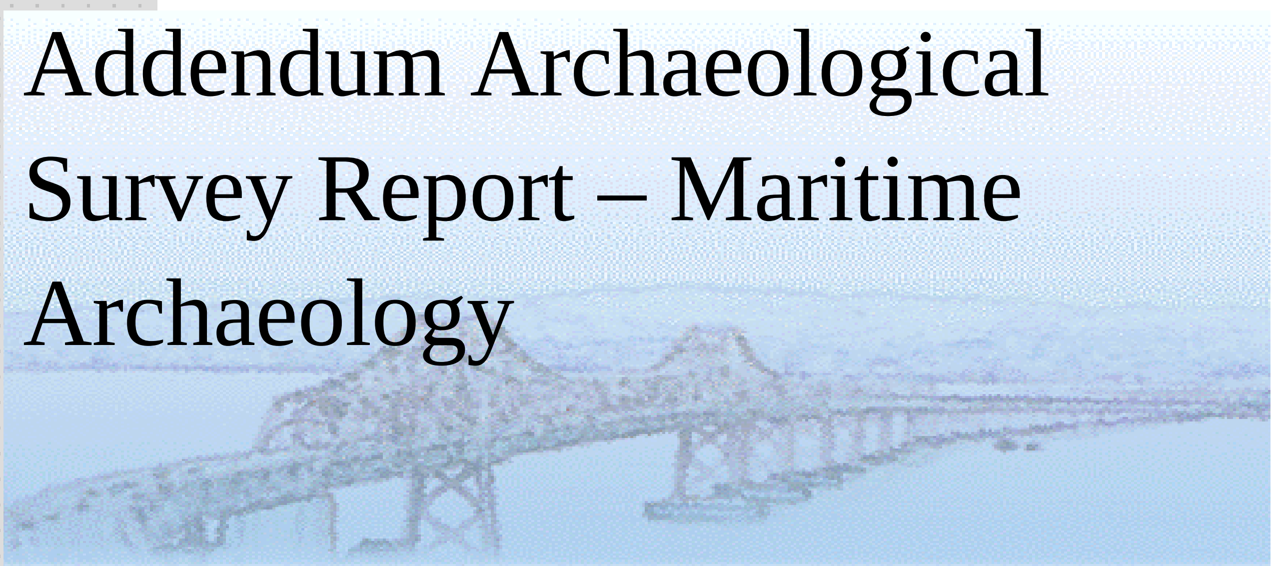
San Francisco – Oakland Bay Bridge
East Span Seismic Safety Project
04-SF-80 PM 7.6/8.9 - 04-ALA-80-PM 0.0/1.3

Addendum Archaeological Survey Report – Maritime Archaeology



March 2000

California Department of Transportation
District 04, Oakland

EA 012000
SHPO # FHWA 980717A

Caltrans Contract 04A0148
Task Order 175.10.15

San Francisco – Oakland Bay Bridge East Span Seismic Safety Project in the Counties of San Francisco and Alameda

EA 012000 Caltrans	**Contract 04A0148**
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Addendum Archaeological Survey Report – Maritime Archaeology

March 2000

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SUMMARY OF FINDINGS

In months April through August 1999, archaeologists from William Self Associates (WSA) conducted remote sensing surveys and ground-truthing[1] operations in the Area of Potential Effects (APE) for Maritime Archaeology for the San Francisco-Oakland Bay Bridge East Span Seismic Safety Project. Prior to commencement of field operations, WSA and Caltrans archaeologists conducted extensive archival research in local repositories, and the National Archives and Library of Congress in Washington, D.C. to develop the historic context of the APE.

In the remote sensing surveys, side scan sonar and a sub-bottom profiler were used to investigate the bottom surface of the APE. Numerous acoustic[2] targets were identified lying on or slightly below the bottom sediment. Of these, 51 targets were determined to be unidentified bottom features (UBFs) that required further analysis. Subsequent analysis of the acoustic data eliminated all but 26 of the UBFs as potential cultural resources.

In the months of May, July, and August 1999, the 26 UBFs were investigated with a camera-equipped Remotely Operated Vehicle, high-resolution side scan sonar, and ground-truthing diver assessments conducted by WSA maritime archaeologists. Isolated deposits of debris, the widespread, disarticulated remains of the Key System pier, discarded steel beams, concrete blocks, and the wheels from railroad cars are examples of the types of material comprising the targets. None of the targets investigated proved to meet the criteria of eligibility for the National Register of Historic Places. One historic archaeological site, the remains of the Key System ferry terminal, lies within the APE. The site lacks the integrity of design, setting, workmanship, and feeling required for consideration of eligibility for inclusion in the National Register. No other archaeological sites are located within the boundaries of the APE.

Based on archival research, data collected during remote sensing surveys of the APE, and archaeological investigation of targets otherwise not identifiable, it is the conclusion of William Self Associates that no further evaluation of cultural resources in the APE is necessary. Although the research for this study did not reveal any potentially eligible resources, such resources may be present within the APE, but buried beneath the bottom sediments. Discoveries of such resources that are made during construction must be evaluated by a qualified archaeologist, who can evaluate the nature and significance of the find.

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[1] Ground-truthing is a term used to describe the evaluation and assessment of a suspected archaeological resource. For submerged sites, archaeologists make this assessment by conducting scuba dives on the target when possible, or by mounting video and 35mm cameras on a submersible, remotely-operated vehicle that is controlled from the surface.

[2] Both the side scan sonar and sub-bottom profiler use sound waves to characterize the bottom surface. An object identified through the propagation and return of a sound wave is therefore referred to as an acoustic target.

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1.0 INTRODUCTION

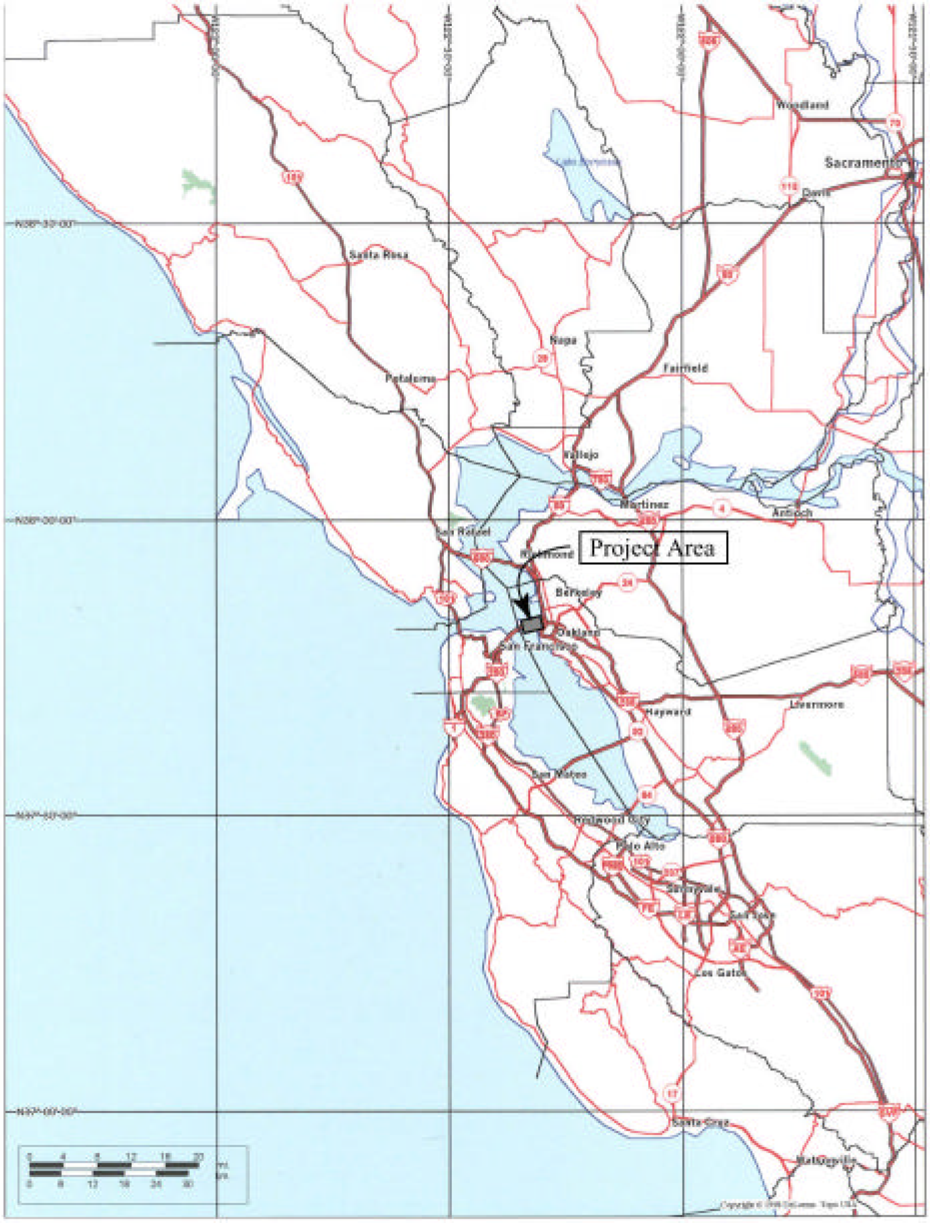
In the months April through August 1999, archaeologists from William Self Associates (WSA) conducted maritime archaeological studies for the San Francisco-Oakland Bay Bridge East Span Seismic Safety Project (ESSSP) between Yerba Buena Island and the City of Oakland, California (Figures 1 and 2). Remote sensing surveys and ground-truthing operations were conducted in the Area of Potential Effects (APE) for Maritime Archaeology, which was established by Caltrans in consultation with the Federal Highway Administration (FHWA) on February 1, 1999 (Figure 3). The size and configuration of the APE was designed to encompass all potential alignments and specifically addressed the anchoring requirements of the project's construction barges, which typically will employ four-point, wide-ranging anchor spreads.

Following an extensive literature and records search conducted by WSA and archaeologists from Caltrans, and the examination of side scan sonar records of the APE previously collected by Fugro West, Inc., a side scan sonar and sub-bottom profile survey was conducted for the entire APE during the period April 26, 1999 through April 29, 1999. Numerous acoustic targets were identified lying on or slightly below the bottom sediment. Most were determined to be either non-cultural in origin or culturally non-diagnostic (i.e. anchor scars, sewer outfalls, buried communication or power cables, etc.). Of the targets identified in the survey, 51 were determined to be unidentified bottom features (UBFs) requiring further analysis. By analyzing the shape, surficial expression, size, acoustic shadow, and association with targets on adjacent survey lines, WSA determined that twenty-two of the UBFs were potentially significant and required ground-truthing to determine their specific nature.

On May 11, 1999, a remotely operated vehicle (ROV) equipped with forward-looking sonar, a high-resolution color video camera, a Silicon Intensifier Targeting camera (SIT)[3,] and two Tungsten-Halogen 250 watt lights was deployed from the 65-foot long research vessel *White Lightning* in the initial ground-truthing effort of the high-priority targets. Due to [the] unusually high levels of water turbidity, neither the color video nor SIT cameras were able to provide images sufficiently clear to adequately identify or assess the targets and this approach to ground-truthing was abandoned.

In order to assess the submerged, widespread remains of the Key System pier and ferry terminal, (one of the targets identified in the initial remote sensing survey), WSA conducted an intensive side scan sonar survey of the target on June 30, 1999, using a high-resolution side scan sonar system.
Ground-truthing operations for the remaining targets, which were accessible by archaeologists equipped with scuba, were conducted in the periods July 13 – July 15, 1999, and August 18 –

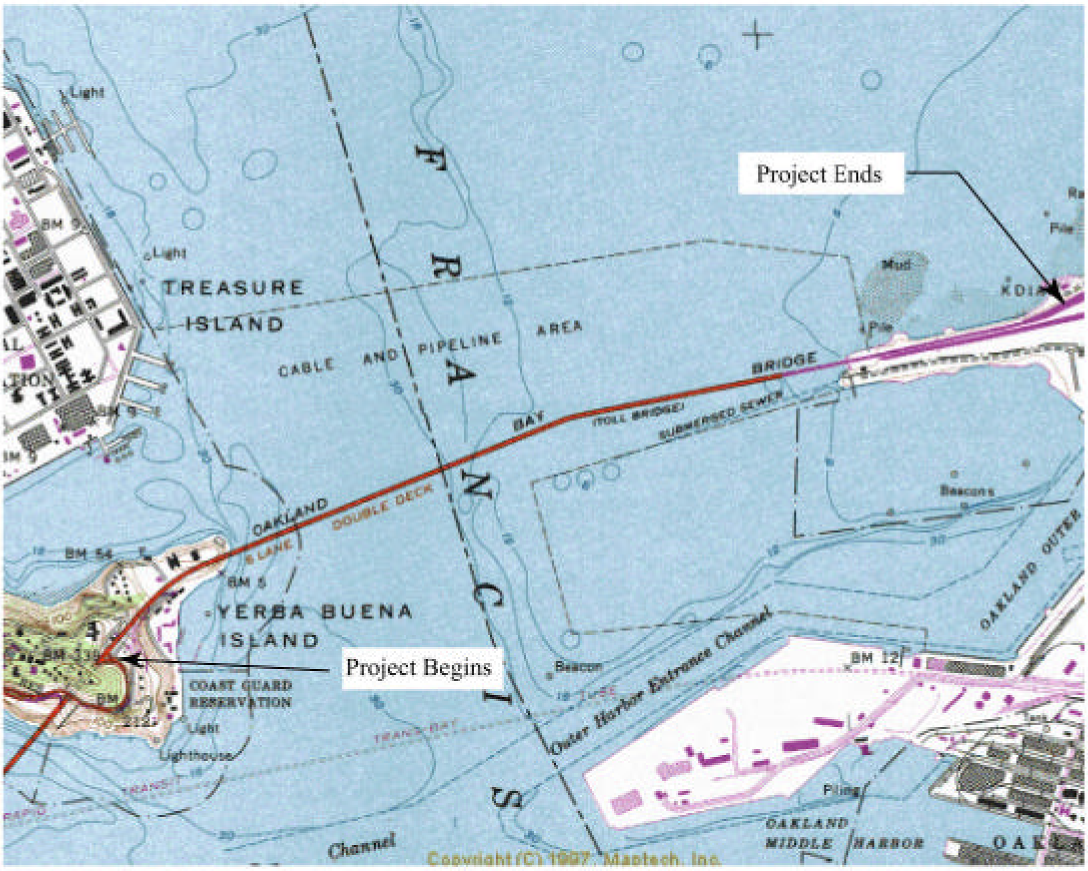
3 The SIT camera is designed to operate in environments with extremely low light levels.



Project Vicinity Map

Figure 1

SFOBB East Span
Seismic Safety Project



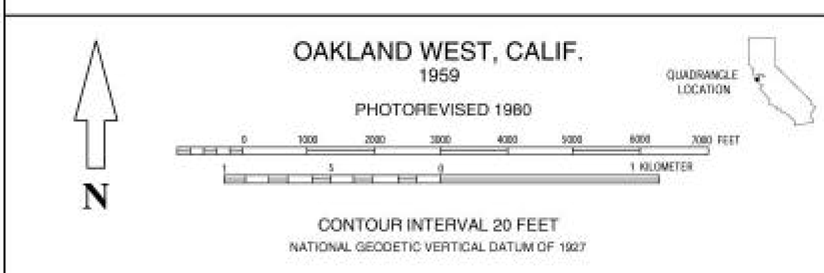
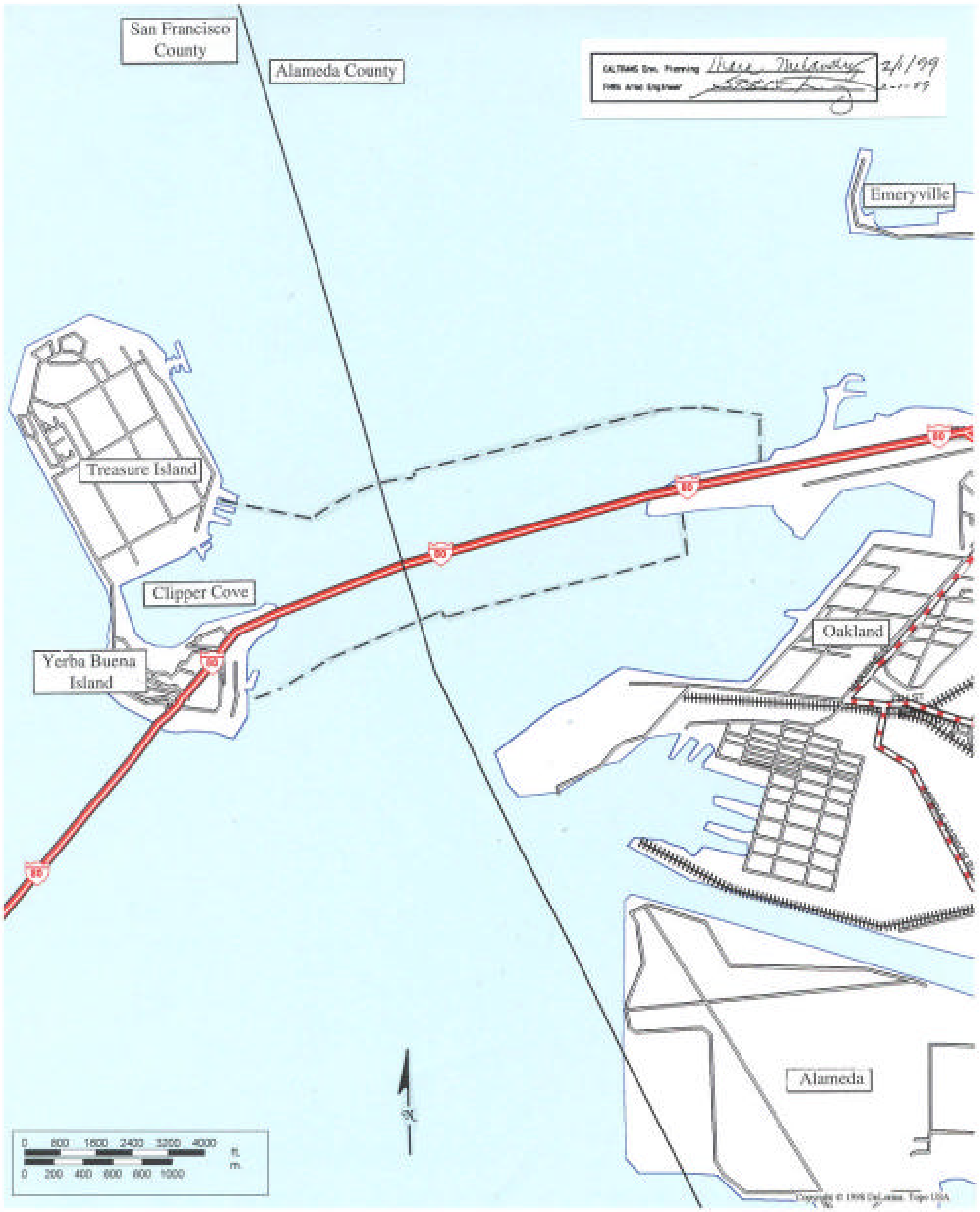


Figure 2
Project Location Map
SF-80: P.M. 7.6/8.9
ALA-80: P.M. 0.0/1.3
SFOBB East Span
Seismic SafetyProject



Maritime Archaeology Area of Potential Effect	Figure 3 SFOBB East Span Seismic Safety Project

August 20, 1999. Using a combination of the high-resolution sonar and diver assessment, each of the 22 high-priority UBFs was investigated during these operations.

Archaeologists and staff of William Self Associates and Caltrans conducted field research and archival research. James M. Allan, Senior Associate of WSA, conducted archaeological and archival research for the project and is the principal author of this report. Mr. Allan is a Ph.D (ABD) in Anthropology whose area of expertise is in maritime archaeology. Mr. Allan has over 12 years experience in the field and has over 10 years experience in California archaeology. Aaron Golbus, a WSA Associate Archaeologist, assisted in the remote sensing survey and ground-truthing operations. Mr. Golbus holds an M.A in Maritime Studies and has over five years experience in the field of maritime archaeology. Caltrans archaeologist Jack Hunter assisted in the remote sensing and ground-truthing operations, and conducted a comprehensive examination and interpretation of historic charts and associated literature to develop the analysis of the historic bathymetry of the APE. Mr. Hunter has over 20 years experience in maritime archaeology, holds a B.A. in Anthropology, and is completing an M.A in Environmental Studies. Jason Reimers, a WSA Associate Archaeologist, also assisted in the ground-truthing operations. Mr. Reimers holds a B.A. degree in Anthropology and has over three years experience in California archaeology. Mr. Allan, Mr. Hunter, and Caltrans Archaeology Manager Janet L. Pape conducted the records, literature, and archival research in local repositories and in the National Archives and in the Library of Congress, Washington D.C. Ms. Pape holds an M.A. degree in Cultural Resources Management and has over 18 years experience in California archaeology. Historian Marjorie Dobkin conducted research into the Key System pier and terminal and prepared the historic background on the facility. Ms. Dobkin is a Ph.D. in History and has over ten years experience conducting research and preparing historic contexts pertinent to California's past.

2.0 PROJECT LOCATION AND DESCRIPTION

The San Francisco-Oakland Bay Bridge East Span Seismic Safety Project involves the seismic upgrade of the east span of the San Francisco-Oakland Bay Bridge on Interstate 80 in the County of Alameda and the City and County of San Francisco. The ESSSP crosses San Francisco Bay between the cities of San Francisco and Oakland. The project encompasses the eastern span of the bridge from Yerba Buena Island (04-SF-80 PM 7.6/8.9) on the west to the eastern touchdown in the City of Oakland (04-ALA-80 PM 0.0/1.3) (refer to Figure 2).

3.0 SOURCES CONSULTED

Records and literature searches were conducted at repositories and archives in California and in Washington D.C. These included the California Historic Resources File System, Northwest Information Center, Sonoma State University; the National Archives, Pacific Sierra Region; the San

Francisco History Center of the San Francisco Public Library; the J. Porter Shaw Maritime Library; the California Historical Society; the Oakland Public Library; the Bancroft Library of the University of California; the shipwreck inventory of the California State Lands Commission; the Library of

Congress, the Naval History Center, and the National Archives in Washington, D.C.; historic bathymetric survey reports and the Automated Wreck and Obstruction Information System (AWOIS) of the National Oceanographic and Atmospheric Administration.

Additional sources consulted include the United States Department of Interior's National Register of Historic Places (1966-1991), California Inventory of Historic Places (California State Office of Historic Preservation 1976), and the California Historical Landmarks (California State Office of Historic Preservation 1982). Historic maps were copied from the collection of the National Archives in Washington D.C. and were gathered at the University of California at Berkeley's Historic Map Center.

A recent report of the maritime archaeology conducted within the APE for the ESSSP's Pile Installation Demonstration Project (PIDP) was also reviewed for information regarding the potential for submerged cultural resources in the ESSSP APE (Allan 1999). With the exception of the survey conducted for the PIDP, no other maritime cultural resource surveys have been conducted, nor have any eligible maritime archaeological sites been recorded within one-half mile of the ESSSP's APE, an opinion with which California's State Historic Preservation Officer concurred on December 1, 1999 (Appendix A).

Research of the records and literature mentioned above determined that over 100 shipwrecks have occurred within the immediate confines of San Francisco Bay. Of these, 15 were identified as potentially occurring within or near the boundaries of the APE, or may have drifted into the APE before sinking. These wrecks are listed below in Table 1. A map depicting their estimated locations, a synopsis of each vessel's history and of the wrecking incident may be found in Appendix B.

Although they did not occur within the project's APE, information on the wrecks of the *San Carlos*, the *Utica*, and the *Norman*, each mentioned in preliminary documentation for the project (PAR 1997:21), is included in the table and in Appendix B. Archival research also identified a previously unknown wreck, the *Kronprinzeessin von Hanover* (*Crown Princess*) (*Alta California*, Dec. 1, 1849). The ship was towed onto the flats of Yerba Buena Island after striking Blossom Rock and is included in the table and Appendix B since its exact location and final disposition could not be determined. None of the wreck or obstruction sites recorded in NOAA's AWOIS for San Francisco Bay lie within the ESSSP APE.

Table 1: Chronological Listing of Potential Shipwrecks in or near Maritime Archaeology APE

Date	Rig & type	Name of vessel	onnag	Value	Cargo	Loss	Location of incident	Nature of casualty
3/23/1797	Barque-wood	San Carlos	n/a	n/a	Supplies	Total	S.F. Presidio	Sunk in storm while at anchor
11/20/184	Ship-wood	Kronprinzeessin von Hanover	n/a	n/a	n/a	Total	Bay of S.F.	Struck rock, towed to flats of YBI
n.d.	Ship-wood	Utica	525	n/a	n/a	Total	Bay of S.F.	Towed to YBI and sunk
6/1/1874	Schooner-wood	Dolly Varden	9	$600	Sand	$600	Bay of SF	Foundered
2/6/1877	Steamer-wood	Pearl	48	$8,000	Jute	$3,000	East Oakland	Fire
9/20/1877	Schooner-wood	Col. Baker	76	$3,500	Stone	$350	Entrance to Oakland channel	Foundere and capsized
10/18/187	Schooner-wood	Mabel & Edith	48	$2,500	Gas pipe	$1,000	3/4 mile NW Goat Isl	Foundered
10/6/1879	Scow sloop-wood	Norman	19	$400	Hay	$400	Near Berkeley	Went ashore
12/7/1884	Scow schooner-wood	Which[sic] of the Bay	2134	$1,000	Coal	$800	Mouth of Oakland mole	Driven on the rocks
2/28/1892	Schooner-wood	Louisa/West	17	$800	Lumber	$800	Two miles off W. Berkeley	Foundered
11/30/189	Schooner-wood	Caroline Dixon	45	$2,000	RR iron	$1,500	Oakland mole	foundered
8/2/1903	Schooner-wood	Prosperous	32	$1,000	Rock	$1,000	Berkeley flat	Foundered
11/4/1912	Sternwheel str-wood	Herald	293	$6,650	None	$6,000	Oakland pier	Burned
3/23/1919	Ferry Steamer-wood	San Jose	1115	$172,935	None	$172,935	Key Sytem pier	Fire
12/22/191	Steamer-wood/gas	Venice	8	$2,500	None	$1,000	Goat Island shoal	Stranded
5/6/1927	Steamer schooner-steel	Port Saunders	12	$40,000	None	$40,000	1000 yds SE Goat island	Struck amidships by SS Madrone
5/6/1923	Ferry Seamer-iron	Peralta	2075	$975,400	None	$975,400	Key System terminal, slips 1	Fire-terminal and pier burned
10/10/193	Tug-wood	Valiant	30	$10,000	None	$10,000	Mouth of Oakland estuary	Collision w/SS Lumberman

In addition to those resources described above, research for preparation of the historic context for the Key System pier, trestle, and passenger terminal also included the following archives and libraries: the Moffitt Library at U.C. Berkeley; Oakland History Room; AC Transit Archive; Oakland Cultural Heritage Survey Archive, and the California State Railroad Museum.[4]

The following people provided valuable assistance in the preparation of the Key System historic context: Michael Corbett; Peter Ho, Carrie Powell, and Margot Perez-Bruhn of AC Transit; Celia McCarthy, Port of Oakland; Betty Marvin, Oakland Cultural Heritage Survey; Woody Minor; Bart Nadeau, Rick Borgwardt, and Ted Wurm of the Rio Vista Railway Museum; and Bill Sturm, Oakland History Room, Oakland Public Library.

4.0 BACKGROUND

4.1 Environment

The ESSSP Maritime Archaeology APE is situated in San Francisco Bay between the Bay's eastern shore and the east side of Yerba Buena Island (refer to Figure 3). The bay itself occupies a late Pliocene trough that was subject to repeated flooding during the interglacial periods of the Pleistocene. The trough extends to the south, where it forms the Santa Clara and San Benito valleys, and to the north where it forms the Petaluma, Sonoma, and Napa valleys. Before about 10,000 years ago, the Sacramento River flowed through the deep gorge that is the Golden Gate and across what is today the submerged continental shelf. The river eventually met the ocean some 25 kilometers to the west of today's modern shoreline. Between 10,000 and 8,000 years ago, rising sea levels caused by the melting of continental glaciers began to flood the trough, eventually creating the San Pablo and San Francisco Bays (Moratto 1984:220-221).

The geologic history of the bay suggests that human adaptation to its environs began less than 8,000 years ago and that any evidence of the earliest settlements around the bay lies deeply buried under bay sediments. Rising water levels in the Bay may also account for shifts through time in the exploitation of particular food resources that, in turn, were affected by changes in microclimates and biotic communities resulting from the rising sea levels (Bickel 1978).

The modern climate of the area is characterized by annual precipitation that varies from 20 to 40 inches, with precipitation concentrated in the fall, winter, and spring months. This climate is similar to that found in the Mediterranean: mild, rainy winters, and dry, warm summers. After the first rain at the end of October or early November, the vegetation covering the hills surrounding the Bay becomes green and remains so, until late February, when the grasses begin

[4] The Western Railway Museum Collection at Rio Vista, including documents and photographs originally collected by railroad historians Vernon Sappers and Harre Demoro was unfortunately not available during preparation of this report. Telephone consultation with several people connected with the museum –

to grow rapidly. By early May, these have usually changed to a dry golden color and remain that way until fall (Brown 1985). Due to the cooling effects of the local Bay environment, temperatures in the project area are mild in the summer, usually averaging 55-65° (Moratto 1984:223). The cold water of the Bay also creates frequent fog, and relative humidity remains high most of the time (Schoenherr 1992:627). Runoff created by the rainfall of the late fall, winter, and spring carries significant sediment load from the surrounding hillside that, in turn, increases the turbidity of the bay's water.

4.2 Historic Bathymetry

The issue of the historic depth of the bay floor in the vicinity of Yerba Buena Island (YBI) requires some discussion in order to determine whether or not the side-scan sonar survey was at least theoretically capable of detecting historical cultural material (i.e. shipwrecks) that may have been deposited within the APE. The question under consideration is based on the possibility that modern sediments may overlie the historic bay floor to a depth sufficient to cover any sizeable deposit of cultural material that would otherwise be visible within the APE. Such a situation would likely mask the cultural feature from detection by side-scan sonar, possibly to the extent that a buried shipwreck or other historic cultural deposit could go unnoticed until impacted during dredging or other construction activity. In exploring this question, a series of historic and modern bathymetric charts were examined and compared for indications of significant changes in the depth of water through time.

Differences in the thickness of sediments between present and historic bay bottoms could result from several factors, which include historic hydraulic mining, reclamation of shoreline by landfill, and altered water current circulation due to modern development. Locating historic bathymetry is a hit or miss proposition and while most charts show depths, the measurements were not always taken exactly where they would be the most useful to this study, nor were the soundings of sufficient density to allow confident re-construction of historic bathymetric curves. In addition, the details of data collection, such as references to tidal correction, the time of year the data were collected (wet verses dry season), etc. is often not indicated. If the bay floor in the APE was subject to seasonal fluctuation due to changes in the annual sediment load of contributing watercourses or to variable current patterns, this could not be accounted for in this study.

The physiographic environment within the APE can be divided into three areas: Clipper Cove, which was largely created through the construction of Treasure Island; a relatively short but deep channel just off the northeast point of YBI that appears to be getting deeper through historic time;

and the remainder of the APE, which generally shallows to the east towards Oakland. No offshore geotechnical cores were examined for sediment characteristics during this analysis, as none were available during the period of the study. This results in an acknowledged gap of

archivist Bart Nadeau, Rick Borgwardt, and Ted Wurm -- revealed that the museum is not yet ready to house these materials, which are not catalogued or indexed, and are stored off site in a variety of locations information in reconstructing the now submerged sub aerial Pleistocene and prehistoric landscape within the project area.

The oldest map examined offering recorded depths within the APE is that of the U.S. Exploring Expedition of 1841. Under the command of Charles Wilkes, this survey focused on other portions of the bays of San Francisco and San Pablo but did record a few lead-line soundings around Yerba Buena Island, and along a discontinuous, meandering 3.5-fathom (21 ft, 6.4m) curve between YBI and the Oakland shoreline to the east. The extensive Oakland area mudflat to the east of YBI is recognized, but not the deep channel next to YBI. Clipper Cove is still part of the shoal area north of the Island.

The Cadwalader Ringgold expedition of 1850 produced the *Chart of the Bay of San Pablo, Straits of Caquines* [sic] *and part of the Bay of San Francisco California*. While this chart contains a more detailed representation of YBI, the bathymetry used is that of the 1841 Wilkes Expedition, incorporated without change or comment except to connect the 3.5-fathom curve to the northwest side of YBI. The Oakland shoreline mudflat is so labeled.

The U.S. Coast Survey Office in Washington D.C. published *Entrance to San Francisco Bay, California* in 1859. The survey party of James Alden obtained the hydrography within the APE during the years of 1853-1855 and 1857. A draft, working copy of the map dated 1853 and 1855 from which the 1859 publication resulted, was obtained from National Oceanographic and Atmospheric Administration's cartographic archives in Silver Spring, Maryland. This map displays additional soundings that were not included in the published version of 1859. It is useful to cite a note on this chart that the:

> Soundings are expressed in feet to 18 feet or within the dotted surfaces, beyond them in fathoms and show the depth at the mean of the lowest low water of each 24 hours - the plain of reference. The dotted surfaces beyond low water represent the bottom within the respective depths of 6, 12, and 18 feet. The characteristic soundings only are given on the map; they are selected from the numerous soundings taken in the survey, so as to represent the figure of the bottom.

Mean Lower Low Water (MLLW) as a plane of reference was utilized on the U.S. Pacific Coast until 1980. Due to changes in modern sea level, the absolute elevation of these datums has been modified over the years to correspond to various tidal epochs, occurring in 19-year cycles (NOAA 1999).

T.J. Arnold produced an undated map for the Board of State Harbor Commissioners that is stamped by the Department of Engineers as received in 1875. The map was produced to show the existing and proposed landfill areas around San Francisco Bay. The soundings recorded for the project area are carried forward from Alden's Coast Survey map of 1859.

Thus, it appears that Alden's 1853/1855 survey depths are the standard used throughout the nineteenth century. As little in the way of construction or navigation was practiced in this period that required charts of greater accuracy, none were commissioned for publication. It was the construction of harbor facilities around the bay in the twentieth century, and the development of vessels with deeper drafts, that required the U.S. Army Corps of Engineers and others to note any changes in depth that could affect commerce and safety.

Comparison of twentieth century charts to those of the nineteenth century show minor fluctuations of several feet or more depending on the precise location. At the center of the APE, along the alignment of the existing east span of the SFOBB, differences are minor. In some areas, tidal scour caused by constriction of the bay's original shorelines may have deepened the APE several feet beyond its nineteenth century depth. The channel on the east side of YBI appears to have deepened from the 72 feet (12 fathoms) indicated on the 1859 chart to 98 feet (30m) recorded in 1998 (Fugro-Earth Mechanics 1998).

In conclusion, cultural material such as a shipwreck, deposited during the nineteenth century in the open water portion of the APE between YBI and the present Oakland shoreline, would appear to have a maximum of less than a meter of sediment in which to be buried. It is unlikely that a vessel 20-30 feet or more in length could deteriorate and remain undetected on the mud that forms the bottom of the existing APE. The gradual deepening of the channel area on the east side of YBI would seem to preclude the possibility that a significantly large structure would remain undetectable at that location. Clipper Cove sedimentation has caused shoaling around its margins that could conceivably hide culture material from view, but it would be only that material deposited after Treasure Island was constructed. Material that may have been buried in this location prior to the construction of Treasure Island is exempted, as it is not detectable with current technology.

4.3 Ethnography

At the time of historic contact with the Spanish missionaries and explorers, the Costanoan group of Native Americans occupied the eastern shore of San Francisco Bay (near the modern anchorage of the existing eastern span of the San Francisco-Oakland Bay Bridge) (Kroeber 1970). The term Costanoan is derived from the Spanish word *Costaños*, or "coast people" and designates a linguistic family of eight languages. Of these, Chochenyo was the language spoken by the estimated 2,000 individuals who occupied the area now designated as Richmond-Berkeley-Oakland (Levy 1978). The tribal groups that occupied the east shore of San Francisco Bay spoke a dialect known as Chochenyo. The Chochenyo tribal group that is believed to have occupied the area from Richmond south to Emeryville is the *Huchiun* or *Juchiun* (Milliken 1983:102-103). Milliken suggests that Yerba Buena Island was probably included within the territory of the *Huchiun* group, although a review of the records maintained by the Spanish padres of the mission era give no indication that the island was occupied during that period (Milliken 1995: 228, 243).

Their diet mainly consisted of vegetal foods gathered from seasonally available staples such as acorns, greens, roots, bulbs, and seeds. These resources were supplemented with protein-rich fish, waterfowl, and shellfish recovered from the waters, shore, and marshy shallows of San Francisco Bay, as well as by deer and other inland fauna that were hunted for both their meat and hides (Holman 1992:8). Using seine and dip nets, harpoons, weirs, basketry traps, hooks, and fish poisons, the Ohlone fished the waters of the bay and the saltwater marshes, streams, and rivers that flowed into it. They were accomplished watermen, employing small, lightweight boats fabricated from tule reed. In these fragile craft, formed from cigar-shaped bundles of reeds, the Ohlone gained access to the offshore islands where they raided seabird rookeries, and hunted seals and sea lions. Because they were a mobile people, the Ohlone built their boats to last only a season, and could leave them behind with little afterthought (Margolin 1978: 37-38, 54-56).

The arrival of the Spanish in the San Francisco Bay Area in 1775 led to the rapid demise of native California populations. Diseases, declining birth rates, and the effects of the mission system served to eradicate the aboriginal life ways (which are currently experiencing a resurgence among Ohlone descendants). Brought into the missions, the surviving Ohlone along with former neighboring groups of Esselen, Yokuts, and Miwok were transformed from hunters and gatherers into agricultural laborers (Cambra, et al. 1996; Levy 1978; Garaventa 1983; Shoup and Milliken with Brown, 1994). With abandonment of the mission system and Mexican takeover in the 1840s, numerous ranchos were established. Generally, the few Native Californians who remained were then forced, by necessity, to work on the ranchos. For a thorough discussion of the Ohlone, see Cambra, et al. (1996). For a more extensive review of Costanoan ethnography, see Kroeber (1970), Levy (1978), Milliken (1983), and Garaventa (1983).

4.4 History

The historic period in the eastern San Francisco Bay region begins with the Fages-Crespi expedition of 1770. The Fages party explored the eastern shore of San Francisco Bay, eventually reaching the location of modern Fremont, where they traded with the local Costanoans. Members of the expedition first sighted the entrance to San Francisco Bay from the Oakland Hills. In 1772, a second Fages expedition traveled from Monterey

through modern-day Milpitas, San Lorenzo, Oakland, and Berkeley, finally reaching Pinole on March 28, 1772 (Cook 1957:131). From there they traveled through the locations of today's Rodeo and Crockett to Martinez, made a brief foray into the delta region of the Central Valley, and then camped somewhere near Pittsburg or Antioch. On 31 March, the Fages party began the return journey to Monterey. They traveled to the vicinity of modern-day Walnut Creek, turned south, and then made their way to the vicinity of Danville, where they spent the night. On 1 April, they passed through today's San Ramon, Dublin, and Pleasanton, finally arriving back in the area of Milpitas on the following day.

In 1776, the Anza-Font expedition traveled through the same area and traded with residents of native villages encountered along the way. The significant impact of the European presence on the local California natives, however, was not felt until the Spanish missions were established in the region. The preceding year, Captain Juan Manuel Ayala, commanding the ship *San Carlos*, explored San Francisco Bay, venturing up the Sacramento and San Joaquin Rivers in search of a suitable mission site. Ayala's sailing master, José de Cañizares used the ship's longboat to create the first map of San Francisco Bay, navigating from its southern terminus, to the mouth of the delta in the north (Galvin 1971:99).

The first mission in the region was established on October 9, 1776 with the completion of San Francisco de Asis (Mission Dolores) in San Francisco (Beck and Haase1974: 19). Mission Santa Clara de Asis followed in 1777, and Mission San Jose in 1797. The ensuing Mission era lasted for the next 46 years and proved to be the downfall of the native inhabitants of the region, who were brought to the missions as conscripts for labor under the pretense of "Christianization." The missions became the loci of native "missionization," which brought disease, subjugation, and ultimately decimation, to the native Californian groups. It is reported that by 1810, the traditional Costanoan lifestyle ceased to exist (Levy 1978:486). Diseases introduced by the early expeditions and missionaries, and the contagions associated with the forced communal life at the missions, killed a large number of local peoples, exemplified by a mass burial of 18 individuals adjacent to the Hotchkiss Mound site near Oakley (Heizer 1954). Cook (1943) estimates that by 1832, the Costanoan population had been reduced from a high of over 10,000 in 1770 to less than 2000.

