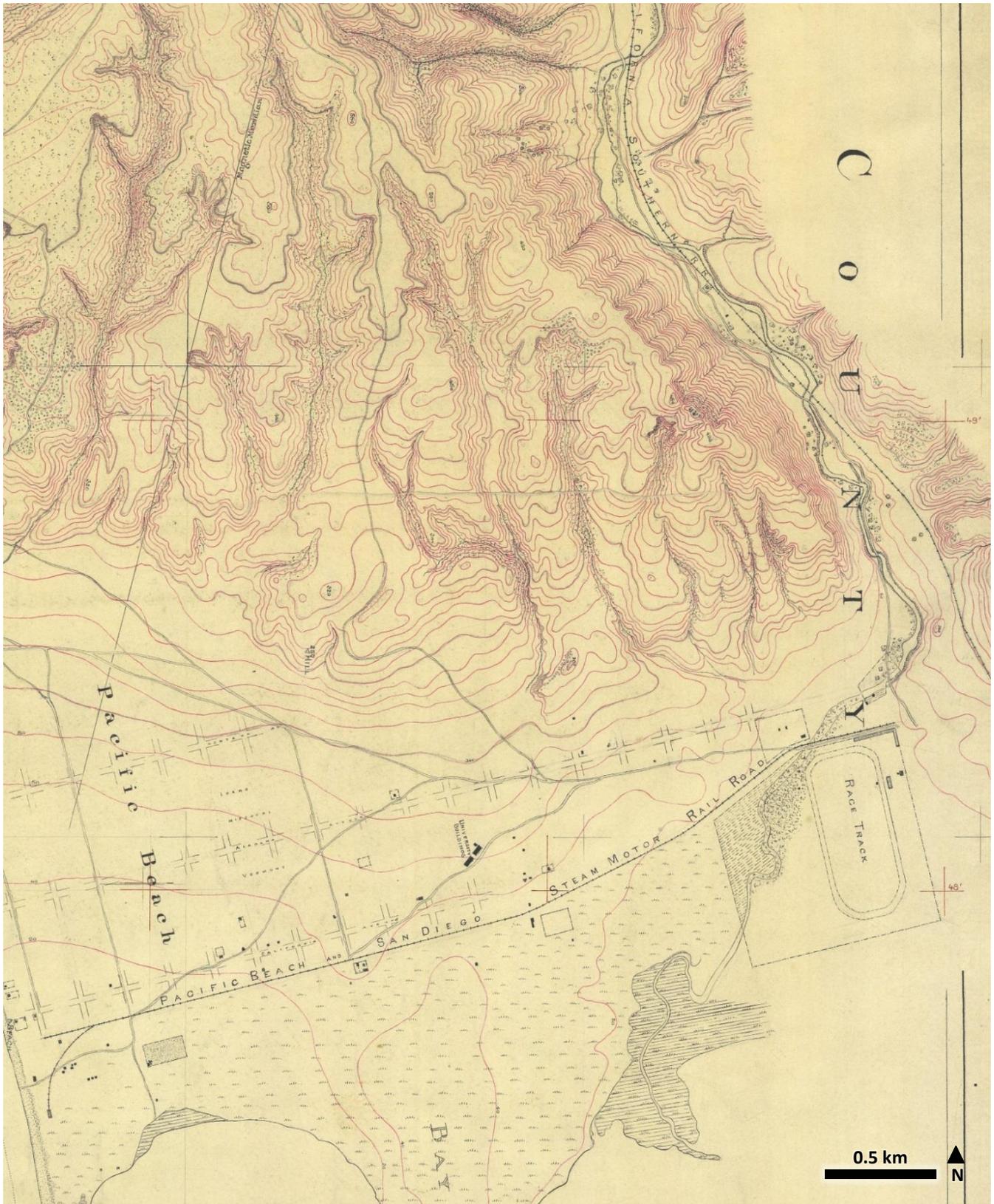


Figure 3. Crop of T-2013 (Rodgers and Nelson 1889), depicting the northeast corner of Mission Bay—plus areas north and west—during the late-19th century. When compared to T-363 (Harrison 1852; Figure 2), this map suggests that a rapid expansion of vegetated tidal marsh habitat occurred at the mouth of Rose Creek over the previous 37 years. It is also useful for its depiction of riparian habitats along Rose Creek. Image courtesy of the National Oceanic and Atmospheric Administration (NOAA).

USGS topographic quadrangles

The U.S. Geological Survey began producing topographic quadrangles (“quads”) in the San Diego area in 1903. The maps provide complete coverage of the study extent and offer information on the region’s topography and hydrography. Because they were regularly reproduced and utilize a standardized symbology, the quads are also particularly useful for assessing change over time. The majority of Mission Bay is located within the La Jolla quadrangle, for which maps were published in 1903 (Figure 4) 1930, 1943, and 1953. A small portion of southern Mission Bay is found in the San Diego quadrangle (later renamed the Point Loma quadrangle), with maps published in 1904, 1930, 1942, and 1953.

