Research, Data Collection and Synthesis

for the

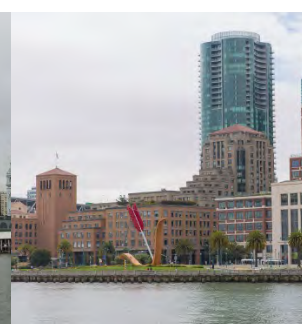
Seawall Earthquake Vulnerability Study

at

Northern Seawall–San Francisco, California

Phase 1 Report

July 2016



Prepared for:
Port of San Francisco

Prepared by:
GHD-GTC Joint Venture

Research, Data Collection and Synthesis for the Seawall Vulnerability Study
PHASE 1 REPORT

Northern Seawall,
San Francisco, CA

July 2016

This Phase 1 Report for Research, Data Collection and Synthesis for the Seawall Vulnerability Study ("Report"):

1. *has been prepared by GHD-GTC Joint Venture for the Port of San Francisco (POSF);*
2. *may only be used and relied on by POSF;*
3. *must not be copied to, used by, or relied on by any person other than POSF without the prior written consent of GHD-GTC Joint Venture;*
4. *may only be used for the purpose of prioritizing and evaluating rehabilitation approaches with the intent to select the most appropriate solution.*

GHD-GTC Joint Venture and its subcontractors, employees and officers otherwise expressly disclaim responsibility to any person other than POSF arising from or in connection with this Report.

To the maximum extent permitted by law, all implied warranties and conditions in relation to the services provided by GHD-GTC Joint Venture and the Report are excluded unless they are expressly stated to apply in this Report.

The services undertaken by GHD in connection with preparing this Report:

- *were limited to those specifically detailed in Section 1 of this Report;*
- *did not include visual condition surveys and assessments*
- *did not include material testing*

The opinions, conclusions and any recommendations in this Report are based on assumptions made by GHD-GTC Joint Venture when undertaking services and preparing the Report ("Assumptions") including, but not limited to:

- *record drawings and technical reports provided by the POSF and other third-party entities*
- *material properties as represented on the record drawings commensurate with the date of construction*
- *present-day design codes applicable for structural assessment*

GHD-GHD Joint Venture expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with any of the Assumptions being incorrect.

Subject to the paragraphs in this section of the Report, the opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the time of preparation and may be relied upon for 12 months from the date of condition survey, after which time, GHD-GTC Joint Venture expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with those opinions, conclusions and any recommendations.

List of Preparers

A consultant team headed by GHD-GTC Joint Venture prepared this report under the guidance of the Port of San Francisco, Engineering Division. A list of the consultant team personnel that worked on the Earthquake Vulnerability Study of the Northern Waterfront Seawall is provided below.

Lead Agency

Port of San Francisco, Engineering Division
Steven Reel, PE, LEED AP, Project Manager

Consultant Team

Personnel	Roles
GHD Inc.	**Project Management and Marine Structural Engineering**
Craig Lewis, PE, SE	Project Manager, Technical Approach and Review, Report Preparation, QA/QC
Clay Serrahn, PE, SE	Background Review, Structural Analysis, Vulnerability Assessment, Report Preparation
Renee Remillard	Graphics
Geotechnical Consultants, Inc.	**Geotechnical Engineering and Seismicity**
Deron J. van Hoff, PE, GE	Project Manager, Background Review and Organization, Technical Approach, Report Preparation, QA/QC
Shahriar Vahdani, Ph.D., PE	Technical Approach
Aurie Patterson, PG	Geology and Soils, Seismicity, GIS Database
Joseph N. Seibold, PE, GE	Geologic Profiles, Geotechnical Analysis
Dustin Agnew, PE	Site Response Analysis, Geotechnical Analysis
Tanya Telson	Background Review and Organization
Carolyn J. Mosher	Graphics
New Albion Geotechnical, Inc.	**Geotechnical and Earthquake Engineering**
Stephen E. Dickenson, Ph.D., PE, D.PE	Site Response Analysis, Geotechnical Analysis, Technical Approach, Report Preparation, QA/QC
Rollo and Ridley, Inc.	**Geotechnical Engineering**
Christopher A. Ridley, PE, GE	Geotechnical Analysis
Chris Yu Boon Tan, PE	Geotechnical Analysis
Telamon Engineering Consultants, Inc.	**Civil Engineering**
Mennor Chan, PE	Critical Infrastructure and Utilities Assessment
ESA	**Coastal Engineering**
Louis White, PE	Flooding and Climate Change Vulnerability Studies
Land Use Economics	**Economic Planning and Valuation**
Greg Cory	Economic Assets and Impact Assessment

Contents

Table Index

Figure Index

1. Executive Summary

1.1 Project Description and Scope of Work

The Port of San Francisco ("Port") is a self-supporting, municipal enterprise agency overseeing 7-1/2 miles of waterfront property along the San Francisco Bay. The Port has initiated a program to identify and upgrade portions of the waterfront vulnerable to earthquakes, flooding, and climate change.

As such, the Port wishes to undertake an earthquake vulnerability study of the Northern Waterfront Seawall which extends approximately 3 miles from Fisherman's Wharf to Pier 46. Components of the study will include: assessment of available information and condition, state of the art engineering analysis to determine likely damage to the seawall and infrastructure within the zone of influence, economic impacts resulting from multiple earthquake scenarios, development of conceptual level retrofits/costs, and recommendations for implementation of improvements and/or further study.

The overall study consists of three phases: 1) research, data collection and synthesis, 2) earthquake vulnerability study, and 3) recommendations for mitigation of earthquake hazards. This Phase 1 report presents our findings, conclusions and recommendations regarding the research, data collection and synthesis phase of this study.

For the Phase 1 work, GHD/GTC's scope of work, with Port assistance, is to collect and research available information applicable to the project locations including, but not limited to, geotechnical investigation data and reports along the various seawall sections and adjacent locations, bulkhead wharf, pier wharf, and seawall structure condition surveys and associated assessments, rapid structural evaluations, and nearby infrastructure. The information collected will serve as a basis for the Phase 2 assessment of the geotechnical and structural conditions applicable to each seawall section.

Flooding vulnerability will be assessed for intact and damaged seawall conditions associated with seismic events. The assessment will consider existing and higher future sea levels. The scope of work for Phase 1 is to collect and research the available information that will be used to inform the flooding vulnerability assessment. In particular, the data include coastal flooding and sea level rise inundation mapping completed by FEMA, the San Francisco Public Utilities Commission, and the Port of San Francisco. Pertinent jurisdictional, policy and sea level rise guidance issued by the State and the City and County of San Francisco will be reviewed and summarized.

The geotechnical and structural data collection is quite specific for each seawall section delineated in this study, since the specific data will be used to ascertain site-specific hazards and their potential effects on geotechnical and structural damage or failure for each seawall section. Other study disciplines, specifically utilities, flooding vulnerability and economics are more global in their coverage and do not necessarily lend themselves to such site-specific consideration. The collection of this other discipline data remains in progress but is also summarized in this Phase 1 report.

1.2 Zone of Influence

The zone of influence of the Earthquake Vulnerability Study of the Northern Waterfront Seawall is defined as the areal extent of land, piers and building structures, and other important infrastructure including the Embarcadero Promenade and Roadway, the Muni light rail line, BART facilities, and major utilities including SFPUC pipelines, PG&E, and telecommunications lines that may be impacted by the movement of the seawall in the event of an earthquake. The zone of influence will be studied more closely during the analysis phase (Phase 2) of the project. However, it was important to define a conservative boundary of the zone of influence during Phase 1 in order to define the project limits for the purpose of compiling relevant data including geotechnical reports and boring logs, construction drawings of the potentially-affected structures, condition surveys, rapid structural evaluations, utility information, and economic data.

At the upper limit, the influence will be within the zone that may experience lateral displacement, which according to the 1992 liquefaction study (HLA et al., 1992) is all of their study area corresponding roughly with the original shoreline. Independent of the degree of strengthening done at the seawall and near shore area, the lateral spreading displacements far inland from the improvements will not be mitigated. Therefore, the zone of influence should be limited to only the portion of land that will be positively affected by seawall improvements. This zone of influence will range from about 200 feet for better soil conditions (i.e., no or limited liquefaction) to up to about 1,200 feet for poor soil conditions (i.e., widespread liquefaction). Our recommended approach, which was adopted for purposes of the data collection phase of the project, was to set the zone of influence as the study area limits in the 1992 liquefaction study report but also further limited to within 1,200 feet of the seawall structures. This Zone of Influence is shown graphically on ***Figure 1-1 – Seawall Zone of Influence Map***. The finger piers and bulkhead structures were also included within the zone of influence.

1.3 Geotechnical Research and Data Results

General

The GHD/GTC team collected and compiled geotechnical data that was made available by the Port of San Francisco and that was obtained from our project files. The team obtained additional reports from SFPUC, SFDPW, and BART. For this study, over 100 geotechnical data sources have been compiled, and over 600 exploration locations have been catalogued in an Excel spreadsheet and entered into a GIS database. The exploration locations mapped in the GIS database are represented in ***Figure 1-2 – Historical Exploration Location Map***.

Data Obtained

The geotechnical data sources are provided in Table 3-2 – List of Geotechnical Reports. The catalogue of exploration locations is provided in Table 3-3 – Historical Geotechnical Data within the Seawall Zone of Influence.

1.4 Structural Research and Data Results

General

The structural research consisted of obtaining, reviewing and organizing available design drawings applicable to the seawall sections applicable to this study. Drawings were provided by the Port and/or obtained from the JV data base. The various drawings applicable to this study were organized by seawall section, reviewed for data applicable to the structural work of this study, and missing data were identified.

Data Obtained

Various types of data needed for various aspects of the structural analysis were collected. The types of data collected for each seawall section were divided by seawall section component, namely, rock dike, seawall, marginal wharf and finger pier. The rock dike represents a common component that has geotechnical and structural implications. The seawall structures will be assessed for their stability and design basis load capacity. The marginal wharf and finger pier structures will be assessed to ascertain their contribution to design basis load resistance of the seawall structures and to provide structural capacity limits for use in damage assessments of these substructures and their supported buildings.

Data Gaps and Assumptions

Figure 4-1 summarizes the data obtained so far for these various seawall sections and seawall structural types. The summary is sorted by seawall section and seawall structure type, with data listed for the rock dike, seawall, marginal wharfs and finger piers. The individual blocks are color-coded to represent the data item status (green for data in-hand through red for data that is unavailable or not yet obtained). Where a data item is in-hand, the data value is indicated in the block. If data are not available, data may be assumed based on seawall sections of similar construction period and design, or by other criteria appropriate for the particular structural data item under consideration.

1.5 Utilities Research and Data Results

General

For the infrastructure utility systems study, TECI compiled existing utility information within the zone of influence, identifying critical utilities and their vulnerability due to earthquake, settlement and flooding as defined by the project.

SFDPW formed a Lifeline Council that is performing a similar earthquake vulnerability study for the downtown area. With the Port of San Francisco's recommendation, TECI was able to work in conjunction with SFDPW to collaborate our effort in gathering existing utility system information.

TECI categorized the information in order to study with the team and the individual utility agencies to understand the impact to their utilities as a result of the various vulnerability study scenarios.

We have processed the gathered information as follow:

1. Pipe sizes were grouped and color coded to facilitate team's identification of trunk lines versus laterals.
2. To follow up with various utility agencies to study and understand the effect on the utility system based on the individual seawall segment failure as identified by the team.

Data Obtained

Partial information received through Lifeline Council has been grouped and shown on the exhibits. This includes GIS files for Water, AWSS, Storm Sewerage and some communication companies' cell sites. These files contain some useful GIS data such as age and materials for the pipe system.

Data Gaps and Assumptions

Unfortunately, some files only include the downtown area and the file data does not extend the information to include the remaining area that is within the Seawall study zone of influence. Data for other agencies, such as PGE, ATT, SFMTA are still missing.

Due to the lead time in receiving the information and the amount of missing information, TECI sent a Notice of Intent to utility agencies that we have not yet received information from them as of March 25, 2015.

1.6 Flooding Vulnerability Research and Data Results

General

The vulnerability of the San Francisco waterfront to flooding and inundation will be assessed for intact and damaged seawall conditions associated with seismic activity in Phase 2 of the study. The assessment will consider existing and higher future sea levels. The assessment will utilize prior studies completed for the Port and the City and County of San Francisco and the Federal Emergency Management Agency (FEMA).

Typical sections of the seawall will be developed based on available information. Damaged conditions will be estimated based on seismic loadings and land deformations. The typical sections will be selected to best represent different seawall conditions and the possible impacts resulting from seismic damage. Flooding potential will be reported for each seawall reach using the typical section to assess inundation and wave runup potential.

A numeric vulnerability index will be developed as a function of the exposure, sensitivity, and adaptive capacity of the waterfront to sea level rise and flooding. These criteria will consist of numeric rankings related to physical variables, including the inundation depth, the wave height and runup, sea level rise amounts, and the approximate degree of potential impacts and consequences. The increase in flood risk associated with the seawall segments along the San Francisco waterfront over time will be estimated as a function of the flood event likelihoods and consequences.

Based on the results of the vulnerability and risk assessment, adaptation strategies will be described. The strategies will consist of type of adaptation (approach) and approximate time thresholds for implementation. The adaptation approaches developed for the Port (URS and AGS 2012) will be used. The flood vulnerability and adaptation priority will be incorporated into the findings of the structural and geotechnical team members to facilitate the overall seawall improvements strategies.

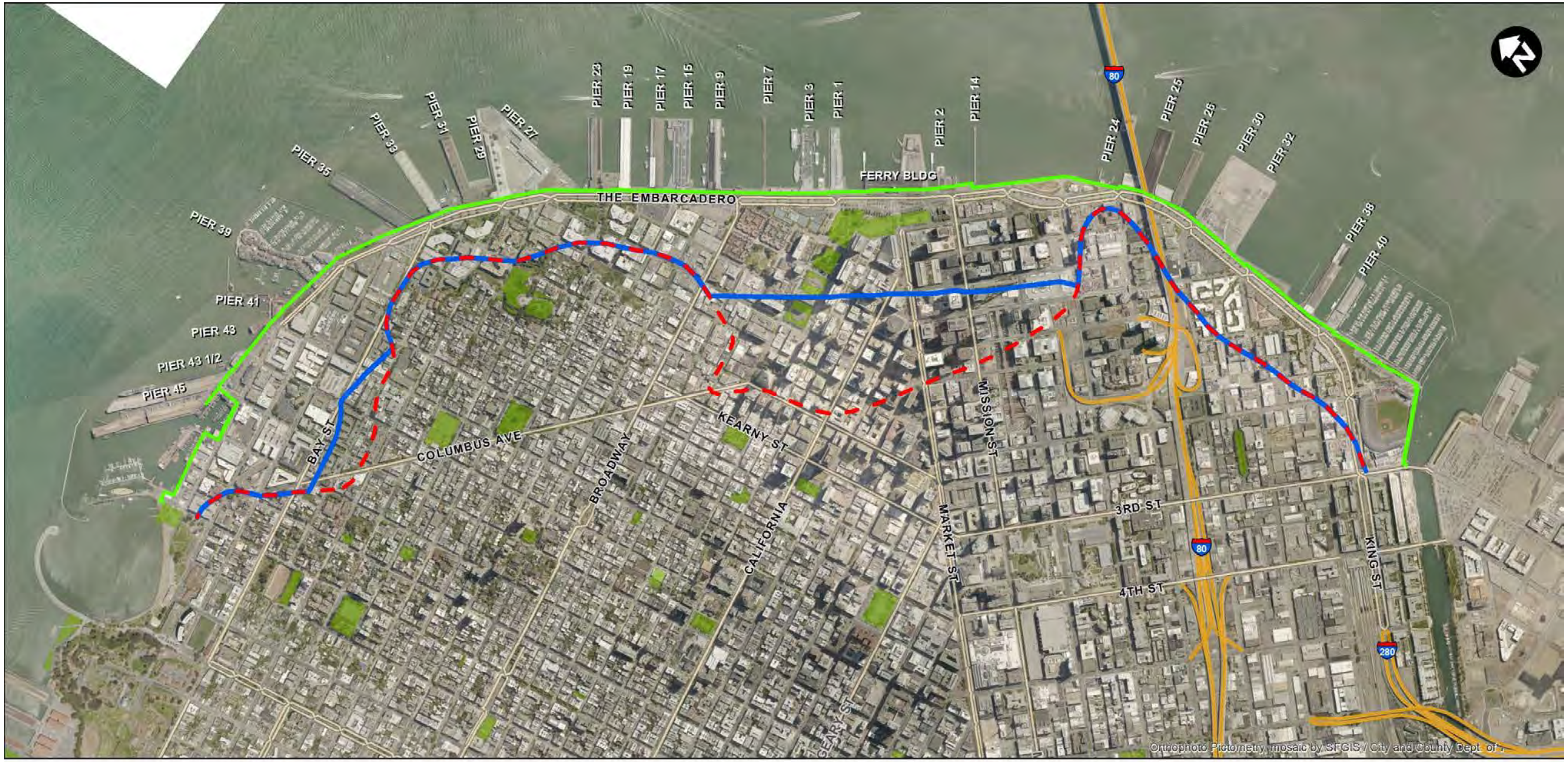
Data Obtained

The following data have been obtained to inform our assessment of flooding and sea level rise:

- Relevant information on jurisdiction, policy, and sea level rise guidance, including the State of California 2013 Sea Level Rise Guidance Document (OPC 2013), and policy and sea level rise guidance recently adopted by the City and County of San Francisco through its OneSF program (CCSF 2014).
- Preliminary FEMA Flood Hazard maps from 2007 and the San Francisco Interim Flood Plain Maps from 2008.
- Sea level rise inundation mapping of San Francisco prepared as part of San Francisco Sewer System Improvement Program (SSIP) (SFPUC 2014).
- Sea level rise mapping and wave runup estimates prepared for the Port of San Francisco (URS and AGS 2012).
- Elevation data and typical seawall sections summarized by the team's structural and geotechnical engineers, including the modified sections representative of damaged conditions associated with a seismic event.

Data Gaps and Assumptions

The analysis described in this report can be completed using the data described above, but could benefit from additional information. Such additional information includes other coastal flood studies that have been completed for the Port and the City of San Francisco, such as a runup study prepared by Coast and Harbor Engineers, and the newly revised provisional FEMA flood hazard maps. Although the Port of San Francisco is reviewing the provisional FEMA maps, the Port expects them to change and doesn't want them used for this study. The study team should review them so that we are familiar with what they show.



LEGEND

- Seawall Bulkhead
- Lateral Spread Hazard Boundary (HLA et al., 1992)
- Zone of Influence, within 1200 feet of the Seawall Bulkhead and within the Lateral Spread Hazard Zone

0 500 1,000 2,000 Feet

Lateral Spread Boundary Source: Harding Lawson Associates (HLA), Dames & Moore, Kennedy/Jenks/Chilton, EQE Engineering, 1992. Final Report, Liquefaction Study, North Beach, Embarcadero Waterfront, South Beach, and Upper Mission Creeek Area, San Francisco, California.

Figure 1-1: – Seawall Zone of Influence Map

Figure 1-2:– Historical Exploration Location Map

2. Introduction

2.1 Background

The Port of San Francisco ("Port") is a self-supporting, municipal enterprise agency overseeing 7-1/2 miles of waterfront property along the San Francisco Bay. The Port has initiated a program to identify and upgrade portions of the waterfront vulnerable to earthquakes, flooding, and climate change.

As such, the Port wishes to undertake an earthquake vulnerability study of the Northern Waterfront Seawall which extends approximately 3 miles from Fisherman's Wharf to Pier 46. Components of the study will include: assessment of available information and condition, state of the art engineering analysis to determine likely damage to the seawall and infrastructure within the zone of influence, economic impacts resulting from multiple earthquake scenarios, development of conceptual level retrofits/costs, and recommendations for implementation of improvements and/or further study.

The overall study consists of three phases: 1) research, data collection and synthesis, 2) earthquake vulnerability study, and 3) recommendations for mitigation of earthquake hazards. This Phase 1 report presents our findings, conclusions and recommendations regarding the research, data collection and synthesis phase of this study.

For the Phase 1 work, GHD/GTC's scope of work, with Port assistance, is to collect and research available information applicable to the project locations including, but not limited to, geotechnical investigation data and reports along the various seawall sections and adjacent locations, bulkhead wharf, pier wharf, and seawall structure condition surveys and associated assessments, rapid structural evaluations, and nearby infrastructure. The information collected will serve as a basis for the Phase 2 assessment of the geotechnical and structural conditions applicable to each seawall section.

Flooding vulnerability will be assessed for intact and damaged seawall conditions associated with seismic events. The assessment will consider existing and higher future sea levels. The scope of work for Phase 1 is to collect and research the available information that will be used to inform the flooding vulnerability assessment. In particular, the data include coastal flooding and sea level rise inundation mapping completed by FEMA, the San Francisco Public Utilities Commission, and the Port of San Francisco. Pertinent jurisdictional, policy and sea level rise guidance issued by the State and the City and County of San Francisco will be reviewed and summarized.

The geotechnical and structural data collection is quite specific for each seawall section delineated in this study, since the specific data will be used to ascertain site-specific hazards and their potential effects on geotechnical and structural damage or failure for each seawall section. Other study disciplines, specifically utilities, flooding and economics are more global in their coverage and do not necessarily lend themselves to such site-specific consideration. The collection of this other discipline data remains in progress but is also summarized in this Phase 1 report.

2.2 Seawall Section Descriptions

This study considers twenty-three seawall sections that are delineated by their approximate time of original construction of the seawall, bulkhead wharf and finger piers. Generally, the more detailed overall descriptions that follow were obtained, for the most part, from the Port of San Francisco's "National Register Nomination, Port of San Francisco Embarcadero Historic District," Section 7, January 2006.

Section FW – Fisherman's Wharf

Seawall Section FW consists of at least six different original types of seawall construction, Types 4, 5, 8, 9, 10 and 11, and from the east and south sides of the Fisherman's Wharf harbor. Seawall Type 4 is adjacent to and aligned along Taylor Street between Jefferson Street and the Embarcadero. Seawall Types 5, and 8, are adjacent to and aligned along Jefferson Street between Taylor Street and Jones Street. Seawall Types 9, 10 and 11 form the bulkhead walls for Wharf J5, J9 and J10, respectively.

Section B – 1000 Feet Between Taylor and Powell Streets (Piers 43, 43.5, 45)

Seawall Section B consists of three pier and seawall configurations that presently differ from one another.

The Pier 45 section of the bulkhead wharf stretches 663 feet along the waterfront from east of the foot of Taylor Street to the foot of Jones Street. East of Taylor Street, it overlaps Section B. It is 46 feet wide. It was built in 1926-1929.

The Pier 45 bulkhead wharf is an unusual structure both in the design of its parts and in the fact that it is built through a solid rock fill rather than over water. Its parts are like other bulkhead wharves, consisting of a concrete deck that spans from the seawall to the water front line with intermediate support from concrete piles. However, instead of the usual straight alignments of piles between the seawall and the water front line, the piles are in a complex pattern created by the juxtaposition of three different patterns within the area of the bulkhead wharf. From the seawall, there are perpendicular alignments of piles. Other alignments of piles parallel to the axis of the pier, which is diagonal to the seawall, intersect with the first alignments of piles in an irregular pattern. Overlaid on these are three curving alignments of piles for rail spurs.

The buildings associated with Pier 45 are all on the piers so that the bulkhead wharf is open.

Visible changes to the Pier 45 Section of the bulkhead wharf are repaving of the asphalt surfaces and removal of the Belt Railroad tracks. In addition, the bulkhead wharf may have been altered along with Pier 45 when that structure was strengthened following the 1989 Loma Prieta earthquake (Port of San Francisco 2004).

Pier 43.5 was partially demolished and a new promenade structure constructed in its place in 2011. This upgrade project may have resulted in a seismic separation of the new substructures from the seawall structure in this seawall section.

Pier 43 remains as a smaller version of its original condition.

Section A – 561 Feet Between Powell and Stockton Streets (Pier 41)

Seawall Section A originally consisted of one type of seawall, designated Type 1 on the original construction drawings. This seawall type consists of a concrete cutoff wall about 8.5 feet high from top of rock dike to bottom of wharf deck. The seawall fronts a marginal wharf and existing Pier 41 substructures.

Section 1 – 1158 Feet Between Stockton and Kearney Streets (Pier 39)

Seawall Section 1 originally consisted of one type of seawall, designated Type 1 on the original construction drawings. This seawall type consists of a concrete cutoff wall about 8.5 feet high from top of rock dike to bottom of wharf deck. The seawall fronts a marginal wharf and existing Pier 39 substructures.

Section 2 – 1000 Feet Between North Point and Francisco Streets

Section 2 of the bulkhead wharf is in two parts built on Section 2 of the seawall. Section 2 of the seawall is 1,000 feet long and was built in 1878-1880. Section 2 stretches from the foot of North Point Street on the north, almost to the foot of Francisco Street on the south.

The northernmost of the two parts of Section 2 of the bulkhead wharf was built in 1914-1916 in association with Pier 35. The details of the construction of this part of the bulkhead wharf are not known. The floor framing plan is a consistent grid from one end to the other, except for additional support where the Belt Railroad crossed the bulkhead wharf from the Embarcadero to the aprons on each side of the pier. As this structure has been described as similar to the bulkhead wharf at Piers 19, 29, and 39, this part of the bulkhead wharf is probably supported on alignments of concrete piles from the seawall to the water front line.

The southernmost of the two parts of Section 2 of the bulkhead wharf was built in 1917-1919 in association with Pier 33. A plan of the inner end of the substructure of Pier 33 s hows an irregular bulkhead wharf structure of varying widths — 44 feet at the north end and in front of the pier, nearly 50 feet at the south side of the pier, and 42 feet at the south end. For most of its length there appear to be alignments of three piles between the top of the seawall and the water front line. In some of the first and last bays of the grid of the deck between the seawall and the water front line, there are additional supports parallel to the water front line. There are also additional supports in two curving alignments of the Belt Railroad onto the pier and for "Globe Milling Co.'s Tunnel."

Outshore of the bulkhead wharf between Piers 35 and 37 there is a connecting wharf, originally described as being: "irregular in shape but has an average length of 285 feet and an average width of 90 feet. The wharf, which was elevated truck height above the street, was constructed on t imber piles with precast reinforced concrete jackets and the timber deck was paved with asphalt. The building is a timber structure with continuous steel rolling doors along the Embarcadero.)".

The building has been demolished, but the wharf remains.

Outshore of the bulkhead wharf between Piers 31 and 33 and outside of the historic district boundaries, there is a connecting wharf, built in 1962, that expands the open space between the piers. Roughly half of this appears to be outshore of Section 2 and half outshore of Section 3 of the bulkhead wharf. There are mooring bitts and fenders at the outshore edge of this extended wharf.

In association with Section 2 of the bulkhead wharf, the wood shed on the connecting wharf between Piers 35 and 37, part of which stood in Section 2, has been removed and the surface of the wharf has been altered. Apart from this, the major structures associated with the Section 2 bulkhead wharf remain — Pier 35 and Pier 33 and the sections of the bulkhead wharf, the bulkhead buildings, and the piers and transit sheds. The Belt Railroad tracks have been removed and the paved asphalt surface has been repaved. The substructure of Section 2 appears little altered. The altered connecting wharf between Piers 35 and 37 post dates the district's period of significance and therefore is outside the district boundaries.

Seawall Section 2 originally consisted of one type of seawall, designated Type 1 on the original construction drawings. This seawall type consists of a concrete cutoff wall about 9 feet high from top of rock dike to bottom of wharf deck. The seawall fronts a marginal wharf and ex isting Piers 35 and 33 substructures.

Section 3 – 1000 Feet Between Francisco and Lombard Streets

Section 3 of the bulkhead wharf was built in three reinforced concrete sections. It was built on Section 3 of the seawall, a 1,000 foot long structure built in 1879-1881. The three parts were built in association with Pier 29 in 1915-1916, Pier 31 in 1917-1918, and Pier 27 in 1918-1919.

Section 3 stretches from the foot of Lombard Street to a point west of the foot of Francisco Street.

The portion of the bulkhead wharf built in association with Pier 29 was described at the time it was built as "a section of reinforced concrete bulkhead wharf, 44 feet wide and 608 feet long, extending each side of the pier. This bulkhead wharf is similar in type to that described in connection with Pier 39". This is a wharf that spans the distance from the top of a new concrete retaining wall on top of the rock seawall to the water front line on four concrete piles. These support "a reinforced concrete deck paved with asphalt."

The portion of the bulkhead wharf built in association with Pier 31 is a reinforced concrete structure 256 feet long and 45 feet wide. Engineering drawings show this to be similar in construction to the bulkhead wharf at Pier 29, with the bulkhead wharf supported on alignments of four concrete piles between the top of the seawall and the water front line.

Outshore of the bulkhead wharf between Piers 29 and 31, there is a concrete connecting wharf on concrete piles measuring 150 feet wide and 245 feet long. Linking Piers 29 and 31 is a single bulkhead building that sits on the bulkhead wharf and the connecting wharf.

Outshore of the bulkhead wharf between Piers 31 and 33, there is a connecting wharf, built in 1962, that expands the open working area between the piers. Roughly half of this appears to be outshore of Section 2 and half outshore of Section 3 of the bulkhead wharf. There are mooring bitts and fenders at the outshore edge of this extended wharf. This connecting wharf is within the district boundary because it is an integral part of the Piers 31 and 33 resource complex.

The portion of the bulkhead wharf built in association with Pier 27 is "of typical reinforced concrete pile construction." It is 45 feet wide and, together with the adjoining wharf in section 4, is 303 feet long. Pier 27 itself has been demolished and the outshore area of the southern part of Section 3 of the bulkhead wharf is a connecting wharf between Pier 29 and the modern Pier 27 built in 1965.

Section 3 of the bulkhead wharf appears to be little altered except for removal of the Belt Railroad tracks, repaving of its original asphalt surface, and construction of an office building on its surface between Pier 27 and Pier 29 in 1962.

Seawall Section 3 originally consisted of one type of seawall, designated Type 1 on the original construction drawings. This seawall type consists of a concrete cutoff wall about 9 feet high from top of rock dike to bottom of wharf deck. The seawall fronts a marginal wharf and existing Piers 31 and 29 substructures.

Section 4 – 1000 Feet Between Lombard and Union Streets

Section 4 of the bulkhead wharf was built in two parts independently of the piers in Section 4. Originally built for old wood piers 21, 23, 25, and part of 27, today most of Pier 19, Pier 23, and part of Pier 27 Terminal are standing along Section 4 and the Pier 23 Restaurant sits on the bulkhead wharf for Section 4. Section 4 stretches 1,000 feet from a point between the foot of Union and the foot of Filbert streets to the foot of Lombard Street.

The part of the bulkhead wharf stretching from the north side of old Pier 25 to approximately the midpoint of old Pier 27 — an area largely abutting Pier 27 Terminal today — at the north end of Section 4, was built in 1920. Nothing is known about this except that it is of reinforced concrete construction.

The part of the bulkhead wharf at the southern end of Section 4, stretching from old Pier 21 to old Pier 25 — the area between Pier 19 and Pier 27 Terminal today — is of "reinforced concrete pile construction." It is 46 feet wide and 745 feet long. It is "of standard design". No other details are known about this structure.

Since the period of significance, Piers 27 and 25 have been removed along with their bulkhead buildings. In addition, Pier 27 Terminal has been built. The bulkhead wharf substructure itself appears to remain intact.

Seawall Section 4 originally consisted of two types of seawall, designated Types Y and Z on the original construction drawings. These seawall types consist of a concrete cutoff and concrete bulkhead walls. The seawall fronts a marginal wharf and existing Piers 27, 23 and 19 substructures.

The seismic retrofit of Pier 27 in the 1990s resulted in a seismic separation of the substructure from the seawall structure in this seawall section.

Section 5 – 1000 Feet Between Union and Vallejo Streets

Section 5 of the bulkhead wharf is in four parts, built on Section 5 of the seawall — 1,000 feet long — built in 1883-1884. The four parts were built between 1912-1913 and 1921-1922. Section 5 of the bulkhead wharf is described below from north to south.

The northernmost section was built in 1921-1922. According to an early description, it measures 745 feet along the waterfront and is 46 feet wide (BSHC 1921: 53). Plans of Pier 19 show it to be 60 feet wide at that point. A photograph of this portion of the bulkhead wharf under construction appeared in the biennial report for 1920-1922. The south side of Pier 19 projects into the bay from the north end of Section 5 of the bulkhead wharf — the rest of Pier 19 is in Section 4.

The Board of State Harbor Commissioners described this part of the bulkhead wharf as "of reinforced concrete of standard design". The only available detail about this design is from a plan of the similarly designed Pier 23 prepared by the Board of State Harbor Commissioners, indicating that the deck of the bulkhead wharf is supported by alignments of five piles from the top of the seawall to a point just short of the water front line with a cantilever past the last pile to the water front line.

The next part of Section 5 of the bulkhead wharf to the south, measuring 324 feet along the waterfront, was completed in 1912 as part of Pier 17. The concrete deck of the bulkhead wharf rests on alignments of four concrete piles. Although described as sixty feet wide, drawings indicate that the distance from the top of the seawall to the water front line is only about 45 feet, a distance consistent with the use of four piles.

The next part of Section 5 of the bulkhead wharf to the south was built in 1914-1915 in association with old Pier 15, a wood structure. This was replaced by a concrete Pier 15 in 1930-1931. The bulkhead wharf measures 101 feet along the waterfront and 41 feet from the top of the seawall to the water front line. It is "supported on reinforced concrete piles driven through the old rock seawall. There is a concrete retaining wall at the inside, carried down to thirteen feet below city base and resting on wooden piles also driven through the seawall. The deck is of the usual girder, beam and slab type and is paved with asphalt".

The southernmost part of Section 5 of the bulkhead wharf was built in 1916-1917 adjacent to an existing wood pier, Pier 11 (demolished prior to 1936). The design of this part of the bulkhead wharf was described by the Board of State Harbor Commissioners as similar to Piers 29 and 39. Only Pier 39 has been described by the Board of State Harbor Commissioners: concrete piles were driven through the old rock seawall, “supporting a concrete deck paved with asphalt. The retaining wall is 16 inches thick and is carried down to nine feet below city base.” From a plan of Pier 39, it appears that the bulkhead wharf was supported by four concrete piles between the seawall and the water front line.

Today, there are mooring bitts and a mooring cleat (defined in Definitions – Section 8) along the edge of the bulkhead wharf between Pier 9 and Pier 15, and there are mooring bitts between Pier 17 and Pier 19.

Since the end of the period of significance, Section 5 of the bulkhead wharf has changed in the following ways: asphalt surfaces have been repaved, Belt Railroad tracks have been removed, and Piers 15 and 17 have been connected by the construction of a connecting wharf the entire length of the piers, referred to by Port’s Engineers as a pier “Valley”. The construction of this connecting wharf allowed the piers to be adapted to truck transportation, with truck traffic entering the complex across the bulkhead wharf.

Seawall Section 5 originally consisted of two types of seawall, designated Types X and W on the original construction drawings. These seawall types consist of a concrete cutoff and concrete bulkhead walls. The seawall fronts a marginal wharf and existing Piers 17 and 15 substructures.

The seismic retrofit of Piers 15-17 as a part of the Exploratorium seismic upgrades in the 2000s may have resulted in a seismic separation of the substructures from the seawall structure in this seawall section.

Section 6 – 800 Feet Between Vallejo and Pacific Streets

Section 6 of the bulkhead wharf was built in three parts from south of the foot of Pacific Avenue to the foot of Vallejo Street. It is built on Section 6 of the seawall which is 800 feet long.

The first part of this portion of the bulkhead wharf was built in association with Pier 7 in 1915-1916. This is a reinforced concrete structure measuring 363 feet along the waterfront and 44 feet from the top of the seawall to the water front line. A reinforced concrete deck spans this distance on alignments of five concrete piles. The deck rests on a new concrete retaining wall built on the old rock seawall. While Pier 7 and its transit shed have been destroyed, a portion of the remodeled bulkhead building still stands on the bulkhead wharf.

The second part of this portion of the bulkhead wharf was built in 1917, measuring 233 feet along the water front line and 44 feet from the top of the seawall to the water front line. “It is the typical reinforced concrete bulkhead wharf construction on concrete piles” (BSHC 1919: 38).

Engineering plans show this as consisting of a reinforced concrete deck supported on alignments of four concrete piles outshore of the seawall. The deck is supported on a grid of beams with additional beams perpendicular to the seawall in many cells of the grid near the seawall and near the water front line. There are also additional supports in a curving alignment for a spur of the Belt Railroad. The Pier 9 bulkhead building sits on this portion of the bulkhead wharf.

The third part of the bulkhead wharf was built in 1920 at Pier 5 — this part overlaps the line between Section 6 and Section 7 of the bulkhead wharf. This is a “typical reinforced concrete pile structure” measuring 311 feet along the waterfront and 45 feet from the top of the seawall to the water front line. In addition, along the north end of this structure, there is “a creosoted pile addition” (BSHC 1921: 36-37) — a connecting wharf — measuring 15 or 16 feet wide and 154 feet long. The concrete deck rests on alignments of four concrete piles outshore of the seawall. The deck is framed in a continuous grid of reinforced concrete beams except for extra supports in a curving alignment for a spur of the Belt Railroad.

The original asphalt paving of the deck has been replaced. This part of the bulkhead wharf supports the Pier 5 bulkhead building.

There are mooring bitts along the edge of the bulkhead wharf between Pier 7 (Waterfront Restaurant) and Pier 9.

The principal alterations to Section 6 of the bulkhead wharf since the end of the period of significance are the removal of the Belt Railroad tracks, repaving the asphalt surfaces, and establishment of a park on the surface between Pier 5 and Pier 7 (Waterfront Restaurant). A new structure called Pier 7 was built for fishing and pedestrian access to the waterfront in the 1990s — this is outside the district boundaries. In addition, portions of the old Pier 7 bulkhead building were removed after a fire in 1973.

The substructure of Section 6 appears little altered since the period of significance.

Seawall Section 6 originally consisted of one type of seawall, designated Type W on the original construction drawings. This seawall type consisted of a concrete cutoff wall 10 feet high. The seawall fronts a marginal wharf and existing Piers 9 and 7 substructures.

Section 7 – 980 Feet Between Pacific and Clay Streets

Following construction of Section 7 of the seawall in 1887-1889, Section 7 of the bulkhead wharf was built in six parts, described below from south to north. The first part, built in association with the Ferry Building, is described with Sections 8a and 8b of the bulkhead wharf.

The second part of the Section 7 bulkhead wharf, built in two phases in 1909 for Pier 1, stretches 274 feet north from the Ferry Building and then another 679 feet north of that. This is the most complicated section, because the third part, a 1930 structure is “constructed over” it. It is not clear how much of the 1909 structure survives. The 1909 structure was built with an average distance of over 26 feet from the seawall to the water front line. This was accomplished in two spans of steel I-beams — almost fourteen feet from the seawall to a central line of piles and a second span to piles at the water front line. By 1924, this part of the bulkhead wharf was developed as an automobile ferry terminal with a large flat roofed shed extending from the north end of the Ferry Building. Automobiles drove through this shed to ferry slips A and 1. This structure was removed by 1949 (Sanborn Map Company 1949), probably because of the changing transportation patterns associated with the Bay Bridge.

On top of this, the third part extends beyond it to the north. This 1930 structure also reaches from the seawall to the water front line in two spans. The distances of these spans are less than those of the 1909 structure. The outshore line of piles is inset from the water front line so the deck is cantilevered to the water front line. Except for rail spur supports, the details of the construction of this part of the bulkhead wharf are unknown. The Pier 1 bulkhead wharf is part of Pier 1. It supports the Pier 1 bulkhead building.

Fourth, the Pier 3 bulkhead wharf, built in 1917-1918, is 423 feet long. Although details of this structure are not clear, a section drawing shows that it reaches 44 feet 8 inches from the seawall to the water front line in four spans. The Pier 3 bulkhead wharf is part of Pier 3. It supports the Pier 3 bulkhead building.

Fifth, the Pier 5 bulkhead wharf, built in 1920, is 311 feet long and about 45 feet wide from the seawall to the water front line. The wharf spans the distance in four equal spans. The piles and deck are of reinforced concrete construction. The central area of this part of the bulkhead wharf was designed to connect with Pier 5. Except for supports in a diagonal path for a rail spur, there is no structural difference between the portion adjacent to the pier and those portions between piers. The outshore edges of the wharf between piers are fitted with car springs and wood pile fenders. The Pier 5 bulkhead wharf supports the Pier 5 bulkhead building. Sixth, the Pier 1 bulkhead wharf replaced portions of the 1909 bulkhead wharf or was “constructed over” it. This is a reinforced concrete structure measuring 210 feet long and about 40 feet wide.

Changes to the Section 7 bulkhead wharf since the period of significance are replacement of the original asphalt surface, removal of the Belt Railroad tracks, and construction of a connecting wharf known as Pier 1/2 between the bulkhead wharf and the south apron of Pier 1 in 2002.

Seawall Section 7 originally consisted of four types of seawall, designated Types W, V, U and T on the original construction drawings. These seawall types consisted of a concrete cutoff and bulkhead walls. The seawall fronts a marginal wharf and existing Pier 3 and Pier 1 substructures.

Section 8a – 392 Feet Between Clay and Market Streets

Section 8a of the bulkhead wharf — otherwise known as the foundation of the Ferry Building — is part of a continuous substructure for the Ferry Building that also includes portions of Section 8b and Section 7. The front wall of the Ferry Building appears to rest on the seawall while the projecting central pavilion sits slightly inshore of the seawall (*Engineering News* 1897: 67). The entire structure was described at the time it was built by Howard C. Holmes, Chief Engineer:

“The foundation of the approaches to ferry slips Nos. 2, 3, 4, 5 and 6, which will also serve as foundation for the new union depot and ferry house, was completed Sept. 1, 1895. The same consists of 111 concrete piers of the dimensions of 16 by 28 ft. at the base and of 8½ by 28 ft. at the top, with a depth of 20 ft. below city base, and also portion of the concrete seawall in front of Section 8a and 8b. These are joined together by a series of groined concrete arches (2 ft. thick at the soffit) into one immense area of floor space, 160 ft. in width by 670 ft. in length. This enormous foundation rests on a sub-foundation of grillage supported by over 5,000 piles, each not less than 80 ft. in length; 28,000 cu. yds. of concrete with 36,000 bbls of cement were required in the construction of the arches and floors. Assuming the weight of concrete to be 4,000 lbs. per cu. yd., the total weight of this structure would be 112,000,000 lbs., or 56,000 net tons. (*Engineering News* 1897: 66)”.

The structure itself appears to remain intact as it was built. The ferry slips behind it were removed after the period of significance, and replaced by a concrete platform associated with the BART tunnel under the bay. The Ferry Building has undergone two major conversions since the end of the period of significance — most recently (2003) as a market hall and office complex.

Seawall Section 8a originally consisted of one type of seawall, designated Type S on the original construction drawings. This seawall type consisted of a concrete bulkhead wall 17’-10” high. This seawall fronts the Ferry Plaza substructure.

The seismic retrofit of the Ferry Plaza in the 1990s resulted in a seismic separation of the substructure from the seawall structure in this seawall section.

Section 8b – 450 Feet Between Market and Mission Streets

Section 8b of the bulkhead wharf, stretching 350 feet along the waterfront is in three parts built from south to north in association with the Post Office (now Agriculture Building), the Ferry Building Extension, and the Ferry Building.

At the south end, Section 8b forms a small part of the substructure for the Agriculture Building, most of which sits on Section 8. The substructure for the Agriculture Building, built in 1915, appears to be a reinforced concrete structure. The details of the construction of this substructure are unknown. The Agriculture Building still stands on this portion of Section 8b of the bulkhead wharf.

In the middle, Section 8b appears to be a reinforced concrete portion of a larger structure built in 1915 and partly demolished in the 1960s, along with the Ferry Building extension on top of it. That portion of the structure that functions as a bulkhead wharf, extending from the top of the seawall to the toe of the seawall, appears to survive. Its original asphalt surface has been repaved.

At the north end, Section 8b of the bulkhead wharf — otherwise known as the foundation of the Ferry Building — is part of a continuous substructure for the Ferry Building that also includes portions of Section 8a and Section 7. The front wall of the Ferry Building appears to rest on the seawall while the projecting central pavilion sits slightly inshore of the seawall (*Engineering News* 1897)

The entire structure was described at the time it was built by Howard C. Holmes, Chief Engineer: "The foundation of the approaches to ferry slips Nos. 2, 3, 4, 5 and 6, which will also serve as foundation for the new union depot and ferry house, was completed Sept. 1, 1895. The same consists of 111 concrete piers of the dimensions of 16 by 28 ft. at the base and of 8½ by 28 ft. at the top, with a depth of 20 ft. below city base, and also portion of the concrete seawall in front of Section 8a and 8b. These are joined together by a series of groined concrete arches (2 ft. thick at the soffit) into one immense area of floor space, 160 ft. in width by 670 ft. in length. This enormous foundation rests on a sub-foundation of grillage supported by over 5,000 piles, each not less than 80 ft. in length; 28,000 cu. yds. of concrete with 36,000 bbls. of cement were required in the construction of the arches and floors. Assuming the weight of concrete to be 4,000 lbs. per cu. yd., the total weight of this structure would be 112,000,000 lbs., or 56,000 net tons. (*Engineering News* 1897)

The three parts of Section 8b have been altered by the loss of the ferry slips and associated structures behind Section 8b (all removed after the period of significance) and by the partial demolition of the middle section to accommodate BART.

Seawall Section 8b originally consisted of one type of seawall, designated Type R on the original construction drawings. This seawall type consisted of a concrete bulkhead wall 17'-10" high. This seawall fronts the Ferry Plaza substructure.

The seismic retrofit of the Ferry Plaza in the 1990s resulted in a seismic separation of the substructure from the seawall structure in this seawall section.

Section 8 – 300 Feet Between Mission and Point North of Howard Streets

Section 8 of the bulkhead wharf, located south of the Ferry Building, appears to be a reinforced concrete structure built in association with the Post Office (now Agriculture Building) in 1915. It is a four-sided structure measuring roughly 280 feet along the Embarcadero, 90 feet wide at its south end, and 125 feet wide at its north end. The Agriculture Building still stands, approximately, on the north half of the bulkhead wharf. The details of the construction of Section 8 of the bulkhead wharf are unknown.

Principle changes to the Section 8 bulkhead wharf since the period of significance are the demolition of the Railway Express Company buildings south of the Agriculture Building and the demolition of ferry slips and dolphin sheds outshore of the bulkhead wharf. In addition, the original asphalt surfaces have been replaced. From what is known, the structure of Section 8 appears little altered.

Seawall Section 8 originally consisted of one type of seawall, designated Type Q on the original construction drawings. This seawall type consisted of a concrete bulkhead wall 30 feet high. This seawall fronts the Pier 2 marginal wharf and substructure.

Section 9a – 990 Feet South of Mission to Folsom Street

Seawall Section 9a originally consisted of one type of seawall, designated Type P on the original construction drawings. This seawall type consists of a bulkhead wall about 13 feet high from top of rock dike to bottom of wharf deck. The seawall originally fronted a marginal wharf and a number of piers along the entire length of this seawall section. Most of this marginal wharf and pier substructure has been removed or modified. Presently, a new Pier 14 substructure is all that exist along this seawall section. The new Pier 14 is deemed to not provide any significant structural support for this seawall section.

Section 9b – 788 Feet Between Folsom and Harrison Streets

Seawall Section 9b originally consisted of one type of seawall, designated Type P on the original construction drawings. This seawall type consists of a concrete bulkhead wall about 13 feet high from top of rock dike to bottom of wharf deck. The seawall originally fronted a marginal wharf and a number of piers along the entire length of this seawall section. Most of this marginal wharf and pier substructure has been removed or modified. Presently, a downsized Pier 22.5 substructure is all that exists along this seawall section.

Section 9 – 990 Feet South of Mission to Folsom Street

Section 9 of the bulkhead wharf stretches 999 feet along the Embarcadero in three legs in the form of a wide "U." The southernmost leg, beginning south of the intersection of Bryant and Spear streets, is 210 feet long. This leg forms an obtuse angle with the central leg, 539 feet long. The central leg forms an obtuse angle with the northernmost leg, 250 feet long, which terminates at the foot of Harrison Street. The entire structure was built in 1909-1910.

This is a reinforced concrete structure whose details are little known due to a lack of documentation. Extrapolating from a superseded plan for the wharf (designed to accommodate three piers, it was reconfigured for two piers), and from section drawings of Pier 26 and Pier 28, the design appears to follow the example of other early bulkhead wharves which were built as one structure with two types of construction according to location and original purpose. For those sections of the bulkhead wharf that adjoin the piers, the bulkhead wharf appears to consist of a single 27 foot span from the seawall to a row of heavy piles at the water front line. These areas are crossed by reinforced paths for rail spurs.

For those sections of the bulkhead wharf between the piers, the bulkhead wharf appears to consist of a span from the seawall that cantilevers beyond an inset row of piles. The outshore edge of the cantilevered deck is outfitted with wood fender piles.

Between Pier 32 and Pier 28 there are mooring bitts along the edge of the bulkhead wharf at the water front line. The only known changes to Section 9 of the bulkhead wharf since the period of significance appear to be replacement of the original asphalt paving with concrete and removal of the Belt Railroad tracks.

Seawall Section 9 originally consisted of one type of seawall, designated Type O on the original construction drawings. This seawall type consisted of a concrete bulkhead wall 30 feet high. This seawall fronts the marginal wharf and the Pier 26 and 28 substructures.

Section 10 – 537 Feet North of Beale to Main Street

Section 10 of the bulkhead wharf stretches 537 feet along the Embarcadero from a point between the foot of Beale Street and the foot of Main Street on the south to the foot of Spear Street on the north. Built in 1910-1911 for Piers 30 and 32, it runs from the mid-point of Pier 32 on the south to the north edge of Pier 30 on the north.

Section 10 of the bulkhead wharf is a rectangular structure measuring 537 feet along the waterfront by 27 feet from the seawall to the water front line. Although a single structure, its design varies according to its location and original purpose. For 108 feet on the north side of its junction with Pier 32 and for 218 feet at its junction with Pier 30, it is designed to carry loads associated with transit sheds and rail spurs and built to an elevation of 1.5 feet above City Base. For 206 feet between the piers, it is designed for lighter loads and is built to an elevation of City Base.

For those portions designed to meet the piers, Section 10 of the bulkhead wharf consists of twenty-six to thirty inch steel I-beams that span the 27 feet from the seawall (labeled "retaining wall" on the drawings) to a heavy reinforced concrete pile at the water front line. Supports for three rail spurs cross Pier 30.

For those portions designed for the area between the piers, twenty-inch I-beams are cantilevered. The outshore edge of the Section 10 bulkhead wharf abuts the piers and connecting wharf of Pier 30-32.

The only changes to Section 10 of the bulkhead wharf since the period of significance appear to be replacement of the original asphalt paving and removal of the Belt Railroad tracks. The setting has changed with the construction of a connecting wharf between Pier 30 and Pier 32 in 1952, and with the loss by fire of the Pier 30-32 sheds in 1984.

Seawall Section 10 originally consisted of one type of seawall, designated Type N on the original construction drawings. This seawall type consisted of a concrete bulkhead wall 30 feet high. This seawall fronts a marginal wharf and the Pier 30-32 substructures.

Section 11a – 281 Feet South of Main to Beale Street

Section 11a of the bulkhead wharf stretches 281 feet along the Embarcadero from the foot of Beale Street near its intersection with Brannan Street to the midpoint of Pier 32.

Section 11a of the bulkhead wharf was built in 1912-1914 together with Piers 30-32, most of which lie to the north of Section 11a. The structure is 281 feet long and 51 feet wide from the seawall to the water front — the "true water front line" is up to seven feet outshore of the edge of the bulkhead wharf. The south end of the structure, 177 feet long, runs between the north side of the site of Pier 34 on the south and Pier 32 on the north at an elevation of the City Base. The north end, 104 feet long, meets Pier 32 at an elevation of 1.5 feet above City Base.

Although the Section 11a bulkhead wharf serves two functions (it is between piers and it meets a pier), it is structurally consistent from one end to the other. The bulkhead wharf is generally supported on a grid of concrete piles so that there are rows of five piles between the seawall and the water front line. The outermost piles are inset from the edge of the reinforced concrete deck so that it is cantilevered to the water front line. The grid of beams on the deck is interrupted by supports for a rail spur in a gently curving alignment.

At either end of the Section 11a bulkhead wharf, there are concrete retaining walls similar in design but perpendicular to the seawall. They are concrete structures two feet wide at the top and seven feet wide at the bottom. Elements labeled "the old seawall" on Port drawings contribute to the support of the deck, sometimes in place of the concrete piles.

Changes to the Section 11a bulkhead wharf since the period of significance include replacement of the original asphalt surfaces and removal of the Belt Railroad tracks.

The Section 11a seawall bulkhead wall, 14 feet high, does not appear to have been significantly modified since its original construction. As a result of the Brannan Street Wharf construction in 2013, the marginal wharf was removed and the bulkhead wall height reduced about 2 feet. The new Brannan Street Wharf structure is not structurally connected to the seawall in this seawall section.

Section 11 – 353 Feet North of Beale to Fremont Street

Section 11 of the bulkhead wharf stretches 353 feet along the waterfront from a point north of the foot of Fremont Street to the foot of Beale Street near its intersection with Brannan Street. The south end of this portion of the bulkhead wharf is about 44 feet north of Pier 36.

Section 11 of the bulkhead wharf was built in 1909-1910. The contract for construction covered an area 353 feet long and 60 feet wide. The bulkhead wharf itself is 25 feet wide from the water front line to the seawall. From the seawall to the curb of the Embarcadero is 35 feet.

Section 11 of the bulkhead wharf is a single structure with two types of construction. Unlike Section 12, these are not given different names but are described on the drawings simply by their locations: for example, "section at pier" and "section between piers." The section at the pier is of heavier construction than the sections between piers. The section at the pier is built to an elevation of 1.5 feet above City Base while the sections between piers are built to City Base.

The bulkhead wharf at the point where it previously met with Pier 34 is 121 feet across. In that area, the upper portion of the seawall appears to be part of the new structure — the rock base of the seawall was built in 1908-1909 (BSHC 1910: 84, 86). This portion of the seawall consists of a concrete block on top of a rock base. The concrete block is twenty feet high, three feet wide at the top and seven feet wide at the bottom with a straight wall on the inshore side and a battered wall on the outshore side. The 25-foot distance between the seawall and piles at the water front line is spanned by 24-inch steel I-beams encased in concrete. The reinforced concrete piles at the water front line are three feet six inches in diameter.

The lengths of the bulkhead wharf on either side of the former site of Pier 34 are built with eighteen-inch steel I-beams encased in concrete spanning twenty feet from the seawall to wood piles (two foot diameters) with reinforced concrete casings. These I-beams are cantilevered an additional five feet to the water front line.

Both portions of the bulkhead wharf are covered by a deck of steel I-beams encased in concrete supporting a six-inch reinforced concrete slab that extends inshore to a curb at the Embarcadero. Built into the deck adjacent to the former location of Pier 34 are supports for a rail line.

The only changes to the bulkhead wharf in Section 11 since the period of significance appear to be replacement of the original asphalt surfaces and removal of the Belt Railroad tracks.

The Section 11 seawall bulkhead wall, 20 feet high, does not appear to have been significantly modified since its original construction. As a result of the Brannan Street Wharf construction, the marginal wharf and Piers 34 and 36 have been removed and the bulkhead wall height reduced about 2 feet. The new Brannan Street Wharf structure is not structurally connected to the seawall at this seawall section.

Section 12 – 1167 Feet Between Fremont and King Streets

Section 12 of the bulkhead wharf stretches 1,167 feet along the waterfront from the foot of King Street to the foot of Fremont Street. In plan, it consists of two straight legs that meet near the intersection of Townsend and First streets in an obtuse angle. These legs were built about the same time — both were completed in 1909 — to somewhat different designs under different contracts by different construction companies.

The northern leg was built in 1908-1909. Drawings for the structure show that the contract covered an area that measured 600 feet along the Embarcadero by 60 feet wide from the water front line to the street curb on the Embarcadero. The bulkhead wharf itself is 24 feet wide from the water front line to the top of the seawall. It appears that the seawall was provided with a new concrete top section as part of the construction of the bulkhead wharf.

The north leg of the bulkhead wharf is a single structure with two types of construction corresponding on the one hand to those areas which would meet Piers 36 and 38, and on the other hand to the areas between the piers. Those areas adjacent to the piers, which the drawings called “pier approaches,” are of more massive construction and rise to an elevation of 1.5 feet above City Base — in contrast to the connecting wharves between the piers, called “bulkheads,” which are at the same elevation as the City Base.

For the pier approaches, twenty-six-inch steel I-beams encased in concrete span the area from the top of the seawall to reinforced concrete piles at the water front line. The piles are 3.5 feet in diameter. For the connecting wharves, eighteen-inch steel I-beams encased in concrete span the area from the top of the seawall to a line of wood piles “protected with reinforced concrete” (two feet in diameter). These are set back five feet from the water front line so that the deck of the wharf cantilevers to the water front line. The deck itself is outfitted with mooring bitts. Both the pier approaches and the connecting wharves are covered by a deck of steel I-beams encased in concrete supporting a six-inch reinforced concrete slab that extends inshore to a granite curb at the Embarcadero. The concrete slab was originally topped with two inches of asphalt paving. Crossing portions of both types of construction on the north leg, there is a diagonal path of supports in the deck for one rail spur into Pier 36.

The southern leg of the Section 12 bulkhead wharf is less completely documented than the northern leg. While it was built under a single contract, drawings are available only for the pier approach to Pier 40 — there are no drawings of the connecting wharves on either side of Pier 40.

The pier approach to Pier 40 measures 130 feet along the Embarcadero, 26 feet across from the water front line to the seawall, and 60 feet from the water front line to the curb of the Embarcadero. The design is different from the northern leg in two respects. This section of the bulkhead wharf is tied into the seawall and the fill behind it by reinforced concrete wing walls at either end, each measuring twenty feet long, four feet across, and thirteen feet high. While the wharf also spans the area between the seawall and the water front line on a twenty-six-inch steel I-beam, here each beam is supported at its outshore end by two piles each about two feet in diameter. One of these is inset four feet from the water front line and one is at the water front line. The inner pile is a “wood pile protected by concrete casing” beneath a reinforced concrete pile. The outer pile is reinforced concrete. The deck structure and paving are similar in design to those for the northern leg.

Changes to the bulkhead wharf in all of Section 12 since the period of significance are replacement of the original asphalt surface, removal of Belt Railroad tracks, and removal of the Pier 40 bulkhead building. In addition, the setting has been altered by the development of South Beach Harbor marina and a park south of Pier 40 in Section 13.

The Section 12 seawall consists of two types of seawall, designated Types K and J, 12 and 20 feet high, respectively, on the original construction drawings. The two types of bulkhead walls do not appear to have been modified since their original construction but the marginal wharf between the original Piers 36 and 38 has been removed in 2013 by the Brannan Street Wharf structure construction. There is no existing substructure connected to the seawall in this seawall section.

Section 13 – 830 Feet Between King and Berry Streets

Seawall Section 13 originally consisted of two types of seawall, designated Type I and H on the original construction drawings. These seawall types consist of a pile-supported concrete bulkhead wall about 9.5 feet high from top of rock dike to top of the bulkhead wall and a cutoff wall consisting of a 5 foot high, 6 inch thick concrete panel supported by concrete jacketed timber piles. T he seawall bulkhead wall originally fronted a marginal wharf and Pier 42. The seawall cutoff wall originally fronted a marginal wharf and Pier 44.

These substructures have since been removed and there is no marginal wharf or pier structure presently existing in this seawall section.

Section P46-AT&T Park – 1240 Feet Between Berry Street and Third Street Bridge

Seawall Section P46 originally consisted of two different types of seawall types, designated Types G through F on the original construction drawings. This seawall type consisted of a cutoff wall about 15 feet high, fronting Pier 46A.

This Pier 46A substructure has since been removed and t here is no m arginal wharf or pier structure presently existing in this seawall section. The seawall structures may have been modified or replaced as a part of the construction for the existing marina or AT&T Park.

The AT&T Park section originally consisted of four different types of seawall types, designated Types E through B on t he original construction drawings. These seawall types consisted of various cutoff wall configurations, differing in form as a function of the presence of fronting Pier 46B.

This Pier 46B substructure has since been removed and t here is no m arginal wharf or pier structure presently existing in this seawall section. The seawall structures may have been modified or replaced as a part of the construction for the new AT&T Park.

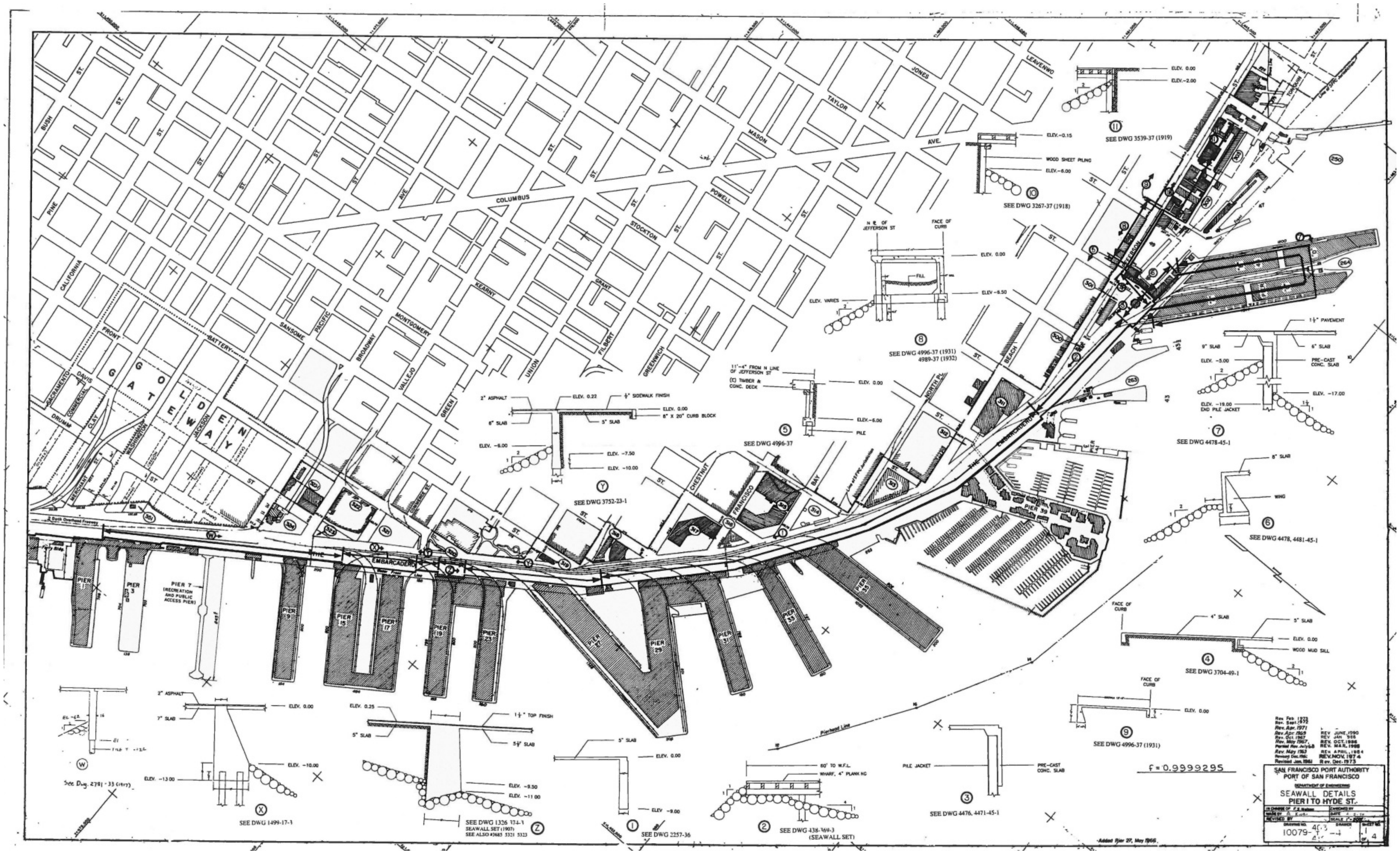


Figure 2-1: Seawall Map and Section Definition – Pier 7 to Fisherman's Wharf

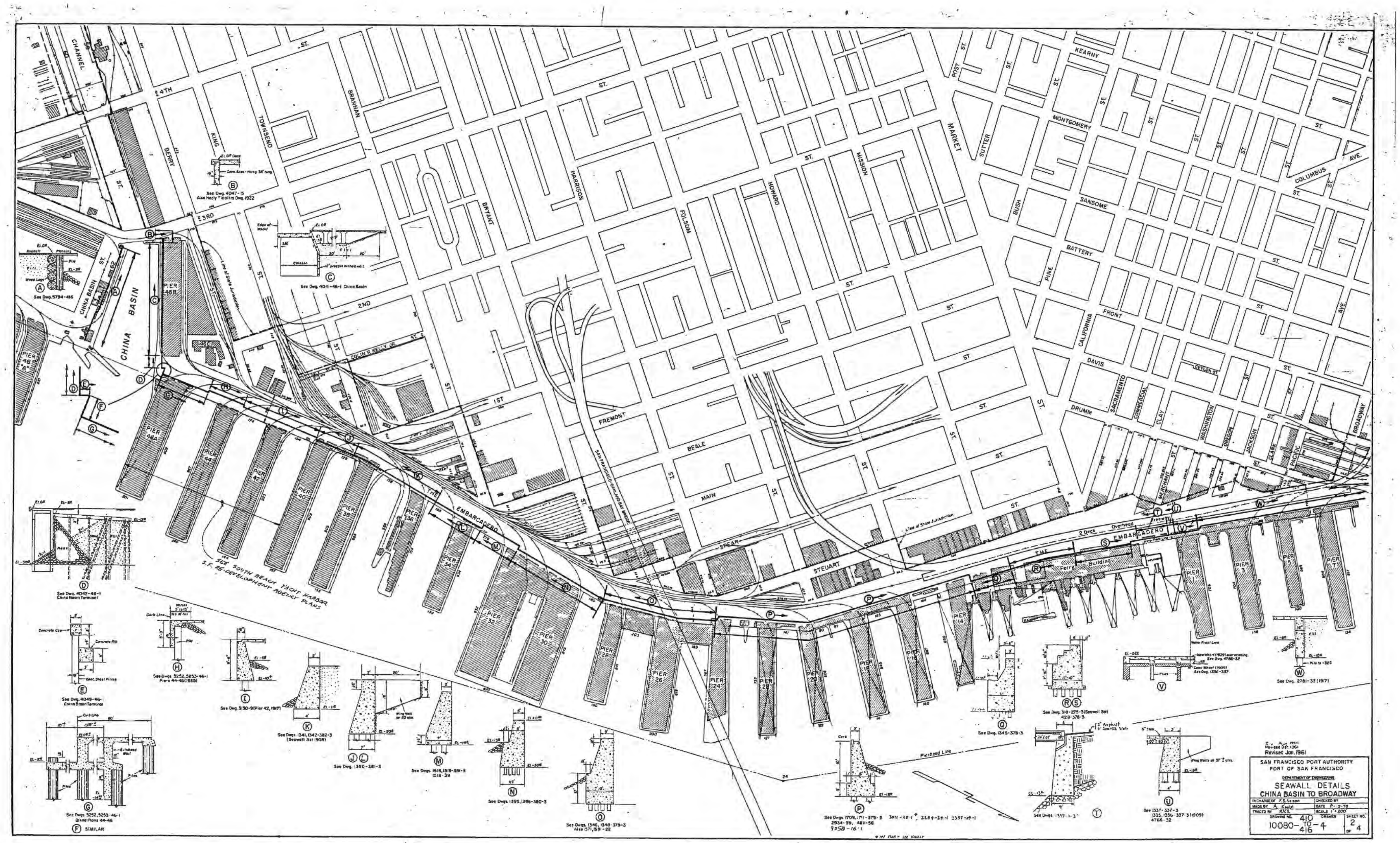


Figure 2-2: Seawall Map and Section Definition – China Basin to Pier 7

3. Geotechnical Research, Data Collection and Synthesis

Geotechnical Consultants, Inc. (GTC) performed the geotechnical research, data collection and synthesis for Phase 1 of this study. As part of this study GTC obtained and reviewed numerous geotechnical reports for projects within the zone of influence. Figures showing the thicknesses of artificial fill and young bay mud, and the elevations at the top of the young bay mud, bottom of young bay mud and top of bedrock follow this section.