In 1820, Sergeant Luis Maria Peralta received a grant of 10 square leagues of land in the East Bay in recognition of his long, faithful military service in California. Peralta named his grant Rancho San Antonio. It comprised the land that lay from the water's edge to the crest of the Oakland hills between San Leandro Creek in the south and El Cerrito Creek in the north (Hendry and Bowman 1940:585). The eastern anchorage of today's San Francisco-Oakland Bay Bridge is situated in an area once encompassed by Peralta's holdings.

In 1842, Peralta formally divided his holdings among his four sons. Vicente Peralta received the area between Lake Merritt and the southern border of Berkeley. On the north bank of Temescal Creek, near the intersection of Telegraph Avenue, 55th Street, and Highway 24, he built his home, a chapel, corrals, storerooms, and other buildings (Bowman 1951: 225-226; Hendry and Bowman 1940: 589-591; Judd 1984:2). Corrals were also situated along the lower course of Temescal Creek and two structures stood at its mouth.

Hides and tallow from the Peralta cattle herds were processed at the mouth of the creek and then shipped to San Francisco.

Following the U.S. takeover of Alta California from Mexico in 1846, Rancho lands began to be divided up and generally overrun by the Anglo immigration to the area coincident with the land boom following the Gold Rush of 1849. By the beginning of 1850, Vicente Peralta had lost nearly $100,000 in rustled cattle, and squatters were usurping his land (Davis 1967:252). Rancho San Antonio suffered the fate of most Mexican land grants in northern California, with squatters taking quasi-legal title to lands, and the courts denying title to the original grantees. By 1870, most of the Peralta grant was divided; what remained in title to the Peralta family was but a fraction of the original grant (Hendry and Bowman 1940:585).

The discovery of gold in the Sierra Nevada in 1848 produced a major population increase in the northern half of California as immigrants poured into the territory seeking gold or the opportunities inherent in producing goods or services for miners. Prior to the gold rush, San Francisco - then known as Yerba Buena - was a sleepy hamlet situated on the shores of Yerba Buena Cove. This situation quickly changed once word of the gold discovery reached the east coast. In the three months December 1848 to February 1849 alone, 136 vessels cleared Atlantic ports, en route to San Francisco. On February 28, 1849, the paddle-wheel steamer *California* passed through the Golden Gate, carrying the first boatload of forty-niners (Gilliam 1957:61). Over the course of that year, 775 ships from all over the world arrived in California (Engle and Lott 1975:140). With this sudden influx of thousands of optimistic gold seekers, a city of canvas and wood sprang up around the cove and on the sand dunes and hills that surrounded it. Yerba Buena Cove itself filled with ships, abandoned by the crews who fled them for the gold fields.

To accommodate the burgeoning population of gold-seekers and the merchants who followed them, the city spread out in all directions - including into the waters of Yerba Buena Cove, which had defined the eastern boundary of the early settlement. Street alignments were projected into the waters of the cove and pilings were driven along the alignments to define "water lots" that were later filled and built upon. Construction of docks and wharves along the waterline began shortly after the first influx of gold seekers reached the shores of Yerba Buena Cove. Many of the ships they abandoned were converted into commercial depots – stores, hotels, and even a jail. Some of these were later entombed in the fill of Yerba Buena Cove. The remaining deserted hulks were removed from the Cove, and by 1850 a substantial arrangement of wharves projected across the shallow waters of the cove. The wharves and the businesses built upon them serviced the booming maritime trade spawned by the unprecedented population growth associated with the gold rush.

In 1851, departures from the port began to outnumber arrivals and the harbor, no longer clogged with deserted vessels, grew into a vital port that bolstered the maritime economy of San Francisco. The City became the hub of coastal and intercoastal trade. Lumber logged from the north coast and the agricultural bounty of the state's fertile soil provided much of the impetus for this growth. The proximity of San Francisco to the Pacific Ocean's whaling grounds led to the port's evolution into one of the principal whaling centers of the world. This portal of the Pacific also became the gateway to the Orient. Down the gangways of the San Francisco-based Pacific Mail Steamship Company's ships poured the immigrants of China, Japan, and other Asian countries that helped fuel the unprecedented growth of California and the west coast (Delgado 1990:80, 174). By 1890, San Francisco was the third most important sailing port in the world, trailing only Liverpool and Newcastle (Australia) in volume of ship traffic (Engle and Lott 1975:147).

In the 50 years between the beginning of this remarkable transformation and the turn of the 20th century, transportation links were established between San Francisco and the communities that had sprung up around the Bay. By the mid-1870s, four ferry lines crossed the Bay between San Francisco and the east shore, linking what had become known as California's Queen City with the cities of Alameda and Oakland, the latter dubbed the "Bride of the Bay" in response to San Francisco self-proclaimed title. In excess of 8,000 passengers each day were ferried back and forth across the Bay (Lloyd 1999: 387-391). Ferry steamers likewise linked San Francisco with San Rafael, Sausalito, and San Quentin. By 1890, nearly 364,000 people (57% of the state's total population) lived in the principal cities that ringed the Bay - San Francisco, Oakland, Alameda, and Berkeley (Demoro 1985:12).

The transbay transportation system eventually came under the near-monopolistic control of the Southern Pacific Railroad Company, which combined a fleet of ferryboats with its steam-powered trains. In 1903, Francis Marion "Borax" Smith opened the San Francisco, Oakland, and San Jose Railway as a direct competitor to the Southern Pacific.

4.5 Key System Trestle, Pier, and Passenger Terminal

<u>Origin of the Key System: Company Founder Francis Marion "Borax" Smith</u>

Francis Marion ("Borax") Smith, born in Wisconsin in 1846, had made a fortune in the borax industry in Nevada and Death Valley, California, and settled in Oakland in the early 1880s. He had great ambitions for development of his adopted city as "the natural transcontinental terminus and ocean seaport." Smith believed that transportation improvements in Oakland were the essential starting point for its emergence as a true metropolis, rather than simply a suburb of the Bay Area's pre-eminent city, San Francisco. He wrote, "Instead of occupying its natural and important terminal position, Oakland has heretofore ranked simply as a 'way station." By the early 1890s Smith was involved in Oakland transportation development, starting with local street railways but envisioning a comprehensive system including passenger, freight, and ferry transportation, and terminal, public utility, and real estate operations (Smith, quoted in

Smythe 1937:66-67; Smythe 1937: Chapter II: 37-91; Sappers 1948:3; Demoro 1958a: 12).

Smith began his railway venture with the purchase of the California and Nevada Railroad Company in the 1890s. It was a narrow-gauge steam railroad about 22 miles long, operating from Emeryville to Orinda. Development of the railroad was never realized and Smith later sold the company, but he retained control of its rights of way and a partly completed trestle near Emeryville that were later incorporated into the Key System (Sappers 1948:3; Demoro 1985a: 14).

By 1902, Smith had achieved two of his goals: the formation of a street railway monopoly and its coordination with a real estate development company. He then focused on the development of transbay passenger service (Demoro 1985a: 14; Smythe 1937:92).

Smith's initial 1902 plan for transbay service called for a ferry terminal on Yerba Buena Island. This terminal was to be reached by a long wooden trestle into San Francisco Bay and an underwater tube to the island. The Yerba Buena Island terminal idea never materialized due to opposition from the U.S. military, which had posts on the island. Nonetheless, the long trestle leading to an offshore ferry dock was to be a central feature of the Key System (Demoro 1985a: 14; Sappers 1948:3)

The Key System emerged as a competitor to the existing transbay passenger service run by the Southern Pacific Company (SP) whose operation had begun in the 1860s and remained essentially the same at the turn of the century. The SP equipment and service were, by 1902, somewhat outmoded. In the Southern Pacific service, ferries ran from the Ferry Building in San Francisco to ferry terminals at the Oakland Mole and Alameda. From there, steam trains carried passengers along three lines – to Berkeley, Oakland, and Alameda (Smythe 1937:92-93).

Instead of the interurban steam railroad system that Southern Pacific was using, and that Smith had envisioned in the 1890s, he now adopted the newer, faster electrically driven cars that were ideal for high-speed interurban passenger transportation. Electric trains were faster, cleaner and quieter than steam trains. They were also more cost effective, requiring less maintenance and less complex terminal facilities (Demoro 1985a: 14; Sappers 1948:3).

Smith's plan was to link the East Bay communities with the South Bay via an electric interurban railway. He and his business partner F.C. Havens formed the Key System's first operating company called the San Francisco, Oakland, and San Jose Railway (SFO&SJ) incorporated in June 1902. The new company was organized to build and operate a ferry system and interurban railway from San Francisco to Oakland, Emeryville, Piedmont, Hayward, San Jose, Santa Clara, Saratoga, and Los Gatos (Smythe 1937 94; Sappers1948: 3).

Key Route and Trestle, View East, ca. 1921
(Photo courtesy of A.C. Transit)

Key System transbay operations began on October 26, 1903, only sixteen months after the company was organized in June 1902. Smith and Havens had accomplished a great deal in sixteen months. Real estate had been purchased, and the new rail line constructed, along with its major components: a wood trestle extending 3.26 miles across tidelands to deep water; a pier and pier terminal; two newly built steam ferry boats; sixteen electric interurban car bodies and track set; a new steam-driven power plant for the delivery of electricity; and a car house. To avoid crossing the Southern Pacific tracks in Emeryville, a double-tracked underpass, or subway, was also built near the bay shore (Smythe 1937: 92,96; Demoro 1985a: 14).

<u>Location</u>

The Key System's trestle, pier, and the terminal building at the far end of the pier, were situated in Oakland's Outer Harbor, on the eastern shore of San Francisco Bay opposite the city of San Francisco. The trestle and pier extended from the foot of Yerba Buena Avenue, in the City of Oakland, into the bay opposite Yerba Buena Island. The water was too shallow at the shoreline for the operation of ferryboats, so Key System and other railroad companies built trestles and solid fill moles from the shoreline 1.25 to 3.26 miles out into the bay to reach deeper water. By the late 1920s much of the Outer Harbor was occupied by railroad terminals operating transbay ferry service between the East Bay and San Francisco (USACOE 1927:233).

Port of Oakland, 1928 (Thomas Bros.)

Corporate Name

The company that owned and operated the trestle, pier and terminal that are the focus of this report was organized in 1902 as the San Francisco, Oakland and San Jose Railway Company and did not officially adopt the name Key System until 1923. (Once adopted, the Key System name was used in a number of variations until 1960). Nevertheless, “Key System” had been a company slogan from 1912, replacing the nickname “Key Route” which had been adopted right from the start in 1903. The nickname, coined by W.F. Kelly, the railway’s first general manager, was based on a diagram of a key. The East Bay cities of Oakland, Berkeley, and Piedmont were the handle of the key; the long trestle leading to the pier was the shaft, and the ferry slip represented the teeth of the key. The nickname caught on with the public, becoming a central feature of the railway company’s promotional campaigns and a reminder of its corporate ambitions (Demoro 1985a: 12-40; Walker 1978:5). The company changed its official name several times during the period from 1902-1939, reflecting an ongoing crisis in corporate and financial management. After a bus company, the National City Lines, purchased controlling interest in 1946, the name was changed to Key System Transit Lines. The all-bus Key System was sold to the Alameda-Contra Costa Transit District in 1960 (Sappers 1948:2).

Time Period

The trestle, pier, and terminal that are the focus of this report were used from 1903 until 1939 during the period when Key System’s transbay service consisted primarily of electric trains and connecting ferries. The trestle, pier, and terminal were dismantled after the Bridge Railway replaced the train-ferry service in 1939. The Bridge Railway was an electric train service operated by Key System and other railway companies over the San Francisco Oakland Bay Bridge (SFOBB). Because this report is specifically about the trestle, pier, and terminal, rather than the history of the Key System as a whole, it does not cover the Bridge Railway period from 1939-1958, nor the Key System bus operation that started in 1937 and continued past the demise of the Bridge Railway in 1958.

Rivalry with Southern Pacific

Key System proved popular with commuters from the beginning. The rates were the same as those charged by the Southern Pacific -- 10 cents for a single fare, and $3.00 per month for commuter tickets. But the Key System had clean new smooth-riding electric cars and fast new ferry boats. Edward M. Boggs conveyed an insider's excitement about the success of the Berkeley electric rail line, its vast superiority over the Southern Pacific steam trains, and the advent of a new era in Bay Area transportation:

> Minerva-like, it sprang into existence full-grown, and it was an instant success. From the first day, it transported the thousands who had awaited its advent with impatience and who welcomed the smooth, swift, and quiet electric trains of the Key System – the first rapid transit that had ever been afforded to this region. The contrast between the old and the new types of services was most striking. The trains of the older [SP] road were drawn by steam locomotives whose noise and smoke emitted when climbing the heavy grades leaving the Bay shore were highly objectionable in the streets of cities; their cars were dimly lit by oil lamps, were gloomy and uninviting. The electric trains were free from smoke and cinders and practically noiseless; brilliantly illuminated within and with electric lamps lighting all platforms and steps they marked the opening of a new era in the transportation life of the San Francisco bay region (quoted in Demoro 1985a: 20).

Railroad historian Vernon Sappers, echoing Boggs' enthusiasm and point of view, believed that Key System's electric rail cars were a dramatic improvement over the steam trains of the Southern Pacific:

> The Key Route was SP's first real transbay competition in a long time. Key System had a longer pier and newer, faster equipment. The Key ferry terminal at the end of the 3.26-mile long pier trestle was only 2.7 miles from the San Francisco Ferry Building; the ferry trip to San Francisco from the SP's Oakland Pier was 3.5 miles. Not only was the Key System's ferry distance almost a mile shorter than SP's, but its ferries, like its rail cars, were faster. Key System used the newer propeller-driven ferry; the SP for the most part used the older, slower, side-wheeled ferries (Sappers 1948:3.

Southern Pacific responded to its competition from Key System by quickly improving the quality of its own service, and began to electrify its railway lines in 1908, opening its first electric lines in Alameda in 1911. The two companies then began a building race, offering directly competing service to a large portion of the East Bay (Sappers 1948:4-5; Smythe 1937:103).

Key Route Trestle, ca. 1907. (Photo courtesy of A.C. Transit)

There is no doubt that improved transportation helped spur development of the East Bay. Urban population in the East Bay more than doubled from 1900 to 1910, and there was a major real estate boom during the same decade. Subdivision activity was particularly intense in the newer sections of the East Bay in Berkeley and North Oakland. In 1900, the East Bay urban population was only 30% of that of San Francisco. By 1910, it was 56% (Smythe 1937:98,130)

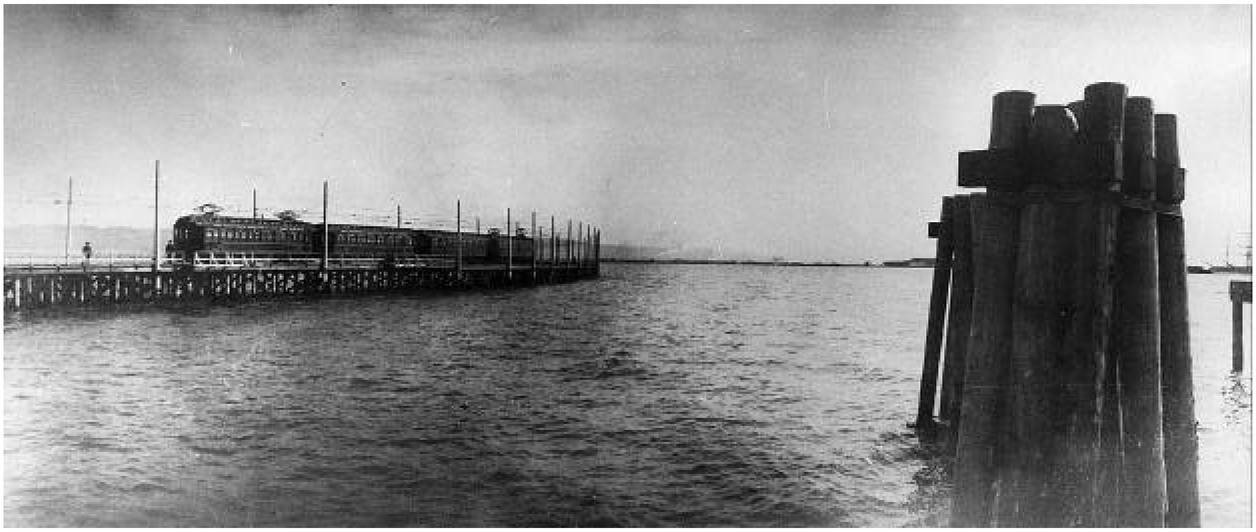
The Key System's transbay traffic grew rapidly at the same time, both before and after the San Francisco earthquake of 1906. Many San Francisco residents and business owners sought refuge in the East Bay right after the quake, and some decided to stay. The earthquake opened the door to a surge of settlement and business activity in the East Bay. Transbay commutation rates on the Key System remained at $3 a month after the earthquake to encourage the trend. Between 1900 and 1910 Oakland's population increased from 67,000 to 150,000 (Smythe 1937:99, 107; Minor 2000:17).

<u>Financial Crisis in the Key System</u>

"Borax" Smith achieved many of his goals but his ambitions outstripped his resources, his management practices were always chaotic, and he was eventually forced to declare bankruptcy. According to both Demoro and economist Dallas Walker Smythe, who wrote his Ph.D. dissertation on the topic, Smith's failure came about through his tendency to embark on too many railway and real estate ventures at once, creating various companies and borrowing money between them (Demoro 1985a:33,37; Smythe 1937 Chapters 4-12). Smith died in Oakland in 1931, soon after the Key System properties emerged from a reorganization that had finally untangled the financial mess resulting from Smith's bankruptcy (Demoro 1985a: 41).

Trestle Construction 1902-1903

Key System's 3.26-mile long wood pile trestle built out into San Francisco Bay in 1902-1903 was one of the longest structures of its kind in the world at the time (Sappers 1948:3). The terminal at the far end of the trestle was closer to San Francisco than any of the other pier rail terminals in the East Bay. The shorter, faster ferryboat run gave the Key System a distinct competitive advantage over its rivals (Sappers 1948:3).



Key Route Pier, 1908, View East (Photo Courtesy of A.C. Transit)

The wooden trestle was built of Douglas fir pilings from northern California forests, and eucalyptus trees on the Piedmont hills, brought to the shoreline by train. The new trestle also incorporated elements of an old, unfinished pier constructed by the California and Nevada Railroad (Demoro 1985a: 51). In 1926 Edward M. Boggs, the civil engineer for the Key Route, recalled the construction of the ferry pier trestle, including the remnants of the older pier, in an uncited report quoted in Demoro's book on the Key System:

> One of my early tasks nearly 25 years ago was removing the track throughout the entire line of the California & Nevada Railroad, demolishing the engine-house and coach-shed which stood near the foot of Yerba Buena Avenue…. There also was a pier running a considerable distance into the Bay on the line of Yerba Buena Avenue produced across the Southern Pacific Co. right of way, which was understood to have been intended for passenger service: also a pier branching to the northwest from the direct line, intended for freight. It is my recollection that these structures in the Bay had not been completed at the time of purchase of the road in our interest; also that an actual crossing of the SP's numerous tracks had never been effected, nor any track laid on these piers. When our own…trestle…was built out from the west end of (the shore) the new piles were intermingled with those of the old pier, as far as the latter extended (Demoro 1985a: 15).

According to Demoro, the designers of the trestle had built the portion nearest the shoreline in 1902-1903 as a temporary structure, planning for its early replacement with fill material. The pilings on that part of the trestle were of poor quality and spaced further apart than other sections. The trestle's crude design and lack of proper maintenance led to early deterioration. By 1908 it was in such disrepair and considered so dangerous that company engineers recommended that it be replaced with a 200 foot wide fill (Smythe 1937:123, 206; Demoro 1985a: 51).

<u>Trestle Reconstruction 1908-1916</u>

The trestle reconstruction, carried out in two stages, resulted in a 200 feet wide causeway, known either as the mole or the fill. Construction began in 1908, when the old wooden trestle built in 1903 was replaced by filled material (rock and earth) for 1,680 feet from the subway on the shoreline west into San Francisco Bay. The reconstruction was then interrupted until 1913, due to refusal by the federal government to grant permission for its completion (Demoro 1985a: 51). When the project resumed, the wooden trestle was replaced by fill for 5,585 feet; an additional 3,850 feet of fill was built on a new alignment. A new, more substantial 3,800 feet wooden trestle was built, connecting the end of the fill with the ferry terminal. The new trestle approached the ferry terminal on a pair of curves to permit later construction of a loop through the train shed (Demoro 1985a: 51; Sappers 1948:7; Sanborn Map Company 1951:2). The new solid fill was completed on June 30, 1916; it ran from the subway on the shoreline to a point about one third of a mile east of the Pier Terminal.

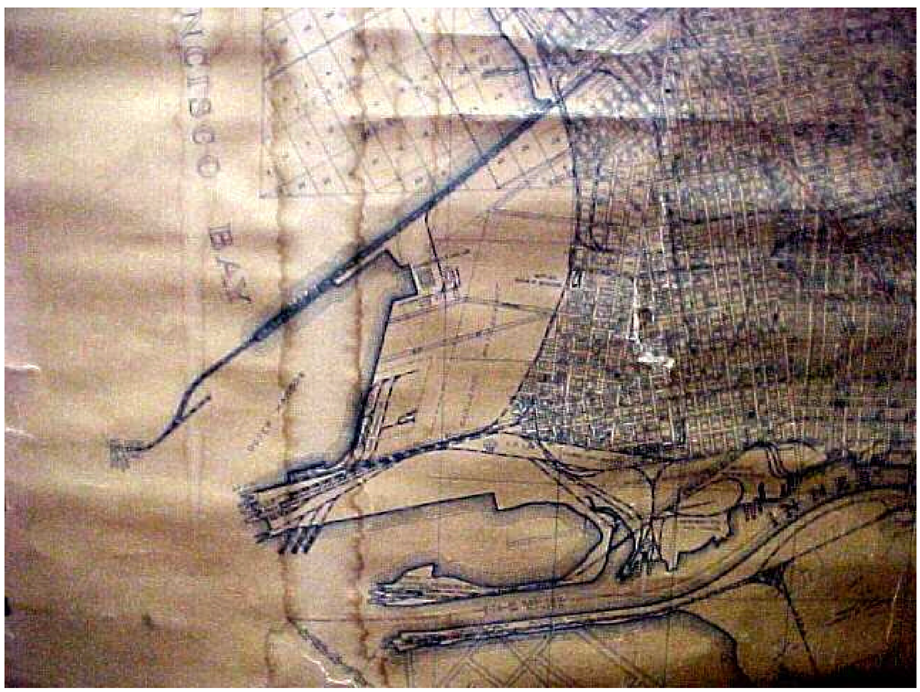
Key System Pier, 1930 (Photo: Pacific Aerial Surveys, (courtesy of Jack Hunter, Caltrans)

The only remnant of the old wooden trestle was a stub used for car storage during off-peak hours. This part of the trestle was dismantled in 1932 when storage tracks were laid on the fill next to the powerhouse. Sappers describes this stub as 400 feet long, but a *Key System News* edition of 1920 says it was 1,347 feet long (Sappers 1948:7; *Key System News* Vol. II No. 13:3).

The *Key System News* edition of June 12, 1920 included a sketch of the system's facilities. It shows the solid fill, 2.09 miles long, built from the shoreline into the bay, made of 494,787 cubic yards of rock and 2,491,313 yards of earth. It also shows the new wooden trestle and the train shed extending from the fill for 1.03 miles; and a 1,347 foot section of the old wooden trestle used for car storage (*Key System News* Vol. II No. 13: 3). The new causeway, more than two miles long, opened on May 18, 1916, and regular train service began operating on the new trestle and fill on May 21. The causeway and trestle cost $1.2 million and were equipped with an automatic block signal system similar to that on the old trestle (Demoro 1985a: 51-52; (*San Francisco Chronicle* May 22, 1916:8/4).

Demoro notes that even the rebuilt wooden trestle caused some anxiety among passengers:

> Despite having all the of the modern safety conveniences that included signals designed to prevent collisions, many passengers felt a tinge of uncertainty riding on a wooden trestle into the middle of the Bay, especially on a foggy night. Indeed, crews were advised not to stop trains on the trestle because the vibration caused by passing trains would make passengers on the stopped trains uneasy (Demoro 1985b: 174).



Sanborn Fire Insurance Co. Map, 1913
(Courtesy of Oakland Public Library)

The new filled causeway was intended to be the northern breakwater of a proposed deepwater port associated with the Key System. Maps of the period referred to the water between the fill and the approach to the Southern Pacific Pier as the Key Route Basin. Later, a large port did develop there, owned by the City of Oakland. The causeway became the foundation for the automobile approach to the Bay Bridge in the 1930s (Demoro 1985a: 52).

The cost of the new Key System trestle and pier was itemized in a company periodical, the *Key System News*, published twice every month for distribution to the public. The issue of July 7, 1917, (Volume 1, No. 24) stated that the total cost of the trestle and pier reconstruction during the period from 1913-1917 was $1,468,580.01.

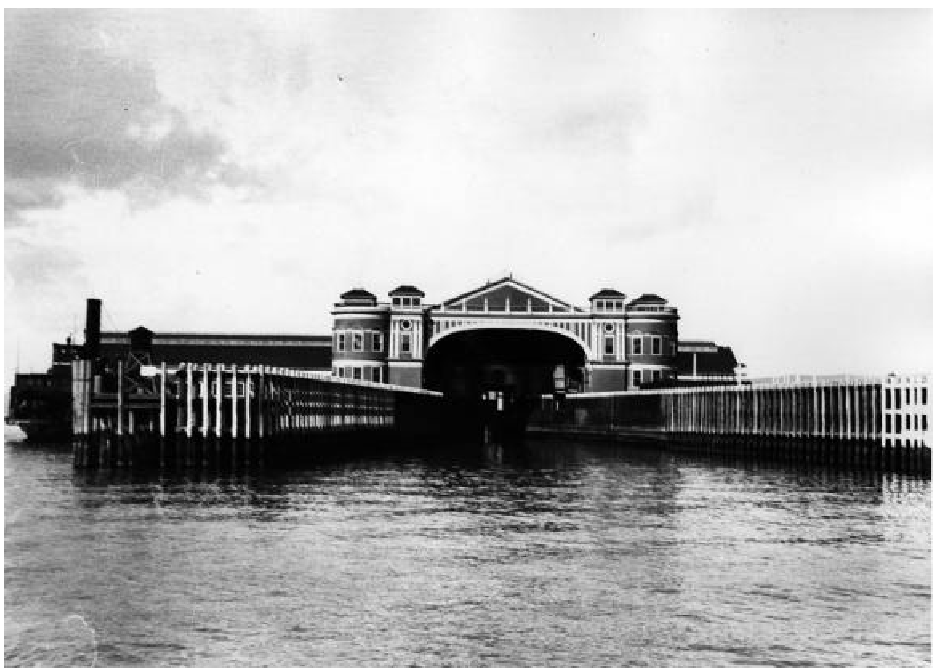
The Key System pier and pier terminal were major engineering and construction projects. Few electric railways took their passengers out to sea and the busy trestle and ferry pier were considered significant engineering feats by electric railway experts (Demoro 1985b: 174).

Terminal Architect Walter J. Mathews

Walter J. Mathews, one of Oakland's most prominent architects, designed the ferry terminal. Mathews (1850-1947), who practiced architecture in Oakland for more than fifty years, came from a family of prominent architects and artists. His father, Julius C. Mathews, an architect/building contractor was best known for his work as a painter and craftsman and a leader in the Arts and Crafts Movement in California (Historic American Buildings Survey; Oakland Cultural Heritage Survey). Walter Mathews was City Architect of Oakland in the 1890s, and designed several city buildings, including the first skyscraper in Oakland, the Easton building (also known as the Union Savings Bank Building) near 14th and Broadway, in 1904.

Pier Features: Tracks, Slips, Tower

The Key System pier originally had one passenger ferry slip and three rail tracks. By the mid-1920s, it had grown to three ferry slips and nine tracks. The company added the ninth track to the pier in the 1920s to increase capacity during a period of record high transbay traffic (Demoro 1985a: Appendix; Sanborn Map Company 1913, 1951).



Key System Terminal ca. 1906 (Photo Courtesy of A.C. Transit)

The second ferry slip was added to accommodate increased traffic for the Panama-Pacific International Exposition (PPIE) of 1915. The Key System was the only ferry service operator to the PPIE; it built a ferry terminal at the foot of Mason Street in San Francisco. The third ferry slip was built at the pier in the 1920s (Demoro 1985a:147; 1985b:170).

Additional tracks were added to the terminal as early as 1905, along with an interlocking tower installed at the pier terminal. The tower, which opened on February 20, 1905, replaced the trackside switchmen. At the tower, a towerman used levers to throw switches and control signals governing train movements in and out of the terminal. Tower No. 1 at the Key Pier dispatched trains every 30-40 seconds. The long levers in the pier tower (Tower No. 1) moved switches leading to the Pier train shed and controlled signals that directed train crews (Demoro 1985a: 28; Demoro 1985b:200). The original pier had a maintenance area on the two most northerly tracks. However, the area was uncovered, and workmen had no protection from the elements. After the trestle and pier reconstruction in 1916, all tracks were covered (Demoro 1985b: 177).

Pier Operation

According to Harre Demoro, the ferry pier was the hub of the Key System transbay operation from the opening of the train-ferry service in 1903 until its closure in 1939. His description of the pier terminal in San Francisco Bay, about three miles from both San Francisco and the East Bay shoreline, is a vivid one:

Key System Terminal and Ferry Slips, 1907

> Here, ferrymen battled wind, tides, fog and rain with precision and had an almost unblemished safety record, given the intensity of the traffic and congested

conditions. The train shed, which grew from three tracks in 1903 to nine tracks in 1924, was among the busiest commuter terminals in the United States and could be compared to the great Pennsylvania Station in New York in the 1920s for number of train movements per day (Demoro 1985b: 167).

In comparing the Key System transbay service to the traffic at Penn Station in New York, Demoro may have been relying on a similar comparison made by the *Key System News* in 1920:

> During a normal week day 459 revenue trains, with a total of 2,905 cars, move in and out of the Pennsylvania Terminal; while 636 revenue trains, with a total of 1,244 cars, move in and out of our Pier Terminal. We, therefore, operate normally 177 more daily trains in and out of our Pier Terminal than is the case with the Pennsylvania Terminal, and while the total number of cars in our trains show considerably less than those of the Pennsylvania Terminal, such condition is due to the fact that 75% of our cars are required for but three hours' service each day (*Key System News*, June 12, 1920 Vol. II. No. 13:n.p.)

Trains departing the pier, operating as often as 40 seconds apart, entered a double track trestle and fill about three miles long. There were 148 signals between the 3.83 miles stretch between the Pier and San Pablo Avenue (Demoro 1985b: 171). Trains traveling west on the pier from the shoreline ran on a two-tracked trestle that widened into nine tracks as trains approached the train shed (Demoro 1985b: 172; Demoro 1985a: Map 1).

Key System Passenger Waiting Room (Photo courtesy of A.C. Transit)

The interval between train departures was set by ferry crossing time, and was usually 15-20 minutes. Every Key Route rail line met every boat. Operations at the Pier Terminal were complicated by the fact that each ferryboat had to connect with two groups of passengers – incoming and outgoing. The pace was hectic and the timing had to be absolutely precise, as Demoro explains:

> "Trains arriving at the Pier would unload as the patrons disembarked from the ferry. The passengers would pass one another and the train shed was arranged so that there would not be a conflict. So tight was the scheduling that, with 15-minute service, the parade of trains would barely be clear of the train shed and

switches, and have entered the double-tracked trestle enroute to the East Bay, as a parade of westbound trains was approaching the terminal and another ferry was arriving" (Demoro 1985b: 169-70).

Passengers arriving at the terminal found trains lined up by route. Amenities for passengers included a terminal waiting room and rest rooms but no newsstand (Demoro 1985b: 170). During rush hour, many of the trains were so long they stuck out from the trainshed. Train congestion on the pier and trestle, and space limitations on the pier eventually led Key System to reduce the number of trains by coupling some of them together (Demoro 1985b: 171, 175).

On a typical weekday in 1920, 104 trains operated on each line in each direction (with consolidated trains counted as two trains). The number of trains daily totaled 636 (Demoro 1985b: 180).

The 1903 wooden terminal building was so compact and congested that the most trivial problems could lead to disruptions of service. Key System assigned not only conductors but also a variety of shop men -- foremen, trainmen, motormen, and train directors -- to terminal duty to handle recurring problems (Demoro 1985b: 170).

The trainmaster, Key Division superintendent and the head of ferryboat operations were all stationed at the Pier, which had facilities for them and other workers: a locker room and gilly room for crews, a first-aid station, cashier's office, commissary branch for ferry dining rooms, and dormitory for ferry crews (Demoro 1985b: 170).

Pier Maintenance

Demoro notes that constant wear and tear from wind, tides, and fog made the pier terminal the most expensive portion of the Key System to maintain. The V-shaped ferry slips were often rammed by ferryboats docking in inclement weather, and needed constant maintenance (Demoro 1985a: 52).

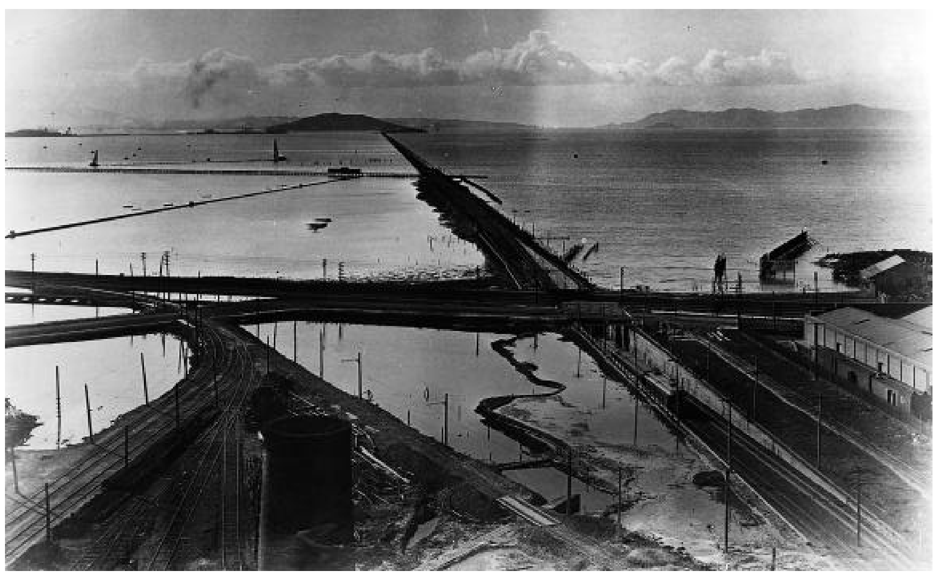
Key System Terminal, Pier, and Ferry, ca. 1905
(Photo Courtesy of A.C. Transit)

The reconstruction of the pier terminal to provide for more adequate, convenient facilities was under consideration continually from 1914-1926. Company officials were concerned not only about existing conditions but also about anticipated increases in ferry traffic, including facilities for automobile ferry traffic. However, lack of funds prevented completion of any of the company's plans. Development of a ferry terminal on Yerba Buena Island was proposed but like other Key System waterfront ventures, this one too was unrealized. Several earlier attempts had been by Key System and Southern Pacific to secure the island or the shoals lying north of it for a railroad terminal, but opposition by interests in San Francisco led to government refusal (*Key System News* Vol. II No. 26; September 16, 1921:n.p; Smythe 1937:420-423; *San Francisco Chronicle* December 11, 1912:1/19).

Key System management during this period was very inefficient, according to an expert investigator hired by Smith himself. During the whole life of the company, the upkeep of the pier terminal was in the hands of one outside engineer who let the work out to a single contractor without competition. There was inadequate fire protection and insurance of the wooden terminal and trestle. A wrecking crane bought for emergency use on the pier terminal and trestle proved to be too heavy to be taken out on them at all (Smythe 1937:123-4).

Shoreline Features of the Key System

Subway: The subway, built under the main line steam tracks of the Southern Pacific Company near the bay shore, was a notable feature of the Key System. It provided a grade separation that allowed Key System to avoid the delays and collisions that might have arisen if their trains had been routed across the SP property at that point, where there were seven tracks of three transcontinental lines as well as many local lines (Sappers 1948:3). The subway is shown on a 1912 Sanborn Fire Insurance Map near the intersection of Yerba Buena Avenue and Beach Street on the bay shoreline (Sanborn Map Company 1912:Vol. 1 Sheets 1,3).



Key Pier and Underpass, no date. View West
(Photo courtesy of A.C. Transit)

Electrical Power Plants: When it opened in 1903, the Key System built Yerba Buena Station, a steam-driven generating station, for the first line operating through Berkeley. It generated 600 volts direct current for trolley voltage. This was the main power plant for both Key System trains and streetcars, and was located near the subway on San Francisco Bay. The Yerba Buena plant was so overloaded by the mid-1920s that Key System was forced to build a new facility for generating electricity. In 1925-1926, Key System built the Pier Substation at the end of the fill where the pier trestle began (Hope 1998:3; Demoro 1985b: 182):

After the abandonment of transbay ferry traffic on the pier and the opening of the Bridge Railway on the SFOBB in 1939, the substation was adapted for bridge railway service, including new tracks on the north side of the building (Hope 1998:3). The station continued in use throughout the Bridge Railway period until 1958, but was later acquired by Caltrans, which used it storage as part of its SFOBB maintenance facilities (Hope 1998:3). Caltrans evaluated the electrical plant building in 1998 as part of the Historic Property Survey Report for the SFOBB East Ban Seismic Safety Project. Historian Andrew Hope described it as “a rare surviving component of the historically significant Key System Railway,” finding that it appeared to be individually eligible for the National Register (Hope 1998:3).

Fire of May 6, 1933

There were two interruptions of service in 1933. A relatively small fire on the trestle in January 1933 caused a two-day cessation of service, and damage to 150 feet of trestle (*Oakland Tribune* May 7, 1933:1).

Key Pier Fire, May 6, 1933 (Photo courtesy A.C. Transit)

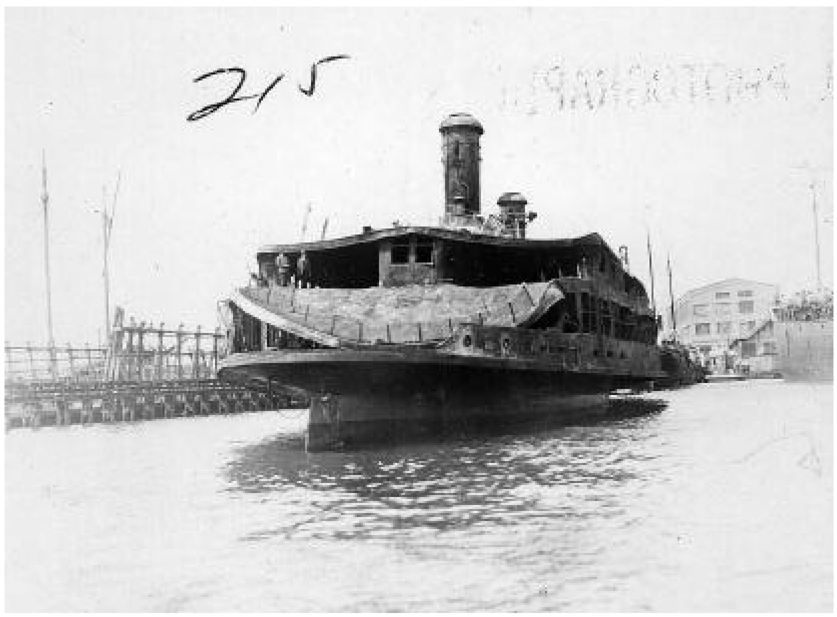
On the night of May 6, 1933, another fire broke out on the pier terminal, described by the *San Francisco Chronicle* as “the worst conflagration the Bay Region waterside has seen in recent years”

(*San Francisco Chronicle* May 7 1933:1). The *Oakland Tribune* described the origin of the fire as "mysterious," reporting that:

> firemen were powerless in their efforts to check the flames which spread through the [terminal] building and, carried by a strong wind, swept along the wooden trestle toward the shore… the overcast sky was reddened and the blaze was visible from throughout the bay area….Thousands of East Bay residents were attracted by the fire and thronged vantage points along the waterfront and hilltops, from which the blaze was clearly visible" (*Oakland Tribune* May 7, 1933:1).