Historical soil surveys

Information available in historical soil maps and their accompanying survey reports, including soil texture, depth, water-holding capacity, salinity, presence or absence of a hardpan, and associated vegetation, often provides evidence for the historical presence and extent of certain habitat types. Soils are a relatively persistent feature, and thus historical soil maps, while not as early as other sources, can provide a window into early 20th-century conditions. Two early soil surveys covering the project’s study extent were obtained during this project. The first, published in 1918, is a reconnaissance survey that mapped soils at a relatively coarse scale (Holmes and Pendleton 1918). A finer scale survey was then published 12 years later (Figure 5; Storie and Carpenter 1930). As part of the compilation process, we generated a spreadsheet that documents the soil types found within the study extent, along with each soil type’s key attributes.



Figure 4. Crop of the earliest available USGS quadrangle (USGS 1903) depicting Mission Bay and surroundings. The map offers some insight into the flow permanence of Mission Bay’s tributaries—Rose Creek, Tecolote Creek, and the San Diego River are all drawn with a dashed line, indicating that surface flow was intermittent or ephemeral at the time of the survey. As it exits its canyon, the lower reaches of Rose Creek are shown as a sandy channel bed (brown stipples) before entering Mission Bay through a tidal creek. Image courtesy of the U.S. Geological Survey (USGS).