3.1 Regional Geology

The Northern Waterfront Seawall project area is situated within the western portion of the Coast Ranges Geomorphic Province of California. Past episodes of tectonism have folded and faulted the rock of the Coast Ranges creating the regional topography of northwest-trending ridges and valleys that is characteristic of this province. The strong northwesterly trend of ridges and valleys that characterizes most of the Coast Ranges is obscured in the City itself, although it is suggested by such minor features as Russian, Potrero, and Telegraph Hills and the valley between them. The San Francisco Bay and other local topographic depressions have been subsequently filled with various marine, estuarine, alluvial, and wind-blown sediments. Basement rock in the region is comprised of Franciscan Complex rocks of Jurassic and Cretaceous age that form the bedrock both east and west of the San Andreas fault on the San Francisco Peninsula. The Franciscan Complex consists of an intermixed assemblage of volcanic, sedimentary and low grade metamorphic rocks that accumulated along and were subsequently highly deformed in the boundary between two converging tectonic plates.

The current Northern Waterfront Seawall is located entirely outside of the mid-1800's shoreline and crosses areas that were open bay, tidal flats, and wooden wharves. Geologic units underlying and adjacent to the current seawall consist primarily of artificial fill and Young Bay Mud deposits. Geologic deposits within the vicinity of the Northern Waterfront Seawall include near-surface sedimentary deposits of artificial fill, Young Bay Mud, Dune Sand, and Upper Layered Sediments. The Upper Layered Sediments have sediments of varying sources and depositional history and include beach sand, estuarine deposits, alluvium, and colluvium. These near-surface deposits overlie older sedimentary deposits that include undifferentiated older alluvium and colluvium, Colma Formation, and Old Bay Deposits, all which overlie basement rock of the Franciscan Complex.

Artificial Fill. Artificial fill that resulted from grading operations during development of the northeastern pier area of the City during the mid to late 1800's blankets the northern edge of San Francisco. The most extensive fill areas coincide with former coves such as the North Beach and Yerba Buena Coves. Artificial fill in the project area was generally derived from local native sediments such as dune sands and dredged bay sediments, and miscellaneous debris, including brick, concrete, and wood fragments. Artificial fill in the former Yerba Buena Cove is known to contain numerous ships and debris from ships that were abandoned by their crews during the Gold Rush; many of these abandoned ships were sunk and used as fill. The artificial fill is highly variable in texture and composition, depending on the source of the fill material. The fill sediments were generally sourced from the local sand dunes and from dredged bay sediments and haphazardly placed; thus consisting of loose poorly graded sand to clayey sand and soft clay, with rubble and debris including brick, asphalt, concrete, wood, broken rock, and scattered gravel. Thickness of artificial fill within the project study area is presented in ***Figure 3-1 – Thickness of Artificial Fill***.

Young Bay Mud. Young Bay Mud is located both offshore and onshore within the study area. Offshore it is located at and below the mudline or underlies pockets of fill and debris in the vicinity of the piers and wharves. Onshore, Young Bay Mud underlies areas of filled land. It predominantly consists of moderate to high plasticity silty clay (CL/CH), with local clayey silt and silt (ML and MH), shells and shell fragments, organic material, and sandy clay (CL) to clayey sand (SC) layers and lenses. Offshore the soft clays are commonly overlain by a layer of fine silty to clayey sand and/or sandy silt. Typically, young bay mud is soft, highly compressible, low strength, and has very low permeabilities. Thickness of the Young Bay Mud varies considerably as presented in ***Figure 3-2 – Thickness of the Young Bay Mud***. ***Figure 3-3 – Elevation of Top of Young Bay Mud*** and ***Figure 3-4 – Elevation of Bottom of Young Bay Mud*** present the elevations relative to the NAVD88 datum of the top and bottom of the Young Bay Mud, respectively, based on historical boring information.

Dune Sand. Within the project area, naturally occurring dune deposits occur locally at the surface, underlying artificial fill, and overlying Young Bay Mud. In portions of the study area where the artificial fill was derived from the local dune deposits it is sometimes difficult to distinguish the fill from the underlying Dune Sand deposits. Dune Sand deposits are generally fine to very fine grained, gray to brown poorly-graded sand (SP) with minor poorly-graded sand with silt (SP-SM) and silty sand (SM). The Dune Sands are primarily medium dense to dense with relatively high permeabilities.

Upper Layered Sediments. Layered and interfingered alluvial, colluvial, and beach sediments are located locally at and near the surface and underlying the artificial fill near and shoreward of the 1800's shoreline and consist of variable layers of medium dense to very dense poorly graded to clayey sand and stiff to very stiff silty to sandy clay. Layered and interfingered alluvial, beach, and estuarine deposits are located beneath the Young Bay Mud and consist of layers of medium dense to very dense, poorly graded to clayey sand and medium stiff to very stiff, lean to sandy clay with low to high plasticity. Local thin layers of loose, poorly graded sand to silty sand are present beneath the artificial fill and Young Bay Mud. Alternative geologic unit names lumped within the Upper Layered Sediments include Bayside Sands, Colma Formation, San Antonio Formation, and Posey and Merritt Sands from the East Bay.

Old Bay Clay. Old Bay Clay is a unit that was deposited during the Sangamon interglacial stage approximately 100,000 years ago, and is comprised primarily of gray marine high-plasticity clay (CH). It had a similar depositional history as the present-day Young Bay Mud, but is overconsolidated and stronger because of the subsequent deposition of younger deposits upon its surface. The Old Bay Clay lies between the Upper Layered Sediments and Lower Layered Sediments.

Lower Layered Sediments. The Lower Layered Sediments were deposited on the Franciscan Complex bedrock and is dated to the late Pleistocene. These alluvial and marine sediments are typically comprised of interbedded very dense sands and hard clays. This unit has also been called Alameda Formation in previous geologic reports.

Franciscan Complex Bedrock. The Franciscan Complex makes up the basement rock at the site and consists of an assemblage of deformed and metamorphosed rock units, including sandstone, shale, serpentinite and greenstone. ***Figure 3-5 – Elevation of Top of Bedrock*** presents the elevation (NAVD88) of the top of the Franciscan Complex bedrock in the study area.

Figure 3-1: Thickness of Artificial Fill

Figure 3-2: Thickness of Young Bay Mud

LEGEND

Seawall Bulkhead

Zone of Influence, within 1200 feet of the Seawall Bulkhead and within the Lateral Spread Hazard Zone

Historic Geotechnical Borings

5 foot Contours of Elevation of Top of Young Bay Mud (NAVD88)

0 600 1,200 2,400 Feet

Figure 3-3: Elevation of Top of Young Bay Mud

Figure 3-4: Elevation of Bottom of Young Bay Mud

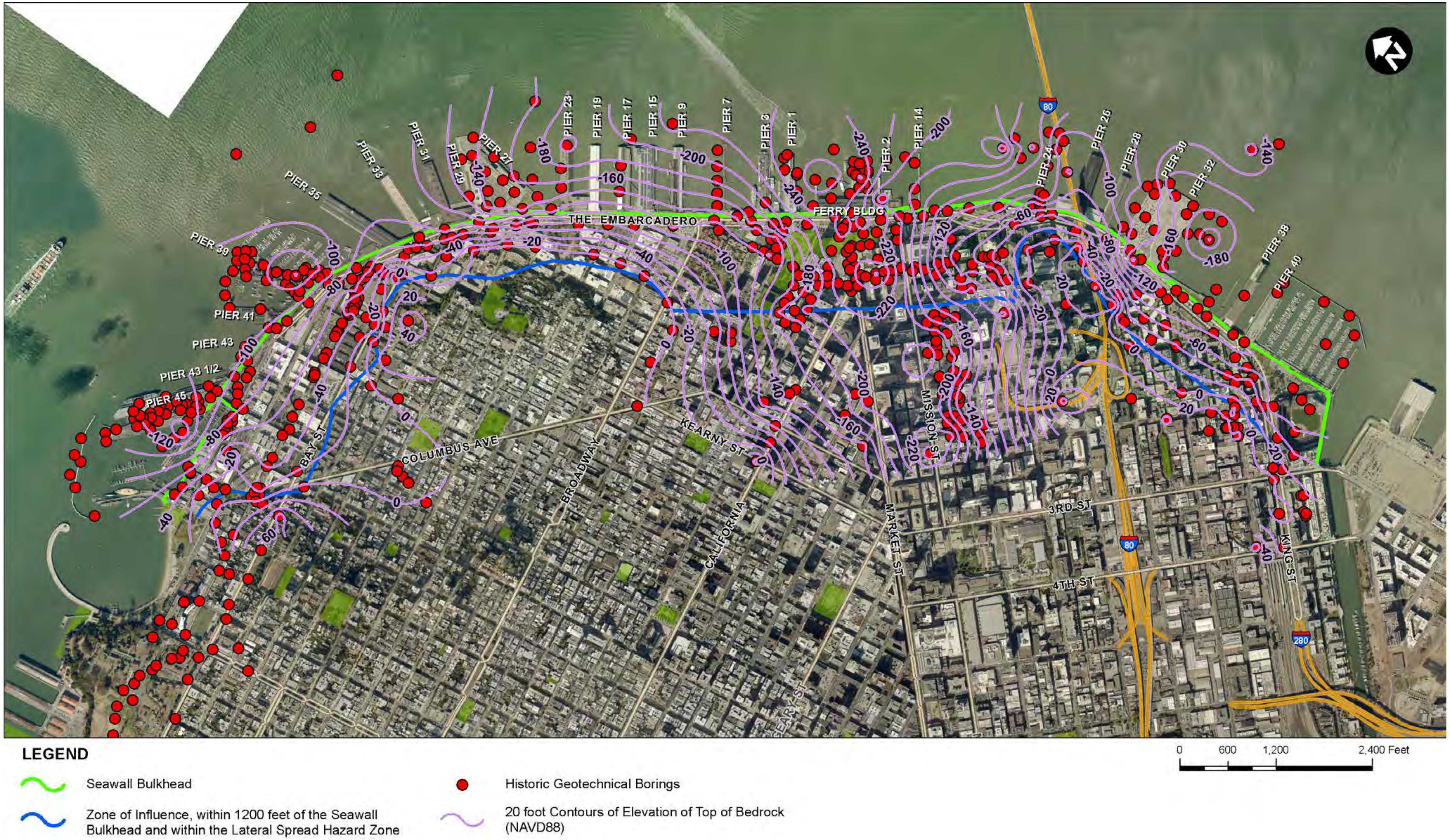


Figure 3-5: Elevation of Top of Bedrock

3.2 Historical Seismicity

San Francisco is located within a seismically active area near the boundary between two major tectonic plates, the Pacific Plate to the southwest and the North American Plate to the northeast. Strong ground shaking along the Northern Waterfront Seawall could occur as a result of an earthquake on any one of the active regional faults. The San Andreas Fault Zone, the dominant tectonic feature of the San Francisco Peninsula, is the primary structure within the broad transform boundary that accommodates right lateral motion between the North American and Pacific tectonic plates. Movement of these plates is primarily translated in the Bay Area as right lateral slip along faults of the San Andreas Fault Zone.

The United States Geological Survey (USGS) Working Group on California Earthquake Probabilities concluded that there is a 62 percent probability of a strong earthquake (M≥6.7) occurring in the San Francisco Bay Region in a thirty year period between 2003 and 2032 (WGCEP, 2003). Additionally the 2007 Working Group on California Earthquake Probabilities (WGCEP, 2008) has concluded that within the next 30 years the probability of a strong earthquake (M≥6.7) occurring on regional faults is as follows: 21% for the N. San Andreas Fault Zone, 31% for the Hayward-Rodgers Creek Fault Zone, and 6% for the San Gregorio Fault.

The USGS Working Group (WG02) has segmented the major faults in the San Francisco Bay Area. Based on this segmentation, various fault rupture scenarios were developed that include earthquakes and rupture of segments of the individual faults in varying combinations (WGCEP, 2003), i.e. rupture of one segment by itself or rupture of two or more segments concurrently. These scenarios result in differing earthquake and fault parameters for each of the potential segment combinations.

Active faults in California have been divided into activity categories by the California Geological Survey based on t heir predicted activity and ability to generate strong earthquakes; “Type A” faults which generally have higher and more well-defined slip rates and well defined recurrence intervals and “Type B” faults with well-defined slip rates but poorly constrained recurrence intervals. “Type A” faults are commonly considered more active (generally with higher slip rates) and/or capable of generating larger earthquakes than “Type B” faults. Both “Type A” and “Type B” faults that are mapped in the vicinity of the project site are summarized in ***Table 3-1 – Significant Active Faults***. There are no known active fault zones or designated Alquist-Priolo Earthquake Fault Zones mapped as crossing or within the City of San Francisco or Northern Waterfront Seawall project area and the nearest fault to the Northern Waterfront Seawall is the San Andreas fault – Peninsula segment, passing about 8.8 miles to the southwest of the northwesterly limit of the Northern Waterfront Seawall. The distance to significant active faults and their associated potential segment rupture combinations, CGS assigned fault type (“A” or “B”), estimated maximum magnitude earthquake, and the 30-year probability of a M≥6.7 earthquake on the significant active faults within 50 miles of the project site are summarized in ***Table 3-1***.

Two significant earthquakes have affected the site since the construction of the Northern Waterfront Seawall: The Great M 7.8 1906 San Francisco Earthquake and the M 6.9 1989 Loma Prieta Earthquake. A brief synopsis of these two earthquakes and their effect on the seawall and adjoining areas is provided in the following sections.

1906 San Francisco Earthquake. The California earthquake of April 18, 1906 occurred at 5:12 a.m. with an inferred epicenter approximately 2 miles off the coast of San Francisco and resulted in a 296-mile long rupture along the San Andreas fault from San Juan Bautista in the south to Cape Mendocino in the north. It is estimated to have had a moment magnitude of 7.8. The duration of shaking in San Francisco was about one minute.

In the districts along the waterfront in the areas of “filled” or “made” land, the damage was severe where the pavements were buckled, arched and fissured, brick and frame houses were damaged extensively or destroyed, portions of streets were moved laterally several feet, sewer and water mains were broken, and streetcar tracks were bent into wavelike forms (Lawson, 1908). Near the Ferry Building, the Lawson report indicates that the streets sank as much as 2 feet, probably more, and that the surface of the ground was deformed into waves and small open fissures were formed, especially close to the wharves. Buildings along the water side generally slumped seaward, in some cases as much as 2 feet. The report goes on to say that the damage was greatest close to the water’s edge, growing less as the solid land was approached, gradually at first, then more rapidly.

The United States Geological Survey (USGS) prepared a report to summarize the reported ground failures in Northern California as a result of earthquakes between 1769 and 1970 (Youd and Hoose, 1978). Because of the severity of the earthquake shaking from the 1906 Earthquake, the majority of the ground failures summarized in their report are from this event, and more specifically as reported in the Lawson report.

1989 Loma Prieta Earthquake. The Loma Prieta Earthquake occurred on October 17, 1989 at 5:04 pm in which San Francisco experienced the highest intensity earthquake shaking since the 1906 Earthquake. It was a much smaller seismic event than the 1906 Earthquake though, as the moment magnitude of the Loma Prieta Earthquake was approximately 6.9 and the epicenter was 60 miles south-southeast of San Francisco in the Santa Cruz Mountains. The earthquake occurred over a 30-mile long segment of the San Andreas fault, and coincided with the southernmost segment of the 1906 Earthquake rupture surface. The duration of the shaking was approximately 8 to 15 seconds.

Despite the relatively low levels of shaking and short duration, soil liquefaction affected sites in the City and County of San Francisco. Most of the reported damage occurred in the Marina District which is outside the project area, though lesser damage was noted at Pier 45, Piers 27 and 29, along The Embarcadero between Fisherman’s Wharf to the area north of the Bay Bridge, and at the Ferry Plaza (Seed et al., 1990; SEAOC, 1991). Effects of soil liquefaction in the project area included settlement, pavement cracking and sand boils. The SEAOC report indicates that the seawall along The Embarcadero to the Bay Bridge was damaged throughout much of its length. In several places, the wall experienced horizontal cracking or opening of horizontal construction joints on the exposed face. The report also indicates that the soil at the base of the seawall on the bayward side settled and spread laterally due to liquefaction and the retained soils liquefied leading to settlement of paving and other improvements. The USGS report (Holzer, 1998) also reports evidence of liquefaction and lateral spread along the waterfront with settlement of up to 3 to 8 inches in some areas next to the piers as well as in the financial district.

Table 3-1: Significant Active Faults

Fault Name and Fault Segment Rupture Combinations	Closest Distance to Fault [1] (miles)	Closest Seawall Section	Estimated Earthquake Magnitude [2]	30-Year Probability of M>6.7 Earthquake [3] (%)
Type A Faults				
N. San Andreas (Varying rupture combinations of segments of the N. San Andreas Peninsula segment alone and with the Offshore, North Coast, Peninsula, and Santa Cruz Mountain segments)	8.8	FW	7.2-7.9	21
N. San Andreas (Varying rupture combinations of segments of the N. San Andreas North Coast segment alone and with the Offshore segment)	15.4	FW	7.5-7.8	
N. San Andreas (Rupture of the N. San Andreas Santa Cruz Mountain segment)	38.2	46	7.0	
Hayward-Rodgers Creek (Varying rupture combinations of the Hayward North segment alone and with the Rogers Creek and South segments)	9.3	9a, 9b	6.5-7.3	31
Hayward-Rodgers Creek (Rupture of the Hayward South segment alone)	12.9	46	6.7	
Hayward-Rodgers Creek (Rupture of the Rodgers Creek segment alone)	24.9	FW	7.0	
Calaveras (Varying rupture combinations of the Calaveras N orthern segment alone and with the Central and Southern segments)	19.2	9,10	6.8-6.9	7
Calaveras (Varying rupture combinations of the Calaveras Central segment alone and with Southern segment)	36.9	46	6.2-6.4	
Type B Faults				
San Gregorio Connected[4]	11.3	FW	7.5	-
Mount Diablo Thrust	20.0	9b, 9	6.6	-
Green Valley Connected	24.6	3, 4	6.7	-

Notes:

1. Fault-to-site distances based on the 2008 National Seismic Hazard Maps - Fault Parameters website at http://geohazards.usgs.gov/cfusion/hazfaults_search/hf_search_main.cfm; and the U.S.G.S. and C.G.S., 2010, Quaternary fault and fold database for the United States at http://earthquake.usgs.gov/hazards/qfaults/download.php.
2. Maximum Moment Magnitude based on The Uniform California Earthquake Rupture Forecast, Version 2 (UCERF 2) by the USGS (WGCEP, 2008).
3. 30-year probability of M>6.7 earthquake based on 2007 Working Group on California Earthquake Probabilities (WGCEP, 2008).
4. San Gregorio fault analyzed as a Type A fault by the 2007 Working Group on California Earthquake Probabilities.

3.3 Site and Subsurface Conditions

The following sections of the report describe the site and subsurface conditions anticipated at each of the 23 seawall sections based on available subsurface boring information.

Section FW – 1460 Feet Between Hyde and Taylor Streets (Fisherman's Wharf)

Section FW of the seawall is located in an area that was once offshore of North Point and North Beach and the entire project study area for this section is located within this former offshore area. B orings indicate that young geologic units within the project study area for this section include: artificial fill, Young Bay Mud, and Upper Layered Sediments. Artificial fill was found to range from 10 to 31 feet thick and Young Bay Mud landward of the seawall ranges from 0 to 26.5 feet thick in the borings. Offshore of the seawall are Young Bay Mud overlying Upper Layered Sediments with pockets of fill and debris along and near current and former piers/wharves. Artificial fill underlying Fisherman's Wharf ranges from 0 to 44.5 feet in thickness and Young Bay Mud thickness is reported as ranging from 0 to 35 feet underlying the wharf. Young Bay Mud in the vicinity of Section FW is generally underlain by alternating layers of dense to very dense brown to grayish brown poorly graded to clayey sand and stiff to very stiff greenish gray lean to sandy clay.

Section B – 1000 Feet Between Taylor and Powell Streets

Section B of the seawall is located in an area that was once offshore of North Beach and the entire project study area for this section is located within this former offshore area. Borings indicate that young near-surface geologic units within the project study area for this section include: artificial fill, Young Bay Mud, and Upper Layered Sediments. Artificial fill was found to range from 9.5 to 25 feet thick and Young Bay Mud landward of the seawall ranges from 7 to 26 feet thick in the borings. Limited borings offshore of the seawall along Section B indicate Young Bay Mud of at least 10 feet thick and pockets of fill and debris located along and near current and former piers/wharves. Young Bay Mud in the vicinity of Section B is generally underlain by Upper Layered Sediments consisting of alternating layers of dense to very dense brown to grayish brown poorly graded to clayey sand and stiff to very stiff greenish gray lean to sandy clay. The Upper Layered Sediments are underlain by Franciscan Complex bedrock. T he bedrock surface dips bayward with the bedrock approximately 110 feet below ground surface at the seawall.

Section A – 561 Feet Between Powell and Stockton Streets

Section A of the seawall is located in an area that was once offshore of North Beach and almost the entire project study area for this section is located within this former offshore area, with the exception of a small approximately 110-foot length near current Stockton and Francisco Streets. Borings indicate that young geologic units within the project study area for this section include: artificial fill, Young Bay Mud, and Upper Layered Sediments. Artificial fill was found to range from 10.5 to 33.5 feet thick and Young Bay Mud landward of the seawall ranges from 2 to 29 feet thick in the borings. Offshore borings indicate

Young Bay Mud with thicknesses ranging from at least 8 to 33 feet. Young Bay Mud in the vicinity of Section A is generally underlain by Upper Layered Sediments consisting of alternating layers of dense to very dense brown to grayish brown and reddish brown poorly graded to clayey sand and stiff to very stiff greenish gray or reddish brown lean to sandy clay.

Section 1 – 1000 Feet Between Stockton and Kearny Streets

Section 1 of the seawall is located in an area that was once offshore of North Beach and Telegraph Hill with almost the entire project study area for this section located within the former offshore area. The edge of the project study area for this section is located along the former 1800's shoreline which coincides with the bedrock ridge for Telegraph Hill. Borings indicate that young geologic units within the project study area for this section include: artificial fill, Young Bay Mud, and Upper Layered Sediments. Artificial fill was found to range from 0 to 36 feet thick and Young Bay Mud landward of the seawall ranges from 14 to 37 feet thick in the borings. Offshore borings along this section and along Pier 39 indicate Young Bay Mud with thicknesses ranging from at least 8 to 48 feet. Young Bay Mud in the vicinity of Section 1 is generally underlain by Upper Layered Sediments consisting of alternating layers of dense to very dense yellowish brown to grayish brown poorly graded to clayey sand and stiff to very stiff greenish gray to brown to yellowish brown lean to sandy clay. Franciscan Complex bedrock of reddish-brown shale and sandstone were noted at about 40 to 50 feet depth near North Point Street. The bedrock surface dips bayward with the bedrock approximately 95 feet below ground surface at the seawall.

Section 2 – 1000 Feet Between North Point and Francisco Streets

Section 2 of the seawall is located in an area that was once offshore of Telegraph Hill with almost the entire project study area for this section located within the former offshore area. The edge of the project study area for this section is located within and along the former 1800's shoreline which coincides with the bedrock ridge for Telegraph Hill. Borings indicate that young geologic units within the project study area for this section include: artificial fill, Young Bay Mud, and Upper Layered Sediments. Artificial fill was found to range from 14.5 to 39 feet thick and Young Bay Mud landward of the seawall ranges from 0 to 22 feet thick in the borings. No offshore borings were mapped along this section. Young Bay Mud in the vicinity of Section 2 was found to be underlain by Upper Layered Sediments consisting of layers of dense to very dense yellowish brown to brown poorly graded to clayey sand and stiff to very stiff brown to yellowish brown lean to sandy clay. Gray Franciscan Complex shale and sandstone underlie the site approximately 100 feet below the ground surface at the seawall.

Section 3 – 1000 Feet Between Francisco and Lombard Streets

Section 3 of the seawall is located in an area that was once offshore of Telegraph Hill with the project study area for this section located within the former offshore and historic wharf areas, and the hills adjacent to Telegraph Hill. The edge of the project study area for this section is located within and along the former 1800's shoreline which coincides with the Telegraph Hill bedrock high. The borings indicate that young geologic units within the project study area for this section include: artificial fill, Young Bay Mud, and Upper Layered Sediments. Landward of the seawall, artificial fill was found to range from 21 to 46 feet thick and Young Bay Mud approximately 20 feet thick in the borings. Young Bay Mud was found to be 29 to 69 feet thick in the offshore borings at Piers 27 and 29. Young Bay Mud in the vicinity of Section 3 was found to be underlain by Upper Layered Sediments consisting of layers of dense to very dense light brown to gray poorly graded to clayey sand and stiff to very stiff brown to gray lean to sandy clay. Gray Franciscan Complex shale, sandstone, and serpentinite were noted in the onshore borings at depths of 75 to 104 feet. The bedrock surface dips bayward with the bedrock approximately 130 feet below ground surface at the seawall.

Section 4 – 1000 Feet Between Lombard and Union Streets

Section 4 of the seawall is located in an area that was once offshore of Telegraph Hill with the seawall and project study area for this section located within the former offshore and historic wharf areas. The edge of the project study area for this section is located within the former 1800's shoreline and coincides approximately with the Telegraph Hill bedrock high. The borings indicate that young geologic units within the project study area for this section include: artificial fill, Young Bay Mud, and Upper Layered Sediments. Landward of the seawall, artificial fill was found to range from 17.5 to 24.8 feet thick and Young Bay Mud approximately 20 feet thick in the borings mapped in this area. Young Bay Mud was found to be 16 to 52 feet thick in the borings offshore and at Piers 27 and 23. Young Bay Mud in the vicinity of Section 4 was found to be underlain by Upper Layered Sediments consisting of layers of dense to very dense light brown to gray poorly graded to clayey sand and stiff to very stiff brown to gray lean to sandy clay. Gray Franciscan Complex shale, sandstone, and serpentinite were noted in the onshore and two near shore borings at depths of 83 to 138 feet.

Section 5 – 1000 Feet Between Union and Vallejo Streets

Section 5 of the seawall is located in an area that was once offshore of the Telegraph Hill area and near Yerba Buena Cove with the seawall and project study area for this section located within the former offshore and historic wharf areas. The edge of the project study area for this section is located within the former 1800's shoreline and coincides approximately with the Telegraph Hill bedrock high. The borings indicate that young geologic units within the project study area for this section include: artificial fill, Young Bay Mud, and Upper Layered Sediments. Landward of the seawall, artificial fill was found to range from 35 to 47.5 feet thick and Young Bay Mud from 24.5 to 59 feet thick in the borings mapped in this area. Young Bay Mud was found to be 28 to 29 feet thick in the borings at Pier 17. Young Bay Mud in the vicinity of Section 5 was found to be underlain by Upper Layered Sediments consisting of layers of dense to very dense brown to gray poorly graded to clayey sand and stiff to very stiff brown to gray lean to sandy clay. Gray Franciscan Complex sandstone and gray serpentinite were noted in two of the onshore borings at depths of 131 and 138 feet.

Section 6 – 800 Feet Between Vallejo and Pacific Streets

Section 6 of the seawall is located in an area that was once offshore of Yerba Buena Cove, with the seawall and project study area for this section located within the former offshore and historic wharf areas and on made land. The edge of the project study area for this section is located within the former 1800's shoreline across a portion of the filled Yerba Buena Cove. Borings indicate that this area is underlain by young geologic units of: artificial fill, Young Bay Mud, and Upper Layered Sediments. Artificial fill landward of the seawall was found to depths ranging from 36.5 to 51 feet and Young Bay Mud with thicknesses of approximately 70 feet beneath the fill. Young Bay Mud was found to be 96 to 111.5 feet thick offshore along Pier 7. Young Bay Mud in the vicinity of Section 6 was found to be underlain by Upper Layered Sediments consisting of layers of dense to very dense gray poorly graded to clayey sand and stiff to very stiff gray lean to sandy clay. Brown to gray Franciscan Complex sandstone was noted in the onshore borings at depths ranging from 121 to 152 feet.

Section 7 – 980 Feet Between Pacific and Clay Streets

Section 7 of the seawall is located in an area that was once offshore of Yerba Buena Cove, with the seawall and project study area for this section located within the former offshore and historic wharf areas and on made land. The edge of the project study area for this section is located within the former 1800's shoreline across a portion of the filled Yerba Buena Cove. The borings indicate that this area is underlain by young geologic units of: artificial fill, Young Bay Mud, and Upper Layered Sediments. The borings located landward of the seawall were noted to have artificial fill to depths ranging from 18 to 54.5 feet and Young Bay Mud at thicknesses ranging from 62 to 99 feet beneath the fill. Young Bay Mud was found to be 97.5 to 116 feet thick offshore and along Piers 1 and 3. Young Bay Mud in the vicinity of Section 7 was found to be underlain by Upper Layered Sediments consisting of layers of dense to very dense gray poorly graded to clayey sand and stiff to very stiff gray lean to sandy clay. Brown to gray Franciscan Complex sandstone and serpentinite were noted in the onshore borings at depths of 143 to 221 feet. The bedrock surface dips downward toward the east to a low off the shore of the Ferry Building with the bedrock approximately 210 feet below ground surface at the seawall.

Section 8a – 392 Feet Between Clay and Market Streets

Section 8a of the seawall is located in an area that was once offshore of Yerba Buena Cove, with the seawall and project study area for this section located within the former offshore and historic wharf areas and on made land. The edge of the project study area for this section is located within the former 1800's shoreline across a portion of the filled Yerba Buena Cove. The borings indicate that this area is underlain by young geologic units of: artificial fill, Young Bay Mud, and Upper Layered Sediments. The borings located landward of the seawall were noted to have artificial fill to depths ranging from 19 to 42 feet and Young Bay Mud at thicknesses ranging from 60 to 114 feet beneath the fill. Young Bay Mud was found to be 100.5 to 116 feet thick offshore and at the Ferry Building, with artificial fill noted beneath the Ferry Building to depths of up to 29.5 feet. Young Bay Mud in the vicinity of Section 8a was found to be underlain by Upper Layered Sediments consisting of layers of dense to very dense gray to greenish gray to brown poorly graded sand to clayey sand and stiff to very stiff gray to greenish gray lean to sandy clay. Franciscan Complex bedrock was noted in the onshore borings at a depths of 224 to 264 feet.

Section 8b – 450 Feet Between Market and Mission Streets

Section 8b of the seawall is located in an area that was once offshore of Yerba Buena Cove, with the seawall and project study area for this section located within the former offshore and historic wharf areas and on made land. The edge of the project study area for this section is located within the former 1800's shoreline across a portion of the filled Yerba Buena Cove. The borings indicate that this area is underlain by young geologic units of: artificial fill, Young Bay Mud, and Upper Layered Sediments. The borings located landward of the seawall were noted to have artificial fill to depths ranging from 20.5 to 45 feet and Young Bay Mud at thicknesses ranging from 60 to 89 feet beneath the fill. Offshore and along the Ferry Plaza/Ferry Terminal Pier, Young Bay Mud was found to be 50 to 100 feet thick, with artificial fill noted beneath the pier ranging from 20.5 to 45 feet thick. The thicker sequences of offshore artificial fill are associated with construction of the BART tunnels and ventilation structure. Young Bay Mud in the vicinity of Section 8b was found to be underlain by Upper Layered Sediments consisting of layers of dense to very dense gray to greenish gray to brown poorly graded sand to clayey sand and stiff to very stiff gray to brown to greenish gray lean to sandy clay. Franciscan Complex bedrock was noted in the onshore borings at a depths of 216.5 to 252.5 feet. The bedrock dips downward off of Telegraph Hill, located to the northwest, and downward off of Rincon Hill, located to the south, to a bedrock trough off the shore of the Ferry Building. The bedrock is approximately 230 feet below ground surface at the seawall.

Section 8 – 300 Feet Between Mission and Point North of Howard Streets

Section 8 of the seawall is located in an area that was once offshore of Yerba Buena Cove, with the seawall and project study area for this section located within the former offshore and historic wharf areas and on made land. The edge of the project study area for this section is located within the former 1800's shoreline across a portion of the filled Yerba Buena Cove. The borings indicate that this area is underlain by young geologic units of: artificial fill, Young Bay Mud, and Upper Layered Sediments. Borings were noted to have artificial fill to depths ranging from 19 to 40 feet and Young Bay Mud at thicknesses ranging from 71 to 92 feet beneath the fill. Offshore of the seawall, Young Bay Mud was found to be 90 to 100 feet thick. Young Bay Mud in the vicinity of Section 8 was found to be u nderlain by Upper Layered Sediments consisting of layers of dense to very dense gray to brown poorly graded sand to clayey sand and stiff to very stiff gray to brown lean to sandy clay. Franciscan Complex sandstone was noted in two of the borings at depths of 206.5 to 210 feet.

Section 9a – 990 Feet South of Mission to Folsom Street

Section 9a of the seawall is located in an area that was once offshore of Yerba Buena Cove, with the seawall and project study area for this section located within the former offshore and historic wharf areas and on made land. The edge of the project study area for this section is located within the former 1800's shoreline across a portion of the filled Yerba Buena Cove. The borings indicate that this area is underlain by young geologic units of: artificial fill, Young Bay Mud, and Upper Layered Sediments. Borings were noted to have artificial fill to depths ranging from 9.5 to 61 feet and Young Bay Mud at thicknesses ranging from 77 to 123 feet beneath the fill. Young Bay Mud in the vicinity of Section 9a was found to be underlain by Upper Layered Sediments consisting of layers of dense to very dense gray to grayish brown poorly graded sand to clayey sand and stiff to very stiff gray to brown lean to sandy clay. Franciscan Complex bedrock was noted in one of the borings near the seawall at a depth of 154 feet. The bedrock surface dips offshore towards the north with the bedrock ranging from approximately 120 to 180 feet below ground surface at the seawall.

Section 9b – 788 Feet Between Folsom and Harrison Streets

Section 9b of the seawall is located in an area that was once offshore of Rincon Point, with the seawall and project study area for this section located within the former offshore and historic wharf areas at the end of Rincon Point. The edge of the project study area for this section is located along the bedrock high along the edge of Rincon Point. The borings indicate that this area is underlain by young geologic units of: artificial fill, Young Bay Mud, and Upper Layered Sediments. The borings located landward of the seawall were noted to have artificial fill to depths ranging from 16.5 to 28 feet and Young Bay Mud at thicknesses ranging from 12.5 to 36.5 feet beneath the fill. Offshore and on the Fire Station 49 Pier, Young Bay Mud was found to be 29 to 64.5 feet thick, with artificial fill associated with the rock dike noted beneath the pier ranging from 16.5 to 28 feet thick. Young Bay Mud in the vicinity of Section 9b was found to be underlain by Upper Layered Sediments consisting of layers of dense to very dense gray to reddish brown poorly graded sand to clayey sand and stiff to very stiff gray to brown to reddish brown lean to sandy clay. Franciscan Complex shale was noted in the borings at depths of 48 to123 feet.

Section 9 – 990 Feet South of Mission to Folsom Street

Section 9 of the seawall is located in an area that was once offshore of Rincon Point, with the seawall and project study area for this section located within the former offshore and historic wharf areas near the end of Rincon Point. The edge of the project study area for this section is located just below the bedrock high along the edge of Rincon Point. The borings indicate that this area is underlain by young geologic units of: artificial fill, Young Bay Mud, and Upper Layered Sediments. The borings located landward of the seawall were noted to have artificial fill to depths ranging from approximately 20 to 32 feet and Young Bay Mud at thicknesses ranging from approximately 10 to 25 feet beneath the fill. Offshore and along Pier 30, Young Bay Mud was found to be 38 to 53 feet thick. Young Bay Mud in the vicinity of Section 9 was found to be underlain by Upper Layered Sediments consisting of layers of dense to very dense gray to yellowish brown to brown poorly graded sand to clayey sand and stiff to very stiff gray to brown lean to sandy clay. Franciscan Complex shale was noted at depths of 93 to 130 feet.

Section 10 – 537 Feet North of Beale to Main Street

Section 10 of the seawall is located east of Rincon Point in a former offshore area, with the seawall and project study area for this section located entirely within the former offshore area. The western edge of the project study area for this section is located crossing through a former cove between Rincon and Steamboat Points. The borings indicate that this area is underlain by young geologic units of: artificial fill, Young Bay Mud, and Upper Layered Sediments. Artificial fill depths in borings range from 10 to 45 feet and a relatively thin layer of Young Bay Mud beneath the fill with thicknesses of 2.5 to 10 feet. Offshore along and beneath Pier 30, there was generally no artificial fill except near the bay end of the pier where it ranged from 30 to 40.5 feet thick associated with the rock dike. Young Bay Mud beneath and adjacent to the pier was found to be 0 to 49.5 feet thick with the areas of absent or thin Young Bay Mud where offshore rock dike fill was noted. Young Bay Mud in the vicinity of Section 10 is underlain by Upper Layered Sediments consisting of layers of dense to very dense gray to grayish brown to brown poorly graded sand to clayey sand and stiff to very stiff gray to brown lean to sandy clay. Franciscan Complex shale was noted in many of the borings at depths of 110.5 to 210 feet.

Section 11a – 281 Feet South of Main to Beale Street

Section 11a of the seawall is located east of Rincon Point in a former offshore area, with the seawall and project study area for this section located entirely within that offshore area. The western edge of the project study area for this section is located crossing through a former cove between Rincon and Steamboat Points. The borings indicate that this area is underlain by young geologic units of: artificial fill, Young Bay Mud, and Upper Layered Sediments. On the landward side of the seawall, artificial fill ranges from approximately 10 to 16.5 feet thick over a relatively thin layer of Young Bay Mud of approximately 10 feet thick. Offshore along and beneath the southern side of Pier 30, Young Bay Mud was found to be between 9 and 55.5 feet thick. Young Bay Mud in the vicinity of Section 11a is underlain by Upper Layered Sediments consisting of layers of dense to very dense gray to grayish brown to brown poorly graded sand to clayey sand and stiff to very stiff gray to brown lean to sandy clay. Franciscan Complex shale and sandstone was noted in onshore borings at depths ranging from 39 to 52 feet.

Section 11 – 353 Feet North of Beale to Fremont Street

Section 11 of the seawall is located in a former offshore area between Rincon and Steamboat Points, with the seawall and project study area for this section located entirely within that offshore area. The western edge of the project study area for this section is located crossing through the former cove between Rincon and Steamboat Points. The borings indicate that this area is underlain by young geologic units of: artificial fill, Young Bay Mud, and Upper Layered Sediments. The borings landward of the seawall have artificial fill ranging from 3 to 49 feet deep below ground surface. Young Bay Mud beneath the artificial fill is relatively thin with thicknesses of up to approximately 10 feet. Young Bay Mud was noted in the offshore borings between 9 and 34.5 feet thick. The Young Bay Mud and areas of artificial fill not underlain by Young Bay Mud in the vicinity of Section 11 are underlain by Upper Layered Sediments consisting of layers of dense to very dense gray to grayish brown to brown poorly graded sand to clayey sand and stiff to very stiff gray to brown lean to sandy clay.

Section 12 – 1167 Feet Between Fremont and King Streets

Section 12 of the seawall is located in a former offshore area near to and northeast of Steamboat Point, with the seawall and project study area for this section located almost entirely within the former offshore area. The western edge of the project study area for this section is primarily located crossing through the former cove between Rincon and Steamboat Points with about 230 feet of it crossing the northern end of Steamboat Point. Both the onshore and offshore borings indicate that this area is underlain by young geologic units of artificial fill, Young Bay Mud, and Upper Layered Sediments. The borings landward of the seawall have artificial fill ranging from 15 to 39.5 feet deep below ground surface. Young Bay Mud was noted beneath the fill ranging from 1.5 to 17 feet thick. Young Bay Mud was observed in the offshore borings to be between 24.5 and 43 feet thick. The Young Bay Mud in the vicinity of Section 12 is underlain by Upper Layered Sediments consisting of layers of dense to very dense gray to yellowish brown to brown poorly graded sand to clayey sand and stiff to very stiff gray to grayish brown lean to sandy clay and dark gray silt. Franciscan Complex shale was encountered in two of the onshore borings at depths of 55.5 and 88.5 feet. The bedrock surface dips bayward with the bedrock approximately 180 feet below ground surface at the seawall.

Section 13 – 600 Feet Between King and Berry Streets

Section 13 of the seawall is located in a former offshore area near to and east of Steamboat Point, with the seawall and project study area for this section located almost entirely within the former offshore area. The western edge of the project study area for this section is located crossing through the northern end of Steamboat Point and through the former offshore area adjacent to the point. Borings indicate that this area is underlain by young geologic units of artificial fill, Young Bay Mud, and Upper Layered Sediments. The borings landward of the seawall have artificial fill ranging from 4 to 34.5 feet deep below ground surface. Young Bay Mud was noted beneath the fill ranging from 0 to 20 feet thick. Young Bay Mud was observed to be between 16 and 30.5 feet thick offshore. The Young Bay Mud in the vicinity of Section 13 is underlain by Upper Layered Sediments consisting of layers of dense to very dense gray to yellowish brown to brown poorly graded sand to clayey sand and stiff to very stiff gray to grayish brown and yellowish brown lean to sandy clay and dark gray silt. Franciscan Complex shale was encountered in onshore borings at depths ranging from 11 feet adjacent to the Steamboat Point bedrock high to 91 feet in the former offshore area.

Section 46 - AT&T Park – 1240 Feet Between Berry Street and Third Street Bridge (China Basin Channel)

The Pier 46 Section of the seawall is located in a former offshore area east of Steamboat Point, with the seawall and project study area for this section located entirely within the former offshore area. The western edge of the project study area for this section is located crossing just offshore of the former Steamboat Point shoreline. Borings indicate that this area is underlain by young geologic units of artificial fill, Young Bay Mud, and Upper Layered Sediments. The borings landward of the seawall have artificial fill ranging from 13.5 to 38 feet deep below ground surface. Young Bay Mud was noted beneath the fill ranging from 2 to 19.5 feet thick. No artificial fill was observed in the offshore borings and Young Bay Mud was observed to be between 23.5 and 34.5 feet thick offshore. The Young Bay Mud in the vicinity of the Pier 46 Section is underlain by Upper Layered Sediments consisting of layers of dense to very dense gray to yellowish brown to olive brown poorly graded sand to clayey sand and stiff to very stiff gray to grayish brown and olive brown lean to sandy clay. Franciscan Complex shale was encountered in several of the onshore borings at depths ranging from 33 to 70.5 feet below ground surface. The bedrock surface dips bayward with the bedrock approximately 125 feet below ground surface at the seawall.

3.4 Geotechnical Reports and Data

Table 3-2 presents a list of geotechnical reports applicable to this study that were identified during this study phase. ***Table 3-3*** presents a list of historical geotechnical boring logs that are contained in the referenced reports and a compilation of the elevation data. The data presented in ***Table 3-3*** was compiled in a GIS database.

Table 3–2 List of Geotechnical Reports

File Name	Report ID Number	Section	Title	Author	Date	Prepared For
P39-10_Fisherman's Wharf Seafood Center Water Quality Report_November 29, 1989	FW-1	Fisherman's Wharf	Fisherman's Wharf Seafood Center Water Quality Report	Selina Bendix, Ph.D, R.E.A.	29-Nov-89	Office of Environmental Review San Francisco Department of City Planning
P39-11_Fisherman's Wharf Seafood Center Sediment Report_November 29, 1989	FW-2	Fisherman's Wharf	Fisherman's Wharf Seafood Center Sediment Report	Selina Bendix, Ph.D, R.E.A.	29-Nov-89	Office of Environmental Review, San Francisco Department of City Planning
P45-6_ Pier 45 Fisherman's Wharf Sa_September 1, 1994	FW-3	Fisherman's Wharf	FINAL REPORT Results of Compaction Grouting Program Pier 45 Fisherman's Wharf San Francisco	AGS, Inc.	1-Sep-94	Port of San Francisco
P47-4_Final Report Pier 47A Reconstruction _April 2, 1996	FW-4	Fisherman's Wharf	FINAL REPORT Geptechnical Study Pier 47A Reconstruction Port of San Francisco, California	AGS, Inc.	2-Apr-96	Port of San Francisco
Fishermans Wharf Breakwater 1984	FW-5	Fisherman's Wharf	Geotechnical Investigation Fisherman's Wharf Breakwater	Geotechnical Consultants, Inc.	1-Apr-84	Port of San Francisco and U.S. Army Corps of Engineers
Jefferson Street Seawall Photos 1985	FW-6	Fisherman's Wharf	*SF83054/SF95011 Jefferson St. Seawall Reconstruction (8 photos and a Port of SF Magazine Article)*	Geotechnical Consultants, Inc.	1985	N/A (Internal Document)
Jefferson Street Seawall Reconstruction Project 1984	FW-7	Fisherman's Wharf	Jefferson Street Seawall Reconstruction Project, Port of San Francisco, California	Geotechnical Consultants, Inc.	1-Mar-84	URS/John A. Blume & Associates Engineers
P45-2_Logs of field Borings and Generalized Cross Section_October 19, 1981	FW-8	Fisherman's Wharf	Pier 45 1975 Logs of Field Borings and Generalized Cross Section	Woodward-Clyde Consultants	19-Oct-81	Port of San Francisco
P45-3_Supplement Geotech Study Pier 45 Seismic Repair _April 1, 1990	FW-9	Fisherman's Wharf	Geotechnical Study Pier 45 Seismic Repair	AGS, Inc.	1-Apr-90	Port of San Francisco
P45-7_Shed D Pier 45 Earthquake Repair Fisherman's W_March 23, 1995	FW-10	Fisherman's Wharf	Results of Compaction Grouting at Shed D Pier 45 Earthquake Repair Fisherman's Wharf	AGS, Inc.	23-Mar-95	Port of San Francsico
Slope Stability Analysis Wharf J-10 SF GTC 2005	FW-11	Fisherman's Wharf	Slope Stability Analyses, Wharf J-10, San Francisco, CA	Geotechnical Consultants, Inc.	12-May-05	Parsons Brinckerhoff Quade & Douglas, Inc.
P43-1_Pier 43-1_2 Fisherman's Wharf Franciscan Restaurant_Januray 13, 2003	SB-1	Section B	Geotechnical Investigation Pier 43-1/2 Fisherman's Wharf San Francisco, California	Treadwell & Rollo	13-Jan-03	Franciscan Restaurant, San Francisco, CA
P43-2_Pier 43-1_2 Promenade and Seawall Study (Winzler & Ke_July 10, 2009	SB-2	Section B	Geotechnical Investigation Pier 43-1/2 Promenade and Seawall Study San Francisco, California	Treadwell & Rollo	10-Jul-09	Winzler & Kelly
Pier 45_6-5-08 b-1 thru b-4	SB-3	Section B	SF08007 Pier 45 Sewer Line Project Boring logs (4 pages)	Geotechnical Consultants, Inc.	March, 2008	SFDPW
Pier 45_Corrosivity tests	SB-4	Section B	Corrosivity Tests- Pier 45 Sewer, San Francisco, CA Your #SF08007, SA #08-0567LAB	Schiff Associates	14-May-08	Geotechnical Consultants, Inc.
Pier45_LabResultsFaxed	SB-5	Section B	Soil Mechanics Laboratory SF08007	Soil Mechanics Laboratory	28-Apr-08	Geotechnical Consultants, Inc.
Pier 45_Boring locations photos_03122008_compressed	SB-6	Section B	Pictures of Boring Locations for SF08007 (word document)	Geotechnical Consultants, Inc.	31-Mar-08	SFDPW
Pier 45_Boring Map	SB-7	Section B	GTC SF08007 Boring Map	Geotechnical Consultants, Inc.	11-Mar-08	San Francisco Department of Public Works
3623.01 - 11 April 03 rpt - Boudin	SB-8	Section B	Geotechnical Investigation Boudin Bakery at the Wharf 160 Jefferson Street	Treadwell & Rollo	11-Apr-03	Boudin Bakery
EMB-3_ North Point Submarine Outfall Line_June 17, 1971	SA-1	Section A	Report Foundation Investigation North Point Submarine Outfall Line	Dames & Moore	17-Jun-71	For the City and County of San Francisco
EMB-8_Site Plan & Boring Logs for Victorian Village_May 19, 1975	SA-2	Section A	*Site Plan and Boring Logs for Victorian Village*	Harding Lawson Associates	19-May-75	Port of San Francisco
P39_41-1_North Point Pier Complex Piers 39 and 41_June 13, 1977	SA-3	Section A	Soils Investigation, North Point Pier Complex Piers 39 and 41	Dames & Moore	13-Jun-77	North Point Pier
P39-4_Test Pile Driving Proposed Parking Garage_December 21, 1977	SA-4	Section A	Report- Test Pile Driving Proposed Parking Garage San Francisco, California	Dames & Moore	21-Dec-77	North Point Pier
P39-5_Geotechnical Investigation For Pier 39 Breakwater _July 1, 1982	SA-5	Section A	Geotechnical Investigation for Pier 39 Breakwater San Francisco, California	Peter Kaldveer and Associates	Jul-82	Pier 39-A Limited Partnership, c/o Len H. Teasley- Consulting Engineers
P39-8_Pier 39 West Break Water Repair Project_November 6, 1984	SA-6	Section A	Addendum Number One and Two for West Breakwater Repair Project Pier 39, San Francisco, California	Peter Kaldveer and Associates	6-Nov-84	Port of San Francisco
P39-1_Report - The Embarcadero and B_July 20, 1977	SA-7	Section A	Report- Foundation Investigation Proposed Parking Garage The Embarcadero and Beach Street	Dames & Moore	20-Jul-77	North Point Pier

File Name	Report ID Number	Section	Title	Author	Date	Prepared For
(E) borings 1 of 3	SA-8	Section A	A single map of borings from piers 39 to Pier 43-1/2	Dames & Moore	*Unknown*	San Francisco Port Commission Department of Engineering
(E) borings 2 of 3	SA-9	Section A	Borings The Embarcadero, between Pier 39 & Pier 41	Dames & Moore	*Unknown*	San Francisco Port Commission Department of Engineering
(E) borings 3 of 3	SA-10	Section A	Borings The Embarcadero, between Pier 39 & Pier 41 (Con't)	Dames & Moore	*Unknown*	San Francisco Port Commission Department of Engineering
P39-4_Foundation Investigation Proposed Service Building_July 21, 1977	SA-11	Section A	Report, Foundation Investigation, Proposed Service Building, San Francisco, California	Dames & Moore	21-Jul-77	North Point Pier
P39-2_Report, Observation and Inspection, During Pile Driving, Pier 39_November 4, 1977	S1-1	Section 1	Report- Observation and Inspection During Pile Driving Pier 39 San Francisco, California	Dames & Moore	4-Nov-77	North Point Pier
P39-9_Seismic Response Study Investigation for Underwater World at Pier 39_March 15, 1988	S1-2	Section 1	Seismic Response Study Investigation for Underwater World at Pier 39	Harza Kaldveer	15-Mar-88	Harrison, Teasley and Associates, Inc.
P39-12_Updated Response Study and Supplemental Pile Design Recommendations Underwater W_November 12, 1993	S1-3	Section 1	Updated Seismic Response Study and Supplemental Pile Design Recommendations Underwater World- Pier 39	Harza Kaldveer	12-Nov-93	Tarlton Aquistar, L.P.
P39-13_Geotechnical Investigation for Underwater World at Pier 39_May 12, 1988	S1-4	Section 1	Geotechnical Investigation for Underwater World at Pier 39	Harza Kaldveer	12-May-88	Questar of New Zealand
Northpoint Sewage Treatment Plant Dames & Moore 1971	S1-5	Section 1	Report- Foundation Investigation Onshore Portion of Sewage Outfall Line, North Point Sewage Treatment Plant	Dames & Moore	28-Sep-71	Department of Public Works City and County of San Francisco
EMB-4_Soil Investigation Embarcadero Triangle Office Building_June 19, 1972	S1-6	Section 1	Soil Investigation Embarcadero Triangle Office Building San Francisco, California	Harding, Miller, Lawson & Associates	19-Jun-72	Embarcadero Triangle Associates
EMB-10_North Point Pump Station_June 24, 1977	S2-2	Section 2	*Untitled, pages from an unknown report*	Dames & Moore	1977	*Unknown*
North Point Water Pollution Control Plant Treadwell & Rollo-Olivia Chen Feb 1999	S2-3	Section 2	North Point Water Pollution Control Plant Proposed Hopper Building and Effluent Channel Extension	Treadwell & Rollo, Inc./Olivia Chen Consultants, Inc.	3-Feb-99	San Francisco Department of Public Works
P35_37_39_41-1_Request to Perform Subsurface Investigation_March 23, 1977	S2-4	Section 2	Request for Permission to Perform Subsurface Investigation	Port of San Francisco	23-Mar-77	Dames & Moore
P27_29-3_Development of Seismic Design Parameters Ferry Plaza Piers 27_29 Se_November, 1993	S2-5	Section 2	FINAL REPORT Development of Seismic Design Parameters Ferry Plaza Piers 27/29 Seismic Repair	AGS, Inc.	1-Nov-93	Port of San Francisco
P27_29-4_Extra Non-Linear T-H Pile Model Calcs._December 5, 1994	S2-6	Section 2	Pier 27-29 Extra Non-Linear T-H Pile Model Calcs.	Winzler & Kelly	5-Dec-94	Port of San Francisco
GTC Pier33 5-DataReport 2012April	S2-7	Section 2	Geotechnical Soil Corrosivity Investigation Data Report Pier 33 1/2 PG&E Vault Project San Francisco, California	Geotechnical Consultants, Inc.	24-Apr-12	Creegan & D'Angelo Infrastructure Engineers
EMB-7_Proposed North Shore Outfalls Consolidation Projec_April 23, 1976	S3-1	Section 3	Exploratory Probings Proposed North Shore Outfalls Consolidation Project The Embarcadero Between Jackson and North Point Streets	Cooper Clark & Associates	23-Apr-76	City and County of San Francisco Department of Public Works Bureau of Engineering
EMB-9_Soil Borings @ Embarcadero_February 10, 1977	S3-2	Section 3	*Soils Report- Boring Logs FC-1 thru FC7*	Fruin-Colnon Corporation	9-Feb-77	Port of San Francisco
P27_29-1_Pier 27_29 Substructure-General Conditions(Construction De_March 31, 1999	S3-3	Section 3	Preliminary Report on Pier 27/29 Substructure-General Conditions (Construction Description and Site Observation)	STRUCTUS, Inc.	31-Mar-99	Port of San Francisco
P27_29-2_Pier 27-29 Port of San Francisco City and County_February, 1995	S3-4	Section 3	DRAFT Report Geotechnical Study Pier 27-29	AGS, Inc.	1-Feb-95	Port of San Francisco
P27-1_Foundation Investigation Pier 27 San Francisco Port Facility_April 5, 1965	S3-5	Section 3	Report- Foundation Investigation Pier 27 San Francisco Port Facility	Dames & Moore	5-Apr-65	San Francisco Port Authority
P31-1_Pier 31 Substructure-General Conditions(Construction Descr_May 10, 1999	S3-6	Section 3	Preliminary Report on Pier 31 Substructure- General Conditions (Construction Description and Site Observation)	STRUCTUS, Inc.	10-May-99	Port of San Francisco
P23-1_Foundation Investigation Proposed Addition to Pier 23_May 25, 1970	S4-2	Section 4	Report- Foundation Investigation Proposed Addition to Pier 23 San Francisco, California	Dames & Moore	25-May-70	San Francisco Port Commission

File Name	Report ID Number	Section	Title	Author	Date	Prepared For
P15-1_Geotechnical Investigation, The Exploritorium Pier 15, San Franc_January 12, 2007	S5-1	Section 5	Progress Report Geotechnical Investigation The Exploratorium Pier 15 San Francisco, California	Treadwell & Rollo	12-Jan-07	The Exploratorium
Geotech_44530102-LTR-06-12-07.PDF	S5-2	Section 5	Progress Report No. 2- Pier 17 Geotechnical Consultation The Exploratorium Piers 15 and 17	Treadwell & Rollo	12-Jun-07	The Exploratorium
Pier 9 Geotech 1_14_09	S5-3	Section 5	Geotechnical Consultation, WETA Berths at Pier 9, San Francisco, California	Treadwell & Rollo	14-Jan-09	Moffatt & Nichol Engineers
10032 GTC Port of SF Pier 9 PDA	S5-4	Section 5	Dynamic Pile Test Report, Pier 9 North Apron	Abe Construction Services	14-May-10	Geotechnical Consultants, Inc.
P07-1_Geotechnical Investigation Pier 7 Reconstruction _January 1, 1985	S6-2	Section 6	Pier 7 Reconstruction Port of San Francisco	Allstate Geotechnical Services	1-Jan-85	T.Y. Lin International
P07-2_Pier 7 Test Boring Negatives_March 11, 1985	S6-3	Section 6	Pier 7 Test Boring Negative (1 Sheet)	Minimax International	11-Mar-85	SF Port Commission
8 Washington - Geotechnical Report - Final 7_9_2012	S7-1	Section 7	Geotechnical Investigation 8 Washington Street San Francisco, California	Rollo & Ridley	9-Jul-12	San Francisco Waterfront Partners, LLC
8 Washington - Seismic Hazards	S7-2	Section 7	Seismic Hazards 8 Washington Street San Francisco California	Rollo & Ridley	24-May-12	San Francisco Waterfront Partners, LLC
P01-1_2_3_5-1_Geotech Investigation and Probabilistic Seismic Hazard Analysis_July 24, 2002	S7-3	Section 7	Geotechnical Investigation and Probabilistic Seismic Hazard Analysis Piers 1-1/2, 3 and 5	Treadwell & Rollo	24-Jul-02	Waterfront Partners, LLC
Northgate_North Shore Force Main	S7-4	Section 7	Environmental and Geotechnical Engineering Data Report North Shore to Channel Force Main Improvement Proejct	Northgate Environmental Management, Inc.	17-Oct-11	City and County of San Francisco Department of Public Works
Embarcadero Center	S7-5	Section 7	Foundation Investigation Embarcadero Center Office Building Block 231	Harding, Miller, Lawson & Associates	28-Apr-71	John Portan & Associates
P01-1_8.488-acre Surplus Area North Of_June 12, 1964	S8a-1	Section 8a	Report- Field Exploration and Laboratory Testing 8,488-Acre Surplus Area North of Ferry Building Between Pier 1 and Heliport	Dames & Moore	12-Jun-64	San Francisco Port Authority
North Shore Force Main Project	S8a-2	Section 8a	North Shore Force Main Project	Treadwell & Rollo	3-Jun-10	
BART Ferry Building Plaza_1T0017	S8b-1	Section 8b	San Francisco Bay Area Rapid Transit District Plans for the Construction of Ferry Building Plaza Platform Trans Bay Line	PBQ&D, Inc.	2-Mar-71	San Francisco Bay Area Rapid Transit District
BART Transbay Line_1B0031	S8b-2	Section 8b	BART Reference Drawings Trans Bay Line San Francisco Approach Borehole Plan and Notes	PBQ&D, Inc.	24-Oct-67	San Francisco Bay Area Rapid Transit District
BART Transbay Line_1T0011	S8b-3	Section 8b	BART Trans Bay Line Trans Bay Tube Boring Plan	PBQ&D, Inc.	13-Aug-65	San Francisco Bay Area Rapid Transit District
EMB-11_Muni Metro Turnaround Facility for bechtel Nat_January 31, 1986	S8b-4	Section 8b	Factual Report Site Investigation MUNI Metro Turnaround Facility	Dames & Moore	31-Jan-86	Bechtel National, Inc.
EMB-12_Site Investigation Muni Metro Turnaround Facility for Bechtel Nat_January 31, 1986	S8b-5	Section 8b	Factual Report Site Investigation MUNI Metro Turnaround Facility, Volume II- Appendix A and Appendix B	Dames & Moore	31-Jan-86	Bechtel National, Inc.
BART SF Transition Structure Seismic Retrofit_Oct 2007	S8b-6	Section 8b	BART Earthquake Safety Program Final Design Engineering Report for BART San Francisco Transition Structure Seismic Retrofit Volume 2- Geotechnical Design Report	PB Americas, Inc.	3-Oct-07	San Francisco Bay Area Rapid Transit District
EMB-13_Muni Metro Turnaround Facility Phase IA- Preliminary Enginee_April 8, 1988	S8b-7	Section 8b	Geotechnical Report MUNI Metro Turnaround Facility Phase IA- Preliminary Engineering Volume II. Appendices A, B, and C.	Dames & Moore	8-Apr-88	Bechtel National, Inc.
730160403.02_MML_REPORT_SF Ferry Terminal	S8b-8	Section 8b	Geotechnical Investigation, San Francisco Ferry Terminal - Phase 2, San Francisco, California	Langan Treadwell Rollo	22-Sep-15	ROMA Design Group
730160403.03_JG_Site Specific Response Memo	S8b-9	Section 8b	Development of the Site Specific Response Spectra and SSI Seawall Stability, San Francisco Ferry Terminal - Phase 2	Langan Treadwell Rollo	7-Oct-15	San Francisco Bay Area Water Emergency Transportation Authority

File Name	Report ID Number	Section	Title	Author	Date	Prepared For
Final Geotechnical Data Report - Vol 1	S8-1	Section 8	Transbay Transit Center Program Transbay Transit Center Contract No. 08-04-CMGG-000 100% CD Buttress/Shoring/Excavation-Issued for Structural Design Review Volume Seven A	Arup North America, Ltd.	26-Feb-10	Transbay Joint Powers Authority
Final Geotechnical Data Report- Vol 2	S8-2	Section 8	Transbay Transit Center Program Transbay Transit Center Contract No. 08-04-CMGG-000 100% CD Buttress/Shoring/Excavation-Issued for Structural Design Review Volume Seven B	Arup North America, Ltd.	26-Feb-10	Transbay Joint Powers Authority
Final_Geotechnical_Rpt_Transbay_4-15_09	S8-3	Section 8	Transbay Transit Center Program Geotechnical Study Relocation of Utilities Project San Francisco, California	URS	April, 2009	Transbay Joint Powers Authority
T&R Ferry Building and Pier 14- 13 Oct '95 Rpt	S8-4	Section 8	Geotechnical Investigation San Francisco Ferry Terminal Breakwater Structure/Access Pier	Treadwell & Rollo	10/13/1995	ROMA Design Group
T&R Folsom and Main GTK report	S9a-1	Section 9a	Geotechnical Investigation The Pacific Exchange	Treadwell & Rollo	5/8/1998	Thomas Realty Advisors
Howard and Main Borings	S9a-2	Section 9a	Folger Building Addition Howard & Main Streets	Harding Lawson Associates	10/7/1970	
Gap Building at Folsom and Spear Borings	S9b-1	Section 9b	Gap Building at Folsom and Spear Borings	Dames & Moore	2/1/1997	
P22-5_AGS - Fire Station 49_Jul-93	S9-1	Section 9	Final Report Geotechnical Study Seismic Safety Evaluation of Fire Station No. 49- Fire Boat Headquarters	AGS, Inc.	1-Jul-93	EQE Engineering and Design
P30_32-1_Geotechnical Investigation Pier 30_32 Rehabilitation _March 1, 1987	S10-1	Section 10	Geotechnical Investigation Pier 30/32 Rehabilitation, Port of San Francisco, California	Lee and Praszker	1-Mar-87	Jefferson Associates
P30-32-2_Pier 30_32 Rehabilitation Port Of San Francisco California Structur_April 6, 1987	S10-2	Section 10	FINAL REPORT Pier 30/32 Rehabilitation Port of San Francisco, California Structural Investigation for Vertical and Lateral Loads	Rudolf Fehr	6-Apr-87	Jefferson Associates
AmericasCup_Report_2-10-12	S10-3	Section 10	Final Geotechnical Report Pier 30/32 Seismic Retrofit Project, America's Cup 34 Port of San Francisco California	Earth Mechanics, Inc.	10-Feb-12	AECOM
Brannan Street Wharf Draft Data Report	S11-1	Section 11	Geotechnical Data Report (DRAFT) Brannan Street Wharf San Francisco, CA	Geotechnical Consultants, Inc.	July, 2009	Winzler & Kelly
BSW FINAL DESIGN REPORT	S11-2	Section 11	Geotechnical Design Report Brannan Street Wharf San Francisco, CA	Geotechnical Consultants, Inc.	June, 2010	Winzler & Kelly/ Structus JV
Geotechnical Memo Brannan St Wharf_rev1	S11-3	Section 11	Geotechnical Memorandum of Preliminary Geotechnical Recommendations, Brannan Street Wharf, San Francisco, CA	Geotechnical Consultants, Inc.	28-May-09	Winzler & Kelly
HLA Report Bayside Village San Francisco	S11-4	Section 11	HLA Report Bayside Village San Francisco	Harding Lawson Associates	1-Dec-85	
P38-2_Geotechnical Investigation Site K_February 15, 1991	S12-1	Section 12	Geotechnical Investigation Site K San Francisco, California	Treadwell & Associates, Inc.	15-Feb-91	Bridge Housing Corporation
GTC-AWSS-PS1, Final GDR, 20120130	S12-2	Section 12	Geotechnical Data Report Auxiliary Water Supply System (AWSS) Pump Station No. 1 (San Francisco Fire Department Headquarters) 698 Second Street San Francisco, California Project No. CUWAWSAW05 Contract No. CS-998B	Geotechnical Consultants, Inc.	1-Jan-12	San Francisco Public Utilities Commission
Geotechnical Memo Pier 38	S12-3	Section 12	Geotechnical Memorandum Pier 38 Seismic Retrofit San Francisco, California	Geotechnical Consultants, Inc.	28-Jan-13	STRUCTUS, Inc.
AWSS-PS1 Final Geotechnical Report	S12-4	Section 12	Geotechnical Report Auxiliary Water Supply System (AWSS) Pump Station No. 1	Geotechnical Consultants, Inc.	January, 2012	San Francisco Public Utilities Commission
Final Task 12.3 TM	S12-5	Section 12	CS-199 Planning Support Services for Auxiliary Water Supply System (AWSS) Task 12.3-Pump Station 1 Tunnel Geotechnical Study	AECOM/ AGS, JV	July, 2013	San Francisco Public Utilities Commission

