Berkeley Water Transportation Pier Ferry Project

BCDC ECRB Meeting

February 25, 2026

City of Berkeley

- Liza McNulty, PE - Capital Improvement Program Manager

COWI

- James Connolly, PE, SE
- Jessica Rivas
- Jacob Shaw, PE
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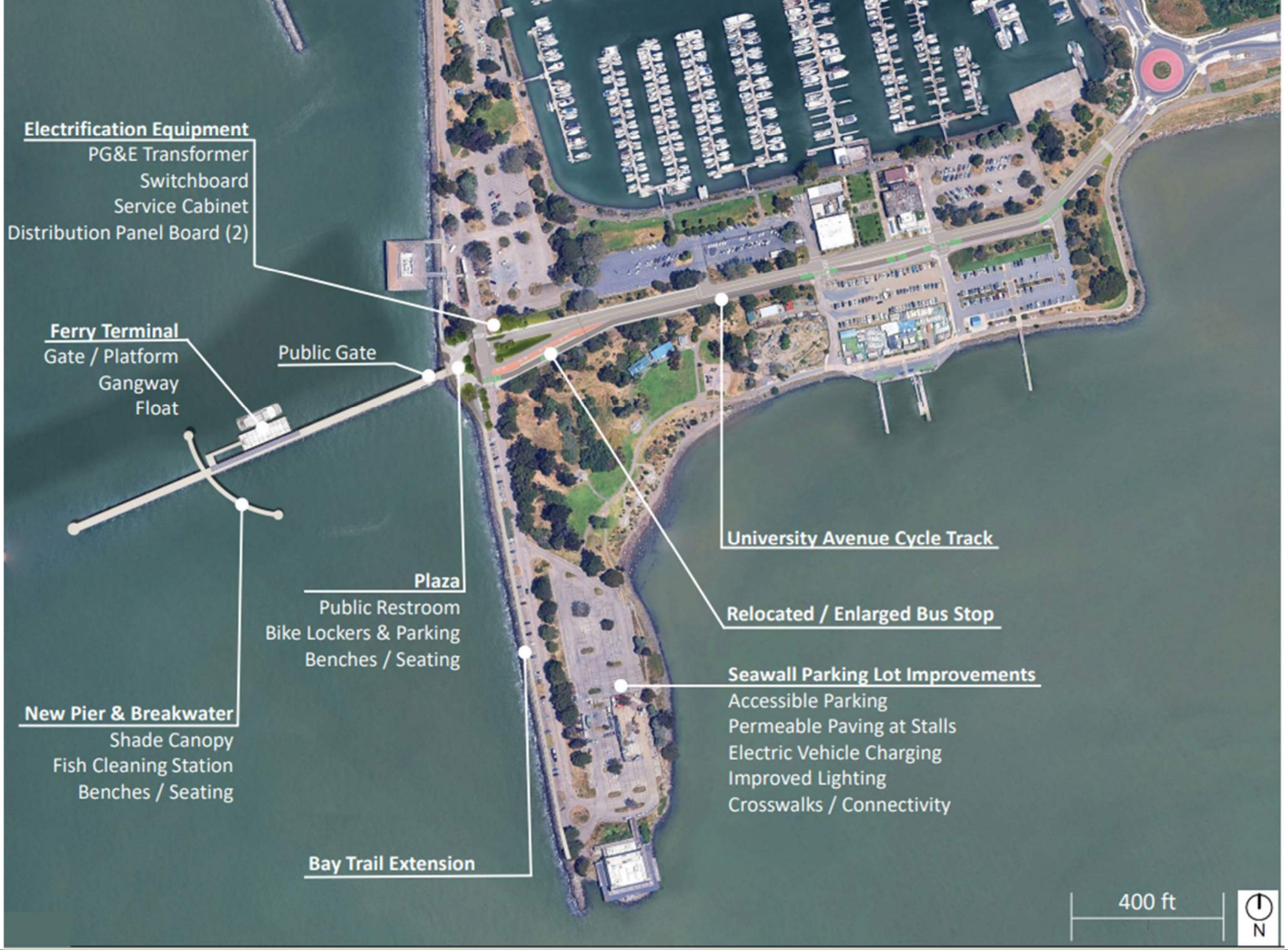
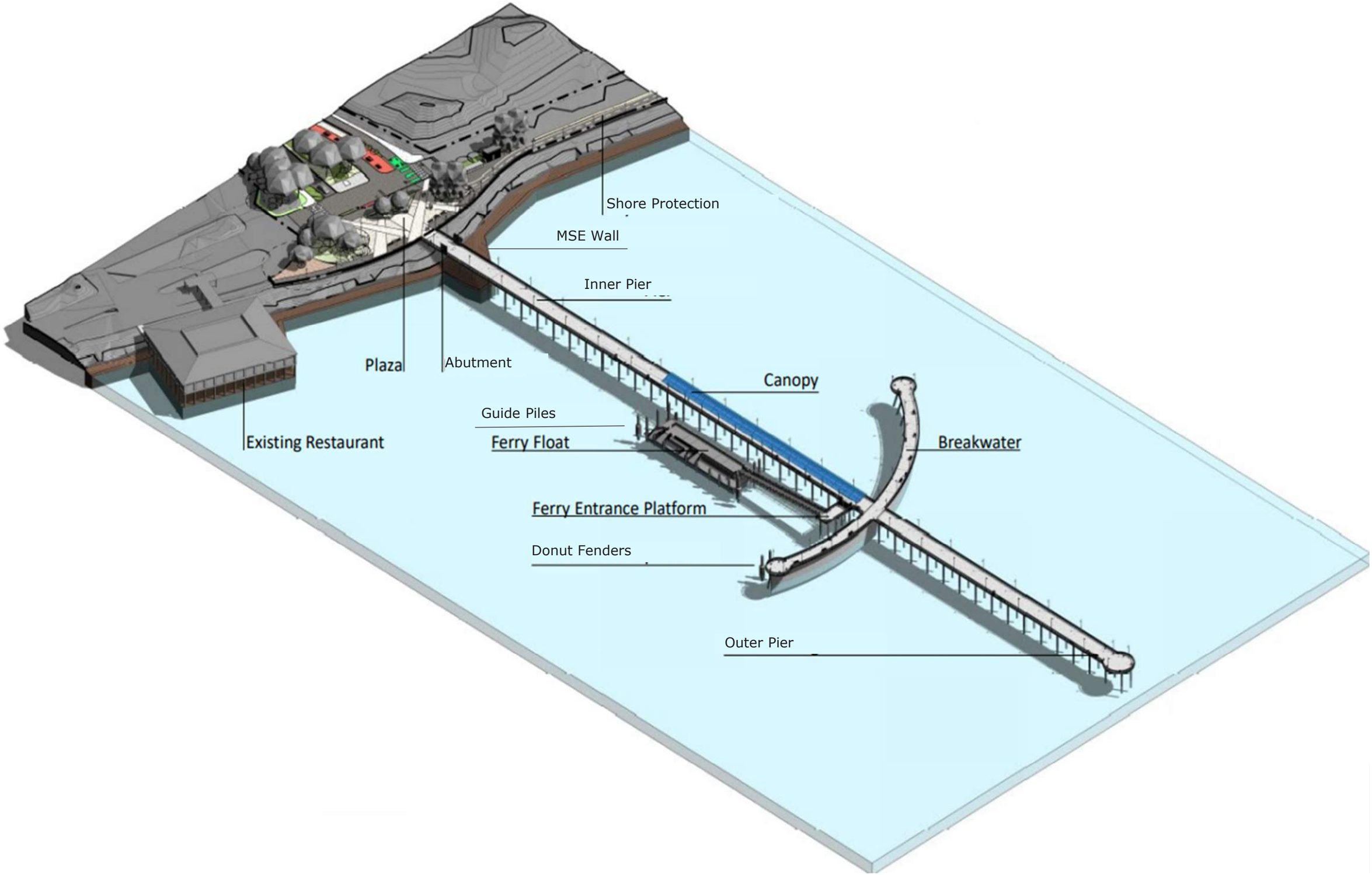
ENGEO

- Jeff Fippin, PE, GE
- Vlad Zasmolin, PE

- Introduction
- Project Overview
- Design Criteria
- Geotechnical
- Coastal
- Structural
- Dredging
- Q&A

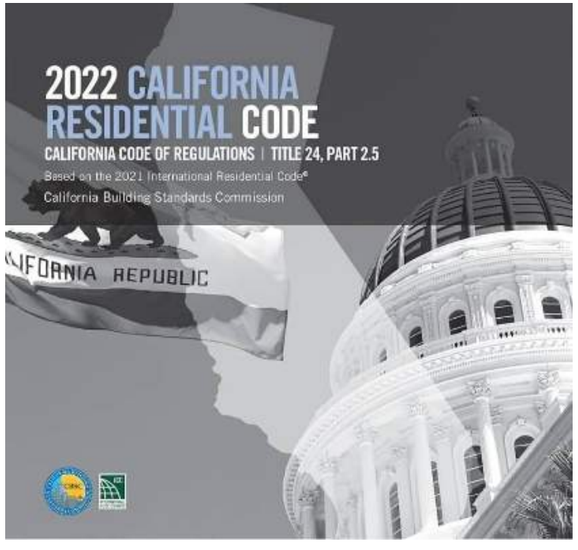

Electrification Equipment
PG&E Transformer
Switchboard
Service Cabinet
Distribution Panel Board (2)
Ferry Terminal
Gate / Platform
Gangway
Float
Public Gate
Plaza
Public Restroom
Bike Lockers & Parking
Benches / Seating
New Pier & Breakwater
Shade Canopy
Fish Cleaning Station
Benches / Seating
Bay Trail Extension
University Avenue Cycle Track
Relocated / Enlarged Bus Stop
Seawall Parking Lot Improvements
Accessible Parking
Permeable Paving at Stalls
Electric Vehicle Charging
Improved Lighting
Crosswalks / Connectivity
400 ft
N

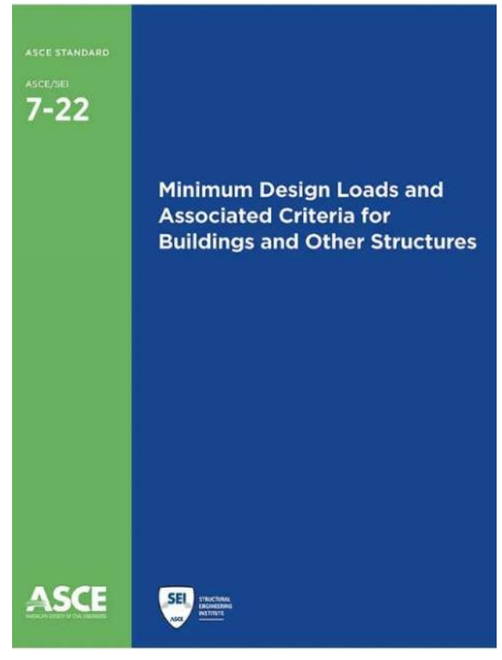


5. Project Overview - New Waterfront Elements

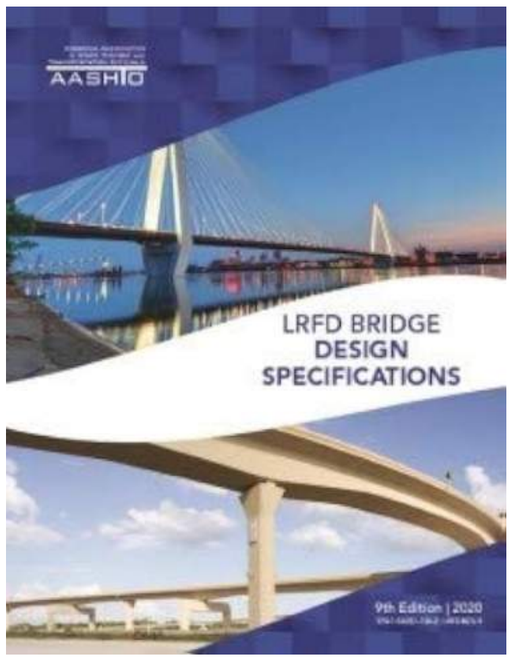
- Originally constructed in 1926 as a 3.5-mile-long, two-lane automobile causeway extending from the foot of University Avenue.
- Converted to a fishing pier in 1960 when marina was built out
- Pier closed to public since July 2015 due to deterioration
- Pile Supported Concrete Pier – 22ft wide
- 18” SQ Precast Piles w/ 18” Diameter Timber Batter Piles

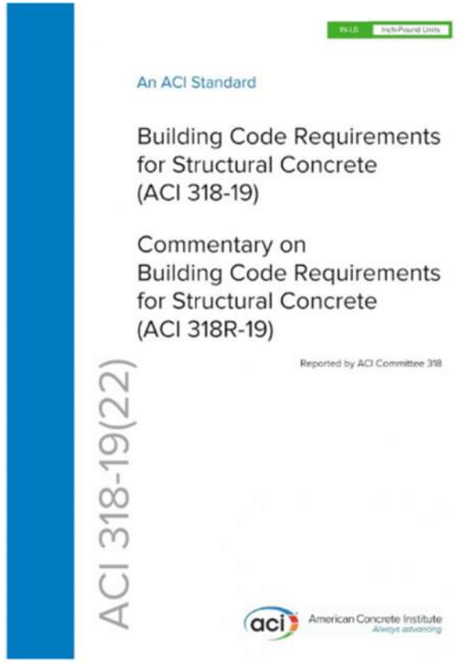
- ASCE 61-14, Seismic Design of Piers and Wharves
- CBC 2022, California Building Code
- ASCE 7-22, Min Design Loads for Buildings and Other Structure
- AASHTO 2020 9th Ed

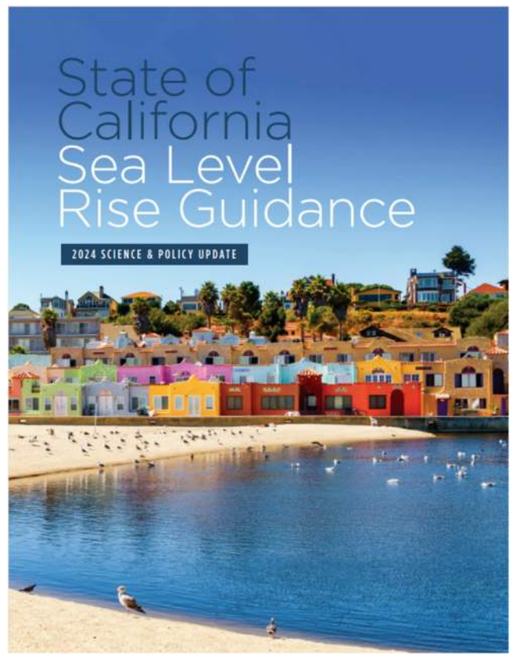




- ACI 318-19 (22), Building Code and Commentary for Structural Concrete
- OPC California Sea Level Rise Guidance 2024

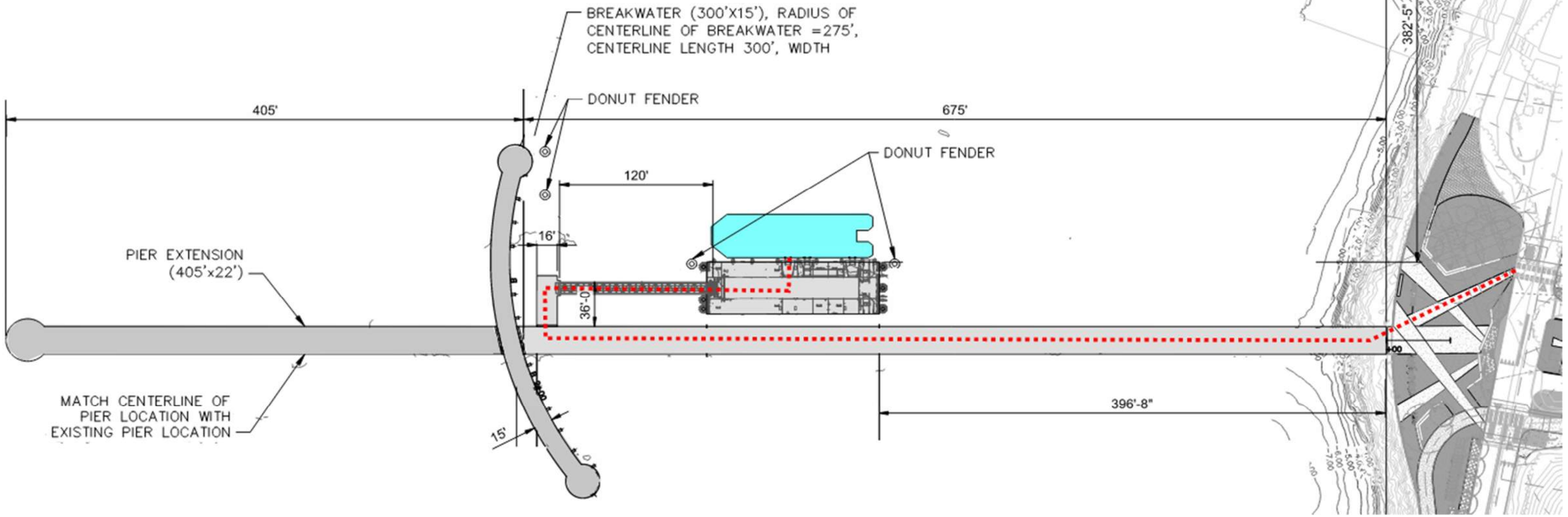






- Restore Public Access to the Waterfront
- Ferry Landing serviced by SF Bay Ferry
- Ferry Landing, Inner Pier, and Plaza designed to support emergency response
- Minimum 50-year Design Life

- Live Load
  - Pier: 250psf | AASHTO HL-93
  - Breakwater: 250psf | AASHTO H15-44
  - Gangway & Float: 100psf | 650 lb
- Environmental Loads: Wind, Wave, Currents, Tsunami



8. Design Criteria - General Performance

2.2 DESIGN CLASSIFICATIONS

Structures designed in accordance with this standard shall be assigned, by the authority having jurisdiction, one of the design classifications presented in Sections 2.2.1 through 2.2.3. An owner is permitted to assign a structure a more severe design classification.

2.2.1 High Structures shall be assigned a design classification of "high" if they are essential to the region's economy or post-event recovery and they require a level of seismic performance beyond life safety protection.

2.2.2 Moderate Structures shall be assigned a design classification of "moderate" if they are of secondary importance to the regional economy and not essential to post-event recovery but they require a level of seismic performance beyond life safety protection.

2.2.3 Low Structures not assigned a design classification of "high" or "moderate" shall be assigned a design classification of "low."

2.3 DESIGN CRITERIA

Minimum design criteria for structures in each design classification are shown in Table 2-1.

2.4 PERFORMANCE LEVELS

The required structural response for each performance level considered in this standard is presented in Sections 2.4.1 through 2.4.3.

2.4.1 Life Safety Protection A structure shall be classified as providing "life safety protection" when (a) the post-earthquake damage state is such that the structure continues to support gravity loads, (b) damage that does occur does not prevent egress, and (c) there is no loss of containment of materials in a manner that would pose a public hazard.

2.4.2 Controlled and Repairable Damage A structure shall be classified as having achieved "controlled and repairable damage" when (a) the structure responds in a controlled and ductile manner, experiencing limited inelastic deformations at locations where repair is possible; (b) the required repairs result in a loss of serviceability for no more than several months; and (c) there is no loss of containment of materials in a manner that would pose a public hazard.

2.4.3 Minimal Damage A structure shall be classified as having achieved "minimal damage" when (a) it exhibits near-elastic structural response with minor or no residual deformation, (b) there is no loss of serviceability of the structure, and (c) there is no loss of containment of materials in a manner that would pose a public hazard.

Table 2-1. Minimum Seismic Hazard and Performance Requirements

	Seismic hazard level and performance level					
	Operating level earthquake (OLE)		Contingency level earthquake (CLE)		Design earthquake (DE)	
	Ground motion probability of exceedance	Performance level	Ground motion probability of exceedance	Performance level	Seismic hazard level	Performance level
High	50% in 50 years (72-year return period)	Minimal damage	10% in 50 years (475-year return period)	Controlled and repairable damage	Design earthquake per ASCE 7 (2005)	Life safety protection
Moderate	N/A	N/A	20% in 50 years (224-year return period)	Controlled and repairable damage	Design earthquake per ASCE 7 (2005)	Life safety protection
Low	N/A	N/A	N/A	N/A	Design earthquake per ASCE 7 (2005)	Life safety protection

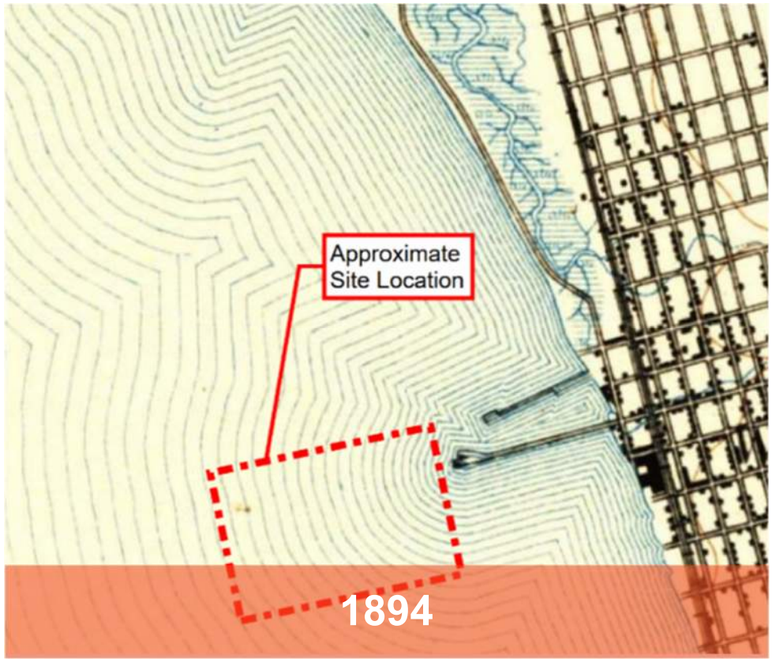
- **Inner Pier** design is based on ASCE 61-14 design procedures but conservatively adapted for consideration of "Essential" importance level.

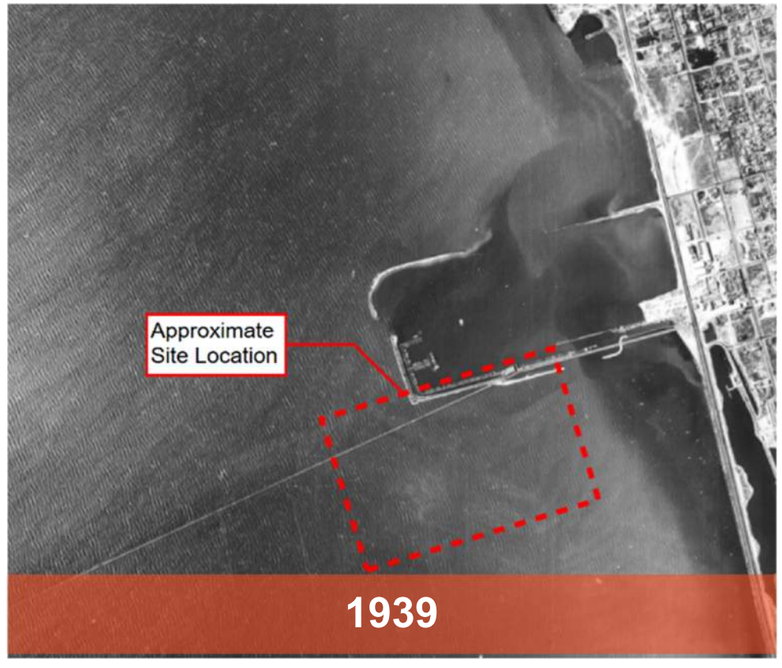
Performance Level	Criteria	Performance Requirement
Operating Level Earthquake (OLE)	50% in 50 years (72-year return period)	No Damage
Contingency Level Earthquake (CLE)	10% in 50 years (475-year return period)	Minimal Damage
Design Earthquake (DE)	Design Earthquake per ASCE 7	Minimal Damage
Maximum Considered Earthquake (MCE)	MCE Earthquake per ASCE 7	Controlled and Repairable Damage

- **Outer Pier and Breakwater** design is based on ASCE 61-14 design procedures for "Moderate" importance level that is not essential to post event recovery but require a level of seismic performance beyond life safety protection.