The first alarm was turned in at 10:09 P.M. By the time the fire was discovered by the G.H. Rice, trainmaster on the pier, it had consumed the entire width of the pier (Sappers 1948:7). Trainmaster Rice told his story to the *Oakland Tribune* the next day:

"I watched the 9:40 p.m. boat leave for San Francisco. Three or four minutes later, I went to the superintendent's office to make out my train records. I had been there less than 10 minutes when I glanced through the window and saw a sheet of flame at least 50 feet across rising from the main slip. I yelled at two men in the office with me, Bert Jones and George Hansen. Our exit by the stairway had been cut off. I seized all the cash I could carry, about $800, and we smashed a window and jumped to the upper deck of the *Peralta*. No sooner had we got there than she burst into flame. We cast off hawsers as fast as we could and had her clear, except for one line which we couldn't reach because of the intense heat. That burned away and we started to drift, almost the whole boat on fire" (*Oakland Tribune* May 8, 1933:2). Rice and his two colleagues on the *Peralta* were rescued by a Western Pacific tugboat master. The rest of the pier crew escaped by running along the trestle and there were no human casualties (*Oakland Tribune* May 8, 1933:2).



Burned ferryboat *Peralta*, May 1933 (Photo courtesy of A.C. Transit)

The pier shed was in flames when fire-fighting tugs arrived. The Key System fire car and City of Oakland fire engines, mounted on specially equipped flat cars, were hauled out onto the trestle to pump bay water onto the blaze, but there was a power failure, and the equipment was stranded between the shore and the pier (Sappers 1948:7; *Oakland*

Tribune May 7 1933:1). Most of the fire fighting was done by a San Francisco fireboat, and by several tugs equipped with hose and pumps for the use of salt water (*Oakland Tribune* May 8, 1933:2).

The fire razed the wooden pier terminal building and about two thirds of the pier head including two of the three ferry slips, the ferry boat *Peralta* and 14 interurban cars – the loss valued at about $1,600,000. Although the cause of the blaze could not be determined, some investigators at the time and historian Demoro believe that it was probably an arson fire (Demoro 1985a: 74; Smythe 1937:553; Sappers 1948:7; *Oakland Tribune* May 8, 1933:1; *S.F. Chronicle* May 8 1933:1).

The Key System Annual Report for 1933 assessed the impact of the fire on terminal facilities):

> The terminal facilities remaining after the fire were utterly inadequate, particularly as regards means for loading and unloading the ferry steamers during peak hours, and also because no shelter whatever from rain or inclement weather remained for the patrons nor to house the company's staff stationed at the terminal (Key System, Ltd. 1933:3.

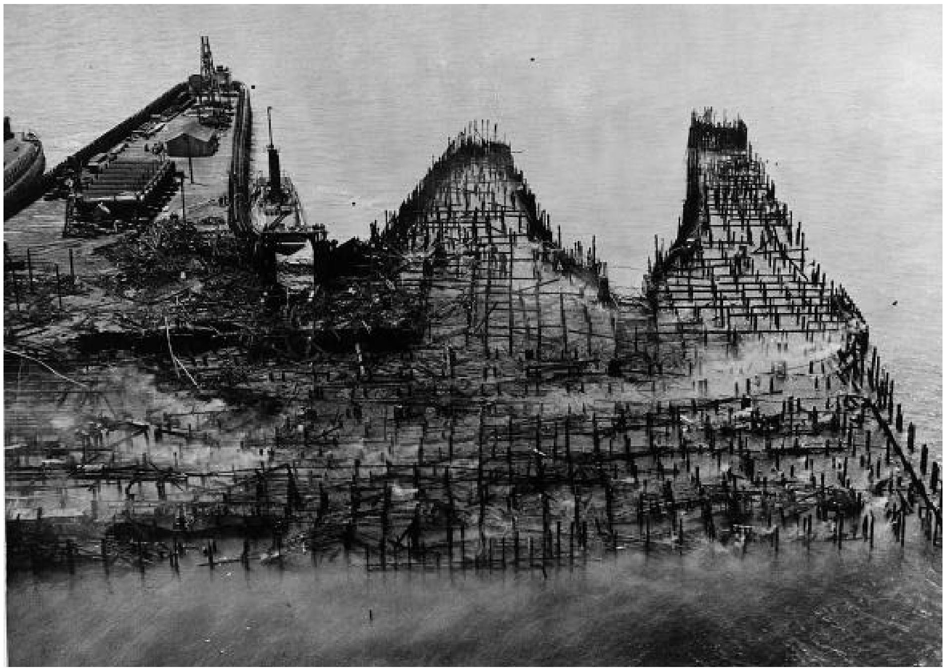
Service was crippled for almost a year. For about nine months afterward, the Southern Pacific Company handled some of the Key System's passengers. Trains used a makeshift ferry terminal after service was restored. For several months after the fire, patrons walked from ferry to train with no protection from the elements. A new terminal building was built to replace the one that burned, but neither the destroyed ferry boat nor the rail cars were replaced in view of the prospective completion of the San Francisco-Oakland Bay Bridge, which would lead to a switch from the train-ferry service to the Bridge Railway (Smythe 1937:553; Demoro 1985a: 74; *San Francisco Chronicle* May 9, 1933:1).

The Key System spent only as much money on the reconstruction as was required to maintain train-ferry service until the bridge rail tracks were ready (Demoro 1985a: 77). The Key System Annual Report for 1933 said:

> In view of the doubtful future value of ferry steamers because of the construction of the San Francisco-Oakland Bay Bridge, it was decided not to replace the SS. 'Peralta,' but to rent a spare steamer when needed. The three remaining steamers (SS. 'Yerba Buena,' SS. 'Hayward,' and SS. 'San Leandro') are sufficient to provide for the regular service, a fourth boat being required only when one of these is out of service" (Key System, Ltd. 1933:4).

Pier Reconstruction after the Fire of 1933

Key System management, looking ahead to the opening of the Bridge Railway, and the closure of the train-ferry service, expended a minimum of capital and effort on the post-fire reconstruction of the ferry terminal.



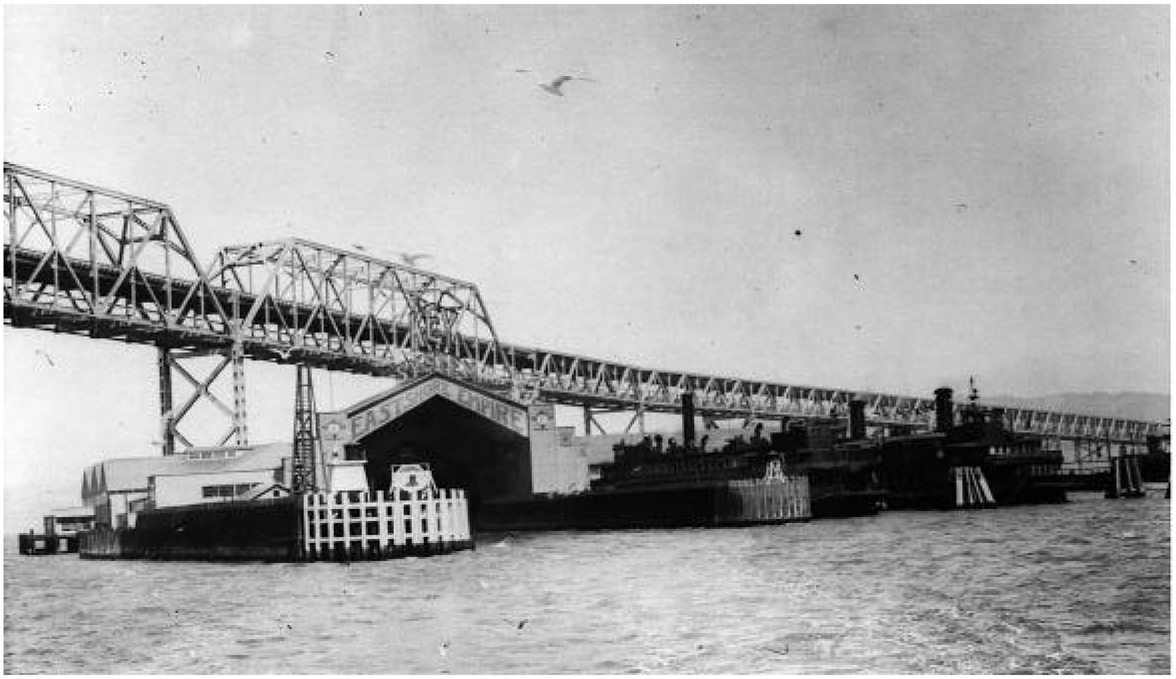
Post-fire devastation, ca. May 1933 (Photo courtesy of A.C. Transit)

The Key System Annual Report for 1933 explained the rationale for its short-term perspective in light of prospective development of the Bay Bridge:

> "On account of the construction of the San Francisco-Oakland Bay Bridge, it was realized that any improvements at the Pier Terminal might have to be abandoned in a few years. Moreover, shortly after the fire, condemnation proceedings were instituted by the California Toll Bridge Authority, and possession obtained, of a portion of the North Fairway and Franchise Strip of Key Terminal Railway, Ltd., including the site of the burned portion of the terminal building, making it impossible to reconstruct any facilities in that area. The only alternatives which presented themselves were the construction of a minimum amount of facilities to adequately and safely handle the traffic, or to discontinue the transbay business entirely. It was found possible to adopt the first alternative with a total expenditure approximately equal to the proceeds of insurance received for the portion of the old terminal which was destroyed (Key System, Ltd. 1933:4).

Key System decided not to rebuild the two ferry slips on the pier that had been destroyed by fire but to use the one that was undamaged. The Key System Annual Report for 1933 stated: "The San Francisco-Oakland Bay Bridge also influenced our decision with respect to reconstruction of landing slips at the Pier Terminal. It was decided to operate with the single slip which remained… "(Key System, Ltd. 1933:5).

The company settled for $1.1 million in insurance coverage and quickly began construction of a metal train shed and ferry wharf (Smythe 1937:553; *San Francisco Chronicle* May 9 1933; *Oakland Tribune* May 25, 1933; *San Francisco Examiner* May 8, 1933).



Rebuilt Ferry Terminal, no date (PhotoCourtesy of A.C. Transit)

The new terminal building was much plainer than the old terminal designed by Walter Mathews. The new pier was built under the joint supervision of the company's engineering staff under the direction of Vice-President H.P. Bell, and the architecture firm of Kent & Hass. The design team made as many improvements as possible within the strict budget allowed, drawing on studies of operations at the old terminal. The new building was to be not only fireproof but also more efficient. One of the innovations was the removal of fuel oil tanks to a detached wharf, which can be seen on the Sanborn Map next to the Signal Tower, just before the approach to the train concourse. Design of the new terminal was described in the Key System Annual Report in 1933:

> "The speed with which peak hour traffic can be discharged from ferry steamers has been greatly improved by the installation of side loading bridges and aprons on both upper and lower decks. The building portion of the new terminal is entirely of fireproof construction, the principal materials used being steel trusses and columns of which various sections are bolted rather than riveted to facilitate removal, and corrugated galvanized sheathing. To further reduce fire hazard, fuel oil tanks were removed to a detached wharf; fire pump and air compressor to another detached wharf; Interlocking Tower No. 1 protected by sheet metal sheathing on walls and roof; numerous hydrants with fire hose installed; metal

> covered man holes and hose holes provided; a manual and automatic circuit breaker installed to permit disconnection of all trolley current from the terminal; and many other measures taken to minimize fire hazard, insure prompt discovery of fire, and provide means of combating the same efficiently and safely. The floor has been covered with a fire resistant material" (Key System, Ltd. 1933:4).

The new pier terminal was completed and ready for service on February 1, 1934. It had a huge illuminated sign facing the ferry lanes with the word "Key System." The terminal building itself had the words "Eastshore Empire" over the ferry entrance – this promotional slogan had been used on timetables, brochures, and in public speeches for a few years prior to the fire of 1933 (Demoro 1985a: 77).

<u>San Francisco-Oakland Bay Bridge</u>

Demoro calls construction of the San Francisco Oakland Bay Bridge "the most important event in the history of Key's transbay operation since its founding as the Key Route in 1903" (Demoro 1985a: 72). By 1931, plans for the SFOBB had reached the point where both the Key System and Southern Pacific began considering changes in their transbay transportation service (Smythe 1937:553; Key System Ltd. 1931:3; Key System Ltd. 1932:3; Key System 1934:6; 1935:5).

From the start, plans for the bridge included the idea of rail rapid transit tracks, which would cause both the Key System and Southern Pacific to abandon their transbay ferry operations. In 1936, both companies gained operating rights on the bridge for train service, sharing the bridge tracks in a system known as the Bridge Railway. The ferries and their pier terminals would be obsolete when the Bridge Railway took the place of the old train-ferry service (Smythe 1937:580;Demoro 1985a: 73; Key System 1936:9-11).

The bridge opened to vehicular traffic on November 12, 1936 (Key System 1936:11). The end of train-ferry service and its replacement by an all-rail operation into San Francisco was scheduled for January 14-15, 1939. Night workers on the Key System mole lit bonfires as they waited for the last trains to leave the ferry pier. At dawn on January 15, they were scheduled to disconnect the rail link to the trestle and connect the tracks to the bridge approach (Demoro 1985a: 95; Key System 1939:4)

The main sentiment of the day was excitement over the opening of the Bridge Railway. Nonetheless, there were some nostalgic looks back at the end of the ferry boat era, as is shown in the *San Francisco News* editorial of January 14, 1939:

> So farewell, today, to the passenger ferryboats. To the countless times we have stood on their decks and watched them swash through the waters of the Bay…The outmoded ferries go to the limbo of horse-drawn streetcars. And the people of the Bay Area who dared invest $110 million in bridges, hail the era of streamlining, speed and comfort in mass transportation…(quoted in Demoro 1985a: 89):

Key System revived the East Bay train-ferry service briefly for the Golden Gate International Exposition on Treasure Island, from February to October 1939. The Key pier terminal was temporarily re-opened for the duration of the fair and a new track was built that by-passed the approach to the Bridge Railway. Exposition trains (The X-exposition line) carried passengers to connecting ferries from 9 a.m. until after 2 a.m. every day (Demoro 1985a: 101). Key System also operated ferries to Treasure Island from the San Francisco Ferry Building. However, that was to be the last chapter of the Key System train-ferry service from the East Bay. When the Exposition re-opened in 1940, Key System resumed ferry service to Treasure Island from San Francisco but operated bus service to the fairgrounds from the East Bay.

Dismantling the Key System Pier, ca. 1942
(Photo Courtesy of A.C. Transit)

Dismantling of Trestle, Pier, and Terminal, 1942

The train shed built after the fire was of all-steel construction, and designed for easy disassembly so that it could be sold as an industrial building after the abandonment of the train-ferry operation in 1939. In the fall of 1942, the trestle was torn up and the buildings and train shed were dismantled and sold for scrap. All evidence of the terminal was completely obliterated at the site. However, parts of the train shed were, as the company had hoped, incorporated into a steel company plant on West Grand Avenue and Cypress Street in Oakland, where it remained in use as late as 1984 (Demoro 1985a: 77; Sappers 1948:9).

The decline of the Key System and the termination of its train-ferry service in 1939 was due to a variety of factors: the opening of the San Francisco-Oakland Bay Bridge, the Depression of the 1930s, competition from automobiles, and company mismanagement (Demoro 1985:67). In retrospect it seems remarkable that the Key System train-ferry service lasted as long as it did, operating on the brink of financial collapse for much of the time, surviving one crisis after another. In large part, its survival can be attributed to the loyalty, even affection of the people who rode Key System trains and ferries. The Key System was a big hit with the public right from the start in 1903, and retained popular support into the Bridge Railway era from 1939 to 1958. It has a hold on the public imagination to this day, surfacing recently in the floating of proposals for renewal of rail service across the Bay Bridge.

5.0 FIELD METHODS

During the four-day period April 26-29, 1999 William Self Associates conducted side scan sonar and sub-bottom profile surveys of the underwater archaeology area of potential effects (APE) for the San Francisco-Oakland Bay Bridge East Span Seismic Safety Project. An EdgeTech Model 260-TH 100 kHz Side Scan Sonar and a Geopulse 5430A transmitter and 5210A receiver, coupled with an EPC GSP-1086 printer were used to collect the remote sensing data. The equipment was deployed from the 26-foot survey vessel *Betty Jo*, owned, and operated by Sea Surveyor of Benicia, California. Sea Surveyor, Inc. also provided bathymetric information and incorporated differential global positioning information into its on-board navigational computer to maintain horizontal control of the survey.

With the exception of seven survey lines, the entire APE was surveyed in transects that were oriented in a north-south direction, perpendicular to the orientation of the existing east span of the Bay Bridge. The exceptions were oriented in an east-west direction due to the shallowness of the waters in the northeast portion of the APE. Transects were surveyed in intervals of 50 meters and the side scan sonar data were collected at a range of 50 meters per channel, providing a 100% overlap of each transect (Figure 4).

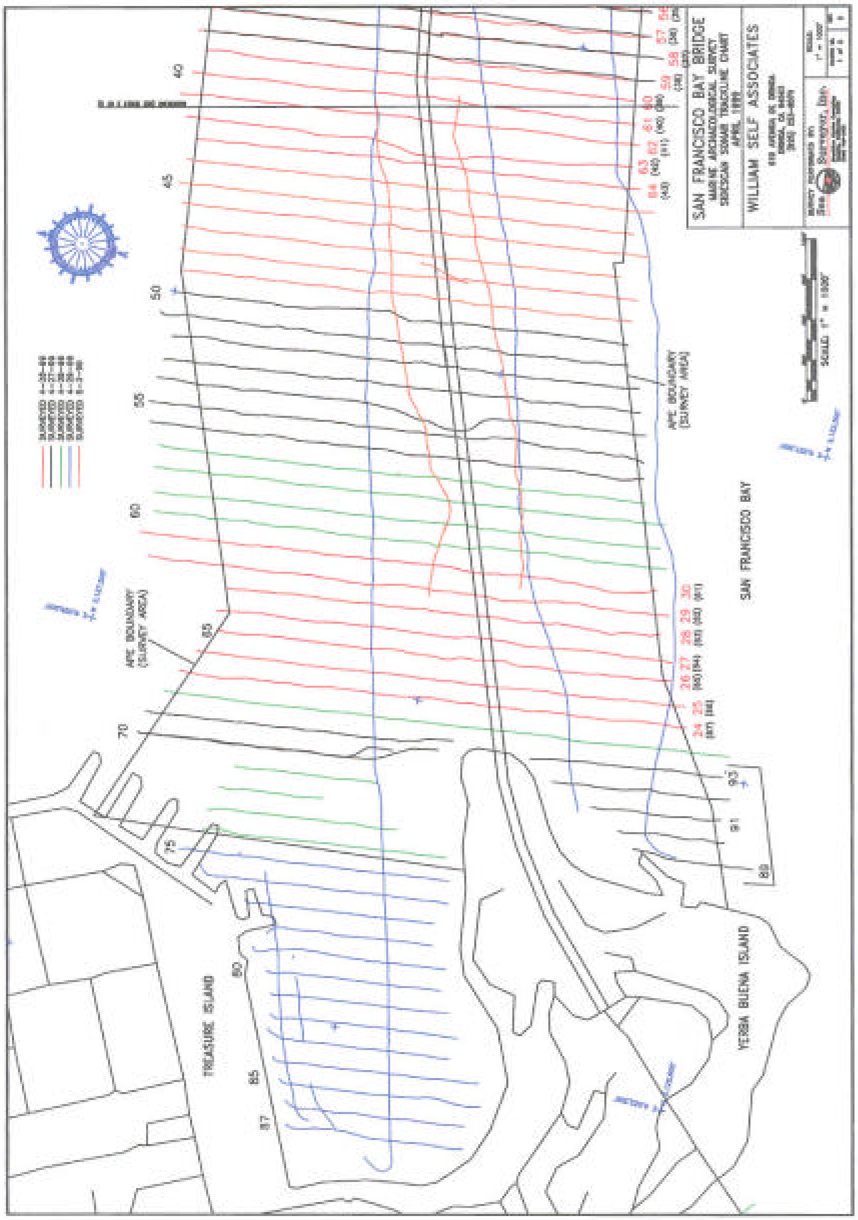
Sea Surveyor's technical staff conducted preliminary analysis of the side scan sonar and sub-bottom profile data. WSA archaeologists re-analyzed the data to identify the location and nature of any submerged cultural resources lying within the boundaries of the APE. Although numerous acoustic targets were identified lying on or slightly below the bottom sediment, most were determined to be either non-cultural in origin or culturally non-diagnostic (i.e. anchor scars, sewer outfalls, buried communication or power cables, etc.). Of all the targets identified in the survey, 51 were determined to be unidentified bottom features (UBF) requiring further analysis.

By analyzing the shape, surficial expression, size, acoustic shadow, and association with targets on adjacent survey lines, WSA determined that twenty-two of the UBFs required ground-truthing to determine their specific nature (Figure 5). Ground-truthing operations commenced on May 11, 1999. The timing of the operations was planned to take advantage of optimal tide and current conditions in the area of San Francisco Bay east of Yerba Buena Island. Differentially corrected GPS coordinates for each of the high-priority targets were entered into the on-board navigation computer of the 65-foot long research vessel *White Lightning.* After arriving at the location of the first ground-truthing target (designated target number 3), a Phantom HD2+2 Remotely Operated Vehicle (ROV), equipped with forward-looking sonar, a high-resolution color video camera, a Silicon Intensifier Targeting camera (SIT)[5,] and two Tungsten-Halogen 250 watt lights was deployed from the *White Lightning* for target investigation (Photos 1 & 2). For archival purposes, the images produced by the color video and SIT cameras were recorded on a VHS-format video recorder.

Using the ROV's sonar system, target 3 was located immediately However, because of the unusually high levels of water turbidity, neither the color video nor SIT cameras were able to provide a clear image of the target. Although the SIT camera was able to return an image, the turbidity of the water required the camera to be positioned so close to the target that the image's resolution was too indistinct to allow for either target identification or assessment. The turbid condition of the water, associated with spring runoff and late winter rains, is a typical condition found in the Bay at the time of the initial ground-truthing operation and it proved to be a significant impediment to the use of the cameras in evaluating the acoustic targets.

To assess the further impact of the water's turbidity on the ROV approach to ground-truthing, five other targets situated across the breadth of the APE were selected for investigation. Target 13, the

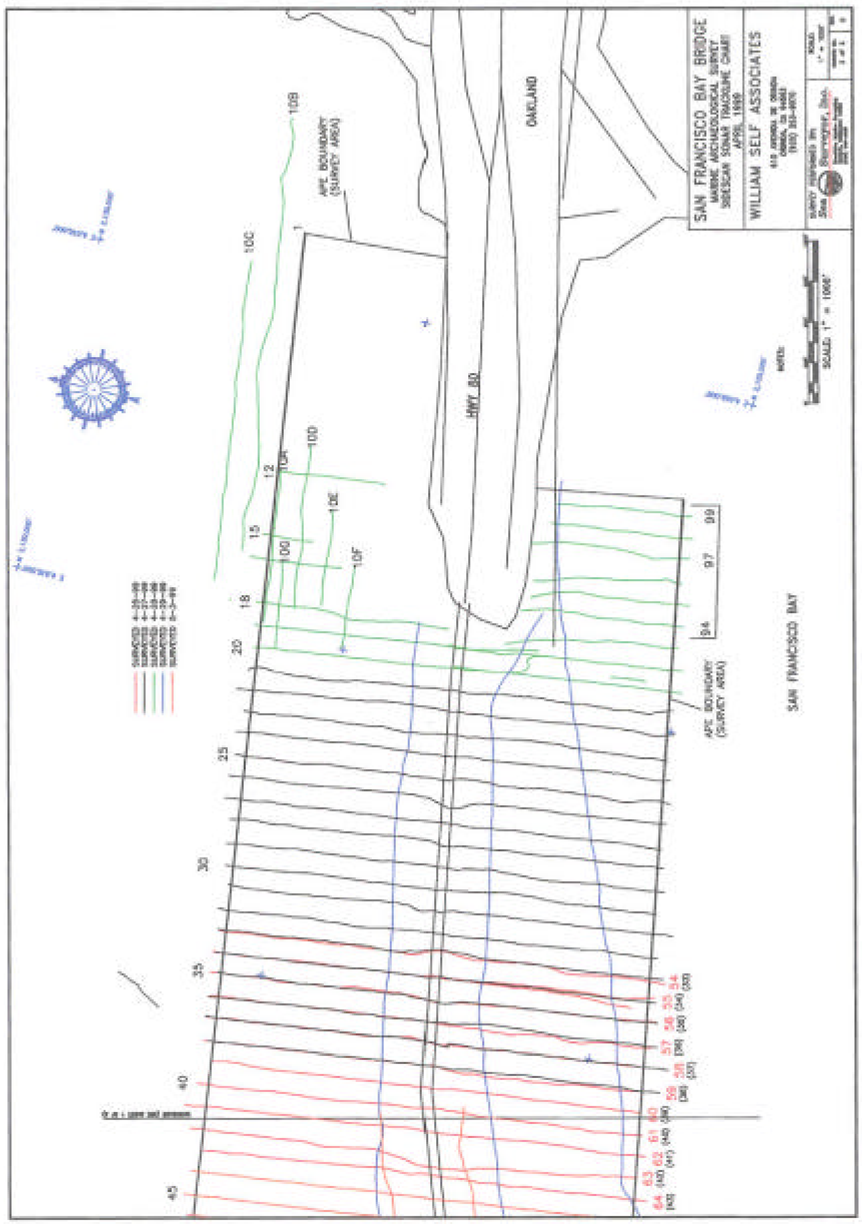
5 The SIT camera is designed to operate in environments with extremely low light levels.



Survey Transects, Western Half of APE

Figure 4

SFOBB East Span Seismic Safety Project



Survey Transects, Eastern Half of APE

Figure 4

SFOBB East Span
Seismic Safety Project

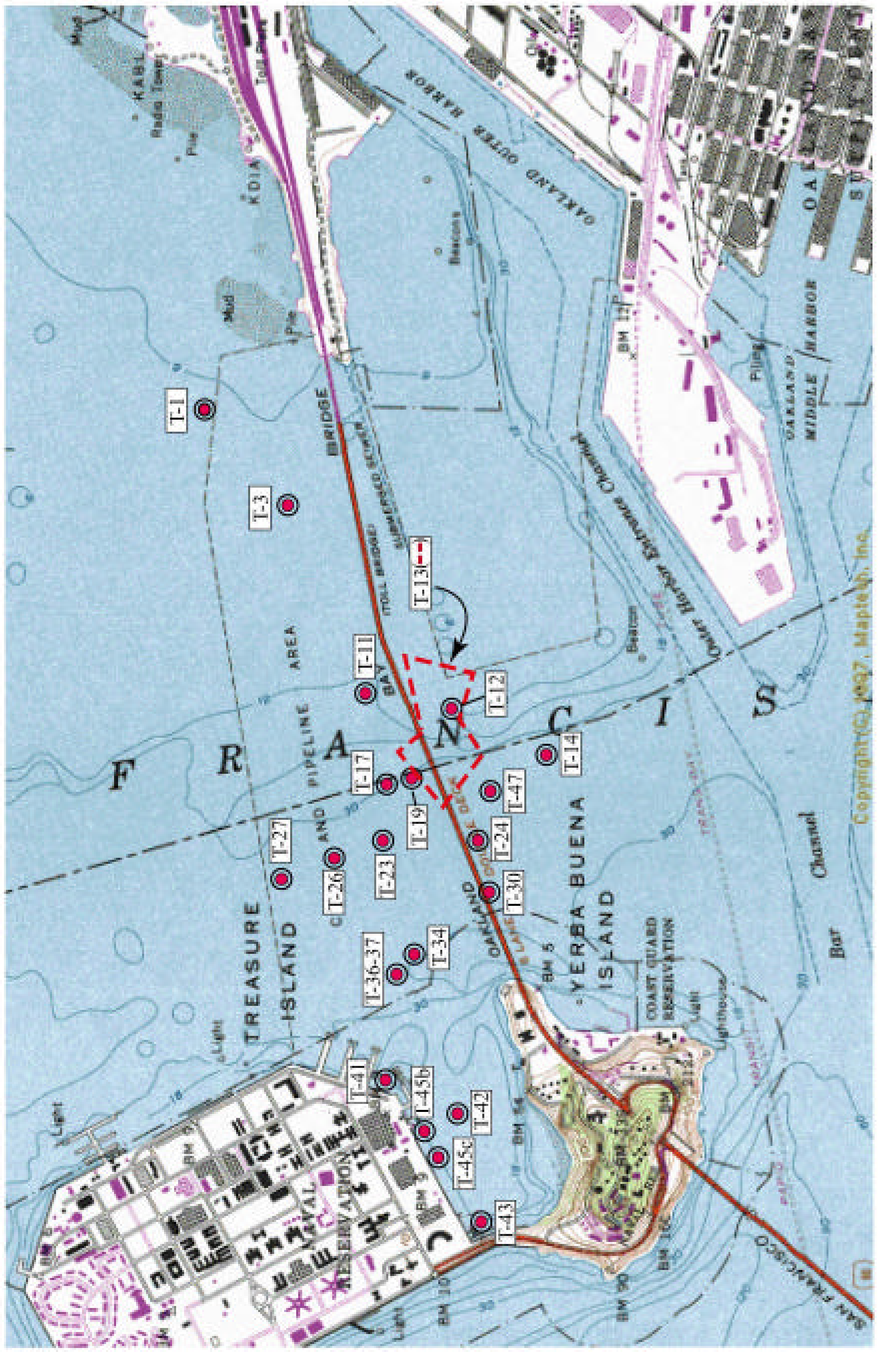


Figure 5
SFOBB East Span Seismic Safety Project

Location of Potentially Significant UBFs

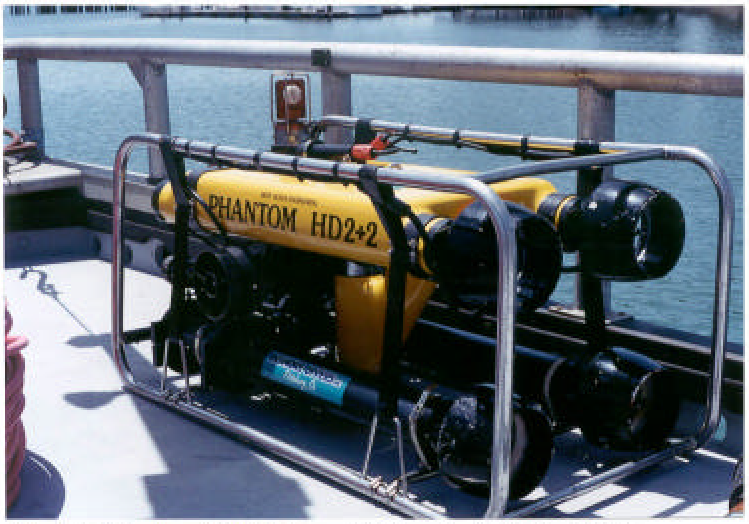


Photo 1: Phantom HD2+2 Remotely Operated Vehicle (ROV)

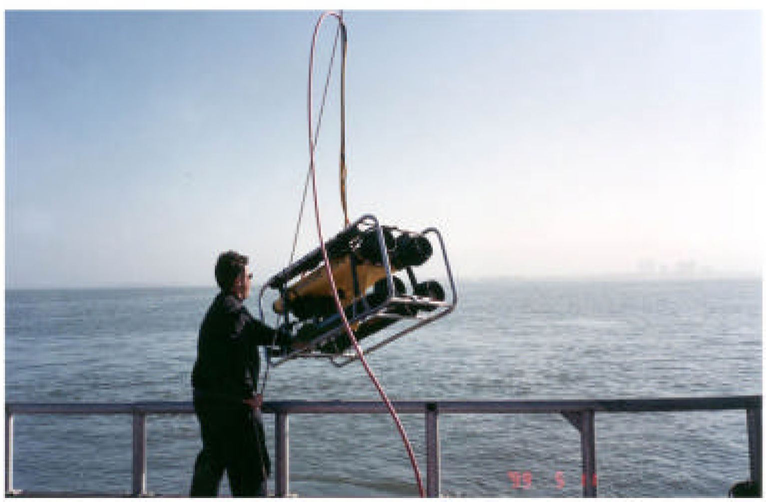


Photo 2: Deployment of ROV

Photos 1 and 2	SFOBB East Span Seismic Safety Project

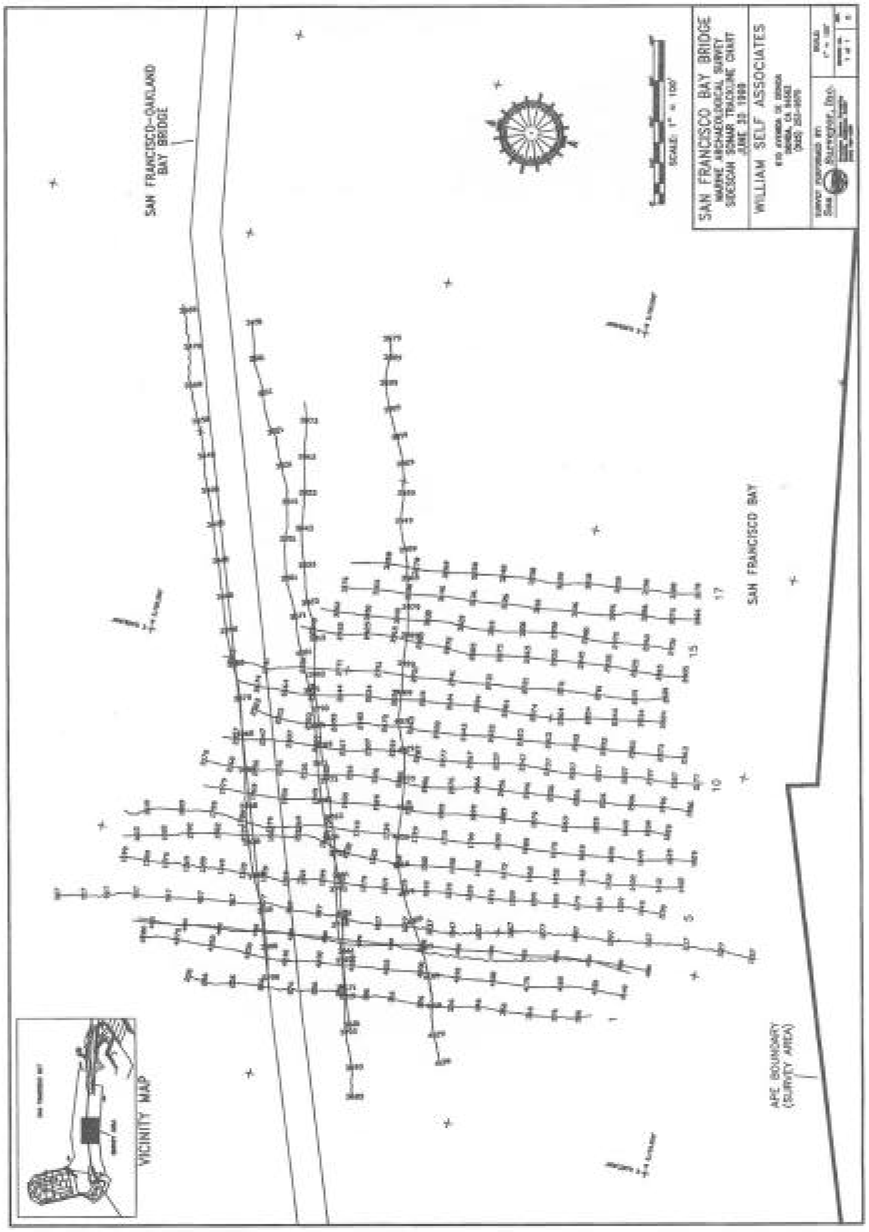
disarticulated remains of the Key System pier and a known quantity in terms of its orientation and configuration, was investigated with the ROV. As with target 3, the cameras were unable to provide either an overview or perspective view of the target. The substance of the target was not visible in the images returned by either camera unless the lens was positioned directly on top of the object, which prevented any interpretation about the nature, configuration, orientation, or association with other target components. Investigations of targets in Clipper Cove and on the north side of the existing bridge had the same results (refer to Figures 3 and 5). Sonar images were used to locate the targets but an assessment of their nature and configuration with the ROV's camera array was not possible because of the turbidity of the water.

As a result of the visibility problems, ground-truthing operations were terminated at the end of the first day and a reassessment of the approach was made. The ROV when equipped with SIT and color video cameras is an effective, efficient, and economical tool for ground-truthing. It is designed to operate in the poor light, swift currents and dynamic tidal changes that are the normal underwater environmental conditions found in the Bay. However, the unexpectedly high levels of seasonal turbidity found in the water column in the month of May proved to be too much to effectively assess the targets, and the ROV investigation was abandoned.

In June 1999, a two-phase approach combining both hands-on evaluation by SCUBA-certified maritime archaeologists and the use of high-resolution sonar was implemented to evaluate the nature and configuration of 21 of the 22 discrete UBFs identified in the APE. The broad spatial extent of the remaining target (number 13), and the environmental conditions in which it is found, precluded any attempt at diver evaluation. For target 13, the remains of the Key System pier, WSA conducted an intensive high-resolution side scan sonar survey, using a Marine Sonics Sea Scan 600 kHz sonar system that provided optimal, near-photographic quality images of the pier's remains.

As discussed below, the high-resolution sonar survey produced a data set of target images sufficiently clear and detailed to allow for assessments of spatial arrangement, integrity, and significance as defined by the National Register of Historic Places (NRHP) Criteria of Evaluation.

WSA maritime archaeologists conducted the side scan sonar survey of target 13 on June 30, 1999. The 600 kHz sonar system was deployed from Sea Surveyor, Inc.'s 26-foot vessel *Betty Jo*. Differential global positioning information was used in the vessel's on-board navigational computer to control the survey. Twenty-two transects separated by intervals of 20 meters were surveyed over the target area (Figure 6). The sonar range was set to a swath width of 20 meters, providing a 100% overlap of the target area. Subsequent analysis of the remote sensing data identified four additional acoustic targets in the debris field of target 13.



Survey Transects for Target 13: Key System Pier

Figure 6

SFOBB East Span Seismic Safety Project

The two-phase ground-truthing operations for the remaining 21 targets and the four newly identified targets within the boundaries of target 13 commenced on July 13, 1999 and continued through July 15, 1999. Logistical constraints made it necessary to substitute a 300 kHz system for the 600 kHz system used in the June 30 survey of target 13. Although the resolution was slightly lower than that provided by the 600 kHz system, image clarity was still far superior to that acquired from the 100 kHz system used in the April 1999 survey.

Ground-truthing operations began with sonar acquisition of a particular target location. Because of the high resolution provided by the 300 kHz system, visual assessment of some targets was possible on the basis of the sonar image alone. For targets that were less clearly defined, WSA maritime archaeologists made scuba dives to conduct tactile assessments of the targets. In the latter instance, a buoy line, heavily weighted to overcome the drift effects introduced by the strong tidal currents, was dropped on the coordinates of the target location. The sonar was then deployed to determine the relative locations of the buoy line anchor and the target. Based on that determination, the diver was directed by two-way, surface-to-diver communications through the zero-visibility water conditions to the target location. In compliance with OSHA regulations, a tender on the diving platform controlled a tether to the diver, who was in constant communication with the diving platform. A standby diver was outfitted on the dive platform during all diving operations, as required. During this portion of the investigation, 14 targets were investigated, some multiple times as discussed below.

On August 18, 1999, target assessment and ground-truthing efforts resumed and continued through August 20, 1999. During this second phase, a 600 kHz Marine Sonics Sea Scan sonar system replaced the 300 kHz system used in the July 13-15, 1999 effort. The methodology described above was used to investigate the remaining 12 targets (including the four new targets identified within the debris field of target 13). Fifteen SCUBA dives were conducted on 13 of the targets. The remaining targets were assessed on the basis of the acoustic data collected in the side scan sonar investigation. A summary of the ground-truthing targets is shown in Table 2.