File Name	Report ID Number	Section	Title	Author	Date	Prepared For
Pier 36 drawings	S12-6	Section 12	Soundings of Pier 36	Board of State Harbor Commissioners Department of Engineering	14-Aug-08	*Unknown*
P40-46A-1_South Beach Small Boat Harbor and Park Piers 40 thru 46A_January 18, 1983	S13-1	Section 13	South Beach Small Boat Harbor and Park Piers 40 through 46A	Harding Lawson Associates	18-Jan-83	Winzler and Kelly
CB-5_Geotechnical Investigation Pacific Bell Park_April 11, 1997	P46-1	Pier 46 Section	Geotechnical Investigation Pacific Bell Park	Treadwell & Rollo	11-Apr-97	San Francisco Giants 3Com Park at Candlestick Point
CS-2_Channel Outfalls Consolidation Project_January 23, 1976	MS-1	Multiple Sections	Geotechnical Investigation of the Proposed Channel Outfalls Consolidation Project	Woodward-Clyde Consultants	23-Jan-76	City and County of San Francisco Department of Public Works Bureau of Engineering
CS-3_Channel Outfalls Consolidation Project_November 28, 1975	MS-2	Multiple Sections	Geotechnical Investigation of the Proposed Channel Outfalls Consolidation Project	Woodward-Clyde Consultants	28-Nov-75	City and County of San Francisco Department of Public Works Bureau of Engineering
North Shore Outfalls Consolidation Project N1 Dames and Moore January 1979	MS-3	Multiple Sections	Soil and Rock Data Contract N1 North Shore Outfalls Consolidation Project	Dames & Moore	26-Jan-79	City and County of San Francisco Department of Public Works
North Shore Outfalls Consolidation Project N2 Dames and Moore March 1979	MS-4	Multiple Sections	Soil and Rock Data Contract N2 North Shore Outfalls Consolidation Project	Dames & Moore	6-Mar-79	City and County of San Francisco Department of Public Works
North Shore Outfalls DM November 1977	MS-5	Multiple Sections	Final Report- Subsurface Investigation North Shore Outfalls Consolidation Project Contracts N1, N2, and N4	Dames & Moore	1-Nov-77	City and County of San Francisco Department of Public Works
2nd and Townsend Borings - TJPA	MS-6	Multiple Sections	Transbay Transit Center Program Downtown Rail Extension Project- Second and Townsend Streets Soil Borings	Transbay Joint Powers Authority	3-Aug-11	San Francisco Water, Power and Sewer Management Bureau
finalreportgeote1199peni	MS-7	Multiple Sections	Final Report Geotechnical Site Investigation in S.F. Downtown Station Relocation EIS/EIR Project Volume 1 Main Report	ICF Kaiser Engineers/DeLeuw Cather Team in Association with Dames& Moore, AGS, and MIG	25-Sep-95	Peninsula Corridor Joint Powers Board
finalreportgeote2199peni	MS-8	Multiple Sections	Final Report Geotechnical Site Investigation in S.F. Downtown Station Relocation EIS/EIR Project Volume II Appendices A and B	ICF Kaiser Engineers/DeLeuw Cather Team in Association with Dames& Moore, AGS, and MIG	25-Sep-95	Peninsula Corridor Joint Powers Board
reportgeotechnic95peni	MS-9	Multiple Sections	Geotechnical Engineering Recommendations Report	ICF Kaiser Engineers/DeLeuw Cather Team in Association with Dames& Moore, AGS, and MIG	27-Dec-95	Peninsula Corridor Joint Powers Board
9101-403-410-2 (existing borings)	MS-10	Multiple Sections	Plan of Borings & Test Piles Pier 1 to Hyde St. (Sheet 1 of 7)	Port of San Francisco	1-Oct-61	San Francisco Port Authority, Port of San Francisco
D0001001	MS-11	Multiple Sections	Plan of Borings & Test Piles China Basin to Pier 1 (Sheet 1 of 5)	San Francisco Port Authority Department of Engineering	July, 1961	Port of San Francisco
D0002001	MS-12	Multiple Sections	Plan of Borings & Test Piles China Basin to Pier 1 (Sheet 2 of 5)	San Francisco Port Authority Department of Engineering	July, 1961	Port of San Francisco
D0003001	MS-13	Multiple Sections	Plan of Borings & Test Piles China Basin to Pier 1 (Sheet 3 of 5)	San Francisco Port Authority Department of Engineering	July, 1961	Port of San Francisco
AWSS_Final_Task_7_Seawater intake Tunnels	MS-14	Multiple Sections	CS-199 Planning Support Services for Auxiliary Water Supply System (AWSS) Task 7-Seawater Intake Tunnels Technical Memorandum	AECOM/ AGS, JV	January, 2013	San Francisco Public Utilities Commission
ASCE Pipelines 2014 paper 141 Myerson-et-al	MS-15	Multiple Sections	Seismic Reliability of Seawater Intake Tunnels for San Francisco's Auxiliary Water Supply System (AWSS)	AECOM/ AGS, JV, SFPUC	2014	ASCE
Bayside Facilities Plan Element 4_Aug 1982	MS-16	Multiple Sections	Bayside Facilities Plan Expanded Geotechnical Investigation Element 4: North Shore Transport Facility	Caldwell, Gonzalez, Kennedy, Tudor Consulting Engineers	August, 1982	San Francsico Clean Water Program City and County of San Francisco

File Name	Report ID Number	Section	Title	Author	Date	Prepared For
North Shore Outfalls Consolidation_CooperClark_1975	MS-17	Multiple Sections	Proposed North Shore Outfalls Consolidation The Embarcadero Between Jackson and North Point Streets	Cooper & Clark	10-Dec-75	City and County of San Francisco
North Shore Transport and Storage Facility_GTC	MS-18	Multiple Sections	North Shore Transport and Storage Facility Bayside Facilities Planning Project Soil Investigation Records from The Embarcadero Freeway and BARTD	Geotechnical Consultants, Inc.	23-Jul-56	N/A (Internal Document)
Rincon Point - Master Geotechnical Report 1982	MS-19	Multiple Sections	Master Geotechnical Report Rincon Point- South Beach Redevelopment Project	Harding Lawson Associates	June, 1982	San Francisco Redevelopment Agency
FEMAFloodMappingAppnESWCert	MS-20	Multiple Sections	Geotechnical Engineering Consultation Seawall Stability Evaluation FEMA Flood Mapping AGS Job No. KF0206-4	AGS, Inc.	5-Dec-07	Port of San Francisco
Geology of SF North Quadrangle_Schlocker_1974	MS-21	Multiple Sections	Geology of the San Francisco North Quadrangle, California Geological Survey Professional Paper 782	Julius Schlocker	1974	United State Department of the Interior Geological Survey

Table 3–3 Historical Geotechnical Data within the Seawall Zone of Influence

Record No	Report ID	Company	Boring ID	Date Drilling Started	Date Drilling Finished	Drilling Method	Hammer Type	Boring Depth (feet)	Ground Surface Elevation (feet)	Datum	Ground Surface Elevation (feet, NAVD88)	Ground - water Depth (feet)	Ground-water Elevation (feet, NAVD88)	Depth to Top of Young Bay Mud (feet)	Depth to Bottom of Young Bay Mud (feet)	Depth to Top of Bedrock (feet)	Elevation of Top of Young Bay Mud (feet, NAVD88)	Elevation of Bottom of Young Bay Mud (feet, NAVD88)	Elevation to Top of Bedrock (feet, NAVD88)	Thickness of Artificial Fill (feet)	Thickness of Young Bay Mud (feet)	Comments
12	FW-4	AGS	B-1	6/22/1995	6/22/1995	Rotary Wash	140 lb/30"	101.5	-22.0	SFCD	-10.7			0.0	35.0		-10.7	-45.7		0.0	35.0	offshore, depths/elevations from mudline
13	FW-4	AGS	B-2	6/23/1995	6/23/1995	Rotary Wash	140 lb/30"	101.5	-22.7	SFCD	-11.4			0.0	35.0		-11.4	-46.4		0.0	35.0	offshore, depths/elevations from mudline
14	FW-4	AGS	B-3	6/26/1995	6/26/1995	Rotary Wash	140 lb/30"	149.8	-22.7	SFCD	-11.4			0.0	30.0	148.0	-11.4	-41.4	-159.4	0.0	30.0	offshore, depths/elevations from mudline
15	FW-5	GTC	DH-1	8/22/1983	8/22/1983	Rotary Wash	140 lb safety hammer/30"	88.5	-27.0	SFCD	-15.7			0.0	26.0		-15.7	-41.7		0.0	26.0	offshore, depths/elevations from mudline
16	FW-5	GTC	DH-2	8/23/1983	8/23/1983	Rotary Wash	140 lb safety hammer/30"	90	-28.5	SFCD	-17.2			0.0	51.0		-17.2	-68.2		0.0	51.0	offshore, depths/elevations from mudline
17	FW-5	GTC	DH-3	8/24/1983	8/24/1983	Rotary Wash	140 lb safety hammer/30"	91.8	-48.5	SFCD	-37.2			0.0	26.0		-37.2	-63.2		0.0	26.0	offshore, depths/elevations from mudline
18	FW-5	GTC	DH-4	8/26/1983	8/26/1983	Rotary Wash	140 lb safety hammer/30"	49.5	-64.0	SFCD	-52.7			0.0	16.5		-52.7	-69.2		0.0	16.5	offshore, depths/elevations from mudline
19	FW-5	GTC	DH-5	9/1/1983	9/2/1983	Rotary Wash	140 lb safety hammer/30"	91	-35.5	SFCD	-24.2			0.0	18.5		-24.2	-42.7		0.0	18.5	pier/offshore, depths/elevations from mudline
20	FW-5	GTC	DH-6	8/29/1983	8/31/1983	Rotary Wash	140 lb safety hammer/30"	89	-37.5	SFCD	-26.2			0.0	19.5		-26.2	-45.7		0.0	19.5	pier/offshore, depths/elevations from mudline
21	FW-5	GTC	DH-7	8/24/1983	8/24/1983	Rotary Wash	140 lb safety hammer/30"	100.5	-51.5	SFCD	-40.2			0.0	27.5		-40.2	-67.7		0.0	27.5	offshore, depths/elevations from mudline
22	FW-5	GTC	DH-8	8/30/1983	8/30/1983	Rotary Wash	140 lb safety hammer/30"	88.5	-30.5	SFCD	-19.2			0.0	42.0		-19.2	-61.2		0.0	42.0	offshore, depths/elevations from mudline
23	FW-7	GTC	DH-1	10/25/1983	10/26/1983	Rotary Wash	140 lb/30"	77.5	0.0	SFCD	11.3			22.0	39.0		-10.7	-27.7		22.0	17.0	
24	FW-7	GTC	DH-2	10/28/1983	10/28/1983	Rotary Wash	140 lb/30"	75	0.0	SFCD	11.3			20.0	43.0		-8.7	-31.7		20.0	23.0	
25	FW-7	GTC	DH-3	10/24/1983	10/24/1983	Rotary Wash	140 lb/30"	84.5	-5.5	SFCD	5.8			15.5	32.5		-9.7	-26.7		15.5	17.0	pier onshore, depths/elevations from ground surface below pier
26	FW-7	GTC	DH-4	10/26/1983	10/27/1983	Rotary Wash	140 lb/30"	80	-5.0	SFCD	6.3			14.5	36.5		-8.2	-30.2		14.5	22.0	pier onshore, depths/elevations from ground surface below pier
27	FW-7	GTC	DH-5	10/31/1983	10/31/1983	Rotary Wash	140 lb/30"	74.5	-22.0	SFCD	-10.7			0.0	21.0		-10.7	-31.7		0.0	21.0	offshore, depths/elevations from mudline
28	FW-7	GTC	DH-6	11/2/1983	11/2/1983	Rotary Wash	140 lb/30"	76.5	-17.0	SFCD	-5.7			0.0	25.0		-5.7	-30.7		0.0	25.0	offshore, depths/elevations from mudline
29	FW-7	GTC	DH-7	11/1/1983	11/1/1983	Rotary Wash	140 lb/30"	44.5	-1.0	SFCD	10.3			15.0	41.0		-4.7	-30.7		15.0	26.0	
30	FW-7	GTC	DH-8	11/3/1983	11/3/1983	Rotary Wash	140 lb/30"	75.5	-1.0	SFCD	10.3			14.5	41.0		-4.2	-30.7		14.5	26.5	
31	FW-8	WCC	1	2/27/1975	2/27/1975	Rotary Wash		78.5	-41.5	SFCD	-30.2			8.5	16.5		-38.7	-46.7		8.5	8.0	pier/offshore, depths/elevations from mudline
32	FW-8	WCC	2	2/25/1975	2/25/1975	Rotary Wash		61.5	-39.5	SFCD	-28.2									12.0	0.0	pier/offshore, depths/elevations from mudline, disturbed Bay Mud and Rip Rap top 12 ft
33	FW-8	WCC	3	2/28/1975	2/28/1975	Rotary Wash		70	-30.5	SFCD	-19.2									18.0	0.0	pier/offshore, depths/elevations from mudline, disturbed Bay Mud and Rip Rap top 18 ft
34	FW-8	WCC	4	2/25/1975	2/25/1975	Rotary Wash		75.3	1.0	SFCD	12.3			27.5	32.5		-15.2	-20.2		27.5	5.0	
35	FW-8	WCC	5	3/5/1975	3/5/1975	Rotary Wash		82.5	1.0	SFCD	12.3			37.5	57.0		-25.2	-44.7		37.5	19.5	
36	FW-8	WCC	6	3/3/1975	3/3/1975	Rotary Wash		85.5	1.0	SFCD	12.3									44.5	0.0	
37	FW-8	WCC	7	3/6/1975	3/6/1975	Rotary Wash		61	-40.0	SFCD	-28.7			8.5	24.0		-37.2	-52.7		8.5	15.5	pier/offshore, depths/elevations from mudline
38	FW-8	WCC	8	3/3/1975	3/3/1975	Rotary Wash		73.5	-36.0	SFCD	-24.7			11.5	28.5		-36.2	-53.2		11.5	17.0	pier/offshore, depths/elevations from mudline
39	FW-8	WCC	9	3/5/1975	3/5/1975	Rotary Wash		58	-33.5	SFCD	-22.2			14.0	24.0		-36.2	-46.2		14.0	10.0	pier/offshore, depths/elevations from mudline, disturbed Bay Mud and Rip Rap/cobbles top 14 ft
477	FW-9	AGS	B-1	1/29/1990	1/29/1990	Rotary Wash	140 lb/30"	75.5	1.0	SFCD	12.3	8.0	4.3	33.0	58.0		-20.7	-45.7		33.0	25.0	
478	FW-9	AGS	B-2	1/30/1990	1/30/1990	Rotary Wash	140 lb/30"	76.5	1.0	SFCD	12.3	8.0	4.3	23.0	43.0		-10.7	-30.7		23.0	20.0	
479	FW-9	AGS	B-3	1/25/1990	1/25/1990	Rotary Wash	140 lb/30"	51.5	2.0	SFCD	13.3	7.0	6.3	27.0	43.0		-13.7	-29.7		27.0	16.0	

Record No	Report ID	Company	Boring ID	Date Drilling Started	Date Drilling Finished	Drilling Method	Hammer Type	Boring Depth (feet)	Ground Surface Elevation (feet)	Datum	Ground Surface Elevation (feet, NAVD88)	Ground - water Depth (feet)	Ground- water Elevation (feet, NAVD88)	Depth to Top of Young Bay Mud (feet)	Depth to Bottom of Young Bay Mud (feet)	Depth to Top of Bedrock (feet)	Elevation of Top of Young Bay Mud (feet, NAVD88)	Elevation of Bottom of Young Bay Mud (feet, NAVD88)	Elevation to Top of Bedrock (feet, NAVD88)	Thickness of Artificial Fill (feet)	Thickness of Young Bay Mud (feet)	Comments
480	FW-9	AGS	B-4	1/10/1990	1/10/1990	Rotary Wash	140 lb/30"	42	1.0	SFCD	12.3	8.0	4.3	30.0			-17.7			30.0		
481	FW-9	AGS	B-5	1/25/1990	1/25/1990	Rotary Wash	140 lb/30"	51	-3.0	SFCD	8.3	5.0	3.3	28.5	42.5		-20.2	-34.2		28.5	14.0	
482	FW-9	AGS	B-6	1/11/1990	1/11/1990	Rotary Wash	140 lb/30"	56.5	-3.0	SFCD	8.3	5.0	3.3	29.0	44.0		-20.7	-35.7		29.0	15.0	
483	FW-9	AGS	B-7	1/15/1990	1/15/1990	Rotary Wash	140 lb/30"	66.5	1.0	SFCD	12.3	9.0	3.3	32.0	44.0		-19.7	-31.7		32.0	12.0	
484	FW-9	AGS	B-8	1/10/1990	1/10/1990	Rotary Wash	140 lb/30"	42	-2.0	SFCD	9.3	4.5	4.8	33.0			-23.7			33.0		
485	FW-9	AGS	B-9	1/24/1990	1/24/1990	Rotary Wash	140 lb/30"	51.5	-3.0	SFCD	8.3	3.0	5.3	34.0	48.0		-25.7	-39.7		34.0	14.0	
486	FW-9	AGS	B-10	1/16/1990	1/16/1990	Rotary Wash	140 lb/30"	51.5	1.0	SFCD	12.3	5.5	6.8	32.5	43.0		-20.2	-30.7		32.5	10.5	
487	FW-9	AGS	B-11	1/11/1990	1/12/1990	Rotary Wash	140 lb/30"	66.5	-1.0	SFCD	10.3	5.5	4.8	32.0	65.0		-21.7	-54.7		32.0	33.0	
488	FW-9	AGS	B-12	1/22/1990	1/23/1990	Rotary Wash	140 lb/30"	76.5	-3.0	SFCD	8.3	3.0	5.3	29.0	64.0		-20.7	-55.7		29.0	35.0	
489	FW-9	AGS	B-13	1/17/1990	1/18/1990	Rotary Wash	140 lb/30"	45.5	1.0	SFCD	12.3	7.5	4.8	44.0			-31.7			44.0		
490	FW-9	AGS	B-14	1/24/1990	1/24/1990	Rotary Wash	140 lb/30"	51.5	-2.0	SFCD	9.3	4.5	4.8	25.0			-15.7			25.0		
491	FW-9	AGS	B-15	1/15/1990	1/15/1990	Rotary Wash	140 lb/30"	53.5	1.0	SFCD	12.3	7.0	5.3	35.0			-22.7			35.0		
492	FW-9	AGS	B-16	1/30/1990	1/30/1990	Rotary Wash	140 lb/30"	51.5	-3.0	SFCD	8.3	8.0	0.3	24.0	48.0		-15.7	-39.7		24.0	24.0	
493	FW-9	AGS	B-17	1/26/1990	1/26/1990	Rotary Wash	140 lb/30"	76.5	-3.0	SFCD	8.3	3.5	4.8	31.0	55.5		-22.7	-47.2		31.0	24.5	
494	FW-9	AGS	B-18	1/23/1990	1/23/1990	Rotary Wash	140 lb/30"	46.5	-2.0	SFCD	9.3	4.5	4.8							38.0	0.0	
495	FW-9	AGS	B-19	1/22/1990	1/22/1990	Rotary Wash	140 lb/30"	31.5	1.0	SFCD	12.3	7.0	5.3									boring ended in Fill
496	FW-9	AGS	B-20	1/23/1990	1/23/1990	Rotary Wash	140 lb/30"	46.5	-3.0	SFCD	8.3	3.5	4.8							33.0	0.0	
497	FW-9	AGS	B-21	1/16/1990	1/17/1990	Rotary Wash	140 lb/30"	76.5	1.0	SFCD	12.3	7.5	4.8							38.0	0.0	
498	FW-9	AGS	B-22	1/18/1990	1/19/1990	Rotary Wash	140 lb/30"	46.5	1.0	SFCD	12.3	7.5	4.8							39.0	0.0	
537	FW-11	TPGC	8	10/14/2002	10/14/2002	Rotary Wash	140 lb/30"	61	11.6	MLLW	11.3			18.5	44.5		-7.2	-33.2		18.5	26.0	
538	FW-11	TPGC	9	4/23/2003	4/23/2003	Rotary Wash	140 lb/30"	55.5	6.2	MLLW	5.9			28.0	38.0		-22.1	-32.1		28.0	10.0	Elevations and depths from ground surface/mudline, not deck.
539	FW-11	TPGC	10	4/21/2003	4/22/2003	Rotary Wash	140 lb/30"	57.5	6.7	MLLW	6.4			32.5	35.5		-26.1	-29.1		32.5	3.0	Elevations and depths from ground surface/mudline, not deck.
540	FW-11	TPGC	11	4/22/2003	4/23/2003	Rotary Wash	140 lb/30"	61	11.8	MLLW	11.5			25.0	42.0		-13.5	-30.5		25.0	17.0	
541	FW-11	TPGC	12	4/23/2003	4/23/2003	Rotary Wash	140 lb/30"	13.5	11.8	MLLW	11.5											Boring ended in Fill
473	SB-1	T&R	B-1	12/4/2002	12/4/2002	Hollow Stem Auger	Safety Hammer, 140 lb/30"	66.5	-14.0	SFCD	-2.7			0.0	50.0		-2.7	-52.7		0.0	50.0	pier/offshore, depths/elevations from mudline
474	SB-1	T&R	B-2	12/2/2002	12/2/2002	Hollow Stem Auger	Safety Hammer, 140 lb/30"	64.5	-16.5	SFCD	-5.2			0.0	35.0		-5.2	-40.2		0.0	35.0	pier/offshore, depths/elevations from mudline
475	SB-2	T&R	TR-1	12/19/2008	12/20/2008	Rock Core/Mud Rotary	Automatic Hammer, 140 lb/30"	46.5	13.6	MLLW	13.3	5.0	8.3	27.0	42.0		-13.7	-28.7		27.0	15.0	
476	SB-2	T&R	TR-2	12/17/2008	12/18/2008	Rock Core/Mud Rotary	Automatic Hammer, 140 lb/30"	101.5	10.6	MLLW	10.3	6.0	4.3	24.0	44.5		-13.7	-34.2		24.0	20.5	
631	SB-2	T&R	B-1	12/4/2002	12/4/2002	Hollow Stem Auger	Safety, 140 lb/30"	81.5	-14.0	SFCD	-2.7			0.0	65.0		-2.7	-67.7		0.0	65.0	Elevations and depths from ground surface/mudline, not deck.
632	SB-2	T&R	B-2	12/2/2002	12/2/2002	Hollow Stem Auger	Safety, 140 lb/30"	81.5	-16.5	SFCD	-5.2			0.0	52.0		-5.2	-57.2			52.0	Elevations and depths from ground surface/mudline, not deck.
40	SB-3	GTC	B-1	3/24/2009	3/24/2009	Solid Flight Auger	NA	7	-4.0	SFCD	7.3		7.3									Boring abandoned at 7 ft due to obstruction
41	SB-3	GTC	B-2	3/26/2009	3/26/2009	Solid Flight Auger/Rotary Wash	Automatic Hammer, 140 lb/30"	40.5	-2.0	SFCD	9.3			18.0	25.0		-8.7	-15.7		18.0	7.0	
42	SB-3	GTC	B-3	3/25/2009	3/25/2009	Solid Flight Auger/Rotary Wash	Automatic Hammer, 140 lb/30"	40.5	-1.0	SFCD	10.3			16.0	24.5		-5.7	-14.2		16.0	8.5	
43	SB-3	GTC	B-4	3/24/2009	3/26/2009	Solid Flight Auger/Rotary Wash	Automatic Hammer, 140 lb/30"	40.5	-5.0	SFCD	6.3									38.0		
542	SB-8	T&R	B-1	6/26/2003	2/27/2003	Rotary Wash	Rope & Cathead	80.5	0.0	SFCD	11.3	8.2	3.1	18.0	43.5		-6.7	-32.2		18.0	25.5	
543	SB-8	T&R	B-2	2/25/2003	2/26/2003	Rotary Wash	Rope & Cathead	76	0.0	SFCD	11.3	7.9	3.4	17.5	43.0		-6.2	-31.7		17.5	25.5	
544	SB-8	T&R	B-3	2/25/2003	2/25/2003	Rotary Wash	Rope & Cathead	81	0.0	SFCD	11.3	7.9	3.4	19.0	44.0		-7.7	-32.7		19.0	25.0	

Record No	Report ID	Company	Boring ID	Date Drilling Started	Date Drilling Finished	Drilling Method	Hammer Type	Boring Depth (feet)	Ground Surface Elevation (feet)	Datum	Ground Surface Elevation (feet, NAVD88)	Ground - water Depth (feet)	Ground-water Elevation (feet, NAVD88)	Depth to Top of Young Bay Mud (feet)	Depth to Bottom of Young Bay Mud (feet)	Depth to Top of Bedrock (feet)	Elevation of Top of Young Bay Mud (feet, NAVD88)	Elevation of Bottom of Young Bay Mud (feet, NAVD88)	Elevation to Top of Bedrock (feet, NAVD88)	Thickness of Artificial Fill (feet)	Thickness of Young Bay Mud (feet)	Comments
545	SB-8	T&R	B-4	2/27/2003	2/27/2003	Rotary Wash	Rope & Cathead	76.5	0.0	SFCD	11.3	7.0	4.3	17.5	43.0		-6.2	-31.7		17.5	25.5	
413	SA-1	D&M	1	4/2/1971	4/2/1971	Rotary Wash		56.5	-20.5	MLLW	-20.8			0.0	21.5		-20.8	-42.3		0.0	21.5	offshore, depths/elevations from mudline
414	SA-1	D&M	2	3/29/1971	3/29/1971	Rotary Wash		59	-28.0	MLLW	-28.3			0.0	17.5		-28.3	-45.8		0.0	17.5	offshore, depths/elevations from mudline
415	SA-1	D&M	3	3/30/1971	3/30/1971	Rotary Wash		40	-42.0	MLLW	-42.3			0.0	28.5		-42.3	-70.8		0.0	28.5	offshore, depths/elevations from mudline
416	SA-1	D&M	4	3/31/1971	3/31/1971	Rotary Wash		33.5	-48.0	MLLW	-48.3			0.0	32.0		-48.3	-80.3		0.0	32.0	offshore, depths/elevations from mudline
417	SA-1	D&M	5	3/31/1971	3/31/1971	Rotary Wash		39.5	-49.0	MLLW	-49.3			0.0	38.0		-49.3	-87.3		0.0	38.0	offshore, depths/elevations from mudline
418	SA-1	D&M	6	4/2/1971	4/2/1971	Rotary Wash		24.5	-64.5	MLLW	-64.8									0.0		offshore, depths/elevations from mudline
419	SA-1	D&M	7	4/2/1971	4/2/1971	Rotary Wash		20	-72.0	MLLW	-72.3									0.0		offshore, depths/elevations from mudline
420	SA-1	D&M	8	4/2/1971	4/2/1971	Rotary Wash		21.5	-74.0	MLLW	-74.3									0.0		offshore, depths/elevations from mudline
421	SA-1	D&M	9	4/1/1971	4/1/1971	Rotary Wash		16.5	-76.0	MLLW	-76.3									0.0		offshore, depths/elevations from mudline
422	SA-1	D&M	10	4/1/1971	4/1/1971	Rotary Wash		17.5	-75.0	MLLW	-75.3									0.0		offshore, depths/elevations from mudline
423	SA-1	D&M	11	4/1/1971	4/1/1971	Rotary Wash		17.5	-77.0	MLLW	-77.3									0.0		offshore, depths/elevations from mudline
424	SA-1	D&M	12	4/1/1971	4/1/1971	Rotary Wash		18	-77.0	MLLW	-77.3									0.0		offshore, depths/elevations from mudline
425	SA-1	D&M	13	4/1/1971	4/1/1971	Rotary Wash		19.5	-74.5	MLLW	-74.8									0.0		offshore, depths/elevations from mudline
426	SA-1	D&M	14	4/29/1971	5/3/1971	Cable Tool	325 lb / 24"	44.2	10.7	MLLW	10.4			32.0	35.0		-21.6	-24.6		32.0	3.0	
427	SA-1	D&M	15	4/28/1971	4/28/1971	Cable Tool/Rotary Wash		114	-1.5	MLLW	-1.8			30.5	34.0	111.5	-32.3	-35.8	-113.3	30.5	3.5	Pier onshore, depths/elevations from ground surface
428	SA-2	HLA	1	1/28/1974	1/28/1974	Rotary Wash		?	-0.5	SFCD	10.8	6.5	4.3							13.0	0.0	
429	SA-2	HLA	2	1/29/1974	1/29/1974	Rotary Wash		86	-0.5	SFCD	10.8	8.0	2.8	9.5	42.5		1.3	-31.7		9.5	33.0	
430	SA-2	HLA	3	2/1/1974	2/1/1974	Rotary Wash		76	-1.0	SFCD	10.3	6.0	4.3	12.5	43.0		-2.2	-32.7		12.5	30.5	
431	SA-2	HLA	4	1/31/1974	1/31/1974	Rotary Wash		76	0.0	SFCD	11.3	6.5	4.8	10.0	44.5		1.3	-33.2		10.0	34.5	
432	SA-2	HLA	5	1/30/1974	1/30/1974	Rotary Wash		79	-0.5	SFCD	10.8			10.0	42.5		0.8	-31.7		10.0	32.5	
433	SA-2	HLA	6	1/31/1974	1/31/1974	Rotary Wash		70.5	-0.5	SFCD	10.8	6.5	4.3	16.0	42.0		-5.2	-31.2		16.0	26.0	
434	SA-3	D&M	1	3/3/1977	3/3/1977	Rotary Wash	U or TW: 300 lb/30" SPT: 140 lb/30"	113	-15.2	MLLW	-15.5			0.0	8.0		-15.5	-23.5		0.0	8.0	pier/offshore, depths/elevations from mudline
435	SA-3	D&M	2	3/10/1977	3/10/1977	Rotary Wash	U or TW: 300 lb/30" SPT: 140 lb/30"	113	-20.0	MLLW	-20.3			0.0	12.0		-20.3	-32.3		0.0	12.0	pier/offshore, depths/elevations from mudline
436	SA-3	D&M	3	2/14/1977	2/14/1977	Rotary Wash	U or TW: 300 lb/30" SPT: 140 lb/30"	115	-20.0	MLLW	-20.3			0.0	31.0		-20.3	-51.3		0.0	31.0	pier/offshore, depths/elevations from mudline
437	SA-3	D&M	4	3/7/1977	3/7/1977	Rotary Wash	U or TW: 300 lb/30" SPT: 140 lb/30"	115	-28.0	MLLW	-28.3			0.0	14.0		-28.3	-42.3		0.0	14.0	pier/offshore, depths/elevations from mudline
438	SA-3	D&M	5	3/8/1977	3/8/1977	Rotary Wash	U or TW: 300 lb/30" SPT: 140 lb/30"	110.5	-24.5	MLLW	-24.8			0.0	13.5		-24.8	-38.3		0.0	13.5	pier/offshore, depths/elevations from mudline
439	SA-3	D&M	6	3/15/1977	3/15/1977	Rotary Wash	U or TW: 300 lb/30" SPT: 140 lb/30"	95	-20.0	MLLW	-20.3			0.0	15.5		-20.3	-35.8		0.0	15.5	pier/offshore, depths/elevations from mudline
440	SA-3	D&M	7	3/17/1977	3/17/1977	Rotary Wash	U or TW: 300 lb/30" SPT: 140 lb/30"	121	-13.0	MLLW	-13.3			0.0	37.0		-13.3	-50.3		0.0	37.0	pier/offshore, depths/elevations from mudline

Record No	Report ID	Company	Boring ID	Date Drilling Started	Date Drilling Finished	Drilling Method	Hammer Type	Boring Depth (feet)	Ground Surface Elevation (feet)	Datum	Ground Surface Elevation (feet, NAVD88)	Ground - water Depth (feet)	Ground-water Elevation (feet, NAVD88)	Depth to Top of Young Bay Mud (feet)	Depth to Bottom of Young Bay Mud (feet)	Depth to Top of Bedrock (feet)	Elevation of Top of Young Bay Mud (feet, NAVD88)	Elevation of Bottom of Young Bay Mud (feet, NAVD88)	Elevation to Top of Bedrock (feet, NAVD88)	Thickness of Artificial Fill (feet)	Thickness of Young Bay Mud (feet)	Comments
441	SA-3	D&M	8	3/18/1977	3/18/1977	Rotary Wash	U or TW: 300 lb/30" SPT: 140 lb/30"	80	-20.0	MLLW	-20.3			0.0	33.0		-20.3	-53.3		0.0	33.0	pier/offshore, depths/elevations from mudline
442	SA-3	D&M	9	3/21/1977	3/21/1977	Rotary Wash	U or TW: 300 lb/30" SPT: 140 lb/30"	115	-5.0	MLLW	-5.3			18.0	36.0		-23.3	-41.3		18.0	18.0	pier/offshore, depths/elevations from mudline
443	SA-3	D&M	14	4/21/1977	4/21/1977	Rotary Wash	U or TW: 340 lb/16" SPT: 140 lb/30"	51	-37.0	MLLW	-37.3			0.0	22.0		-37.3	-59.3		0.0	22.0	offshore, depths/elevations from mudline
444	SA-3	D&M	15	4/22/1977	4/22/1977	Rotary Wash	U or TW: 340 lb/16" SPT: 140 lb/30"	72	-18.0	MLLW	-18.3			0.0	31.0		-18.3	-49.3		0.0	31.0	offshore, depths/elevations from mudline
445	SA-3	D&M	16	4/25/1977	4/25/1977	Rotary Wash	U or TW: 340 lb/16" SPT: 140 lb/30"	45	-41.0	MLLW	-41.3			0.0	25.0		-41.3	-66.3		0.0	25.0	offshore, depths/elevations from mudline
446	SA-3	D&M	17	4/26/1977	4/26/1977	Rotary Wash	U or TW: 340 lb/16" SPT: 140 lb/30"	48	-42.0	MLLW	-42.3			0.0	20.0		-42.3	-62.3		0.0	20.0	offshore, depths/elevations from mudline
447	SA-3	D&M	18	4/27/1977	4/27/1977	Rotary Wash	U or TW: 340 lb/16" SPT: 140 lb/30"	72	-23.0	MLLW	-23.3			0.0	26.0		-23.3	-49.3		0.0	26.0	offshore, depths/elevations from mudline
448	SA-3	D&M	19	4/28/1977	4/28/1977	Rotary Wash	U or TW: 340 lb/16" SPT: 140 lb/30"	59	-32.0	MLLW	-32.3			0.0	30.0		-32.3	-62.3		0.0	30.0	offshore, depths/elevations from mudline
449	SA-3	D&M	20	4/29/1977	4/29/1977	Rotary Wash	U or TW: 340 lb/16" SPT: 140 lb/30"	37	-12.0	MLLW	-12.3			0.0	31.0		-12.3	-43.3		0.0	31.0	offshore, depths/elevations from mudline
450	SA-3	D&M	21	4/30/1977	4/30/1977	Rotary Wash	U or TW: 340 lb/16" SPT: 140 lb/30"	68	-13.0	MLLW	-13.3			0.0	30.0		-13.3	-43.3		0.0	30.0	offshore, depths/elevations from mudline
451	SA-3	D&M	22	4/30/1977	4/30/1977	Rotary Wash	U or TW: 340 lb/16" SPT: 140 lb/30"	62	-19.0	MLLW	-19.3			0.0	30.0		-19.3	-49.3		0.0	30.0	offshore, depths/elevations from mudline
452	SA-3	D&M	23	5/2/1977	5/2/1977	Rotary Wash	U or TW: 340 lb/16" SPT: 140 lb/30"	69	-21.0	MLLW	-21.3			0.0	22.0		-21.3	-43.3		0.0	22.0	offshore, depths/elevations from mudline
453	SA-3	D&M	24	5/3/1977	5/3/1977	Rotary Wash	U or TW: 340 lb/16" SPT: 140 lb/30"	51	-23.0	MLLW	-23.3			0.0	28.0		-23.3	-51.3		0.0	28.0	offshore, depths/elevations from mudline
454	SA-3	D&M	25	5/4/1977	5/4/1977	Rotary Wash	U or TW: 340 lb/16" SPT: 140 lb/30"	58	-37.0	MLLW	-37.3			0.0	31.0		-37.3	-68.3		0.0	31.0	offshore, depths/elevations from mudline
455	SA-3	D&M	26	5/5/1977	5/5/1977	Rotary Wash	U or TW: 340 lb/16" SPT: 140 lb/30"	59	-24.0	MLLW	-24.3			0.0	27.0		-24.3	-51.3		0.0	27.0	offshore, depths/elevations from mudline
456	SA-3	D&M	27	5/5/1977	5/5/1977	Rotary Wash	U or TW: 340 lb/16" SPT: 140 lb/30"	44	-24.0	MLLW	-24.3			0.0	32.0		-24.3	-56.3		0.0	32.0	offshore, depths/elevations from mudline
457	SA-3	D&M	28	5/6/1977	5/6/1977	Rotary Wash	U or TW: 340 lb/16" SPT: 140 lb/30"	38	-40.0	MLLW	-40.3			0.0	8.0		-40.3	-48.3		0.0	8.0	offshore, depths/elevations from mudline
458	SA-3	D&M	29	5/7/1977	5/7/1977	Rotary Wash	U or TW: 340 lb/16" SPT: 140 lb/30"	50	-40.0	MLLW	-40.3			0.0	19.0		-40.3	-59.3		0.0	19.0	offshore, depths/elevations from mudline
459	SA-4	D&M	10	3/24/1977	3/24/1977	Rotary Wash	U sampler: 300lb/30" ; SPT: 140 lb/30"	90	-11.5	MLLW	-11.8			0.0	48.0		-11.8	-59.8		0.0	48.0	pier/offshore, depths/elevations from mudline

Record No	Report ID	Company	Boring ID	Date Drilling Started	Date Drilling Finished	Drilling Method	Hammer Type	Boring Depth (feet)	Ground Surface Elevation (feet)	Datum	Ground Surface Elevation (feet, NAVD88)	Ground - water Depth (feet)	Ground-water Elevation (feet, NAVD88)	Depth to Top of Young Bay Mud (feet)	Depth to Bottom of Young Bay Mud (feet)	Depth to Top of Bedrock (feet)	Elevation of Top of Young Bay Mud (feet, NAVD88)	Elevation of Bottom of Young Bay Mud (feet, NAVD88)	Elevation to Top of Bedrock (feet, NAVD88)	Thickness of Artificial Fill (feet)	Thickness of Young Bay Mud (feet)	Comments
460	SA-4	D&M	11	3/25/1977	3/28/1977	Rotary Wash	U sampler: 300lb/30" ; SPT: 140 lb/30"	92.5	-7.5	MLLW	-7.8			0.0	38.5	89.5	-7.8	-46.3	-97.3	0.0	38.5	pier/offshore, depths/elevations from mudline
461	SA-4	D&M	12	3/28/1977	3/29/1977	Cable Tool/Rotary Wash	U sampler: 300lb/30" ; SPT: 140 lb/30"	86	4.5	MLLW	4.2					84.0			-79.8	38.0	0.0	pier onshore, depths/elevations from ground surface
462	SA-4	D&M	13	3/28/1977	3/28/1977	Cable Tool/Rotary Wash	U sampler: 300lb/30" ; SPT: 140 lb/30"	117.3	11.8	MLLW	11.5			41.8	80.3	98.3	-30.3	-68.8	-86.8	41.8	38.5	
463	SA-5	PKA	EB-1	5/10/1982	5/10/1982	Rotary Wash	140 lb/ 30"	70	-18.5	MLLW	-18.8			0.0	55.5		-18.8	-74.3		0.0	55.5	offshore, depths/elevations from mudline
464	SA-5	PKA	EB-2	4/13/1982	4/13/1982	Rotary Wash	140 lb/ 30"	63	-19.5	MLLW	-19.8			0.0	57.5		-19.8	-77.3		0.0	57.5	offshore, depths/elevations from mudline
465	SA-5	PKA	EB-3	4/19/1982	4/19/1982	Rotary Wash	140 lb/ 30"	64	-17.5	MLLW	-17.8			0.0	44.5		-17.8	-62.3		0.0	44.5	offshore, depths/elevations from mudline
466	SA-5	PKA	EB-4	4/20/1982	4/20/1982	Rotary Wash	140 lb/ 30"	73.5	-19.0	MLLW	-19.3			0.0	44.0		-19.3	-63.3		0.0	44.0	offshore, depths/elevations from mudline
467	SA-5	PKA	EB-5	4/26/1982	4/26/1982	Rotary Wash	140 lb/ 30"	58	-32.0	MLLW	-32.3			0.0	29.0		-32.3	-61.3		0.0	29.0	offshore, depths/elevations from mudline
468	SA-5	PKA	EB-6	4/28/1982	4/28/1982	Rotary Wash	140 lb/ 30"	29.5	-43.0	MLLW	-43.3			0.0	19.5		-43.3	-62.8		0.0	19.5	offshore, depths/elevations from mudline
469	SA-5	PKA	EB-7	4/29/1982	4/29/1982	Rotary Wash	140 lb/ 30"	46	-39.0	MLLW	-39.3			0.0	21.0		-39.3	-60.3		0.0	21.0	offshore, depths/elevations from mudline
470	SA-5	PKA	EB-8	5/3/1982	5/3/1982	Rotary Wash	140 lb/ 30"	46.5	-37.5	MLLW	-37.8			0.0	40.5		-37.8	-78.3		0.0	40.5	offshore, depths/elevations from mudline
471	SA-7	D&M	30	5/19/1977	5/19/1977	Rotary Wash	Type U: 275 lb/18" ; SPT: 140 lb/30"	80.5	11.0	MLLW	10.7	8.0	2.7	15.0	44.0		-4.3	-33.3		15.0	29.0	
472	SA-7	D&M	31	5/20/1977	5/20/1977	Rotary Wash	Type U: 275 lb/18" ; SPT: 140 lb/30"	80.5	11.0	MLLW	10.7	9.0	1.7	18.0	44.0		-7.3	-33.3		18.0	26.0	
253	S1-4	HK	EB-1	1/6/1988	1/7/1988	Rotary Wash	Mod cal: 350 lb/24" SPT: 140 lb/30"	131.5	-16.0	MSL	-13.3			0.0	34.5	128.0	-13.3	-47.8	-141.3	0.0	34.5	pier/offshore, depths/elevations from mudline
254	S1-4	HK	EB-2	1/8/1988	1/7/1988	Rotary Wash	Mod cal: 350 lb/24" SPT: 140 lb/30"	111	-4.0	MSL	-1.3			0.0	46.0	108.0	-1.3	-47.3	-109.3	0.0	46.0	pier/offshore, depths/elevations from mudline
255	S1-4	HK	EB-3	4/4/1988	4/4/1988	Rotary Wash	Mod cal: 350 lb/24" SPT: 140 lb/30"	113.5	-13.5	MSL	-10.8			0.0	49.5	109.5	-10.8	-60.3	-120.3	0.0	49.5	offshore, depths/elevations from mudline
256	S1-4	HK	EB-4	4/5/1988	4/5/1988	Rotary Wash	Mod cal: 350 lb/24" SPT: 140 lb/30"	77.5	-14.0	MSL	-11.3			0.0	51.0		-11.3	-62.3		0.0	51.0	offshore, depths/elevations from mudline
257	S1-4	HK	EB-5	4/6/1988	4/5/1988	Rotary Wash	Mod cal: 350 lb/24" SPT: 140 lb/30"	126.5	-14.0	MSL	-11.3			0.0	43.0	124.0	-11.3	-54.3	-135.3	0.0	43.0	offshore, depths/elevations from mudline
258	S1-4	HK	EB-6	4/7/1988	4/7/1988	Rotary Wash	Mod cal: 350 lb/24" SPT: 140 lb/30"	87.5	-14.0	MSL	-11.3			0.0	41.0		-11.3	-52.3		0.0	41.0	offshore, depths/elevations from mudline
259	S1-4	HK	EB-7	4/8/1988	4/8/1988	Rotary Wash	Mod cal: 350 lb/24" SPT: 140 lb/30"	106.5	-4.0	MSL	-1.3			24.0	61.0	106.0	-25.3	-62.3	-107.3	24.0	37.0	pier/offshore, depths/elevations from mudline
260	S1-5	D&M	1	4/27/1971	4/27/71	Rotary Wash	U: 245lb/18" or SPT: 140 lb/30"	35	0.5	SFCD	11.8											obstruction at 35 ft
261	S1-5	D&M	2	4/23/1971	4/26/71	Rotary Wash	U: 245lb/18" or SPT: 140 lb/30"	68	0.4	SFCD	11.7			36.0			-24.3			36.0		
262	S1-5	D&M	3	4/23/1971	4/28/71	Rotary Wash	U: 245lb/18" or SPT: 140 lb/30"	60	0.4	SFCD	11.7			24.0	54.5		-12.3	-42.8		24.0	30.5	

Record No	Report ID	Company	Boring ID	Date Drilling Started	Date Drilling Finished	Drilling Method	Hammer Type	Boring Depth (feet)	Ground Surface Elevation (feet)	Datum	Ground Surface Elevation (feet, NAVD88)	Ground - water Depth (feet)	Ground-water Elevation (feet, NAVD88)	Depth to Top of Young Bay Mud (feet)	Depth to Bottom of Young Bay Mud (feet)	Depth to Top of Bedrock (feet)	Elevation of Top of Young Bay Mud (feet, NAVD88)	Elevation of Bottom of Young Bay Mud (feet, NAVD88)	Elevation to Top of Bedrock (feet, NAVD88)	Thickness of Artificial Fill (feet)	Thickness of Young Bay Mud (feet)	Comments
263	S1-5	D&M	4	4/22/1971	4/22/71	Rotary Wash	U: 245lb/18" or SPT: 140 lb/30"	50	0.3	SFCD	11.6			26.5			-14.9			26.5		
264	S1-5	D&M	14	4/29/1971	5/3/71	Rotary Wash	U: 245lb/18" or SPT: 140 lb/30"	50	11.5	MLLW	11.2			33.5	35.5		-22.3	-24.3		33.5	2.0	
265	S1-5	D&M	15	4/28/1971	4/28/71	Rotary Wash	U: 245lb/18" or SPT: 140 lb/30"	52	-2.0	MLLW	-2.3			30.0	33.5		-32.3	-35.8		30.0	3.5	pier/onshore, depth/elevations from ground surface beneath pier
266	S1-6	HMLA	Boring 1	5/16/1972	5/16/1972	Rotary Wash	140lb/30"	106	0.0	SFCD	11.3			26.0	54.0	90.0	-14.7	-42.7	-78.7	26.0	28.0	
267	S1-6	HMLA	Boring 2	5/17/1972	5/17/1972	Rotary Wash	140lb/30"	91	0.0	SFCD	11.3	7.5	3.8	11.0	43.0	75.5	0.3	-31.7	-64.2	11.0	32.0	
268	S1-6	HMLA	Boring 3	5/18/1972	5/18/1972	Rotary Wash	140lb/30"	91	0.0	SFCD	11.3	7.0	4.3	12.0	31.0	73.0	-0.7	-19.7	-61.7	12.0	19.0	
269	S1-6	HMLA	Boring 4	5/19/1972	5/19/1972	Rotary Wash	140lb/30"	79	0.0	SFCD	11.3			20.5	41.0	72.0	-9.2	-29.7	-60.7	20.5	20.5	
270	S1-6	HMLA	Boring 5	5/22/1972	5/22/1972	Rotary Wash	140lb/30"	89	0.0	SFCD	11.3			22.0	36.0	81.0	-10.7	-24.7	-69.7	22.0	14.0	
271	S2-2	D&M	5	6/20/1977	6/21/1977	Flight Auger, Bucket Auger, and Core Bucket		56	5.0	SFCD	16.3			26.5	27.5	27.5	-10.2	-11.2	-11.2	26.5	1.0	
272	S2-3	T&R/OCC	B-1	12/22/1998	12/22/1998	Hollow stem auger		55.6												0.0	0.0	
273	S2-4	D&M	10	3/24/1977	3/24/1977	Rotary Wash	U/TW: 300 lb/30" ; SPT: 140 lb/30"	101.5	-11.5	MLLW	-11.8			0.0	47.5	87.5	-11.8	-59.3	-99.3	0.0	47.5	pier/offshore, depths/elevations from mudline
274	S2-4	D&M	11	3/25/1977	3/28/1977	Rotary Wash	U/TW: 300 lb/30" ; SPT: 140 lb/30"	100.25	-8.0	MLLW	-8.3			0.0	55.0	89.0	-8.3	-63.3	-97.3	0.0	55.0	pier/offshore, depths/elevations from mudline
275	S2-4	D&M	12	3/28/1977	3/29/1977	Rotary Wash	U/TW: 300 lb/30" ; SPT: 140 lb/30"	88.5	6.5	MLLW	6.2			42.0	56.0	85.5	-35.8	-49.8	-79.3	42.0	14.0	pier/onshore, depths/elevations from ground surface under pier
276	S2-4	D&M	13	3/28/1977	3/28/1977	Rotary Wash	U/TW: 300 lb/30" ; SPT: 140 lb/30"	117.5	11.8	MLLW	11.5			42.0	80.0	98.0	-30.5	-68.5	-86.5	42.0	38.0	
277	S2-7	GTC	B-1	4/16/2012	4/16/2012	Soilid Flight Auger	Cathead pully	10.5	0.0	SFCD	11.3	8.7	2.6									Fill to full depth of boring
503	S3-2	FCC	FC-1	2/9/1977	2/9/1977	15" Diam. Auger		32														Fill to full depth of boring
504	S3-2	FCC	FC-2			15" Diam. Auger		40						40.0						40.0		
505	S3-2	FCC	FC-3			15" Diam. Auger		35						20.0						20.0		
506	S3-2	FCC	FC-4			15" Diam. Auger		30														Fill to full depth of boring
507	S3-2	FCC	FC-5			15" Diam. Auger		20														Fill to full depth of boring
508	S3-2	FCC	FC-6			15" Diam. Auger		20														Fill to full depth of boring
509	S3-2	FCC	FC-7			15" Diam. Auger		13														Fill to full depth of boring
278	S3-4	AGS	B-1	7/6/1994	7/6/1994	Rotary Wash	140 lb/30"	122	-32.0	SFCD	-20.7			0.0	24.0		-20.7	-44.7		0.0	24.0	offshore, depths/elevations from mudline
279	S3-4	AGS	B-2	7/7/1994	7/8/1994	Rotary Wash	140 lb/30"	150	-32.0	SFCD	-20.7			0.0	28.0		-20.7	-48.7		0.0	28.0	offshore, depths/elevations from mudline
280	S3-5	D&M	1	2/8/1965	2/19/1965	Chop-and-wash	140 lb/30"	142	-11.0	MLLW	-11.3			0.0	35.0		-11.3	-46.3		0.0	35.0	offshore, depths/elevations from mudline
281	S3-5	D&M	2	2/25/1965	2/26/1965	Chop-and-wash	140 lb/30"	121	-35.0	MLLW	-35.3			0.0	29.0		-35.3	-64.3		0.0	29.0	offshore, depths/elevations from mudline
282	S3-5	D&M	3	3/1/1965	3/2/1965	Chop-and-wash	140 lb/30"	124	-40.0	MLLW	-40.3			0.0	38.0		-40.3	-78.3		0.0	38.0	offshore, depths/elevations from mudline
283	S3-5	D&M	4	2/23/1965	2/25/1965	Chop-and-wash	140 lb/30"	142	-10.0	MLLW	-10.3			0.0	35.0		-10.3	-45.3		0.0	35.0	offshore, depths/elevations from mudline

Record No	Report ID	Company	Boring ID	Date Drilling Started	Date Drilling Finished	Drilling Method	Hammer Type	Boring Depth (feet)	Ground Surface Elevation (feet)	Datum	Ground Surface Elevation (feet, NAVD88)	Ground - water Depth (feet)	Ground-water Elevation (feet, NAVD88)	Depth to Top of Young Bay Mud (feet)	Depth to Bottom of Young Bay Mud (feet)	Depth to Top of Bedrock (feet)	Elevation of Top of Young Bay Mud (feet, NAVD88)	Elevation of Bottom of Young Bay Mud (feet, NAVD88)	Elevation to Top of Bedrock (feet, NAVD88)	Thickness of Artificial Fill (feet)	Thickness of Young Bay Mud (feet)	Comments
284	S3-5	D&M	5	3/7/1965	3/8/1965	Chop-and-wash	140 lb/30"	109	-49.0	MLLW	-49.3			0.0	36.0		-49.3	-85.3		0.0	36.0	offshore, depths/elevations from mudline
285	S3-5	D&M	6	3/9/1965	3/10/1965	Chop-and-wash	140 lb/30"	130	-23.0	MLLW	-23.3			0.0	34.0		-23.3	-57.3		0.0	34.0	offshore, depths/elevations from mudline
286	S3-5	D&M	1L	3/3/1965	3/5/1965	Rotary Wash	140 lb/30"	135	-2.0	MLLW	-2.3			0.0	38.0	131.0	-2.3	-40.3	-133.3	0.0	38.0	pier/offshore, depths/elevations from mudline
287	S3-5	D&M	2L	2/27/1965	2/28/1965	Rotary Wash	140 lb/30"	141	-10.0	MLLW	-10.3			0.0	31.0	138.0	-10.3	-41.3	-148.3	0.0	31.0	pier/offshore, depths/elevations from mudline
288	S3-5	D&M	3L	3/4/1965	3/5/1965	Rotary Wash	140 lb/30"	150	-18.0	MLLW	-18.3			0.0	42.0	142.0	-18.3	-60.3	-160.3	0.0	42.0	pier/offshore, depths/elevations from mudline
289	S3-5	D&M	4L	3/6/1965	3/7/1965	Rotary Wash	140 lb/30"	130	-27.0	MLLW	-27.3			0.0	31.0	115.0	-27.3	-58.3	-142.3	0.0	31.0	pier/offshore, depths/elevations from mudline
290	S3-5	D&M	5L	2/25/1965	2/27/1965	Rotary Wash	140 lb/30"	151	-19.0	MLLW	-19.3			0.0	17.0		-19.3	-36.3		0.0	17.0	pier/offshore, depths/elevations from mudline
291	S3-5	D&M	6L	2/28/1965	3/3/1965	Rotary Wash	140 lb/30"	140	-12.0	MLLW	-12.3			0.0	16.0		-12.3	-28.3		0.0	16.0	pier/offshore, depths/elevations from mudline
292	S3-5	D&M	7L	3/7/1965	3/7/1965	Rotary Wash	140 lb/30"	152	-25.0	MLLW	-25.3			0.0	43.0		-25.3	-68.3		0.0	43.0	pier/offshore, depths/elevations from mudline
293	S3-5	D&M	8L	3/1/1965	3/2/1965	Rotary Wash	140 lb/30"	151	-38.0	MLLW	-38.3			0.0	69.0		-38.3	-107.3		0.0	69.0	pier/offshore, depths/elevations from mudline
294	S3-5	D&M	9L	3/7/1965	3/9/1965	Rotary Wash	140 lb/30"	152	-28.0	MLLW	-28.3			0.0	20.0		-28.3	-48.3		0.0	20.0	pier/offshore, depths/elevations from mudline
295	S3-5	D&M	10L	2/25/1965	2/27/1965	Rotary Wash	140 lb/30"	150	-30.0	MLLW	-30.3			0.0	41.0		-30.3	-71.3		0.0	41.0	pier/offshore, depths/elevations from mudline
296	S3-5	D&M	11L	3/9/1965	3/10/1965	Rotary Wash	140 lb/30"	91	-25.0	MLLW	-25.3			0.0	47.0		-25.3	-72.3		0.0	47.0	pier/offshore, depths/elevations from mudline
297	S4-2	D&M	1	4/8/1970	4/8/1970	Rotary Wash	U or TW: 335 lb/33" SPT: 140 lb/30"	109	-36.0	SFCD	-24.7			0.0	52.0		-24.7	-76.7		0.0	52.0	pier/offshore, depths/elevations from mudline
298	S4-2	D&M	2	4/9/1970	4/9/1970	Rotary Wash	U or TW: 335 lb/33" SPT: 140 lb/30"	109	-35.0	SFCD	-23.7			0.0	41.0		-23.7	-64.7		0.0	41.0	pier/offshore, depths/elevations from mudline
299	S5-1	T&R	CPT-01	9/7/2006	9/7/2006	Cone Penetrometer	Not applicable	135														depth from pier deck
300	S5-1	T&R	CPT-02	9/7/2006	9/7/2006	Cone Penetrometer	Not applicable	134.02														depth from pier deck
301	S5-1	T&R	CPT-03	9/7/2006	9/7/2006	Cone Penetrometer	Not applicable	102.85														depth from pier deck
302	S5-2	T&R	TR-1	2/15/2007	2/15/2007	Rotary Wash	Automatic 140 lb/30"	130	-8.0	MLLW	-8.3			0.0	29.0		-8.3	-37.3		0.0	29.0	pier/offshore, depths/elevations from mudline
303	S5-2	T&R	TR-2	2/14/2007	2/14/2007	Rotary Wash	Automatic 140 lb/30"	120.5	-9.0	MLLW	-9.3			0.0	28.0		-9.3	-37.3		0.0	28.0	pier/offshore, depths/elevations from mudline
304	S6-2	AGS	DH-1	10/22/1984	10/23/1984	Rotary Wash	Safety Hammer, 140 lb/30"	147.5	-39.0	SFCD	-27.7			0.0	96.0		-27.7	-123.7		0.0	96.0	pier/offshore, depths/elevations from mudline
305	S6-2	AGS	DH-2	10/23/1984	10/24/1984	Rotary Wash	Safety Hammer, 140 lb/30"	165.5	-21.0	SFCD	-9.7			0.0	111.0		-9.7	-120.7		0.0	111.0	pier/offshore, depths/elevations from mudline
306	S6-2	AGS	DH-3	10/24/1984	10/25/1984	Rotary Wash	Safety Hammer, 140 lb/30"	163	-22.0	SFCD	-10.7			0.0	108.0		-10.7	-118.7		0.0	108.0	pier/offshore, depths/elevations from mudline
307	S6-2	AGS	DH-4	10/25/1984	10/26/1984	Rotary Wash	Safety Hammer, 140 lb/30"	127.5	-19.5	SFCD	-8.2			0.0	111.5		-8.2	-119.7		0.0	111.5	pier/offshore, depths/elevations from mudline
308	S6-2	AGS	DH-5	10/26/1984	10/26/1984	Rotary Wash	Safety Hammer, 140 lb/30"	119	-24.0	SFCD	-12.7			0.0	109.0		-12.7	-121.7		0.0	109.0	pier/offshore, depths/elevations from mudline
518	S7-1	R&R	RR-1	7/1/2011	7/1/2011	Rotary Wash	Automatic Safty, 140lbs/30"	126.5	0.0	SFCD	11.3			36.5	103.5	121.0	-25.2	-92.2	-109.7	36.5	67.0	
519	S7-1	R&R	RR-2	2/9/2012	2/9/2012	Rotary Wash	Automatic Safty, 140lbs/30"	151.5	0.0	SFCD	11.3			16.0	112.0	145.0	-4.7	-100.7	-133.7	16.0	96.0	
510	S7-1	HLA	1	3/16/1984	3/16/1984			137	-0.8	SFCD	10.5	11.5	-1.0	39.0	110.0	131.0	-28.5	-99.5	-120.5	39.0	71.0	
511	S7-1	HLA	2	3/8/1984	3/8/1984			139.5	-1.2	SFCD	10.1	10.5	-0.4	23.5	112.0	133.0	-13.4	-101.9	-122.9	23.5	88.5	

Record No	Report ID	Company	Boring ID	Date Drilling Started	Date Drilling Finished	Drilling Method	Hammer Type	Boring Depth (feet)	Ground Surface Elevation (feet)	Datum	Ground Surface Elevation (feet, NAVD88)	Ground - water Depth (feet)	Ground-water Elevation (feet, NAVD88)	Depth to Top of Young Bay Mud (feet)	Depth to Bottom of Young Bay Mud (feet)	Depth to Top of Bedrock (feet)	Elevation of Top of Young Bay Mud (feet, NAVD88)	Elevation of Bottom of Young Bay Mud (feet, NAVD88)	Elevation to Top of Bedrock (feet, NAVD88)	Thickness of Artificial Fill (feet)	Thickness of Young Bay Mud (feet)	Comments
512	S7-1	HLA	3	3/14/1984	3/14/1984			204.5	-2.4	SFCD	8.9	7.0	1.9	25.0	113.5	200.0	-16.1	-104.6	-191.1	25.0	88.5	
513	S7-1	HLA	4	3/20/1984	3/20/1984			147	-1.1	SFCD	10.2	7.0	3.2	31.0	110.0	143.0	-20.8	-99.8	-132.8	31.0	79.0	
514	S7-1	HLA	5	3/27/1984	3/27/1984			131.5	-0.9	SFCD	10.4			52.0	107.0	130.0	-41.6	-96.6	-119.6	52.0	55.0	
515	S7-1	HLA	6	3/28/1984	3/28/1984			152	-1.0	SFCD	10.3	9.0	1.3	22.5	111.0	149.0	-12.2	-100.7	-138.7	22.5	88.5	
516	S7-1	HLA	7	3/23/1984	3/23/1984			142.5	-1.0	SFCD	10.3			23.5	112.0		-13.2	-101.7		23.5	88.5	
517	S7-1	HLA	8	3/22/1984	3/22/1984				0.0	SFCD	11.3	9.0	2.3	26.0	110.5		-14.7	-99.2		26.0	84.5	
309	S7-3	T&R	CPT-1	5/7/2001	5/7/2001	Cone Penetrometer	Not applicable	131.2	0.0	SFCD	11.3											
310	S7-3	T&R	CPT-2	4/2/2001	4/2/2001	Cone Penetrometer	Not applicable	46.6	0.0	SFCD	11.3											
311	S7-3	T&R	CPT-3	5/7/2001	5/7/2001	Cone Penetrometer	Not applicable	131.2	0.0	SFCD	11.3											
312	S7-3	T&R	CPT-4	5/7/2001	5/7/2001	Cone Penetrometer	Not applicable	131.6	0.0	SFCD	11.3											
313	S7-3	T&R	CPT-5	5/7/2001	5/7/2001	Cone Penetrometer	Not applicable	127.5	0.0	SFCD	11.3											
314	S7-3	T&R	B-1	12/27/2001	12/28/2001	Rotary Wash	Safety with rope & pully, 140 lb/30"	126	-20.5	SFCD	-9.2			0.0	106.5		-9.2	-115.7		0.0	106.5	pier/offshore, depths/elevations from mudline
315	S7-3	T&R	B-2	1/2/2002	1/2/2002	Rotary Wash	Safety with rope & pully, 140 lb/30"	128	-13.0	SFCD	-1.7			0.0	116.0		-1.7	-117.7		0.0	116.0	pier/offshore, depths/elevations from mudline
316	S7-3	T&R	TR-1	12/8/1998	12/8/1998	Rotary Wash	Safety, 140 lb/30"	123.5	-9.3	MLLW	-9.6			0.0	113.0		-9.6	-122.6		0.0	113.0	pier/offshore, depths/elevations from mudline
317	S7-3	T&R	CPT-A	8/8/1998	8/8/1998	Cone Penetrometer	Not applicable	127.95														offshore, depth from waterline
318	S7-3	T&R	CPT-B	8/8/1998	8/8/1998	Cone Penetrometer	Not applicable	138.45														offshore, depth from waterline
319	S7-3	T&R	CPT-C	8/8/1998	8/8/1998	Cone Penetrometer	Not applicable	138.45														
320	S7-3	D&M	DM-2	5/27/1964	5/27/1964			170	-21.0	SFCD	-9.7			0.0	110.0		-9.7	-119.7		0.0	110.0	pier/offshore, depths/elevations from mudline
321	S7-3	D&M	DM-3	5/26/1964	5/26/1964			114	-29.0	SFCD	-17.7			0.0	105.0		-17.7	-122.7		0.0	105.0	pier/offshore, depths/elevations from mudline
322	S7-3	D&M	DM-4	6/1/1964	6/1/1964			233	-34.0	SFCD	-22.7			0.0	98.0	229.0	-22.7	-120.7	-251.7	0.0	98.0	pier/offshore, depths/elevations from mudline
546	S7-4	Northgate	G-1	8/13/2011	8/13/2011	CPT	NA	40														
547	S7-4	Northgate	G-2	7/23/2011	7/23/2011	Rotary Wash		43				13.0		28.0						28.0		No elevation data, boring ended in Qybm
548	S7-4	Northgate	G-3	4/27/2011	4/27/2011	Hollow Stem Auger		30.5				13.5		24.3						24.3		No elevation data, boring ended in Qybm
549	S7-4	Northgate	G-4	8/20/2011	8/20/2011	CPT	NA	10														
550	S7-4	Northgate	G-6	8/14/2011	8/14/2011	Rotary Wash		5.5														No elevation data, boring ended in Fill
551	S7-4	Northgate	G-7	7/23/2011	7/23/2011	Rotary Wash		43				10.0		30.0						30.0		No elevation data, boring ended in Qybm
552	S7-4	Northgate	G-8	7/16/2011	7/16/2011	Rotary Wash		8														No elevation data, boring ended in Fill
553	S7-4	Northgate	G-8A	8/20/2011	8/20/2011	Rotary Wash		43				9.0		19.0						19.0		No elevation data, boring ended in Qybm
554	S7-4	Northgate	G-9	7/17/2011	7/17/2011	Rotary Wash		41				8.5										No elevation data, Fill to bottom of boring
555	S7-4	Northgate	G-10	7/30/2011	7/30/2011	Rotary Wash		43				9.5		15.0						15.0		No elevation data, boring ended in Qybm
556	S7-4	Northgate	G-11	7/30/2011	7/30/2011	Rotary Wash		43				9.5		22.5						22.5		No elevation data, boring ended in Qybm
557	S7-4	Northgate	G-12	8/13/2011	8/13/2011	Rotary Wash		41.5				9.0		25.0						25.0		No elevation data, boring ended in Qybm