Performance Level	Criteria	Performance Requirement
Contingency Level Earthquake (CLE)	20% in 50 years (224-year return period)	Controlled and Repairable Damage
Design Earthquake (DE)	Design Earthquake per ASCE 7	Life Safety

- **Review of Historical Aerial Images and Maps**
- **Geotechnical Investigation**
  - Landside
    - Five Mud Rotary Boreholes
    - Four CPTs
    - Nine Pavement Cores
    - Seven Sonic Borings
  - Offshore (Performed on Quin Delta Drill Ship)
    - Six Mud Rotary Borings
    - Three CPTs
    - Geotechnical Investigation
- **Analysis Including:**
  - Young Bay Mud settlement
  - Liquefaction Evaluation
  - Site-specific response spectra
  - Seismic Shoreline Stability
  - Vertical and Lateral Pile soil-structure interaction


Approximate
Site Location
1894


Approximate
Site Location
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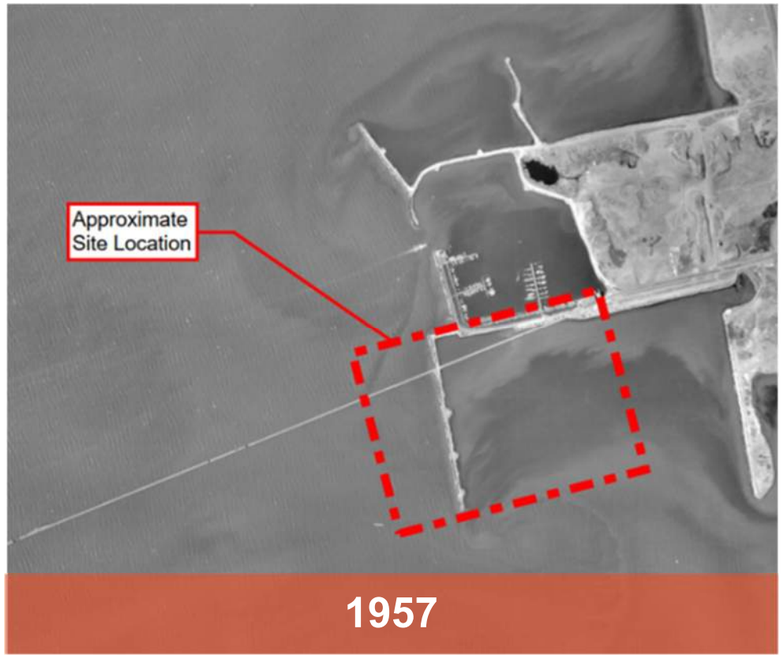
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Site Location
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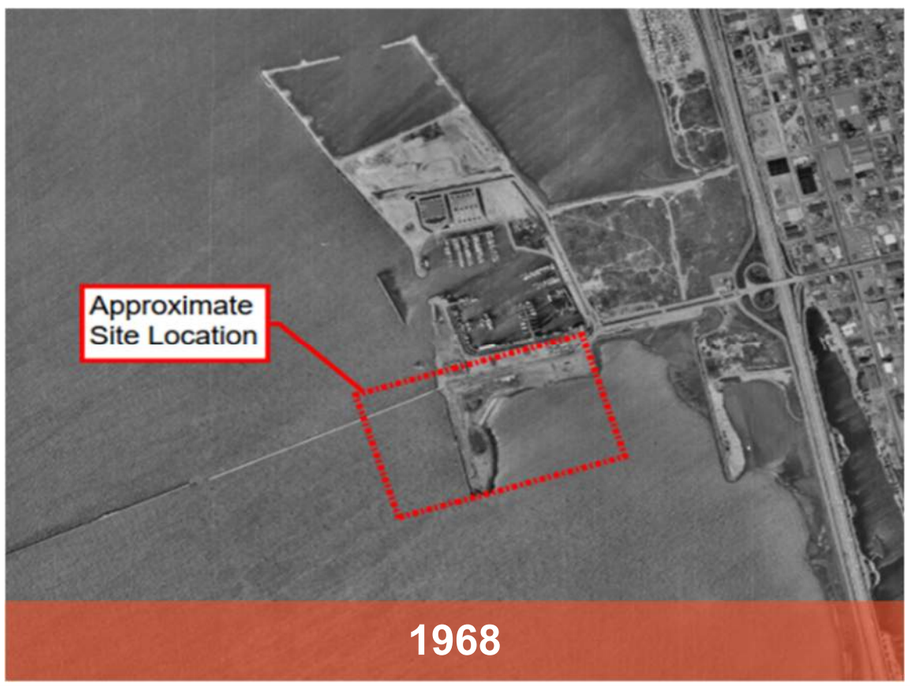
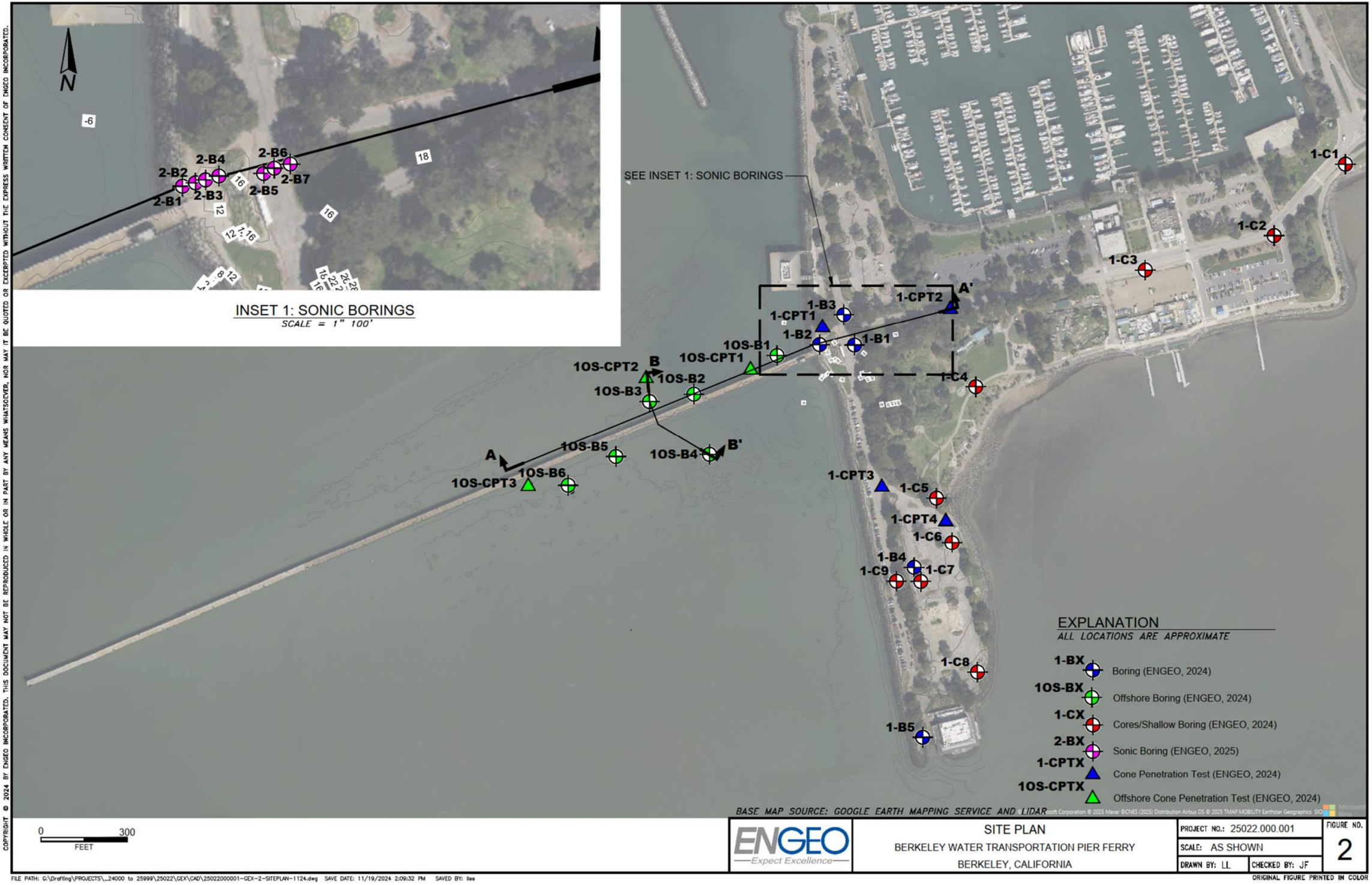
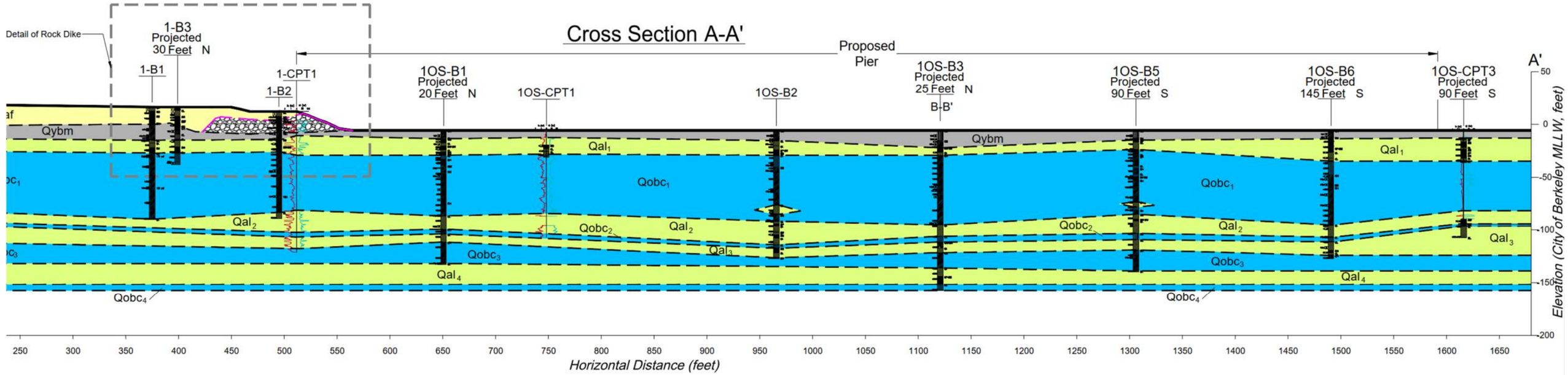
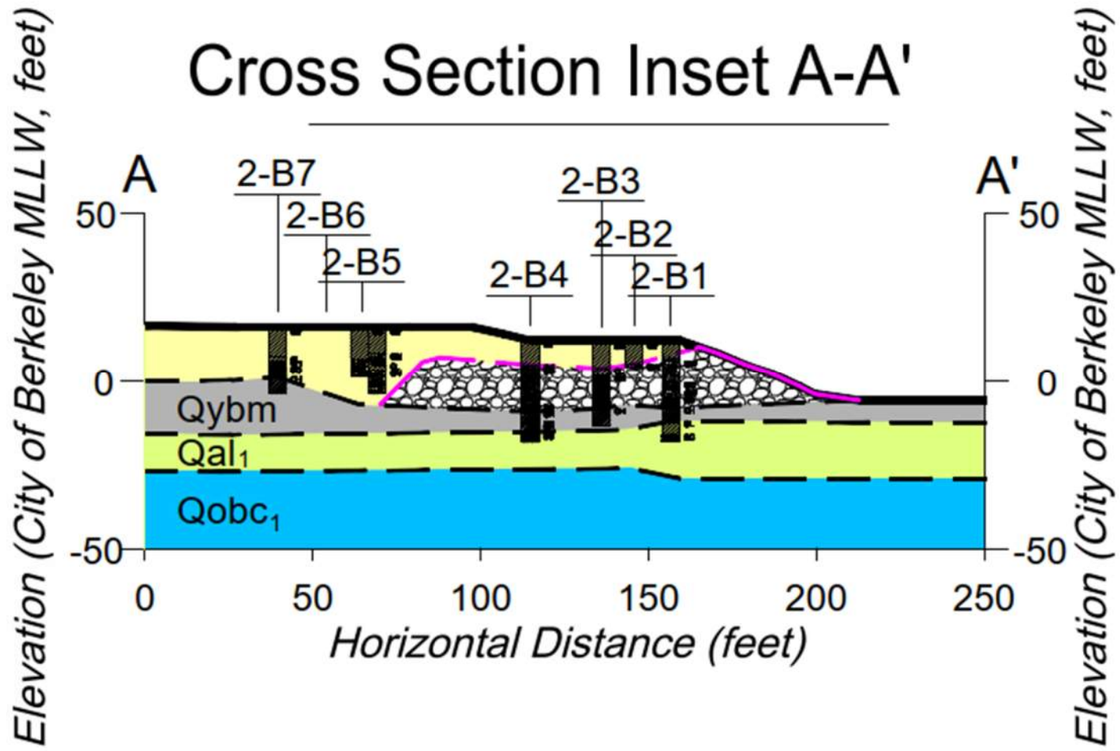

Approximate
Site Location
1968

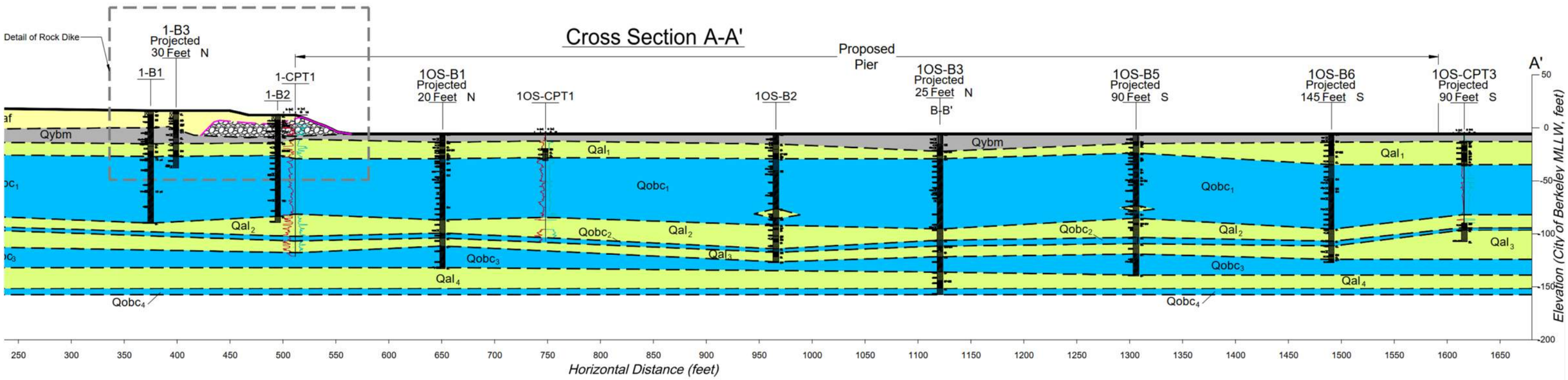

Approximate
Site Location
2002




Cross Section A-A'
Detail of Rock Dike
1-B3
Projected
30 Feet N
1-B1
1-CPT1
1-B2
1OS-B1
Projected
20 Feet N
1OS-CPT1
1OS-B2
Proposed
Pier
1OS-B3
Projected
25 Feet N
B-B'
1OS-B5
Projected
90 Feet S
1OS-B6
Projected
145 Feet S
1OS-CPT3
Projected
90 Feet S
A'
Qybm
Qal1
Qobc1
Qal2
Qobc2
Qal3
Qobc3
Qal4
Qobc4
250 300 350 400 450 500 550 600 650 700 750 800 850 900 950 1000 1050 1100 1150 1200 1250 1300 1350 1400 1450 1500 1550 1600 1650
Horizontal Distance (feet)
50 0 -50 -100 -150 -200
Elevation (City of Berkeley MLLW, feet)

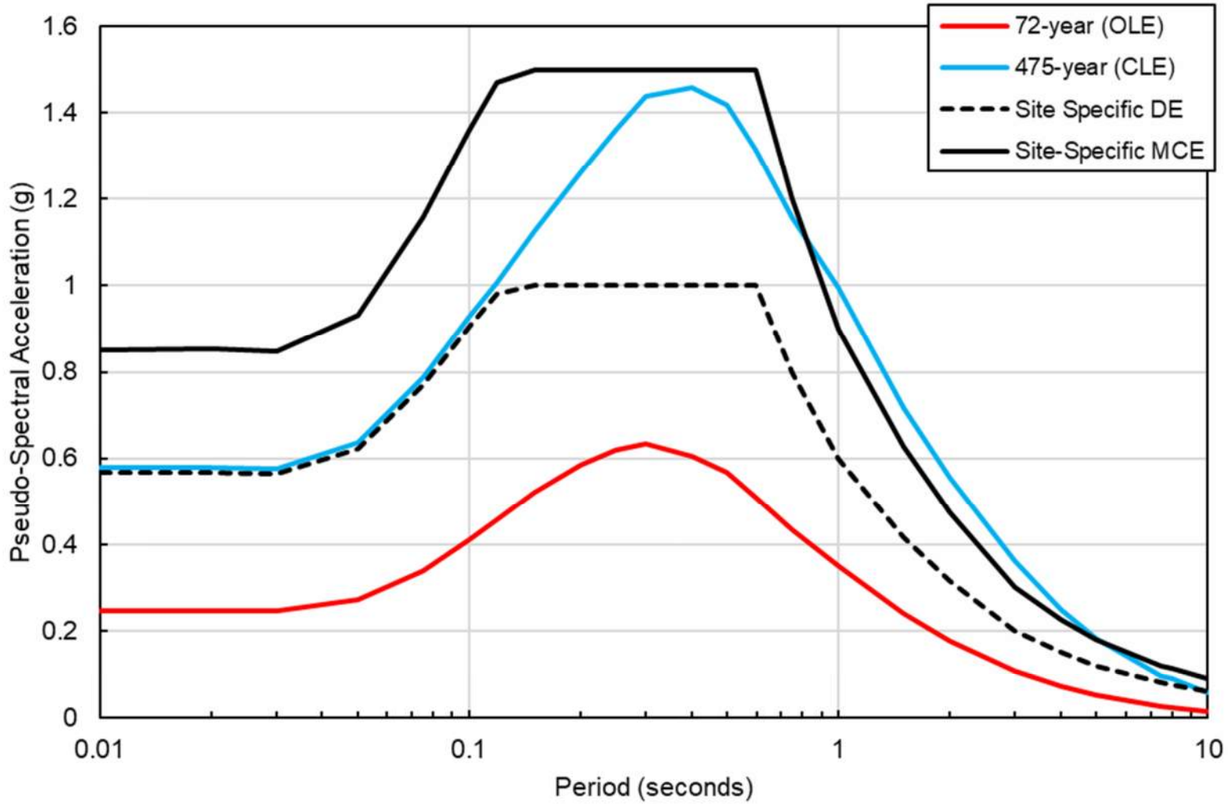

Cross Section Inset A-A'
A
A'
2-B7
2-B6
2-B5
2-B4
2-B3
2-B2
2-B1
Qybm
Qal1
Qobc1
50 0 -50
0 50 100 150 200 250
Horizontal Distance (feet)
Elevation (City of Berkeley MLLW, feet)

- **Fill (Qaf) - onland**
  - Up to 23 feet. Generally not engineered. Mix of clay ranging in stiffness from soft to stiff and sand and gravel ranging in density from medium dense to dense.
- **Rock Dike – at shoreline**
  - Well graded gravel with cobble up to 4½-inches in diameter.
  - There is Young Bay Mud under the Rock Dike.
- **Recent Bay Deposits/Young Bay Mud (Qybm)**
  - Between 4 to 16 feet thick. Thicker deposits offshore
  - Offshore, Young Bay Mud is overlain by veneer of recent bay deposits.
- **Alluvium and Old Bay Clay (Qal/Qobc)**
  - Stiff to hard clay interbedded with medium to very dense sand and gravel.

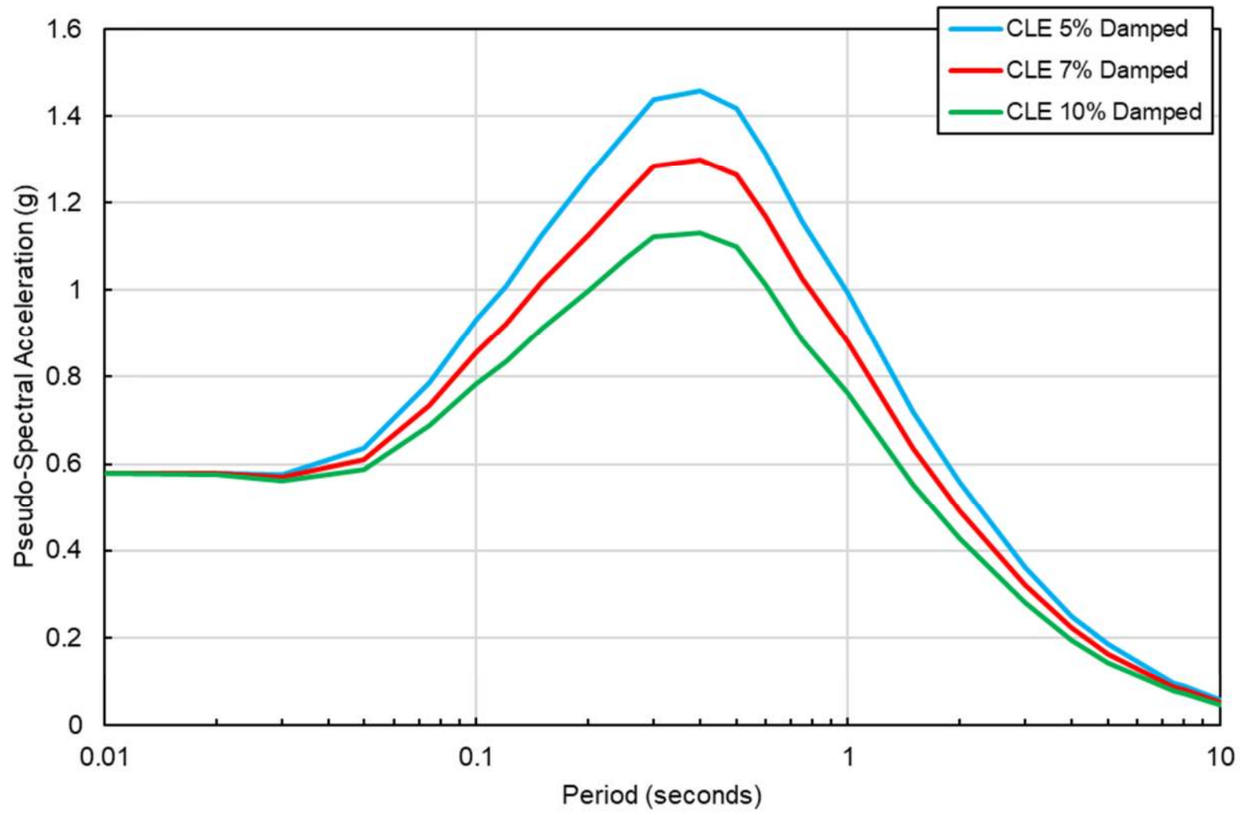


- **Static Load Consolidation**
  - Grades will be raised by up to 5½ feet at the pier plaza.
  - Estimate 1- to 5½-inches of static settlement due to fill placement.
  - Mitigation of settlement at the Pier Plaza by
    - 1. Surcharging the Pier Plaza with an 8-foot-high embankment for 3 months
    - 2. Placement of lightweight cellular concrete extending 14-feet back from the seawall
    - 3. Construction of a flexible precast concrete panel MSE wall
- **Liquefaction**
  - **PGA = 0.85g; Mw = 8.0 - MCE**
  - Majority of the sandy fill is intermixed with high-plasticity fines.
  - Native soil is predominantly clay. Lenses of sand are sufficiently dense to resist liquefaction or are intermixed with plastic fines.
  - Liquefiable layers are relatively thin and discontinuous.
  - **Landside:** Up to 2½-inches of vertical settlement.
  - **Offshore:** Nominal liquefaction