Table 2: Summary of Ground-Truthing Targets

Date	Target	Sonar	Dive	Depth (Feet)	DiveTime (Min.)
08/20/99	1	600 kHz	N		
07/13/99	3	300 kHz	N		
07/13/99	11a, 11b, 46	300 kHz	Y	18	15
08/19/99	12	600 kHz	N		
06/30/99	13	300 kHz	N		
08/18/99	13-1	600 kHz	Y	27	25

08/18/99	13-2	600 kHz	Y	30	10
08/18/99	13-3	600 kHz	Y	32	13
08/19/99	13-4	600 kHz	Y	20	15
07/15/99	14	300 kHz	N		
07/15/99	17	300 kHz	N		
07/15/99	19a	300 kHz	Y	30	30
07/14/99	19a,b, c	300 kHz	N		
07/15/99	19b	300 kHz	Y	26	19
07/13/99	21	300 kHz	N		
08/20/99	23	600 kHz	N		
07/14/99	23a&b	300 kHz	N		
08/19/99	23a&b	600 kHz	N		
07/15/99	24	300 kHz	N		
08/20/99	24	600 kHz	Y	45	35
07/14/99	26	300 kHz	N		
08/19/99	26	600 kHz	Y	26	18
07/13/99	27	300 kHz	N		
07/14/99	27	300 kHz	Y	36	30
07/14/99	27	300 kHz	Y	36	19
08/19/99	27	600 kHz	Y	41	25
07/15/99	30	300 kHz	N		
08/20/99	30	600 kHz	Y	46	16
07/15/99	34 a & c	300 kHz	N		
07/15/99	34b	300 kHz	N		
07/14/99	36	300 kHz	N		
08/20/99	36	600 kHz	N		
07/14/99	37	300 kHz	N		
08/20/99	41	600 kHz	N		
08/20/99	42	600 kHz	N		
08/20/99	43	600 kHz	N		
08/20/99	45b	600 kHz	Y	15	18
08/20/99	45c	600 kHz	Y	15	16
08/19/99	47	600 kHz	N		
08/20/99	47	600 kHz	N		

6.1 Findings

Target Assessment

For the sake of continuity, all figures referenced in the following discussion may be found in Appendix C. Target locations are illustrated in the Location of Potentially Significant UBFs (refer to Figure 5).

Target 1: In the April 1999 100 kHz side scan survey, a linear target approximately 30-meters in length was identified near the eastern edge of the APE. Located in less than 12 feet of water, the target exhibited straight sides and what appeared to be a slightly pointed eastern end, suggesting the presence of a feature that was culturally produced (Figure 7). During ground-truthing operations, the target was reinvestigated with the 600 kHz sonar system. The higher resolution image revealed that the target was a deep scar in the bottom sediment that extended for a length of nearly 60-meters. The seemingly straight sides of the target that were apparent in the 100 kHz image were the product of the lower resolution of that system, which apparently only reflected the harder, interior surface of the scar, losing the acoustic return of the irregular-shaped edge in the soft bottom sediments. The target appears to be an anchor scar and is of no cultural or archaeological significance and may be disregarded.

Target 3: A hard acoustic return, roughly elliptical in shape and approximately 8-meters in length was identified in the April 1999 100 kHz sonar survey. The target's shape and size suggested it might be a length of cable, chain, or possibly the remains of a small boat (Figure 8). During ground-truthing operations, four transects were surveyed over the target, designated as number 3, two transects at a range of 50 meters, and two at a range of 20 meters. The higher resolution of the 300 kHz image revealed that the target is likely a low mound that is nearly circular in shape, with oblong dimensions, rather than culturally modified material. The mound extends approximately 7.5 meters north-south and approximately 8.5 meters east-west. The mound appears to slope up from west to east to a maximum height at the center of approximately 90 centimeters above the bottom sediment. The irregular configuration of the target's edges and its similarity to natural bottom features in the surrounding area suggest the target is a natural, non-conforming irregularity in the bottom sediments. Diving operations on this target were considered unnecessary, and it is reported as a means of documenting the target for future reference only, should additional remote sensing work ever be conducted in the area. The target is not associated with any cultural material, nor is it temporally or culturally diagnostic and need not be considered further.

Target 11: In the 100 kHz side scan sonar survey conducted in April 1999, a target was observed in approximately the same location on three different survey lines. Initially identified as targets 11a, 11b, and 46, the three images were subsequently determined to be different views of the same feature, and eventually designated simply as target 11. In the best 100 kHz image, the two-meter diameter target appears to represent a pair of circular objects in a small cluster. During the ground- truthing operations conducted in the period July 13-15, 1999, the target was re-acquired with the 300 kHz sonar and several passes were made over it using the 50 meter, 20 meter, and 10 meter range scales (Figure 9). In the higher-resolution image, the target appears to be a linear object, approximately 1.5 meters in length, oriented in a northeast-southwest direction and resting in a circular depression approximately two-meters in diameter. Along the southeast and southern edges of the depression, the harder bottom sediments appear to be slightly mounded, which is a typical result of the tidal scouring that creates a depression around objects embedded in the bottom. To the west of the low mound, a second circular depression, more faintly defined is also evident. The location and configuration of the two depressions is consistent with the target(s) observed in the April survey, but the specific nature of the linear object could not be determined from analysis of the side scan image alone. Consequently, a WSA maritime archaeologist conducted a scuba dive on the target.

As described above, a buoy was dropped at the target location and its proximity to the target was confirmed with the sonar. Following buoy deployment and recovery of the sonar, diving operations commenced. Typical zero visibility water conditions were encountered, so target evaluation was conducted solely by touch. The target, which was found resting in a depression, appeared to be a concrete or stone block measuring approximately 10-centimeters by 30-centimeters with an estimated length of over 3.6-meters. After evaluating the target, the diver conducted a circle sweep of the area surrounding the buoy anchor. The search pattern covered an area within a 9-meter radius of the buoy anchor. No other cultural material was encountered.

Although visual assessment was not possible, acoustic examination and tactile evaluation of the target suggested it is a singular piece of debris, the composition and shape of which was not discernable. It does not appear to be associated with any other cultural material in the area and nothing in any of the archival information gathered for the project gives any indication as to what it might be. From the evaluation that was possible, it does not appear to be either temporally or culturally diagnostic, or capable of meeting any federal or state significance criteria. Target 11 has therefore been eliminated as a cultural resource requiring further consideration.

Target 12: The 100 kHz image of Target 12 retrieved during the April 1999 survey depicts a small array of pile stubs, east of which lies several horizontal objects (Figure 10). During the ground-truthing operations of August 18-20, 1999 this target was re-examined with the

600 kHz side scan sonar. It was subsequently determined to be a portion of Target 13, which is discussed below.

As depicted in the higher-resolution image for Target 12, an array of five pile stubs project approximately 2.8 meters above the bottom surface. East of this array, three or four piles lie on the bottom surface. These appear to be 5 to 7 meters in length with a surficial expression of approximately 1.5 meters. Substantial bottom scouring has occurred between these piles. A single vertical projection is situated southeast of the pile array. It projects above the bottom approximately 4.4 meters and may be the remains of a pile, although it appears to be smaller in diameter than the adjacent pile stubs. Alternatively, it may be a single plank or possibly a fragment of railroad iron. The clarity of the images obtained during the acoustic assessment of the target was sufficient to determine that the elements comprising the target do not appear to be either temporally or culturally diagnostic, nor are they capable of meeting the test of significance as measured against the National Register of Historic Places (NRHP) Criteria for Evaluation. Target 12 has therefore been eliminated as a cultural resource requiring further consideration.

Target 13: As discussed above, in May 1933, fire destroyed the Key System's passenger terminal building, the ferry *Peralta*, and 16 rail cars that stood at the head of the system's mole,[6] which once projected more than three miles into San Francisco Bay (refer to Photos X-X – *in press*). The remains of both the *Peralta* and the railroad cars were removed from the damaged mole and the head of the pier was eventually re-built (Oakland Tribune, May 7 1933:1; Walker 1978:28).

Target 13 is a wide-spread feature comprising the partial, disarticulated remains of either the burned pier, or the remains of a portion of the pier as left following its dismantling after abandonment in 1939. The feature is scattered along the southern edge, beneath, and on the north side of the existing span. The boundaries of target 13 are depicted in red outline on the target location map (refer to Figure 5). As described above, the broad spatial extent of the feature, swift currents, and zero visibility water conditions found in the target area made impossible anything other than an acoustic assessment of the feature as a whole. Because the images acquired with the 100 kHz system in April 1999 were not adequate for this assessment the Marine Sonics 600 kHz, high resolution sonar system was used in June, 1999 to intensively re-survey the feature.

Acoustic images of target 13 generated from both the 100 kHz and the high resolution surveys may be found in Figures 11-22[7]. Each of the figures contains a small location map

[6]A mole is an earthen or stone wall used as a breakwater and built to enclose or protect an anchorage or a harbor.

[7]Images for target 13 are identified with a number that refers to a particular file within the data set comprising the survey record.

indicating the position of the target component relative to the boundary of target 13 as a whole. Analysis of the images captured in this survey indicates the feature consists almost entirely of disarticulated pilings, cable, and lengths of railroad iron scattered over an area approximately 300 x 200 meters. Pilings range in size from 6 to over 15 meters in length and many rest crossed, one upon the other. Stubs of many of the pilings at the eastern side of the feature appear to be upright, still embedded in the bottom sediment. These project approximately 2 meters into the water column (Figures 14-16). The feature comprising target 13 is largely concentrated directly beneath and south of the existing bridge alignment.

As indicated in the map depicting the location of the UBFs (refer to Figure 5)**,** a scattered, less-concentrated portion of the feature also lies on the north side of the bridge (Figures 11, 12, 20, 21, 22). As discussed below, the remains of the Key System's pier do not meet the test of significance as measured against the National Register of Historic Places (NRHP) criteria for evaluation and therefore this feature has been eliminated as a resource requiring further consideration.

As mentioned above, in the analysis of the high-resolution acoustic data acquired in the June 30 survey of target 13, four distinctive targets were identified within its boundaries that appeared to be unrelated to the remains of the Key System's pier. These were not visible in the data collected in the April 1999 100 kHz survey (refer to Figures 11-22). Investigation of these four targets, identified as targets 13-1 through 13-4 respectively, occurred on August 18th and 19th, 1999, during the second phase of ground-truthing operations.

Target 13-1: An aggregation of debris entirely different in appearance from that observed in the debris field associated with the Key System's pier was identified in the analysis of the side scan sonar data collected in the survey of target 13. Its acoustic image suggests a mound of debris spread over an area of approximately 100 square meters, with a surficial expression of as much as 4.5 meters (Figure 23). A beam or pole approximately 60 centimeters in width and 7.7 meters in height projects vertically from the center of the debris field. The appearance of this debris field is markedly different from the appearance of the remains of the Key System pier. Its location suggested the possibility it was detritus associated with the construction or maintenance of the existing ESSSP east span, but this could not be determined with certainty based on the sonar data alone. Consequently, a WSA maritime archaeologist conducted a scuba dive to the target. As with all other diving investigations, zero visibility conditions precluded visual assessment of the target, so the examination was conducted by touch.

The central portion of the target is a rectangular metal concretion projecting through the bottom sediments. Above it, a tangle of 3 to 5-inch diameter iron pipes project in various directions. Two of the largest pipes project vertically from the rectangular concretion and turn 90 degrees, one to the north, and the other to the south. The pipe trending to the south is bent, undulating up and down along its length. It continues into a second pile of intertwined pipes, steel cable, and wood boards that leads off in several directions. An 8 to 12-inch diameter pipe rests near a solid, cylindrical object approximately 3-feet in diameter. Scattered around the perimeter of the large pile of wood and cable were smaller pieces of wood, cable, and pipe.

Although target 13-1's acoustic image is significantly different from the those of the other remains of the Key System's pier, it appears that the conglomeration of pipe, wood, and intertwined cable is more debris from the Key System's pier and the structures that once stood upon it. The debris does not appear to be either temporally or culturally diagnostic nor, as discussed below, is it capable of meeting any of the significance criteria established for NRHP evaluation. Consequently, target 13-1 requires no further consideration.

Target 13-2: The second target identified within the Key System pier debris field is rectangular and appeared to be fabricated from a type of large open-mesh material. Designated as target 13-2, this object is approximately 1.8 meters long and 1.3 meters wide and projects approximately 1 to 1.5 meters above the bottom surface (Figure 24). In the acoustic image, rectangular handles appear to protrude from the target's upper end. Their shadows suggest the projections to be approximately 75 centimeters long and 40 centimeters wide. A cable or rod approximately 8 meters long is attached to the southeast corner of the target. This appears to be slightly bowed relative to the bottom surface. A long, possibly triangular object, approximately 6 meters in length lies about 1.5 meters from the southwest corner of the target. This linear object appears to project into the water column as much as 1.7 meters. The configuration of target 13-2 and its proximity to the existing bridge suggested it might be a piece of maintenance equipment, possibly a large basket-like carrier. As with target 13-1, a diving assessment by WSA archaeologists was necessary to determine the exact nature of the target.

Tactile evaluation of the target determined that it is a concrete block, approximately 1.8 meters long and 1.3 meters wide. Four evenly spaced rows of three steel I-beams project 50-60 centimeters from the top surface of the block. Two rows of two steel I-beams project from the two sides of the block that were exposed above the bottom sediments. Numerous strands of thin plastic-coated cable are intertwined and wrapped around the projecting I-beams. A cylindrical object estimated at 75-centimeters in diameter rests approximately 2-meters to the southeast of the block. The material from which it was fabricated could not be determined.

The block may be associated with the structural elements of the Key System pier, but its seemingly relatively modern appearance suggests it is more likely debris associated with construction or maintenance of the existing east span of the bridge. Its nature suggests it is neither temporally nor culturally diagnostic nor, as discussed below, does it meet any of the significance criteria established for NRHP evaluation. Consequently, target 13-2 need not be considered further.

Target 13-3: The acoustic image of target 13-3 suggests an object that is approximately 5.8 meters in length and 25 centimeters thick. Its southern end appears to project above the bottom surface nearly 4.5 meters in a long sweeping arc (Figure 25). Although it appeared to be a length of cable or a bowed piece of metal, its position in the water column and the shadow it projects suggested it might be something more substantial. A diving assessment by WSA archaeologists was determined necessary in order to ascertain its exact nature.

Tactile evaluation of the target determined it to be a length of railroad iron, approximately 7.6- meters in length. It is bent and projects above the bottom approximately 3.6-meters in a long, graceful arch. Its western end is buried in the bottom sediments, while the eastern end terminates in a small pile of three or four shorter pieces of bent railroad iron, all of which lie flat on the bottom. Target 13-3 is not considered diagnostic and does not meet any of the significance criteria established for NRHP evaluation and it need not be considered further.

Target 13-4: As depicted in Figure 26, target 13-4 appears to be a singular large, triangular mound of material with sharply defined edges. It projects approximately 5.6-meters into the water column and covers an area of 42-square meters. It appears to be approximately 7-meters long and 6-meters wide, although the substantive portion of the mound is closer to 3-meters in width. The mound does not appear to be associated with the light scatter of debris lying approximately 17-meters to the south. The singular, compact nature of this target and its unusual configuration required a diving assessment by WSA archaeologists to determine its exact nature.

In reacquiring the target's location with the 600 kHz sonar system, multiple views of its configuration were taken on August 19, 1999 (Figure 26). Analysis of these images suggested a slightly different arrangement of the target's components. Rather than the sharply defined, triangular object observed in the original sonar image, the target appeared to be a conglomeration of long, flat objects - possibly timbers or more railroad iron. WSA archaeologists conducted a diving assessment of the target in order to determine its nature and to clarify the ambiguity of the sonar record.

Target 13-4 proved to be an amalgamation of numerous flat, wood planks, approximately 12-inches wide, 6 to 10-feet long, and 1.5 to 2-inches thick. The planks overlap each other and are lying in a north-south orientation. Several planks cross the main portion of the target at various angles. Tidal scour around the pile and beneath the pile is substantial, so that several larger timbers, perhaps 4-inch by 4-inch in size, lie across the depression, effectively suspended above the bottom. Intermixed in the pile of flat planks are several 4-inch by 8-inch planks, as well as several 8-inch by 8-inch and 12-inch by 12-inch square beams, the latter crossing the pile at approximately a 90-degree angle to the general orientation of the other components. Spike holes penetrate the flat planks but no fasteners were located. Target 13-4 appears to be structural remains of the Key System pier, intermixed with elements of a structure that perhaps once stood on the pier itself. No other cultural material was located in or around the debris constituting the target. Nothing in the debris pile appeared to be either temporally or culturally diagnostic. The disarticulated nature of the debris pile and the lack of any associated cultural material suggest the feature would not meet any of the criteria of significance established for NRHP evaluation. Consequently, the debris constituting target 13-4 need not be considered further.

Targets 14, 17, & 34: The 100 kHz images for these targets depict round irregularities in the bottom surface that are similar in appearance to concentrated debris fields or possibly ballast piles. Because the images lacked sufficient clarity to determine the nature of the acoustic disturbances, they were re-examined with the higher-resolution 300 kHz sonar system on July 15, 1999. As depicted in Figures 27 and 28, the targets proved to be discrete exposures of the natural wacke sandstone from the Franciscan complex that lies below the muddy bottom sediments, and are part of the natural geological substrate.

Target 19a, 19b, 19c: In the sonar data collected with the 100 kHz system during the April 1999 remote sensing survey, three targets were identified on alternate survey lines and on a perpendicular tie-line transect. The targets appeared to lie in close proximity to each other, and were situated immediately adjacent to the west side of target 13. During the ground-truthing operations conducted on July 15, 1999, several transects were surveyed over the targets' coordinates with the 300 kHz systems, using 50 meter, 20 meter and 10 meter range scales. Two of the three targets comprising the three loci of target 19 were re-acquired with the sonar. Subsequent sonar searches around the coordinates for the loci beneath the existing bridge span (19c) were negative. The absence of a confirmed culturally related source for this target suggests the image generated in the April 1999 survey may have been that of a non-conforming irregularity in the bottom sediments.

The sonar image of target 19a depicts a target that is nearly rectangular (Figure 29). It is approximately 2.85 meters long, 1.37 meters wide, and is approximately 1.3 meters in height. It rests in a north-south orientation in a surrounding depression approximately 60 centimeters deep. Its rectangular configuration clearly suggests the target is cultural in origin but the nature of the object could not be determined from analysis of the side scan image alone. Consequently, a WSA maritime archaeologist conducted a scuba dive on the target.

As described above, a buoy was dropped at the target location and its proximity to the target was confirmed with the sonar. The buoy anchor was dropped within 6 meters of the target location, a degree of accuracy considered quite good given the strength of the tidal current. Following buoy deployment and recovery of the sonar, diving operations commenced. Typical zero visibility water conditions were encountered. As with the evaluation of target 11, assessment of target 19a was conducted solely by touch.

The target appeared to be either a concrete or stone block approximately 7 to 8-feet in length and 3 to 4-feet in width. A metal pipe protruded from one end of the block and another angled away from one side (Figure 30). The length of the former could not be determined, as it continued into the sidewall of the bottom sediment. The latter pipe continued for a length of approximately 7 to 8-feet before it too disappeared into the bottom sediment. The eastern side of the block appeared to have some curvature as it continued into the bottom of the scoured depression. Although it could not be determined with certainty, the 3-inch diameter pipes felt as if they were fabricated of iron. The southern end of the block was buried in the bottom sediment, so its overall length could not be determined. No definitive identification of the feature was possible but its proximity to the estimated boundary of target 13, the remains of the Key System pier, suggest it may be a fragment of debris associated with that feature.

A circle sweep of the surrounding area indicated the block was situated northeast of a large scatter of stones that covered an area of at least 30 square meters. The stones at the northern end of the scatter were too large to be moved by an individual, but decreased in size towards the southern edge. The configuration and location of the scatter indicate it is the source of acoustic target 19b. The extent and nature of the scatter suggest the stones may be an exposed portion of the natural geologic substrate, although its shape and configuration are also similar to those of a ballast pile or a ballast throw[8]. The large size of the stones at the scatter's northern end, however, make this interpretation somewhat unlikely.

Alternatively, the scatter may be the remnants of an intentionally dumped quarry cargo, as no other cultural material or structural components were found in the surrounding area, although these may lie buried beneath the bottom sediments. The proximity of the concrete or stone block to the scatter of stones suggests that they may have been deposited at the same time, but they do not appear to be functionally related.

Archival research conducted for the project gives no indication of the presence of any cultural material in this area. Although visual assessment was not possible due to the diving conditions, acoustic examination and tactile evaluation of target 19a suggest it is neither temporally nor culturally diagnostic, nor does it appear to meet any of the criteria of significance established for NRHP evaluation. Consequently, target 19a need not be considered further.

Target 21: A linear target was observed in two adjacent survey lines in the 100 kHz side scan sonar survey conducted in April 1999. The intensity of a portion of the target and its overall length suggested the target might have been an anchor with attached chain. To assess this interpretation, the target was re-examined on July 13, 1999 during the 300 kHz side scan survey (Figure 31). With the improved resolution provided by the 300 kHz image,

[8] Stone used as ship ballast was often discarded when cargo of sufficient weight was to be carried. The discarded pile of ballast stone is commonly referred to as a ballast throw.

the target appeared to be an anchor scar, rather than a chain or any other type of remnant cultural material. At its northern end, the 47-meter long scar forms a deep gouge in the bottom sediments, which are mounded to a height of approximately 35-cm for the first 10-meters of its length. The gouge becomes shallower as the scar trends toward the south. No cultural material appears to be associated with this feature and it need not be considered further.

Target 23: A small, elliptical depression with a hard edge along its western edge was observed in the data collected during the 100 kHz survey of April 1999. Reexamination of this target during the 600 kHz survey of August 19, 1999 determined that the target was a narrow, linear object, 3-meters long, and approximately 10-cm wide (Figure 32). A shallow tidal scour, approximately 30-cm deep, has formed along the eastern edge of the object. The small target appears to be an isolated piece of debris. Its proximity to target 13 suggests it may be a plank that drifted to its present location before becoming embedded in the bottom sediments. It does not appear to be either culturally or temporally diagnostic, nor does it appear to be capable of meeting any of the criteria of significance established for NRHP evaluation. Consequently, target 23 need not be considered further.

Target 24: Two parallel, linear targets, apparently connected at the southern end, were observed in the 100 kHz side scan sonar data obtained during the April 1999 survey. The objects appeared to be 3 to 4 meters in length, and the eastern component appeared to have some curvature to it as it extended to the north (Figure 33). The target was reinvestigated with the 300 kHz sonar system on July 15, 1999. Acoustic images obtained in that survey indicated the two parallel components were connected, and the target as a whole appeared to be elliptical in shape, and approximately 7-meters in length.

During ground-truthing operations conducted on August 20, 1999, the target was investigated again with the 600 kHz system. Acoustic images collected during the investigation indicated that the target was actually rectangular, rather than elliptical in shape, and appeared to measure approximately 2.3-meters x 1 meter in size. At least two perpendicular members appeared to cross the width of the rectangle. Its rectangular configuration clearly suggested the target was cultural in origin but the specific nature of the object could not be determined from analysis of the side scan data alone. Consequently, a WSA maritime archaeologist conducted a scuba dive on the target. As with all other targets investigated during diving operations, zero visibility water conditions were encountered, so the evaluation of target 24 was conducted solely by touch.

The target was found lying in a depression, approximately 10-feet deep, created by tidal scour along the eastern side. The southern portion of the target was a rectangular block approximately 3-feet by 4-feet in size. It angled down into the depression so that its upper end projected above the relatively flat bottom by approximately 6-feet (Figure 34). The block may have been fabricated of concrete. A metal "T-beam" girder, 12-inches wide and approximately 8-feet long, lay below the concrete block and may have been attached to the block, although this could not be ascertained with certainty. The girder was oriented perpendicular to the rectangular block. Twelve to 18-inches along the length of the beam, and oriented perpendicular to it, a second metal beam was encountered. Its mass was buried in the bottom sediment but its top surface was approximately the same width of the "T-beam." It may have been a beam of similar design. Three-feet further along the length of the "T-beam" a second rectangular block was encountered. It was similar in shape, size, and feel to the first block and may have been fabricated from concrete as well. Although not observed during the ground-truthing investigation, analysis of the acoustic data suggests a second beam is aligned parallel to the first, along the edge of the depression.

Target 24 appears to be an isolated, discarded fragment of construction debris. It does not appear to be either culturally or temporally diagnostic, nor does it appear to be capable of meeting the criteria established for NRHP eligibility. Consequently, target 24 need not be considered further.

Target 26: An "L"-shaped acoustic target, measuring approximately 5-meters x 7-meters was observed in the 100 kHz side scan sonar data collected during the April 1999 survey. The target's western edge gave a particularly hard acoustic return, and created a shadow sufficient to suggest a surficial expression of approximately 50-centimeters (Figure 35). The unusual configuration of the target and its clearly defined edges prompted further investigation during the higher resolution ground-truthing assessments conducted with the 300 kHz and 600 kHz side scan sonar. Subsequent to this reevaluation, a ground-truthing dive was conducted on the target.

Target 26 proved to be a 12-meter long portion of exposed telephone or fiber optic cable lying in a trough 3 to 4-feet deep. The cable was intact and continued into the ends of the trough in both directions. No reason could be determined for the discrete exposure of the otherwise buried cable, which is neither culturally nor temporally diagnostic. Target 26 need not be considered further.

Target 27: A small rectangular object, approximately 2-meters x 3-meters in size, was observed in the 100 kHz sonar data obtained during the April 1999 remote sensing survey. The rectangular target appeared to have perpendicular cross-members spanning its width and exhibited a surficial expression of approximately 40 to 60-cm. The target was reinvestigated in July and August with both the 300 kHz and 600 kHz sonar systems (Figure 36).

On August 19, 1999, two ground-truthing scuba dives were conducted on the target. Three pair of nested railroad wheels and axels had generated the acoustic images observed in the remote sensing data (Figure 37). Because of the zero visibility conditions encountered during both dives, only a tactile evaluation of the target was possible. Measurements of the feature are estimations made during the course of the two dives.

The target rests in a shallow depression caused by tidal scour of the bottom sediments around the nested wheel sets. Each wheel appeared to be approximately 4 to 5-feet in diameter, and the edges of each are grooved in the manner typical of railroad wheels, but the edges are pierced with oval shaped openings. The axles appeared to be 4 to 5 feet wide. The axle of the center wheel set is pierced with a metal rod, attached to which is a triangular, pivot hook or clamping device. At the east end of the depression, a small pile of six or seven bricks was encountered. These appeared to be intrusive and not associated with the nested wheel sets.

Nothing in the historic literature was found to indicate how or why the three pair of railroad wheels were deposited in their present location, so far removed from land or any associated railroad components. The components of the feature appear to be relatively modern and are neither culturally nor temporally diagnostic. Although the location of the feature imbues it with the traits of a historical curiosity, it does not appear to be capable of meeting the criteria of significance established for NRHP evaluation. Consequently, target 27 need not be considered further.

Target 30: In the 100 kHz survey of April 1999, a small rectangular target measuring approximately 3-meters by 1.5-meters was observed in the sonar data. The target appeared to have a single perpendicular cross member running across its width, and a surficial expression of approximately 50-cm (Figure 38). The target was reinvestigated with the 300 and 600 kHz systems in July and August 1999. On August 20, 1999, a ground-truthing scuba dive was conducted on the target to identify the nature of the object generating the acoustic image. Because the typical zero visibility water conditions were encountered during the dive, only a tactile evaluation of the target was possible.

Target 30 is situated in a shallow tidal-scour depression at a depth of approximately 47-feet. The target appears to be a steel girder, approximately 2.5 to 3-feet in width, lying in a northwest-southeast orientation. A series of bolts project through one side of the girder. The southern portion of the girder is flush with the bottom sediment, while the northern end projects slightly above the bottom, an alignment enhanced by the fact that the bottom sediments along the northern half have been scoured away to a depth of 2 to 3-feet. The girder appeared to be at least 20-feet long. Approximately 8-feet along its length, a second metal object was encountered that was oriented perpendicular to the alignment of the girder. It may have been steel cable, although it was not possible to determine this with certainty. The location and orientation of this member is apparently the cross piece observed in the side scan record. The bottom surrounding the girder and cross-piece was littered with small scraps of wood and various smaller pieces of metal, the shape and function of which it was not possible to determine. Although it was not detected during the ground-truthing dive, the remote sensing data suggests a second, parallel girder lies to the north and may be connected to the first with the perpendicular cable or member observed during the dive.

Although the material comprising target 30 appears to be structural in nature, it is located too far west of the remains of target 13 to be associated with the remains of the Key System pier. Its proximity to the existing span of the ESSSP suggests it may be debris associated with either construction or maintenance of the bridge. Nothing about the feature appears to be either temporally or culturally diagnostic, nor does it appear to be capable of meeting the criteria of significance established for NRHP evaluation. Consequently, target 30 need not be considered further.

Targets 36 and 37: A small linear target, approximately 5-meters in length was observed in the sonar data collected during the April 1999 remote sensing survey. The target was first observed on a north-south survey transect, and was later captured on an east-west crosstie transect. The image on the crosstie transect was classified as a separate target (number 37) until post-processing data analysis determined that it was the same target identified on the north-south transect as target 36.

The target appears to be resting on the upper edge of a shallow depression and has considerable surficial projection (Figure 39). The target was re-examined during ground-truthing operations conducted on August 20, 1999. The higher resolution image generated by the 600 kHz sonar system indicates the target stands upright on the bottom, projecting into the water column approximately 3.5-meters. It appears to be approximately 60-cm in diameter. Its size, configuration, and location at the mouth of the entrance channel to Clipper Cove (refer to Figure 5) suggest the target may be the remaining piling of a lost or abandoned channel marker or day board. The absence of any visible cultural material in the surrounding area and the likelihood that the target is the stub of a piling made any further investigation unnecessary. Nothing about the target appears to be either temporally or culturally diagnostic, nor does it appear to be capable of meeting the criteria of significance established for NRHP evaluation. Consequently, target 36 need not be considered further.

Target 41: During the 100 kHz survey of April 1999, a large elliptical target was observed in both channels of the sonar sensor (Figure 40). The shape and appearance of the target suggested a discrete conglomeration of rock, similar to that of a ballast pile. In the higher resolution 600 kHz survey of August 20, 1999, multiple transects were surveyed over the coordinates of the target on the 50-meter and 20-meter range scales. The target depicted in the 100 kHz data could not be re-acquired. Presumably, the original target was a temporary exposure of the lithic wacke sandstone from the Franciscan complex that lies below the muddy bottom sediment; similar to that comprising targets 14, 17, and 34. Failure to relocate the geological feature with the higher resolution sonar system was likely the result of tidal activity that redeposited bottom sediments on top of the exposed substrate.

Target 42: A large, round target located in the center of Clipper Cove was identified in the 100 kHz side scan sonar data collected in the April 1999 survey (Figure 41). The unusual shape of the target and the strength of the acoustic return that generated the image was sufficient to warrant further investigation during the 600 kHz remote sensing survey of August, 1999. During that survey, several transects were surveyed over the coordinates of the target. Multiple anchor scars mark the bottom of the cove and, as illustrated in Figure 41, at least one is semi-circular. Although none of the scars exhibit the same shape as that observed in the 100 kHz data, the location of the semicircular scar is the same as that of the circular target observed in the April survey. Presumably, the image in the 100 kHz data is a distortion of that scar, perhaps introduced by movement of the sensor associated with the short length and tight turns of the survey transects that were required to accommodate the narrow width of the cove.

Target 43: A rectangular target, approximately 18-meters long and 4-meters wide was observed in the side scan sonar data acquired from the starboard channel of the 100 kHz survey conducted in April 1999 (Figure 42). The target was identified on a survey transect at the western end of Clipper Cove. The acoustic data for the target faintly suggested that the object forming the rectangle had some surficial expression. On August 20, 1999, the target was re-acquired during the 600 kHz sonar survey associated with the ground-truthing operation. Analysis of the target in the higher resolution data determined it to be another exposure of the lithic wacke sandstone that lies below the muddy bottom sediment; similar to that comprising targets 14, 17, 34, and 41. The rectangular configuration of the target observed in the 100 kHz data was again suggested by the image in the 600 kHz data. However, the greater detail provided by the latter image indicated that the shape of the natural geological exposure lacked the hard, straight lines that would be generated by a cultural resource and was, in fact, only approximately rectangular.

Target 45b: In the 100 kHz sonar data collected during the April 1999 remote sensing survey, two targets were identified immediately adjacent to the seawall that forms the northern edge of Clipper Cove (Figure 43). Because of their close proximity and the possibility that they were associated with each other, they were designated as targets 45b and 45c (target 45a was the anchor for a buoy marking the location of target 45b). Target 45b, as depicted in the 100 kHz data is a linear object approximately 8-meters on length, with a sharp bend at its southern end. The target appeared to project above the bottom surface approximately 3.5-meters. During the ground-truthing operation of August 20, 1999, the target was re-examined with the 600 kHz sonar system and a diving investigation of the target was conducted. Because typical zero visibility water conditions were encountered during the dive, only a tactile evaluation of the target was possible.

Target 45b proved to be a steel structure situated immediately adjacent to Treasure Island, south of the seawall that forms the north side of Clipper Cove (Figure 44). It is exposed above the bottom sediments for a length of approximately 8-meters. The north and south ends of the structure were buried in the bottom sediments but tactile investigation suggests the structure continues for some depth into the bottom. The exposed upper surface of the structure appeared to be slightly bowed (Figure 45). Midway along its length, a vertical seam was encountered, indicating the structure is composed of at least two components. At the top of each seam, a recessed cutout was observed that accommodated a bolt and nut that joined the two components together. No appendages or attached structural members were observed in the investigation. The target is solid on both exposed planes. The function of the structure comprising the target could not be determined, nor was any temporally diagnostic material observed. The material from which the target is made appeared to be steel, rather than iron, and it had the overall character of a relatively modern object but it could not be determined with certainty if the object was culturally or temporally diagnostic. Although situated in the archaeological APE, its location in Clipper Cove and its proximity to the seawall substantially diminish the likelihood that it will be impacted by construction activities associated with the ESSSP project.

Target 45c: Adjacent to target 45b, a long linear object was observed in the 100 kHz sonar data collected during the remote sensing survey of April 1999. Small round objects were observed along the length of the target, offset on both sides (Figure 46). The target appeared to be approximately 24 meters long, with a small deposit of additional debris at its northern end. The target was reinvestigated on August 20, 1999 with the higher resolution, 600 kHz sonar system, and a ground-truthing diver investigation of the target was subsequently conducted. Because typical zero visibility water conditions were encountered during the dive, only a tactile evaluation of the target was possible.

Target 45c proved to be a steel object, approximately 72-feet long. It is partially buried in the bottom sediments but had a surficial expression of approximately 12-inches. In cross-section, the object appeared to be approximately 12-inches wide and 24-inches tall, with approximately 12-inches of exposure above the bottom sediment. Along the top of the southern half of the steel beam, a 1-inch steel cable was observed running along a groove in the beam. At least five perpendicular appendages were observed along the eastern side of the beam. Fragments of wood may be attached to the perpendiculars but the diving conditions were such that this could not be determined with certainty.

No diagnostic materials were observed in association with the feature. Like target 45b, the material from which the target is made appeared to be steel, rather than iron, and it has the overall character of a relatively modern object. Its configuration as determined by tactile evaluation suggests it may be a remnant of a supporting member for a wharf or dock – perhaps associated with the docks that once were situated along the seawall in Clipper Cove, although this could not be determined with any degree of certainty. As with the associated target 45b, although this feature is situated in the archaeological APE, its location in Clipper Cove and its proximity to the seawall substantially diminish the likelihood that it will be impacted by construction activities associated with the ESSSP project.

Target 47: A linear target approximately 7-meters long was observed in the 100 kHz side scan data obtained during the remote sensing survey of April 1999. The target appeared to be lying at the edge of a shallow depression created by tidal scouring along the object's north side. It was reinvestigated with the high-resolution, 600 kHz side scan system on August 20, 1999 (Figure 47). The target appears to be a length of cable or possibly the exposed edge of a pile fragment. It is approximately 3-meters in length and projects above the bottom surface approximately 20cm. Its exposed width is approximately 10-15cm. Three smaller linear fragments rest at the north end of the feature. The isolated nature of the target and the lack of any associated material in the surrounding area suggests the feature is an isolated deposit of debris. Its proximity to the estimated boundary of target 13 suggests it may be a pile fragment from the Key System pier that drifted to its present location. The feature does not appear to be either temporally or culturally diagnostic, nor does it appear to be capable of meeting the criteria of significance established for NRHP evaluation. Consequently, target 47 need not be considered further.

6.2 Conclusions

The significance of cultural resources is judged in accordance with the criteria for eligibility to the National Register of Historic Places as defined in 36 CFR 60.4. If such resources are determined to be significant, and therefore eligible for National Register listing, they are afforded certain protection under the National Historic Preservation Act (16 U.S.C. 470f). The Advisory Council on Historic Preservation must be given an opportunity to comment on any federally funded or permitted undertaking that could adversely affect such resources. Those resources determined not eligible for National Register listing are considered no further.

Cultural resources identified within the boundary of the ESSSP Maritime Archaeology APE must be assessed for National Register of Historic Places eligibility. These criteria state that "eligible historic properties" are:

> ...districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and that (a) are associated with events that have made a significant contribution to the broad patterns of our history; or (b) that are associated with the lives of persons significant in our past; or (c) that embody the distinctive characteristics of a type, period, or method of construction, or that possess high artistic values, or that represent a significant distinguishable entity whose components may lack individual distinction; or (d) that have yielded or may be likely to yield, information important to history or prehistory.

To evaluate cultural resources against such broad criteria requires consideration, among other things, of the overall integrity of the feature or deposit, the regional culture history, and the nature of questions that researchers are attempting to address regarding the history or prehistory of the region. The evaluations of the isolated cultural resources identified within the boundary of the ESSSP Maritime Archaeology APE have been addressed above. The evaluations assess the potential of the features to meet one or more of the criteria for National Register eligibility based upon analysis of remote sensing data, tactile investigation of the evidence identified at each target location, and information gathered during the literature and record searches. As discussed, none of the 26 targets meet the test of significance as measured against the NRHP criteria for evaluation and none merit further consideration as resources with the potential to yield information about the past.

Target 13, the widespread remains of the Key System pier, represents the only coherent archaeological resource in the APE. Taken in its entirety, however, the feature comprising the target does not meet the test of significance as measured against the NRHP criteria for evaluation, nor is it a contributing element to the nearby, land-based Key Pier Substation, which has been determined eligible for the National Register (SHPO 1998).

Although the remains of the Key System's pier may retain integrity of location and materials, they lack the integrity of design, setting, workmanship, and feeling that are requisite components of the significance threshold. On the basis of its inability to meet the test of integrity alone, the feature cannot meet the criteria for evaluation. Furthermore, although the remains of the pier clearly are associated with events that have made a significant contribution to the broad pattern of our history (criterion a), and are associated with Borax Smith, the system's developer and original owner, and a person significant in our past (criterion b), they fail to meet criteria c and d. The disarticulated nature of the feature's components and its wide-spread dispersal have destroyed the distinctive characteristics of its type and method of construction that may have met criterion c and have likewise eliminated the possibility that the feature would yield information important to our history (criterion d). Consequently, the remains of the Key System pier cannot be recommended as significant since they do not appear to retain integrity sufficient to meet the criteria for evaluation for the NRHP, an opinion with which SHPO concurred on December 1, 1999 (Appendix A).

Although 100 percent of the ESSSP Maritime Archaeology APE was surveyed, and all targets with the potential for significance were investigated and assessed, the possibility remains that other unidentified resources may be present below the bottom sediments of the APE. Discoveries of such resources that are made during construction must be evaluated by a qualified archaeologist, who may propose mitigation measures if warranted.

It is Caltrans policy to avoid cultural resources whenever possible. If the site(s) cannot be avoided, then additional assessment or mitigation may be warranted. If buried cultural materials are encountered during construction, it is Caltrans policy that work in that area must be halted until a qualified archaeologist can evaluate the nature and significance of the finds (Environmental Handbook, Vol. 2, Chapter 1.)

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SHPO

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APPENDIX A

Letter of Concurrence from SHPO

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CALIFORNIA DIVISION
980 Ninth Street, Suite 400
Sacramento, CA 95814-2724

FHWA ——
previous project HK

October 27, 1999

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OCT 28 1999

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04-Ala-80-0.0/2.1KP
Document #:24801
FHWA980717A

CERTIFIED RECEIPT RETURNED: Z 211 285 336 OHP

Mr. Daniel Abeyta
Acting State Historic Preservation Officer
Office of State Historic Preservation
P.O. Box 942896
Sacramento, CA 94296-0001

Dear Mr. Abeyta:

SUBJECT: PIDP/SFOBB - MARINE ARCHEOLOGY: NO PROPERTIES

Enclosed for your review is a copy of the "Phase I Archaeological Survey Report - Maritime Archaeology." This study was prepared for the San Francisco-Oakland Bay Bridge East Span Seismic Safety (SFOBB) Project - Pile Installation Demonstration Project (PIDP). The Pile Installation Demonstration Project is an engineering study that will provide essential information for the design of piles for any of the alternatives for the SFOBB project.