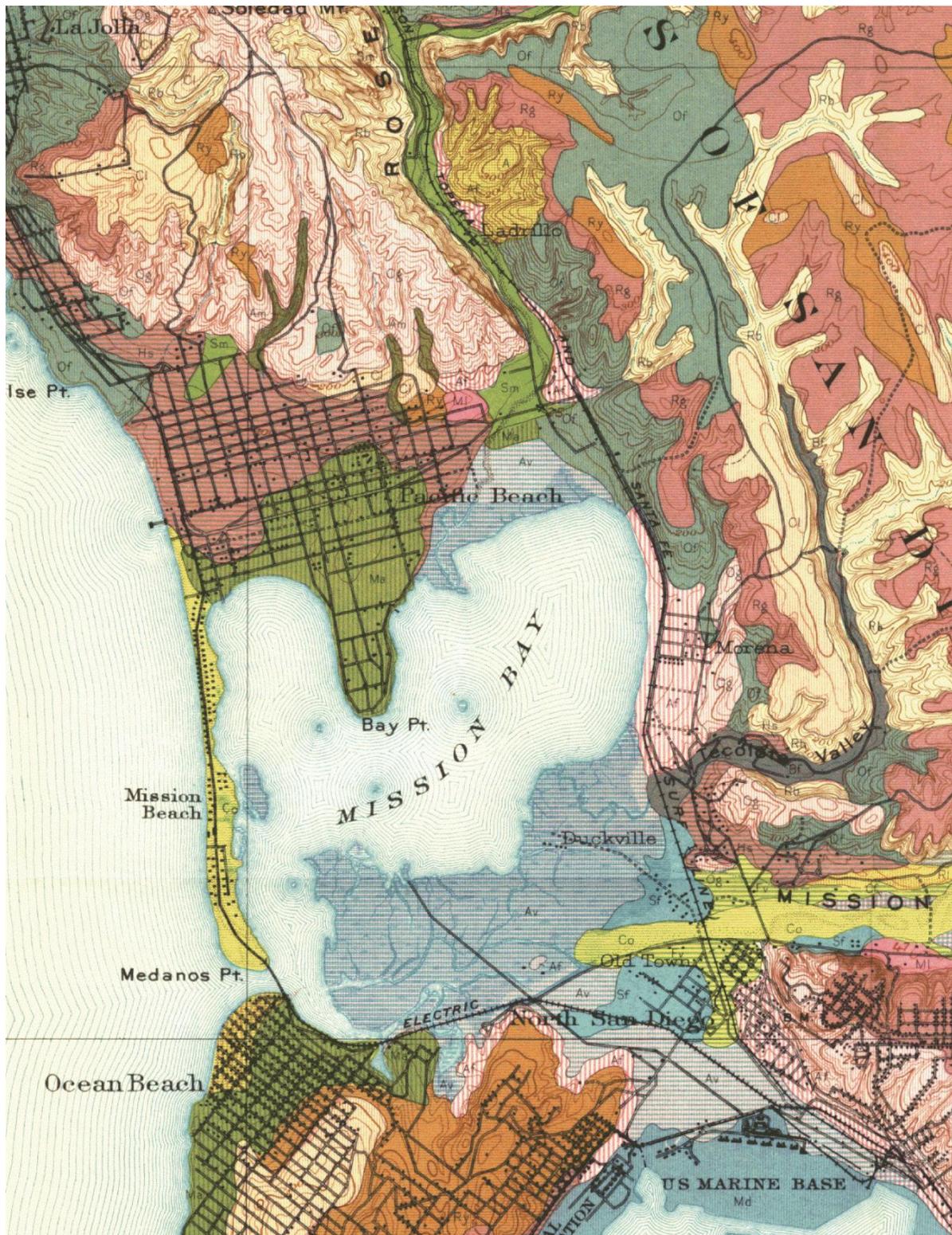


Figure 5. Crop of a survey (Storie and Carpenter 1930) of the soils surrounding Mission Bay in the early 1900s. One notable soil type in northeast Mission Bay is “Alviso very fine sandy loam” (denoted with “Av” on the map), which was said to support a cover of pickleweed, salt grass, and some areas of salt flats (Storie and Carpenter 1923)—this soil type is broadly associated with tidal marshes, the high marsh transition zone, and alkali meadow habitats. “Olivenhain fine sandy loam” (“Of”), which also borders the marshes of northeast Mission Bay, has an impervious subsoil and is characterized by a distinctive “hog-wallow” topography (otherwise known as “mima mounds”) that supports vernal pools in the depressions between mounds. Remnants of this microtopography are apparent in early aerial photographs. Image courtesy of the University of Alabama.

Historical aerial photographs

The earliest known vertical aerial photographs of the study extent were produced for the San Diego County government during the winter of 1928-1929. While photographs from this era post-date major Euro-American landscape modification, they often still show many remnant and relict ecological features. Historical aerial photographs are often useful for mapping features depicted on earlier, less spatially accurate sources, and for documenting change over time.

For this study, we obtained 64 digitized photographs from the San Diego Department of Public Works (all of the photographs for Index No. 59). Of these photographs, the 12 images that cover the northeast portion of Mission Bay were deemed “first tier.” The 13 additional images that cover the remainder of our study extent were deemed “second tier.” First tier images were individually georeferenced, orthorectified, and mosaicked using the LPS extension of ERDAS Imagine 9.3 software (the orthorectification process improves the horizontal accuracy of an aerial image by removing distortion associated with each photograph’s perspective and underlying relief). Since the orthorectification process is labor intensive, we did not orthorectify second tier images during this reconnaissance study. Instead, second tier images were combined with first tier images to generate a seamless composite photograph using Photoshop’s “Photomerge” tool. We then georeferenced this composite image using ArcGIS. Although the composite image has not been orthorectified, it allows users to view historical imagery from the whole study extent and roughly compare it to other sources.



Figure 6. A 1928 aerial photograph of northeast Mission Bay. Twenty-five of these photographs were stitched together to create the mosaic image seen in Figure 7. Note that east is up. Image courtesy of the County of San Diego.



Figure 7. 1928 aerial photograph mosaic of Mission Bay and surroundings. Individual images courtesy of the County of San Diego.

General Land Office (GLO) Public Land Survey System (PLSS) records

Established in 1812, the GLO was charged with surveying and overseeing the sale of public lands in the western U.S. In areas not claimed through the land grant system, the U.S. Public Land Survey divided the land into a grid of 1x1 mile squares (known as “sections”). Surveyors systematically walked section boundaries, keeping detailed field notes on the natural and cultural features encountered along the way. Notes and plat maps from these surveys are useful for their ecological information and have been extensively utilized in research concerning historical landscapes (e.g., Buordo 1956).

Unfortunately, because this project’s study extent falls entirely within the borders of the San Diego Pueblo Lands (which was not considered public land), very few PLSS data exist for Mission Bay. The boundary between Ranges 3 and 4 W in Township 16, which runs from La Jolla to the tip of Crown Point, was surveyed by J.E. Freeman in 1854, but only crosses two sections within our study extent (Figure 8). Additionally, the boundary of the Pueblo Lands, including the perimeter of False Bay, was surveyed by J.C. Hays in 1858 (Figure 8). We obtained the plat maps and survey notes associated with this latter survey from the San Diego History Center, but were not able to obtain the limited Freeman survey notes during this reconnaissance study since the relevant Bureau of Land Management office was in the process of moving the records. Although they only cover a relatively small area, they should be acquired during future research efforts.