Summary of 5% Damped Response Spectra

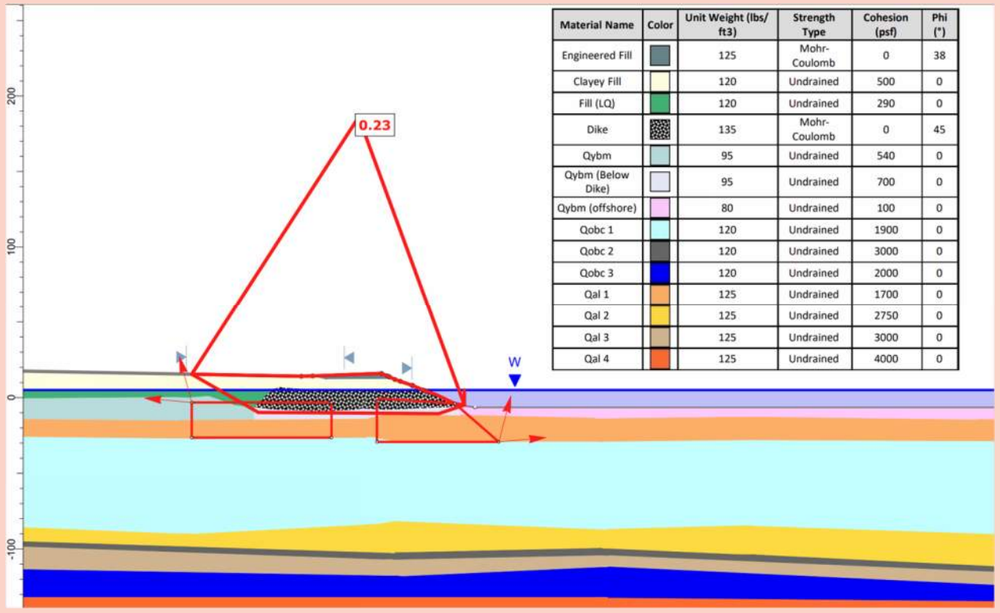


CLE 5%,7%, and 10% Damped Response Spectra



Acceptance Criteria ≈ ½ foot during MCE Level Event

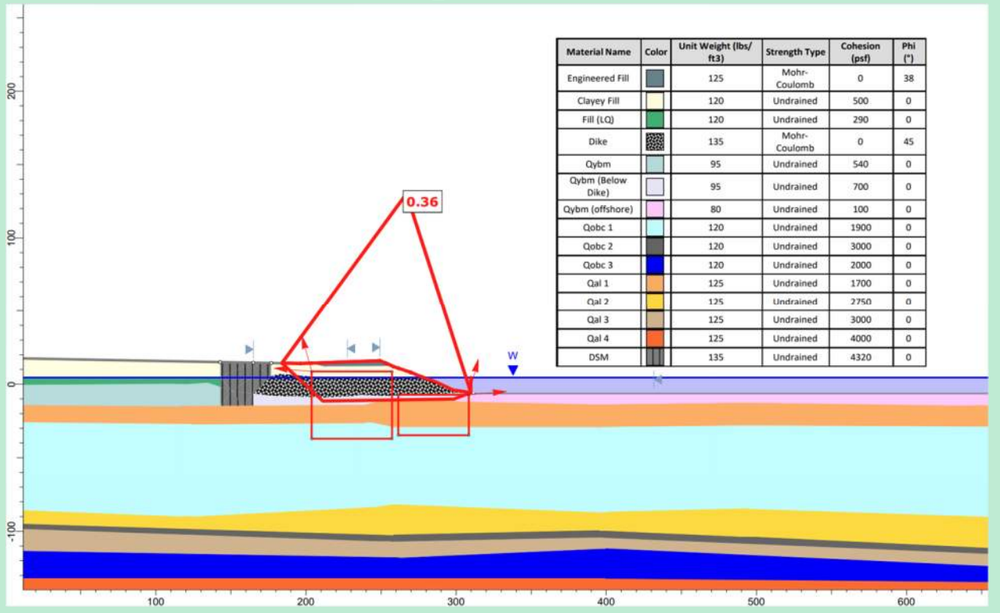
Existing Conditions
Ky = 0.23



Material Name	Color	Unit Weight (lbs/ ft3)	Strength Type	Cohesion (psf)	Phi (°)
Engineered Fill		125	Mohr-Coulomb	0	38
Clayey Fill		120	Undrained	500	0
Fill (LQ)		120	Undrained	290	0
Dike		135	Mohr-Coulomb	0	45
Qybm		95	Undrained	540	0
Qybm (Below Dike)		95	Undrained	700	0
Qybm (offshore)		80	Undrained	100	0
Qobc 1		120	Undrained	1900	0
Qobc 2		120	Undrained	3000	0
Qobc 3		120	Undrained	2000	0
Qal 1		125	Undrained	1700	0
Qal 2		125	Undrained	2750	0
Qal 3		125	Undrained	3000	0
Qal 4		125	Undrained	4000	0

Displacement
CLE Level Event ≈ ½ foot
MCE Level Event ≈ 1½ to 2 feet

DSM Ground Improved
Ky = 0.36



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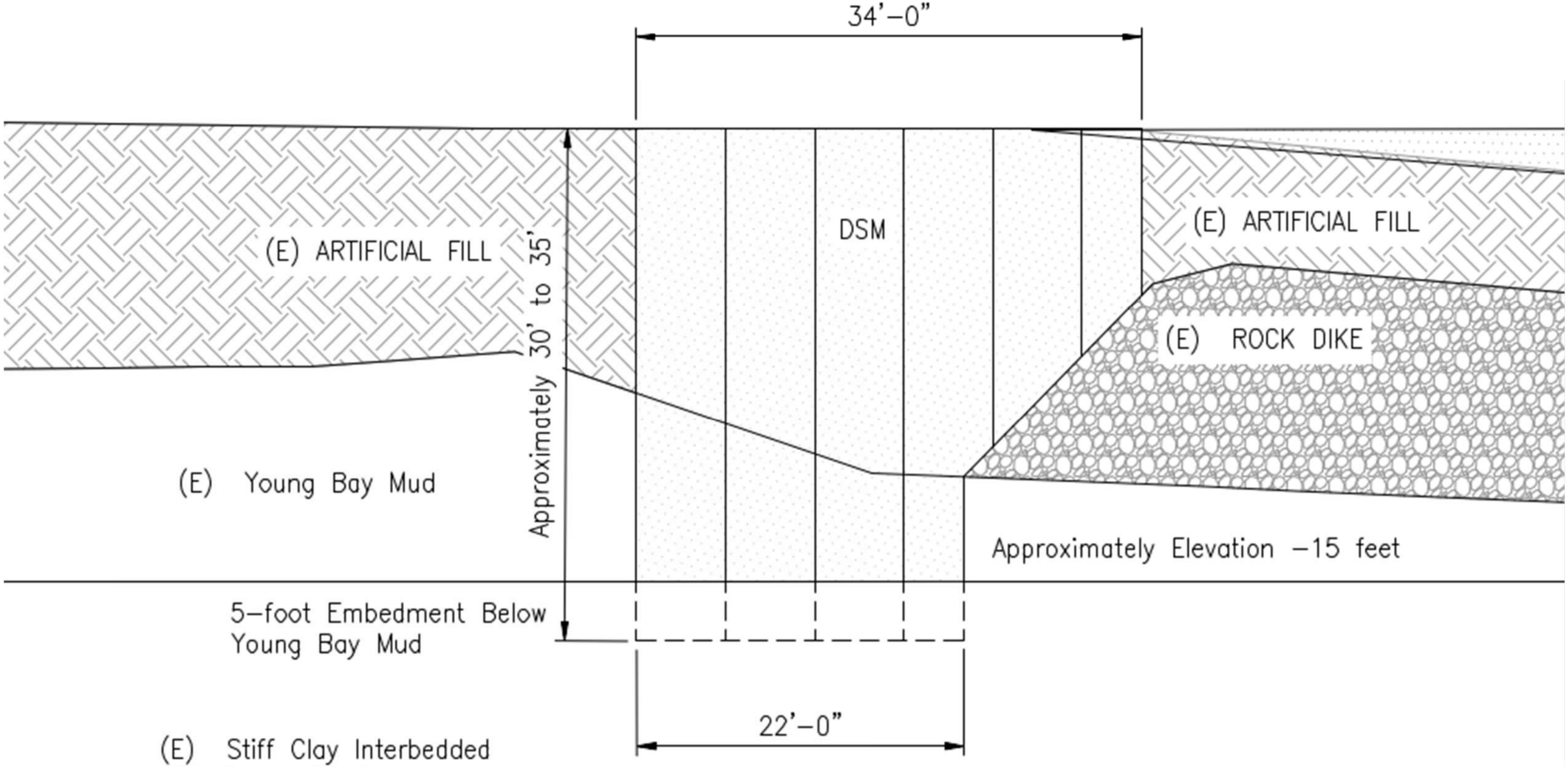
Dike		135	Mohr-Coulomb	0	45
Qybm		95	Undrained	540	0
Qybm (Below Dike)		95	Undrained	700	0
Qybm (offshore)		80	Undrained	100	0
Qobc 1		120	Undrained	1900	0
Qobc 2		120	Undrained	3000	0
Qobc 3		120	Undrained	2000	0
Qal 1		125	Undrained	1700	0
Qal 2		125	Undrained	2750	0
Qal 3		125	Undrained	3000	0
Qal 4		125	Undrained	4000	0
DSM		135	Undrained	4320	0

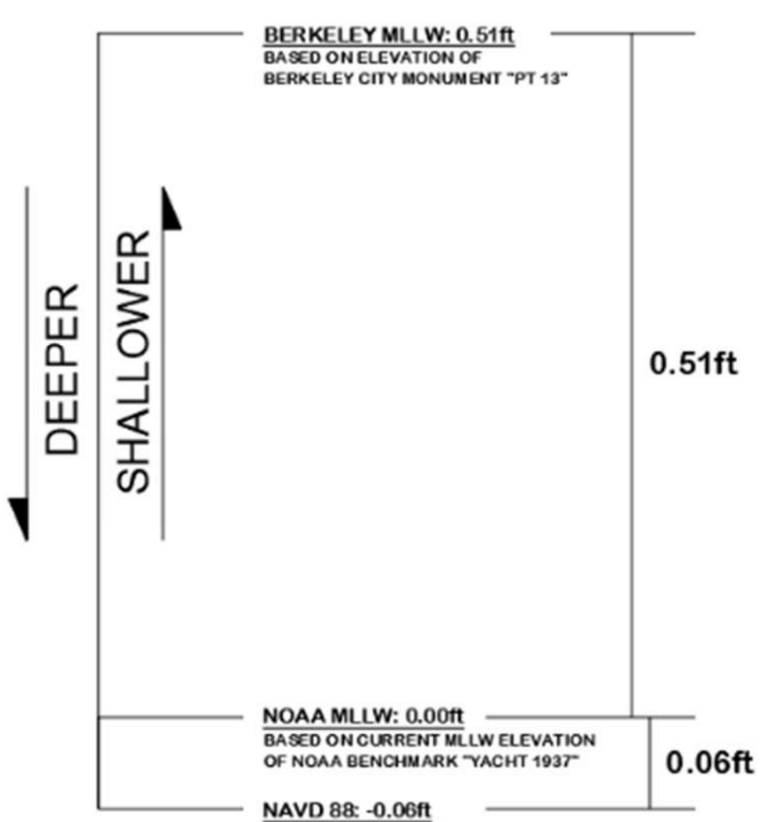
Displacement
CLE Level Event ≈ <½ foot
MCE Level Event ≈ ½ foot


34'–0"
(E) ARTIFICIAL FILL
DSM
(E) ARTIFICIAL FILL
(E) ROCK DIKE
Approximately 30' to 35'
(E) Young Bay Mud
Approximately Elevation –15 feet
5–foot Embedment Below
Young Bay Mud
22'–0"
(E) Stiff Clay Interbedded
with Dense Sand

- Project Tidal Datum – City of Berkeley MLLW
- Conversion between Berkeley MLLW and NAVD88 determined by surveyor (eTrac)
- Berkeley Tide Station 9414816

Datum	Value (ft Berkeley MLLW)	Description
HAT	8.4	Highest Astronomical Tide
MHHW	6.8	Mean Higher-High Water
MHW	6.2	Mean High Water
MSL	4.0	Mean Sea Level
NAVD 88	0.57	North American Vertical Datum of 1988
Berkeley MLLW	0.0	Berkeley Mean Lower-Low Water
LAT	-1.6	Lowest Astronomical Tide

Vertical Shift Analysis Between NAVD88, NOAA MLLW, and City of Berkeley MLLW



OPC California Sea Level Rise Guidance 2024

TABLE 6. *Sea Level Scenarios for San Francisco.*

Median values of Sea Level Scenarios, in feet, for each decade from 2020 to 2150, with a baseline of 2000. All median scenario values incorporate the local estimate of vertical land motion.

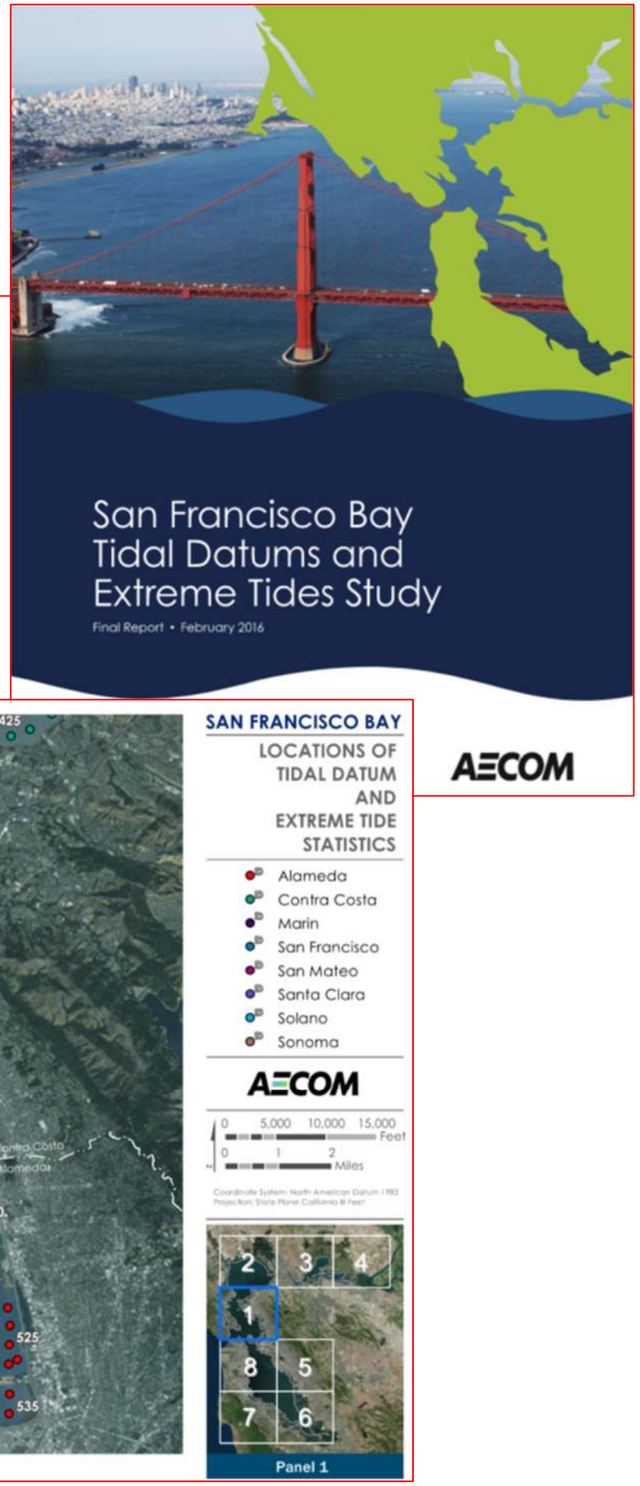
YEAR	LOW	INT-LOW	INTERMEDIATE	INT-HIGH	HIGH
2020	0.2	0.2	0.2	0.3	0.3
2030	0.3	0.4	0.4	0.4	0.4
2040	0.4	0.5	0.6	0.7	0.8
2050	0.5	0.6	0.8	1.0	1.3
2060	0.6	0.8	1.1	1.5	2.0
2070	0.7	1.0	1.4	2.2	2.9
2080	0.8	1.2	1.8	3.0	4.1
2090	0.9	1.4	2.4	3.8	5.3
2100	1.0	1.6	3.1	4.8	6.5
2110	1.0	1.8	3.8	5.6	7.8
2120	1.1	2.0	4.4	6.4	9.0
2130	1.2	2.2	4.9	7.0	9.9
2140	1.3	2.4	5.4	7.6	10.8
2150	1.3	2.6	6.0	8.1	11.7

2075

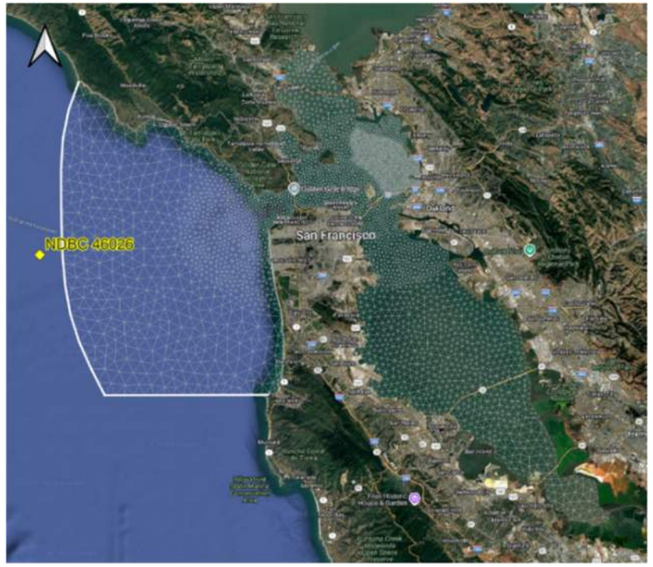
1.6 **2.6** **3.5**

2075 – Design Report

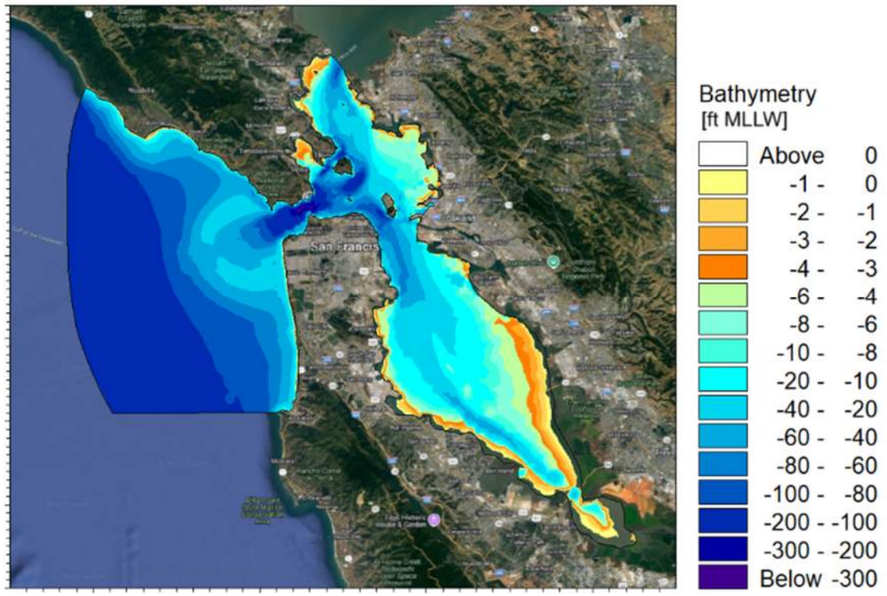
Year	Inter	Inter-High	High
2025	Extreme Water Level (1% AEP) 10.3 [ft-Berkeley MLLW)		
2075	11.9	12.9	13.0
2080	12.1	13.3	14.4
2100	13.4	15.1	16.8



- NOAA wave hindcasts (27 years)
- Buoy wave observations
- Spatially variable wind forcing
- Wave generation and propagation – DHI Mike21 SW
- Long-term nearshore wave conditions
- Directional and spectral wave information

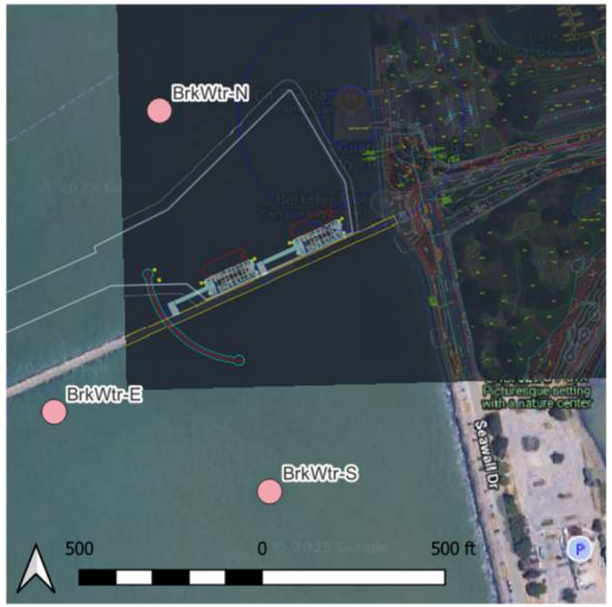


Model Mesh



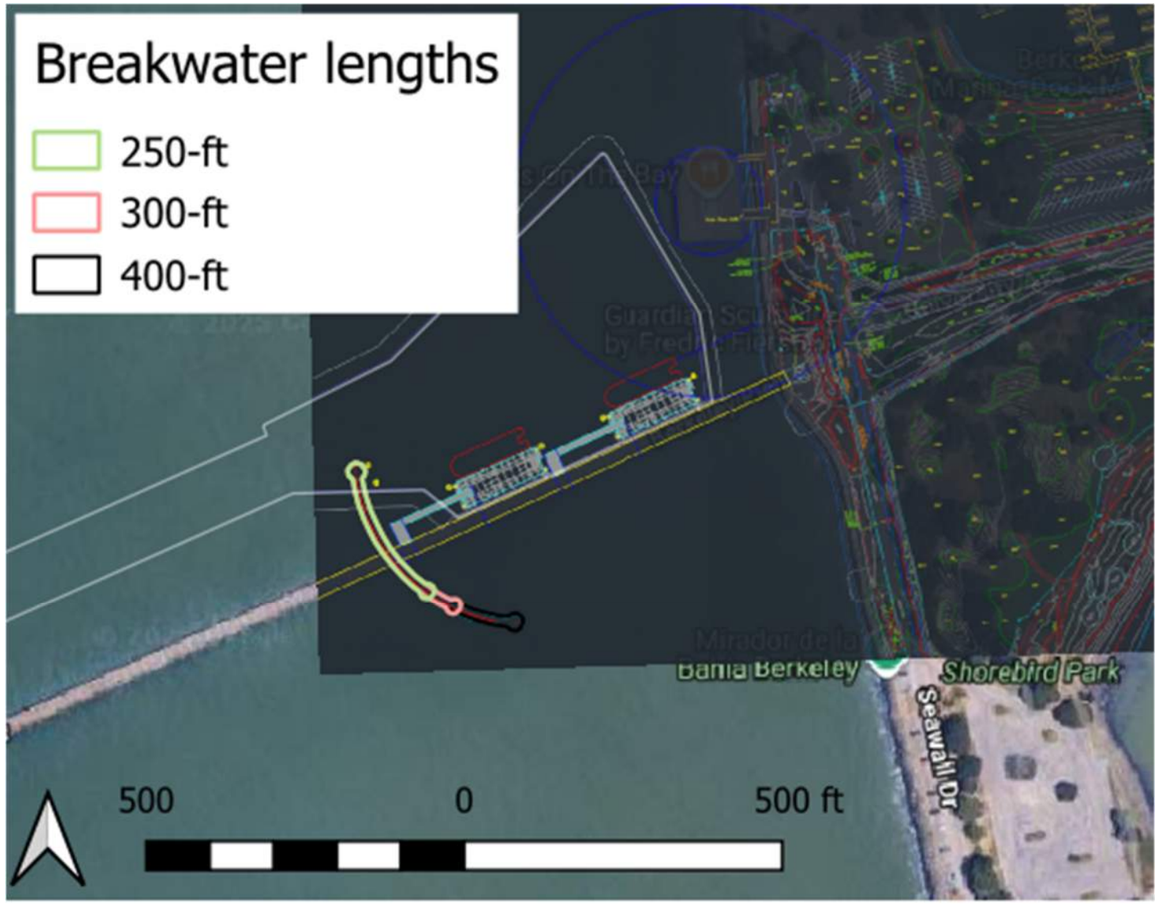
Model Bathymetry

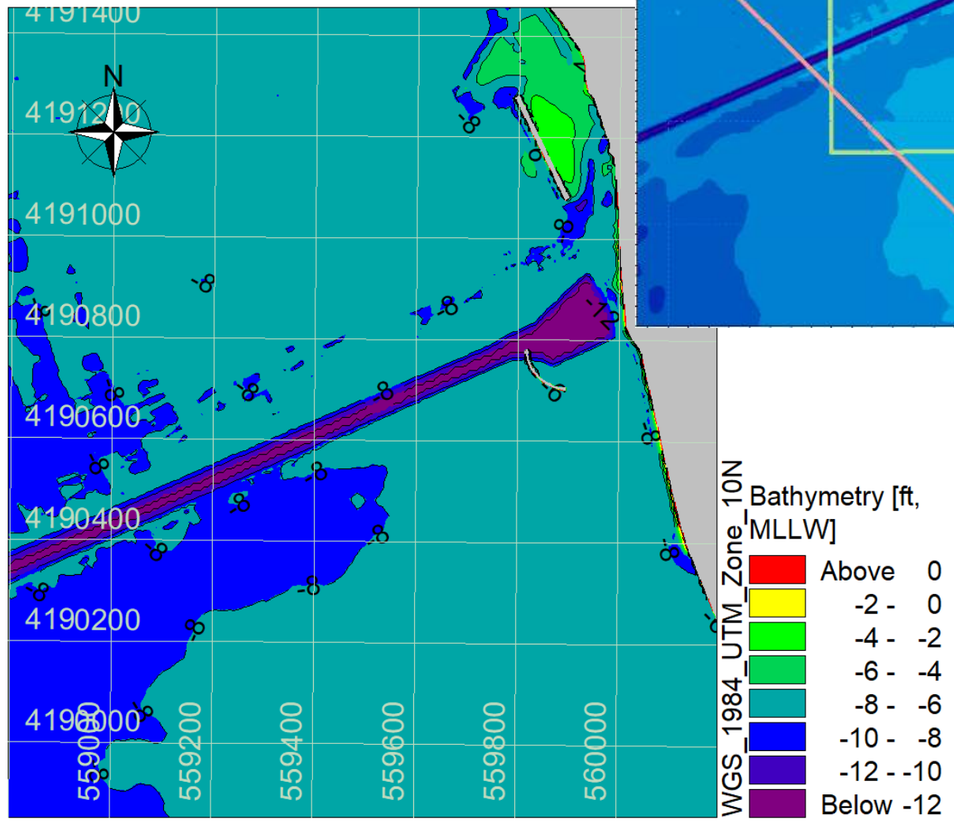
Wind Distribution

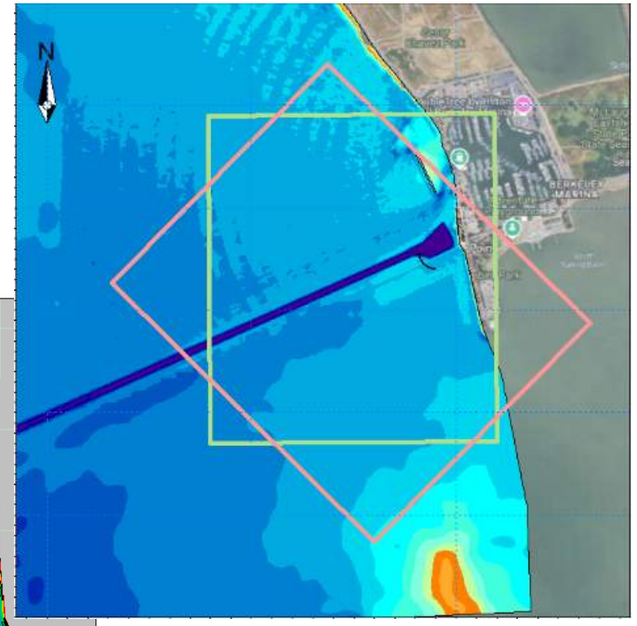


Site - Output Points

- Wave Disturbance MIKE 21 BW (Boussinesq model)
  - Wave diffraction and transformation inside terminal – DHI Mike21 BW
  - Breakwater configurations: 250, 300, and 400 ft