The area of potential effect for the PIDP is a small triangle within the larger SFOBB area of potential effect. This report is part of a "phased identification" study report for marine archeology within the SFOBB project's area of potential effect. As indicated in the Addendum Finding of Adverse Effect sent to you by our letter dated October 20, 1999, we have completed the SFOBB marine archeology studies with negative results. The report documenting our findings for the remainder of the SFOBB marine archeology area of potential effect will be submitted to you within a couple of months.

We have determined that there are no National Register listed or eligible properties located within the PIDP area of potential effect. If we do not receive any comment from you within 30 days of your receipt of our letter, we will presume agreement with our finding and proceed with the PIPD.

If you have any questions, please contact Joan Bollman at 498-5028 or Bill Wong at 498-5042.

CONCUR: [signature]
Daniel Abeyta, Acting
State Historic Preservation Officer

Sincerely,

Robert F Tally Jr.
For
Jeffrey A. Lindley
Division Administrator

Enclosure

DEC 01 1999
TOTAL P.02

APPENDIX B

Potential Shipwrecks in or near the APE

San Carlos

The earliest recorded shipwreck in San Francisco Bay is that of the bark *San Carlos*. Namesake of the vessel piloted by Jose de Canizares who first charted the waters of the Bay, the second *San Carlos* arrived at the San Francisco Presidio in March 1797 with a cargo of supplies and ordnance for the outpost. On March 27, 1797, an unexpected storm struck the vessel and sent her to the bottom (Marshall 1978:66). The suggested location of the sinking is near the intersection of modern-day Broadway and Front Streets, although this appears to be too far east of the likely Presidio anchorage.

Kronprinzeessin von Hanover

The *Alta California* of December 1, 1849 reported that the:

> Hanoverian ship *Crown Princess*, in beating out of the bay on the 20th instant, when abreast of Pt. Diavolo, missed stays and struck. She was got of by the USS *Savannah*'s boat and by assistance from the harbor and was towed by the *Senator* on the flats where she lies full of water. She has been abandoned and will be sold for the benefit of all concerned (*Alta California* for the steamer *Unicorn*, 12/1/1849: pg.2).

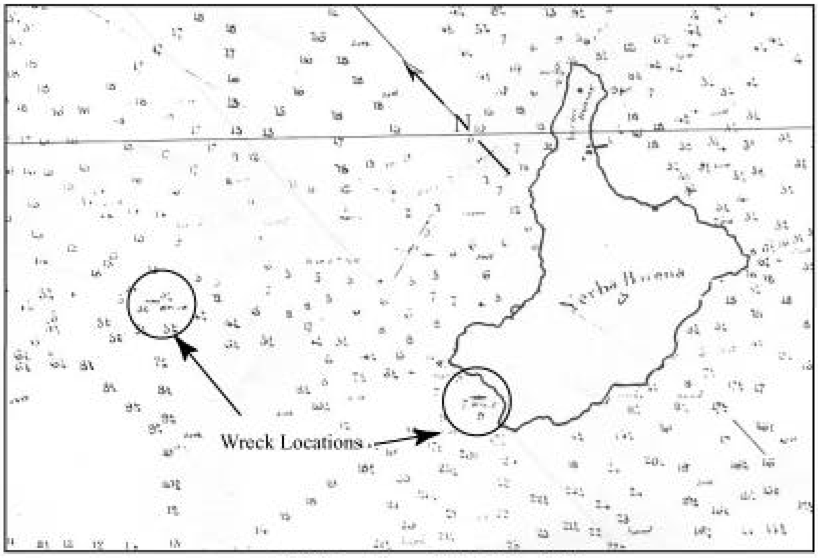
Subsequent news articles identified the vessel as the *Konphreneisson* and later as the *Kronprinzeessin von Hanover*, which apparently struck Blossom Rock while attempting to clear the port.

The foundering ship was towed onto the shallow mud flats of Yerba Buena. Although a "Sale by Auction" announcement was published in the *Alta* regarding the vessel, it is not clear whether she was ever sold. The 1850 U.S. Coast Survey of San Francisco Bay and Yerba Buena Island depicts a wreck on the shoals of the island. It is shown in the same location in subsequent U.S. Coast Survey maps through 1875 (Figure A1). Although it is not identified by name in the maps, the wreck is the only vessel drawn up on the Yerba Buena shoals and, with the exception of the *Utica* discussed below, it is the only vessel described in such a location in the historic literature. Analysis of the charted location of the wreck site indicates it now lies below the eastern edge of Treasure Island, approximately midway along the length of the island (Figure A2).

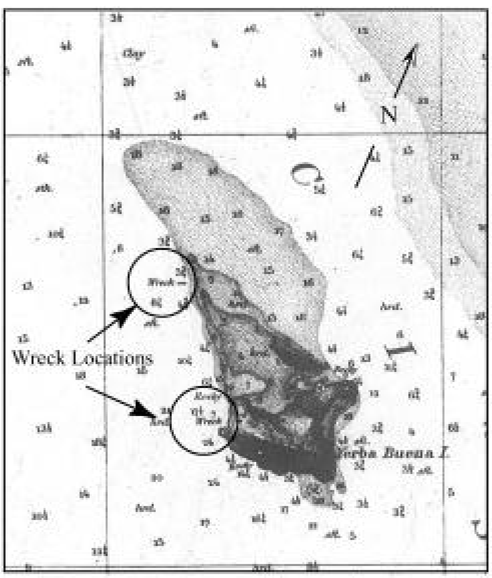
Utica

As early as 1822, American packets[9] were traveling from the east coast to La Havre. The first of these was Francis Depaws' Havre Line. Its success spawned two competitive lines, one started

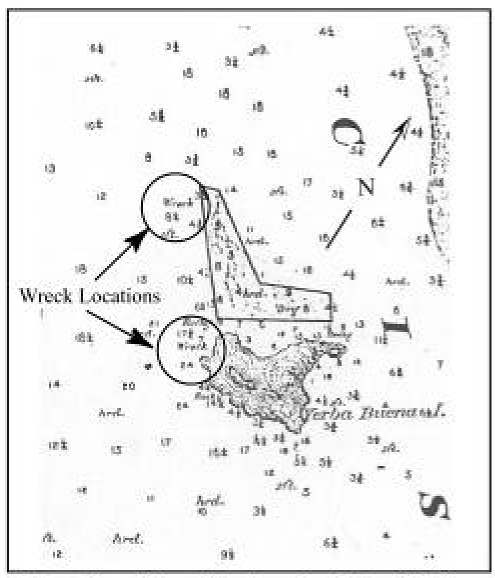
[9] Packets are ships carrying passengers, mail and freight to specific destinations, adhering to regular, published departure schedules.



U.S. Coast Survey1850, 1851, 1853

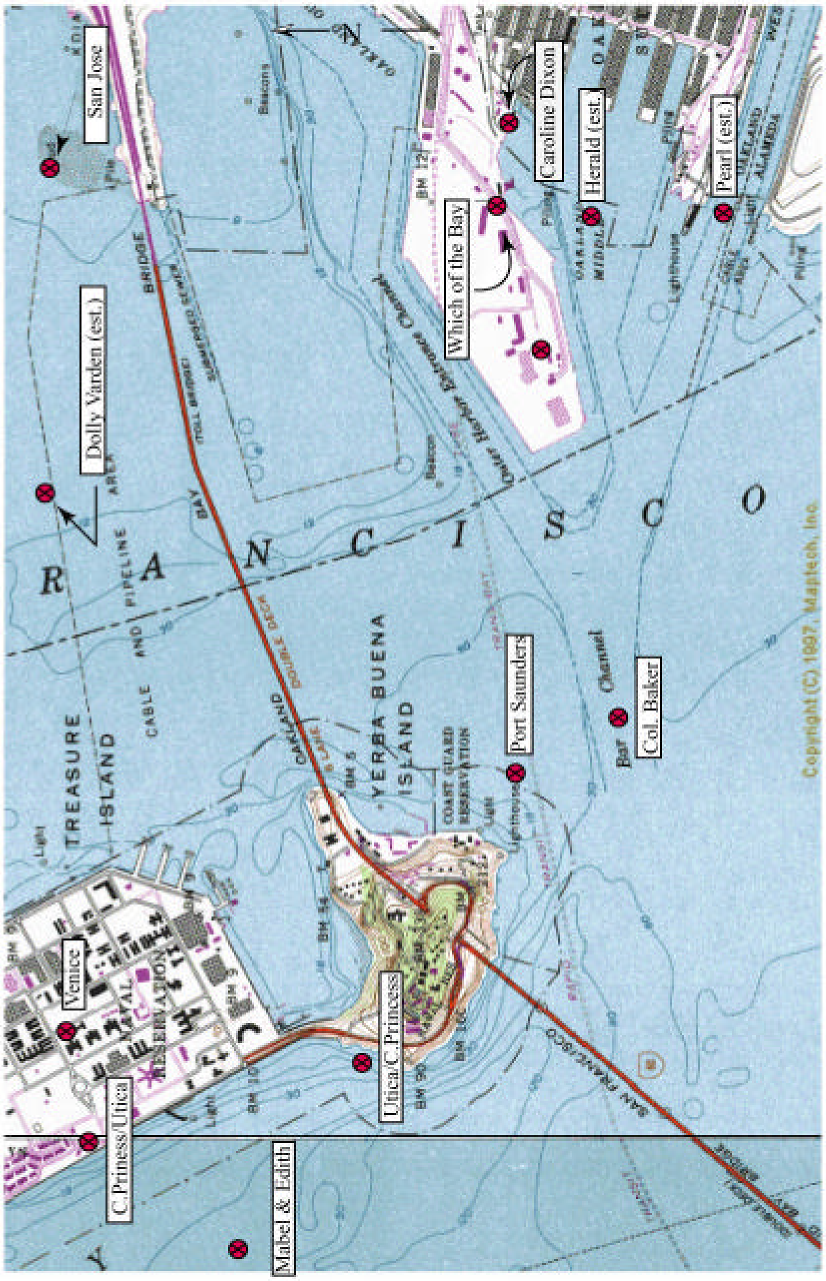


From Map: "Entrance to San Francisco Bay"
1859



From Map: "Bays of San Francisco & San Pablo"
1875

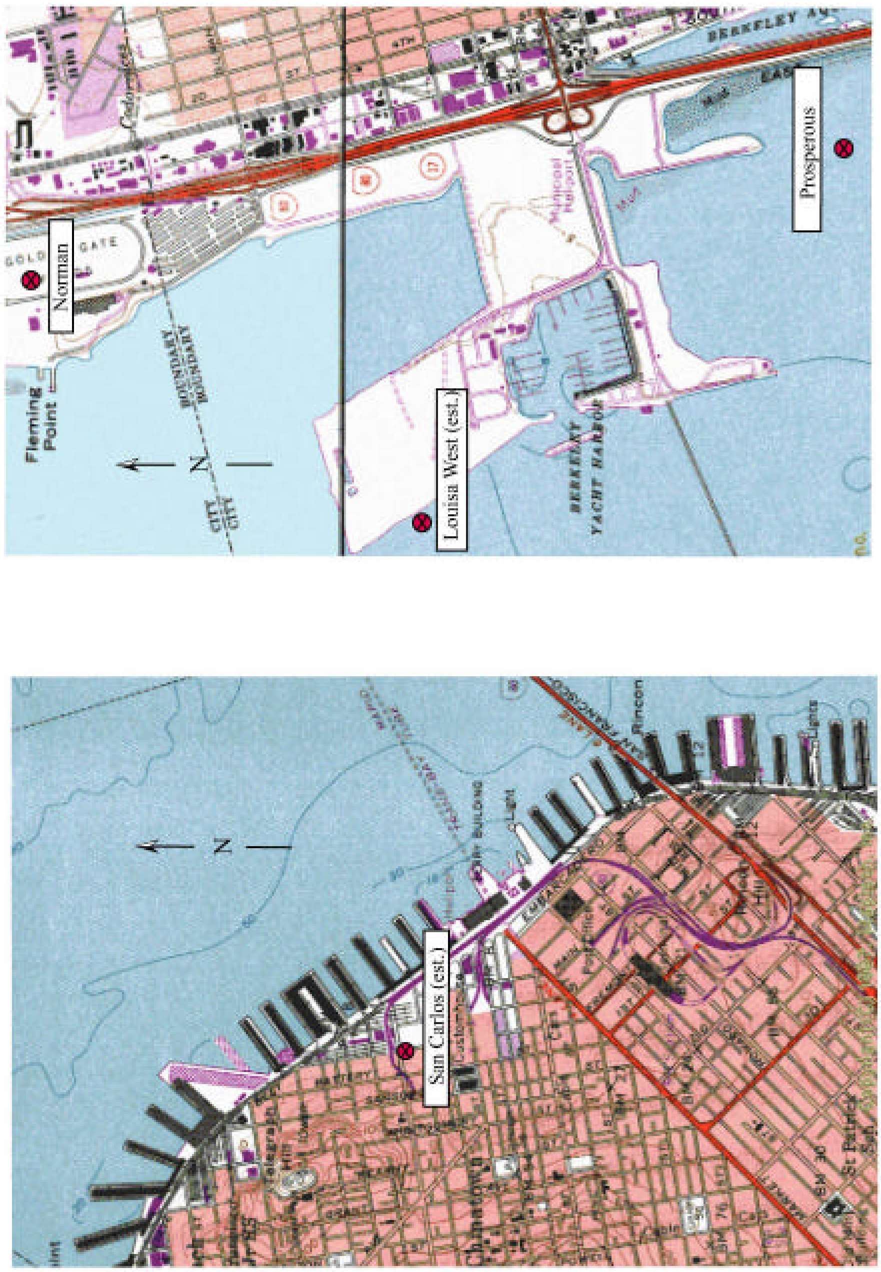
Charted Locations of Two Unidentified Wrecks on the West Side of Yerba Buena Island	Figure A1 SFOBB East Span Seismic Safety Project



Projected and Estimated Locations of Shipwrecks Potentially In or Near the APE

Figure A2

SFOBB East Span Seismic Safety Project



Projected and Estimated Locations of Shipwrecks
Potentially In or Near the APE

Figure A3

SFOBB East Span
Seismic Safety Project

in New York in 1823 by John Boyd and known as the Boyd Line, the other started in New York in 1832 by William Whitlock, Jr. The Boyd Line operated nine vessels, one of which was the 525-ton square-rigger *Utica* (Fairburn 1897:1116; Lubbock 1988:22).

Built in New York in 1833 by C. Bergh and Co., the *Utica* had two decks and was rigged with three masts. The ship was 131-feet, three inches long with a beam of 29-feet, 8 inches and a depth of hold of 14-feet, 10 inches and carried a woman figurehead (Enrollment Register No. 281, 8/31/1833). The *Utica* operated in the Havre packet service for 15 years, averaging crossings of 40 days between 1833 and 1848 (Fairburn 1897:1114). The vessel was last registered in the Port of New York on May 4, 1848 and was removed from the registry on August 6, 1856.[10]

Although the exact date could not be determined, the *Utica* apparently arrived in San Francisco between June 1 and July 13, 1850. The ship is not listed as being in port in the "Vessels in Port" section of the *Alta California* of June 1, 1850, but appears on that list in a special edition of the paper prepared on July 13, 1850 for the steamers *Tennessee* and *Isthmus*.

The *Utica* remained in port through September 1, 1850, as it is listed continuously in steamer editions of the *Alta* through that date, but it is not shown in the "List of Vessels Remaining in Port of San Francisco" prepared by the Harbor Master for the September 15, 1850 *Alta* published for the steamers *Tennessee* and *Ecuador*. No record of the *Utica*'s sailing was found, nor was any mention made of the final disposition of the vessel in the issues of the *Alta* available for study.

In a footnote in his *History of California*, Bancroft lists the *Utica* among nine ships wrecked along the coast (Bancroft 1886:135). The grammatical structure of his footnote suggests that the nine vessels burned in 1850, but among those listed are the *Frolic* and the *Crown Princess* [*Kronprinzeessin von Hanover*], both of which are known not to have burned. A careful reading of the footnote indicates it is only the last vessel in Bancroft's list, the *Brothers*, that actually burned. Whether it burned or not, Marshall (1978:79) suggests the *Utica* was "towed to Goat Island, San Francisco Bay, then sank," although he erroneously indicates this occurred in July, 1850, two months before the ship drops off the "List of Vessels Remaining in Port of San Francisco" prepared by the Harbor Master.

[10] It was the practice of the register of the Department of the Treasury to remove vessels from documentation if nothing had been heard about the vessel after a period of time (JohnVandereedt, National Arhives 1999, pers.comm.)

If this is correct, it is probable that the *Utica* is one of the two wrecks depicted adjacent to the west side of Yerba Buena Island in the chart prepared by the U.S. Coast Survey in 1851, and shown continuously there through 1875 (refer to Figure A1). Since the *Kronprinzeessin von Hanover* is known to have been abandoned on the flats of the island, the *Utica* is probably the southernmost of the two charted wrecks, and today would lie just west of the original landform of Yerba Buena Island (refer to Figure A2).

Dolly Varden

While sailing from San Francisco to Oakland, the wood scow schooner *Dolly Varden* sprung a leak and sunk on Monday, June 1, 1874. The 9-ton vessel, built the year before in 1873, was carrying a 16 ton cargo of sand, which "dampened with water and sunk her." No information on the incident could be found in contemporary news accounts, and the wreck report filed on May 7th 1877, four years after the sinking, indicated only that the sinking occurred in the "Bay of San Francisco" (wreck reports, vol. 1875-76-77, p.132). The location depicted in Figure A1 is an estimation based on a hypothetical sailing course.

Pearl

The steam schooner *Pearl* caught fire and was scuttled in "East Oakland, San Francisco Bay" on Tuesday, February 6, 1877. The 48-ton wood vessel, built in 1874, was loaded with a cargo of refuse jute and apparently tied up at Larue's Wharf in East Oakland when a spark from the smoke stack set her on fire at approximately 6:00 p.m. The Oakland Fire Department responded to the fire and at some point during the effort to extinguish the blaze, the vessel was "scuttled and sunk to save her." The ultimate disposition of the vessel was not determined (*Alta California*, Feb. 7, 1877; wreck reports, vol. 1875-76-77, p.110.) The location depicted in Figure A1 is conjectural.

Col. Baker

While attempting to cross the bar of the Oakland Channel, the 76-ton wood scow schooner *Col. Baker* sprung a heavy leak, foundered, capsized and sank at approximately 1:00 a.m. on Thursday, September 20, 1877. The vessel, built in 1864, was carrying a cargo of stone and a crew of five. All hands escaped safely but the cargo was a total loss. Damage to the vessel was listed as $350, suggesting that it was recoverable. No other information about the incident could be found and the schooner's final disposition is not known (wreck reports, vol. 1877-78, p.29).

Mabel and Edith

The 48-ton wood scow schooner sprung a leak at approximately 5:00 p.m. on Thursday October 18, 1877 while sailing from San Francisco to Oakland. Three-quarters of a mile northwest of Goat Island the 10-year old vessel foundered and sank, carrying her load of gas pipes with her to the bottom. The Wreck Report of the incident lists damage to the vessel, which was valued at $2500, at $1900. The cargo was valued at $5000 but the loss was listed at $2500. Together, these figures suggest the vessel and part of her cargo may have been salvaged during the intervening 30 days, although final disposition of the schooner could not be determined (wreck reports, vol. 1877-78, p.55).

Norman

The wood scow sloop *Norman* dragged her anchors during a sudden, unexpected gale at approximately 10:00 a.m. on Monday, October 6, 1879. The 19-ton sloop had been riding at anchor near Berkeley "intending to haul in to Judson's Wharf to finish loading. A SE gale suddenly sprung up" and the vessel dragged her anchors. Sails were raised quickly with the intention of beaching the vessel to save her. The sails were carried away by the storm and the vessel was left helpless. "She drifted on the rocks and in 5 minutes went to pieces." The crew got ashore using the main boom. The vessel, built in San Francisco in 1853, was valued at $400 and was loaded with a cargo of hay, valued at $250. Both the vessel and cargo were total losses. Owned by William Nichols of San Francisco, the vessel and the owner were both misidentified as *C. Nichols* in newspaper accounts of the incident. The *Oakland Weekly Times* reported the schooner "was driven ashore on Berkeley Beach, at Fleming's Point, almost abreast of the chemical works" (wreck reports, vol. 1879-80, p.16; Oakland Weekly Tribune, 10/18/1879; Oakland Weekly Times, 10/17/1879). Fleming's Point is the location of modern-day's Golden Gate Fields (Figure A3).

Which [sic] *of the Bay*

A severe winter storm drove the wood scow schooner *Which of the Bay* onto the rocks at the mouth of the Oakland mole on Sunday, December 7, 1884. The storm carried away the 21-ton vessel's sails and anchor and drove it onto the north side of the mole. Built in 1870, the schooner was valued at $1000 and was carrying a deckload of coal. The cargo was considered a total loss. On December 14, 1884, when the incident was officially reported, the vessel - still on the rocks with "part of her bottom. . . stove in" - had been sold for $2000. Final disposition of the vessel could not be determined (*Alta California,* Dec. 8, 1884; wreck reports, vol. 1883-84-85, p.62).

Louisa/West

Loaded with 21,000 board feet of lumber, the 17-ton wood scow schooner *Louisa/West* foundered in a storm at 10:00 a.m. on Tuesday, February 28, 1892. Bound for Sausalito from West Berkeley, the vessel met its end "two miles of [sic] West Berkeley." The schooner had been built in 1861 and was valued at $800; the cargo was valued at $400. Both were a total loss. The crew of two escaped safely (wreck reports, vol.1892, p.101).

Caroline Dixon

An unusually intense storm, lasting for the five days November 26-November 30, 1892 damaged numerous vessels around the bay. Among these was the *Caroline Dixon*, a 45-ton wood schooner loaded with a cargo of railroad iron. The schooner, which was moored at the Oakland mole, dragged her anchors at approximately 4:00 a.m. in the 75-mile per hour gale and was tossed onto the rocks of the mole's embankment. Built in 1878, the vessel was valued at $2000 and sustained approximately $1500 in damages. The cargo of railroad iron was valued at $980, $500 of which was lost in the incident. Final disposition of the vessel could not be determined (*S.F. Chronicle*, Dec. 1. 1892; wreck reports, vol. 1892, p.14).

Prosperous

At approximately 2:30 p.m. on Sunday, August 2, 1903, the 32-ton wood schooner *Prosperous* sprung a leak and foundered near the mudflats of Berkeley. The wood schooner, built in 1867 and valued at $1000 at the time of loss, was bound for Redwood City with a cargo of crushed rock. Both the master and crewman escaped, but the vessel and her cargo were declared a complete loss. The vessel's final disposition could not be determined (wreck reports, vol. 1901-02-03, p.169.)

Herald

A spark ignited fuel oil left in the ash pan of the steamer *Herald*, setting the wood stern-wheeler on fire at approximately 2:00 a.m. on Monday Nov. 4, 1912. The 293-ton vessel, built in 1878, was tied up at the Oakland Pier and under the charge of a fireman of the Central Pacific R.R. Co. In getting up steam, the fireman failed to notice the fuel oil and was unable to control the fire once it started. The firetug *Ajax* and the fire brigade of the Oakland Pier responded to the alarm but failed to get the fire under control. The *Ajax* towed the burning vessel away from the wharf and sunk her "to save [the] hull, at a point between Oakland Pier and shipyard." The vessel, valued at $6650 before the fire, sustained $6000 in damages. Final disposition of the hull could not be determined (wreck reports, vol. XI, 1911-12, p. 170).

San Jose

On Sunday, March 23, 1919, the U.S. ferry steamer *San Jose* caught fire while moored at the Key System pier. The fire apparently started at approximately 3:00 p.m. when a spark from the firebox ignited oil drippings in the engine room of the wood vessel. The U.S. Navy tug *Vigilant* pulled the ferry away from the pier and towed it to the adjacent mud flats, where fire tugs pumped water on her until 6:00 a.m. March 24, 1919, when all the fire was out. The 1115 gross ton vessel had been built in 1903 and was valued at $172,935.31. Subsequent to the fire, it was declared a total loss (*Oakland Tribune* March 24, 1919; wreck reports, vol. XVII, 1916-1919, p.120).

Venice

On the foggy evening of December 22, 1919, the 8-ton wood steamer *Venice* ran aground on "Goat Island Shoal," was struck by a towing barge, and sunk. The vessel, valued at $2500, had been built in 1909. It is not clear in the report filed on this incident whether the *Venice* was towing the barge, but it appears likely that it was. Final disposition of the vessel could not be determined (wreck reports vol. XVII, 1919-20, p. 139.)

Port Saunders

The U.S. Lighthouse Service tender *S.S. Madrona* struck the steam whaler *Port Saunders* at approximately 2:00 p.m. on Friday, May 6, 1927. The accident occurred approximately 1000 yards southeast of the "Goat Island light." While steaming for the lighthouse base on Goat Island from San Francisco's Pier 15 the *Madrona* plowed into the port side of the *Port Saunders,* just aft of her midship. The *Port Saunders* had been steaming across the bay from the Oakland Estuary, in formation with the rest of the California Sea Products Co.'s whaling fleet, which was heading for Pier 43 to take on fuel. The steel 12-ton *Port Saunders* was built in 1904 and was the pride of the fleet. The captain and crew of the vessel were rescued in a lifeboat after efforts to get lines on the rapidly sinking vessel were abandoned. Seven minutes after the last man had left her, the *Port Saunders* went down stern-first in six fathoms of water "approximately 1200 feet off the point of Goat Island . . . but it's possible she may have drifted after she sank" (*S.F. Chronicle,* May 7, 1927; wreck reports, vol. XXII, 1926-1927, p.80).

Peralta

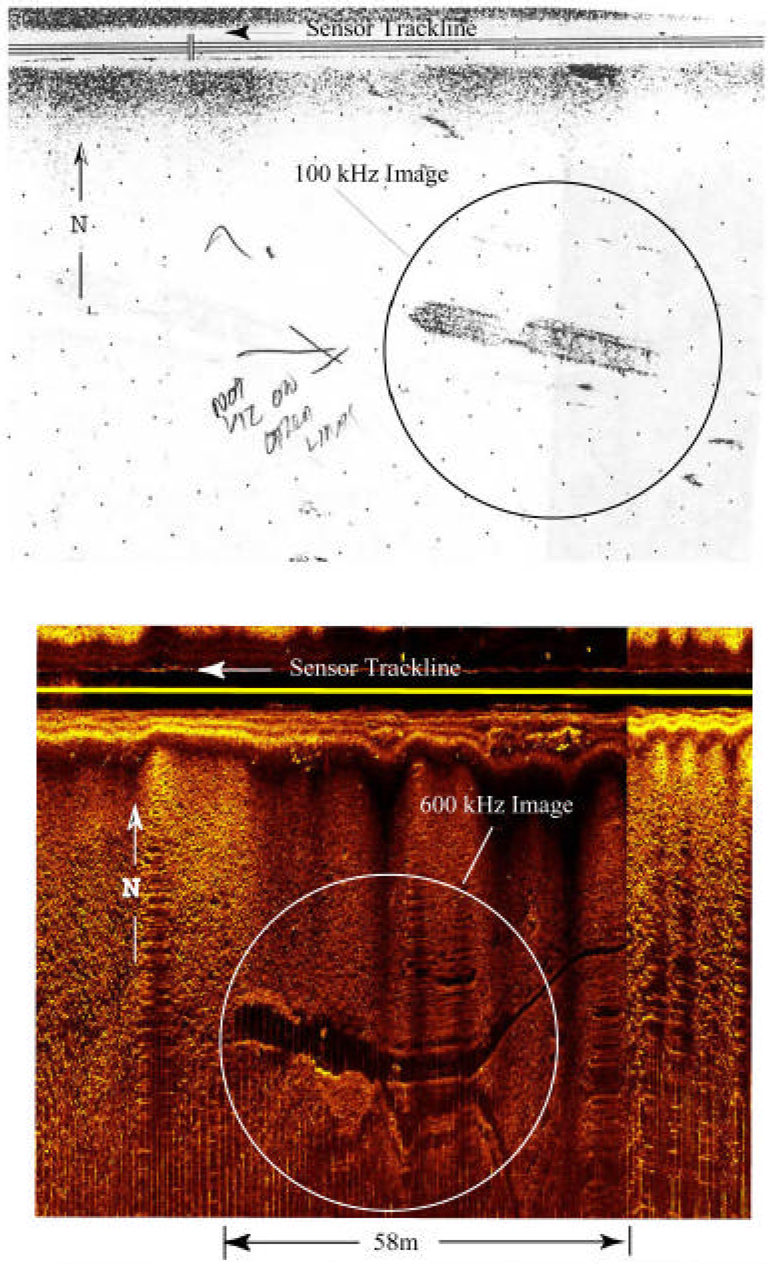
The catastrophic fire that engulfed the end of the Key System pier and terminal building on May 6, 1933 also destroyed the 2,075 –ton iron ferry *Peralta.* The six year-old ferry was out of service at the time of the fire and tied up in slip # 1 at the head of the pier. At approximately 10:00 p.m., fire broke out on the pier and swept onto the vessel. It quickly spread throughout the vessel, which was eventually pulled away from the pier and towed to Alameda Beach. When the fire was extinguished, the remains of the vessel were towed to the Moore Drydock Co. in Oakland (*S.F. Chronicle,* May 7-10, 1933; wreck reports, vol. XXVII, 1932-34, P. 48.)

Valiant

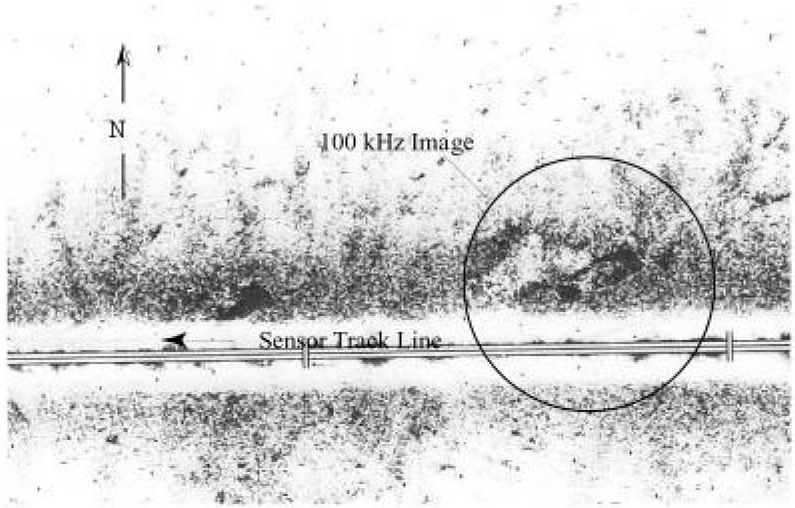
At 3:30 a.m. on Wednesday, October 10, 1934, the 30-ton wood tug *Valiant* was run down and cut in half by the schooner *Lumberman.* Two passengers of the *Valiant* were drowned in the incident, which occurred near the mouth of the Oakland Estuary. The *Valiant*, built in 1906, was valued at $10,000 and was a total loss. The tug was on a "joyride" when the collision occurred. Robert Litton, skipper of the *Valiant,* met one of the victims in a cigar store around midnight on October 9th. He agreed to take a party of nine people for a ride around Yerba Buena Island and had completed one trip. While beginning a second trip around the island, the tug crossed directly in the path of the unseen, on-coming *Lumberman*, which struck the tug near the stern and cut it in half, causing "almost instantaneous sinking" of the vessel (*S.F. Chronicle*, Oct. 11, 1934; *Casualty Reports 1934*, Book XXVIX. May 18, 1934-December 31, 1934).

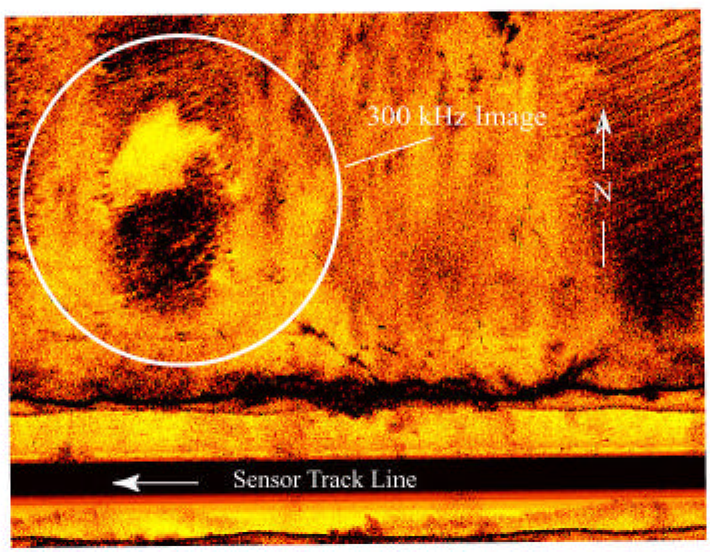
APPENDIX C

Acoustic Images of Targets Identified in Remote Sensing Surveys (Figures 7-47)



Side Scan Sonar Target 1 (View from Port Channel)	Figure 7 SFOBB East Span Seismic Safety Project

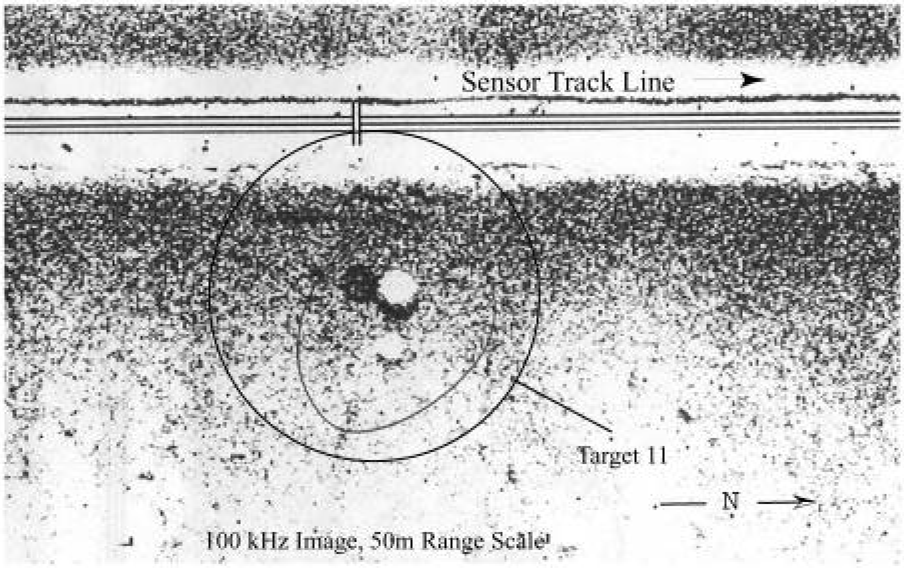


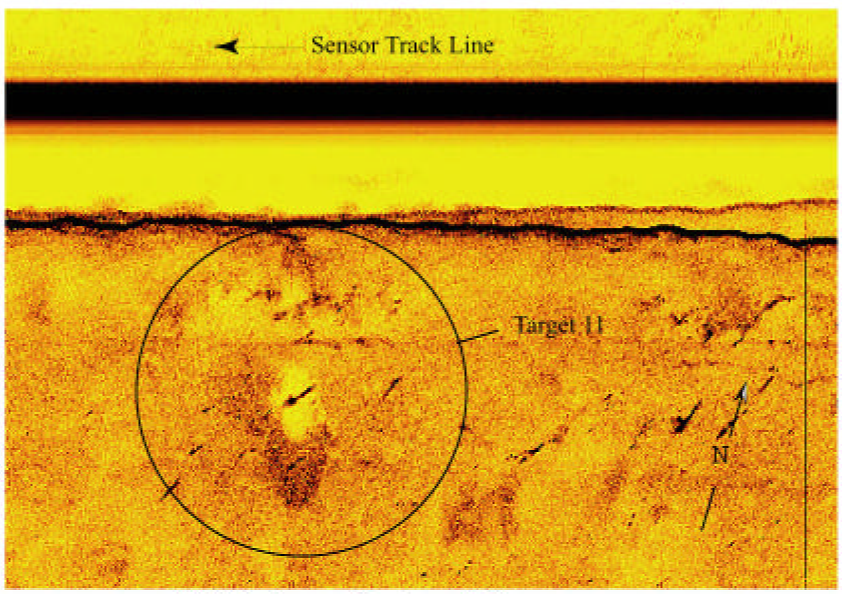


Side Scan Sonar Target 3
(View from Starboard Channel)

Figure 8

SFOBB East Span
Seismic Safety Project





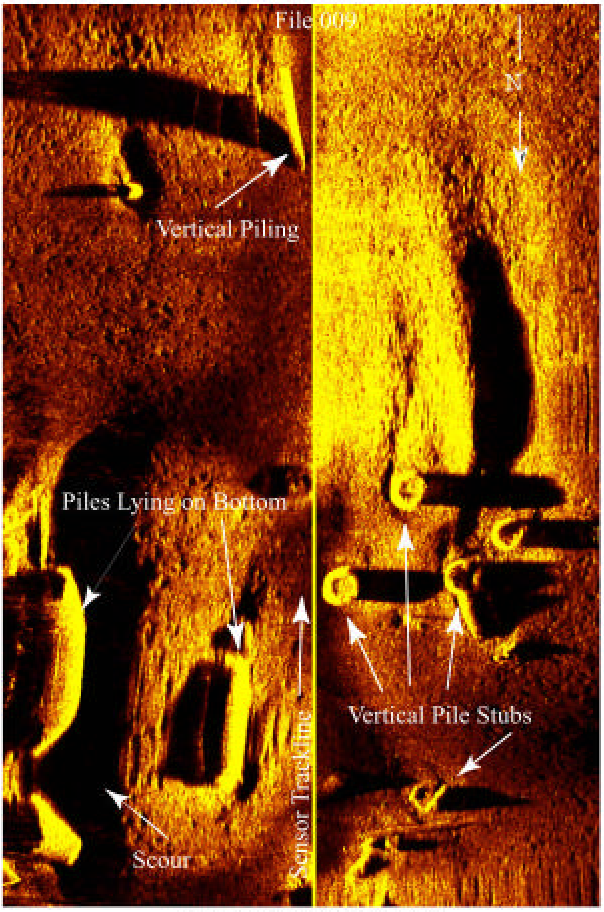
300 kHz Image, 50m Range Scale

Side Scan Sonar Target 11

(100 kHz View from Starboard Channel;
300 kHz View from Port Channel)