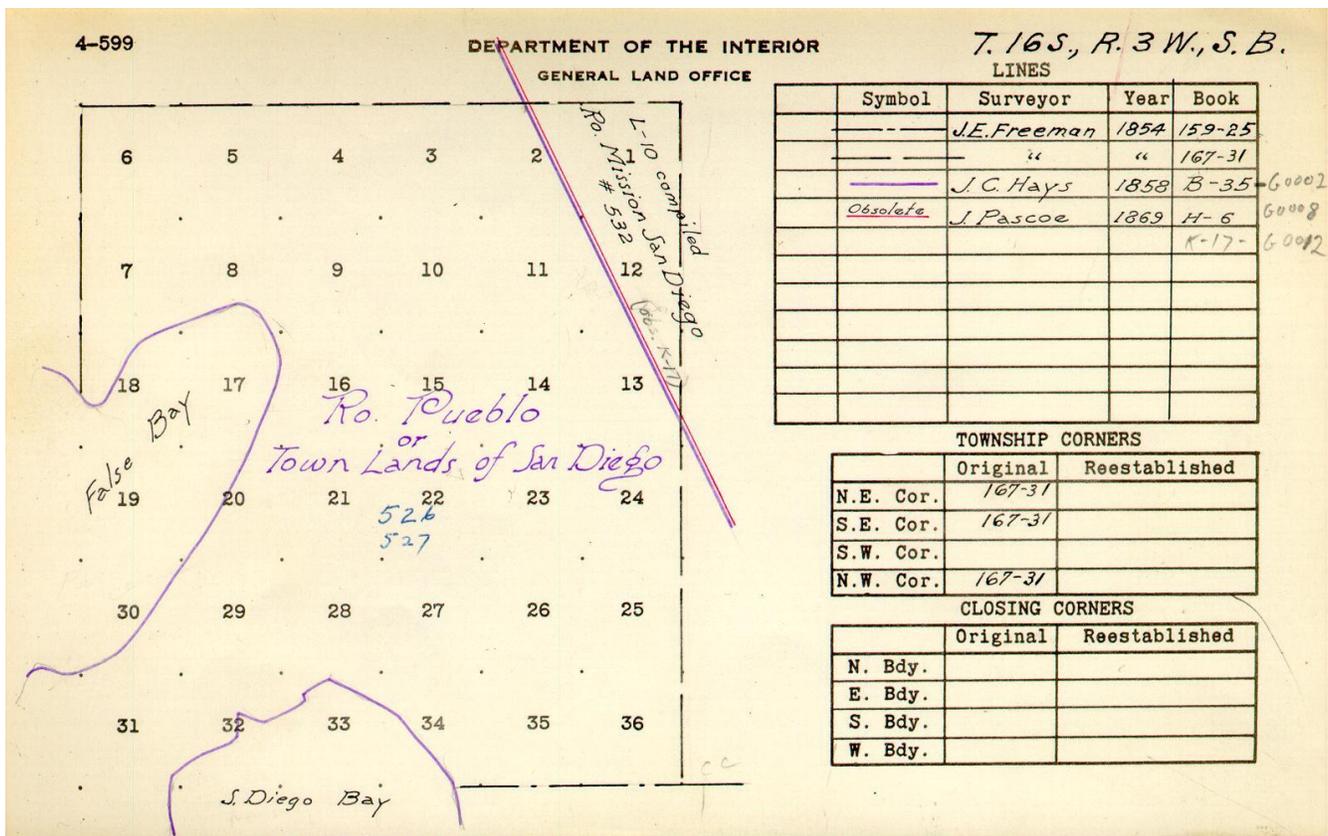


Figure 8. A General Land Office index card obtained from the Bureau of Land Management that shows the limited number of lines surveyed within the project’s study extent. Notes for the survey represented by the purple line (Hays 1858) were collected for this reconnaissance study; those represented by the dashed black line (Freeman 1854) have not yet been obtained. Image courtesy of the Bureau of Land Management.

Other datasets

In addition to the standard datasets described above, we collected hundreds of additional sources. These data, which build upon the foundation of the standard datasets, are detailed, unique, and place-specific sources that are needed to create a nuanced understanding of the historical landscape. Three classes of additional data collected for the reconnaissance study are described below—photographs, maps, and texts.

Photographs

We collected approximately 300 historical photographs for this study. Approximately 60 of these photographs were vertical aerial photographs taken in 1928, as described above in the “Historical aerial photographs” section. We also collected ground-level landscape photographs, which span from ca. 1870 to ca. 1960, and oblique aerial photographs, which begin ca. 1920. Some highlights from the assembled collection of photographs are discussed below.