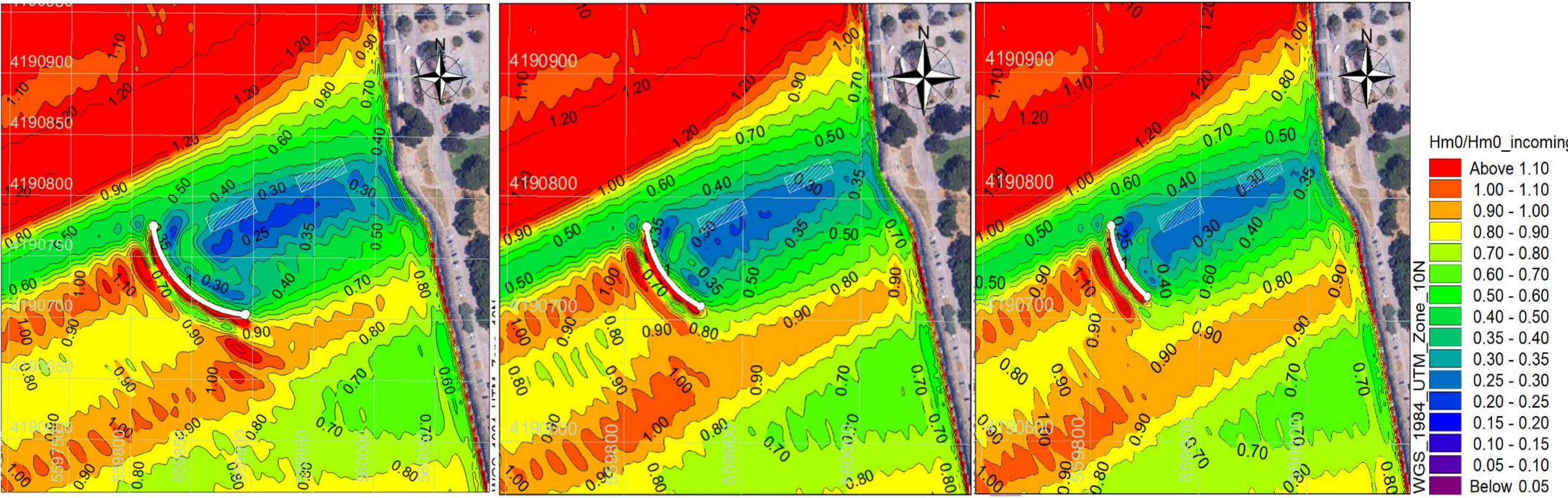




- Dredged depths explicitly included in wave propagation and shoaling computations
- Wave disturbance coefficients at berths and plaza for timeseries generation

- Breakwater length comparison

Wave disturbance plot for Dir = 255°N at MHHW Tp = 6 sec



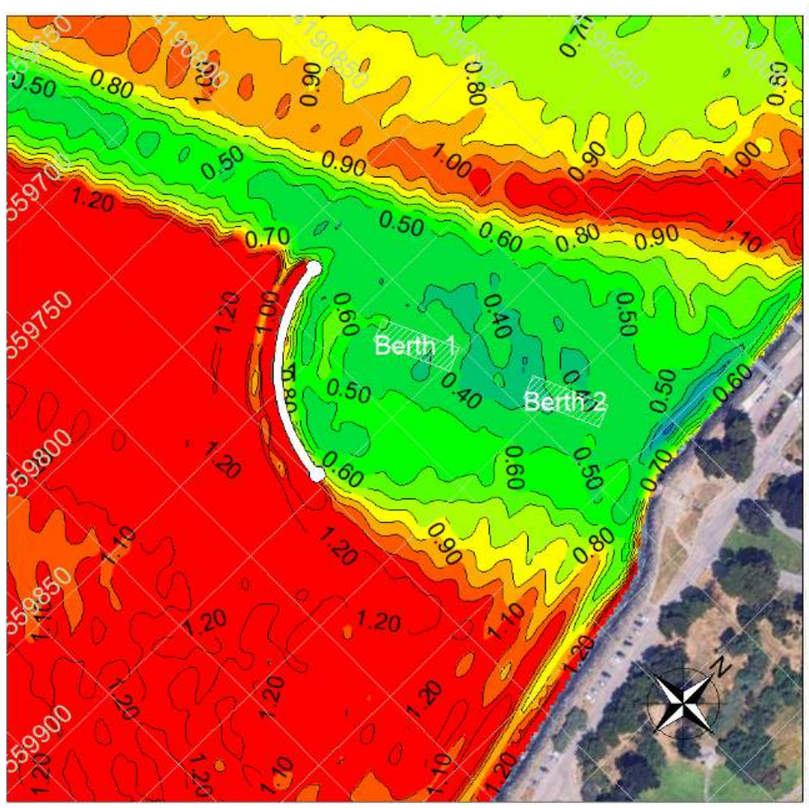
BW Length = 400 ft

BW Length = 300 ft

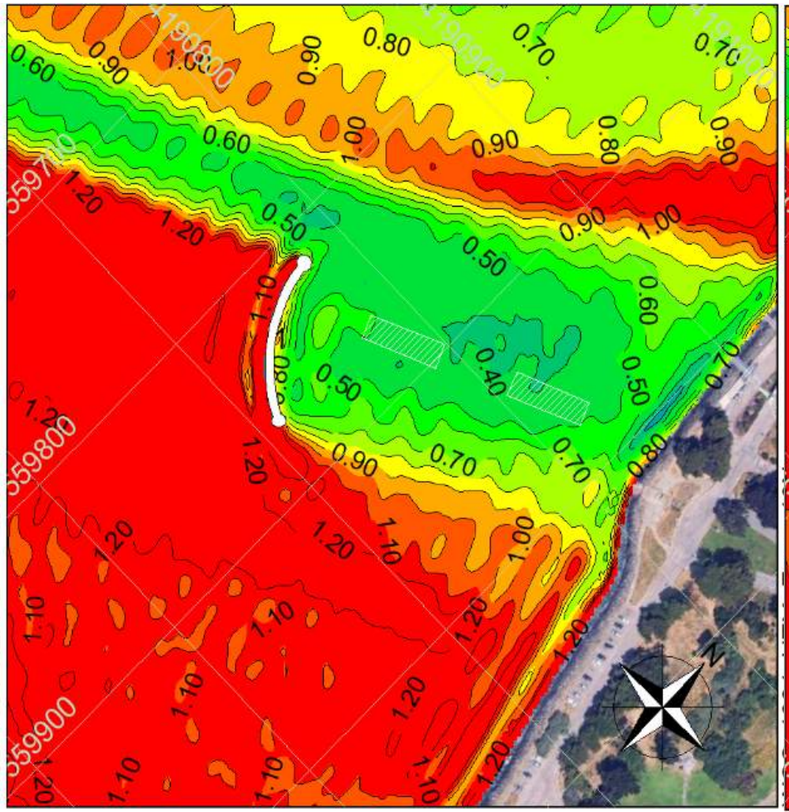
BW Length = 250 ft

- Breakwater length comparison

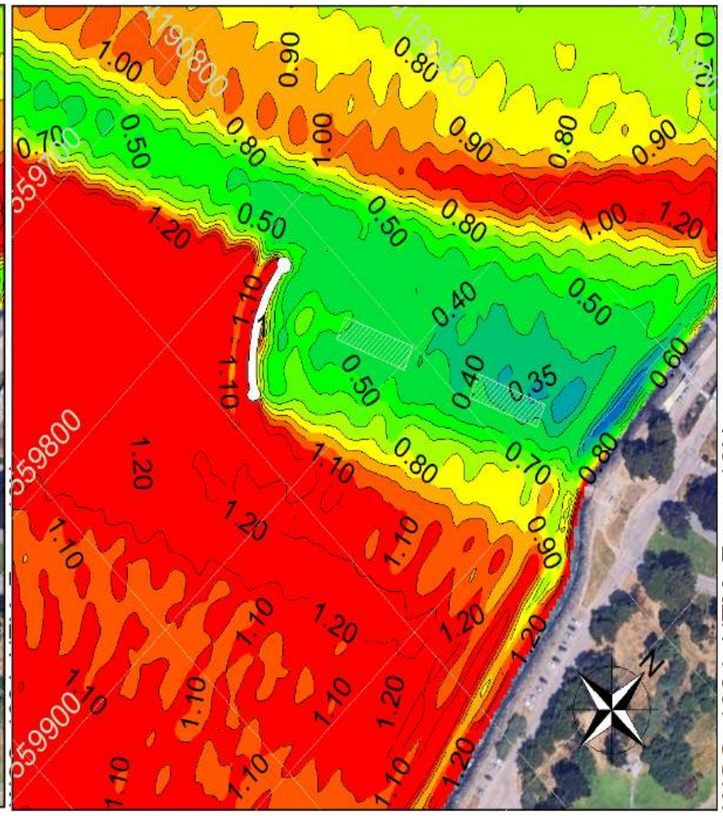
Wave disturbance plot for Dir = 240°N at MHHW Tp = 6 sec.



BW Length = 400 ft

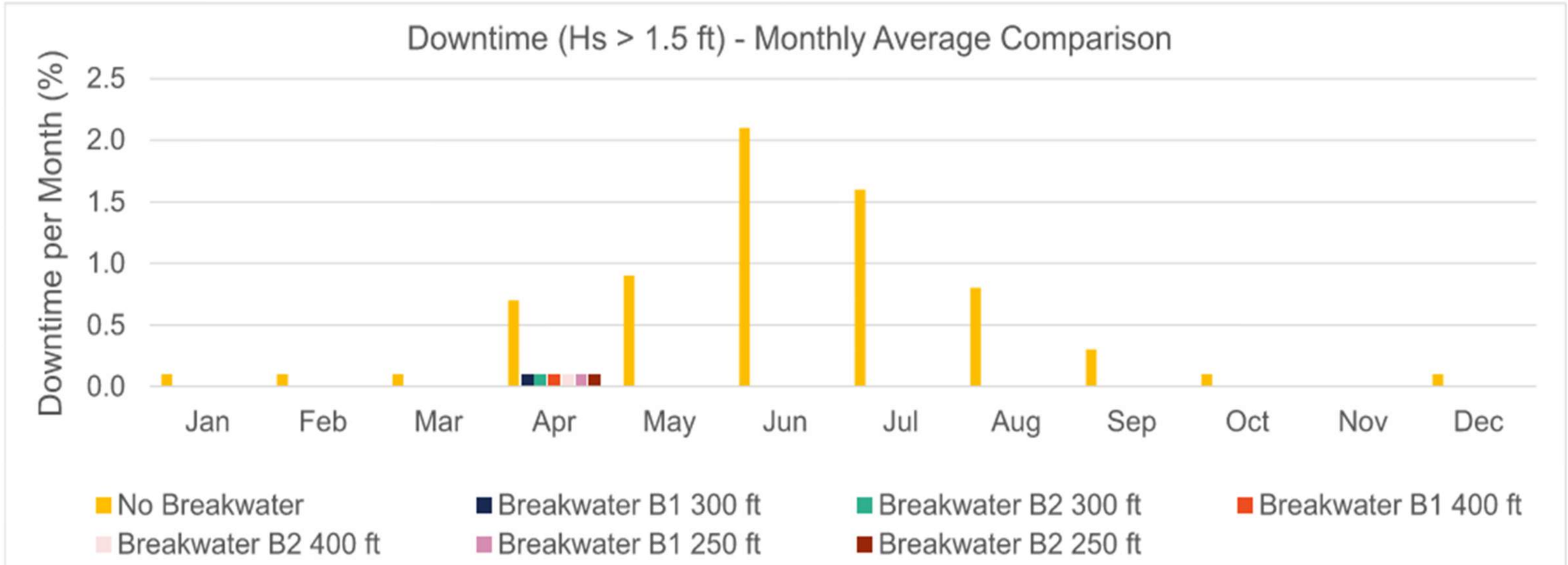


BW Length = 300 ft



BW Length = 250 ft

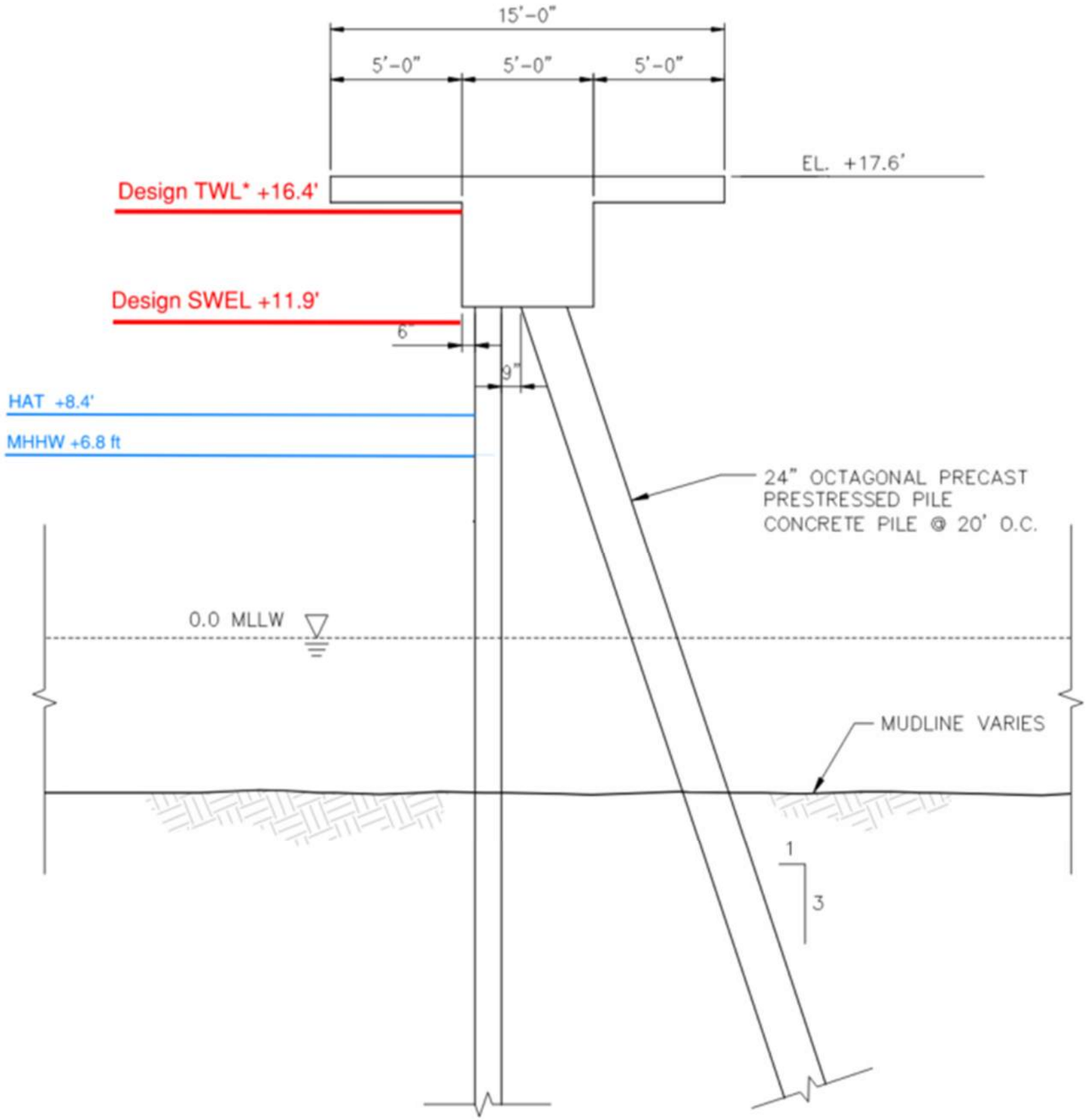
- Downtime Criteria
  - Wave height threshold: 1.5 feet
  - Wind speed threshold: 20 knots (1-hour average)
- Upper limit of safe marine operations
- Limit based on historic operation data provided by SF Bay Ferry
- COWI compared the wave agitation at other San Francisco Bay ferry terminal locations for the specific days interruptions occurred to determine operation thresholds



› Wave effects and minimum breakwater crest elevation

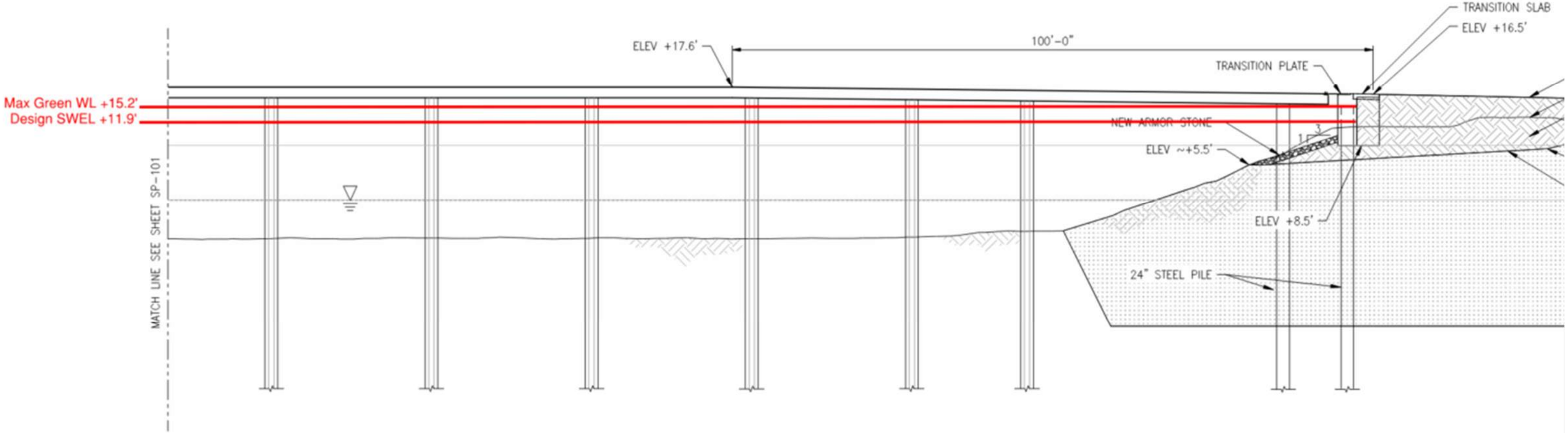
Wave Run-up 2%	4.5 ft
Average Overtopping Discharge*	0.09 l/m/s
Minimum Breakwater Elevation	17.6 ft Berkeley MLLW

› *Acceptable discharge (< 0.1 l/m/s) at El. +17.56ft Berkeley MLLW



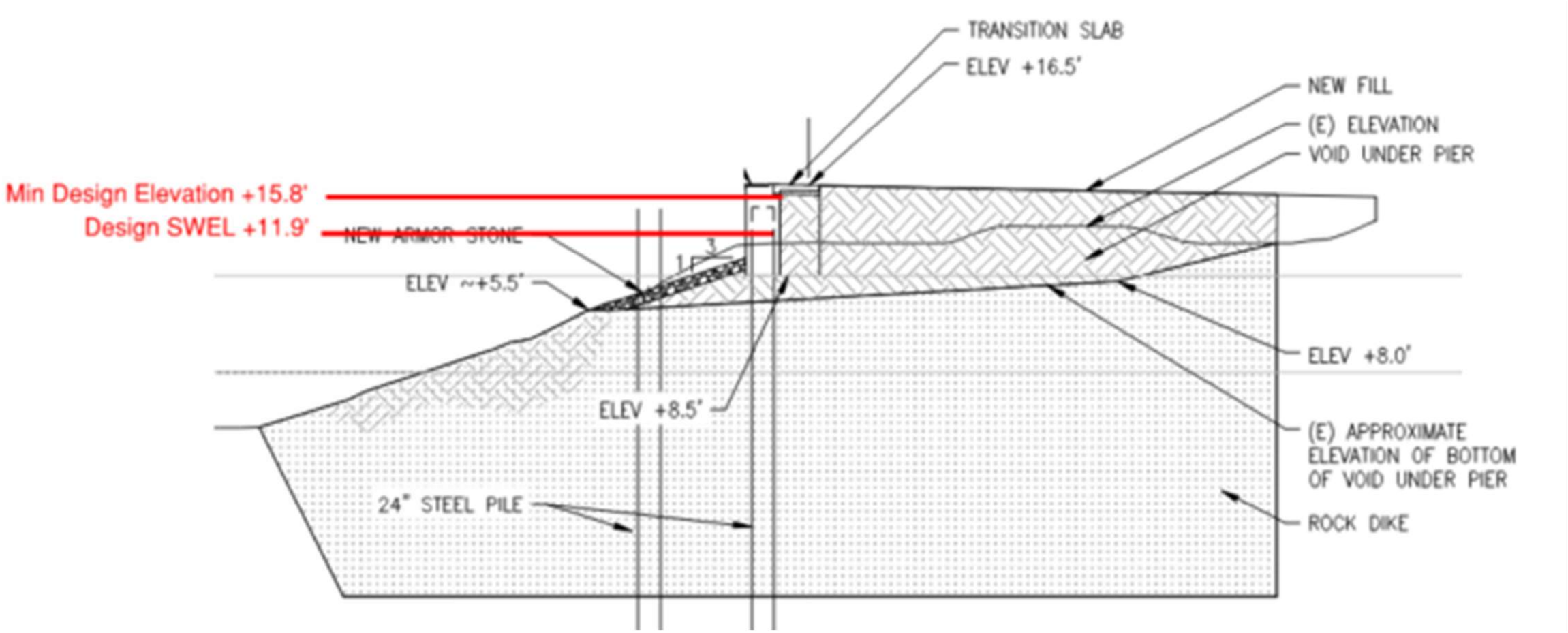
- Maximum green water elevation along length of Pier