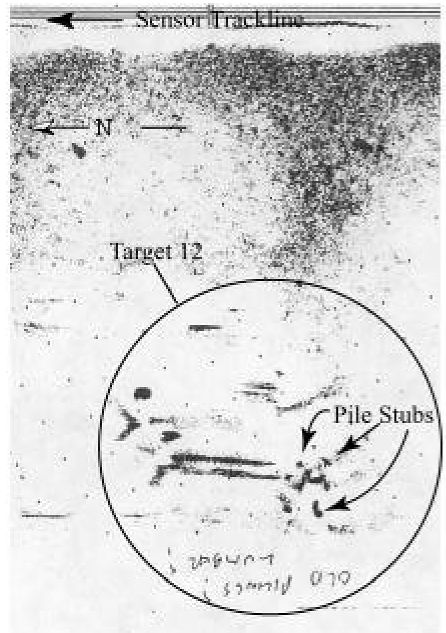
Figure 9

SFOBB East Span
Seismic Safety Project

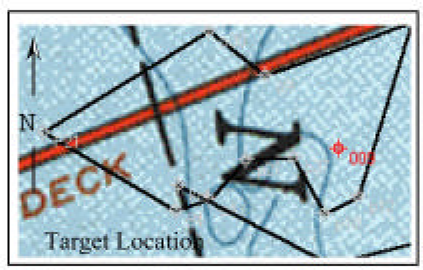


Target 12- Dual Channel

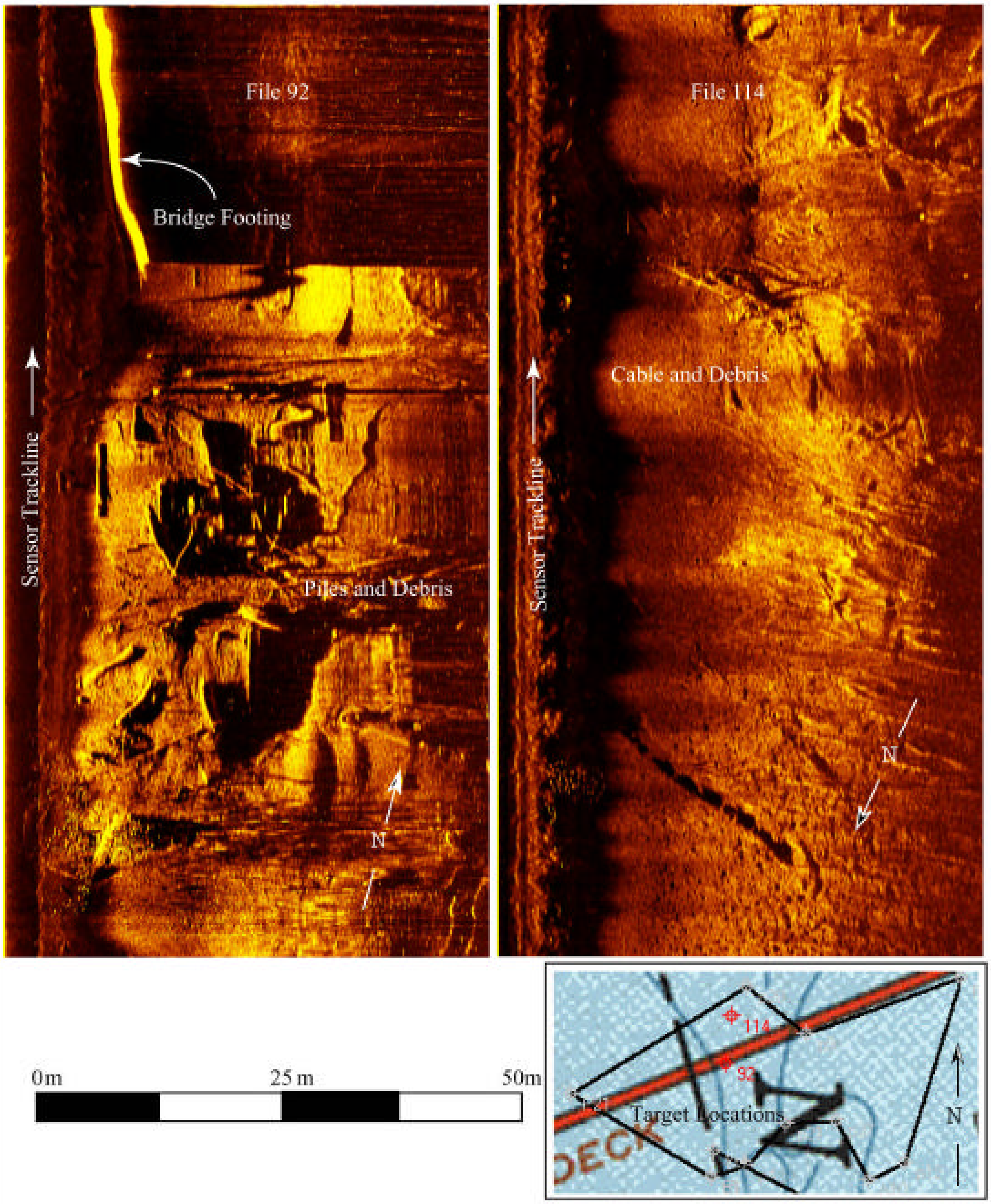
0m 10m 20m



Port Channel View

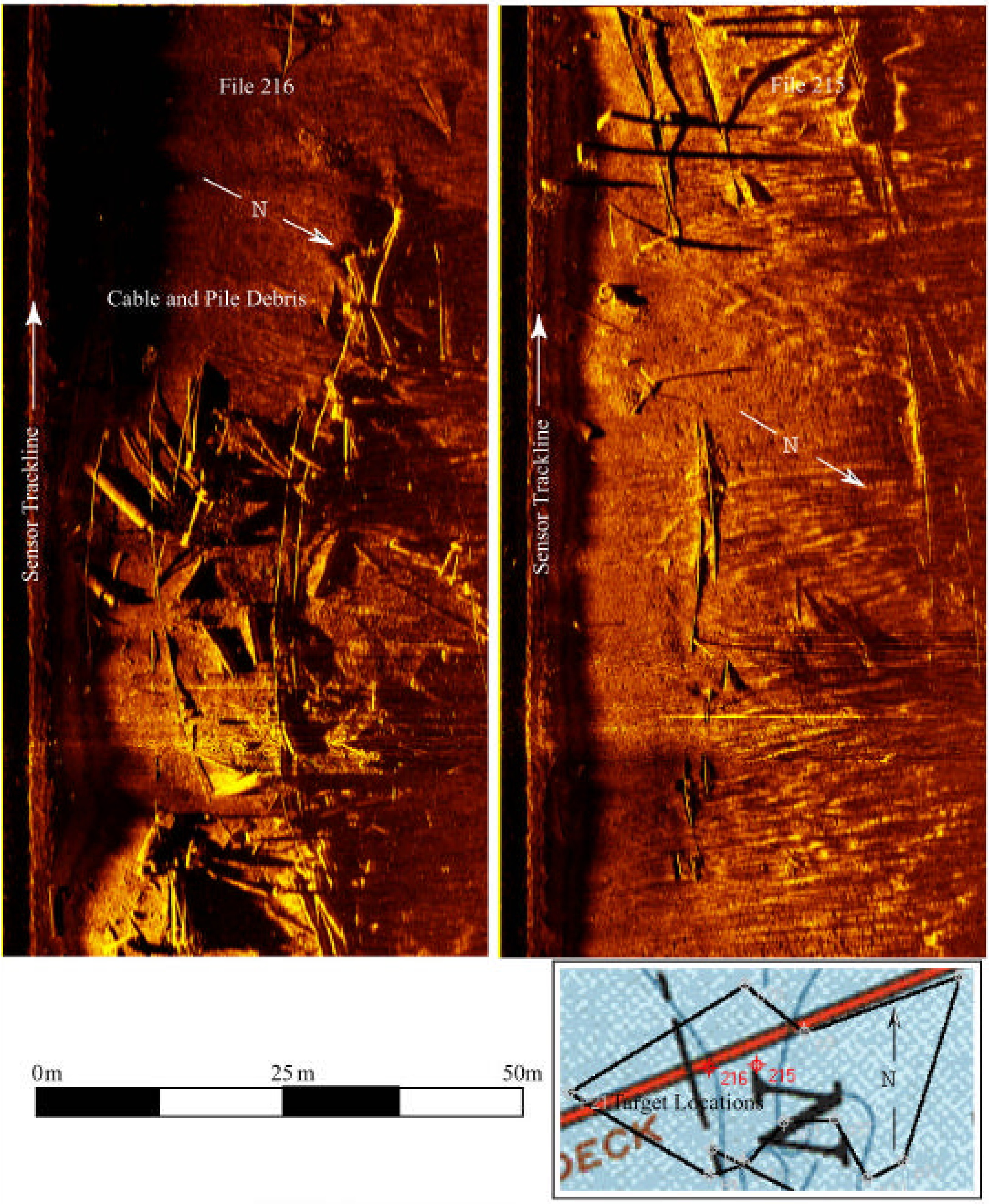


Side Scan Sonar Target 12 (100 kHz View from Port Channel; 600 kHz View: Dual Channel)	Figure 10 SFOBB East Span Seismic Safety Project



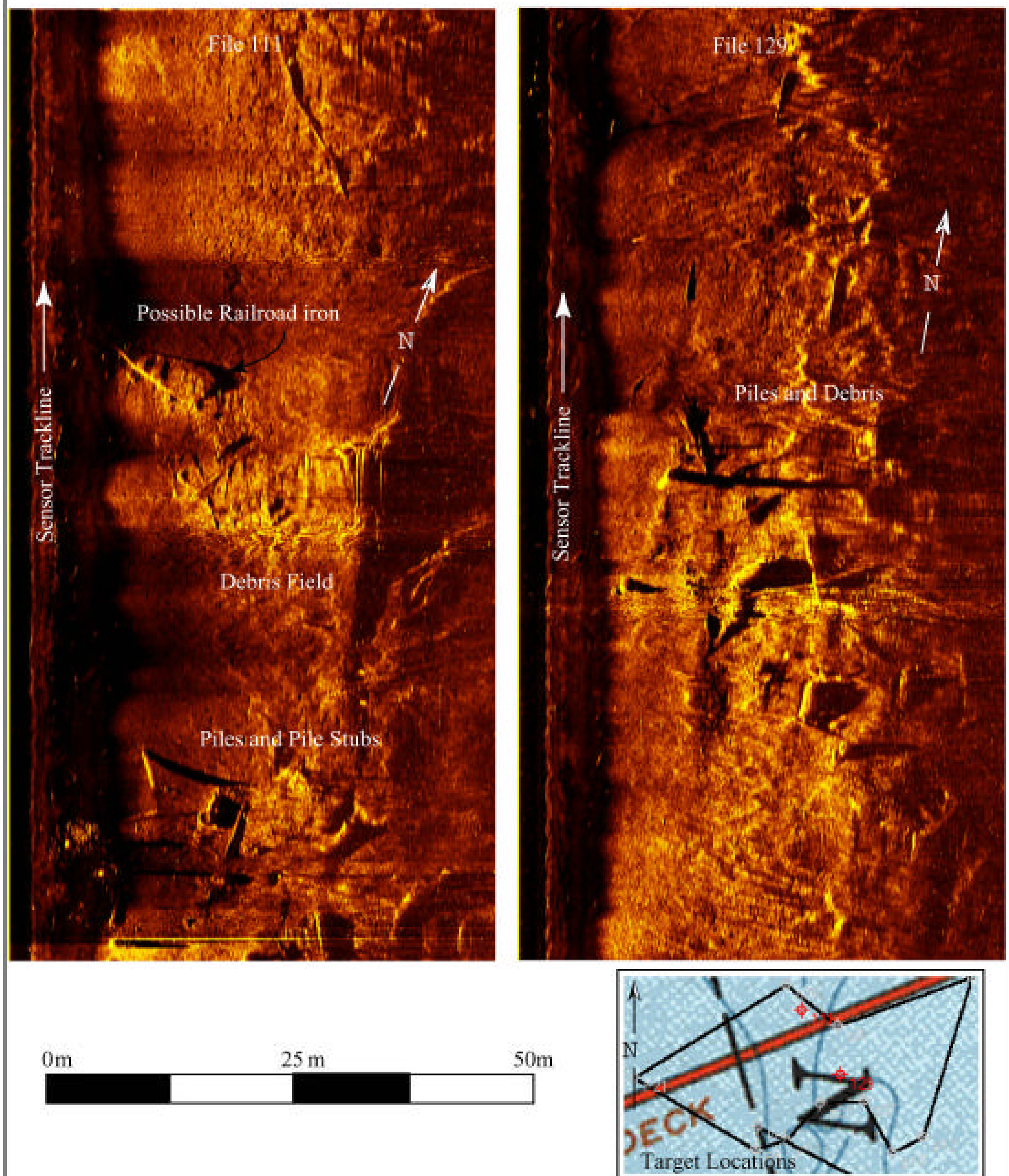
Side Scan Sonar Target 13
(600 kHz View from Starboard Channel)

Figure 11
SFOBB East Span
Seismic Safety Project

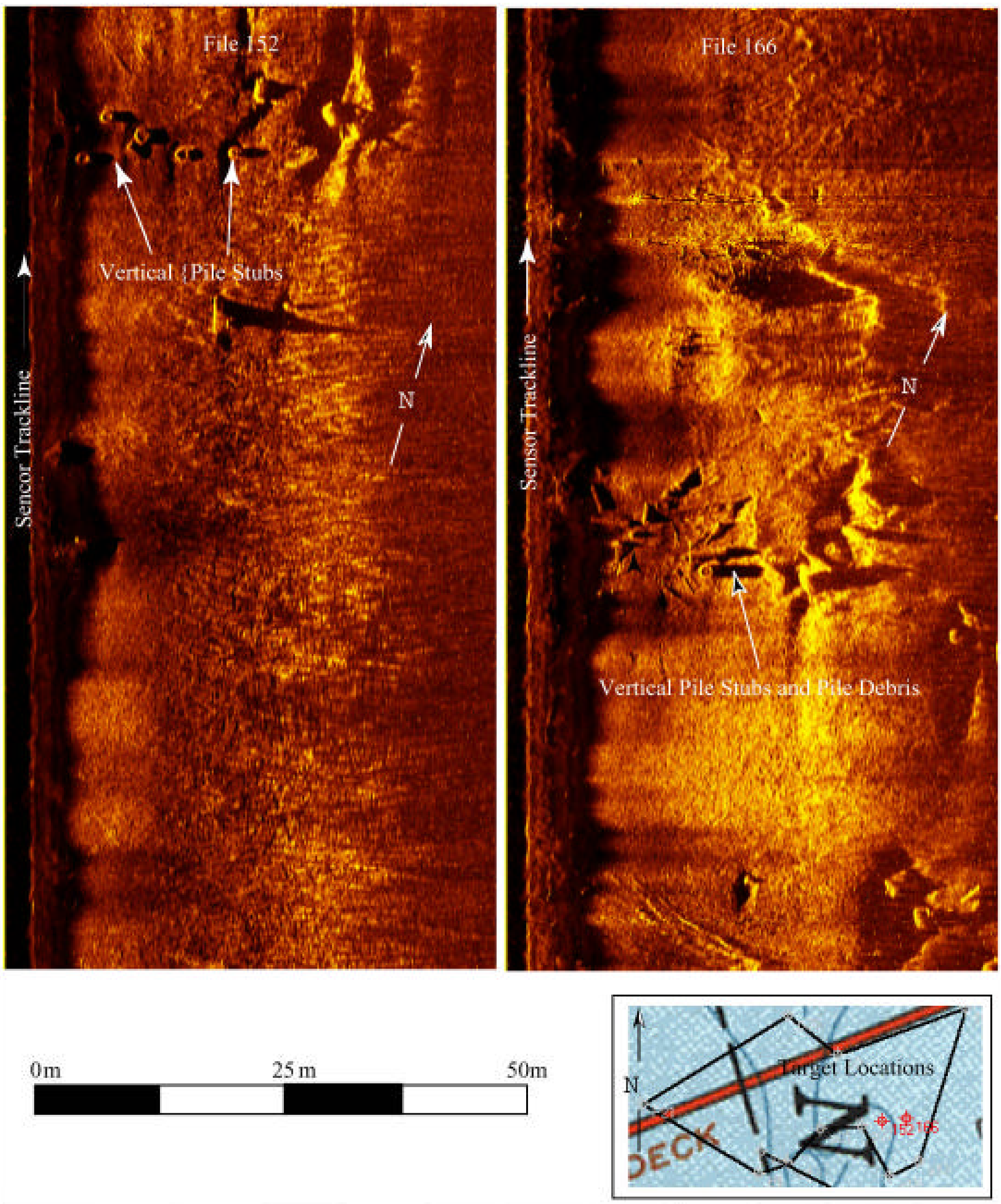


Side Scan Sonar Target 13
(600 kHz View from Starboard Channel)

Figure 12
SFOBB East Span
Seismic Safety Project

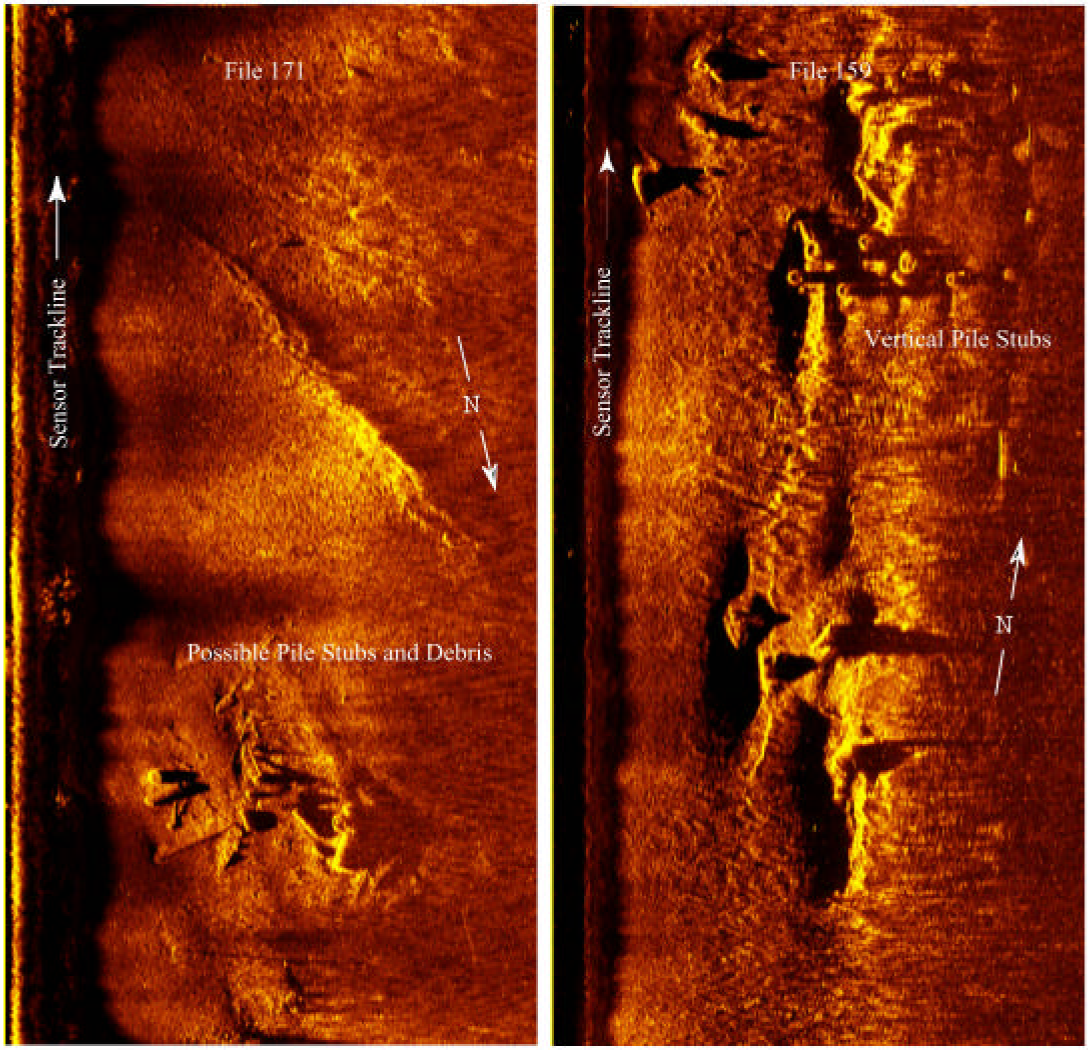


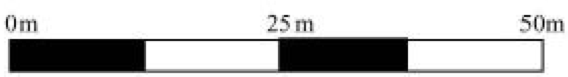
Side Scan Sonar Target 13 (600 kHz View from Starboard Channel)	Figure 13 SFOBB East Span Seismic Safety Project

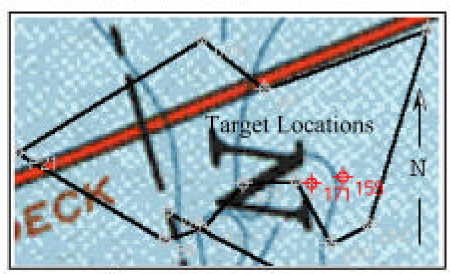


Side Scan Sonar Target 13
(600 kHz View from Starboard Channel)

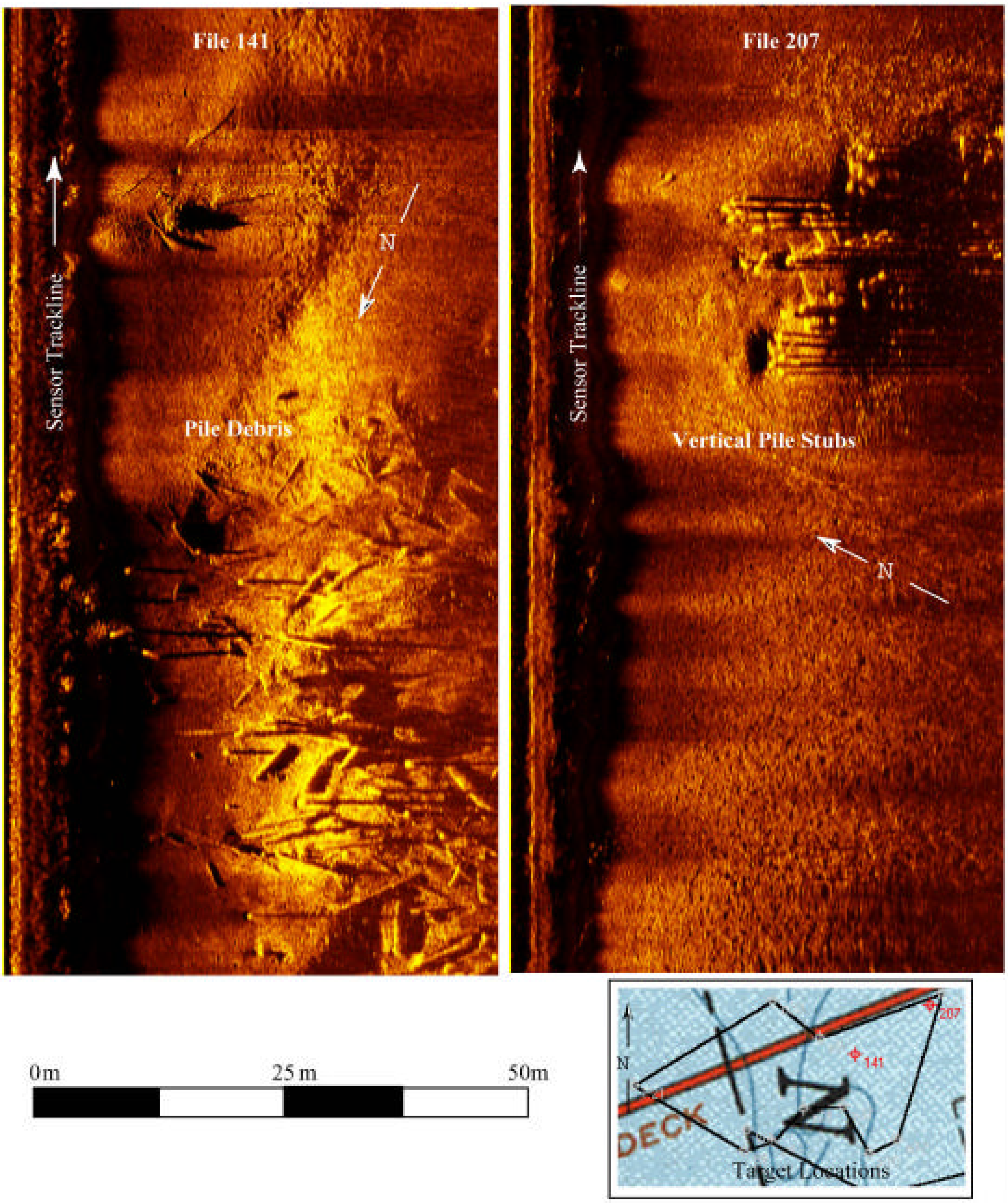
Figure 14
SFOBB East Span
Seismic Safety Project



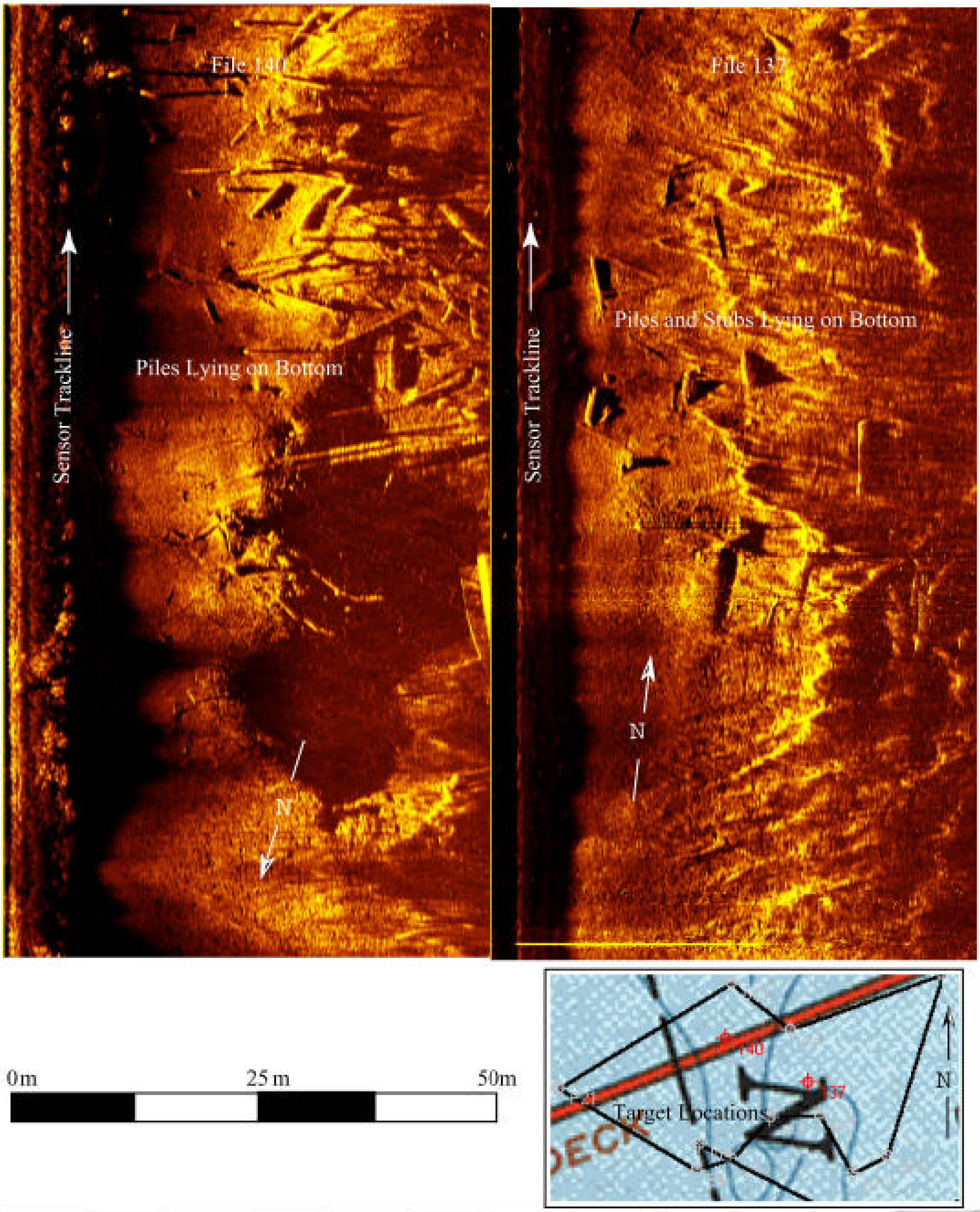




Side Scan Sonar Target 13 (600 kHz View from Starboard Channel)	Figure 15 SFOBB East Span Seismic Safety Project

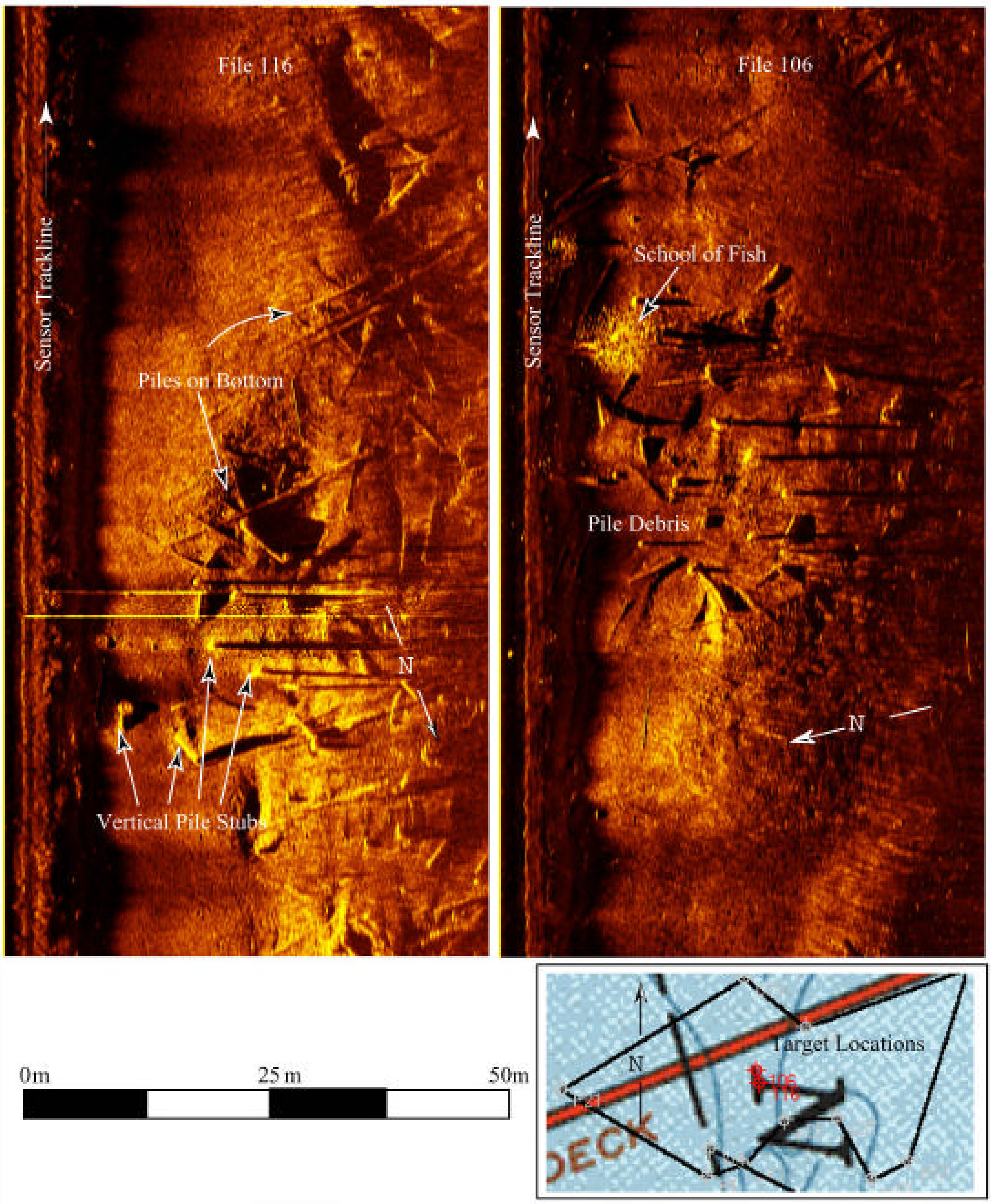


Side Scan Sonar Target 13 (600 kHz View from Starboard Channel)	Figure 16 SFOBB East Span Seismic Safety Project



Side Scan Sonar Target 13
(600 kHz View from Starboard Channel)

Figure 17
SFOBB East Span
Seismic Safety Project

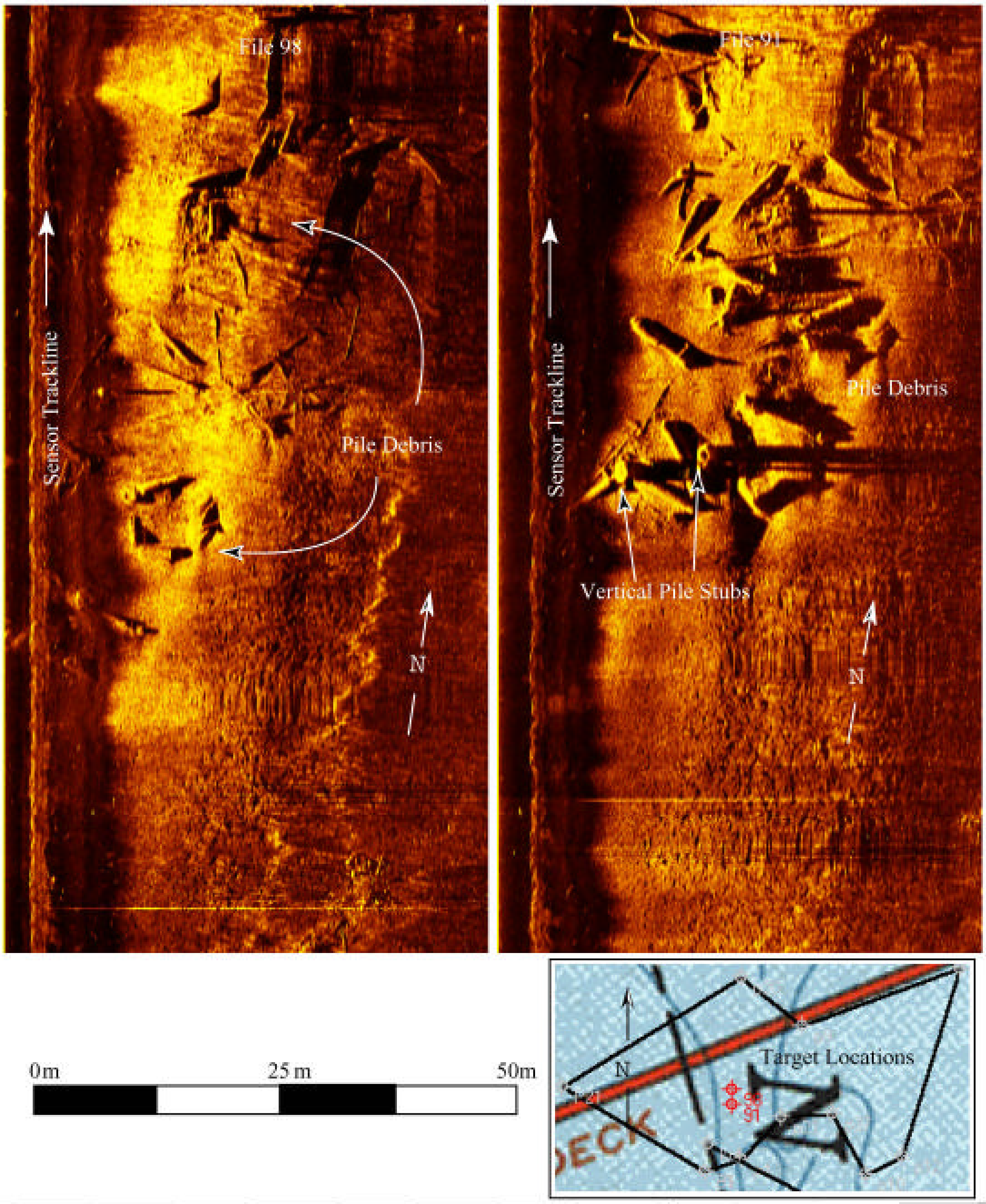


Side Scan Sonar Target 13

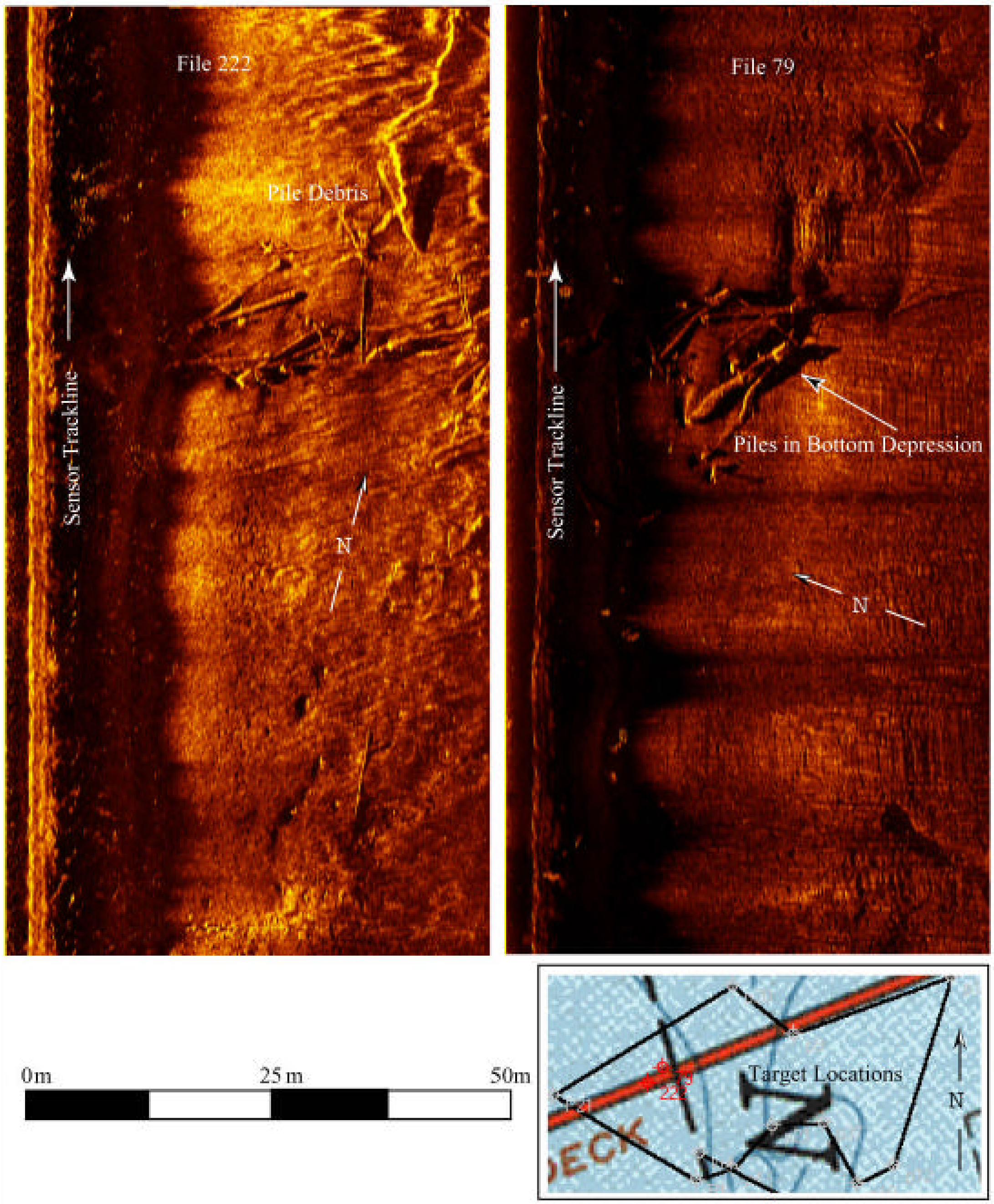
(600 kHz View from Starboard Channel)