Northeast Mission Bay and Rose Creek

Northeast Mission Bay is fairly well represented in the historical photographs obtained for this study. The earliest images of the area are dated 1906. These images look west from the present-day location of Interstate 5 and show shallow open water habitat, a narrow exposed band of mudflat, marshland, and—above the marshes—a large salt flat. Later photographs show the “new,” shifted outlet of Rose Creek. In these photos, the creek appears very straight, has noticeable banks (perhaps a few feet tall), and what appears to be an inset subtidal or low-flow channel. Its banks are vegetated and not yet armored. Other photographs from the same period depict dense riparian vegetation within and along Rose Creek, though the riparian corridor already seems to be laterally compressed by human infrastructure.

A brief review of photographs depicting upland portions of northeast Mission Bay shows that the coastal lowlands of modern-day Pacific Beach were largely treeless during the late 19th century, and instead were dominated by brush and an herbaceous cover.

Mission Valley and San Diego River

High-value early photographs of San Diego River (from Mission Valley to Mission Bay) are numerous, and we obtained dozens of images that offer information on the river’s historical hydrology, geomorphology, and ecology. Early photographs of Old Town, for example, show a wide, sandy river channel with scattered short-statured vegetation; photographs taken elsewhere show patches of vegetation that are much denser and taller. Further compilation and synthesis of the collected images will be needed to identify and understand any overarching spatiotemporal patterns in riverine habitats and processes.

Other high-value photographs

Many photographs offer glimpses into the various habitat types that characterized Mission Bay during the target period. Early photographs of what is now Mission Beach capture sizeable sand dunes and a moderate slope down to unvegetated tidal flats and the waters of Mission Bay (Figure 9). Other photographs suggest the character of Mission Bay’s shoreline varied with location: some images (such as those taken at Crown Point) show a steep cliff-like shoreline, while some show a vegetated shoreline defined by expansive swaths of tidal marsh. In the interior of the Bay, many photographs show isolated shoals/mudflats, but also many grassy “islands”—the latter appear to be low tidal marshes dominated by cordgrass.



Figure 9. “False Bay (later known as Mission Bay) collecting ground at low tide. 1906.” An example of a high-value photograph collected for this study. This image, taken by Herbert R. Fitch on Mission Beach, shows sizeable sand dunes and a sandy shoreline interrupted by short rocky reaches. Photo courtesy of the Special Collections & Archives, UC San Diego Library.

Maps

We collected approximately 100 maps for this study, ranging from the charts of early Spanish explorers to modern vegetation maps of the Kendall Frost Reserve. Spanning a period of more than 400 years (1602 to present), the maps were produced for a wide variety of purposes and vary significantly in terms of scale, accuracy, and level of detail. Highlights from the assembled collection of maps are presented below (but also see the “Standard datasets” section for a description of the U.S. Coast Survey maps, USGS topographic quadrangles, and historical soil maps obtained for this study).

Maps from the Spanish period (1542-1820s)

The first known map depicting Mission Bay is the chart drawn by Capitan Geronimo Palacios in 1602 entitled “Puerto Bueno de S. Diego.” Although extremely generalized, the chart gives soundings of 2 brazas (~11 ft) at the mouth of Mission Bay and soundings of 4 and 5 brazas (~22-27 ft) within the interior of the bay. These data will be useful for assessing changes to Mission Bay’s bathymetry over time. Other maps from the Spanish era collected for this study include a series of charts derived from Pantoja’s chart of 1782, which, although very generalized, depicts the general shape of Mission Bay, its islands, and the approximate location of some tributaries.

Maps from the Mexican period (1820s-1848)

Maps from the Mexican period similarly provide generalized depictions of the landscape. These maps include charts made by the English sea captain John Hall in 1822 and the French explorer Eugene Duflot de Mofras in 1841-2. For the purposes of historical ecology, the most important map from this period is likely the *diseño* of the Pueblo lands drawn in 1845 by Henry D. Fitch. *Diseños* were “rough sketches” of properties submitted to the Mexican government in land grant claims. Like many *diseños*, the “Fitch map” (which has a long and complicated history of its own; see Harlow 1987), although generalized, depicts many physical landmarks that would have served as boundaries or provided natural resources, such as

creeks, sloughs, forests, and sand dunes. Especially notable are the hand-drawn trees that line the course of Rose Creek and indicate the historical presence of significant riparian vegetation.