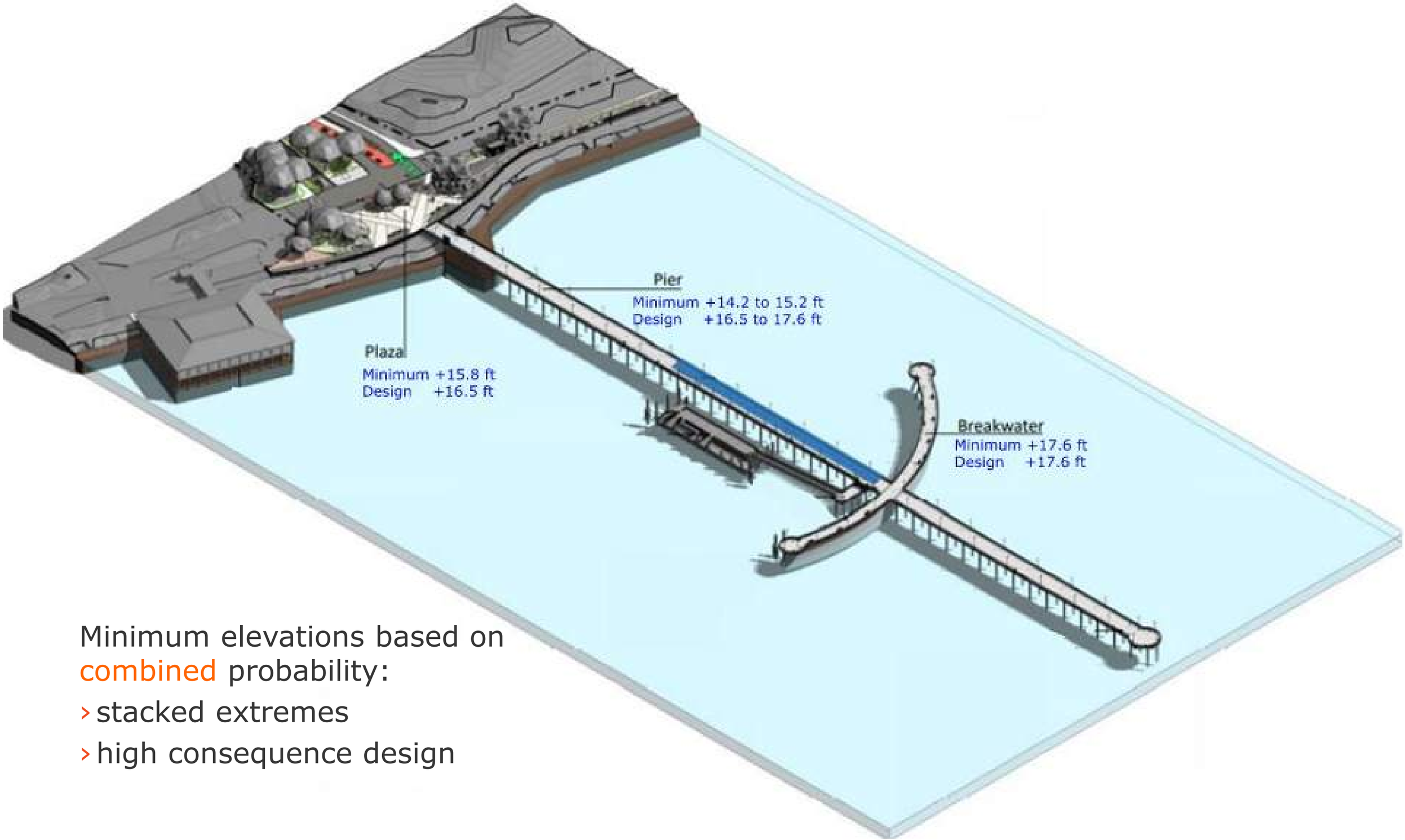
Parameter	Elevation (ft MLLW Berkeley)
Design Still Water Level	11.9
100-year Max Crest Height	2.3-3.3
Max. Green Water Level	14.2-15.2



Wave effects and minimum plaza elevation

Wave Overtopping	<0.1 l/m/s
Minimum Plaza Elevation	15.8 ft Berkeley MLLW





Minimum elevations based on combined probability:

- stacked extremes
- high consequence design

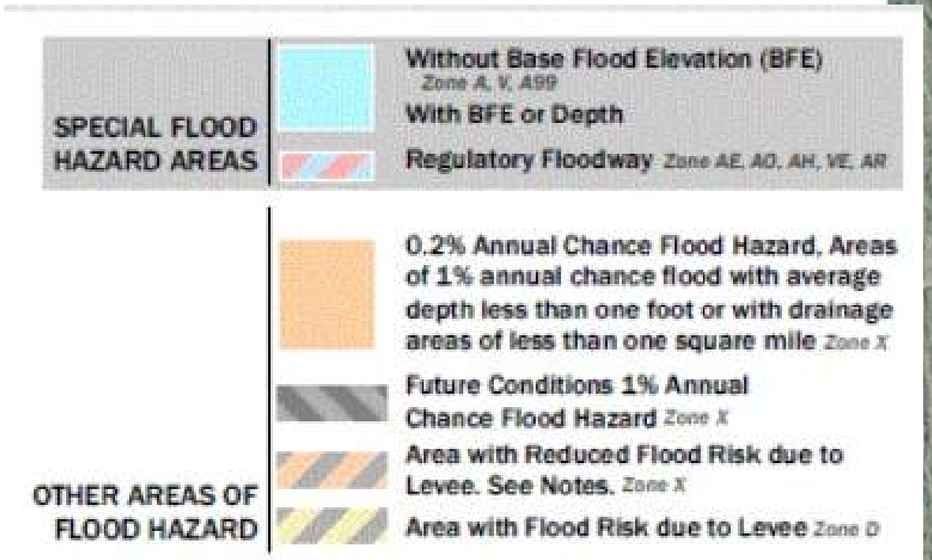
Number	Scenario	Year	SLR (ft)	Still Water Level (ft MLLW)	Breakwater (17.6 ft MLLW)		Deck (16.5 to 17.5 ft MLLW)		Plaza (16.5 ft MLLW)	
					Total Water Level*	Status	Max Green Water Level**	Status	Total Water Level***	Status
0 (Design)	Intermediate	2075	1.6	11.9	16.4	OK	15.2	OK	15.8	OK
1	Intermediate	2100	3.1	13.4	17.9	OK	16.7	OK	17.3	OK
2	Intermediate-High	2075	2.6	12.9	17.4	OK	16.2	OK	16.8	OK
3	Intermediate-High	2100	4.8	15.1	19.6	OT	18.4	OT	19.0	OT
4	High	2075	3.5	13.8	18.3	OT	17.1	OT	17.7	OT
5	High	2100	6.5	16.8	21.3	OT	20.1	Inundation	20.7	Inundation

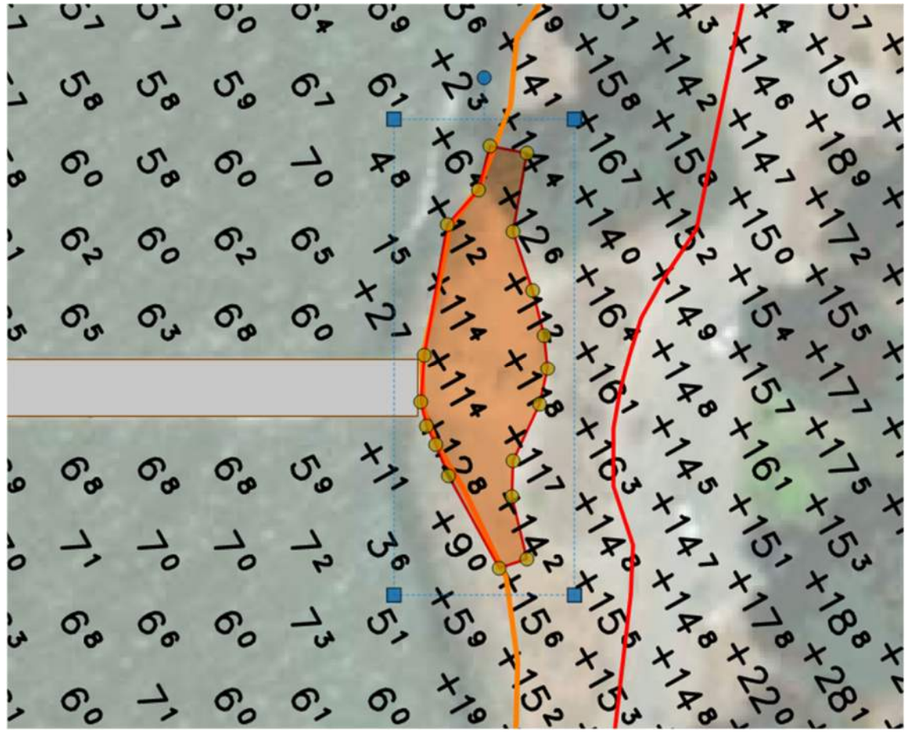
•OK: Element is **above the design water elevation and will not be subjected to flooding** during the scenario considered (overtopping < 1 l/m/s)
•OT: Element will be subjected to overtopping during the scenario considered

*Total Water Level Breakwater = Still Water Level + Run up 2% (4.5 ft)
**Maximum Green Water Level = Still Water Level + Max Crest Height (3.3 ft)
*** Total Water Level Plaza = Still Water Level + Run up 2% (3.9 ft)

- New Pier, Breakwater, Plaza designed to be resilient to overtopping. Designed with concrete and other materials selected for saltwater environment

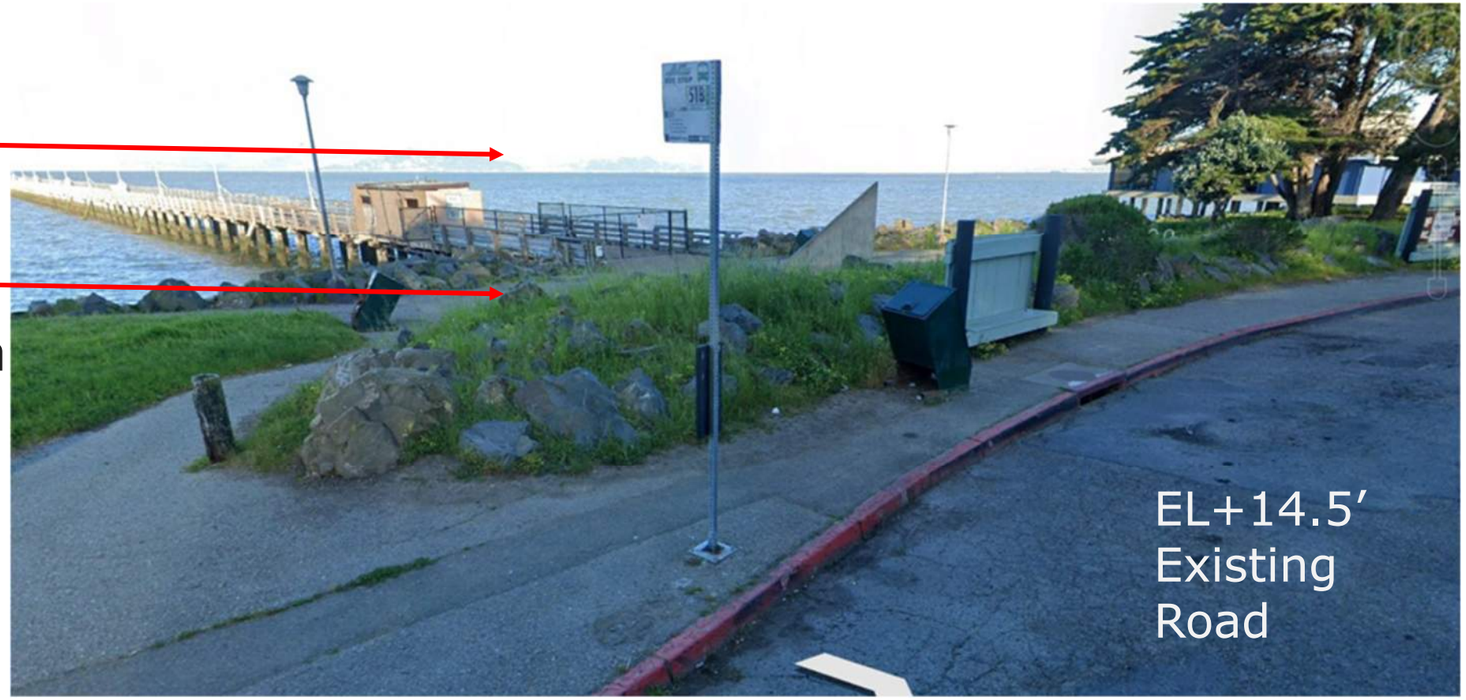
- FEMA FIRM 06001D0052H
- Zone VE EL 13’ NAVD88





EL+16.5’
New Pier/Plaza

EL+11.4’
Existing Pier/Plaza



35. Coastal - Flood Risk – At Pier/Plaza Interface

TOTAL WATER LEVEL: 84-inches

Printed from:
explorer.adaptingtorisingtides.org

Sea Level Rise	+	Storm Surge
42"		100-year
48"		50-year
52"		25-year
54"		10-year
60"		5-year
66"		2-year
72"		King Tide
84"		No Storm Surge

Depth of Flooding

- 0 - 2 feet
- 2 - 4 feet
- 4 - 6 feet
- 6 - 8 feet
- 8 - 10 feet
- 10 - 12 feet
- 12+ feet

Shoreline Overtopping

- Overtopping
- No Overtopping

Low-lying Areas

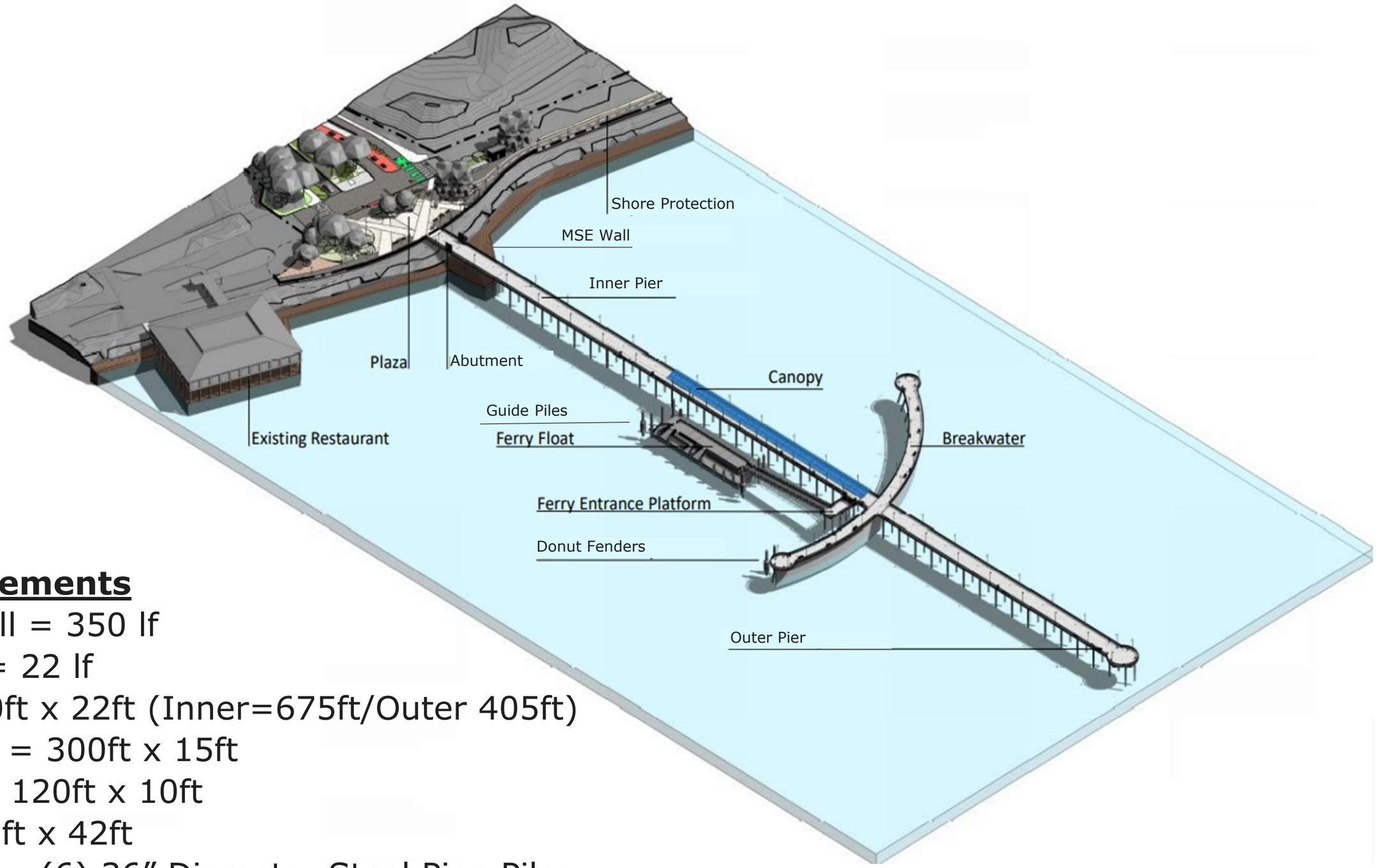
- Low-lying Area

Legal Delta

- Legal Delta

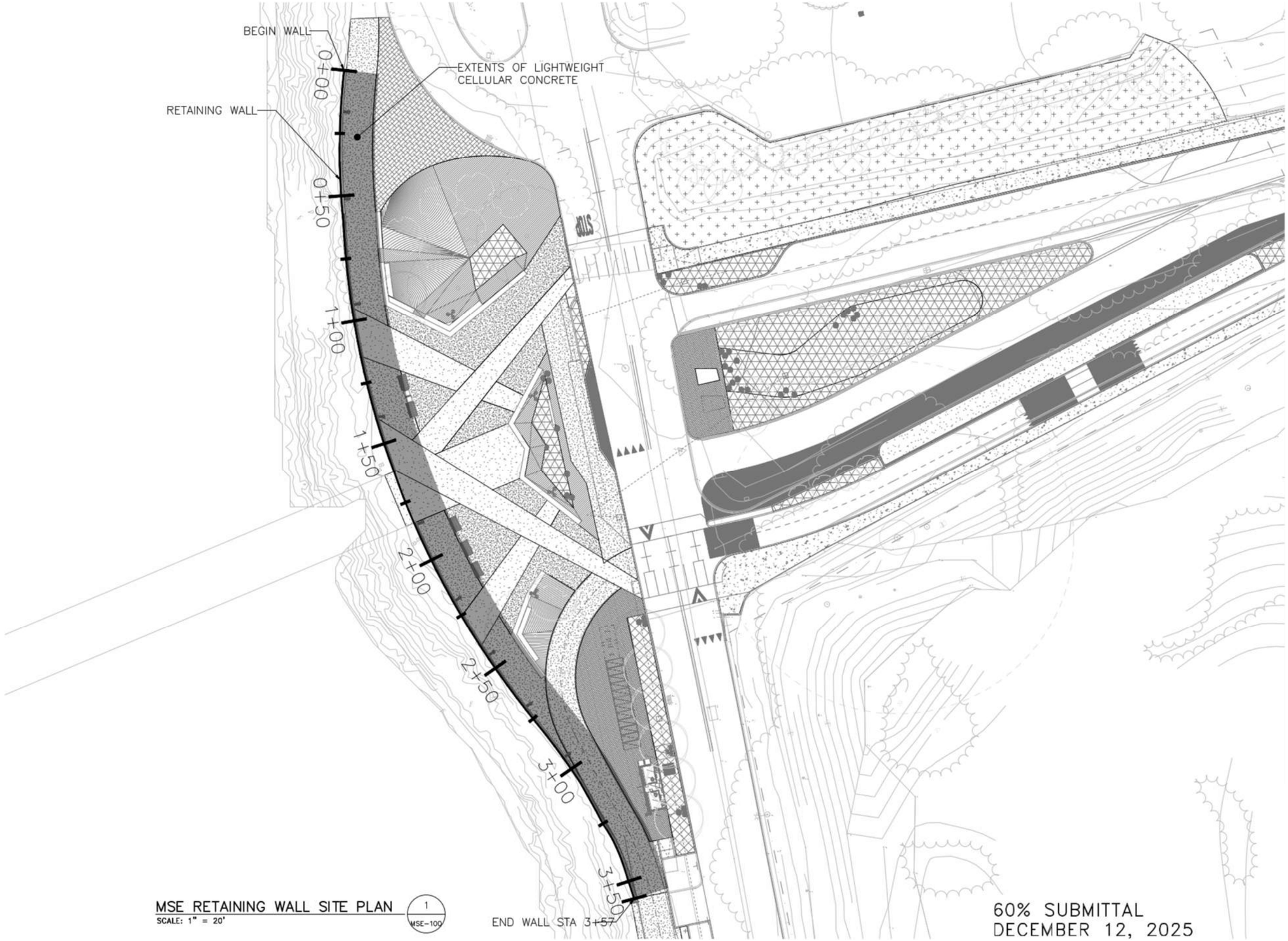
At the regional scale, these scenarios present average water levels that are representative of what could occur along the entire Bay shoreline. The mapped scenarios are based on binning the water levels with a tolerance of ±3 inches.

Icons by Icons8. Map tiles by ESRI, Maxar, Earthstar Geographics, and the GIS User Community.



Structural Elements

- MSE Seawall = 350 lf
- Abutment = 22 lf
- Pier = 1080ft x 22ft (Inner=675ft/Outer 405ft)
- Breakwater = 300ft x 15ft
- Gangway = 120ft x 10ft
- Float = 135ft x 42ft
- Guide Piles = (6) 36” Diameter Steel Pipe Piles
- Donut Fender Piles = (4) 36” Dia. With 6ft fenders

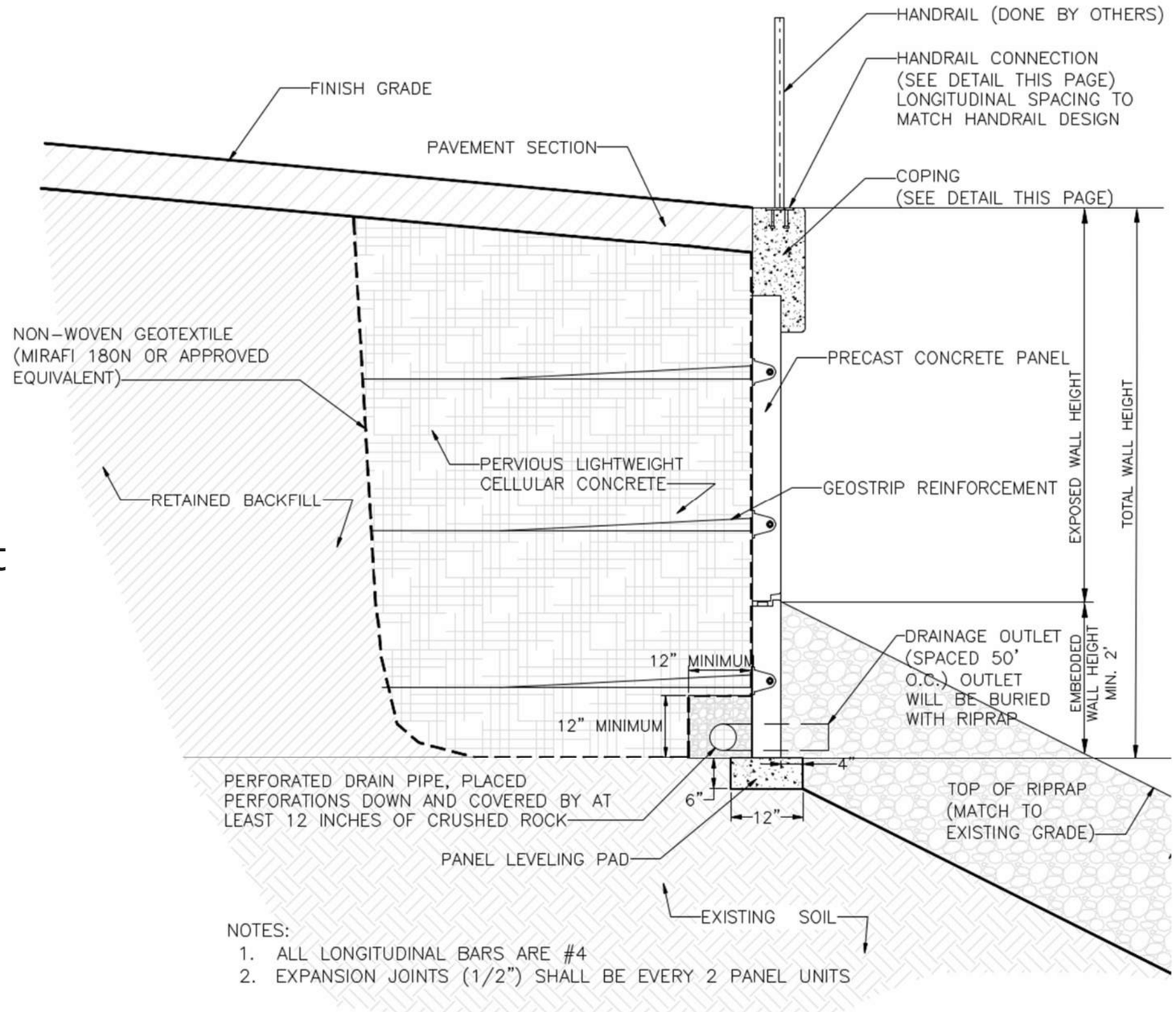


MSE RETAINING WALL SITE PLAN (1 / MSE-100)
SCALE: 1" = 20'

60% SUBMITTAL
DECEMBER 12, 2025

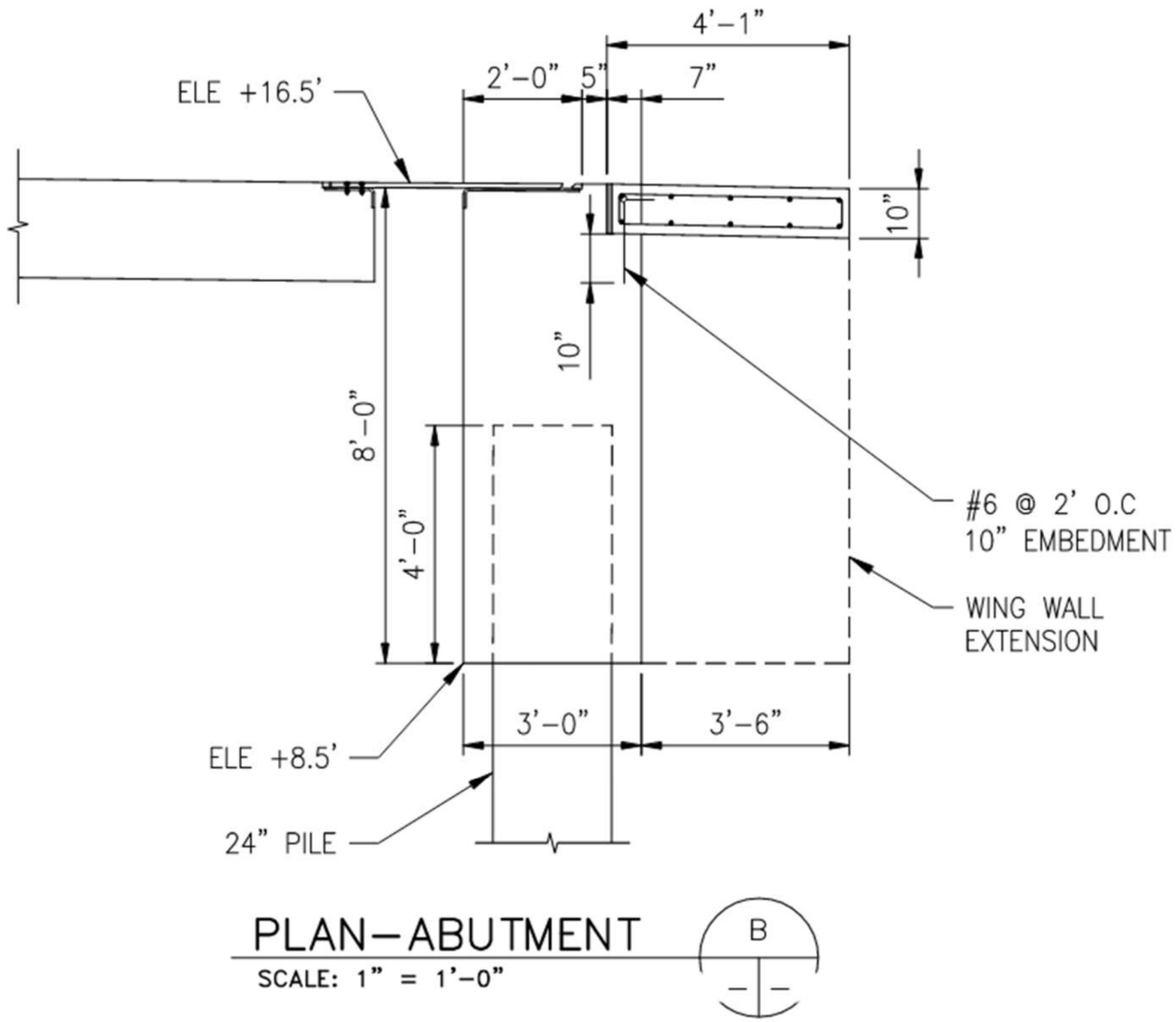
Design Summary

- Precast concrete panel retaining wall with geostrip reinforcement.
- Backfill will comprise pervious lightweight cellular concrete (LWCC).
- Geostrips will be embedded in the LWCC to support panels.
- Design incorporates surcharge loading from handrail, pedestrian, and firetrucks.
- System allows a relatively lightweight structure that has some flexibility for minor weight-induced settlement.
- Analyzed both static and seismic conditions.