Figure 18

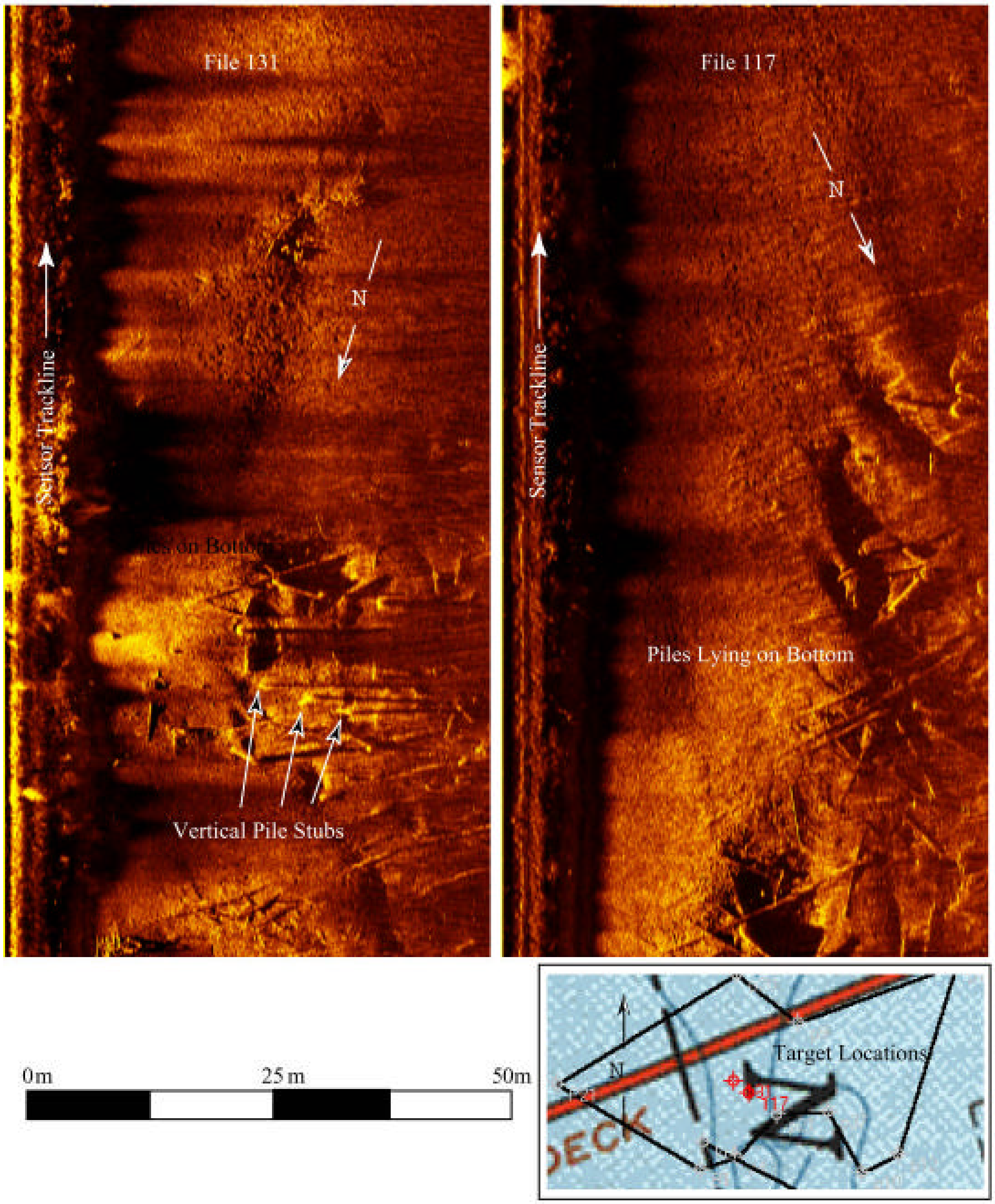
SFOBB East Span Seismic Safety Project



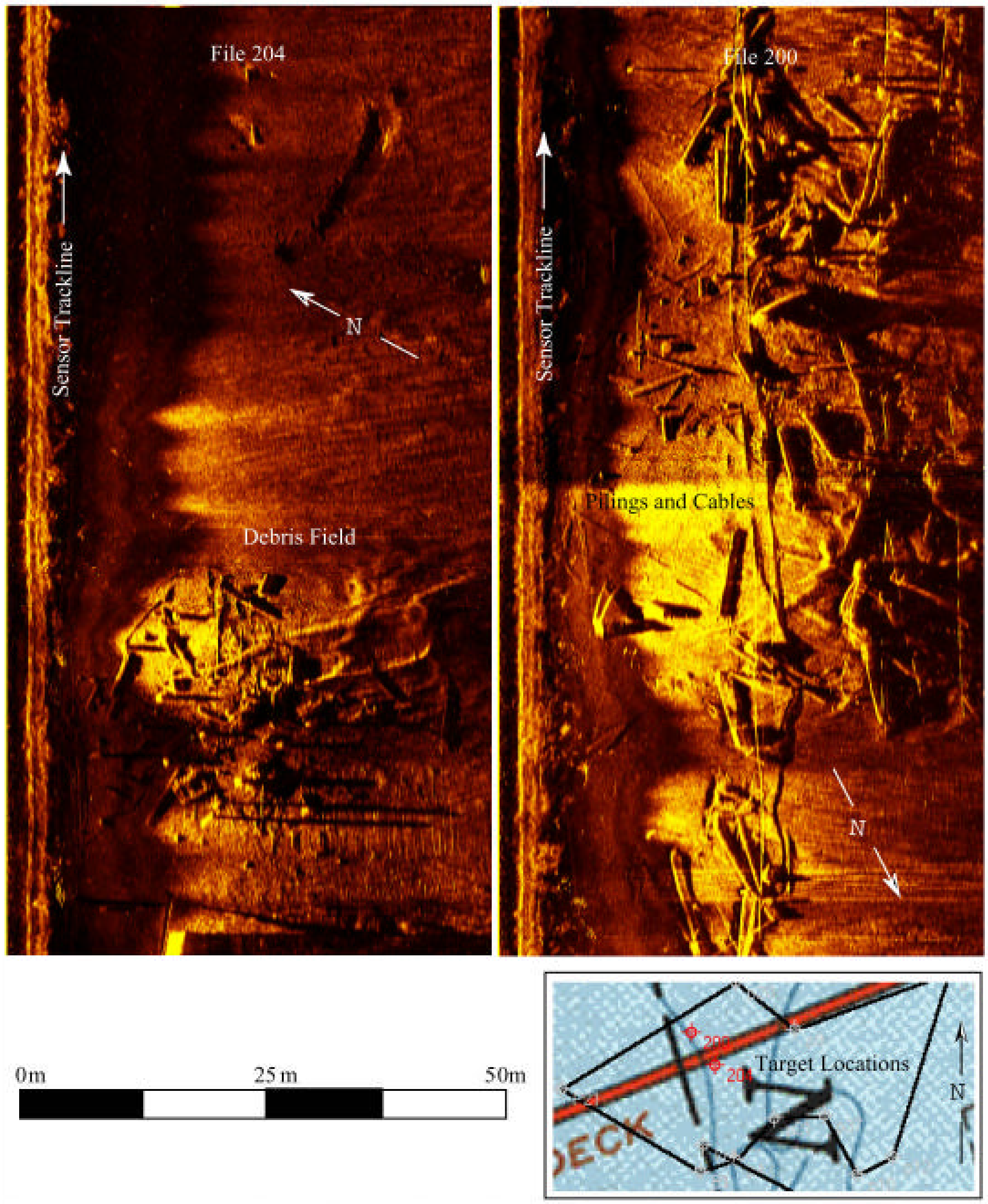
Side Scan Sonar Target 13 (600 kHz View from Starboard Channel)	Figure 19 SFOBB East Span Seismic Safety Project



Side Scan Sonar Target 13 (600 kHz View from Starboard Channel)	Figure 20 SFOBB East Span Seismic Safety Project

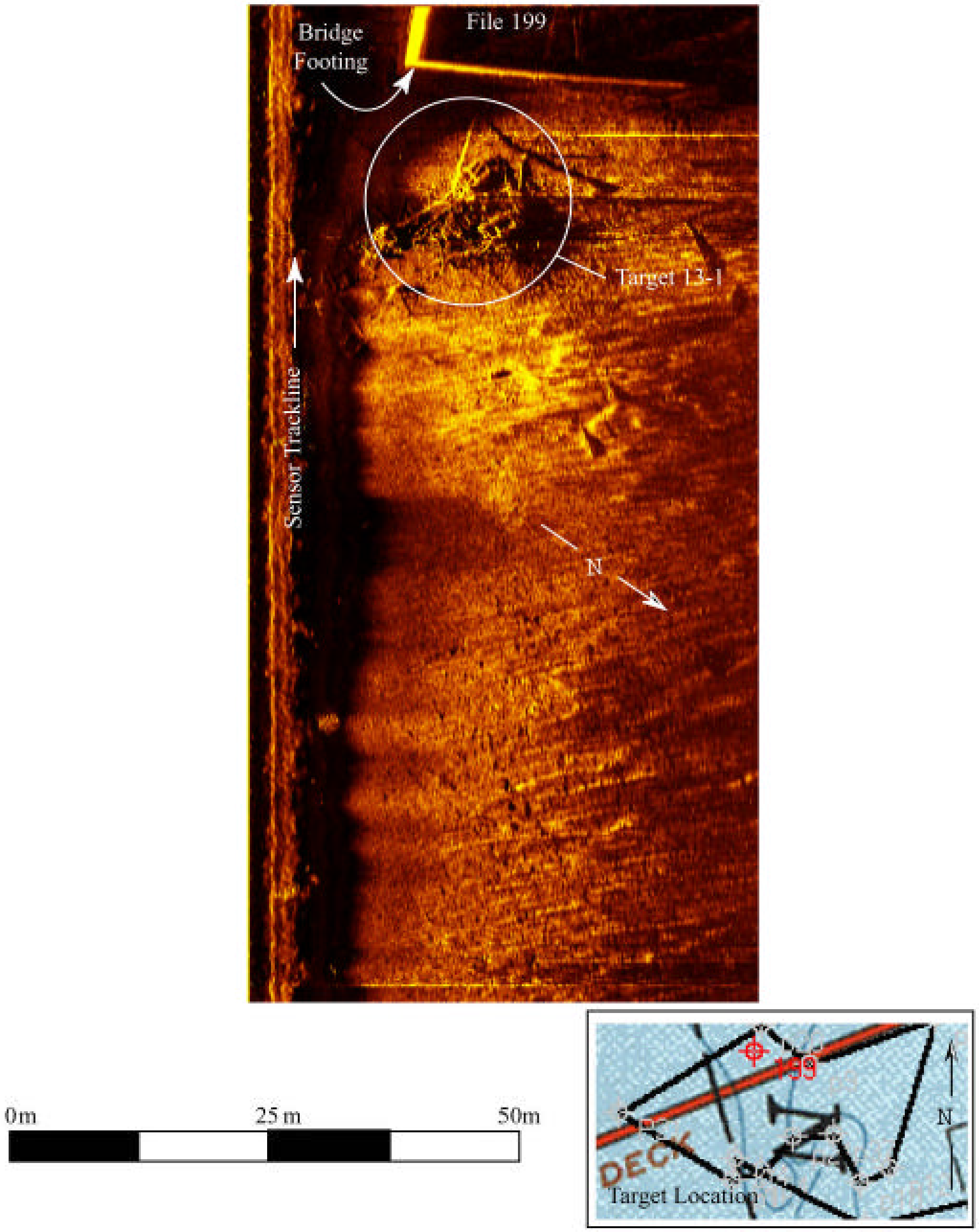


Side Scan Sonar Target 13 (600 kHz View from Starboard Channel)	Figure 21 SFOBB East Span Seismic Safety Project



Side Scan Sonar Target 13
(600 kHz View from Starboard Channel)

Figure 22
SFOBB East Span
Seismic Safety Project

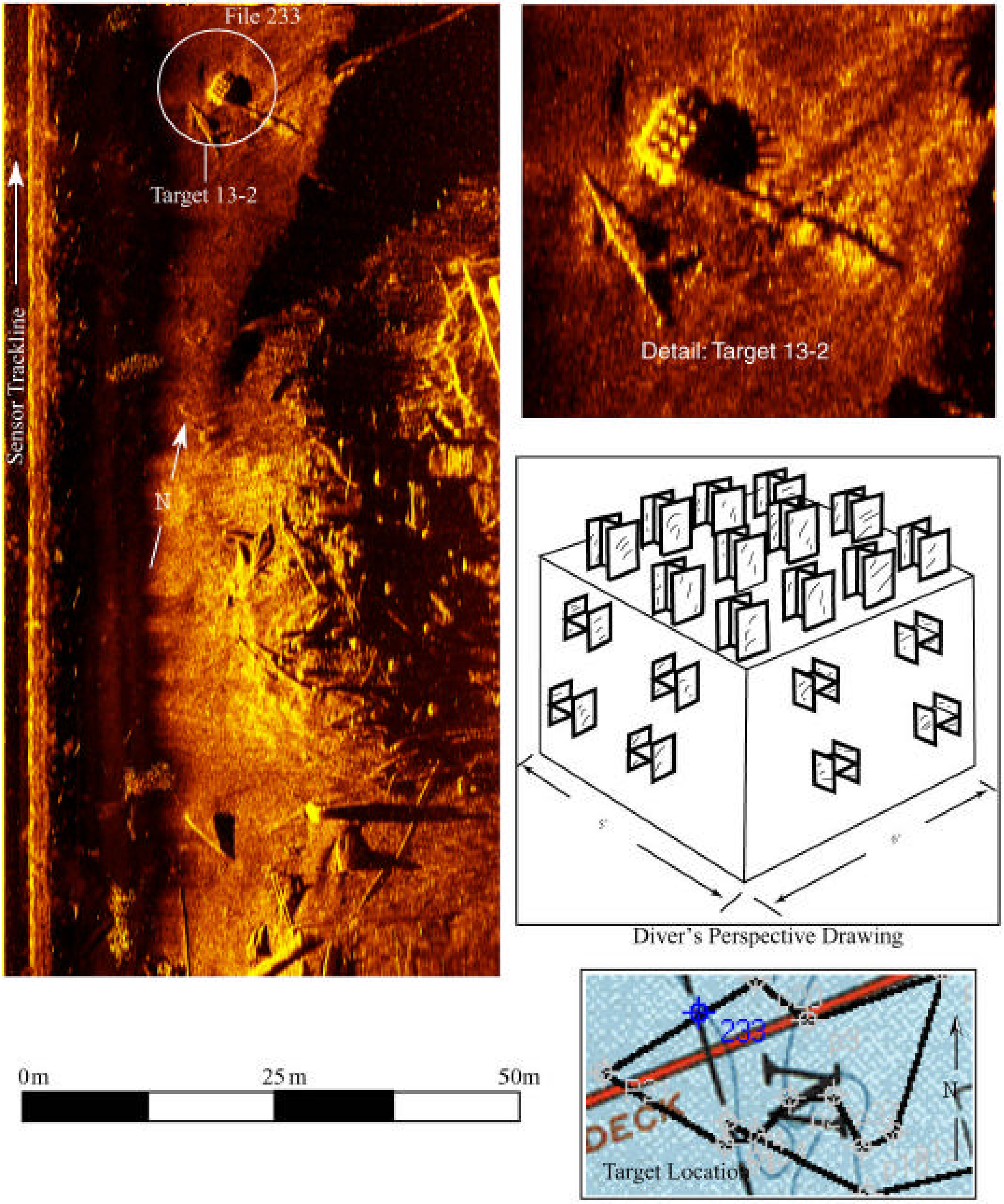


Side Scan Sonar Target 13-1

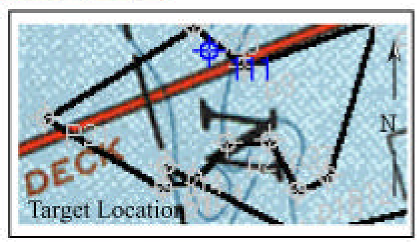
(600 kHz View from Starboard Channel)

Figure 23

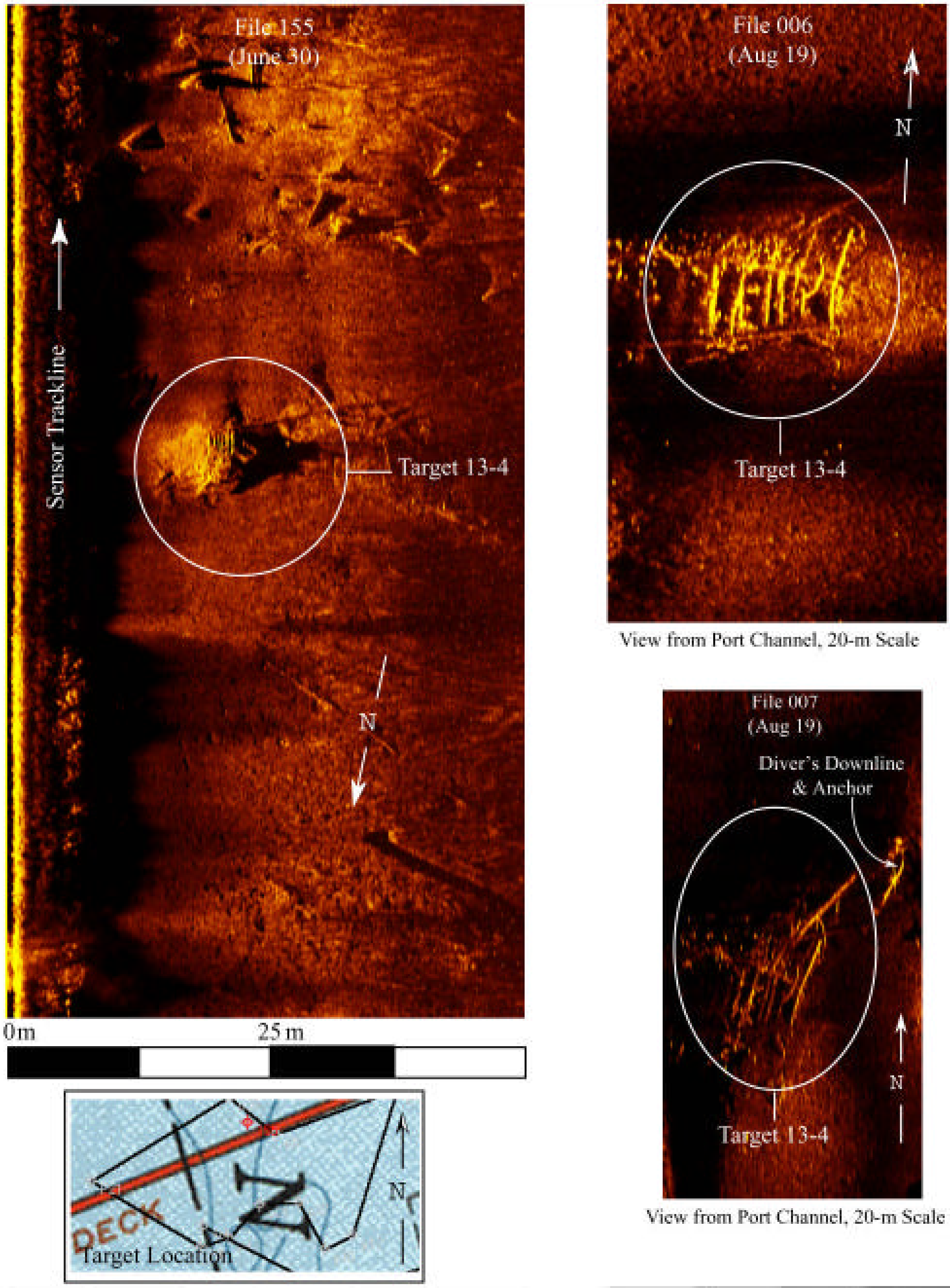
SFOBB East Span Seismic Safety Project



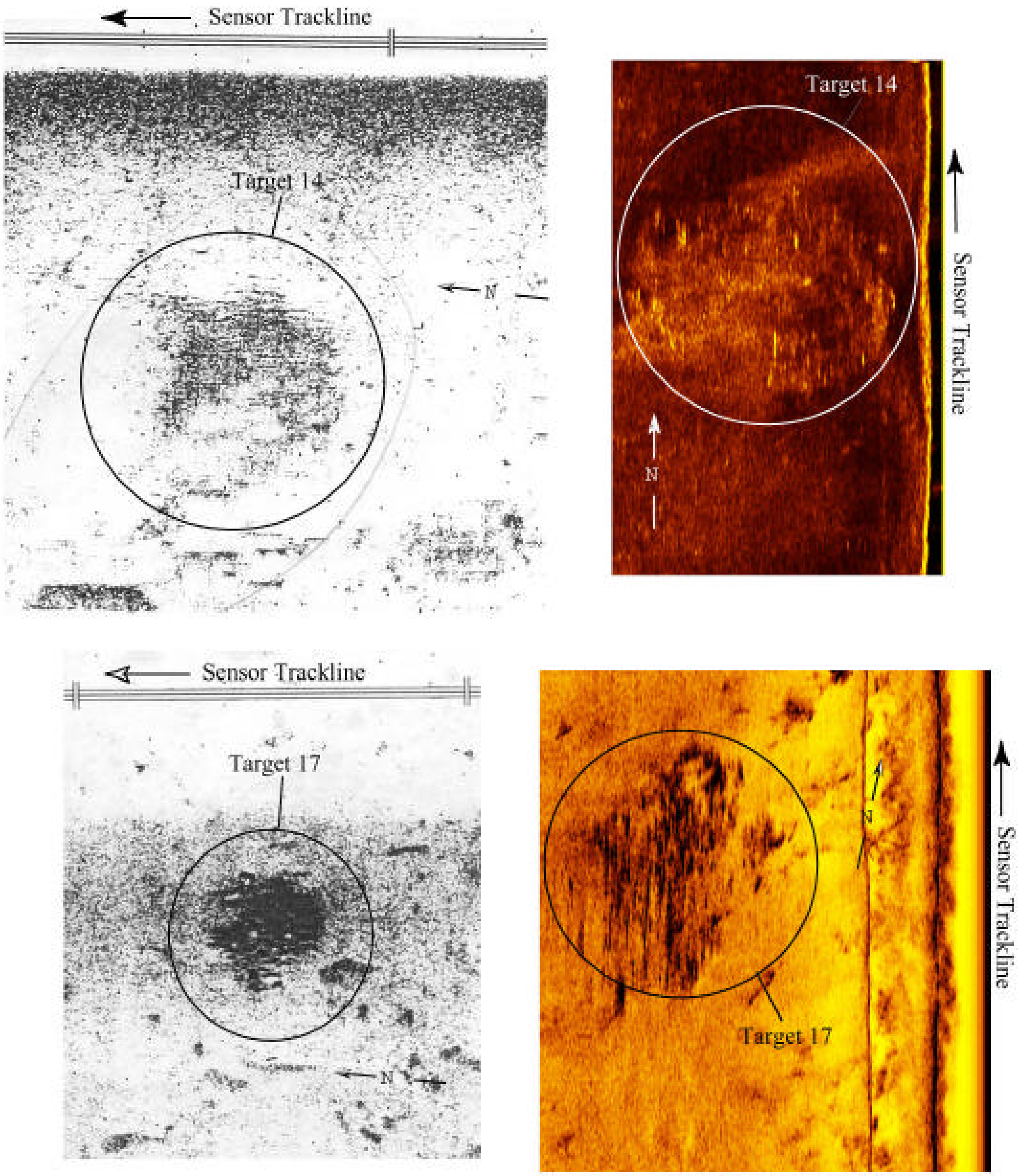
Side Scan Sonar Target 13-2 (600 kHz View from Starboard Channel)	Figure 24 SFOBB East Span Seismic Safety Project



Side Scan Sonar Target 13-3 (600 kHz View from Starboard Channel)	Figure 25 SFOBB East Span Seismic Safety Project



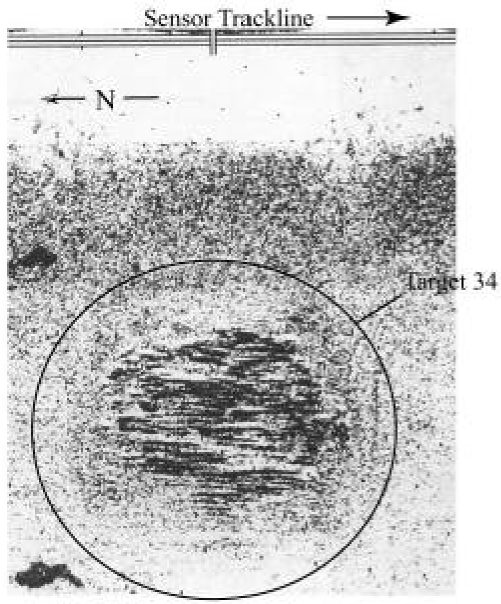
Side Scan Sonar Target 13-4 (600 kHz View from Starboard Channel)	Figure 26 SFOBB East Span Seismic Safety Project



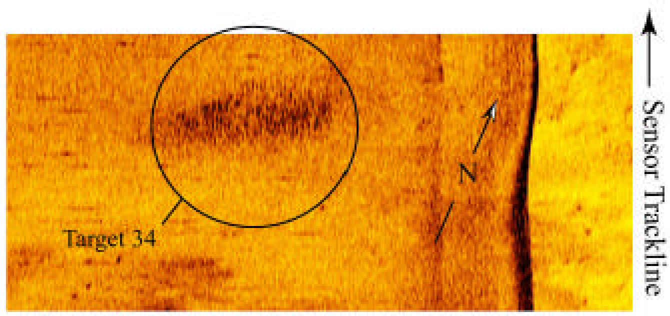
Side Scan Sonar Targets 14 & 17
(Views from Port Channel)

Figure 27

SFOBB East Span
Seismic Safety Project

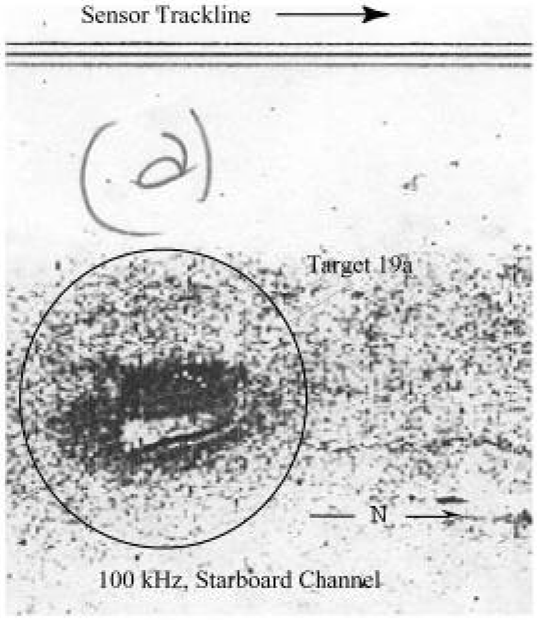


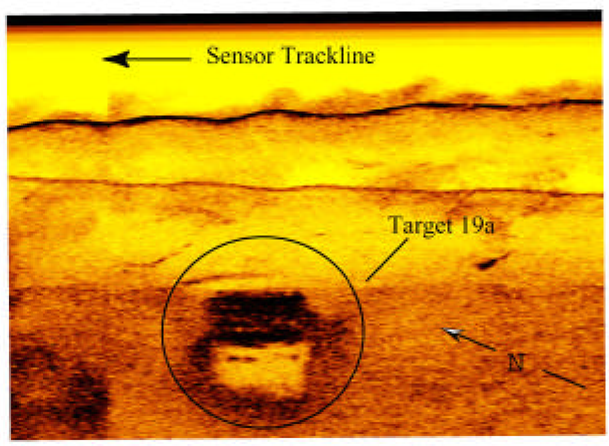
100 kHz-50m Scalke
Starboard Channel



300 kHz-20m Scale
Port Channel

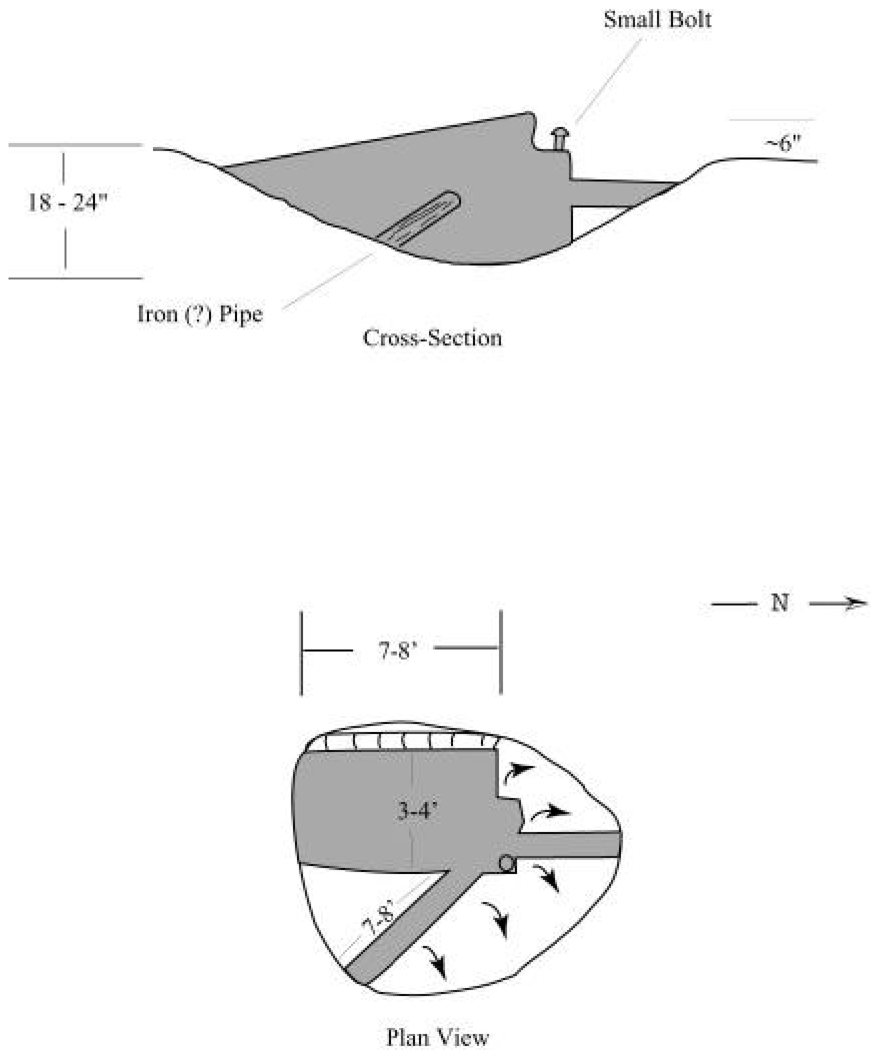
Side Scan Sonar Target 34	Figure 28 SFOBB East Span Seismic Safety Project





300 kHz, Port Channel

Side Scan Sonar Target 19a	Figure 29 SFOBB East Span Seismic Safety Project

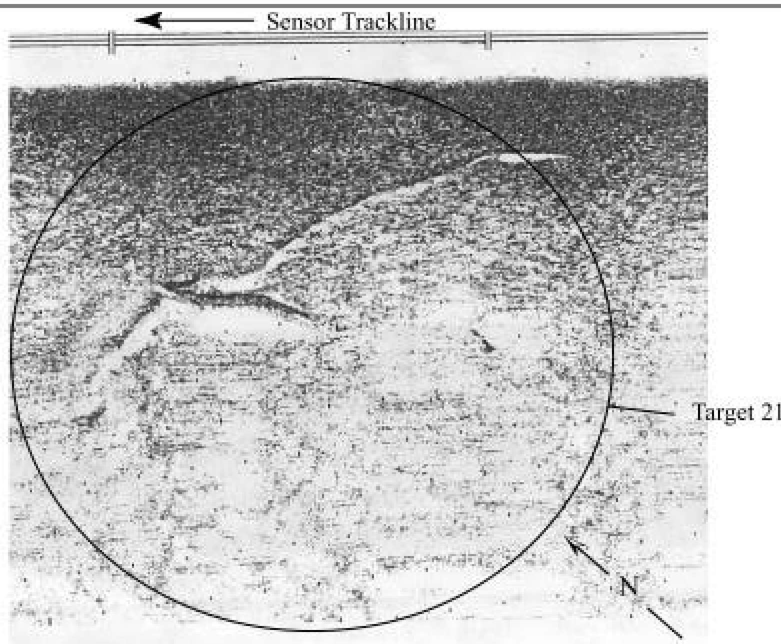


Not to Scale
Measurements are Diver's Estimates

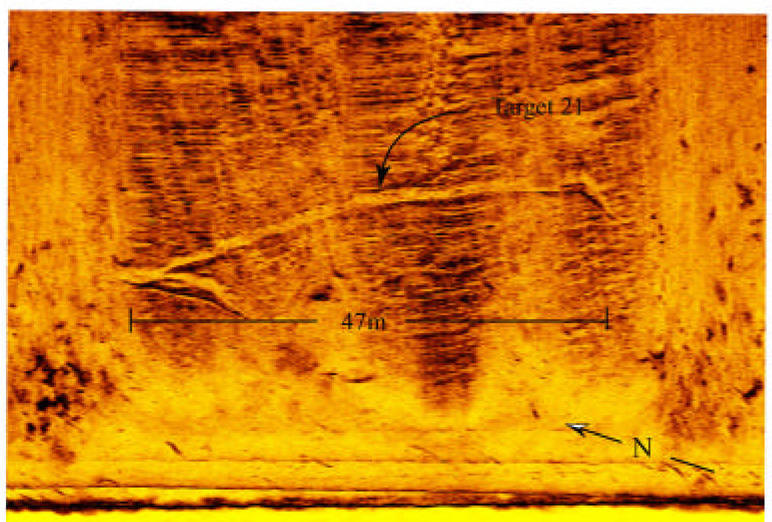
Line Drawing of Diver's Perspective:
Side Scan Sonar Target 19a

Figure 30

SFOBB East Span
Seismic Safety Project



View from Port Channel



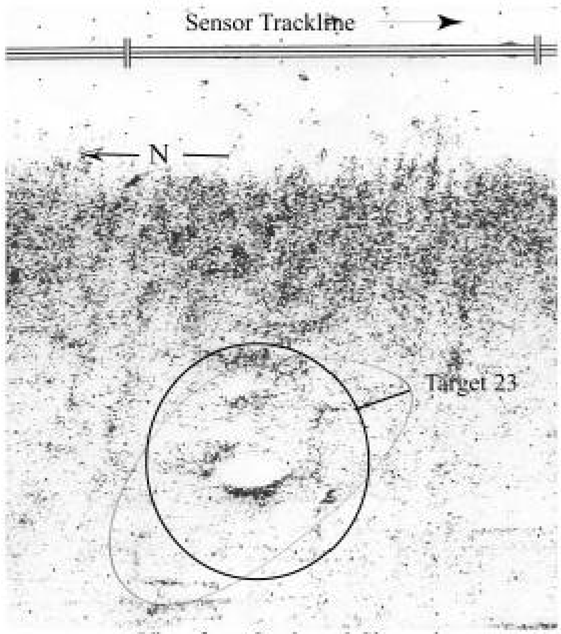
Sensor Trackline

View from Starboard Channel

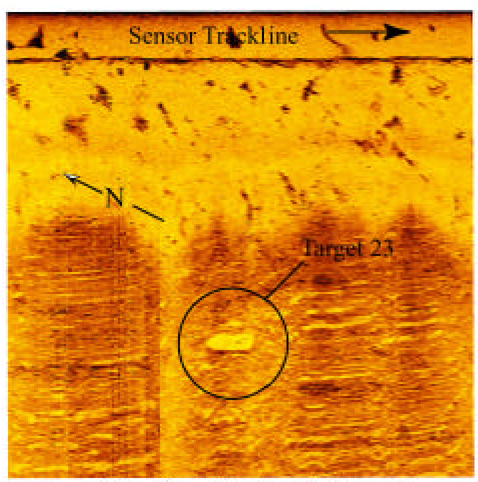
Side Scan Sonar Target 21

Figure 31

SFOBB East Span
Seismic Safety Project



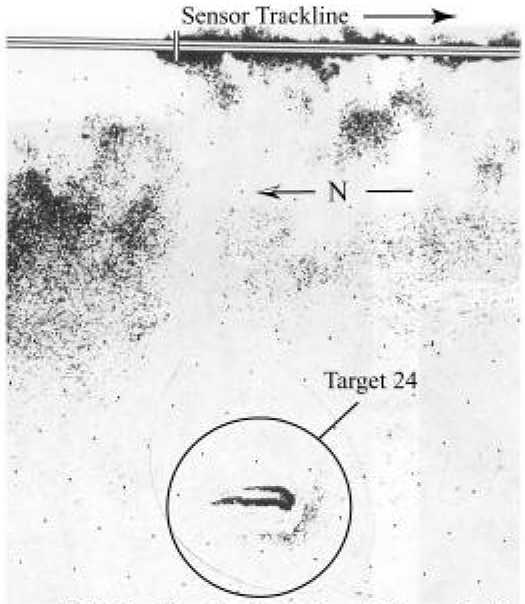
View from Starboard Channel



View from Starboard Channel

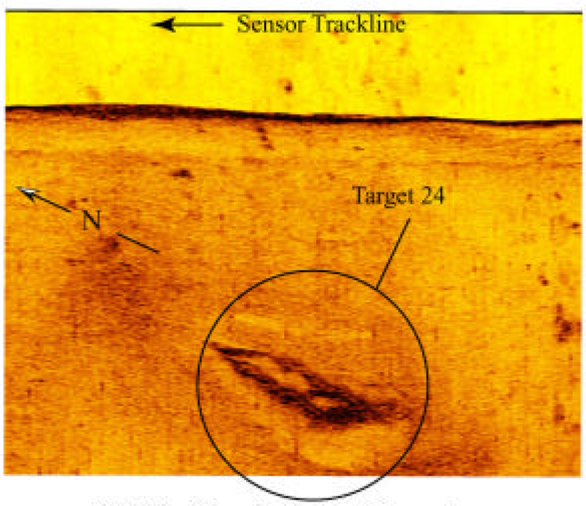
0 6m 12m

Side Scan Sonar Target 23	Figure 32 SFOBB East Span Seismic Safety Project

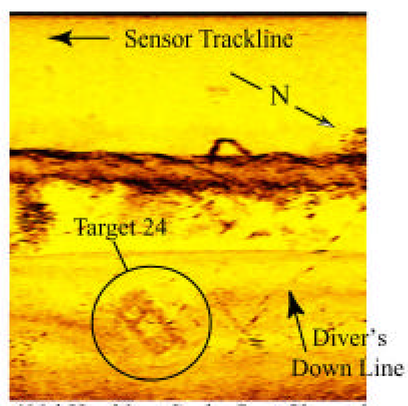


100 kHz, 50-m Scale; Starboard Channel

0 25m



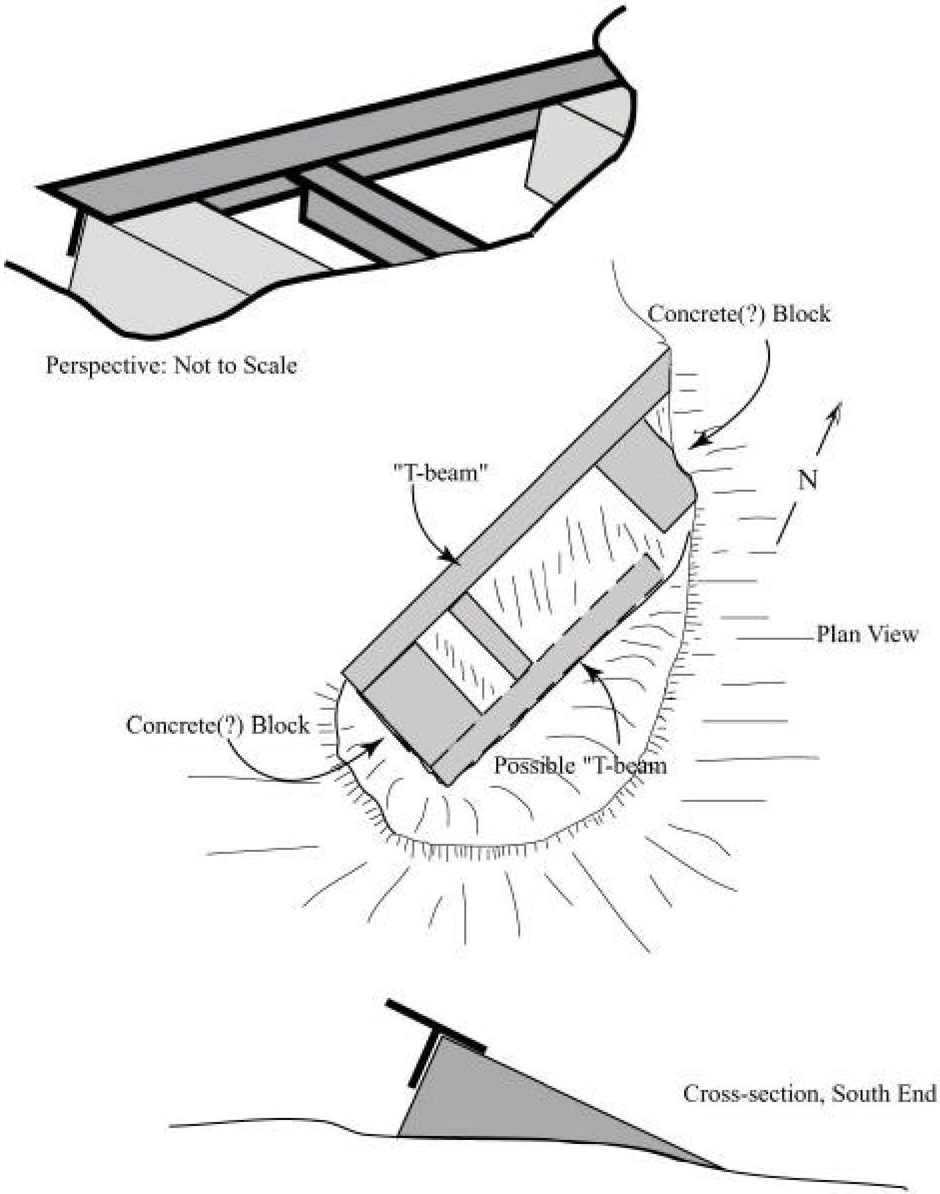
300 kHz, 20-m Scale; Port Channel



600 kHz, 20-m Scale; Port Channel

0 3' 6'