Record No	Report ID	Company	Boring ID	Date Drilling Started	Date Drilling Finished	Drilling Method	Hammer Type	Boring Depth (feet)	Ground Surface Elevation (feet)	Datum	Ground Surface Elevation (feet, NAVD88)	Ground - water Depth (feet)	Ground-water Elevation (feet, NAVD88)	Depth to Top of Young Bay Mud (feet)	Depth to Bottom of Young Bay Mud (feet)	Depth to Top of Bedrock (feet)	Elevation of Top of Young Bay Mud (feet, NAVD88)	Elevation of Bottom of Young Bay Mud (feet, NAVD88)	Elevation to Top of Bedrock (feet, NAVD88)	Thickness of Artificial Fill (feet)	Thickness of Young Bay Mud (feet)	Comments
558	S7-4	Northgate	G-13	8/13/2011	8/13/2011	Rotary Wash		43				10.0		17.5						17.5		No elevation data, boring ended in Qybm
559	S7-5	HMLA	1	8/5/1970		Rotary Wash	335 lb/30", blows conv. to 140lb/30"	202.5	-0.3	SFCD	11.1	11.0	0.1	15.0	58.0	192.0	-3.9	-46.9	-180.9	12.0	43.0	
560	S7-5	HMLA	2	8/7/1970		Rotary Wash	335 lb/30", blows conv. to 140lb/30"	199	-0.5	SFCD	10.9			16.5	70.0	187.0	-5.6	-59.1	-176.1	15.0	53.5	
561	S7-5	HMLA	3	8/11/1970		Rotary Wash	335 lb/30", blows conv. to 140lb/30"	187	0.1	SFCD	11.4	7.5	3.9	26.5	87.0	176.0	-15.1	-75.6	-164.6	26.5	60.5	
562	S7-5	HMLA	4	8/14/1970		Rotary Wash	335 lb/30", blows conv. to 140lb/30"	186	-0.2	SFCD	11.1			27.0	103.0	172.0	-15.9	-91.9	-160.9	27.0	76.0	
563	S7-5	HMLA	5	8/20/1970		Rotary Wash	335 lb/30", blows conv. to 140lb/30"	224	-0.4	SFCD	10.9	11.0	-0.1	27.5	104.0	177.0	-16.6	-93.1	-166.1	27.5	76.5	
564	S7-5	HMLA	6	7/21/1970		Rotary Wash	335 lb/30", blows conv. to 140lb/30"	227	-0.6	SFCD	10.7	10.5	0.2	24.0	62.5	186.0	-13.3	-51.8	-175.3	24.0	38.5	
565	S7-5	HMLA	7	8/3/1970		Rotary Wash	335 lb/30", blows conv. to 140lb/30"	217	-0.5	SFCD	10.8			23.5	62.5	207.0	-12.7	-51.7	-196.2	23.5	39.0	
566	S7-5	HMLA	8	7/13/1970		Rotary Wash	335 lb/30", blows conv. to 140lb/30"	240	0.1	SFCD	11.4	14.0	-2.6	29.0	95.0	192.0	-17.6	-83.6	-180.6	29.0	66.0	
567	S7-5	HMLA	9	7/20/1970		Rotary Wash	335 lb/30", blows conv. to 140lb/30"	233	-0.6	SFCD	10.7	11.0	-0.3	28.0	100.0	189.0	-17.3	-89.3	-178.3	28.0	72.0	
568	S7-5	HMLA	10	9/15/1970		Rotary Wash	335 lb/30", blows conv. to 140lb/30"	189	0.8	SFCD	12.1	12.5	-0.4	12.5	63.5	176.0	-0.4	-51.4	-163.9	12.5	51.0	
569	S7-5	HMLA	11	9/24/1970		Rotary Wash	335 lb/30", blows conv. to 140lb/30"	194.5	1.4	SFCD	12.7			21.0	70.0		-8.3	-57.3		21.0	49.0	
570	S7-5	HMLA	12	9/2/1970		Rotary Wash	335 lb/30", blows conv. to 140lb/30"	227.5	0.2	SFCD	11.5			16.0	82.0	217.0	-4.5	-70.5	-205.5	16.0	66.0	
571	S7-5	HMLA	13	8/28/1970		Rotary Wash	335 lb/30", blows conv. to 140lb/30"	215	0.9	SFCD	12.2	15.0	-2.8	25.0	89.0	205.0	-12.8	-76.8	-192.8	25.0	64.0	
572	S7-5	HMLA	14	8/25/1970		Rotary Wash	335 lb/30", blows conv. to 140lb/30"	216.5	-0.1	SFCD	11.2			24.5	98.0	205.5	-13.3	-86.8	-194.3	24.5	73.5	
361	S8a-1	D&M	1	5/25/1964	5/25/1964	Rotary Wash		179	-18.0	SFCD	-6.7			1.0	116.0		-7.7	-122.7		1.0	115.0	pier/offshore, depths/elevations from mudline
362	S8a-1	D&M	2	5/27/1964	5/27/1964	Rotary Wash		171	-21.0	SFCD	-9.7			0.0	110.0		-9.7	-119.7		0.0	110.0	pier/offshore, depths/elevations from mudline
363	S8a-1	D&M	3	5/28/1964	5/28/1964	Chop-and-wash		115	-29.0	SFCD	-17.7			0.0	105.0		-17.7	-122.7		0.0	105.0	offshore, depthselevations from mudline
364	S8a-1	D&M	4	6/1/1964	6/1/1964	Rotary Wash		233	-34.0	SFCD	-22.7			0.0	97.5	229.0	-22.7	-120.2	-251.7	0.0	97.5	pier/offshore, depths/elevations from mudline
365	S8a-1	D&M	5	5/20/1964	5/20/1964	Chop-and-wash		119	-35.0	SFCD	-23.7			0.0	105.0		-23.7	-128.7		0.0	105.0	offshore, depths/elevations from mudline
366	S8a-1	D&M	6	5/25/1964	5/25/1964	Chop-and-wash		108	-34.0	SFCD	-22.7			0.0	92.0		-22.7	-114.7		0.0	92.0	offshore, depths/elevations from mudline
367	S8a-1	D&M	7	5/25/1964	5/25/1964	Chop-and-wash		117	-24.0	SFCD	-12.7			0.0	98.0		-12.7	-110.7		0.0	98.0	offshore, depths/elevations from mudline

Record No	Report ID	Company	Boring ID	Date Drilling Started	Date Drilling Finished	Drilling Method	Hammer Type	Boring Depth (feet)	Ground Surface Elevation (feet)	Datum	Ground Surface Elevation (feet, NAVD88)	Ground - water Depth (feet)	Ground-water Elevation (feet, NAVD88)	Depth to Top of Young Bay Mud (feet)	Depth to Bottom of Young Bay Mud (feet)	Depth to Top of Bedrock (feet)	Elevation of Top of Young Bay Mud (feet, NAVD88)	Elevation of Bottom of Young Bay Mud (feet, NAVD88)	Elevation to Top of Bedrock (feet, NAVD88)	Thickness of Artificial Fill (feet)	Thickness of Young Bay Mud (feet)	Comments
573	S8a-2	HMLA	HLA71-4	8/14/1970																		Same as Report S7-5 Boring 4
574	S8a-2	HMLA	HLA71-5	8/20/1970																		Same as Report S7-5 Boring 5
575	S8a-2	HMLA	HLA71-9	7/20/1970																		Same as Report S7-5 Boring 9
576	S8a-2	HMLA	HLA68-4	1968'		Rotary Wash		260	0.2	SFCD	11.5	13.5	-2.0	27.0	79.0	246.0	-15.5	-67.5	-234.5	27.0	52.0	
577	S8a-2	HLA	HLA84-1	3/16/1984																		Same as Report S7-1 Boring 1
578	S8a-2	HLA	HLA84-2	3/8/1984																		Same as Report S7-1 Boring 2
579	S8a-2	HLA	HLA84-5	3/27/1984																		Same as Report S7-1 Boring 5
580	S8a-2	HMLA	HLA68-5	1968'		Rotary Wash		257.5	-0.8	SFCD	10.5	12.0	-1.5	19.0	90.0	242.0	-8.5	-79.5	-231.5	19.0	71.0	
581	S8a-2	HMLA	HLA68-7	1968'		Rotary Wash		277	-1.7	SFCD	9.6	11.0	-1.4	24.0	98.0	216.0	-14.4	-88.4	-206.4	24.0	74.0	
582	S8a-2	D&M	S702-5	6/30/1984																		Same as Report S8b-2 S702-5
583	S8a-2	D&M	S715-24	3/7/1968	3/8/1968			144	8.5	MSL	11.2			32.0	84.0		-20.8	-72.8		32.0	52.0	
584	S8a-2	D&M	LP71-2	9/30/1971	10/1/1971			278	-0.6	SFCD	10.7			19.0	102.0	273.0	-8.3	-91.3	-262.3	19.0	83.0	
585	S8a-2	D&M	LP71-5	10/21/1971	10/25/1971			259	-1.5	SFCD	9.8			17.0	100.0	247.0	-7.2	-90.2	-237.2	17.0	83.0	
586	S8a-2	D&M	LP71-7	10/26/1971	10/27/1971			221.5	-0.2	SFCD	11.1			22.0	102.0	217.0	-10.9	-90.9	-205.9	22.0	80.0	
587	S8a-2	D&M	LP71-10	3/7/1972	3/10/1972			272	-0.7	SFCD	10.6	13.0	-2.4	30.0	98.0	268.0	-19.4	-87.4	-257.4	30.0	68.0	
588	S8a-2	D&M	FRB-3	3/6/1978				198	1.2	SFCD	12.5			14.0	94.0		-1.5	-81.5		14.0	80.0	
589	S8a-2	D&M	FRB-6	3/21/1978				147.5	0.5	SFCD	11.8			22.0	70.0		-10.2	-58.2		22.0	48.0	
590	S8a-2	L&P	LP81-TB1	4/15/1981	4/16/1981	Rotary Wash	325 lb/18"	131	0.0	SFCD	11.3			21.0	95.0		-9.7	-83.7		21.0	74.0	
591	S8a-2	L&P	LP80-TB2	1/16/1980		Rotary Wash	330 lb/24"	116.5	0.0	SFCD	11.3			15.5	79.5		-4.2	-68.2		15.5	64.0	
592	S8a-2	L&P	LP80-TB3	1/17/1980		Rotary Wash	330 lb/24"	127.5	0.0	SFCD	11.3			28.0	65.5		-16.7	-54.2		28.0	37.5	
593	S8a-2	L&P	LP72-4	2/15/1972		Rotary Wash	140 lb/30"	101.5	0.0	SFCD	11.3			11.5	56.5		-0.2	-45.2		11.5	45.0	
594	S8a-2	L&P	TB-1P	5/21/1985		Rotary Wash	340 lb/18"	123	0.0	SFCD	11.3	10.0	1.3	10.0	76.0	121.0	1.3	-64.7	-109.7	10.0	66.0	
595	S8a-2	L&P	TB-4	5/4/1985		Rotary Wash	345 lb/18"	105	0.0	SFCD	11.3			14.5	97.0	100.0	-3.2	-85.7	-88.7	14.5	82.5	
368	S8b-1	PBQ&D	PB-1	8/24/1970	8/25/1970			140.5	-20.5	MSL	-17.8			29.5	102.5		-50.0	-123.0		29.5	73.0	offshore, depths/elevations from mudline
369	S8b-1	PBQ&D	PB-2	8/26/1970	8/27/1970			119	-31.0	MSL	-28.3			48.0	98.0		-79.0	-129.0		48.0	50.0	offshore, depths/elevations from mudline
370	S8b-1	PBQ&D	PB-3	8/28/1970	8/29/1970			115	-43.0	MSL	-40.3			25.0	85.0		-68.0	-128.0		25.0	60.0	offshore, depths/elevations from mudline
371	S8b-1	PBQ&D	PB-4	8/27/1970	8/28/1970			142.7	-25.3	MSL	-22.6			38.7	96.7		-64.0	-122.0		38.7	58.0	offshore, depths/elevations from mudline
372	S8b-1	PBQ&D	PB-5	8/25/1970	8/26/1970			135.3	-26.7	MSL	-24.0			11.3	84.3		-38.0	-111.0		11.3	73.0	offshore, depths/elevations from mudline
373	S8b-1	PBQ&D	PB-6	9/2/1970	9/3/1970			150.5	-14.5	MSL	-11.8			0.0	100.5		-14.5	-115.0		0.0	100.5	offshore, depths/elevations from mudline
374	S8b-1	PBQ&D	PB-7	8/31/1970	9/1/1970			142.5	-18.5	MSL	-15.8			0.0	89.5		-18.5	-108.0		0.0	89.5	offshore, depths/elevations from mudline
375	S8b-2	PBQ&D	S-701-1	?	?			140	6.0	MSL	8.7			23.0	112.0		-14.3	-103.3		23.0	89.0	
376	S8b-2	PBQ&D	S-702-1	6/22/1964	6/22/1964			?	-16.5	MSL	-13.8			0.0	96.0		-13.8	-109.8		0.0	96.0	offshore, depths/elevations from mudline
377	S8b-2	PBQ&D	S-701-2	11/2/1963	?			130	8.0	MSL	10.7			29.0	88.0		-18.3	-77.3		29.0	59.0	

Record No	Report ID	Company	Boring ID	Date Drilling Started	Date Drilling Finished	Drilling Method	Hammer Type	Boring Depth (feet)	Ground Surface Elevation (feet)	Datum	Ground Surface Elevation (feet, NAVD88)	Ground - water Depth (feet)	Ground-water Elevation (feet, NAVD88)	Depth to Top of Young Bay Mud (feet)	Depth to Bottom of Young Bay Mud (feet)	Depth to Top of Bedrock (feet)	Elevation of Top of Young Bay Mud (feet, NAVD88)	Elevation of Bottom of Young Bay Mud (feet, NAVD88)	Elevation to Top of Bedrock (feet, NAVD88)	Thickness of Artificial Fill (feet)	Thickness of Young Bay Mud (feet)	Comments
378	S8b-2	PBQ&D	S-702-2	6/15/1964	6/15/1964			180	8.0	MSL	10.7			27.0	115.0		-16.3	-104.3		27.0	88.0	
379	S8b-2	PBQ&D	S-702-3	7/7/1964	7/7/1964			182	8.0	MSL	10.7			45.0	114.0		-34.3	-103.3		45.0	69.0	Repeated in MS-18
380	S8b-2	PBQ&D	S-702-4	?				180	8.0	MSL	10.7			42.0	116.0		-31.3	-105.3		42.0	74.0	Repeated in MS-18
381	S8b-2	PBQ&D	S-702-5	?				179	8.0	MSL	10.7			21.0	108.0		-10.3	-97.3		21.0	87.0	
382	S8b-3	PBQ&D	20	?		Rotary Wash		167	-25.0	MSL	-22.3			0.0	100.0		-22.3	-122.3		0.0	100.0	offshore, depths/elevations from mudline
383	S8b-3	PBQ&D	21	?		Rotary Wash		169	-24.0	MSL	-21.3			0.0	99.0		-21.3	-120.3		0.0	99.0	offshore, depths/elevations from mudline
384	S8b-3	PBQ&D	23	?		Churn Drill		126	-22.0	MSL	-19.3			0.0	91.0		-19.3	-110.3		0.0	91.0	offshore, depths/elevations from mudline
385	S8b-3	PBQ&D	24	?		Churn Drill		129	-22.0	MSL	-19.3			0.0	89.0		-19.3	-108.3		0.0	89.0	offshore, depths/elevations from mudline
386	S8b-3	PBQ&D	25	?		Churn Drill		125	-24.0	MSL	-21.3			0.0	81.0		-21.3	-102.3		0.0	81.0	offshore, depths/elevations from mudline
387	S8b-5	D&M	B-1	11/9/1985	11/10/1985	Rotary Wash	U: 340 lb/18", SPT: 140 lb/30"	150				12.0		38.0	97.0					38.0	59.0	
388	S8b-5	D&M	B-2	11/9/1985	11/9/1985	Rotary Wash	U: 340 lb/18", SPT: 140 lb/30"	6.5														Boring ended in fill due to obstruction
389	S8b-5	D&M	B-3	11/7/1985	11/8/1985	Rotary Wash	U: 340 lb/18", SPT: 140 lb/30"	150				7.5		22.0	107.0					22.0	85.0	
390	S8b-5	D&M	B-4	11/16/1985	11/16/1985	Rotary Wash	U: 340 lb/18", SPT: 140 lb/30"	151.5						23.0	107.5					23.0	84.5	
391	S8b-5	D&M	B-5	10/17/1985	10/21/1985	Rotary Wash	U: 340 lb/18", SPT: 140 lb/30"	151.5				11.0		24.5	113.0					24.5	88.5	
392	S8b-5	D&M	B-6	11/4/1985	11/5/1985	Rotary Wash	U: 340 lb/18", SPT: 140 lb/30"	150				11.5		19.0	114.0					19.0	95.0	
393	S8b-5	D&M	B-7	10/1/1985	10/2/1985	Rotary Wash	U: 340 lb/18", SPT: 140 lb/30"	150				11.5		27.0	112.0					27.0	85.0	
394	S8b-5	D&M	B-8	9/30/1985	10/1/1985	Rotary Wash	U: 340 lb/18", SPT: 140 lb/30"	150				11.0		25.5	109.0					25.5	83.5	
395	S8b-5	D&M	B-9	10/4/1985	10/5/1985	Rotary Wash	U: 340 lb/18", SPT: 140 lb/30"	148				10.0		23.0	107.0					23.0	84.0	
396	S8b-5	D&M	B-10	10/14/1985	10/15/1985	Rotary Wash	U: 340 lb/18", SPT: 140 lb/30"	151.5				9.0		19.0	109.5					19.0	90.5	
397	S8b-5	D&M	B-11	10/7/1985	10/8/1985	Rotary Wash	U: 340 lb/18", SPT: 140 lb/30"	150				8.0		20.5	108.0					20.5	87.5	
398	S8b-5	D&M	B-12	10/8/1985	10/9/1985	Rotary Wash	U: 340 lb/18", SPT: 140 lb/30"	150				8.0		22.0	109.0					22.0	87.0	
399	S8b-5	D&M	B-13	10/10/1985	10/11/1985	Rotary Wash	U: 340 lb/18", SPT: 140 lb/30"	150				4.0		19.0	112.5					19.0	93.5	
400	S8b-5	D&M	FV-1	11/16/1985	11/16/1985	Field Vane Test	Not applicable	96.5						38.5						38.5		
401	S8b-5	D&M	FV-2	11/14/1985	11/14/1985	Field Vane Test	Not applicable	104.7						23.5						23.5		
402	S8b-5	D&M	FV-3	11/15/1985	11/15/1985	Field Vane Test	Not applicable	107.9						22.0						22.0		
403	S8b-5	D&M	FV-4	11/13/1985	11/13/1985	Field Vane Test	Not applicable	106.3						21.0						21.0		
404	S8b-5	D&M	FV-5	11/12/1985	11/12/1985	Field Vane Test	Not applicable	106.3						22.0						22.0		
405	S8b-5	D&M	FV-6	10/11/1985	10/11/1985	Field Vane Test	Not applicable	88.6						24.5						24.5		
406	S8b-5	D&M	FV-7	10/4/1985	10/4/1985	Field Vane Test	Not applicable	86.9						24.5						24.5		

Record No	Report ID	Company	Boring ID	Date Drilling Started	Date Drilling Finished	Drilling Method	Hammer Type	Boring Depth (feet)	Ground Surface Elevation (feet)	Datum	Ground Surface Elevation (feet, NAVD88)	Ground - water Depth (feet)	Ground-water Elevation (feet, NAVD88)	Depth to Top of Young Bay Mud (feet)	Depth to Bottom of Young Bay Mud (feet)	Depth to Top of Bedrock (feet)	Elevation of Top of Young Bay Mud (feet, NAVD88)	Elevation of Bottom of Young Bay Mud (feet, NAVD88)	Elevation to Top of Bedrock (feet, NAVD88)	Thickness of Artificial Fill (feet)	Thickness of Young Bay Mud (feet)	Comments
407	S8b-5	D&M	FV-8	10/7/1985	10/7/1985	Field Vane Test	Not applicable	90.2						23.0						23.0		
408	S8b-5	D&M	FV-9	10/8/1985	10/8/1985	Field Vane Test	Not applicable	88.6						20.5						20.5		
409	S8b-5	D&M	FV-10	10/9/1985	10/9/1985	Field Vane Test	Not applicable	88.6						19.0						19.0		
323	S8-1	ARUP	CCB-01	9/6/2005	9/8/2005	Rotary Wash	cathead and rope	182	19.6	NAVD88	19.6			27.5	54.0	171.0	-7.9	-34.4	-151.4	15.0	26.5	Fill over Dune Sand over Young Bay Mud
324	S8-1	ARUP	CCB-02	7/28/2005	8/1/2005	Rotary Wash	cathead and rope	197.2	21.7	NAVD88	21.7			26.0	44.0	185.0	-4.3	-22.3	-163.3	14.0	18.0	Fill over Dune Sand over Young Bay Mud
325	S8-1	ARUP	CCB-04	8/3/2005	8/5/2005	Rotary Wash	cathead and rope	220	23.0	NAVD88	23.0			24.0	36.0	210.0	-1.0	-13.0	-187.0	13.0	12.0	Fill over Dune Sand over Young Bay Mud
326	S8-1	ARUP	CCB-06A	8/17/2005	8/18/2005	Rotary Wash	cathead and rope	181	24.6	NAVD88	24.6					170.5			-145.9	12.5	0.0	Fill over Dune Sand over marsh deposits
327	S8-1	ARUP	CCB-07A	8/15/2005	8/17/2005	Rotary Wash	cathead and rope	196.2	25.4	NAVD88	25.4	20.5	4.9			182.0			-156.6	13.5	0.0	Fill over Dune Sand over marsh deposits
328	S8-1	ARUP	TTB-01	9/13/2005	9/14/2005	Rotary Wash	cathead and rope	229.5	13.1	NAVD88	13.1			20.0	45.0	218.0	-6.9	-31.9	-204.9	20.0	25.0	Fill over Young Bay Mud
329	S8-1	ARUP	TTB-02	9/9/2008	9/15/2008	Rotary Wash/Coring	cathead and rope	265	22.3	NAVD88	22.3			28.0	49.0	251.0	-5.7	-26.7	-228.7	15.0	21.0	Fill over Dune Sand over Young Bay Mud
330	S8-1	ARUP	TTB-03	10/7/2008	10/13/2008	Rotary Wash/Coring	cathead and rope	256	20.6	NAVD88	20.6	20.0	0.6	27.0	44.5	225.0	-6.4	-23.9	-204.4	14.0	17.5	Fill over Dune Sand over Young Bay Mud
331	S8-1	ARUP	TTB-04	8/27/2005	8/29/2008	Rotary Wash	cathead and rope	226	20.1	NAVD88	20.1	14.0	6.1	26.5	42.0	213.0	-6.4	-21.9	-192.9	14.0	15.5	Fill over Dune Sand over Young Bay Mud
332	S8-1	ARUP	TTB-05	8/4/2008	8/6/2008	Rotary Wash	cathead and rope	220	18.3	NAVD88	18.3	17.0	1.3	27.0	34.0		-8.7	-15.7		16.5	7.0	Fill over Dune Sand over Young Bay Mud
333	S8-1	ARUP	TTB-05A	2/3/2009	2/6/2009	Rotary Wash/Coring	cathead and rope	350	17.9	NAVD88	17.9	14.0	3.9	28.0	38.0	232.0	-10.1	-20.1	-214.1	14.0	10.0	Fill over Dune Sand over Young Bay Mud
334	S8-1	ARUP	TTB-06	9/2/2008	9/5/2008	Rotary Wash/Coring	cathead and rope	271	18.0	NAVD88	18.0			32.8	38.5	233.0	-14.8	-20.5	-215.0	20.0	5.8	Fill over Dune Sand over Young Bay Mud
335	S8-1	ARUP	TTB-07	12/17/2009	12/22/2009	Rotary Wash	cathead and rope	237.5	2.0	SFCD	13.3			19.0	40.0	226.0	-5.7	-26.7	-212.7	19.0	21.0	Fill over Young Bay Mud
336	S8-1	ARUP	TTB-08	10/4/2008	10/6/2008	Rotary Wash	cathead and rope	249.5	13.8	NAVD88	13.8			20.0	29.5	243.0	-6.2	-15.7	-229.2	20.0	9.5	Fill over Young Bay Mud
337	S8-1	ARUP	TTB-09	12/9/2009	12/15/2009	Rotary Wash/Coring	cathead and rope	237.5	2.0	SFCD	13.3			19.0	44.5	226.5	-5.7	-31.2	-213.2	19.0	25.5	Fill over Young Bay Mud
338	S8-1	ARUP	TTB-10	9/22/2008	9/23/2008	Rotary Wash/Coring	cathead and rope	188.5	13.8	NAVD88	13.8	16.0	-2.2	20.0	48.8	180.0	-6.2	-35.0	-166.2	20.0	28.8	Fill over Young Bay Mud
339	S8-1	ARUP	TTB-11	9/16/2008	9/19/2008	Rotary Wash/Coring	cathead and rope	225.7	23.0	NAVD88	23.0			29.0	52.0	214.0	-6.0	-29.0	-191.0	14.5	23.0	Fill over Dune Sand over Young Bay Mud
340	S8-1	ARUP	TTB-12	8/7/2008	8/12/2008	Rotary Wash/Coring	cathead and rope	228.5	20.4	NAVD88	20.4	22.0	-1.6	26.5	50.0	192.0	-6.1	-29.6	-171.6	17.0	23.5	Fill over Dune Sand over Young Bay Mud
341	S8-1	ARUP	TTB-13	8/20/2008	8/25/2008	Rotary Wash/Coring	cathead and rope	204	12.3	NAVD88	12.3			26.5	46.5	189.0	-14.2	-34.2	-176.7	26.5	20.0	Fill over Young Bay Mud
342	S8-1	ARUP	TTB-14	8/14/2008	8/19/2008	Rotary Wash/Coring	cathead and rope	200	19.6	NAVD88	19.6			26.5	57.0	168.5	-6.9	-37.4	-148.9	17.5	30.5	Fill over Dune Sand over Young Bay Mud
343	S8-1	ARUP	TTB-15	8/11/2008	8/19/2008	Rotary Wash/Coring	cathead and rope	225	18.2	NAVD88	18.2	8.5	9.7	31.5	50.5	180.0	-13.3	-32.3	-161.8	10.0	19.0	Fill over Dune Sand over Young Bay Mud
344	S8-1	ARUP	TTB-15A	1/12/2009	1/12/2009	Rotary Wash	cathead and rope	91.5	18.2	NAVD88	18.2			32.0	62.0		-13.8	-43.8		10.0	30.0	Fill over Dune Sand over Young Bay Mud
345	S8-1	ARUP	TTB-16	9/4/2008	9/8/2008	Rotary Wash/Coring	cathead and rope	231.5	17.5	NAVD88	17.5			30.0	58.0	217.5	-12.5	-40.5	-200.0	14.5	28.0	Fill over Dune Sand over Young Bay Mud
346	S8-1	ARUP	TTB-17	9/9/2008	9/12/2008	Rotary Wash/Coring	cathead and rope	236	15.4	NAVD88	15.4			24.5	39.0	221.0	-9.1	-23.6	-205.6	19.0	14.5	Fill over Dune Sand over Young Bay Mud
347	S8-1	ARUP	TTB-19	10/6/2008	10/9/2008	Rotary Wash/Coring	cathead and rope	243	13.6	NAVD88	13.6	7.5	6.1	16.0	29.0	209.5	-2.4	-15.4	-195.9	16.0	13.0	Fill over Young Bay Mud
348	S8-1	ARUP	TTB-20	9/24/2008	9/25/2008	Rotary Wash/Coring	cathead and rope	183	12.7	NAVD88	12.7	9.5	3.2	19.5	44.0	172.0	-6.8	-31.3	-159.3	19.5	24.5	Fill over Young Bay Mud

Record No	Report ID	Company	Boring ID	Date Drilling Started	Date Drilling Finished	Drilling Method	Hammer Type	Boring Depth (feet)	Ground Surface Elevation (feet)	Datum	Ground Surface Elevation (feet, NAVD88)	Ground - water Depth (feet)	Ground-water Elevation (feet, NAVD88)	Depth to Top of Young Bay Mud (feet)	Depth to Bottom of Young Bay Mud (feet)	Depth to Top of Bedrock (feet)	Elevation of Top of Young Bay Mud (feet, NAVD88)	Elevation of Bottom of Young Bay Mud (feet, NAVD88)	Elevation to Top of Bedrock (feet, NAVD88)	Thickness of Artificial Fill (feet)	Thickness of Young Bay Mud (feet)	Comments
349	S8-1	ARUP	TTB-22	9/29/2008	10/1/2008	Rotary Wash/Coring	cathead and rope	190	23.9	NAVD88	23.9	23.0	0.9	24.0	29.0	160.0	-0.1	-5.1	-136.1	14.5	5.0	Fill over Dune Sand over Young Bay Mud
350	S8-1	ARUP	TTB-23	8/28/2008	9/3/2008	Rotary Wash/Coring	cathead and rope	172.5	23.4	NAVD88	23.4	21.5	1.9	18.0	22.0	147.0	5.4	1.4	-123.6	9.5	4.0	Fill over Dune Sand over Young Bay Mud
351	S8-3	D&M/AGS	B-1	9/29/2008	9/29/2008	Hollow Stem Auger	140 lb/30"	31.5	20.8	NAVD88	20.8	17.8	3.0							9.5	0.0	Fill over Dune Sand over marine sand deposits
352	S8-3	D&M/AGS	B-2	9/29/2008	9/29/2008	Hollow Stem Auger	140 lb/30"	51.5	18.1	NAVD88	18.1	25.0	-6.9	19.8	21.5		-1.7	-3.4		8.5	1.8	Fill over Dune Sand over Young Bay Mud
353	S8-3	D&M/AGS	B-3	10/27/2008	10/27/2008	Hollow Stem Auger	140 lb/30"	31.5	18.9	NAVD88	18.9	17.2	1.7							11.0	0.0	Fill over Dune Sand over marine sand deposits
354	S8-3	D&M/AGS	B-4	0/27/2008	10/27/2008	Hollow Stem Auger	140 lb/30"	32.5	14.2	NAVD88	14.2	13.0	1.2	21.0	32.0		-6.8	-17.8		13.5	11.0	Fill over beach sand deposits? over Young Bay Mud
355	S8-3	D&M/AGS	B-5	10/28/2008	10/28/2008	Hollow Stem Auger	140 lb/30"	31.5	12.7	NAVD88	12.7	13.5	-0.8	30.8			-18.1			13.0		Fill over beach sand deposits? over Young Bay Mud
356	S8-3	D&M/AGS	B-6	10/24/2008	10/24/2008	Hollow Stem Auger	140 lb/30"	51.5	12.6	NAVD88	12.6	12.0	0.6	26.0	38.0		-13.4	-25.4		20.5	12.0	Fill over beach sand deposits? over Young Bay Mud
357	S8-3	D&M/AGS	B-7	10/3/2008	10/3/2008	Hollow Stem Auger	140 lb/30"	51.5	14.9	NAVD88	14.9	18.0	-3.1	21.5	40.0		-6.6	-25.1		19.0	18.5	Fill over beach sand deposits? over Young Bay Mud
358	S8-3	D&M/AGS	B-8	10/2/2008	10/2/2008	Hollow Stem Auger	140 lb/30"	51.5	18.6	NAVD88	18.6	18.0	0.6	31.5			-12.9			4.5		Fill over Dune Sand over Young Bay Mud
359	S8-3	D&M/AGS	B-9	9/30/2008	9/30/2008	Hollow Stem Auger	140 lb/30"	51.5	19.9	NAVD88	19.9	19.5	0.4	35.0			-15.1			4.0		Fill over Dune Sand over Young Bay Mud
360	S8-3	D&M/AGS	B-10	9/30/2008	9/30/2008	Hollow Stem Auger	140 lb/30"	31.5	21.8	NAVD88	21.8	20.3	1.5	30.5			-8.7			9.5		Fill over Dune Sand over Young Bay Mud
596	S8-4	T&R	BW-1	8/8/1995		Rotary Wash	S&H 280 lb/18" ; SPT 140 lb/30"	131.5	-5.5	MLLW	-5.8			0.0	98.0		-5.8	-103.8		0.0	98.0	Offshore, elevations/depths from mudline
597	S8-4	T&R	BW-2	8/9/1995		Rotary Wash	S&H 280 lb/18" ; SPT 140 lb/30"	143	-7.0	MLLW	-7.3			0.0	100.5		-7.3	-107.8		0.0	100.5	Offshore, elevations/depths from mudline
598	S8-4	T&R	BW-3	8/10/1995		Rotary Wash	S&H 280 lb/18" ; SPT 140 lb/30"	171.5	-5.5	MLLW	-5.8			0.0	103.0		-5.8	-108.8		0.0	103.0	Offshore, elevations/depths from mudline
599	S8-4	T&R	BW-4	8/11/1995		Rotary Wash	S&H 280 lb/18" ; SPT 140 lb/30"	184	-8.0	MLLW	-8.3			0.0	100.5		-8.3	-108.8		0.0	100.5	Offshore, elevations/depths from mudline
600	S9a-1	T&R	B-1	12/4/1997		Rotary Wash	140 lb/30" Rope & Pully	81.5	4.5	SFCD	15.8			15.0	36.5	79.0	0.8	-20.7	-63.2	15.0	21.5	
601	S9a-1	T&R	B-2	12/3/1997		Rotary Wash	140 lb/30" Rope & Pully	100	2.5	SFCD	13.8			12.0	41.0	86.5	1.8	-27.2	-72.7	12.0	29.0	
602	S9a-1	T&R	B-3	12/5/1997		Rotary Wash	140 lb/30" Rope & Pully	63.5	0.5	SFCD	11.8			17.0	43.0	51.0	-5.2	-31.2	-39.2	17.0	26.0	
603	S9a-1	T&R	EB-1	12/4/1997		Direct Push		24	0.5	SFCD	11.8	8.8	3.1	15.5			-3.7			15.5		
604	S9a-1	T&R	EB-2	12/4/1997		Direct Push		21	3.5	SFCD	14.8	9.5	5.3	16.0			-1.2			16.0		
605	S9a-1	T&R	EB-3	12/5/1997		Direct Push		19	4.5	SFCD	15.8	9.5	6.3	16.0			-0.2			16.0		
606	S9a-1	T&R	EB-4	12/4/1997		Direct Push		21	3.0	SFCD	14.3	9.0	5.3	13.0			1.3			13.0		
607	S9a-1	T&R	EB-5	12/5/1997		Direct Push		16	1.0	SFCD	12.3	8.5	3.8	15.0			-2.7			15.0		
608	S9a-1	T&R	EB-6	12/4/1997		Direct Push		30	5.0	SFCD	16.3	8.0	8.3	12.0			4.3			12.0		
621	S9a-2	HMLA	1	9/4/1970		Rotary Wash		147	0.0	SFCD	11.3	11.0	0.3	17.0	52.0	135.0	-5.7	-40.7	-123.7	17.0	35.0	
622	S9a-2	HMLA	2	9/16/1970		Rotary Wash		99	0.0	SFCD	11.3	10.0	1.3	11.0	49.0	91.5	0.3	-37.7	-80.2	11.0	38.0	
623	S9a-2	HMLA	3	9/17/1970		Rotary Wash		66.5	-0.3	SFCD	11.0			21.0	52.0		-10.0	-41.0		21.0	31.0	
624	S9a-2	HMLA	4	9/10/1970		Rotary Wash		132	-0.8	SFCD	10.5	11.0	-0.5	21.5	53.5	120.0	-11.0	-43.0	-109.5	21.5	32.0	
625	S9a-2	HMLA	5	9/8/1970		Rotary Wash		105	-1.2	SFCD	10.1	10.0	0.1	22.0	51.0	89.0	-11.9	-40.9	-78.9	22.0	29.0	
626	S9-1	D&M	B-2		12/6/1996			58	0.0	SFCD	11.3	7.5	3.8	16.0	40.0	40.0	-4.7	-28.7	-28.7	16.0	24.0	
627	S9-1	D&M	B-5		12/8/1996			65	0.0	SFCD	11.3	7.0	4.3	21.0	47.5	55.0	-9.7	-36.2	-43.7	21.0	26.5	
628	S9-1	D&M	B-8		12/8/1996			25.5	0.0	SFCD	11.3	7.5	3.8	20.0			-8.7			20.0		
629	S9-1	D&M	B-9		12/7/1996			15.5	0.0	SFCD	11.3	8.0	3.3									Fill to bottom of boring
410	S9-1	AGS	B-1	4/22/1993	4/22/1993	Rotary Wash	140 lb/30"	71	-13.0	SFCD	-1.7			45.0	57.5	67.5	-46.7	-59.2	-69.2	45.0	12.5	
411	S9-1	AGS	B-2	4/20/1993	4/21/1993	Rotary Wash	140 lb/30"	75.5	-13.0	SFCD	-1.7			45.0	59.0	70.5	-46.7	-60.7	-72.2	45.0	14.0	
412	S9-1	AGS	B-3	4/19/1993	4/20/1993	Rotary Wash	140 lb/30"	85.5	-18.0	SFCD	-6.7			36.0	51.5	77.0	-42.7	-58.2	-83.7	36.0	15.5	

Record No	Report ID	Company	Boring ID	Date Drilling Started	Date Drilling Finished	Drilling Method	Hammer Type	Boring Depth (feet)	Ground Surface Elevation (feet)	Datum	Ground Surface Elevation (feet, NAVD88)	Ground - water Depth (feet)	Ground- water Elevation (feet, NAVD88)	Depth to Top of Young Bay Mud (feet)	Depth to Bottom of Young Bay Mud (feet)	Depth to Top of Bedrock (feet)	Elevation of Top of Young Bay Mud (feet, NAVD88)	Elevation of Bottom of Young Bay Mud (feet, NAVD88)	Elevation to Top of Bedrock (feet, NAVD88)	Thickness of Artificial Fill (feet)	Thickness of Young Bay Mud (feet)	Comments
499	S9-1	AGS	B-4A	4/23/1999	4/23/1999	Rotary Wash	140 lb/30"	12.5	-27.0	SFCD	-15.7			0.0			-15.7			0.0		pier/offshore, depths/elevations from mudline
500	S9-1	AGS	B-5	4/23/1999	4/23/1999	Rotary Wash	140 lb/30"	37	-26.0	SFCD	-14.7			0.0			-14.7			0.0		pier/offshore, depths/elevations from mudline
501	S9-1	AGS	B-6	4/23/1999	4/23/1999	Rotary Wash	140 lb/30"	36	-28.0	SFCD	-16.7			0.0			-16.7			0.0		pier/offshore, depths/elevations from mudline
502	S9-1	AGS	B-7	4/23/1999	4/23/1999	Rotary Wash	140 lb/30"	34	-26.0	SFCD	-14.7			0.0			-14.7			0.0		pier/offshore, depths/elevations from mudline
200	S10-1	L&P	1	12/2/1986	12/3/1986	Rotary Wash		116.5	-25.5	SFCD	-14.2			0.0	49.5	110.5	-14.2	-63.7	-124.7	0.0	49.5	pier/offshore, depths/elevations from mudline
201	S10-1	L&P	2	12/3/1986	12/4/1986	Rotary Wash		120.5	-23.0	SFCD	-11.7			0.0	39.0	118.5	-11.7	-50.7	-130.2	0.0	39.0	pier/offshore, depths/elevations from mudline
202	S10-1	L&P	3	12/4/1986	12/5/1986	Rotary Wash		119	-19.5	SFCD	-8.2			0.0	35.0	116.0	-8.2	-43.2	-124.2	0.0	35.0	pier/offshore, depths/elevations from mudline
203	S10-1	L&P	4	12/8/1986	12/8/1986	Rotary Wash		106	-44.5	SFCD	-33.2			0.0	32.5		-33.2	-65.7		0.0	32.5	pier/offshore, depths/elevations from mudline
204	S10-1	L&P	5	12/9/1986	12/10/1986	Rotary Wash		126.5	-24.0	SFCD	-12.7			0.0	34.5		-12.7	-47.2		0.0	34.5	pier/offshore, depths/elevations from mudline
205	S10-1	L&P	6	12/10/1986	12/11/1986	Rotary Wash		132	-18.0	SFCD	-6.7			0.0	44.0		-6.7	-50.7		0.0	44.0	pier/offshore, depths/elevations from mudline
206	S10-3	EMI	LB-01	6/15/2011	6/15/2011	Rotary Wash	140 lb automatic hammer	71.5	0.0	SFCD	11.3			41.5	45.0		-30.2	-33.7		41.5	3.5	
207	S10-3	EMI	LB-02	6/17/2011	6/17/2011	Rotary Wash	140 lb automatic hammer	86.5	0.0	SFCD	11.3			45.0	47.5		-33.7	-36.2		45.0	2.5	
208	S10-3	EMI	WB-01	5/24/2011	5/54/2011	Rotary Wash	140 lb automatic hammer	113.3	-21.3	SFCD	-10.0			0.0	38.0	93.0	-10.0	-48.0	-103.0	0.0	38.0	offshore, depths/elevations from mudline
209	S10-3	EMI	WB-02	5/18/2011	5/18/2011	Rotary Wash	140 lb automatic hammer	130.4	-19.5	SFCD	-8.2			0.0	50.0	130.0	-8.2	-58.2	-138.2	0.0	50.0	offshore, depths/elevations from mudline
210	S10-3	EMI	WB-03	5/19/2011	5/19/2011	Rotary Wash	140 lb automatic hammer	130.3	-26.4	SFCD	-15.1			0.0	53.0	105.0	-15.1	-68.1	-120.1	0.0	53.0	offshore, depths/elevations from mudline
211	S10-3	EMI	WB-04	5/23/2011	5/23/2011	Rotary Wash	140 lb automatic hammer	120.1	-67.6	SFCD	-56.3					120.2			-176.5	6.0	0.0	offshore, depths/elevations from mudline
212	S10-3	EMI	WB-06	5/20/2011	520/2011	Rotary Wash	140 lb automatic hammer	156.5	-30.8	SFCD	-19.5			0.0	55.5		-19.5	-75.0		0.0	55.5	offshore, depths/elevations from mudline
213	S10-3	EMI	WB-07	5/24/2011	5/24/2011	Rotary Wash	140 lb automatic hammer	133	-26.0	SFCD	-14.7			0.0	29.5		-14.7	-44.2		0.0	29.5	pier/offshore, depths/elevations from mudline
214	S10-3	SCI	B-1	1/10/2001	1/11/2001	Rotary Wash	140 lb rope and cathead	103.6	-22.9	SFCD	-11.6			0.0	33.0	94.5	-11.6	-44.6	-106.1	0.0	33.0	pier/offshore, depths/elevations from mudline
215	S10-3	SCI	B-2	1/16/2001	1/17/2001	Rotary Wash	140 lb rope and cathead	124.3	-35.2	SFCD	-23.9					113.0			-136.9	40.5	0.0	pier/offshore, depths/elevations from mudline
216	S10-3	SCI	B-3	1/19/2001	1/22/2001	Rotary Wash	140 lb rope and cathead	142	-20.6	SFCD	-9.3			0.0	39.0	121.0	-9.3	-48.3	-130.3	0.0	39.0	pier/offshore, depths/elevations from mudline
217	S10-3	SCI	B-4	1/18/2001	1/19/2001	Rotary Wash	140 lb rope and cathead	138.5	-32.1	SFCD	-20.8			30.0	39.5		-50.8	-60.3		30.0	9.5	pier/offshore, depths/elevations from mudline
218	S10-3	SCI	B-5	1/12/2001	1/12/2001	Rotary Wash	140 lb rope and cathead	140.5	-19.2	SFCD	-7.9			0.0	49.5		-7.9	-57.4		0.0	49.5	pier/offshore, depths/elevations from mudline
219	S10-3	SCI	B-6	1/15/2001	1/16/2001	Rotary Wash	140 lb rope and cathead	144.5	-31.7	SFCD	-20.4									40.0	0.0	pier/offshore, depths/elevations from mudline
220	S10-3	SCI	B-7	3/22/2001	3/22/2001	Rotary Wash	140 lb rope and cathead	136.5	-28.8	SFCD	-17.5			0.0	34.5		-17.5	-52.0		0.0	34.5	offshore, depths/elevations from mudline
221	S10-3	SCI	B-8	3/20/2001	3/20/2001	Rotary Wash	140 lb rope and cathead	81.5	-56.2	SFCD	-44.9			0.0	9.0		-44.9	-53.9		0.0	9.0	offshore, depths/elevations from mudline
222	S10-3	SCI	B-9	3/21/2001	3/21/2001	Rotary Wash	140 lb rope and cathead	175	-41.9	SFCD	-30.6			0.0	22.0		-30.6	-52.6		0.0	22.0	offshore, depths/elevations from mudline
223	S10-3	SCI	GB-1	12/18/2000	12/18/2000	Rotary Wash	140 lb rope and cathead	88.5	-0.4	SFCD	10.9			22.5	36.0		-11.6	-25.1		22.5	13.5	
224	S10-3	SCI	GB-2	12/15/2000	12/15/2000	Rotary Wash	140 lb rope and cathead	78	-0.2	SFCD	11.1			15.0	22.0	68.0	-3.9	-10.9	-56.9	15.0	7.0	

Record No	Report ID	Company	Boring ID	Date Drilling Started	Date Drilling Finished	Drilling Method	Hammer Type	Boring Depth (feet)	Ground Surface Elevation (feet)	Datum	Ground Surface Elevation (feet, NAVD88)	Ground - water Depth (feet)	Ground- water Elevation (feet, NAVD88)	Depth to Top of Young Bay Mud (feet)	Depth to Bottom of Young Bay Mud (feet)	Depth to Top of Bedrock (feet)	Elevation of Top of Young Bay Mud (feet, NAVD88)	Elevation of Bottom of Young Bay Mud (feet, NAVD88)	Elevation to Top of Bedrock (feet, NAVD88)	Thickness of Artificial Fill (feet)	Thickness of Young Bay Mud (feet)	Comments
225	S10-3	SCI	GB-3	12/14/2000	12/14/2000	Rotary Wash	140 lb rope and cathead	74.5	-0.2	SFCD	11.1			12.0	34.5	68.0	-0.9	-23.4	-56.9	12.0	22.5	
226	S11-1	GTC	CPT-1 (Predrill)	4/20/2009	4/20/2009	Trash barrel & Rotary Wash		41.5	11.0	NAVD88	11.0			39.0			-28.0			39.0		
227	S11-1	GTC	CPT-2 (Predrill)	4/20/2009	4/20/2009	Trash barrel & Rotary Wash		38.5	11.0	NAVD88	11.0			36.5			-25.5			36.5		
228	S11-1	GTC	B-1	4/21/2009	4/22/2009	Rotary Wash	Automatic: 140 lb/30"	121.5	11.0	NAVD88	11.0									42.0	0.0	
229	S11-1	GTC	B-2	4/21/2009	4/21/2009	Rotary Wash	Automatic: 140 lb/30"	8	11.0	NAVD88	11.0											Refusal in fill at 8 feet
230	S11-1	GTC	B-3	4/23/2009	4/24/2009	Rotary Wash	Automatic: 140 lb/30"	121.9	-6.0	NAVD88	-6.0			0.0	24.5		-6.0	-30.5		0.0	24.5	pier/offshore, depths/elevations from mudline
231	S11-1	GTC	B-4	4/22/2009	4/23/2009	Rotary Wash	Automatic: 140 lb/30"	79.9	-8.0	NAVD88	-8.0			0.0	28.0		-8.0	-36.0		0.0	28.0	pier/offshore, depths/elevations from mudline
232	S11-1	GTC	CPT-01	4/20/2009	4/20/2009	Cone Penetrometer	Not applicable	137.63	11.0	NAVD88	11.0											
233	S11-1	GTC	CPT-02	4/20/2009	4/20/2009	Cone Penetrometer	Not applicable	139.93	11.0	NAVD88	11.0											
612	S11-4	HLA	B-1	12/5/1985		Rotary Wash		107	1.1	SFCD	12.4	9.0	3.4	17.5	24.0		-5.1	-11.6		17.5	6.5	
613	S11-4	HLA	B-2	12/5/1985		Rotary Wash		47.5	3.5	SFCD	14.8	10.5	4.3	18.5	24.0		-3.7	-9.2		18.5	5.5	
614	S11-4	HLA	B-3	12/6/1985		Rotary Wash		46.5	5.5	SFCD	16.8	12.0	4.8	20.5	22.0		-3.7	-5.2		20.5	1.5	
615	S11-4	HLA	B-4	12/6/1985		Rotary Wash		22	8.7	SFCD	20.0	13.0	7.0			16.0			4.0	16.0	0.0	
616	S11-4	HLA	B-5	12/6/1985		Rotary Wash		54	5.0	SFCD	16.3	10.0	6.3	17.0	22.0		-0.7	-5.7		17.0	5.0	
617	S11-4	HLA	B-6	12/6/1985		Rotary Wash		17	0.0	SFCD	11.3	6.0	5.3	10.0			1.3			10.0		Boring ended in Qybm
618	S11-4	HLA	PB-1	12/22/1981		Rotary Wash		40	1.0	SFCD	12.3	5.0	7.3	14.0	22.5	39.0	-1.7	-10.2	-26.7	14.0	8.5	
619	S11-4	HLA	PB-2	12/23/1981		Rotary Wash		52	1.5	SFCD	12.8			13.0	23.5	51.5	-0.2	-10.7	-38.7	13.0	10.5	
620	S11-4	HLA	PB-3	9/25/1985		Rotary Wash		96	0.1	SFCD	11.4	6.0	5.4	16.0	37.5		-4.6	-26.1		16.0	21.5	
234	S12-1	T&A	B-1	1/9/1991	1/9/1991	Rotary Wash	300 lb/ 24"	91.3	1.3	SFCD	12.6			30.0	38.5	88.5	-17.4	-25.9	-75.9	30.0	8.5	
235	S12-1	T&A	B-2	1/7/1991	1/7/1991	Rotary Wash	300 lb/ 24"	71.5	0.9	SFCD	12.2			20.5	32.5		-8.3	-20.3		20.5	12.0	
236	S12-1	T&A	B-3	1/8/1991	1/8/1991	Rotary Wash	300 lb/ 24"	61	0.7	SFCD	12.0	9.0	3.0	14.5	32.5	61.0	-2.5	-20.5	-49.0	14.5	18.0	
237	S12-1	T&A	B-4	1/8/1991	1/8/1991	Rotary Wash	300 lb/ 24"	61	4.4	SFCD	15.7	12.0	3.7	23.5	28.0	55.5	-7.8	-12.3	-39.8	23.5	4.5	
520	S12-2	HLA	B-1	3/25/1992	3/25/3992			13	13.0	SFCD	24.3					6.0			18.3	6.0	0.0	
521	S12-2	HLA	B-2	3/23/1992	3/23/1992			9.5	10.0	SFCD	21.3					0.8			20.6	0.8	0.0	
522	S12-2	HLA	B-3	3/24/1992	3/24/1992			25	11.0	SFCD	22.3					12.5			9.8	12.5	0.0	
523	S12-2	HLA	B-4	3/24/1992	3/24/1992			39	13.0	SFCD	24.3					0.8			23.6	0.8	0.0	
524	S12-2	HLA	B-1	1/2/1997	1/2/1997	Rotary Wash		65	4.0	SFCD	15.3			22.0	35.0	52.5	-6.7	-19.7	-37.2	22.0	13.0	
525	S12-2	HLA	B-2	1/3/1997	1/3/1997	Rotary Wash		60	5.0	SFCD	16.3			23.0	35.0	48.5	-6.7	-18.7	-32.2	23.0	12.0	
526	S12-2	HLA	B-3	1/2/1997	1/2/1997	Rotary Wash		55	4.0	SFCD	15.3			22.0	27.0	46.0	-6.7	-11.7	-30.7	22.0	5.0	
238	S12-3	GTC	B-1	12/6/2012	12/7/2012	Rotary Wash	Automatic: 140 lb/30"	101.5	-18.5	SFCD	-7.2			0.0	32.0		-7.2	-39.2		0.0	32.0	pier/offshore, depths/elevations from mudline
239	S12-5	AECOM/AGS	B-1	10/19/2012	10/19/2012	Solid Continuous Flight Auger	140 lb/30"	20.5	18.0	NAVD88	18.0					11.0			7.0	4.0	0.0	
240	S12-5	AECOM/AGS	B-2	12/10/2012	12/10/2012	Rotary Wash	140 lb/30"	30	11.0	NAVD88	11.0			15.0			-4.0			15.0		
241	S12-5	AECOM/AGS	B-3	12/11/2012	12/12/2012	Rotary Wash	140 lb/30"	106.5	9.0	NAVD88	9.0	8.0	1.0	22.5	38.5		-13.5	-29.5		22.5	16.0	
242	S12-5	AECOM/AGS	B-4	2/6/2013	2/7/2013	Rotary Wash	140 lb/30"	131.5	8.0	NAVD88	8.0	8.0	0.0	39.5	41.0		-31.5	-33.0		39.5	1.5	
243	S12-5	AECOM/AGS	CPT-1			Cone Penetrometer	Not applicable	18														
244	S12-5	AECOM/AGS	CPT-2			Cone Penetrometer	Not applicable	82														
245	S13-1	HLA	1	11/12/1982	11/12/1982	Rotary Wash		66	-9.0	MLLW	-9.3			0.0	43.0		-9.3	-52.3		0.0	43.0	pier/offshore, depths/elevations from mudline

Record No	Report ID	Company	Boring ID	Date Drilling Started	Date Drilling Finished	Drilling Method	Hammer Type	Boring Depth (feet)	Ground Surface Elevation (feet)	Datum	Ground Surface Elevation (feet, NAVD88)	Ground - water Depth (feet)	Ground-water Elevation (feet, NAVD88)	Depth to Top of Young Bay Mud (feet)	Depth to Bottom of Young Bay Mud (feet)	Depth to Top of Bedrock (feet)	Elevation of Top of Young Bay Mud (feet, NAVD88)	Elevation of Bottom of Young Bay Mud (feet, NAVD88)	Elevation to Top of Bedrock (feet, NAVD88)	Thickness of Artificial Fill (feet)	Thickness of Young Bay Mud (feet)	Comments
246	S13-1	HLA	2	11/11/1982	11/11/1982	Rotary Wash		65	-9.0	MLLW	-9.3			0.0	31.5		-9.3	-40.8		0.0	31.5	pier/offshore, depths/elevations from mudline
247	S13-1	HLA	3	11/22/1982	11/22/1982	Rotary Wash		101	12.0	MLLW	11.7			29.0	46.0		-17.3	-34.3		29.0	17.0	
248	S13-1	HLA	4	11/16/1982	11/16/1982	Rotary Wash		69	-21.0	MLLW	-21.3			0.0	26.0		-21.3	-47.3		0.0	26.0	pier/offshore, depths/elevations from mudline
249	S13-1	HLA	5	11/19/1982	11/19/1982	Rotary Wash		54.5	-35.0	MLLW	-35.3			0.0	16.0		-35.3	-51.3		0.0	16.0	pier/offshore, depths/elevations from mudline
250	S13-1	HLA	6	11/15/1982	11/15/1982	Rotary Wash		77.5	-10.0	MLLW	-10.3			0.0	30.5		-10.3	-40.8		0.0	30.5	pier/offshore, depths/elevations from mudline
251	S13-1	HLA	7	11/17/1982	11/17/1982	Rotary Wash		69	-22.5	MLLW	-22.8			0.0	23.5		-22.8	-46.3		0.0	23.5	pier/offshore, depths/elevations from mudline
252	S13-1	HLA	8	11/18/1982	11/18/1982	Rotary Wash		88.5	-9.5	MLLW	-9.8			0.0	34.5		-9.8	-44.3		0.0	34.5	pier/offshore, depths/elevations from mudline
1	P46-1	T&R	B-1	5/17/1996	5/20/1996	Rotary Wash	Safety Hammer	121.5	12.0	MLLW	11.7	1.5	12.8	34.5	45.5		-22.8	-33.8		34.5	11.0	
2	P46-1	T&R	B-2	5/20/1996	5/21/1996	Rotary Wash	Safety Hammer	51.5	12.5	MLLW	12.2			19.5	39.0		-7.3	-26.8		19.5	19.5	
3	P46-1	T&R	B-3	5/21/1996	5/22/1996	Rotary Wash	Safety Hammer	106.5	12.5	MLLW	12.2	10.0	21.3	38.0	40.0		-25.8	-27.8		38.0	2.0	
4	P46-1	T&R	B-4	6/6/1996	6/7/1996	Rotary Wash	Safety Hammer	41.5	15.0	MLLW	14.7	12.0	23.3	18.0	25.0	33.0	-3.3	-10.3	-18.3	18.0	7.0	
5	P46-1	T&R	B-5	6/7/1996	6/7/1996	Rotary Wash	Safety Hammer	56.5	11.5	MLLW	11.2			13.5	26.5	50.0	-2.3	-15.3	-38.8	13.5	13.0	
6	P46-1	T&R	B-6	6/7/1996	6/7/1996	Rotary Wash	Safety Hammer	56.3	16.0	MLLW	15.7			19.0	33.5	50.0	-3.3	-17.8	-34.3	19.0	14.5	
7	P46-1	T&R	B-7	6/10/1996	6/10/1996	Rotary Wash	Safety Hammer	95.2	14.5	MLLW	14.2			19.0	33.0	91.0	-4.8	-18.8	-76.8	19.0	14.0	
8	P46-1	T&R	CPT-1	6/22/1996	6/22/1996	Cone Penetrometer	Not applicable	61.52	12.5	MLLW	12.2											
9	P46-1	T&R	CPT-2	6/22/1996	6/22/1996	Cone Penetrometer	Not applicable	85.96	12.5	MLLW	12.2											
10	P46-1	T&R	CPT-3	6/22/1996	6/22/1996	Cone Penetrometer	Not applicable	74.97	12.5	MLLW	12.2											
11	P46-1	T&R	CPT-4	6/22/1996	6/22/1996	Cone Penetrometer	Not applicable	64.8	12.5	MLLW	12.2											
44	MS-1	WCC	1	8/20/1975	8/21/1975	Rotary Wash	* = 335 lb/18"; otherwise 140 lb/30"	158	0.0	SFCD	11.3	6.0	5.3	16.0	39.0	151.5	-4.7	-27.7	-140.2	16.0	23.0	
45	MS-1	WCC	2	8/21/1975	8/22/1975	Rotary Wash	* = 335 lb/18"; otherwise 140 lb/30"	144.5	0.0	SFCD	11.3	8.5	2.8	19.0	32.0	139.0	-7.7	-20.7	-127.7	19.0	13.0	
46	MS-1	WCC	3	8/24/1975	8/25/1975	Rotary Wash	* = 335 lb/18"; otherwise 140 lb/30"	146	0.0	SFCD	11.3	7.5	3.8	13.0	24.5	140.0	-1.7	-13.2	-128.7	13.0	11.5	
47	MS-1	WCC	4	9/8/1975	9/8/1975	Rotary Wash	140 lb/30"	45.5	0.0	SFCD	11.3	8.5	2.8	43.5			-32.2			43.5		
48	MS-1	WCC	5	9/5/1975	9/8/1975	Rotary Wash	140 lb/30"	40	0.0	SFCD	11.3	6.5	4.8	32.5			-21.2			32.5		
49	MS-1	WCC	6	8/26/1975	8/27/1975	Rotary Wash	* = 335 lb/18"; otherwise 140 lb/30"	139	0.0	SFCD	11.3	6.5	4.8	37.5	127.0		-26.2	-115.7		37.5	89.5	
50	MS-1	WCC	7	8/29/1975	8/29/1975	Auger	140 lb/30"	45	0.0	SFCD	11.3	6.0	5.3	39.0			-27.7			39.0		
51	MS-1	WCC	8	8/29/1975	8/29/1975	Auger	140 lb/30"	53	0.0	SFCD	11.3	7.0	4.3	46.0			-34.7			46.0		
52	MS-1	WCC	9	8/27/1975	8/28/1975	Rotary Wash	140 lb/30"	61	0.0	SFCD	11.3			31.0	58.0		-19.7	-46.7		31.0	27.0	
53	MS-1	WCC	10	9/10/1975	9/12/1975	Rotary Wash	* = 335 lb/18"; otherwise 140 lb/30"	201.5	0.0	SFCD	11.3	8.5	2.8	28.5	109.0	193.0	-17.2	-97.7	-181.7	28.5	80.5	
54	MS-1	WCC	11	9/9/1975	9/10/1975	Rotary Wash	* = 335 lb/18"; otherwise 140 lb/30"	87	-3.0	SFCD	8.3	8.5	-0.2	38.5	76.0		-30.2	-67.7		38.5	37.5	
55	MS-1	WCC	12	9/9/1975	9/10/1975	Rotary Wash	140 lb/30"	27.5	0.0	SFCD	11.3	5.0	6.3	13.5	16.0	19.0	-2.2	-4.7	-7.7	13.5	2.5	
56	MS-1	WCC	12A	9/18/1975	9/18/1975	Auger	140 lb/30"	23	0.0	SFCD	11.3	6.5	4.8	13.5	18.0	18.0	-2.2	-6.7	-6.7	13.5	4.5	
57	MS-1	WCC	12B	9/18/1975	9/18/1975	Auger	140 lb/30"	18	0.0	SFCD	11.3	8.0	3.3	15.0	17.0	17.0	-3.7	-5.7	-5.7	15.0	2.0	
58	MS-1	WCC	12C	9/18/1975	9/18/1975	Auger	140 lb/30"	23	0.0	SFCD	11.3	8.0	3.3	17.5	18.0	18.0	-6.2	-6.7	-6.7	17.5	0.5	
59	MS-1	WCC	12D	9/18/1975	9/18/1975	Auger	140 lb/30"	18	0.0	SFCD	11.3	8.0	3.3	12.5	15.5	15.5	-1.2	-4.2	-4.2	12.5	3.0	
60	MS-1	WCC	12E	9/18/1975	9/18/1975	Auger	140 lb/30"	23	0.0	SFCD	11.3	10.5	0.8	13.0	21.0	21.0	-1.7	-9.7	-9.7	13.0	8.0	
61	MS-1	WCC	12F	9/18/1975	9/18/1975	Auger	140 lb/30"	33	0.0	SFCD	11.3			20.0	32.5	32.5	-8.7	-21.2	-21.2	20.0	12.5	

Record No	Report ID	Company	Boring ID	Date Drilling Started	Date Drilling Finished	Drilling Method	Hammer Type	Boring Depth (feet)	Ground Surface Elevation (feet)	Datum	Ground Surface Elevation (feet, NAVD88)	Ground - water Depth (feet)	Ground-water Elevation (feet, NAVD88)	Depth to Top of Young Bay Mud (feet)	Depth to Bottom of Young Bay Mud (feet)	Depth to Top of Bedrock (feet)	Elevation of Top of Young Bay Mud (feet, NAVD88)	Elevation of Bottom of Young Bay Mud (feet, NAVD88)	Elevation to Top of Bedrock (feet, NAVD88)	Thickness of Artificial Fill (feet)	Thickness of Young Bay Mud (feet)	Comments
62	MS-1	WCC	12G	9/20/1975	9/20/1975	Auger	140 lb/30"	28	0.0	SFCD	11.3			13.0	22.0	22.0	-1.7	-10.7	-10.7	13.0	9.0	
63	MS-1	WCC	12H	9/20/1975	9/20/1975	Auger	140 lb/30"	33	0.0	SFCD	11.3			13.5	24.0	30.0	-2.2	-12.7	-18.7	13.5	10.5	
64	MS-1	WCC	12I	9/20/1975	9/20/1975	Auger	140 lb/30"	23	0.0	SFCD	11.3			16.5	18.5	18.5	-5.2	-7.2	-7.2	16.5	2.0	
65	MS-1	WCC	13	8/29/1975	8/29/1975	Rotary Wash	* = 335 lb/18"; otherwise 140 lb/30"	102	0.0	SFCD	11.3	5.5	5.8	13.5	30.5	70.5	-2.2	-19.2	-59.2	13.5	17.0	
66	MS-1	WCC	14	9/18/1975	9/22/1975	Rotary Wash	* = 335 lb/18"; otherwise 140 lb/30"	132.5	0.0	SFCD	11.3			28.0	92.5	123.0	-16.7	-81.2	-111.7	28.0	64.5	
67	MS-1	WCC	15	9/16/1975	9/17/1975	Rotary Wash	* = 335 lb/18"; otherwise 140 lb/30"	187	0.0	SFCD	11.3	8.0	3.3	36.0	46.0	178.0	-24.7	-34.7	-166.7	36.0	10.0	
68	MS-1	WCC	16	9/2/1975	9/2/1975	Rotary Wash	* = 335 lb/18"; otherwise 140 lb/30"	84.5	0.0	SFCD	11.3	8.0	3.3	32.0	56.5		-20.7	-45.2		32.0	24.5	
69	MS-1	WCC	17	9/4/1975	9/5/1975	Rotary Wash	* = 335 lb/18"; otherwise 140 lb/30"	59	0.0	SFCD	11.3	5.0	6.3	19.0	48.0	48.0	-7.7	-36.7	-36.7	19.0	29.0	
70	MS-1	WCC	18	9/18/1975	9/18/1975	Rotary Wash	* = 335 lb/18"; otherwise 140 lb/30"	55	0.0	SFCD	11.3	5.0	6.3	16.5	53.0	53.0	-5.2	-41.7	-41.7	16.5	36.5	
71	MS-1	WCC	19	9/23/1975	9/24/1975	Rotary Wash	* = 335 lb/18"; otherwise 140 lb/30"	118	0.0	SFCD	11.3			31.0	108.0		-19.7	-96.7		31.0	77.0	
72	MS-1	WCC	20	9/24/1975	9/25/1975	Rotary Wash	* = 335 lb/18"; otherwise 140 lb/30"	118	0.0	SFCD	11.3			26.0	107.5		-14.7	-96.2		26.0	81.5	
73	MS-1	WCC	21	10/24/1975	10/24/1975	Auger	140 lb/30"	30.5	0.0	SFCD	11.3	6.5	4.8	11.0	14.0	14.0	0.3	-2.7	-2.7	11.0	3.0	
74	MS-1	WCC	22	10/25/1975	10/25/1975	Auger	140 lb/30"	23	5.0	SFCD	16.3					19.5			-3.2	19.5	0.0	
75	MS-1	WCC	23	10/24/1975	10/24/1975	Auger	140 lb/30"	29	5.0	SFCD	16.3					14.0			2.3	14.0	0.0	
76	MS-1	WCC	24	10/24/1975	10/25/1975	Auger	140 lb/30"	53.5	0.0	SFCD	11.3	12.0	-0.7	18.0	38.0	52.0	-6.7	-26.7	-40.7	18.0	20.0	
77	MS-1	WCC	25	10/24/1975	10/24/1975	Auger	140 lb/30"	31	0.0	SFCD	11.3	11.0	0.3			2.0			9.3	2.0	0.0	
116	MS-3	D&M	6	6/9/1975	6/10/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	56.1	12.1	SFCD	23.4	13.0	10.4							0.0	0.0	loose to dense dune sand (0-34.5 ft) over alluvium/colluvium/Quls, no Fill
117	MS-3	D&M	7	6/11/1975	6/12/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	80	43.8	SFCD	55.1									0.0	0.0	medium dense to dense dune sand (0-37.5 ft) over alluvium/colluvium/Quls, no Fill
118	MS-3	D&M	8	6/12/1975	6/13/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	96.5	62.3	SFCD	73.6	24.5	49.1	55.3	59.8	78.8	18.3	13.8	-5.2	55.3	4.5	medium dense to dense dune sand over Young Bay Mud, no Fill
119	MS-3	D&M	9	6/6/1975	6/11/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	108.5	75.8	SFCD	87.1	26.3	60.8			38.3			48.8	0.0	0.0	loose to dense dune sand over alluvium/colluvium/Quls, no Fill
120	MS-3	D&M	19	6/20/1975	6/25/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	110	74.9	SFCD	86.2	12.0	74.2			24.0			62.2	4.5	0.0	medium dense dune sand over alluvium/colluvium/Quls
121	MS-3	D&M	20	6/4/1975	6/5/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	104	69.0	SFCD	80.3	30.0	50.3			81.0			-0.7	0.0	0.0	medium dense dune sand over alluvium/colluvium/Quls, no Fill
122	MS-3	D&M	21	6/23/1975	6/26/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	120	80.1	SFCD	91.4	13.5	77.9			36.0			55.4	0.0	0.0	alluvium/colluvium over bedrock, no Fill
123	MS-3	D&M	22	6/7/1975	6/20/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	128	91.0	SFCD	102.3	39.0	63.3			25.0			77.3	0.0	0.0	very loose to loose dune sand over alluvium/colluvium/Quls, no Fill