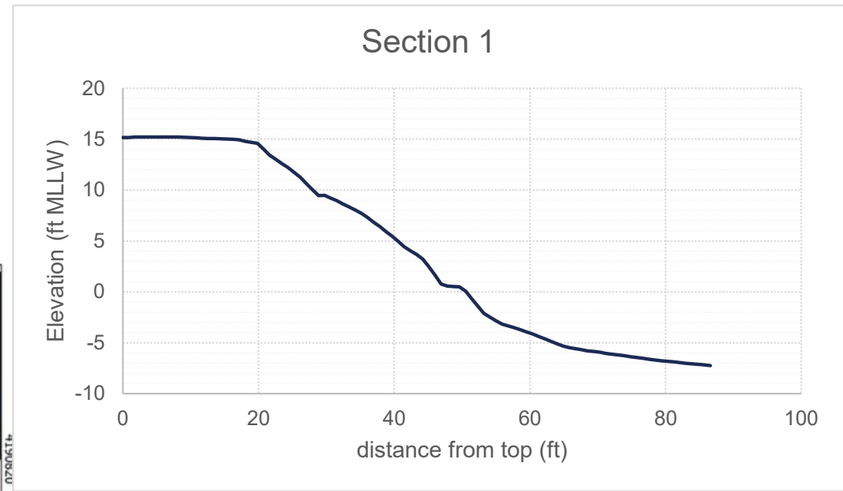
Design Summary

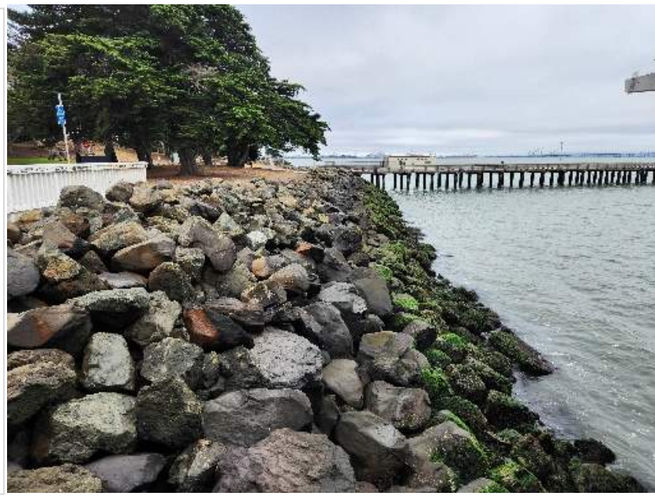
- 24” Steel Pipe Piles with Concrete Cap beam and Wing Walls
- Design incorporates surcharge loading pedestrian, and firetrucks.
- Analyzed both static and seismic conditions.
- Approach Slab Designed to accommodate settlement

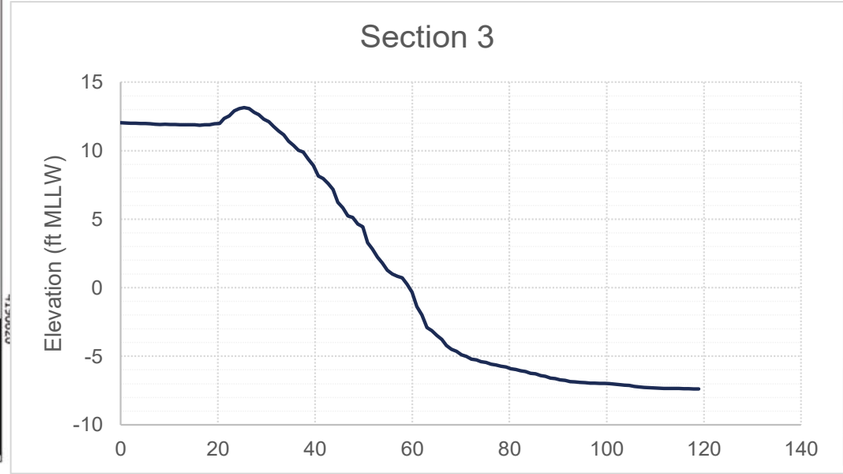


Design Summary

- Existing rip rap in good condition
- Rip rap to be restored along MSE wall and Abutment

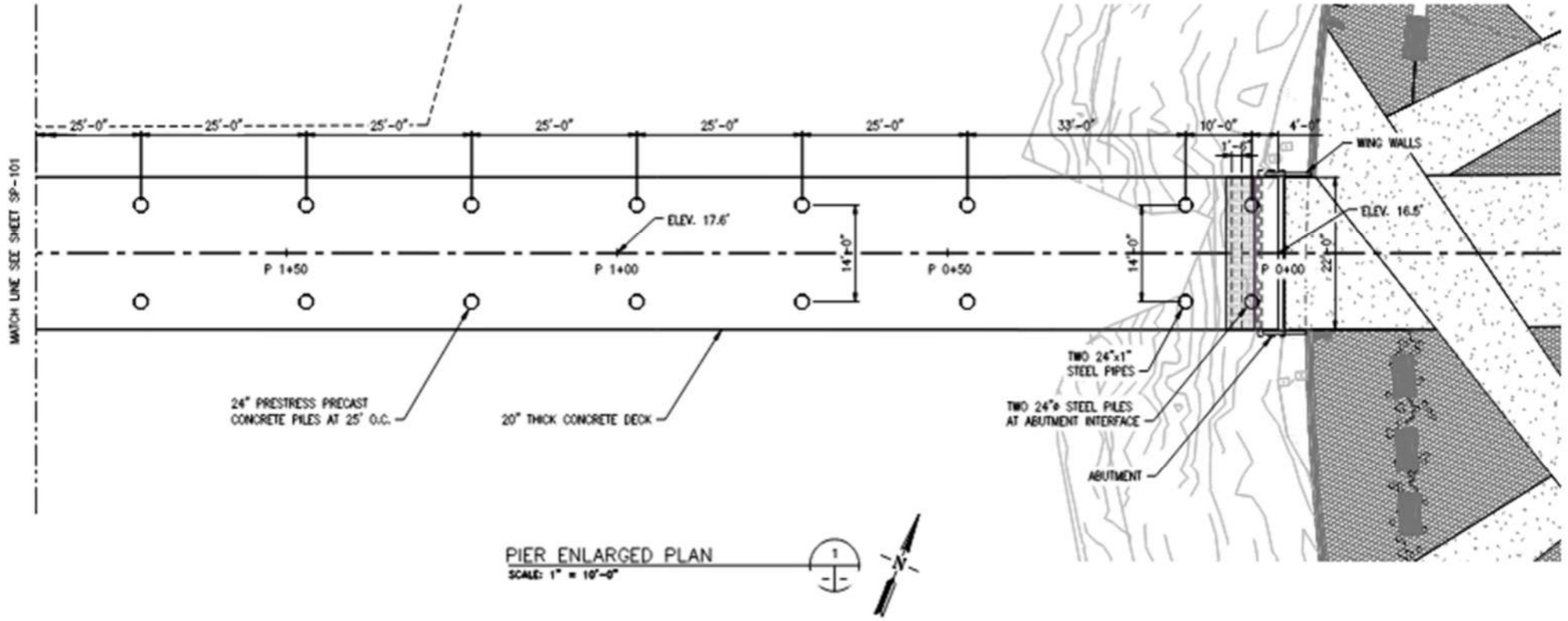


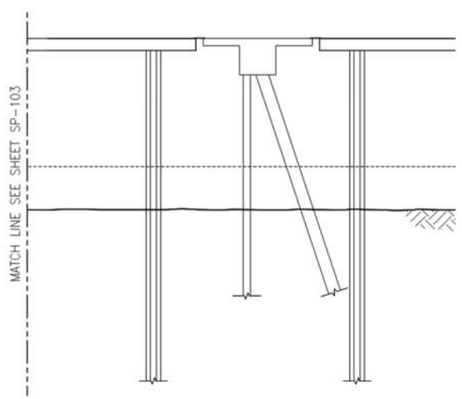


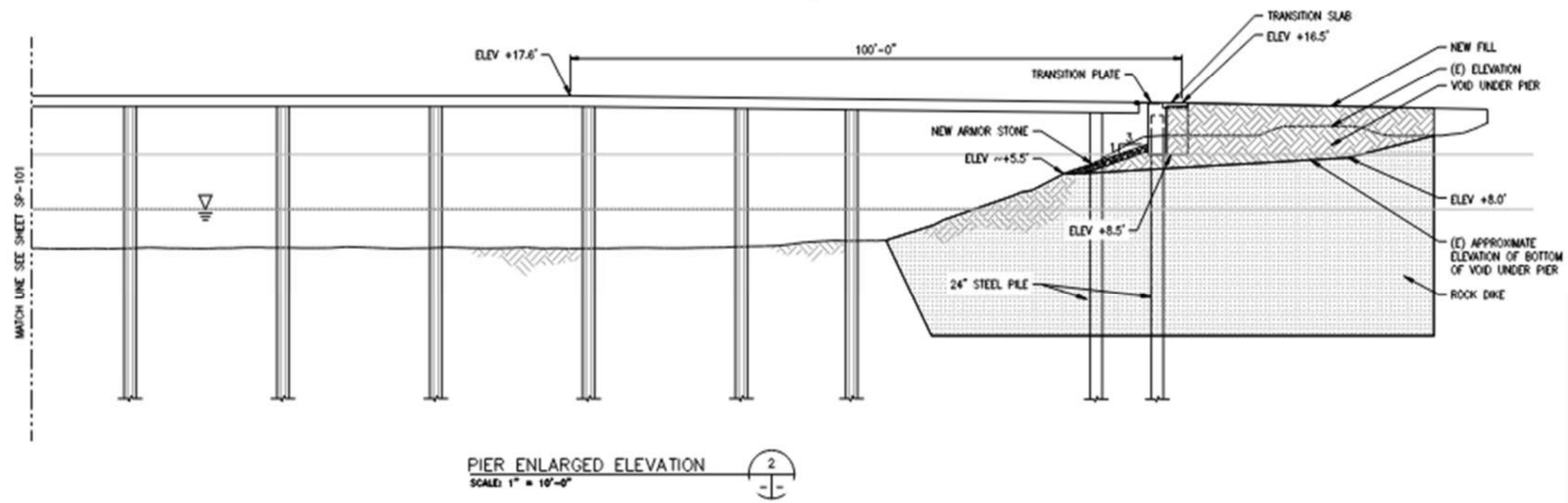


Design Summary

- Pier= 1080ft x 22ft (Inner=675ft x 22ft | Outer 405ft x 22ft)
- Seismic Isolation Joints btw. Landing Platform, Inner Pier, Breakwater, Outer Pier)
- Bents @ 25ft OC
- (2) 24” Oct. Prestressed Concrete Piles per Bent
- 20” CIP Concrete Deck
- Marine Concrete, 3” concrete cover, and corrosion inhibitor to meet minimum 50-year service life for structure exposed to water and waves

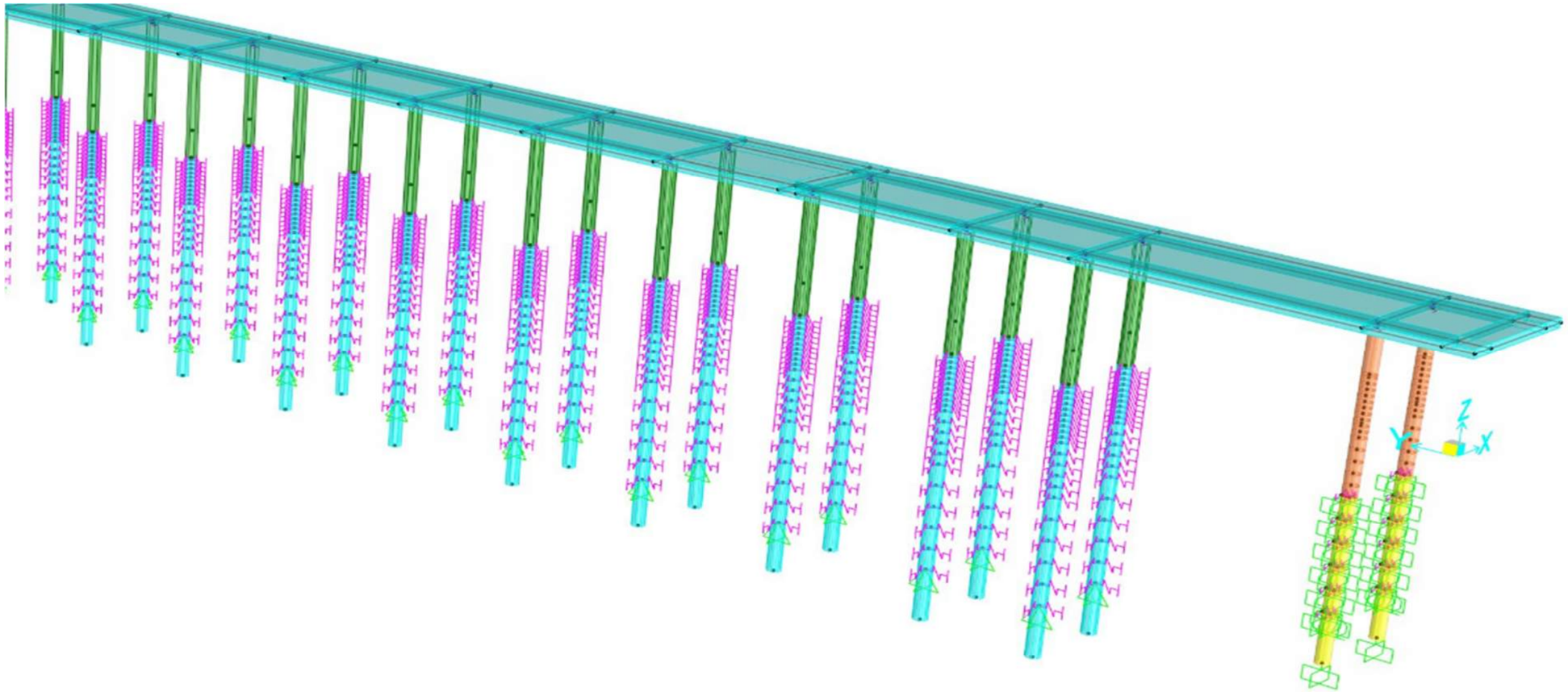




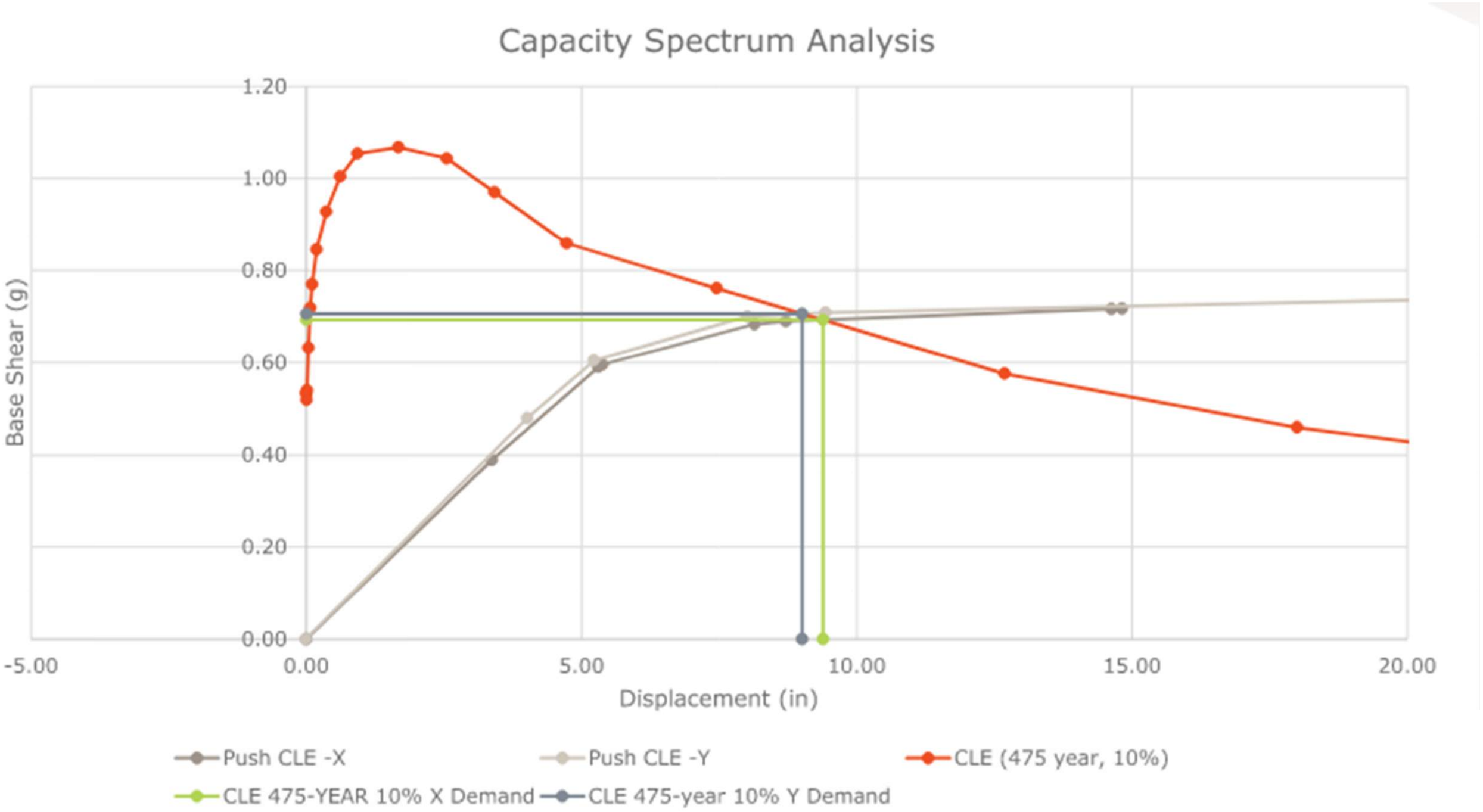


Seismic Design

- ASCE 61-14, ACI 318-19(22)
- Non-linear pushover analysis for pier.
- Seismic strains limited for no damage, minimal damage, repairable damage.
- Upper Bound (200%) and Lower Bound (50%) Soil Springs
- MCE Kinematic displacement of 6” mitigated by sleeving 24” diameter pile with 36” pile
- 10% Live load considered in seismic mass



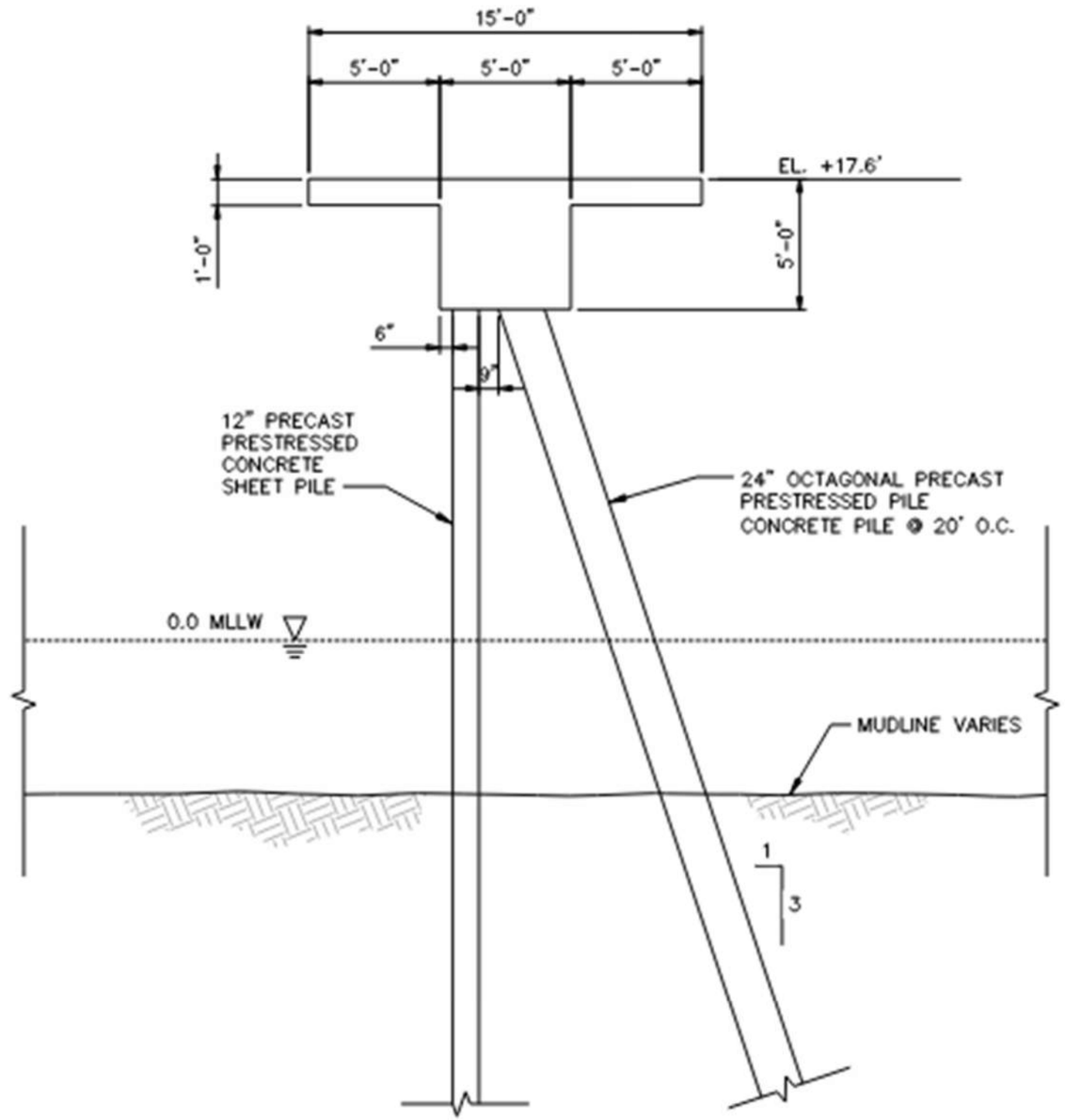
Direction	Seismic Event			
	OLE	CLE	DE	MCE
Longitudinal	3.1 in	9.0 in	6.2 in	11.4 in
Transverse	2.5 in	8.0 in	5.4 in	8.9 in