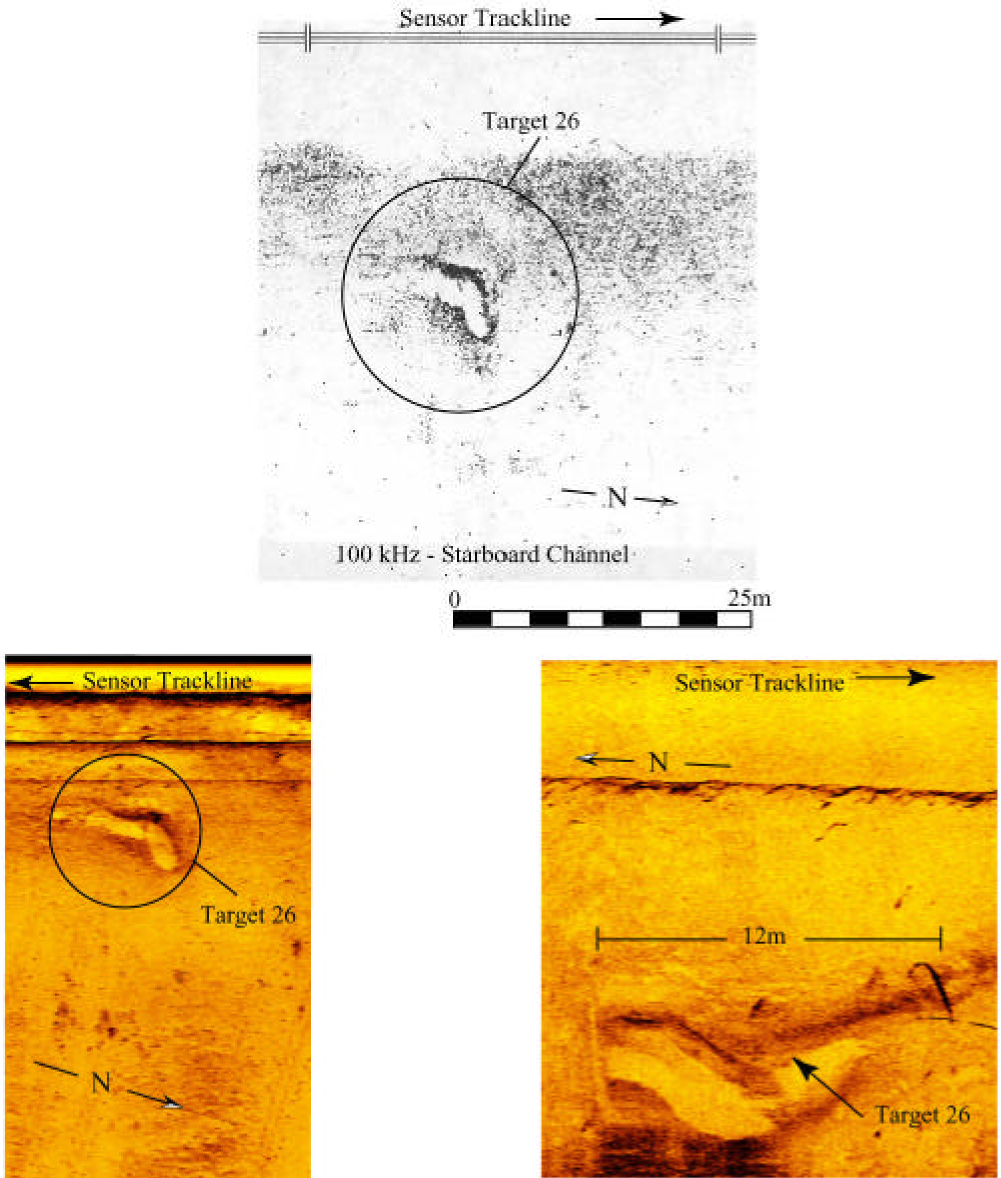
Side Scan Sonar Target 24	Figure 33 SFOBB East Span Seismic Safety Project



Side Scan Sonar Target 24

Figure 34

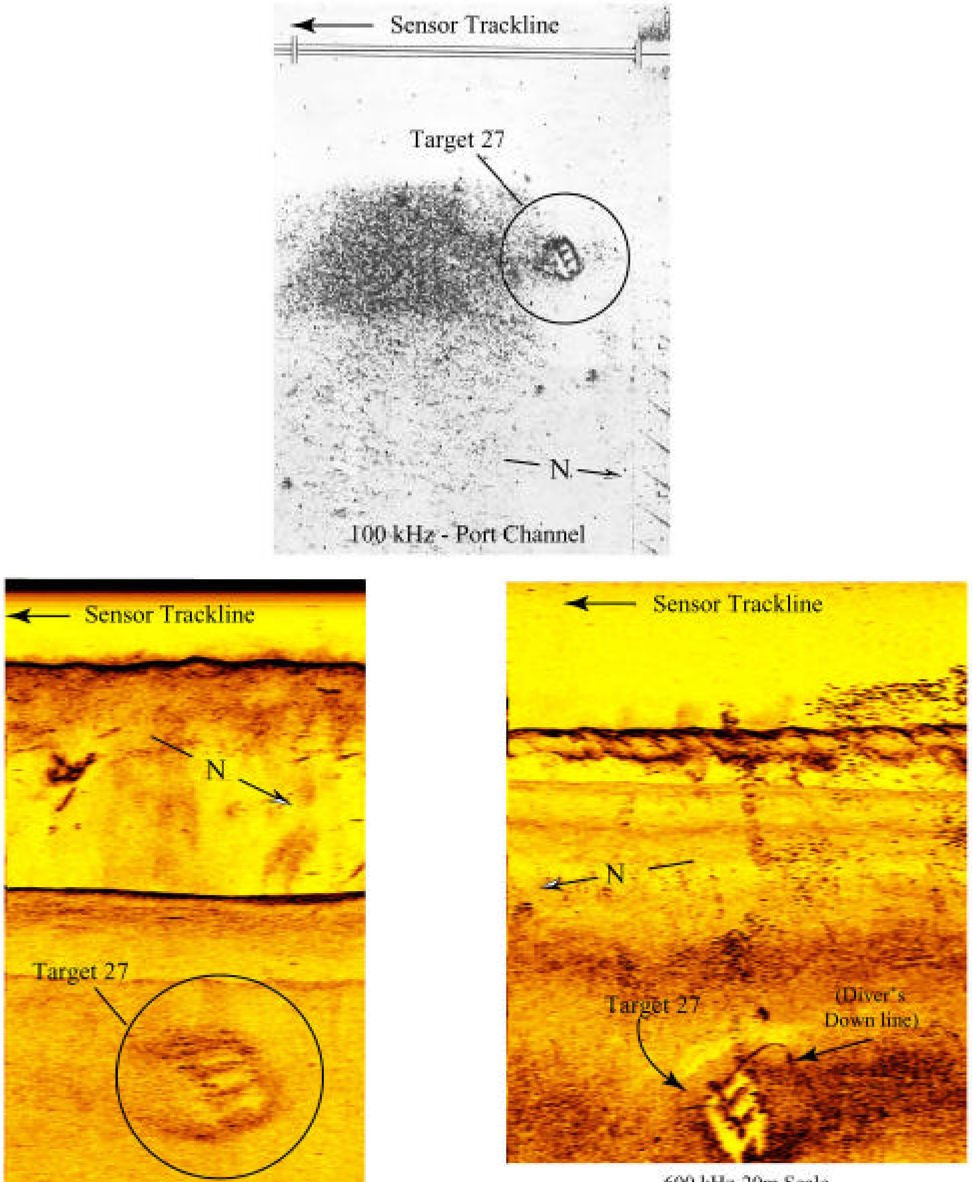
SFOBB East Span
Seismic Safety Project



300 kHz-50m Scale
Port Channel

600 kHz-20m Scale
Starboard Channel

Side Scan Sonar Target 26	Figure 35 SFOBB East Span Seismic Safety Project



300 kHz-20m Scale
Port Channel

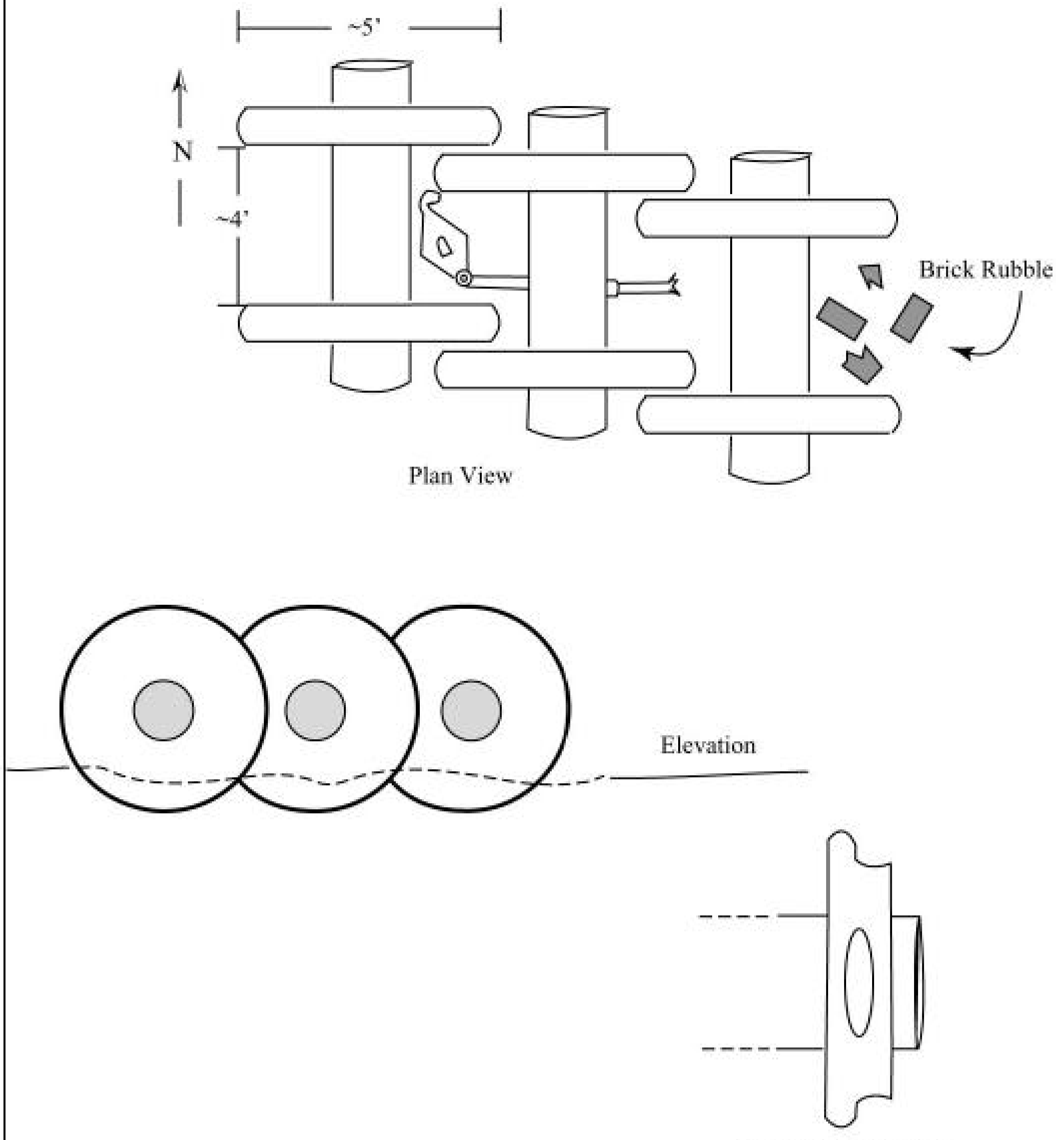
600 kHz-20m Scale
Port Channel

0 5m 10m

Side Scan Sonar Target 27

Figure 36

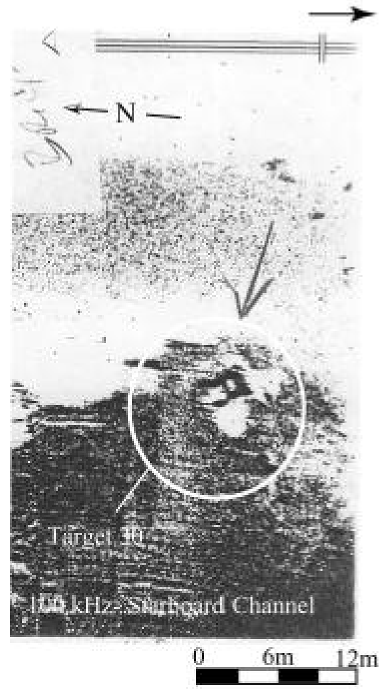
SFOBB East Span
Seismic Safety Project

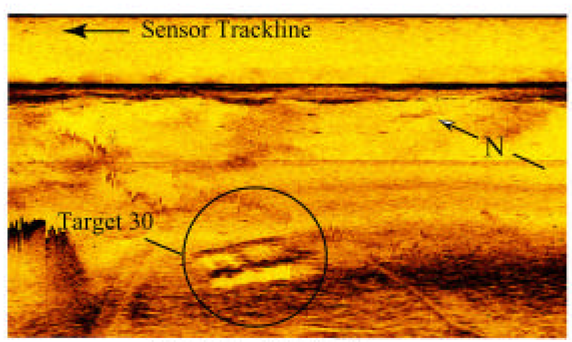


Side Scan Sonar Target 27

Figure 37

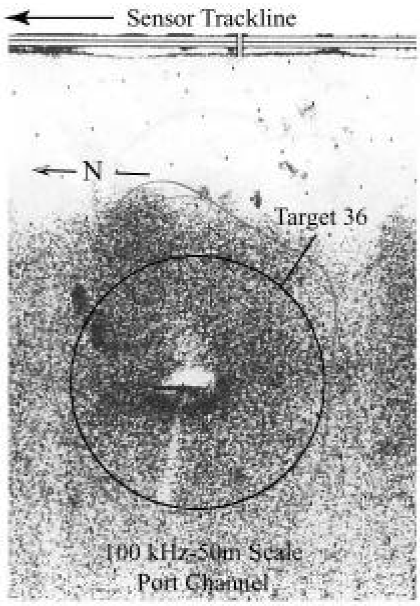
SFOBB East Span
Seismic Safety Project

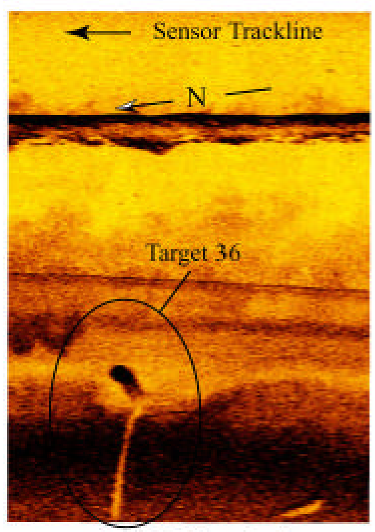




600 kHz - 20m Scale
Port Channel

Side Scan Sonar Target 30	Figure 38 SFOBB East Span Seismic Safety Project





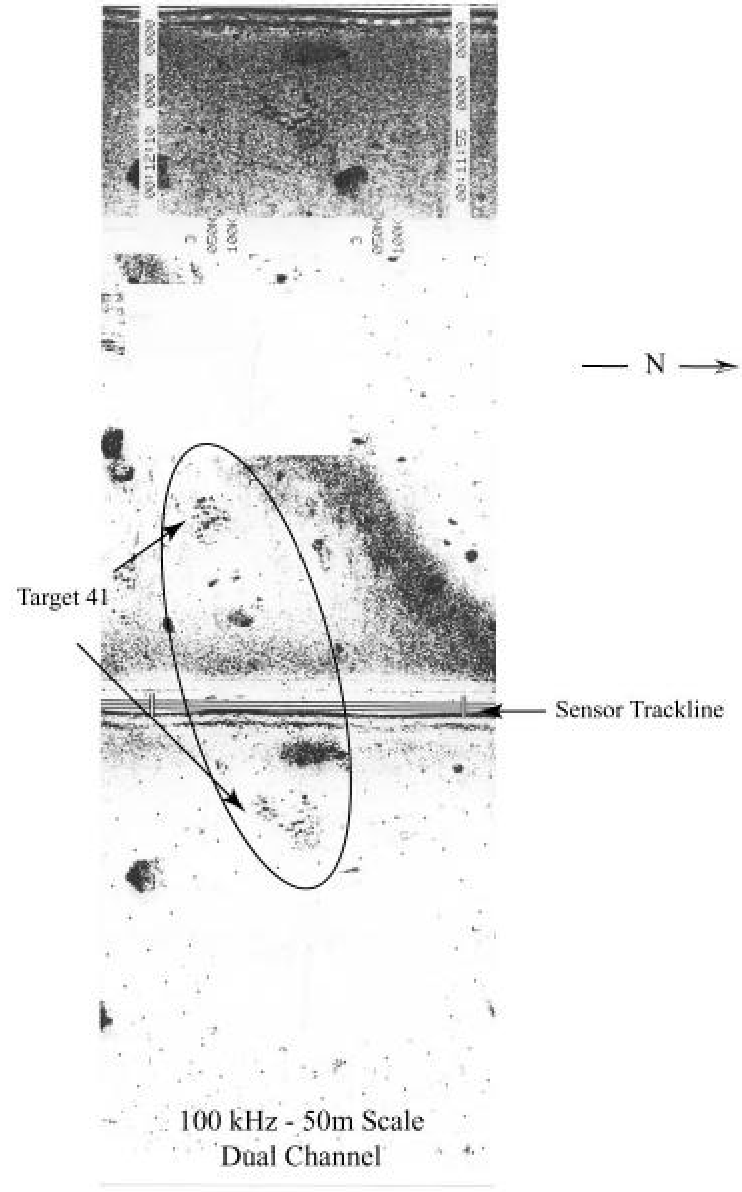
600 kHz-20m Scale
Port Channel

0 3m

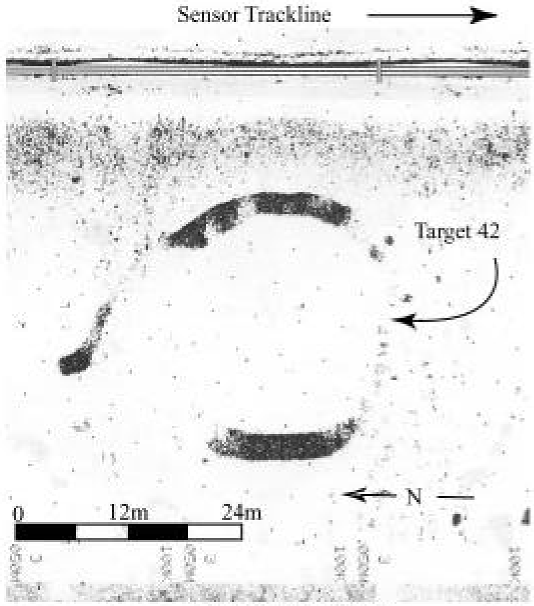
Side Scan Sonar Target 36

Figure 39

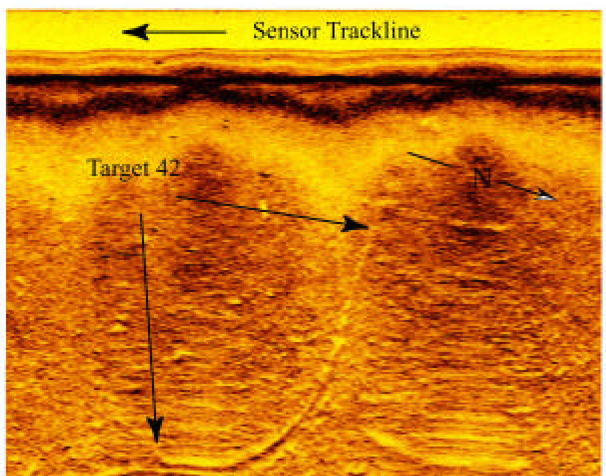
SFOBB East Span
Seismic Safety Project



Side Scan Sonar Target 41	Figure 40 SFOBB East Span Seismic Safety Project

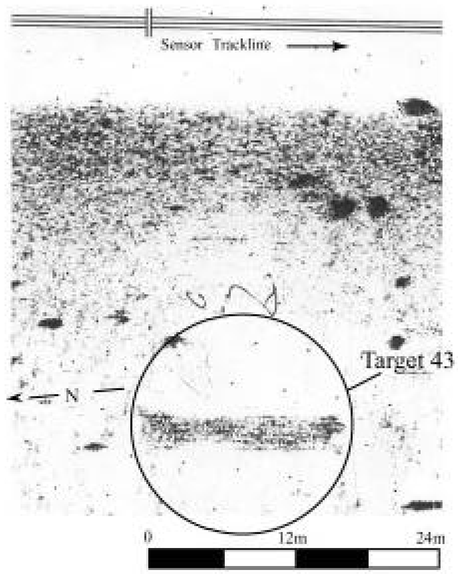


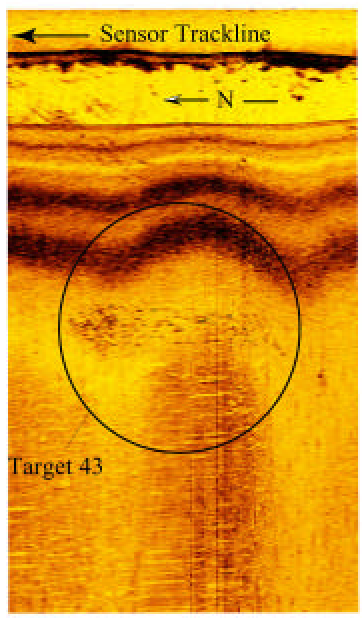
100 kHz-50m Scale
Starboard Channel



600 kHz- 20m Range Scale
Port Channel

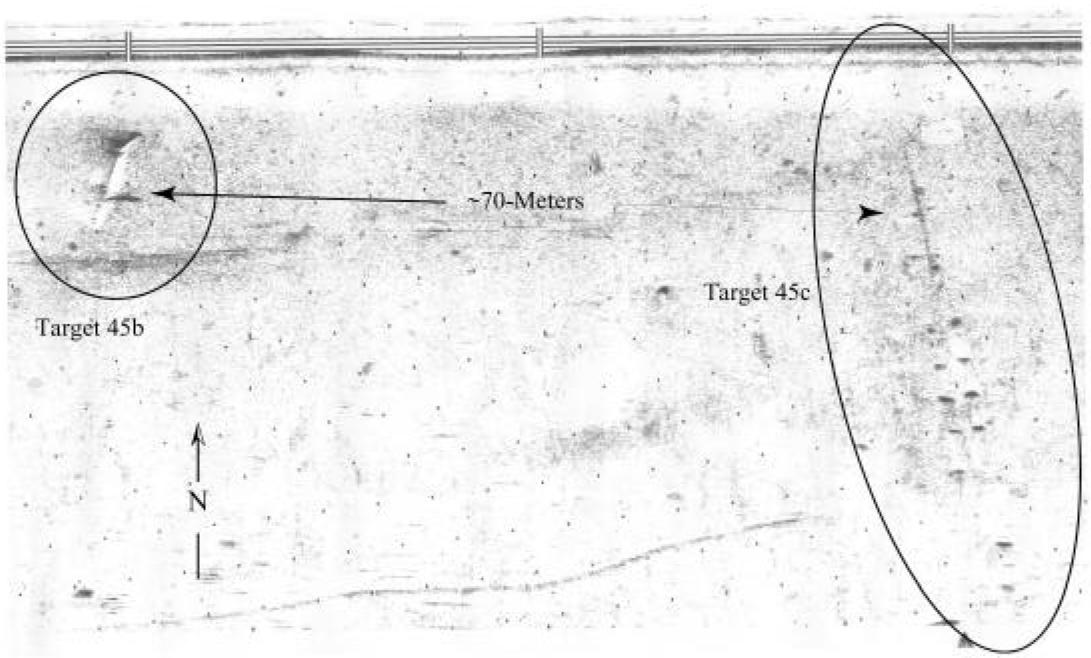
Side Scan Sonar Target 42	Figure 41 SFOBB East Span Seismic Safety Project





600 kHz, 50m Range Scale
Port Channel

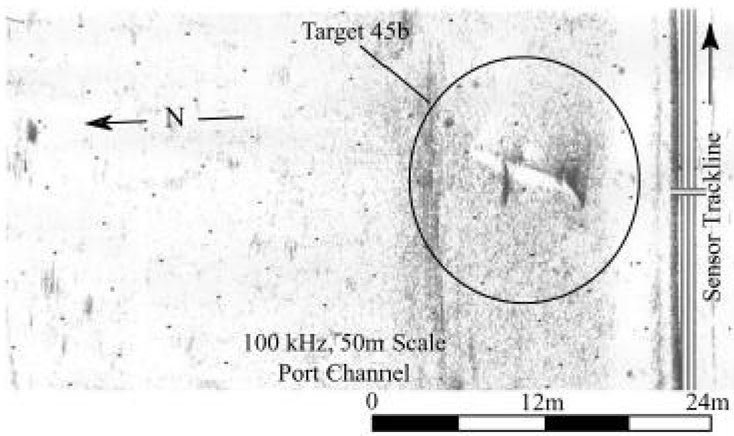
Side Scan Sonar Target 43	Figure 42 SFOBB East Span Seismic Safety Project

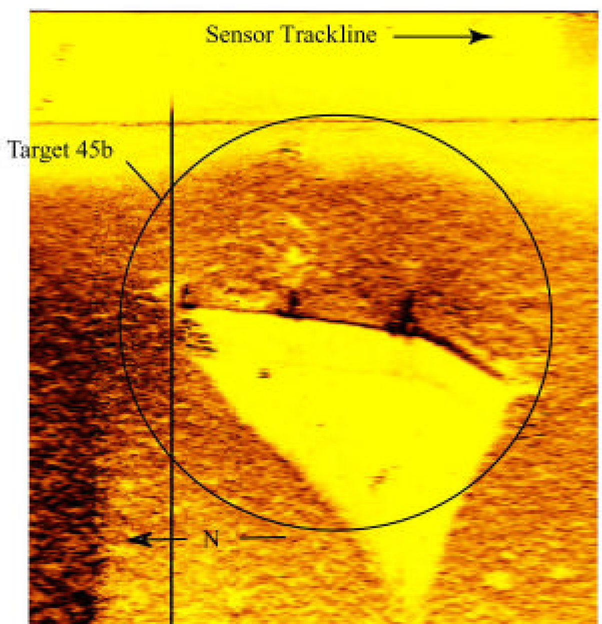


Side Scan Sonar Target 45b&c

Figure 43

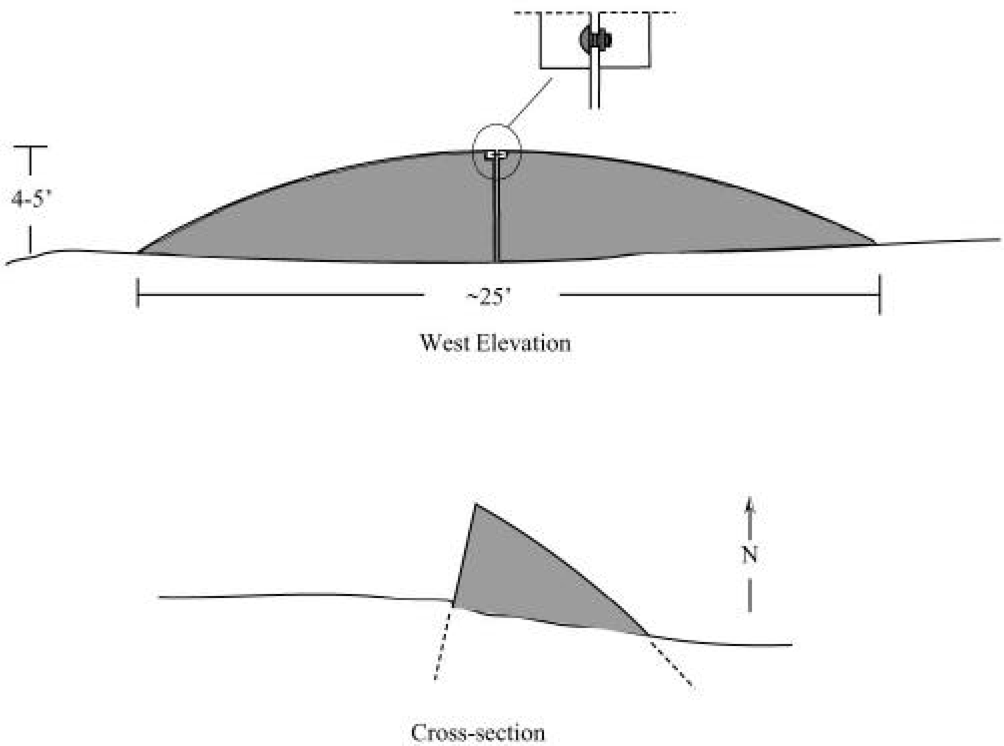
SFOBB East Span
Seismic Safety Project





600 kHz, 20m Range Scale
Starboard Channel

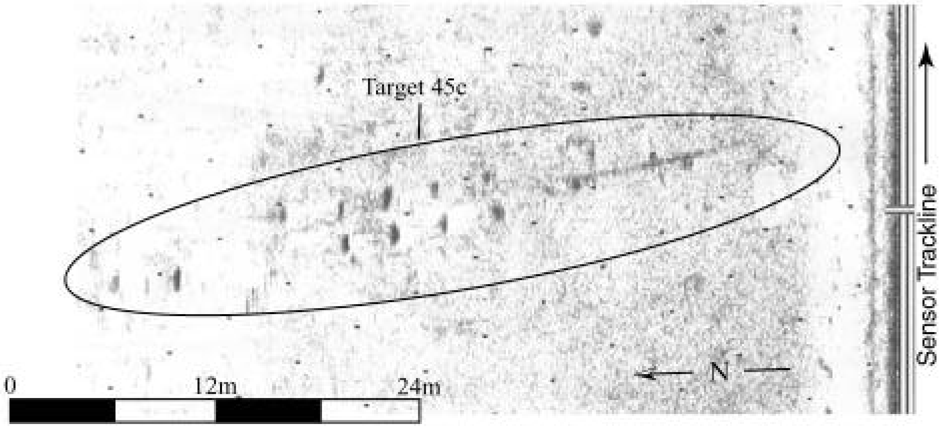
Side Scan Sonar Target 45b	Figure 44 SFOBB East Span Seismic Safety Project

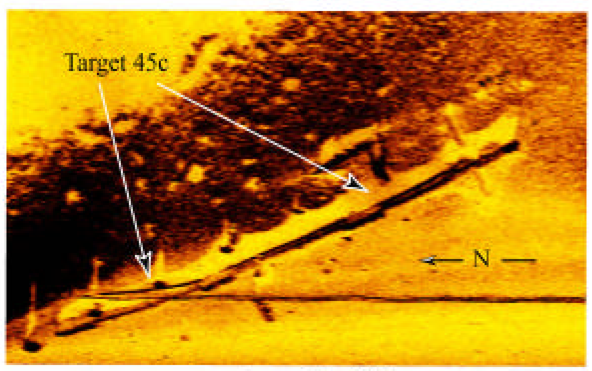


Side Scan Sonar Target 45b

Figure 45

SFOBB East Span
Seismic Safety Project



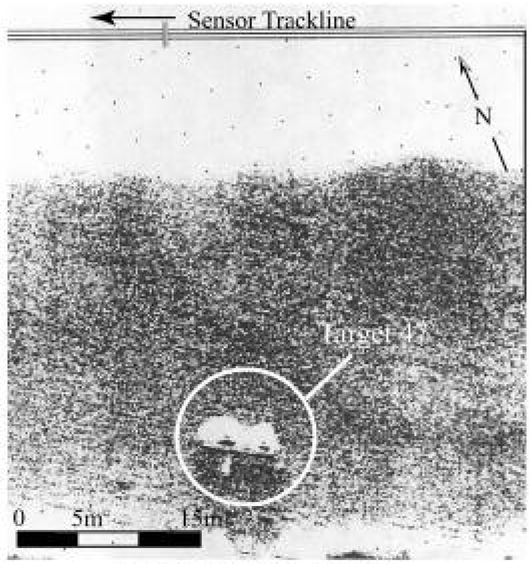


Sensor Trackline

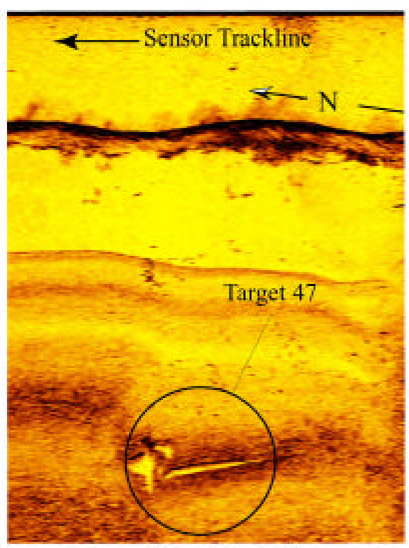
Side Scan Sonar Target 45c

Figure 46

SFOBB East Span
Seismic Safety Project



100 kHz, 50m Range Scale
Port Channel



600 kHz, 20m Scale
Port Channel

Side Scan Sonar Target 47	Figure 47 SFOBB East Span Seismic Safety Project

APPENDIX D

DPR Primary Record P-01-002164

Remains of Key System Pier

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

PRIMARY RECORD

Primary # P-01-002164
HRI #
Trinomial
NRHP Status Code

Other Listings
Review code Reviewer Date

Page 1 of 2 *Resource Name or #: (Assigned by recorder) SFOBB-Pile Installation Demonstration Project

P1. Other Identifier: SFOBB East Span Seismic Safety Project

*P2. Location: ☒Not for Publication ☐Unrestricted *a. County Alameda and
(P2b and P2c or P2d. Attach a Location Map as necessary.)

*b. USGA 7.5' Quad Oakland West, Calif. Date 1959 (1980) T n/a ; R n/a ; n/a 1/4 of ___ 1/4 of Sec n/a ; ___ B.M.

c. Address n/a City Oakland Zip

d. UTM: Zone 10 , 557398/557694 mE/ 4185686/4185408mN

e. Other Locational Data (e.g., parcel #, legal description, directions to resource, elevation, etc., as appropriate): N-S along county line on either side of SFO Bay Bridge.

*P3a. Description: (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries): Feature is a wide-spread debris field comprising the partial, disarticulated remains of either the burned Key System pier, or the remains of a portion of the pier as left following its dismantling after abandonment in 1939. Portions of the feature are scattered on both the north and south sides of the existing SFO Bay Bridge span. The feature consists almost entirely of disarticulated pilings and lengths of railroad iron scattered over an area approximately 300 x 200 meters. Pilings range in size from 6 to over 15 meters in length and many rest crossed, one upon the other. The pilings at the eastern side of the feature appear to be upright, still embedded in the bottom sediment. These project approximately 2 meters into the water column. The feature is largely concentrated directly beneath and south of the existing bridge alignment. A scattered, less-concentrated portion of the feature also lies on the north side of the bridge.

*P3b. Resource Attributes: (List attributes and codes) HP17; AH13;

*P4. Resources Present: ☐Building ☐Structure ☐Object ☐Site ☐District ☐Element of District ■Other (Isolates, etc).

P5. Photo or Drawing (Photo required for buildings, structures, and objects.)

*P5b. Description of Photo (view, date, accession #)

*P6. Date Constructed/Age and Sources: ☒Historic ☐ Prehistoric ☐ Both
1903; Historic Literature

*P7. Owner and Address:

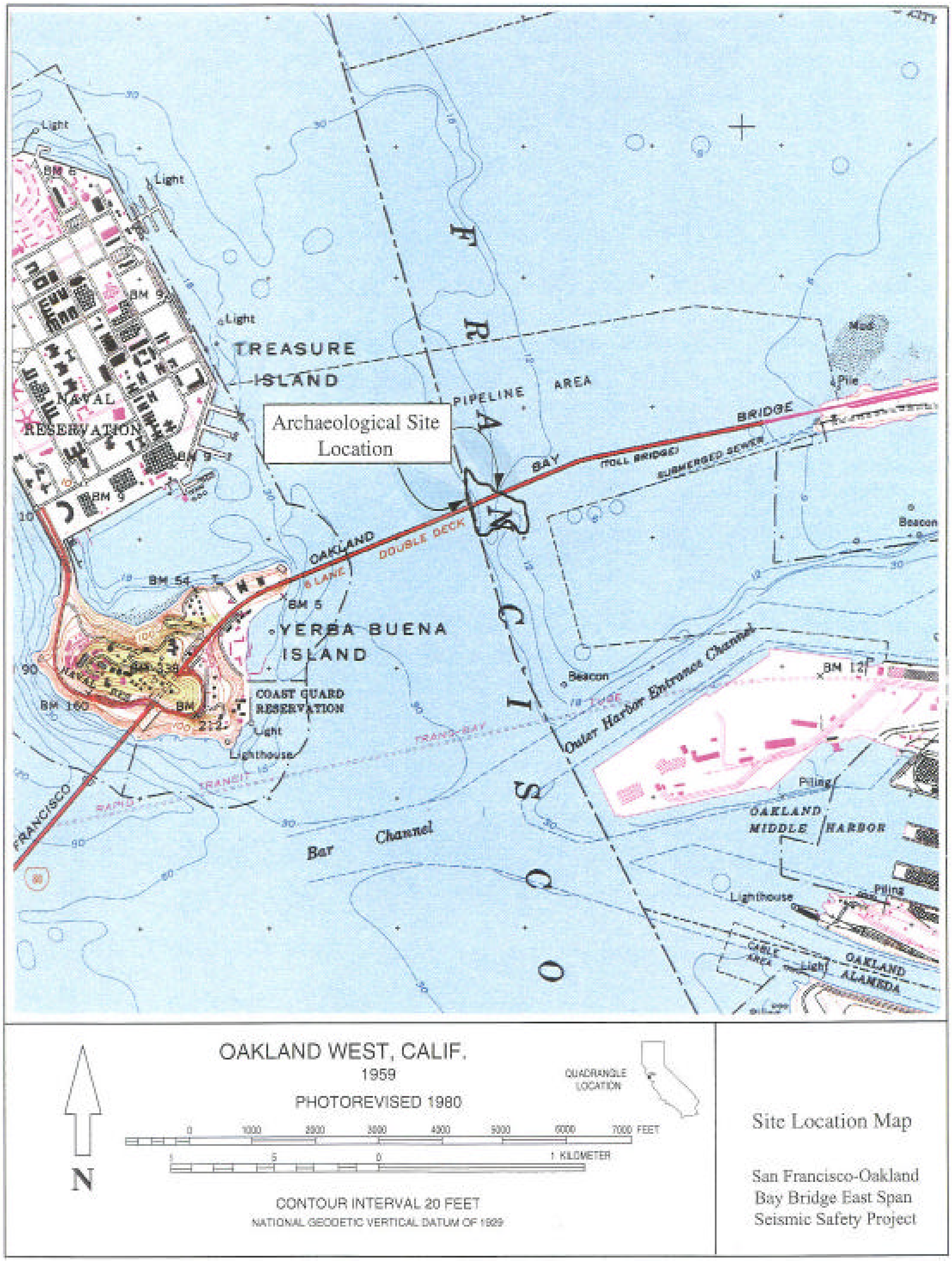
*P8. Recorded by (Name, affiliation, and address): James M. Allan, William Self Associates, PO Box 2192, Orinda, CA 94563

*P9. Date Recorded: Sept. 18, 1999

*P10. Survey Type: (Describe)
Remote Sensing: Side scan sonar and sub-bottom profiler.

*P11. Report Citation (Cite survey report and other sources, or enter "none."): Phase 1 Archaeological Survey Report-Maritime Archaeology. San Francisco-Oakland Bay Bridge Pile Installation Demonstration Project.

*Attachments: ☐NONE ☒Location Map ☐Sketch Map ☐Continuation Sheet ☐Building, Structure, and Object Record ☐Archaeological Record ☐Artifact Record ☐Photograph Record ☐Other (List):



Site Location Map

San Francisco-Oakland Bay Bridge East Span Seismic Safety Project