Record No	Report ID	Company	Boring ID	Date Drilling Started	Date Drilling Finished	Drilling Method	Hammer Type	Boring Depth (feet)	Ground Surface Elevation (feet)	Datum	Ground Surface Elevation (feet, NAVD88)	Ground - water Depth (feet)	Ground-water Elevation (feet, NAVD88)	Depth to Top of Young Bay Mud (feet)	Depth to Bottom of Young Bay Mud (feet)	Depth to Top of Bedrock (feet)	Elevation of Top of Young Bay Mud (feet, NAVD88)	Elevation of Bottom of Young Bay Mud (feet, NAVD88)	Elevation to Top of Bedrock (feet, NAVD88)	Thickness of Artificial Fill (feet)	Thickness of Young Bay Mud (feet)	Comments
124	MS-3	D&M	23	6/27/1975	7/3/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	126.5	89.5	SFCD	100.8	39.0	61.8			25.5			75.3	9.5	0.0	loose Fill over medium dense dune sand over alluvium/colluvium/Quls
125	MS-3	D&M	30	10/20/1975	10/20/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	66	12.0	SFCD	23.3									0.0	0.0	dune sand to depth of boring, no Fill
126	MS-3	D&M	31	10/22/1975	10/23/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	129	75.0	SFCD	86.3	19.0	67.3			58.0			28.3	2.0	0.0	thin Fill over dune sand over alluvium/colluvium/Quls
127	MS-3	D&M	32	10/22/1975	10/24/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	95	60.3	SFCD	71.6	4.8	66.8			2.0			69.6	2.0	0.0	thin Fill over bedrock
128	MS-3	D&M	33	10/21/1975	10/22/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	67	22.0	SFCD	33.3	20.0	13.3			40.0			-6.7	19.0	0.0	loose Fill over colluvium over bedrock
129	MS-3	D&M	34	10/21/1975	10/21/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	126	48.0	SFCD	59.3	30.0	29.3			118.0			-58.7	0.0	0.0	dune sand over colluvium over bedrock
130	MS-3	D&M	35	1/23/1976	1/23/1976	Rotary Wash	Type U: 335 lb/18" ; SPT: 140 lb/30"	70	67.0	SFCD	78.3	57.0	21.3			64.0			14.3	9.0	0.0	Fill over dune sand over colluvium over bedrock
131	MS-3	D&M	36	1/26/1976	1/26/1976	Rotary Wash	Type U: 335 lb/18" ; SPT: 140 lb/30"	76	61.0	SFCD	72.3					71.5			0.8	0.0	0.0	dune sand over colluvium over bedrock
132	MS-3	D&M	49	8/1/1977	8/1/1977	Rotary Wash	Type U: 320 lb/18" ; SPT: 140 lb/30"	116.5	56.7	SFCD	68.0					100.0			-32.0	0.0	0.0	dune sand over colluvium/alluvium over melange bedrock
133	MS-3	D&M	50	8/4/1977	8/4/1977	Rotary Wash	Type U: 320 lb/18" ; SPT: 140 lb/30"	91.5	75.0	SFCD	86.3					42.0			44.3	2.0	0.0	thin fill over dune sand over alluvium/colluvium over melange
134	MS-3	D&M	51	8/10/1977	8/10/1977	Rotary Wash	Type U: 320 lb/18" ; SPT: 140 lb/30"	52	78.6	SFCD	89.9					45.0			44.9	2.0	0.0	thin fill over dune sand over alluvium/colluvium over melange
135	MS-3	D&M	52	8/11/1977	8/11/1977	Rotary Wash	Type U: 320 lb/18" ; SPT: 140 lb/30"	51	76.0	SFCD	87.3					39.0			48.3	2.0	0.0	thin fill over dune sand over alluvium/colluvium over melange
136	MS-3	D&M	53	8/15/1977	8/15/1977	Rotary Wash	Type U: 320 lb/18" ; SPT: 140 lb/30"	67.5	76.6	SFCD	87.9					58.5			29.4	4.5	0.0	thin fill over dune sand over alluvium/colluvium over melange
137	MS-4	D&M	14	6/11/1975	6/12/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	61	13.8	SFCD	25.1		25.1	28.5	38.5	53.5	-3.4	-13.4	-28.4	28.5	10.0	
138	MS-4	D&M	15	6/12/1975	6/13/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	66.5	2.4	SFCD	13.7	10.5	3.2	9.5	20.0		4.2	-6.3		9.5	10.5	Young Bay Mud may be disturbed
139	MS-4	D&M	16	7/22/1975	6/23/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	55.5	1.7	SFCD	13.0	8.5	4.5	15.5			-2.5			15.5		Young Bay Mud to bottom of boring
140	MS-4	D&M	37	8/3/1976	8/4/1976	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	116	1.2	SFCD	12.5			25.0	45.0		-12.5	-32.5		25.0	20.0	
141	MS-4	D&M	38	8/2/1976	8/3/1976	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	78.5	6.1	SFCD	17.4			21.0	40.0	74.0	-3.6	-22.6	-56.6	21.0	19.0	
142	MS-4	D&M	39	8/19/1976	8/19/1976	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	60	1.0	SFCD	12.3			8.0			4.3			8.0		Young Bay Mud to bottom of boring

Record No	Report ID	Company	Boring ID	Date Drilling Started	Date Drilling Finished	Drilling Method	Hammer Type	Boring Depth (feet)	Ground Surface Elevation (feet)	Datum	Ground Surface Elevation (feet, NAVD88)	Ground - water Depth (feet)	Ground- water Elevation (feet, NAVD88)	Depth to Top of Young Bay Mud (feet)	Depth to Bottom of Young Bay Mud (feet)	Depth to Top of Bedrock (feet)	Elevation of Top of Young Bay Mud (feet, NAVD88)	Elevation of Bottom of Young Bay Mud (feet, NAVD88)	Elevation to Top of Bedrock (feet, NAVD88)	Thickness of Artificial Fill (feet)	Thickness of Young Bay Mud (feet)	Comments
143	MS-4	D&M	40	8/20/1976	8/20/1976	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	49	0.0	SFCD	11.3	9.5	1.8	20.0	39.5	42.5	-8.7	-28.2	-31.2	20.0	19.5	
144	MS-4	D&M	41	8/23/1976	8/23/1976	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	57	1.6	SFCD	12.9	9.0	3.9	10.5	39.5		2.4	-26.6		10.5	29.0	
145	MS-4	D&M	42	8/24/1976	8/24/1976	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	57.5	1.7	SFCD	13.0	9.5	3.5	15.5	41.5		-2.5	-28.5		15.5	26.0	
146	MS-4	D&M	43	8/24/1976	8/25/1976	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	41.5	9.0	SFCD	20.3	9.0	11.3	10.0	16.0		10.3	4.3		10.0	6.0	
147	MS-4	D&M	44	8/25/1976	8/26/1976	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	56	1.8	SFCD	13.1	8.0	5.1	16.0			-2.9			16.0		Young Bay Mud to bottom of boring
148	MS-4	D&M	45	9/3/1976	9/3/1976	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	54	0.5	SFCD	11.8			22.5	49.0	49.0	-10.7	-37.2	-37.2	22.5	26.5	
149	MS-4	D&M	46	9/7/1976	9/7/1976	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	55	0.5	SFCD	11.8	8.5	3.3	21.0	41.5	41.5	-9.2	-29.7	-29.7	21.0	20.5	
150	MS-4	D&M	47	9/8/1976	9/8/1976	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	77.5	0.5	SFCD	11.8	8.5	3.3	15.5	47.5	67.5	-3.7	-35.7	-55.7	15.5	32.0	
151	MS-4	D&M	48	9/25/1976	9/25/1976	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	47.5	0.5	SFCD	11.8			24.5	41.5	42.5	-12.7	-29.7	-30.7	24.5	17.0	
152	MS-4	D&M	54	8/16/1977	8/16/1977	Rotary Wash	Type U: 320 lb/18" ; SPT: 140 lb/30"	66	0.9	SFCD	12.2	4.0	8.2	23.0	44.0	57.0	-10.8	-31.8	-44.8	23.0	21.0	
153	MS-4	D&M	55	8/18/1977	8/18/1977	Rotary Wash	Type U: 320 lb/18" ; SPT: 140 lb/30"	52	0.0	SFCD	11.3			16.5	39.0	45.0	-5.2	-27.7	-33.7	16.5	22.5	
154	MS-4	D&M	56	8/18/1977	8/18/1977	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	52.5	0.0	SFCD	11.3			22.5	43.0	43.0	-11.2	-31.7	-31.7	22.5	20.5	
155	MS-4	D&M	57	8/19/1977	8/19/1977	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	68.5	0.7	SFCD	12.0	6.5	5.5	17.5	48.0	48.0	-5.5	-36.0	-36.0	17.5	30.5	
156	MS-4	D&M	58	8/23/1977	8/23/1977	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	48	0.4	SFCD	11.7	4.5	7.2	18.5	42.5	42.5	-6.8	-30.8	-30.8	18.5	24.0	
157	MS-4	D&M	59	8/24/1977	8/24/1977	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	51	14.9	SFCD	26.2			31.0	37.0	37.0	-4.8	-10.8	-10.8	31.0	6.0	
158	MS-4	D&M	60	8/26/1977	8/26/1977	Rotary Wash	Type U: 320 lb/18" ; SPT: 140 lb/30"	62	15.9	SFCD	27.2					42.0			-14.8	13.0	0.0	Fill over colluvium/alluvium over bedrock
159	MS-4	D&M	61	8/29/1977	8/31/1977	Rotary Wash	Type U: 320 lb/18" ; SPT: 140 lb/30"	72.5	25.5	SFCD	36.8					36.5			0.3	12.5	0.0	Fill over dune sand over bedrock
160	MS-4	D&M	62	9/1/1977	9/1/1976	Rotary Wash	Type U: 320 lb/18" ; SPT: 140 lb/30"	35	1.0	SFCD	12.3	7.5	4.8	7.0			5.3			7.0		Young Bay Mud to bottom of boring
161	MS-4	D&M	63	9/21/1977	9/21/1977	Rotary Wash	Type U: 320 lb/18" ; SPT: 140 lb/30"	62	38.0	SFCD	49.3					39.0			10.3	0.0	0.0	alluvium/colluvium over bedrock
162	MS-4	D&M	A-1	8/31/1976	8/31/1976	Bucket auger	Not applicable	25	15.3	SFCD	26.6	22.5	4.1							17.0	0.0	Fill over alluvium/colluvium

Record No	Report ID	Company	Boring ID	Date Drilling Started	Date Drilling Finished	Drilling Method	Hammer Type	Boring Depth (feet)	Ground Surface Elevation (feet)	Datum	Ground Surface Elevation (feet, NAVD88)	Ground - water Depth (feet)	Ground-water Elevation (feet, NAVD88)	Depth to Top of Young Bay Mud (feet)	Depth to Bottom of Young Bay Mud (feet)	Depth to Top of Bedrock (feet)	Elevation of Top of Young Bay Mud (feet, NAVD88)	Elevation of Bottom of Young Bay Mud (feet, NAVD88)	Elevation to Top of Bedrock (feet, NAVD88)	Thickness of Artificial Fill (feet)	Thickness of Young Bay Mud (feet)	Comments
163	MS-4	D&M	A-2	8/26/1976	8/26/1976	Bucket auger	Not applicable	46.5	2.4	SFCD	13.7	10.5	3.2	19.5	36.5		-5.8	-22.8		19.5	17.0	
164	MS-4	D&M	A-3	8/26/1976	8/27/1976	Bucket auger	Not applicable	44.5	1.6	SFCD	12.9	11.5	1.4	20.5	39.5		-7.6	-26.6		20.5	19.0	
165	MS-4	D&M	A-4	8/24/1976	8/24/1976	Rotary Wash	Not applicable	45.5	1.4	SFCD	12.7	10.5	2.2	24.0	44.5		-11.3	-31.8		24.0	20.5	
166	MS-4	D&M	A-5	8/25/1976	8/25/1976	Bucket auger	Not applicable	45	1.8	SFCD	13.1	10.0	3.1	17.0						17.0		Young Bay Mud to bottom of boring
167	MS-4	D&M	A-6	8/27/1976	8/30/1976	Bucket auger	Not applicable	27	-0.5	SFCD	10.8	7.0	3.8	14.0			-3.2			14.0		Young Bay Mud to bottom of boring
168	MS-4	D&M	P-1	8/31/1976	8/31/1976	Bucket auger	Not applicable	27	0.5	SFCD	11.8	7.5	4.3	20.5			-8.7			20.5		Young Bay Mud to bottom of boring
169	MS-4	D&M	P-2	8/30/1976	8/30/1976	Rotary Wash	Not applicable	26	1.8	SFCD	13.1	8.5	4.6	19.5			-6.4			20.0		Young Bay Mud to bottom of boring
170	MS-4	D&M	P-3	8/30/1976	8/30/1976	Bucket auger	Not applicable	25.5	1.7	SFCD	13.0	9.5	3.5	17.0						17.0		Young Bay Mud to bottom of boring
171	MS-4	D&M	P-4	9/1/1976	9/1/1976	Bucket auger	Not applicable	27	1.5	SFCD	12.8	12.5	0.3	17.5			-4.7			17.5		Young Bay Mud to bottom of boring
172	MS-5	D&M	1	6/4/1975	6/4/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	86.5	0.4	SFCD	11.7	7.5	4.2	18.5	60.5		-6.8	-48.8		18.5	42.0	
173	MS-5	D&M	1A	7/25/1975	7/25/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	32	0.5	SFCD	11.8	6.5	5.3	28.5			-16.7			28.5		Young Bay Mud to bottom of boring
174	MS-5	D&M	2	6/5/1975	6/5/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	120.5	0.3	SFCD	11.6	6.5	5.1	10.5	96.0		1.1	-84.4		10.5	85.5	
175	MS-5	D&M	3	6/6/1975	6/6/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	97	0.3	SFCD	11.6	8.0	3.6	14.5	75.0		-2.9	-63.4		14.5	60.5	
176	MS-5	D&M	4	6/9/1975	6/9/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	75.5	0.9	SFCD	12.2	8.5	3.7	9.0	58.5		3.2	-46.3		9.0	49.5	
177	MS-5	D&M	5	6/10/1975	6/11/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	24	0.4	SFCD	11.7	7.0	4.7								0.0	
178	MS-5	D&M	5A	6/19/1975	6/20/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	112	1.3	SFCD	12.6	8.5	4.1	29.0	95.5		-16.4	-82.9		29.0	66.5	
179	MS-5	D&M	10	7/14/1975	7/21/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	90	56.0	SFCD	67.3	5.0	62.3			10.0			57.3	0.0	0.0	colluvium over bedrock
180	MS-5	D&M	11	7/22/1975	7/24/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	85.5	48.0	SFCD	59.3	37.0	22.3							0.0	0.0	dune sand over alluvium/colluvium over Old Bay Clay
181	MS-5	D&M	12	6/3/1975	7/1/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	97	59.8	SFCD	71.1									0.0	0.0	dune sand over alluvium/colluvium
182	MS-5	D&M	13	6/26/1975	6/27/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	95	56.1	SFCD	67.4									0.0	0.0	dune sand over alluvium/colluvium
183	MS-5	D&M	17	6/13/1975	6/13/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	66	28.3	SFCD	39.6	31.5	8.1	54.0			-14.4			0.0		dune sand over alluvium over Young Bay Mud to bottom of boring
184	MS-5	D&M	18	6/16/1975	6/17/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	88	54.7	SFCD	66.0	11.0	55.0							0.0	0.0	dune sand over alluvium/colluvium
185	MS-5	D&M	24	6/13/1975	6/16/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	51.5	9.2	SFCD	20.5			28.5	40.5		-8.0	-20.0		28.5	12.0	

Record No	Report ID	Company	Boring ID	Date Drilling Started	Date Drilling Finished	Drilling Method	Hammer Type	Boring Depth (feet)	Ground Surface Elevation (feet)	Datum	Ground Surface Elevation (feet, NAVD88)	Ground - water Depth (feet)	Ground- water Elevation (feet, NAVD88)	Depth to Top of Young Bay Mud (feet)	Depth to Bottom of Young Bay Mud (feet)	Depth to Top of Bedrock (feet)	Elevation of Top of Young Bay Mud (feet, NAVD88)	Elevation of Bottom of Young Bay Mud (feet, NAVD88)	Elevation to Top of Bedrock (feet, NAVD88)	Thickness of Artificial Fill (feet)	Thickness of Young Bay Mud (feet)	Comments
186	MS-5	D&M	25	6/17/1975	6/18/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	66.5	3.4	SFCD	14.7	9.5	5.2	18.5	38.5		-3.8	-23.8		18.5	20.0	
187	MS-5	D&M	26	6/18/1975	6/19/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	57	6.5	SFCD	17.8	11.5	6.3	24.5	43.0		-6.7	-25.2		24.5	18.5	
188	MS-5	D&M	27	6/13/1975	6/13/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	52.5	6.4	SFCD	17.7	14.0	3.7							8.4	0.0	Fill over colluvium/alluvium
189	MS-5	D&M	28	6/10/1975	6/12/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	68.5	25.5	SFCD	36.8					4.5			32.3	1.0	0.0	
190	MS-5	D&M	29	6/5/1975	6/10/1975	Rotary Wash	Type U: 352 lb/18" ; SPT: 140 lb/30"	99	49.8	SFCD	61.1	11.0	50.1			1.0			60.1	1.0	0.0	
527	MS-6	ARUP	TB-15A	7/20/2005	7/22/2005	Rotary Wash HQ Core	NA	121	28.9	NAVD88	28.9					1.0			27.9	1.0	0.0	
528	MS-6	ARUP	TB-16	9/22/2005	9/27/2005	Rotary Wash HQ Core	NA	120	28.5	NAVD88	28.5					1.0			27.5	1.0	0.0	
529	MS-6	ARUP	TB-16A	4/18/2005	4/18/2005	Rotary Wash HQ Core	NA	80	30.7	NAVD88	30.7					1.5			29.2	1.5	0.0	
530	MS-6	ARUP	TB-17	4/15/2005	4/16/2005	Rotary Wash HQ Core	NA	80	23.2	NAVD88	23.2					0.5			22.7	0.5	0.0	
531	MS-6	ARUP	TB-26	9/4/2008	9/8/2008	Rotary Wash HQ Core	NA	120	26.6	NAVD88	26.6					2.5			24.1	2.5	0.0	
191	MS-8	D&M	B-1		5/10/1995	Rotary Wash/Coring	140 lb/30"	117	0.0	SFCD	11.3	9.5	1.8	11.0	17.0	79.0	0.3	-5.7	-67.7	11.0	6.0	
192	MS-8	D&M	B-2		5/12/1995	Coring	Not applicable	52	11.0	SFCD	22.3	11.5	10.8			1.5			20.8	1.5	0.0	
193	MS-8	D&M	B-3		5/17/1995	Rotary Wash/Coring	140 lb/30"	81.8	16.8	SFCD	28.1	18.5	9.6			30.5			-2.4	20.0	0.0	
194	MS-8	D&M	B-4		5/31/1995	Rotary Wash/Coring	140 lb/30"	135	5.0	SFCD	16.3	10.0	6.3	16.5	23.0	52.0	-0.2	-6.7	-35.7	16.5	6.5	
195	MS-8	D&M	B-5		5/2/1995	Rotary Wash/Coring	140 lb/30"	150.5	8.3	SFCD	19.6	13.0	6.6			144.0			-124.4	19.0	0.0	
196	MS-8	D&M	B-7		5/5/1995	Rotary Wash/Coring	140 lb/30"	54	10.0	SFCD	21.3	5.0	16.3			3.0			18.3	3.0	0.0	
197	MS-8	D&M	B-8		5/23/1995	Rotary Wash/Coring	140 lb/30"	98.4	50.0	SFCD	61.3	14.0	47.3			22.0			39.3	18.0	0.0	
198	MS-8	D&M	B-9		6/2/1995	Rotary Wash/Coring	140 lb/30"	77.5	60.0	SFCD	71.3	11.5	59.8			3.0			68.3	3.0	0.0	
199	MS-8	D&M	B-10		7/28/1995	Rotary Wash/Coring	140 lb/30"	72	35.0	SFCD	46.3					2.0			44.3	2.0	0.0	
630	MS-8	D&M	B-11		8/8/1995	Rotary Wash/Coring	140 lb/30"	96	3.0	SFCD	14.3	9.0	5.3	19.0	35.0		-4.7	-20.7		9.0	16.0	
78	MS-17	CC&A	1		Jul-1975	Rotary Wash	330 lb/24" and/or 140 lb/30" (SPT)	146.5	-1.0	SFCD	10.3			36.5	116.0	143.0	-26.2	-105.7	-132.7	36.5	79.5	
79	MS-17	CC&A	2/2A		Jul-75	Rotary Wash/Cable Tool	330 lb/24" and/or 140 lb/30" (SPT)	156	-1.0	SFCD	10.3			51.0	121.0	152.0	-40.7	-110.7	-141.7	51.0	70.0	
80	MS-17	CC&A	3		Jul-75	Rotary Wash	330 lb/24" and/or 140 lb/30" (SPT)	138	0.0	SFCD	11.3	7.0	4.3	46.0	114.0	133.0	-34.7	-102.7	-121.7	46.0	68.0	
81	MS-17	CC&A	4		Jul-75	Rotary Wash	330 lb/24" and/or 140 lb/30" (SPT)	140	0.0	SFCD	11.3			35.0	94.0	136.5	-23.7	-82.7	-125.2	35.0	59.0	
82	MS-17	CC&A	5		Jul-75	Rotary Wash	330 lb/24" and/or 140 lb/30" (SPT)	107	0.0	SFCD	11.3			39.0	72.0	104.0	-27.7	-60.7	-92.7	39.0	33.0	
83	MS-17	CC&A	6		Jul-75	Rotary Wash	330 lb/24" and/or 140 lb/30" (SPT)	102	0.0	SFCD	11.3			47.5	72.0		-36.2	-60.7		47.5	24.5	

Record No	Report ID	Company	Boring ID	Date Drilling Started	Date Drilling Finished	Drilling Method	Hammer Type	Boring Depth (feet)	Ground Surface Elevation (feet)	Datum	Ground Surface Elevation (feet, NAVD88)	Ground - water Depth (feet)	Ground-water Elevation (feet, NAVD88)	Depth to Top of Young Bay Mud (feet)	Depth to Bottom of Young Bay Mud (feet)	Depth to Top of Bedrock (feet)	Elevation of Top of Young Bay Mud (feet, NAVD88)	Elevation of Bottom of Young Bay Mud (feet, NAVD88)	Elevation to Top of Bedrock (feet, NAVD88)	Thickness of Artificial Fill (feet)	Thickness of Young Bay Mud (feet)	Comments
84	MS-17	CC&A	7		Jul-75	Rotary Wash	330 lb/24" and/or 140 lb/30" (SPT)	89	0.0	SFCD	11.3	7.0	4.3	17.5	60.0	83.0	-6.2	-48.7	-71.7	17.5	42.5	
85	MS-17	CC&A	8		Jul-75	Rotary Wash	330 lb/24" and/or 140 lb/30" (SPT)	94	0.0	SFCD	11.3			24.8	65.0	93.0	-13.4	-53.7	-81.7	24.8	40.3	
86	MS-17	CC&A	9		Jul-75	Rotary Wash	330 lb/24" and/or 140 lb/30" (SPT)	114	0.0	SFCD	11.3			24.0	65.5	111.0	-12.7	-54.2	-99.7	24.0	41.5	
87	MS-17	CC&A	10		Jul-75	Rotary Wash	330 lb/24" and/or 140 lb/30" (SPT)	82	-1.0	SFCD	10.3	7.0	3.3	21.0	74.0	75.5	-10.7	-63.7	-65.2	21.0	53.0	
88	MS-17	CC&A	11		Jul-75	Rotary Wash	330 lb/24" and/or 140 lb/30" (SPT)	107	-1.0	SFCD	10.3			46.0	67.0	104.0	-35.7	-56.7	-93.7	46.0	21.0	
89	MS-17	CC&A	12		Jul-75	Rotary Wash	330 lb/24" and/or 140 lb/30" (SPT)	103.5	0.0	SFCD	11.3	8.5	2.8	36.0	64.5	99.0	-24.7	-53.2	-87.7	36.0	28.5	
90	MS-17	CC&A	13		Jul-75	Rotary Wash	330 lb/24" and/or 140 lb/30" (SPT)	48	2.0	SFCD	13.3	7.5	5.8	21.0	43.0	43.0	-7.7	-29.7	-29.7	21.0	22.0	
91	MS-17	CC&A	14		Jul-75	Rotary Wash	330 lb/24" and/or 140 lb/30" (SPT)	37.5	2.0	SFCD	13.3			17.0	31.0	31.0	-3.7	-17.7	-17.7	17.0	14.0	
92	MS-17	CC&A	15/15A		Jul-75	Rotary Wash	330 lb/24" and/or 140 lb/30" (SPT)	77	0.0	SFCD	11.3			39.0	60.0	71.5	-27.7	-48.7	-60.2	39.0	21.0	
93	MS-17	CC&A	16		Jul-75	Rotary Wash	330 lb/24" and/or 140 lb/30" (SPT)	70	0.0	SFCD	11.3			37.0	54.0	64.0	-25.7	-42.7	-52.7	37.0	17.0	
94	MS-17	CC&A	17		Jul-75	Rotary Wash	330 lb/24" and/or 140 lb/30" (SPT)	30	2.0	SFCD	13.3					14.5			-1.2	14.5	0.0	
95	MS-18	GTC	B-132		12/7/1954	Rotary Wash		160	10.7	CHC	10.4			61.0	138.0	154.0	-50.6	-127.6	-143.6	61.0	77.0	
96	MS-18	GTC	B-4		11/6/1954	Rotary Wash		165	9.5	CHC	9.2			9.5	132.5		-0.3	-123.3		9.5	123.0	
97	MS-18	GTC	B-157			Rotary Wash		211	10.3	CHC	10.0			40.0	132.0	210.0	-30.0	-122.0	-200.0	40.0	92.0	
98	MS-18	GTC	B-139		12/8/195?	Rotary Wash		198	9.6	CHC	9.3			39.5	110.5	206.5	-30.2	-101.2	-197.2	39.5	71.0	
99	MS-18	GTC	B-165		6/8/5?	Rotary Wash		265	10.8	CHC	10.5			38.5	115.5	252.5	-28.0	-105.0	-242.0	38.5	77.0	
100	MS-18	GTC	B-168		6/??/1954	Rotary Wash		245	10.3	CHC	10.0			41.0	111.0	246.0	-31.0	-101.0	-236.0	41.0	70.0	
101	MS-18	GTC	B-151		2/23/1958	Rotary Wash		219	11.5	CHC	11.2			31.5	117.5	216.5	-20.3	-106.3	-205.3	31.5	86.0	
102	MS-18	GTC	B-170		???	Rotary Wash		270	12.1	CHC	11.8			42.0	122.0	264.0	-30.2	-110.2	-252.2	42.0	80.0	
103	MS-18	GTC	B-166		6/8/1955	Rotary Wash		265	10.1	CHC	9.8			31.0	112.0	249.0	-21.2	-102.2	-239.2	31.0	81.0	
104	MS-18	GTC	B-167		6/10/1955	Rotary Wash		253	11.0	CHC	10.7			39.0	123.0	251.0	-28.3	-112.3	-240.3	39.0	84.0	
105	MS-18	GTC	B-171		6/21/165?	Rotary Wash		225	9.2	CHC	8.9			28.0	115.0	224.0	-19.1	-106.1	-215.1	28.0	87.0	
106	MS-18	GTC	B-158		2/17/1955	Rotary Wash		225	10.5	CHC	10.2			26.5	120.5	220.5	-16.3	-110.3	-210.3	26.5	94.0	
107	MS-18	GTC	B-160		3/29/1955	Rotary Wash		222	10.6	CHC	10.3			54.5	116.5	219.5	-44.2	-106.2	-209.2	54.5	62.0	
108	MS-18	GTC	B-169		6/15/1955	Rotary Wash		214	10.2	CHC	9.9			18.0	117.0	211.0	-8.1	-107.1	-201.1	18.0	99.0	
109	MS-18	GTC	B-161		4/4/1955	Rotary Wash		196	10.6	CHC	10.3			47.5	116.5	192.5	-37.2	-106.2	-182.2	47.5	69.0	
110	MS-18	GTC	B-163		4/11/1955	Rotary Wash		178	10.7	CHC	10.4			40.5	130.0	176.5	-30.1	-119.6	-166.1	40.5	89.5	
111	MS-18	GTC	B-162		4/7/1955	Rotary Wash		150	10.8	CHC	10.5			48.0	124.0	148.0	-37.5	-113.5	-137.5	48.0	76.0	not on boring location maps
112	MS-18	GTC	B-17		11/14/1952	Rotary Wash		130	10.6	CHC	10.3			36.5	105.0	129.5	-26.2	-94.7	-119.2	36.5	68.5	not on boring location maps
113	MS-18	GTC	B-164		4/12/1955	Rotary Wash		152	10.3	CHC	10.0			27.0	123.0	147.0	-17.0	-113.0	-137.0	27.0	96.0	not on boring location maps
114	MS-18	GTC/D&M	S-702-3	7/7/1964	7/7/1964	Rotary Wash		181.5	8.0	MSL	10.7			45.0	115.0		-34.3	-104.3		45.0	70.0	
115	MS-18	GTC/D&M	S-702-4	7/10/1964	7/10/1964	Rotary Wash		181	8.0	MSL	10.7			42.0	120.0		-31.3	-109.3		42.0	78.0	
532	MS-19	HLA	Boring 1	1/4/1982	1/4/1982	Rotary Wash		88	0.0	SFCD	11.3			28.0	59.0	80.0	-16.7	-47.7	-68.7	20.0	31.0	
533	MS-19	HLA	Boring 2	1/4/1982	1/4/1982	Rotary Wash		53	0.0	SFCD	11.3			14.0	48.0	48.0	-2.7	-36.7	-36.7	14.0	34.0	
534	MS-19	HLA	Boring 3	12/22/1981	12/22/1981	Rotary Wash		40	1.0	SFCD	12.3			14.0	22.5	39.0	-1.7	-10.2	-26.7	14.0	8.5	
535	MS-19	HLA	Boring 4	12/23/1981	12/23/1981	Rotary Wash		52	1.5	SFCD	12.8			13.5	23.0	51.5	-0.7	-10.2	-38.7	13.5	9.5	
536	MS-19	HLA	Boring 5	12/23/1981	12/23/1981	Rotary Wash		5	9.5	SFCD	20.8					0.0			20.8	0.0	0.0	
700	MS-21	Schlocker								MSL						-4.0			-1.3			
701	MS-21	Schlocker								MSL						-13.0			-10.3			

Record No	Report ID	Company	Boring ID	Date Drilling Started	Date Drilling Finished	Drilling Method	Hammer Type	Boring Depth (feet)	Ground Surface Elevation (feet)	Datum	Ground Surface Elevation (feet, NAVD88)	Ground - water Depth (feet)	Ground-water Elevation (feet, NAVD88)	Depth to Top of Young Bay Mud (feet)	Depth to Bottom of Young Bay Mud (feet)	Depth to Top of Bedrock (feet)	Elevation of Top of Young Bay Mud (feet, NAVD88)	Elevation of Bottom of Young Bay Mud (feet, NAVD88)	Elevation to Top of Bedrock (feet, NAVD88)	Thickness of Artificial Fill (feet)	Thickness of Young Bay Mud (feet)	Comments
702	MS-21	Schlocker								MSL						-8.0			-5.3			
703	MS-21	Schlocker								MSL						-13.0			-10.3			
704	MS-21	Schlocker								MSL						-33.0			-30.3			
705	MS-21	Schlocker								MSL						-15.0			-12.3			
706	MS-21	Schlocker								MSL						-1.0			1.7			
707	MS-21	Schlocker								MSL						4.0			6.7			
708	MS-21	Schlocker								MSL						-42.0			-39.3			
709	MS-21	Schlocker								MSL						-40.0			-37.3			
710	MS-21	Schlocker								MSL						-36.0			-33.3			
711	MS-21	Schlocker								MSL						-3.0			-0.3			
712	MS-21	Schlocker								MSL						-11.0			-8.3			
713	MS-21	Schlocker								MSL						-56.0			-53.3			
714	MS-21	Schlocker								MSL						36.0			38.7			
715	MS-21	Schlocker								MSL						-46.0			-43.3			
716	MS-21	Schlocker								MSL						-236.0			-233.3			
717	MS-21	Schlocker								MSL						-165.0			-162.3			
718	MS-21	Schlocker								MSL						-161.0			-158.3			
719	MS-21	Schlocker								MSL						-213.0			-210.3			
720	MS-21	Schlocker								MSL						-206.0			-203.3			
721	MS-21	Schlocker								MSL						-232.0			-229.3			
722	MS-21	Schlocker								MSL						-277.0			-274.3			
723	MS-21	Schlocker								MSL						-255.0			-252.3			
724	MS-21	Schlocker								MSL						-265.0			-262.3			
725	MS-21	Schlocker								MSL						-240.0			-237.3			
726	MS-21	Schlocker								MSL						-146.0			-143.3			
727	MS-21	Schlocker								MSL						-155.0			-152.3			
728	MS-21	Schlocker								MSL						-124.0			-121.3			
729	MS-21	Schlocker								MSL						-166.0			-163.3			
730	MS-21	Schlocker								MSL						-125.0			-122.3			
731	MS-21	Schlocker								MSL						-81.0			-78.3			
732	MS-21	Schlocker								MSL						-98.0			-95.3			
733	MS-21	Schlocker								MSL						-132.0			-129.3			
734	MS-21	Schlocker								MSL						-109.0			-106.3			
735	MS-21	Schlocker								MSL						-86.0			-83.3			
736	MS-21	Schlocker								MSL						15.0			17.7			
737	MS-21	Schlocker								MSL						-34.0			-31.3			
738	MS-21	Schlocker								MSL						40.0			42.7			
739	MS-21	Schlocker								MSL						33.0			35.7			
740	MS-21	Schlocker								MSL						29.0			31.7			
741	MS-21	Schlocker								MSL						-90.0			-87.3			
742	MS-21	Schlocker								MSL						-65.0			-62.3			
743	MS-21	Schlocker								MSL						43.0			45.7			
744	MS-21	Schlocker								MSL						-163.0			-160.3			
745	MS-21	Schlocker								MSL						-225.0			-222.3			
746	MS-21	Schlocker								MSL						-164.0			-161.3			
747	MS-21	Schlocker								MSL						-114.0			-111.3			
748	MS-21	Schlocker								MSL						-259.0			-256.3			
749	MS-21	Schlocker								MSL						-219.0			-216.3			
750	MS-21	Schlocker								MSL						-185.0			-182.3			
751	MS-21	Schlocker								MSL						-152.0			-149.3			
752	MS-21	Schlocker								MSL						-178.0			-175.3			
753	MS-21	Schlocker								MSL						-137.0			-134.3			
754	MS-21	Schlocker								MSL						-157.0			-154.3			
755	MS-21	Schlocker								MSL						-84.0			-81.3			
756	MS-21	Schlocker								MSL						25.0			27.7			
757	MS-21	Schlocker								MSL						-45.0			-42.3			

Record No	Report ID	Company	Boring ID	Date Drilling Started	Date Drilling Finished	Drilling Method	Hammer Type	Boring Depth (feet)	Ground Surface Elevation (feet)	Datum	Ground Surface Elevation (feet, NAVD88)	Ground - water Depth (feet)	Ground- water Elevation (feet, NAVD88)	Depth to Top of Young Bay Mud (feet)	Depth to Bottom of Young Bay Mud (feet)	Depth to Top of Bedrock (feet)	Elevation of Top of Young Bay Mud (feet, NAVD88)	Elevation of Bottom of Young Bay Mud (feet, NAVD88)	Elevation to Top of Bedrock (feet, NAVD88)	Thickness of Artificial Fill (feet)	Thickness of Young Bay Mud (feet)	Comments
758	MS-21	Schlocker								MSL						-88.0			-85.3			
759	MS-21	Schlocker								MSL						-136.0			-133.3			
760	MS-21	Schlocker								MSL						-15.0			-12.3			
761	MS-21	Schlocker								MSL						-15.0			-12.3			
762	MS-21	Schlocker								MSL						-17.0			-14.3			
763	MS-21	Schlocker								MSL						-88.0			-85.3			
764	MS-21	Schlocker								MSL						-54.0			-51.3			
765	MS-21	Schlocker								MSL						31.0			33.7			
766	MS-21	Schlocker								MSL						-34.0			-31.3			
767	MS-21	Schlocker								MSL						-5.0			-2.3			
768	MS-21	Schlocker								MSL						-33.0			-30.3			
769	MS-21	Schlocker								MSL						-13.0			-10.3			
800	MS-21	Schlocker	contour pnt							MSL						0.0			2.7			
801	MS-21	Schlocker	contour pnt							MSL						0.0			2.7			
802	MS-21	Schlocker	contour pnt							MSL						0.0			2.7			
803	MS-21	Schlocker	contour pnt							MSL						0.0			2.7			
804	MS-21	Schlocker	contour pnt							MSL						0.0			2.7			
805	MS-21	Schlocker	contour pnt							MSL						0.0			2.7			
806	MS-21	Schlocker	contour pnt							MSL						0.0			2.7			
807	MS-21	Schlocker	contour pnt							MSL						0.0			2.7			
808	MS-21	Schlocker	contour pnt							MSL						0.0			2.7			
809	MS-21	Schlocker	contour pnt							MSL						0.0			2.7			
810	MS-21	Schlocker	contour pnt							MSL						0.0			2.7			
811	MS-21	Schlocker	contour pnt							MSL						0.0			2.7			
812	MS-21	Schlocker	contour pnt							MSL						0.0			2.7			
813	MS-21	Schlocker	contour pnt							MSL						0.0			2.7			
814	MS-21	Schlocker	contour pnt							MSL						0.0			2.7			
815	MS-21	Schlocker	contour pnt							MSL						0.0			2.7			
816	MS-21	Schlocker	contour pnt							MSL						0.0			2.7			
817	MS-21	Schlocker	contour pnt							MSL						0.0			2.7			
818	MS-21	Schlocker	contour pnt							MSL						0.0			2.7			
819	MS-21	Schlocker	contour pnt							MSL						0.0			2.7			
820	MS-21	Schlocker	contour pnt							MSL						0.0			2.7			
821	MS-21	Schlocker	contour pnt							MSL						0.0			2.7			
822	MS-21	Schlocker	contour pnt							MSL						0.0			2.7			

Record No	Report ID	Company	Boring ID	Date Drilling Started	Date Drilling Finished	Drilling Method	Hammer Type	Boring Depth (feet)	Ground Surface Elevation (feet)	Datum	Ground Surface Elevation (feet, NAVD88)	Ground - water Depth (feet)	Ground-water Elevation (feet, NAVD88)	Depth to Top of Young Bay Mud (feet)	Depth to Bottom of Young Bay Mud (feet)	Depth to Top of Bedrock (feet)	Elevation of Top of Young Bay Mud (feet, NAVD88)	Elevation of Bottom of Young Bay Mud (feet, NAVD88)	Elevation to Top of Bedrock (feet, NAVD88)	Thickness of Artificial Fill (feet)	Thickness of Young Bay Mud (feet)	Comments
823	MS-21	Schlocker	contour pnt							MSL						0.0			2.7			
824	MS-21	Schlocker	contour pnt							MSL						-100.0			-97.3			
825	MS-21	Schlocker	contour pnt							MSL						-100.0			-97.3			
826	MS-21	Schlocker	contour pnt							MSL						-100.0			-97.3			
827	MS-21	Schlocker	contour pnt							MSL						-50.0			-47.3			
828	MS-21	Schlocker	contour pnt							MSL						-50.0			-47.3			
829	MS-21	Schlocker	contour pnt							MSL						-50.0			-47.3			
830	MS-21	Schlocker	contour pnt							MSL						-50.0			-47.3			
831	MS-21	Schlocker	contour pnt							MSL						-50.0			-47.3			
832	MS-21	Schlocker	contour pnt							MSL						-100.0			-97.3			

4. Structural Research, Data Collection and Synthesis

GHD, Inc. (GHD) performed the structural research, data collection and synthesis for Phase 1 of this study.

4.1 General

This study section presents the structural research, data collection and data synthesis needed for subsequent structural analysis and/or assessment of the various seawall structures.

The structural research consisted of obtaining, reviewing and organizing available design drawings applicable to the seawall sections applicable to this study. Drawings were provided by the Port and/or obtained from the JV database. The various drawings applicable to this study were organized by seawall section, reviewed for data applicable to the structural work of this study, and missing data were identified.

Various types of data needed for various aspects of the structural analysis were collected. The types of data collected for each seawall section were divided by seawall section component, namely, rock dike, bulkhead, marginal wharf and f inger pier. T he rock dike represents a common component that has geotechnical and structural implications. The bulkheads will be assessed for their stability and structural capacity in Phase 2 of the study. The marginal wharf and f inger pier structures will be assessed to ascertain their contribution to design basis load resistance of the bulkhead and to provide structural capacity limits for use in damage assessments of these substructures and their supported buildings.

Data for these component structures were further divided to specific line items including, but not limited to, the following:

1. Rock dike
   - Height and width of rock dike
   - Bayside slope of rock dike
   - Rock dike elevation at face of seawall
2. Bulkhead Wall (or Bulkhead)
   - Type of bulkhead (e.g., concrete cutoff wall, concrete bulkhead wall, timber lagging wall)
   - Height of wall above dike
   - Wall thickness
   - Details of supporting piles, if any
   - Details of bulkhead wing walls, if any
3. Marginal wharf
   - Wharf plan dimensions
   - Bulkhead wharf building plan dimensions
   - Supporting pile details (e.g., type, size, reinforcing, spacing, lengths)
4. Finger piers
   - Pier plan dimensions
   - Transit shed plan dimensions
   - Supporting pile details (e.g., type, size, reinforcing, spacing, lengths)

The Seawall was originally constructed in 24 Sections (FW, B, A, 1, 2, 3, 4, 5, 6, 7, 8a, 8b, 8, 9a, 9b, 9, 10, 11, 11a, 12, 13, 13a, 46b, and 3rd St) and generally consisted of the Rock Dike, Bulkheads, Wharves and The Embarcadero Fill. Over the years, many of the original Bulkheads and Wharves have been replaced and some have been substantially modified or demolished. The current configuration of bulkheads and wharves is complex and includes at least 40 different types. In some cases, the current bulkheads span over the original Seawall Sections. Some bulkheads are the same type, or similar enough to be considered the same, representing at least thirty-three distinctly different seawall structure configurations, plus additional seawall structure modifications that have occurred. Such structural revisions have, or may have, occurred at Pier 43.5, Pier 27-29, Pier 15 and 17, the Ferry Plaza, the Brannan Street Wharf (old Piers 34 and 36), the seawall along the original Piers 42 through 46, and along the seawall fronting AT&T Park and Promenade.

The waterfront construction components are described as follows:

- **Rock Dike** – generally consists of rock revetment constructed in a trench approximately 100 feet wide, with rock dike height up to 40 feet. Rock dike bayside slopes vary from 4H:1V to 1H:1V. Rock dike slopes may have significant variation within a given seawall section and may have changed over time.
- **Bulkhead Wall (or Bulkhead)** – generally consists of timber or concrete cut-off walls or unreinforced concrete bulkhead walls. Bulkheads are generally constructed on top of the rock dike and may or may not be pile supported. The Bulkheads function as retaining walls, as shoreline protection within the tidal and wave zone, and often as structural support for the marginal wharves.
- **Marginal Wharf (or Bulkhead Wharf, or Wharf)** – generally consists of timber or reinforced concrete substructures with timber, reinforced concrete piles or cylinders.
- **Finger Pier** – generally consists of timber or reinforced concrete substructures with timber, reinforced concrete piles or cylinders.

Waterfront structural improvements since the original construction consist of:

- Pier 43.5 Promenade – reinforced concrete promenade substructure, additional revetment, new reinforced concrete seawall retaining wall structure.
- Pier 27-29 seismic retrofit – seismic retrofit of original batter piles, addition of seismic joint in pier deck, no known modifications to original seawall.
- Pier 15-17 seismic retrofit – seismic retrofit of Piers 15 and 17 substructure, data not available or not yet assimilated.
- Ferry Plaza seismic retrofit – seismic retrofit of original batter piles, no known modifications to original seawall.
- Brannan Street Wharf – demolition of existing marginal wharf and Pier 36, seismic separation of BSW structure from existing seawall.
- AT&T Park and Promenade – data not available or not yet assimilated.

The original dates of construction range from 1878 to 1931. Generally, materials of construction are not shown on the record drawings. Where needed for this study, concrete material strength data will be based on typical values applicable to the time of construction, namely:

1. design concrete 28-day compression strength of 5,000 psi
2. design concrete reinforcing steel yield strength of 33,000 psi.
3. design timber pile (Douglas Fir equivalent), fy (bending) = 1,800 psi

Figure 4-1 summarizes the data obtained for the various seawall structural types. The summary is sorted by original seawall section and structure type, with data listed for the rock dike, bulkhead, marginal wharfs and finger piers. The individual blocks are color-coded to represent the data item status (green for data in-hand through red for data not present). Where data is in-hand, the data value is indicated in the block. Finally, the summary data is used to ascertain seawall sections and/or types that appear to be structurally similar. This is represented by the structural group ID color-coded in blue and pink. Presently, Figure 1 indicates sixteen distinct structural groups for subsequent structural assessment. This delineation may be revised as the project team revises and makes subsequent use of these data.

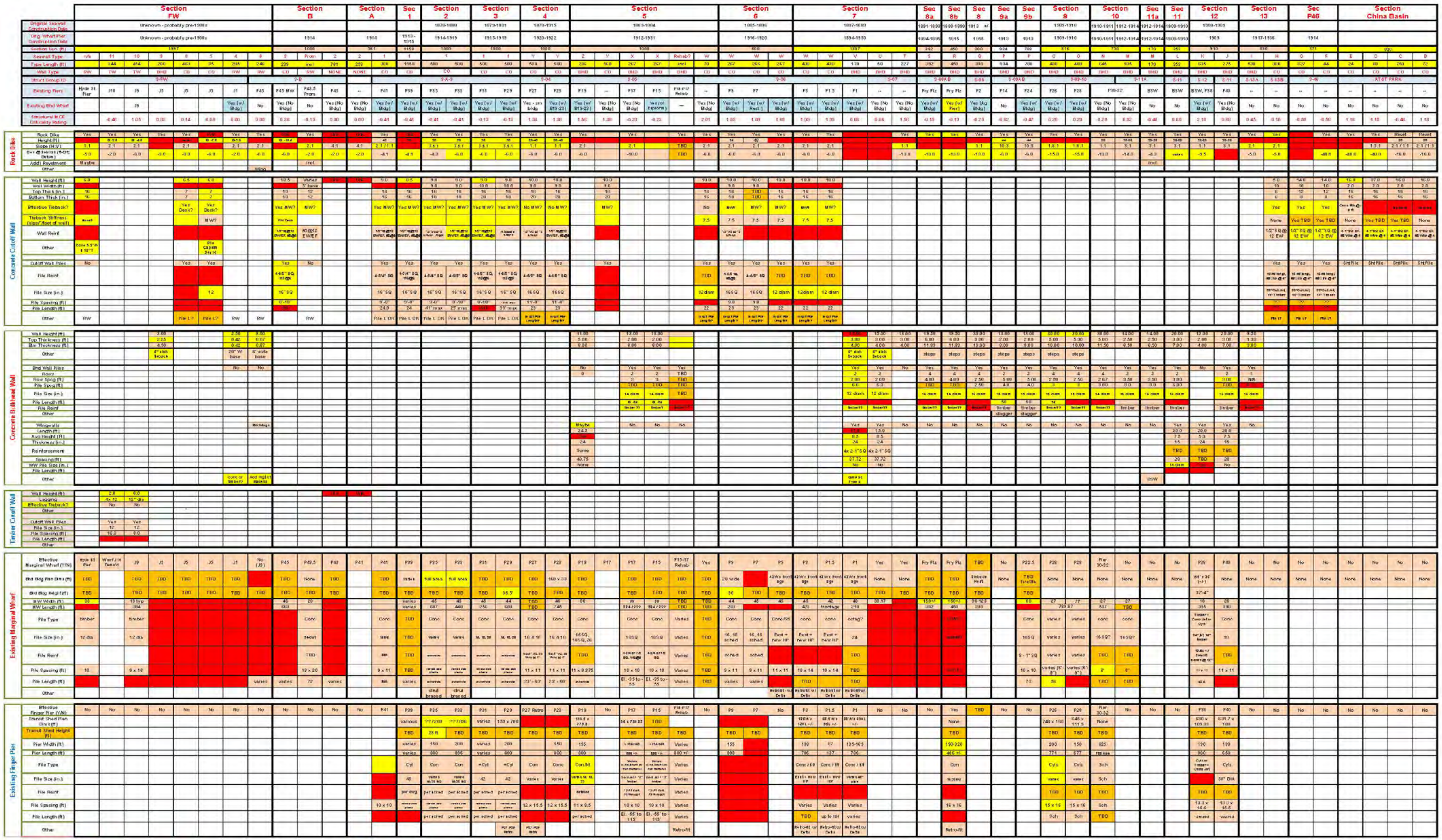


Figure 4-1: Seawall Structural Data Register

4.2 Section FW – 1460 Feet Between Hyde and Taylor Streets (Fisherman's Wharf)

Description

Seawall Section FW consists of at least six different original types of seawall construction, Types 4, 5, 8, 9, 10 and 11, and form the east and south sides of the Fishermans Wharf harbor. Seawall Type 4 is adjacent to and aligned along Taylor Street between Jefferson Street and the Embarcadero. Seawall Types 5, 8, and 9 are adjacent to and aligned along Jefferson Street between Taylor Street and Jones Street. Seawall Types 10 and 11 form the bulkhead walls for Wharf J9 and J10, respectively.

Drawings

The POSF drawing revised in 1973, 10079-403to410-4, Details 4, 5, 8, 9, 10 and 11 indicate the original seawall construction for this wall section. These seawall Types 4, 5, 8, 9, 10 and 11 are shown on Figures 4-2 through 4-7.

Technical Reports

None.

Section Seawall Data Summary

According to record drawings in our possession, seawall Type 4 originally sat on a rock dike or revetment of unknown material, height with a bayside slope of 2.0H:1.0V. This section of seawall originally consisted of a concrete cutoff wall of unknown height and thickness. The cutoff wall height and thickness scales to about 2 feet and 5 inches, respectively. The cutoff wall base is indicated as "wood mud sill" and no supporting piles are indicated. The top Elevation of the rock dike is presumed to be at Elevation -2.0 feet (City Datum). The length of seawall Type 4 is estimated to be about 260 feet.

According to record drawings in our possession, seawall Type 5 originally sat on a rock dike or revetment of unknown material, height, width and bayside slope. This section of seawall originally consisted of a concrete cutoff wall, about 6 feet high, of unknown thickness, supported on a rectangular grade beam of unknown cross-sectional dimension which is supported on piles of unknown material, size, length and spacing. The cutoff wall thickness scales to about 6 inches and the grade beam cross-section scales to about 16 inches high by 24 inches wide. The pile dimension scales to about 12 inches. The length of seawall Type 5 is estimated to be about 45 feet.

According to record drawings in our possession, seawall Type 8 originally sat on a rock dike or revetment of unknown material, height and width with a bayside slope of 2H:1V. This section of seawall originally consisted of a concrete cutoff wall, about 6.5 feet high and 7 inches thick, supported on a square grade beam which is supported on piles of unknown material, size, length and spacing. The grade beam cross-section scales to about 18 inches square. The pile dimension scales to about 12 inches. The length of seawall Type 8 is estimated to be about 425 feet.

According to record drawings in our possession, seawall Type 9 originally sat on a rock dike or revetment of unknown material, height, width and bayside slope. This section of seawall originally consisted of a concrete bulkhead wall, about 3 feet high with an unknown top thickness and a bottom thickness of 4'-6". No supporting piles are indicated. The length of seawall Type 9 is estimated to be about 20 feet.

Seawall Type 10 fronts Wharf J9. According to record drawings in our possession, seawall Type 10 originally sat on a rock dike or revetment of unknown material, height, width and bayside slope. The slope shown scales to about 2H:1V. This section of seawall originally consisted of a timber pile and timber lagging wall, about 6 feet high with "wood sheet piling" as lagging. Other drawings show this lagging to be four 12-inch diameter logs. Timber piles are indicated as 12-inch diameter and of unknown length. The length of seawall Type 10 is estimated to be about 375 feet.

Seawall Type 11 fronts Wharf J10. According to record drawings in our possession, seawall Type 11 originally sat on a rock dike or revetment of unknown material, height and width with a bayside slope of 2H:1V. This section of seawall originally consisted of a timber pile and timber plank lagging wall, about 2 feet high. Other drawings show this lagging to be 4x12 redwood planks. Timber piles are indicated as 12-inch diameter and of unknown length. The length of seawall Type 11 is estimated to be about 340 feet.

Section Marginal Wharf Data Summary

Equivalent marginal wharf structures may exist along all six seawall types. With the exception of seawall Types 10 and 11 (Wharf J9 and J10), marginal wharf data is not presently in our possession for any of these wharf locations.

Wharf J9 (Seawall Type 10) functions as a marginal wharf. This wharf has timber piles and pile bents spaced at 16 feet centers. There are typically four 12-inch diameter timber piles per bent spaced at 9 feet. The pile lengths are unknown.

Wharf J10 (Seawall Type 11) functions as a marginal wharf. This wharf has timber piles and pile bents spaced at 10 feet centers. There are typically six 12-inch diameter timber piles per bent spaced at 10 feet maximum. The pile lengths are unknown.

Section Finger Pier Data Summary

There are no existing finger piers in this seawall section.

Section Structural Data Gaps

- Rock dike or revetment material, height, width, and bayside slope
- Seawall Type 4 cutoff wall height, thickness, reinforcing if any, and material strength data
- Seawall Type 5 cutoff wall thickness, grade beam and pile dimensions, reinforcing if any, and material strength data
- Seawall Type 8 grade beam and supporting pile dimensions, reinforcing if any, and material strength data
- Seawall Type 9 bulkhead wall top thickness, reinforcing if any, and material strength data
- “Marginal” wharf supporting pile data, pile type, size, reinforcement, spacing and length, and material strength data for seawall Types 4, 5, 8 and 9; supporting pile length and material strength data for seawall Types 10 and 11..
- Finger pier data: not needed.

If data is not available, data will be assumed based on seawall sections of similar construction period and design.

Assumed Data for Data Gaps

Unless revised by additional data, the following will be assumed for data gaps applicable to this seawall section:

1. Concrete material strength data will be based on typical values applicable to the time of construction, i.e., design concrete strength of 5,000 psi and reinforcing yield strength of 33,000 psi.
2. Timber material will be assumed to be equivalent to structural grade Douglas Fir.
3. Rock dike will be assumed to not control the structural capacity of the seawall.

4. Seawall supporting piles will be assumed to be 12-inch diameter timber piles, longitudinally spaced at 8 feet centers, and of sufficient length to not control seismic stability of the seawall.
5. Marginal wharf supporting pile data: per adjacent sections commensurate with time of construction, pile lengths assumed sufficient to accommodate lateral load demands.

Other

A site visit may be warranted to confirm missing data. U se of a P ort boat and operator should be requested for this activity.

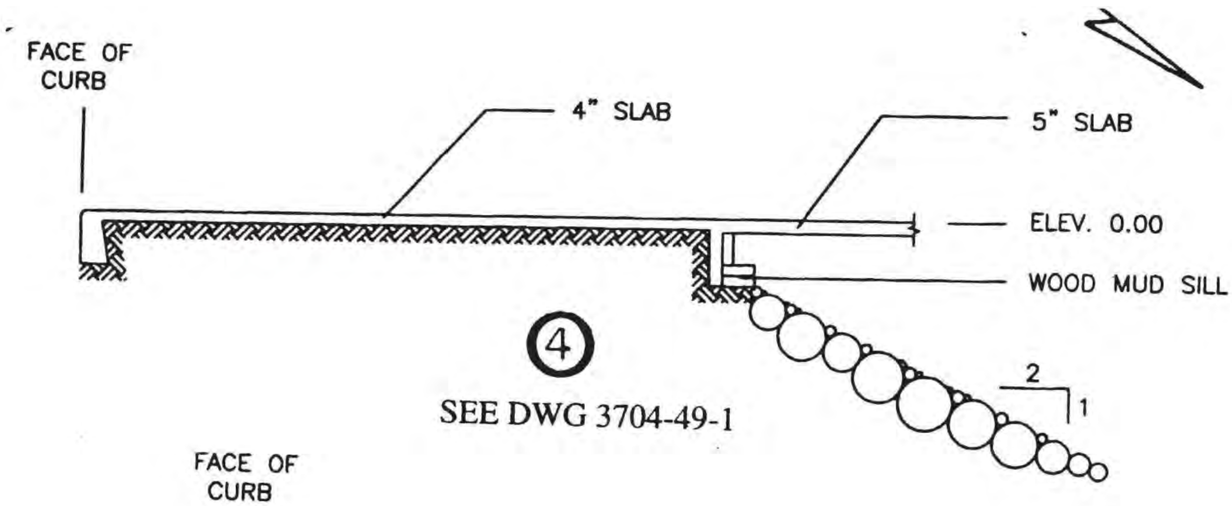


Figure 4-2: Seawall Section FW - Seawall Type 4

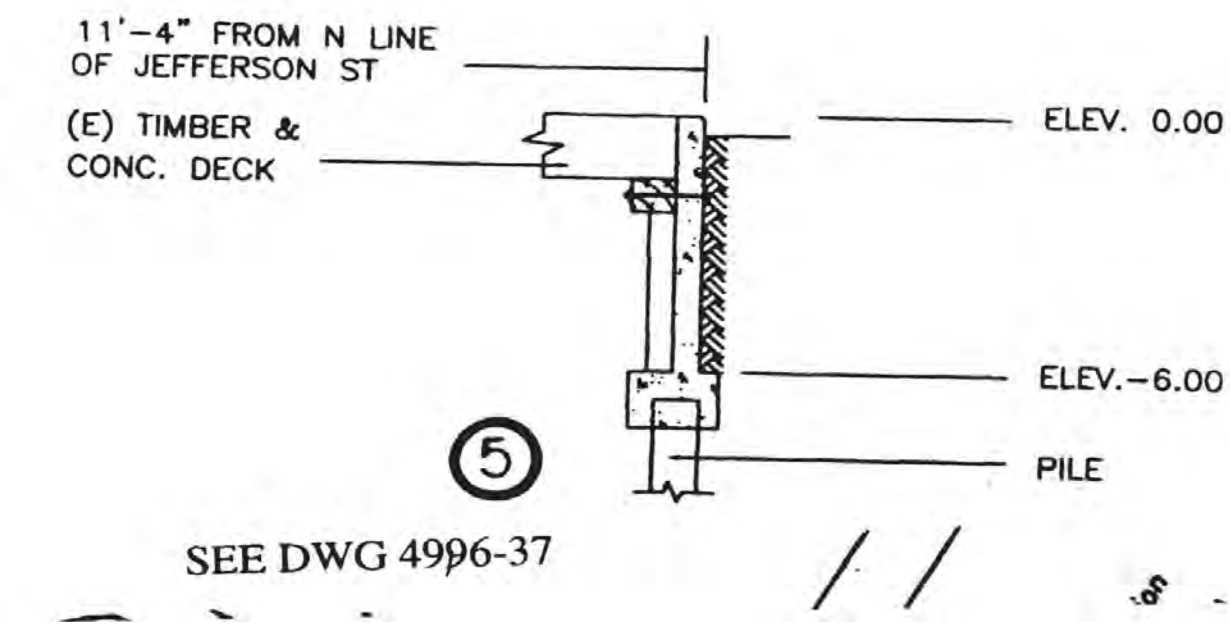


Figure 4-3: Seawall Section FW - Seawall Types 5

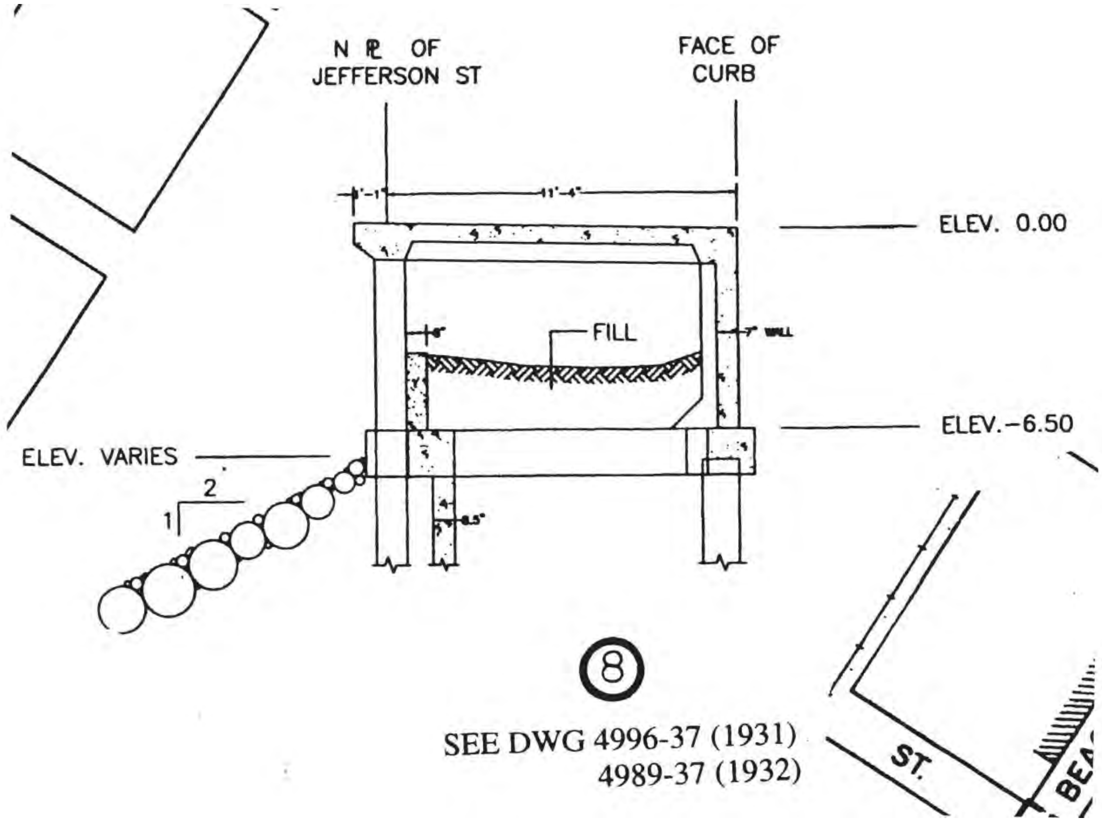


Figure 4-4: Seawall Section FW - Seawall Types 8

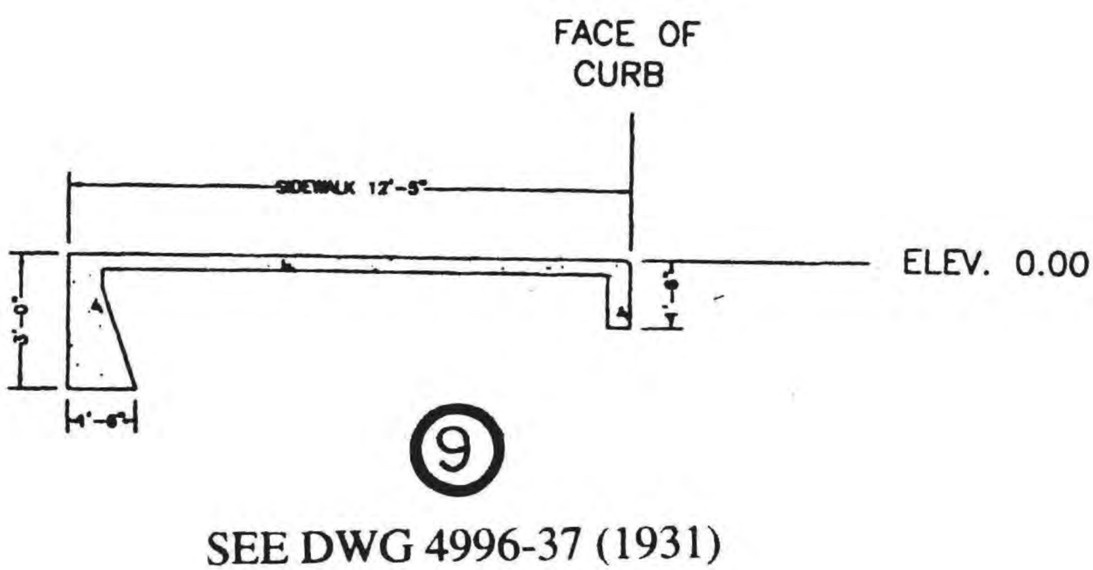


Figure 4-5: Seawall Section FW - Seawall Types 9

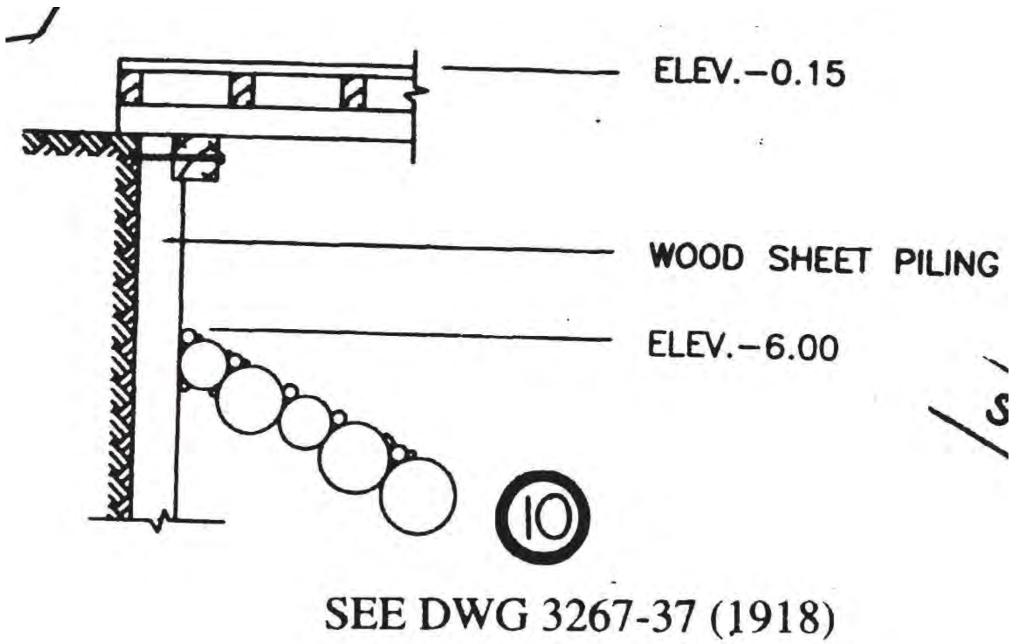


Figure 4-6: Seawall Section FW - Seawall Types 10

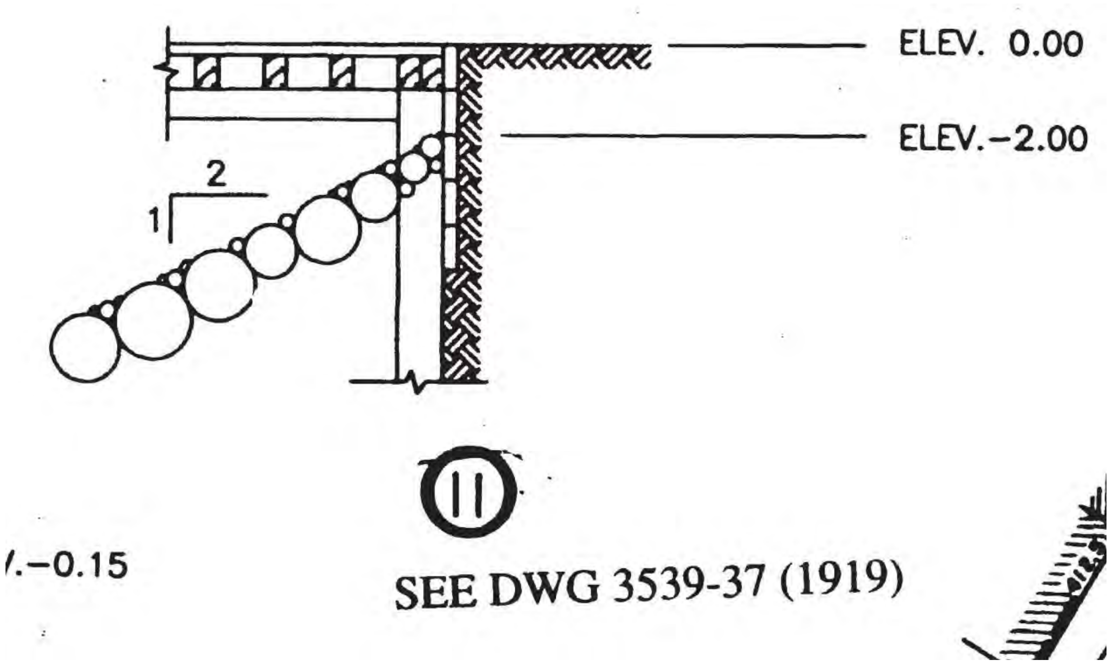


Figure 4-7: Seawall Section FW - Seawall Types 11

4.3 Section B – 1000 Feet Between Taylor and Powell Streets (Piers 43, 43.5 45)

Description

Seawall Section B originally consisted of three types of seawall, designated Types 6, 3 and 2 on the original construction drawings. These seawall types consist of a concrete cutoff and concrete bulkhead walls. The seawall fronts Pier 45, the Pier 45 marginal wharf, the relatively new Pier 43.5 promenade, and what remains of Pier 43.