Maps from the American period (1848- ca. 1940)

Maps from this period are much more numerous and detailed than those from the earlier periods. In addition to the maps discussed above (USC[G]S surveys, USGS topographic maps, and USDA soil maps), maps from this period include dozens of late-19th and early 20th-century county surveys, real-estate maps, road maps, water resource schematics, and geology maps. Due to its proximity to Old Town San Diego and the San Diego River, the southeast corner of Mission Bay is particularly well represented. The wetlands, sandy plain, and channels associated with the delta of the San Diego River were all detailed in mid-19th century maps drawn by the U.S. Topographical Engineers to support the diversion of the river from San Diego Bay to Mission Bay (Figure 10). The area is also detailed in an 1851 map by Henry Clayton and Eugene Hesse (which shows, amongst other things, tidal creeks, ponds, marshes, and a “road to wood lots”) and an 1854 map by Charles Poole. It should be noted that, compared with the southwest corner of Mission Bay, the rest of the study extent has very few 19th-century maps that contain ecologically-relevant information concerning the historical landscape. One exception, in addition to the USC[G]S maps described in Table 4, is James Pascoe’s 1870 “Official Map of the Pueblo Lands of San Diego,” which depicts the course of Rose Creek, the location of a spring on the eastern edge of Mission Bay, and a lagoon in Mission Valley.

Texts

Textual data were collected from a wide variety of sources, including journals, land surveys, regional histories, court documents, land claims dockets, field notes, letters, travel accounts, newspaper articles, scientific articles, technical reports, and books. Collected documents span in time from the account of the Juan Cabrillo expedition, which briefly landed in San Diego Bay in 1542, to modern research papers. Over the course of this reconnaissance study, we read hundreds of documents, ultimately collecting material from at least 100 individual sources.

Given San Diego’s importance as a harbor, there are a relatively large number of early observations of the landscape in the area. Expeditions that generated writings on Mission Bay and its surroundings prior to the American era include those of Cabrillo (1542), Vizcaíno (1602), Portolá (1769), Anza (1775), Vancouver (1792), Duhaut-Cilly (1827), Dana (1835), Wyeth (1836), Belcher (1839), and Duflot de Mofras (1841).

One of the earliest written sources specifically describes the northeast portion of Mission Bay. In July of 1769, the Portolá expedition, travelling north from San Diego, paused at a Native American village at the mouth of Rose Canyon and made camp near Rose Creek. The account of Juan Crespi, a missionary attached to the expedition, offers valuable information on the upland vegetation along the western margin of the Bay, native wildlife, Native American land use, the hydrology of lower Rose Creek, riparian vegetation, and groundwater conditions (Crespi [Brown] 1769 [2001]).

Texts from the American era are numerous. Well-covered topics include the bathymetry on Mission Bay, the hydrology and geomorphology of the lower San Diego River, and native wildlife, to name a few. Speaking generally, the collected textual data provide insight into the nearly all of the project’s guiding questions and could support a detailed study of Mission Bay’s historical ecology.