Capacity Spectrum Analysis
Base Shear (g)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
-5.00
0.00
5.00
10.00
15.00
20.00
Displacement (in)
Push CLE -X
Push CLE -Y
CLE (475 year, 10%)
CLE 475-YEAR 10% X Demand
CLE 475-year 10% Y Demand

Seismic Event	Limit State	Top Hinge 8#11	Bottom Hinge 8#11 + 16 Prestress Strands
OLE	No Damage	0.0%	0.0%
CLE	Min. Damage	81.5%	71.4%
DE	Min Damage	18.5%	35.7%
MCE	Controlled and Repairable Damage	23.2%	65.4%

Design Summary

- 24” Oct Prestressed Concrete Batter Piles
- 12” Precast Prestressed Concrete Sheet Pile Wall
- 5’x5’ Concrete Cap
- 12” Concrete Slab (Thicker at intersection of pier)
- Marine Concrete, 3” concrete cover, and corrosion inhibitor to meet minimum 50-year service life for structure exposed to water and waves
- Design Loads
  - Uniform (LU): 250 psf
  - Ambulance/Maintenance Truck: AASHTO H15-44: 24kip axel load (one lane)
  - Wave Loading:2.6ft significant wave height, 100-year return period
  - Uplift of deck considered



BREAKWATER SECTION
SCALE: 1/4" = 1'-0"

Seismic Design

- Seismic Design in accordance with ASCE 61-14
- Forced Based Design
  - R=1 for DE
- Soil springs will be added for final analysis

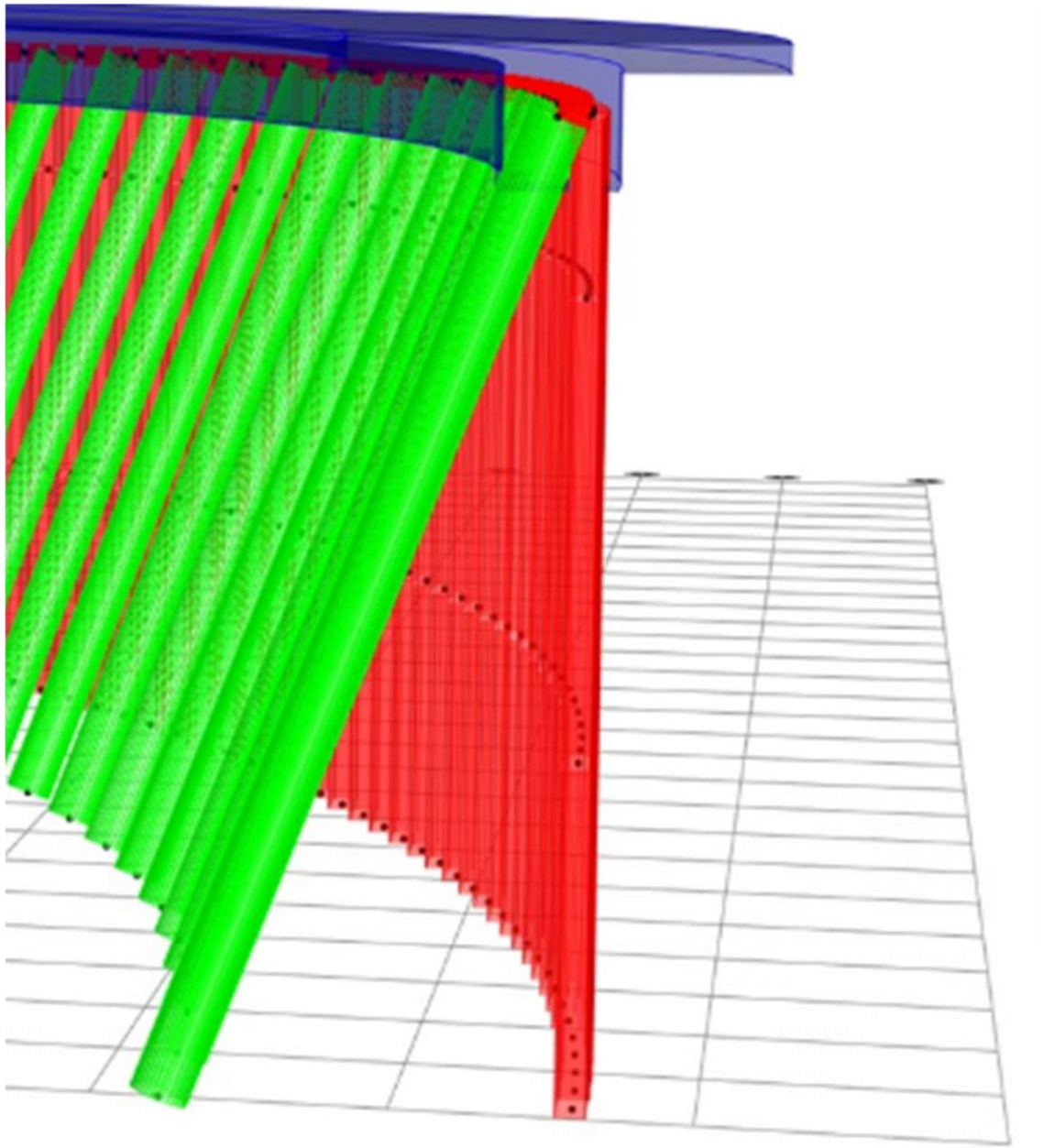
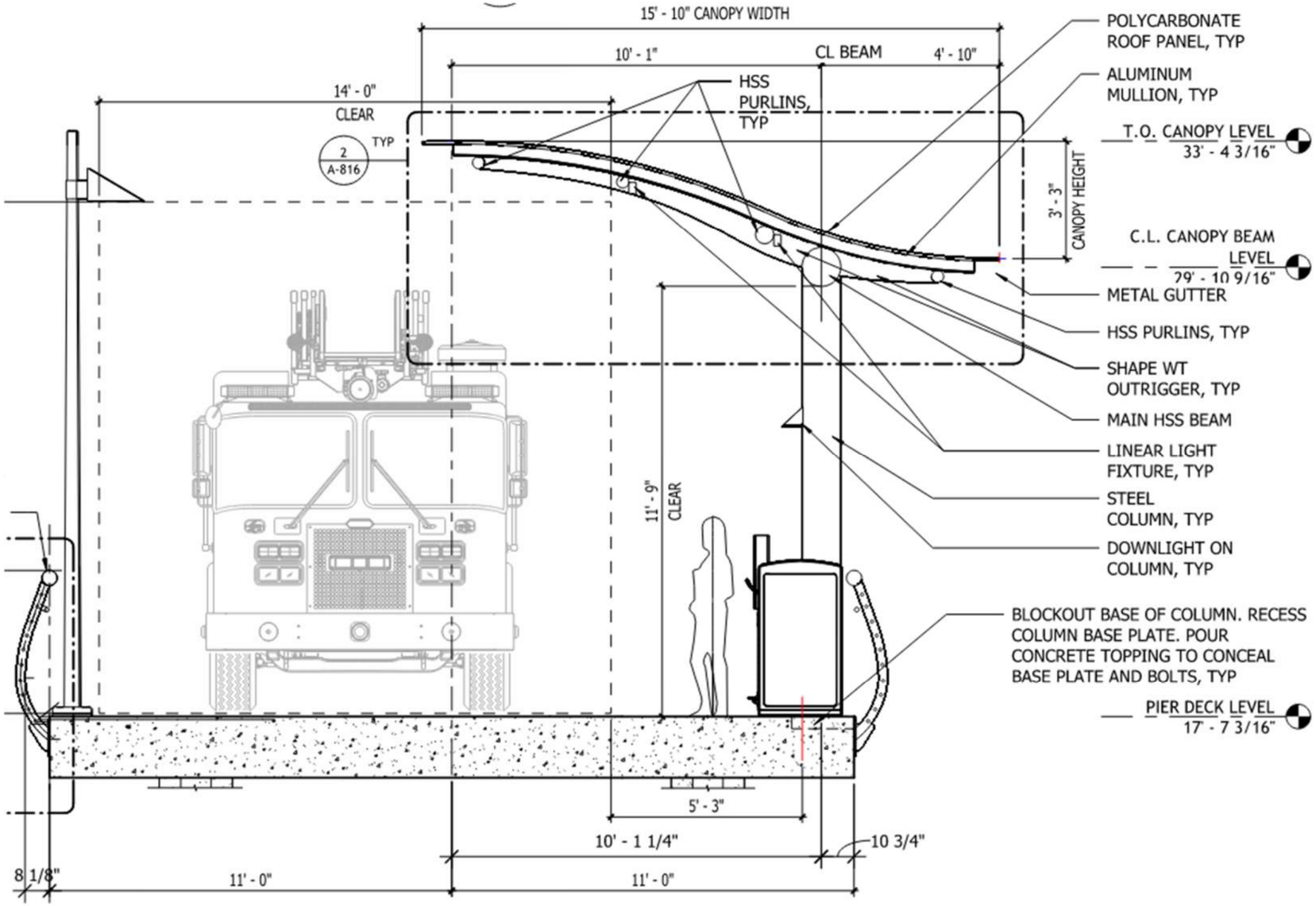


Figure 1b - Breakwater Structure Section View

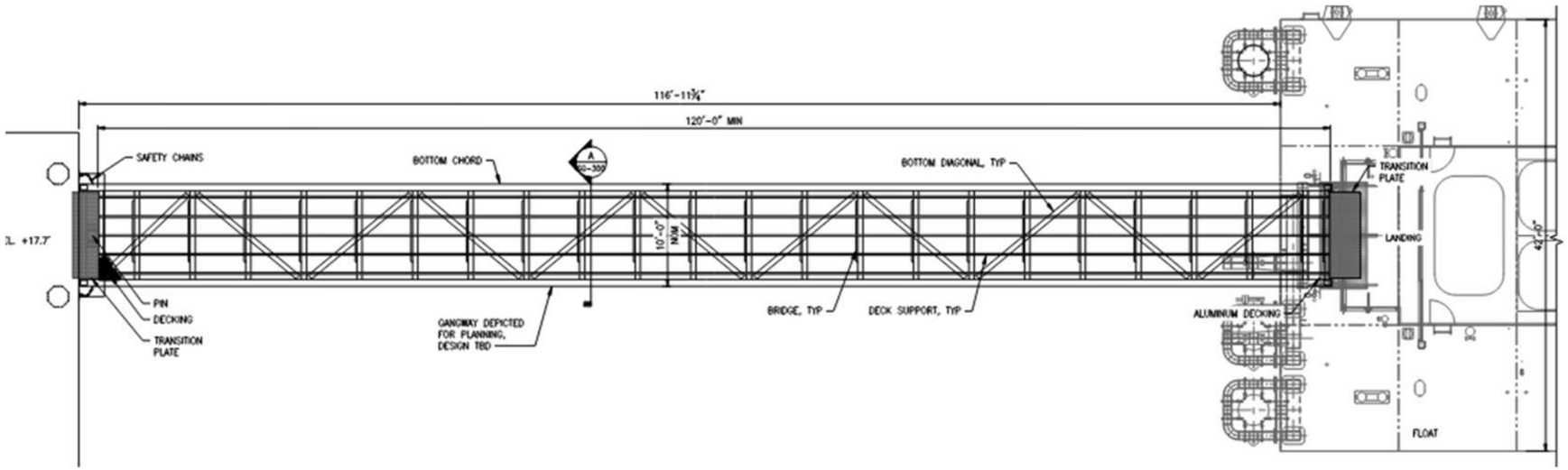
Design Summary

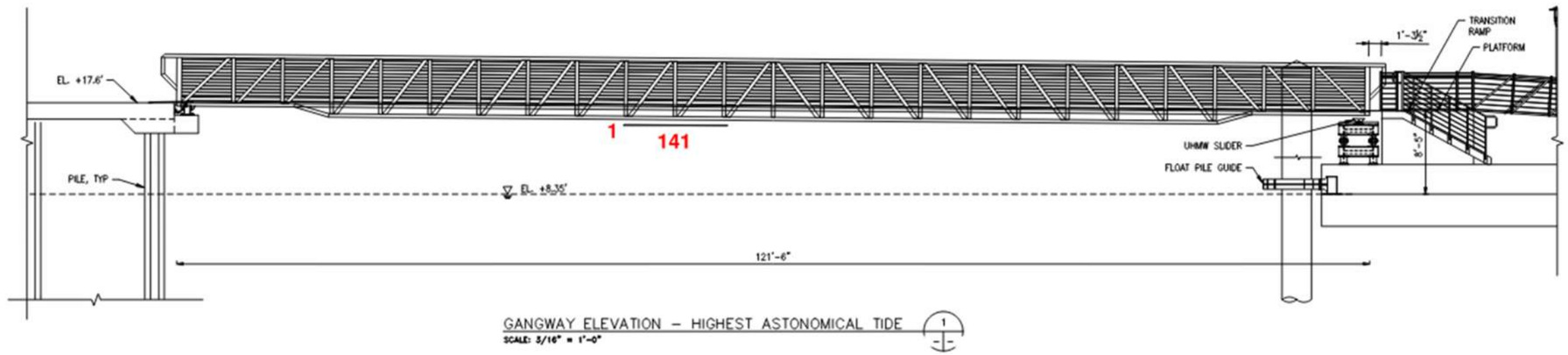
- Steel and Aluminum Framing
- Poly Carbonate Roof Panel
- Wind Speed ASCE 7-22 Risk Category IV. 105 mph
- Seismic Forces determined by ASCE 7-22 Chapter 13
- Designed to clear fire trucks



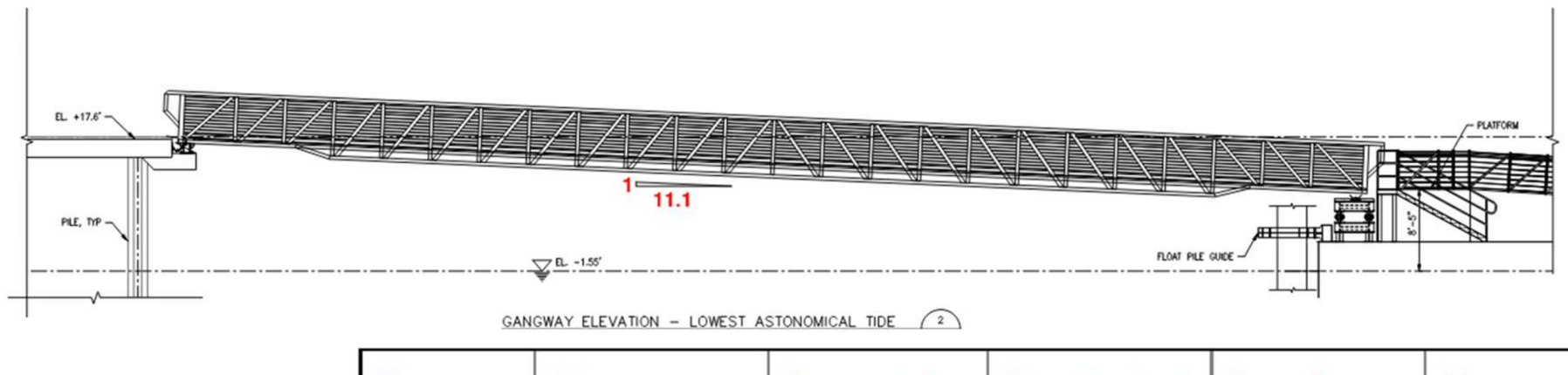
Design Summary

- Same construction as other SF Bay Ferry terminals
- ADA compliant per Access Board, “Proposed Accessibility Guidelines for Passenger Vessels”, 2013
- Aluminum framing
- Micro-mesh FRP grating
- Design Loads
  - Uniform: 100 psf
  - Point: 650 lbs
- Design-Build Element





GANGWAY ELEVATION – HIGHEST ASTONOMICAL TIDE (1)
SCALE: 3/16" = 1'-0"



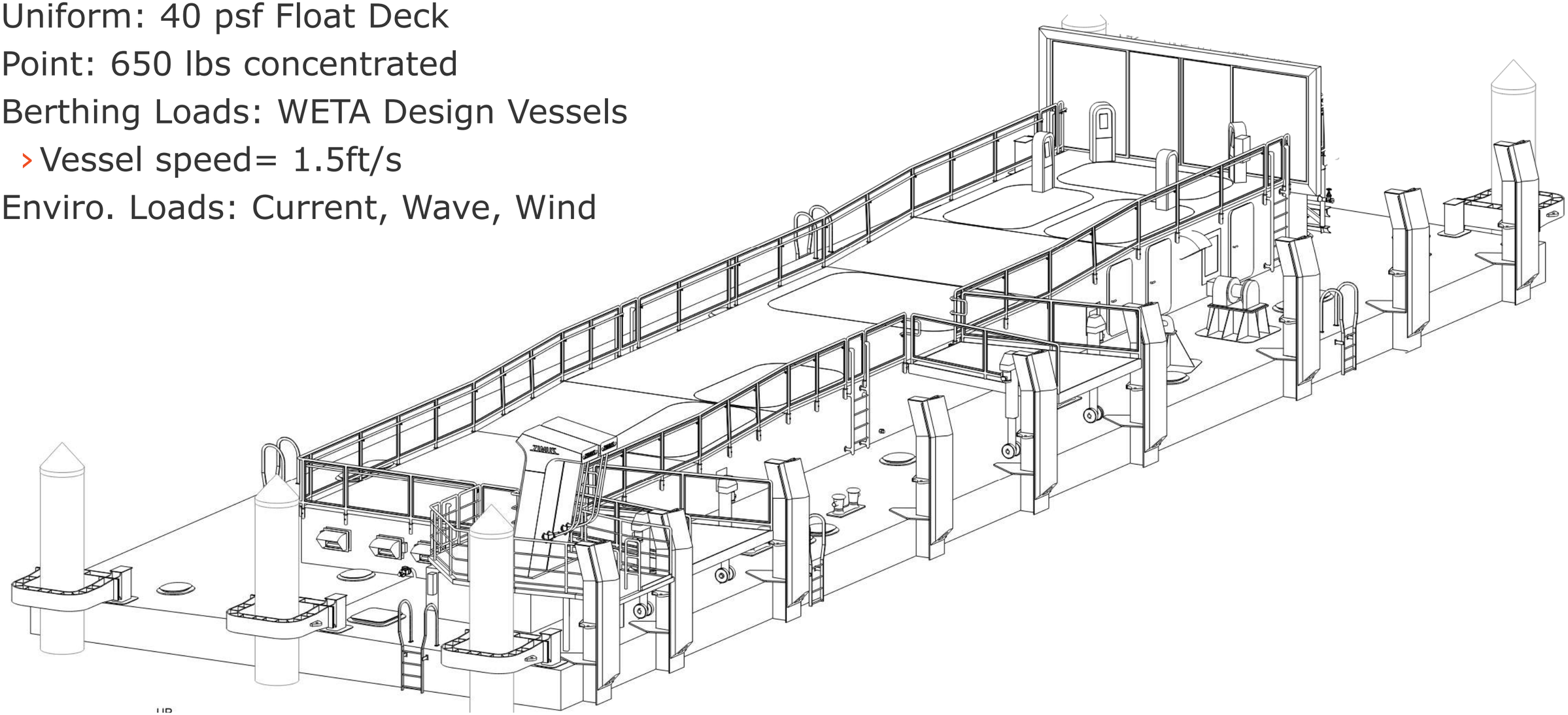
GANGWAY ELEVATION – LOWEST ASTONOMICAL TIDE (2)

Gangway Length Comparison

Gangway Length (ft)	Gangway Slope at LOWL	Days out of compliance (per year)	Hours* out of compliance (per year)	Exceedance frequency (%)	Gangway Slope at LAT
80	1:7.8	303	1,069	18.3	1:7.4
90	1:8.7	203	538	9.2	1:8.3
100	1:9.7	84	169	2.9	1:9.3
110	1:10.7	14	21	0.37	1:10.2
120	1:11.7	<1	0.7	0.01	1:11.1

Design Summary

- Universal Charging Float (UCF) – Same construction as SF Ferry Building Gates E & F
- Uniform: 100 psf Walking Area
- Uniform: 40 psf Float Deck
- Point: 650 lbs concentrated
- Berthing Loads: WETA Design Vessels
  - Vessel speed= 1.5ft/s
- Enviro. Loads: Current, Wave, Wind

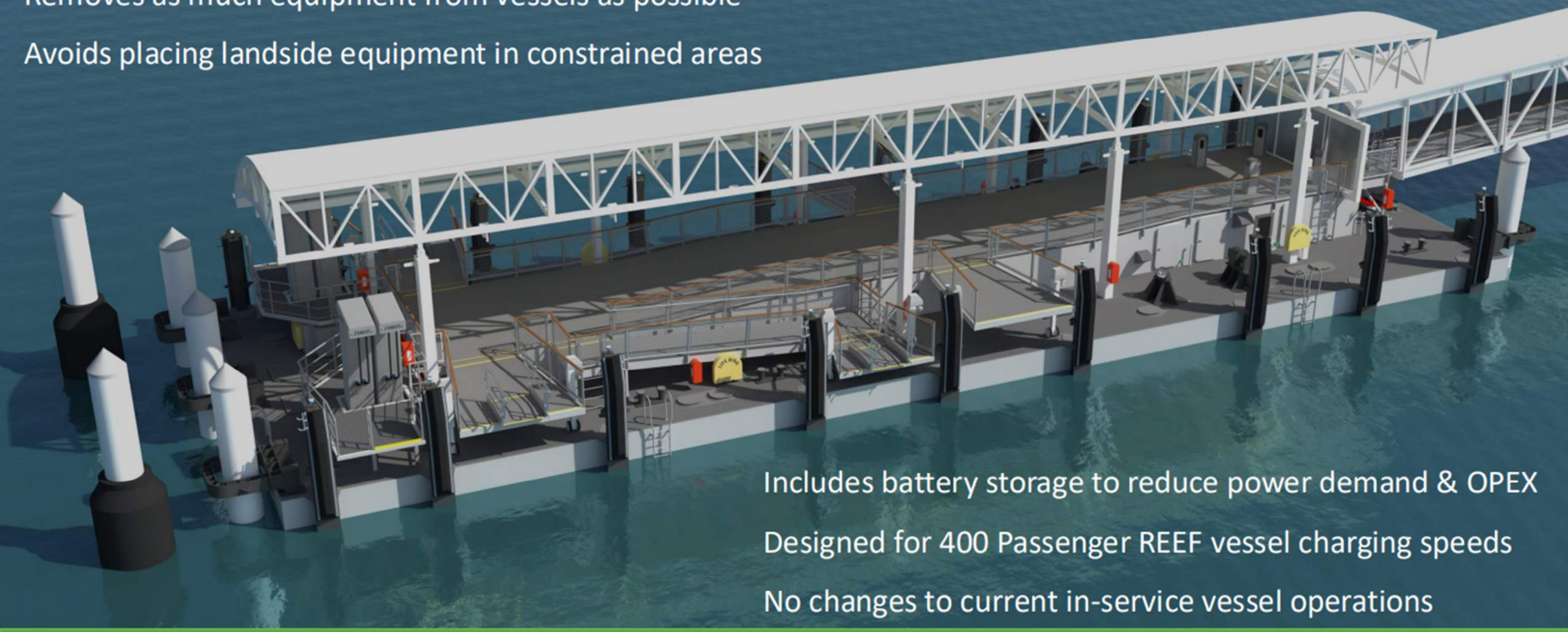


UNIVERSAL CHARGING FLOAT CONCEPT REVIEW

Uses existing float footprint to house all charging system equipment

Removes as much equipment from vessels as possible

Avoids placing landside equipment in constrained areas



Includes battery storage to reduce power demand & OPEX

Designed for 400 Passenger REEF vessel charging speeds

No changes to current in-service vessel operations

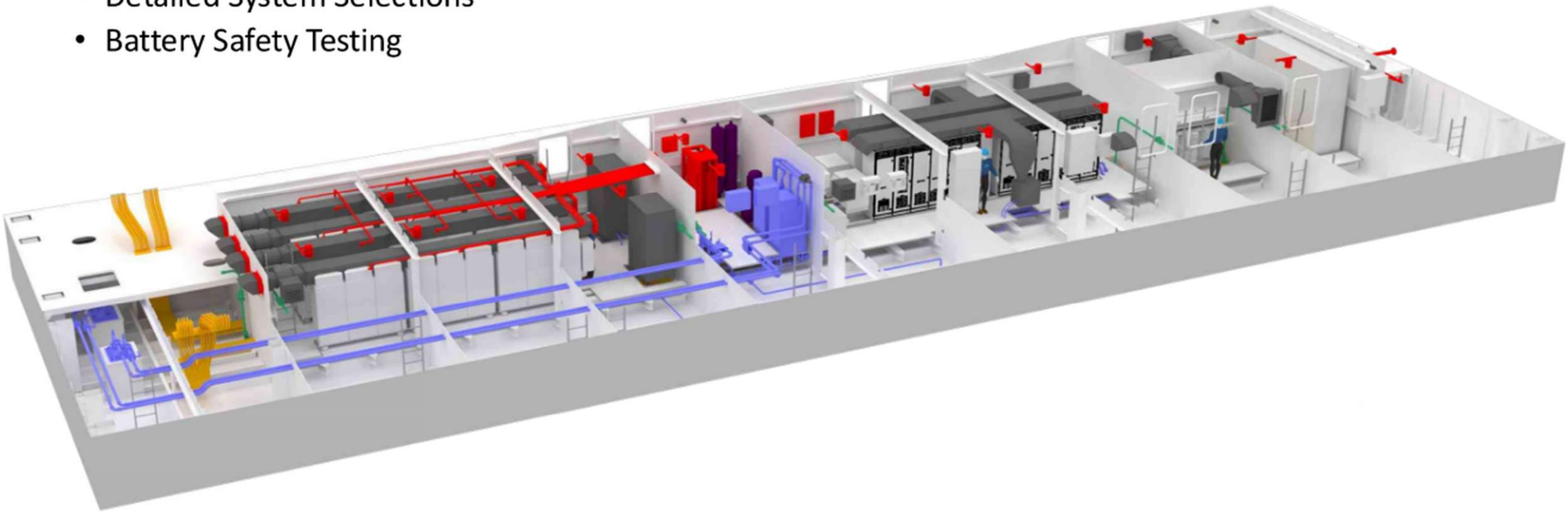
San Francisco Bay Ferry

UNIVERSAL CHARGING FLOAT SCOPE & SOLICITATION

First of its kind combined system in floating structure

Risk Mitigation Efforts:

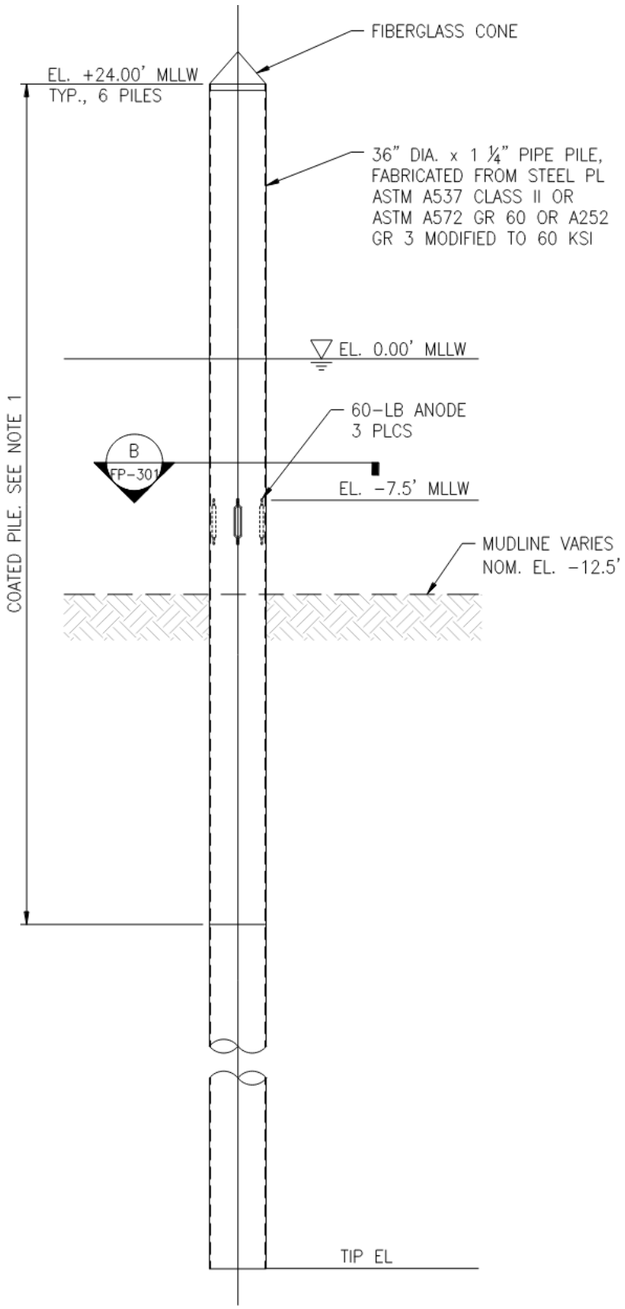
- Extensive Preliminary Design pre-RFP release
- Detailed System Selections
- Battery Safety Testing



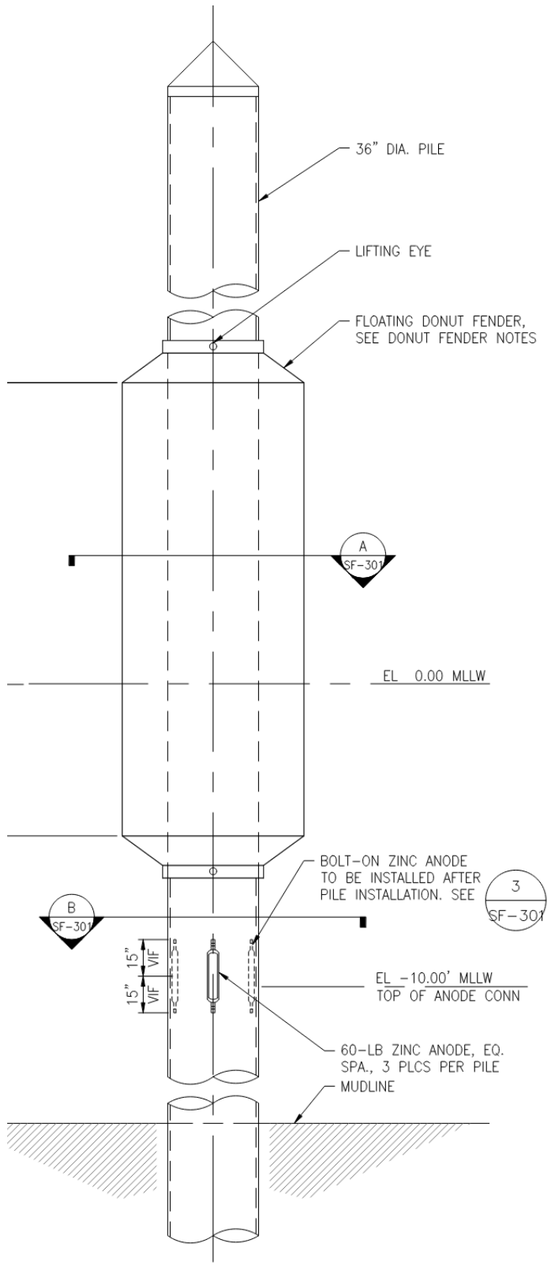
San Francisco Bay Ferry

Design Summary

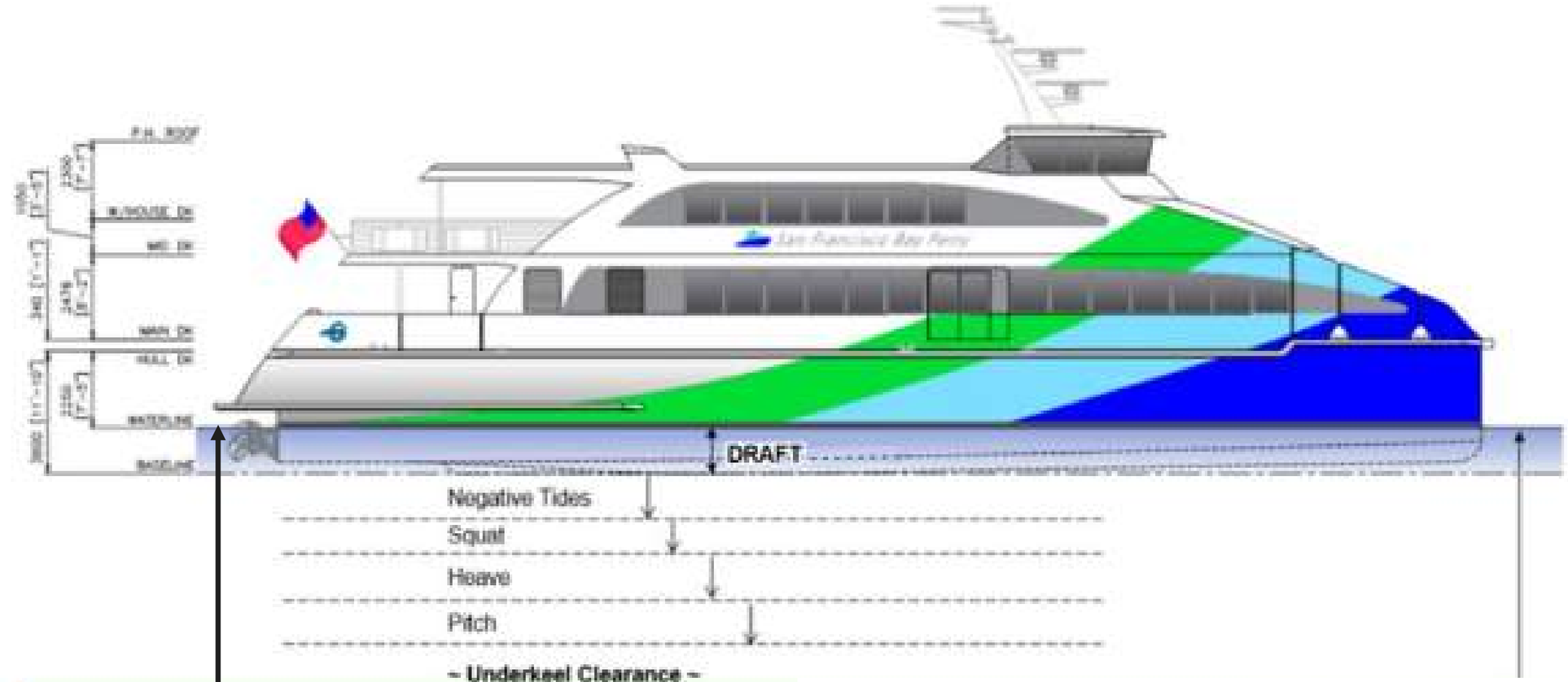
- Float guide piles sized for vessel berthing and enviro. loading on float
- Donut fenders located to reduce risk of accidental impact at critical locations



FLOAT GUIDE PILE – ELEVATION 1 SF-101
SCALE: 3/16" = 1'-0"

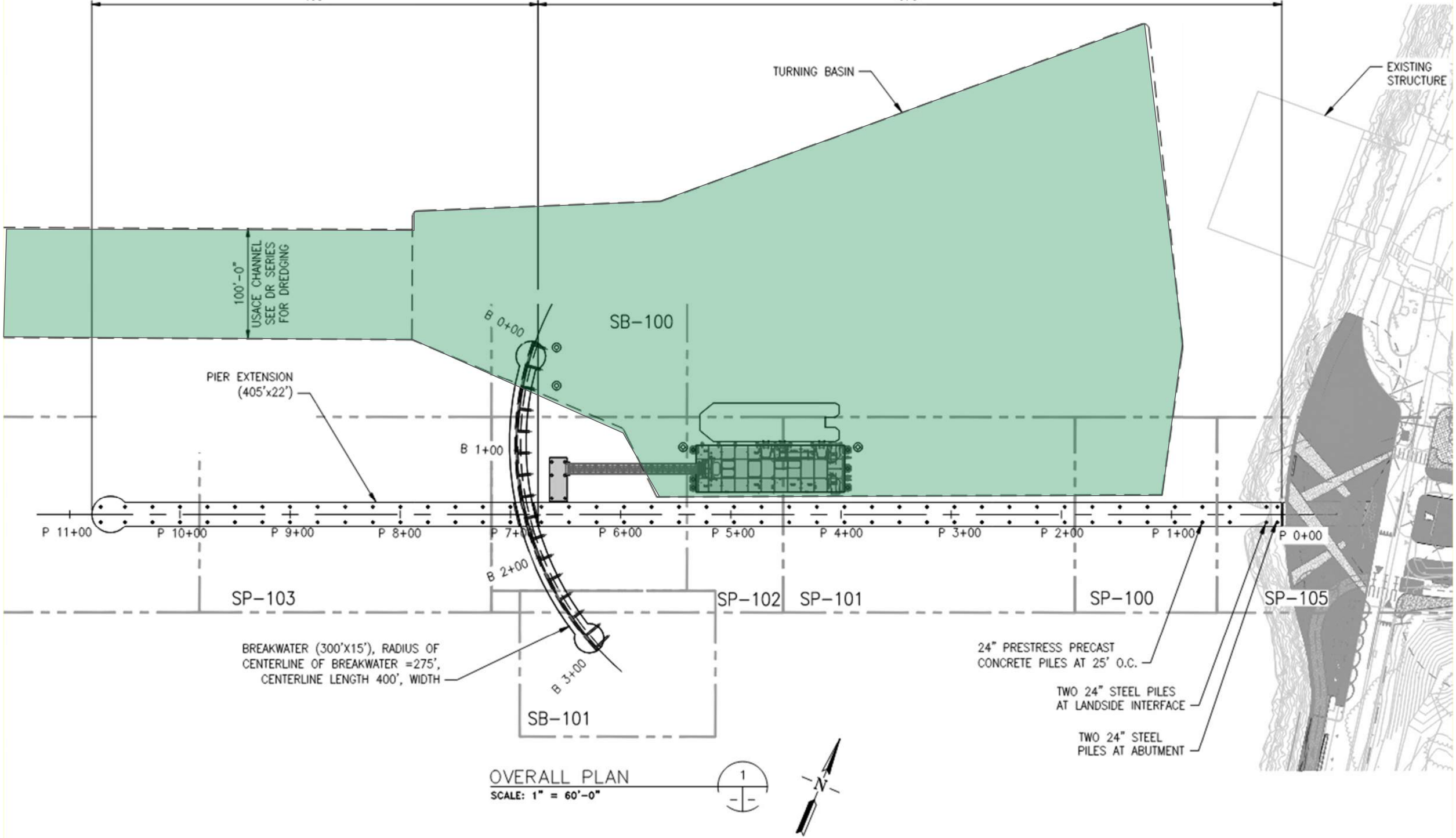


DETAIL – DONUT FENDER 2 SF-300
SCALE: 3/8" = 1'-0"



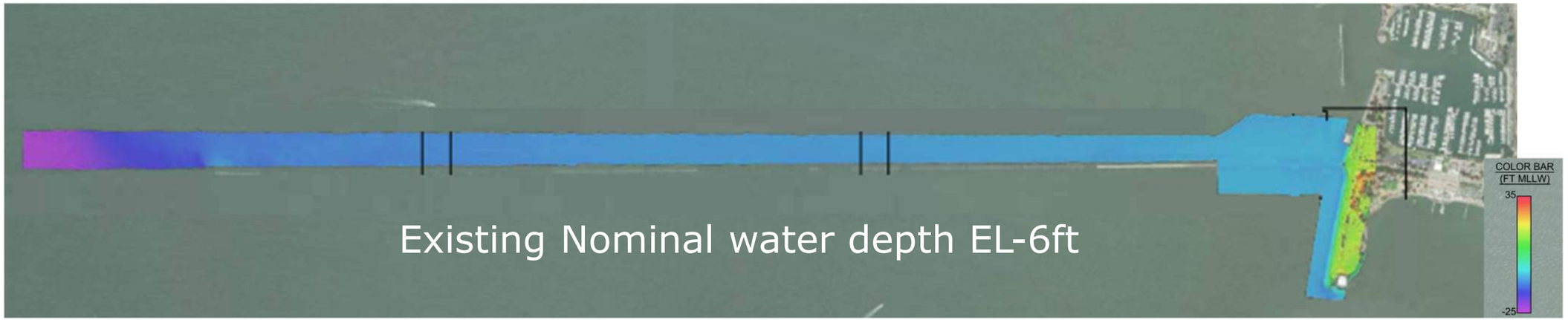
- Maximum Vessel Draft (See section 0): 7.0 ft
- LAT (Lowest Astronomical Tide NOAA MLLW): -2.25 ft
- Underkeel Clearance: 1.0 ft
- Squat, Heave, Pitch: 1.0 ft
- Sedimentation Allowance (~50year, see Section 0): 0.75 ft
- Conversion from NOAA MLLW TO City of Berkeley MLLW 0.51 ft
- Dredge Depth (City of Berkeley MLLW Datum): -12.51 ft

Dredge Depth: -12.51’ MLLW with 1ft Overdredge

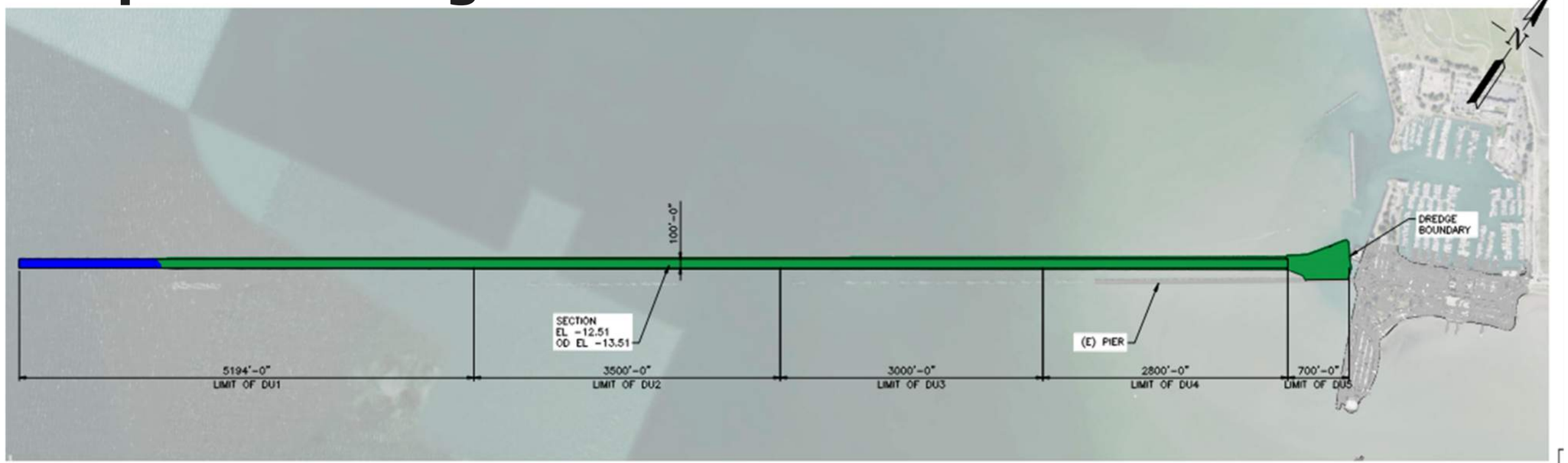


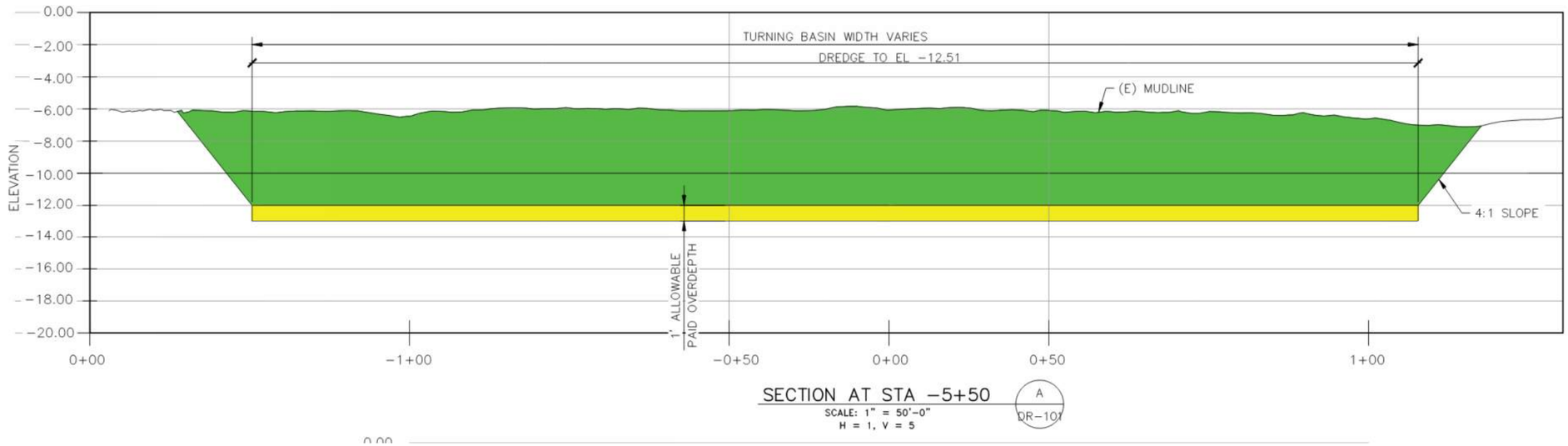
57. Dredging - Channel and Turning Basin Dredge Layout

Hydrographic Survey



Proposed Dredge Extents





Design Depth
EL -12.51’ + 1’ Overdredge

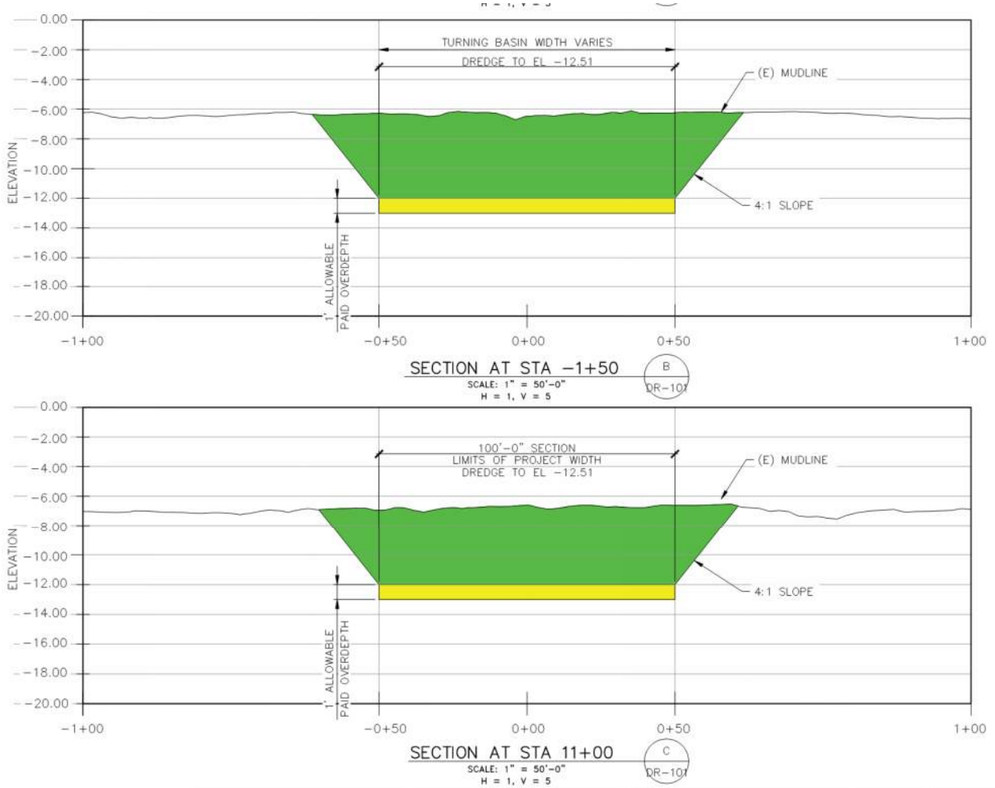
Side Slope
Typical: 4:1

Pacific EcoRisk Environmental Consulting and Testing

Table 1-1. Berkeley Water Transportation Pier Ferry Project Dredging Volumes.

Dredge Unit	Dredge Footprint (Acres)[A]	Proposed Depth (ft. MLLW)	Estimated Volume (yd^3)	Over-depth (ft.)	Estimated Volume (yd^3)	Permitted Depth + Over-depth (ft. MLLW)	Total Estimated Volume (yd^3)[B]
DU1	9.91	-12.51	59,349	+1.0	22,172	-13.51	81,521
DU2	7.38	-12.51	66,818	+1.0	16,511	-13.51	83,329
DU3	6.59	-12.51	70,207	+1.0	14,546	-13.51	84,753
DU4	5.66	-12.51	70,432	+1.0	12,483	-13.51	82,915
DU5	4.58	-12.51	58,715	+1.0	8,767	-13.51	67,482
Total:	**34.1**		**325,521**		**74,479**		**400,000**

Notes:
ft = feet.
MLLW = Mean Lower Low Water.
yd^3 = cubic yards.
A - Dredge boundary is 37.9 acres
B - Dredge volumes are estimates are based on eTrac Multi-beam bathymetric survey performed in July 2024, plus a 10% contingency.



60. Dredging - Dredging at Marina Entrance in 2025