Pier 43.5 was partially demolished and a new promenade structure constructed in its place in 2011. This upgrade project may have resulted in a seismic separation of the new substructures from the seawall structure in this seawall section.

What remains of Pier 43 remains as in its original condition.

Drawings

The POSF drawing revised in 1973, 10079-403to410-4, Details 2, 3, and 6 indicate the original seawall construction for this wall section. These seawall Types 2, 3 and 6 are shown on Figures 4-8 through 4-10. The Pier 43.5 Promenade seawall is shown on Figure 4-11.

Technical Reports

None.

Section Seawall Data Summary

According to record drawings in our possession, this section of seawall originally sat on a rock dike of undocumented height for the most part with an estimated bayside slope varying from 2H:1V to 4H:1V. The 2011 Pier 43.5 promenade construction resulted in additional revetment added to the seawall at this location.

This section of seawall originally consisted of three types of seawall, designated Types 6, 3, and 2 on the original construction drawings.

The Type 6 seawall fronts most of the width of Pier 45 which is now a rock filled pier. The unique construction of Pier 45 probably was intended to serve as a breakwater for the Fishermans Wharf harbor and the Hyde Street Pier beyond. The Type 6 seawall consists of a concrete wing-braced retaining wall, stem height and thickness unknown and a base width of 6 feet and unknown thickness. Unknown thicknesses may be on the order of 8 inches. The spacing, size and thickness of the wing braces are not indicated. Since this seawall is now faced with fill on both sides of the seawall, the seawall performance is deemed structurally ineffective and not significant to this study.

The Type 3 seawall fronts a portion of Pier 45 and the marginal wharf between Pier 45 and Pier 43.5. This Type 3 seawall consists of a pre-cast concrete cutoff wall of unknown height and thickness, presumably supported on piles of unknown type, size, spacing and length.

The Type 2 seawall originally fronted Piers 43.5 and 43 with the wharf timber deck founded on the rock dike. Present evidence suggests that a timber retaining wall was added later but this addition is deemed to be non-structural and most of it was removed as a part of the Pier 43.5 promenade development.

The Pier 43.5 Promenade seawall was rebuilt in 2011 and consists of a relatively short un-piled reinforced concrete retaining wall structure founded on additional revetment.

Section Marginal Wharf Data Summary

No effective marginal wharf presently exists at Piers 45.

The Pier 43.5 promenade consists of pre-cast pre-stressed concrete piles of varying spacing and length. What is left of the original Pier 43.5 and Pier 43 consists of timber piles at varying diameter and spacing, and of unknown length.

Data for the marginal wharf pile data at Pier 41 are not presently in our possession.

Section Finger Pier Data Summary

Data for the Pier 41 pile data are not presently in our possession. There are no other effective finger piers in this seawall section.

Section Structural Data Gaps

- Existing rock dike or revetment height, width and bayside slope other than that in our possession for Pier 43.5 promenade.
- Type 6 seawall data: not needed.
- Type 3 (if still present at this seawall section): cutoff wall height, thickness, supporting pile type, size, reinforcing, spacing and length, and material strength data.
- Type 2 (if still present at this seawall section): not needed.
- Seawall Type 1 supporting piles, including type, size, reinforcement, spacing, length and material strength data.
- Pier 43 marginal wharf pile data: pile type, size, spacing and length, and material strength data
- Pier 43 finger pier pile data: pile type, size, spacing and length, and material strength data.

Assumed Data for Data Gaps

Unless revised by additional data, the following will be assumed for data gaps applicable to this seawall section:

1. Concrete material strength data will be based on typical values applicable to the time of construction, i.e., design concrete strength of 5,000 psi and reinforcing yield strength of 33,000 psi.
2. Rock dike constructed width at base will be based on dike height of 30 feet height, slope of 2H:1V.
3. Type 6 seawall: not needed.
4. Type 3 seawall: TBD.
5. Type 2 seawall: TBD.
6. Type 1 seawall supporting pile data: per adjacent sections commensurate with time of construction, pile lengths sufficient to accommodate lateral load demands.
7. Pier 43 marginal wharf supporting pile data: per adjacent sections commensurate with time of construction, pile lengths sufficient to accommodate lateral load demands.
8. Pier 43 supporting pile data: per adjacent sections commensurate with time of construction, pile lengths sufficient to accommodate lateral load demands.

Other

A site visit is warranted to confirm missing data. Use of a Port boat and operator should be requested for this activity.

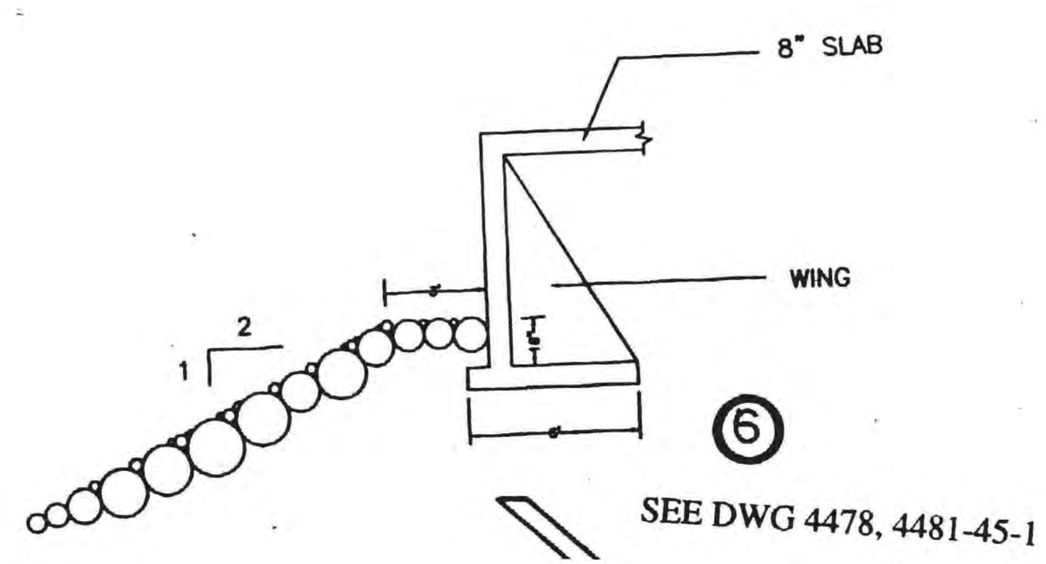


Figure 4-8: Seawall Section B - Seawall Types 6

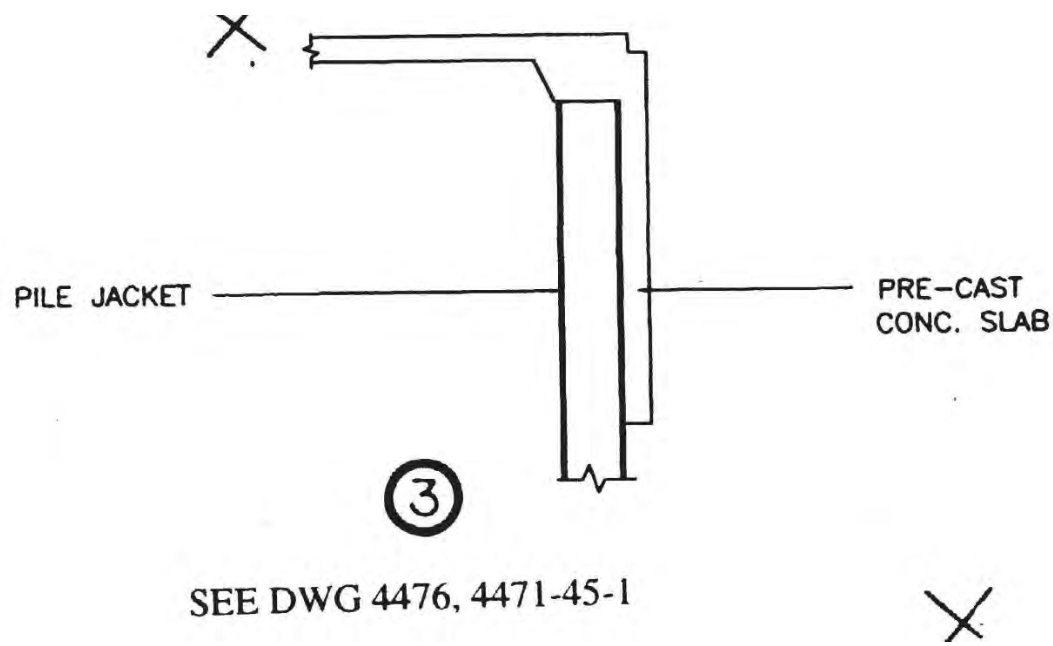


Figure 4-9: Seawall Section B - Seawall Types 3

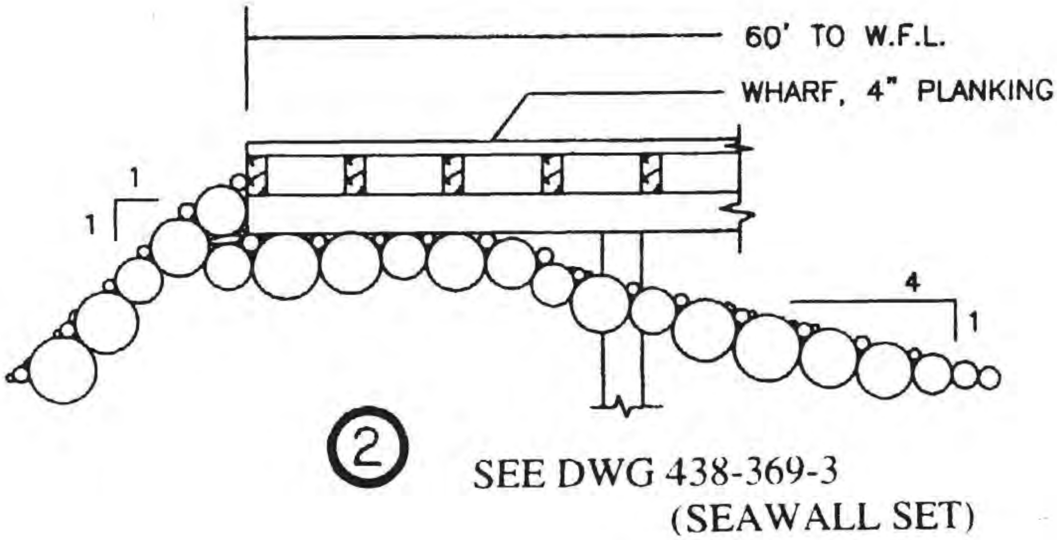


Figure 4-10: Seawall Section B - Seawall Types 2

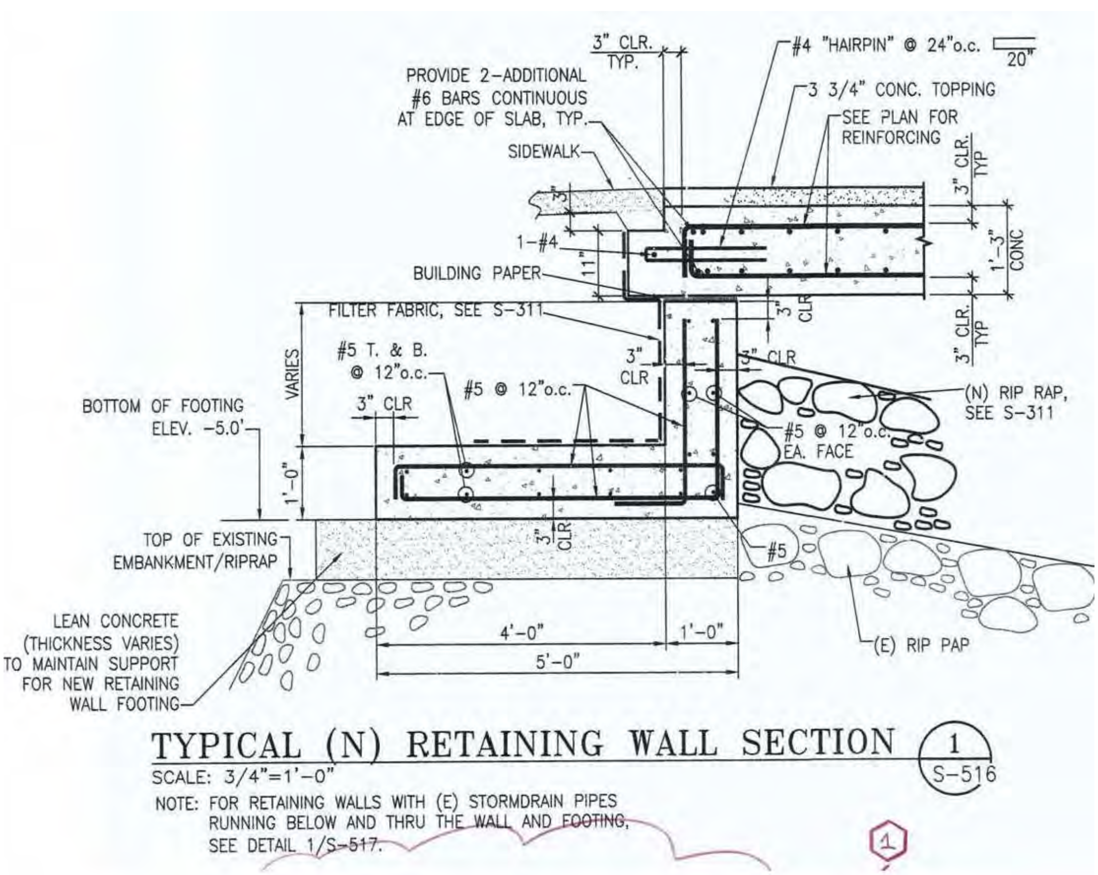


Figure 4-11: Seawall Section B – Pier 43.5 Promenade Seawall

4.4 Section A – 561 Feet Between Powell and Stockton Streets (Pier 41)

Description

Seawall Section A originally consisted of one type of seawall, designated Type 1 on the original construction drawings. This seawall type consists of a concrete cutoff wall about 8.5 feet high from top of rock dike to bottom of wharf deck. The seawall fronts a m arginal wharf and ex isting Pier 41 substructures.

Drawings

The POSF drawing revised in 1973, 10079-403to410-4, Detail 1, indicates the original seawall construction for this wall section. This seawall Type 1 is shown on Figure 4-12.

Technical Reports

None.

Section Seawall Data Summary

According to record drawings in our possession, this section of seawall originally sat on a rock dike 30 to 40 feet high with an estimated bayside slope of 1.0H:1.0V.

This section of seawall originally consisted of one type of seawall, designated Type 1 on the original construction drawings. This seawall type is an 18-inch thick concrete cutoff wall about 9 feet high from top of rock dike to bottom of wharf deck. Supporting piles are not indicated but based on a djacent sections, are assumed to be present at 9 feet spacing.

Section Marginal Wharf Data Summary

A marginal wharf with assumed width of about 44 feet exists at this seawall section. The Pier 41 marginal wharf is supported by 16-inch square concrete piles, 5.5 ft by 9.5 ft pile spacing with four longitudinal ¾" or 7/8" square reinforcing bars in accordance with a record drawing pile schedule. Pile length data are not available.

Section Finger Pier Data Summary

Pier 41 is located in this seawall section.

Pier 41 is probably supported by timber piles at 10 foot spacing each way. Pile size and length data are not available.

Section Structural Data Gaps

- Rock dike constructed width at base.
- Seawall Type 1 supporting piles, including type, size, reinforcement, spacing, length and material strength data.
- Marginal wharf pile lengths and material strength data.
- Pier 41 pile type, size, reinforcement (if concrete), length and material strength data.

If data is not available, data will be assumed based on seawall sections of similar construction period and design.

Assumed Data for Data Gaps

Unless revised by additional data, the following will be assumed for data gaps applicable to this seawall section:

1) Concrete material strength data will be based on typical values applicable to the time of construction, i.e., design concrete strength of 5,000 psi and reinforcing yield strength of 33,000 psi.
2) Rock dike constructed width at base will be based on dike height of 30 feet height, slope of 1.0H:1V.
3) Seawall supporting pile data: per adjacent sections commensurate with time of construction, pile lengths sufficient to accommodate lateral load demands.
4) Marginal wharf supporting pile data: per adjacent sections commensurate with time of construction, pile lengths sufficient to accommodate lateral load demands.
5) Pier 41 supporting pile data: per adjacent sections commensurate with time of construction, pile lengths sufficient to accommodate lateral load demands.

Other

A site visit is warranted to confirm missing data. Use of a Port boat and operator should be requested for this activity.

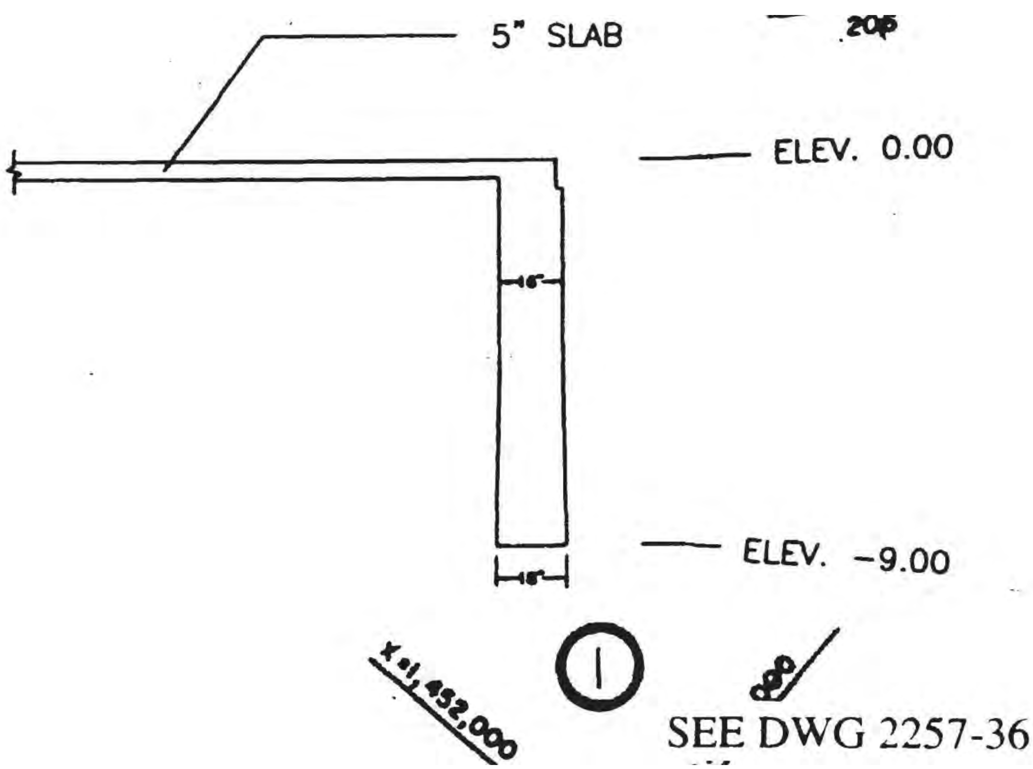


Figure 4-12: Seawall Section B through 3 Seawall Type 1

4.5 Section 1 – 1000 Feet Between Stockton and Kearney Streets (Pier 39)

Description

Seawall Section 1 originally consisted of one type of seawall, designated Type 1 on the original construction drawings. This seawall type consists of a concrete cutoff wall about 8.5 feet high from top of rock dike to bottom of wharf deck. The seawall fronts a marginal wharf and existing Pier 39 substructures.

Drawings

The POSF drawing revised in 1973, 10079-403to410-4, Detail 1, indicates the original seawall construction for this wall section. This seawall Type 1 is shown on Figure 4-12.

Technical Reports

None.

Section Seawall Data Summary

No information on the original rock dike construction for this seawall section is presently in our possession.

According to record drawings in our possession, this section of seawall originally consisted of one type of seawall, designated Type 1 on the original construction drawings. Contrary to the generic Type 1 cutoff wall structure, other record drawings indicate that this cutoff wall is a 16-inch thick concrete cutoff wall about 8.5 feet high from top of rock dike to bottom of wharf deck. Piles are not indicated but based on adjacent sections, are assumed to be present at 9 feet spacing.

Section Marginal Wharf Data Summary

A marginal wharf with assumed width of 44 to 46 feet exists at this seawall section. Details of the marginal wharf piling are not in our possession.

Section Finger Pier Data Summary

Pier 39 is located in this seawall section.

Pier 39 is supported by circular concrete piles. Pile sizes, spacing, length and reinforcement data are not in our possession.

Section Structural Data Gaps

- Rock dike constructed height and width at base, constructed bayside slope.
- Seawall Type 1 supporting piles, including type, size, reinforcement, spacing , length and material strength data.
- Marginal wharf pile size, reinforcement, spacing, length and material strength data.
- Pier 39 wharf pile size, reinforcement, spacing, length and material strength data.

If data is not available, data will be assumed based on seawall sections of similar construction period and design.

Assumed Data for Data Gaps

Unless revised by additional data, the following will be assumed for data gaps applicable to this seawall section:

1. Concrete material strength data will be based on typical values applicable to the time of construction, i.e., design concrete strength of 5,000 psi and reinforcing yield strength of 33,000 psi.
2. Rock dike constructed width at base will be based on dike height of 30 feet height, slope of 1.0H:1V.

3. Seawall supporting pile data: per adjacent sections commensurate with time of construction, pile lengths sufficient to accommodate lateral load demands.
4. Marginal wharf supporting pile data: per adjacent sections commensurate with time of construction, pile lengths sufficient to accommodate lateral load demands.
5. Pier 39 supporting pile data: per adjacent sections commensurate with time of construction, pile lengths sufficient to accommodate lateral load demands.

Other

A site visit is warranted to confirm missing data. Use of a Port boat and operator should be requested for this activity.

4.6 Section 2 – 1000 Feet Between North Point and Francisco Streets

Description

Seawall Section 2 originally consisted of one type of seawall, designated Type 1 on the original construction drawings. This seawall type consists of a concrete cutoff wall about 9 feet high from top of rock dike to bottom of wharf deck. The seawall fronts a marginal wharf and existing Piers 35 and 33 substructures.

Drawings

The POSF drawing revised in 1973, 10079-403to410-4, Detail 1, indicates the original seawall construction for this wall section. This seawall Type 1 is shown on Figure 4-12.

Technical Reports

None.

Section Seawall Data Summary

According to record drawings in our possession, this section of seawall originally sat on a rock dike 30 to 40 feet high with an estimated bayside slope of 3.5H:1.0V.

This section of seawall originally consisted of one type of seawall, designated Type 1 on the original construction drawings. This cutoff wall is an 18-inch thick concrete cutoff wall about 9 feet high from top of rock dike to bottom of wharf deck. Piles are not indicated but based on adjacent sections, are assumed to be present at 9 feet spacing.

Section Marginal Wharf Data Summary

A marginal wharf with assumed width of 44 to 46 feet exists at this seawall section. The wharf is supported by square concrete piles of varying size in accordance with record drawing pile schedules. Pile spacing and length data are not available.

Section Finger Pier Data Summary

Pier 35 is located in this seawall section.

Pier 35 is supported by square concrete piles of varying size in accordance with record drawing pile schedules. Pile spacing and length data are not available.

Section Structural Data Gaps

- Rock dike constructed width at base.
- Seawall Type 1 supporting piles, including type, spacing, .size, reinforcement and material strength data.
- Marginal wharf pile spacing, length, and material strength data.
- Pier 35 pile spacing, length and material strength data.

If data is not available, data will be assumed based on seawall sections of similar construction period and design.

Assumed Data for Data Gaps

Unless revised by additional data, the following will be assumed for data gaps applicable to this seawall section:

1. Concrete material strength data will be based on typical values applicable to the time of construction, i.e., design concrete strength of 5,000 psi and reinforcing yield strength of 33,000 psi.

2. Rock dike constructed width at base will be based on dike height of 30 feet height, slope of 3.5H or 1.0H:1V, as appropriate.
3. Seawall supporting pile data: per adjacent sections commensurate with time of construction, pile lengths sufficient to accommodate lateral load demands.
4. Marginal wharf supporting pile data: per adjacent sections commensurate with time of construction, pile lengths sufficient to accommodate lateral load demands.
5. Pier 35 supporting pile data: per adjacent sections commensurate with time of construction, pile lengths sufficient to accommodate lateral load demands.

4.7 Section 3 – 1000 Feet Between Francisco and Lombard Streets

Description

Seawall Section 3 originally consisted of one type of seawall, designated Type 1 on the original construction drawings. This seawall type consists of a concrete cutoff wall about 9 feet high from top of rock dike to bottom of wharf deck. The seawall fronts a marginal wharf and existing Piers 31 and 29 substructures.

Drawings

The POSF drawing revised in 1973, 10079-403to410-4, Details Y and 1, indicate the original seawall construction for this wall section. Seawall types applicable to this seawall section are Types 1, shown on Figure 4-12.

Technical Reports

None.

Section Seawall Data Summary

According to record drawings in our possession, this section of seawall originally sat on a rock dike 30 to 40 feet high with an estimated bayside slope varying from 2H:1V to 3.5H:1.0V.

This section of seawall originally consisted of one type of seawall, designated Type 1 on the original construction drawings.

The Type 1 cutoff wall is an 18-inch thick concrete cutoff wall about 9 feet high from top of rock dike to bottom of wharf deck. Piles are not indicated but based on adjacent sections, are assumed to be present at 9 feet spacing.

Section Marginal Wharf Data Summary

A marginal wharf with assumed width of 44 to 46 feet exists at this seawall section. The wharf is supported by square concrete piles of varying size in accordance with record drawing pile schedules. Pile spacing and length data are not available.

Section Finger Pier Data Summary

Piers 29 and 31 are located in this seawall section.

Both piers are supported by 42-inch diameter cylinders and square concrete piles of varying size in accordance with record drawing pile schedules. Pile spacing and length data are not available.

Section Structural Data Gaps

- Rock dike constructed width at base.
- Seawall Type 1 supporting piles, including type, spacing, .size, reinforcement and material strength data.
- Marginal wharf pile spacing, length, and material strength data.
- Pier 35 pile spacing, length and material strength data.

If data is not available, data will be assumed based on seawall sections of similar construction period and design.

Assumed Data for Data Gaps

Unless revised by additional data, the following will be assumed for data gaps applicable to this seawall section:

1. Concrete material strength data will be based on typical values applicable to the time of construction, i.e., design concrete strength of 5,000 psi and reinforcing yield strength of 33,000 psi.
2. Rock dike constructed width at base will be based on dike height of 30 feet height, slope of 2H:1V, top of dike Elevation -6.0 feet (City Datum)..
3. Seawall supporting pile data: per adjacent sections commensurate with time of construction, pile lengths sufficient to accommodate lateral load demands.
4. Marginal wharf supporting pile data: per adjacent sections commensurate with time of construction, pile lengths sufficient to accommodate lateral load demands.
5. Piers 29 and 31 supporting pile data: per adjacent sections commensurate with time of construction, pile lengths sufficient to accommodate lateral load demands.

4.8 Section 4 – 1000 Feet Between Lombard and Union Streets

Description

Seawall Section 4 originally consisted of two types of seawall, designated Types Y and Z on the original construction drawings. These seawall types consist of a concrete cutoff and concrete bulkhead walls. The seawall fronts a marginal wharf and existing Piers 27, 23 and 19 substructures.

The seismic retrofit of Pier 27 in the 1990s resulted in a seismic separation of the substructure from the seawall structure in this seawall section.

Drawings

The POSF drawing revised in 1973, 10079-403to410-4, Details Y and Z, indicates the original seawall construction for this wall section. The seawall Types Y and Z are shown on Figures 4-13 and 4-14.

Technical Reports

None.

Section Seawall Data Summary

According to record drawings in our possession, this section of seawall originally sat on a rock dike 30 to 40 feet high with an estimated bayside slope of 3.5H:1.0V. However, Pier 27 record drawings indicate a steeper rock dike bayside slope of 1V:1H.

This section of seawall originally consisted of two types of seawall, designated Type Y and Z on the original construction drawings.

The Type Y seawall is a 16-inch thick concrete cutoff wall, increasing to 18-inch thick at the pile support, 10 feet high from top of rock dike to bottom of wharf deck. The cutoff wall is braced to the marginal wharf deck at 9-feet spacing. Piles are indicated as “Type A” piles, 16-inch square concrete, 23 feet long, with four-5/8” longitudinal reinforcing bars.

The Type Z seawall is a pile-supported concrete bulkhead wall 11 feet high with unknown wall top and bottom thicknesses. No supporting piles are indicated.

Section Marginal Wharf Data Summary

A marginal wharf 46 feet wide exists at this seawall section. The marginal wharf is supported by square concrete piles of varying size in accordance with record drawing pile schedules. Pile size, spacing and length data are not available for the marginal wharf at Piers 19 and 23.

We have no data in our possession for the Pier 23 marginal wharf piles.

The Pier 27 marginal wharf is supported by 16-inch square concrete piles at 11-feet spacing each way with record drawing pile schedules. Pile spacing and length data are not available.

Section Finger Pier Data Summary

Piers 19, 23 and 27 are located in this seawall section. Pier 27 is part of the combined Pier 27-29 complex.

Pier 19 is supported by square concrete piles of varying size in accordance with record drawing pile schedules. Pile spacing and length data are not available.

We have no data in our possession for the Pier 23 finger pier piles.

Pier 27 is supported by 18-inch square concrete plumb piles at 12-feet by 15.5 ft spacing and 20-inch square concrete batter piles. Batter pile connections were seismically retrofitted in 1995. Pile length data are not available.

Section Structural Data Gaps

- Rock dike constructed width at base.
- Seawall Type Y –pile material strength data.
- Seawall Type Z –bulkhead wall thickness and material strength data.
- Marginal wharf pile size, spacing, length, and material strength data.
- Pier 19 pile length and material strength data.
- Pier 23 all pier pile data (type, size, reinforcement, spacing, length and material strength).
- Pier 27 pile length and material strength data.

If data is not available, data will be assumed based on seawall sections of similar construction period and design.

Assumed Data for Data Gaps

Unless revised by additional data, the following will be assumed for data gaps applicable to this seawall section:

1. Concrete material strength data will be based on typical values applicable to the time of construction, i.e., design concrete strength of 5,000 psi and reinforcing yield strength of 33,000 psi.
2. Rock dike constructed width at base will be based on dike height of 20 feet height, slope of 3.5H or 1.0H:1V, as appropriate.
3. Seawall supporting pile data: per adjacent sections commensurate with time of construction, pile lengths sufficient to accommodate lateral load demands.
4. Seawall Type Z bulkhead wall top and bottom wall thickness the same as Type X with no supporting piles.
5. Marginal wharf supporting pile data: per adjacent sections commensurate with time of construction, pile lengths sufficient to accommodate lateral load demands.
6. Piers 19, 23 and 27 supporting pile data: per adjacent sections commensurate with time of construction, pile lengths sufficient to accommodate lateral load demands.

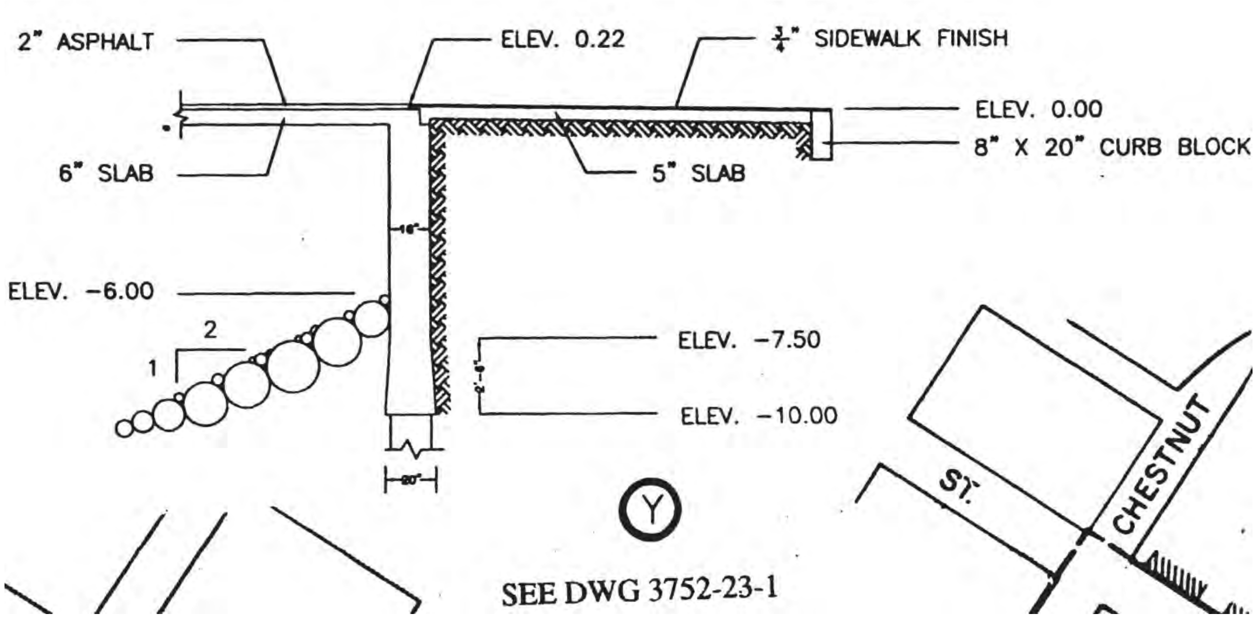


Figure 4-13: Seawall Sections 3 Through 5: Seawall Type Y

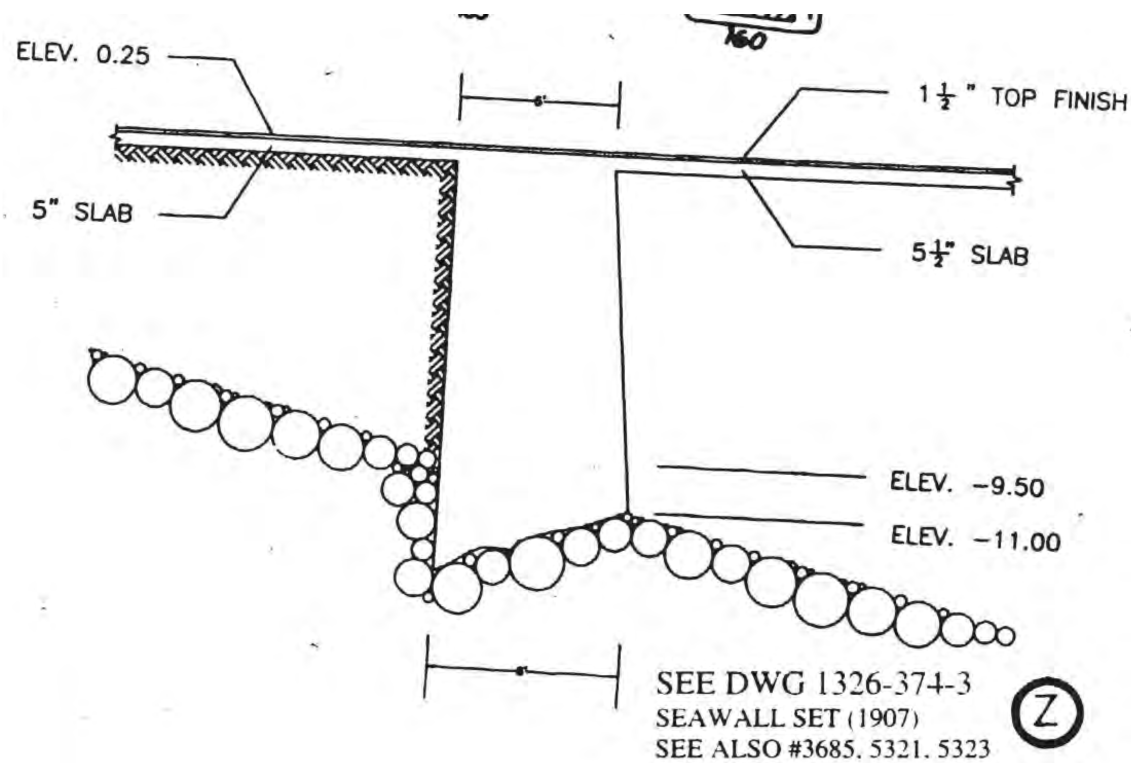


Figure 4-14: Seawall Section 5: Seawall Type Z

4.9 Section 5 – 1000 Feet Between Union and Vallejo Streets

Description

Seawall Section 5 originally consisted of two types of seawall, designated Types X and W on the original construction drawings. These seawall types consist of a concrete cutoff and concrete bulkhead walls. The seawall fronts a marginal wharf and existing Piers 17 and 15 substructures.

The seismic retrofit of Piers 15-17 as a part of the Exploratorium seismic upgrades in the 2000s may have resulted in a seismic separation of the substructures from the seawall structure in this seawall section.

Drawings

The POSF drawing revised in 1973, 10079-403to410-4, Details X and W, indicates the original seawall construction for this wall section. Seawall types applicable to this seawall section are Types X and W shown on Figure 4-15 and 4-16.

Technical Reports

None.

Section Seawall Data Summary

According to record drawings in our possession, this section of seawall originally sat on a rock dike of unknown height with an estimated bayside slope of 2H:1V.

This section of seawall originally consisted of two types of seawall, designated Types X, and W on the original construction drawings.

The Type X seawall is a pile-supported concrete bulkhead wall 13 feet high with an estimated top and bottom wall thickness of 2 feet and 6 feet, respectively. Two rows of supporting piles are indicated but all other supporting pile data is presently unavailable to us.

The Type W cutoff wall is a 16-inch thick concrete cutoff wall about 10 feet high from top of rock dike to bottom of wharf deck. Piles are indicated and, based on adjacent sections, are assumed to be 12-inch square concrete piles with four 5/8-inch longitudinal reinforcing bars. Piles are assumed to be 32 feet long. Pile spacing is not indicated.

Section Marginal Wharf Data Summary

A marginal wharf at least 40 feet wide exists at this seawall section. The Pier 17 marginal wharf may have been supported by square concrete piles on 10 feet by 10 feet spacing. The Pier 15 marginal wharf may have been supported by concrete jacketed timber piles on 10 feet by 9.5 feet spacing. Pile length and reinforcement data are not available for the marginal wharf at Piers 15 and 27.

Section Finger Pier Data Summary

Piers 15 and 17 are located in this seawall section. These piers were seismically retrofitted for the Exploratorium project in 2010.

Both piers may have been supported by concrete jacketed timber piles. The Pier 17 pile spacing was originally 10 feet by 10 feet spacing. The Pier 15 pile spacing was originally 10 feet by 9.5 feet spacing. Pile length and reinforcement data are not available for these finger pier piles.

Section Structural Data Gaps

- Rock dike constructed height and width at base.
- Seawall Type X –bulkhead wall supporting pile type, size, spacing, length and material strength data.
- Seawall Type W supporting pile spacing, length and material strength data.

- Marginal wharf pile size, length, and material strength data.
- Piers 15 and 17 pile size, length, and material strength data.

If data is not available, data will be assumed based on seawall sections of similar construction period and design.

Assumed Data for Data Gaps

Unless revised by additional data, the following will be assumed for data gaps applicable to this seawall section:

1. Concrete material strength data will be based on typical values applicable to the time of construction, i.e., design concrete strength of 5,000 psi and reinforcing yield strength of 33,000 psi.
2. Rock dike constructed height and width at base will be based on dike height of 20 feet height, slope of 2H:1V.
3. Seawall Type X and W supporting pile data: per adjacent sections commensurate with time of construction, pile lengths sufficient to accommodate lateral load demands.
4. Marginal wharf supporting pile data: per adjacent sections commensurate with time of construction, pile lengths sufficient to accommodate lateral load demands.
5. Piers 15 and 17 supporting pile data: per adjacent sections commensurate with time of construction, pile lengths sufficient to accommodate lateral load demands.

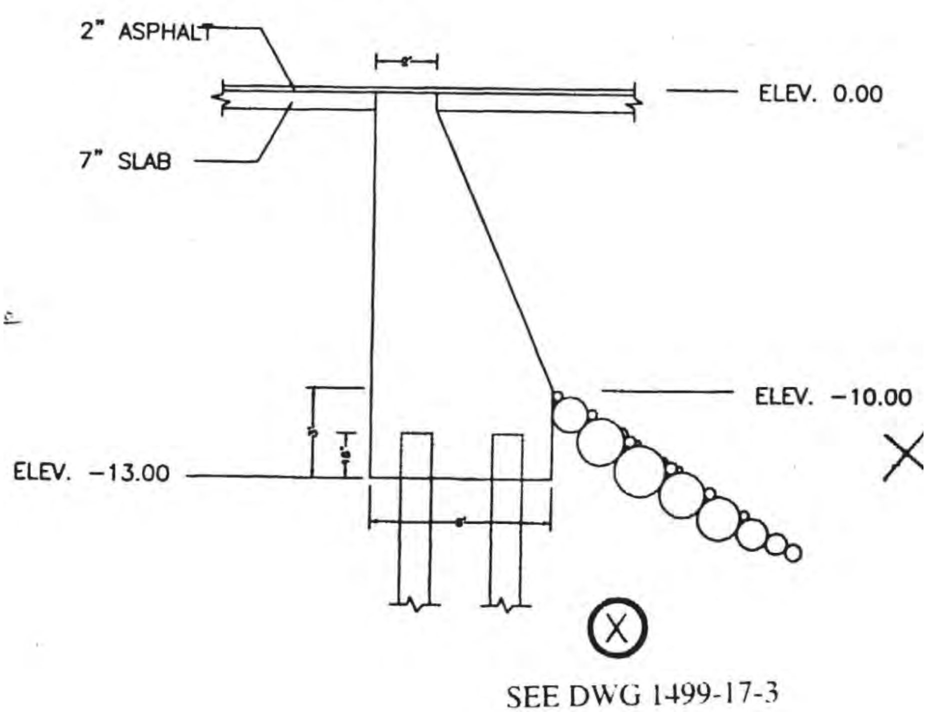


Figure 4-15: Seawall Section 5: Seawall Type X

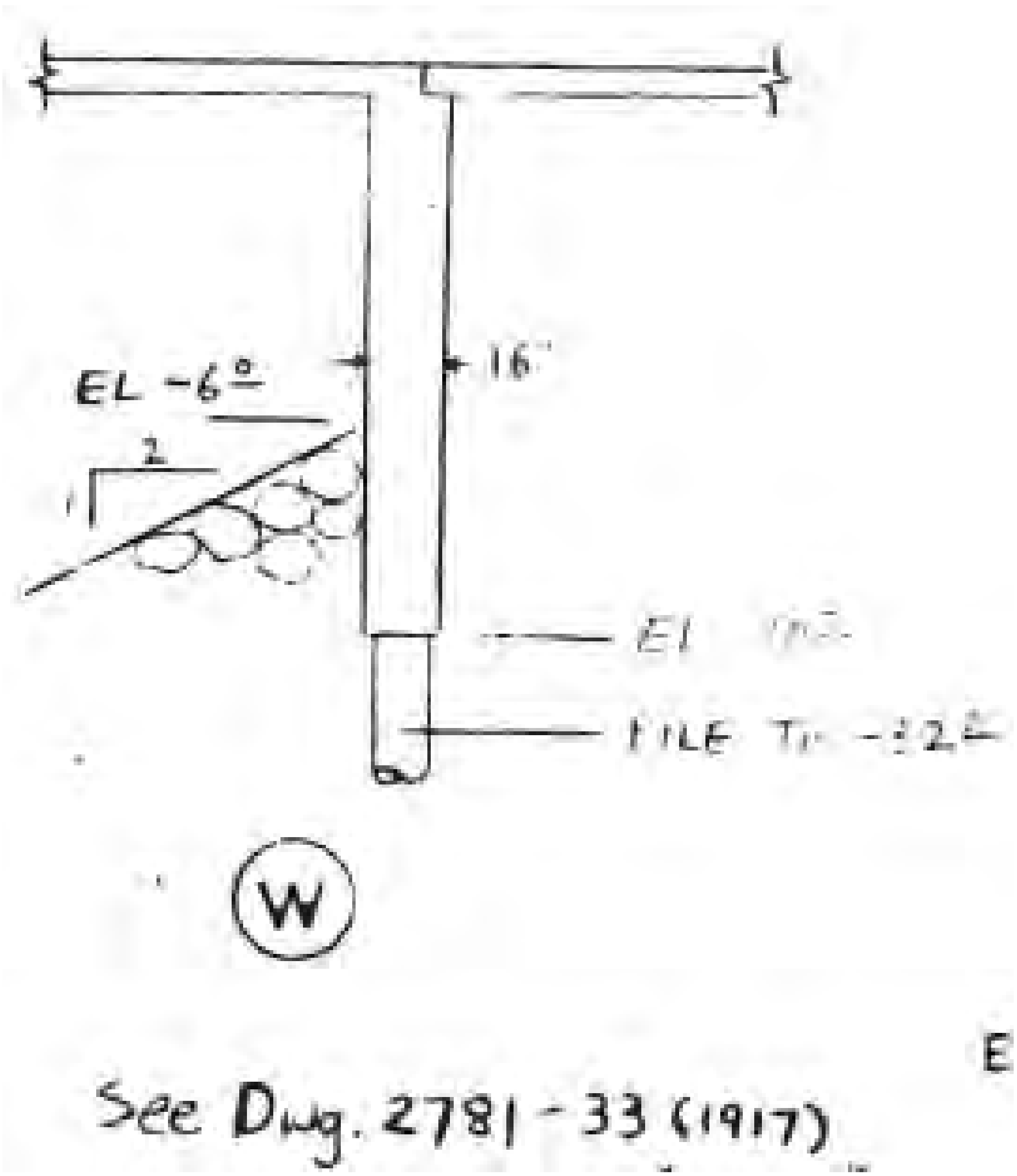


Figure 4-16: Seawall Sections 6 and 7: Seawall Type W

4.10 Section 6 – 800 Feet Between Vallejo and Pacific Streets

Description

Seawall Section 6 originally consisted of one type of seawall, designated Type W on the original construction drawings. This seawall type consisted of a concrete cutoff wall 10 feet high. The seawall fronts a marginal wharf and existing Piers 9 and 7 substructures.

Drawings

The POSF drawing revised in 1973, 10079-403to410-4, Detail W, indicates the original seawall construction for this wall section. This seawall Type W is shown on Figure 4-16.

Technical Reports

None.

Section Seawall Data Summary

According to record drawings in our possession, this section of seawall originally sat on a rock dike with an estimated bayside slope of 2H:1V. The rock elevation on the seawall is purported to be at Elevation -6.0 feet (City Datum). There is presently no data available to us regarding the height of the rock dike.

This section of seawall originally consisted of one type of seawall, designated Type W on the original construction drawings. This cutoff wall is a 16-inch thick concrete cutoff wall about 10 feet high from top of rock dike to bottom of wharf deck. Piles are indicated and, based on adjacent sections, are assumed to be 12-inch square concrete piles with four 5/8-inch longitudinal reinforcing bars. Piles are assumed to be 32 feet long. Pile spacing is not indicated.

Section Marginal Wharf Data Summary

There is presently no data available to us for the marginal wharf located in this seawall section.

Section Finger Pier Data Summary

Piers 7 and 9 are located in this seawall section.

There is presently no data available to us for the finger piers located in this seawall section.

Section Structural Data Gaps

- Rock dike constructed height and width at base.
- Seawall Type W supporting pile spacing, length and material strength data.
- Marginal wharf pile size, reinforcement, spacing, length and material strength data.
- Piers 7 and 9 pile size, reinforcement, spacing, length and material strength data.

If data is not available, data will be assumed based on seawall sections of similar construction period and design.

Assumed Data for Data Gaps

Unless revised by additional data, the following will be assumed for data gaps applicable to this seawall section:

1. Concrete material strength data will be based on typical values applicable to the time of construction, i.e., design concrete strength of 5,000 psi and reinforcing yield strength of 33,000 psi.
2. Rock dike constructed height and width at base will be based on assumed minimum dike height of adjacent sections or 20 feet height, slope of 2H:1V.

3. Seawall Type W supporting pile spacing will be assumed to be the maximum of adjacent seawall sections, and of sufficient length to not control seismic stability of the seawall.

Other

A site visit is warranted to confirm missing data. Use of a Port boat and operator should be requested for this activity.

4.11 Section 7 – 980 Feet Between Pacific and Clay Streets (Piers 1 and 3)

Description

Seawall Section 7 originally consisted of four types of seawall, designated Types W, V, U and T on the original construction drawings. These seawall types consisted of a concrete cutoff and bulkhead walls. The seawall fronts a marginal wharf and existing Pier 3 and Pier 1 substructures.

Drawings

The POSF drawing revised in 1978, 10080-410to416-4, Details T, U, V, and W, indicate the original seawall construction for this wall section. Seawall types applicable to this seawall section are Types W, V, U and T, shown on Figures 4-16 through 4-19.

Technical Reports

None.

Section Seawall Data Summary

According to record drawings in our possession, this section of seawall originally sat on a rock dike with an estimated bayside slope varying from 2H:1V (Type W) to an apparent 1H:1V (Type T) with rock dike slopes at seawall Types V and U not indicated. The rock elevation on the seawall is purported to be at Elevation -6.0 feet (City Datum) at seawall Type W and -13.0 ft at Type T. There is presently no data available to us regarding the height of the rock dike at Types V and U.

This section of seawall originally consisted of four types of seawall, designated Type W, V, U and T on the original construction drawings and consists of cutoff and bulkhead walls.

The Type W cutoff wall is a 16-inch thick concrete cutoff wall about 10 feet high from top of rock dike to bottom of wharf deck. Piles are indicated and, based on adjacent sections, are assumed to be 12-inch square concrete piles with four 5/8-inch longitudinal reinforcing bars. Piles are assumed to be 32 feet long. Pile spacing is not indicated.

The Type V appears to originally consist of a cutoff wall of unknown height and thickness, with the presence of supporting piles not indicated. Indications are that in 1929, a new wharf deck was constructed over the original wharf deck constructed in 1909.

The Type U seawall is a pile-supported concrete bulkhead wall is15 feet high with wall thickness varying from 3 feet at the top of the wall to 4 feet at the bottom of the wall. Two rows of piles are indicated but all other supporting pile data is presently unavailable to us. This seawall section is indicated to have wind walls at 37 feet centers but all other wing wall data is not provided; no wing wall support piles are indicated. The provided detail is not drawn to scale.

The Type T seawall is a concrete bulkhead wall is13 feet high with wall thickness varying from 3 feet at the top of the wall to 4 feet at the bottom of the wall. No supporting piles or wing walls are indicated. .

Section Marginal Wharf Data Summary

There is presently no data available to us for the marginal wharf located in this seawall section.

Section Finger Pier Data Summary

Piers 1 and 3 are located in this seawall section.

There is presently no data available to us for the finger piers located in this seawall section.

Section Structural Data Gaps

- Rock dike Types W, constructed width at base and materials of construction. .

- Rock dike Types V and U, constructed height and width at base, bayside slope and materials of construction. .
- Rock dike Types T, constructed width at base, bayside slope and materials of construction. .
- Seawall Type W supporting pile spacing, length and material strength data.
- Seawall Type V cutoff wall height, thickness and supporting pile type, spacing, length and material strength data.
- Seawall Type U bulkhead supporting pile type, spacing, length, wall wing wall height, width and thickness, and material strength data.
- Seawall Type T bulkhead wall material strength data.
- Marginal wharf pile type, size, reinforcement, spacing, length and material strength data.
- Piers 1 and 3 pile type, size, reinforcement, spacing, length and material strength data.

If data is not available, data will be assumed based on seawall sections of similar construction period and design.

Assumed Data for Data Gaps

Unless revised by additional data, the following will be assumed for data gaps applicable to this seawall section:

1. Concrete material strength data will be based on typical values applicable to the time of construction, i.e., design concrete strength of 5,000 psi and reinforcing yield strength of 33,000 psi.
2. Rock dike constructed height and width at base will be based on assumed minimum dike height of adjacent sections or 20 feet height, slope of 1H:1V.
3. Seawall Types W, V, U and T supporting pile spacing will be assumed to be the maximum of adjacent seawall sections, and of sufficient length to not control seismic stability of the seawall.
4. Marginal wharf supporting pile data: commensurate with adjacent piers and data of construction.
5. Piers 1 and 3 supporting pile data: commensurate with adjacent piers and data of construction.

Other

A site visit is warranted to confirm missing data. Use of a Port boat and operator should be requested for this activity.

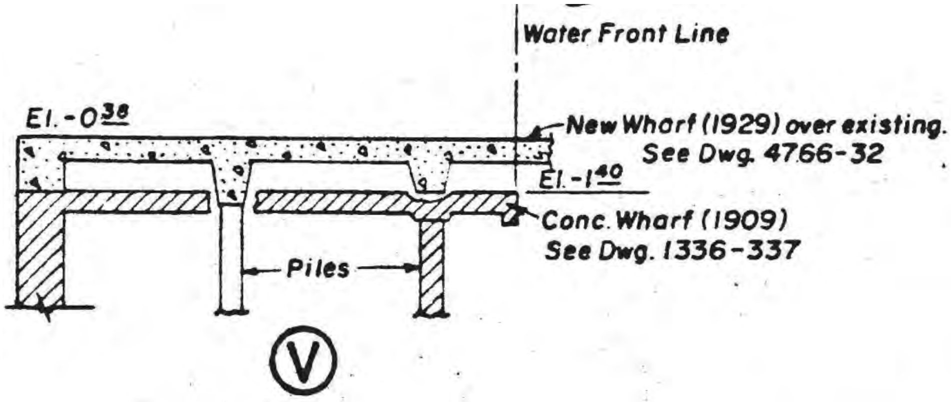


Figure 4-17: Seawall Section 7: Seawall Type V

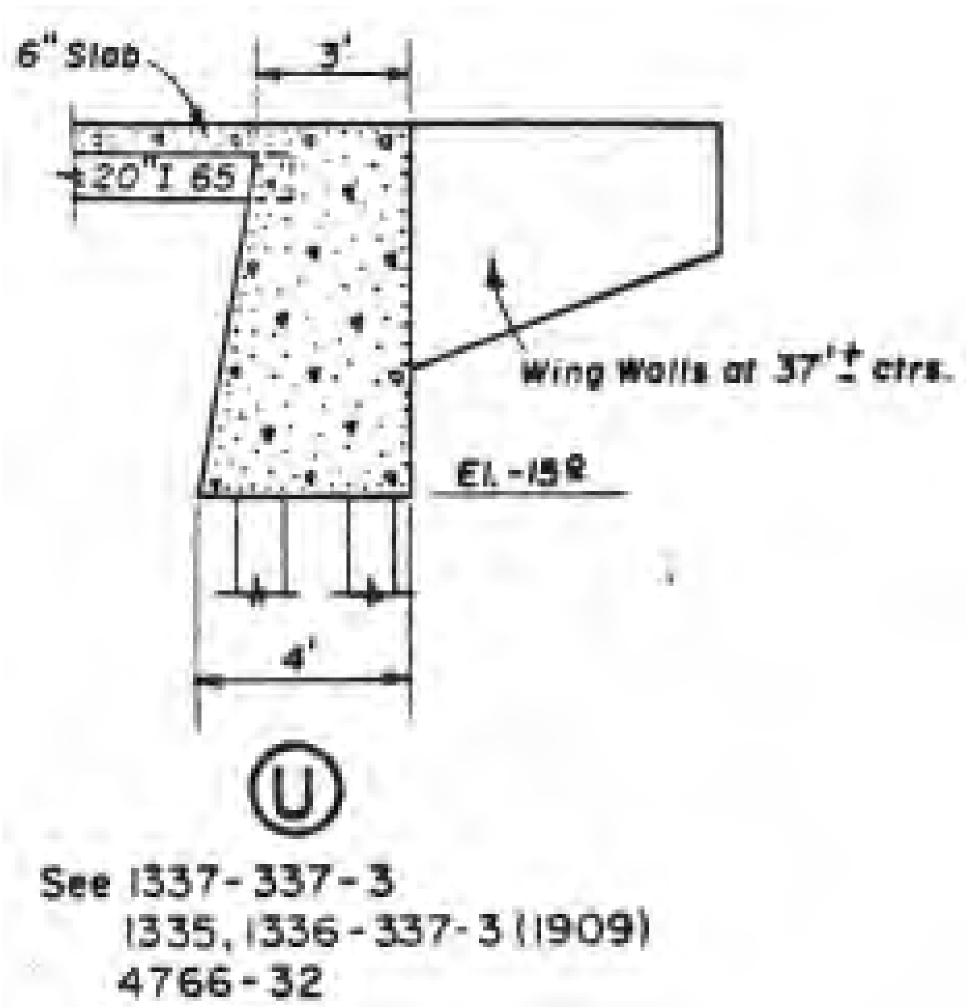


Figure 4-18: Seawall Section 7: Seawall Types U

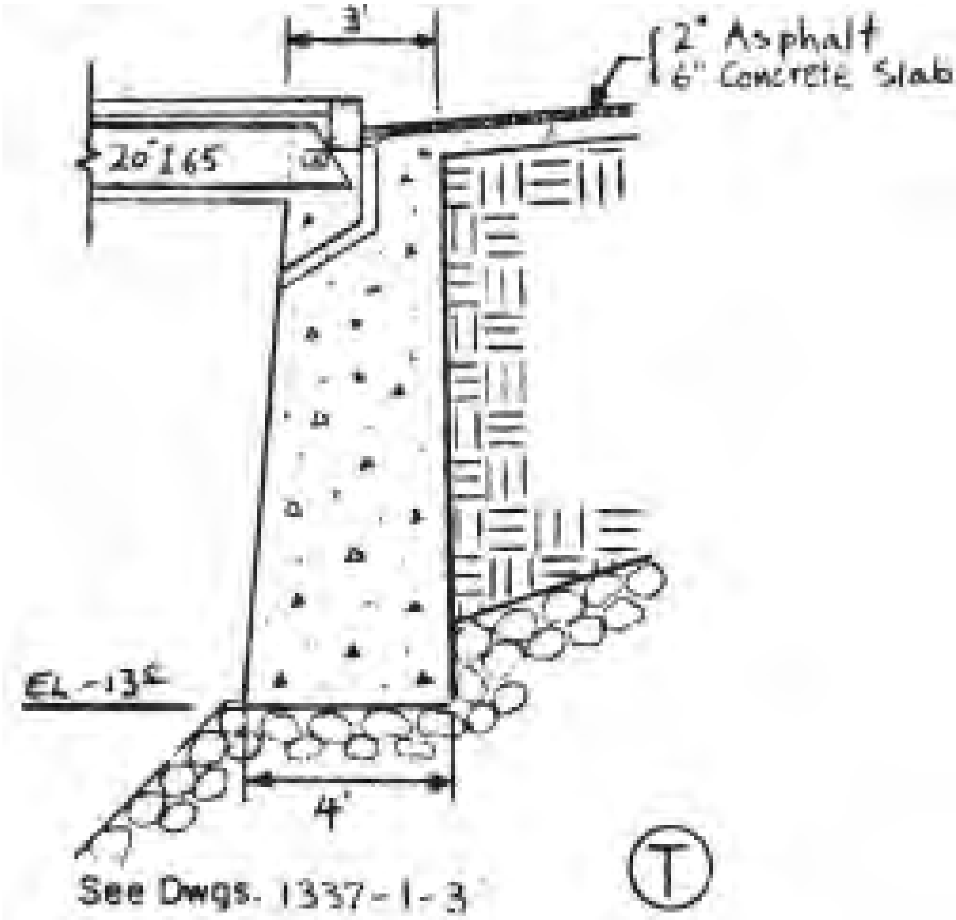


Figure 4-19: Seawall Section 7: Seawall Types T

4.12 Section 8a – 392 Feet Between Clay and Market Streets

Description

Seawall Section 8a or iginally consisted of one type of seawall, designated Type S on the original construction drawings. This seawall type consisted of a c oncrete bulkhead wall 17’-10” high. T his seawall fronts the Ferry Plaza substructure.

The seismic retrofit of the Ferry Plaza in the 1990s resulted in a seismic separation of the substructure from the seawall structure in this seawall section.

Drawings

The POSF drawing revised in 1978, 10080-410to416-4, Detail S, indicates the original seawall construction for this wall section. This seawall Type S is shown on Figure 4-20.

Technical Reports

None.

Section Seawall Data Summary

There is presently no data on the rock dike for this seawall section available to us. However, the top of the rock dike should be at least at Elevation -17.83 feet (City Datum) to be consistent with the base of the bulkhead wall.

This section of seawall originally consisted of one t ype of seawall, designated Type S on t he original construction drawings. Type S appears to be t he same as Type R discussed for seawall Section 8b, following. This pile-supported concrete bulkhead wall is17’-10” high with stepped wall thicknesses varying from 6 feet at the top of the wall to 11’-10” at the bottom of the wall. Four rows of piles are indicated but all other supporting pile data is presently unavailable to us.

Section Marginal Wharf Data Summary

There are presently no data available to us for the marginal wharf piles located in this seawall section.

Section Finger Pier Data Summary

The Ferry Plaza is not located in this seawall section.

Section Structural Data Gaps

- Rock dike constructed height and width at base, and constructed bayside slope.
- Seawall Type S supporting pile type, size, spacing, length and material strength data.
- Marginal wharf width and pile size, reinforcement, spacing, length and material strength data.

If data is not available, data will be assumed based on seawall sections of similar construction period and design.

Assumed Data for Data Gaps

Unless revised by additional data, the following will be assumed for data gaps applicable to this seawall section:

1. Concrete material strength data will be based on typical values applicable to the time of construction, i.e., design concrete strength of 5,000 psi and reinforcing yield strength of 33,000 psi.
2. Rock dike constructed height, width at base, and bayside slope will be based on assumed minimum dike height of adjacent sections or 20 feet height, slope of 1H:1V.

3. Seawall Type S supporting piles will be assumed to be 16-inch diameter timber piles, longitudinally spaced at 8 feet centers with row spacing scaled from available drawings (or three pile diameters), and of sufficient length to not control seismic stability of the seawall.