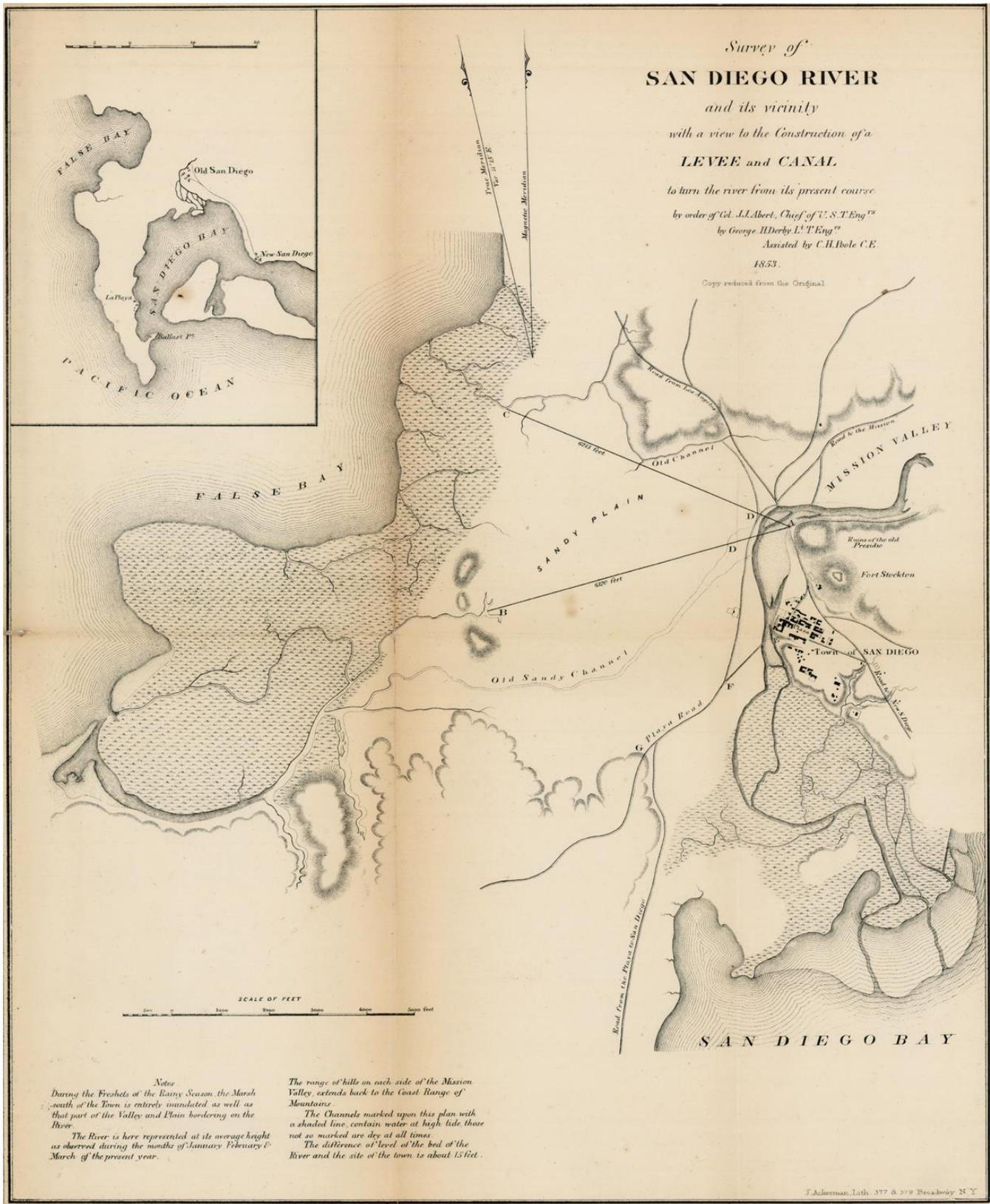


Figure 10. A map by George Derby (1853) depicting the San Diego River delta, including at least three courses of the river, tidal wetlands, a network of creeks cutting through the marshes of Mission and San Diego bays, and the expansive “sandy plain” between these two outlets. The map also uses shading to indicate the upper extent of the tides within the creeks. Image courtesy of www.RareMaps.com -- Barry Lawrence Ruderman Antique Maps Inc.

NEXT STEPS

The goal of this reconnaissance study was to survey and collect available data concerning the historical ecology of Mission Bay, begin compiling these data, and identify potential next steps for a more comprehensive study. To this end, our work suggests that substantial historical data are available for Mission Bay and that these data could support a detailed analytical study of the system's historical character and function. In addition, we found substantial data for connected neighboring areas such as upper Rose Creek, the San Diego River, northern San Diego Bay, and Point Loma.

The data collected during this reconnaissance survey will serve as an important foundation for any future work; however, additional data collection and compilation is needed improve any interpretation and synthesis efforts. Next steps for data collection and compilation include:

- **Visit additional institutions** likely to yield information on the historical landscape of Mission Bay. These include the Junípero Serra Museum, San Diego Maritime Museum, San Diego Natural History Museum, San Diego Public Library, La Jolla Historical Society, Pacific Beach Historical Society, Huntington Library, and National Archives.
- **Additional data collection at key archives already visited during the reconnaissance study**, including the Bancroft Library, San Diego History Center, and San Diego State University. Reasons to revisit a source institution include the need to collect sources only identified through the process of reviewing sources obtained during the initial round of data collection, and to query our full suite of search terms.
- **Acquire early species records** from online databases, including the Global Biodiversity Information Facility, VertNet, and the Consortium of California Herbaria. These data are useful for documenting changes in species composition and distribution, and as supporting information to map historical habitat types. These data generally require significant compilation, synthesis, and analysis.
- **Research archival materials for railroads** that were located or conducted operations within the study extent. These include the Santa Fe; San Diego, Gila, Southern Pacific & Atlantic; Texas and Pacific; California Southern Railroad Company; and San Diego, Pacific Beach, and La Jolla Railroad. The California State Railroad Museum (located in Sacramento, California) is the primary repository for these materials and has proven a valuable archive for other Southern California historical ecology studies.
- **Pursue other relevant data types** not comprehensively collected during the reconnaissance study include archaeological reports, precipitation records, and stream gauge data.
- **Pursue additional specific sources identified during reconnaissance study**, including the 1851 maps of Soledad, Las Lleguas, and Mission Valleys by Eugene Hesse cited in Harlow (1987) and Lorey (ca. 1988).
- **Obtain high-resolution copies** of certain maps and photographs.
- **Collect additional contemporary data**, such as recent scientific literature, modern soils maps, and information on groundwater, climate, and land use to contextualize historical data and characterize historical trends.
- **Orthorectify the reminder of historical aerial photographs** to help reconstruct the extent and distribution of Mission Bay's historical habitat types in a rigorous, spatially-explicit way.