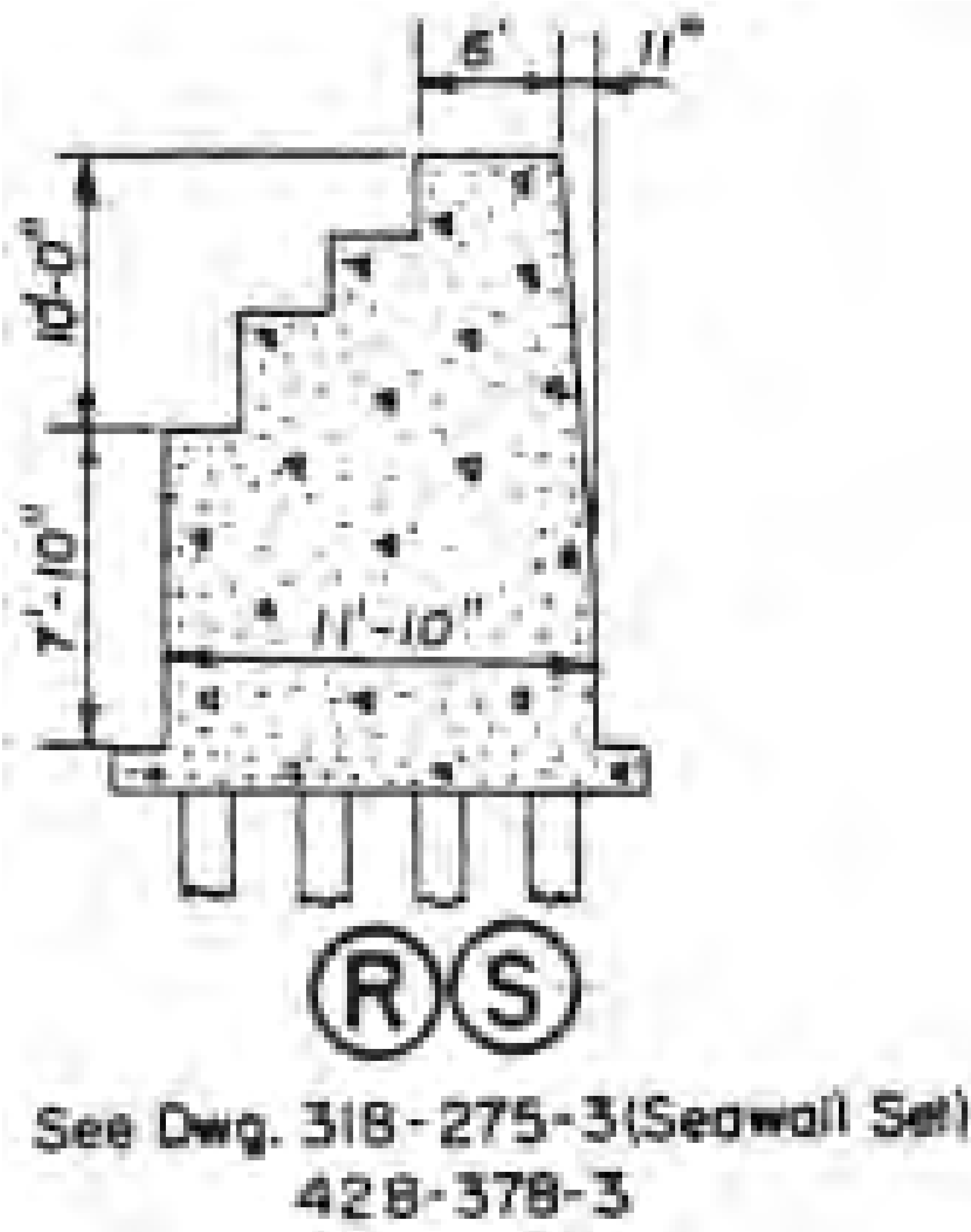


Figure 4-20: Seawall Sections 8a and 8b: Seawall Types S and R

4.13 Section 8b – 450 Feet Between Market and Mission Streets

Description

Seawall Section 8b originally consisted of one type of seawall, designated Type R on the original construction drawings. This seawall type consisted of a concrete bulkhead wall 17'-10" high. This seawall fronts the Ferry Plaza substructure.

The seismic retrofit of the Ferry Plaza in the 1990s resulted in a seismic separation of the substructure from the seawall structure in this seawall section.

Drawings

The POSF drawing revised in 1978, 10080-410to416-4, Detail R, indicates the original seawall construction for this wall section. This seawall Type R is shown on Figure 4-20.

Technical Reports

None.

Section Seawall Data Summary

There is presently no data on the rock dike for this seawall section available to us. However, the top of the rock dike should be at least at Elevation -17.83 feet (City Datum) to be consistent with the base of the bulkhead wall.

This section of seawall originally consisted of one type of seawall, designated Type R on the original construction drawings. Type R appears to be the same as Type S discussed for the previous seawall section. This pile-supported concrete bulkhead wall is17'-10" high with stepped wall thicknesses varying from 6 feet at the top of the wall to 11'-10" at the bottom of the wall. Four rows of piles are indicated but all other supporting pile data is presently unavailable to us.

Section Marginal Wharf Data Summary

There is presently no data available to us for the marginal wharf piles located in this seawall section.

Section Finger Pier Data Summary

The Ferry Plaza is located in this seawall section.

There is presently no data available to us for the finger pier piles located in this seawall section.

The Ferry Plaza finger pier batter piles were seismically retrofitted in 1996.

Section Structural Data Gaps

- Rock dike constructed height and width at base, and constructed bayside slope.
- Seawall Type R supporting pile type, size, spacing, length and material strength data.
- Marginal wharf width and pile size, reinforcement, spacing, length and material strength data.
- Ferry Plaza pile size, reinforcement, spacing, length and material strength data.

If data is not available, data will be assumed based on seawall sections of similar construction period and design.

Assumed Data for Data Gaps

Unless revised by additional data, the following will be assumed for data gaps applicable to this seawall section:

1. Concrete material strength data will be based on typical values applicable to the time of construction, i.e., design concrete strength of 5,000 psi and reinforcing yield strength of 33,000 psi.

2. Rock dike constructed height, width at base, and bayside slope will be based on assumed minimum dike height of adjacent sections or 20 feet height, slope of 1H:1V.
3. Seawall Type R supporting piles will be assumed to be 16-inch diameter timber piles, longitudinally spaced at 8 feet centers with row spacing scaled from available drawings (or three pile diameters), and of sufficient length to not control seismic stability of the seawall.

4.14 Section 8 – 300 Feet Between Mission and Point North of Howard Streets

Description

Seawall Section 8 originally consisted of one type of seawall, designated Type Q on the original construction drawings. This seawall type consisted of a concrete bulkhead wall 30 feet high. This seawall fronts the Pier 2 marginal wharf and substructure.

Drawings

The POSF drawing revised in 1978, 10080-410to416-4, Detail Q, indicates the original seawall construction for this wall section. This seawall Type Q is shown on Figure 4-21.

Technical Reports

None.

Section Seawall Data Summary

The original top of rock appears to be at Elevation -13.0 feet (City Datum). All other rock dike data for this seawall section is not available to us. The rock bayside slope appears to scale to about 1H:1V.

This section of seawall originally consisted of one type of seawall, designated Type Q on the original construction drawings. This pile-supported concrete bulkhead wall is 30 feet high with stepped wall thicknesses varying from 3 feet at the top of the wall to 10 feet at the bottom of the wall. Four rows of piles are indicated but all other supporting pile data is presently unavailable to us.

Section Marginal Wharf Data Summary

There is no marginal wharf structure in this seawall section that will provide significant support of the existing seawall.

Section Finger Pier Data Summary

Pier 2 and the Agricultural Building are located in this seawall section.

There is no finger pier structure in this seawall section that will provide significant support of the existing seawall.

Section Structural Data Gaps

- Rock dike constructed height and width at base, constructed bayside slope.
- Seawall Type Q supporting pile type, size, spacing and material strength data.
- Marginal wharf data: none needed.
- Finger pier data: none needed.

If data is not available, data will be assumed based on seawall sections of similar construction period and design.

Assumed Data for Data Gaps

Unless revised by additional data, the following will be assumed for data gaps applicable to this seawall section:

1. Concrete material strength data will be based on typical values applicable to the time of construction, i.e., design concrete strength of 5,000 psi and reinforcing yield strength of 33,000 psi.
2. Rock dike constructed height, width at base, and bayside slope will be based on assumed minimum dike height of adjacent sections or 20 feet height, slope of 1H:1V.

3. Seawall Type Q supporting piles will be assumed to be 16-inch diameter timber piles, longitudinally spaced at 8 feet centers with row spacing scaled from available drawings (or three pile diameters), and of sufficient length to not control seismic stability of the seawall.

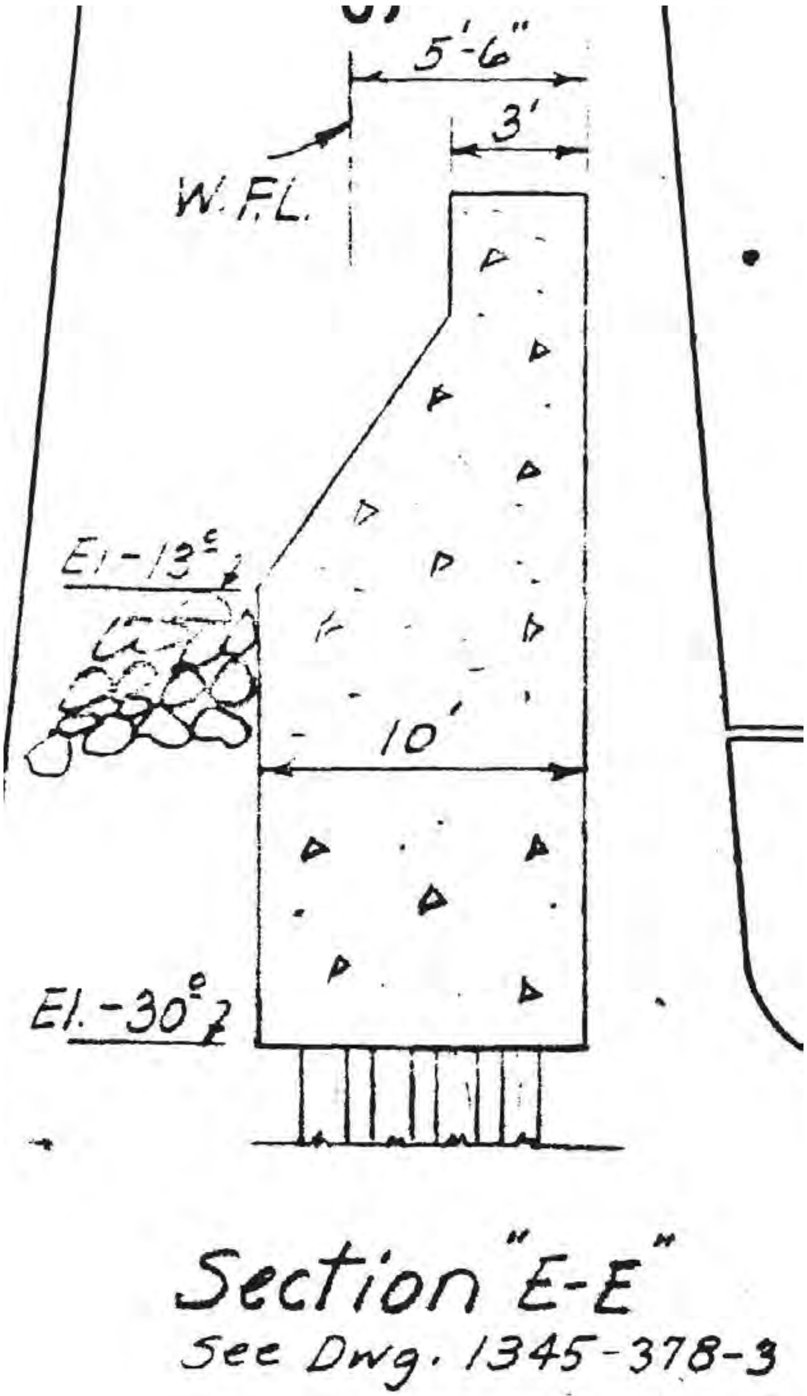


Figure 4-21: Seawall Section 8: Seawall Type Q

4.15 Section 9a – 990 Feet South of Mission to Folsom Street

Description

Seawall Section 9a originally consisted of one type of seawall, designated Type P on the original construction drawings. This seawall type consists of a bulkhead wall about 13 feet high from top of rock dike to bottom of wharf deck. The seawall originally fronted a marginal wharf and a number of piers along the entire length of this seawall section. Mos t of this marginal wharf and pier substructure has been removed or modified. Presently, a new Pier 14 substructure is all that exist along this seawall section. The new Pier 14 is deemed to not provide any significant support for this seawall section.

Drawings

The POSF drawing revised in 1978, 10080-410to416-4, Detail P, indicates the original seawall construction for this wall section. This seawall Type P is shown on Figure 4-22.

Technical Reports

None.

Section Seawall Data Summary

According to record drawings in our possession, this section of seawall originally sat on a rock dike with an estimated bayside slope of 1.8H:1.0V. The constructed height and width of the rock dike is presently not available to us. The top of rock dike elevation on the seawall is estimated to be Elevation -5 feet (City Datum).

This section of seawall originally consisted of one t ype of seawall, designated Type P on the original construction drawings. This pile-supported concrete bulkhead wall is 13 f eet high with stepped wall thicknesses varying from 2 feet at the top of the wall to 8 feet at the bottom of the wall. Two rows of piles are indicated but all other supporting pile data is presently unavailable to us. The seawall has purportedly been raised at least twice to mitigate settlement issues since its original construction.

Section Marginal Wharf Data Summary

There is no marginal wharf structure in this seawall section that will provide significant support of the existing seawall.

Section Finger Pier Data Summary

The relatively new Pier 14 replacement pier is located in this seawall section.

There is no finger pier structure in this seawall section that will provide significant support of the existing seawall.

Section Structural Data Gaps

- Rock dike constructed height and width at base.
- Seawall Type P supporting pile type, size, spacing and material strength data.
- Marginal wharf data: none needed.
- Finger pier data: none needed.

If data is not available, data will be assumed based on seawall sections of similar construction period and design.

Assumed Data for Data Gaps

Unless revised by additional data, the following will be assumed for data gaps applicable to this seawall section:

1. Concrete material strength data will be based on typical values applicable to the time of construction, i.e., design concrete strength of 5,000 psi and reinforcing yield strength of 33,000 psi.
2. Rock dike constructed height and width at base will be based on assumed minimum dike height of adjacent sections or 20 feet height.
3. Seawall Type P supporting piles will be assumed to be 16-inch diameter timber piles, longitudinally spaced at 8 feet centers with row spacing scaled from available drawings (or three pile diameters), and of sufficient length to not control seismic stability of the seawall.

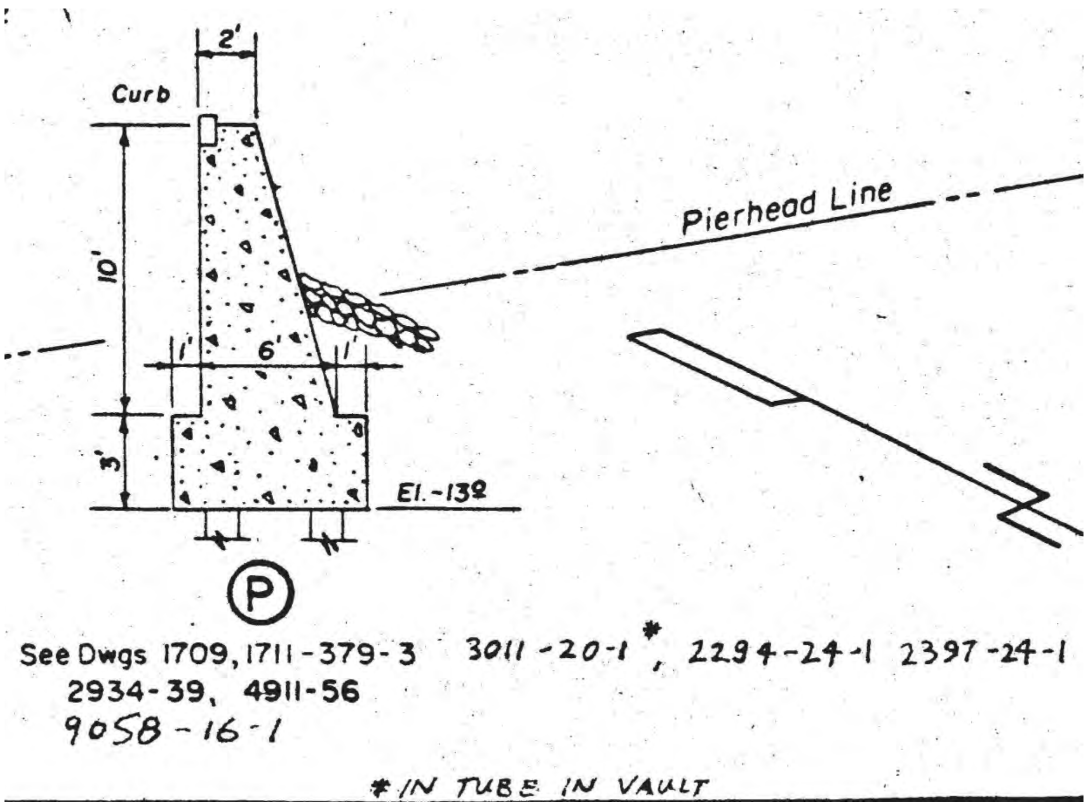


Figure 4-22: Seawall Sections 9a and 9b: Seawall Type P

4.16 Section 9b – 788 Feet Between Folsom and Harrison Streets

Seawall Section 9b originally consisted of one type of seawall, designated Type P on the original construction drawings. This seawall type consists of a concrete bulkhead wall about 13 feet high from top of rock dike to bottom of wharf deck. The seawall originally fronted a marginal wharf and a number of piers along the entire length of this seawall section. Most of this marginal wharf and pier substructure has been removed or modified. P resently, a downsized Pier 22.5 substructure is all that exist along this seawall section.

Drawings

The POSF drawing revised in 1978, 10080-410to416-4, Detail P, indicates the original seawall construction for this wall section. This seawall Type P is shown on Figure 4-22.

Technical Reports

None.

Section Seawall Data Summary

According to record drawings in our possession, this section of seawall originally sat on a rock dike with an estimated bayside slope of 1.8H:1.0V. The constructed height and width of the rock dike is presently not available to us. The top of rock dike elevation on the seawall is estimated to be Elevation -5 feet (City Datum).

This section of seawall originally consisted of one t ype of seawall, designated Type P on t he original construction drawings. This pile-supported concrete bulkhead wall is 13 f eet high with stepped wall thicknesses varying from 2 feet at the top of the wall to 8 feet at the bottom of the wall. Two rows of piles are indicated but all other supporting pile data is presently unavailable to us. The seawall has purportedly been raised at least twice to mitigate settlement issues since its original construction.

Section Marginal Wharf Data Summary

There is no marginal wharf structure in this seawall section that will provide significant support of the existing seawall.

Section Finger Pier Data Summary

The down-sized Pier 24 is located in this seawall section.

There is presently no data available to us for the Pier 24 piles located in this seawall section. It is likely that such structure will not provide significant support of the existing seawall.

Section Structural Data Gaps

- Rock dike constructed height and width at base.
- Seawall Type P supporting pile type, size, spacing and material strength data.
- Marginal wharf data: none needed.
- Pier 24 pile size, reinforcement, spacing, length and material strength data.

If data is not available, data will be assumed based on seawall sections of similar construction period and design.

Assumed Data for Data Gaps

Unless revised by additional data, the following will be assumed for data gaps applicable to this seawall section:

1. Concrete material strength data will be based on typical values applicable to the time of construction, i.e., design concrete strength of 5,000 psi and reinforcing yield strength of 33,000 psi.
2. Rock dike constructed height and width at base will be based on assumed minimum dike height of adjacent sections or 20 feet height.
3. Seawall Type P supporting piles will be assumed to be 16-inch diameter timber piles, longitudinally spaced at 8 feet centers with row spacing scaled from available drawings (or three pile diameters), and of sufficient length to not control seismic stability of the seawall.

4.17 Section 9 – 990 Feet South of Mission to Folsom Street (Harrison to Bryant??)

Description

Seawall Section 9 originally consisted of one type of seawall, designated Type O on the original construction drawings. This seawall type consisted of a concrete bulkhead wall 30 feet high. This seawall fronts the marginal wharf and the Pier 26 and 28 substructures.

Drawings

The POSF drawing revised in 1978, 10080-410to416-4, Detail O, indicates the original seawall construction for this wall section. This seawall Type O is shown on Figure 4-23.

Technical Reports

None.

Section Seawall Data Summary

According to record drawings in our possession, this section of seawall originally sat on a rock dike with an estimated bayside slope of 1.8H:1.0V. The constructed height and width of the rock dike is presently not available to us. The top of rock dike elevation on the seawall is estimated to be Elevation -15 feet (City Datum).

This section of seawall originally consisted of one type of seawall, designated Type O on the original construction drawings. This pile-supported concrete bulkhead wall is 30 feet high with stepped wall thicknesses varying from 5 feet at the top of the wall to 10 feet at the bottom of the wall. Four rows of piles are indicated but all other supporting pile data is presently unavailable to us.

Section Marginal Wharf Data Summary

A marginal wharf with assumed width of about 27 feet exists at this seawall section. The marginal wharf supporting pile data is presently unavailable to us.

Section Finger Pier Data Summary

Piers 26 and 28 are located in this seawall section.

Piers 26 and 28 are supported by 3'-6" or 4'-0" concrete cylinders with a cylinder base structure, in accordance with record drawing pile schedules. Pile spacing and length data are available.

Section Structural Data Gaps

- Rock dike constructed height and width at base.
- Seawall Type O supporting pile type, size, spacing and material strength data.
- Marginal wharf pile type, size, reinforcement, spacing, length and material strength data.
- Pier 26 and 28 pile size: none needed.

If data is not available, data will be assumed based on seawall sections of similar construction period and design.

Assumed Data for Data Gaps

Unless revised by additional data, the following will be assumed for data gaps applicable to this seawall section:

1. Concrete material strength data will be based on typical values applicable to the time of construction, i.e., design concrete strength of 5,000 psi and reinforcing yield strength of 33,000 psi.
2. Rock dike constructed height and width at base will be based on assumed minimum dike height of adjacent sections or 20 feet height.

3. Seawall Type O supporting piles will be assumed to be 16-inch diameter timber piles, longitudinally spaced at 8 feet centers with row spacing scaled from available drawings (or three pile diameters), and of sufficient length to not control seismic stability of the seawall.

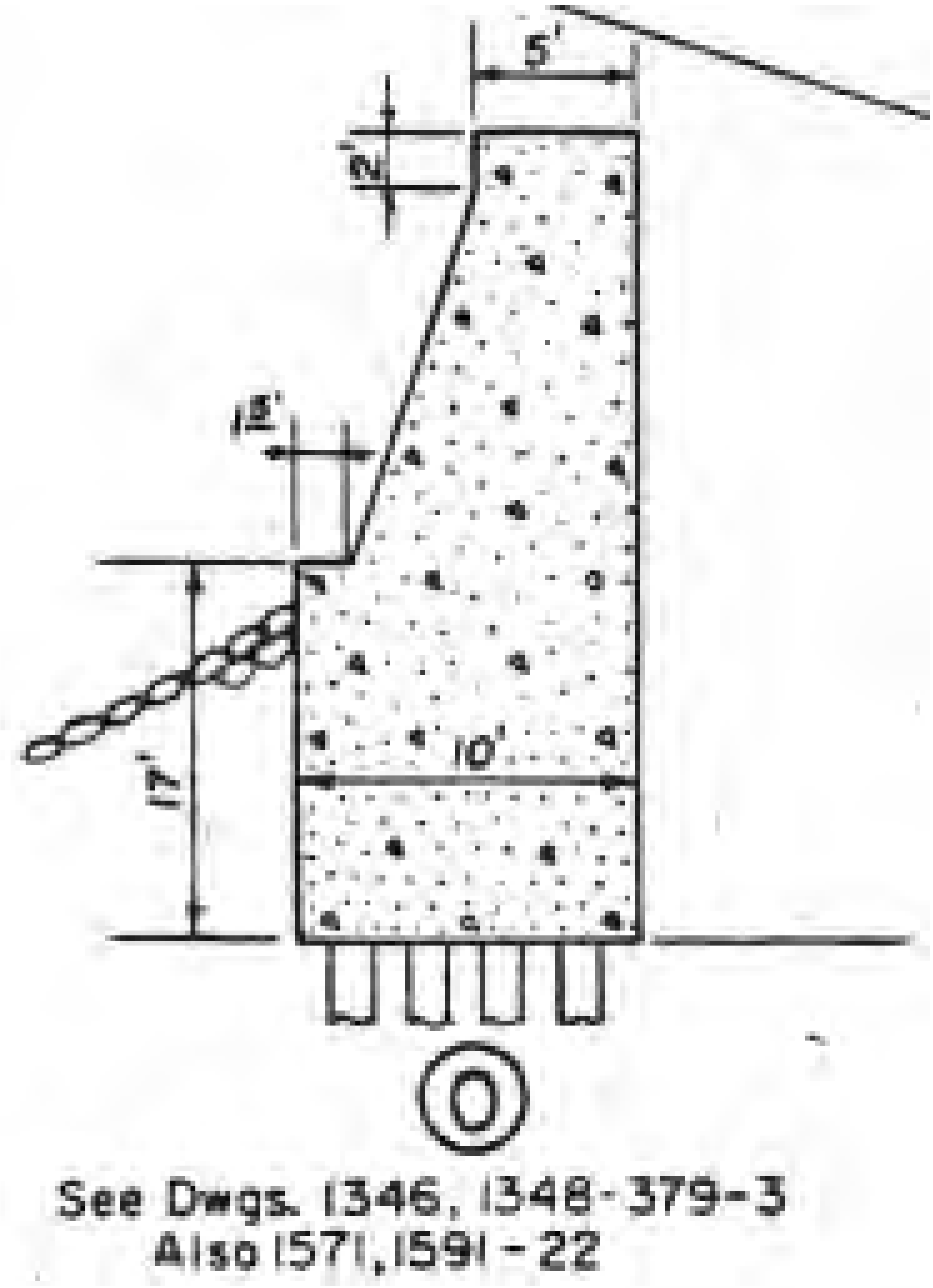


Figure 4-23: Seawall Section 9: Seawall Type O

4.18 Section 10 – 537 Feet North of Beale to Main Street

Description

Seawall Section 10 originally consisted of two types of seawall, designated Types N and M on the original construction drawings.

The Type N seawall type consisted of a concrete bulkhead wall 30 feet high. This seawall fronts most of the marginal wharf and the Pier 30-32 substructures.

The Type M concrete bulkhead wall is 14 feet high and fronts a small portion of the marginal wharf adjacent to seawall Section 11a.

Drawings

The POSF drawing revised in 1978, 10080-410to416-4, Detail N, indicates the original seawall construction for this wall section. Seawall types applicable to this seawall section are Types N and M, shown on Figures 4-24and 4-26, respectively.

The AECOM drawings for the 2013 Americas Cup project give details on the seawall Type N cross-section, Figure 4-25.

Technical Reports

None.

Section Seawall Data Summary

According to record drawings in our possession, the Type N section of seawall originally sat on a rock dike 20 to 30 feet high with an estimated bayside slope of 1H:1V. The top of rock dike elevation on the Type N seawall is estimated to be Elevation -13 feet (City Datum).

The Type N section of seawall originally consisted of one type of pile supported concrete bulkhead seawall, designated Type N on the original construction drawings.

This Type N concrete bulkhead wall is about 30 feet high with wall thicknesses varying from 5'-0" at the top of the wall to 11'-6" feet at the bottom of the wall. Four rows of supporting piles are indicated but all other supporting pile data are not provided.

According to record drawings in our possession, the Type M section of seawall originally sat on a rock dike 20 to 30 feet high with an estimated bayside slope of 1H:1V. The raised revetment that occurred in Section 11a in 2013 does not have a significant effect on the Section 10 seawall.

The Type M section of seawall originally consisted of one type of pile supported concrete bulkhead seawall, designated Type M on the original construction drawings. This Type M concrete bulkhead wall is 14 feet high with wall thicknesses varying from 2'-6" at the top of the wall to 6'-6" at the bottom of the wall. Two rows of 16-inch diameter timber piles at 8' longitudinal spacing are indicated. The spacing between pile rows and the pile lengths are not indicated.

Section Marginal Wharf Data Summary

A marginal wharf with about 23 feet wide exists at this seawall section. The marginal wharf supporting pile data is presently unavailable to us but is assumed to be the same as for seawall Section 11a, following.

Section Finger Pier Data Summary

Pier 30-32 is located in this seawall section.

Piers 30-32 is supported by combination of 3’-0”, 3’-6” or 4’-0” concrete cylinders with a cylinder base structure, in-fill 16-, 18- and 28-inch square concrete piles, and extended pier 20-inch square concrete piles, in accordance with record drawing pile schedules. Pile spacing and length data are available.

Section Structural Data Gaps

- Rock dike constructed width at base, top of rock dike elevation (Type N).
- Seawall Type N supporting pile type, size, spacing, lengths and material strength data.
- Seawall Type M supporting pile row spacing, pile lengths and material strength data.
- Marginal wharf pile type, size, reinforcement, spacing, length and material strength data.
- Pier 30-32: none needed.

If data is not available, data will be assumed based on seawall sections of similar construction period and design.

Assumed Data for Data Gaps

Unless revised by additional data, the following will be assumed for data gaps applicable to this seawall section:

1. Concrete material strength data will be based on typical values applicable to the time of construction, i.e., design concrete strength of 5,000 psi and reinforcing yield strength of 33,000 psi.
2. Rock dike constructed width at base will be based on assumed minimum dike height of 20 feet, slope and top of dike elevation of Elevation -13 feet (City Datum), based on seawall Type N.
3. Seawall Types M and N supporting piles will be assumed to be 16-inch diameter timber piles, longitudinally spaced at 8 feet centers with row spacing scaled from available drawings (or three pile diameters), and of sufficient length to not control seismic stability of the seawall.

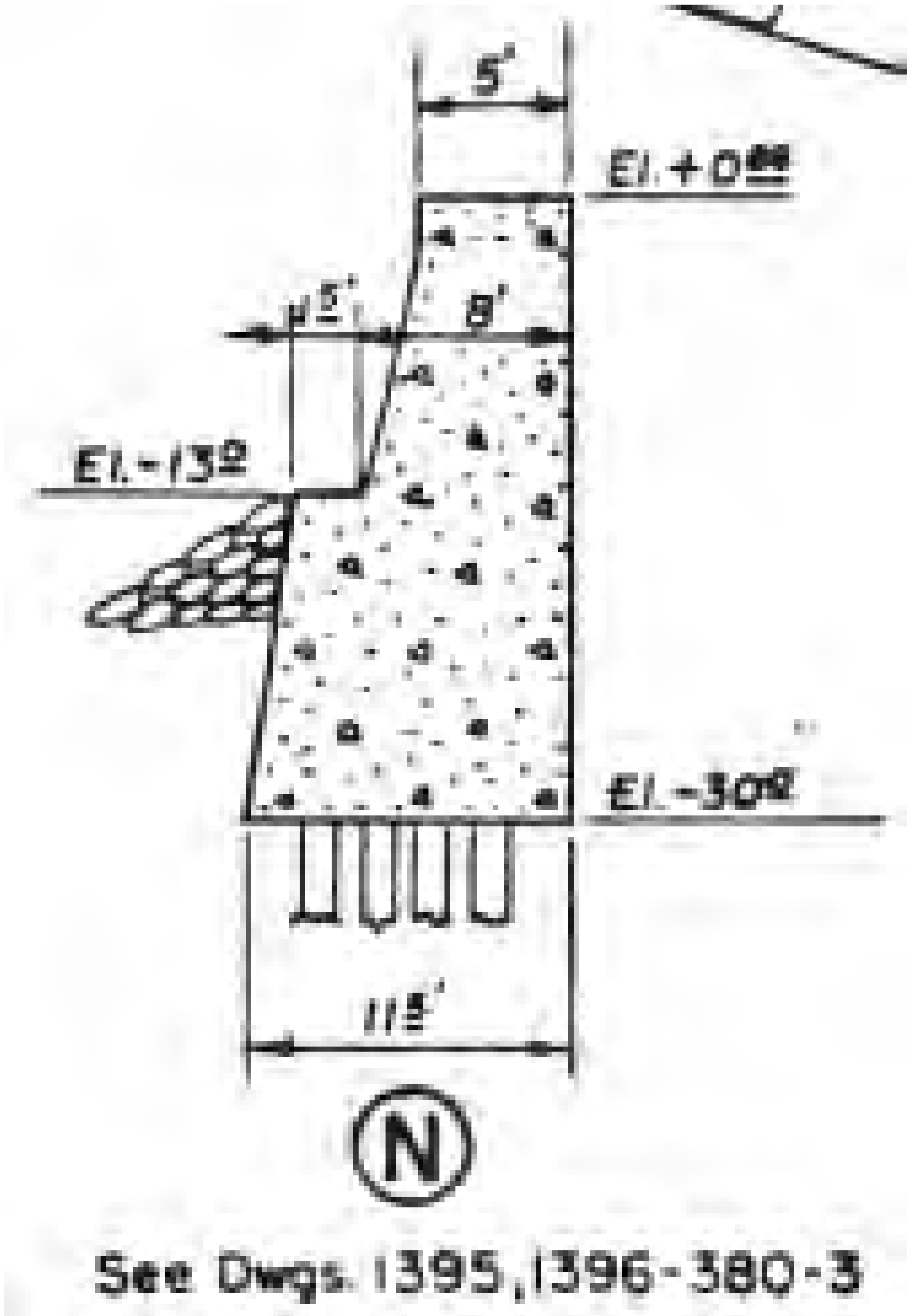


Figure 4-24: Seawall Section 10: Seawall Type N

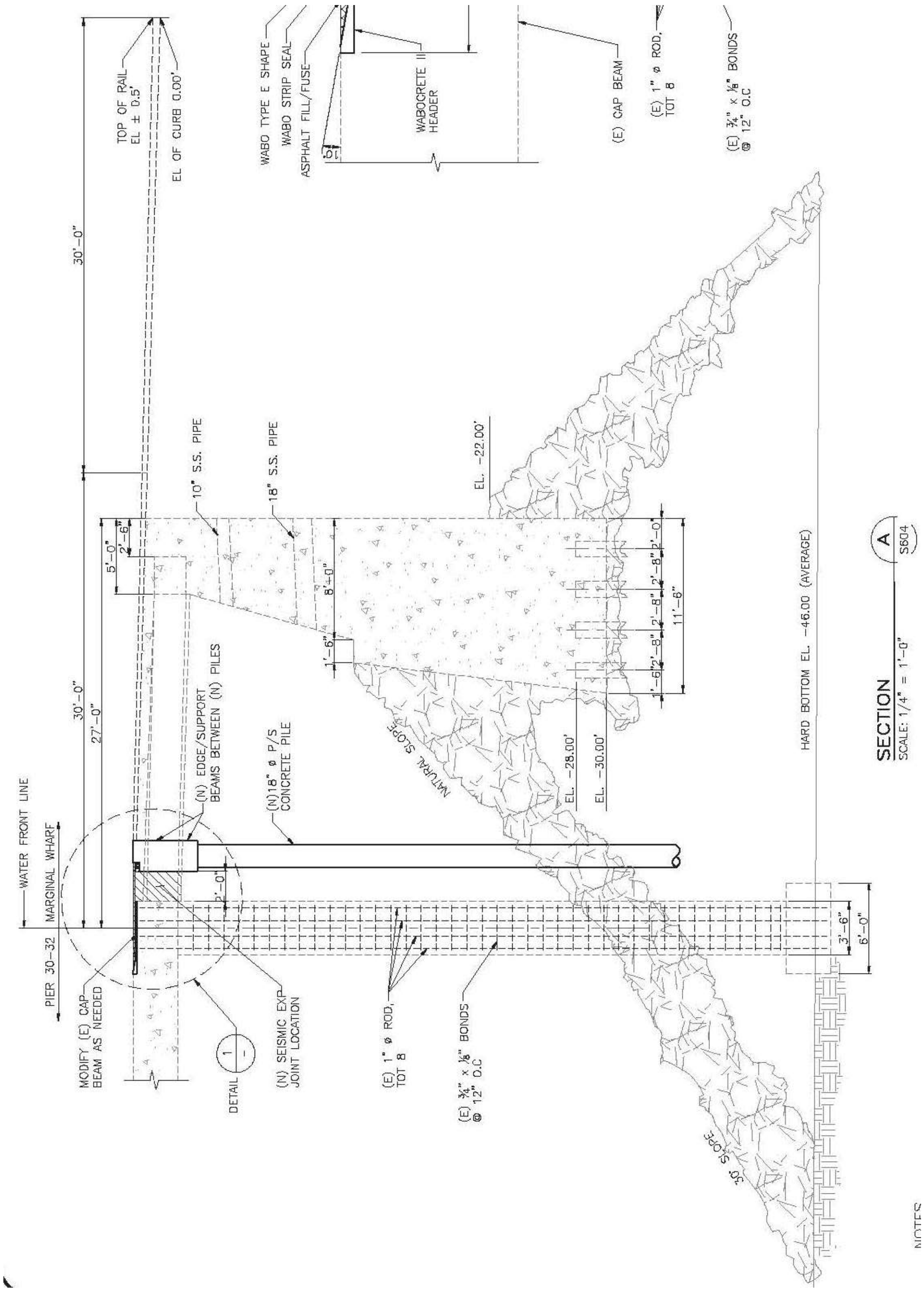


Figure 4-25: Seawall Section 10: Seawall Type N (per AECOM Drawing)

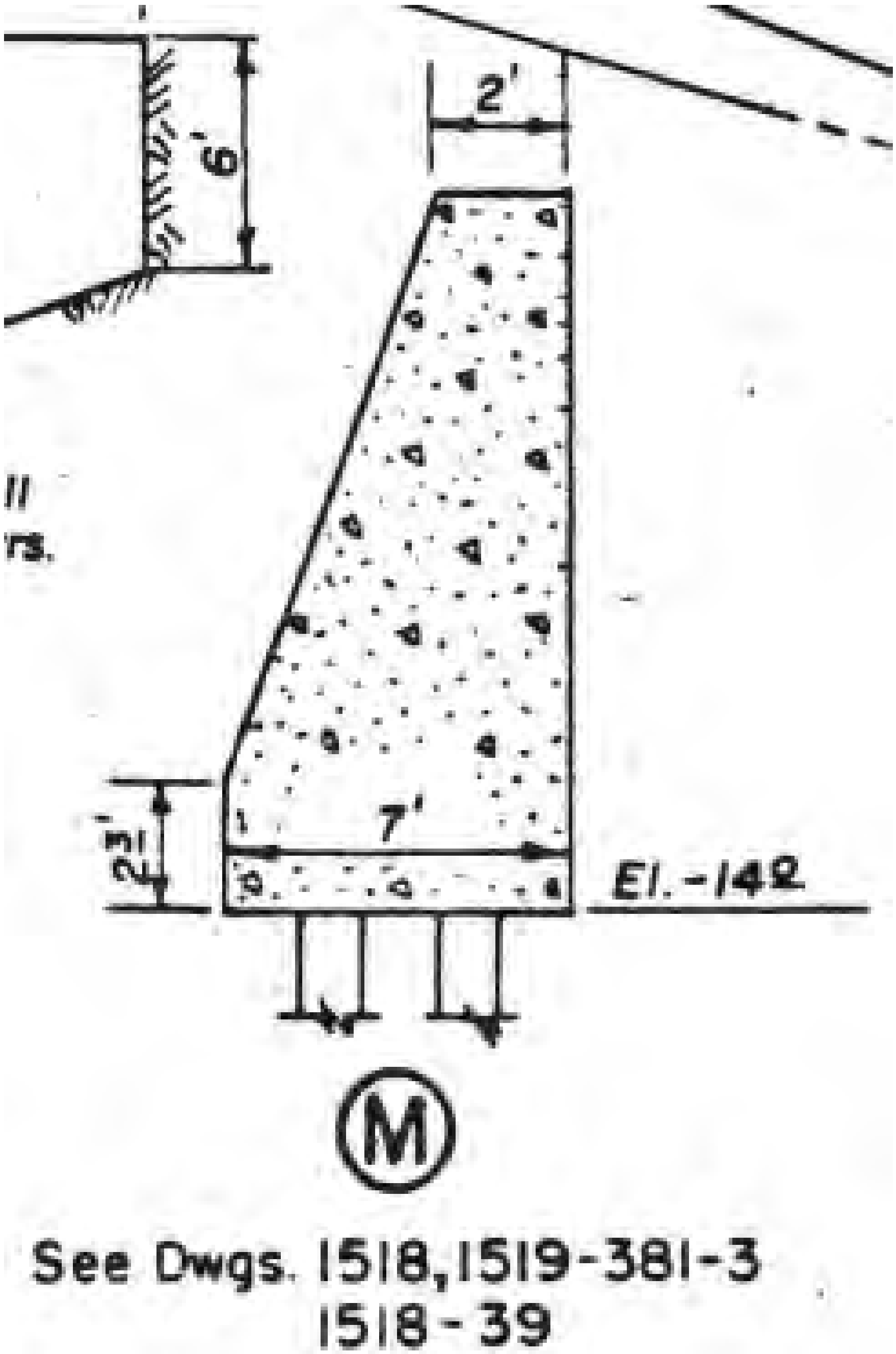


Figure 4-26: Seawall Sections 10 and 11a: Seawall Type M

4.19 Section 11a – 281 Feet South of Main to Beale Street

Description

Section 11a of the bulkhead wharf stretches 281 feet along the Embarcadero from the foot of Beale Street near its intersection with Brannan Street to the midpoint of Pier 32.

The Section 11a seawall bulkhead wall, 14 feet high, does not appear to have been modified since its original construction but the marginal wharf has been removed and replaced in 2013 by the Brannan Street Wharf structure. The new Brannan Street Wharf structure is not structurally connected to the seawall in this seawall section.

Drawings

The POSF drawing revised in 1978, 10080-410to416-4, Detail M, indicates the original seawall construction for this wall section. This seawall Type M is shown on Figure 4-26.

The Brannan Street Wharf Structure drawings indicate added revetment to this seawall section (Figure 4-27).

Technical Reports

None.

Section Seawall Data Summary

According to record drawings in our possession, this section of seawall originally sat on a rock dike 20 to 30 feet high with an estimated bayside slope of 1H:1V. The top of rock dike elevation on the Type M seawall was raised (rehabilitated) as a part of the Brannan Street Wharf project and is presently at Elevation +7.0 feet, MLLW with a bayside slope of 3H:1V. This rehabilitated seawall is shown on Figure 4-26.

This section of seawall originally consisted of one type of pile supported concrete bulkhead seawall, designated Type M on the original construction drawings. This Type M concrete bulkhead wall is 14 feet high with wall thicknesses varying from 2'-6" at the top of the wall to 6'-6" at the bottom of the wall. Two rows of 16-inch diameter timber piles at 8' longitudinal spacing are indicated. The spacing between pile rows and the pile lengths are not indicated.

Section Marginal Wharf Data Summary

No marginal wharf exists at this seawall section. The Brannan Street Wharf structure is not structurally connected to the seawall and would not provide significant structural support for the seawall.

Section Finger Pier Data Summary

The Brannan Street Wharf, constructed in 2013, is located in this seawall section.

The Brannan Street Wharf structure is not structurally connected to the seawall and would not provide significant structural support for the seawall.

Section Structural Data Gaps

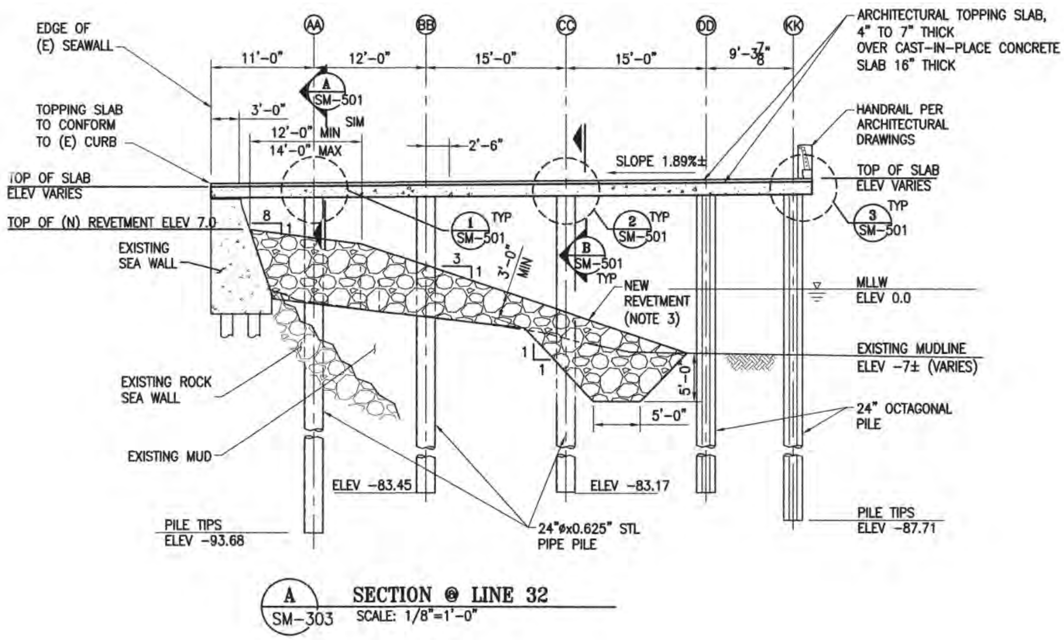
- Rock dike constructed width at base.
- Seawall Type M supporting pile row spacing, pile lengths and material strength data.
- Marginal wharf: none needed.
- Brannan Street Wharf: none needed.

If data is not available, data will be assumed based on seawall sections of similar construction period and design.

Assumed Data for Data Gaps

Unless revised by additional data, the following will be assumed for data gaps applicable to this seawall section:

1. Concrete material strength data will be based on typical values applicable to the time of construction, i.e., design concrete strength of 5,000 psi and reinforcing yield strength of 33,000 psi.
2. Rock dike constructed width at base will be based on assumed minimum dike height of 20 feet, slope and top of dike elevation.
3. Seawall Type M supporting piles will be assumed to be 16-inch diameter timber piles, longitudinally spaced at 8 feet centers with row spacing scaled from available drawings (or three pile diameters), and of sufficient length to not control seismic stability of the seawall.



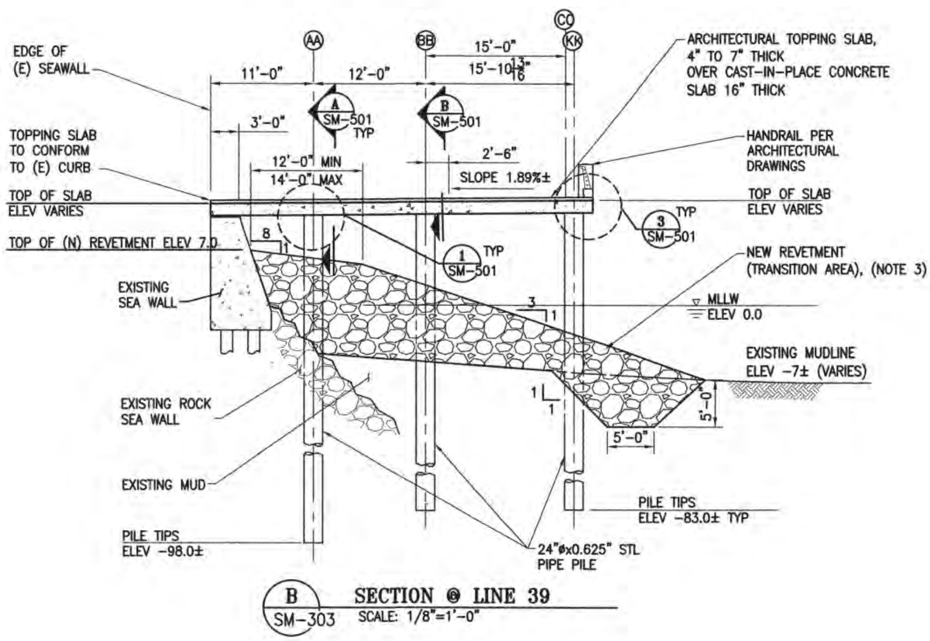


Figure 4-27: Seawall Section 11a: Seawall Type M (Rehabilitated)

4.20 Section 11 – 353 Feet North of Beale to Fremont Street

Description

The Section 11 seawall bulkhead wall, 20 feet high, does not appear to have been modified since its original construction but the marginal wharf and Piers 34 and 36 have been removed and replaced in 2013 by the Brannan Street Wharf structure. The new Brannan Street Wharf structure is not structurally connected to the seawall in this seawall section.

Drawings

The POSF drawing revised in 1978, 10080-410to416-4, Detail L, indicates the original seawall construction for this wall section. This seawall Type L is shown on Figure 4-28.

Technical Reports

None.

Section Seawall Data Summary

According to record drawings in our possession, this section of seawall originally sat on a rock dike 20 to 30 feet high with an estimated bayside slope of 1H:1V. The top of rock dike elevation on the Type L is presently not available to us. Condition surveys (2009) prior to the Brannan Street Wharf construction showed this elevation to vary but this has not been confirmed since the new wharf construction.

This section of seawall originally consisted of one type of pile supported concrete bulkhead seawall, designated Type L on the original construction drawings. This Type L concrete bulkhead wall is 20 feet high with wall thicknesses varying from 3'-0" at the top of the wall to 7'-0" at the bottom of the wall. Two rows of timber piles are indicated. The pile size, spacing between piles and pile rows, and the pile lengths are not indicated. This bulkhead type has reinforced concrete wing walls, average height 7'-6", 20-feet length, 1'-3" thickness and spaced at 20 feet centers.

Section Marginal Wharf Data Summary

No marginal wharf exists at this seawall section. The Brannan Street Wharf structure is not structurally connected to the seawall and would not provide significant structural support for the seawall.

Section Finger Pier Data Summary

The Brannan Street Wharf, constructed in 2013, is located in this seawall section.

The Brannan Street Wharf structure is not structurally connected to the seawall and would not provide significant structural support for the seawall.

Section Structural Data Gaps

- Rock dike constructed width at base, top of dike elevation at seawall.
- Seawall Type L supporting pile size, pile and pile row spacing, pile lengths and material strength data.
- Marginal wharf: none needed.
- Brannan Street Wharf: none needed.

If data is not available, data will be assumed based on seawall sections of similar construction period and design.

Assumed Data for Data Gaps

Unless revised by additional data, the following will be assumed for data gaps applicable to this seawall section:

1. Concrete material strength data will be based on typical values applicable to the time of construction, i.e., design concrete strength of 5,000 psi and reinforcing yield strength of 33,000 psi.
2. The top of rock dike on the face of the Type L seawall will be assumed at the lower of Types K and M which is either Elevation -9.5 feet (City Datum) or +7 feet MLLW. Rock dike constructed width at base will be based on assumed dike height of 20 feet, slope and this minimum top of dike elevation.
3. Seawall Type L supporting piles will be assumed to be 16-inch diameter timber piles, longitudinally spaced at 8 feet centers with row spacing scaled from available drawings (or three pile diameters), and of sufficient length to not control seismic stability of the seawall.

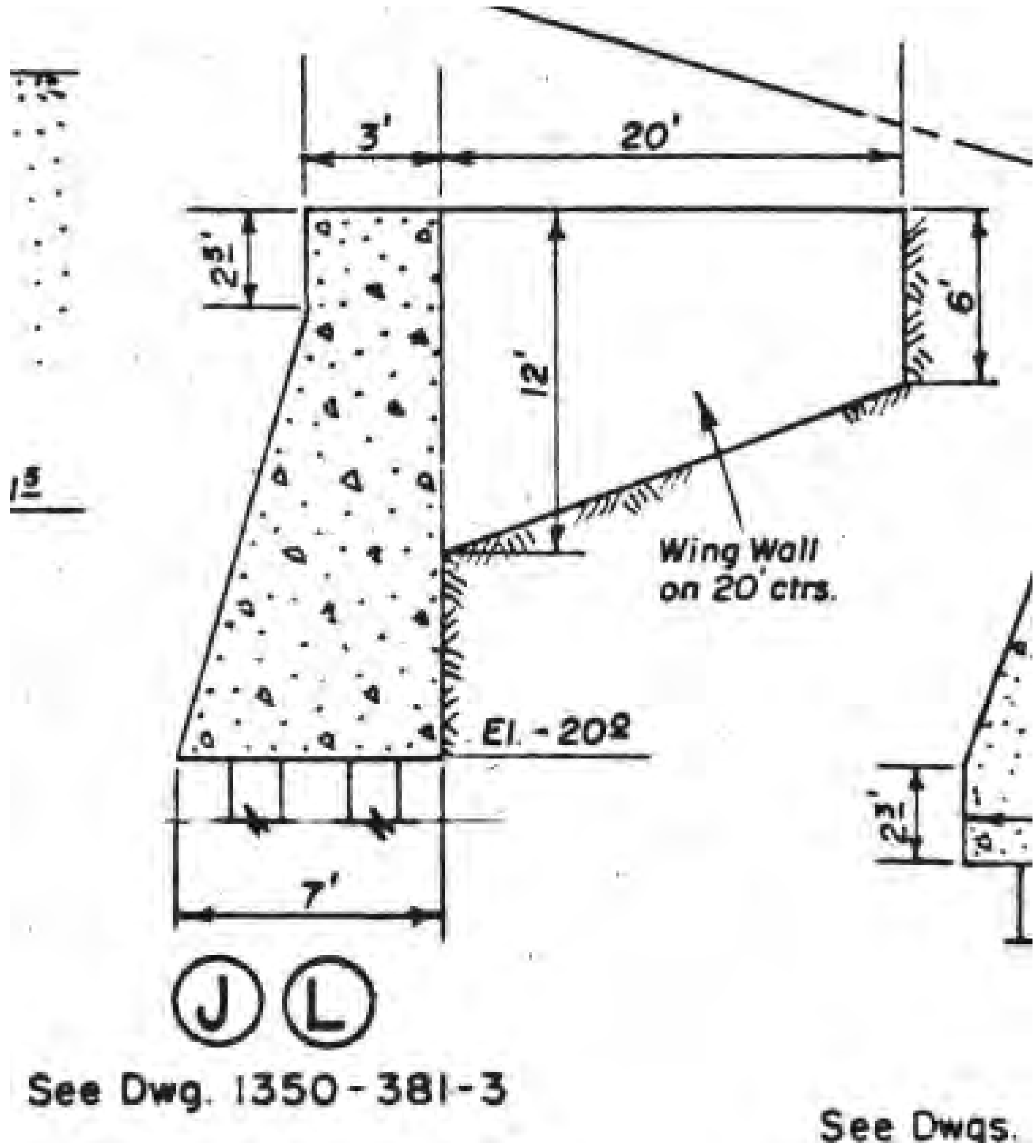


Figure 4-28: Seawall Section 11: Seawall Types J and L

4.21 Section 12 – 1167 Feet Between Fremont and King Streets

Description

The Section 12 seawall consists of two types of seawall, designated Types K and J, 12 and 20 feet high, respectively, on the original construction drawings. The two types of bulkhead walls do not appear to have been modified since their original construction but the marginal wharf between the original Piers 36 and 38 has been removed in 2013 by the Brannan Street Wharf structure construction. There is no existing substructure connected to the seawall in this seawall section.

Drawings

The POSF drawing revised in 1978, 10080-410to416-4, Details K and J, indicate the original seawall construction for this wall section. Seawall types applicable to this seawall section are Types J and K, shown on Figure 4-29 and Figure 4-28.

Technical Reports

None.

Section Seawall Data Summary

According to record drawings in our possession, this section of seawall originally sat on a rock dike 20 to 30 feet high with an estimated bayside slope of 1H:1V. The top of rock dike elevation on the Type J and K is presently not available to us. Condition surveys (2009) prior to the Brannan Street Wharf construction showed this elevation to vary but this has not been confirmed since the new wharf construction. Record drawings for Pier 38/40 indicate a top of dike elevation on the seawall of -9.5 feet (City Datum)

This section of seawall originally consisted of two types of pile supported concrete bulkhead seawall, designated Type K and Type J on the original construction drawings.

The Type K concrete bulkhead wall is 12 feet high with wall thicknesses varying from 2'-0" at the top of the wall to 4'-0" at the bottom of the wall. No supporting piles are indicated. This bulkhead type has reinforced concrete wing walls, average height 5'-0", 20-feet length, 2'-0" thick and spaced at 20 feet centers. The presence of wing wall supporting piles is indicated but all other supporting pile data is unknown.

The Type J concrete bulkhead wall is 20 feet high with wall thicknesses varying from 3'-0" at the top of the wall to 7'-0" at the bottom of the wall. Two rows of timber piles are indicated. The pile size, spacing between piles and pile rows, and the pile lengths are not indicated. This bulkhead type has reinforced concrete wing walls, average height 9'-0", 20-feet length, and spaced at 20 feet centers. The wing wall thickness and the presence of wing wall supporting piles is unknown.

Section Marginal Wharf Data Summary

No marginal wharf exists at the Type K seawall section. The Brannan Street Wharf structure is not structurally connected to the seawall and would not provide significant structural support for the seawall.

A marginal wharf with about 10 feet wide exists at the Type J seawall section at Piers 38 and 40. Pier 40 marginal wharf is supported by 18-inch square concrete piles at 11 foot spacing, each way. Pile reinforcement and length data is not available. The marginal wharf is assumed to be the same at Pier 38.

Section Finger Pier Data Summary

The Brannan Street Wharf, constructed in 2013, and Piers 38 and 40 are located in this seawall section.

The Brannan Street Wharf structure is not structurally connected to the seawall and would not provide significant structural support for the Type K seawall.

Pier 38 is supported by concrete cylinders with a cylinder base structure at 13'-4" by 15'-0" spacing. Pile size, reinforcement and length data are not available. Pier 40 data is assumed similar. This data would apply to the Type J seawall.

Section Structural Data Gaps

- Rock dike constructed width at base, top of dike elevation at seawall.
- Seawall Type K wing wall supporting pile size, reinforcement, pile lengths and material strength data.
- Seawall Type J supporting pile size, pile and pile row spacing, pile lengths and material strength data.
- Marginal wharf at Type J seawall, pile reinforcement, length and material strength data.
- Pier 38 and 40 cylinder pile size, reinforcement, length and material strength data.

If data is not available, data will be assumed based on seawall sections of similar construction period and design.

Assumed Data for Data Gaps

Unless revised by additional data, the following will be assumed for data gaps applicable to this seawall section:

1. Concrete material strength data will be based on typical values applicable to the time of construction, i.e., design concrete strength of 5,000 psi and reinforcing yield strength of 33,000 psi.
2. The top of rock dike on the face of the Types K and J seawalls will be assumed at Elevation -9.5 feet (City Datum). Rock dike constructed width at base will be based on assumed dike height, slope and top of dike elevation.
3. Seawall Types K and J supporting piles will be assumed to be 16-inch diameter timber piles, longitudinally spaced at 8 feet centers with row spacing scaled from available drawings (or three pile diameters), and of sufficient length to not control seismic stability of the seawall.

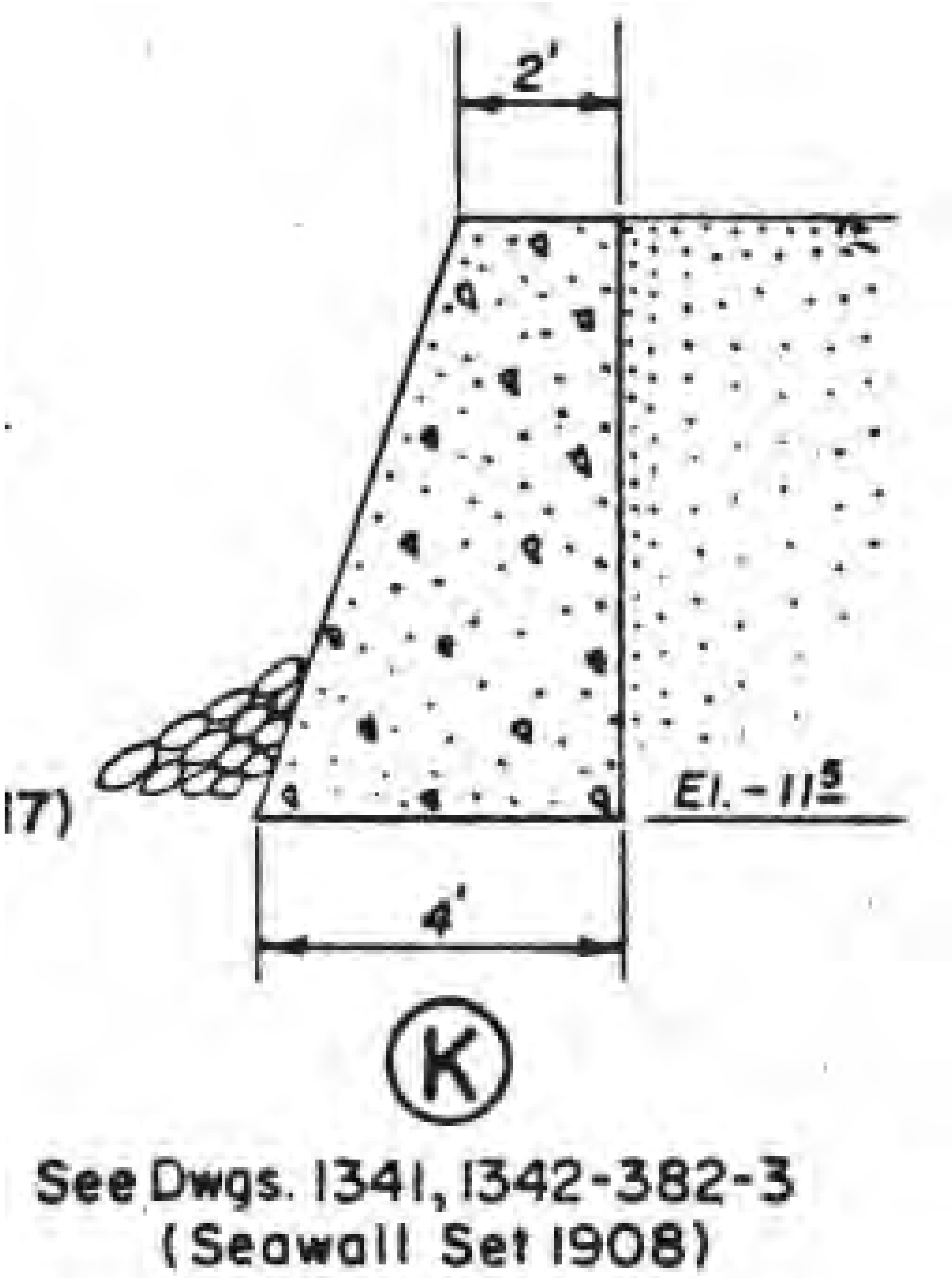


Figure 4-29: Seawall Section 12: Seawall Type K

4.22 Section 13 – 600 Feet Between King and Berry Streets

Description

Seawall Section 13 originally consisted of one type of seawall, designated Type I on the original construction drawings. This seawall type consists of a pile-supported concrete bulkhead wall about 9.5 feet high from top of rock dike to bottom of wharf deck. This seawall originally fronted a marginal wharf and Pier 42.

These substructures have since been removed and there is no marginal wharf or pier structure presently existing in this seawall section.

Drawings

The POSF drawing revised in 1978, 10080-410to416-4, Detail I, indicates the original seawall construction for this wall section. This seawall Type I is shown on Figure 4-30.

Technical Reports

None.

Section Seawall Data Summary

According to record drawings in our possession, this section of seawall originally sat on a rock dike with an estimated bayside slope of 2H:1V. The top of rock dike elevation on the Type I is indicated to be Elevation -5.0 feet (City Datum). The rock dike height and width data is not presently available to us.

This section of seawall originally consisted of one t ype of pile supported concrete bulkhead seawall, designated Type I on the original construction drawings. This Type I concrete bulkhead wall is 10 feet high with a top of wall thicknesses of 1'-4". The bottom of wall thickness is presently not available to us. A single row of piles is indicated. The pile type, size, spacing between piles, and the pile lengths are not indicated. No wing walls are indicated.

Section Marginal Wharf Data Summary

No marginal wharf exists at this seawall section.

Section Finger Pier Data Summary

No finger piers exist at this seawall section.

Section Structural Data Gaps

- Rock dike constructed height and width at base.
- Seawall Type I supporting pile type, size, pile spacing, pile lengths and material strength data.
- Marginal wharf: none needed.
- Finger piers: none needed.

If data is not available, data will be assumed based on seawall sections of similar construction period and design.

Assumed Data for Data Gaps

Unless revised by additional data, the following will be assumed for data gaps applicable to this seawall section:

1. Concrete material strength data will be based on typical values applicable to the time of construction, i.e., design concrete strength of 5,000 psi and reinforcing yield strength of 33,000 psi.
2. Rock dike constructed height and width at base will be assumed to not control seismic stability of the seawall.

3. The seawall bottom width will be assumed based on a 6V:1H slope of the bulkhead face. This results in a minimum bottom width of 3 feet
4. Seawall Type I supporting piles will be assumed to be 16-inch diameter timber piles, spaced at 8 feet centers, and of sufficient length to not control seismic stability of the seawall.