Emerging findings will be presented to San Diego Audubon staff at the conclusion of this project. However, additional data collection, interpretation, and analysis will be required to form a thorough, well-supported understanding of the historical landscape that can be used to guide present-day restoration and management efforts. The data interpretation and synthesis process involves carefully comparing sources from multiple points in time and interpreting these sources in the context of land-use history and daily, annual, and decadal variation in climate (cf. Grossinger 2005, Grossinger et al. 2007). Synthesizing these sources into a map of historical habitat types is a useful way to visually summarize the historical ecology of a place and can serve as the basis for further analysis of landscapes and how they have changed over time (e.g. SFEI-ASC 2014).

ACKNOWLEDGEMENTS

Thank you to the staff at the historical societies, libraries, archives, and agencies where we gathered data for this project, including Robert Laudy at the County of San Diego Department of Public Works, Heather Smedberg at the University of San Diego Special Collections, Adam Burkhart at the San Diego State University Special Collections & University Archives, and Jane Kenealy and Samantha Mills at the San Diego History Center. Thank you also to Sean Baumgarten (SFEI), Tyler McIntosh (Stanford University), Julio Lorda (Tijuana River National Estuarine Research Reserve), Micha Salomon (SFEI), and Rebecca Schwartz (San Diego Audubon Society), who all assisted with historical data collection efforts.

REFERENCES

- Buordo EA. 1956. A review of the General Land Office survey and of its use in quantitative studies of former forests. *Ecology* 37:754-768.
- Crespí J, Brown AK. 2001. A description of distant roads: original journals of the first expedition into California, 1769-1770. San Diego, CA: San Diego State University Press.
- Derby HG. 1853. Survey of San Diego River and its vicinity with a view to the construction of a levee and canal to turn the river from its present course. Senate Ex. Doc No. 1, 1st Session, 33rd Congress. *Courtesy of Barry Lawrence Ruderman Antique Maps Inc.*
- [Fitch HD]. U.S. District Court, Southern District. [1845]. [Pueblo lands of San Diego, Calif.]. Land Case Map D-1436. *Courtesy of The Bancroft Library, UC Berkeley.*
- Grossinger RM, Askevold RA. 2005. *Historical analysis of California Coastal landscapes: methods for the reliable acquisition, interpretation, and synthesis of archival data. Report to the U.S. Fish and Wildlife Service San Francisco Bay Program, the Santa Clara University Environmental Studies Institute, and the Southern California Coastal Water Research Project, SFEI Contribution 396.* San Francisco Estuary Institute, Oakland. 48.
- Grossinger RM, Striplen CJ, Askevold RA, et al. 2007. Historical landscape ecology of an urbanized California valley: wetlands and woodlands in the Santa Clara Valley. *Landscape Ecology* 22:103-120.
- Grossinger RM. 2005. Documenting local landscape change: the San Francisco Bay area historical ecology project. In *The historical ecology handbook: a restorationist's guide to reference ecosystems*, ed. Dave Egan and Evelyn A. Howell, 425-442. Washington, D.C.: Island Press.
- Harlow N. 1987. *Maps of the Pueblo Land of San Diego, 1602-1874.* Los Angeles: Dawson's Book Shop.
- Harrison AM. 1852. Map of False Bay near San Diego California. U.S. Coast Survey (USCS).
- Holmes LC, Pendleton RL. 1915. U.S. Department of Agriculture: Bureau of Chemistry. 1915. Soil map: California, reconnaissance survey—San Diego sheet.
- Lorey F. ca. 1988. Rose Canyon History. Brian Smith & Associates. Unpublished manuscript. *Courtesy of the San Diego History Center.*
- Rodgers AF, Nelson J. 1889. Topography, Pacific coast, from False Bay to La Jolla, California, register no. 2013. U.S. Coast and Geodetic Survey (USCGS).
- SFEI-ASC (San Francisco Estuary Institute-Aquatic Science Center. 2014. A delta transformed: ecological functions, spatial metrics, and landscape change in the Sacramento-San Joaquin Delta. Prepared for the California Department of Fish and Wildlife and Ecosystem Restoration Program, a report of SFEI-ASC's Resilient Landscapes Program, publication #729, San Francisco Estuary Institute-Aquatic Science Center, Richmond, CA.
- Storie RE, Carpenter EJ. 1923. *Soil survey of the El Cajon area, California.* U.S. Department of Agriculture: Bureau of Chemistry and Soils.
- Storie RE, Carpenter EJ. U.S. Department of Agriculture: Bureau of Chemistry and Soils. 1930. Soil map: el Cajon area: California.
- USCGS (U.S. Coast and Geodetic Survey). 1933. California north of San Diego Bay, Mission Bay, air photo compilation no. T-5374.
- USGS (U.S. Geological Survey). 1903. La Jolla Quadrangle, California: 15-minute series (Topographic).