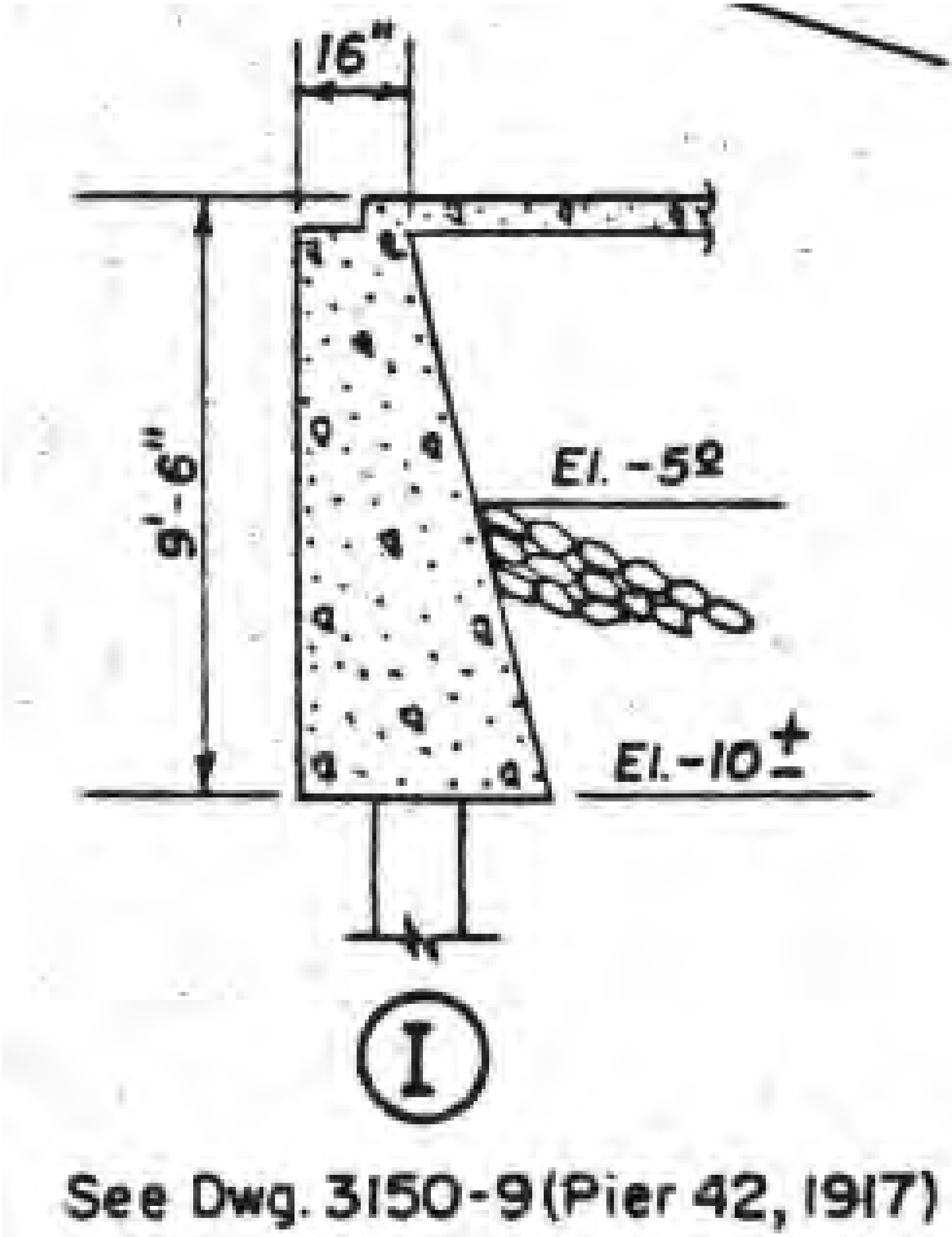


Figure 4-30: Seawall Section 13: Seawall Type I

4.23 Section P46-AT&T Park – 1240 Feet Between Berry Street and Third Street Bridge (China Basin Channel)

Description

Seawall Section P46 originally consisted of up to seven different types of seawall types, designated Types H through B on the original construction drawings. These seawall types consisted of various cutoff and bulkhead wall configurations, all very different in form as a function of the presence of fronting Piers 44, 46A and 46B.

These substructures have since been removed and there is no marginal wharf or pier structure presently existing in this seawall section. The seawall structures were most likely modified or replaced as a part of the construction for the new AT&T Park.

Drawings

The POSF drawing revised in 1978, 10080-410to416-4, Details B through H, indicate the original seawall construction for this wall section. Seawall types applicable to this seawall section are shown on Figures 4-31 through 4-36.

Technical Reports

None.

Section Seawall Data Summary

No data on the original rock dike is presently available to us for the original Type H, G, C, and B seawalls. The original Type D seawall had revetment placed at the dredge line at Elevation -50 feet at a 1.5H:1V slope to about Elevation -38 feet on the sheet pile wall.

The original seawall Type H, originally fronting Pier 44,l consists of a 6-inch thick cutoff wall that is 5 feet high. The cutoff wall is supported by piles of unknown type, size, length and spacing. This seawall most likely has been replaced or modified during the construction of AT&T Park and/or the South Beach marina.

The original seawall Types F and G, originally fronting Pier 46A consists of a concrete frame complex with a 12- and 8-inch thick concrete bulkhead wall supported by piles. The bottom of the bulkhead wall is at Elevation -14.83 feet (City Datum). The pile type and size are not shown but the pile dimension scales to about 18 inches. This seawall most likely has been replaced or modified during the construction of AT&T Park and/or the South Beach marina.

The original seawall Type E consists of 16-inch concrete sheet piling with a 24-inch square concrete pile cap and a 3-foot square concrete wale beam that is 4.5 feet below the pile cap. This concrete sheet piling length is unknown. This seawall may have been replaced or modified during the construction of AT&T Park and adjacent promenade.

Seawall Types D, C and B originally fronted Pier 46B. The original seawall Type D consists of a concrete sheet pile with the bottom of the sheet pile below Elevation -50.0 feet (City Datum). The thickness of the concrete sheet pile is not indicated but scales to about 2 feet. This seawall may have been replaced or modified during the construction of AT&T Park and adjacent promenade.

The original seawall Type C consists of a 12-inch thick precast arched wall, top of wall Elevation at El. 0.0 feet (City Datum), bottom of arched wall elevation is not known but scales to Elevation -17 ft. This seawall may have been replaced or modified during the construction of AT&T Park and adjacent promenade.

The original seawall Type B consists of 16-inch concrete sheet piling that supports the concrete deck at Elevation 0.0 (City Datum). This concrete sheet piling is 35 feet long. This seawall may have been replaced or modified during the construction of AT&T Park and adjacent promenade.

Section Marginal Wharf Data Summary

There are no existing marginal wharfs at this seawall section. The supported finger piers have been removed.

Section Finger Pier Data Summary

There are no existing finger piers at this seawall section. Piers 44, 46A and 46B have been removed.

Section Structural Data Gaps

- Existing rock dike height, width at base, bayside slope, and elevation of top of rock dike.
- Seawall Types H, through B: revised structure design and construction including, but not limited to, material strength data, concrete size, thickness, reinforcement, length and spacing, due to new construction for AT&T Park and adjacent promenade.
- Marginal wharf: none needed.
- Finger piers: none needed.

If data is not available, data will be assumed based on seawall sections of similar construction period and design.

Assumed Data for Data Gaps

Unless revised by additional data, the following will be assumed for data gaps applicable to this seawall section:

1. Concrete material strength data will be based on typical values applicable to the time of construction, i.e., design concrete strength of 5,000 psi and reinforcing yield strength of 33,000 psi.
2. Rock dike constructed height and width at base will be assumed to not control seismic stability of the seawall.
3. The seawall bottom width will be assumed based on a 6V:1H slope of the bulkhead face. This results in a minimum bottom width of 3 feet

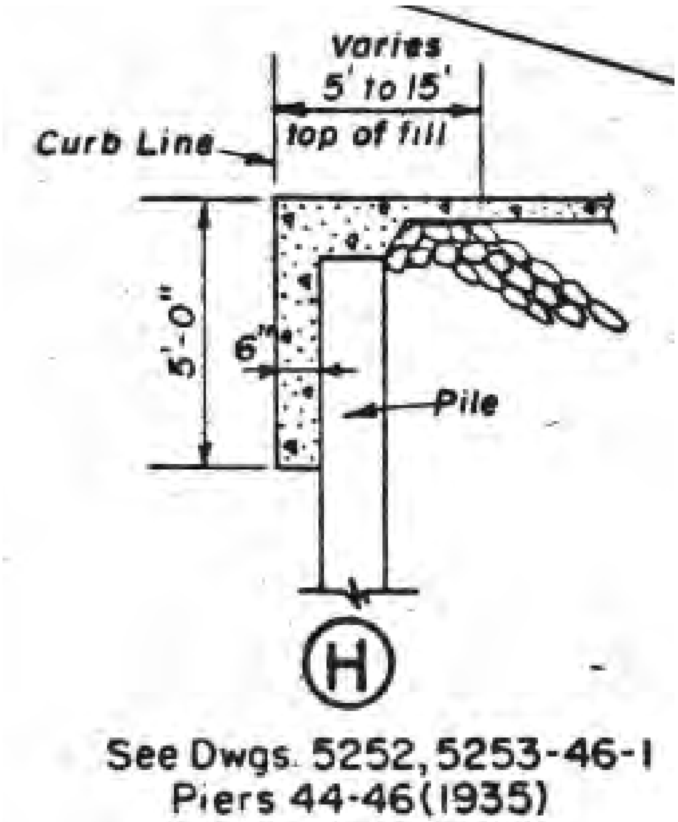


Figure 4-31: Seawall Section P46: Seawall Type H

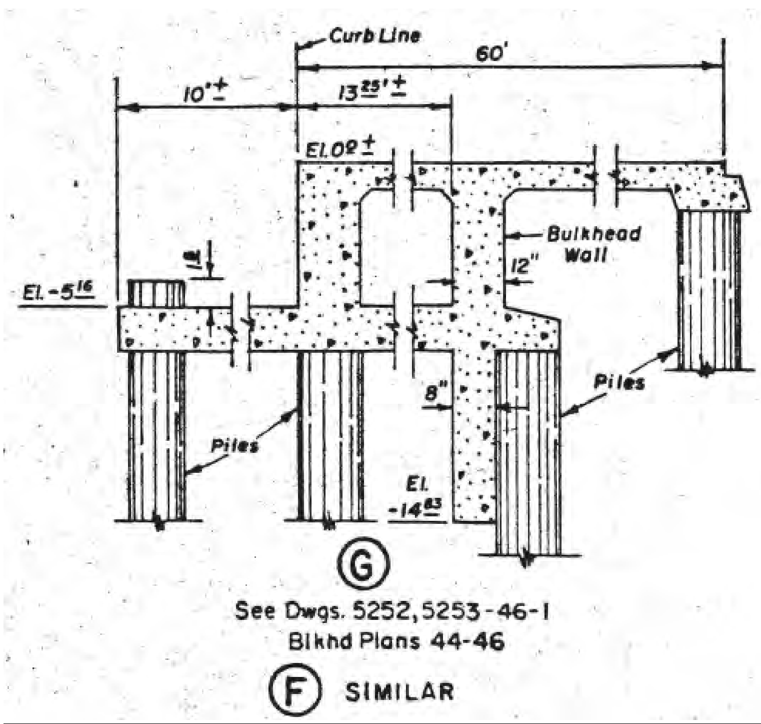


Figure 4-32: Seawall Section P46: Seawall Types F and G

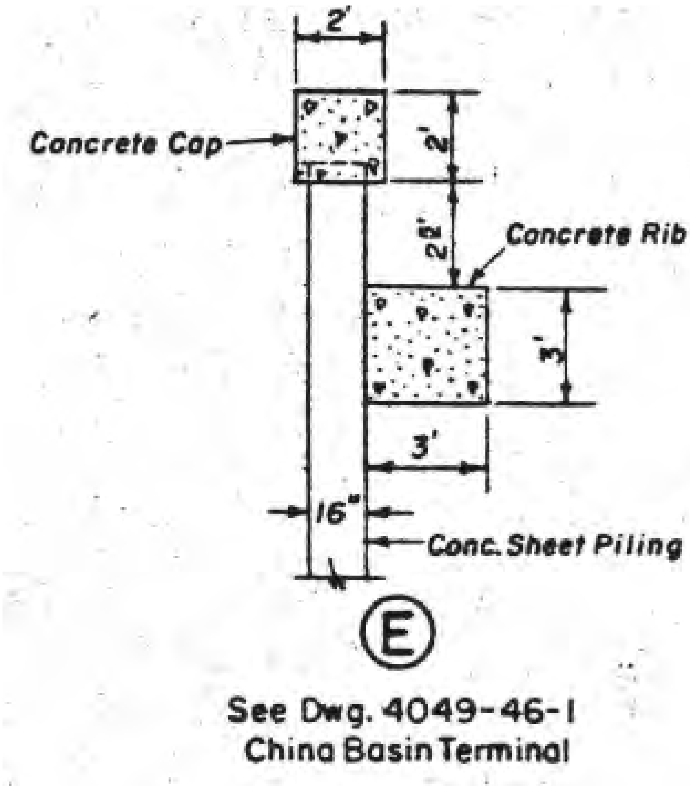


Figure 4-33: Seawall Section P46: Seawall Type E

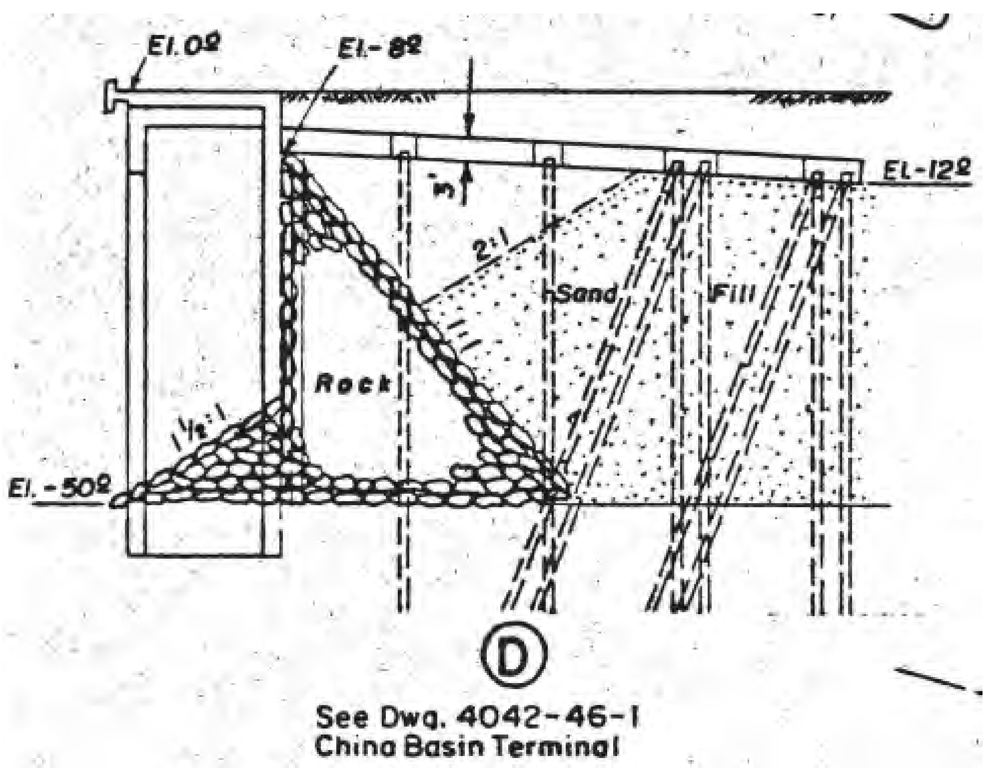


Figure 4-34: Seawall Section P46: Seawall Type D

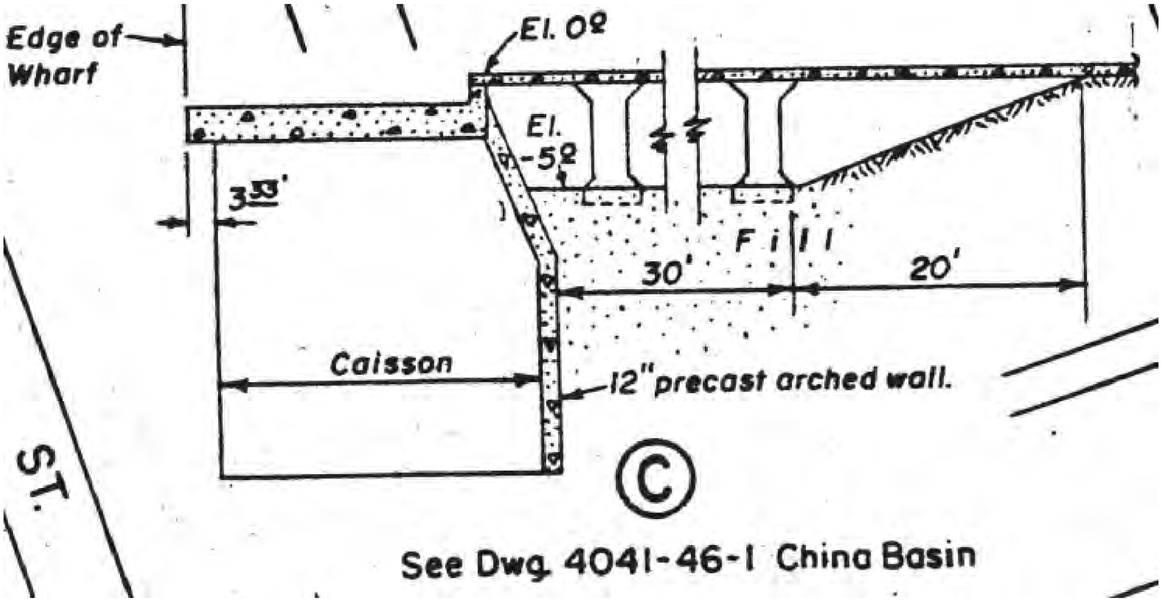


Figure 4-35: Seawall Section P46: Seawall Type C

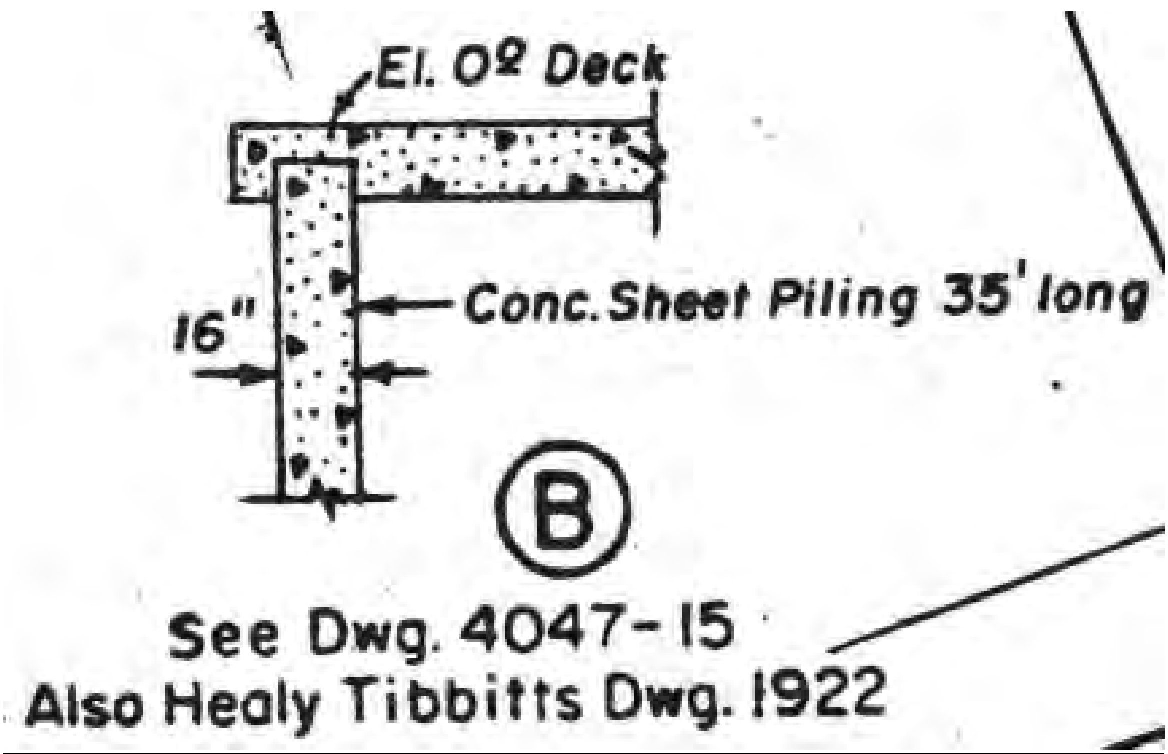


Figure 4-36: Seawall Section P46: Seawall Type B

4.24 References

The following documents were reviewed during the structural research, data collection and synthesis phase of this study:

California Building Standards Commission, “2013 California Building Code (CBC),” California Code of Regulations, Title 24, Parts 1 and 2, 2013.

International Code Council, “2012 International Building Code (IBC),” 2012.

5. Utilities Research, Data Collection and Synthesis

Telamon Engineering Consultants Inc (TECI) performed the utilities vulnerability research, data collection and synthesis for Phase 1 of this study.

5.1 General

For the infrastructure utility systems study, TECI is to compile existing utility information within the zone of influence, identifying critical utilities and their vulnerability due to earthquake, settlement and flooding as defined by the project.

Initially, TECI has prepared a draft Notice of Intent and an exhibit showing the influence zone in preparation to request for Utility Information for this project. As indicated by the Port, SFDPW has formed a Lifeline Council that is performing similar earthquake vulnerability study for the downtown area. TECI was directed to coordinate and combine our effort in obtaining the existing utility information for both the downtown area and the influence zone for our project. The team has prepared and forwarded a modified zone of influence map for DPW to include in their request for existing utility information.

5.2 Data Obtained

TECI gathered available in-house existing utility data from project that TECI was part of, including Pier 27, Pier 29 and Central Subway Phase 3 study.

6. Flooding Vulnerability Research, Data Collection and Synthesis

Environmental Science Associates (ESA) performed the flooding vulnerability research, data collection and synthesis for Phase 1 of this study.

6.1 Introduction

The vulnerability of the San Francisco waterfront to flooding and inundation will be evaluated for different seismic scenarios that could occur for both existing and future conditions with sea level rise. The assessment will utilize prior studies completed for the Port and the City and County of San Francisco, as well as recently adopted guidance for incorporating sea level rise into planning in San Francisco, to define the existing and future flood elevations, extents and pathways. Refinements to these data will be performed to best represent the potential impacts of different combinations of sea level rise, storms, and intact or deformed seawall and its zone of influence. Flood vulnerability will be measured on a semi-quantitative basis using criteria that will be developed during the study in collaboration with the project team and the Port of San Francisco.

The approach to evaluating the flood vulnerability along the San Francisco waterfront will comprise selecting flood elevations and estimating the approximate extents of flooding for the conditions of an intact seawall and a damaged seawall associated with seismic scenarios. The increase in risk over time will be assessed by considering sea level rise amounts consistent with City guidance at 2050 and 2100. Still water level (SWL) elevations and wave runup heights along the study area will be derived using the SFPUC (2014) and URS and AGS (2012) mapping and tabulations of values.

The following sections are organized as follows:

- Section 6.2 Key Terminology, Datums, and Extreme Values: presents a summary of the tidal elevations and extreme water levels along the San Francisco waterfront, as well as defining terminology that is used in coastal flooding and vulnerability assessments;
- Section 6.3 Jurisdiction, Policy, and Sea Level Rise Guidance: presents a description of pertinent policies and guidance for incorporating sea level rise into planning, sea level rise projections, and defines vulnerability and risk terminology;
- Section 6.4 Available Maps and Data Products: summarizes available coastal flood maps and data for existing and future conditions with sea level rise along the San Francisco waterfront;
- Section 6.5 Approach to Assessing Flooding Vulnerability: describes the proposed approach that will be used to evaluate the vulnerability of the San Francisco waterfront to flooding for existing and future conditions with sea level rise.

6.2 Key Terminology, Datums, and Extreme Values

This section presents a description of the terminology used in coastal flooding analysis, tidal datums and elevations used along the San Francisco waterfront, and extreme values of water levels and wave runup elevations.

Coastal Flooding Terminology

Coastal flooding is caused by a combination of tides, storm surge, and the effects of waves, including wave setup and wave runup (Figure 6-1). These physical processes are derived from measurements of water levels and waves and from hydrodynamic models. Flood elevations are typically reported using the following terminology (FEMA 2005):

- The still water level (SWL) is the elevation of the free surface in the absence of waves and wave effects, and includes the astronomical tide, El Nino, and surge due to wind effects
- Wave setup is the additional elevation of the water level due to the effects of transferring wave-related momentum to the surf zone
- Wave runup is the the vertical extent of wave uprush on the shore or a structure
- The total water level (TWL) is the sum of the SWL, the wave setup, and wave runup

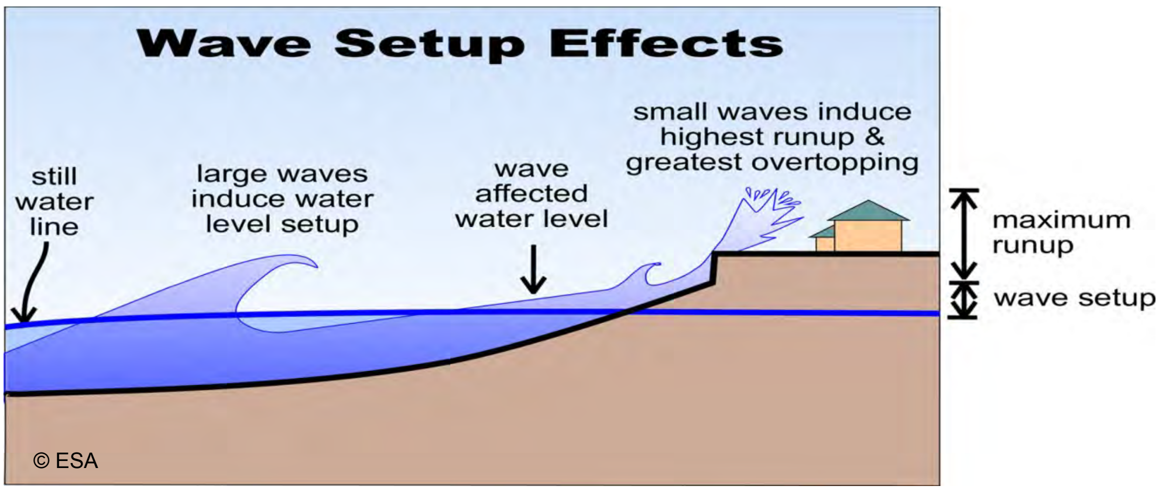


Figure 6-1: Diagram illustrating the still water level (SWL), wave setup, and wave runup: The total water level (TWL) is the elevation of the maximum wave runup

Recurrence frequencies are commonly used to describe the probability of an extreme event occurring within a given time period. The return period, or recurrence interval, is an estimate of the likelihood of an event and is based on the probability that the given event will be equaled or exceeded in any given year. For example, the 100-year SWL is the flood level that has a 1% chance of being equaled or exceeded in any given year. Similarly, the 100-year TWL can be calculated, although the 1% TWL does not correspond to any single physical event. Rather, it is an extrapolation of the TWL conditions from the largest events because of the limited duration of the available data (FEMA 2005). Wave overtopping occurs if the TWL exceeds the backshore elevation. The TWL primarily depends on the water level, wave conditions, and the beach face or structure slope.

Datums

Water levels are commonly referenced to two datums along the San Francisco waterfront: NAVD88 and the San Francisco City Datum. Published tidal datums derived from water level of measurements at the San Francisco Presidio tide gage (NOAA NOS Station 9414290) can be converted from NAVD88 to the San Francisco City datum by subtracting 11.326 feet (Table 6-1). This report presents existing and future water surface elevations in feet relative to NAVD88.

Table 6-1. Summary of tidal datums from the San Francisco Presidio tide gage, NOAA NOS Station 9414290, relative to NAVD88 and the San Francisco City Datum

Datum	NAVD88 (feet)	SF City Datum (feet)**
SF City Datum	11.326	0
Highest Observed Water Level (1/27/83)	8.72	-2.606
Mean Higher High Water (MHHW)	5.92	-5.406
Mean High Water (MHW)	5.31	-6.016
Mean Tide Level (MTL)	3.26	-8.066
Mean Sea Level (MSL)	3.20	-8.126
NGVD29	2.72	-8.606
Mean Low Water (MLW)	1.22	-10.106
Mean Lower Low Water (MLLW)	0.08	-11.246
NAVD88	0	-11.326
Lowest Observed Water Level	-2.82	-14.146

- *** Conversion from NAVD88 to SF City Datum based on: SF City Datum = 11.326 feet NAVD88*

Extreme Values

Several studies have estimated extreme values of water levels in San Francisco Bay (USACE 1984; PWA 2007; DHI 2011; URS and AGS 2012; SFPUC 2014). Although these studies rely on measurements at the Presidio tide gage, the extreme values differ due to differences in the methods used:

- Length of time series: studies for FEMA and SFPUC used shorter time series of 30 years (DHI 2011), whereas studies for the Port and the State considered the full record extending to 1901
- Extreme value distribution: URS and AGS (2012) fit a Weibull distribution to the data and DHI (2011) fit a GEV distribution to the shorter time series, which gives higher values.

The 100-year SWL of 9.2 to 9.3 feet NAVD was reported by the study for the Port (URS and AGS 2012). In the study for FEMA, DHI (2011) reported 100-year SWL of 9.6 to 9.8 feet NAVD, approximately 0.5 feet higher than the value developed using the longer time series and less conservative extreme value distribution. The future extreme SWL is typically calculated by adding the sea level rise amount to the extreme still water level for existing conditions and is described further in Section 6.4.3.

The existing 100-year TWL was estimated along the waterfront for the Port (URS and AGS 2012). TWL values up to 13.2 feet NAVD were reported in areas exposed to longer fetches and predominant wind directions. The mapping products and future TWL is described further in Section 6.4.3.

6.3 Jurisdiction, Policy, and Sea Level Rise Guidance

Guidance for assessing the risks of sea level rise has been issued by the State of California as well as the City and County of San Francisco. The guidance generally presents projections of sea level rise through 2100, and describes recommended methods for evaluating risk and incorporating sea level rise into planning. Summaries of guidance recently adopted by the City and County of San Francisco and issued by the State of California are presented below.

Guidance for Incorporating SLR into Capital Planning: OneSF (CCSF 2014)

As part of the City and County of San Francisco's *OneSF*[1] program, new sea level rise guidance was adopted by the City to require that sea level rise is incorporated into the capital planning and projects that could be impacted by sea level rise. The program recommends using sea level rise values of 1 foot and 3 feet for the years 2050 and 2100, respectively, which are considered mid-range but likely by guidance established by the State (OPC 2013). The program recommends using the SFPUC (2014) inundation mapping to evaluate the impacts to projects and established guidelines for assessing the risk of sea level rise largely consistent with requirements of the San Francisco Bay Conservation and Development Commission (BCDC) and the California Coastal Commission (CCC).

State of California Sea Level Rise Guidance Document (OPC 2013)

On March 15, 2013, the Ocean Protection Council (OPC) staff presented an update to the *State of California Sea-Level Rise Interim Guidance Document*. The purpose of the document remained the same, to help state agencies incorporate future sea-level rise impacts into planning decisions, and was updated to include the best available science from the National Academy of Sciences: Sea-Level Rise for the Coasts of California, Oregon, and Washington (NRC 2012). The guidance document seeks to enhance consistency across agencies as each develops its respective approach to planning for sea level rise. Table 6-2 summarizes the recommended sea level rise projections for use along the coast of California.

Table 6-2. Recommended Sea Level Rise Projections by NRC (2012)

Time Period	Sea Level Rise Ranges	Mid-level Projection**
2000-2030	2 - 12 inches	6 ± 2 inches
2000-2050	5 - 24 inches	11 ± 4 inches
2000-2100	17 - 66 inches	36 ± 10 inches

- *** The mid level curve is referred to as a "projection" in some parts of the NRC (2012) report but is not referred to as such in the OPC (2013) State guidance adopting the NRC (2012) report. OneSF emphasizes the mid-level as a projection. However, the USACE, State, BCDC and CCC have not yet adopted this distinction and have maintained a range.*

The OPC's 2013 *California Sea Level Rise Guidance Document* contains seven recommendations for incorporating sea level rise into project planning:

4. Use sea level rise projections from the December 2009 Proceedings of National Academy of Sciences, along with agency- and context-specific considerations of risk tolerance and adaptive capacity;
5. Consider timeframes, adaptive capacity, and risk tolerance when selecting estimates of sea level rise;
6. Coordinate with other state agencies when selecting sea level rise projections, and use the same projections, where feasible;
7. Do not base future sea level rise projections on linear extrapolation of historic sea level observations;
8. Consider trends in relative local mean sea level;

[1] City and County of San Francisco's OneSF program: http://onesanfrancisco.org/

9. Consider storms and extreme events; and
10. Consider changing shorelines.

The guidance document is expected to be updated regularly, to keep pace with scientific advances associated with sea level rise. This guidance is generally considered to be based on the best scientific data available as of the date of this summary, and is used by BCDC when reviewing projects planned for the shoreline within BCDC's jurisdiction.

6.4 Available Maps and Data Products

Several studies have been conducted that evaluate the existing and future flood risk along the San Francisco Waterfront. The sections below present summaries of available coastal flood and sea level rise maps and data products developed for the following:

- FEMA preliminary flood maps and San Francisco Interim Flood Plain Maps
- SFPUC SSIP Sea Level Rise Inundation Mapping (SFPUC 2014)
- Sea level rise mapping for the Port of San Francisco (URS and AGS 2012)

100-year Flood Zones from San Francisco Interim Flood Plain Maps

The Federal Emergency Management Agency (FEMA) released a preliminary Flood Insurance Rate Map (FIRM) for the City and County of San Francisco on September 21, 2007, which includes approximate designations of property in coastal flood hazard zones for existing conditions. The preliminary FIRM shows Special Flood Hazard Areas within the City as:

- Zone A: areas of coastal flooding with no wave hazard; or waves less than three feet in height; and
- Zone V: areas of coastal flooding subject to the additional hazards associated with wave action.

The preliminary FIRM does not associate the Special Flood Hazard Areas with elevations, but it does provide an indication of the approximate extents of the 100-year coastal flood zone.

Based on the preliminary FIRM, the City created the "Interim Floodplain Map" to support the implementation of the Floodplain Management Ordinance.[2] The Interim Floodplain Map shows that limited areas along the waterfront are within the extents of the Special Flood Hazard Area (Figure 6-2).

FEMA is in the process of completing coastal engineering analyses and mapping of the San Francisco Bay shoreline to provide flood and wave data for the City and County of San Francisco's Flood Insurance Study (FIS) report and Flood Insurance Rate Map (FIRM) panels. Although revised preliminary maps have been prepared, the CCSF and FEMA are currently finalizing the mapping products prior to public release. However, a KMZ file is available on the FEMA website that contains Google Earth layers of designated special flood hazard zones and their elevations, which we reviewed. However, the Port of San Francisco is still reviewing the revised provisional flood hazard maps and expects them to change, and therefore does not want them used in this study.

The effects of sea level rise are not included in the FEMA data shown in Figure 6-2. The future flood limits with SLR can be calculated by adjusting the FEMA map and reevaluating the wave contributions to flooding.

[2] Floodplain Management Ordinance for the City and County of San Francisco can be accessed online: http://sfgsa.org/Modules/ShowDocument.aspx?documentid=7520

Figure 6-2: 2007 Preliminary FEMA Map (left) and 2008 San Francisco Interim Flood Plain Map (right)

SFPUC SSIP Sea Level Rise Inundation Mapping

The San Francisco Public Utilities Commission (SFPUC) recently developed SLR inundation maps for the shore of San Francisco to inform the Sewer System Improvement Program (SSIP). The maps prepared for the “Bayside” show inundation resulting from an increase in the MHHW by fixed amounts of sea level rise, and do not include the effects of wind or waves which would tend to increase the flood hazard (SFPUC 2014). The description of the analysis performed indicates that the tidal modeling using MIKE21 performed by DHI (2011) for FEMA were used to estimate tidal statistics (e.g. MHHW and extreme recurrences of the SWL). For each of the several points along the shore, tidal water levels were projected into the future by adding fixed amounts of SLR to the calculated MHHW elevation. The “future” water levels were then projected landward along transects to map the extents and depths of inundation. This process is known as a “bathtub” model, dependent on several assumptions including:

- The effects of waves and wind are not included, which tends to understate the hazard; and
- The mechanisms of flooding and drainage are simplified to allow the site to fill instantaneously, which tends to overstate the hazard.

Several model extraction points are located over the length of the study boundaries. The range in daily tidal elevation and extreme (2-, 50-, and 100-year) SWL for existing conditions reported in SFPUC (2014) are:

- Existing MHHW = 6.1 to 6.3 feet NAVD;
- Existing 2-year SWL = 7.6 to 7.9 feet NAVD;
- Existing 50-year SWL = 9.1 to 9.3 feet NAVD; and
- Existing 100-year SWL = 9.6 to 9.8 feet NAVD.

Note the 100-year SWL calculated by DHI (2011) for FEMA is approximately 0.5 foot higher than several other studies that report a 100-year SWL of 9.2 feet NAVD (USACE 1984; PWA 2007; URS and AGS 2012). This difference resulted from the statistical analysis methods used: DHI (2011) used a shorter time series of 30 years and fit a GEV distribution, which gives higher numbers, whereas the other studies used a longer data set from the Presidio tide gage and used a different extreme value distribution, yielding the 100-year SWL of 9.2 feet NAVD that is widely used and referenced.

The PUC produced maps showing inundation for different water levels. The water levels are listed in terms of Mean Higher High Water (MHHW) plus additional heights of water which are specifically 3.5 feet, 4.5 feet and 6.5 feet. In order to apply these PUC maps for this project, we will associate each map and its flood elevation to an extreme water level with a selected recurrence interval (e.g. the 100-year water level) plus sea level rise: The sea level rise is calculated by subtracting the selected extreme water level from the mapped elevation, as described below. In this way, we can convert the maps to a range of extreme water levels and sea level rise amounts (Table 6-3).

Table 6–3. Typical and extreme still water levels extracted along the study site from the SFPUC (2014) and adjusted with sea level rise

Time Horizon	Sea Level Rise Amount (feet)	Mean Higher High Water (feet NAVD)	2-year SWL (feet NAVD)	**50-year SWL (feet NAVD)**	**100-year SWL (feet NAVD)**
Existing	0	6.1 - 6.3	7.6 - 7.9	9.1 - 9.3	9.6 - 9.8
2050	1	7.1 - 7.3	8.6 - 8.9	10.1 - 10.3	10.6 - 10.8
2100	3	9.1 - 9.3	10.6 - 10.9	12.1 - 12.3	12.6 - 12.8

Subtracting the MHHW elevations for existing conditions from the extreme elevations for both existing and future conditions facilitates the identification of the appropriate mapping to be used for the particular scenario. As an example, Figures 6-2 and 6-3 present the inundation caused by the existing MHHW plus 52” and 77” of sea level rise, respectively, which are close to the calculated future SWL for the future 100-year events. The mapping of a 52” rise in sea level is representative of the 100-year SWL for the year 2050, and the mapping of 77” is representative of the 100-year SWL for the year 2100.

Due to the differences in mapping approaches and methods, the future elevations estimated using the inundation mapping can not be compared to the FEMA draft FIRM coastal flood elevation. However, the accommodation of sea level rise and other effects such as waves, or freeboard, can be approximated by subtracting the extreme 100-year SWL for existing conditions. This yields a freeboard of 1 foot and 3 feet for the 52” and 77” SLR scenarios, respectively.

Therefore, impacts shown by the 77” SLR inundation map may understate the potential hazards by allowing approximately 3 feet accommodation for the combined sea level rise and effects of waves, though may overstate the flooding extents due to the “bathtub” modeling technique.

Figure 6-3: Flood inundation mapping for the existing MHHW + 52": representative of the 100-year SWL at year 2050 (SFPUC 2014)

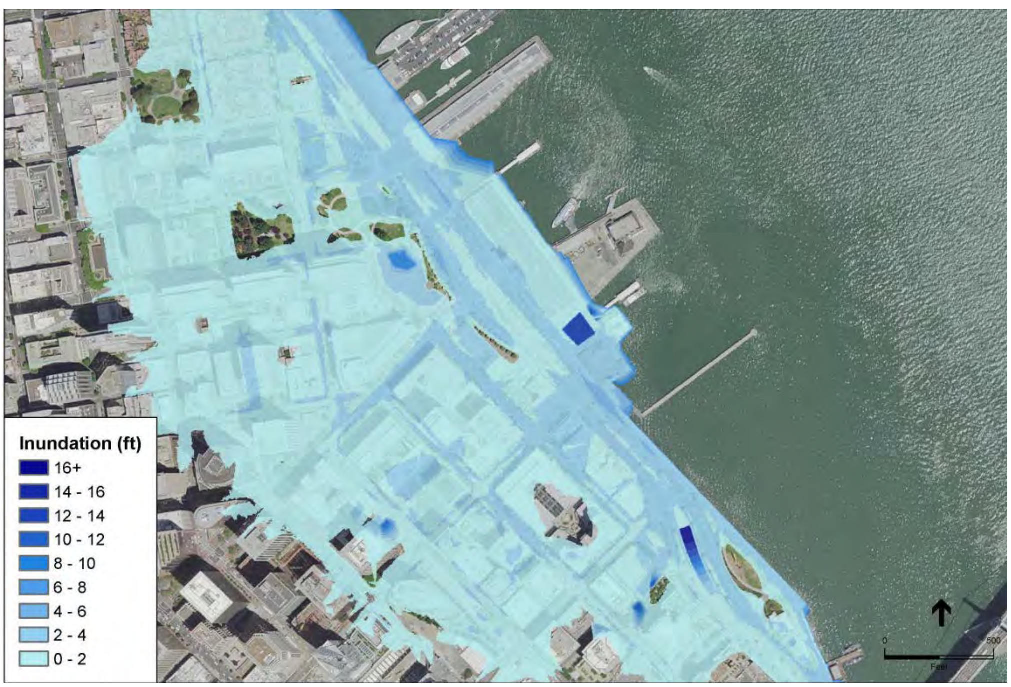


Figure 6-4: Flood inundation mapping for the existing MHHW + 77": representative of the 100-year SWL at year 2100 (SFPUC 2014)

Sea level rise mapping for the Port of San Francisco

Sea level rise and coastal flood mapping prepared for the Port of San Francisco shows the inundation of existing (2010) and future (2050 and 2100) 100-year SWL, and estimates of the 100-year total water level (TWL) along the waterfront (URS & AGS 2012). The Port of San Francisco maps differ in that the fixed amounts of SLR are tied to planning horizons and a re added t o the existing extreme 100-year SWL, rather than add a fixed amount of SLR to the MHHW or daily tidal inundation elevation. In addition, the contribution of extreme wave runup was estimated along the San Francisco waterfront for existing and future conditions, although only the extreme SWL was mapped.

Mapping of the future water levels were completed by adding 15” and 55” of SLR to the existing 100-year SWL for 2050 and 2100, respectively (Figure 6-5). The UGS & AGS (2012) study estimated the 100-year SWL to be approximately 9.2 feet NAVD along the waterfront using a MIKE21 model (different from the DHI 2011 model), more than 0.5 lower than that estimated for the FEMA study. The mapped limits shown in Figure 6-5 represent a “bathtub” projection the existing and future 100-year SWL without the effects of waves and wind. This is similar to the SFPUC (2014) study, except that an extreme event is mapped, and different values of SLR are used.

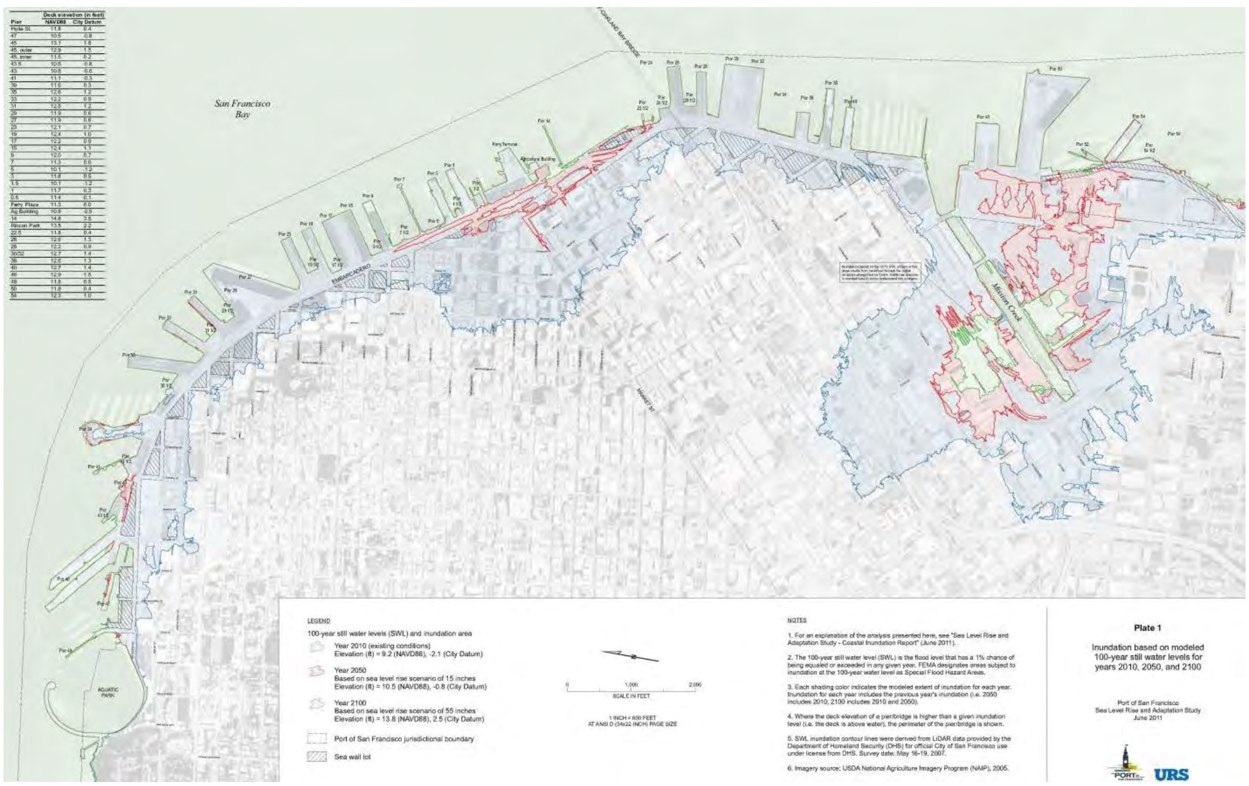


Figure 6-5: Mapping of the 100-year SWL for years 2010, 2050, and 2100 (URS & AGS 2012)

The 100-year total water levels along the waterfront were estimated for existing and f uture conditions using a t ime series methodology at several analysis points. Figure 6-6 shows the results of the TWL analysis completed for 2100. The results show that although the 100-year SWL increases by the SLR projection, the 100-year TWL increases non-linearly due to changes in the depths and resulting wave runup heights.

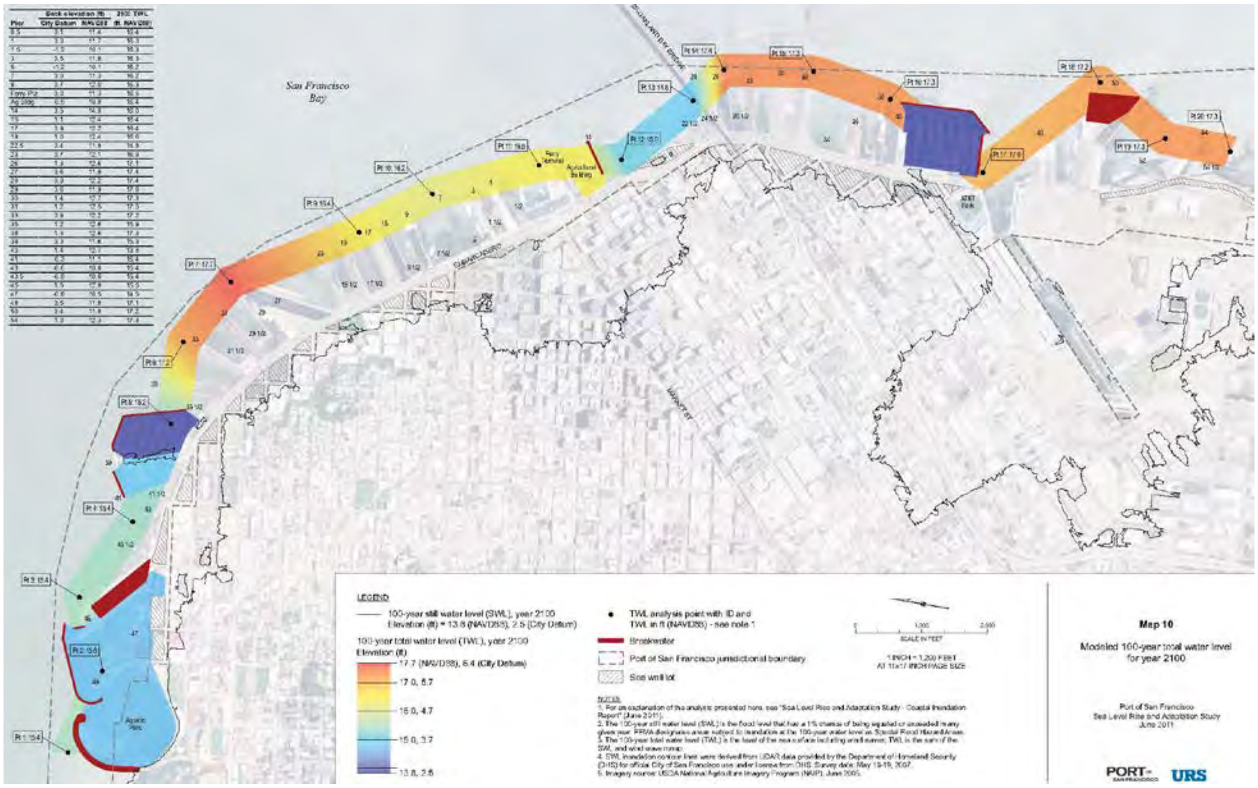


Figure 6-6: 100-year Total Water Level for years 2100 (URS & AGS 2012)

6.5 Methodology Approach

The approach to evaluating the flood vulnerability along the San Francisco waterfront will comprise selecting flood elevations and es timating the approximate extents of flooding for the conditions of an intact seawall and a damaged seawall associated with seismic scenarios. The increase in risk over time will be assessed by considering sea level rise amounts consistent with City guidance at 2050 and 2100. Still water level (SWL) elevations and wave runup heights along the study area will be derived using the SFPUC (2014) and URS and AGS (2012) mapping and tabulations of values.

Flooding conditions, including the elevation, the landward extent of inundation, average inundation depth, wave exposure and runup, will be tabulated for the seawall segments. These evaluations will be developed for typical seawall sections for intact and damaged conditions. Seawall segments will be classified and grouped by geometry and composition in order to develop typical seawall sections representative of multiple locations, which will reduce the number of calculations that are needed to provide results. The typical sections for the damaged seawall condition will be developed based on impacts of seismic scenarios, including deformed geometry of the seawall, and the depth and extents of lateral displacements and subsidence, which could result in flooding and inundation.

Flooding vulnerability will be based on a combination of the San Francisco waterfront's exposure to flooding, its sensitivity, and its adaptive capacity:

- Evaluate *exposure*: degree to which an asset is exposed (e.g., depth of flooding due to sea level rise, wave run up and/or storm surge)
- Assess *sensitivity*: degree to which an asset is affected (e.g., temporary flooding causes minimal impact, or results in complete loss of asset or shut-down of operation)

- Determine *adaptive capacity*: ability of an asset to adjust to climate change, to moderate potential damages, to take advantage of opportunities, or cope with the consequences

These criteria will consist of numeric rankings related to physical variables, including the inundation depth, the wave height and runup, and sea level rise amounts, and the approximate degree of the impacts. Numeric rankings for each variable will be developed by the team in collaboration with the Port of San Francisco, including a weighting scheme that will be used to develop a flooding vulnerability index for evaluating the seawall segments.

Similarly, the increase in flood risk associated with the seawall segments along the San Francisco waterfront over time will be estimated as a function of the flood event likelihoods and consequences. Estimates of the risk require several assumptions that will be developed by the team, including the duration that a seawall segment is damaged following a seismic event and the relative consequences between segments and seismic scenarios. The probabilities of flood events occurring within the duration that a seawall is damaged prior to repairs will be used to quantify the events' likelihoods.

Finally, adaptation strategies will be described in general terms of type of adaptation (e.g. structural) and approximate time thresholds for implementation of the adaptation strategy. This approach will be based on sea level rise adaptation approaches that were previously developed for the Port (URS and AGS 2012). Additional adaptation strategies may be developed if needed. The adaptation strategies will be informed by the vulnerability and risk estimates to help develop prioritization of improvements to seawall segments. The flood vulnerability will be incorporated into the findings of the structural and geotechnical team members to facilitate the overall seawall improvements strategies.

6.6 References

The following documents were reviewed during the flooding vulnerability research, data collection and synthesis phase of this study:

City and County of San Francisco (CCSF), 2014, Guidance for Incorporating Sea Level Rise into Capital Planning in San Francisco: Assessing Vulnerability and Risk to Support Adaptation, Prepared by the City and County of San Francisco Sea Level Rise Committee for the San Francisco Capital Planning Committee, Adopted by the Capital Planning Committee, September 22, 2014.

DHI, 2011, Regional Coastal Hazard Modeling Study for North and Central Bay, Prepared for FEMA, September 2011.

Federal Emergency Management Agency (FEMA), 2005, Final Draft Guidelines for Coastal Flood Hazard Analysis and Mapping for the Pacific Coast of the United States, prepared by FEMA Region IX, FEMA Region X, FEMA Headquarters, and FEMA Study Contractor Northwest Hydraulic Consultants, Inc., January 2005.

National Research Council (NRC), 2012, Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future, the National Academies Press, Washington, DC.

Ocean Protection Council (OPC), 2013, State of California Sea-Level Rise Guidance Document, Developed by the Coastal and Ocean Working Group of the California Climate Action Team (CO-CAT), the Ocean Protection Council's Science Advisory Team and the California Ocean Science Trust, March 2013 update.

Philip Williams & Associates, Ltd. (PWA), 2007, Flood Analyses Report, Appendix to EDAW et al. 2007, Final Environmental Impact Statement/Report, South Bay Salt Pond Restoration Project, Prepared for U.S. Fish and Wildlife Service and California Department of Fish and Game, December 2007.

San Francisco Public Utilities Commission (SFPUC), 2014, Climate Stressors and Impact: Bayside Sea Level Rise Mapping, Technical Memorandum, Prepared for San Francisco Public Utilities Commission by the Sewer System Improvement Program, Prepared by Program Management Consultant AECOM Contract CS-165, June 2014.

URS, and AGS, 2012, Sea Level Rise and Adaptation Study: Project Report Compilation, Report Prepared for the Port of San Francisco, June 29, 2012.

U.S Army Corps of Engineers (USACE), 1984, San Francisco Bay Tidal Stage vs. Frequency Study, San Francisco District U.S. Army Corps of Engineers, October 1984.

7. Economics Research, Data Collection and Synthesis

Land Use Economics (LUE) performed the economics vulnerability research, data collection and synthesis for Phase 1 of this study.

7.1 General

During Phase I of this study, Land Use Economics (LUE) has been exploring third party published documents related to measuring the economic impacts of seismic events. A full list of relevant background material is contained elsewhere in this Draft Report. What was evident in the research was that a wide variety of approaches have been used for different events, sometimes with very specific objectives that may or may not have been inclusive of all impacts. The documents catalogue various scholarly approaches since 1990. Fortunately, during the course of the research it became clear that the HAZUS model adopted by the Department of Homeland Security has become the default tool in the United States for quantifying damage from natural disasters, to include hurricanes, flooding, and seismic events. HAZUS is an overlay on top of ArcView GIS mapping software that allows for a high degree of user customization.

The HAZUS model has been used by the San Francisco Planning Department to assess potential seismic damage to over 80 specific City owned buildings, has been recently acquired for use by the Controllers' Office of Economic Analysis, and recently acquired by the Port. HAZUS has become the standard tool for uses such as this by the City and County of San Francisco, and it is the logical tool for measuring total damage as well as specific damage to Port facilities.

As described in this document, the seawall is comprised of 22 sections, each with different, unique construction characteristics. Each of those should be further subdivided into three zones including:

The middle zone including the seawall itself, the marginal wharf on top of it, and the bulkhead buildings on top of that, and including the Embarcadero public right of way.

A bay side zone including finger piers and the building structures on top of them.

Backlands that are on the inland side of Embarcadero, and which include a few Port owned seawall lots (generally used as surface parking at the moment).

As a consequence, the affected zone represents 66 input records for HAZUS, each with as many variables as needed to characterize the building sizes, types, values, uses, etc. Based on our understanding of the model structure, the level of detail in HAZUS outputs is the same as the detail in the inputs. We should be able to input 66 blocks of data into the model, it will predict the results of an earthquake, and we should be able to see the predicted outcomes separately for each of the 66 Analysis Areas.

With the help of an experienced HAZUS operator, we can export the detailed outputs into a spreadsheet format for further manipulation by LUE. In addition to the individual output for each of the 66 Analysis Areas, HAZUS will also provide some roll-up totals of direct impact (i.e., value of destruction/cost to rebuild), and indirect impacts of the loss of business effects on the larger economy. We will probably want to report on the roll-up totals in our executive summary, but much of our focus will no doubt be comparing the outputs at the 66-Analysis Areas level.

Since the data inputs can be specific to the individual buildings and tenants in each of the Analysis Areas LUE will be able to disaggregate the data and focus solely on the impact to Port owned assets. These assets include office tenants on fixed rent leases as well as operating businesses with participating lease structures. Thus, we believe the analysis should focus on two impacts: the replacement cost of existing structures, and then calculating the business interruption damage sustained by the Port. We propose this latter approach to approximate the net present value of lost revenue stemming from the interruption of normal business operations.

In order to accomplish these calculations, and to properly create the inputs for HAZUS, it is critical that we obtain from the Port detailed data on all Port assets in the Analysis Areas, including, but not limited to:

- The gross and net leasable square footage of every building in the zone of influence
- The physical type of construction material for each building, including the number of floors
- The type and mix of tenants in each building with a breakdown of leasable square footage for each
- The rent structure for each tenant, i.e. fixed or percentage based, and/or total rent actually collected by the Port for some recent time period
- The typical annual occupancy for each asset (assumes some tenant turnover)
- Size and revenue factors for Port properties that are not based on building areas, such as parking lots (e.g., total square footage, number of spaces, rent collected, etc.)

7.2 References

The following documents were reviewed during the economics research, data collection and synthesis phase of this study:

Voluntary Seismic Strengthening of Soft-Story, Wood –frame Buildings: Economic Impact Report; Controller's Office of Economic Analysis, January 8, 2010.

Here Today-Here Tomorrow: The Road to Earthquake Resilience in San Francisco: Applied Technology Council, 2010.

Hazus (HAZ United States) Analysis for the City and County of San Francisco's High Priority City Owned Buildings, MMI Engineering.

San Francisco Commerce & Industry Inventory, November 2012.

Catalog of Residential Depth-Damage Functions, US Army Corps of Engineers.

Downton Plan Annual Monitoring Report, 2012; San Francisco Planning Department.

Downtown Annual Report, 2013, San Francisco Data.

Flooding Vulnerability Assessment for The Portland Society for Architecture and the City of Portland, Catalysis Adaptation Partners LLC, 2012.

Hazus2 MH Data Dictionary.

Hazus- MH MR5 Advanced Engineering Building Module (AEBM), Department of Homeland Security, Federal Emergency Management Agency Mitigation Division.

In Search of a Common Methodology on Damage Estimation, Workshop Proceedings, European Commission DG Joint Research Centre, 2003.

Economic Impacts of the Loma Prieta Earthquake: A Focus on Small Business, U.C. Transportation Center and the Center for Real Estate and Urban Economics, University of California at Berkeley, January 1991.

Lifelines Interdependency Study 1 Report, The Lifelines Council, City and County of San Francisco, April 2014.

Hazards Risk Assessment/HAZUS, National Institute of Building Sciences, 2011.

Direct Economic Losses in the Northridge Earthquake: A Three Year Post Event Perspective; Earthquake Spectra, May 1998.

Northern Waterfront Seawall: History, Performance and Future Challenges, Capital Planning Committee, Port of San Francisco, September 2014.

Analysis Certificates of Participation to Fund the Moscone Expansion Project: Economic Impact Report, Controller's Office of Economic Analysis, January 30, 2012.

Economic Impact of Sea level Rise to the City of Los Angeles, Price School of Public Policy and Center for Risk and Economic Analysis of Terrorism Events, University of Southern California, January 27, 2013.

Guidance for Incorporating Sea Level Rise into Capital Planning in San Francisco, City and County of San Francisco, Sea Level Rise Committee for the San Francisco Capital Planning Committee, September 22, 2014.

8. Recommendations, Conclusions, and Assumptions

The following conclusions and recommendations are presented based on the research, data collection and synthesis phases of this project for each discipline.

8.1 Geotechnical Research and Data Results

Recommendations

Although our research continues, the JV team does not see a need for additional subsurface information to fill any data gaps. For a broad-based study, the existing subsurface information is sufficient. It is unlikely, though possible, that additional subsurface information will be required for seawall sections that are studied more rigorously. This is because of the extensive database of existing subsurface information and the wealth of prior knowledge regarding the seismic behavior of loose sands prone to liquefaction and of young bay mud. Of course, any engineering projects or soil improvement projects that follow this initial earthquake vulnerability study will require site-specific subsurface information for design and construction purposes.

Conclusions

The existing subsurface information along the Northern Waterfront Seawall, along the finger piers, and within the Seawall Zone of Influence is quite extensive. The JV team has catalogued approximately 500 exploration locations in an Excel spreadsheet and into a GIS database. This amount of data is sufficient to develop seawall section groupings and to evaluate geotechnical performance including ground motions and earthquake-induced ground hazards such as liquefaction, lateral spreading, permanent ground deformations and slope stability during the Phase 2 earthquake vulnerability study. Several sources of data have been identified that have not been obtained thus far, and the JV team will continue to attempt to obtain these additional geotechnical reports.

8.2 Structural Research and Data Results

Recommendations

The JV team is continuing its research to complete as much missing structural data as possible. Where data continues to be incomplete and can be field determined, it is recommended that the JV team perform site visits with Port assistance to quantify such missing data.

Conclusions

Given the dates of original construction and the variations in both originally designed, as-built and subsequently modified seawall and associated structure components, the available structural data is relatively complete with a majority of data items presently quantified. The JV team is continuing its research to complete missing data. Data gaps occur for specific seawall sections as shown on Figure 4-1.

Assumptions

The original dates of construction range from 1878 to 1931. Generally materials of construction are not shown on the record drawings. Where needed for this study, concrete material strength data will be based on typical values applicable to the time of construction, namely:

1. design concrete 28-day compression strength of 5,000 psi
2. design concrete reinforcing steel yield strength of 33,000 psi.
3. design timber pile (Douglas Fir equivalent), fy (bending) = 1800 psi

Other missing data will be assumed based on available data on other similar sections as deemed appropriate.

Conclusions

For the infrastructure utility systems study, TECI is to compile existing utility information within the zone of influence, identifying critical utilities and their vulnerability due to earthquake, settlement and flooding as defined by the project.

Initially, TECI has prepared a draft Notice of Intent and an exhibit showing the influence zone in preparation to request for Utility Information for this project. As indicated by the Port, SFDPW has formed a Lifeline Council that is performing similar earthquake vulnerability study for the downtown area. TECI was directed to coordinate and combine our effort in obtaining the existing utility information for both the downtown area and the influence zone for our project. The team has prepared and forwarded a modified zone of influence map for DPW to include in their request for existing utility information.

Assumptions

Waiting to review the completeness of the SFDPW collected digital information before we can identify gaps and assumptions.

8.3 Flooding Vulnerability Research and Data Results

Recommendations

Before the Phase 2 work proceeds, we recommend that the team and the Port agree on the proposed methodology approach, the data sets that will be used to inform the flooding extents and inundation depths, and the amounts of sea level rise that will be used for the future conditions. Additional studies noted should be provided to the team for review, including the wave runup study along the waterfront by Coast and Harbor Engineers and the revised provisional FEMA maps.

Conclusions

The vulnerability of the San Francisco waterfront to flooding and inundation will be assessed for intact and damaged seawall conditions associated with seismic activity. The assessment will consider existing and higher future sea levels. The assessment will utilize prior studies completed for the Port and the City and County of San Francisco and the Federal Emergency Management Agency (FEMA).

Relevant jurisdictional, policy, and sea level rise guidance by the State of California and by the City and County of San Francisco was reviewed. These policy and guidance documents provide recommended amounts of sea level rise that should be considered for future conditions, as well as an outline of recommendations for evaluating vulnerability of coastal assets to flooding and sea level rise.

Available maps and data products developed by FEMA, San Francisco Public Utilities Commission, and the Port of San Francisco were collected and summarized. The mapping for FEMA comprises the 2007 preliminary flood zone hazard mapping and the subsequent San Francisco Interim Floodplain Maps developed as part of the City and County of San Francisco's Floodplain Management Ordinance of 2008. Recently revised provisional FEMA maps are still being reviewed by the Port of San Francisco. These maps are expected to change, and therefore the Port does not want them used in this study. However, we should review the revised provisional FEMA maps so that we're familiar with what they show.

The study will primarily rely on sea level rise inundation mapping developed for the SFPUC Sewer System Improvement Program (SSIP) (SFPUC 2014) and for the Port of San Francisco (URS and AGS 2012). The SFPUC (2014) inundation mapping presents a series of maps that show inundation depths for fixed amounts of sea level rise and storm surge relative to the mean higher high water elevation for existing conditions. The URS and AGS (2012) maps include maps of the 100-year still water level for existing and future conditions with sea level rise, and also tabulated the variation in 100-year total water levels along the waterfront.

Typical seawall sections will be developed by the team and used to assess the flooding vulnerability for intact seawall and damaged seawall conditions associated with seismic events for existing and future conditions with sea level rise. The results are anticipated to be reported as approximate flood extents and inundation depths for the different seawall segments and scenarios. Numeric criteria will be derived to relate these parameters to a vulnerability index and risk ratings to inform prioritization of seawall improvements and possible adaptation approaches.

The data collected and described in this report is considered sufficient to complete the analysis. Additional information, including other studies that have assessed coastal flooding and wave runup, such as a wave runup study by Coast and Harbor Engineers and the revised provisional FEMA maps, could be useful to augment the data sets and analysis.

Assumptions

Assessment of the flooding vulnerability along the San Francisco waterfront requires assumptions associated with the application of prior mapping and data products, and additional assumptions for addressing data gaps. Flood mapping of the still water level for the SFPUC SSIP mapping and for the Port of San Francisco used a bathtub modeling approach, which assumes that low ground areas subject to flooding are inundated instantaneously, tending to overstate the hazard, and does not include the additional effects of waves, tending to understate the hazard. Therefore, for this project, the inundation areas mapped previously are assumed to be representative of the actual potential flood limits in the study area. We also assume that the 100-year wave runup and total water level elevations by URS and AGS (2012) are representative of the extreme wave runup elevations along the waterfront, and can be used to inform the additional flood exposure due to waves. If needed, we assume that total water levels representative of events more frequent than the 100-year recurrence will be estimated using simple wave runup methods and engineering judgement, unless otherwise available in studies not mentioned in this report. We assume that the results of this flood vulnerability assessment will be used to inform the prioritization of seawall improvements, in addition to the assessments of other disciplines. We also assume that the economic impact of flooding will be assessed by others, or qualitatively included into the economic impacts evaluated in this study.

GHD-GTC Joint Venture

GHD Inc.

505 Montgomery Street
Suite 2300
San Francisco, CA 94111 USA

T: 1 415 283 4970
F: 1 415 283 4980
E: sanfrancisco@ghd.com

Geotechnical Consultants, Inc.

500 Sansome Street
Suite 402
San Francisco, CA 94111 USA

T: 1 415 981 9950
F: 1 415 981 9951
E: deron@gtcgeotech.com